SECTION EM
ENGINE MECHANICAL

CONTENTS

QR25DE

VQ35DE

PRECAUTION

PRECAUTIONS

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

INFOID:0000000012601931

The Supplemental Restraint System such as “AIR BAG” and “SEAT BELT PRE-TENSIONER”, used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the 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, it is recommended that all maintenance and repair be performed by an authorized NISSAN/INFINITI dealer.**
- **Improper repair, 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 or batteries, and wait at least three minutes before performing any service.**

Precaution for Draining Coolant and Engine Oil

INFOID:0000000012601932

Drain engine coolant and engine oil after the engine has cooled completely.

Precaution for Disconnecting Fuel Piping

INFOID:0000000012601933

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

Precaution for Removal and Disassembly

INFOID:0000000012601934

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

Precaution for Inspection, Repair and Replacement

INFOID:0000000012601935

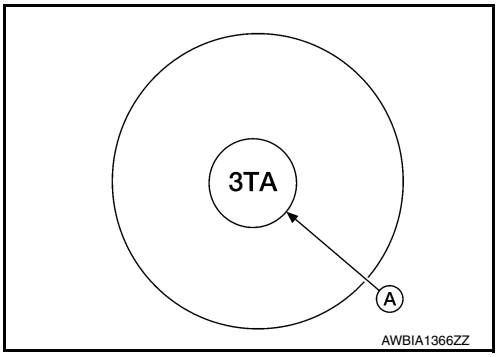
- Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

Special Cautions to Ensure the Safe Disposal of Sodium-filled Exhaust Valves

INFOID:0000000012601936

Handling and disposal of sodium-filled exhaust valves requires special care and consideration. Under conditions such as breakage with subsequent contact with water, metal sodium which lines the inner portion of exhaust valve will react violently, forming sodium hydroxide and hydrogen which may result in an explosion. Sodium-filled exhaust valve is identified on the top of its stem as shown in illustration.

(A) : Identification mark of sodium-filled exhaust valve



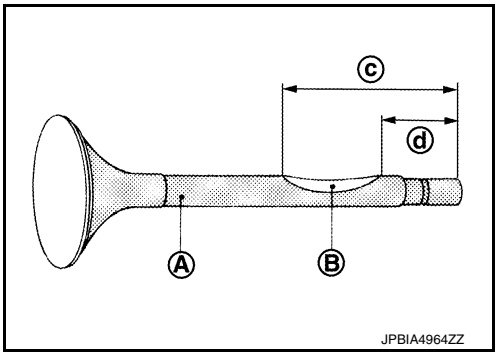
DEALER DISPOSAL INSTRUCTIONS

CAUTION:

- **Use approved shatter-resistant eye protection when performing this procedure.**
- **Perform this and all subsequent disposal work procedures in an open room, away from flammable liquids. Keep a fire extinguisher, rated at least 10 ABC, in close proximity to the work area.**
- **Be sure to wear rubber gloves when performing the following operations.**
- **Make sure the resultant (high alkalinity) waste water does not contact your skin. If the waste water does contact you, wash the contacted area immediately with large quantities of water.**
- **Dealers should check their respective state and local regulations concerning any chemical treatment or waste water discharge permits which may be required to dispose of the resultant (high alkalinity) waste water.**

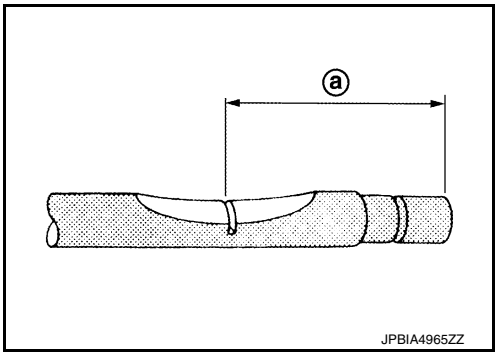
1. Clamp valve stem in a vice.
2. The valve has a specially-hardened surface. To cut through it, first remove a half-round section, approximately 30 mm (1.18 in) long using air-powered grinder until black color is removed and silver color appears.

(A) : Black color
(B) : Silver color
(c) : 47 mm (1.85 in)
(d) : 17 mm (0.67 in)

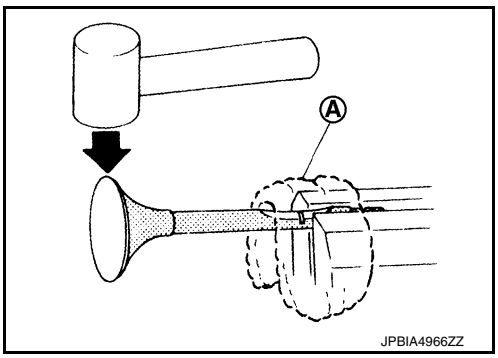


3. Use hacksaw to cut through approximately half the diameter of valve stem. Make the serration at a point 40 mm (1.57 in) from the end of valve stem.

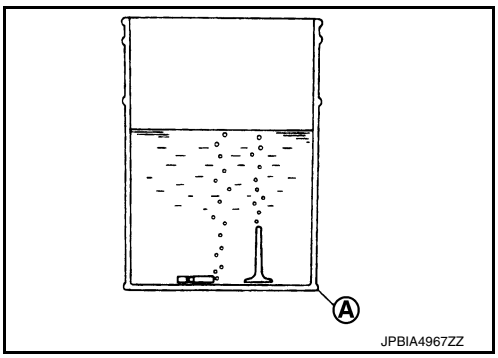
(a) : 40 mm (1.57 in)



4. Cover the serrated end of the valve with a large shop towel (A). Strike the valve face end with a hammer, separating it into two pieces.
5. Fill a bucket, such as a 20 ℓ (5-1/4 US gal, 4-3/8 Imp gal) oil can, with at least 10 ℓ (2-5/8 US gal, 2-1/4 Imp gal) of water. Carefully place the already cut (serrated) valves into the water one-at-a-time using a set of large tweezers and quickly move away at least 2.7 m (9 ft).



6. The valves should be placed in a standing position as shown in the illustration to allow complete reaction. After the bubbling action has subsided, additional valves can be placed into the bucket allowing each subsequent chemical reaction to subside. However, no more than 8 valves should be placed in the same 10 ℓ (2-5/8 US gal, 2-1/4 Imp gal) amount of water. The complete chemical reaction may take as long as 4 to 5 hours. Remove the valves using a set of large tweezers after the chemical reaction has stopped. Afterwards, valves can be disposed as ordinary scrap.



A : Bucket [Such as 20 ℓ (5-1/4 US gal, 4-3/8 Imp gal) oil can]

Precaution for Assembly and Installation

INFOID:0000000012601937

- Use torque wrench to tighten bolts or nuts.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, follow the specifications.
- Always replace the old with a new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check oil or coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Bleed the air trapped within the system after draining the coolant.
- Before starting engine, apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then make sure that there are no leaks at fuel line connections.
- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage or rattles.

Parts Requiring Angular Tightening

INFOID:0000000012601938

- Use an angle wrench for the final tightening of the following engine parts.
- Cylinder head bolts
- Lower cylinder block bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Precaution for Liquid Gasket

INFOID:0000000012601939

REMOVAL OF LIQUID GASKET SEALING

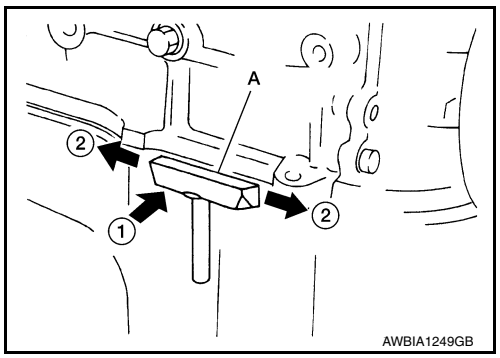
CAUTION:

Do not damage the mating surfaces.

- After removing the bolts and nuts, separate the mating surface and remove the liquid gasket using Tool (A).

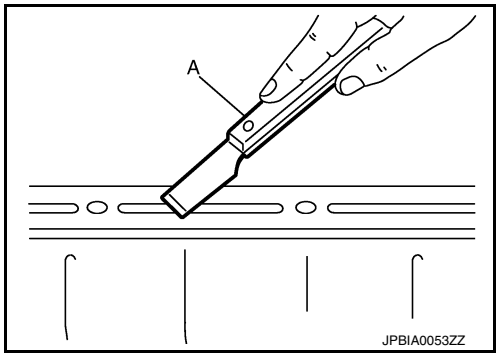
Tool Number (A) : KV10111100 (J-37228)

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

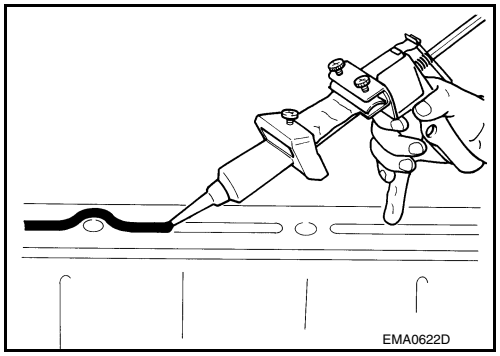


LIQUID GASKET APPLICATION PROCEDURE

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

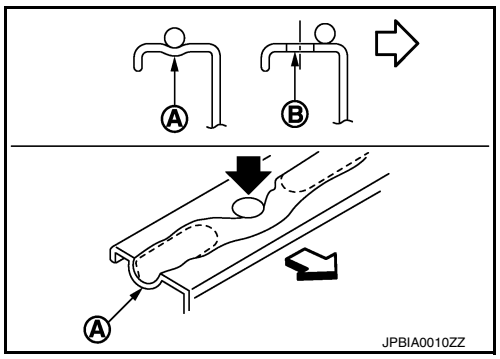


3. Attach liquid gasket tube to the suitable tool.
   Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
   - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



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

(A) : Groove
⇦ : Inside



- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten bolts or nuts after the installation.
- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant. Refer to LU-10, "Changing Engine Oil" and CO-11, "Changing Engine Coolant".

CAUTION:
If there are more specific instructions in the procedures contained in this manual concerning liquid gasket application, observe them.

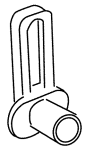
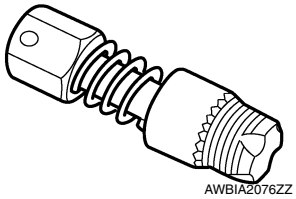
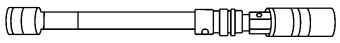
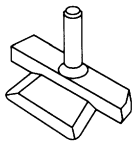
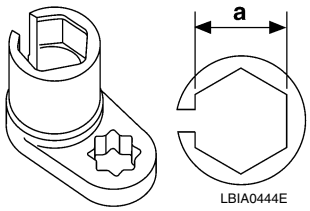
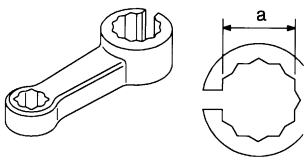
PREPARATION

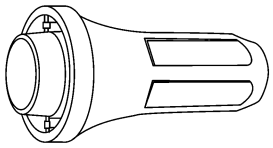
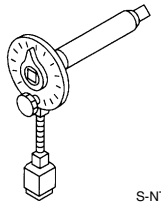
PREPARATION

Special Service Tools

INFOID:0000000012601940

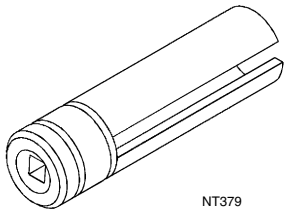
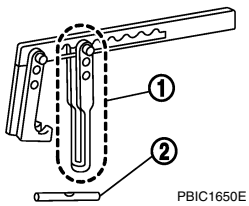
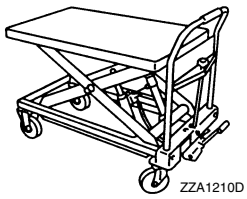
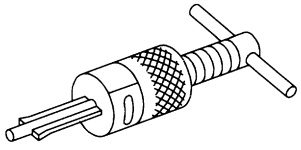
The actual shape of the tools may differ from those illustrated here.

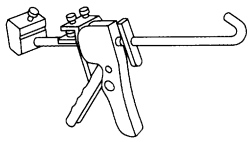
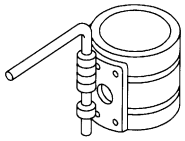
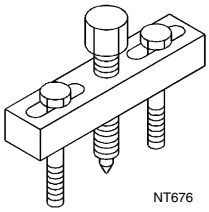
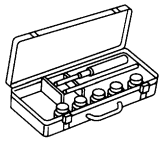
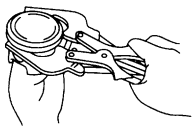
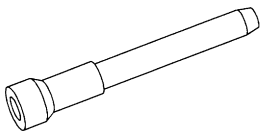
Tool number (TechMate No.) Tool name	Description
16441 6N210 (J-45488) Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
— (J-43897-18) Oxygen sensor thread cleaner  AWBIA2076ZZ	Reconditioning the exhaust system threads before installing a new oxygen sensor (Use with anti-seize lubricant shown below.) **J-43897-18 (18 mm dia.) for zirconia oxygen sensor**
— (J-48891) Spark plug socket  AWBIA1785ZZ	Removing and installing spark plug
KV10111100 (J-37228) Seal cutter  S-NT046	Removing oil pan and timing chain case
KV991J0050 (J-44626) Air fuel sensor Socket  LBIA0444E	Loosening or tightening air fuel ratio A/F sensor **a: 22 mm (0.87 in)**
KV10114400 (J-38365) Heated oxygen sensor wrench  NT636	Loosening or tightening air fuel ratio A/F sensor **a: 22 mm (0.87 in)**

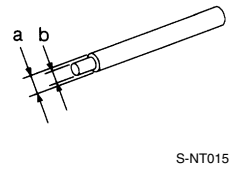
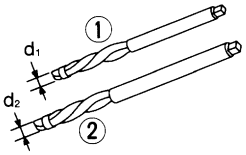
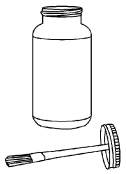
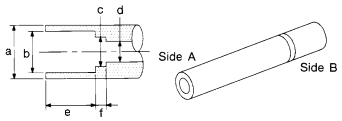
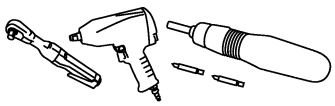
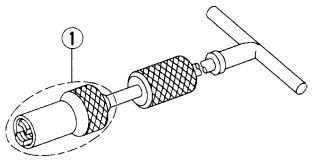
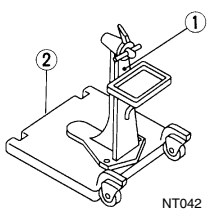
Tool number (TechMate No.) Tool name		Description
— (J-37067) Seal installer	 AWBIA2081ZZ	Installing rear main seal
KV10112100 (BT-8653-A) Torque angle meter	 S-NT014	Tightening bolts for bearing cap, cylinder head, etc.

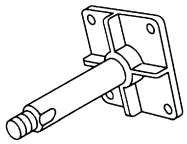
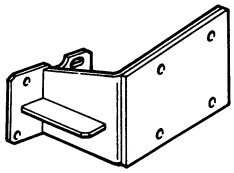
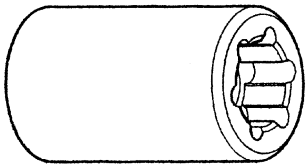
Commercial Service Tool

INFOID:0000000012601941

Tool number (TechMate No.) Tool name		Description
KV10117100 (J-36471-A) Heated oxygen sensor wrench	 NT379	Loosening or tightening heated oxygen sensor **For 22 mm (0.87 in) hexagon nut**
KV10116200 (J-26336-A) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2. KV10109220 (—) Adapter	 PBIC1650E	Disassembling valve mechanism Part (1) is a component of KV10116200 (J-26336-A), but part (2) is not.
— (—) Manual lift table caddy	 ZZA1210D	Removing and installing engine
ST16610001 (J-23907) Pilot converter puller	 S-NT045	Removing crankshaft pilot converter

Tool number (TechMate No.) Tool name	Description
— (—) Tube presser  S-NT052	Pressing the tube of liquid gasket
— (—) Piston ring compressor  S-NT044	Installing piston assembly into cylinder bore
— (—) Pulley holder  ZZA1010D	Crankshaft pulley removing and installing
— (—) Pulley puller  NT676	Removing crankshaft pulley
— (—) Valve seat cutter set  S-NT048	Finishing valve seat dimensions
— (—) Piston ring expander  S-NT030	Removing and installing piston ring
— (J-39386) Valve oil seal drift  NT024	Installing valve oil seal

Tool number (TechMate No.) Tool name	Description
— (—) Valve guide drift  S-NT015	Removing and installing valve guide **Intake & Exhaust:** **a: 9.5 mm (0.374 in) dia.** **b: 5.5 mm (0.217 in) dia.**
— (—) Valve guide reamer  S-NT016	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide **Intake & Exhaust:** **d_1: 6.0 mm (0.236 in) dia.** **d_2: 10.2 mm (0.402 in) dia.**
— (—) 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
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) dia.** **c: 10.3 (0.406) dia.** **f: 5 (0.20) dia.** Unit: mm (in)
— (—) Power tool  PIIB1407E	Loosening nuts, screws, and bolts
KV10107902 (J-38959) Valve oil seal puller with adapter (1)  S-NT605	Removing valve oil seal
ST0501S000 Engine stand assembly (—) 1. ST05011000 (—) Engine stand 2. ST05012000 (—) Base  NT042	Disassembling and assembling

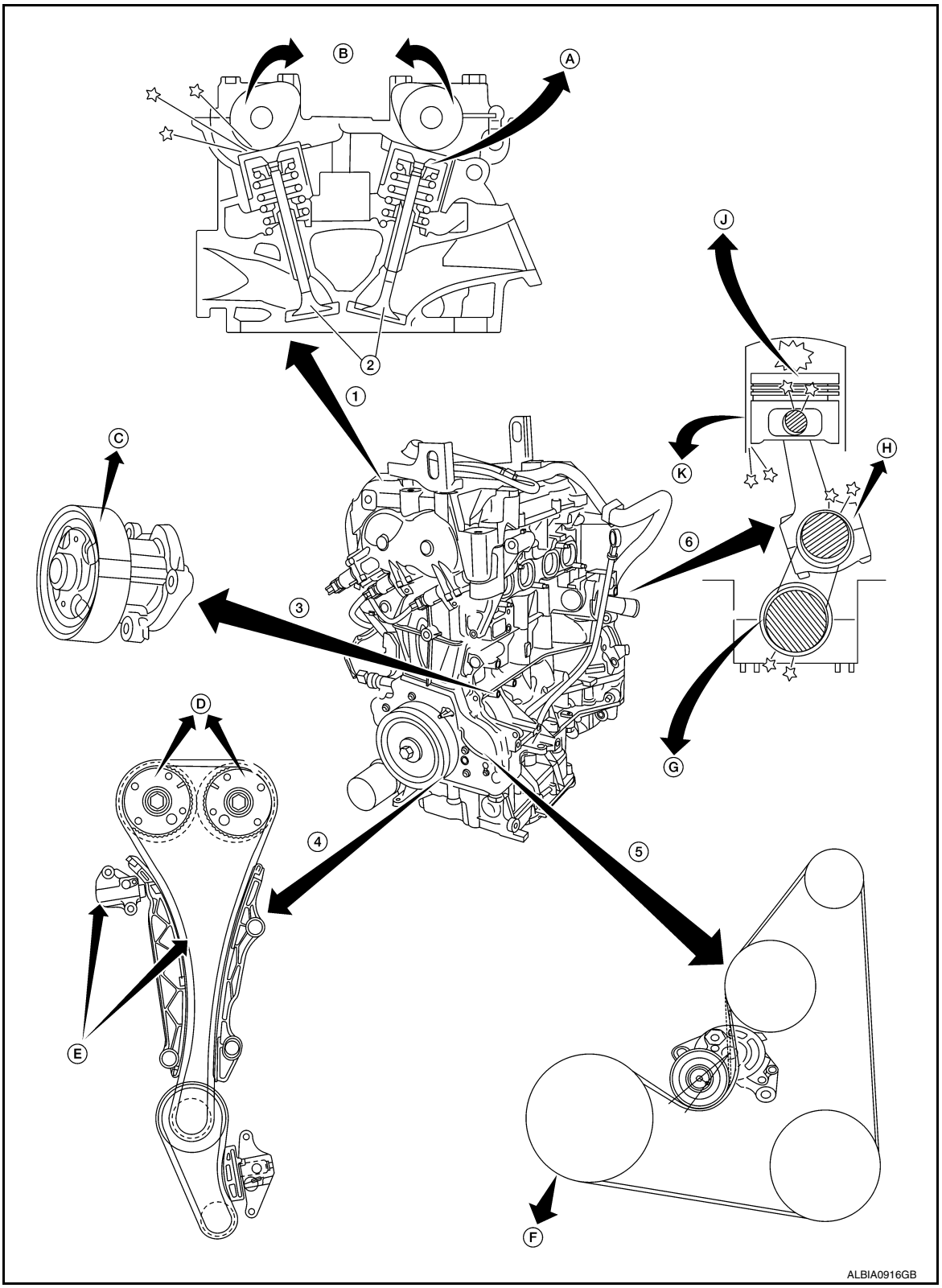
Tool number (TechMate No.) Tool name	Description
KV10106500 (—) Engine stand shaft  NT028	Engine supporting
KV10115300 (—) Engine sub-attachment  ZZA1078D	Disassembling and assembling
— (J-45816) E20 Socket  LBIA0285E	Removing and installing CVT drive plate bolts

SYMPTOM DIAGNOSIS

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:0000000012601942



1. Valve mechanism
2. Intake and exhaust valve
3. Water pump
4. Timing chain
5. Drive belt
6. Rotation mechanism
A. Tappet noise
B. Camshaft bearing noise
C. Water pump noise
D. VTC noise
E. Timing chain and chain tensioner noise
F. Drive belt noise (slipping)
G. Main bearing noise
H. Connecting rod bearing noise
J. Piston pin noise
K. Piston slap noise

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

INFOID:0000000012601943

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-23
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-113 EM-113
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-113 EM-113
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-113 EM-113 EM-113 EM-113
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-113 EM-113
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-113 EM-113
Front of engine Timing chain cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-62

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			
Front of engine	Squeaking or fizzing	A	B	—	B	—	B	Drive belts (Sticking or slipping)	Drive belts deflection	EM-19
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-19
	Rattle	—	—	A	—	—	—	VTC	VTC sprockets	EM-61

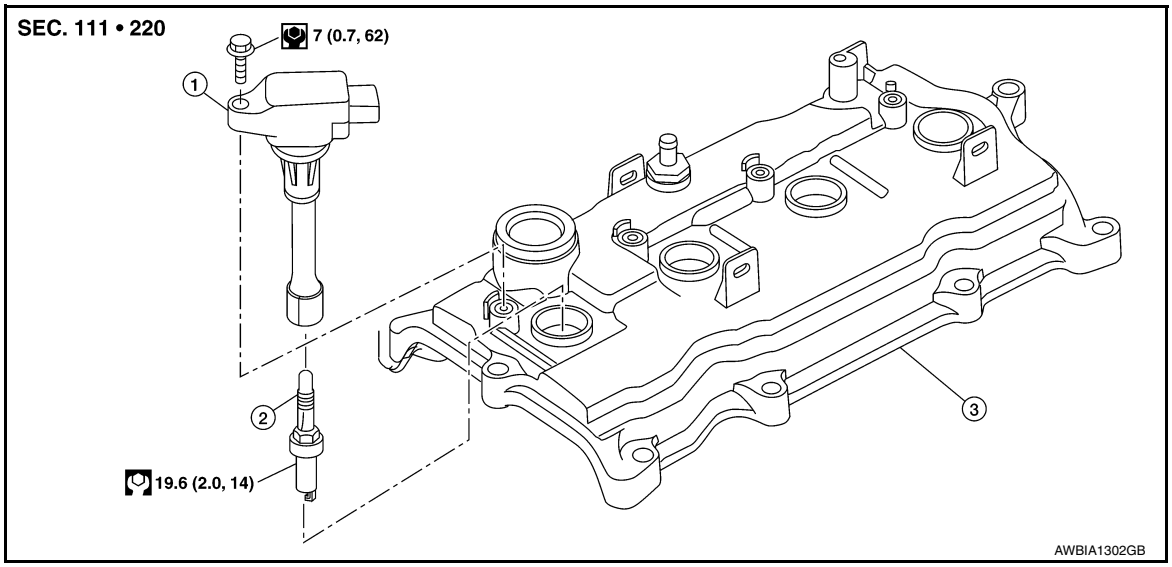
A: Closely related B: Related C: Sometimes related —: Not related

PERIODIC MAINTENANCE

SPARK PLUG

Exploded View

INFOID:0000000012601944



1. Ignition coil
2. Spark plug
3. Rocker cover

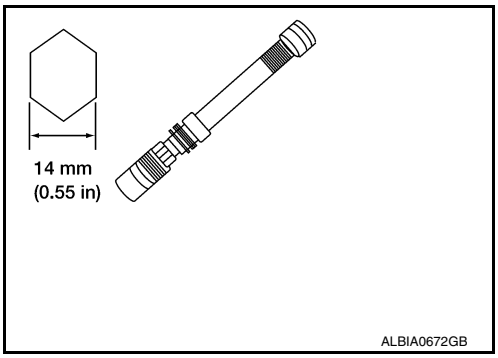
Removal and Installation

INFOID:0000000012601945

REMOVAL

1. Remove engine room cover. Refer to EM-28, "Removal and Installation".
2. Remove the ignition coil. Refer to EM-41, "Removal and Installation".
3. Remove the spark plug using Tool.

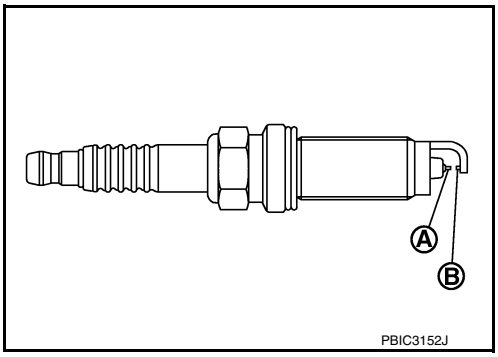
Tool number : — (J-48891)



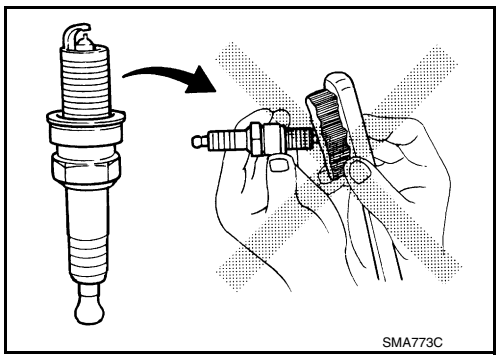
INSPECTION AFTER REMOVAL

- Visually check the electrode for dirt and wear and the insulator for burning.

(A) : Iridium alloy
(B) : Iridium alloy



- Do not use a wire brush for cleaning the spark plugs. Replace as necessary.

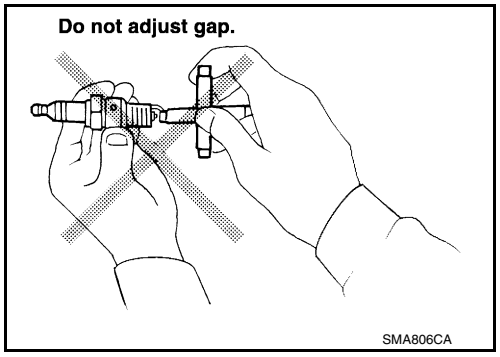


- If plug is covered with carbon, a spark plug cleaner may be used.

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

- Checking and adjusting plug gap is not required between change intervals. If the gap is out of specification, replace the spark plug.

CAUTION:
- **Do not drop or shock spark plug.**
- **Do not drop or shock ignition coil.**
- **Discard any spark plug which has been dropped or shocked.**
- **Discard any ignition coil which has been dropped or shocked.**



INSTALLATION

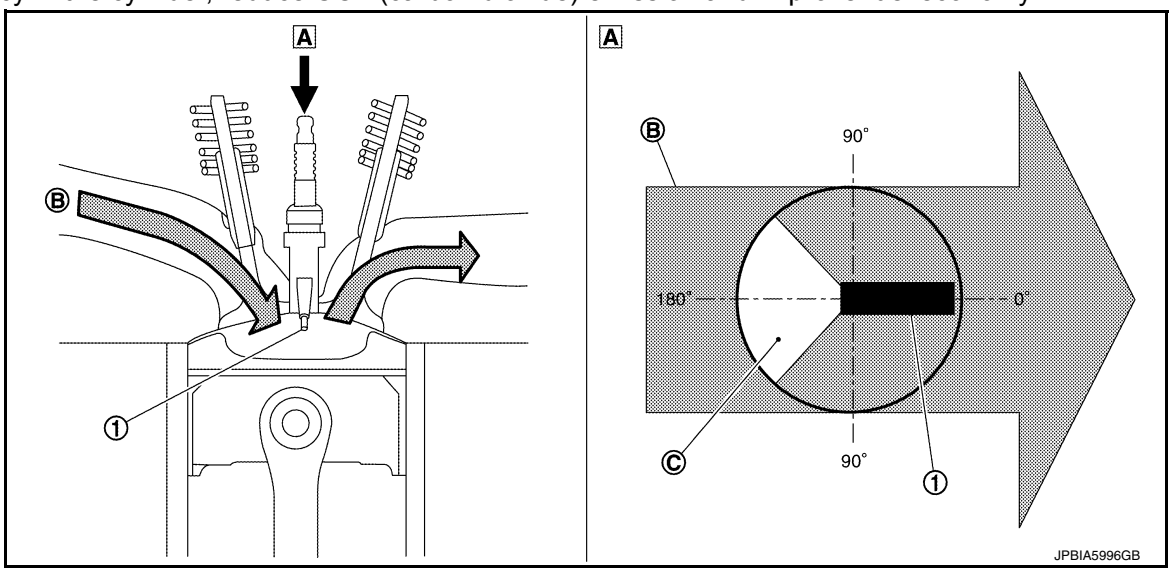
Installation is in the reverse order of removal.

Standard type*	DENSO
	FXE20HE11C
Gap (nominal)	1.1 mm (0.043 in)

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

CAUTION:
Always tighten the spark plug to specified torque to align the orientation of electrodes. The ground electrode of a genuine spark plug is positioned in the area of maximum ignitability by tightening to the specified torque. When replacing spark plugs, use genuine spark plugs of which the ground electrode is adjusted.
NOTE:

The ground electrode of the spark plug is positioned in the area of maximum ignitability to improve combustion efficiency in the cylinder, reduce CO2 (carbon dioxide) emission and improve fuel economy.

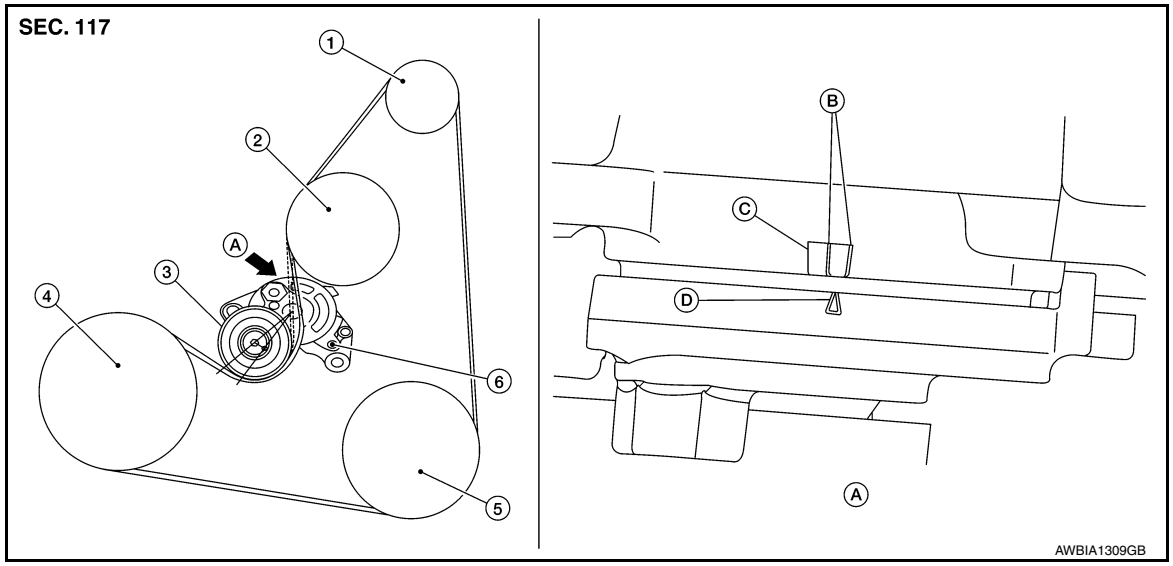


1. Ground electrode of spark plug
A. Top view
B. Air-fuel mixture flow
C. Poor ignitability region

DRIVE BELTS

Exploded View

INFOID:0000000012601946



1. Generator pulley
2. Water pump pulley
3. Drive belt auto-tensioner
4. Crankshaft pulley
5. A/C compressor pulley
6. Drive belt retainer boss
A. View A
B. New drive belt range
C. Possible use range
D. Indicator (notch)

Checking Drive Belts

INFOID:0000000012601947

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

1. Visually check entire drive belt for wear, damage or cracks.
2. Check that the drive belt auto-tensioner indicator is within the possible use range.
   NOTE:
   - When new drive belt is installed, the drive belt auto-tensioner indicator should be within the new drive belt range.
   - Check the drive belt auto-tensioner indicator when the engine is cold.
3. If the drive belt auto-tensioner indicator is out of the possible use range or belt is damaged, replace drive belt.

Tension Adjustment

INFOID:0000000012601948

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

Removal and Installation

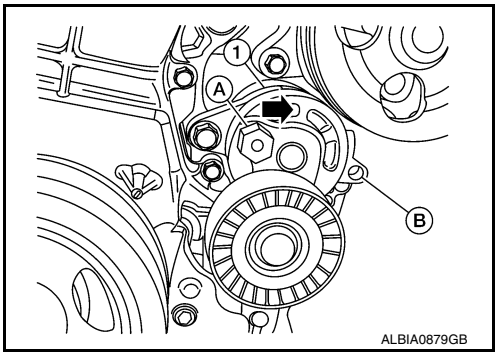
INFOID:0000000012601949

REMOVAL

1. Remove the fender protector side cover (RH). Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".

2. Securely hold the hexagonal part (A) of drive belt auto-tensioner (1) using suitable tool, and move in the direction of arrow (loosening direction of tensioner).

WARNING:
Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.



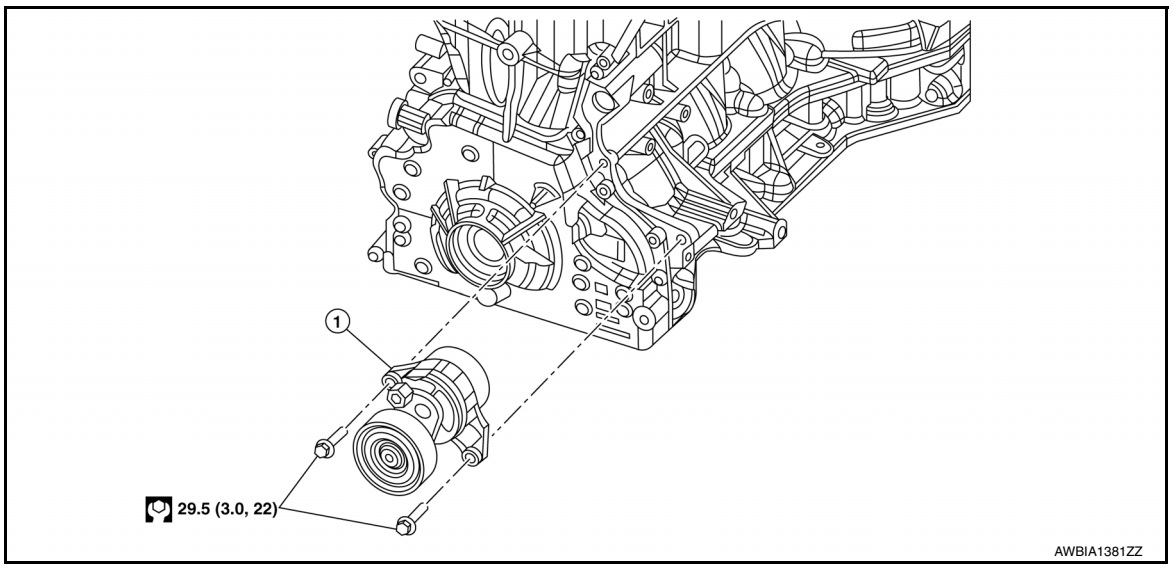
3. Insert a rod approximately 6 mm (0.24 in) in diameter through the rear of the drive belt auto-tensioner into retaining boss (B) to lock drive belt auto-tensioner pulley.
NOTE:
Leave drive belt auto-tensioner pulley arm locked until drive belt is installed again.
4. Loosen drive belt from drive belt auto-tensioner and then remove it from the other pulleys.

INSTALLATION

1. Install the drive belt onto all of the pulleys except for the drive belt auto-tensioner. Then install the drive belt onto drive belt auto-tensioner last.
CAUTION:
Confirm belts are completely set on the pulleys.
2. Release drive belt auto-tensioner, and apply tension to drive belt.
WARNING:
Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.
3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Confirm the indicator is within the possible use range. Refer to EM-19, "Checking Drive Belts".
5. Install the fender protector side cover (RH). Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".

Removal and Installation of Drive Belt Auto-tensioner

INFOID:0000000012601950



1. Drive belt auto-tensioner

REMOVAL

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

1. Remove the front wheel and tire (RH) using power tool. Refer to WT-54, "Adjustment".
2. Remove the fender protector side cover (RH). Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".

3. Remove the engine room cover. Refer to EM-28, "Removal and Installation".
4. Remove the drive belt. Refer to EM-19, "Removal and Installation".
5. Remove the drive belt auto-tensioner.

INSTALLATION

Installation is in the reverse order of removal.

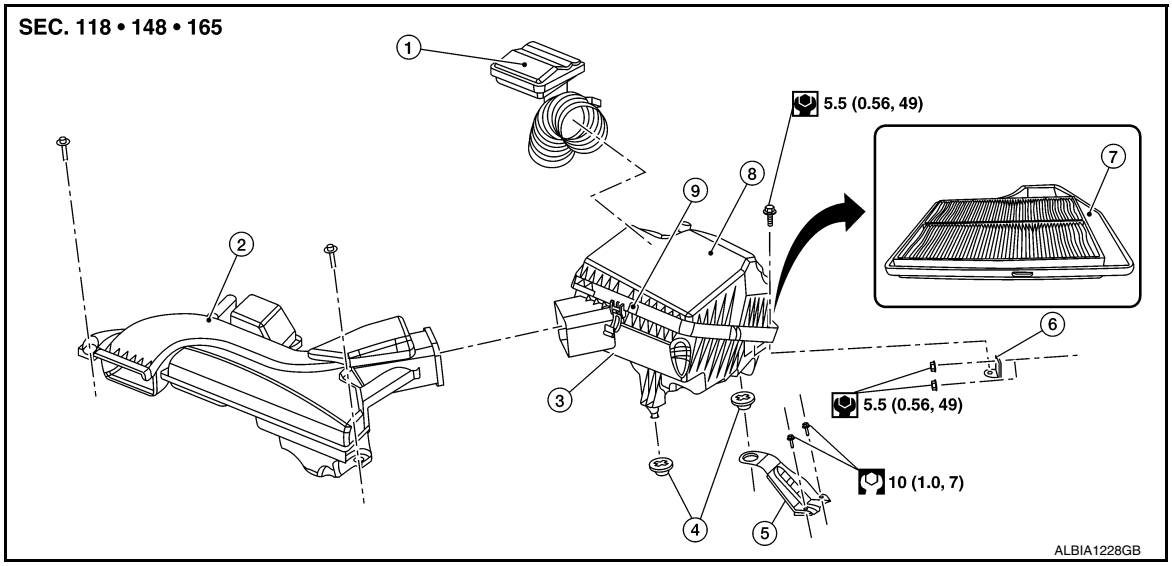
CAUTION:

- **If there is damage greater than peeled paint, replace drive belt auto-tensioner unit.**
- **Install the drive belt auto-tensioner carefully so not to damage the water pump pulley.**

AIR CLEANER FILTER

Exploded View

INFOID:0000000012601951



1. Air duct hose and resonator
2. Front air duct
3. Air cleaner case (bottom)
4. Grommets
5. Air cleaner mounting bracket
6. Air cleaner mounting bracket
7. Air cleaner filter
8. Air cleaner case (top)
9. Air cleaner case clips

Removal and Installation

INFOID:0000000012601952

CHANGING THE AIR CLEANER FILTER

1. Release the air cleaner case clips.
2. Open the air cleaner case (top).
3. Remove the air cleaner filter.
4. Install a new air cleaner filter.
5. Close the air cleaner case (top).
6. Secure the air cleaner case clips.

INSPECTION AFTER REMOVAL

Examine the air cleaner filter for stains, clogging, or damage.

- Remove dirt and foreign objects (such as dead leaves) on air cleaner filter surface and inside cleaner case.
- If clogging or damage is observed, replace the air cleaner filter.

CAUTION:

Do not clean the viscous paper type air cleaner filter by blowing as there is a risk of deterioration of its performance.

MAINTENANCE INTERVAL

Refer to MA-8, "Introduction of Periodic Maintenance".

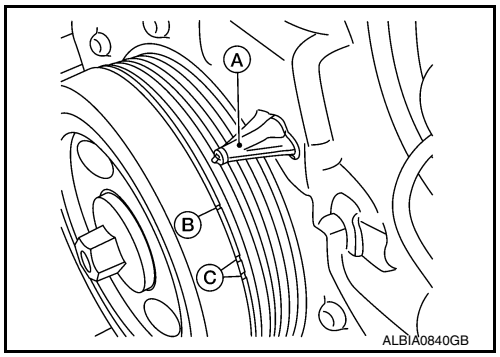
CAMSHAFT VALVE CLEARANCE

Camshaft valve clearance

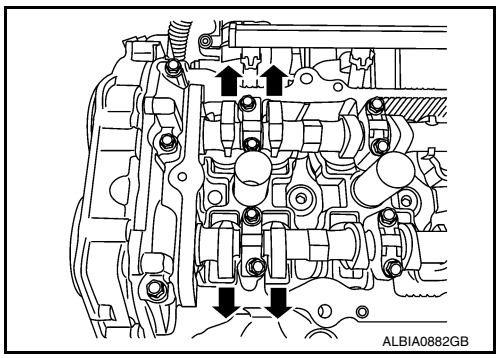
INFOID:0000000012601953

- Perform this inspection as follows after removal, installation, or replacement of the camshaft or any valve-related parts, or if there are any unusual engine conditions due to changes in valve clearance over time (starting, idling, and/or noise).

1. Remove the fender protector side cover (RH). Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".
2. Remove the rocker cover using power tool. Refer to EM-46, "Removal and Installation".
3. Turn crankshaft pulley clockwise when viewed from front to align TDC identification mark (B) with timing indicator (A).
   NOTE:
   Do not confuse TDC mark (B) with paint marks (C).



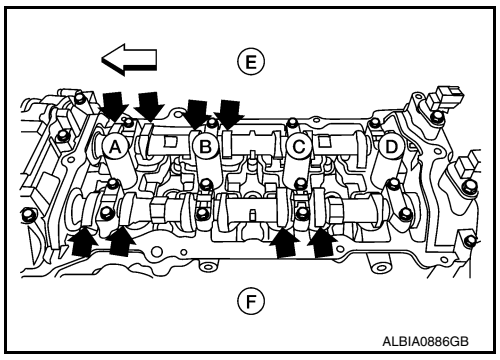
4. At this time, check that the both intake and exhaust cam lobes of No. 1 cylinder face outside.
   - If they do not face outside, turn crankshaft pulley once more.



5. Measure valve clearances with a feeler gauge at locations marked (X) in the table below.
   - No.1 cylinder compression TDC.

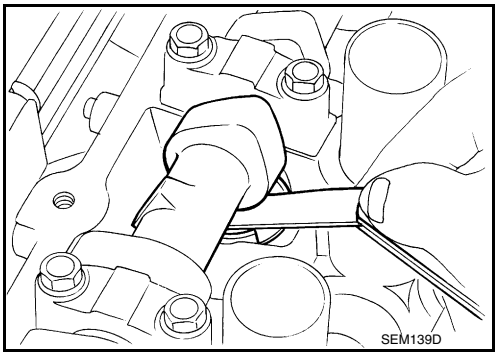
Cylinder	No.1 (A)		No.2 (B)		No.3 (C)		No.4 (D)	
Valve	INT (E)	EXH (F)	INT (E)	EXH (F)	INT (E)	EXH (F)	INT (E)	EXH (F)
Measure	x	x	x			x		

⇦ : Engine front

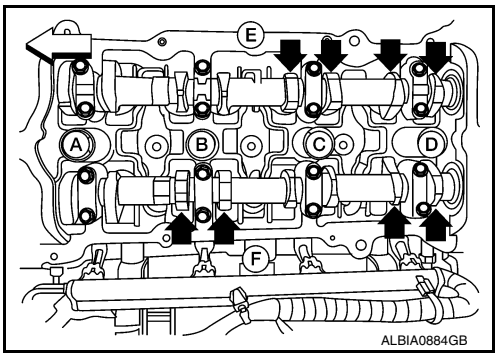


- Use a feeler gauge to measure the clearance between valve lifter and camshaft.

Valve clearance: **Refer to EM-113, "Standard and Limit".**



6. Turn crankshaft one complete revolution (360°) and align mark on crankshaft pulley with pointer.
7. Measure valve clearances with a feeler gauge at locations marked (X) in the table below.
   - No.4 cylinder compression TDC.



Cylinder	No.1 (A)		No.2 (B)		No.3 (C)		No.4 (D)	
Valve	INT (E)	EXH (F)	INT (E)	EXH (F)	INT (E)	EXH (F)	INT (E)	EXH (F)
Measure				x	x		x	x

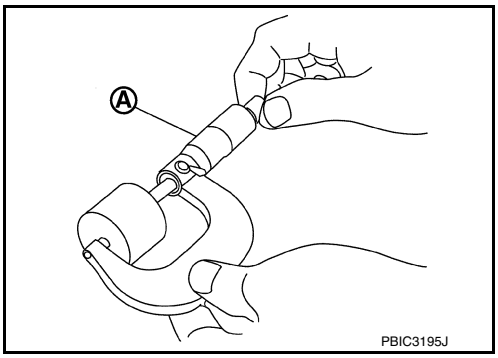
If out of specifications, make necessary adjustment.

⇦ : Engine front

ADJUSTMENT

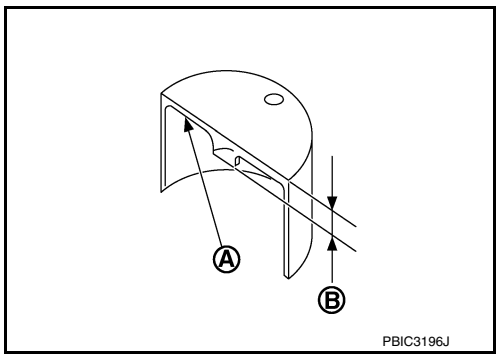
NOTE:
Perform adjustment by selecting the valve lifter with the correct head thickness.

1. Remove camshaft. Refer to EM-48, "Removal and Installation".
2. Remove the valve lifters at the locations that are outside the standard.
3. Measure the center thickness of the removed valve lifters with a micrometer (A).



4. Use the equation below to calculate valve lifter thickness for replacement.
   - Valve lifter thickness calculation.
     t = t1 + (C1 - C2)
     t = Thickness of replacement valve lifter.
     t1 = Thickness of removed valve lifter.
     C1 = Measured valve clearance.
     C2 = Standard valve clearance.

- Thickness of a new valve lifter (B) can be identified by stamp marks (A) on the reverse side (inside the cylinder).
  Stamp mark 324H indicates a thickness of 3.00 mm (0.1181 in)
  Available thickness of valve lifter: 26 sizes with a range of 3.00 to 3.50 mm (0.1181 to 0.1378 in), in steps of 0.02 mm (0.0008 in), when assembled at the factory.



5. Install the selected valve lifter.
6. Install camshaft. Refer to EM-48, "Removal and Installation".
7. Install timing chain and related parts. Refer to EM-62, "Removal and Installation".
8. Manually rotate crankshaft pulley a few rotations.
9. Check that valve clearances for cold engine are within specifications by referring to the specified values.

Valve clearance **Refer to EM-113, "Standard and Limit".**

10. Install all removed parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

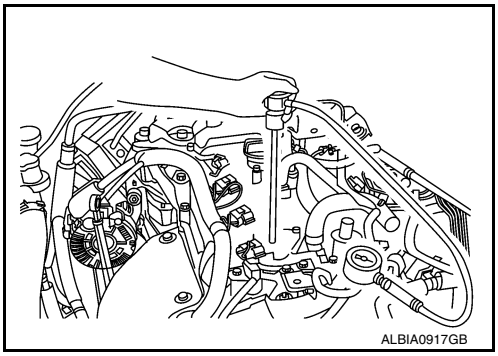
COMPRESSION PRESSURE

Compression pressure

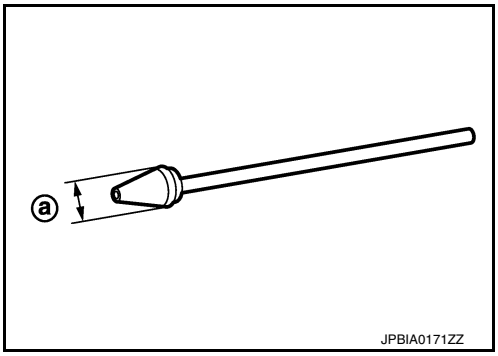
INFOID:0000000012601954

CHECKING COMPRESSION PRESSURE

1. Warm up the engine to full operating temperature.
2. Release the fuel pressure. Refer to EC-190, "Work Procedure".
3. Remove the ignition coil and spark plug from each cylinder. Refer to EM-41, "Removal and Installation".
4. Connect engine tachometer (not required in use of CONSULT).
5. Disconnect the fuel injector harness connector to avoid any residual fuel injection during the measurement.
6. Install the compression tester with the adapter into the spark plug hole.



- Use compression tester whose end (a) (rubber portion) is smaller than 20 mm (0.79 in) in diameter. Otherwise, it may be caught by cylinder head during removal.



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

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

Standard	Minimum	Difference limit between cylinders
1410 (14.4, 204.5) / 250	1220 (12.4, 176.9) / 250	100 (1.0, 14) / 250

CAUTION:

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

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

- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, the head gasket is leaking. In such a case, replace the cylinder head gasket.

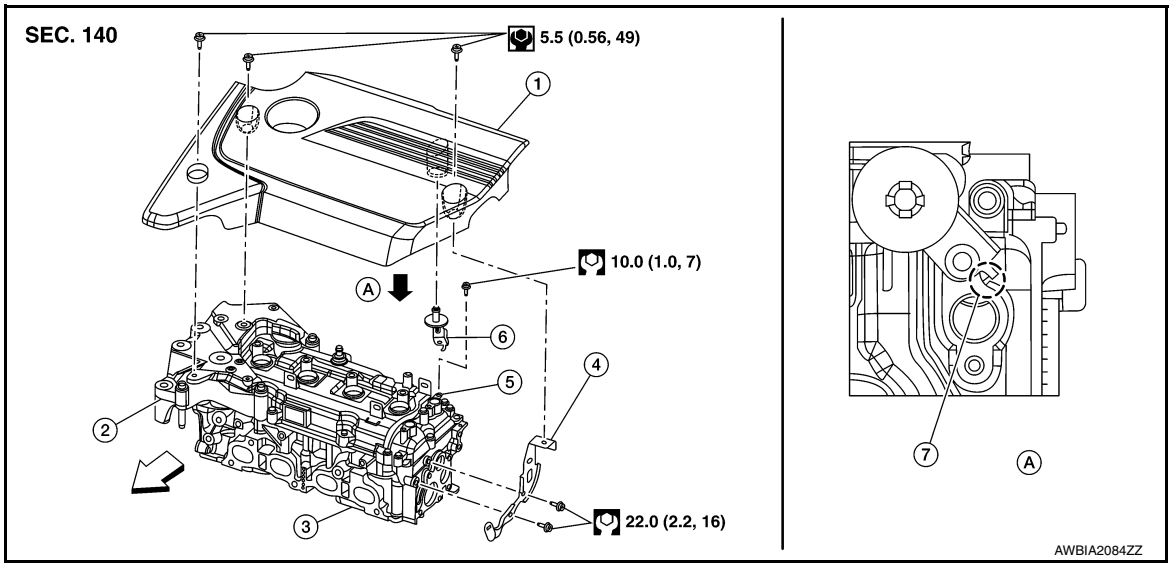
8. Install spark plug, ignition coil and harness connectors. Refer to EM-41, "Exploded View".

REMOVAL AND INSTALLATION

ENGINE ROOM COVER

Exploded View

INFOID:0000000012601955



1. Engine room cover
2. Engine mounting bracket (RH)
3. Cylinder head
4. Engine room cover bracket
5. Camshaft position sensor bracket
6. Engine room cover bracket
7. Bracket stopper
A. View A
⇦ Front

Removal and Installation

INFOID:0000000012601956

CAUTION:
Do not damage or scratch engine room cover.

REMOVAL

1. Remove the engine room cover bolts.
2. Lift up on engine room cover firmly to dislodge snap fit mounts.
3. Remove engine room cover.

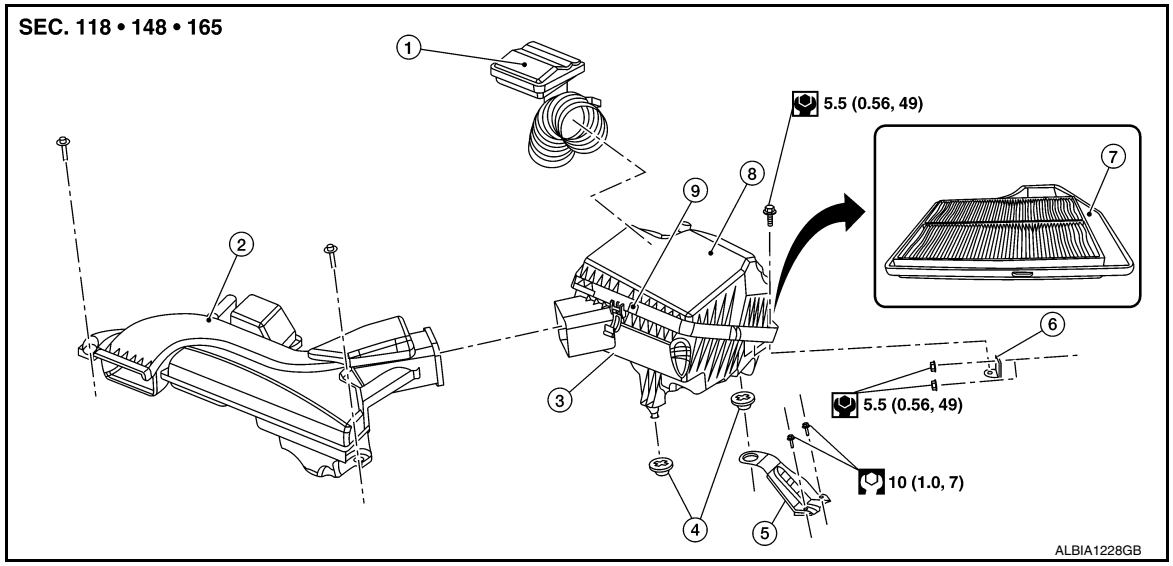
INSTALLATION

Installation is in the reverse order of removal.

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:0000000012601957



1. Air duct hose and resonator
2. Front air duct
3. Air cleaner case (bottom)
4. Grommets
5. Air cleaner mounting bracket
6. Air cleaner mounting bracket
7. Air cleaner filter
8. Air cleaner case (top)
9. Air cleaner case clips

Removal and Installation

INFOID:0000000012601958

REMOVAL

1. Remove the core support cover. Refer to EXT-24, "Exploded View".
2. Remove front air duct.
3. Remove the engine room cover. Refer to EM-28, "Removal and Installation".
4. Disconnect the air duct hose clamps at the electric throttle control actuator and the air cleaner case assembly.
5. Disconnect the blow-by hose.
6. Remove air duct hose and resonator.
7. Disconnect the mass air flow sensor and remove the harness retainers from the air cleaner case assembly.
8. Disconnect the transaxle breather hose from the air cleaner case assembly.
9. Remove mass air flow sensor harness connector from the air cleaner case assembly (if necessary).
   CAUTION:
   Handle the mass air flow sensor with care:
   - **Do not shock it.**
   - **Do not disassemble it.**
   - **Do not touch the internal sensor.**
10. Remove the air cleaner case assembly.

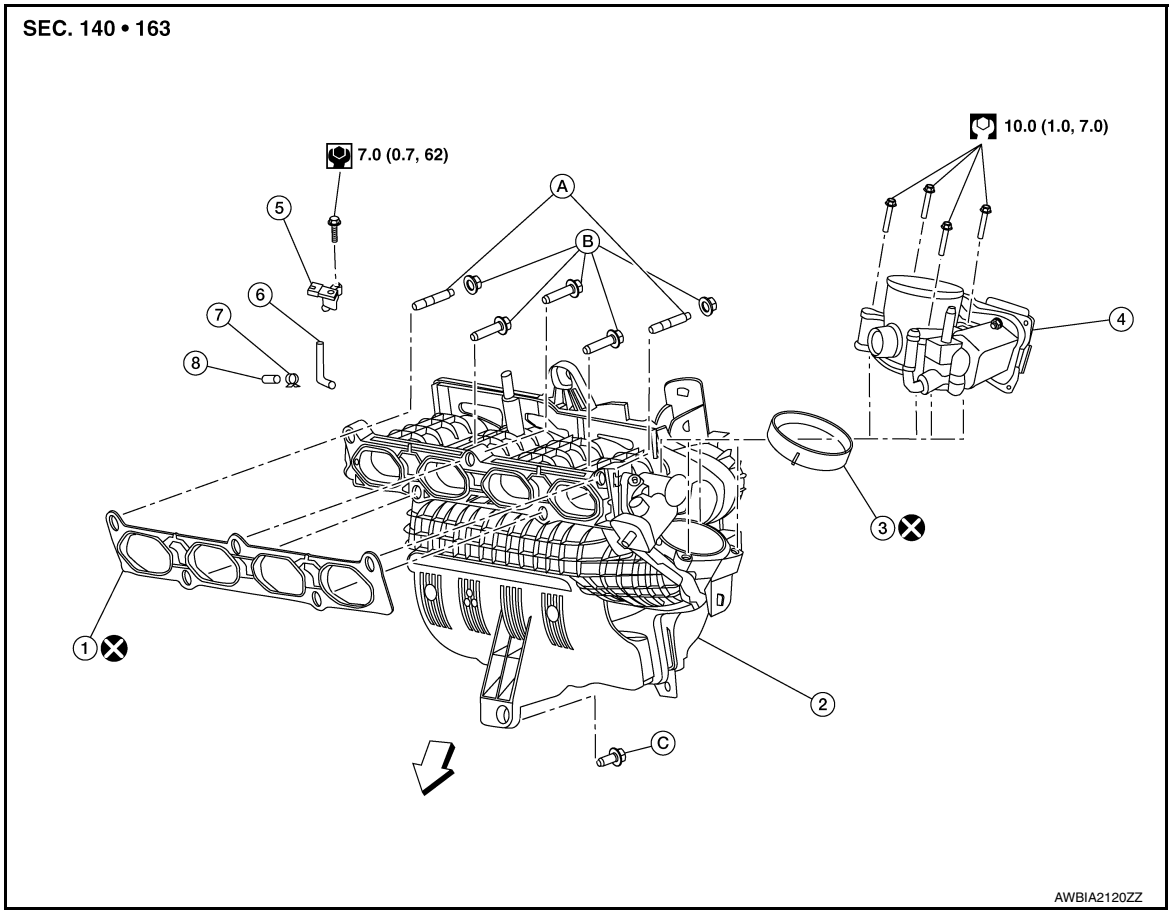
INSTALLATION

Installation is in the reverse order of removal.

INTAKE MANIFOLD

Exploded View

INFOID:0000000012601959



1. Intake manifold gasket
2. Intake manifold
3. Electric throttle control actuator O-ring
4. Electric throttle control actuator
5. Map sensor (California only)
6. Map hose (California only)
7. Clamp
8. Cap (except California)
A. Refer to INSTALLATION
B. Refer to INSTALLATION
C. Refer to INSTALLATION
⇦ Front

Removal and Installation

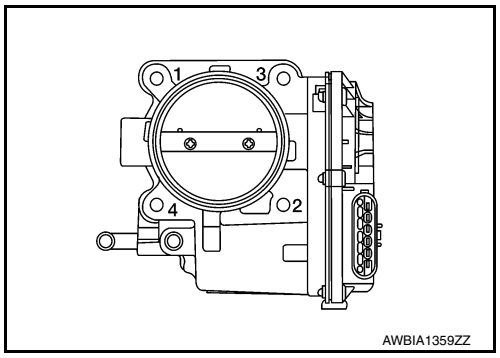
INFOID:0000000012601960

REMOVAL

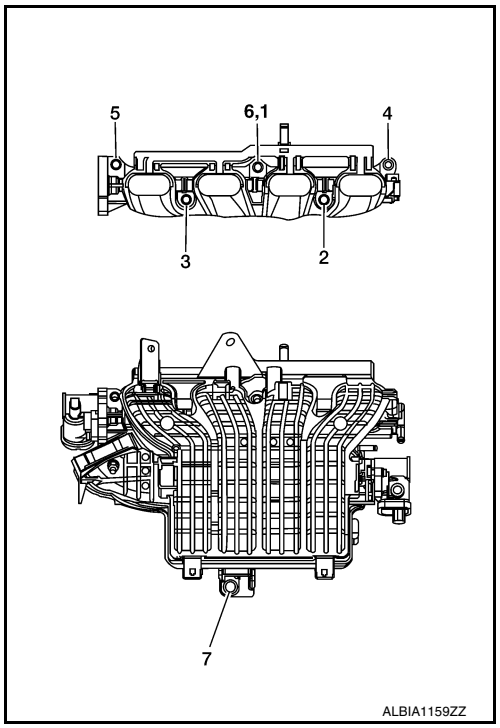
WARNING:
To avoid the danger of being scalded, do not drain the coolant when the engine is hot.
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

1. Disconnect battery negative terminal. Refer to PG-81, "Removal and Installation".
2. Release the fuel pressure. Refer to EC-190, "Work Procedure".
3. Partially drain engine coolant. Refer to CO-11, "Changing Engine Coolant".
4. Remove the air cleaner case assembly and air duct hose and resonator assembly. Refer to EM-29, "Removal and Installation".
5. Remove cowl top finisher. Refer to EXT-34, "Removal and Installation".
6. Remove strut tower bar. Refer to FSU-18, "Exploded View".
7. Disconnect the PCV hose from the rocker cover.
8. Disconnect the EVAP hose and EVAP canister purge volume control solenoid.

9. Disconnect the brake booster vacuum hose from the intake manifold.
10. Disconnect the fuel quick connector from the fuel tube assembly. Refer to EM-42, "Exploded View".
11. Disconnect the water hoses from the electric throttle control actuator.
NOTE:
When removing only intake manifold, position electric throttle control actuator aside without disconnecting the water hose.
12. Loosen bolts in reverse order as shown, then remove electric throttle control actuator and gasket.
CAUTION:
Handle carefully to avoid any damage.



13. Disconnect the radiator hose (upper) from the water outlet. Refer to CO-13, "Exploded View".
14. Disconnect harness connectors from the tumble control valve, tumble control valve position sensor, and power valve motor.
15. Remove the fuel tube assembly. Refer to EM-42, "Exploded View".
16. Remove the bolts and nuts in the reverse order shown and remove the intake manifold assembly with gasket.
CAUTION:
Cover engine openings to prevent entry of foreign materials.
NOTE:
Disregard No. 6 when loosening.
17. Remove tumble control valve position sensor from intake manifold (if necessary).



INSTALLATION

Installation is in the reverse order of removal.
- Add engine coolant (if necessary). Refer to CO-11, "Changing Engine Coolant".
- Perform the “Throttle Valve Closed Position Learning” when harness connector of electric throttle control actuator is disconnected. Refer to EC-186, "Description".
- Perform the “Idle Air Volume Learning” and “Throttle Valve Closed Position Learning” when electric throttle control actuator is replaced. Refer to EC-187, "Description".

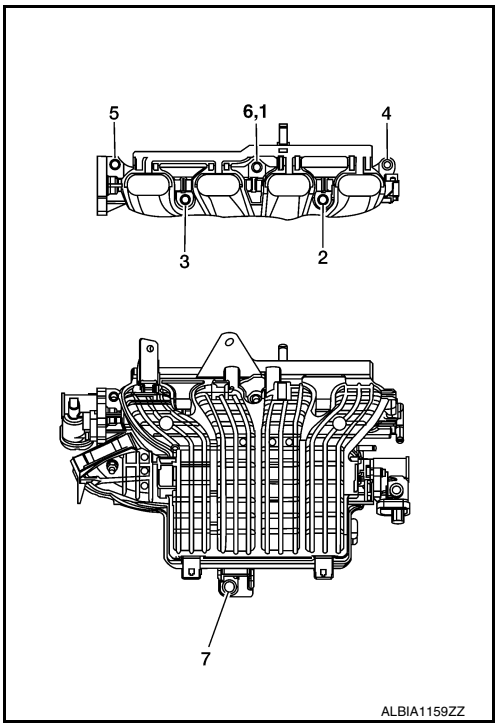
Intake Manifold

1. Securely install intake manifold gasket to the mounting groove.
CAUTION:
Do not reuse intake manifold gasket.
2. If studs were removed, install them and tighten to specification.

Studs : 9.4 N·m (0.96 kg-m, 83 in-lb)

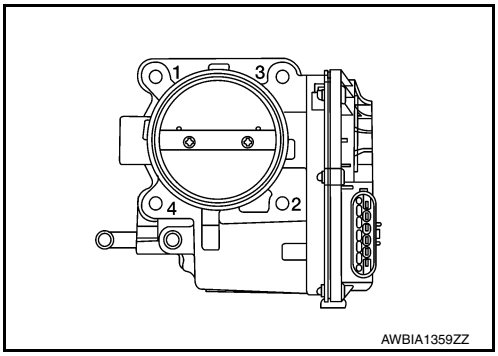
3. Tighten in numerical order as shown.
CAUTION:
After tightening the five bolts in the order shown, the 1, 6 position designates that the first bolt tightened is to be retightened to specification.

Bolts 1, 2, 3, 4, 5, 6 : 25.0 N·m (2.6 kg-m, 18 ft-lb)
Nuts 4, 5 : 25.0 N·m (2.6 kg-m, 18 ft-lb)
Bolt 7 : 45.0 N·m (4.6 kg-m, 33 ft-lb)



Electric Throttle Control Actuator

1. Install a new O-ring on the electric throttle control actuator.
CAUTION:
Do not reuse O-ring.
2. Tighten the bolts of electric throttle control actuator in numerical order as shown.



INSPECTION AFTER INSTALLATION

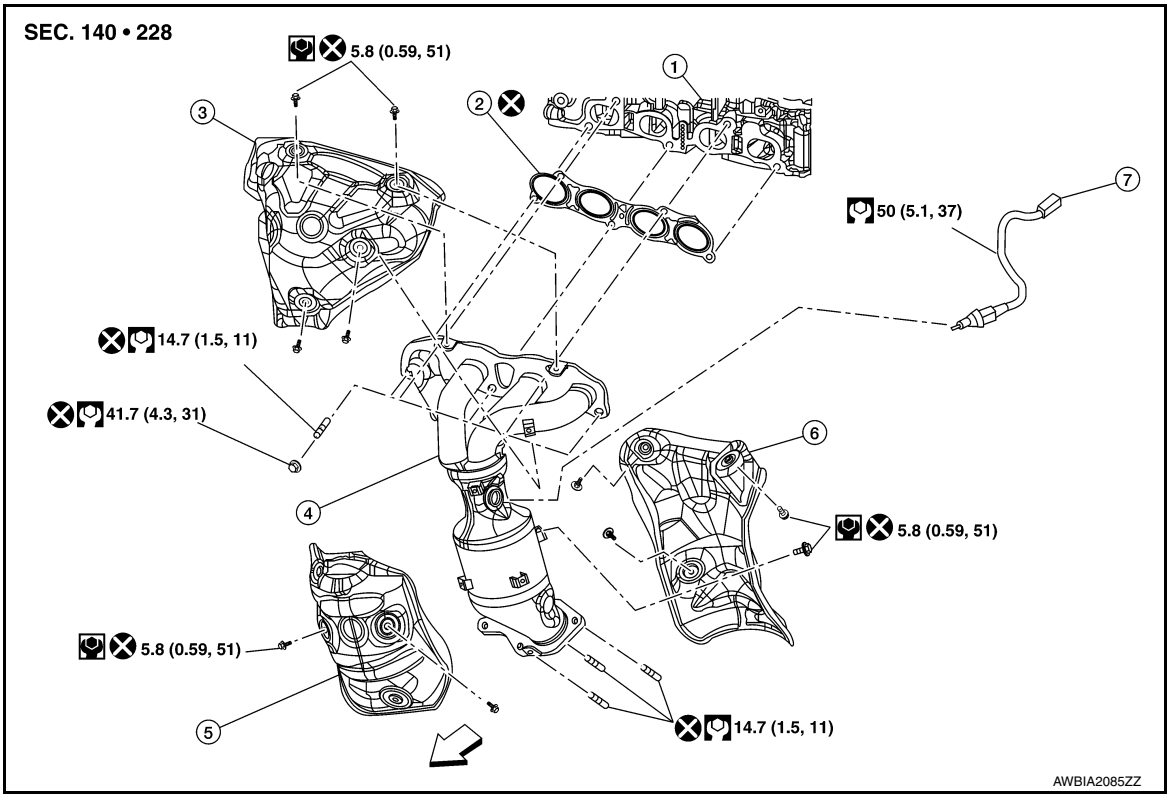
Make sure there are no fuel leaks at connections as follows:

1. Apply fuel pressure to fuel lines by turning ignition switch ON (with engine stopped). Then check for fuel leaks at connections.
NOTE:
Use mirrors for checking on connections out of the direct line of sight.
2. Start the engine and rev it up and check for fuel leaks at connections.
WARNING:
Do not touch engine immediately after stopping as engine is extremely hot.

EXHAUST MANIFOLD AND THREE WAY CATALYST

Exploded View

INFOID:0000000012601961



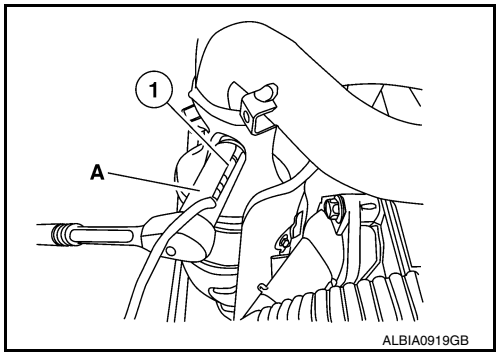
1. Cylinder head
2. Exhaust manifold gasket
3. Exhaust manifold cover (upper)
4. Exhaust manifold and three way catalyst assembly
5. Exhaust manifold cover (lower front)
6. Exhaust manifold cover (lower rear)
7. Air fuel ratio (A/F) sensor 1
⇦ Front

Removal and Installation

INFOID:0000000012601962

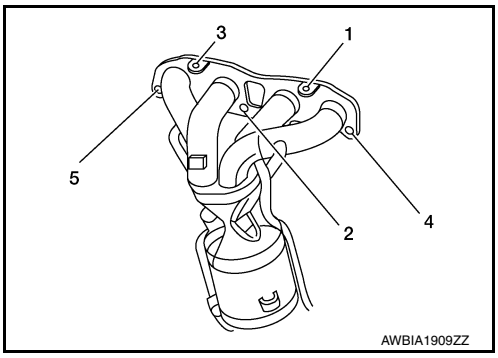
REMOVAL

1. Remove the front under cover. Refer to EXT-38, "FRONT UNDER COVER : Removal and Installation".
2. Remove the exhaust front tube. Refer to EX-5, "Exploded View".
3. Remove the front air duct and air cleaner case assembly. Refer to EM-29, "Removal and Installation".
4. Disconnect harness connector from the air fuel ratio (A/F) sensor 1.
5. Remove the exhaust manifold cover (upper).
6. Remove the air fuel ratio (A/F) sensor 1 (1) using a suitable tool (A) (if necessary).
   CAUTION:
   - **Clean exhaust manifold and three way catalyst port securing air fuel ratio (A/F) sensor 1 with anti-seize lubricant, or equivalent.**
   - **Do not damage air fuel ratio (A/F) sensor 1.**
   - **Discard any air fuel ratio (A/F) sensor 1 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new one.**



7. Remove the oil level gauge and oil level gauge guide. Refer to EM-91, "Exploded View".

8. Remove the exhaust manifold cover (lower front).
9. Loosen the exhaust manifold and three way catalyst nuts in the reverse order as shown.



10. Remove the exhaust manifold and three way catalyst assembly and gasket. Discard the gasket.
11. Remove the exhaust manifold cover (lower rear).

INSPECTION AFTER REMOVAL

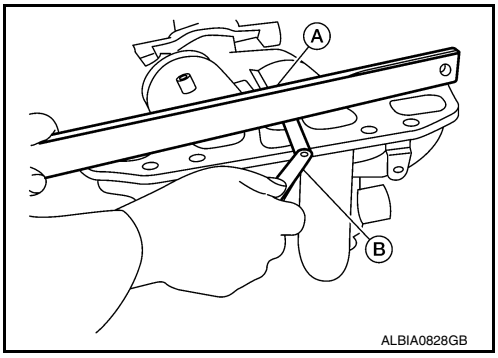
Surface Distortion

Use suitable tool (A) and (B) to check the flatness of exhaust manifold mating surface.

NOTE:

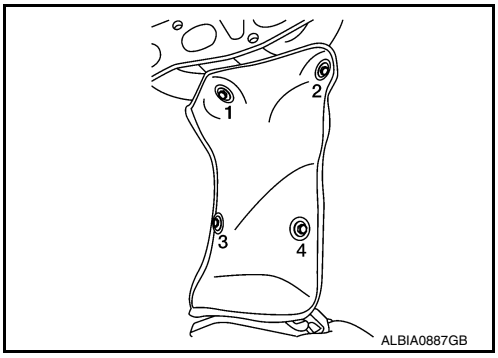
Place the suitable tool (A) diagonally and measure in several locations.

Limit : 0.3 mm (0.012 in)



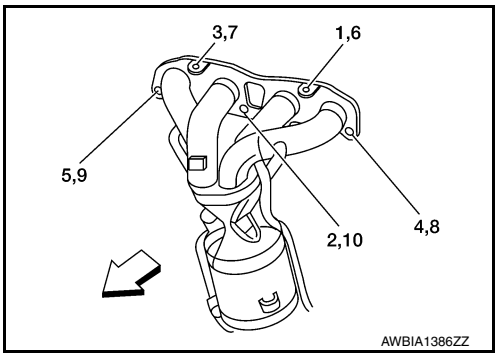
INSTALLATION

1. Install studs in cylinder head and exhaust manifold (if removed). Then tighten to specification.
   CAUTION:
   Do not reuse cylinder head or exhaust manifold studs.
2. Install exhaust manifold cover (lower rear) (if removed) and bolts. Then tighten the bolts to specification in the numerical order shown.
   CAUTION:
   Do not reuse bolts.

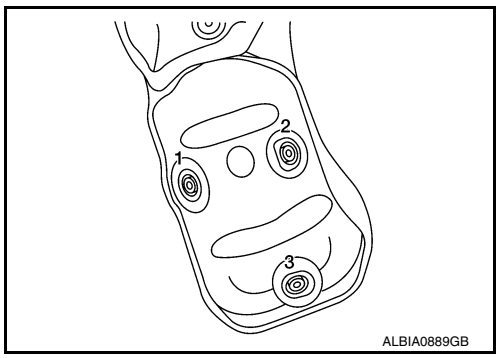


3. Install the exhaust manifold and gasket. Then tighten the nuts to specification in the numerical order shown.
   CAUTION:
   Do not reuse gasket.

⇦ : Front



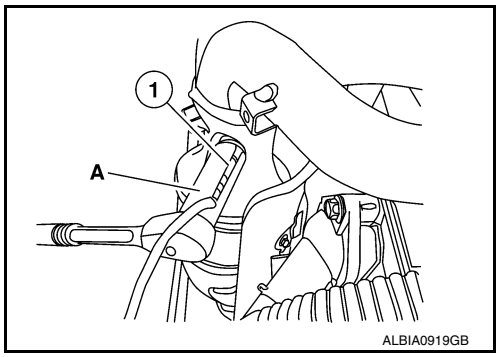
4. Install the exhaust manifold cover (lower front) and bolts. Then tighten the bolts to specification in the numerical order shown.
CAUTION:
Do not reuse bolts.



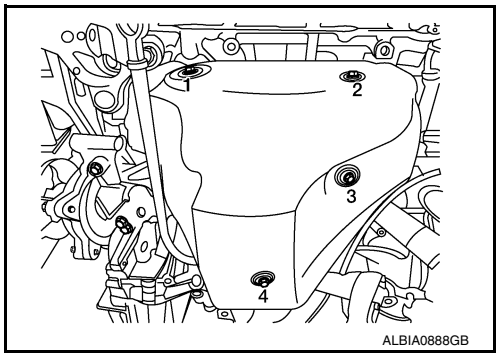
5. Clean exhaust manifold and three way catalyst port securing air fuel ratio (A/F) sensor 1 with Tool.

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

6. Install the air fuel ratio (A/F) sensor 1 (1) using a suitable tool (A) and tighten to specification.
CAUTION:
- **Do not damage air fuel ratio (A/F) sensor 1.**
- **Discard any air fuel ratio (A/F) sensor 1 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new one.**
- **Do not over-tighten the air fuel ratio (A/F) sensor 1. Doing so may cause damage to the air fuel ratio (A/F) sensor 1, resulting in a malfunction and the MIL coming on.**



7. Install the exhaust manifold cover (upper). Then tighten the bolts to specification in the numerical order shown.
CAUTION:
Do not reuse bolts.

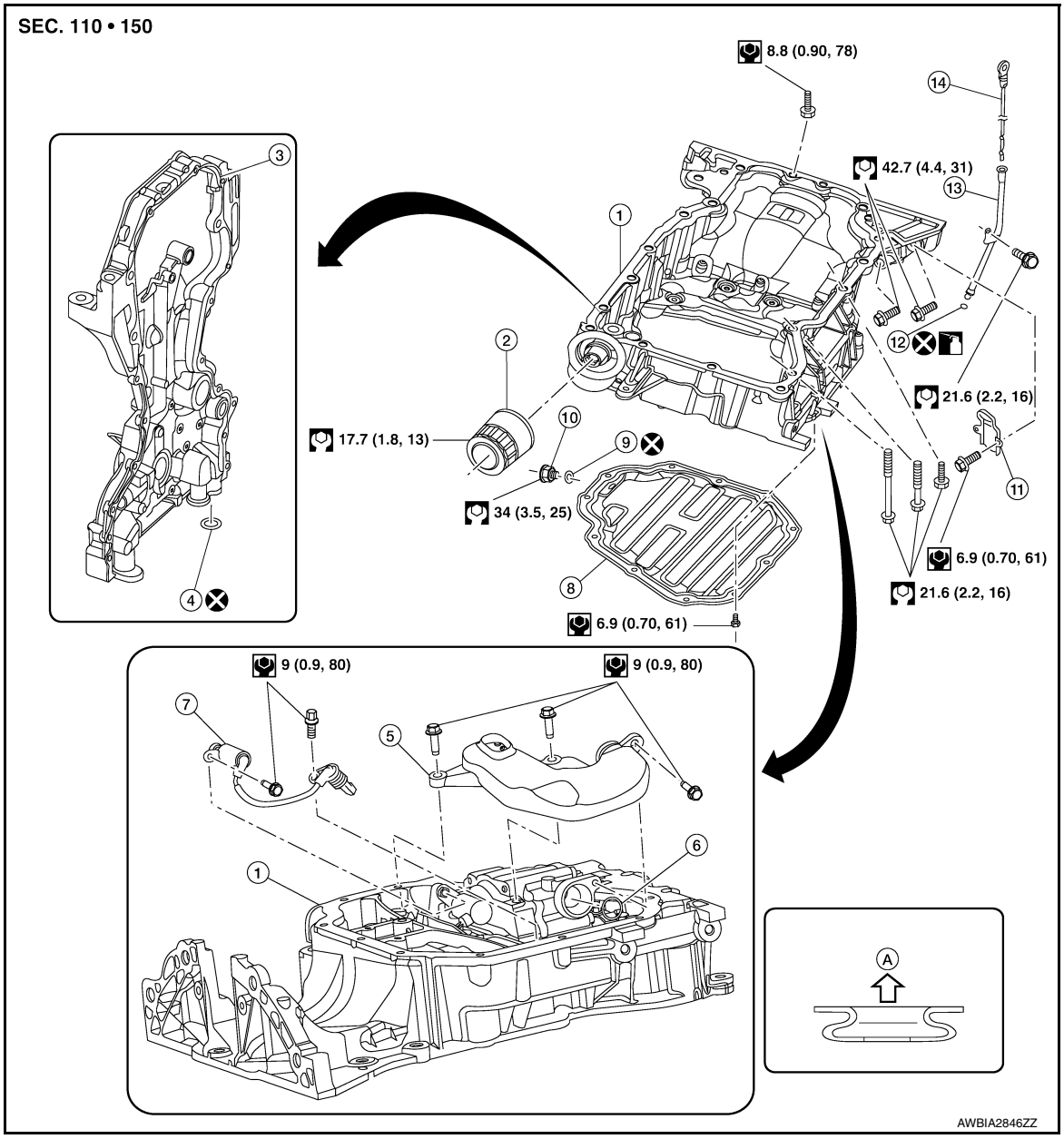


8. Installation of the remaining components is in the reverse order of removal.

OIL PAN AND OIL STRAINER

Exploded View

INFOID:0000000012601963



1.	Oil pan (upper)	2.	Oil filter	3.	Front cover
4.	O-ring	5.	Oil strainer	6.	O-ring
7.	Engine oil pressure control solenoid valve	8.	Oil pan (lower)	9.	Washer
10.	Drain plug	11.	Rear cover plate	12.	O-ring
13.	Oil level gauge guide	14.	Oil level gauge	A.	To oil pan (lower)

Removal and Installation

INFOID:0000000012601964

REMOVAL

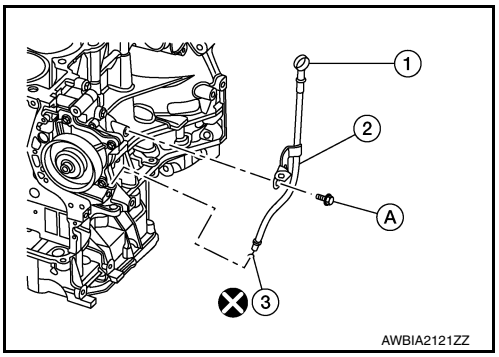
WARNING:

To avoid the danger of being scalded, do not drain the engine oil when the engine is hot.

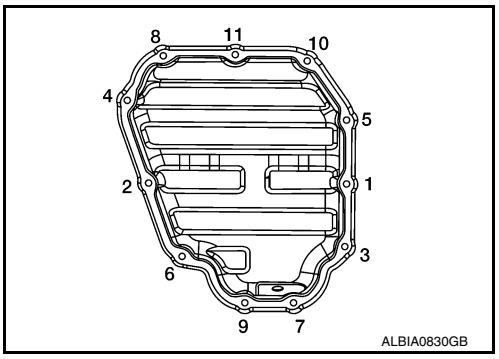
NOTE:

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

1. Drain engine oil. Refer to LU-10, "Changing Engine Oil".
2. Remove the oil filter. Refer to LU-12, "Removal and Installation".
3. Remove the front exhaust tube and gaskets. Refer to EX-5, "Exploded View".
4. Remove the fender protector side cover (RH). Refer to EXT-36, "FENDER PROTECTOR : Exploded View".
5. Remove bolt (A) securing oil level gauge (1) and oil level gauge guide (2). Remove O-ring (3).
   CAUTION:
   Do not reuse O-ring.

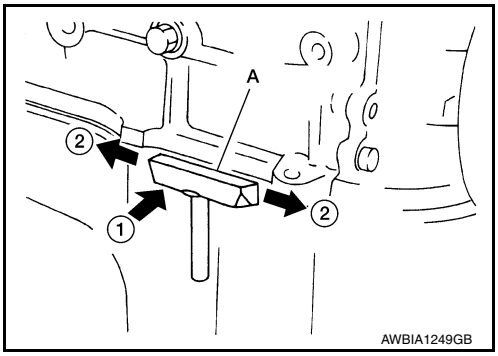


6. Disconnect harness connector from the air fuel ratio (A/F) sensor 1.
7. Remove the front driveshaft (LH) and front driveshaft (RH). Refer to FAX-10, "Removal and Installation (LH)" (LH) and FAX-13, "Removal and Installation (RH)" (RH).
8. Remove the connecting rod (LH) and the connecting rod (RH). Refer to FSU-13, "Exploded View".
9. Remove the tie rod end from the steering knuckle (RH) and the tie rod end from the steering knuckle (LH). Refer to ST-37, "Exploded View".
10. Remove the power steering gear bolts and support the power steering gear. Refer to ST-37, "Removal and Installation".
11. Remove the rear engine mount torque rod bracket. Refer to EM-84, "Exploded View".
12. Remove the front suspension member for clearance to remove the oil pan. Refer to FSU-19, "Removal and Installation".
13. Disconnect harness connector from A/C compressor.
14. Remove the drive belt. Refer to EM-19, "Removal and Installation".
15. Remove the A/C compressor bolts, position the A/C compressor aside and support. Refer to HA-30, "COMPRESSOR : Removal and Installation".
16. Remove the lower oil pan bolts in the reverse order as shown.

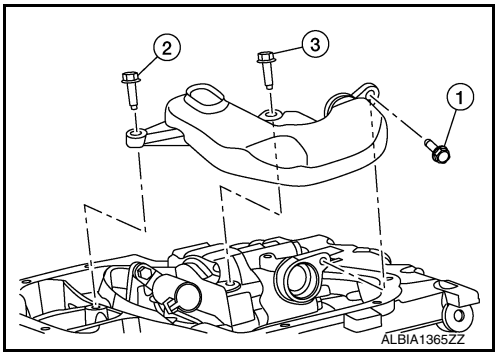


17. Remove the lower oil pan using Tool (A).
CAUTION:
Do not damage the mating surfaces.
NOTE:
In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the liquid gasket is applied. Use a plastic hammer to slide (2) the cutter by tapping on the side.

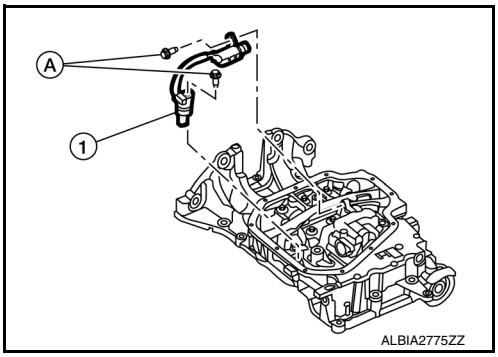
Tool number (A) : KV10111100 (J-37228)



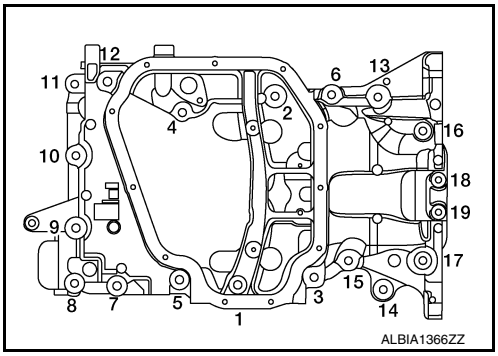
18. Remove the oil strainer bolts and in the reverse order as shown then remove the oil strainer.



19. Remove engine oil pressure control solenoid valve bolts (A) and remove engine oil pressure control solenoid valve.



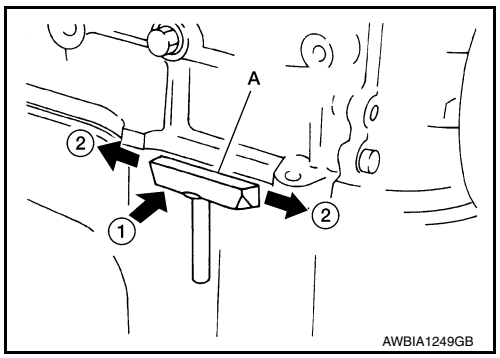
20. Remove rear cover plate, and four engine-to transaxle bolts.
21. Loosen the upper oil pan bolts in the order shown using power tool.



22. Remove upper oil pan using Tool (A).
    - Remove the three O-rings from the upper oil pan and front cover.

CAUTION:
Do not damage the mating surfaces.
NOTE:
In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the liquid gasket is applied. Use a plastic hammer to slide (2) the cutter by tapping on the side.

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



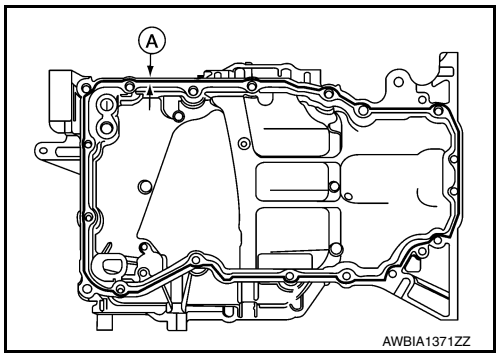
INSPECTION AFTER REMOVAL

Clean the oil strainer screen to remove any foreign material.

INSTALLATION

1. Apply Genuine Silicone RTV Sealant or equivalent to the upper oil pan at the specified sealant bead diameter (A) as shown. Refer to GI-21, "Recommended Chemical Products and Sealants".

Sealant bead diameter (A) : 4.0 - 5.0 mm (0.157 - 0.197 in)



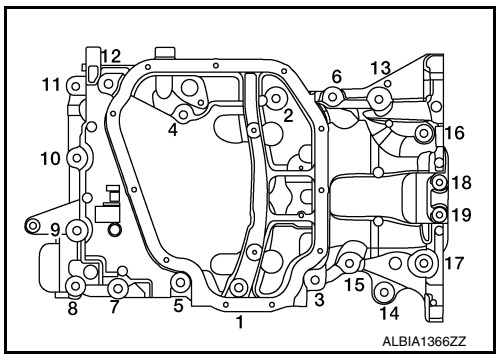
CAUTION:
- **Install two new O-rings in the upper oil pan and a new O-ring in the front cover.**
- **Do not reuse O-rings.**
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the liquid gasket to cure.**

2. Install the upper oil pan to the block and tighten the upper oil pan bolts to specification in the order shown.

CAUTION:
Install upper oil pan bolts in the same position from which they were removed.

All bolts except 18 and 19 : 21.6 N·m (2.2 kg-m, 16.0 ft-lb)

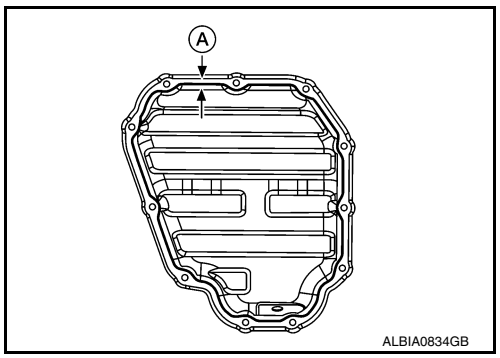
Bolts 18 and 19 : 8.8 N·m (0.90 kg-m, 78.0 in-lb)



3. Apply Genuine Silicone RTV Sealant or equivalent to the lower oil pan at the specified sealant bead diameter (A) as shown. Refer to GI-21, "Recommended Chemical Products and Sealants".

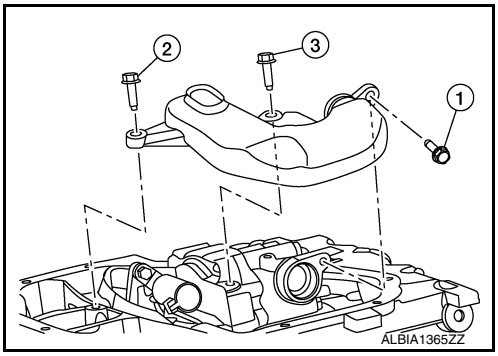
CAUTION:
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the liquid gasket to cure.**

Sealant bead diameter (A) : 4.0 - 5.0 mm (0.157 - 0.197 in)



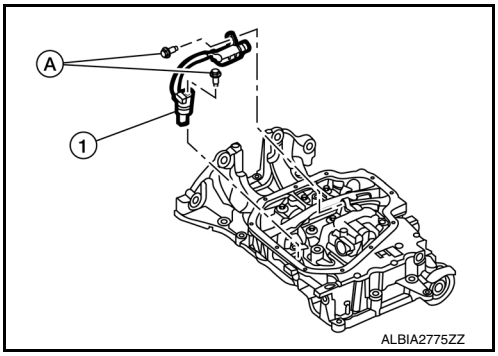
4. Install the oil strainer and install the oil strainer bolts in the order shown to the specified torque.

Bolts 1-3 : 9 N·m (0.9 kg-m, 80 in-lb)



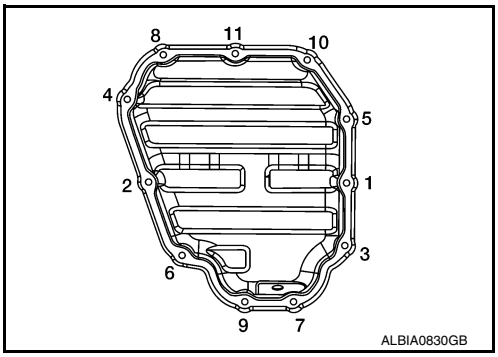
5. Install engine oil pressure control solenoid valve tighten engine oil pressure control solenoid valve bolts (A) to the specified torque.

Bolts (A) : 9 N·m (0.9 kg-m, 80 in-lb)



6. Install the lower oil pan to the upper oil pan and tighten the lower oil pan bolts to specification in the numerical order shown.

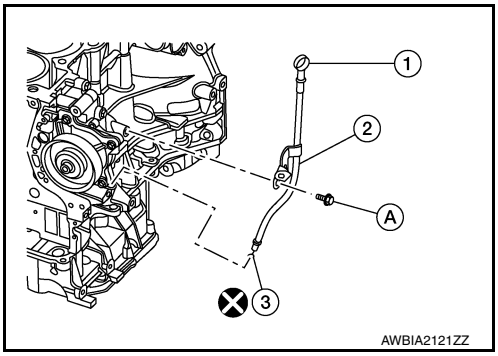
CAUTION:
Do not reuse drain plug washer.



7. Tighten bolt (A) securing oil level gauge (1) and oil level gauge guide (2) to specification.

Bolt (A) : 21.6 N·m (2.2 kg-m, 16 ft-lb)

CAUTION:
Do not reuse oil level gauge guide O-ring.



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

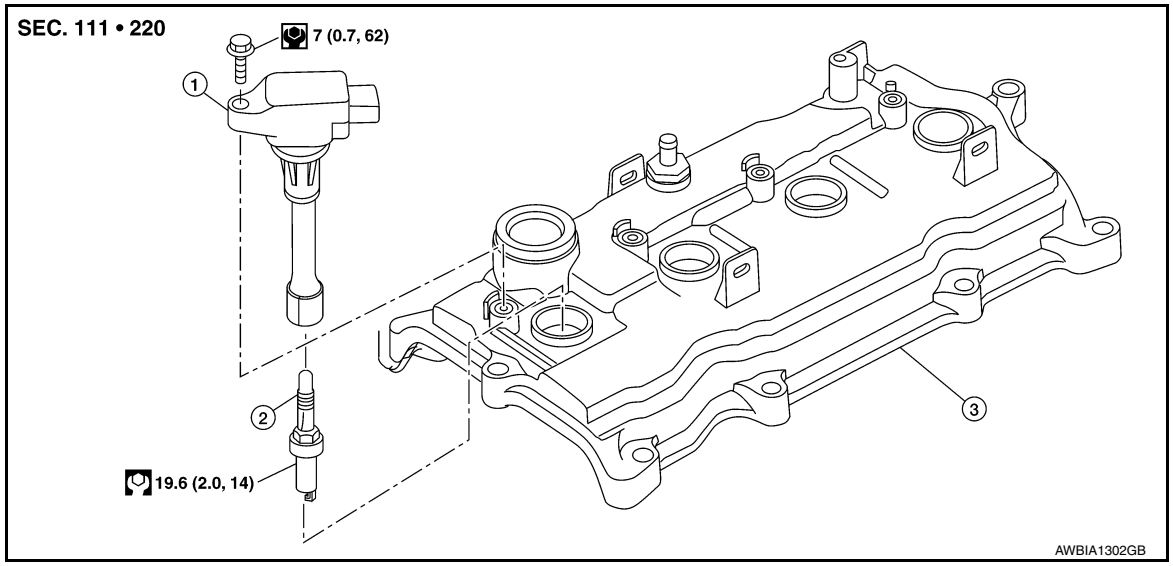
INSPECTION AFTER INSTALLATION

Check for engine oil leaks with the engine at operating temperature and running at idle.

IGNITION COIL

Exploded View

INFOID:0000000012601965



1. Ignition coil
2. Spark plug
3. Rocker cover

Removal and Installation

INFOID:0000000012601966

REMOVAL

1. Remove the engine room cover. Refer to EM-28, "Removal and Installation".
2. Disconnect the harness connector from the ignition coil.
3. Remove the ignition coil.
   CAUTION:
   Discard any ignition coil which has been dropped or shocked.

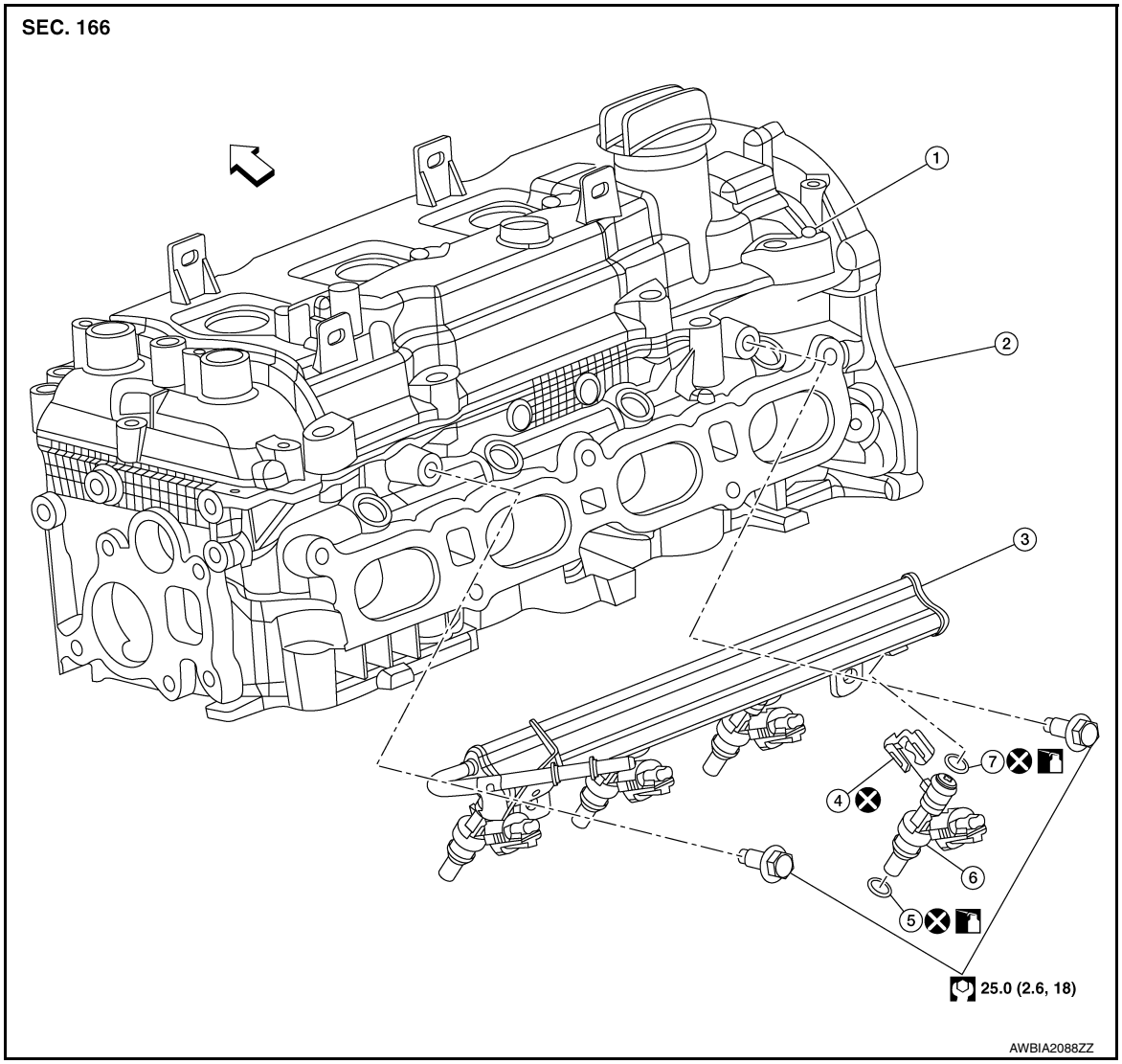
INSTALLATION

Installation is in the reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:0000000012601967



1. Rocker cover
2. Cylinder head
3. Fuel tube
4. Clip
5. O-ring (green)
6. Fuel injector
7. O-ring (black)
⇦ Front

Removal and Installation

INFOID:0000000012601968

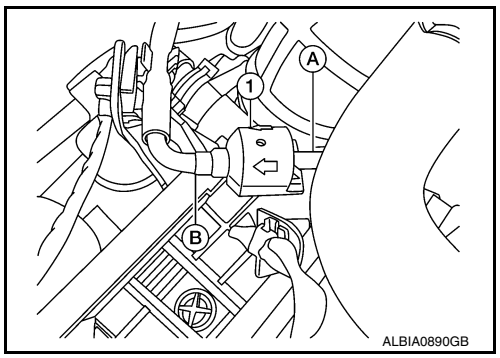
CAUTION:
- **Apply new engine oil before installing the parts, as shown above.**
- **Do not remove or disassemble parts unless instructed as shown.**

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

REMOVAL

1. Remove engine room cover. Refer to EM-28, "Removal and Installation".
2. Release the fuel pressure. Refer to EC-190, "Work Procedure".
3. Disconnect the battery negative terminal. Refer to PG-78, "Removal and Installation".
4. Remove the air duct hose and resonator. Refer to EM-29, "Removal and Installation".

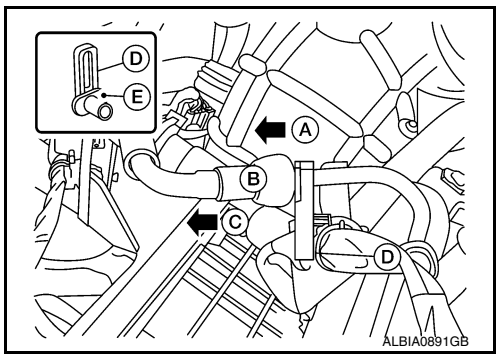
5. Remove quick connector cap (1) from the fuel feed side (B) and the fuel tube side (A).



6. Disconnect the fuel hose quick connector at the fuel tube side using Tool (D).

Tool number (D) : 16441 6N210 (J-45488)

CAUTION:
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Be sure to cover openings of disconnected pipes with plug or plastic bag to avoid fuel leaks and entry of foreign materials.**
- **Do not reuse O-ring.**



a. With the sleeve (E) side of Tool (D) facing quick connector, install Tool onto fuel tube.

b. Insert Tool into quick connector until sleeve contacts and goes no further (A). Hold the Tool on that position.

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

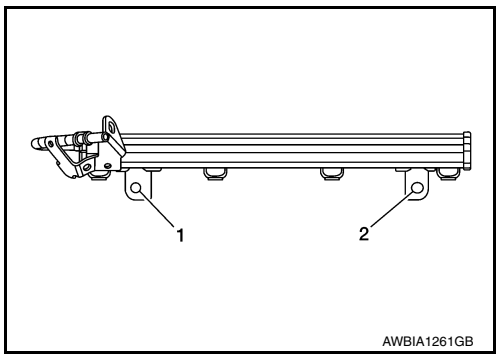
c. Hold the fuel tube in the location (B) and pull the quick connector straight out in direction (C) from the fuel tube.

7. Disconnect the EVAP canister purge volume control solenoid.
8. Remove the PCV hose from the rocker cover.
9. Disconnect sub-harness for injectors at engine front side, and remove it from bracket.
10. Disconnect the harness connectors from fuel injectors.
11. Loosen the bolts in the reverse order shown, then remove fuel tube and fuel injectors as an assembly.
12. Remove the fuel injectors from the fuel tube (if necessary).

a. Release the clip.

b. Pull fuel injector straight out of the fuel tube.

CAUTION:
- **Do not damage the nozzle.**
- **Avoid any impact, such as dropping the fuel injector.**
- **Do not disassemble or adjust the fuel injector.**



INSTALLATION

1. Install new O-rings on the fuel injector.

CAUTION:
- **Do not reuse O-rings.**
- **Upper and lower O-rings are different. Do not confuse them.**

Fuel tube side : Black
Nozzle side : Green

- **Handle O-rings with bare hands only. Do not wear gloves.**
- **Do not clean O-rings with solvent.**
- **Make sure that O-ring and its mating part are free of foreign material.**
- **Do not scratch O-rings during installation.**
- **Do not twist or stretch the O-ring. If the O-ring was stretched while it is attached, do not insert it into the fuel tube immediately.**

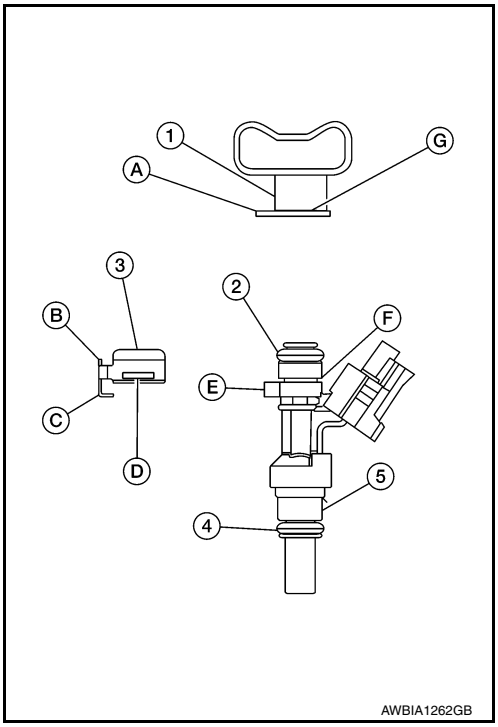
2. Install the fuel injector (5) into the fuel tube (1) with the following procedure:
(2): O-ring (black)
(4): O-ring (green)

a. Insert the new clip (3) into the clip mounting groove (F) on fuel injector (5).
- Insert the clip (3) so that protrusion (E) of fuel injector (5) matches cutout (C) of the clip (3).

CAUTION:
- **Do not reuse clip (3), 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 (5) into fuel tube (1) with clip (3) attached.
- Insert fuel injector (5) so that protrusion (A) of fuel tube (1) matches cut-out (B) of the clip (3).
- Check that fuel tube flange (G) is securely fixed in flange groove (D) on the clip (3).

c. Check that installation is complete by checking that fuel injector (5) does not rotate or come off.

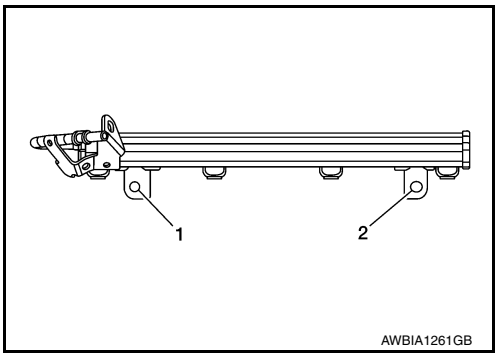


3. Install fuel tube and fuel injector assembly with the following procedure:

a. Insert the tip of each fuel injector into intake manifold.

b. Tighten the bolts to specification in the numerical order as shown.

CAUTION:
After properly connecting fuel tube assembly to injector and fuel hose, check connection for fuel leaks.



4. Connect the fuel hose quick connector.

a. Make sure no foreign substances are deposited in and around the fuel tube and quick connector, and there is no damage to them.

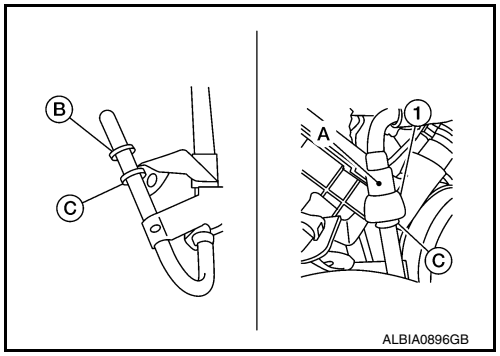
b. Thinly apply new engine oil around the fuel tube tip end.

c. Align center to insert quick connector straight onto fuel tube.

d. Insert fuel tube into quick connector (1) until the top spool (B) on fuel tubes is inserted completely and the second level spool (C) is positioned slightly below the quick connector bottom end.

CAUTION:

- **Hold at position (A) as shown, when inserting the fuel tube into the quick connector.**
- **Carefully align to center to avoid inclined insertion to prevent damage to the O-ring inside the quick connector.**
- **Insert the fuel tube until you hear a "click" sound and actually feel the engagement.**
- **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**
- **Do not reuse O-ring.**



e. Before clamping the fuel hose with the hose clamp, pull the quick connector hard by hand, holding at the (A) position, as shown. Make sure it is completely engaged (connected) so that it does not come off of the fuel tube.

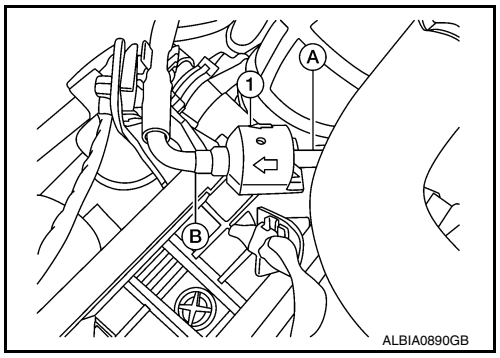
NOTE:

Recommended pulling force is 50 N (5.1 kg, 11.2 lb).

f. Install quick connector cap (1) over fuel hose side (B) and fuel tube side (A).

NOTE:

Direct arrow mark on quick connector cap (1) to fuel hose side.



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

INSPECTION AFTER INSTALLATION

Make sure there are no fuel leaks at connections as follows:

1. Apply fuel pressure to fuel lines by turning ignition switch ON (with engine stopped). Then check for fuel leaks at connections.
2. Start the engine and rev it up and check for fuel leaks at connections.
   - Perform procedures for "Throttle Valve Closed Position Learning" after finishing repairs. Refer to EC-186, "Description".
   - If electric throttle control actuator is replaced, perform procedures for "Idle Air Volume Learning" after finishing repairs. Refer to EC-187, "Description".

   WARNING:

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

   NOTE:

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

ROCKER COVER

Exploded View

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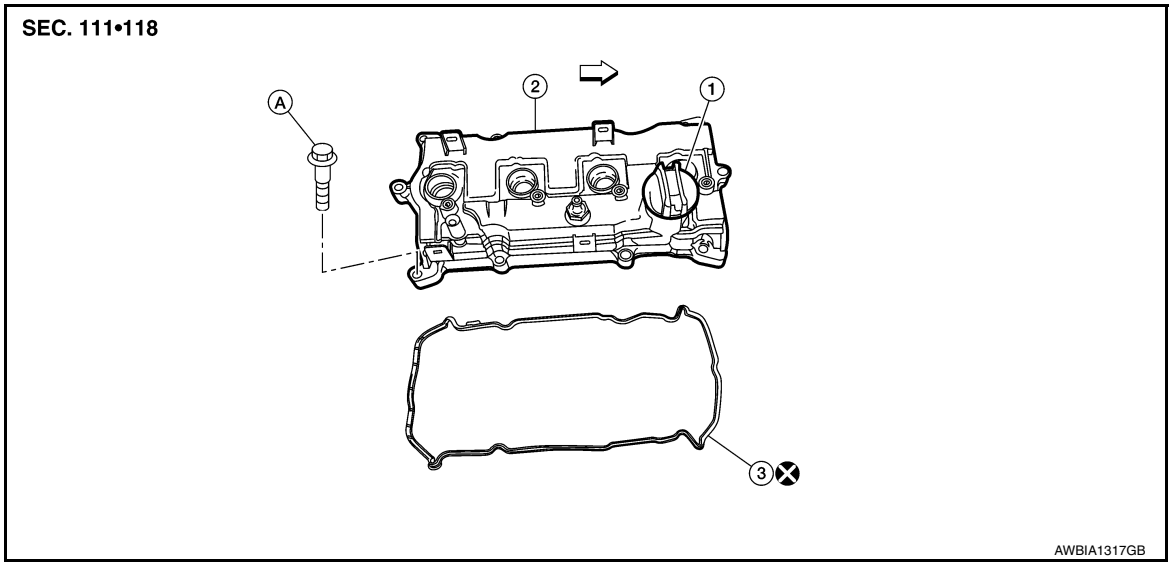


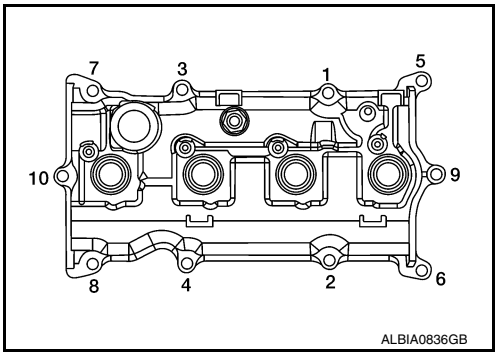
1. Oil filler cap
2. Rocker cover
3. Rocker cover gasket
A. Refer to INSTALLATION
⇦ Engine front

Removal and Installation

INFOID:0000000012601970

REMOVAL

1. Disconnect the battery negative terminal. Refer to PG-78, "Removal and Installation".
2. Remove the engine room cover. Refer to EM-28, "Removal and Installation".
3. Remove the core support cover. Refer to EXT-25, "Removal and Installation".
4. Remove the front air duct. Refer to EM-29, "Exploded View".
5. Remove the engine mount torque rod (RH). Refer to EM-84, "Exploded View".
6. Support the engine using a suitable jack.
7. Remove harness grounds from the top of the engine mount bracket.
8. Remove the engine support bracket (RH). Refer to EM-84, "Exploded View".
9. Remove the engine mounting bracket (RH). Refer to EM-84, "Exploded View".
10. Disconnect the PCV hose.
11. Remove the ignition coils. Refer to EM-41, "Removal and Installation".
12. Remove the spark plugs. Refer to EM-16, "Removal and Installation".
13. Loosen the bolts in the reverse order as shown.
14. Remove the rocker cover and the rocker cover gasket. Discard the rocker cover gasket.
    CAUTION:
    Do not reuse the rocker cover gasket.
15. Remove the oil filler cap (if necessary).



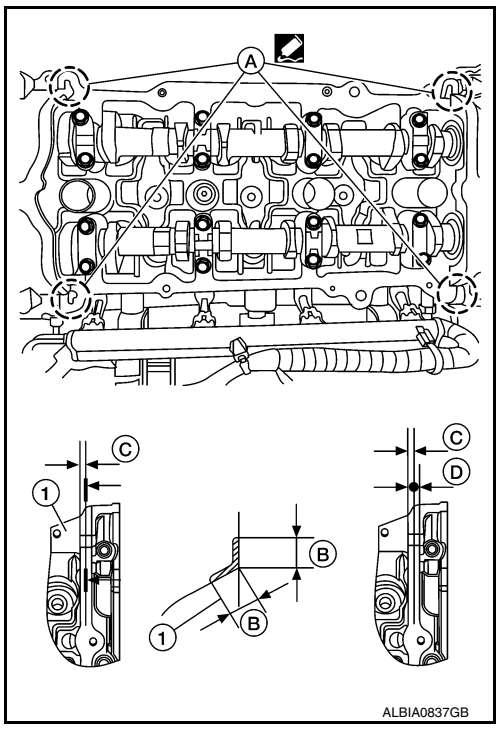
INSTALLATION

1. Apply liquid gasket to the position shown (A) with the following procedure:

a. Apply liquid gasket to joint part of No.1 camshaft bracket (1) and cylinder head.

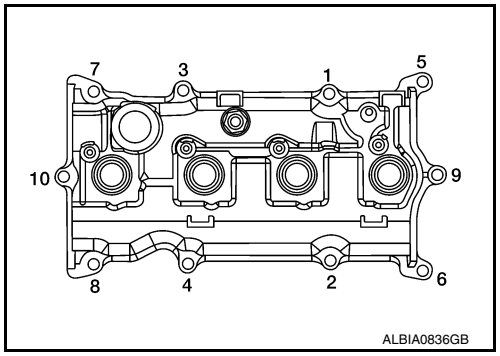
b. Apply liquid gasket in a 90° degree angle (B).
- **Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21.**

(B) : 10 mm (0.39 in)
(C) : 4 mm (0.16 in)
(D) : 5 mm (0.20 in)



2. Install rocker cover gasket to rocker cover.
CAUTION:
Do not reuse gasket.
NOTE:
The rocker cover gasket must be securely installed in the groove in the rocker cover.
3. Install the rocker cover and rocker cover gasket onto the cylinder head.
4. Tighten the rocker cover bolts to specification in two steps in the order shown.

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

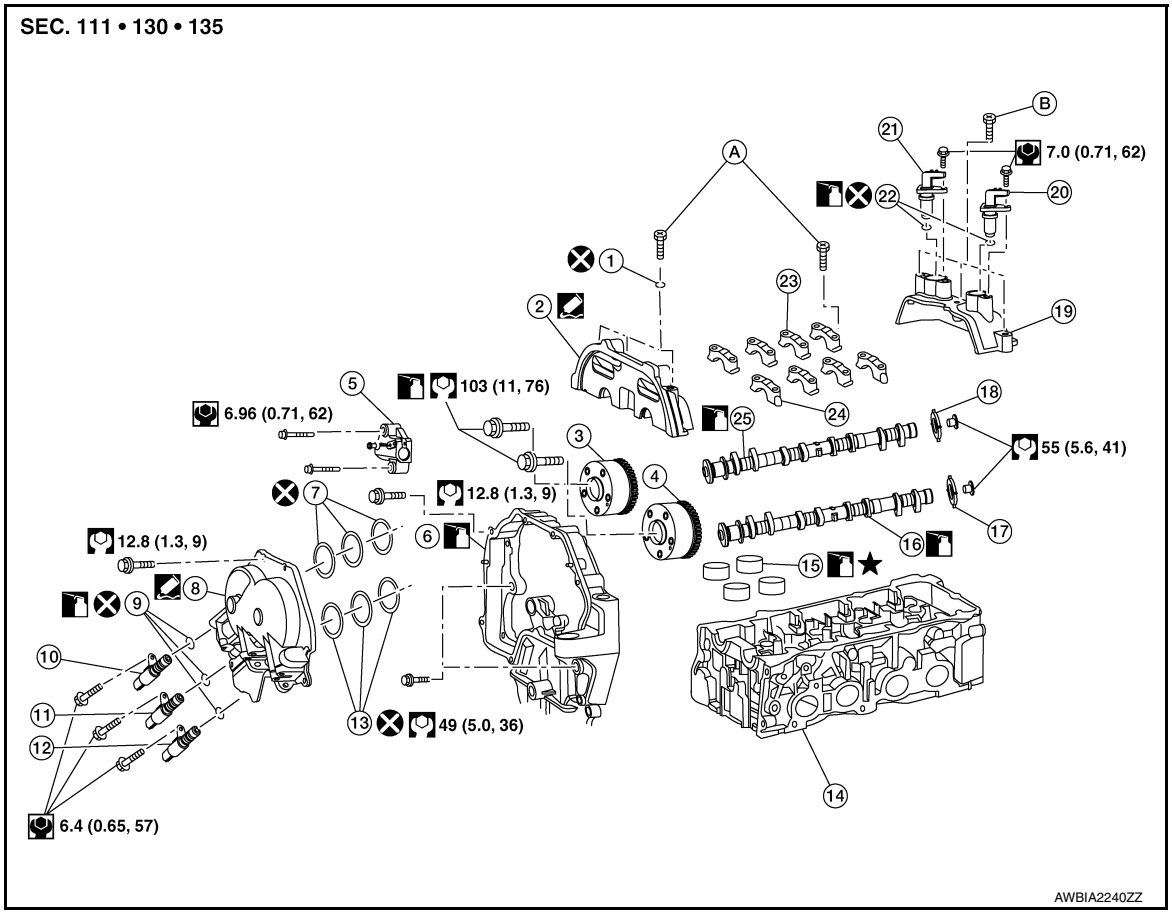


5. Installation of the remaining components is in the reverse order of removal.

CAMSHAFT

Exploded View

INFOID:0000000012601971



1. Washer
2. Camshaft bracket (No.1)
3. Camshaft sprocket (INT)
4. Camshaft sprocket (EXH)
5. Chain tensioner
6. Front cover (partial view)
7. Valve timing control cover O-rings (INT)
8. Valve timing control cover
9. Valve timing control solenoid valve O-rings
10. Intake valve timing intermediate lock control solenoid valve
11. Intake valve timing control solenoid valve
12. Exhaust valve timing control solenoid valve
13. Valve timing control cover O-rings (EXH)
14. Cylinder head
15. Valve lifters
16. Camshaft (EXH)
17. Signal plate (EXH)
18. Signal plate (INT)
19. Camshaft position sensor bracket
20. Camshaft position sensor (EXH)
21. Camshaft positions sensor (INT)
22. Camshaft position sensor O-rings
23. Camshaft brackets (INT)
24. Camshaft brackets (EXH)
25. Camshaft (INT)
A. Refer to INSTALLATION
B. Refer to INSTALLATION

Removal and Installation

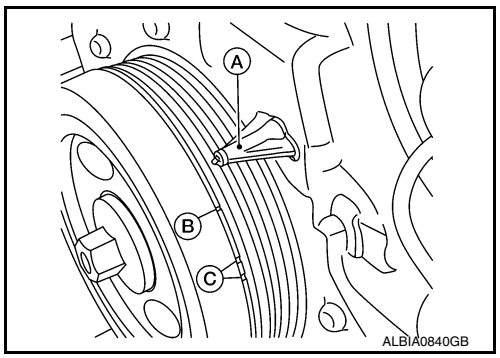
INFOID:0000000012601972

REMOVAL

1. Remove the rocker cover. Refer to EM-46, "Removal and Installation".
2. Remove camshaft position sensors.
3. Remove camshaft position sensor bracket.
4. Remove the valve timing control cover. Refer to EM-59, "Valve Timing Control Cover".

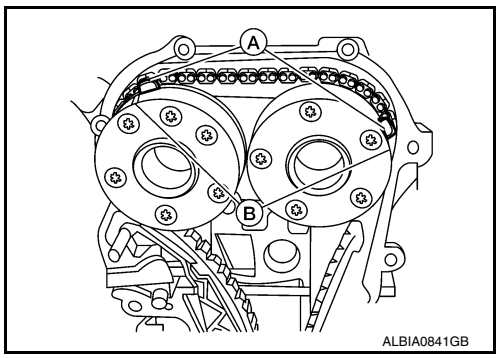
5. Set the No.1 cylinder at TDC on its compression stroke using the following procedure:

a. Rotate crankshaft pulley clockwise, and align mating mark for TDC (B) with timing indicator (A) on front cover, as shown.
NOTE:
Do not use the white paint mark (C).



b. At the same time, make sure that the mating marks (outer groove) (B) on camshaft sprockets are lined up with the pink links (A) in the timing chain, as shown.
- If not, rotate crankshaft pulley one more turn to line up the mating marks (outer groove) (B) to the pink links (A), as shown.

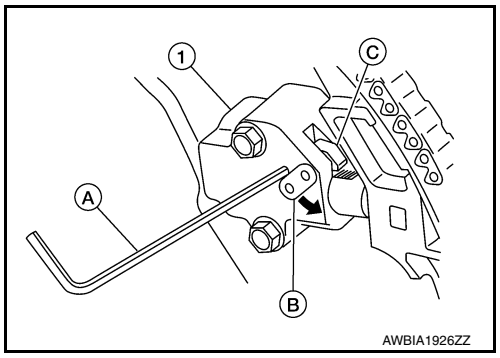
NOTE:
Shown with front cover removed for illustration purposes only.



6. Remove chain tensioner (1) and timing chain using the following procedure:

a. Pull the lever (B) down and release the plunger stopper tab (C).
- Plunger stopper tab (C) can be pushed up to release (coaxial structure with lever (B)).

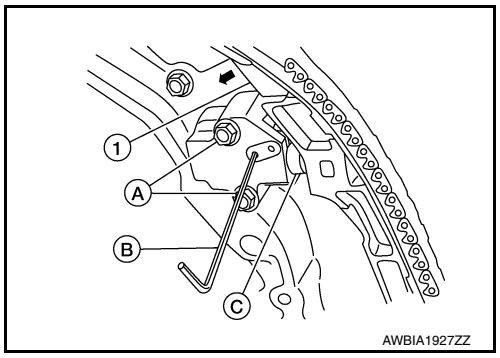
b. Insert the stopper pin (A) into the tensioner body hole to hold the lever (B) and keep tab released.
NOTE:
Allen wrench [2.5 mm (0.098)] is used for a stopper pin as an example.



c. Insert plunger (C) into tensioner body by pressing timing chain slack guide (1).

d. Keep timing chain slack (1) guide pressed and hold it by pushing the stopper pin (B) through the lever hole and body hole.

e. Remove the chain tensioner bolts (A) and chain tensioner.



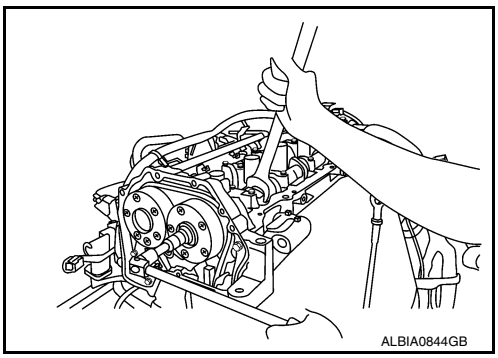
f. Remove the timing chain from camshaft sprocket (INT) and camshaft sprocket (EXH).
CAUTION:
- **Use suitable tool to prevent timing chain from falling into front cover after it has been removed from camshaft sprocket (INT) and camshaft sprocket (EXH).**
- **Do not rotate the crankshaft or camshafts while the timing chain is removed. It can cause damage to the valves and pistons.**

7. Remove the camshaft sprockets using the following procedure:
CAUTION:

Do not rotate the crankshaft or camshafts while the timing chain is removed. It can cause damage to the valves and pistons.

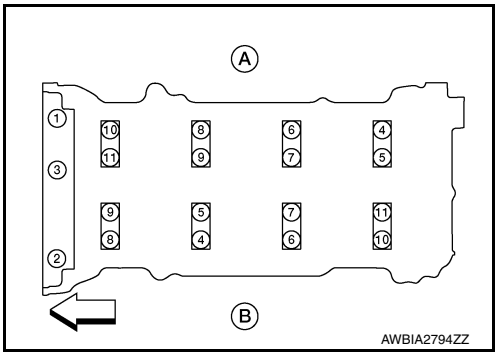
a. Secure hexagonal part of the camshaft with a suitable tool and loosen the camshaft sprocket bolt.

b. Remove the camshaft sprocket bolt and camshaft sprockets for both camshafts.



8. Loosen the camshaft bracket bolts in the reverse order as shown, and remove the camshaft brackets and camshafts.
NOTE:
Remove camshaft bracket (No. 1) by slightly tapping it with a rubber mallet.

(A) : Intake side
(B) : Exhaust side
⇦ : Engine front



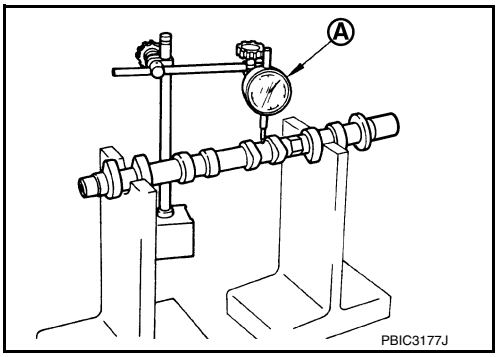
9. Remove the valve lifters.
NOTE:
Check installation positions, and set them aside in the order removed.

INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put the camshaft on a V-block supporting the No.2 and No.5 journals.
CAUTION:
Do not support the No. 1 journal (on the side of the camshaft sprocket) because it has different diameter from the other four locations.
2. Set suitable tool (A) vertically on the No.3 journal.
3. Turn camshaft in one direction by hand, and measure the camshaft runout on the dial gauge total indicator reading.

Standard : Refer to EM-113, "Standard and Limit".



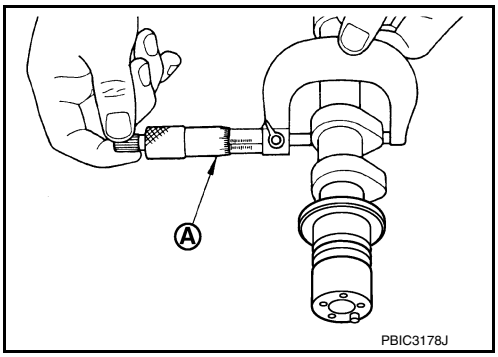
Camshaft Cam Height

1. Measure the camshaft cam height using suitable tool (A).

Standard intake cam height : Refer to EM-113, "Standard and Limit".

Standard exhaust cam height : Refer to EM-113, "Standard and Limit".

2. If wear is beyond the limit, replace the camshaft.



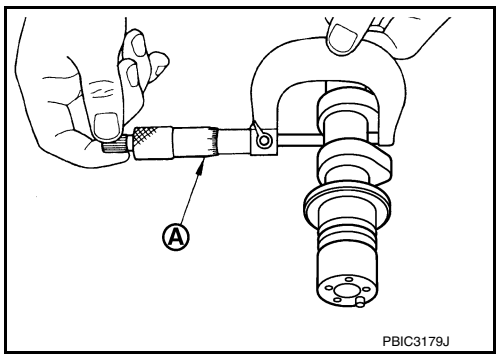
Camshaft Journal Clearance

Outer Diameter of Camshaft Journal

- Measure the outer diameter of the camshaft journal using suitable tool (A).

Standard No.1 outer diameter : Refer to EM-113, "Standard and Limit".

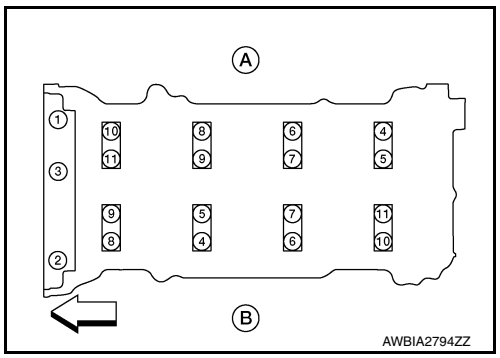
Standard No.2, 3, 4, 5, outer diameter : Refer to EM-113, "Standard and Limit".



Inner Diameter of Camshaft Bracket

- Tighten the camshaft bracket bolts to the specified torque following the tightening pattern as shown.

Step 1 (bolts 9 - 11) : 1.96 N·m (0.20 kg-m, 17 in-lb)
Step 2 (bolts 1 - 8) : 1.96 N·m (0.20 kg-m, 17 in-lb)
Step 3 (bolts 1 - 11) : 5.88 N·m (0.60 kg-m, 52 in-lb)
Step 4 (bolts 1 - 11) : 10.41 N·m (1.1 kg-m, 8 ft-lb)

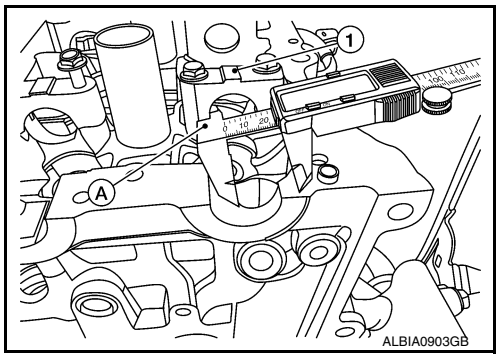


(A) : Intake side
(B) : Exhaust side
⇦ : Engine front

- Using suitable tool (A), measure inner diameter of camshaft bracket (1).

Standard No.1 : Refer to EM-113, "Standard and Limit".

Standard No.2, 3, 4, 5 : Refer to EM-113, "Standard and Limit".



Calculation of Camshaft Journal Clearance

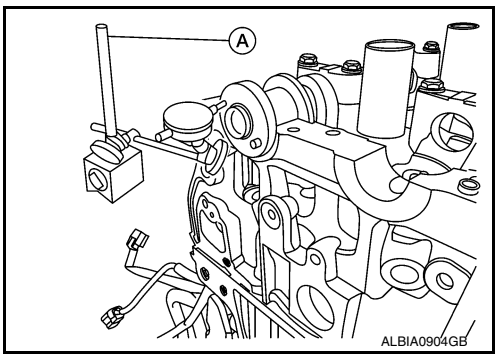
- (Journal clearance) = (inner diameter of camshaft bracket) – (outer diameter of camshaft journal)

Standard : Refer to EM-113, "Standard and Limit".

- When out of the specified range above, replace either or both the camshaft and the cylinder head assembly.
NOTE:
Inner diameter of the camshaft bracket is manufactured together with the cylinder head. If the camshaft bracket is out of specification, replace the whole cylinder head assembly.

Camshaft End Play

1. Install suitable tool (A) in the thrust direction on the front end of the camshaft. Measure the end play with the dial gauge while moving the camshaft forward and backward (in direction to axis).



Standard end play : Refer to EM-113, "Standard and Limit".

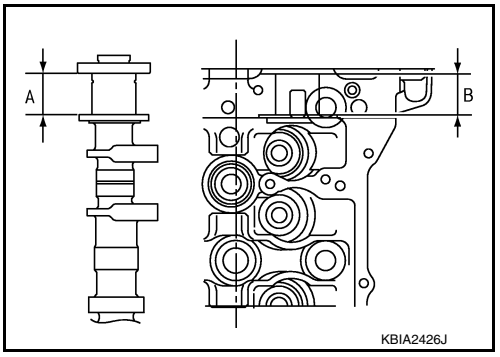
- Measure the following parts if out of the standard.
- Dimension (A) for camshaft No. 1 journal

Standard : Refer to EM-113, "Standard and Limit".

- Dimension (B) for cylinder head No. 1 journal

Standard : Refer to EM-113, "Standard and Limit".

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

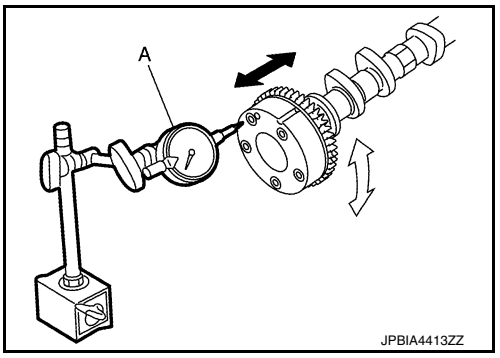


Camshaft Sprocket Runout

1. Install the camshaft in the cylinder head.
2. Install the camshaft sprocket on the camshaft.
3. Measure camshaft sprocket runout while turning the camshaft by hand using suitable tool (A).

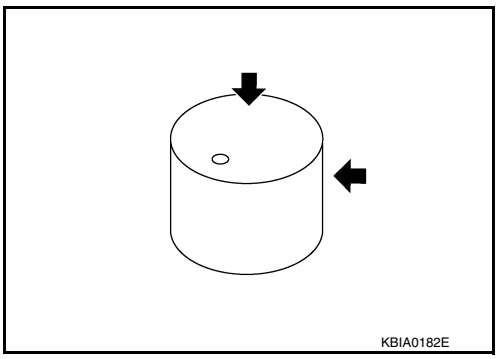
Runout : Refer to EM-113, "Standard and Limit".

4. If it exceeds the specification, replace camshaft sprocket.



Valve Lifter

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



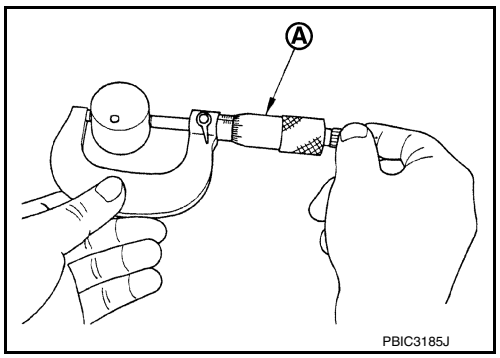
Valve Lifter Clearance

Outer Diameter of Valve Lifter

- Measure the outer diameter of the valve lifter using suitable tool (A).

Valve lifter outer diameter : Refer to EM-113, "Standard and Limit".

- If out of the specified range, replace the valve lifter.

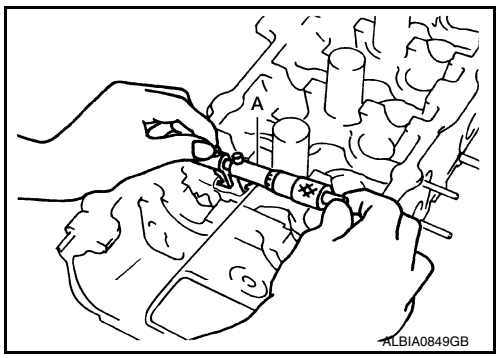


Valve Lifter Bore Inner Diameter

- Measure diameter of valve lifter bore of cylinder head using suitable tool (A).

Standard : Refer to EM-113, "Standard and Limit".

- If out of the specified range, replace the cylinder head assembly.



Calculation of Valve Lifter Clearance

- (Valve lifter clearance) = (hole diameter for valve lifter) – (outer diameter of valve lifter)

Standard : Refer to EM-113, "Standard and Limit".

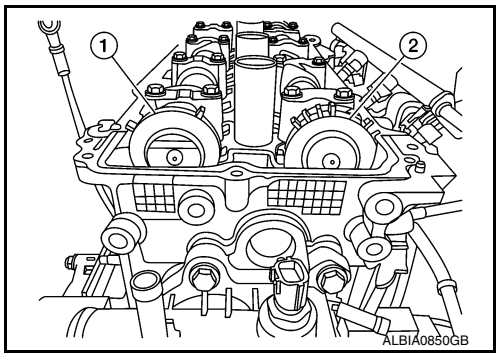
- If out of specified range, replace either or both valve lifter and cylinder head assembly.

INSTALLATION

1. Install the valve lifter.
   - Install them in the same position from which they were removed.
2. Install the camshafts.

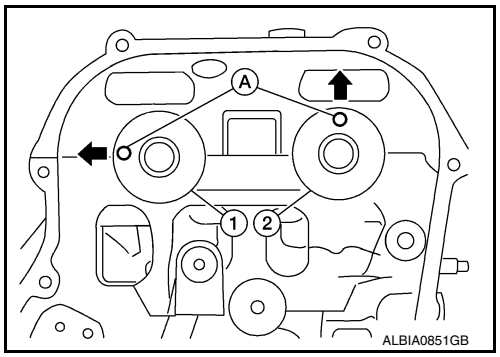
(1) : Exhaust camshaft
(2) : Intake camshaft

NOTE:
The distinction between the intake and exhaust camshafts is the difference in the shape of the rear.

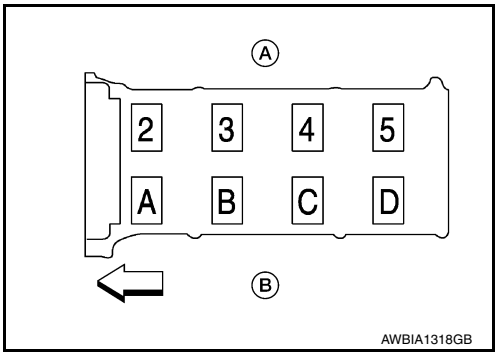


- Install camshafts so that the dowel pins (A) on the front side are positioned as shown.

(1) : Intake camshaft
(2) : Exhaust camshaft

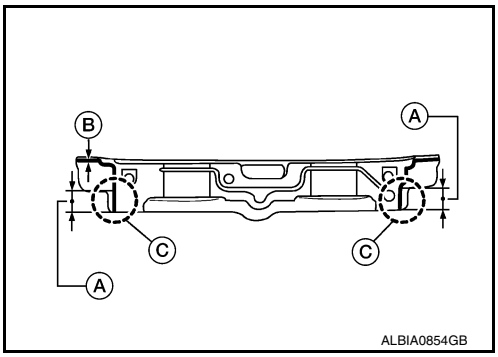


3. Install camshaft brackets.
   - Install by referring to identification mark on upper surface mark.
   - Install so that identification mark can be correctly read when viewed from the exhaust side.



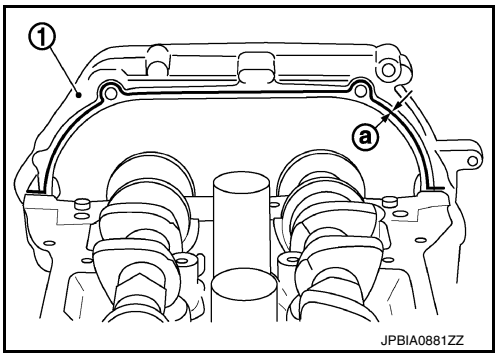
(A) : Intake side
(B) : Exhaust side
⇦ : Engine front

- Install camshaft bracket (No. 1) as follows.
- Apply liquid gasket to camshaft bracket (No. 1) as shown (A), (B). Refer to EM-6, "Precaution for Liquid Gasket".



- Apply liquid gasket to camshaft bracket (No. 1) contact surface on the front cover backside. Refer to EM-6, "Precaution for Liquid Gasket".

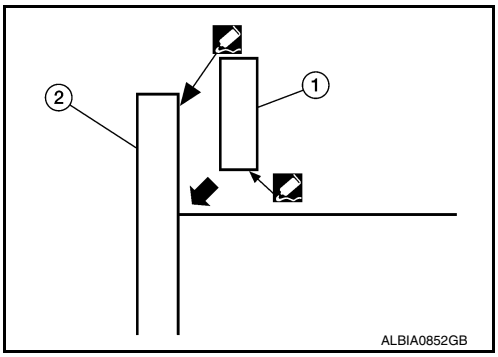
(a) : 3.4 - 4.4 mm (0.134-0.173 in)



(1) : Front cover

- Apply liquid gasket to the outside of bolt hole on front cover. Refer to EM-6, "Precaution for Liquid Gasket".

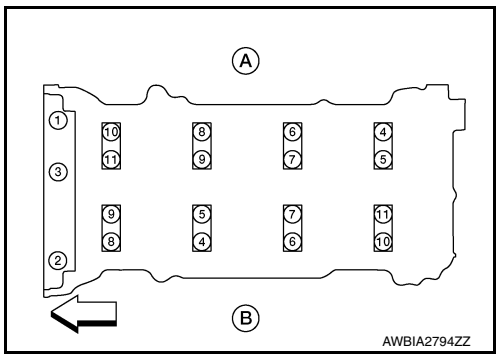
- Position the camshaft bracket (No. 1) near the installation position, and install it without disturbing the liquid gasket applied to the surfaces.



(1) : Camshaft bracket (No. 1)
(2) : Front cover

4. Tighten camshaft bracket bolts in four steps in the order as shown.

Step 1 (bolts 9 - 11) : 1.96 N·m (0.20 kg-m, 17 in-lb)
Step 2 (bolts 1 - 8) : 1.96 N·m (0.20 kg-m, 17 in-lb)
Step 3 (bolts 1 - 11) : 5.88 N·m (0.60 kg-m, 52 in-lb)
Step 4 (bolts 1 - 11) : 10.41 N·m (1.1 kg-m, 8 ft-lb)

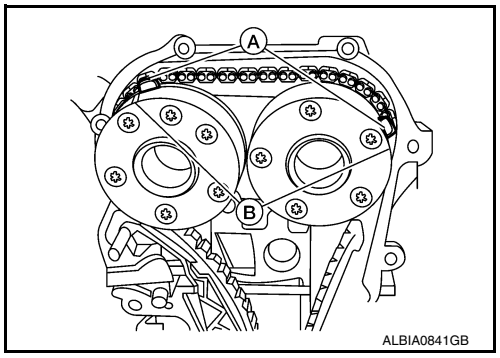


(A) : Intake side
(B) : Exhaust side
⇦ : Engine front

CAUTION:
After tightening camshaft bracket bolts, be sure to wipe off excessive liquid gasket from the parts listed below.
- **Mating surface of rocker cover.**
- **Mating surface of front cover, when installed without the front cover.**

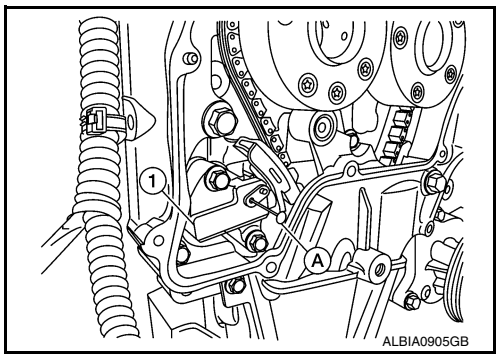
5. Install camshaft sprockets.
- Install them by lining up the mating marks (outer groove) (B) on each camshaft sprocket with the painted marks (A) on the timing chain during removal.
- Before installation of chain tensioner, it is possible to re-match the painted marks (A) on timing chain with the mating marks (B) on each sprocket.

CAUTION:
- **Aligned mating marks could slip. Therefore, after matching them, hold the timing chain in place by hand.**
- **Before and after installing chain tensioner, check again to make sure that mating marks have not slipped.**



6. Install timing chain tension guide.
7. Install chain tensioner using the following procedure:
a. Install stopper pin (A) into the chain tensioner (1).
b. Install the chain tensioner and pull the stopper pin out.

CAUTION:
After installation, pull the stopper pin out, and make sure that the tensioner is fully released.



8. Install intake valve timing control cover with the following procedure.
a. Install intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, and exhaust valve timing control solenoid valve to valve timing control cover.

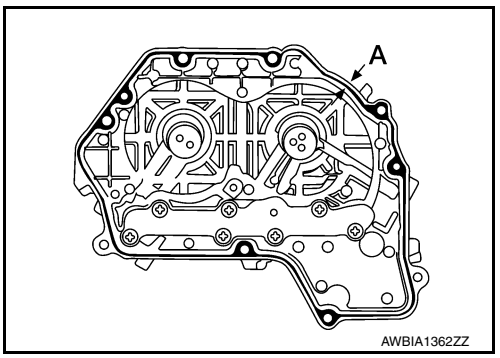
CAUTION:
Do not reuse O-ring.

b. Install O-ring to front cover side.

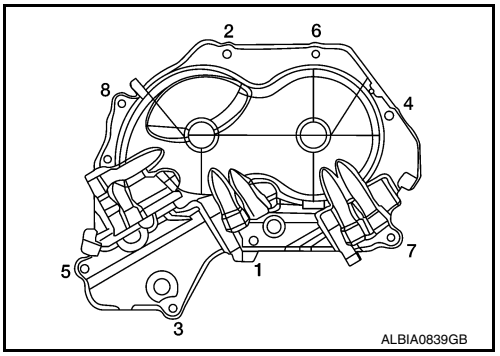
CAUTION:
Do not reuse O-ring.

c. Apply liquid gasket to the positions shown. Refer to GI-21, "Recommended Chemical Products and Sealants".

Diameter (A) : 3.4 - 4.4 mm (0.134 - 0.173 in)



d. Install valve timing control cover.
- Tighten the bolts to specification in the numerical order as shown.

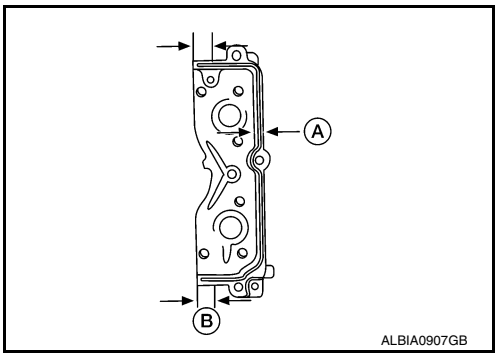


9. Check and adjust valve clearances. Refer to EM-113, "Standard and Limit".
10. Install camshaft position sensor bracket.

a. Apply liquid gasket to camshaft position sensor bracket as shown.

(A) : 2.0 - 3.0 mm (0.079-0.118)

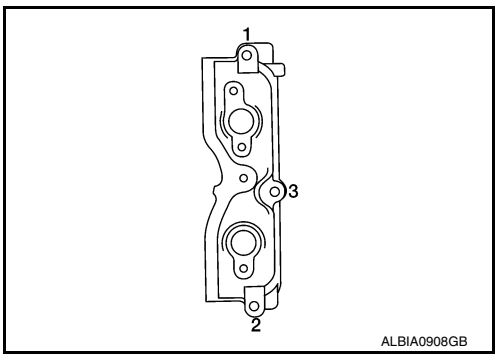
(B) : 10.5 mm (0.413 in)



CAUTION:
- **Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".**
- **After installation be sure to wipe off excessive liquid gasket leaking from part (B).**
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with engine oil for at least 30 minutes after the components are installed to allow the liquid gasket to cure.**

b. Tighten bolts to specification in numerical order shown.

Camshaft position sensor bracket bolts : 10.41 N·m (1.1 kg-m, 8 ft-lb)



11. Install the camshaft position sensors. Refer to EM-48, "Exploded View".
12. Installation of the remaining components is in the reverse order of removal.

Inspection After Installation

INFOID:0000000012601973

Inspection of Camshaft Sprocket (INT) Oil Groove and Camshaft Sprocket (EXH) Oil Groove

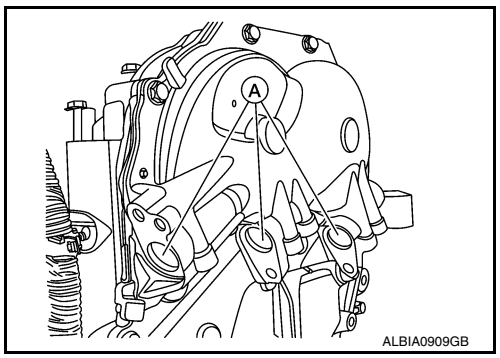
WARNING:
Check when engine is cold so as to prevent burns from any splashing engine oil.
CAUTION:
Perform this inspection only when DTC P0011, P0014, P052A, P052B is detected in self-diagnostic results of CONSULT and it is directed according to inspection procedure of EC section.

1. Check engine oil level and adjust oil level as necessary. Refer to LU-9, "Inspection".
2. Remove the intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, and exhaust valve timing control solenoid valve. Refer to EM-58, "Exploded View".
3. Perform the following procedure to prevent the engine from being unintentionally started while checking.

a. Release fuel pressure. Refer to EC-190, "Work Procedure" (for Korea, Mexico, Argentina, Brazil, and Israel) and EC-190, "Work Procedure" (except for Korea, Mexico, Argentina, Brazil, and Israel).

b. Disconnect injector harness connectors.

4. Crank engine, and then make sure that engine oil comes out of the valve timing control cover oil holes (A). End cranking after checking.



WARNING:
Do not touch rotating parts (drive belt, crankshaft pulley, etc.).
CAUTION:
- **Engine oil may squirt from intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, exhaust valve timing control solenoid valve installation holes during cranking. Use a shop cloth to prevent engine oil from splashing on worker, engine components and vehicle.**
- **Do not allow engine oil to get on rubber components such as drive belts or engine mount insulators. Immediately wipe off any splashed engine oil.**

5. If engine oil does not come out from valve timing control cover oil holes (A), diagnose problem in lubrication circuit such as dirty oil groove between oil strainer and intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, or exhaust valve timing control solenoid valve. Refer to LU-7, "Lubrication Circuit".

a. Remove components between intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, exhaust valve timing control solenoid valve and camshaft sprocket (INT) or camshaft sprocket (EXH) (if necessary) and then check each oil groove for clogging.

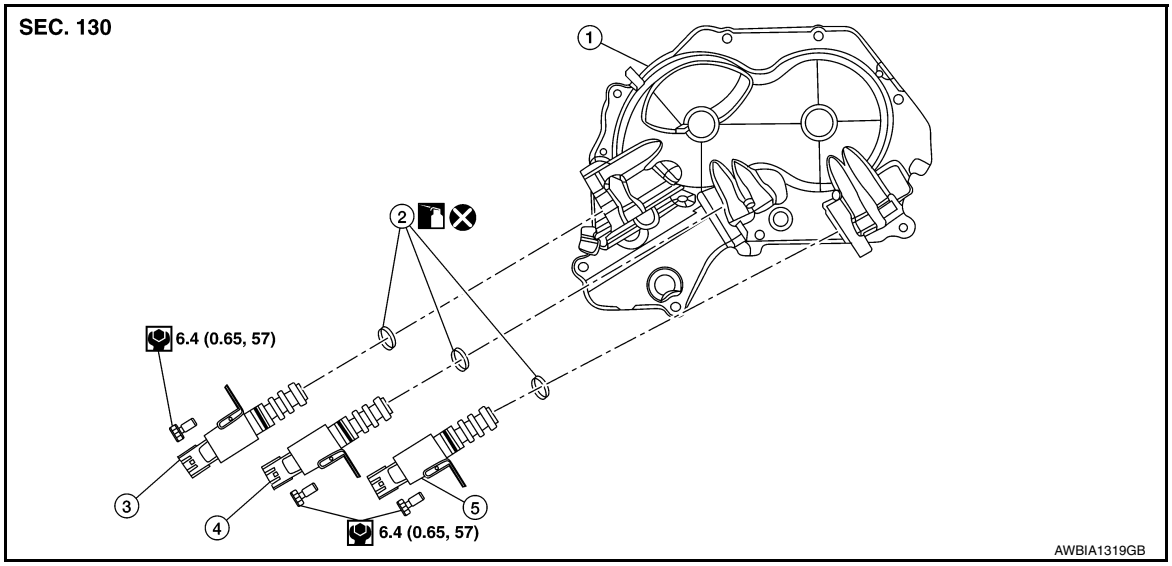
b. Clean oil groove if necessary. Refer to LU-7, "Lubrication Circuit".

6. After inspection, install the remaining components in the reverse order of removal.

VALVE TIMING CONTROL

Exploded View

INFOID:0000000012601974



1. Valve timing cover
2. O-rings
3. Intake valve timing intermediate lock control solenoid valve
4. Intake valve timing control solenoid valve
5. Exhaust valve timing control solenoid valve

Intake Valve Timing Intermediate Lock Control Solenoid Valve, Intake Valve Timing Control Solenoid Valve, and Exhaust Valve Timing Control Solenoid Valve

INFOID:0000000012601975

REMOVAL

1. Disconnect the battery negative terminal. Refer to PG-78, "Removal and Installation".
2. Remove the core support cover. Refer to EXT-25, "Removal and Installation".
3. Remove the front air duct. Refer to EM-29, "Exploded View".
4. Remove the engine room cover. Refer to EM-28, "Removal and Installation".
5. Support the engine using a suitable jack.
6. Remove the engine mounting support bracket (RH). Refer to EM-85, "Removal and Installation".
7. Remove the engine mount torque rod (RH). Refer to EM-84, "Exploded View".
8. Remove PCV hose from rocker cover.
9. Disconnect intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, and exhaust valve timing control solenoid valve connectors.
10. Remove intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, and exhaust valve timing control solenoid valve bolts.
11. Remove intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, exhaust valve timing control solenoid valve from valve timing control cover.
12. Remove O-rings from intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, and exhaust valve timing control solenoid valve.
    CAUTION:
    Do not reuse O-rings.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

- **Do not reuse O-rings.**

- **Lubricate O-rings with clean engine oil before installing.**

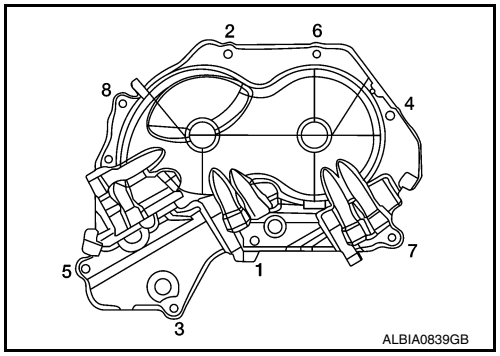
Valve Timing Control Cover

INFOID:0000000012601976

REMOVAL

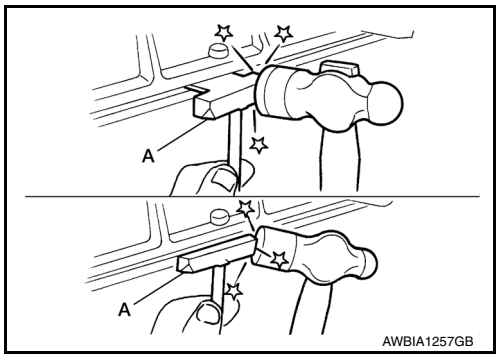
1. Remove the intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve, exhaust valve timing control solenoid valve. Refer to EM-58, "Intake Valve Timing Intermediate Lock Control Solenoid Valve, Intake Valve Timing Control Solenoid Valve, and Exhaust Valve Timing Control Solenoid Valve".
2. Remove harness grounds and retainers from the top if the engine mount bracket.
3. Loosen the valve timing control cover bolts in the reverse order shown.

a. Remove the valve timing control cover bolts.

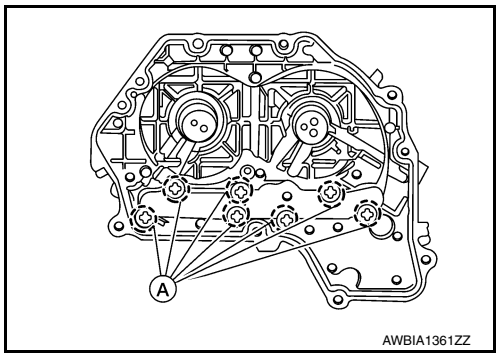


b. Remove the valve timing control cover by cutting the liquid gasket using Tool (A).

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



NOTE:
Do not loosen screws (A) on the back of the valve timing control cover.



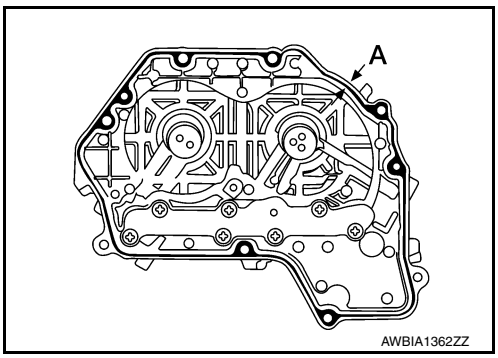
INSTALLATION

1. Install valve timing control cover with the following procedure:

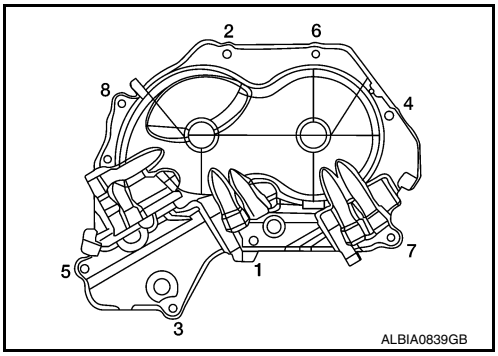
a. Install O-ring to front cover side.
CAUTION:
Do not reuse O-ring.

b. Apply liquid gasket to the positions shown. Refer to GI-21, "Recommended Chemical Products and Sealants".

Diameter (A) : 3.4 - 4.4 mm (0.134 - 0.173 in)



c. Install valve timing control cover.
- Tighten the bolts to specification in the numerical order shown.

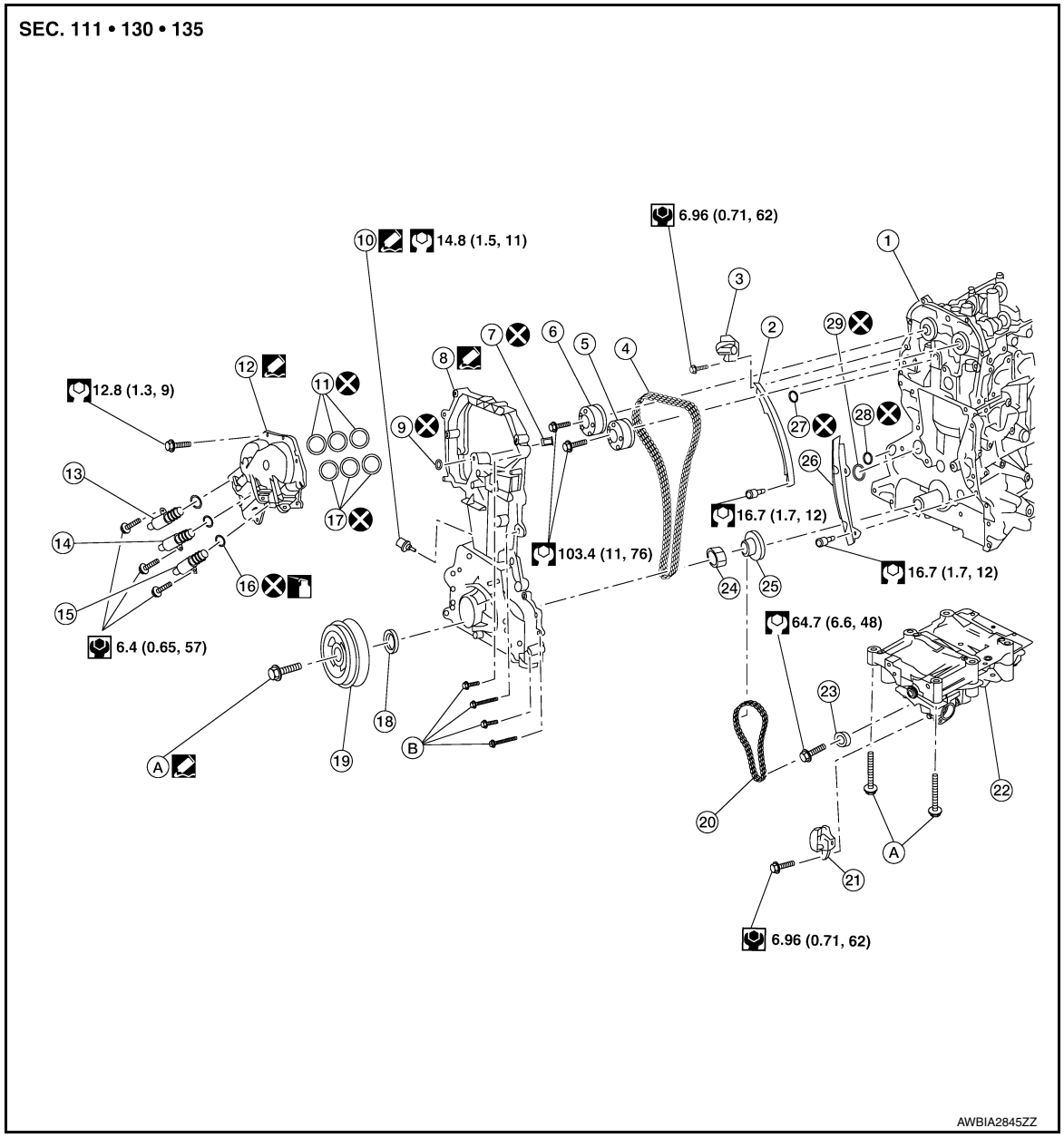


d. Install intake valve timing intermediate lock control solenoid valve, intake valve timing control solenoid valve and exhaust valve timing control solenoid valve to valve timing control cover.

TIMING CHAIN

Exploded View

INFOID:0000000012601977



1. Cylinder block
2. Timing chain slack guide
3. Chain tensioner
4. Timing chain
5. Camshaft sprocket (EXH)
6. Camshaft sprocket (INT)
7. Oil filter
8. Front cover
9. O-ring
10. Oil pressure sensor
11. Valve timing control cover O-rings
12. Valve timing control cover
13. Intake valve timing intermediate lock control solenoid valve
14. Intake valve timing control solenoid valve
15. Exhaust valve timing control solenoid valve
16. Valve timing control solenoid valve O-rings
17. Valve timing control cover O-rings
18. Front oil seal
19. Crankshaft pulley
20. Balancer unit timing chain
21. Balancer unit timing chain tensioner
22. Balancer unit
23. Balancer unit sprocket
24. Oil pump drive spacer
25. Crankshaft sprocket
26. Timing chain tension guide
27. O-ring

28. O-ring
29. O-ring
A. Refer to INSTALLATION
B. Refer to INSTALLATION

Removal and Installation

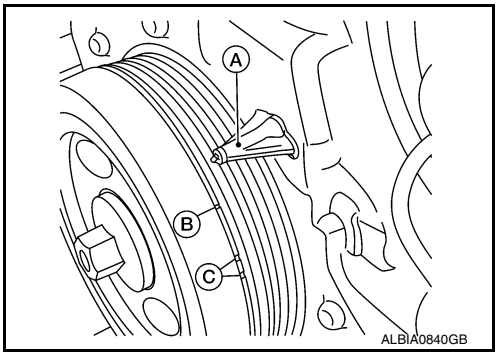
INFOID:0000000012601978

CAUTION:
Apply new engine oil to parts as indicated in the illustration before installation.

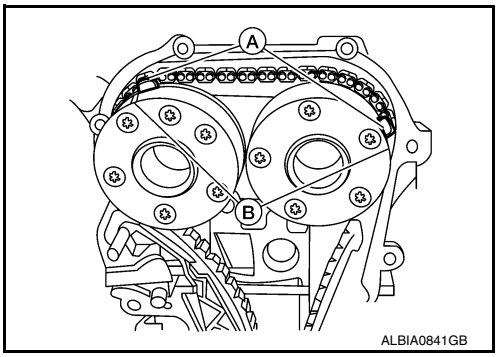
REMOVAL

1. Remove the engine and transaxle assembly. Refer to EM-85, "Removal and Installation".
2. Separate the engine from the transaxle assembly. Refer to EM-85, "Removal and Installation".
3. Remove the drive plate assembly if using an engine stand that attaches to the rear of the engine block.
4. Install engine to a suitable engine stand.
5. Remove the upper and lower oil pan, oil strainer, and O-ring. Refer to EM-36, "Removal and Installation".
6. Remove generator and bracket. Refer to CHG-32, "QR25DE : Removal and Installation".
7. Remove the engine mount bracket. Refer to EM-84, "Exploded View".
8. Set the No.1 cylinder at TDC on the compression stroke using the following procedure:

a. Rotate the crankshaft pulley clockwise and align the mating mark (B) to the timing indicator (A) on the front cover.
NOTE:
Do not use the white paint marks (C).

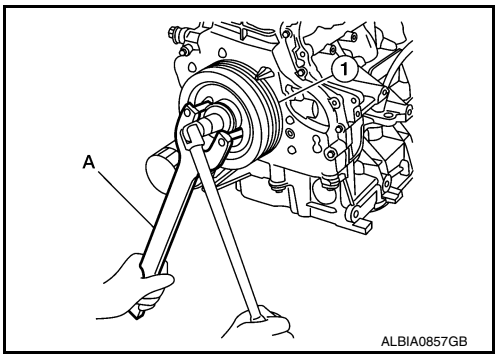


b. At the same time, make sure that the camshaft sprocket mating marks (B) line up with the painted marks on the timing chain (A).
• If not lined up, rotate the crankshaft pulley one more turn to line up the mating marks to the positions as shown.

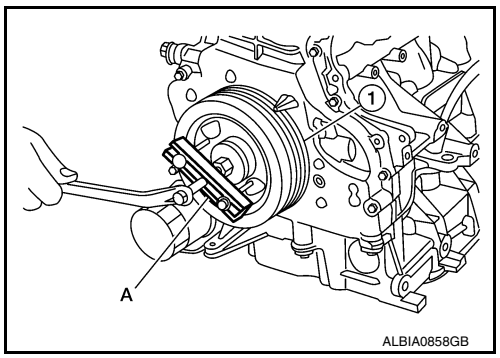


9. Remove crankshaft pulley (1) using the following procedure:

a. Hold the crankshaft pulley (1) using suitable tool (A), then loosen and remove the crankshaft pulley bolt.

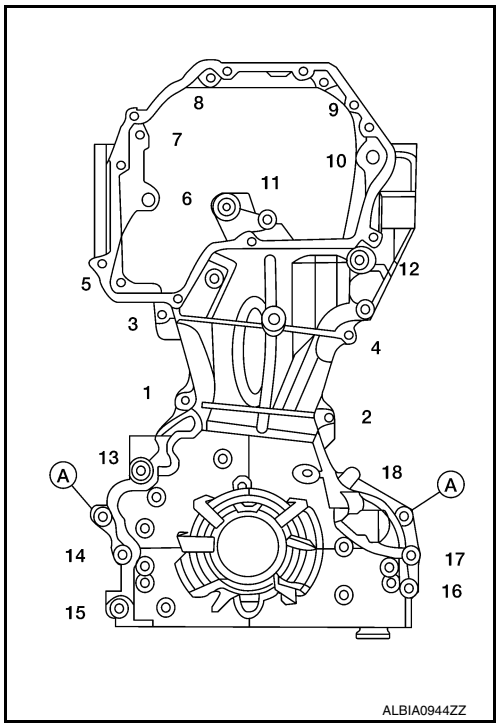


b. Attach suitable tool (A) in the M 6 (0.24 in diameter) thread hole on crankshaft pulley (1), and remove crankshaft pulley.



10. Remove the intake valve timing control cover. Refer to EM-59, "Valve Timing Control Cover".
11. Remove the front cover using the following procedure:
a. Loosen the bolts in reverse order as shown, and remove them.

(A) : Dowel pin



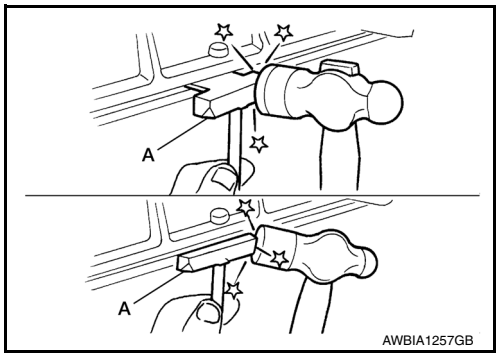
b. Cut liquid gasket using Tool (A).

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

CAUTION:
Do not damage the front cover.

c. Remove the front cover.
d. Remove front oil seal using suitable tool (if necessary).

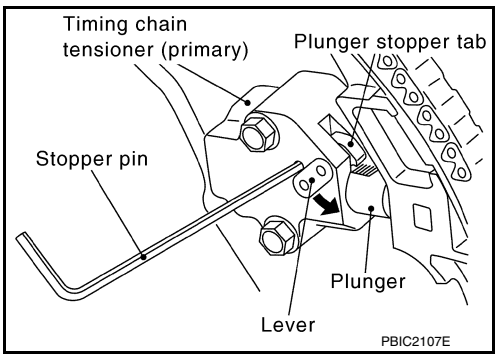
CAUTION:
Do not damage the front cover.



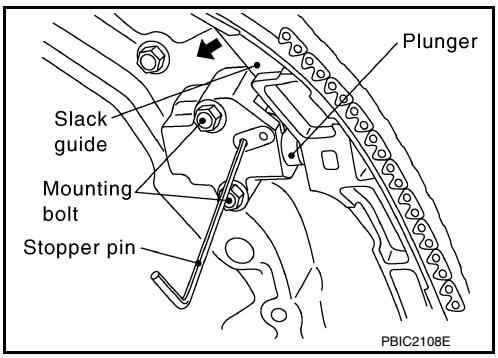
12. Remove timing chain tensioner (primary) and timing chain using the following procedure:
a. Pull the lever down and release the plunger stopper tab.

- Plunger stopper tab can be pushed up to release (coaxial structure with lever).

b. Insert the stopper pin into the tensioner body hole to hold the lever and keep tab released.
NOTE:
Allen wrench [2.5 mm (0.098)] is used for a stopper pin as an example.

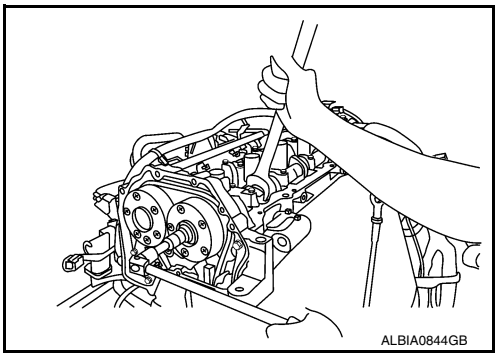


c. Insert plunger into tensioner body by pressing slack guide.
d. Keep slack the guide pressed and hold it by pushing the stopper pin through the lever hole and body hole.
e. Remove the bolts and remove the timing chain tensioner (primary).



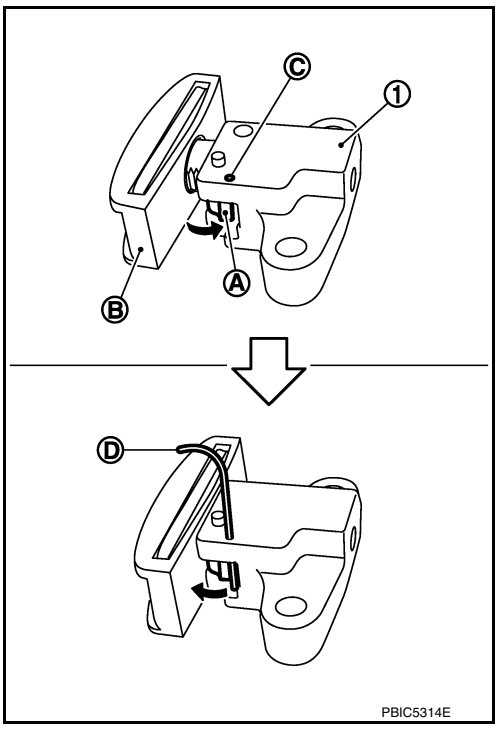
f. Remove the timing chain.
CAUTION:
Do not rotate the crankshaft or camshafts while the timing chain is removed. It can cause damage to the valve and piston.

13. Remove the camshaft sprockets using the following procedure:
a. Secure hexagonal part of the camshaft with a wrench and loosen the camshaft sprocket bolt.
b. Remove the camshaft sprocket bolt and camshaft sprockets for both camshafts.



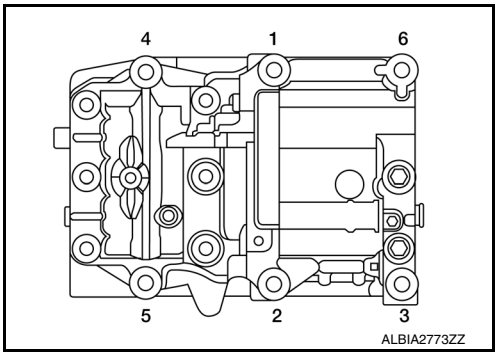
14. Remove the chain slack guide, tension guide, and oil pump drive spacer.

15. Press stopper tab (A) in the direction shown to push the timing chain slack guide (B) toward timing chain tensioner (1) for the balancer unit.
    • The slack guide (B) is released by pressing the stopper tab (A). As a result, the slack guide (B) can be moved.
16. Insert stopper pin (D) into tensioner body hole (C) to secure timing chain slack guide (B).
    NOTE:
    Use a hard metal pin with a diameter of approximately 1.2 mm (0.047 in) as a stopper pin.
17. Remove timing chain tensioner (1) for balancer unit.
18. Secure width across flats of the balancer unit LH side shaft using a suitable tool. Loosen the balancer unit sprocket bolt.
19. Remove balancer unit timing chain, balancer unit sprocket and crankshaft sprocket.



20. Loosen bolts in the reverse order shown, and remove balancer unit.
    CAUTION:
    Do not disassemble balancer unit.

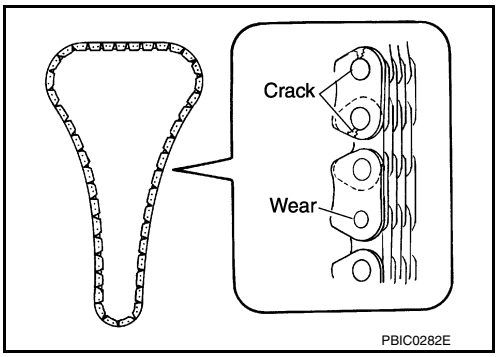
⇦ : Engine front



INSPECTION AFTER REMOVAL

Timing Chain

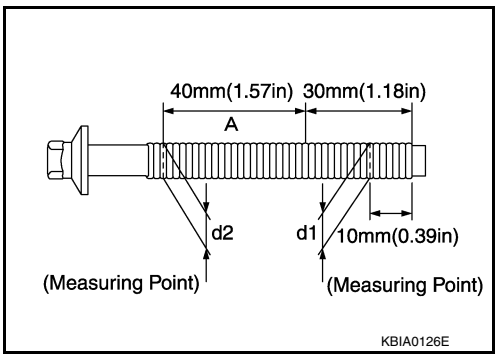
Check the timing chain for cracks or excessive wear. If a defect is found, replace the timing chain.



Balancer Unit Bolt Outer Diameter

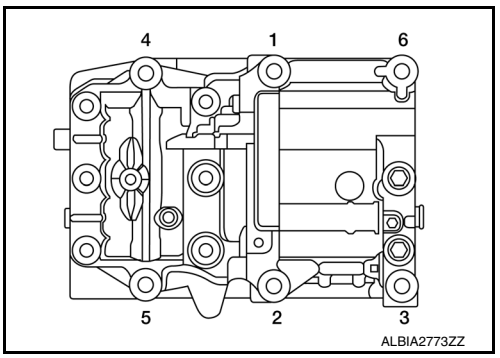
- Measure outer diameters (d1, d2) at the two positions as shown.
- Measure d2 within the range (A).
- If the value difference (d1 - d2) exceeds the limit, replace the balancer unit bolt with a new one.

Limit : 0.15 mm (0. 0059 in) or more



INSTALLATION

1. Make sure the crankshaft key points straight up.
2. Install the balancer unit and tighten the bolts in the numerical order as shown:

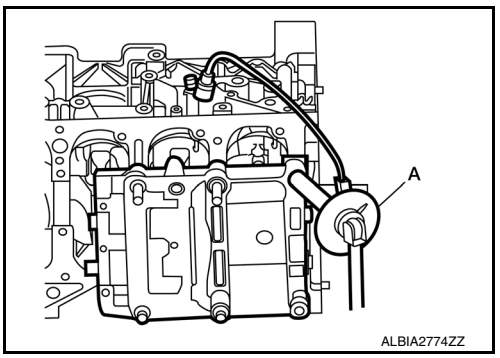


⇦ : Engine front

CAUTION:
- **When reusing a bolt, check its outer diameter before installation. Follow the Balancer Unit Bolt Outer Diameter procedure.**
- **Apply new engine oil to threads and seating surfaces of bolts.**

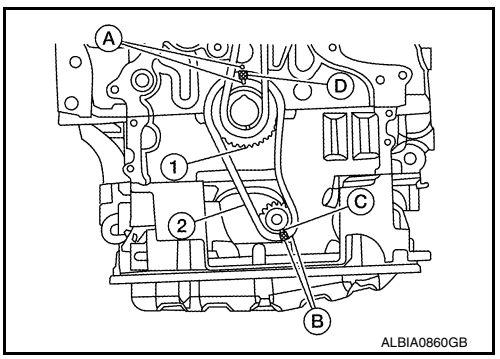
- **Check tightening angle with Tool (A) or a protractor. Do not make judgment by visual check alone.**

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

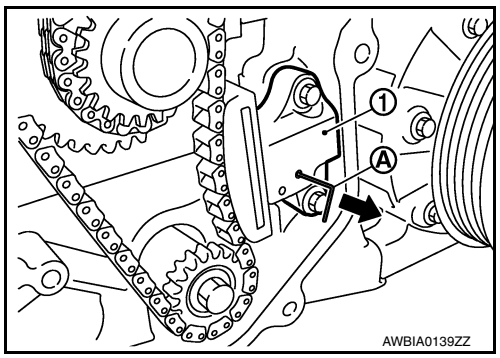


Step 1	**Bolts 1-5**	**: 42 N·m (4.3 kg-m, 31 ft-lb)**
	Bolt 6	**: 36 N·m (3.7 kg-m, 27 ft-lb)**
Step 2	**Bolts 1-5**	**: 120° + 5°**
	Bolt 6	**: 90° + 5°**
Step 3	**Loosen in reverse order**	**: 0 N·m (0 kg-m, 0 ft-lb)**
Step 4	**Bolts 1-5**	**: 42 N·m (4.3 kg-m, 31 ft-lb)**
	Bolt 6	**: 36 N·m (3.7 kg-m, 27 ft-lb)**
Step 5	**Bolts 1-5**	**: 120° + 5°**
	Bolt 6	**: 90° + 5°**

3. Install the crankshaft sprocket (1) and timing chain (2) for the balancer unit.
   - Make sure that the crankshaft sprocket (1) is positioned with mating marks (A) on the block and sprocket meeting at the top.
   - Install it by lining up mating marks on each sprocket (A), (C) and timing chain (B), (D).
   - (B): Pink link
   - (D): Yellow link

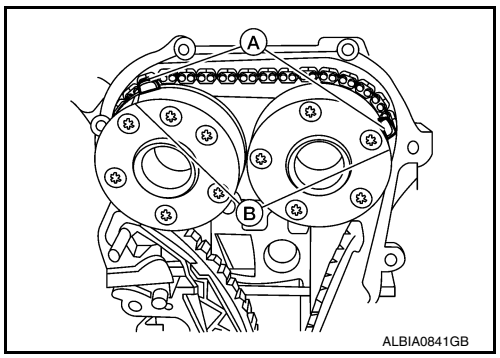


4. Install timing chain tensioner for balancer unit (1).
   - Compress the plunger, insert a stopper pin (A), and then install the tensioner for the balancer unit.
   - Do not pull out (⬅) the stopper pin until after installing the timing chain tensioner for balancer unit.
   - Check matching mark position of balancer unit drive chain and each sprocket again.



5. Install camshaft sprockets.
   - Install them by lining up the mating marks on each camshaft sprocket (B) with the ones painted on the timing chain (A) during removal.
   - Before installation of chain tensioner, it is possible to re-match the marks on timing chain with the ones on each sprocket.

   CAUTION:
   - **Aligned mating marks could slip. Therefore, after matching them, hold the timing chain in place by hand.**
   - **Before and after installing chain tensioner, check again to make sure that mating marks have not slipped.**

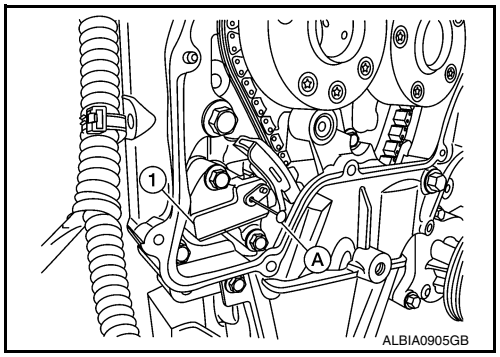


6. Install chain tensioner using the following procedure:

a. Install stopper pin (A) into the chain tensioner (1).

b. Install the chain tensioner and pull the stopper pin out.

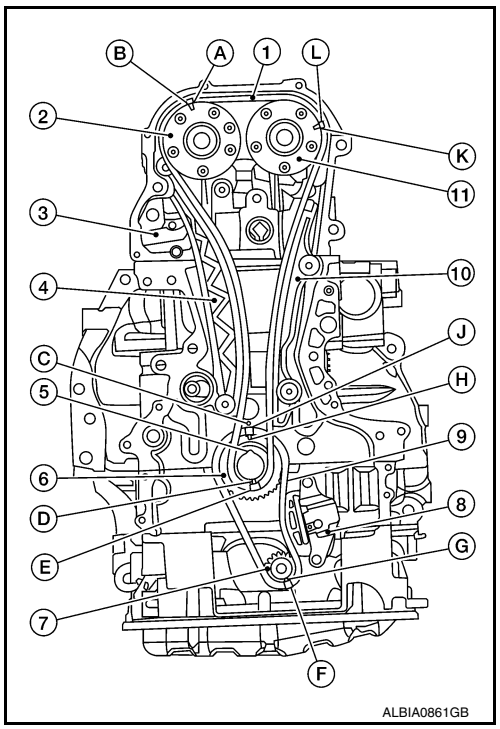
   CAUTION:
   After installation, pull the stopper pin out, and make sure that the tensioner is fully released.



7. Install timing chain (1) and related parts.
   - Install by lining up mating marks on each sprocket and timing chain as shown.
   - Before and after installing chain tensioner (3), check to make sure the mating marks have not slipped.
   - After installing timing chain tensioner (3), remove the stopper pin, and make sure that the tensioner moves freely.

   CAUTION:
   - **For the following note, after the mating marks are aligned, keep them aligned by holding them by hand.**
   - **To avoid skipped teeth, do not move crankshaft and camshaft until front cover is installed.**

   NOTE:
   - Before installing chain tensioner (3) it is possible to slip the chain on the sprocket to align the chain timing mark with the sprocket timing mark.
   - There may be two color variations of the link marks (link colors) on the timing chain.
   - There are 26 links between the pink mating marks on the timing chain; and 64 links between the camshaft sprocket pink link and the crankshaft sprocket yellow link, on the timing chain side without the tensioner.



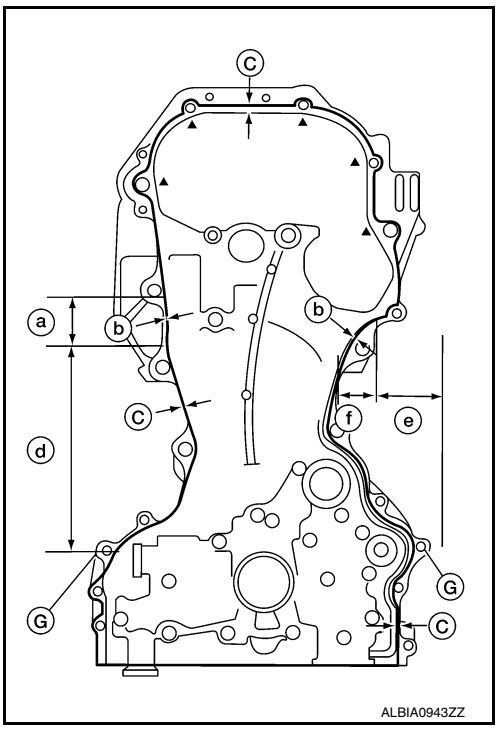
(2) : Camshaft sprocket (INT)
(4) : Timing chain slack guide
(5) : Crankshaft key
(6) : Crankshaft sprocket
(7) : Balancer unit sprocket
(8) : Balancer unit chain tensioner
(9) : Balancer unit timing chain
(10) : Timing chain tension guide
(11) : Camshaft sprocket (EXH)
(A) : Mating mark (Outer groove)
(B) : Pink link
(C) : Mating mark (lug)
(D) : Mating mark (stamp)
(E) : Yellow link
(F) : Pink link
(G) : Mating mark (stamp)
(H) : Mating mark (stamp)
(J) : Yellow link
(K) : Mating mark (Outer groove)
(L) : Pink link

8. Install new front oil seal to front cover. Refer to EM-71, "FRONT OIL SEAL : Removal and Installation".
9. Install front cover with the following procedure:

a. Install O-rings to cylinder head and cylinder block.
CAUTION:
Do not reuse O-rings.

b. Apply a continuous bead of liquid gasket to front cover as shown.

(a) : 35.7 mm (1.406 in)
(b) : 6.0 – 6.5 mm (0.236 – 0.256 in)
(c) : 3.4 – 4.4 mm (0.134 – 0.173 in)
(d) : 179.6 mm (7.07 in)
(e) : 35.5 mm (1.398 in)
(f) : 31.3 mm (1.232 in)
(G) : Dowel pin hole



Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
CAUTION:
- **For bolt holes with ▲ marks (5 locations), apply liquid gasket outside the holes.**
- **Installation should be done within 5 minutes after application of liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the liquid gasket to cure.**

c. Make sure the mating marks on the timing chain and each sprocket are still aligned. Then install the front cover.
CAUTION:
Do not damage the front oil seal during installation.

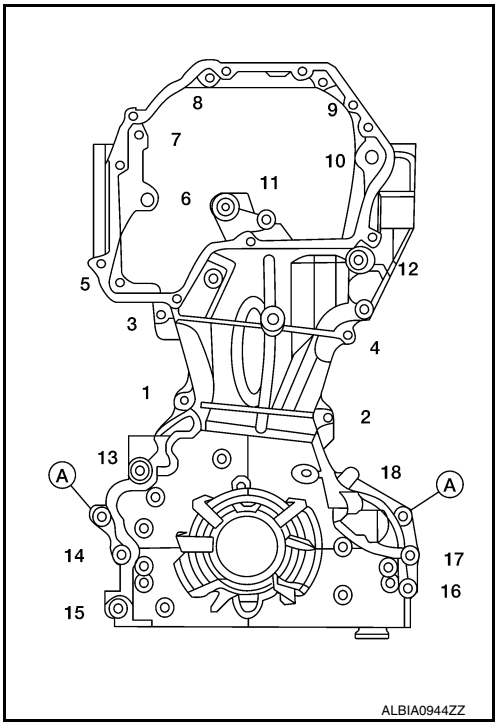
d. Tighten front cover bolts in the numerical order shown.

e. After all bolts are tightened, retighten them to the specified torque.

Front cover bolts

Bolts 6, 10, 12	**: 49 N·m (5.0 kg-m, 36 ft-lb)**
Bolts (all remaining)	**: 12.7 N·m (1.3 kg-m, 9 ft-lb)**
(A)	**: Dowel pin**

CAUTION:
Wipe off excess sealant leaking at the surface for installing the oil pan.

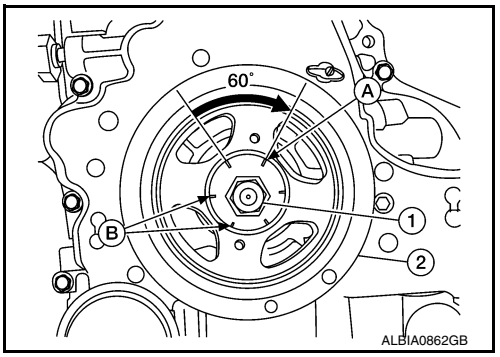


10. Install the chain guide between the camshaft sprockets.
11. Install valve timing control cover. Refer to EM-59, "Valve Timing Control Cover".
12. Insert crankshaft pulley by aligning with crankshaft key.
    - Tap its center with a plastic hammer to insert.
    - Do not tap the crankshaft pulley outer diameter.
13. Tighten crankshaft pulley bolt.
    - Secure crankshaft pulley with tool to tighten the bolt.
    - Perform angle tightening with the following procedure:

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

b. Tighten to initial specifications:

Crankshaft bolt (1) : 42.1 N·m (4.3 kg-m, 31 ft-lb)



c. Apply a paint mark (A) on the front cover, mating with any one of six easy to recognize stamp marks on bolt flange (B).

d. Turn crankshaft pulley bolt an additional 60 degrees +6/-0 degrees.
NOTE:
Check that the assembled unit does not interfere with adjacent components by turning the crankshaft in the tightening direction.

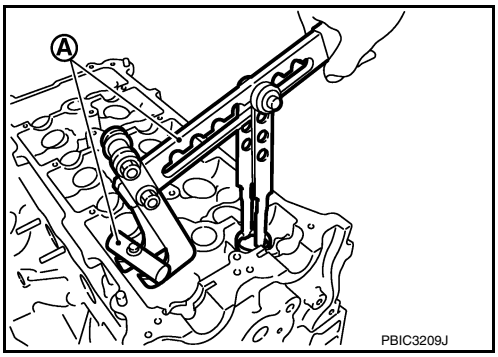
14. Installation of the remaining components is in the reverse order of removal.

OIL SEAL
VALVE OIL SEAL
VALVE OIL SEAL : Removal and Installation

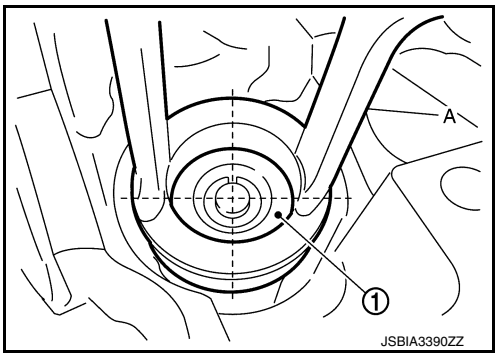
INFOID:0000000012601979

REMOVAL

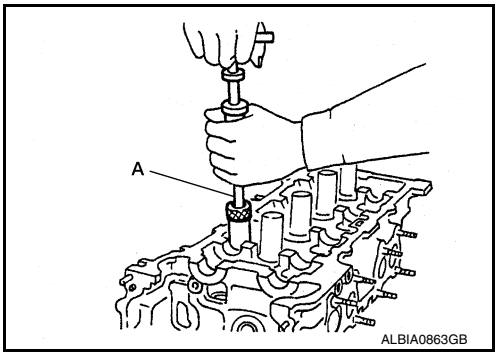
1. Remove camshafts. Refer to EM-48, "Removal and Installation".
2. Remove valve lifters. Refer to EM-48, "Exploded View".
3. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.
   CAUTION:
   When rotating crankshaft, be careful to avoid scarring front cover with timing chain.
4. Remove valve collet.
   - Compress valve spring using suitable tool (A). Remove valve collet with a magnet.



   CAUTION:
   - **Do not damage valve lifter holes.**
   - **Install suitable tool (A) in the center of valve spring retainer (1) to press it.**



5. Remove valve spring retainer and valve spring (with valve spring seat).
   CAUTION:
   Do not remove valve spring seat from valve spring.
6. Remove valve oil seal using suitable tool (A).

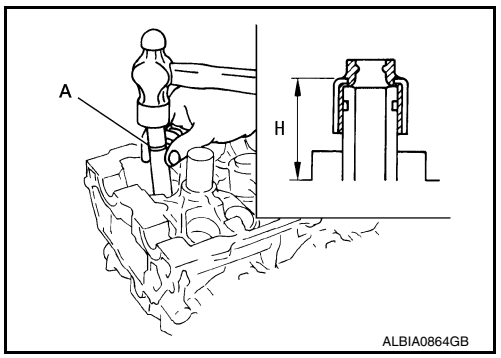


INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.

2. Press in valve oil seal to the height “H” as shown using suitable tool (A).

Height “H” **: Refer to EM-113, "Standard and Limit"**



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

FRONT OIL SEAL

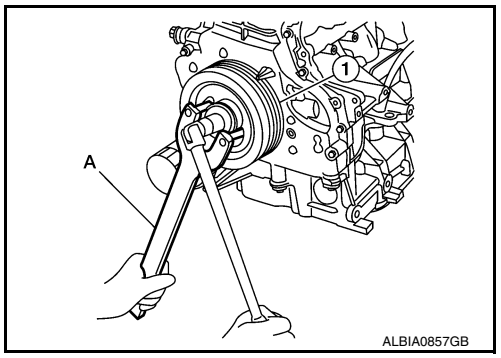
FRONT OIL SEAL : Removal and Installation

INFOID:0000000012601980

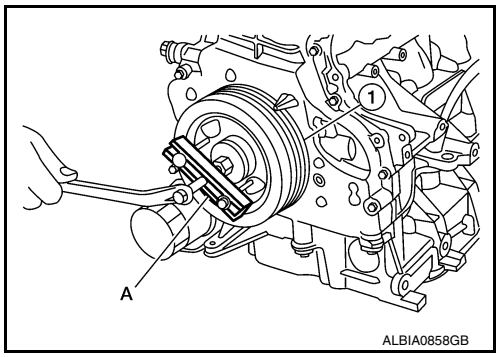
REMOVAL

1. Remove front under cover. Refer to EXT-38, "FRONT UNDER COVER : Removal and Installation".
2. Remove front fender protector. Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".
3. Remove drive belt. Refer to EM-19, "Removal and Installation".
4. Remove crankshaft pulley (1) using the following procedure:

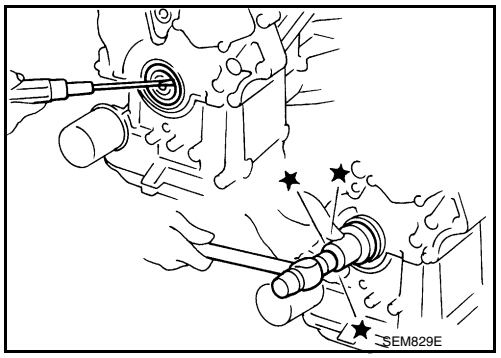
a. Hold the crankshaft pulley (1) using suitable tool (A), then loosen and remove the crankshaft pulley bolt.



b. Attach suitable tool (A) in the threaded hole on crankshaft pulley (1), and remove crankshaft pulley.



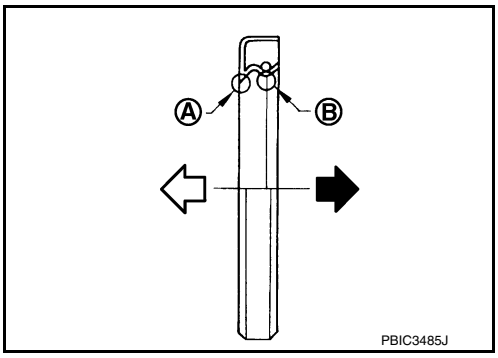
5. Remove front oil seal with a suitable tool.
CAUTION:
Do not damage front cover and crankshaft.



INSTALLATION

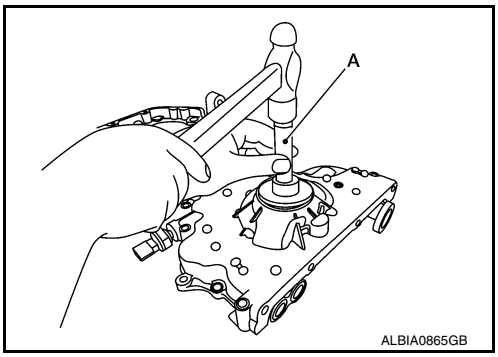
1. Apply new engine oil to seal lip.
2. Install front oil seal so that each seal lip is oriented as shown.

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



- Press-fit front oil seal until it is flush with front end surface of front cover using a suitable drift (A).

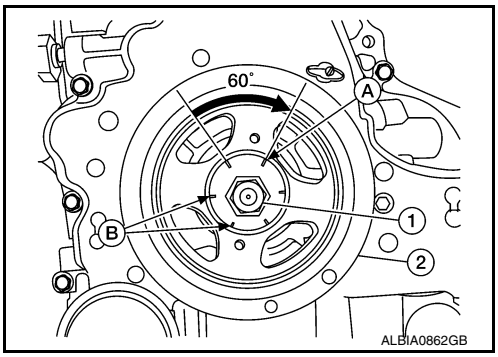
CAUTION:
- **Do not damage front cover and crankshaft.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Do not touch the grease applied to the oil seal lip.**
- **Do not reuse oil seal.**



3. Insert crankshaft pulley by aligning with crankshaft key.
   - Tap its center with a plastic hammer to insert.
   - Do not tap the crankshaft pulley outer diameter.
4. Tighten crankshaft pulley bolt.
   - Secure crankshaft pulley with suitable tool to tighten the bolt.
   - Perform angle tightening with the following procedure.

a. Apply new engine oil to threads and seat surfaces of bolts.
b. Apply a paint mark (A) on the front cover, mating with any one of six easy to recognize stamp marks on bolt flange (B).
c. Tighten crankshaft bolt (1) to specification.
NOTE:
Check that the assembled unit does not interfere with adjacent components by turning the crankshaft in the tightening direction.

Step 1 : 42.1 N·m (4.3 kg-m, 31 ft-lb)
Step 2 : Turn crankshaft bolt (1) an additional 60° +6°/ -0°.



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

REAR OIL SEAL

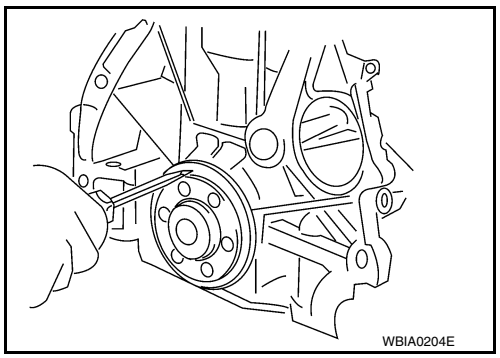
REAR OIL SEAL : Removal and Installation

INFOID:0000000012601981

REMOVAL

1. Remove the engine and transaxle. Refer to EM-85, "Removal and Installation".
2. Separate engine from transaxle.
3. Remove drive plate. Refer to EM-90, "Setting".

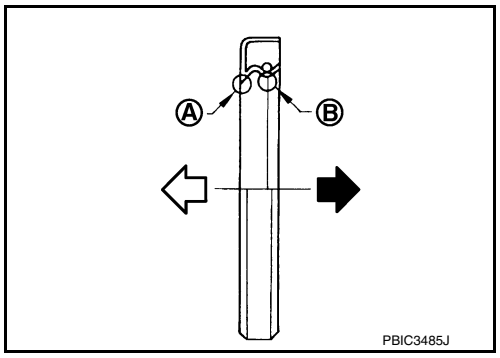
4. Remove rear oil seal with a suitable tool.
CAUTION:
Do not damage crankshaft and cylinder block.



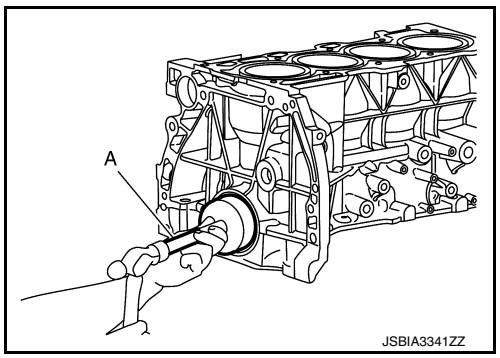
INSTALLATION

1. Apply new engine oil to rear oil seal lip.
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

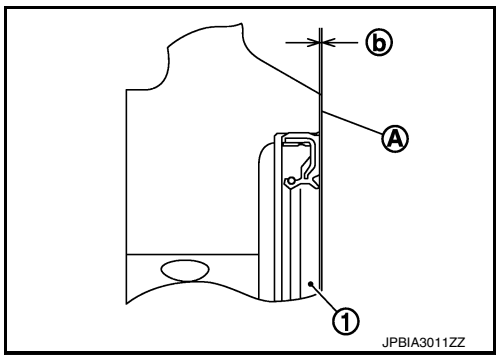


- Press-fit rear oil seal with a suitable drift (A).
CAUTION:
  - **Do not reuse rear oil seal.**
  - **Do not damage crankshaft and cylinder block.**
  - **Press-fit oil seal straight to avoid causing burrs or tilting.**
  - **Do not touch grease applied onto oil seal lip.**
  - **Apply neutral detergent (if needed) to outer circumference of oil seal to aid installation. Do not allow detergent to contact inner circumference of oil seal.**



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

(A) : Rear end surface of cylinder block
(b) : 0.0 mm - 0.5 mm (0.000 in - 0.020 in)

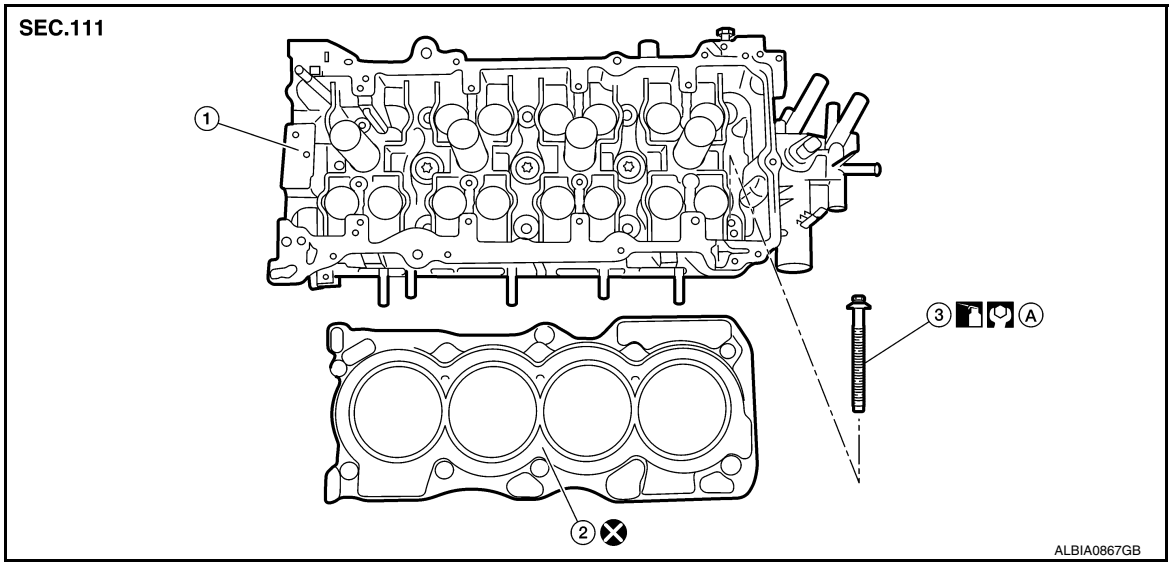


3. Installation of the remaining components is in the reverse order of removal.

CYLINDER HEAD

Exploded View

INFOID:0000000012601982



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

A. Refer to INSTALLATION

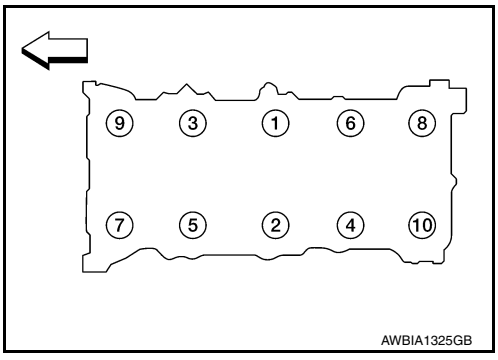
Removal and Installation

INFOID:0000000012601983

REMOVAL

1. Remove the timing chain. Refer to EM-62, "Removal and Installation".
2. Remove the camshafts. Refer to EM-48, "Removal and Installation".
3. Remove spark plugs. Refer to EM-16, "Removal and Installation".
4. Remove the intake manifold. Refer to EM-30, "Removal and Installation".
5. Remove the exhaust manifold and three way catalyst. Refer to EM-33, "Removal and Installation".
6. Loosen the cylinder head bolts in the reverse order shown.

⇦ : Engine front



7. Remove cylinder head.
8. Remove cylinder head gasket.

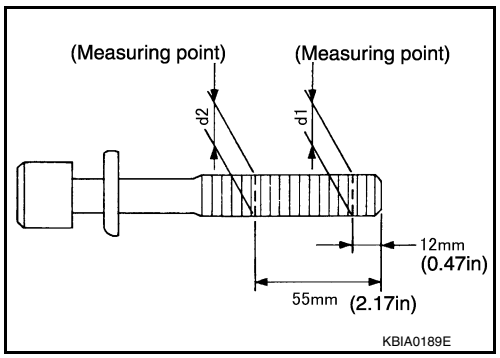
INSPECTION AFTER REMOVAL

Outer Diameter of Cylinder Head Bolts

- Replace the cylinder heads bolts with new ones if the size difference between d1 and d2 exceeds the limit.

Limit (d1 - d2) : 0.23 mm (0.0091 in) or more

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

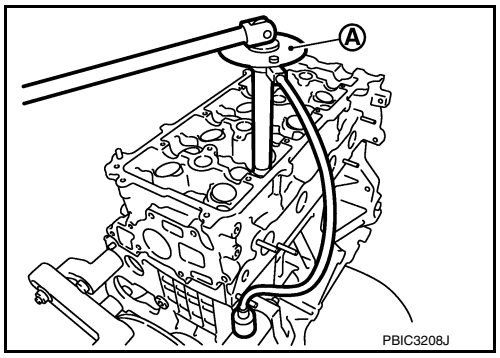


INSTALLATION

1. Clean surfaces of cylinder head and cylinder block.
2. Install a new cylinder head gasket.
   CAUTION:
   Do not reuse cylinder head gasket.
3. Install the cylinder head.
4. Follow the steps below to tighten the cylinder head bolts in the numerical order as shown.
   - Clean threads and seating surfaces of bolts.
   - Apply new engine oil to the threads and the seating surfaces of bolts.

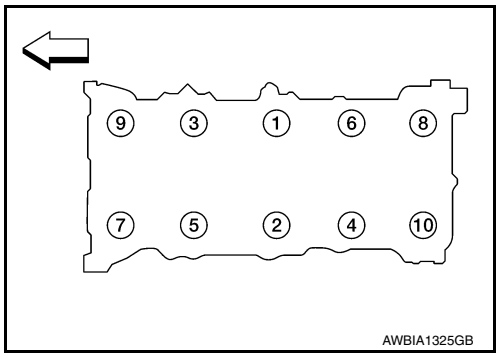
   CAUTION:
   - **If cylinder head bolts are re-used, check their outer diameters before installation. Follow the Outer Diameter of Cylinder Head Bolts measurement procedure.**
   - **Check and confirm the tightening angle by using Tool (A) or protractor. Do not judge angle by visual inspection.**

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



Step a : 50 N·m (5.1 kg-m, 37 ft-lb) in order
Step b : 60° clockwise in order
Step b : Loosen to 0 N·m in order
Step c : 39.2 N·m (4.0 kg-m, 29 ft-lb) in order
Step d : 75° clockwise in order
Step e : 75° clockwise in order

⇦ : Engine front



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

Disassembly and Assembly

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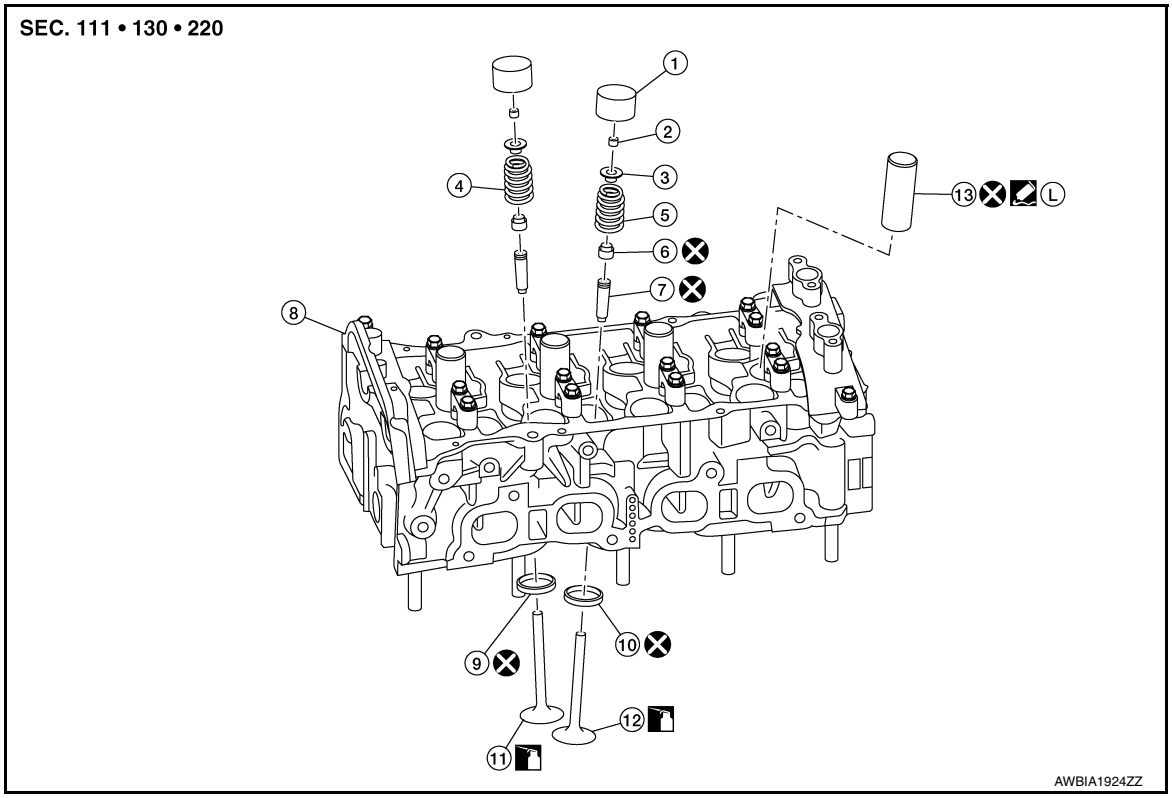


1. Valve lifter
2. Valve collet
3. Valve spring retainer
4. Valve spring (INT)
5. Valve spring (EXH)
6. Valve oil seal
7. Valve guide
8. Cylinder head
9. Valve seat (INT)
10. Valve seat (EXH)
11. Valve (INT)
12. Valve (EXH)
13. Spark plug tube
L. Apply thread locking sealant

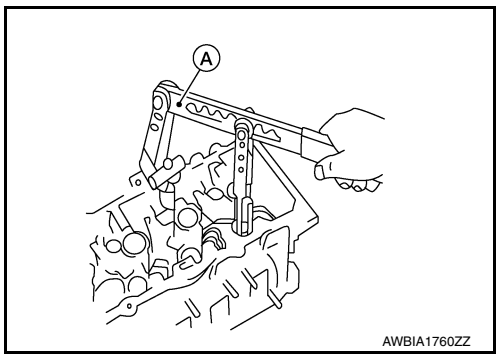
CAUTION:

- **When installing camshafts, chain tensioners, oil seals or other sliding parts, lubricate contacting surfaces with new engine oil.**
- **Apply new engine oil to threads and seat surfaces when installing the cylinder head, camshaft sprocket, crankshaft pulley and camshaft bracket.**
- **Attach tags to valve lifters so all parts are assembled in their original position.**
- **The exhaust valve contains metallic sodium. Therefore, extreme caution must be taken when handling and disposing of the exhaust valve. Refer to EM-5, "Special Cautions to Ensure the Safe Disposal of Sodium-filled Exhaust Valves".**

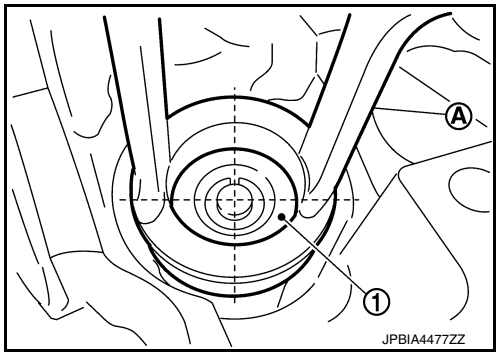
DISASSEMBLY

1. Remove the valve lifter.
   NOTE:
   Confirm installation point to return valve lifter to original location during assembly.

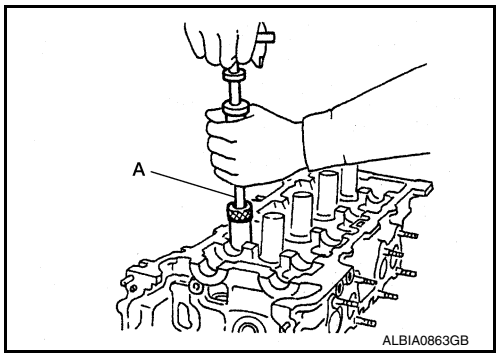
2. Remove valve collet, valve spring retainer, and valve spring using suitable tool (A). Remove valve collet with magnetic hand.
CAUTION:
- **Do not damage valve lifter holes.**



- **Install suitable tool (A) in the center of valve spring retainer (1) to install it.**



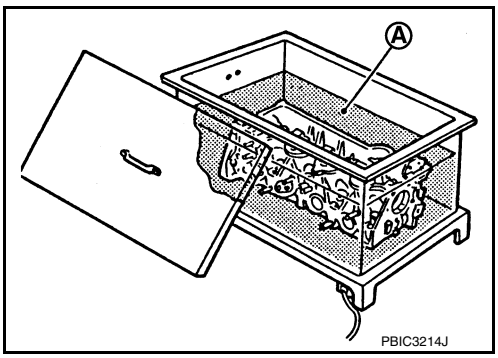
3. Remove valve spring retainer and valve spring (with valve spring seat).
CAUTION:
Do not remove valve spring seat from valve spring.
4. Push valve stem to combustion chamber side, and remove valve.
- Inspect valve guide clearance before removal. Refer to EM-81, "Inspection After Disassembly".
- Confirm installation point to return valve to original location during assembly.
5. Remove valve oil seal using suitable tool (A).



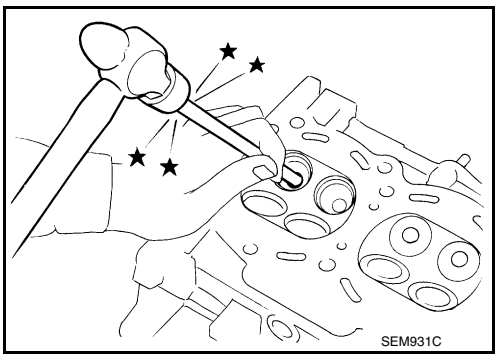
6. Remove valve seat (if necessary).
- Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to EM-76, "Disassembly and Assembly".
CAUTION:
Do not bore excessively to prevent damage to cylinder head.
7. Remove valve guide (if necessary).

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

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



b. Drive out valve guide using suitable tool.



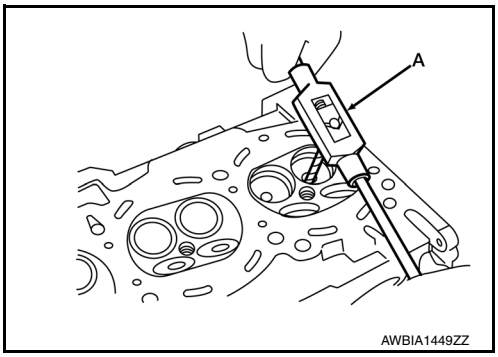
8. Remove spark plugs. Refer to EM-16, "Removal and Installation".
9. Remove spark plug tubes (if necessary) using suitable tool.

CAUTION:
- **Do not damage cylinder head.**
- **Do not remove spark plug tube if not necessary. Once removed, the spark plug tube cannot be reused because of deformation during removal.**

ASSEMBLY

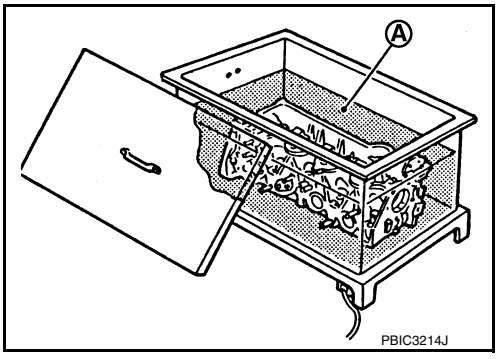
1. Install valve guide (if removed).

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



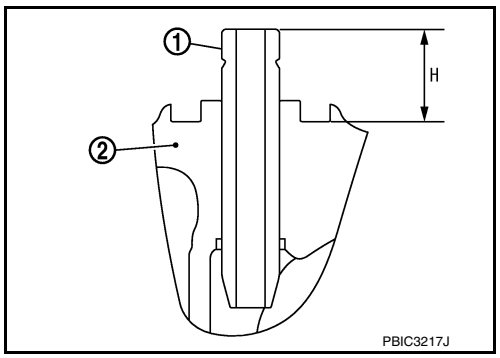
b. Heat cylinder head to 110°C to 130°C (230°F to 266°F) by soaking in heated engine oil (A).

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

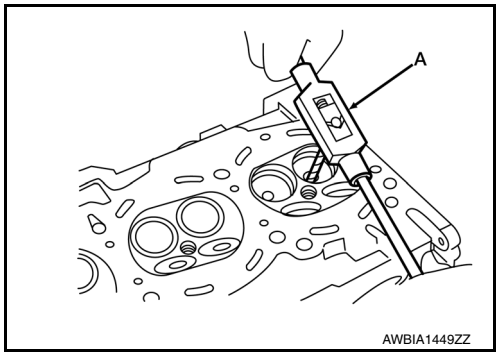


c. Press valve guide (1) into cylinder head (2) from camshaft side to dimension as shown.

Projection (H) : Refer to EM-113, "Standard and Limit"

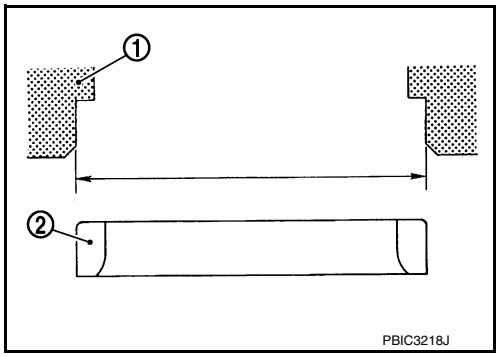


d. Apply reamer finish to valve guide using suitable tool (A).



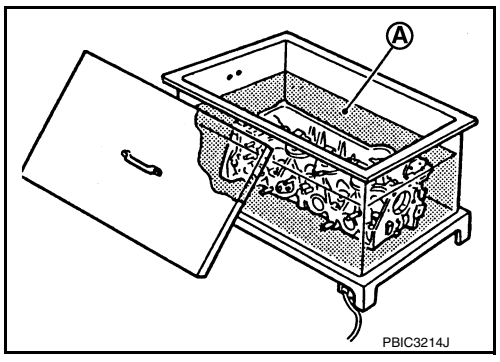
2. Install valve seat (if removed).

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



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

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



c. Allow valve seats to cool with dry ice. Press-fit valve seat into cylinder head.

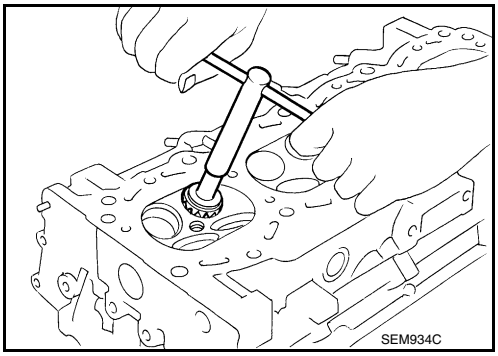
CAUTION:
Do not touch cold valve seats directly.

d. Finish valve seat to the specified dimension using suitable tool. Refer to EM-113, "Standard and Limit".

CAUTION:

When using valve seat cutter, firmly grip the cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on the cutter or cutting many different times may result in stage valve seat.

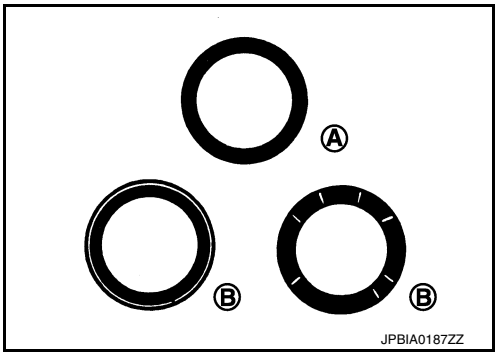
e. Using compound, grind to adjust valve.



f. Check again for normal contact. Refer to EM-113, "Standard and Limit".

(A) : OK

(B) : NG

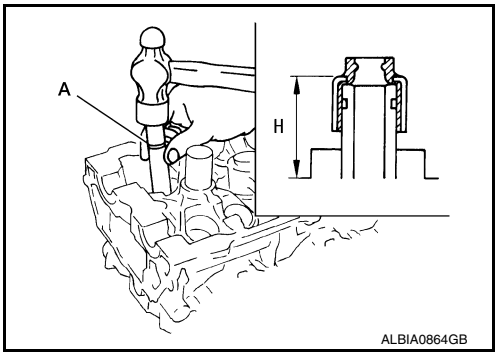


3. Apply new engine oil to new valve oil seal joint surface and seal lip.
4. Install new valve oil seal using suitable tool (A) as shown.

NOTE:

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

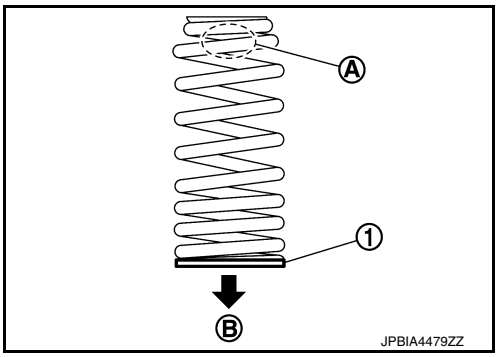
Projection (H) : Refer to EM-113, "Standard and Limit"



5. Install valve.
   - Install larger diameter to intake side.
6. Install valve spring with valve spring seat (1).
   - Install valve spring so that the identification color faces upward (A).
   - Install smaller pitch to cylinder head side (B).
   - Confirm the identification color of the valve spring.

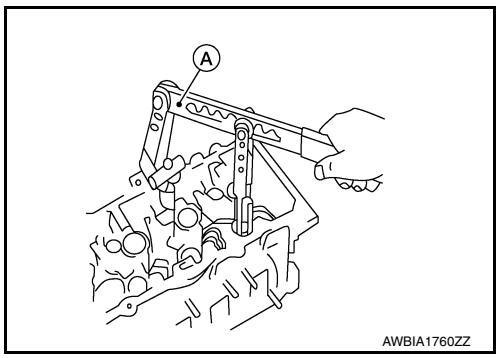
Intake : White

Exhaust : Light blue



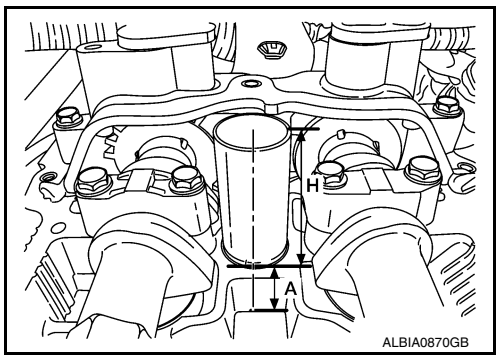
7. Install valve spring retainer.
8. Install valve collet.

- Compress valve spring using suitable tool (A). Install valve collet with a magnet hand.
  CAUTION:
  When working do not damage valve lifter holes.
- Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.



9. Install valve lifter.
10. Install spark plug tube.

a. Remove old liquid gasket from cylinder head mounting hole.
b. Apply liquid gasket all around on spark plug tube with a 12 mm (0.47 in) width from edge of spark plug tube on the press fit side.
   - Use Three Bond or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
c. Press fit spark plug tube so that height (H) is as shown.



Press fit height (H) standard value : 41.7 mm (1.642 in)

CAUTION:
- **When press fitting be careful not to deform spark plug tube.**
- **After press fitting, wipe off any protruding liquid gasket on top surface of cylinder head.**

11. Install spark plug. Refer to EM-16, "Removal and Installation".

Inspection After Disassembly

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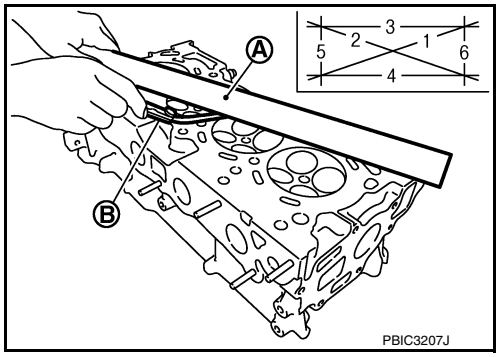
CYLINDER HEAD DISTORTION

1. Wipe off engine oil and remove water scale deposits, old gasket, old sealer, and carbon using a suitable tool.
   CAUTION:
   Use 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 distortion in six directions using suitable tools (A, B).



Limit : Refer to EM-113, "Standard and Limit"

- If measurements exceed the limit, replace cylinder head.

VALVE DIMENSIONS

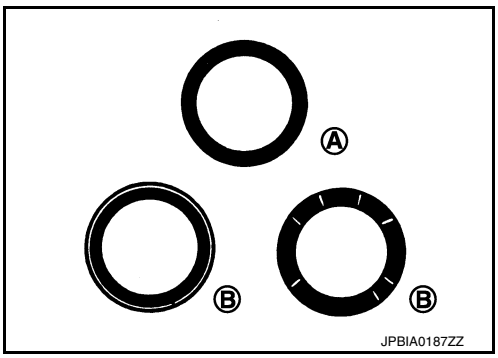
1. Check dimensions of each valve. Refer to EM-113, "Standard and Limit".
2. If dimensions are out of the standard, replace valve and check valve seat contact.

VALVE SEAT CONTACT

NOTE:
After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure:

1. Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the vavle contact on the seat surface.
2. Ensure that the contact area band is continuous all around the circumference.

(A) : OK
(B) : NG



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

VALVE GUIDE CLEARANCE

1. Measure diameter of valve stem using suitable tool (A) as shown.

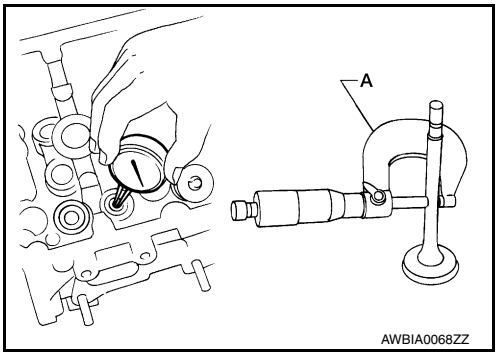
Standard : Refer to EM-113, "Standard and Limit"

2. Measure inner diameter of valve guide using suitable tool.

Standard : Refer to EM-113, "Standard and Limit"

3. Valve guide clearance = (Valve guide inner diameter) - (Valve stem diameter)

Standard and Limit : Refer to EM-113, "Standard and Limit"



4. If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to EM-76, "Disassembly and Assembly"

VALVE SPRING SQUARENESS

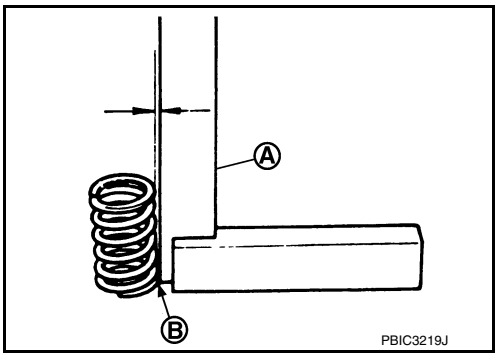
CAUTION:
Do not remove the valve spring seat from the valve spring

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

(B) : Contact

Limit : Refer to EM-113, "Standard and Limit".

2. If the valve spring exceeds the limit, replace the valve spring with the valve spring seat.



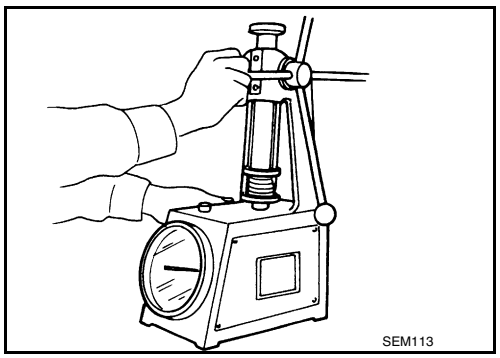
VALVE SPRING PRESSURE LOAD

CAUTION:
Do not remove the valve spring seat.

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

Standard : Refer to EM-113, "Standard and Limit".

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



INSPECTION AFTER INSTALLATION

Inspection for Leaks

1. 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 CO-11, "Changing Engine Coolant" and LU-10, "Changing Engine Oil".
2. Use the following steps to check for fuel leaks.

a. Turn ignition switch "ON" (with engine stopped).
b. With fuel pressure applied to fuel piping, check for fuel leaks at connection points.
c. Start engine.
d. With engine speed increased, check again for fuel leaks at connection points.

3. 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.
4. Warm up engine thoroughly to check there are no fuel leaks, exhaust gas leaks, or any oil/fluid leaks including engine oil and engine coolant.
5. Bleed air from lines and hoses of applicable lines, such as in cooling system.
6. After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leaks	Level
Engine oil		Level	Leaks	Level
Transmission / transaxle fluid	AT & CVT Models	Leaks	Level / Leaks	Leaks
	MT Models	Level / Leaks	Leaks	Level / Leaks
Other oils and fluids*		Level	Leaks	Level
Fuel		Leaks	Leaks	Leaks
Exhaust gases		—	Leaks	—

*: Power steering fluid, brake fluid, etc.

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

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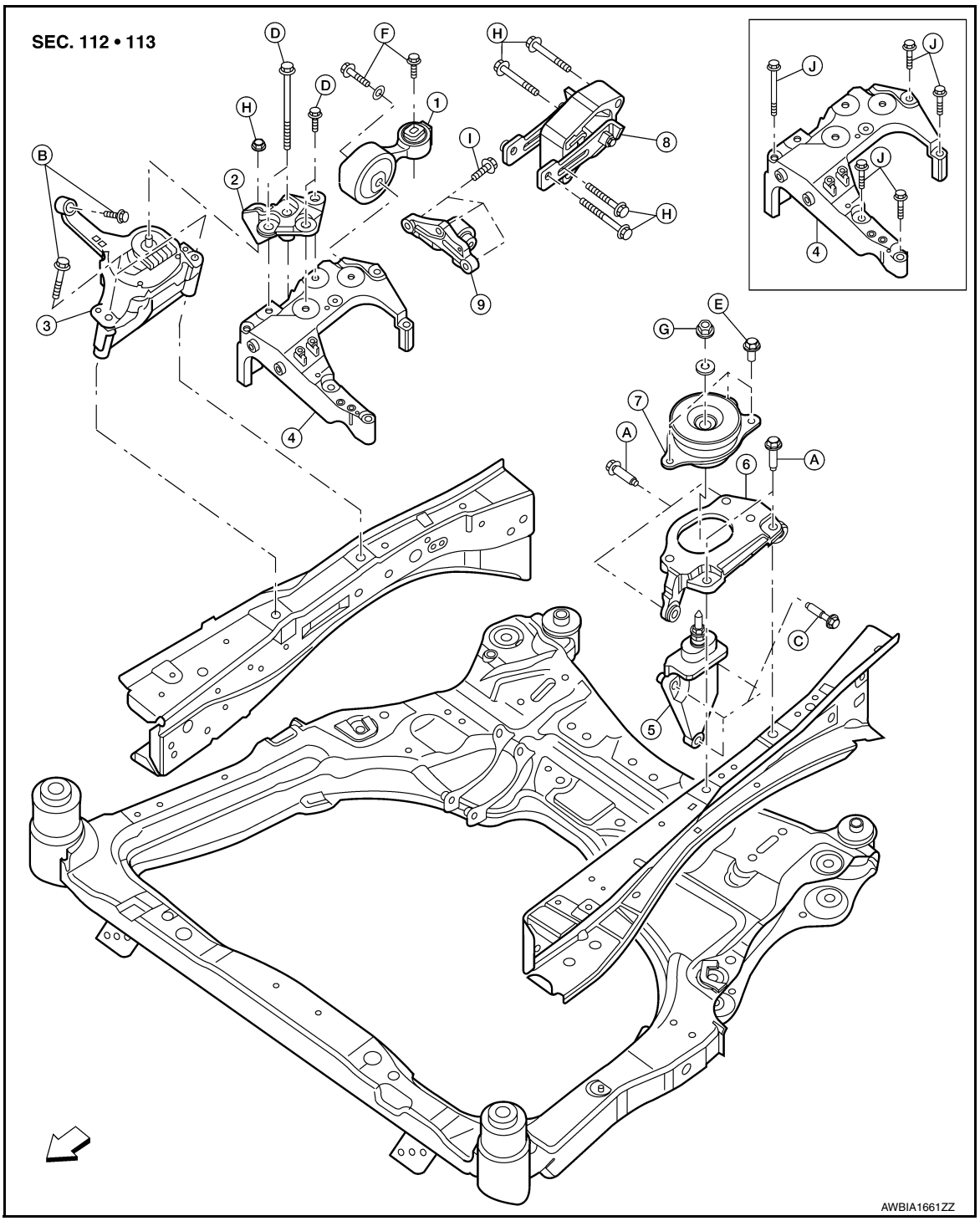

1. Engine mount torque rod (RH)
2. Engine support bracket (RH)
3. Engine mounting insulator (RH)
4. Engine mounting bracket (RH)
5. Transmission mounting bracket
6. Engine mounting bracket (LH)
7. Engine mounting insulator (LH)
8. Rear engine mount torque rod
9. Rear engine mount torque rod bracket

A. 40 N·m (4.1 kg-m, 30 ft-lb)
B. 41 N·m (4.2 kg-m, 30 ft-lb)
C. 45 N·m (4.6 kg-m, 33 ft-lb)
D. 50 N·m (5.1 kg-m, 37 ft-lb)
E. 60 N·m (6.1 kg-m, 44 ft-lb)
F. 85 N·m (8.7 kg-m, 63 ft-lb)

G. 90 N·m (9.2 kg-m, 66 ft-lb) H. 103 N·m (11 kg-m, 76 ft-lb) I. 70 N·m (7.1 kg-m, 52 ft-lb)
J. 48.2 N·m (4.9 kg-m, 36 ft-lb) ⇦ Front

Removal and Installation

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WARNING:
- **Place chocks at the front and back of the rear wheels.**
- **For engines not equipped with slingers, attach proper slingers and bolts as described in the Parts Catalog.**

CAUTION:
- **Do not start working until the exhaust system and coolant are cool.**
- **If items or work required are not covered by the engine main body section, follow the applicable procedures.**
- **Use the correct supporting points for lifting and jacking. Refer to GI-33, "Garage Jack and Safety Stand".**
- **In removing the drive shaft, do not damage the grease seals on the transaxle.**

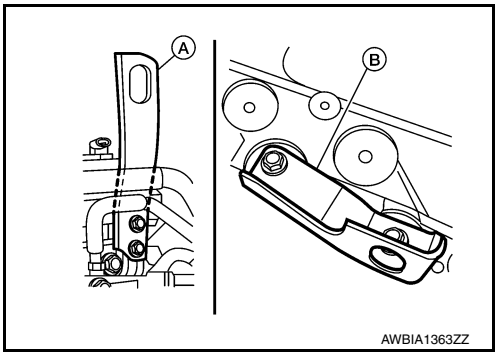
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

REMOVAL

1. Remove engine room cover. Refer to EM-28, "Removal and Installation".
2. Relieve fuel system pressure. Refer to EC-190, "Work Procedure".
3. Disconnect the negative and positive battery terminal. Refer to PG-82, "Exploded View" and PG-81, "Exploded View".
4. Disconnect the fuel rail at the fuel hose quick connector (engine side). Refer to EM-42, "Exploded View".
5. Drain the engine coolant. Refer to CO-11, "Changing Engine Coolant".
6. Remove the front under cover. Refer to EXT-38, "FRONT UNDER COVER : Removal and Installation".
7. Remove hood assembly. Refer to DLK-167, "HOOD ASSEMBLY : Removal and Installation".
8. Remove core support cover.
9. Remove the front air duct and air cleaner case assembly. Refer to EM-29, "Removal and Installation".
10. Remove battery and battery tray. Refer to PG-80, "Removal and Installation".
11. Remove cowl top. Refer to EXT-34, "Removal and Installation".
12. Remove strut tower brace. Refer to FSU-18, "Exploded View".
13. Disconnect EVAP hose and vacuum hose from intake manifold.
14. Remove upper and lower radiator hoses (engine side).
15. Remove CVT cooler lines.
16. Disconnect engine room harness connector at the CVT and ECM connectors.
    CAUTION:
    Protect the harness connector with plastic bags or suitable covering to help prevent damage and intrusion of foreign materials into the connectors.
17. Remove the brake booster vacuum hose.
18. Disconnect the heater hoses.
19. Remove fender protector side cover. Refer to EXT-36, "FENDER PROTECTOR : Exploded View".
20. Remove the front wheels and tires using a power tool. Refer to WT-54, "Adjustment".
21. Remove the fender protector side covers (LH/RH). Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".
22. Remove tie rod ends from the steering knuckles. Refer to ST-45, "Exploded View".
23. Remove the power steering gear bolts and support the power steering gear. Refer to ST-37, "Exploded View".
24. Remove rear cover plate.
25. Remove the torque converter nuts.
26. Remove the rear engine mount torque rod.
27. Remove front exhaust tube and gaskets. Refer to EX-5, "Exploded View".

28. Remove the drive shafts (LH/RH). Refer to FAX-10, "Removal and Installation (LH)" (LH), FAX-13, "Removal and Installation (RH)" (RH).
29. Remove the drive belt. Refer to EM-19, "Removal and Installation".
30. Remove the front suspension member. Refer to FSU-19, "Removal and Installation".
31. Remove the A/C compressor with piping connected and support using suitable wire.
32. Disconnect the transaxle shift controls.
33. Install engine slingers into the rear of the cylinder head (A) and front engine mounting bracket holes (B).
    - Use engine bolt holes for front slinger.
    - Use the holes in the rear of the cylinder head for the rear slinger.

    Slinger bolts (A) : 28 N·m (2.8 kg-m, 21 ft-lb)
    Slinger bolts (B) : 48 N·m (4.9 kg-m, 35 ft-lb))



34. Support engine and transaxle assembly with engine lifting equipment from the top with the vehicle raised on a hoist.
35. Remove the engine mount torque rod (RH), engine support bracket (RH) and engine mounting insulator and bracket (RH).
36. Remove transaxle mounting insulator (LH) through-bolts.
37. Lower the engine and transaxle assembly from the engine compartment using suitable tool.
    CAUTION:
    - **Before and during this procedure, always check if any harnesses are left connected.**
    - **Avoid any damage to, or any oil/grease smearing or spills onto the engine mounting insulators.**
38. Remove the starter motor. Refer to STR-21, "QR25DE : Removal and Installation".
39. Remove engine and transaxle harness.
40. Separate engine and transaxle. Refer to EM-90, "Setting".

INSTALLATION

Installation is in the reverse order of removal.

NOTE:

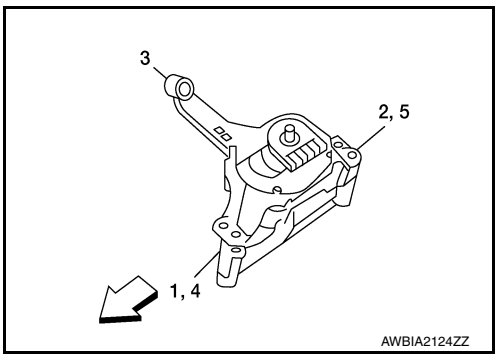
- Tighten the transmission bolts to specification. Refer to TM-210, "Exploded View" (RE0F10D) and TM-415, "Exploded View" (RE0F10E).
- Do not allow oil to get on mounting insulators. Be careful not to damage mounting insulators.

1. Install the engine mount insulator (RH) as follows:

a. Temporarily tighten the bolts.

b. Tighten the bolts in sequence as shown to the specified torque. Refer to EM-84, "Exploded View".
   NOTE:
   Bolts are initially installed at positions 1 and 2; Positions 3 - 5 are then tightened to specification.

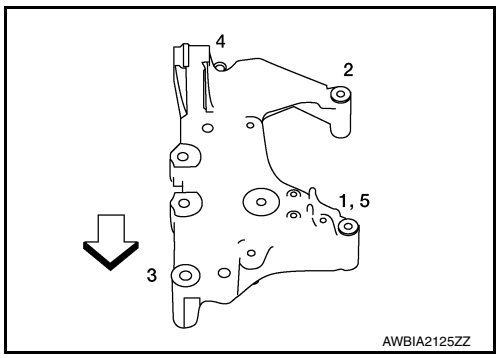
⇦ : Front



2. Install the engine mounting bracket (RH) as following:

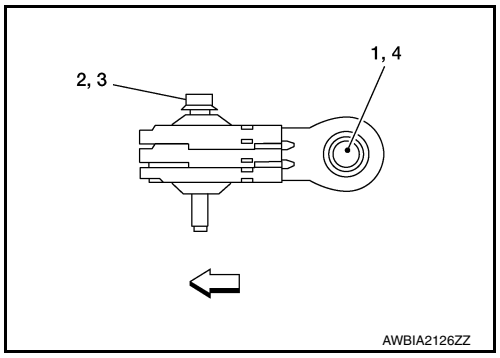
a. Temporarily tighten the bolts.
b. Tighten the bolts in sequence as shown to the specified torque. Refer to EM-84, "Exploded View".
NOTE:
Bolt is initially installed at position 1; Positions 2 - 5 are then tightened to specification.

⇦ : Front



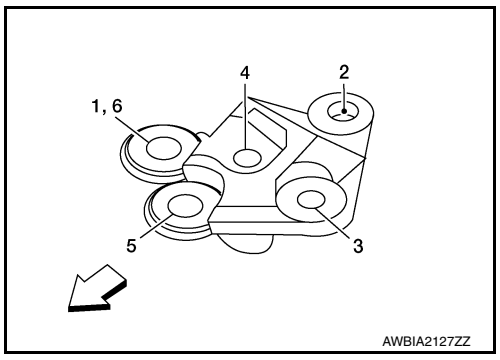
3. Install the engine mount torque rod (RH) as follows:
a. Temporarily tighten bolts.
b. Tighten the bolts in sequence as shown to the specified torque. Refer to EM-84, "Exploded View".
NOTE:
Bolts are initially installed at positions 1 and 2; Positions 3 and 4 are then tightened to specification.

⇦ : Front



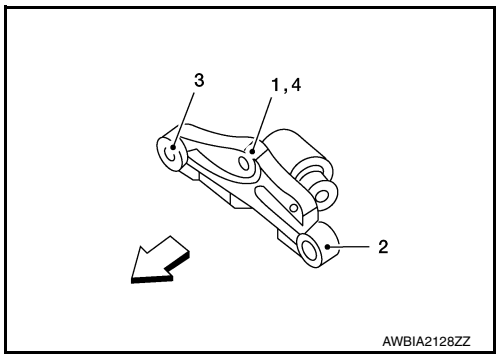
4. Install the engine support bracket (RH) as follows:
a. Temporarily tighten the bolts.
b. Tighten the bolts in sequence as shown to the specified torque. Refer to EM-84, "Exploded View".
NOTE:
Bolt is initially installed at position 1; Positions 2 - 6 are then tightened to specification.

⇦ : Front



5. Install the rear engine mount torque rod bracket as follows:
a. Temporarily tighten the bolts.
b. Tighten the bolts in sequence as shown to the specified torque. Refer to EM-84, "Exploded View".
NOTE:
Bolt is initially installed at position 1; Positions 2 - 4 are then tightened to specification.

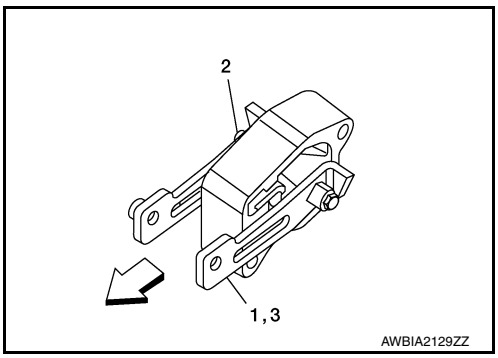
⇦ : Front



6. Install the rear engine mount torque rod as follows:

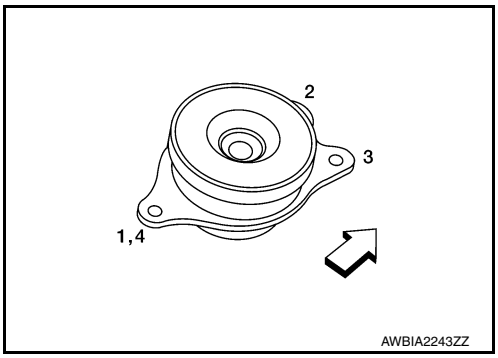
a. Temporarily tighten the bolts.
b. Tighten the bolts in sequence as shown to the specified torque. Refer to EM-84, "Exploded View".
NOTE:
Bolt is initially installed at position 1; Positions 2 and 3 are then tightened to specification.

⇦ : Front



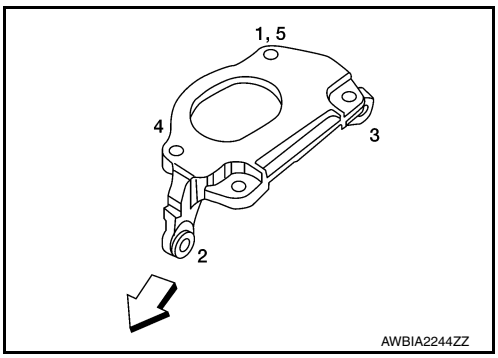
7. Install the engine mounting insulator (LH) as follows:
a. Temporarily tighten the bolts.
NOTE:
Bolt is initially installed at position 1; Positions 2 - 3 are then tightened to specification. Refer to EM-84, "Exploded View".
b. Tighten the bolts in sequence as shown to the specified torque.

⇦ : Front



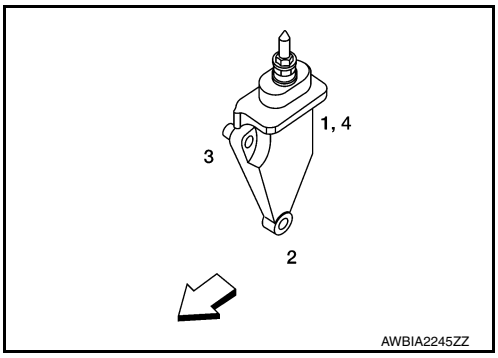
8. Install the engine mounting bracket (LH) as follows:
a. Temporarily tighten the bolts.
b. Tighten the bolts in sequence as shown to the specified torque. Refer to EM-84, "Exploded View".
NOTE:
Bolt is initially installed at position 1; Positions 2 - 5 are then tightened to specification.

⇦ : Front



9. Install the transmission mounting bracket as follows:
a. Temporarily tighten the bolts.
b. Tighten the bolts in sequence as shown to the specified torque. Refer to EM-84, "Exploded View".
NOTE:
Bolt is initially installed at position 1; Positions 2 - 4 are then tightened to specification.

⇦ : 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	Leaks	Level
Engine oil		Level	Leaks	Level
Transmission/ transaxle fluid	A/T and CVT Models	Leaks	Level/Leaks	Leaks
	M/T Models	Level/Leaks	Leaks	Level/Leaks
Other oils and fluids*		Level	Leaks	Level
Fuel		Leaks	Leaks	Leaks
Exhaust gas		—	Leaks	—

*Power steering fluid, brake fluid, etc.

UNIT DISASSEMBLY AND ASSEMBLY

CYLINDER BLOCK

Setting

INFOID:0000000012601988

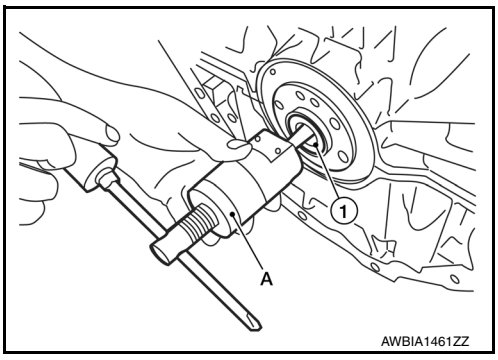
NOTE:
Explained here is how to disassemble with engine stand supporting transaxle surface. When using a different type of engine stand, note difference in steps, etc.

1. Remove engine and transaxle assembly from vehicle, and separate transaxle from engine. Refer to EM-85, "Removal and Installation".
2. Install engine to engine stand with the following procedure:

a. Remove reinforcement plate. Refer to EM-91, "Exploded View".

b. Remove drive plate.
- Secure drive plate using suitable tool and remove bolts using suitable tool.

c. Remove pilot converter (1) from the rear end of the crankshaft using suitable tool (A) (if necessary).

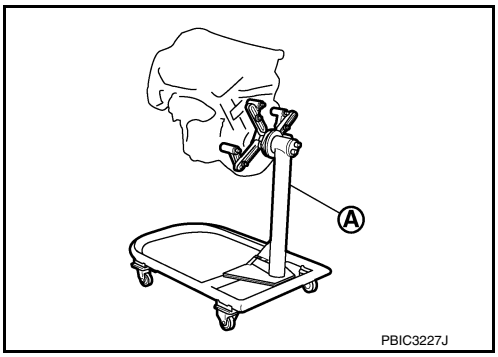


d. Lift the engine with a hoist to install it onto widely used engine stand.

CAUTION:
- **Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.**
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
- Intake manifold: Refer to EM-30, "Removal and Installation".
- Exhaust manifold: Refer to EM-33, "Removal and Installation".
- Rocker cover: Refer to EM-46, "Removal and Installation".

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

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



Exploded View

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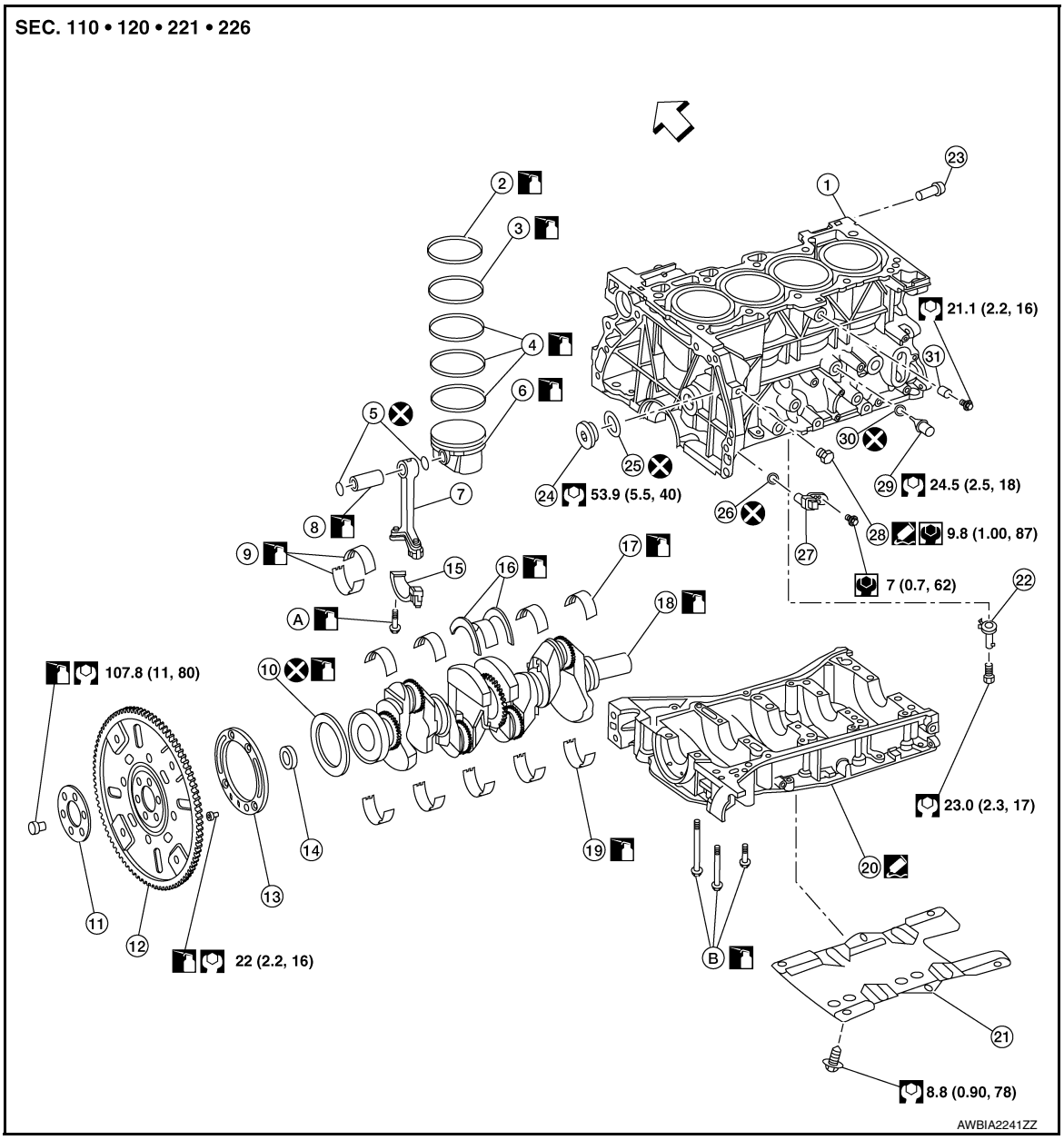


1. Cylinder block
2. Top ring
3. Second ring
4. Oil ring
5. Snap ring
6. Piston
7. Connecting rod
8. Piston pin
9. Connecting rod bearing
10. Rear oil seal
11. Reinforcement plate
12. Drive plate
13. Signal plate
14. Pilot converter
15. Connecting rod bearing cap
16. Thrust bearing
17. Main bearing (upper)
18. Crankshaft
19. Main bearing (lower)
20. Lower cylinder block
21. Baffle plate
22. Oil jet
23. Block heater (for Canada)
24. Drain plug
25. O-ring
26. O-ring
27. Crankshaft position sensor (POS)
28. Drain plug
29. Oil temperature sensor
30. O-ring
31. Knock sensor
A. Refer to INSTALLATION
B. Refer to INSTALLATION

⇦ Front

Disassembly and Assembly

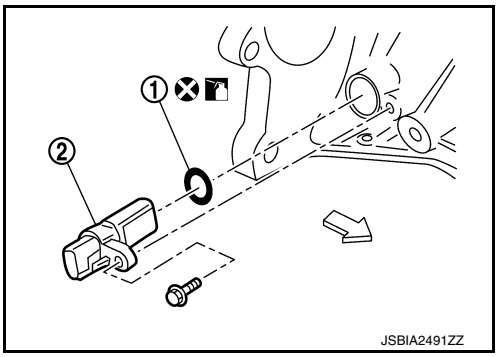
INFOID:0000000012601990

DISASSEMBLY

1. Remove rear oil seal from crankshaft.
   CAUTION:
   Do not damage the crankshaft or cylinder block when removing the rear main seal.
2. Mount the engine on a suitable engine stand. Refer to EM-90, "Setting".
3. Drain any remaining engine oil and engine coolant (if necessary).
4. Remove drain plugs from cylinder block.
5. Remove cylinder head. Refer to EM-74, "Removal and Installation".
6. Remove block heater (for Canada). Refer to EM-91, "Exploded View".
7. Remove oil cooler. Refer to LU-17, "Removal and Installation".
8. Remove knock sensor.
   CAUTION:
   Carefully handle knock sensor avoiding shocks.
9. Remove crankshaft position sensor (POS) (2).

   (1) : O-ring
   ⇦ : Engine front

   CAUTION:
   - **Avoid impacts such as dropping.**
   - **Do not disassemble.**
   - **Keep crankshaft position sensor (POS) away from metal particles.**
   - **Do not place crankshaft position sensor (POS) in a location where it is exposed to magnetism.**



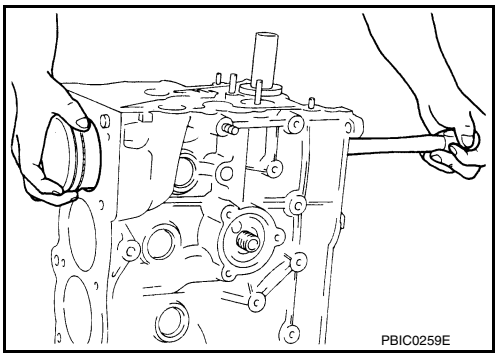
10. Remove oil temperature sensor.
    CAUTION:
    Do not reuse O-ring.
11. Remove piston and connecting rod assembly with the following procedure:
    - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-99, "Inspection".

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

b. Remove connecting rod cap. Number connecting rod caps so they can be assembled in the same position and direction.

c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to cylinder head side.
   CAUTION:
   - **Do not damage matching surface with connecting rod cap.**
   - **Do not damage cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.**

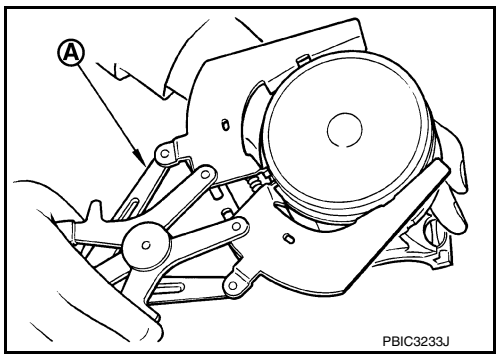
   NOTE:
   Number the pistons and rods so they can be installed in the same position.



12. Remove connecting rod bearings.
    CAUTION:
    When removing them note the installation position. Keep them in the correct order.
13. Remove piston rings from piston.
    - Before removing piston rings check the piston ring side clearance. Refer to EM-99, "Inspection".

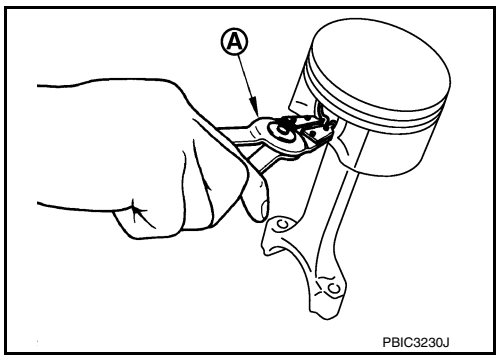
- Remove piston rings using suitable tool (A).

CAUTION:
- **When removing piston rings, do not damage the piston.**
- **Do not damage piston rings by expanding them excessively.**

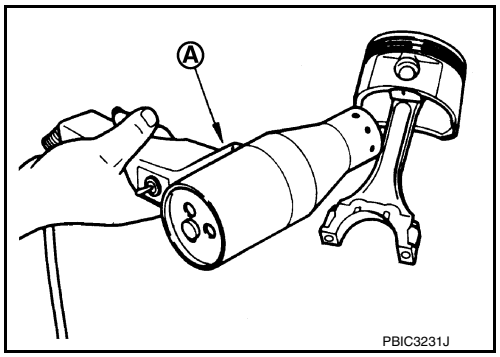


14. Remove piston from connecting rod using the following procedure:

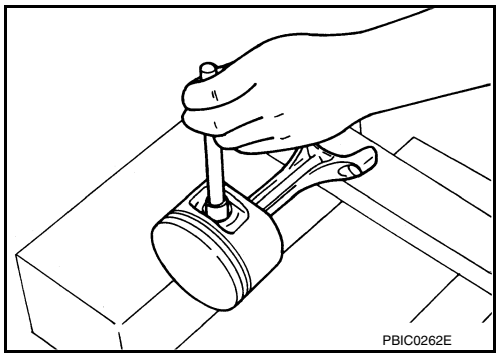
a. Remove snap rings using snap ring pliers (A).



b. Heat piston to 60°C to 70°C (140°F to 158°F) with a heat gun (A).



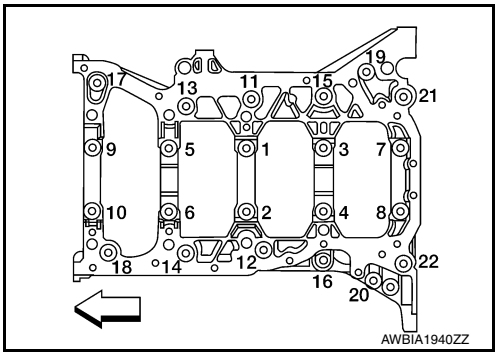
c. Push out piston pin using a suitable tool.



15. Remove lower cylinder block using the following procedure:
- Measure crankshaft end play before loosening lower cylinder block bolts. Refer to EM-99, "Inspection".

a. Remove baffle plate. Refer to EM-91, "Exploded View".

b. Loosen and remove lower cylinder block bolts in reverse order as shown.



c. Remove the lower cylinder block using Tool (A).

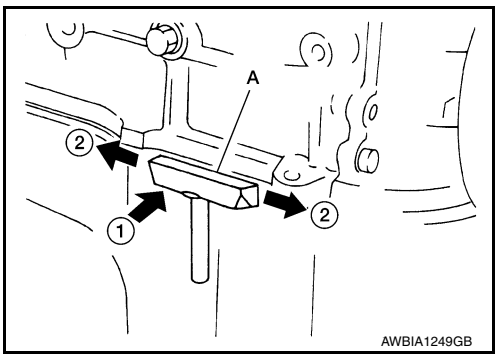
CAUTION:

Do not damage the mating surfaces.

NOTE:

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

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

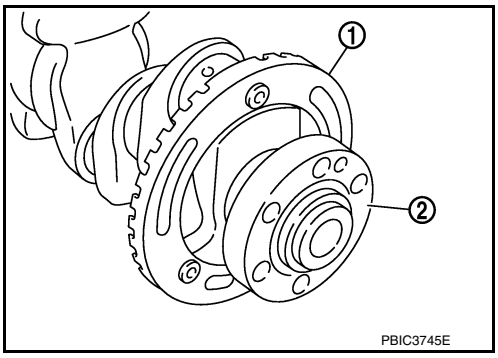


d. Remove the lower cylinder block while tapping lightly with a plastic hammer.

16. Remove crankshaft (2).

CAUTION:

- **Do 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 contact between signal plate and floor surface.**
- **Do not remove signal plate unless it is necessary.**



17. Remove main bearing (upper and lower) and thrust bearings from cylinder block and lower cylinder block.

CAUTION:

When removing bearings note the installation position. Keep them in the correct order.

NOTE:

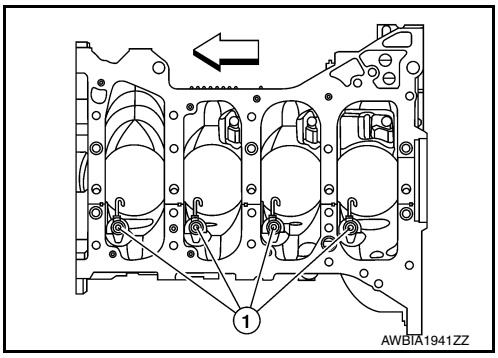
When removing the rear oil seal without removing the cylinder block, use a suitable tool to pull it out between the crankshaft and block.

18. Remove oil jets (1) from cylinder block (if necessary).

⇦ : Engine front

CAUTION:

When removing oil jet assemblies note the installation position. Keep them in the correct order.



ASSEMBLY

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

CAUTION:

Use goggles to protect your eyes.

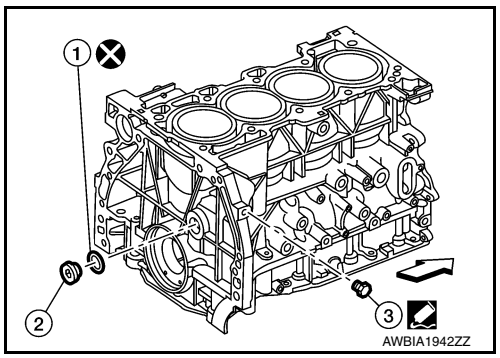
2. Install drain plugs to cylinder block as shown.

CAUTION:

Do not reuse washer (1).

- Apply liquid gasket to the threads of drain plug (3).
  Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
  NOTE:
  Do not apply liquid gasket to the thread of plug (2).

⇦ : Engine front



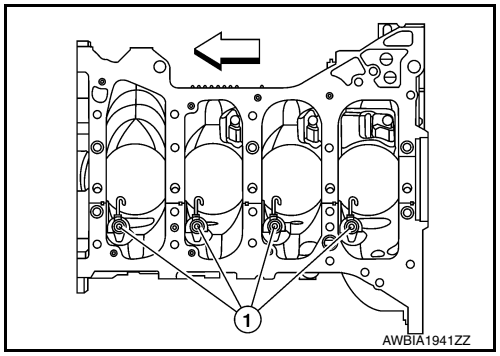
- Tighten each plug as specified below.

Part	Washer	Tightening torque
2	Yes	53.9 N·m (5.5 kg-m, 40 ft-lb)
3	No	9.8 N·m (1.00 kg-m, 17 in-lb)

3. Install oil jets (1).

⇦ : Engine front

Oil jets (1) : 23 N·m (2.3 kg-m, 17 ft-lb)



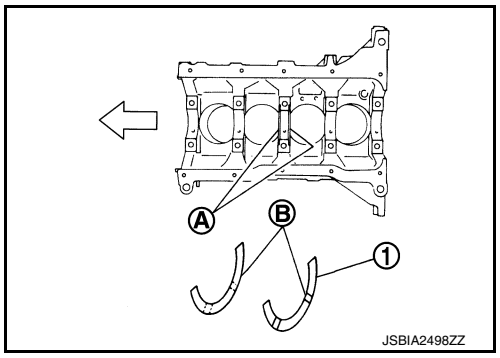
4. Install main bearings and thrust bearings using following procedure:

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

b. Install thrust bearings (1) to both sides of the No. 3 journal (A) housing on cylinder block.

⇦ : Engine front

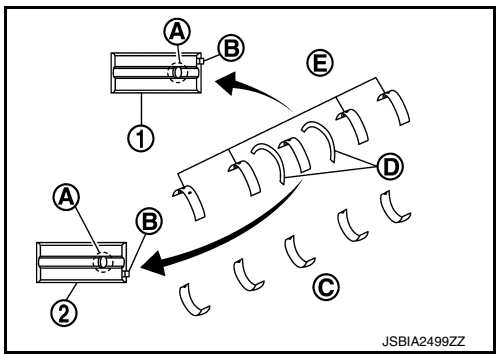
- Install thrust bearings with the oil groove (B) facing crankshaft arm (outside).



c. Install the main bearings paying attention to the direction.
- Main bearing with an oil hole and groove (E) goes on cylinder block. The one without them (C) goes on lower cylinder block.
- Only main bearing (on cylinder block) for No. 3 journal (2) has different specifications.

(1) : Journal other than no. 3
(D) : Thrust bearings

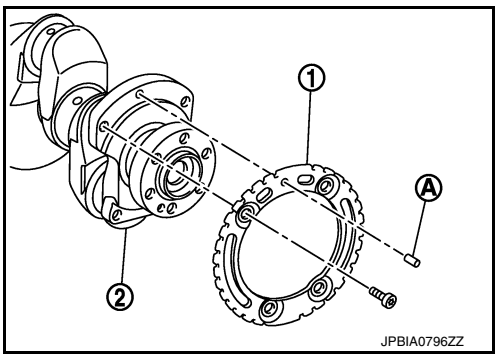
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- When installing, align main bearing stopper (B) to the notch.
- Ensure the oil holes (A) on cylinder block and those on the corresponding bearing are aligned.



5. Install signal plate to crankshaft (if removed). Refer to EM-91, "Exploded View".

a. Set the signal plate with flange facing toward the counterweight side (engine front side).

b. After positioning crankshaft (2) and signal plate (1) with positioning dowel pin (A), tighten bolts.



(1) : Signal plate
(2) : Crankshaft
(A) : Dowel pin (used to position the signal plate)

c. Remove dowel pin.
CAUTION:
Be sure to remove dowel pin.

6. Install crankshaft to cylinder block.
• While turning crankshaft by hand, check that it turns smoothly.
CAUTION:
Do not install rear oil seal yet.

7. Install lower cylinder block with the following procedure:

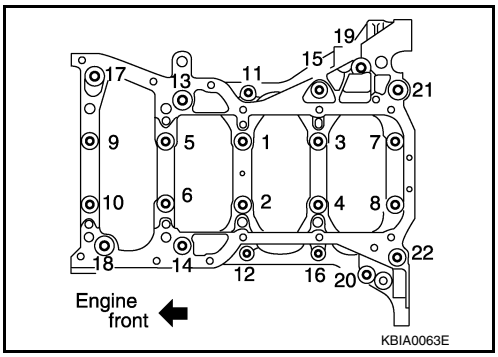
a. Apply liquid gasket with a suitable tool to lower cylinder block.
Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

(B) : Apply liquid gasket to an end
(a) : 4.0 - 5.0 mm (0.157- 0.197 in)

NOTE:
Lower cylinder block cannot be replaced as a single part because it is machined together with cylinder block.

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

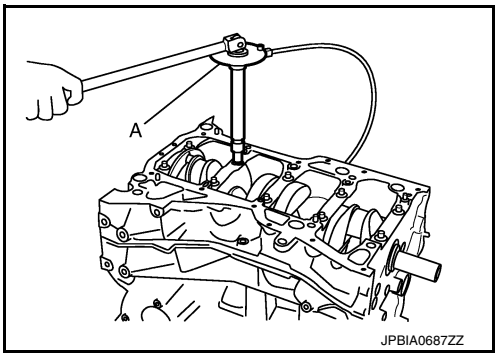
c. Tighten lower cylinder block bolts to specification in the numerical order as shown.



d. Tighten bolts to specification using suitable tool and Tool (A).
CAUTION:
Check tightening angle. Do not judge angle by visual inspection.

Step 1, bolts 11 - 22 only : 25.1 N·m (2.6 kg-m, 19 ft-lb)
Step 2, bolts 1 - 10 only : 39.2 N·m (4.0 kg-m, 29 ft-lb)
Step 3, bolts 1 - 10 only : 60°degrees rotation

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



e. Install rear oil seal. Refer to EM-72, "REAR OIL SEAL : Removal and Installation".

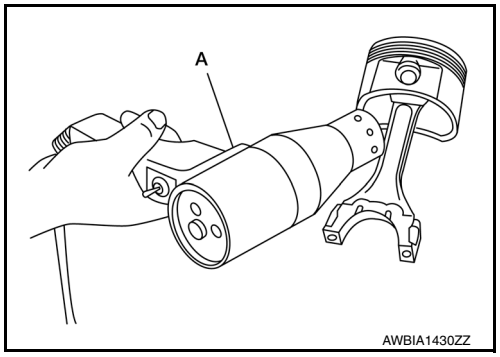
f. Install baffle plate. Refer to EM-91, "Exploded View".
• After installing bolts, check that crankshaft can be rotated smoothly by hand.
• Wipe off completely any protruding liquid gasket on front side of engine.
• Check crankshaft end play. Refer to EM-99, "Inspection".

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

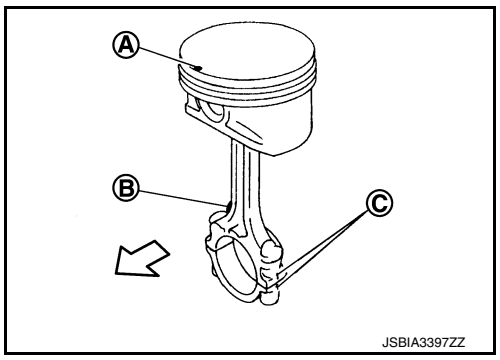
a. Install new snap ring to the groove of the piston rear side using snap ring pliers.
- Insert it fully into groove to install.

CAUTION:
Do not reuse snap rings.

b. Assemble piston to connecting rod.
- Using a heat gun, heat piston until piston pin can be pushed in by hand without excess force [approximately 60°C to 70°C (140°F to 158°F)]. From the front to the rear, insert piston pin into piston and connecting rod.



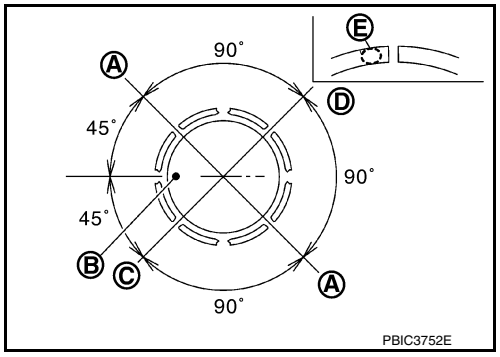
- Set so that the front mark (A) on the piston head, the oil splash (B) and the cylinder number (C) on connecting rod are positioned as shown.



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

9. Install piston rings using suitable tool.
- Position each ring with the gap as shown referring to the piston front mark (B).

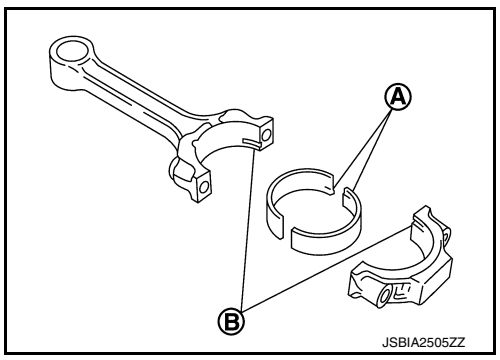
(A) : Oil ring upper or lower rail gap (either of them)
(C) : Second ring and oil ring spacer gap
(D) : Top ring gap



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

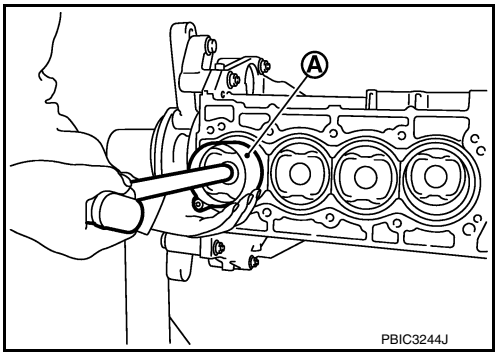
CAUTION:
- **Do not damage piston.**
- **Do not damage piston rings by expanding them excessively.**
- **Do not contact rail end gap under oil ring with oil drain cast groove of piston.**

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.
- When installing, align the connecting rod bearing stopper protrusion (A) with the cutout (B) of connecting rod and connecting rod cap to install.
- Ensure the oil hole on connecting rod and that on the corresponding bearing are aligned.



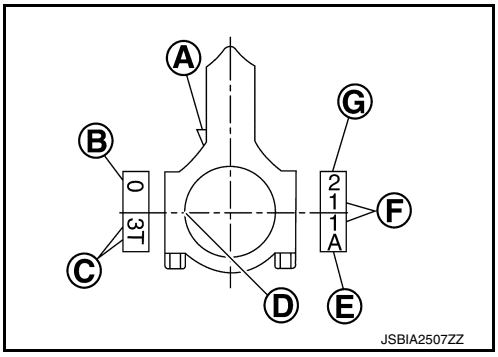
11. Install piston and connecting rod assembly to crankshaft.
    - Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
    - Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
    - Match the cylinder position with the cylinder number on connecting rod to install.
    - Using a suitable tool (A), install piston with the front mark on the piston head facing the front of the engine.

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



12. Install connecting rod cap.
    - Match the stamped cylinder number marks on connecting rod with those on connecting rod cap to install.

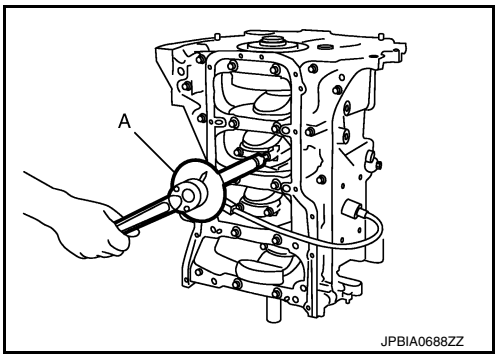
    (A) : Oil splash
    (B) : Small end diameter grade
    (C) : Production control number
    (D) : Bearing stopper groove
    (E) : Production control number
    (F) : Cylinder number
    (G) : Big end diameter grade



13. Tighten connecting rod bolts using Tool (A) with the following procedure:
    - Apply engine oil to the threads and seats of the connecting rod bolts.

    CAUTION:
    Check tightening angle. Do not judge angle by visual inspection.

    Step 1 : 27.4 N·m (2.8 kg-m, 20 ft-lb)
    Step 2 : 0 N·m
    Step 3 : 19.6 N·m (2.0 kg-m, 14 lb-ft)
    Step 4 : Rotate bolts 90° + 0.5°

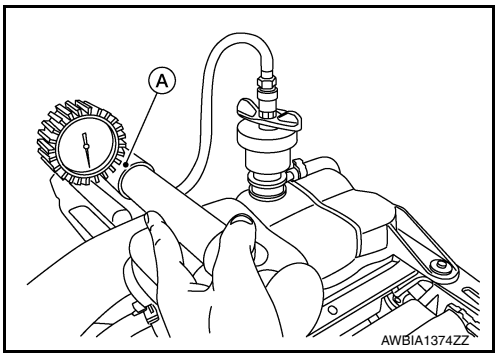


    Tool number (A) : KV10112100 (BT-8653-A)

    - After tightening connecting rod bolts, check that crankshaft rotates smoothly.
    - Check the connecting rod side clearance. Refer to EM-99, "Inspection".

14. Install drive plate (2). Refer to EM-91, "Exploded View".
    - Install drive plate (2), reinforcement plate (3) and pilot converter (4) as shown.
    - Using a drift with 33 mm (1.30 in) diameter, push pilot converter (4) into the end of the crankshaft (1).

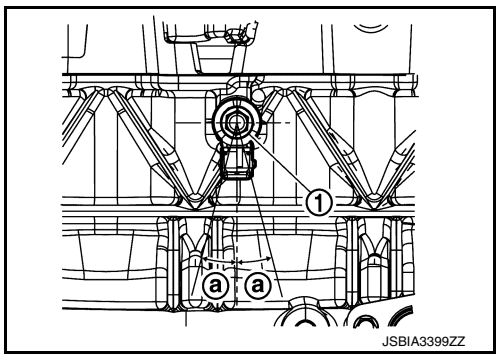
    (A) : Rounded
    (B) : Chamfered



15. Install knock sensor (1). Refer to EM-91, "Exploded View".
    - Install knock sensor with connector facing 180° +/- 15° (a) as shown.

    CAUTION:
    - **Do not tighten bolts while holding 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.



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16. Install oil temperature sensor. Refer to EM-91, "Exploded View".
17. Install crankshaft position sensor (POS). Refer to EM-91, "Exploded View".
18. Assembly of remaining components is in the reverse order of disassembly.

Inspection

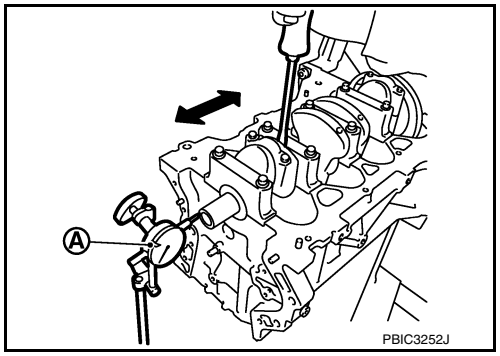
INFOID:0000000012601991

CRANKSHAFT END PLAY

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

Standard and Limit : Refer to EM-113, "Standard and Limit".

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



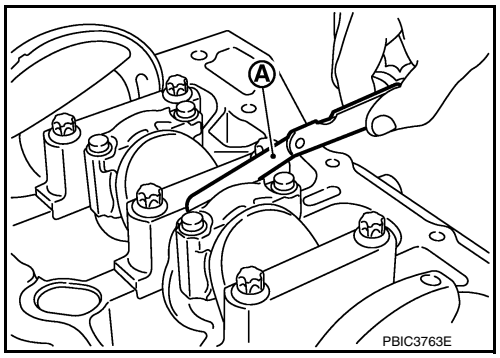
PBIC3252J

CONNECTING ROD SIDE CLEARANCE

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

Standard and Limit : Refer to EM-113, "Standard and Limit".

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



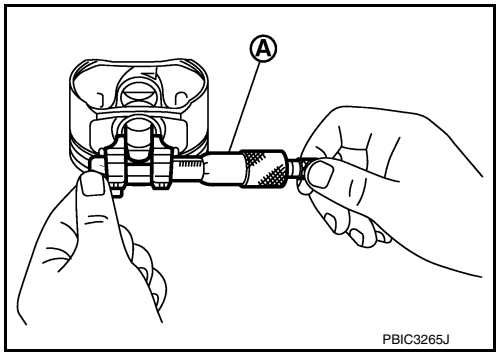
PBIC3763E

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

- Measure inner diameter of piston pin hole using suitable tool (A).

Standard : Refer to EM-113, "Standard and Limit".

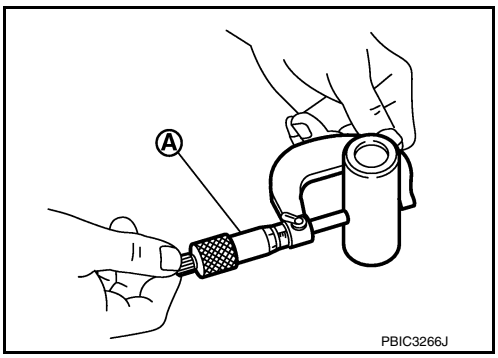


PBIC3265J

Piston Pin Outer Diameter

• Measure outer diameter of piston pin using suitable tool (A).

Standard : Refer to EM-113, "Standard and Limit".



Piston to Piston Pin Oil Clearance

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

Standard : Refer to EM-113, "Standard and Limit".

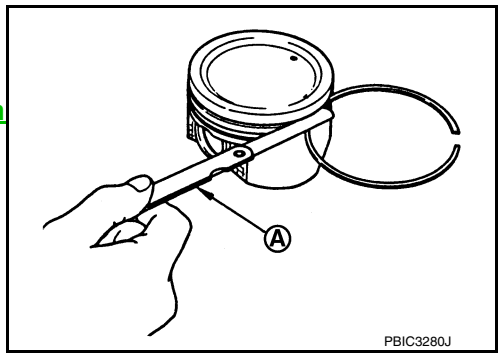
• If oil clearance value exceeds the limit replace piston and piston pin assembly.

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

PISTON RING SIDE CLEARANCE

• Measure side clearance of piston ring and piston ring groove using suitable tool (A).

Standard and Limit : Refer to EM-113, "Standard and Limit".



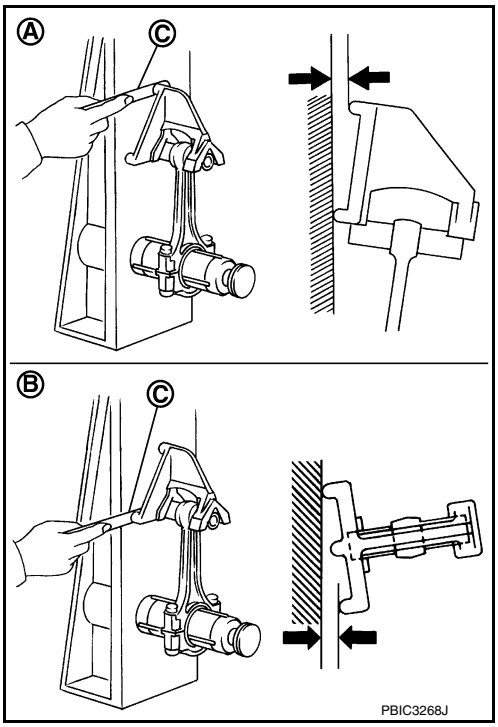
• If measured value exceeds limit replace piston ring and measure again. If value still exceeds the limit replace piston.

CONNECTING ROD BEND AND TORSION

• Check with a connecting rod aligner.

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

Limit : Refer to EM-113, "Standard and Limit".

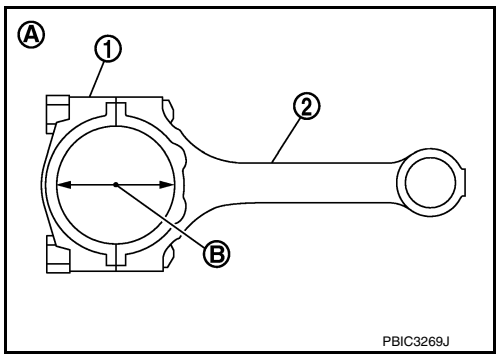


• If measured value exceeds limit replace connecting rod assembly.

CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap (1) without connecting rod bearing installed and tighten connecting rod bolts. Refer to EM-92, "Disassembly and Assembly".

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



- Measure inner diameter of connecting rod big end using suitable tool.

Standard : Refer to EM-113, "Standard and Limit".

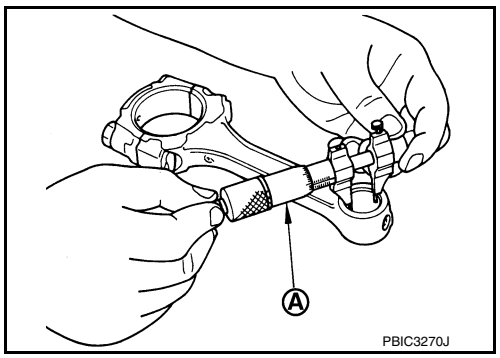
- If measured value exceeds standard replace connecting rod assembly.

CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

- Measure inner diameter of connecting rod bushing using suitable tool (A).

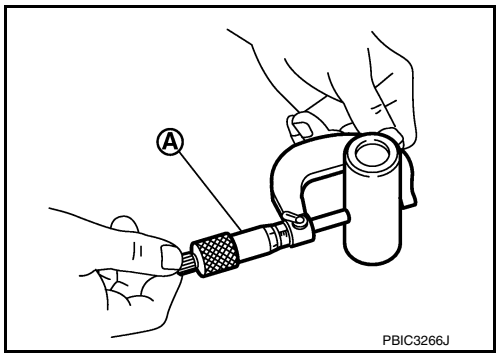
Standard : Refer to EM-113, "Standard and Limit".



Piston Pin Outer Diameter

- Measure outer diameter of piston pin using suitable tool (A).

Standard : Refer to EM-113, "Standard and Limit".



Connecting Rod Bushing Oil Clearance

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

Standard : Refer to EM-113, "Standard and Limit".

- If measured value exceeds standard replace connecting rod assembly and/or piston and piston pin assembly.

CYLINDER BLOCK TOP SURFACE DISTORTION

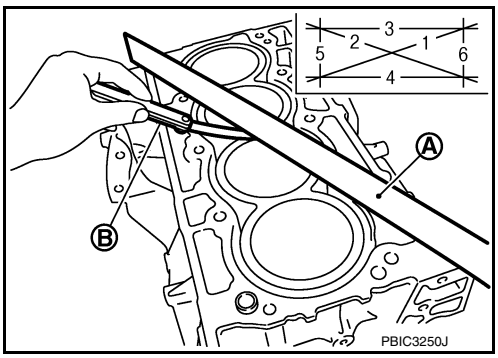
- Remove gasket on the cylinder block surface and also remove engine oil, scale, carbon and other contamination using suitable tool.

CAUTION:
Do not allow gasket flakes to enter engine oil or engine coolant passages.

- Measure distortion on cylinder block upper face at some different points in six directions using suitable tools (A/B).

Limit : Refer to EM-113, "Standard and Limit".

- If measured value exceeds standard replace cylinder block.



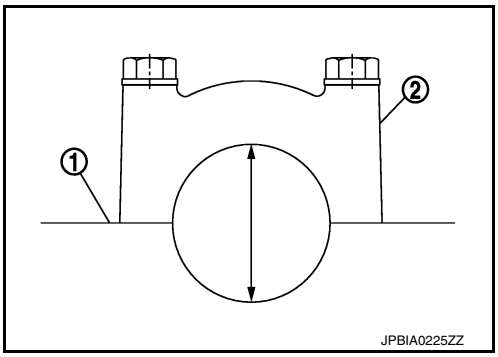
MAIN BEARING HOUSING INNER DIAMETER

- Install lower cylinder block without main bearings installed and tighten lower cylinder block bolts. Refer to EM-92, "Disassembly and Assembly".
- Measure inner diameter of main bearing housing using suitable tool.

Standard : Refer to EM-113, "Standard and Limit".

- If measured value exceeds standard replace cylinder block (1) and lower cylinder block (2) assembly.

NOTE:
Lower cylinder block cannot be replaced as a single unit because it is machined together with cylinder block.



PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

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

(f) : 10 mm (0.39 in)
(g) : 75 mm (2.95 in)
(h) : 140 mm (5.51 in)

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

Standard:

Cylinder bore inner diameter

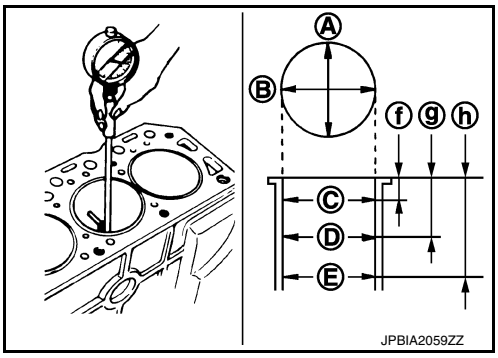
: Refer to EM-113, "Standard and Limit".

Limit:

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

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

: Refer to EM-113, "Standard and Limit".

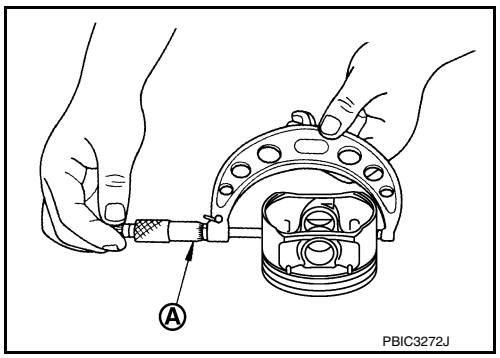


- If measured value exceeds limit or if there are scratches and/or seizure on the cylinder inner wall hone or re-bore the cylinder inner wall.

Piston Skirt Diameter

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

Standard : Refer to EM-113, "Standard and Limit".



Piston to Cylinder Bore Clearance

- (Piston to cylinder bore clearance) = (Cylinder bore inner diameter) - (Piston skirt diameter)

Standard and Limit : Refer to EM-113, "Standard and Limit".

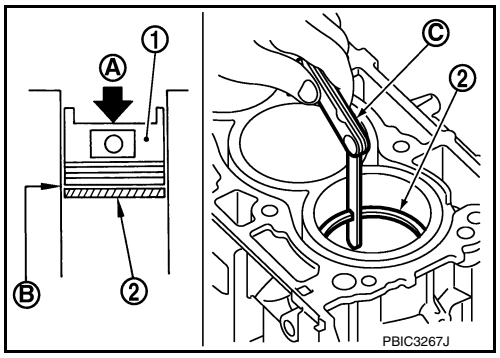
- If measured value exceeds limit replace piston and piston pin assembly..

PISTON RING END GAP

- Check that cylinder bore inner diameter is within standards.
- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert (A) piston ring to middle of cylinder (B) with piston and measure piston ring end gap using suitable tool (C).

Standard and Limit : Refer to EM-113, "Standard and Limit".

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

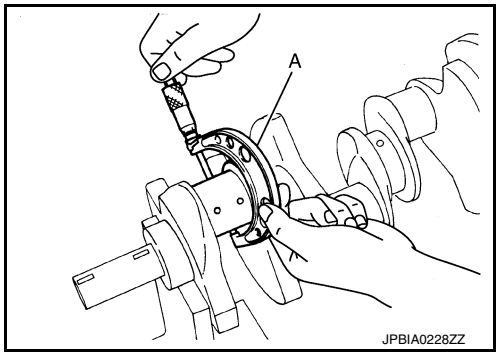


CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure outer diameter of crankshaft main journals using suitable tool (A).

Standard : Refer to EM-113, "Standard and Limit".

- If measured value exceeds limit measure the main bearing oil clearance and use undersize bearing.



CRANKSHAFT PIN JOURNAL DIAMETER

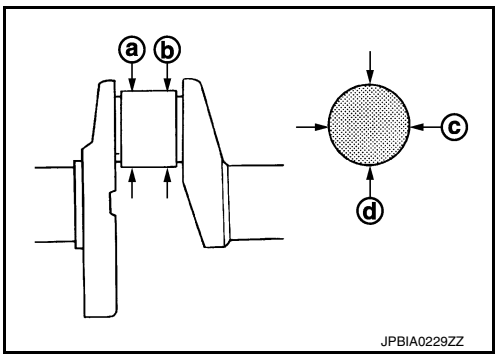
- Measure outer diameter of crankshaft pin journal using suitable tool.

Standard : Refer to EM-113, "Standard and Limit".

- If measured value exceeds limit measure connecting rod bearing oil clearance and use undersize bearing.

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Measure dimensions at four different points as shown on each main journal and pin journal using suitable tool.
- Out-of-round is indicated by the difference in dimension between (a) and (b) at (c) and (d).
- Taper is indicated by difference in dimension between (c) and (d) at (a) and (b).



Limit:

Out-of-round [Difference between (a) and (b)]

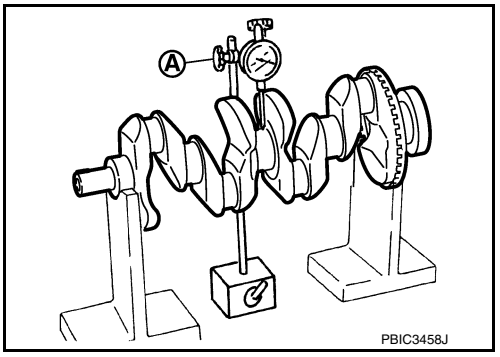
Taper [Difference between (c) and (d)]

: Refer to EM-113, "Standard and Limit".

- If measured value exceeds limit correct or replace crankshaft.
- If corrected, measure bearing oil clearance of corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing.

CRANKSHAFT RUNOUT

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



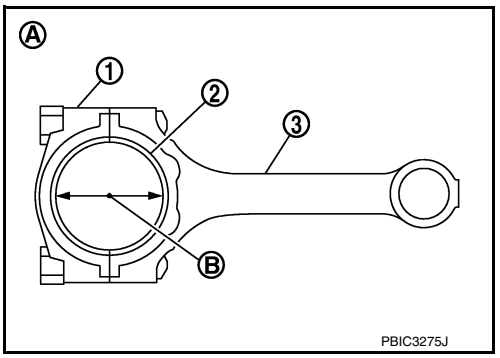
Limit : Refer to EM-113, "Standard and Limit".

- If measured value exceeds limit replace crankshaft.

CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

- Install connecting rod bearings (2) to connecting rod (3) and connecting rod bearings cap (1) and tighten connecting rod bolts. Refer to EM-92, "Disassembly and Assembly".



(A) : Example

- Measure inner diameter (B) of connecting rod bearing using suitable tool.
- (Bearing oil clearance) = (Connecting rod bearing inner diameter) - (Crankshaft pin journal diameter)

Standard and Limit : Refer to EM-113, "Standard and Limit".

- If measured value exceeds limit select proper connecting rod bearing. Use connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance.

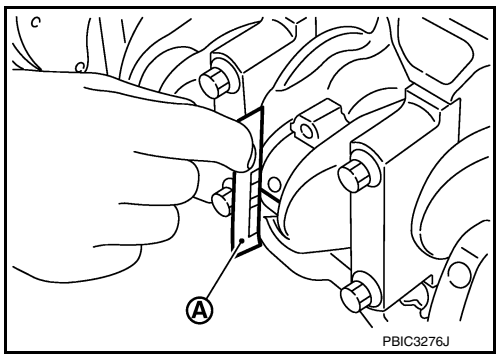
Method by Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut plastigage slightly shorter than bearing width and place it in crankshaft axial direction avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap and tighten connecting rod bolts. Refer to EM-92, "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

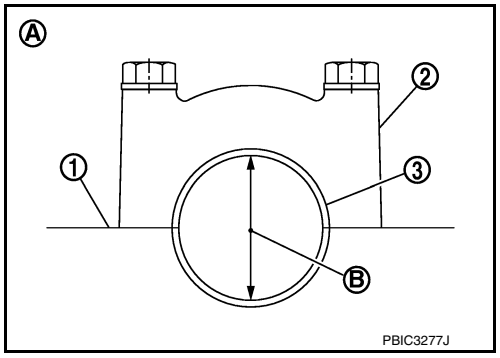
Method by Calculation

- Install main bearings (3) to cylinder block (1) and lower cylinder block (2) and tighten lower cylinder block bolts. Refer to EM-92, "Disassembly and Assembly".

  (A) : Example

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

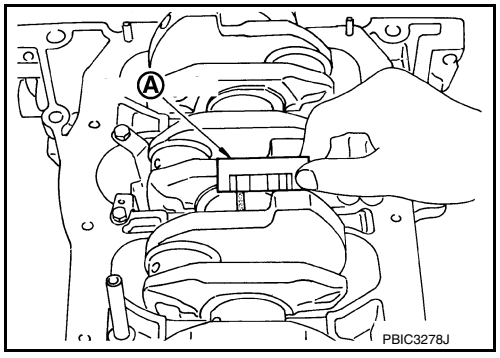
Standard and Limit : Refer to EM-113, "Standard and Limit".



- If measured value exceeds limit select proper main bearing. Use main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to EM-92, "Disassembly and Assembly".

Method by Using Plastigage

- Remove engine oil and dust on crankshaft main journal and surfaces of each bearing completely.
- Cut plastigage slightly shorter than bearing width and place it in crankshaft axial direction avoiding oil holes.
- Install main bearings on cylinder block and lower cylinder block and tighten lower cylinder block bolts. Refer to EM-92, "Disassembly and Assembly".
  CAUTION:
  Do not rotate crankshaft.
- Remove lower cylinder block and bearings and using the scale (A) on the plastigage bag measure the plastigage width.
  NOTE:
  The procedure when measured value exceeds the limit is same as that described in “Method by Calculation”.



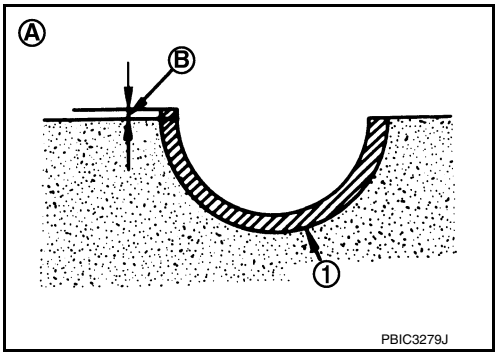
MAIN BEARING CRUSH HEIGHT

- When lower cylinder block is removed after being tightened to specified torque with main bearings (1) installed, tip end of bearing must protrude (B). Refer to EM-92, "Disassembly and Assembly".

(A) : Example

Standard: There must be crush height.

- If standard is not met, replace main bearings.



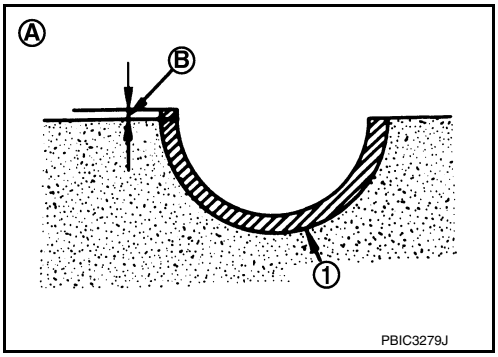
CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod bearing cap is removed after being tightened to specified torque with connecting rod bearings (1) installed, tip end of bearing must protrude (B). Refer to EM-92, "Disassembly and Assembly".

(A) : Example

Standard: There must be crush height.

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

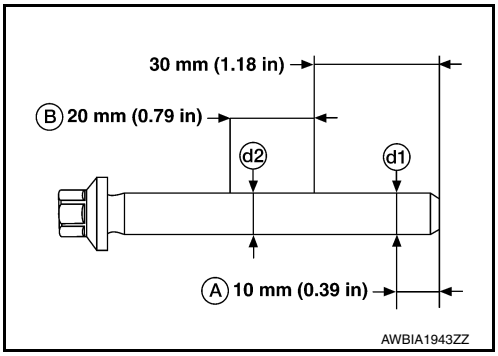


LOWER CYLINDER BLOCK BOLT OUTER DIAMETER

- Measure outer diameters (d1) and (d2) at two positions as shown.
- If reduction appears in (B) range, regard it as (d_2).

Limit [(d_1) - (d_2)]: 0.13 mm (0.0051 in)

- If measured value exceeds limit (a large difference in dimensions) replace lower cylinder block bolt with new one.

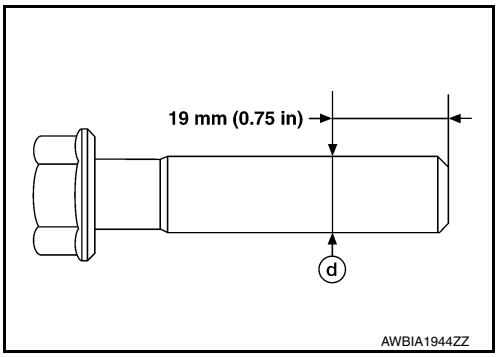


CONNECTING ROD BOLT OUTER DIAMETER

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

Limit: 7.75 mm (0.3051 in)

- If measured value exceeds limit (large difference in dimensions) replace connecting rod bolt with new one.



HOW TO SELECT PISTON AND BEARING

How to Select Piston and Bearing

INFOID:0000000012601992

DESCRIPTION

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

*For the service parts, the grade for fitting cannot be selected between a piston pin and a connecting rod. (Only 0 grade is available.) The information at the shipment from the plant is described as a reference.

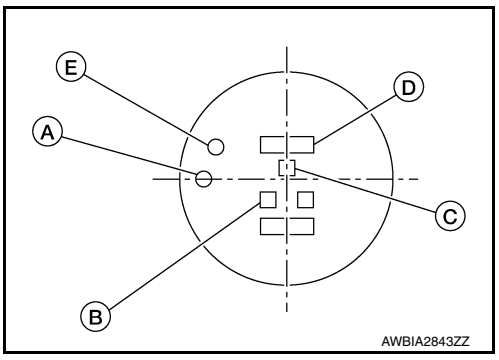
- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.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

HOW TO SELECT A PISTON

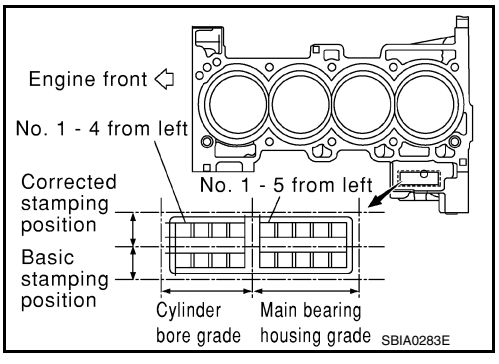
When New Cylinder Block is Used:

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

(A) : Front mark
(B) : Piston pin bore grade
(C) : Piston grade I.D. stamp
(D) : Piston crown I.D. code stamp
(E) : ID marks



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



When a Cylinder Block is Reused:

1. Measure the cylinder block bore inner diameter.
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table". Select the piston of the same grade.

Piston Selection Table

• For the piston selection table, refer to EM-113, "Standard and Limit".

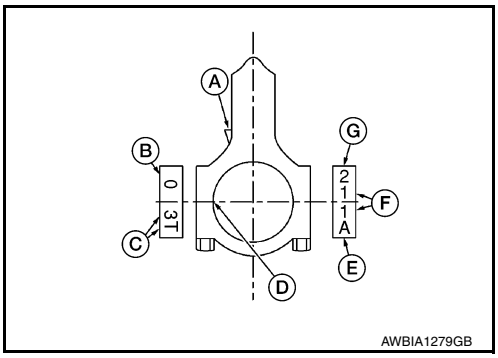
NOTE:

• The piston is available together with piston pin as an assembly.
• The piston pin (piston pin bore) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. Only 0 grade is available.

HOW TO SELECT A CONNECTING ROD BEARING

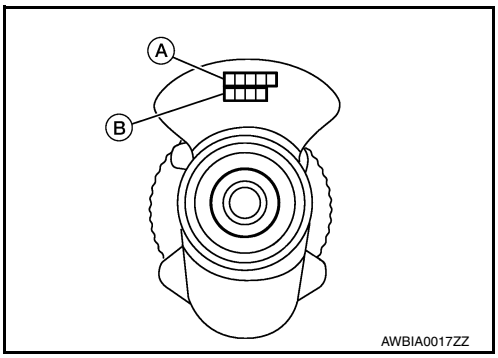
When New Connecting Rod and Crankshaft are Used:

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



(A) : Oil splash
(B) : Small end diameter grade
(C) : Reference code
(D) : Bearing stopper groove
(E) : Reference code
(F) : Cylinder No.
(G) : Big end diameter grade

2. Apply pin diameter grade (B) stamped on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".
   • Journal diameter grade (A)
3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to connecting rod bearing grade table to select.



When Crankshaft and Connecting Rod are Reused:

1. Measure dimensions of the big end inner diameter of connecting rod and outer diameter of crankshaft pin individually.
2. Apply the dimension measured to the "Connecting Rod Bearing Selection Table" below.

Connecting Rod Bearing Selection Table

Connecting rod blg end. inner diameter / Crankshaft pin outer diameter	Mark	0	1	2	3	4	5	6	7	8	9	A	B	C
Mark	Outer diameter Unit: mm (in)	Inner diameter Unit: mm (in)												
		48. 000 - 48. 001 (1. 8898 - 1. 8898)	48. 001 - 48. 002 (1. 8898 - 1. 8898)	48. 002 - 48. 003 (1. 8898 - 1. 8899)	48. 003 - 48. 004 (1. 8899 - 1. 8899)	48. 004 - 48. 005 (1. 8899 - 1. 8900)	48. 005 - 48. 006 (1. 8890 - 1. 8900)	48. 006 - 48. 007 (1. 8890 - 1. 8900)	48. 007 - 48. 008 (1. 8890 - 1. 8901)	48. 008 - 48. 009 (1. 8901 - 1. 8901)	48. 009 - 48. 010 (1. 8901 - 1. 8902)	48. 010 - 48. 011 (1. 8902 - 1. 8902)	48. 011 - 48. 012 (1. 8902 - 1. 8902)	48. 012 - 48. 013 (1. 8902 - 1. 8903)
A	44. 974 - 44. 973 (1. 7706 - 1. 7706)	0	0	0	0	01	01	01	1	1	1	12	12	12
B	44. 973 - 44. 972 (1. 7706 - 1. 7705)	0	0	0	01	01	01	1	1	1	12	12	12	2
C	44. 972 - 44. 971 (1. 7705 - 1. 7705)	0	0	01	01	01	1	1	1	12	12	12	2	2
D	44. 971 - 44. 970 (1. 7705 - 1. 7705)	0	01	01	01	1	1	1	12	12	12	2	2	2
E	44. 970 - 44. 969 (1. 7705 - 1. 7704)	01	01	01	1	1	1	12	12	12	2	2	2	23
F	44. 969 - 44. 968 (1. 7704 - 1. 7704)	01	01	1	1	1	12	12	12	2	2	2	23	23
G	44. 968 - 44. 967 (1. 7704 - 1. 7704)	01	1	1	1	12	12	12	2	2	2	23	23	23
H	44. 967 - 44. 966 (1. 7704 - 1. 7703)	1	1	1	12	12	12	2	2	2	23	23	23	3
J	44. 966 - 44. 965 (1. 7703 - 1. 7703)	1	1	12	12	12	2	2	2	23	23	23	3	3
K	44. 965 - 44. 964 (1. 7703 - 1. 7702)	1	12	12	12	2	2	2	23	23	23	3	3	3
L	44. 964 - 44. 963 (1. 7702 - 1. 7702)	12	12	12	2	2	2	23	23	23	3	3	3	34
M	44. 963 - 44. 962 (1. 7702 - 1. 7702)	12	12	2	2	2	23	23	23	3	3	3	34	34
N	44. 962 - 44. 961 (1. 7702 - 1. 7701)	12	2	2	2	23	23	23	3	3	3	34	34	34
P	44. 961 - 44. 960 (1. 7701 - 1. 7701)	2	2	2	23	23	23	3	3	3	34	34	34	4
R	44. 960 - 44. 959 (1. 7701 - 1. 7700)	2	2	23	23	23	3	3	3	34	34	34	4	4
S	44. 959 - 44. 958 (1. 7700 - 1. 7700)	2	23	23	23	3	3	3	34	34	34	4	4	4
T	44. 958 - 44. 957 (1. 7700 - 1. 7700)	23	23	23	3	3	3	34	34	34	4	4	4	4
U	44. 957 - 44. 956 (1. 7700 - 1. 7699)	23	23	3	3	3	34	34	34	4	4	4	4	4

AWBIA0021GB

Connecting Rod Bearing Grade Table. Refer to EM-113, "Standard and Limit".

Undersize Bearing Usage Guide

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

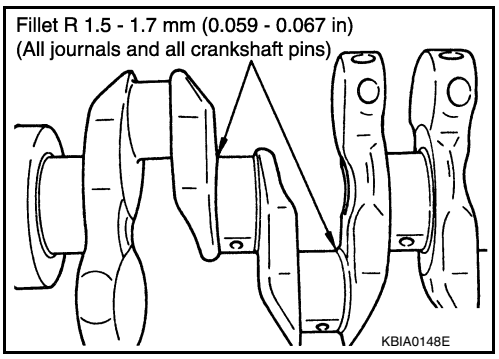
Bearing Undersize Table

Unit: mm (in)

Size U.S.	Thickness
0.25 (0.0098)	1.622 - 1.630 (0.0639 - 0.0642)

CAUTION:

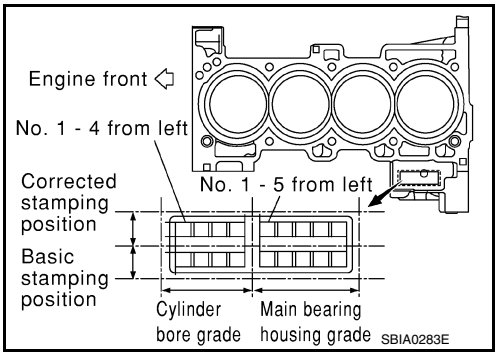
In grinding the crankshaft pin to use undersize bearings, do not damage the fillet R (All crankshaft pins).



HOW TO SELECT A MAIN BEARING

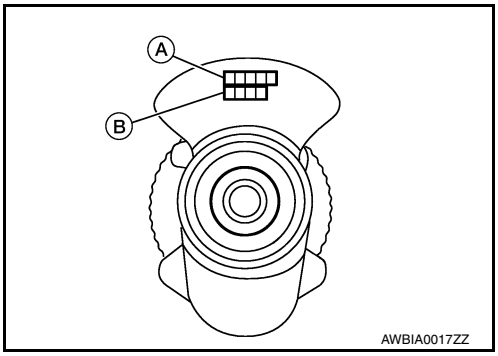
When New Cylinder Block and Crankshaft are Used:

1. "Main Bearing Selection Table" rows correspond to bearing housing grade on rear left side of cylinder block.
   • If there is a corrected stamp mark on the cylinder block, use it as a correct reference.



2. Apply journal diameter grade (A) stamped on crankshaft front side to column in "Main Bearing Selection Table".

   (B) : Pin diameter grade



3. Find value at crossing of row and column in "Main Bearing Selection Table".
   CAUTION:
   • **There are two main bearing selection tables. One is for odd-numbered journals (1, 3, and 5) and the other is for even-numbered journals (2 and 4). Make certain to use the appropriate table. This is due to differences in the specified clearances.**
4. Apply the symbol obtained to "Main Bearing Grade Table" to select.
   NOTE:
   • Service parts are available as a set of both upper and lower.

When Cylinder Block and Crankshaft are Reused:

1. Measure inner diameter of cylinder block main bearing housing and outer diameter of crankshaft journal.
2. Apply measurement in above step 1 to the "Main Bearing Selection Table".
3. Follow steps 3 and 4 in "When New Cylinder Block and Crankshaft are Used".

Main Bearing Selection Table (No.1, 3, and No.5 journals)

Cylinder block main bearing housing inner diameter / Crankshaft journal outer diameter	Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
Mark	Outer diameter Unit: mm (in)	Inner diameter Unit: mm (in)																							
		58.944 – 58.945 (2.3206 – 2.3207)	58.945 – 58.946 (2.3207 – 2.3207)	58.946 – 58.947 (2.3207 – 2.3207)	58.947 – 58.948 (2.3207 – 2.3208)	58.948 – 58.949 (2.3208 – 2.3208)	58.949 – 58.950 (2.3208 – 2.3209)	58.950 – 58.951 (2.3209 – 2.3209)	58.951 – 58.952 (2.3209 – 2.3209)	58.952 – 58.953 (2.3209 – 2.3210)	58.953 – 58.954 (2.3210 – 2.3210)	58.954 – 58.955 (2.3210 – 2.3211)	58.955 – 58.956 (2.3211 – 2.3211)	58.956 – 58.957 (2.3211 – 2.3211)	58.957 – 58.958 (2.3211 – 2.3212)	58.958 – 58.959 (2.3212 – 2.3212)	58.959 – 58.960 (2.3212 – 2.3213)	58.960 – 58.961 (2.3213 – 2.3213)	58.961 – 58.962 (2.3213 – 2.3213)	58.962 – 58.963 (2.3213 – 2.3214)	58.963 – 58.964 (2.3214 – 2.3214)	58.964 – 58.965 (2.3214 – 2.3215)	58.965 – 58.966 (2.3215 – 2.3215)	58.966 – 58.967 (2.3215 – 2.3215)	58.967 – 58.968 (2.3215 – 2.3216)
A	54.979 – 54.978 (2.1645 – 2.1645)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
B	54.978 – 54.977 (2.1645 – 2.1644)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
C	54.977 – 54.976 (2.1644 – 2.1644)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
D	54.976 – 54.975 (2.1644 – 2.1644)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
E	54.975 – 54.974 (2.1644 – 2.1643)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
F	54.974 – 54.973 (2.1643 – 2.1643)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
G	54.973 – 54.972 (2.1643 – 2.1642)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
H	54.972 – 54.971 (2.1642 – 2.1642)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
J	54.971 – 54.970 (2.1642 – 2.1642)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
K	54.970 – 54.969 (2.1642 – 2.1641)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
L	54.969 – 54.968 (2.1641 – 2.1641)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
M	54.968 – 54.967 (2.1641 – 2.1641)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
N	54.967 – 54.966 (2.1641 – 2.1640)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
P	54.966 – 54.965 (2.1640 – 2.1640)	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
R	54.965 – 54.964 (2.1640 – 2.1639)	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
S	54.964 – 54.963 (2.1639 – 2.1639)	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
T	54.963 – 54.962 (2.1639 – 2.1639)	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
U	54.962 – 54.961 (2.1639 – 2.1638)	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67
V	54.961 – 54.960 (2.1638 – 2.1638)	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7
W	54.960 – 54.959 (2.1638 – 2.1637)	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7
X	54.959 – 54.958 (2.1637 – 2.1637)	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7
Y	54.958 – 54.957 (2.1637 – 2.1637)	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7
4	54.957 – 54.956 (2.1637 – 2.1636)	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	7
7	54.956 – 54.955 (2.1636 – 2.1636)	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	7	7

KBIA0149E

Main Bearing Selection Table (No.2,and 4 journals)

Cylinder block main bearing housing inner diameter / Crankshaft journal outer diameter	Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
Mark	Outer diameter Unit: mm (in)	Inner diameter Unit: mm (in)																							
		58.944 – 58.945 (2.3206 – 2.3207)	58.945 – 58.946 (2.3207 – 2.3207)	58.946 – 58.947 (2.3207 – 2.3207)	58.947 – 58.948 (2.3207 – 2.3208)	58.948 – 58.949 (2.3208 – 2.3208)	58.949 – 58.950 (2.3208 – 2.3209)	58.950 – 58.951 (2.3209 – 2.3209)	58.951 – 58.952 (2.3209 – 2.3209)	58.952 – 58.953 (2.3209 – 2.3210)	58.953 – 58.954 (2.3210 – 2.3210)	58.954 – 58.955 (2.3210 – 2.3211)	58.955 – 58.956 (2.3211 – 2.3211)	58.956 – 58.957 (2.3211 – 2.3211)	58.957 – 58.958 (2.3211 – 2.3212)	58.958 – 58.959 (2.3212 – 2.3212)	58.959 – 58.960 (2.3212 – 2.3213)	58.960 – 58.961 (2.3213 – 2.3213)	58.961 – 58.962 (2.3213 – 2.3213)	58.962 – 58.963 (2.3213 – 2.3214)	58.963 – 58.964 (2.3214 – 2.3214)	58.964 – 58.965 (2.3214 – 2.3215)	58.965 – 58.966 (2.3215 – 2.3215)	58.966 – 58.967 (2.3215 – 2.3215)	58.967 – 58.968 (2.3215 – 2.3216)
A	54.979 – 54.978 (2.1645 – 2.1645)	0	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3
B	54.978 – 54.977 (2.1645 – 2.1644)	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3
C	54.977 – 54.976 (2.1644 – 2.1644)	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3
D	54.976 – 54.975 (2.1644 – 2.1644)	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34
E	54.975 – 54.974 (2.1644 – 2.1643)	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34
F	54.974 – 54.973 (2.1643 – 2.1643)	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34
G	54.973 – 54.972 (2.1643 – 2.1642)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
H	54.972 – 54.971 (2.1642 – 2.1642)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
J	54.971 – 54.970 (2.1642 – 2.1642)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
K	54.970 – 54.969 (2.1642 – 2.1641)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
L	54.969 – 54.968 (2.1641 – 2.1641)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
M	54.968 – 54.967 (2.1641 – 2.1641)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
N	54.967 – 54.966 (2.1641 – 2.1640)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
P	54.966 – 54.965 (2.1640 – 2.1640)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
R	54.965 – 54.964 (2.1640 – 2.1639)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
S	54.964 – 54.963 (2.1639 – 2.1639)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
T	54.963 – 54.962 (2.1639 – 2.1639)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
U	54.962 – 54.961 (2.1639 – 2.1638)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
V	54.961 – 54.960 (2.1638 – 2.1638)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
W	54.960 – 54.959 (2.1638 – 2.1637)	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
X	54.959 – 54.958 (2.1637 – 2.1637)	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
Y	54.958 – 54.957 (2.1637 – 2.1637)	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
4	54.957 – 54.956 (2.1637 – 2.1636)	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
7	54.956 – 54.955 (2.1636 – 2.1636)	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67

KBIA0150E

Main Bearing Grade Table (All Journals) Refer to EM-113, "Standard and Limit".

Use Undersize Bearing Usage Guide

- Use undersize (U.S.) bearing when oil clearance with standard size main bearing is not within specification.
- When using undersize (U.S.) bearing, measure the bearing inner diameter with the bearing installed and grind journal until oil clearance falls within specification.

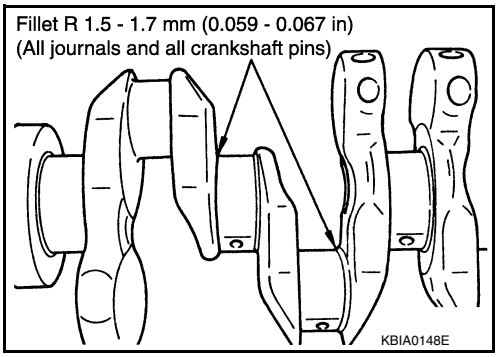
Bearing Undersize Table

Unit: mm (in)

Size U.S.	Thickness
0.25 (0.0098)	2.106 - 2.114 (0.0829 - 0.0832)

CAUTION:

Do not damage fillet R when grinding crankshaft journal in order to use an undersize bearing (all journals).



SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

Standard and Limit

INFOID:0000000012601993

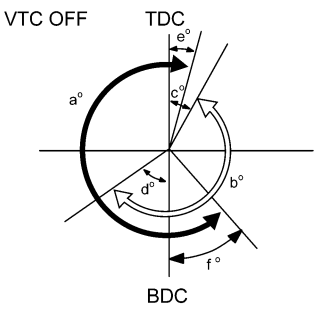
GENERAL SPECIFICATIONS

Cylinder arrangement		In-line 4
Displacement cm^3 (in^3)		2,488 (151.82)
Bore and stroke mm (in)		89.0 x 100 (3.50 x 3.94)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		10.0:1
Compression pressure kPa (kg/cm^2, psi) / 250 rpm	Standard	1410 (1.41, 14.4, 204.5)
	Minimum	1220 (1.22, 12.4, 176.9)
	Differential limit between cylinders	100 (1.0, 14)

VALVE TIMING

Unit: degree

Valve timing
⇦: Intake valve
⬅: Exhaust valve



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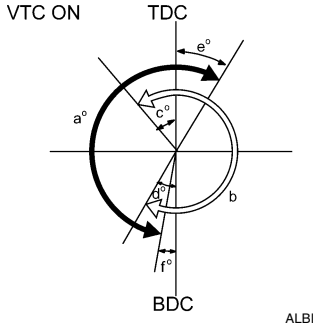

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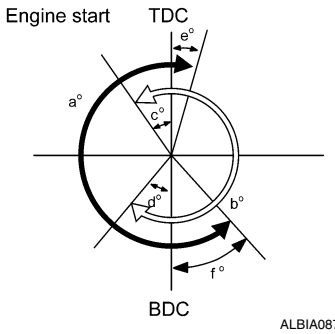

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	a	b	c	d	e	f
VTC Minimum phasing (Mechanical) *1	224	244	-5	69	3	41
VTC Maximum phasing (Mechanical) *2	224	244	35	29	48	4
Intermediate lock phasing (Mechanical) *3	224	244	5	59	3	41

*1: When running at idle with engine coolant temperature more than 60°C (140°F).

*2: When the intake or exhaust valve opening angle is at the maximum.

*3: When starting the engine with engine coolant temperature 60°C (140°F) or less.

DRIVE BELTS

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

EXHAUST MANIFOLD

Unit: mm (in)

Surface distortion	Description	Limit
	Exhaust manifold	0.3 (0.012)

SPARK PLUG

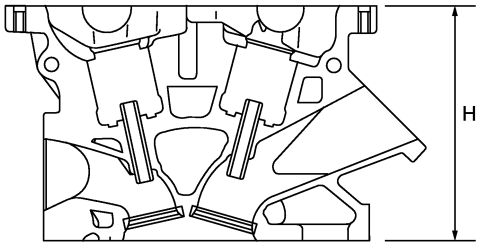
Unit: mm (in)

Make		DENSO
Type*	Standard	FXE20HE11C
Gap (nominal)		1.1 (0.043)

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

CYLINDER HEAD

Unit: mm (in)



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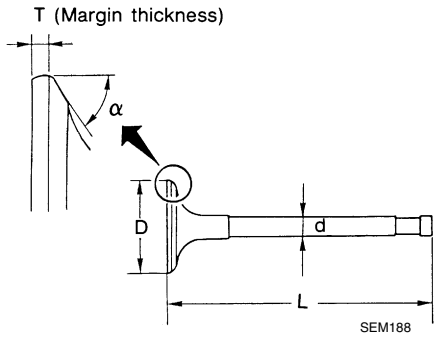
Description	Standard
Normal cylinder head height (H)	129.4 (5.09)
Description	Limit
Head surface distortion	0.1 (0.004)
Description	Standard
Spark plug tube installation height	41.7 (1.642)

VALVE

Valve Dimensions

Unit: mm (in)



Valve head diameter (D)	Intake	35.5 - 35.8 (1.398 - 1.409)
	Exhaust	30.3 - 30.6 (1.193 - 1.205)
Valve length (L)	Intake	101.72 (4.0047)
	Exhaust	102.78 (4.0464)
Valve stem diameter (d)	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle α	Intake	45°15′ - 45°45′
	Exhaust	
Valve margin (T)	Intake	1.08 (0.0425)
	Exhaust	1.38 (0.0543)

Valve Clearance

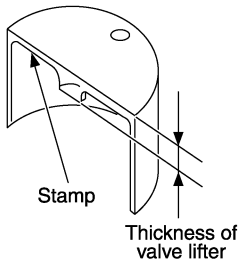
Unit: mm (in)

	Cold	Hot*
Intake	0.24 - 0.32 (0.009 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.26 - 0.34 (0.010 - 0.013)	0.308 - 0.432 (0.012 - 0.017)

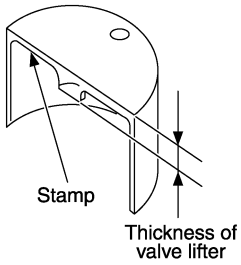
* Approximately 80°C (176°F)

Available Valve Lifter

Unit: mm (in)



Thickness	Identification mark (Stamp)*
3.00 (0.1181)	300H
3.02 (0.1189)	302H
3.04 (0.1197)	304H
3.06 (0.1205)	306H
3.08 (0.1213)	308H
3.10 (0.1220)	310H



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Thickness	Identification mark (Stamp)*
3.12 (0.1228)	312H
3.14 (0.1236)	314H
3.16 (0.1244)	316H
3.18 (0.1252)	318H
3.20 (0.1260)	320H
3.22 (0.1268)	322H
3.24 (0.1276)	324H
3.26 (0.1283)	326H
3.28 (0.1291)	328H
3.30 (0.1299)	330H
3.32 (0.1307)	332H
3.34 (0.1315)	334H
3.36 (0.1323)	336H
3.38 (0.1331)	338H
3.40 (0.1339)	340H
3.42 (0.1346)	342H
3.44 (0.1354)	344H
3.46 (0.1362)	346H
3.48 (0.1370)	348H
3.50 (0.1378)	350H

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

Valve Spring

Free height standard	Intake	47.02 mm (1.8512 in)
	Exhaust	47.75 mm (1.8799 in)
Installation height	Intake	35.96 mm (1.4157 in)
	Exhaust	35.96 mm (1.4157 in)
Installation load–	Intake	153 N - 173 N (15.6 kg - 17.6 kg, 34.4 lb - 38.9 lb)
	Exhaust	153 N - 173 N (15.6 kg - 17.6 kg, 34.4 lb - 38.9 lb)
Height during valve open	Intake	25.76 mm (1.0142 in)
	Exhaust	27.46 mm (1.0811 in)
Load with valve open	Intake	337 N - 381 N (34.4 kg - 38.9 kg, 75.8 lb - 85.6 lb)
	Exhaust	302 N - 340 N (30.8 kg - 34.7 kg, 67.9 lb - 76.4 lb)

Identification color	Intake	White
	Exhaust	Light blue
Out-of-square		1.0 mm (0.0394 in)

Valve Lifter

Unit: mm (in)

Description	Standard
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Valve lifter bore inner diameter	34.000 - 34.021 (1.3386 - 1.3394)
Clearance between lifter and lifter guide	0.023 - 0.034 (0.0009 - 0.0013)

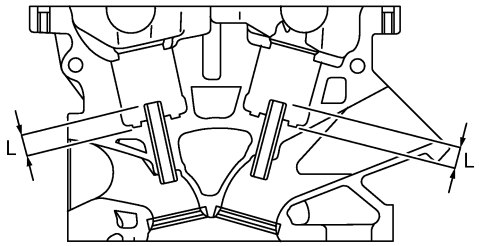
Valve Oil Seal

Unit: mm (in)

Description	Standard
Valve oil seal installation height (A)	12.1 (0.476)

Valve Guide

Unit: mm (in)



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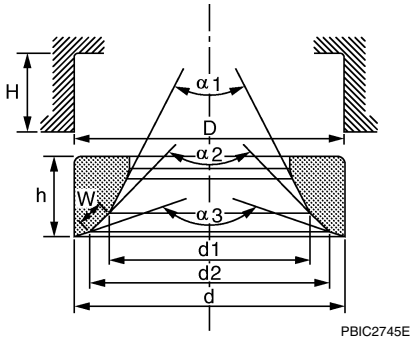
Description		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	5.3 - 5.5 (0.2087 - 0.2165)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	
Valve guide clearance (Standard)	Intake	0.020 - 0.053 (0.0008 - 0.0021)	
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	
Valve guide clearance (Limit)	Intake	0.08 (0.003)	
	Exhaust	0.09 (0.004)	
Projection length (L)	Intake	10.1 - 10.3 (0.398 - 0.406)	
	Exhaust	10.0 - 10.4 (0.394 - 0.409)	

Valve Seat

Unit: mm (in)



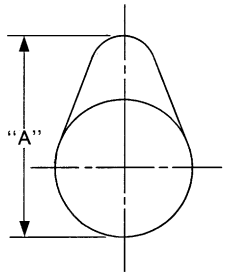
Description		Standard	Service
Cylinder head seat recess diameter (D)	Intake	36.500 - 36.516 (1.4370 - 1.4376)	37.000 - 37.016 (1.4567 - 1.4573)
	Exhaust	31.500 - 31.516 (1.2402 - 1.2408)	32.000 - 32.016 (1.2598 - 1.2605)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.084 - 0.116 (0.0033 - 0.0046)	
Valve seat outer diameter (d)	Intake	36.597 - 36.613 (1.4408 - 1.4415)	37.097 - 37.113 (1.4605 - 1.4611)
	Exhaust	31.600 - 31.616 (1.2441 - 1.2447)	32.100 - 32.116 (1.2638 - 1.2644)
Diameter (d1)	Intake	30.85 - 31.15 (1.2146 - 1.2264)	
	Exhaust	25.05 - 25.35 (0.9862 - 0.9980)	
Diameter (d2)	Intake	34.35 - 34.65 (1.3524 - 1.3642)	
	Exhaust	29.35 - 29.65 (1.1555 - 1.1673)	
Angle (α1)	Intake	18° - 22°	
	Exhaust	18° - 22°	
Angle (α2)	Intake	58° - 62°	
	Exhaust	58° - 62°	
Angle (α3)	Intake	180°	
	Exhaust	180°	
Contacting width (W)*1	Intake	0.99 - 1.35 (0.0390 - 0.0531)	
	Exhaust	1.19 - 1.55 (0.0469 - 0.0610)	

*1 Machining data

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard
Camshaft runout [TIR*]	Less than 0.02 (0.0008)

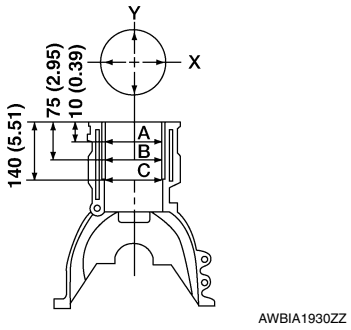


		Standard
Cam height (A)	Intake	45.865 - 46.055 (1.8057 - 1.8132)
	Exhaust	44.175 - 44.365 (1.7392 - 1.7467)
Outer diameter of camshaft journal		No. 1 27.935 - 27.955 (1.0998 - 1.1006) No. 2, 3, 4, 5 23.435 - 23.455 (0.9226 - 0.9234)
Inner diameter of camshaft bracket		No.1 28.000 - 28.021 (1.1024 - 1.1032) No.2, 3, 4, 5 23.500 - 23.521 (0.9252 - 0.9260)
Camshaft journal clearance		0.045 - 0.086 (0.0018 - 0.0034)
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)
Camshaft sprocket runout [TIR*]		Less than 0.15 (0.0059)

*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



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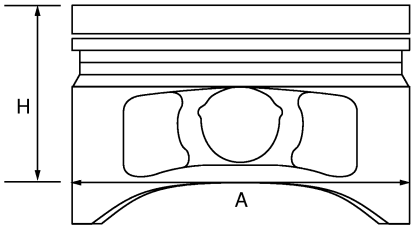
Surface distortion	Limit			0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)
			Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)
		Wear limit		0.2 (0.008)
Out-of-round (X – Y)				Less than 0.015 (0.0006)
Taper (C – A)				Less than 0.01 (0.0004)

Main journal inner diameter grade (Without bearing)	Grade No. A	58.944 - 58.945 (2.3206 - 2.3207)
	Grade No. B	58.945 - 58.946 (2.3207 - 2.3207)
	Grade No. C	58.946 - 58.947 (2.3207 - 2.3207)
	Grade No. D	58.947 - 58.948 (2.3207 - 2.3208)
	Grade No. E	58.948 - 58.949 (2.3208 - 2.3208)
	Grade No. F	58.949 - 58.950 (2.3208 - 2.3209)
	Grade No. G	58.950 - 58.951 (2.3209 - 2.3209)
	Grade No. H	58.951 - 58.952 (2.3209 - 2.3209)
	Grade No. J	58.952 - 58.953 (2.3209 - 2.3210)
	Grade No. K	58.953 - 58.954 (2.3210 - 2.3210)
	Grade No. L	58.954 - 58.955 (2.3210 - 2.3211)
	Grade No. M	58.955 - 58.956 (2.3211 - 2.3211)
	Grade No. N	58.956 - 58.957 (2.3211 - 2.3211)
	Grade No. P	58.957 - 58.958 (2.3211 - 2.3212)
	Grade No. R	58.958 - 58.959 (2.3212 - 2.3212)
	Grade No. S	58.959 - 58.960 (2.3212 - 2.3213)
	Grade No. T	58.960 - 58.961 (2.3213 - 2.3213)
	Grade No. U	58.961 - 58.962 (2.3213 - 2.3213)
	Grade No. V	58.962 - 58.963 (2.3213 - 2.3214)
	Grade No. W	58.963 - 58.964 (2.3214 - 2.3214)
	Grade No. X	58.964 - 58.965 (2.3214 - 2.3215)
	Grade No. Y	58.965 - 58.966 (2.3215 - 2.3215)
	Grade No. 4	58.966 - 58.967 (2.3215 - 2.3215)
	Grade No. 7	58.967 - 58.968 (2.3215 - 2.3216)
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

PISTON, PISTON RING, AND PISTON PIN

Available Piston

Unit: mm (in)



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Piston skirt diameter (A)	Standard	Grade*	Dimension
		Grade No. 2	88.990 - 89.000 (3.5035 - 3.5039)
		Grade No. 3	89.000 - 89.010 (3.5039 - 3.5043)
(H) dimension			37.5 (1.476)
Piston pin bore diameter		Grade No. 0	19.993 - 19.999 (0.7871 - 0.7874)
		Grade No. 1	19.999 - 20.005 (0.7874 - 0.7876)
Piston clearance to cylinder block		Standard	0.010 - 0.030 (0.0004 - 0.0012)
		Limit	0.08 (0.0031)

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

Piston Ring

Unit: mm (in)

	Standard	Limit

Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil ring	0.045 - 0.125 (0.0018 - 0.0049)	—
End gap	Top	0.21 - 0.31 (0.0083 - 0.0122)	0.53 (0.0209)
	2nd	0.37 - 052 (0.0146 - 0.0205)	0.71 (0.0280)
	Oil (rail ring)	0.20 - 0.45 (0.0079 - 0.0177)	0.80 (0.0315)

Piston Pin

Unit: mm (in)

Piston pin outer diameter	Grade No.0	19.989 - 19.995 (0.7870 - 0.7872)
	Grade No.1	19.995 - 20.001 (0.7872 - 0.7874)
Piston to piston pin clearance (Standard)		0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)

CONNECTING ROD

Unit: mm (in)

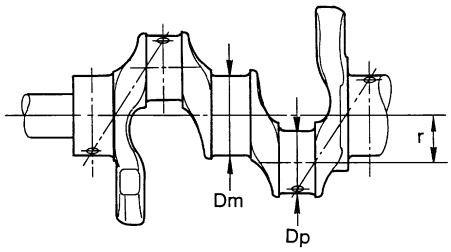
Center distance		143.00 - 143.10 (5.63 - 5.63)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end inner diameter		20.000 - 20.012 (0.7874 - 0.7879)
Connecting rod small end inner bushing diameter[1]	Grade[2]	Dimension
	Grade No. 0	20.000 - 20.006 (0.7874 - 0.7876)
	Grade No. 1	20.006 - 20.012 (0.7876 - 0.7879)
Connecting rod big end inner diameter		48.000 - 48.013 (1.8898 - 1.8903)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.50 (0.0197)
Connecting rod bearing housing	Grade[2]	Dimension
	Grade No. 0	48.000 - 48.001 (1.8898 - 1.8898)
	Grade No. 1	48.001 - 48.002 (1.8898 - 1.8898)
	Grade No. 2	48.002 - 48.003 (1.8898 - 1.8899)
	Grade No. 3	48.003 - 48.004 (1.8899 - 1.8899)
	Grade No. 4	48.004 - 48.005 (1.8899 - 1.8899)
	Grade No. 5	48.005 - 48.006 (1.8899 - 1.8900)
	Grade No. 6	48.006 - 48.007 (1.8900 - 1.8900)
	Grade No. 7	48.007 - 48.008 (1.8900 - 1.8901)
	Grade No. 8	48.008 - 48.009 (1.8901 - 1.8901)
	Grade No. 9	48.009 - 48.010 (1.8901 - 1.8902)
	Grade No. A	48.010 - 48.011 (1.8902 - 1.8902)
	Grade No. B	48.011 - 48.012 (1.8902 - 1.8902)
	Grade No. C	48.012 - 48.013 (1.8902 - 1.8903)

[1]: After installing in connecting rod.

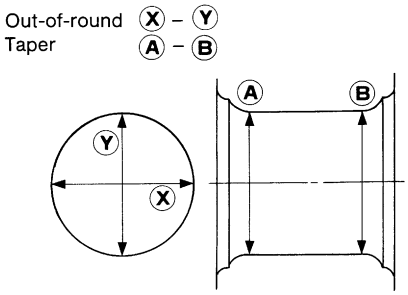
[2]: Always check with the Parts Department for the latest parts information.

CRANKSHAFT

Unit: mm (in)



SEM645



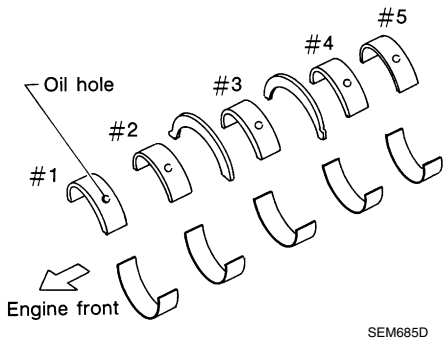
SEM715

Pin journal dia. (DP)	Grade No. A	44.974 - 44.973 (1.7706 - 1.7706)
	Grade No. B	44.973 - 44.972 (1.7706 - 1.7705)
	Grade No. C	44.972 - 44.971 (1.7705 - 1.7705)
	Grade No. D	44.971 - 44.970 (1.7705 - 1.7705)
	Grade No. E	44.970 - 44.969 (1.7705 - 1.7704)
	Grade No. F	44.969 - 44.968 (1.7704 - 1.7704)
	Grade No. G	44.968 - 44.967 (1.7704 - 1.7704)
	Grade No. H	44.967 - 44.966 (1.7704 - 1.7703)
	Grade No. J	44.966 - 44.965 (1.7703 - 1.7703)
	Grade No. K	44.965 - 44.964 (1.7703 - 1.7702)
	Grade No. L	44.964 - 44.963 (1.7702 - 1.7702)
	Grade No. M	44.963 - 44.962 (1.7702 - 1.7702)
	Grade No. N	44.962 - 44.961 (1.7702 - 1.7701)
	Grade No. P	44.961 - 44.960 (1.7701 - 1.7701)
	Grade No. R	44.960 - 44.959 (1.7701 - 1.7700)
	Grade No. S	44.959 - 44.958 (1.7700 - 1.7700)
	Grade No. T	44.958 - 44.957 (1.7700 - 1.7700)
	Grade No. U	44.957 - 44.956 (1.7700 - 1.7699)
Main journal dia. (Dm) grade	Grade No. A	54.979 - 54.978 (2.1645 - 2.1645)
	Grade No. B	54.978 - 54.977 (2.1645 - 2.1644)
	Grade No. C	54.977 - 54.976 (2.1644 - 2.1644)
	Grade No. D	54.976 - 54.975 (2.1644 - 2.1644)
	Grade No. E	54.975 - 54.974 (2.1644 - 2.1643)
	Grade No. F	54.974 - 54.973 (2.1643 - 2.1643)
	Grade No. G	54.973 - 54.972 (2.1643 - 2.1642)
	Grade No. H	54.972 - 54.971 (2.1642 - 2.1642)
	Grade No. J	54.971 - 54.970 (2.1642 - 2.1642)
	Grade No. K	54.970 - 54.969 (2.1642 - 2.1641)
	Grade No. L	54.969 - 54.968 (2.1641 - 2.1641)
	Grade No. M	54.968 - 54.967 (2.1641 - 2.1641)
	Grade No. N	54.967 - 54.966 (2.1641 - 2.1640)
	Grade No. P	54.966 - 54.965 (2.1640 - 2.1640)
	Grade No. R	54.965 - 54.964 (2.1640 - 2.1639)
	Grade No. S	54.964 - 54.963 (2.1639 - 2.1639)
	Grade No. T	54.963 - 54.962 (2.1639 - 2.1639)
	Grade No. U	54.962 - 54.961 (2.1639 - 2.1638)
	Grade No. V	54.961 - 54.960 (2.1638 - 2.1638)
	Grade No. W	54.960 - 54.959 (2.1638 - 2.1637)
	Grade No. X	54.959 - 54.958 (2.1637 - 2.1637)
	Grade No. Y	54.958 - 54.957 (2.1637 - 2.1637)
	Grade No. 4	54.957 - 54.956 (2.1637 - 2.1636)
	Grade No. 7	54.956 - 54.955 (2.1636 - 2.1636)
Center distance (r)		49.60 - 50.04 (1.9528 - 1.9701)
Out-of-round (X – Y)	Standard	Less than 0.005 (0.0002)
Taper (A – B)	Standard	Less than 0.005 (0.0002)
Runout [TIR*]	Limit	Less than 0.05 (0.002)
Free end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (0.0118)

*: Total indicator reading

MAIN BEARING

Unit: mm (in)



SEM685D

Grade number*		Thickness	Identification color	Remarks
-1		1.970 - 1.973 (0.0776 - 0.0777)	Red	Grade and color are the same for upper and lower bearings.
0		1.973 - 1.976 (0.0777 - 0.0778)	Black	
1		1.976 - 1.979 (0.0778 - 0.0779)	Brown	
2		1.979 - 1.982 (0.0779 - 0.0780)	Green	
3		1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
4		1.985 - 1.988 (0.0781 - 0.0783)	Blue	
5		1.988 - 1.991 (0.0783 - 0.0784)	Pink	
6		1.991 - 1.994 (0.0784 - 0.0785)	Purple	
7		1.994 - 1.997 (0.0785 - 0.0786)	White	
-10	UPR	1.970 - 1.973 (0.0776 - 0.0777)	Red	Grade and color are different for upper and lower bearings.
	LWR	1.973 - 1.976 (0.0777 - 0.0778)	Black	
01	UPR	1.973 - 1.976 (0.0777 - 0.0778)	Black	
	LWR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
12	UPR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
	LWR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
23	UPR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
	LWR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
34	UPR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
	LWR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
45	UPR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
	LWR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
56	UPR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
	LWR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
67	UPR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
	LWR	1.994 - 1.997 (0.0785 - 0.0786)	White	

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

Undersize

Unit: mm (in)

Size U.S.	Thickness	Main journal diameter
0.25 (0.0098)	2.106 - 2.114 (0.0829 - 0.0832)	Grind so that bearing clearance is the specified value.

Bearing Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	No. 1 and 5	0.012 - 0.022 (0.0005 - 0.0009)
		No. 2 and 4	0.018 - 0.028 (0.0007 - 0.0011)
		No. 3	0.021 - 0.031 (0.0008 - 0.0012)
	Limit		0.1 (0.004)

CONNECTING ROD BEARING

Grade number*		Thickness	Identification color	Remarks
0		1.493 - 1.496 (0.0588 - 0.0589)	Black	Grade and color are the same for upper and lower bearings.
1		1.496 - 1.499 (0.0589 - 0.0590)	Brown	
2		1.499 - 1.502 (0.0590 - 0.0591)	Green	
3		1.502 - 1.505 (0.0591 - 0.0593)	Yellow	
4		1.505 - 1.508 (0.0593 - 0.0594)	Blue	
01	UPR	1.493 - 1.496 (0.0588 - 0.0589)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.496 - 1.499 (0.0589 - 0.0590)	Brown	
12	UPR	1.496 - 1.499 (0.0589 - 0.0590)	Brown	
	LWR	1.499 - 1.502 (0.0590 - 0.0591)	Green	
23	UPR	1.499 - 1.502 (0.0590 - 0.0591)	Green	
	LWR	1.502 - 1.505 (0.0591 - 0.0593)	Yellow	
34	UPR	1.502 - 1.505 (0.0591 - 0.0593)	Yellow	
	LWR	1.505 - 1.508 (0.0593 - 0.0594)	Blue	

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

Undersize

Unit: mm (in)

Size U.S.	Thickness	Crank pin journal diameter
0.25 (0.0098)	1.622 - 1.630 (0.0639 - 0.0642)	Grind so that bearing clearance is the specified value.

Bearing Clearance

Unit: mm (in)

Connecting rod bearing clearance	Standard	0.035 - 0.045 (0.0014 - 0.0018)
	Limit	0.10 (0.0039)

PRECAUTION

PRECAUTIONS

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

INFOID:0000000012601994

The Supplemental Restraint System such as “AIR BAG” and “SEAT BELT PRE-TENSIONER”, used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the 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, it is recommended that all maintenance and repair be performed by an authorized NISSAN/INFINITI dealer.**
- **Improper repair, 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 or batteries, and wait at least three minutes before performing any service.**

Precaution for Drain Coolant and Engine Oil

INFOID:0000000012601995

- Drain engine coolant and engine oil after the engine has cooled completely.

Precaution for Disconnecting Fuel Piping

INFOID:0000000012601996

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

Precaution for Removal and Disassembly

INFOID:0000000012601997

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

Precaution for Inspection, Repair and Replacement

INFOID:0000000012601998

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

Precaution for Assembly and Installation

INFOID:0000000012601999

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

- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check oil or coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route after draining coolant.
- Before starting engine, apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then make sure that there are no leaks at fuel line connections.
- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage.

Parts Requiring Angular Tightening

INFOID:0000000012602000

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

Precaution for Liquid Gasket

INFOID:0000000012602001

REMOVAL OF LIQUID GASKET

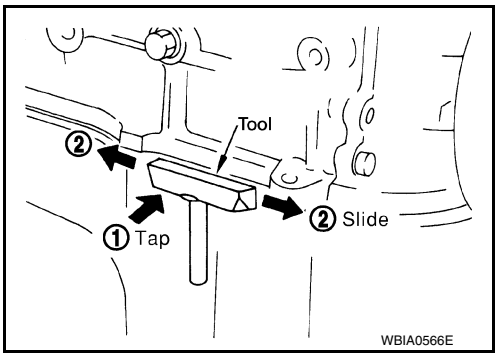
CAUTION:

Do not damage the mating surfaces.

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

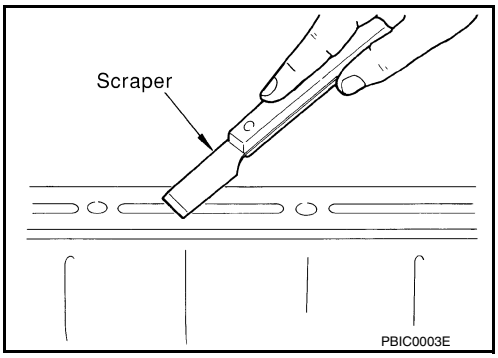
Tool number : KV10111100 (J-37228)

- In areas where the Tool is difficult to use, use a plastic hammer to lightly tap (1) the Tool where the liquid gasket is applied. Use a plastic hammer to slide (2) the Tool by tapping on the side.

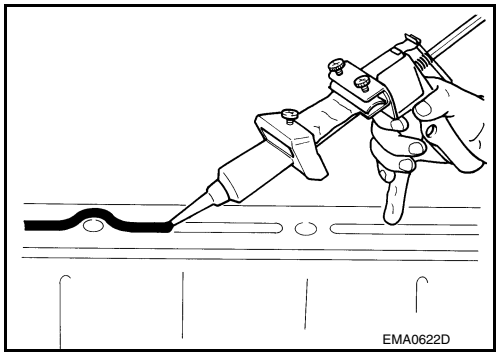


LIQUID GASKET APPLICATION PROCEDURE

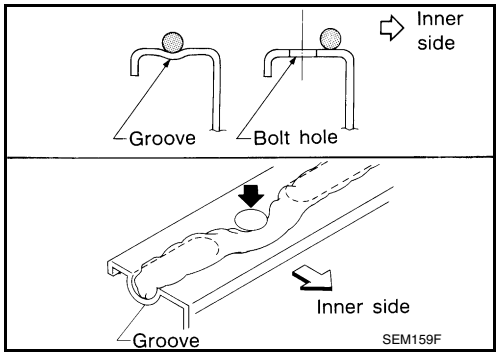
1. Remove the old liquid gasket adhering to the gasket application surface and the mating surface using suitable tool.
   - Remove the liquid gasket completely from the groove of the liquid gasket application surface, bolts, and bolt holes.
2. Thoroughly clean the mating surfaces and remove adhering 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:
If there are more specific instructions in the procedures contained in this manual concerning liquid gasket application, observe them.

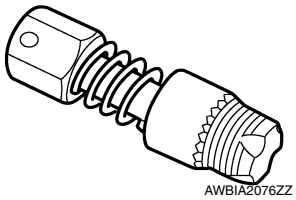
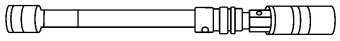
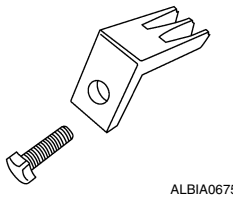
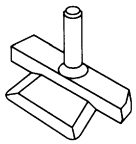
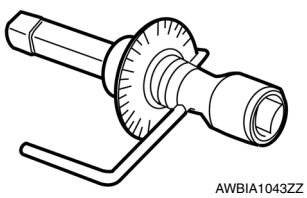
PREPARATION

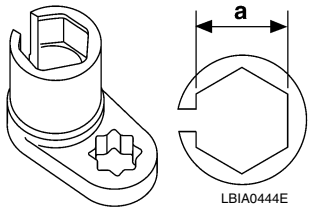
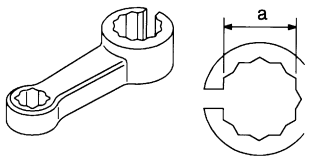
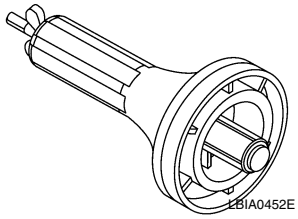
PREPARATION

Special Service Tool

INFOID:0000000012602002

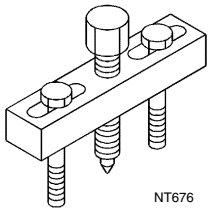
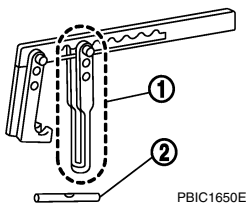
The actual shape of the tools may differ from those illustrated here.

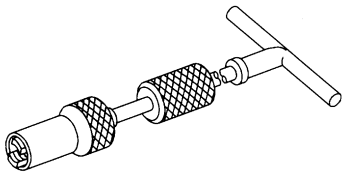
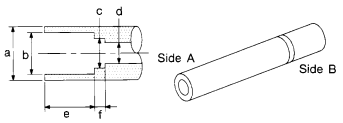
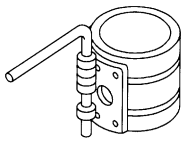
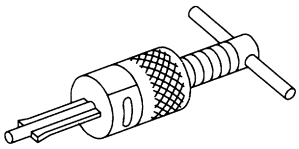
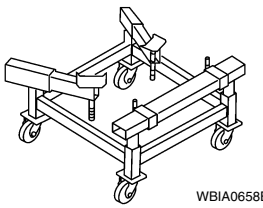
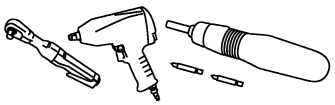
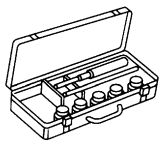
Tool number (TechMate No.) Tool name	Description
— (J-43897-18) Oxygen sensor thread cleaner  AWBIA2076ZZ	Reconditioning the exhaust system threads before installing a new oxygen sensor (Use with anti-seize lubricant shown below.) **J-43897-18 (18 mm dia.) for zirconia oxygen sensor**
— (J-48891) Spark plug socket  AWBIA1785ZZ	Removing and installing spark plug
— (J-50288) Ring gear stopper  ALBIA0675ZZ	Removing and installing crankshaft pulley
KV10111100 (J-37228) Seal cutter  NT046	Removing oil pan and rear timing chain case
16441 6N210 (J-45488) Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
KV10112100 (BT-8653-A) Angle wrench  AWBIA1043ZZ	Tightening bolts for cylinder head, main bearing cap and connecting rod cap

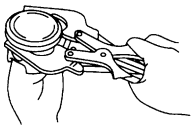
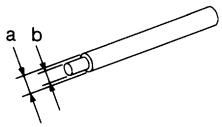
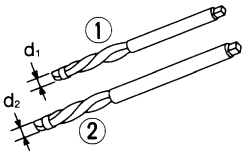
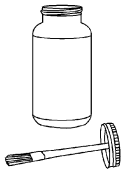
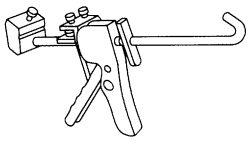
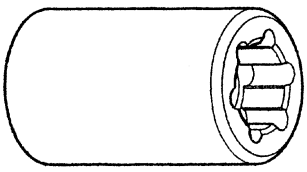
Tool number (TechMate No.) Tool name		Description
KV991J0050 (J-44626) Air fuel sensor Socket	 LBIA0444E	Loosening or tightening air fuel ratio A/F sensor **a: 22 mm (0.87 in)**
KV10114400 (J-38365) Heated oxygen sensor wrench	 NT636	Loosening or tightening rear heated oxygen sensor **a: 22 mm (0.87 in)**
— (J-47128) Seal installer	 LBIA0452E	Installing rear main seal

Commercial Service Tool

INFOID:0000000012602003

Tool number (TechMate No.) Tool name		Description
— (—) Pulley puller	 NT676	Removing crankshaft pulley
— (—) Pulley holder	 ZZA1010D	Removing and installing crankshaft pulley (Holding crankshaft pulley)
KV10116200 (J-26336-A) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2. KV10109220 (—) Adapter	 PBIC1650E	Disassembling valve mechanism Part (1) is a component of KV10116200 (J-26336-A), but part (2) is not.

Tool number (TechMate No.) Tool name	Description
KV10107902 (J-38959) Valve oil seal puller  S-NT011	Removing valve oil seal
KV10115600 (J-38958) Valve oil seal drift  S-NT603	Installing valve oil seal **Use side A.** **a: 20 (0.79) dia.** **d: 8 (0.31) dia.** **b: 13 (0.51) dia.** **e: 10.7 (0.421) dia.** **c: 10.3 (0.406) dia.** **f: 5 (0.20) dia.** Unit: mm (in)
EM03470000 (J-8037) Piston ring compressor  S-NT044	Installing piston assembly into cylinder bore
ST16610001 (J-23907) Pilot bushing puller  NT045	Removing crankshaft pilot bushing
— (J-47242) Engine support table  WBIA0658E	Removing engine and transmission assembly
— (—) Power tool  PIIB1407E	Loosening nuts, screws and bolts
— (—) Valve seat cutter set  NT048	Finishing valve seat dimensions

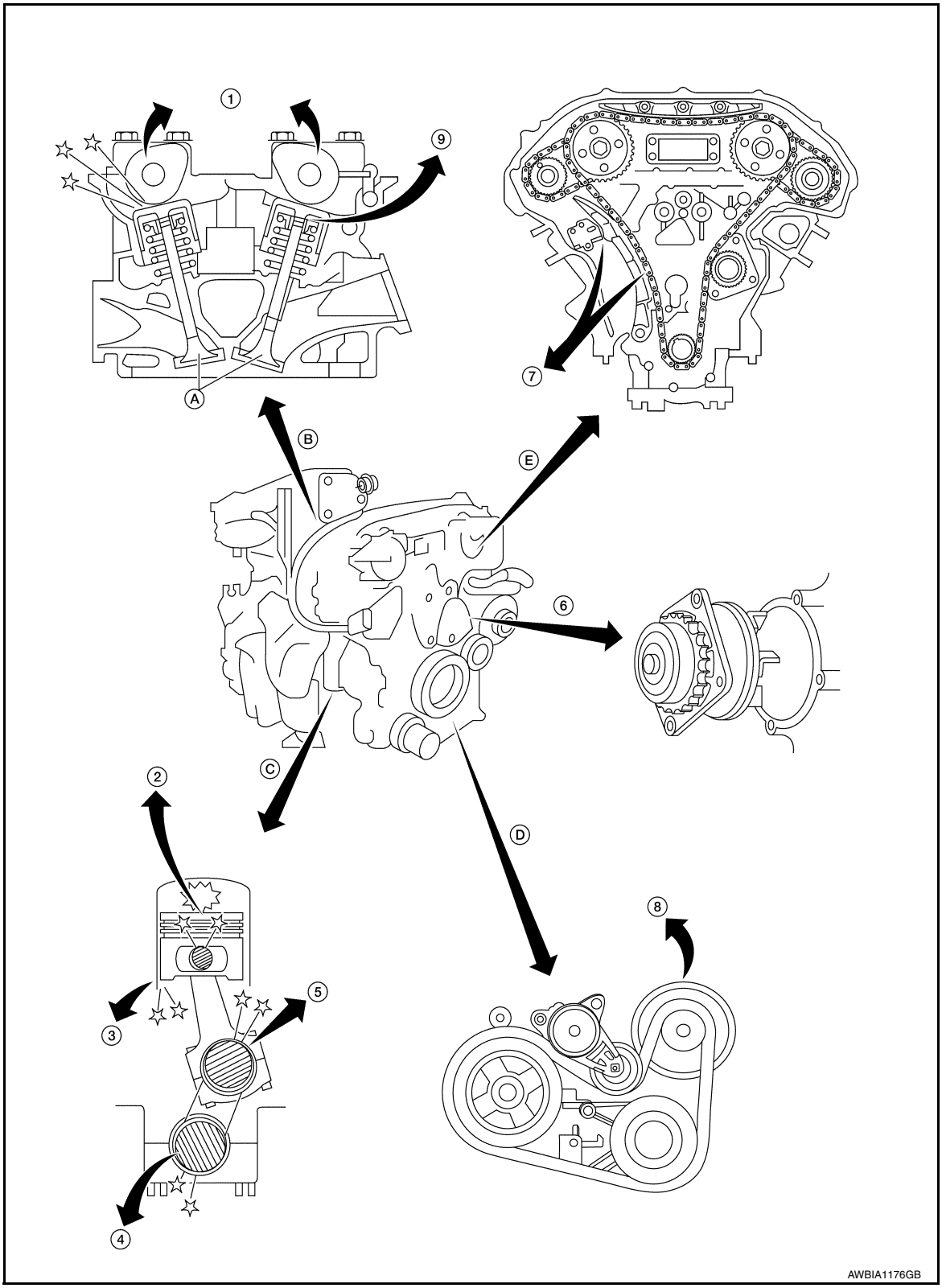
Tool number (TechMate No.) Tool name	Description
— (—) Piston ring expander  NT030	Removing and installing piston ring
— (—) Valve guide drift  NT015	Removing and installing valve guide **Intake & Exhaust:** **a: 9.5 mm (0.374 in) dia.** **b: 5.5 mm (0.217 in) dia.**
— (—) Valve guide reamer  NT016	Reaming valve guide 1 or hole for oversize valve guide 2 **Intake & Exhaust:** **d1: 6.0 mm (0.236 in) dia.** **d2: 10.2 mm (0.402 in) dia.**
— (—) 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
— (—) Tube presser  S-NT052	Pressing the tube of liquid gasket
— (J-45816) E20 Socket  LBIA0285E	Removing and installing CVT drive plate bolts

SYSTEM DESCRIPTION

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:0000000012602004



1. Camshaft bearing noise
2. Piston pin noise
3. Piston slap noise
4. Main bearing noise
5. Connecting rod bearing noise
6. Water pump noise

7. Timing chain and chain tensioner noise
8. Drive belt noise (Sticking/Slipping)
9. Tappet noise

A. Valve
B. Valve mechanism
C. Rotation mechanism
D. Drive belt
E. Timing chain

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

INFOID:0000000012602005

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source. Repair or replace the identified part as necessary.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-140
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-253
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-258
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-258
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-262
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-261
Front of engine Timing chain cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-187
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-136
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-41

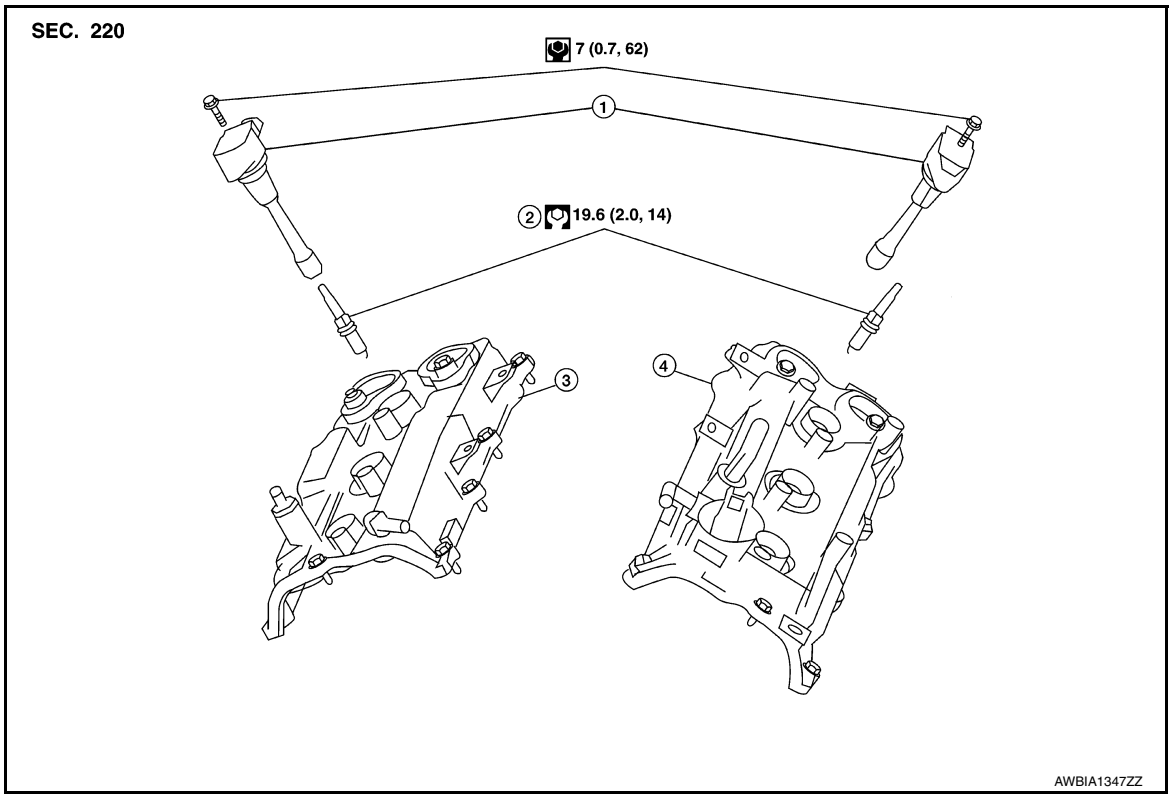
A: Closely related B: Related C: Sometimes related —: Not related

PERIODIC MAINTENANCE

SPARK PLUG

Exploded View

INFOID:0000000012602006



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

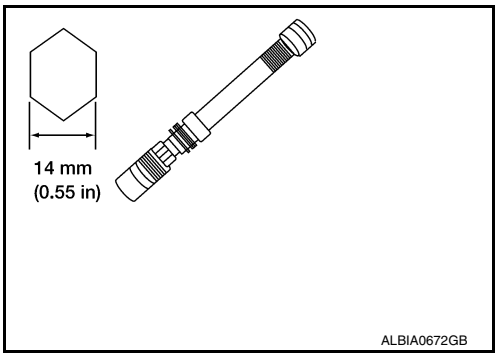
Removal and Installation

INFOID:0000000012602007

REMOVAL

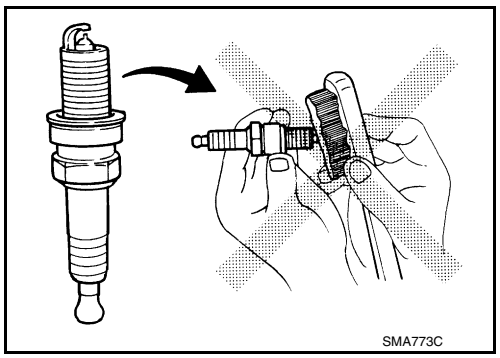
1. Remove the ignition coil. Refer to EM-166, "Removal and Installation (bank 2)" (LH side) and EM-166, "Removal and Installation (bank 1)" (RH side).
2. Remove the spark plug using Tool.

Tool number : — (J-48891)



INSPECTION AFTER REMOVAL

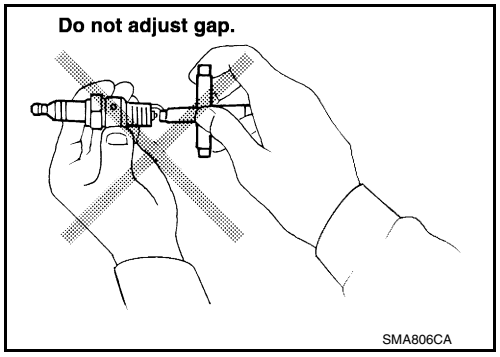
- Do not use a wire brush for cleaning the spark plugs. Replace as necessary.



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

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

- Checking and adjusting plug gap is not required between change intervals. If the gap is out of specification, replace the spark plug.



INSTALLATION

Installation is in the reverse order of removal.

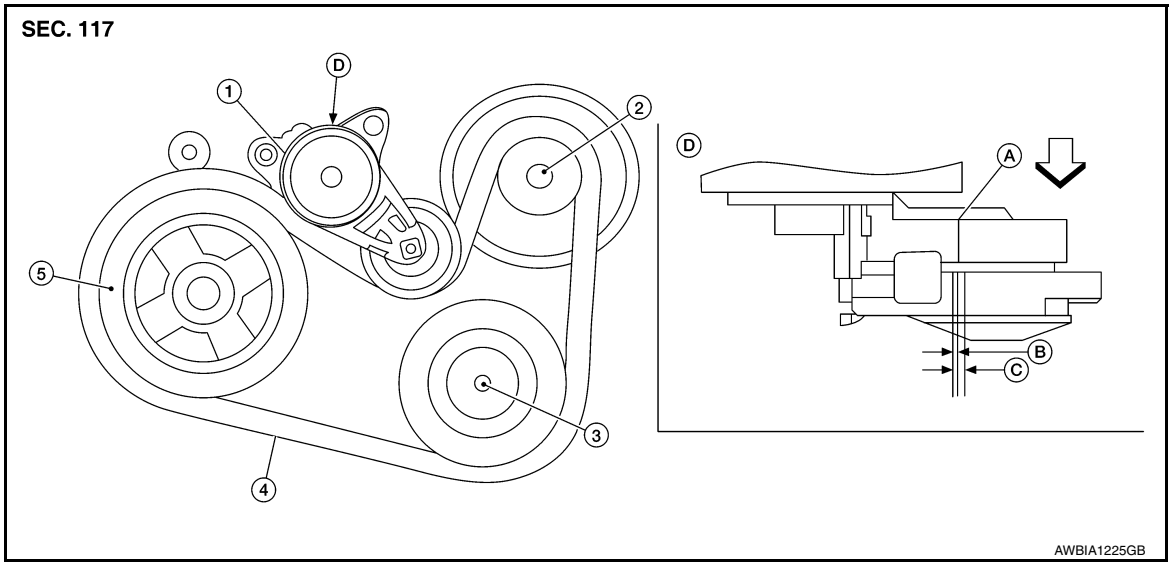
Standard type*	DENSO
	FXE22HR11
Gap (nominal)	1.1 mm (0.043 in)

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

DRIVE BELTS

Exploded View

INFOID:0000000012602008



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

⇦ Engine front

Checking Drive Belt

INFOID:0000000012602009

WARNING:

Inspect and check the drive belt with the engine off.

1. Visually check entire drive belt for wear, damage or cracks.
2. Check that the drive belt auto-tensioner indicator is within the possible use range.
   NOTE:
   - When new drive belt is installed, the drive belt auto-tensioner indicator should be within the new drive belt range.
   - Check the drive belt auto-tensioner indicator when the engine is cold.
3. If the drive belt auto-tensioner indicator is out of the possible use range or drive belt is damaged, replace drive belt.

Tension Adjustment

INFOID:0000000012602010

- Drive belt tension is automatically adjusted by the drive belt auto-tensioner.
- Drive belt tension is not manually adjustable.

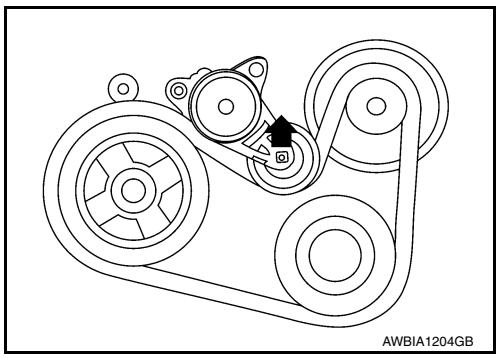
Removal and Installation

INFOID:0000000012602011

REMOVAL

1. Remove the front wheel and tire (RH) using power tool. Refer to WT-54, "Adjustment".
2. Remove the fender protector side cover (RH). Refer to EXT-36, "FENDER PROTECTOR : Exploded View".

3. While securely holding the hexagonal part in pulley center of drive belt auto-tensioner, move in the direction of arrow (loosening direction of drive belt auto-tensioner) using suitable tool.



WARNING:
Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.
CAUTION:
Do not loosen the drive belt auto-tensioner pulley bolt. (Do not turn it counterclockwise. If turned counterclockwise, the complete drive belt auto-tensioner must be replaced as a unit, including pulley.)

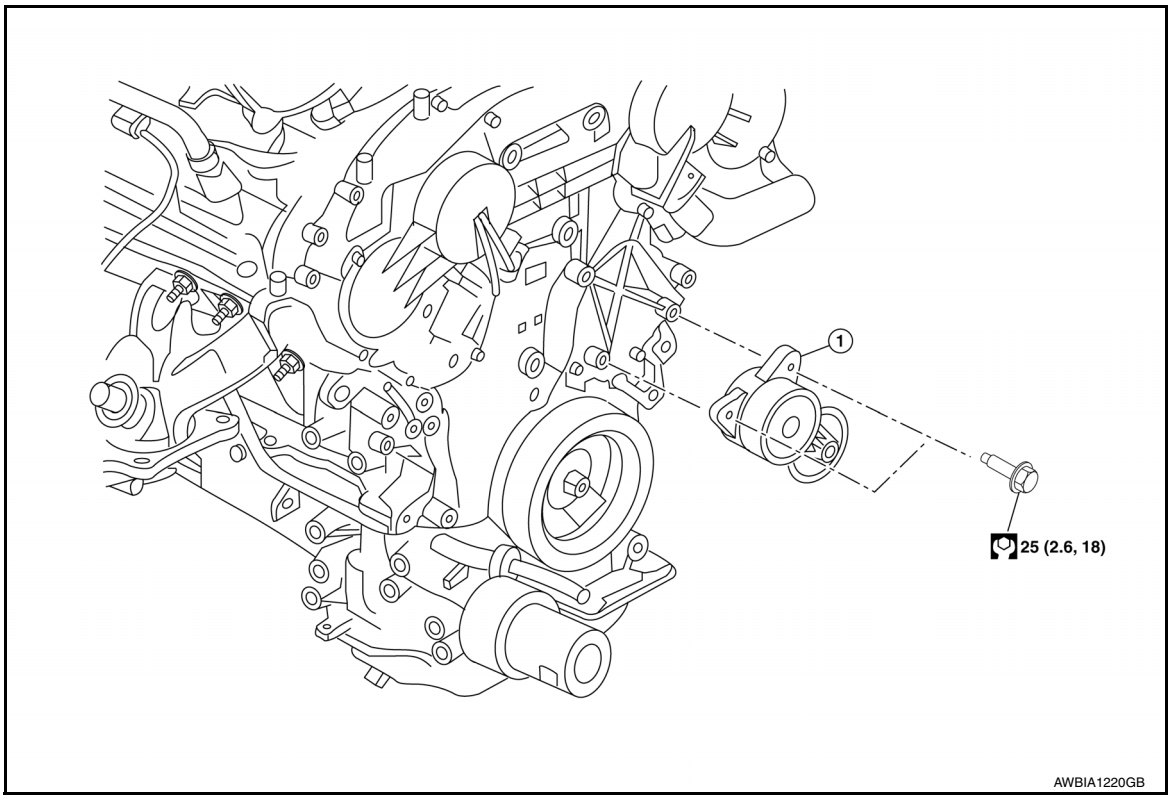
4. Insert a rod approximately 6 mm (0.24 in) in diameter through the rear of drive belt auto-tensioner into retaining boss to lock drive belt auto-tensioner pulley.
NOTE:
Leave drive belt auto-tensioner pulley arm locked until drive belt is installed.
5. Remove drive belt from crankshaft pulley and then remove it from the other pulleys.

INSTALLATION

1. Install the drive belt onto all of the pulleys.
CAUTION:
Confirm belt is completely set on the pulleys.
2. Release drive belt auto-tensioner, and apply tension to drive belt.
WARNING:
Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.
CAUTION:
Do not loosen the drive belt auto-tensioner pulley bolt. (Don't turn it counterclockwise. If turned counterclockwise, the complete drive belt auto-tensioner must be replaced as a unit, including pulley.)
3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Confirm drive belt auto-tensioner indicator is within the possible use range. Refer to EM-136, "Checking Drive Belt".
5. Install the fender protector side cover (RH). Refer to EXT-36, "FENDER PROTECTOR : Exploded View".
6. Install the front wheel and tire (RH). Refer to WT-54, "Adjustment".

Removal and Installation of Drive Belt Auto-tensioner

INFOID:0000000012602012



1. Drive belt auto-tensioner

REMOVAL

1. Remove the drive belt. Refer to EM-136, "Removal and Installation".
2. Remove the drive belt auto-tensioner.

CAUTION:

- **The complete drive belt auto-tensioner must be replaced as a unit, including the pulley.**
- **Do not loosen the drive belt auto-tensioner pulley bolt. (Do not turn it counterclockwise. If turned counterclockwise, the complete drive belt auto-tensioner must be replaced as a unit, including pulley).**

INSTALLATION

Installation is in the reverse order of removal.

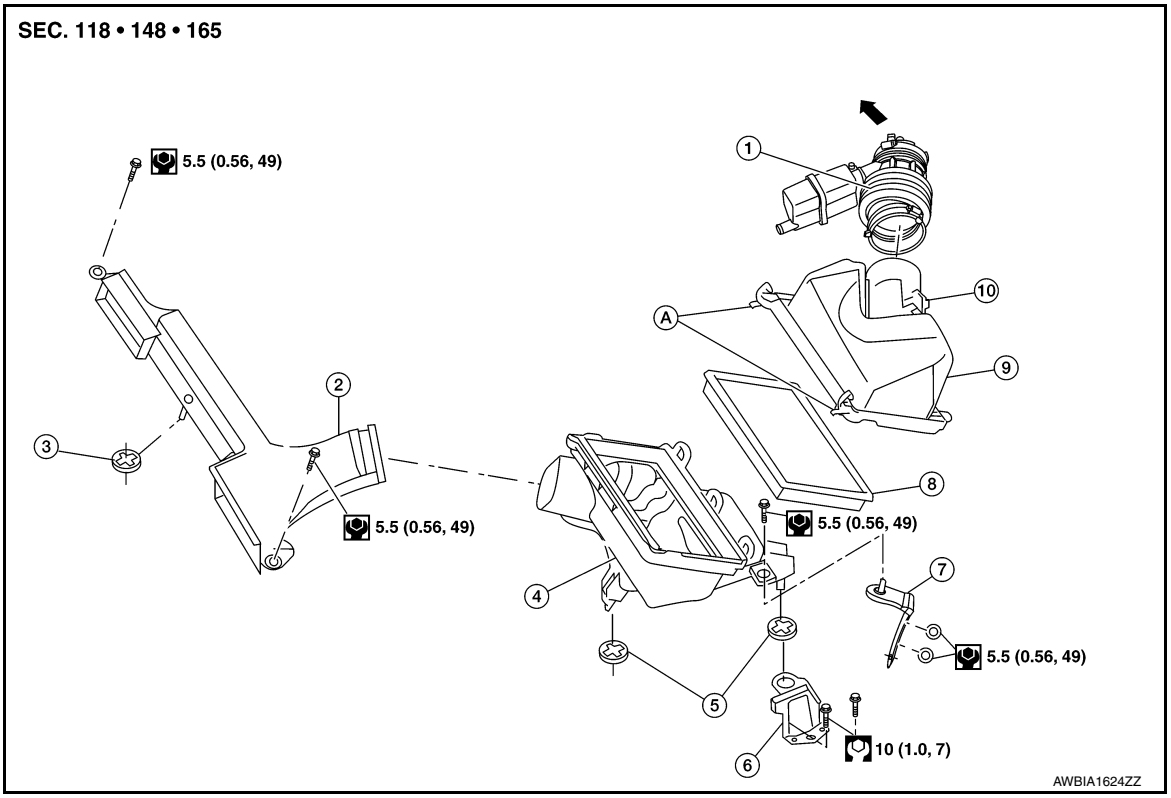
CAUTION:

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

AIR CLEANER FILTER

Exploded View

INFOID:0000000012602013



1. Air duct hose and resonator assembly	2. Front air duct	3. Grommet
4. Air cleaner case (lower)	5. Grommets	6. Air cleaner case mounting bracket
7. Bracket	8. Air cleaner filter	9. Air cleaner case (upper)
10. Mass air flow sensor	A. Air cleaner case (upper) side clips	⬅ To electric throttle control actuator

Removal and Installation

INFOID:0000000012602014

REMOVAL

CAUTION:

It is not necessary to remove the front air duct to replace the air cleaner filter.

NOTE:

Replace the air cleaner filter per the periodic maintenance schedule or as necessary. Refer to MA-8, "Introduction of Periodic Maintenance".

1. Unhook air cleaner case side clips and lift air cleaner case (upper).
2. Remove the air cleaner filter.

INSTALLATION

Installation is in the reverse order of removal.

CAMSHAFT VALVE CLEARANCE

Valve Clearance

INFOID:0000000012602015

CHECKING

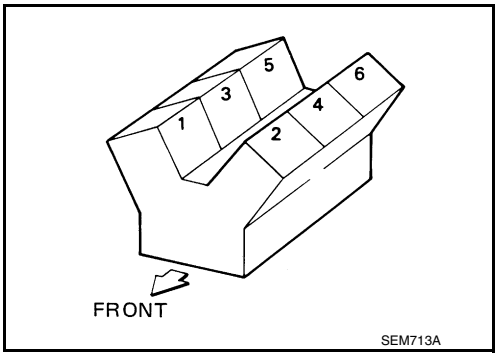
CAUTION:

Check valve clearance while engine is cold and not running.

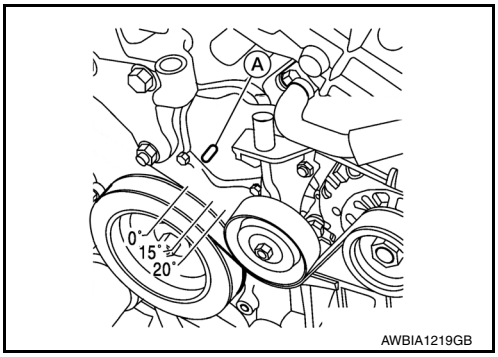
NOTE:

Perform valve clearance inspection after removal, installation or replacement of camshaft or valve related parts, or as necessary.

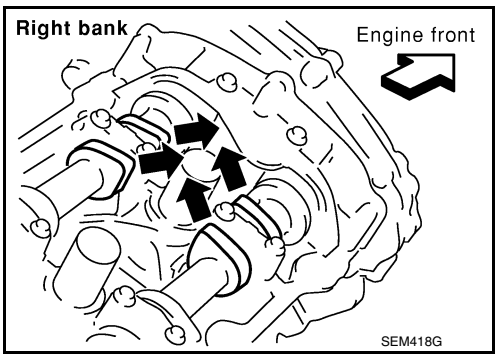
1. Remove the air duct with air cleaner case, collectors, hoses, wires, harnesses, and connectors. Refer to EM-146, "Removal and Installation".
2. Remove the intake manifold collector. Refer to EM-148, "Removal and Installation".
3. Remove the ignition coils and spark plugs. Refer to EM-166, "Exploded View".
4. Remove the rocker covers. Refer to EM-172, "Exploded View".
5. Set No.1 cylinder at TDC on its compression stroke.



a. Align pointer (A) with TDC mark (0°) on crankshaft pulley.

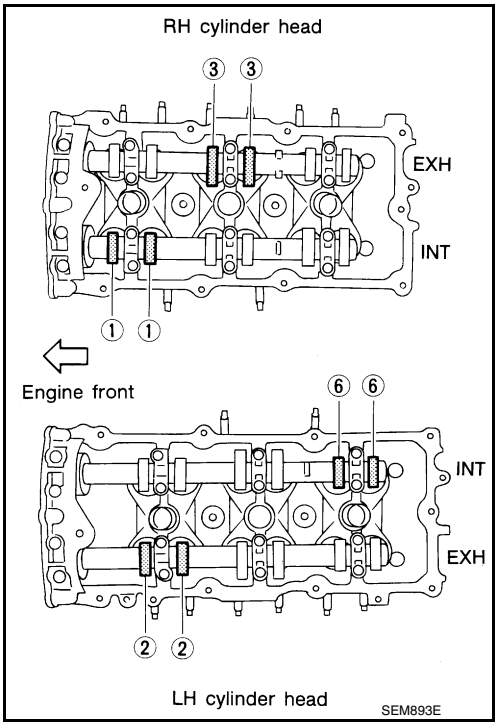


b. Check that the valve lifters on No.1 cylinder are loose and valve lifters on No.4 are tight. If not, turn the crankshaft one full revolution (360°) and align as shown.



6. Check only the valves as shown.

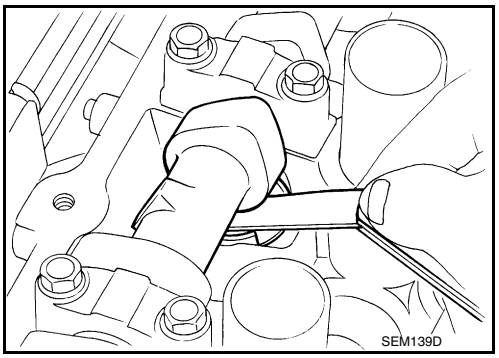
Crank Position	Valve No. 1	Valve No. 2	Valve No. 3	Valve No. 6
No. 1 TDC	Intake	Exhaust	Exhaust	Intake

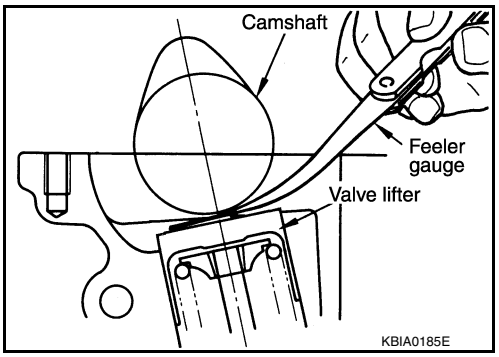


a. Measure the clearance between the valve lifter and camshaft using suitable tool.

Valve clearance : Refer to EM-252, "General Specification".

b. Record any valve clearance measurements which are out of specification. They will be used later to determine the required replacement lifter size.

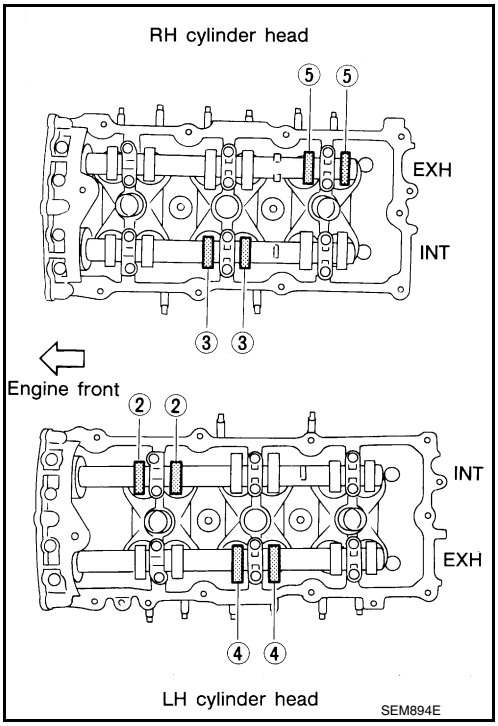




7. Turn crankshaft 240°.
8. Set No.3 cylinder at TDC on its compression stroke.

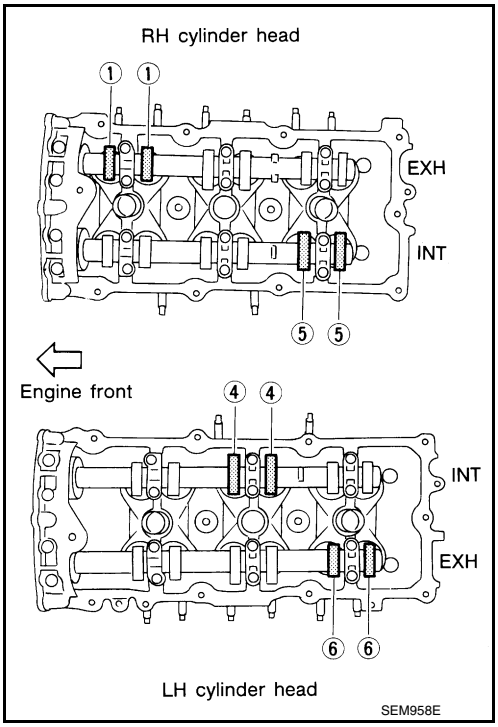
9. Check only those valves as shown.

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



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

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



13. Perform adjustment if the measured values are out of the specification range.
14. Installation of components is in the reverse order of removal.

VALVE ADJUSTING

CAUTION:

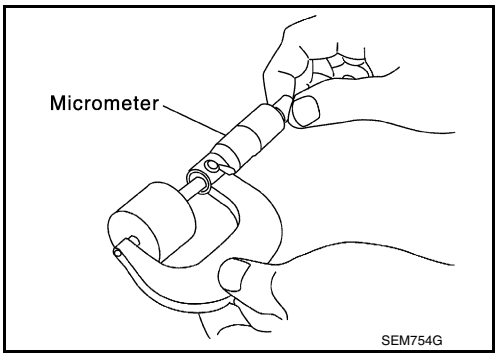
Adjust valve clearance while engine is cold.

NOTE:

- Perform adjustment by selecting the correct head thickness of the valve lifter (adjusting shims are not used).

- The specified valve lifter thickness dimension is measured at room temperature.
- Use specifications for hot engine for hot engine condition to confirm valve clearances.

1. Remove the camshaft.
2. Remove the valve lifter that was measured as being outside the standard specifications.
3. Measure the center thickness of the removed valve lifter using suitable tool as shown.



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

Valve lifter thickness calculation: **$(C_1 – C_2) + t1=t$**

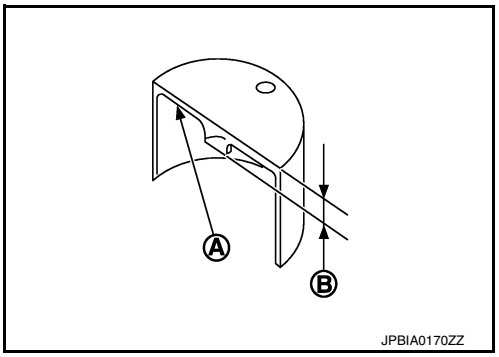
C_1 = measured valve clearance

C_2 = standard valve clearance

t_1 = thickness of the removed valve lifter

t = thickness of the replacement valve lifter

a. The thickness of the new valve lifter can be identified by the stamp mark (A) on the reverse side (inside the valve lifter).
NOTE:
Available thicknesses of the valve lifters (B) are: 7.88 - 8.40 mm (0.3102 - 0.3307 in), in 0.02 mm (0.0008 in) increments. Refer to EM-253, "Camshaft"



5. Install the selected replacement valve lifter.
6. Install the camshaft.
7. Rotate the crankshaft a few turns by hand.
8. Confirm that the valve clearances are within specification.
9. After the engine has been run to full operating temperature, confirm that the valve clearances are within specification.

Standard Valve Clearance	Cold[1] (reference data)	Hot[2] (reference data)
Intake	0.26 - 0.34 mm (0.010 - 0.013 in)	0.304 - 0.416 mm (0.012 - 0.016 in)
Exhaust	0.29 - 0.37 mm (0.011 - 0.015 in)	0.308 - 0.432 mm (0.012 - 0.017 in)

[1] : Approximately 20°C (68°F)

[2] : Approximately 80°C (176°F)

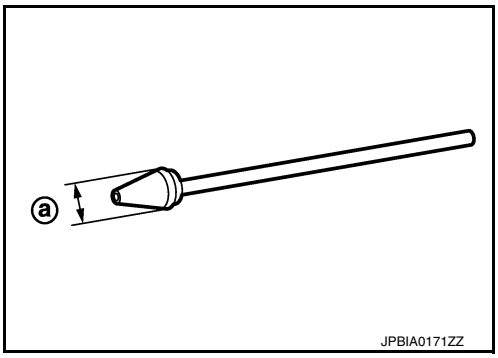
COMPRESSION PRESSURE

On-Vehicle Service

INFOID:0000000012602016

CHECKING COMPRESSION PRESSURE

1. Run the engine until it reaches normal operating temperature.
2. Turn the ignition switch to OFF.
3. Release fuel pressure and leave the fuel pump electrically disconnected.
   Refer to EC-736, "Work Procedure".
4. Remove all six spark plugs.
   Refer to EM-134, "Removal and Installation".
5. Install the compression tester with the adapter into the spark plug hole.
   - Use compression tester whose end (a) (rubber portion) is smaller than 20 mm (0.79 in) in diameter. Otherwise, it may be caught by cylinder head during removal.



6. Depress accelerator pedal fully to keep the electric throttle control actuator butterfly-valve wide open to maximize air intake flow.
7. Crank the engine and record the highest gauge indication.
8. Repeat the measurement on each cylinder (steps 5 - 7).
   NOTE:
   Always use a fully charged battery to obtain specified engine speed.

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

Standard	Minimum	Difference limit between cylinders
1,275 (13.0, 185)/300	981 (10.0, 142)/300	98 (1.0, 14)/300

9. If compression in one or more cylinders is low:

a. Pour a small amount of engine oil into cylinders through the spark plug holes.

b. Retest compression (steps 5 - 8).

- If adding oil helps raise compression pressure, then the piston rings may be worn or damaged. If so, replace piston rings after checking piston.
- If the pressure stays low, a valve may be sticking or is seating improperly. Inspect and repair the valve and/or valve seat. Refer to EM-218, "Inspection After Disassembly". If the valve and/or valve seat is damaged replace as necessary.
- If compression stays low in two or more cylinders that are next to each other:

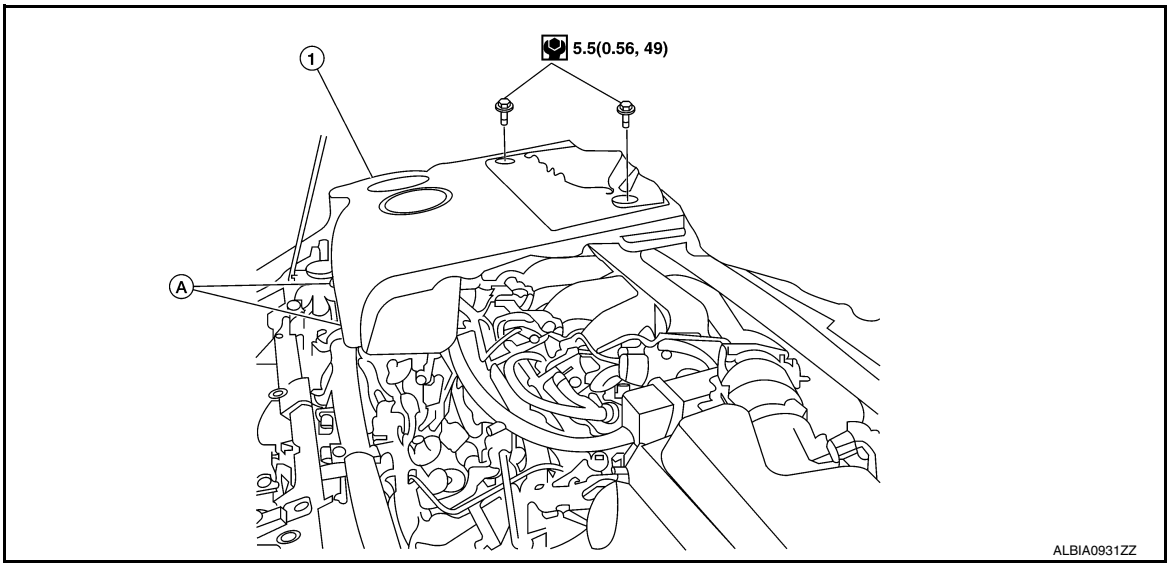
- The cylinder head gasket may be leaking.
- Both cylinders may have valve component damage. Inspect and repair as necessary.

REMOVAL AND INSTALLATION

ENGINE ROOM COVER

Exploded View

INFOID:0000000012602017



1. Engine room cover
A. Engine room cover locking tabs

Removal and Installation

INFOID:0000000012602018

CAUTION:
Do not damage or scratch engine room cover when installing or removing.

REMOVAL

1. Remove front air duct. Refer to EM-146, "Removal and Installation".
2. Remove engine room cover bolts.
3. Remove engine room cover by lifting straight up releasing engine room cover locking tabs.

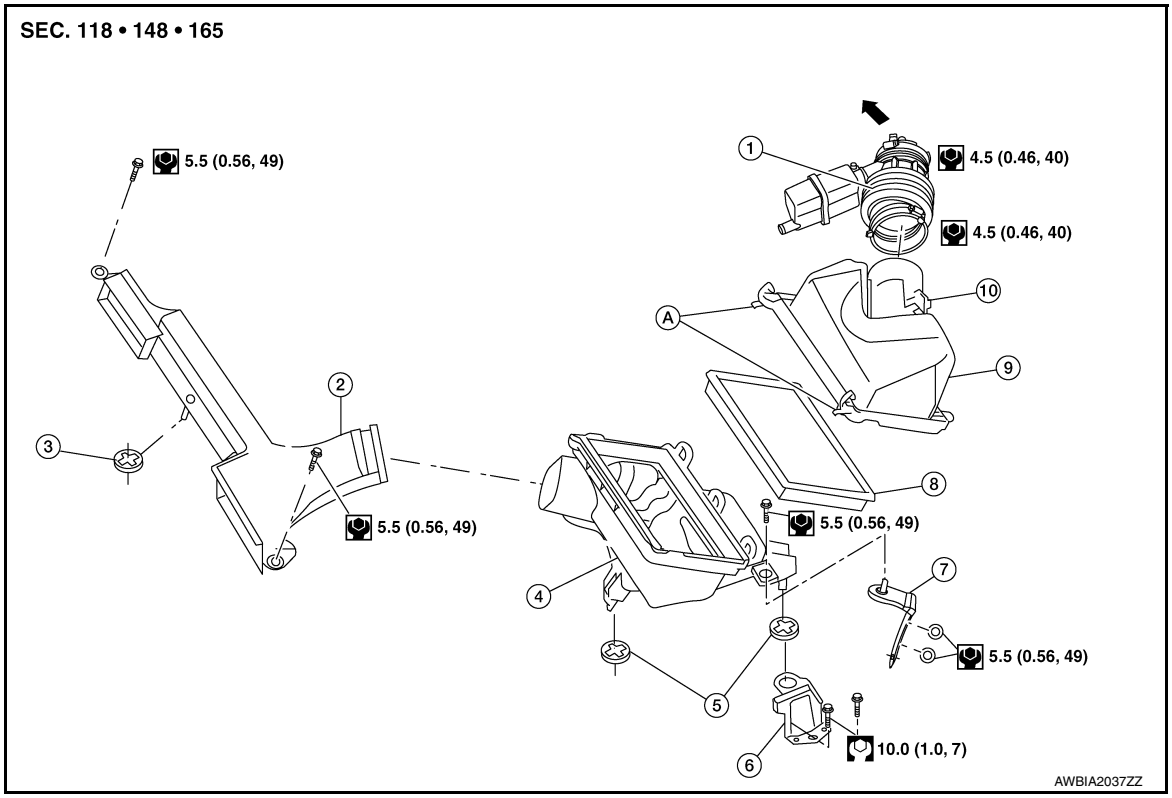
INSTALLATION

Installation is in the reverse order of removal.

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:0000000012602019



1. Air duct hose and resonator assembly	2. Front air duct	3. Grommet
4. Air cleaner case (lower)	5. Grommets	6. Air cleaner case mounting bracket
7. Bracket	8. Air cleaner filter	9. Air cleaner case (upper)
10. Mass air flow sensor	A. Air cleaner case (upper) side clips	⬅ To electric throttle control actuator

Removal and Installation

INFOID:0000000012602020

REMOVAL

1. Remove engine room cover. Refer to EM-145, "Removal and Installation".
2. Remove core support cover. Refer to EXT-24, "Exploded View".
3. Remove duct sub-cover and front air duct.
4. Disconnect the blow-by hose.
5. Disconnect the tube clamp at the electric throttle control actuator and at the air duct hose and resonator assembly.
6. Remove air duct hose and resonator assembly.
7. Disconnect the harness connector from mass air flow sensor.
8. Remove mass air flow sensor from air cleaner assembly (if necessary).
   CAUTION:
   Handle mass air flow sensor with care.
   - **Do not shock it.**
   - **Do not disassemble it.**
   - **Do not touch its sensor.**
9. Disconnect transaxle breather hose.
10. Remove air cleaner assembly.

INSPECTION AFTER REMOVAL

Inspect air cleaner case assembly, front air duct, air duct hose and resonator assembly for cracks or tears. Replace as necessary.

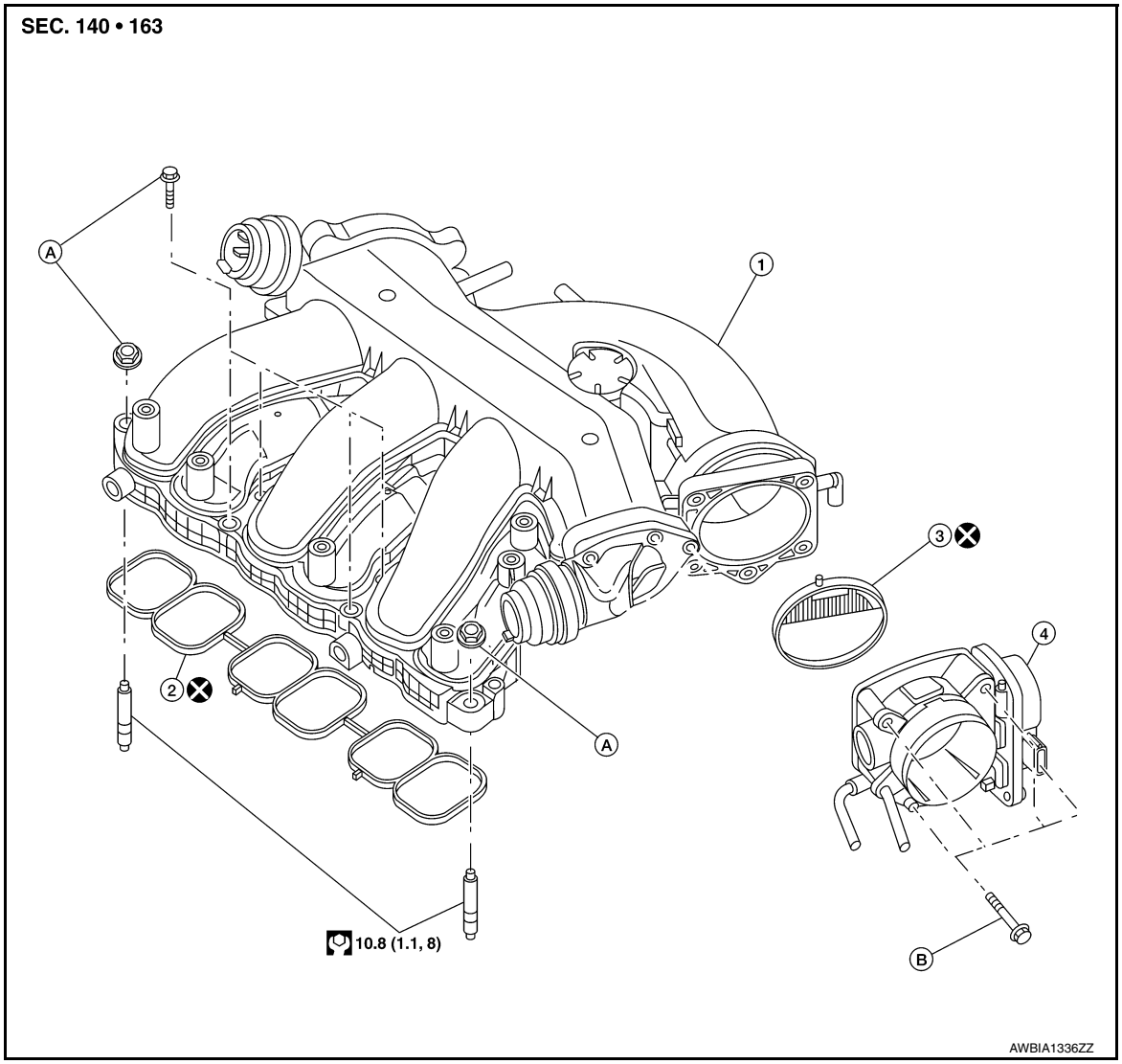
INSTALLATION

Installation is in the reverse order of removal.

INTAKE MANIFOLD COLLECTOR

Exploded View

INFOID:0000000012602021



1. Intake manifold collector
2. Intake manifold collector gasket
3. Electric throttle control actuator gasket
4. Electric throttle control actuator
A. Refer to INSTALLATION
B. Refer to INSTALLATION

Removal and Installation

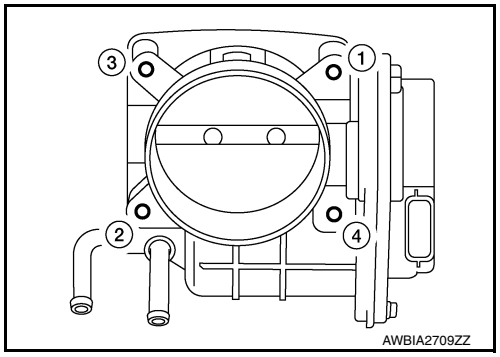
INFOID:0000000012602022

REMOVAL

WARNING:
To avoid the danger of being scalded, do not drain the coolant when the engine is hot.
CAUTION:
Do not remove power valves.
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

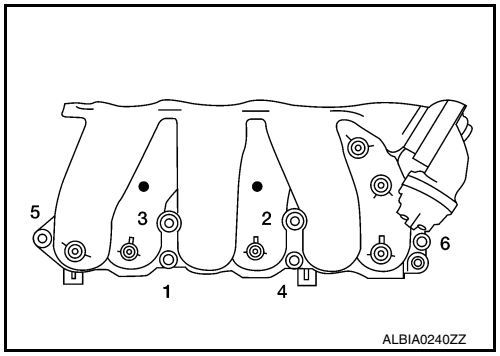
1. Remove the cowl top. Refer to EXT-34, "Removal and Installation".
2. Remove the strut tower bar. Refer to FSU-18, "Exploded View".
3. Remove the engine room cover. Refer to EM-145, "Removal and Installation".

4. Remove front air duct and air duct hose and resonator assembly. Refer to EM-146, "Removal and Installation".
5. Partially drain the engine coolant. Refer to CO-35, "Changing Engine Coolant".
   NOTE:
   This step is only required when removing electric throttle control actuator from the vehicle.
6. Remove the electric throttle control actuator bolts in the reverse order as shown and remove the electric throttle control actuator and position aside.
   CAUTION:
   - **Handle carefully to avoid any shock to the electric throttle control actuator.**
   - **Do not disassemble the electric throttle control actuator.**



7. Disconnect the following:
   - Power brake booster vacuum hose
   - Fuel injector harness connectors
   - PCV hose
   - Electric throttle control actuator harness connector
   - EVAP canister purge hose

   CAUTION:
   Cover any engine openings to avoid the entry of any foreign material.
8. Remove the EVAP canister purge volume solenoid valve bracket bolt. Position the valve aside.
9. Loosen the intake manifold collector nuts and bolts in the reverse order as shown using power tool, and remove the intake manifold collector and gasket.



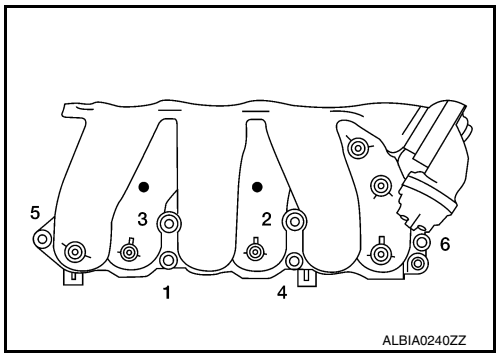
10. If necessary remove the following components:
    - VIAS control solenoid valve
    - EVAP canister purge volume control solenoid valve

INSTALLATION

CAUTION:
Do not reuse intake manifold collector gasket or electric throttle control actuator gasket.
Installation is in the reverse order of removal.

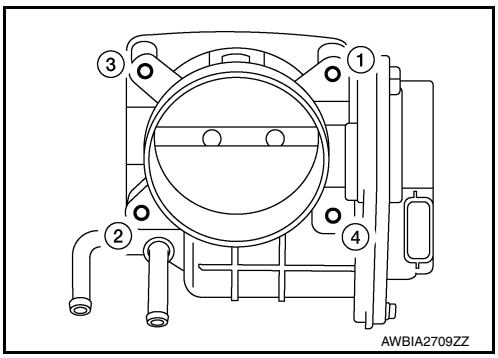
- Tighten intake manifold collector nuts and bolts in the order as shown.

Nuts and bolts :11.0 N·m (1.1 kg-m, 8 ft-lb)



- Tighten electric throttle control actuator bolts in the order shown.

Bolts : 8.4 N·m (0.86 kg-m, 74 in-lb)



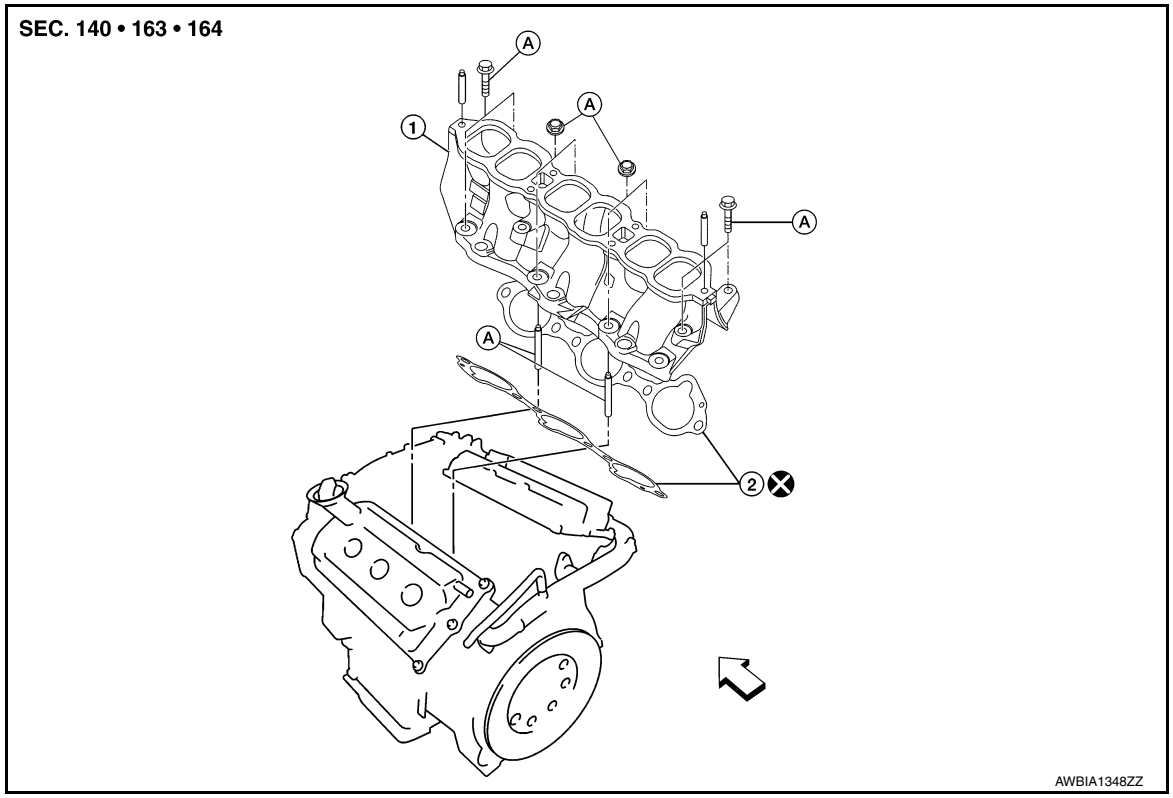
NOTE:
After installation, it is necessary to re-calibrate the electric throttle control actuator as follows:

1. Perform the ″Throttle Valve Closed Position Learning″ when harness connector of the electric throttle control actuator is disconnected. Refer to EC-731, "Description".
2. Perform the ″Idle Air Volume Learning″ when the electric throttle control actuator is replaced. Refer to EC-732, "Description".

INTAKE MANIFOLD

Exploded View

INFOID:0000000012602023



1. Intake manifold
2. Intake manifold gaskets
A. Refer to INSTALLATION

⇦ Engine front

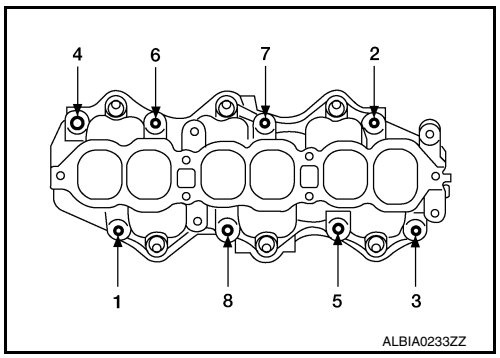
Removal and Installation

INFOID:0000000012602024

REMOVAL

WARNING:
To avoid the danger of being scalded, do not drain the coolant when the engine is hot.
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

1. Remove fuel injectors and fuel tube. Refer to EM-167, "Removal and Installation".
2. Remove the intake manifold and the intake manifold gaskets. Loosen nuts and bolts in reverse order as shown.
   CAUTION:
   Cover the engine openings to avoid the entry of foreign materials.

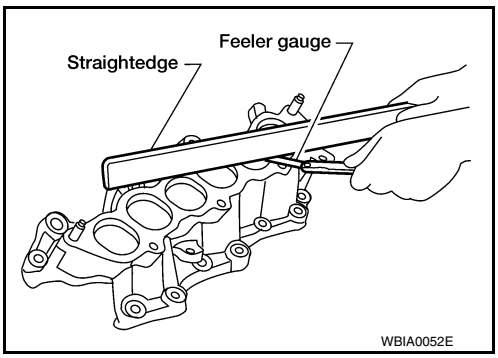


INSPECTION AFTER REMOVAL

Surface Distortion

Using straightedge and feeler gauge, inspect the surface distortion of the intake manifold. Refer to EM-148, "Removal and Installation".

Standard : 0.1 mm (0.004 in)



INSTALLATION

Installation is in the reverse order of removal.

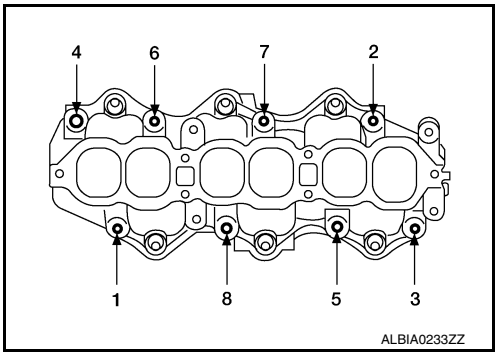
CAUTION:

Do not reuse intake manifold gaskets.

- Install intake manifold nuts and bolts in two steps in the numerical order as shown.

Step 1 : 7.4 N·m (0.75 kg-m, 65 in-lb)

Step 2 : 25.5 N·m (2.6 kg-m, 19 ft-lb)



INSPECTION AFTER INSTALLATION

Make sure there are no fuel leaks at the connections as follows:

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

   WARNING:

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

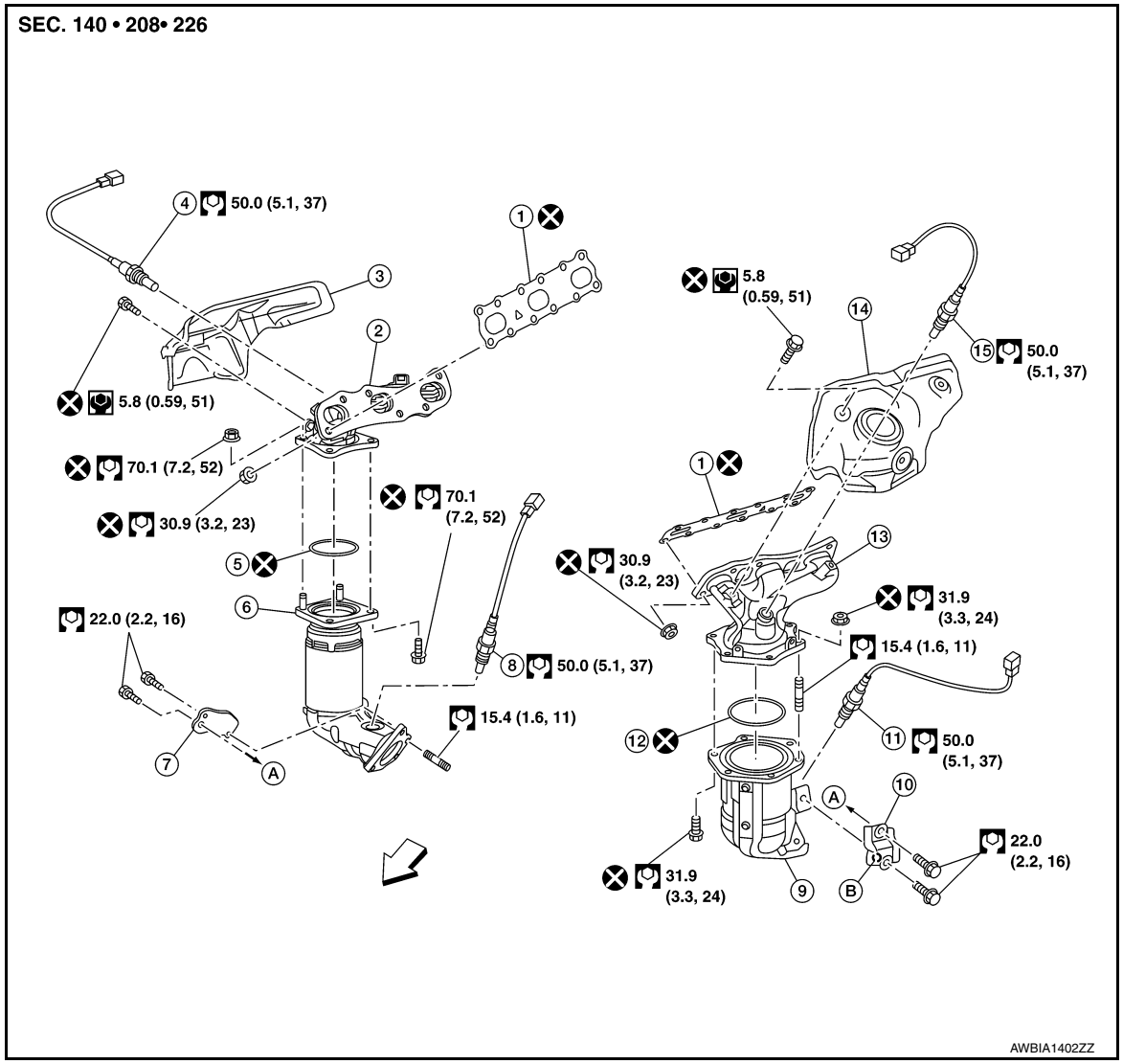
   NOTE:

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

EXHAUST MANIFOLD AND THREE WAY CATALYST

Exploded View

INFOID:0000000012602025



1.	Gasket	2.	Exhaust manifold (bank 1)	3.	Exhaust manifold heat shield (bank 1)
4.	Air fuel ratio sensor 1 (bank 1)	5.	Ring gasket	6.	Three way catalyst (bank 1)
7.	Three way catalyst support (bank 1)	8.	Heated oxygen sensor 2 (bank 1)	9.	Three way catalyst (bank 2)
10.	Three way catalyst support (bank 2)	11.	Heated oxygen sensor 2 (bank 2)	12.	Ring gasket
13.	Exhaust manifold (bank 2)	14.	Exhaust manifold heat shield (bank 2)	15.	Air fuel ratio sensor 1 (bank 2)
A.	To oil pan (upper)	B.	Upper mark	⇦	Engine front

Removal and Installation (bank 2)

INFOID:0000000012602026

REMOVAL

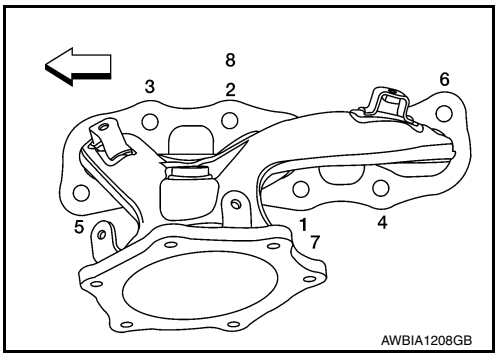
WARNING:

- **Perform the work when the exhaust system has completely cooled down.**
- **When removing the front and rear engine through bolts and nuts, lift the engine up slightly for safety.**

NOTE:

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

1. Remove the radiator. Refer to CO-37, "Removal and Installation".
2. Remove the three way catalyst. Refer to EM-157, "Removal and Installation (bank 2)".
3. Loosen and remove the exhaust manifold nuts in the reverse order as shown.



⇦ : Engine front

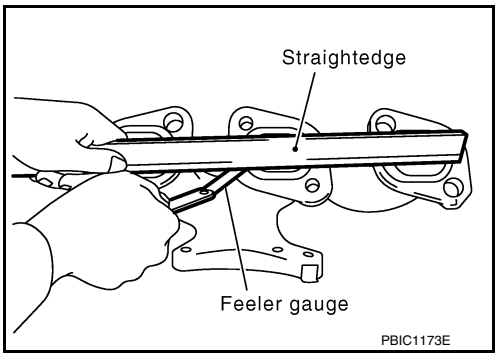
NOTE:
Number 7 and 8 are not applicable to removal.

4. Remove the exhaust manifold (bank 2) and gasket.

INSPECTION AFTER REMOVAL

Surface Distortion

- Use a suitable tool to check the flatness of the exhaust manifold mating surfaces as shown.



Limit : 0.3 mm (0.012 in)

- Replace the exhaust manifold if the measurement exceeds specifications.

INSTALLATION

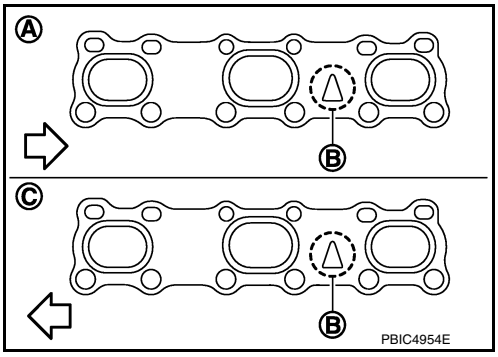
Installation is in the reverse order of removal.

1. Install the studs in the exhaust manifold (if removed), and tighten to specification.

Exhaust manifold studs : 15.4 N·m (1.6 kg-m, 11 ft-lb)

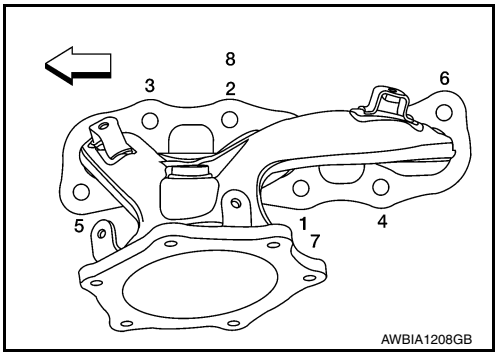
2. Install the exhaust manifold gasket in the direction shown.

CAUTION:
Do not reuse exhaust manifold gaskets.



(A) : Bank 1
(B) : Triangle press
(C) : Bank 2
⇦ : Engine front

3. Install the exhaust manifold (bank 2) nuts and tighten to specification in the order shown.



⇦ : Engine front

NOTE:
Number 7 and 8 are tightened a second time.

CAUTION:
- **Before installing a heated oxygen sensor 2 or air fuel ratio (A/F) sensor 1, clean the exhaust manifold threads using the oxygen sensor thread cleaner tool and apply anti-seize lubricant.**

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

- **Do not over-tighten the air fuel ratio (A/F) sensor 1 or heated oxygen sensors 2. Doing so may cause damage.**

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

Removal and Installation (bank 1)

INFOID:0000000012602027

REMOVAL

WARNING:
- **Perform the work when the exhaust and cooling system have completely cooled down.**
- **When removing the front and rear engine through bolts and nuts, lift the engine up slightly for safety.**

1. Remove the engine and transaxle assembly. Refer to EM-226, "Removal and Installation".
2. Remove the three way catalyst support (bank 1).
3. Remove rear engine mount bracket. Refer to EM-226, "Exploded View".
4. Remove heated oxygen sensor 2 (bank 1), air fuel ratio (A/F) sensor 1 (bank 1).

a. Disconnect the harness connector from heated oxygen sensor 2 (bank 1) and air fuel ratio (A/F) sensor 1, and remove the harness from the bracket and middle clamp.

b. Remove both heated oxygen sensors 2 (bank 1) and air fuel ratio (A/F) sensors 1 using Tool.

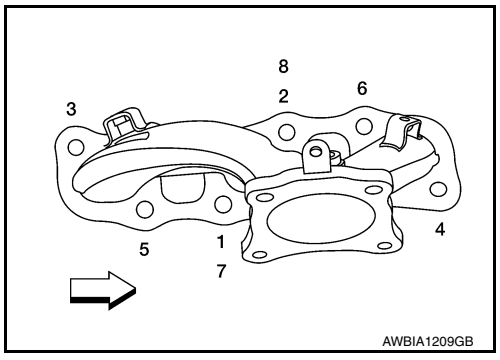
Tool numbers : KV10114400 (J-38365)
: KV991J0050 (J-44626)

CAUTION:
- **Do not damage heated oxygen sensors 2 or air fuel ratio (A/F) sensors 1.**
- **Discard any heated oxygen sensor 2 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.**

5. Remove exhaust manifold heat shield (bank 1) and three way catalyst heat shields (bank 1) using power tool.
6. Remove the three way catalyst (bank 1) by loosening the bolts first and then removing the nuts and through bolts.
7. Loosen the exhaust manifold nuts in the reverse order as shown and remove the exhaust manifold (bank 1).

⇦ : Engine front

NOTE:
Number 7 and 8 are not applicable to removal.

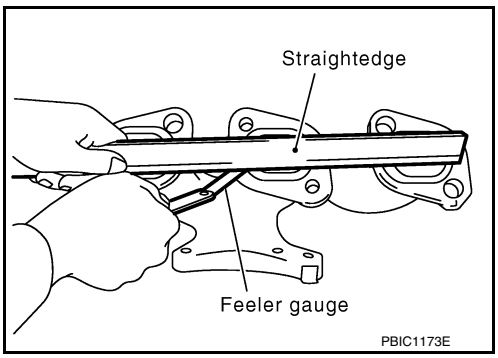


INSPECTION AFTER REMOVAL

Surface Distortion

Use a suitable tool to check the flatness of the exhaust manifold mating surfaces as shown.

Limit : 0.3mm (0.012 in)



INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

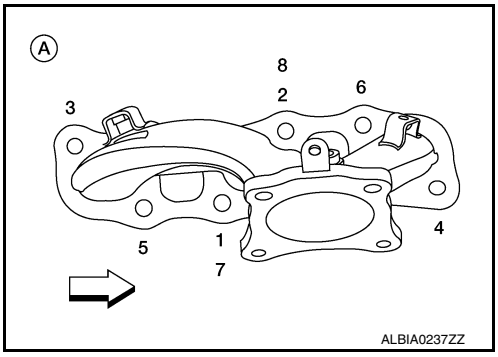
Do not reuse exhaust manifold gaskets.

- Install the exhaust manifold nuts in the order as shown (A).

⇦ : Engine front

NOTE:

Number 7 and 8 are tightened a second time.



CAUTION:

- **Before installing a heated oxygen sensor 2 or air fuel ratio (A/F) sensor 1, clean the exhaust manifold threads using the oxygen sensor thread cleaner tool, and apply anti-seize lubricant.**

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

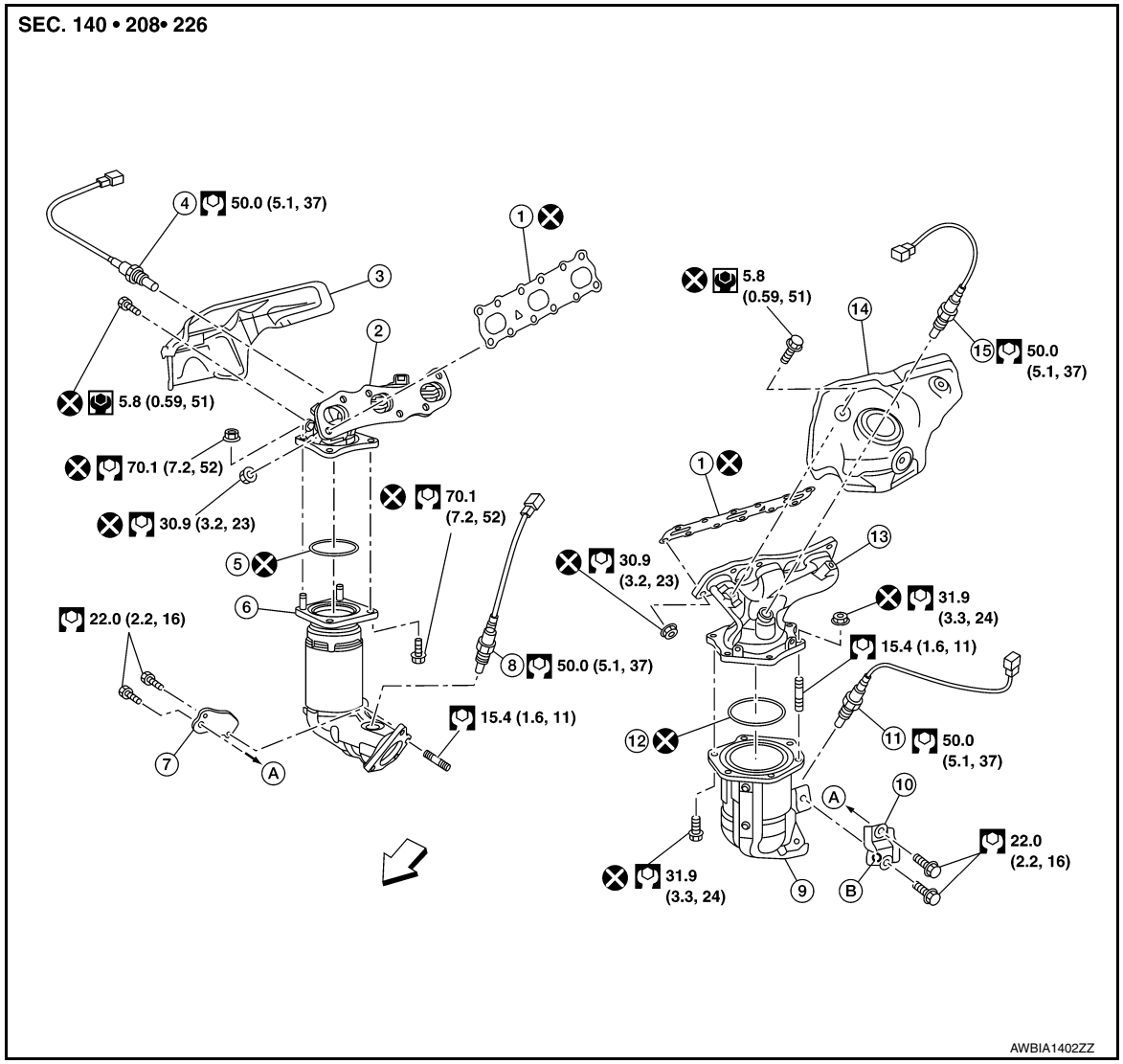
- **Do not over-tighten the air fuel ratio (A/F) sensor 1 or heated oxygen sensors 2. Doing so may cause damage.**

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

THREE WAY CATALYST

Exploded View

INFOID:0000000012602028



1.	Gasket	2.	Exhaust manifold (bank 1)	3.	Exhaust manifold heat shield (bank 1)
4.	Air fuel ratio sensor 1 (bank 1)	5.	Ring gasket	6.	Three way catalyst (bank 1)
7.	Three way catalyst support (bank 1)	8.	Heated oxygen sensor 2 (bank 1)	9.	Three way catalyst (bank 2)
10.	Three way catalyst support (bank 2)	11.	Heated oxygen sensor 2 (bank 2)	12.	Ring gasket
13.	Exhaust manifold (bank 2)	14.	Exhaust manifold heat shield (bank 2)	15.	Air fuel ratio sensor 1 (bank 2)
A.	To oil pan (upper)	B.	Upper mark	⇦	Engine front

Removal and Installation (bank 2)

INFOID:0000000012602029

REMOVAL

WARNING:

Perform the work when the exhaust system has completely cooled down.

NOTE:

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

1. Remove the fan shroud and motor assembly. Refer to CO-39, "Removal and Installation".

2. Remove radiator hose (upper). Refer to CO-37, "Exploded View".
3. Remove heater pipe. Refer to CO-48, "Exploded View".
4. Remove water bypass pipe. Refer to CO-48, "Exploded View".
5. Remove heater hose.
6. Remove front under cover. Refer to EXT-38, "FRONT UNDER COVER : Removal and Installation".
7. Remove the front exhaust tube. Refer to EX-10, "Exploded View".
8. Remove the three way catalyst support (bank 2).
9. Disconnect harness connectors from heated oxygen sensor 2 (bank 2) and air fuel ratio (A/F) sensor 1 (bank 2).
10. Remove heated oxygen sensor 2 (bank 2) (if necessary), using suitable tool.

CAUTION:
- **Do not damage heated oxygen sensor 2 (bank 2).**
- **Discard any heated oxygen sensor 2 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.**

11. Remove exhaust manifold heat shield (bank 2).
12. Remove the three way catalyst (bank 2) by loosening the bolts first and then removing the nuts and through bolts.
13. Remove the three way catalyst (bank 2) heat shield (if necessary).

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:
- **Before installing heated oxygen sensor 2 (bank 2), clean the exhaust manifold threads using the oxygen sensor thread cleaner tool and apply anti-seize lubricant.**

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

- **Do not over-tighten the heated oxygen sensor 2 (bank 2). Doing so may cause damage.**

NOTE:
After installation, it is necessary to re-calibrate the electric throttle control actuator as follows:
- Perform the "Throttle Valve Closed Position Learning" when harness connector of the ECM is disconnected. Refer to EC-731, "Description".
- Perform the "Accelerator Pedal Released Position Learning" when harness connector of the ECM is disconnected. Refer to EC-730, "Description".

Removal and Installation (bank 1)

INFOID:0000000012602030

REMOVAL

WARNING:
- **Perform the work when the exhaust system has completely cooled down.**
- **When removing the front and rear engine through bolts and nuts, lift the engine up slightly for safety.**

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

1. Remove intake manifold collector. Refer to EM-148, "Removal and Installation".
2. Remove the front fender protector side cover. Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".
3. Remove drive shaft (RH). Refer to FAX-13, "Removal and Installation (RH)".
4. Remove the front exhaust tube. Refer to EX-10, "Exploded View".
5. Disconnect harness connectors from heated oxygen sensor 2 (bank 1) and air fuel ratio (A/F) sensor 1 (bank 1).
6. Remove heated oxygen sensor 2 (bank 1) (if necessary), using suitable tool.
   CAUTION:
   - **Do not damage heated oxygen sensor 2 (bank 1).**
   - **Discard any heated oxygen sensor 2 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.**
7. Remove exhaust manifold heat shield (bank 1).

8. Remove the three way catalyst support (bank 1).
9. Remove the three way catalyst (bank 1) by loosening the bolts first and then removing the nuts and through bolts.
10. Remove the three way catalyst (bank 1) heat shield (if necessary).

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

- **Before installing heated oxygen sensor 2 (bank 1), clean the exhaust manifold threads using the oxygen sensor thread cleaner tool and apply anti-seize lubricant.**

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

- **Do not over-tighten the heated oxygen sensor 2 (bank 1). Doing so may cause damage.**

NOTE:

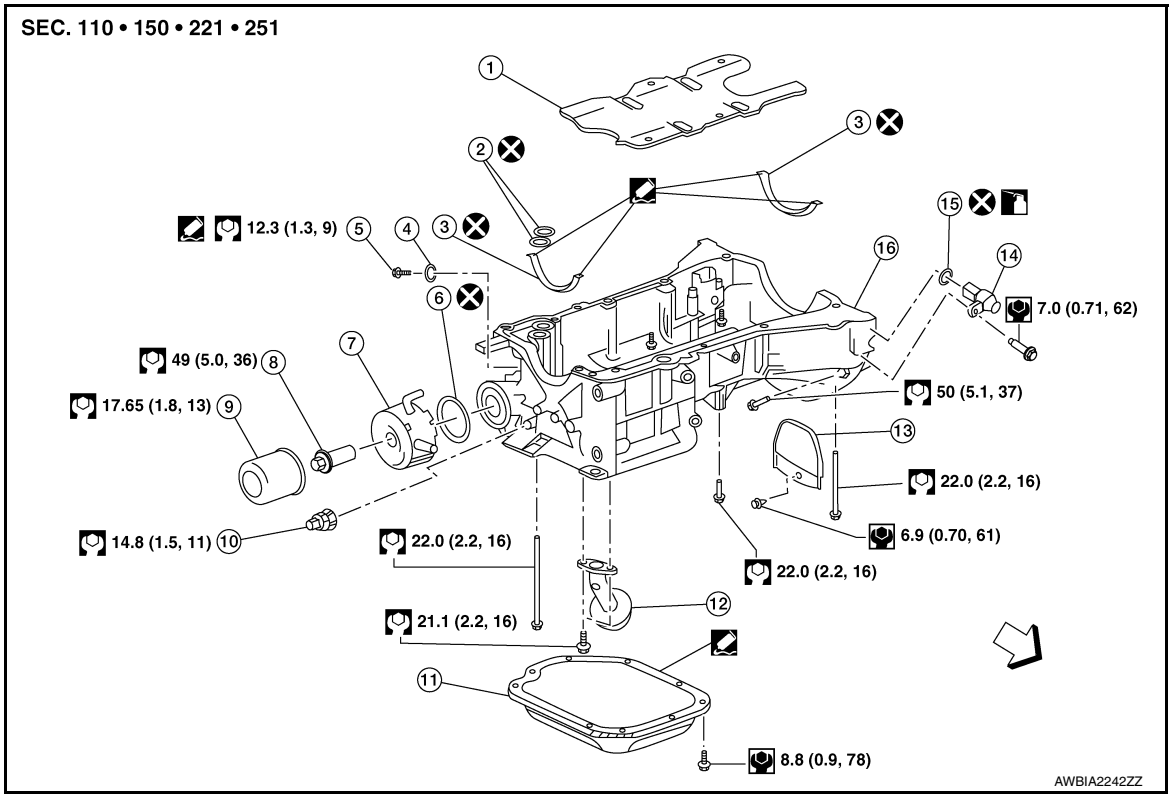
After installation, it is necessary to re-calibrate the electric throttle control actuator as follows:

- Perform the "Throttle Valve Closed Position Learning" when harness connector of the electric throttle control actuator is disconnected. Refer to EC-731, "Description".
- Inspect CVT fluid level. Refer to TM-185, "Inspection" (REOF10D) or TM-388, "Inspection" (REOF10H).

OIL PAN AND OIL STRAINER

Exploded View

INFOID:0000000012602031



1.	Oil pan baffle	2.	O-ring	3.	Upper oil pan gasket
4.	Blind plug O-ring	5.	Blind plug	6.	Oil cooler O-ring
7.	Oil cooler	8.	Oil cooler connection	9.	Oil filter
10.	Oil pressure switch	11.	Lower oil pan	12.	Oil strainer
13.	Rear cover plate	14.	Crankshaft position sensor (POS)	15.	O-ring
16.	Upper oil pan	⇦	Front		

Removal and Installation (Lower Oil Pan)

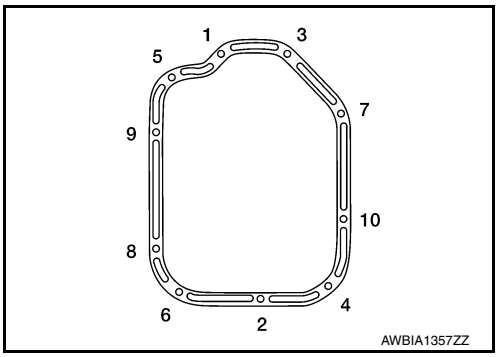
INFOID:0000000012602032

REMOVAL

WARNING:

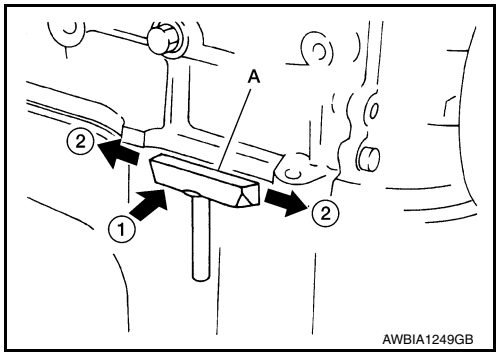
Do not remove the oil pan until the exhaust system and cooling system have completely cooled off.

1. Drain the engine oil. Refer to LU-29, "Changing Engine Oil".
2. Loosen the lower oil pan bolts in the reverse order as shown.



3. Remove the lower oil pan.

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



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

CAUTION:
- **Do not damage the mating surface.**
- **Do not insert a screwdriver or similar tool, this will damage the mating surfaces.**

b. In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the liquid gasket is applied. Use a plastic hammer to slide (2) the cutter by tapping on the side.

4. If re-installing the original lower oil pan, remove the old liquid gasket from the mating surfaces using a scraper.
   - Also remove the old liquid gasket from mating surface of the upper oil pan.
   - Remove the old liquid gasket from the bolt holes and threads.

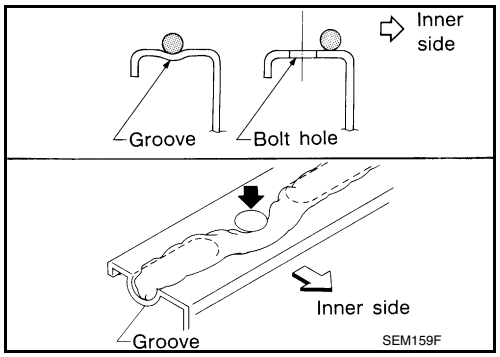
CAUTION:
Do not scratch or damage the mating surfaces when cleaning off the old liquid gasket.

INSPECTION AFTER REMOVAL

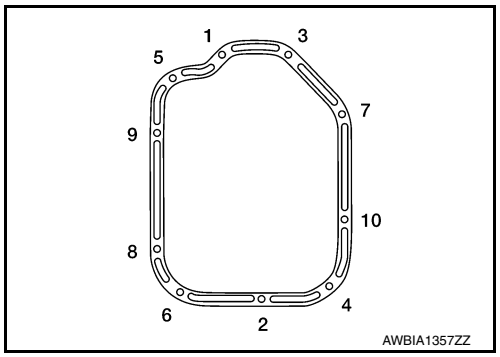
Clean oil strainer if any object is attached.

INSTALLATION

1. Apply a continuous bead of liquid gasket to the lower oil pan.
   - Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
   - Be sure the liquid gasket is 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
   - Installation must be done within 5 minutes after applying liquid gasket.



2. Install the lower oil pan. Tighten the lower oil pan bolts in order as shown.
   - Wait at least 30 minutes before refilling the engine with oil.



3. Refill the engine oil. Refer to LU-29, "Changing Engine Oil".

INSPECTION AFTER INSTALLATION

- Start the engine and check for leaks.
- Inspect the engine oil level. Refer to LU-28, "Inspection".

Removal and Installation (Upper Oil Pan)

INFOID:0000000012602033

REMOVAL

WARNING:
- **Do not remove the oil pan until the exhaust system and cooling system have completely cooled off.**
- **When removing the front and rear engine through bolts and nuts, lift the engine up slightly for safety. For engine slingers, refer to EM-226, "Removal and Installation".**

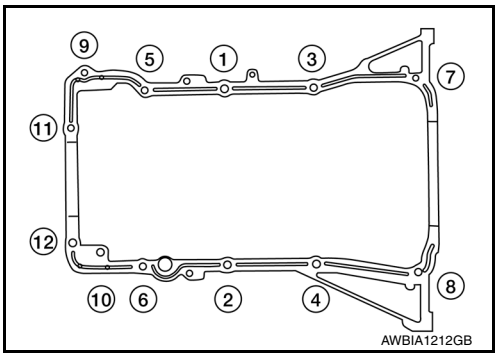
CAUTION:

- **When removing the upper oil pan from the engine, first remove the crankshaft position sensor (POS).**
- **Do not damage sensor edges or signal plate teeth.**

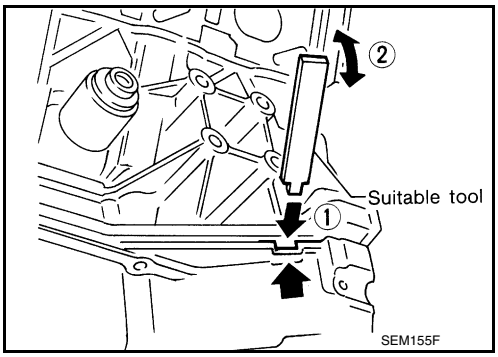
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

1. Remove the engine from the vehicle. Refer to EM-226, "Removal and Installation".
2. Drain the engine oil. Refer to LU-29, "Changing Engine Oil".
3. Remove the oil level gauge guide.
4. Remove the drive belt. Refer to EM-136, "Removal and Installation".
5. Disconnect the harness connector from A/C compressor.
6. Remove the A/C compressor bolts and remove the A/C compressor. Refer to HA-30, "COMPRESSOR : Removal and Installation".
7. Remove coolant pipe bolts. Refer to CO-48, "Removal and Installation".
8. Disconnect the coolant lines from the engine oil cooler.
9. Remove the oil filter and engine oil cooler from the upper oil pan.
10. Remove the oil pressure switch, and the crankshaft position sensor (POS) from the upper oil pan.
11. Remove the lower oil pan. Refer to EM-160, "Removal and Installation (Lower Oil Pan)".
12. Remove the upper oil pan.

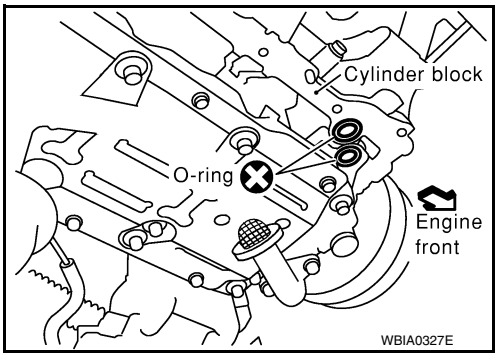
a. Loosen the bolts in the order as shown.



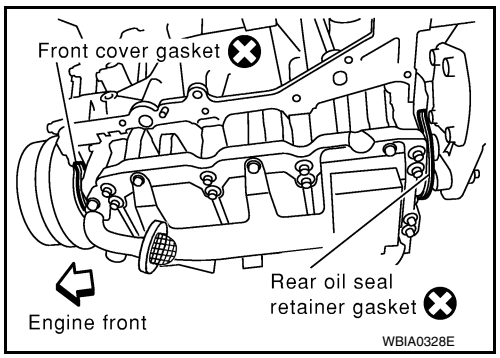
b. Insert an appropriate size tool into the notch (1) of the upper oil pan as shown.
c. Pry off the upper oil pan by moving the tool up and down (2) as shown.



13. Remove the O-ring seals from the bottom of the cylinder block and oil pump housing. Use new O-rings for installation.
CAUTION:
Do not reuse O-rings.

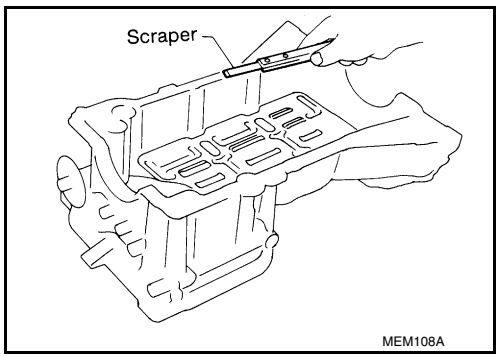


14. Remove front cover gasket and rear oil seal retainer gasket.
CAUTION:
Do not reuse gaskets.
15. Remove the oil strainer.



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

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

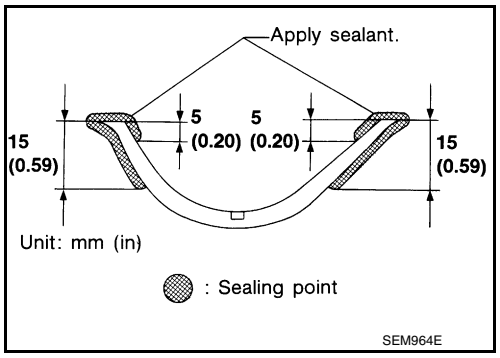


INSPECTION AFTER REMOVAL

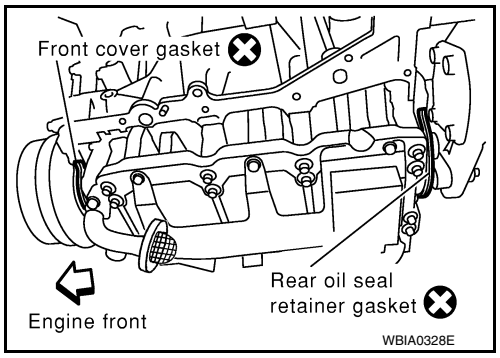
Clean oil strainer if any object is attached.

INSTALLATION

1. Install oil strainer and tighten bolts to specified torque. Refer to EM-160, "Exploded View".
2. Apply Genuine Silicone RTV Sealant or equivalent, to the front cover gasket and the rear oil seal retainer gasket as shown. Refer to GI-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 operating the engine.



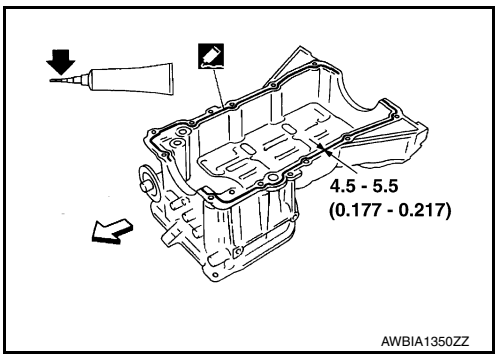
3. Install the front cover gasket and rear oil seal retainer gasket as shown.
CAUTION:
Do not reuse gaskets.



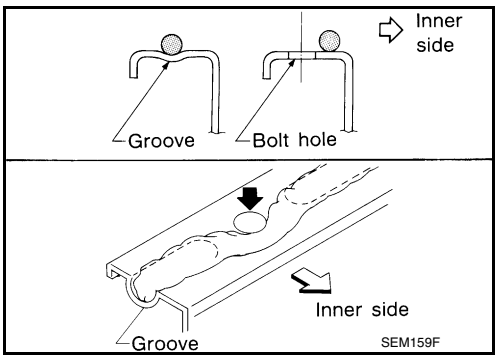
4. Apply a bead of sealant to the cylinder block mating surface of the upper oil pan to a limited portion as shown.
   - Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
   - Be sure the sealant is applied to a limited portion as shown, and the sealant is 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
   - Attaching should be done within 5 minutes after coating.

   ⇦ :Engine front

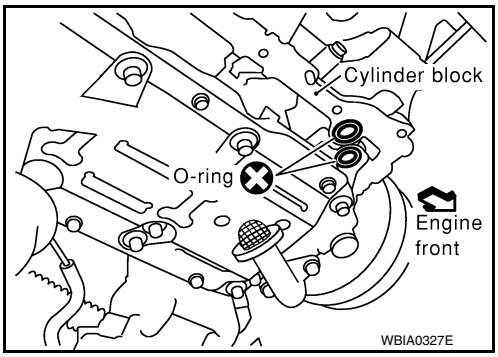
   ⬅ :Cut here



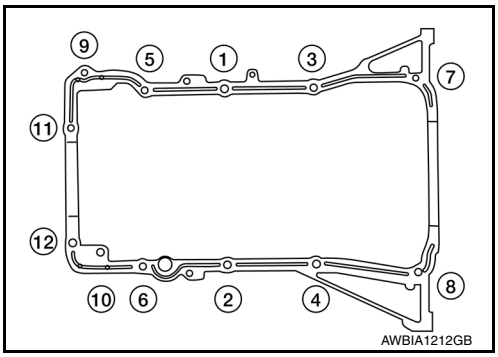
CAUTION:
The components must be installed within 5 minutes of the liquid gasket application. Then allow 30 minutes for the liquid gasket to set before operating the engine.



5. Install new O-rings on the cylinder block and oil pump body.
   CAUTION:
   Do not reuse O-rings.



6. Install the upper oil pan.
   - Tighten upper oil pan bolts in the order as shown.
   - Wait at least 30 minutes before refilling the engine with oil.



7. Install the lower oil pan. Refer to EM-160, "Removal and Installation (Lower Oil Pan)".
8. 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:

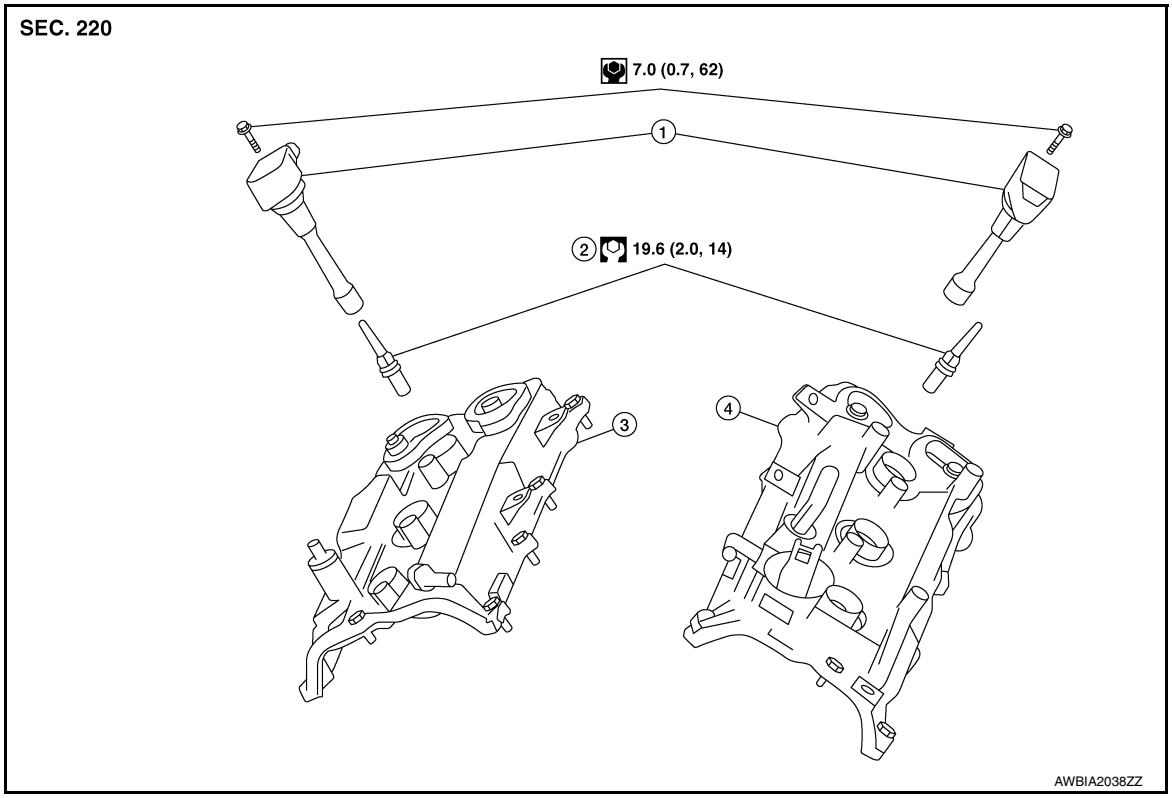
Item		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leaks	Level
Engine oil		Level	Leaks	Level
Transmission/ transaxle fluid	A/T and CVT Models	Leaks	Level/Leaks	Leaks
	M/T Models	Level/Leaks	Leaks	Level/Leaks
Other oils and fluids*		Level	Leaks	Level
Fuel		Leaks	Leaks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

*Power steering fluid, brake fluid, etc.

IGNITION COIL

Exploded View

INFOID:0000000012602034



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

Removal and Installation (bank 2)

INFOID:0000000012602035

REMOVAL

1. Remove engine room cover. Refer to EM-145, "Removal and Installation".
2. Disconnect the harness connector from ignition coil.
3. Remove the ignition coil.
   CAUTION:
   Do not shock ignition coil.

INSTALLATION

Installation is in the reverse order of removal.

Removal and Installation (bank 1)

INFOID:0000000012602036

REMOVAL

1. Disconnect the battery negative terminal. Refer to PG-78, "Removal and Installation".
2. Remove the intake manifold collector. Refer to EM-148, "Removal and Installation".
3. Disconnect the harness connector from ignition coil.
4. Remove the ignition coil.
   CAUTION:
   Do not shock ignition coil.

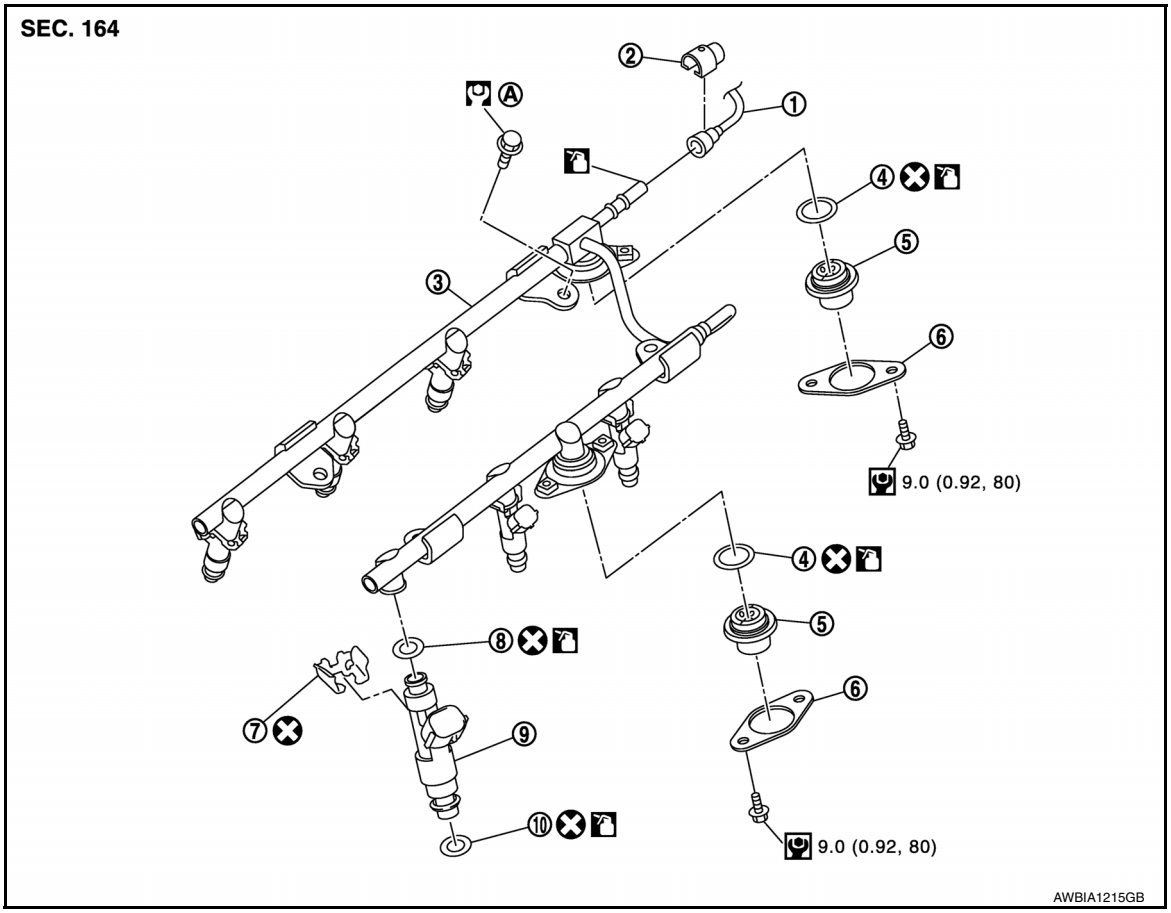
INSTALLATION

Installation is in the reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:0000000012602037



1. Fuel feed hose	2. Quick connector cap	3. Fuel tube
4. O-ring	5. Fuel damper	6. Fuel damper cap
7. Clip	8. O-ring (black)	9. Fuel injector
10. O-ring (green)	A. Refer to INSTALLATION	

Removal and Installation

INFOID:0000000012602038

REMOVAL

WARNING:
- **Put a "CAUTION: FLAMMABLE" sign in the workshop.**
- **Be sure to work in a well ventilated area and furnish workshop with a CO_2 fire extinguisher.**
- **Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.**
- **To avoid the danger of being scalded, do not drain engine coolant when engine is hot.**

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

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

1. Remove engine room cover. Refer to EM-145, "Removal and Installation".
2. Release the fuel pressure. Refer to EC-736, "Work Procedure".
3. Disconnect the battery negative terminal. Refer to PG-78, "Removal and Installation".
4. Remove front wiper arm and cowl top extension. Refer to EXT-34, "Removal and Installation".

5. Remove strut tower bar. Refer to FSU-18, "Exploded View".
6. Remove intake manifold collector. Refer to EM-148, "Removal and Installation".
7. When separating fuel feed hose and fuel tube connection, disconnect quick connector as follows:

a. Remove quick connector cap from quick connector.

b. Disconnect quick connector from fuel tube as follows:

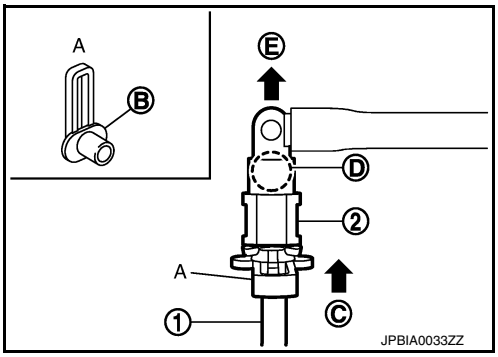
CAUTION:
Disconnect quick connector by using Tool (A), not by picking out retainer tabs.

Tool number : 16441 6N210 (J-45488)

i. With the sleeve side (B) of Tool (A) facing to quick connector, install the Tool (A) onto fuel tube.

ii. Insert the Tool (A) into quick connector (2) until sleeve (B) contacts and goes no further. Hold Tool (A) on that position.

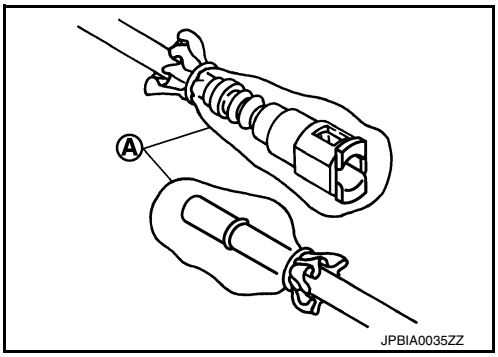
(C) : Insert and retain



CAUTION:
Inserting Tool (A) hard will not disconnect quick connector. Hold Tool (A) where it contacts and goes no further.

iii. Draw and pull out quick connector straight from fuel tube (1).

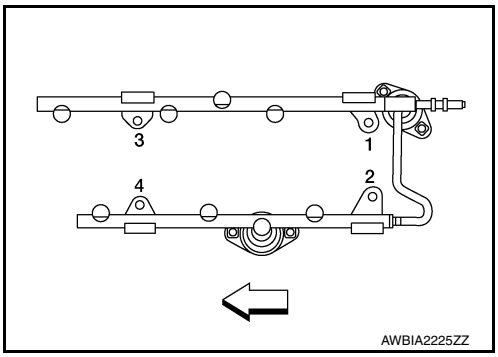
CAUTION:
- **Do not reuse O-ring.**
- **Pull quick connector (E) holding position (D) as shown.**
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Keep parts away from heat source. Especially, be careful when welding is performed around them.**
- **Do not expose parts to battery electrolyte or other acids.**
- **Do not bend or twist connection between quick connector and fuel feed hose (with damper) during installation/removal.**
- **To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags, etc. (A) or something similar.**



8. Disconnect harness connector from fuel injector.
9. Loosen bolts in reverse order as shown, and remove fuel tube and fuel injector assembly.

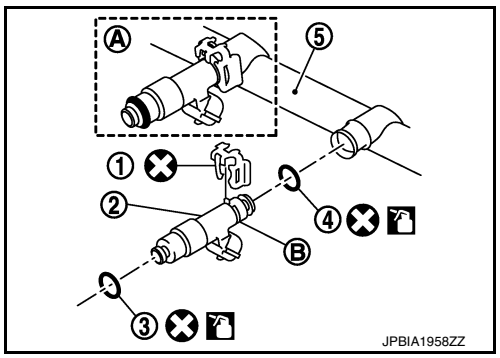
⇦ : Engine front

CAUTION:
Do not tilt fuel tube, or remaining fuel in pipes may flow out from pipes.



10. Remove fuel injector from fuel tube as follows:

a. Open and remove clip (1).



(3) : O-ring (green)
(4) : O-ring (black)
(A) : Installed condition
(B) : Clip groove

b. Remove fuel injector (2) from fuel tube (5) by pulling straight.

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

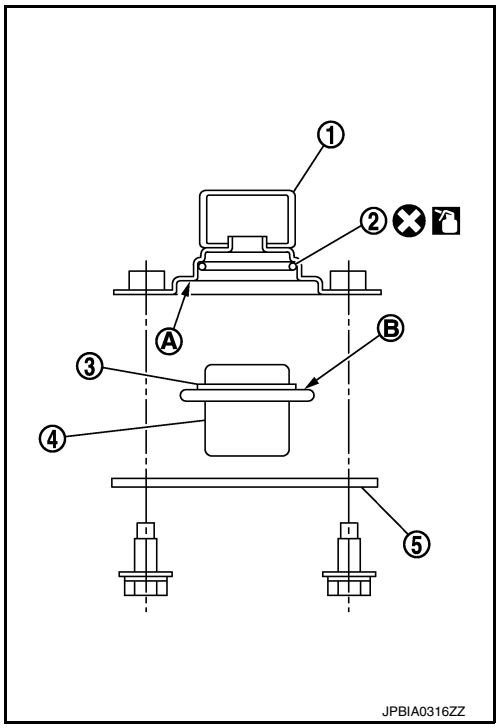
11. Remove fuel damper from fuel tube (if necessary).

INSTALLATION

1. Install fuel damper as follows:

a. Install new O-ring (2) to fuel tube (1) as shown. When handling new O-ring, be careful of the following:

CAUTION:
- **Do not reuse O-ring.**
- **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, do not scratch it with tool or fingernails. Also do not twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.**
- **Insert new O-ring straight into fuel tube. Do not twist it.**



b. Install spacer (3) to fuel damper (4).

c. Insert fuel damper straight into fuel tube.

CAUTION:
- **Insert straight, checking that the axis is lined up.**
- **Do not pressure-fit with excessive force.**

Reference value : 130 N (13.3 kg, 29.2 lb)

- **Insert fuel damper until (B) is touching (A) of fuel tube.**

d. Tighten bolts evenly in turn.
- After tightening bolts, check that there is no gap between fuel damper cap (5) and fuel tube.

2. Install new O-rings to fuel injector paying attention to the following.

CAUTION:
- **Do not reuse O-rings.**
- **Upper and lower O-rings are different. Do not confuse 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, do not scratch it with tool or fingernails. Also do not twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.**
- **Insert O-ring straight into fuel injector. Do not twist it.**

3. Install fuel injector to fuel tube as follows:

a. Insert clip (3) into clip groove (F) on fuel injector (5).

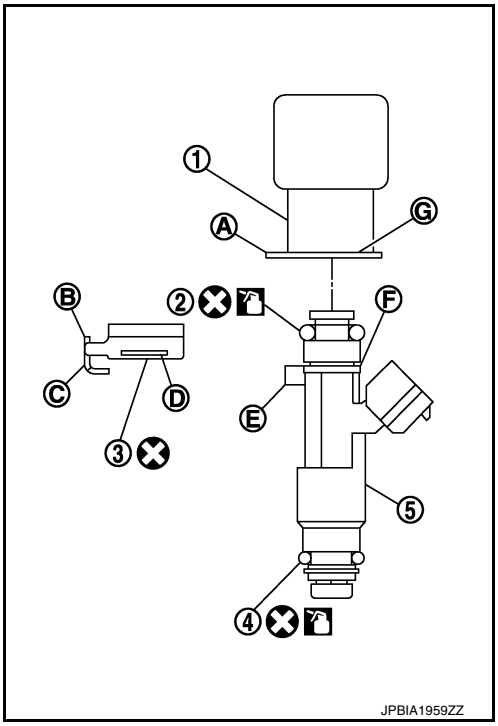
(2) : O-ring (black)
(4) : O-ring (green)

- Insert clip so that protrusion (E) of fuel injector matches cutout (C) of clip.

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

b. Insert fuel injector into fuel tube (1) with clip attached.
- Insert it while matching it to the axial center.
- Insert fuel injector so that protrusion (A) of fuel tube matches cutout (B) of clip.
- Check that fuel tube flange (G) is securely fixed in flange fixing groove (D) on clip.

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

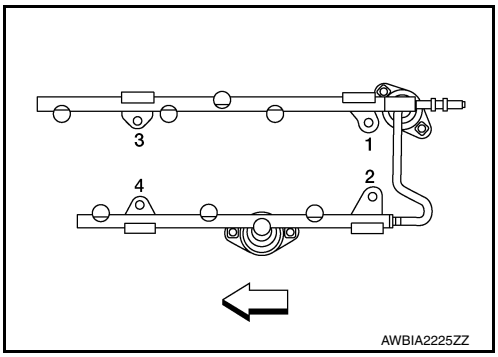


4. Install fuel tube and fuel injector assembly to intake manifold.

CAUTION:
Do not let tip of injector nozzle come in contact with other parts.
- Tighten bolts in two steps in numerical order as shown.

⇦ : Engine front

1st step : 10.1 N·m (1.0 kg-m, 7 ft-lb)
2nd step : 22.0 N·m (2.2 kg-m, 16 ft-lb)



5. Connect fuel injector harness.
6. Install intake manifold collector. Refer to EM-148, "Removal and Installation".
7. Connect quick connector between fuel feed hose and fuel tube connection with the following procedure:

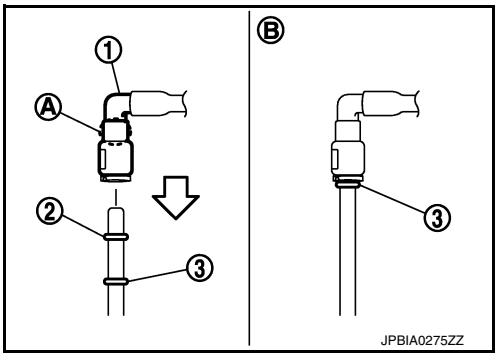
a. Check no foreign substances are deposited in and around fuel tube and quick connector, and no damage on them.

b. Thinly apply new engine oil around fuel tube from tip end to spool end.

c. Align center to insert quick connector straightly into fuel tube.
- Insert quick connector (1) to fuel tube until top spool (2) is completely inside quick connector, and 2nd level spool (3) exposes right below quick connector.

(B) : Installed condition
⇦ : Upright insertion

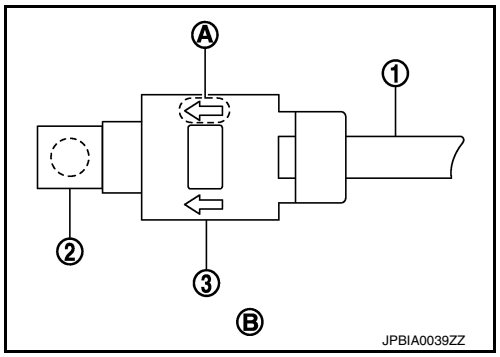
CAUTION:
- **Do not reuse O-ring.**
- **Hold (A) position as shown when inserting fuel tube into quick connector.**
- **Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.**



- **Insert until you hear a "click" sound and actually feel the engagement.**
- **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**

d. Pull quick connector by hand holding position. Check it is completely engaged (connected) so that it does not come out from fuel tube.

e. Install quick connector cap (3) to quick connector.



(1) : Fuel feed hose
(2) : Fuel tube
(B) : Upper view

- Install quick connector cap with arrow (A) on surface facing in direction of quick connector (fuel feed hose side).

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

f. Secure fuel feed hose to clamp of quick connector cap.

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

INSPECTION AFTER INSTALLATION

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

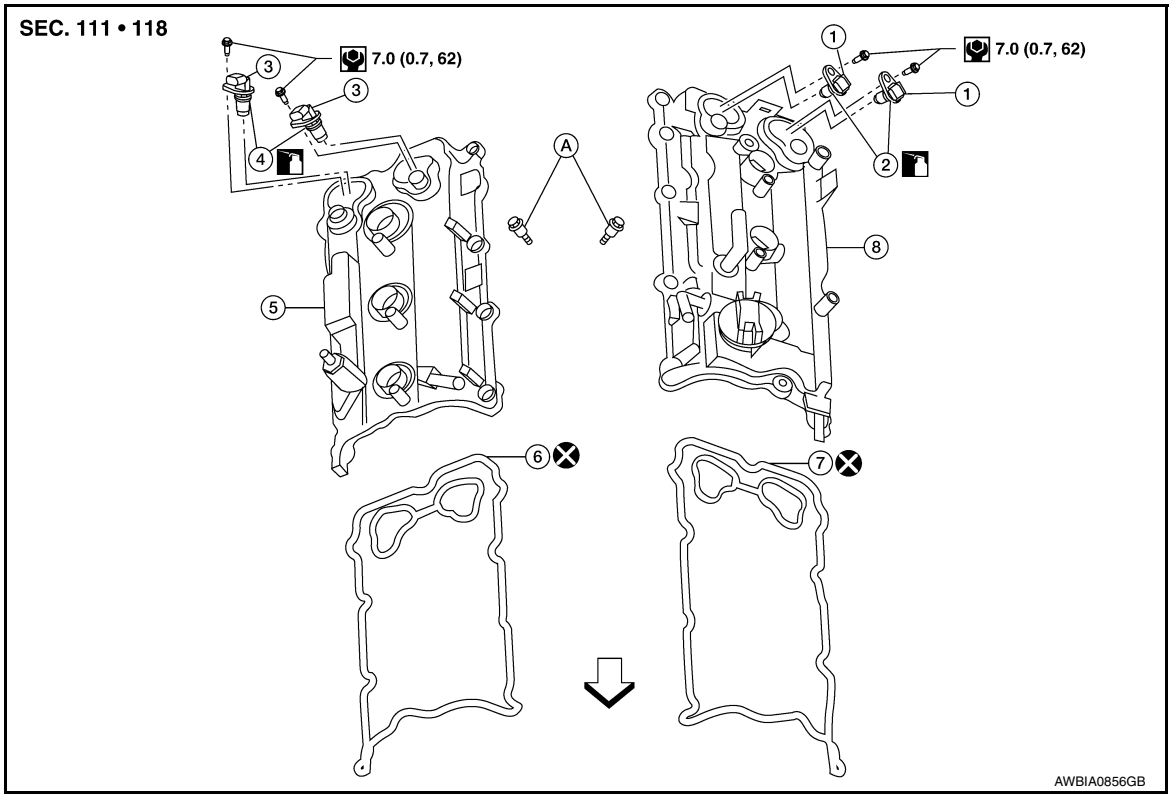
1. Apply fuel pressure to fuel lines by turning ignition switch ON (with engine stopped). Then check for fuel leaks at connections.
2. Start the engine and rev it up and check for fuel leaks at connections.

WARNING:
Do not touch engine immediately after stopping as engine is extremely hot.
NOTE:
Use mirrors for checking on connections out of the direct line of sight.

ROCKER COVER

Exploded View

INFOID:0000000012602039



1. Camshaft position sensor (bank 2)
2. O-ring
3. Camshaft position sensor (bank 1)
4. O-ring
5. Rocker cover (bank 1)
6. Rocker cover gasket (bank 1)
7. Rocker cover gasket (bank 2)
8. Rocker cover (bank 2)
A. Refer to INSTALLATION

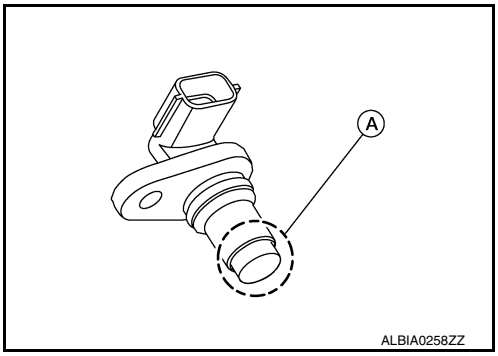
⇦ Engine front

Removal and Installation (bank 2)

INFOID:0000000012602040

REMOVAL

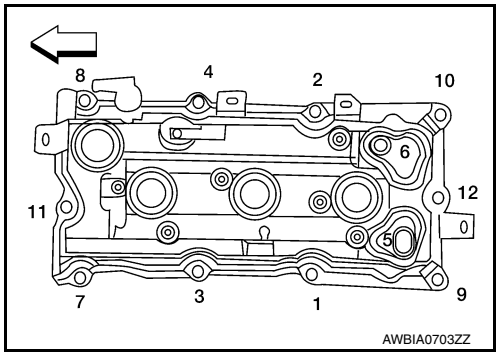
1. Remove front air duct. Refer to EM-146, "Removal and Installation".
2. Remove blow by hose and breather hose from rocker cover.
3. Remove camshaft position sensor (bank 2).
   CAUTION:
   - **Handle carefully to avoid dropping and shocks.**
   - **Do not disassemble.**
   - **Do not allow metal powder to adhere to magnetic part at sensor tip (A).**
   - **Do not place sensors in a location where they are exposed to magnetism.**



4. Disconnect the harness connectors from ignition coil.
5. Remove the ignition coils. Refer to EM-166, "Removal and Installation (bank 2)" (bank 2).
   CAUTION:
   Do not shock ignition coils.

6. Remove rocker cover bolts from cylinder head in reverse order as shown.

⇦ :Engine front



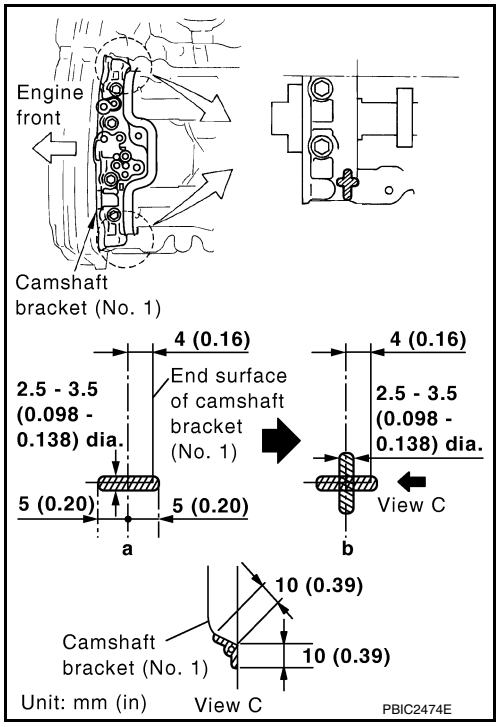
INSTALLATION

Installation is in the reverse order of removal.

- Apply sealant to the areas on the front corners using suitable tool.
- Use Genuine Silicone RTV Sealant or equivalent. Refer to EM-126, "Precaution for Liquid Gasket".

CAUTION:

The components must be installed within 5 minutes of the liquid gasket application. Then allow 30 minutes for the liquid gasket to set before operating the engine.



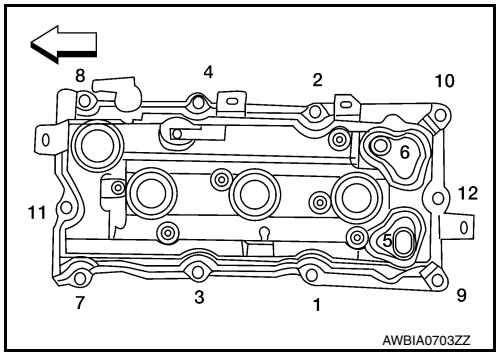
- Tighten the rocker cover bolts in two steps in the order as shown.

⇦ : Engine front

Rocker cover bolts

Step 1 : 1.96 N·m (0.20 kg-m, 17 in-lb)

Step 2 : 8.33 N·m (0.85 kg-m, 74 in-lb)



Removal and Installation (bank 1)

INFOID:0000000012602041

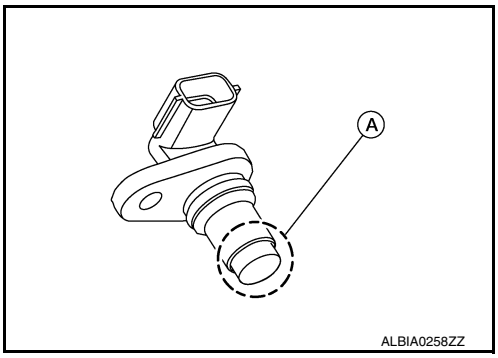
REMOVAL

1. Remove the engine room cover. Refer to EM-145, "Removal and Installation".
2. Remove the intake manifold collector. Refer to EM-148, "Removal and Installation".
3. Disconnect the harness connectors from ignition coil.
4. Remove ignition coils. Refer to EM-166, "Removal and Installation (bank 1)" (bank 1).

CAUTION:

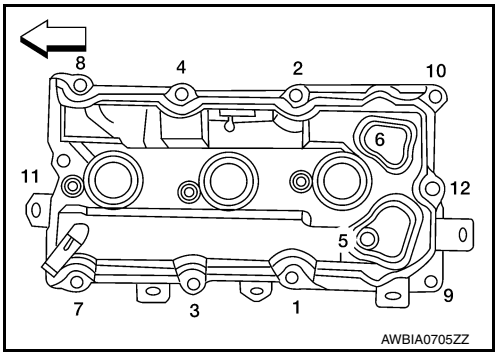
Do not shock ignition coils.

5. Remove blow by hose and breather hose from rocker cover.
6. Remove camshaft position sensor.



CAUTION:
- **Handle carefully to avoid dropping and shocks.**
- **Do not disassemble.**
- **Do not allow metal powder to adhere to magnetic part at sensor tip (A).**
- **Do not place sensors in a location where they are exposed to magnetism.**

7. Remove rocker cover bolts from cylinder head in reverse order as shown.



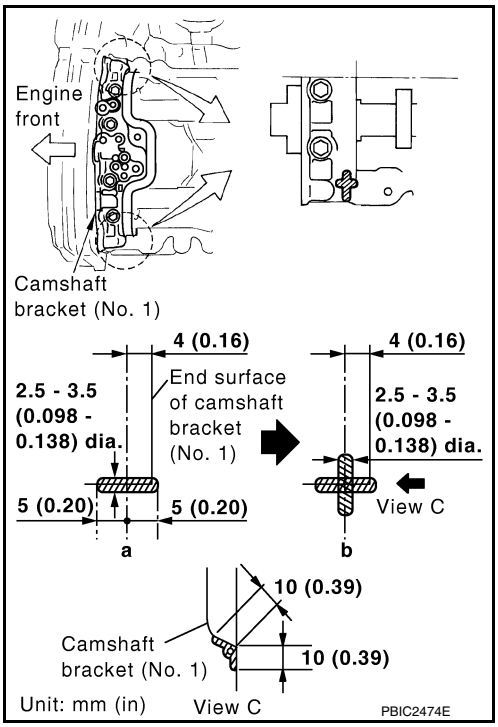
⇦ : Engine front

INSTALLATION

Installation is in the reverse order of removal.

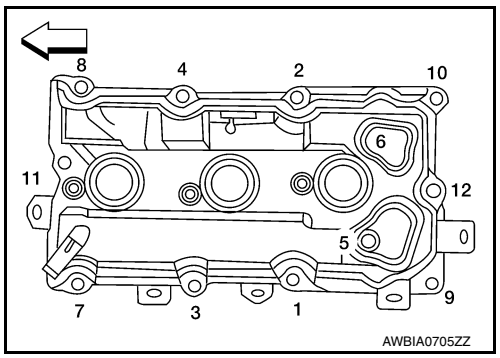
- Apply sealant to the areas on the front corners using suitable tool.
- Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

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 operating the engine.



- Tighten the rocker cover bolts in two steps in the order as shown.

⇦ : Engine front



Rocker cover bolts

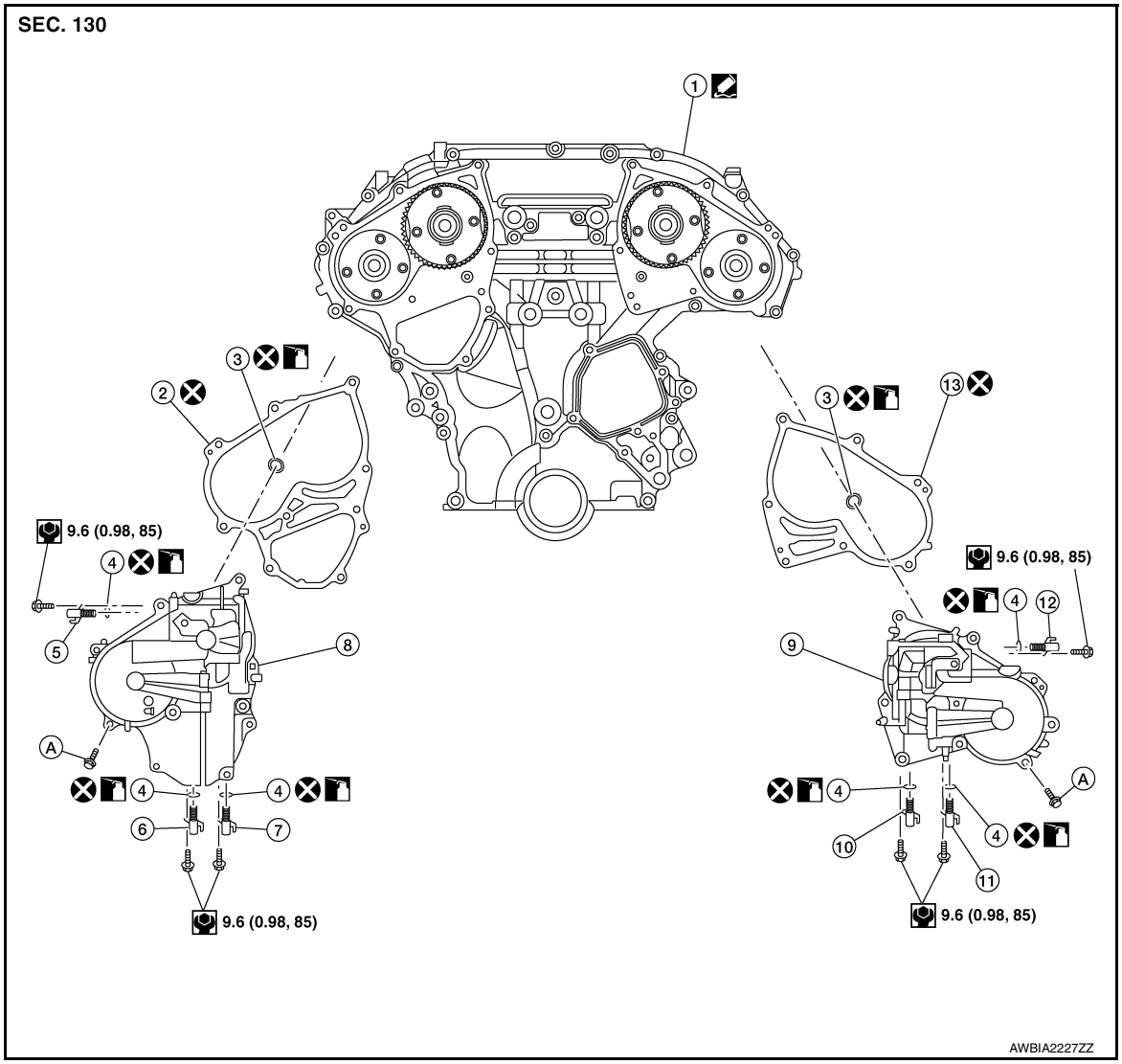
Step 1 : 1.96 N·m (0.20 kg-m, 17 in-lb)

Step 2 : 8.33 N·m (0.85 kg-m, 74 in-lb)

VALVE TIMING CONTROL

Exploded View

INFOID:0000000012602042



1.	Front timing chain case	2.	Valve timing control cover gasket (bank 1)	3.	O-ring
4.	O-ring	5.	Intake valve timing intermediate lock control solenoid valve (bank 1)	6.	Exhaust valve timing control solenoid valve (bank 1)
7.	Intake valve timing control solenoid valve (bank 1)	8.	Valve timing control cover (bank 1)	9.	Valve timing control cover (bank 2)
10.	Intake valve timing control solenoid (bank 2)	11.	Exhaust valve timing control solenoid (bank 2)	12.	Intake valve timing intermediate lock control solenoid valve (bank 2)
13.	Valve timing control cover gasket (bank 2)	A.	Refer to INSTALLATION		

Valve Timing Control Cover (bank 1)

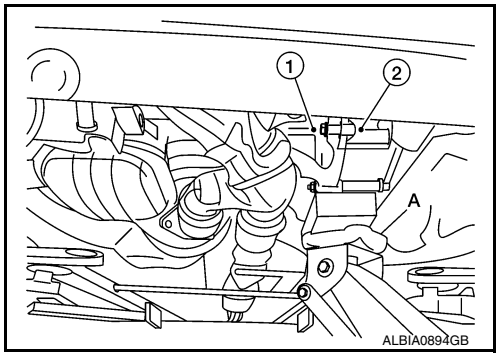
INFOID:0000000012602043

REMOVAL

1. Disconnect battery negative terminal. Refer to PG-82, "Exploded View".
2. Remove core support cover. Refer to EXT-24, "Exploded View".

3. Remove front air duct. Refer to EM-146, "Exploded View".
4. Remove cowl top. Refer to EXT-34, "Exploded View".
5. Remove strut tower brace.
6. Remove reservoir tank. Refer to CO-37, "Exploded View".
7. Remove power steering oil pump. Refer to ST-39, "Removal and Installation".
8. Support engine (1) and transaxle (2) using suitable jack (A).

CAUTION:
- **Position a suitable jack under the engine and transaxle assembly as shown.**
- **Do not damage the front exhaust tube or transaxle oil pan with the jack.**



9. Remove upper torque rod, engine mounting insulator (RH), and engine mounting bracket (RH). Refer to EM-226, "Removal and Installation".
10. Disconnect the harness connector from intake valve timing intermediate lock control solenoid valve (bank 1).
11. Disconnect the harness connector from exhaust valve timing control solenoid valve (bank 1).
12. Disconnect the harness connector from intake valve timing control solenoid valve (bank 1).
13. Remove intake valve timing intermediate lock control solenoid valve (bank 1), exhaust valve timing control solenoid valve (bank 1), and intake valve timing control solenoid valve (bank 1) from valve timing control cover (bank 1).

CAUTION:
Do not reuse O-rings.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:
- **Do not reuse O-rings.**
- **Lubricate O-rings with clean engine oil prior to installation.**

Valve Timing Control Cover (bank 2)

INFOID:0000000012602044

REMOVAL

1. Remove core support cover. Refer to EXT-24, "Exploded View".
2. Remove front air duct. Refer to EM-146, "Exploded View".
3. Remove reservoir tank. Refer to CO-37, "Exploded View".
4. Disconnect the harness connector from intake valve timing intermediate lock control solenoid valve (bank 2).
5. Disconnect the harness connector from exhaust valve timing control solenoid valve (bank 2).
6. Disconnect the harness connector from intake valve timing control solenoid valve (bank 2).
7. Remove intake valve timing intermediate lock control solenoid valve (bank 2), exhaust valve timing control solenoid valve (bank 2), and intake valve timing control solenoid valve (bank 2) from valve timing control cover (bank 2).

CAUTION:
Do not reuse O-rings.

INSTALLATION

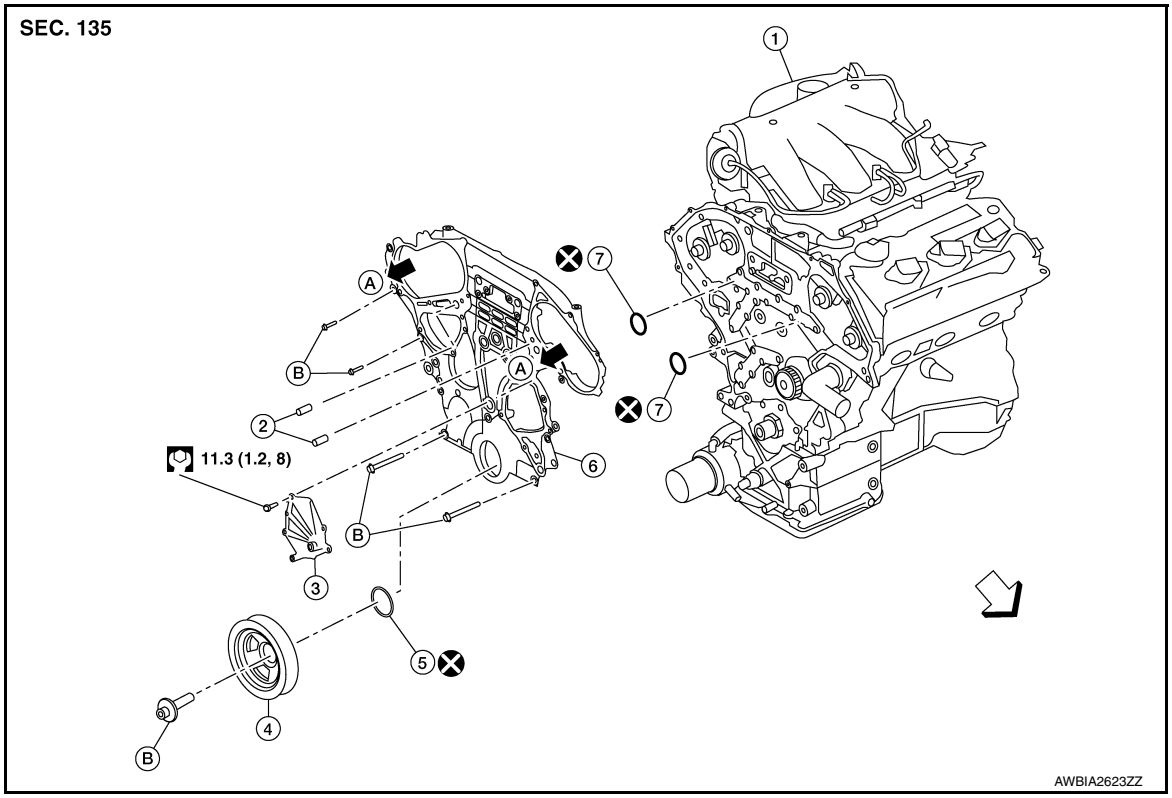
Installation is in the reverse order of removal.

CAUTION:
- **Do not reuse O-rings.**
- **Lubricate O-rings with clean engine oil prior to installation.**

FRONT TIMING CHAIN CASE

Exploded View

INFOID:0000000012602045



1. Engine assembly
2. Front timing chain case oil filter
3. Water pump cover
4. Crankshaft pulley
5. Front oil seal
6. Front timing chain case
7. O-ring
A. To valve timing control cover (bank 1/ bank 2). Refer to EM-176 and EM-177.
B. Refer to INSTALLATION

⇦ Front

Removal and Installation

INFOID:0000000012602046

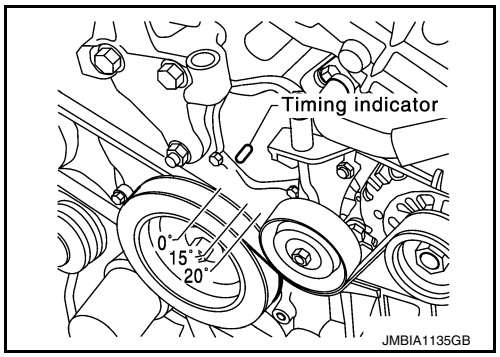
NOTE:
- This section describes the procedure for removal/installation of the front timing chain case without removing the engine from the vehicle.
- When rear timing chain case must be removed, remove the engine from the vehicle. Refer to EM-226, "Removal and Installation". Then remove front timing chain case, timing chain related parts, and rear timing chain case in this order, and install in reverse order of removal.
- When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

REMOVAL

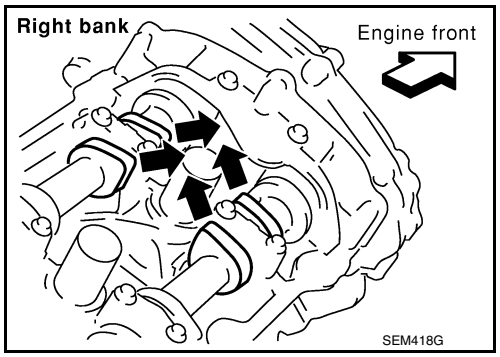
1. Remove front under cover. Refer to EXT-38, "FRONT UNDER COVER : Removal and Installation".
2. Drain the engine coolant from the radiator. Refer to MA-25, "ENGINE COOLANT : Changing Engine Coolant".
3. Drain the engine oil. Refer to MA-28, "ENGINE OIL : Changing Engine Oil".
4. Drain the power steering fluid. Refer to ST-31, "Draining and Refilling".
5. Remove engine room cover. Refer to EM-145, "Removal and Installation".
6. Remove front air duct. Refer to EM-146, "Removal and Installation".
7. Remove battery tray. Refer to PG-78, "Removal and Installation".
8. Remove cowl top. Refer to EXT-34, "Removal and Installation".

9. Remove upper radiator hose.
10. Disconnect engine coolant reservoir hose from the radiator and remove engine coolant reservoir tank.
11. Remove cooling fan assembly. Refer to CO-39, "Removal and Installation".
12. Disconnect lower radiator hose from engine.
13. Remove the radiator. Refer to CO-37, "Removal and Installation".
14. Disconnect the power steering fluid reservoir tank hose from the power steering pump and fluid cooler and remove the power steering fluid reservoir tank. Refer to ST-39, "Exploded View".
15. Remove the front wheel and tire (RH) using power tool. Refer to MA-41, "WHEELS : Adjustment".
16. Remove the fender protector side cover (RH). Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".
17. Remove the drive belt. Refer to EM-136, "Removal and Installation".
18. Remove the rocker covers (if necessary). Refer to EM-172, "Removal and Installation (bank 2)" (bank 2) and EM-173, "Removal and Installation (bank 1)" (bank 1).
NOTE:
Necessary only when removing timing chains.
19. If removing the timing chains, obtain compression TDC of No. 1 cylinder as follows:

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



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



20. Remove the access plate and lock the ring gear using Tool.

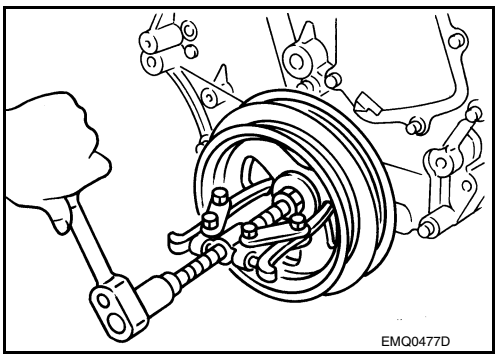
Tool number : — (J-50288)

CAUTION:
Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when installing Tool.

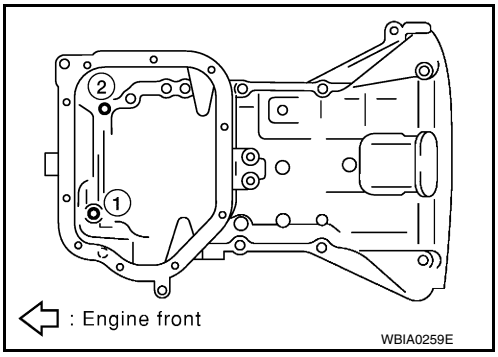
21. Remove the crankshaft pulley as follows:

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

b. Position a pulley puller at recess hole of crankshaft pulley to remove crankshaft pulley.
CAUTION:
Do not use a puller claw on crankshaft pulley periphery.



22. Remove the power steering pump. Refer to ST-39, "Removal and Installation".
23. Remove the lower oil pan. Refer to EM-160, "Removal and Installation (Lower Oil Pan)".
24. Remove upper oil pan bolts (1) and (2) as shown. Refer to EM-161, "Removal and Installation (Upper Oil Pan)".



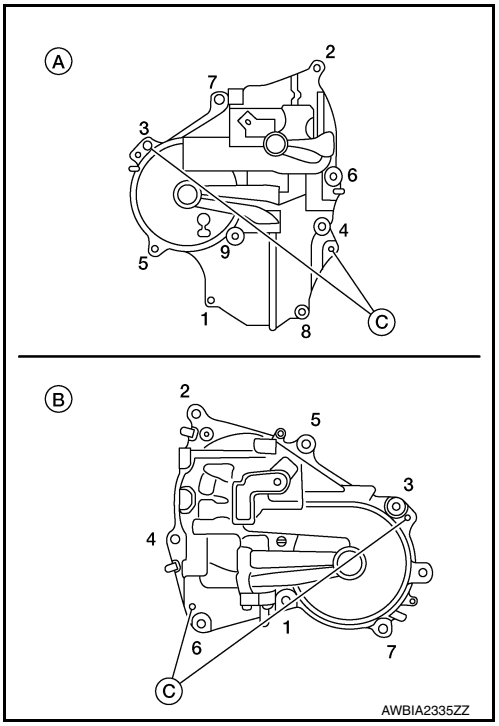
25. Remove the generator. Refer to CHG-34, "VQ35DE : Removal and Installation".
26. Disconnect the A/C tubes from the A/C compressor and position aside. Refer to HA-23, "Recycle Refrigerant".
27. Remove the A/C compressor bolts and the A/C compressor. Refer to HA-30, "COMPRESSOR : Removal and Installation".
28. Remove the generator bracket. Refer to CHG-34, "VQ35DE : Removal and Installation".
29. Support the engine with suitable jack and remove the RH engine insulator, mount and torque rod. Refer to EM-226, "Removal and Installation".
30. Disconnect the harness connector from oil pressure switch.
31. Disconnect the harness connector from intake valve timing control solenoid valve.

32. Remove the valve timing control cover (bank 1) (A) and valve timing control cover (bank 2) (B).

(C) : Dowel pin hole

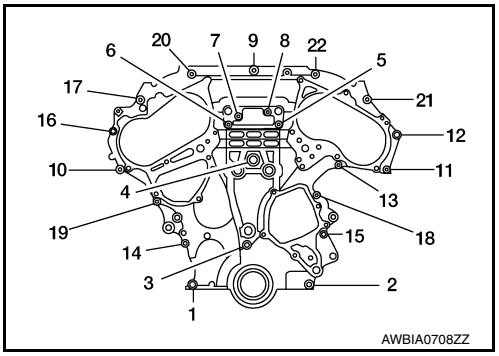
- Loosen the intake valve timing control solenoid valve cover bolts in the reverse order as shown.

CAUTION:
The shaft in the intake valve timing control solenoid valve cover is inserted into the center hole of the intake camshaft sprocket. Remove the intake valve timing control solenoid valve cover by pulling straight out until the intake valve timing control solenoid valve cover disengages from the camshaft sprocket.



33. Remove the drive belt auto-tensioner. Refer to EM-138, "Removal and Installation of Drive Belt Auto-tensioner".
34. Remove the water pump cover (if necessary).
35. Remove the front timing chain case.

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

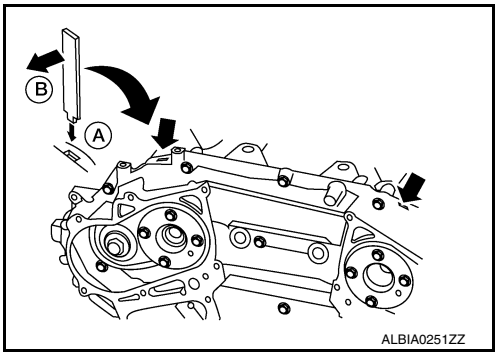


b. Insert the appropriate size suitable tool into the notch (A) at the top of the front timing chain case as shown.

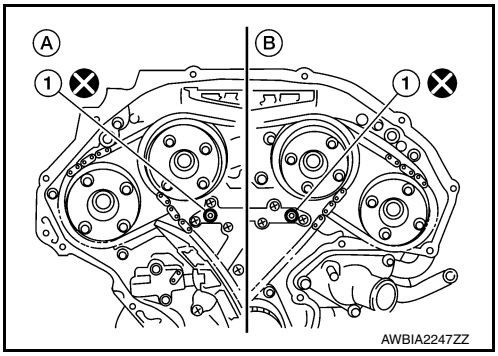
c. Pry off the case by moving the suitable tool (B) as shown.
- Cut liquid gasket for removal using Tool.

Tool number: KV10111100 (J-37228)

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



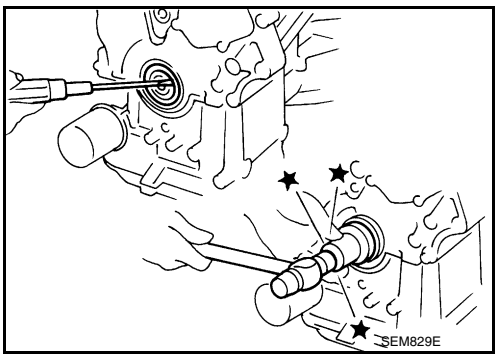
36. Remove O-rings (1) from rear timing chain case.



(A) : Bank 1 (RH)
(B) : Bank 2 (LH)

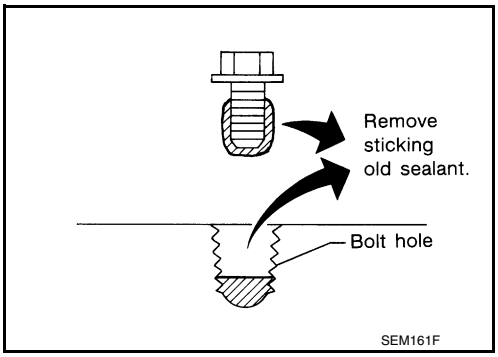
CAUTION:
Do not reuse O-rings.

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



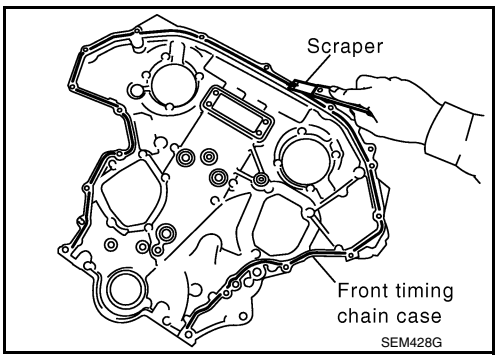
CAUTION:
Do not damage the front cover.

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



CAUTION:
Do not damage the threads or mating surfaces.

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



CAUTION:
Do not damage the mating surfaces.

40. Remove front timing chain case oil filters (if necessary).

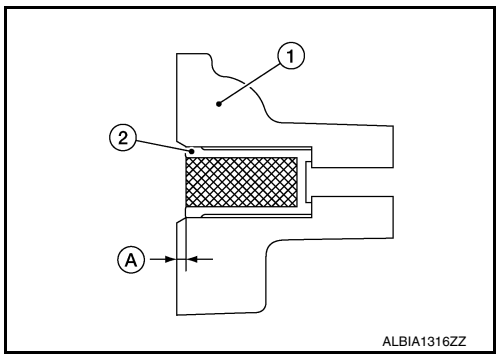
INSTALLATION

1. Install front timing chain case oil filter (2) (if removed).

CAUTION:

- **Insert front timing chain case oil filter (2) into the front timing chain case (1) to specified distance (A).**
- **Ensure oil filter mesh remains intact during insertion into the front timing chain case (1).**
- **Ensure oil filter mesh does not protrude from front timing chain case (1).**

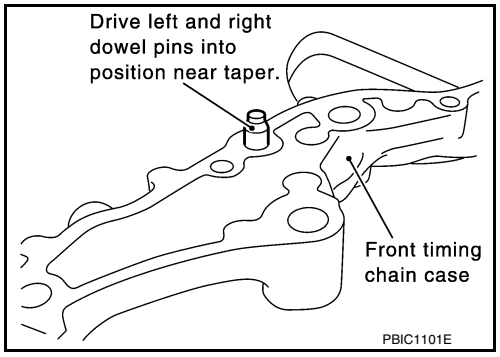
(A) : 1.0 - 1.5 mm (0.039 - 0.059 in)



2. Install dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.

NOTE:

Be sure to place the dowel pins in original hole locations in the front timing chain case.



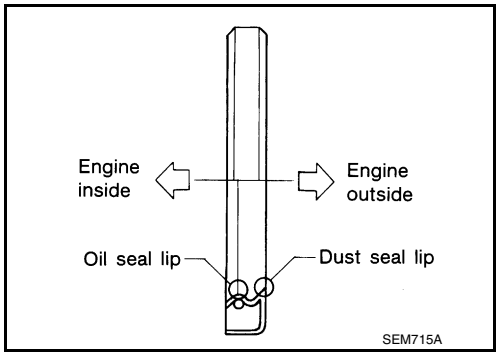
3. Install the new front oil seal on the front timing chain case. Apply new engine oil to the oil seal edges.

CAUTION:

Do not reuse front oil seal.

NOTE:

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



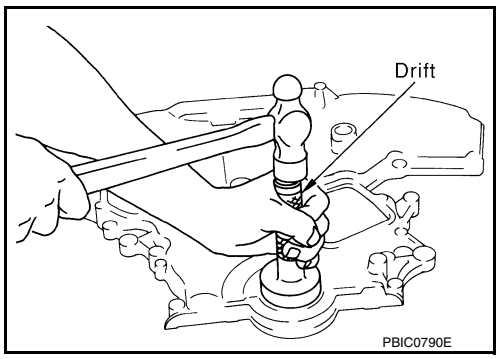
a. Install the new front oil seal so that it becomes flush with the face with front timing chain case using suitable tool.

CAUTION:

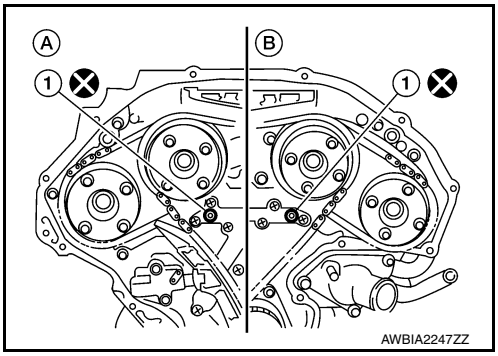
Press fit straight and avoid causing burrs or tilting the oil seal.

NOTE:

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



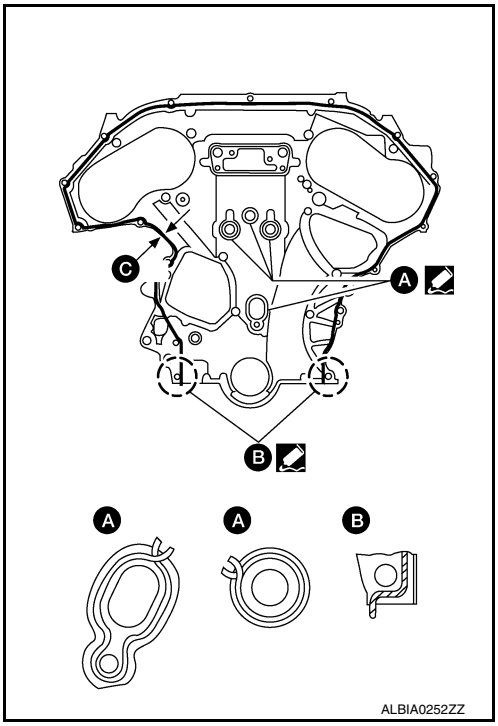
4. Install new O-rings (1) on rear timing chain case.



(A) : Bank 1 (RH)
(B) : Bank 2 (LH)

CAUTION:
Do not reuse O-rings.

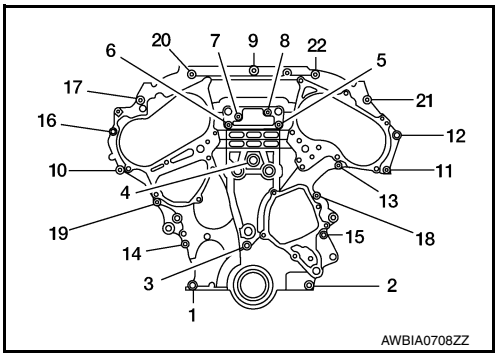
5. Apply Silicone RTV Sealant to front timing chain case as shown.
   - Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
   - Before installation, wipe off the protruding sealant.
   - (C): 2.6 - 3.6 mm (0.102 - 0.142 in) dia.



6. Install dowel pin on the front timing chain case into dowel pin hole in the rear timing chain case.
7. Loosely install the front timing chain case bolts.

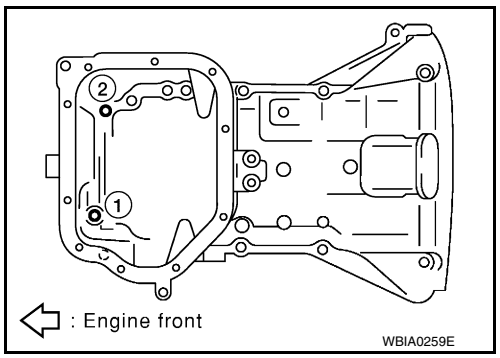
Bolt position	Bolt diameter
1, 2	: 8 mm (0.31 in)
3 – 22	: 6 mm (0.24 in)

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



Bolt position	Tightening specification
1, 2	: 28.4 N·m (2.9 kg-m, 21 ft-lb)
3 – 22	: 12.7 N·m (1.3 kg-m, 9 ft-lb)

9. Install upper oil pan bolts (1) and (2) as shown. Refer to EM-161, "Removal and Installation (Upper Oil Pan)".



10. Install lower oil pan. Refer to EM-160, "Removal and Installation (Lower Oil Pan)".
11. Install intake valve timing control solenoid valve covers as follows:
CAUTION:
Do not reuse cover gasket.

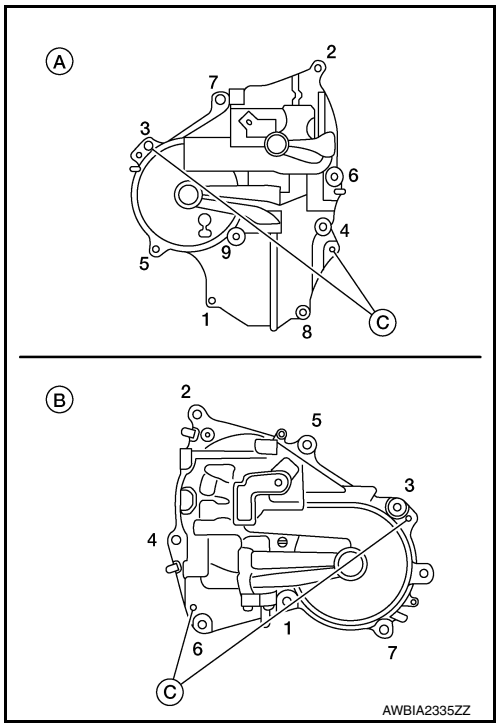
a. Install new O-rings in shaft grooves.
CAUTION:
Do not reuse O-rings.

b. Being careful not to move O-rings from the installation grooves, align dowel pins on front timing chain case with the holes to install valve timing control covers.

c. Tighten intake valve timing control solenoid valve cover bolts in numerical order as shown.

(A) : Bank 1 (RH)
(B) : Bank 2 (LH)
(C) : Dowel pin hole

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

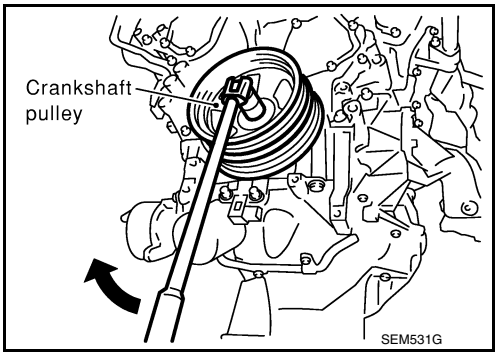


12. Apply liquid gasket and install the water pump cover (if removed).
• Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

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

    Step 1 : 44 N·m (4.5 kg-m, 32 ft-lb)
    Step 2 : 84° - 90° degrees clockwise

    Tool Number : KV10112100 (BT-8653-A)



14. Remove Tool and install the access plate.

    Tool number : — (J-50288)

    CAUTION:
    Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when removing the Tool.

15. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
16. 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	Leaks	Level
Engine oil		Level	Leaks	Level
Transmission/ transaxle fluid	CVT Models	Leaks	Level/Leaks	Leaks
Other oils and fluids*		Level	Leaks	Level
Fuel		Leaks	Leaks	Leaks
Exhaust gas		—	Leaks	—

*Power steering fluid, brake fluid, etc.

TIMING CHAIN

Exploded View

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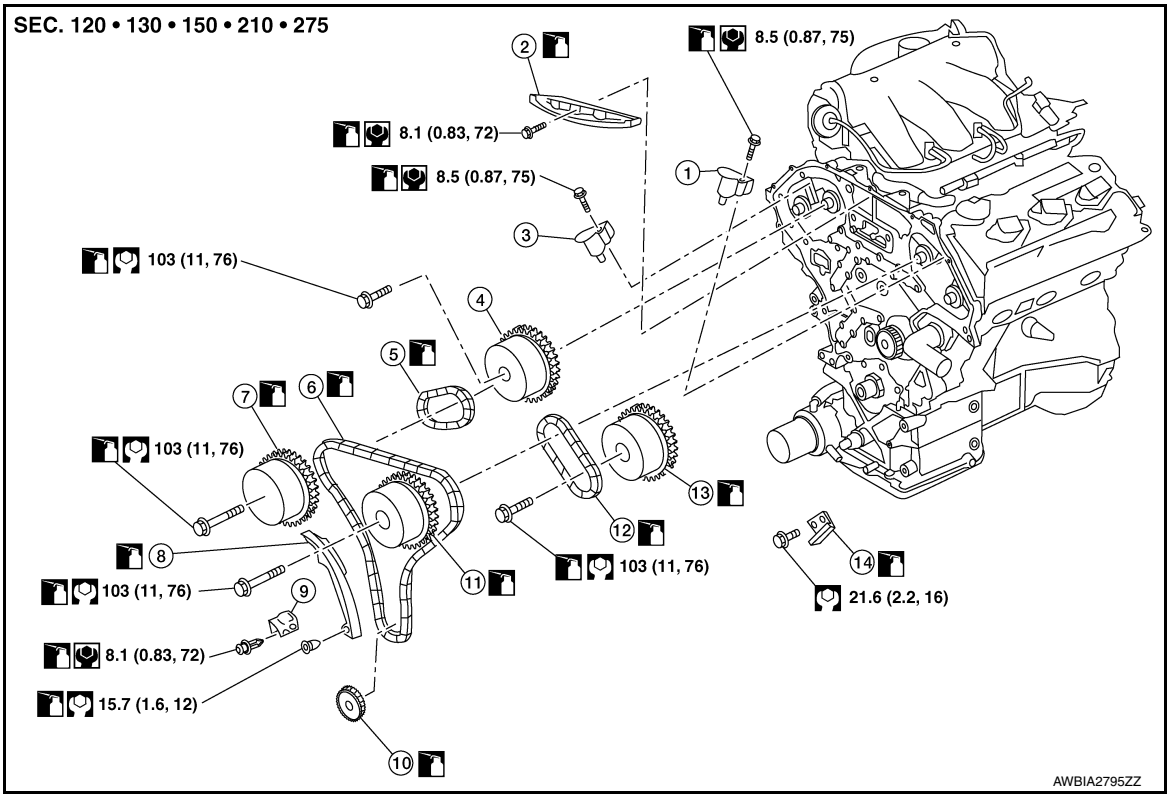


1. Timing chain tensioner (secondary) (bank 2)
2. Internal chain guide
3. Timing chain tensioner (secondary) (bank 1)
4. Camshaft sprocket (bank 1) (EXH)
5. Timing chain (secondary)
6. Timing chain (primary)
7. Camshaft sprocket (bank 1) (INT)
8. Slack guide
9. Timing chain tensioner (primary)
10. Crankshaft sprocket
11. Camshaft sprocket (bank 2) (INT)
12. Timing chain (secondary)
13. Camshaft sprocket (bank 2) (EXH)
14. Tension guide

Removal and Installation

INFOID:0000000012602048

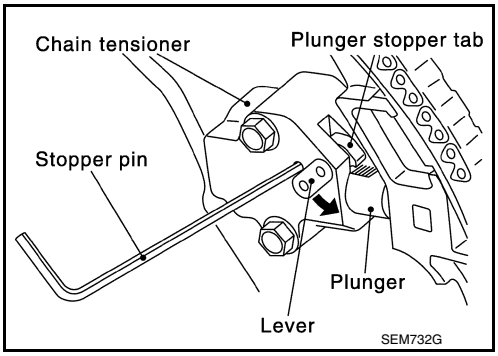
CAUTION:

- **After removing timing chains, do not turn the crankshaft and camshaft separately or the valves will strike the pistons.**
- **When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.**
- **Apply new engine oil to bolt threads and seat surfaces when installing camshaft sprockets, camshaft brackets, and crankshaft pulley.**

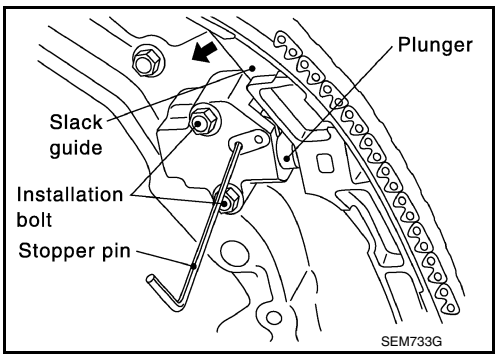
REMOVAL

1. Remove front timing chain case. Refer to EM-178, "Removal and Installation".
2. Remove the intake manifold collector. Refer to EM-148, "Removal and Installation".
3. Remove the spark plugs. Refer to EM-134, "Removal and Installation".
4. Place paint marks on the timing chain and sprockets to indicate the correct position of the components for installation.
5. Disconnect the harness connectors from camshaft position sensor.
6. Remove the timing chain tensioner (primary).

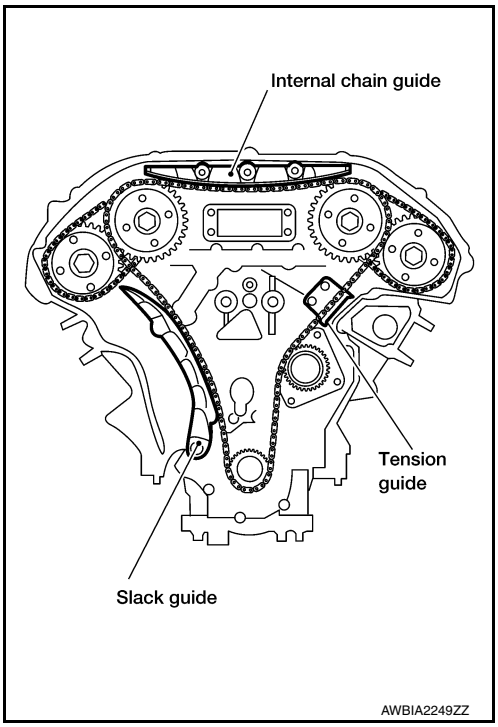
a. Pull lever down and release plunger stopper tab. Plunger stopper tab can be pushed up to release (coaxial structure with lever).



b. Insert stopper pin into timing chain tensioner (primary) body hole to hold lever, and keep the tab released. An Allen wrench [1.2 mm (0.047 in)] is used for a stopper pin as an example.
c. Insert plunger into tensioner body by pressing the slack guide.
d. Keep the slack guide pressed and hold it by pushing the stopper pin through the lever hole and body hole.
e. Remove the bolts and remove the timing chain tensioner (primary).

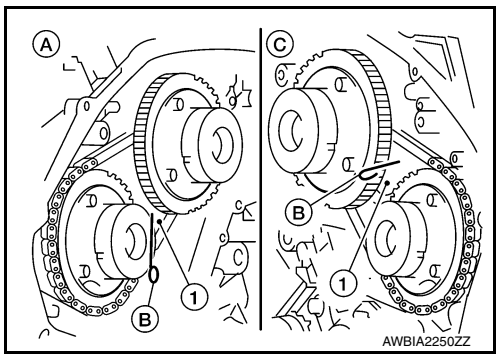


7. Remove internal chain guide, tension guide and slack guide.
NOTE:
Tension guide can be removed after removing timing chain (primary).



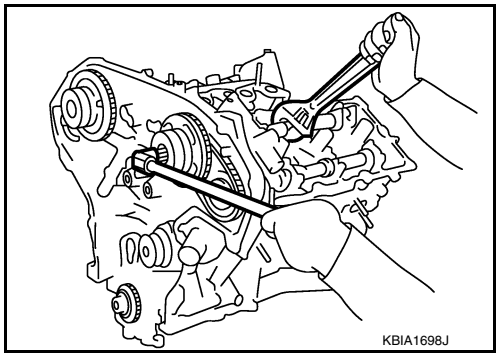
8. Remove timing chain (primary) and crankshaft sprocket.
CAUTION:
After removing timing chains, do not turn the crankshaft and camshaft separately or the valves will strike the pistons.
9. Remove timing chain (secondary) and camshaft sprockets as follows:

a. Attach a suitable stopper pin (B) to the bank 1 [RH (A)] and bank 2 [LH (C)] timing chain tensioners (secondary) (1).
NOTE:
- Use approximately 0.5 mm (0.02 in) diameter hard metal pin as a stopper pin.
- Removal of camshaft bracket (No. 1) is required prior to removing the timing chain tensioner (secondary).



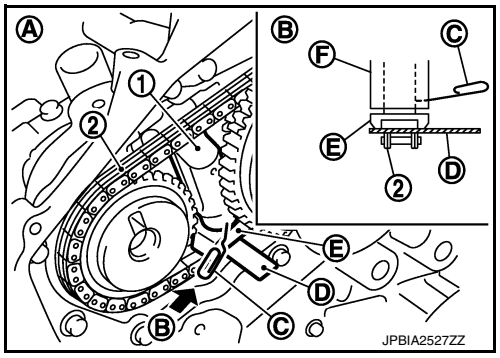
b. Remove camshaft sprockets (INT/EXH) bolts.
- Secure the hexagonal portion of camshaft using a suitable tool to loosen bolts.

CAUTION:
Do not loosen bolts using anything other than the camshaft hexagonal portion. Do not apply tension to the timing chain.



c. Remove timing chain (secondary) together with camshaft sprockets (bank 1 shown).
- Turn camshaft slightly to keep the chain tight when removing the timing chain (secondary).
- Insert 0.5 mm (0.020 in) thick metal or resin plate between timing chain and timing chain tensioner plunger (guide) (E). Remove timing chain (secondary) (2) together with camshaft sprockets with timing chain loose from guide groove.

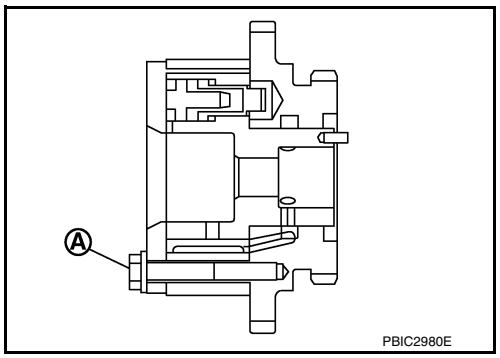
(1) : Timing chain tensioner (secondary)
(A) : Bank 1 (RH)
(B) : View B
(C) : Stopper pin
(D) : Plate
(F) : Timing chain tensioner (body)



CAUTION:
Be careful of plunger coming off when removing timing chain (secondary). The plunger of timing chain tensioner (secondary) moves during operation, which could cause the stopper pin to fall out.

d. Camshaft sprocket (INT) is two-for-one structure of sprockets for timing chain (primary) and for timing chain (secondary).

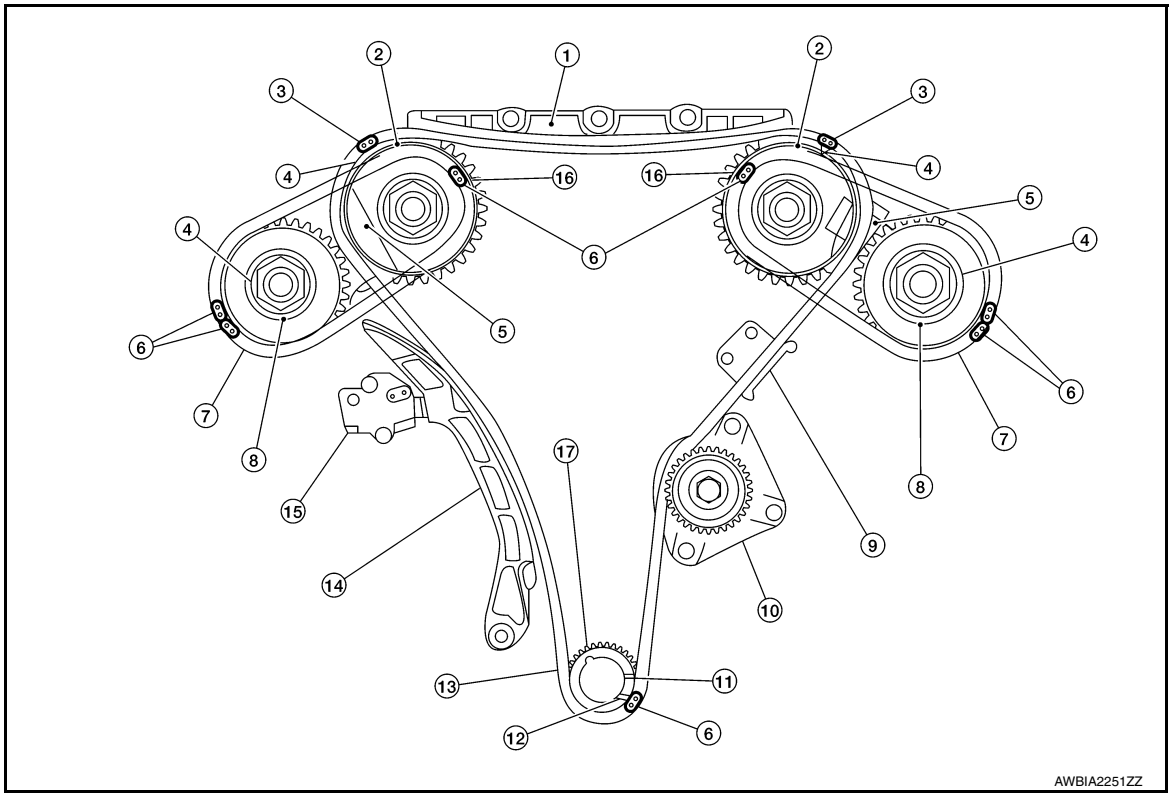
CAUTION:
- **Handle camshaft sprocket (INT) carefully to avoid any shock to camshaft sprocket.**
- **Do not disassemble. [Do not loosen bolts (A) as shown].**



INSPECTION

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

INSTALLATION

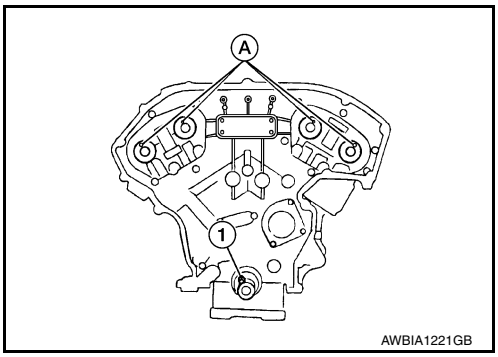


1. Internal chain guide	2. Camshaft sprocket (INT)	3. Mating mark (green link)
4. Mating mark (punched)	5. Timing chain tensioner (secondary)	6. Mating mark (orange link)
7. Timing chain (secondary)	8. Camshaft sprocket (EXH)	9. Tension guide
10. Water pump	11. Crankshaft sprocket	12. Mating mark (notched)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

NOTE:
This illustration shows the relationship between the mating mark on each timing chain and on the corresponding sprocket with the components installed.

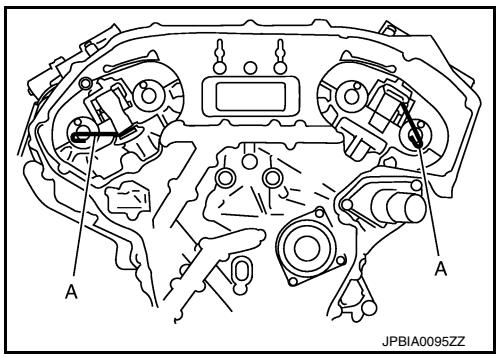
1. Install timing chain tensioners (secondary) with a new O-ring and the stopper pin attached.
   CAUTION:
   Do not reuse O-ring.
2. Check that dowel pin (A) and crankshaft key (1) are located as shown. (No. 1 cylinder at compression TDC)
   NOTE:
   Though camshaft does not stop at the position as shown, for the placement of cam nose, it is generally accepted camshaft is placed in the same direction.

   Camshaft dowel pin
   : At cylinder head upper face side in each bank
   Crankshaft key
   : At cylinder head side of bank 1



3. Install timing chain (secondary) and camshaft sprockets (INT and EXH) as follows:
   CAUTION:
   Mating marks between timing chain and sprockets slip easily. Confirm all mating mark positions repeatedly during the installation process.

a. Push plunger of timing chain tensioner (secondary) and keep it pressed in with stopper pin (A).

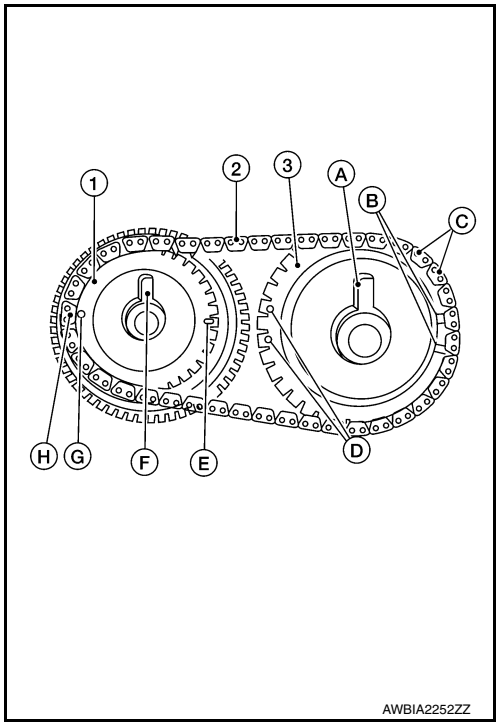


b. Install timing chain (secondary) (2) and camshaft sprockets [INT (1) and EXH (3)].

(A) : Dowel pin groove
(B) : Mating mark (2 oblong on rear face)
(C) : Orange link
(D) : Mating mark (2 circles on rear face)
(E) : Mating mark (Oblong on rear face)
(F) : Dowel pin groove
(G) : Mating mark (Circle on rear face)
(H) : Orange link

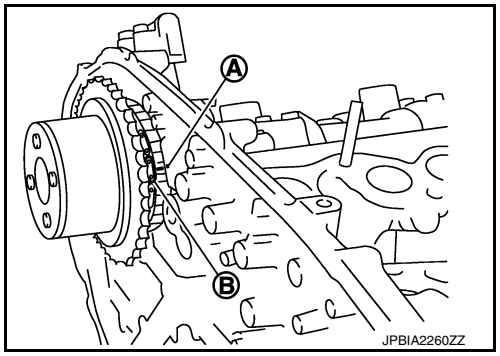
NOTE:
Bank 1 shown (rear view).

- Align the mating marks on timing chain (secondary) (orange link) with the mating marks on camshaft sprockets (INT and EXH), and install them.
- Align dowel pin on camshafts with the groove on sprockets, and install them.
- Tighten the bolts for the camshaft sprockets by hand enough to prevent the dowel pins from falling out of the grooves.

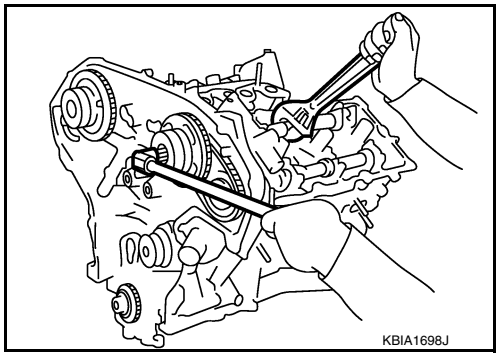


- It may be difficult to visually check the dislocation of mating marks during and after installation. To make the matching easier, make a mating mark (A) on the top of sprocket teeth and its extended line with paint.

(B) : Mating mark (orange link)

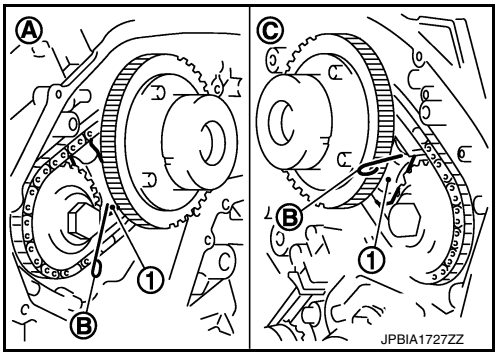


4. After confirming the mating marks are aligned, tighten the camshaft sprocket bolts.
   - Secure the camshaft using a wrench at the hexagonal portion to tighten the bolts.

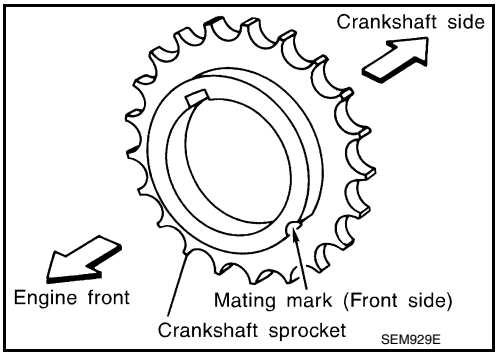


5. Pull stopper pins (B) out from timing chain tensioners (secondary) (1).

(A) : Bank 1 (RH)
(C) : Bank 2 (LH)

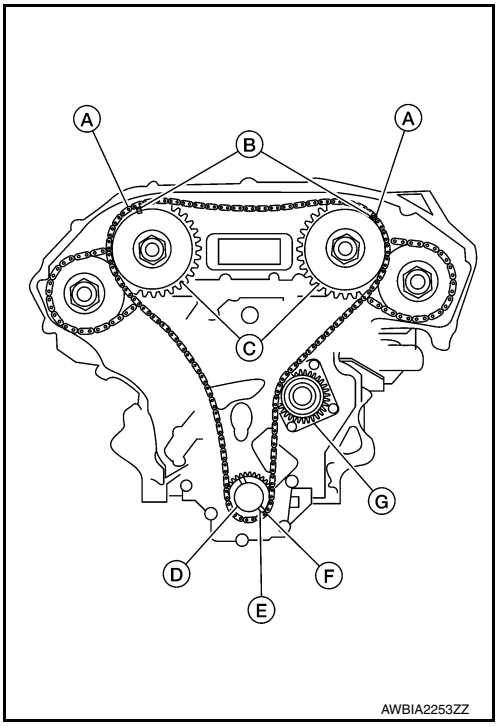


6. Install the crankshaft sprocket on the crankshaft.
   - Make sure the mating marks on the crankshaft sprocket face the front of the engine.



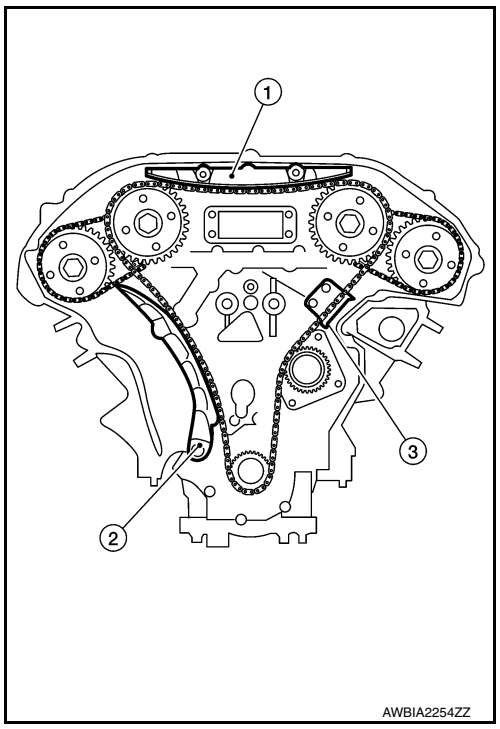
7. Install the timing chain (primary).
   - Install timing chain (primary) so the mating mark (punched) (B) on camshaft sprocket (C) is aligned with the green link (A) on the timing chain, while the mating mark (notched) (E) on the crankshaft sprocket (D) is aligned with the orange one (F) on the timing chain, as shown.
   - When it is difficult to align mating marks of the timing chain (primary) with each sprocket, gradually turn the camshaft using a wrench on the hexagonal portion to align it with the mating marks.
   - During alignment, be careful to prevent dislocation of mating mark alignments of the secondary timing chains.

(G) : Water pump



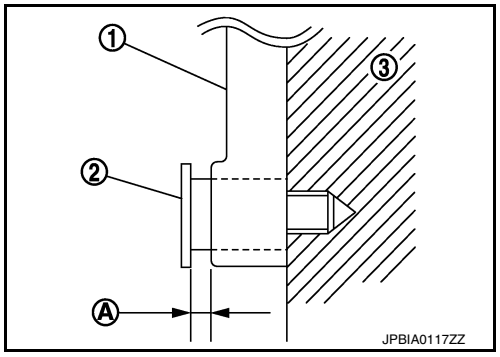
8. Install the internal chain guide (1) and slack guide (2).

(3) : Tension guide



CAUTION:
Do not over tighten slack guide bolt (2). It is normal for a gap (A) to exist under the bolt seat when bolt is tightened to specification.

(1) : Slack guide
(3) : Cylinder block



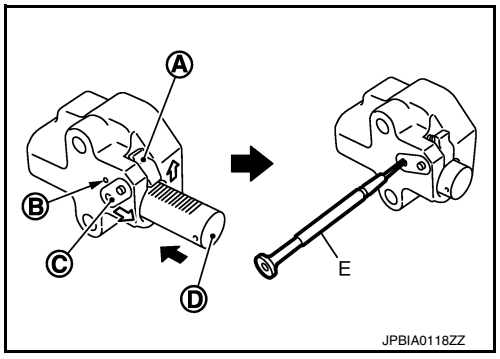
9. Install the timing chain tensioner (primary) with the following procedure:

a. Pull plunger stopper tab (A) up (or turn lever downward) so as to remove plunger stopper tab from the ratchet of plunger (D).
NOTE:
Plunger stopper tab and lever (C) are synchronized.

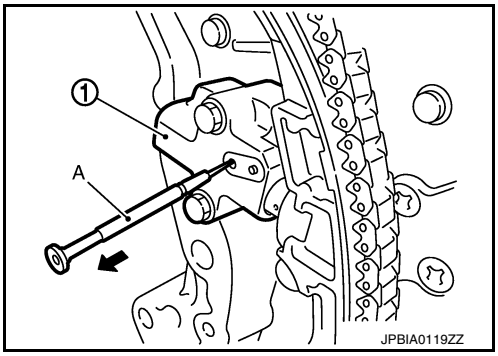
b. Push plunger into the inside of tensioner body.

c. Hold plunger in the fully compressed position by engaging plunger stopper tab with the tip of ratchet.

d. To secure lever, insert stopper pin (E) through hole of lever into tensioner body hole (B).
• The lever parts and the tab are synchronized. Therefore, the plunger will be secured under this condition.
NOTE:
Illustration shows the example of 1.2 mm (0.047 in) diameter thin screwdriver being used as the stopper pin.



e. Install timing chain tensioner (primary) (1).
   • Remove any dirt and foreign materials completely from the back and the mounting surfaces of timing chain tensioner (primary).
f. Pull out stopper pin (A) after installing, and then release plunger.

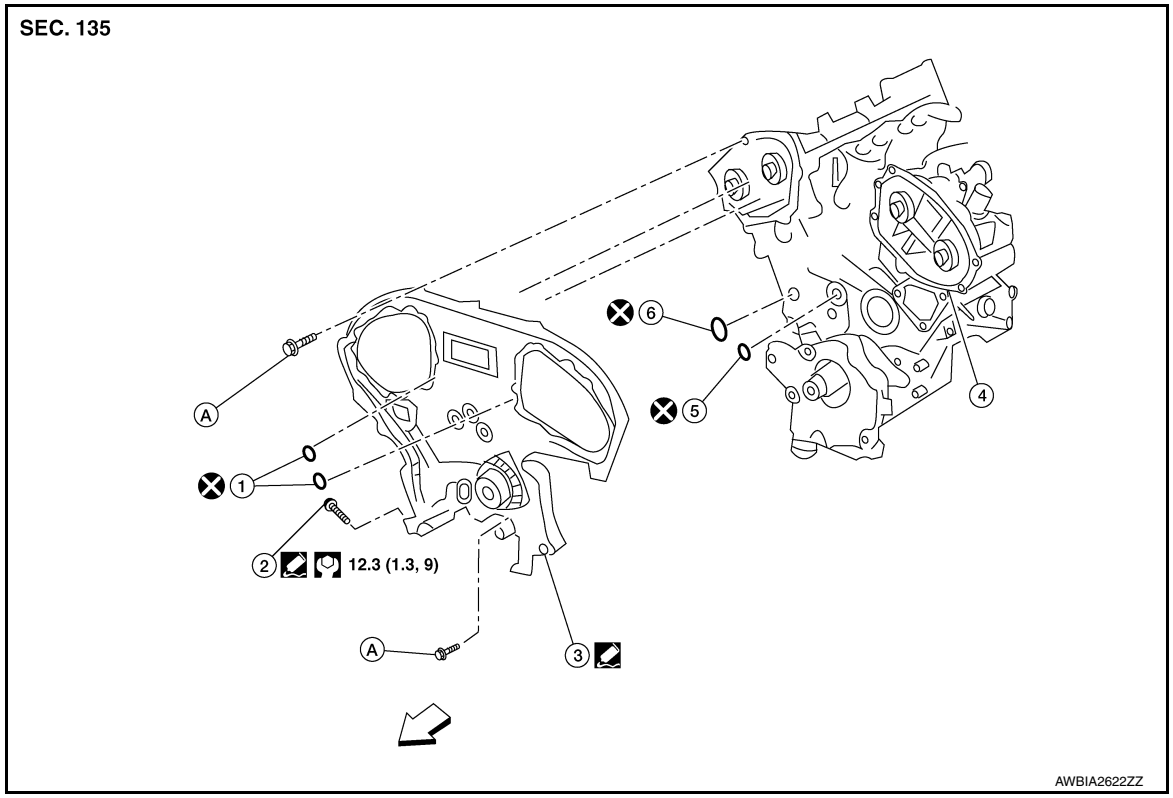


10. Reconfirm that the matching marks on the sprockets and the timing chain have not slipped out of alignment.
11. Install the spark plugs. Refer to EM-134, "Removal and Installation".
12. Install the intake manifold collector. Refer to EM-148, "Removal and Installation".
13. Install the front timing chain case. Refer to EM-178, "Removal and Installation".

REAR TIMING CHAIN CASE

Exploded View

INFOID:0000000012602049



1. O-ring
2. Blind plug (if equipped)
3. Rear timing chain case
4. Cylinder block
5. O-ring
6. O-ring

A. Refer to INSTALLATION
⇦ Engine front

Removal and Installation

INFOID:0000000012602050

CAUTION:

- **After removing timing chain, do not turn the crankshaft and camshaft separately, or the valves will strike the pistons.**
- **Before removing the upper oil pan, remove the crankshaft position sensor (POS).**
- **Do not damage sensor edges.**

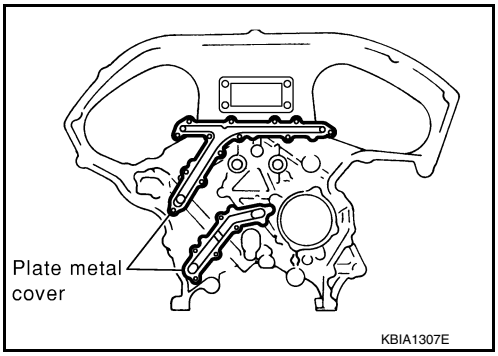
REMOVAL

1. Remove the engine assembly. Refer to EM-226, "Removal and Installation".
2. Remove upper oil pan. Refer to EM-161, "Removal and Installation (Upper Oil Pan)".
3. Remove the front timing chain case. Refer to EM-178, "Exploded View".
4. Remove the timing chains (primary) and (secondary). Refer to EM-187, "Exploded View".

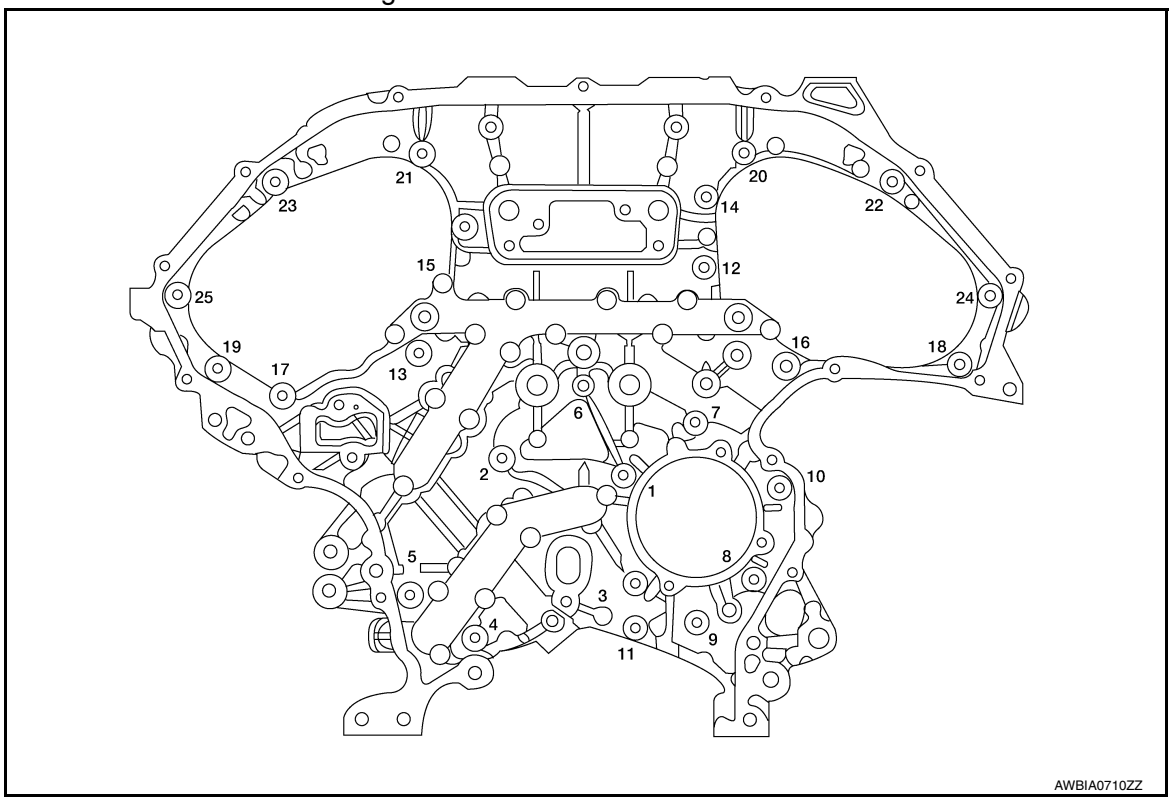
5. Remove the rear timing chain case.

CAUTION:

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



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



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

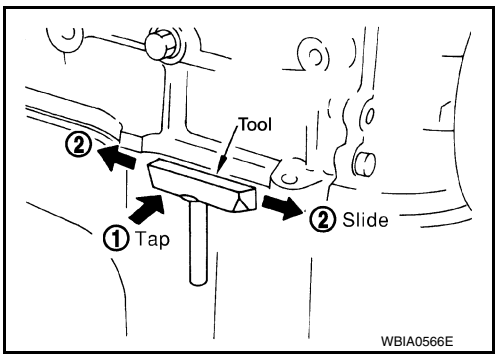
- After removing the bolts, separate the mating surface and remove the old liquid gasket using Tool.

Tool number : KV10111100 (J-37228)

CAUTION:

Do not damage the mating surfaces.

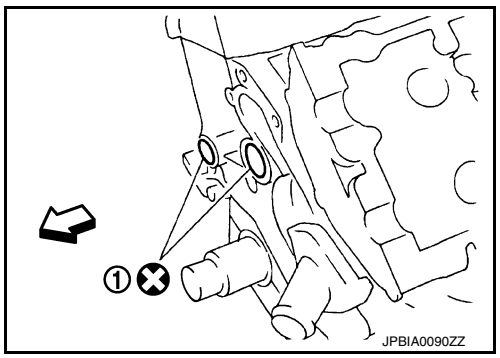
- Tap the seal cutter to insert it (1).
- In areas where the Tool is difficult to use, lightly tap to slide it (2).



6. Remove O-rings (1) from cylinder block.

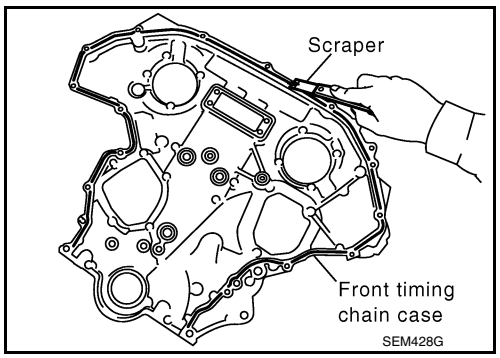
⇦ : Engine front

CAUTION:
Do not reuse O-rings.



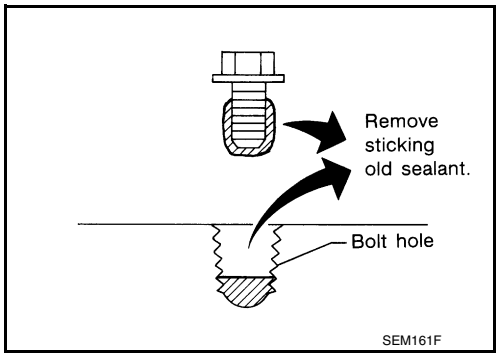
7. Use a scraper to remove all of the old Silicone RTV Sealant from the front and rear timing chain case and opposite mating surfaces.

CAUTION:
Do not damage the mating surfaces.



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

CAUTION:
Do not damage the threads or mating surfaces.

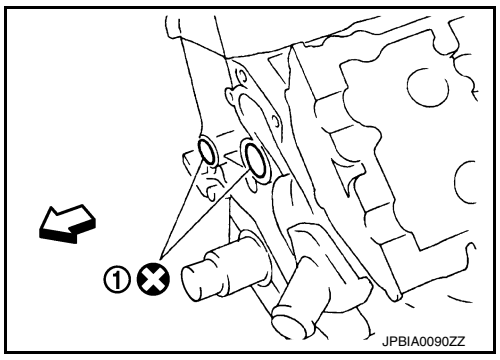


INSTALLATION

1. Install O-rings (1) on cylinder block.

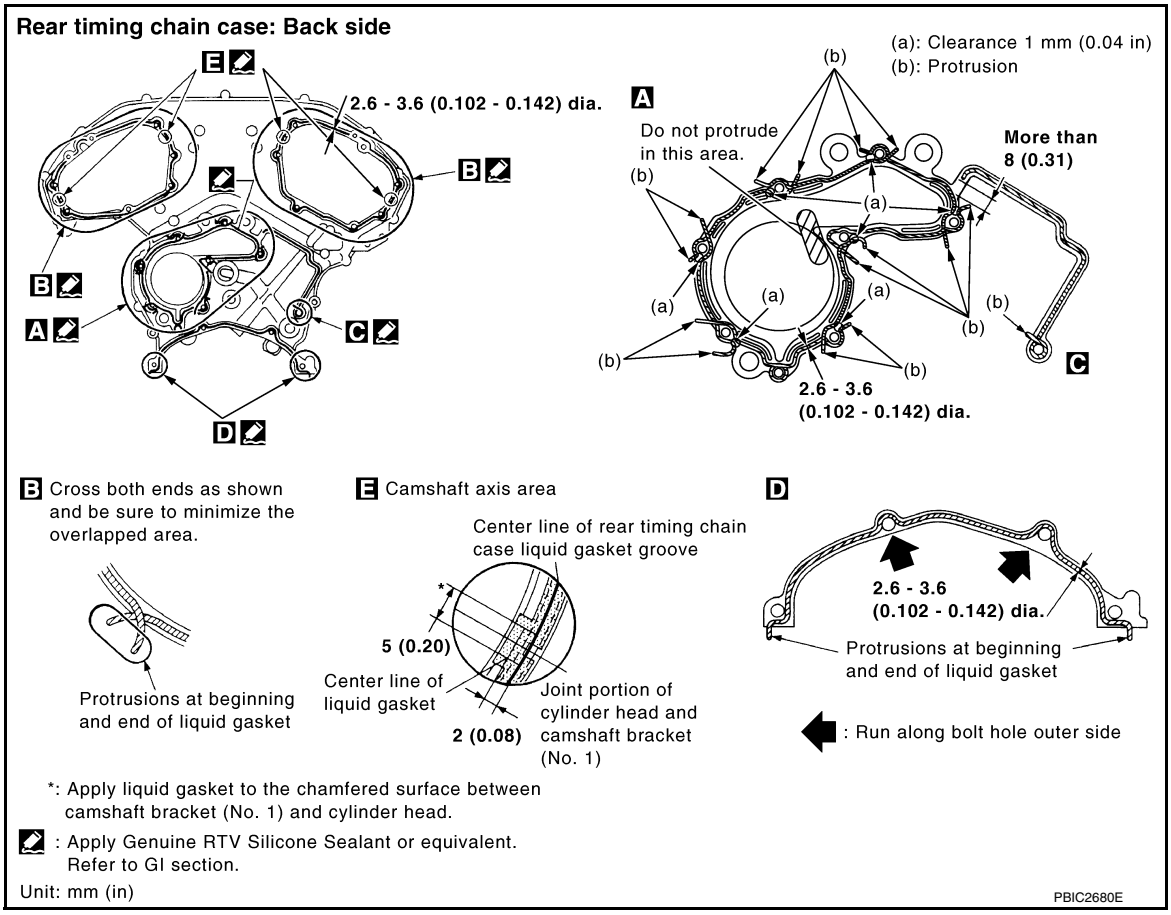
⇦ : Engine front

CAUTION:
Do not reuse O-rings.



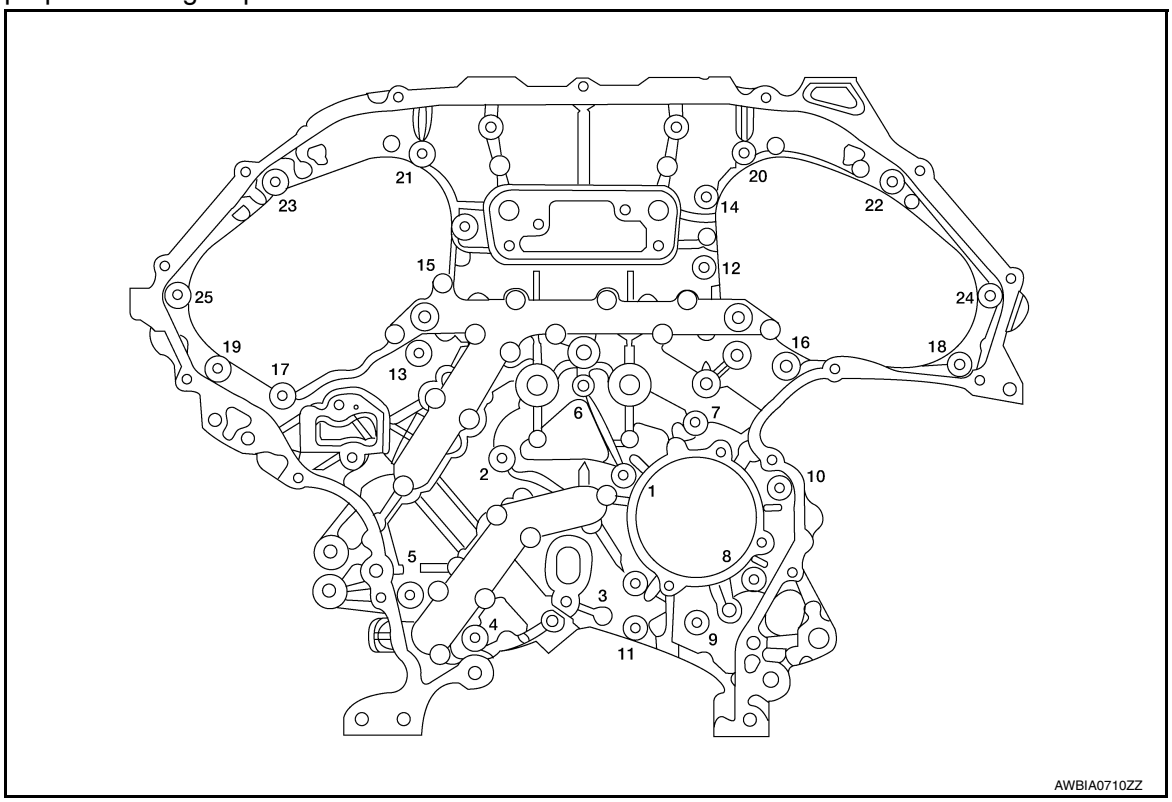
2. Apply Genuine Silicone RTV Sealant or equivalent, to the rear timing chain case using suitable tool as shown. Refer to GI-21, "Recommended Chemical Products and Sealants".

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 components are installed to allow the sealant to cure.**
- **Wipe off liquid gasket where it touches the engine coolant passage at point “a”.**
- **Follow the installation instructions for applying the liquid gasket. Pay particular attention to the water pump and cylinder area.**



3. Align the rear timing chain case and water pump assembly with the dowel pins (RH/LH) on the cylinder block and install the case. Make sure the O-rings stay in place during installation.

a. Tighten the bolts in the numerical order as shown. There are two bolt lengths used. Follow the chart below for proper bolt length specifications.



Bolt length	Bolt position	Torque specification
20 mm (0.79 in)	1, 2, 3, 6, 7, 8, 9, 10	12.7 N·m (1.3 kg-m, 9 ft-lb)
16 mm (0.63 in)	All except the above	12.7 N·m (1.3 kg-m, 9 ft-lb)

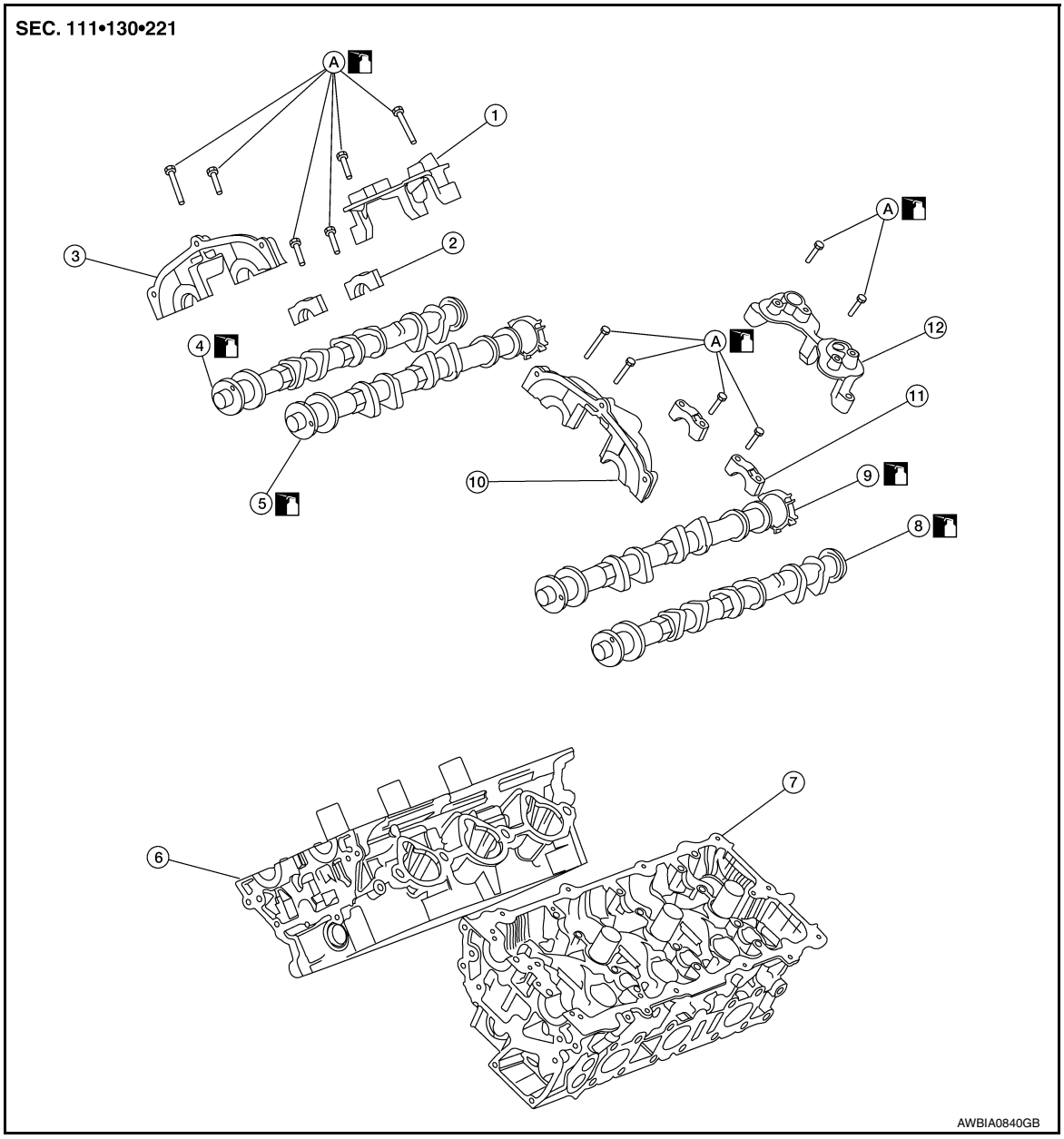
b. After all bolts are initially tightened, retighten them to the specification in the numerical order as shown.
NOTE:
If liquid gasket protrudes, wipe it off immediately.

4. Install the timing chains (primary and secondary). Refer to EM-187, "Exploded View".
5. Install the front timing chain case. Refer to EM-178, "Removal and Installation".
6. Install the upper oil pan. Refer to EM-161, "Removal and Installation (Upper Oil Pan)".
7. Install the engine assembly. Refer to EM-226, "Removal and Installation".

CAMSHAFT

Exploded View

INFOID:0000000012602051



1.	Camshaft position sensor bracket (bank 1)	2.	Camshaft brackets	3.	No. 1 camshaft bracket (bank 1)
4.	Camshaft (EXH) (bank 1)	5.	Camshaft (INT) (bank 1)	6.	Cylinder head (bank 1)
7.	Cylinder head (bank 2)	8.	Camshaft (EXH) (bank 2)	9.	Camshaft (INT) (bank 2)
10.	No. 1 camshaft bracket (bank 2)	11.	Camshaft brackets	12.	Camshaft position sensor bracket (bank 2)

A. Refer to INSTALLATION

Removal and Installation

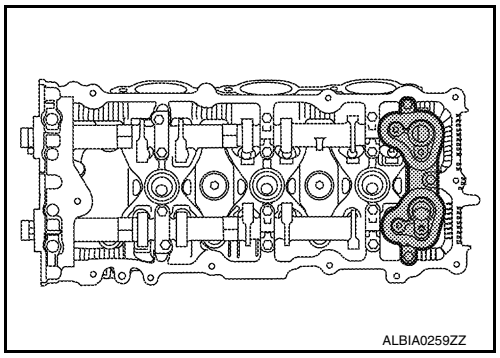
INFOID:0000000012602052

CAUTION:

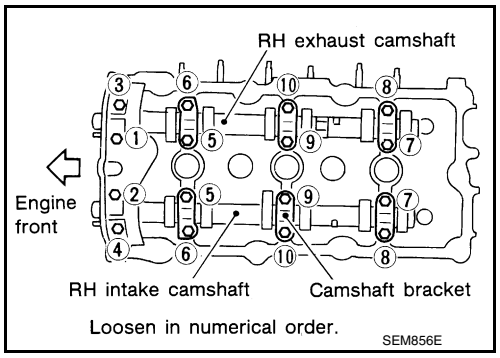
Apply new engine oil to parts marked in illustration before installation.

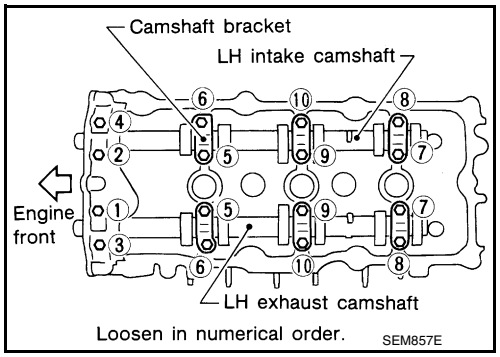
REMOVAL

1. Remove the timing chains. Refer to EM-187, "Exploded View".
2. Remove camshaft position sensor brackets (RH shown LH similar).



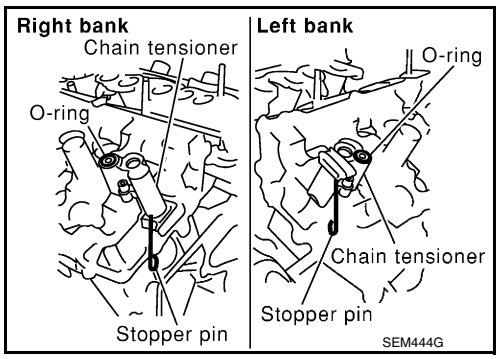
3. Remove the intake and exhaust camshaft brackets and the camshafts.
   - Mark the camshafts, camshaft brackets, and bolts so they are placed in the same position and direction for installation.
   - Equally loosen the camshaft bracket bolts in several steps in the numerical order as shown.





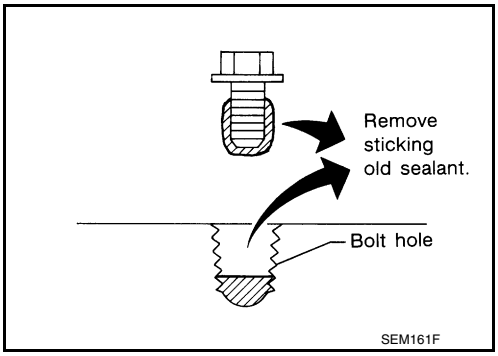
4. Remove valve lifters (if necessary).
   NOTE:
   Identify installation positions to ensure proper installation.
5. Remove secondary timing chain tensioner from cylinder head
   - Remove secondary tensioner with its stopper pin attached.

   NOTE:
   Stopper pin was attached when secondary timing chain was removed.

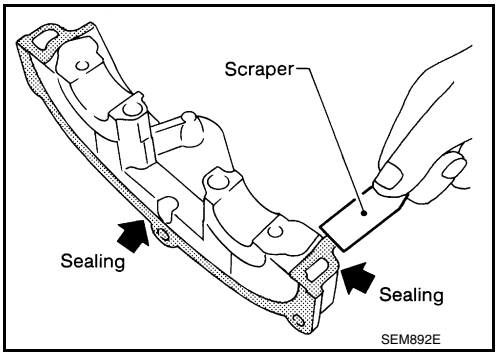


INSTALLATION

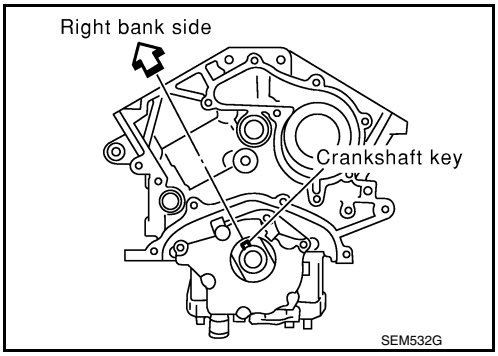
1. Before installation, remove any old Silicone RTV Sealant from component mating surfaces using a scraper.
   - Remove the old Silicone RTV Sealant from the bolt holes and threads.
   - Do not scratch or damage the mating surfaces.



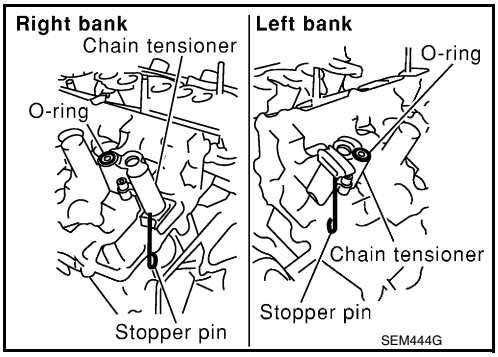
2. Before installing the front cam bracket, remove the old Silicone RTV Sealant from the mating surface using a scraper.
   - Do not scratch or damage the mating surface.



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

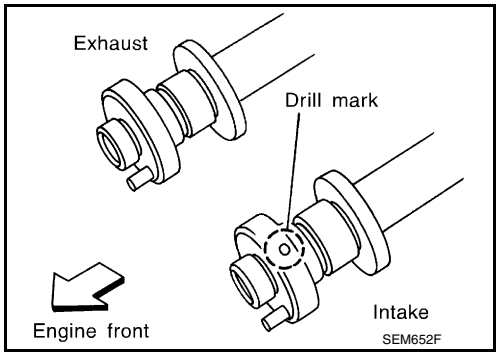


4. Install camshaft chain tensioners on both sides of cylinder head. Refer to EM-187, "Exploded View".
   CAUTION:
   Do not reuse O-rings.



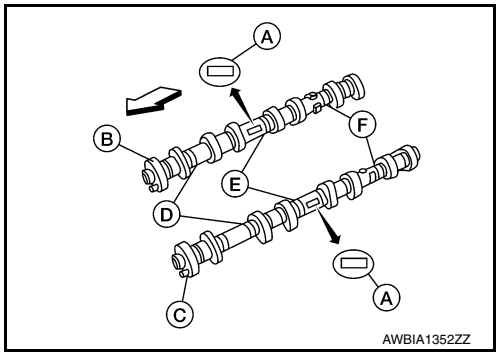
5. Install valve lifters (if removed).
   NOTE:
   Install them in original positions.

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



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

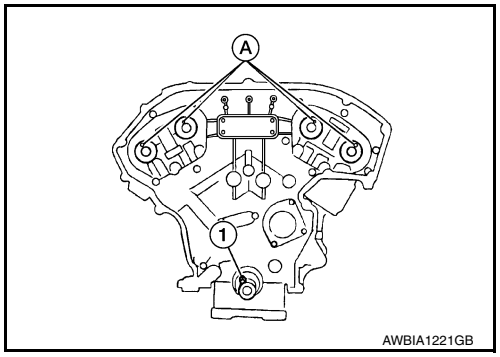
⇦ :Engine front



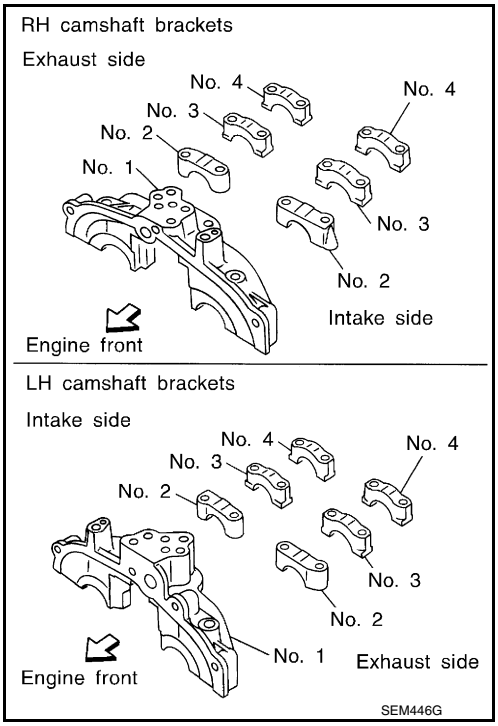
Bank	INT/EXH	ID mark (A)	Drill mark	Paint marks		
				M1 (E)	M2 (F)	M3 (D)
1 (B)	INT	1A	Yes	Purple	No	Light blue
	EXH	1C	No	No	Brown	Light blue
2 (C)	INT	1B	Yes	Purple	No	Light blue
	EXH	1D	No	No	Brown	Light blue

   - Position the camshaft dowel pins (A) as shown.

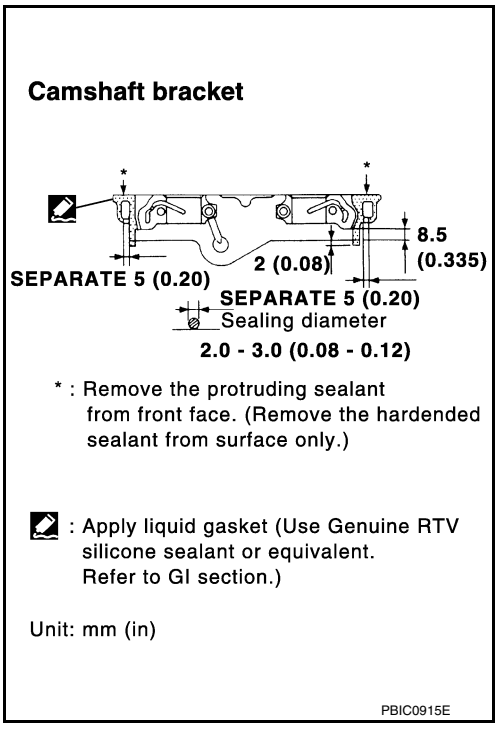
(1) :Crankshaft key



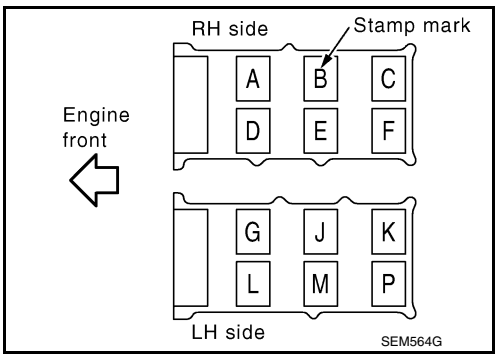
7. Before installing camshaft brackets, apply sealant to mating surface of No. 1 camshaft bracket.
   - **Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".**



   - Before installation, wipe off any protruding sealant. Refer to EM-126, "Precaution for Liquid Gasket".



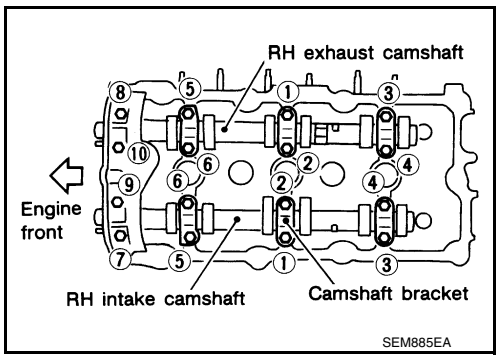
   - Install camshaft brackets in their original positions and direction. Align the stamp marks as shown.
   - **If checking and adjusting any part of valve assembly or camshaft, check valve clearance according to the reference data. Refer to EM-140, "Valve Clearance".**

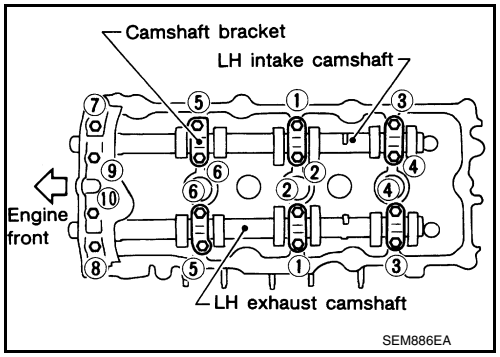


Valve clearance (cold) Intake	**: 0.26 - 0.34 mm (0.010 - 0.013 in)**
Valve clearance (cold) Exhaust	**: 0.29 - 0.37 mm (0.011 - 0.015 in)**

- Tighten the camshaft brackets in the three steps, in numerical order as shown.

1	10.41 N·m (1.10 kg-m, 8 ft-lb)	Tighten No. 7 - 10, then tighten 1 - 6 in numerical order as shown.
2	10.41 N·m (1.10 kg-m, 8 ft-lb)	Tighten all in numerical order as shown.
3	10.41 N·m (1.10 kg-m, 8 ft-lb)	Tighten No. 1 - 10 in numerical order as shown.

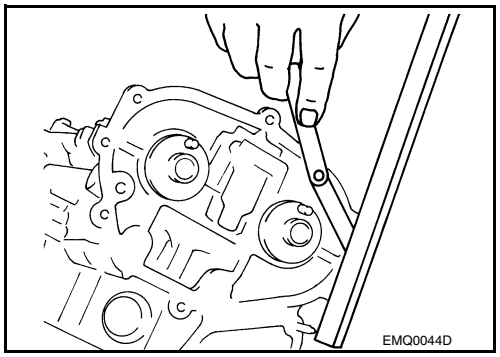




8. Measure difference in levels between front end faces of No. 1 camshaft bracket and cylinder head.

Standard : – 0.14 (– 0.0055 in)

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



9. Install camshaft position sensor bracket (PHASE) (RH and LH bank.)
10. Install the timing chains. Refer to EM-187, "Exploded View".

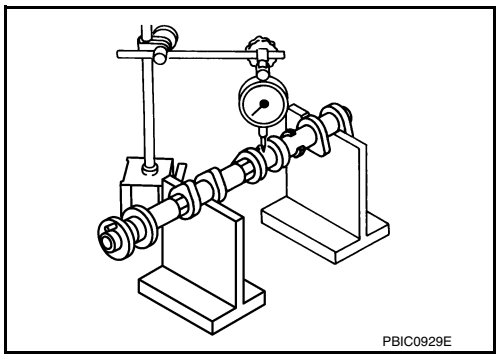
INSPECTION AFTER REMOVAL

Camshaft Visual Check

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

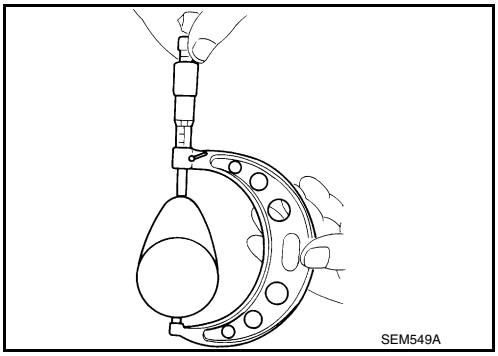
Camshaft Runout

1. Put V-block on precise flat bed and support No. 2 and No. 4 journal of camshaft as shown.
2. Set dial gauges vertically to No. 3 journal as shown.
3. Turn camshaft in one direction slowly by hand, measure the camshaft runout on the dial gauges.
   - Runout is the largest indicator reading after one full revolution. Refer to EM-253, "Camshaft".
4. If actual runout exceeds the limit, replace the camshaft.



Camshaft Cam Lobe Height

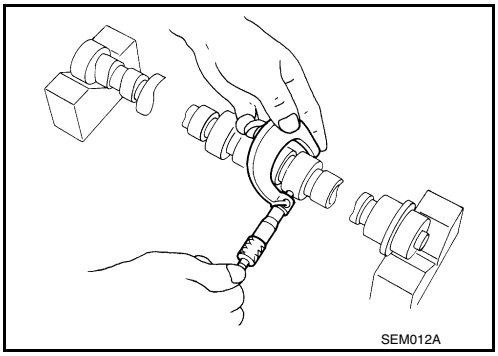
1. Measure camshaft cam lobe height as shown. Refer to EM-253, "Camshaft".
2. If wear has reduced the lobe height below specifications, replace the camshaft.



Camshaft Journal Clearance

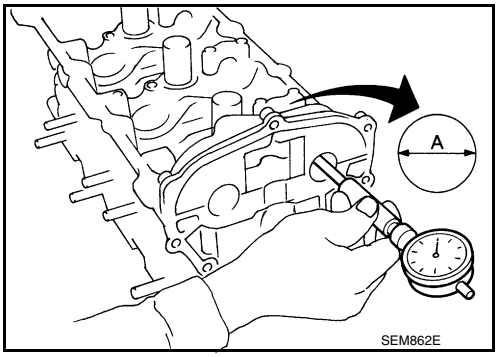
Outer Diameter of Camshaft Journal

- Measure outer diameter of camshaft journal as shown. Refer to EM-253, "Camshaft".



Inner Diameter of Camshaft Bracket

1. Tighten camshaft bracket bolt with specified torque.
2. Using inside micrometer, measure inner diameter (A) of camshaft bearing. Refer to EM-253, "Camshaft".



Calculation of Camshaft Journal Clearance

(Journal clearance) = (inner diameter of camshaft bracket) – (outer diameter of camshaft journal). Refer to EM-253, "Camshaft".

- When out of the specified range, replace either or both camshaft and cylinder head.

  NOTICE:

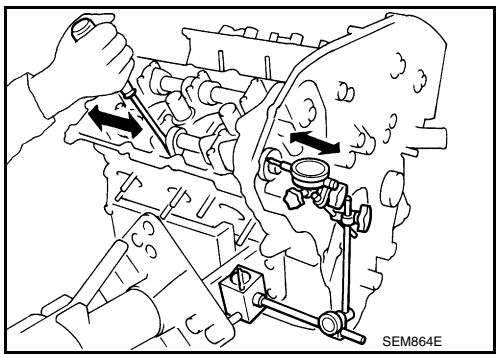
  Inner diameter of camshaft bracket is manufactured together with cylinder head. Replace the whole cylinder head assembly.

Camshaft End Play

1. Install the camshaft in the cylinder head.

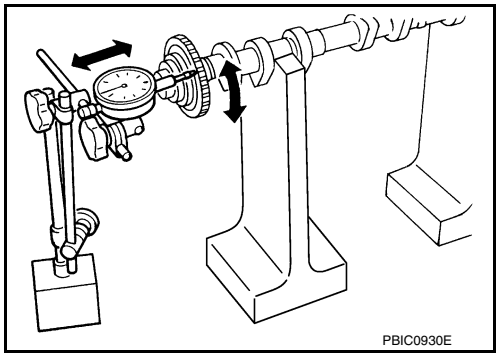
2. Install dial gauge in thrust direction on front end of camshaft. Measure end play when camshaft is moved forward/backward (in direction to axis) as shown. Refer to EM-253, "Camshaft".

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



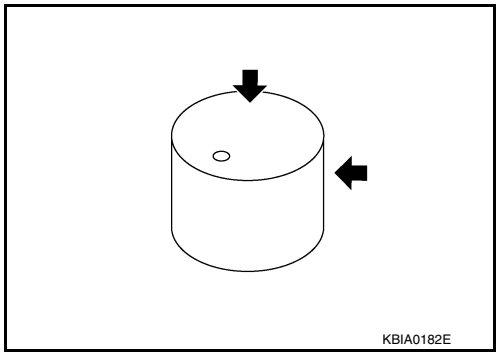
Camshaft Sprocket Runout

1. Put V-block on precise flat bed and support No. 2 and No. 4 journal of camshaft as shown.
2. Install camshaft sprocket on camshaft.
3. Measure camshaft sprocket runout. Refer to EM-253, "Camshaft".
4. If sprocket runout exceeds the limit, replace camshaft sprocket.



Valve Lifter

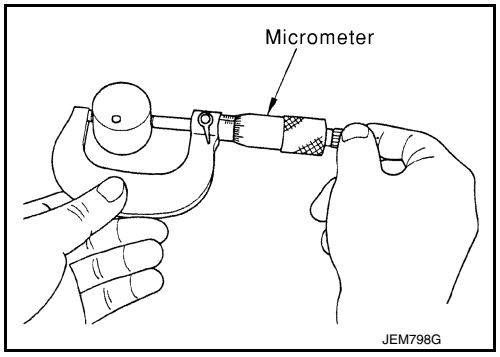
- Check if the surface of the valve lifter has any excessive wear or cracks, replace as necessary.



Valve Lifter Clearance

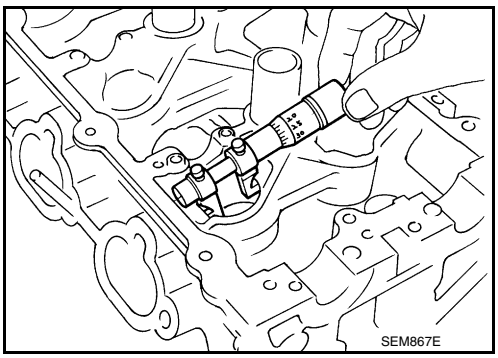
Outer Diameter of Valve Lifter

- Measure the outer diameter of the valve lifter. Refer to EM-253, "Camshaft".
- If out of the specified range, replace the valve lifter.



Valve Lifter Bore Diameter

- Using inside micrometer, measure diameter of valve lifter bore of cylinder head. Refer to EM-253, "Camshaft".
- If out of the specified range, replace the cylinder head assembly.



Calculation of Valve Lifter Clearance

- (Valve lifter clearance) = (hole diameter for valve lifter) – (outer diameter of valve lifter) Refer to EM-253, "Camshaft".
- If out of specified range, replace either or both valve lifter and cylinder head assembly.

Inspection after Installation

INFOID:0000000012602053

INSPECTION OF CAMSHAFT SPROCKET (INT) OIL GROOVE

WARNING:

Check when engine is cold so as to prevent burns from any splashing engine oil.

CAUTION:

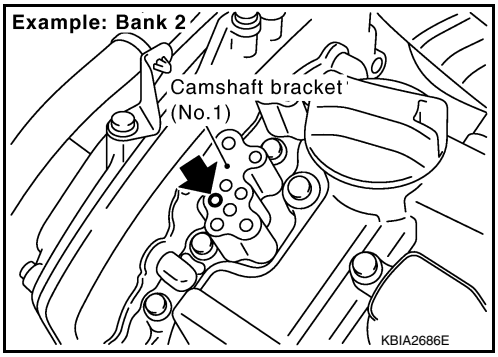
Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT and it is directed according to inspection procedure of EC section. Refer to EC-765, "Diagnosis Procedure".

1. Check engine oil level. Refer to MA-28, "ENGINE OIL : Inspection".
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release fuel pressure. Refer to FL-4, "Inspection".

b. Disconnect ignition coil and injector harness connectors if practical.

3. Remove intake valve timing control solenoid valve.
4. Crank engine, and then make sure that engine oil comes out from intake valve timing control solenoid valve cover oil hole. End cranking after checking.



WARNING:

Do not touch rotating parts (drive belts, idler pulley, and crankshaft pulley, etc.).

CAUTION:

- **Engine oil may squirt from intake valve timing control solenoid valve installation hole during cranking. Use a shop cloth to prevent engine oil from splashing on worker, engine components and vehicle.**
- **Do not allow engine oil to get on rubber components such as drive belts or engine mount insulators. Immediately wipe off any splashed engine oil.**

5. Clean oil groove between oil strainer and intake valve timing control solenoid valve if engine oil does not come out from intake valve timing control solenoid valve cover oil hole.
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.
7. After inspection, installation of the remaining components is in the reverse order of removal.

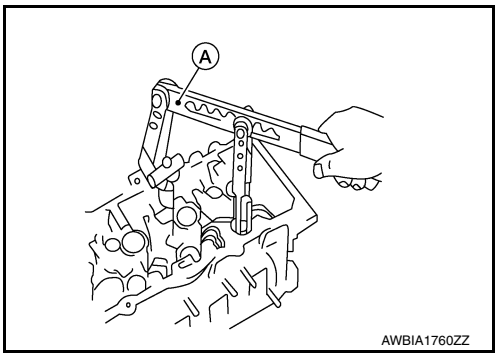
OIL SEAL

Removal and Installation of Valve Oil Seal

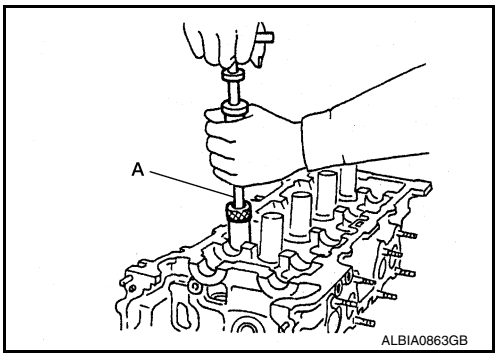
INFOID:0000000012602054

REMOVAL

1. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent valve from dropping into cylinder.
   CAUTION:
   When rotating crankshaft, be careful to avoid scarring the front cover with the timing chain.
2. Remove camshaft relating to valve oil seal to be removed. Refer to EM-200, "Removal and Installation".
3. Remove valve lifters.
4. Remove valve collet, valve spring retainer and valve spring using suitable tool (A).
   CAUTION:
   When working, take care not to damage valve lifter bore.
   • Compress valve spring using Tool, attachment and adapter. Remove valve collet with magnet hand.



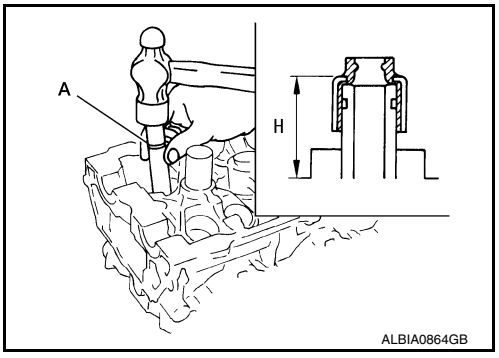
5. Remove valve oil seal using suitable tool (A).



INSTALLATION

1. Apply new engine oil to new valve oil seal joint surface and seal lip.
2. Press in valve oil seal to height (H) using suitable tool (A).
   NOTE:
   Dimension (H): height measured before valve spring seat installation.

   Intake and exhaust (H) : 14.3 - 14.9 mm (0.563 - 0.587 in)
3. Installation of the remaining components is in the reverse order of removal.



Removal and Installation of Front Oil Seal

INFOID:0000000012602055

REMOVAL

1. Remove drive belt. Refer to EM-136, "Removal and Installation".
2. Lock the drive plate using Tool.

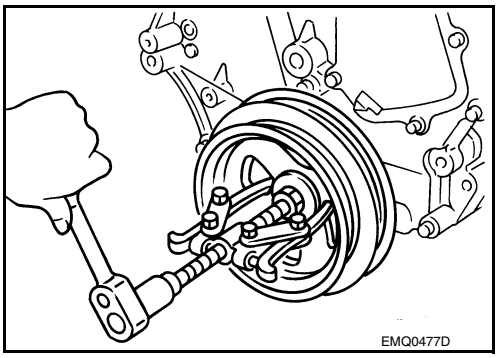
   Tool number : — (J-50288)

CAUTION:
Do not damage the ring gear teeth or the signal plate teeth behind the ring gear when setting the Tool.

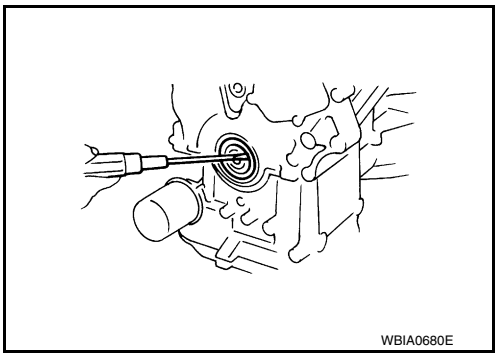
3. Remove the crankshaft pulley as follows:

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

b. Position a pulley puller at recess hole of crankshaft pulley to remove crankshaft pulley.
CAUTION:
Do not use a puller claw on the outer diameter of the crankshaft pulley.

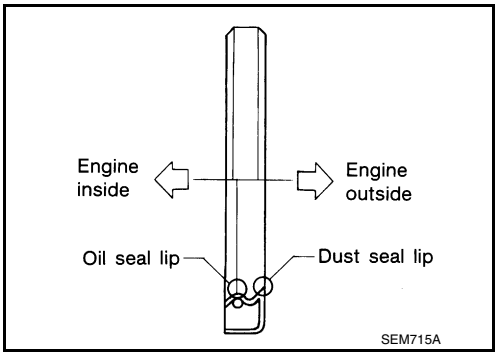


4. Remove front oil seal from front cover using a suitable tool.
CAUTION:
Do not damage front cover or crankshaft.

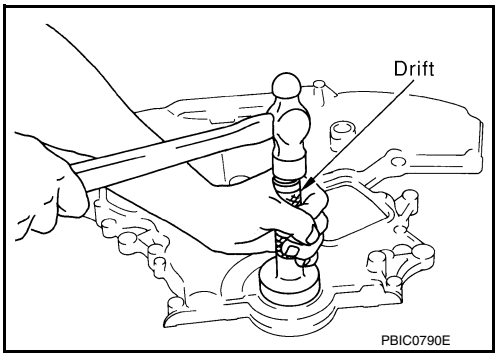


INSTALLATION

1. Apply new engine oil to new oil seal and install.
• Install new oil seal in the direction as shown.
CAUTION:
• **Do not reuse front oil seal.**
• **Press fit straight and avoid causing burrs or tilting the oil seal.**



• Press-fit oil seal until it becomes flush with the timing chain case end face, using suitable tool.
• Make sure the garter spring in the oil seal is in position and seal lip is not inverted.



2. Install crankshaft pulley and tighten the bolt in two steps.
• Lubricate thread and seat surface of the bolt with new engine oil.
• For the second step angle tighten using Tool.
CAUTION:

- **Do not damage the front oil seal when inserting crankshaft pulley.**
- **Use only brass or plastic hammer if tapping on the crankshaft pulley.**
- **Do not hammer on pulley grooves.**

Step 1 : 44.1 N·m (4.5 kg-m, 33 ft-lb)
Step 2 : 90°(+0°/-6°) degrees clockwise

Tool number : KV10112100 (BT-8653-A)

3. Remove the Tool to unlock the drive plate.

Tool number : — (J-50288)

CAUTION:
Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when removing the Tool.

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

Removal and Installation of Rear Oil Seal

INFOID:0000000012602056

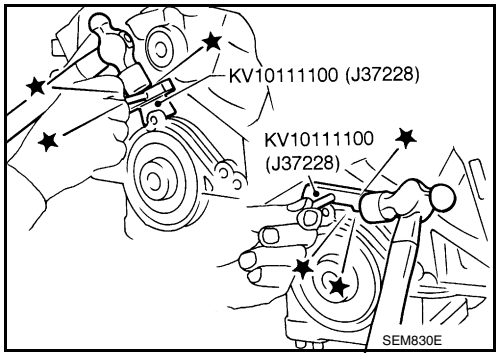
REMOVAL

1. Remove the upper oil pan. Refer to EM-161, "Removal and Installation (Upper Oil Pan)".
2. Remove drive plate. Refer to EM-230, "Exploded View".
3. Remove rear oil seal retainer using Tool.

Tool Number : KV10111100 (J-37228)

CAUTION:
- **Do not damage mating surface.**
- **If rear oil retainer is removed, replace it with a new one**

NOTE:
Rear oil seal and retainer form a single part and are replaced as an assembly.



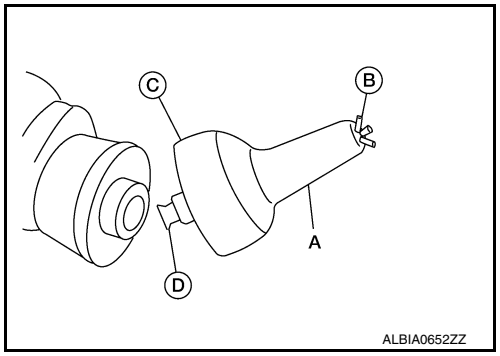
INSTALLATION

1. Remove old liquid gasket material from mating surface of cylinder block and oil pan using a suitable scraper.
2. Install the rear oil seal retainer using Tool (A).

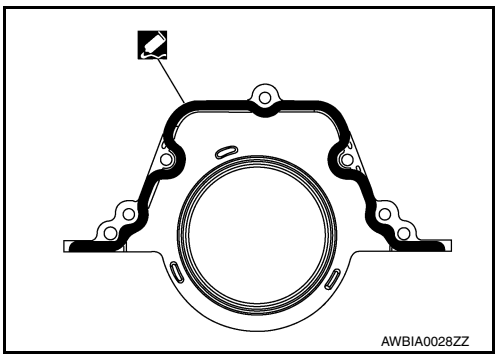
CAUTION:
Do not reuse rear oil seal retainer.

Tool number (A) : — (J-47128)

a. Loosen the wing nut (B) on the end of the Tool (A).
b. Insert the arbor (D) into the crankshaft pilot hole until the outer lip (C) of the Tool (A) covers the edge of the crankshaft sealing surface.
c. Tighten the wing nut (B) to secure the Tool (A) to the crankshaft.

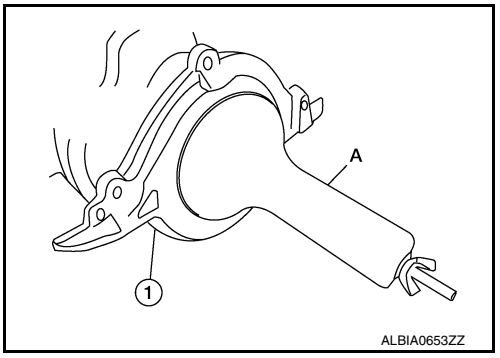


d. Apply sealant to rear oil seal retainer as shown.
Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
CAUTION:
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the liquid gasket to cure.**



e. Lubricate the sealing surface of the new rear main seal with new engine oil.
f. Slide the new rear main seal (1) over the Tool (A) and onto the crankshaft.
g. Loosen the wing nut and push the threaded rod into the handle to remove the Tool (A).
h. Tighten the rear oil seal retainer bolts to specification.

Rear oil seal retainer bolts : 8.8 N·m (0.9 kg-m, 78 in-lb)



3. Installation of the remaining components is in the reverse order of removal.
CAUTION:
- **When replacing an engine or transmission you must make sure the dowels are installed correctly during re-assembly.**
- **Improper alignment caused by missing dowels may cause vibration, oil leaks or breakage of drivetrain components.**

CYLINDER HEAD

Exploded View

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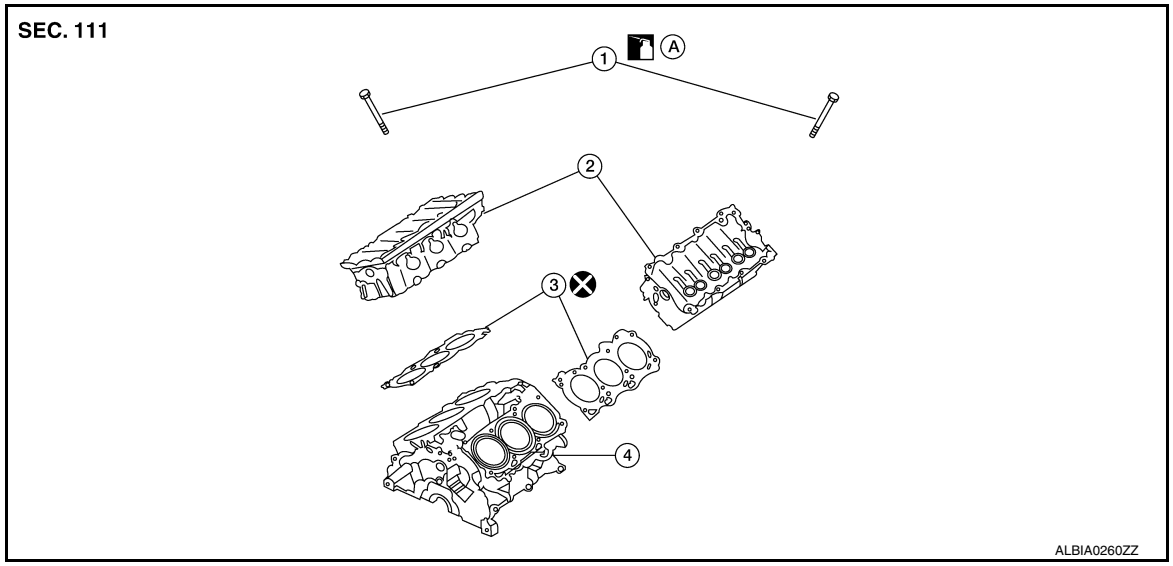


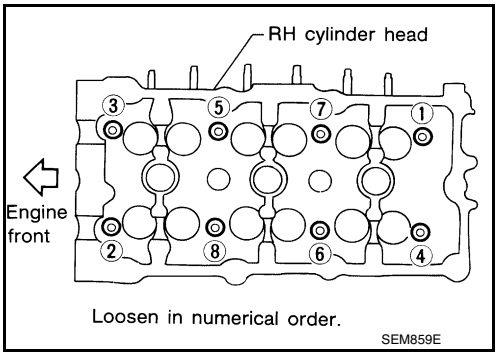
1. Cylinder head bolt
2. Cylinder head
3. Cylinder head gasket
4. Engine block
A. Refer to INSTALLATION

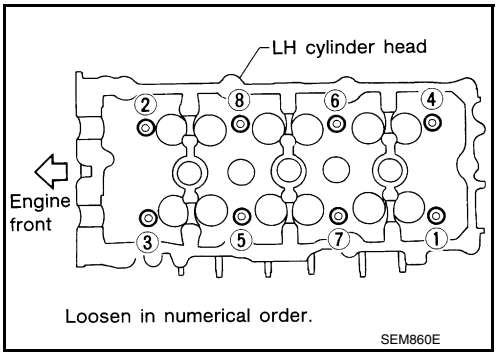
Removal and Installation

INFOID:0000000012602058

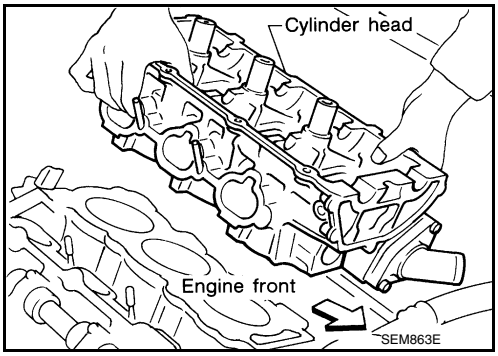
REMOVAL

1. Remove the engine from the vehicle. Refer to EM-226, "Removal and Installation".
2. Remove the rear timing chain case. Refer to EM-195, "Removal and Installation".
3. Remove the intake manifold. Refer to EM-151, "Removal and Installation".
4. Remove the exhaust manifold and three way catalyst (bank 1/bank 2). Refer to EM-153, "Exploded View".
5. Remove the intake and exhaust camshafts. Refer to EM-200, "Removal and Installation".
6. Remove the water outlet housing. Refer to CO-48, "Exploded View".
7. Remove the (bank 1/ bank 2) cylinder head bolts.
   - The bolts should be loosened gradually in three stages.
   - Loosen the bolts in the numerical order as shown.



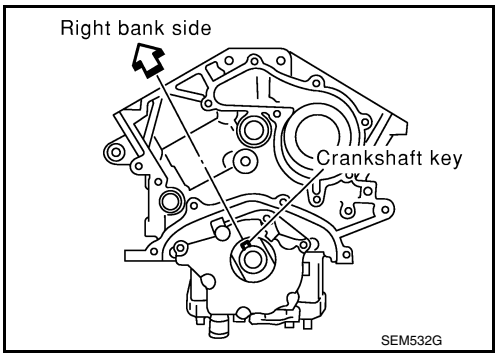


8. Remove cylinder heads and gaskets.
   • Discard the cylinder head gaskets and use new gaskets for installation.

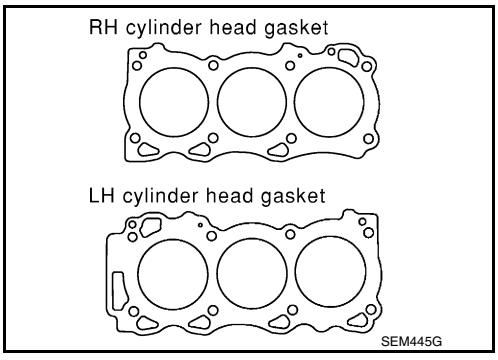


INSTALLATION

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



2. Install new cylinder head gaskets.
   CAUTION:
   Do not reuse cylinder head gaskets.

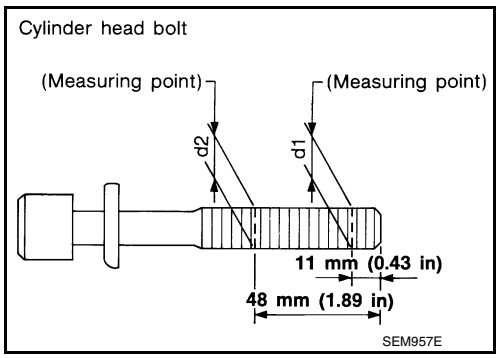


3. Inspect the cylinder head bolts before installing the cylinder heads.
   CAUTION:

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

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

- **Lubricate threads and seat surfaces of the bolts with new engine oil.**

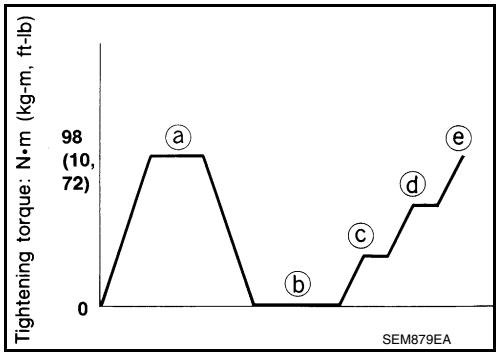


4. Install the cylinder heads on the cylinder block. Tighten the cylinder head bolts in the five steps in the numerical order as shown using Tool.

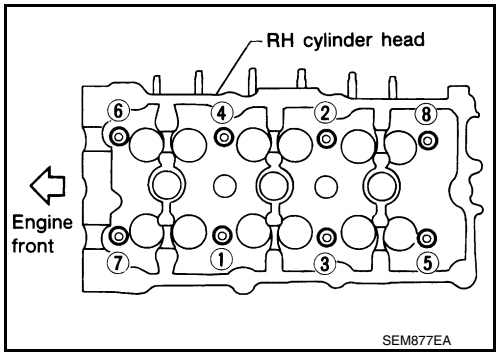
CAUTION:
Do not rotate crankshaft and camshaft separately or valves will strike piston heads.

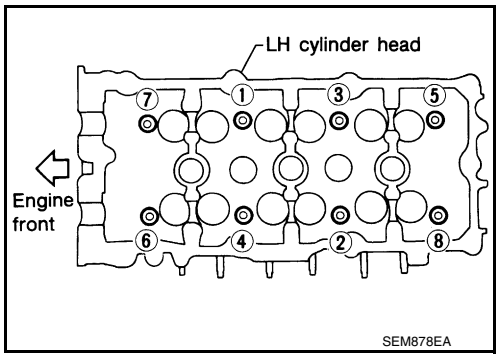
Tool Number : KV10112100 (BT-8653-A)

- **Tightening procedure:**



Cylinder head bolts
Step a : 98.1 N·m (10 kg-m, 72 ft-lb) in order
Step b : Loosen in the reverse order of tightening
Step c : 39.2 N·m (4.0 kg-m, 29 ft-lb) in order
Step d : 103° degrees rotation clockwise in order
Step e : 103° degrees rotation clockwise in order





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

Disassembly and Assembly

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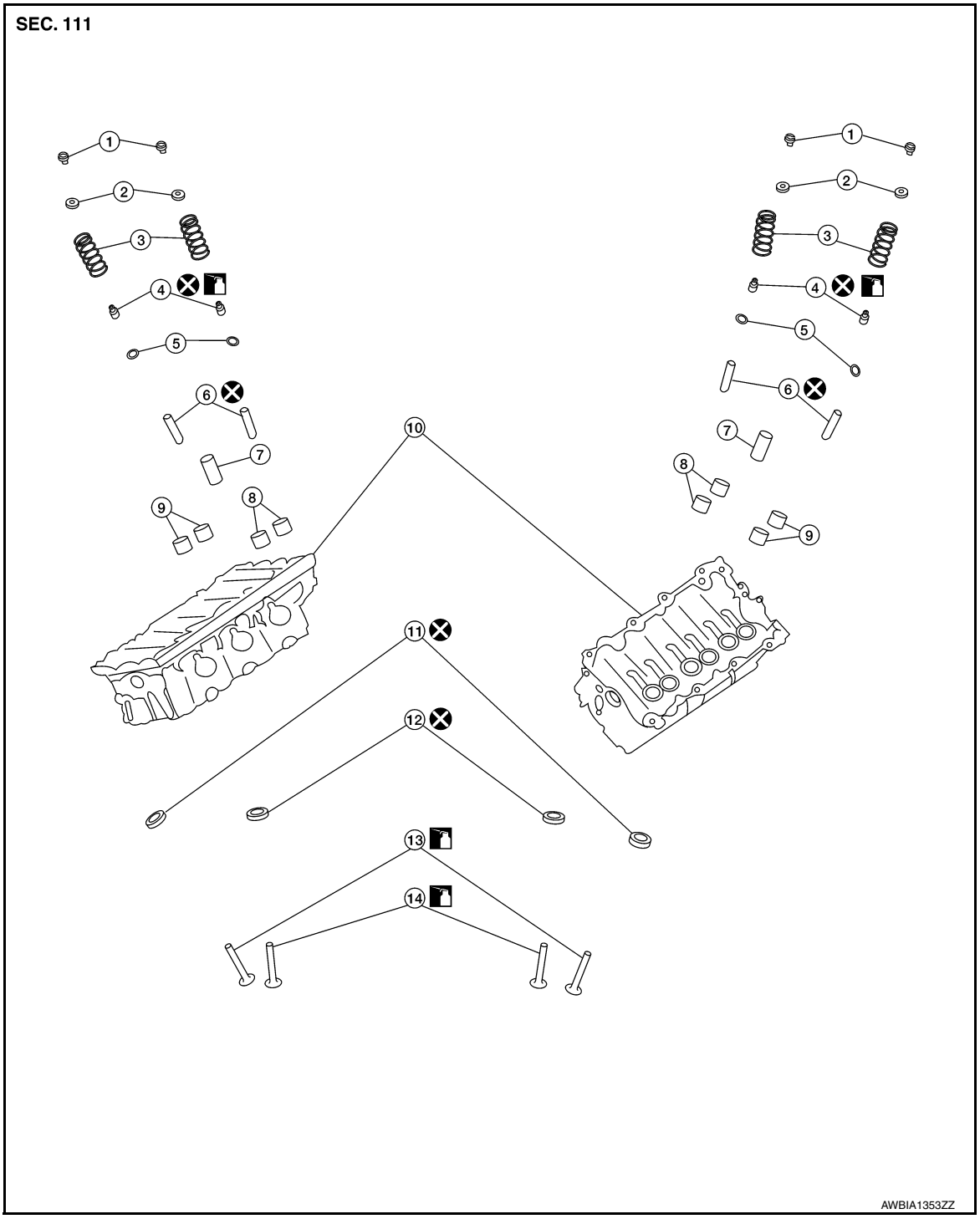


1. Valve collet
2. Valve spring retainer
3. Valve spring
4. Valve oil seal
5. Valve spring seat
6. Valve guide
7. Spark plug tube
8. Lifter (INT)
9. Lifter (EXH)
10. Cylinder head
11. Valve seat (EXH)
12. Valve seat (INT)
13. Valve (EXH)
14. Valve (INT)

CAUTION:

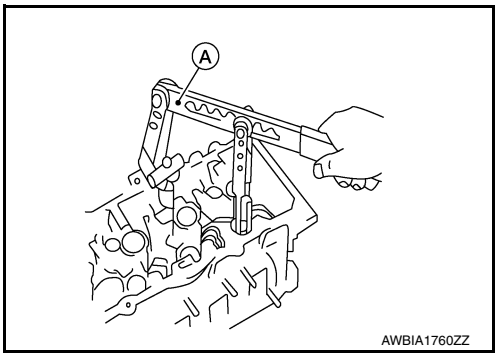
- **When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.**
- **Apply new engine oil to threads and seat surface when installing cylinder head, camshaft sprocket, crankshaft pulley, and camshaft bracket.**

- **Attach tags to valve lifters so as not to mix them up.**

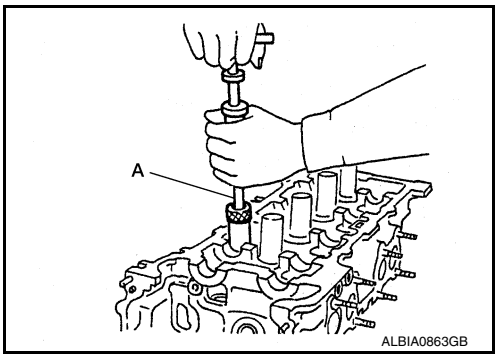
DISASSEMBLY

1. Remove spark plug.
2. Remove valve lifter.
   - Identify installation positions and store them without mixing them up.
3. Remove valve collet.
   - Compress valve spring and remove valve collet with magnet hand using suitable tool (A)

   CAUTION:
   When working, take care not to damage valve lifter bore.



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



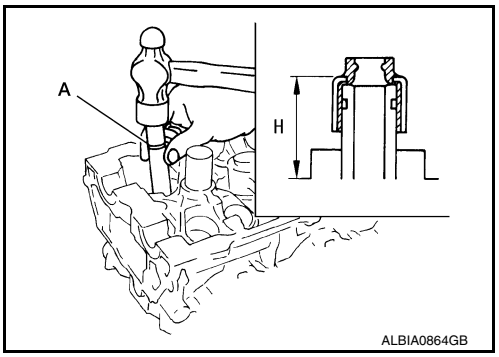
7. Remove valve seat (if necessary). Refer to EM-218, "Inspection After Disassembly".
8. Remove valve guide (if necessary). Refer to EM-218, "Inspection After Disassembly".
9. Remove spark plug tube (if necessary).
   - Using pair of pliers, pull spark plug tube out of cylinder head.

   CAUTION:
   - **Take care not to damage cylinder head.**
   - **Once removed, spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.**

ASSEMBLY

1. Install valve guide (if removed). Refer to EM-218, "Inspection After Disassembly".
2. Install valve seat (if removed). Refer to EM-218, "Inspection After Disassembly".
3. Install valve oil seals using suitable tool (A).

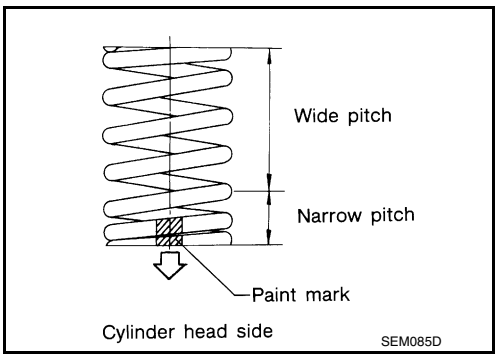
   Height (H) (Without valve spring seat installed)
   Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)



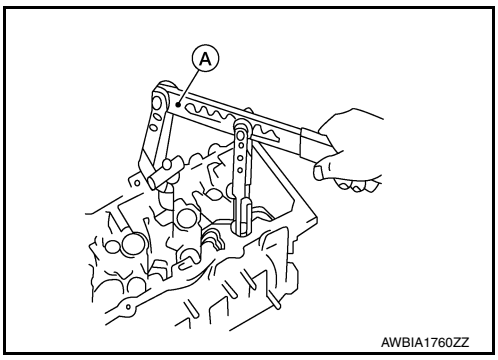
4. Install valve spring seat.
5. Install valves.
   - Install it in the original position.

   NOTE:
   Larger diameter valves are for intake side.

6. Install valve spring (uneven pitch type) with narrow pitch end (paint mark) to cylinder head side (valve spring seat side).



7. Install valve spring retainer.
8. Install valve collet.
   - Compress valve spring using suitable tool (A), attachment and adapter. Install valve collet with magnet hand.
     CAUTION:
     When working, take care not to damage valve lifter bore.
   - Tap valve stem edge lightly with plastic hammer after installation to check its installed condition.



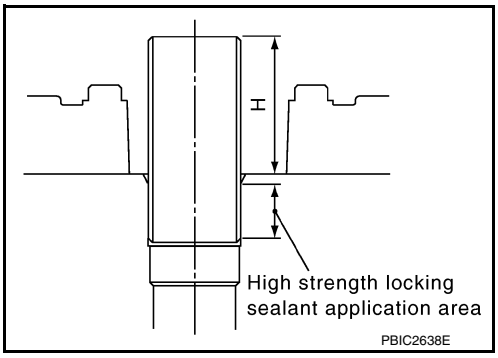
9. Install valve lifter.
   - Install it in the original position.
10. Install spark plug tube.
    - Press-fit spark plug tube as follows:

a. Remove old liquid gasket adhering to cylinder head mounting hole.

b. Apply sealant to area within approximately 12 mm (0.47 in) from edge of spark plug tube press-fit side.
Use Genuine High Strength Locking Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

c. Press-fit spark plug tube so that its height (H) is as specified in using suitable tool. Refer to EM-255, "Cylinder Head".
CAUTION:
- **When press-fitting, take care not to deform spark plug tube.**
- **After press-fitting, wipe off liquid gasket protruding onto cylinder-head upper face.**

11. Install spark plug. Refer to EM-134, "Removal and Installation".



Inspection After Disassembly

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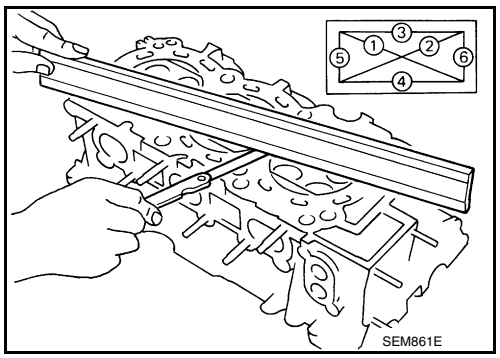
CYLINDER HEAD DISTORTION

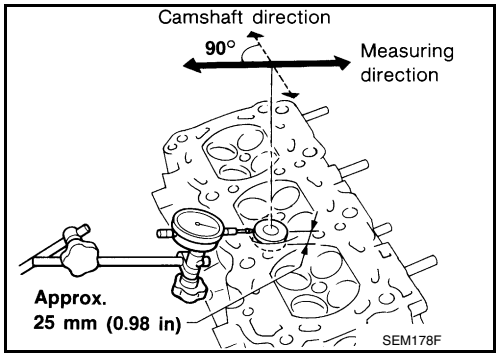
Clean the surface of the cylinder head. Use a reliable straightedge and feeler gauge to check the flatness of cylinder head surface.

Check along six positions as shown. Refer to EM-216, "Disassembly and Assembly"
If it exceeds the limit, replace the cylinder head.
The limit for cylinder head resurfacing is determined by the cylinder block resurfacing. Refer to EM-255, "Cylinder Head"
After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.



VALVE GUIDE CLEARANCE

1. Measure valve deflection as shown (Valve and valve guide mostly wear in this direction). Refer to EM-255, "Cylinder Head".

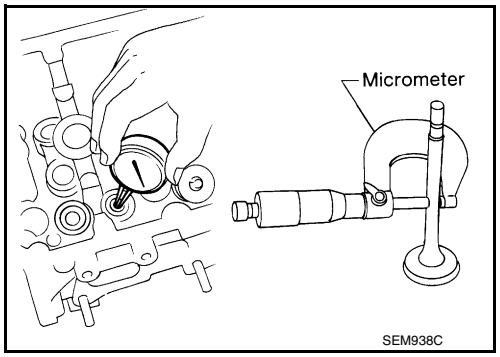


2. If it exceeds the limit, check valve to valve guide clearance.

a. Measure valve stem diameter and valve guide inner diameter. Refer to EM-255, "Cylinder Head".

b. Check that clearance is within specification.
(Valve guide clearance) = (Valve guide inner diameter) - (Valve stem diameter). Refer to EM-255, "Cylinder Head".

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

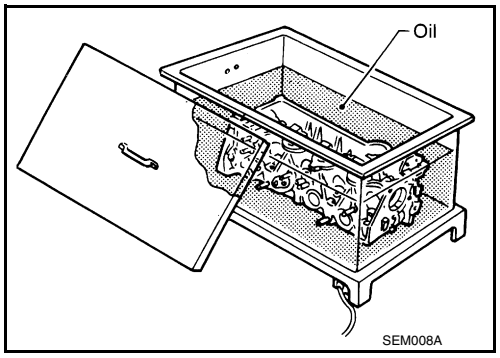


VALVE GUIDE REPLACEMENT

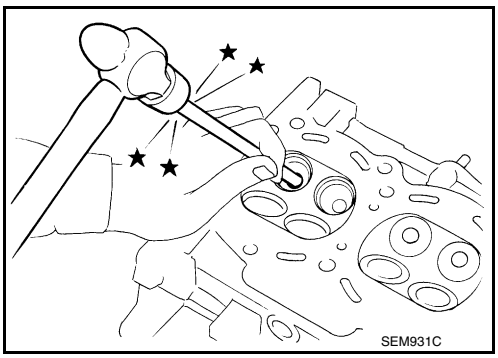
When valve guide is removed, replace with oversized [0.2 mm (0.008 in)] valve guide.

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

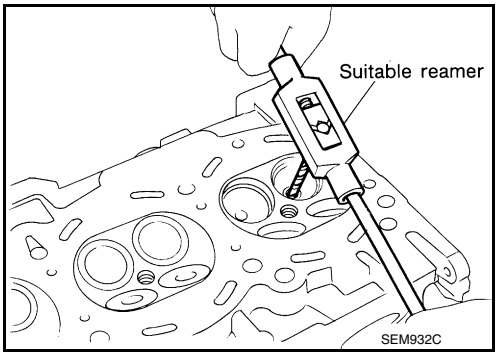
WARNING:
Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.



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

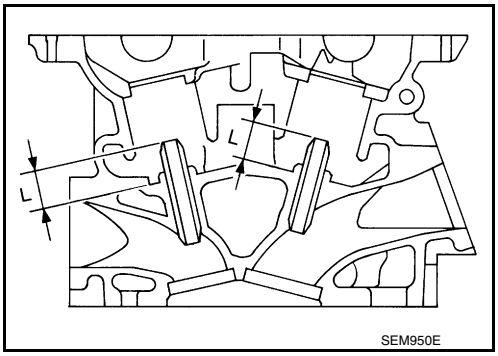


3. Ream cylinder head valve guide hole. Refer to EM-255, "Cylinder Head".



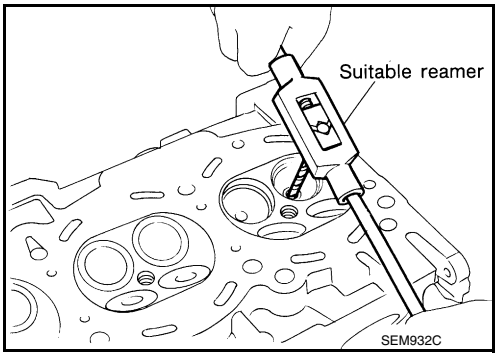
4. Heat cylinder head to 110 - 130°C (230 - 266°F) by soaking in heated oil and press new valve guide from camshaft side into the cylinder head to the dimensions as shown. Refer to EM-255, "Cylinder Head".

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



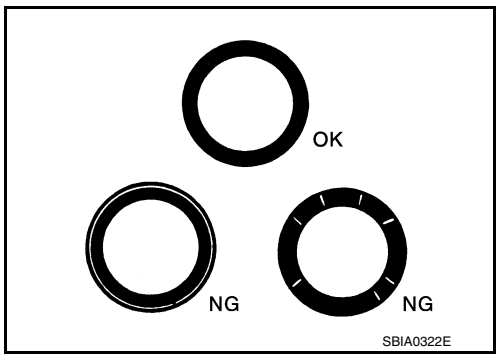
5. Using a valve guide reamer, apply a reamer finish to the valve guide.

Intake and exhaust finished size	**: 6.000 - 6.018 mm (0.2362 - 0.2369 in)**



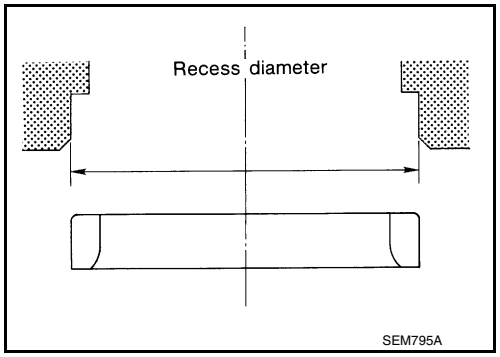
VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure.
- Apply prussian blue onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has NG conditions even after the re-check, replace valve seat.

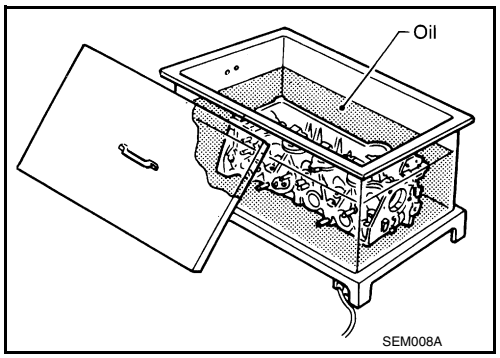


VALVE SEAT REPLACEMENT

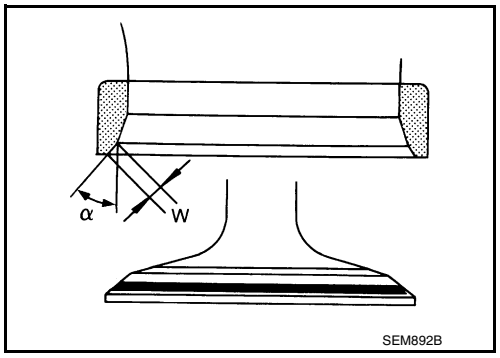
1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
2. Ream cylinder head recess for service valve seat. Refer to EM-255, "Cylinder Head"
   CAUTION:
   Be sure to ream in circles concentric to the valve guide center. This will enable valve seat to fit correctly.



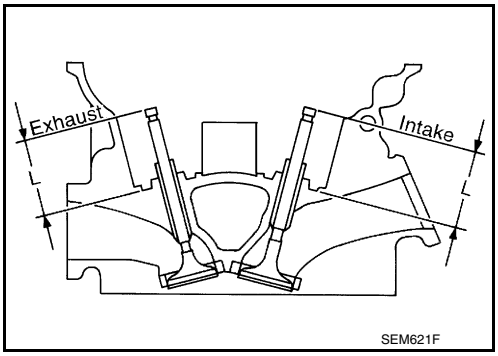
3. Heat cylinder head to 110 - 130°C (230 - 266°F) by soaking in heated oil.
   WARNING:
   Cylinder head contains heat. when working, wear protective equipment to avoid getting burned.



4. Press fit valve seat until it seats on the bottom.
5. Cut or grind valve seat using suitable tool to the specified dimensions. Refer to EM-255, "Cylinder Head".
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition. Refer to EM-255, "Cylinder Head".

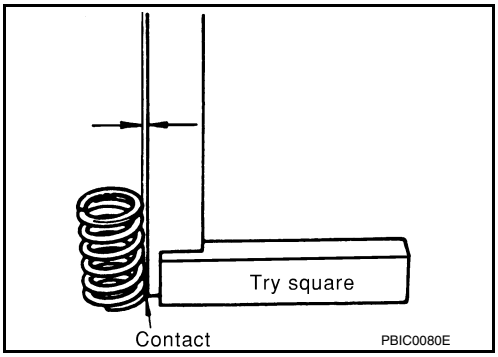


8. Use a depth gauge to measure the distance between the mounting surface of the cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 to adjust it. If it is longer, replace the valve seat with a new one. Refer to EM-255, "Cylinder Head".



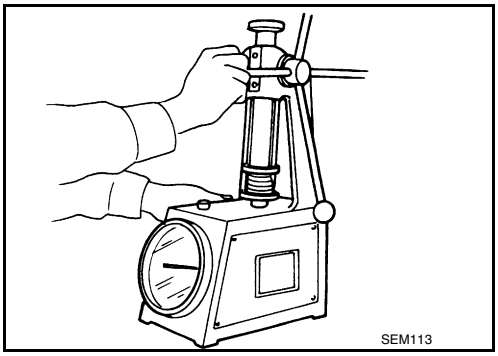
VALVE SPRING SQUARENESS

Set try square along the side of valve spring and rotate the spring. Measure the maximum clearance between the top face of spring and try square. Refer to EM-255, "Cylinder Head".



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

Check valve spring pressure at specified spring height.
If it is not within specifications, replace the spring. Refer to EM-255, "Cylinder Head".



ENGINE MOUNT
ENGINE MOUNT (FRONT)
ENGINE MOUNT (FRONT) : Removal and Installation

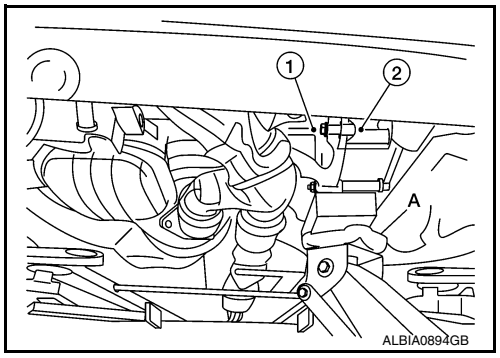
INFOID:0000000012602061

WARNING:
- **Situate the vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **Always work safely.**
- **Do not start work until the engine and exhaust system are cooled completely.**

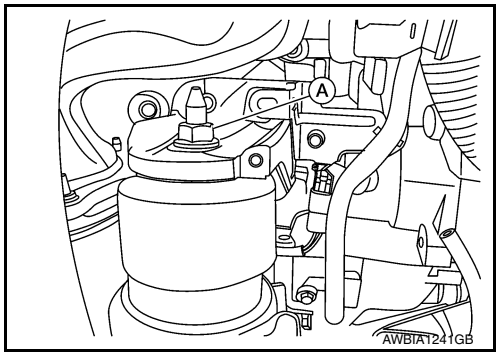
CAUTION:
Do not damage or spill oil on the engine mount insulator (front).
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

REMOVAL

1. Remove the air cleaner assembly, front air duct, and air duct hose and resonator assembly. Refer to EM-146, "Removal and Installation".
2. Remove the battery and battery tray assembly. Refer to PG-78, "Removal and Installation".
3. Remove the front under cover. Refer to EXT-38, "FRONT UNDER COVER : Removal and Installation".
4. Remove the fender protector side covers (RH/LH). Refer to EXT-37, "REAR WHEEL HOUSE PROTECTOR : Removal and Installation".
5. Partially remove the fender protectors (RH/LH). Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".
6. Remove the radiator. Refer to CO-37, "Removal and Installation".
7. Remove the cooling fan shroud and motor assembly. Refer to CO-39, "Removal and Installation".
8. Remove the exhaust manifold heat shield (LH). Refer to EX-10, "Exploded View".
9. Support the engine (1) and transaxle (2) using a suitable jack (A) as shown.
   CAUTION:
   - **Position a suitable jack under the engine and transaxle assembly as shown.**
   - **Do not damage the front exhaust tube or transaxle oil pan with the jack.**

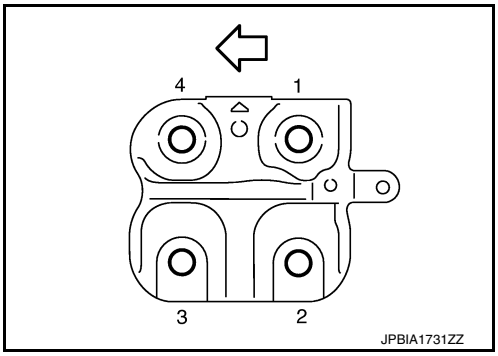


10. Disconnect the engine mounting insulator (front) vacuum hose.
11. Remove the engine insulator (front) nut (A).



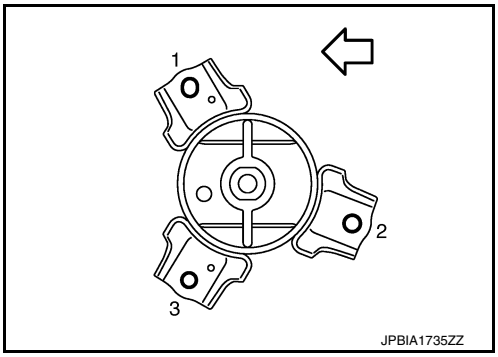
12. Loosen the engine bracket (front) bolts in the reverse order shown.

⇦ : Engine front

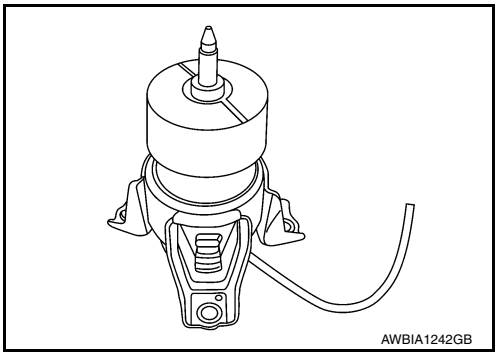


13. Remove the engine mounting bracket (front).
14. Remove the engine insulator (front) bolts in the reverse order as shown.

⇦ :Front

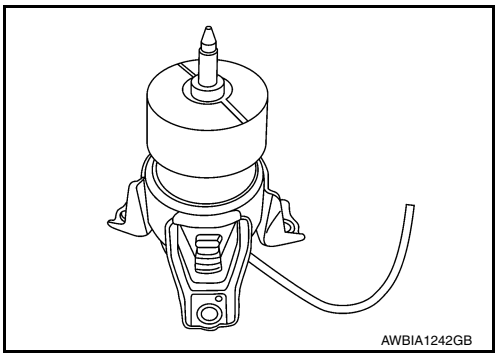


15. Remove the engine mounting insulator (front).



INSTALLATION

1. Install the engine mounting insulator (front).

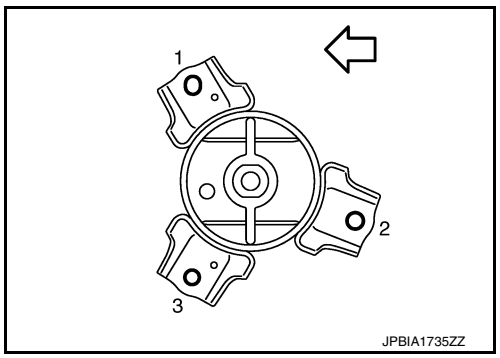


2. Install the engine insulator (front) bolts and tighten to specification in the order shown.

⇦ :Front

Engine insulator (front) bolts : 43 N·m (4.4 kg-m, 32 ft-lb)

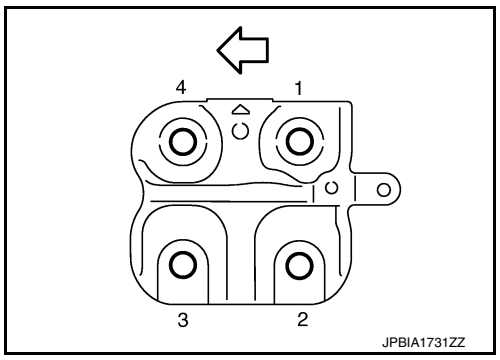
CAUTION:
Check engine mounting insulator (front) is seated properly before tightening.



3. Install the engine mounting bracket (front) to the engine block.
4. Tighten the engine bracket (front) bolts to specification in the order shown.

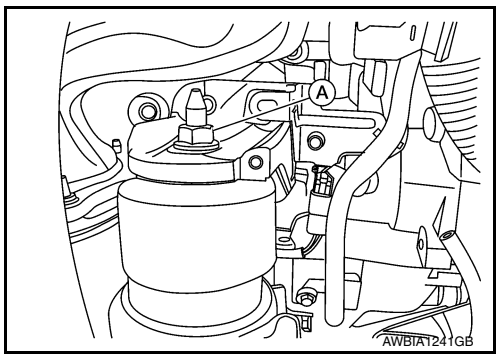
⇦ :Engine front

Engine bracket (front) bolts : 40 N·m (4.1 kg-m, 30 ft-lb)



5. Install the engine insulator (front) nut (A) and tighten to specification.

Engine insulator (front) nut : 103 N·m (11 kg-m, 76 ft-lb)



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

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

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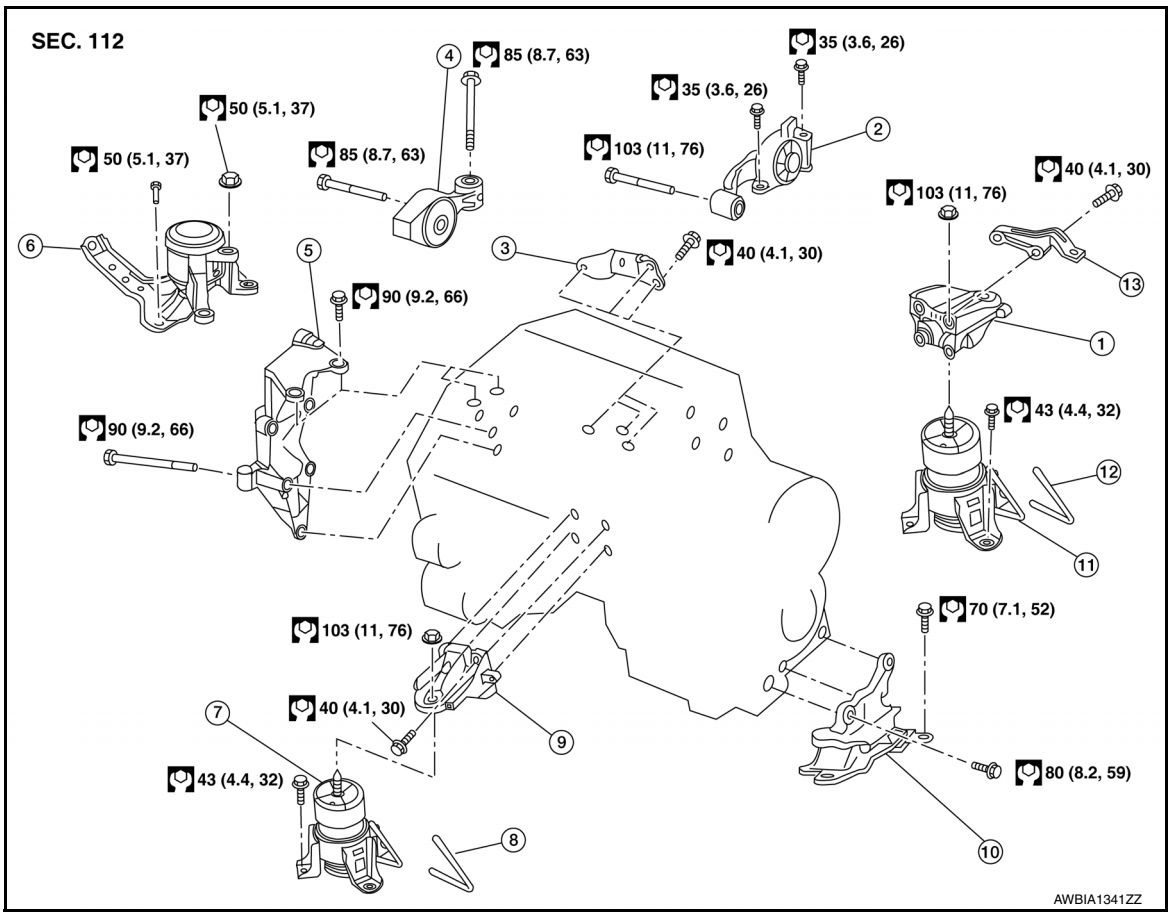


1. Engine mounting bracket (rear)
2. Rear torque rod
3. Rear torque rod bracket
4. Upper torque rod
5. Engine mounting bracket (RH)
6. Engine mounting insulator (RH)
7. Engine mounting insulator (front)
8. Front engine mounting insulator vacuum hose
9. Engine mounting bracket (front)
10. Engine mounting insulator (LH)
11. Engine mounting insulator (rear)
12. Rear engine mounting insulator vacuum hose
13. Gusset

Removal and Installation

INFOID:0000000012602063

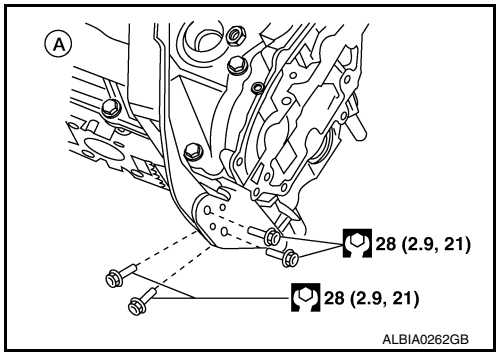
WARNING:
- **Place chocks at front and back of rear wheels.**
- **For engines not equipped with engine slingers, attach proper slingers and bolts as described in the NISSAN Parts Catalog.**
- **Do not start working until exhaust system and coolant are cool.**

CAUTION:
- **If items or work required are not covered by the engine main body section, follow the applicable procedures.**
- **Use the correct supporting points for lifting and jacking. Refer to GI-33, "Garage Jack and Safety Stand".**
- **In removing the drive shafts, do not damage any transaxle grease seals.**
- **Before separating the engine and transaxle, remove the crankshaft position sensor (POS).**
- **Do not damage the edge of the crankshaft position sensor (POS) or the ring gear teeth.**

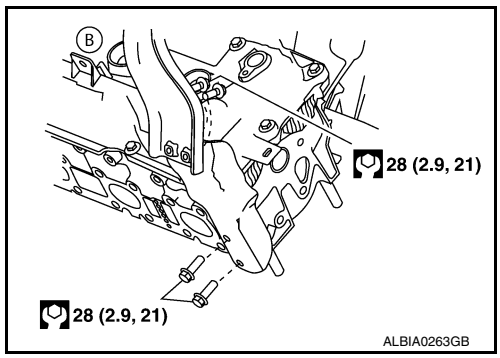
REMOVAL

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

1. Remove hood assembly. Refer to DLK-167, "HOOD ASSEMBLY : Removal and Installation".
2. Release fuel pressure. Refer to FL-4, "Inspection".
3. Drain engine coolant. Refer to CO-35, "Changing Engine Coolant".
4. Drain power steering fluid. Refer to ST-31, "Draining and Refilling".
5. Remove front wheels and tires (RH/LH) using a power tool. Refer to WT-54, "Adjustment".
6. Remove fender protector side covers (RH/LH). Refer to EXT-36, "FENDER PROTECTOR : Removal and Installation".
7. Remove the front under cover. Refer to EXT-38, "FRONT UNDER COVER : Removal and Installation".
8. Remove the engine room cover. Refer to EM-145, "Removal and Installation".
9. Remove air duct hose and resonator assembly and air cleaner case assembly with mass air flow sensor. Refer to EM-146, "Removal and Installation".
10. Remove battery and battery tray. Refer to PG-80, "Removal and Installation".
11. Remove transmission control module. Refer to TM-190, "Removal and Installation".
12. Remove cowl top. Refer to EXT-34, "Removal and Installation".
13. Remove strut brace using power tools. Refer to FSU-18, "Exploded View".
14. Remove IPDM E/R. Refer to PCS-47, "Removal and Installation".
15. Remove the following parts:
    - EVAP vacuum hose
    - Brake booster vacuum hose
    - Heater hoses (engine side)
16. Disconnect transaxle shift control cables. Refer to TM-391, "Removal and Installation".
17. Remove upper and lower radiator hoses.
18. Disconnect CVT fluid cooler hoses.
19. Remove power steering reservoir, suction hose and high pressure hose.
20. Disconnect fuel hose quick connection at vehicle piping side. Refer to EM-167, "Removal and Installation".
21. Remove the front exhaust tube. Refer to EX-10, "Exploded View".
22. Discharge and recover the R134a refrigerant. Refer to HA-23, "Recycle Refrigerant".
23. Remove the A/C compressor using power tools. Refer to HA-30, "COMPRESSOR : Removal and Installation".
24. Install engine slingers into front of cylinder head (LH) and rear of cylinder head (RH).
    - (A): Cylinder head (RH)



• (B): Cylinder head (LH)



25. Remove rear cover plate.
26. Remove the torque converter nuts.
27. Remove nuts of stabilizer connecting rods from struts. Refer to FSU-18, "Exploded View".
28. Remove front wheel speed sensors and position aside. Refer to BRC-363, "Removal and Installation - Front Wheel Sensor".
29. Remove front brake rotors. Refer to BR-39, "BRAKE CALIPER ASSEMBLY : Removal and Installation".
30. Remove piston rod nut. Refer to FSU-18, "Exploded View".
31. Remove front drive shaft (LH/RH). Refer to FAX-10, "Removal and Installation (LH)" and FAX-13, "Removal and Installation (RH)".
32. Remove RH drive shaft center bearing bracket.
33. Remove lower steering column pinch bolt. Refer to ST-34, "Exploded View".
34. Remove three way catalyst (manifold) (bank 1) heat shield.
35. Disconnect front and rear engine mounting insulator vacuum hoses.
36. Remove front and rear engine insulator nut.
37. Position a suitable support table under suspension member and engine assembly.TM-210, "Removal and Installation"
38. Disconnect the engine mounting insulator (LH), upper torque rod, and engine mounting insulator (RH).
39. For additional safety, secure the engine in position with suitable tool.
40. Remove suspension member bolts. Refer to ST-34, "Exploded View".
41. Carefully lower the engine, transaxle assembly and suspension member using Tool, avoiding interference with the vehicle body.
    CAUTION:
    - **Before and during this procedure, always check if any harnesses are left connected.**
    - **Avoid any damage to, or any oil/grease smearing or spilling onto the engine mounting insulators.**

    Tool number : KV101J0010 (J-47242)
42. Remove the starter motor. Refer to STR-22, "VQ35DE : Removal and Installation".
43. Remove the crankshaft position sensor (POS).
44. Remove engine and transaxle harness.
45. Separate the engine and transaxle and mount the engine on a suitable engine stand.

INSTALLATION

Installation is in the reverse order of removal.

NOTE:

Tighten transmission bolts to specification. Refer to TM-210, "Removal and Installation".

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	Leaks	Level
Engine oil		Level	Leaks	Level
Transmission/ transaxle fluid	CVT Models	Leaks	Level/Leaks	Leaks
Other oils and fluids*		Level	Leaks	Level
Fuel		Leaks	Leaks	Leaks
Exhaust gas		—	Leaks	—

*Power steering fluid, brake fluid, etc.

UNIT DISASSEMBLY AND ASSEMBLY

CYLINDER BLOCK

Exploded View

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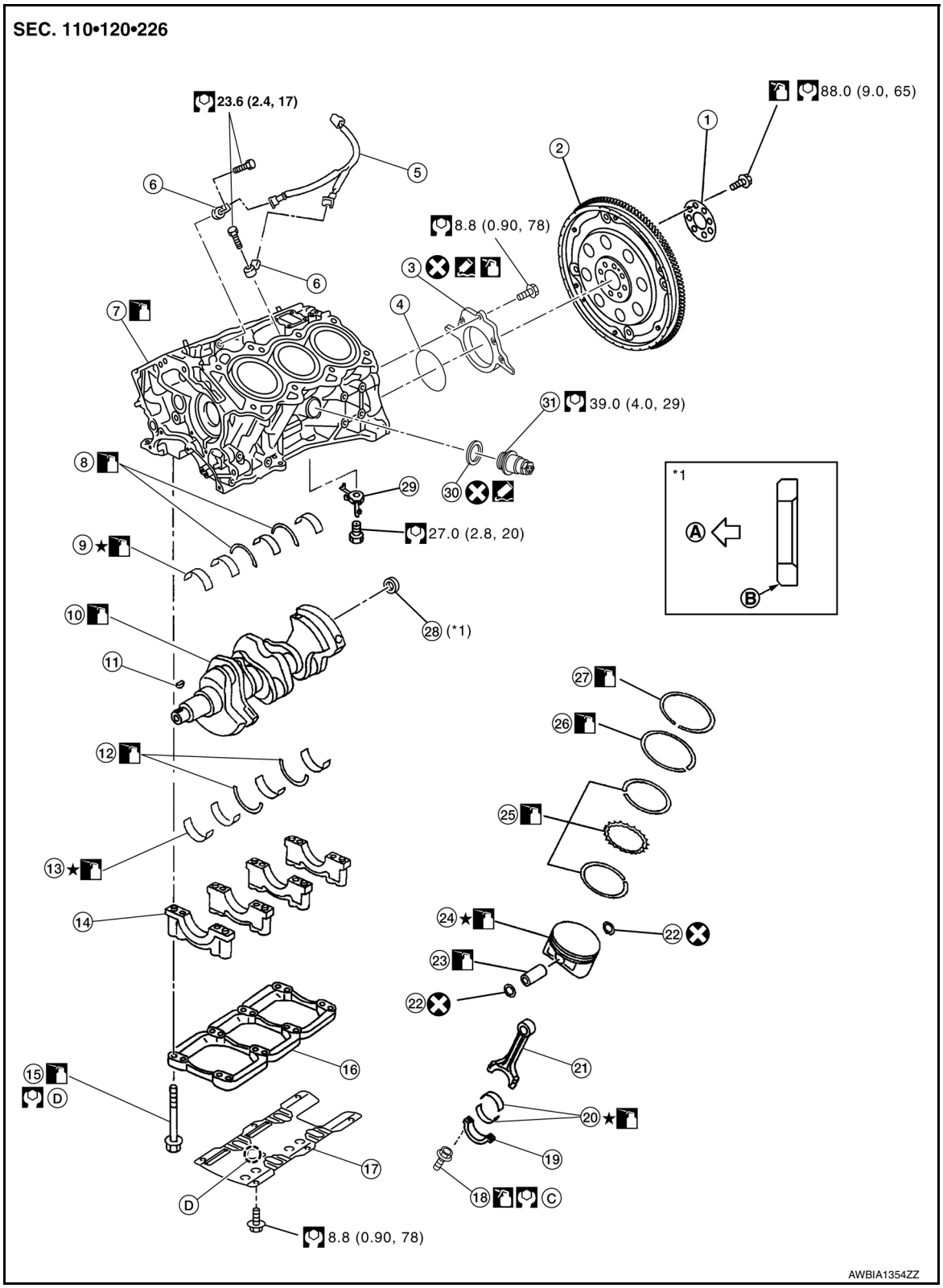


1. Reinforcement plate
2. Drive plate
3. Rear oil seal retainer
4. Rear oil seal
5. Sub harness
6. Knock sensor
7. Cylinder block
8. Thrust bearing (upper)
9. Main bearing (upper)
10. Crankshaft
11. Crankshaft key
12. Thrust bearing (lower)
13. Main bearing (lower)
14. Main bearing cap
15. Main bearing cap bolt
16. Main bearing beam
17. Baffle plate
18. Connecting rod bolt
19. Connecting rod bearing cap
20. Connecting rod bearing
21. Connecting rod
22. Snap ring
23. Piston pin
24. Piston
25. Oil ring
26. Second ring
27. Top ring
28. Pilot converter
29. Oil jet
30. Gasket (for Canada)
31. Cylinder block heater (for Canada)
A. Crankshaft side
B. Chamfered
C. Refer to INSTALLATION
D. Front mark

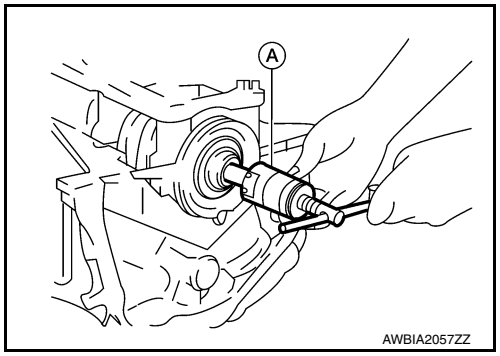
Disassembly and Assembly

INFOID:0000000012602065

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

DISASSEMBLY

1. Remove the engine assembly. Refer to EM-226, "Removal and Installation".
2. Remove the drive plate. Refer to EM-230, "Exploded View".
3. Remove pilot converter using suitable tool (A).

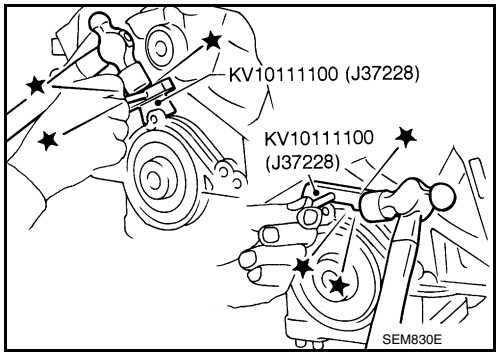


4. Cut away liquid gasket and remove rear oil seal retainer using Tool. Refer to EM-126, "Precaution for Liquid Gasket".

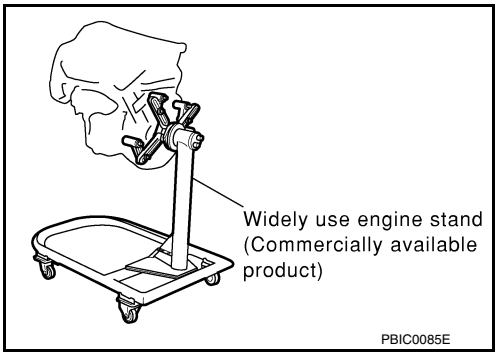
Tool number : KV10111100 (J-37228)

CAUTION:
- **Do not damage mounting surface.**
- **If rear oil seal retainer is removed, replace it with a new one.**

NOTE:
Rear oil seal and retainer form a single part and are replaced as an assembly.

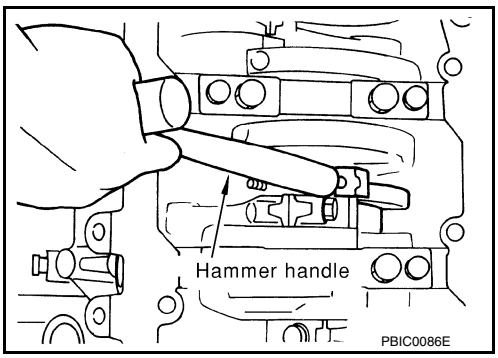


5. Install the engine on engine stand. Any commercially available engine stand can be used.
CAUTION:
- **Use an engine stand that has a load capacity [approximately 240kg (529 lb) or more] large enough for supporting the engine weight.**
- **Before removing the hanging chains, make sure the engine stand is stable and there is no risk of overturning.**

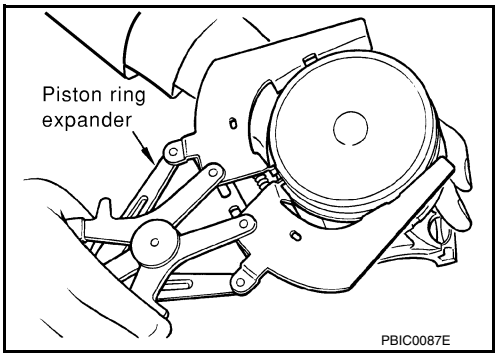


6. Remove the knock sensor.
CAUTION:
Carefully handle sensor to avoid shocking it.
7. Drain engine coolant. Refer to CO-35, "Changing Engine Coolant".
8. Drain engine oil. Refer to LU-29, "Changing Engine Oil".
9. Remove the upper oil pan. Refer to EM-161, "Removal and Installation (Upper Oil Pan)".
10. Remove the crankshaft pulley.
- Use a suitable tool to prevent the crankshaft from turning.
11. Remove the timing chain. Refer to EM-187, "Removal and Installation".
12. Remove the cylinder head. Refer to EM-213, "Removal and Installation".

13. Remove the piston and connecting rod assemblies.
a. Position the crankshaft pin corresponding to the connecting rod to be removed onto the bottom dead center.
b. Remove the connecting rod cap.
c. Using a hammer handle or similar tool, push the piston and connecting rod assembly out to the cylinder head side.
- Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-262, "Connecting Rod Bearing".



14. Remove the connecting rod bearings.
CAUTION:
When removing the connecting rod side bearings, note the installation position. Keep them in the correct order.
15. Remove the piston rings from the piston.
- Use a piston ring expander.
CAUTION:
- **When removing the piston rings, do not damage the piston. Do not expand the rings excessively.**
- **Be careful to mark the rings if they are to be reused so they are installed in their original position.**
- Before removing the piston rings, check the piston ring side clearance. Refer to EM-241, "Inspection".

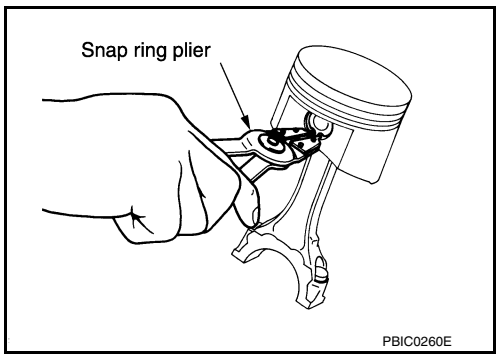


16. Remove the piston from the connecting rod as follows.

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

CAUTION:

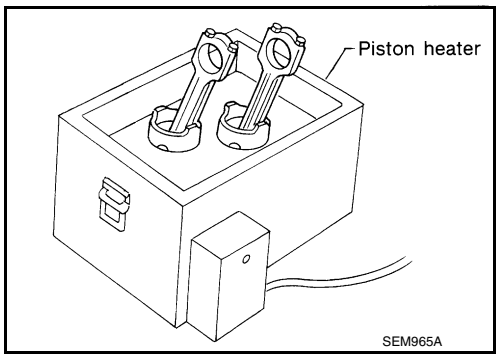
Do not reuse snap rings, always replace with new ones.



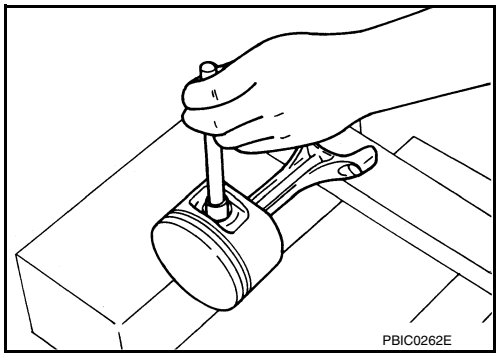
b. Heat the pistons to 60° - 70°C (140° - 158°F).

WARNING:

Pistons contain heat. When working, wear protective equipment to avoid getting burned.



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

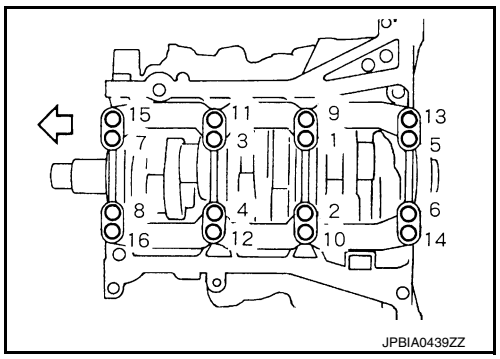


17. Remove the baffle plate from the main bearing beam.

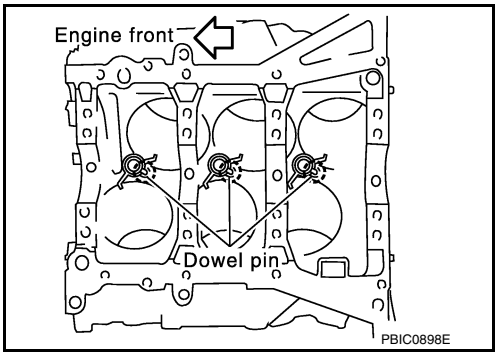
18. Loosen the bolts in the reverse order shown and remove the main bearing beam, bearing caps and crankshaft.

- Before loosening the main bearing cap bolts, measure the crankshaft side clearance. Refer to EM-241, "Inspection".

⇦ : Engine front



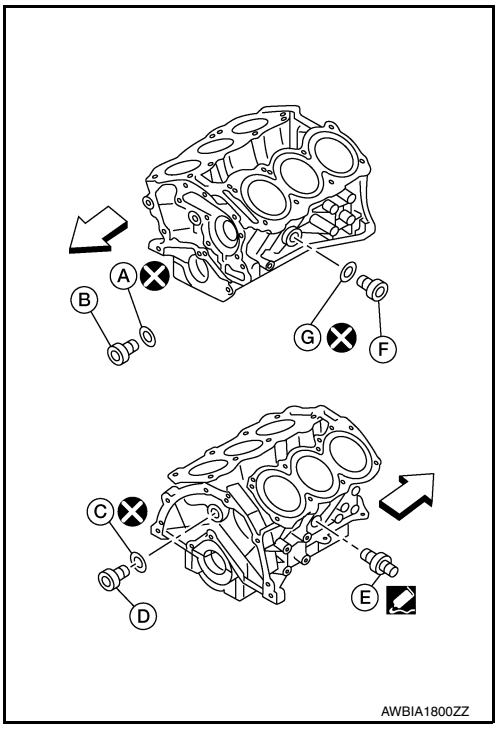
19. Remove the oil jets and dowel pins.
20. Remove the main bearings and thrust bearings from the cylinder block and main bearing caps.
    - When removing them, note the direction and position. Keep them in the correct order for installation.



21. Remove cylinder block plugs.
    - Remove the water drain plug (B) and (F), connector bolt (E), and copper sealing washer (A) and (G) on the cylinder block.
    - Remove water drain plug (D) and copper sealing washer (C) during engine overhaul.

CAUTION:
Do not reuse copper sealing washers.
NOTE:
For Canada, (F) is not plug but block heater.

⇦ : Engine front



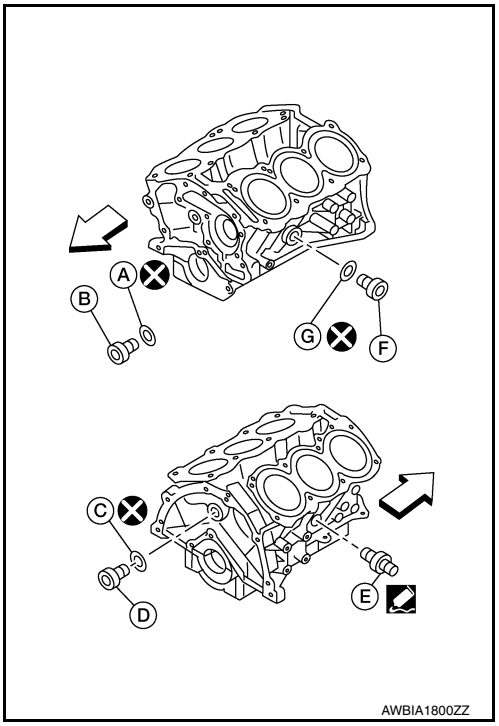
ASSEMBLY

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

CAUTION:
Use goggles to protect your eyes.

2. Install the cylinder block drain plugs.
   - Install the water drain plug (B) and (F), connector bolt (E), and copper sealing washer (A) and (G) on the cylinder block.
   - Install water drain plug (D) and copper sealing washer (C) during engine overhaul.
   - Tighten each plug and connector bolt to specifications.

Water drain plug (B) : 62.0 N·m (6.3 kg-m, 46 ft-lb)
Water drain plug (D) : 78.0 N·m (8.0 kg-m, 58 ft-lb)
Connector Bolt (E) : 27.0 N·m (2.8 kg-m, 20 ft-lb)
Water drain plug (F) : 6.0 N·m (0.61 kg-m, 53 in-lb)

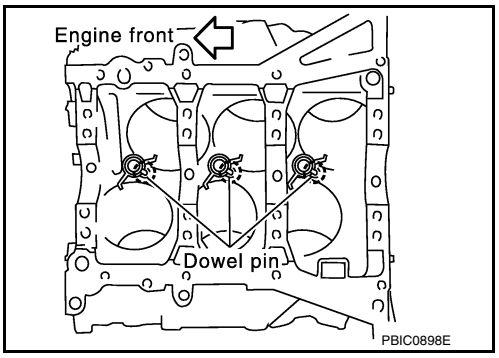


CAUTION:
- **Use Genuine High Performance Thread Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".**
- **Do not reuse copper sealing washers.**
- **Installation should be done within 5 minutes of applying liquid gasket.**
- **Do not fill the engine with engine coolant for at least 30 minutes after the components are installed to allow the sealant to cure.**

NOTE:
For Canada, (F) is not plug but block heater.

⇦ : Engine front

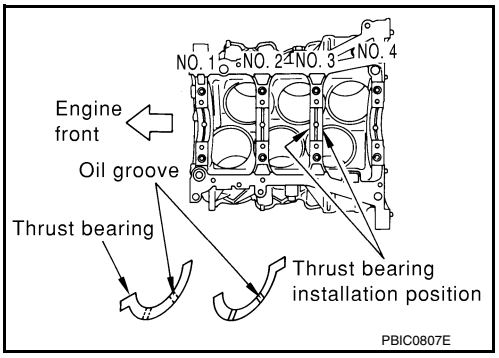
3. Install the oil jets.
   - Insert the oil jet dowel pin into the cylinder block dowel pin hole, and tighten the bolts.



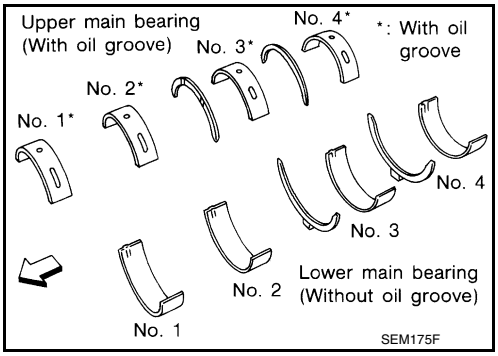
4. Install the main bearings and the thrust bearings.

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

b. Install the thrust bearings to both sides of the No. 3 journal housing on the cylinder block and the main bearing cap.
   - Install the thrust bearings with the oil groove facing the crankshaft arm (outside).
   - Install bearing with a projection on one end on cylinder block and bearing with a projection at center on cap. Align each projection with mating notch.

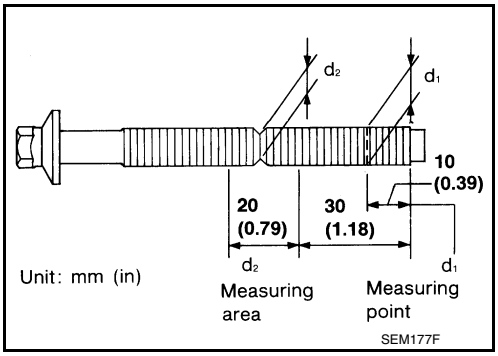


5. Set the upper main bearings in their proper positions on the cylinder block.
   - Confirm the correct main bearings are used. Refer to EM-241, "Inspection".

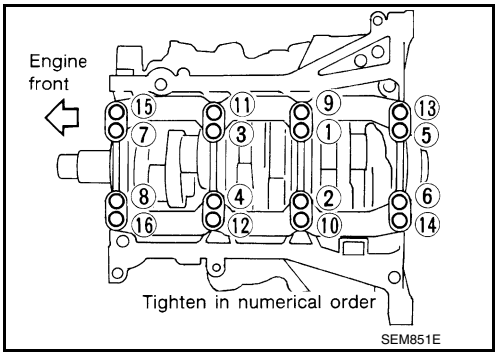


6. Instructions for the re-use of the main bearing cap bolts.
   - A plastic zone tightening method is used for tightening the main bearing cap bolts. Measure (d1) and (d2) as shown.
   - For (d2), select the minimum diameter in the measuring area.
   - If the difference between (d1) and (d2) exceeds the limit, replace the bolts for assembly.

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



7. After installing the crankshaft, lower main bearings, main bearing caps, main bearing beam, and bearing cap bolts. Tighten the bearing cap bolts in the numerical order as shown.

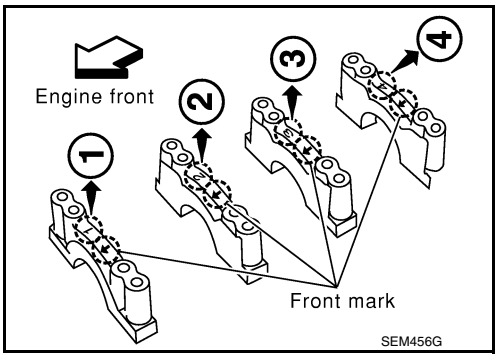


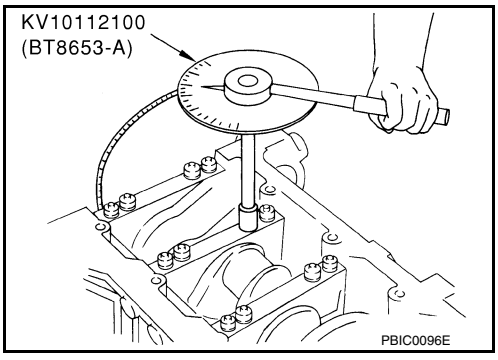
a. Make sure that the front marks on the main bearing beam faces the front of the engine.
b. Prior to tightening all the bearing cap bolts, place the bearing beam in its proper position by shifting the crankshaft in the axial position.
c. After tightening the bearing cap bolts, make sure the crankshaft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

   CAUTION:
   Measure the tightening angle in two stages using Tool. Do not measure with eyes only, be sure to use Tool.

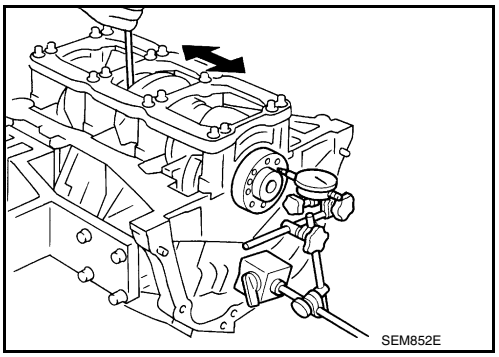
   Stage 1 : 32.3 - 38.3 N·m (3.3 - 3.9 kg-m, 24 - 28 ft-lb)
   Stage 2 : 90° - 95° degrees clockwise

   Tool number : KV10112100 (BT-8653-A)





8. Measure crankshaft end play.
   - If beyond the limit, replace the thrust bearing with a new one. Refer to EM-258, "Cylinder Block".

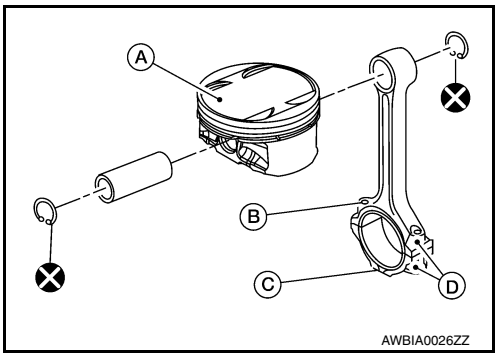


9. Install the piston to the connecting rod.

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

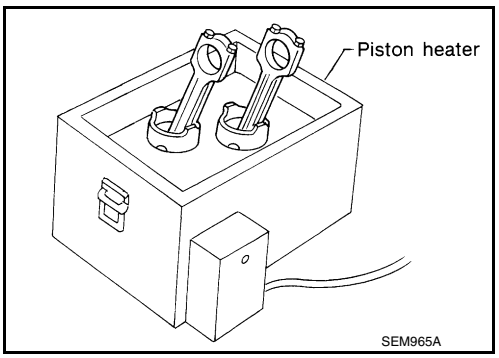
CAUTION:
Do not reuse snap rings.

(A) : Piston front mark
(B) : Oil hole
(C) : Connecting rod front mark
(D) : Cylinder No.



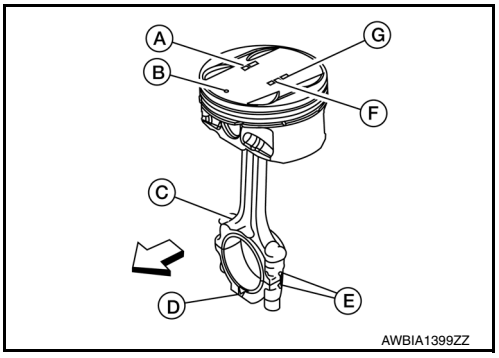
b. Install the piston to the connecting rod.
   - Heat the piston until the piston pin can be pushed in by hand without excess force [approximately 60 - 70°C (140 - 158°F)]. From the front to the rear, insert the piston pin into the piston and through the connecting rod.

WARNING:
Pistons contain heat. When working, wear protective equipment to avoid getting burned.



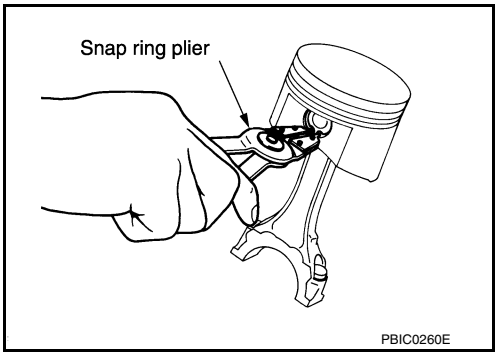
   - Assemble so that the piston front mark (B) on the crown and the oil hole (C), connecting rod front mark (D) and Cylinder No. (E) on the connecting rod are positioned as shown.

⇦ : Engine front
(A) : Piston grade number
(F) : Pin grade number
(G) : Crown I.D. code



c. Install the snap ring into the front of the piston pin-groove.
- After installing, check that the connecting rod pivots smoothly on the pin.

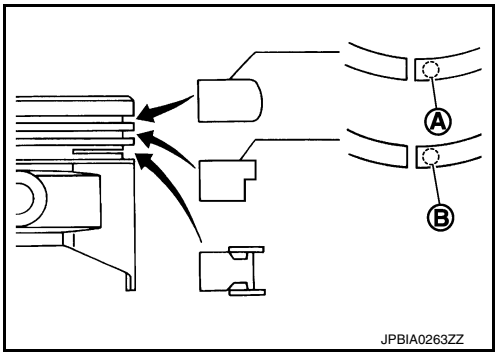
CAUTION:
Do not reuse snap rings, always replace with new ones.



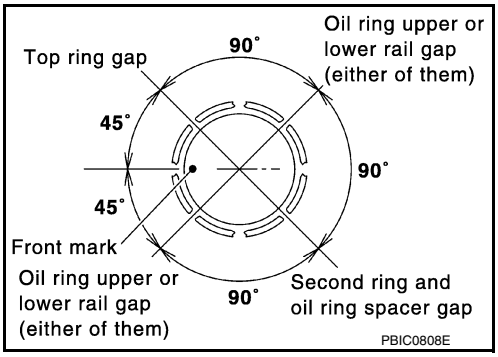
10. Using a piston ring expander, install the piston rings.

(A) : Top ring
(B) : Second ring

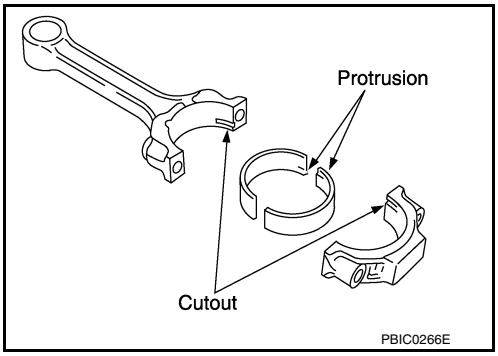
CAUTION:
- **Do not damage the piston.**
- **When the piston rings are not replaced, remount the rings in their original positions.**
- **When replacing the piston rings, those without stamped surface (A) can be mounted either side up.**
- **Install the second ring with the stamped surface (B) facing upward. If the ring is not stamped it can face in either direction.**



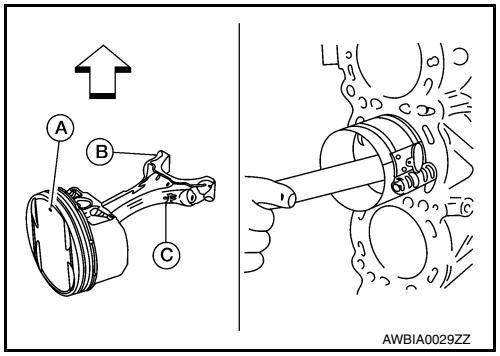
- Position each ring with the gap as shown, referring to the piston front mark.



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



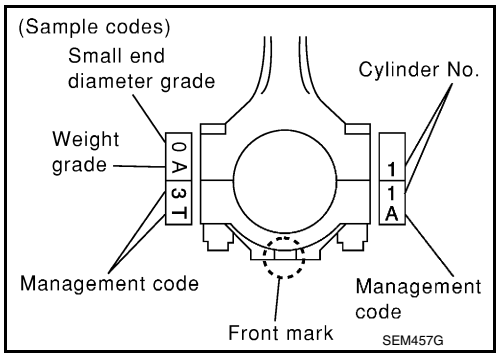
12. Install the piston and connecting rod assembly into the corresponding cylinder.
    - Position the crankshaft pin corresponding to the connecting rod to be installed onto the bottom dead center.
    - Apply engine oil sufficiently to the cylinder bore, piston, and crankshaft pin.
    - Match the cylinder position with the cylinder No. (B) on the connecting rod to install.
    - Install the piston with the piston front mark (A) on the crown facing the front of the engine (⇦) using a suitable tool.



(C) : Oil hole

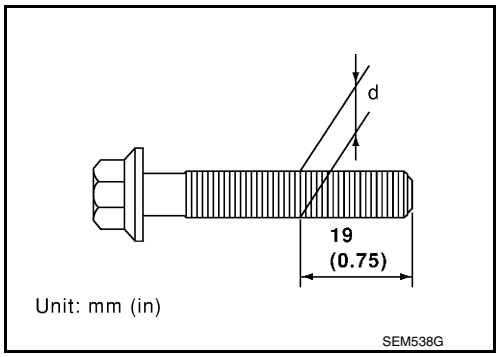
CAUTION:
Do not damage the crankshaft pin and cylinder wall, resulting from interference of the connecting rod big end.

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



14. Check the connecting rod cap bolts before reusing, then install in their original position in the connecting rod. The bolts should screw in smoothly by hand.
    - Measure the outer diameter of the connecting rod cap bolt as shown.

Outer diameter (d) of the connecting rod bolt
Standard : 7.90 - 8.00 mm (0.3110 - 0.3150 in)
Limit : 7.75 mm (0.3051 in)

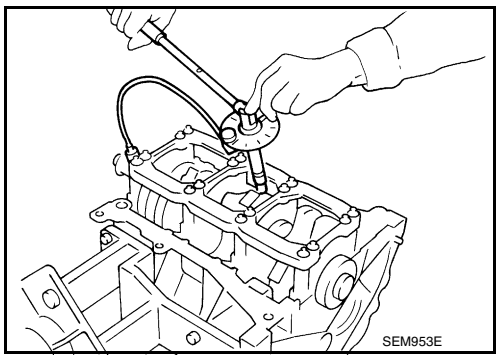


15. Tighten the connecting rod nuts in two stages using Tool:

Stage 1 : 19 - 21 N·m (1.9 - 2.1 kg-m, 14 - 15 ft-lb)
Stage 2 : 90° - 95° degrees clockwise

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

Tool number : KV10112100 (BT-8653-A)

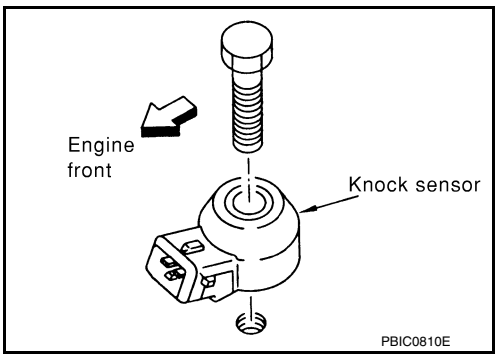


- Apply engine oil to the threads and seats of the connecting rod bolts and nuts.
- After tightening the nuts, make sure that the crankshaft rotates smoothly.
- Check the connecting rod side clearance. If beyond the limit, replace the connecting rod and/or crankshaft. Refer to EM-258, "Cylinder Block".

16. Install the baffle plate to the main bearing beam.

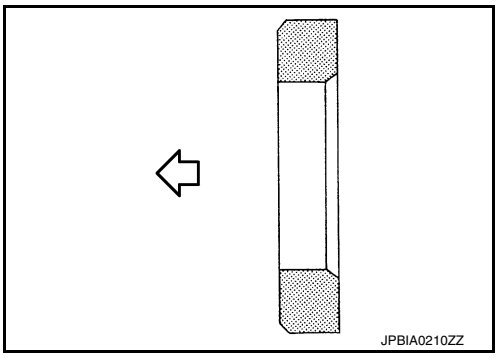
17. Install the knock sensor.
    - Make sure that there is no foreign material on the cylinder block mating surface and the back surface of the knock sensor.
    - Install the knock sensor with the connector facing the rear of the engine.
    - Do not tighten the bolts while holding the connector.
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

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



18. Install the cylinder head. Refer to EM-213, "Removal and Installation".
19. Install the timing chain. Refer to EM-187, "Removal and Installation".
20. Install the oil pan. Refer to EM-160, "Removal and Installation (Lower Oil Pan)" and EM-161, "Removal and Installation (Upper Oil Pan)".
21. Remove the engine from the stand.
22. Install the pilot converter with its chamfer facing crankshaft as shown.

    ⇦ : Crankshaft side

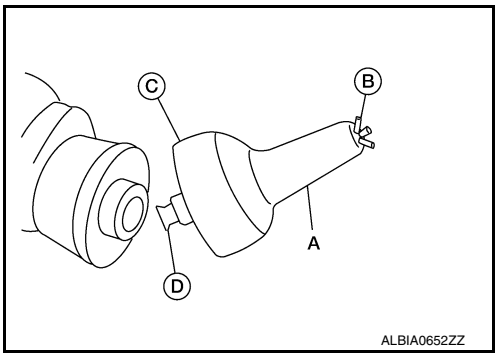


23. Install the rear oil seal retainer using Tool (A).

    CAUTION:
    Do not reuse rear oil seal retainer.

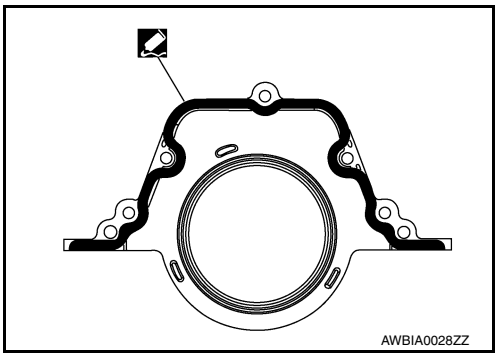
    Tool number (A) : — (J-47128)

    a. Loosen the wing nut (B) on the end of the Tool (A).
    b. Insert the arbor (D) into the crankshaft pilot hole until the outer lip (C) of the Tool (A) covers the edge of the crankshaft sealing surface.
    c. Tighten the wing nut (B) to secure the Tool (A) to the crankshaft.



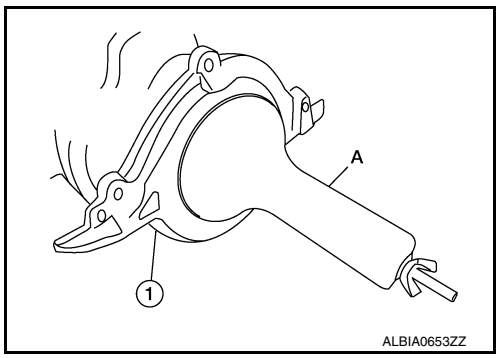
    d. Apply sealant to rear oil seal retainer as shown.
    Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

    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 components are installed to allow the sealant to cure.**



    e. Lubricate the sealing surface of the new rear main seal with new engine oil.

f. Slide the new rear main seal (1) over the Tool (A) and onto the crankshaft.
g. Loosen the wing nut and push the threaded rod into the handle to remove the Tool (A).
h. Tighten the rear oil seal retainer bolts to specification. Refer to EM-211, "Removal and Installation of Rear Oil Seal".



24. Install the drive plate. Refer to EM-230, "Exploded View".
25. Install the engine assembly into the vehicle. Refer to EM-226, "Removal and Installation".

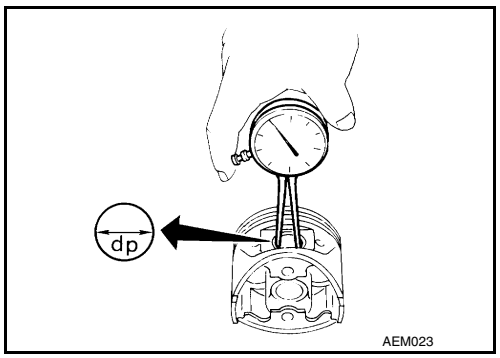
Inspection

INFOID:0000000012602066

PISTON AND PISTON PIN CLEARANCE

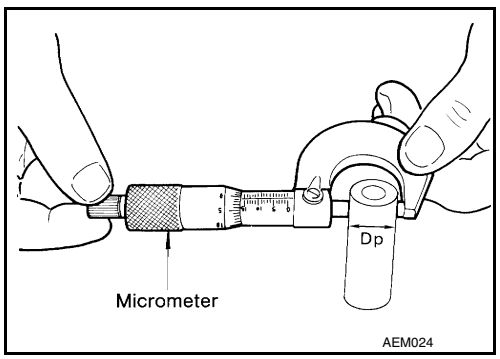
Inner Diameter of Piston Pin Hole

- Measure the inner diameter of piston pin hole (dp). Refer to EM-258, "Cylinder Block".

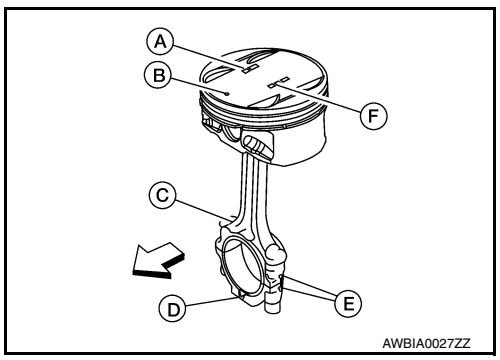


Outer Diameter of Piston Pin

- Measure outer diameter of piston pin (Dp). Refer to EM-241, "Inspection".



⇦ : Engine front
(A) : Piston Grade No.
(B) : Piston front mark
(C) : Oil hole
(D) : Connecting rod front mark
(E) : Cylinder No.
(F) : Pin Grade No.



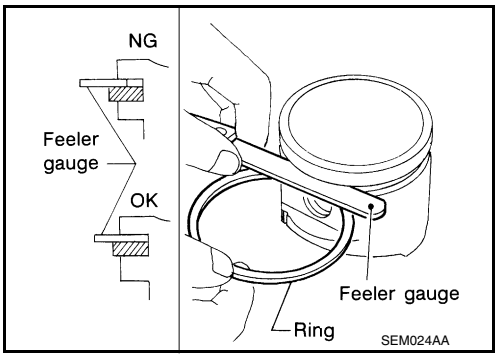
Piston and Piston Pin Interference Fit
Standard Interference Fit = (Dp) – (dp)

Standard : 0.002 – 0.010 mm (0.0001 – 0.0004 in)

- If clearance is exceeds specification, replace either or both of piston/piston pin assembly and connecting rod assembly with reference to specification of each part.

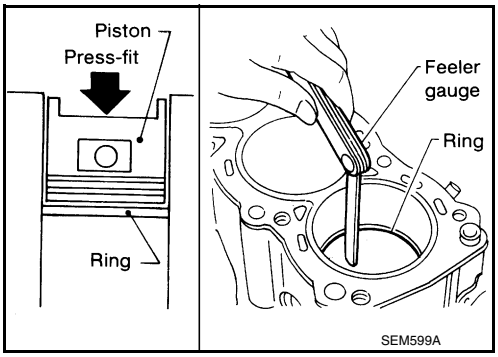
PISTON RING SIDE CLEARANCE

- Measure side clearance of piston ring and piston ring groove with feeler gauge.
- If out of specification, replace piston ring assembly. If clearance exceeds maximum limit with new rings, replace piston. Refer to EM-258, "Cylinder Block".

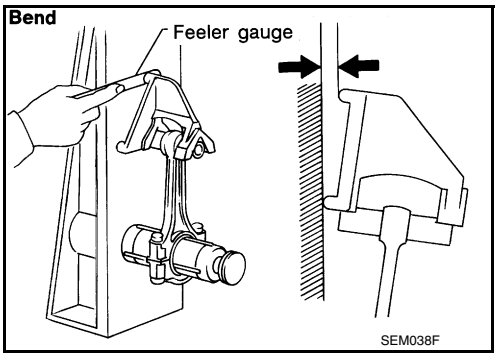


PISTON RING END GAP

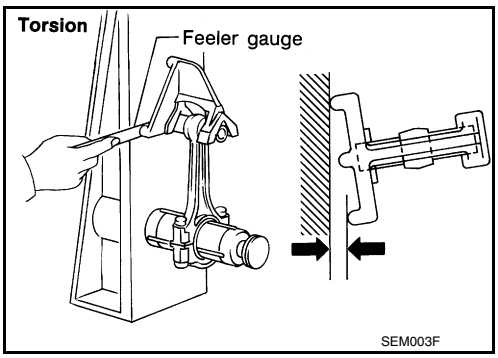
- Insert piston ring until it is in the middle of the cylinder bore and measure the end gap.
- If out of specification, replace piston ring. Refer to EM-258, "Cylinder Block"



CONNECTING ROD BEND AND TORSION

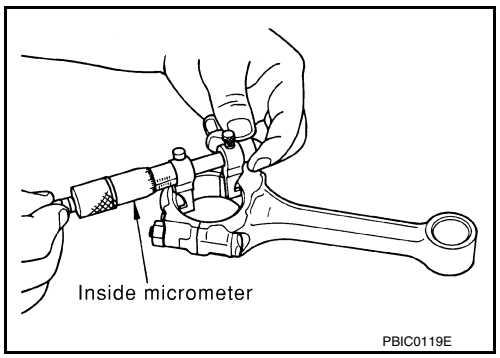


- If it exceeds the limit, replace connecting rod assembly. Refer to EM-262, "Connecting Rod Bearing".



CONNECTING ROD BEARING HOUSING DIAMETER (BIG END)

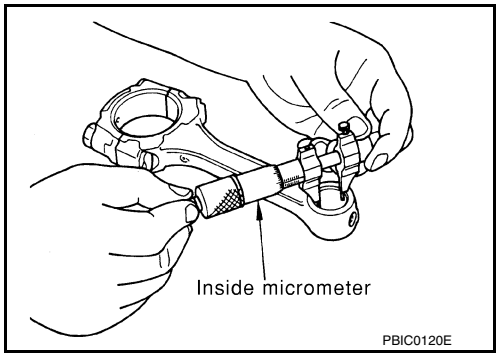
- Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod nut to the specified torque, measure the connecting rod bearing housing big end inner diameter using an inside micrometer. Refer to EM-262, "Connecting Rod Bearing".



CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

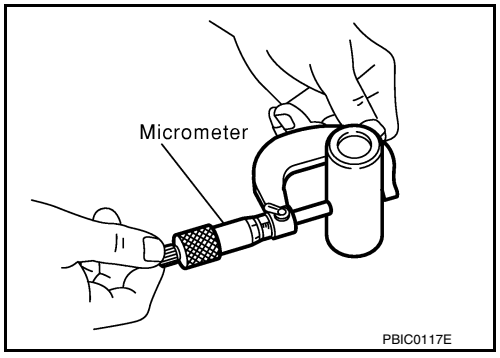
Inner Diameter of Connecting Rod (Small End)

- Measure inner diameter of piston pin bushing. Refer to EM-262, "Connecting Rod Bearing".



Outer Diameter of Piston Pin

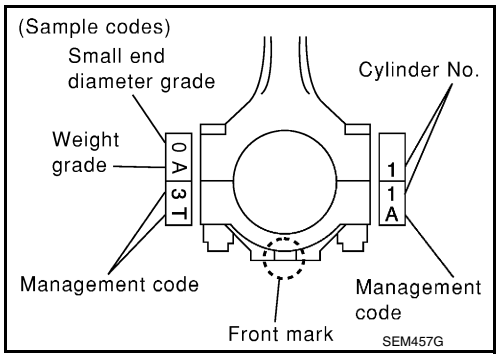
- Measure outer diameter of piston pin. Refer to EM-258, "Cylinder Block".



Connecting Rod Bushing Oil Clearance (Small End)

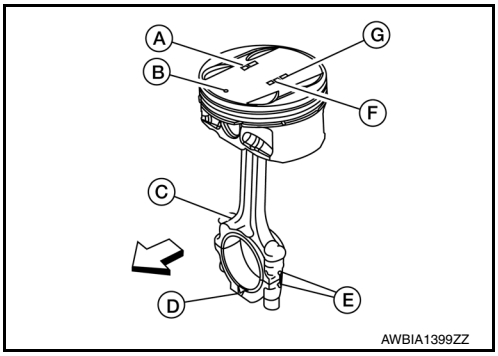
(Connecting rod small end oil clearance) = (Inner diameter of connecting rod small end) – (Outer diameter of piston pin). Refer to EM-258, "Cylinder Block".

- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, use the Table for Selective Fitting for Piston to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Follow the "PISTON-TO-CYLINDER BORE CLEARANCE" procedure.



Factory installed parts grading:

⇦ : Engine front
(A) : Piston Grade No.
(B) : Piston front mark
(C) : Oil hole
(D) : Connecting rod front mark
(E) : Cylinder No.
(F) : Pin Grade No.
(G) : Crown I.D. code



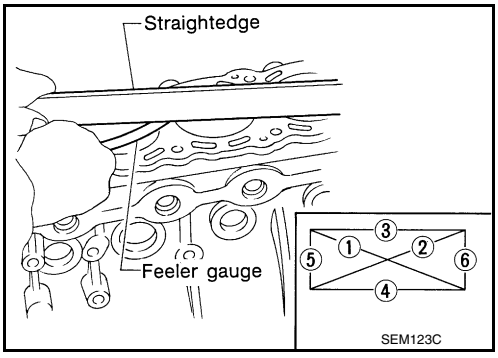
Service parts apply only to grade 0.

Unit: mm (in)

Grade	0	1
Connecting rod small end inner diameter	22.000 - 22.006 (0.8661 - 0.8664)	22.006 - 22.012 (0.8664 - 0.8666)
Piston pin outer diameter	21.989 - 21.995 (0.8657 - 0.8659)	21.995 - 22. 001 (0.8659 - 0.8662)
Piston pin hole diameter	21.993 - 21.999 (0.8659 - 0.8661)	21.999 - 22.005 (0.8661 - 0.8663)

CYLINDER BLOCK DISTORTION

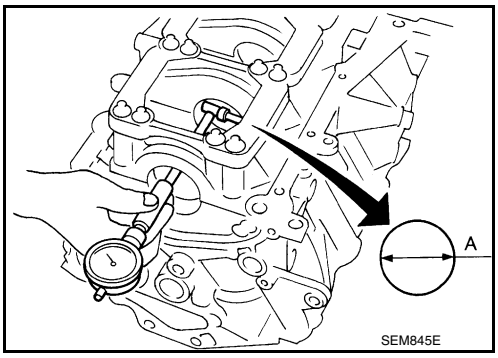
- Using a scraper, remove any old gasket material on the cylinder block surface and remove any oil, scale, carbon, or other contamination.
  CAUTION:
  Do not allow gasket flakes to enter the oil or coolant passages.
- Measure the distortion on the block upper face at different points in six directions. Refer to EM-258, "Cylinder Block".
- If out of specification, resurface the cylinder block. The allowable amount of resurfacing is dependent on the amount of any cylinder head resurfacing. The resurfacing limit is [amount of cylinder head resurfacing] + [amount of cylinder head resurfacing] = 0.2 mm (0.008 in).



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

INNER DIAMETER OF MAIN BEARING HOUSING

- Install the main bearing caps with the main bearings removed, and tighten the bolts to the specified torque.
- Using a bore gauge, measure the inner diameter of the main bearing housing (A). Refer to EM-258, "Cylinder Block".
- If out of the standard, replace the cylinder block and main bearing caps as an assembly.
  NOTE:
  These components cannot be replaced as a single unit, because they were processed together.

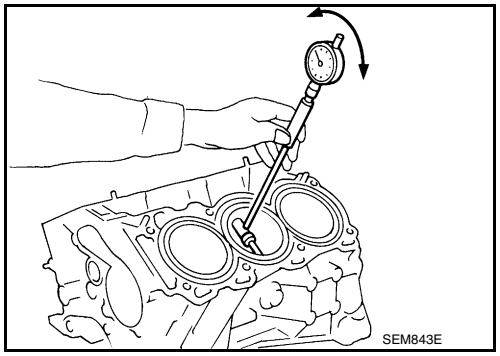


PISTON-TO-CYLINDER BORE CLEARANCE

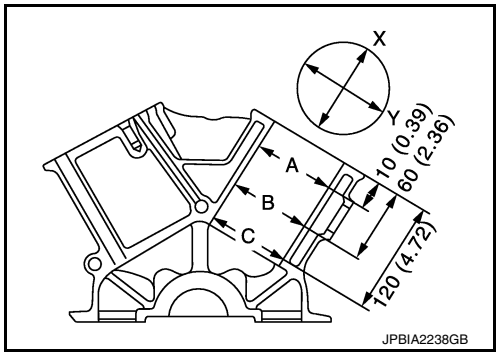
1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper at (A), (B) and (C). The X axis is in the longitudinal direction of the engine.

Cylinder bore inner diameter

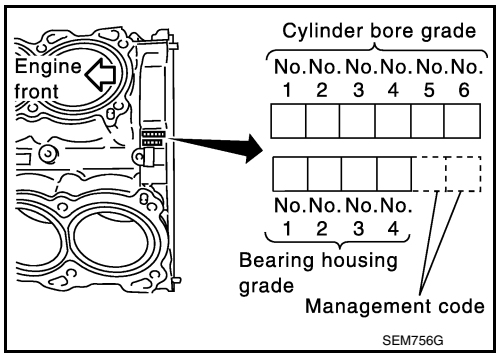
Grade No.	Standard inner diameter	Wear limit
No. 1	95.500 - 95.510 mm (3.7598 - 3.7602 in)	0.20 mm (0.0079 in)
No. 2	95.510 - 95.520 mm (3.7602 - 3.7606 in)	
No. 3	95.520 - 95.530 mm (3.7606 - 3.7610 in)	



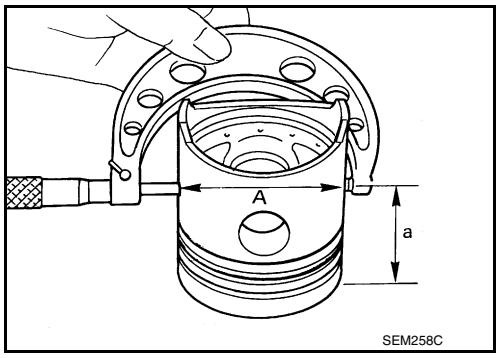
If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary. Refer to EM-258, "Cylinder Block".



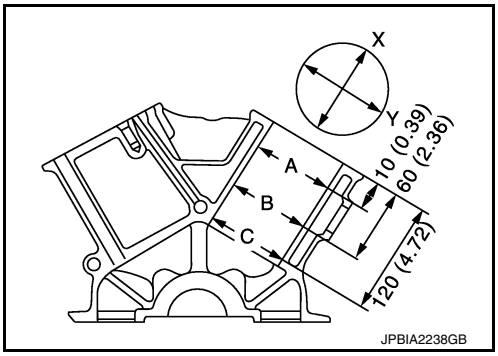
2. Check for scratches and seizure. If seizure is found, hone it.
   - **If both cylinder block and piston are replaced with new ones, select piston of the same grade number punched on cylinder block rear position. These numbers are punched in either Arabic or Roman numerals.**



3. Measure piston skirt diameter. Refer to EM-258, "Cylinder Block".



4. Check that piston-to-bore clearance is within specification. Refer to EM-258, "Cylinder Block".
   • The piston-to-bore clearance is measured at the (B) level in the cylinder as shown.



5. Cylinder bore size is determined by adding piston-to-bore clearance to piston diameter (A).

Rebored size calculation : D = A + B − C

where,

(D) : Bored diameter

(A) : Piston diameter as measured

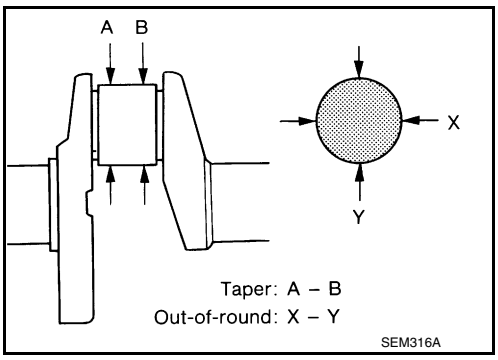
(B) : Piston-to-bore clearance

(C) : Honing allowance 0.02 mm (0.0008 in)

6. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted after boring.
7. Cut cylinder bores.
   • **When any cylinder needs boring, all other cylinders must also be bored.**
   • **Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.**
8. Hone cylinders to obtain specified piston-to-bore clearance.
9. Measure finished cylinder bore for out-of-round and taper.
   • **Measurement should be done after cylinder bore cools down.**

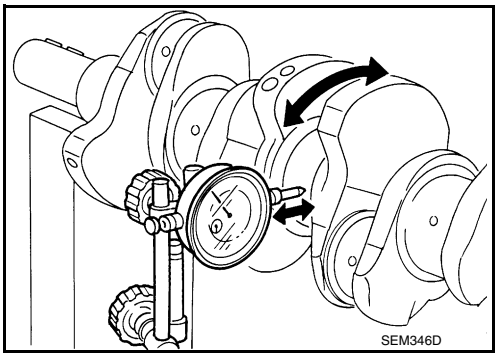
CRANKSHAFT

1. Check the crankshaft main and pin journals for scoring, wear, or cracks.
2. Measure the journals for taper and out-of-round. Refer to EM-258, "Cylinder Block".



3. Measure crankshaft runout.

a. Place a V-block on a precise flat table to support the journals on the both ends of the crankshaft.
b. Place a dial gauge straight up on the No. 3 journal.
c. While rotating the crankshaft, read the movement of the pointer on the dial gauge. Refer to EM-258, "Cylinder Block".



BEARING CLEARANCE

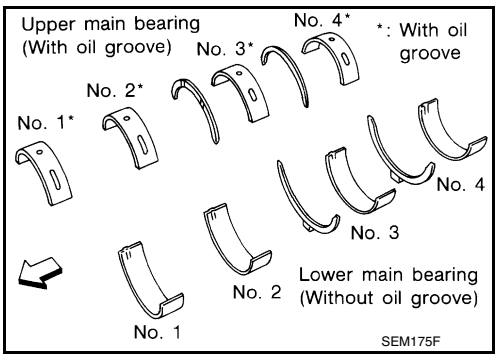
- Use either of the following two methods, however method (A) gives more reliable results and so is the preferred method.

Method A (Using Bore Gauge and Micrometer)

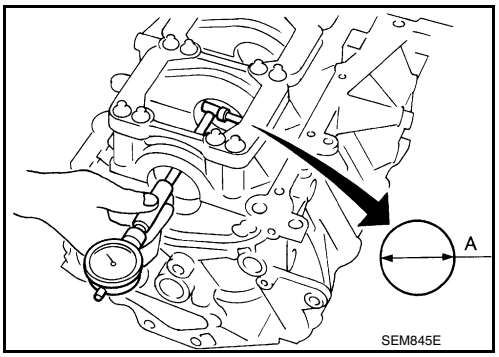
Main Bearing

1. Set the main bearings in their proper positions on the cylinder block and the main bearing cap.
2. Install the main bearing caps and bearing beam to the cylinder block. Tighten all bolts in the numerical order as specified. Refer to EM-231, "Disassembly and Assembly".

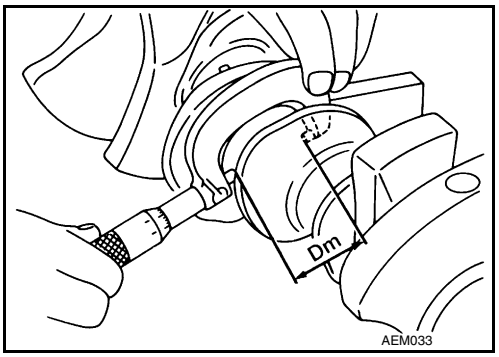
⇦ :Engine front



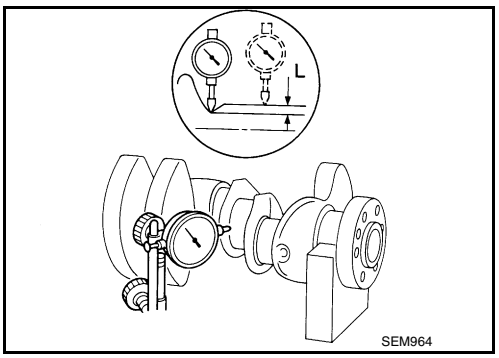
3. Measure the inner diameters (A) of each main bearing as shown.



4. Measure the outer diameters (Dm) of each crankshaft main journal as shown.
5. Calculate the main bearing clearance. Refer to EM-261, "Main Bearing".
   - If it exceeds the limit, replace the bearing.
   - If clearance cannot be adjusted using any standard bearing grade, grind crankshaft journal and use an undersized bearing.

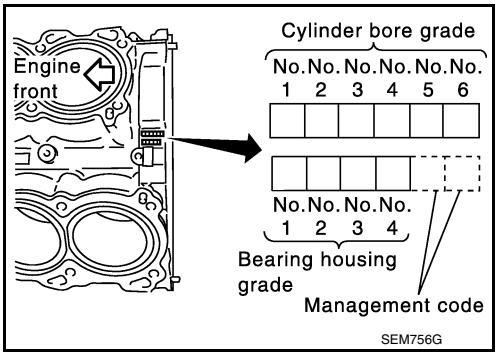


   - When grinding the crankshaft journal, confirm that the (L) dimension in the fillet role is more than the specified limit. Refer to EM-258, "Cylinder Block".

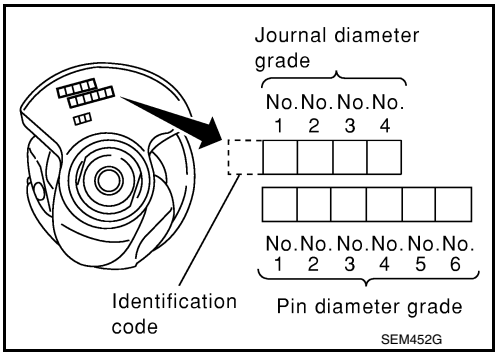


6. If the crankshaft or the cylinder block is replaced with a new one, select thickness of the main bearings as follows:

a. The grade number of each cylinder block main journal is punched on the respective cylinder block. These numbers are punched in either Arabic or Roman numerals. If measured diameter is out of the grade punched, decide suitable grade from available main bearings.



b. The grade number of each crankshaft main journal is punched on the crankshaft end. These numbers are punched in either Arabic or Roman numerals. If measured diameter is out of grade punched, decide the suitable grade from available main bearings.



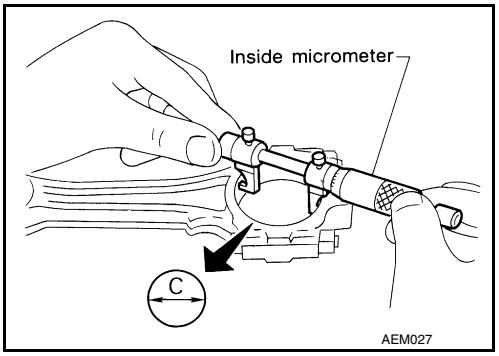
c. Select the main bearing suitable thickness according to the following table:

Crankshaft main journal diameter Unit: mm (in) / Cylinder block bearing housing inner diameter Unit: mm (in)		Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
		Hole diameter	63.993 - 63.994 (2.5194 - 2.5194)	63.994 - 63.995 (2.5194 - 2.5195)	63.995 - 63.996 (2.5195 - 2.5195)	63.996 - 63.997 (2.5195 - 2.5196)	63.997 - 63.998 (2.5196 - 2.5196)	63.998 - 63.999 (2.5196 - 2.5196)	63.999 - 64.000 (2.5196 - 2.5197)	64.000 - 64.001 (2.5197 - 2.5197)	64.001 - 64.002 (2.5197 - 2.5198)	64.002 - 64.003 (2.5198 - 2.5198)	64.003 - 64.004 (2.5198 - 2.5198)	64.004 - 64.005 (2.5198 - 2.5199)	64.005 - 64.006 (2.5199 - 2.5199)	64.006 - 64.007 (2.5199 - 2.5200)	64.007 - 64.008 (2.5200 - 2.5200)	64.008 - 64.009 (2.5200 - 2.5200)	64.009 - 64.010 (2.5200 - 2.5201)	64.010 - 64.011 (2.5201 - 2.5201)	64.011 - 64.012 (2.5201 - 2.5202)	64.012 - 64.013 (2.5202 - 2.5202)	64.013 - 64.014 (2.5202 - 2.5202)	64.014 - 64.015 (2.5202 - 2.5203)	64.015 - 64.016 (2.5203 - 2.5203)	64.016 - 64.017 (2.5203 - 2.5203)
Mark	Axle diameter																									
A	59.975 - 59.974 (2.3612 - 2.3612)	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	
B	59.974 - 59.973 (2.3612 - 2.3611)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	
C	59.973 - 59.972 (2.3611 - 2.3611)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	
D	59.972 - 59.971 (2.3611 - 2.3611)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	
E	59.971 - 59.970 (2.3611 - 2.3610)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	
F	59.970 - 59.969 (2.3610 - 2.3610)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	
G	59.969 - 59.968 (2.3610 - 2.3609)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	
H	59.968 - 59.967 (2.3609 - 2.3609)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	
J	59.967 - 59.966 (2.3609 - 2.3609)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	
K	59.966 - 59.965 (2.3909 - 2.3608)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	
L	59.965 - 59.964 (2.3608 - 2.3608)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	
M	59.964 - 59.963 (2.3608 - 2.3607)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	
N	59.963 - 59.962 (2.3607 - 2.3607)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	
P	59.962 - 59.961 (2.3607 - 2.3607)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	
R	59.961 - 59.960 (2.3607 - 2.3606)	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	
S	59.960 - 59.959 (2.3606 - 2.3606)	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	
T	59.959 - 59.958 (2.3606 - 2.3605)	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	
U	59.958 - 59.957 (2.3605 - 2.3605)	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	
V	59.957 - 59.956 (2.3605 - 2.3605)	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	
W	59.956 - 59.955 (2.3605 - 2.3604)	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	
X	59.955 - 59.954 (2.3604 - 2.3604)	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	
Y	59.954 - 59.953 (2.3604 - 2.3603)	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	
4	59.953 - 59.952 (2.3603 - 2.3603)	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	
7	59.952 - 59.951 (2.3603 - 2.3603)	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	7	

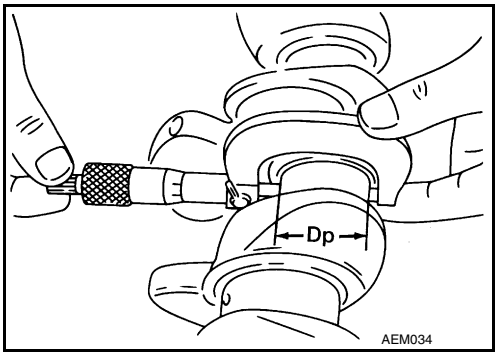
PBIC0814E

Connecting Rod Bearing (Big End)

1. Install the connecting rod bearing to the connecting rod and cap.
2. Install the connecting rod cap to the connecting rod. Tighten to specification. Refer to EM-231, "Disassembly and Assembly".
3. Measure the inner diameter (C) of each connecting rod (big end) as shown.



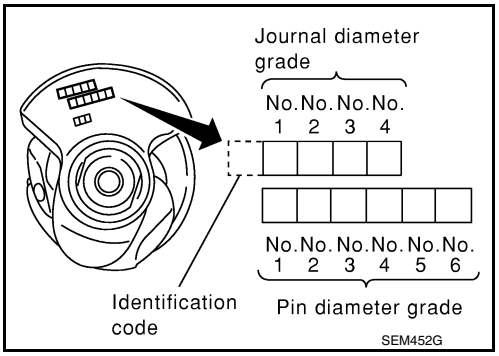
4. Measure the outer diameter (Dp) of each crankshaft pin journal.
5. Calculate the connecting rod bearing clearance. Refer to EM-262, "Connecting Rod Bearing".
   Connecting rod bearing clearance = (C) - (Dp)
6. If the calculated clearance exceeds the specified limit, replace the bearings.
7. If the clearance cannot be adjusted within the standard of any bearing, grind the crankshaft journal and use undersized bearings.



8. If the crankshaft is replaced with a new one, select the connecting rod bearings according to the following table:
   Connecting Rod Bearing Grade Number (Identification Color)

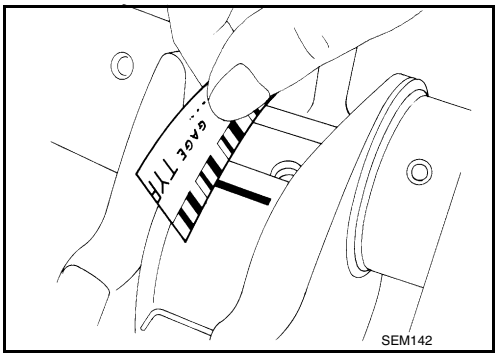
Crankshaft pin journal grade number	Connecting rod bearing grade number
0	0 (black)
1	1 (brown)
2	2 (green)

   These numbers are punched in either Arabic or Roman numerals.



Method B (Using Plastigage)

- Remove oil and dust on the crankshaft pin and the surfaces of each bearing completely.
- Cut a Plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install the connecting rod bearings to the connecting rod cap, and tighten the connecting rod nuts to the specified torque.
  CAUTION:
  Do not rotate the crankshaft.
- Remove the connecting rod cap and bearings, and using the scale on the Plastigage bag, measure the Plastigage width.
  NOTE:
  The procedure when the measured value exceeds the repair limit is same as that described in "Method A (Using Bore Gauge and Micrometer)".

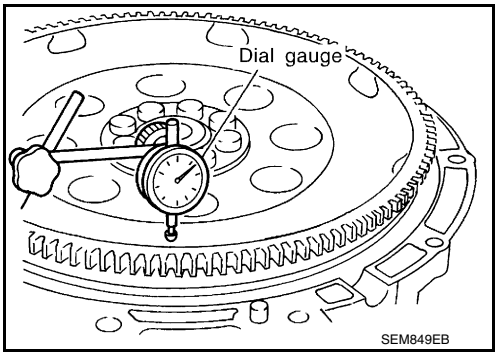


DRIVE PLATE RUNOUT

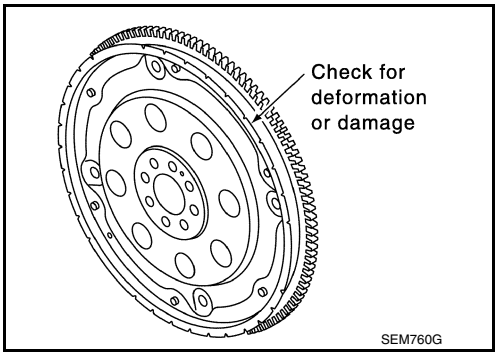
Use a suitable tool to measure the runout (Total Indicator Reading) as shown. Refer to EM-263, "Drive Plate".

CAUTION:

- **The signal plate is built into the drive assembly. Do not damage the signal plate, particularly the teeth.**



- **Check the drive plate and signal plate for deformation or cracks.**
- **Keep all magnetized objects away from the signal plate, particularly the teeth.**

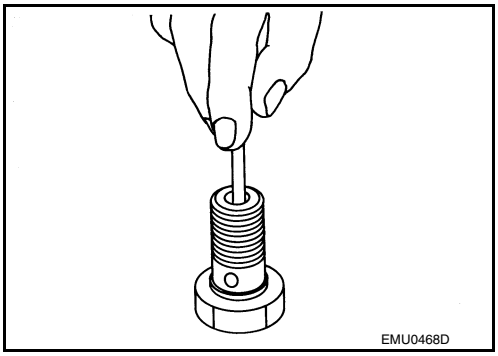


OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- If it is not operating properly, replace oil jet.

OIL JET RELIEF VALVE

- Using a clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.
- If it is not operating properly, replace oil jet relief valve.

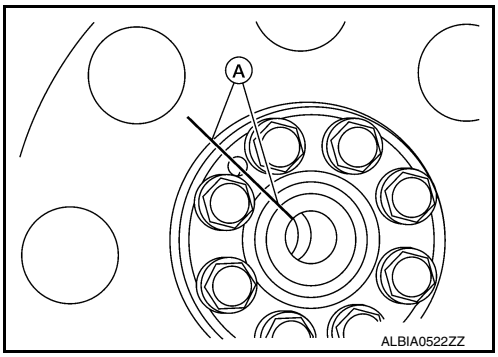


Dowel Pin Alignment

INFOID:0000000012602067

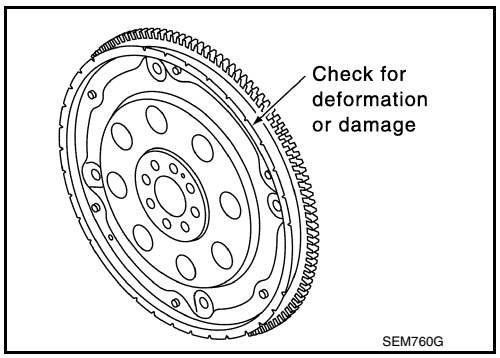
REMOVAL

1. Use suitable tool to lock the drive plate and match mark (A) the drive plate before removing the bolts.
   CAUTION:
   Do not damage the ring gear teeth or the signal plate teeth behind the ring gear.



2. Remove drive plate.
   • Loosen the drive plate in a diagonal order.

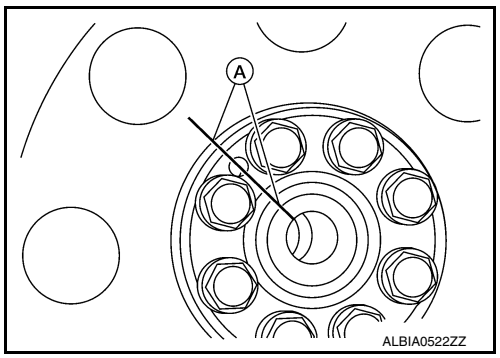
CAUTION:
- **Do not place drive plate with signal plate facing down.**
- **When handling the signal plate, take care not to damage or scratch it.**
- **Handle the signal plate in a manner that prevents it from becoming magnetized.**



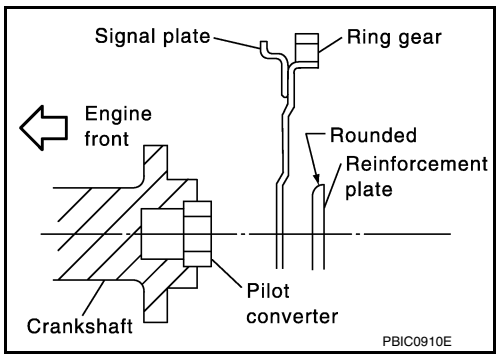
INSTALLATION

Installation is in the reverse order of removal.

- When installing the drive plate to the crankshaft, use the match mark (A) as shown to correctly align the crankshaft side dowel pin to the drive plate side dowel pin hole.



- Install the drive plate and the reinforcement plate in the direction as shown.



- Tighten the drive plate bolts to specification in a diagonal pattern. Refer to EM-230, "Exploded View".
- Use a suitable tool to lock the drive plate.

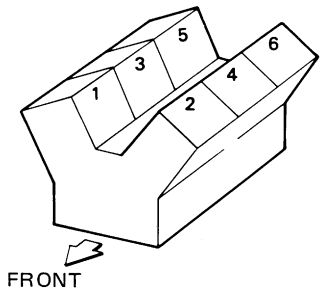
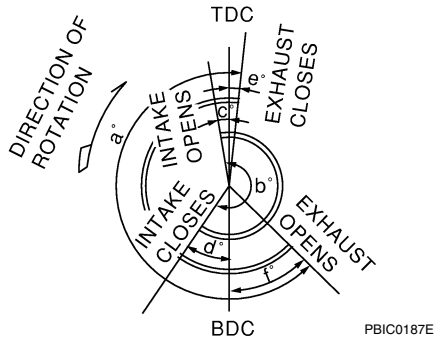
SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:0000000012602068

GENERAL SPECIFICATIONS

Cylinder arrangement		V-6
Displacement cm^3 (cu in)		3,498 (213.45)
Bore and stroke mm (in)		95.5 x 81.4 (3.760 x 3.205)
Valve arrangement		DOHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		10.3:1
Compression pressure kPa (kg/cm^2, psi)/300 rpm	Standard	1,275 (12.75, 13.0, 185)
	Minimum	981 (9.81, 10.0, 142)
	Differential limit between cylinders	98 (0.98, 1.0, 14)
Cylinder number	 SEM713A	
Valve timing (Valve timing control - “OFF”)	 PBIC0187E	

Unit: degree

a	b	c	d	e	f
240	240	−10	70	10	50

Drive Belt

INFOID:0000000012602069

DRIVE BELT

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

Spark Plug

INFOID:0000000012602070

SPARK PLUG

Unit: mm (in)

Make		DENSO
Standard type*		FXE22HR11
Gap	Standard	1.1 (0.043)

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

Intake Manifold

INFOID:0000000012602071

INTAKE MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Intake manifold	0.1 (0.004)

Exhaust Manifold

INFOID:0000000012602072

EXHAUST MANIFOLD

Unit: mm (in)

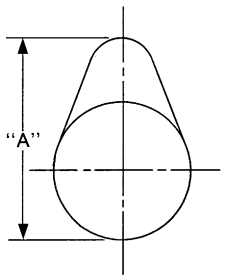
Items		Limit
Surface distortion	Exhaust manifold	0.3 (0.012)

Camshaft

INFOID:0000000012602073

CAMSHAFT

Unit: mm (in)



SEM671

Items		Standard	Limit
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
	No. 2, 3, 4	0.035 - 0.076 (0.0014 - 0.0030)	
Camshaft bracket inner diameter	No. 1	26.000 - 26.021 (1.0236 - 1.0244)	—
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)	—
Camshaft journal diameter	No. 1	25.935 - 25.955 (1.0211 - 1.0218)	—
	No. 2, 3, 4	23.445 - 23.465 (0.9230 - 0.9238)	—
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)
Camshaft lobe height "A"	Intake	45.475 - 45.665 (1.7904 - 1.7978)	0.2 (0.008)*1
	Exhaust	45.485 - 45.675 (1.7907 - 1.7982)	0.2 (0.008)*1
Camshaft runout [TIR*2]		Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*2]		Less than 0.15 (0.0059)	—

*1: Cam wear limit

*2: Total indicator reading

VALVE LIFTER

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Valve lifter bore diameter	34.000 - 34.016 (1.3386 - 1.3392)
Valve lifter clearance	0.023 - 0.029 (0.0009 - 0.0011)

VALVE CLEARANCE

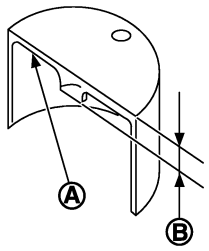
Unit: mm (in)

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

*: Approximately 80°C (176°F)

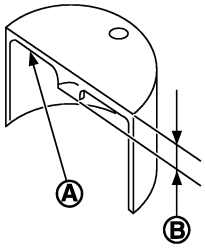
AVAILABLE VALVE LIFTER

Unit: mm (in)



JPBIA0170ZZ

Identification (stamped) mark*	Thickness
788U	7.88 (0.3102)
790U	7.90 (0.3110)
792U	7.92 (0.3118)
794U	7.94 (0.3126)
796U	7.96 (0.3134)
798U	7.98 (0.3142)
800U	8.00 (0.3150)
802U	8.02 (0.3157)
804U	8.04 (0.3165)
806U	8.06 (0.3173)
808U	8.08 (0.3181)
810U	8.10 (0.3189)
812U	8.12 (0.3197)
814U	8.14 (0.3205)
816U	8.16 (0.3213)
818U	8.18 (0.3220)
820U	8.20 (0.3228)
822U	8.22 (0.3236)
824U	8.24 (0.3244)



JPBIA0170ZZ

Identification (stamped) mark*	Thickness
826U	8.26 (0.3252)
828U	8.28 (0.3260)
830U	8.30 (0.3268)
832U	8.32 (0.3276)
834U	8.34 (0.3283)
836U	8.36 (0.3291)
838U	8.38 (0.3299)
840U	8.40 (0.3307)

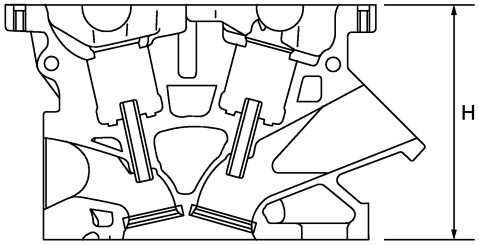
*: Always check with the Parts Department for the latest parts information.

Cylinder Head

INFOID:0000000012602074

CYLINDER HEAD

Unit: mm (in)

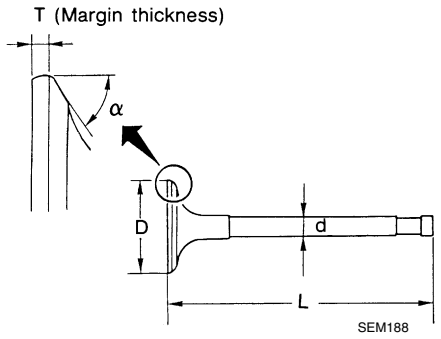


PBIC0924E

Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height (H)	126.4 (4.98)	—
Spark plug tube installation height	38.2 +0.5/- 0.5 (1.5 +0.020 / -0.020)	—

VALVE DIMENSIONS

Unit: mm (in)



Valve head diameter (D)	Intake	36.6 - 36.9 (1.441 - 1.453)
	Exhaust	30.2 - 30.5 (1.189 - 1.201)
Valve length (L)	Intake	102.02 (4.0165)
	Exhaust	99.56 (3.9197)
Valve stem diameter (d)	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle α)	Intake	45°15′ - 45°45′
	Exhaust	
Valve margin (T)	Intake	1.15 - 1.45 (0.0453 - 0.0571)
	Exhaust	1.45 - 1.75 (0.0571 - 0.0689)
Valve margin (T) limit		More than 0.5 (0.020)
Valve stem end surface grinding limit		Less than 0.2 (0.008)

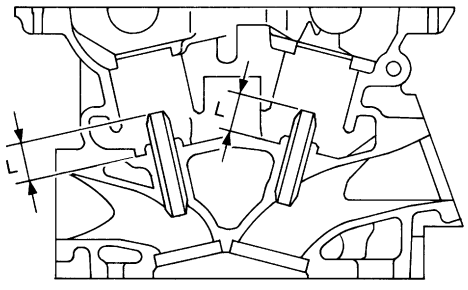
VALVE OIL SEAL

Unit: mm (in)

Description	Standard
Valve oil seal installation height	14.3 - 14.9 (0.563 - 0.587)

VALVE GUIDE

Unit: mm (in)

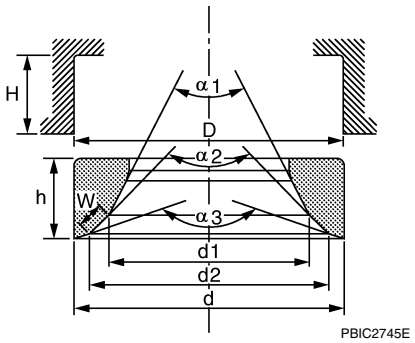


Items		Standard	Oversize (Service) [0.2 (0.008)]
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	5.3 - 5.5 (0.2087 - 0.2165)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit

Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.01 (0.004)
Valve deflection	Intake	—	0.24 (0.0094)
	Exhaust	—	0.28 (0.0110)
Projection length (L)		12.6 - 12.8 (0.496 - 0.504)	

VALVE SEAT

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize (Service) [0.5 (0.02)]
Cylinder head seat recess diameter "D"	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	31.600 - 31.616 (1.2441 - 1.2447)	32.100 - 32.116 (1.2638 - 1.2644)
Valve seat outer diameter "d"	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	31.680 - 31.696 (1.2472 - 1.2479)	32.180 - 32.196 (1.2669 - 1.2676)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Diameter "d1"*1	Intake	34.6 (1.362)	
	Exhaust	27.7 (1.091)	
Diameter "d2"*2	Intake	35.9 - 36.4 (1.413 - 1.433)	
	Exhaust	31.680 - 31.696 (1.2472 - 1.2479)	
Angle "α1"	Intake	30°	
	Exhaust	30°	
Angle "α2"	Intake	45°	
	Exhaust	45°	
Angle "α3"	Intake	60°	
	Exhaust	60°	
Contacting width "W"*3	Intake	1.18 - 1.22 (0.0465 - 0.0480)	
	Exhaust	1.38 - 1.42 (0.0543 - 0.0559)	
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.0 - 5.1 (0.197 - 0.201)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.9 - 5.0 (0.193 - 0.197)
Depth "H"	Intake	41.16 - 41.76 (1.6205 - 1.6441)	
	Exhaust	41.09 - 41.69 (1.6177 - 1.6413)	

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

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

*: Machining data

VALVE SPRING

Items	Standard
Free height	46.89 mm (1.8461 in)
Installation height	37.00 mm (1.4567 in)
Installation load	166 - 188 N (16.9 - 19.2 kg, 37.3 - 42.3 lb)
Height during valve open	27.00 mm (1.0630 in)
Load with valve open	384 - 432 N (39.2 - 44.1 kg, 86.3 - 97.1 lb)

Unit: mm (in)

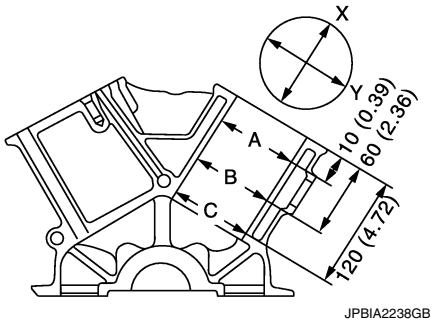
Items	Limit
Squareness	2.0 (0.079)

Cylinder Block

INFOID:0000000012602075

CYLINDER BLOCK

Unit: mm (in)



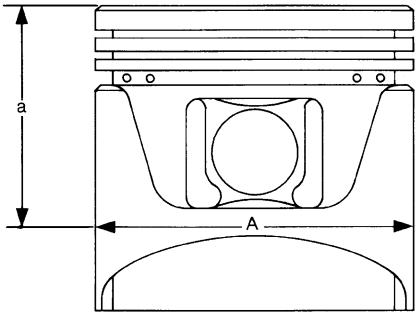
JPBIA2238GB

Surface distortion		Standard		Less than 0.03 (0.0012)
		Limit		0.10 (0.0039)
Cylinder bore	Main bearing housing inner diameter	Standard	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
		Wear limit		0.20 (0.0079)
Out-of-round		Limit		0.015 (0.0006)
Taper (Difference between A and C)				0.015 (0.0006)

Main bearing housing inner diameter grade (Without bearing)	Grade No. A	63.993 - 63.994 (2.5194 - 2.5194)
	Grade No. B	63.994 - 63.995 (2.5194 - 2.5195)
	Grade No. C	63.995 - 63.996 (2.5195 - 2.5195)
	Grade No. D	63.996 - 63.997 (2.5195 - 2.5196)
	Grade No. E	63.997 - 63.998 (2.5196 - 2.5196)
	Grade No. F	63.998 - 63.999 (2.5196 - 2.5196)
	Grade No. G	63.999 - 64.000 (2.5196 - 2.5197)
	Grade No. H	64.000 - 64.001 (2.5197 - 2.5197)
	Grade No. J	64.001 - 64.002 (2.5197 - 2.5198)
	Grade No. K	64.002 - 64.003 (2.5198 - 2.5198)
	Grade No. L	64.003 - 64.004 (2.5198 - 2.5198)
	Grade No. M	64.004 - 64.005 (2.5198 - 2.5199)
	Grade No. N	64.005 - 64.006 (2.5199 - 2.5199)
	Grade No. P	64.006 - 64.007 (2.5199 - 2.5200)
	Grade No. R	64.007 - 64.008 (2.5200 - 2.5200)
	Grade No. S	64.008 - 64.009 (2.5200 - 2.5200)
	Grade No. T	64.009 - 64.010 (2.5200 - 2.5201)
	Grade No. U	64.010 - 64.011 (2.5201 - 2.5201)
	Grade No. V	64.011 - 64.012 (2.5201 - 2.5202)
	Grade No. W	64.012 - 64.013 (2.5202 - 2.5202)
	Grade No. X	64.013 - 64.014 (2.5202 - 2.5202)
	Grade No. Y	64.014 - 64.015 (2.5202 - 2.5203)
	Grade No. 4	64.015 - 64.016 (2.5203 - 2.5203)
	Grade No. 7	64.016 - 64.017 (2.5203 - 2.5203)
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

AVAILABLE PISTON

Unit: mm (in)



SEM882E

Items	Grade*	Standard
Piston skirt diameter (A)	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)
	Grade No. 2	95.490 - 95.500 (3.7594 - 3.7598)
	Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)
(a) dimension		38.0 (1.496)
Piston pin hole diameter	Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)
	Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)
Piston to cylinder bore clearance		0.010 - 0.030 (0.0004 - 0.0012)

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

PISTON RING

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	—
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	—
	Oil ring	0.045 - 0.125 (0.0018 - 0.0049)	—

End gap	Top	0.23 - 028 (0.0091 - 0.0110)	0.50 (0.0197)
	2nd	0.33 - 0.43 (0.0130 - 0.0169)	0.62 (0.0244)
	Oil (rail ring)	0.20 - 0.45 (0.0079 - 0.0177)	0.80 (0.0315)

PISTON PIN

Unit: mm (in)

Items	Grade*	Standard	Limit
Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)	—
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)	—
Piston to piston pin oil clearance		0.002 - 0.006 (0.0001 - 0.0002)	—
Connecting rod bushing oil clearance		0.005 - 0.017 (0.0002 - 0.0007)	0.030 (0.0012)

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

CONNECTING ROD

Unit: mm (in)

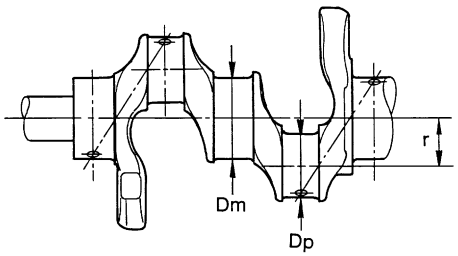
Center distance		144.15 - 144.25 (5.68 - 5.68)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end inner diameter		23.980 - 24.000 (0.9441 - (0.9449)
Connecting rod bushing inner diameter[2]	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)
Connecting rod big end diameter (Without bearing)		55.000 - 55.013 (2.1654 - 2.1659)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)

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

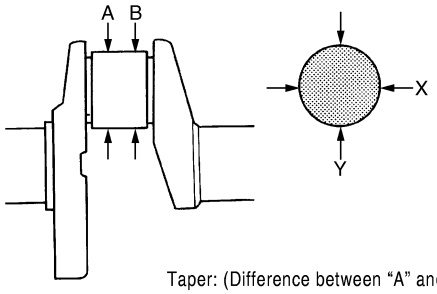
[2]: After installing in connecting rod.

CRANKSHAFT

Unit: mm (in)



SEM645



Taper: (Difference between “A” and “B”)
Out-of-round: (Difference between “X” and “Y”)
SBIA0535E

		Grade[1]	Dimension
Main journal diameter.(Dm) grade	Standard	Grade No. A	59.975 - 59.974 (2.3612 - 2.3612)
		Grade No. B	59.974 - 59.973 (2.3612 - 2.3611)
		Grade No. C	59.973 - 59.972 (2.3611 - 2.3611)
		Grade No. D	59.972 - 59.971 (2.3611 - 2.3611)
		Grade No. E	59.971 - 59.970 (2.3611 - 2.3610)
		Grade No. F	59.970 - 59.969 (2.3610 - 2.3610)
		Grade No. G	59.969 - 59.968 (2.3610 - 2.3609)
		Grade No. H	59.968 - 59.967 (2.3609 - 2.3609)
		Grade No. J	59.967 - 59.966 (2.3609 - 2.3609)
		Grade No. K	59.966 - 59.965 (2.3609 - 2.3608)
		Grade No. L	59.965 - 59.964 (2.3608 - 2.3608)
		Grade No. M	59.964 - 59.963 (2.3608 - 2.3607)
		Grade No. N	59.963 - 59.962 (2.3607 - 2.3607)
		Grade No. P	59.962 - 59.961 (2.3607 - 2.3607)
		Grade No. R	59.961 - 59.960 (2.3607 - 2.3606)
		Grade No. S	59.960 - 59.959 (2.3606 - 2.3606)
		Grade No. T	59.959 - 59.958 (2.3606 - 2.3605)
		Grade No. U	59.958 - 59.957 (2.3605 - 2.3605)
		Grade No. V	59.957 - 59.956 (2.3605 - 2.3605)
		Grade No. W	59.956 - 59.955 (2.3605 - 2.3604)
		Grade No. X	59.955 - 59.954 (2.3604 - 2.3604)
		Grade No. Y	59.954 - 59.953 (2.3604 - 2.3603)
		Grade No. 4	59.953 - 59.952 (2.3603 - 2.3603)
		Grade No. 7	59.952 - 59.951 (2.3603 - 2.3603)
Pin journal diameter. (Dp) grade	Standard	Grade No. 0	51.968 - 51.974 (2.0460 - 2.0462)
		Grade No. 1	51.962 - 51.968 (2.0457 - 2.0460)
		Grade No. 2	51.956 - 51.962 (2.0445 - 2.0457)
Center distance (r)			40.66 - 40.74 (1.6008 - 1.6039)
Taper [Difference between (A) and (B)]	Limit		Less than 0.002 (0.0001)
Out-of-round [Difference between (X) and (Y)]			Less than 0.002 (0.0001)
Crankshaft runout [TIR*]	Standard		Less than 0.05 (0.0020)
	Limit		0.10 (0.0039)
Crankshaft end play	Standard		0.10 - 0.25 (0.0039 - 0.0098)
	Limit		0.30 (0.0118)
Fillet role of crankshaft journal	Standard		More than 0.10 (0.0039)

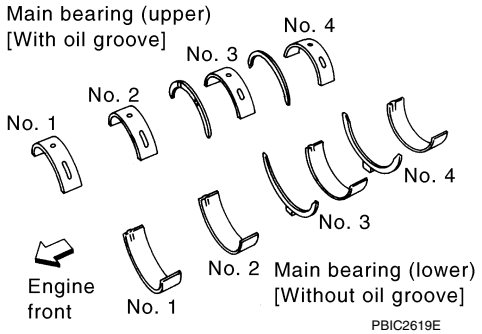
*: Total indicator reading

Main Bearing

INFOID:0000000012602076

MAIN BEARING

Unit: mm (in)



PBIC2619E

Grade number*	Thickness	Identification color	Remarks

0		2.000 - 2.003 (0.0787 - 0.0789)	Black	Grade is the same for upper and lower bearings.
1		2.003 - 2.006 (0.0789 - 0.0790)	Brown	
2		2.006 - 2.009 (0.0790 - 0.0791)	Green	
3		2.009 - 2.012 (0.0791 - 0.0792)	Yellow	
4		2.012 - 2.015 (0.0792 - 0.0793)	Blue	
5		2.015 - 2.018 (0.0793 - 0.0794)	Pink	
6		2.018 - 2.021 (0.0794 - 0.0796)	Purple	
7		2.021 - 2.024 (0.0796 - 0.0797)	White	
01	UPR	2.003 - 2.006 (0.0789 - 0.0790)	Brown	Grade and color are different for upper and lower bearings.
	LWR	2.000 - 2.003 (0.0787 - 0.0789)	Black	
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)	Green	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)	Brown	
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)	Yellow	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)	Green	
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue	
	LWR	2.009 - 2.012 (0.0791 - 0.0792)	Yellow	
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink	
	LWR	2.012 - 2.015 (0.0792 - 0.0793)	Blue	
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple	
	LWR	2.015 - 2.018 (0.0793 - 0.0794)	Pink	
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White	
	LWR	2.018 - 2.021 (0.0794 - 0.0796)	Purple	

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

UNDERSIZE

Unit: mm (in)

Items	Thickness	Main journal diameter
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	Grind so that bearing clearance is the specified value.

MAIN BEARING OIL CLEARANCE

Unit: mm (in)

Items	Standard	Limit
Main bearing oil clearance	0.012 - 0.022 (0.0005 - 0.0009)*	0.065 (0.0026)

*: Actual clearance

Connecting Rod Bearing

INFOID:0000000012602077

CONNECTING ROD BEARING

Unit: mm (in)

Grade number*	Thickness	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

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

UNDERSIZE

Unit: mm (in)

Items	Thickness	Crank pin journal diameter (Dp)
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

Items	Standard	Limit
Connecting rod bearing oil clearance	0.020 - 0.045 (0.0008 - 0.0018)*	0.070 (0.0028)

*: Actual clearance

Drive Plate

INFOID:0000000012602078

Unit: mm (in)

Drive plate runout [TIR]* - on torque converter mount surface	Less than 0.35 (0.0138)
Drive plate runout [TIR]* - on ring gear	0.5 (0.0197)

*: Total indicator reading