SECTION EM
ENGINE MECHANICAL

CONTENTS

QR25DE

VQ35DE

PRECAUTIONS

PFP:00001

Precautions for Draining Coolant

EBS007OM

- Drain coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS007ON

- 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.

Precautions for Removal and Disassembly

EBS007OO

- 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.

Precautions for Inspection, Repair and Replacement

EBS007OP

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

Precautions for Assembly and Installation

EBS007OQ

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

Parts Requiring Angular Tightening

EBS007OR

- 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.

Precautions for Liquid Gasket

EBS007OS

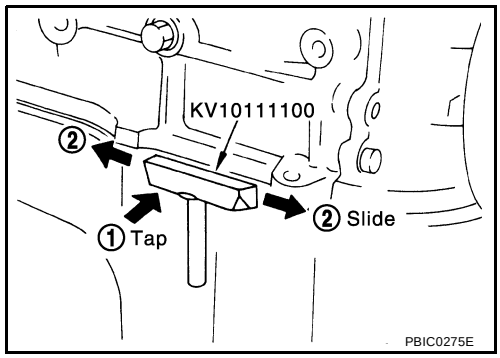
REMOVAL OF LIQUID GASKET SEALING

- After removing the mounting bolts and nuts, disconnect the component using a seal cutter.

  CAUTION:
  Be careful not to damage the mating surfaces.

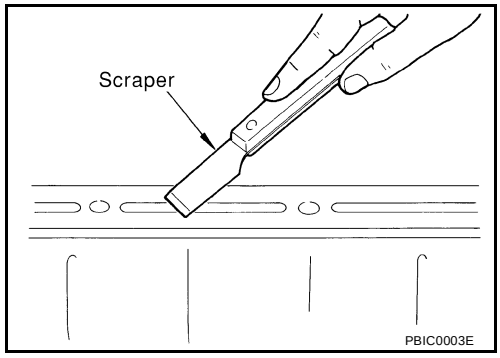
- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap the areas where the sealant is applied to disconnect the component.

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

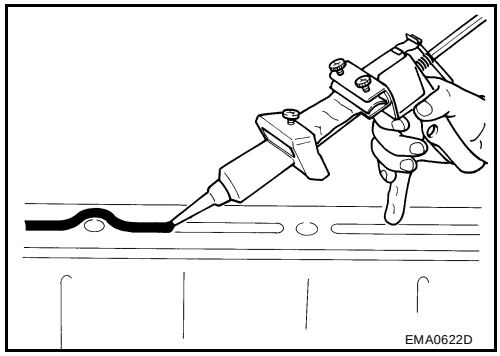


LIQUID GASKET APPLICATION PROCEDURE

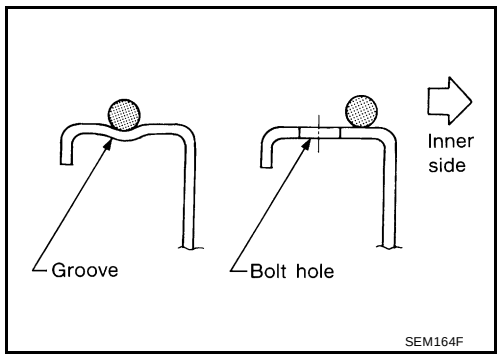
1. Using a scraper, remove the old RTV Silicone Sealant adhering to the gasket application surface and the mating surface.
   - Remove the sealant completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
2. Thoroughly clean the gasket application surface and the mating surface and remove adhering moisture, grease and foreign materials.
3. Attach the sealant tube to the tube presser.
   Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



4. Apply the sealant without breaks to the specified location with the specified dimensions.



   - If there is a groove for the sealant application, apply the sealant to the groove.
   - As for the bolt holes, normally apply the sealant inside the holes. If specified, it should be applied outside the holes. Make sure to read the text of this manual.
   - Within five minutes of the sealant application, install the mating component.
   - If the sealant protrudes, wipe it off immediately.
   - Do not retighten after the installation.
   - After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to MA-12, "RECOMMENDED FLUIDS AND LUBRICANTS" .



CAUTION:
Follow all specific instructions in this manual.

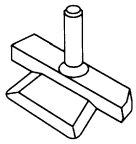
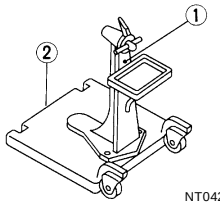
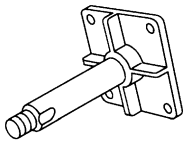
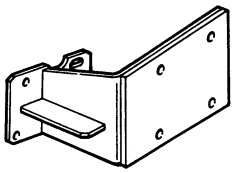
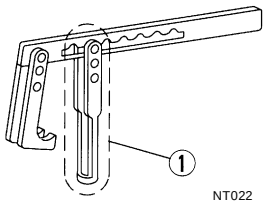
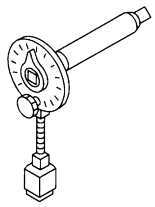
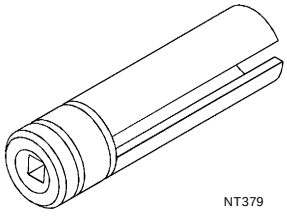
PREPARATION

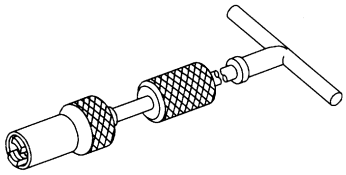
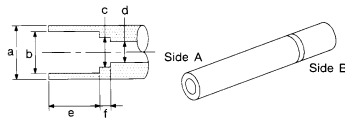
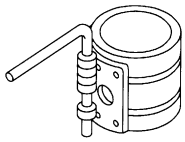
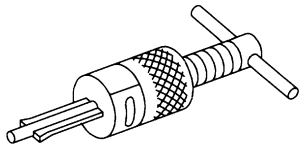
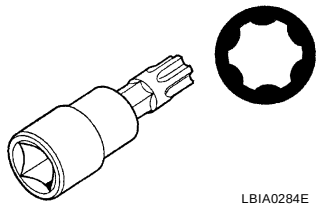
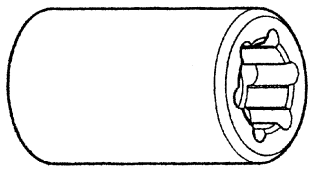
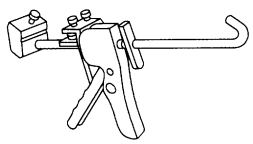
PFP:00002

Special Service Tools

EBS007OT

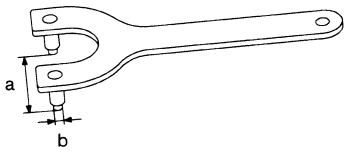
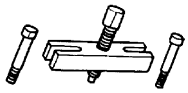
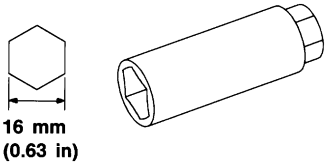
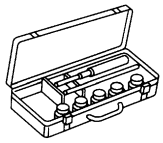
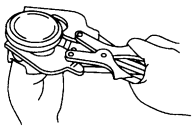
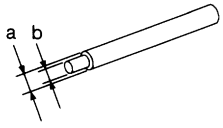
The actual shapes of the Kent-Moore tools may differ from those of the special service tools illustrated here.

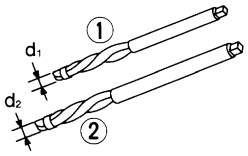
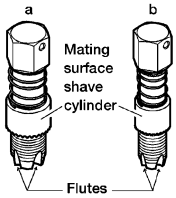
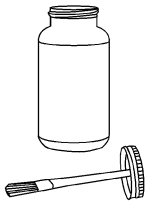
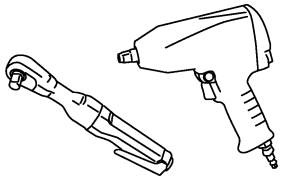
Tool number (Kent-Moore No.) Tool name		Description
KV10111100 (J-37228) Seal cutter	 S-NT046	Removing steel oil pan and rear timing chain case
ST0501S000 Engine stand assembly 1, ST05011000 (—) Engine stand 2, ST05012000 (—) Base	 NT042	Disassembling and assembling
KV10106500 (—) Engine stand shaft	 NT028	
KV10115300 (—) Engine sub-attachment	 ZZA1078D	
KV10116200 (J26336-B) Valve spring compressor 1, KV10115900 (J-26336-20) Attachment	 NT022	Disassembling valve mechanism
KV10112100 (BT8653-A) Angle wrench	 S-NT014	Tightening bolts for bearing cap, cylinder head, etc.
KV10117100 (J36471-A) Heated oxygen sensor wrench	 NT379	Loosening or tightening heated oxygen sensors with 22 mm 80.87 in) hexagon nut

Tool number (Kent-Moore No.) Tool name	Description
KV10107902 (J38959) Valve oil seal puller  S-NT011	Removing valve oil seal
KV10115600 (J38958) 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 (J8037) Piston ring compressor  S-NT044	Installing piston assembly into cylinder bore
ST16610001 (J23907) Pilot bushing puller  S-NT045	Removing crankshaft pilot bushing
— (J-45737) TP50 Torx® plus bit  LBIA0284E	Removing and installing flywheel bolts (M/T models)
— (J-45816) E20 Torx® socket  LBIA0285E	Removing and installing drive plate bolts (A/T models)
WS39930000 (—) Tube presser  S-NT052	Pressing the tube of liquid gasket

Commercial Service Tools

EBS007OU

(Kent-Moore No.) Tool name	Description
Quick connector release	 PBIC0198E Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
Pulley holder	 NT628 Crankshaft pulley removing and installing a: 68 mm (2.68 in) dia. b: 8 mm (0.31 in) dia.
Crank puller	 ZZA0010D Crankshaft pulley removing
Spark plug wrench	 S-NT047 Removing and installing spark plug
Valve seat cutter set	 S-NT048 Finishing valve seat dimensions
Piston ring expander	 S-NT030 Removing and installing piston ring
Valve guide drift	 S-NT015 Removing and installing valve guide **Intake & Exhaust:** **a: 9.5 mm (0.374 in) dia.** **b: 5.5 mm (0.217 in) dia.**

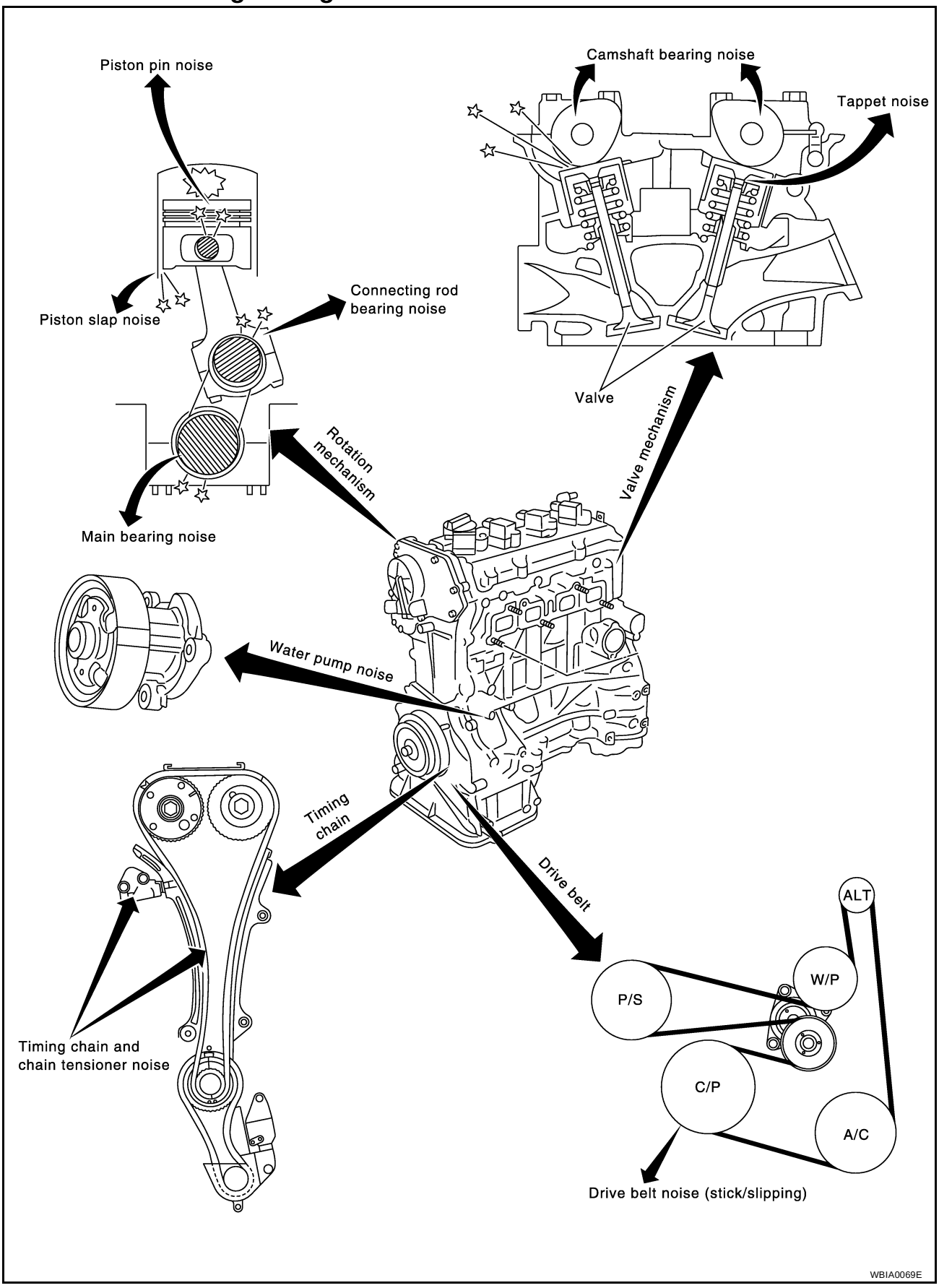
(Kent-Moore No.) Tool name	Description	
Valve guide reamer	 S-NT016	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide **Intake & Exhaust:** **d_1 : 6.0 mm (0.236 in) dia.** **d_2 : 10.2 mm (0.402 in) dia.**
a: (J43897-18) b: (J43897-12) Oxygen sensor thread cleaner	 AEM488	Reconditioning the exhaust system threads before installing a new oxygen sensor (Use with anti-seize lubricant shown below.) **a: (18 mm 0.71in) for zirconia oxygen sensor** **b: (12 mm 0.47 in) for titania oxygen sensor**
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)	 AEM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads
Power tool	 PBIC0190E	Loosening bolts and nuts

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting — Engine Noise

EBS007OV



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

EBS007OW

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-41
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-37 EM-36
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-84 EM-84
	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-84 EM-83 EM-83 EM-84
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-84 EM-84
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-88 EM-88
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-45
Front of engine	Squeaking or fizzing	A	B	—	B	—	B	Drive belts (Sticking or slipping)	Drive belts deflection	EM-12
	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-9

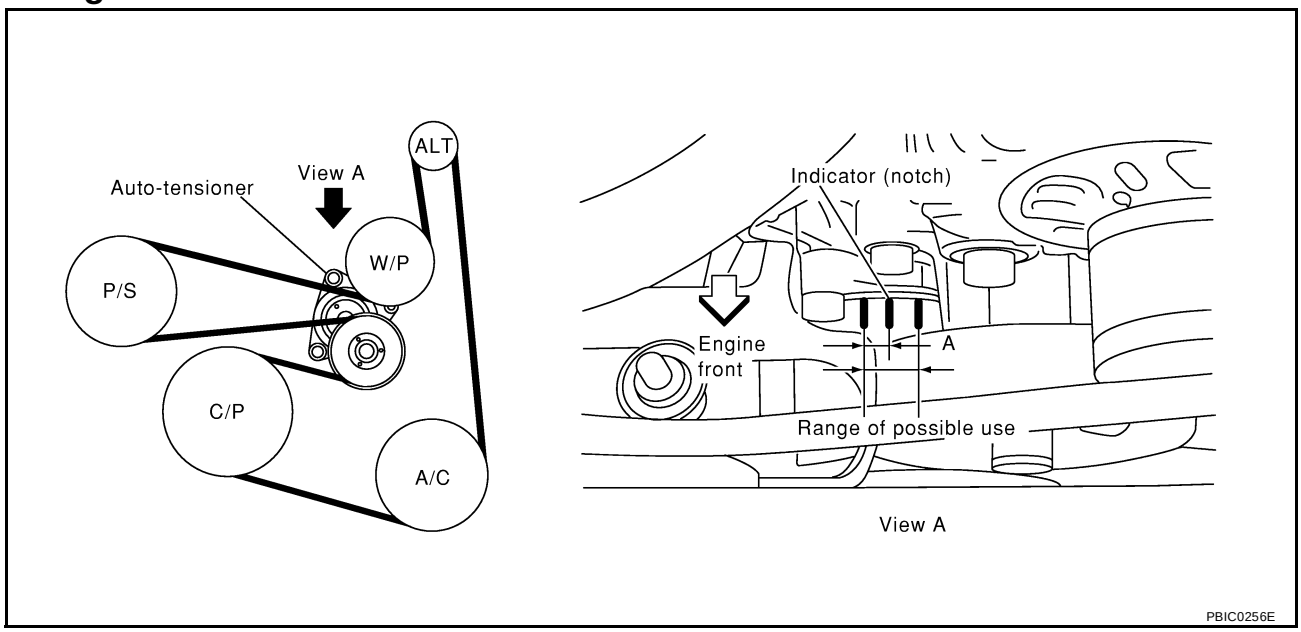
A: Closely related B: Related C: Sometimes related —: Not related

DRIVE BELTS

PFP:02117

Checking Drive Belts

EBS007OX



NOTE:
On vehicles not equipped with A/C, there is an idler pulley in the position for the drive belt routing.

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

Make sure that the stamp mark of auxiliary drive belt auto-tensioner is within the usable range.

- Check the auto-tensioner indication when the engine is cold.
- When the new drive belt is installed, the range should be A.
- Visually check entire belt for wear, damage or cracks.
- If the indicator is out of allowable use range or belt is damaged, replace the belt.

Tension Adjustment

EBS007OY

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

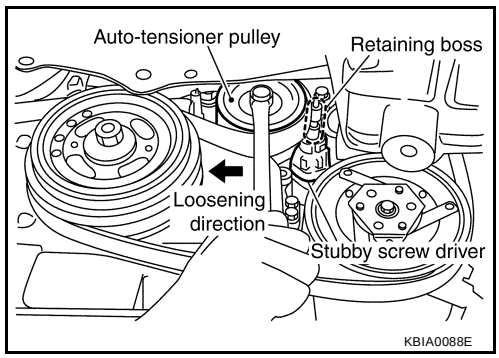
Removal and Installation

EBS007OZ

REMOVAL

1. Remove front RH engine side cover.
2. With box wrench, and while securely holding the hexagonal part in pulley center of automatic tensioner, move the wrench handle in the direction of arrow (loosening direction of tensioner).

   CAUTION:
   Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.
3. Insert a rod approximately 6 mm (0.24 in) in diameter through the rear of engine into holding boss to fix tensioner pulley.
   - Leave tensioner pulley arm locked until belt is installed again.
4. Loosen auxiliary drive belt from water pump pulley in sequence, and remove it.



INSTALLATION

1. With box wrench, and while securely holding the hexagonal part in pulley center of automatic tensioner, move the wrench handle in the direction of arrow [loosening direction of tensioner].

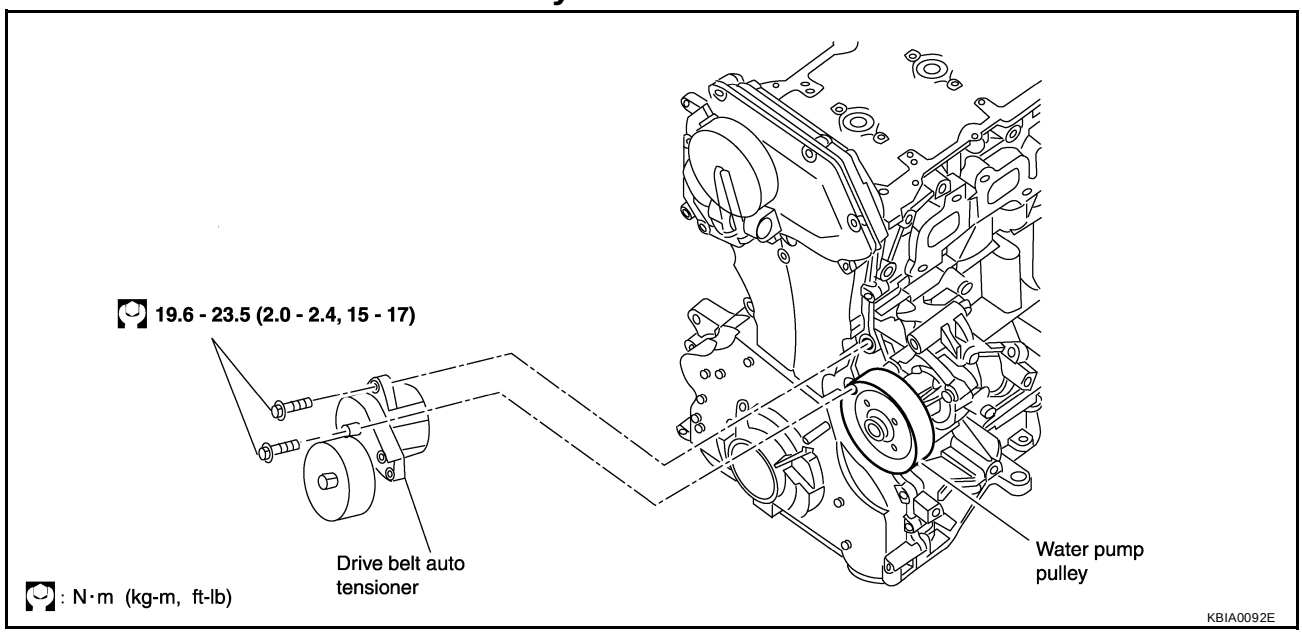
   CAUTION:
   Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.

2. Insert a rod approximately 6 mm (0.24 in) in diameter through the rear of engine into holding boss to fix tensioner pulley.
3. Hook the auxiliary drive belt onto all of the pulleys except for the water pump pulley. Hook the drive belt onto water pump pulley last.

   CAUTION:
   Confirm belts are completely set on the pulleys.
4. Release tensioner, and apply tensions to belt.
5. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
6. Confirm tensions of belt at indicator is within the allowable use range. Refer to EM-12, "Checking Drive Belts" .

Removal and Installation of Auxiliary Drive Belt Auto-tensioner

EBS007P0



REMOVAL

1. Remove the front RH engine side cover.
2. Remove the auxiliary drive belt.
   - Keep the auto-tensioner pulley held back with a tool such as a short-length screwdriver.
3. Remove the alternator. Refer to SC-33, "Removal and Installation" .
4. Remove the auxiliary drive belt auto-tensioner, with power tool.

INSTALLATION

Installation is in the reverse order of removal.

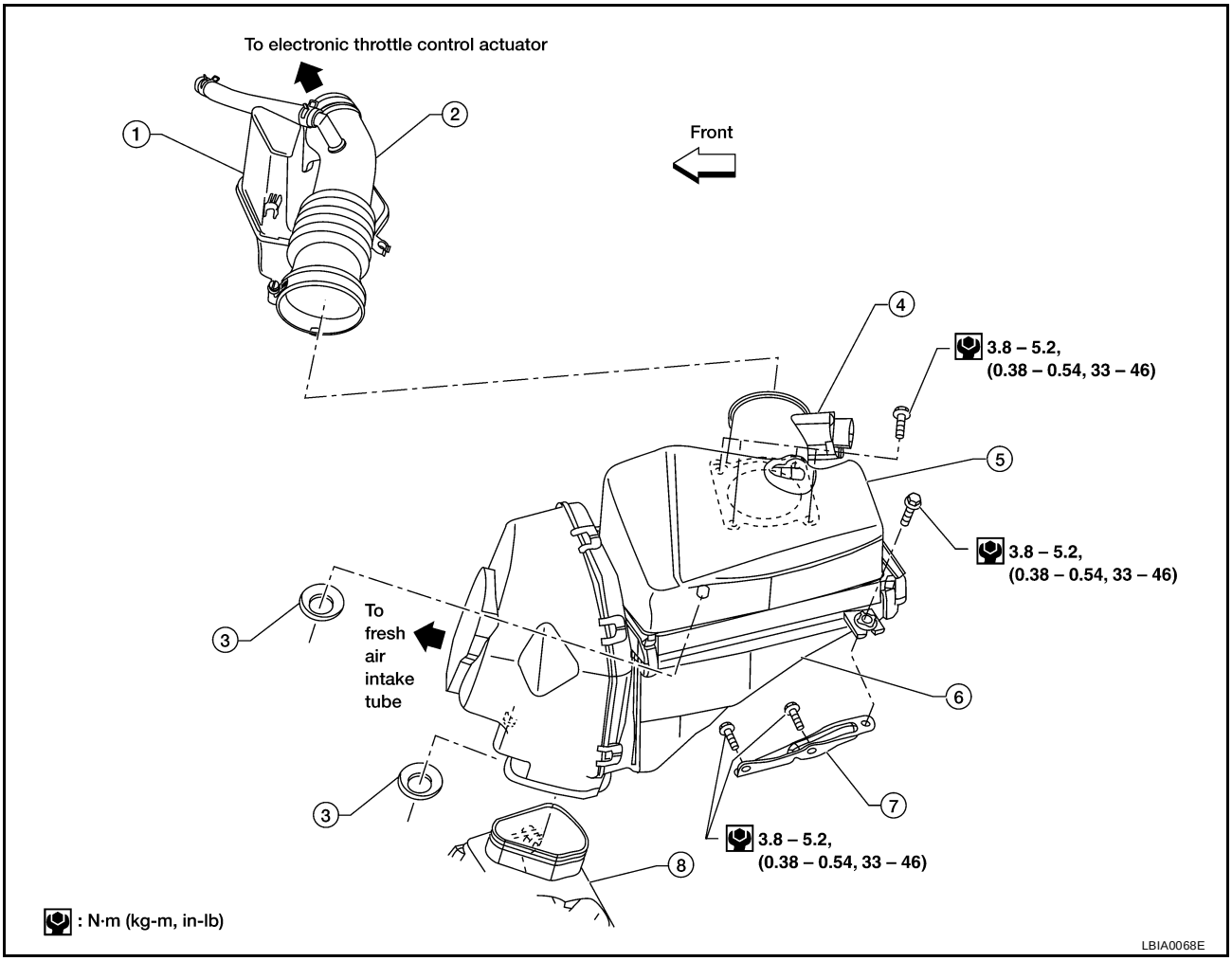
CAUTION:
Install the auxiliary drive belt auto-tensioner carefully so not to damage the water pump pulley.

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

EBS007P1



1. Resonator
2. Air cleaner to electronic throttle control actuator tube
3. Grommet
4. Mass air flow sensor
5. Air cleaner case (upper)
6. Air cleaner case (lower)
7. Air cleaner case mounting bracket
8. Resonator in fender

REMOVAL

1. Disconnect the mass air flow sensor electrical connector.
2. Disconnect the tube clamp at the electronic throttle control actuator and the fresh air intake tube.
3. Remove air cleaner to electronic throttle control actuator tube, air cleaner case (upper), with mass air flow sensor attached.
4. Remove mass air flow sensor from air cleaner case (upper), as necessary.

   CAUTION:
   Handle the mass air flow sensor with care:
   - **Do not shock it.**
   - **Do not disassemble it.**
   - **Do not touch the internal sensor.**
5. Remove the resonator in the fender cavity, as necessary.

INSTALLATION

Installation is in the reverse order of removal.

- Attach each joint according to the alignment marks made during removal. Screw all clamps firmly.

CHANGING THE AIR CLEANER ELEMENT

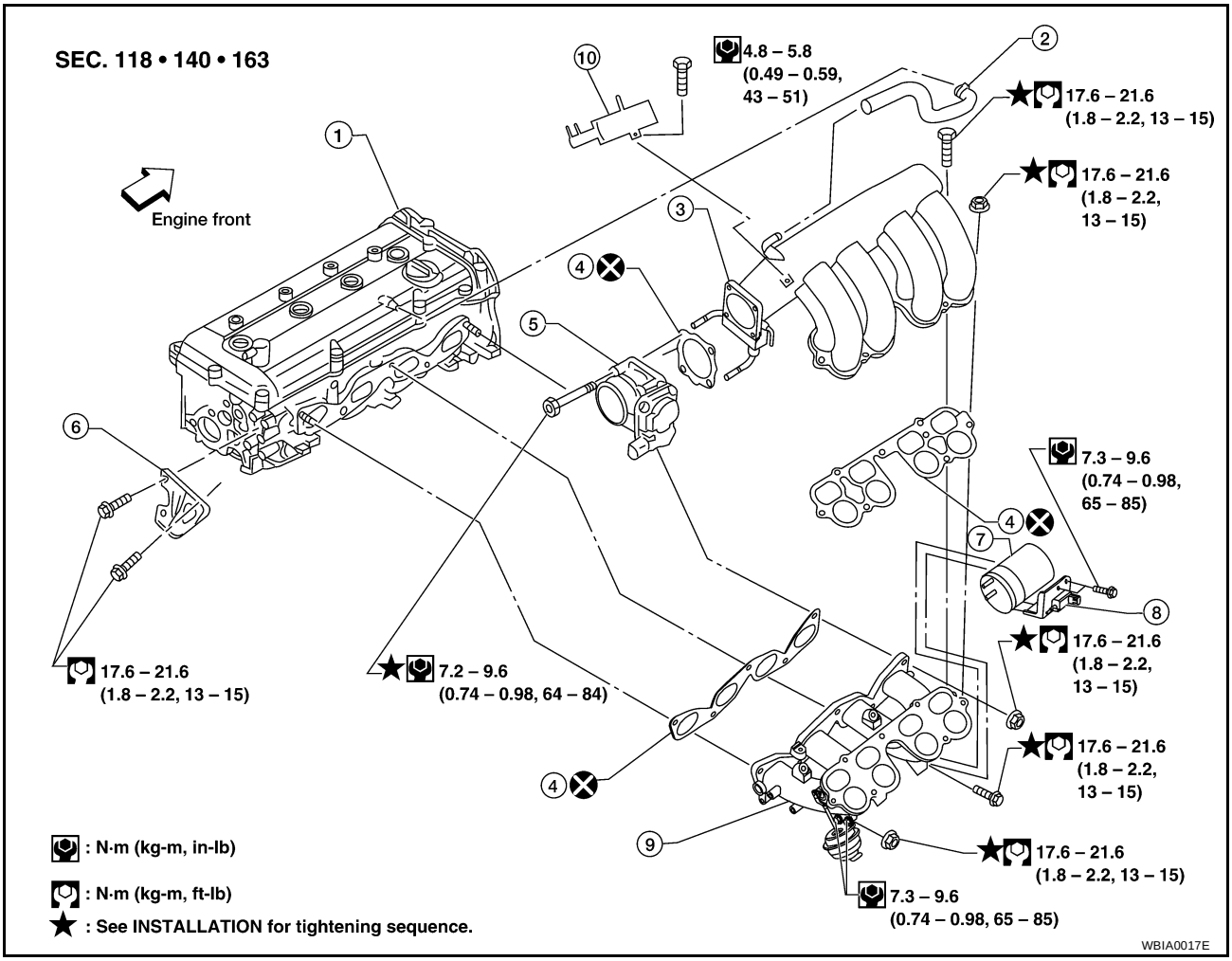
1. Unhook the air cleaner case side clips and raise the air cleaner case (upper).
2. Remove the air cleaner element.
3. Install the new element, facing in the direction indicated on the element
4. position the air cleaner case (upper) and secure the air cleaner case side clips.

INTAKE MANIFOLD

PFP:14003

Removal and Installation

EBS007P2



1. Cylinder head assembly
2. PCV hose
3. Intake manifold collector
4. Gasket
5. Electric throttle control actuator
6. Intake manifold support
7. Vacuum reservoir tank
8. VIAS control solenoid valve
9. Intake manifold
10. EVAP canister purge volume control solenoid

REMOVAL

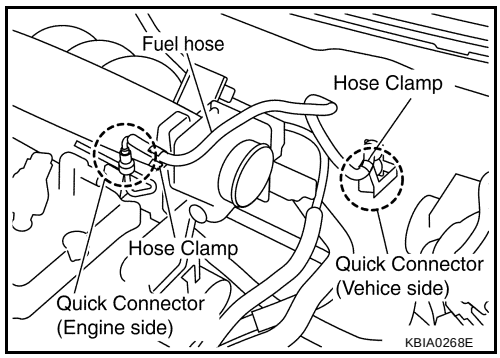
WARNING:

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

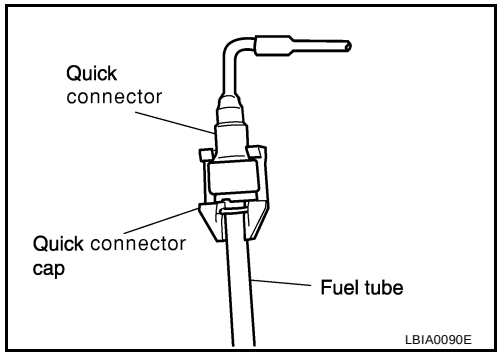
1. Disconnect the negative battery terminal.
2. Release the fuel pressure.
   Refer to EC-51, "FUEL PRESSURE RELEASE" .
3. Drain coolant when engine is cooled. Refer to MA-14, "Changing Engine Coolant" .
4. Disconnect the MAF sensor electrical connector.
5. Remove air cleaner case and air duct assembly.
   Refer to EM-14, "Removal and Installation" .
6. Disconnect the following components at the intake side:

a. PCV hose
b. EVAP canister purge volume control solenoid
c. Electric throttle control actuator
d. Brake booster vacuum hose

7. Disconnect fuel hose quick connector on the vehicle engine side.
   - Using the quick connector release tool (here after called “release tool”), and perform the following steps to disconnect the fuel tube quick connector.



a. Remove quick connector cap.

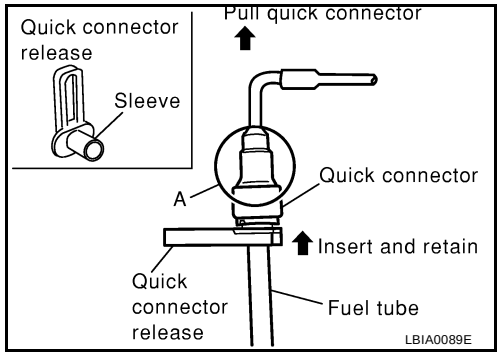


b. With the sleeve side of release facing quick connector, install release tool onto the fuel tube as shown.

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

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

d. Pull the quick connector straight out from the fuel tube.



CAUTION:
- **Pull quick connector holding it at the "A" position, as shown.**
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Be sure to cover openings of disconnected pipes with plug or plastic bag to avoid fuel leakage and entry of foreign materials.**

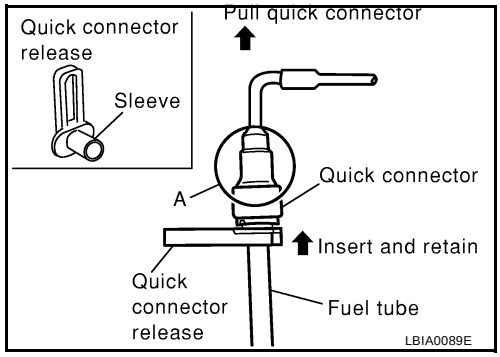
8. If necessary, disconnect the fuel tube, on the vehicle piping side, using the quick connector release tool (here after called "release tool"). Perform the following steps to disconnect the fuel tube quick connector.

a. With the sleeve side of the release facing quick connector, install release tool onto the fuel tube as shown.

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

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

c. Pull the quick connector straight out off of the fuel tube.



CAUTION:
- **Pull quick connector holding it at the "A" position, as shown.**

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

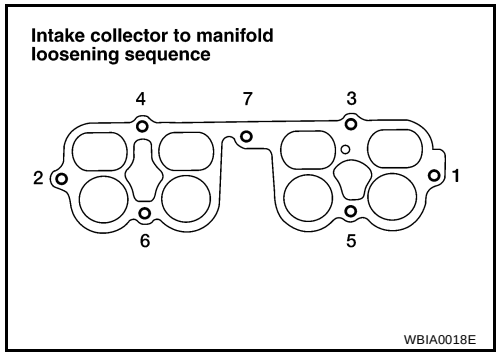
9. Loosen mounting bolts diagonally, and remove the electric throttle control actuator.

   CAUTION:
   Handle carefully to avoid any damage.

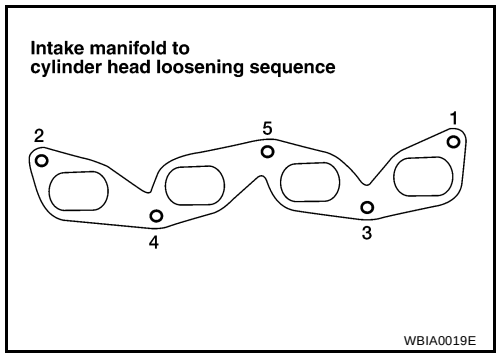
10. Disconnect intake manifold collector harness, and vacuum hose.

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

11. Remove intake manifold collector mounting bolts on the support, using power tools.
12. Loosen the mounting bolts and nuts in the order shown to remove the intake manifold collector, using power tools.



13. Loosen the bolts in the order shown to remove the intake manifold assembly, using power tools.

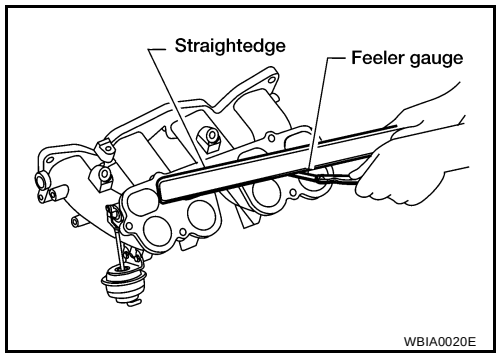


INSPECTION AFTER REMOVAL

Surface Distortion

- Using straightedge and feeler gauge, inspect surface distortion of intake manifold collector and intake manifold surface.

  Standard : 0.1 mm (0.004 in)



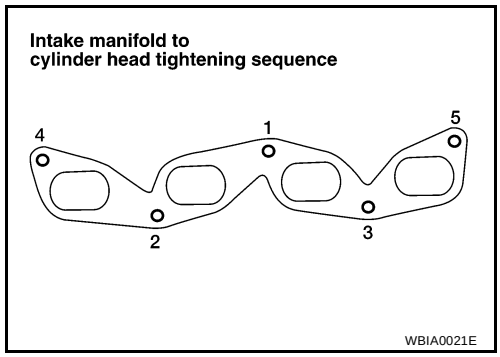
INSTALLATION

Install the intake manifold bolts and nuts in the reverse order of removal, following the tightening sequences below.

Tightening the Intake Manifold Bolts and Nuts

- Tighten in numerical order as shown.

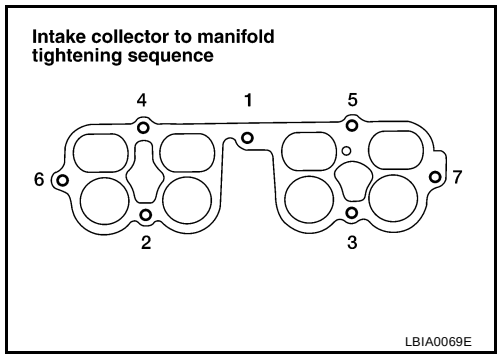
CAUTION:
After tightening No.5, retighten the No.1 mounting bolt to specification.



Tightening the Intake Manifold Collector Bolts and Nuts

- Tighten in numerical order as shown.

CAUTION:
After tightening No.7, retighten the No.1 mounting bolt to specification.



Installation of the Electric Throttle Control Actuator

- Tighten the electric throttle control actuator bolts equally and diagonally in several steps.

Electric throttle control actuator bolts : 7.2 - 9.6 N·m (0.74 - 0.98 kg-m, 64 - 84 in-lb)

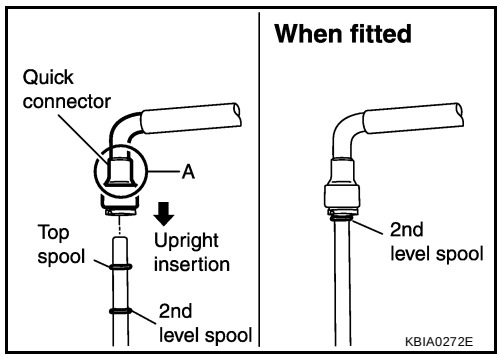
- After installation perform procedure in EM-20, "Inspection After Installation" .

Connecting the Quick Connector for the Fuel Hose (Engine Side)

- Install the fuel tube quick connector (engine side) as follows.

1. Make sure no foreign substances are deposited in and around tube and quick connector and there is no damage on them.
2. Thinly apply new engine oil around the fuel tube tip end.
3. Align center to insert quick connector straight into fuel tube.
   - Insert fuel tube into quick connector until the top spool on fuel tubes is inserted completely and the second level spool is positioned slightly below the quick connector bottom end.

CAUTION:
- **Hold it at the "A" position in illustration 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.**



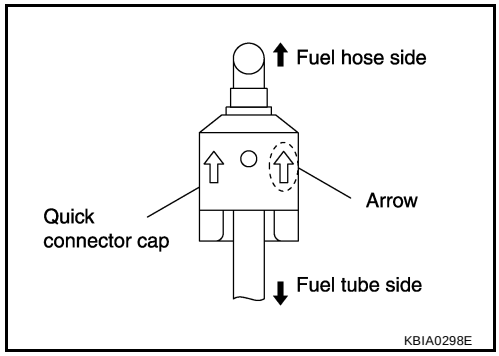
4. Before clamping fuel hose with hose clamp, pull the quick connector hard by hand with the recommended puling force, holding it at the "A" position, as shown. Make sure it is completely engaged (connected) so that it does not come off of the fuel tube.

Pulling force : 50 N (5.1 kg, 11.2 lb)

5. Install quick connector cap on quick connector joint.

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

6. Install fuel hose to hose clamp.

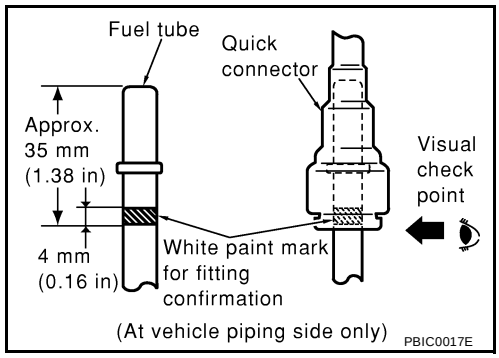


Connecting the Quick Connector for the Fuel Hose (Vehicle Piping Side)

- Install the fuel tube quick connector (vehicle piping side) as follows.

1. Make sure no foreign substances are deposited in and around tube and quick connector and there is no damage on them.
2. Thinly apply new engine oil around the fuel tube tip end.
3. Align center to insert quick connector straight into fuel tube.
   - Insert fuel tube into quick connector until the top spool on fuel tubes is inserted completely and the paint mark is positioned slightly below the quick connector bottom end.

   CAUTION:
   - **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.**



4. Before clamping fuel hose with hose clamp, pull the quick connector hard by hand with the recommended pulling force. Make sure it is completely engaged (connected) so that it does not come off of the fuel tube.

Pulling force : 50 N (5.1 kg, 11.2 lb

INSPECTION AFTER INSTALLATION

1. Start the engine and run it for a few minutes with the engine at idle.
   - Check connections for fuel leakage.
2. Stop the engine and check for fuel leakage both visually and by odor of gasoline.
   - Perform procedures for “Throttle Valve Closed Position Learning” after finishing repairs. Refer to EC-49, "Throttle Valve Closed Position Learning" .
   - If electric throttle control actuator is replaced, perform procedures for “Idle Air Volume Learning” after finishing repairs. Refer to EC-49, "Idle Air Volume Learning" .

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

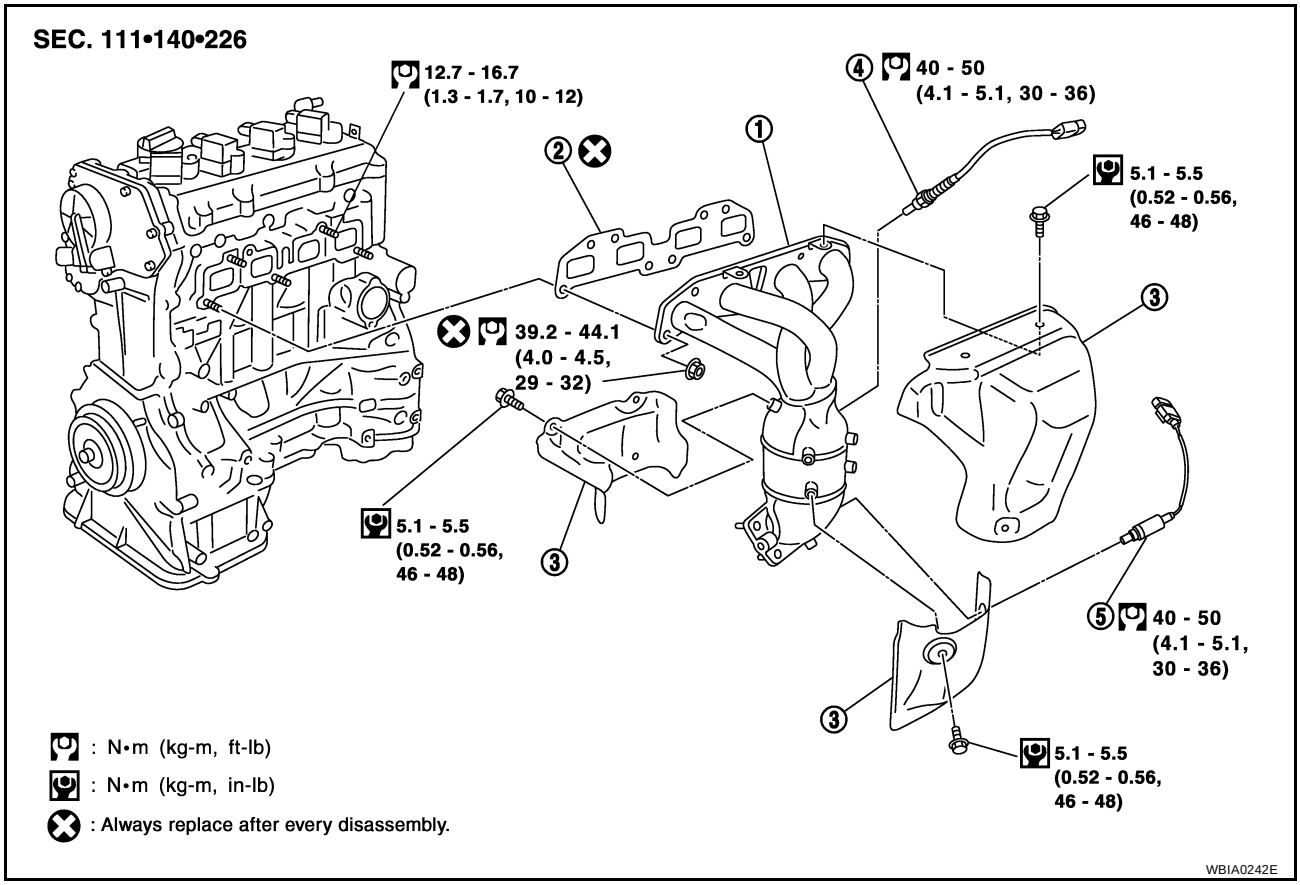
CAUTION:
Do not touch engine immediately after stopped, as engine becomes extremely hot.

EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

Removal and Installation

EBS007P3

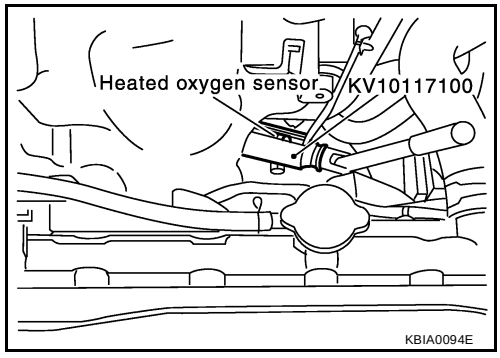


1. Exhaust manifold and three way catalyst assembly
2. Exhaust manifold gasket
3. Exhaust manifold cover (upper and lower)
4. Heated oxygen sensor 1 (front)
5. Heated oxygen sensor 2 (rear)

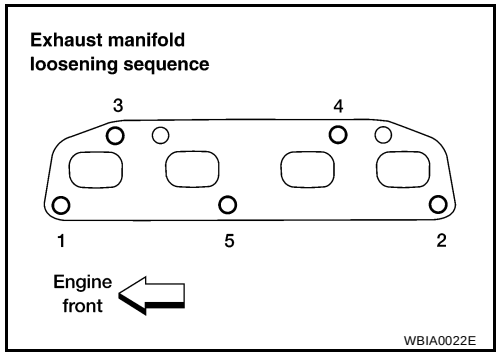
REMOVAL

1. Remove engine under cover, with power tool.
2. Disconnect the electrical connector of each heated oxygen sensor, and unhook the harness from the bracket and middle clamp on the cover.
3. Remove the heated oxygen sensors with Tool.

   CAUTION:
   - **Be careful not to damage heated oxygen sensor.**
   - **Discard any heated oxygen sensor which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; use a new one.**
4. Remove the lower exhaust manifold cover.
5. Remove the exhaust front tube. Refer to EX-3, "Removal and Installation" .
6. Remove the upper exhaust manifold cover.



7. Loosen the nuts in the sequence shown, on the exhaust manifold and three way catalyst.
8. Remove the exhaust manifold and three way catalyst assembly and gasket. Discard the gasket.

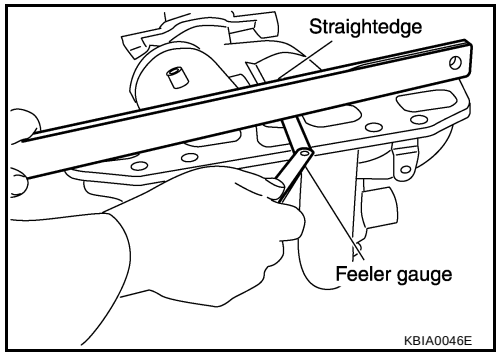


INSPECTION AFTER REMOVAL

Surface Distortion

- Use a reliable straightedge and feeler gauge to check the flatness of exhaust manifold fitting surface.

Standard : 0.3 mm (0.012 in)

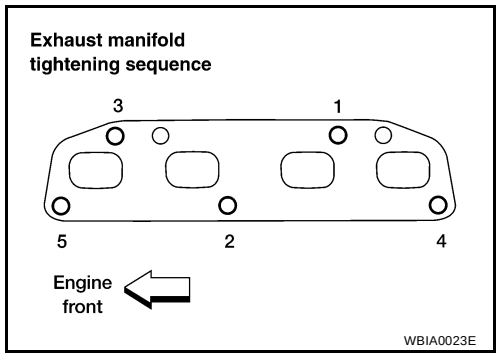


INSTALLATION

Installation is in the reverse order of removal. Pay attention to the following.

Tightening the Exhaust Manifold Bolts

- Tighten the nuts in the numerical order shown, to specification. After tightening No. 5, retighten No. 1 and then No. 3 to specification.



Installation of the Heated Oxygen Sensors

Clean the heated oxygen sensor threads with the Tool, then apply the anti-seize lubricant to the threads before installing the heated oxygen sensors.

CAUTION:

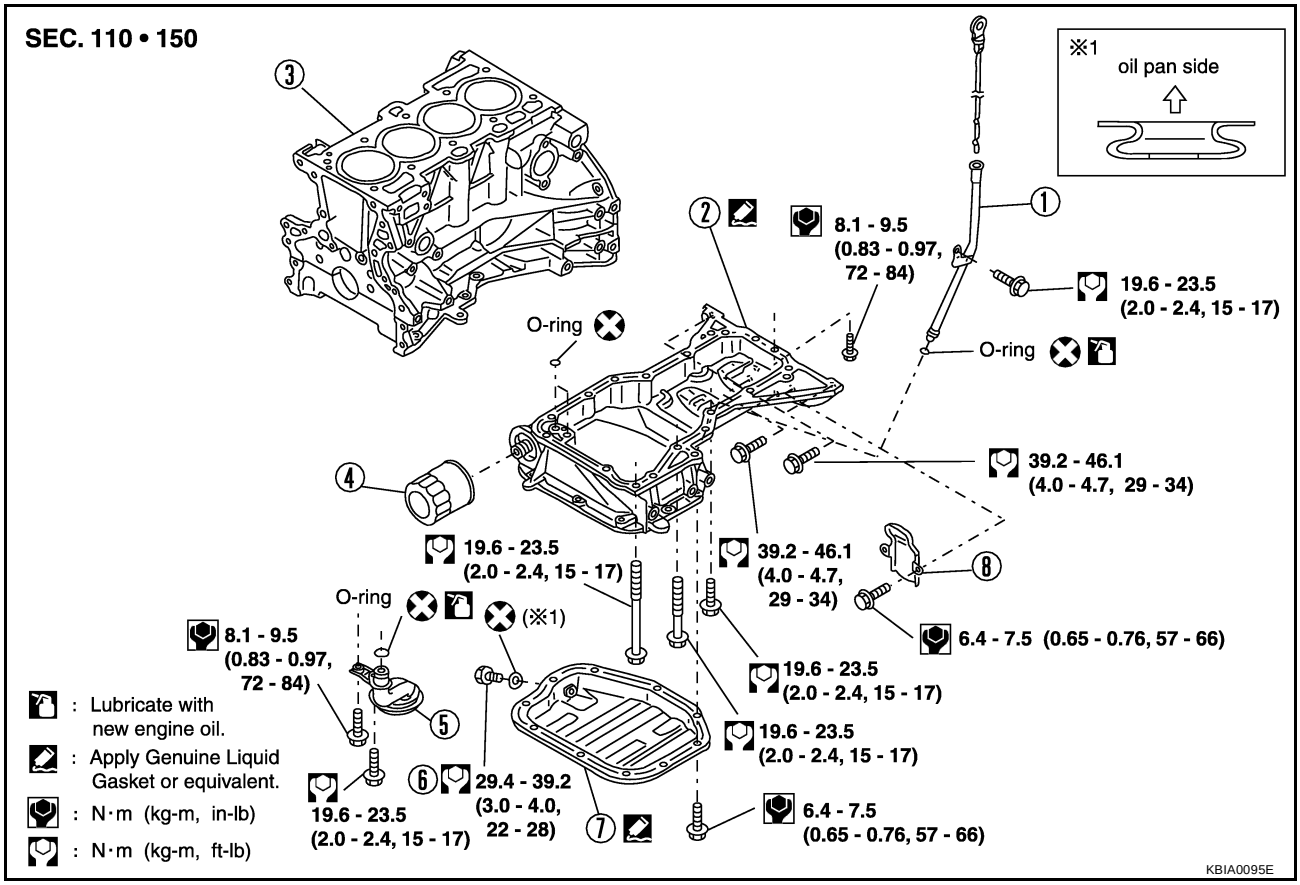
Do not over-tighten the heated oxygen sensors. Doing so may cause damage to the heated oxygen sensors, resulting in a malfunction and the MIL coming on.

OIL PAN AND OIL STRAINER

PFP:11110

Removal and Installation

EBS007P4



1. Oil dipstick tube
2. Oil pan, upper
3. Cylinder block
4. Oil filter
5. Oil pickup screen
6. Drain plug
7. Oil pan, lower
8. Rear plate cover

REMOVAL

WARNING:

To avoid the danger of being scalded, never drain the engine oil when the engine is hot.

1. Remove the engine under covers on both sides, using power tool.
2. Drain engine oil. Refer to LU-7, "Changing Engine Oil" .
3. Remove the front exhaust tube. Refer to EX-3, "Removal and Installation" .
4. Remove the front suspension member, using power tool.

a. Unhook the power steering reservoir from the mounting bracket and reposition it lower to add slack to the power steering lines.

b. Disconnect the A/C compressor with piping connected from the mounting bracket and suspend with a strong wire. Refer toMTC-83, "Removal and Installation for Compressor — QR25DE Models" .

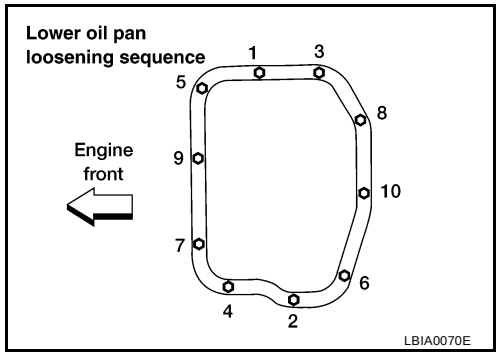
c. Disconnect the upper swaybar links. Refer to FSU-11, "Removal and Installation" .

d. Remove the front and rear engine mount through bolts while supporting the front suspension member with a suitable jack and tools. Refer to EM-63, "Removal and Installation" .

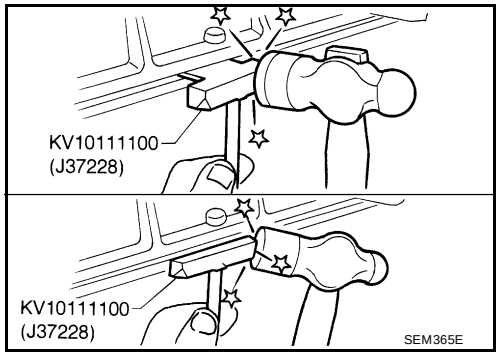
e. Disconnect the lower ball joints. Refer to FSU-14, "Removal and Installation" .

f. Remove the two steering gear mounting bolts (do not remove the mounting bracket from the steering gear housing). Refer to PS-13, "Removal and Installation" .

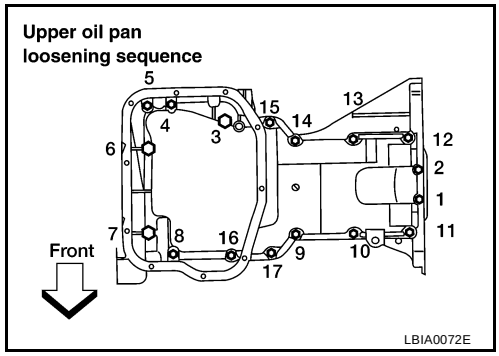
5. Remove the lower oil pan bolts. Loosen the bolts in the order shown, using power tool.



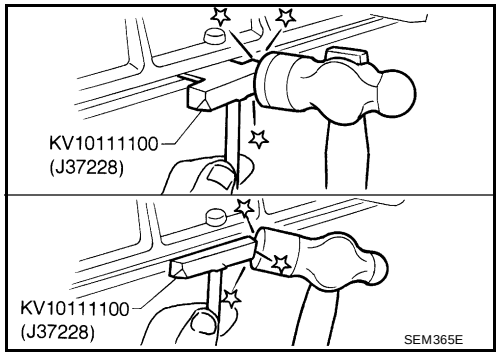
6. Insert the Tool between lower oil pan and the upper oil pan to separate them. Tap gently on the side to move the Tool around the pan; do not damage the mating surface.
7. Remove the lower oil pan.
8. Remove the oil pickup screen.
9. Remove rear plate cover, and four engine-to transaxle bolts, using power tool.



10. Loosen the upper oil pan bolts in the order shown to remove upper oil pan, using power tool.



11. Insert the Tool between the upper oil pan and the cylinder block to separate them. Tap gently on the side to move the Tool around the pan; do not damage the mating surface.



12. Remove the upper oil pan.

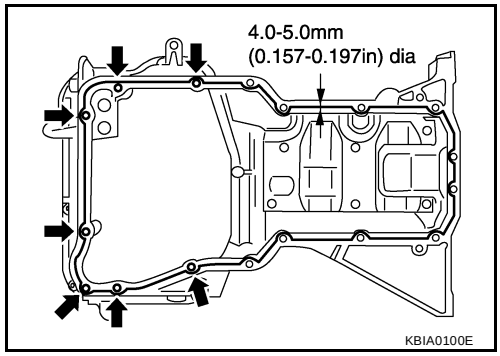
INSPECTION AFTER REMOVAL

- Clean the oil pickup screen to remove any foreign material.

INSTALLATION

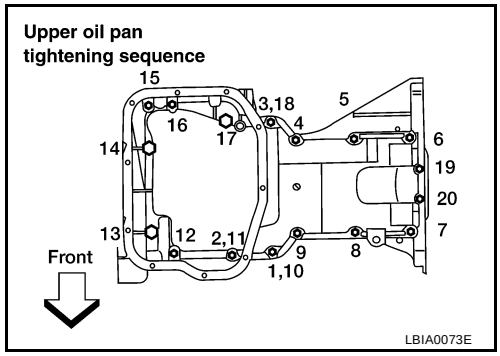
1. Installation is in the reverse order of removal. Paying attention to the following.

a. Apply Genuine RTV Silicone Sealant, or equivalent, to the upper oil pan. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" , and EM-5, "Precautions for Liquid Gasket" .
   - Install the two new O-rings in the upper oil pan.

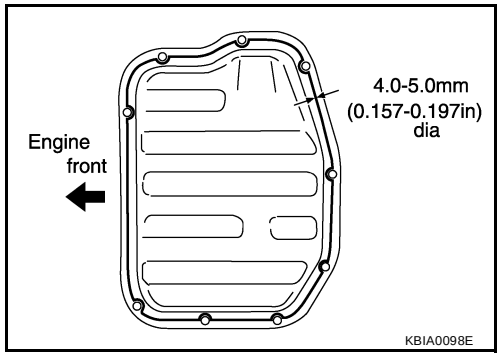


b. Tighten the upper oil pan bolts in the order as shown.
   - Bolt No.10,11,18 indicate a double tightening in the sequence of bolt No.s 1, 2, 3.

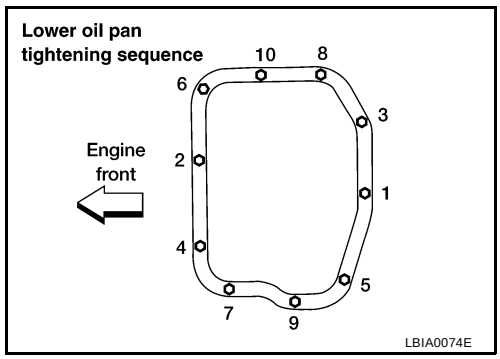
   NOTE:
   Refer below for specified bolt sizes:
   M6 × 20 mm (0.79 in): No.19, 20
   M8 × 25 mm (0.98 in): No.1, 3, 4, 9
   M8 x 45 mm (1.77 in): No.2, 5, 6, 7, 8, 17
   M8 x100 mm (3.97 in): No.12, 13, 14, 15, 16



c. Apply Genuine RTV Silicone Sealant, or equivalent to the lower oil pan. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" , and EM-5, "Precautions for Liquid Gasket"



d. Tighten the lower oil pan bolts in the numerical order shown.
   - Wait at least 30 minutes after the oil pans are installed before filling the engine with oil.



INSPECTION AFTER INSTALLATION

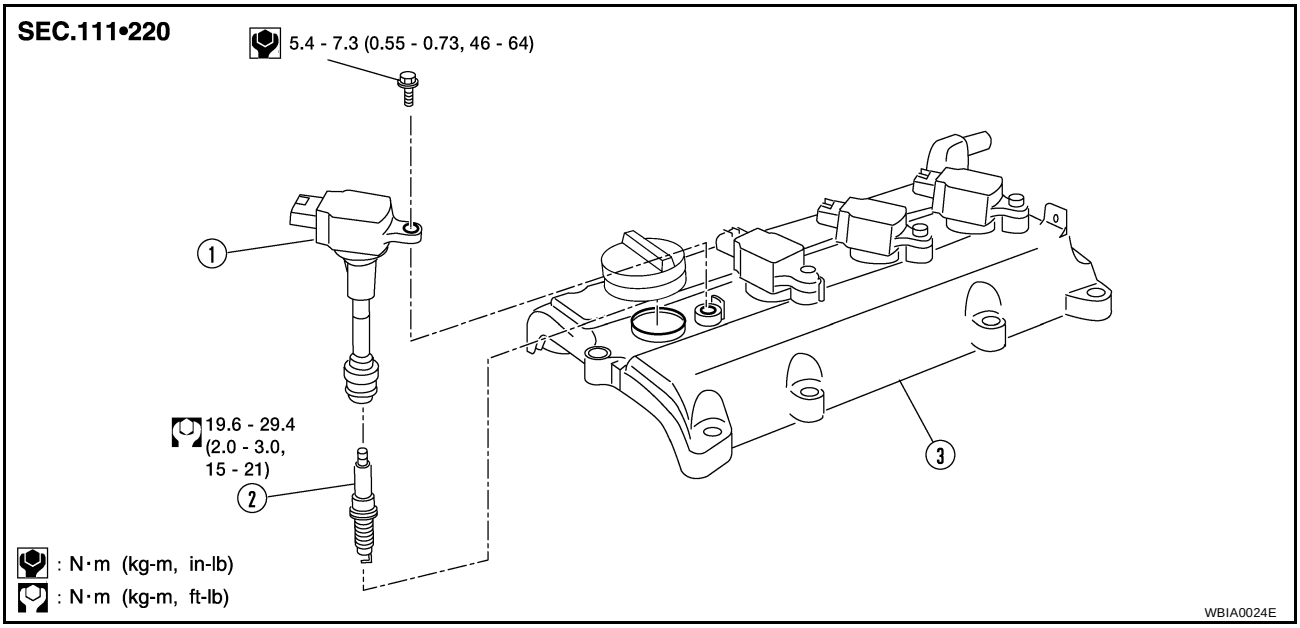
- Check for any engine oil leaks with the engine at operating temperature and running at idle.

IGNITION COIL

PFP:22448

Removal and Installation

EBS007P5



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

REMOVAL

1. Remove the engine cover.
2. Disconnect the harness connector from the ignition coil.
3. Remove the ignition coil.

CAUTION:
Do not drop or shock it.

INSTALLATION

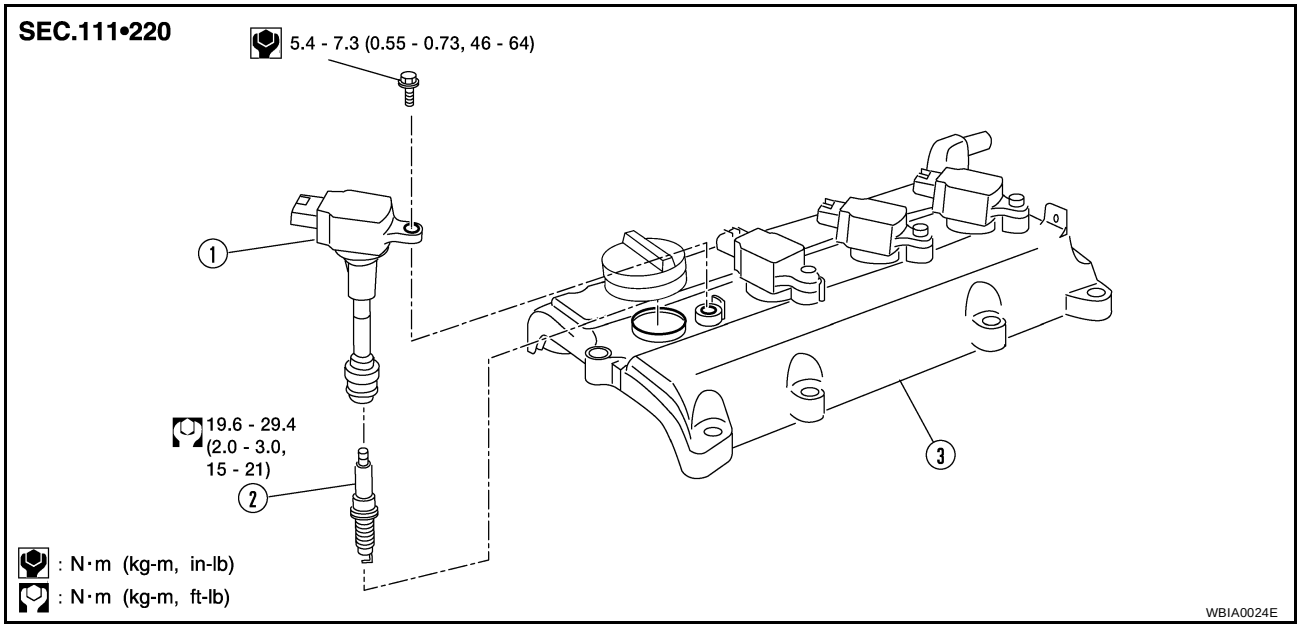
Installation is in the reverse order of removal.

SPARK PLUG

PFP:22401

Removal and Installation

EBS007P6

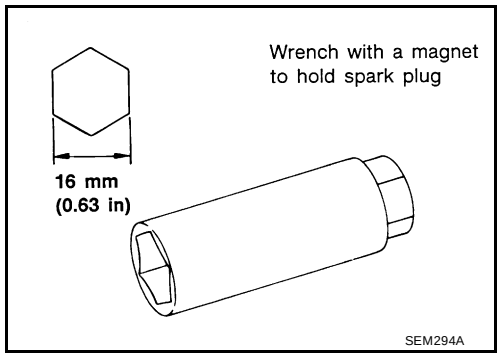


1. Ignition coil
2. Spark plug
3. Rocker cover

REMOVAL

1. Remove the ignition coil. Refer to EM-26, "Removal and Installation" .
2. Remove the spark plug with a suitable spark plug socket and wrench.

Temperature Range	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11



INSPECTION AFTER REMOVAL

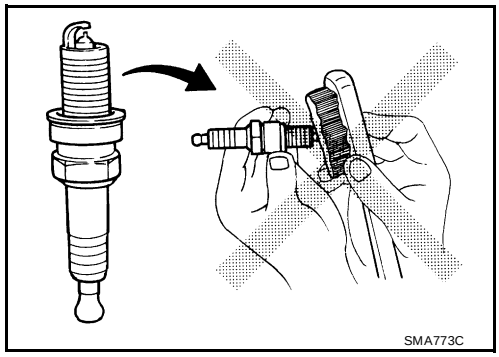
Use standard type spark plug for normal conditions.
The hot type spark plug is suitable when fouling occurs with the standard type spark plug under conditions such as:

- frequent engine starts.
- low ambient temperatures.

The cold type spark plug is suitable when spark plug knock occurs with the standard type spark plug under conditions such as:

- extended highway driving.
- frequent high engine revolution.

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

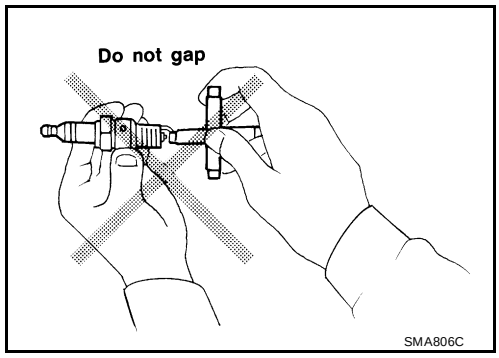


If a spark plug is covered with carbon, a spark plug cleaner may be used.

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

Checking and adjusting the spark plug gap is not required between replacement intervals.

Gap : 1.0 - 1.1 mm (0.039 - 0.043 in)



INSTALLATION

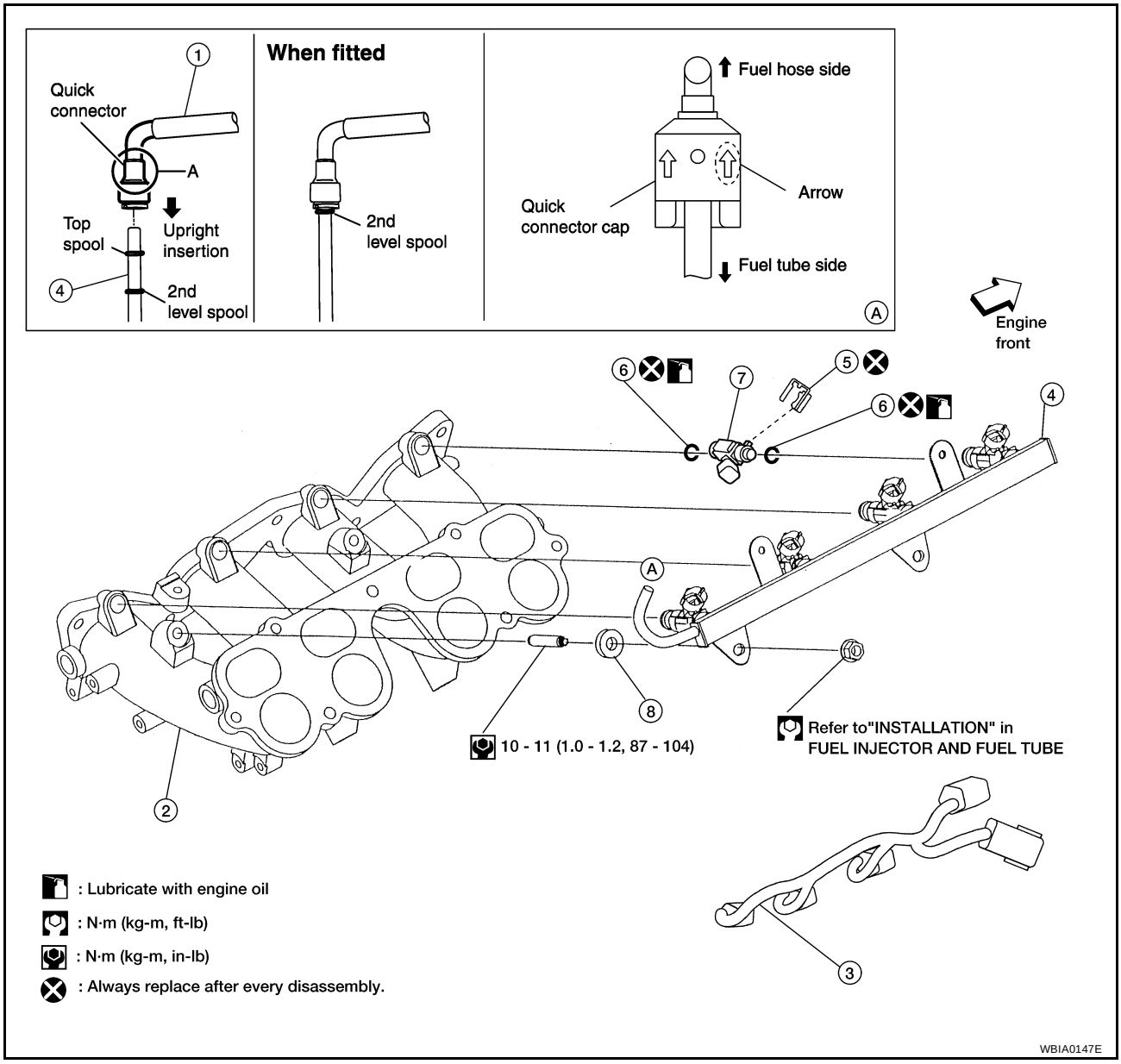
- Installation is in the reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Removal and Installation

EBS007P7



1. Fuel hose
2. Quick connector cap
3. Sub-harness
4. Fuel tube
5. Clip
6. O-ring
7. Fuel injector
8. Insulator

CAUTION:

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

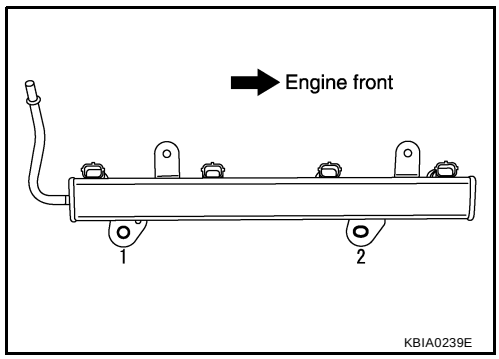
REMOVAL

1. Release the fuel pressure. Refer to EC-51, "FUEL PRESSURE RELEASE" .
2. Remove the intake air duct. Refer to EM-14, "Removal and Installation" .
3. Disconnect the fuel hose quick connector at the fuel tube side.
   - For how to disconnect and connect the quick connector, refer to EM-16, "INTAKE MANIFOLD" .

   CAUTION:
   - **Prepare a container and cloth for catching any spilled fuel.**
   - **This operation should be performed in a place that is free from any open flames.**

- **While hoses are disconnected seal their openings with vinyl bag or similar material to prevent foreign material from entering them.**

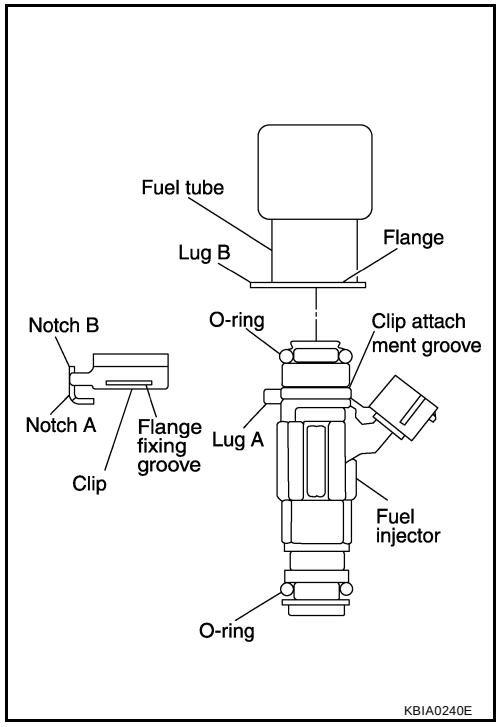
4. Remove the intake collector. Refer to EM-16, "INTAKE MANIFOLD" .
5. Disconnect sub-harness for injector at engine front side, and remove it from bracket.
6. Loosen the mounting bolts in the order as shown, then remove fuel tube and fuel injectors as an assembly.
7. Remove the fuel injectors from the fuel tube.
   - Release the clip and remove the fuel injector.
   - Pull fuel injector straight out of the fuel tube.
   - Be careful not to damage the nozzle.
   - Avoid any impact, such as dropping the fuel injector.
   - Do not disassemble or adjust the fuel injector.



INSTALLATION

1. Install new O-rings on the fuel injector.
   - Lubricate the O-rings lightly with new engine oil.
   - Be careful not to scratch it during installation. Also be careful not to 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 into the fuel tube with the following procedure:
   - Do not reuse the clip, replace it with a new one.
   - Insert the new clip into the clip mounting groove on fuel injector.
   - Insert the clip so that projection "A" of fuel injector matches notch "A" of the clip.
3. Insert the fuel injector into the fuel tube with the clip attached.
   - Insert it while matching it to the axial center.
   - Insert fuel injector so that projection "B" of fuel injector matches notch "B" of the clip.
   - Make sure that fuel tube flange is securely fixed in flange fixing groove on the clip.
   - Make sure that installation is complete by checking that fuel injector does not rotate or come off.
4. Install the fuel tube assembly.

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



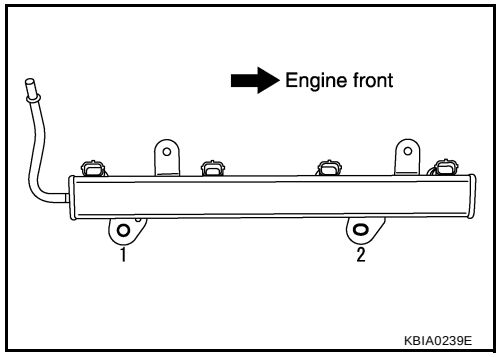
b. Tighten the mounting bolts in two steps in the numerical order shown.

1st step : 9.3 - 10.8 N·m (0.95 - 1.1 kg-m, 83 - 95 in-lb)

2nd step : 20.6 - 26.5 N·m (2.1 - 2.7 kg-m, 16 - 19 ft-lb)

CAUTION:

- **After properly connecting fuel tube assembly to injector and fuel hose, check connection for fuel leakage.**



5. Install the intake collector. Refer to EM-16, "INTAKE MANIFOLD" .
6. Connect the fuel hose quick connector. Refer to EM-16, "INTAKE MANIFOLD" .
7. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Check connections for fuel leakage:

1. Start the engine and run it for a few minutes with engine at idle.
2. Stop the engine and check for fuel leakage both visually and by odor of gasoline.

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

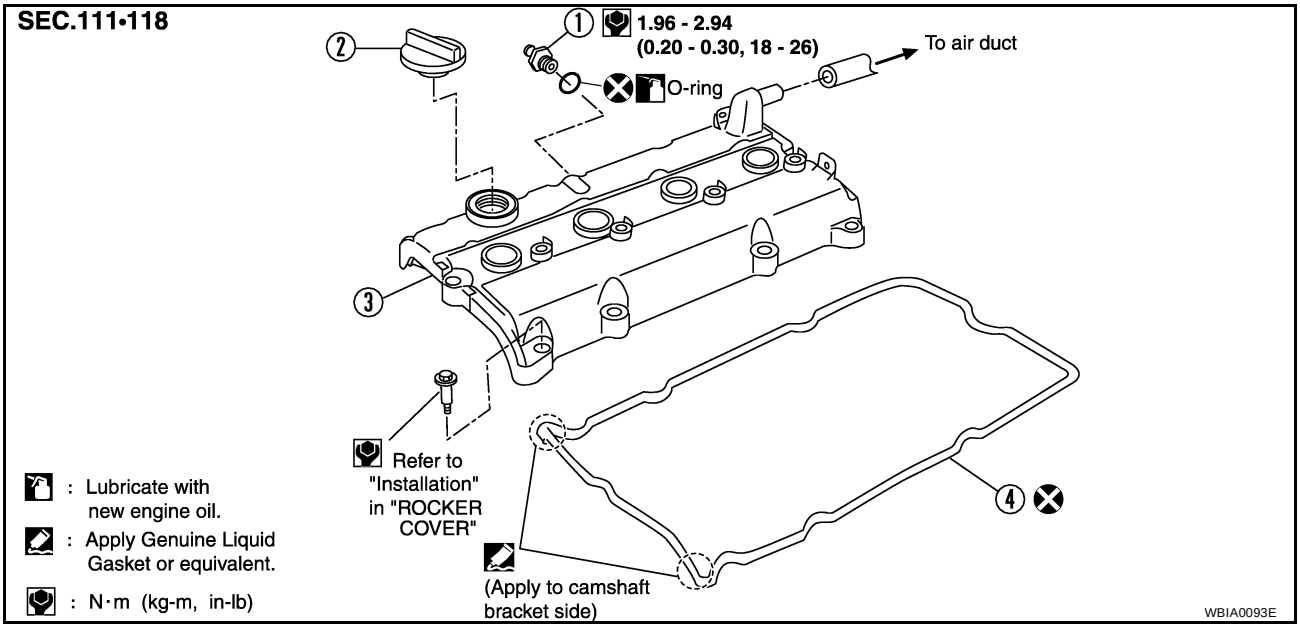
CAUTION:
Do not touch the engine immediately after stopping as engine is extremely hot.

ROCKER COVER

PFP:13264

Removal and Installation

EBS007P8

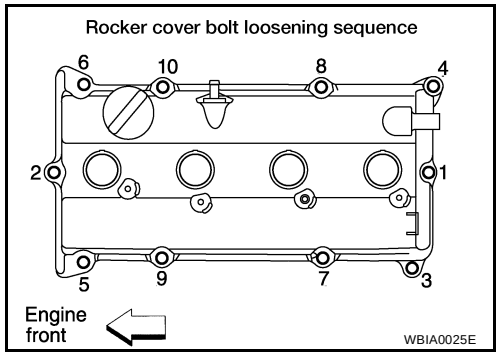


1 PCV valve 2 Oil filler cap 3 Rocker cover

4 Rocker cover gasket

REMOVAL

1. Remove the ignition coils. Refer to EM-26, "Removal and Installation" .
2. Disconnect the PCV hose and breather hose from the rocker cover.
3. Loosen the bolts in the numerical order as shown using power tool.
4. Remove the rocker cover. Remove the oil filler cap and PCV valve if necessary to transfer to the new rocker cover.



INSTALLATION

1. Apply RTV Silicone Sealant to the joint part of the cylinder head and camshaft bracket following the steps below:

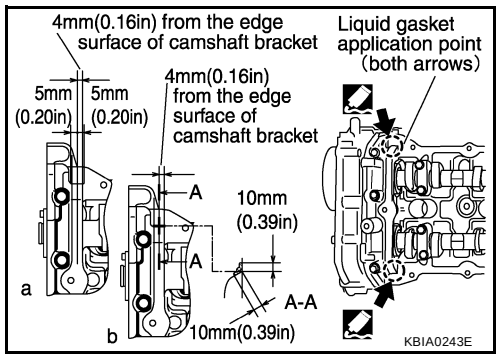
a. Refer to illustration “a” to apply sealant to joint part of No.1 camshaft bracket and cylinder head.

b. Refer to illustration “b” to apply sealant in a 90° degree angle to the illustration “a”.

- Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .

2. Install the rocker cover.

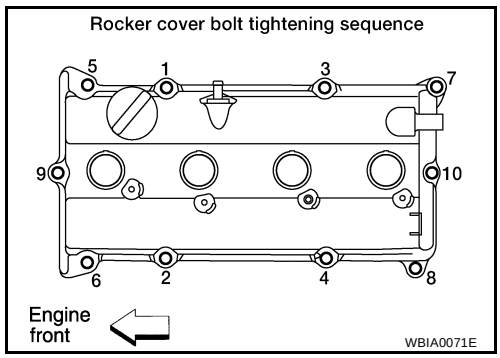
- The rocker cover gasket must be securely installed in the groove in the rocker cover.



3. Tighten the rocker cover bolts in two steps, in the numerical order as shown.

   1st step : 1.0 - 2.9 N·m (0.1 - 0.3 kg-m, 9 - 26 in-lb)

   2nd step : 7.4 - 9.3 N·m (0.75 - 0.95 kg-m, 65 - 82 in-lb)



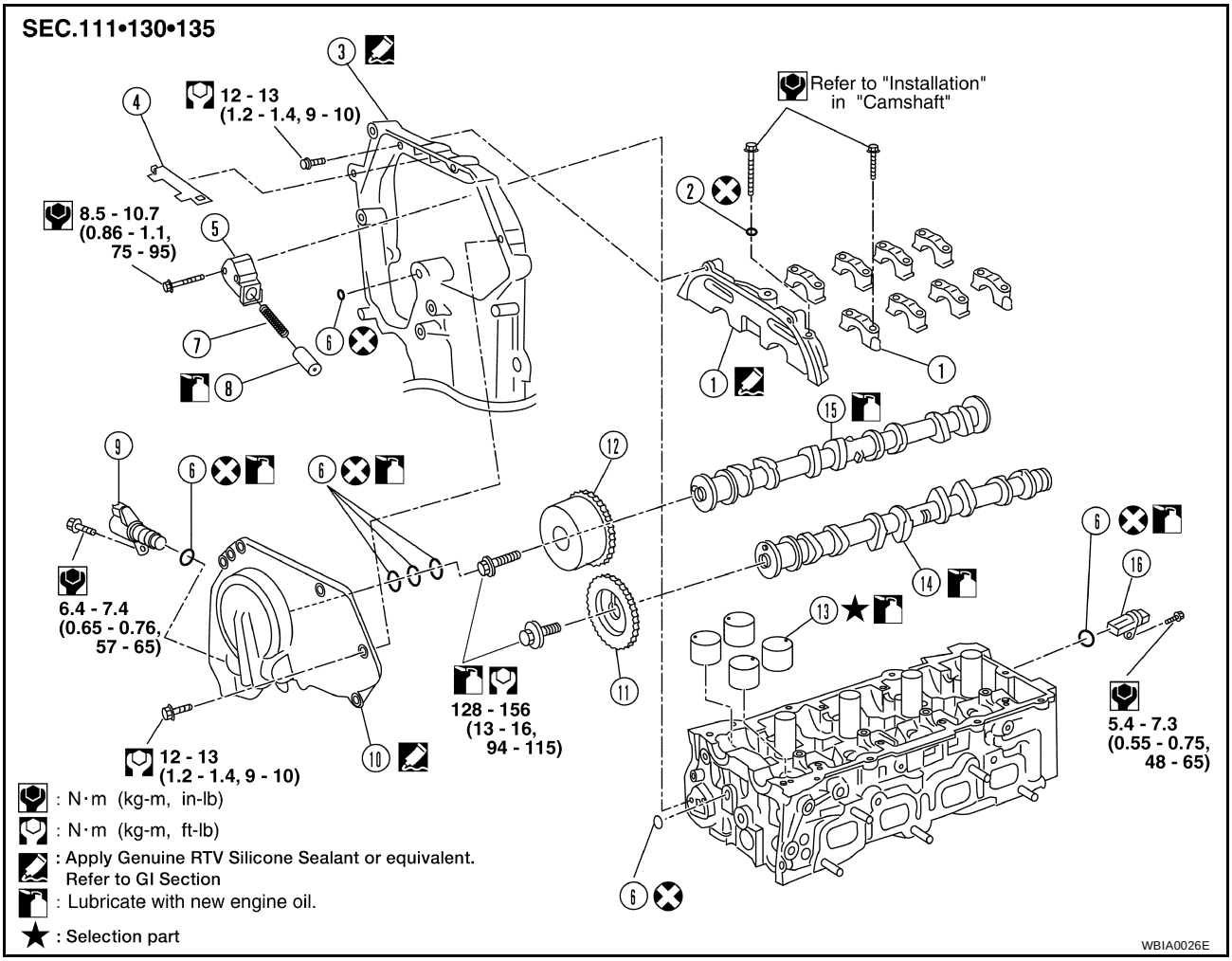
4. Connect the PCV hose and breather hose to the rocker cover. If necessary, install the oil filler cap and PCV valve and lubricate the PCV valve O-ring with new engine oil.
5. Install the ignition coils. Refer to EM-26, "Removal and Installation" .

CAMSHAFT

PFP:13001

Removal and Installation

EBS007P9

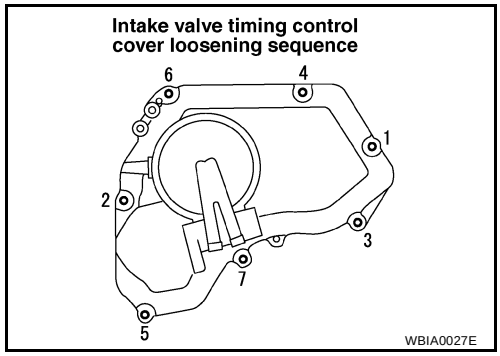


1. Camshaft brackets (1 - 5)
2. Washer
3. Front cover (partial view)
4. Chain guide
5. Chain tensioner
6. O-ring(s)
7. Chain tensioner spring
8. Chain tensioner plunger
9. IVTC solenoid valve
10. IVTC cover
11. Camshaft sprocket (EXH)
12. Camshaft sprocket (INT)
13. Valve lifter
14. Camshaft (EXH)
15. Camshaft (INT)
16. Camshaft position sensor (PHASE)

REMOVAL

1. Remove the rocker cover. Refer to EM-32, "Removal and Installation" .
2. Remove the front right side tire and wheel using power tool.
3. Remove the RH splash shield using power tool.
4. Remove the auxiliary drive belt.
5. Remove the coolant overflow reservoir tank.

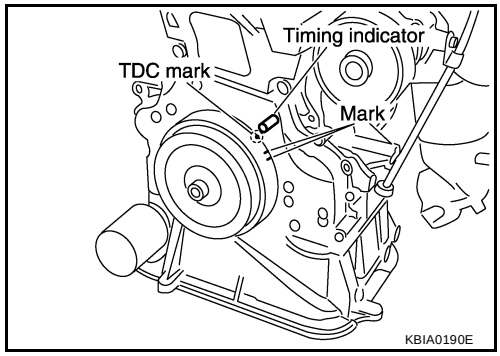
6. Remove the IVTC (intake valve timing control) cover by cutting the sealant using the Tool.
   - Loosen the bolts in the order shown.



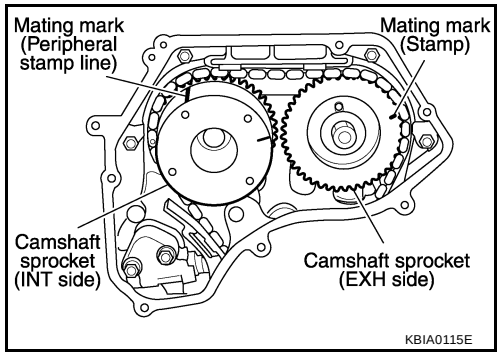
7. Set the No.1 cylinder at TDC on its compression stroke with the following procedure:

a. Open the splash cover on RH under cover.

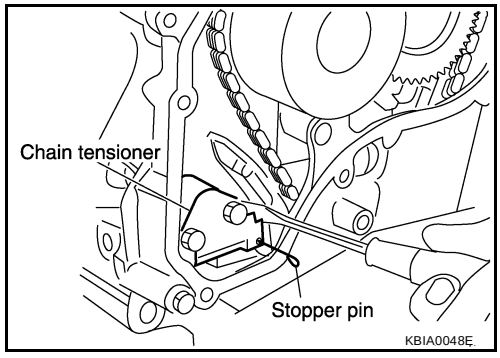
b. Rotate crankshaft pulley clockwise, and align mating marks for TDC with timing indicator on front cover, as shown.



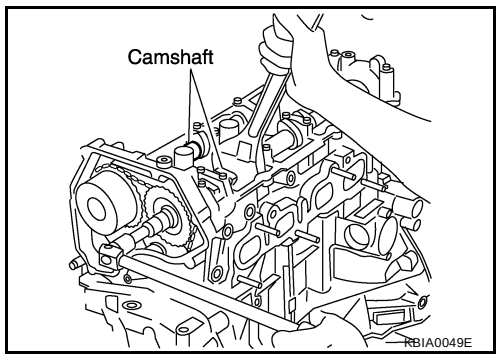
c. At the same time, make sure that the mating marks on camshaft sprockets are lined up with the yellow links in the timing chain, as shown.
   - If not, rotate crankshaft pulley one more turn to line up the mating marks to the yellow links, as shown.



8. Pull the timing chain guide out between the camshaft sprockets through front cover.



9. Remove camshaft sprockets with the following procedure.



CAUTION:

- **Do not rotate the crankshaft or camshaft while the timing chain is removed. It causes interference between valve and piston.**

NOTE:

- Chain tension holding work is not necessary. Crank sprocket and timing chain do not disconnect structurally while front cover is attached.

a. Line up the mating marks on camshaft sprockets with the yellow links in the timing chain, and paint an indelible mating mark on the sprocket and timing chain link plate.

b. Push in the tensioner plunger and hold. Insert a stopper pin into the hole on tensioner body to hold the chain tensioner. Remove the timing chain tensioner.

- Use a wire with 0.5 mm (0.02 in) diameter for a stopper pin.

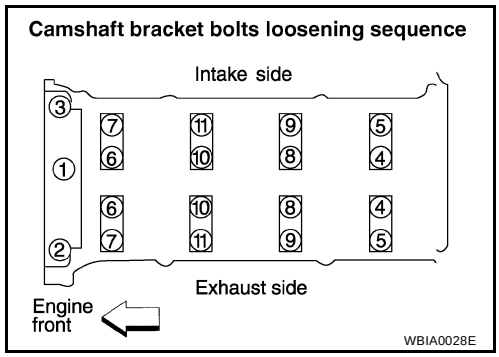
c. Secure the hexagonal part of camshaft with a suitable tool. Loosen the camshaft sprocket mounting bolts and remove the camshaft sprockets.

10. Loosen the camshaft bracket bolts in the order shown, and remove the camshaft brackets and camshafts.

- Remove No.1 camshaft bracket by slightly tapping it with a rubber mallet.

11. Remove the valve lifters.

- Check mounting positions, and set them aside in the order removed.

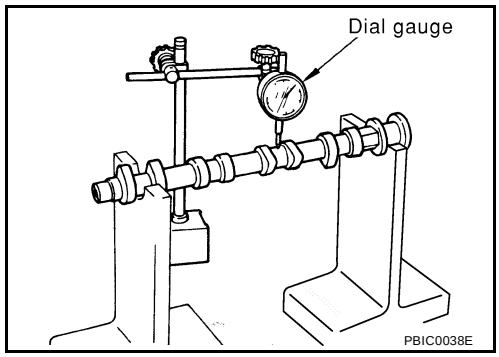


INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put the camshaft on a V-block supporting the No.2 and No.5 journals.
2. Set the dial gauge vertically on the No.3 journal.
3. Turn camshaft in one direction by hand, and measure the camshaft runout on the dial gauge total indicator reading.

Standard : Less than 0.04 mm (0.0016 in)



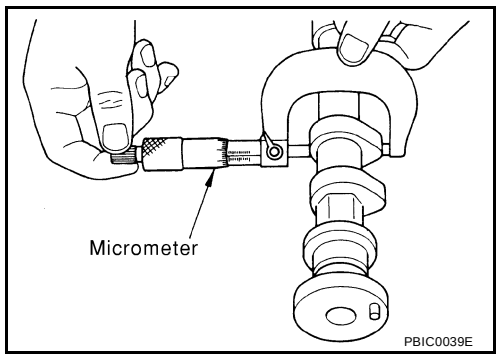
Camshaft Cam Height

1. Measure the camshaft cam height.

Standard intake cam height : 45.665 - 45.855 mm (1.7978 - 1.8053 in)

Standard exhaust cam height : 43.975 - 44.165 mm (1.7313 - 1.7388 in)

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

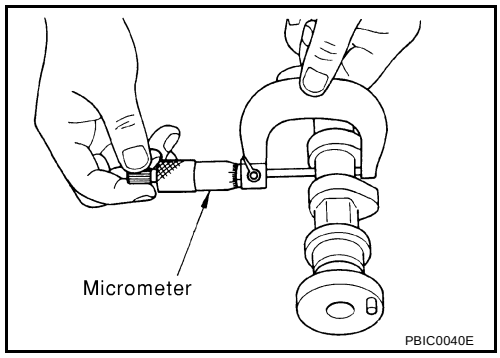


Camshaft Journal Clearance

Outer Diameter of Camshaft Journal

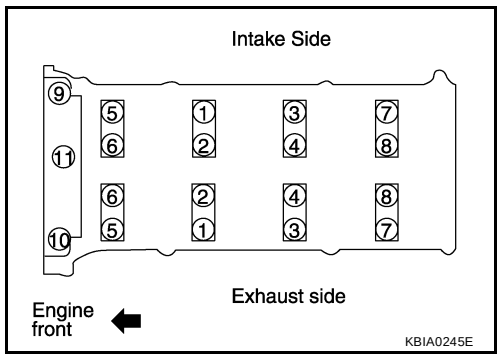
- Measure the outer diameter of the camshaft journal.

Standard No.1 outer diameter	**: 27.935 - 27.955 mm (1.0998 - 1.1006 in)**
Standard No.2, 3, 4, 5, outer diameter	**: 23.435 - 23.455 mm (0.9226 - 0.9234 in)**



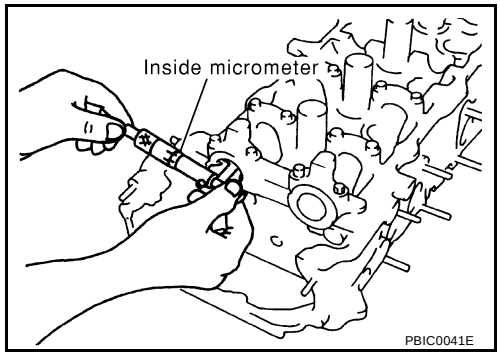
Inner Diameter of Camshaft Bracket

- Tighten the camshaft bracket bolts to the specified torque following the tightening pattern as shown. Refer to Step 4 of EM-39, "INSTALLATION" , of "CAMSHAFT" for the specified torque sequence.



- Using inside micrometer, measure inner diameter of camshaft bracket.

Standard No.1	**: 28.000 - 28.021 mm (1.1024 - 1.1032 in)**
Standard No.2, 3, 4, 5	**: 23.500 - 23.521 mm (0.9252 - 0.9260 in)**



Calculation of Camshaft Journal Clearance

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

Standard : 0.045 - 0.086 mm (0.0018 - 0.0034 in)

- When out of the specified range above, replace either or both the camshaft and the cylinder head assembly.

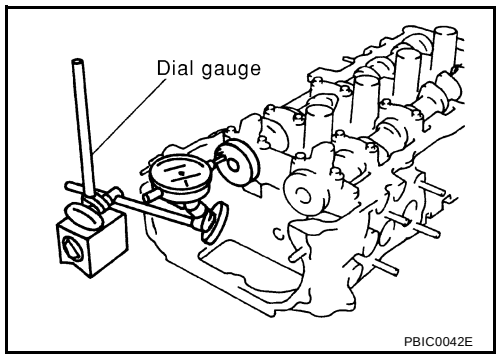
NOTE:
Inner diameter of the camshaft bracket is manufactured together with the cylinder head. If the camshaft bracket is out of specification, replace the whole cylinder head assembly.

Camshaft End Play

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

   Standard end play : 0.115 - 0.188 mm (0.0045 - 0.0074 in)

2. If out of the specified range, replace with new camshaft and measure again.
3. If out of the specified range again, replace with new cylinder head assembly.

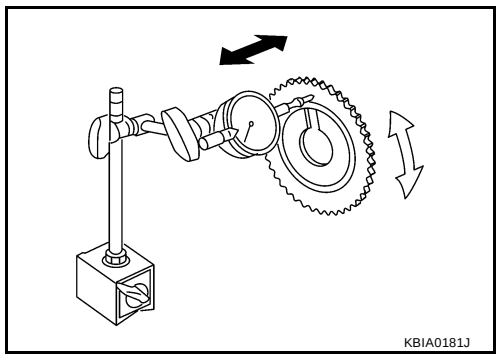


Camshaft Sprocket Runout

1. Install the camshaft in the cylinder head.
2. Install the camshaft sprocket on the camshaft.
3. Measure camshaft sprocket runout while turning the camshaft by hand.

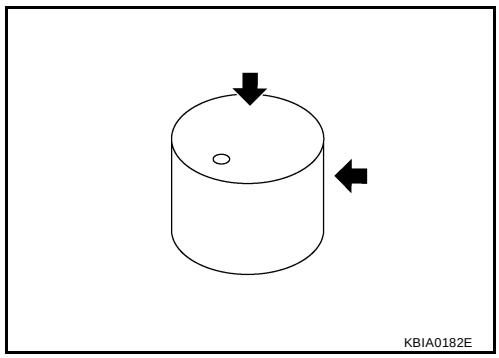
   Runout : Less than 0.15 mm (0.0059 in)

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



Valve Lifter

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



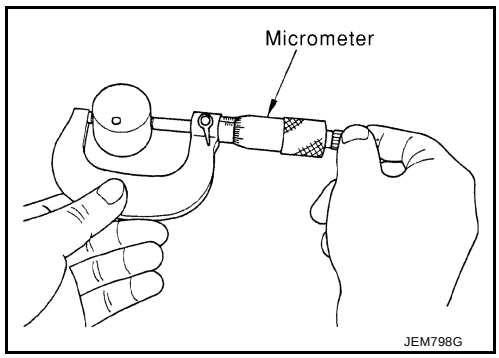
Valve Lifter Clearance

Outer Diameter of Valve Lifter

- Measure the outer diameter of the valve lifter.

  Valve lifter outer diameter : 33.965 - 33.980 mm (1.3372 - 1.3378 in)

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

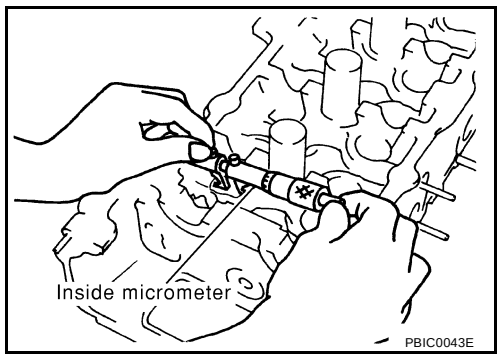


Valve Lifter Hole Diameter

- Using inside micrometer, measure diameter of valve lifter hole of cylinder head.

Standard : 34.000 - 34.021 mm (1.3386 - 1.3394 in)

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



Calculation of Valve Lifter Clearance

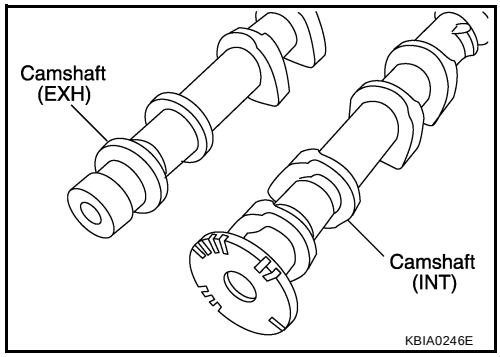
- (Valve lifter clearance) = (hole diameter for valve lifter) – (outer diameter of valve lifter)

Standard : 0.020 - 0.056 mm (0.0008 - 0.0022 in)

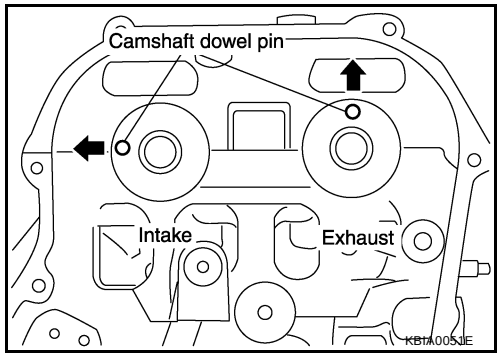
- If out of specified range, replace either or both valve lifter and cylinder head assembly.

INSTALLATION

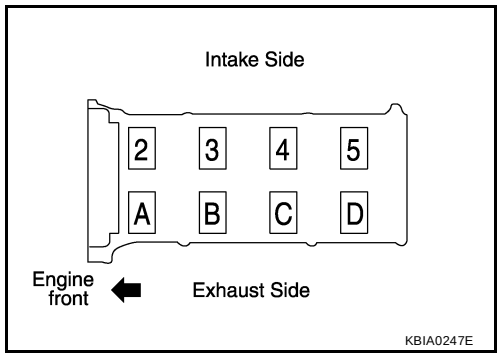
1. Install the valve lifter.
   - Install them in the same position from which they were removed.
2. Install the camshafts.
   - The distinction between the intake and exhaust camshafts is in a difference of shapes of the back end:
     Intake: Signal plate for the camshaft position sensor (PHASE)
     Exhaust: Cone end shape



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



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



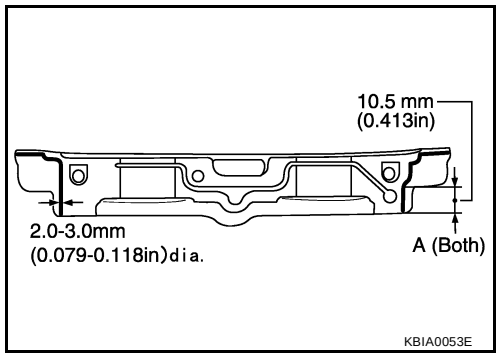
- Install No. 1 camshaft bracket as follows.

– Apply sealant to No.1 camshaft bracket as shown.

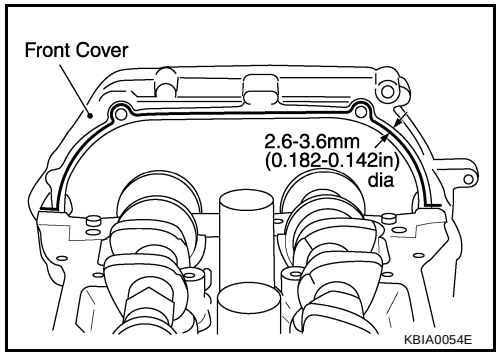
- Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .

CAUTION:

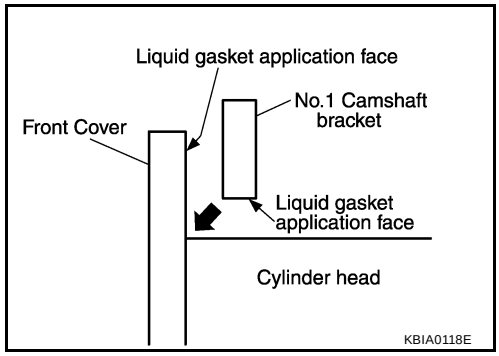
- **After installation, be sure to wipe off any excessive sealant leaking from part “A” (both on right and left sides).**



- Apply sealant to camshaft bracket contact surface on the front cover backside.
- Apply sealant to the outside of bolt hole on front cover.



- Position the No.1 camshaft bracket near the mounting position, and install it without disturbing the sealant applied to the surfaces.



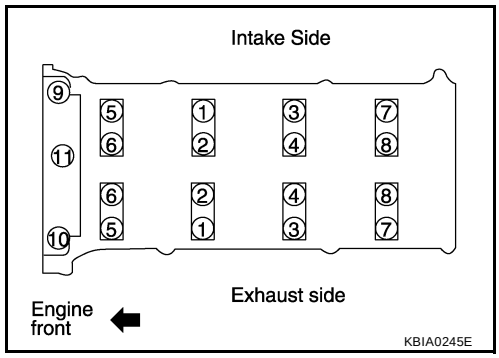
4. Tighten fixing bolts of camshaft brackets as follows.

a. Tighten in the order from 9 to 11 with tightening torque 2.0 N·m (0.2 kg-m, 17 in-lb).

b. Tighten in the order from 1 to 8 with tightening torque 2.0 N·m (0.2 kg-m, 17 in-lb).

c. Tighten in the order from 1 to 11 with tightening torque 5.9 N·m (0.6 kg-m, 52 in-lb).

d. Tighten in the order from 1 to 11 with tightening torque 9.0 to 11.8 N·m (0.92 to 1.2 kg-m, 80 to 104 in-lb).



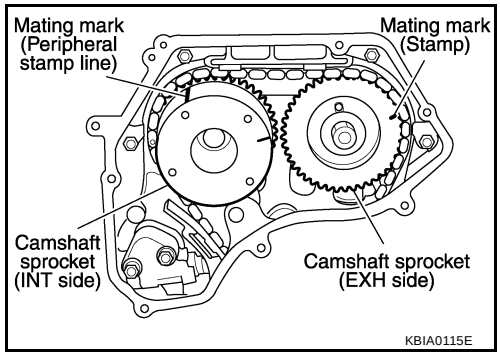
CAUTION:

After tightening fixing bolts of camshaft brackets, be sure to wipe off excessive sealant from the parts listed below:

- Mating surface of rocker cover.
- Mating surface of front cover, when installed without the front cover.

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

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



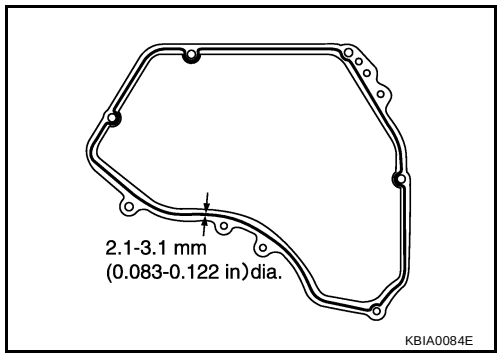
6. Install chain tensioner.

   CAUTION:
   - **After installation, pull the stopper pin off completely, and make sure that the tensioner is fully released.**
7. Install chain guide.
8. Install IVTC (intake valve timing control) cover with the following procedure.

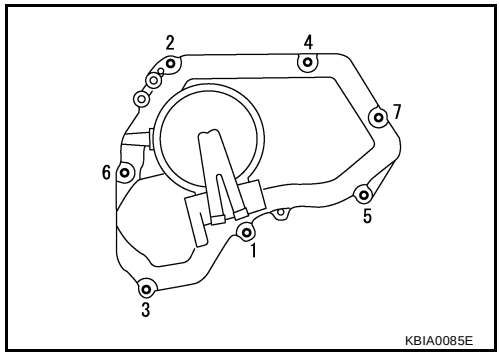
a. Install IVTC solenoid valve to intake valve timing control cover.

b. Install O-ring to front cover side.

c. Apply Genuine RTV Silicone Sealant to the positions shown in the figure. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



d. Install IVTC cover.
   - Tighten the bolts in the numerical order as shown.
9. Check and adjust valve clearances. Refer to EM-41, "Valve Clearance" .
10. For the following operations, perform steps in the reverse order of removal.



Valve Clearance

EBS007PA

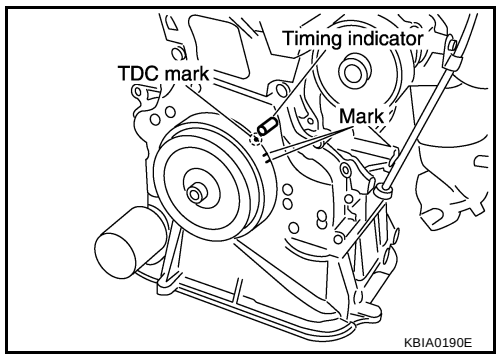
INSPECTION

NOTE:

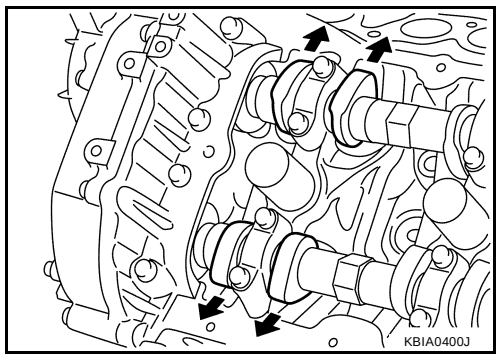
Perform this inspection as follows after removal, installation, or replacement of the camshaft or any valve-related parts, or if there are any unusual engine conditions due to changes in valve clearance over time (starting, idling, and/or noise).

1. Warm up the engine, then stop it.
2. Remove front RH engine under cover using power tool.
3. Remove the rocker cover using power tool.
   Refer to EM-32, "Removal and Installation" .

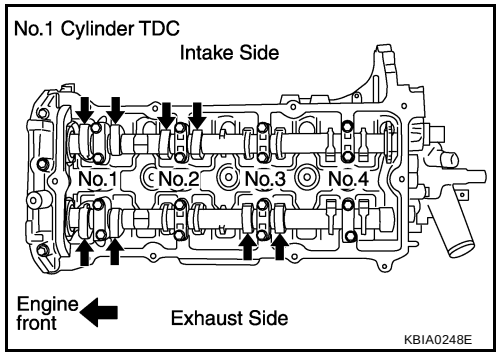
4. Turn crankshaft pulley in normal direction (clockwise when viewed from front) to align TDC identification mark (without paint mark) with timing indicator.



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



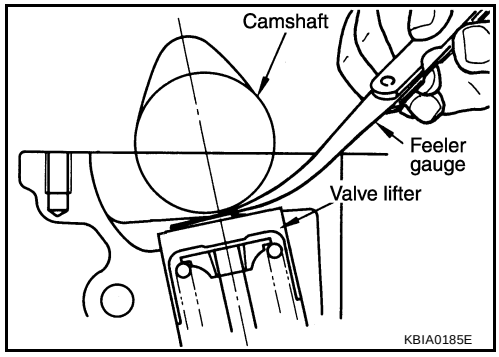
6. By referring to the figure, measure valve clearances at locations marked X as shown in the table below (locations indicated with black arrow in figure) with a feeler gauge.



   - No.1 cylinder compression TDC.

Cylinder	No.1		No.2		No.3		No.4	
Valve	INT	EXH	INT	EXH	INT	EXH	INT	EXH
Measurable	×	×	×			x		

   - Use a feeler gauge, measure clearance between valve and camshaft.



Valve clearance standard:

Hot	**Intake**	**: 0.32 - 0.40 mm (0.013 - 0.016 in)**
	Exhaust	**: 0.33 - 0.41 mm (0.013 - 0.016 in)**
Cold*	**Intake**	**: 0.24 - 0.32 mm (0.009 - 0.013 in)**
	Exhaust	**: 0.26 - 0.34 mm (0.010 - 0.013 in)**

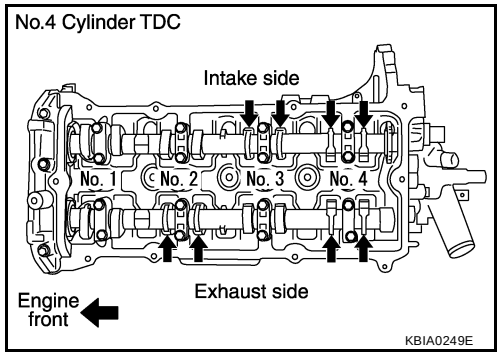
*Reference data at approximately 20°C (68°F)

CAUTION:

If inspection was carried out with cold engine, check that values with fully warmed up engine are still within specifications.

7. Turn crankshaft one complete revolution (360°) and align mark on crankshaft pulley with pointer.

8. By referring to the figure, measure valve clearances at locations marked X as shown in the table below (locations indicated with black arrow in figure).
   - No.4 cylinder compression TDC.



Cylinder	No.1		No.2		No.3		No.4	
Valve	INT	EXH	INT	EXH	INT	EXH	INT	EXH
Measurable				x	×		x	×

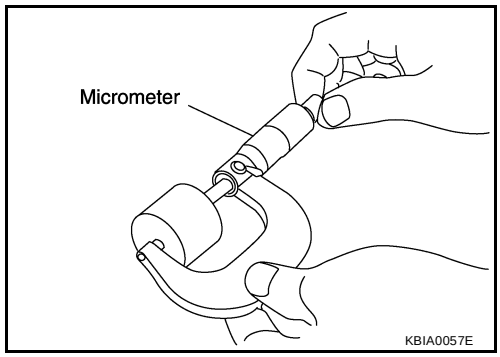
9. If out of specifications, adjust as follows.

ADJUSTMENT

NOTE:

- Perform adjustment depending on selected head thickness of valve lifter.
- The specified valve lifter thickness is the dimension at normal temperatures. Ignore dimensional differences caused by temperature. Use the specifications for hot engine condition to adjust.

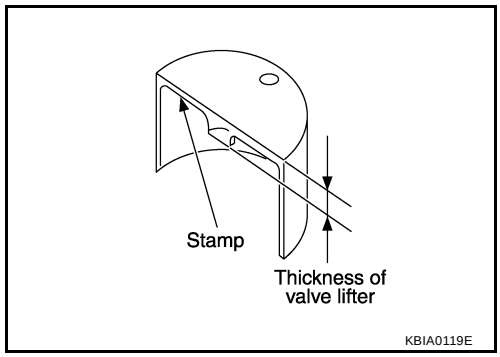
1. Remove camshaft. Refer to EM-34, "Removal and Installation" .
2. Remove the valve lifters at the locations that are outside the standard.
3. Measure the center thickness of the removed valve lifters with a micrometer.



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

     Intake : 0.36 mm (0.0142 in)
     Exhaust : 0.37 mm (0.0146 in)

   - Thickness of a new valve lifter can be identified by stamp marks on the reverse side (inside the cylinder).
     Stamp mark 696 indicates a thickness of 6.96 mm (0.2740 in)
     Available thickness of valve lifter: 26 sizes with a range of 6.96 to 7.46 mm (0.2740 to 0.2937 in), in steps of 0.02 mm (0.0008 in), when assembled at the factory.



5. Install the selected valve lifter.
6. Install camshaft.
7. Manually turn crankshaft pulley a few turns.
8. Check that valve clearances for cold engine are within specifications, by referring to the specified values.
9. After completing the repair, check valve clearances again with the specifications for warmed engine. Use a feeler gauge to measure the clearance between the valve and camshaft. Make sure the values are within specifications.

Valve Clearance

Unit: mm (in)

Valve	Cold* (reference data)	Hot
Intake	0.24 - 0.32 (0.009 - 0.013)	0.32 - 0.40 (0.013 - 0.016)
Exhaust	0.26 - 0.34 (0.010 - 0.013)	0.33 - 0.41 (0.013 - 0.016)

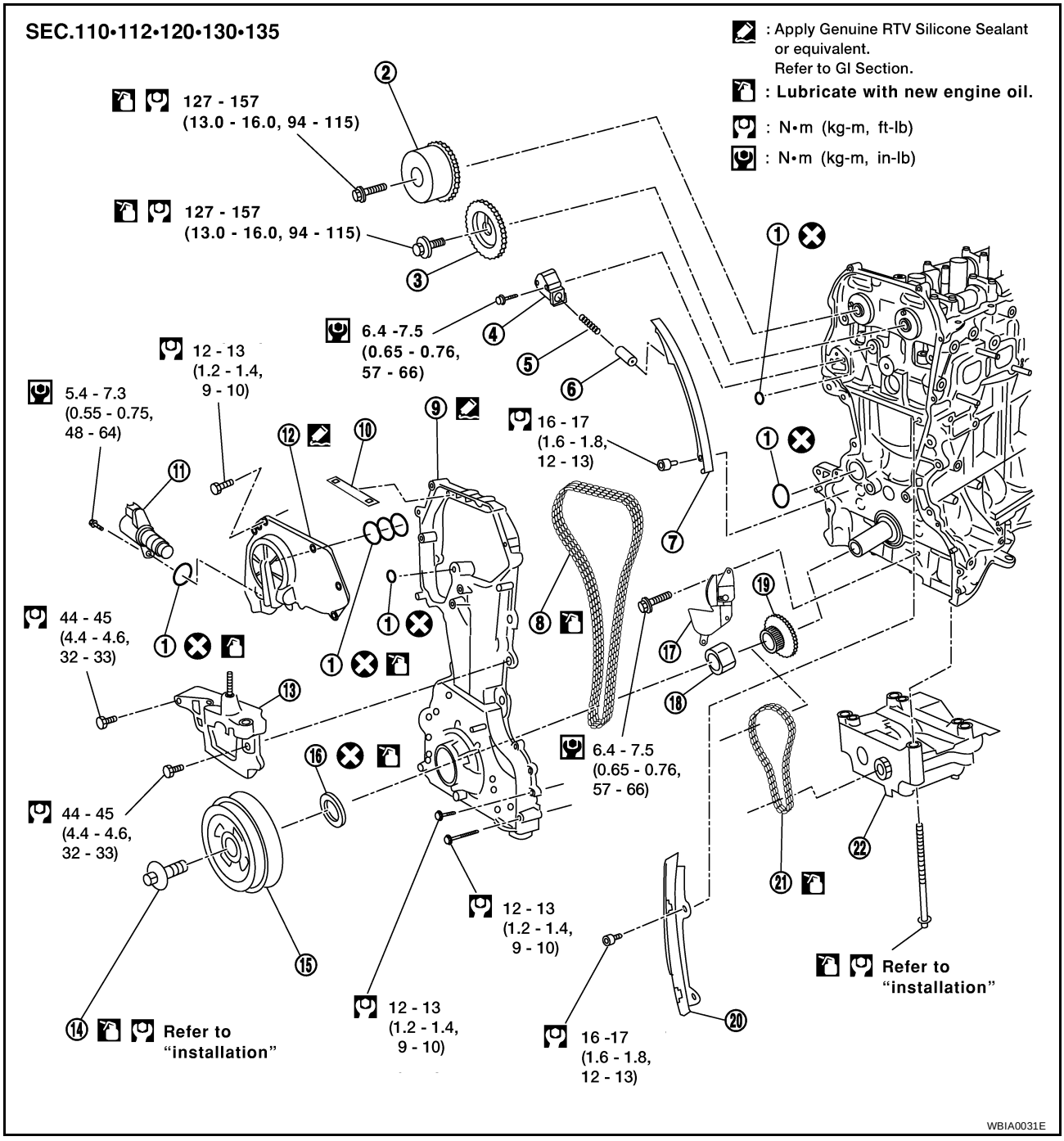
*: Reference data at approximately 20°C (68°F)

TIMING CHAIN

PFP:13028

Removal and Installation

EBS007PB



1. Oil rings	2. Camshaft sprocket (INT)	3. Camshaft sprocket (EXH)
4. Chain tensioner	5. Spring	6. Chain tensioner plunger
7. Timing chain slack guide	8. Timing chain	9. Front cover
10. Chain guide	11. IVTC solenoid valve	12. IVTC cover
13. Engine mounting bracket	14. Crankshaft pulley bolt	15. Crankshaft pulley
16. Front oil seal	17. Balancer unit timing chain tensioner	18. Oil pump drive spacer
19. Crankshaft sprocket	20. Timing chain tension guide	21. Balancer unit timing chain
22. Balancer unit		

CAUTION:

Apply new engine oil to parts marked in illustration before installation.

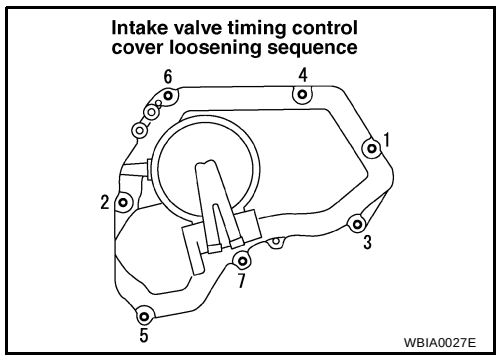
REMOVAL

1. Support the engine and transaxle assembly with suitable tools.
2. Remove the upper and lower oil pan, and oil strainer. Refer to EM-23, "Removal and Installation" .
3. Remove the IVTC (intake valve timing control) cover.

a. Loosen bolts in the numerical order as shown.

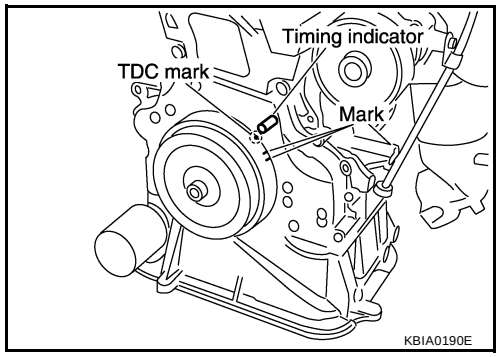
b. Remove the cover with suitable tool to cut the sealant.

4. Pull chain guide between camshaft sprockets out through front cover.



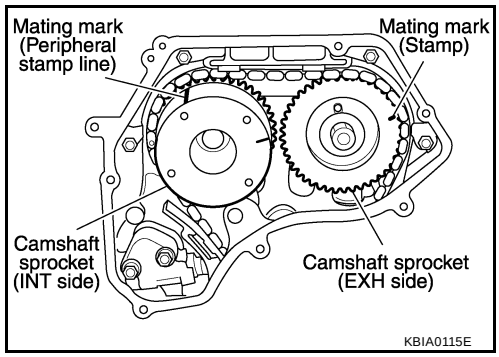
5. Set the No.1 cylinder at TDC on the compression stroke with the following procedure:

a. Rotate the crankshaft pulley clockwise and align the mating marks to the timing indicator on the front cover.



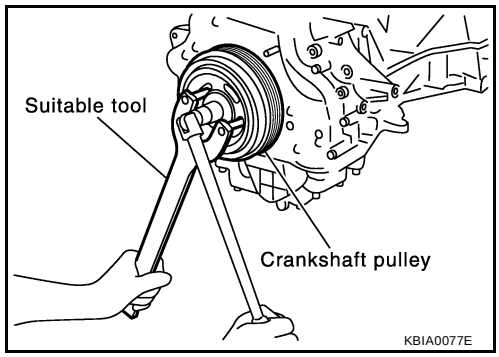
b. At the same time, make sure that the mating marks on the camshaft sprockets are lined up as shown.

- If not lined up, rotate the crankshaft pulley one more turn to line up the mating marks to the positions as shown.

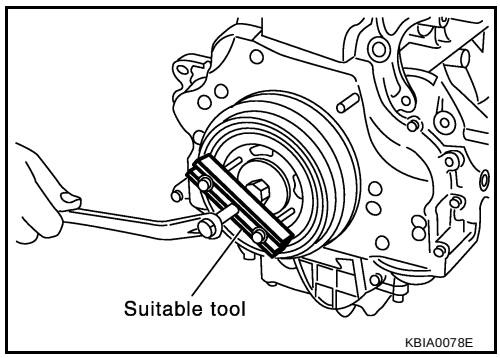


6. Remove crankshaft pulley with the following procedure:

a. Hold the crankshaft pulley with a suitable tool, then loosen the crankshaft pulley mounting bolt, and pull the pulley out about 10 mm (0.39 in).



b. Attach a pulley puller in the M 6 (0.24 in diameter) thread hole on crankshaft pulley, and remove crankshaft pulley.



7. Remove the front cover with the following procedure:

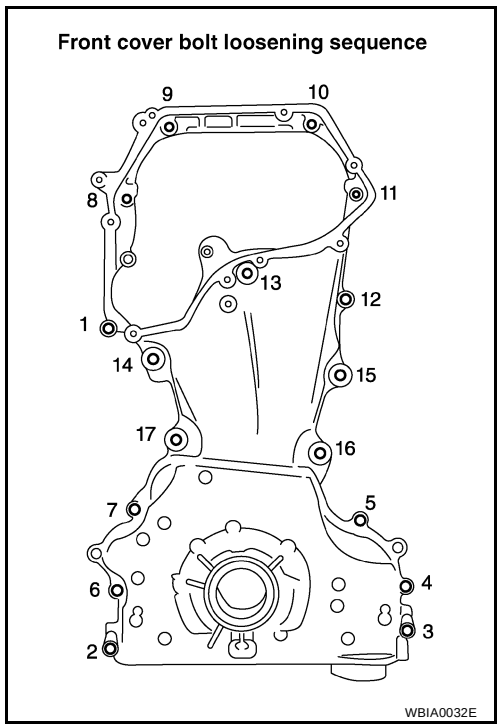
a. Loosen the mounting bolts in the reverse order shown in the figure, and remove them.

b. Remove the front cover.

CAUTION:

- **Be careful not to damage the mounting surface.**

8. If the front oil seal needs to be replaced, lift it out with a screwdriver to remove it.

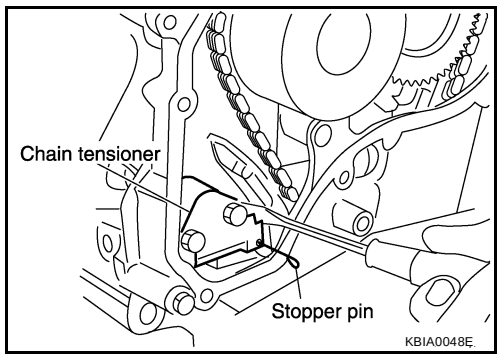


9. Remove timing chain with the following procedure:

a. Push in the tensioner plunger. Insert a stopper pin into the hole on the tensioner body to hold the chain tensioner.

- Use a wire of 0.5 mm (0.02 in) diameter as a stopper pin.

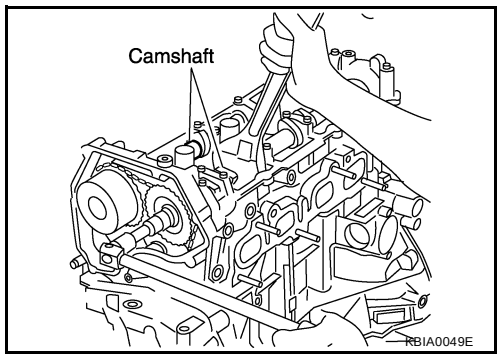
b. Remove the chain tensioner.



c. Secure hexagonal part of the camshaft with a wrench and loosen the camshaft sprocket mounting bolt and remove the camshaft sprocket for both camshafts.

CAUTION:

- **Do not rotate the crankshaft or camshafts while the timing chain is removed. It can cause damage to the valve and piston.**



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

11. Remove the timing chain tensioner for the balancer unit with the following procedure:

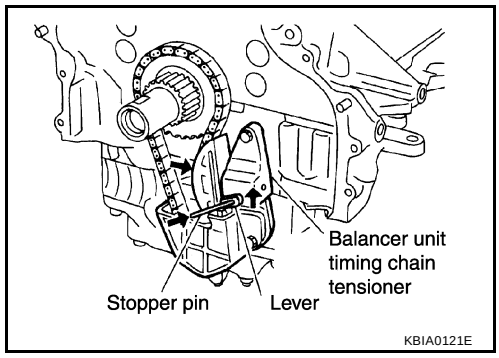
a. Lift the tensioner lever up, and release the ratchet claw for installation.

b. Push tensioner sleeve in, and hold it.

c. Matching the hole on lever with the one on body, insert a stopper pin to secure tensioner sleeve.

d. Remove the timing chain tensioner for the balancer unit.

12. Remove timing chain for balancer unit and crankshaft sprocket.

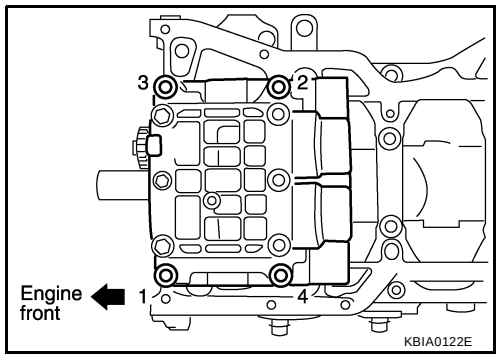


13. Loosen mounting bolts in reverse order shown in the figure, and remove balancer unit.

- Use Torx socket (size E14)

CAUTION:

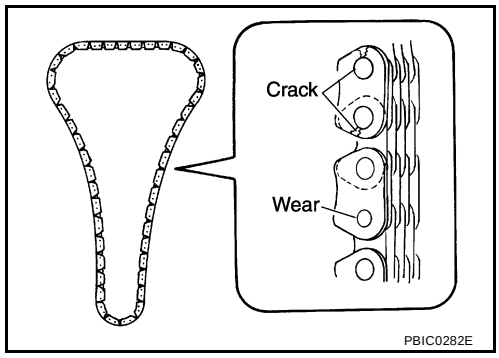
- **Do not disassemble balancer unit.**



INSPECTION AFTER REMOVAL

Timing Chain

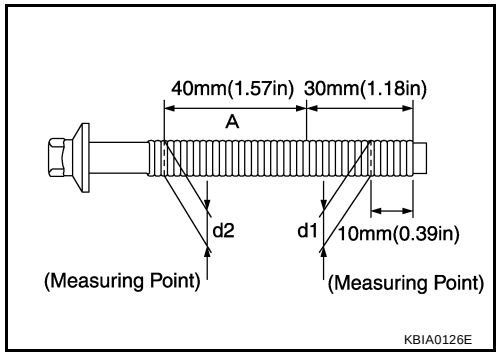
Check the timing chain for cracks or serious wear. If a defect is detected, replace it.



Balancer Unit Mounting Bolt Outer Diameter

- Measure outer diameters (d1, d2) at the two positions shown in the figure.
- Measure d2 within the range A.
- If the value difference (d1 - d2) exceeds the limit (a dimension difference is large), replace it with a new one.

Limit (d1 – d2) : 0.15 mm (0. 0059 in) or more

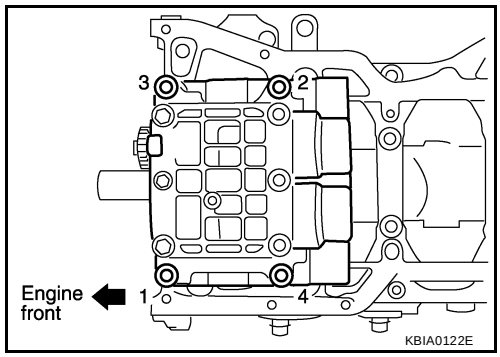


INSTALLATION

NOTE:

- There may be two color variations of the link marks (link colors) on the timing chain.
- There are 26 links between the gold/yellow mating marks on the timing chain; and 64 links between the camshaft sprocket gold/yellow link and the crankshaft sprocket orange/blue link, on the timing chain side without the tensioner.

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



CAUTION:

- **When reusing a mounting bolt, check its outer diameter before installation. Refer to EM-48, "Balancer Unit Mounting Bolt Outer Diameter" .**

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

b. Tighten them to 45.2 - 51.0 N·m (4.6 - 5.2 kg-m, 34 - 37 ft-lb).

c. Turn them another 90° - 95° degrees (Target: 90° degrees).

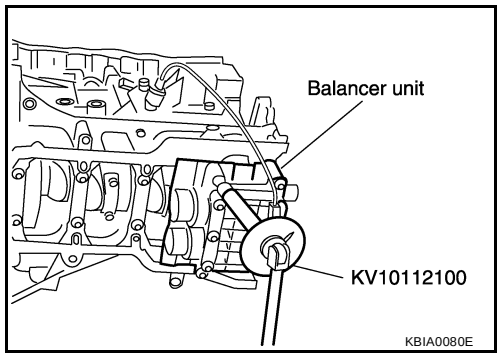
d. Fully loosen in the reverse order of tightening to 0 N·m (0 kg-m, 0 ft-lb).

e. Tighten them to 45.2 - 51.0 N·m (4.6 - 5.2 kg-m, 34 - 37 ft-lb).

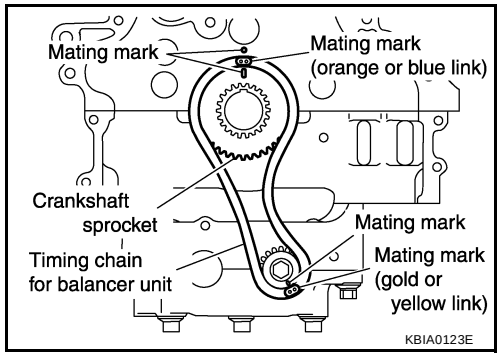
f. Turn them another 90° - 95° degrees (Target: 90° degrees).

CAUTION:

- **Check tightening angle with an angle wrench or a protractor. Do not make judgment by visual check alone.**



3. Install the crankshaft sprocket and timing chain for the balancer unit.
   - Make sure that the crankshaft sprocket is positioned with mating marks on the block and sprocket meeting at the top.
   - Install it by lining up mating marks on each sprocket and timing chain.

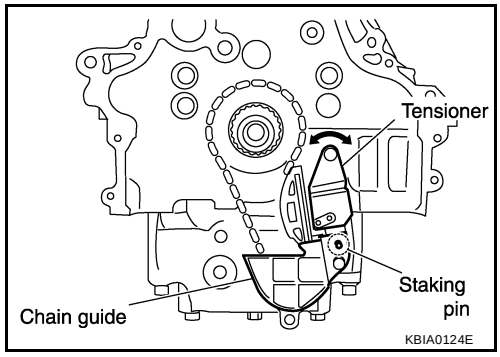


4. Install timing chain tensioner for balancer unit.

NOTE:

Chain guide and tensioner move freely with the caulking pin as the axle. Therefore, bolt hole position of the three points could be changed during removal. If points change, temporarily fix the two mounting bolts on the chain guide and move the tensioner to match the bolt holes.

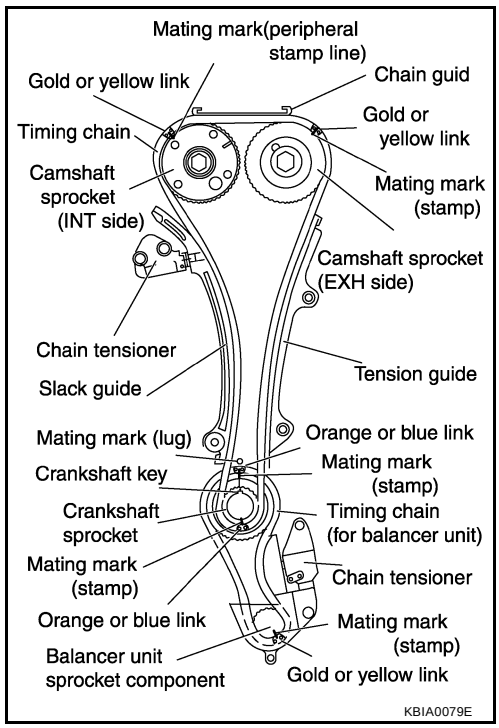
- Be careful not to let mating marks of each sprocket and timing chain slip.
- After installation, make sure the mating marks have not slipped, then remove stopper pin and release tensioner.



5. Install timing chain and related parts.
   - Install by lining up mating marks on each sprocket and timing chain as shown.

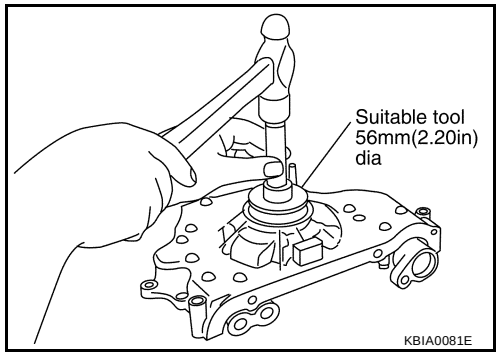
   NOTE:
   Before installing chain tensioner, it is possible to change the position of mating mark on timing chain for that of each sprocket for alignment.

   CAUTION:
   For the above reason, after the mating marks are aligned, keep them aligned by holding them with a hand.
   - Before and after installing chain tensioner, check again to make sure that mating marks have not slipped.
   - After installing chain tensioner, remove stopper pin, and make sure the tensioner moves freely.
   - To avoid skipped teeth, do not move crankshaft and camshaft until front cover is installed.



6. Install front oil seal to front cover.
   - Using a drift of 56 mm (2.20 in) diameter, press oil seal in until it is flush with front end surface of front cover.

   CAUTION:
   Be careful not to cause damage to circumference of oil seal.



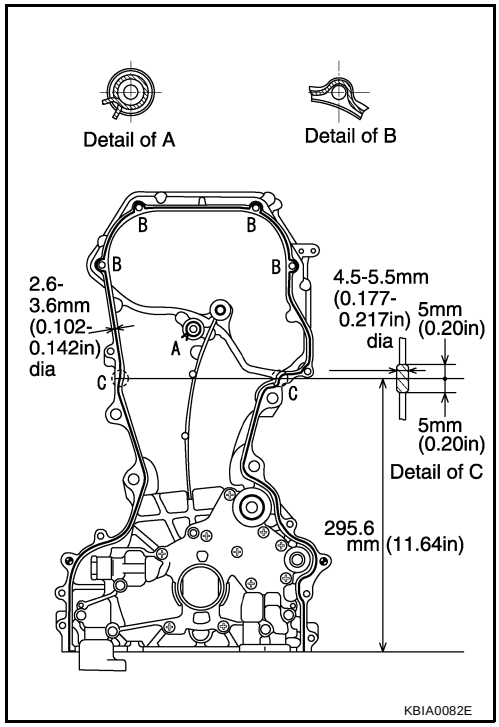
7. Install front cover with the following procedure:

a. Install O-rings to cylinder head and cylinder block.

b. Apply Genuine RTV Silicone Sealant or equivalent, to positions specified in the figure. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .

c. Make sure the mating marks on the timing chain and each sprocket are still aligned. Then install the front cover.

   CAUTION:
   - **Be careful not to damage the front oil seal during installation with the front end of the crankshaft.**



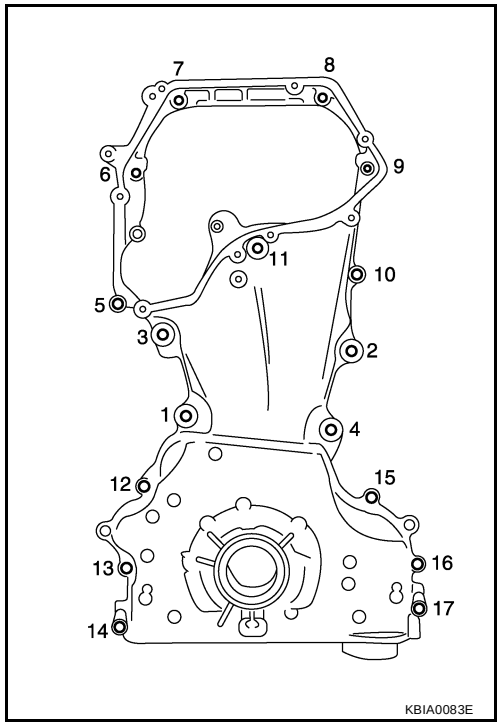
d. Tighten mounting bolts in the numerical order shown.

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

Front cover bolts : 12 - 13 N·m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)

CAUTION:

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



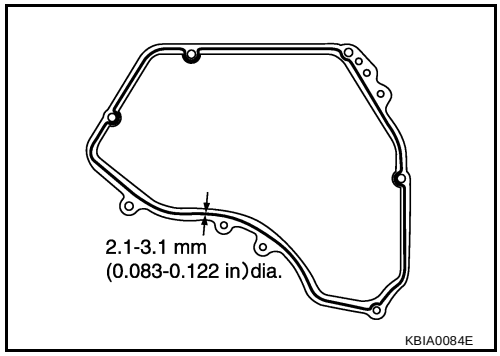
8. Install the chain guide between the camshaft sprockets.
9. Install IVTC cover with the following procedure:

a. Install IVTC solenoid valves to IVTC cover.

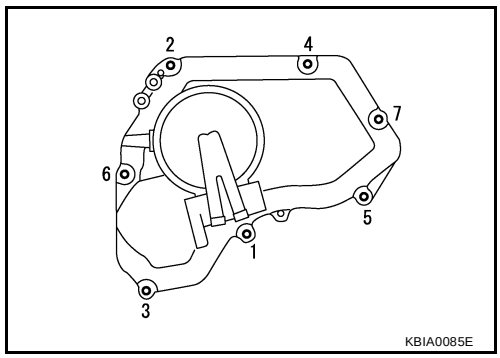
b. Install oil rings to the intake camshaft sprocket insertion points on Intake valve timing control backside cover.

c. Install O-ring to front cover.

d. Apply RTV Silicone Sealant to the positions in the figure.



e. Tighten the mounting bolts in the numerical order as shown.



10. Insert crankshaft pulley by aligning with crankshaft key.
    - Tap its center with a plastic hammer to insert.
    - Do not tap the belt hook.
11. Tighten crankshaft pulley mounting bolts.

- Secure crankshaft pulley with a pulley holder to tighten the bolt.
- Perform angle tightening with the following procedure:

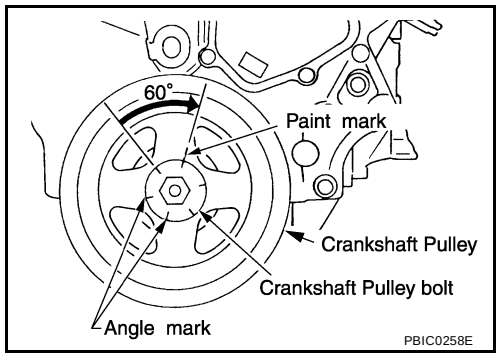
a. Apply new engine oil to threads and seat surfaces of mounting bolts.

b. Tighten to initial specifications:·

Crankshaft pulley bolt initial tightening : 37.3 - 47.1 N·m (3.8 - 4.8 kg-m, 28 - 34 ft-lb)

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

d. Turn crankshaft pulley bolt another 60° to 66° degrees [Target: 60° degrees].
   - Check vertical mounting angle with movement of one stamp mark.



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

CYLINDER HEAD

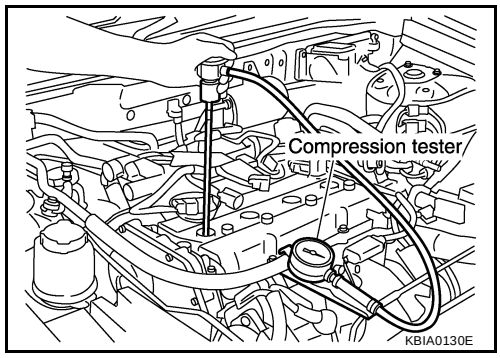
PFP:11041

On-Vehicle Service

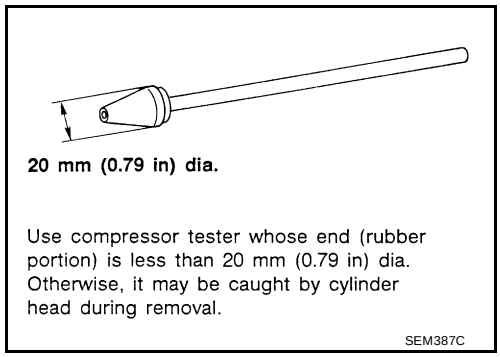
EBS007PC

CHECKING COMPRESSION PRESSURE

1. Warm up the engine to full operating temperature.
2. Release the fuel pressure. Refer to EC-51, "FUEL PRESSURE RELEASE" .
3. Remove the ignition coil and spark plug from each cylinder.
   Refer to EM-27, "Removal and Installation" .
4. Connect engine tachometer (not required in use of CONSULT-II).
5. Disconnect the fuel injector harness connector to avoid any residual fuel injection during the measurement.
6. Install the compression tester with the adapter into the spark plug hole.



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



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

Engine Compression Pressure

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

Standard	Minimum	Difference limit between cylinders
1,250 (12.8) / 250	1,060 (10.8) / 250	100 (1.0) / 250

CAUTION:

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

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

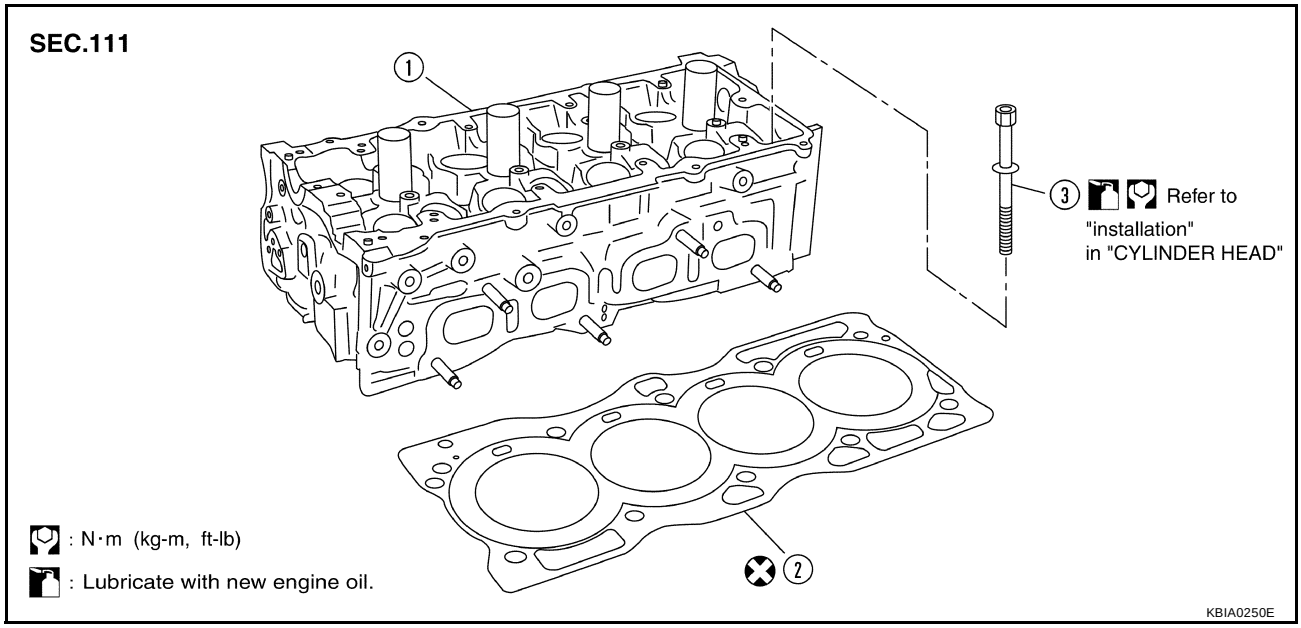
- If the compression pressure remains at low level despite the addition of engine oil, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.

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

8. Install spark plug, ignition coil and harness connectors.

Removal and Installation

EBS007PD

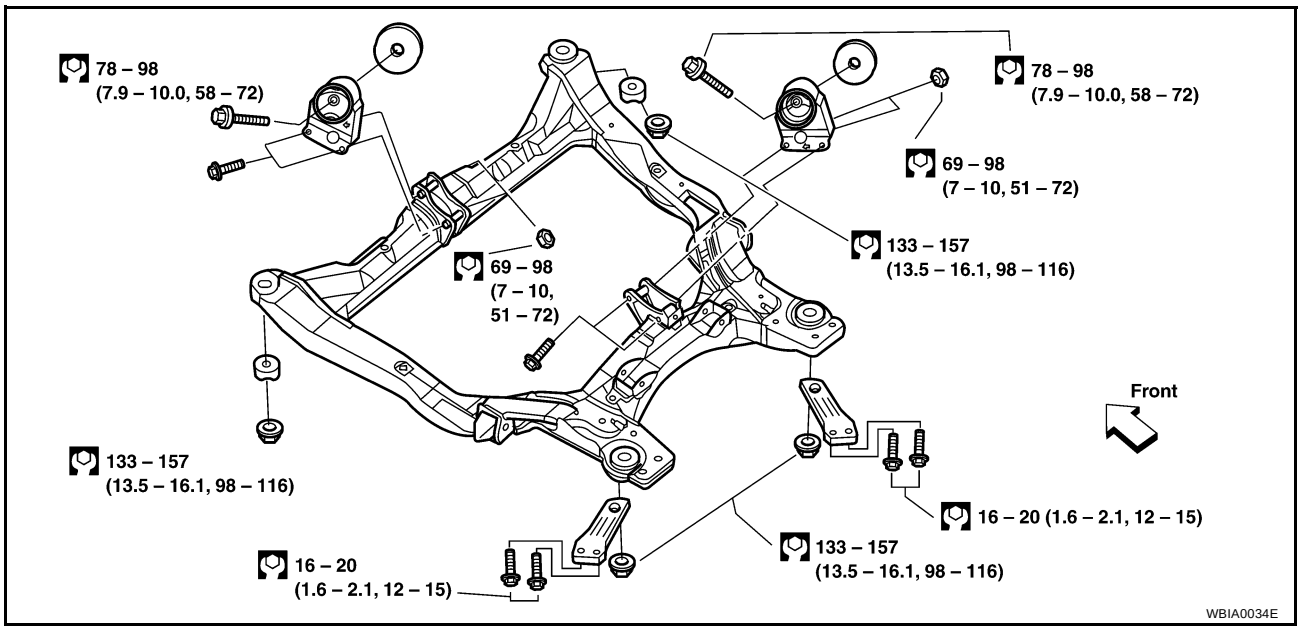


1. Cylinder head assembly
2. Cylinder head gasket
3. Cylinder head bolt

REMOVAL

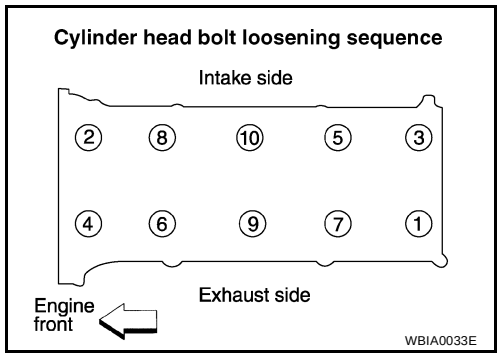
1. Release fuel pressure. Refer to EC-51, "FUEL PRESSURE RELEASE" .
2. Remove the hood.
3. Drain engine coolant and engine oil.
4. Position the RH engine compartment fuse and relay box aside.
5. Remove the engine undercovers using power tool.
6. Remove the timing chain. Refer to EM-45, "Removal and Installation" .
7. Remove the camshafts. Refer to EM-34, "CAMSHAFT" .
8. Remove the exhaust manifold using power tool.
9. Support the engine from above and underneath with suitable hoist and floor jack.

10. Lower the front suspension member for clearance to remove the oil pan by disconnecting the following:



- Position the power steering reservoir aside.
- Remove auxiliary drive belts. Refer to EM-12, "Removal and Installation" .
- Dismount the A/C compressor and position it out of the way with wire.
- Disconnect the upper swaybar links. Refer to FSU-11, "Removal and Installation" .
- Remove the through bolts from the front and rear engine mounts.
- Disconnect the lower ball joints. Refer to FSU-5, "Components" .
- Remove the two steering gear housing mounting bolts. Refer to PS-13, "Removal and Installation" .

11. Remove cylinder head loosening bolts in the order shown, using power tool.
12. If necessary to transfer to new cylinder head or remove for reconditioning, remove the intake manifold collector, intake manifold, and fuel tube assembly. Refer to EM-16, "Removal and Installation" .



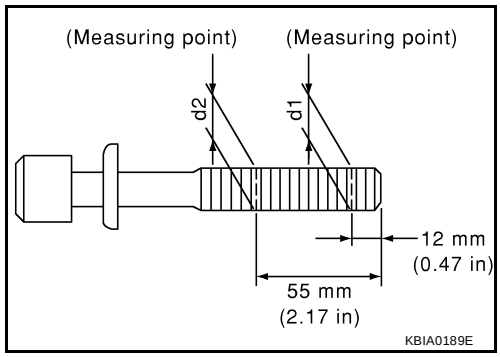
INSPECTION AFTER REMOVAL

Outer Diameter of Cylinder Head Bolts

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

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

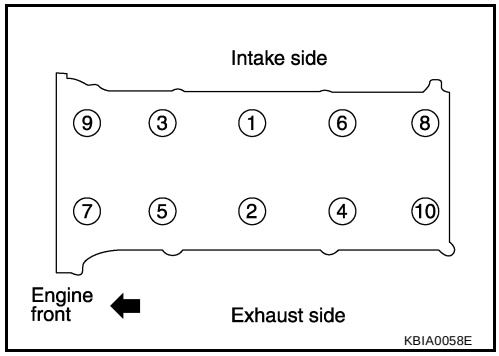
- If reduction of outer diameter appears in a position other than d2, use it as d2 point.



INSTALLATION

1. Install a new cylinder head gasket.

2. Follow the steps below to tighten the cylinder head bolts in the numerical order as shown.



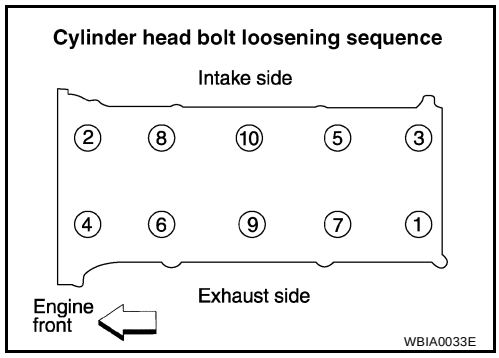
CAUTION:

- **If cylinder head bolts are re-used, check their outer diameters before installation. Refer to EM-55, "Outer Diameter of Cylinder Head Bolts" .**

a. Apply new engine oil to the threads and the seating surfaces of mounting bolts.

b. Tighten all bolts to 98.1 N·m (10 kg-m, 72 ft-lb).

c. Completely loosen all bolts in the order shown.



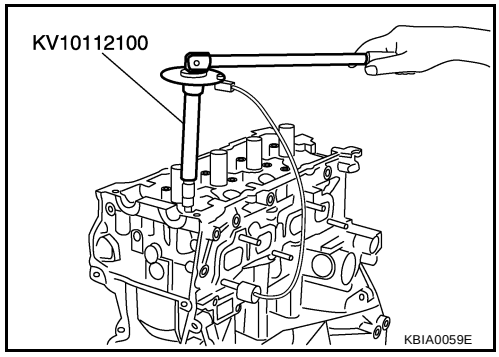
d. Retighten all bolts to 34.3 - 44.1 N·m (3.5 - 4.4 kg-m, 26 - 32 ft-lb).

e. Turn all bolts 75° - 80° degrees (target: 75° degrees) clockwise.

f. Turn all bolts 75° to 80° degrees (target: 75° degrees) clockwise again.

CAUTION:

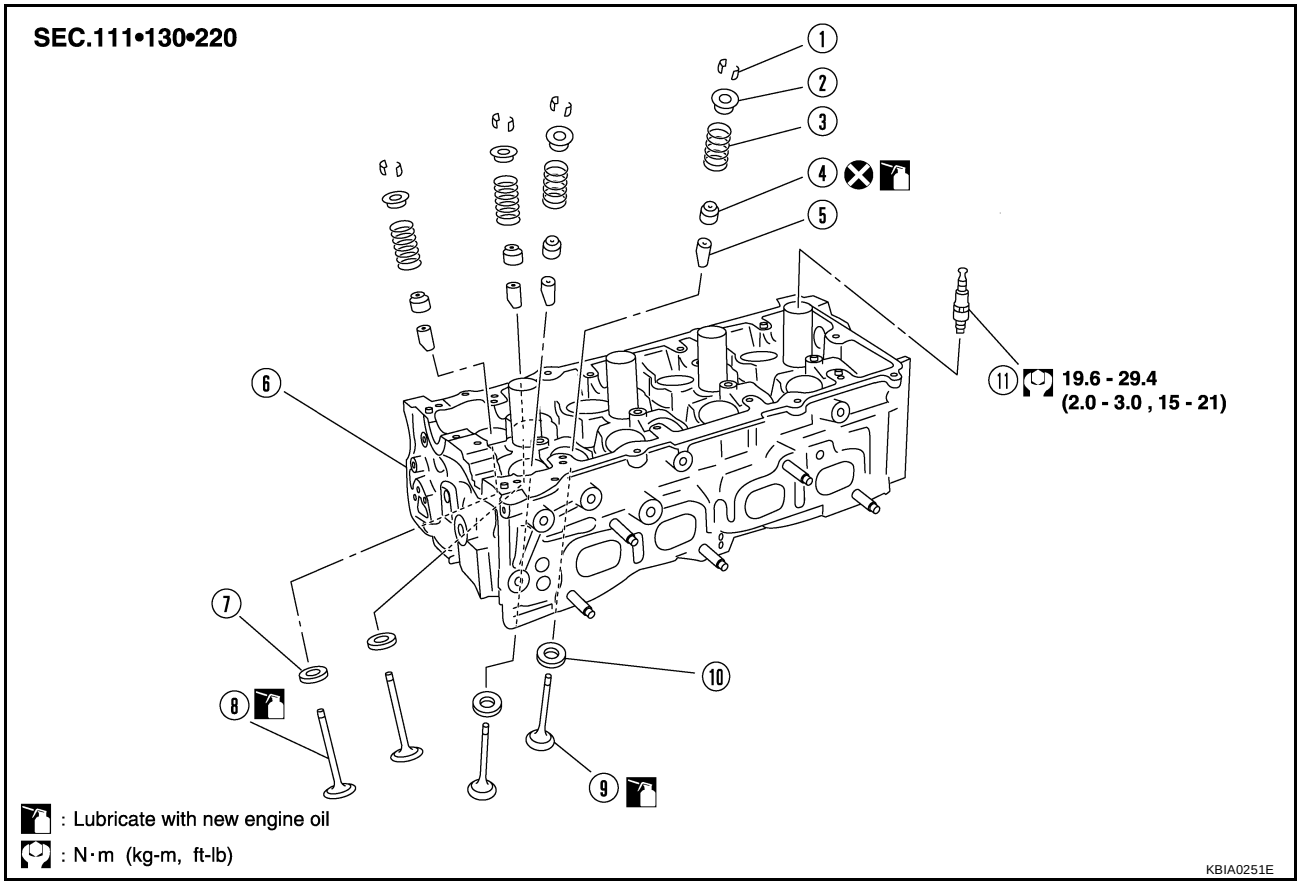
Check and confirm the tightening angle by using angle wrench or protractor. Avoid judgment by visual inspection without the tool.



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

Disassembly and Assembly

EBS007PE



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

CAUTION:

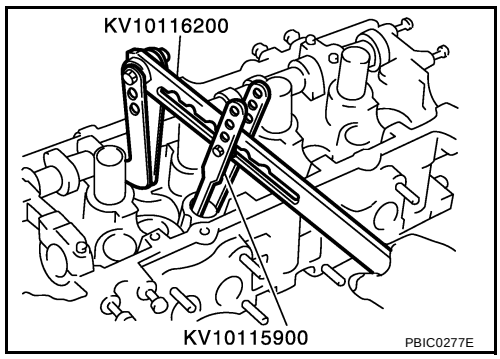
- **When installing camshafts, chain tensioners, oil seals or other sliding parts, lubricate the contact surfaces with new engine oil.**
- **Apply new engine oil to threads and seat surfaces when installing the cylinder head, camshaft sprocket, crankshaft pulley and camshaft bracket.**
- **Attach tags to valve lifters so all parts are assembled in their original position.**

DISASSEMBLY

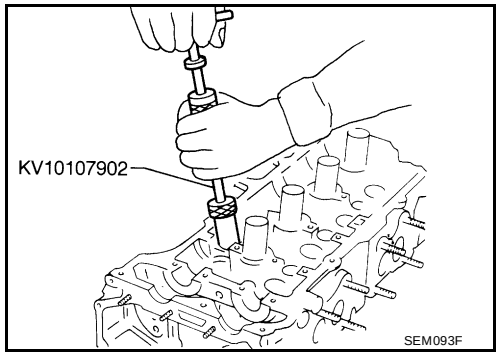
1. Remove the valve lifter.
   - Confirm installation point.
2. Remove the valve collet.
   - Compress valve spring with valve spring compressor. Remove valve collet with magnet driver.
3. Remove valve spring retainer and valve spring.

   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-59, "VALVE GUIDE CLEARANCE" .
   - Confirm installation point.

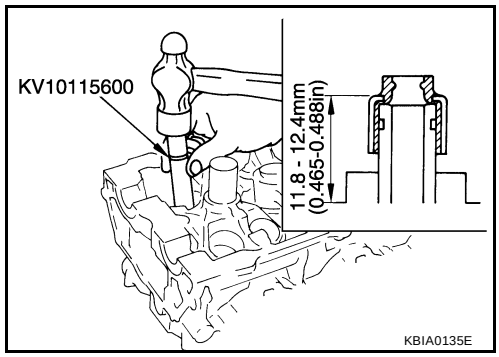


5. Remove valve oil seal with valve oil seal puller.
6. When valve seat must be replaced, refer to EM-61, "VALVE SEAT REPLACEMENT" .
7. When valve guide must be replaced, refer to EM-59, "VALVE GUIDE REPLACEMENT" .
8. Remove spark plug with spark plug wrench.

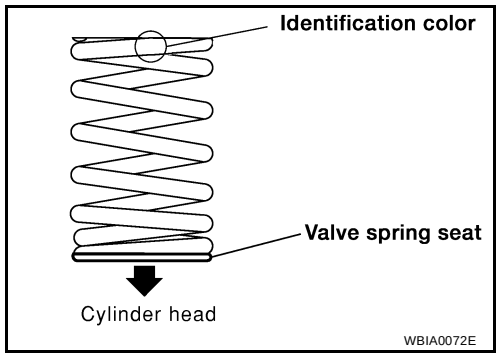


ASSEMBLY

1. Install valve guide. Refer to EM-59, "VALVE GUIDE REPLACEMENT" .
2. Install valve seat. Refer to EM-61, "VALVE SEAT REPLACEMENT" .
3. Install valve oil seal.
   - Install with valve oil seal drift to match dimension in illustration.
4. Install valve.
   - Install larger diameter to intake side.



5. Install valve spring.
   - Install smaller pitch (valve spring seat side) to cylinder head side.
   - Confirm the identification color of the valve spring:
     Intake: blue
     Exhaust: yellow
6. Install valve spring retainer.
7. Install valve collet.
   - Compress valve spring with valve spring compressor. Install valve collet with magnet hand.
   - Tap stem edge lightly with plastic hammer after installation to check its installed condition.
8. Install valve lifter.
9. Install spark plug.



Inspection After Disassembly

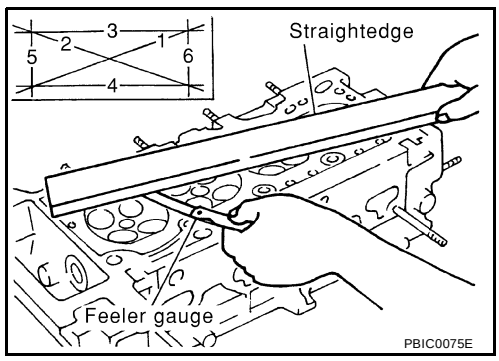
EBS007PF

CYLINDER HEAD DISTORTION

1. Wipe off oil and remove water scale deposits, old gasket, old sealer, and carbon with a scraper.

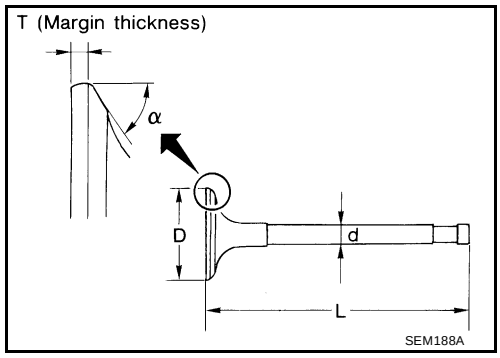
   CAUTION:
   Use care not to allow gasket debris to enter passages for oil or water.
2. At each of several locations on bottom surface of cylinder head, measure distortion in six directions.

   Standard : 0.1 mm (0.004 in) or less



VALVE DIMENSIONS

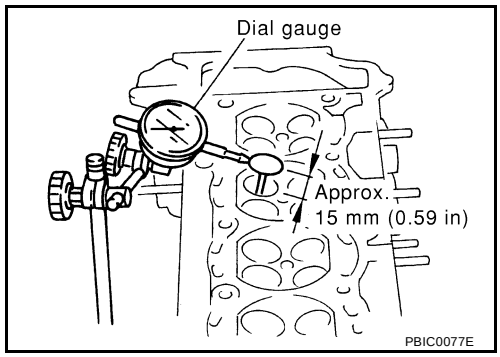
Check dimensions of each valve. Refer to EM-92, "VALVE" .



VALVE GUIDE CLEARANCE

NOTE:
Perform this inspection before removing the valve guide.

1. Make sure that the valve stem diameter is within the specification.
2. Push the valve out by approximately 15 mm (0.59 in) toward the combustion chamber side to measure the valve's run-out volume (in the direction of dial gauge) with dial gauge.
3. Half of the run-out volume accounts for the valve guide clearance.

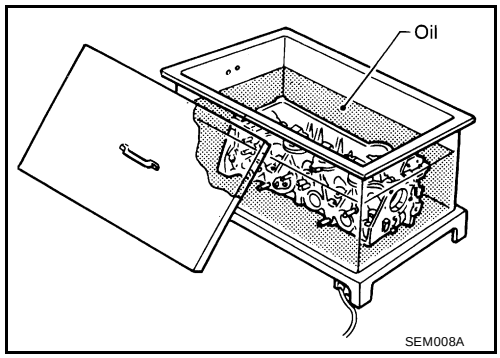


Intake run-out	**: 0.020 - 0.053 mm (0.0008 - 0.0021 in) or less**
Exhaust run-out	**: 0.030 - 0.063 mm (0.0012 - 0.0025 in) or less**

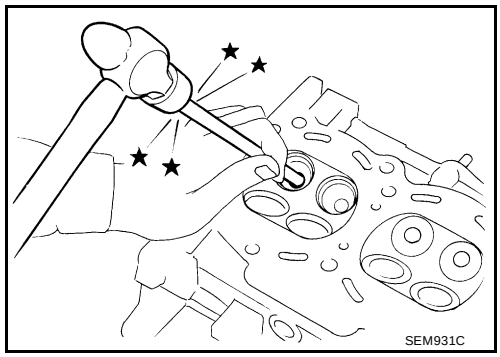
VALVE GUIDE REPLACEMENT

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

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

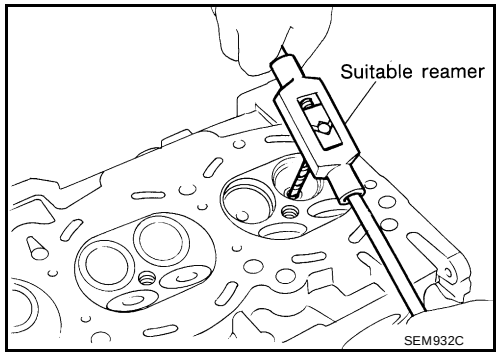


2. Drive out valve guide with a press [under a 20 kN (2.2 ton-force) pressure] or hammer and suitable tool.

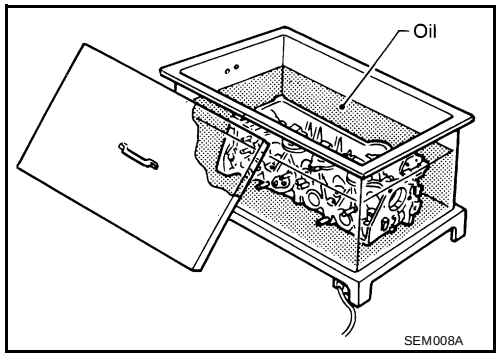


3. Ream cylinder head valve guide hole.

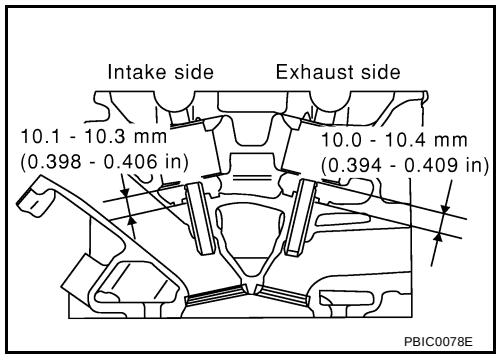
Valve guide hole diameter for intake and exhaust : **10.175 - 10.196 mm (0.4006 - 0.4014 in)**



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

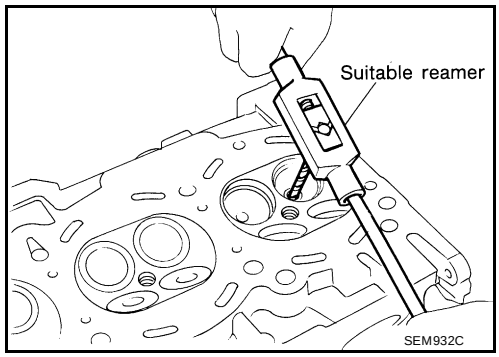


5. Press valve guide from camshaft side to dimensions as in illustration.



6. Using a suitable valve guide reamer, apply the reamer to finish the valve guide to the specified inner diameter.

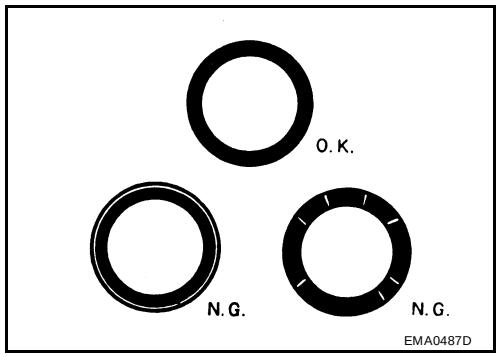
Intake and exhaust valve guide (inner diameter finished size) : **6.000 - 6.018 mm (0.2362 - 0.2369 in)**



VALVE SEAT CONTACT

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

- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the seat surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has N.G. conditions even after the re-check, replace the valve seat.



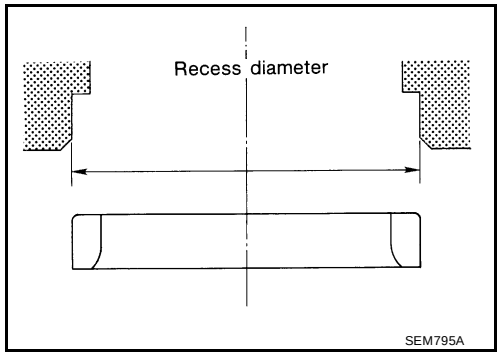
VALVE SEAT REPLACEMENT

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

1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in the cylinder head. Set the machine depth stop to ensure this.
2. Ream cylinder head recess diameter for service valve seat.

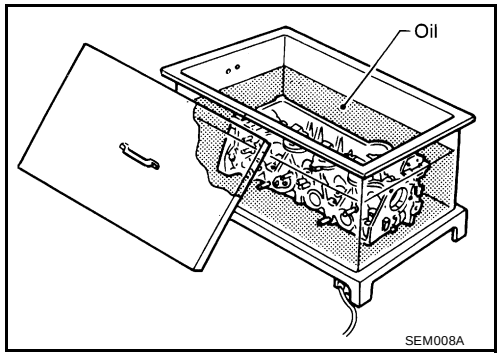
   Oversize : 0.5 mm (0.020 in)
   Intake : 37.000 - 37.016 mm (1.4567 - 1.4573 in)
   Exhaust : 32.000 - 32.016 mm (1.2598 - 1.2605 in)

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



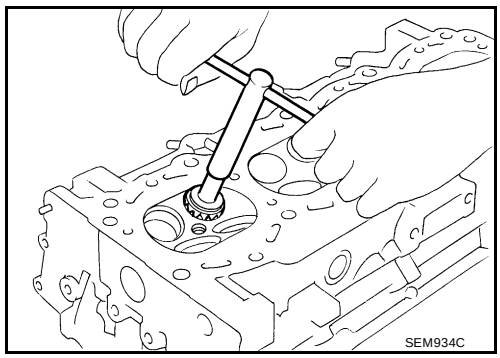
3. Heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil.
4. Provide valve seats cooled well with dry ice. Force fit valve seat into cylinder head.

   CAUTION:
   Avoid directly touching the cold valve seats.



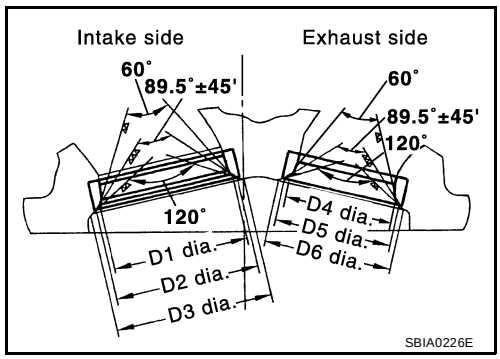
5. Using a valve seat cutter set or a valve seat grinder, finish the seat to the specified dimensions.

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



   Grind the valve seat to obtain the specified dimensions as shown.

   Standard
   D1 dia. : 33.5 mm (1.3189 in)
   D2 dia. : 35.1 - 35.3 mm (1.382 - 1.390 in)
   D3 dia. : 39.0 - 39.2 mm (1.535 - 1.543 in)
   D4 dia. : 28 mm (1.10 in)
   D5 dia. : 29.9 - 30.1 mm (1.177- 1.185 in)
   D6 dia. : 33.5 - 33.7 mm (1.319 - 1.327 in)

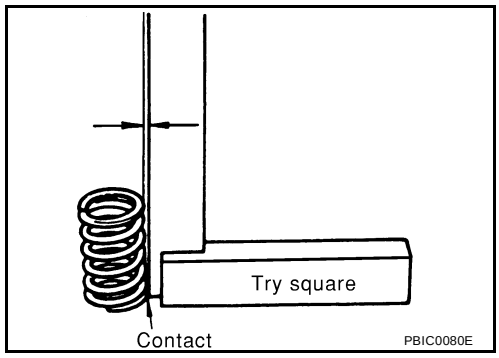


6. Using compound, grind the valve seat to adjust the valve fitting.
7. Check again for normal contact.

VALVE SPRING SQUARENESS

Set try square along the side of the valve spring and rotate the spring. Measure the maximum clearance between the top face of the spring and the try square.

Squareness limit : 1.9 mm (0.0748 in)

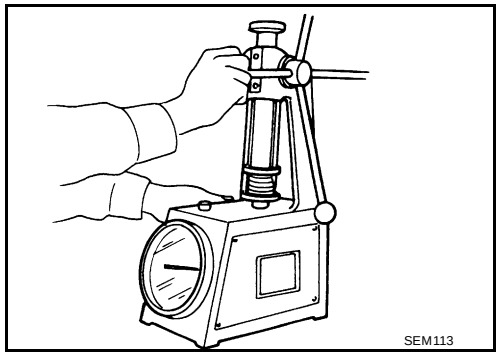


VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

Check valve spring pressure with valve spring seat installed at specified spring height. Replace if not within specifications.

CAUTION:

Do not remove the valve spring seat.



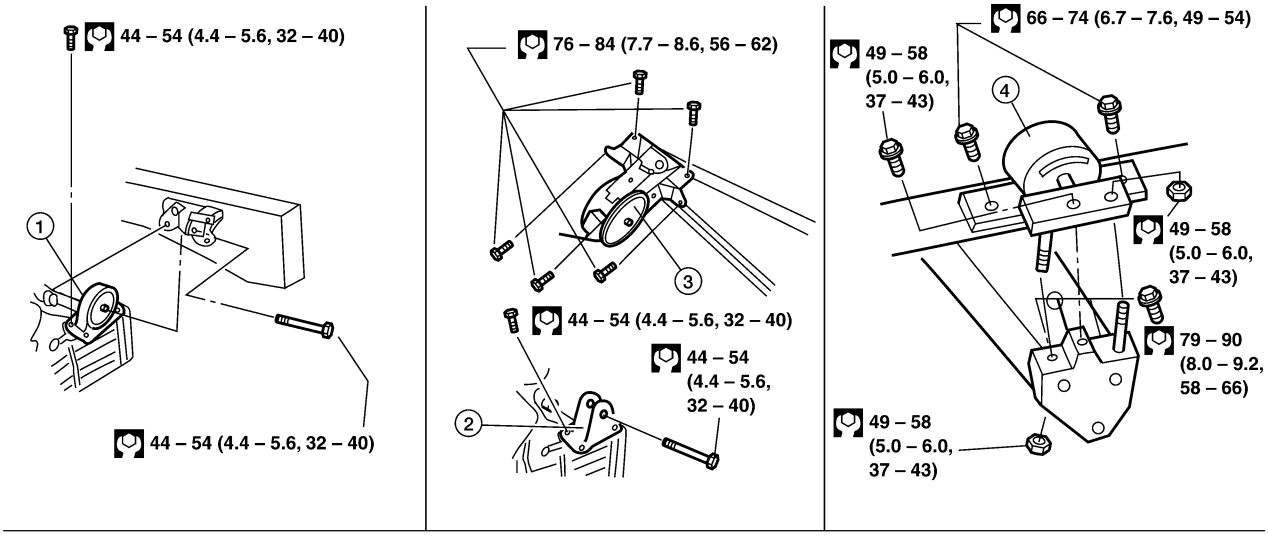
STANDARD	INTAKE (identification color: blue)	EXHAUST (identification color: yellow)
Free height	44.84 - 45.34 mm (1.7654 - 1.7850 in)	45.28 - 45.78 mm (1.7827 - 1.8024 in)
Installation height	35.30 mm (1.390 in)	35.30 mm (1.390 in)
Installation load	151 - 175 N (15.4 - 17.8 kg-force, 34 - 39 lb-force)	151 - 175 N (15.4 - 17.8 kg-force, 34 - 39 lb-force)
Height during valve open	24.94 mm (0.9819 in)	26.39 mm (1.0390 in)
Load with valve open	358 - 408 N (36.5 - 41.6 kg-force, 80 - 92 lb-force)	325 - 371 N (33.1 - 37.8 kg-force, 73-83 lb-force)

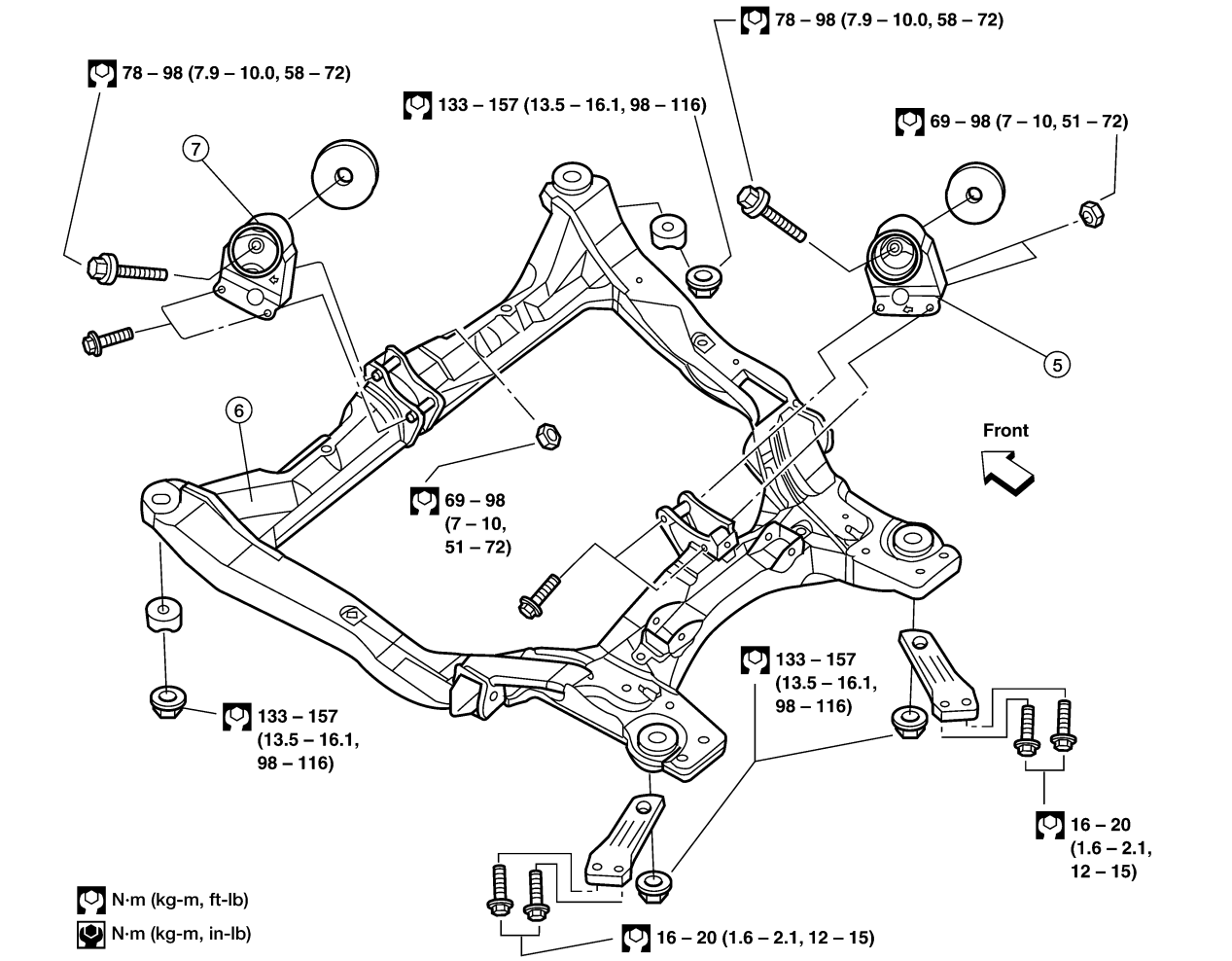
ENGINE ASSEMBLY

PFP:10001

Removal and Installation

EBS007PG





WBIA0221E

1. LH transaxle mounting insulator (A/T)
2. LH transaxle mounting bracket (M/T)
3. LH transaxle mounting insulator (M/T)
4. RH engine mounting insulator
5. Rear engine mounting insulator (orient by direction mark)
6. Front suspension member
7. Front engine mounting insulator (orient by direction mark)

WARNING:

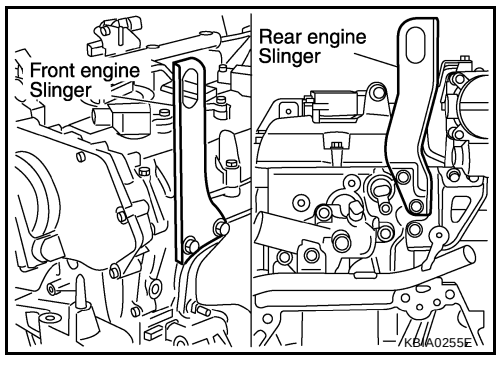
- **Place chocks at the front and back of the rear wheels.**
- **For engines not equipped with slingers, attach proper slingers and bolts as described in the parts catalog.**

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, refer to the applicable sections.**
- **Use the correct supporting points for lifting and jacking. Refer to GI-37, "LIFTING POINT" .**
- **In removing the drive shaft, be careful not to damage the grease seals on the transaxle.**
- **Before separating the engine and transaxle, remove the crankshaft position sensor (POS) from the assembly.**
- **Be sure not to damage the edge of the crankshaft position sensor (POS) or the ring gear teeth.**

REMOVAL

1. Release fuel pressure. Refer to EC-51, "FUEL PRESSURE RELEASE" .
2. Disconnect the fuel rail at the fuel hose quick connector (engine side). Refer to EM-16, "INTAKE MANIFOLD" .
3. Drain the engine oil. Refer to MA-17, "Changing Engine Oil" .
4. Drain the engine coolant. Refer to MA-14, "DRAINING ENGINE COOLANT" .
5. Remove the engine hood assembly. Refer to BL-13, "Removal and Installation of Hood Assembly" .
6. Remove the battery, battery hold downs and battery tray.
7. Disconnect engine room harness from the engine side and position it aside. Disconnect engine harness ground connections. Access the connector through the glove box opening.
8. Disconnect the MAF sensor electrical connector.
9. Remove the air duct and air cleaner case assembly. Refer to EM-14, "Removal and Installation" .
10. Disconnect the heater hoses.
11. Remove the radiator and radiator fan assembly. Refer to CO-12, "Removal and Installation" .
12. Remove engine coolant reservoir tank.
13. Disconnect and set aside the IPDME/R and remove the IPDME/R bracket. Refer to PG-24, "Removal and Installation of IPDM E/R" .
14. Remove the generator. Refer to SC-33, "Removal" .
15. Remove the engine under covers and splash shield, using power tool.
16. Dismount the A/C compressor with piping connected and secure with wire to the radiator support.
17. Disconnect the engine wiring harness retainers and ground strap.
18. Remove clutch operating cylinder from transaxle, and move it aside (M/T models).
19. Disconnect the transaxle shift controls.
20. Remove front exhaust tube. Refer to EX-3, "Removal and Installation" .
21. Remove the left and right drive shafts. Refer to FAX-11, "Removal and Installation" .
22. Remove the front suspension member. Refer to FSU-14, "Removal and Installation" .
23. Dismount the power steering pump with piping connected and position it aside with wire.
24. Install engine slingers into front left cylinder head and rear right cylinder head.
    - Use alternator bracket mounting bolt holes for the front slinger.
    - Use the proper slingers and bolts as described in the Parts Catalog.

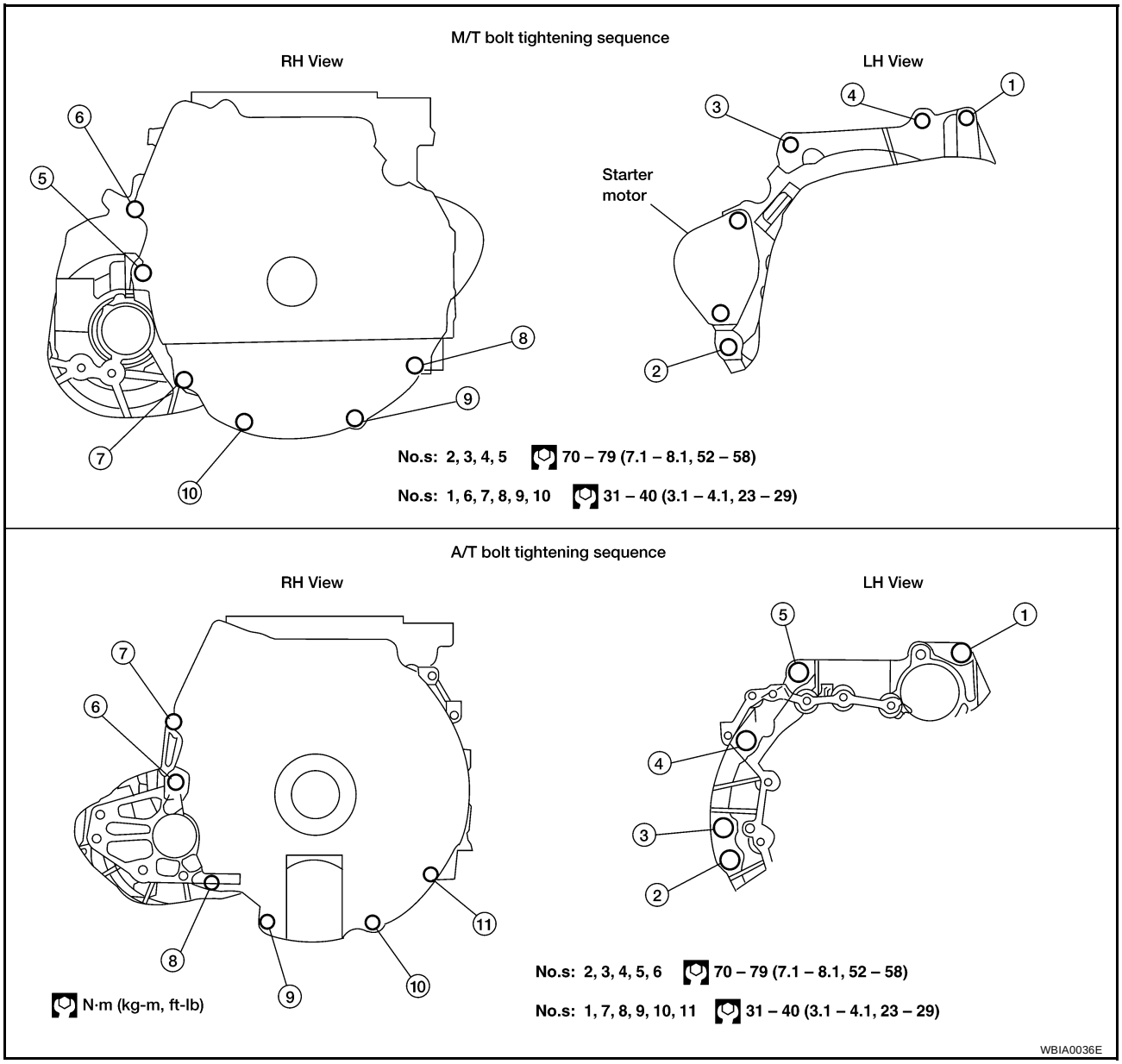


Slinger bolts - front	**: 51.0 - 64.7 N·m (5.2 - 6.5 kg-m, 38 - 47 ft-lb)**
Slinger bolts - rear	**: 24.5 - 31.4 N·m (2.5 - 3.2 kg-m, 18 - 23 ft-lb)**

25. Support engine and transaxle assembly with engine lifting equipment from the top with the vehicle raised on a hoist.
26. Remove RH engine mounting insulator.
27. Remove LH transaxle mounting insulator through-bolts.
28. Lower the engine and transaxle assembly from the engine compartment.
29. Remove the starter motor. Refer to SC-23, "Removal and Installation" .
30. Separate engine and transaxle.

INSTALLATION

Installation is in the reverse order of removal.



- Do not allow oil to get on mounting insulators. Be careful not to damage mounting insulators.
- If parts have a direction mark (arrow) this indicates front of the vehicle, and the parts must be installed according to the identification mark.

INSPECTION AFTER INSTALLATION

- Before starting engine, check the levels of engine coolant, lubricants, engine oil. If less than required quantity, fill to the specified level.
- Run engine to check for unusual noise and vibration.

- Warm up engine thoroughly to make sure there is no leakage of coolant, lubricants, oil, fuel, and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines.

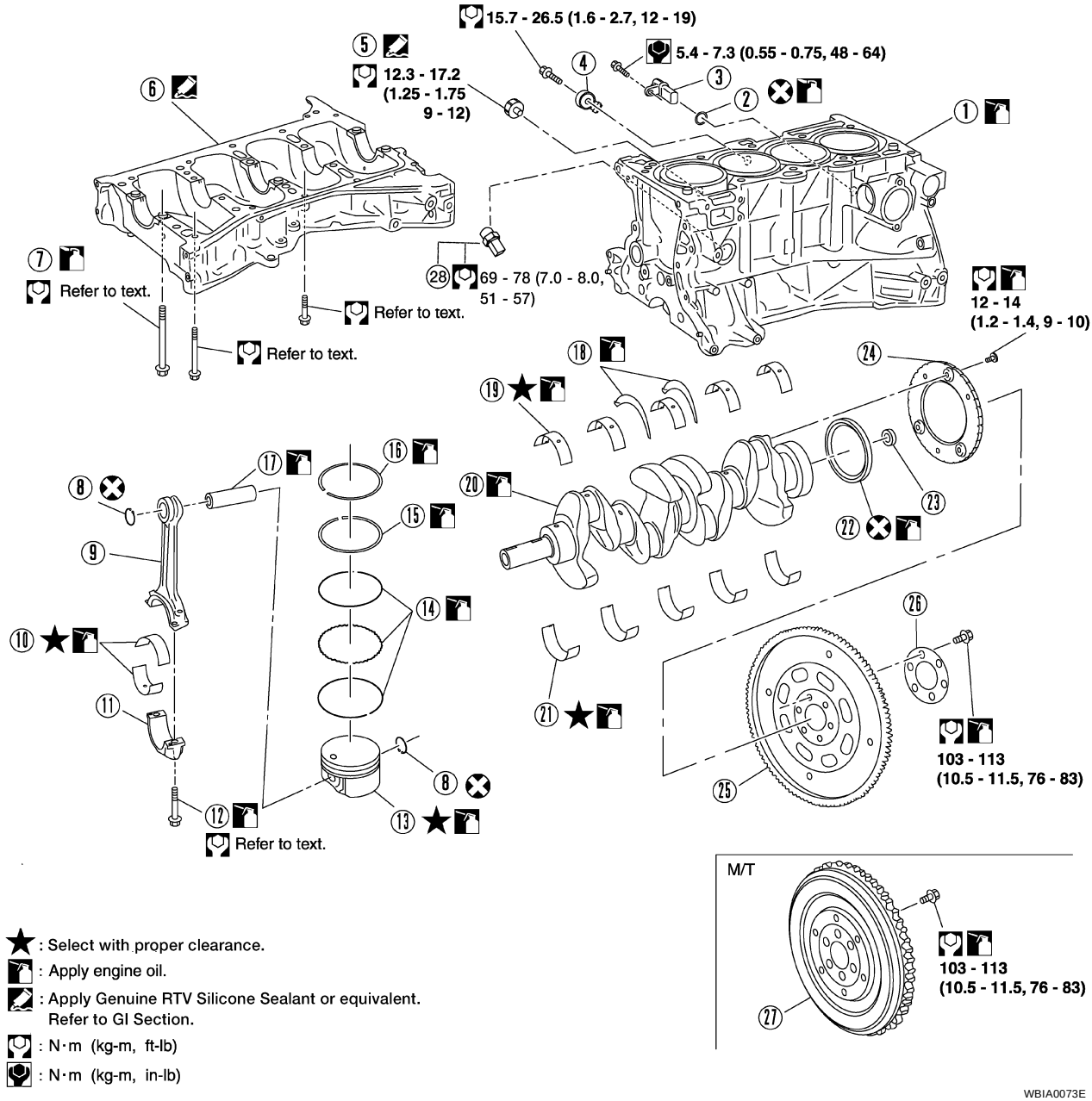
CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

EBS007PH

SEC.110 • 120 • 221 • 226



1. Cylinder block
2. O-ring
3. Crankshaft position sensor (POS)
4. Knock sensor
5. Oil pressure switch
6. Lower cylinder block
7. Lower cylinder block bolt
8. Snap ring
9. Connecting rod
10. Connecting rod bearing
11. Connecting rod bearing cap
12. Connecting rod bearing cap bolt
13. Piston
14. Oil ring
15. Second ring
16. Top ring
17. Piston pin
18. Main thrust bearing
19. Main bearing upper
20. Crankshaft
21. Main bearing lower
22. Crankshaft rear oil seal
23. Pilot converter (A/T only)
24. Crankshaft signal plate
25. Drive plate
26. Reinforcement plate
27. Flywheel
28. Cylinder block heater (if equipped)

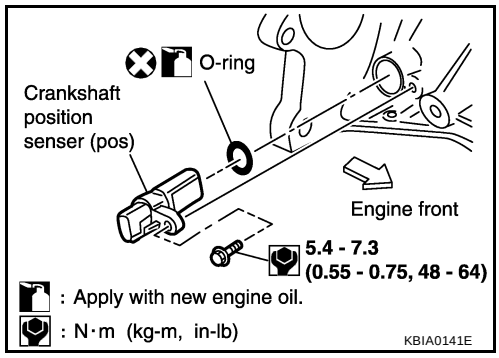
CAUTION:
Apply new engine oil to parts marked in illustration before installation.

DISASSEMBLY

1. Remove the engine and transaxle as an assembly from the vehicle, and separate the transaxle from the engine. Refer to EM-63, "Removal and Installation" .
2. Mount the engine on a suitable engine stand.
3. Drain any remaining engine oil and coolant from the engine.
4. Remove the following components and associated parts.
   - Exhaust manifold and three way catalyst assembly. Refer to EM-21, "Removal and Installation" .
   - Intake manifold collector. Refer to EM-16, "Removal and Installation" .
   - Intake manifold and fuel tube assembly. Refer to EM-16, "Removal and Installation" .
   - Ignition coils. Refer to EM-26, "Removal and Installation" .
   - Rocker cover. Refer to EM-32, "Removal and Installation" .
   - Front cover, timing chain, and balancer unit. Refer to EM-45, "Removal and Installation" .
   - Cylinder head. Refer to EM-54, "Removal and Installation" .
5. Remove the knock sensor.

   CAUTION:
   Carefully handle the sensor and do not drop the sensor.
6. Remove crankshaft position sensor (POS).

   CAUTION:
   - **Avoid impacts such as a dropping.**
   - **Do not disassemble.**
   - **Keep it away from metal particles.**
   - **Do not place sensor close to magnetic materials.**

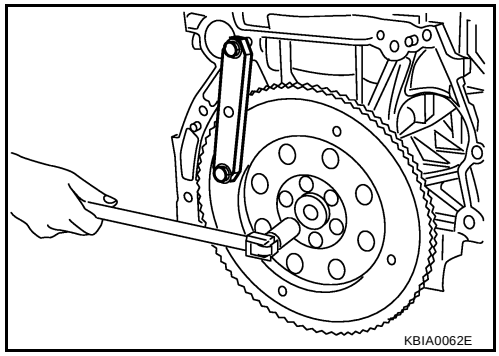


7. Remove the flywheel (M/T models) or drive plate (A/T models) using specified Tool. Hold the crankshaft with a stopper plate and remove the mounting bolts.

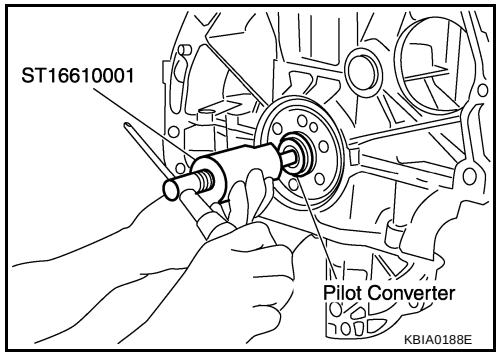
   Flywheel bolt Tool : J-45737
   Drive plate bolt Tool : J-45816

   CAUTION:
   Be careful not to damage the flywheel contact surface for the clutch disc.

   NOTE:
   The flywheel two-block construction allows movement in response to transmission side pressure, or when twisted in its rotational direction, therefore, some amount of noise is normal.



8. Remove pilot converter using Tool (A/T models).



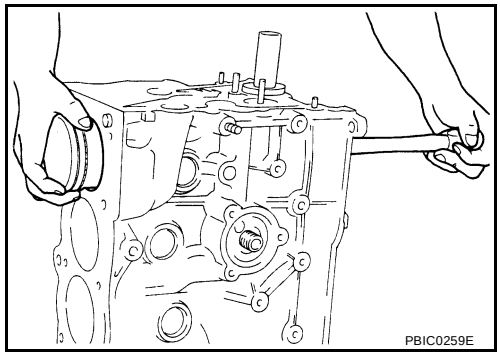
9. Remove the piston and connecting rod assemblies.

a. Position the crankshaft and corresponding connecting rod, to be removed, to the bottom dead center stroke.

b. Remove the connecting rod cap. Number the cap so it can be assembled in the same position.

c. Using a hammer handle or similar tool, push the piston and connecting rod assembly out of the top of the cylinder block. Number the piston and rod so it can be assembled in the same position.

- Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-82, "CONNECTING ROD SIDE CLEARANCE" .



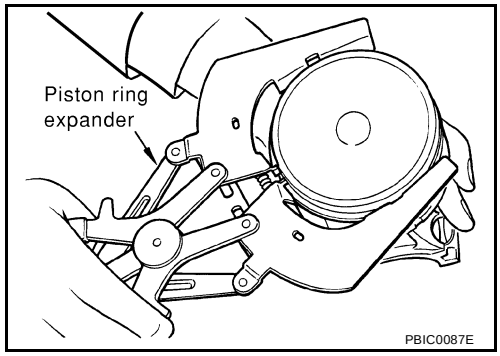
10. Remove the connecting rod bearings. If reusing, number them so they can be assembled in the same position and direction.

CAUTION:
When removing them, note the position for installation. Keep them in the correct order.

11. Remove the piston rings from the piston using a suitable piston ring expander.

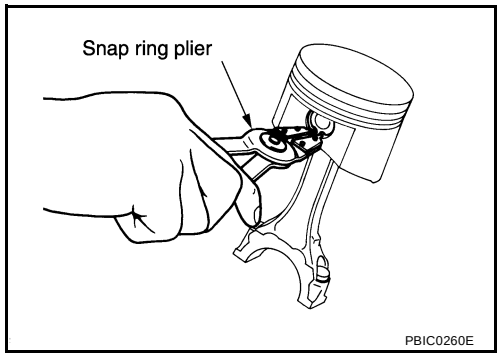
- Before removing the piston rings, check the piston ring side clearance. Refer to EM-83, "PISTON RING SIDE CLEARANCE" .

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

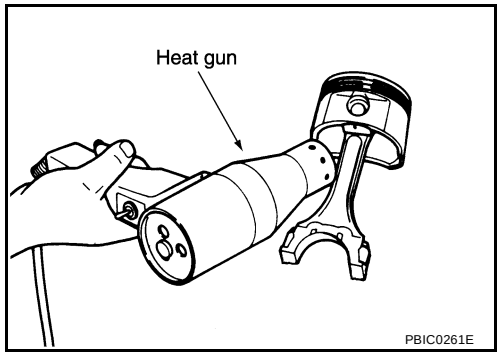


12. Remove the piston from the connecting rod as follows.

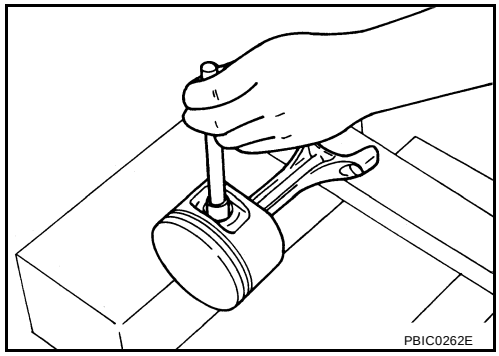
a. Using a snap ring pliers, remove the two snap rings.



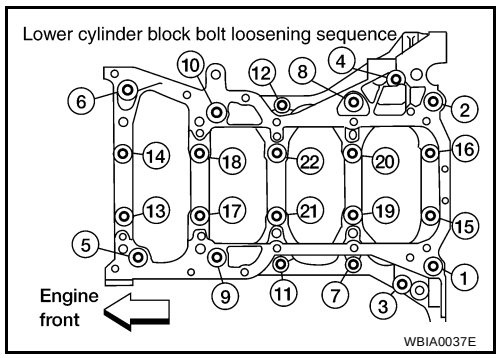
b. Heat the piston to 60° - 70°C (140° - 158°F) with a heat gun, or equivalent.



c. Push out piston pin with a punch of an outer diameter of approximately 19 mm (0.75 in).

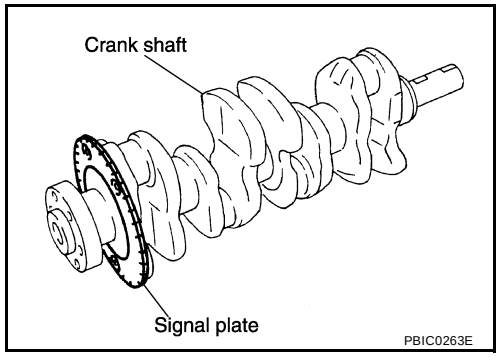


13. Remove the lower cylinder block mounting bolts.
    - Before loosening the lower cylinder block mounting bolts, measure the crankshaft side clearance. Refer to EM-81, "CRANKSHAFT SIDE CLEARANCE" .
    - Loosen them in the order shown to remove them.



14. Remove the lower cylinder block.
    - Using Tool (seal cutter) cut the RTV Silicone Sealant and remove the lower cylinder block from the cylinder block.

    CAUTION:
    Be careful not to damage the mounting surface.



15. Remove the crankshaft.

    CAUTION:
    - **Do not damage or deform the signal plate while mounted on the crankshaft.**
    - **When setting the crankshaft on a flat surface, use a block of wood to avoid interference between the signal plate and the surface.**
    - **Do not remove signal plate unless it is necessary.**

16. Pull the rear oil seal out of the rear end of the crankshaft.

    CAUTION:
    Do not to damage the crankshaft or cylinder block when removing the rear oil seal.

    NOTE:
    When replacing the rear oil seal without removing the cylinder block, use a screwdriver to pull it out from between crankshaft and block.

17. Remove the main bearings and thrust bearings from the cylinder block and lower cylinder block.

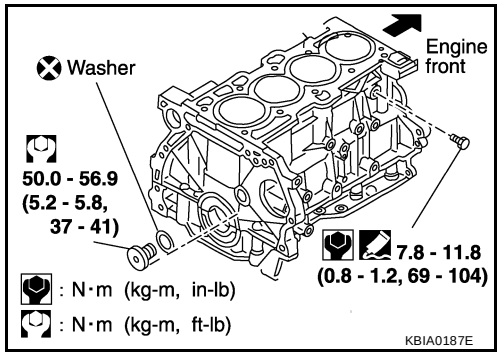
    CAUTION:
    Identify and number the bearings, if reusing them, so that they are assembled in the same position and direction.

ASSEMBLY

1. Using compressed air, clean out the coolant and oil passages in the cylinder block, the cylinder bore and the crankcase to remove any foreign material.

   CAUTION:
   Use approved safety glasses to protect your eyes.

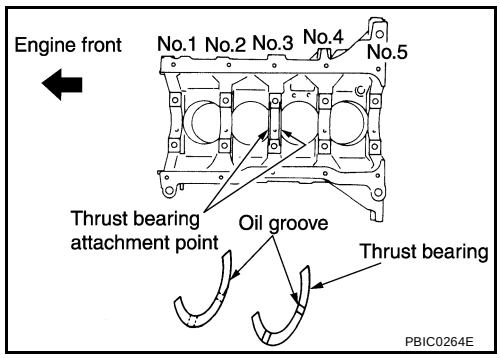
2. Install the drain plugs on the cylinder block.
   - Apply RTV Silicone Sealant.
     Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
   - Replace the copper washers with new ones.



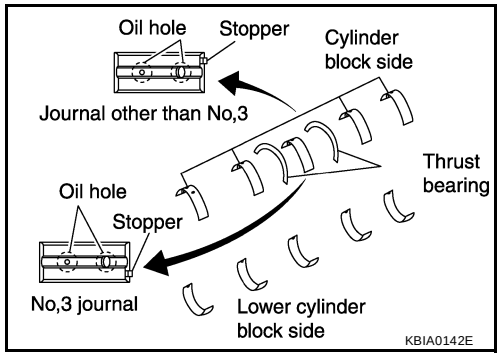
3. Install the main bearings and the thrust bearings.

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

b. Install the thrust bearings to both sides of the No. 3 main bearing journal on the cylinder block.
   - Install the thrust bearings with the oil groove facing the crankshaft arm (outside).



c. Install the main bearings paying attention to their position and direction.
   - The main bearing with an oil hole and groove goes on the cylinder block. The one without them goes on the lower cylinder block.
   - Only the main bearing (on the cylinder block) for No. 3 journal has different specifications.
   - Before installing the bearings, apply engine oil to the bearing friction surface (inside). Do not apply oil to the back surface, but thoroughly clean it.
   - When installing, align the bearing stopper to the notch.
   - Make sure that the oil holes on the cylinder block and those on the corresponding bearing are aligned.



4. Install the signal plate to the crankshaft.

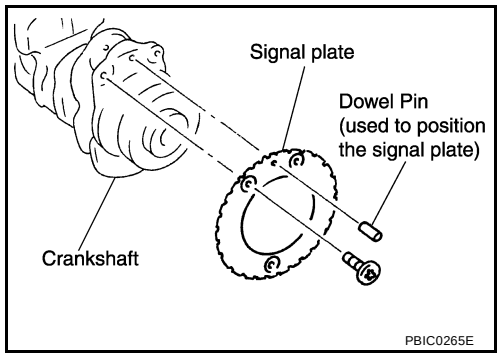
   Signal plate bolts : 12 - 14 N·m (1.22 - 1.43 kg-m, 9 - 10 ft-lb)

a. Position the crankshaft and signal plate using a positioning dowel pin, and tighten the mounting bolts to specification.

b. Remove the dowel pin.

   CAUTION:
   Be sure to remove dowel pin before installing the crankshaft.

   NOTE:
   Dowel pins for the crankshaft and signal plate are supplied as a set for each.

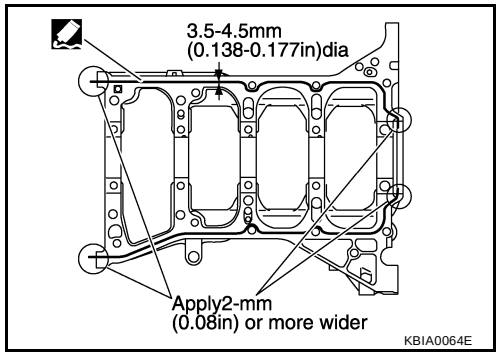


5. Install the crankshaft onto the cylinder block.
   - While turning the crankshaft by hand, check that it turns smoothly.

6. Install the lower cylinder block.
   - Apply RTV Silicone Sealant to the positions as shown.

   NOTE:
   Cylinder block and lower cylinder block are machined together. Neither of them can be replaced separately.

   CAUTION:
   After the RTV Silicone Sealant is applied, the lower cylinder block installation must be finished within 5 minutes.

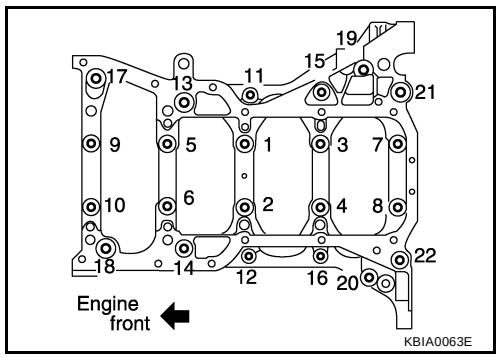


7. Tighten lower cylinder block mounting bolts in the numerical order shown and according to the following steps:

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

b. Tighten bolts No. 1 - 10 only in the order shown, to specification below.

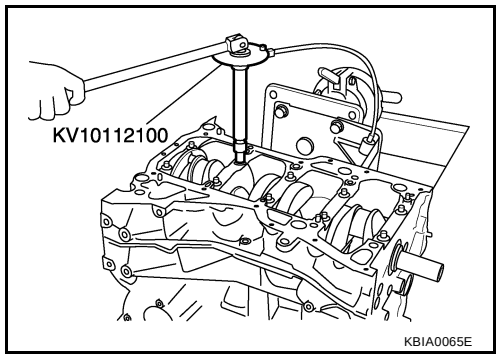
First tightening, bolts 1 - 10 only	**: 36.3 - 42.2 N·m (3.7 - 4.3 kg-m, 27 - 31 ft-lb)**



c. Tighten bolts No. 1 - 10 only in the order shown, to specification below.

   CAUTION:
   Use an angle wrench (special service tool) or protractor to check tightening angle. Do not make judgment by visual inspection.

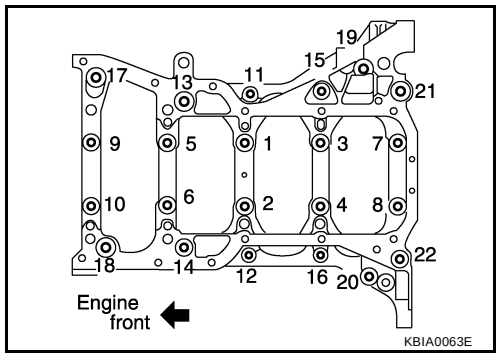
Second tightening, bolts 1 - 10 only	**: 60° - 65° degrees rotation (target: 60° degrees)**



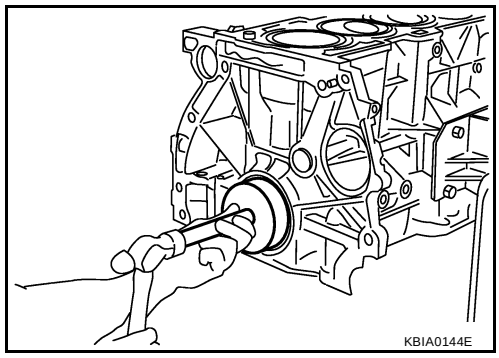
d. Tighten bolts No. 11 - 22 only in the order shown, to specification below.

Third tightening, bolts 11 - 22 only	**: 22.6 - 27.5 N·m (2.3 - 2.8 kg-m, 17 - 20 ft-lb)**

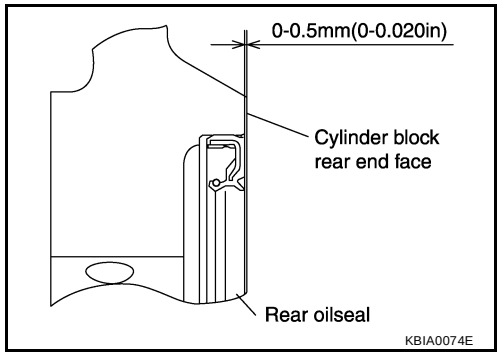
- Wipe off completely any protruding RTV Silicone Sealant on the exterior of engine.
- Check crankshaft side clearance. Refer to EM-81, "CRANKSHAFT SIDE CLEARANCE" .
- After installing the mounting bolts, make sure that the crankshaft can be rotated smoothly by hand.



8. Install the rear oil seal.
   - Press the oil seal between cylinder block and crankshaft with a suitable drift as shown.
   - Be careful not to touch the grease on the oil seal lip.
   - Be careful not to cause scratches or burrs when pressing in the rear oil seal.



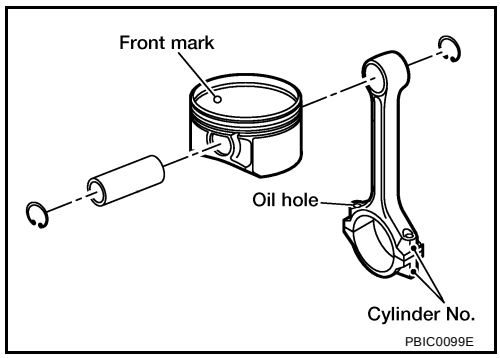
- Press in rear oil seal to the specified height as shown.



9. Install the piston to the connecting rod. Assemble the components in their original positions.

a. Using a snap ring pliers, install the snap ring to the grooves of the piston's rear side.
   - Insert the piston pin snap ring fully into groove.

b. Install the piston to the connecting rod.
   - Using a heat gun, heat the piston [approximately 60° - 70 C° (140° - 158 °F)] until the piston pin can be pushed in by hand without excessive force. From the front to the rear, insert the piston pin into the piston and the connecting rod.
   - Assemble so that the front mark on the piston crown and the oil holes and the cylinder No. on the connecting rod are positioned as shown.



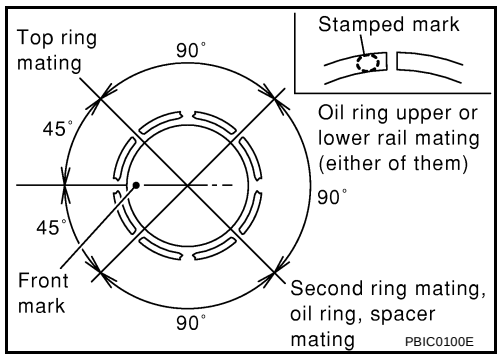
c. Install the piston pin snap ring into the front of the piston.
   - Check that the connecting rod moves smoothly.

10. Using a piston ring expander, install the piston rings. Assemble the components in their original positions.

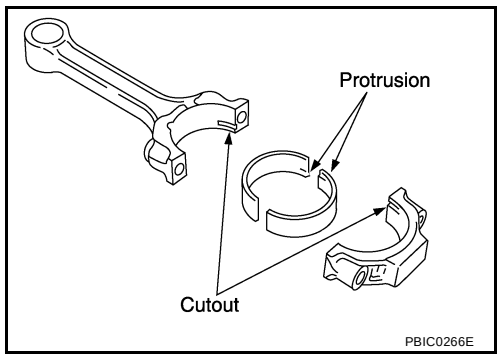
CAUTION:
Be careful not to damage the piston.

- Position each ring with the gap as shown in the figure, referencing the piston front mark as the starting point.
- Install the top ring and the second ring with the stamped surface facing upward.

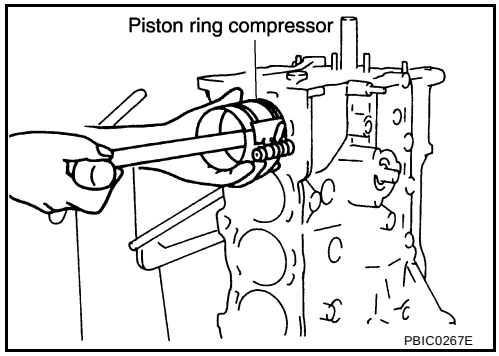
Stamped mark (face upwards)
Top ring : A
Second ring : 2A



11. Install the connecting rod bearings to the connecting rod and the connecting rod cap. Assemble the components in their original positions.
   - When installing the connecting rod bearings, apply engine oil to the bearing friction surface (inside). Do not apply oil to the back surface, but thoroughly clean the back.
   - When installing, align the connecting rod bearing stopper protrusion with the notch of the connecting rod to install.
   - Check the oil holes on the connecting rod and those on the corresponding bearing are aligned.

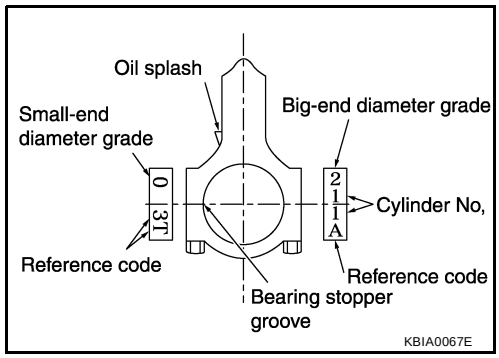


12. Install the piston and connecting rod assembly to the crankshaft. Assemble the components in their original positions.
    - Rotate the crankshaft so the pin corresponding to the connecting rod to be installed is at the bottom dead center position.
    - Apply engine oil sufficiently to the cylinder bore, piston, and crankshaft pin.
    - Match the cylinder position number with the cylinder No. on the connecting rod for installation.
    - Using a piston ring compressor, install the piston with the front mark on the piston crown facing the front of the engine.



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

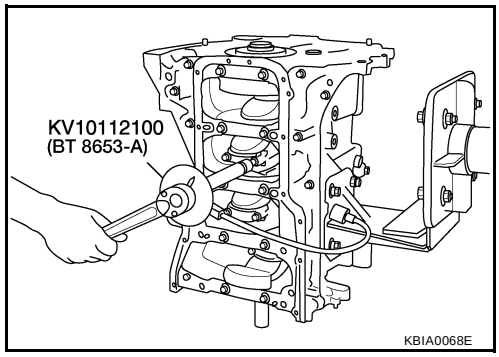
13. Install the connecting rod caps. Assemble the components in their original positions.
    - Match the stamped cylinder number marks on the connecting rod with those on the cap to install.



14. Tighten the connecting rod bolt as follows:
    Apply engine oil to the threads and seats of the connecting rod bolts.

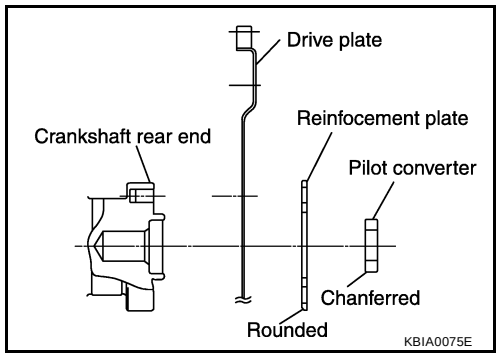
CAUTION:
Always use either an angle wrench or protractor. Avoid tightening based on visual check alone.

Stage 1 : 18.6 - 20.6 N·m (1.9 - 2.1 kg-m, 14 - 15 ft-lb)
Stage 2 : Rotate bolts 85° - 95° degrees (target 90° degrees)

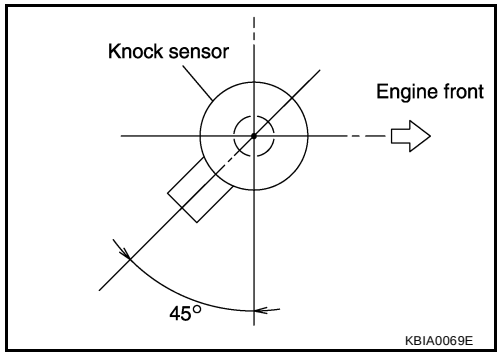


- Check the connecting rod side clearance. Refer to EM-82, "CONNECTING ROD SIDE CLEARANCE" .
- After tightening the bolts, make sure that the crankshaft rotates smoothly.

15. Install flywheel (M/T Models), or drive plate (A/T Models).
    - Install drive plate, reinforcement plate and pilot converter as shown in figure.
    - Using a drift with 33 mm (1.30 in) diameter, push pilot converter into the end of the crankshaft.



16. Install the knock sensor.
    - Make sure that there is no foreign material on the cylinder block mating surface and the back surface of the knock sensor.
    - Install the knock sensor with the connector facing lower left by 45° as shown.
    - Do not tighten the mounting bolts while holding the connector.
    - Make sure that the knock sensor does not interfere with other parts.



Knock sensor bolt : 15.7 - 26.5 N·m (1.6 - 2.7 kg-m, 12 - 19 ft-lb)

CAUTION:
If the knock sensor is dropped, replace it with new one.

17. Install the crankshaft position sensor (POS).

Crankshaft position sensor bolt : 5.4 - 7.3 N·m (0.55 - 0.75 kg-m, 48 - 65 in-lb)

18. Remaining installation is in the reverse order of removal.

How to Select Piston and Bearing

EBS007PI

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	—	—	—

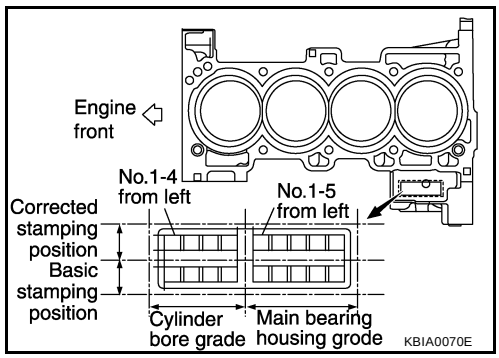
*For the service parts, the grade for fitting cannot be selected between a piston pin and a connecting rod. (Only 0 grade is available.) The information at the shipment from the plant is described as a reference.

- 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, refer to the text.

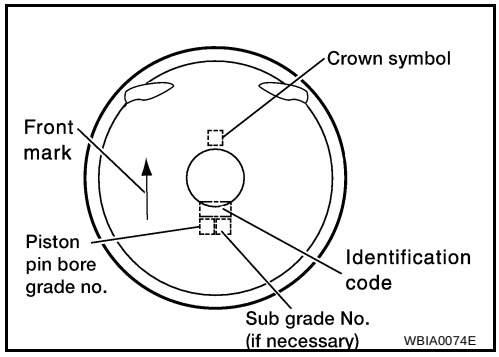
HOW TO SELECT A PISTON

When a New Cylinder Block is Used:

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



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



When a Cylinder Block is Reused:

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

Piston Selection Table

Unit: mm (in)

Grade number (Mark)	1	2 (or no mark)	3
Inner diameter of cylinder bore	89.000-89.010 (3.5039-3.5043)	89.010-89.020 (3.5043-3.5047)	89.020-89.030 (3.5047-3.5051)
Outer diameter of piston	88.980-88.990 (3.5031-3.5035)	88.990-89.000 (3.5035-3.5039)	89.000-89.010 (3.5039-3.5043)

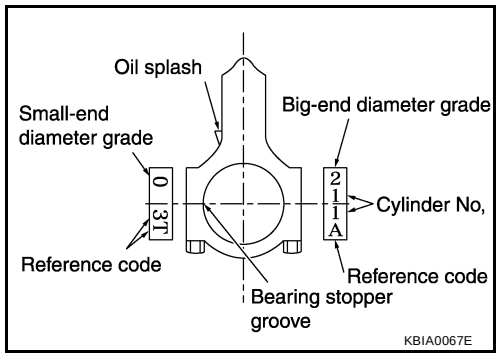
NOTE:

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

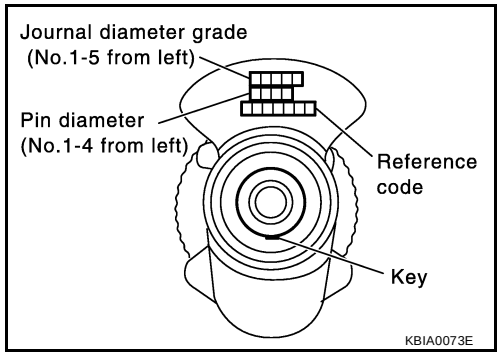
HOW TO SELECT A CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used:

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



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



When Crankshaft and Connecting Rod are Reused:

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

Connecting Rod Bearing Selection Table

Crankshaft pin outer diameter: Mark	Crankshaft pin outer diameter: Outer diameter Unit: mm (in)	Connecting rod big end. inner diameter: Mark	0	1	2	3	4	5	6	7	8	9	A	B	C
		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 (1.8900 – 1.8900)	48.006 – 48.007 (1.8900 – 1.8900)	48.007 – 48.008 (1.8900 – 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	0	0	0	0	1	1	1	1	1
B	44.973 – 44.972 (1.7706 – 1.7705)		0	0	0	0	0	0	0	1	1	1	1	1	1
C	44.972 – 44.971 (1.7705 – 1.7705)		0	0	0	0	0	0	1	1	1	1	1	1	1
D	44.971 – 44.970 (1.7705 – 1.7705)		0	0	0	0	0	1	1	1	1	1	1	1	1
E	44.970 – 44.969 (1.7705 – 1.7704)		0	0	0	0	1	1	1	1	1	1	1	1	2
F	44.969 – 44.968 (1.7704 – 1.7704)		0	0	0	1	1	1	1	1	1	1	1	2	2
G	44.968 – 44.967 (1.7704 – 1.7704)		0	0	1	1	1	1	1	1	1	1	2	2	2
H	44.967 – 44.966 (1.7704 – 1.7703)		0	1	1	1	1	1	1	1	1	2	2	2	2
J	44.966 – 44.965 (1.7703 – 1.7703)		1	1	1	1	1	1	1	1	2	2	2	2	2
K	44.965 – 44.964 (1.7703 – 1.7702)		1	1	1	1	1	1	1	2	2	2	2	2	2
L	44.964 – 44.963 (1.7702 – 1.7702)		1	1	1	1	1	1	2	2	2	2	2	2	2
M	44.963 – 44.962 (1.7702 – 1.7702)		1	1	1	1	1	2	2	2	2	2	2	2	2
N	44.962 – 44.961 (1.7702 – 1.7701)		1	1	1	1	2	2	2	2	2	2	2	2	3
P	44.961 – 44.960 (1.7701 – 1.7701)		1	1	1	2	2	2	2	2	2	2	2	3	3
R	44.960 – 44.959 (1.7701 – 1.7700)		1	1	2	2	2	2	2	2	2	2	3	3	3
S	44.959 – 44.958 (1.7700 – 1.7700)		1	2	2	2	2	2	2	2	2	3	3	3	3
T	44.958 – 44.957 (1.7700 – 1.7700)		2	2	2	2	2	2	2	2	3	3	3	3	3
U	44.957 – 44.956 (1.7700 – 1.7699)		2	2	2	2	2	2	2	3	3	3	3	3	3

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Connecting Rod Bearing Grade Table

Grade	0	1	2	3
Upper / Lower thickness mm (in)	1.499 / 1.495 (0.0590/0.0589)	1.503 / 1.499 (0.0592 / 0.0590)	1.507 / 1.503 (0.0593 / 0.0592)	1.511 / 1.507 (0.0595 / 0.0593)
Identification color	Black	Brown	Green	Yellow

Undersize Bearing Usage Guide

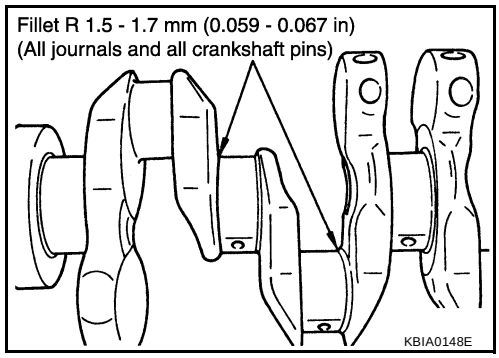
- When the specified oil clearance is not obtained with standard size connecting rod bearing, use undersize (US) bearing.
- When using undersize bearing, measure the bearing inner diameter with bearing installed, and grind the crankshaft pin so that the oil clearance satisfies the standard.

Bearing Undersize Table

Unit: mm (in)

Size U.S.	Thickness
0.25 (0.0098)	1.624 - 1.632 (0.0639 - 0.0643)

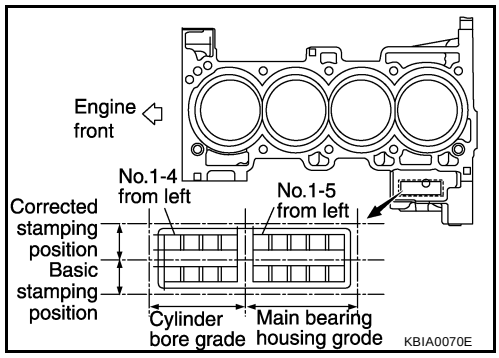
CAUTION:
In grinding the crankshaft pin to use undersize bearings, do not damage the fillet R (All crankshaft pins).



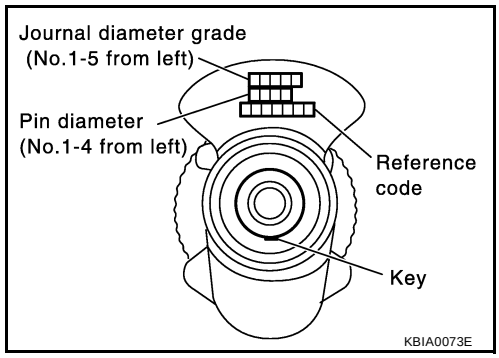
HOW TO SELECT A MAIN BEARING

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 stamped on crankshaft front side to column in "Main Bearing Selection Table".



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

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

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

KBIA0150E

Main Bearing Grade Table (All Journals)

Unit: mm (in)

Grade number	Thickness	Identification color (UPR / LWR)	Remarks
0	1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
2	1.979 - 1.982 (0.0779- 0.0780)	Green	
3	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
4	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
5	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
6	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
7	1.994 - 1.997 (0.0785 - 0.0786)	Orange	

01	UPR	1.973 - 1.976 (0.0777 - 0.0778)	Black / Brown	Grade and color are different for upper and lower bearings.
	LWR	1.976 - 1.979 (0.0778 - 0.0779)		
12	UPR	1.976 - 1.979 (0.0778 - 0.0779)	Brown / Green	
	LWR	1.979 - 1.982 (0.0779 - 0.0780)		
23	UPR	1.979 - 1.982 (0.0779 - 0.0780)	Green / Yellow	
	LWR	1.982 - 1.985 (0.0780 - 0.0781)		
34	UPR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow / Blue	
	LWR	1.985 - 1.988 (0.0781 - 0.0783)		
45	UPR	1.985 - 1.988 (0.0781 - 0.0783)	Blue / Pink	
	LWR	1.988 - 1.991 (0.0783 - 0.0784)		
56	UPR	1.988 - 1.991 (0.0783 - 0.0784)	Pink / Purple	
	LWR	1.991 - 1.994 (0.0784 - 0.0785)		
67	UPR	1.991 - 1.994 (0.0784 - 0.0785)	Purple / Orange	
	LWR	1.994 - 1.997 (0.0785 - 0.0786)		

Use Undersize Bearing Usage Guide

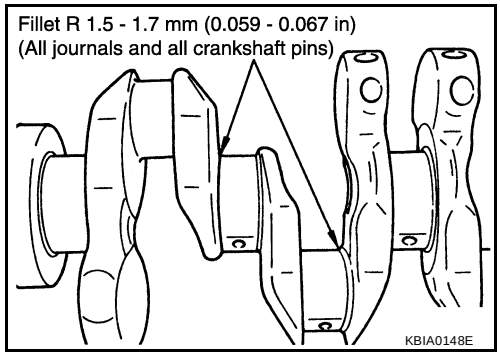
- Use undersize (U.S.) bearing when oil clearance with standard size main bearing is not within specification.
- When using undersize (U.S.) bearing, measure the bearing inner diameter with the bearing installed and grind journal until oil clearance falls within specification.

Bearing Undersize Table

Unit: mm (in)

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

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



Inspection After Disassembly

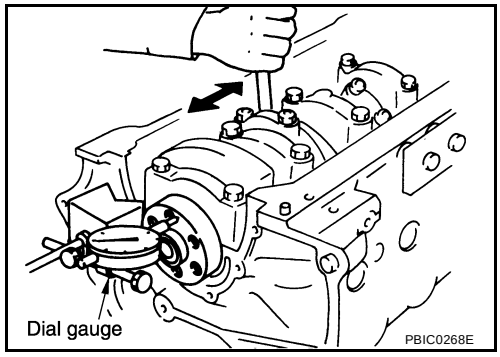
EBS007PJ

CRANKSHAFT SIDE CLEARANCE

- Using a dial gauge, measure the clearance between the thrust bearings and the crankshaft arm when the crankshaft is moved fully forward or backward.

  Standard : 0.10 - 0.26 mm (0.0039 - 0.0102 in)
  Limit : 0.30 mm (0.0118 in)

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

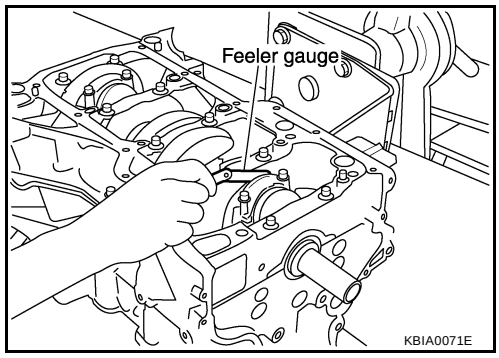


CONNECTING ROD SIDE CLEARANCE

- Measure side clearance between connecting rod and crankshaft arm with feeler gauge.

  Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)
  Limit : 0.50 mm (0.0197 in)

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

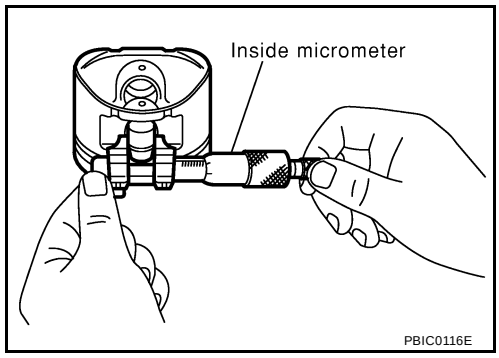


PISTON AND PISTON PIN CLEARANCE

Inner Diameter of Piston Pin

- Measure the inner diameter of piston pin bore with an inside micrometer.

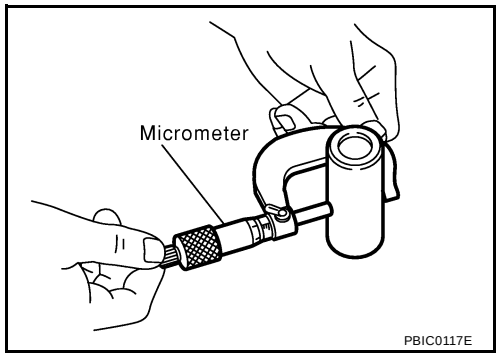
  Standard : 19.993 - 20.005 mm (0.7871 - 0.7876 in)



Outer Diameter of Piston Pin

- Measure outer diameter of piston pin with a micrometer.

  Standard : 19.989 - 20.001 mm (0.7870 - 0.7874 in)

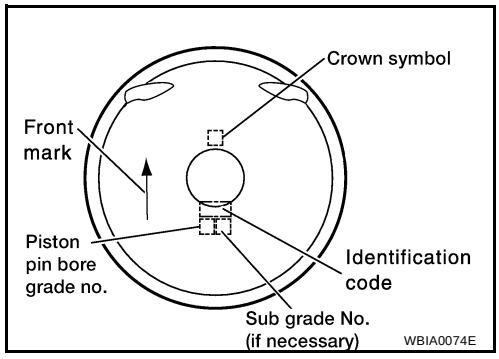


Piston and Piston Pin Clearance

(Piston pin clearance) = (Piston pin bore diameter) – (Outer diameter of piston pin)

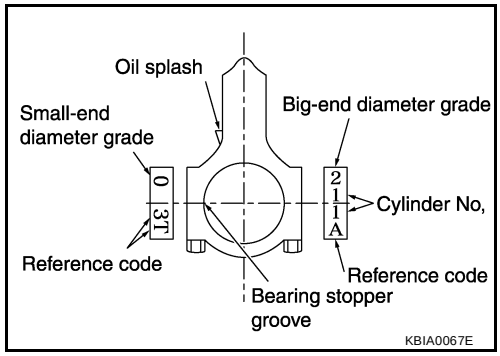
Standard : 0.002 - 0.006 mm (0.0001 - 0.0002 in)

- If clearance exceeds specification, replace either or both of piston/piston pin assembly and connecting rod assembly with reference to specification of each parts.
- Refer to piston selection table to replace piston/piston pin assembly. Refer to EM-76, "HOW TO SELECT A PISTON" .



- Refer to connecting rod bearing selection table to replace connecting rod. Refer to EM-76, "HOW TO SELECT A CONNECTING ROD BEARING" .

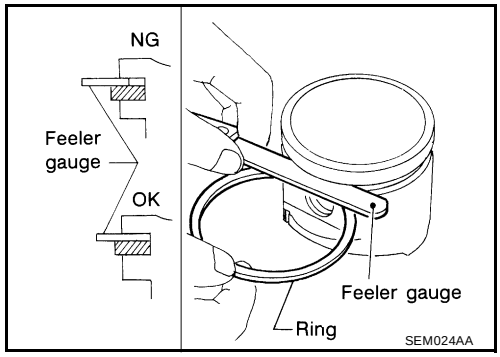
  NOTE:
  The connecting rod small end grade and piston pin hole (piston pin) grade are provided only for the parts installed at the plant. For service parts, no grades can be selected. Only 0 grade is available.



- Refer to EM-84, "CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)" for the values for each grade at the plant.
- Regarding marks on piston head, Refer to EM-76, "HOW TO SELECT A PISTON" .

PISTON RING SIDE CLEARANCE

- Measure side clearance of piston ring and piston ring groove with feeler gauge.



Standard

Top ring	**: 0.045 - 0.080 mm (0.0018 - 0.0031 in)**
2nd ring	**: 0.030 - 0.070 mm (0.0012 - 0.0028 in)**
Oil ring	**: 0.065 - 0.135 mm (0.0026 - 0.0053 in)**

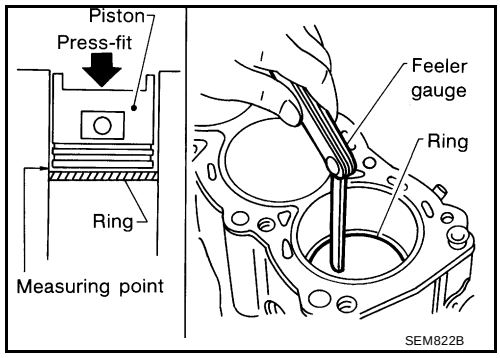
Limit

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

- If out of specification, replace piston and/or piston ring assembly.

PISTON RING END GAP

- Check if inner diameter of cylinder bore is within specification. Refer to EM-86, "PISTON TO CYLINDER BORE CLEARANCE" .
- Insert piston ring until middle of cylinder with piston, and measure gap.



Standard

Top ring	**: 0.21 - 0.31 mm (0.0083 - 0.0122 in)**
2nd ring	**: 0.32 - 0.47 mm (0.0126 - 0.0185 in)**
Oil ring	**: 0.20 - 0.60 mm (0.0079 - 0.0236 in)**

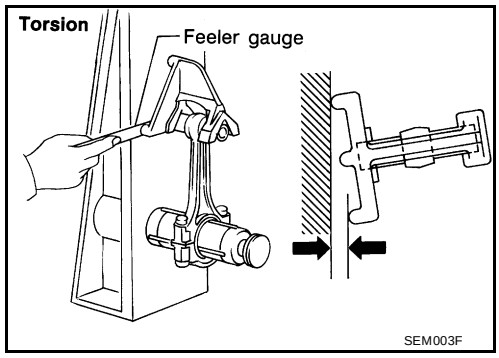
Limit

Top ring	**: 0.54 mm (0.0213 in)**
2nd ring	**: 0.67 mm (0.0264 in)**
Oil ring	**: 0.95 mm (0.0374 in)**

- If out of specification, replace piston ring. If gap still exceeds the limit even with a new ring, re-bore cylinder and use oversized piston and piston ring.

CONNECTING ROD BEND AND TORSION

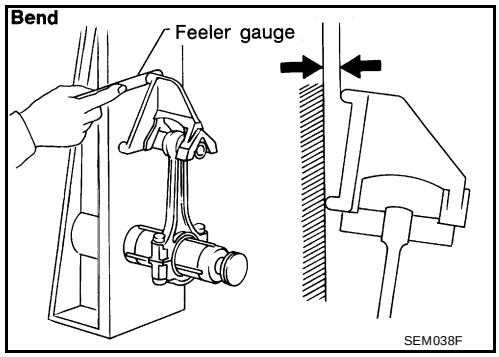
- Check the connecting rod bend and torsion on the aligner.



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

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

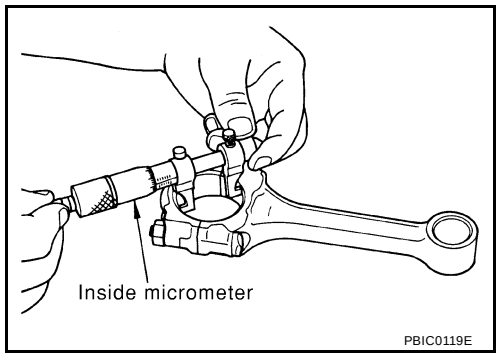
Torsion limit : **0.30 mm (0.0118 in) per 100 mm (3.94 in) length**



CONNECTING ROD BEARING (BIG END)

- Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod bolt to the specified torque, measure the connecting rod big end inner diameter using an inside micrometer.

Standard : **48.000 - 48.013 mm (1.8898 - 1.8903 in)**

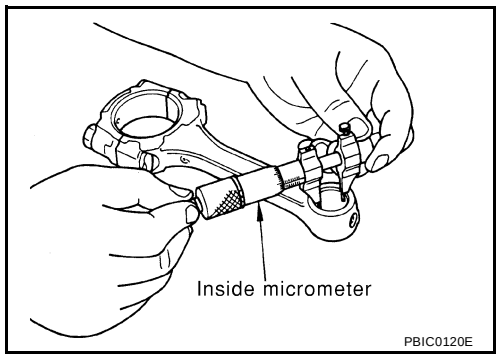


CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

Inner Diameter of Connecting Rod (Small End)

- Measure inner diameter of bushing.

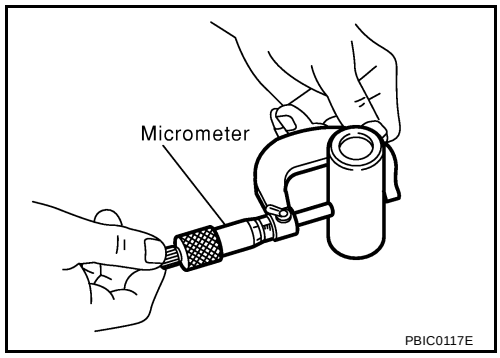
Standard : **20.000 - 20.012 mm (0.7874 - 0.7879 in)**



Outer Diameter of Piston Pin

- Measure outer diameter of piston pin.

Standard : 19.989 - 20.001 mm (0.7870 - 0.7874 in)

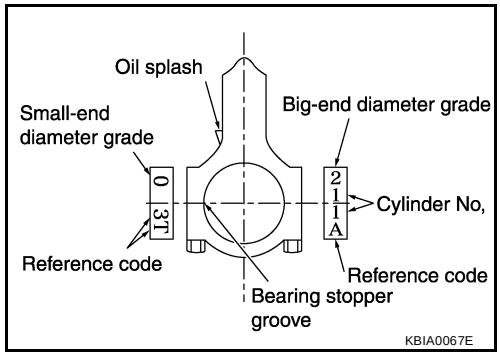


Connecting Rod Bushing Oil Clearance (Small End)

(Connecting rod small end oil clearance) = (Inner diameter of connecting rod small end) – (Outer diameter of piston pin)

Standard : 0.005 - 0.017 mm (0.0002 - 0.0007 in)

- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, refer to the "Piston Selection Table" to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Refer to EM-76, "HOW TO SELECT A PISTON" .

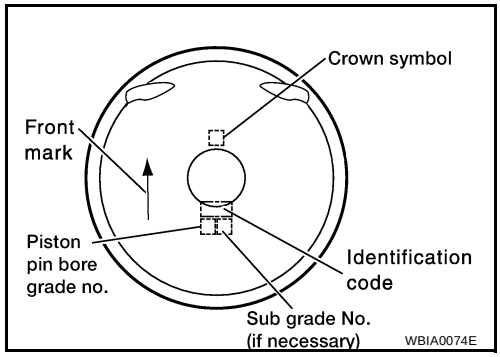


Factory Installed Parts Grading:

NOTE:
Service parts apply only to grade 0.

Unit: mm (in)

Grade	0	1
Connecting rod small end inner diameter	20.000 - 20.006 (0.7874 - 0.7876)	20.006 - 20.012 (0.7876 - 0.7879)
Piston pin outer diameter	19.989 - 19.995 (0.7870 - 0.7872)	19.995 - 20. 001 (0.7872 - 0.7874)
Piston pin bore diameter	19.993 - 19.999 (0.7871- 0.7874)	19.999 - 20.005 (0.7874 - 0.7876)

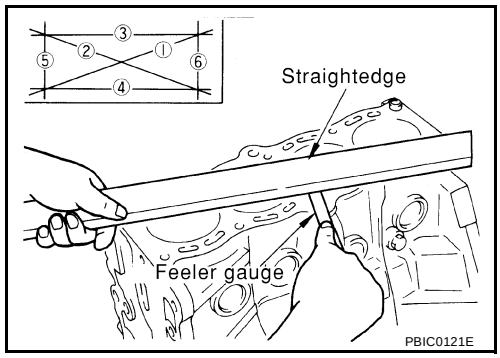


CYLINDER BLOCK DISTORTION

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

  CAUTION:
  Be careful not to allow gasket debris to enter the oil or coolant passages.
- Measure the distortion on the block upper face at some different points in 6 directions.
- If out of the distortion limit, replace the cylinder block.

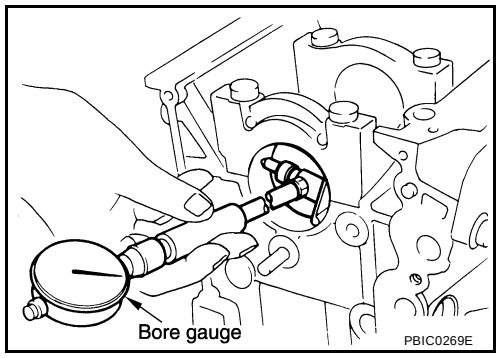
Limit : 0.1 mm (0.004 in)



INNER DIAMETER OF MAIN BEARING HOUSING

- Install the main bearing caps with the main bearings removed and tighten the mounting bolts to the specified torque. Refer to EM-70, "ASSEMBLY" .
- Using a bore gauge, measure the inner diameter of the main bearing housing.
- If out of the standard, replace the cylinder block and lower cylinder block assembly.

NOTE:
These components cannot be replaced as a single unit because they were processed together.



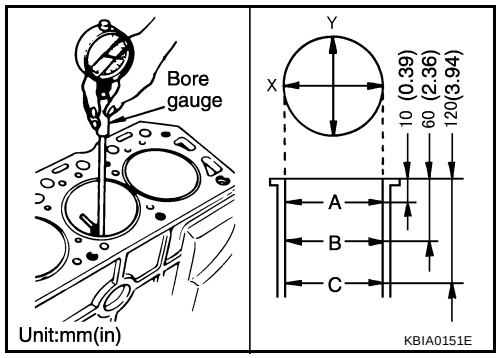
Standard : 58.944 - 58.967 mm (2.3206 - 2.3215 in)

PISTON TO CYLINDER BORE CLEARANCE

Inner Diameter of Cylinder Bore

- Using a bore gauge, measure cylinder bore for wear, out-of-round and taper at 6 different points on each cylinder. (X and Y directions at A, B and C). The Y axis is in the longitudinal direction of the engine.

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



Standard inner diameter:	**89.000 - 89.030 mm (3.5039 - 3.5051 in)**
Wear limit:	**0.2 mm (0.008 in)**
Out-of-round (difference between X – Y):	**0.015 mm (0.0006 in)**
Taper limit (difference between C – A):	**0.01 mm (0.0004 in)**

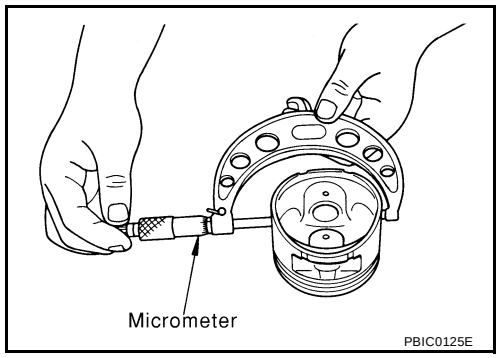
- If the measured value rebore exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone the inner wall.
- An oversize piston is provided. When using an oversize piston, rebore the cylinder so that the clearance of the piston cylinder satisfies the standard.

Over size (OS) : 0.2 mm (0.008 in)

Outer Diameter of Piston

- Measure piston skirt diameter.

Standard : 88.980 - 89.010 mm (3.5031 - 3.5043 in)



- Measure point (distance from the top): 42 mm (1.65 in)

Piston to Cylinder Bore Clearance

- Calculate by outer diameter of piston skirt and inner diameter of cylinder (direction X, position B).

(Clearance) = (Inner diameter of cylinder) – (Outer diameter of piston skirt).

Standard : 0.010 - 0.030 mm (0.0004 - 0.0012 in)
Limit : 0.08 mm (0.0031 in)

- If it exceeds the limit, replace piston/piston pin assembly.

Reboring Cylinder Bore

1. Cylinder bore size is determined by adding piston-to-bore clearance to piston diameter “A”.

   Rebored size calculation: D = A + B - C
   D : Bored diameter
   A : Piston diameter as measured
   B : Piston-to-bore clearance (standard value)
   C : Honing allowance 0.02 mm (0.0008 in)

2. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.
   - When any cylinder needs boring, all other cylinders must also be bored.
   - Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.
4. Hone cylinders to obtain specified piston-to-bore clearance.
5. Measure finished cylinder bore for out-of-round and taper.
   - Measurement should be done after cylinder bore cools down.

OUTER DIAMETER OF CRANKSHAFT JOURNAL

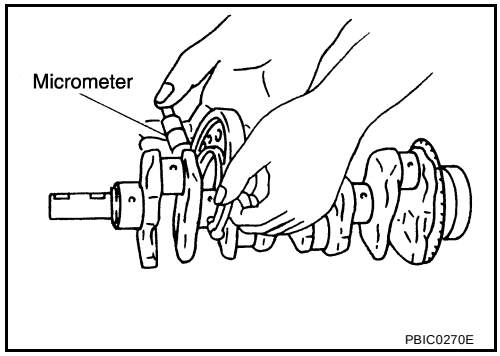
Measure outer diameter of crankshaft journals.

Standard : 54.955 - 54.979 mm (2.1636 - 2.1645 in)

OUTER DIAMETER OF CRANKSHAFT PIN

Measure outer diameter of crankshaft pin.

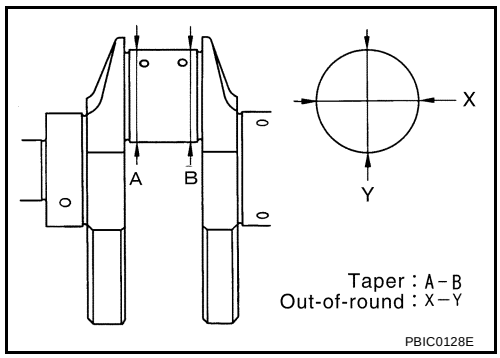
Standard : 44.956 - 44.974 mm (1.7699 - 1.7706 in)



OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Using a micrometer, measure the dimensions at four different points shown in the figure on each journal and pin.
- Out-of-round is indicated by the difference in dimensions between (X —Y) at A and B.
- Taper is indicated by the difference in dimensions between (A – B) at X and Y.

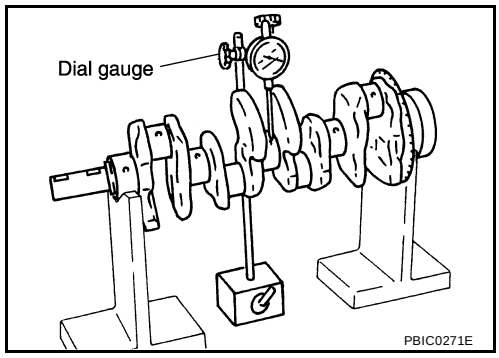
Limit
Out-of-round (X - Y) : 0.005 mm (0.0002 in)
Taper (A - B) : 0.005 mm (0.0002 in)



CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on both ends of the crankshaft.
- Place a dial gauge straight up on the No. 3 journal.
- While rotating the crankshaft, read the movement of the pointer on the dial gauge, the total indicator reading.

Limit : 0.05 mm (0.002 in)

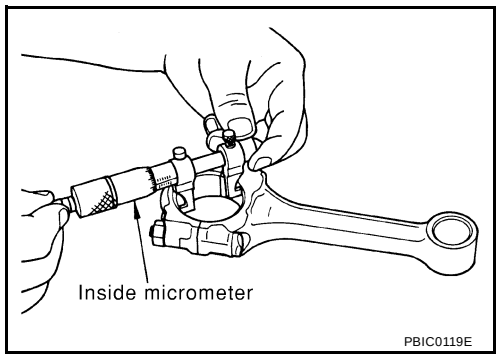


OIL CLEARANCE OF CONNECTING ROD BEARING

Method of Measurement

- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod bolts to the specified torque. Using a inside micrometer measure the inner diameter of connecting rod bearing.
  (Oil clearance) = (Inner diameter of connecting rod bearing) – (Outer diameter of crankshaft pin)

Standard : 0.028 - 0.045 mm (0.0011 - 0.0018 in)
Limit : 0.10 mm (0.0039 in)



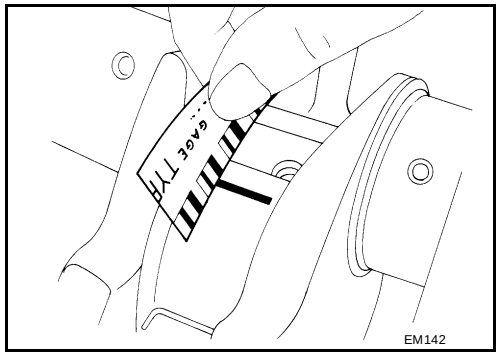
- If clearance cannot be adjusted within the standard, grind crankshaft pin and use undersized bearing. Refer to EM-76, "HOW TO SELECT A CONNECTING ROD BEARING" .

Method of Using Plastigage

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

CAUTION:
Never rotate the crankshaft.

- Remove the connecting rod cap and bearings, and using the scale on the Plastigage bag, measure the Plastigage width.



NOTE:
The procedure when the measured value exceeds the limit is same as that described in the method by calculation.

OIL CLEARANCE OF MAIN BEARING

Method of Measurement

- Install the main bearings to the cylinder block and bearing cap. Measure the main bearing inner diameter with the bearing cap bolt tightened to the specified torque.
  (Oil clearance) = (Inner diameter of main bearing) – (Outer diameter of crankshaft journal)

Standard
No. 1, 3, and 5 journals : 0.012 - 0.022 mm (0.0005 - 0.0009 in)
No. 2 and 4 journals : 0.018 - 0.028 mm (0.0007 - 0.0011 in)
Limit : 0.1 mm (0.004 in)

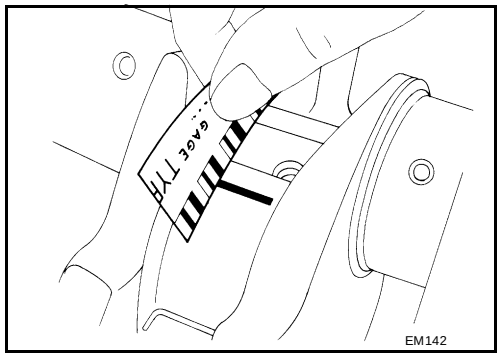
- If the measured value exceeds the limit, select main bearings referring to the main bearing inner diameter and crankshaft journal outer diameter, so that the oil clearance satisfies the standard. Refer to EM-78, "HOW TO SELECT A MAIN BEARING" .

Method of Using Plastigage

- Remove oil and dust on the crankshaft journal and the surfaces of each bearing completely.
- Cut the Plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Tighten the main bearing bolts to the specified torque.

  CAUTION:
  Never rotate the crankshaft.
- Remove the bearing cap and bearings, and using the scale on the plastigage bag, measure the plastigage width.

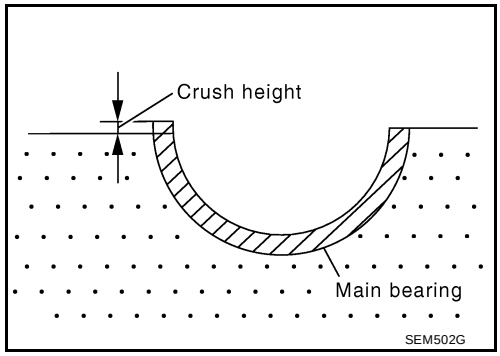
  NOTE:
  The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



CRUSH HEIGHT OF MAIN BEARING

- When the bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude.

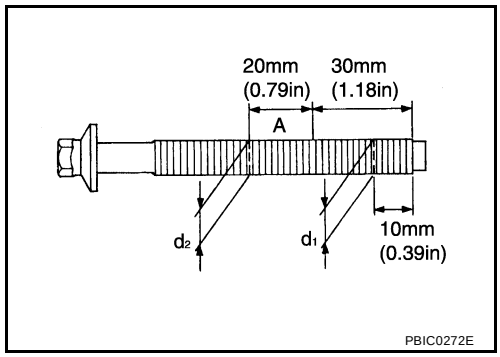
  Standard : There must be crush height.
- If the standard is not met, replace main bearings.



OUTER DIAMETER OF LOWER CYLINDER BLOCK MOUNTING BOLT

- Perform only with M10 (0.39 in) bolts.
- Measure outer diameters (d1, d2) at two positions as shown.
- Measure d2 at a point within block A.
- When the value of d1- d2 exceeds the limit (a large difference in dimensions), replace the bolt with a new one.

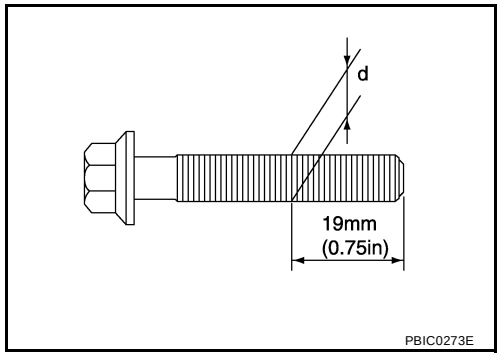
  Limit : 0.13 mm (0.0051 in) or more



OUTER DIAMETER OF CONNECTING ROD BOLT

- Measure outer diameter (d) at position shown in the figure.
- When “d” exceeds the limit (when it becomes thinner), replace the bolt with a new one.

  Limit : 7.75 mm (0.3051 in) or less



MOVEMENT AMOUNT OF FLYWHEEL (M/T MODEL)

NOTE:

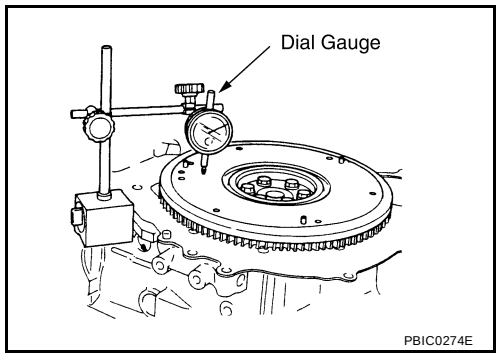
- Inspection for double mass flywheel only.
- Do not disassemble double mass flywheel.

Flywheel Deflection

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

Standard : 0.45 mm (0.0177 in) or less
Limit : 1.3 mm (0.051 in) or less

- When measured value exceeds the limit, replace the flywheel with a new one.

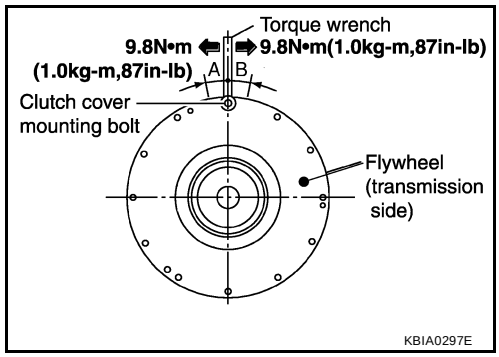


Movement Amount in Radial (Rotation) Direction

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

Standard : 28.3 mm (1.114 in) or less

- When the measured value is outside the standard, replace the flywheel.



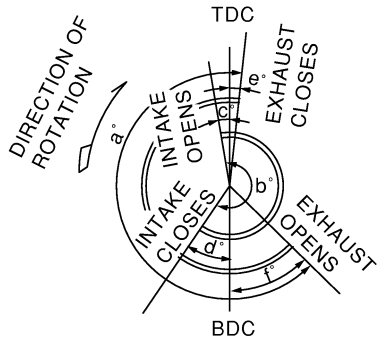
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

Standard and Limit

EBS007PK

GENERAL SPECIFICATIONS

Cylinder arrangement		4 in-line
Displacement cm^3 (cu in)		2,488 (151.82)
Bore and stroke mm (in)		89.0x 100 (3.50 - 3.94)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		9.5
Compression pressure kPa (kg/cm^2 , psi) / 250 rpm	Standard	1,250 (12.8, 181.3)
	Minimum	1,060 (10.8, 153.7)
	Differential limit between cylinders	100 (1.0, 14)
Valve timing		

PBIC0187E

Unit: degree

a	b	c	d	e	f
224	244	0	64	3	41

INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

		Limit
Surface distortion	Intake manifold collector	0.1 (0.004)
	Intake manifold	0.1 (0.004)
	Exhaust manifold	0.3 (0.012)

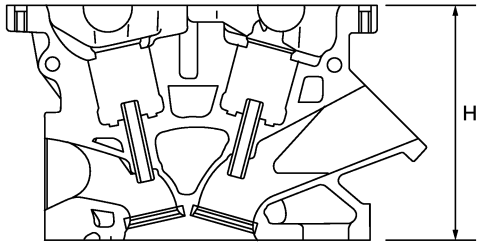
DRIVE BELTS

Tension of drive belts	Auto adjustment by auto tensioner

CYLINDER HEAD

Unit: mm (in)

	Limit
Head surface distortion	0.1 (0.004)



Nominal cylinder head height:
H = 129.4 mm (5.09 in)

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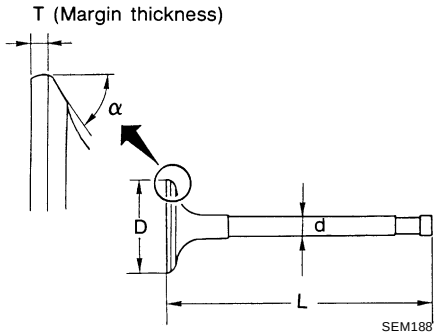
VALVE

Valve Dimensions

Unit: mm (in)



SEM188

Valve head diameter “D”	Intake	35.5 - 35.8 (1.398 - 1.409)
	Exhaust	30.5 - 30.8 (1.201 - 1.213)
Valve length “L”	Intake	97.16 (3.8252)
	Exhaust	98.82 (3.8905)
Valve stem diameter “d”	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle “α”	Intake	45°15′ - 45°45′
	Exhaust	
Valve margin “T”	Intake	1.1 (0.043)
	Exhaust	1.3 (0.051)

Valve Clearance

Unit: mm (in)

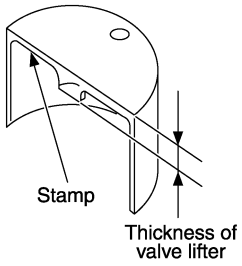
	Cold* (reference data)	Hot
Intake	0.24 - 0.32 (0.009 - 0.013)	0.32 - 0.40 (0.013 - 0.016)
Exhaust	0.26 - 0.34 (0.010 - 0.013)	0.33 - 0.41 (0.013 - 0.016)

*: Approximately 20°C (68 °F)

Available Valve Lifter

Thickness mm (in)	Identification mark
6.96 (0.2740)	696
6.98 (0.2748)	698
7.00 (0.2756)	700

Thickness mm (in)	Identification mark
7.02 (0.2764)	702
7.04 (0.2772)	704
7.06 (0.2780)	706
7.08 (0.2787)	708
7.10 (02795)	710
7.12 (0.2803)	712
7.14 (0.2811)	714
7.16 (0.2819)	716
7.18 (0.2827)	718
7.20 (0.2835)	720
7.22 (0.2843)	722
7.24(0.2850)	724
7.26 (0.2858)	726
7.28 (0.2866)	728
7.30(0.2874)	730
7.32 (0.2882)	732
7.34 (0.2890)	734
7.36 (0.2898)	736
7.38 (0.2906)	738
7.40 (0.2913)	740
7.42 (0.2921)	742
744 (0.2929)	744
7.46 (0.2937)	746



KBIA0119E

Valve Spring

Free height standard mm (in)	Intake	44.84 - 45.34 (1.7654 - 1.7850)
	Exhaust	45.28 - 45.78 (1.7827 - 1.8024)
Pressure standard N (kg, lb) at height mm (in)	Intake and Exhaust	151 - 175 (15.4 - 17.8, 34 - 39) at 35.30 (1.390)
Out-of-square mm (in)		1.9 (0.0748)

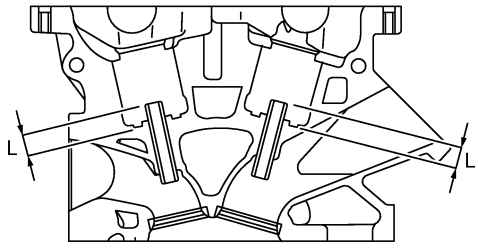
Valve Lifter

Unit: mm (in)

	Standard
Valve lifter outer diameter	33.965 - 33.980 (1.3372 - 1.3378)
Lifter guide inner diameter	34.000 - 34.021 (1.3386 - 1.3394)
Clearance between lifter and lifter guide	0.020 - 0.056 (0.0008 - 0.0022)

Valve Guide

Unit: mm (in)

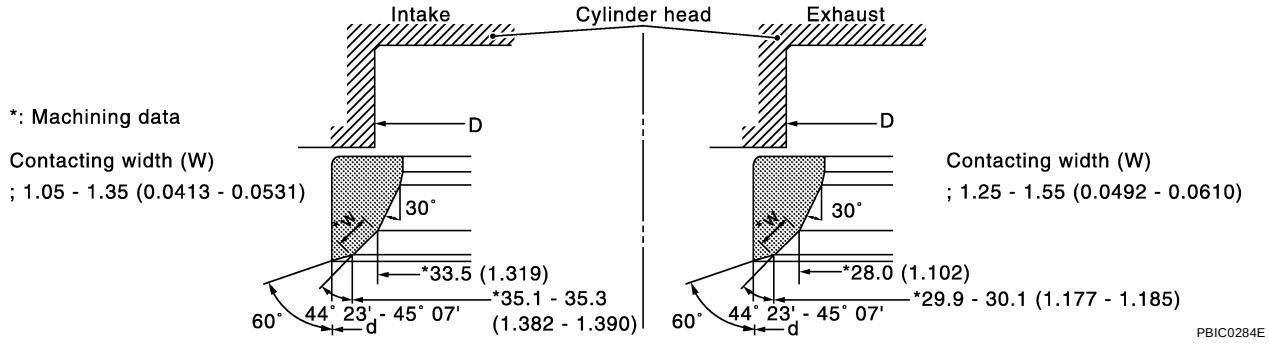


PBIC0184E

		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
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	
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	
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)



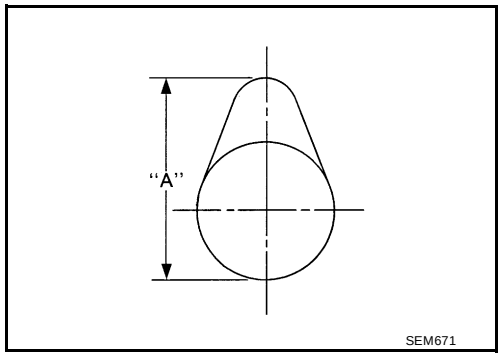
PBIC0284E

		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)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

		Standard
Camshaft runout [TIR*]		Less than 0.04 (0.0016)

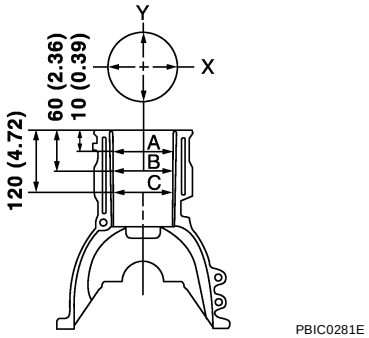


Cam height "A"	Intake	45.665 - 45.855 (1.7978 - 1.8053)
	Exhaust	43.975 - 44.165 (1.7313 - 1.7388)
Outer diameter of camshaft journal		No. 1 27.935 - 27.955 (1.0998 - 1.1006) No. 2, 3, 4, 5 23.435 - 23.455 (0.9226 - 0.9234)
Inner diameter of camshaft bracket		No.1 28.000 - 28.021 (1.1024 - 1.1032) No.2, 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)



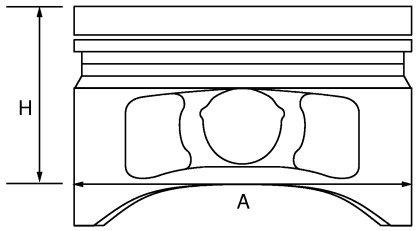
Surface flatness	Limit			0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 1	89.000 - 89.010 (3.5039 - 3.5043)
			Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)
			Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)
		Wear limit		0.2 (0.008)
Out-of-round (X – Y)				Less than 0.015 (0.0006)
Taper (C – A)				Less than 0.01 (0.0004)

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

PISTON, PISTON RING, AND PISTON PIN

Available Piston

Unit: mm (in)



PBIC0188E

Piston skirt diameter “A”	Standard	Grade No. 1	88.980 - 88.990 (3.5031 - 3.5035)
		Grade No. 2	88.990 - 89.000 (3.5035 - 3.5039)
		Grade No. 3	89.000 - 89.010 (3.5039 - 3.5043)
		0.20 (0.0079) oversize (service)	89.180 - 89.210 (3.5110 - 3.5122)
“H” dimension			42 (1.65)
Piston pin bore diameter		Grade No. 0	19.993 - 19.999 (0.7871 - 0.7874)
		Grade No. 1	19.999 - 20.005 (0.7874 - 0.7876)
Piston clearance to cylinder block		Standard	0.010 - 0.030 (0.0004 - 0.0012)
		Limit	0.08 (0.0031)

Piston Ring

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.004)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.21- 0.31 (0.0083 - 0.0122)	0.54 (0.0213)
	2nd	0.32 - 0.47 (0.0126 - 0.0185)	0.67 (0.0264)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.95 (0.0374)

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)
Interference fit of piston pin to piston		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)

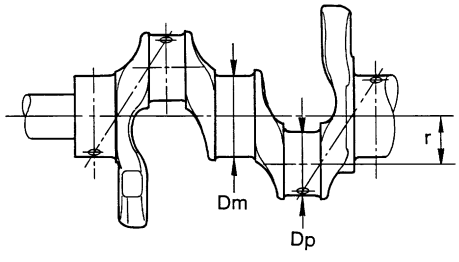
Center distance		143.00 - 143.10 (5.63 - 5.63)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end inner diameter		22.000 - 22.012 (0.7874 - 0.7879)
Connecting rod small end inner diameter*	Grade No. 0	20.000 - 20.006 (0.7874 - 0.7876)
	Grade No. 1	20.006 - 20.012 (0.7876 - 0.7879)
Connecting rod big end inner diameter		48.000 - 48.013 (1.8898 - 1.8903)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.50 (0.0197)
Connecting rod bearing housing	Grade No. 0	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)

*: After installing in connecting rod

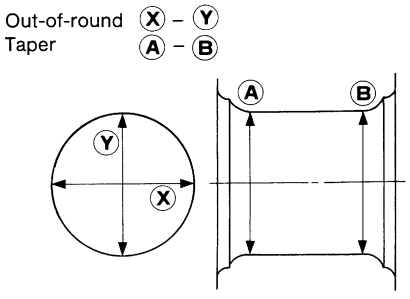
CRANKSHAFT

Unit: mm (in)

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)



SEM645

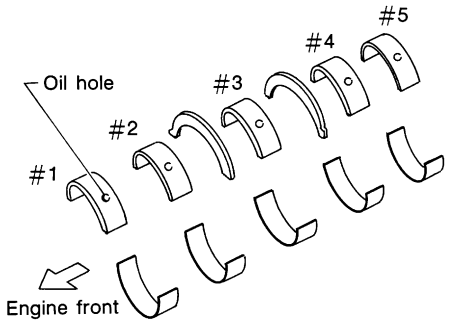


SEM715

*: Total indicator reading

MAIN BEARING

Unit: mm (in)



SEM685D

Grade number		Thickness	Identification color (UPR / LWR)	Remarks
0		1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1		1.976 - 1.979 (0.0778 - 0.0779)	Red	
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)	Orange	
01	UPR	1.973 - 1.976 (0.0777 - 0.0778)	Black / Red	Grade and color are different for upper and lower bearings.
	LWR	1.976 - 1.979 (0.0778 - 0.0779)		
12	UPR	1.976 - 1.979 (0.0778 - 0.0779)	Red / Green	
	LWR	1.979 - 1.982 (0.0779 - 0.0780)		
23	UPR	1.979 - 1.982 (0.0779 - 0.0780)	Green / Yellow	
	LWR	1.982 - 1.985 (0.0780 - 0.0781)		
34	UPR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow / Blue	
	LWR	1.985 - 1.988 (0.0781 - 0.0783)		
45	UPR	1.985 - 1.988 (0.0781 - 0.0783)	Blue / Pink	
	LWR	1.988 - 1.991 (0.0783 - 0.0784)		
56	UPR	1.988 - 1.991 (0.0783 - 0.0784)	Pink / Purple	
	LWR	1.991 - 1.994 (0.0784 - 0.0785)		
67	UPR	1.991 - 1.994 (0.0784 - 0.0785)	Purple / Orange	
	LWR	1.994 - 1.997 (0.0785 - 0.0786)		

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 clearance	Standard	No.1, 3, and 5	0.012 - 0.022 (0.0005 - 0.0009)
		No.2 and 4	0.018 - 0.028 (0.0007 - 0.0011)
	Limit		0.1 (0.004)

CONNECTING ROD BEARING

Grade number	Thickness mm (in)	Identification color (mark)
0	1.499 - 1.495 (0.0590 - 0.0589)	Black
1	1.503 - 1.499 (0.0592 - 0.0590)	Red
2	1.507 - 1.503 (0.0593 - 0.0592)	Green
3	1.511 - 1.507 (0.0595 - 0.0593)	Yellow

Undersize

Unit: mm (in)

Size U.S.	Thickness	Crank pin journal diameter
0.25 (0.0098)	1.624 - 1.632 (0.0639 - 0.0643)	Grind so that bearing clearance is the specified value.

Bearing Clearance

Unit: mm (in)

Connecting rod bearing clearance	Standard	0.028 - 0.045 (0.0011 - 0.0018)
	Limit	0.10 (0.0039)

PRECAUTIONS

PFP:00001

Precautions for Draining Coolant

EBS007PL

- Drain coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS007PM

- 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.

Precautions for Removal and Disassembly

EBS007PN

- 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.

Precautions for Inspection, Repair and Replacement

EBS007PO

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

Precautions for Assembly and Installation

EBS007PP

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

Parts Requiring Angular Tightening

EBS007PQ

- 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.

Precautions for Liquid Gasket

EBS007PR

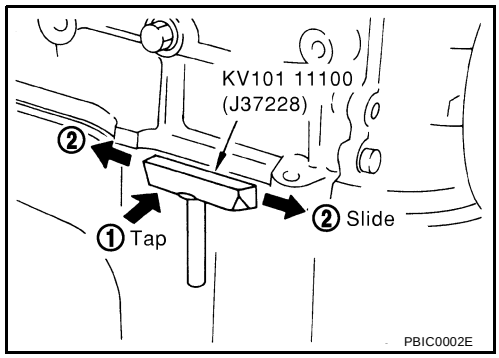
REMOVAL OF LIQUID GASKET SEALING

- After removing the mounting bolts and nuts, disconnect the component using a seal cutter.

  CAUTION:
  Be careful not to damage the mating surfaces.

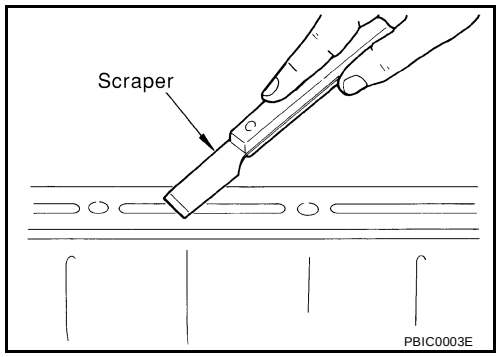
- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap the areas where the sealant is applied to disconnect the component.

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

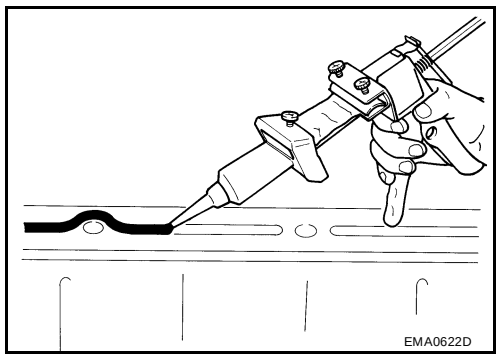


LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, remove the old sealant adhering to the gasket application surface and the mating surface.
   - Remove the sealant completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
2. Completely clean the gasket application surface and the mating surface to remove all of the adhering moisture, grease, and foreign materials.
3. Attach the sealant tube to the tube presser.
   Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



4. Apply the sealant without breaks to the specified location with the specified dimensions.
   - If there is a groove for the sealant application, apply the sealant to the groove.
   - As for the bolt holes, normally apply the sealant inside the holes. If specified, it should be applied outside the holes. Make sure to read the text in this manual.
   - Within five minutes of sealant application, install the mating component.
   - If the sealant protrudes, wipe it off immediately.
   - Do not retighten after the installation.
   - Wait 30 minutes or more after installation before filling the engine with oil and coolant.



CAUTION:
Follow all specific instructions in this manual.

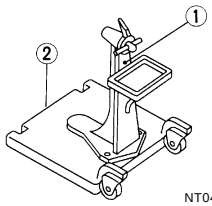
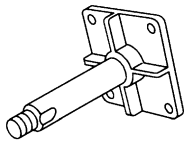
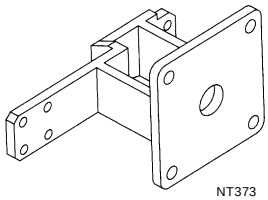
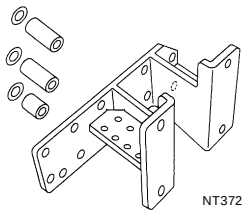
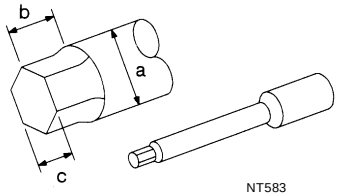
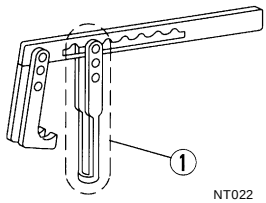
PREPARATION

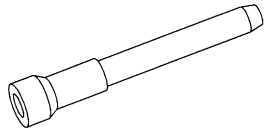
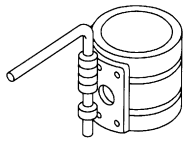
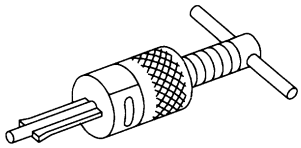
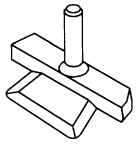
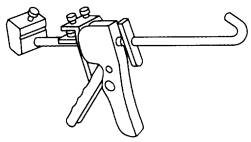
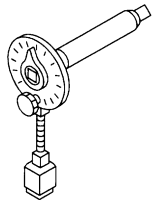
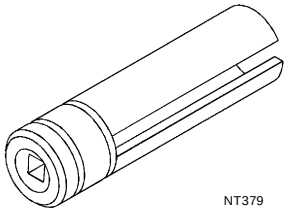
PFP:00002

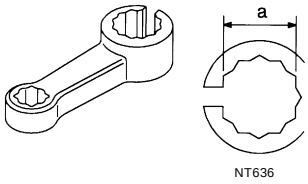
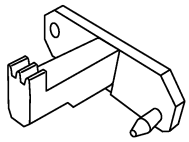
Special Service Tools

EBS007PS

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

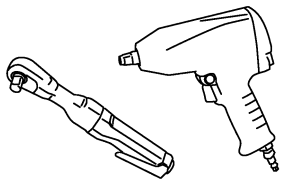
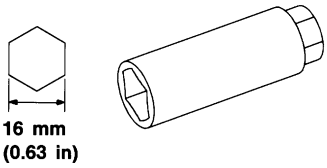
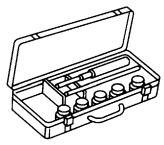
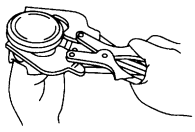
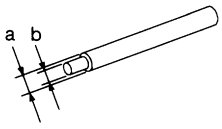
Tool number (Kent-Moore No.) Tool name		Description
ST0501S000 (—) Engine stand assembly 1 ST05011000 (—) Engine stand 2 ST05012000 (—) Base	 NT042	Disassembling and assembling
KV10106500 (—) Engine stand shaft	 NT028	
KV10117000 (J41262) Engine sub-attachment	 NT373	KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable).
KV10117001 (—) Engine sub-attachment	 NT372	Installing on the cylinder block
ST10120000 (J24239-01) Cylinder head bolt wrench	 NT583	Loosening and tightening cylinder head bolt **a: 13 mm (0.51 in) diameter** **b: 12 mm (0.47in) height** **c: 10 mm (0.39 in) width**
KV10116200 (J26336-A) Valve spring compressor 1 KV10115900 (J26336-20) Attachment	 NT022	Disassembling valve mechanism

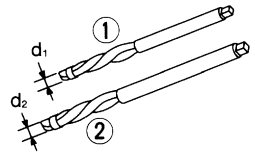
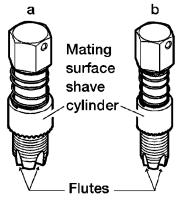
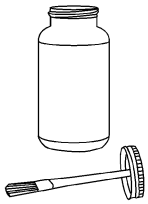
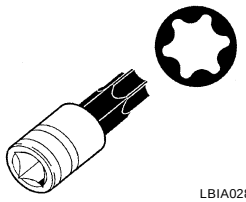
Tool number (Kent-Moore No.) Tool name	Description
(J39386) Valve oil seal drift  NT024	Installing valve oil seal
EM03470000 (J8037) Piston ring compressor  NT044	Installing piston assembly into cylinder bore
ST16610001 (J23907) Pilot bushing puller  NT045	Removing crankshaft pilot bushing
KV10111100 (J37228) Seal cutter  NT046	Removing steel oil pan and rear timing chain case
WS39930000 (—) Tube presser  NT052	Pressing the tube of liquid gasket
KV10112100 (BT8653-A) Angle wrench  NT014	Tightening bolts for bearing cap, cylinder head, etc.
KV10117100 (J3647-A) Heated oxygen sensor wrench  NT379	Loosening or tightening heated oxygen sensor **For 22 mm (0.87 in) hexagon nut**

Tool number (Kent-Moore No.) Tool name	Description
KV10114400 (J38365) Heated oxygen sensor wrench  NT636	Loosening or tightening rear heated oxygen sensor **a: 22 mm (0.87 in)**
KV10117700 (J44716) Ring gear stopper  NT822	Removing and installing crankshaft pulley

Commercial Service Tools

EBS007PT

(Kent-Moore No.) Tool name	Description
Power tool  PBIC0190E	Loosening bolts and nuts
Spark plug wrench  NT047	Removing and installing spark plug
Valve seat cutter set  NT048	Finishing valve seat dimensions
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.**

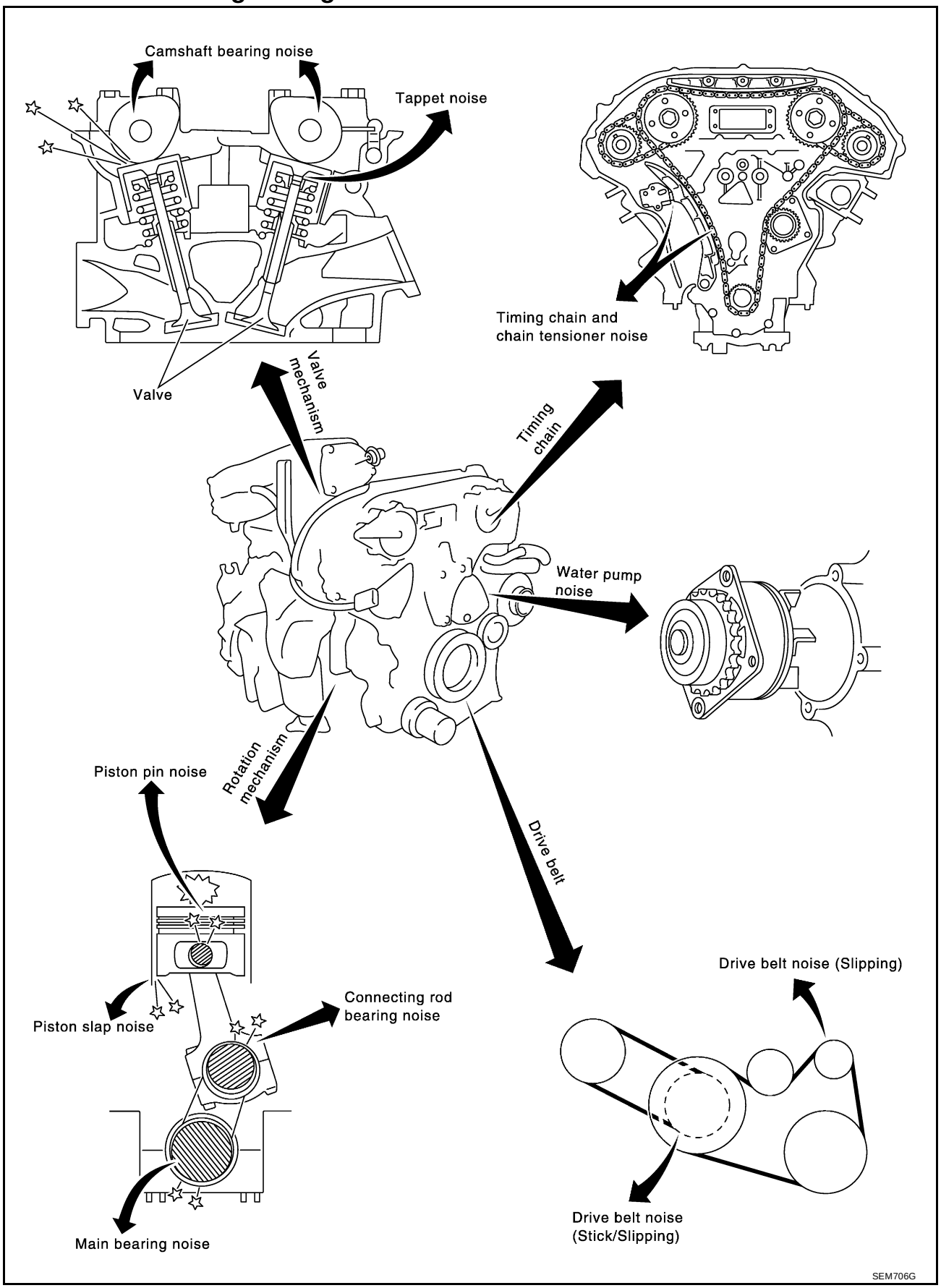
(Kent-Moore No.) Tool name	Description
Valve guide reamer  NT016	Reaming valve guide 1 or hole for oversize valve guide 2 **Intake & Exhaust:** **d_1 = 6.0 mm (0.236 in) dia.** **d_2 = 10.2 mm (0.402 in) dia.**
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner  AEM488	Reconditioning the exhaust system threads before installing a new oxygen sensor (use with anti-seize lubricant shown below) **a = J-43897-18 (18 mm dia.) for zirconia oxygen sensor** **b = J-43897-12 (12 mm dia.) for titania oxygen sensor**
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  AEM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads
T55 Torx® bit  LBIA0286E	Removing and installing the driveplate bolts (A/T), and the flywheel bolts (M/T)

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting — Engine Noise

EBS007PU



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

EBS007PV

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-164
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-134
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-164
	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-186
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-186
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-186
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-146
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-109
	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

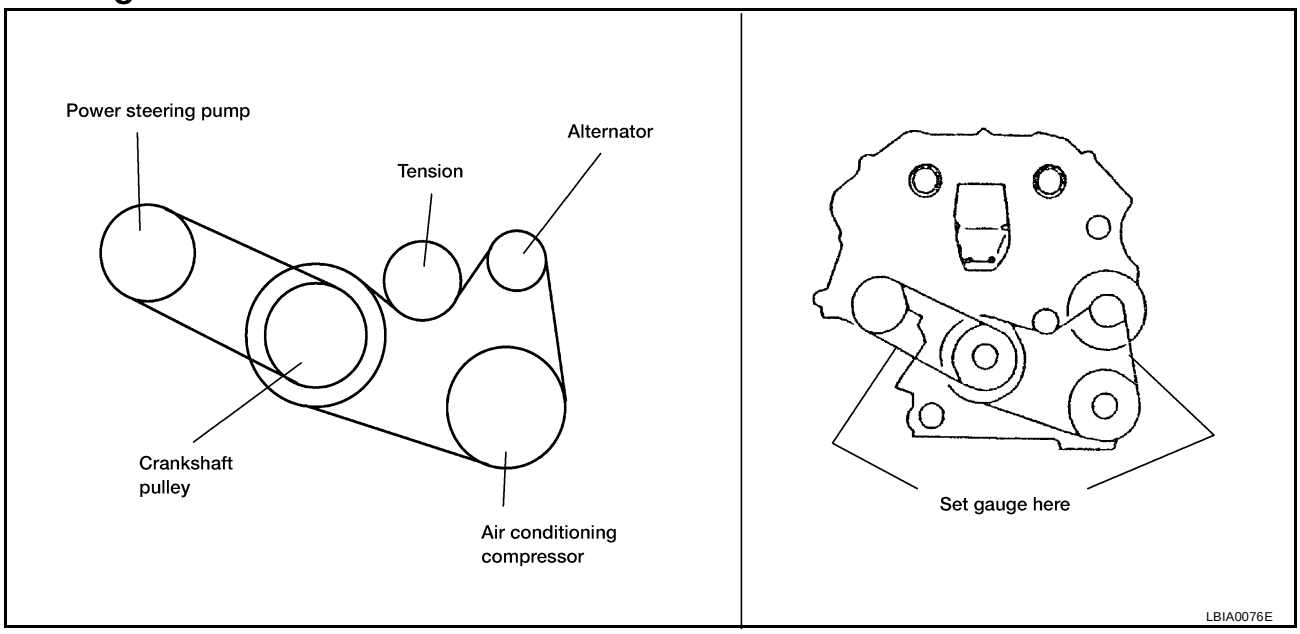
A: Closely related B: Related C: Sometimes related —: Not related

DRIVE BELTS

PFP:02117

Checking Drive Belts

EBS007PW



1. Inspect belt for cracks, fraying, wear or oil adhesion. If necessary, replace with a new one.
2. Inspect drive belt deflections by pushing on the belt midway between pulleys as shown.
3. Rotate the crankshaft pulley two times then check the belt tension using the Tool.

NOTE:
Inspect drive belt deflection or tension when engine is cold.
Adjust if belt deflections exceed the limit or if belt tension is not within specifications.

Belt Deflection and Tension

	Deflection adjustment		Unit: mm (in)	Tension adjustment*		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator and air conditioning compressor	7 (0.28)	4.2 - 4.6 (0.17 - 0.18)	3.7 - 4.1 (0.15 - 0.16)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
Power steering pump	11 (0.43)	7.3 - 8 (0.29 - 0.30)	6.5 - 7.2 (0.26 - 0.28)	196 (20, 44)	495 - 583 (50.5 - 59.5, 111 - 131)	603 - 691 (61.5 - 70.5, 135.6 - 155.4)
Applied pushing force	98 (10, 22)			—		

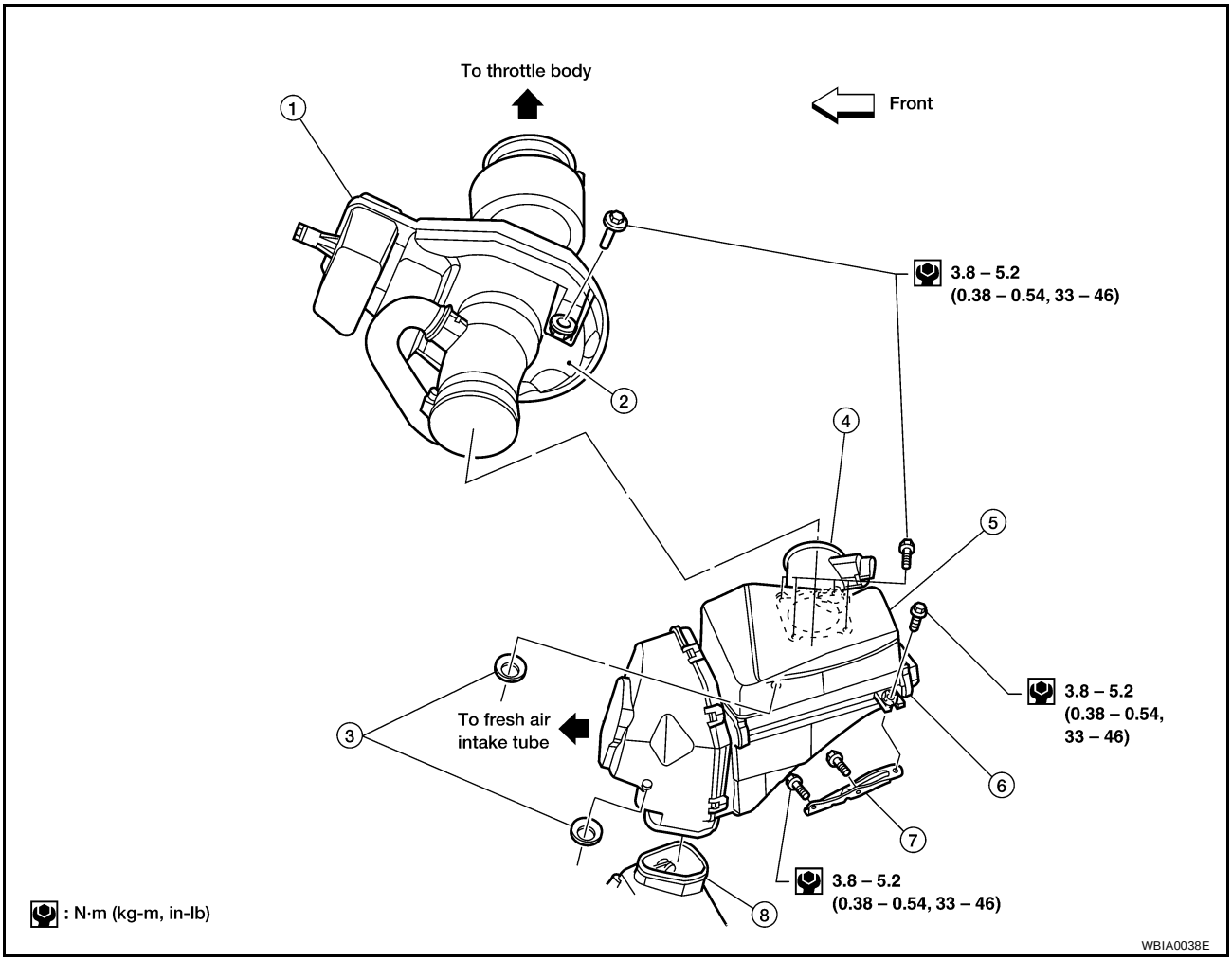
*: If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on the belt.

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

EBS007PX



1. Resonator
2. Air cleaner to electric throttle control actuator tube
3. Grommet
4. Mass air flow sensor
5. Air cleaner case (upper)
6. Air cleaner case (lower)
7. Air cleaner case mounting bracket
8. Resonator in fender

REMOVAL

1. Disconnect the harness connector from the mass air flow sensor.
2. Disconnect the tube clamp at the electric throttle control actuator and at the fresh air intake tube.
3. Remove air cleaner to electric throttle control actuator tube, air cleaner case (upper) with the mass air flow sensor attached.
4. Remove mass air flow sensor from air cleaner case (upper), as necessary.

   CAUTION:
   Handle mass air flow sensor with care.
   - **Do not shock it.**
   - **Do not disassemble it.**
   - **Do not touch its sensor.**
5. Remove resonator in the fender, lifting left fender protector, as necessary.

INSTALLATION

Installation is in the reverse order of removal.

CHANGING AIR CLEANER ELEMENT

1. Unhook the air cleaner case side clips and lift up the air cleaner case (upper).

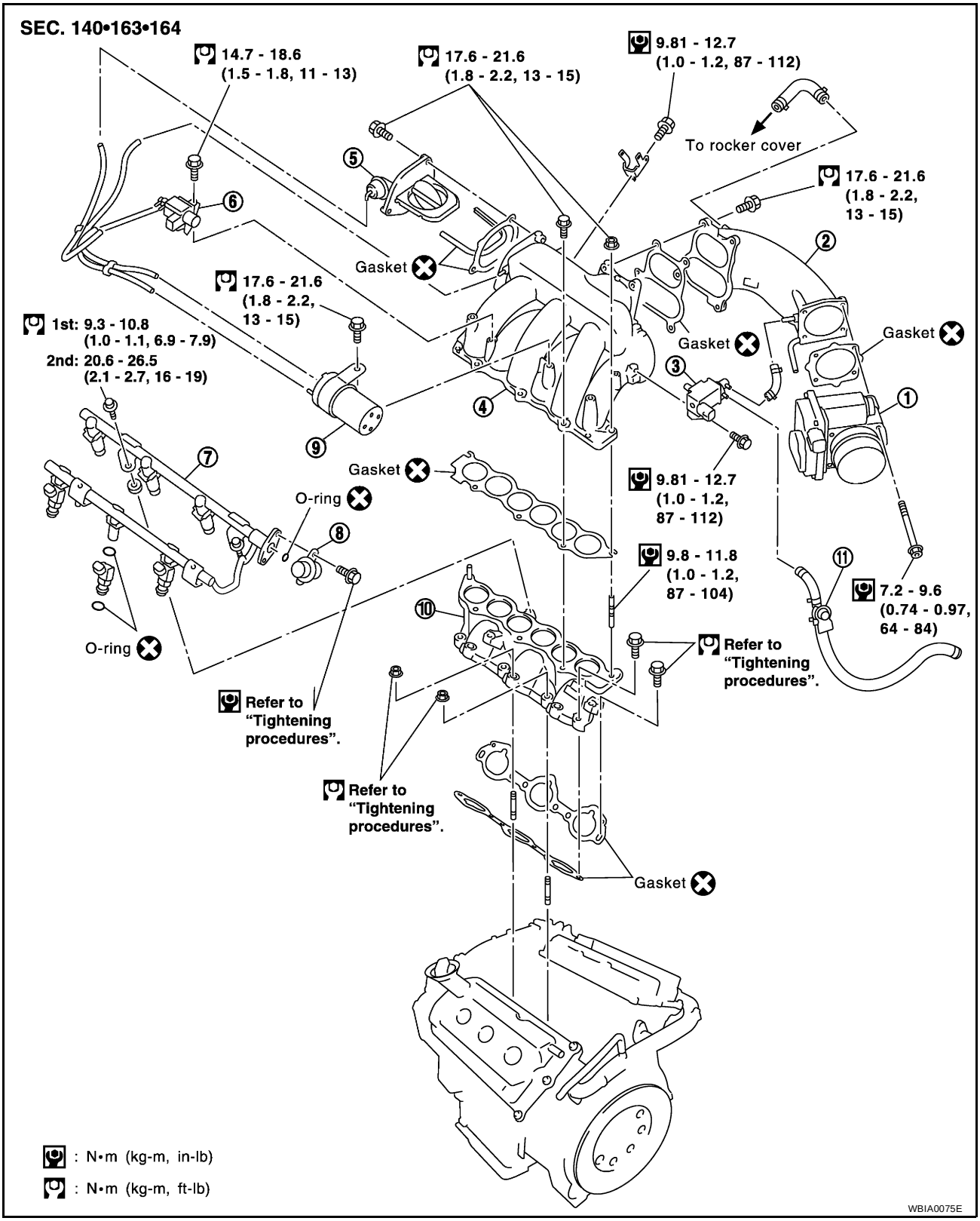
2. Remove the air cleaner element.
3. Install the new air cleaner element, making sure it is facing in the correct direction.
4. Install the air cleaner case (upper) and hook the air cleaner case side clips securely.

INTAKE MANIFOLD

PFP:14003

Removal and Installation

EBS007PY



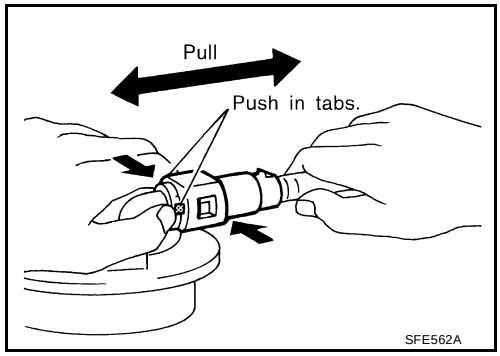
1. Electric throttle control actuator
2. Intake manifold collector (upper)
3. EVAP canister purge volume control solenoid valve
4. Intake manifold collector (lower)
5. Power valve
6. VIAS control solenoid valve
7. Fuel tube
8. Fuel damper
9. Vacuum tank
10. Intake manifold
11. Service port

REMOVAL

WARNING:

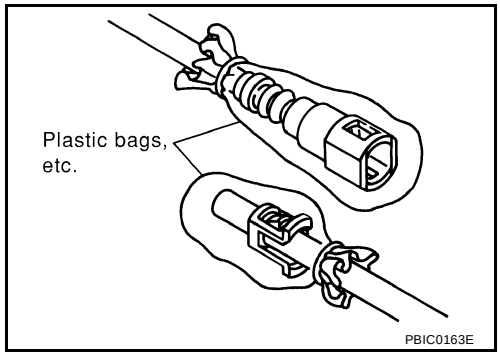
To avoid the danger of being scalded, never drain the coolant when the engine is hot.

1. Remove the engine cover with power tool.
2. Release the fuel pressure.
   Refer to EC-51, "FUEL PRESSURE RELEASE" .
3. Remove air cleaner case lid and mass air flow sensor, and air intake tube as an assembly.
   Refer to EM-110, "Removal and Installation" .
4. Partially drain the coolant when the engine is cool. Refer to EC-1102, "Description" .
5. Disconnect fuel tube quick connector at vehicle piping side.
6. To remove the quick connector cap, hold the sides of the connector, push in the tabs and pull out the tube. (Figure is for reference only.)



   NOTE:
   If the connector and the tube are stuck together, push and pull several times until they start to move. Then disconnect them by pulling.

   CAUTION:
   - **The tube can be removed when the tabs are completely depressed. Do not twist it more than necessary.**
   - **Do not use any tools to remove the quick connector.**
   - **Keep the resin tube away from heat. Be especially careful when welding near the tube.**
   - **Prevent acid liquids such as battery electrolyte, etc. from getting on the resin tube.**
   - **Do not bend or twist the tube during removal or installation.**
   - **Do not remove the remaining retainer on the tube**
   - **When the tube is replaced, also replace the retainer with a new one.**
   - **To keep the connecting portion clean and to avoid damage and foreign materials entering, cover the ends of the fuel tubes with plastic bags or something similar.**

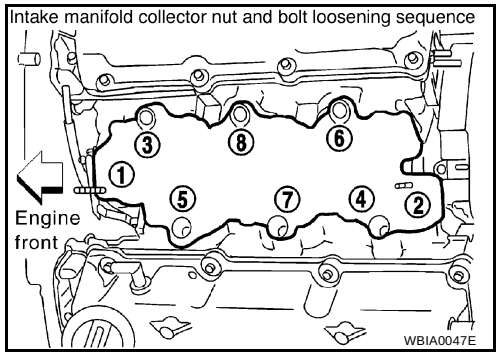


7. Disconnect the power brake booster vacuum hose, the coolant hoses from the electric throttle control actuator, the swirl control vacuum lines, the fuel injectors electrical connectors, and the PCV hose.

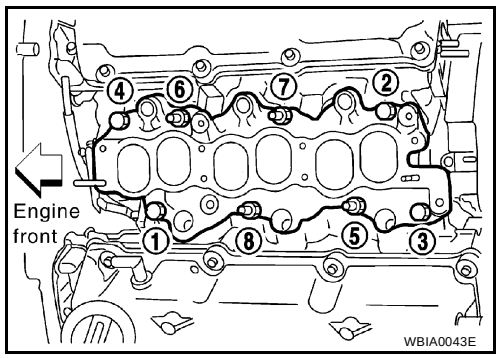
   CAUTION:
   Cover any engine openings to avoid the entry of any foreign material.
8. Disconnect the electric throttle control actuator electrical connectors.
9. Remove the cowl top grille and the windshield wiper assembly.
   Refer to EI-18, "Removal and Installation" .
10. Disconnect the power steering hose bracket.
11. Remove the vacuum tank from the back of the intake manifold collector.
12. Remove the intake manifold collector pipe and electric throttle control actuator by loosening the four bolts in a diagonal pattern.

    CAUTION:
    Handle carefully to avoid any shock to the electric throttle control actuator.

13. Loosen the bolts in the order shown, and remove the intake manifold collector with power tool.
14. Remove the fuel rail with the fuel injectors attached, from the intake manifold. Remove the fuel injector O-rings and use new O-rings for installation.



15. Loosen the bolts in the order shown, and remove the intake manifold with power tool.

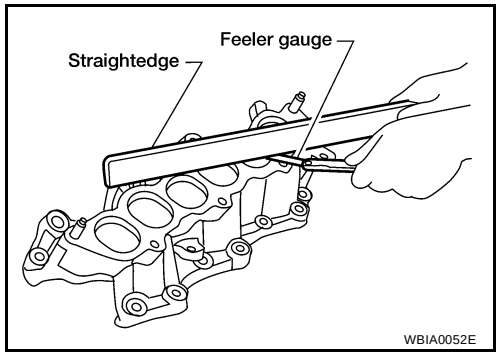


INSPECTION AFTER REMOVAL

Surface Distortion

- Using straightedge and feeler gauge, inspect the surface distortion of both the intake manifold and the intake manifold collector.

Standard : 0.1 mm (0.004 in)



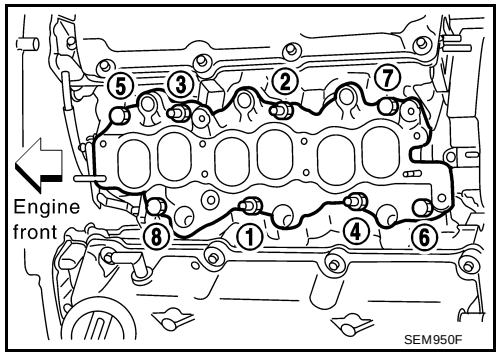
INSTALLATION

Installation is in the reverse order of removal. Follow the procedures below for specific tightening sequences and procedures.

- Install intake manifold bolts in two stages in the numerical order as shown.

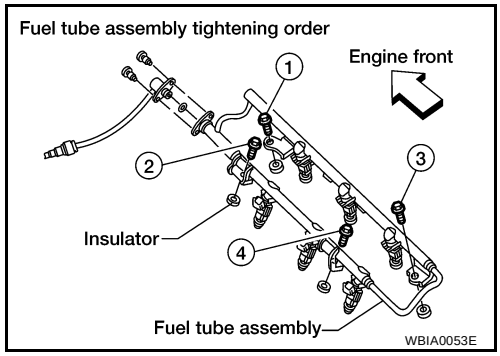
Stage 1 : 5- 10 N·m (0.5 - 1.0 kg-m, 44 - 86 in-lb)

Stage 2 : 26 - 31 N·m (2.7 - 3.2 kg-m, 20 - 23 ft-lb)



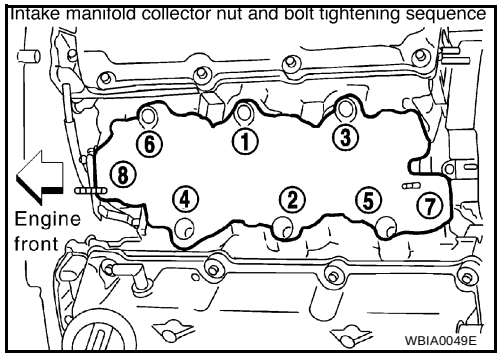
- Seat the fuel injectors into the intake manifold with new O-rings. Tighten the fuel rail bolts as shown, in two stages:

  Stage 1 : 9.3 - 10.8 N·m (0.95 - 1.1 kg-m, 83 - 95 in-lb)
  Stage 2 : 21 - 26 N·m (2.1 - 2.7 kg-m, 15 - 20 ft-lb)



- Install the intake manifold collector bolts in the numerical order as shown.

  Intake manifold collector bolts : 18 - 21 N·m (1.8 - 2.2 kg-m, 13 - 15 ft-lb)

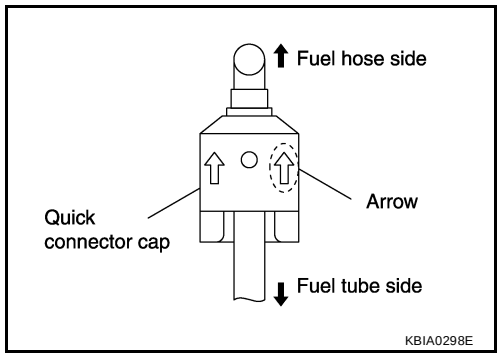


- Tighten the mounting bolts of the intake manifold collector pipe and electric throttle control actuator assembly equally and diagonally to specification.

  Electric throttle control actuator bolts : 7.2 - 9.6 N·m (0.74 - 0.97 kg-m, 64 - 84 in-lb)

- Install the quick connector as follows:

- Make sure no foreign substances are deposited in and around the fuel tube and quick connector and that there is no damage.
- Align the center to insert the quick connector straight onto the fuel tube.
- Insert the fuel tube until a click is heard.
- Install the quick connector cap on the quick connector joint. Align the arrow mark on the quick connector cap to the upper side.
- Install the fuel hose into the hose clamp.



NOTE:
After installation, it is necessary to re-calibrate the electric throttle control actuator as follows:

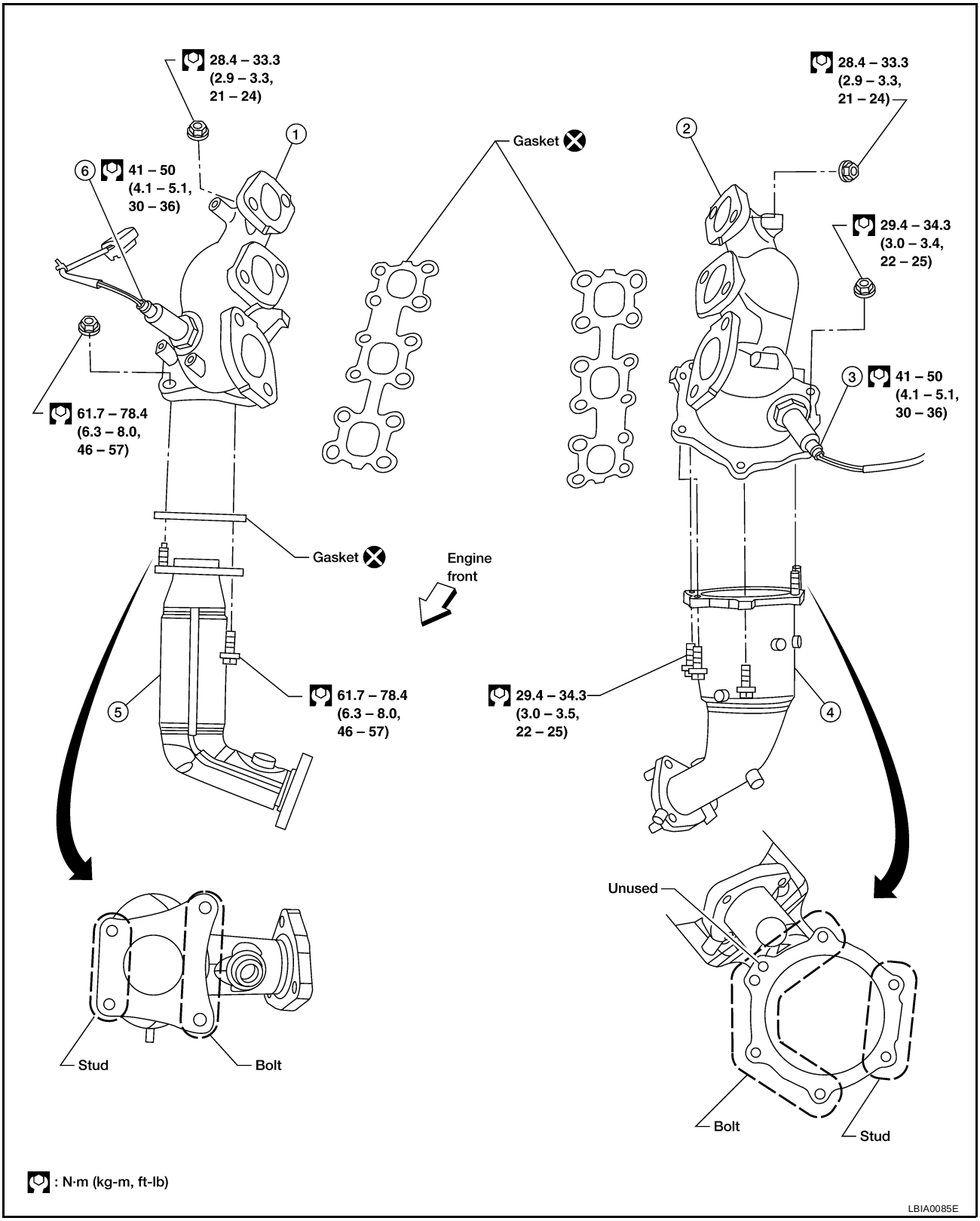
1. Perform the "Throttle Valve Closed Position Learning" when harness connector of the electric throttle control actuator is disconnected. Refer to EC-657, "BASIC SERVICE PROCEDURE" .
2. Perform the "Idle Air Volume Learning" when the electric throttle control actuator is replaced. Refer to EC-657, "BASIC SERVICE PROCEDURE" .

EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

Removal and Installation

EBS007PZ



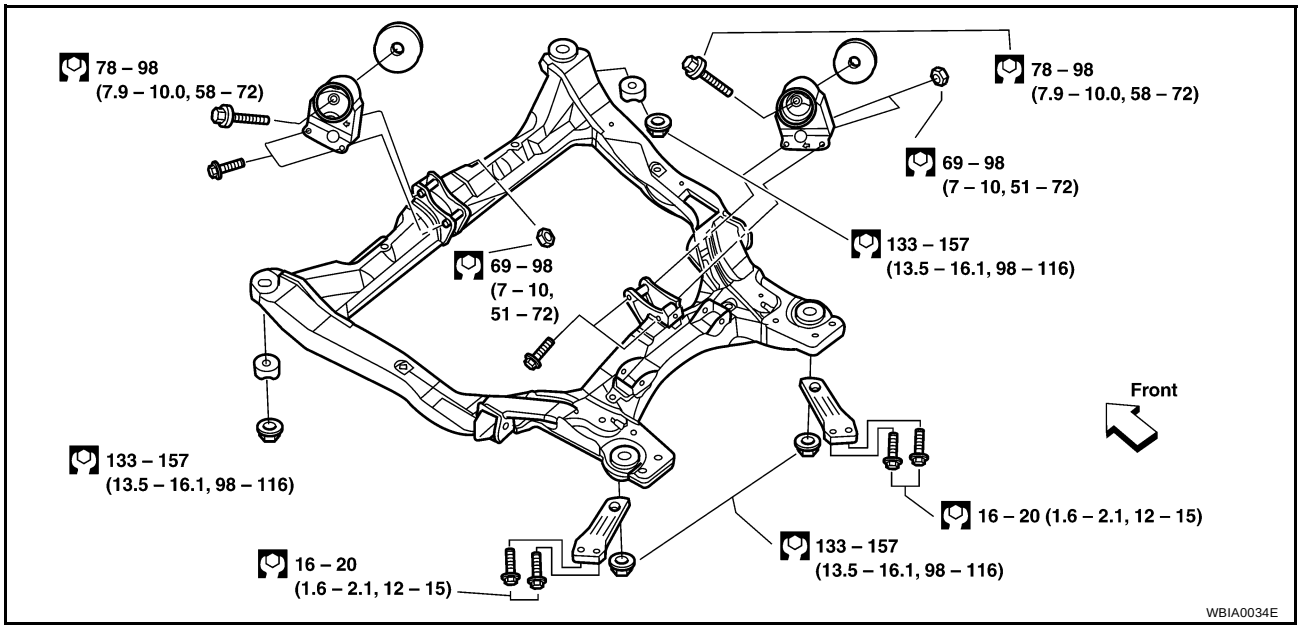
1. Exhaust manifold (bank 1)
2. Exhaust manifold (bank 2)
3. Heated oxygen sensor 1 (front) (bank 2)
4. Three way catalyst (manifold) (bank 2)
5. Three way catalyst (manifold) (bank 1)
6. Heated oxygen sensor 1 (front) (bank 1)

REMOVAL

WARNING:

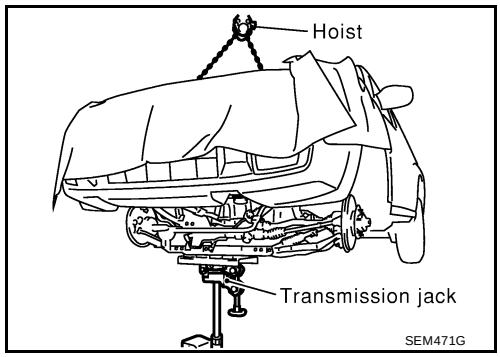
- **Perform the work when the exhaust and cooling system have completely cooled down.**
- **When removing the front and rear engine mounting through bolts and nuts, lift the engine up slightly for safety. For engine slingers, refer to step 17 in EM-183, "REMOVAL" .**

1. Remove the front wheel and tires with power tool.
2. Remove the engine undercovers with power tool.
3. Remove the inner wheel well splash shields with power tool.
4. Remove the radiator and cooling fan assembly.
   Refer to EC-1079, "Component Description" .
5. Remove the front exhaust tube.
   Refer to EX-6, "Removal and Installation" .
6. Remove the front suspension member as follows:



CAUTION:

Before disconnecting, support the front suspension member with a suitable power lift. Use the lift to lower the member to remove it.



a. Disconnect the lower ball joints.
   Refer to FSU-14, "FRONT SUSPENSION MEMBER" .
b. Remove the steering gear mounting bolts.
   Refer to PS-13, "Removal and Installation" .
c. Disconnect the upper sway bar connecting rod.
   Refer to FSU-11, "Removal and Installation" .
d. Disconnect the front and rear engine mounts electrical connectors, if equipped. Remove the front and rear engine mount through bolts and nuts using power tool.

CAUTION:

For vehicles equipped with an automatic transaxle, the front and rear engine mounts are electrically controlled. Disconnect the engine mount electrical connector(s) before removing the through bolt and nut.

e. Disconnect the power steering line bracket.
f. Remove the LH and RH drive axles.
   Refer to FAX-11, "Removal and Installation" .
g. Remove the front suspension member mounting nuts and lower the member out of the engine compartment.

7. Remove heated oxygen sensor 1 (front) (bank 1) and heated oxygen sensor 2 (front) (bank 2).

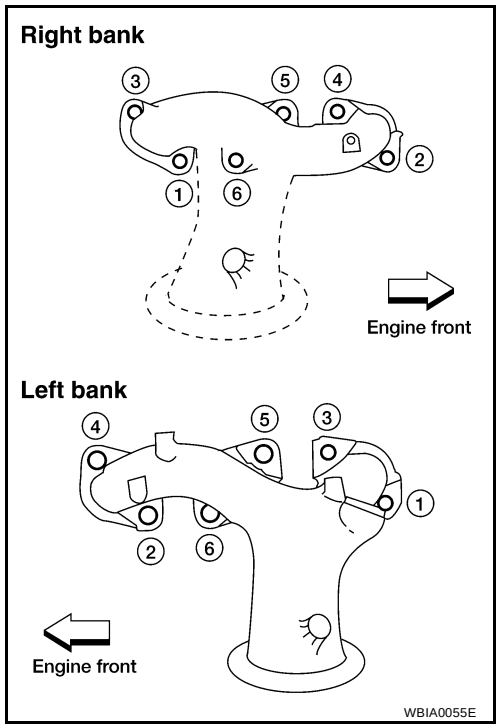
a. Remove harness connector of each heated oxygen sensor, and disconnect the harness from the bracket and middle clamp.

b. Remove both heated oxygen sensors with the Tool.

CAUTION:

- **Be careful not to damage heated oxygen sensor.**
- **Discard any heated oxygen sensor which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.**

8. Remove exhaust manifolds and the three way catalyst heat shields with power tool.
9. Remove the three way catalyst (manifold) (bank 1) and three way catalyst (manifold) (bank 2) by loosening the bolts first and then removing the nuts and through bolts.
10. Remove the exhaust manifolds. Loosen the nuts in the numerical order as shown.



INSPECTION AFTER REMOVAL

Surface Distortion

Use a reliable straightedge and feeler gauge to check the flatness of the exhaust manifold mating surfaces.

Distortion limit : 0.3 mm (0.012 in)

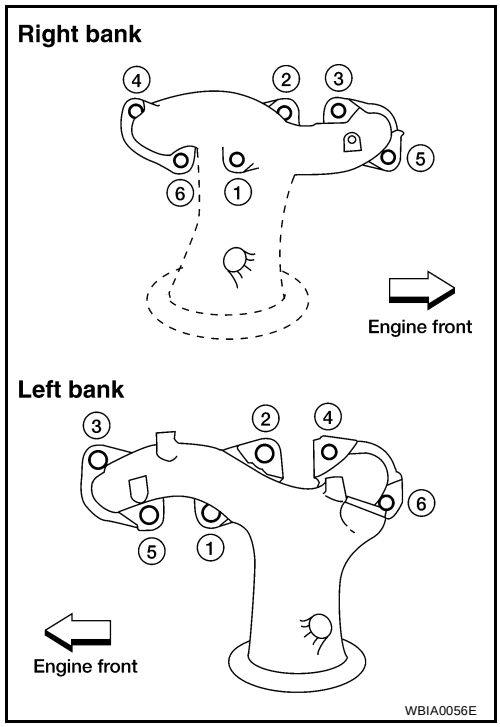
INSTALLATION

Installation is in the reverse order of removal.

- Install the exhaust manifold nuts in the numerical order as shown.

CAUTION:

- **When using the heated oxygen sensor wrench, tighten to the middle of specified torque range, because the length of the Tool may increase the actual tightness. Do not tighten to the maximum specified torque range.**
- **Before installing a heated oxygen sensor, clean the exhaust manifold threads using the oxygen sensor thread cleaner tool, and apply anti-seize lubricant.**
- **Do not over-torque the heated oxygen sensors. Doing so may cause damage to the heated oxygen sensors.**

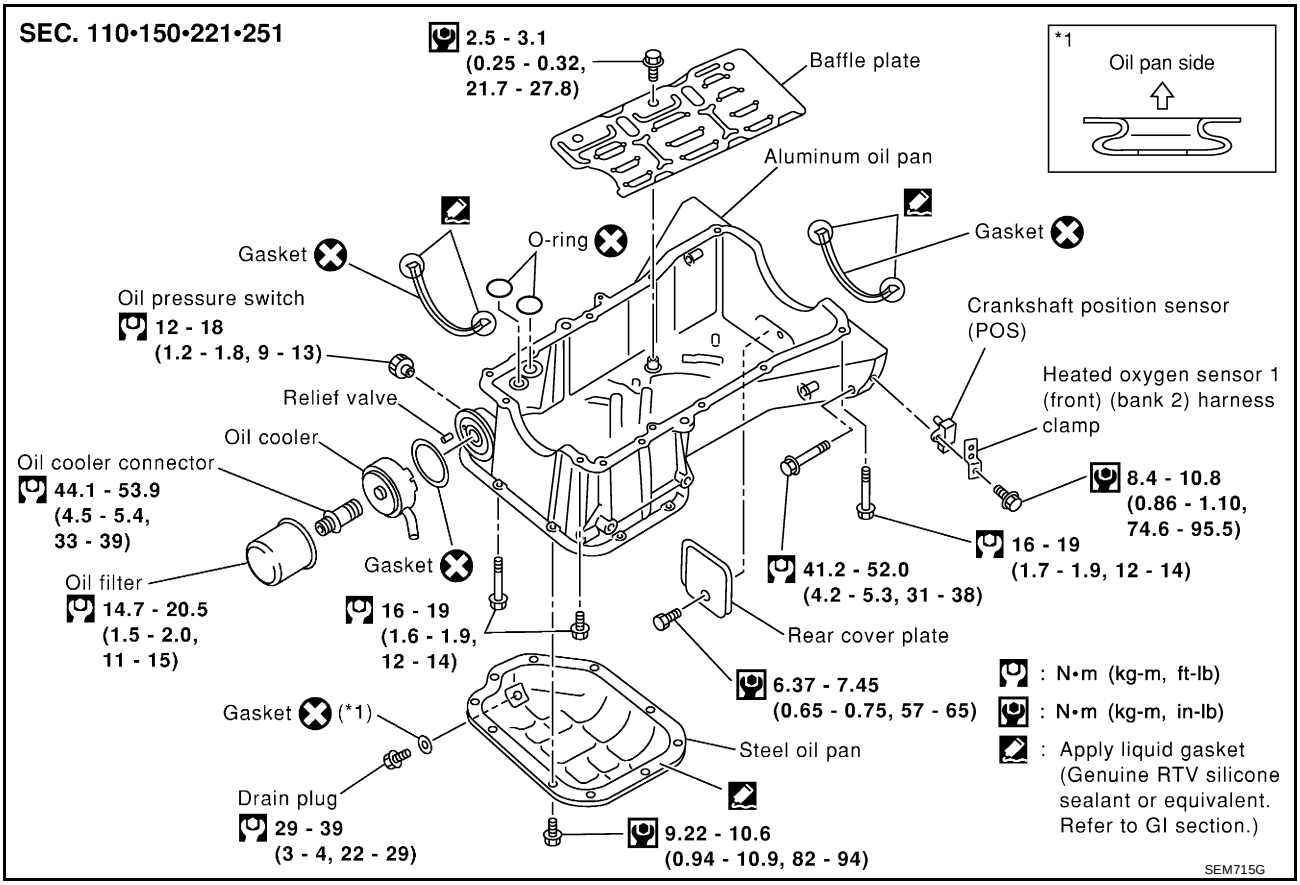


OIL PAN

PFP:11110

Removal and Installation

EBS007Q0



REMOVAL

WARNING:

- **You should not remove the oil pan until the exhaust system and cooling system have completely cooled off.**
- **When removing the front and rear engine mounting through bolts and nuts, lift the engine up slightly for safety. For engine slingers, refer to step 18 in EM-183, "REMOVAL" .**

CAUTION:

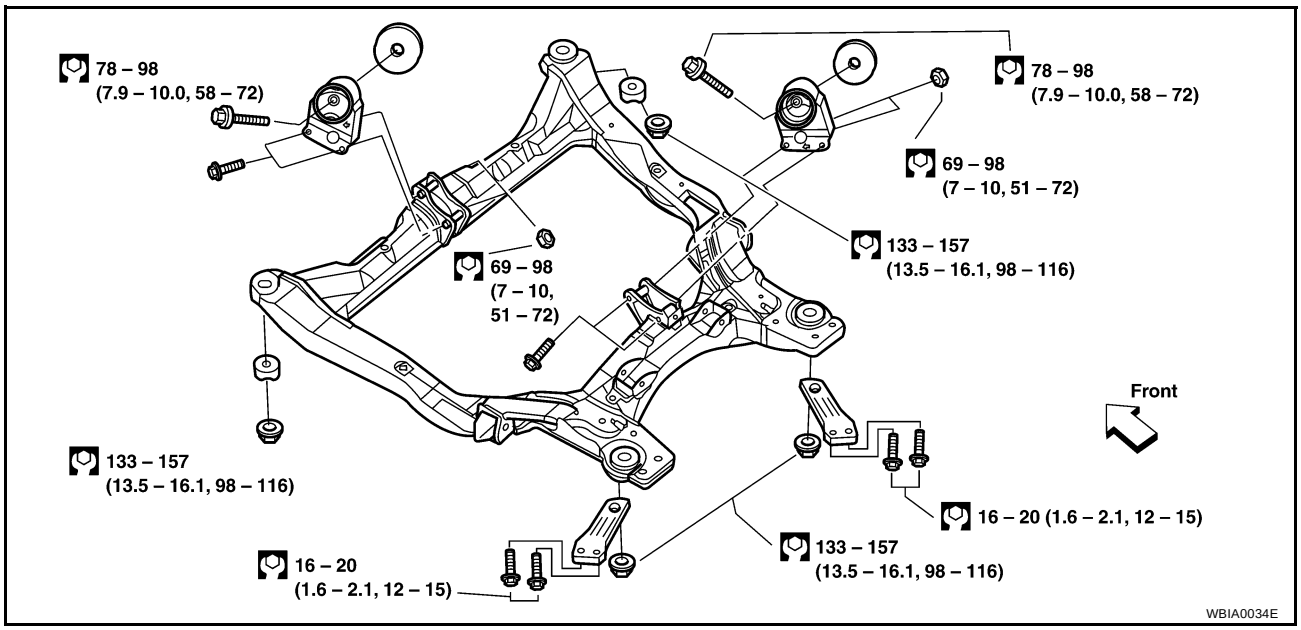
When removing the upper oil pan from the engine, first remove the crankshaft position sensor (POS). Be careful not to damage sensor edges or signal plate teeth.

1. Remove the front RH wheel and tire with power tool.
2. Disconnect the battery negative terminal.
3. Remove the oil dipstick.
4. Drain the engine coolant. Refer to EC-1102, "Description" .
5. Remove the engine undercover using power tool.
6. Remove the RH inner fender splash shield using power tool.
7. Remove the A/C drive belt.
8. Remove the front exhaust tube. Refer to EX-6, "Removal and Installation" .
9. Dismount the A/C compressor with piping attached, and reposition it out of the way securely with wire.

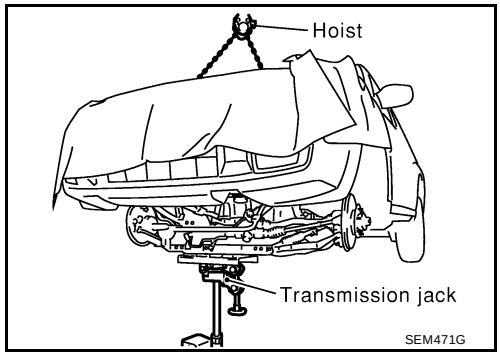
   CAUTION:

   Do not pull on or crimp the A/C lines and hoses.
10. Disconnect the coolant lines from the engine oil cooler and plug them to prevent coolant loss.
11. Remove the oil filter and engine oil cooler from the upper oil pan.
12. Remove the oil pressure switch, and the crankshaft position sensor (POS) from the upper oil pan.

13. Remove the front suspension member, as follows:



CAUTION:
Before disconnecting, support the front suspension member with a suitable power lift. Use the lift to lower the front suspension member to remove it.



a. Disconnect the lower ball joints
Refer to FSU-5, "FRONT SUSPENSION ASSEMBLY" .

b. Disconnect the power steering line bracket.

c. Disconnect the steering gear mounting bolts.
Refer to PS-13, "Removal and Installation" .

d. Disconnect the upper sway bar links.
Refer to FSU-5, "FRONT SUSPENSION ASSEMBLY" .

e. Remove the LH and RH drive axles.
Refer to FAX-11, "Removal and Installation" .

f. Disconnect the front engine mounts electrical connectors, if equipped. Remove the front and rear engine mounts through bolts and nuts using power tool.

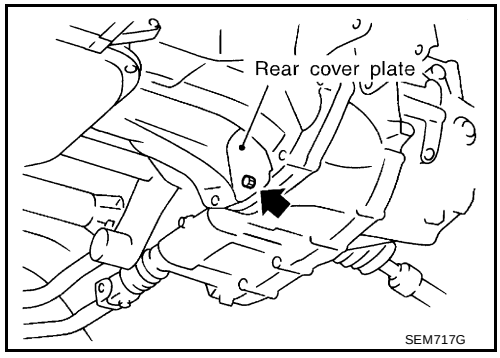
WARNING:
For additional safety, support the engine from above with a suitable hoist.

CAUTION:
For vehicles equipped with an automatic transaxle, the front and rear engine mounts are electrically controlled. Disconnect the engine mount electrical connector before removing the through bolt.

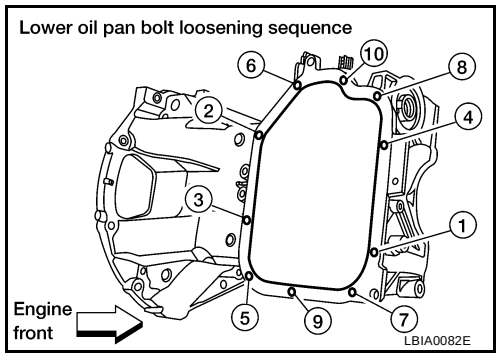
g. Remove the front suspension member mounting nuts and lower the member out of the engine compartment.

14. Disconnect the heated oxygen sensors and remove the two catalytic convertors from the exhaust manifolds using power tool.

15. Remove the rear plate cover from the upper oil pan.



16. Remove the bottom oil pan. Loosen the bolts in the numerical sequence as shown with power tool.

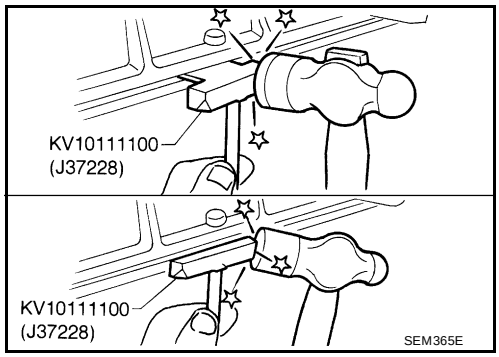


a. Insert a tool between the lower oil pan and the upper oil pan.

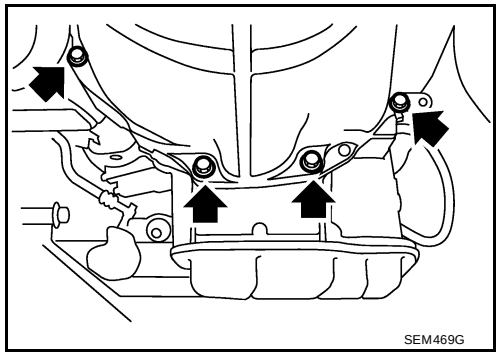
CAUTION:

- **Be careful not to damage the mating surface.**
- **Do not insert a screwdriver, this will damage the mating surfaces.**

b. Slide the tool by tapping its side with a hammer to remove the lower oil pan from the upper oil pan.

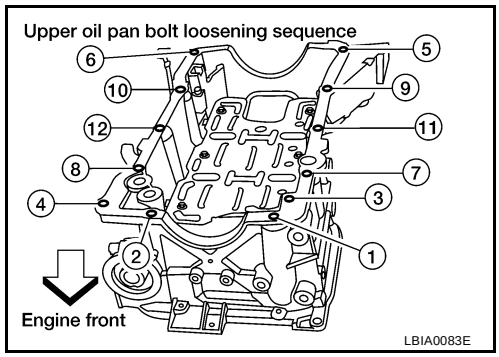


17. Remove the four engine-to-transaxle bolts.



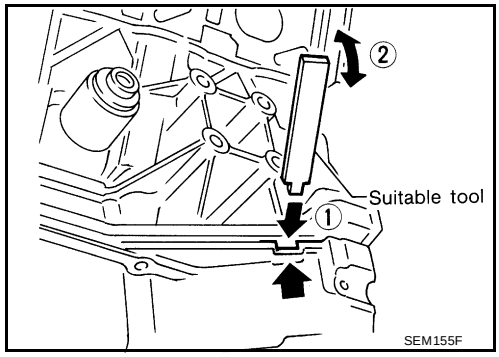
18. Remove the upper oil pan.

a. Loosen the bolts in the numerical order as shown, using power tool.

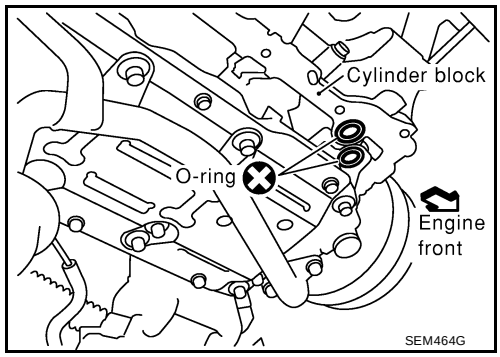


b. Insert an appropriate size tool into the notch of the upper oil pan as shown (1).

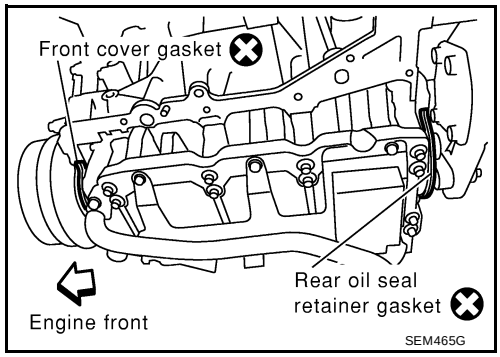
c. Pry off the upper oil pan by moving the tool up and down as shown (2).



19. Remove the O-ring seals from the bottom of the cylinder block and oil pump housing, use new O-rings for installation.

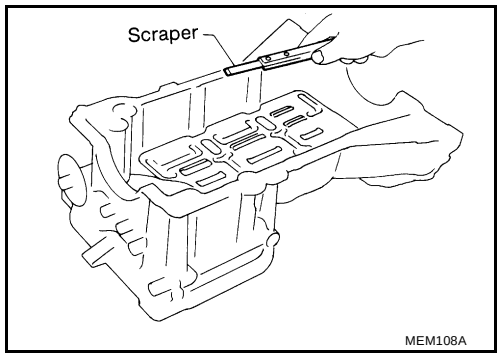


20. Remove front cover gasket and rear oil seal retainer gasket.



21. 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.

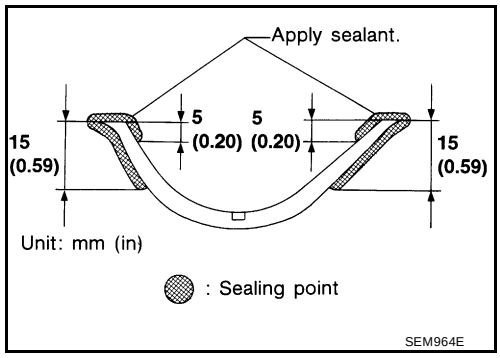


INSTALLATION

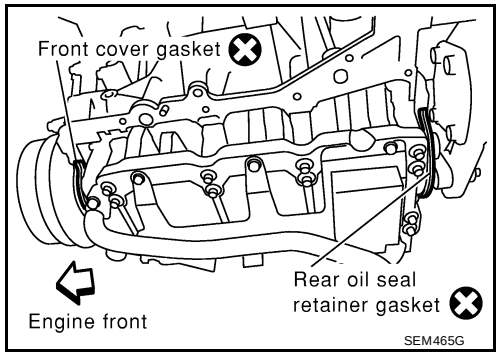
1. Installation is in the reverse order of removal.

   CAUTION:
   Wait at least 30 minutes before refilling the engine with oil.

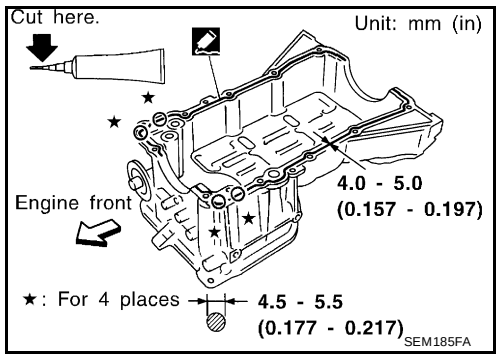
a. Apply Genuine RTV Silicone Sealant or equivalent, to the front cover gasket and the rear oil seal retainer gasket as shown. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .

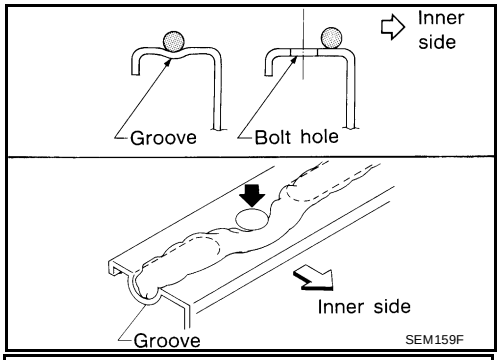


b. Install the front cover gasket and rear oil seal retainer gasket as shown.

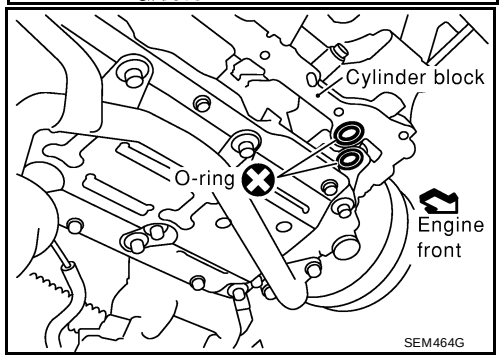


c. Apply a bead of sealant to the cylinder block mating surface of the upper oil pan to a limited portion as shown.
- Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
- Be sure the sealant is applied to a limited portion as shown, and the sealant is 4.0 - 5.0 mm (0.157 - 0.197 in) or 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
- Attaching should be done within 5 minutes after coating.

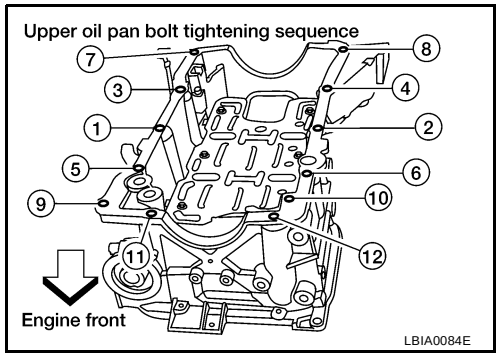




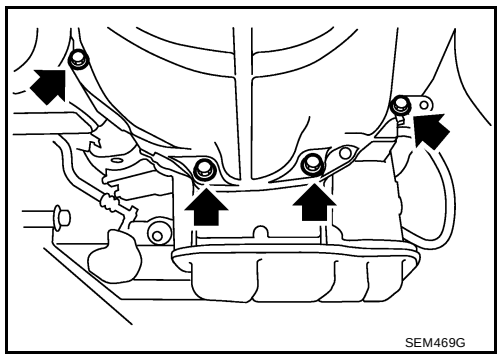
d. Install new O-rings on the cylinder block and oil pump body.



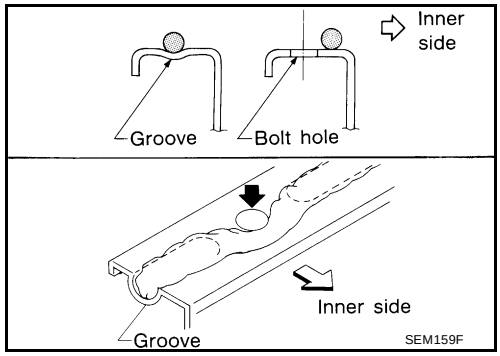
e. Install the upper oil pan.
- Tighten bolts in numerical order.
- Wait at least 30 minutes before refilling the engine with oil.



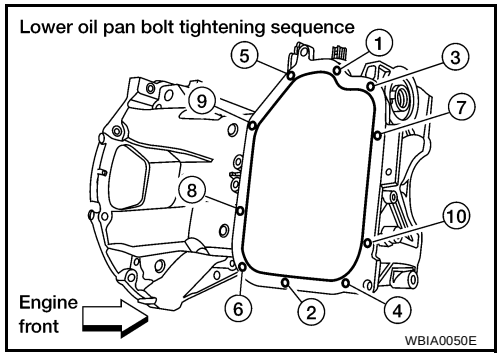
f. Install the four engine-to-transmission bolts. Refer to EM-182, "Removal and Installation" .



g. Apply a continuous bead of sealant to the lower oil pan.
- Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
- Be sure the sealant is 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
- Attaching should be done within 5 minutes after coating.



h. Install the lower oil pan. Tighten the bolts in the numerical order as shown.
- Wait at least 30 minutes before refilling the engine with oil.

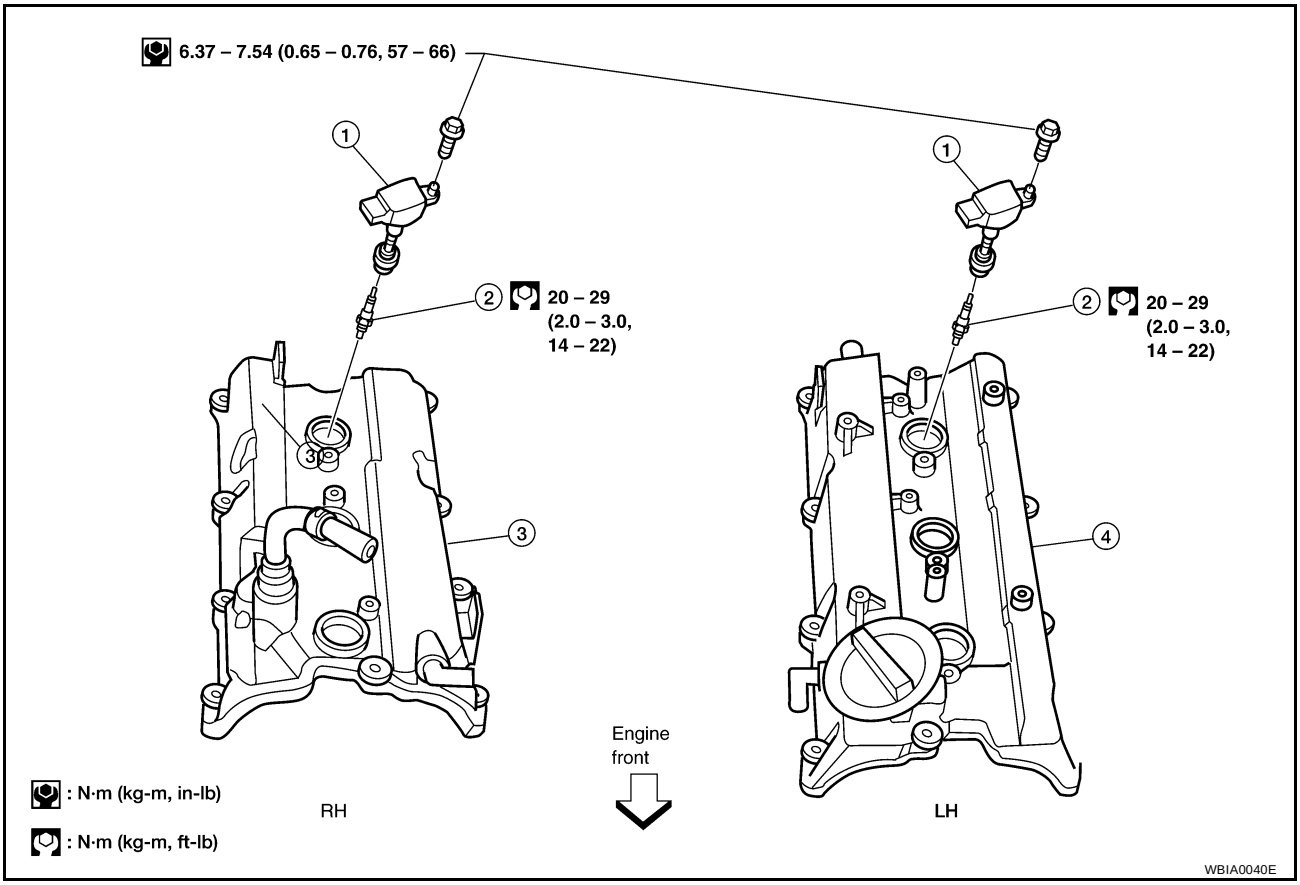


IGNITION COIL

PFP:22448

Removal and Installation

EBS007Q1



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

REMOVAL

1. Remove the engine cover, with power tool.
2. Drain engine coolant. Refer to MA-22, "DRAINING ENGINE COOLANT" .
3. Disconnect the mass air flow sensor electrical connector and remove the air cleaner assembly and air intake tubes. Refer to EM-110, "Removal and Installation" .
4. Remove the windshield wiper arms and motor assembly and the front cowl panel. Refer to EI-18, "Removal and Installation" .
5. Remove the intake manifold collector, gasket, and throttle body. Refer to EM-112, "Removal and Installation" .
6. Remove the six ignition coils.

INSTALLATION

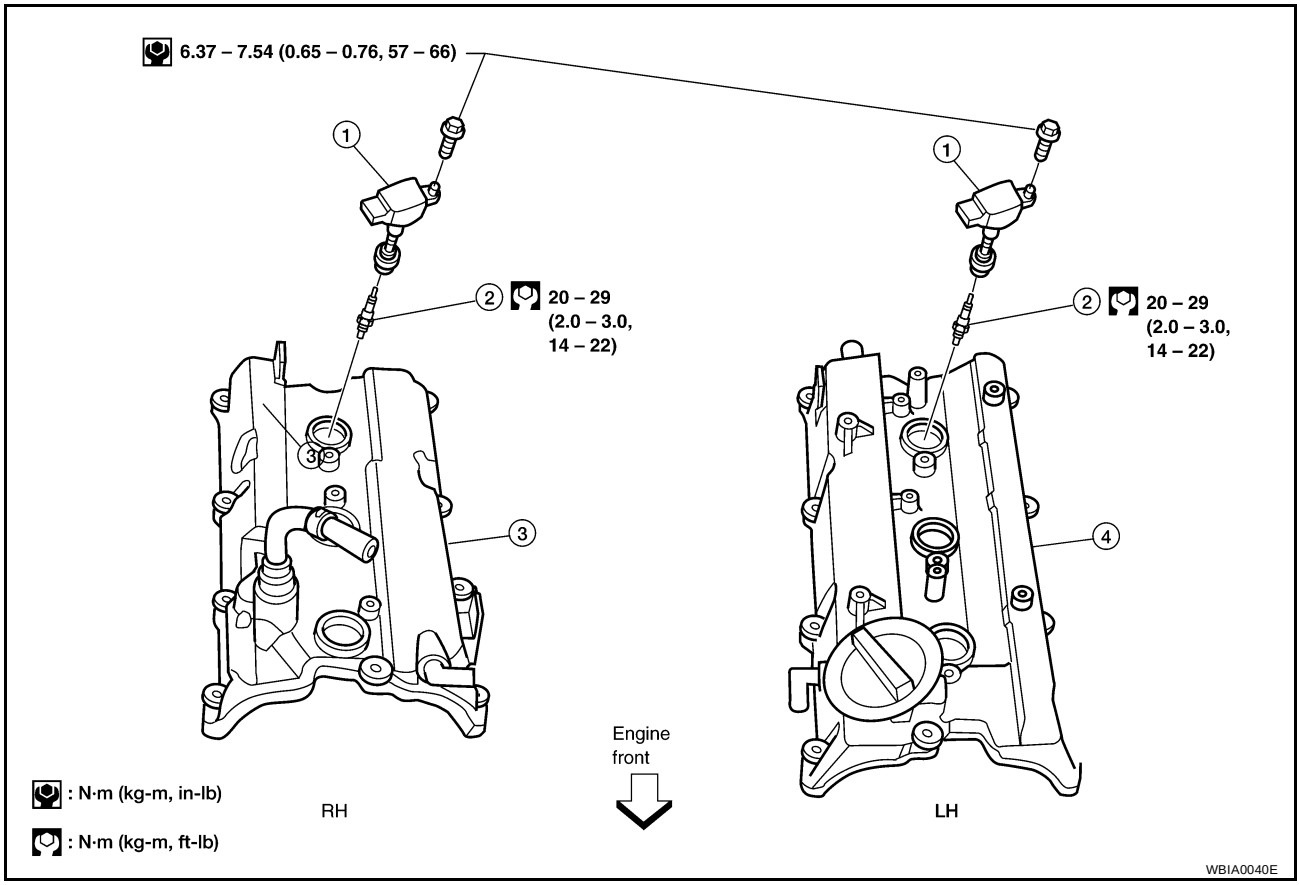
Installation is in the reverse order of removal.

SPARK PLUG (PLATINUM-TIPPED TYPE)

PFP:22401

Removal and Installation

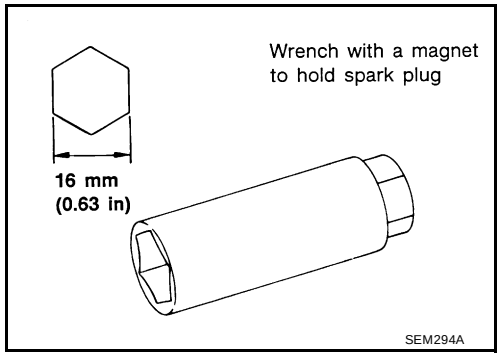
EBS007Q2



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

REMOVAL

1. Remove the engine cover, with power tool.
2. Drain engine coolant. Refer to MA-22, "DRAINING ENGINE COOLANT" .
3. Disconnect the mass air flow sensor electrical connector and remove the air cleaner assembly and air intake tubes. Refer to EM-110, "Removal and Installation" .
4. Remove the windshield wiper arms and motor assembly and the front cowl panel. Refer to EI-18, "Removal and Installation" .
5. Remove the intake manifold collector, gasket, and throttle body. Refer to EM-112, "Removal and Installation" .
6. Remove the six ignition coils.
7. Remove the six spark plugs with a suitable tool.
   - If replacing the spark plugs use the correct spark plug for maximum performance. Refer to MA-26, "Changing Spark Plugs (Platinum - Tipped Type)" .



INSPECTION AFTER REMOVAL

CAUTION:
Use standard type spark plug for normal driving conditions.

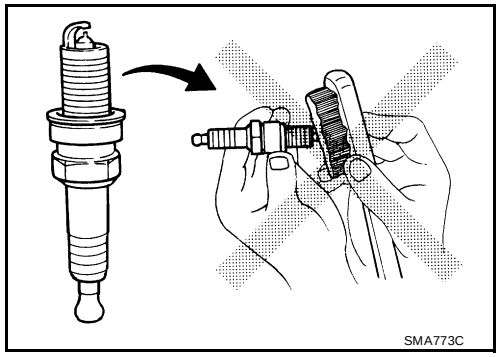
The hot type spark plug is suitable when fouling occurs with the standard type spark plug under conditions such as:

- frequent engine starts
- low ambient temperatures

The cold type spark plug is suitable when engine spark knock occurs with the standard type spark plug under conditions such as:

- extended highway driving
- frequent high engine revolution

CAUTION:
Do not use a wire brush for cleaning.

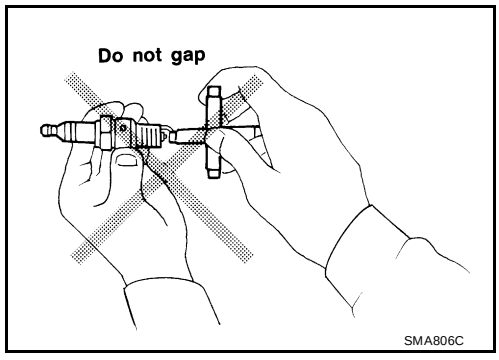


NOTE:
If plug tip is covered with carbon, a spark plug cleaner may be used.

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

NOTE:
Checking and adjusting plug gap is not required between change intervals.

Gap (nominal) : 1.1 mm (0.043 in)



INSTALLATION

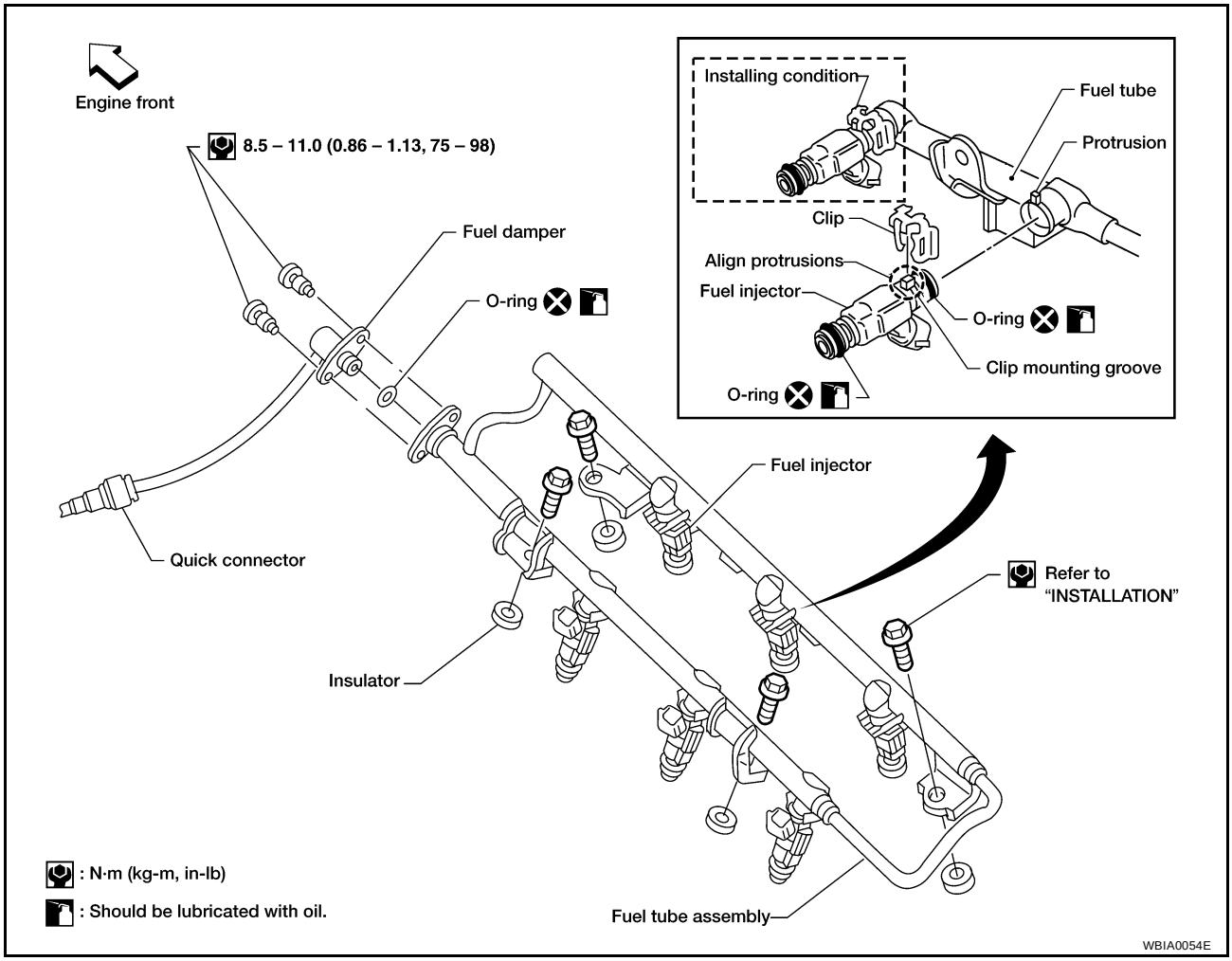
Installation is in the reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Removal and Installation

EBS007Q3



CAUTION:

- **Apply new engine oil when installing the parts that specified to do so in the figure.**
- **Do not remove or disassemble parts unless instructed as shown in the figure.**

REMOVAL

WARNING:

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

1. Remove the engine cover using power tool.
2. Release the fuel pressure.
   Refer to EC-671, "FUEL PRESSURE RELEASE" .
3. Remove air cleaner case lid and mass air flow sensor, and air intake tube as an assembly.
   Refer to EM-110, "Removal and Installation" .
4. Partially drain the coolant when the engine is cool. Refer to EC-1102, "Description" .
5. Disconnect fuel tube quick connector at vehicle piping side.
   Refer to step 5 of EM-113, "REMOVAL" .
6. Disconnect the power brake booster vacuum hose, the coolant hoses from the electric throttle control actuator, the swirl control vacuum lines, the fuel injectors electrical connectors, and the PCV hose.

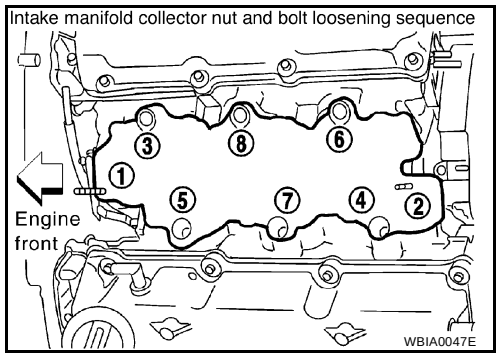
   CAUTION:

   Cover any engine openings to avoid the entry of any foreign material.
7. Disconnect the electric throttle control actuator electrical connector and coolant hoses.
8. Remove the cowl top grille and the windshield wiper assembly.
   Refer to EI-18, "Removal and Installation" .
9. Disconnect the power steering hose bracket.

10. Remove the vacuum tank from the back of the intake manifold collector.
11. Remove the intake manifold collector pipe and electric throttle control actuator, by loosening the four bolts in a diagonal pattern.

CAUTION:
Handle carefully to avoid any shock to the electric throttle control actuator.

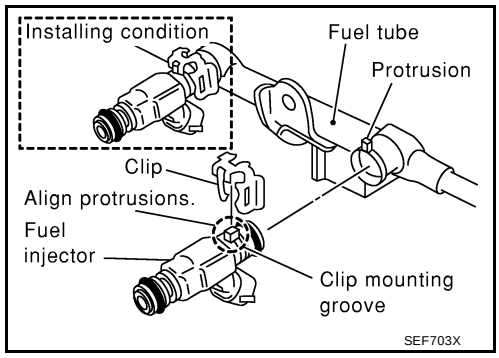
12. Loosen the bolts in the order shown, and remove the intake manifold collector using power tool.
13. Remove the fuel rail with the fuel injectors attached, from the intake manifold. Remove the fuel injector O-rings and use new O-rings for installation.



INSTALLATION

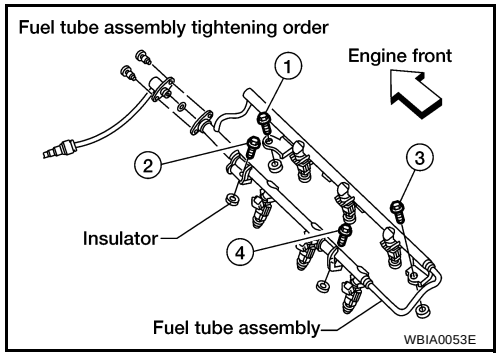
1. Installation is in the reverse order of removal.

- Carefully install new O-rings, including the one used with the fuel damper.
- **Lubricate O-rings by lightly coating with new engine oil.**
- **Be careful not to damage the O-rings and surfaces for O-ring sealing surfaces. Do not expand or twist O-rings.**
- **Discard old clips; replace with new ones.**
- Position clips in grooves on the fuel injectors.
- **Make sure that protrusions of fuel injectors are aligned with cutouts of clips after installation.**



- Align the protrusions of the fuel tube assembly with those of the fuel injectors.
- After properly inserting the fuel injectors onto the fuel tube assembly, check that the fuel tube protrusions are engaged with those of fuel injectors, and the flanges of the fuel tube assembly are fully engaged with the clips.
- Tighten fuel tube assembly mounting bolts as shown, in two steps:

1st step	**: 9.3 - 10.8 N·m (0.95 - 1.1 kg-m, 6.2 - 7.9 ft-lb)**
2nd step	**: 20.6 - 26.5 N·m (2.1 - 2.7 kg-m, 16 - 19 ft-lb)**

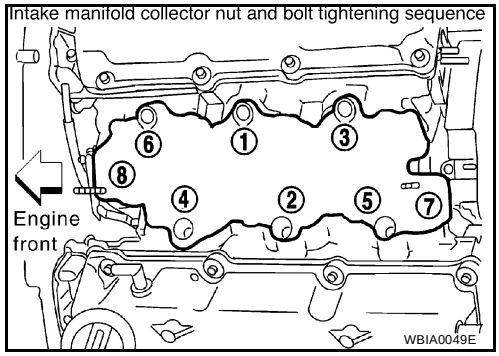


CAUTION:

- **After properly connecting fuel tube assembly to injector and fuel hose, check connection for fuel leakage.**

- Install the intake manifold collector bolts in the numerical order as shown.

Intake manifold collector bolts	**: 18 - 21 N·m (1.8 - 2.2 kg-m, 13 - 15 ft-lb**



- Tighten the mounting bolts of the intake manifold collector pipe and electric throttle control actuator assembly diagonally to specification.

Electric throttle control actuator bolts : 7.2 - 9.8 N·m (0.74 - 0.97 kg-m, 64 - 84 ft-lb)

- After installation, it is necessary to re-calibrate the electric throttle control actuator.
  - Perform "Throttle Control Closed Position Learning" when the harness connector of the electric throttle control actuator is disconnected. Refer to EC-657, "BASIC SERVICE PROCEDURE" .
  - Perform "Idle Air Volume Learning" when the electric throttle control actuator is replaced. Refer to EC-657, "BASIC SERVICE PROCEDURE" .
- Install the quick connector.
  Refer to EM-114, "INSTALLATION" .

INSPECTION AFTER INSTALLATION

Check for fuel leaks

1. Start the engine, and run it for a few minutes with the engine at idle.
2. Stop the engine, and check for fuel leaks both visually and by odor.

NOTE:
Use mirrors for checking at points out of clear sight.

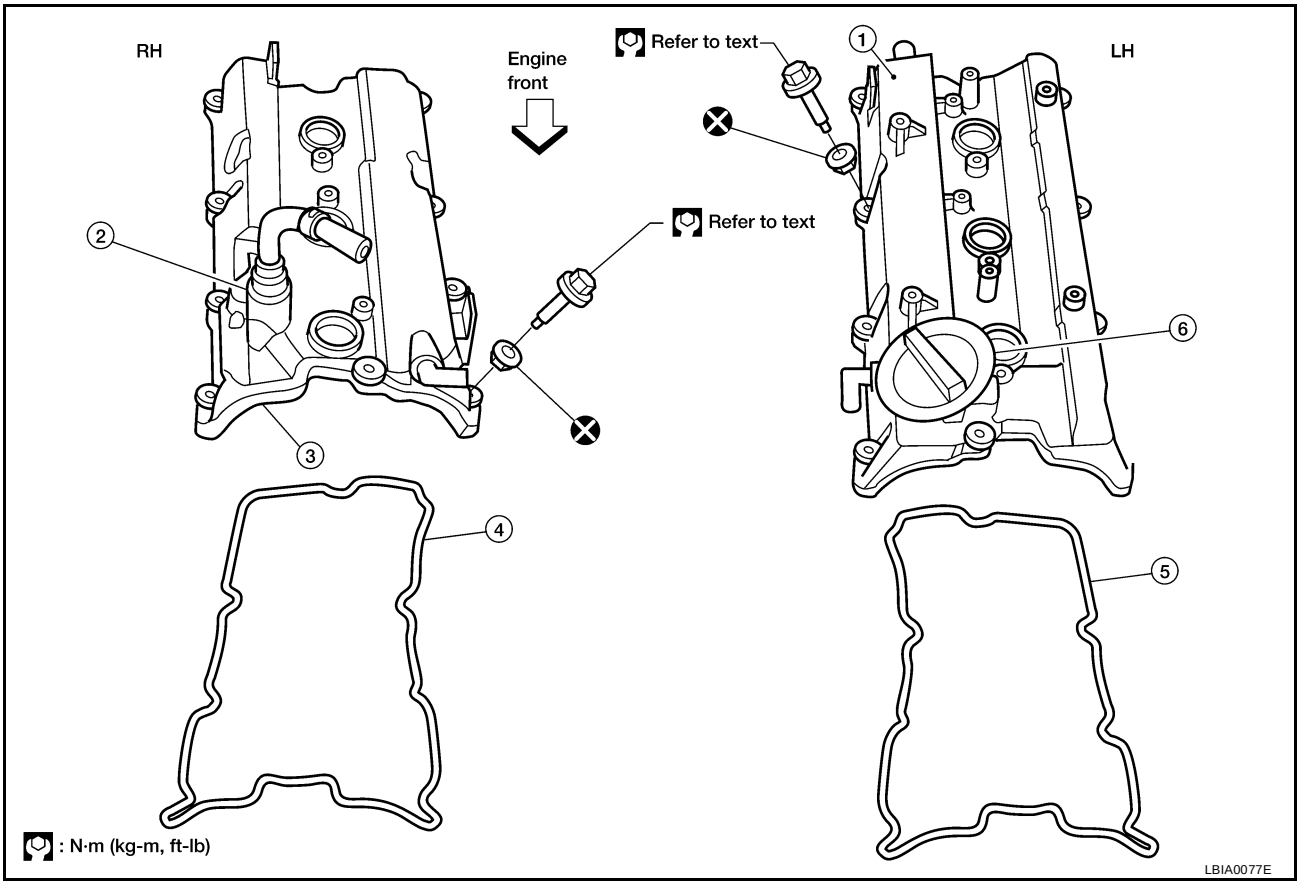
CAUTION:
Do not touch the engine immediately after stopped, as engine becomes extremely hot.

ROCKER COVER

PFP:13264

Removal and Installation

EBS007Q4

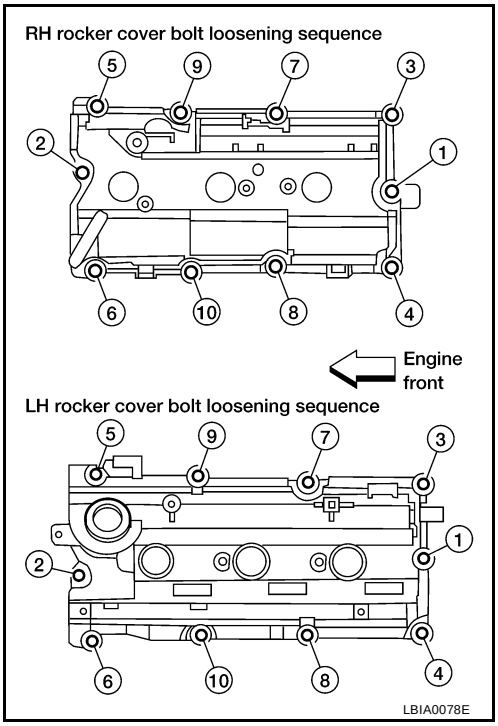


1. Rocker cover (left bank)
2. PCV valve
3. Rocker cover (right bank)
4. Rocker cover gasket (right bank)
5. Rocker cover (left bank)
6. Oil filler cap

REMOVAL

1. Remove the engine cover, using power tool.
2. Drain engine coolant. Refer to MA-22, "DRAINING ENGINE COOLANT" .
3. Disconnect the mass air flow sensor electrical connector and remove the air cleaner assembly and air intake tubes. Refer to EM-110, "Removal and Installation" .
4. Remove the windshield wiper arms and motor assembly and the front cowl panel. Refer to WW-25, "Removal and Installation for Wiper Motor and Linkage" .
5. Remove the intake manifold collector using power tool. Remove gasket and the electric throttle control actuator. Refer to EM-112, "Removal and Installation" .
6. Remove the six ignition coils. Refer to EM-126, "Removal and Installation" .
7. Remove the two intake valve timing control solenoid valves and gaskets. Refer to EC-773, "INTAKE VALVE TIMING CONTROL SOLENOID VALVE" .

8. Remove RH and LH rocker covers from cylinder head.
   - Follow the loosening sequence for each side rocker cover bolts as shown.

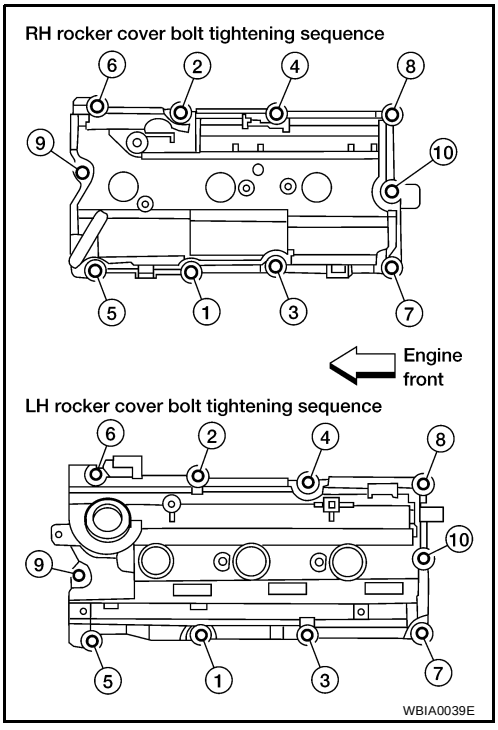


INSTALLATION

Installation is in the reverse order of removal.

- Apply sealant to the areas on the front corners. Refer to EM-148, "POSITION FOR APPLYING LIQUID GASKET" .
- Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
- Tighten the rocker cover bolts in two stages and in the numerical order as shown.

Stage 1 rocker cover bolts	**: 0.96 - 2.96 N·m (0.10 - 0.30 kg-m, 9 - 26 in-lb)**
Stage 2 rocker cover bolts	**: 7.33 - 9.33 N·m (0.75 - 0.95 kg-m, 65 - 82 in-lb)**

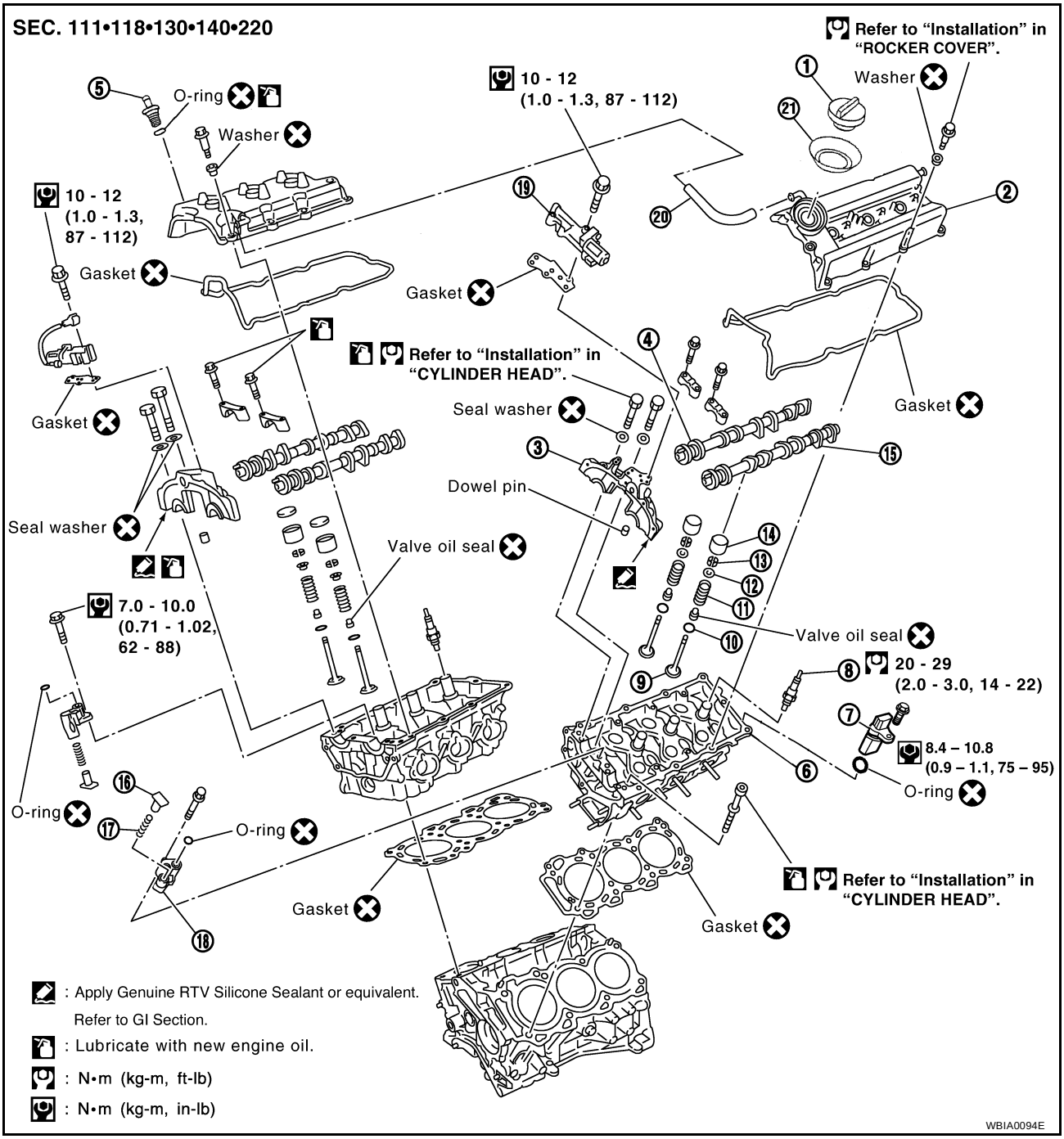


CAMSHAFT

PFP:13001

Removal and Installation

EBS007Q5



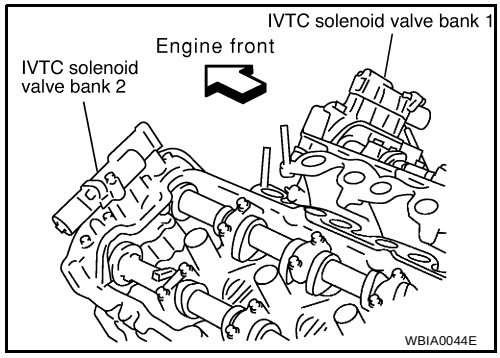
1. Oil filler cap	2. Rocker cover (LH)	3. Camshaft bracket (LH)
4. Camshaft (INT)	5. PCV valve	6. Cylinder head
7. Camshaft position sensor (PHASE)	8. Spark plug	9. Valve
10. Valve spring seat	11. Valve spring	12. Valve spring retainer
13. Valve collet	14. Valve lifter	15. Camshaft (EXH)
16. Chain tensioner	17. Tensioner spring	18. Tensioner sleeve
19. IVTC solenoid valve	20. PCV hose	21. Oil catcher

CAUTION:

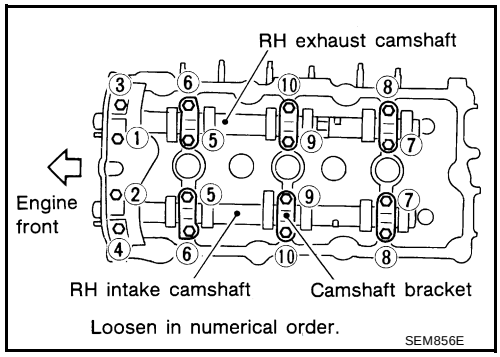
Apply new engine oil to parts marked in illustration before installation.

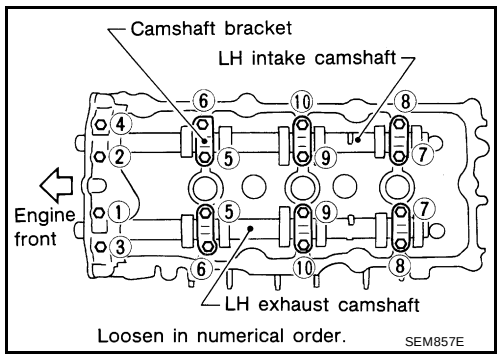
REMOVAL

1. Remove the timing chains. Refer to EM-149, "Removal" .
2. Remove the fuel rail and injectors. Refer to EM-129, "Removal and Installation" .
3. Remove the IVTC (intake valve timing control) solenoid valves.
   - Discard the IVTC solenoid valve gaskets and use new gaskets for installation.



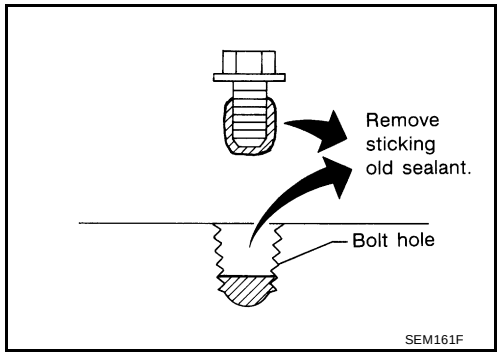
4. Remove the intake and exhaust camshaft brackets and the camshafts.
   - Mark the camshafts, camshaft brackets, and bolts so they are placed in the same position and direction for installation.
   - Equally loosen the camshaft bracket bolts in several steps in the numerical order shown.



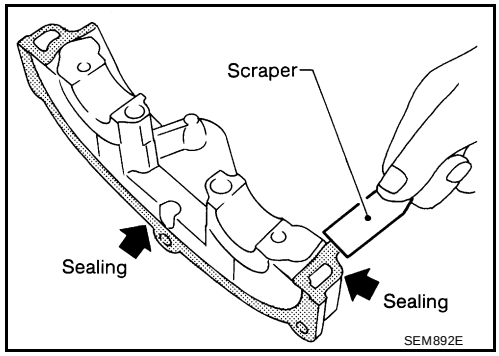


INSTALLATION

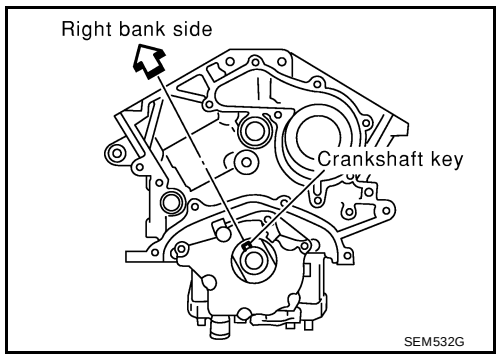
1. Before installation, remove any old RTV Silicone Sealant from component mating surfaces using a scraper.
   - Remove the old RTV Silicone Sealant from the bolt holes and threads.
   - Do not scratch or damage the mating surfaces.



2. Before installing the front cam bracket, remove the old RTV Silicone Sealant from the mating surface using a scraper.
   - Do not scratch or damage the mating surface.

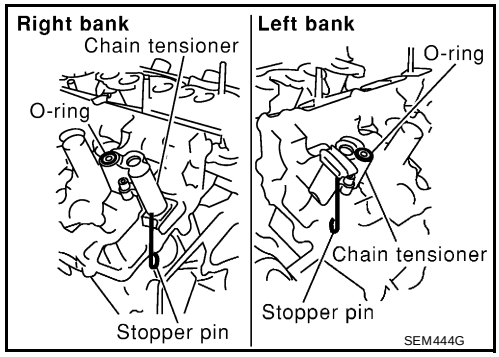


3. Turn the crankshaft until No. 1 piston is set at TDC on the compression stroke.
   - The crankshaft key should line up with the right bank cylinder center line as shown.

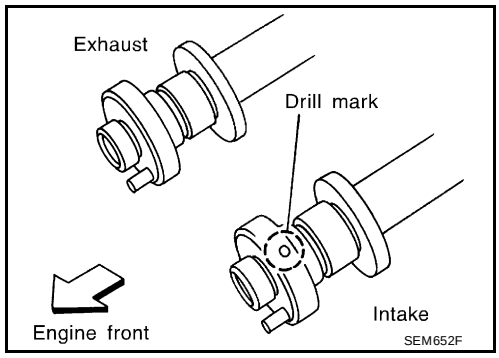


4. Install camshaft chain tensioners on both sides of cylinder head.

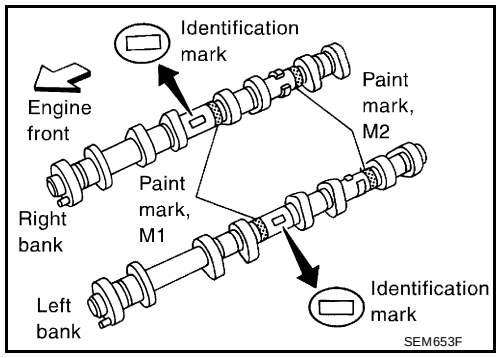
   Camshaft chain tensioner bolts : 7 - 10 N·m (0.7 - 1.0 kg-m, 62 - 89 in-lb)



5. Install exhaust and intake camshafts and camshaft brackets.
   - Intake camshaft has a drill mark on camshaft sprocket mounting flange.



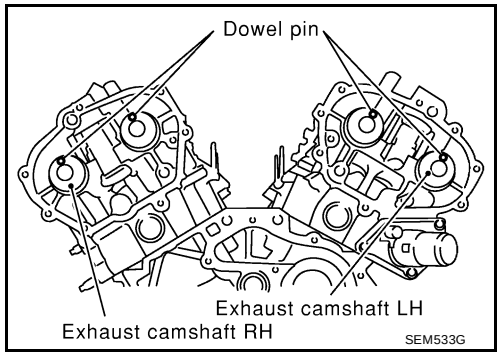
   - Follow your identification marks made during removal, or follow the identification marks that are present on the new camshafts components for proper placement and direction of the components.



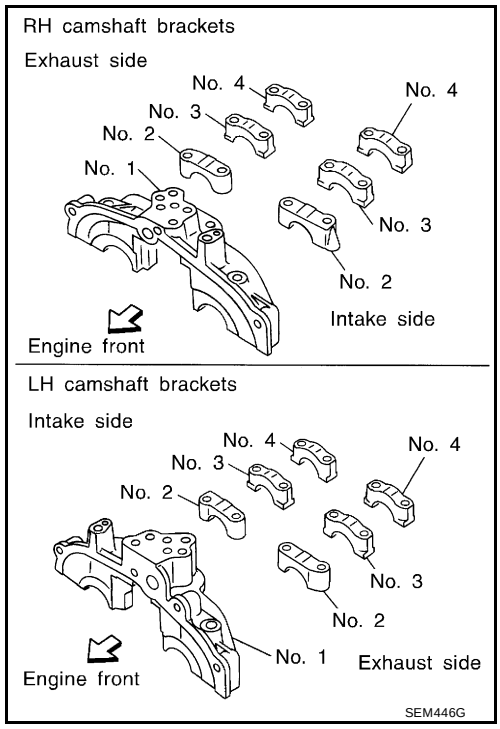
Bank	INT/EXH	ID mark	Drill mark	Paint marks	
				M1	M2
RH	INT	RE	Yes	Yes	No
	EXH	RE	No	No	Yes

Bank	INT/EXH	ID mark	Drill mark	Paint marks	
				M1	M2
LH	INT	LH	Yes	Yes	No
	EXH	LH	No	No	Yes

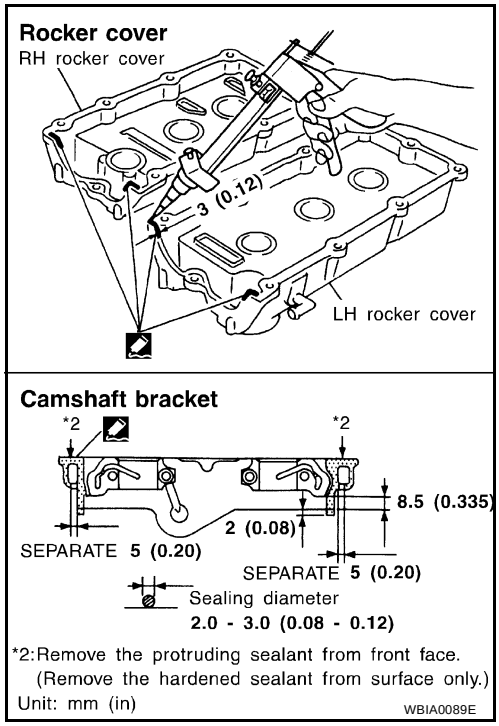
- Position the camshafts:
  RH exhaust camshaft dowel pin at about 10 o'clock.
  LH exhaust camshaft dowel pin at about 2 o'clock.



6. Before installing camshaft brackets, apply sealant to mating surface of No. 1 camshaft bracket.
   - Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .

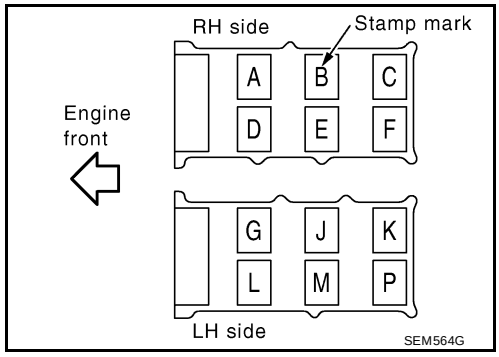


- Before installation, wipe off any protruding sealant.
- Refer to EM-102, "LIQUID GASKET APPLICATION PROCEDURE" .



- 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-141, "Valve Clearance" .

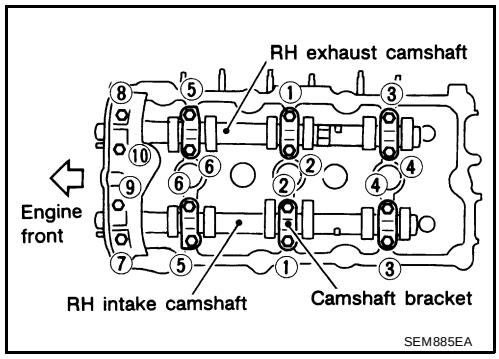
Valve clearance (cold) Intake	**: 0.26 - 0.34 mm (0.010 - 0.013 in)**
Valve clearance (cold) Exhaust	**: 0.29 - 0.37 mm (0.011 - 0.015 in)**

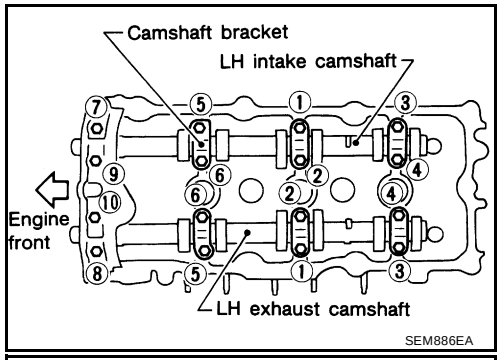


- Lubricate the threads and seat surfaces of the camshaft bracket bolts with new engine oil before installation.

- Tighten the camshaft brackets in the following steps, in numerical order as shown.

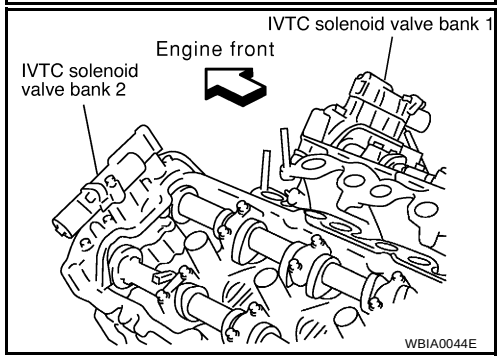
Step	Tightening torque	Tightening order
1	1.96 N·m (0.2 kg-m, 17 in-lb)	Tighten No.s 7 to 10, then tighten 1 to 6 in order as shown.
2	6 N·m (0.6 kg-m, 52 in-lb)	Tighten in numerical order as shown.
3	9.02 - 11.8 N·m (0.92 - 1.20 kg-m, 79.9 - 104.2 in-lb)	Tighten No. 1 -6 in the numerical order as shown.
4	8.30 - 10.3 N·m (0.90 - 1.00 kg-m, 74 - 91 in-lb)	Tighten No. 7 - 10 in the numerical order as shown





7. Install the IVTC solenoid valves with new gaskets.

IVTC solenoid valve bolts	**: 10 - 12 N·m (1.0 - 1.3 kg-m, 87 - 112 in-lb)**



8. Install the fuel rail and injectors. Refer to EM-129, "Removal and Installation" .
9. Install the timing chains. Refer to EM-155, "Installation" .

INSPECTION AFTER REMOVAL

Camshaft Visual Check

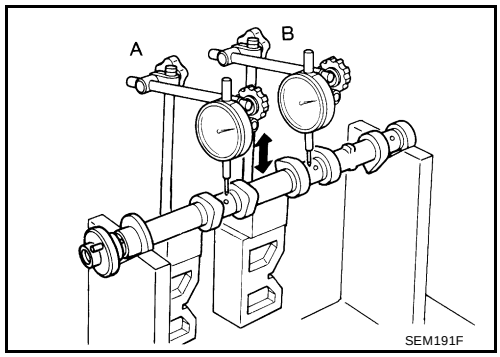
Check camshaft for scratches, seizure and wear. Replace if necessary.

Camshaft Runout

1. Measure the camshaft runout at "A" and "B" as shown.
2. Set dial gauges vertically 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.

Maximum runout limit	**: 0.05 mm (0.0020 in)**

4. If actual runout exceeds the limit, replace the camshaft.

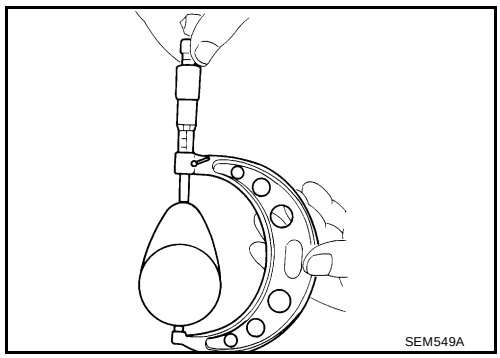


Camshaft Cam Lobe Height

1. Measure camshaft cam lobe height as shown.

Standard cam lobe height - intake and exhaust	**: 44.865 - 44.055 mm (1.7763 - 1.7738 in)**
Cam lobe wear limit	**: 0.2 mm (0.008 in)**

2. If wear has reduced the lobe height below specifications, replace the camshaft.

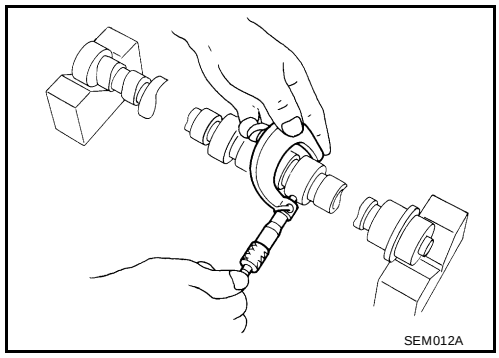


Camshaft Journal Clearance

Outer Diameter of Camshaft Journal

- Measure outer diameter of camshaft journal as shown.

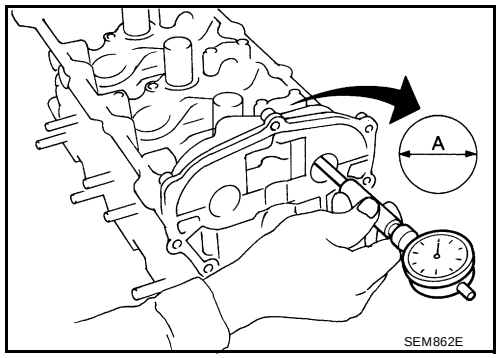
Standard outer diameter, No.1	**: 25.935 - 25.955 mm (1.0211 - 1.0218 in)**
Standard outer diameter, No.2, 3, 4	**: 23.445 - 23.465 mm (0.9230 - 0.9238 in)**



Inner Diameter of Camshaft Bracket

1. Tighten camshaft bracket bolt with specified torque.
2. Using inside micrometer, measure inner diameter "A" of camshaft bearing.

Standard inner diameter No.1	**: 26.000 - 26.021 mm (1.0236 - 1.0244 in)**
Standard inner diameter No.2, 3, 4	**: 23.500 - 23.521 mm (0.9252 - 0.9260 in)**



Calculation of Camshaft Journal Clearance

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

Standard No.1	**: 0.045 - 0.086 mm (0.0018 - 0.0034 in)**
Standard No.2, 3, 4	**: 0.035 - 0.076 mm (0.0014 - 0.0030 in)**
Limit	**: 0.15 mm (0.0059 in)**

- When out of the specified range, replace either or both camshaft and cylinder head.

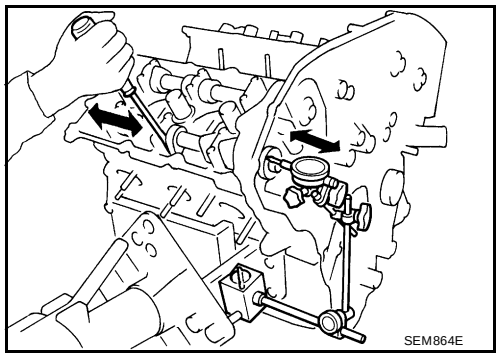
NOTE:
Inner diameter of camshaft bracket is manufactured together with cylinder head. Replace the whole cylinder head assembly.

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.

Standard	**: 0.115 - 0.188 mm (0.0045 - 0.0074 in)**
Limit	**: 0.24 mm (0.0094 in)**

- 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.

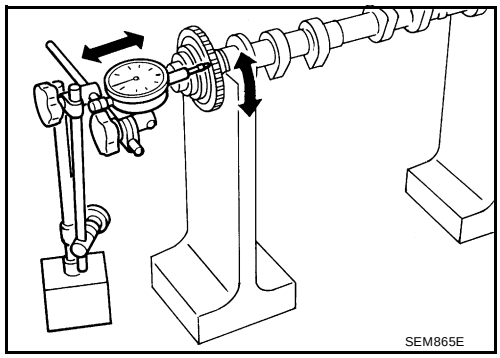


Camshaft Sprocket Runout

1. Install camshaft sprocket on camshaft.
2. Measure camshaft sprocket runout.

Runout : Less than 0.15 mm (0.0059 in)

3. If sprocket runout exceeds the limit, replace camshaft sprocket.



Valve Clearance

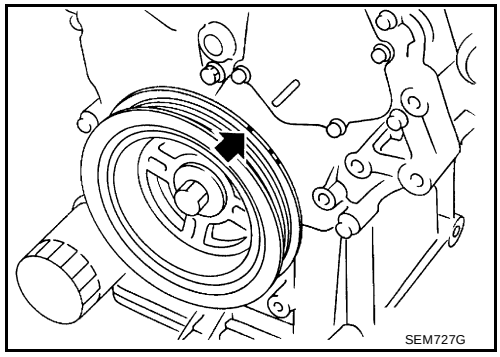
EBS007Q6

CHECKING

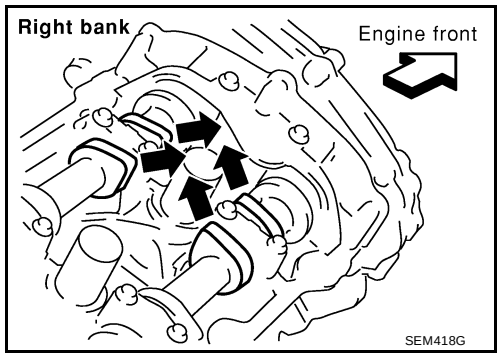
CAUTION:

Check valve clearance while engine is cold and not running.

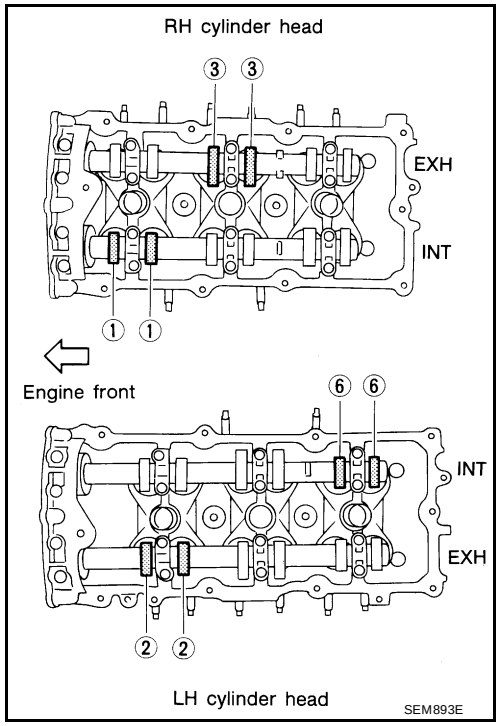
1. Remove the air duct with air cleaner case, collectors, hoses, wires, harnesses, and connectors.
2. Remove the intake manifold collectors.
3. Remove the ignition coils and spark plugs.
4. Remove the rocker covers.
5. Set No.1 cylinder at TDC on its compression stroke.
   - Align pointer with TDC mark on crankshaft pulley.



   - 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 above.

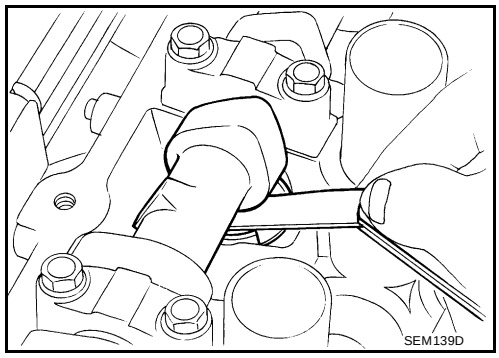


6. Check only the valves as shown.



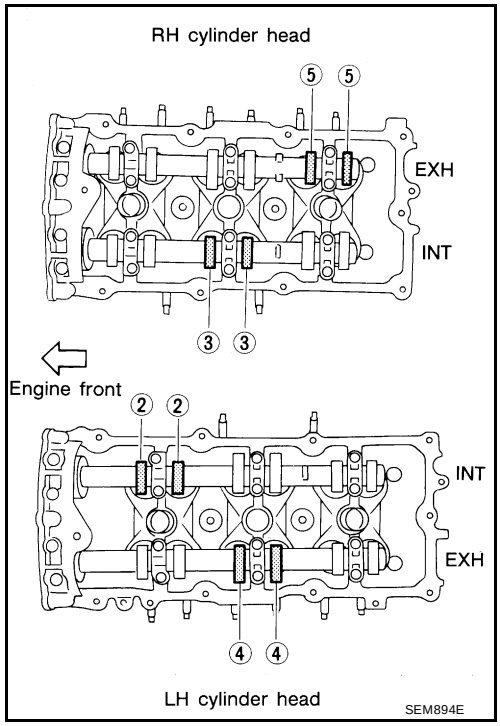
Crank Position	Valve No. 1	Valve No. 2	Valve No. 3	Valve No. 6
No. 1 TDC	Intake	Exhaust	Exhaust	Intake

- Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
- Record any valve clearance measurements which are out of specification. They will be used later to determine the required replacement lifter size.



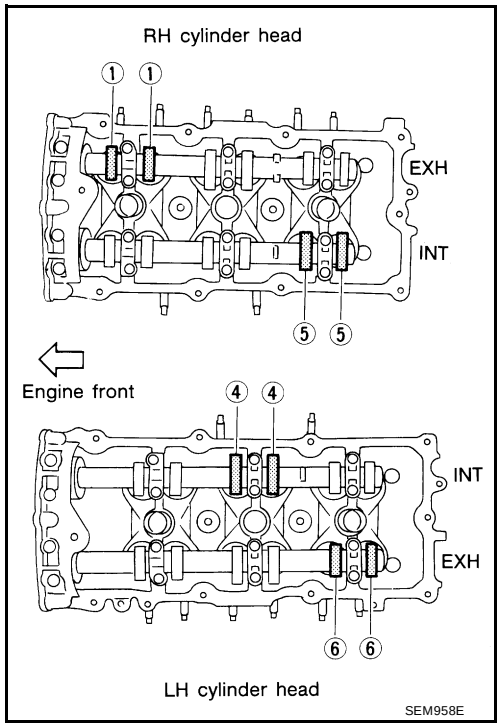
7. Turn crankshaft 240° and align as above.
8. Set No.3 cylinder at TDC on its compression stroke.

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. If the valve clearances are out of specification, adjust the valve clearances.

Valve Clearance Specification for Checking (Cold)

Intake : 0.26 - 0.34 mm (0.010 - 0.013 in)

Exhaust : 0.29 - 0.37 mm (0.011 - 0.015 in)

If all valve clearances are within specification, install the following components:

- Intake manifold collectors
- Rocker covers
- All spark plugs
- All ignition coils

ADJUSTING

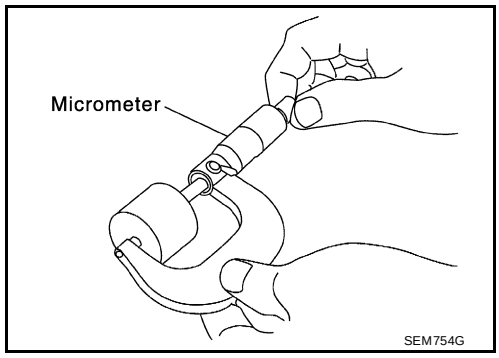
CAUTION:

Adjust valve clearance while engine is cold.

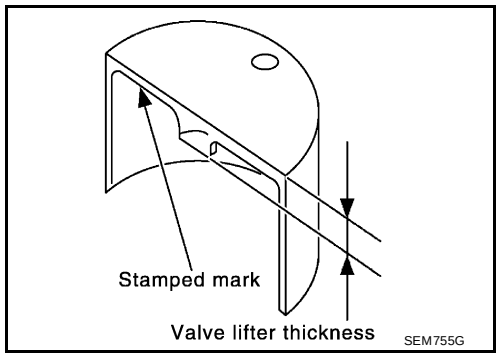
NOTE:

Perform adjustment by selecting the correct head thickness of the valve lifter (adjusting shims are not used).

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 lifter with a micrometer, as shown.



4. Use the equation below to calculate the replacement valve lifter thickness.
   Valve lifter thickness calculation equation: t = t1 + (C1 - C2)
   t = thickness of the replacement lifter
   t1 = thickness of the removed lifter
   C1 = measured valve clearance
   C2 = standard valve clearance
   - The thickness of the new valve lifter can be identified by the stamp mark on the reverse side (inside the lifter).
   - Available thickness of the valve lifter (factory setting): 7.88 - 8.36 mm (0.3102 - 0.3291 in), in 0.02 mm (0.0008 in) increments, in 25 sizes (intake / exhaust).



Value lifter thickness:

Intake : 0.30 mm (0.012 in)

Exhaust : 0.33 mm (0.013 in)

Valve Shims

Stamp Mark	Thickness of Valve Lifter
Starting: 788C	7.88 mm (0.3102 in)
Ending: 836C	8.36 mm (0.3291 in)

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.

Valve Clearance	Cold	Hot* (reference data)
Intake	0.26 - 0.34 mm (0.010 - 0.013 in)	0.32 - 0.40 mm (0.013 - 0.016 in)
Exhaust	0.29 - 0.37 mm (0.011 - 0.015 in)	0.33 - 0.41 mm (0.013 - 0.016 in)

* Approximately 80°C (176°F)

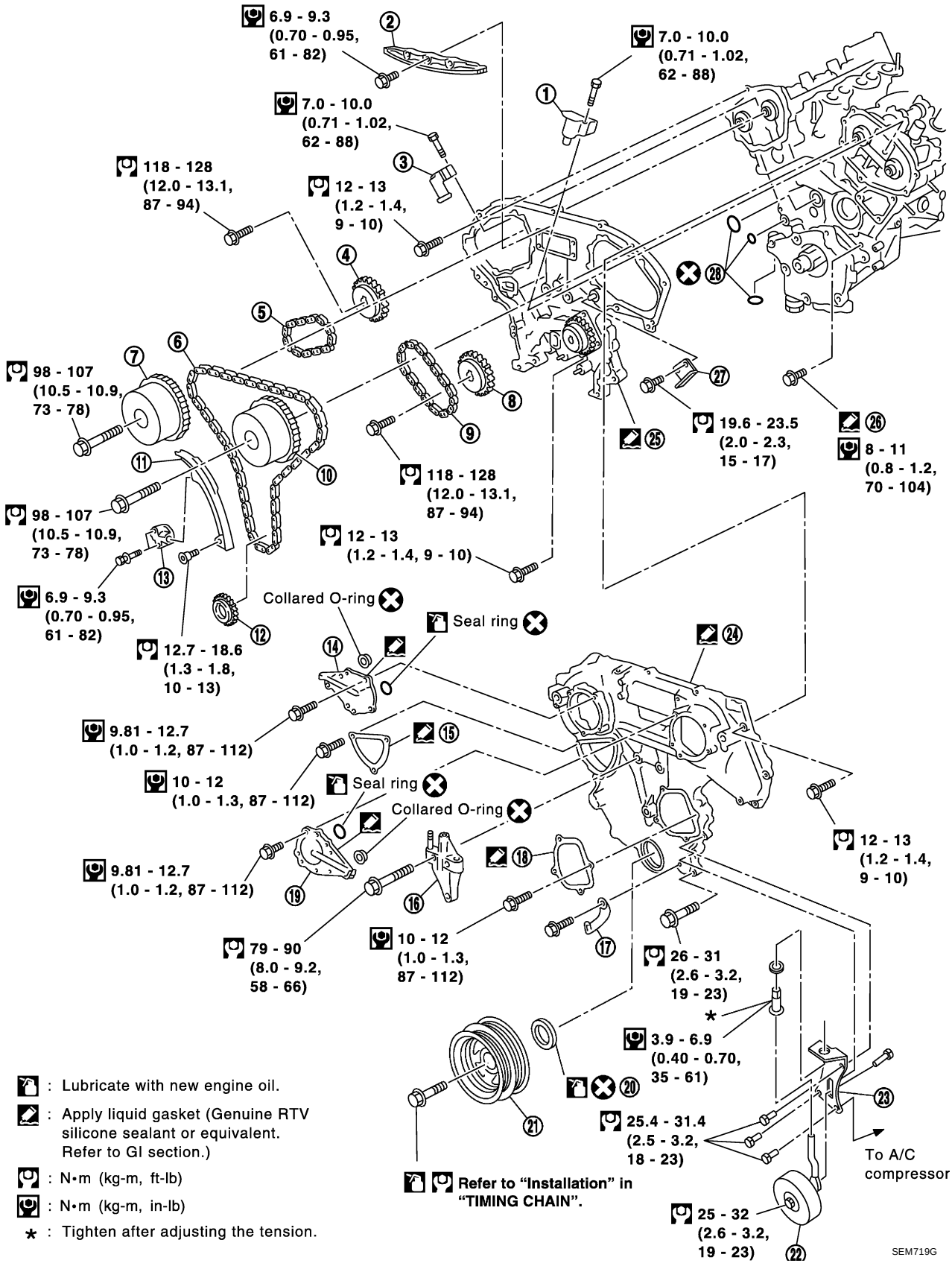
TIMING CHAIN

PFP:13028

Components

EBS007Q7

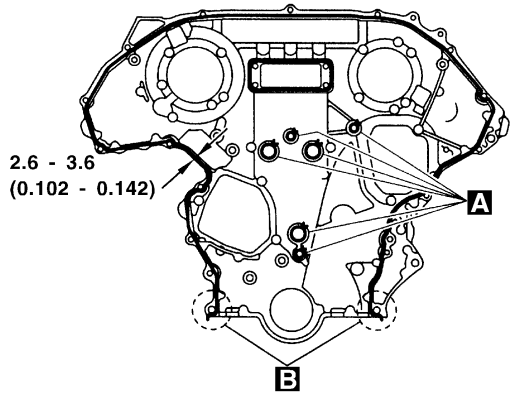
SEC. 120•130•150•210•275

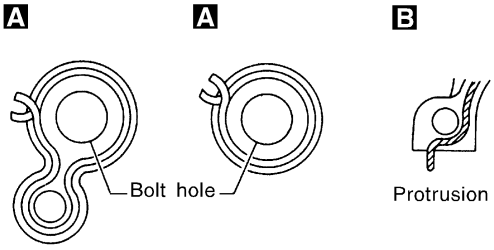


1. Timing chain tensioner
2. Internal chain guide
3. Timing chain tensioner
4. Camshaft sprocket (EXH)
5. Timing chain (secondary)
6. Timing chain (primary)
7. Camshaft sprocket (INT)
8. Camshaft sprocket (EXH)
9. Timing chain (secondary)
10. Camshaft sprocket (INT)
11. Slack guide
12. Crankshaft sprocket
13. Timing chain tensioner
14. IVTC valve cover
15. Chain tensioner cover
16. RH engine mounting bracket
17. Water hose clamp
18. Water pump cover
19. IVTC valve cover
20. Front oil seal
21. Crankshaft pulley
22. Idler pulley
23. Idler pulley bracket
24. Front timing chain case
25. Rear timing chain case
26. Water drain plug
27. Tension guide
28. O-ring

POSITION FOR APPLYING LIQUID GASKET

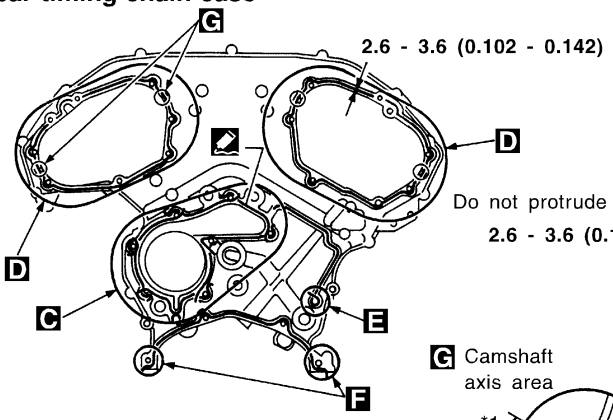
Front timing chain case

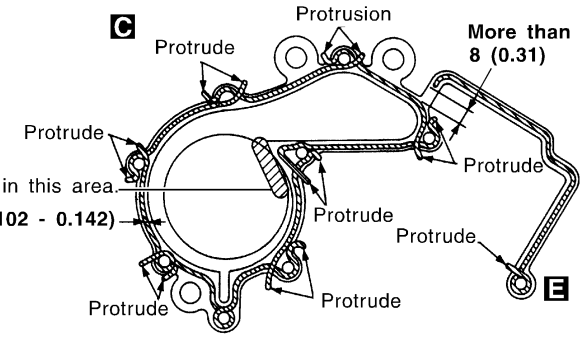


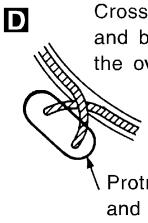


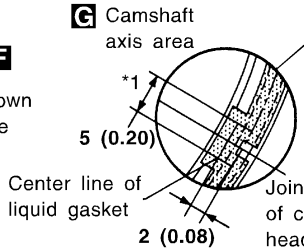
Sealant protrusion away from bolt hole

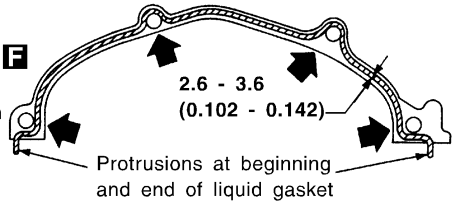
Rear timing chain case





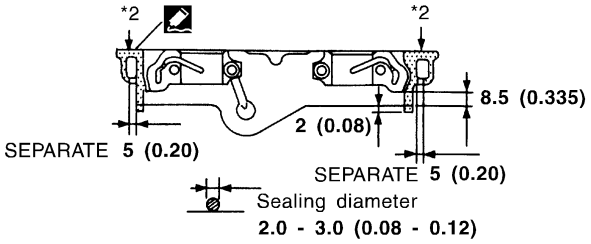






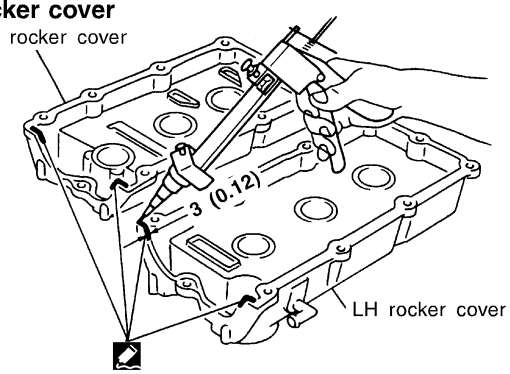
*1: Apply liquid gasket to the chamfered surface between camshaft bracket and cylinder head.

Camshaft bracket



*2: Remove the protruding sealant from front face.
(Remove the hardened sealant from surface only.)

Rocker cover



Unit: mm (in)

SEM411G

- Refer to EM-102, "Precautions for Liquid Gasket" .
- Before installation, wipe off any protruding sealant.

CAUTION:

- **After removing timing chain, 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.**

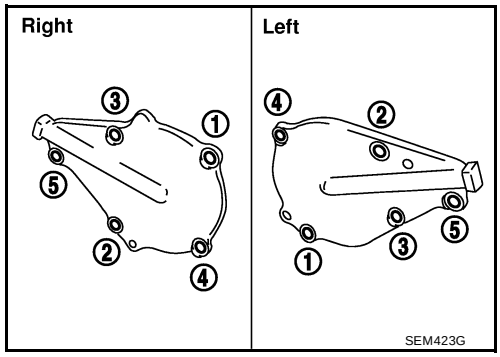
- **Apply new engine oil to bolt threads and seat surfaces when installing camshaft sprockets, camshaft brackets, and crankshaft pulley.**
- **Before disconnecting fuel hose, release fuel pressure. Refer to EC-671, "FUEL PRESSURE RELEASE" .**
- **Before removing the upper oil pan, remove the crankshaft position sensor (POS).**
- **Be careful not to damage sensor edges.**
- **Do not spill engine oil or coolant on drive belts.**

Removal

EBS007Q8

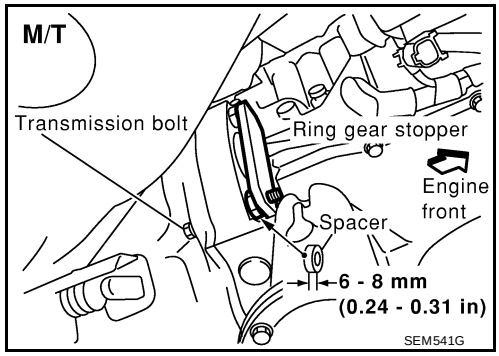
1. Release the fuel pressure.
   Refer to EC-671, "FUEL PRESSURE RELEASE" .
2. Remove the battery.
3. Drain the engine cooling system.
   Refer to EC-1102, "Description" .
4. Drain engine oil.
   Refer to MA-24, "Changing Engine Oil" .
5. Remove engine cover with power tool.
6. Remove the intake air duct with the air cleaner case lid and mass air flow sensor.
7. Remove the engine coolant reservoir.
8. Disconnect the fuel rail quick connector at the vehicle piping side.
   Refer to EM-129, "Removal and Installation" .
9. Remove the cowl top grille and the windshield wiper assembly.
   Refer to EI-18, "Removal and Installation" .
10. Remove the front RH wheel and tire with power tool.
11. Remove the engine undercovers with power tool.
12. Remove the inner fender splash shield with power tool.
13. Remove the drive belts and idler pulley.
14. Recover the A/C system R134a and remove the A/C compressor.
    Refer to MTC-16, "REFRIGERATION SYSTEM" .
15. Dismount the power steering oil pump and reservoir tank. Tie them down with wire to reposition them out of the way.
16. Remove the lower and upper oil pans.
    Refer to EM-120, "Removal and Installation" .
17. Remove the A/C high pressure line.
    Refer to MTC-79, "REFRIGERANT LINES" .
18. Remove the alternator.
    Refer to SC-33, "Removal and Installation" .
19. Disconnect the engine harness and set aside.
20. Support the engine and remove the RH engine mount and bracket.
21. Remove the IVTC valve covers, bank 1 and bank 2. Loosen the bolts in the numerical order as shown.

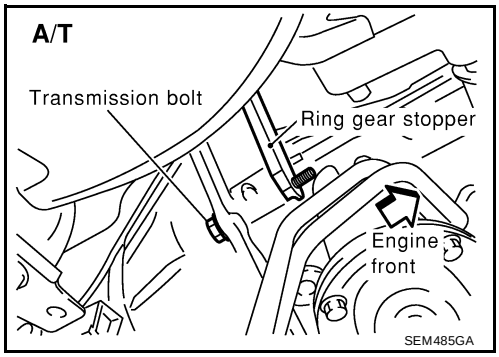
    NOTE:
    The shaft in the cover is inserted into the center hole of the intake camshaft sprocket. Remove the cover by pulling straight out until the cover disengages from the camshaft sprocket.
22. Remove the starter motor. Refer to SC-23, "Removal and Installation" .



23. Set the ring gear stopper using the mounting bolt hole.

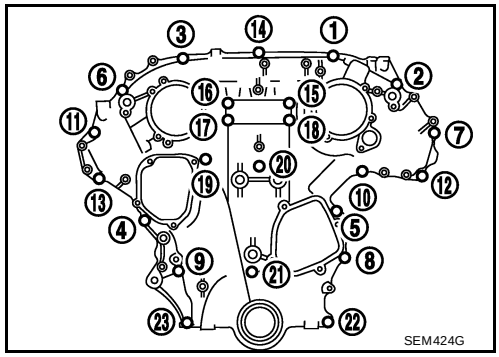
CAUTION:
Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when setting the stopper.



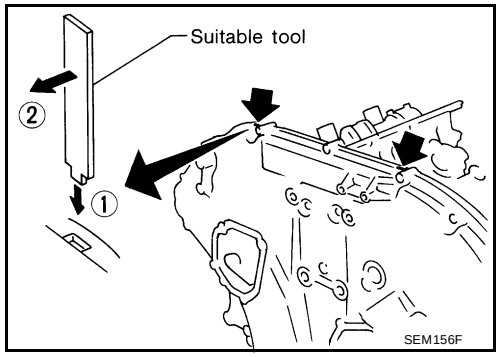


24. Remove the crankshaft pulley.
25. Remove the front timing chain case.

a. Loosen the bolts in the numerical order as shown.

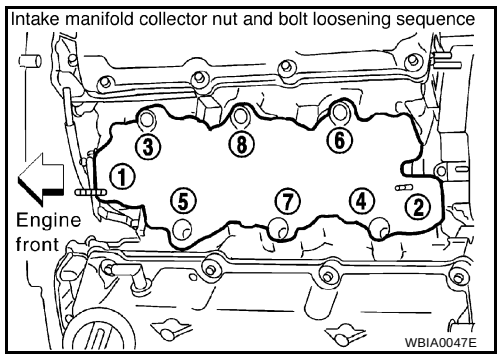


b. Insert the appropriate size tool into the notch at the top of the front timing chain case as shown (1).
c. Pry off the case by moving the tool as shown (2).

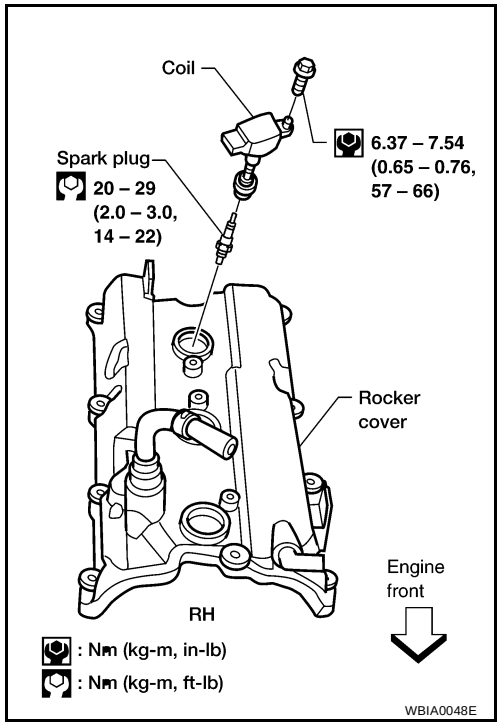


26. Disconnect the power brake booster vacuum hose.
27. Disconnect the electric throttle control actuator.
28. Disconnect the coolant hoses at the electric throttle control actuator.
29. Disconnect the PCV hose.
30. Disconnect the EVAP canister purge volume control solenoid vacuum hose.

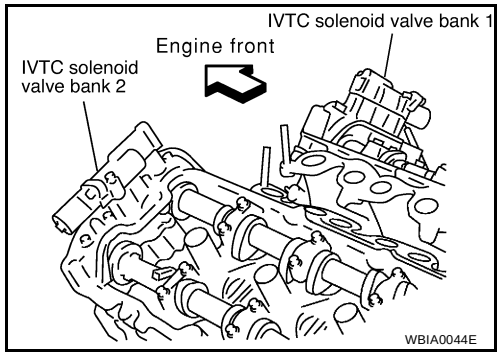
31. Remove the intake manifold collector. Loosen the bolts and nuts in the numerical order as shown.



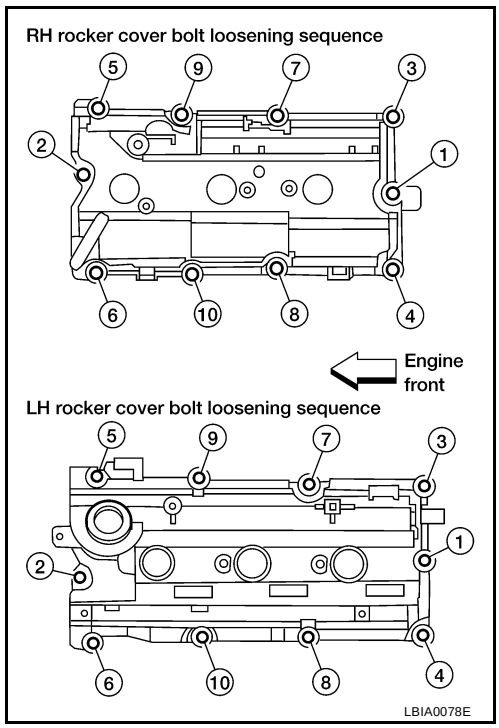
32. Remove the six ignition coils.
33. Remove the six spark plugs.
34. Remove the engine oil dipstick.



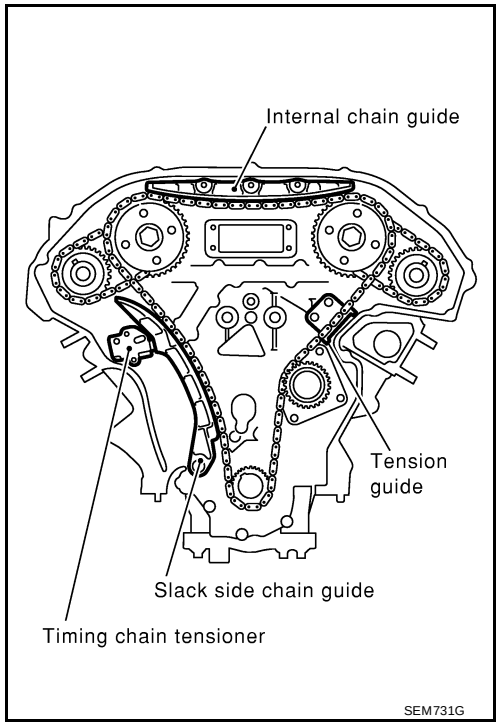
35. Remove the IVTC (intake valve timing control) solenoid valve bank 1 and bank 2.
    - Discard the gaskets and use new gaskets for installation.



36. Remove the rocker covers. Loosen the bolts in the numerical order as shown.

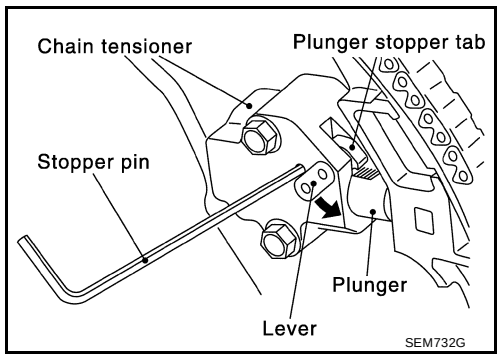


37. Remove the internal chain guide.



38. Remove the timing chain tensioner and slack side chain guide.
    - Place paint marks on the timing chain and sprockets to indicate the correct position of the components for installation.

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

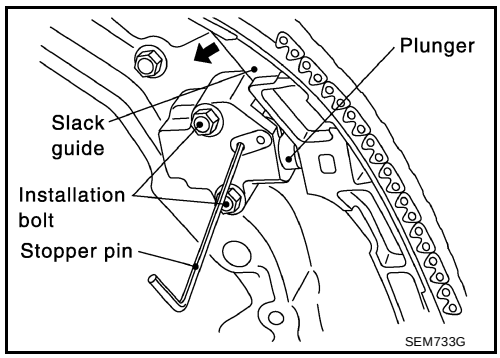


b. Insert stopper pin into tensioner body hole to hold lever, and keep the tab released. An Allen wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.

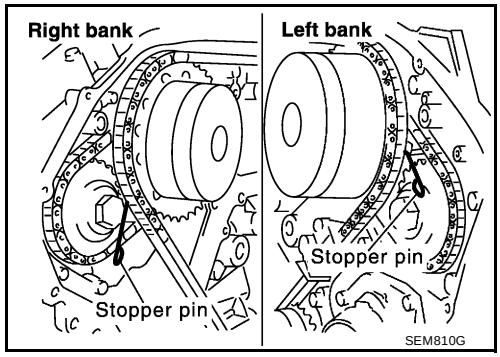
c. Insert plunger into tensioner body by pressing the slack side chain guide.

d. Keep the slack side chain guide pressed and hold it by pushing the stopper pin through the lever hole and body hole.

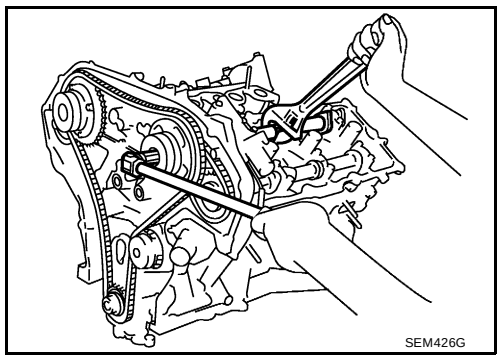
e. Remove the mounting bolts and remove the timing chain tensioner.



39. Attach a suitable stopper pin to the RH and LH camshaft chain tensioners (for secondary timing chains).

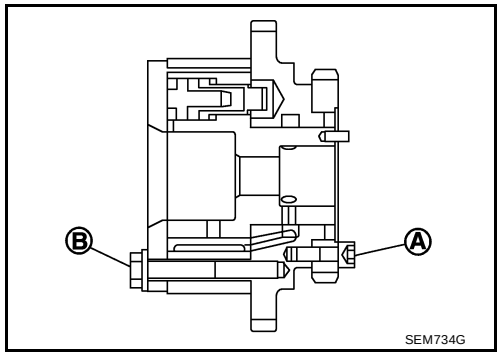


40. Remove the intake and exhaust camshaft sprocket bolts.
    - Apply paint to the timing chain and camshaft sprockets for alignment during installation.
    - Secure the hexagonal portion of the camshaft using a wrench to loosen the mounting bolts.



41. Remove the primary and secondary timing chains with camshaft sprockets.
    - Intake camshaft sprocket is two-for-one structure of primary and secondary sprockets.
    - Handle the intake sprockets as an assembly.

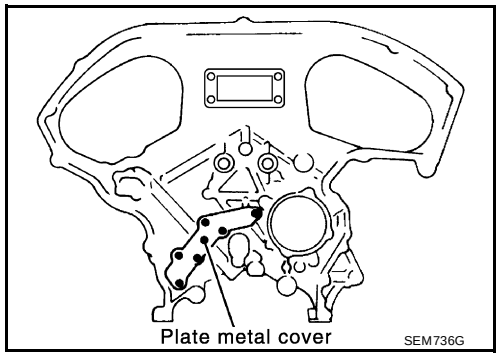
    CAUTION:
    - **Avoid impact or dropping the intake sprockets.**
    - **Do not disassemble the intake sprockets (never loosen bolts A and B as shown).**



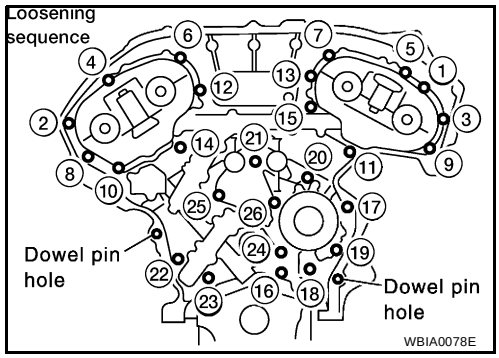
42. Remove the chain tension guide and crankshaft sprocket.
43. Remove the rear timing chain case.

CAUTION:

- **Do not remove the metal plate cover for the oil passage.**
- **After removing the chain case, do not apply any load to the case that might bend it.**



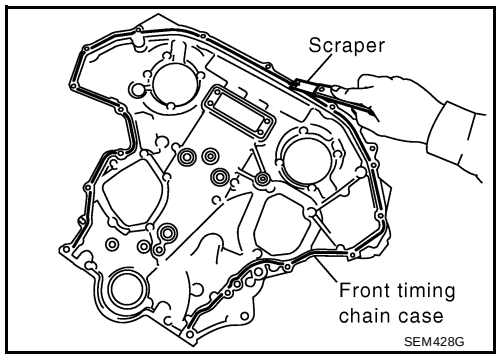
a. Loosen and remove the mounting bolts in the order shown.
b. Cut the sealant with an appropriate tool and remove the rear timing chain case.



44. Use a scraper to remove all of the old RTV Silicone Sealant from the front timing chain case.

CAUTION:

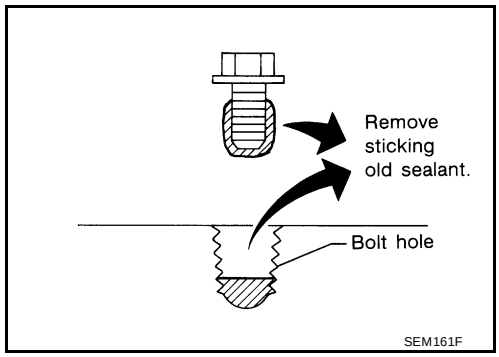
Do not damage the mating surfaces.



45. Remove all old RTV Silicone Sealant from all the bolt holes and bolts.

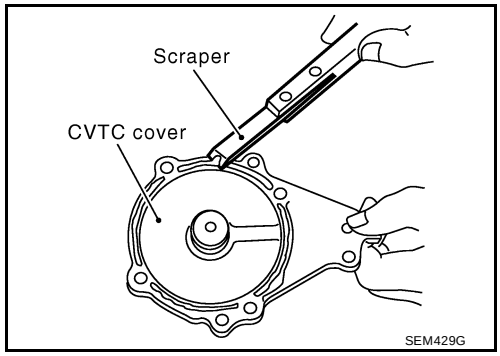
CAUTION:

Do not damage the threads or mating surfaces.



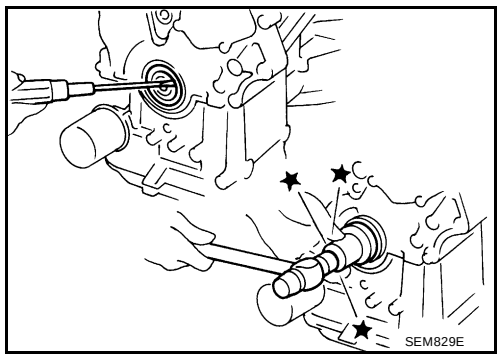
46. Use a scraper to remove all the old RTV Silicone Sealant from the water pump cover and IVTC valve covers.

CAUTION:
Do not damage the mating surfaces.



47. Remove the front oil seal from the front timing chain case using a suitable tool.

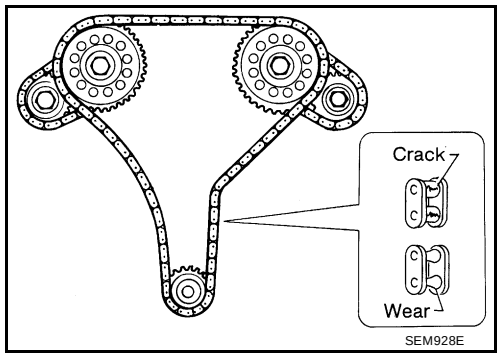
CAUTION:
Do not damage the front cover.



Inspection

EBS007Q9

Check for cracks and any excessive wear at the roller links of the timing chain. Replace the timing chain as necessary.

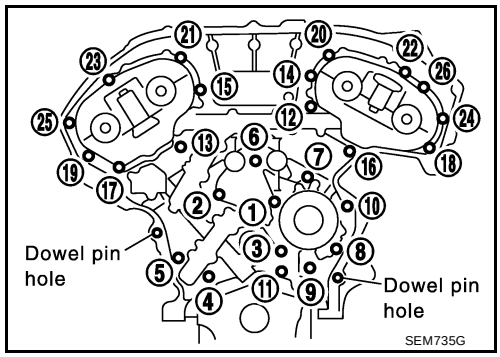


Installation

EBS007QA

1. Apply Genuine RTV Silicone Sealant or equivalent, to the rear timing chain case. Refer to EM-148, "POSITION FOR APPLYING LIQUID GASKET" .
2. Align the rear timing chain case and water pump assembly with the dowel pins (RH and LH) on the cylinder block and install the case. Make sure the O-rings stay in place during installation.

a. Tighten the mounting bolts in the numerical order as shown. There are two bolt lengths used. Follow the chart below for proper bolt length specifications.



Bolt position	Bolt length
1, 2, 3, 6, 7, 8, 9, 10	20 mm (0.79 in)
4, 5, 11 - 26	16 mm (0.63 in)

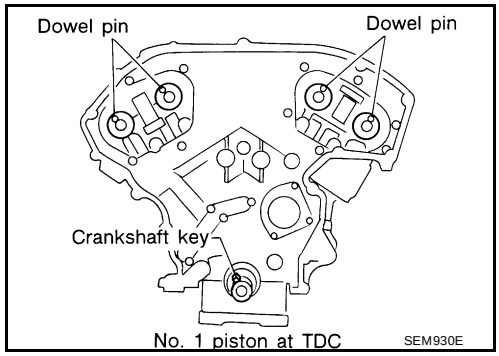
b. After all bolts are initially tightened, retighten them to the specification in the numerical order as shown.

Rear timing chain case bolts : 12 - 13 N·m (1.2 - 1.4 kg-m, 9 -10 ft-lb)

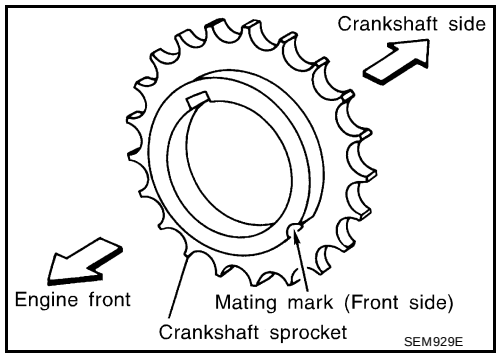
3. Install the timing chain tension guide.

4. Position the crankshaft so No. 1 piston is set at TDC on the compression stroke.
   - Make sure that the dowel pin hole, dowel pin and crankshaft key are located as shown.
     Camshaft dowel pin hole (intake side): at cylinder head upper face side in each bank.
     Camshaft dowel pin (exhaust side): at cylinder head upper face side in each bank.
     Crankshaft key: at cylinder head side of RH bank.

   CAUTION:
   Hole on small diameter side must be used for intake dowel pin. Do not misidentify (ignore big diameter side).

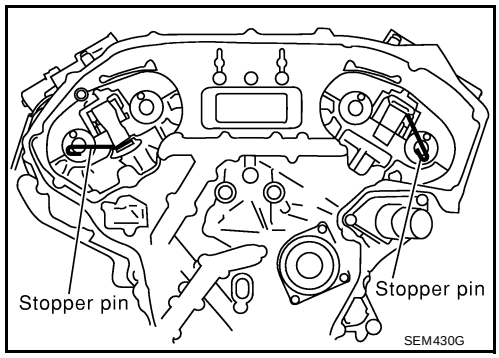


5. Install the crankshaft sprocket on the crankshaft.
   - Make sure the mating marks on the crankshaft sprocket face the front of the engine.



6. Install the secondary timing chains and camshaft sprockets.

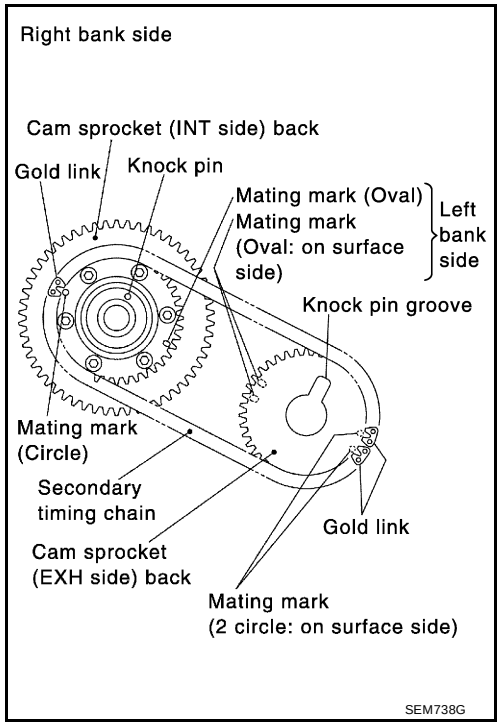
   CAUTION:
   Matching marks between the timing chain and sprockets slip easily. Confirm all matching mark positions repeatedly during the installation process.



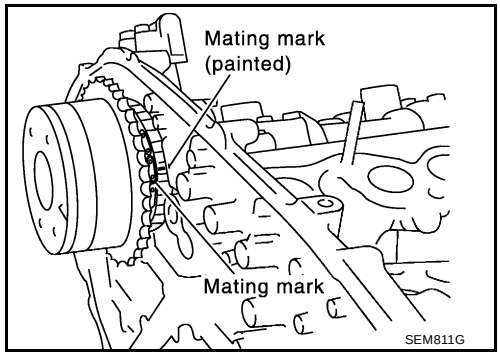
- Push the sleeve of the secondary chain tensioner and keep it pressed in with a stopper pin.

a. Align the matching marks on the secondary timing chain (gold link) with the ones on the intake and exhaust sprockets (stamped), and install them.
   - Matching marks for the intake sprocket are on the back side of the secondary sprocket.
   - There are two types of matching marks, round and oval types. They should be used for the RH and LH banks, respectively.
     RH bank: use round type.
     LH bank: use oval type.

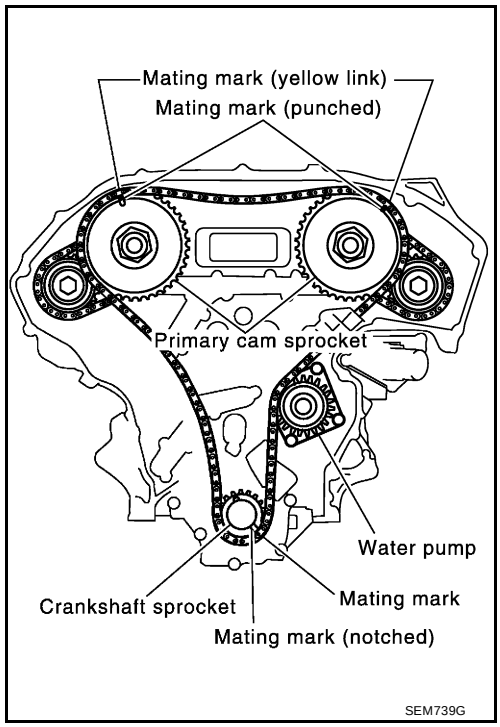
b. Align the knock pin and pin hole on the camshaft with the groove and knock pin on the sprocket, and install them.
   - On the intake side, align the pin hole on the small diameter side of the camshaft front end with the knock pin on the back side of the camshaft sprocket, and install them.
   - On the exhaust side, align the knock pin on the camshaft front end with the pin groove on the camshaft sprocket, and install them.
   - Mounting bolts for the camshaft sprockets must be tightened in the next step. Tightening them by hand is enough to prevent the dislocation of the knock pins.



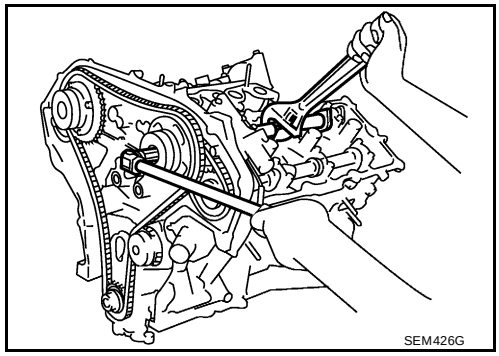
- It may be difficult to visually check the dislocation of mating marks during and after installation. To make the matching easier, make a mating mark on the sprocket teeth in advance with paint.



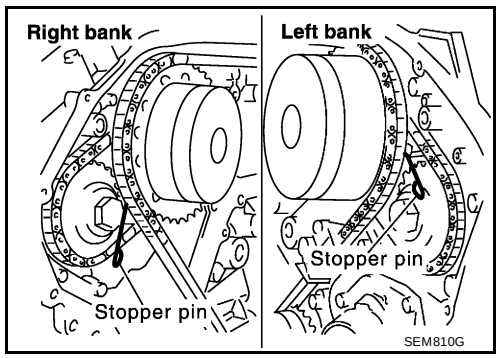
7. Install the secondary timing chain and sprocket to the other bank. Install the primary timing chain at the same time.
   - Installation of the secondary timing chain follows the procedure in step 6.
   - Install primary timing chain so the mating mark (punched) on camshaft sprocket is aligned with the yellow link on the timing chain, while the mating mark (notched) on the crankshaft sprocket is aligned with the orange one on the timing chain, as shown.
   - When it is difficult to align mating marks of the primary timing chain 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.



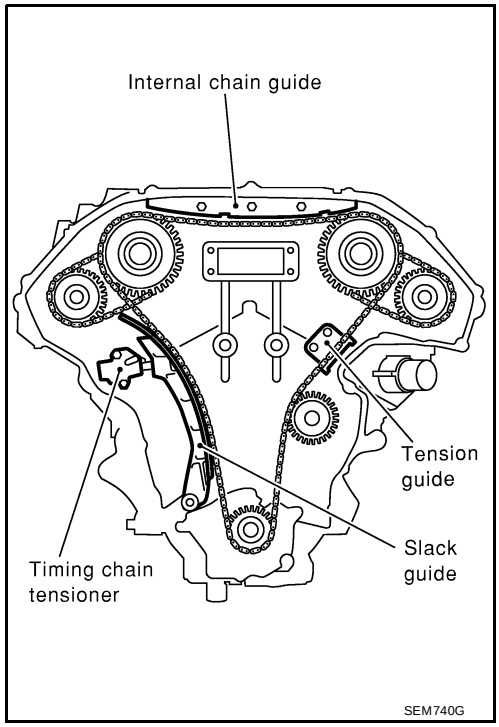
8. After confirming the mating marks are aligned, tighten the camshaft sprocket mounting bolts.
   - Secure the camshaft using a wrench at the hexagonal portion to tighten the mounting bolts.



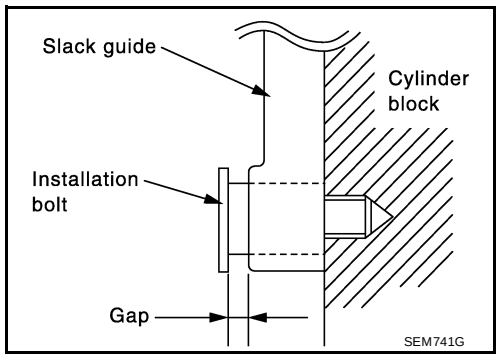
9. Pull the stopper pins out from the secondary timing chain tensioners.



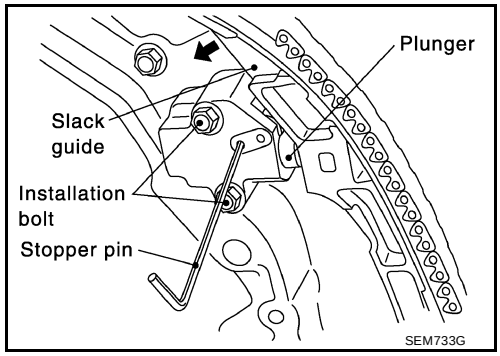
10. Install the internal chain guide.



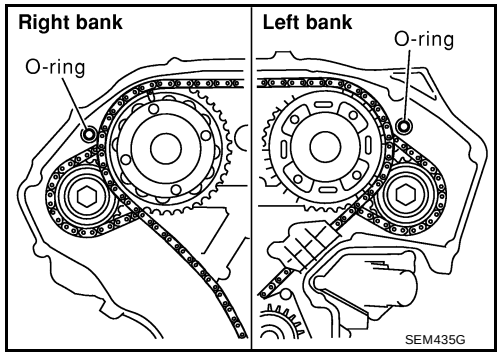
11. Install the slack guide.
   - Do not overtighten the slack guide mounting bolts. It is normal for a gap to exist under the bolt seats when the mounting bolts are tightened to specification.



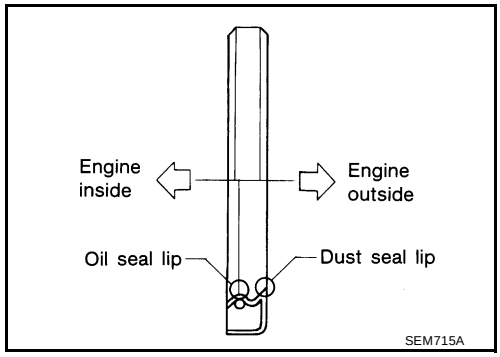
12. Install the timing chain tensioner for the slack guide.
    - When installing the chain tensioner, push in the sleeve and keep it pressed in with the stopper pin.
    - Remove any dirt and foreign materials completely from the back and the mounting surfaces of the chain tensioner.
    - After installation, pull out the stopper pin by pressing the slack guide.
13. Reconfirm that the matching marks on the sprockets and the timing chain have not slipped out of alignment.



14. Install new O-rings on the rear timing chain case.

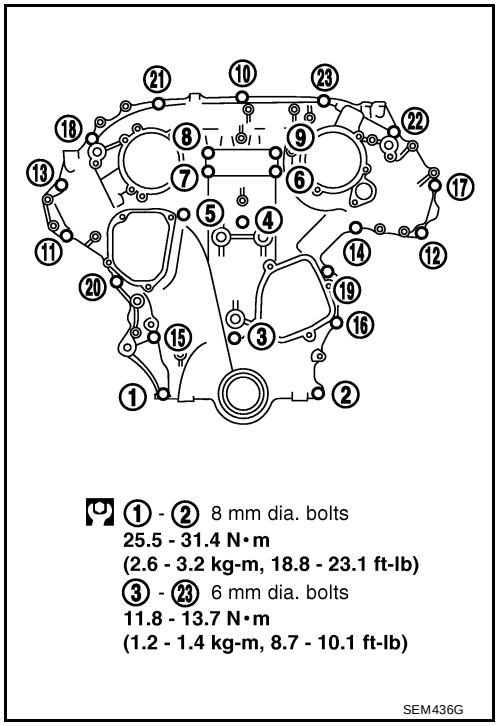


15. Install the front oil seal on the front timing chain case using a suitable tool. Apply clean engine oil to the oil seal edges.

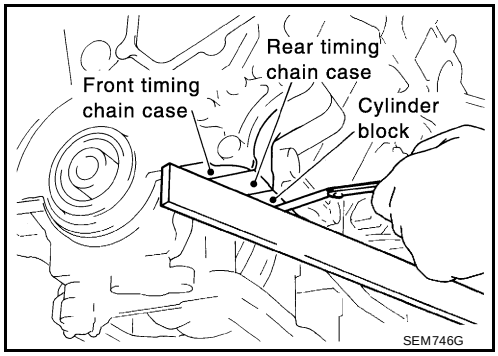


16. Apply liquid gasket to front timing chain case.
    Refer to EM-148, "POSITION FOR APPLYING LIQUID GASKET" .
    - Before installation, wipe off the protruding sealant.

17. Install the rear case pin into dowel pin hole on front timing chain case.
18. Tighten bolts to the specified torque in order shown in the figure.



19. After installing the front timing chain case, check the surface height difference between the following parts on the oil pan mounting surface.
    - If not within specification, repeat the installation procedure.



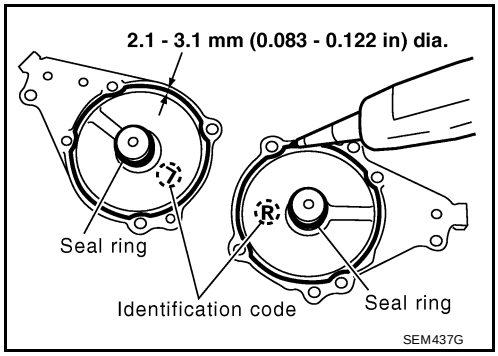
Front timing chain case to rear timing chain case	**: (–0.14) - 0.14 mm [(–0.005) - 0.0055 in]**
Oil pump to cylinder block	**: (–0.36) - (–0.10) mm [(–0.0142) - (–0.0039) in]**
Rear timing chain case to cylinder block	**: (–0.24) - 0.14 mm [(–0.0094) - 0.0055 in]**

20. Install IVTC valve covers as follows:

a. Install new O-rings on the front of the timing chain case.

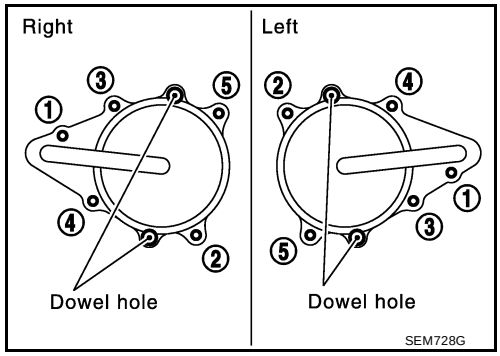
b. Install new seal rings on the IVTC valve covers.

c. Apply RTV Silicone Sealant to the IVTC solenoid valve covers. Use genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .

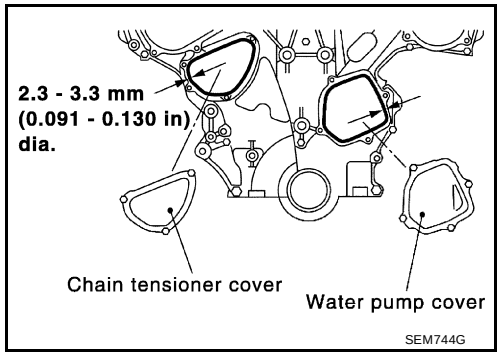


- Being careful not to move the seal ring from the installation groove, align the dowel pins on the chain case with the holes to install the IVTC solenoid valve covers.

- Tighten in the numerical order as shown.

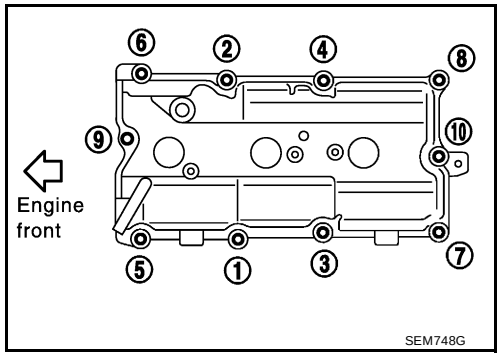


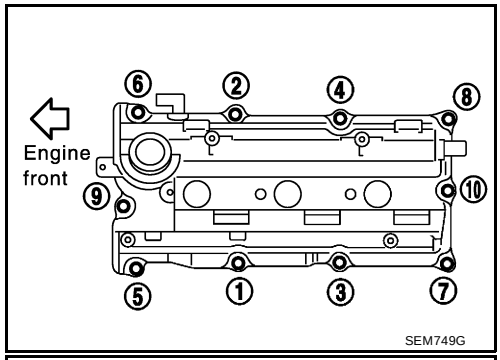
21. Install the water pump cover and the chain tensioner cover. Apply RTV Silicone Sealant or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



22. Install the RH and LH rocker covers.
- Tighten the rocker cover bolts in two stages in the numerical order as shown.

Stage 1 : 0.96 - 2.96 N·m (0.1 - 0.3 kg-m, 9 - 26 in-lb)
Stage 2 : 7.33 - 9.33 N·m (0.75 - 0.95 kg-m, 65 - 82 in-lb)

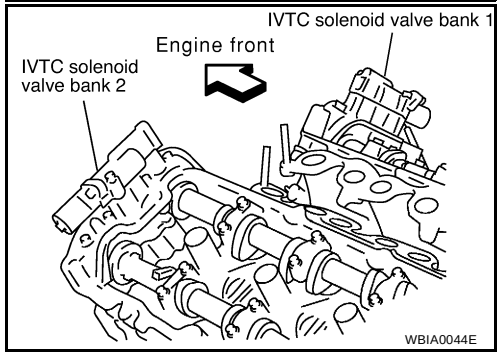




23. Install the IVTC solenoid valve bank 1 and bank 2.

IVTC solenoid valve bolts : 10 - 12 N·m (1.0 - 1.3 kg-m, 87 - 112 in-lb)

24. Install the engine oil dipstick.

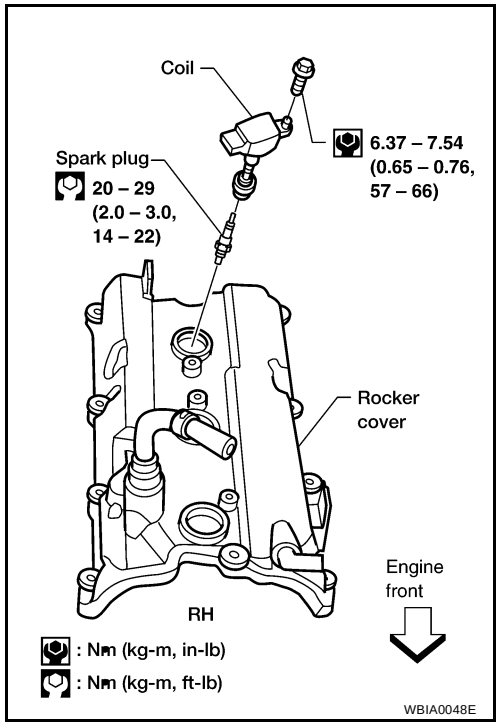


25. Install the six spark plugs to their original positions.

Spark plugs (6) : 20 - 29 N·m (2.0 - 3.0 kg-m, 14 - 22 ft-lb)

26. Install the six ignition coils to their original positions.

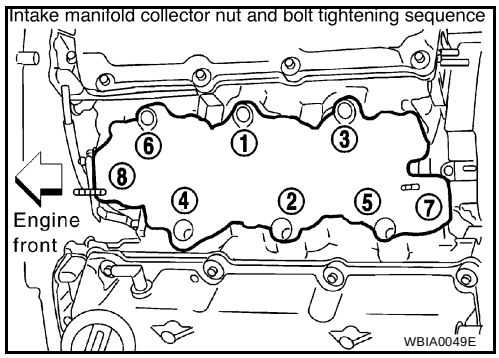
Ignition coils (6) : 6.37 - 7.54 N·m (0.65 - 0.76 kg-m, 57 - 66 in-lb)



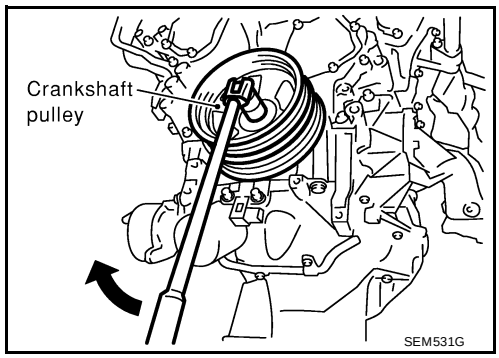
27. Install the intake manifold collector. Tighten the bolts and nuts in numerical order as shown.

Intake manifold collector bolts : 18 - 21 N·m (1.8 - 2.2 kg-lb, 13 - 15 ft-lb)

28. Connect the EVAP purge volume control solenoid hose.
29. Connect the PCV hose.
30. Connect the coolant hoses to the electric throttle control actuator.
31. Connect the power brake booster vacuum hose.
32. Connect the electric throttle control actuator harness electrical connector.

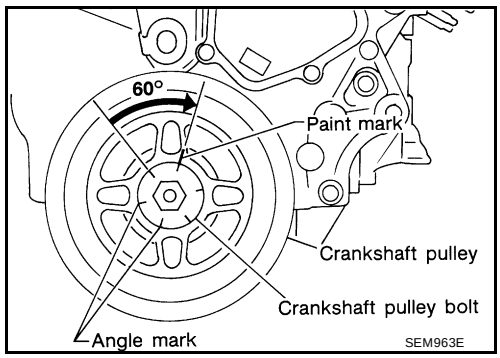


33. Install crankshaft pulley and tighten the bolt in two stages.
    - Lubricate thread and seat surface of the bolt with new engine oil.



- Apply a paint mark for the second stage of angle tightening.

Stage 1 : **39 - 49 N·m (4.0 - 5.0 kg-m, 29 - 36 ft-lb)**
Stage 2 : **60° - 65° degrees clockwise**



34. Remove the ring gear stopper.
35. Install the starter motor. Refer to SC-23, "Removal and Installation" .
36. Install the RH engine mount and bracket.

Engine mount to frame bolts (2)	**: 66 - 74 N·m (6.7 - 7.6 kg-m, 49 - 54 ft-lb)**
Engine mount bracket to front cover bolts (2)	**: 79 - 90 N·m (8.0 - 9.2 kg-m, 58 - 66 ft-lb)**
Engine mount bracket to front cover nut (1)	**: 10 - 15 N·m (1.0 - 1.6 kg-m, 87 - 138 in-lb)**
Engine mount to bracket nuts (2)	**: 49 - 58 N·m (5.0 - 6.0 kg-m, 37 - 43 ft-lb)**

37. Reposition and reconnect the engine harness.
38. Install the alternator.
    Refer to SC-33, "Removal and Installation" .
39. Install the upper and lower oil pans.
    Refer to EM-120, "Removal and Installation" .
40. Install the power steering pump.
    Refer to PS-20, "Removal and Installation" .
41. Install the A/C compressor and recharge the system.
    Refer to ATC-122, "Removal and Installation for Compressor" .
42. Install the idler pulley and the drive belts.
    Refer to EM-109, "Checking Drive Belts" .
43. Install the inner fender splash shield and the engine undercovers.
44. Install the RH wheel and tire.
    Refer to WT-4, "WHEEL AND TIRE ASSEMBLY" .
45. Install the windshield wiper assembly and the cowl top grille.
    Refer to EI-18, "Removal and Installation" .
46. Install the fuel hose quick connector to the fuel tube at the vehicle piping side.
    Refer to EM-129, "Removal and Installation" .
47. Install the engine coolant reservoir.
48. Install the intake air duct with the air cleaner case lid and mass air flow sensor.
49. Install engine cover.
50. Refill the engine with oil and coolant.
    Refer to MA-12, "Fluids and Lubricants" .

    CAUTION:
    Wait at least 30 minutes for the RTV Silicone Sealant to set before filling the engine with fluids to avoid leaks.
51. Install the battery.
52. Activate the fuel system. Check for any leaks when the system is repressurized and correct as necessary.
53. Start the engine and check all systems for leaks or improper operation. Correct as necessary.

    NOTE:
    After starting engine, keep idling for three minutes. Then rev engine up to 3,000 rpm under no load to purge air from the high-pressure oil chamber of the chain tensioners. The engine may produce a rattling noise. This indicates that air still remains in the chamber and is not a matter of concern.

CYLINDER HEAD

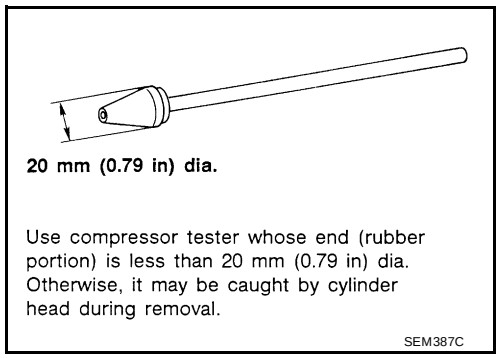
PFP:11041

On-Vehicle Service

EBS007QB

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-671, "FUEL PRESSURE RELEASE" .
4. Remove all six spark plugs.
   Refer to EM-127, "Removal and Installation" .
5. Attach a compression tester to No. 1 cylinder.
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).
   - Always use a fully-charged battery to obtain specified engine speed.



Engine Compression Pressure

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

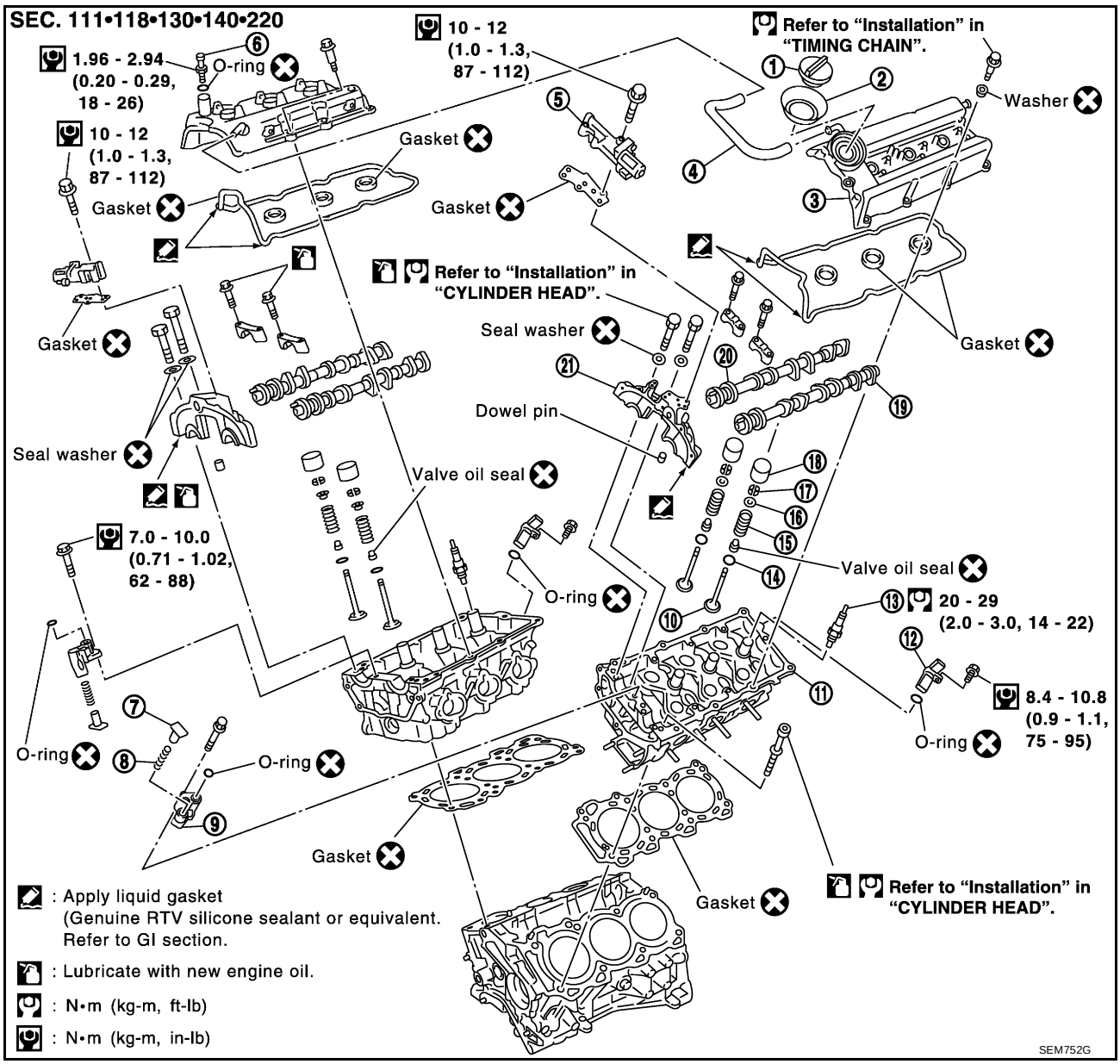
9. If compression in one or more cylinders is low:

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-207, "VALVE" . If the valve and/or valve seat is damaged excessively, 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

EBS007QC

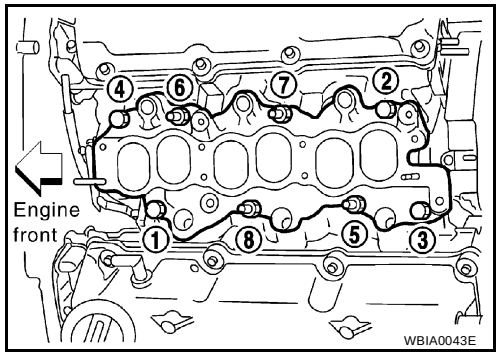


1.	Oil filler cap	2.	Oil catcher	3.	Rocker cover
4.	PCV hose	5.	IVTC solenoid valve	6.	PCV valve
7.	Chain tensioner	8.	Spring	9.	Tensioner sleeve
10.	Valve	11.	Cylinder head	12.	Camshaft position sensor (PHASE)
13.	Spark plug	14.	Valve spring seat	15.	Valve spring
16.	Valve spring retainer	17.	Valve collet	18.	Valve lifter
19.	Camshaft (EXH)	20.	Camshaft (INT)	21.	Camshaft bracket

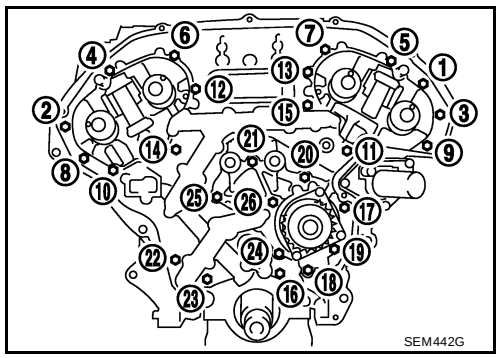
REMOVAL

1. Remove the timing chains. Refer to EM-149, "Removal" .
2. Remove the fuel rail and injectors. Refer to EM-129, "Removal and Installation" .

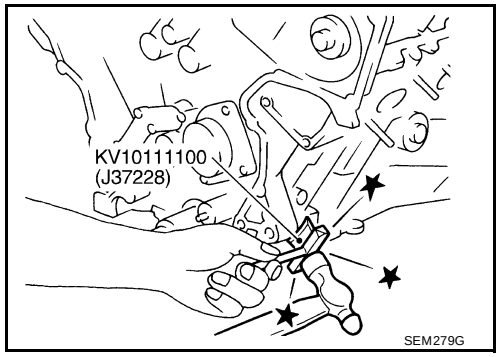
3. Remove the intake manifold using power tool.
   - Loosen the bolts in the numerical order as shown.
4. Remove the coolant outlet housing.



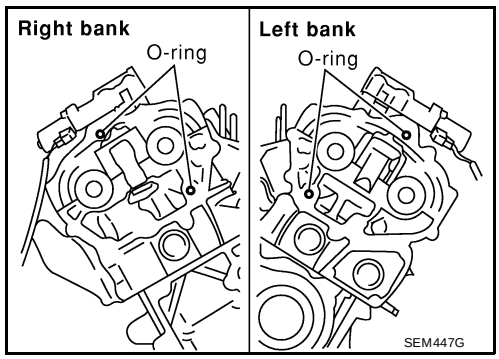
5. Remove rear timing chain case bolts using power tool.
   - Loosen the bolts in the numerical order as shown.



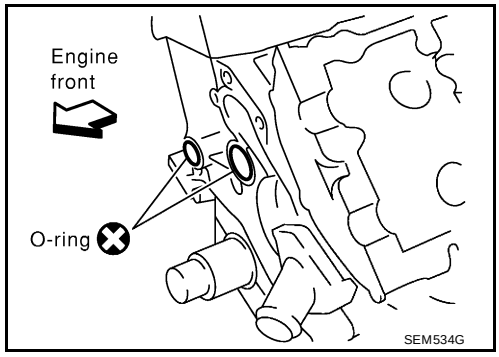
6. Remove rear timing chain case using the Tool.



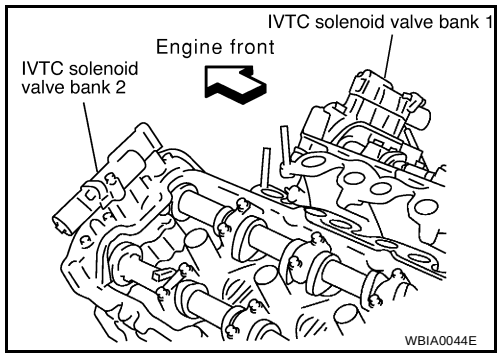
7. Remove the O-rings from the front of the cylinder heads.
   - Discard the O-rings and use new O-rings for installation.



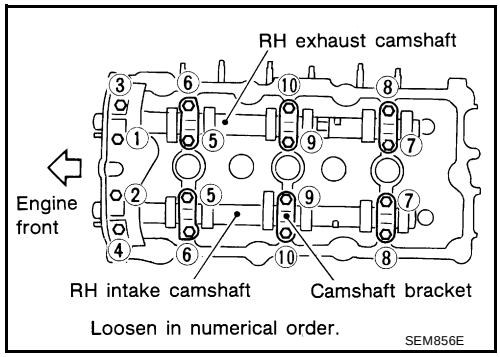
8. Remove the O-rings from the cylinder block.
   - Discard the O-rings and use new O-rings for installation.

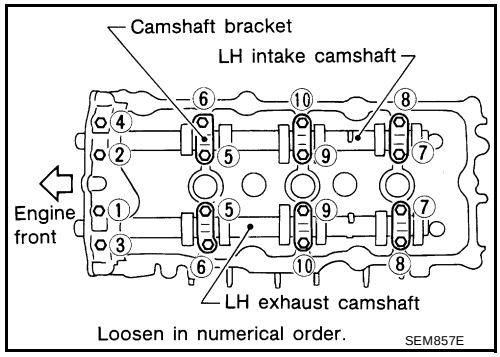


9. Remove the IVTC (intake valve timing control) valves.
   - Discard the IVTC valve gaskets and use new gaskets for installation.



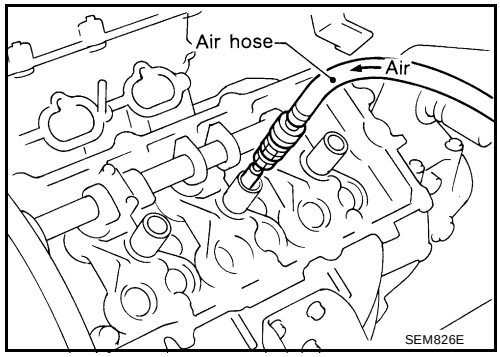
10. Remove the intake and exhaust camshafts and the camshaft brackets.
    - Mark the camshaft brackets so they are placed in the same position and direction for installation.
    - Equally loosen the camshaft bracket bolts in several steps in the numerical order shown.





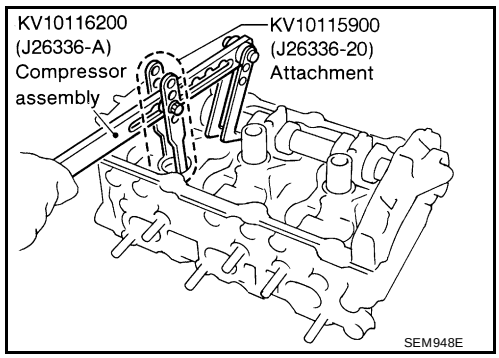
NOTE:
If replacing the oil seals only, without removing the cylinder head, follow the steps below. Use method A or Method B to hold the valve in place while removing the component parts, so the valve does not fall into the combustion chamber.

a. Method A:
Without removing the cylinder head, set the piston being worked on to TDC to prevent the valve from falling into the combustion chamber.
Method B:
Without removing the cylinder head, remove the spark plug from the head, then install an air hose adapter into the spark plug hole and apply air pressure of 490 kPa (5 kg/cm2, 71 psi), as shown. The air pressure will hold the valve in place. This method will only work if the valves and valve seats are in good condition, if not, use Method A.

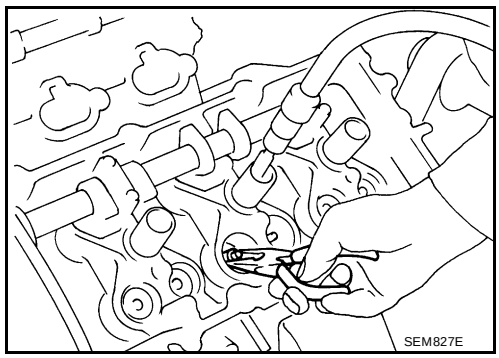


b. Remove the valve lifters. Mark the lifters so they are installed in their original position if being reused.

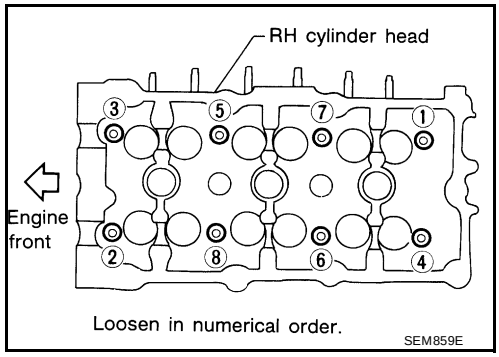
c. Compress the valve spring with the Tool and remove the following components:
- Valve collet
- Valve spring retainer
- Valve spring
- Valve spring seat

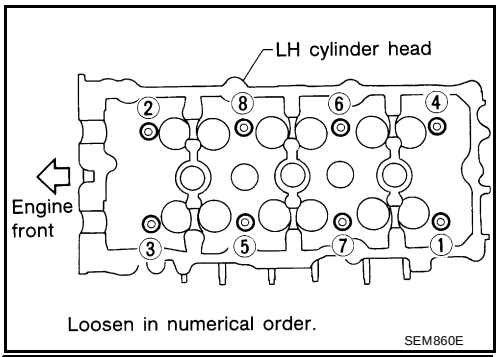


d. With suitable pliers, remove the valve oil seal and replace it.

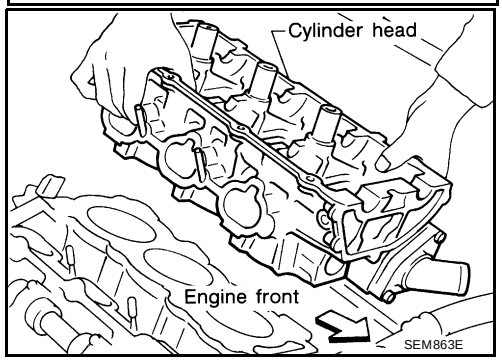


11. Remove the RH and LH cylinder head bolts, with power tool.
- The bolts should be loosened gradually in three stages.
- Loosen the bolts in the numerical order as shown.



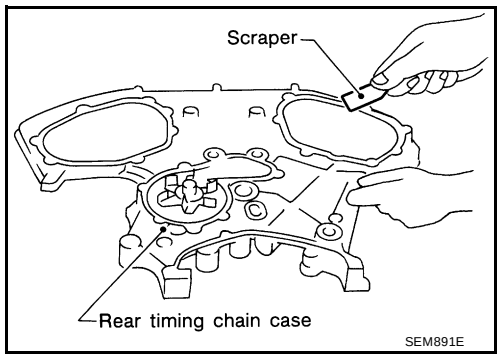


12. Remove cylinder heads and gaskets.
- Discard the cylinder head gaskets and use new gaskets for installation.

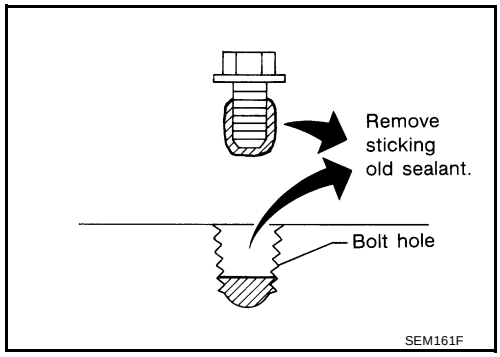


INSTALLATION

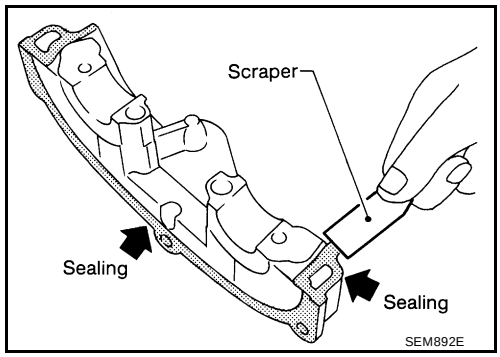
1. Before installing the rear timing chain case, remove the old RTV Silicone Sealant from mating surface using a scraper.
   - Also remove old sealant from mating surface of cylinder block.



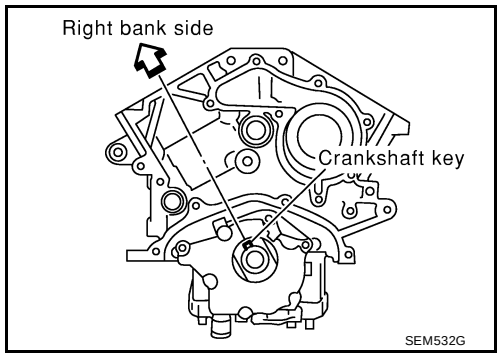
   - Remove the old RTV Silicone Sealant from the bolt hole and thread.



2. Before installing the front cam bracket, remove the old RTV Silicone Sealant from the mating surface using a scraper.
   - Do not scratch the mating surface.

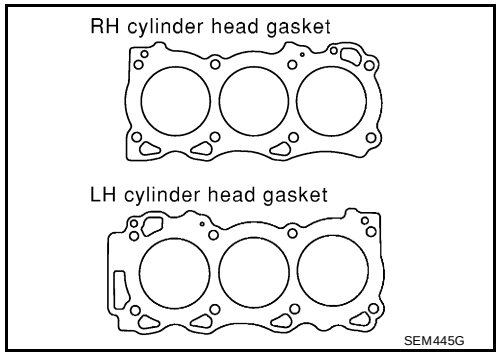


3. Turn the crankshaft until No. 1 piston is set at TDC on the compression stroke.
   - The crankshaft key should line up with the right bank cylinder center line as shown.



4. Install new gaskets on the cylinder heads.

CAUTION:
Do not rotate crankshaft and camshaft separately or valves will strike piston heads.

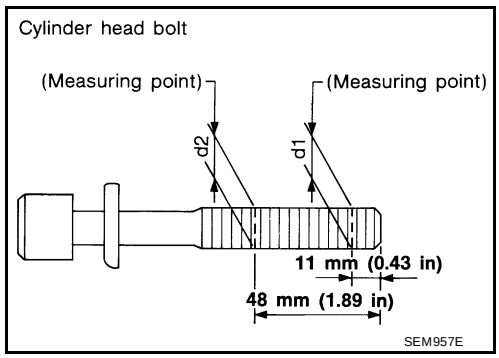


5. Inspect the cylinder head bolts before installing the cylinder heads.

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.

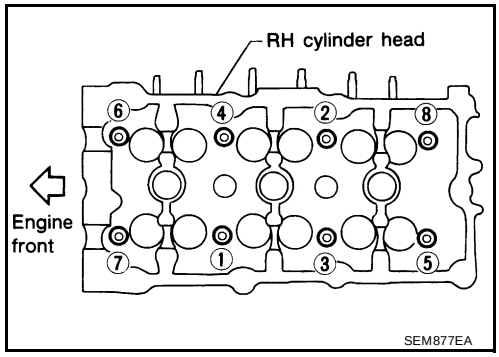
Limit (d1 - d2) : 0.11 mm (0.0043 in)

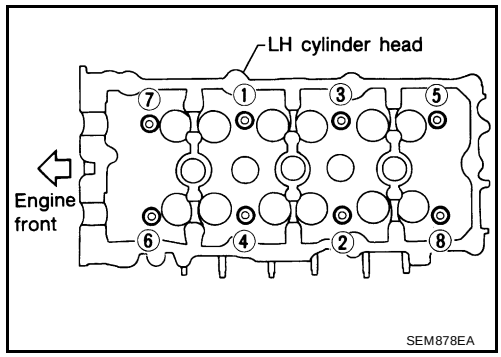
- Lubricate threads and seat surfaces of the bolts with new engine oil.



6. Install the cylinder heads on the cylinder block.

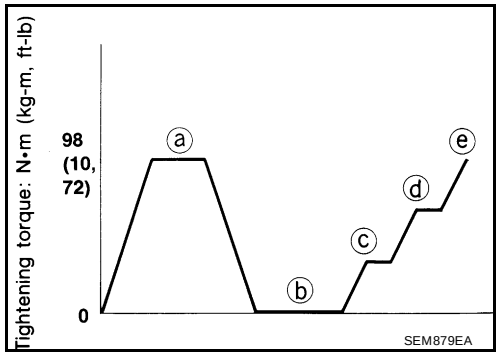
- The cylinder head bolts must be tightened in the numerical order as shown.





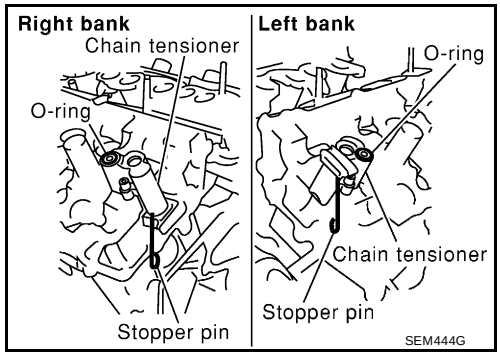
- Tightening the cylinder head bolts is a five stage procedure:

Stage a : 98 N·m (10 kg-m, 72 ft-lb) in order
Stage b : Loosen all bolts in the reverse order of tightening.
Stage c : 34.3 - 44.1 N·m (3.5 - 4.4 kg-m, 26 - 32 ft-lb)
Stage d : Turn all bolts 90° - 95° degrees clockwise
Stage e : Turn all bolts 90° - 95° degrees clockwise

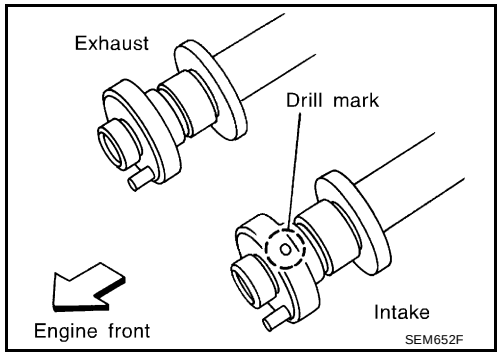


7. Install camshaft chain tensioners on both sides of cylinder head.

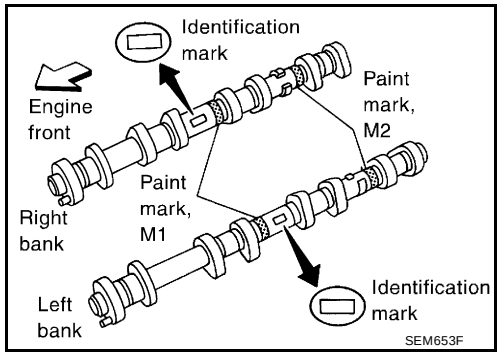
Camshaft chain tensioner bolts : 7 - 10 N·m (0.7 - 1.0 kg-m, 62 - 89 in-lb)



8. Install exhaust and intake camshafts and camshaft brackets.
   - Intake camshaft has a drill mark on camshaft sprocket mounting flange.

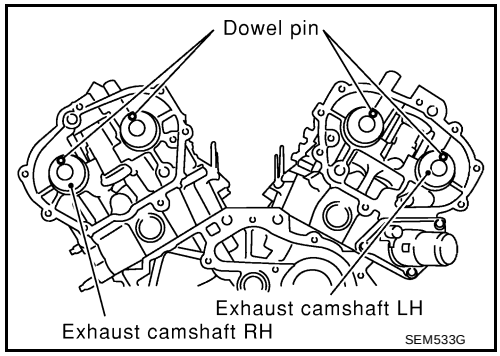


   - Follow your identification marks made during removal, or follow the identification marks that are present on the new camshaft components for proper placement.

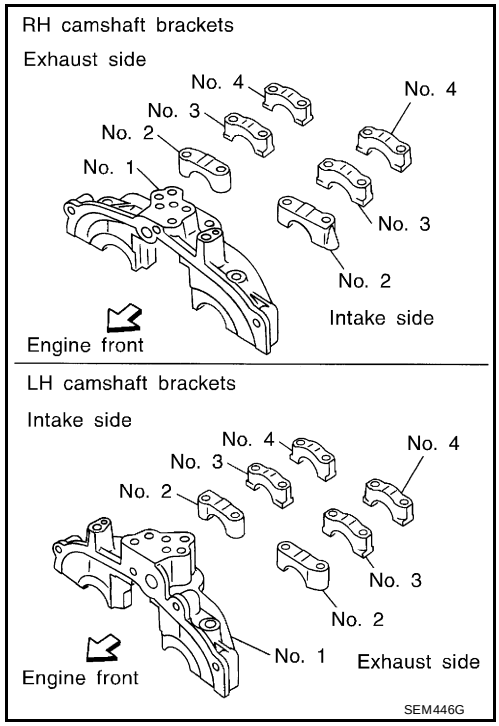


Bank	INT/EXH	ID mark	Drill mark	Paint marks	
				M1	M2
RH	INT	RE	Yes	Yes	No
	EXH	RE	No	No	Yes
LH	INT	LH	Yes	Yes	No
	EXH	LH	No	No	Yes

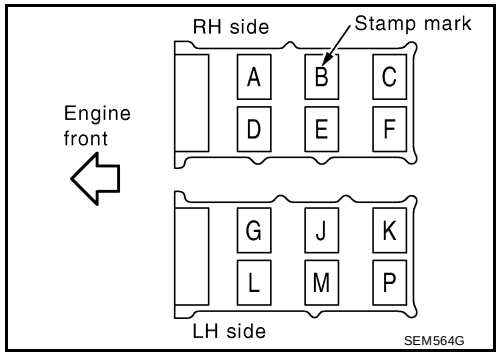
   - Position the camshafts:
     RH exhaust camshaft dowel pin at about 10 o'clock.
     LH exhaust camshaft dowel pin at about 2 o'clock.



9. Before installing camshaft brackets, apply sealant to mating surface of No. 1 journal head.
   - Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
   - Refer to EM-148, "POSITION FOR APPLYING LIQUID GASKET" .



   - Install camshaft brackets in their original positions and direction. Align the stamp marks as shown.
   - If any part of valve assembly or camshaft is replaced, check and adjust the valve clearance. Refer to EM-141, "Valve Clearance" .

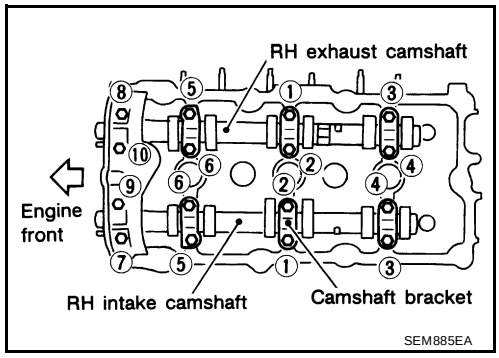


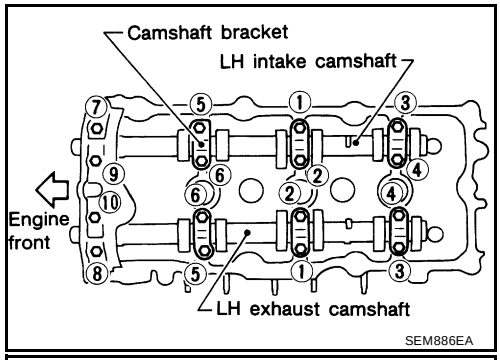
Valve clearance (cold) Intake	**: 0.26 - 0.34 mm (0.010 - 0.013 in)**
Valve clearance (cold) Exhaust	**: 0.29 - 0.37 mm (0.011 - 0.015 in)**

   - Lubricate the threads and seat surfaces of the camshaft bracket bolts with new engine oil before installation.

   - Tighten the camshaft brackets in the following four steps.

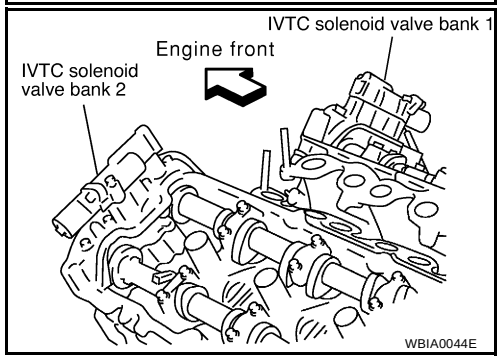
Step	Tightening torque	Tightening order
1	1.96 N·m (0.2 kg-m, 17 in-lb)	Tighten No.s 7 to 10, then tighten 1 to 6 in order as shown.
2	6 N·m (0.6 kg-m, 52 in-lb)	Tighten in numerical order as shown.
3	9.02 - 11.8 N·m (0.92 - 1.20 kg-m, 79.9 - 104.2 in-lb)	Tighten 1 - 6 in numerical order as shown.
4	8.3 - 10.3 N·m (0.9 - 1.0 kg-m, 74 - 91 in-lb)	Tighten 7 - 10 in numerical order as shown.



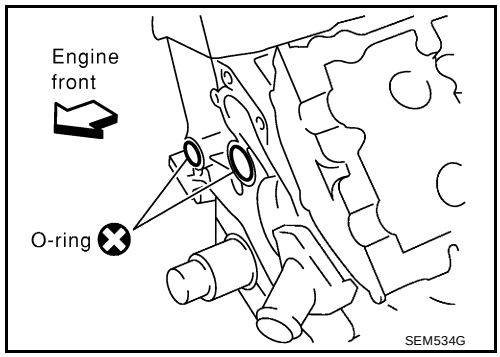


10. Install the IVTC solenoid valves with new gaskets.

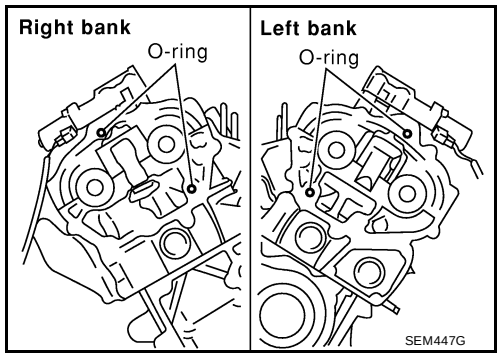
IVTC solenoid valve bolts	**: 10 - 12 N·m (1.0 - 1.3 kg-m, 87 - 112 in-lb)**



11. Install the new O-rings on the cylinder block.

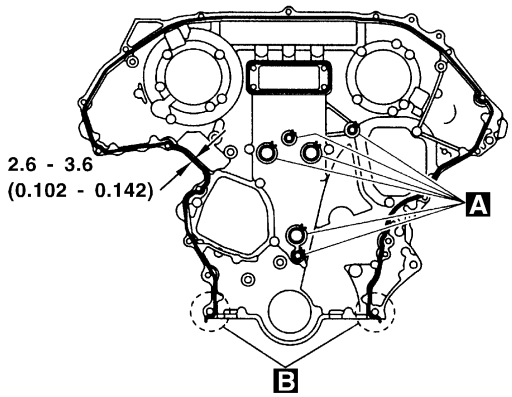


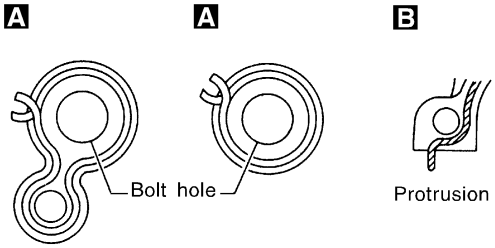
12. Install the new O-rings on the cylinder head.



13. Apply sealant to the specified portion of the rear timing chain case. Refer to EM-102, "Precautions for Liquid Gasket" .

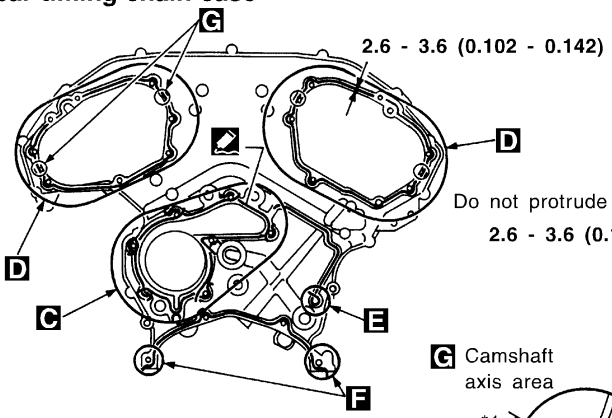
Front timing chain case

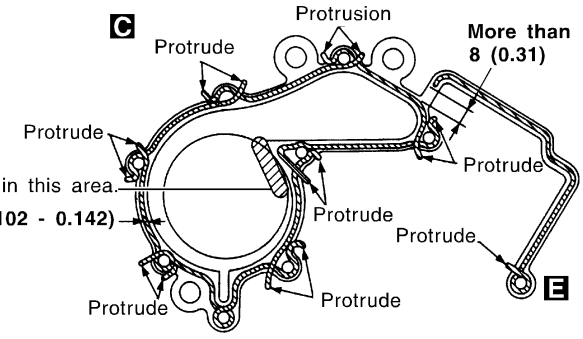


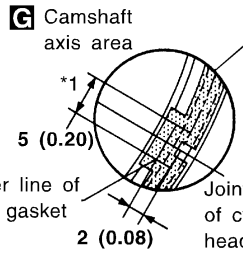


Sealant protrusion away from bolt hole

Rear timing chain case

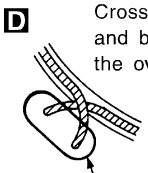






Center line of rear timing chain case sealant groove

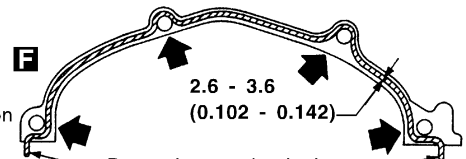
: Run along bolt hole outer side.



Cross both ends as shown and be sure to minimize the overlapped area.

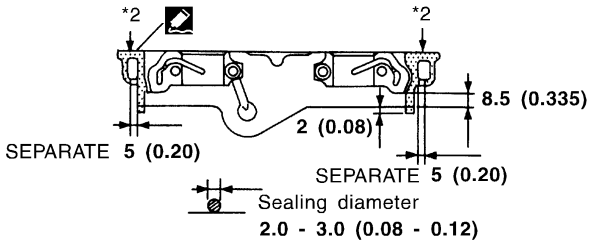
Protrusions at beginning and end of liquid gasket

Joint portion of cylinder head and camshaft bracket



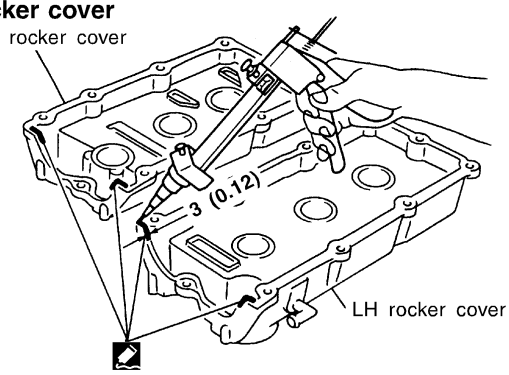
*1: Apply liquid gasket to the chamfered surface between camshaft bracket and cylinder head.

Camshaft bracket



*2: Remove the protruding sealant from front face.
(Remove the hardened sealant from surface only.)

Rocker cover

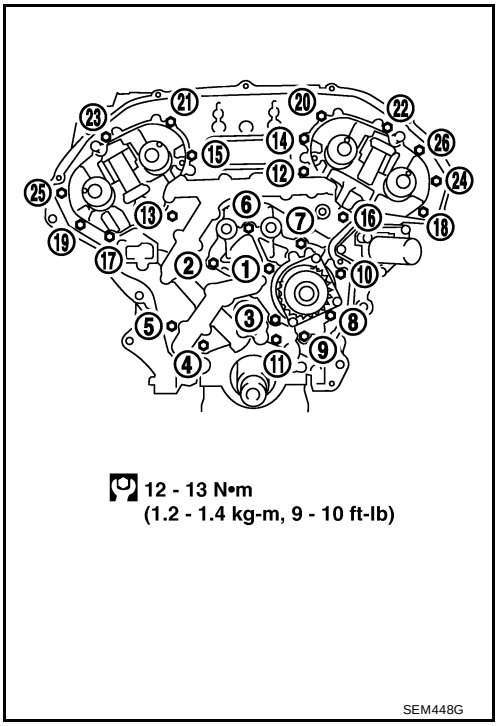


Unit: mm (in)

SEM411G

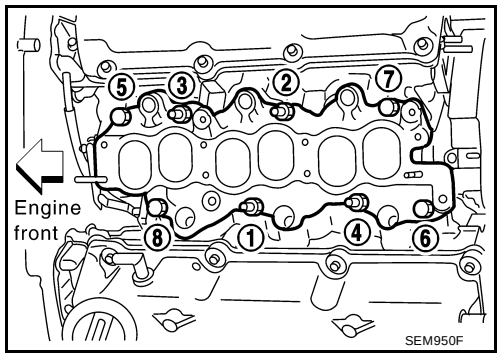
- Before installation, wipe off the protruding sealant.

14. Align rear timing chain case with dowel pins, then install on cylinder head and block.
15. Tighten rear chain case bolts in two stages.
a. Tighten bolts in numerical order shown.
b. Retighten bolts in numerical order shown.



16. Install the coolant outlet housing.
17. Install the intake manifold with a new gasket.
- Tighten the bolts in the numerical order as shown.

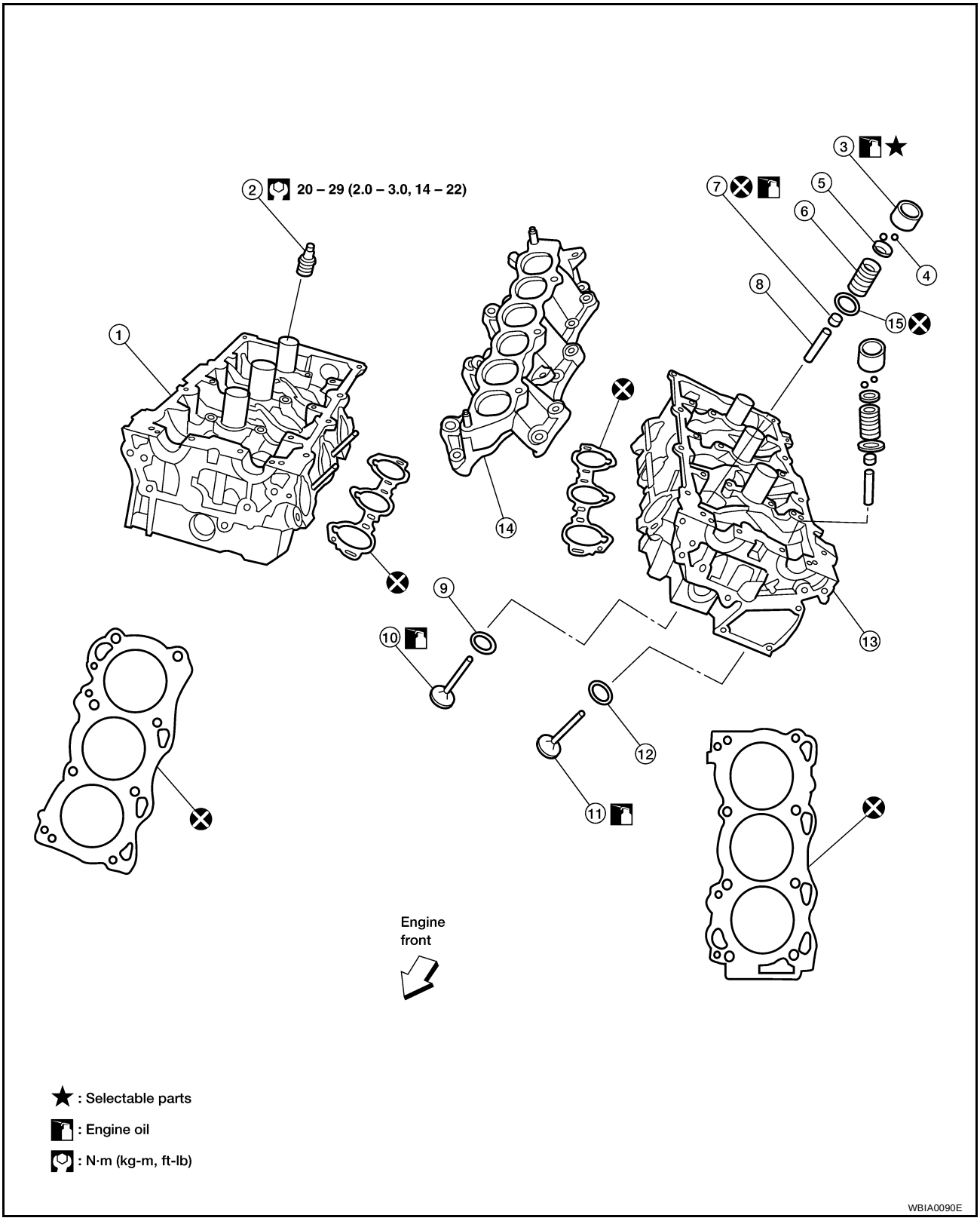
Stage 1 : 5 - 10 N·m (0.5 - 1.0 kg-m, 44 - 86 in-lb)
Stage 2 : 26 - 31 N·m (2.7 - 3.2 kg-m, 20 - 23 ft-lb)



18. Install the fuel rail and injectors. Refer to EM-129, "Removal and Installation" .
19. Install the timing chains. Refer to EM-155, "Installation" .

Disassembly and Assembly

EBS007QD



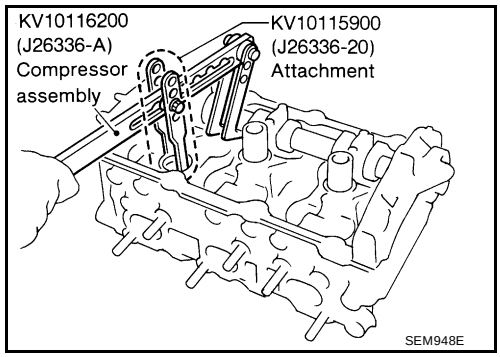
1. Cylinder head (right bank)
2. Spark plug
3. Valve lifter
4. Valve collet
5. Valve spring retainer
6. Valve spring
7. Valve oil seal
8. Valve guide
9. Valve seat (INT)
10. Valve (INT)
11. Valve (EXH)
12. Valve seat (EXH)
13. Cylinder head (left bank)
14. Intake manifold
15. Valve spring seat

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.**

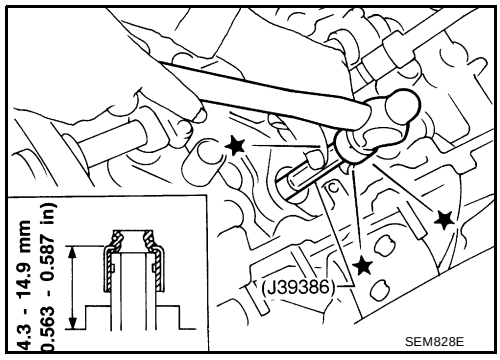
DISASSEMBLY

1. Remove valve lifter.
   - Mark position for installation.
2. Remove valve collet.
   - Compress valve spring with valve spring compressor. Remove valve collet with magnet driver.
3. Remove valve spring retainer, valve spring, and valve spring seat.
4. Push valve stem to combustion chamber side, and remove valve, mark for assembly.
   - Inspect valve guide clearance before removal. Refer to EM-178, "VALVE GUIDE CLEARANCE" .
   - Confirm installation point.
5. Remove the valve oil seals.
6. If valve seat must be replaced, refer to EM-180, "VALVE SEAT REPLACEMENT" .
7. If valve guide must be replaced, refer to EM-179, "VALVE GUIDE REPLACEMENT" .
8. Remove spark plug with spark plug wrench.

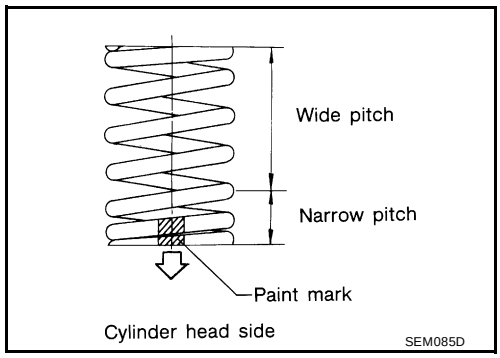


ASSEMBLY

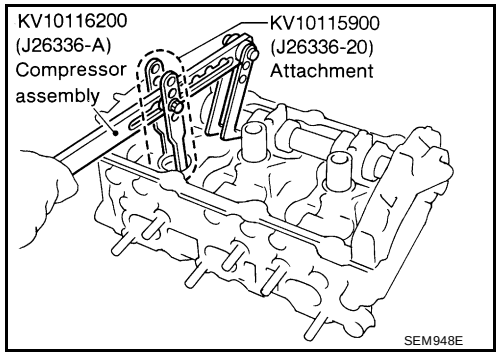
1. Install valve guide. Refer to EM-179, "VALVE GUIDE REPLACEMENT" .
2. Install valve seat. Refer to EM-180, "VALVE SEAT REPLACEMENT" .
3. Install new valve spring seats and new valve oil seals.
   - Install with valve oil seal drift to match dimension in illustration.
4. Install the valves in their original position, as marked during disassembly.



5. Install valve spring (uneven pitch type).
   - Install smaller pitch end (paint mark) to cylinder head side (valve spring seat side).
6. Install valve spring retainer.



7. Install valve collet.
   - Compress valve spring with valve spring compressor. Install valve collet with magnet hand.
   - Tap stem edge lightly with plastic hammer after installation to check its installed condition.
8. Install valve lifter.
9. Install spark plug with spark plug wrench.



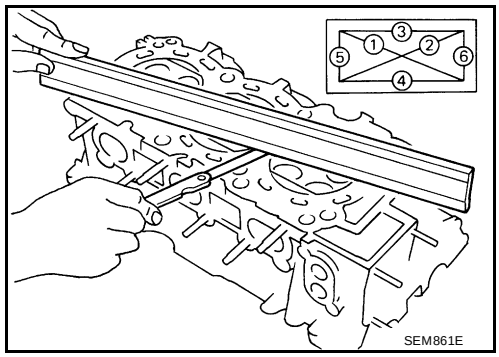
Inspection After Disassembly

EBS007QE

CYLINDER HEAD DISTORTION

1. 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.

   Head surface flatness : Limit 0.1 mm (0.004 in)



2. If beyond the specified limit, resurface or replace it.
   The limit for cylinder head resurfacing is determined by the cylinder block resurfacing.

   Resurfacing Limit

   Amount of cylinder head resurfacing is “A”.

   Amount of cylinder block resurfacing is “B”.

   The maximum limit : A + B = 0.2 mm (0.008 in)

3. After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

   Nominal cylinder head height : 126.3 - 126.5 mm (4.972 - 4.980 in)

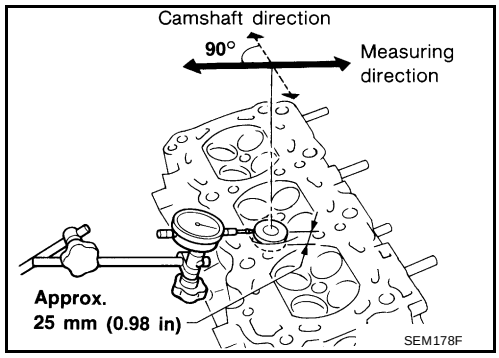
VALVE GUIDE CLEARANCE

1. Measure valve deflection as shown in the figure. (Valve and valve guide mostly wear in this direction.)

   Valve deflection limit (dial gauge reading)

   Intake : 0.24 mm (0.0094 in)

   Exhaust : 0.28 mm (0.0110 in)



2. If it exceeds the limit, check valve to valve guide clearance.

a. Measure valve stem diameter and valve guide inner diameter.

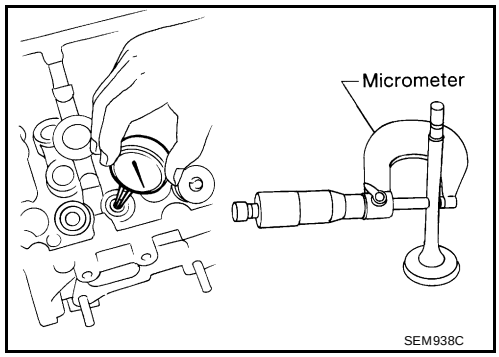
b. Check that clearance is within specification.

   Valve to valve guide clearance limit

   Intake : 0.08 mm (0.0031 in)

   Exhaust : 0.1 mm (0.004 in)

c. If it exceeds the limit, replace valve or valve guide.

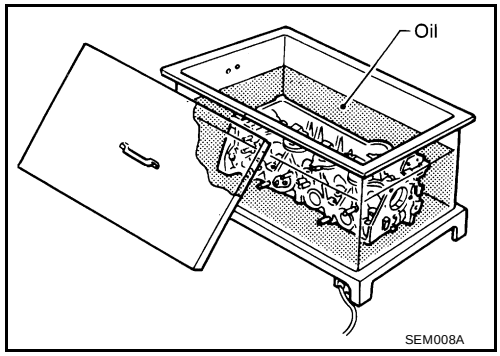


VALVE GUIDE REPLACEMENT

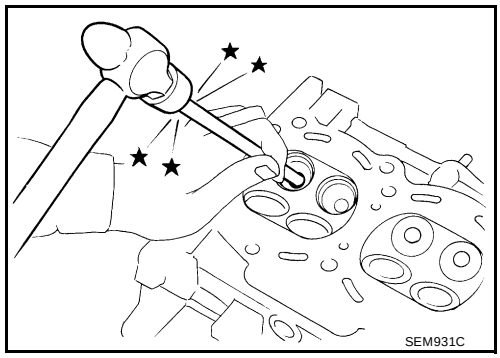
CAUTION:

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

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

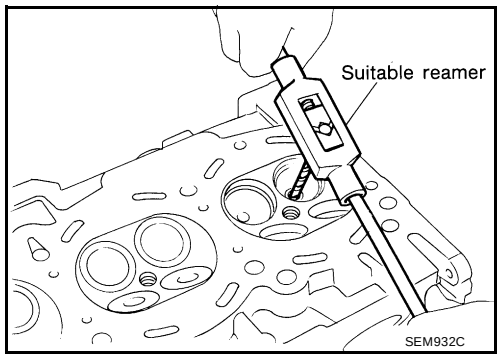


2. Drive out the valve guide with a press [under a 20 kN (2.2 US ton) pressure] or hammer and suitable tool.



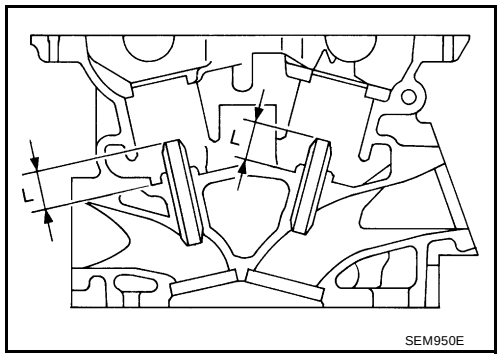
3. Ream cylinder head valve guide hole.

Valve guide hole diameter (for service parts), intake and exhaust	**: 10.175 - 10.196 mm (0.4006 - 0.4014 in)**



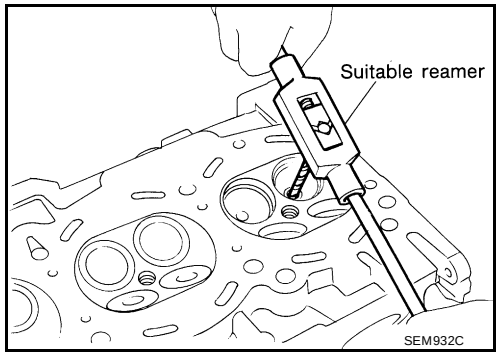
4. Heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil and press new valve guide from camshaft side into the cylinder head to the dimensions as shown.

Projection "L" : 12.6 - 12.8 mm (0.496 - 0.504 in)



5. Using a valve guide reamer, apply a reamer finish to the valve guide.

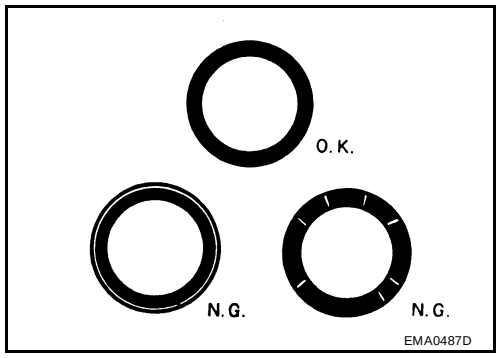
Intake and exhaust finished size	**: 6.000 - 6.018 mm (0.2362 - 0.2369 in)**



VALVE SEAT CONTACT

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

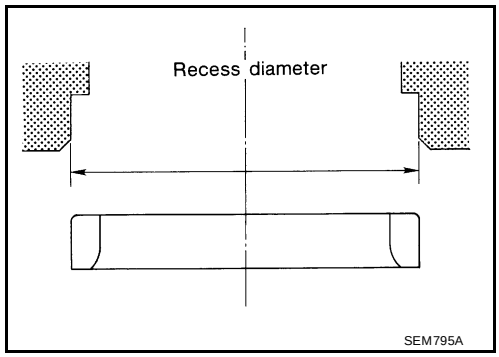
1. Apply prussian blue onto contacting surface of valve seat to check the condition of the valve contact on the surface.
2. Check if the contact area band is continuous all around the circumference.
3. If not, grind to adjust valve fitting and check again. If the contacting surface still has N.G conditions 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.

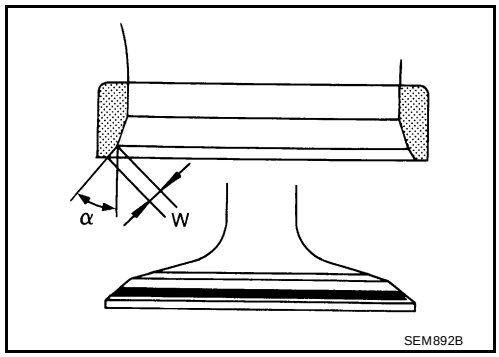
Oversize	**: 0.5 mm (0.020 in)**
Intake	**: 38.500 - 38.516 mm (1.5157 - 1.5164 in)**
Exhaust	**: 32.700 - 32.716 mm (1.2874 - 1.2880 in)**



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° to 130°C (230° to 266°F) by soaking in heated oil.
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-207, "VALVE" .
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.

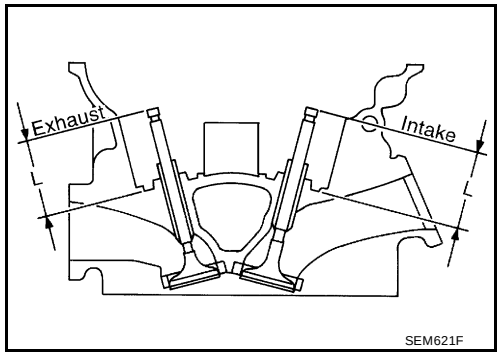
Seat face angle “α”	**: 45° 15' - 45° 45' degrees/minutes**
Contacting width “W” for intake	**: 1.09 - 1.31 mm (0.0429 - 0.0516 in)**
Contacting width “W” for exhaust	**: 1.29 - 1.51 mm (0.0508 - 0.0594 in)**



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.

Valve seat resurface limit "L" intake : **41.07 - 41.67 mm (1.6169 - 1.6405 in)**

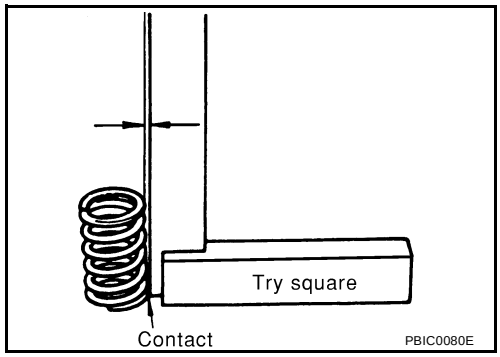
Valve seat resurface limit "L" exhaust : **41.00 - 41.60 mm (1.6142 - 1.6378 in)**



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.

Out-of-square limit : **Less than 2.0 mm (0.079 in)**



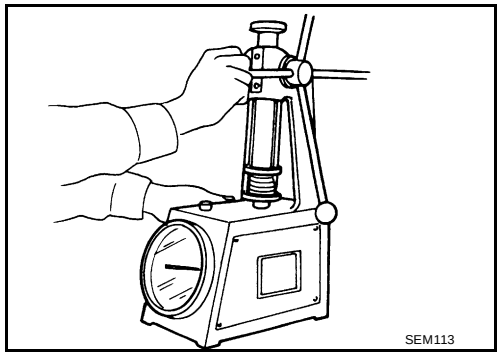
VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

Check valve spring pressure at specified spring height.

Standard : **196 N (20.0 kg, 44.1 lb) at height 37.0 mm (1.457 in)**

Limit : **More than 433 N (44.2 kg, 97.3 lb) at height 27.8 mm (1.094 in)**

If it is not within specifications, replace the spring.



ENGINE ASSEMBLY

PFP:10001

Removal and Installation

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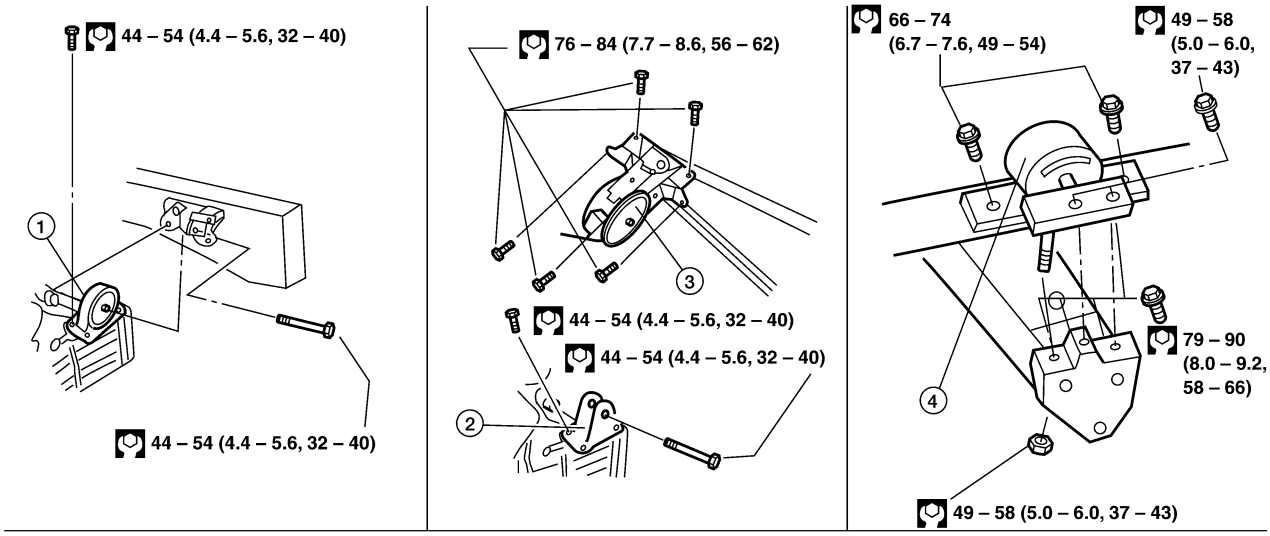
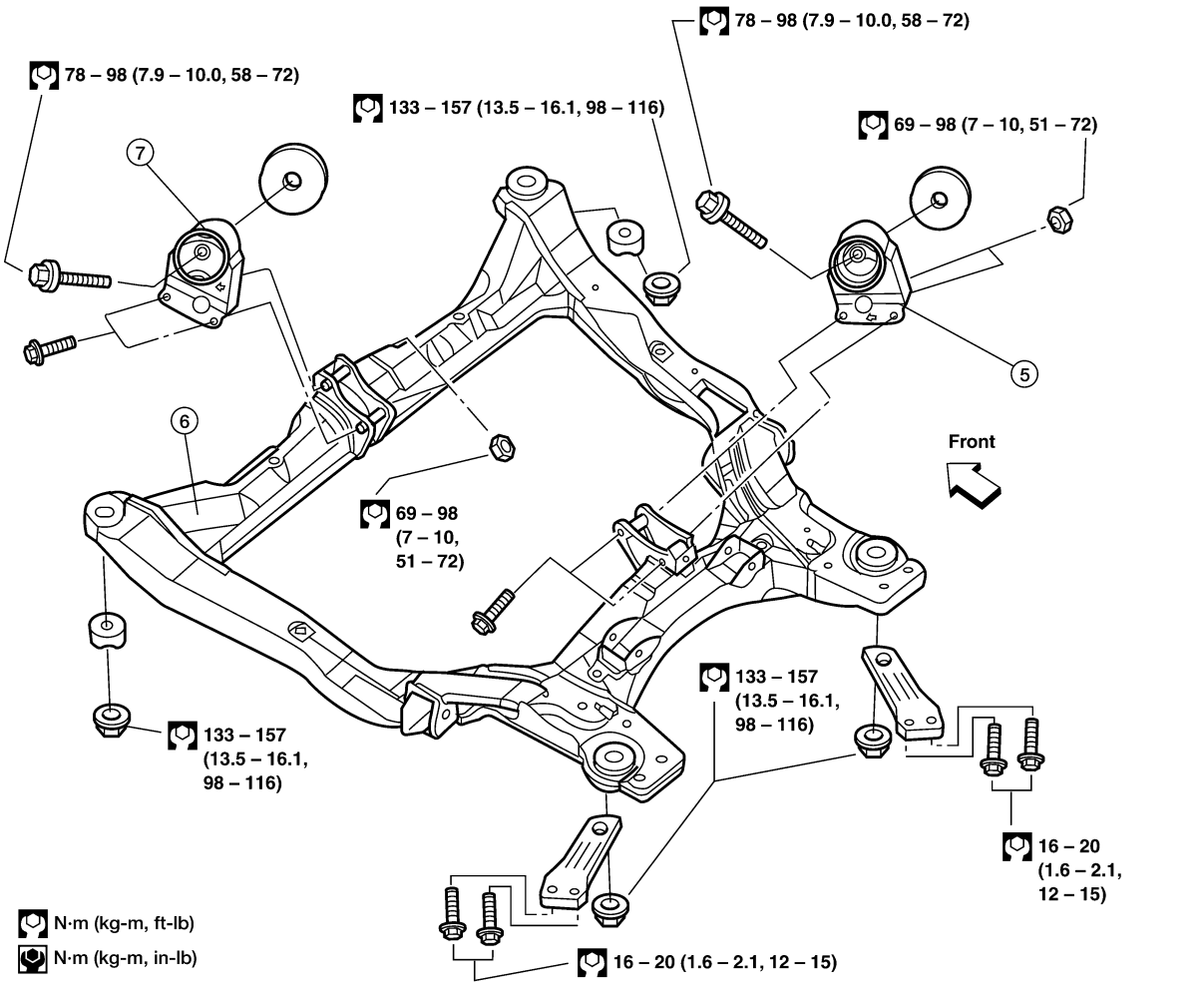




WBIA0220E

1. LH transaxle mounting insulator (A/T) 2. LH transaxle mounting bracket (M/T) 3. LH transaxle mounting bracket (M/T)

4. RH engine mounting insulator
5. Rear engine mounting insulator (electrically controlled with automatic transaxle)
6. Front suspension member
7. Front engine mounting insulator (electrically controlled with automatic transaxle)

WARNING:

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

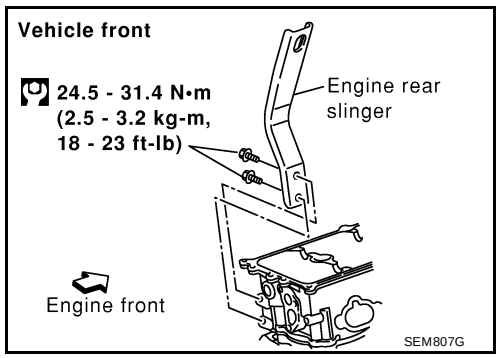
CAUTION:

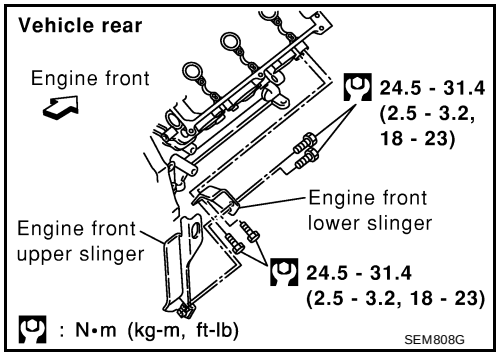
- **Do not start working until exhaust system and coolant are cool.**
- **If items or work required are not covered by the engine main body section, refer to the applicable sections.**
- **Use the correct supporting points for lifting and jacking. Refer to GI-37, "LIFTING POINT" .**
- **In removing the drive shafts, be careful not to 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

1. Release fuel pressure.
   Refer to EC-671, "FUEL PRESSURE RELEASE" .
2. Remove the engine cover using power tool.
3. Drain the engine oil.
   Refer to MA-24, "Changing Engine Oil" .
4. Drain the M/T oil, refer to MA-28, "Changing M/T Oil" or A/T fluid, refer to MA-29, "Changing A/T Fluid" .
5. Disconnect engine room harness from the engine side and position it aside. Disconnect engine harness ground connections. Access the connector through the glove box opening. Refer to IP-10, "INSTRUMENT PANEL ASSEMBLY" .
6. Drain coolant.
   Refer to MA-22, "DRAINING ENGINE COOLANT" .
7. Remove and position aside the IPDM E/R and bracket and position aside.
8. Remove the following parts:
   - Hood assembly. Refer to BL-13, "Removal and Installation of Hood Assembly" .
   - Battery and tray using power tools
   - Air inlet duct, air intake duct and air cleaner case assembly with mass air flow sensor. Refer to EM-110, "Removal and Installation" .
   - Power brake booster vacuum hose
   - Drive belts.
   - Radiator assembly, coolant reservoir, and system hoses
     Refer to EC-1079, "Component Description" .
   - Top cowl grille.
     Refer to EI-18, "Removal and Installation" .
   - Front windshield wiper assembly
     Refer to WW-25, "Removal and Installation for Wiper Motor and Linkage" .
9. Disconnect heater hoses.
10. Remove the front wheel and tires.
11. Remove splash shield.
12. Remove the engine undercover using power tool.
13. Remove the front exhaust tube using power tools.
    Refer to EX-6, "Removal and Installation" .
14. Remove oil cooler pipe bolts.
15. Remove the idler pulley and idler bracket.

16. Remove the A/C compressor using power tools. Discharge and recover the R134a refrigerant. Refer to ATC-119, "HFC-134a (R-134a) Service Procedure" .
17. Remove the front drive shafts. Refer to FAX-11, "Removal and Installation" .
18. Remove the front suspension member. Refer to FSU-14, "Removal and Installation" .
19. Disconnect fuel hose quick connection at vehicle piping side. Refer to EM-129, "Removal and Installation" .
20. Disconnect the transaxle shift controls.
21. Remove the clutch operating cylinder without disconnecting line and position aside.
22. Disconnect the engine harness retainers and ground strap.
23. Disconnect reservoir tank for the power steering from engine compartment bracket and position it aside.
24. Disconnect the power steering pump from the engine, without disconnecting the piping, and position it aside.
25. Install engine slingers into front of left bank cylinder head and rear of right bank cylinder head.





26. Support the engine and transaxle assembly with engine lifting equipment front the top with the vehicle raised on a hoist.
27. Disconnect the LH transaxle mount and the RH engine mount.
28. Carefully lower the engine and transaxle assembly, avoiding interference with the vehicle body.

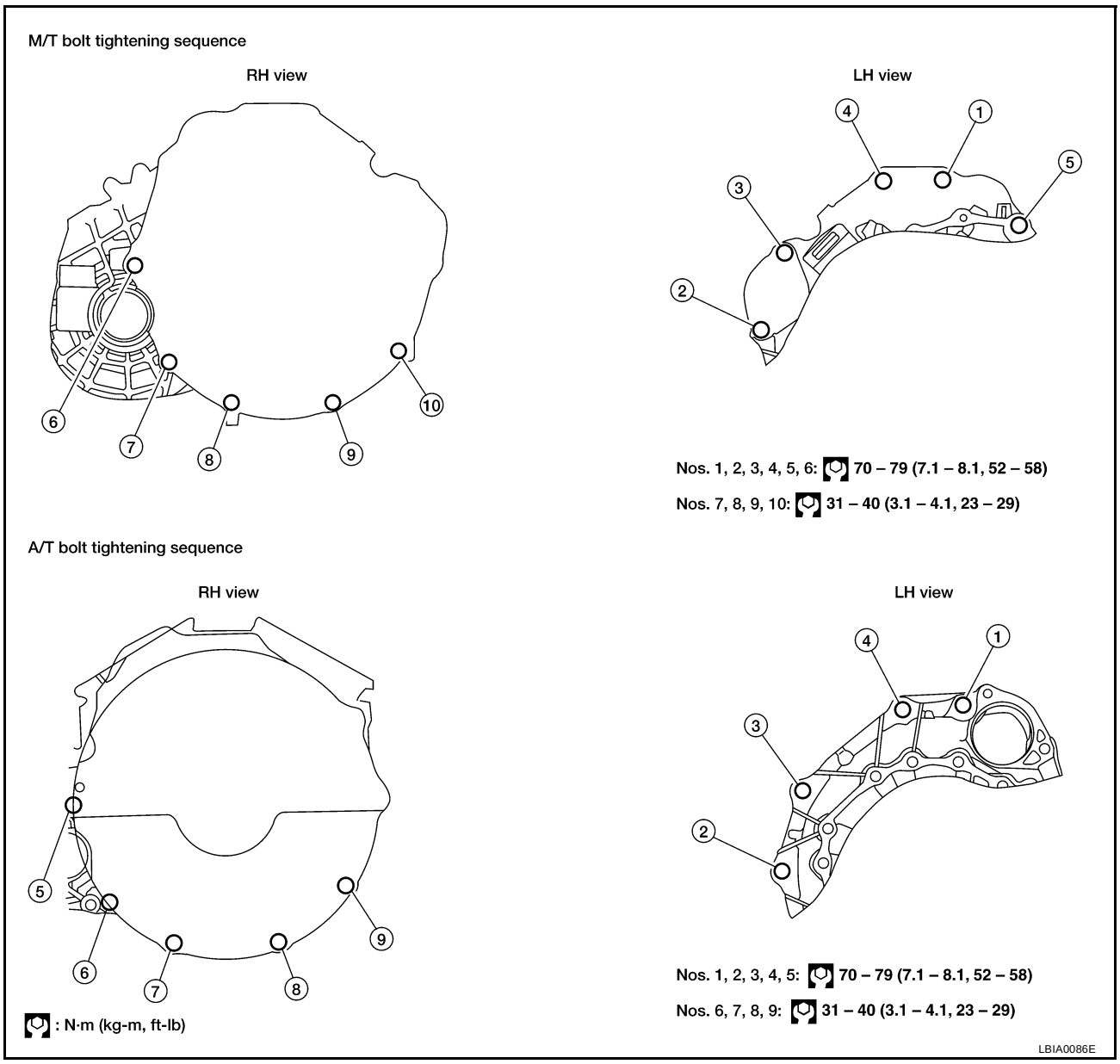
CAUTION:

- **Before and during this procedure, always check if any harnesses are left connected.**
- **Avoid any damage to, or any oil/grease smearing or spills onto the engine mounting insulators.**

29. Remove the starter motor. Refer to SC-23, "Removal and Installation" .
30. Remove the crankshaft position sensor (POS).
31. Separate the engine and transaxle and mount the engine on a suitable engine stand.

INSTALLATION

Installation is in the reverse order of removal.



INSPECTION AFTER INSTALLATION

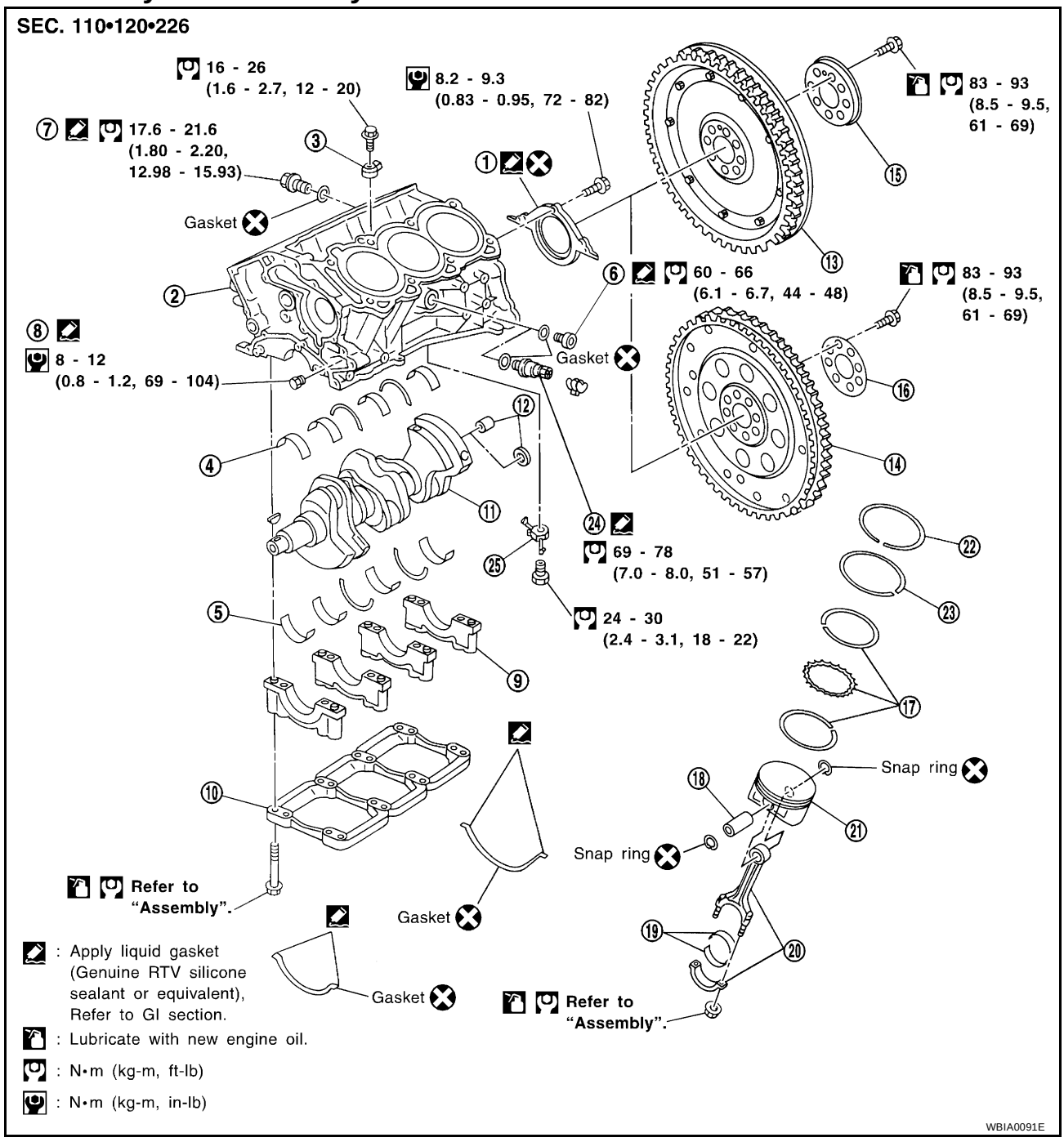
- Before starting engine, check the levels of coolant, lubrications, working oils, and of air conditioner refrigerant. If less than required quantity, fill to the specified level.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of coolant, lubricants, oil, fuel, or exhaust gas.

CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

EBS007QG



1.	Rear oil seal retainer	2.	Cylinder block	3.	Knock sensor
4.	Upper main bearing	5.	Lower main bearing	6.	Water drain plug (LH side)
7.	Water drain plug (RH side)	8.	Water drain plug (water pump side)	9.	Main bearing cap
10.	Main bearing beam	11.	Crankshaft	12.	Pilot bushing or pilot converter
13.	Flywheel with signal plate (M/T)	14.	Drive plate with signal plate (A/T)	15.	Flywheel reinforcement
16.	Drive plate reinforcement	17.	Oil ring set	18.	Piston pin
19.	Connecting rod bearing	20.	Connecting rod	21.	Piston
22.	Top ring	23.	Second ring	24.	Cylinder block heater (Canada only)
25.	Oil jet				

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

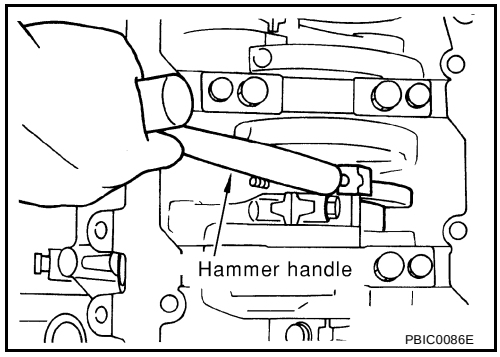
1. Remove the engine assembly. Refer to EM-182, "ENGINE ASSEMBLY" .
2. Install the engine on the engine stand.
3. Remove the knock sensor.
4. Drain the engine of all coolant and oil.
5. Remove the oil pan. Refer to EM-120, "Removal and Installation" .
6. Remove the timing chain. Refer to EM-149, "Removal" .
7. Remove the cylinder head. Refer to EM-165, "Removal and Installation" .
8. Remove the flywheel (M/T), or the drive plate (A/T) using a T55 Torx® socket.
9. 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-213, "CONNECTING ROD" .



10. Remove the connecting rod bearings.

CAUTION:

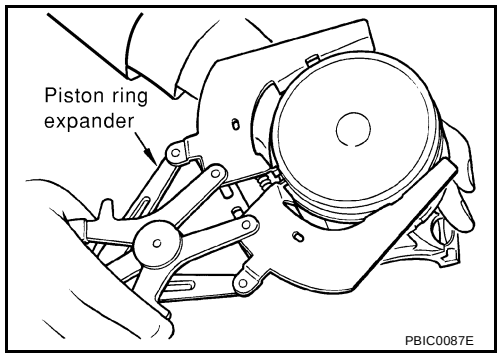
- **When removing the connecting rod side bearings, note the installation position. Keep them in the correct order.**

11. Remove the piston rings from the piston using a piston ring expander.

- Before removing the piston rings, check the piston ring side clearance. Refer to EM-195, "PISTON RING SIDE CLEARANCE" .
- Be careful to mark the rings if they are to be reused so they are installed in their original position.

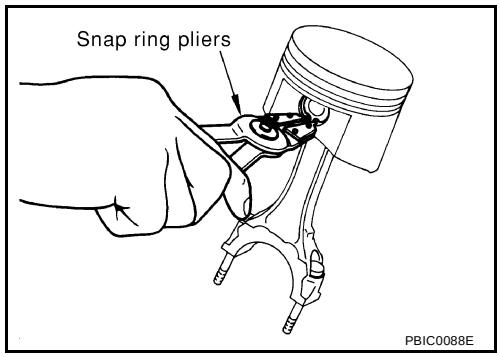
CAUTION:

- **When removing the piston rings, be careful not to damage the piston. Do not expand the rings excessively.**

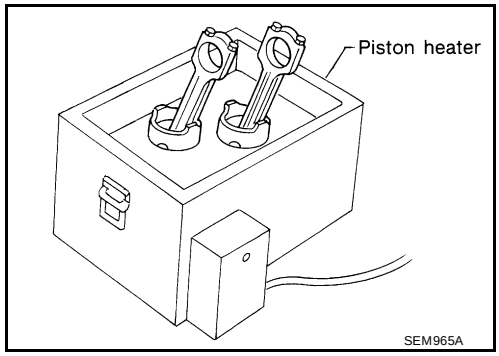


12. Remove the piston from the connecting rod as follows.

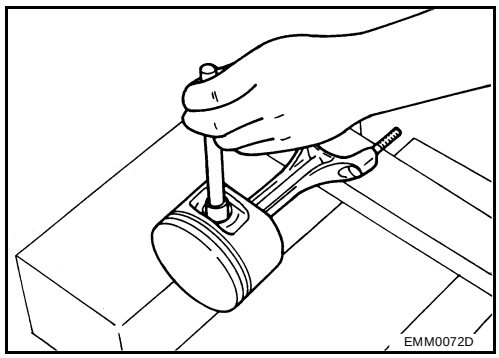
a. Using a snap ring pliers, remove the snap ring.



b. Heat the pistons to 60° - 70°C (140° - 158°F).



c. Push out the piston pin with a suitable tool, with an outer diameter approximately 20 mm (0.8 in).

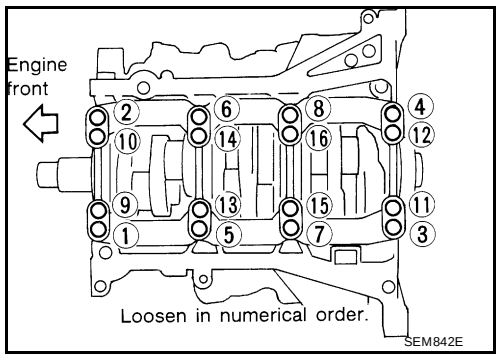


13. Remove the rear oil seal retainer from the cylinder block.
    - Insert a screwdriver or similar tool between the rear end of the crankshaft counter weight and rear oil seal retainer, and separate the liquid gasket to remove.

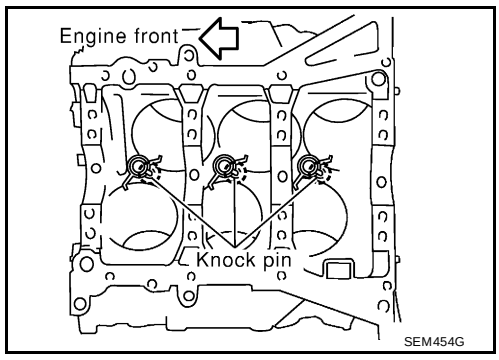
    CAUTION:
    Be careful not to damage the mating surface.

    NOTE:
    When replacing the rear oil seal during on-vehicle service, it is necessary to remove the oil pan. Refer to EM-120, "Removal and Installation" .

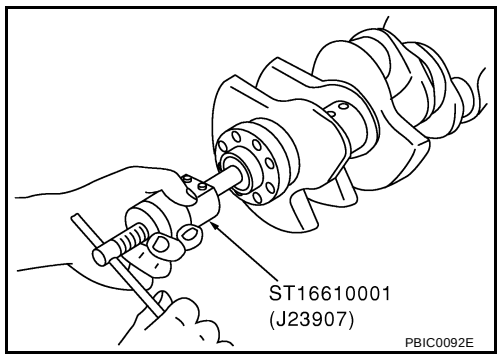
14. Loosen the bolts in the numerical order as shown and remove the main bearing beam, bearing caps and crankshaft.
    - Before loosening the main bearing cap bolts, measure the crankshaft side clearance.
      Refer to EM-199, "CRANKSHAFT" .



15. Remove the oil jets.
    - Note the location of the knock pins for installation.
16. 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.

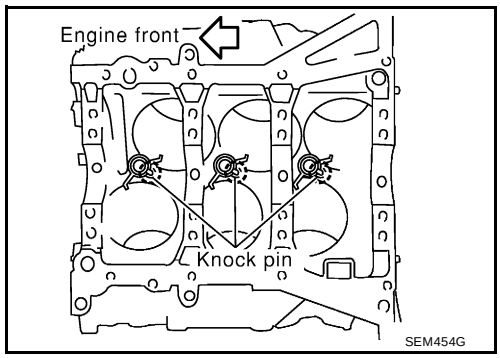


17. If the pilot bushing (M/T) or pilot converter (A/T) must be removed, remove it from the rear end of the crankshaft using a pilot bearing puller.

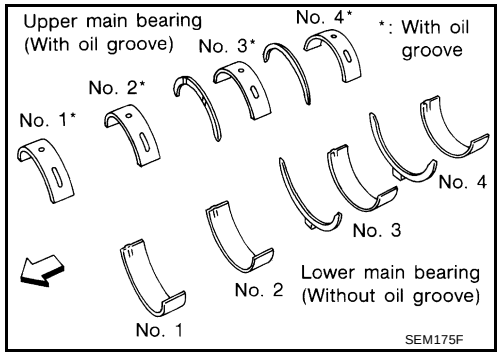


ASSEMBLY

1. Install the oil jets.
   - Insert the oil jet knock pin into the cylinder block knock pin hole, and tighten the mounting bolts.

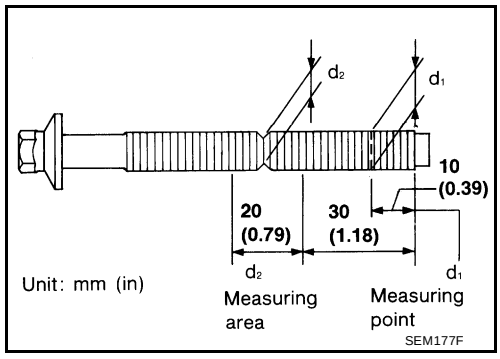


2. Set the upper main bearings in their proper positions on the cylinder block.
   - Confirm the correct main bearings are used. Refer to EM-198, "PISTON-TO-BORE CLEARANCE" .

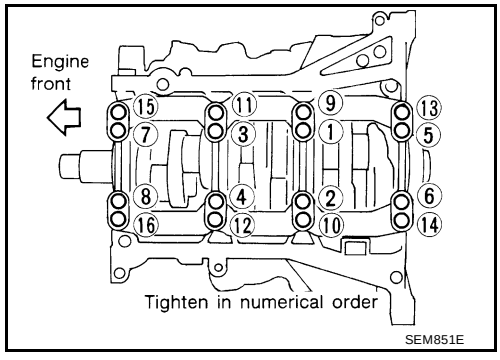


3. Instructions for the re-use of the main bearing cap bolts.
   - A plastic zone tightening method is used for tightening the main bearing cap bolts. Measure d1 and d2 as shown.
   - For d2, select the minimum diameter in the measuring area.
   - If the difference between d1 and d2 exceeds the limit, replace the bolts for assembly.

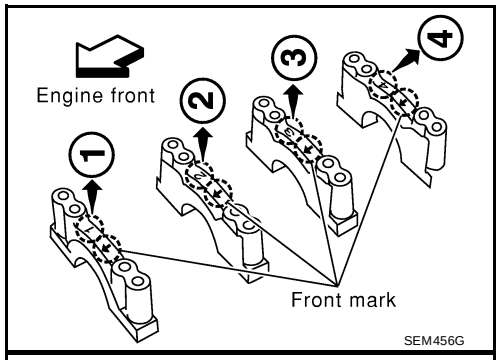
   Limit (d1 - d2) : 0.11 mm (0.0043 in)



4. 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.



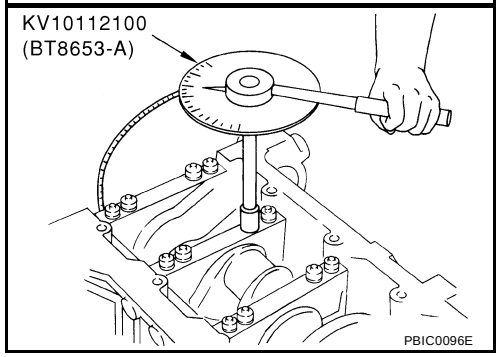
a. Make sure that the front marks on the main bearing beam faces the front of the engine.
b. Prior to tightening all the bearing cap bolts, place the bearing beam in its proper position by shifting the crankshaft in the axial position.
c. After tightening the bearing cap bolts, make sure the crankshaft turns smoothly.
d. Lubricate the threads and seat surfaces of the bolts with new engine oil.



e. Tighten the bolts in two stages:

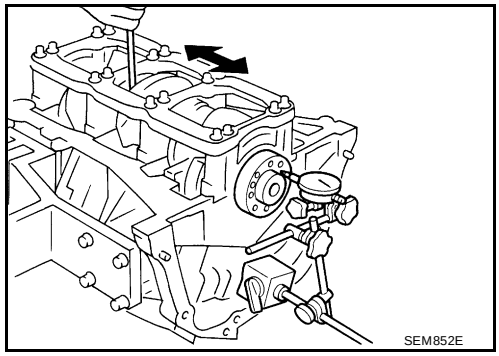
CAUTION:
Measure the tighten angle in stage 2 with an angle wrench. Do not measure visually.

Stage 1	**: 32 - 38 N·m (3.3 - 3.9 kg-m, 24 - 28 ft-lb)**
Stage 2	**: 90° - 95° degrees clockwise**

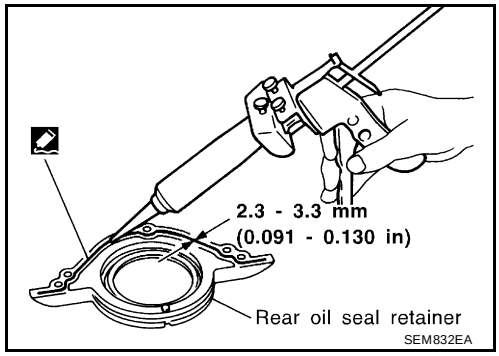


5. Measure crankshaft end play.
- If beyond the limit, replace the bearing with a new one.

Standard	**: 0.10 - 0.25 mm (0.0039 - 0.0098 in)**
Limit	**: 0.30 mm (0.0118 in)**

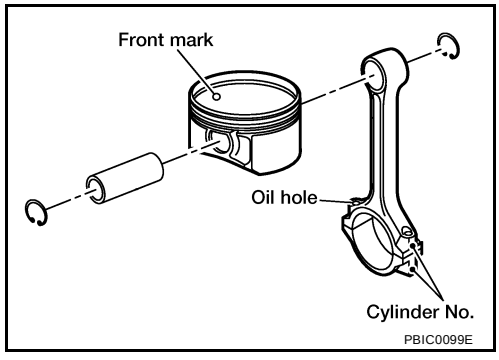


6. Install the rear oil seal retainer.
- Apply sealant to rear oil seal retainer as shown.
  Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



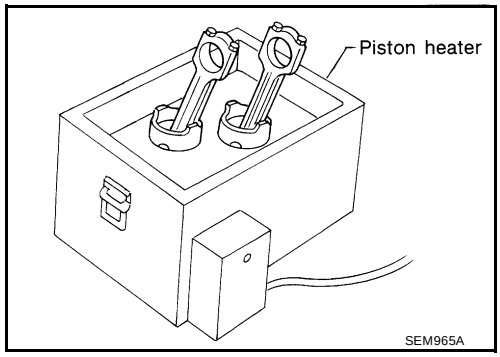
7. Install the piston to the connecting rod.

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

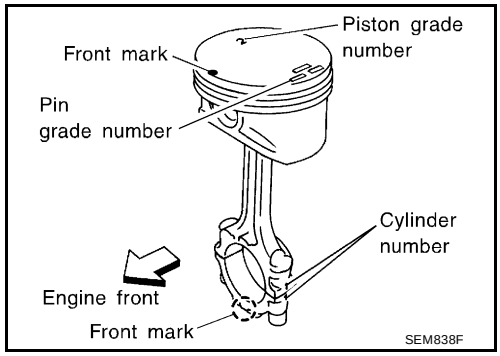


b. Install the piston to the connecting rod.

- Heat the piston until the piston pin can be pushed in by hand without excess force [approx. 60° - 70°C (140° to 158°F)]. From the front to the rear, insert the piston pin into the piston and through the connecting rod.

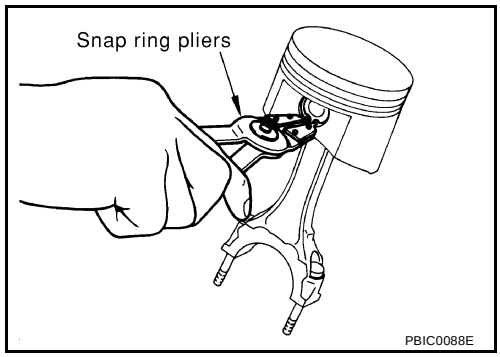


- Assemble so that the front mark on the piston crown and the oil holes and the cylinder No. on the connecting rod are positioned as shown.



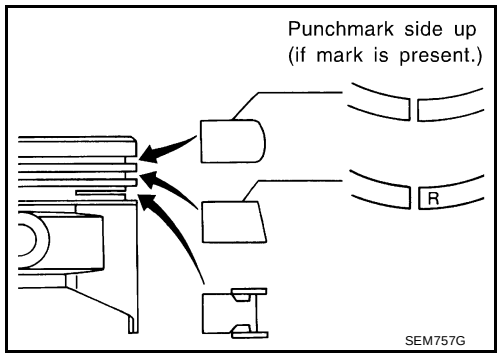
c. Install the snap ring into the front of the piston pin-groove.

- After installing, check that the connecting rod pivots smoothly on the pin.



8. Using a piston ring expander, install the piston rings.

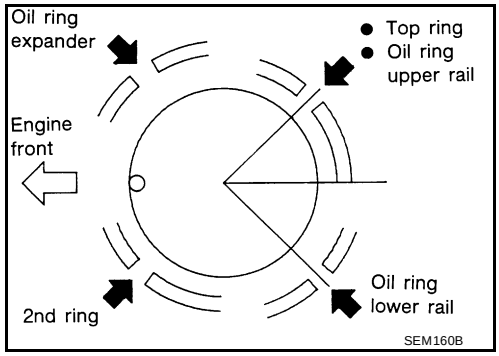
- Install the top ring and the second ring with the stamped surface facing upward. If the ring is not stamped it can face in either direction.



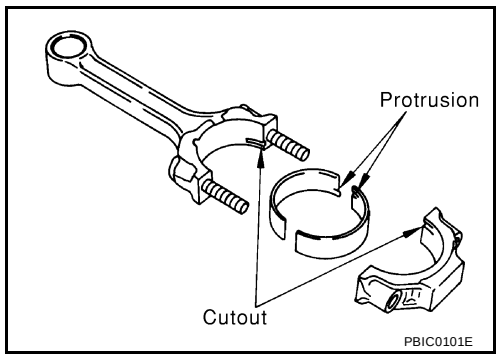
- Position each ring with the gap as shown, referring to the piston front mark.

CAUTION:

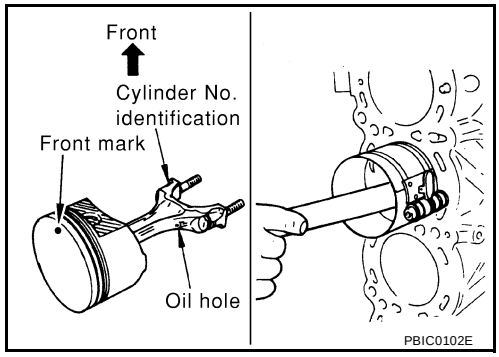
- **Be careful not to damage the piston.**
- **When the piston rings are not replaced, remount the rings in their original positions.**
- **When replacing the piston rings, those without punch-marks can be mounted either side up.**



9. 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.



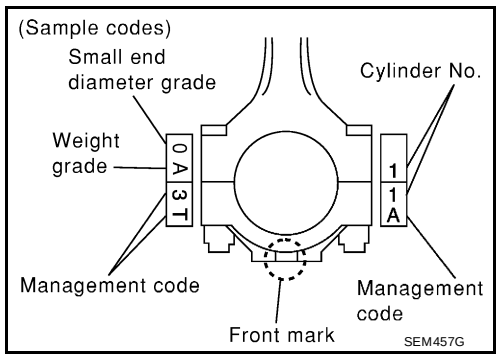
10. Install the piston and connecting rod assembly into the corresponding cylinder.
    - Position the crankshaft pin corresponding to the connecting rod to be installed onto the bottom dead center.
    - Apply engine oil sufficiently to the cylinder bore, piston, and crankshaft pin.
    - Match the cylinder position with the cylinder No. on the connecting rod to install.
    - Using a piston ring compressor, install the piston with the front mark on the piston crown facing the front of the engine.



CAUTION:

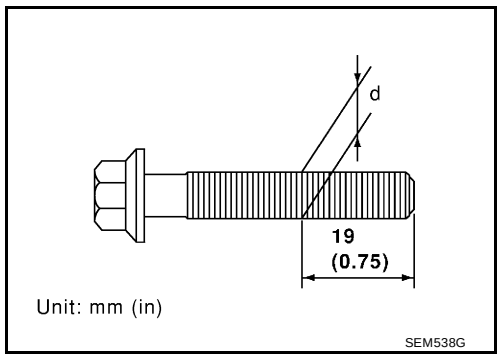
Be careful not to damage the crankshaft pin and cylinder wall, resulting from an interference of the connecting rod big end.

11. 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.



12. 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)

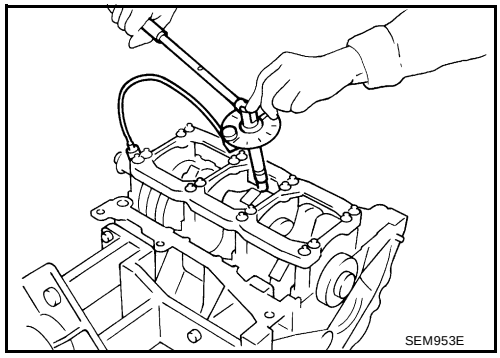


13. Tighten the connecting rod nuts in two stages:

    Stage 1 : 19 - 21 N·m (1.9 - 2.1 kg-m, 14 - 15 ft-lb)
    Stage 2 : 90° - 95° degrees clockwise

    - 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.

    Connecting rod side clearance:
    Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)
    Limit : 0.40 mm (0.0157 in)

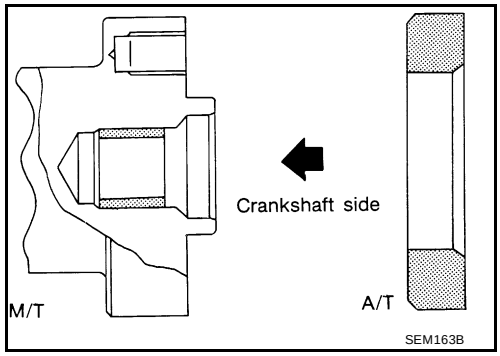


CAUTION:
Always use either an angle wrench or protractor. Avoid tightening based on visual check alone.

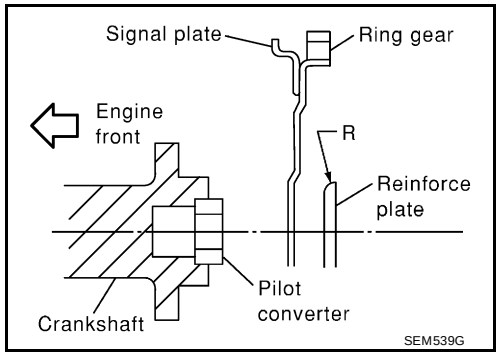
14. Install the knock sensor.
    - Make sure that there is no foreign material on the cylinder block mating surface and the back surface of the knock sensor.
    - Install the knock sensor with the connector facing the rear of the engine.
    - Do not tighten the mounting bolts while holding the connector.
    - 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.

15. Install the pilot bushing (M/T) or converter (A/T) as shown.



16. Install the flywheel (M/T), or the drive plate (A/T).



17. Install the cylinder head. Refer to EM-165, "Removal and Installation" .
18. Install the timing chain. Refer to EM-155, "Installation" .
19. Install the oil pan. Refer to EM-120, "Removal and Installation" .
20. Remove the engine from the stand and install the engine assembly into the vehicle. Refer to EM-182, "Removal and Installation" .
21. Assembly of the remaining parts is in the reverse order of disassembly.
22. Fill the engine with the specified oil and coolant. Refer to MA-12, "Fluids and Lubricants" .

CAUTION:
Wait at least 30 minutes for the sealant to set-up before filling the engine with fluids and running it.

Inspection

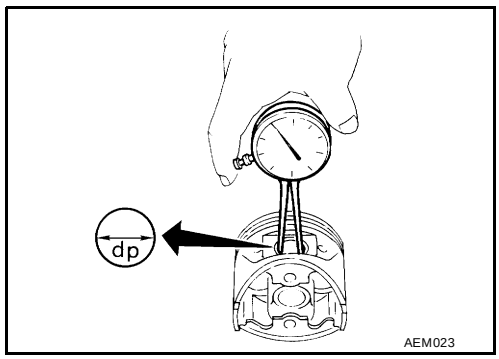
EBS007QH

PISTON AND PISTON PIN CLEARANCE

Inner Diameter of Piston Pin

- Measure the inner diameter of piston pin bore "dp".

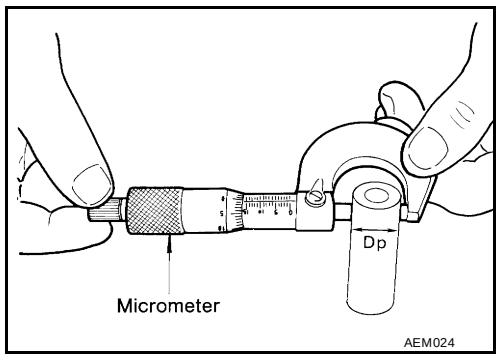
Standard diameter "dp"
Grade No. 0 : 21.993 - 22.999 mm (0.8659 - 0.8661 in)
Grade No. 1 : 21.999 - 22.005 mm (0.8661 - 0.8663 in)



Outer Diameter of Piston Pin

- Measure outer diameter of piston pin "Dp".

Standard diameter "Dp"
Grade No. 0 : 21.989 - 21.995 mm (0.8657 - 0.8659 in)
Grade No. 1 : 21.995 - 22.001 mm (0.8659 - 0.8662 in)

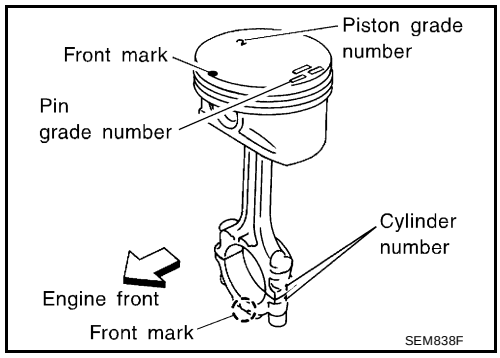


Piston and Piston Pin Interference Fit

Standard Interference Fit = "Dp" – "dp"

Standard : [0.002 mm (0.0001 in)] - [0.006 mm (0.0002 in)] = [- 0.0004 mm (-0.0001 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

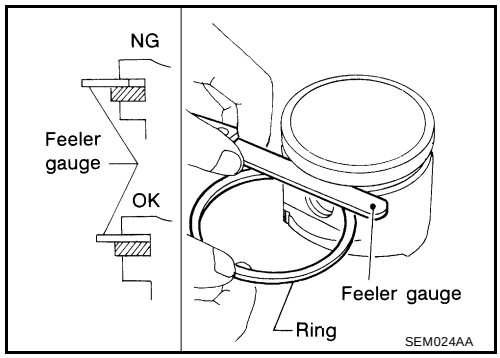
- Measure side clearance of piston ring and piston ring groove with feeler gauge.

Standard Side Clearance

Top ring : 0.045 - 0.080 mm (0.0018 - 0.0031 in)
2nd ring : 0.030 - 0.070 mm (0.0012 - 0.0028 in)
Oil ring : 0.065 - 0.135 mm (0.0026 - 0.0053 in)

Maximum Limit

Top ring : 0.11 mm (0.0043 in)
2nd ring : 0.1 mm (0.004 in)
Oil ring : —



- If out of specification, replace piston ring assembly. If clearance exceeds maximum limit with new rings, replace piston

PISTON RING END GAP

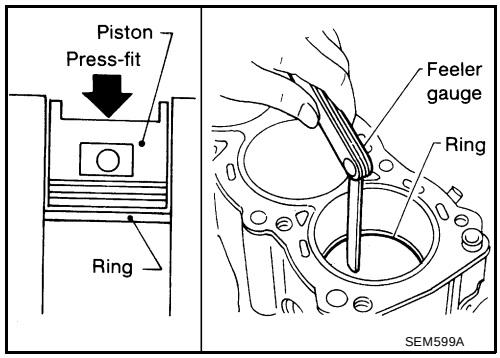
- Insert piston ring until it is in the middle of the cylinder bore and measure the end gap.

Standard

Top ring : 0.23 - 0.33 mm (0.0091 - 0.0130 in)
2nd ring : 0.33 - 0.48 mm (0.0130 - 0.0189 in)
Oil ring : 0.20 - 0.50 mm (0.0079 - 0.0197 in)

Limit:

Top ring : 0.54 mm (0.0213 in)
2nd ring : 0.80 mm (0.0315 in)
Oil ring : 0.95 mm (0.0374 in)



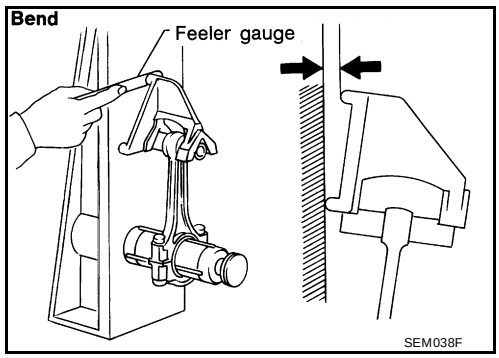
- If out of specification, replace piston ring. If gap still exceeds the limit even with a new ring, re-bore cylinder and use oversized piston and piston ring.

CONNECTING ROD BEND AND TORSION

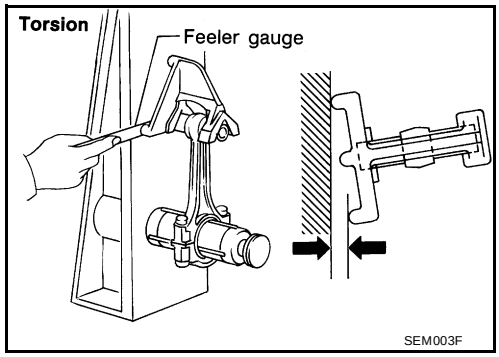
- Measure the bend and torsion of each connecting rod as shown.

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

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



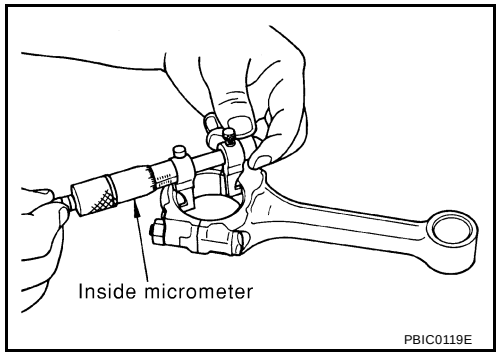
- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BEARING (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 large end inner diameter using an inside micrometer.

Standard : **55.000 - 55.013 mm (2.1654 - 2.1659 in)**



CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

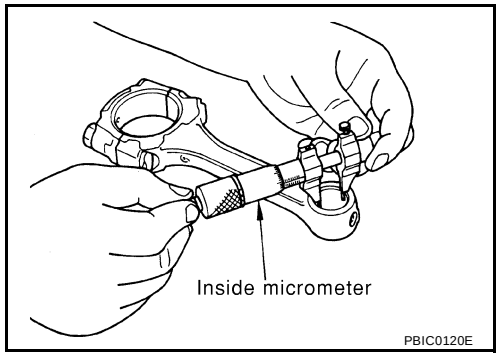
Inner Diameter of Connecting Rod (Small End)

- Measure inner diameter of bushing.

Standard

Grade No. 0 : **22.000 - 22.006 mm (0.8661 - 0.8664 in)**

Grade No. 1 : **22.006 - 22.012 mm (0.8664 - 0.8666 in)**



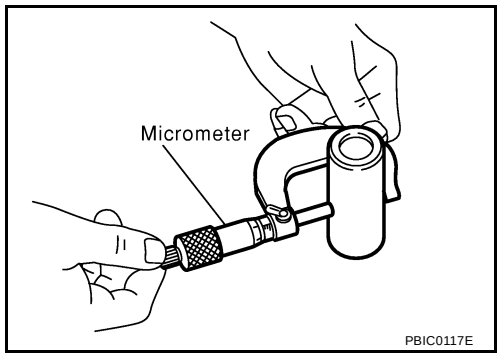
Outer Diameter of Piston Pin

- Measure outer diameter of piston pin.

Standard

Grade No. 0 : 21.989 - 21.995 mm (0.8657 - 0.8659 in)

Grade No. 1 : 21.995 - 22.001 mm (0.8659 -0.8662 in)



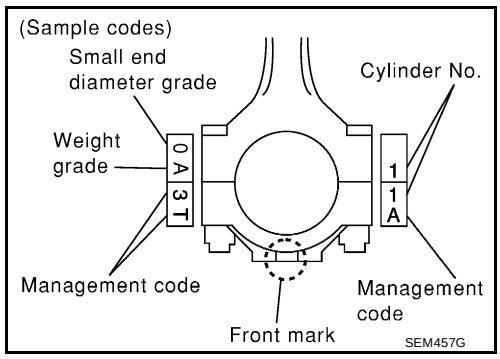
Connecting Rod Bushing Oil Clearance (Small End)

(Connecting rod small end oil clearance) = (Inner diameter of connecting rod small end) – (Outer diameter of piston pin)

Standard : 0.005 - 0.017 mm (0.0002 - 0.007 in)

Limit : 0.030 - mm (0.0012 in)

- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, refer to the Table for Selective Fitting for Piston to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Refer to EM-198, "PISTON-TO-BORE CLEARANCE" .

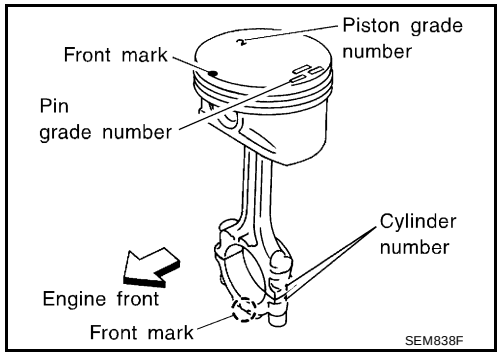


Factory installed parts grading:

NOTE:
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 bore diameter	21.993 - 21.999 (0.8659 - 0.8661)	21.999 - 22.005 (0.8661 - 0.8663)



CYLINDER BLOCK DISTORTION AND WEAR

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

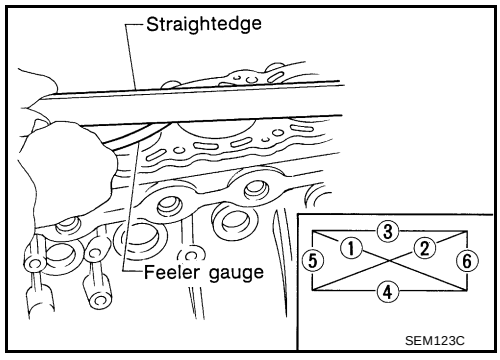
CAUTION:
Be careful not to allow gasket flakes to enter the oil or coolant passages.

- Measure the distortion on the block upper face at different points in six directions.

Distortion limit : 0.10 mm (0.0039 in)

- 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 block resurfacing] + [amount of cylinder head resurfacing] = 0.2 mm (0.008 in).

Cylinder block height limit : 214.95 - 215.05 mm (8.4626 - 8.4665 in)



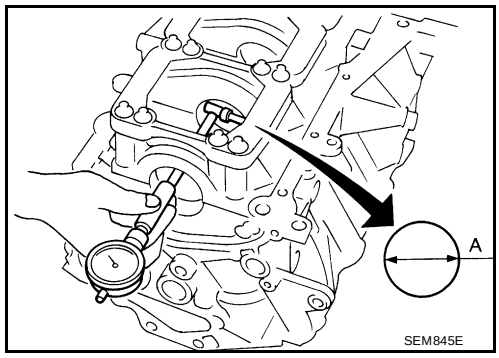
INNER DIAMETER OF MAIN BEARING HOUSING

- Install the main bearing caps with the main bearings removed, and tighten the mounting bolts to the specified torque.
- Using a bore gauge, measure the inner diameter of the main bearing housing.

Standard : 63.993 - 64.017 mm (2.5194 - 2.5203 in)

- 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.

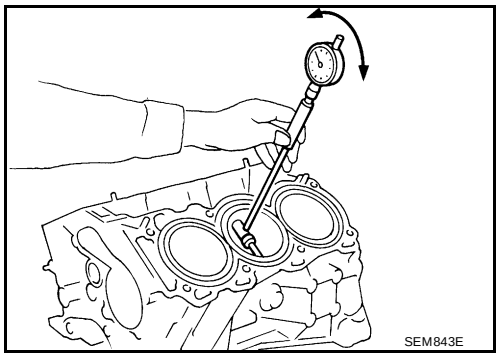


PISTON-TO-BORE CLEARANCE

1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper. The X axis is in the longitudinal direction of the engine.

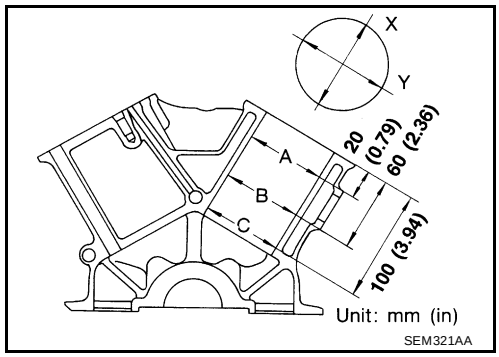
Cylinder bore inner diameter

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)	

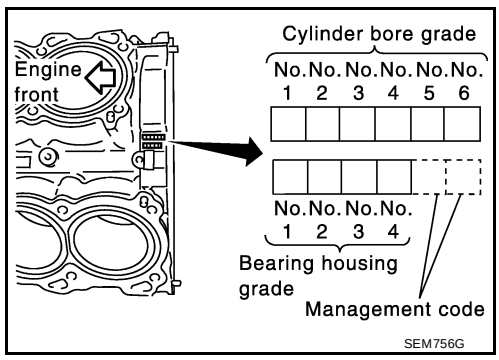


If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.

Out-of-round (Y – X) : limit 0.015 mm (0.0006 in)
Taper (C – A) : limit 0.015 mm (0.0006 in)



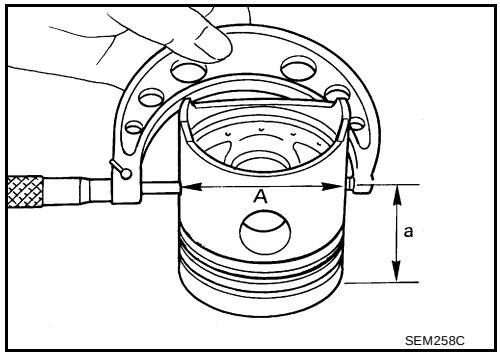
2. Check for scratches and seizure. If seizure is found, hone it.
   - If both cylinder block and piston are replaced with new ones, select piston of the same grade number punched on cylinder block rear position. These numbers are punched in either Arabic or Roman numerals.



3. Measure piston skirt diameter.

Piston diameter "A" : Refer to EM-212, "PISTON, PISTON RING AND PISTON PIN" .

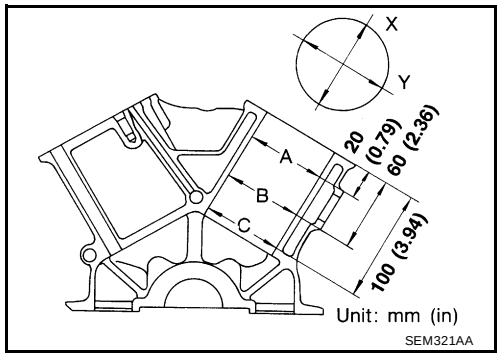
Measuring point "a" (distance from the top) : 41.0 mm (1.61 in)



4. Check that piston-to-bore clearance is within specification.

Piston-to-bore clearance at "B" : 0.010 - 0.030 mm (0.0004 - 0.0012 in)

- The piston-to-bore clearance is measured at the "B" level in the cylinder as shown.



5. Determine piston oversize according to amount of cylinder wear.
Oversize pistons are available for service.
Refer to EM-212, "PISTON, PISTON RING AND PISTON PIN" .
6. 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)

7. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
8. 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.
9. Hone cylinders to obtain specified piston-to-bore clearance.
10. Measure finished cylinder bore for out-of-round and taper.
    - Measurement should be done after cylinder bore cools down.

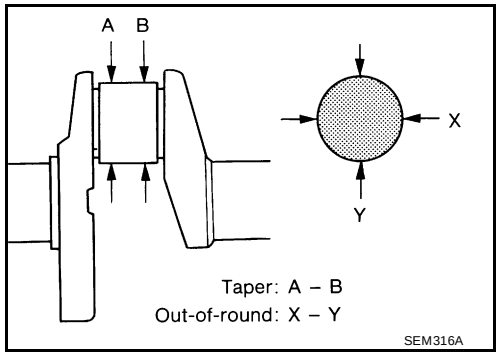
CRANKSHAFT

1. Check the crankshaft main and pin journals for scoring, wear, or cracks.

2. Measure the journals for taper and out-of-round.

Standard

Out-of-round (X - Y)	**: 0.002 mm (0.0001 in)**
Taper (A - B)	**: 0.002 mm (0.0001 in)**



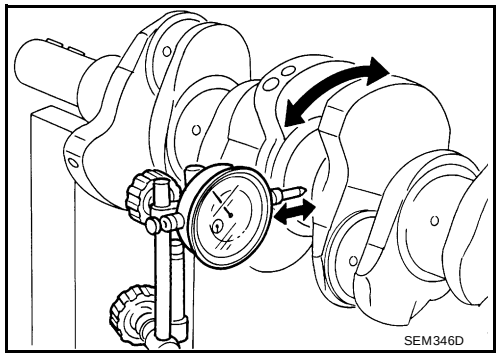
3. Measure crankshaft runout.

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.

Runout limit (total indicator reading) : 0.10 mm (0.0039 in)



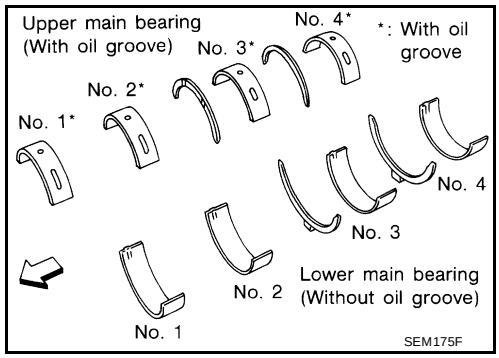
BEARING CLEARANCE

NOTE:
Use either of the following two methods, however method "A" gives more reliable results and so is the preferred method.

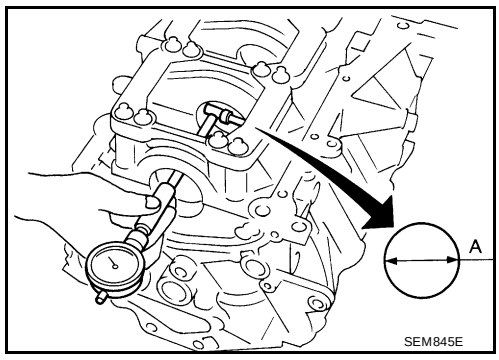
Method A (Using Bore Gauge and Micrometer)

Main Bearing

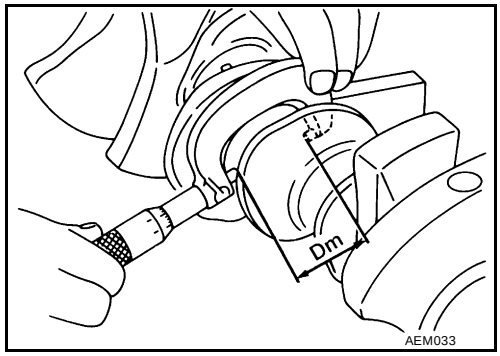
1. Set the main bearings in their proper positions on the cylinder block and the main bearing cap.
2. Install the main bearing caps and bearing beam to the cylinder block. Tighten all bolts in the numerical order as specified. Refer to EM-186, "Disassembly and Assembly" .



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.



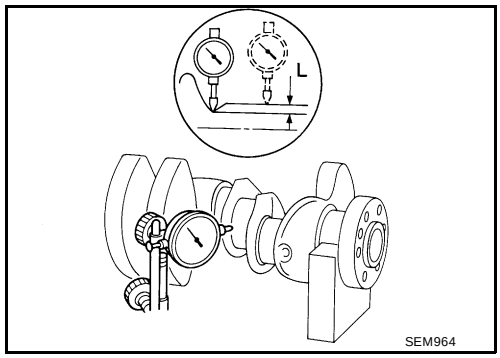
5. Calculate the main bearing clearance.
Main bearing clearance = "A" - "Dm"

Standard : 0.035 - 0.045 mm (0.0014 - 0.0018 in)
Limit : 0.065 mm (0.0026 in)

- 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.

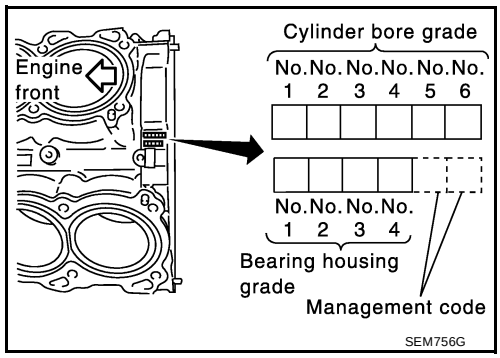
- When grinding the crankshaft journal, confirm that the "L" dimension in the fillet role is more than the specified limit.

"L" : 0.1 mm (0.004 in)

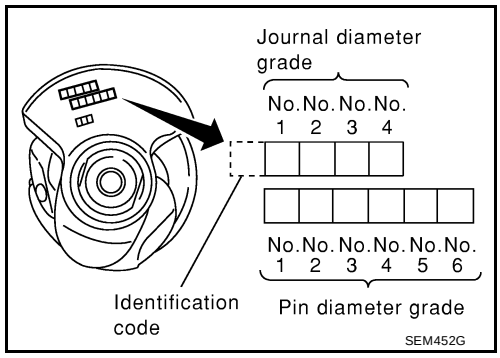


6. If the crankshaft or the cylinder block is replaced with a new one, select thickness of the main bearings as follows:

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:

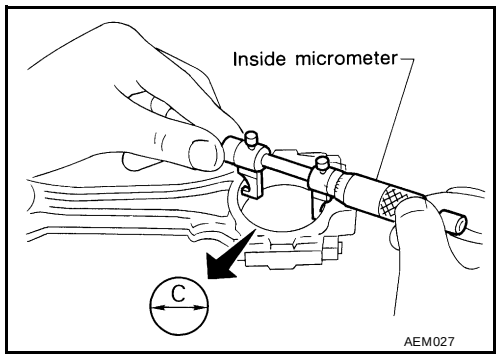
Main bearing selection table

Mark	Axle diameter	Hole diameter: A (63.993 - 63.994 (2.5194 - 2.5194))	B (63.994 - 63.995 (2.5194 - 2.5195))	C (63.995 - 63.996 (2.5195 - 2.5195))	D (63.996 - 63.997 (2.5195 - 2.5196))	E (63.997 - 63.998 (2.5196 - 2.5196))	F (63.998 - 63.999 (2.5196 - 2.5196))	G (63.999 - 64.000 (2.5196 - 2.5197))	H (64.000 - 64.001 (2.5197 - 2.5197))	J (64.001 - 64.002 (2.5197 - 2.5198))	K (64.002 - 64.003 (2.5198 - 2.5198))	L (64.003 - 64.004 (2.5198 - 2.5198))	M (64.004 - 64.005 (2.5198 - 2.5199))	N (64.005 - 64.006 (2.5199 - 2.5199))	P (64.006 - 64.007 (2.5199 - 2.5200))	R (64.007 - 64.008 (2.5200 - 2.5200))	S (64.008 - 64.009 (2.5200 - 2.5200))	T (64.009 - 64.010 (2.5200 - 2.5201))	U (64.010 - 64.011 (2.5201 - 2.5197))	V (64.011 - 64.012 (2.5197 - 2.5202))	W (64.012 - 64.013 (2.5202 - 2.5202))	X (64.013 - 64.014 (2.5202 - 2.5202))	Y (64.014 - 64.015 (2.5202 - 2.5203))	4 (64.015 - 64.016 (2.5203 - 2.5203))	7 (64.016 - 64.017 (2.5203 - 2.5203))
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 - 2.4005)	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 (2.4005 - 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	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			

WBIA0092E

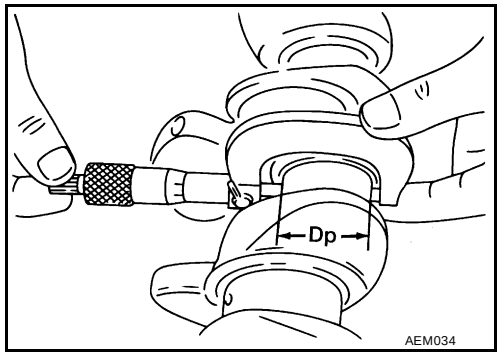
Connecting Rod Bearing (Big End)

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-186, "Disassembly and Assembly" .
3. Measure the inner diameter "C" of each connecting rod (big end) as shown.



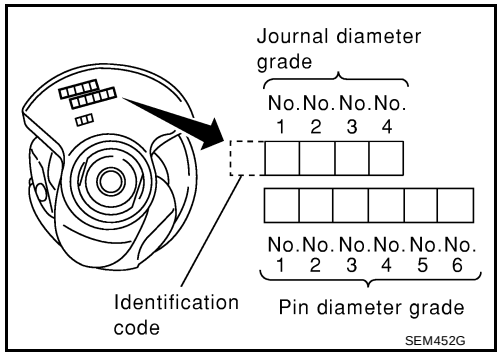
4. Measure the outer diameter "Dp" of each crankshaft pin journal.
5. Calculate the connecting rod bearing clearance.
   Connecting rod bearing clearance = C - Dp

   Standard : 0.034 - 0.059 mm (0.0013 - 0.0023 in)
   Limit : 0.070 mm (0.0028 in)



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)



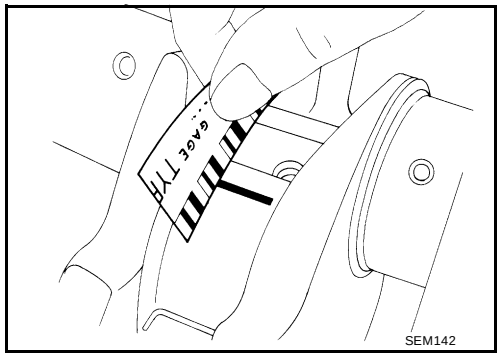
NOTE:
These numbers are punched in either Arabic or Roman numerals.

Method B (Using Plastigage)

1. Remove oil and dust on the crankshaft pin and the surfaces of each bearing completely.
2. Cut a plasticgage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
3. Install the connecting rod bearings to the connecting rod cap, and tighten the connecting rod nuts to the specified torque.

   CAUTION:
   Never rotate the crankshaft.
4. Remove the connecting rod cap and bearings, and using the scale on the plasticgage bag, measure the plasticgage width.

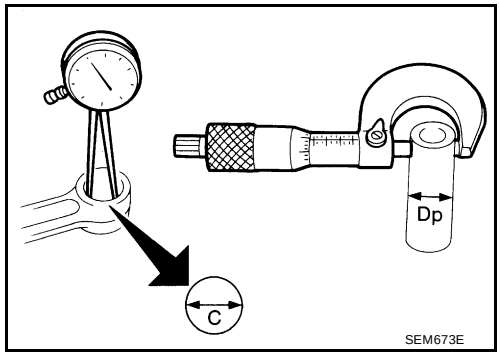
   NOTE:
   The procedure when the measured value exceeds the repair limit is same as that described in "Method A (Using Bore Gauge and Micrometer)".



CONNECTING ROD BUSHING CLEARANCE (SMALL END)

1. Measure the inner diameter "C" of the connecting rod bushing (small end).
2. Measure the outer diameter "Dp" of the piston pin.
3. Calculate the connecting rod bushing clearance.
   Connecting Rod Bushing Clearance = "C" - "Dp"

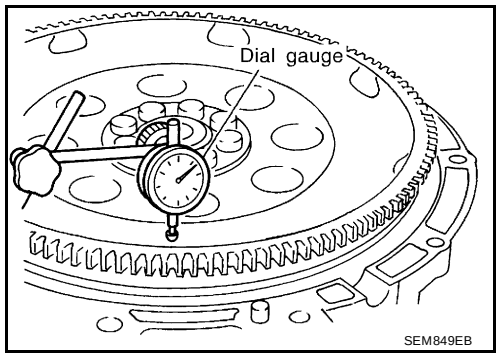
   Standard : 0.005 - 0.017 mm (0.0002 - 0.0007 in)
   Limit : 0.030 mm (0.0012 in)
4. If the calculated clearance exceeds the limit, replace the connecting rod assembly, or the connecting rod bushing, or the piston and pin set.



DRIVE PLATE RUNOUT (A/T)

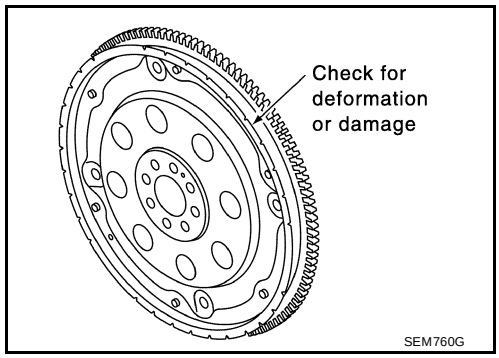
Using a dial gauge, measure the drive plate runout (Total Indicator Reading).

Drive plate runout (A/T) : less than 0.15 mm (0.0059 in) TIR



CAUTION:

- **The signal plate is built into the drive assembly. Be careful not to damage the signal plate, particularly the teeth.**
- **Check the drive plate and signal plate for deformation or damage.**
- **Keep any magnetized objects away from the signal plate, particularly the teeth.**



FLYWHEEL RUNOUT (M/T)

NOTE:

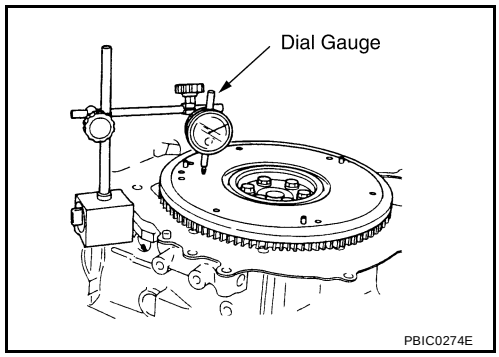
- This inspection is for double mass flywheel only.
- Do not disassemble the double mass flywheel.

Flywheel Deflection

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

Standard : 0.45 mm (0.0177 in) or less
Limit : 1.3 mm (0.051 in) or less

- When measured value exceeds the limit, replace the flywheel with a new one.



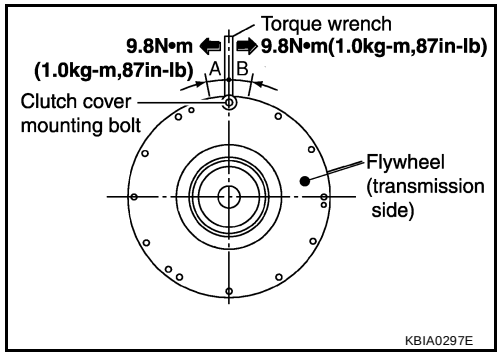
Movement Around in the Radial (rotation) Direction

Check the movement amount with the following procedure:

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

Standard : 24 mm (0.94 in) or less

4. Measure dimensions of movement amounts A and B on the circumference of the flywheel on the transaxle side.
5. When the measured value exceeds the standard, replace the flywheel.



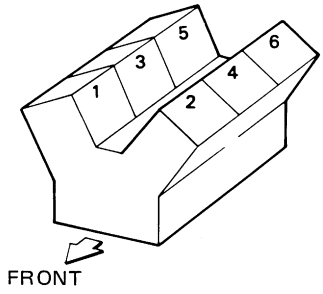
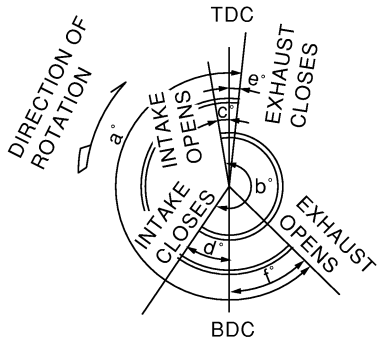
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00100

Standard and Limit

EBS007QI

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 (3.76 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		10.0
Compression pressure kPa (kg/cm^2 , psi)/300 rpm	Standard	1,275 (13.0, 185)
	Minimum	981 (10.0, 142)
	Differential limit between cylinders	98 (1.0, 14)
Cylinder number	 SEM713A	
Valve timing (IVTC - OFF)	 PBIC0187E	

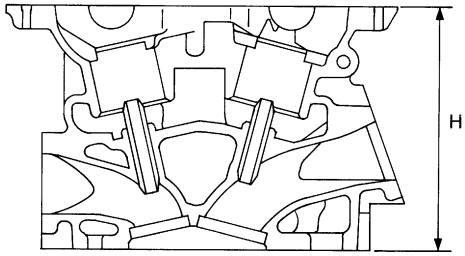
Unit: degree

a	b	c	d	e	f
240	238	- 6	64	8	52

CYLINDER HEAD

Unit: mm (in)

	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)



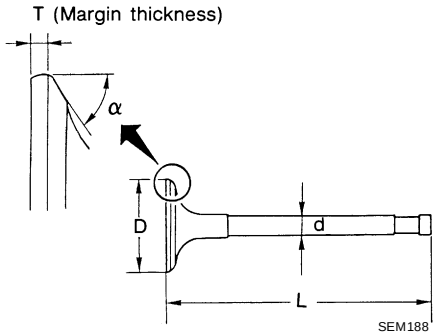
Nominal cylinder head height:
H = 126.3 - 126.5 mm (4.972 - 4.980 in)

SEM949E

VALVE

Valve Dimensions

Unit: mm (in)



SEM188

Valve head diameter “D”	Intake	37.0 - 37.3 (1.4567 - 1.4685)
	Exhaust	31.2 - 31.5 (1.228 - 1.240)
Valve length “L”	Intake	96.12 - 96.62 (3.7842 - 3.8039)
	Exhaust	93.65 - 94.15 (3.6870 - 3.7067)
Valve stem diameter “d”	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.945 - 5.960 (0.2341 - 0.2346)
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 Clearance

Unit: mm (in)

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

*: Approximately 80°C (176°F)

Valve Spring

Free height mm (in)	47.10 (1.8543)

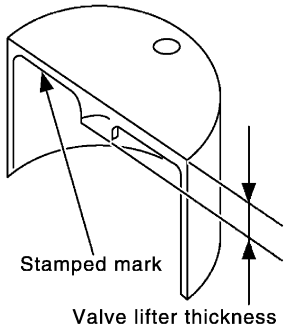
Pressure N (kg, lb) at height mm (in)	Standard	202 (20.6, 45.4) at 37.0 (1.457)
	Limit	436 (44.5, 98.1) at 28.2 (1.110)
Out-of-square mm (in)		Less than 2.0 (0.079)

Valve Lifter

Unit: mm (in)

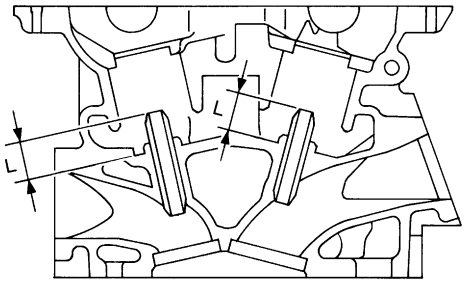
Valve lifter outer diameter	34.960 - 34.975 (1.3764 - 1.3770)
Lifter guide inner diameter	35.000 - 35.021 (1.3780 - 1.3788)
Clearance between lifter and lifter guide	0.025 - 0.061 (0.0010 - 0.0024)

Identification Mark	Thickness mm (in)
788C	7.88 (0.3102)
790C	7.90 (0.3110)
792C	7.92 (0.3118)
794C	7.94 (0.3126)
796C	7.96 (0.3134)
798C	7.98 (0.3142)
800C	8.00 (0.3150)
802C	8.02 (03.157)
804C	8.04 (0.3165)
806C	8.06 (0.3173)
808C	8.08 (0.3181)
810C	8.10 (0.3189)
812C	8.12 (0.3197)
814C	8.14 (0.3205)
816C	8.16 (0.3213)
818C	8.18 (0.3220)
820C	8.20 (0.3228)
822C	8.22 (0.3236)
824C	8.24 (0.3244)
826C	8.26 (0.3252)
828C	8.28 (0.3260)
830C	8.30 (0.3268)
832C	8.32 (0.3276)
834C	8.34 (0.3283)
836C	8.36 (0.3291)



Valve Guide

Unit: mm (in)

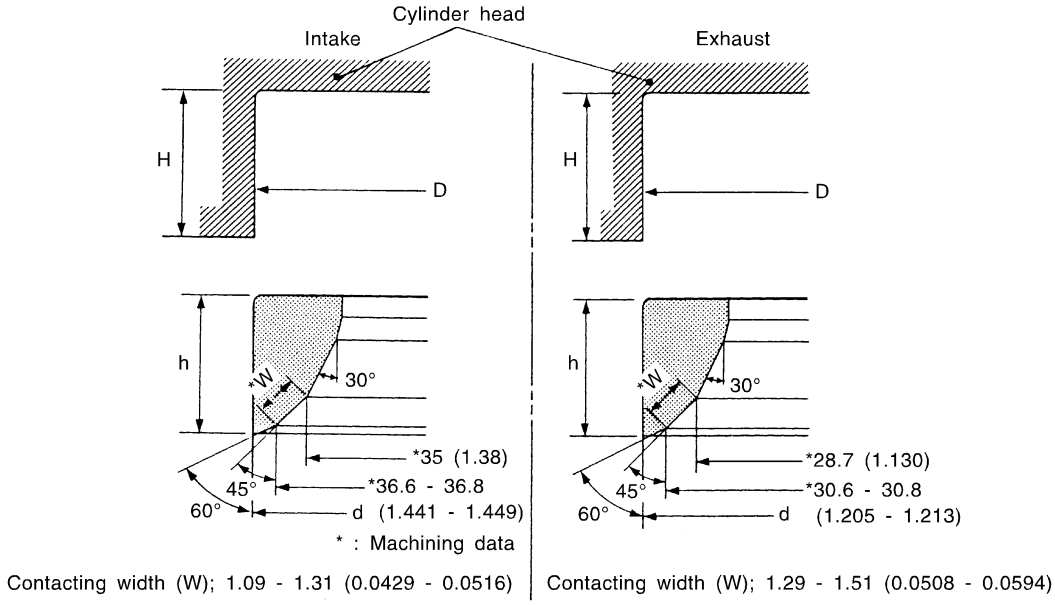


SEM950E

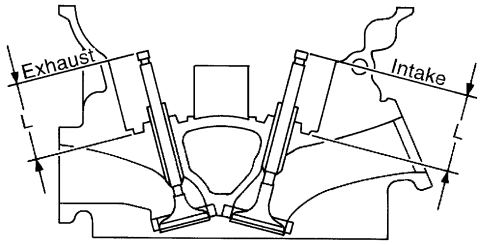
		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
Valve guide	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	Max. tolerance
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
Valve deflection limit	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)



SEM021EB



SEM621F

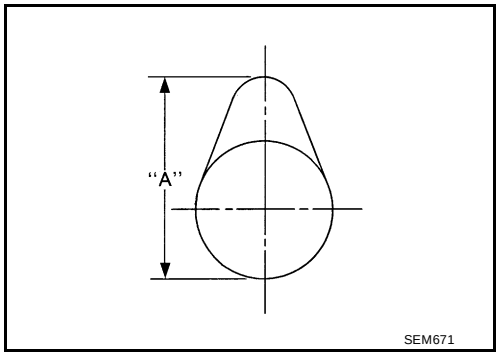
		Standard	Service
Cylinder head seat recess diameter (D)	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Height (h)	Intake	5.9 - 6.0 (0.232 - 0.236)	5.05 - 5.15 (0.1988 - 0.2028)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth (H)		5.9 - 6.1 (0.232 - 0.240)	
Depth (L)	Intake	41.07 - 41.67 (1.6169 - 1.6405)	
	Exhaust	41.00 - 41.60 (1.6142 - 1.6378)	

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard	Limit
Camshaft journal to bearing clearance	No. 1 0.045 - 0.086 (0.0018 - 0.0034) No. 2, 3, 4 0.035 - 0.076 (0.0014 - 0.0030)	0.15 (0.0059)
Inner diameter of camshaft bearing	No. 1 26.000 - 26.021 (1.0236 - 1.0244) No. 2, 3, 4 23.500 - 23.521 (0.9252 - 0.9260)	—
Outer diameter of camshaft journal	No. 1 25.935 - 25.955 (1.0211 - 1.0218) No. 2, 3, 4 23.445 - 23.465 (0.9230 - 0.9238)	—
Camshaft runout [TIR*]	Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]	Less than 0.15 (0.0059)	—
Camshaft end play	0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)

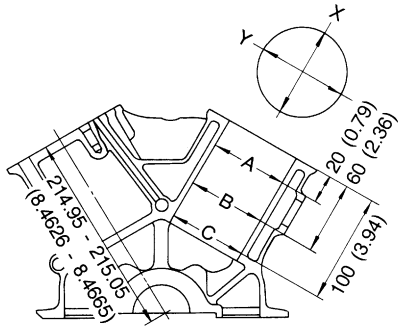
*: Total indicator reading



Cam height "A"	Intake and exhaust	44.465 - 44.655 (1.7506 - 1.7581)
Wear limit of cam height		0.2 (0.008)

CYLINDER BLOCK

Unit: mm (in)



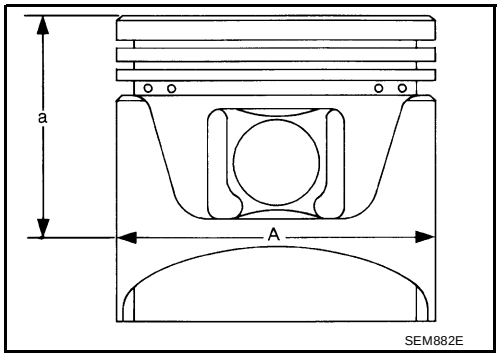
Surface flatness	Standard			Less than 0.03 (0.0012)
	Limit			0.10 (0.0039)
Cylinder bore	Inner diameter	Standard	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
		Wear limit		0.20 (0.0079)
Out-of-round (Y – X)				Less than 0.015 (0.0006)

Taper (C – A)		Less than 0.015 (0.0006)
Main journal 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)

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



Piston skirt diameter “A”	Standard	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)
		0.20 (0.0079) oversize (Service)	95.680 - 95.710 (3.7669 - 3.7681)
“a” dimension			41.0 (1.614)
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 clearance to cylinder block			0.010 - 0.030 (0.0004 - 0.0012)

Piston Ring

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.54 (0.0213)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.80 (0.0315)
	Oil (rail ring)	0.20 - 0.50 (0.0079 - 0.0197)	0.95 (0.0374)

Piston Pin

Unit: mm (in)

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)
Interference fit of piston pin to piston		0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)
	Limit	0.030 (0.0012)

*: Values measured at ambient temperature of 20°C (68°F)

CONNECTING ROD

Unit: mm (in)

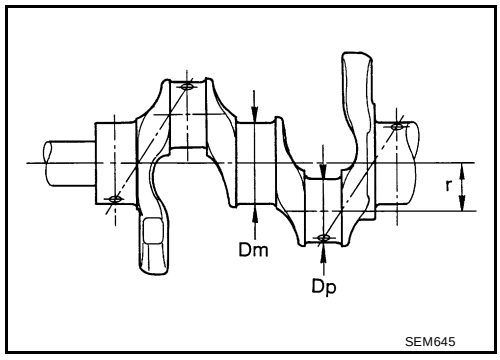
Center distance		144.15 - 144.25 (5.6752 - 5.6791)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end inner diameter		23.980 - 24.000 (0.9441 - 0.9449)
Piston pin bushing inner diameter*	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)
Connecting rod big end inner diameter		55.000 - 55.013 (2.1654 - 2.1659)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)

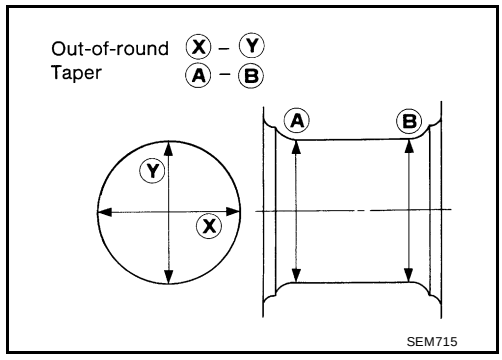
*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)

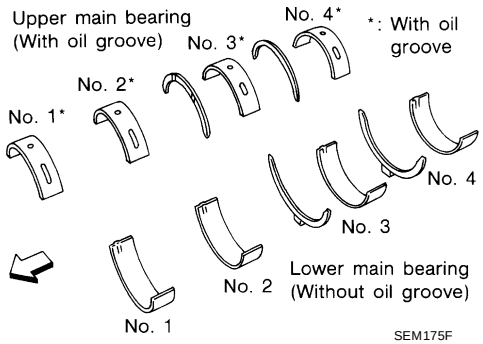
Main journal dia. “Dm” grade	Grade No. A	59.975 - 59.974 (2.3612 - 2.3612)
	Grade No. B	59.974 - 59.973 (2.3612 - 2.3611)
	Grade No. C	59.973 - 59.972 (2.3611 - 2.3611)
	Grade No. D	59.972 - 59.971 (2.3611 - 2.3611)
	Grade No. E	59.971 - 59.970 (2.3611 - 2.3610)
	Grade No. F	59.970 - 59.969 (2.3610 - 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 dia. “Dp”	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”		40.36 - 40.44 (1.5890 - 1.5921)
Out-of-round (X – Y)	Standard	Less than 0.002 (0.0001)
Taper (A – B)	Standard	Less than 0.002 (0.0001)
Runout [TIR*]	Limit	Less than 0.10 (0.0039)
Free end play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)





*: Total indicator reading

AVAILABLE MAIN BEARING



SEM175F

Grade number		Thickness "T" mm (in)	Width "W" mm (in)	Identification color (UPR/LWR)	Remarks
0		2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	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	UPP	2.003 - 2.006 (0.0789 - 0.0790)		Brown/Black	Grade is different for upper and lower bearings.
	LWR	2.000 - 2.003 (0.0787 - 0.0789)			
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)		Green/Brown	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)			
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)		Yellow/Green	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)			
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)		Blue/Yellow	
	LWR	2.009 - 2.012 (0.0791 - 0.0792)			
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)		Pink/Blue	
	LWR	2.012 - 2.015 (0.0792 - 0.0793)			
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)		Purple/Pink	
	LWR	2.015 - 2.018 (0.0793 - 0.0794)			
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)		White/Purple	
	LWR	2.018 - 2.021 (0.0794 - 0.0796)			

Undersize

Unit: mm (in)

	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	Grind so that bearing clearance is the specified value.

CONNECTING ROD BEARING

Grade number	Thickness "T" mm (in)	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

Undersize

Unit: mm (in)

	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.

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Flywheel deflection [TIR]* - Standard	Less than 0.45 (0.0177)
Flywheel deflection [TIR]* - Limit	1.3 (0.051)
Drive plate runout [TIR]*	Less than 0.15 (0.0059)
Flywheel movement in radial (rotation) direction	Less than 24 (0.94)

*: Total Indicator Reading

BEARING CLEARANCE

Unit: mm (in)

Main bearing clearance	Standard	0.035 - 0.045 (0.0014 - 0.0018)*
	Limit	0.065 (0.0026)
Connecting rod bearing clearance	Standard	0.034 - 0.059 (0.0013 - 0.0023)*
	Limit	0.070 (0.0028)

*: Actual clearance