SECTION EM
ENGINE MECHANICAL

CONTENTS

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VQ

PRECAUTIONS

PFP:00001

Precautions for Supplemental Restraint System (SRS) “AIR BAG” and “SEAT BELT PRE-TENSIONER”

EBS00T36

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

WARNING:

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

Precautions for Drain Engine Coolant and Engine Oil

EBS00NGC

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

Precautions for Disconnecting Fuel Piping

EBS00NGD

- 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

EBS00NGE

- 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 a tape or the equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and re-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

EBS00NGF

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

Precautions for Assembly and Installation

EBS00NGG

- 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.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, make sure that dowel pins are installed in the original position.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.

- Before starting the engine, apply fuel pressure to fuel lines with turning ignition switch “ON” (with the engine stopped). Then make sure there are no leaks at fuel line connections.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

Parts Requiring Angle Tightening

EBS00NGH

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

Tool number : KV10112100 (BT-8653-A)

- Cylinder head bolts
- Lower cylinder block bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No angle wrench is required as bolt flange is provided with notches for angle tightening)

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

Precautions for Liquid Gasket

EBS00NGI

REMOVAL OF LIQUID GASKET SEALING

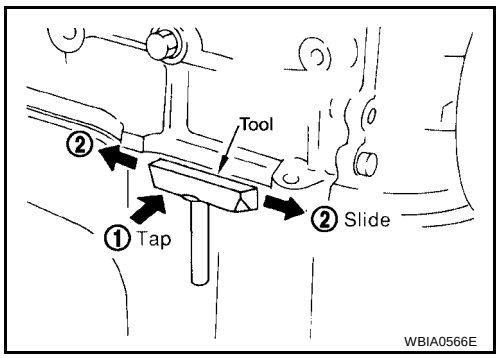
- After removing nuts and bolts, separate the mating surface and remove old liquid gasket sealing using Tool.

Tool number : KV10111100 (J-37228)

CAUTION:
Be careful not to damage the mating surfaces.

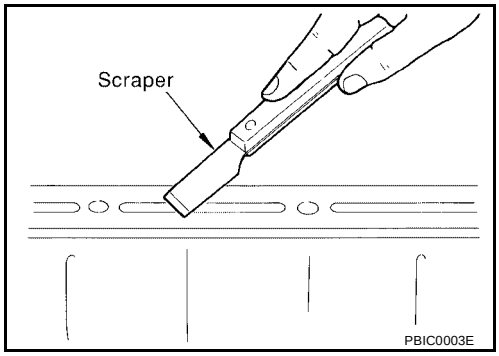
- Tap seal cutter to insert it, and then slide it by tapping on the side as shown.
- In areas where Tool is difficult to use, use plastic hammer to lightly tap the parts, to remove it.

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



LIQUID GASKET APPLICATION PROCEDURE

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

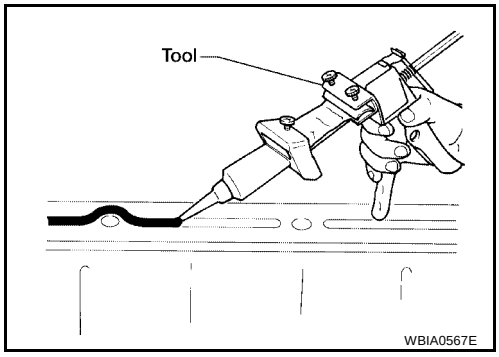


3. Attach liquid gasket tube to Tool.

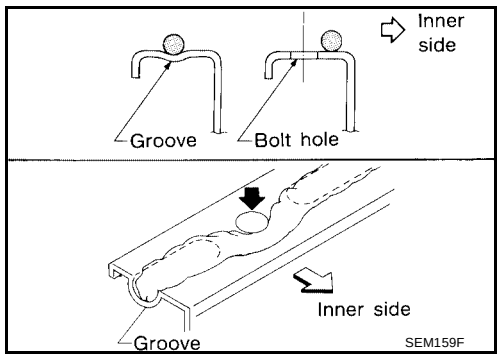
Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

4. Apply liquid gasket without breaks to the specified location with the specified dimensions.
   - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



- As for bolt holes, normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten nuts or bolts after the installation.
- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.



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

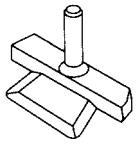
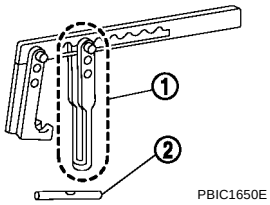
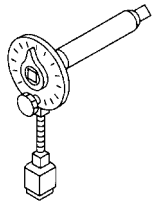
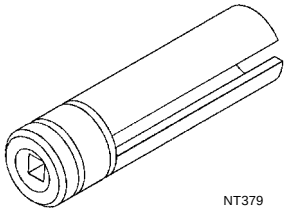
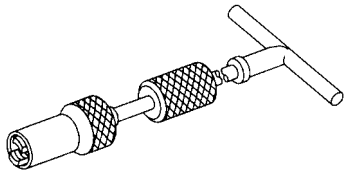
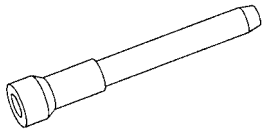
PREPARATION

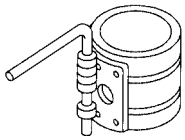
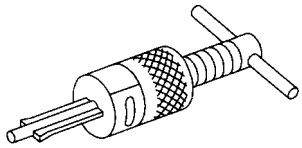
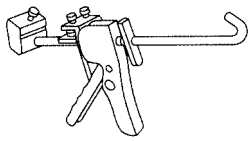
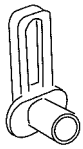
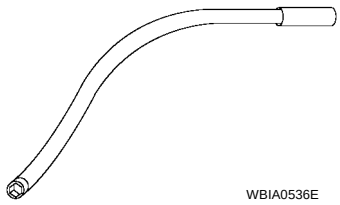
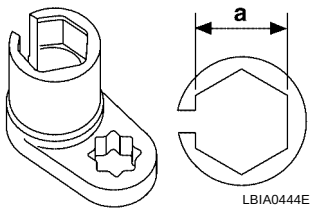
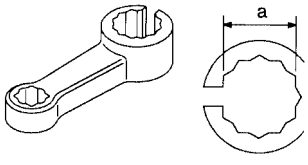
PFP:00002

Special Service Tools

EBS00NGJ

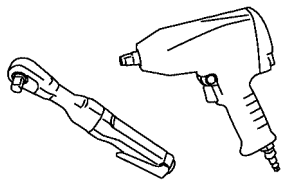
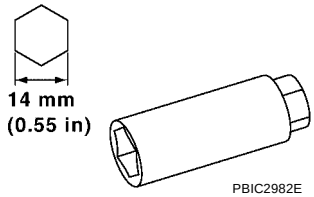
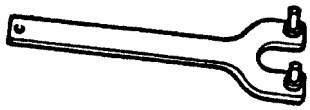
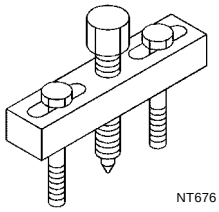
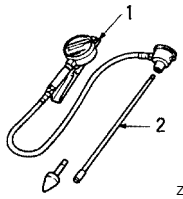
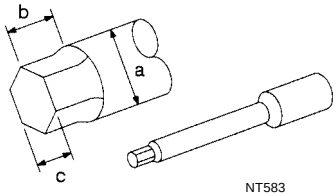
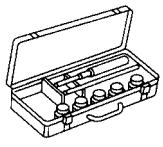
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

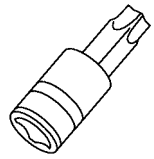
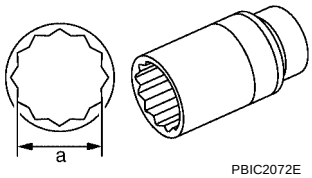
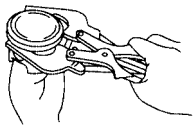
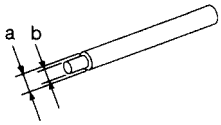
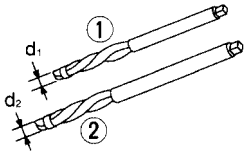
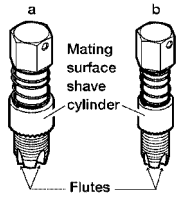
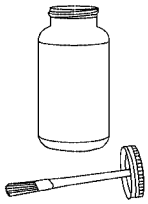
Tool number (Kent-Moore No.) Tool name	Description
KV10111100 (J-37228) Seal cutter  S-NT046	Removing oil pan and front cover, etc.
KV10116200 (J-26336-A) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2. KV10109220 (—) Adapter  PBIC1650E	Disassembling valve mechanism Part (1) is a component of KV10116200 (J-26336-A), but Part (2) is not so.
KV10112100 (BT-8653-A) Angle wrench  NT014	Tightening bolts for connecting rod bearing cap, cylinder head, etc. in angle
KV10117100 (J-36471-A) Heated oxygen sensor wrench  NT379	Loosening or tightening air fuel ratio sensor 1 **For 22 mm (0.87 in) width hexagon nut**
KV10107902 (J-38959) Valve oil seal puller  NT011	Replacing valve oil seal
KV10115600 (J-38958) Valve oil seal drift  NT024	Installing valve oil seal

Tool number (Kent-Moore No.) Tool name	Description
EM03470000 (J-8037) Piston ring compressor  NT044	Installing piston assembly into cylinder bore
ST16610001 (J-23907) Pilot bushing puller  NT045	Removing pilot bushing (M/T models) or pilot converter (A/T models)
WS39930000 (—) Tube presser  NT052	Pressing the tube of liquid gasket
— (J-45488) Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
— (J-46535) Drive belt tension releaser  WBIA0536E	Releasing drive belt tension
— (J-44626) Air fuel sensor Socket  LBIA0444E	Loosening or tightening air fuel ratio A/F sensor **a: 22 mm (0.87 in)**
KV10114400 (J-38365) Heated oxygen sensor wrench  NT636	Loosening or tightening heated oxygen sensor 1 **a: 22 mm (0.87 in)**

Commercial Service Tools

EBS00NGK

(Kent-Moore No.) Tool name	Description
Power tool  PBIC0190E	Loosening nuts and bolts
(—) Spark plug wrench  PBIC2982E	Removing and installing spark plug
(—) Pulley holder  ZZA1010D	Removing and installing crankshaft pulley
(—) Pulley puller  NT676	Removing crankshaft pulley
(—) 1. Compression tester 2. Adapter  ZZA0008D	Checking compression pressure
(J-24239-01) Cylinder head bolt wrench  NT583	Loosening and tightening cylinder head bolt, and used with the angle wrench [SST: KV10112100 (BT8653-A)] **a: 13 (0.51) dia.** **b: 12 (0.47)** **c: 10 (0.39)** Unit: mm (in)
(—) Valve seat cutter set  S-NT048	Finishing valve seat dimensions

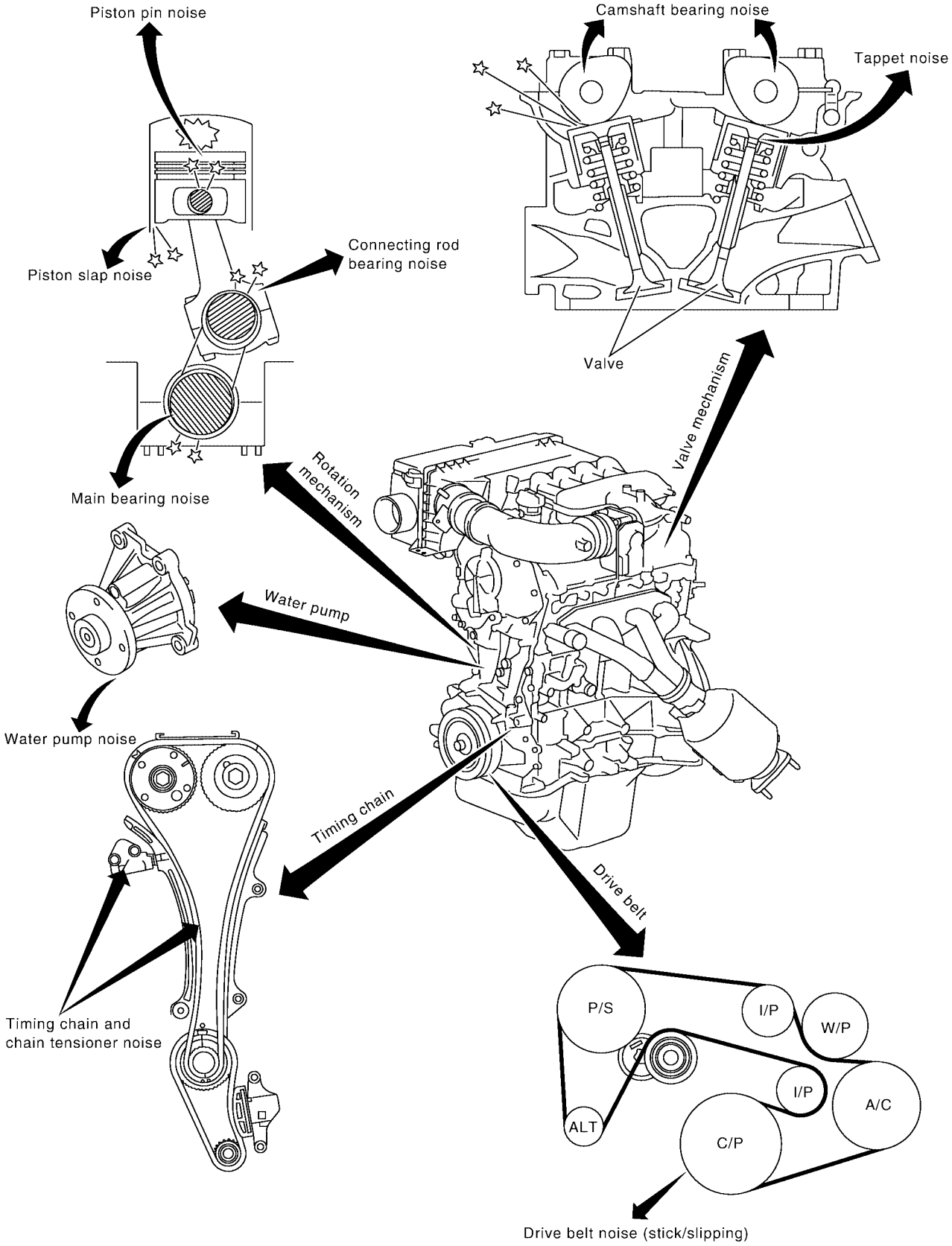
(Kent-Moore No.) Tool name	Description
TORX socket  PBIC1113E	Removing and installing flywheel **Size: T55**
Deep socket  PBIC2072E	Removing and installing oil pressure switch **a: 27 mm (1.06 in)**
(—) Piston ring expander  S-NT030	Removing and installing piston ring
(—) Valve guide drift  S-NT015	Removing and installing valve guide **Intake and Exhaust:** **a: 9.5 mm (0.374 in) dia.** **b: 5.5 mm (0.217 in) dia.**
(—) Valve guide reamer  S-NT016	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide **Intake and Exhaust:** **d_1 : 6.0 mm (0.236 in) dia.** **d_2 : 10.2 mm (0.402 in) dia.**
a: (J-43897-18) b: (J-43897-12) Oxygen sensor thread cleaner  AEM488	Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.) **a = 18 mm (0.71 in) dia. for zirconia heated oxygen sensor** **b = 12 mm (0.47 in) dia. for titania heated oxygen sensor**
(—) Anti-seize lubricant i.e.: (Permatex™ 133AR or equivalent meeting MIL specification MIL-A-907)  AEM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting — Engine Noise

EBS00NHK



PBIC2983E

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

EBS00NHL

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-103
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-39 EM-38
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	EM-92 EM-94
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-96 EM-93 EM-93 EM-94
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-94 EM-98
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-99 EM-98
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-52 EM-48
Front of engine	Squeaking or fizzing	A	B	—	B	—	B	Drive belt (Sticking or slipping)	Drive belt deflection	EM-14
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-19, "WATER PUMP"

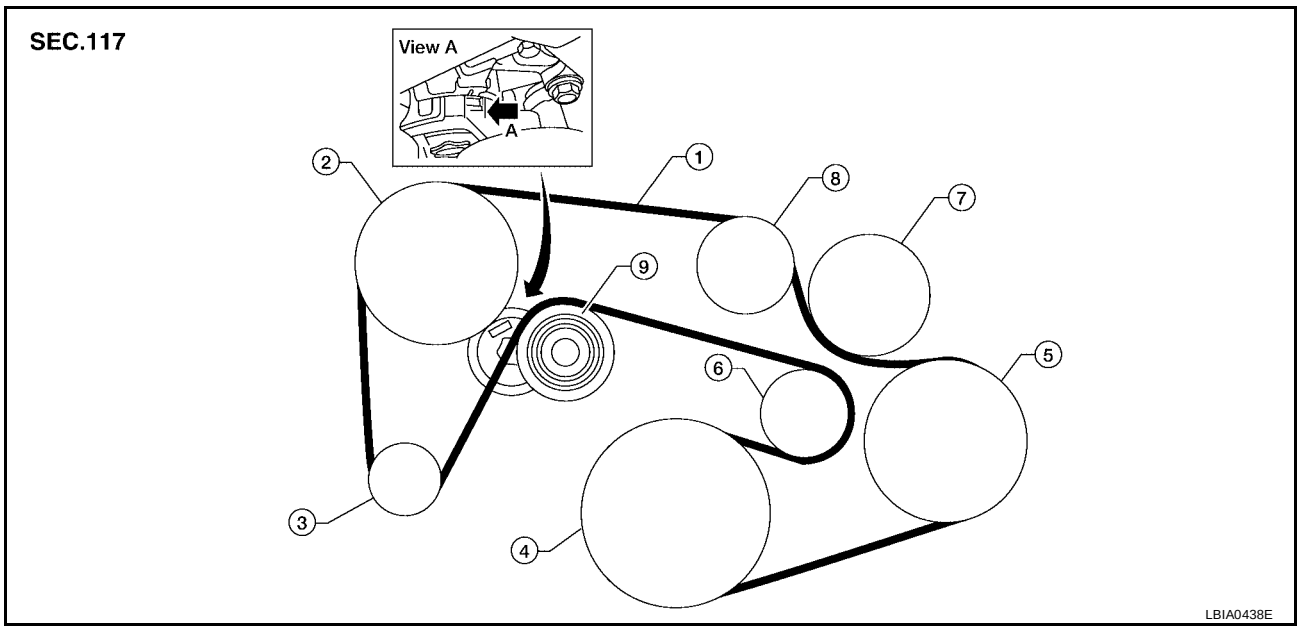
A: Closely related B: Related C: Sometimes related —: Not related

DRIVE BELTS

PFP:02117

Checking Drive Belt

EBS00NHM



1.	Drive belt	2.	Power steering oil pump pulley	3.	Generator pulley
4.	Crankshaft pulley	5.	A/C compressor (if equipped) or idler pulley	6.	Idler pulley
7.	Water pump	8.	Idler pulley	9.	Drive belt auto- tensioner

WARNING:

- **Be sure to perform this step when the engine is stopped.**
- **Make sure that the indicator (fixed side) of the drive belt auto-tensioner is within the possible use range (moving side) as shown.**

NOTE:

- On vehicles not equipped with A/C, there is an idler pulley in the A/C compressor position for the drive belt routing.
- Check the drive belt auto-tensioner indication when the engine is cold.
- Visually check entire drive belt for wear, damage or cracks.
- When new drive belt is installed, the indicator (fixed side) should be within the range "A". If the indicator (fixed side) is out of the possible use range or drive belt is damaged, replace drive belt.

Tension Adjustment

EBS00NHN

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

Removal and Installation

EBS00NIG

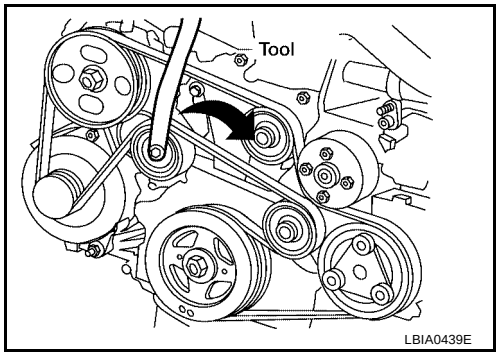
REMOVAL

1. Install Tool on auto tensioner pulley bolt, move in the direction of arrow (loosening direction of tensioner) using Tool.

   Tool number : — (J-46535)

   CAUTION:

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



2. Remove drive belt.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

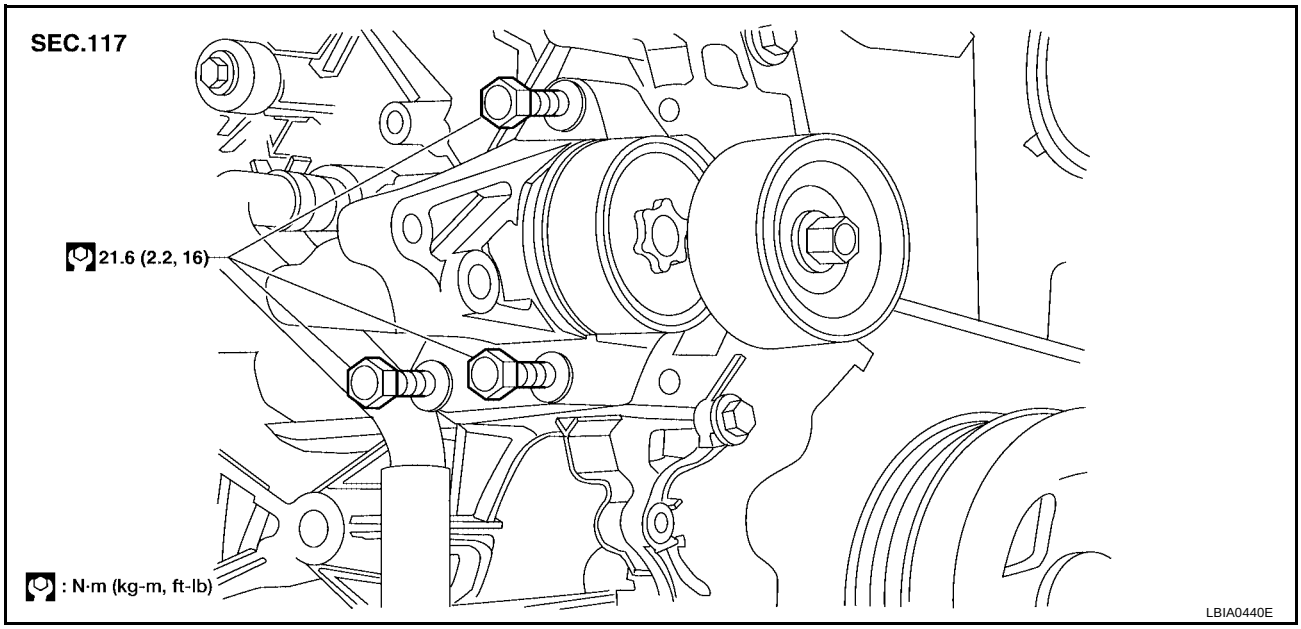
- **Do not loosen the auto-tensioner pulley bolt. (Do not turn it counterclockwise.) If turned counter-clockwise, the complete auto-tensioner must be replaced as a unit, including pulley.**
- **Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.**
- **Confirm belts are completely set on the pulleys.**
- **Check that there are no engine working fluids on the drive belt or pulley grooves.**

NOTE:

- Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
- Confirm tension of drive belt indicator (fixed side) is within the possible use range.

Removal and Installation of Drive Belt Auto-Tensioner

EBS00NHP



REMOVAL

1. Remove air cleaner and air duct EM-16, "REMOVAL" .
2. Remove drive belt. Refer to EM-14, "REMOVAL" .
3. Remove the power steering oil pump and position aside. Refer to PS-22, "REMOVAL" .
4. Remove generator. Refer to SC-37, "REMOVAL" .
5. Remove drive belt auto-tensioner.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

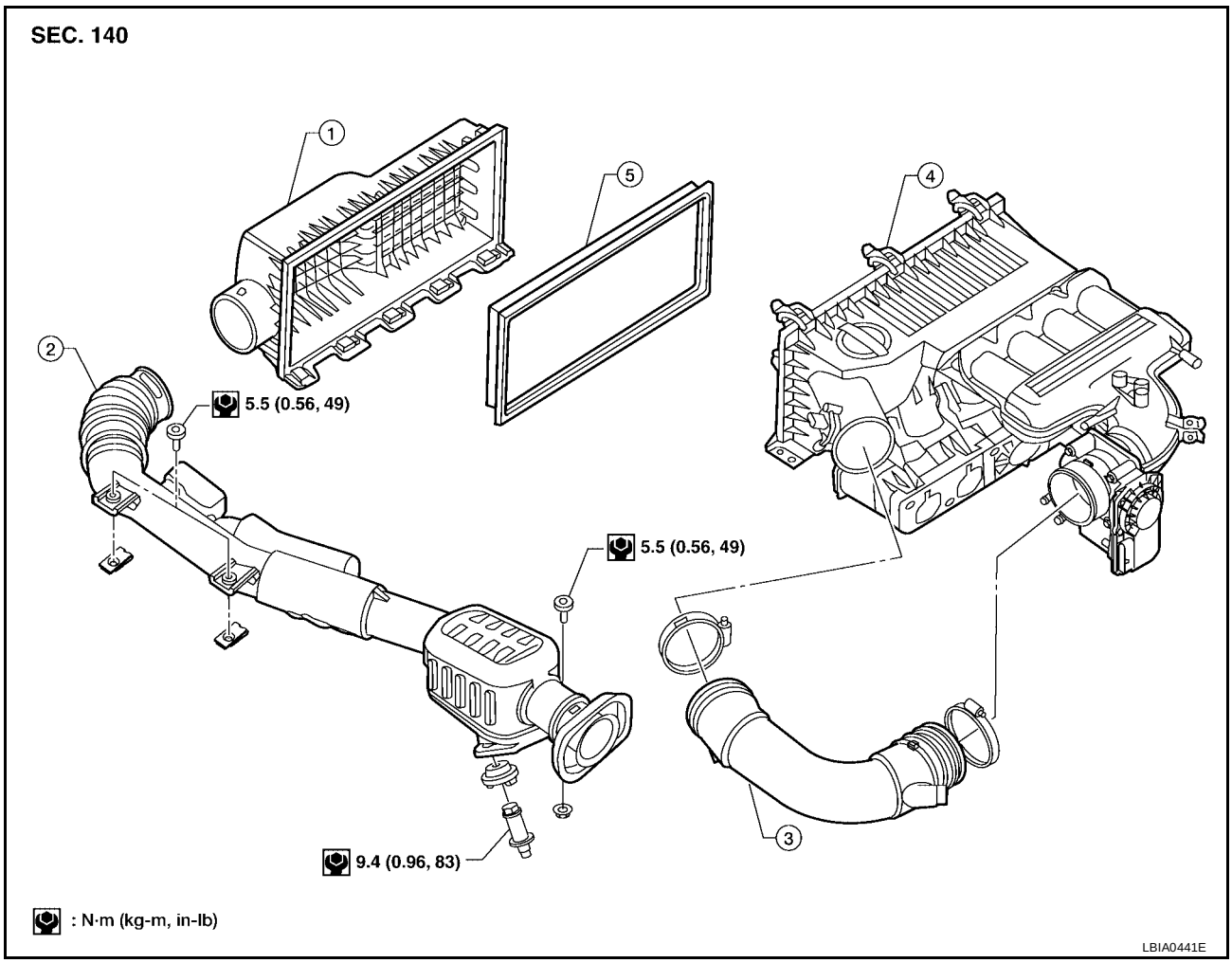
If there is damage greater than peeled paint, replace drive belt auto-tensioner.

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

EBS00NHR



1. Air cleaner case
2. Air duct and resonator assembly
3. Air duct
4. Intake manifold
5. Air cleaner filter

REMOVAL

1. Remove two bolts and remove air duct.
   - Add mating marks as necessary for easier installation.
2. Remove resonator in fender lifting left fender protector, as necessary.

INSPECTION AFTER REMOVAL

Inspect air duct assembly for cracks or tear.

- Replace air duct assembly, if necessary.

INSTALLATION

Installation is in the reverse order of removal.

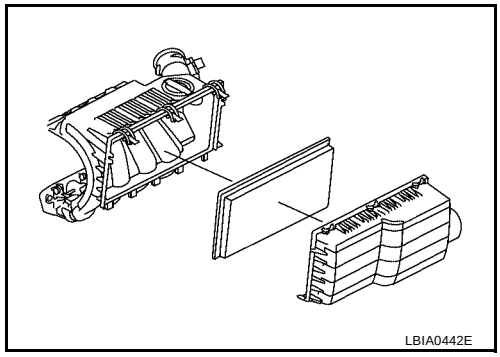
- Align marks. Attach each joint. Screw clamps firmly.
- Install duct to intake manifold by aligning "LOCK-UNLOCK" upward.

Changing Air Cleaner Filter

EBS00NHS

REMOVAL

1. Unfasten clips and lift up air cleaner case upper.
2. Remove air cleaner filter.



INSTALLATION

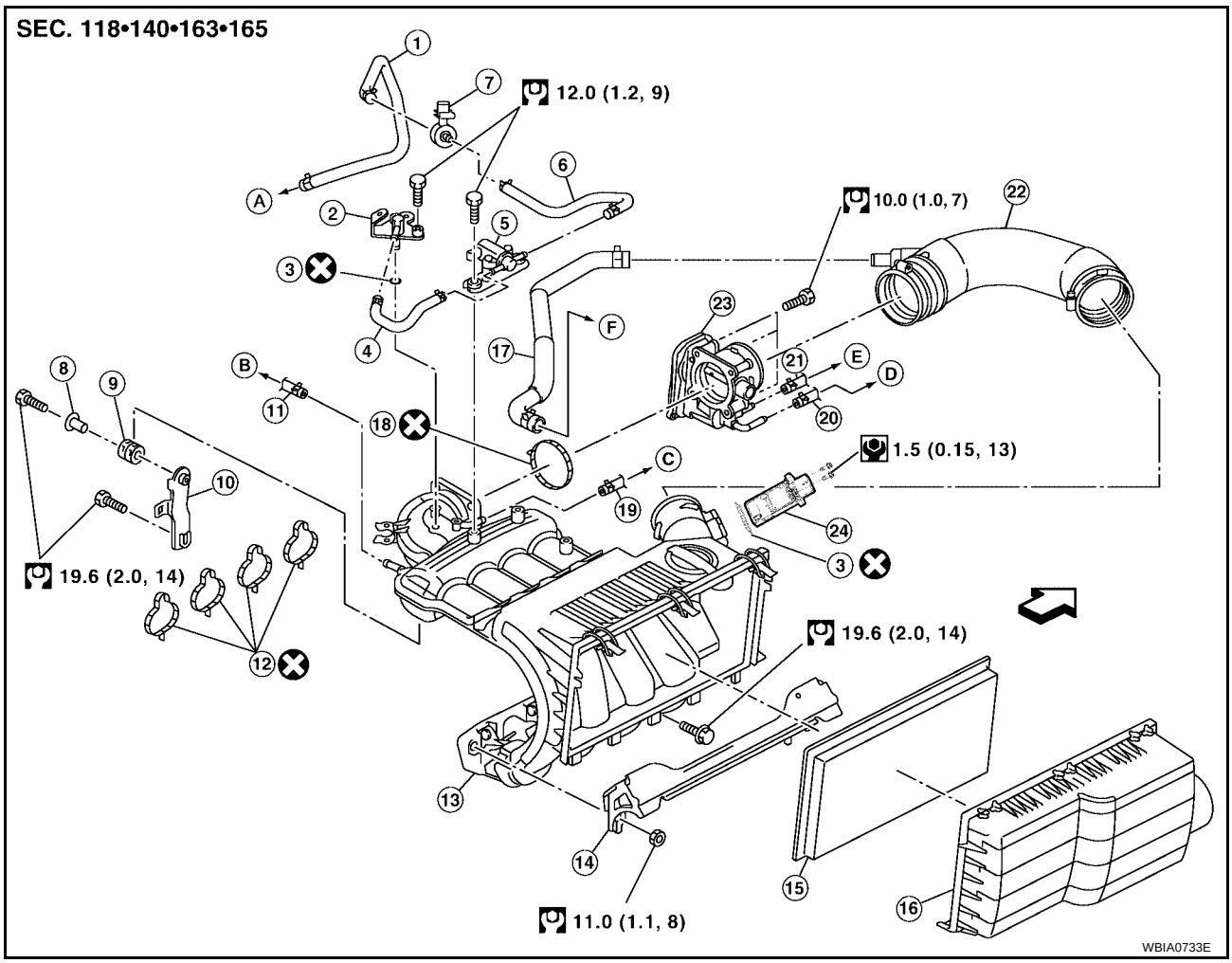
Installation is in the reverse order of removal.

INTAKE MANIFOLD

PFP:14003

Removal and Installation

EBS00NHT



1.	Vacuum hose	2.	Vacuum hose adapter	3.	O–ring
4.	Vacuum hose	5.	EVAP canister purge volume control solenoid valve	6.	Vacuum hose
7.	Service port	8.	Collar	9.	Grommet
10.	Intake manifold support	11.	Vacuum hose	12.	Gasket
13.	Intake manifold	14.	Fuel tube protector	15.	Air cleaner
16.	Air cleaner case	17.	PCV hose	18.	Gasket
19.	PCV hose	20.	Water hose	21.	Water hose
22.	Air duct	23.	Electric throttle control actuator	24.	Mass air flow sensor
A.	To vacuum pipe (EVAP canister)	B.	To brake booster	C.	To PCV valve
D.	To heater outlet	E.	To heater pipe	F.	To rocker cover
→	Engine front				

CAUTION:

Do not remove or disassemble parts unless instructed as shown in the figure.

REMOVAL

1. Release fuel pressure. Refer to EC-86, "FUEL PRESSURE RELEASE" .
2. Remove air cleaner case, air cleaner and air duct.
3. Disconnect water hoses from electric throttle control actuator, and pinch water hoses near electric throttle control actuator to prevent engine coolant spilling.

   CAUTION:

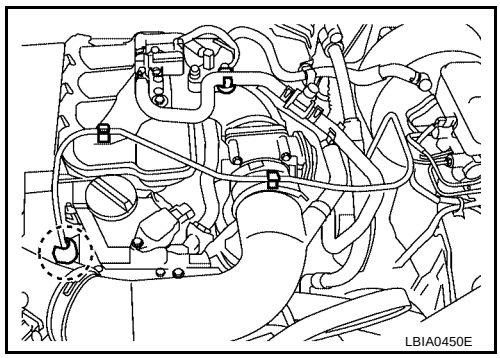
   - **Perform this step when engine is cold.**

- **Do not spill engine coolant on drive belt.**

4. Remove mass air flow sensor from intake manifold.

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 quick connector cap, and disconnect quick connector at the engine side. Refer to EM-29, "FUEL INJECTOR AND FUEL TUBE" .

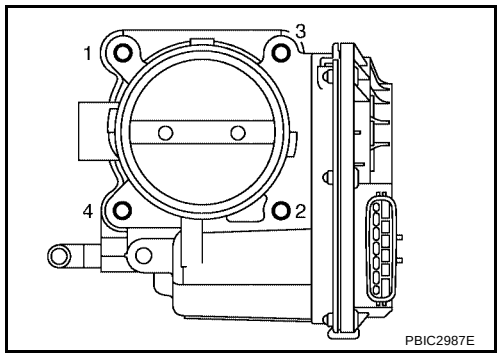


6. Remove electric throttle control actuator with the following procedure:

a. Disconnect harness connector.

b. Loosen bolts in reverse order as shown, and remove electric throttle control actuator and gasket.

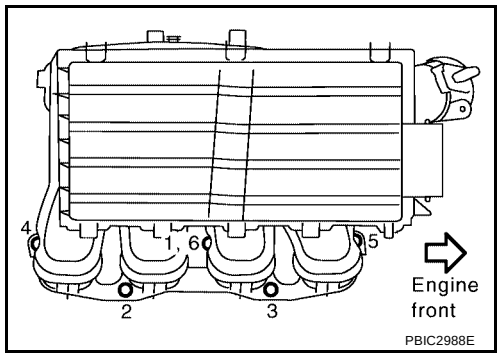
CAUTION:
- **Handle carefully to avoid any shock to electric throttle control actuator.**
- **Do not disassemble.**



7. Disconnect harness, vacuum hoses and PCV hoses from intake manifold, and move them aside.
8. Remove intake manifold support.
9. Loosen nuts and bolts in reverse order as shown, and remove intake manifold, fuel tube protector and gasket.

CAUTION:
- **Cover engine openings to avoid entry of foreign materials.**
- **Do not disassemble intake manifold.**

NOTE:
Disregard No. 6 when loosening.



10. Remove EVAP canister purge volume control solenoid valve and vacuum hose adapter from intake manifold, if necessary.
11. Disconnect sub-harness from fuel injector. Refer to EM-29, "FUEL INJECTOR AND FUEL TUBE" .
12. Remove fuel tube and fuel injector assembly from intake manifold. Refer to EM-29, "FUEL INJECTOR AND FUEL TUBE" .

INSTALLATION

Installation in the reverse order of removal.

Intake Manifold and Fuel Tube Protector

- If stud bolts were removed, install them and tighten to the specified torque below.

Intake manifold bolts : 9.4 N·m (0.96 kg-m, 83in-lb)

- Tighten in numerical order as shown.

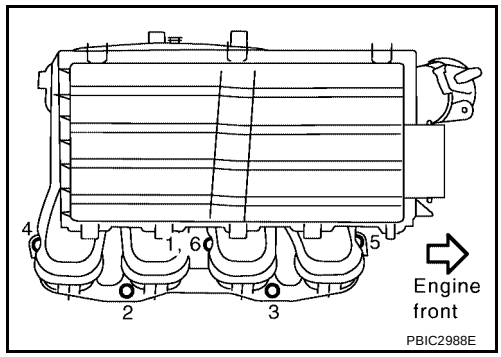
NOTE:
No. 6 means double tightening of bolt No. 1.

Refer to the following for locating bolts and nuts.

M8 x 38 mm (1.50 in) (Color green) : No. 1, 6

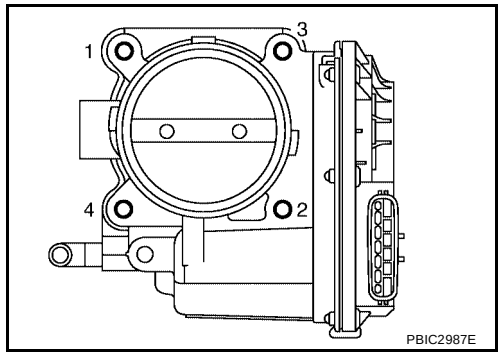
M8 x 35 mm (1.38 in) : No. 2, 3

Nut : No. 4, 5



Electric Throttle Control Actuator

- Tighten bolts equally and diagonally in several steps and in numerical order as shown.
- Perform the “Throttle Valve Closed Position Learning” when harness connector of electric throttle control actuator is disconnected. Refer to EC-84, "Throttle Valve Closed Position Learning" .
- Perform the “Idle Air Volume Learning” and “Throttle Valve Closed Position Learning” when electric throttle control actuator is replaced. Refer to EC-84, "Idle Air Volume Learning" .



INSPECTION AFTER INSTALLATION

Make sure there are no fuel leaks at connections with the following procedure:

1. Apply fuel pressure to fuel lines with turning ignition switch “ON” (with the engine stopped). Then make sure there are no fuel leaks at connections.

   NOTE:
   Use mirrors for checking on invisible points.

2. Start the engine. With engine speed increased, make sure again there are no fuel leaks at connections.

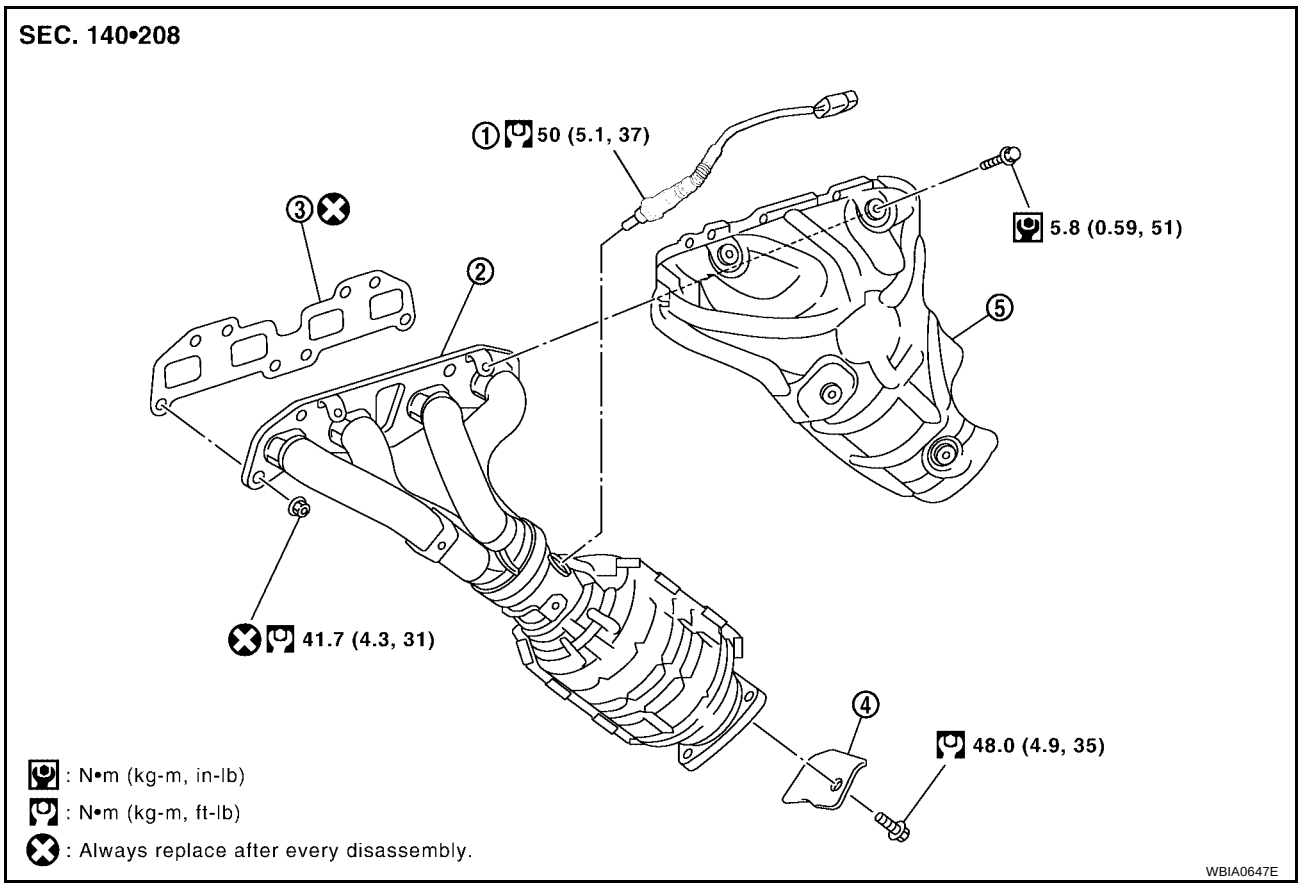
   CAUTION:
   Do not touch the engine immediately after stopped as the engine becomes extremely hot.

EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

Removal and Installation

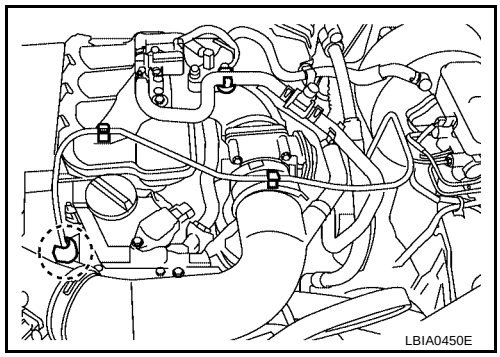
EBS00NHU



1. Air fuel ratio sensor 1
2. Exhaust manifold and three way catalyst assembly
3. Gasket
4. Bracket
5. Exhaust manifold cover

REMOVAL

1. Release fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .
2. Remove quick connector cap, and disconnect quick connector at the engine side. Refer to EM-16, "AIR CLEANER AND AIR DUCT" .



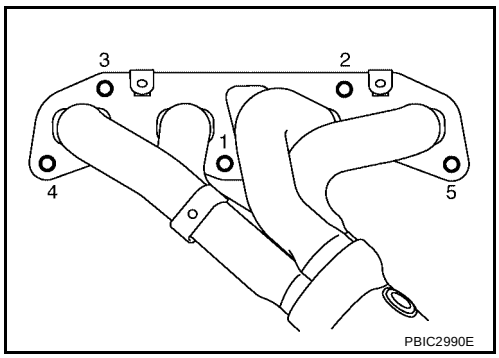
3. Remove air duct, PCV hose (between air duct and rocker cover) and electric throttle control actuator. Refer to EM-18, "INTAKE MANIFOLD" .
4. Disconnect harness connector of air fuel ratio sensor 1, and harness from bracket and middle clamp.
5. Remove air fuel ratio sensor 1 using Tool.

Tool number : — (J-44626)

CAUTION:

- **Be careful not to damage air fuel ratio sensor 1.**
- **Discard any air fuel ratio sensor 1 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new one.**

6. Remove exhaust front tube. Refer to EX-6, "REMOVAL" .
7. Remove exhaust manifold cover.
8. Remove bracket between exhaust manifold–three way catalyst assembly and transmission assembly.
9. Loosen nuts in reverse order as shown to remove exhaust manifold and three way catalyst assembly.



10. Remove gasket.

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

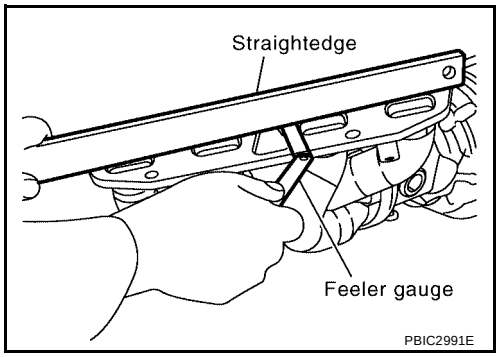
INSPECTION AFTER REMOVAL

Surface Distortion

- Using a straightedge and a feeler gauge, check the surface distortion of exhaust manifold and three way catalyst assembly mating surface.

Limit : 0.3 mm (0.012 in)

- If it exceeds the limit, replace exhaust manifold and three way catalyst assembly.



INSTALLATION

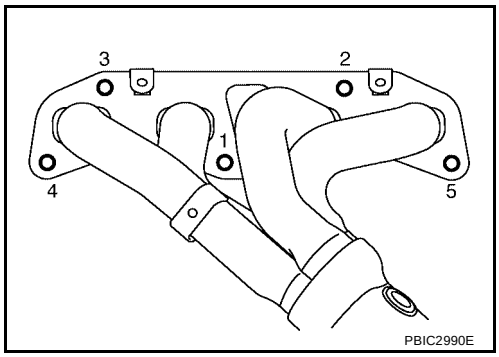
installation is in the reverse order of removal.

Exhaust Manifold

1. If stud bolts were removed, install them and tighten to the specified torque below.

Exhaust manifold stud bolt : 14.7 N·m (1.5 kg-m, 11 ft-lb)

2. Tighten nuts in numerical order as shown.
3. Tighten nuts in numerical order as shown again.



Air Fuel Ratio Sensor 1

CAUTION:

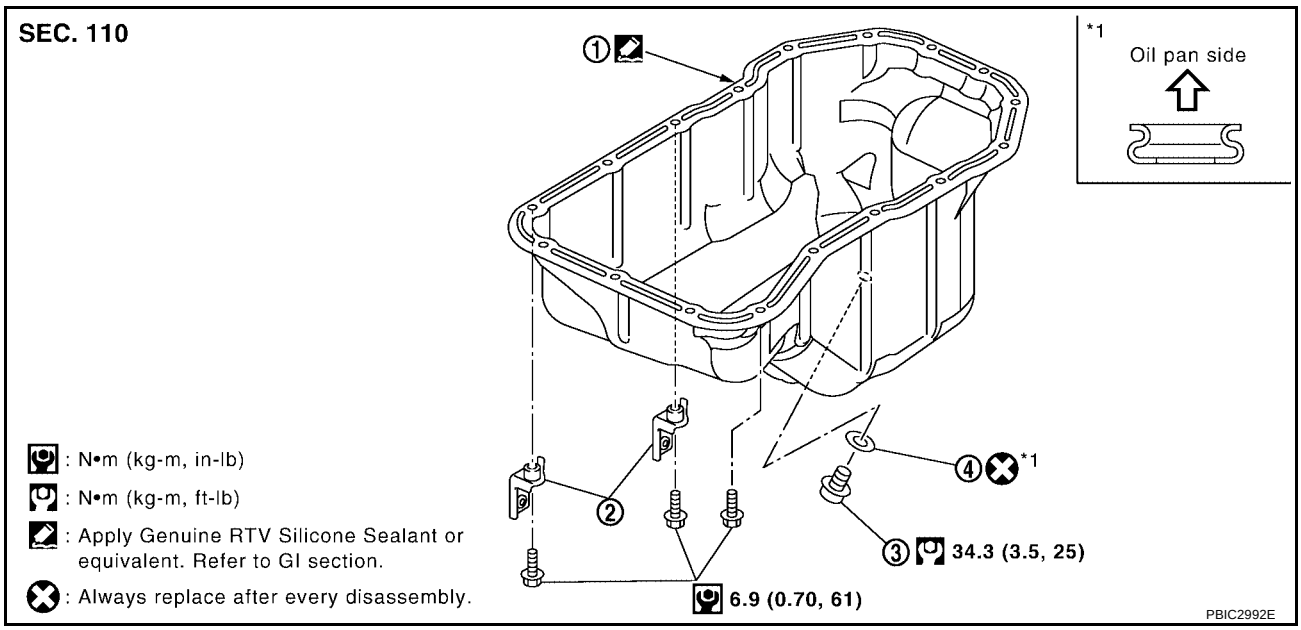
- **Before installing new air fuel ratio sensor 1, clean exhaust system threads using a heated oxygen sensor thread cleaner (commercial service tool: J-43897-18 or J-43897-12) and apply anti-seize lubricant (commercial service tool).**
- **Do not over torque air fuel ratio sensor 1. Doing so may cause damage to air fuel ratio sensor 1, resulting in the "MIL" coming on.**

OIL PAN

PFP:11110

Removal and Installation

EBS00NHV



1. Oil pan
2. A/T fluid cooler tube bracket (A/T models)
3. Drain plug
4. Drain plug washer

REMOVAL

WARNING:

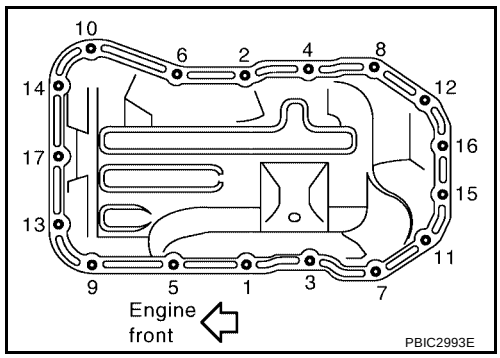
To avoid the danger of being scalded, do not drain the engine oil when the engine is hot.

1. Remove engine undercover.
2. Drain engine oil. Refer to MA-26, "Changing Engine Oil" .

   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Do not spill engine oil on drive belt.**
3. Remove oil pan with the following procedure:

a. Remove A/T fluid cooler tube (A/T models). Refer to AT-247, "TRANSMISSION ASSEMBLY" .

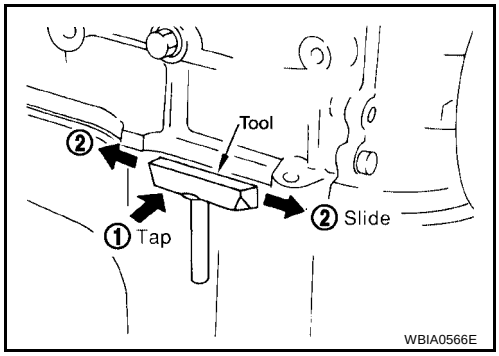
b. Loosen bolts in reverse order as shown with power tool. Remove A/T fluid cooler tube bracket (A/T models).



c. Insert the seal cutter [SST] between oil pan and cylinder block, and slide it by tapping on the side of the tool with a hammer. Remove oil pan.

Tool number : KV10111100 (J-37228)

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

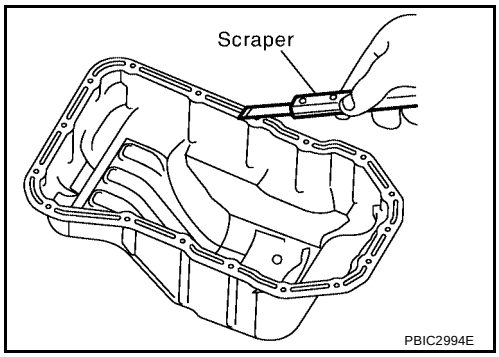


INSTALLATION

1. Install oil pan with the following procedure:

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

CAUTION:
Do not scratch or damage the mating surfaces when cleaning off old liquid gasket.

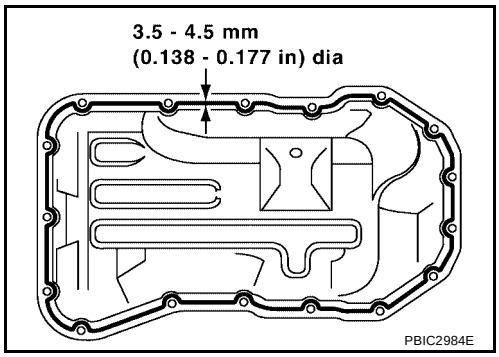


b. Apply a continuous bead of liquid gasket using Tool as shown.

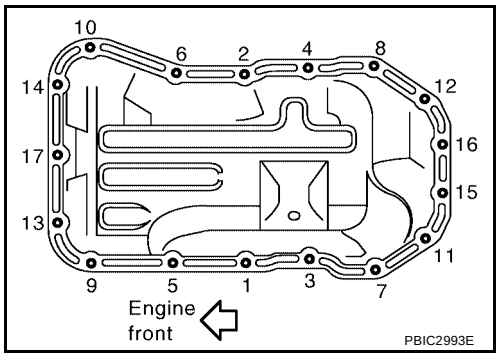
Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

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



c. Tighten bolts in numerical order as shown.
- Install A/T fluid cooler tube bracket with bolts No.1 and 9 as shown (A/T models).



2. Install oil pan drain plug. Refer to MA-26, "Changing Engine Oil" .
3. Install in the reverse order of removal after this step.

NOTE:
Pour engine oil at least 30 minutes after oil pan is installed.

INSPECTION AFTER INSTALLATION

1. Check the engine oil level, and adjust the level. Refer to LU-6, "ENGINE OIL LEVEL" .

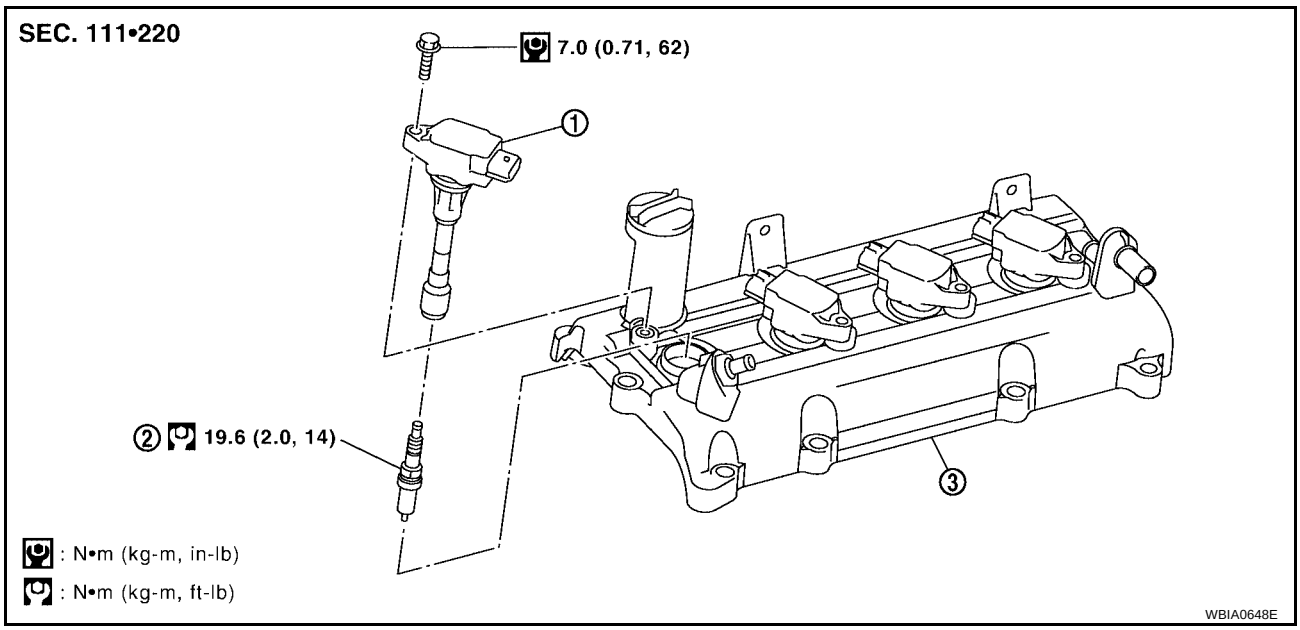
2. Start the engine, and make sure there is no leaks of engine oil.
3. Stop the engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to LU-6, "ENGINE OIL LEVEL" .

IGNITION COIL

PFP:22448

Removal and Installation

EBS00NHW



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

REMOVAL

1. Remove intake manifold (except for ignition coil No.1). Refer to EM-18, "INTAKE MANIFOLD" .
2. Disconnect harness connector from ignition coil.
3. Remove ignition coil.

CAUTION:
Do not drop or shock it.

INSTALLATION

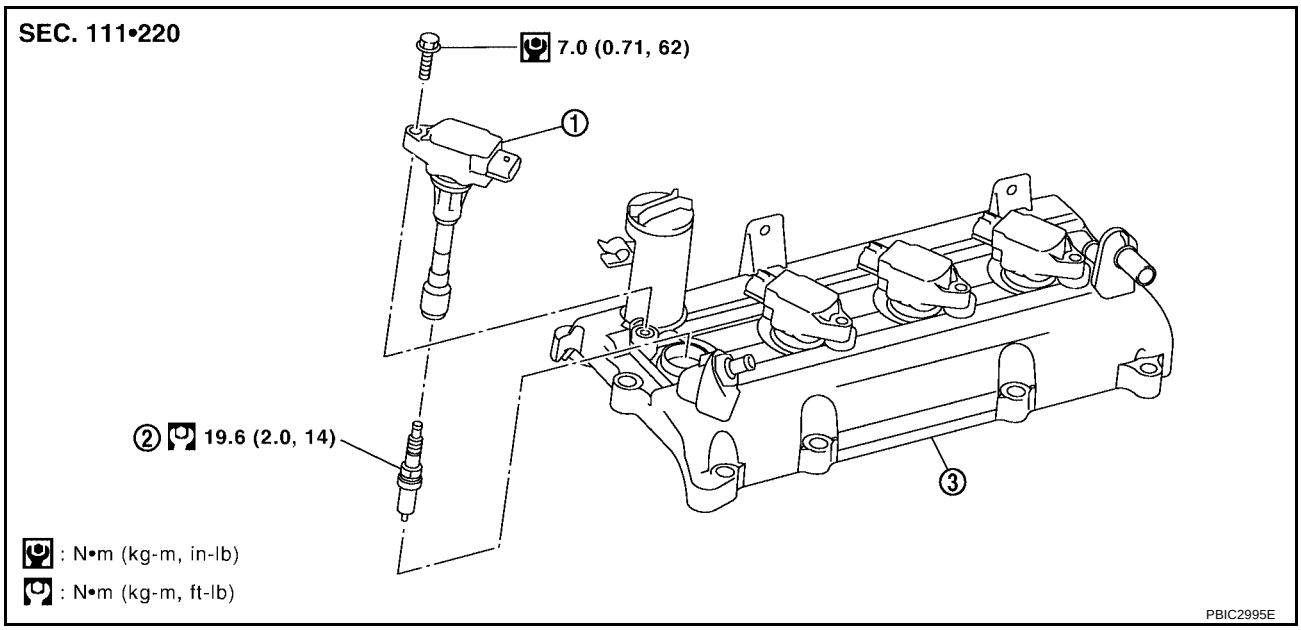
Installation is in the reverse order of removal.

SPARK PLUG (PLATINUM-TIPPED TYPE)

PFP:22401

Changing Spark Plugs (Platinum - Tipped Type)

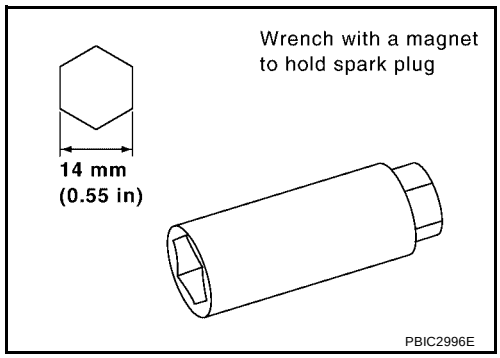
EBS00T2Y



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

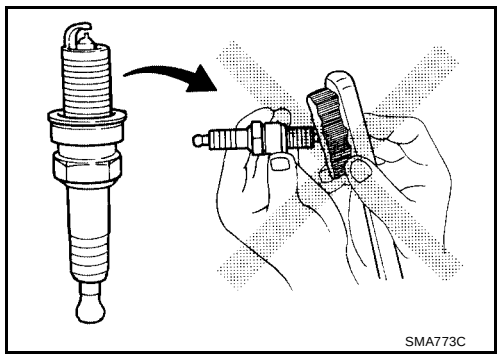
REMOVAL

1. Remove the intake manifold (except for spark plug No.1). Refer to EM-18, "INTAKE MANIFOLD" .
2. Remove the ignition coil. Refer to EM-26, "IGNITION COIL" .
3. Remove the spark plug using a suitable tool.



INSPECTION AFTER REMOVAL

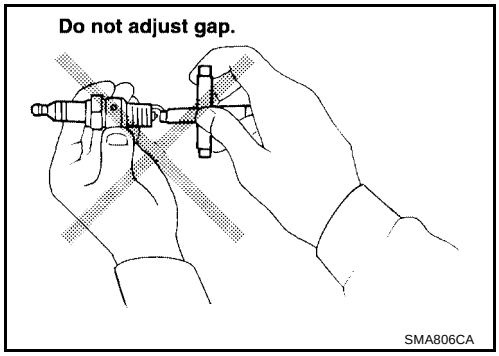
- Do not use a wire brush to clean the spark plug.



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

Cleaner air pressure : Less than 588 kPa (5.9 bar, 6 kg/cm^2 , 85 psi)
Cleaning time : Less than 20 seconds

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



CAUTION:
Do not drop or shock the spark plug.

INSTALLATION

Installation is in the reverse order of removal.

- Use the 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

Spark Plug Types

Make	NGK
Standard type	PLKAR6A-11
Hot type	PLKAR5A-11
Cold type	PLKAR7A-11
Gap (nominal)	1.1 mm (0.043 in)

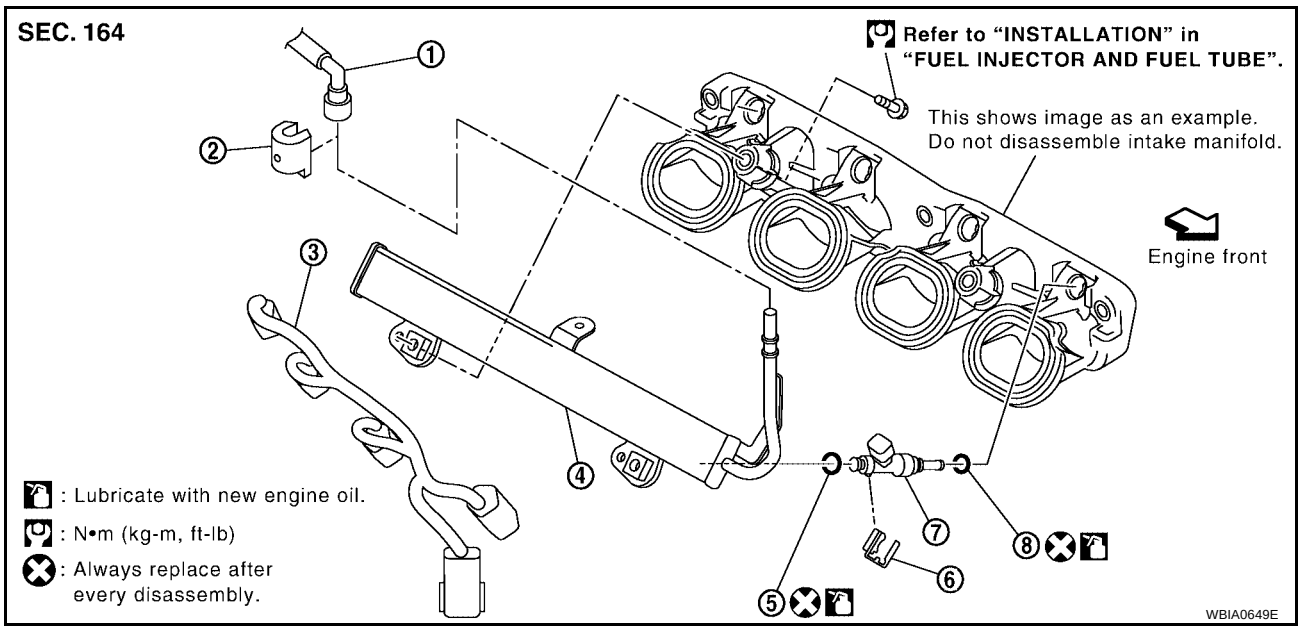
CAUTION:
Do not drop or shock the spark plug.

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Removal and Installation

EBS00NHY



1. Fuel feed hose
2. Quick connector cap (engine side)
3. Sub-harness
4. Fuel tube
5. O-ring (black)
6. Clip
7. Fuel injector
8. O-ring (green)

CAUTION:

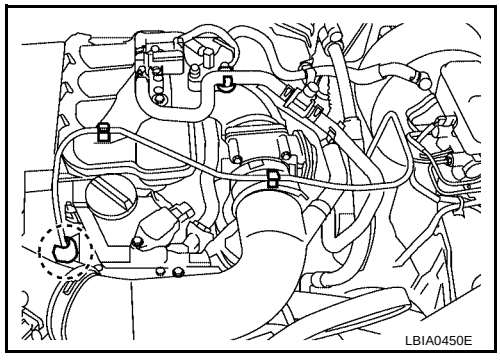
Do not remove or disassemble parts unless instructed as shown.

REMOVAL

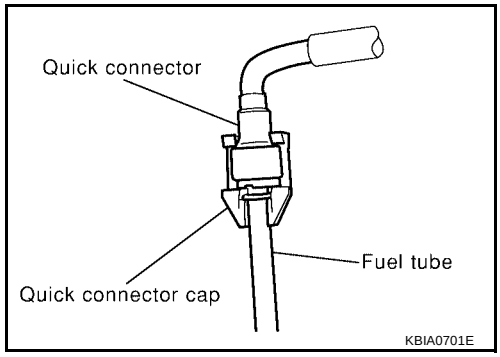
WARNING:

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

1. Release fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .



2. Remove quick connector cap (engine side).

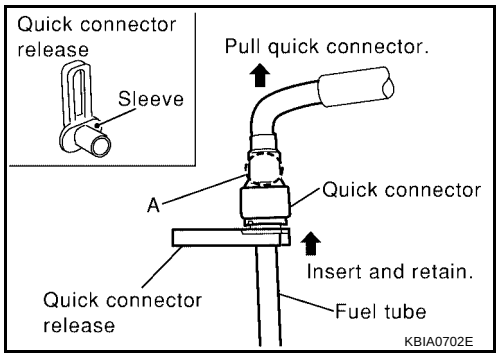


3. With the sleeve side of quick connector release facing quick connector, install quick connector release onto fuel tube.
4. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

Tool number : — (J-45488)

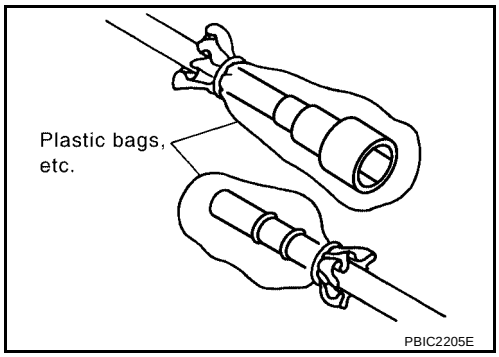
CAUTION:
Disconnect quick connector by using tool, not by picking out retainer tabs.

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



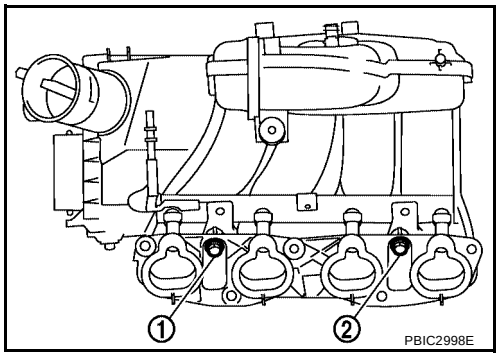
5. Draw and pull out quick connector straight from fuel tube.

CAUTION:
- **Pull quick connector holding “A” position in the figure.**
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Keep parts away from heat source. Especially, be careful when welding is performed around them.**
- **Do not expose parts to battery electrolyte or other acids.**
- **Do not bend or twist connection between quick connector and fuel feed hose during installation/removal.**
- **To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.**



6. Remove intake manifold. Refer to EM-18, "REMOVAL" .
7. Disconnect sub-harness for fuel injector.
8. Loosen bolts in reverse order as shown.
9. Remove fuel tube and fuel injector assembly.

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



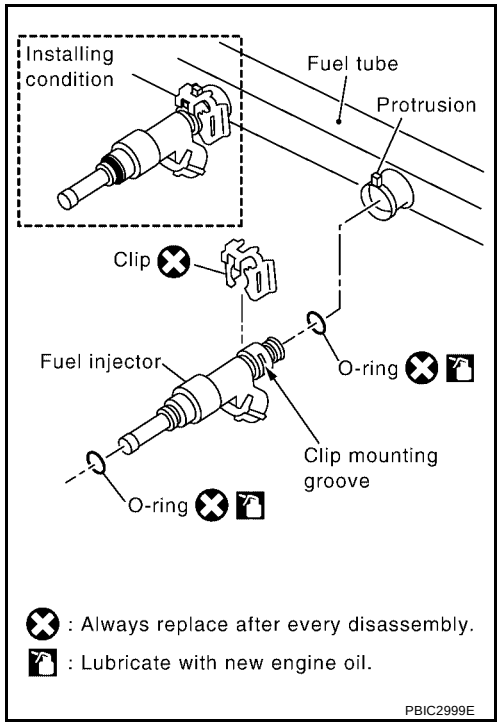
10. Remove fuel injector from fuel tube with the following procedure:

a. Open and remove clip.

b. Remove fuel injector from fuel tube by pulling straight.

CAUTION:

- **Be careful with remaining fuel that may go out from fuel tube.**
- **Be careful not to damage fuel injector nozzle during removal.**
- **Do not bump or drop fuel injector.**
- **Do not disassemble fuel injector.**



INSTALLATION

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

CAUTION:

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

Fuel tube side : Black
Nozzle side : Green

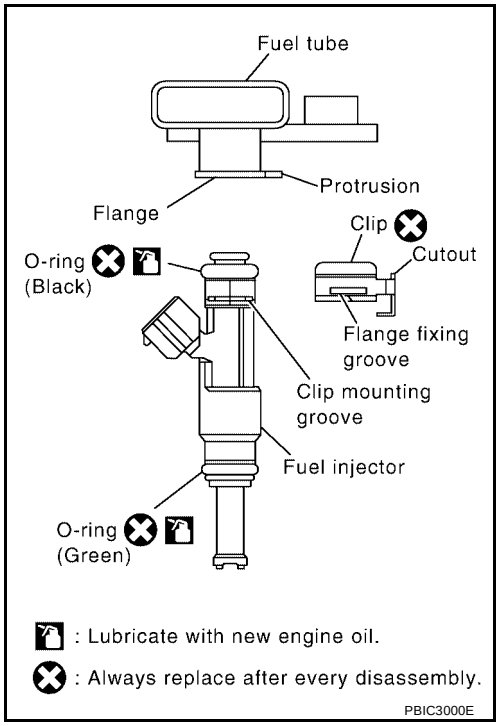
- **Handle O-ring with bare hands. Do not wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Do not clean O-ring with solvent.**
- **Make sure that O-ring and its mating part are free of foreign material.**
- **When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.**

- **Insert O-ring straight into fuel tube. Do not decenter or twist it.**

2. Insert clip into clip attachment groove on fuel injector.

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

3. Insert fuel injector into fuel tube with clip attached.
   - Insert it while matching it to the axial center.
   - Insert fuel injector so that protrusion of fuel tube matches cut-out of clip.
   - Make sure that fuel tube flange is securely fixed in flange fixing groove on clip.
4. Make sure that installation is complete by checking that fuel injector does not rotate or come off.



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

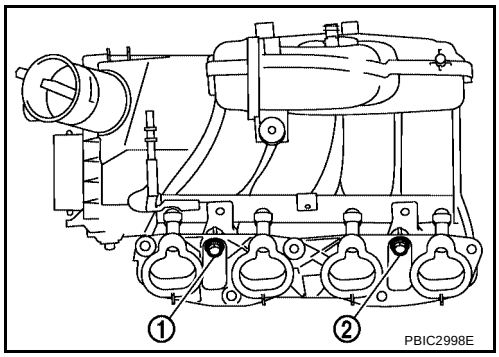
CAUTION:
When installing, be careful to avoid any interference with fuel injector.

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

b. Tighten bolts evenly in two steps in numerical order as shown.

Fuel tube bolts

1st step	**: 12.8 N·m (1.3 kg-m, 9 ft-lb)**
2nd step	**: 28.0 N·m (2.9 kg-m, 21 ft-lb)**



6. Connect sub-harness for fuel injector.
7. Install intake manifold. Refer to EM-19, "INSTALLATION" .
8. Note the following, and connect quick connector at the engine side to install fuel feed hose.

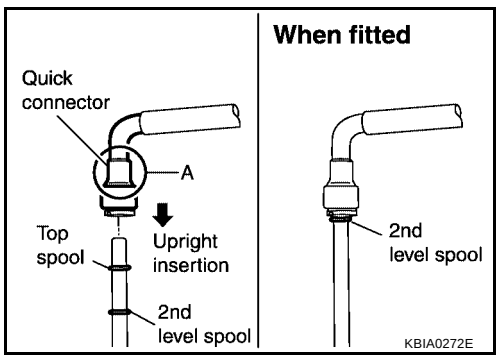
a. Check the connection for foreign material and damage.

b. Align center to insert quick connector straightly into fuel tube.

NOTE:
The figure shows the engine side as an example.

- Insert quick connector to fuel tube until the top spool on fuel tube is inserted completely and the second level spool is positioned slightly below quick connector bottom end.

CAUTION:
- **Hold “A” position in the figure when inserting fuel tube into quick connector.**
- **Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.**
- **Insert until you hear a “click” sound and actually feel the engagement.**



- **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**

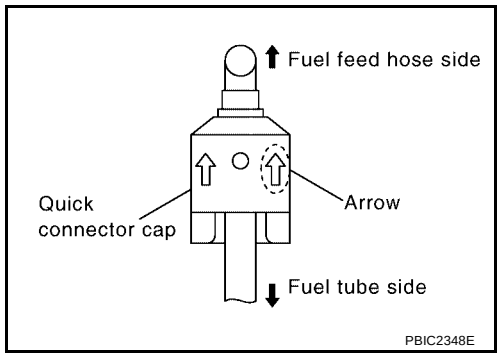
c. Before clamping fuel feed hose with hose clamps, pull quick connector hard by hand holding “A” position. Make sure it is completely engaged (connected) so that it does not come out from fuel feed tube.

d. Install quick connector cap to quick connector connection. (engine side)

- Install so that the arrow mark on the side faces up.

CAUTION:

- **Make sure that quick connector and fuel tube are securely fit into quick connector cap installation groove.**
- **If quick connector cap cannot be installed smoothly, quick connector may have not been installed correctly. Check the connection again.**



9. Install fuel feed hose to hose clamp.
10. Installation is in the reverse order of removal after this step.

INSPECTION AFTER INSTALLATION

Check on Fuel Leaks

1. Apply fuel pressure to fuel lines with turning ignition switch “ON” (with the engine stopped). Then make sure there are no fuel leaks at connections.

   NOTE:
   Use mirrors for checking on invisible points.

2. Start the engine. With engine speed increased, make sure again there are no fuel leaks at connections.

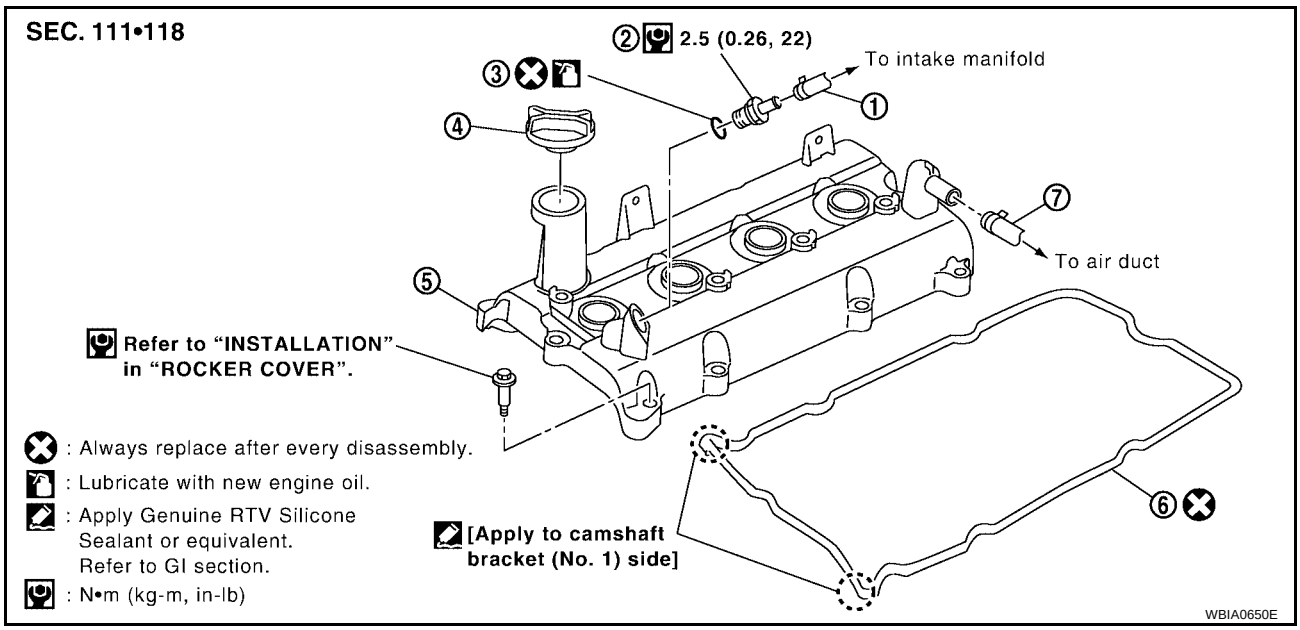
   CAUTION:
   Do not touch the engine immediately after stopped as the engine becomes extremely hot.

ROCKER COVER

PFP:13264

Removal and Installation

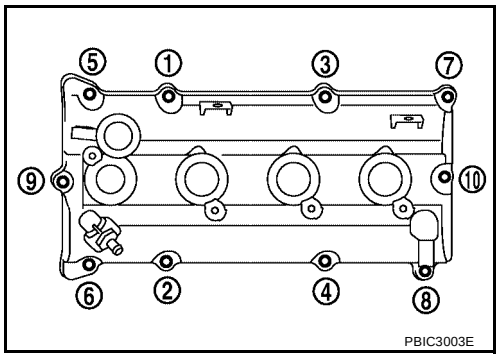
EBS00NHZ



1. PCV hose
2. PCV valve
3. O-ring
4. Oil filler cap
5. Rocker cover
6. Rocker cover gasket
7. PCV hose

REMOVAL

1. Remove intake manifold. Refer to EM-18, "INTAKE MANIFOLD" .
2. Disconnect PCV hose from rocker cover.
3. Remove ignition coil. Refer to EM-26, "IGNITION COIL" .
4. Remove PCV valve and O-ring from rocker cover, if necessary.
5. Remove oil filler cap from rocker cover, if necessary.
6. Loosen bolts in reverse order shown.



7. Remove rocker cover gasket from rocker cover.
8. Use scraper to remove all traces of liquid gasket from cylinder head and camshaft bracket (No. 1).

CAUTION:

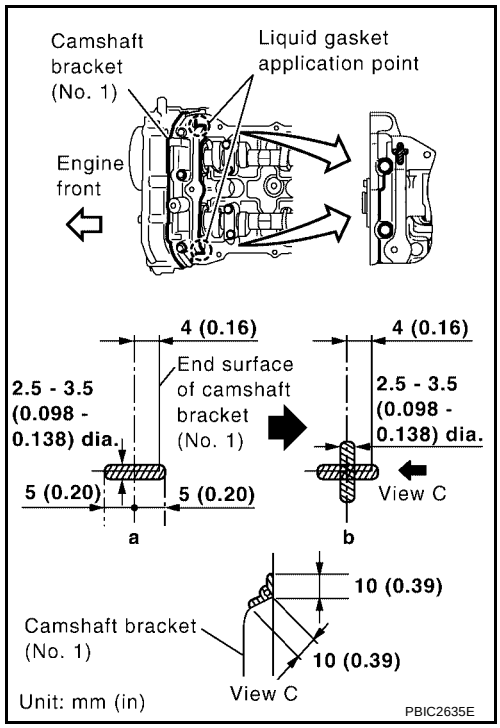
Do not scratch or damage the mating surface when cleaning off old liquid gasket.

INSTALLATION

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

a. Refer to figure “a” to apply liquid gasket to joint part of camshaft bracket (No. 1) and cylinder head.

b. Refer to figure “b” to apply liquid gasket in 90° to figure “a”.
Use Genuine RTV Silicone Sealant or equivalent. Refer to **GI-48, "Recommended Chemical Products and Sealants"** .



2. Install new rocker cover gasket to rocker cover.
3. Install rocker cover.
   - Check if rocker cover gasket is not dropped from the installation groove of rocker cover.
4. Tighten bolts in two steps separately in numerical order as shown.

Rocker cover bolts

1st step	**: 2.0 N·m (0.2 kg-m, 18 in-lb)**
2nd step	**: 8.3 N·m (0.85 kg-m, 73 in-lb)**

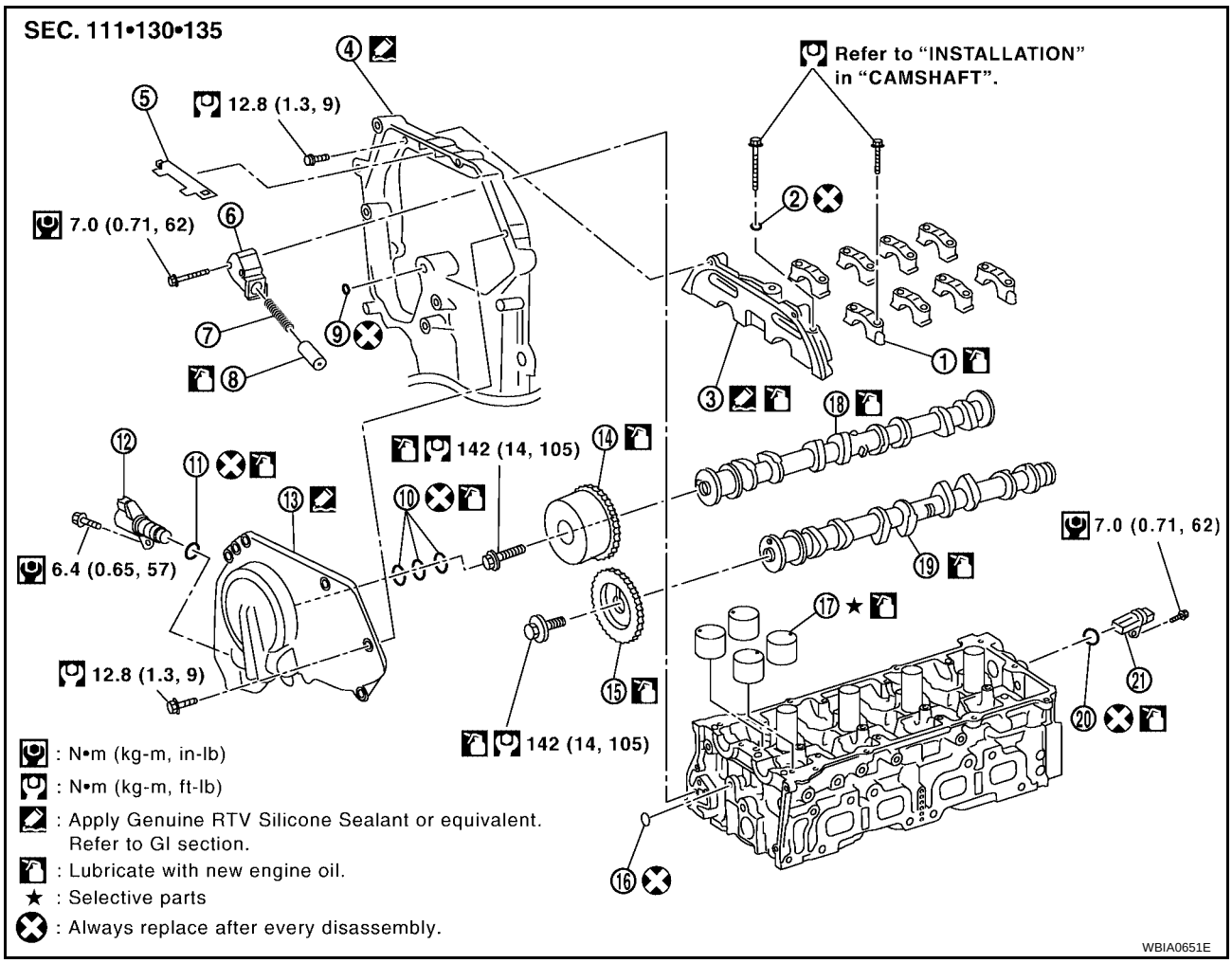
5. Installation of the remaining components is in the reverse order of removal.

CAMSHAFT

PFP:13001

Removal and Installation

EBS00NI0



1. Camshaft bracket (No. 2 to 5)	2. Seal washer	3. Camshaft bracket (No. 1)
4. Front cover	5. Chain guide	6. Chain tensioner
7. Spring	8. Chain tensioner plunger	9. O-ring
10. Oil ring	11. O-ring	12. Intake valve timing control solenoid valve
13. Intake valve timing control cover	14. Camshaft sprocket (INT)	15. Camshaft sprocket (EXH)
16. O-ring	17. Valve lifter	18. Camshaft (INT)
19. Camshaft (EXH)	20. O-ring	21. Camshaft position sensor (PHASE)

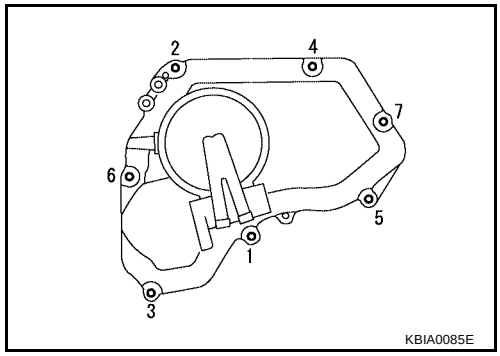
NOTE:
This section describes removal/installation procedure of camshaft without removing front cover. If front cover is removed or installed, refer to EM-48, "TIMING CHAIN" .

REMOVAL

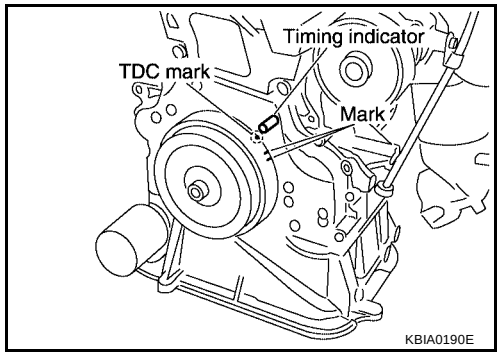
1. Remove the rocker cover. Refer to EM-34, "REMOVAL" .
2. Remove the drive belt. Refer to EM-14, "REMOVAL" .
3. Disconnect and remove the camshaft position sensor (PHASE).
4. Disconnect the IVT control solenoid electrical connector.
5. Disconnect the ground electrical connections from the front cover.

6. Remove IVT control cover bolts in the order as shown.
7. Remove the IVT control cover by cutting the sealant using Tool.

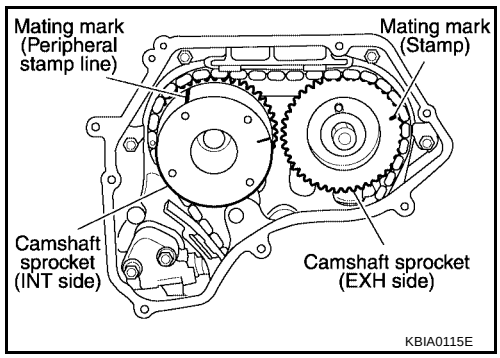
Tool number : KV10111100 (J-37228)



8. Set the No.1 cylinder at TDC on its compression stroke with the following procedure:
9. Rotate crankshaft pulley clockwise, and align mating marks for TDC with timing indicator on front cover, as shown.



10. 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.



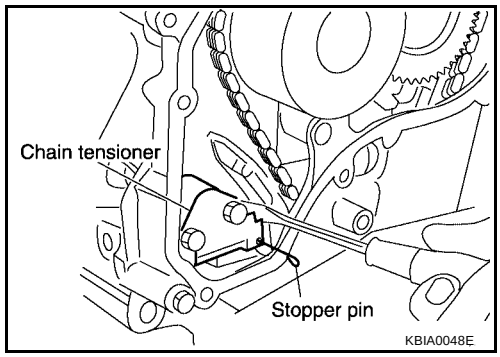
11. Pull the timing chain guide out between the camshaft sprockets through front cover.

12. 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.

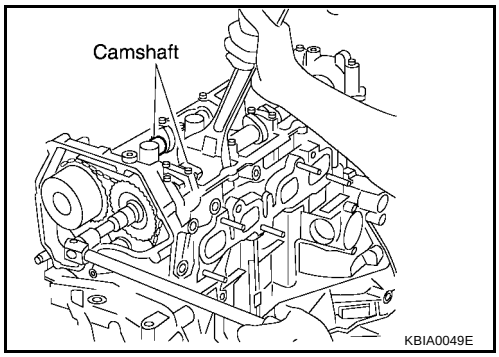
CAUTION:
Do not rotate the crankshaft or camshaft while the timing chain is removed. It causes interference between valve and piston.

NOTE:
Chain tension holding work is not necessary. Crankshaft sprocket and timing chain do not disconnect structurally while front cover is attached.

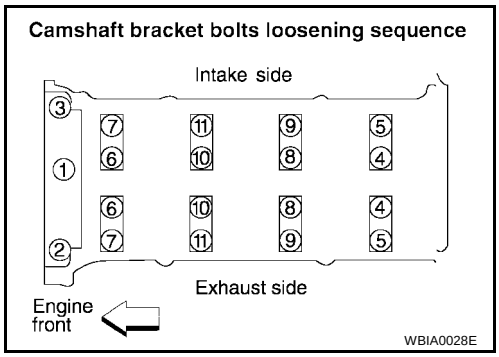
13. Push in the tensioner plunger and hold. Insert a stopper pin into the hole on tensioner body to hold the chain tensioner. Remove the timing chain tensioner.
    - Use a wire with 0.5 mm (0.02 in) diameter for a stopper pin.



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



15. Loosen the camshaft bracket bolts in the order as shown, and remove the camshaft brackets and camshafts.
    - Remove No.1 camshaft bracket by slightly tapping it with a rubber mallet.
    - Note positions, and set them aside in the order removed.
16. Remove the valve lifters.
    - Note positions, and set them aside in the order removed.



INSPECTION AFTER REMOVAL

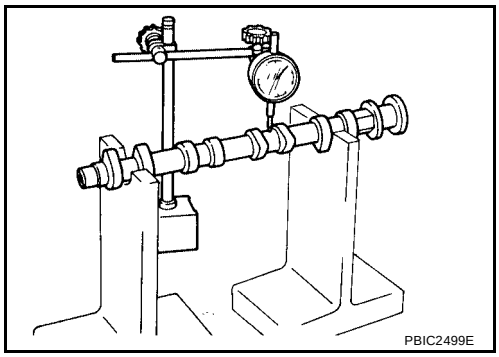
Camshaft Runout

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

   CAUTION:

   Do not support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.
2. Set a dial indicator vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on the dial indicator. (Total indicator reading)

   Standard: Less than 0.02 mm (0.0008 in).
4. If out of the standard, replace camshaft.



Camshaft Cam Height

1. Measure the camshaft cam height with a micrometer.

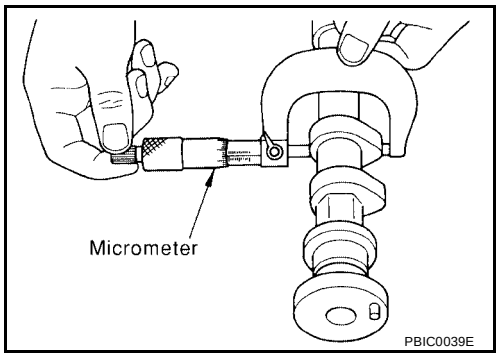
   Standard:

   Intake : 45.015 - 45.205 mm (1.7722 - 1.7797 in)

   Exhaust : 43.975 - 44.165 mm (1.7313 - 1.7388 in)

   Cam wear limit

   : 0.2 mm (0.008 in)
2. If wear is beyond the limit, replace camshaft.



Camshaft Journal Oil Clearance

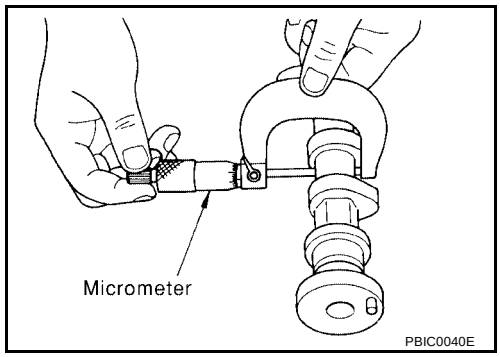
CAMSHAFT JOURNAL DIAMETER

Measure the outer diameter of camshaft journal with a micrometer.

Standard:

No. 1 : 27.935 - 27.955 mm (1.0998 - 1.1006 in)

No. 2, 3, 4, 5 : 23.435 - 23.455 mm (0.9226 - 0.9234 in)



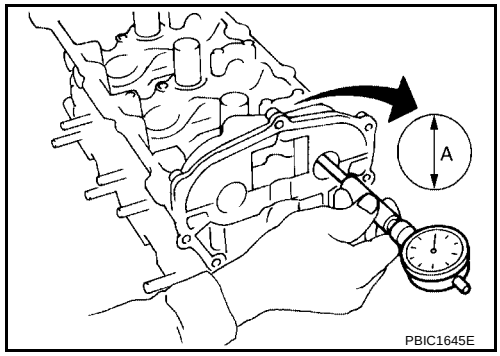
CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to EM-41, "INSTALLATION" for the tightening procedure.
- Measure inner diameter “A” of camshaft bracket with a bore gauge.

Standard:

No. 1 : 28.000 - 28.021 mm (1.1024 - 1.1032 in)

No. 2, 3, 4, 5 : 23.500 - 23.521 mm (0.9252 - 0.9260 in)



CAMSHAFT JOURNAL OIL CLEARANCE

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

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

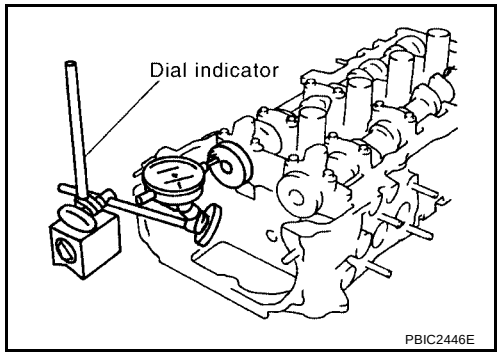
- If out of the standard, replace either or both camshaft and cylinder head.

NOTE:
Camshaft brackets cannot be replaced as single parts, because they are machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Refer to EM-41, "INSTALLATION" for tightening procedure.
2. Install a dial indicator in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

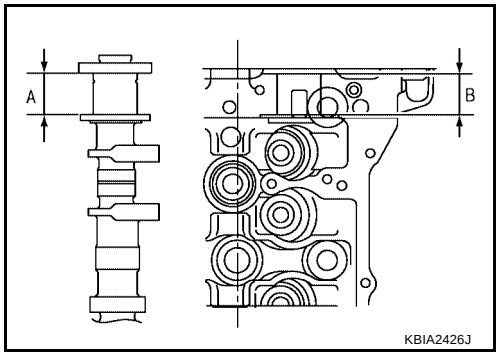
Standard : 0.115 - 0.188 mm (0.0045 - 0.0074 in)



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

    Standard : 25.800 - 25.848 mm (1.0157 - 1.0176 in)
  - Dimension “B” for cylinder head No. 1 journal bearing

    Standard : 25.660 - 25.685 mm (1.0102 - 1.0112 in)
- Refer to the standards above, and then replace camshaft and/or cylinder head.



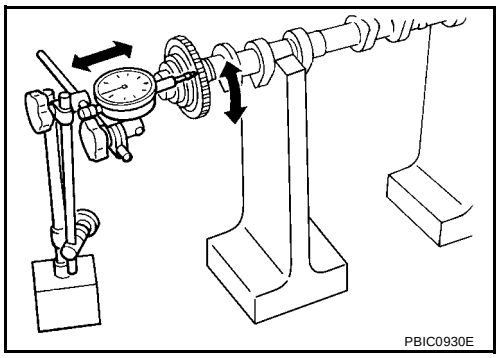
Camshaft Sprocket Runout

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

   CAUTION:
   Do not support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.
2. Measure the camshaft sprocket runout with a dial indicator. (Total indicator reading)

   Limit : 0.15 mm (0.0059 in)

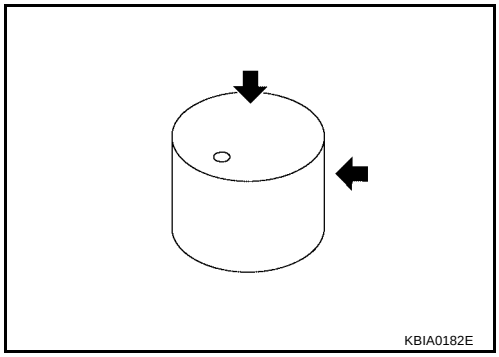
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to EM-103, "Valve Clearance" .

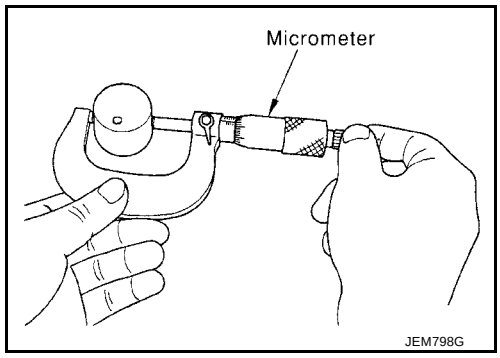


Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

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

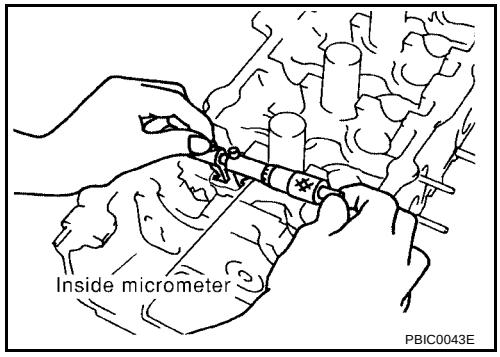
Standard : 33.965 - 33.980 mm (1.3372 - 1.3378 in)



VALVE LIFTER HOLE DIAMETER

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

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



VALVE LIFTER CLEARANCE

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

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

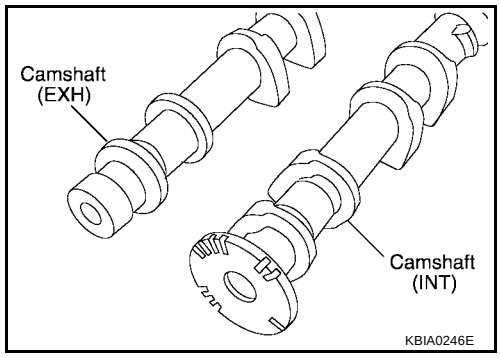
- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

INSTALLATION

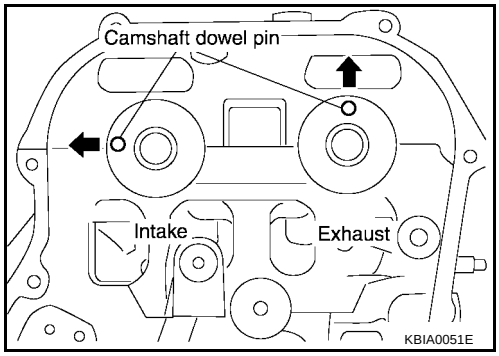
1. Install valve lifters.
   - Install them in the original positions.
2. Install camshafts.
   - Distinction between intake and exhaust camshafts is performed with the different shapes of rear end.

Intake : Signal plate shape for camshaft position sensor (PHASE)

Exhaust : Cone end shape



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

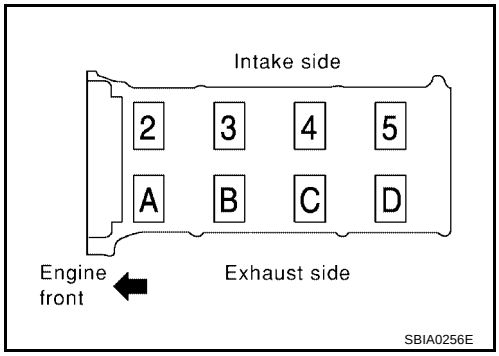


3. Install camshaft brackets with the following procedure:

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

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

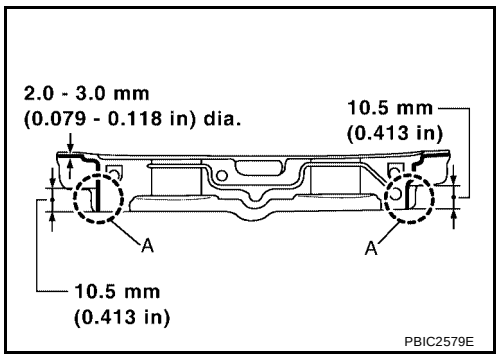
NOTE:
Install so that identification mark can be correctly read when viewed from the exhaust side.



c. Install camshaft bracket (No. 1) with the following procedure:

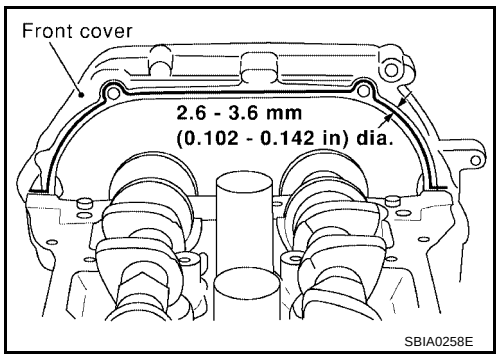
i. Apply liquid gasket to camshaft bracket (No. 1) as shown.
Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

CAUTION:
After installation, be sure to wipe off any excessive liquid gasket leaking from part “A”.

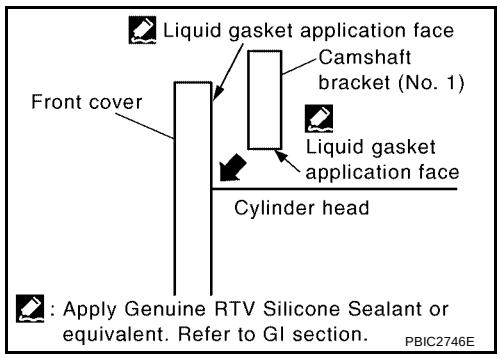


ii. Apply liquid gasket to camshaft bracket (No. 1) contact surface on the front cover backside.
Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

- Apply liquid gasket to the outside of bolt hole on front cover.

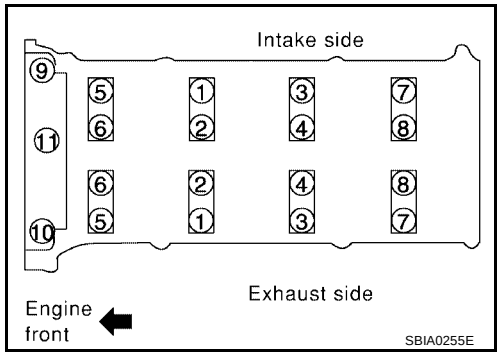


iii. Locate camshaft bracket (No. 1) near installation position, and install it without disturbing the liquid gasket applied to the surfaces.



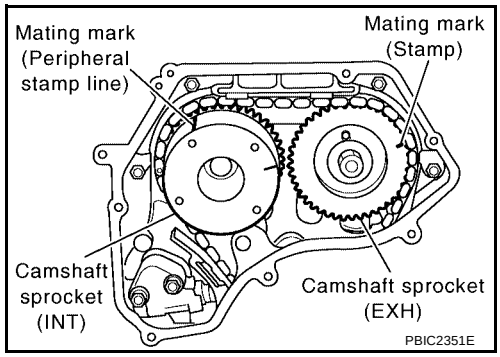
4. Tighten bolts of camshaft brackets in the following steps, in numerical order as shown.

Step 1 (bolts 9 - 11) : 2.0 N·m (0.2 kg-m, 17 in-lb)
Step 2 (bolts 1 - 8) : 2.0 N·m (0.2 kg-m, 17 in-lb)
Step 3 (bolts 1 - 11) : 5.9 N·m (0.6 kg-m, 52 in-lb)
Step 4 (bolts 1 - 11) : 10.4 N·m (1.1 kg-m, 92 in-lb)



CAUTION:
After tightening bolts of camshaft brackets, be sure to wipe off excessive liquid gasket from the parts.

5. Install camshaft position sensor (PHASE).
6. Install camshaft sprockets.
   - Install them by aligning the mating marks on each camshaft sprocket with the paint marks on the timing chain link plates during removal.



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

NOTE:
Before installation of chain tensioner, it is possible to re-match the marks on timing chain with the ones on each sprocket.

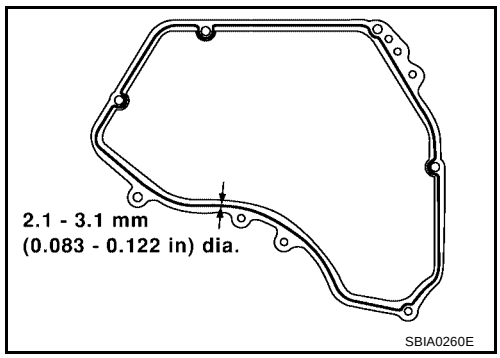
7. Install chain tensioner.

CAUTION:
After installation, pull the stopper pin off completely, and make sure that chain tensioner plunger is released.

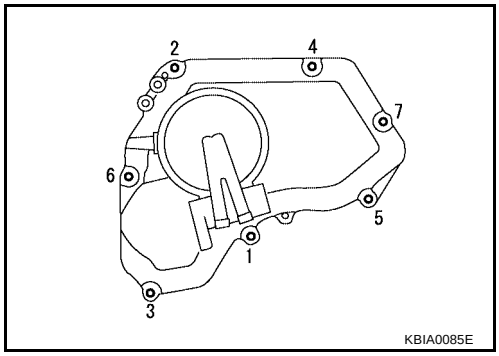
8. Install chain guide.
9. Install oil rings to the camshaft sprocket (INT) insertion points on backside of intake valve timing control cover.
10. Install O-ring to front cover.
11. Apply liquid gasket using Tool to intake valve timing control cover as shown.

Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to **GI-48, "Recommended Chemical Products and Sealants"** **.**



12. Tighten bolts in numerical order as shown.



13. Install intake valve timing control solenoid valve to intake valve timing control cover if removed.
14. Connect ground cables, and install harness clip.
15. Check and adjust valve clearance. Refer toEM-103, "Valve Clearance" .
16. Installation is in the reverse order of removal after this step.

NOTE:
If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after the engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

INSPECTION AFTER INSTALLATION

Inspection of Camshaft Sprocket (INT) Oil Groove

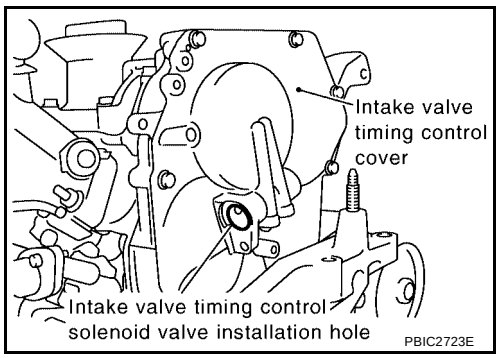
CAUTION:

- **Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT-II and it is directed according to inspection procedure of EC section. Refer to EC-70, "DIAGNOSTIC TEST MODE II — SELF-DIAGNOSTIC RESULTS" .**
- **Check when the engine is cold so as to prevent burns from any splashing engine oil.**

1. Check the engine oil level. Refer to LU-6, "ENGINE OIL LEVEL" .
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release fuel pressure. Refer to EC-86, "FUEL PRESSURE RELEASE" .
b. Disconnect ignition coil and injector harness connectors.
c. Remove drive belt. Refer to EM-14, "DRIVE BELTS" .

3. Remove intake valve timing control solenoid valve. Refer to EM-36, "REMOVAL" .
4. Crank the engine, and then make sure that engine oil comes out from intake valve timing control cover oil hole. End crank after checking.



WARNING:
Be careful not to touch rotating parts (drive belt, idler pulley, and crankshaft pulley, etc.).

CAUTION:
Engine oil may squirt from intake valve timing control solenoid valve installation hole during cranking. Use a shop cloth to prevent the engine components and the vehicle. Do not allow engine oil to get on rubber components such as drive belt or engine mount insulators. Immediately wipe off any splashed engine oil.

- Clean oil groove between oil strainer and intake valve timing control solenoid valve if engine oil does not come out from intake valve timing control cover oil hole. Refer to LU-4, "Lubrication Circuit" .

5. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
   - Clean oil groove if necessary. Refer to LU-4, "Lubrication Circuit" .
6. After inspection, install removed parts.

Valve Clearance

EBS00NI1

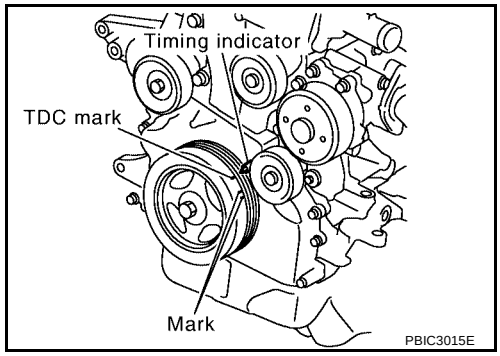
INSPECTION

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

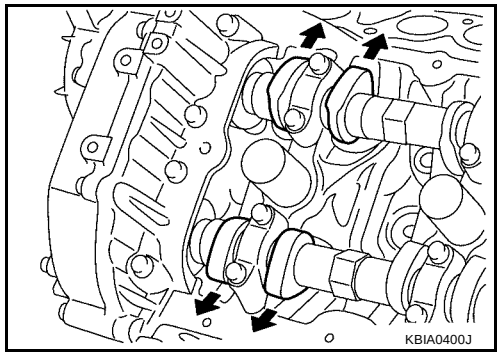
1. Remove rocker cover. Refer to EM-34, "REMOVAL" .
2. Remove undercover.
3. Remove radiator shroud (lower). Refer to CO-15, "REMOVAL" .
4. Measure the valve clearance with the following procedure:

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

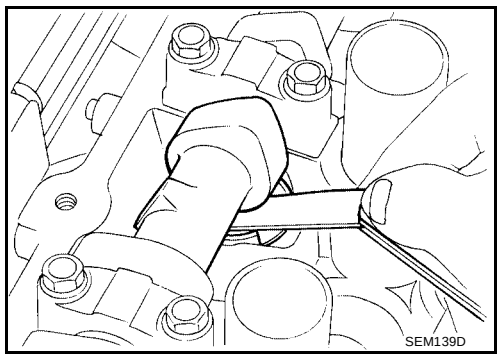
- Rotate crankshaft pulley clockwise and align TDC mark to timing indicator on front cover.



- At the same time, make sure that both intake and exhaust cam noses of No. 1 cylinder face outside as shown.
- If they do not face outside, rotate crankshaft pulley once more (360° degrees) and align as shown.



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



Valve clearance:

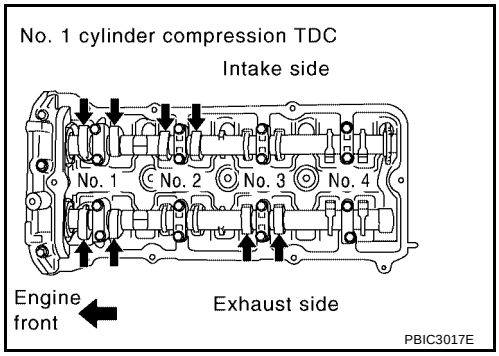
Unit: mm (in)

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

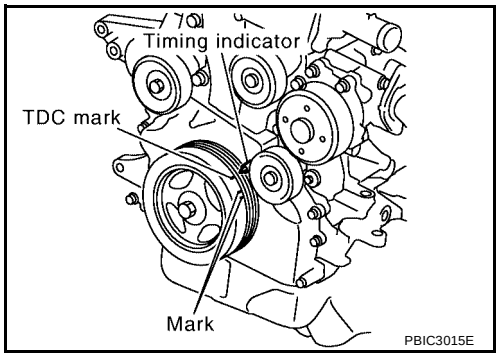
*:Approximately 80°C (176°F)

- By referring to the figure, measure the valve clearances at locations marked "×" as shown in the table below (locations indicated with black arrow in the figure) with a feeler gauge.
- No. 1 cylinder compression TDC

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

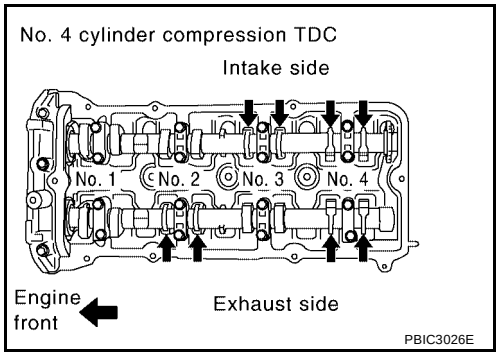


c. Rotate crankshaft pulley one revolution (360° degrees) and align TDC mark to timing indicator on front cover.



- By referring to the figure, measure the valve clearance at locations marked "×" as shown in the table below (locations indicated with black arrow in the figure) with a feeler gauge.
- No. 4 cylinder compression TDC

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

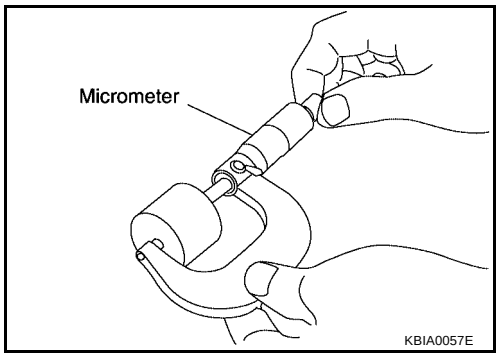


5. If out of standard, perform adjustment. Refer to EM-46, "ADJUSTMENT" .

ADJUSTMENT

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

1. Remove camshaft. Refer to EM-36, "REMOVAL" .
2. Remove valve lifters at the locations that are out of the standard.
3. Measure the center thickness of the removed valve lifters with a micrometer.



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

Valve lifter thickness calculation: $t = t_1 + (C_1 - C_2)$

t = Valve lifter thickness to be replaced

t_1 = Removed valve lifter thickness

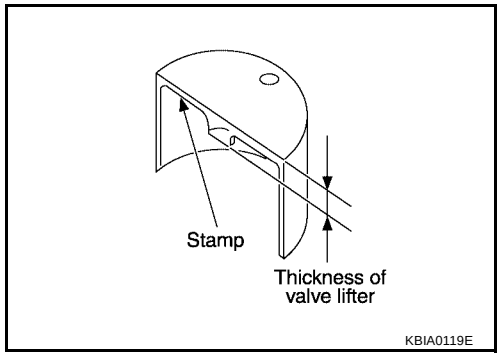
C_1 = Measured valve clearance

C_2 = Standard valve clearance:

Intake : 0.28 mm (0.011 in)

Exhaust : 0.30 mm (0.012 in)

- Thickness of new valve lifter can be identified by stamp mark on the reverse side (inside the cylinder).
  Stamp mark “696” indicates 6.96 mm (0.2740 in) in thickness.



NOTE:
Available thickness of valve lifter: 26 sizes range 6.96 to 7.46 mm (0.2740 to 0.2937 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to EM-104, "Available Valve Lifter" .

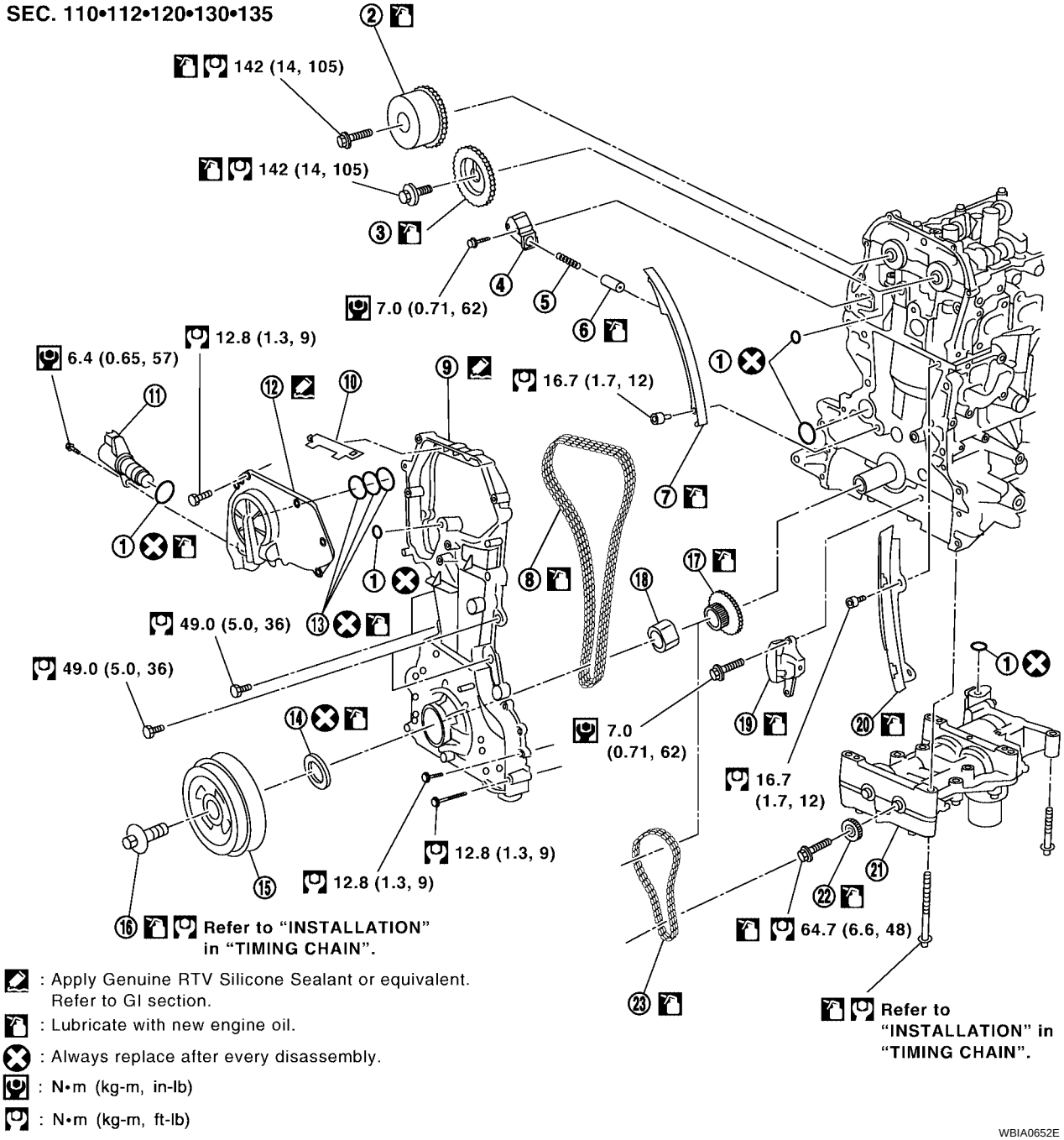
5. Install the selected valve lifter.
6. Install camshaft. Refer to EM-41, "INSTALLATION" .
7. Manually rotate crankshaft pulley a few rotations.
8. Make sure that valve clearances for cold engine are within specifications by referring to the specified values. Refer to EM-45, "INSPECTION" .
9. Installation of the remaining components is in reverse order of removal.
10. Warm up the engine, and check for unusual noise and vibration.

TIMING CHAIN

PFP:13028

Removal and Installation

EBS00NI2



WBIA0652E

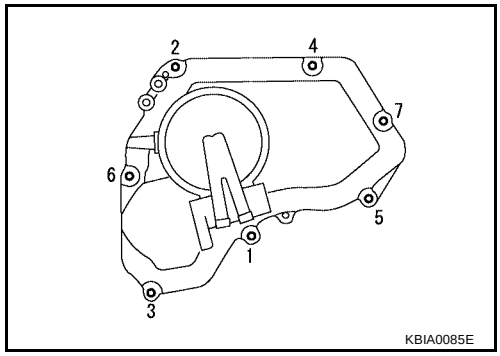
1. O-ring	2. Camshaft sprocket (INT)	3. Camshaft sprocket (EXH)
4. Chain tensioner	5. Spring	6. Chain tensioner plunger
7. Timing chain slack guide	8. Timing chain	9. Front cover
10. Chain guide	11. Intake valve timing control solenoid valve	12. Intake valve timing control cover
13. Oil ring	14. Front oil seal	15. Crankshaft pulley
16. Crankshaft pulley bolt	17. Crankshaft sprocket	18. Spacer
19. Balancer unit timing chain tensioner	20. Timing chain tension guide	21. Balancer unit
22. Balancer unit sprocket	23. Balancer unit timing chain	

REMOVAL

1. Release the fuel pressure. Refer to EC-86, "FUEL PRESSURE RELEASE" .
2. Remove the air cleaner and air duct assembly. Refer to EM-16, "REMOVAL" .
3. Remove the spark plugs. Refer to EM-27, "REMOVAL" .
4. Remove the rocker cover. Refer toEM-34, "REMOVAL" .
5. Remove the coolant overflow reservoir tank.
6. Remove the auxiliary drive belt auto-tensioner. Refer to EM-15, "REMOVAL" .
7. Remove the generator. Refer to SC-37, "REMOVAL" .
8. Remove the strut tower brace. Refer to FSU-5, "Components" .
9. Dismount and position aside the A/C compressor with the piping attached.
10. Dismount and position aside the power steering pump and reservoir tank with the piping attached.
11. Remove the upper and lower oil pan, and oil strainer. Refer to EM-23, "REMOVAL" .
12. Remove IVT control cover bolts in the order as shown.
13. Remove the IVT control cover by cutting the sealant using Tool.

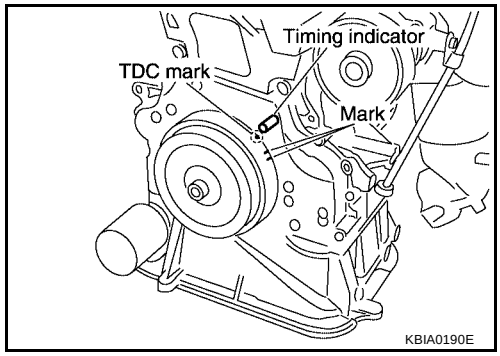
Tool number : KV10111100 (J-37228)

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



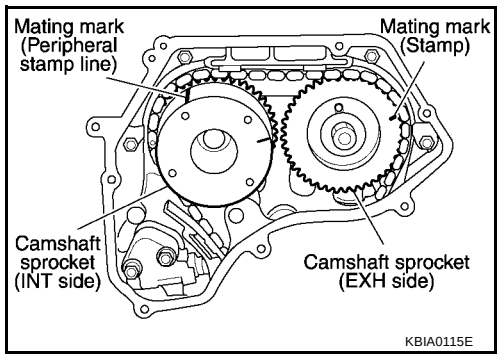
15. Set the No.1 cylinder at TDC on the compression stroke with the following procedure:

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



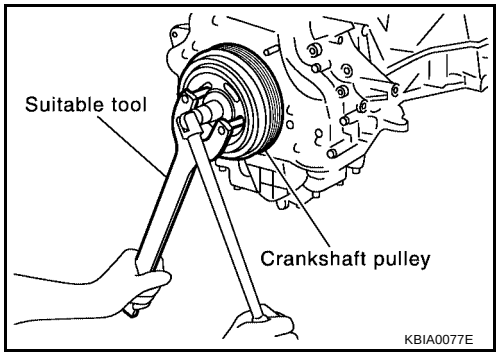
b. At the same time, make sure that the mating marks on the camshaft sprockets are lined up as shown.

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

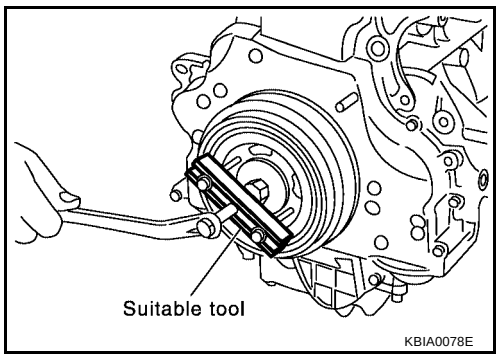


16. Remove crankshaft pulley with the following procedure:

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



b. Attach a pulley puller in the M6 (0.24 in diameter) thread hole on crankshaft pulley, and remove crankshaft pulley.



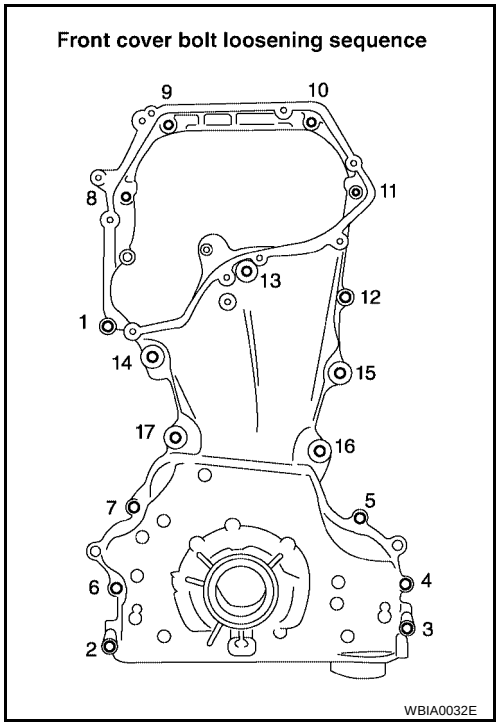
17. Remove the front cover with the following procedure:

a. Loosen the front cover bolts in the order as shown, and remove them.

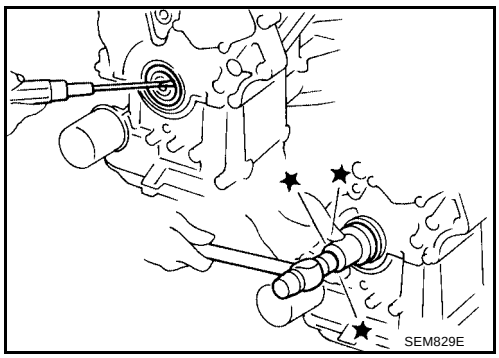
b. Remove the front cover.

CAUTION:

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



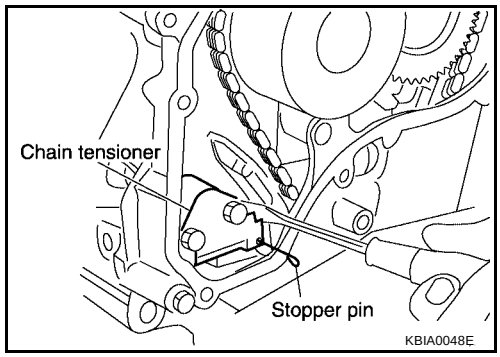
18. If the front oil seal needs to be replaced, remove it using a suitable tool.



19. Remove timing chain with the following procedure:

a. Push in chain tensioner plunger. Insert a stopper pin into hole on chain tensioner body to secure chain tensioner plunger and remove chain tensioner.

NOTE:
Use approximately 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.



b. Remove timing chain.

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

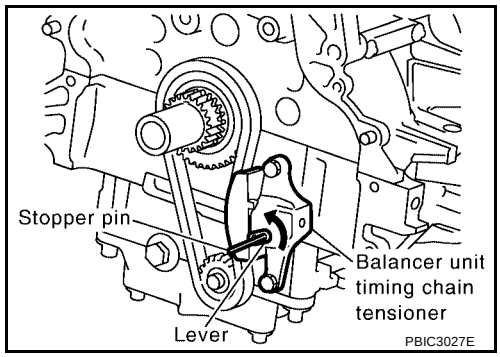
20. Remove camshaft sprockets. Refer to EM-36, "CAMSHAFT" .
21. Remove timing chain slack guide, timing chain tension guide and spacer.

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

a. Lift lever up, and release ratchet claw for return proof.
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.

NOTE:
Use approximately 1 mm (0.04 in) dia. hard metal pin as a stopper pin.

d. Remove balancer unit timing chain tensioner.



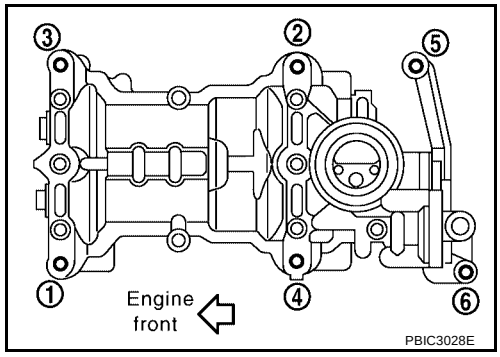
23. Secure the hexagonal portion of the balancer shaft using a suitable tool. Loosen the balancer unit sprocket bolt.
24. Remove balancer unit timing chain, balancer unit sprocket and crankshaft sprocket.

NOTE:
When removing balancer unit timing chain, remove crankshaft sprocket and balancer unit sprocket at the same time.

25. Loosen mounting bolts in reverse order as shown, and remove balancer unit.

CAUTION:
Do not disassemble balancer unit.

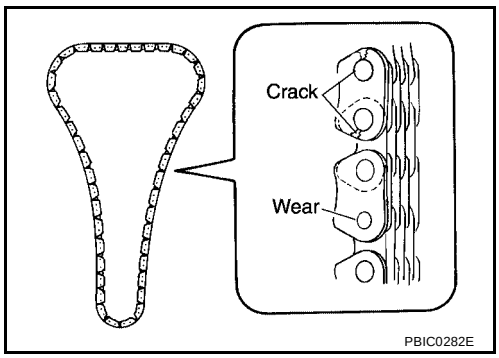
NOTE:
Use TORX socket (size E14) for bolts No.1 to 4.



INSPECTION AFTER REMOVAL

Timing Chain

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

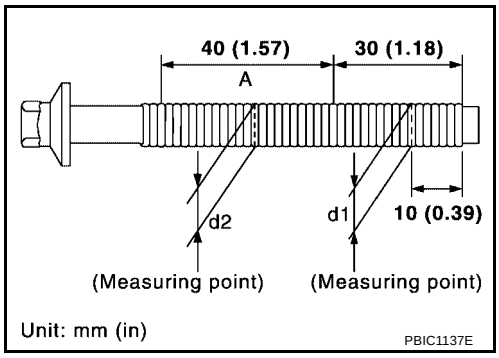


Balancer Unit Bolt Outer Diameter

- Measure outer diameters (“d1”, “d2”) at two positions as shown.
- If reduction appears in “A” range, regard it as “d2”.

Limit (“d1” – “d2”) : 0.15 mm (0.0059 in)

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



Balancer Unit Bolt Length

Measure balancer unit bolt length. If it exceeds the limit, replace balancer unit bolt with a new one.

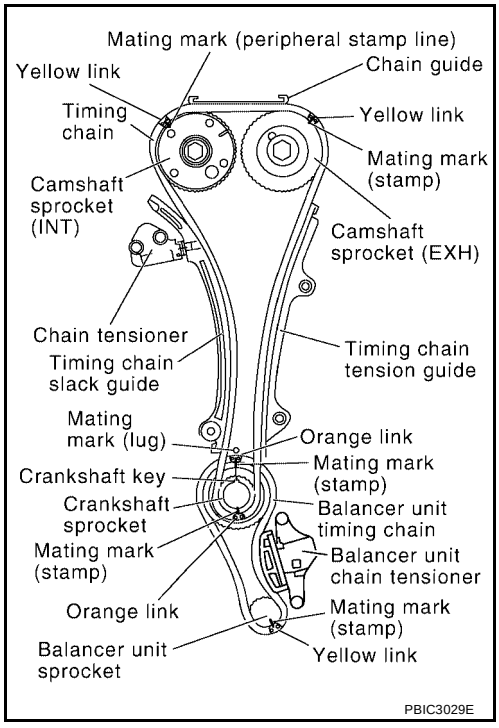
Limit : 177.15 mm (6.974 in)

INSTALLATION

NOTE:

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

1. Make sure that crankshaft key points straight up.



2. Install O-ring to balancer unit.

3. Tighten bolts in numerical order as shown with the following procedure to install balancer unit, using Tool.

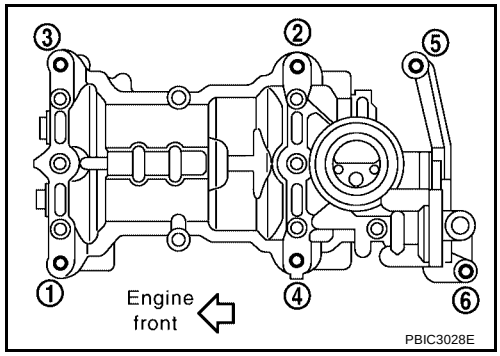
Tool number : KV10112100 (BT8653-A)

CAUTION:

If bolts are re-used, check their outer diameter before installation. Refer to EM-52, "Balancer Unit Bolt Outer Diameter" .

CAUTION:

- **Check tightening angle using Tool or a protractor. Do not make judgment by visual check alone.**
- **In step 3, loosen bolts in reverse order as shown.**

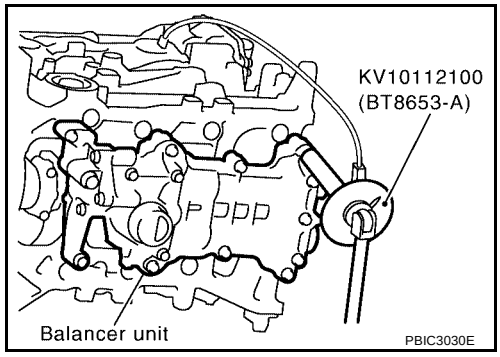


NOTE:

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

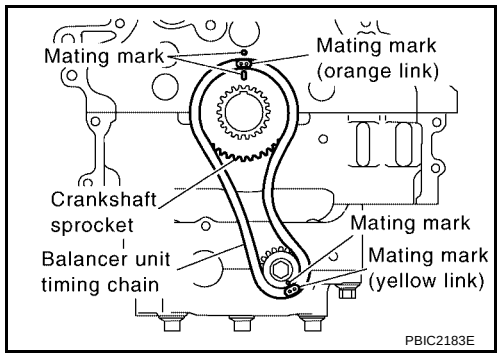
Balancer bolt torque

Step 1 bolts 1 - 4	**: 48.1 N·m (4.9 kg-m, 35 ft-lb)**
Step 2 bolts 1 - 4	**: 100° clockwise**
Step 3 bolts 1 - 4	**: 0 N·m (0 kg-m, 0 ft-lb)**
Step 4 bolts 1 - 4	**: 48.1 N·m (4.9 kg-m, 35 ft-lb)**
Step 5 bolts 1 - 4	**: 100° clockwise**
Step 6 bolts 5 - 6	**: 30.1 N·m (3.1 kg-m, 22 ft-lb)**



4. Install crankshaft sprocket, balancer unit sprocket and balancer unit timing chain.

- Make sure that crankshaft sprocket is positioned with mating marks on cylinder block and crankshaft sprocket meeting at the top.
- Install it by aligning mating marks on each sprocket and balancer unit timing chain.
- Secure the hexagonal portion of the balancer shaft using a suitable tool. Tighten the balancer unit sprocket bolt to the specified torque.

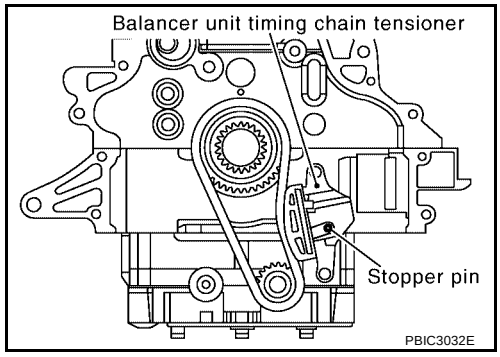


NOTE:

Install crankshaft sprocket, balancer unit sprocket and balancer unit timing chain at the same time.

5. Install balancer unit timing chain tensioner.

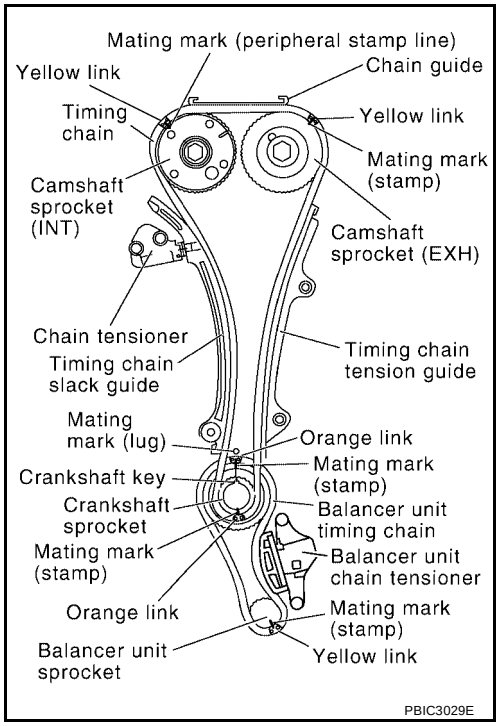
- After installation, make sure the mating marks have not slipped, then remove stopper pin and release tensioner sleeve.



6. Install timing chain and related parts.
   - Install by aligning mating marks on each sprocket and timing chain.
   - 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 that tensioner moves freely.

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

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



7. Install front oil seal to front cover. Refer to EM-57, "Removal and Installation of Front Oil Seal" .
8. Install O-rings to cylinder head and cylinder block.
9. Apply a continuous bead of liquid gasket with the tube presser to front cover as shown, using Tool.

   Tool number : WS39930000 (—)

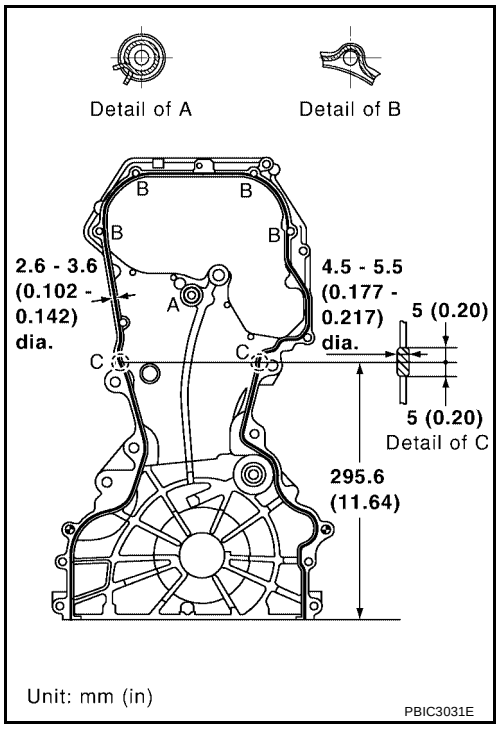
   Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

   NOTE:
   Application instruction differs depending on the position.

   Detail of A : Cross over the start of the application and the end.

   Detail of B : Apply liquid gasket outside of bolt holes. (For all bolt holes other than B, apply to the inside.)

   Detail of C : Between here only, apply 4.5 - 5.5 mm (0.177 - 0.217 in) dia.



10. Make sure that mating marks of timing chain and each sprocket are still aligned. Then install front cover.

    CAUTION:
    Be careful not to damage front oil seal by interference with front end of crankshaft.

11. Tighten bolts in numerical order as shown.
    - Refer to the following for locating M6 bolts.

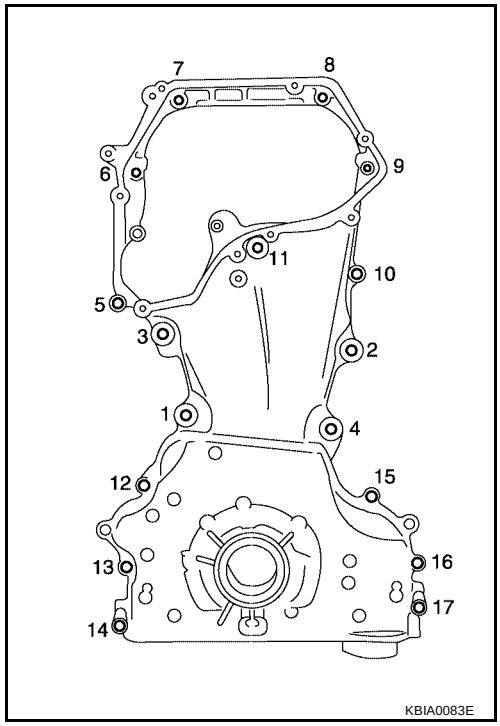
	Bolt position
: 45 mm (1.77 in)	**: 5, 10, 14, 17**
: 20 mm (0.79 in)	**: Except the above (Except 1 to 4)**

    - Tighten bolts to the specified torque.

M6 bolts	**12.8 N·m (1.3 kg-m, 9 ft-lb)**
M10 bolts	**49.0 N·m (5.0 kg-m, 36 ft-lb)**

12. After all bolts are tightened, retighten them to the specified torque in numerical order as shown.

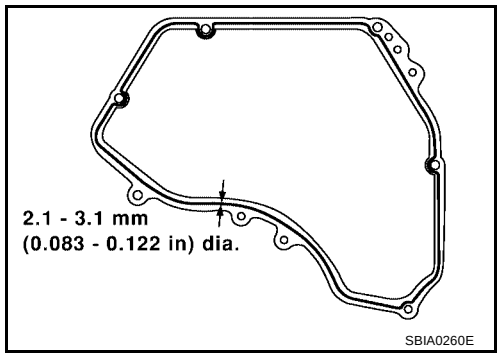
    CAUTION:
    Be sure to wipe off any excessive liquid gasket leaking to surface for fitting oil pan.



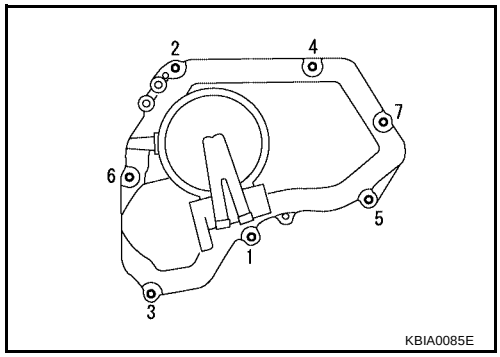
13. Install chain guide between camshaft sprockets.
14. Install oil rings to the camshaft sprocket (INT) insertion points on backside of intake valve timing control cover.
15. Install O-ring to front cover.
16. Apply a continuous bead of liquid gasket using Tool to intake valve timing control cover as shown.

    Tool number : WS39930000 (—)

    Use Genuine RTV Silicone Sealant or equivalent. Refer to **GI-48, "Recommended Chemical Products and Sealants"** **.**



17. Tighten bolts in numerical order as shown.



18. Install intake valve timing control solenoid valve to intake valve timing control cover if removed.
19. Connect ground cables, and install harness clip.
20. Insert crankshaft pulley by aligning with crankshaft key.
    - When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).

    CAUTION:
    Install protecting front oil seal lip section from any damage.

21. Tighten crankshaft pulley bolt using Tool.

Tool number : KV10112100 (BT-8653-A)

- Secure crankshaft pulley using suitable tool, and tighten crankshaft pulley bolt.

a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.

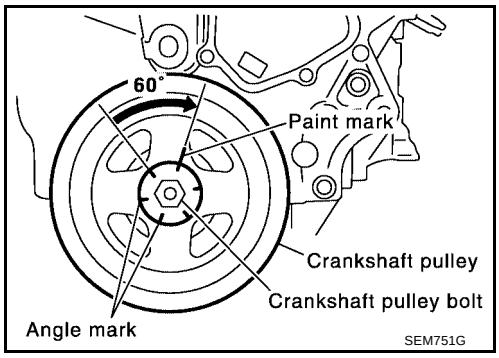
b. Tighten crankshaft pulley bolt.

: 42.1 N·m (4.3 kg-m, 31 ft-lb)

c. Put a paint mark on crankshaft pulley, mating with any one of six easy to recognize angle marks on bolt flange.

d. Turn another 60° degrees clockwise (angle tightening).

- Check the tightening angle with movement of one angle mark.



22. Install all removed parts in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricates leak and exhaust gases leak.

- Before starting the engine, check oil fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-11, "QR25DE" .
- Use procedures below to check for fuel leakage.
  - Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start the engine. With the engine speed increased, check again for fuel leakage at connection points.
- Run the engine to check for unusual noise and vibration.

NOTE:
If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after the engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up the engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/ fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down the engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

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

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

OIL SEAL

PFP:12279

Removal and Installation of Valve Oil Seal

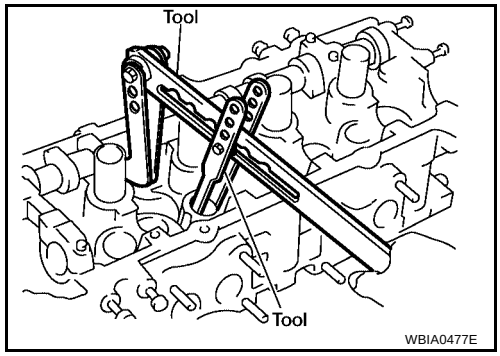
EBS00NI3

REMOVAL

1. Remove fan shroud (lower). Refer to CO-15, "RADIATOR" .
2. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.
3. Remove camshafts. Refer to EM-36, "CAMSHAFT" .
4. Remove valve lifters. Refer to EM-36, "CAMSHAFT" .
5. Remove valve collet, valve spring retainer and valve spring using Tool.

   Tool numbers : KV10116200 (J-26336-B)
   : KV10115900 (J-26336-20)

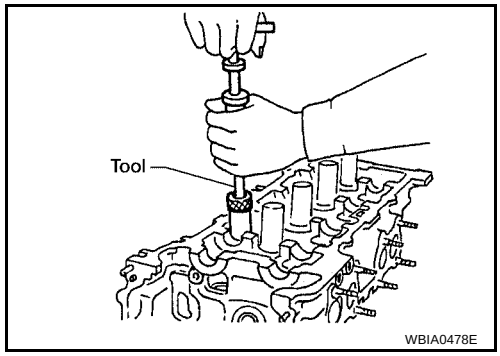
   CAUTION:
   When working, be careful not to damage valve lifter holes.



6. Remove valve spring retainer and valve spring.

   CAUTION:
   Do not remove valve spring seat from valve spring.
7. Remove valve oil seal using Tool.

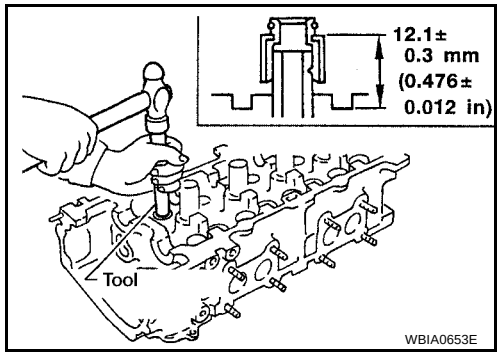
   Tool numbers : KV10107902 (J-38959)



INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.
2. Press in valve oil seal to the height “H” as shown using Tool.

   Tool numbers : KV10107902 (J-38959)



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

Removal and Installation of Front Oil Seal

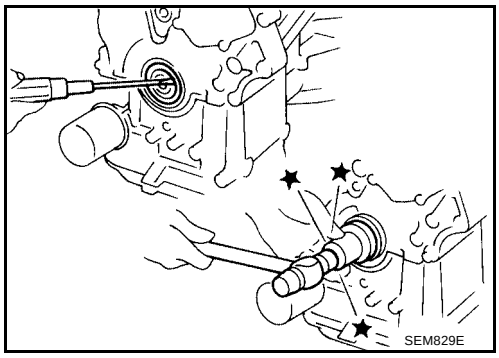
EBS00NI4

REMOVAL

1. Remove engine undercover.
2. Remove fan shroud (lower); Refer to CO-18, "COOLING FAN"
3. Remove cooing fan; Refer to CO-18, "COOLING FAN" .
4. Remove drive belt; Refer to EM-14, "DRIVE BELTS" .

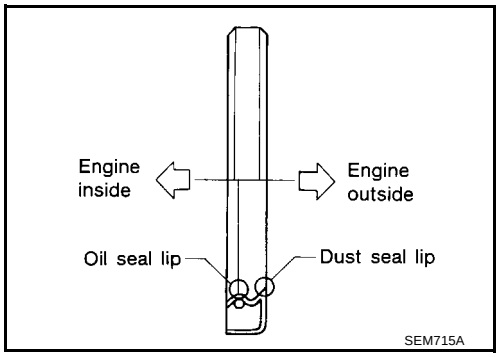
5. Remove crankshaft pulley; Refer to EM-48, "TIMING CHAIN" .
6. Remove front oil seal using a suitable tool.

CAUTION:
Be careful not to damage front cover and crankshaft.



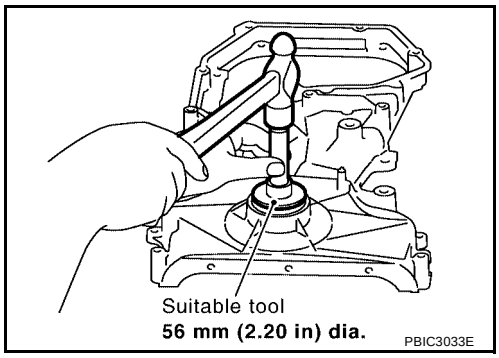
INSTALLATION

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



- Press-fit front oil seal until it is flush with front end surface of front cover using suitable tool.

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



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

Removal and Installation of Rear Oil Seal

EBS00NI5

REMOVAL

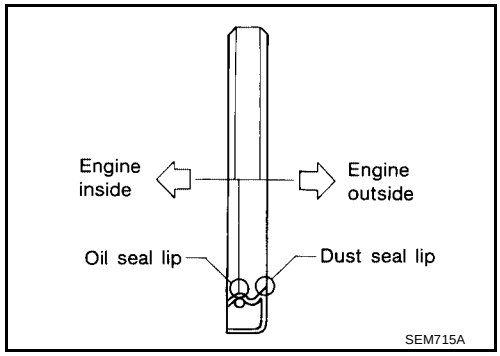
1. Remove transmission assembly. Refer to MT-16, "REMOVAL" (M/T models), MT-67, "REMOVAL" (2WD models), MT-69, "REMOVAL" (4WD models) or AT-252, "REMOVAL" (2WD), AT-254, "REMOVAL" (4WD) (A/T models).
2. Remove clutch cover and clutch disk (M/T models). Refer to CL-18, "REMOVAL" .
3. Remove drive plate (A/T models) or flywheel (M/T models) with power tool. Refer to EM-75, "CYLINDER BLOCK" .
4. Remove rear oil seal with a suitable tool.

CAUTION:
Be careful not to damage crankshaft and cylinder block.

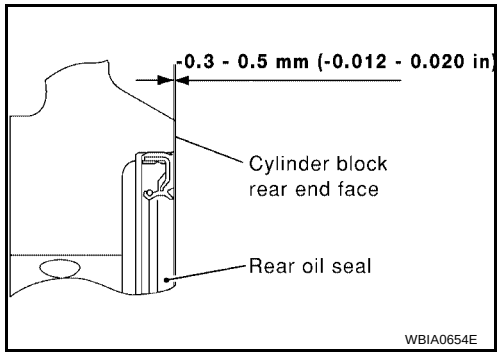
INSTALLATION

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

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



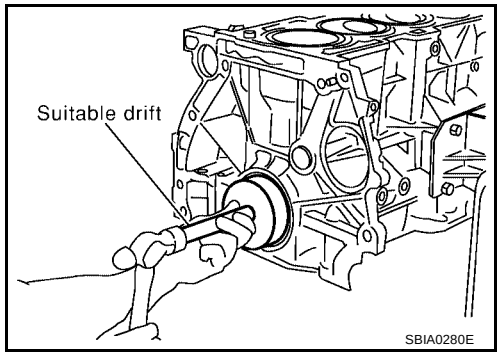
- Press in rear oil seal to the position as shown.



- Press-fit rear oil seal using a suitable drift [outside diameter 102 mm (4.02 in), inside diameter 86 mm (3.39 in)].

  CAUTION:

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



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

CYLINDER HEAD

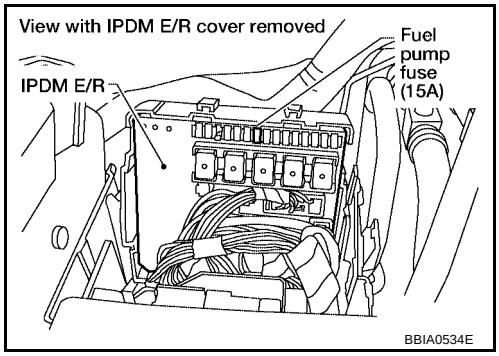
PFP:11041

On-Vehicle Service

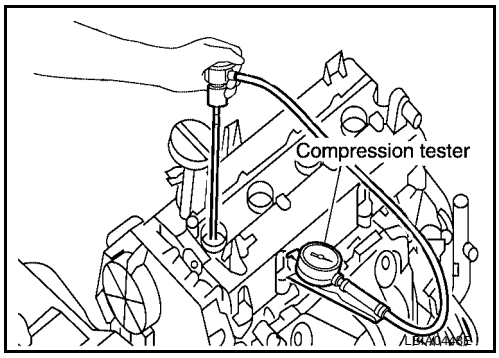
EBS00NI6

CHECKING COMPRESSION PRESSURE

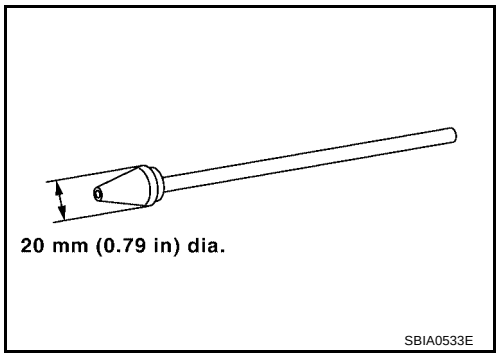
1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.



4. Remove spark plug from each cylinder. Refer to EM-27, "SPARK PLUG (PLATINUM-TIPPED TYPE)" .
5. Connect an engine tachometer (not required in use of CONSULT-II).
6. Install a compression tester with an adapter (commercial service tool) onto spark plug hole.



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



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

Compression pressure:

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

Standard	Minimum	Differential limit between cylinders
1,304 (13.3, 189) / 250	1,108 (11.3, 161) / 250	100 (1.0, 14) / 250

CAUTION:

Always use fully a changed battery to obtain the specified engine speed.

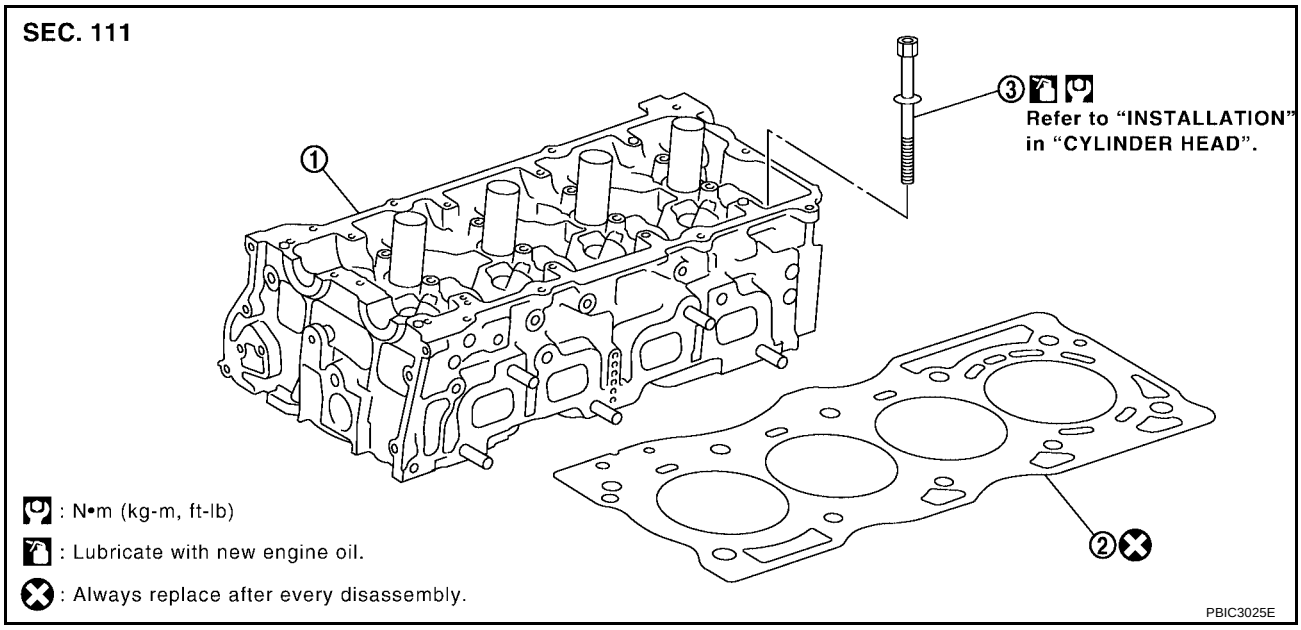
- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.

- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (Valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure the compression pressure again.
- If some cylinder has low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
- If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
- If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gasket is leaking. In such a case, replace cylinder head gasket.

8. After inspection is completed, install removed parts.
9. Start the engine, and confirm that the engine runs smoothly.
10. Perform trouble diagnosis. If DTC appears, erase it. Refer to EC-691, "TROUBLE DIAGNOSIS" .

Removal and Installation

EBS00NI7



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

REMOVAL

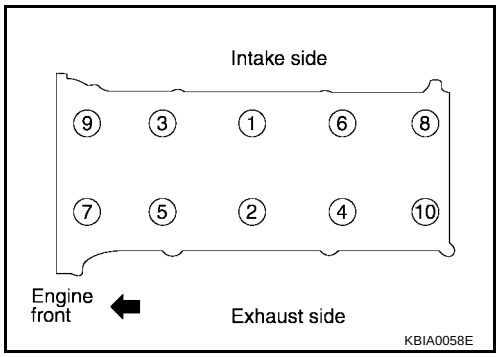
1. Release fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .
2. Drain engine coolant. Refer to CO-11, "DRAINING ENGINE COOLANT" .

   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Do not spill engine coolant on drive belt.**
3. Drain engine oil; Refer to MA-26, "Changing Engine Oil" .

   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Do not spill engine oil on drive belt.**
4. Intake manifold and fuel tube assembly; Refer to EM-18, "INTAKE MANIFOLD" .
5. Remove fuel injector and fuel tube assembly; Refer to EM-29, "FUEL INJECTOR AND FUEL TUBE" .
6. Exhaust manifold and three way catalyst assembly; Refer to EM-21, "EXHAUST MANIFOLD AND THREE WAY CATALYST" .
7. Remove water outlet; Refer to CO-27, "REMOVAL" .
8. Remove heater outlet; Refer to CO-27, "WATER OUTLET AND WATER PIPING" .

NOTE:
Can be removed and installed even when assembled with cylinder head.

9. Remove front cover and timing chain. Refer to EM-48, "TIMING CHAIN" .
10. Remove camshafts. Refer to EM-36, "CAMSHAFT" .
11. Remove cylinder head loosening bolts in reverse order as shown using power tool.
    - Using the cylinder head bolt wrench (commercial service tool: J-24239-01), loosen cylinder head bolts.



12. Remove cylinder head gasket.

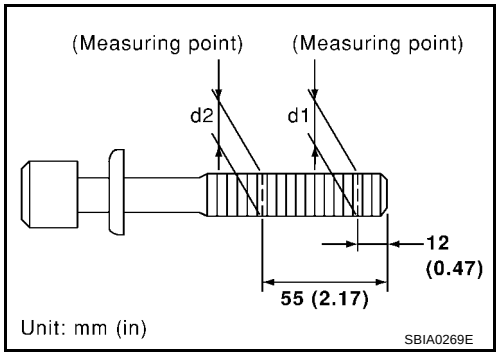
INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

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

  Limit (“d1” – “d2”): 0.23 mm (0.0091 in)

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



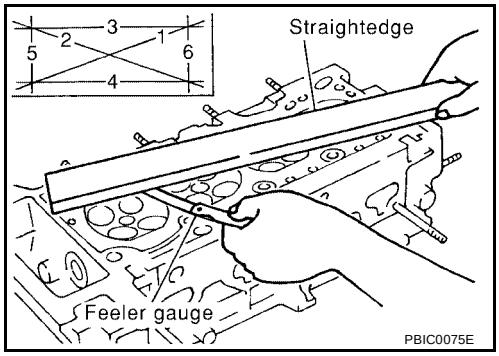
Cylinder Head Distortion

NOTE:
When performing this inspection, cylinder block distortion should be also checking. Refer to EM-95, "CYLINDER BLOCK DISTORTION" .

1. Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.
   CAUTION:
   Use utmost care not to allow gasket debris to enter passages for engine oil or engine coolant.
2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions.

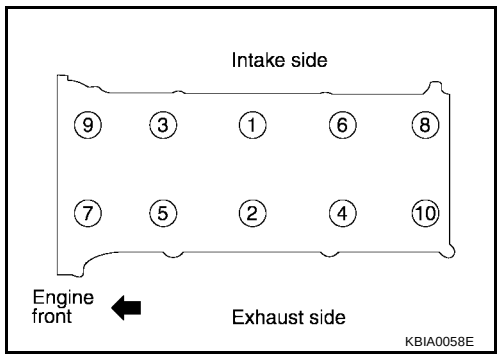
   Limit : 0.1 mm (0.004 in)

   - If it exceeds the limit, replace cylinder head.



INSTALLATION

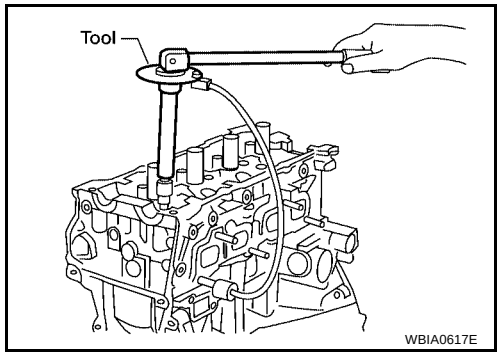
1. Install new cylinder head gasket.
2. Install cylinder head follow the steps below to tighten cylinder head bolts in numerical order as shown.



CAUTION:
If cylinder head bolts re-used, check their outer diameters before installation. Refer to EM-62, "Cylinder Head Bolts Outer Diameter" .

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

Tool number : KV10112100 (BT8653-A)



Step a : 98 N·m (10 kg-m, 72 ft-lb)
Step b : Loosen to 0 N·m in the reverse order of tightening.
Step c : 39.2 N·m (4.0 kg-m, 29 ft-lb)
Step d : 75° clockwise
Step e : 75° clockwise

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

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricates leak and exhaust gases leak.

- Before starting the engine, check oil fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-11, "QR25DE" .
- Use procedures below to check for fuel leakage.
  - Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start the engine. With the engine speed increased, check again for fuel leakage at connection points.
- Run the engine to check for unusual noise and vibration.

NOTE:
If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after the engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up the engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/ fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down the engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

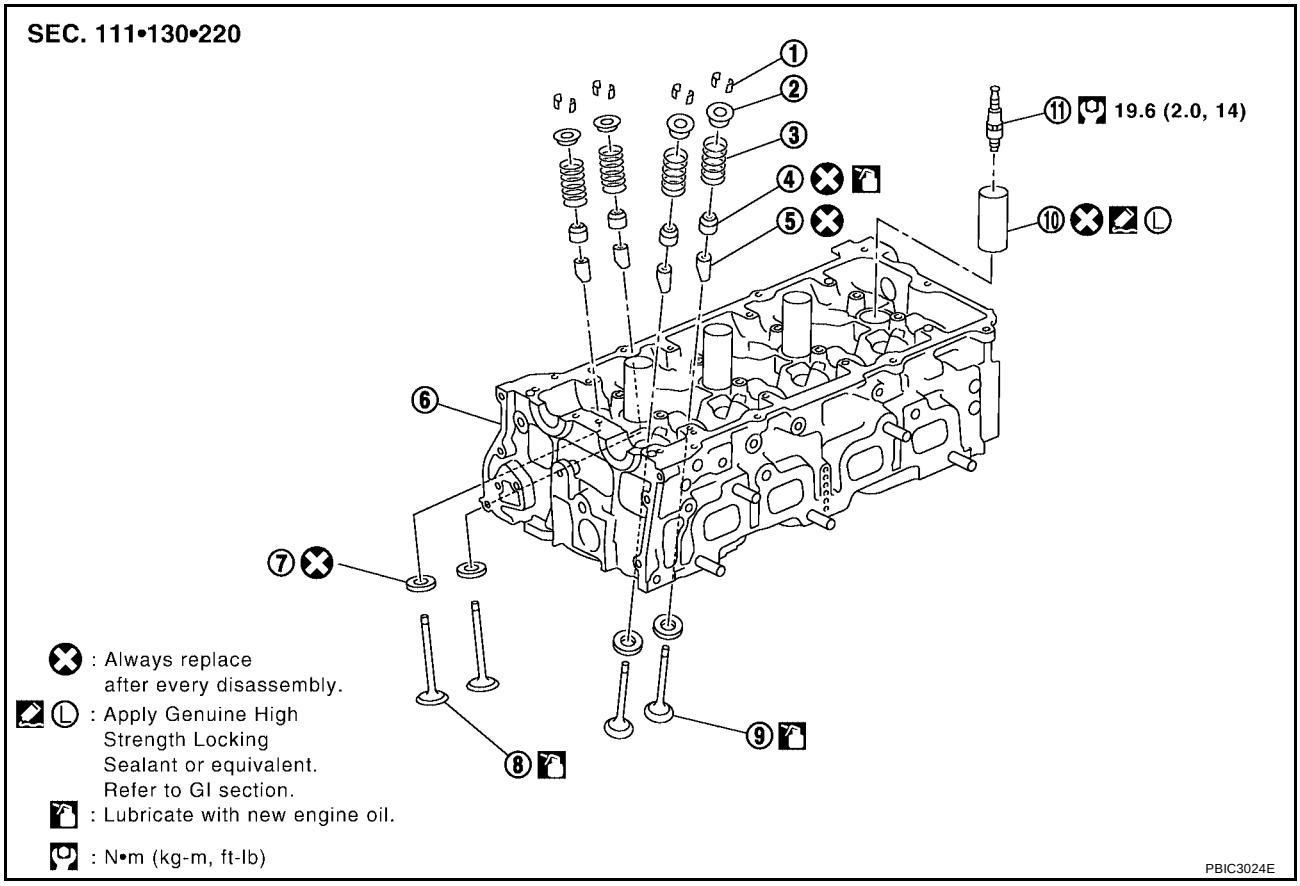
Summary of the inspection items:

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

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

Disassembly and Assembly

EBS00NI8



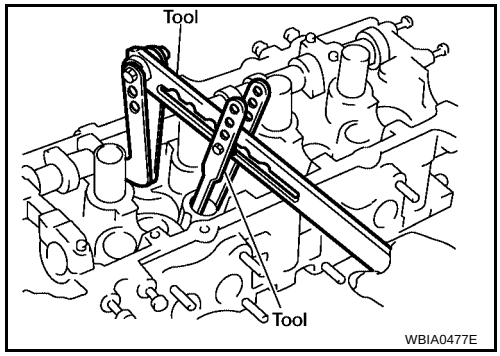
1. Valve collet
2. Valve spring retainer
3. Valve spring (with valve spring seat)
4. Valve oil seal
5. Valve guide
6. Cylinder head
7. Valve seat
8. Valve (INT)
9. Valve (EXH)
10. Spark plug tube
11. Spark plug

DISASSEMBLY

1. Remove spark plug using suitable tool.
2. Remove valve lifter.
   - Identify installation positions, and store them without mixing them up.

3. Remove valve collet, valve spring retainer and valve spring using Tool.

Tool numbers : KV10116200 (J-26336-B)
: KV10115900 (J-26336-20)

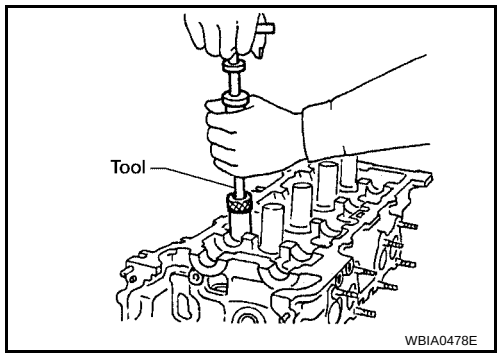


CAUTION:
When working, be careful not to damage valve lifter holes.

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

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

Tool numbers : KV10107902 (J-38959)



6. When valve seat must be replaced, refer to EM-69, "VALVE SEAT REPLACEMENT" .
7. When valve guide must be replaced, refer to EM-67, "VALVE GUIDE REPLACEMENT" .
8. Remove spark plug tube, if necessary.
   - Remove it from cylinder head using suitable tool.

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

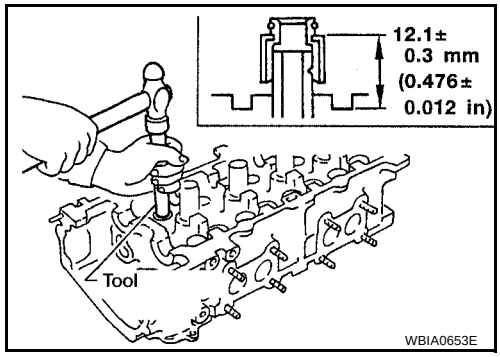
ASSEMBLY

1. Install valve guide if removed. Refer to EM-67, "VALVE GUIDE REPLACEMENT" .
2. Install valve seat if removed. Refer to EM-69, "VALVE SEAT REPLACEMENT" .
3. Install valve oil seal using Tool.

Tool numbers : KV10107902 (J-38959)

NOTE:
Install with the valve oil seal to match dimension as shown.

Height "H" : 11.8 - 12.4 mm (0.465 - 0.488 in)



4. Install valve.

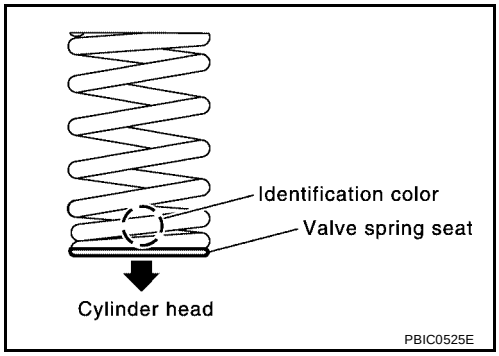
NOTE:
Install larger diameter to intake side.

5. Install valve spring (with valve spring seat).

NOTE:

- Install smaller pitch (valve spring seat side) to cylinder head side.
- Confirm identification color of valve spring.

Intake : Blue
Exhaust : Yellow



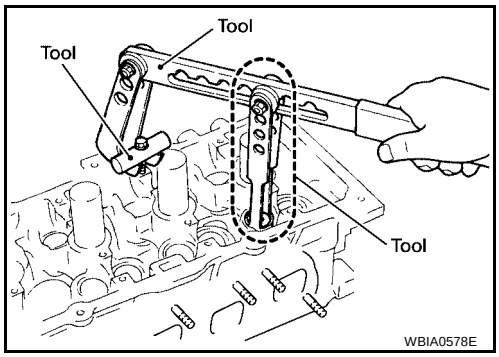
6. Install valve spring retainer.
7. Install valve collet using Tool.

Tool numbers : KV10116200 (J-26336-B)
: KV10115900 (J-26336-20)

- Install valve collet with a magnet hand.

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

- Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.

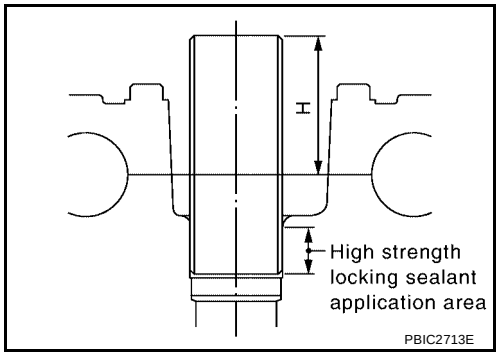


8. Install valve lifter.
9. Install spark plug tube if removed.
   - Press-fit it into cylinder head with the following procedure:

a. Remove old sealant from cylinder head side installation hole.

b. Apply sealant all round on spark plug tube within approximately 12 mm (0.47 in) width from edge of spark plug tube on the press-fit side.
Use Genuine High Strength Locking Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

c. Press-fit spark plug tube so that height is as same as “H” as shown using suitable tool.



Standard press-fit height “H”:
41.2 - 42.2 mm (1.622 - 1.661 in)

CAUTION:

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

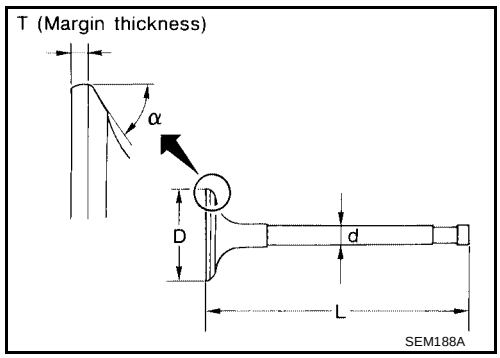
10. Install spark plug.

Inspection After Disassembly

EBS00NI9

VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to EM-67, "VALVE DIMENSIONS" .
- If dimensions are out of the standard, replace valve.



VALVE GUIDE CLEARANCE

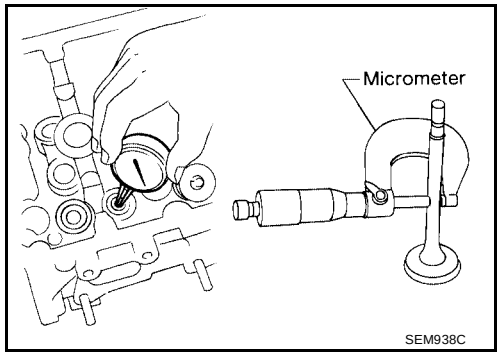
Valve Stem Diameter

Measure the diameter of valve stem with a micrometer.

Standard

Intake : 5.965 - 5.980 mm (0.2348 - 0.2354 in)

Exhaust : 5.955 - 5.970 mm (0.2344 - 0.2350 in)



Valve Guide Inner Diameter

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

Standard

Intake and Exhaust

: 6.000 - 6.018 mm (0.2362 - 0.2369 in)

Valve Guide Clearance

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

Valve guide clearance:

Standard

Intake : 0.020 - 0.053 mm (0.0008 - 0.0021 in)

Exhaust : 0.030 - 0.063 mm (0.0012 - 0.0025 in)

Limit

Intake : 0.08 mm (0.003 in)

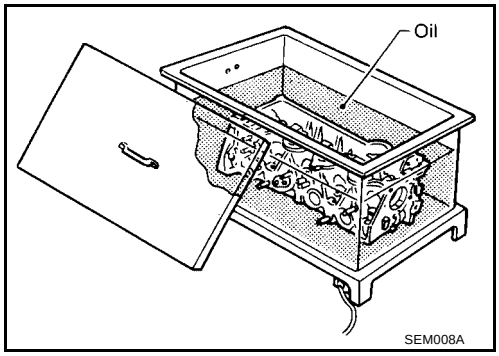
Exhaust : 0.09 mm (0.004 in)

- If it exceeds the limit, replace valve guide and/or valve. When valve guide must be replaced, refer to EM-67, "VALVE GUIDE REPLACEMENT" .

VALVE GUIDE REPLACEMENT

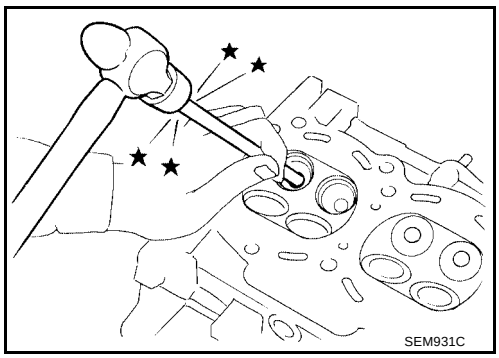
When valve guide is removed, replace with oversized [0.2 mm (0.008 in)] valve guide.

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



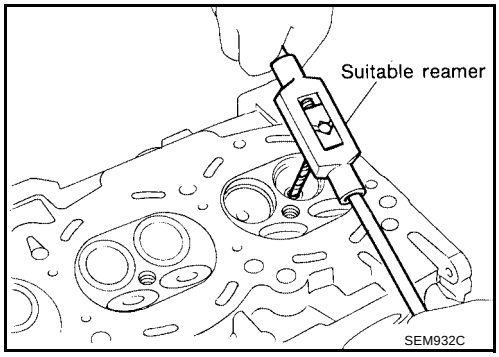
2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 lmp ton) force] or suitable tool.

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

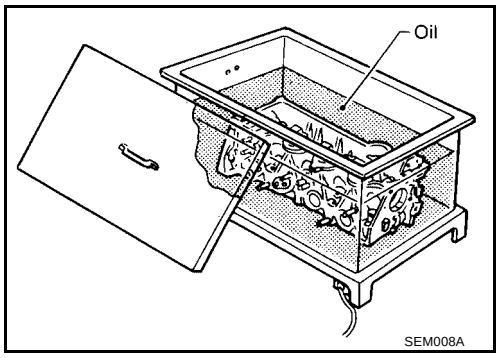


3. Ream cylinder head valve guide hole using suitable reamer.

Valve guide hole diameter (for service parts):
Intake and exhaust
: 10.175 - 10.196 mm (0.4006 - 0.4014 in)



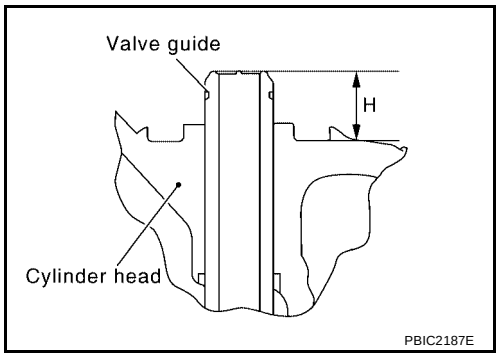
4. Heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil.



5. Press valve guide from camshaft side to dimensions as shown using suitable tool.

Projection "H":
Intake : 10.1 - 10.3 mm (0.398 - 0.406 in)
Exhaust : 10.0 - 10.4 mm (0.394 - 0.409 in)

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

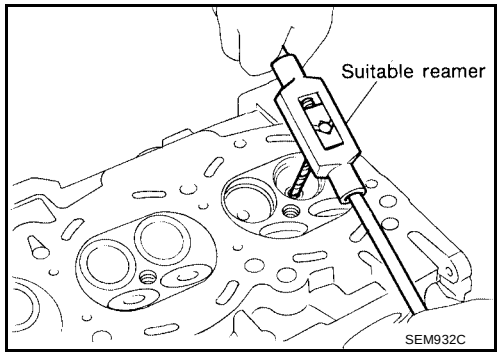


6. Apply reamer finish to valve guide using suitable reamer.

Standard

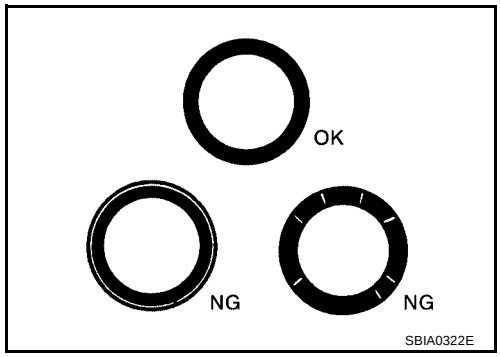
Intake and exhaust:

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 surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has NG conditions even after the re-check, replace valve seat. Refer to EM-69, "VALVE SEAT REPLACEMENT" .



VALVE SEAT REPLACEMENT

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

1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to EM-106, "Valve Seat" .

CAUTION:

Prevent to scratch cylinder head by excessive boring.

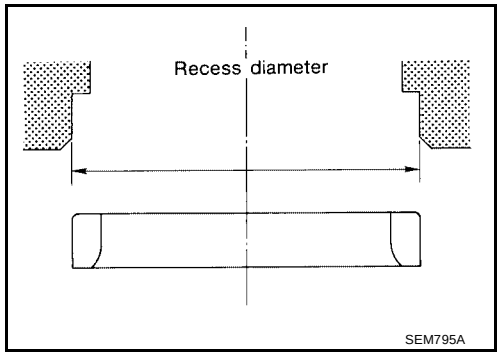
2. Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]

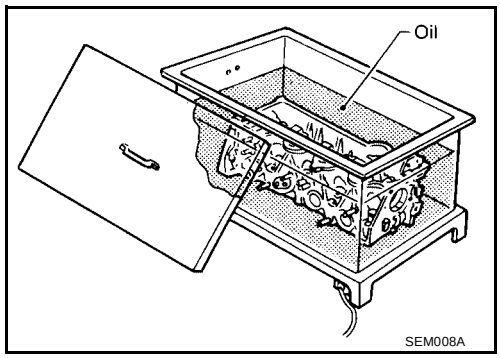
Intake : 37.000 - 37.016 mm (1.4567 - 1.4573 in)

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 valve seat to fit correctly.



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



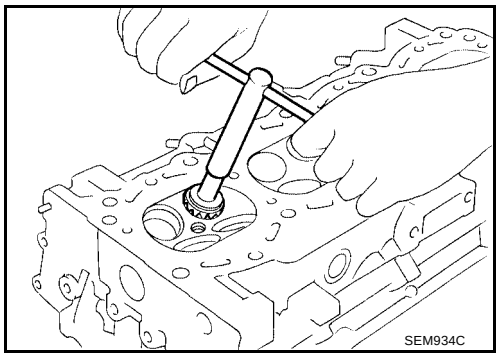
4. Provide valve seats cooled well with a dry ice. Press-fit valve seats into cylinder head.

CAUTION:

- **Avoid directly to touching cold valve seats.**

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

5. Finish valve seat to the specified dimensions. For dimensions, refer to EM-106, "Valve Seat" using suitable tool.

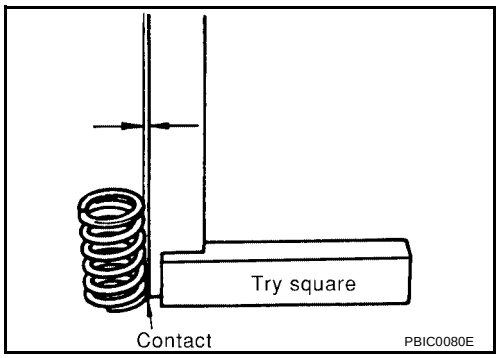


CAUTION:
When using a valve seat cutter, firmly grip the cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on with the cutter or cutting many different times may result in stage valve seat.

6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact. Refer to EM-69, "VALVE SEAT CONTACT" .

VALVE SPRING SQUARENESS

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



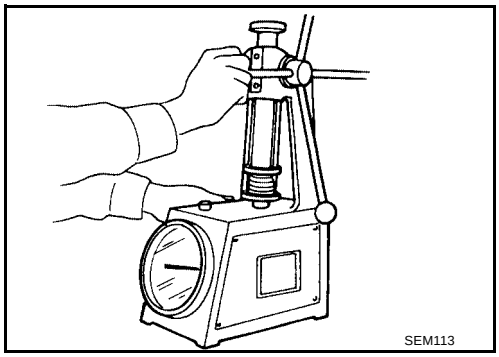
CAUTION:
Do not remove valve spring seat from valve spring.

Limit : 1.9 mm (0.075 in)

- If it exceeds the limit, replace valve spring (with valve spring seat).

VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

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



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

Standard:

Items	Intake	Exhaust
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, 34 - 39 lb)	151 - 175 N (15.4 - 17.8 kg, 34 - 39 lb)
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, 80 - 92 lb)	325 - 371 N (33.1 - 37.8 kg, 73 - 83 lb)
Identification color	Blue	Yellow

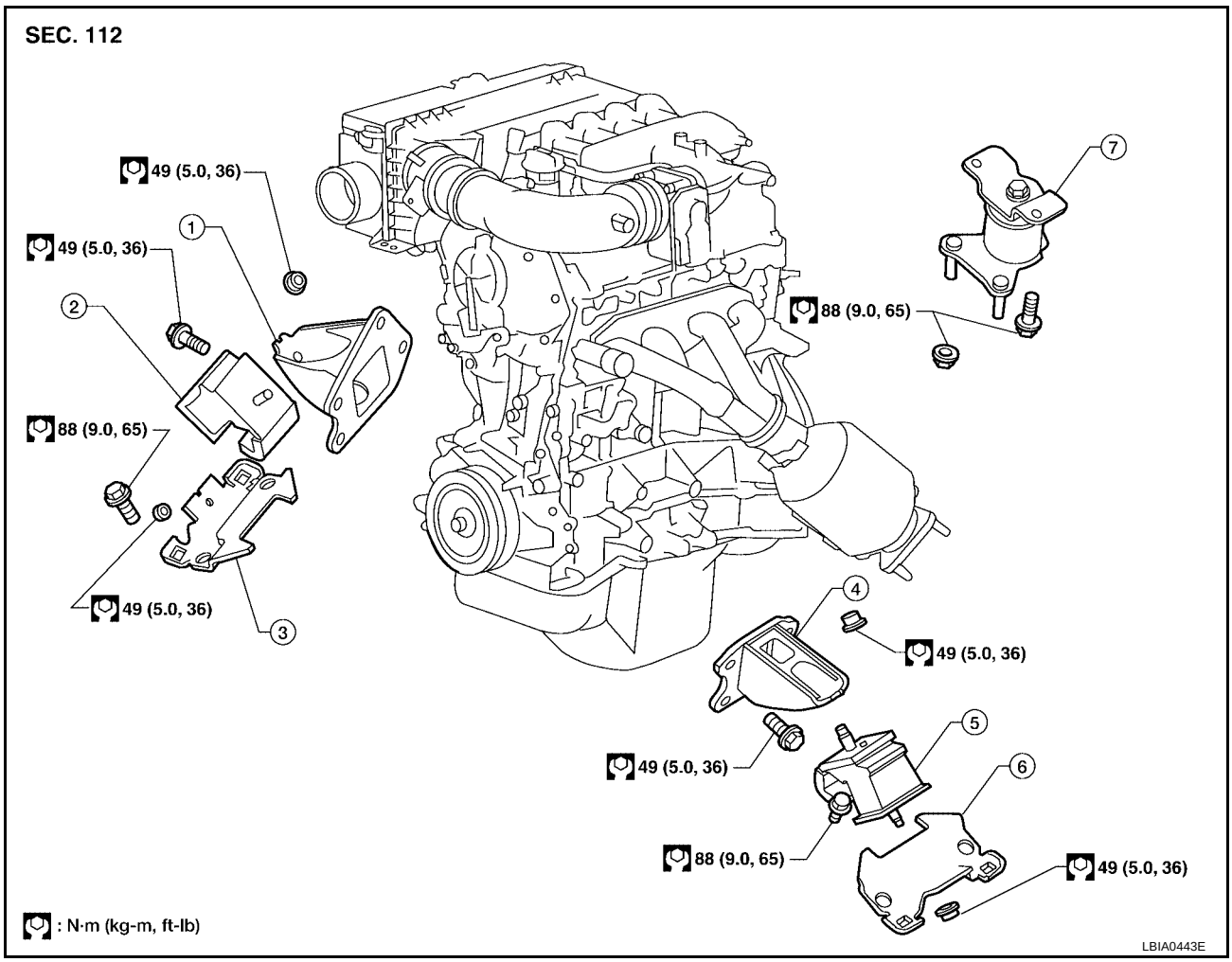
- If the installation load or load with valve open is out of the standard, replace valve spring (with valve spring seat).

ENGINE ASSEMBLY

PFP:10001

Removal and Installation

EBS00NIA



1. RH engine mounting bracket (upper)
2. RH engine mounting insulator
3. RH engine mounting bracket (lower)
4. LH engine mounting bracket (upper)
5. LH engine mounting insulator
6. LH engine mounting bracket (lower)
7. Rear engine mounting insulator

WARNING:

- **Situate the vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **Attach proper slingers and bolts described in PARTS CATALOG if engine slingers are not equipped.**

CAUTION:

- **Always be careful to work safely, avoid forceful or uninstructed operations.**
- **Do not start working until exhaust system and coolant are cool enough.**
- **If items or work required are not covered by the engine section, refer to the applicable sections.**
- **Always use the support point specified for lifting.**
- **Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with a transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.**
- **For supporting points for lifting and jacking point at rear axle, refer to GI-43, "Garage Jack and Safety Stand" .**

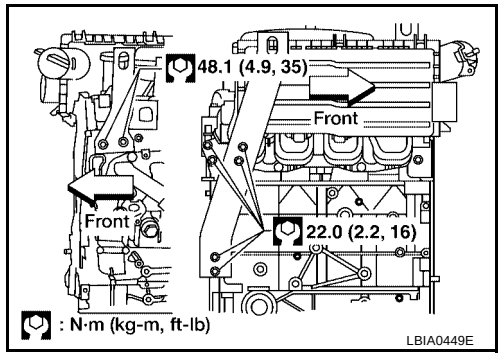
REMOVAL

1. Drain engine coolant. Refer to CO-11, "DRAINING ENGINE COOLANT" .
2. Partially drain A/T fluid. Refer to MA-34, "Changing the Automatic Transmission Fluid (ATF)" .
3. Release fuel pressure. Refer to EC-86, "FUEL PRESSURE RELEASE" .
4. Remove the engine hood. Refer to BL-13, "Removal and Installation of Hood Assembly" .
5. Remove the air duct and air cleaner case assembly. Refer to EM-16, "REMOVAL" .
6. Disconnect vacuum hose between vehicle and engine and set it aside.
7. Remove the radiator assembly and hoses. Refer to CO-15, "REMOVAL" .
8. Remove the drive belts. Refer to EM-14, "REMOVAL" .
9. Remove the engine cooling fan. Refer to CO-18, "REMOVAL" .
10. Disconnect the engine room harness from the engine side and set it aside for easier work.
11. Disconnect the engine harness grounds.
12. Disconnect the reservoir tank for power steering from engine and move it aside for easier work.
13. Disconnect power steering oil pump from engine and position out of the way for easier work. Refer to PS-22, "REMOVAL" .
14. Remove the A/C compressor bolts and set aside. Refer to MTC-103, "REMOVAL" .
15. Disconnect brake booster vacuum line.
16. Disconnect EVAP line.
17. Disconnect the fuel hose at the engine side connection. Refer to EM-29, "REMOVAL" .
18. Disconnect the heater hoses at cowl, and install plugs to avoid leakage of engine coolant.
19. Remove the A/T oil level indicator and indicator tube.
20. Remove three way catalyst. Refer to EM-21, "REMOVAL" .
21. Install engine slingers into left bank and right bank.

    Engine slinger torque

    Front engine slinger : 48.1 N·m (4.9 kg-m, 35 ft-lb)

    Rear engine slinger : 22.0 N·m (2.2 kg-m, 16 ft-lb)



22. Remove transmission. Refer to MT-16, "REMOVAL" (FS5R30A), MT-67, "REMOVAL" (FS6R31A) (2WD models), MT-69, "REMOVAL" (4WD models).
23. Lift with hoist and secure the engine in position.
24. Remove engine assembly from vehicle, avoiding interference with vehicle body.

    CAUTION:

    - **Before and during this lifting, always check if any harnesses are left connected.**

25. Remove the parts that may restrict installation of engine to engine stand.

    NOTE:

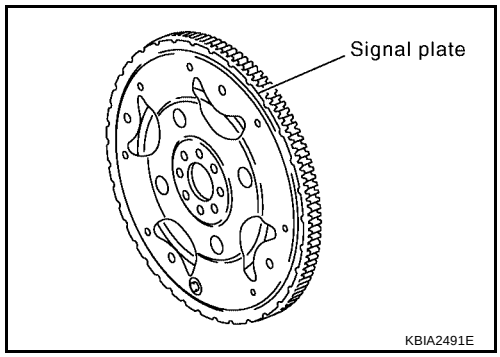
    The procedure is described assuming that you use a engine holding the surface, to which transmission is installed.

a. Remove drive plate.

- Holding crankshaft pulley bolts, lock crankshaft to remove drive plate bolts.
- Loosen bolts diagonally.

CAUTION:

- **Be careful not to damage drive plate. Especially avoid deforming and damaging of signal plate teeth (circumference position).**
- **Place the drive plate with signal plate surface facing other than downward.**
- **Keep magnetic materials away from signal plate.**



CAUTION:

Use an engine stand that has a load capacity [approximately 240kg (529 lb) or more] large enough for supporting the engine weight.

- **If the load capacity of the stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning the stand.**
  - **Remove fuel tube and fuel injector assembly. Refer to EM-29, "REMOVAL" .**
  - **Remove intake manifold. Refer to EM-18, "REMOVAL" .**
  - **Remove rocker cover. Refer to EM-34, "REMOVAL" .**
  - **Other removable brackets.**

CAUTION:

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

26. Remove alternator. Refer to SC-37, "REMOVAL" .
27. Remove engine mounting insulator bracket (upper) with power tool.

INSTALLATION

Note the following, and installation is in the reverse order of removal.

- Do not allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to the figure of components.
- Make sure that each mounting insulator is seated properly, and tighten nuts and bolts.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricates leak and exhaust gases leak.

- Before starting the engine, check oil fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-11, "QR25DE" .
- Use procedures below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start the engine. With the engine speed increased, check again for fuel leakage at connection points.
- Run the engine to check for unusual noise and vibration.

  NOTE:

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

Summary of the inspection items:

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

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

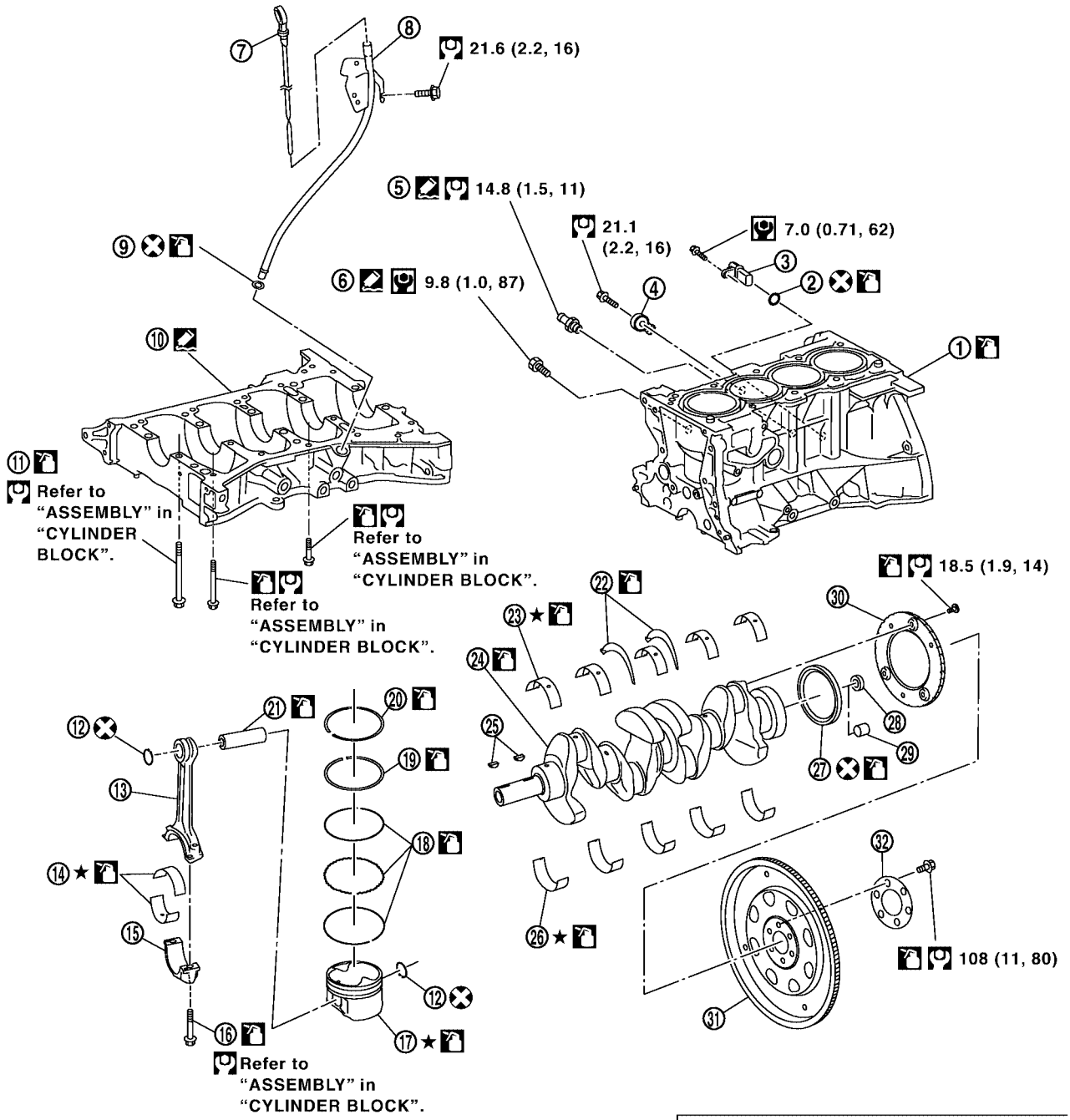
CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

EBS00NIC

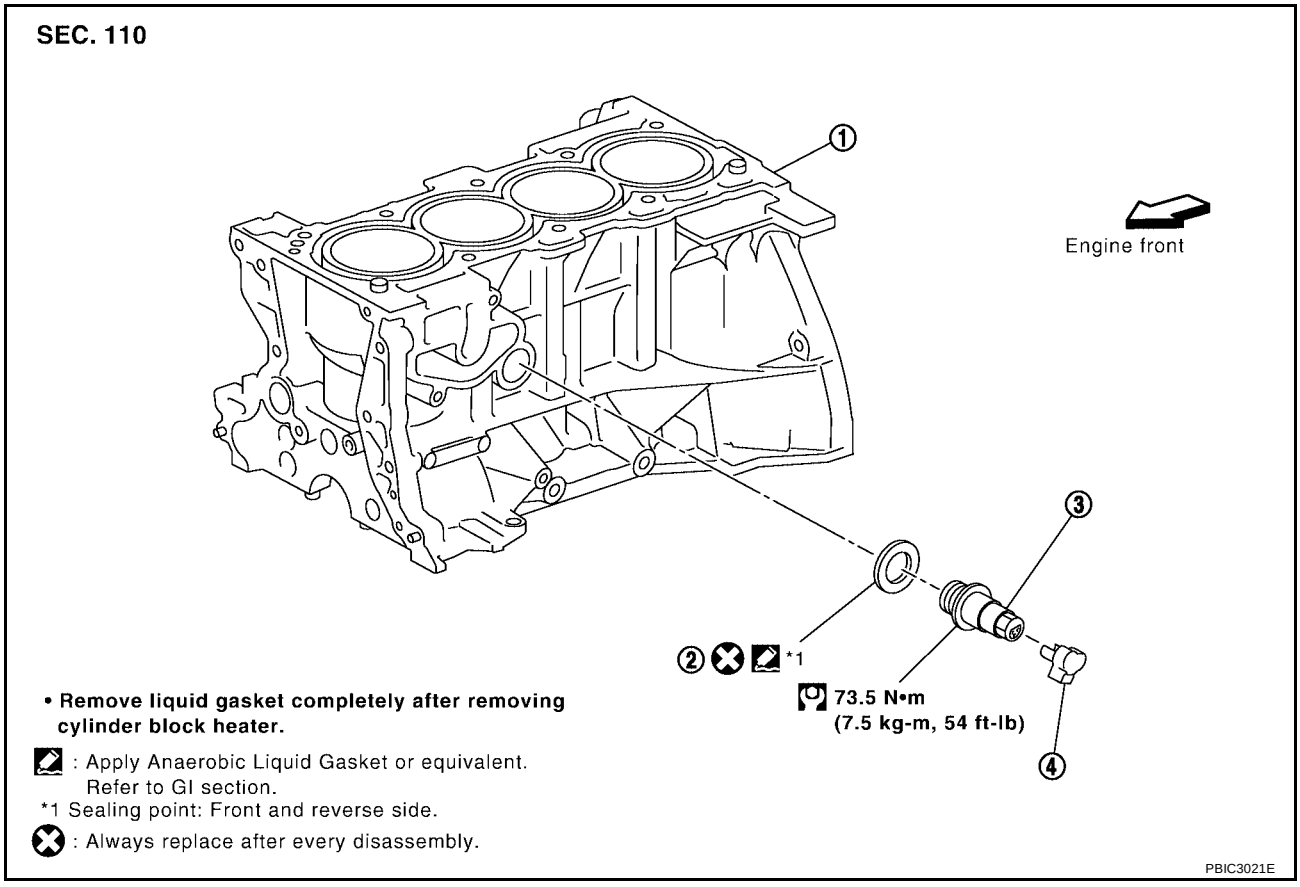
SEC. 110•120•221•226



: Always replace after every disassembly.
★ : Selective parts
: Lubricate with new engine oil.
: Apply Genuine RTV Silicone or equivalent. Refer to GI section.
: N•m (kg-m, ft-lb)
: N•m (kg-m, in-lb)

PBIC3022E

1. Cylinder block
2. O-ring
3. Crankshaft position sensor (POS)
4. Knock sensor
5. Oil pressure switch
6. Water drain plug
7. Oil level gauge
8. Oil level gauge guide
9. O–ring
10. Lower cylinder block
11. Lower cylinder block mounting bolt
12. Snap ring
13. Connecting rod
14. Connecting rod bearing
15. Connecting rod bearing cap
16. Connecting rod bolt
17. Piston
18. Oil ring
19. Second ring
20. Top ring
21. Piston pin
22. Thrust bearing
23. Main bearing upper
24. Crankshaft
25. Crankshaft key
26. Main bearing lower
27. Rear oil seal
28. Pilot convertor (A/T models)
29. Pilot bushing (M/T models)
30. Signal plate
31. Drive plate (A/T models)
32. Reinforce plate (A/T models)
33. Flywheel (M/T models)



1. Cylinder block
2. Gasket
3. Cylinder block heater
4. Connector protector cap

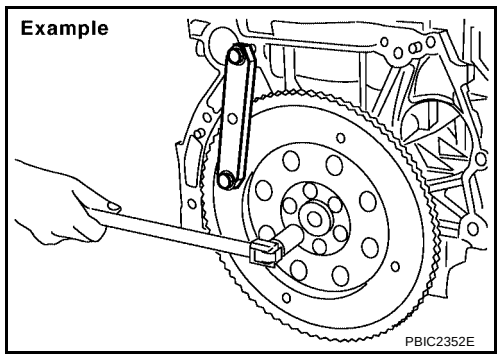
DISASSEMBLY

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

1. Remove the engine and the transmission assembly from the vehicle, and separate the transmission assembly from the engine. Refer to EM-71, "ENGINE ASSEMBLY" .
2. Remove clutch cover and clutch disc (M/T models). Refer to CL-18, "CLUTCH DISC, CLUTCH COVER" .

3. Remove flywheel (M/T models) or drive plate (A/T models) with power tool.
   - Secure crankshaft with a stopper plate, and remove bolts.
   - Loosen bolts using suitable tool.

   Flywheel (M/T models)
   : size T55 (commercial service tool)
   Drive plate (A/T models)
   : size E20



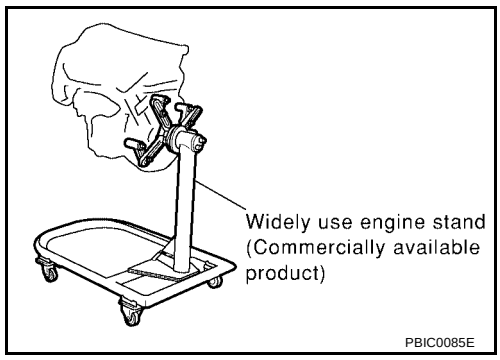
CAUTION:
Be careful not to damage or scratch drive plate (A/T models) and contact surface for clutch disc of flywheel (M/T models).

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.

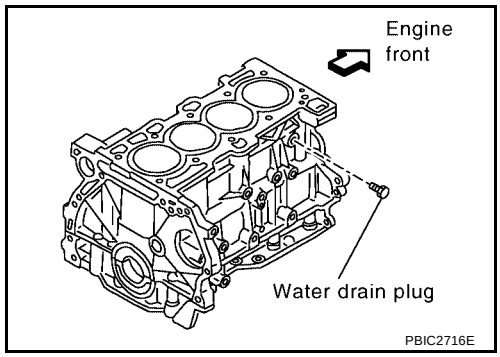
4. Lift the engine with a hoist to install it onto widely use engine stand.

CAUTION:
- **Use the engine stand that has a load capacity [approximately 240kg (529 lb) or more] large enough for supporting the engine weight.**
- **Before removing the hanging chains, make sure the engine stand is stable and there is no risk of overturning.**

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



5. Drain engine oil. Refer to LU-8, "Changing Engine Oil" .
6. Drain engine coolant by removing water drain plug from inside of the engine.

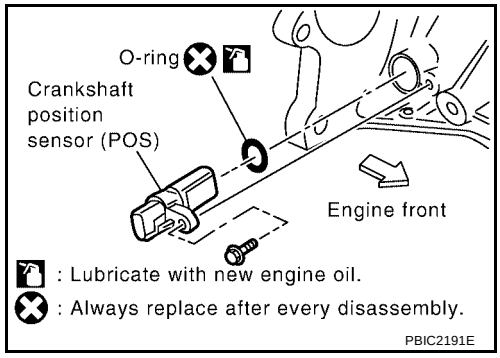


7. Remove cylinder head with power tool. Refer to EM-60, "CYLINDER HEAD" .
8. Remove knock sensor.

CAUTION:
Carefully handle knock sensor avoiding shocks.

9. Remove crankshaft position sensor (POS).

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

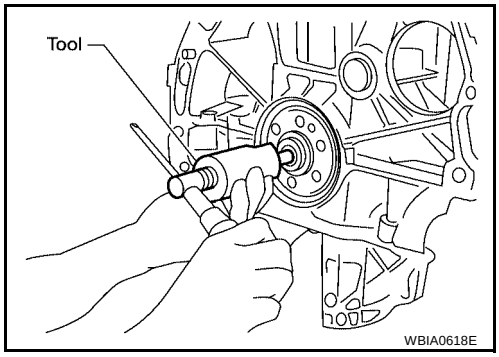


10. Remove oil pressure sensor using a suitable tool.

CAUTION:
Do not drop or shock oil pressure sensor.

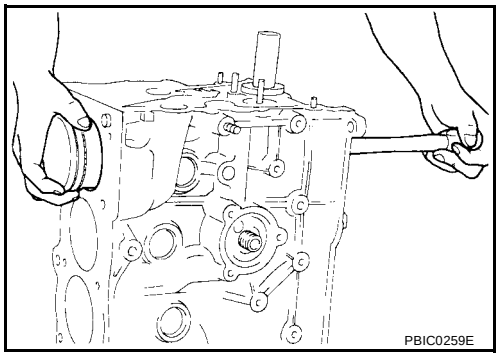
11. Remove pilot converter (A/T models) or pilot bushing (M/T models) using Tool.

Tool number : ST16610001 (J-23907)



12. Remove piston and connecting rod assembly with the following procedure:
    - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-92, "CONNECTING ROD SIDE CLEARANCE" .
13. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
14. Remove connecting rod cap.
15. Push piston and connecting rod assembly out to the cylinder head side using suitable tool.

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

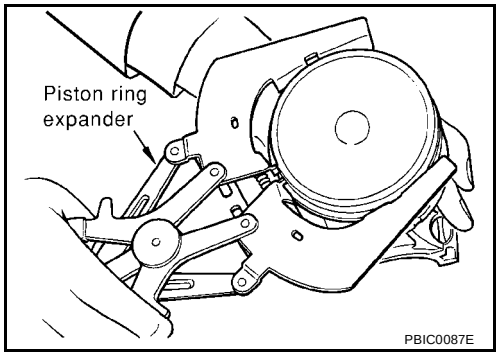


16. Remove connecting rod bearings.

CAUTION:
Identify installation positions, and store them without mixing them up.

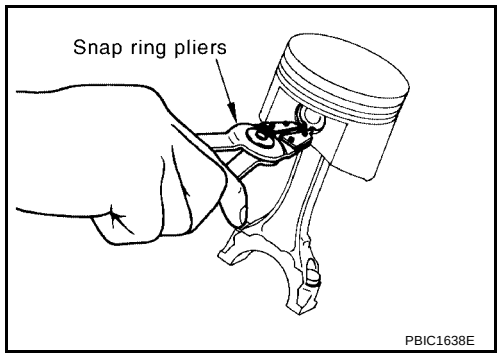
17. Remove piston rings form piston; using piston ring expander or suitable tool.
    - Before removing piston rings, check the piston ring side clearance. Refer to EM-93, "PISTON RING SIDE CLEARANCE" .

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

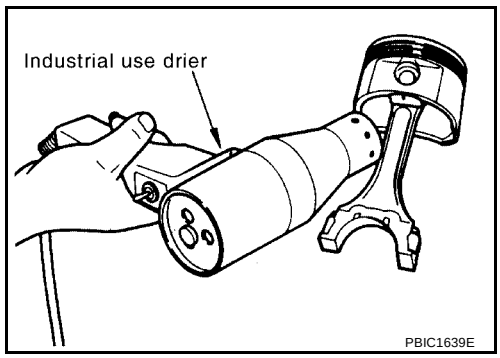


18. Remove piston from connecting rod with the following procedure:

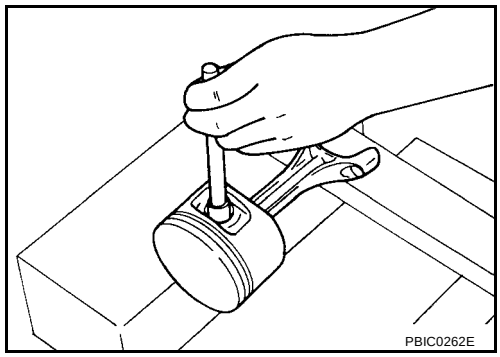
a. Remove snap rings; using suitable snap ring pliers.



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



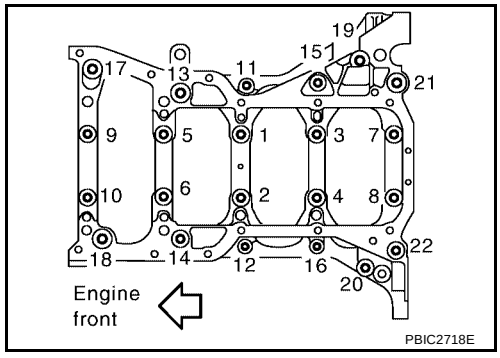
c. Push out piston pin with a stick of outer diameter approximately 19 mm (0.75 in).



19. Remove lower cylinder block bolts.

- Before loosening lower cylinder block bolts, measure crankshaft end play. Refer to EM-92, "CRANK-SHAFT END PLAY" .
- Loosen them in reverse order as shown, and remove them.

NOTE:
Use TORX socket (size E14) for bolts No. 1 to 10.



20. Remove lower cylinder block.

- Cut liquid gasket for removal; using Tool

Tool number : KV10111100 (J-37228)

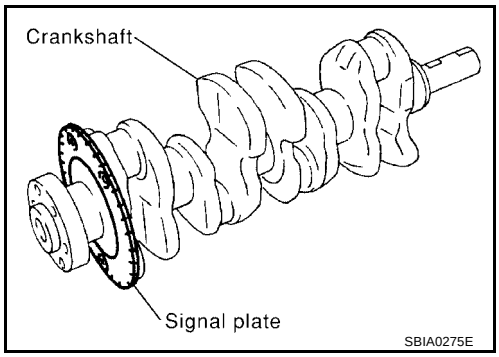
CAUTION:
Be careful not to damage the mounting surface.

21. Remove crankshaft.

CAUTION:

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

NOTE:
When removing or installing signal plate, use TORX socket (size T30).



22. Pull rear oil seal out from rear end of crankshaft.

NOTE:
When replacing rear oil seal without removing lower cylinder block, use a suitable tool to remove the oil seal installed between crankshaft and cylinder block out.

CAUTION:
Be careful not to damage crankshaft and cylinder block.

23. Remove main bearings and thrust bearings from cylinder block and lower cylinder block.

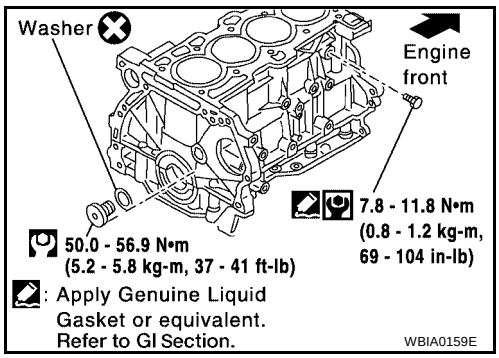
CAUTION:
Identify installation positions, and store them without mixing them up.

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.

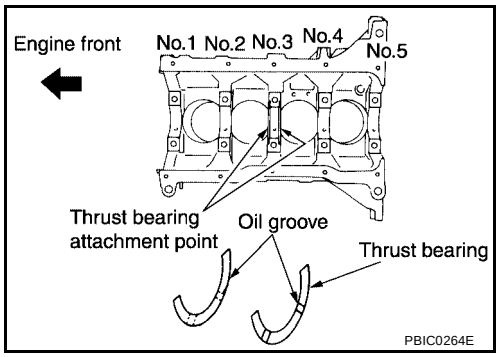
2. Apply Silicone RTV Sealant to the drain plugs. Install the drain plugs on the cylinder block.
   - Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .
   - Replace the copper washers with new ones.



3. Install the main bearings and the thrust bearings.

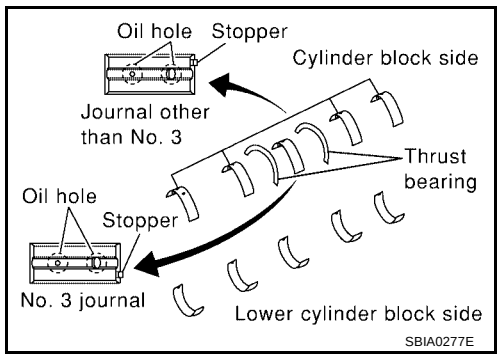
a. Remove dust, dirt, and oil from the bearing mating surfaces of the cylinder block and lower cylinder block.

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.

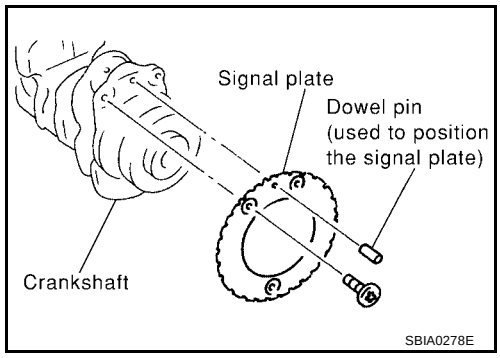
a. Position the crankshaft and signal plate using a positioning dowel pin, and tighten the signal plate bolts to specification.

Signal plate bolts : 18.5 N·m (1.9 kg-m, 14 ft-lb)

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.

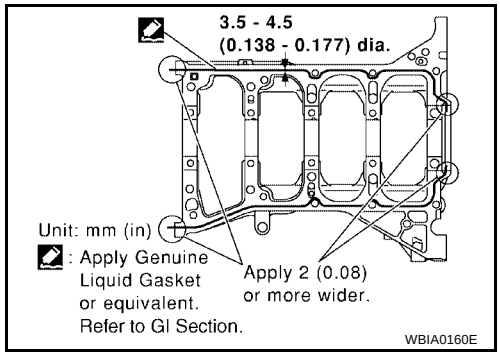
CAUTION:
Do not install rear oil seal at this time.

6. Apply Silicone RTV Sealant to positions shown and install the lower cylinder block.

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

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

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



7. Tighten lower cylinder block bolts in three steps in the order as shown; Using Tool.

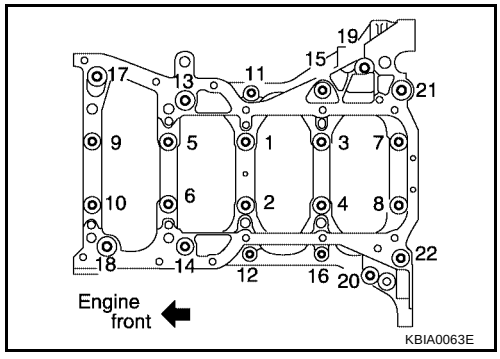
CAUTION:
There are more processes to complete the tightening of lower cylinder bolts. However stop procedure after step 1 and install rear oil seal.

Lower cylinder block bolts

Step 1 (bolts 11 - 22) : 25.1 N·m (2.6 kg-m, 19 ft-lb)

Step 2 (bolts 1 - 10) : 39.2 N·m (4.0 kg-m, 29 ft-lb)

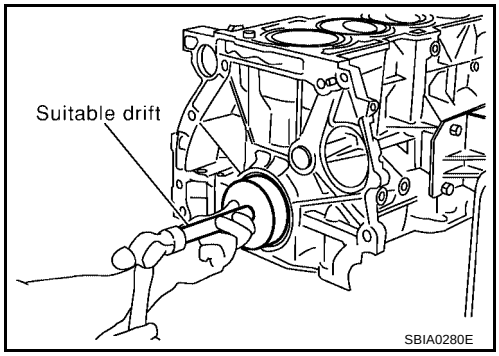
Step 3 (bolts 1 - 10) : 60° - 65° (target: 60°)

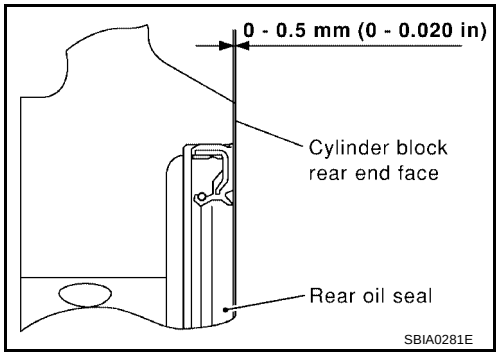


Install rear oil seal using a suitable drift.

CAUTION:

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





NOTE:

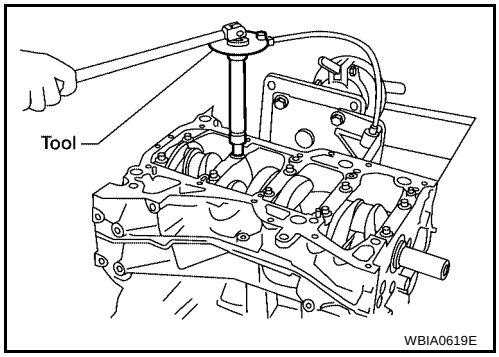
- Apply new engine oil to threads and seat surfaces of the bolts.

CAUTION:

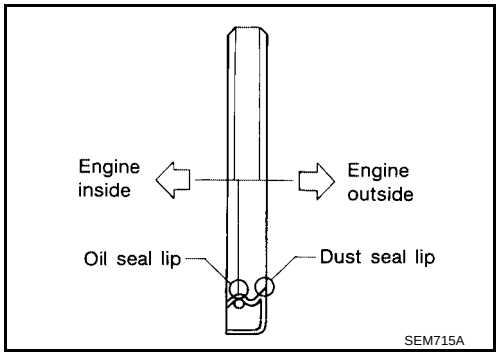
Check tightening angle using Tool. Do not tighten by visual inspection.

Tool number : KV10112100 (BT-8653-A)

- Wipe off completely any protruding Silicone RTV Sealant on the exterior of engine.
- Check crankshaft side clearance. Refer to EM-110, "CRANKSHAFT" .
- After installing the bolts, make sure that the crankshaft can be rotated smoothly by hand.



8. Apply new engine oil to new oil seal and install it using a suitable tool.
   - Install new oil seal in the direction shown.



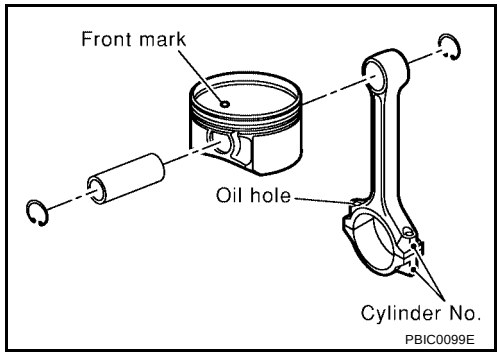
9. Install the piston to the connecting rod. Assemble the components in their original positions.

a. Using a snap ring pliers, install the snap ring into 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 in the figure.

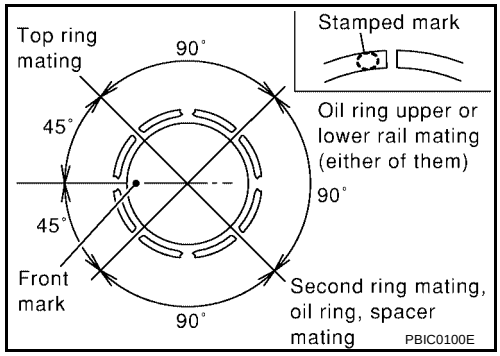
c. Install the piston pin snap ring into the front of the piston.
- Check that the connecting rod moves smoothly.



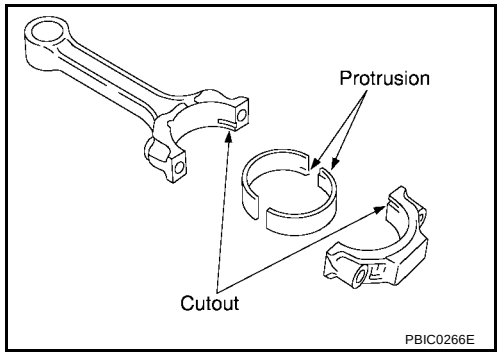
10. Using a piston ring expander, install the piston rings. Assemble the components in their original positions.

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.

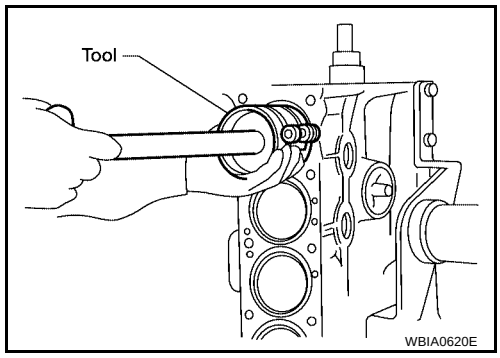
Stamped mark : 2ND (second ring)



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.

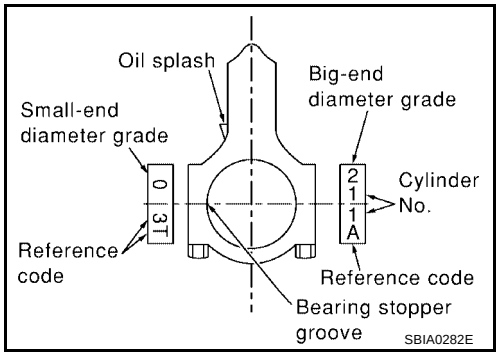


12. Install the piston and connecting rod assembly to the crankshaft. Assemble the components in their original positions.
- Rotate the crankshaft so the pin corresponding to the connecting rod to be installed is at the bottom dead center position.
- Apply engine oil sufficiently to the cylinder bore,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



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

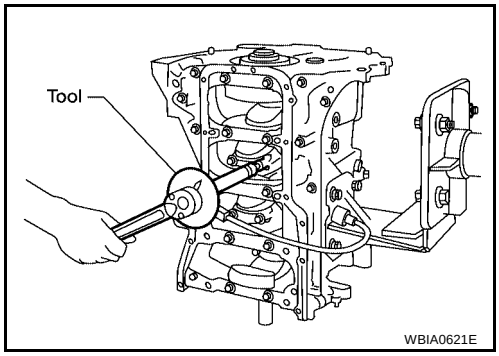
13. Install the connecting rod caps. Assemble the components in their original positions.
    - Match the stamped cylinder number marks on the connecting rod with those on the cap to install.



14. Tighten the connecting rod bolts using Tool in four steps as follows:
    - Apply engine oil to the threads and seats of the connecting rod bolts.

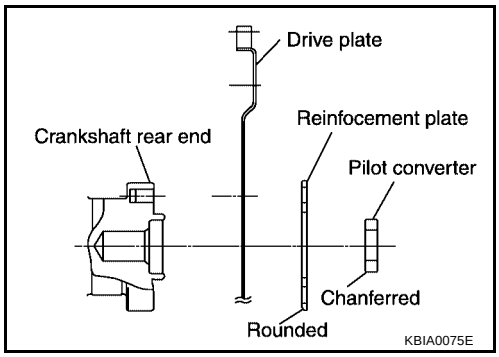
    CAUTION:
    Always use either an angle wrench or protractor. Avoid tightening based on visual check alone.

    Step 1 : 27.4 N·m (2.8 kg-m, 20 lb-ft)
    Step 2 : 0 N·m (0 kg-m, 0 lb-ft
    Step 3 : 19.6 N·m (2.0 kg-m, 14 ft-lb)
    Step 4 : 85° - 95° (target 90° degrees)



    - Check the connecting rod side clearance. Refer toEM-92, "CONNECTING ROD SIDE CLEARANCE" .
    - After tightening the bolts, make sure that the crankshaft rotates smoothly.

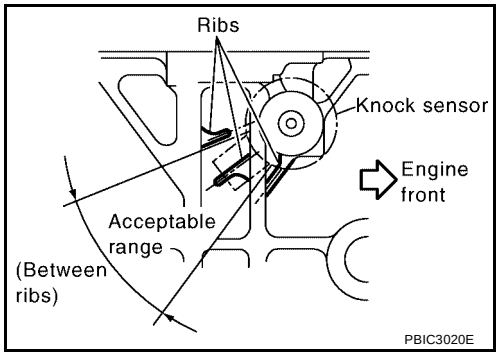
15. Install flywheel (M/T Models), or drive plate (A/T Models).
    - Install drive plate, reinforcement plate and pilot converter as shown.
    - Using a drift with 33 mm (1.30 in) diameter, push pilot converter into the end of the crankshaft.
    - Press fit pilot bushing into the crankshaft as shown; using a suitable drift of 19 mm (0.75 in)



16. Install the cylinder block heater.

    Cylinder block heater : 73.5 N·m (7.5 kg-m, 54 ft-lb)

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



    Knock sensor bolt : 21.1 N·m (2.2 kg-m, 16 ft-lb)

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

18. Install the crankshaft position sensor (POS).

Crankshaft position sensor bolt : 7.0 N·m (0.71 kg-m, 62 in-lb)

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

How to Select Piston and Bearing

EBS00NID

DESCRIPTION

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

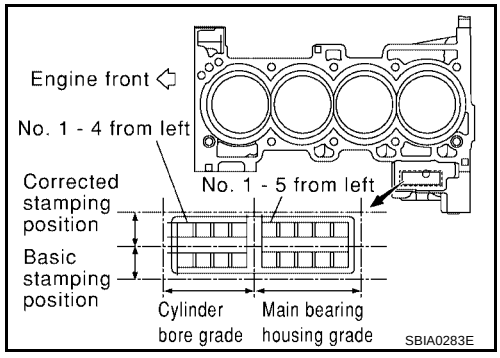
*For the service parts, the grade for fitting cannot be selected between piston pin and connecting rod. (Only grade “0” is available.) The information at the shipment from the plant is described as a reference.

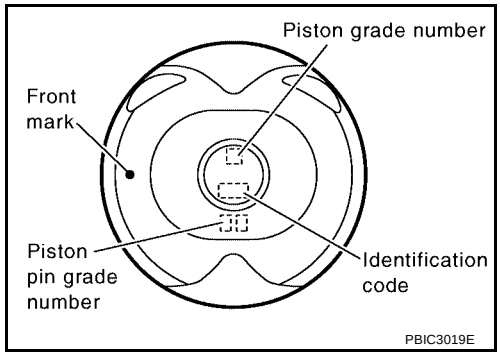
- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.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

When New Cylinder Block Is Used

- Check the cylinder bore grade on rear-left side of cylinder block, and select piston of the same grade.
- If there is a corrected stamp mark on cylinder block, use it as a correct reference.





When Cylinder Block Is Reused

1. Measure the cylinder bore inner diameter. Refer to EM-96, "Cylinder 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”.
3. Select piston of the same grade.

Piston Selection Table

Unit: mm (in)

Grade number (Mark)	2 (or no mark)	3
Cylinder bore Inner diameter	89.010 - 89.020 (3.5043 - 3.5047)	89.020 - 89.030 (3.5047 - 3.5051)
Piston skirt diameter	88.990 - 89.000 (3.5035 - 3.5039)	89.000 - 89.010 (3.5039 - 3.5043)

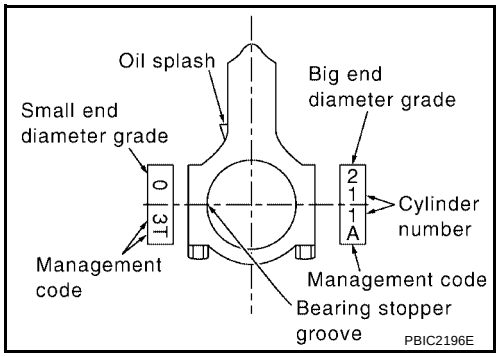
NOTE:

- There is no piston grade “1”.
- Piston is available together with piston pin as an assembly.
- The piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only grade “0” is available.)

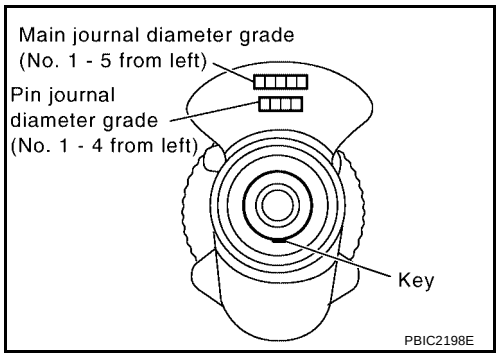
HOW TO SELECT CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft Are Used

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



2. Apply crankshaft pin journal 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 the “Connecting Rod Bearing Grade Table” to select connecting rod bearing.

When Crankshaft and Connecting Rod Are Reused

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to EM-94, "CONNECTING ROD BIG END DIAMETER" and EM-98, "CRANKSHAFT PIN JOURNAL DIAMETER" .
2. Apply the measured dimension to the “Connecting Rod Bearing Selection Table”.
3. Read the symbol at the cross point of selected row and column in the “Connecting Rod Bearing Selection Table”.
4. Apply the symbol obtained to the “Connecting Rod Bearing Grade Table” to select connecting rod bearing.

Connecting Rod Bearing Selection Table

Crankshaft pin journal diameter: Mark	Crankshaft pin journal diameter: Outer diameter Unit: mm (in)	Connecting rod big end diameter: 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)
Mark		0	1	2	3	4	5	6	7	8	9	A	B	C
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

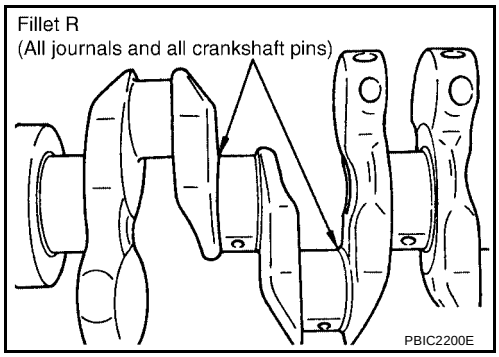
Unit: mm (in)

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

Undersize Bearings Usage Guide

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

CAUTION:
In grinding crankshaft pin to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].



Bearing undersize table

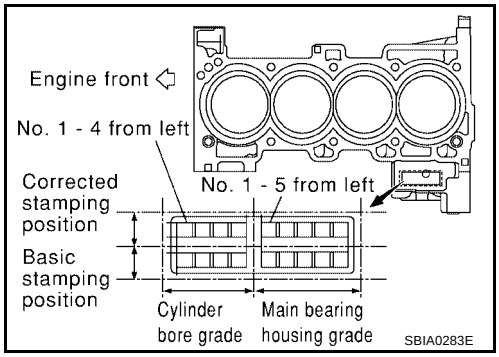
Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.624 - 1.632 (0.0639 - 0.0643)

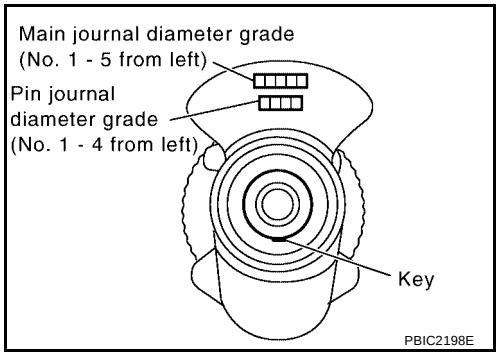
HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft Are Used

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



2. Apply main journal diameter grade stamped on crankshaft front side to column in the "Main Bearing Selection Table".



3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".

   CAUTION:
   There are two main bearing selection tables. One is for odd-numbered journals (No. 1, 3 and 5) and the other is for even-numbered journals (No. 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 the "Main Bearing Grade Table" to select main bearing.

   NOTE:
   Service part is available as a set of both upper and lower.

When Cylinder Block and Crankshaft Are Reused

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to EM-96, "MAIN BEARING HOUSING INNER DIAMETER" and EM-97, "CRANKSHAFT MAIN JOURNAL DIAMETER" .
2. Apply the measured dimension to the "Main Bearing Selection Table".

3. Read the symbol at the cross point of selected row and column in the “Main Bearing Selection Table”.

CAUTION:

There are two main bearing selection tables. One is for odd-numbered journals (No. 1, 3 and 5) and the other is for even-numbered journals (No. 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 the “Main Bearing Grade Table” to select main bearing.

NOTE:

Service part is available as a set of both upper and lower.

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

Cylinder block main bearing housing inner diameter / Crankshaft main journal 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
		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)
Mark	Outer diameter Unit: mm (in)																									
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)

Crankshaft main journal diameter: Mark	Crankshaft main journal diameter: Outer diameter Unit: mm (in)	Cylinder block main bearing housing inner 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
		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

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Main Bearing Grade Table (All Journals)

Unit: mm (in)

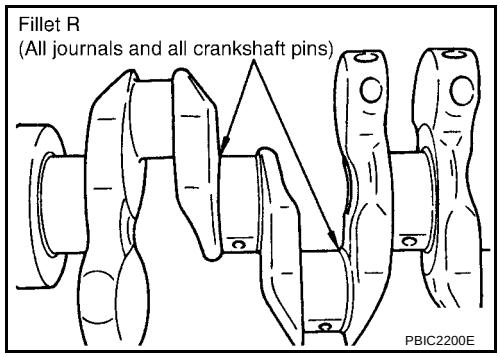
Grade number		Thickness	Identification color	Remarks
0		1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1		1.976 - 1.979 (0.0778 - 0.0779)	Brown	
2		1.979 - 1.982 (0.0779- 0.0780)	Green	
3		1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
4		1.985 - 1.988 (0.0781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

Use Undersize Bearing Usage Guide

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

CAUTION:

In grinding crankshaft main journal to use undersize bearings, keep fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].



Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.106 - 2.114 (0.0829 - 0.0832)

Inspection After Disassembly

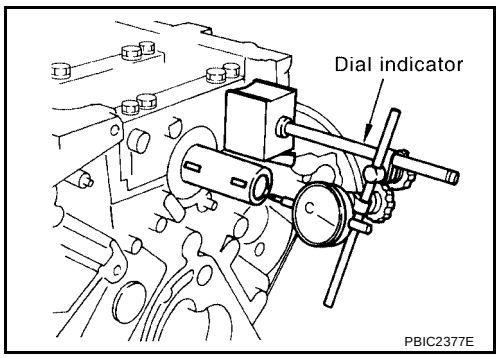
EBS00NIE

CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator.

Standard : 0.10 - 0.26 mm (0.0039 - 0.0102 in)

Limit : 0.30 mm (0.0118 in)



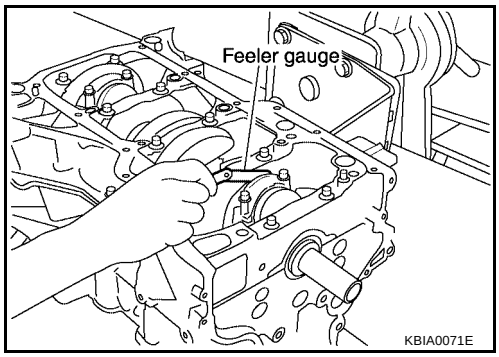
- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

CONNECTING ROD SIDE CLEARANCE

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

Standard : 0.20 - 0.25 mm (0.0079 - 0.098 in)

Limit : 0.50 mm (0.0197 in)



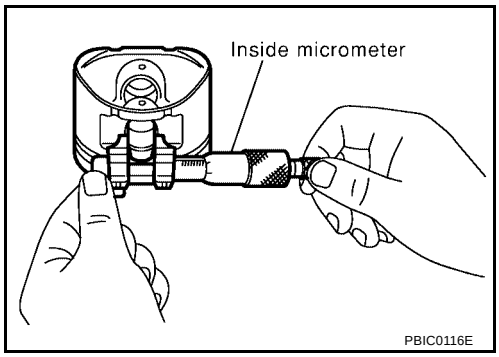
- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

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

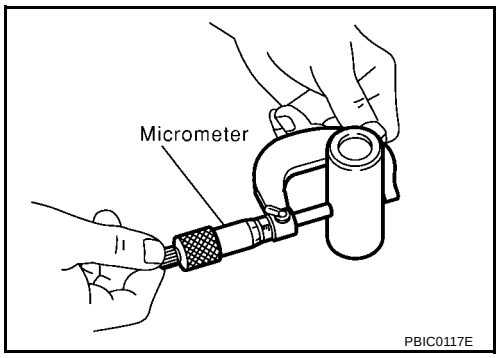
Standard: 19.993 - 20.005 mm (0.7871 - 0.7876 in)



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

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



Piston to Piston Pin Oil Clearance

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

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

- If oil clearance is out of the standard, replace piston and piston pin assembly.

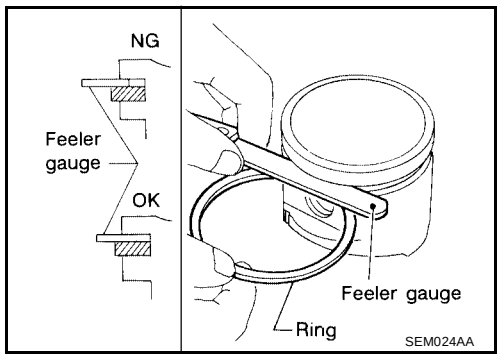
- When replacing piston and piston pin assembly, refer to EM-97, "Piston to Cylinder Bore Clearance" .

NOTE:

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

PISTON RING SIDE CLEARANCE

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



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)**

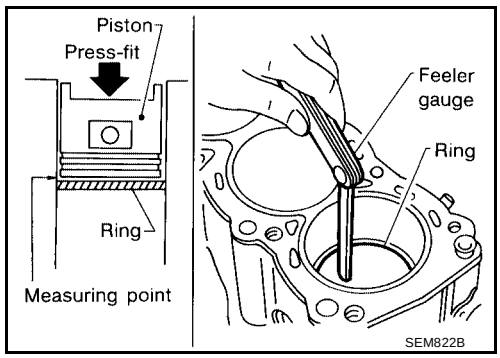
Limit:

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

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

PISTON RING END GAP

- Make sure that cylinder bore inner diameter is within the specification. Refer to EM-96, "Cylinder Bore Inner Diameter" .
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure piston ring end gap with a feeler gauge.



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 (rail ring)	**: 0.20 - 0.60 mm (0.0079 - 0.0236 in)**

Limit:

Top ring	**: 0.54 mm (0.0213 in)**
2nd ring	**: 0.65 mm (0.0256 in)**
Oil ring (rail ring)	**: 0.95 mm (0.0374 in)**

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

CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

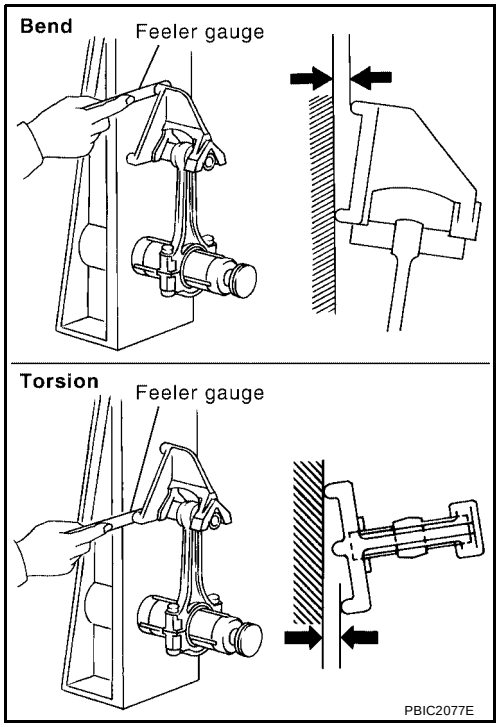
Bend:

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.

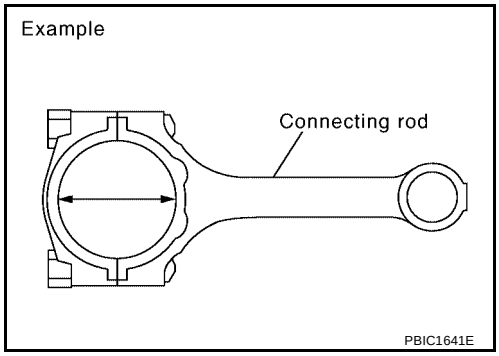


CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap without connecting rod bearing installed, and tightening connecting rod bolts to the specified torque. Refer to EM-80, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of connecting rod big end with an inside micrometer.

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

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

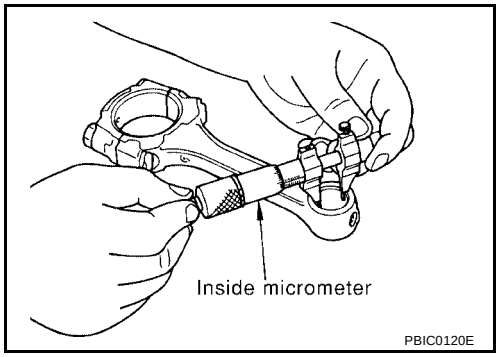


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with an inside micrometer.

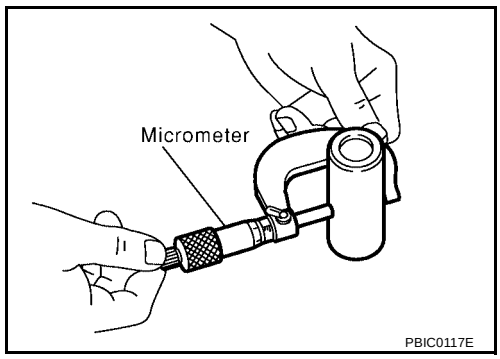
Standard: 20.000 - 20.012 mm (0.7874 - 0.7879 in)



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

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

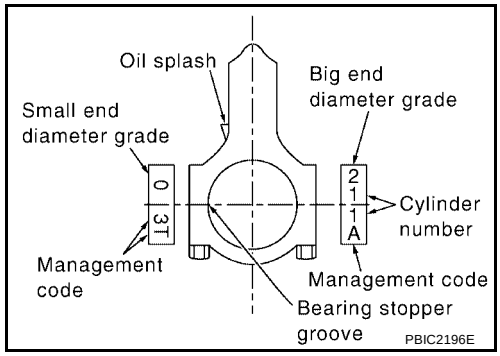


Connecting Rod Bushing Oil Clearance

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

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

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, refer to EM-96, "PISTON TO CYLINDER BORE CLEARANCE" .
- If replacing connecting rod assembly, refer to EM-98, "CONNECTING ROD BEARING OIL CLEARANCE" to select connecting rod bearing.



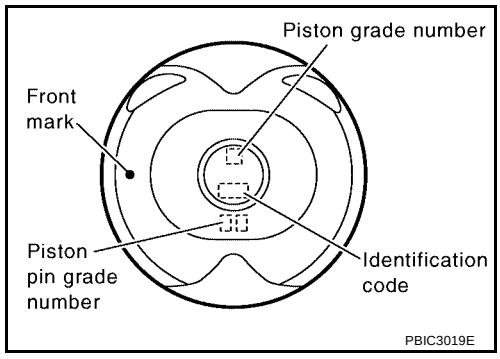
Factory installed parts grading:

- Service parts apply only to grade “0”.

Unit: mm (in)

Grade	0	1
Connecting rod bushing inner diameter*	20.000 - 20.006 (0.7874 - 0.7876)	20.006 - 20.012 (0.7876 - 0.7879)
Piston pin hole diameter	19.993 - 19.999 (0.7871 - 0.7874)	19.999 - 20. 005 (0.7874 - 0.7876)
Piston pin outer diameter	19.989 - 19.995 (0.7870 - 0.7872)	19.995 - 20.001 (0.7872 - 0.7874)

*: After installing in connecting rod.



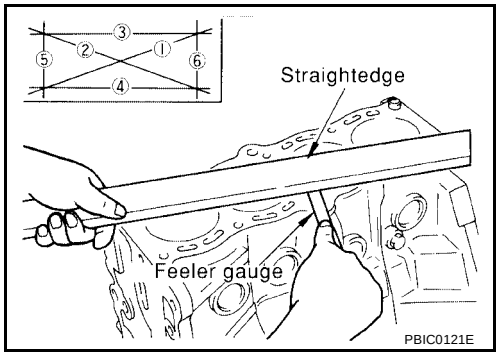
CYLINDER BLOCK DISTORTION

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

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

- Measure the distortion on the cylinder block upper face at some different points in six directions with a straight edge and a feeler gauge.

  Limit: 0.1 mm (0.004 in)



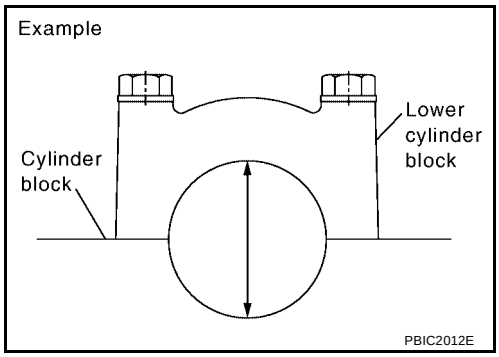
- If it exceeds the limit, replace cylinder block and lower cylinder block assembly.

  NOTE:
  Cylinder block cannot be replaced as a single, because it is machined together with lower cylinder block.

MAIN BEARING HOUSING INNER DIAMETER

- Install lower cylinder block without main bearings installed, and tighten lower cylinder block bolts to the specified torque. Refer to EM-80, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of main bearing housing with a bore gauge.

  Standard: 58.944 - 58.968 mm (2.3206 - 2.3216 in)



- If out of the standard, replace cylinder block and lower cylinder block assembly.

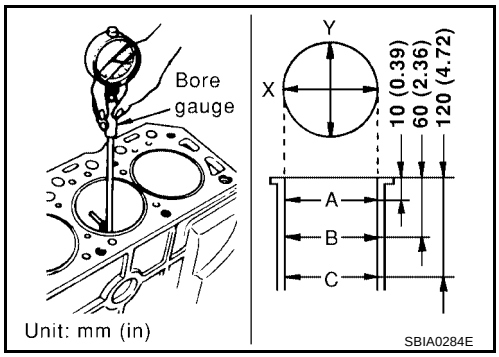
  NOTE:
  Cylinder block cannot be replaced as a single, because it is machined together with lower cylinder block.

PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

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

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



  Standard inner diameter:

  89.010 - 89.030 mm (3.5043 - 3.5051 in)

  Wear limit:

  0.2 mm (0.008 in)

  Out-of-round (Difference between “X” and “Y”):

  0.015 mm (0.0006 in)

  Taper limit (Difference between “A” and “C”):

  0.01 mm (0.0004 in)

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

  CAUTION:
  When using an oversize piston, use oversize pistons for all cylinders with oversize piston rings.

  Oversize (OS): 0.2 mm (0.008 in)

Piston Skirt Diameter

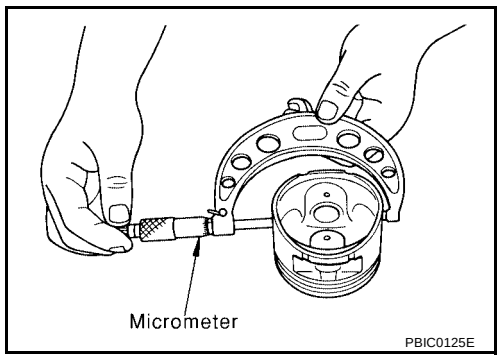
Measure the outer diameter of piston skirt with a micrometer.

Measure point

: Distance from the top 42.98 mm (1.692 in)

Standard

: 88.990 - 89.010 mm (3.5035 - 3.5043 in)



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter (direction “X”, position “B”).
(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)

Standard : 0.010 - 0.030 mm (0.0004 - 0.0012 in)

Limit : 0.08 mm (0.0031 in)

- If it exceeds the limit, replace piston and piston pin assembly. Refer to EM-85, "HOW TO SELECT PISTON" .

Re-boring Cylinder Bore

1. Cylinder bore size is determined by adding piston to cylinder bore clearance to piston skirt diameter.

   Re-bored size calculation: D = A + B - C

   where,

   D: Bored diameter

   A: Piston diameter as measured

   B: Piston - to - cylinder bore clearance (standard value)

   C: Honing allowance 0.02 mm (0.0008 in)

2. Install lower cylinder block, and tighten bolts to the specified torque. Otherwise, cylinder bores may be distorted in final assembly. Refer to EM-80, "ASSEMBLY" for the tightening procedure.
3. Cut cylinder bores.

   NOTE:
   - 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 the specified piston to cylinder bore clearance.
5. Measure the finished cylinder bore for out-of-round and taper.

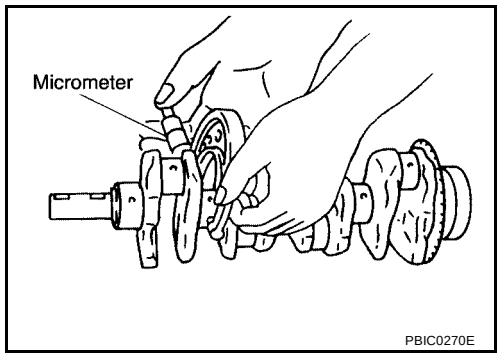
   NOTE:
   Measurement should be done after cylinder bore cools down.

CRANKSHAFT MAIN JOURNAL DIAMETER

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

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

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to EM-99, "MAIN BEARING OIL CLEARANCE" .



CRANKSHAFT PIN JOURNAL DIAMETER

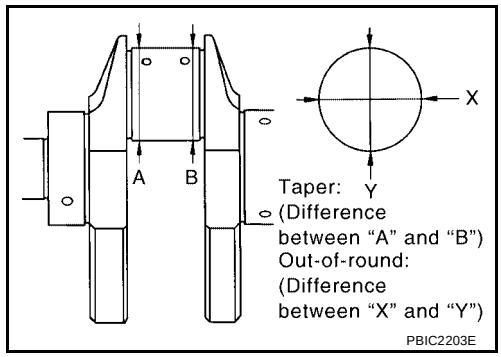
- Measure the outer diameter of crankshaft pin journal with a micrometer.

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

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to EM-98, "CONNECTING ROD BEARING OIL CLEARANCE" .

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Measure the dimensions at four different points as shown on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between “X” and “Y” at “A” and “B”.
- Taper is indicated by the difference in dimension between “A” and “B” at “X” and “Y”.



Limit:

Out-of-round (Difference between “X” and “Y”)

: 0.0025 mm (0.0001 in)

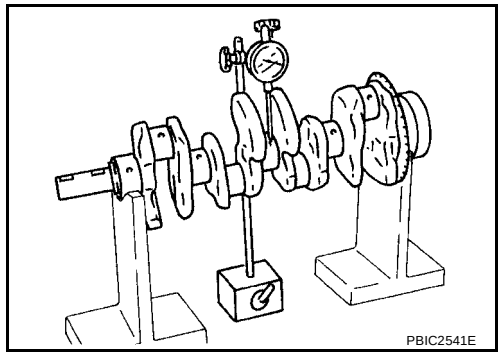
Taper (Difference between “A” and “B”)

: 0.002 mm (0.0001 in)

- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to EM-99, "MAIN BEARING OIL CLEARANCE" and/or EM-98, "CONNECTING ROD BEARING OIL CLEARANCE" .

CRANKSHAFT RUNOUT

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



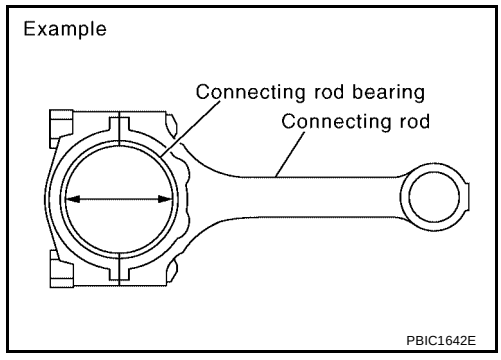
Limit : 0.05 mm (0.0020 in)

- If it exceeds the limit, replace crankshaft.

CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to EM-80, "ASSEMBLY" for tightening procedure.
- Measure the inner diameter of connecting rod bearing with an inside micrometer.
  (Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)



Standard : 0.037 - 0.055 mm (0.0015 - 0.0022 in)

- If the clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain the specified bearing oil clearance. Refer to EM-86, "HOW TO SELECT CONNECTING ROD BEARING" .

Method of Using Plastigage

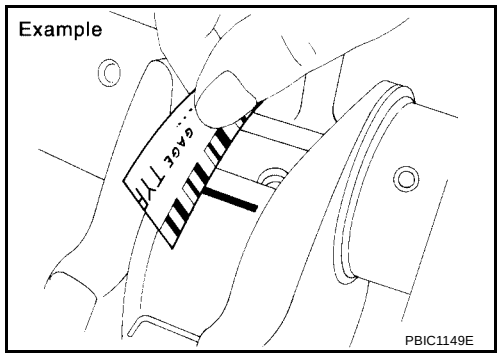
- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.

- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to EM-80, "ASSEMBLY" for the tightening procedure.

CAUTION:
Do not rotate crankshaft.

- Remove connecting rod cap and bearing, 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”.



MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Refer to EM-80, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of main bearing with a bore gauge.

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

Standard:

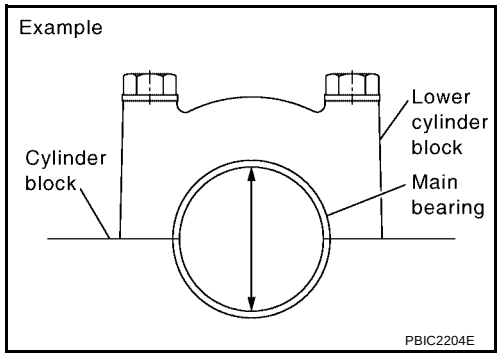
No. 1, 3 and 5 journals

: 0.028 - 0.042 mm (0.0011 - 0.0017 in)

No. 2 and 4 journals

: 0.041 - 0.056 mm (0.0016 - 0.0022 in)

Limit : 0.1 mm (0.004 in)



- If the clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain the specified bearing oil clearance. Refer to EM-88, "HOW TO SELECT MAIN BEARING" .

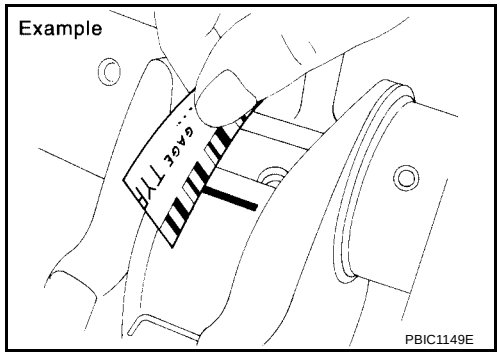
Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Refer to EM-80, "ASSEMBLY" for the tightening procedure.

CAUTION:
Do not rotate crankshaft.

- Remove lower cylinder block 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”.

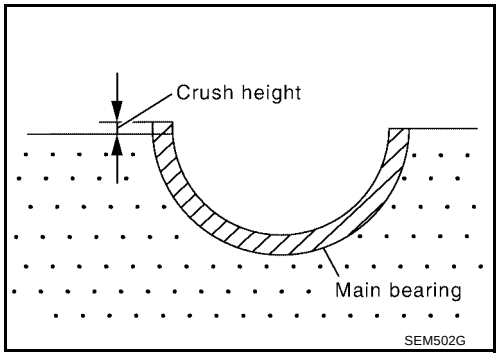


MAIN BEARING CRUSH HEIGHT

- When lower cylinder block is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to EM-80, "ASSEMBLY" for the tightening procedure.

Standard: There must be crush height.

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

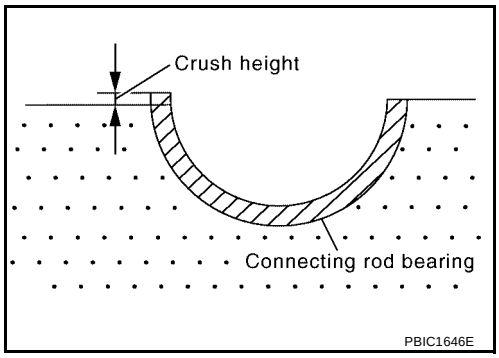


CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to EM-80, "ASSEMBLY" for the tightening procedure.

Standard: There must be crush height.

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

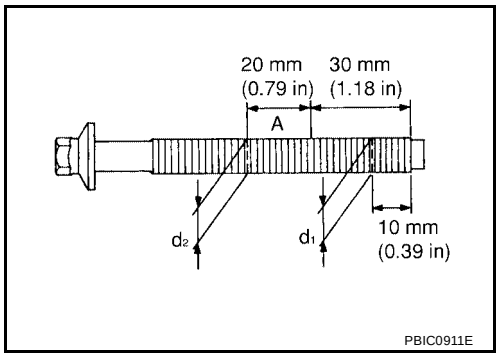


LOWER CYLINDER BLOCK MOUNTING BOLT OUTER DIAMETER

- Perform only with M10 bolts.
- Measure the outer diameters (“d_1 ”, “d_2”) at two positions as shown.
- If reduction appears in “A” range, regard it as “d_2 ”.

Limit (“d_1 ” – “d_2 ”): 0.13 mm (0.0051 in)

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

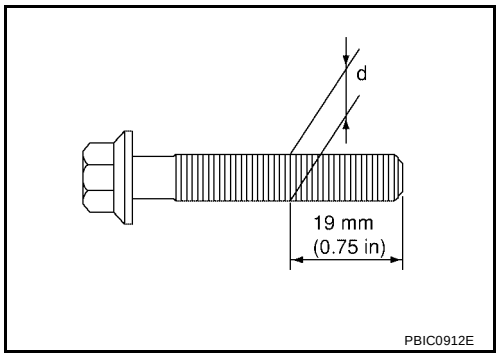


CONNECTING ROD BOLT OUTER DIAMETER

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

Limit: 7.75 mm (0.3051 in)

- When “d ” falls below the limit (when it becomes thinner), replace connecting rod bolt with a new one.



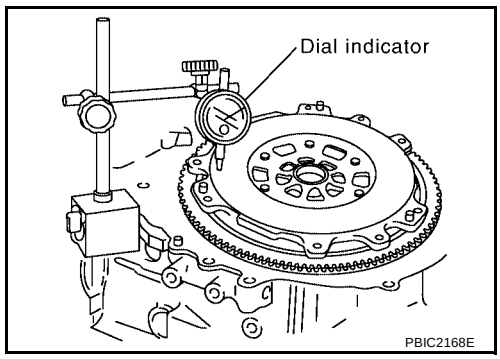
FLYWHEEL DEFLECTION (M/T MODELS)

- Measure the deflection of flywheel contact surface to clutch with a dial indicator.
- Measure the deflection at 250 mm (9.84 in) dia.

Standard : 0.45 mm (0.0177 in) or less.

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

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



MOVEMENT AMOUNT OF FLYWHEEL (M/T MODELS)

CAUTION:
Do not disassemble double mass flywheel.

Movement Amount of Thrust (Fore-and-Aft) Direction

- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

Standard : 1.3 mm (0.051 in) or less

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

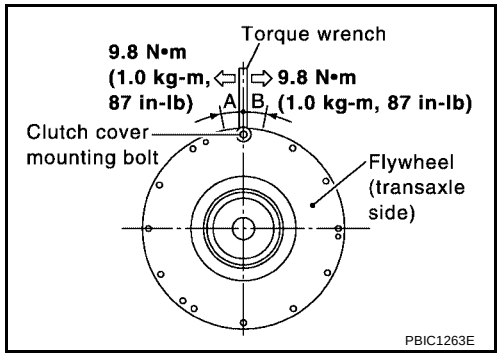
Movement Amount in Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction with the following procedure:

1. Install a bolt to clutch cover mounting hole, and place a torque wrench on the extended line of the flywheel center line.
   - Tighten bolt at a force of 9.8 N·m (1.0 kg-m, 87 in-lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of 9.8 N·m (1.0 kg-m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transmission side.
4. Measure the dimensions of movement amounts “A” and “B” on circumference of flywheel on the transmission side.

Standard: 44.3 mm (1.744 in) or less.

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



SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

Standard and Limit

EBS00NIF

GENERAL SPECIFICATIONS

Cylinder arrangement		In-line 4
Displacement cm^3 (cu in)		2,488 (151.82)
Bore and stroke mm (in)		89.0 x 100.0 (3.504 x 3.937)
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	1,304 (13.3, 189)
	Minimum	1,108 (11.3, 161)
	Differential limit between cylinders	100 (1.0, 14)

DRIVE BELT

Tension of drive belt	Auto adjustment by auto-tensioner

EXHAUST MANIFOLD AND THREE WAY CATALYST ASSEMBLY

Unit: mm (in)

Item	Limit
Surface distortion	0.3 (0.012)

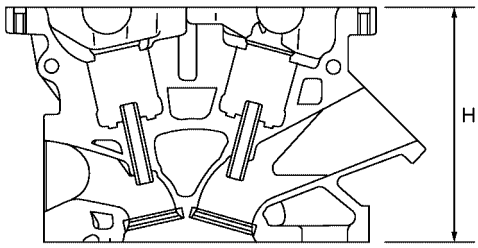
SPARK PLUG

Make	NGK
Standard type	PLZKAR6A–11
Hot type	PLZKAR5A–11
Cold type	PLZKAR7A–11
Gap (nominal)	1.1 mm (0.043 in)

CYLINDER HEAD

Unit: mm (in)

Items	Limit
Head surface distortion	0.1 (0.004)

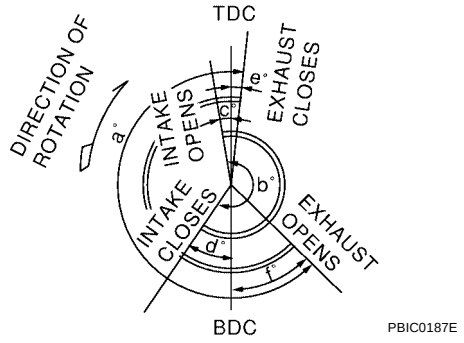


Nominal cylinder head height:
H = 129.4 mm (5.09 in)

PBIC0283E

VALVE

Valve Timing

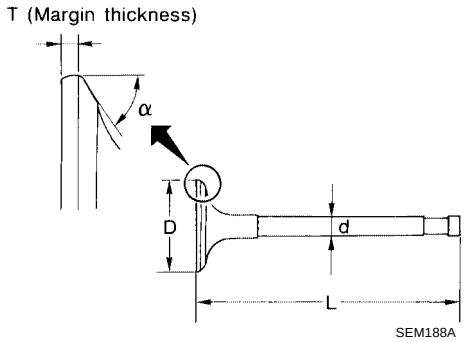
Valve timing	 PBIC0187E

Unit: degree

a	b	c	d	e	f
236	224	-4	60	32	37

Valve Dimensions

Unit: mm (in)



SEM188A

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)

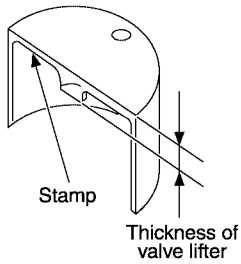
Valve Clearance

Unit: mm (in)

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

*: Approximately 80°C (176°F)

Available Valve Lifter

Thickness mm (in)	Identification mark
 KBIA0119E	
6.96 (0.2740)	696
6.98 (0.2748)	698
7.00 (0.2756)	700
7.02 (0.2764)	702
7.04 (0.2772)	704
7.06 (0.2780)	706
7.08 (0.2787)	708
7.10 (0.2795)	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
7.44 (0.2929)	744
7.46 (0.2937)	746

Valve Spring

Items	Intake	Exhaust
Free height	44.84 - 45.04 mm (1.7654 - 1.7732 in)	45.28 - 45.48 mm (1.7827 - 1.7905 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, 34 - 39 lb)	151 - 175 N (15.4 - 17.8 kg, 34 - 39 lb)
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, 80 - 92 lb)	325 - 371 N (33.1 - 37.8 kg, 73 - 83 lb)
Identification color	Blue	Yellow

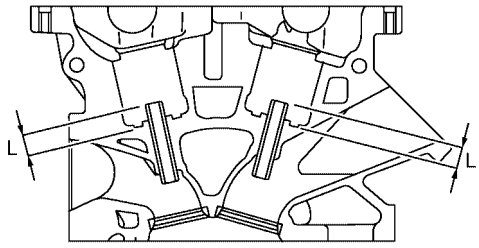
Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	33.965 - 33.980 (1.3372 - 1.3378)
Valve lifter hole diameter	34.000 - 34.021 (1.3386 - 1.3394)
Valve lifter clearance	0.020 - 0.056 (0.0008 - 0.0022)

Valve Guide

Unit: mm (in)

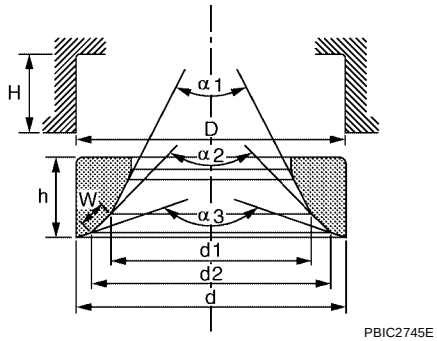


PBIC0184E

Items		Standard part	Service part
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)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.003)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.004)
Projection length “L”	Intake	10.1 - 10.3 (0.398 - 0.406)	
	Exhaust	10.0 - 10.4 (0.394 - 0.409)	

Valve Seat

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize [0.5 (0.02)] (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 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)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.084 - 0.116 (0.0033 - 0.0046)	
Diameter “d1”*1	Intake	33.5 (1.319)	
	Exhaust	28.0 (1.102)	
Diameter “d2”*2	Intake	35.1 - 35.3 (1.382 - 1.390)	
	Exhaust	29.9 - 30.1 (1.177 - 1.185)	
Angle “α1”	Intake	60°	
	Exhaust	60°	
Angle “α2”	Intake	88°45′ - 90°15′	
	Exhaust	88°45′ - 90°15′	
Angle “α3”	Intake	120°	
	Exhaust	120°	
Contacting width “W”*3	Intake	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.25 - 1.55 (0.0492 - 0.0610)	
Height “h”	Intake	5.9 - 6.0 (0.232 - 0.236)	5.0 - 5.1 (0.197 - 0.201)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.91 - 5.01 (0.1933 - 0.1972)
Depth “H”		6.0 (0.236)	

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

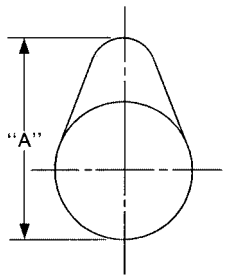
*2 : Diameter made by intersection point of conic angles α2 and α3

*3 : Machining data

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Items		Standard	Limit
Camshaft journal oil clearance		0.045 - 0.086 (0.0018 - 0.0034)	—
Camshaft bracket inner diameter	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 outer diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	23.435 - 23.455 (0.9226 - 0.9234)	—
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	—
Camshaft cam height "A"	Intake	45.015 - 45.205 (1.7722 - 1.7797)	0.2 (0.008)*1
	Exhaust	43.975 - 44.165 (1.7313 - 1.7388)	
Camshaft runout [TIR*2]		Less than 0.02 (0.0008)	—
Camshaft sprocket runout [TIR*2]		—	0.15 (0.0059)



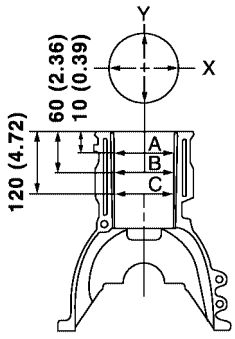
SEM671

*1 : Cam wear limit

*2 : Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



PBIC0281E

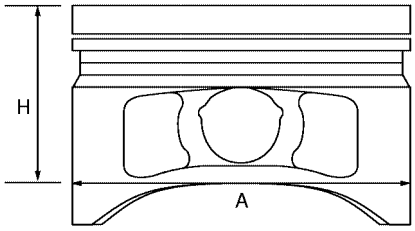
Surface distortion		Limit		0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)
			Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)
		Wear limit		0.2 (0.008)
Out-of-round (Difference between "X" and "Y")		Limit		0.015 (0.0006)
Taper (Difference between "A" and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

Main bearing housing inner diameter grade		Grade No. A	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. 2	88.990 - 89.000 (3.5035 - 3.5039)
		Grade No. 3	89.000 - 89.010 (3.5039 - 3.5043)
		0.20 (0.008) oversize (Service)	89.180 - 89.210 (3.5110 - 3.5122)
Piston height “H” dimension			42.98 (1.692)
Piston pin hole diameter		Grade No. 0	19.993 - 19.999 (0.7871 - 0.7874)
		Grade No. 1	19.999 - 20.005 (0.7874 - 0.7876)
Piston to cylinder bore clearance		Standard	0.010 - 0.030 (0.0004 - 0.0012)
		Limit	0.08 (0.0031)

Piston Ring

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil ring (rail 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 (0.0146 - 0.0205)	0.65 (0.0257)
	Oil ring (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)
Piston to piston pin oil clearance	Standard	0.002 - 0.006 (0.0001 - 0.0002)
Connecting rod bushing oil clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)

CONNECTING ROD

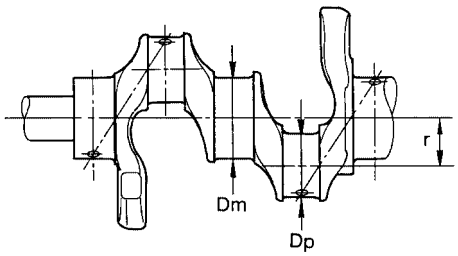
Unit: mm (in)

Center distance		143.00 - 143.10 (5.630 - 5.634)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter*	Grade No. 0	20.000 - 20.006 (0.7874 - 0.7876)
	Grade No. 1	20.006 - 20.012 (0.7876 - 0.7879)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.50 (0.0197)
Connecting rod big end diameter	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 - 1.8900)
	Grade No. 5	48.005 - 48.006 (1.8900 - 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)

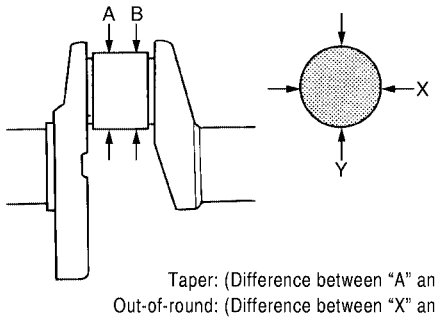
*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)



SEM645



SBIA0535E

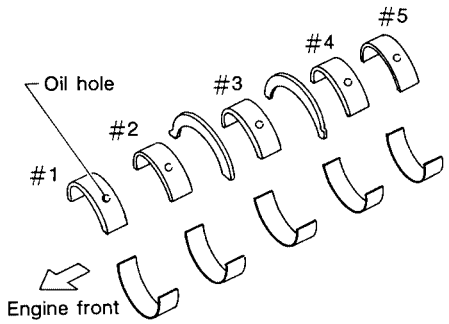
Center distance “r”		49.96 - 50.04 (1.9669 - 1.9701)
Out-of-round (Difference between “X” and “Y”)	Limit	0.0025 (0.0001)
Taper (Difference between “A” and “B”)	Limit	0.0025 (0.0001)
Runout [TIR*]	Limit	0.05 (0.0020)
Crankshaft end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (0.0118)

Pin journal diameter grade. “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 diameter grade. “Dm”	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)

*: Total indicator reading

MAIN BEARING

Unit: mm (in)



SEM685D

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

Undersize

Unit: mm (in)

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

Bearing Oil Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	No. 1, 3 and 5	0.028 - 0.042 (0.0011 - 0.0017)
		No. 2 and 4	0.041 - 0.056 (0.0016 - 0.0022)
	Limit		0.1 (0.004)

CONNECTING ROD BEARING

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

Undersize

Unit: mm (in)

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

Bearing Oil Clearance

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.037 - 0.055 (0.0015 - 0.0022)
	Limit	0.10 (0.0039)

PRECAUTIONS

PFP:00001

Precautions for Supplemental Restraint System (SRS) “AIR BAG” and “SEAT BELT PRE-TENSIONER”

EBS00T37

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

WARNING:

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

Precautions for Drain Engine Coolant

EBS00P44

Drain engine coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS00P45

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

Precautions for Removal and Disassembly

EBS00P46

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- 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 re-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 in the step.

Precautions for Inspection, Repair and Replacement

EBS00P47

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

Precautions for Assembly and Installation

EBS00P48

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

Parts Requiring Angle Tightening

EBS00P49

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

Tool number : KV10112100 (BT-8653-A)

- Cylinder head bolts
- Lower cylinder block bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No angle wrench is required as bolt flange is provided with notches for angle tightening)

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

Precautions for Liquid Gasket

EBS00P4A

REMOVAL OF LIQUID GASKET SEALING

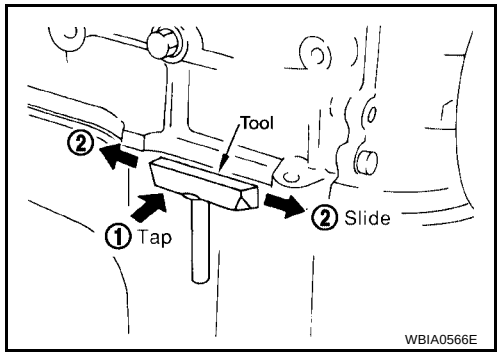
- After removing nuts and bolts, separate the mating surface and remove old liquid gasket sealing using Tool.

Tool number : KV10111100 (J-37228)

CAUTION:
Be careful not to damage the mating surfaces.

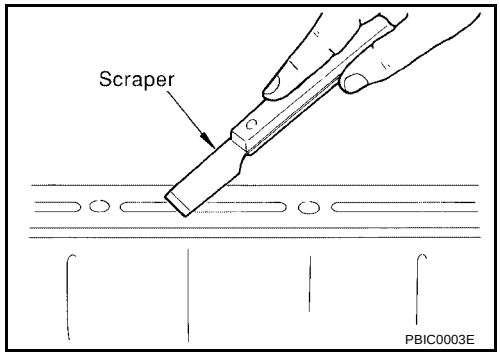
- Tap seal cutter to insert it, and then slide it by tapping on the side as shown.
- In areas where Tool is difficult to use, use plastic hammer to lightly tap the parts, to remove it.

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



LIQUID GASKET APPLICATION PROCEDURE

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

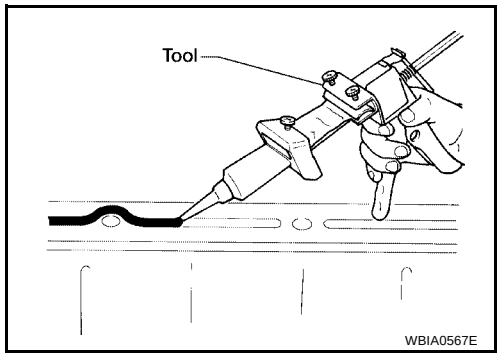


3. Attach liquid gasket tube to Tool.

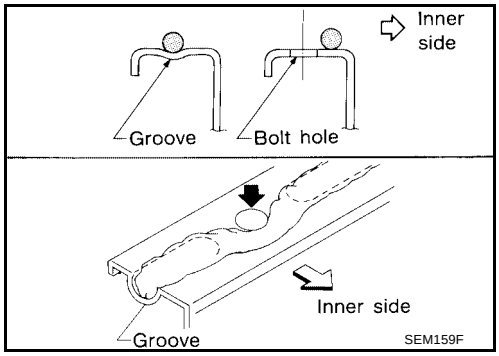
Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

4. Apply liquid gasket without breaks to the specified location with the specified dimensions.
   - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



- As for bolt holes, normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten nuts or bolts after the installation.
- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.



CAUTION:

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

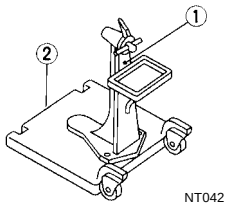
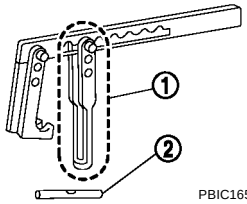
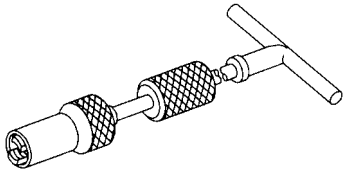
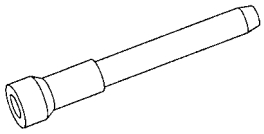
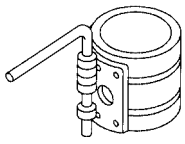
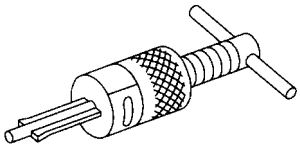
PREPARATION

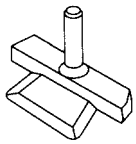
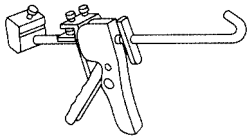
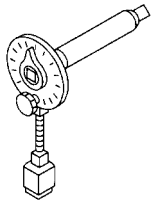
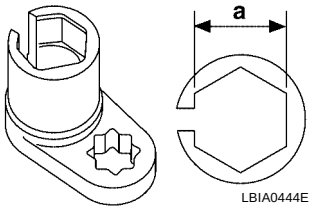
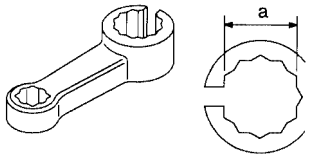
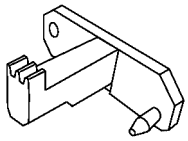
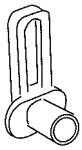
PFP:00002

Special Service Tools

EBS00P4B

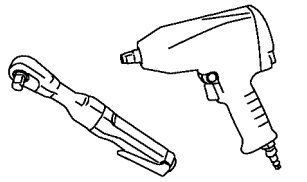
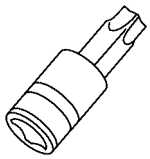
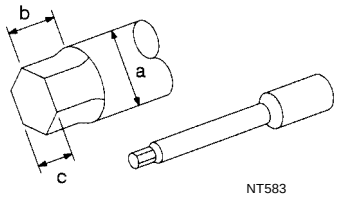
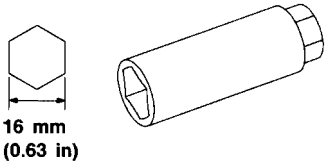
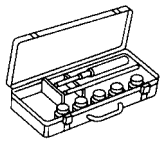
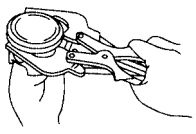
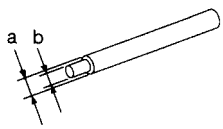
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

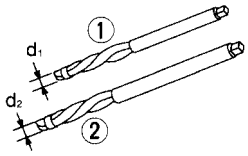
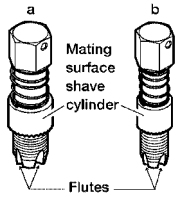
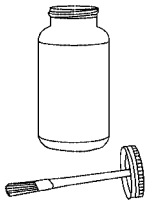
Tool number (Kent-Moore No.) Tool name		Description
ST0501S000 (—) Engine stand assembly 1. ST05011000 (—) Engine stand 2. ST05012000 (—) Base	 NT042	Disassembling and assembling engine
KV10116200 (J-26336-A) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2.KV10109220 (—) Adapter	 PBIC1650E	Disassembling valve mechanism Part (1) is a component of KV10116200 (J-26336-A), but Part (2) is not so.
KV10107902 (J-38959) Valve oil seal puller	 NT011	Replacing valve oil seal
— (J-39386) Valve oil seal drift	 NT024	Installing valve oil seal
EM03470000 (J-8037) Piston ring compressor	 NT044	Installing piston assembly into cylinder bore
ST16610001 (J-23907) Pilot bushing puller	 NT045	Removing pilot converter (A/T models)

Tool number (Kent-Moore No.) Tool name	Description
KV10111100 (J-37228) Seal cutter  NT046	Removing oil pan (lower and upper), front and rear timing chain case, etc.
WS39930000 (—) Tube presser  NT052	Pressing the tube of liquid gasket
KV10112100 (BT-8653-A) Angle wrench  NT014	Tightening bolts for bearing cap, cylinder head, etc. in angle
— (J-44626) Air fuel sensor Socket  LBIA0444E	Loosening or tightening air fuel ratio A/F sensor **a: 22 mm (0.87 in)**
KV10114400 (J-38365) Heated oxygen sensor wrench  NT636	Loosening or tightening heated oxygen sensor 1 **a: 22 mm (0.87 in)**
KV10117700 (J-44716) Ring gear stopper  NT822	Removing and installing crankshaft pulley
— (J-45488) Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)

Commercial Service Tools

EBS00P4C

(Kent-Moore No.) Tool name	Description
(—) Power tool  PBIC0190E	Loosening nuts and bolts
(—) TORX socket  PBIC1113E	Removing and installing flywheel **Size: T55**
(J-24239-01) Cylinder head bolt wrench  NT583	Loosening and tightening cylinder head bolt, and used with angle wrench [SST: KV10112100 (BT-8653-A)] **a: 13 (0.51) dia.** **b: 12 (0.47)** **c: 10 (0.39)** Unit: mm (in)
(—) 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 and Exhaust:** **a: 9.5 mm (0.374 in) dia.** **b: 5.5 mm (0.217 in) dia.**

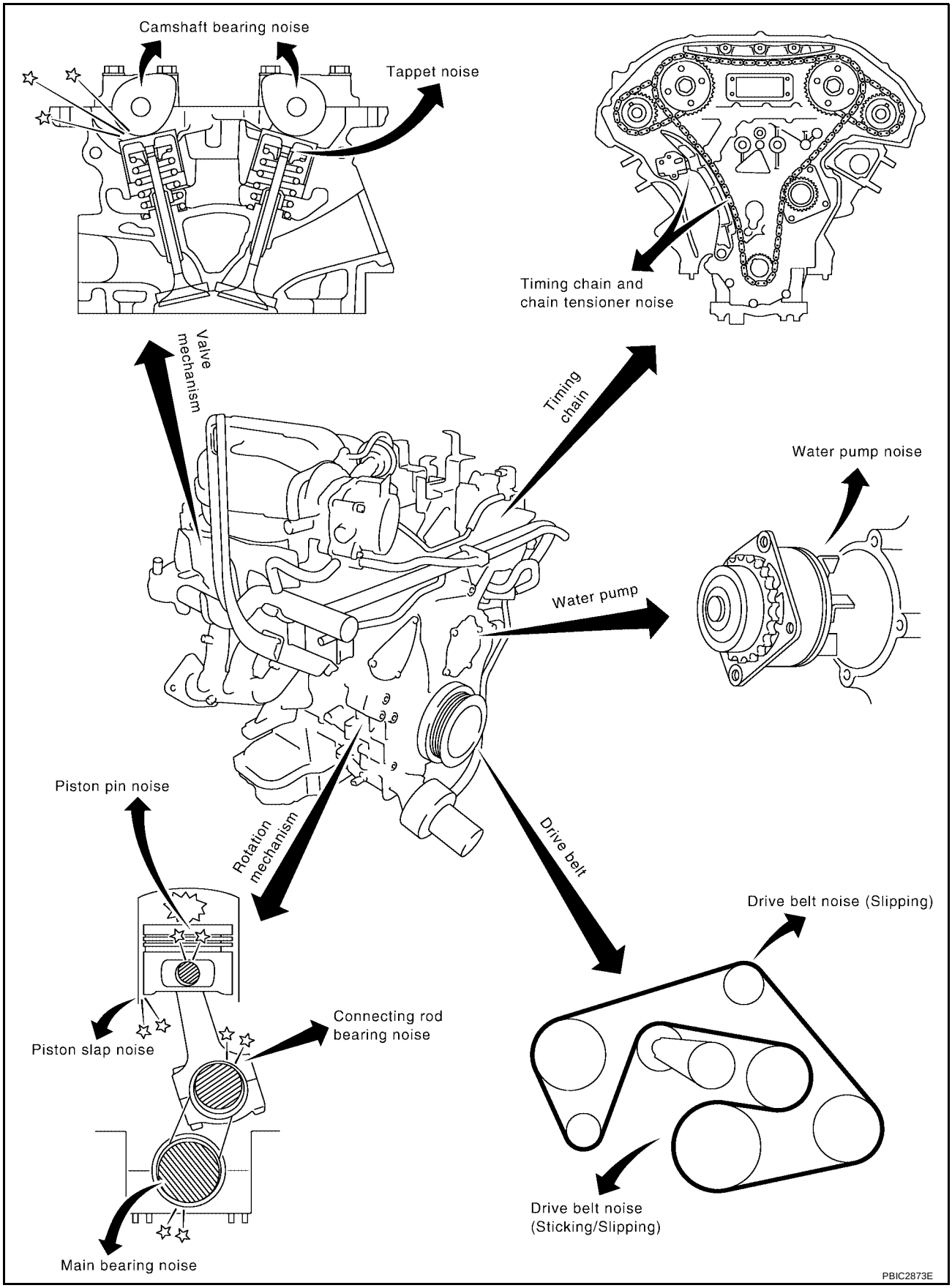
(Kent-Moore No.) Tool name		Description
(—) Valve guide reamer	 NT016	(1): Reaming valve guide inner hole (2): Reaming hole for oversize valve guide **Intake and Exhaust:** **d_1 : 6.0 mm (0.236 in) dia.** **d_2 : 10.2 mm (0.402 in) dia.**
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner	 AEM488	Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.) **a: J-43897-18 [18 mm (0.71 in) dia.] for zirconia heated oxygen sensor** **b: J-43897-12 [12 mm (0.47 in) dia.] for titania heated oxygen sensor**
(—) 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

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting —Engine Noise

EBS00P4D



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

EBS00P4E

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-194
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft runout Camshaft journal oil clearance	EM-187 EM-187
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	EM-233 EM-235
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-237 EM-234 EM-234 EM-235
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-235 EM-239
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-240 EM-239
Front of engine Timing chain case	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-173 EM-165
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-124
	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-49

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

ENGINE ROOM COVER

PFP:14049

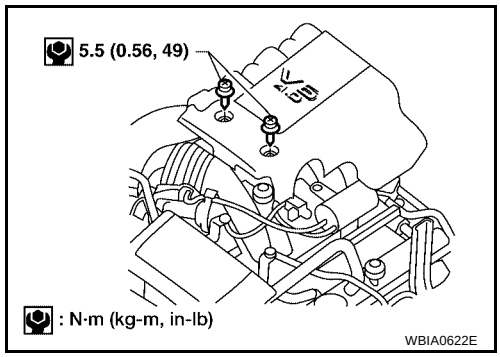
Removal and Installation

EBS00P4F

REMOVAL

1. Remove bolts using power tool.
2. Lift up on engine cover firmly to dislodge snap fit mounts.

CAUTION:
Do not damage or scratch cover when installing or removing.



INSTALLATION

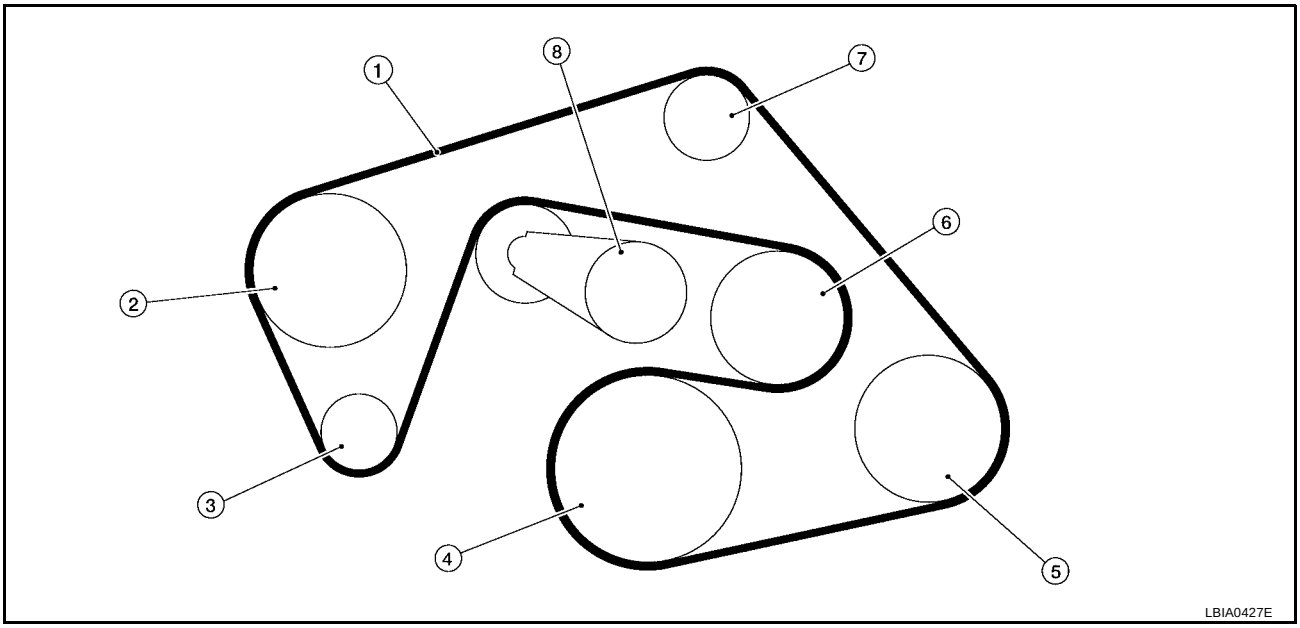
Installation is in the reverse order of removal.

DRIVE BELTS

PFP:02117

Checking Drive Belts

EBS00P4G



1. Drive belt
2. Power steering oil pump pulley
3. Generator pulley
4. Crankshaft pulley
5. A/C compressor
6. Cooling fan pulley
7. Idler pulley
8. Drive belt auto-tensioner

WARNING:

Be sure to perform when the engine is stopped.

1. Remove air duct and resonator assembly (inlet) when inspecting drive belt. Refer to EM-126, "REMOVAL" .
2. Visually check entire belt for wear, damage or cracks.

Tension Adjustment

EBS00P4H

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

Removal and Installation

EBS00P4I

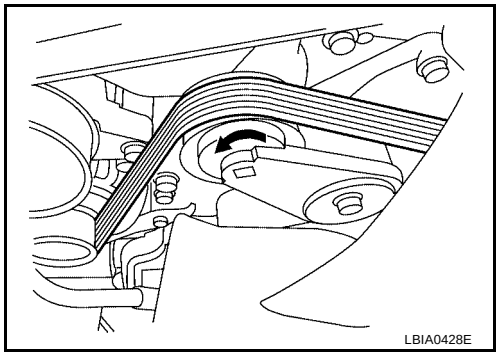
DRIVE BELT

Removal

1. Remove air duct and resonator assembly (inlet). Refer to EM-126, "REMOVAL" .
2. Rotate the drive belt auto-tensioner in the direction of arrow (loosening direction of tensioner) as shown, using suitable tool.

   CAUTION:

   Avoid placing hand in a location where pinching may occur if the tool accidentally comes off.
3. Remove the drive belt.



INSTALLATION

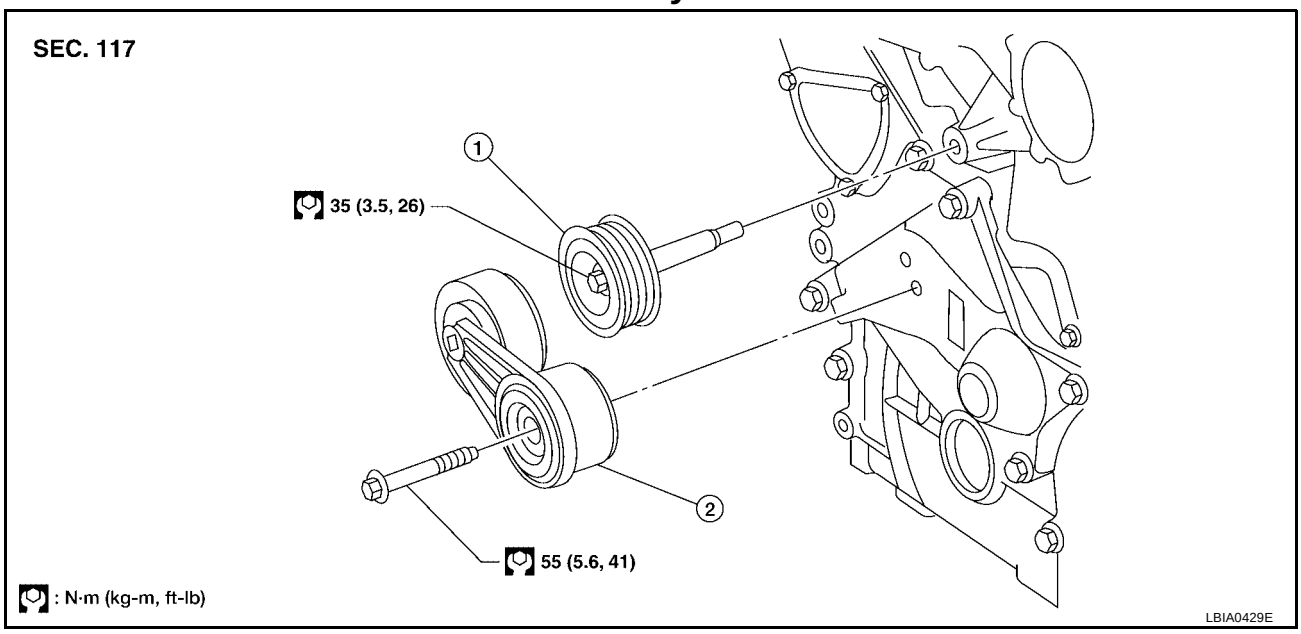
Installation is in the reverse order of removal.

CAUTION:

Make sure belt is securely installed around all pulleys.

Drive Belt Auto-Tensioner and Idler Pulley

EBS00P4J



1. Idler pulley
2. Drive belt auto-tensioner

REMOVAL

1. Remove the air duct and resonator assembly (inlet). Refer to EM-126, "REMOVAL" .
2. Remove the drive belt. Refer to EM-124, "Removal" .
3. Remove the radiator cooling fan assembly. Refer to CO-47, "REMOVAL" .
4. Remove the drive belt auto-tensioner and idler pulley using power tool.

INSTALLATION

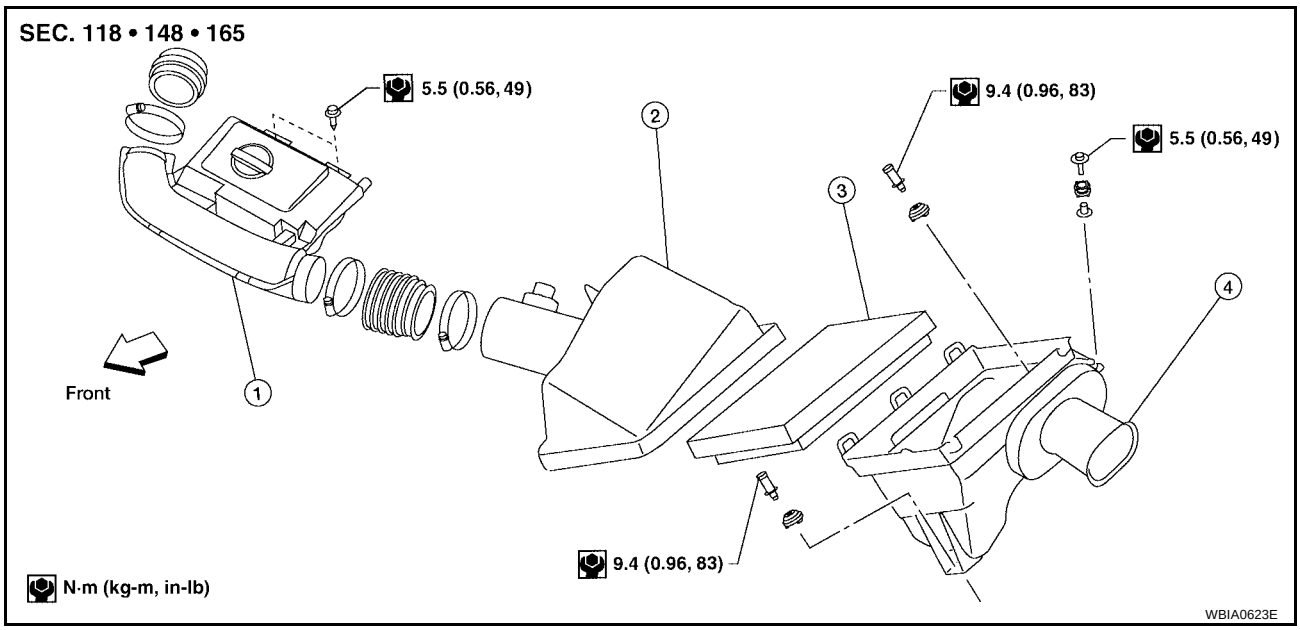
Installation is in the reverse order of removal.

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

EBS00P4K



1. Air duct and resonator
2. Air cleaner case (upper)
3. Air cleaner filter
4. Air cleaner case (lower)

REMOVAL

1. Disconnect harness connector from mass air flow sensor.
2. Disconnect PCV hose.
3. Remove air cleaner case/mass air flow sensor assembly and air duct assembly disconnecting their joints.
   - Add marks as necessary for easier installation.

CAUTION:

Handle mass air flow sensor with care.

- **Do not shock it.**
- **Do not disassemble it.**
- **Do not touch its sensor.**

INSPECTION AFTER REMOVAL

Inspect air duct for crack or tear.

- If anything found, replace air duct.

INSTALLATION

Installation is in the reverse order of removal.

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

Changing Air Cleaner Filter

EBS00P4L

REMOVAL

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

INSTALLATION

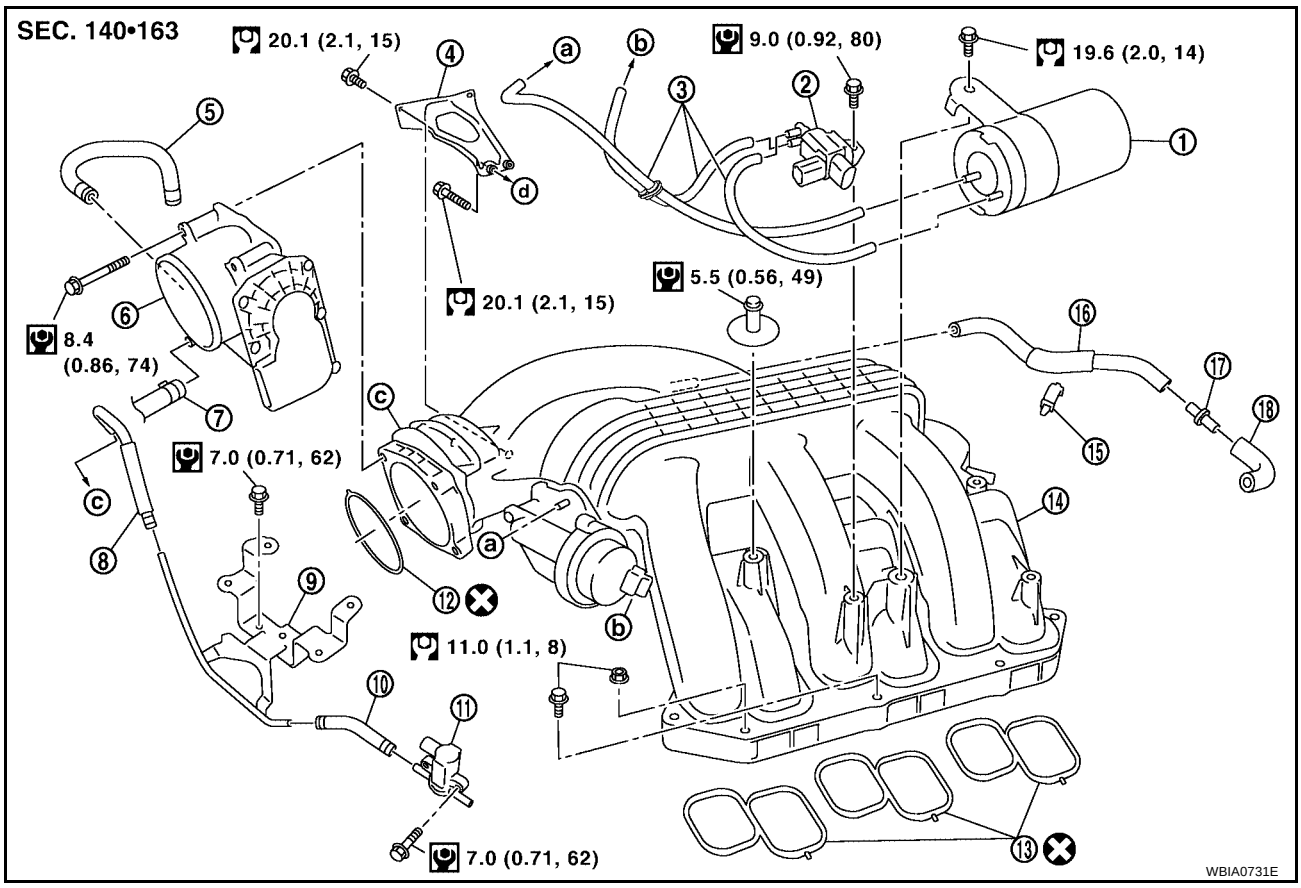
Installation is in the reverse order of removal.

INTAKE MANIFOLD COLLECTOR

PFP:14003

Removal and Installation

EBS00P4M



1.	Vacuum tank	2.	VIAS control solenoid valve	3.	Vacuum hose
4.	Intake manifold collector support	5.	Water hose	6.	Electric throttle control actuator
7.	Water hose	8.	EVAP hose	9.	Bracket
10.	EVAP hose	11.	EVAP canister purge volume control solenoid valve	12.	Gasket
13.	Gasket	14.	Intake manifold collector	15.	Clip
16.	PCV hose	17.	Connector	18.	PCV hose
a.	To intake manifol collector	b.	To power valve	c.	To throttle body
d.	To cylinder head (RH bank)				

REMOVAL

WARNING:

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

1. Remove engine cover. Refer to EM-123, "REMOVAL" .
2. Remove air cleaner case (upper) with mass air flow sensor and air duct assembly. Refer to EM-126, "REMOVAL" .
3. Remove electric throttle control actuator as follows:

a. Drain engine coolant, or when water hoses are disconnected, attach plug to prevent engine coolant leakage. Refer to CO-39, "Changing Engine Coolant" .

CAUTION:

- **Perform when engine is cold.**
- **Do not spill engine coolant on drive belt.**

b. Disconnect water hoses from electric throttle control actuator.

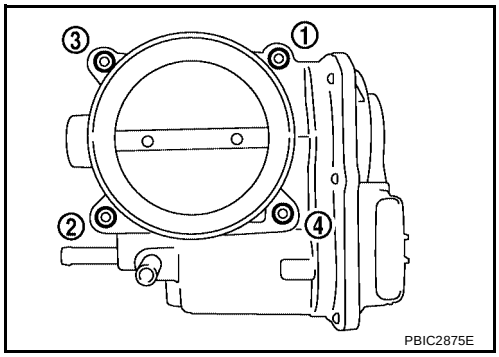
- When engine coolant is not drained from radiator, attach plug to water hoses to prevent engine coolant leakage.

c. Disconnect harness connector.

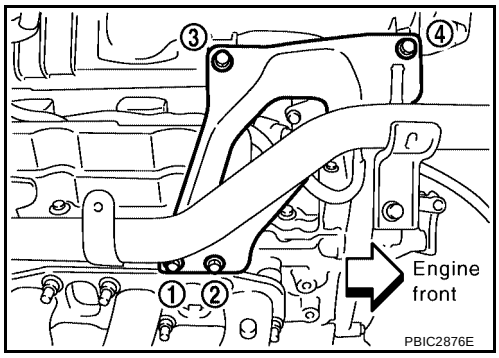
d. Loosen bolts in reverse order as shown.

CAUTION:

- **Handle carefully to avoid any shock to electric throttle control actuator.**
- **Do not disassemble.**



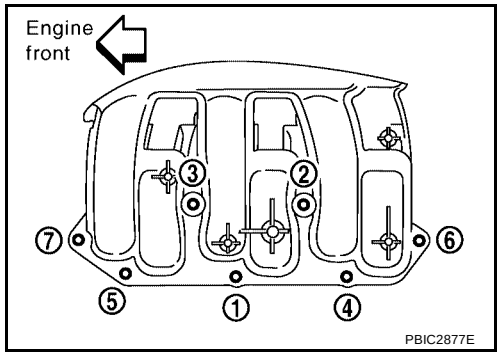
4. Remove the following parts:
   - Vacuum hose (to brake booster)
   - PCV hose
5. Loosen bolts in reverse order as shown to remove intake manifold collector support.



6. Disconnect EVAP hoses and harness connector from EVAP canister purge volume control solenoid valve.
7. Remove EVAP canister purge volume control solenoid valve.
8. Remove VIAS control solenoid valve and vacuum tank.
   - Add mating marks as necessary for easier installation.

9. Loosen nuts and bolts in reverse order as shown with power tool, and remove intake manifold collector.

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



INSTALLATION

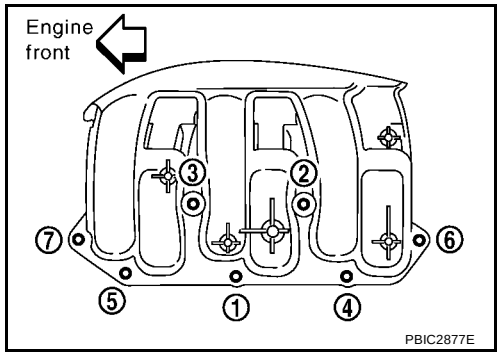
Installation is in the reverse order of removal. Note the following:

Intake Manifold Collector

- If stud bolts were removed from intake manifold, install them and tighten to the specified torque.
- Tighten nuts and bolts in numerical order as shown.

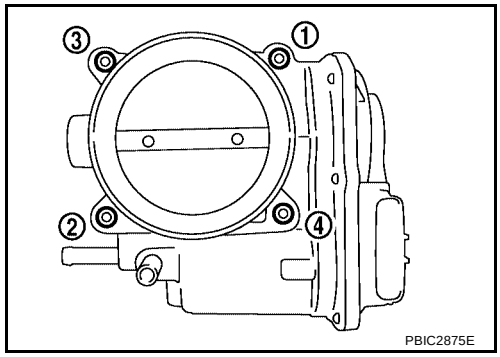
Intake manifold collector bolts and nuts : 11.0 N·m (1.1 kg-m, 8 ft-lb)

Stud bolts : 6.9 N·m (7.0kg-m, 61 in-lb)



Electric Throttle Control Actuator

- Tighten bolts in numerical order as shown.
- Perform the “Throttle Valve Closed Position Learning” when harness connector of electric throttle control actuator is disconnected. Refer to EC-687, "Throttle Valve Closed Position Learning" .
- Perform the “Idle Air Volume Learning” and “Throttle Valve Closed Position Learning” when electric throttle control actuator is replaced. Refer to EC-687, "Idle Air Volume Learning" .

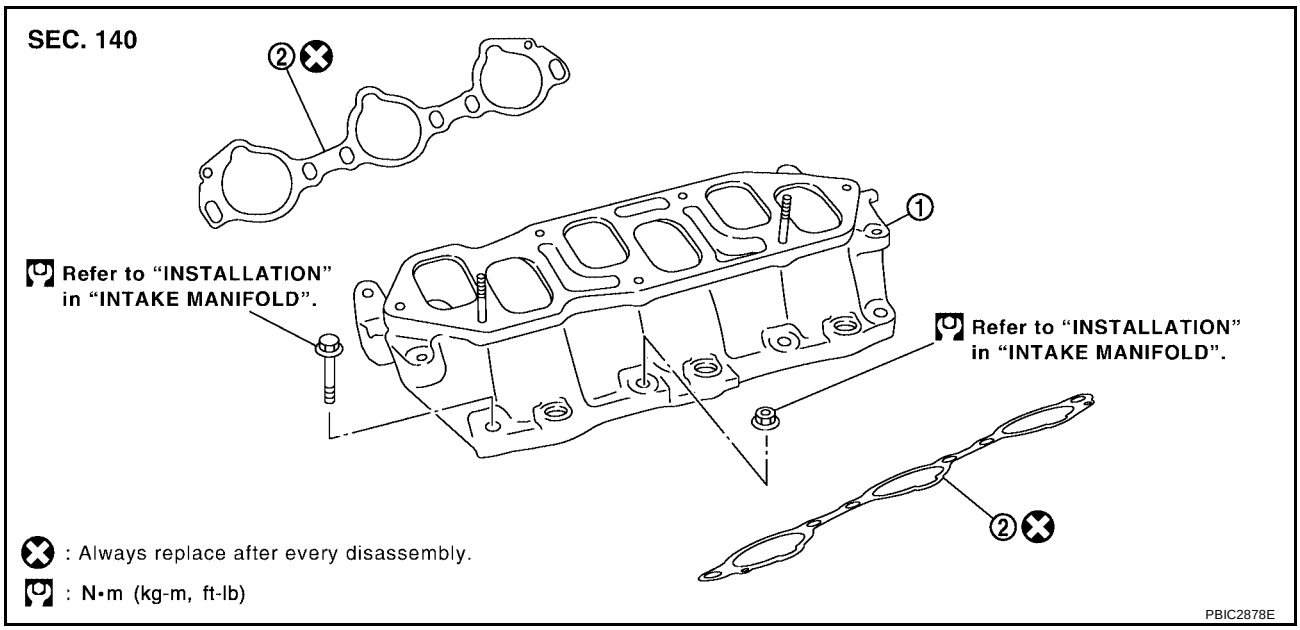


INTAKE MANIFOLD

PFP:14003

Removal and Installation

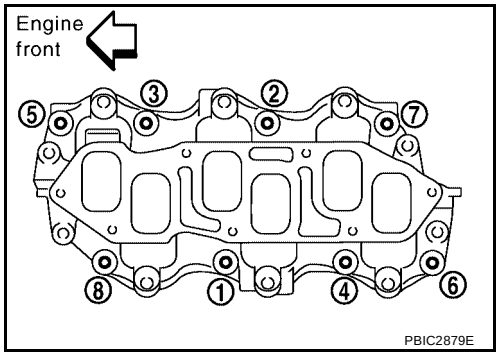
EBS00P4N



1. Intake manifold
2. Gasket

REMOVAL

1. Release fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .
2. Remove intake manifold collector. Refer to EM-128, "REMOVAL" .
3. Remove fuel tube and fuel injector assembly. Refer to EM-145, "REMOVAL" .
4. Loosen nuts and bolts with power tool in reverse order as shown to remove intake manifold.



5. Remove gaskets.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

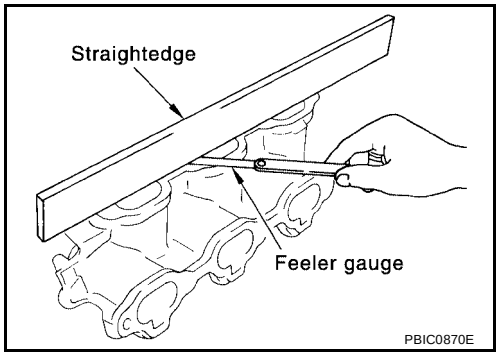
INSPECTION AFTER REMOVAL

Surface Distortion

- Check the surface distortion of the intake manifold mating surface with straightedge and feeler gauge.

  Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace intake manifold.



INSTALLATION

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

Intake Manifold

- If stud bolts were removed from cylinder head, install them and tighten to the specified torque.

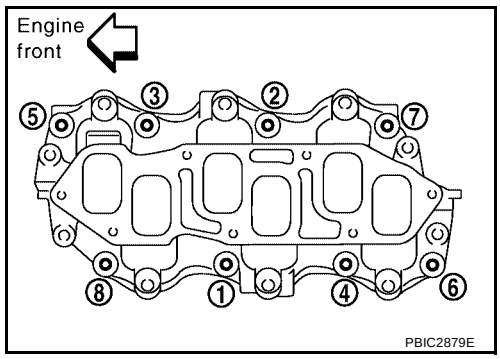
  Intake manifold studs : 11.0 N·m (1.1kg-m, 8 ft-lb)

- Tighten all nuts and bolts to the specified torque in two or more steps in numerical order as shown.

  Intake manifold bolt and nuts

  1st step : 7.4 N·m (0.75 kg-m, 5 ft-lb)

  2nd step and after : 29.0 N·m (3.0 kg-m, 21 ft-lb)

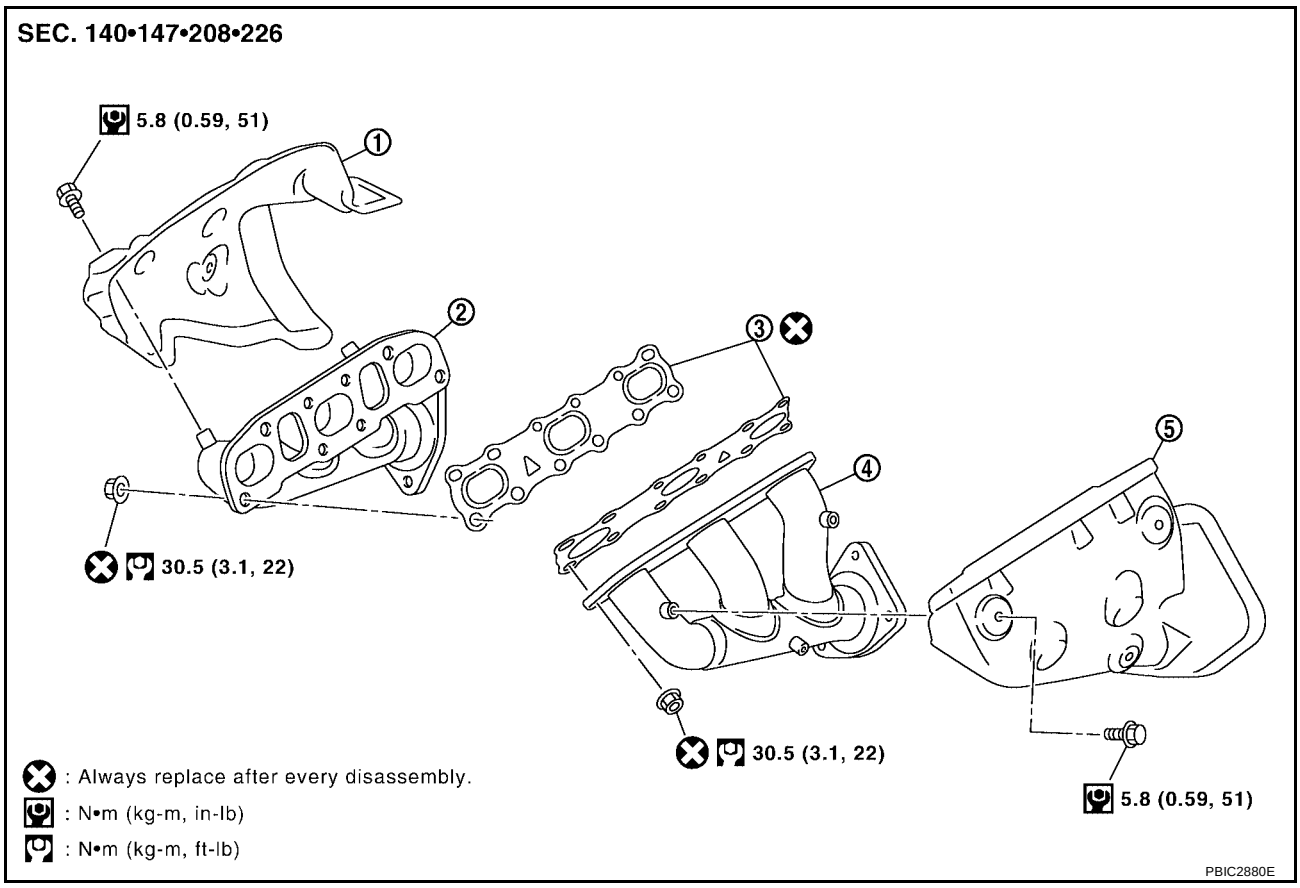


EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

Removal and Installation

EBS00P4O



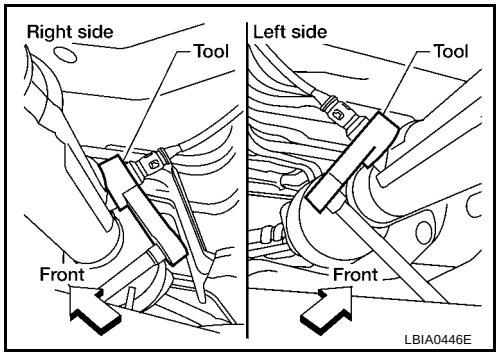
1. Exhaust manifold cover (right bank)
2. Exhaust manifold (right bank)
3. Gasket
4. Exhaust manifold cover (left bank)
5. Exhaust manifold (left bank)

REMOVAL (LEFT BANK)

1. Remove air cleaner case and air duct. Refer to EM-126, "REMOVAL" .
2. Remove engine undercover with power tool.
3. Disconnect harness connector and remove heated oxygen sensor 2 on both banks using Tool.

   Tool number : KV10114400 (J-38365)

   CAUTION:
   - **Be careful not to damage heated oxygen sensor 2.**
   - **Discard any heated oxygen sensor 2 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.**



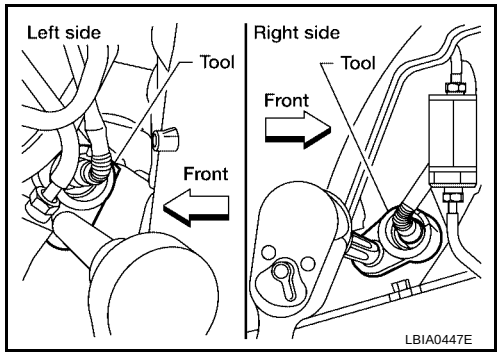
4. Remove center exhaust tube, main muffler and left front exhaust tube. Refer to EX-6, "REMOVAL" .
5. Remove exhaust manifold cover (left bank).

6. Disconnect harness connector and remove air fuel ratio sensor 1 (left bank) using Tool.

Tool number : — (J-44626)

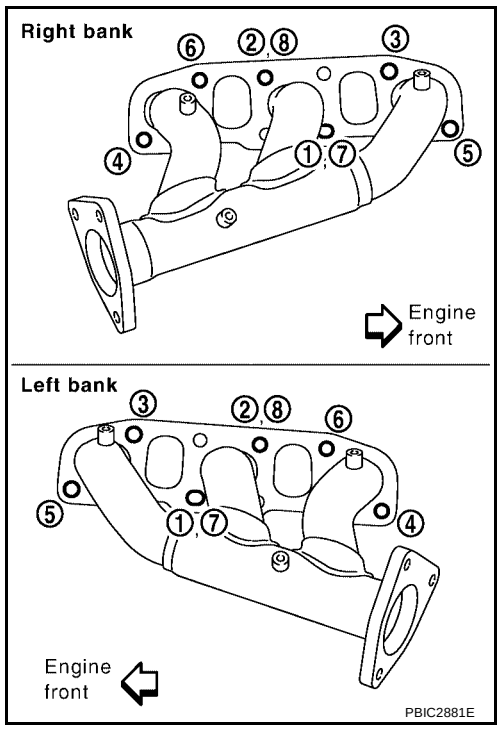
CAUTION:

- **Be careful not to damage air fuel ratio sensor 1.**
- **Discard any air fuel ratio sensor 1 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.**



7. Remove three way catalyst (left bank).
8. Loosen nuts with power tool in reverse order as shown.

NOTE:
Disregard the numerical order No. 7 and 8 in removal.



9. Remove gaskets.

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

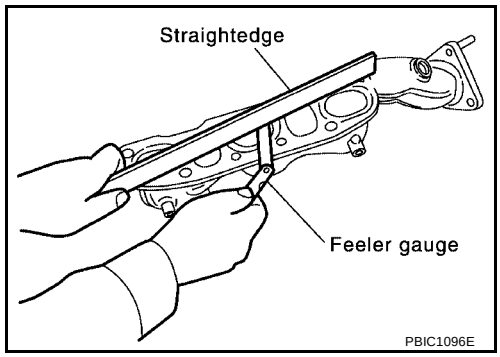
INSPECTION AFTER REMOVAL

Surface Distortion

- Check the surface distortion of the exhaust manifold mating surface with straightedge and feeler gauge.

Limit : 0.3 mm (0.012 in)

- If it exceeds the limit, replace exhaust manifold.

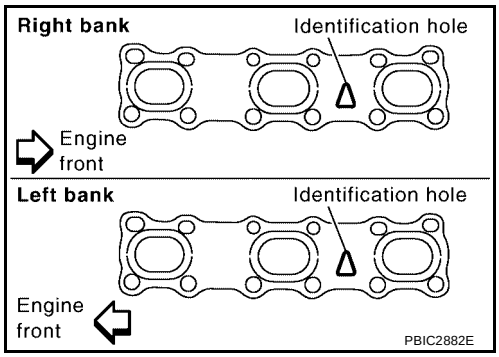


INSTALLATION (LEFT BANK)

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

Exhaust Manifold Gasket

Install in direction as shown.



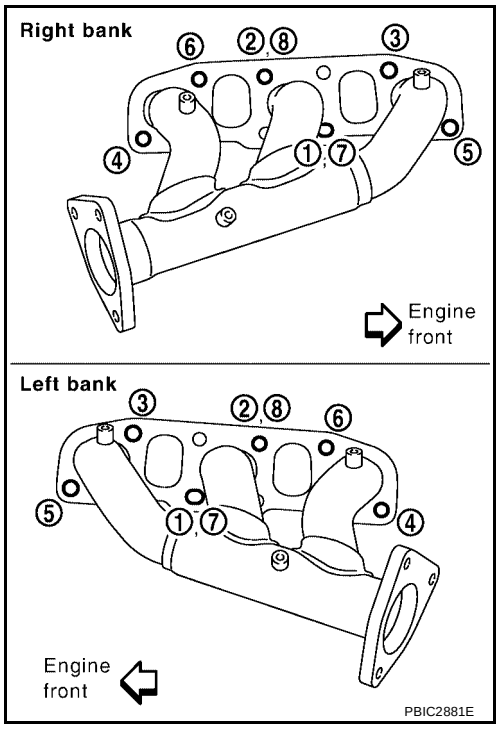
Exhaust Manifold

- If stud bolts were removed, install them and tighten to the specified torque.

  Exhaust manifold stud torque : 14.7 N·m (1.5 kg-m, 11 ft-lb)

- Install exhaust manifold and tighten nuts in numerical order as shown.

  NOTE:
  Tighten nuts No. 1 and 2 in two steps. The numerical order No. 7 and 8 shown second step.



Heated Oxygen Sensor

CAUTION:

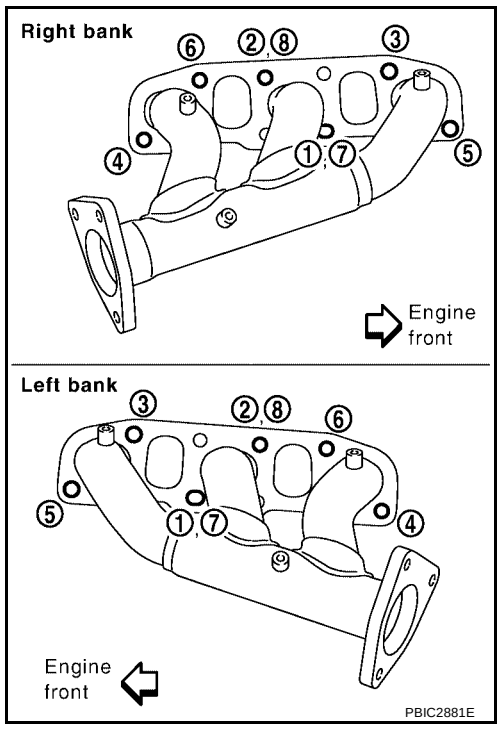
- **Before installing a new air fuel ratio sensor 1 and heated oxygen sensor 2, clean exhaust system threads using oxygen sensor thread cleaner and apply anti-seize lubricant.**

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

- **Do not over torque air fuel ratio sensor 1 and heated oxygen sensor 2. Doing so may cause damage to air fuel ratio sensor 1 and heated oxygen sensor 2, resulting in the "MIL" coming on.**

REMOVAL (RIGHT BANK)

1. Remove engine assembly. Refer to EM-215, "REMOVAL" .
2. Loosen nuts with power tool in reverse order as shown.
   NOTE:
   Disregard the numerical order No. 7 and 8 in removal.



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

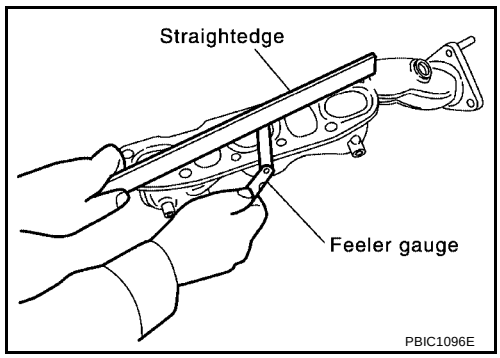
INSPECTION AFTER REMOVAL

Surface Distortion

- Check the surface distortion of the exhaust manifold mating surface with straightedge and feeler gauge.

  Limit : 0.3 mm (0.012 in)

- If it exceeds the limit, replace exhaust manifold.

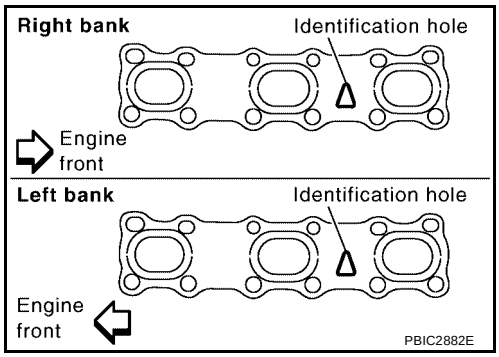


INSTALLATION (RIGHT BANK)

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

Exhaust Manifold Gasket

Install in direction as shown.



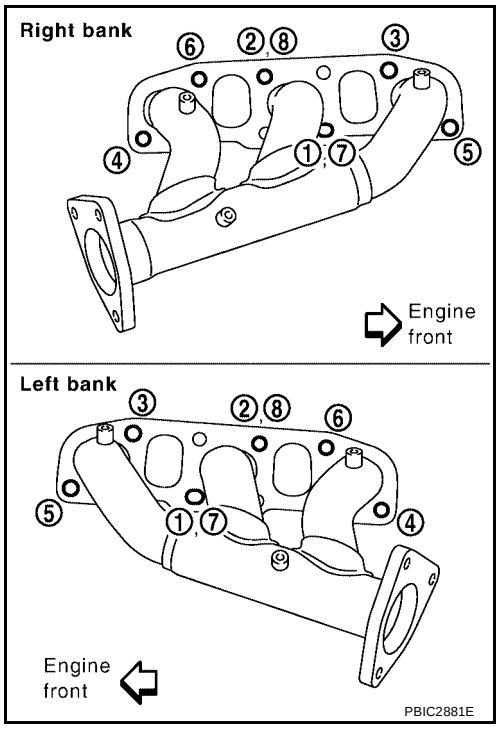
Exhaust Manifold

- If stud bolts were removed, install them and tighten to the specified torque.

  Exhaust manifold stud torque : 14.7 N·m (1.5 kg-m, 11 ft-lb)

- Install exhaust manifold and tighten nuts in numerical order as shown.

  NOTE:
  Tighten nuts No. 1 and 2 in two steps. The numerical order No. 7 and 8 shown second step.



Heated Oxygen Sensor

CAUTION:

- **Before installing a new air fuel ratio sensor 1 and heated oxygen sensor 2, clean exhaust system threads using oxygen sensor thread cleaner and apply anti-seize lubricant.**

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

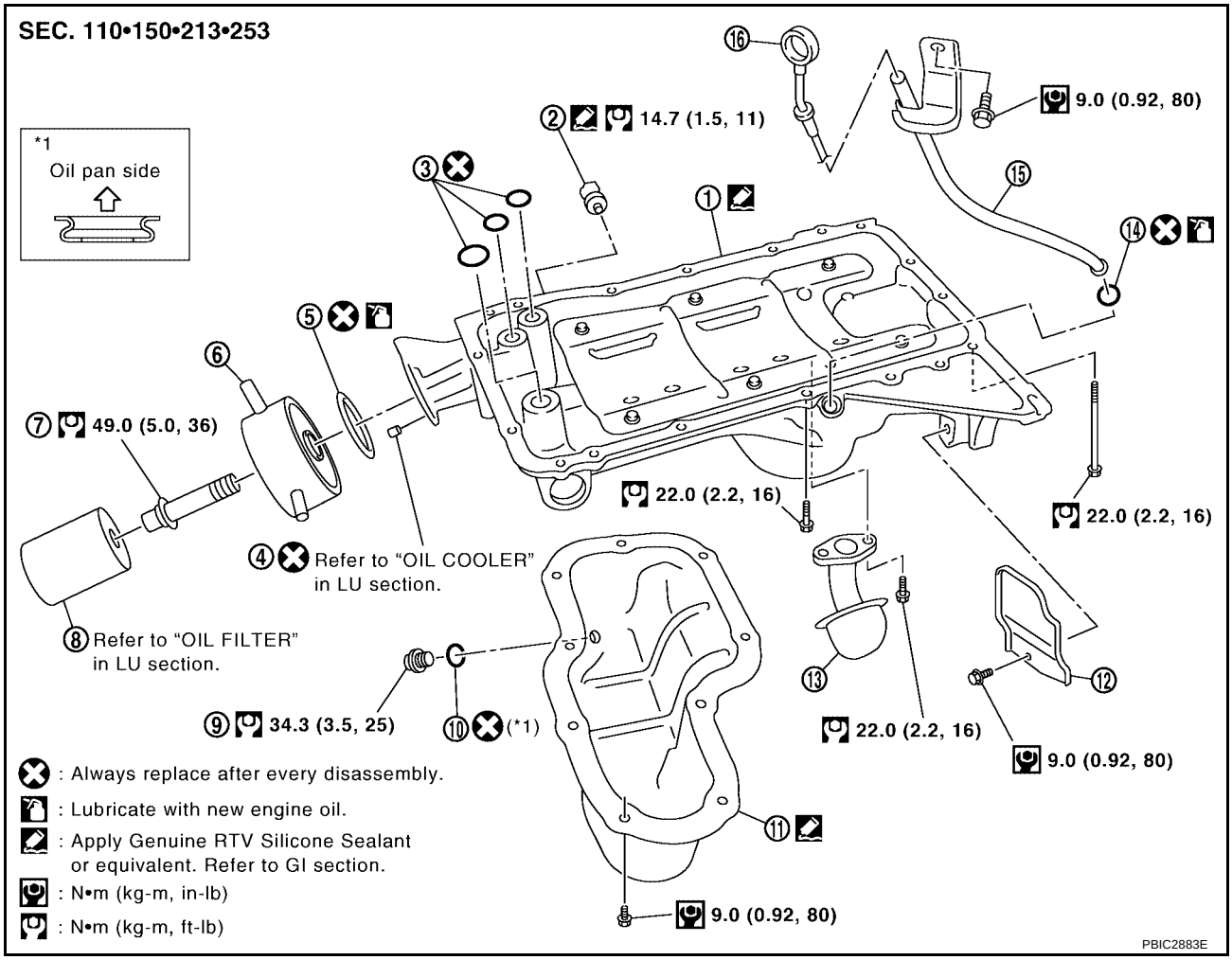
- **Do not over torque air fuel ratio sensor 1 and heated oxygen sensor 2. Doing so may cause damage to air fuel ratio sensor 1 and heated oxygen sensor 2, resulting in the "MIL" coming on.**

OIL PAN AND OIL STRAINER

PFP:11110

Removal and Installation

EBS00P4P



1. Oil pan (upper)
2. Oil pressure sensor
3. O-ring
4. Relief valve
5. O-ring
6. Oil cooler
7. Connector bolt
8. Oil filter
9. Drain plug
10. Drain plug washer
11. Oil pan (lower)
12. Rear cover plate
13. Oil strainer
14 O-ring
15. Oil level gauge guide
16. Oil level gauge

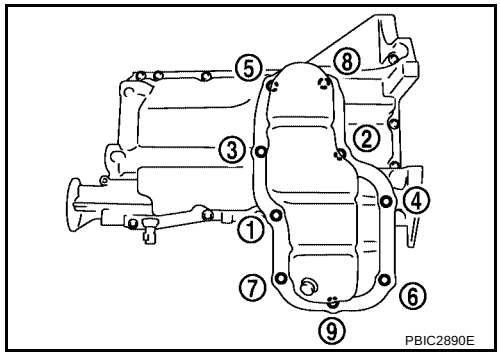
REMOVAL (LOWER)

WARNING:

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

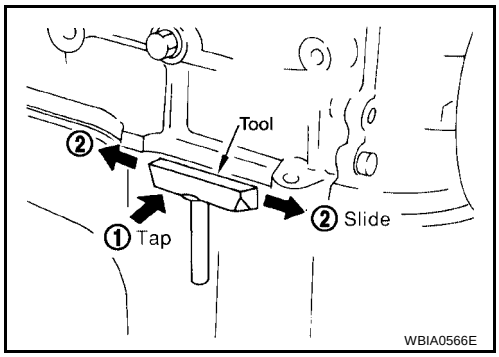
1. Drain engine oil. Refer to MA-26, "Changing Engine Oil" .
2. Remove oil pan (lower) as follows:

a. Loosen bolts with power tool in reverse order as shown to remove.



b. Remove oil pan (lower) using Tool.

Tool number : KV10111100 (J-37228)



CAUTION:

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

NOTE:
Slide seal cutter (1) by tapping on the side (2) of the tool with hammer.

INSPECTION AFTER REMOVAL

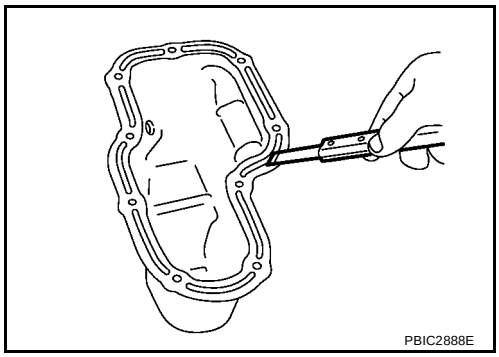
Clean oil strainer if any object attached.

INSTALLATION (LOWER)

1. Install oil pan (lower) as follows:

a. Use scraper to remove old liquid gasket from mating surfaces.

- Also remove old liquid gasket from mating surface of oil pan (upper).
- Remove old liquid gasket from the bolt holes and thread.

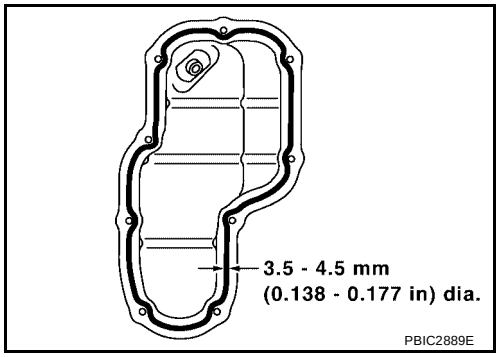


CAUTION:
Do not scratch or damage the mating surfaces when cleaning off old liquid gasket.

b. Apply a continuous bead of liquid gasket using Tool to the oil pan (lower) as shown.

Tool number : WS39930000 (—)

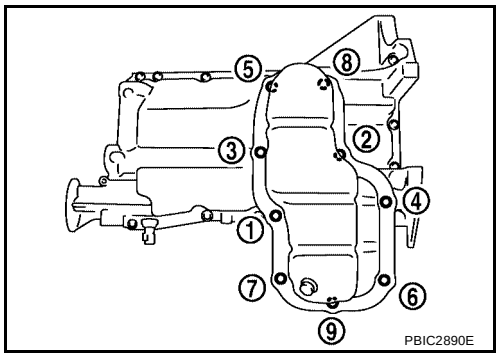
Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .



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

c. Install oil pan (lower).

- Tighten bolts in numerical order as shown.



2. Install oil pan drain plug. Refer to EM-137, "Removal and Installation" .
3. Installation is in the reverse order of removal.

NOTE:
At least 30 minutes after oil pan is installed, pour engine oil.

INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to LU-18, "ENGINE OIL" .
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to LU-18, "ENGINE OIL" .

REMOVAL (UPPER)

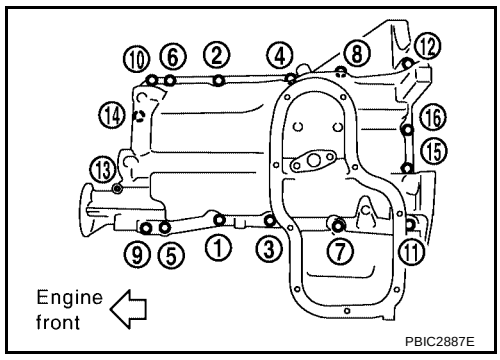
WARNING:

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

1. Remove engine cover with power tool. Refer to EM-123, "REMOVAL" .
2. Remove air duct. Refer to EM-126, "REMOVAL" .
3. Drain engine oil. Refer to LU-20, "Changing Engine Oil" .

   CAUTION:
   - **Perform this step when engine is cold.**
   - **Do not spill engine oil on drive belts.**
4. Drain engine coolant. Refer to CO-39, "Changing Engine Coolant" .

   CAUTION:
   - **Perform this step when engine is cold.**
   - **Do not spill engine coolant on drive belts.**
5. Remove front final drive (4X4). Refer to FFD-14, "REMOVAL" .
6. Disconnect steering gear lower joint shaft bolt and steering gear nuts and bolts, position out of the way. Refer to PS-15, "REMOVAL" .
7. Remove starter motor. Refer to SC-24, "REMOVAL" .
8. Disconnect A/T fluid cooler tube brackets and position out of the way. Refer to EM-23, "REMOVAL" .
9. Remove oil filter, as necessary. Refer to LU-21, "REMOVAL" .
10. Remove oil cooler. Refer to LU-22, "REMOVAL" .
11. Remove oil pan (lower). Refer to EM-137, "REMOVAL (Lower)" .
12. Remove oil strainer.
13. Remove transmission joint bolts which pierce oil pan (upper).
14. Remove rear cover plate.
15. Loosen bolts with power tool in reverse order as shown.

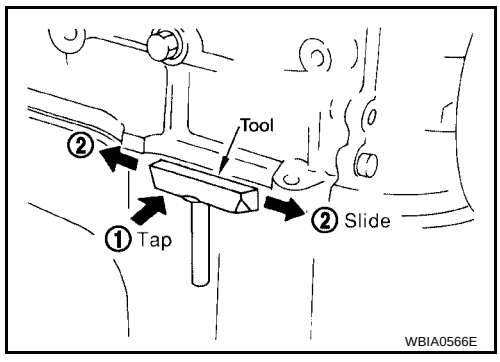


- Insert Tool between oil pan (upper) and lower cylinder block. Slide Tool by tapping on the side of Tool with hammer. Remove oil pan (upper).

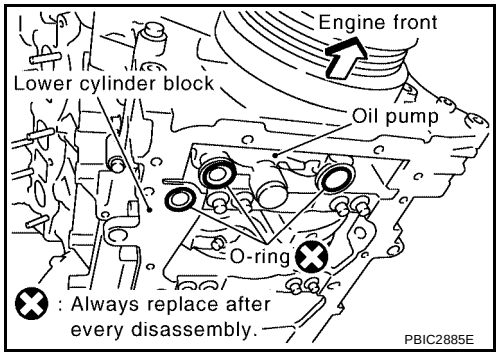
  Tool number : KV10111100 (J-37228)

CAUTION:

Be careful not to damage mating surfaces.



16. Remove O-rings from bottom of lower cylinder block and oil pump.



INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSTALLATION (UPPER)

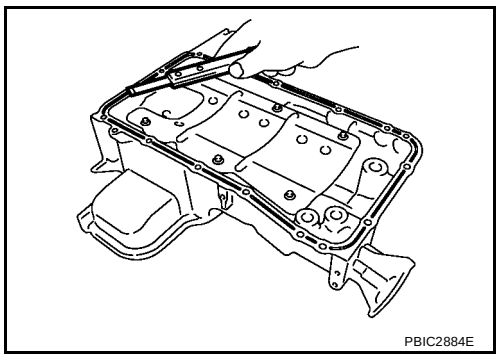
1. Install oil pan (upper) as follows:

a. Use scraper to remove old liquid gasket from mating surfaces.

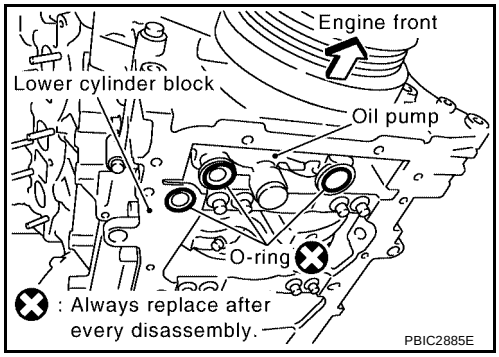
- Also remove the old liquid gasket from mating surface of lower cylinder block.
- Remove old liquid gasket from the bolt holes and threads.

CAUTION:

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



b. Install new O-rings on the bottom of lower cylinder block and oil pump.



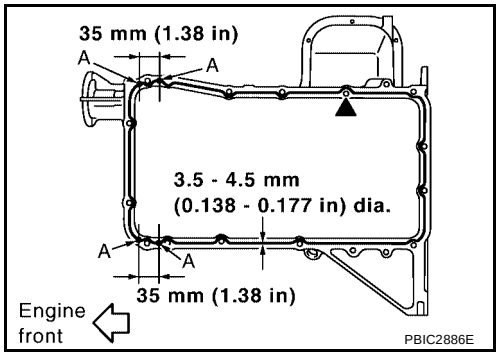
c. Apply a continuous bead of liquid gasket using Tool to the lower cylinder block mating surfaces of oil pan (upper) to a limited portion as shown.

Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to **GI-48, "Recommended Chemical Products and Sealants"** **.**

CAUTION:

- **For bolt holes with ▲ mark, apply liquid gasket outside the hole.**
- **Apply a bead of 4.5 to 5.5 mm (0.177 to 0.217 in) in diameter to area “A”.**
- **Attaching should be done within 5 minutes after coating.**



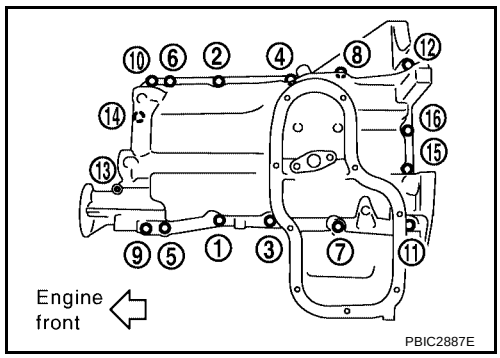
d. Install oil pan (upper).

CAUTION:

Install avoiding misalignment of both oil pan gaskets and O-rings.

- Tighten bolts in numerical order as shown.
- There are two types of bolts. Refer to the following for locating bolts.

M8 × 100 mm (3.97 in) : 7, 11, 12, 13
M8 × 25 mm (0.98 in) : Except the above



e. Tighten transmission joint bolts. Refer to MT-16, "REMOVAL" (FS5R30A), MT-67, "REMOVAL" (FS6R31A) (4X2), MT-69, "REMOVAL" (FS6R31A) (4X4), AT-252, "REMOVAL" (A/T) (4X2), AT-254, "REMOVAL" (A/T) (4X4).

2. Install oil strainer to oil pan (upper).
3. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

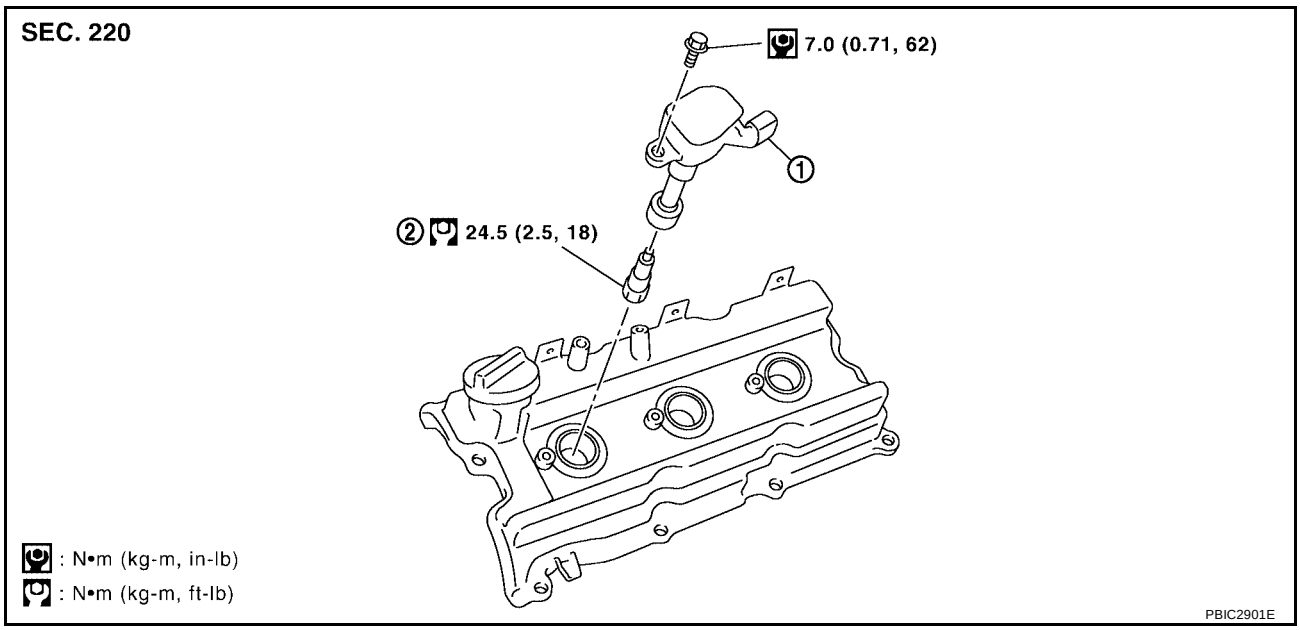
1. Check engine oil level and adjust engine oil. Refer to LU-18, "ENGINE OIL" .
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to LU-18, "ENGINE OIL" .

IGNITION COIL

PFP:22448

Removal and Installation

EBS00P4Q



1. Ignition coil
2. Spark plug

REMOVAL (LEFT BANK)

1. Remove engine cover with power tool. Refer to EM-123, "REMOVAL" .
2. Remove air cleaner case and air duct. (At the left bank side, remove ignition coil) Refer to EM-126, "REMOVAL" .
3. Move aside harness, harness bracket, and hoses located above ignition coil.
4. Disconnect harness connector from ignition coil.
5. Remove ignition coil.

CAUTION:
Do not shock it.

INSTALLATION (LEFT BANK)

Installation is in the reverse order of removal.

REMOVAL (RIGHT BANK)

1. Remove intake manifold collector with power tool. Refer to EM-128, "REMOVAL" .
2. Move aside harness, harness bracket, and hoses located above ignition coil.
3. Disconnect harness connector from ignition coil.
4. Remove ignition coil.

CAUTION:
Do not shock it.

INSTALLATION (RIGHT BANK)

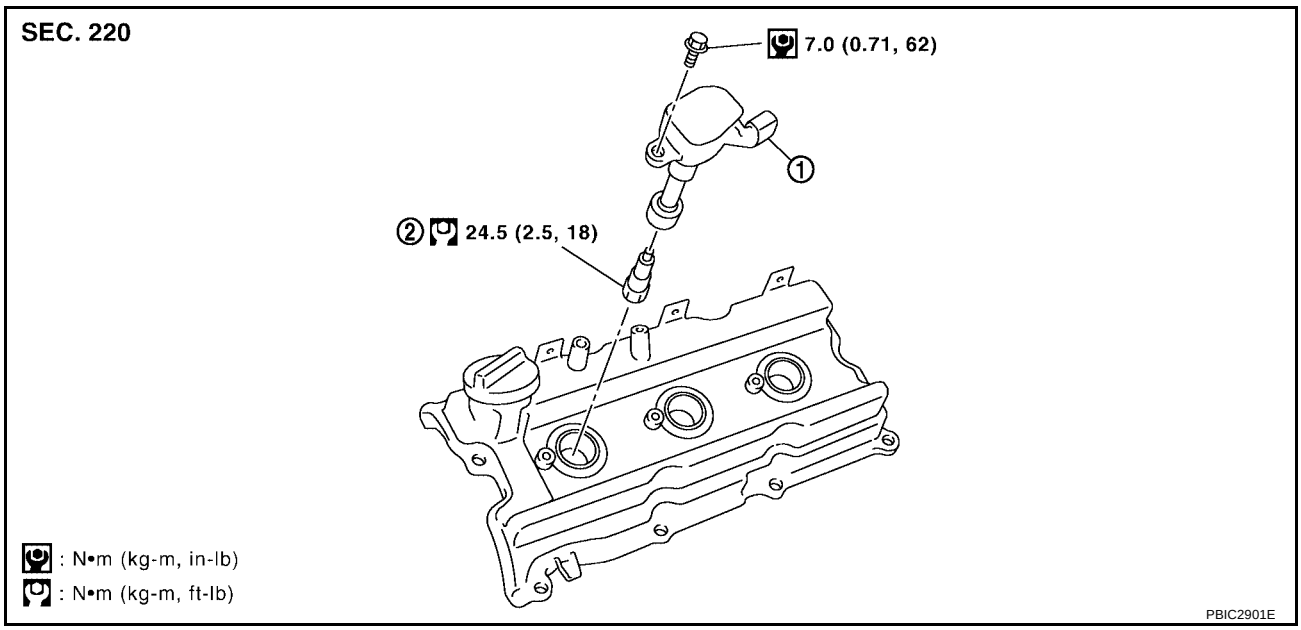
Installation is in the reverse order of removal.

SPARK PLUG (PLATINUM-TIPPED TYPE)

PFP:22401

Changing Spark Plugs (Platinum - Tipped Type)

EBS00T2X

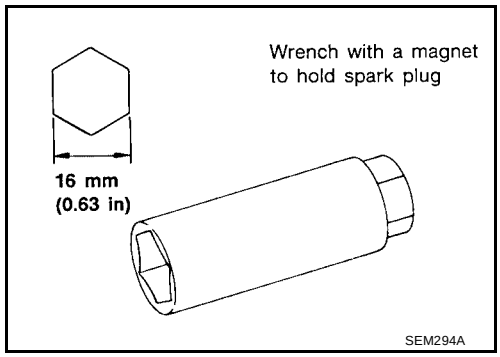


1. Ignition coil
2. Spark plug

REMOVAL

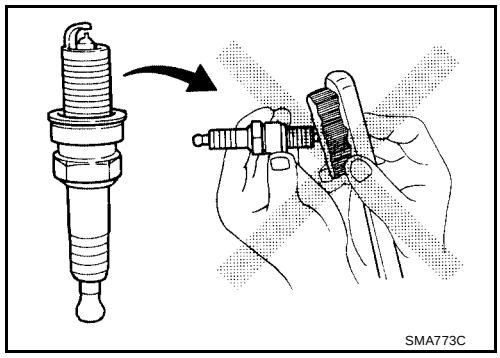
1. Remove the ignition coil. Refer to EM-142, "IGNITION COIL" .
2. Remove the spark plug using a suitable tool.

CAUTION:
Do not drop or shock it.



INSPECTION AFTER REMOVAL

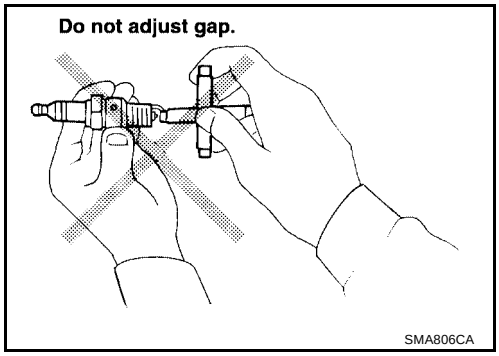
- Do not use a wire brush to clean the spark plug.



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

Cleaner air pressure : Less than 588 kPa (5.9 bar, 6 kg/cm^2 , 85 psi)
Cleaning time : Less than 20 seconds

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



CAUTION:
Do not drop or shock the spark plug.

INSTALLATION

Installation is in the reverse order of 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 knock occurs with the standard type spark plug under conditions such as:
  - Extended highway driving
  - Frequent high engine revolution

Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11
Gap (nominal)	1.1 mm (0.043 in)

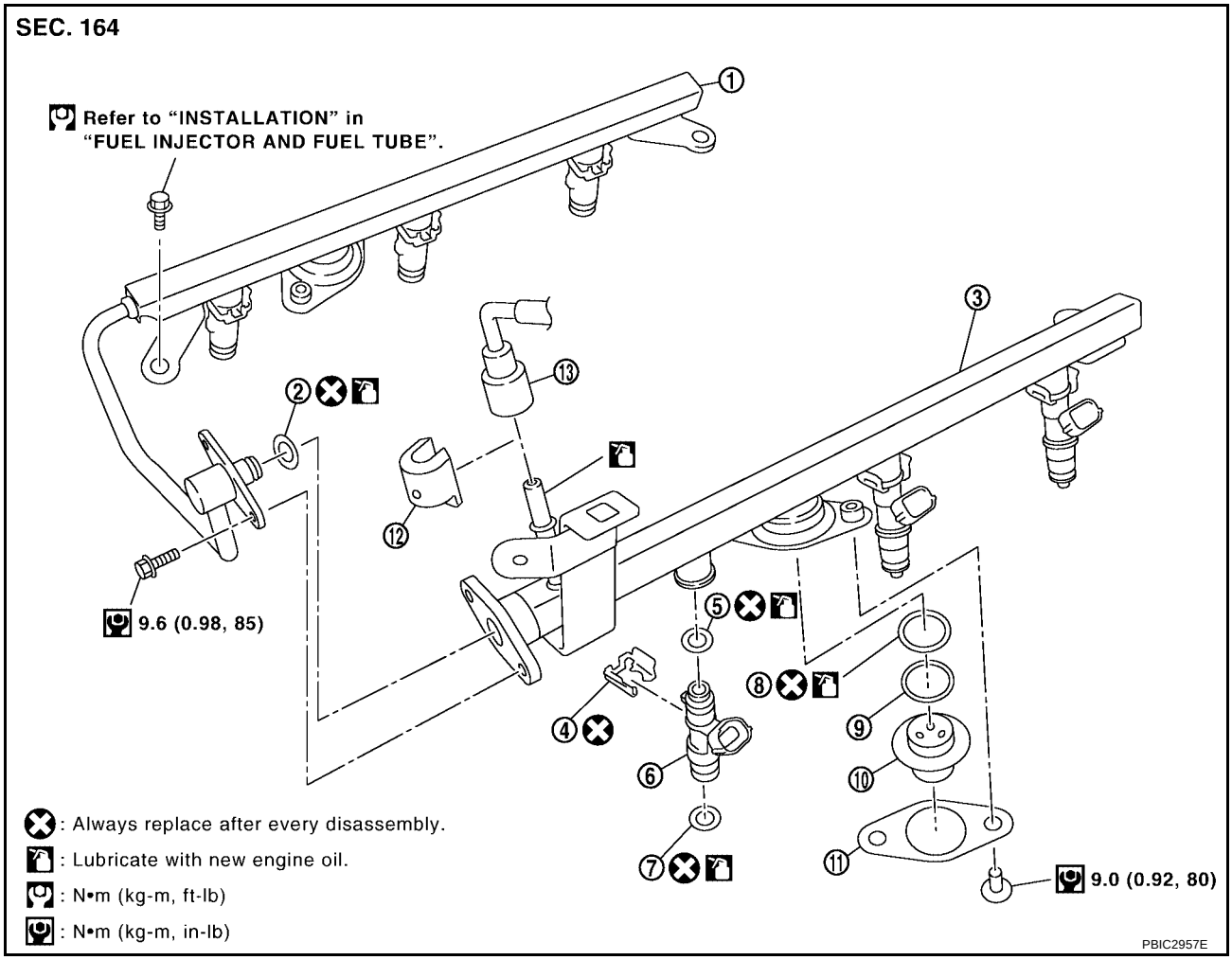
CAUTION:
Do not drop or shock the spark plug.

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Removal and Installation

EBS00P4S



1. Fuel tube (RH)
2. O-ring
3. Fuel tube (LH)
4. Clip
5. O-ring (blue)
6. Fuel injector
7. O-ring (brown)
8. O-ring
9. Spacer
10. Fuel damper
11. Fuel damper cap
12. Quick connector cap
13. Fuel feed hose

REMOVAL

WARNING:

- **Put a "CAUTION INFLAMMABLE" sign in the workshop.**
- **Be sure to work in a well ventilated area and furnish workshop with a CO_2 fire extinguisher.**
- **Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.**
- **To avoid the danger of being scalded, do not drain engine coolant when engine is hot.**

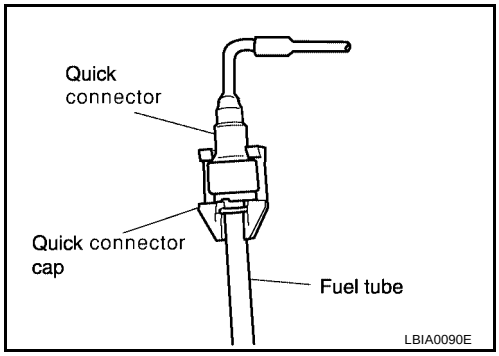
1. Remove intake manifold collector. Refer to EM-128, "REMOVAL" .

   CAUTION:
   Perform this step when engine is cold.

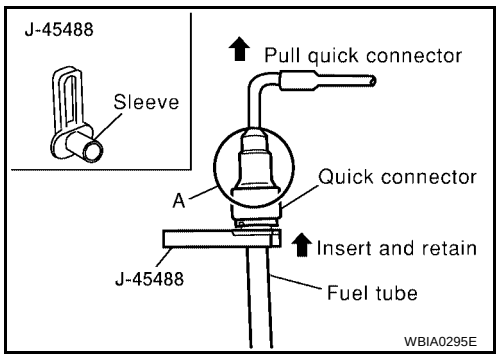
2. Disconnect the fuel quick connector on the engine side.
   - Using Tool perform the following steps to disconnect the quick connector.

   Tool number : — (J-45488)

a. Remove quick connector cap.



b. With the sleeve side of Tool facing quick connector, install Tool onto fuel tube.



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

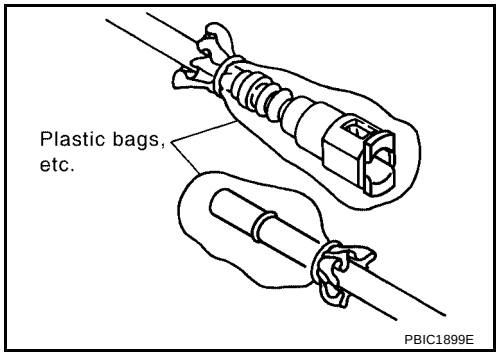
CAUTION:

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

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

CAUTION:

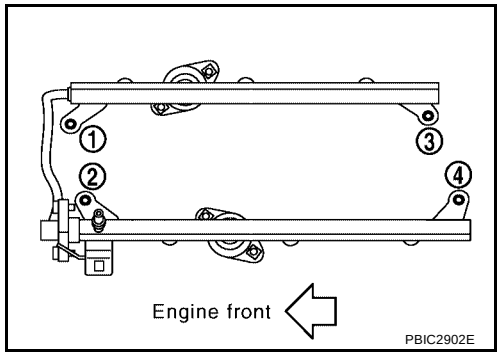
- **Pull quick connector holding it at the ″A″ position, as shown.**
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Be sure to cover openings of disconnected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



3. Remove PCV hose between rocker covers (right and left banks).
4. Disconnect harness connector from fuel injector.

5. Loosen bolts in reverse order as shown, and remove fuel tube and fuel injector assembly.

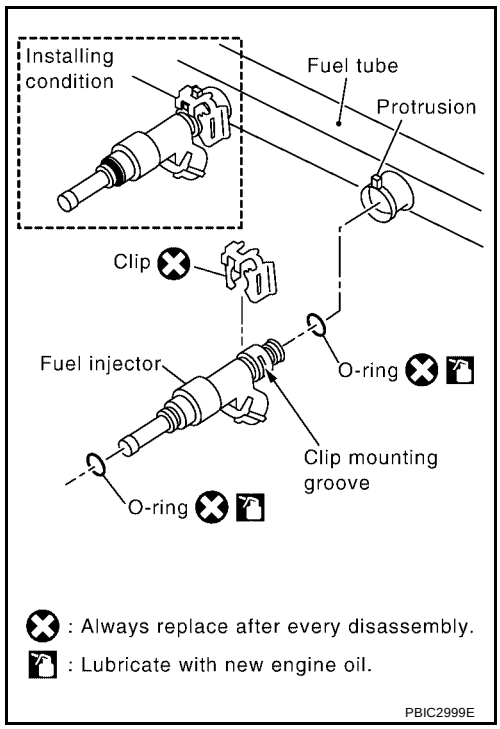
CAUTION:
Do not tilt it, or remaining fuel in pipes may flow out from pipes.



6. Remove bolts which connects fuel tube (RH) and fuel tube (LH).
7. Remove fuel injector from fuel tube as follows:

a. Carefully open and remove clip.
b. Remove fuel injector from fuel tube by pulling straight.

CAUTION:
- **Be careful with remaining fuel that may go out from fuel tube.**
- **Be careful not to damage injector nozzles during removal.**
- **Do not bump or drop fuel injector.**
- **Do not disassemble fuel injector.**



8. Disconnect fuel tube (RH) from fuel tube (LH).
9. Loosen bolts, to remove fuel damper cap and fuel damper, if necessary.

INSTALLATION

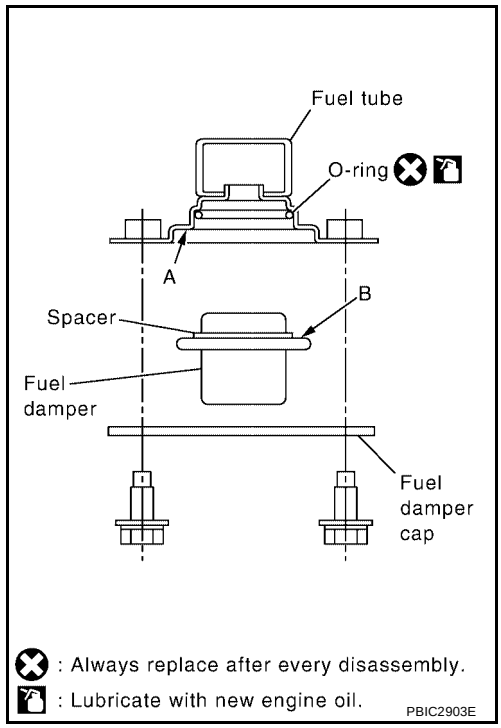
1. Install fuel damper as follows:

a. Install new O-ring to fuel tube as shown.

- When handling new O-rings, be careful of the following caution:

CAUTION:

- **Handle O-ring with bare hands. Do not wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Do not clean O-ring with solvent.**
- **Make sure that O-ring and its mating part are free of foreign material.**
- **When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.**
- **Insert new O-ring straight into fuel tube. Do not twist it.**



b. Install spacer to fuel damper.

c. Insert fuel damper straight into fuel tube.

CAUTION:

- **Insert straight, making sure that the axis is lined up.**
- **Do not pressure-fit with excessive force.**

Reference value : 130 N (13.3 kg, 29.2 lb)

- Insert fuel damper until “B” is touching “A” of fuel tube.

d. Tighten bolts evenly in turn.

- After tightening bolts, make sure that there is no gap between fuel damper cap and fuel tube.

2. Install new O-rings to fuel injector, paying attention to the following.

CAUTION:

- **Upper and lower O-ring are different. Be careful not to confuse them.**

Fuel tube side : Blue
Nozzle side : Brown

- **Handle O-ring with bare hands. Do not wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Do not clean O-ring with solvent.**
- **Make sure that O-ring and its mating part are free of foreign material.**
- **When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.**
- **Insert O-ring straight into fuel injector. Do not twist it.**

3. Install fuel injector to fuel tube as follows:

a. Insert clip into clip mounting groove on fuel injector.

- Insert clip so that protrusion “A” of fuel injector matches cutout “A” of clip.

CAUTION:

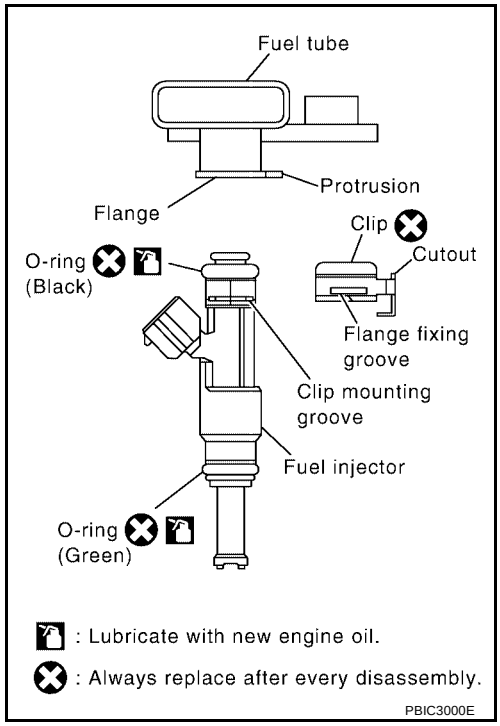
- **Do not reuse clip. Replace it with a new one.**
- **Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.**

b. Insert fuel injector into fuel tube with clip attached.

- Insert it while matching it to the axial center.
- Insert fuel injector so that protrusion “B” of fuel tube matches cutout “B” of clip.
- Make sure that fuel tube flange is securely fixed in flange fixing groove on clip.

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

- Make sure that protrusions of fuel injectors are aligned with cutouts of clips after installation.



4. Connect fuel tube (RH) to fuel tube (LH), and tighten bolts temporarily.

- Tighten bolts with the specified torque after installing fuel tube and fuel injector assembly.

CAUTION:

- **Handle O-ring with bare hands. Do not wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Do not clean O-ring with solvent.**
- **Make sure that O-ring and its mating part are free of foreign material.**
- **When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.**
- **Insert new O-ring straight into fuel tube. Do not twist it.**

5. Install fuel tube and fuel injector assembly to intake manifold.

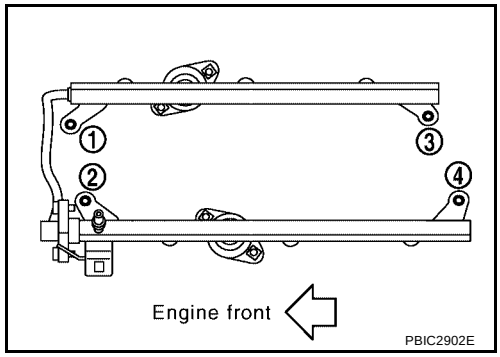
CAUTION:

Be careful not to let tip of injector nozzle come in contact with other parts.

- Tighten bolts in two steps in numerical order as shown.

Fuel injector tube assembly bolts

1st step	**: 10.1 N·m (1.0 kg-m, 7 ft-lb)**
2nd step	**: 22.0 N·m (2.2 kg-m, 16 ft-lb)**



6. Tighten bolts which connects fuel tube (RH) and fuel tube (LH) with the specified torque.
7. Connect fuel injector harness connector.
8. Install intake manifold collector. Refer to EM-129, "INSTALLATION" .
9. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

1. Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.

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

2. Start engine. With engine speed increased, check again for fuel leakage at connection points.

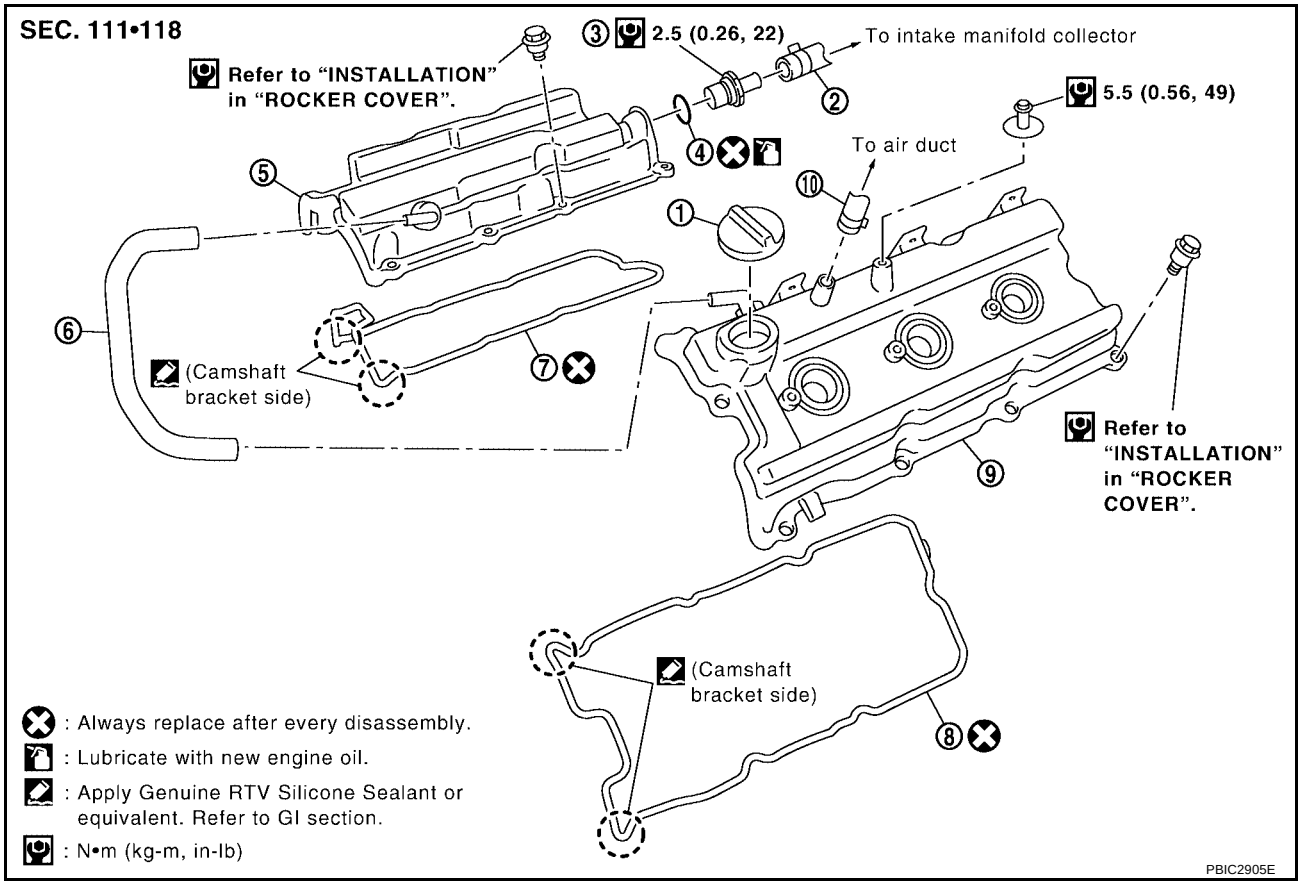
   CAUTION:
   Do not touch engine immediately after stopped, as engine becomes extremely hot.

ROCKER COVER

PFP:13264

Removal and Installation

EBS00P4T

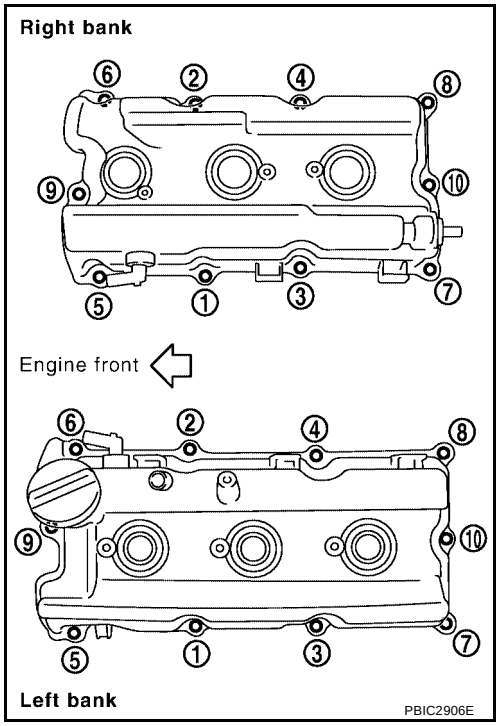


1. Oil filler cap
2. PCV hose
3. PCV valve
4. O-ring
5. Rocker cover (right bank)
6. PCV hose
7. Rocker cover gasket (right bank)
8. Rocker cover gasket (left bank)
9. Rocker cover (left bank)
10. PCV hose

REMOVAL (LEFT BANK)

1. Remove engine cover. Refer to EM-123, "REMOVAL" .
2. Separate engine harness removing their brackets from rocker covers.
3. Remove harness bracket from cylinder head, if necessary.
4. Remove ignition coil. Refer to EM-142, "Removal and Installation" .
5. Remove PCV hoses from rocker covers.
6. Remove oil filler cap from rocker cover (left bank), if necessary.

7. Loosen bolts with power tool in reverse order as shown.



8. Remove rocker cover gaskets from rocker covers.
9. Use scraper to remove all traces of liquid gasket from cylinder head and camshaft bracket (No. 1).

CAUTION:

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

INSTALLATION (LEFT BANK)

1. Apply liquid gasket using Tool to joint part among rocker cover, cylinder head and camshaft bracket (No. 1) as follows:

Tool number : WS39930000 (—)

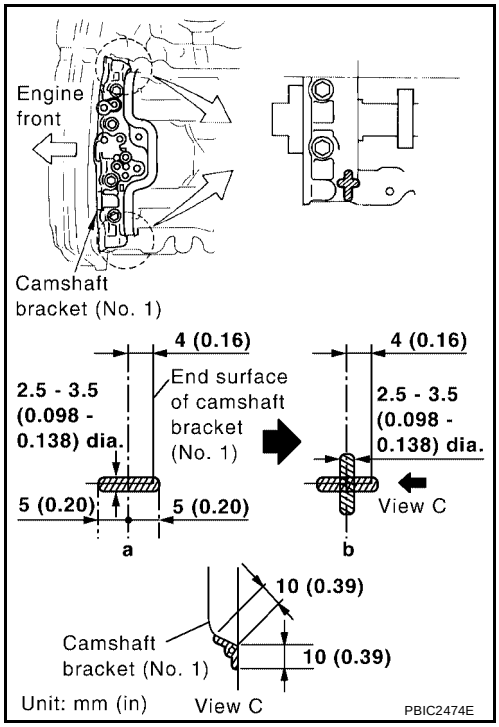
Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" **.**

NOTE:

The figure shows an example of left bank side [zoomed in shows camshaft bracket (No. 1)].

a. Refer to the figure “a” to apply liquid gasket to joint part of camshaft bracket (No. 1) and cylinder head.

b. Refer to the figure “b” to apply liquid gasket to the figure “a” squarely.

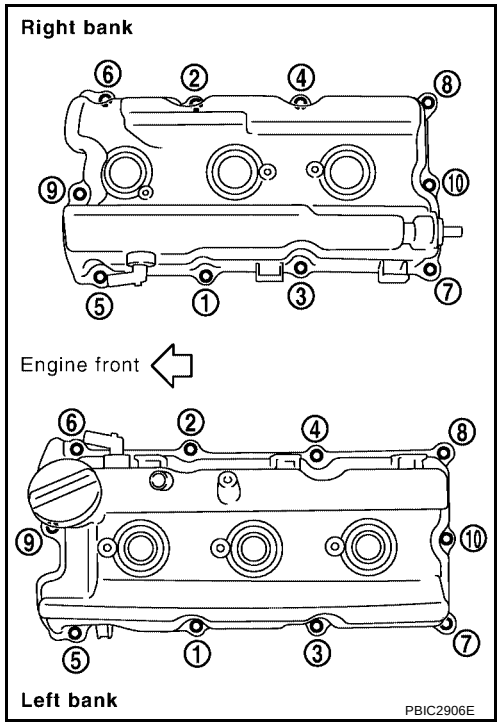


2. Install new rocker cover gasket to rocker cover.
3. Install rocker cover.

- Check if rocker cover gasket is not dropped from installation groove of rocker cover.

4. Tighten bolts in two steps separately in numerical order as shown.

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



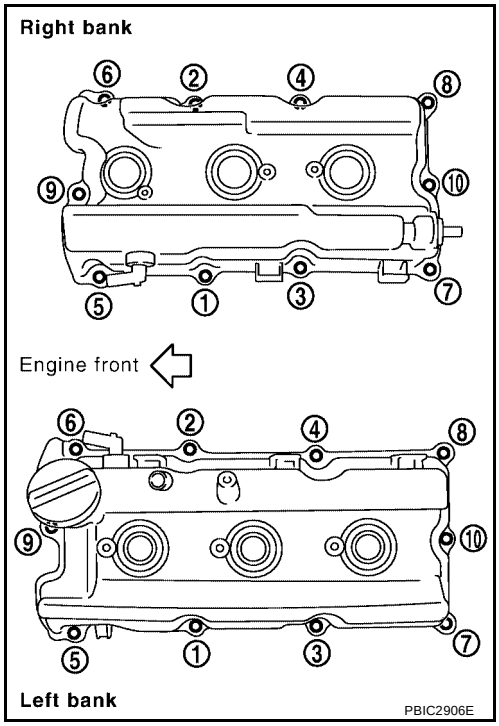
5. Install oil filer cap to rocker cover (left bank), if removed.
6. Install PCV hose.
   - Insert PCV hose by 25 to 30 mm (0.98 to 1.18 in) from connector end.
   - When installing, be careful not to twist or come in contact with other parts.
7. Installation of the remaining components is in the reverse order of removal.

REMOVAL (RIGHT BANK)

1. Remove intake manifold collector. Refer to EM-128, "REMOVAL" .

   CAUTION:
   Perform this step when engine is cold.
2. Separate engine harness removing their brackets from rocker covers.
3. Remove harness bracket from cylinder head (right bank). Refer to EM-202, "CYLINDER HEAD" .
4. Remove ignition coil. Refer to EM-142, "Removal and Installation" .
5. Remove PCV hoses from rocker cover.
6. Remove PCV valve and O-ring from rocker cover (right bank), if necessary.

7. Loosen bolts with power tool in reverse order as shown.



8. Remove rocker cover gaskets from rocker covers.
9. Use scraper to remove all traces of liquid gasket from cylinder head and camshaft bracket (No. 1).

CAUTION:

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

INSTALLATION (RIGHT BANK)

1. Apply liquid gasket using Tool to joint part among rocker cover, cylinder head and camshaft bracket (No. 1) as follows:

Tool number : WS39930000 (—)

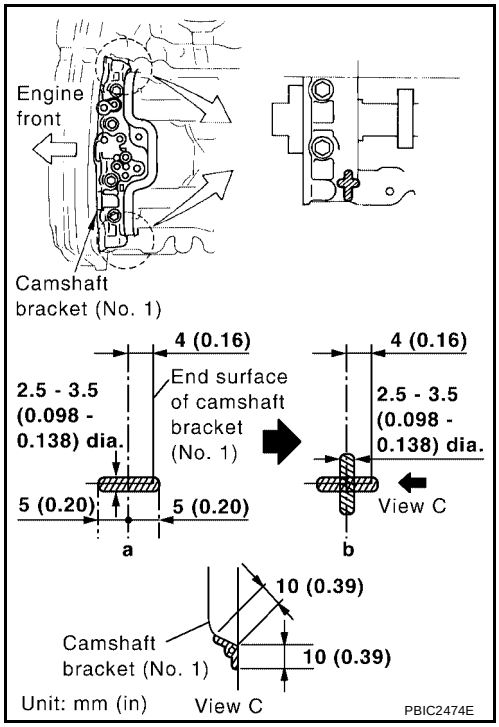
Use Genuine RTV Silicone Sealant or equivalent. Refer to **GI-48, "Recommended Chemical Products and Sealants"** .

NOTE:

The figure shows an example of left bank side [zoomed in shows camshaft bracket (No. 1)].

a. Refer to the figure “a” to apply liquid gasket to joint part of camshaft bracket (No. 1) and cylinder head.

b. Refer to the figure “b” to apply liquid gasket to the figure “a” squarely.

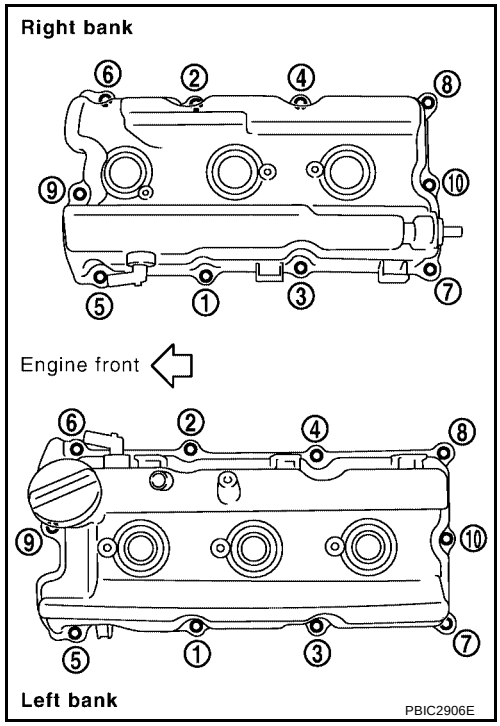


2. Install new rocker cover gasket to rocker cover.
3. Install rocker cover.
   - Check if rocker cover gasket is not dropped from installation groove of rocker cover.

4. Tighten bolts in two steps separately in numerical order as shown.

   1st step : 1.96 N·m (0.20 kg-m, 17 in-lb)

   2nd step : 8.33 N·m (0.85 kg-m, 74 in-lb)



5. Install new O-ring and PCV valve to rocker cover (right bank), if removed.
6. Install PCV hose.
   - Insert PCV hose by 25 to 30 mm (0.98 to 1.18 in) from connector end.
   - When installing, be careful not to twist or come in contact with other parts.
7. Installation of the remaining components is in the reverse order of removal.

FRONT TIMING CHAIN CASE

PFP:13599

Removal and Installation

EBS00P4U

NOTE:

- This section describes removal/installation procedure of front timing chain case and timing chain related parts without removing oil pan (upper) on vehicle.
- When oil pan (upper) needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pans (upper and lower) first. Then remove front timing chain case, timing chain related parts, and rear timing chain case in this order, and installation is in the reverse order of removal. Refer to EM-165, "TIMING CHAIN" .
- Refer to EM-165, "TIMING CHAIN" for component parts location.

REMOVAL

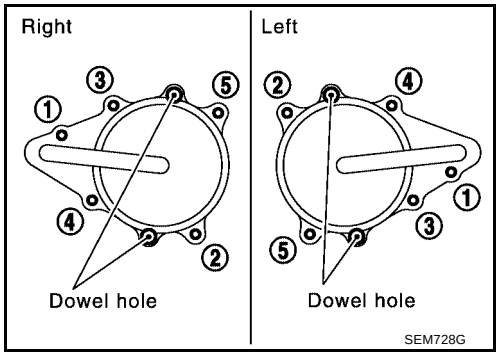
1. Remove engine cover with power tool. Refer to EM-123, "REMOVAL" .
2. Release the fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .
3. Drain engine oil. Refer to LU-20, "Changing Engine Oil" .

   CAUTION:
   - **Perform this step when engine is cold.**
   - **Do not spill engine oil on drive belts.**
4. Drain engine coolant from radiator. Refer to CO-39, "Changing Engine Coolant" .

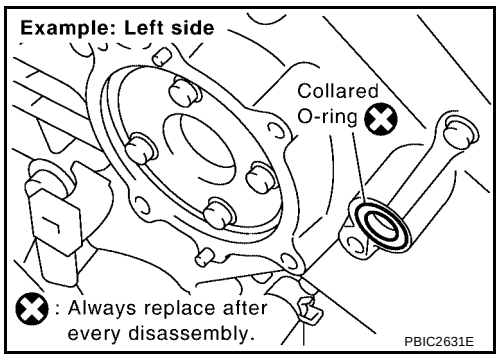
   CAUTION:
   - **Perform this step when engine is cold.**
   - **Do not spill engine coolant on drive belts.**
5. Remove radiator cooling fan assembly. Refer to CO-47, "ENGINE COOLING FAN" .
6. Separate engine harnesses removing their brackets from front timing chain case.
7. Remove drive belts. Refer to EM-124, "Removal" .
8. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to PS-22, "REMOVAL" .
9. Remove power steering oil pump bracket. Refer to PS-22, "REMOVAL" .
10. Remove alternator. Refer to SC-38, "REMOVAL" .
11. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
12. Remove right and left intake valve timing control covers.
    - Loosen bolts in reverse order as shown.
    - Cut liquid gasket for removal using Tool.

    Tool number : KV10111100 (J-37228)

    CAUTION:
    Shaft is internally jointed with camshaft sprocket (INT) center hole. When removing, keep it horizontal until it is completely disconnected.



13. Remove collared O-rings from front timing chain case (left and right side).



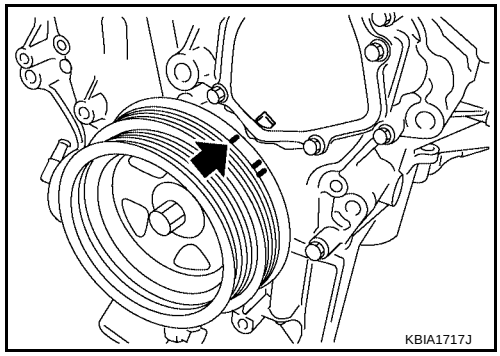
14. Remove rocker covers (right and left banks). Refer to EM-151, "Removal and Installation" .

NOTE:
When only timing chain (primary) is removed, rocker cover does not need to be removed.

15. Obtain No. 1 cylinder at TDC of its compression stroke as follows:

NOTE:
When timing chain is not removed/installed, this step is not required.

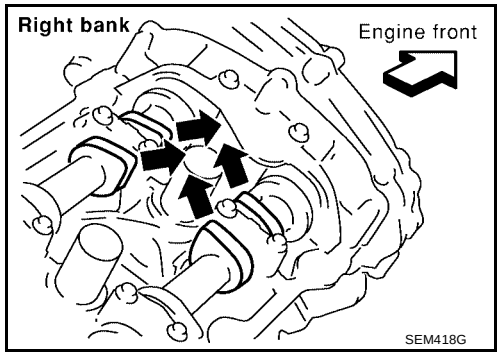
a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown.

- If not, turn crankshaft one revolution (360°) and align as shown.

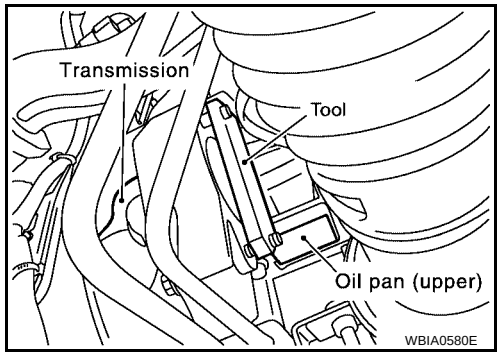
NOTE:
When only timing chain (primary) is removed, rocker cover does not need to be removed. To make sure that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to EM-174, "INSTALLATION" .



16. Remove crankshaft pulley as follows:

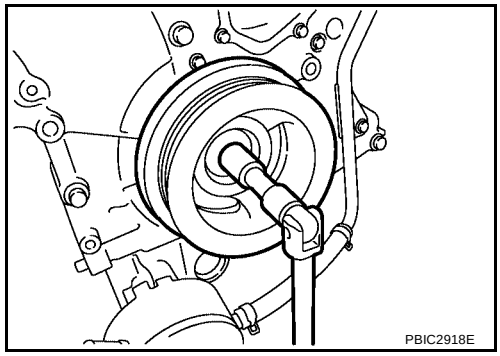
a. Remove starter motor and set Tool. Refer to SC-24, "REMOVAL" .

Tool number : KV10117700 (J-44716)



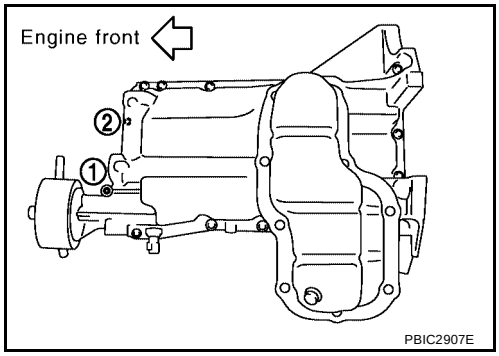
b. Loosen crankshaft pulley bolt and locate bolt seating surface as 10 mm (0.39 in) from its original position.

CAUTION:
Do not remove crankshaft pulley bolt. Keep loosened crankshaft pulley bolt in place to protect the crankshaft pulley from dropping.



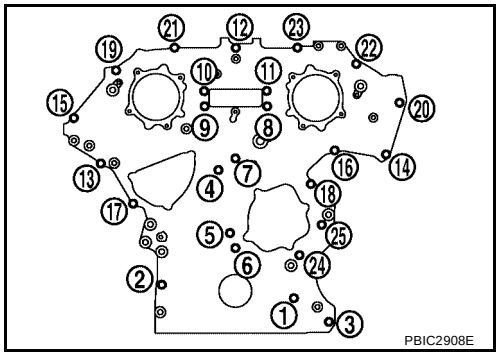
c. Pull crankshaft pulley with both hands to remove it.

17. Loosen two bolts in front of oil pan (upper) in reverse order as shown.



18. Remove front timing chain case as follows:

a. Loosen bolts with power tool in reverse order as shown.



b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).

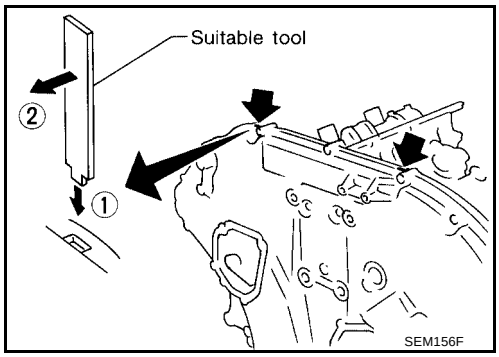
c. Pry off case by moving tool as shown (2).

- Cut liquid gasket for removal using Tool.

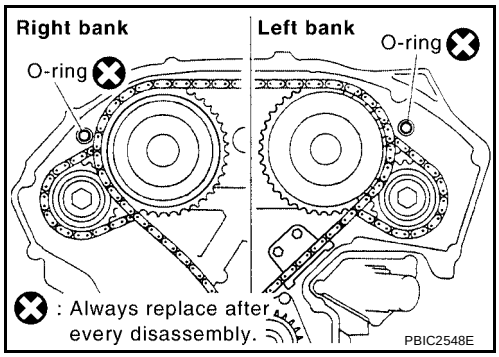
Tool number : KV10111100 (J-37228)

CAUTION:

- **Do not use screwdriver or something similar.**
- **After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.**



19. Remove O-rings from rear timing chain case.

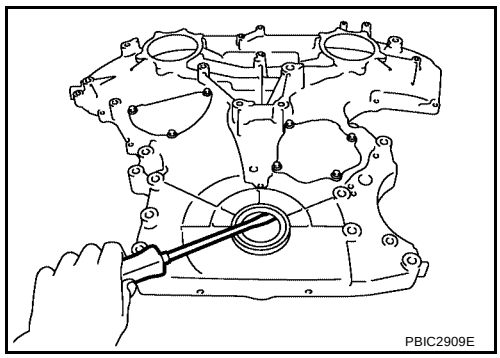


20. Remove water pump cover and chain tensioner cover from front timing chain case, if necessary.

- Cut liquid gasket for removal using Tool.

21. Remove front oil seal from front timing chain case using suitable tool.

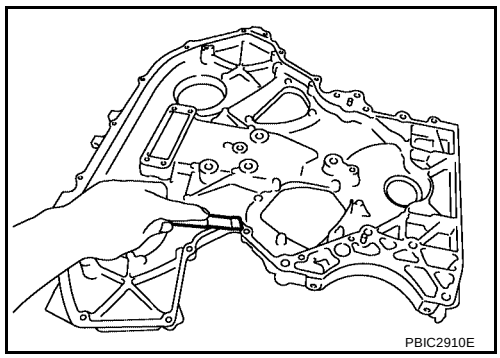
CAUTION:
Be careful not to damage front timing chain case.


PBIC2909E

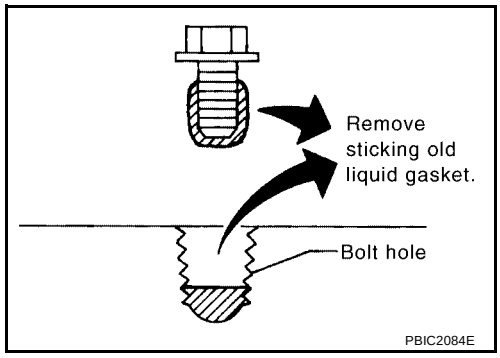
22. Remove timing chain and related parts. Refer to EM-166, "REMOVAL" .

23. Use a scraper to remove all traces of old liquid gasket from front and rear timing chain cases and oil pan (upper), and liquid gasket mating surfaces.

CAUTION:
Be careful not to allow gasket fragments to enter oil pan.

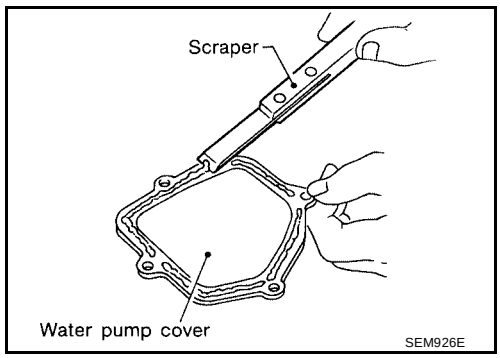

PBIC2910E

- Remove old liquid gasket from bolt hole and thread.



PBIC2084E

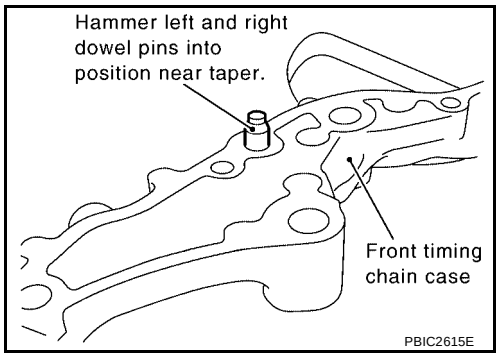
24. Use a scraper to remove all traces of old liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.



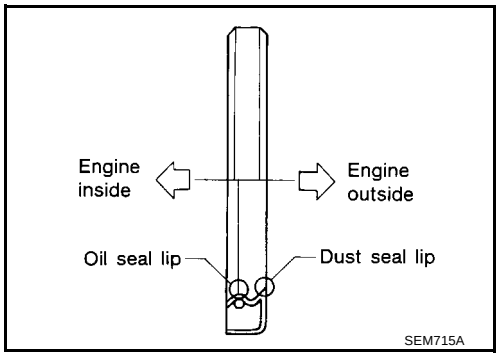
SEM926E

INSTALLATION

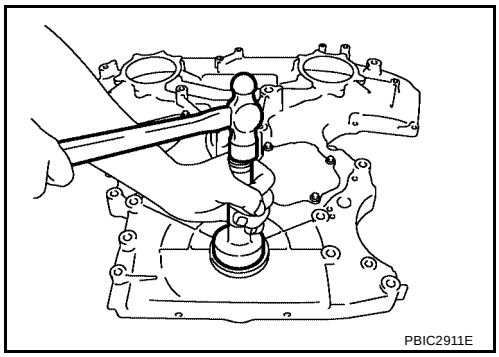
1. Hammer dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.



2. Install new front oil seal on the front timing chain case.
   - Apply new engine oil to both oil seal lip and dust seal lip.
   - Install it so that each seal lip is oriented as shown.



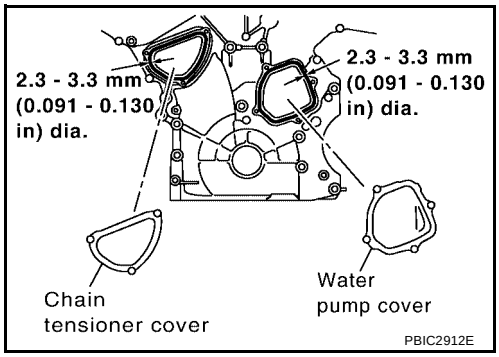
   - Press-fit oil seal until it becomes flush with front timing chain case end face using suitable drift [outer diameter: 60 mm (2.36 in)].
   - Make sure the garter spring is in position and seal lip is not inverted.



3. Install water pump cover and chain tensioner cover to front timing chain case, if removed.
   - Apply a continuous bead of liquid gasket using Tool to front timing chain case as shown.

     Tool number : WS39930000 (—)

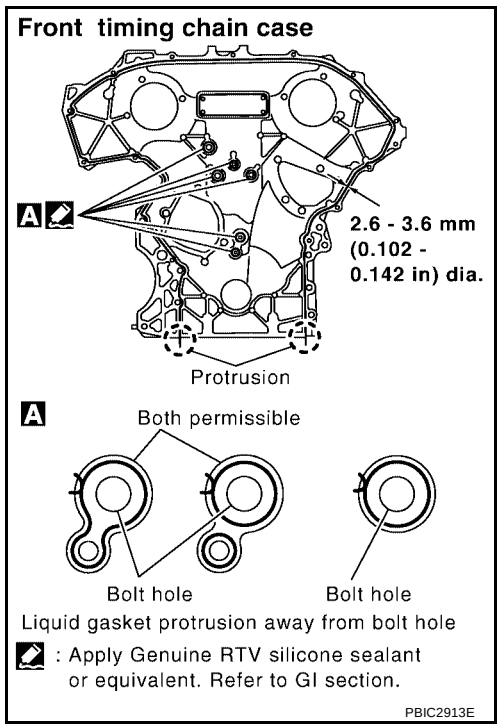
     Use Genuine RTV Silicone Sealant or equivalent. Refer to **GI-48, "Recommended Chemical Products and Sealants"**
     .



4. Install front timing chain case as follows:

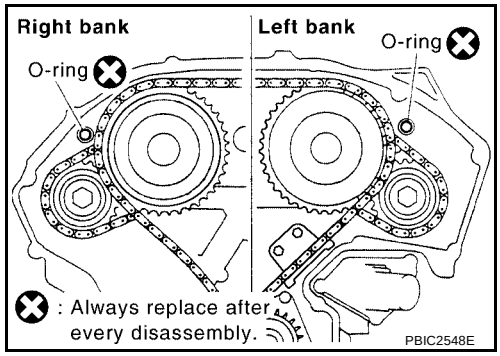
a. Apply a continuous bead of liquid gasket using Tool to front timing chain case back side as shown.

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

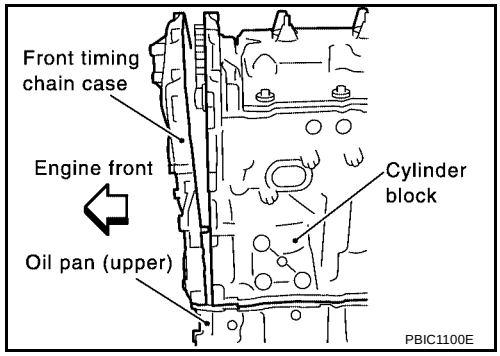


b. Install new O-rings on rear timing chain case.

c. Assemble front timing chain case as follows:

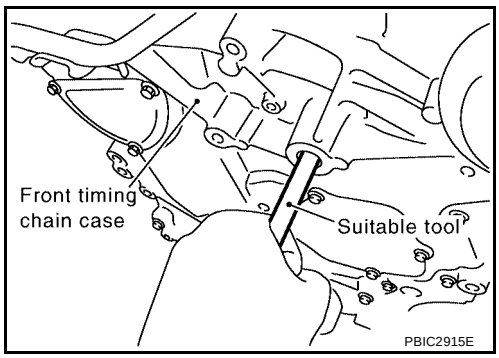


Fit lower end of front timing chain case tightly onto top face of oil pan (upper). From the fitting point, make entire front timing chain case contact rear timing chain case completely.



ii. Since front timing chain case is offset for difference of bolt holes, tighten bolts temporarily while holding front timing chain case from front and top as shown.

iii. Same as the previous step, insert dowel pin while holding front timing chain case from front and top completely.

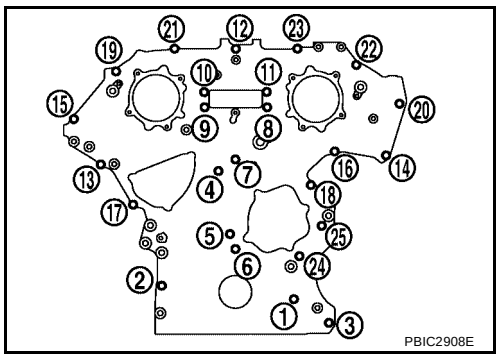


d. Tighten bolts to the specified torque in numerical order as shown.

- There are four type of bolts. Refer to the following for locating bolts.

Bolt position	Bolt diameter
1 - 5	: 10 mm (0.39 in)
6 – 25	: 6 mm (0.24 in)

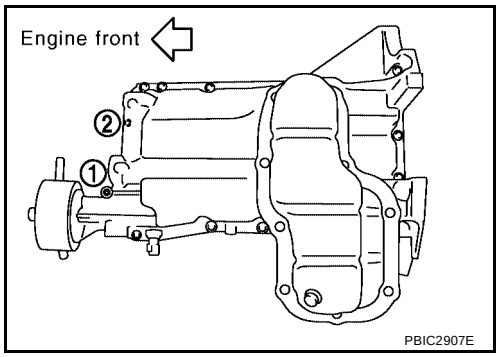
Bolt position	Tightening specification
1 - 5	: 55.0 N·m (5.6 kg-m, 41 ft-lb)
6 – 25	: 12.7 N·m (1.3 kg-m, 9 ft-lb)



e. After all bolts tightened, retighten them to the specified torque in numerical order as shown.

5. Install two bolts in front of oil pan (upper) in numerical order as shown.

Front oil pan bolt torque : 22.0 N·m (2.2 kg-m, 16 ft-lb)



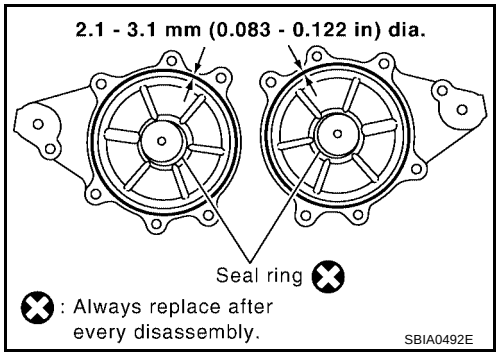
6. Install right and left intake valve timing control covers as follows:

a. Install new seal rings in shaft grooves.

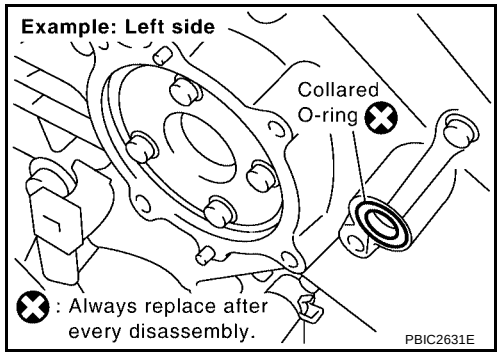
b. Apply a continuous bead of liquid gasket using Tool to intake valve timing control covers as shown.

Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to **GI-48, "Recommended Chemical Products and Sealants" .**

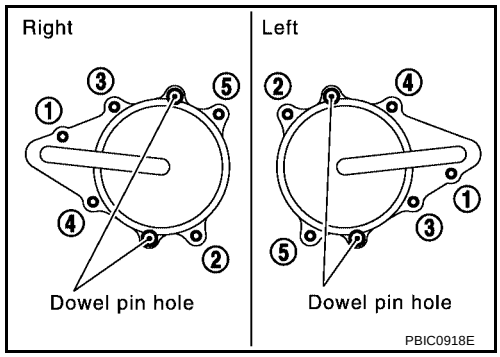


c. Install new collared O-rings in front timing chain case oil hole (left and right sides).



d. Being careful not to move seal ring from the installation groove, align dowel pins on front timing chain case with the holes to install intake valve timing control covers.

e. Tighten bolts in numerical order as shown.



7. Install crankshaft pulley as follows:

a. Install crankshaft pulley, taking care not to damage front oil seal.

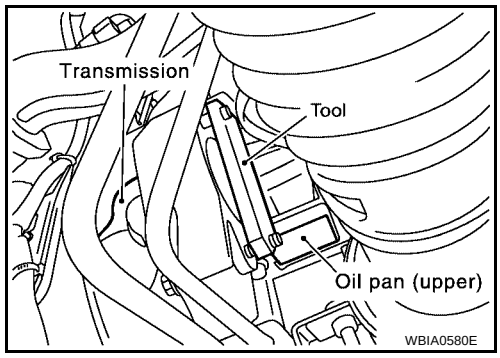
- When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).

b. Tighten crankshaft pulley bolt in two steps.

Step 1 : 44.1 N·m (4.5 kg-m, 33 ft-lb)
Step 2 :84° - 90° degrees clockwise

c. Remove Tool.

Tool number : KV10117700 (J-44716)



8. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
9. Installation of the remaining components is in the reverse order of removal after this step.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricant leaks and exhaust gases leaks.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-11, “RECOMMENDED FLUIDS AND LUBRICANTS”.
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.

- Run engine to check for unusual noise and vibration.

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

Summary of the inspection items:

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

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

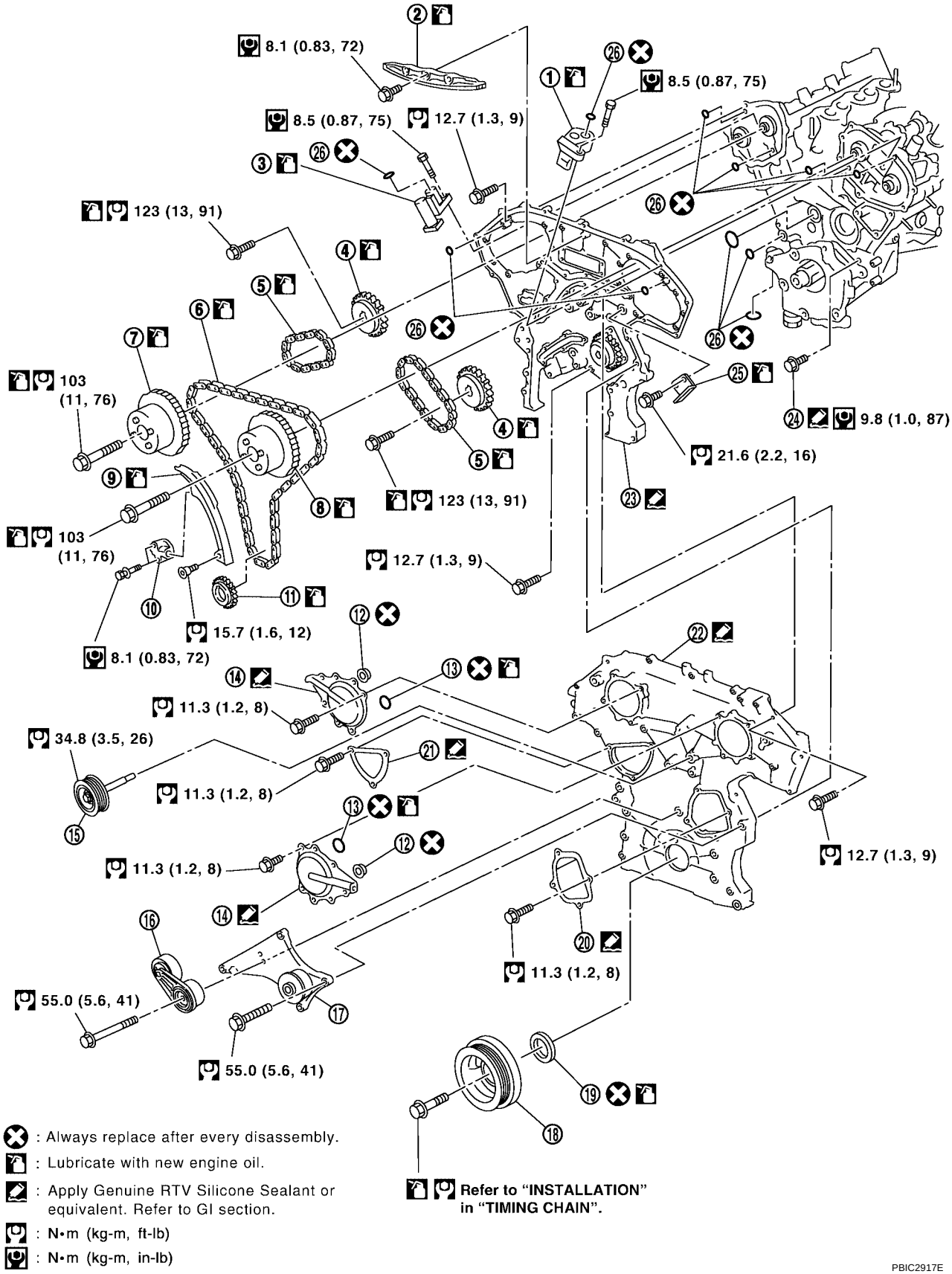
TIMING CHAIN

PFP:13028

Removal and Installation

EBS00P4V

SEC. 120•130•150•210•275



PBIC2917E

1.	Timing chain tensioner (secondary) (left bank)	2.	Internal chain guide	3.	Timing chain tensioner (secondary) (right bank)
4.	Camshaft sprocket (EXH)	5.	Timing chain (secondary)	6.	Timing chain (primary)
7.	Camshaft sprocket (INT)	8.	Camshaft sprocket (INT)	9.	Slack guide
10.	Timing chain tensioner (primary)	11.	Crankshaft sprocket	12.	Collared O-ring
13.	O-ring	14.	Intake valve timing control cover	15.	Idler pulley
16.	Drive belt auto tensioner	17.	Cooling fan bracket	18.	Crankshaft pulley
19.	Front oil seal	20.	Water pump cover	21.	Chain tensioner cover
22.	Front timing chain case	23.	Rear timing chain case	24.	Water drain plug (front)
25.	Tension guide	26.	O-ring		

NOTE:

- This section describes procedures for removing/installing front timing chain case and timing chain related parts, and rear timing chain case, when oil pan (upper) needs to be removed/installed for engine overhaul, etc.
- To remove/install front timing chain case, timing chain, and its related parts without removing oil pan (upper), refer to EM-156, "FRONT TIMING CHAIN CASE" .

REMOVAL

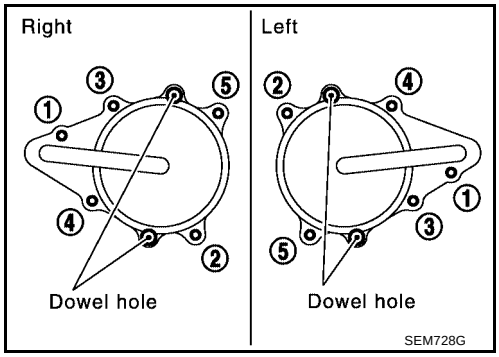
1. Remove engine cover with power tool. Refer to EM-123, "REMOVAL" .
2. Release the fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .
3. Drain engine oil. Refer to LU-20, "Changing Engine Oil" .

   CAUTION:
   - **Perform this step when engine is cold.**
   - **Do not spill engine oil on drive belts.**
4. Drain engine coolant from radiator. Refer to CO-39, "Changing Engine Coolant" .

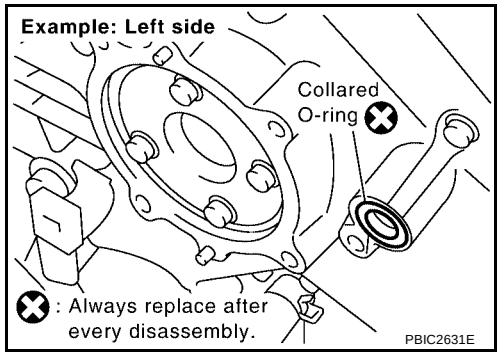
   CAUTION:
   - **Perform this step when engine is cold.**
   - **Do not spill engine coolant on drive belts.**
5. Remove radiator cooling fan assembly. Refer to CO-47, "ENGINE COOLING FAN" .
6. Separate engine harnesses removing their brackets from front timing chain case.
7. Remove drive belts. Refer to EM-124, "Removal" .
8. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to PS-22, "REMOVAL" .
9. Remove power steering oil pump bracket. Refer to PS-22, "REMOVAL" .
10. Remove alternator. Refer to SC-38, "REMOVAL" .
11. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
12. Remove right and left intake valve timing control covers.
    - Loosen bolts in reverse order as shown.
    - Cut liquid gasket for removal using Tool.

    Tool number : KV10111100 (J-37228)

    CAUTION:
    Shaft is internally jointed with camshaft sprocket (INT) center hole. When removing, keep it horizontal until it is completely disconnected.



13. Remove collared O-rings from front timing chain case (left and right side).



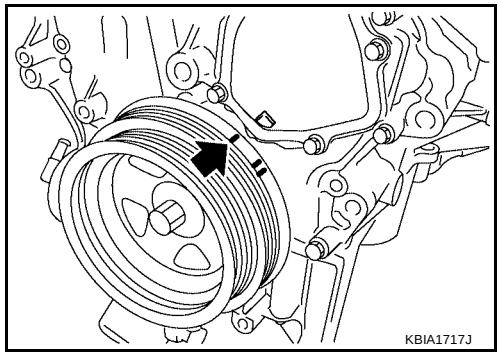
14. Remove rocker covers (right and left banks). Refer to EM-151, "Removal and Installation" .

NOTE:
When only timing chain (primary) is removed, rocker cover does not need to be removed.

15. Obtain No. 1 cylinder at TDC of its compression stroke as follows:

NOTE:
When timing chain is not removed/installed, this step is not required.

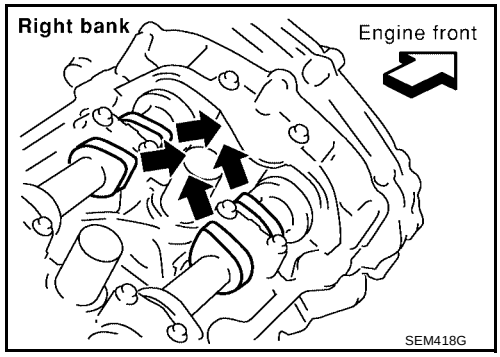
a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown.

- If not, turn crankshaft one revolution (360°) and align as shown.

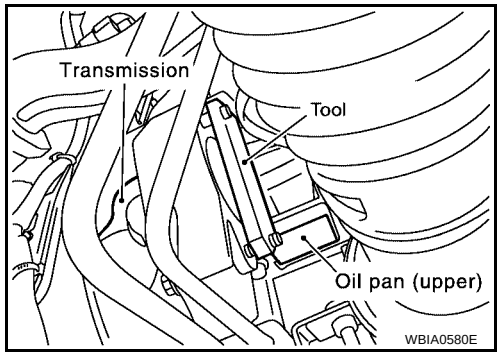
NOTE:
When only timing chain (primary) is removed, rocker cover does not need to be removed. To make sure that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to EM-174, "INSTALLATION" .



16. Remove crankshaft pulley as follows:

a. Remove starter motor and set Tool. Refer to SC-24, "REMOVAL" .

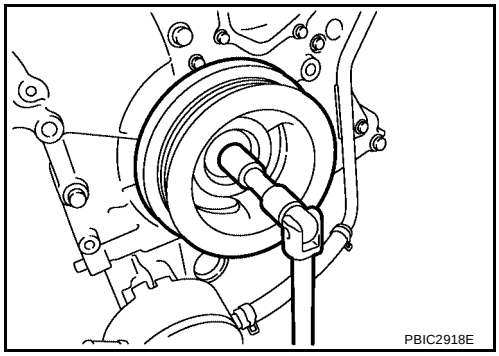
Tool number : KV10117700 (J-44716)



b. Loosen crankshaft pulley bolt and locate bolt seating surface as 10 mm (0.39 in) from its original position.

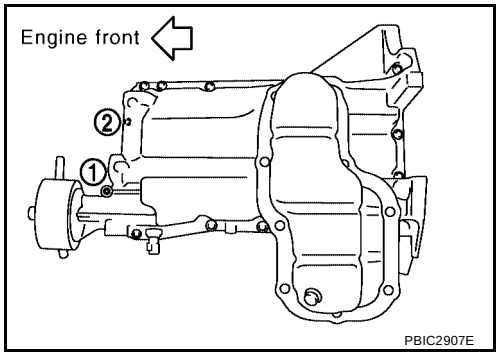
CAUTION:

Do not remove crankshaft pulley bolt. Keep loosened crankshaft pulley bolt in place protect removed crankshaft pulley from dropping.



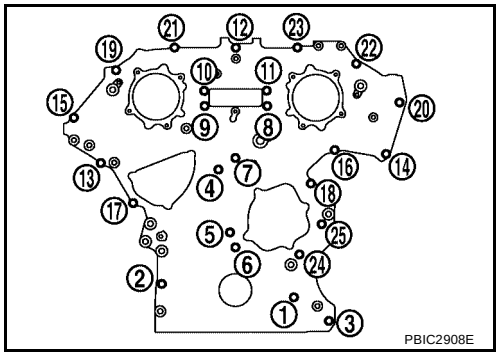
c. Pull crankshaft pulley with both hands to remove it.

17. Loosen two bolts in front of oil pan (upper) in reverse order as shown.



18. Remove front timing chain case as follows:

a. Loosen bolts with power tool in reverse order as shown.



b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).

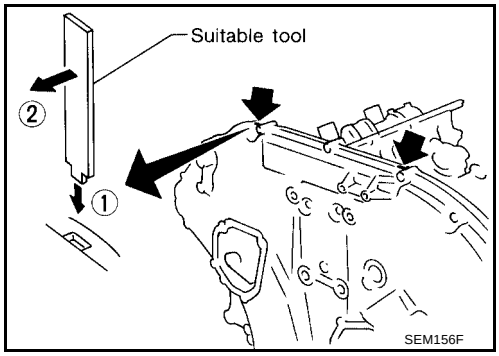
c. Pry off case by moving tool as shown (2).

- Cut liquid gasket for removal using Tool.

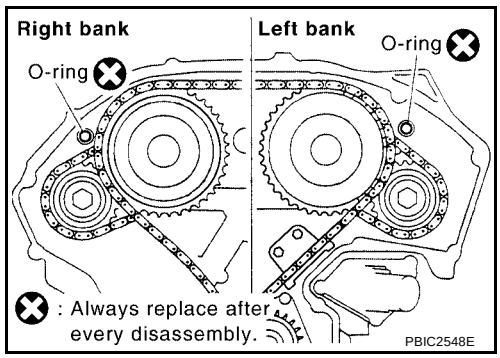
Tool number : KV10111100 (J-37228)

CAUTION:

- **Do not use screwdriver or something similar.**
- **After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.**

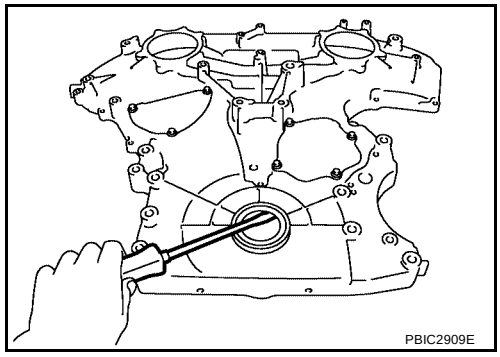


19. Remove O-rings from rear timing chain case.



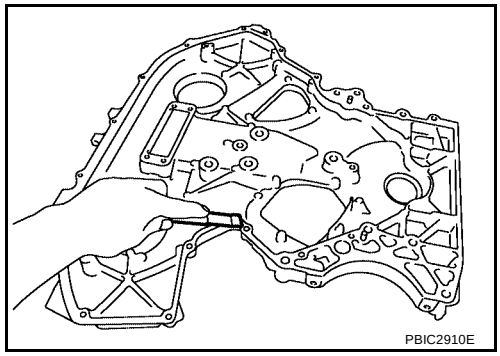
20. Remove water pump cover and chain tensioner cover from front timing chain case, if necessary.
    - Cut liquid gasket for removal using Tool.
21. Remove front oil seal from front timing chain case using suitable tool.

    CAUTION:
    Be careful not to damage front timing chain case.

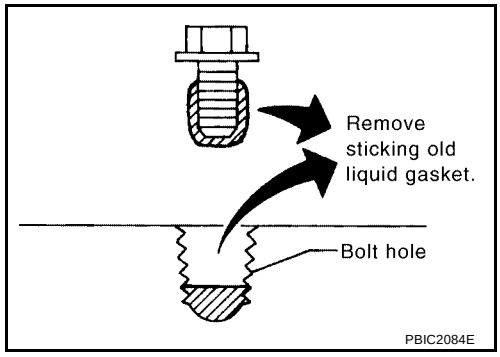


22. Use a scraper to remove all traces of old liquid gasket from front and rear timing chain cases and oil pan (upper), and liquid gasket mating surfaces.

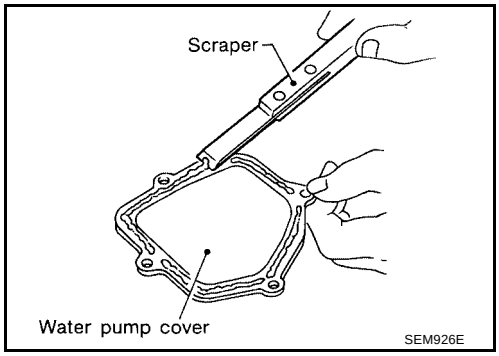
    CAUTION:
    Be careful not to allow gasket fragments to enter oil pan.



    - Remove old liquid gasket from bolt hole and thread.



23. Use a scraper to remove all traces of old liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.

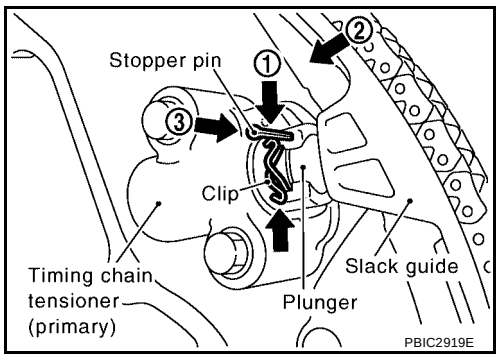


24. Remove timing chain tensioner (primary) as follows:

a. Loosen clip of timing chain tensioner (primary), and release plunger stopper. (1)

b. Insert plunger into tensioner body by pressing slack guide. (2)

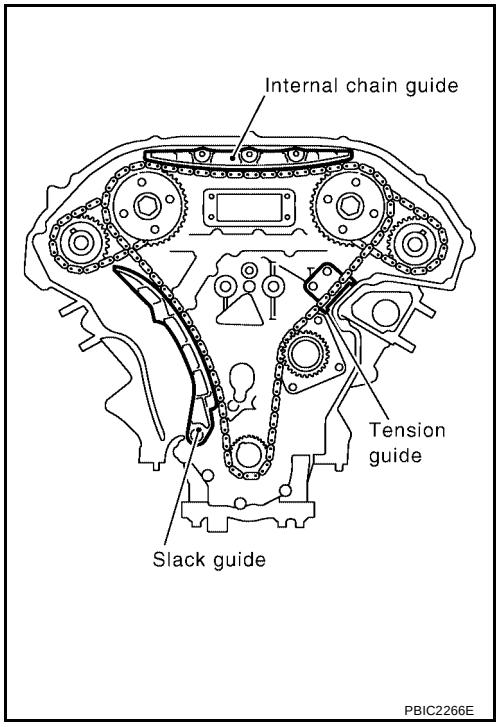
c. Keep slack guide pressed and hold plunger in by pushing stopper pin through the tensioner body hole and plunger groove. (3)



d. Remove bolts and remove timing chain tensioner (primary).

25. Remove internal chain guide, tension guide and slack guide.

NOTE:
Tension guide can be removed after removing timing chain (primary).



26. Remove timing chain (primary) and crankshaft sprocket.

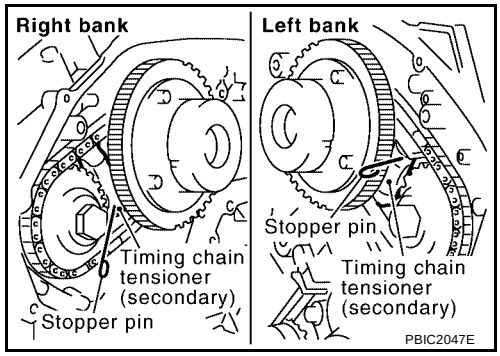
CAUTION:
After removing timing chain (primary), do not turn crankshaft and camshaft separately, or valves will strike the piston heads.

27. Remove timing chain (secondary) and camshaft sprockets as follows:

a. Attach suitable stopper pin to the right and left timing chain tensioners (secondary).

NOTE:

- Use approximately 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.
- For removal of timing chain tensioner (secondary), refer to EM-185, "CAMSHAFT" . [Removing camshaft bracket (No. 1) is required.]

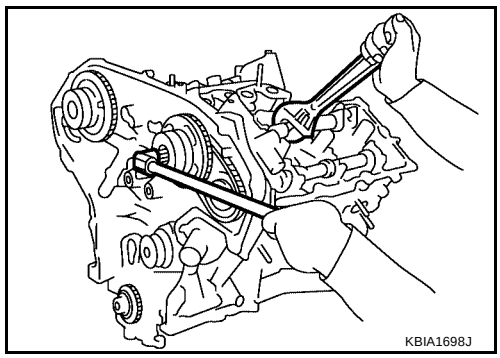


b. Remove camshaft sprocket (INT and EXH) bolts.

- Secure the hexagonal portion of camshaft using wrench to loosen bolts.

CAUTION:

Do not loosen bolts with securing anything other than the camshaft hexagonal portion or with tensioning the timing chain.



c. Remove timing chain (secondary) together with camshaft sprockets.

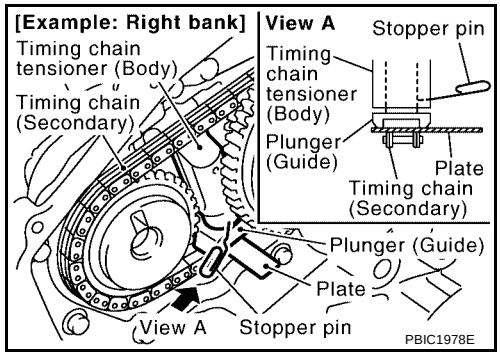
- Turn camshaft slightly to secure slackness of timing chain on timing chain tensioner (secondary) side.
- Insert 0.5 mm (0.020 in)-thick metal or resin plate between timing chain and timing chain tensioner plunger (guide). Remove timing chain (secondary) together with camshaft sprockets with timing chain loose from guide groove.

CAUTION:

Be careful of plunger coming off when removing timing chain (secondary). This is because plunger of timing chain tensioner (secondary) moves during operation, leading to coming off of fixed stopper pin.

NOTE:

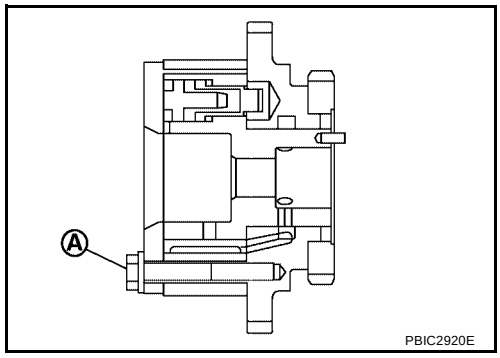
Camshaft sprocket (INT) is a one piece integrated design sprockets for timing chain (primary) and for timing chain (secondary).



- When handling camshaft sprocket (INT), be careful of the following:

CAUTION:

- **Handle carefully to avoid any shock to camshaft sprocket.**
- **Do not disassemble. (Do not loosen bolts “A” as shown).**



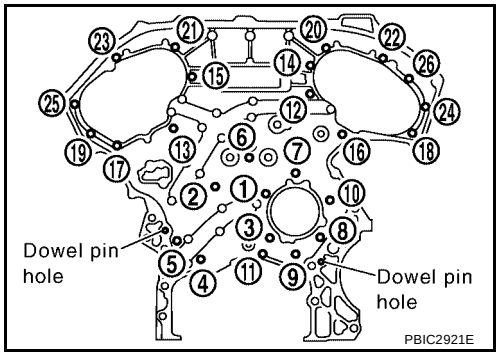
28. Remove water pump. Refer to CO-49, "REMOVAL" .

29. Remove rear timing chain case as follows:

Tool number : KV10111100 (J-37228)

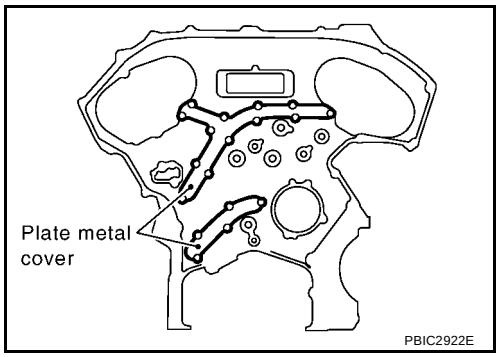
a. Loosen and remove bolts with power tool in reverse order as shown.

b. Cut liquid gasket using Tool and remove rear timing chain case.

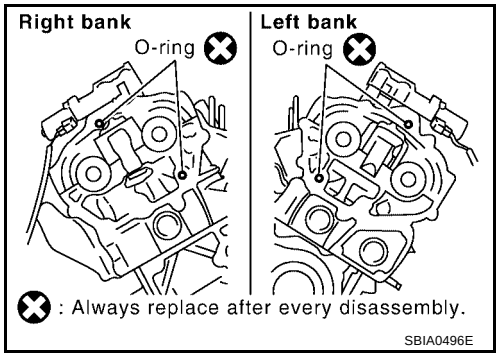


CAUTION:

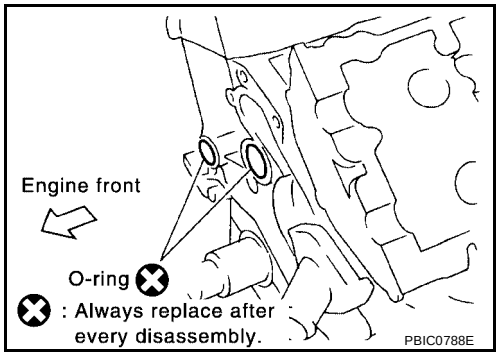
- **Do not remove plate metal cover of oil passage.**
- **After removal, handle rear timing chain case carefully so it does not tilt, cant, or warp under a load.**



30. Remove O-rings from cylinder head and camshaft bracket (No. 1).



31. Remove O-rings from cylinder block.

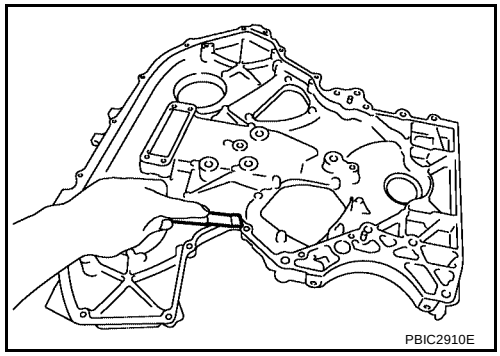


32. Remove timing chain tensioners (secondary) from cylinder head if necessary.

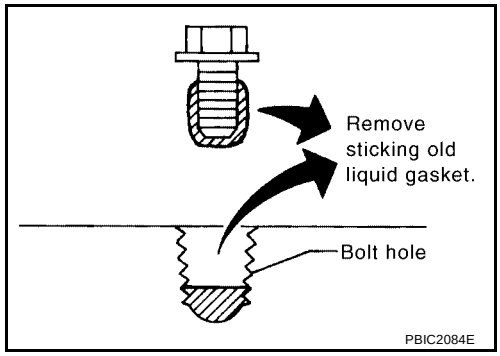
a. Remove camshaft brackets (No. 1). Refer to EM-186, "REMOVAL" .

b. Remove timing chain tensioners (secondary) with stopper pin attached.

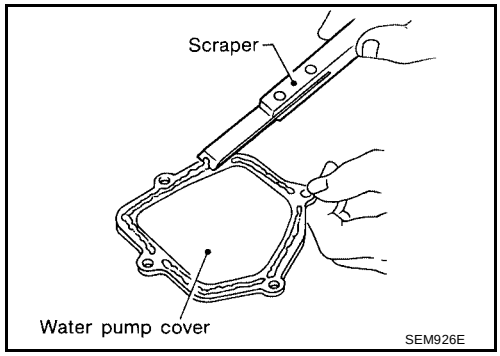
33. Use scraper to remove all traces of old liquid gasket from front and rear timing chain cases, and opposite mating surfaces.



- Remove old liquid gasket from bolt hole and thread.



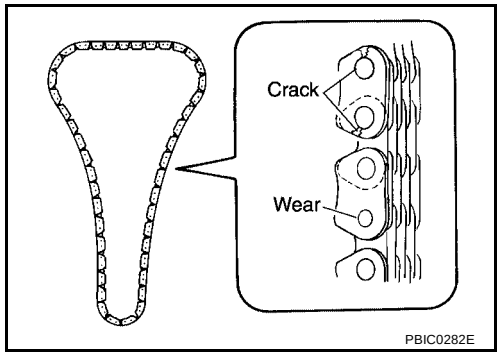
34. Use scraper to remove all traces of liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.



INSPECTION AFTER REMOVAL

Timing Chain

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

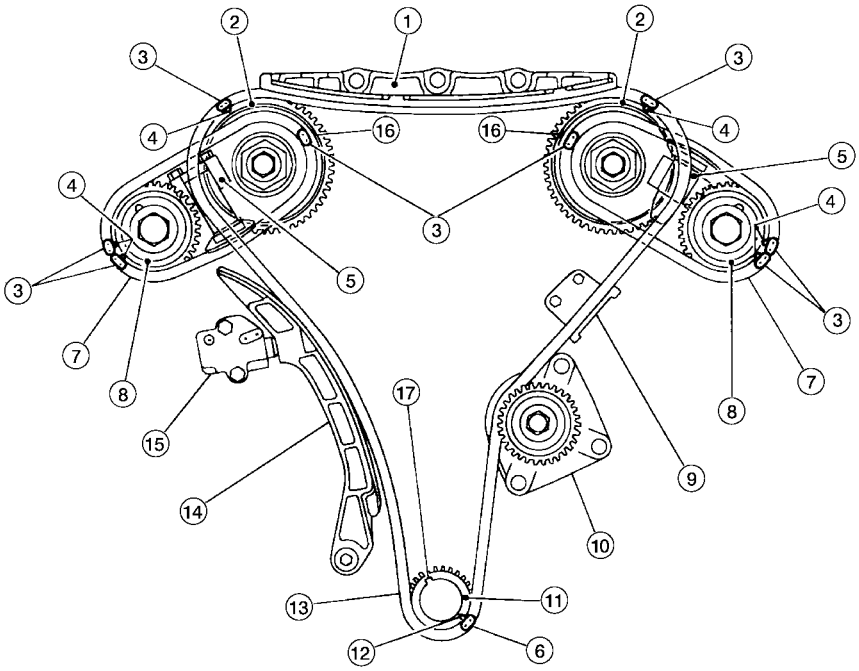


INSTALLATION

NOTE:

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

SEC. 130



1. Internal chain guide
2. Camshaft sprocket (intake)
3. Mating mark (copper link)
4. Mating mark (punched)
5. Secondary timing chain tensioner
6. Mating mark (yellow link)
7. Secondary timing chain
8. Camshaft sprocket (exhaust)
9. Tensioner guide
10. Water pump
11. Crankshaft sprocket
12. Mating mark (notched)
13. Primary timing chain
14. Slack guide
15. Primary timing chain tensioner
16. Mating mark (back side)
17. Crankshaft key

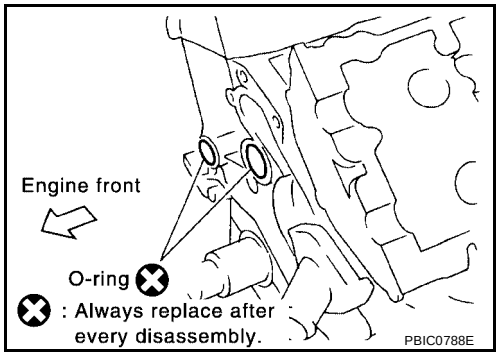
1. Install timing chain tensioners (secondary) to cylinder head if removed. Refer to EM-174, "INSTALLATION" .

a. Install timing chain tensioners (secondary) with stopper pin attached and new O-ring.

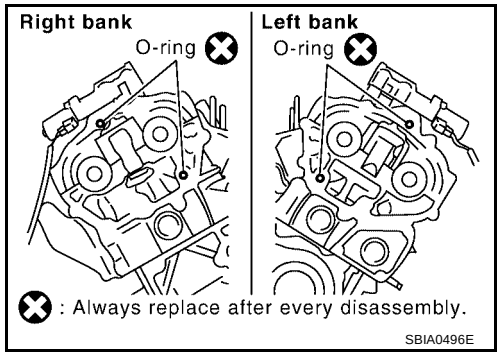
b. Install camshaft brackets (No. 1). Refer to EM-190, "INSTALLATION" .

2. Install rear timing chain case as follows:

a. Install new O-rings onto cylinder block.



b. Install new O-rings to cylinder head and camshaft bracket (No. 1).



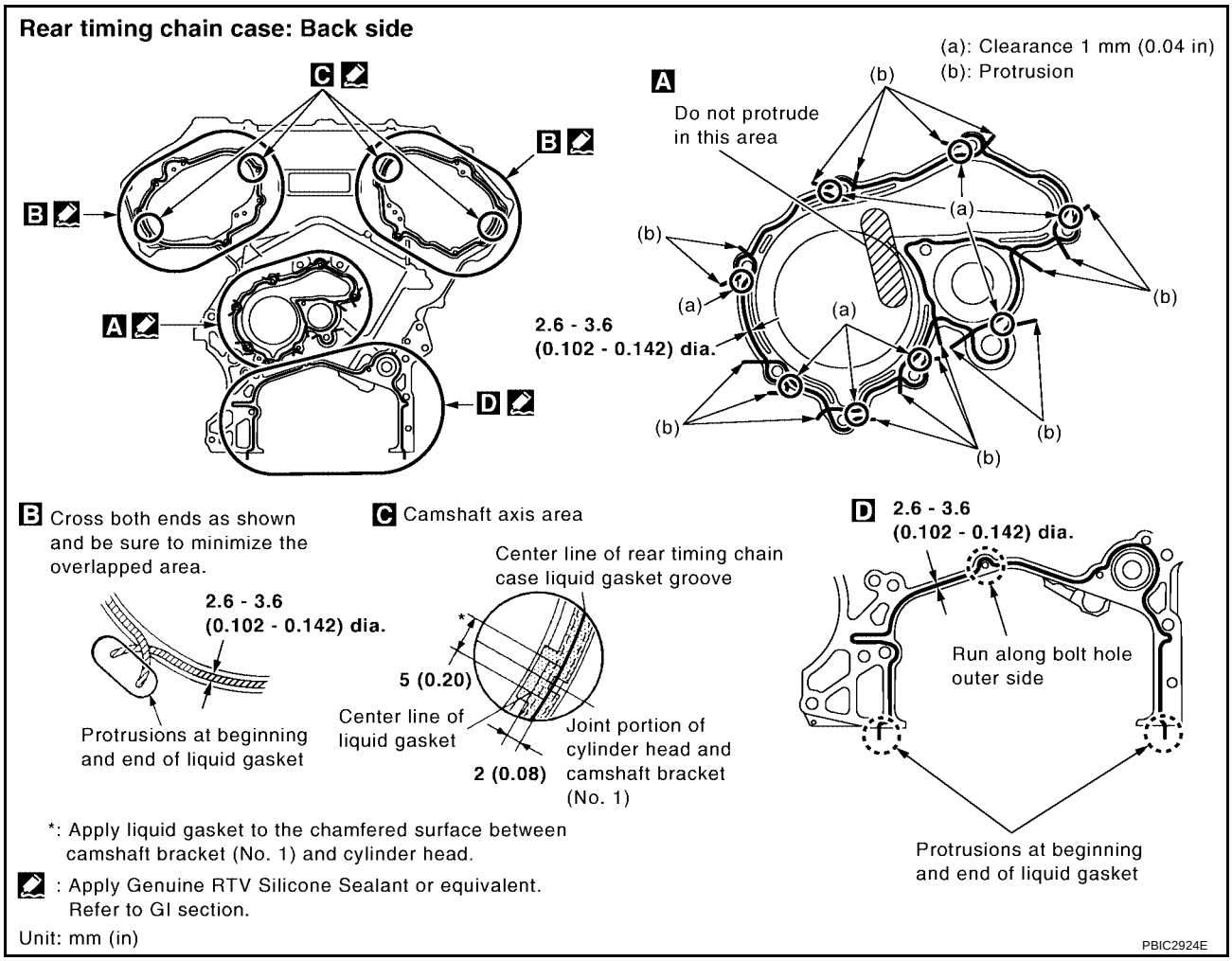
c. Apply liquid gasket using Tool to rear timing chain case back side as shown.

Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

CAUTION:

- **For "A" in the figure, completely wipe out liquid gasket extended on a portion touching at engine coolant.**
- **Apply liquid gasket on installation position of water pump and cylinder head very completely.**



d. Align rear timing chain case with dowel pins (right and left) on cylinder block and install rear timing chain case.

- Make sure O-rings stay in place during installation to cylinder block, cylinder head and camshaft bracket (No. 1).

e. Tighten bolts in numerical order as shown.

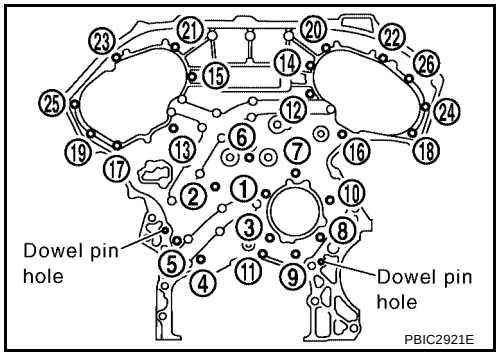
- There are two type of bolts. Refer to the following for locating bolts.

Bolt length: Bolt position

20 mm (0.79 in) : 1, 2, 3, 6, 7, 8, 9, 10

16 mm (0.63 in) : Except the above

Rear timing case bolt torque : 12.7 N·m (1.3 kg-m, 9 ft-lb)



f. After all bolts are tightened, retighten them to the specified torque in numerical order as shown.

- If liquid gasket protrudes, wipe it off immediately.

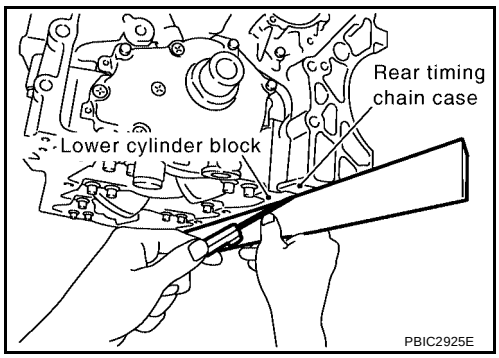
g. After installing rear timing chain case, check the surface height difference between following parts on oil pan (upper) mounting surface.

Standard

Rear timing chain case to lower cylinder block:

–0.24 to 0.14 mm (–0.0094 to 0.0055 in)

- If not within the standard, repeat the installation procedure.



3. Install water pump with new O-rings. Refer to CO-51, "INSTALLATION" .

4. Make sure that dowel pin hole, dowel pin of camshaft and crankshaft key are located as shown. (No. 1 cylinder at compression TDC)

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

Camshaft dowel pin hole (intake side)

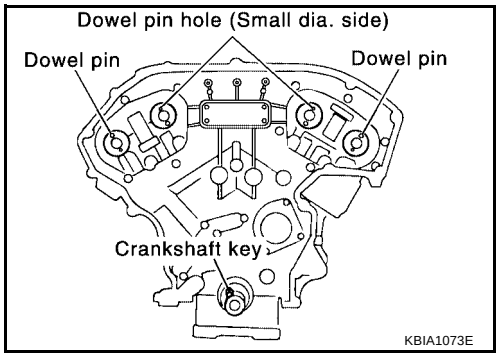
: At cylinder head upper face side in each bank.

Camshaft dowel pin (exhaust side)

: At cylinder head upper face side in each bank.

Crankshaft key

: At cylinder head side of right bank.



CAUTION:

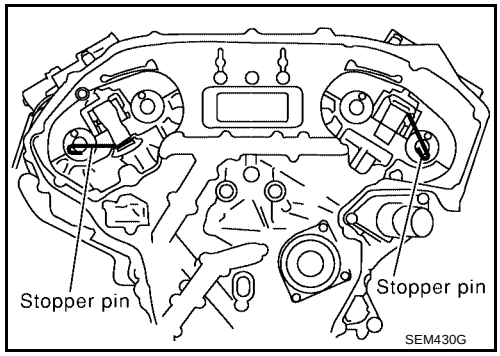
Hole on small dia. side must be used for intake side dowel pin hole. Do not misidentify (ignore big dia. side).

5. Install timing chains (secondary) and camshaft sprockets as follows:

CAUTION:

Mating marks between timing chain and sprockets slip easily. Confirm all mating mark positions repeatedly during the installation process.

a. Push plunger of timing chain tensioner (secondary) and keep it pressed in with stopper pin.

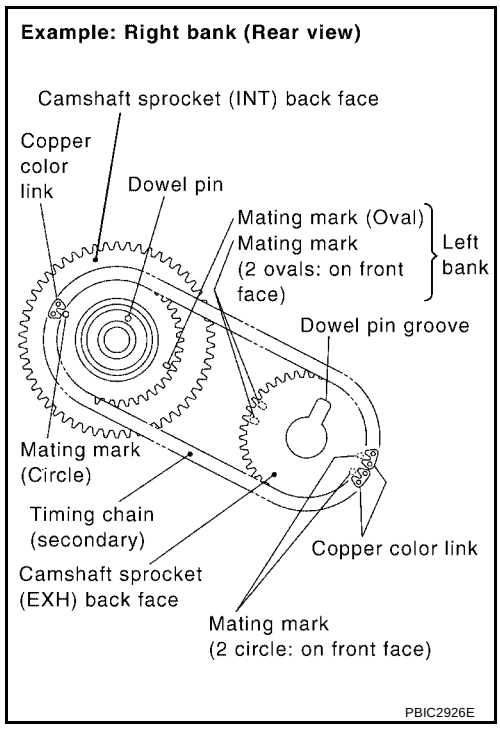


b. Install timing chains (secondary) and camshaft sprockets (INT and EXH).

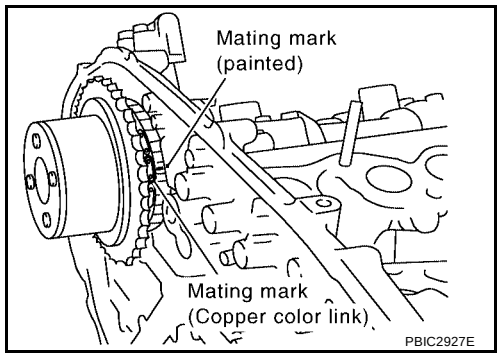
- Align the mating marks on timing chain (secondary) (copper color link) with the ones on camshaft sprockets (INT and EXH) (punched), and install them.

  NOTE:
  - Mating marks for camshaft sprocket (INT) are on the back side of camshaft sprocket (secondary).
  - There are two types of mating marks, circle and oval types. They should be used for the right and left banks, respectively.

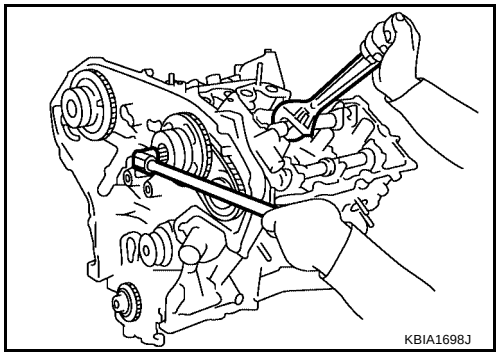
  Right bank : Use circle type.
  Left bank : Use oval type.



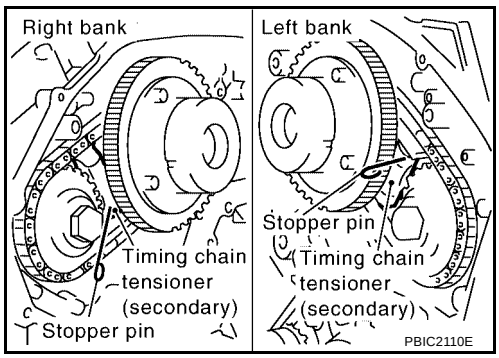
- Align dowel pin and pin hole on camshafts with the groove and dowel pin on sprockets, and install them.
- On the intake side, align pin hole on the small diameter side of the camshaft front end with dowel pin on the back side of camshaft sprocket, and install them.
- On the exhaust side, align dowel pin on camshaft front end with pin groove on camshaft sprocket, and install them.
- In case that positions of each mating mark and each dowel pin are not fit on mating parts, make fine adjustment to the position holding the hexagonal portion on camshaft with wrench or equivalent.
- Bolts for camshaft sprockets must be tightened in the next step. Tightening them by hand is enough to prevent the dislocation of dowel 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 top of sprocket teeth and its extended line in advance with paint.



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

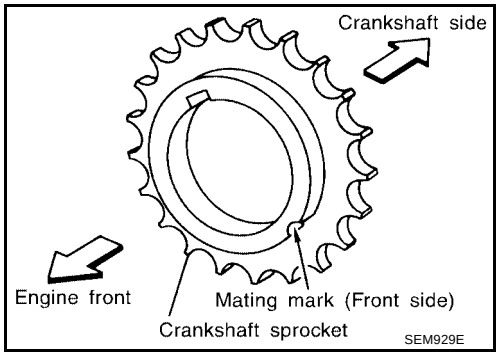


d. Pull stopper pins out from timing chain tensioners (secondary).

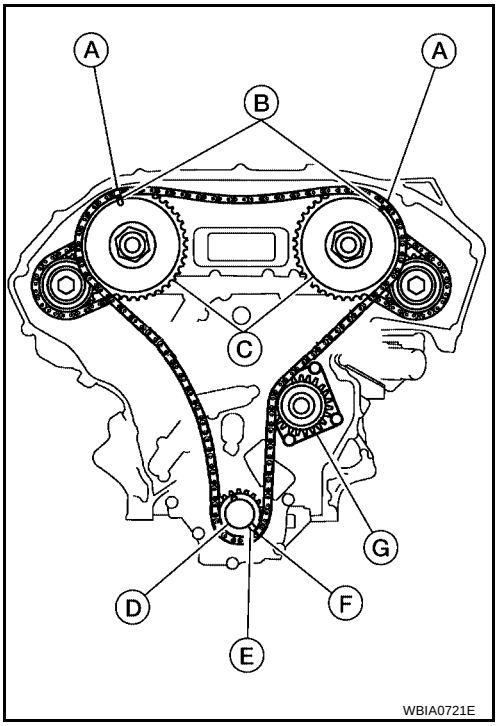


6. Install tension guide.
7. Install timing chain (primary) as follows:

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

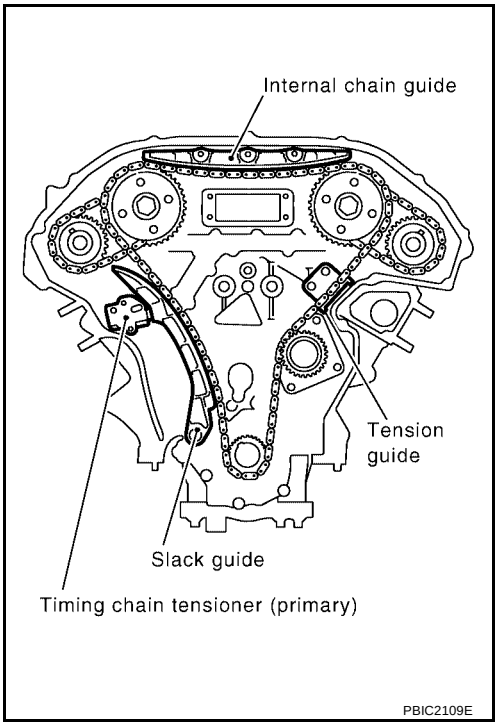


b. Install the primary timing chain.
- Water pump (G).
- Install primary timing chain so the mating mark punched (B) on camshaft sprocket is aligned with the copper link (A) on the timing chain, while the mating mark notched (E) on the crankshaft sprocket (D) is aligned with the yellow link (F) on the timing chain, as shown.
- When it is difficult to align mating marks (A) with (B) and (E) with (F) 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.



WBIA0721E

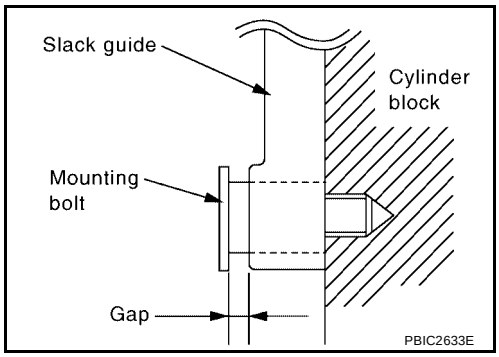
8. Install internal chain guide, slack guide and timing chain tensioner (primary).



PBIC2109E

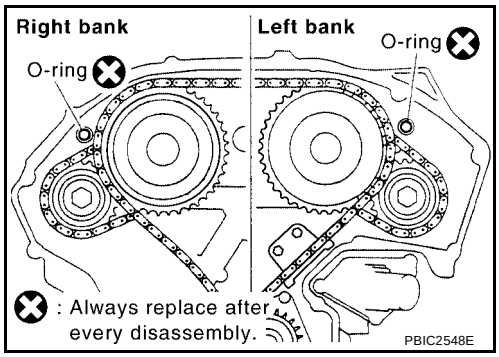
CAUTION:

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

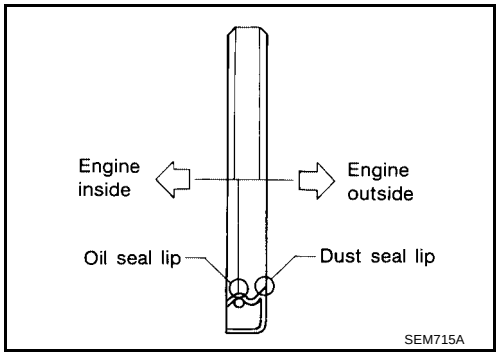


- When installing timing chain tensioner (primary), push in plunger and keep it pressed in with stopper pin.
- Remove any dirt and foreign materials completely from the back and the mounting surfaces of timing chain tensioner (primary).
- After installation, pull out stopper pin by pressing slack guide.

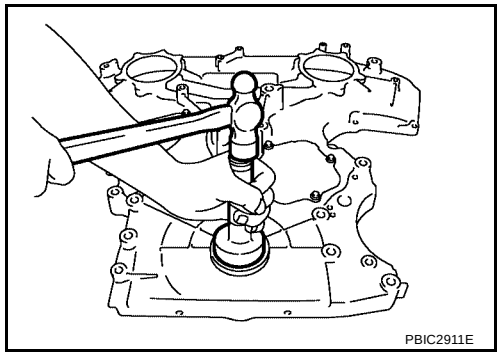
9. Make sure again that the mating marks on camshaft sprockets and timing chain have not slipped out of alignment.
10. Install new O-rings on rear timing chain case.



11. Install new front oil seal on front timing chain case.
    - Apply new engine oil to both oil seal lip and dust seal lip.
    - Install it so that each seal lip is oriented as shown.



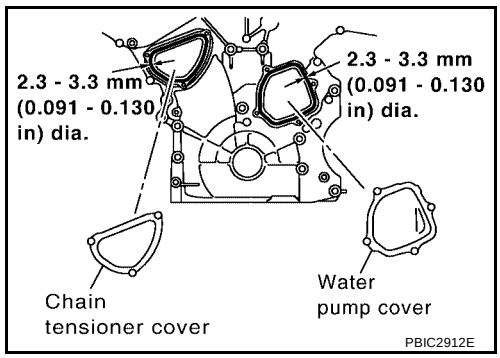
- Press-fit oil seal until it becomes flush with front timing chain case end face using suitable drift [outer diameter: 60 mm (2.36 in)].
- Make sure the garter spring is in position and seal lip is not inverted.


PBIC2911E

12. Install water pump cover and chain tensioner cover to front timing chain case.
- Apply a continuous bead of liquid gasket using Tool to front timing chain case as shown.

Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .



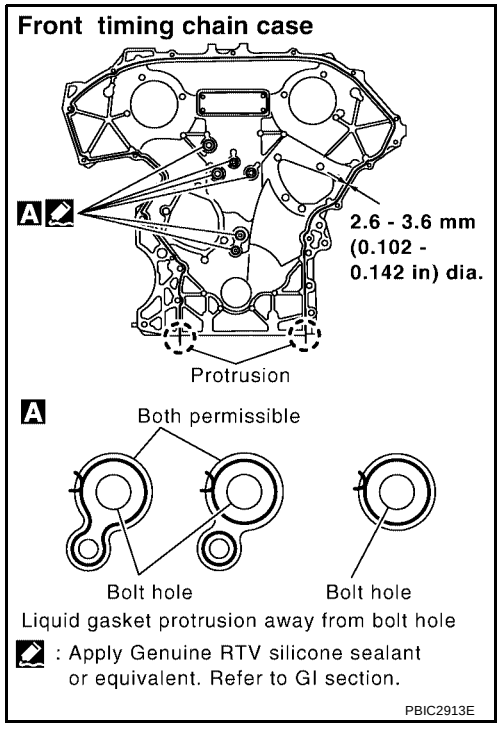
PBIC2912E

13. Install front timing chain case as follows:

a. Apply a continuous bead of liquid gasket using Tool to front timing chain case back side as shown.

Tool number : WS39930000 (—)

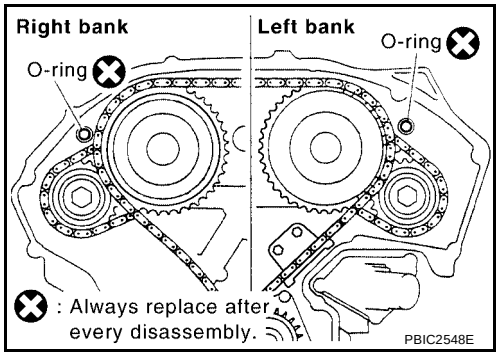
Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .



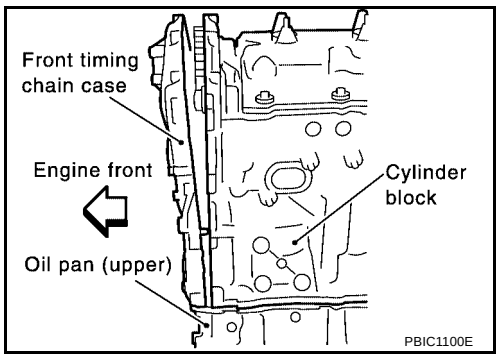
PBIC2913E

b. Install new O-rings on rear timing chain case.

c. Assemble front timing chain case as follows:

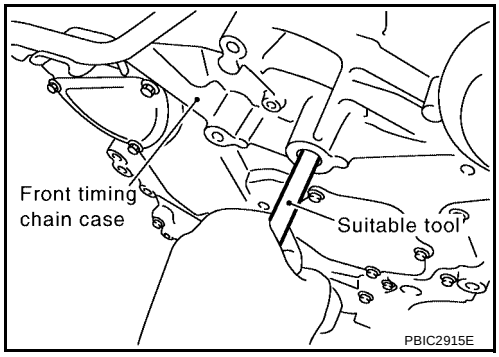


Fit lower end of front timing chain case tightly onto top face of oil pan (upper). From the fitting point, make entire front timing chain case contact rear timing chain case completely.



ii. Since front timing chain case is offset for difference of bolt holes, tighten bolts temporarily while holding front timing chain case from front and top as shown.

iii. Same as the previous step, insert dowel pin while holding front timing chain case from front and top completely.

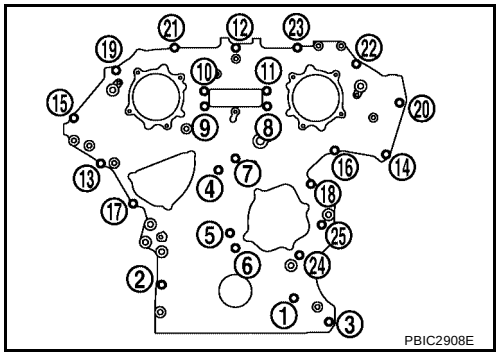


d. Tighten bolts to the specified torque in numerical order as shown.

- There are four type of bolts. Refer to the following for locating bolts.

Bolt position	Bolt diameter
1 - 5	: 10 mm (0.39 in)
6 – 25	: 6 mm (0.24 in)

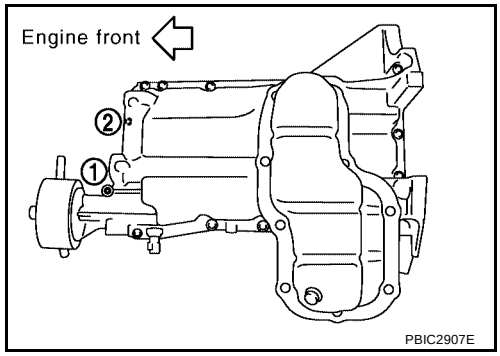
Bolt position	Tightening specification
1 - 5	: 55.0 N·m (5.6 kg-m, 41 ft-lb)
6 – 25	: 12.7 N·m (1.3 kg-m, 9 ft-lb)



e. After all bolts tightened, retighten them to the specified torque in numerical order as shown.

14. Install two bolts in front of oil pan (upper) in numerical order as shown.

Front oil pan bolt torque : 22.0 N·m (2.2 kg-m, 16 ft-lb)



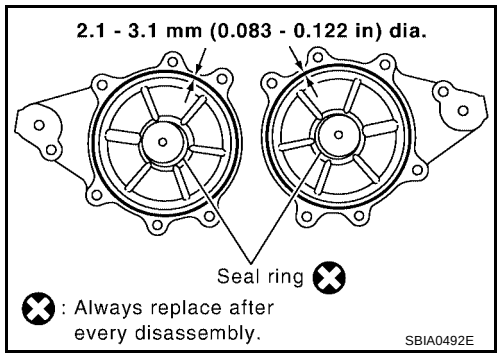
15. Install right and left intake valve timing control covers as follows:

a. Install new seal rings in shaft grooves.

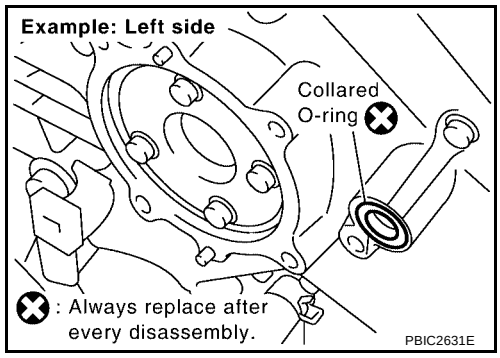
b. Apply a continuous bead of liquid gasket using Tool to intake valve timing control covers as shown.

Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants".

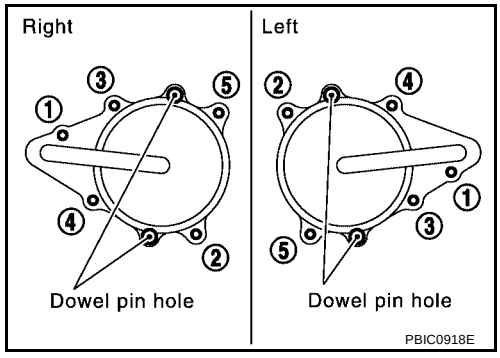


c. Install new collared O-rings in front timing chain case oil hole (left and right sides).



d. Being careful not to move seal ring from the installation groove, align dowel pins on front timing chain case with the holes to install intake valve timing control covers.

e. Tighten bolts in numerical order as shown.



16. Install crankshaft pulley as follows:

a. Install crankshaft pulley, taking care not to damage front oil seal.

- When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).

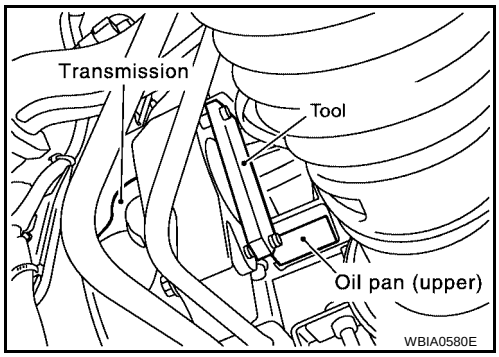
b. Tighten crankshaft pulley bolt in two steps.

Step 1 : 44.1 N·m (4.5 kg-m, 33 ft-lb)

Step 2 :84° - 90° degrees clockwise

c. Remove Tool.

Tool number : KV10117700 (J-44716)



17. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
18. Install oil pans (upper and lower). Refer to EM-137, "Removal and Installation" .
19. Install rocker covers (right and left banks). Refer to EM-151, "Removal and Installation" .
20. Installation of the remaining components is in the reverse order of removal after this step.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricant leaks and exhaust gases leaks.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-11, “RECOMMENDED FLUIDS AND LUBRICANTS”.
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

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

Summary of the inspection items:

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

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

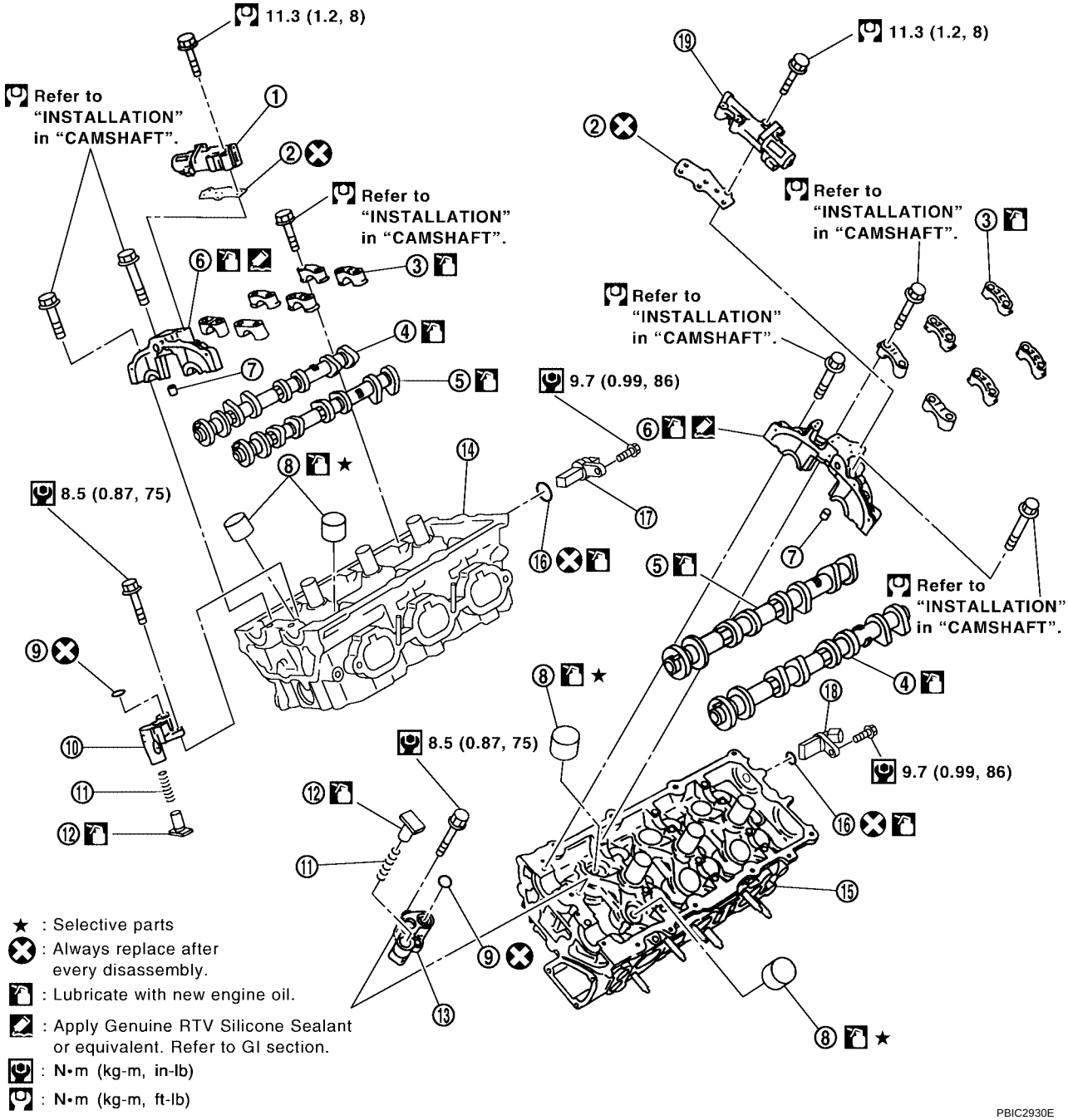
CAMSHAFT

PFP:13001

Removal and Installation

EBS00P4W

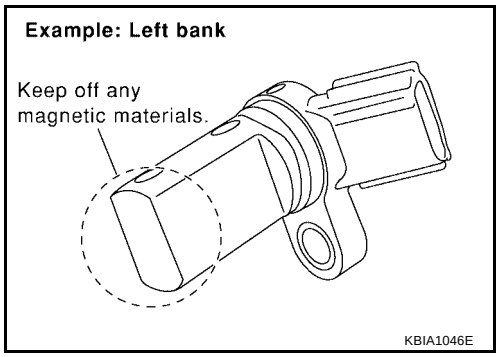
SEC. 111•130



1.	Intake valve timing control solenoid valve (right bank)	2.	Gasket	3.	Camshaft bracket (No. 2 to 4)
4.	Camshaft (EXH)	5.	Camshaft (INT)	6.	Camshaft bracket (No. 1)
7.	Dowel pin	8.	Valve lifter	9.	O-ring
10.	Timing chain tensioner (secondary) (right bank)	11.	Spring	12.	Plunger
13.	Timing chain tensioner (secondary) (left bank)	14.	Cylinder head (right bank)	15.	Cylinder head (left bank)
16.	O-ring	17.	Camshaft position sensor (PHASE) (right bank)	18.	Camshaft position sensor (PHASE) (left bank)
19.	Intake valve timing control solenoid valve (left bank)				

REMOVAL

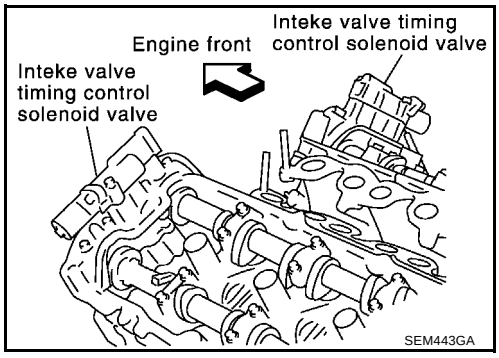
1. Remove front timing chain case, camshaft sprocket, timing chain and rear timing chain case. Refer to EM-166, "REMOVAL" .
2. Remove camshaft position sensor (PHASE) (right and left banks) from cylinder head back side.



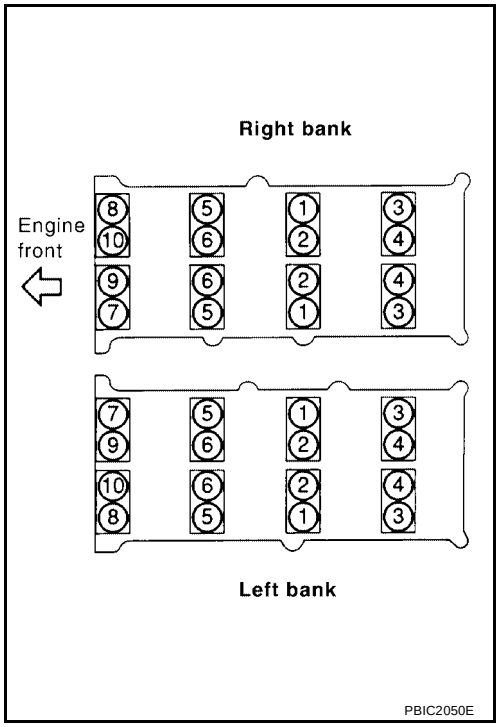
CAUTION:

- **Handle carefully to avoid dropping and shocks.**
- **Do not disassemble.**
- **Do not allow metal powder to adhere to magnetic part at sensor tip.**
- **Do not place sensors in a location where they are exposed to magnetism.**

3. Remove intake valve timing control solenoid valves.
   - Discard intake valve timing control solenoid valve gaskets and use new gaskets for installation.



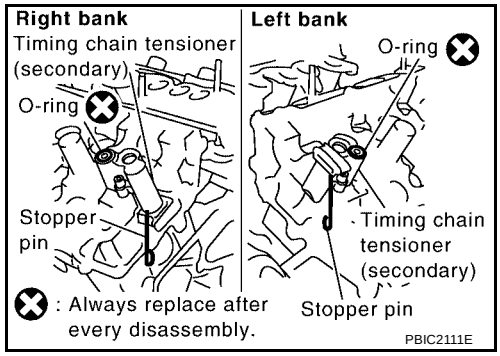
4. Remove camshaft brackets.
   - Mark camshafts, camshaft brackets and bolts so they are placed in the same position and direction for installation.
   - Equally loosen camshaft bracket bolts in several steps in reverse order as shown.



5. Remove camshafts.
6. Remove valve lifters.
   - Identify installation positions, and store them without mixing them up.

7. Remove timing chain tensioner (secondary) from cylinder head.
   - Remove timing chain tensioner (secondary) with its stopper pin attached.

   NOTE:
   Stopper pin was attached when timing chain (secondary) was removed.



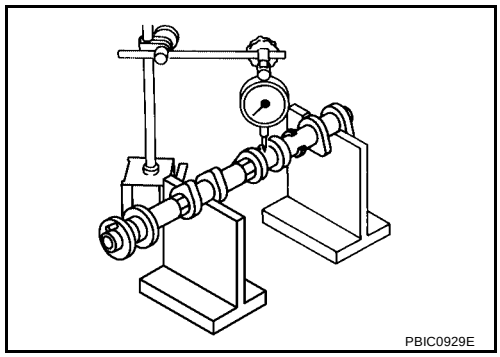
INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put V-block on precise flat table, and support No. 2 and 4 journal of camshaft.

   CAUTION:
   Do not support journal No. 1 (on the side of camshaft sprocket) because it has a different diameter from the other three locations.
2. Set dial indicator vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on dial indicator. (Total indicator reading)

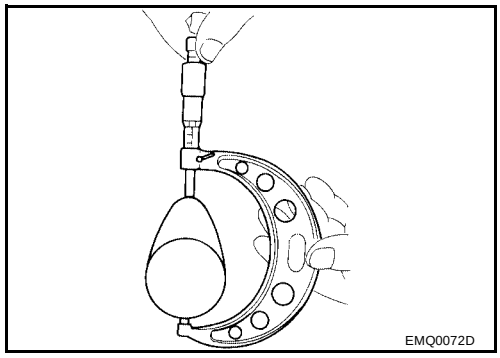
   Standard : Less than 0.02 mm (0.0008 in)
   Limit : 0.05 mm (0.0020 in)
4. If it exceeds the limit, replace camshaft.



Camshaft Cam Height

1. Measure the camshaft cam height with micrometer.

   Standard:
   Intake : 45.465 - 45.655 mm (1.7900 - 1.7974 in)
   Exhaust : 45.075 - 45.265 mm (1.7746 - 1.7821 in)
   Limit:
   Intake : 45.265 mm (1.7821 in)
   Exhaust : 44.875 mm (1.7667 in)
2. If wear exceeds the limit, replace camshaft.

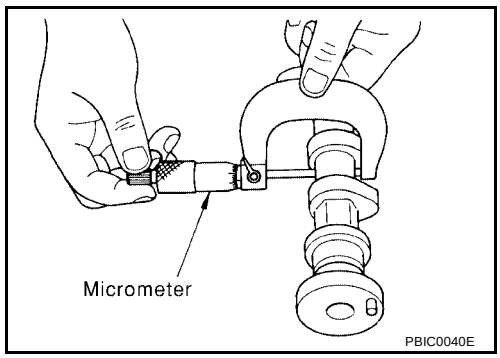


Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

- Measure the outer diameter of camshaft journal with micrometer.

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



CAMSHAFT BRACKET INNER DIAMETER

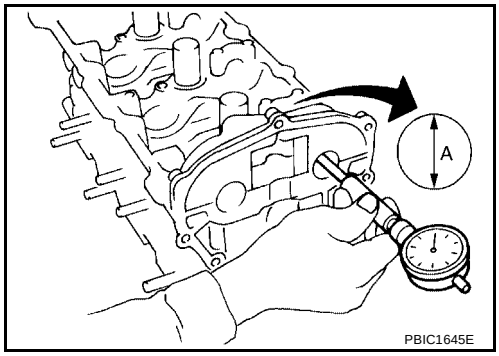
- Tighten camshaft bracket bolt with the specified torque. Refer to EM-190, "INSTALLATION" for the tightening procedure.

- Measure the inner diameter “A” of camshaft bracket with bore gauge.

Standard:

No. 1 : 26.000 - 26.021 mm (1.0236 - 1.0244 in)

No. 2, 3, 4 : 23.500 - 23.521 mm (0.9252 - 0.9260 in)



CAMSHAFT JOURNAL OIL CLEARANCE

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

Standard:

No. 1 : 0.045 - 0.086 mm (0.0018 - 0.0034 in)

No. 2, 3, 4 : 0.035 - 0.076 mm (0.0014 - 0.0030 in)

Limit : 0.15 mm (0.0059 in)

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

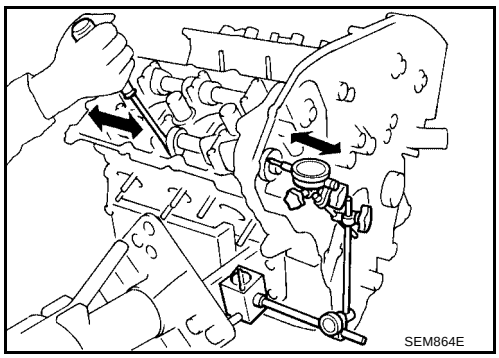
NOTE:
Camshaft bracket cannot be replaced as a single part, because it is machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

- Install dial indicator in thrust direction on front end of camshaft. Measure the end play of dial indicator when camshaft is moved forward/backward (in direction to axis).

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

Limit : 0.24 mm (0.0094 in)



- Measure the following parts if out of the limit.

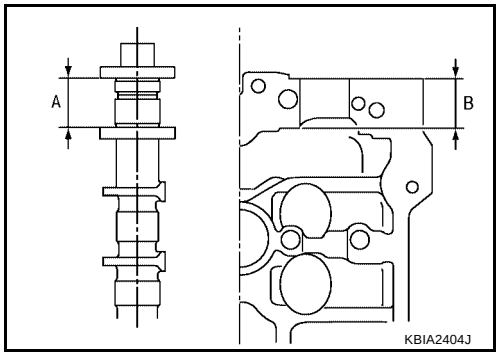
– Dimension “A” for camshaft No. 1 journal

Standard : 27.500 - 27.548 mm (1.0827 - 1.0846 in)

– Dimension “B” for cylinder head No. 1 journal bearing

Standard : 27.360 - 27.385 mm (1.0772 - 1.0781 in)

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



Camshaft Sprocket Runout

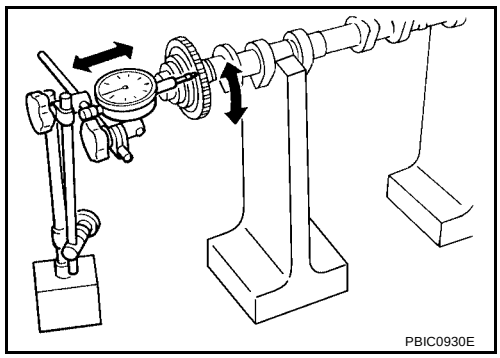
1. Put V-block on precise flat table, and support No. 2 and 4 journal of camshaft.

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

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

Limit : 0.15 mm (0.0059 in)

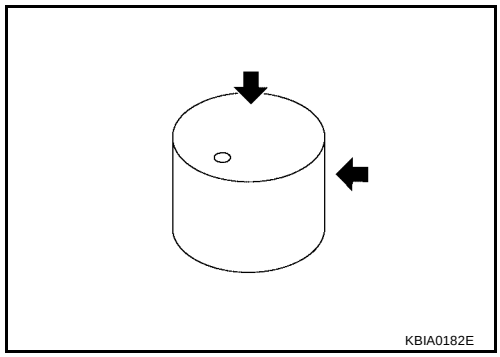
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to EM-247, "Available Valve Lifter" .



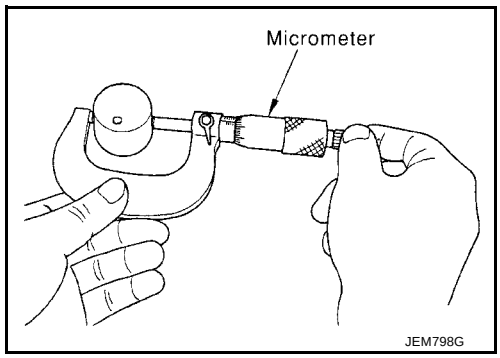
Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter at 1/2 height of valve lifter with micrometer since valve lifter is in barrel shape.

Standard (Intake and exhaust)

: 33.977 - 33.987 mm (1.3377 - 1.3381 in)

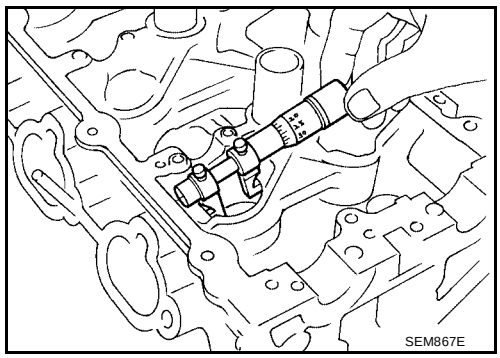


VALVE LIFTER HOLE DIAMETER

- Measure the inner diameter of valve lifter hole of cylinder head with inside micrometer.

Standard (Intake and exhaust)

: 34.000 - 34.016 mm (1.3386 - 1.3392 in)



VALVE LIFTER CLEARANCE

- (Valve lifter clearance) = (Valve lifter hole diameter) – (Valve lifter outer diameter), Refer to EM-194, "Valve Clearance" .

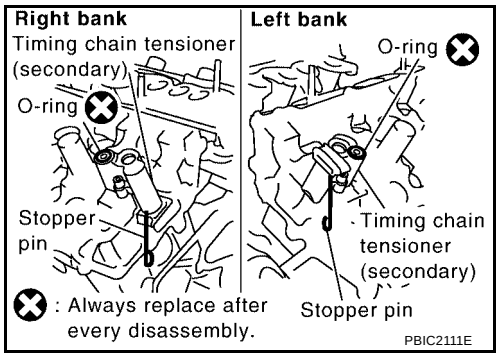
Standard (Intake and exhaust)

: 0.013 - 0.039 mm (0.0005 - 0.0015 in)

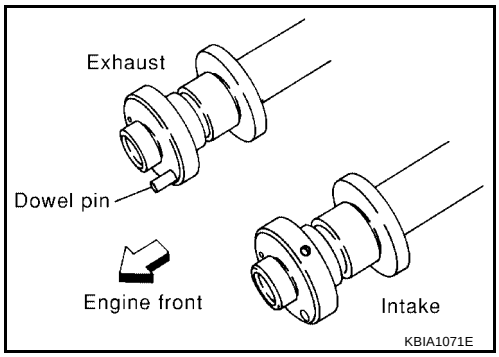
- If the calculated value is out of the standard, referring to each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

INSTALLATION

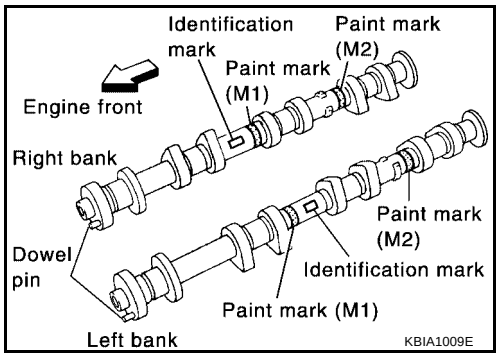
1. Install timing chain tensioners (secondary) on both sides of cylinder head.
   - Install timing chain tensioner with its stopper pin attached.
   - Install timing chain tensioner with sliding part facing downward on right-side cylinder head, and with sliding part facing upward on left-side cylinder head.
   - Install new O-rings as shown.



2. Install valve lifters.
   - Install it in the original position.
3. Install camshafts.
   - Install camshaft with dowel pin attached to its front end face on the exhaust side.



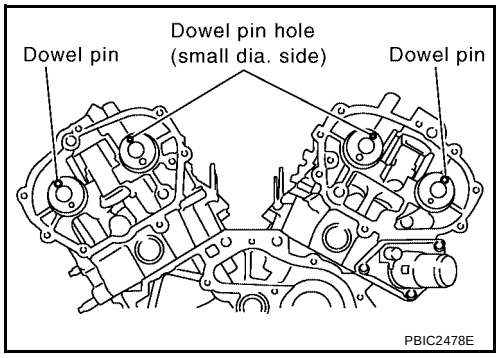
   - Follow your identification marks made during removal, or follow the identification marks that are present on new camshafts for proper placement and direction.



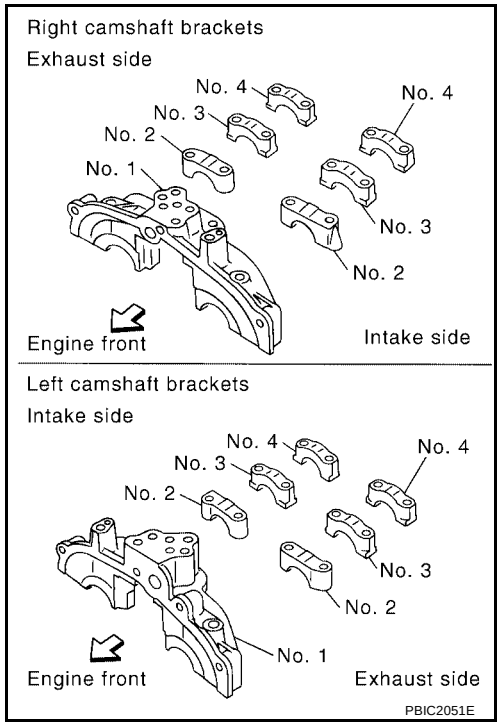
Bank	INT/EXH	Dowel pin	Paint marks		Identification mark
			M1	M2	
RH	INT	No	Green	No	RE
	EXH	Yes	No	White	RE
LH	INT	No	Green	No	LH
	EXH	Yes	No	White	LH

   - Install camshaft so that dowel pin hole and dowel pin on front end face are positioned as shown. (No. 1 cylinder TDC on its compression stroke)

     NOTE:
     - Large and small pin holes are located on front end face of camshaft (INT), at intervals of 180°. Face small dia. side pin hole upward (in cylinder head upper face direction).
     - Though camshaft does not stop at the portion as shown, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction as shown.

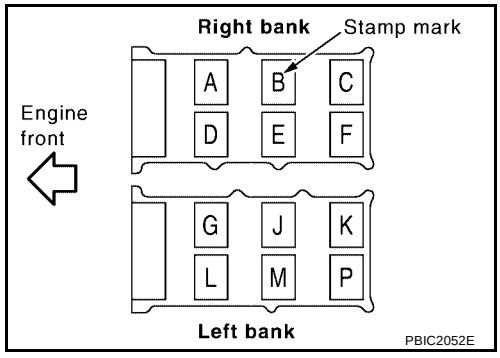


4. Install camshaft brackets.
   - Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
   - Install camshaft bracket in original position and direction as shown.

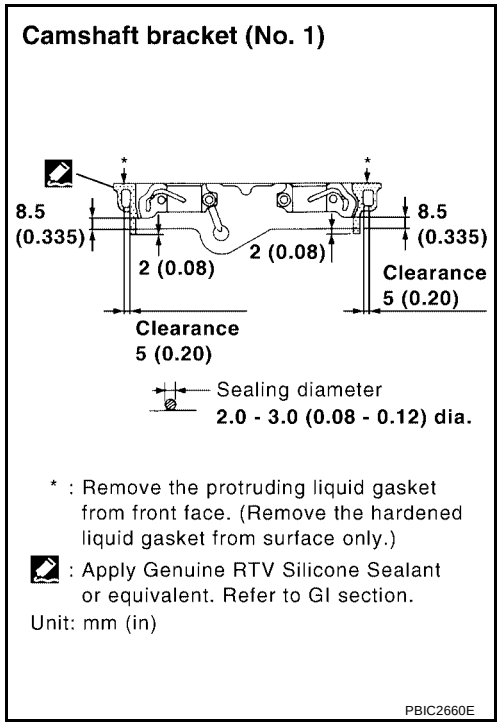


   - Install camshaft brackets (No. 2 to 4) aligning the stamp marks as shown.

     NOTE:
     There are no identification marks indicating left and right for camshaft bracket (No. 1).



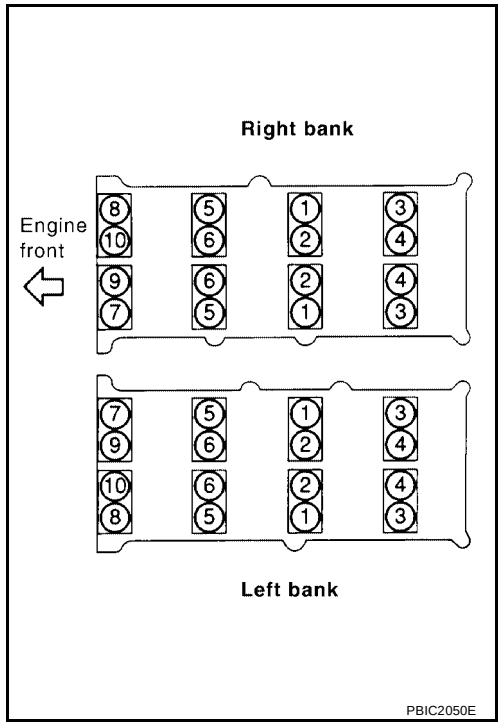
   - Apply liquid gasket to mating surface of camshaft bracket (No. 1) as shown on right and left banks.
     Use Genuine RTV Silicone Sealant or equivalent. Refer to **GI-48, "Recommended Chemical Products and Sealants"**
     .



5. Tighten camshaft bracket bolts in the following steps, in numerical order as shown.

Camshaft bracket bolts

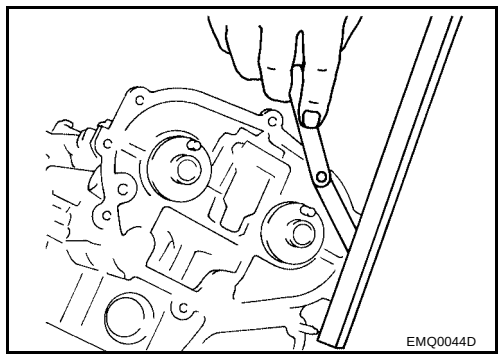
Step 1 (bolts 7 - 10)	**: 1.96 N·m (0.2 kg-m, 17 in-lb)**
Step 2 (bolts 1 - 6)	**: 1.96 N·m (0.2 kg-m, 17 in-lb)**
Step 3	**: 5.88 N·m (0.6 kg-m, 52 in-lb)**
Step 4	**: 10.41 N·m (1.1 kg-m, 92 in-lb)**



6. Measure the difference in levels between front end faces of camshaft bracket (No. 1) and cylinder head.

Standard : –0.14 to 0.14 mm (–0.0055 to 0.0055 in)

- Measure two positions (both intake and exhaust side) for a single bank.
- If the measured value is out of the standard, re-install camshaft bracket (No. 1).



7. Check and adjust the valve clearance. Refer to EM-194, "Valve Clearance" .
8. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Inspection of Camshaft Sprocket (INT) Oil Groove

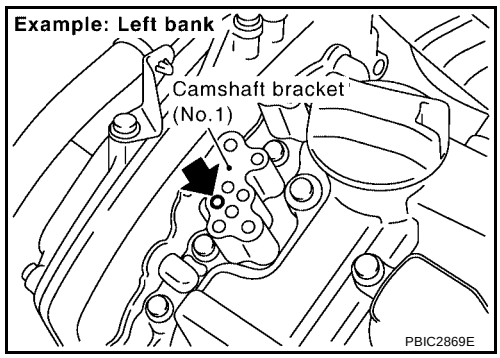
CAUTION:

- **Perform this inspection only when DTC P0011 or P0021 are detected in self-diagnostic results of CONSULT-II and it is directed according to inspection procedure of EC section. Refer to EC-673, "DIAGNOSTIC TEST MODE II — SELF-DIAGNOSTIC RESULTS" .**
- **Check when engine is cold so as to prevent burns from any splashing engine oil.**

1. Check the engine oil level. Refer to LU-18, "ENGINE OIL" .
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .
b. Disconnect ignition coil and injector harness connectors.

3. Remove intake valve timing control solenoid valve. Refer to EM-186, "REMOVAL" .
4. Crank the engine, and then make sure that engine oil comes out from camshaft bracket (No. 1) oil hole. End crank after checking.



WARNING:
Be careful not to touch rotating parts (drive belts, idler pulley, and crankshaft pulley, etc.).

CAUTION:
Engine oil may squirt from intake valve timing control solenoid valve installation hole during cranking. Use a shop cloth to prevent the engine components and the vehicle. Do not allow engine oil to get on rubber components such as drive belt or engine mount insulators. Immediately wipe off any splashed engine oil.

- Clean oil groove between oil strainer and intake valve timing control solenoid valve if engine oil does not come out from camshaft bracket (No. 1) oil hole. Refer to LU-16, "LUBRICATION SYSTEM" .

5. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
   - Clean oil groove if necessary. Refer to LU-16, "LUBRICATION SYSTEM" .
6. After inspection, install removed parts.

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricant leaks and exhaust gases leaks.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-11, "RECOMMENDED FLUIDS AND LUBRICANTS" .
- Use procedure below to check for fuel leakage.

– Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
– Start engine. With engine speed increased, check again for fuel leakage at connection points.

- Run engine to check for unusual noise and vibration.

NOTE:
If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

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

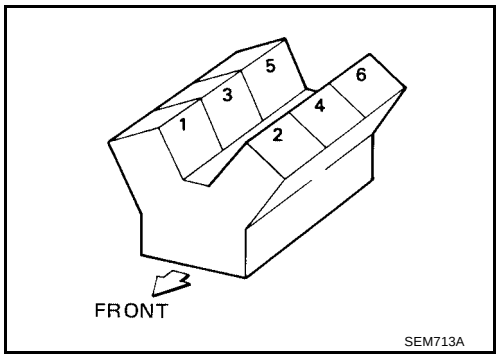
* Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

Valve Clearance

EBS00P4X

INSPECTION

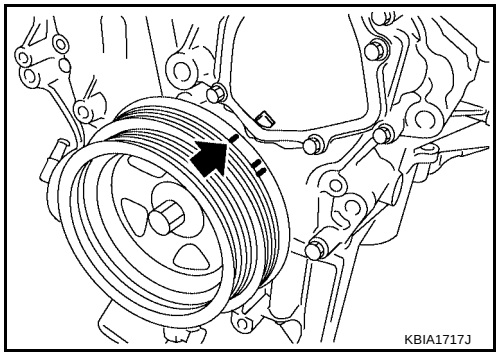
In cases of removing/installing or replacing camshaft and valve-related parts, or of unusual engine conditions due to changes in valve clearance (found malfunctions during stating, idling or causing noise), perform inspection as follows:



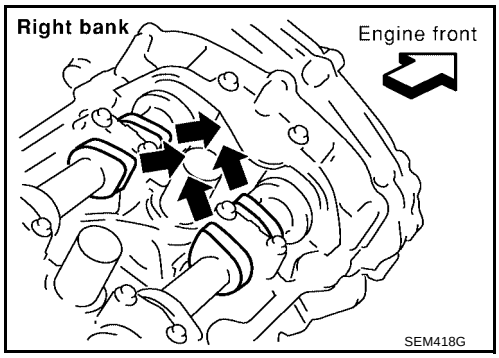
1. Remove rocker covers (right and left banks). Refer to EM-151, "Removal and Installation" .
2. Measure the valve clearance as follows:

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

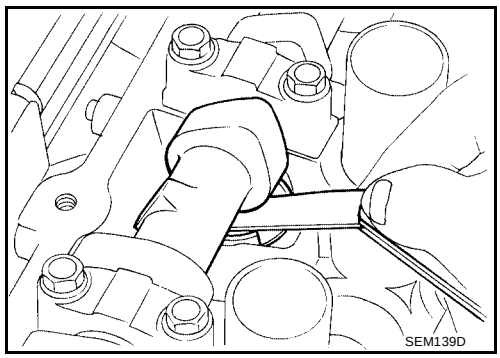
- Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



- Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown.
- If not, rotate crankshaft one revolution (360°) and align as shown.



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



Valve clearance:

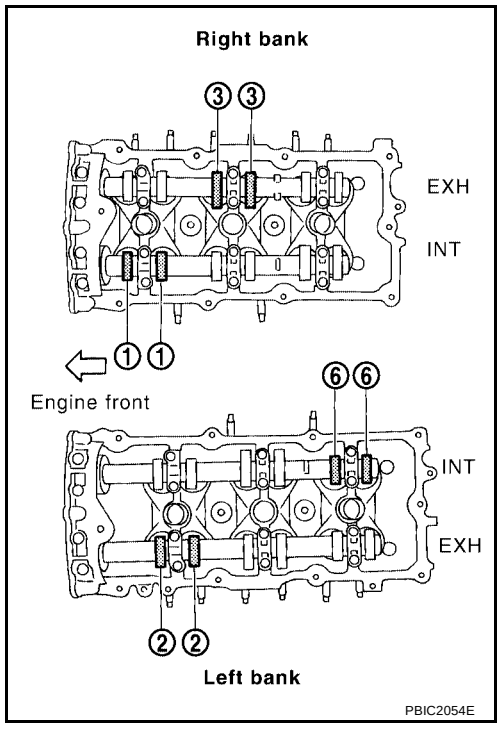
Unit: mm (in)

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

*: Approximately 80°C (176°F)

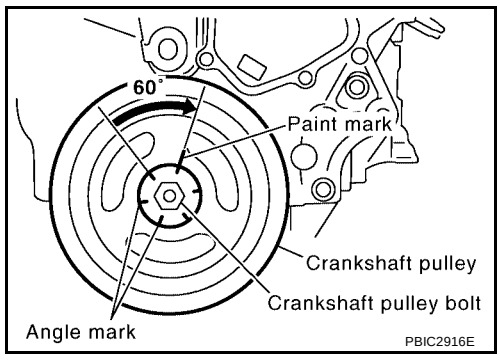
- By referring to the figure, measure the valve clearances at locations marked "×" as shown (locations indicated in the figure) with feeler gauge.
- No. 1 cylinder at compression TDC

Measuring position (right bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 1 cylinder at compression TDC	EXH		×	
	INT	×		
Measuring position (left bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 1 cylinder at compression TDC	INT			×
	EXH	×		



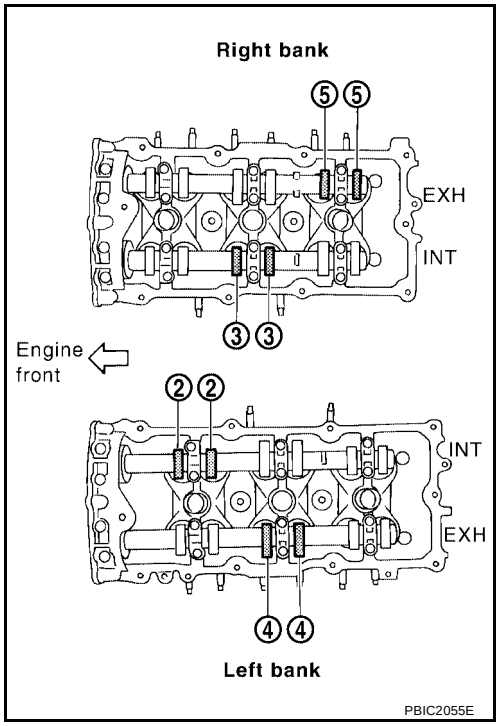
c. Rotate crankshaft by 240° clockwise (when viewed from engine front) to align No. 3 cylinder at TDC of its compression stroke.

NOTE:
Crankshaft pulley bolt flange has a stamped line every 60°. They can be used as a guide to rotation angle.

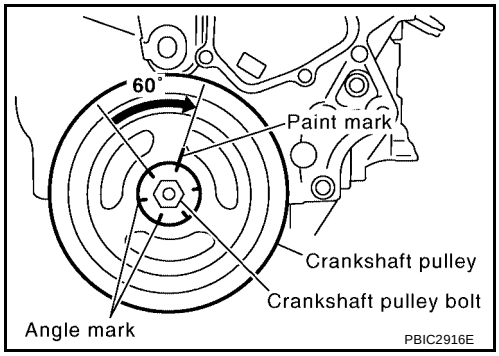


- By referring to the figure, measure the valve clearances at locations marked "×" as shown in the table below (locations indicated in the figure) with feeler gauge.
- No. 3 cylinder at compression TDC

Measuring position (right bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 3 cylinder at compression TDC	EXH			×
	INT		×	
Measuring position (left bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 3 cylinder at compression TDC	INT	×		
	EXH		×	

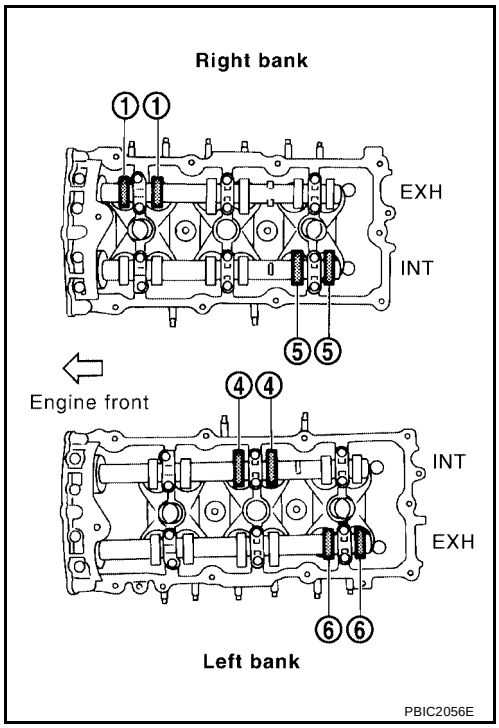


d. Rotate crankshaft by 240° clockwise (when viewed from engine front) to align No. 5 cylinder at TDC of compression stroke.



- By referring to the figure, measure the valve clearances at locations marked "×" as shown in the table below (locations indicated in the figure) with feeler gauge.
- No. 5 cylinder at compression TDC

Measuring position (right bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 5 cylinder at compression TDC	EXH	×		
	INT			×
Measuring position (left bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 5 cylinder at compression TDC	INT		×	
	EXH			×

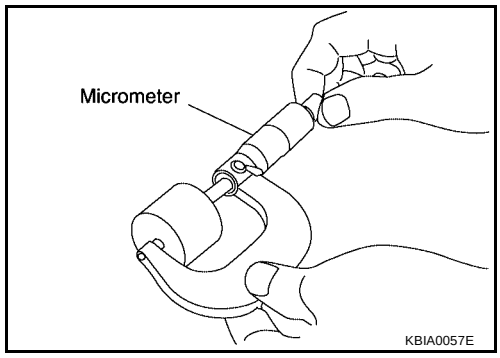


3. For the measured value out of the standard, perform adjustment. Refer to EM-197, "ADJUSTMENT" .

ADJUSTMENT

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

1. Measure the valve clearance. Refer to EM-194, "INSPECTION" .
2. Remove camshaft. Refer to EM-186, "REMOVAL" .
3. Remove valve lifters at the locations that are out of the standard.
4. Measure the center thickness of removed valve lifters with micrometer.



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

Valve lifter thickness calculation: $t = t_1 + (C_1 - C_2)$

t = Valve lifter thickness to be replaced

t_1 = Removed valve lifter thickness

C_1 = Measured valve clearance

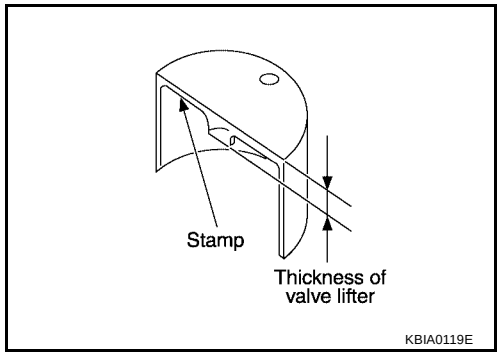
C_2 = Standard valve clearance:

Intake : 0.30 mm (0.012 in)*

Exhaust : 0.33 mm (0.013 in)*

***: Approximately 20°C (68°F)**

- Thickness of new valve lifter can be identified by stamp marks on the reverse side (inside the cylinder).



Intake

Stamp mark	Thickness
788U	7.88 mm (0.3102 in)
790U	7.90 mm (0.3110 in)
.	.
.	.
840U	8.40 mm (0.3307 in)

Available thickness of valve lifter: 27 sizes with range 7.88 to 8.40 mm (0.3102 to 0.3307 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to EM-247, "Available Valve Lifter" .

Exhaust

Stamp mark	Thickness
N788	7.88 mm (0.3102 in)
N790	7.90 mm (0.3110 in)
.	.
.	.
N836	8.36 mm (0.3291 in)

Available thickness of valve lifter: 25 sizes with range 7.88 to 8.36 mm (0.3102 to 0.3291 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to EM-247, "Available Valve Lifter" .

CAUTION:
Install identification letter at the end and top, “U” and “N”, at each of proper positions. (Be careful of mis-installation between intake and exhaust.)

6. Install selected valve lifter.
7. Install camshaft. Refer to EM-190, "INSTALLATION" .
8. Manually turn crankshaft pulley a few turns.
9. Make sure that the valve clearances for cold engine are within the specifications by referring to the specified values.
10. Installation of the remaining components is in the reverse order of removal.
11. Start the engine, and check for unusual noise and vibration.

OIL SEAL

PFP:00100

Removal and Installation of Valve Oil Seal

EBS00P4Y

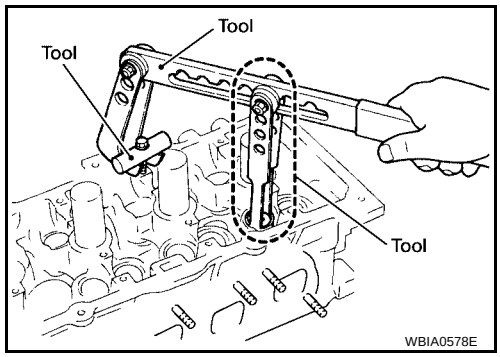
REMOVAL

1. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent valve from dropping into cylinder.
2. Remove camshaft relating to valve oil seal to be removed. Refer to EM-186, "REMOVAL" .
3. Remove valve lifters. Refer to EM-186, "REMOVAL" .
4. Remove valve collet, valve spring retainer and valve spring using Tool.

   CAUTION:
   When working, take care not to damage valve lifter holes.

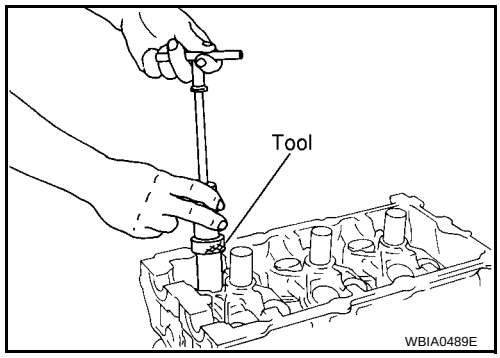
   Tool numbers : KV10116200 (J-26336-B)
   : KV10115900 (J-26336-20)
   : KV10109220 (—)

   - Compress valve spring using Tool attachment, adapter. Remove valve collet with magnet hand.



5. Remove valve oil seal using Tool.

   Tool number : KV10107902 (J-38959)



INSTALLATION

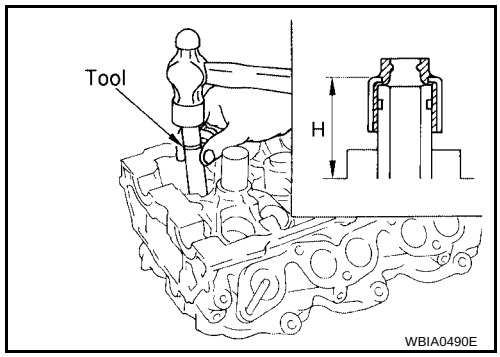
1. Apply new engine oil to new valve oil seal joint surface and seal lip.
2. Press in valve oil seal to height "H" using Tool to specified height.

   Tool number : — (J-39386)

   NOTE:
   Dimension "H": height measured before valve spring seat installation.

   Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)

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



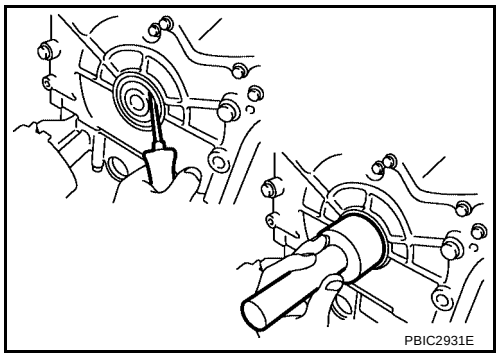
Removal and Installation of Front Oil Seal

EBS00P4Z

REMOVAL

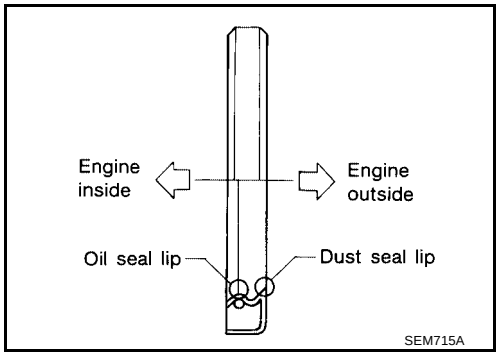
1. Remove engine undercover using power tools.
2. Remove drive belts. Refer to EM-124, "Removal" .
3. Remove engine cooling fan assembly. Refer to CO-47, "ENGINE COOLING FAN" .
4. Remove crankshaft pulley. Refer to EM-166, "REMOVAL" .
5. Remove front oil seal using suitable tool.

CAUTION:
Be careful not to damage front timing chain case and crankshaft.


PBIC2931E

INSTALLATION

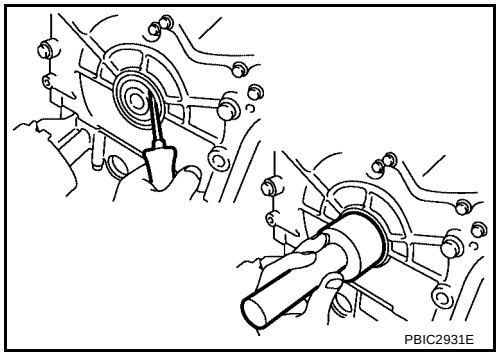
1. Apply new engine oil to both oil seal lip and dust seal lip of new front oil seal.
2. Install front oil seal.
   - Install front oil seal so that each seal lip is oriented as shown.



SEM715A

   - Press-fit until the height of front oil seal is level with the mounting surface using suitable tool.
   - Suitable drift: outer diameter 60 mm (2.36 in), inner diameter 50 mm (1.97 in).

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


PBIC2931E

3. Installation is in the reverse order of removal after this step.

Removal and Installation of Rear Oil Seal

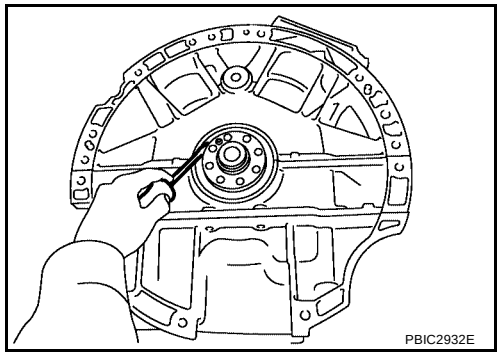
EBS00P50

REMOVAL

1. Remove transmission assembly. Refer to MT-16, "REMOVAL" (FS5R30A), MT-67, "REMOVAL" (FS6R31A, 2WD), MT-69, "REMOVAL" (FS6R31A, 4WD), AT-252, "REMOVAL" (2WD) or AT-254, "REMOVAL" (4WD).

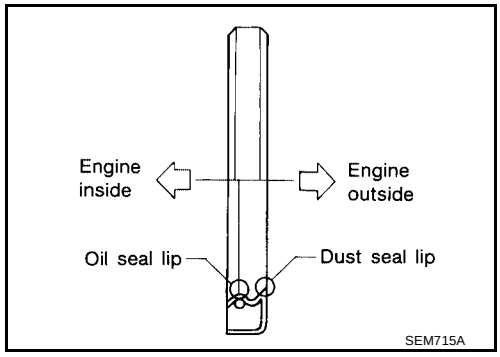
2. Remove rear oil seal with a suitable tool.

CAUTION:
Be careful not to damage crankshaft and cylinder block.

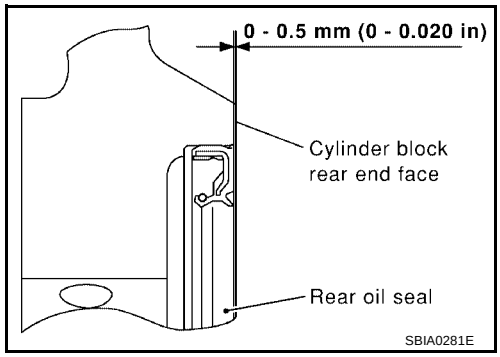


INSTALLATION

1. Apply new engine oil to new rear oil seal joint surface and seal lip.
2. Install rear oil seal so that each seal lip is oriented as shown.



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

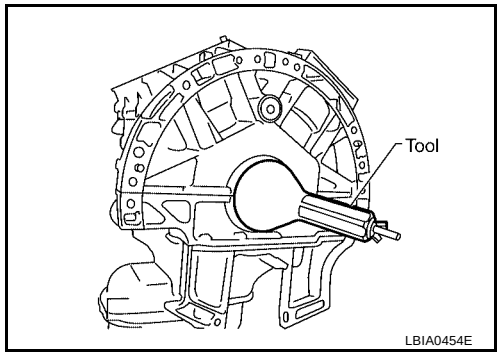


- Press-fit rear oil seal using Tool.

Tool number : — (J-47128)

CAUTION:

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



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

CYLINDER HEAD

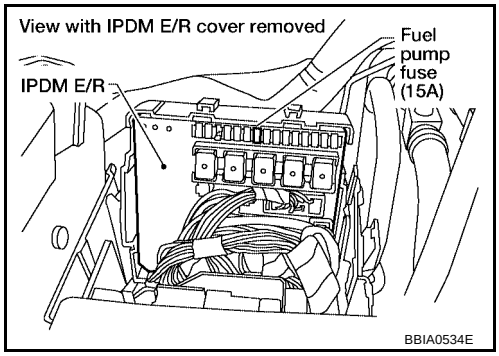
PFP:11041

On-Vehicle Service

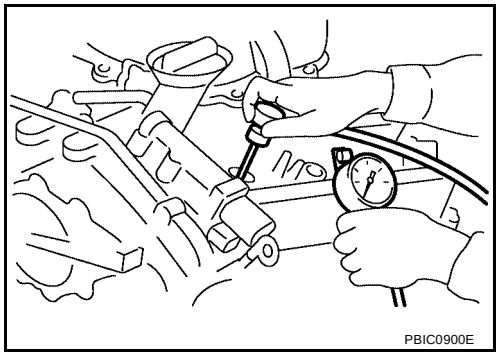
EBS00P51

CHECKING COMPRESSION PRESSURE

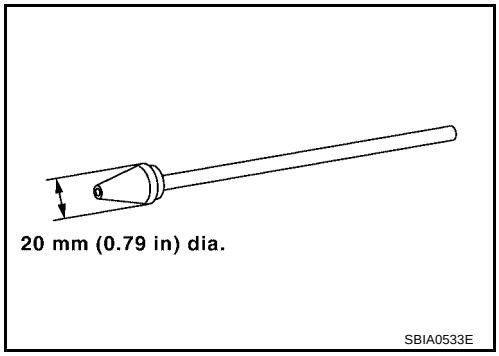
1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.



4. Remove intake manifold collector. Refer to EM-128, "REMOVAL" .
5. Remove spark plug from each cylinder. Refer to EM-143, "REMOVAL" .
6. Connect engine tachometer (not required in use of CONSULT-II).
7. Install compression tester with adapter onto 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.



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

Compression pressure:

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

Standard	Minimum	Differential limit between cylinders
1,275 (13.0, 185) / 300	981 (10.0, 142) / 300	98 (1.0, 14) / 300

CAUTION:

Always use a fully changed battery to obtain specified engine speed.

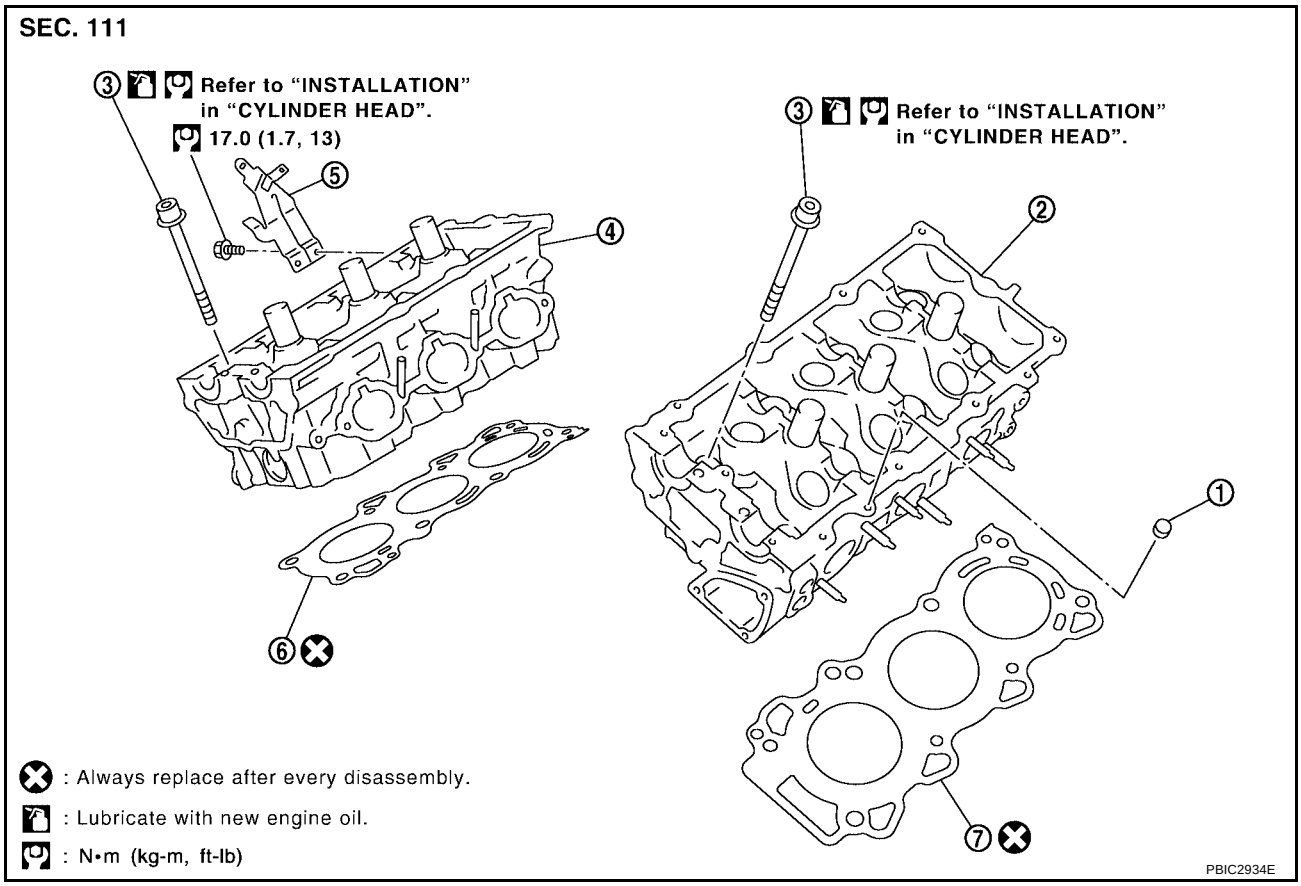
- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.

- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure 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, piston rings may be worn out or damaged. Check the piston rings and replace if necessary.
- If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets.

9. After inspection is completed, install removed parts.
10. Start engine, and make sure that engine runs smoothly.
11. Perform trouble diagnosis. If DTC appears, erase it. Refer to EC-691, "TROUBLE DIAGNOSIS" .

Removal and Installation

EBS00P52



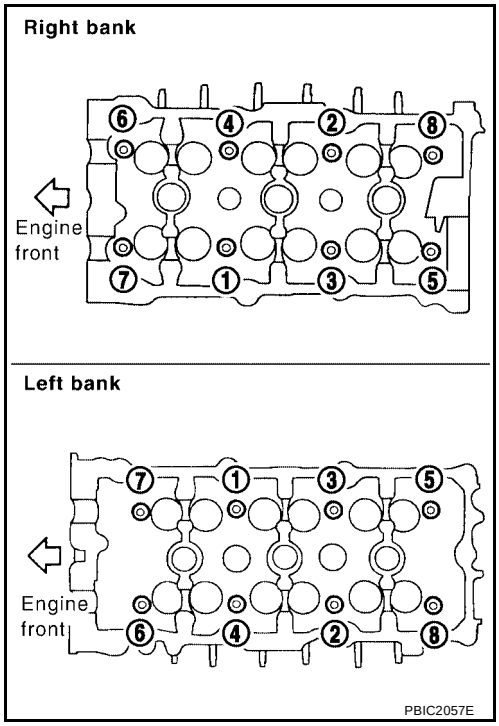
1. Rubber plug
2. Cylinder head (left bank)
3. Cylinder head bolt
4. Cylinder head (right bank)
5. Harness bracket
6. Cylinder head gasket (right bank)
7. Cylinder head gasket (left bank)

REMOVAL

1. Remove camshaft. Refer to EM-186, "REMOVAL" .
2. Remove intake manifold. Refer to EM-130, "REMOVAL" .
3. Remove exhaust manifold. Refer to EM-132, "Removal and Installation" .
4. Remove water inlet and thermostat assembly. Refer to CO-54, "REMOVAL" .
5. Remove water outlet, water pipe and heater pipe. Refer to CO-56, "REMOVAL" .

6. Remove cylinder head bolts in reverse order as shown using commercial service tool and power tool to remove cylinder heads (right and left banks).

Tool number : (J-24239-01)



7. Remove cylinder head gaskets.

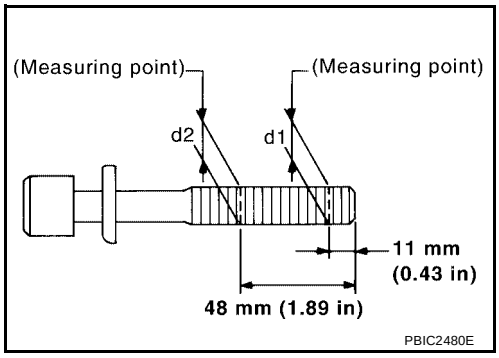
INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

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

Limit (“d1” – “d2”) : 0.11 mm (0.0043 in)

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



Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checked. Refer to EM-236, "CYLINDER BLOCK DISTORTION" .

1. Using suitable tool, wipe off oil, scale, gasket, sealant and carbon deposits from surface of cylinder head.

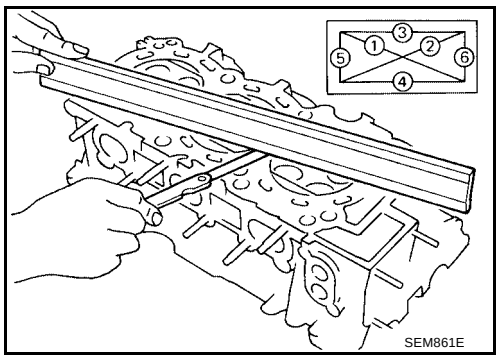
CAUTION:

Do not allow gasket fragments to enter engine oil or engine coolant passages.

2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions.

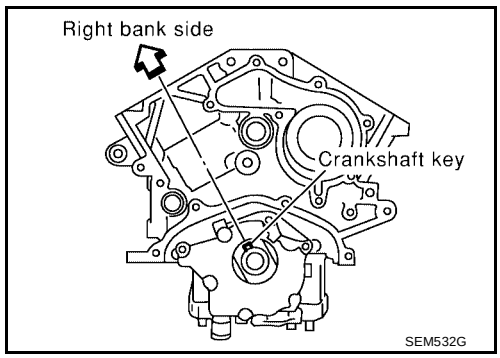
Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder head.



INSTALLATION

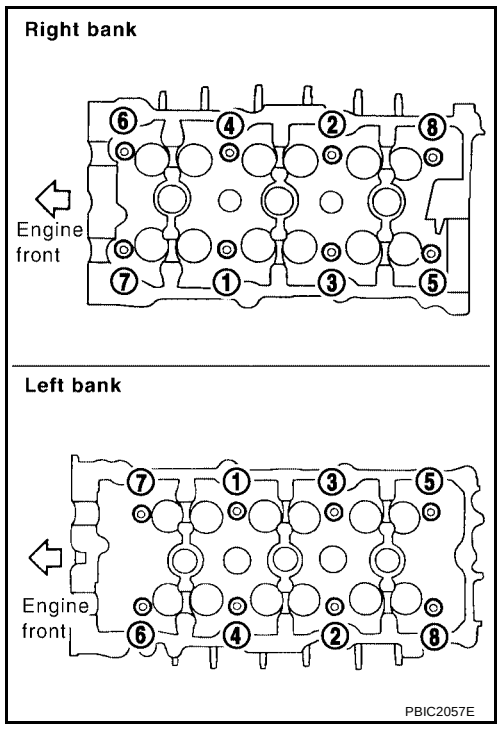
1. Install new cylinder head gasket.
2. Turn crankshaft until No. 1 piston is set at TDC.
   - Crankshaft key should line up with the right bank cylinder center line as shown.

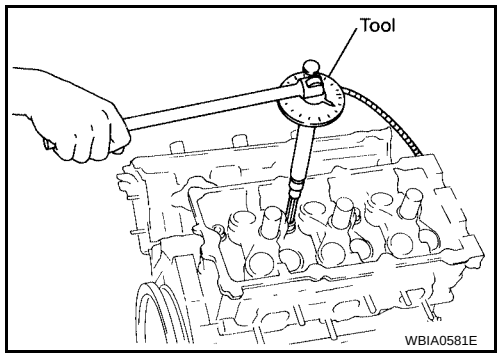


3. Install cylinder head follow the steps below to tighten cylinder head bolts in numerical order as shown.

CAUTION:
If cylinder head bolts re-used, check their outer diameters before installation. Refer to EM-204, "Cylinder Head Bolts Outer Diameter" .

Step a : 98.1 N·m (10 kg-m, 72 ft-lb)
Step b : Loosen to 0 N·m in the reverse order of tightening.
Step c : 39.2 N·m (4.0 kg-m, 29 ft-lb)
Step d : 90° clockwise
Step e : 90° clockwise

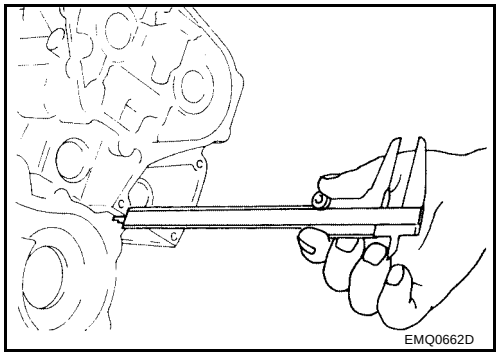




4. After installing cylinder head, measure distance between front end faces of cylinder block and cylinder head (left and right banks).

   Standard : 14.1 - 14.9 mm (0.555 - 0.587 in)

   - If the measured value is out of the standard, re-install cylinder head.



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

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricant leaks and exhaust gases leaks.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-11, "RECOMMENDED FLUIDS AND LUBRICANTS" .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

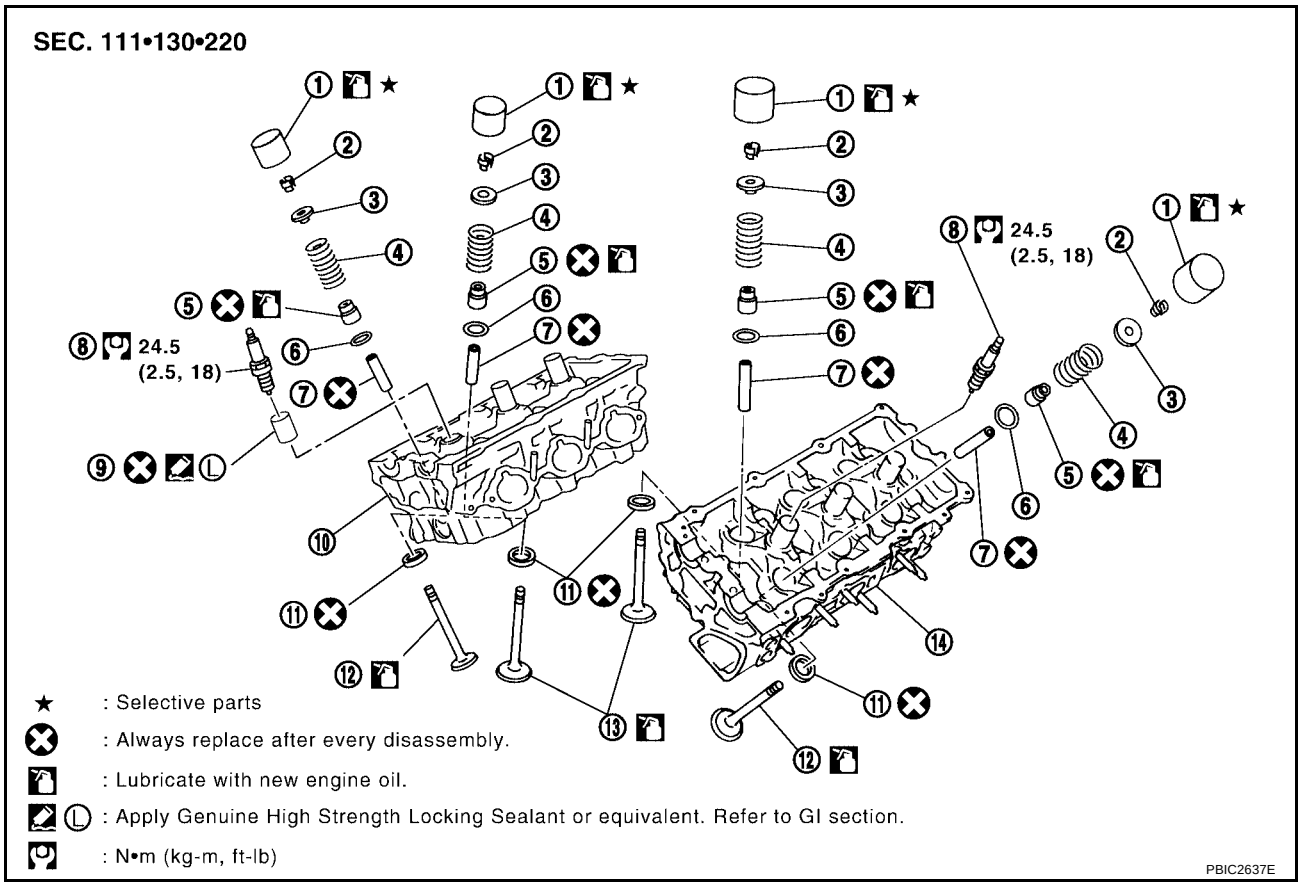
Summary of the inspection items:

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

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

Disassembly and Assembly

EBS00P53



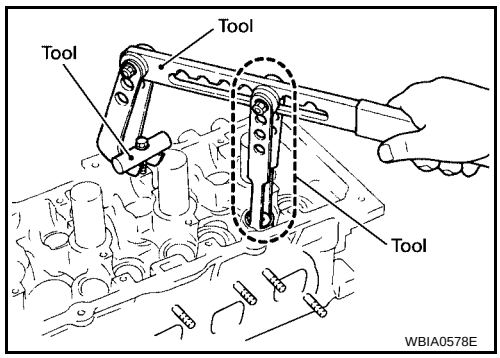
1. Valve lifter
2. Valve collet
3. Valve spring retainer
4. Valve spring
5. Valve oil seal
6. Valve spring seat
7. Valve guide
8. Spark plug
9. Spark plug tube
10. Cylinder head (right bank)
11. Valve seat
12. Valve (EXH)
13. Valve (INT)
14. Cylinder head (left bank)

DISASSEMBLY

1. Remove spark plug.
2. Remove valve lifter.
   - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
   - Compress valve spring and remove valve collet with magnet hand using Tool.

   CAUTION:
   When working, take care not to damage valve lifter holes.

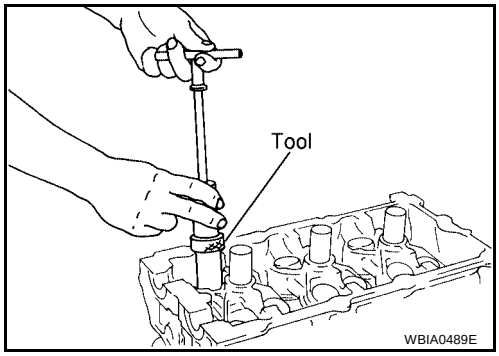
   Tool numbers : KV10109220 (—)
   : KV10116200 (J-26336-A)
   : KV10115900 (J-26336-20)



4. Remove valve spring retainer, valve spring and valve spring seat.
5. Push valve stem to combustion chamber side, and remove valve.
   - Identify installation positions, and store them without mixing them up.

6. Remove valve oil seals using Tool.

Tool number : KV10107902 (J-38959)



7. If valve seat must be replaced, refer to EM-211, "VALVE SEAT REPLACEMENT" .
8. If valve guide must be replaced, refer to EM-210, "VALVE GUIDE REPLACEMENT" .
9. Remove spark plug tube, as necessary.
   - Using pair of pliers, pull spark plug tube out of cylinder head.

CAUTION:
- **Take care not to damage cylinder head.**
- **Once removed, spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.**

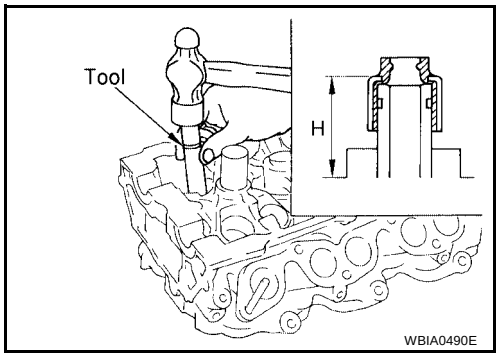
ASSEMBLY

1. When valve guide is removed, install it. Refer to EM-210, "VALVE GUIDE REPLACEMENT" .
2. When valve seat is removed, install it. Refer to EM-211, "VALVE SEAT REPLACEMENT" .
3. Install valve oil seals using Tool.

Tool number : — (J-39386)

Height "H" (Without valve spring seat installed)

Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)



4. Install valve spring seat.
5. Install valves.
   - Install it in the original position.

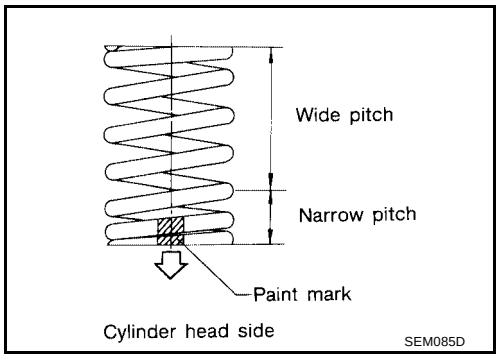
   NOTE:
   Larger diameter valves are for intake side.

6. Install valve spring (uneven pitch type).
   - Install narrow pitch end (paint mark) to cylinder head side (valve spring seat side).
   - Intake side and exhaust side valve springs are different. Install them referring to the following paint mark collar.

Paint mark collar

Intake : White

Exhaust : White

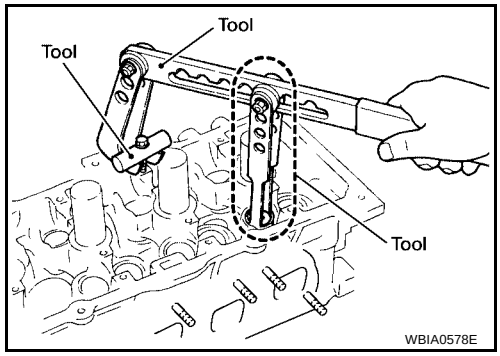


7. Install valve spring retainer.

8. Install valve collet.
   - Compress valve spring using Tool, attachment and adapter using Tool. Install valve collet with magnet hand.

     Tool numbers : KV10109220 (—)
     : KV10116200 (J-26336-A)
     : KV10115900 (J-26336-20)

     CAUTION:
     When working, take care not to damage valve lifter holes or valve stems.
   - Tap valve stem edge lightly with plastic hammer after installation to check its installed condition.

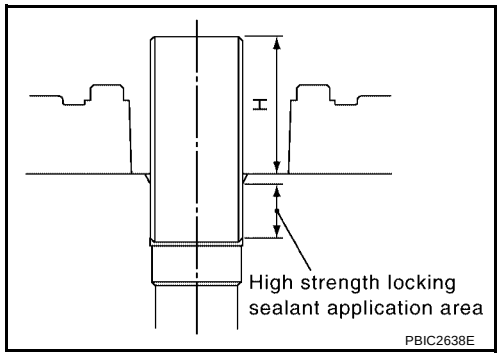


9. Install valve lifter.
   - Install it in the original position.
10. Install spark plug tube.
   - Press-fit spark plug tube as follows:

a. Remove old liquid gasket adhering to cylinder head mounting hole.
b. Apply sealant to area within approximately 12 mm (0.47 in) from edge of spark plug tube press-fit side.
Use Genuine High Strength Locking Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .
c. Press-fit spark plug tube so that its height “H” is as specified in the figure using suitable drift.

Standard press-fit height “H”
: 38.1 - 39.1 mm (1.500 - 1.539 in)

CAUTION:
- **When press-fitting, take care not to deform spark plug tube.**
- **After press-fitting, wipe off liquid gasket protruding onto cylinder-head upper face.**



11. Install spark plug.

Inspection After Disassembly

EBS00P54

VALVE DIMENSIONS

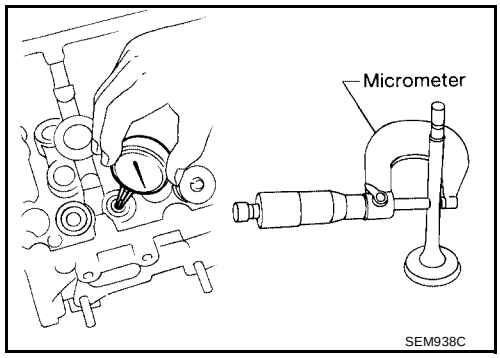
- Check dimensions of each valve. For dimensions, refer to EM-209, "VALVE DIMENSIONS" .
- If dimensions are out of the standard, replace valve and check the valve seat contact. Refer to EM-211, "VALVE SEAT CONTACT" .

VALVE GUIDE CLEARANCE

Valve Stem Diameter

Measure the diameter of valve stem with micrometer.

Standard
Intake : 5.965 - 5.980 mm (0.2348 - 0.2354 in)
Exhaust : 5.955 - 5.970 mm (0.2344 - 0.2350 in)



Valve Guide Inner Diameter

Measure the inner diameter of valve guide with inside micrometer.

Standard

Intake and Exhaust : 6.000 - 6.018 mm (0.2362 - 0.2369 in)

Valve Guide Clearance

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

Valve guide clearance:

Standard

Intake : 0.020 - 0.053 mm (0.0008 - 0.0021 in)

Exhaust : 0.030 - 0.063 mm (0.0012 - 0.0025 in)

Limit

Intake : 0.08 mm (0.003 in)

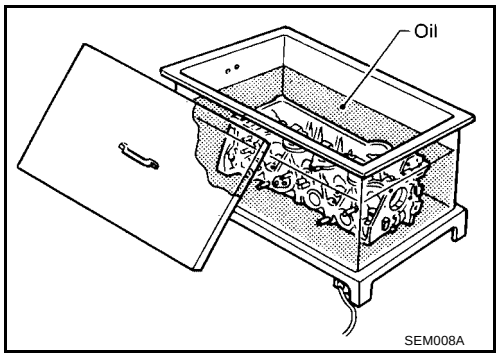
Exhaust : 0.09 mm (0.004 in)

- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced, refer to EM-210, "VALVE GUIDE REPLACEMENT" .

VALVE GUIDE REPLACEMENT

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

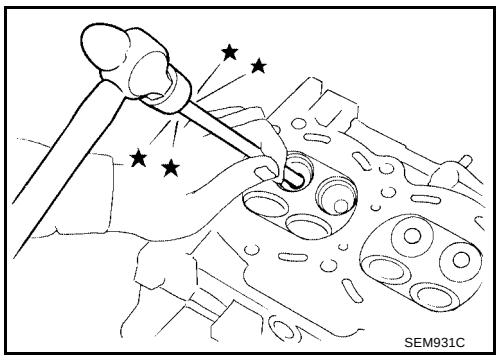
1. To remove valve guide, heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil.



2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and valve guide drift (commercial service tool).

CAUTION:

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

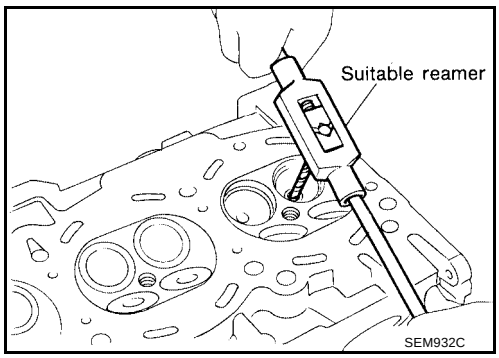


3. Ream cylinder head valve guide hole; using suitable reamer.

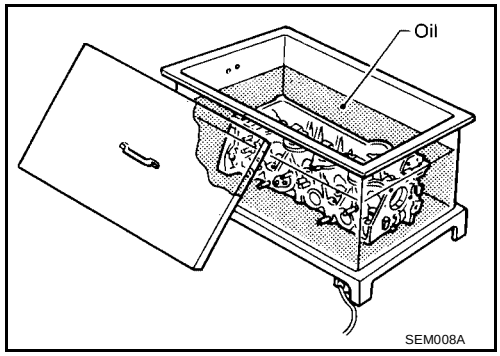
Valve guide hole diameter (for service parts):

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.



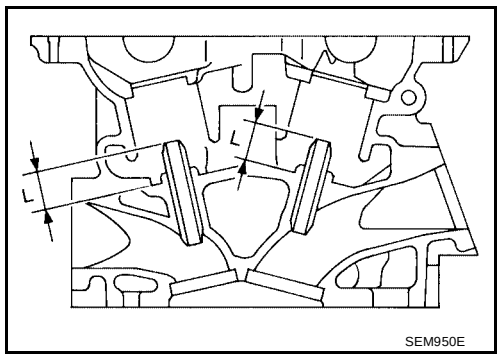
5. Press valve guide from camshaft side to the dimensions as shown using suitable tool.

Projection "L"

Intake and exhaust

: 12.6 - 12.8 mm (0.496 - 0.504 in)

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

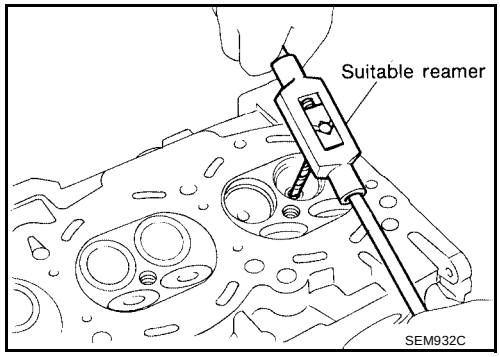


6. Apply reamer finish to valve guide using suitable reamer.

Standard:

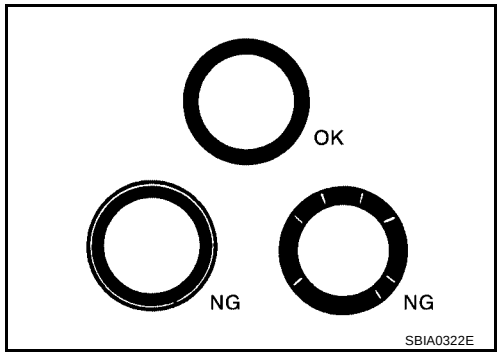
Intake and exhaust

: 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 the specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions even after the re-check, replace valve seat. Refer to EM-211, "VALVE SEAT REPLACEMENT" .



VALVE SEAT REPLACEMENT

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

1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to EM-249, "Valve Seat" .

CAUTION:
Prevent to scratch cylinder head by excessive boring.

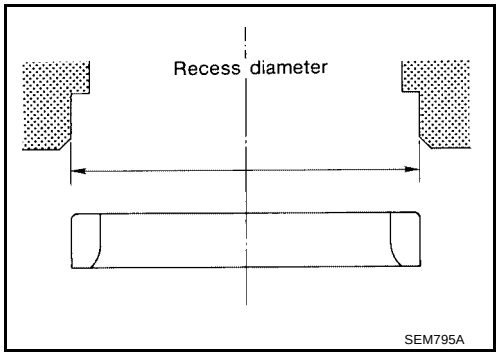
2. Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]

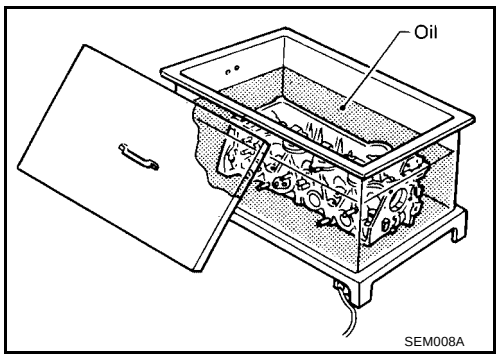
Intake : 38.500 - 38.516 mm (1.5157 - 1.5164 in)

Exhaust : 32.700 - 32.716 mm (1.2874 - 1.2880 in)

- Be sure to ream in circles concentric to valve guide center. This will enable valve 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.

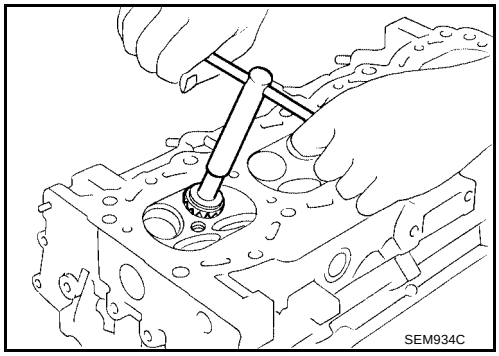
CAUTION:

- **Avoid directly touching cold valve seats.**
- **Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.**

5. Finish seat to the specified dimensions using suitable tool. Refer to EM-249, "Valve Seat" .

CAUTION:

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



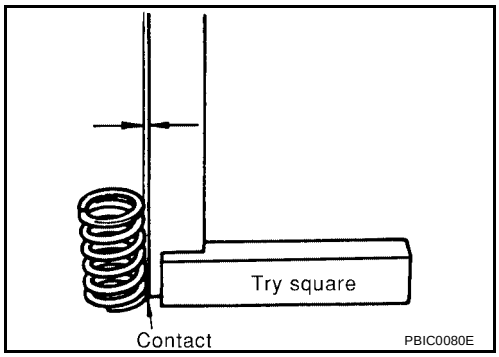
6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact. Refer to EM-211, "VALVE SEAT CONTACT" .

VALVE SPRING SQUARENESS

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

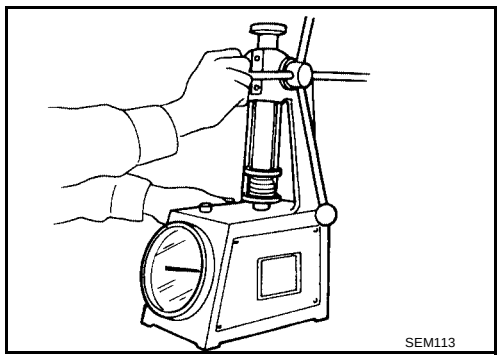
Limit : 2.1 mm (0.083 in)

- If it exceeds the limit, replace valve spring.



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure at the specified spring height.



Standard:

Intake and exhaust

Free height

: 47.07 mm (1.8531 in)

Installation height

: 37.00 mm (1.4567 in)

Installation load

: 166 - 188 N (16.9 - 19.2 kg, 37 - 42 lb)

Height during valve open

: 27.20 mm (1.0709 in)

Load with valve open

: 373 - 421 N (38.0 - 42.9 kg, 84 - 95 lb)

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

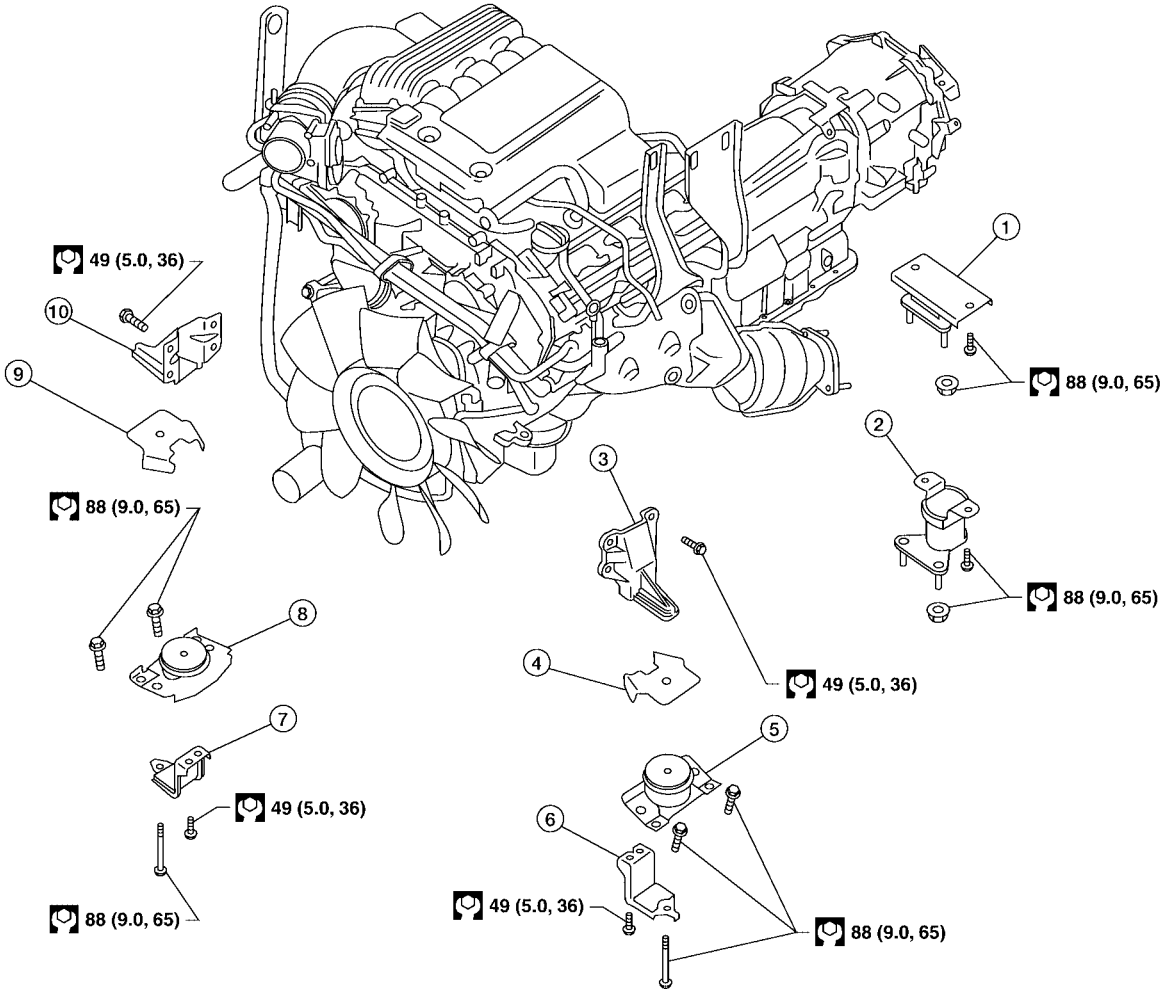
ENGINE ASSEMBLY

PFP:10001

Removal and Installation

EBS00P55

SEC. 112



: N·m (kg-m, ft-lb)

LBIA0432E

1. Rear engine mounting insulator 4x4
2. Rear engine mounting insulator 4x2
3. LH engine mounting bracket (upper)
4. LH heat shield plate
5. LH engine mounting insulator
6. LH engine mounting bracket (lower)
7. RH engine mounting bracket (lower)
8. RH engine mounting insulator (upper)
9. RH heat shield plate
10. RH engine mounting bracket (upper)

WARNING:

- **Situate vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.**

CAUTION:

- **Always be careful to work safely, avoid forceful or uninstructed operations.**

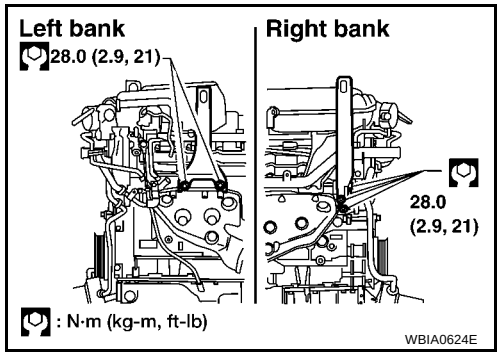
- **Do not start working until exhaust system and engine coolant are cooled sufficiently.**
- **If items or work required are not covered by the engine section, refer to the applicable sections.**
- **Always use the support point specified for lifting.**
- **Use either 2-point lift type or separate type lift. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.**
- **For supporting points for lifting and jacking point at rear axle, refer to GI-43, "Garage Jack and Safety Stand" .**

REMOVAL

Preparation

1. Drain engine coolant. Refer to CO-39, "DRAINING ENGINE COOLANT" .
2. Partially drain A/T fluid. Refer to MA-34, "Changing the Automatic Transmission Fluid (ATF)" .
3. Release fuel pressure. Refer to EC-689, "FUEL PRESSURE RELEASE" .
4. Remove the engine hood. Refer to BL-13, "Removal and Installation of Hood Assembly" .
5. Remove engine room cover using power tools.
6. Remove the air duct and air cleaner case assembly. Refer to EM-126, "REMOVAL" .
7. Disconnect vacuum hose between vehicle and engine and set it aside.
8. Remove the radiator assembly and hoses. Refer to CO-44, "REMOVAL" .
9. Remove the drive belts. Refer to EM-124, "Removal" .
10. Remove the engine cooling fan. Refer to CO-47, "ENGINE COOLING FAN" .
11. Disconnect the engine room harness from the engine side and set it aside for easier work.
12. Disconnect the engine harness grounds.
13. Disconnect the reservoir tank for power steering from engine and move it aside for easier work.
14. Disconnect power steering oil pump from engine. Move it from its location and secure with a rope for easier work. Refer to PS-22, "REMOVAL" .
15. Remove the A/C compressor bolts and set aside. Refer to MTC-103, "REMOVAL" (MTC).
16. Disconnect brake booster vacuum line.
17. Disconnect EVAP line.
18. Disconnect the fuel hose at the engine side connection. Refer to EM-145, "REMOVAL" .
19. Disconnect the heater hoses at cowl, and install plugs to avoid leakage of engine coolant.
20. Remove the A/T oil level indicator and indicator tube.
21. Remove front final drive assembly (4x4 only). Refer to FFD-14, "REMOVAL" .
22. Remove three way catalyst. Refer to EM-132, "Removal and Installation" .
23. Install engine slingers into left bank and right bank.

    Engine slinger torque: 28.0 N·m (2.9 kg-m, 21 ft-lb)



24. Remove transmission. Refer to MT-16, "REMOVAL" , MT-67, "REMOVAL" , MT-69, "REMOVAL" , AT-252, "REMOVAL" or AT-254, "REMOVAL" .
25. Lift with hoist and secure the engine in position.
26. Remove engine assembly from vehicle, avoiding interference with vehicle body.

    CAUTION:
    - **Before and during this lifting, always check if any harnesses are left connected.**
27. Remove the parts that may restrict installation of engine to engine stand.

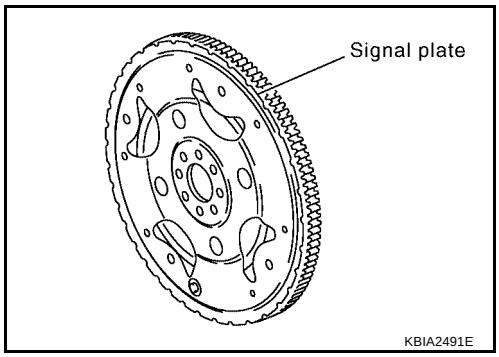
    NOTE:
    The procedure is described assuming that you use a engine holding the surface, to which transmission is installed.

a. Remove drive plate.
   - Holding crankshaft pulley bolts, lock crankshaft to remove drive plate bolts.

- Loosen bolts diagonally.

CAUTION:

- **Be careful not to damage drive plate. Especially avoid deforming and damaging of signal plate teeth (circumference position).**
- **Place the drive plate with signal plate surface facing other than downward.**
- **Keep magnetic materials away from signal plate.**



CAUTION:

Use an engine stand that has a load capacity [approximately 240kg (529 lb) or more] large enough for supporting the engine weight.

- **If the load capacity of the stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning the stand.**
  - **Remove fuel tube and fuel injector assembly. Refer to EM-145, "REMOVAL" .**
  - **Remove intake manifold. Refer to EM-130, "REMOVAL" .**
  - **Remove rocker cover. Refer to EM-151, "Removal and Installation" .**
  - **Other removable brackets.**

CAUTION:

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

28. Remove alternator. Refer to SC-38, "REMOVAL" .
29. Remove engine mounting insulator bracket (upper) with power tool.

INSTALLATION

Installation is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

- Before starting engine, check the levels of engine coolant, engine oil and working fluid. If less than required quantity, fill to the specified level.
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of engine coolant, engine oil, working fluid, fuel and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines, such as in cooling system.
- After cooling down engine, again check amounts of engine coolant, engine oil and working fluid. Refill to specified level, if necessary.
- Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Working fluid	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gas	—	Leakage	—

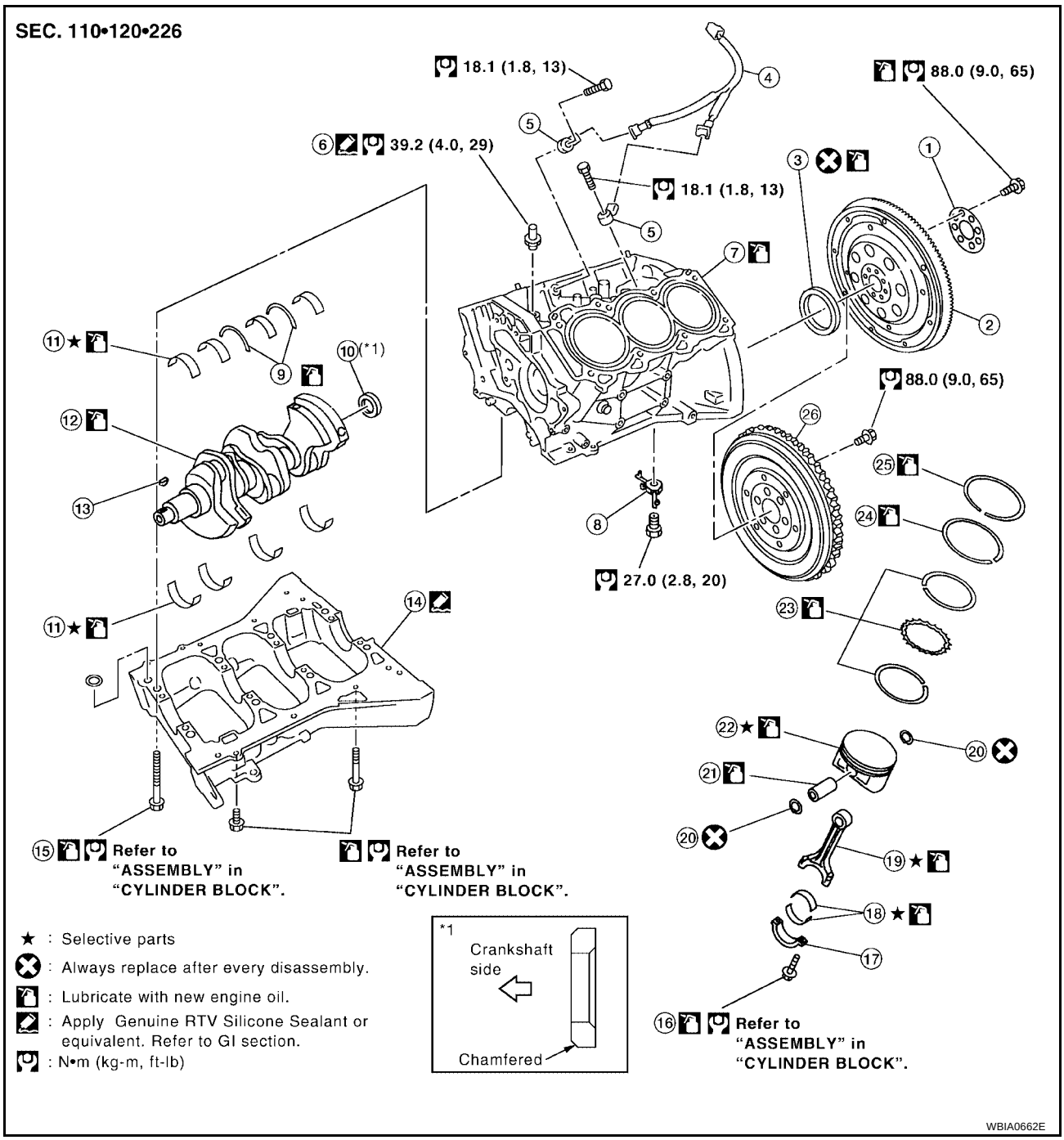
*Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

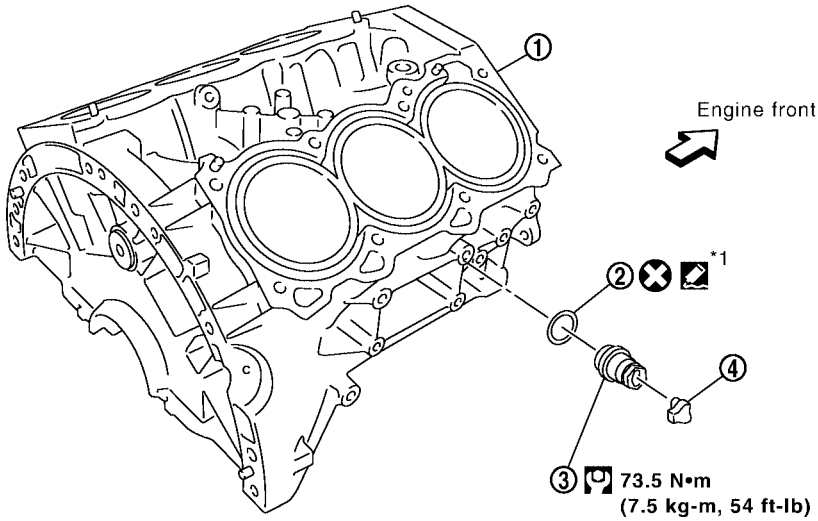
EBS00P56



1. Reinforcement plate
2. Drive plate (A/T models)
3. Rear oil seal
4. Sub harness
5. Knock sensor
6. Water connector
7. Cylinder block
8. Oil jet
9. Thrust bearing
10. Pilot converter (A/T models)
11. Main bearing
12. Crankshaft
13. Crankshaft key
14. Lower cylinder block
15. Lower cylinder block bolt
16. Connecting rod bolt
17. Connecting rod bearing cap
18. Connecting rod bearing
19. Connecting rod
20. Snap ring
21. Piston pin
22. Piston
23. Oil ring
24. Second ring
25. Top ring
26. Flywheel (M/T models)

For Canada

SEC. 110



- **Install cylinder block heater with heater part downward as shown in the figure.**
- **Remove liquid gasket completely after removing cylinder block heater.**

: Apply Anaerobic Liquid Gasket or equivalent. Refer to GI section.

*1 Sealing point : Front and reverse side.

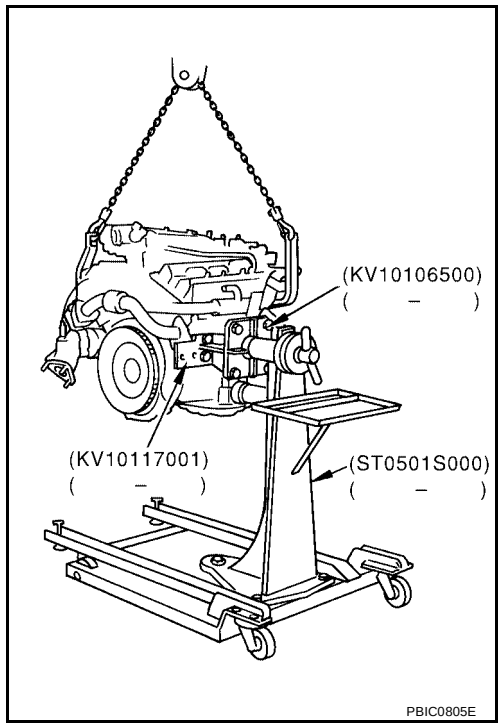
: Always replace after every disassembly.

PBIC2936E

1. Cylinder block
2. Gasket
3. Cylinder block heater
4. Connector protector cap

DISASSEMBLY

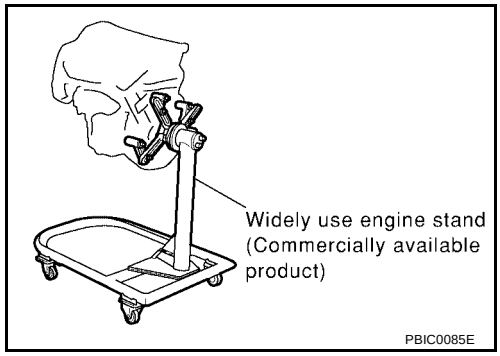
1. Remove engine assembly from vehicle. Refer to EM-215, "REMOVAL" .
2. Remove both exhaust manifolds. Refer to EM-132, "Removal and Installation" .
3. Lift engine, and mount it onto engine stand.



PBIC0805E

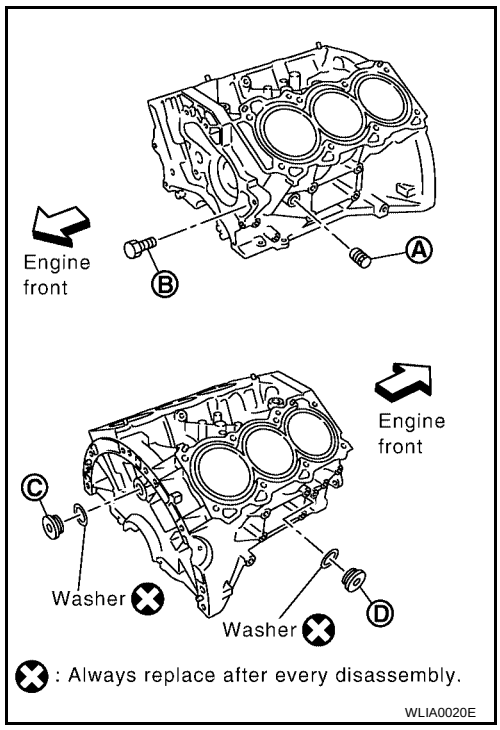
- A widely use engine stand can be used.

CAUTION:
Use engine stand that has a load capacity [approximately 220 kg (441 lb) or more] large enough for supporting the engine weight.



4. Drain engine oil. Refer to LU-20, "Changing Engine Oil" .
5. Drain engine coolant by removing water drain plugs from cylinder block left side at “A” and cylinder block front side at “B” as shown in the figure.

NOTE:
For Canada, “D” in the figure is not plug but block heater.

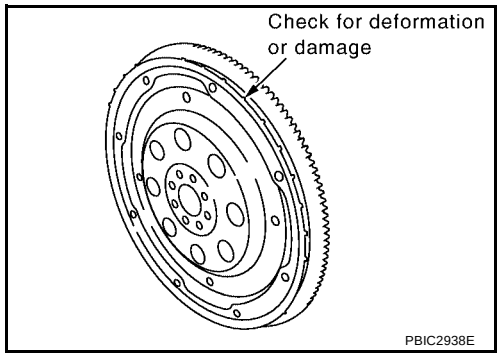


6. Remove drive plate (A/T models); using Tool.

Tool number : KV10117700 (J-44716)

- Loosen bolts in diagonal order.
- Use TORX socket for drive plate bolts.

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

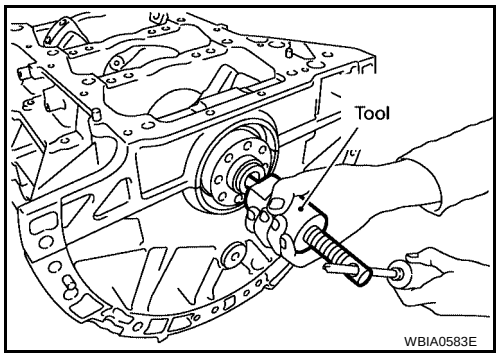


7. Remove cylinder head. Refer to EM-203, "REMOVAL" .
8. Remove sub harness, and remove knock sensors.

CAUTION:
Carefully handle sensor avoiding shocks.

9. Remove pilot converter (A/T models) using Tool as necessary.

Tool number : ST16610001 (J-23907)

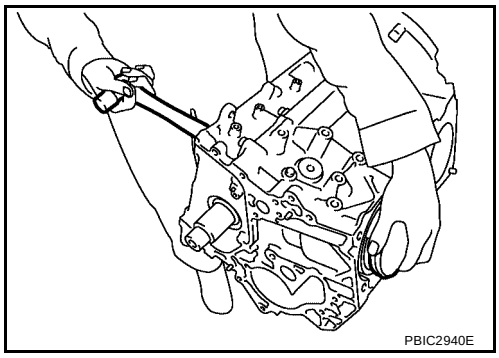


10. Remove piston and connecting rod assembly as follows:
    - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-233, "CONNECTING ROD SIDE CLEARANCE" .

CAUTION:
Be careful not to drop connecting rod bearing, and to scratch the surface.

11. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
12. Remove connecting rod bearing cap.
13. Push piston and connecting rod assembly out to the cylinder head side using suitable tool.

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

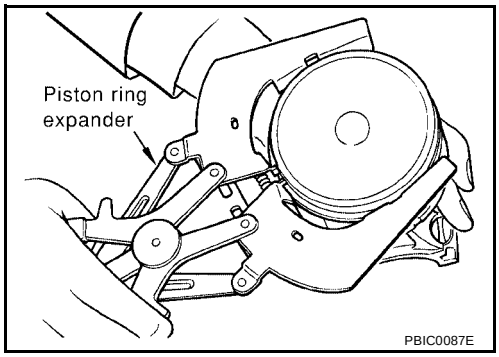


14. Remove connecting rod bearings from connecting rod and connecting rod bearing cap.

CAUTION:
Identify installation position, and store them without mixing them up.

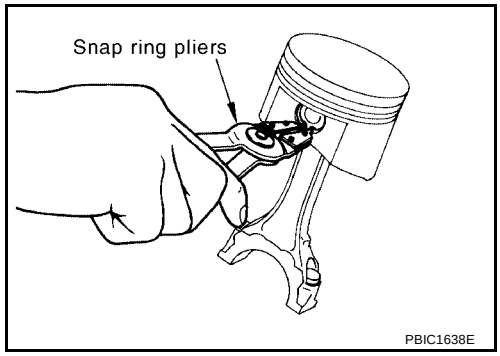
15. Remove piston rings form piston.
    - Before removing piston rings, check the piston ring side clearance. Refer to EM-234, "PISTON RING SIDE CLEARANCE" .
    - Remove piston rings using piston ring expander or suitable tool.

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

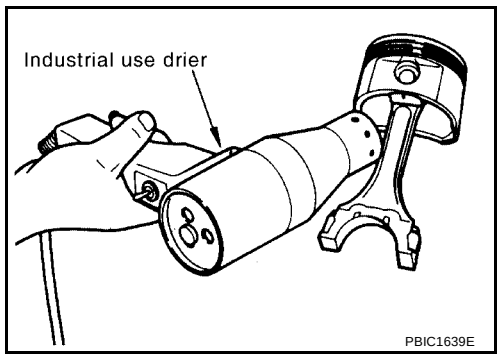


16. Remove piston from connecting rod as follows:

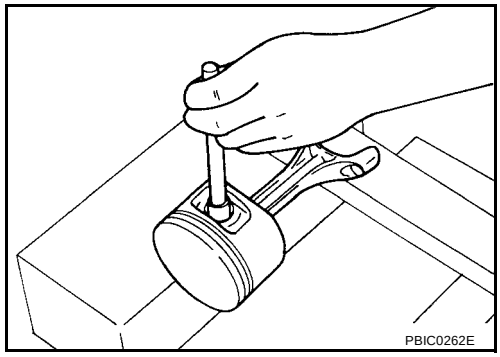
a. Remove snap ring using snap ring pliers.



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

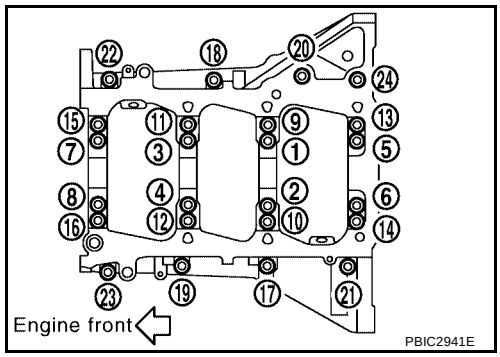


c. Push out piston pin with stick of outer diameter approximately 20 mm (0.79 in).



17. Remove lower cylinder block bolts.
    - Before loosening lower cylinder block bolts, measure the crankshaft end play. Refer to EM-233, "CRANKSHAFT END PLAY" .
    - Loosen lower cylinder block bolts in reverse order as shown in several different steps.

      NOTE:
      Use TORX socket (size E14) for bolts No. 1 to 16 (M10 bolt).



18. Remove lower cylinder block.
    - Cut liquid gasket for removal. Refer to EM-115, "REMOVAL OF LIQUID GASKET SEALING" .

      Tool number : KV10111100 (J-37228)

      CAUTION:
      Be careful not to damage the mounting surfaces.
19. Remove crankshaft.

20. Pull rear oil seal out from rear end of crankshaft.

NOTE:
When replacing rear oil seal without removing lower cylinder block, use a suitable to pull the rear oil seal installed between crankshaft and cylinder block out.

CAUTION:
Be careful not to damage crankshaft and cylinder block.

21. Remove main bearings and thrust bearings from cylinder block and lower cylinder block.

CAUTION:
- **Be careful not to drop main bearing, and to scratch the surface.**
- **Identify installation positions, and store them without mixing them up.**

22. Remove oil jet.

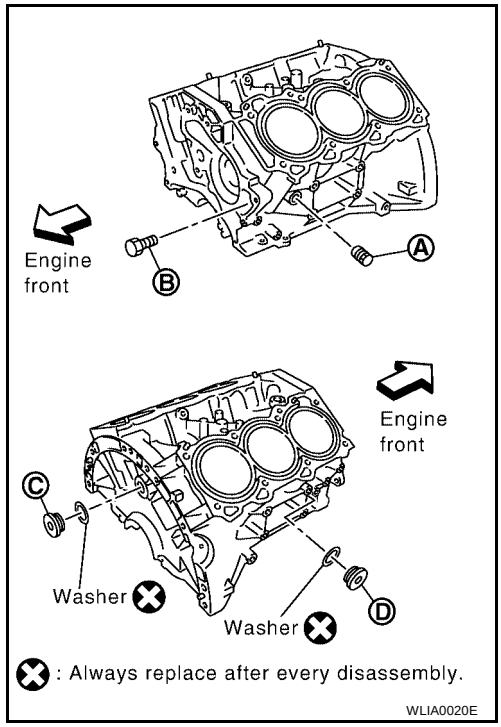
ASSEMBLY

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

CAUTION:
Use a goggles to protect your eye.

2. Install each plug to cylinder block as shown.
   - Apply sealant to the thread of water drain plugs “A” and “B”.
     Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .
   - Apply sealant to the thread of plugs “C”.
     Use Genuine High Strength Thread Locking Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .
   - Apply sealant to the thread of plug “D”.
     Use Anaerobic Liquid Gasket or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

     NOTE:
     For Canada, “D” in the figure is not plug but block heater. Refer to EM-217, "Disassembly and Assembly" .
   - Replace washers with new one.



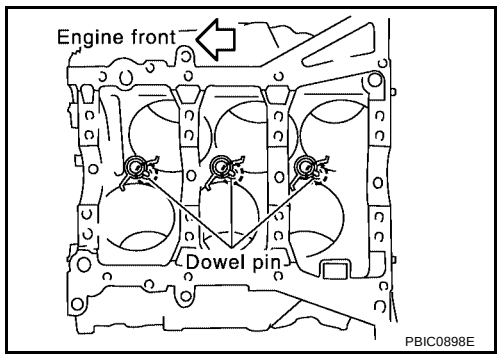
   - Tighten each plug as specified below.

Block Plug and Block Heater Installation

Part		Washer	Tightening Torque
A		No	19.6 N·m (2.0 kg-m, 14 ft-lb)
B	Reuse	No	9.8 N·m (1.0 kg-m, 87 in-lb)
	New		6.0 N·m (0.61 kg-m, 53 in-lb)
C		Yes	116 N·m (11.8 kg-m, 85 ft-lb)
D	Plug	Yes	62 N·m (6.3 kg-m, 46 ft-lb)
	Block heater		73.5 N·m (7.5 kg-m, 54 ft-lb)

3. Install oil jet.

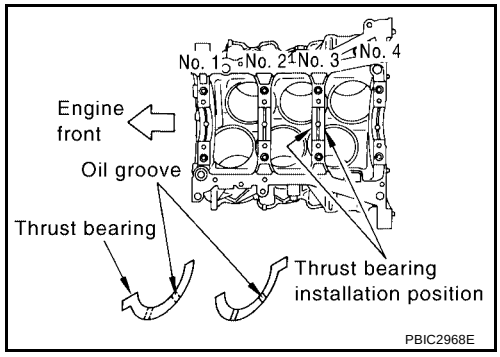
- Insert oil jet dowel pin into cylinder block dowel pin hole, and tighten bolts.



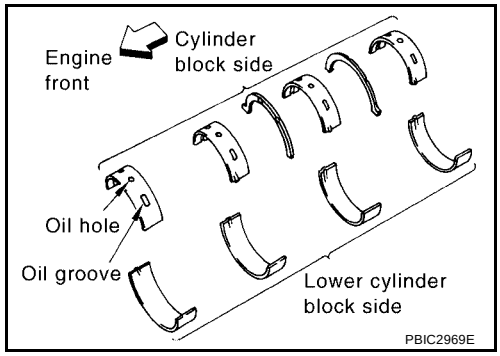
4. Install main bearings and thrust bearings as follows:

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

b. Install thrust bearings to the both sides of the No. 3 journal housing on cylinder block.
   - Install thrust bearings with the oil groove facing crankshaft arm (outside).
   - Install thrust bearing with a projection on one end on cylinder block, Align projection with mating notch.



c. Install main bearings paying attention to the direction.
   - Main bearing with oil hole and groove goes on cylinder block. The one without them goes on lower cylinder block.
   - Before installing main bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
   - When installing, align main bearing stopper protrusion to cut-out of cylinder block and lower cylinder block.
   - Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



5. Install crankshaft to cylinder block.
   - While turning crankshaft by hand, check that it turns smoothly.
6. Inspect the outer diameter of lower cylinder block bolt. Refer to EM-241, "LOWER CYLINDER BLOCK BOLT OUTER DIAMETER" .
7. Install lower cylinder block as follows:

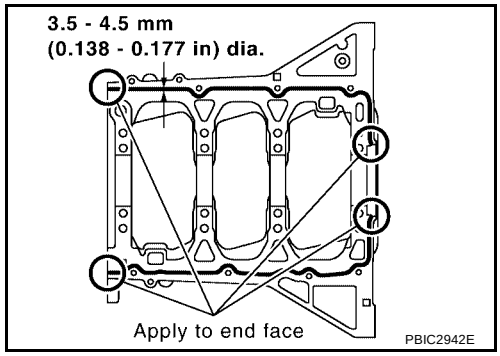
NOTE:
Lower cylinder block cannot be replaced as a single part, because it is machined together with cylinder block.

a. Apply a continuous bead of liquid gasket using Tool to lower cylinder block as shown.

Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "Recommended Chemical Products and Sealants" .

CAUTION:
After liquid gasket is applied, rear oil seal installation must be finished within 5 minutes. Therefore, the following procedure must be performed quickly.



b. Tighten lower cylinder block as follows:

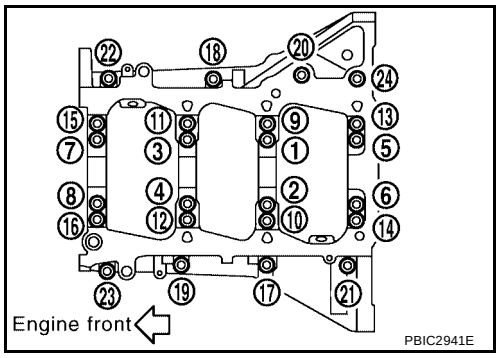
i. Apply new engine oil to threads and seat surfaces of the bolts.

ii. Tighten M8 bolts in numerical order as shown from No. 17 to 24.

Bolts 17 - 24 : 22.1 N·m (2.3 kg-m, 16 ft-lb)

CAUTION:
Wipe off completely any protruding liquid gasket on rear oil seal installation surface.

NOTE:
There are more processes to complete the tightening bolts. However stop procedure here to install rear oil seal.



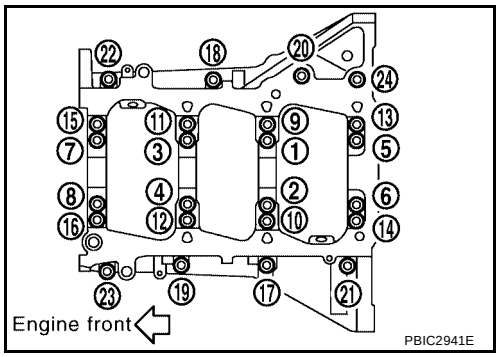
c. Install rear oil seal. Refer to EM-201, "INSTALLATION" .

d. Restart tightening of lower cylinder block bolts as follows:

i. Tighten M10 bolts in numerical order as shown from No. 1 to 16.

NOTE:
Use TORX socket (size E14) for bolts No. 1 to 16 (M10 bolt).

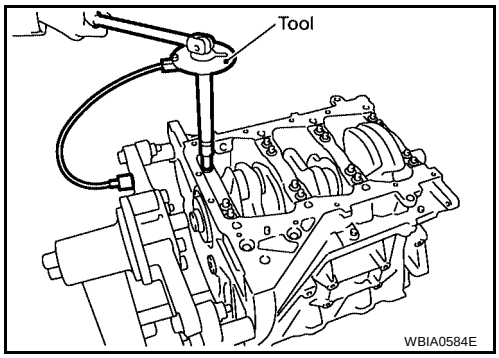
Bolts 1 - 16 : 35.3 N·m (3.6 kg-m, 26 ft-lb)



ii. Turn M10 bolts 90° clockwise in numerical order from No. 1 to 16 using Tool.

Tool number : KV10112100 (BT-8653-A)

CAUTION:
Use angle wrench Tool to check tightening angle. Do not make judgement by visual inspection.



- After installing the bolts, make sure that crankshaft can be rotated smoothly by hand.
- Wipe off completely any protruding liquid gasket on front side of the engine.
- Check the crankshaft end play. Refer to EM-233, "CRANKSHAFT END PLAY" .

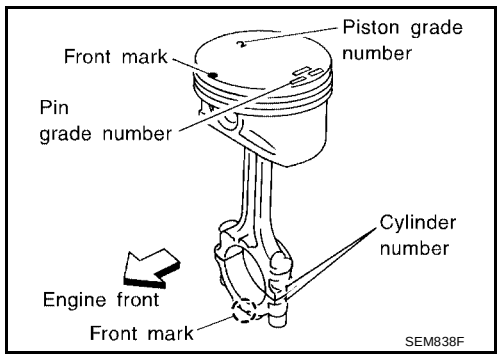
8. Inspect the outer diameter of connecting rod bolt. Refer to EM-242, "CONNECTING ROD BOLT OUTER DIAMETER" .

9. Install piston to connecting rod as follows:

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

b. Install piston to connecting rod.
- Using industrial use drier or similar tool, heat piston until piston pin can be pushed in by hand without excess force [approx. 60° to 70 °C (140° to 158 °F)]. From the front to the rear, insert piston pin into piston and connecting rod.

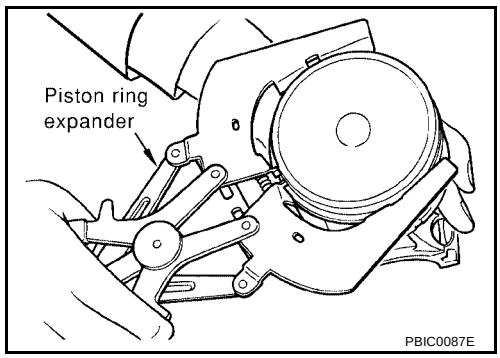
- Assemble so that the front mark on the piston head and the cylinder number on connecting rod are positioned as shown.



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

10. Install piston rings using piston ring expander or suitable tool.

CAUTION:
- **When installing piston rings, be careful not to damage piston.**
- **Be careful not to damage piston rings by expending them excessively.**

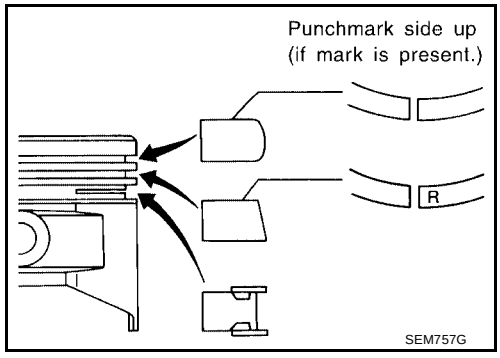


- If there is stamped mark on ring, mount it with marked side up.

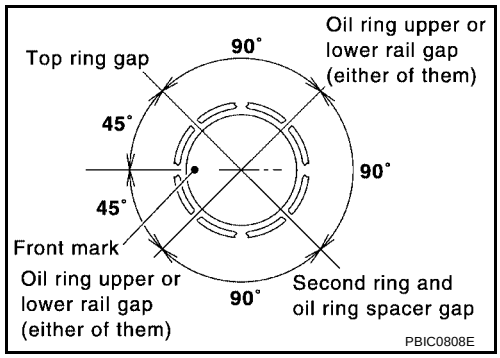
NOTE:
If there is no stamp on ring, no specific orientation is required for installation.

Stamped mark:

Top ring	**: —**
Second ring	**: R**



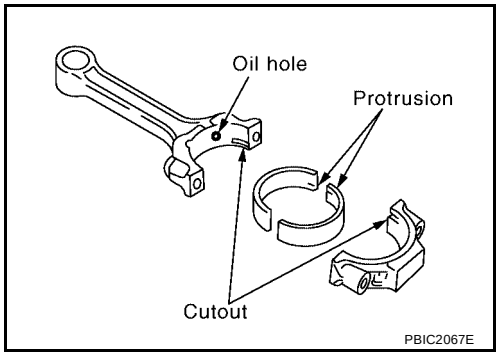
- Position each ring with the gap as shown referring to the piston front mark.



- Check the piston ring side clearance. Refer to EM-234, "PISTON RING SIDE CLEARANCE" .

11. Install connecting rod bearings to connecting rod and connecting rod bearing cap.
- Before installing connecting rod bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.

- When installing, align connecting rod bearing stopper protrusion with cutout of connecting rods and connecting rod bearing caps to install.
- Ensure the oil hole on connecting rod and that on the corresponding bearing are aligned.

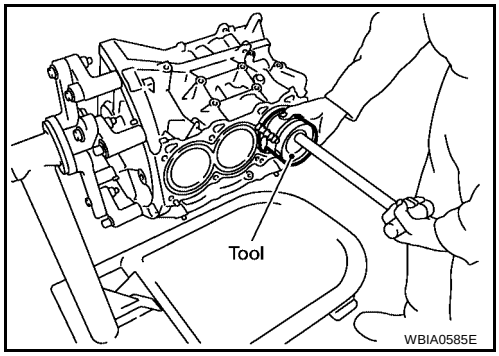


12. Install piston and connecting rod assembly to crankshaft.
13. Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
14. Apply engine oil sufficiently to the cylinder bore, piston and crankshaft pin journal.
15. Match the cylinder position with the cylinder number on connecting rod to install.

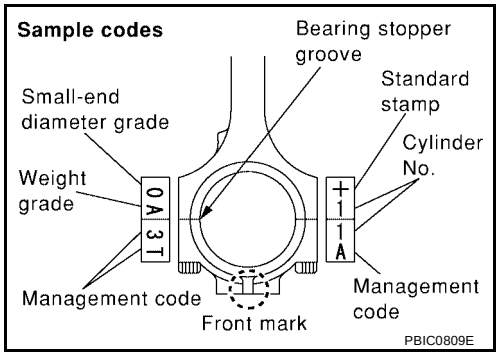
    NOTE:
    Be sure that front mark on piston head is facing front of engine.
16. Install piston with the front mark on the piston head facing the front of engine using Tool.

    Tool number : EM03470000 (J-8037)

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



17. Install connecting rod bearing cap.
    - Match the stamped cylinder number marks on connecting rod with those on connecting rod bearing cap to install.
    - Be sure that front mark on connecting rod bearing cap is facing front of engine.



18. Tighten connecting rod bolts as follows:

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

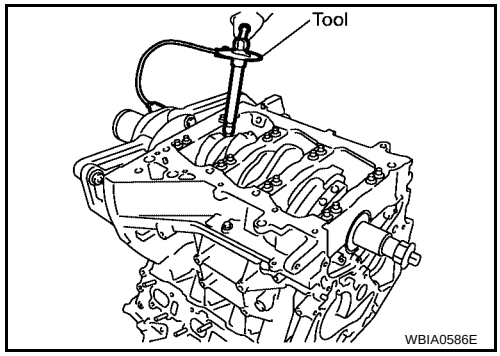
Connecting rod bolt : 19.6 N·m (2.0 kg-m, 14 ft-lb)

c. Then tighten all connecting rod bolts 90° clockwise.

CAUTION:
Always use Tool. Avoid tightening based on visual check alone.

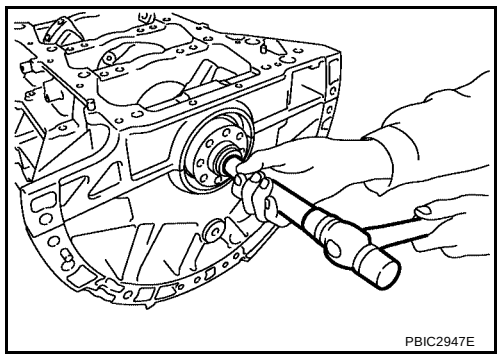
Tool number : KV10112100 (BT-8653-A)

- After tightening connecting rod bolts, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to EM-233, "CONNECTING ROD SIDE CLEARANCE" .

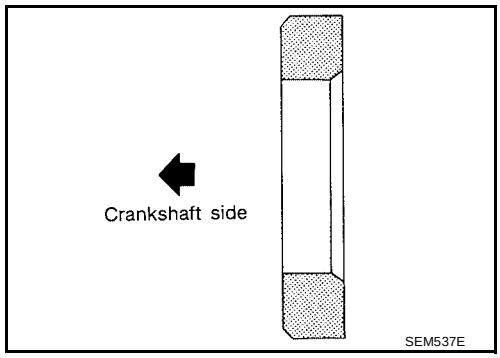


19. Install pilot converter (A/T models).
- With drift of the following outer diameter, press-fit as far as it will go.

Pilot converter : Approx. 33 mm (1.30 in)



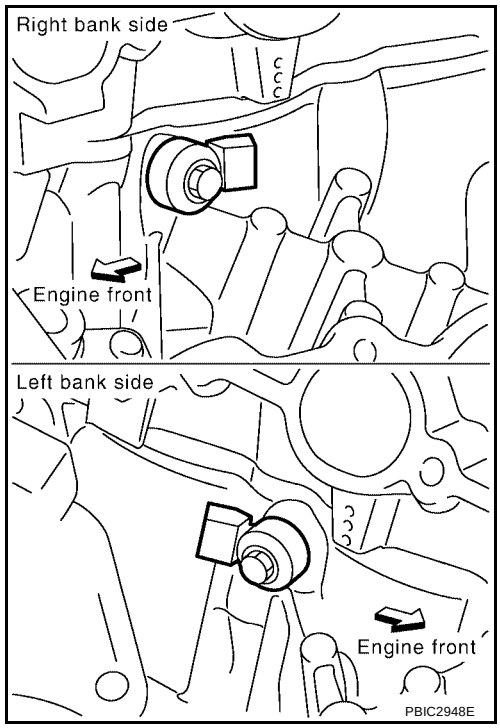
- Press-fit pilot converter with its chamfer facing crankshaft as shown. (A/T models)



20. Install knock sensors.
- Install knock sensor so that connector faces rear of engine.
- After installing knock sensor, connect harness connector, and lay it out to rear of engine.

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

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



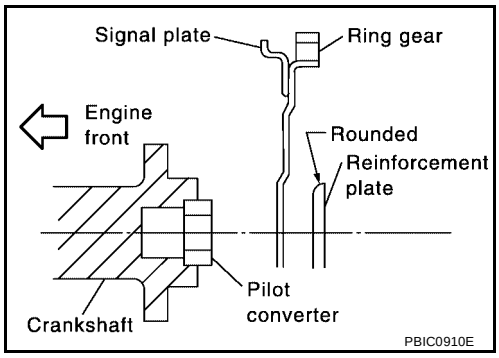
21. Assemble in the reverse order of disassembly after this step.

Drive plate (A/T models)

- Install drive plate and reinforcement plate as shown.
- Holding ring gear using Tool.

Tool number : KV10117700 (J-44716)

- Tighten bolts crosswise over several times.



How to Select Piston and Bearing

EBS00P57

DESCRIPTION

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

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

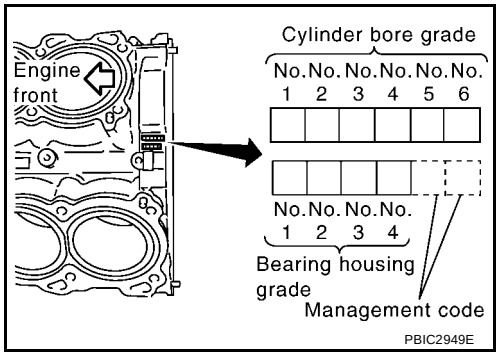
- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.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

When New Cylinder Block is Used

Check the cylinder bore grade (“1”, “2”, or “3”) on rear side of cylinder block, and select piston of the same grade.

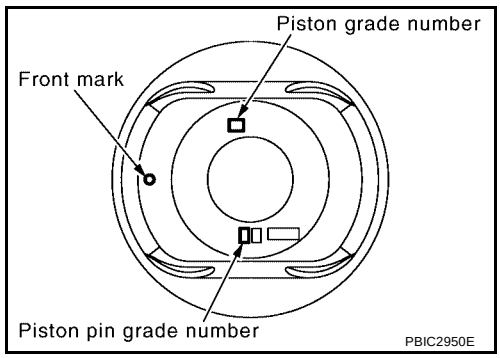
NOTE:
Piston is available with piston pin as a set for the service part. (Only “0” grade piston pin is available.)



When Cylinder Block is Reused

1. Measure the cylinder bore inner diameter. Refer to EM-237, "Cylinder 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”.



3. Select piston of the same grade.

Piston Selection Table

Unit: mm (in)

Grade	1	2 (or no mark)	3
Cylinder bore inner diameter	95.500 - 95.510 (3.7598 - 3.7602)	95.510 - 95.520 (3.7602 - 3.7606)	95.520 - 95.530 (3.7606 - 3.7610)
Piston skirt diameter	95.480 - 95.490 (3.7590 - 3.7594)	95.490 - 95.500 (3.7594 - 3.7598)	95.500 - 95.510 (3.7598 - 3.7602)

NOTE:

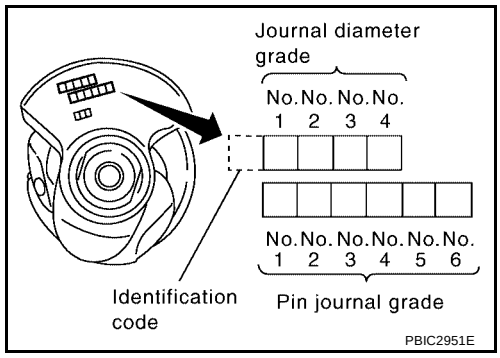
- Piston is available together with piston pin as assembly.
- Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no piston pin grades can be selected. (Only “0” grade is available.)
- No second grade mark is available on piston.

HOW TO SELECT CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used

Check pin journal grade (“0”, “1”, or “2”) on front of crankshaft, and select connecting rod bearing of the same grade.

NOTE:
There is no grading for connecting rod big end diameter.



When Crankshaft and Connecting Rod are Reused

1. Measure the connecting rod big end diameter. Refer to EM-235, "CONNECTING ROD BIG END DIAMETER" .
2. Make sure that the connecting rod big end diameter is within the standard value.
3. Measure the crankshaft pin journal diameter. Refer to EM-239, "CRANKSHAFT PIN JOURNAL DIAMETER" .
4. Determine the grade of crankshaft pin journal grade by corresponding to the measured dimension in “Crankshaft pin journal diameter” column of “Connecting Rod Bearing Selection Table”.
5. Select connecting rod bearing of the same grade.

Connecting Rod Bearing Selection Table

Unit: mm (in)

Connecting rod big end diameter	57.000 - 57.013 (2.2441 - 2.2446)

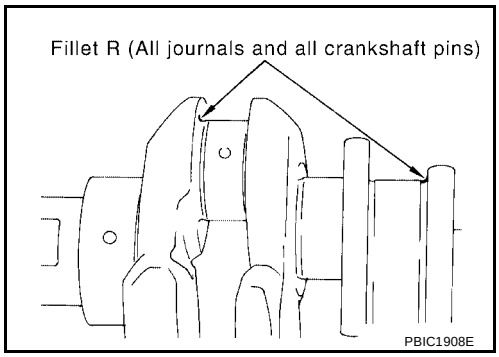
Unit: mm (in)

Crankshaft		Connecting rod bearing		
Crankshaft pin journal diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
53.968 - 53.974 (2.1247 - 2.1250)	0	1.500 - 1.503 (0.0591 - 0.0592)	STD 0	Black
53.962 - 53.968 (2.1245 - 2.1247)	1	1.503 - 1.506 (0.0592 - 0.0593)	STD 1	Brown
53.956 - 53.962 (2.1242 - 2.1245)	2	1.506 - 1.509 (0.0593 - 0.0594)	STD 2	Green

Undersize Bearings Usage Guide

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

CAUTION:
In grinding crankshaft pin to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].



Bearing undersize table

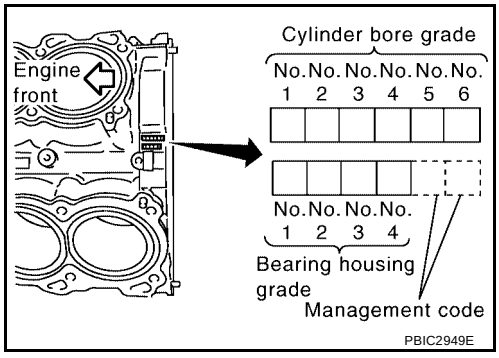
Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)

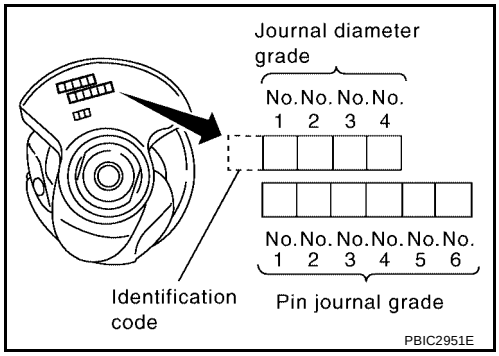
HOW TO SELECT MAIN BEARING

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.



2. “Main Bearing Selection Table” columns correspond to journal diameter grade on front side of crankshaft.



3. Select main bearing grade at the point where selected row and column meet in “Main Bearing Selection Table”.

When Cylinder Block and Crankshaft are Reused

1. Measure cylinder block main bearing housing inner diameter and crankshaft main journal diameter. Refer to EM-237, "MAIN BEARING HOUSING INNER DIAMETER" and EM-238, "CRANKSHAFT MAIN JOURNAL DIAMETER" .
2. Correspond the measured dimension in “Cylinder block main bearing housing inner diameter” row of “Main Bearing Selection Table”.
3. Correspond the measured dimension in “Crankshaft main journal diameter” column of “Main Bearing Selection Table”.
4. Select main bearing grade at the point where selected row and column meet in following selection table.

Main Bearing Selection Table

Cylinder block main bearing housing inner diameter
Unit: mm (in)

Crankshaft main journal diameter
Unit: mm (in)

Mark	Axle diameter	Hole diameter	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
			74.993 - 74.994 (2.9525 - 2.9525)	74.994 - 74.995 (2.9525 - 2.9526)	74.995 - 74.996 (2.9526 - 2.9526)	74.996 - 74.997 (2.9526 - 2.9526)	74.997 - 74.998 (2.9526 - 2.9527)	74.998 - 74.999 (2.9527 - 2.9527)	74.999 - 75.000 (2.9527 - 2.9528)	75.000 - 75.001 (2.9528 - 2.9528)	75.001 - 75.002 (2.9528 - 2.9528)	75.002 - 75.003 (2.9528 - 2.9529)	75.003 - 75.004 (2.9529 - 2.9529)	75.004 - 75.005 (2.9529 - 2.9529)	75.005 - 75.006 (2.9529 - 2.9530)	75.006 - 75.007 (2.9530 - 2.9530)	75.007 - 75.008 (2.9530 - 2.9531)	75.008 - 75.009 (2.9531 - 2.9531)	75.009 - 75.010 (2.9531 - 2.9531)	75.010 - 75.011 (2.9531 - 2.9532)	75.011 - 75.012 (2.9532 - 2.9532)	75.012 - 75.013 (2.9532 - 2.9533)	75.013 - 75.014 (2.9533 - 2.9533)	75.014 - 75.015 (2.9533 - 2.9533)	75.015 - 75.016 (2.9533 - 2.9534)	75.016 - 75.017 (2.9534 - 2.9534)
A	69.975 - 69.974 (2.7549 - 2.7549)		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	69.974 - 69.973 (2.7549 - 2.7548)		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	69.973 - 69.972 (2.7548 - 2.7548)		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	69.972 - 69.971 (2.7548 - 2.7548)		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	69.971 - 69.970 (2.7548 - 2.7547)		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	69.970 - 69.969 (2.7547 - 2.7547)		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	69.969 - 69.968 (2.7547 - 2.7546)		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	69.968 - 69.967 (2.7546 - 2.7546)		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	69.967 - 69.966 (2.7546 - 2.7546)		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	69.966 - 69.965 (2.7546 - 2.7545)		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	69.965 - 69.964 (2.7545 - 2.7545)		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	69.964 - 69.963 (2.7545 - 2.7544)		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	69.963 - 69.962 (2.7544 - 2.7544)		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	69.962 - 69.961 (2.7544 - 2.7544)		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	69.961 - 69.960 (2.7544 - 2.7543)		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	69.960 - 69.959 (2.7543 - 2.7543)		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	69.959 - 69.958 (2.7543 - 2.7542)		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	69.958 - 69.957 (2.7542 - 2.7542)		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	69.957 - 69.956 (2.7542 - 2.7542)		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	69.956 - 69.955 (2.7542 - 2.7541)		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	69.955 - 69.954 (2.7541 - 2.7541)		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	69.954 - 69.953 (2.7541 - 2.7540)		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	69.953 - 69.952 (2.7540 - 2.7540)		34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	X
7	69.952 - 69.951 (2.7540 - 2.7540)		34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	X	X

WBIA0625E

Main Bearing Grade Table (All Journals)

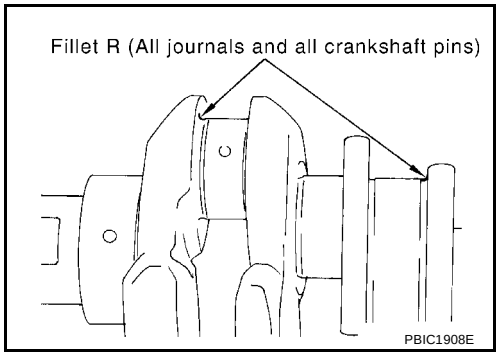
Grade number		Thickness Unit: mm (in)	Width Unit: mm (in)	Identification color	Remarks
0		2.500 - 2.503 (0.0984 - 0.0985)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1		2.503 - 2.506 (0.0985 - 0.0987)		Brown	
2		2.506 - 2.509 (0.0987 - 0.0988)		Green	
3		2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
4		2.512 - 2.515 (0.0989 - 0.0990)		Blue	
5		2.515 - 2.518 (0.0990 - 0.0991)		Pink	
6		2.518 - 2.521 (0.0991 - 0.0993)		Purple	
7		2.521 - 2.524 (0.0993 - 0.0994)		White	
01	UPR	2.503 - 2.506 (0.0985 - 0.0987)		Brown	Grade is different for upper and lower bearings.
	LWR	2.500 - 2.503 (0.0984 - 0.0985)		Black	
12	UPR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
	LWR	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
23	UPR	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
	LWR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
34	UPR	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
	LWR	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
45	UPR	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
	LWR	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
56	UPR	2.518 - 2.521 (0.0991 - 0.0993)		Purple	
	LWR	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
67	UPR	2.521 - 2.524 (0.0993 - 0.0994)		White	
	LWR	2.518 - 2.521 (0.0991 - 0.0993)		Purple	

Undersize Bearing Usage Guide

- When the specified main bearing oil clearance is not obtained with standard size main bearings, use underside (US) bearing.
- When using undersize (US) bearing, measure the main bearing inner diameter with bearing installed, and grind main journal so that the main bearing oil clearance satisfies the standard.

CAUTION:

In grinding crankshaft main journal to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].



Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.633 - 2.641 (0.1037 - 0.1040)

Inspection After Disassembly

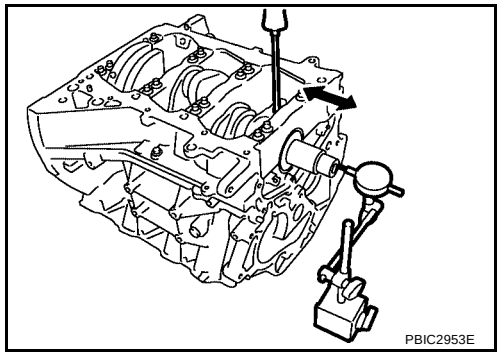
EBS00P58

CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with dial indicator.

Standard : 0.14 - 0.22 mm (0.0055 - 0.0087 in)
Limit : 0.30 mm (0.0118 in)

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

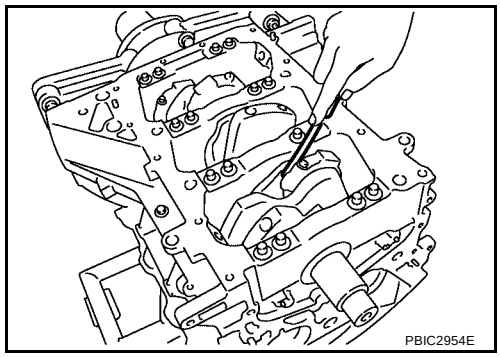

PBIC2953E

CONNECTING ROD SIDE CLEARANCE

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

Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)
Limit : 0.40 mm (0.0157 in)

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

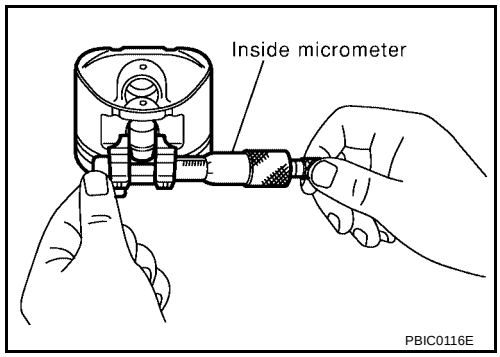

PBIC2954E

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with inside micrometer.

Standard : 21.993 - 22.005 mm (0.8659 - 0.8663 in)

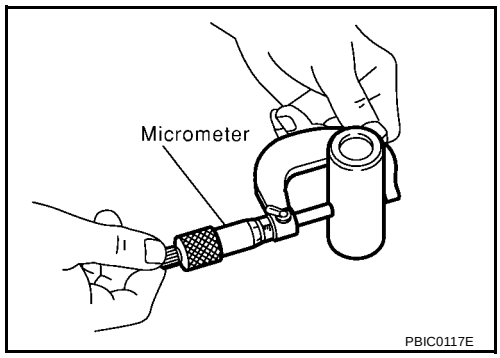


PBIC0116E

Piston Pin Outer Diameter

Measure the outer diameter of piston pin with micrometer.

Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)



PBIC0117E

Piston to Piston Pin Oil Clearance

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

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

- If the calculated value is out of the standard, replace piston and piston pin assembly.

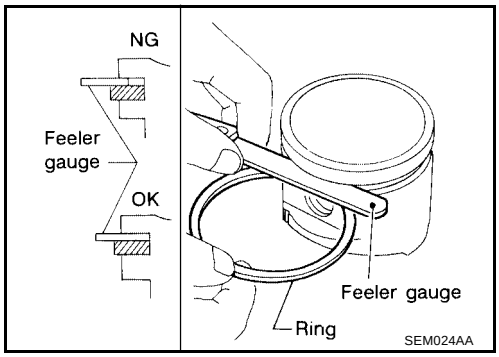
- When replacing piston and piston pin assembly, refer to EM-228, "HOW TO SELECT PISTON" .

NOTE:

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

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)**

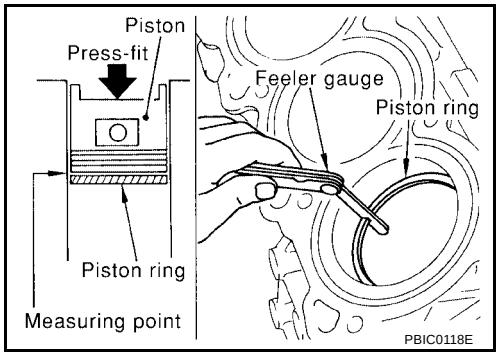
Limit:

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

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

PISTON RING END GAP

- Make sure that the cylinder bore inner diameter is within the specification. Refer to EM-237, "Cylinder Bore Inner Diameter" .
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure the piston ring end gap with feeler gauge.



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	**: 0.56 mm (0.0220 in)**
2nd ring	**: 0.68 mm (0.0268 in)**
Oil ring	**: 0.85 mm (0.0335 in)**

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

CONNECTING ROD BEND AND TORSION

- Check with connecting rod aligner.

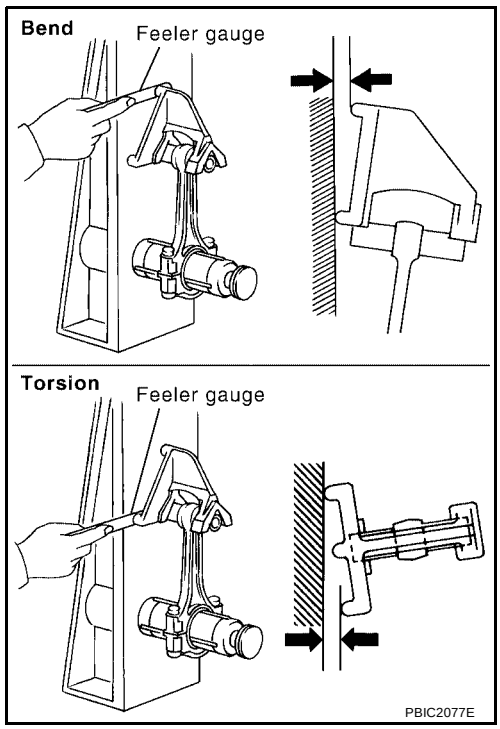
Bend:

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.

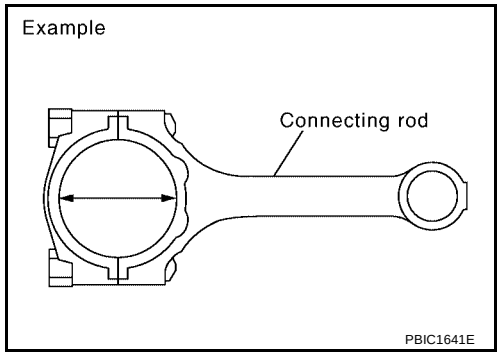


CONNECTING ROD BIG END DIAMETER

- Install connecting rod bearing cap without installing connecting rod bearing, and tightening connecting rod bolts to the specified torque. Refer to EM-222, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of connecting rod big end with inside micrometer.

Standard : 57.000 - 57.013 mm (2.2441 - 2.2446 in)

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

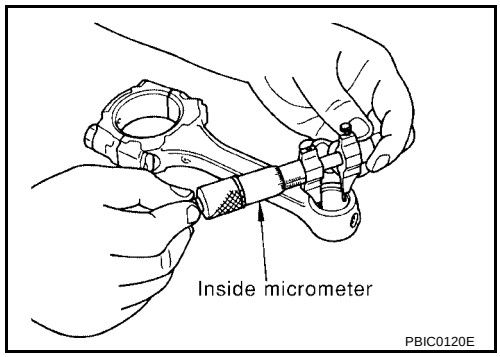


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with inside micrometer.

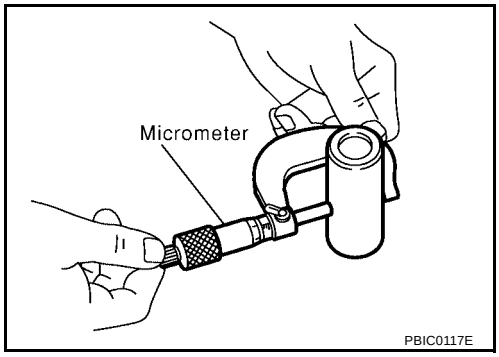
Standard : 22.000 - 22.012 mm (0.8661 - 0.8666 in)



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with micrometer.

Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)



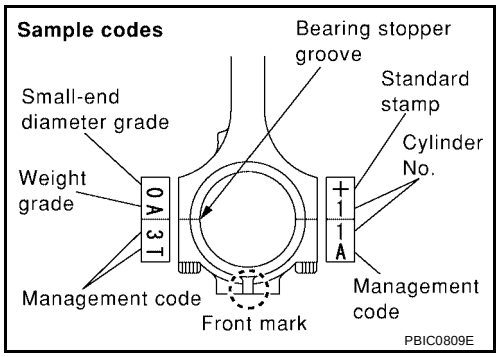
Connecting Rod Bushing Oil Clearance

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

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

Limit : 0.030 mm (0.0012 in)

- If the calculated value exceeds the limit, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, refer to EM-228, "HOW TO SELECT PISTON" .
- If replacing connecting rod assembly, refer to EM-239, "CONNECTING ROD BEARING OIL CLEARANCE" to select the connecting rod bearing.



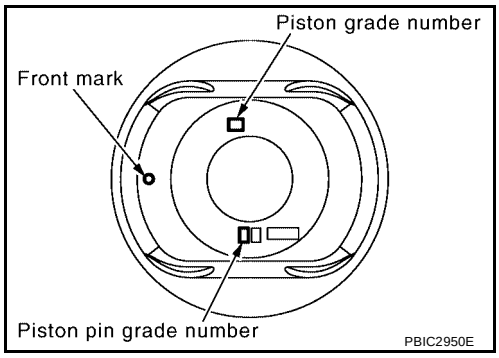
Factory installed parts grading:

- Service parts apply only to grade “0”.

Unit: mm (in)

Grade	0	1
Connecting rod bushing inner diameter *	22.000 - 22.006 (0.8661 - 0.8664)	22.006 - 22.012 (0.8664 - 0.8666)
Piston pin hole diameter	21.993 - 21.999 (0.8659 - 0.8661)	21.999 - 22. 005 (0.8661 - 0.8663)
Piston pin outer diameter	21.989 - 21.995 (0.8657- 0.8659)	21.995 - 22.001 (0.8659 - 0.8662)

*: After installing in connecting rod



CYLINDER BLOCK DISTORTION

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

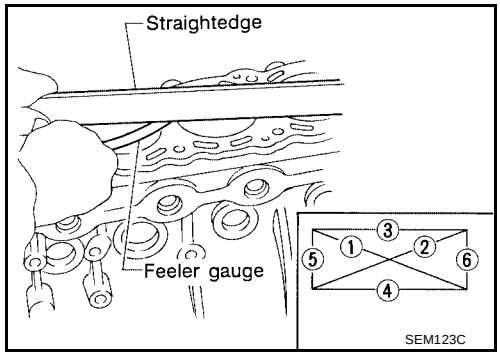
CAUTION:

Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.

- Measure the distortion on the cylinder block upper face at some different points in six directions with straightedge and feeler gauge.

  Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder block.



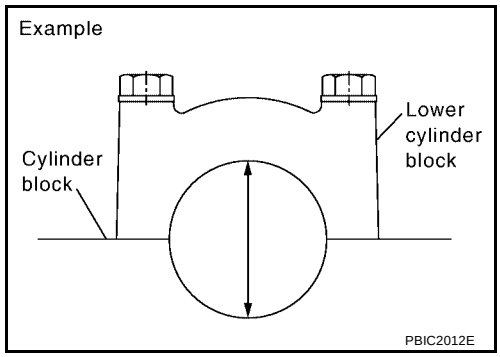
MAIN BEARING HOUSING INNER DIAMETER

- Install lower cylinder block without installing main bearings, and tighten lower cylinder block bolts to the specified torque. Refer to EM-222, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of main bearing housing with bore gauge.

  Standard : 74.993 - 75.017 mm (2.9525 - 2.9534 in)

- If out of the standard, replace cylinder block and lower cylinder block as assembly.

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

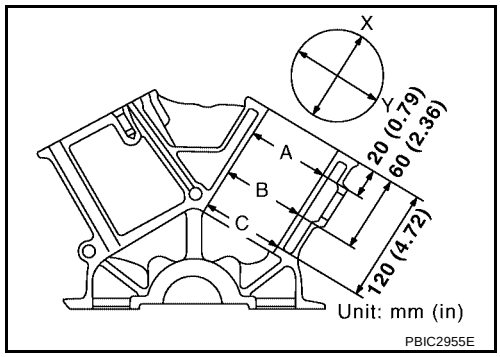


PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

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

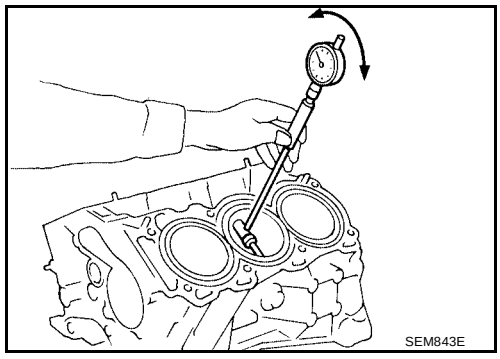
  Standard inner diameter:
  95.500 - 95.530 mm (3.7598 - 3.7610 in)
  Out-of-round (Difference between “X” and “Y”):
  0.015 mm (0.0006 in)
  Taper limit (Difference between “A” and “C”):
  0.01 mm (0.0004 in)



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

  CAUTION:
  When using oversize piston, use oversize pistons for all cylinders with oversize piston rings.

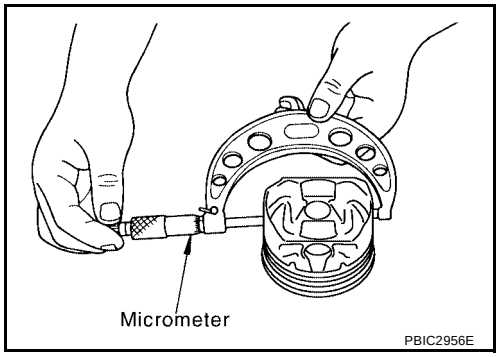
  Oversize (OS) : 0.2 mm (0.008 in)



Piston Skirt Diameter

Measure the outer diameter of piston skirt with micrometer.

Measure point
: Distance from the top 43.03 mm (1.6941 in)
Standard
: 95.480 - 95.510 mm (3.7590 - 3.7602 in)



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter (direction “X”, position “B”).
(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter).

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

- If the calculated value exceeds the limit, replace piston and piston pin assembly. Refer to EM-228, "HOW TO SELECT PISTON" .

Re-boring Cylinder Bore

1. Cylinder bore size is determined by adding piston to cylinder bore clearance to piston skirt diameter.

   Re-bored size calculation: D = A + B – C
   where,
   D: Bored diameter
   A: Piston skirt diameter as measured
   B: Piston to cylinder bore clearance (standard value)
   C: Honing allowance 0.02 mm (0.0008 in)

2. Install lower cylinder block, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.

   NOTE:
   - 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 the specified piston to cylinder bore clearance.
5. Measure finished the cylinder bore for out-of-round and taper.

   NOTE:
   Measurement should be done after cylinder bore cools down.

CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with micrometer.

  Standard : 69.951 - 69.975 mm (2.7540 - 2.7549 in) dia.

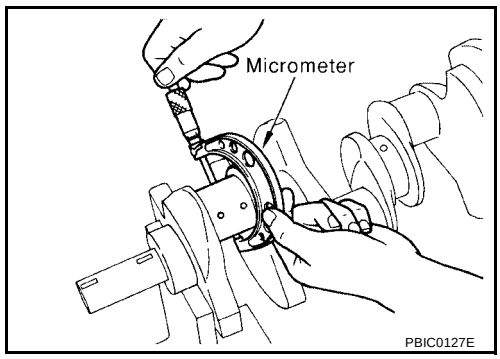
- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to EM-240, "MAIN BEARING OIL CLEARANCE" .

CRANKSHAFT PIN JOURNAL DIAMETER

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

Standard : 53.956 - 53.974 mm (2.1242 - 2.1250 in) dia.

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to EM-239, "CONNECTING ROD BEARING OIL CLEARANCE" .



CRANKSHAFT OUT-OF-ROUND AND TAPER

- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with micrometer.
- Out-of-round is indicated by the difference in the dimensions between “X” and “Y” at “A” and “B”.
- Taper is indicated by the difference in the dimensions between “A” and “B” at “X” and “Y”.

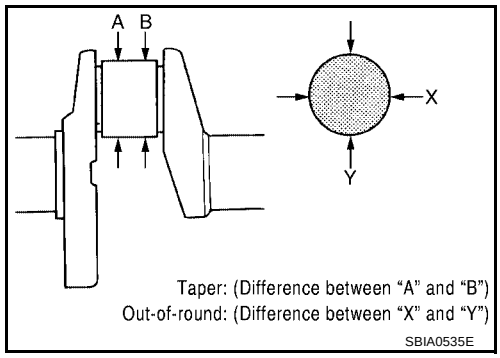
Limit:

Out-of-round (Difference between “X” and “Y”)

: 0.002 mm (0.0001 in)

Taper (Difference between “A” and “B”)

: 0.002 mm (0.0001 in)



- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select the main bearing and/or connecting rod bearing. Refer to EM-240, "MAIN BEARING OIL CLEARANCE" and/or EM-239, "CONNECTING ROD BEARING OIL CLEARANCE" .

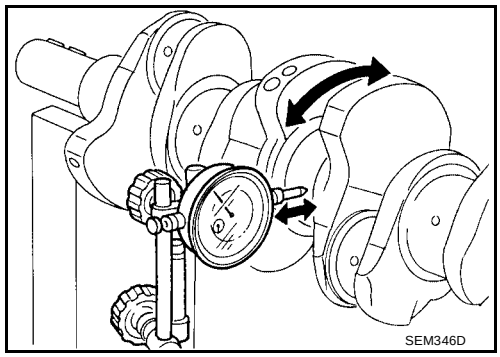
CRANKSHAFT RUNOUT

- Place V-block on precise flat table, and support the journals on the both end of crankshaft.
- Place dial indicator straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on dial indicator. (Total indicator reading)

Standard : Less than 0.05 mm (0.0020 in)

Limit : 0.10 mm (0.0039 in)

- If it exceeds the limit, replace crankshaft.



CONNECTING ROD BEARING OIL CLEARANCE

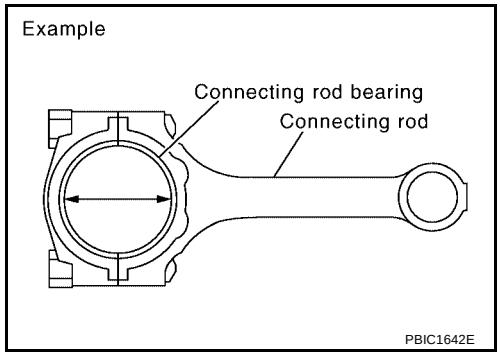
Method by Calculation

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to EM-222, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of connecting rod bearing with inside micrometer.

(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)

Standard : 0.034 - 0.059 mm (0.0013 - 0.0023 in) (actual clearance)

Limit : 0.070 mm (0.0028 in)



- If the calculated value exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain the specified bearing oil clearance. Refer to EM-229, "HOW TO SELECT CONNECTING ROD BEARING" .

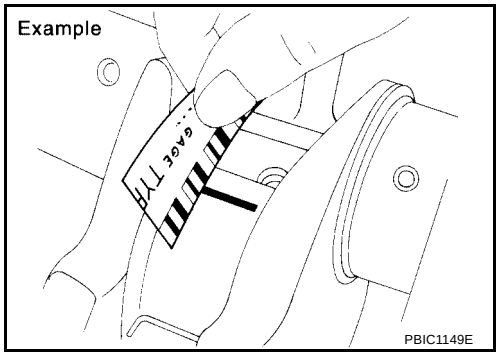
Method of Using Plastigage

- Remove oil and dust on crankshaft pin journal and the surfaces of each bearing completely.
- Cut plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to EM-222, "ASSEMBLY" for the tightening procedure.

  CAUTION:
  Do not rotate crankshaft.

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

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



MAIN BEARING OIL CLEARANCE

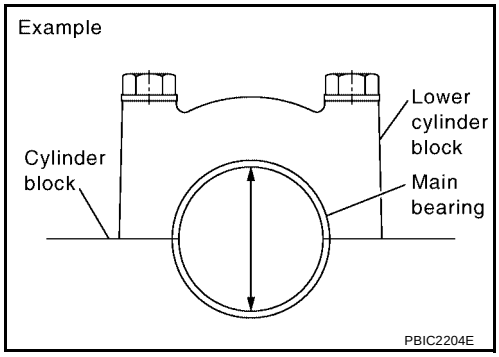
Method by Calculation

- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Refer to EM-222, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of main bearing with bore gauge.

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

Standard : 0.035 - 0.045 mm (0.0014 - 0.0018 in) (actual clearance)

Limit : 0.065 mm (0.0026 in)



- If the calculated value exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to EM-230, "HOW TO SELECT MAIN BEARING" .

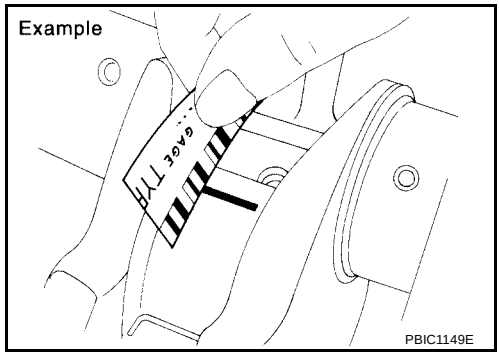
Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Refer to EM-222, "ASSEMBLY" for the tightening procedure.

  CAUTION:
  Do not rotate crankshaft.

- Remove lower cylinder block and bearings, and using scale on 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”.

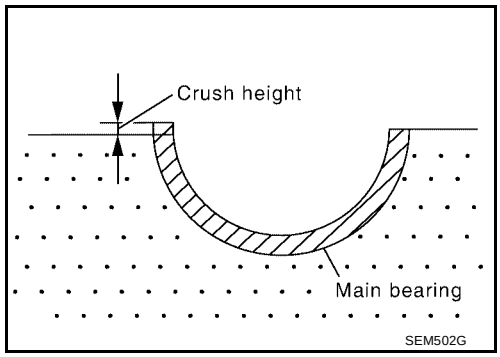


CRUSH HEIGHT OF MAIN BEARING

- When lower cylinder block is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to EM-222, "ASSEMBLY" for the tightening procedure.

  Standard : There must be crush height.

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

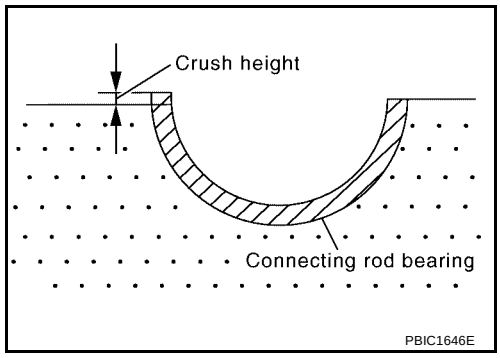


CRUSH HEIGHT OF CONNECTING ROD BEARING

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to EM-222, "ASSEMBLY" for the tightening procedure.

  Standard : There must be crush height.

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

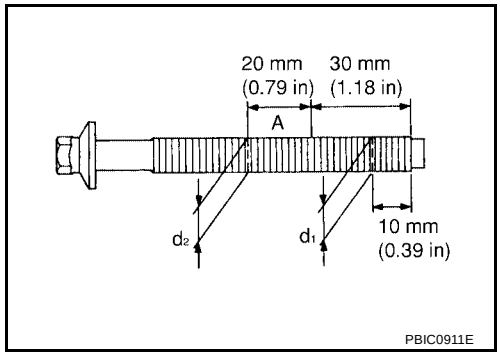


LOWER CYLINDER BLOCK BOLT OUTER DIAMETER

- Measure the outer diameters (“d_1 ”, “d_2 ”) at two positions as shown.
- If reduction appears in “A” range, regard it as “d_2 ”.

  Limit (“d_1 ” – “d_2 ”) : 0.11 mm (0.0051 in)

- If it exceeds the limit (large difference in dimensions), replace lower cylinder block bolt with new one.

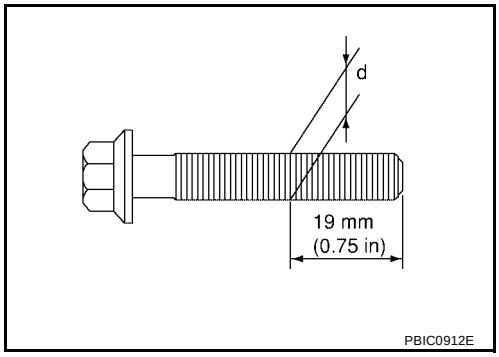


CONNECTING ROD BOLT OUTER DIAMETER

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

Limit : 7.75 mm (0.3051 in)

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



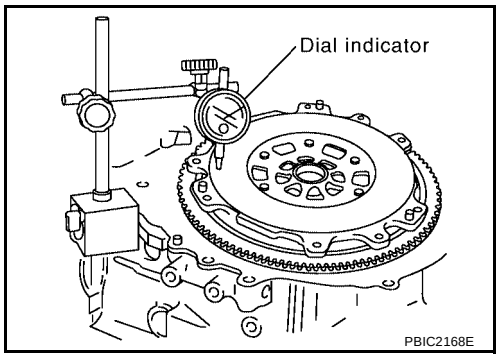
FLYWHEEL DEFLECTION (M/T MODELS)

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

Standard : 0.45 mm (0.0177 in) or less.

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

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



MOVEMENT AMOUNT OF FLYWHEEL (M/T MODELS)

CAUTION:
Do not disassemble double mass flywheel.

Movement Amount of Thrust (Fore-and-Aft) Direction

- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

Standard : 1.3 mm (0.051 in) or less

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

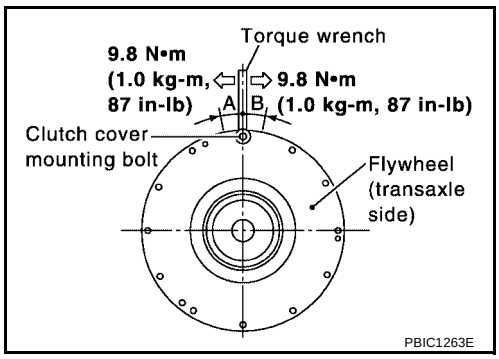
Movement Amount in Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction with the following procedure:

1. Install a bolt to clutch cover mounting hole, and place a torque wrench on the extended line of the flywheel center line.
   - Tighten bolt at a force of 9.8 N·m (1.0 kg-m, 87 in-lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of 9.8 N·m (1.0 kg-m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transmission side.
4. Measure the dimensions of movement amounts “A” and “B” on circumference of flywheel on the transmission side.

Standard: 24 mm (0.94 in) or less.

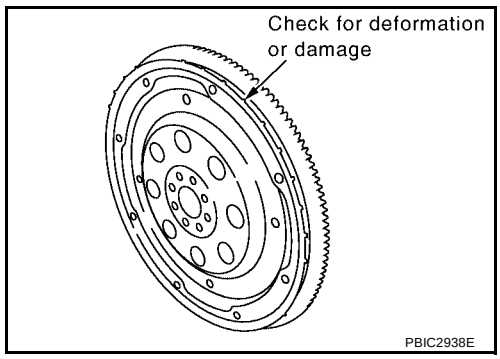
- If measured value is out of the standard, replace flywheel.



DRIVE PLATE

- Check drive plate and signal plate for deformation or cracks.

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

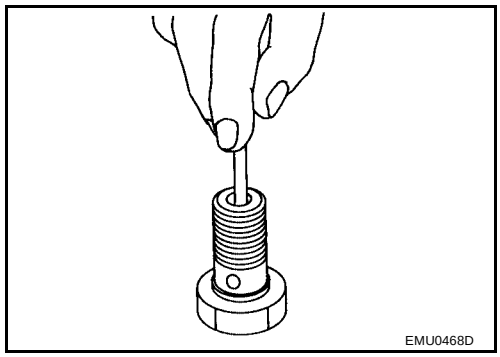


OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- If it is not satisfied, clean or replace oil jet.

OIL JET RELIEF VALVE

- Using clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.
- If it is not satisfied, replace oil jet relief valve.



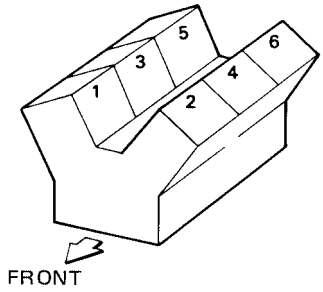
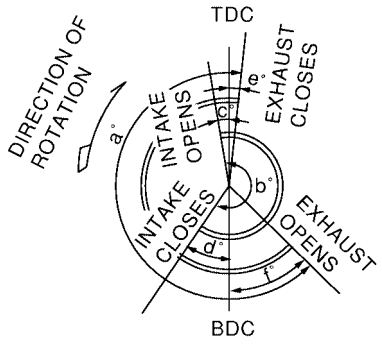
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00100

Standard and Limit

EBS00P59

GENERAL SPECIFICATIONS

Cylinder arrangement		V-6
Displacement cm^3 (cu in)		3,954 (241.30)
Bore and stroke mm (in)		95.5 × 92.0 (3.76 × 3.622)
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		9.7
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 (Intake valve timing control - “OFF”)	 PBIC0187E	

Unit: degree

a	b	c	d	e	f
244	240	–4	64	6	58

DRIVE BELT

Tension of drive belts	Auto adjustment by auto tensioner

INTAKE MANIFOLD COLLECTOR, INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

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

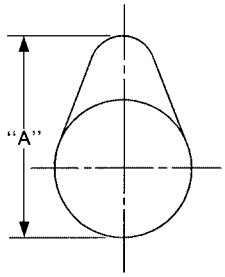
SPARK PLUG

Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11
Gap (nominal)	1.1 mm (0.043 in)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Items		Standard	Limit
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
	No. 2, 3, 4	0.035 - 0.076 (0.0014 - 0.0030)	
Camshaft bracket inner diameter	No. 1	26.000 - 26.021 (1.0236 - 1.0244)	—
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)	—
Camshaft journal diameter	No. 1	25.935 - 25.955 (1.0211 - 1.0218)	—
	No. 2, 3, 4	23.445 - 23.465 (0.9230 - 0.9238)	—
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)
Camshaft cam height “A”	Intake	45.465 - 45.655 (1.7900 - 1.7921)	45.265 (1.7821)
	Exhaust	45.075 - 45.265 (1.7746 - 1.7821)	44.875 (1.7667)
Camshaft runout [TIR*1]		Less than 0.02 mm (0.001)	0.05 (0.002)
Camshaft sprocket runout [TIR*2]		—	0.15 (0.0059)



SEM671

*1 : Total indicator reading

Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Valve lifter hole diameter	34.000 - 34.016 (1.3386 - 1.3392)
Valve lifter clearance	0.013 - 0.039 (0.0005 - 0.0015)

Valve Clearance

Unit: mm (in)

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

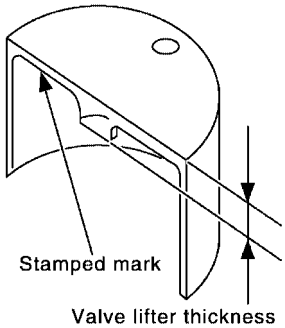
*: Approximately 80°C (176°F)

Available Valve Lifter

VQ40DE

Unit: mm (in)

Identification (stamped) mark		Thickness
Intake	Exhaust	
788U	N788	7.88 (0.3102)
790U	N790	7.90 (0.3110)
792U	N792	7.92 (0.3118)
794U	N794	7.94 (0.3126)
796U	N796	7.96 (0.3134)
798U	N798	7.98 (0.3142)
800U	N800	8.00 (0.3150)
802U	N802	8.02 (0.3157)
804U	N804	8.04 (0.3165)
806U	N806	8.06 (0.3173)
808U	N808	8.08 (0.3181)
810U	N810	8.10 (0.3189)
812U	N812	8.12 (0.3197)
814U	N814	8.14 (0.3205)
816U	N816	8.16 (0.3213)
818U	N818	8.18 (0.3220)
820U	N820	8.20 (0.3228)
822U	N822	8.22 (0.3236)
824U	N824	8.24 (0.3244)
826U	N826	8.26 (0.3252)
828U	N828	8.28 (0.3260)
830U	N830	8.30 (0.3268)
832U	N832	8.32 (0.3276)
834U	N834	8.34 (0.3283)
836U	N836	8.36 (0.3291)
838U	—	8.38 (0.3299)
840U	—	8.40 (0.3307)

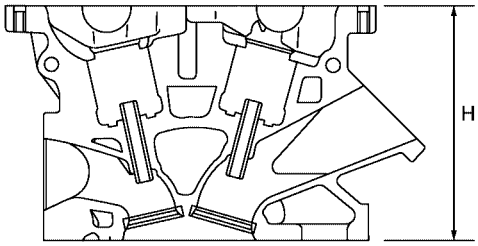


SEM758G

CYLINDER HEAD

Unit: mm (in)

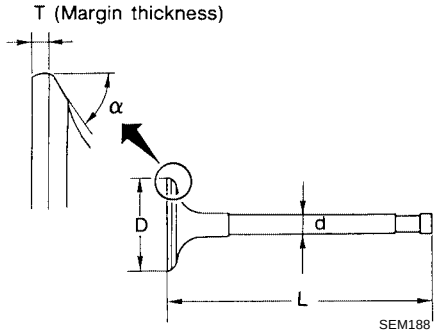
Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height “H”	126.3 - 126.5 (4.972 - 4.980)	—



PBIC0924E

Valve Dimensions

Unit: mm (in)

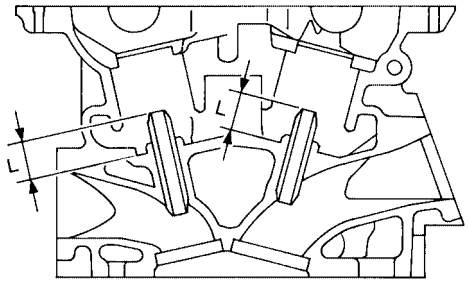


SEM188

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	96.46 (3.7976)
	Exhaust	93.99 (3.7004)
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 Guide

Unit: mm (in)

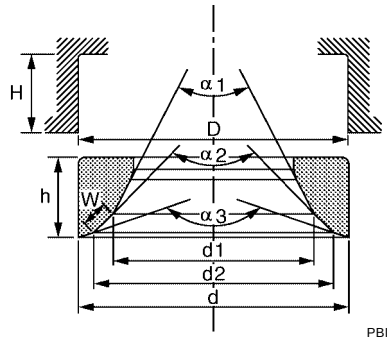


SEM950E

Items		Standard	0.2 (0.008) oversize (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)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.003)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.004)
Projection length “L”		12.6 - 12.8 (0.496 - 0.504)	

Valve Seat

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize [0.5 (0.02)] (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 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)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Diameter “d1”*1	Intake	35 (1.38)	
	Exhaust	28.7 (1.130)	
Diameter “d2”*2	Intake	36.3 - 36.8 (1.429 - 1.449)	
	Exhaust	30.3 - 30.8 (1.193 - 1.213)	
Angle “α1”	Intake	60°	
	Exhaust	60°	
Angle “α2”	Intake	88°45′ - 90°15′	
	Exhaust	88°45′ - 90°15′	

Angle “α3”	Intake	120°	
	Exhaust	120°	
Contacting width “W”*3	Intake	1.0 - 1.4 (0.039-0.055)	
	Exhaust	1.2 - 1.6 (0.047-0.063)	
Height “h”	Intake	5.9 - 6.0 (0.232 - 0.236)	5.05 - 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”		6.0 (0.236)	

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

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

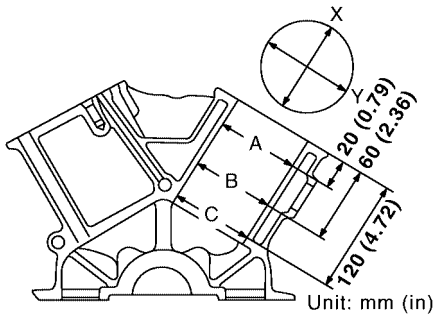
*3: Machining data

Valve Spring

Free height mm (in)		47.07 (1.8531)
Pressure N (kg, lb) at height mm (in)	Installation	166 - 188 (16.9 - 19.2, 37 - 42) at 37.00 (1.4567)
	Valve open	373 - 421 (38.0 - 42.9, 84 - 95) at 27.20 (1.0709)
squareness mm (in)	Limit	2.1 (0.083)

CYLINDER BLOCK

Unit: mm (in)



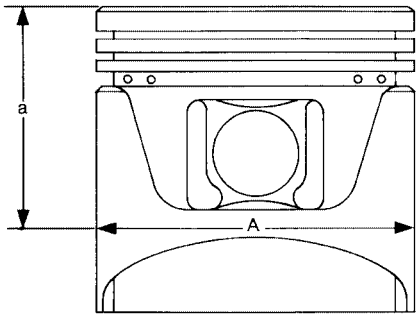
PBIC2955E

Surface flatness		Standard		Less than 0.03 (0.0012)
		Limit		0.1 (0.004)
Main bearing housing inner diameter		Standard		74.993 - 75.017 (2.9525 - 2.9534)
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)
Out-of-round (Difference between “X” and “Y”)		Limit		0.015 (0.0006)
Taper (Difference between “A” and “C”)				0.01 (0.0004)
Main bearing housing inner diameter (Without bearing)			Grade No. A	74.993 - 74.994 (2.9525 - 2.9525)
			Grade No. B	74.994 - 74.995 (2.9525 - 2.9526)
			Grade No. C	74.995 - 74.996 (2.9526 - 2.9526)
			Grade No. D	74.996 - 74.997 (2.9526 - 2.9526)
			Grade No. E	74.997 - 74.998 (2.9526 - 2.9527)
			Grade No. F	74.998 - 74.999 (2.9527 - 2.9527)
			Grade No. G	74.999 - 75.000 (2.9527 - 2.9528)
			Grade No. H	75.000 - 75.001 (2.9528 - 2.9528)
			Grade No. J	75.001 - 75.002 (2.9528 - 2.9528)
			Grade No. K	75.002 - 75.003 (2.9528 - 2.9529)
			Grade No. L	75.003 - 75.004 (2.9529 - 2.9529)
			Grade No. M	75.004 - 75.005 (2.9529 - 2.9529)
			Grade No. N	75.005 - 75.006 (2.9529 - 2.9530)
			Grade No. P	75.006 - 75.007 (2.9530 - 2.9530)
			Grade No. R	75.007 - 75.008 (2.9530 - 2.9531)
			Grade No. S	75.008 - 75.009 (2.9530 - 2.9531)
			Grade No. T	75.009 - 75.010 (2.9531 - 2.9531)
			Grade No. U	75.010 - 75.011 (2.9531 - 2.9532)
			Grade No. V	75.011 - 75.012 (2.9532 - 2.9532)
			Grade No. W	75.012 - 75.013 (2.9532 - 2.9533)
			Grade No. X	75.013 - 75.014 (2.9533 - 2.9533)
			Grade No. Y	75.014 - 75.015 (2.9533 - 2.9533)
			Grade No. 4	75.015 - 75.016 (2.9533 - 2.9534)
			Grade No. 7	75.016 - 75.017 (2.9534 - 2.9534)
Difference in inner diameter between cylinders		Standard		Less than 0.03 (0.0012)

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



SEM882E

Items		Standard	0.20 (0.0079) oversize
Piston skirt diameter “A”	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)	—
	Grade No. 2	95.490 - 95.500 (3.7594 - 3.7598)	—
	Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)	—
	Service	—	95.680 - 95.710 (3.7669 - 3.7681)
Items		Standard	Limit
“a” dimension		43.03 (1.6941)	—
Piston pin hole diameter	Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)	—
	Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)	—
Piston to cylinder bore clearance		0.010 - 0.030 (0.0004 - 0.0012)	0.08 (0.0031)

Piston Ring

Unit: mm (in)

Items		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 (0.0039)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.56 (0.0220)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.68 (0.0268)
	Oil (rail ring)	0.20 - 0.50 (0.0079 - 0.0197)	0.85 (0.0335)

Piston Pin

Unit: mm (in)

Items		Standard	Limit
Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)	—
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)	—
Piston to piston pin oil clearance		0.002 - 0.006 (0.0001 - 0.0002)	—
Connecting rod bushing oil clearance		0.005 - 0.017 (0.0002 - 0.0007)	0.030 (0.0012)

CONNECTING ROD

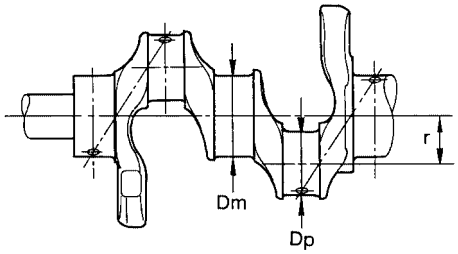
Unit: mm (in)

Items		Standard	Limit
Center distance		165.82 - 165.92 (6.5283 - 6.5323)	—
Bend [per 100 (3.94)]		—	0.15 (0.0059)
Torsion [per 100 (3.94)]		—	0.30 (0.0118)
Connecting rod 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 diameter (Without bearing)		57.000 - 57.013 (2.2441 - 2.2446)	—
Side clearance		0.20 - 0.35 (0.0079 - 0.0138)	—

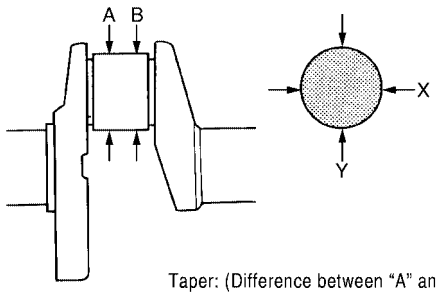
*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)



SEM645



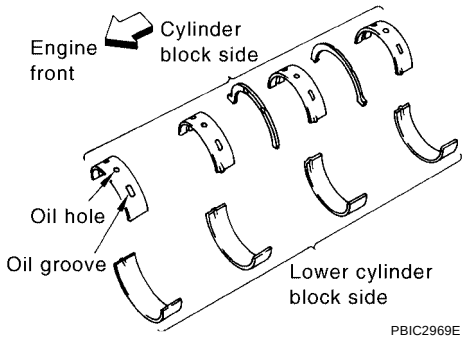
Taper: (Difference between “A” and “B”)
Out-of-round: (Difference between “X” and “Y”)

SBIA0535E

Main journal diameter. “Dm” grade	Standard	Grade No. A	69.975 - 69.974 (2.7549 - 2.7549)
		Grade No. B	69.974 - 69.973 (2.7549 - 2.7548)
		Grade No. C	69.973 - 69.972 (2.7548 - 2.7548)
		Grade No. D	69.972 - 69.971 (2.7548 - 2.7548)
		Grade No. E	69.971 - 69.970 (2.7548 - 2.7547)
		Grade No. F	69.970 - 69.969 (2.7547 - 2.7547)
		Grade No. G	69.969 - 69.968 (2.7547 - 2.7546)
		Grade No. H	69.968 - 69.967 (2.7546 - 2.7546)
		Grade No. J	69.967 - 69.966 (2.7546 - 2.7546)
		Grade No. K	69.966 - 69.965 (2.7546 - 2.7545)
		Grade No. L	69.965 - 69.964 (2.7545 - 2.7545)
		Grade No. M	69.964 - 69.963 (2.7545 - 2.7544)
		Grade No. N	69.963 - 69.962 (2.7544 - 2.7544)
		Grade No. P	69.962 - 69.961 (2.7544 - 2.7544)
		Grade No. R	69.961 - 69.960 (2.7544 - 2.7543)
		Grade No. S	69.960 - 69.959 (2.7543 - 2.7543)
		Grade No. T	69.959 - 69.958 (2.7543 - 2.7542)
		Grade No. U	69.958 - 69.957 (2.7542 - 2.7542)
		Grade No. V	69.957 - 69.956 (2.7542 - 2.7542)
		Grade No. W	69.956 - 69.955 (2.7542 - 2.7541)
		Grade No. X	69.955 - 69.954 (2.7541 - 2.7541)
		Grade No. Y	69.954 - 69.953 (2.7541 - 2.7540)
		Grade No. 4	69.953 - 69.952 (2.7540 - 2.7540)
		Grade No. 7	69.952 - 69.951 (2.7540 - 2.7540)
Pin journal diameter. “Dp” grade	Standard	Grade No. 0	53.968 - 53.974 (2.1247 - 2.1250)
		Grade No. 1	53.962 - 53.968 (2.1245 - 2.1247)
		Grade No. 2	53.956 - 53.962 (2.1242 - 2.1245)
Center distance “r”			45.96 - 46.04 (1.8094 - 1.8126)
Taper (Difference between “A” and “B”)	Limit		0.002 (0.0001)
Out-of-round (Difference between “X” and “Y”)			0.002 (0.0001)
Crankshaft runout [TIR*]	Standard		Less than 0.05 (0.002)
	Limit		0.10 (0.0039)
Crankshaft end play	Standard		0.10 - 0.25 (0.0039 - 0.0098)
	Limit		0.30 (0.0118)

*: Total indicator reading

MAIN BEARING



Grade number	UPR/LWR	Thickness mm (in)	Width mm (in)	Identification color	Remarks
0	—	2.500 - 2.503 (0.0984 - 0.0985)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1	—	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
2	—	2.506 - 2.509 (0.0987 - 0.0988)		Green	
3	—	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
4	—	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
5	—	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
6	—	2.518 - 2.521 (0.0991 - 0.0993)		Purple	
7	—	2.521 - 2.524 (0.0993 - 0.0994)		White	
01	UPR	2.503 - 2.506 (0.0985 - 0.0987)		Brown	Grade is different for upper and lower bearings.
	LWR	2.500 - 2.503 (0.0984 - 0.0985)		Black	
12	UPR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
	LWR	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
23	UPR	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
	LWR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
34	UPR	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
	LWR	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
45	UPR	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
	LWR	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
56	UPR	2.518 - 2.521 (0.0991 - 0.0993)		Purple	
	LWR	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
67	UPR	2.521 - 2.524 (0.0993 - 0.0994)		White	
	LWR	2.518 - 2.521 (0.0991 - 0.0993)		Purple	

Undersize

Unit: mm (in)

Items	Thickness	Main journal diameter
0.25 (0.0098)	2.633 - 2.641 (0.1037 - 0.1040)	Grind so that bearing clearance is the specified value.

Main Bearing Oil Clearance

Unit: mm (in)

Items	Standard	Limit
Main bearing oil clearance	0.035 - 0.045 (0.0014 - 0.0018)*	0.065 (0.0026)

*: Actual clearance

CONNECTING ROD BEARING

Grade number	Thickness 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)

Items	Thickness	Crank pin journal diameter
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

Connecting Rod Bearing Oil Clearance

Unit: mm (in)

Items	Standard	Limit
Connecting rod bearing oil clearance	0.034 - 0.059 (0.0013 - 0.0023)*	0.070 (0.0028)

*: Actual clearance