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SECTION **EM**

ENGINE MECHANICAL

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PRECAUTIONS

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Precautions Necessary for Steering Wheel Rotation After Battery Disconnect

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NOTE:

- This Procedure is applied only to models with Intelligent Key system and NVIS/IVIS (NISSAN/INFINITI VEHICLE IMMOBILIZER SYSTEM - NATS).
- Remove and install all control units after disconnecting both battery cables with the ignition knob in the "LOCK" position.
- Always use CONSULT-II to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

For models equipped with the Intelligent Key system and NVIS/IVIS, an electrically controlled steering lock mechanism is adopted on the key cylinder.

For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.

If steering wheel rotation is required when battery power is interrupted, follow the procedure below before starting the repair operation.

OPERATION PROCEDURE

1. Connect both battery cables.

NOTE:

Supply power using jumper cables if battery is discharged.

2. Use the Intelligent Key or mechanical key to turn the ignition switch to the "ACC" position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.
5. When the repair work is completed, return the ignition switch to the "LOCK" position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
6. Perform a self-diagnosis check of all control units using CONSULT-II.

Precautions for Drain Engine Coolant

ABS005ZK

Drain engine coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

ABS005ZL

- 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

ABS005ZM

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Cover openings of engine system with tape or the equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and 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

ABS005ZN

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

Precautions for Assembly and Installation

ABS005ZO

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

PRECAUTIONS

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

Parts Requiring Angle Tightening

ABS005ZP

- Use an angle wrench [SST: KV10112100 (BT8653-A)] for the final tightening of the following engine parts:
 - Cylinder head bolts
 - Main bearing cap bolts
 - Connecting rod cap nuts
 - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for 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 REMOVAL OF LIQUID GASKET SEALING

ABS005ZQ

- After removing the mounting bolts and nuts, separate the mating surface using a seal cutter (SST) and remove the old liquid gasket sealing.

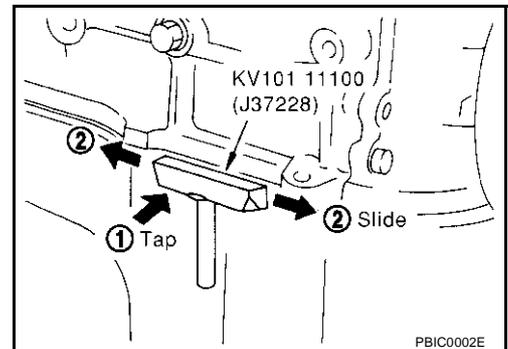
CAUTION:

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 the figure.
- In areas where seal cutter is difficult to use, use plastic hammer to lightly tap the areas where the liquid gasket is applied.

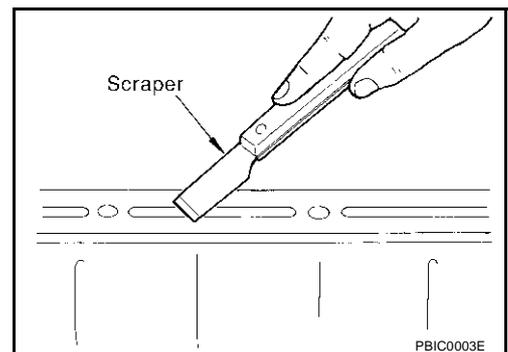
CAUTION:

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



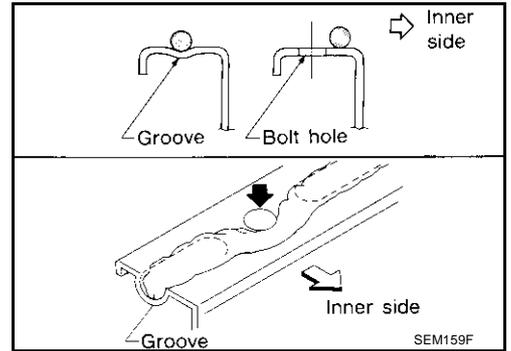
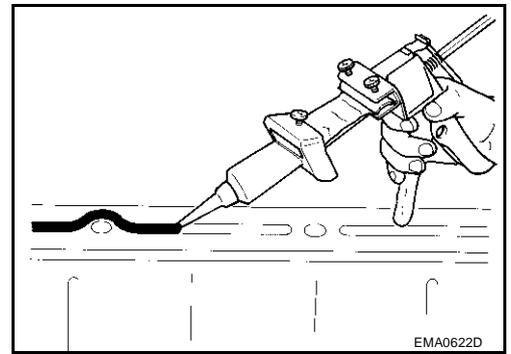
PRECAUTIONS

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3. Attach the liquid gasket tube to the tube presser [SST: WS39930000 (-)].
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.
 - As for the bolt holes, normally apply the liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of service manual.
 - Within five minutes of liquid gasket application, install the mating component.
 - If the liquid gasket protrudes, wipe it off immediately.
 - Do not retighten mounting bolts and nuts after the installation.
 - After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.

CAUTION:

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



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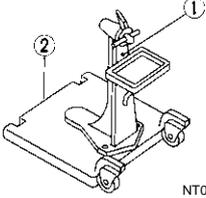
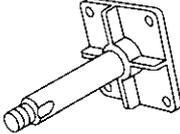
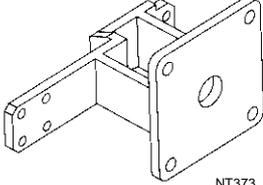
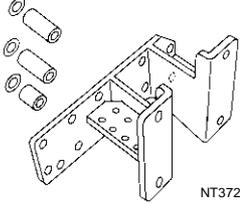
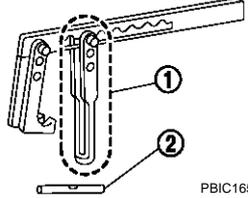
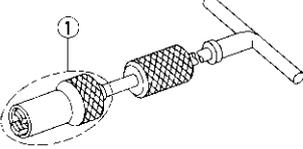
PREPARATION

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Special Service Tools

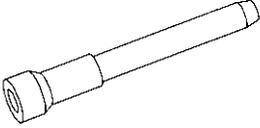
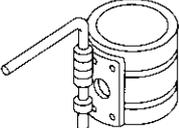
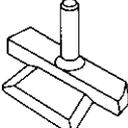
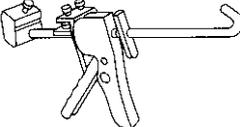
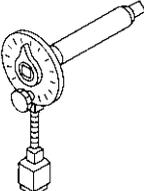
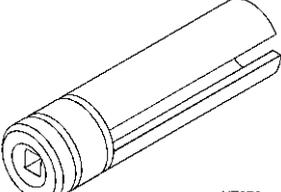
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The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

Tool number (Kent-Moore No.) Tool name	Image	Description
ST0501S000 (—) Engine stand assembly 1. ST05011000 (—) Engine stand 2. ST05012000 (—) Base	 <p style="text-align: right; font-size: small;">NT042</p>	Disassembling and assembling
KV10106500 (—) Engine stand shaft	 <p style="text-align: right; font-size: small;">NT028</p>	
KV10117000 (J-41262) Engine sub-attachment	 <p style="text-align: right; font-size: small;">NT373</p>	KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable).
KV10117001 (—) Engine sub-attachment	 <p style="text-align: right; font-size: small;">NT372</p>	Installing on the cylinder block
KV10116200 (J-26336-A) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2. KV10109220 (—) Adapter	 <p style="text-align: right; font-size: small;">PBIC1650E</p>	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 1. KV10116100 (—) Valve oil seal puller adapter	 <p style="text-align: right; font-size: small;">S-NT605</p>	Replacing valve oil seal

PREPARATION

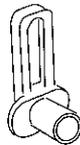
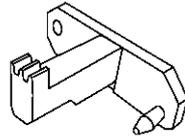
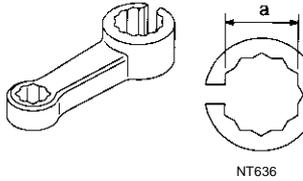
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Tool number (Kent-Moore No.) Tool name	Description	
(J-39386) Valve oil seal drift  NT024	Installing valve oil seal	A EM C
EM03470000 (J-8037) Piston ring compressor  NT044	Installing piston assembly into cylinder bore	D E
ST16610001 (J-23907) Pilot bushing puller  NT045	Removing crankshaft pilot bushing	F G
KV10111100 (J-37228) Seal cutter  NT046	Removing steel oil pan (lower and upper) and front and rear timing chain case	H I J
WS39930000 (—) Tube presser  NT052	Pressing the tube of liquid gasket	K L
KV10112100 (BT8653-A) Angle wrench  NT014	Tightening bolts for bearing cap, cylinder head, etc. in angle	M
KV10117100 (J-3647-A) Heated oxygen sensor wrench  NT379	Loosening or tightening heated oxygen sensor 2 For 22 mm (0.87 in) width hexagon nut	

PREPARATION

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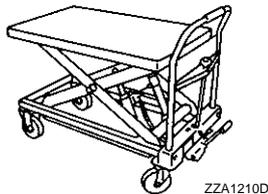
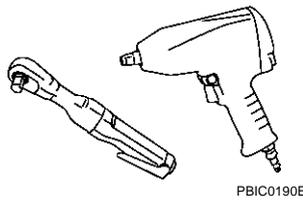
Tool number (Kent-Moore No.) Tool name	Description
KV10114400 (J-38365) Heated oxygen sensor wrench	Loosening or tightening rear heated oxygen sensor 1 a: 22 mm (0.87 in)
KV10117700 (J-44716) Ring gear stopper	Removing and installing crankshaft pulley
10006 31U00 (—) Engine rear slinger	Removing and installing oil pan (upper) for on vehicle service
— (J-45488) Quick connector release	Removing fuel tube quick connectors in engine room (Right member side) (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)



Commercial Service Tools

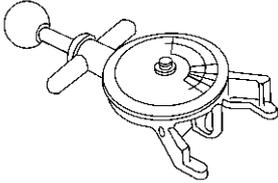
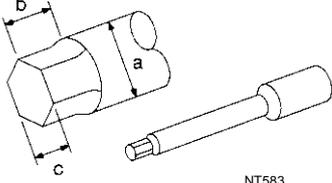
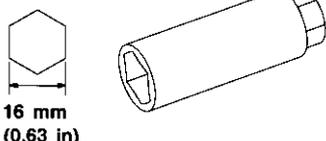
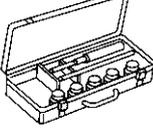
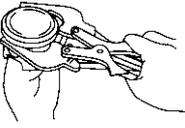
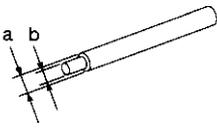
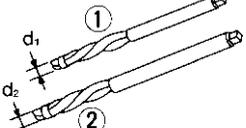
ABS004TU

(Kent-Moore No.) Tool name	Description
Power tool	Loosening bolts and nuts
Manual lift table caddy	Removing and installing engine



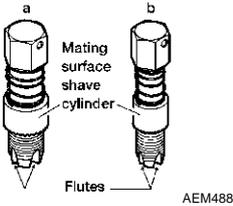
PREPARATION

[VQ35DE]

(Kent-Moore No.) Tool name	Description	A
(BT3373-F) Belt tension gauge  <small>AMA126</small>	Checking drive belt tension	EM C
(J-24239-01) Cylinder head bolt wrench  <small>NT583</small>	Loosening and tightening cylinder head bolt, and used with angle wrench [SST: KV10112100 (BT8653-A)] a: 13 (0.51) dia. b: 12 (0.47) c: 10 (0.39) Unit: mm (in)	D E
Spark plug wrench  <small>NT047</small>	Removing and installing spark plug	F G
Valve seat cutter set  <small>NT048</small>	Finishing valve seat dimensions	H I J
Piston ring expander  <small>NT030</small>	Removing and installing piston ring	K L
Valve guide drift  <small>NT015</small>	Removing and installing valve guide Intake & Exhaust a: 9.5 mm (0.374 in) dia. b: 5.5 mm (0.217 in) dia.	M
Valve guide reamer  <small>NT016</small>	Reaming valve guide with (1) or hole for oversize valve guide with (2) Intake & Exhaust d1 : 6.0 mm (0.236 in) dia. d2: 10.2 mm (0.402 in) dia.	

PREPARATION

[VQ35DE]

(Kent-Moore No.) Tool name	Description
<p>(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner</p> 	<p>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</p>
<p>Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)</p> 	<p>Lubricating heated oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>

A

EM

C

D

E

F

G

H

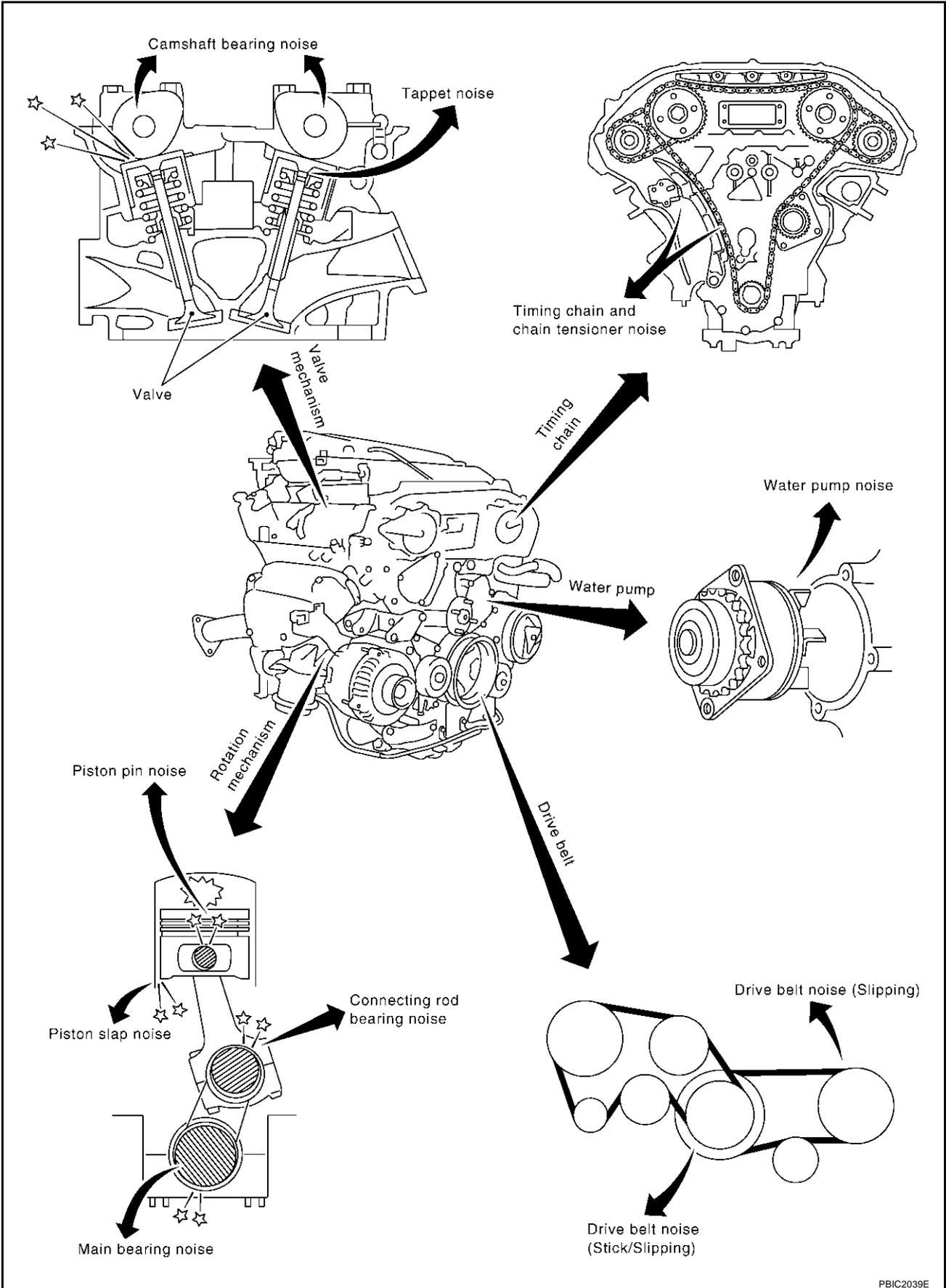
I

J

K

L

M



PBIC2039E

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

[VQ35DE]

ABS004TW

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

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-87
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft runout Camshaft journal clearance	EM-82 EM-82
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin oil clearance Connecting rod bushing oil clearance (Small end)	EM-134 EM-136
	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-138 EM-135 EM-135 EM-135
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance (Small end) Connecting rod bearing oil clearance (Big end)	EM-136 EM-140
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-141 EM-140
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-61
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-15
	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-21 "WATER PUMP"

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

DRIVE BELTS

PFP:02117

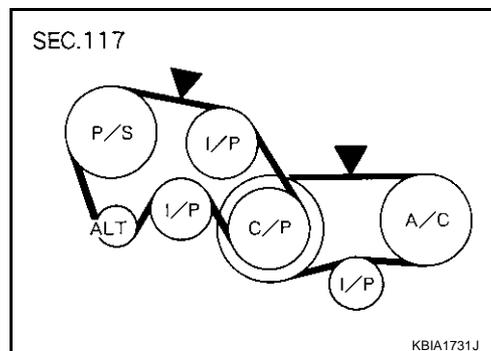
Checking Drive Belts

ABS004TX

WARNING:

Be sure to perform when engine is stopped.

1. Inspect belts for cracks, fraying, wear and oil. If necessary, replace.
2. Inspect drive belt deflection or tension at a point on the belt mid-way between pulleys.
 - Inspection should be done only when engine is cold, or over 30 minutes after engine is stopped.
 - Measure belt tension with belt tension gauge (Commercial Service Tool: BT3373-F or equivalent) at points marked ▼ shown in the figure.
 - When measuring deflection, apply 98 N (10 kg, 22 lb) at the ▼ marked point.
 - Adjust if belt deflection exceeds the limit or if belt tension is not within specifications.



CAUTION:

- **When checking belt deflection or tension immediately after installation, first adjust it to the specified value. Then, after turning the crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.**
- **Tighten idler pulley lock nut by hand and measure deflection or tension without looseness.**

Belt Deflection and Tension

Items	Deflection adjustment		Unit: mm (in)	Tension adjustment*		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator and power steering oil pump belt	7 (0.28)	4 - 5 (0.16 - 0.20)	3.5 - 4.5 (0.138 - 0.177)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
Air conditioner compressor belt	12 (0.47)	9 - 10 (0.35 - 0.39)	8 - 9 (0.31 - 0.35)	196 (20, 44)	348 - 436 (35.5 - 44.5, 78 - 98)	470 - 559 (48 - 57, 106 - 126)
Applied pushing force	98 N (10 kg, 22 lb)			—		

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

Tension Adjustment

ABS004TY

Portion	Belt tightening method for adjustment
Alternator and power steering oil pump belt	Adjusting bolt on idler pulley
Air conditioner compressor belt	Adjusting bolt on idler pulley

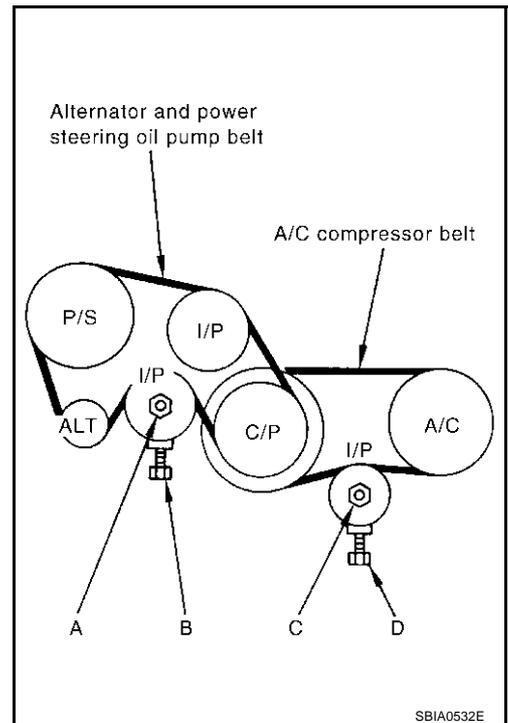
CAUTION:

- **When belt is replaced with a new one, adjust it to value for “New belt” to accommodate for insufficient adaptability with pulley grooves.**
- **When deflection or tension of belt being used exceeds “Limit”, adjust it to value for “After adjustment of used belt”.**
- **When checking belt deflection or tension immediately after installation, first adjust it to the specified value. Then, after turning the crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.**
- **When installing belt, make sure that it is correctly engaged with pulley grooves.**
- **Keep engine oil, working fluid and engine coolant away from belt and pulley grooves.**
- **Do not twist or bend belt excessively.**

ALTERNATOR AND POWER STEERING OIL PUMP BELT

1. Remove front engine undercover with power tool.
2. Loosen idler pulley lock nut (A) and adjust tension by turning adjusting bolt (B).
 - For specified belt tension, refer to [EM-15, "Checking Drive Belts"](#).
3. Tighten nut (A).

: 34.8 N-m (3.5 kg-m, 26 ft-lb)



AIR CONDITIONER COMPRESSOR BELT

1. Remove front engine undercover with power tool.
2. Loosen idler pulley lock nut (C) and adjust tension by turning adjusting bolt (D).
 - For specified belt tension, refer to [EM-15, "Checking Drive Belts"](#).
3. Tighten nut (C).

: 34.8 N-m (3.5 kg-m, 26 ft-lb)

Removal and Installation

REMOVAL

1. Remove front engine undercover with power tool.
2. Remove alternator and power steering oil pump belt. Refer to [EM-16, "ALTERNATOR AND POWER STEERING OIL PUMP BELT"](#).
3. Remove air conditioner compressor belt. Refer to [EM-16, "AIR CONDITIONER COMPRESSOR BELT"](#).

CAUTION:

Grease is applied to idler pulley adjusting bolt. Be careful to keep grease away from belt.

INSTALLATION

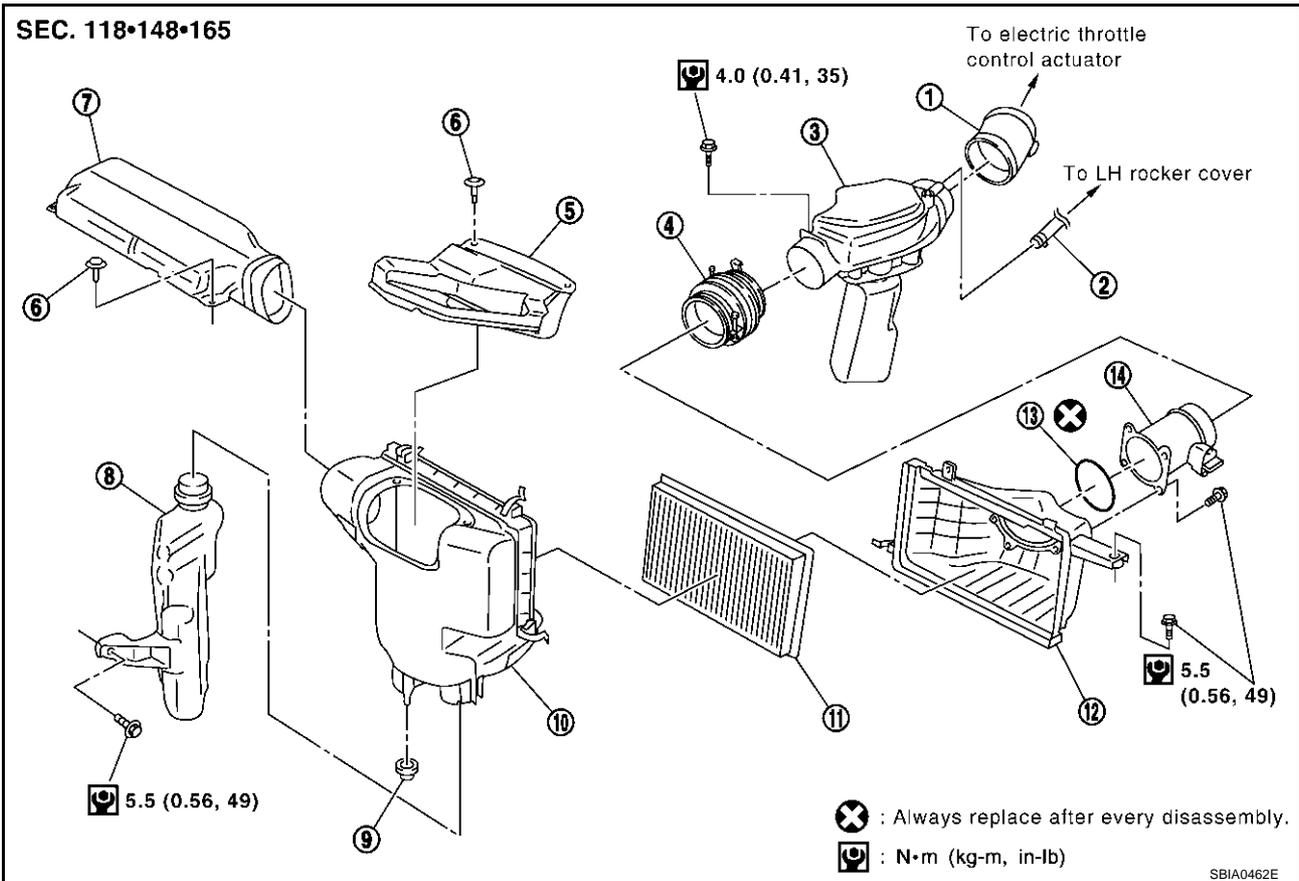
1. Install belts to pulley in reverse order of removal.
 - CAUTION:**
 - Make sure belt is correctly engaged with the pulley groove.
 - Check for engine oil and engine coolant are not adhered to belt and each pulley grooves.
2. Adjust belt tension. Refer to [EM-15, "Tension Adjustment"](#).
3. Tighten each adjusting bolt and nut to the specified torque.
4. Make sure that tension of each belt is within the standard. Refer to [EM-15, "Checking Drive Belts"](#).

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

ABS004U0



- | | | |
|----------------------|--------------------------|----------------------|
| 1. Air hose | 2. PCV hose | 3. Air duct |
| 4. Air hose | 5. Power duct | 6. Clip |
| 7. Air duct (Inlet) | 8. Resonator | 9. Grommet |
| 10. Air cleaner case | 11. Air cleaner filter | 12. Air cleaner case |
| 13. O-ring | 14. Mass air flow sensor | |

REMOVAL

- Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
 - This work is unnecessary when parts located forward of mass air flow sensor are removed/installed.
- Remove air duct (inlet).
- Disconnect the mass air flow sensor harness connector.
- Disconnect PCV hose.
- Remove air cleaner case/mass air flow sensor and air duct disconnecting their joints.
 - Add marks as necessary for easier installation.
- Remove mass air flow sensor from air cleaner case.

CAUTION:

Handle mass air flow sensor with care.

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

- Remove resonator in the fender, lifting left fender protector.

INSTALLATION

Install in the reverse order of removal paying attention to the following.

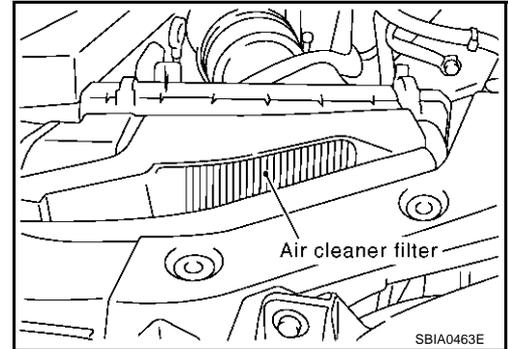
- Align marks. Attach each joint. Screw clamps firmly.

- To position air cleaner case, refer to [EM-18, "Changing Air Cleaner Filter"](#).

Changing Air Cleaner Filter INSPECTION

ABS004U1

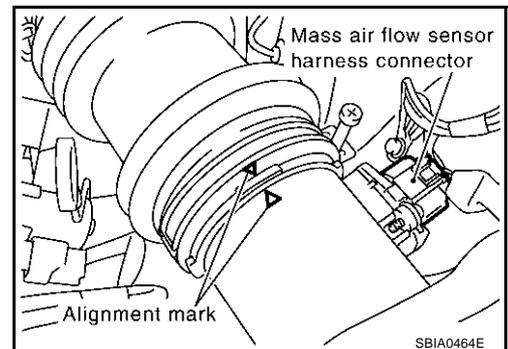
Check status (fouling, damage, etc.) of air cleaner filter at power duct hole.



REMOVAL

Removal in the order below.

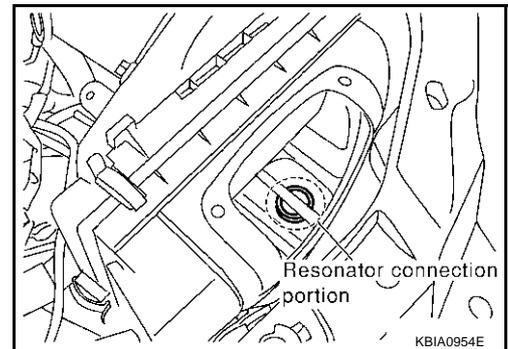
1. Remove air duct (inlet) from air cleaner case.
2. Disconnect harness connector from mass air flow sensor.
3. Loosen clamp bolts of air hose.
4. Remove mounting bolts for air cleaner case. Remove air cleaner case/mass air flow sensor/air hose assembly.
5. Unclip and open air cleaner case, and remove air cleaner filter.



INSTALLATION

Install in the reverse order of removal paying attention to the following.

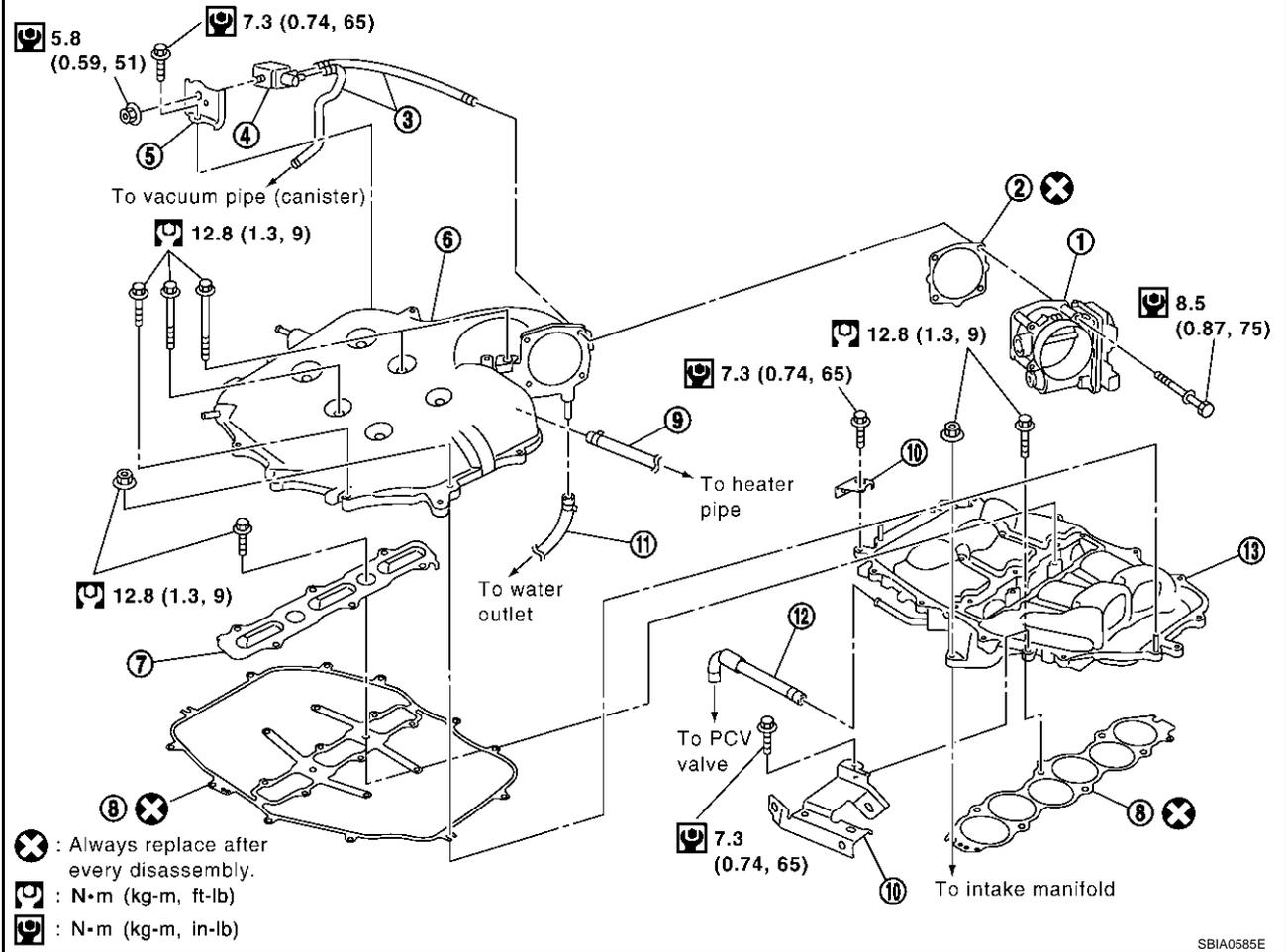
- If grommet at bottom of air cleaner case comes off together with air cleaner case, fix it to vehicle before installation.
- Look at internal bottom face through power duct hole, and position air cleaner case with resonator upper end circle and air cleaner case round hole aligned. Then push air cleaner case straight down.
- At this time, check by hand if protrusion at bottom of air cleaner case has been inserted into grommet on vehicle side.
- Clip power duct with bulge on reverse side of lower end engaged with air cleaner case.



INTAKE MANIFOLD COLLECTOR

Removal and Installation

SEC. 140•147•163



- | | | |
|--|----------------|--------------------------------------|
| 1. Electric throttle control actuator | 2. Gasket | 3. Vacuum hose |
| 4. EVAP canister purge volume control solenoid valve | 5. Bracket | 6. Intake manifold collector (upper) |
| 7. Intake manifold collector cover | 8. Gasket | 9. Water hose |
| 10. Bracket | 11. Water hose | 12. PCV hose |
| 13. Intake manifold collector (lower) | | |

REMOVAL

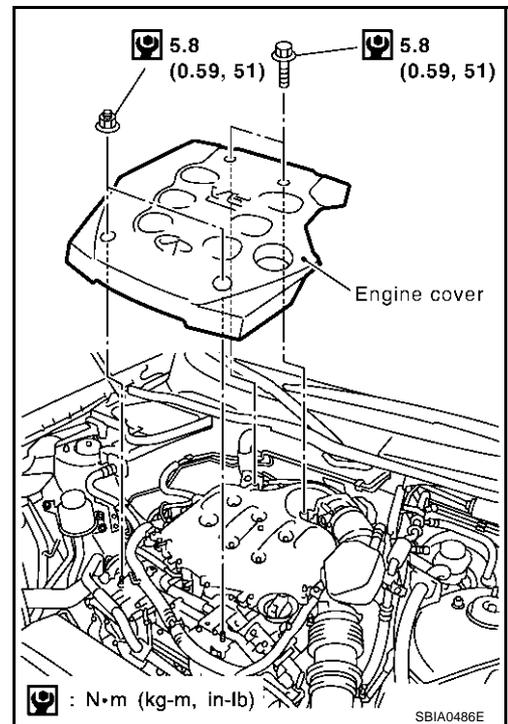
WARNING:

- To avoid the danger of being scalded, never drain engine coolant when engine is hot.
- Gasket for intake manifold collector (upper) is secured together with mounting bolt for intake manifold collector (lower). Thus, even when only gasket for upper side is replaced, gasket for lower side must be also replaced.

INTAKE MANIFOLD COLLECTOR

[VQ35DE]

1. Remove engine cover with power tool.



2. Disconnect water hoses from intake manifold collector (upper), attach blind plug to prevent engine coolant leakage.

CAUTION:

Perform when engine is cold.

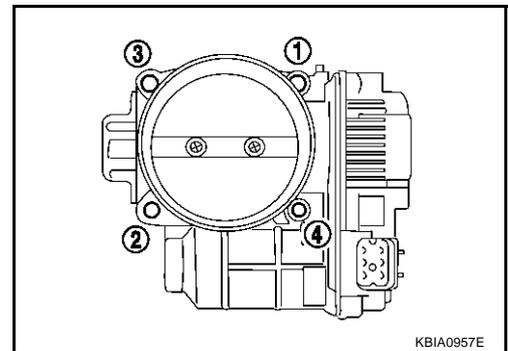
3. Remove air cleaner case and air duct. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#).

4. Remove electric throttle control actuator.

- Loosen bolts in the reverse order of that shown in the figure.

CAUTION:

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

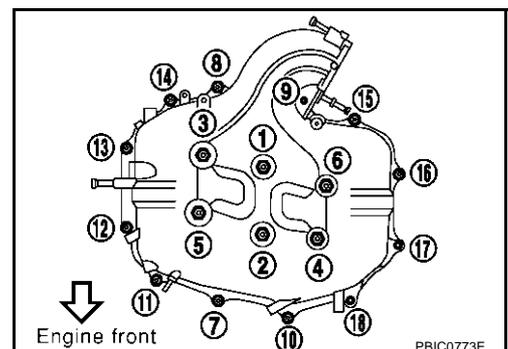


5. Remove fuel sub-tube mounting bolt to disconnect from rear of intake manifold collector (lower). Refer to [EM-43, "FUEL INJECTOR AND FUEL TUBE"](#).

6. Disconnect vacuum hose and water hose from intake manifold collector (upper).

7. Remove EVAP canister purge volume control solenoid valve bracket mounting bolt from intake manifold collector (upper).

8. Loosen bolts in reverse order as shown in the figure to remove intake manifold collector (upper) with power tool.



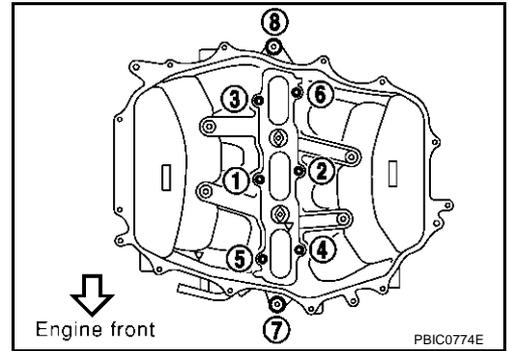
INTAKE MANIFOLD COLLECTOR

[VQ35DE]

- Remove PCV hose [between intake manifold collector and rocker cover (right bank)].
- Loosen bolts in reverse order as shown in the figure, and remove intake manifold collector cover, gasket, intake manifold collector (lower) and gasket with power tool.

CAUTION:

Cover engine openings to avoid entry of foreign materials.



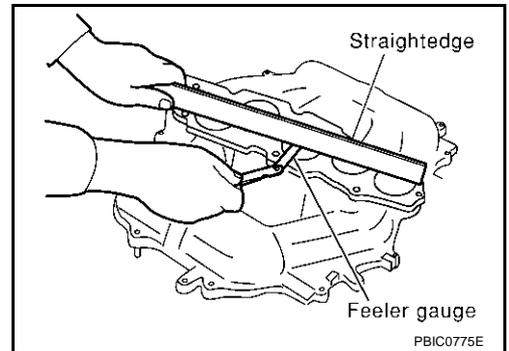
INSPECTION AFTER REMOVAL

Surface Distortion

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

Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace intake manifold collector (upper and/or lower).

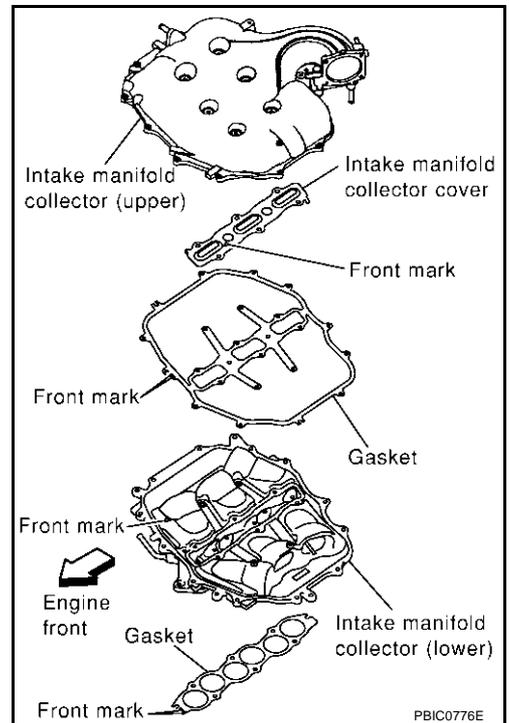


INSTALLATION

Install in the reverse order of removal paying attention to the following.

Part Installation Direction

Referring to front marks, install parts shown in figure.

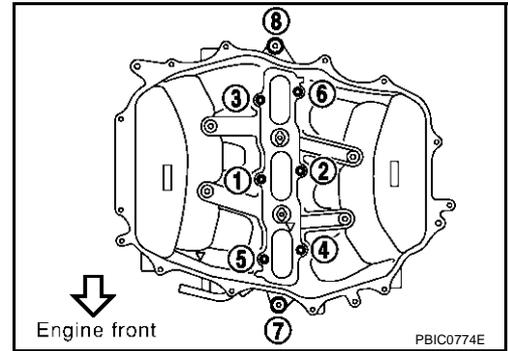


Intake Manifold Collector (Lower)

Tighten in numerical order as shown in the figure.

NOTE:

Tighten mounting bolts to secure gasket (lower), intake manifold collector (lower), gasket (upper), and intake manifold collector cover.



Intake Manifold Collector (Upper)

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

 : 5.9 N·m (0.6 kg-m, 52 in-lb)

- Shank length under bolt head varies with bolt location. Install bolts while referring to numbers shown below and in figure. (Bolt length does not include pilot portion.)

Bolt

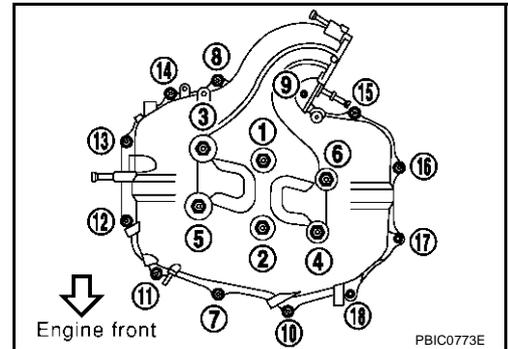
M6 × 25 mm (0.98 in) : 7, 8, 10, 11, 13, 14, 15, 16, 18

M6 × 45 mm (1.77 in) : 2, 4, 5

M6 × 60 mm (2.36 in) : 1, 3, 6, 9

M6 Nut : 12, 17

- Tighten in numerical order as shown in the figure.

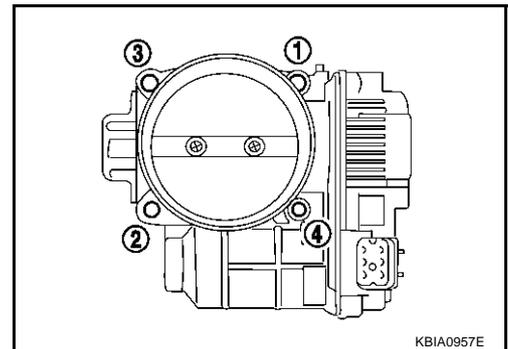


Water Hose

- Insert hose by 27 to 32 mm (1.06 to 1.26 in) from connector end.
- Clamp hose at location of 3 to 7 mm (0.12 to 0.28 in) from hose end.

Electric Throttle Control Actuator

- Install gasket with three protrusions for installation check facing any direction other than upward.
- Tighten in numerical order as shown in the figure.
- Perform the "Throttle Valve Closed Position Learning" when harness connector of electric throttle control actuator is disconnected. Refer to [EC-63, "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-63, "Idle Air Volume Learning"](#).

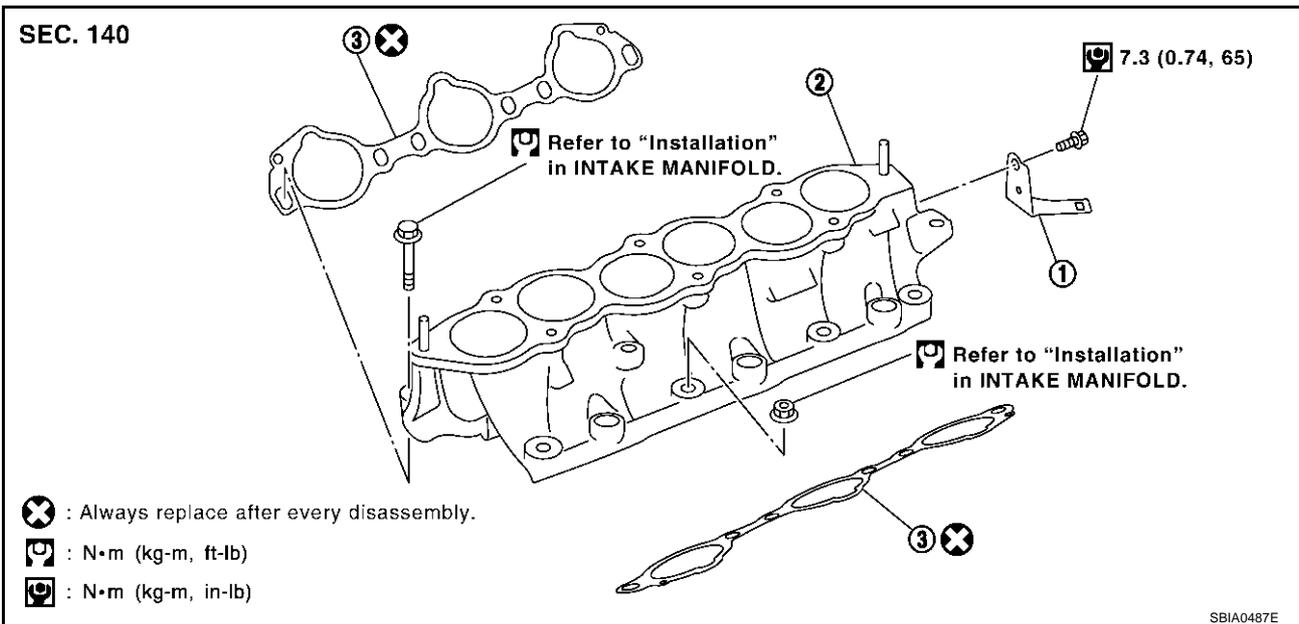


INTAKE MANIFOLD

PFP:14003

Removal and Installation

ABS004U3



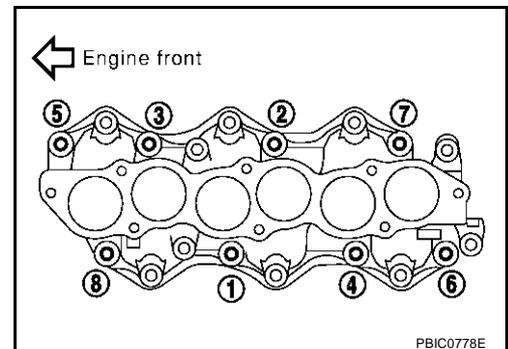
1. Harness bracket

2. Intake manifold

3. Gasket

REMOVAL

1. Release fuel pressure. Refer to [EC-65, "FUEL PRESSURE RELEASE"](#).
2. Remove intake manifold collector (upper and lower). Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
3. Remove fuel tube and fuel injector assembly. Refer to [EM-43, "FUEL INJECTOR AND FUEL TUBE"](#).
4. Loosen bolts and nuts in reverse order of illustration to remove intake manifold assembly with power tool.



5. Remove intake manifold gaskets.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

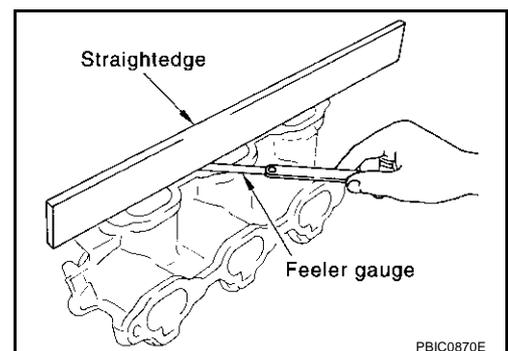
INSPECTION AFTER REMOVAL

Surface Distortion

- Using straightedge and feeler gauge, inspect the surface distortion of each surface on intake manifold.

Limit : 0.1 mm (0.04 in)

- If it exceeds the limit, replace intake manifold.



INSTALLATION

Install in the reverse order of removal paying attention to the following.

Intake Manifold

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

 : 10.8 N·m (1.1 kg-m, 8 ft-lb)

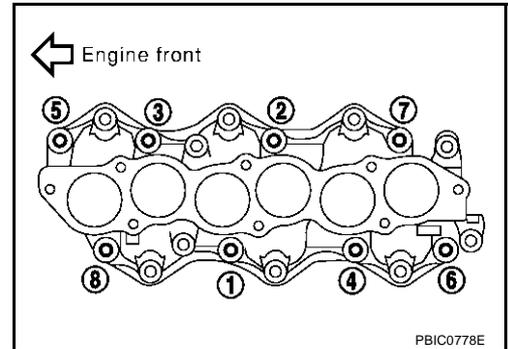
- Tighten all mounting bolts and nuts to specified torque in two or more steps in numerical order shown in figure.

1st step:

 : 7.4 N·m (0.75 kg-m, 5 ft-lb)

2nd step:

 : 29.0 N·m (3.0 kg-m, 21 ft-lb)

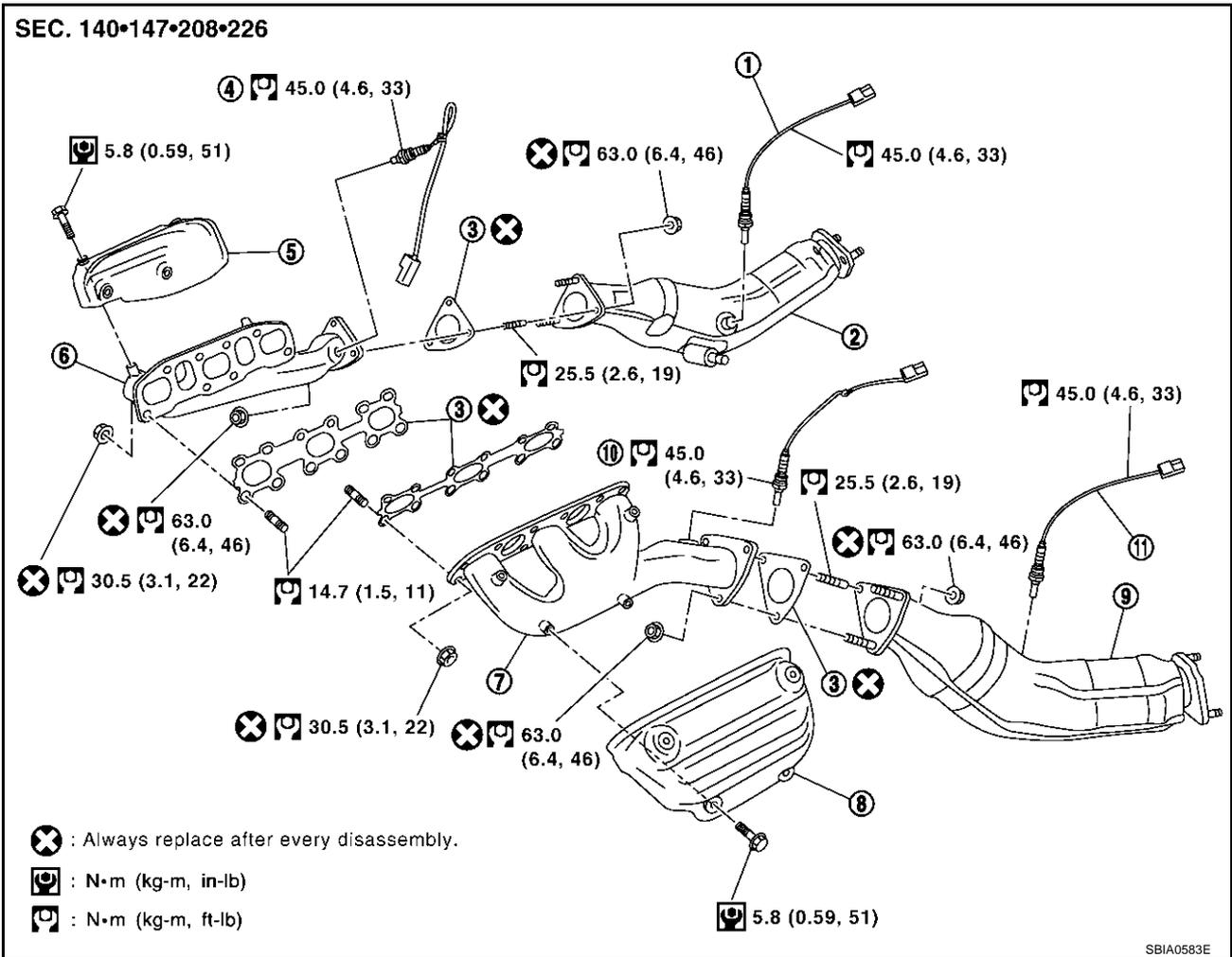


EXHAUST MANIFOLD AND THREE WAY CATALYST

PF14004

Removal and Installation

ABS004U4



- | | | |
|-------------------------------------|--|-----------------------------------|
| 1. Heated oxygen sensor 2 (bank 1) | 2. Three way catalyst (right bank) | 3. Gasket |
| 4. heated oxygen sensor 1 (bank 1) | 5. Exhaust manifold cover (right bank) | 6. Exhaust manifold (right bank) |
| 7. Exhaust manifold (left bank) | 8. Exhaust manifold cover (left bank) | 9. Three way catalyst (left bank) |
| 10. heated oxygen sensor 1 (bank 2) | 11. Heated oxygen sensor 2 (bank 2) | |

REMOVAL

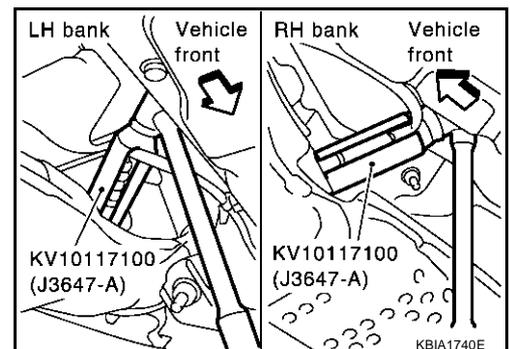
WARNING:

Perform the work when the exhaust and cooling system have completely cooled down.

- Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
- Remove air cleaner case and air duct. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#).
- Remove front and rear engine undercover and front cross bar with power tool.
- Disconnect heated oxygen sensors 2 (bank 1 and bank 2) harness connectors.
- Using heated oxygen sensor wrench (SST), remove heated oxygen sensors 2 (bank 1 and bank 2).

CAUTION:

- Be careful not to damage heated oxygen sensor.
 - Discard any heated oxygen sensor which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.
- Remove bracket between right/left catalytic converter and transmission. Refer to [EX-3, "EXHAUST SYSTEM"](#).



EXHAUST MANIFOLD AND THREE WAY CATALYST

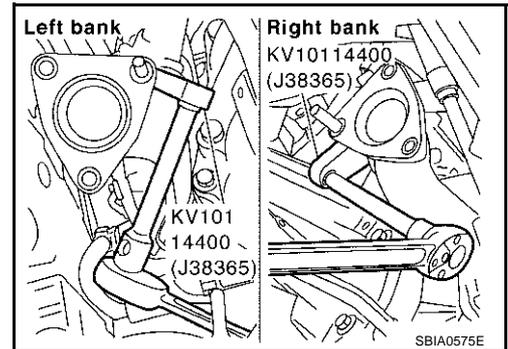
[VQ35DE]

- Remove three way catalyst (RH and LH bank).
- Remove heated oxygen sensors 1 (bank 1 and bank 2) harness connectors and harness clip.
- Using heated oxygen sensor wrench (SST), remove heated oxygen sensors 1 (bank 1 and bank 2).

CAUTION:

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

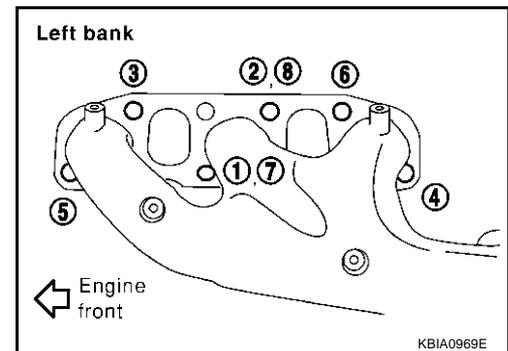
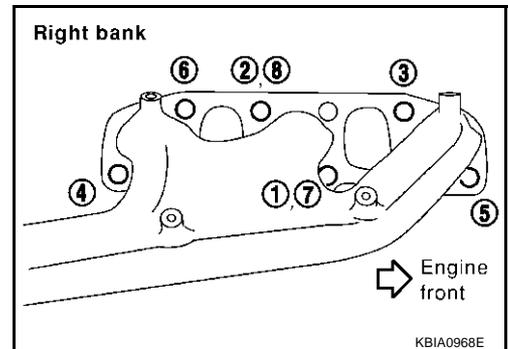
- Remove water pipes on both RH and LH side. Refer to [CO-27](#), "[WATER OUTLET AND WATER PIPING](#)".



- Remove exhaust manifold cover (RH and LH bank).
- Loosen nuts in the reverse order as shown in the figure to remove exhaust manifold with power tool.

NOTE:

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



- Remove exhaust manifold gaskets.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

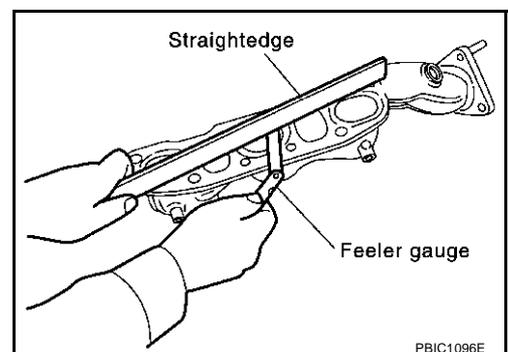
INSPECTION AFTER REMOVAL

Surface Distortion

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

Limit : 0.3 mm (0.012 in)

- If it exceeds the limit, replace exhaust manifold.

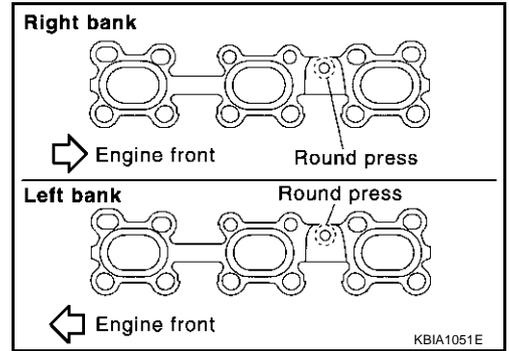


INSTALLATION

Install in the reverse order of removal paying attention to the following.

Exhaust Manifold Gasket

- Install in direction shown below. (Follow same procedure for both banks.)
- Locate thick side of port connecting part on right side from technician's view.
- Locate round press in thick side of port connecting part above center level line of port.

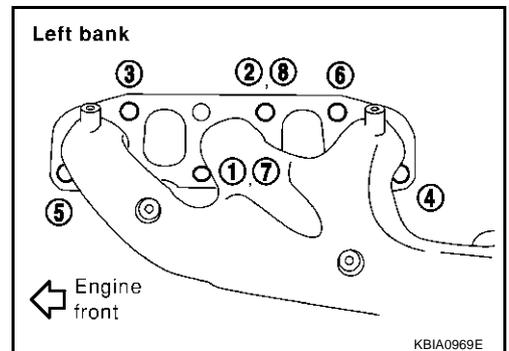
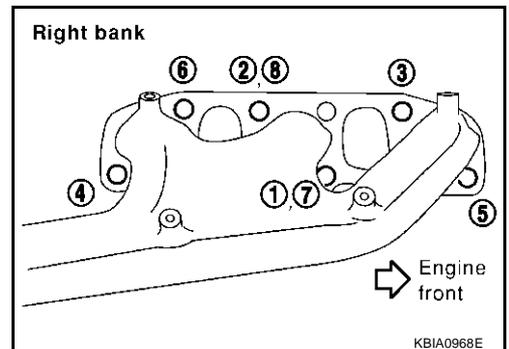


Exhaust Manifold

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

 : 14.7 N·m (1.5 kg·m, 11 ft·lb)

- Install exhaust manifold in the numerical order as shown in the figure.
- Tighten nuts No. 1 and No. 2 in two steps. The numerical order No. 7 and No. 8 shows second step.



Heated Oxygen Sensor

CAUTION:

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

CAUTION:

Perform when engine is cold.

7. Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#) .
8. Remove air hose from air duct to mass air flow sensor side and electric throttle control actuator side. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#) .
9. Removal engine rear lower slinger, and install engine rear slinger to sling engine assembly for positioning. Refer to [EM-8, "Special Service Tools"](#) .

Slinger bolts:

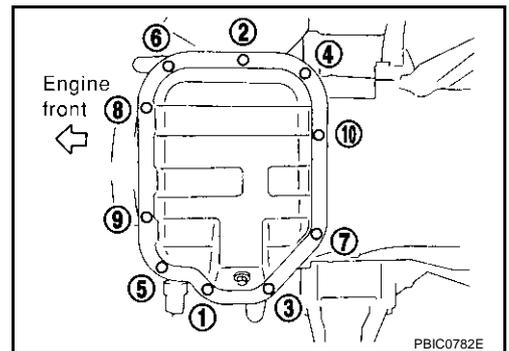
 : 28.0 N-m (2.9 kg-m, 21 ft-lb)

10. Remove front suspension member. Refer to [FSU-17, "FRONT SUSPENSION MEMBER"](#) .
11. Remove drive belt for alternator and power steering pump and A/C compressor. Refer to [EM-15, "DRIVE BELTS"](#) .
12. Remove alternator stay. Refer to [SC-23, "CHARGING SYSTEM"](#) .
13. Remove starter motor. Refer to [SC-10, "STARTING SYSTEM"](#) .
14. Remove alternator and power steering pump and A/C compressor idler pulley and bracket assembly. Refer to [EM-15, "DRIVE BELTS"](#) .
15. Disconnect A/T fluid cooler hoses, and remove oil cooler water pipe mounting bolt. Refer to [LU-14, "OIL COOLER"](#) .
16. Disconnect A/T fluid cooler tube.
17. Remove crankshaft position sensor (POS).

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.

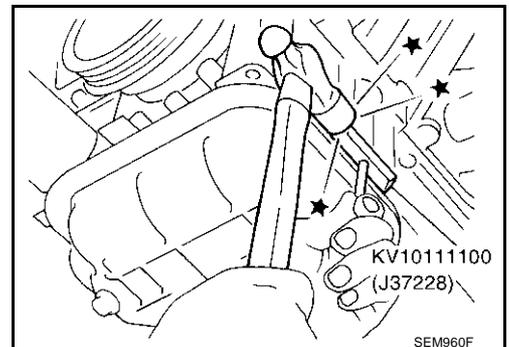
18. Remove oil filter, as necessary. Refer to [LU-10, "OIL FILTER"](#) .
19. Remove oil cooler, as necessary. Refer to [LU-14, "OIL COOLER"](#) .
20. Remove oil pan (lower) as the following:
 - a. Loosen bolts in reverse order as shown in the figure to remove.



- b. Insert seal cutter (SST) between oil pan (upper) and oil pan (lower).
 - c. Slide seal cutter by tapping on the side of tool with hammer. Remove oil pan (lower).

CAUTION:

- Be careful not to damage the mating surface.
- Do not insert flat-bladed screwdriver, this will damage the mating surface.



21. Remove oil strainer.

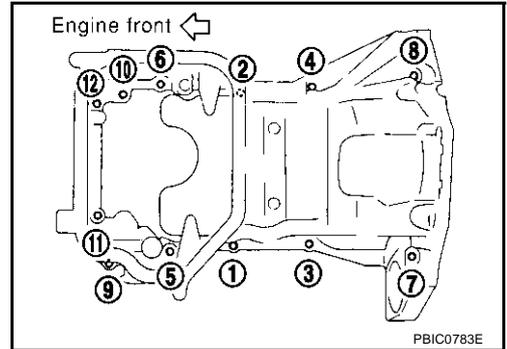
OIL PAN AND OIL STRAINER

[VQ35DE]

22. Remove transmission joint bolts which pierce oil pan (upper). Refer to [AT-269, "TRANSMISSION ASSEMBLY"](#).
23. Remove rear cover plate.
24. Loosen oil pan (upper) bolts with power tool in the reverse order as shown in the figure to remove.
 - Insert seal cutter [SST: KV10111100 (J-37228)] between oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of the tool with a hammer. Remove oil pan (upper).

CAUTION:

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



INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

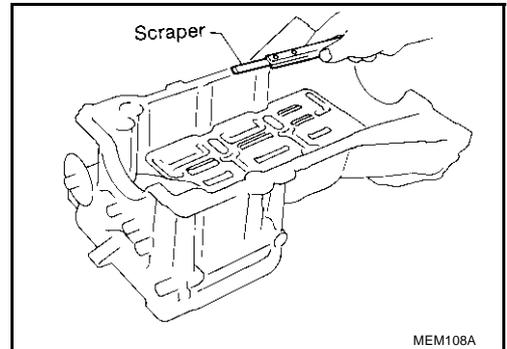
INSTALLATION

1. Install oil pan (upper) as the following:
 - a. Use scraper to remove old liquid gasket from mating surfaces.

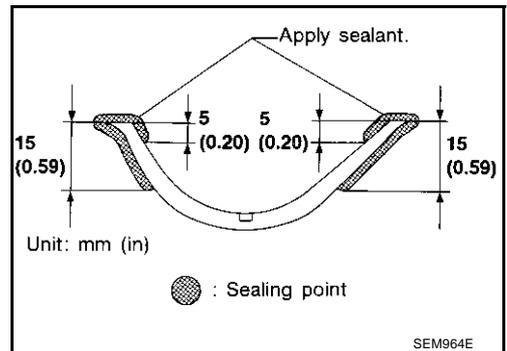
CAUTION:

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

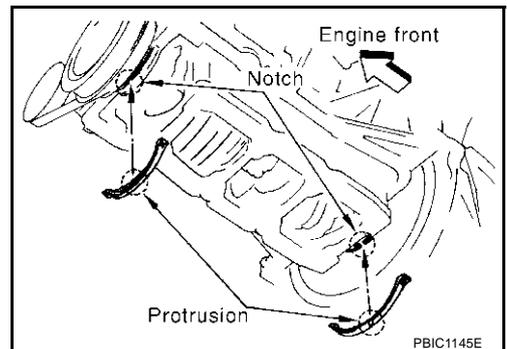
- Also remove old liquid gasket from mating surface of cylinder block.
- Remove old liquid gasket from the bolt holes and threads.



- b. Apply liquid gasket to oil pan gaskets as shown in the figure. **Use Genuine RTV Silicone Sealant or equivalent. Refer to Refer to Service Manual .**



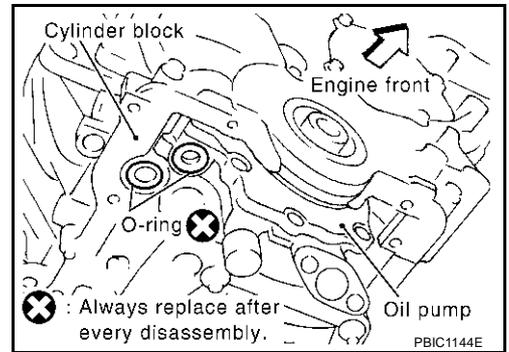
- To install, align protrusion of oil pan gasket with notches of front timing chain case and rear oil seal retainer.
- Install oil pan gasket with smaller arc to front timing chain case side.



OIL PAN AND OIL STRAINER

[VQ35DE]

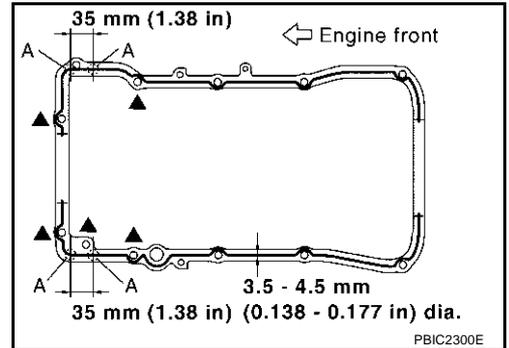
c. Install new O-rings on cylinder block and oil pump side.



d. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 (-)] to the cylinder block mating surface of oil pan (upper) to a limited portion as shown in the figure. **Use Genuine RTV Silicone Sealant or equivalent. Refer to Refer to Service Manual .**

CAUTION:

- For bolt holes with ▲ marks (5 locations), apply liquid gasket outside the holes.
- 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.



e. Install oil pan (upper).

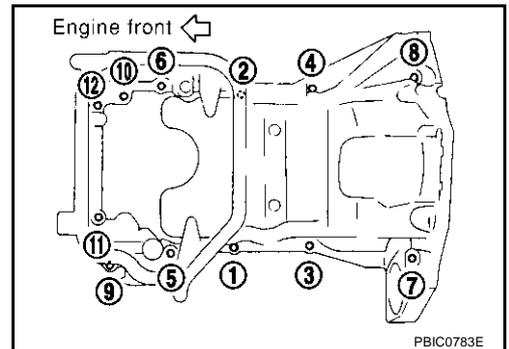
CAUTION:

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

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

M8 × 100 mm (3.97 in) : 5, 7, 8, 11

M8 × 25 mm (0.98 in) : Except the above



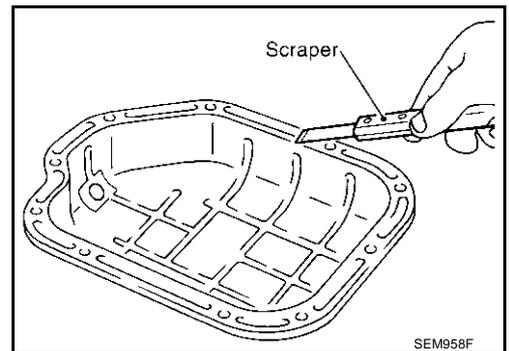
f. Tighten transmission joint bolts. Refer to Refer to Service Manual .

2. Install oil strainer to oil pump.

3. Install oil pan (lower) as the following:

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

- Also remove old liquid gasket from mating surface of oil pan (upper).



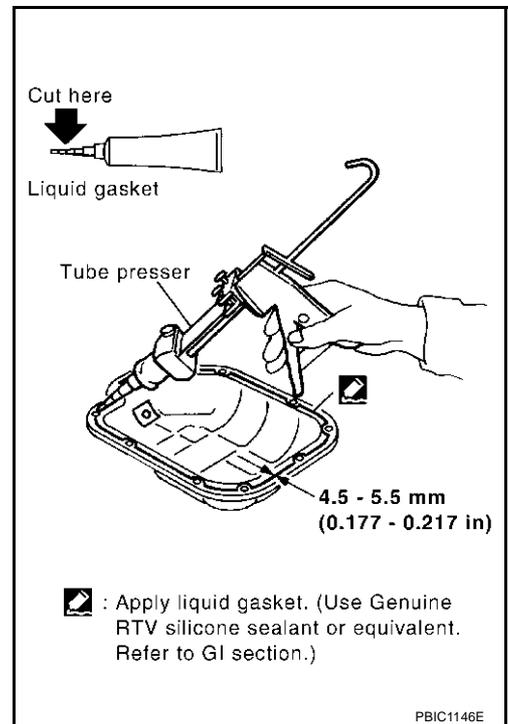
OIL PAN AND OIL STRAINER

[VQ35DE]

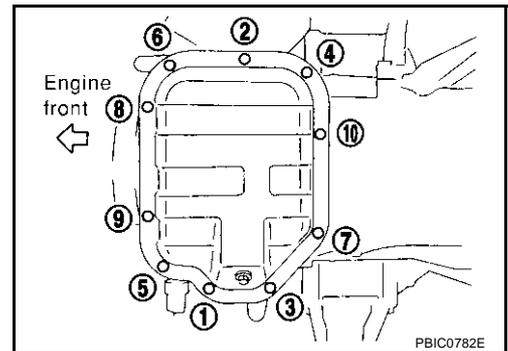
- b. Apply liquid gasket thoroughly with tube presser [SST: WS39930000 (-)] as in illustration.
Use Genuine RTV Silicone Sealant or equivalent. Refer to Refer to Service Manual .

NOTE:

Attaching should be done within 5 minutes after coating.



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



4. Install oil pan drain plug.
● Refer to illustration of components of former page for installation direction of washer.
5. Install in the reverse order of removal after this step.

NOTE:

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

INSPECTION AFTER INSTALLATION

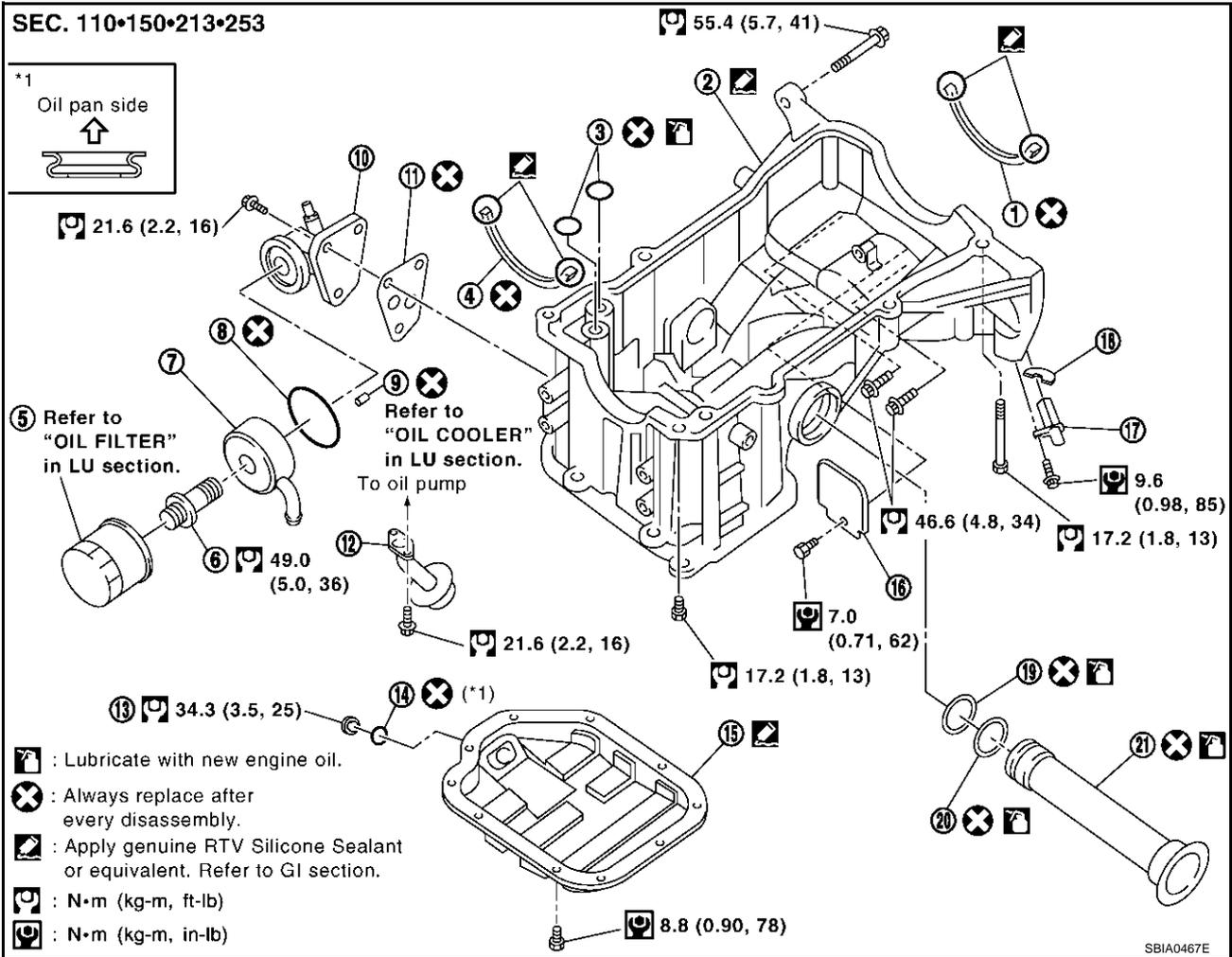
1. Check engine oil level and add engine oil. Refer to [LU-7, "ENGINE OIL"](#) .
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-7, "ENGINE OIL"](#) .

OIL PAN AND OIL STRAINER

[VQ35DE]

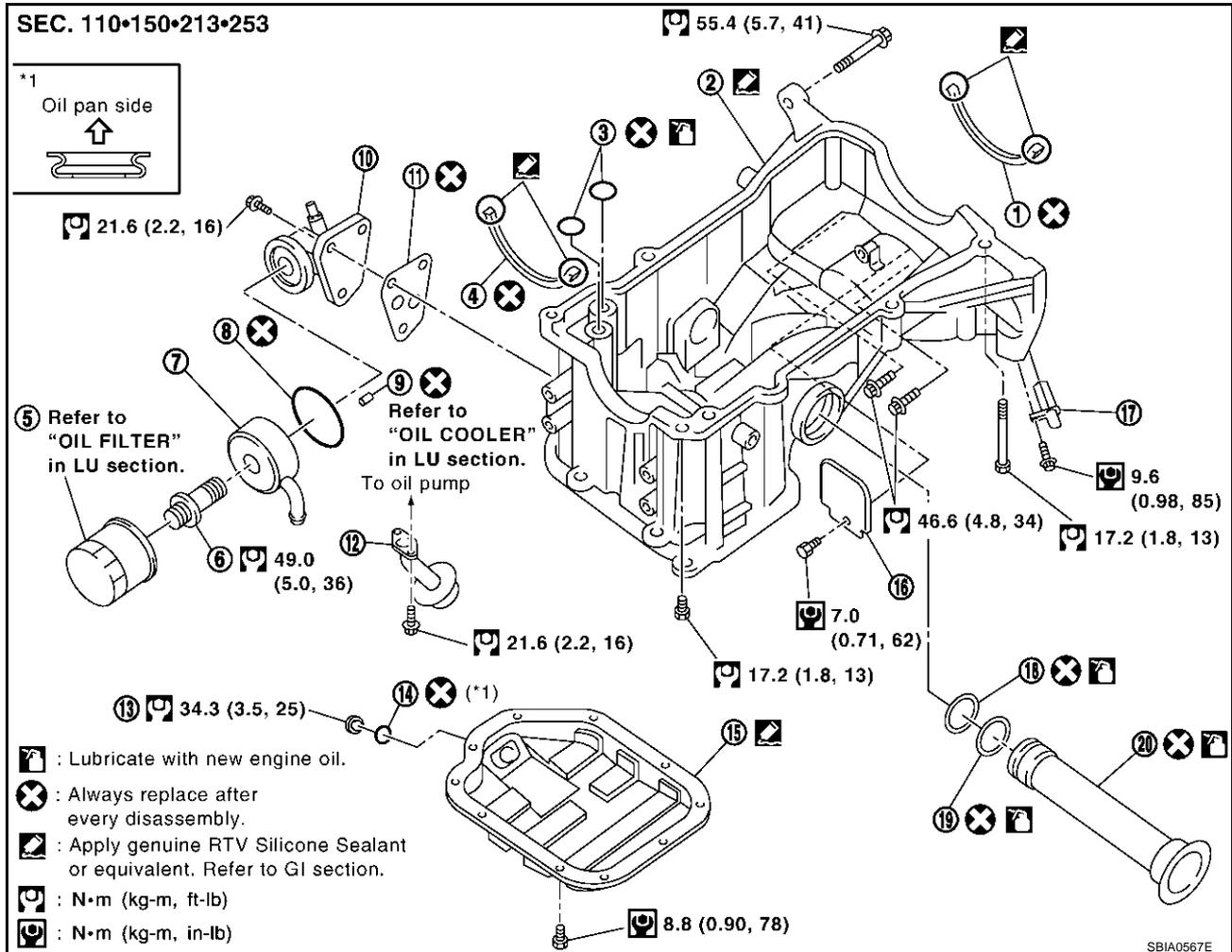
AWD MODEL

Models Produced Before May 2003



- | | | |
|---------------------------|--------------------------------------|---------------------|
| 1. Oil pan gasket (Rear) | 2. Oil pan (Upper) | 3. O-ring |
| 4. Oil pan gasket (Front) | 5. Oil filter | 6. Connector bolt |
| 7. Oil cooler | 8. O-ring | 9. Relief valve |
| 10. Oil filter bracket | 11. Oil filter bracket gasket | 12. Oil strainer |
| 13. Drain plug | 14. Drain plug washer | 15. Oil pan (Lower) |
| 16. Rear plate | 17. Crankshaft position sensor (POS) | 18. Seal rubber |
| 19. O-ring (Small) | 20. O-ring (Large) | 21. Axle pipe |

Models Produced After June 2003



- | | | |
|---------------------------|--------------------------------------|---------------------|
| 1. Oil pan gasket (Rear) | 2. Oil pan (Upper) | 3. O-ring |
| 4. Oil pan gasket (Front) | 5. Oil filter | 6. Connector bolt |
| 7. Oil cooler | 8. O-ring | 9. Relief valve |
| 10. Oil filter bracket | 11. Oil filter bracket gasket | 12. Oil strainer |
| 13. Drain plug | 14. Drain plug washer | 15. Oil pan (Lower) |
| 16. Rear plate | 17. Crankshaft position sensor (POS) | 18. O-ring (Small) |
| 19. O-ring (Large) | 20. Axle pipe | |

REMOVAL

CAUTION:

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

NOTE:

To remove oil pan (lower) only, take step 5, then step 24. Removal of step 1, hood assembly (step 2) and step 4 are unnecessary.

1. Remove front tire.
2. Remove hood assembly. Refer to [BL-14, "HOOD"](#) .
3. Remove front and rear engine undercover with power tool.
4. Remove front cross bar with power tool. Refer to [FSU-17, "FRONT SUSPENSION MEMBER"](#) .
5. Drain engine oil. Refer to [LU-9, "Changing Engine Oil"](#) .
6. Drain engine coolant. Refer to [CO-11, "Changing Engine Coolant"](#) .

CAUTION:

Perform when engine is cold.

7. Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#) .

OIL PAN AND OIL STRAINER

[VQ35DE]

8. Remove air hose from air duct to mass air flow sensor side and electric throttle control actuator side. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#) .
9. Remove drive belt for alternator and power steering pump and A/C compressor. Refer to [EM-15, "DRIVE BELTS"](#) .
10. Remove front drive shaft (LH and RH) and side shaft. Refer to [FAX-12, "FRONT DRIVE SHAFT"](#) .
11. Remove side shaft. Refer to [FFD-10, "FRONT FINAL DRIVE ASSEMBLY"](#) .
12. Removal engine rear lower slinger, and install engine rear slinger to sling engine assembly for positioning. Refer to [EM-8, "Special Service Tools"](#) .

Slinger bolts:

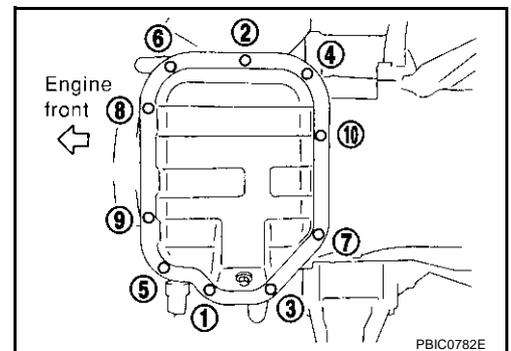
 : 28.0 N-m (2.9 kg-m, 21 ft-lb)

13. Remove front suspension member. Refer to [FSU-17, "FRONT SUSPENSION MEMBER"](#) .
14. Remove engine mounting bracket, engine mounting bracket (lower) and insulator. Refer to [EM-108, "ENGINE ASSEMBLY"](#) .
15. Remove front propeller shaft. Refer to [PR-4, "FRONT PROPELLER SHAFT"](#) .
16. Remove oil filter and oil filter bracket. Refer to [LU-12, "OIL FILTER BRACKET \(AWD\)"](#) .
17. Remove alternator stay. Refer to [SC-23, "CHARGING SYSTEM"](#) .
18. Remove alternator and power steering pump and A/C compressor idler pulley and bracket. Refer to [EM-15, "DRIVE BELTS"](#) .
19. Disconnect A/T fluid cooler hoses, and remove oil cooler water pipe mounting bolt. Refer to [LU-14, "OIL COOLER"](#) .
20. Disconnect A/T fluid cooler tube.
21. Remove front final drive assembly. Refer to [FFD-10, "FRONT FINAL DRIVE ASSEMBLY"](#) .
22. Remove starter motor. Refer to [SC-10, "STARTING SYSTEM"](#) .
23. Remove crankshaft position sensor (POS).

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.

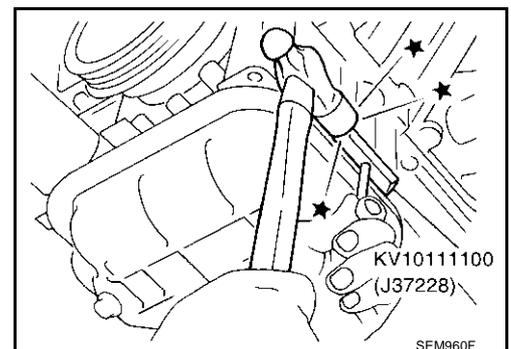
24. Remove oil pan (lower) as the following:
 - a. Loosen bolts in reverse order as shown in the figure to remove.



- b. Insert seal cutter (SST) between oil pan (upper) and oil pan (lower).
 - c. Slide seal cutter by tapping on the side of tool with hammer. Remove oil pan (lower).

CAUTION:

- Be careful not to damage the mating surface.
- Do not insert flat-bladed screwdriver, this will damage the mating surface.

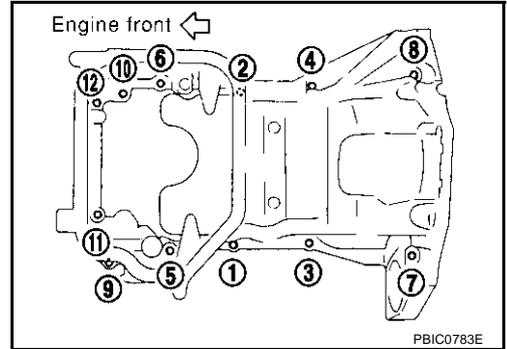


25. Remove oil strainer.
26. Remove transmission joint bolts which pierce oil pan (upper). Refer to [AT-269, "TRANSMISSION ASSEMBLY"](#).
27. Loosen oil pan (upper) bolts with power tool in the reverse order as shown in the figure to remove.

- Insert seal cutter [SST: KV10111100 (J-37228)] between oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of the tool with a hammer. Remove oil pan (upper).

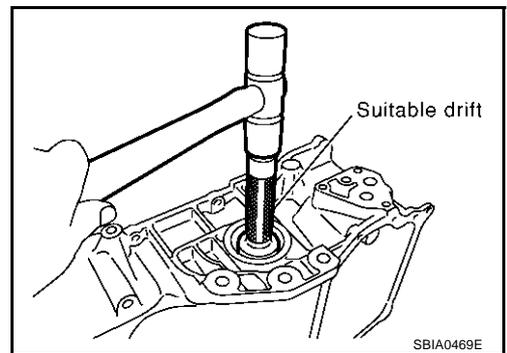
CAUTION:

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



28. Remove axle pipe, as necessary.

- Remove axle pipe from oil pan (upper) using a suitable drift [37 mm (1.46 in)].



INSPECTION AFTER REMOVAL

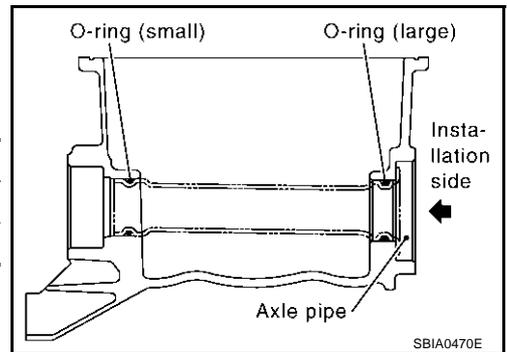
Clean oil strainer if any object attached.

INSTALLATION

1. Install axle pipe to oil pan, if removed.
 - Lubricate O-ring groove of axle pipe, O-ring, and O-ring joint of oil pan with new engine oil.

Unit: mm (in)

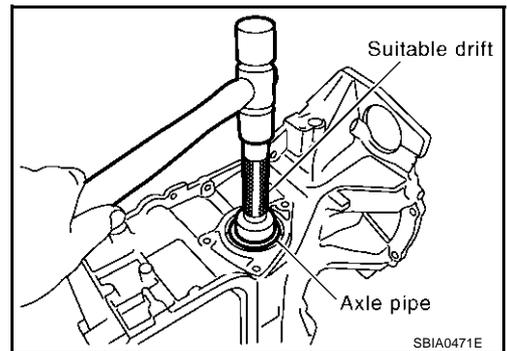
Item	O-ring inner diameter
Final drive side (RH side)	32 (1.26)
Axle pipe flange side (LH side)	34 (1.34)



- Install axle pipe to oil pan from axle pipe flange side (LH side) using a suitable drift [43 - 57 mm (1.69 - 2.24 in)].

CAUTION:

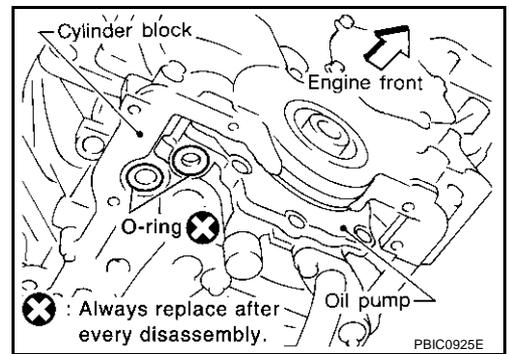
Insert it with care to prevent O-ring from sliding.



OIL PAN AND OIL STRAINER

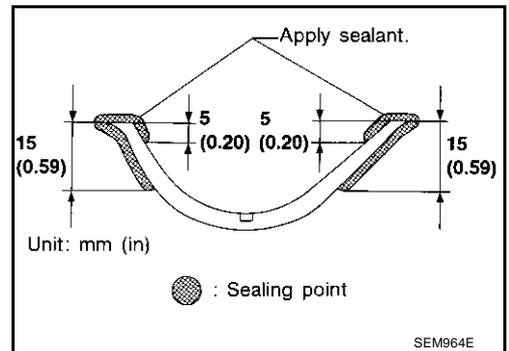
[VQ35DE]

2. Install oil pan (upper) in the order below.
 - a. Install O-ring to cylinder block and oil pump side.

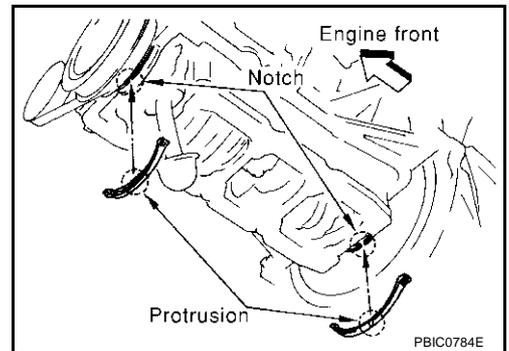


- b. Install oil pan gasket.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



- To install, align protrusion of oil pan gasket with notches of front timing chain case and rear oil seal retainer.
- Install oil pan gasket with smaller arc to front timing chain case side.

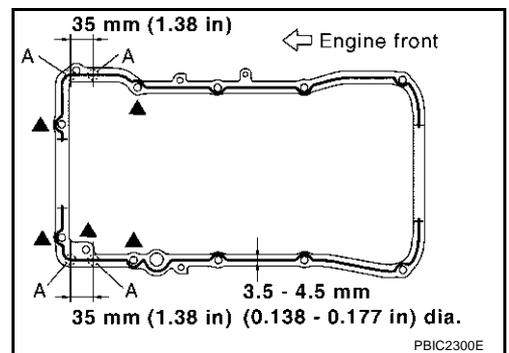


- c. Apply liquid gasket thoroughly as in illustration.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

CAUTION:

- For bolt holes with ▲ marks (5 locations), apply liquid gasket outside the holes.
- 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. Tighten bolts in numerical order as shown in the figure.

CAUTION:

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

A
EM
C
D
E
F
G
H
I
J
K
L
M

OIL PAN AND OIL STRAINER

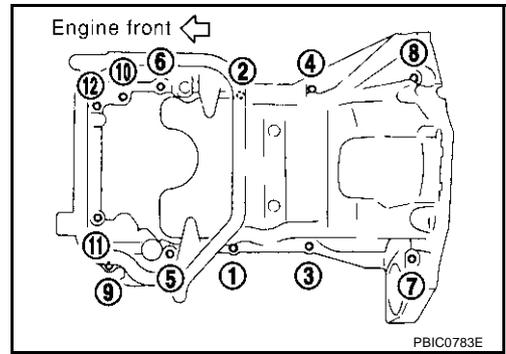
[VQ35DE]

- Install oil pan gasket and O-ring while maintaining proper position.
- Be careful not to damage oil strainer during installation.
- There are three types of mounting bolts. Refer to the following for locating bolts.

M8 × 27 mm (1.06 in) : 1, 2, 3, 4 and 9

M8 × 52 mm (2.05 in) : 8

M8 × 98 mm (3.86 in) : 5, 6, 7, 10, 11 and 12

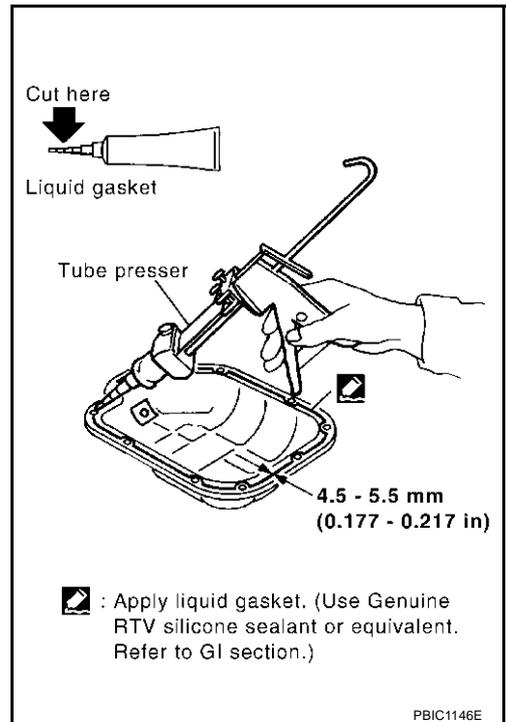


- a. Tighten transmission joint bolts. Refer to [AT-269, "TRANSMISSION ASSEMBLY"](#).
3. Install oil strainer to oil pump.
4. Install oil pan (lower) in the order below.
- a. Apply liquid gasket thoroughly with tube presser [SST: WS39930000 (-)] as in illustration.

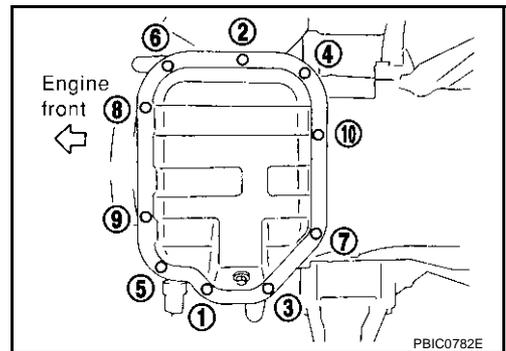
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

NOTE:

Attaching should be done within 5 minutes after coating.



- b. Tighten bolts in numerical order as shown in the figure.



5. Install oil pan drain plug.
 - Refer to illustration of components of former page for installation direction of washer.
6. Install in the reverse order of removal after this step.
7. At least 30 minutes after oil pan is installed, pour engine oil.

INSPECTION AFTER INSTALLATION

1. Check engine oil level and add engine oil. Refer to [LU-7, "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-7, "ENGINE OIL"](#)

A

EM

C

D

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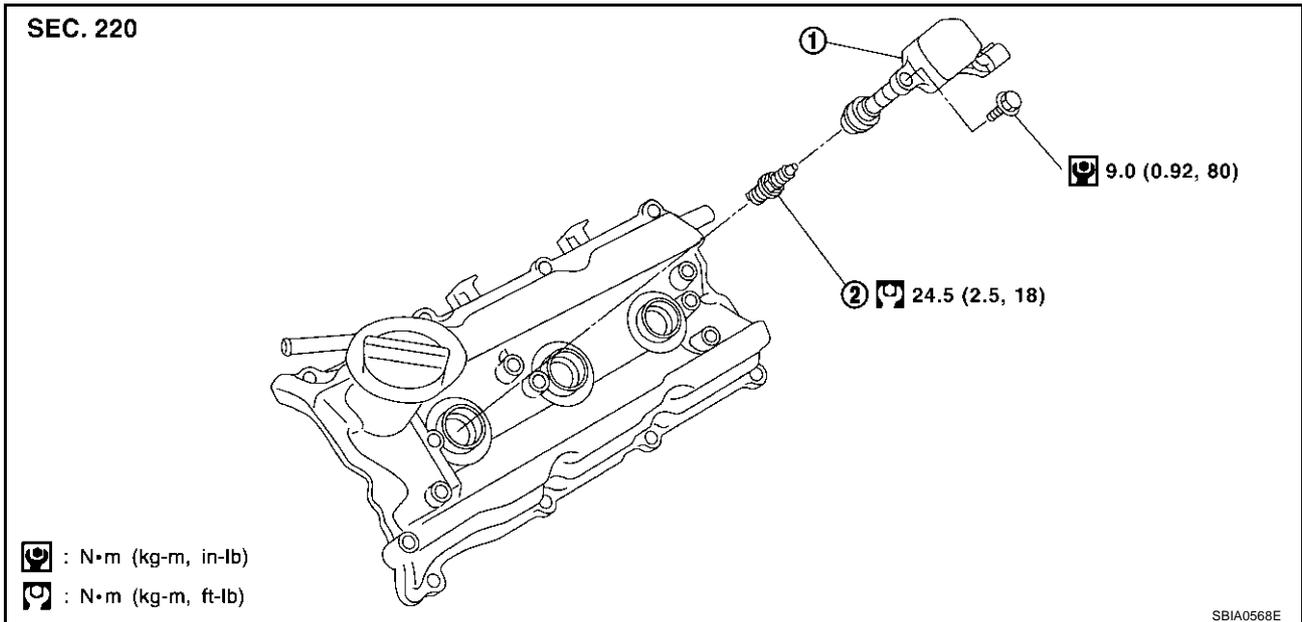
L

M

IGNITION COIL

Removal and Installation

ABS004U6



1. Ignition coil

2. Spark plug

REMOVAL

1. Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove air duct (for ignition coil of LH bank side). Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#).
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

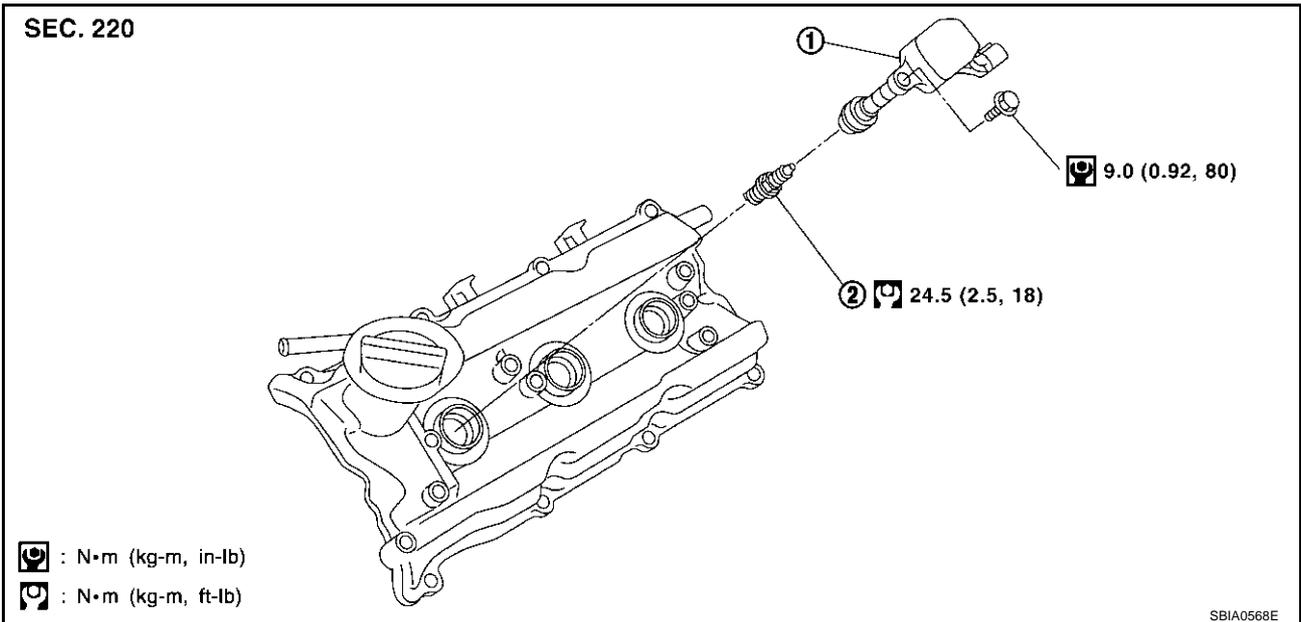
Install in the reverse order of removal.

SPARK PLUG (PLATINUM-TIPPED TYPE)

PF2:22401

Removal and Installation

ABS004W1

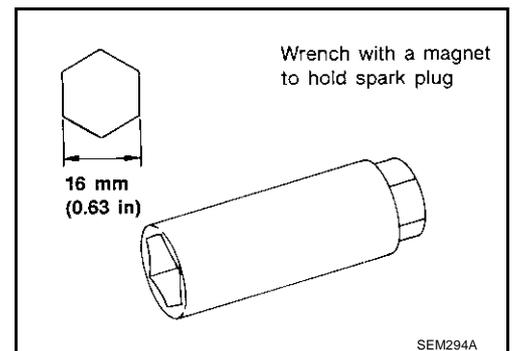


1. Ignition coil

2. Spark plug

REMOVAL

1. Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove ignition coil. Refer to [EM-40, "IGNITION COIL"](#).
3. Remove spark plug with spark plug wrench (commercial service tool).



INSPECTION AFTER REMOVAL

Use standard type spark plug for normal condition.

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)

SPARK PLUG (PLATINUM-TIPPED TYPE)

[VQ35DE]

CAUTION:

- Do not drop or shock spark plug.
- Do not use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

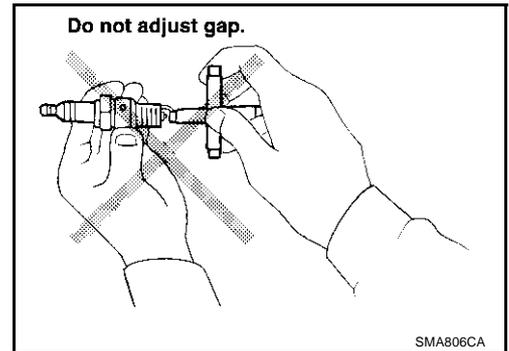
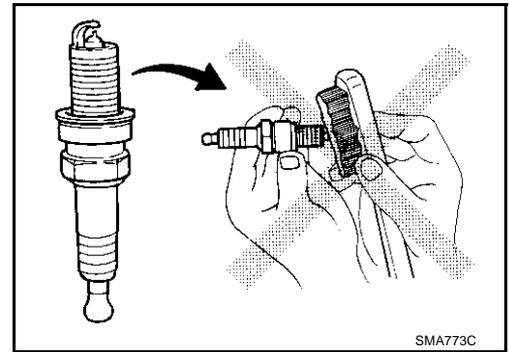
Cleaner air pressure:

Less than 588 kPa (6 kg/cm² , 85 psi)

Cleaning time:

Less than 20 seconds

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

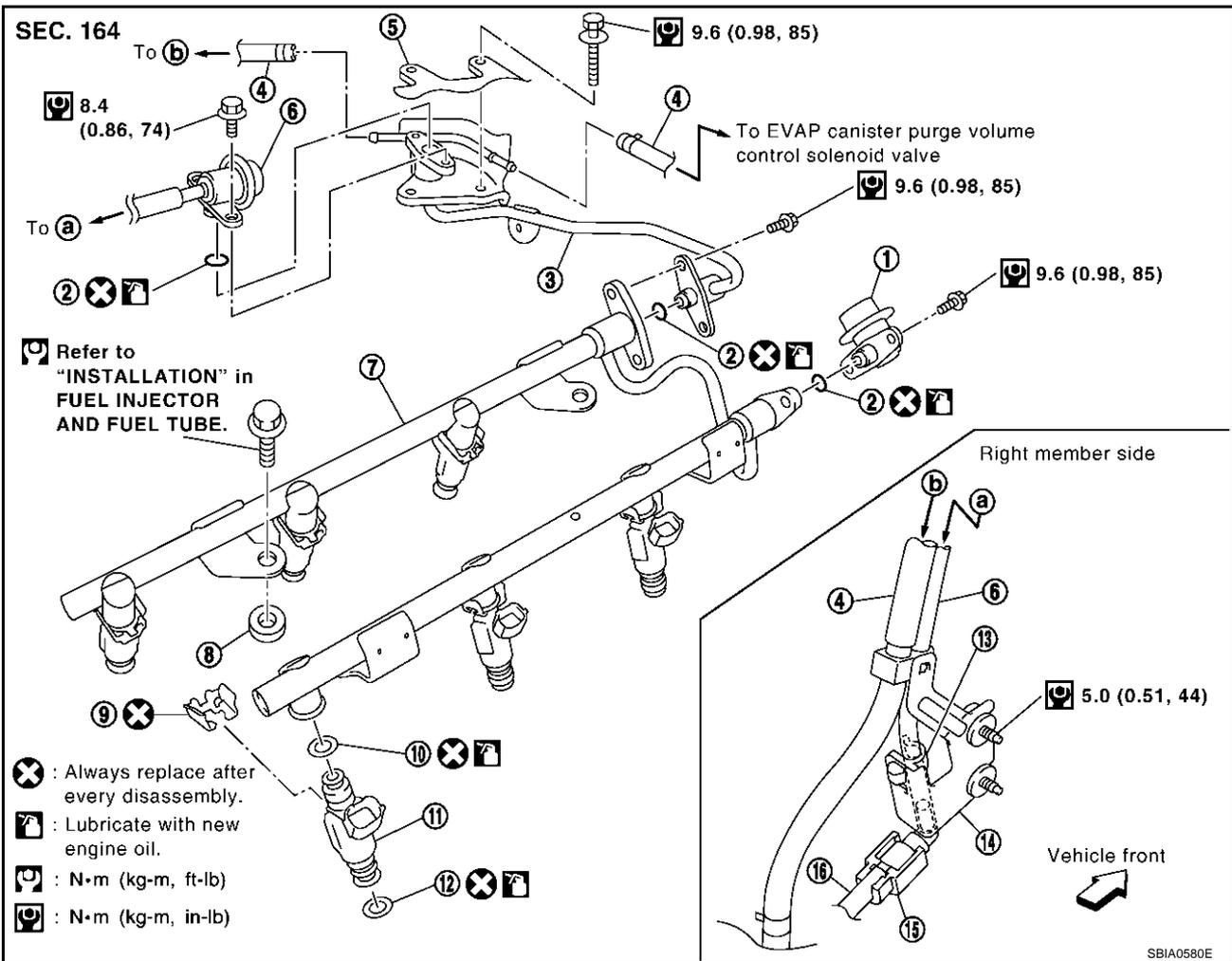


INSTALLATION

Install in the reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

Removal and Installation



EM
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- | | | |
|------------------------------------|--------------------------------------|---------------------------------|
| 1. Fuel damper | 2. O-ring | 3. Fuel sub-tube |
| 4. EVAP hose | 5. Intake manifold collector (Lower) | 6. Fuel feed hose (With damper) |
| 7. Fuel tube | 8. Spacer | 9. Clip |
| 10. O-ring (Black) | 11. Fuel injector | 12. O-ring (Green) |
| 13. Hose clamp | 14. Bracket | 15. Quick connector cap |
| 16. Centralized under-floor piping | | |

CAUTION:

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

REMOVAL

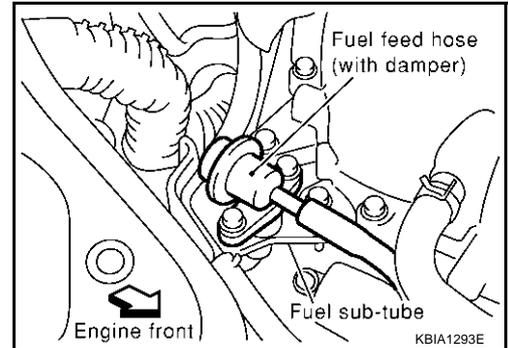
1. Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Release fuel pressure. Refer to [EC-65, "FUEL PRESSURE RELEASE"](#) .
3. Remove fuel feed hose (with damper) from fuel sub-tube.

NOTE:

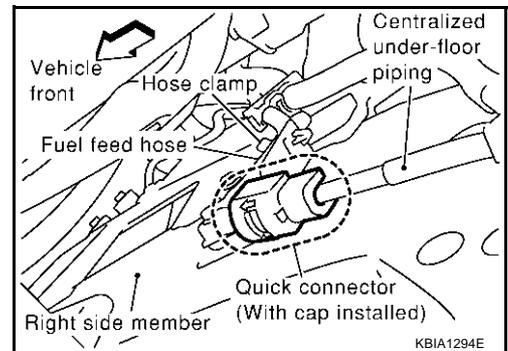
There is no fuel return route.

CAUTION:

- While hoses are disconnected, plug them to prevent fuel from draining.
- Do not separate damper and hose.



4. When separating fuel feed hose and centralized under-floor piping connection, disconnect quick connector with the following procedure.
 - a. Disconnect quick connector cap from quick connector connection on right member side.
 - b. Disconnect fuel feed hose from bracket hose clamp.



- c. Disconnect quick connector from centralized under-floor piping as follows:

CAUTION:

Disconnect quick connector by using quick connector release [SST: — (J-45488)], not by picking out retainer tabs.

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

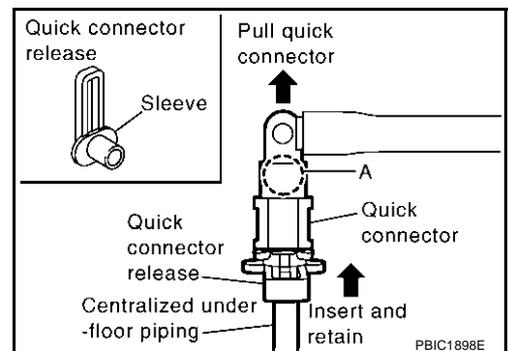
CAUTION:

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

- iii. Draw and pull out quick connector straight from centralized under-floor piping.

CAUTION:

- Pull quick connector holding "A" position as shown in the figure.

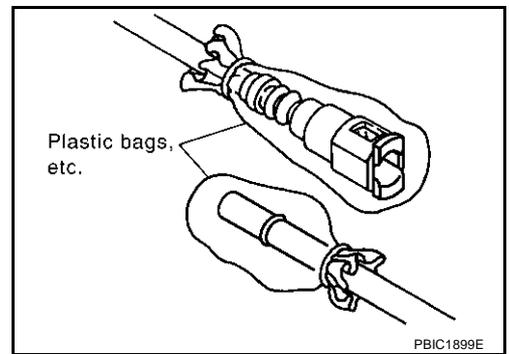


- Do not pull with lateral force applied. O-ring inside quick connector may be damaged.
- Prepare container and cloth beforehand as fuel will leak out.
- Avoid fire and sparks.
- Keep parts away from heat source. Especially, be careful when welding is performed around them.
- Do not expose parts to battery electrolyte or other acids.
- Do not bend or twist connection between quick connector and fuel hose (with damper) during installation/removal.

FUEL INJECTOR AND FUEL TUBE

[VQ35DE]

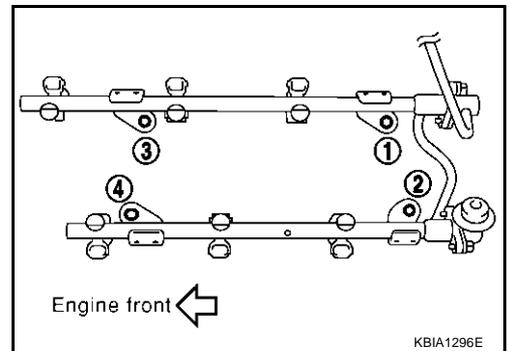
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.



5. Remove intake manifold collector (upper and lower). Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
6. Disconnect harness connector from fuel injector.
7. Loosen mounting bolts in the reverse order in the figure, and remove fuel tube and fuel injector assembly.

CAUTION:

Do not tilt it, or remaining fuel in pipes may flow out from pipes.

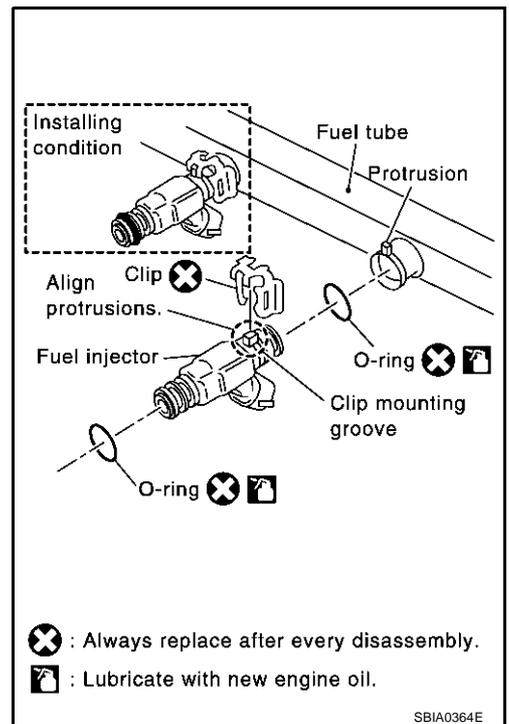


8. Remove spacers on intake manifold.
9. Remove fuel injector from fuel tube with following procedure.
 - a. Open and remove clip.
 - b. Remove fuel injector from fuel tube by pulling straight.

CAUTION:

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

10. Remove fuel sub-tube and fuel damper.



INSTALLATION

1. Install fuel damper and fuel sub-tube.
 - When handling O-rings, be careful of the following:

CAUTION:

 - Handle O-ring with bare hands. Never 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.
 - Insert fuel damper and fuel sub-tube straight into fuel tube.
 - Tighten mounting bolts evenly in turn.
 - After tightening mounting bolts, make sure that there is no gap between flange and fuel tube.
2. Install O-rings to fuel injector paying attention to the items below.

CAUTION:

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

Fuel tube side : Black

Nozzle side : Green

- Handle O-ring with bare hands. Never wear gloves.
- Lubricate O-ring with new engine oil.
- 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.

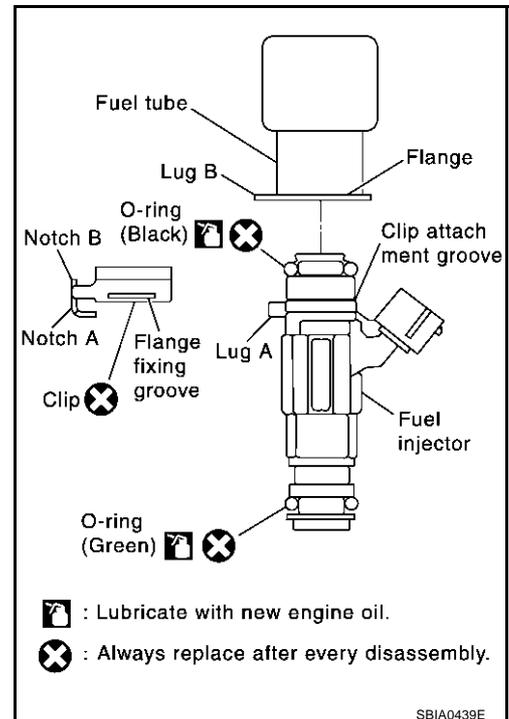
3. Install fuel injector to fuel tube with the following procedure.

- a. Insert clip into clip mounting groove on fuel injector.
- Insert clip so that lug "A" of fuel injector matches notch "A" of the 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 lug "B" of fuel tube matches notch "B" of the 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.



4. Install spacers on intake manifold.

FUEL INJECTOR AND FUEL TUBE

[VQ35DE]

5. Install fuel tube and fuel injector assembly to intake manifold.

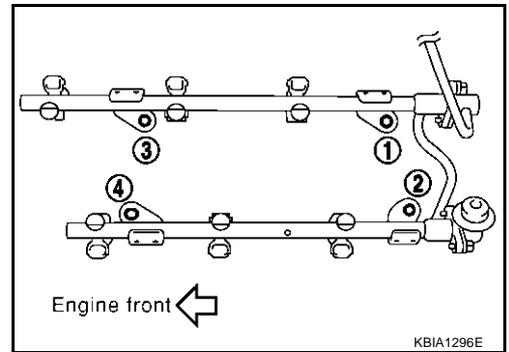
CAUTION:

Be careful not to let tip of injector nozzle come in contact with other parts.

- Tighten mounting bolts in two steps in numerical order shown in figure.

 **1st step: 10.1 N·m (1.0 kg·m, 7 ft·lb)**

 **2nd step: 23.6 N·m (2.4 kg·m, 17 ft·lb)**



6. Connect injector sub-harness.

7. Install intake manifold collector (upper and lower). Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).

8. Install fuel sub-tube on rear end of intake manifold collector (lower).

9. Connect fuel feed hose (with damper).

- Handling procedure of O-ring is the same as that of fuel damper and fuel sub-tube.
- Insert fuel damper straight into fuel sub-tube.
- Tighten mounting bolts evenly in turn.
- After tightening mounting bolts, make sure that there is no gap between flange and fuel sub-tube.

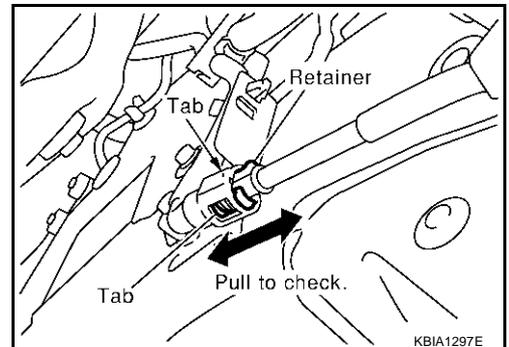
10. Connect quick connector between fuel feed hose and centralized under-floor piping connection with the following procedure:

- a. Check the connection for damage and foreign materials.

- b. Align the connector with the tube, then insert the connector straight into the tube until a click is heard.

- c. After connecting quick connector, use the following method to make sure it is full connected.

- Visually confirm that the two retainer tabs are connected to the connector.
- Pull the tube and the connector to make sure they are securely connected.



- d. Install quick connector cap to quick connector connection.

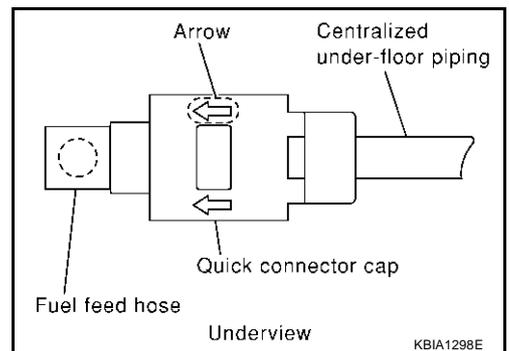
- Install quick connector cap with arrow on surface facing in direction of quick connector (fuel feed hose side).

CAUTION:

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

- e. Secure fuel feed hose to clamp.

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



INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

- After installing fuel tubes, make sure there is no fuel leakage at connections in the following steps.
 - a) Apply fuel pressure to fuel lines with turning ignition switch "ON" (with engine stopped). Then check for fuel leaks at connections.
 - b) Start engine and rev it up and check for fuel leaks at connections.

NOTE:

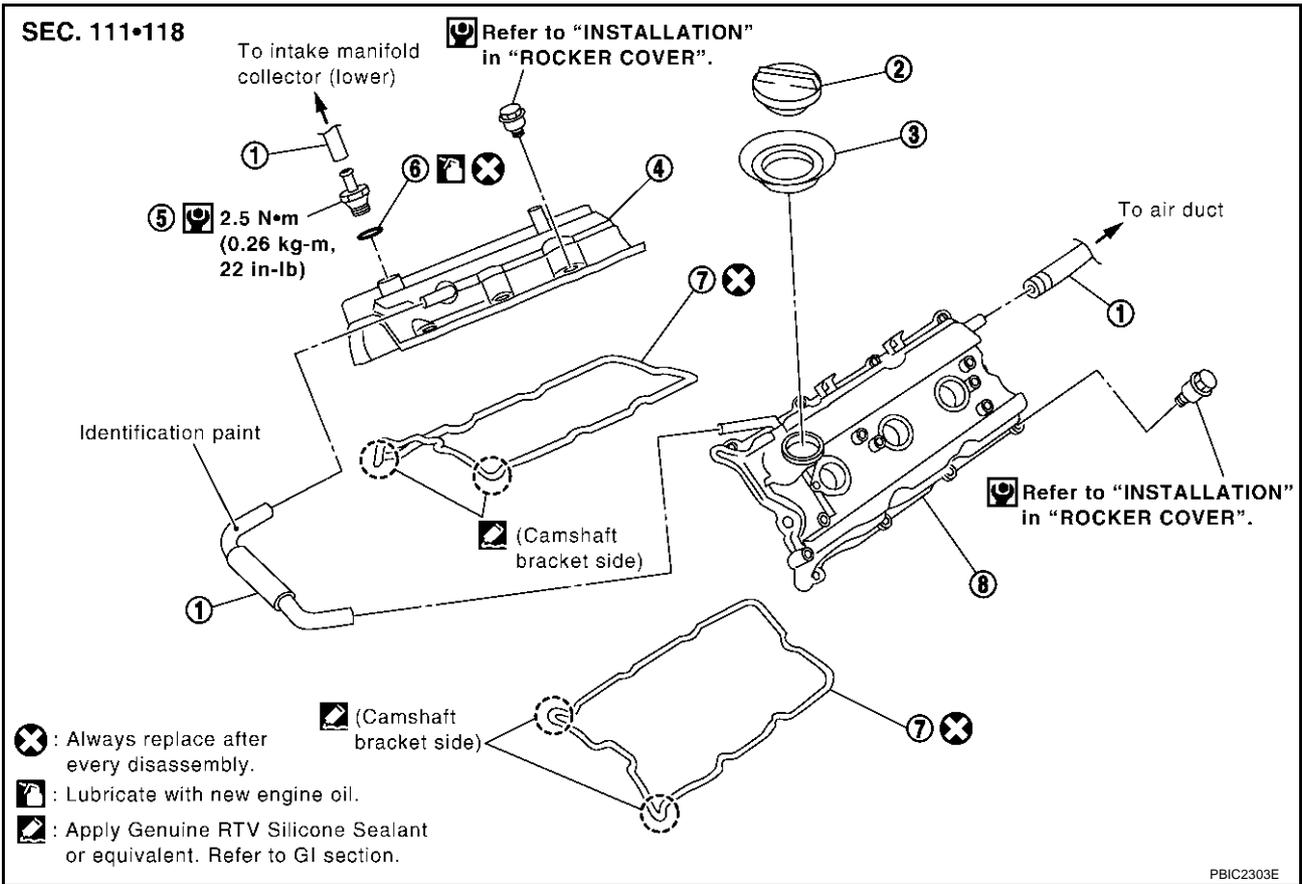
Use mirrors for checking on invisible points.

CAUTION:

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

ROCKER COVER

Removal and Installation



- | | | |
|------------------------------|-----------------------------|----------------|
| 1. PCV hose | 2. Oil filler cap | 3. Oil catcher |
| 4. Rocker cover (right bank) | 5. PCV control valve | 6. O-ring |
| 7. Rocker cover gasket | 8. Rocker cover (left bank) | |

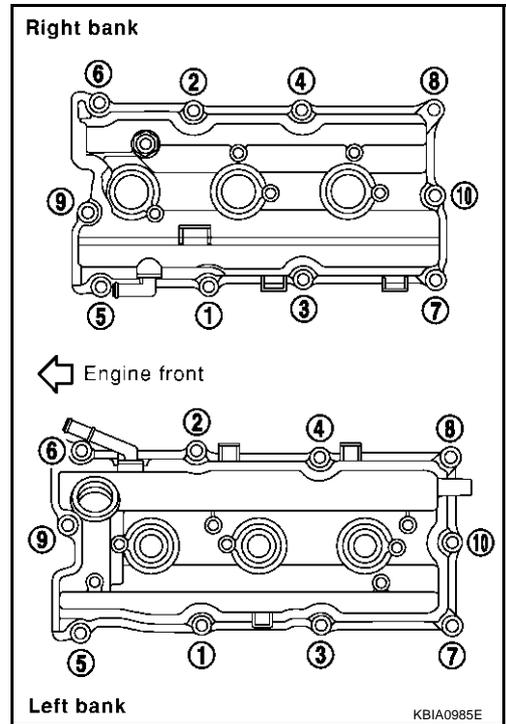
REMOVAL

1. Remove intake manifold collectors (upper and lower). Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove ignition coil. Refer to [EM-40, "IGNITION COIL"](#).
3. Remove PCV hoses from rocker covers.
4. Remove PCV valve and O-ring from rocker cover (right bank), if necessary.
5. Remove oil filler cap from rocker cover (left bank), if necessary.

ROCKER COVER

[VQ35DE]

- Loosen bolts in the reverse order shown in the figure (with power tool).



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

CAUTION:

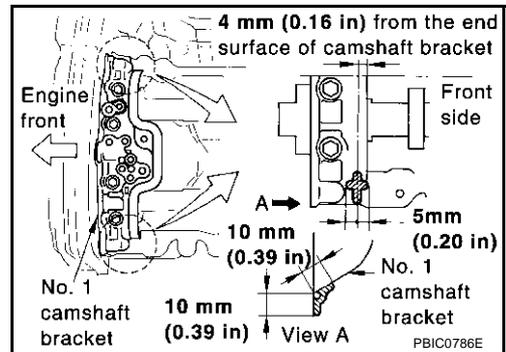
Do not scratch or damage the mating surface when cleaning off old liquid gasket.

INSTALLATION

- Apply liquid gasket of 3.0 mm (0.12 in) diameter to position shown in the figure (both edges of No. 1 camshaft bracket) (on both banks).

- First, apply it to engine longitudinal direction [5.0 mm (0.197 in) + 5.0 mm (0.197 in) side in figure].

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



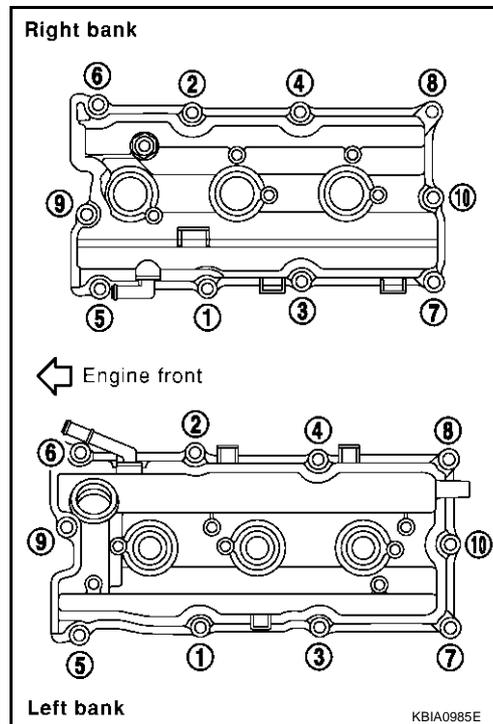
- Install new rocker cover gasket to rocker cover.
- Install rocker cover.
 - Check if rocker cover gasket is dropped from installation groove of rocker cover.

ROCKER COVER

[VQ35DE]

4. Tighten bolts two steps separately in order numbers in illustration.

- 🔧 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 filter cap to rocker cover (left bank), if removed.
6. Install new O-ring and PCV valve to rocker cover (right bank), if removed.
7. 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.
 - Install PCV hose between right and left rocker covers with its identification paint facing upward (right rocker cover side). Refer to component figure in [EM-49, "Removal and Installation"](#).
8. Install in the reverse order of removal after this step.

FRONT TIMING CHAIN CASE

PFP:13599

Removal and Installation

ABS00BYT

NOTE:

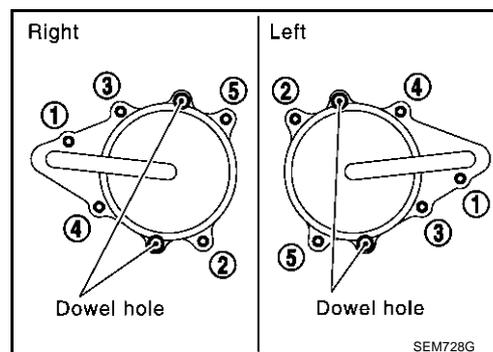
- This section describes removal/installation procedure of front timing chain case and timing chain related parts without removing oil pan (upper) on vehicle.
- When oil pan (upper) needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pans (upper and lower) first. Then remove front timing chain case, timing chain related parts, and rear timing chain case in this order, and install in reverse order of removal. Refer to [EM-61, "TIMING CHAIN"](#).
- Refer to [EM-61, "TIMING CHAIN"](#) for component parts location.

REMOVAL

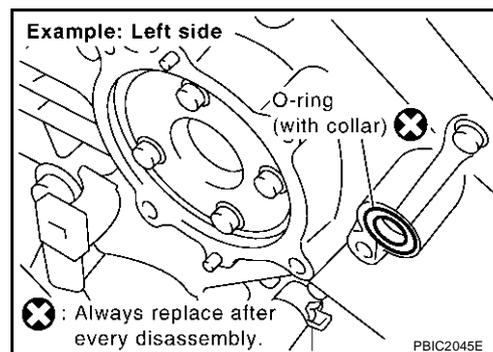
1. Place vehicle onto lift.
2. Disconnect negative battery terminal.
3. Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
4. Remove air cleaner case assembly. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#).
5. Remove front and rear engine undercover with power tool.
6. Drain engine coolant from radiator. Refer to [CO-11, "Changing Engine Coolant"](#).
7. Drain engine oil from oil pan. Refer to [LU-9, "Changing Engine Oil"](#).
8. Remove engine harnesses.
9. Remove intake manifold collectors (upper and lower) with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
10. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [PS-31, "POWER STEERING OIL PUMP"](#).
11. Remove power steering oil pump bracket. Refer to [PS-31, "POWER STEERING OIL PUMP"](#).
12. Remove alternator. Refer to [SC-23, "CHARGING SYSTEM"](#).
13. Remove water bypass hose, water hose clamp and idler pulley bracket and alternator and power steering oil pump and A/C compressor belt tensioner from front timing chain case.
14. Remove right and left intake valve timing control covers with power tool.
 - Loosen bolts in reverse order as shown in the figure.
 - Use seal cutter [SST: KV10111100 (J-37228)] or an equivalent tool to cut liquid gasket for removal.

CAUTION:

Shaft is internally jointed with intake camshaft sprocket center hole. When removing, keep it horizontal until it is completely disconnected.



15. Remove collared O-rings from front timing chain case (left and right side).



16. Remove right and left rocker covers. Refer to [EM-49, "ROCKER COVER"](#).

NOTE:

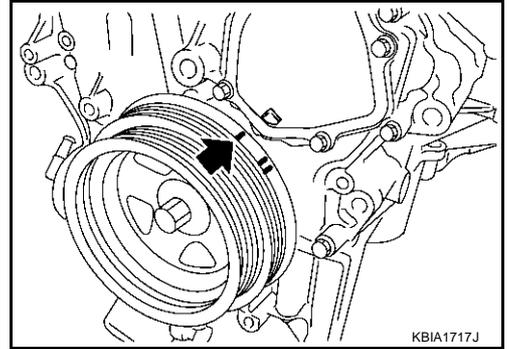
When secondary timing chain is not removed/installed, this step is not required.

17. Obtain compression TDC of No. 1 cylinder 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.

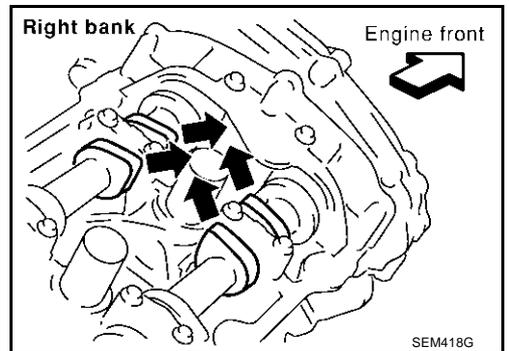


- b. Make sure intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.

- If not, turn crankshaft one revolution (360°) and align as shown.

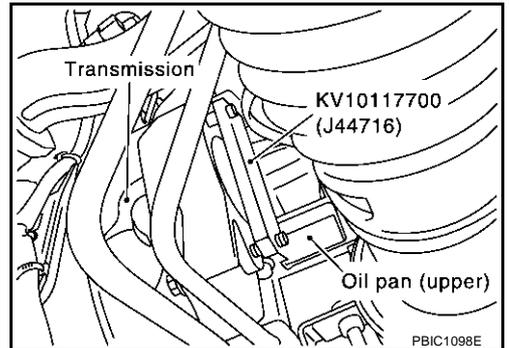
NOTE:

When only primary timing chain is removed, rocker cover does not need to be removed. To confirm 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-61, "TIMING CHAIN"](#).



18. Remove crankshaft pulley with the following procedure:

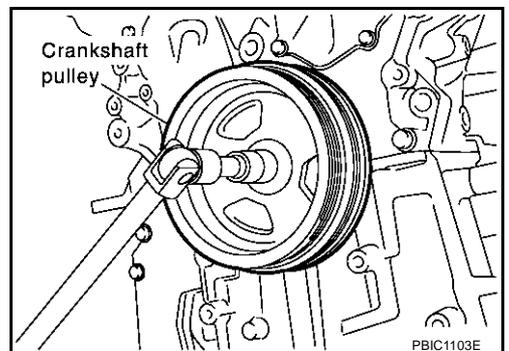
- a. Remove rear cover plate (2WD) or starter motor (AWD) and set ring gear stopper (SST) as shown in the figure. Refer to [SC-10, "STARTING SYSTEM"](#).



- 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 as it will be used as a supporting point for suitable puller.



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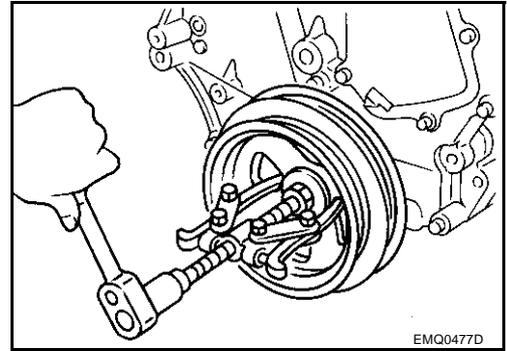
FRONT TIMING CHAIN CASE

[VQ35DE]

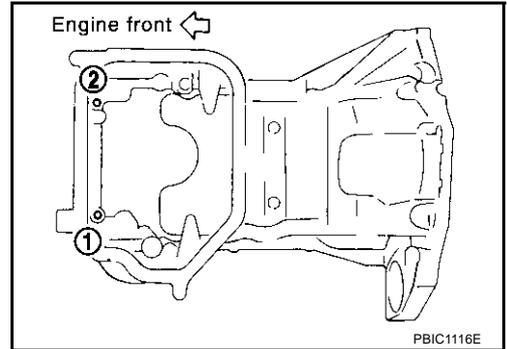
- c. Place suitable puller tab on holes of crankshaft pulley, and pull crankshaft pulley through.

CAUTION:

Do not put suitable puller tab on crankshaft pulley periphery, as this will damage internal damper.

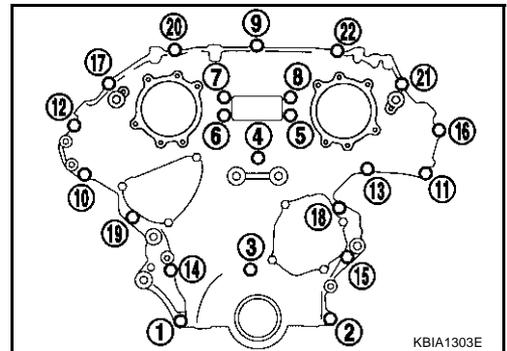


19. Remove oil pan (lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#) .
20. Loosen two mounting bolts in front of oil pan (upper) with power tool in reverse order as shown in the figure.



21. Remove front timing chain case.

- a. Loosen mounting bolts with power tool in reverse order as shown in the figure.



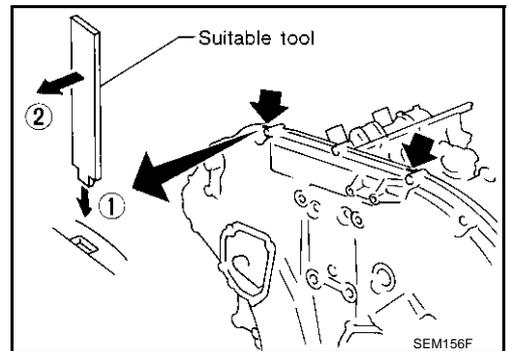
- b. Insert suitable tool into the notch at the top of front timing chain case as shown (1) in the figure.

- c. Pry off case by moving tool as shown (2) in the figure.

- Use seal cutter [SST: KV10111100 (J-37228)] or an equivalent tool to cut liquid gasket for removal.

CAUTION:

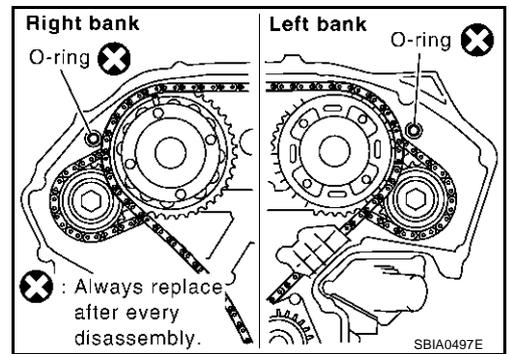
- Do not use screwdrivers or something similar.
- After removal, handle it carefully so it does not tilt, cant, or warp under a load.



FRONT TIMING CHAIN CASE

[VQ35DE]

22. Remove O-rings from rear timing chain case.



23. Remove oil pan gasket front side. Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#) .

24. Remove water pump cover and chain tensioner cover from front timing chain case.

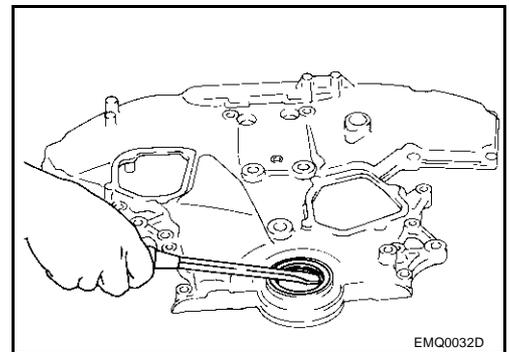
- Use seal cutter [SST: KV1011100 (J-37228)] or an equivalent tool to cut liquid gasket for removal.

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

- Use flat-bladed screwdriver for removal.

CAUTION:

Exercise care not to damage front timing chain case.

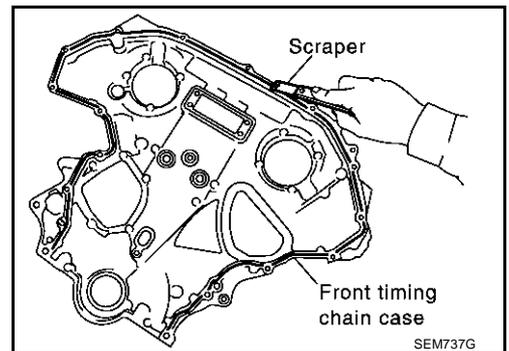


26. Remove timing chain and related parts. Refer to [EM-61, "TIMING CHAIN"](#) .

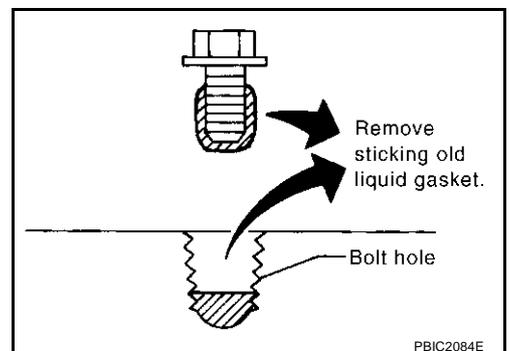
27. Use a scraper to remove all traces of old liquid gasket from front and rear timing chain cases and oil pan (upper), and liquid gasket mating surfaces.

CAUTION:

Be careful not to allow gasket fragments to enter oil pan.



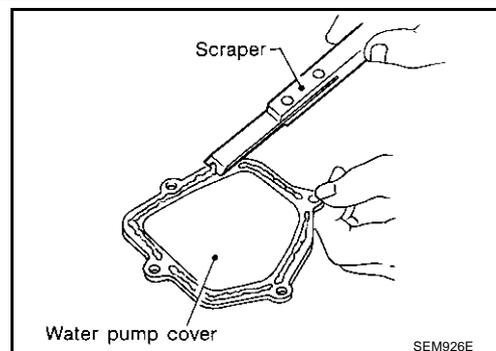
- Remove old liquid gasket from bolt hole and thread.



FRONT TIMING CHAIN CASE

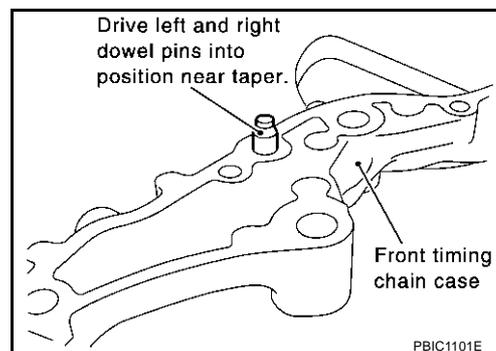
[VQ35DE]

28. Use a scraper to remove all traces of liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.

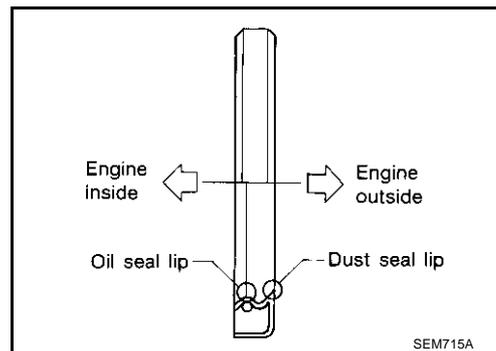


INSTALLATION

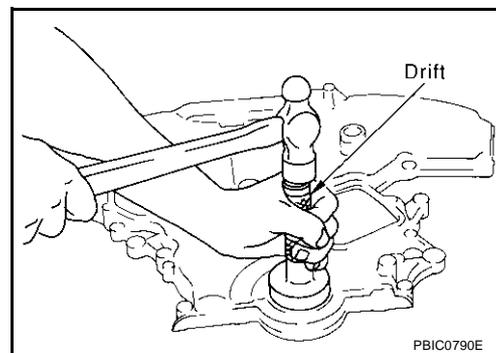
1. Install timing chain and related parts. Refer to [EM-61, "TIMING CHAIN"](#).
2. Hammer dowel pins (left and right) into front timing chain case up to a point close to taper in order to shorten protrusion length.



3. Install front oil seal on front timing chain case.
 - Apply new engine oil to the oil seal edges.
 - Install it so that each seal lip is oriented as shown in the figure.



- Using suitable drift, press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



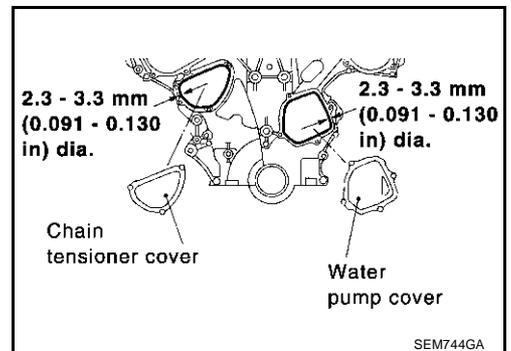
FRONT TIMING CHAIN CASE

[VQ35DE]

4. Install water pump cover and chain tensioner cover to front timing chain case.

- Apply liquid gasket to front timing chain case front side as shown in the figure with tube presser [SST: WS39930000 (-)].

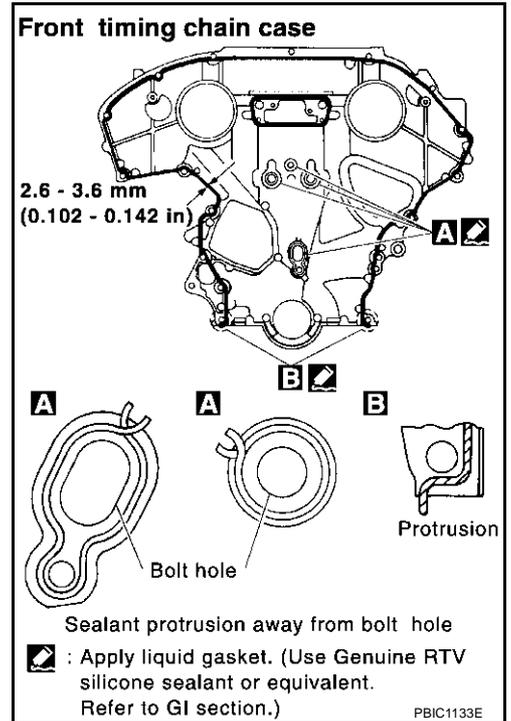
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



5. Install front timing chain case as follows:

a. Apply liquid gasket to front timing chain case back side as shown in the figure with tube presser [SST: WS39930000 (-)].

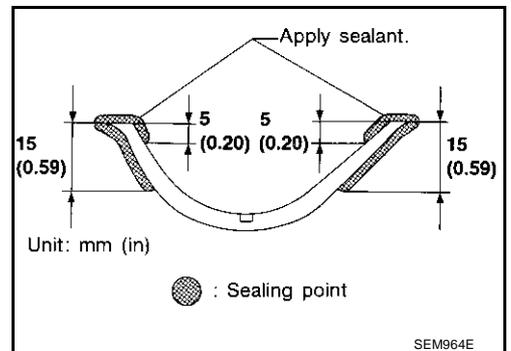
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



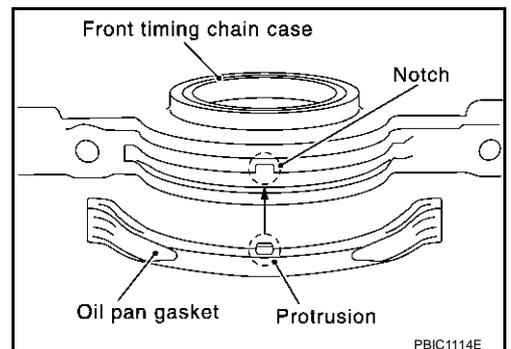
b. Install oil pan gasket front side.

- Apply liquid gasket to oil pan gasket as shown in the figure with tube presser [SST: WS39930000 (-)].

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



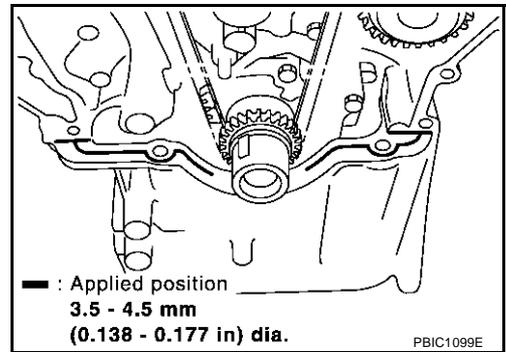
- Align notch of front timing chain case with protrusion of oil pan gasket.



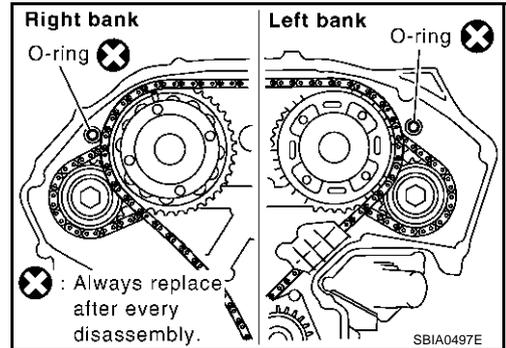
FRONT TIMING CHAIN CASE

[VQ35DE]

- Apply liquid gasket to top surface of oil pan (upper) as shown in the figure with tube presser [SST: WS39930000 (-)].
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



- c. Install new O-rings on rear timing chain case.

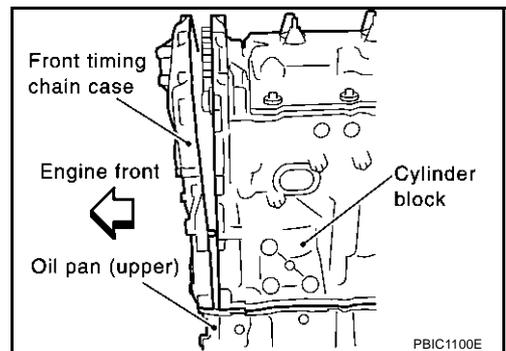


- d. Assemble front timing chain case as follows.

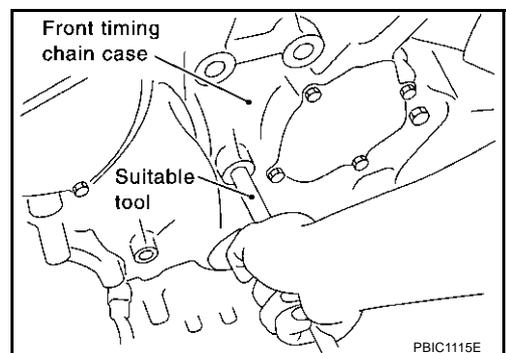
- i. Fit lower end of front timing chain case tightly onto top face of oil pan (upper). From the fitting point, make entire front timing chain case contact rear timing chain case completely.

CAUTION:

Be careful that oil pan gasket is in place.



- ii. While pressing front timing chain case from its front and top as shown in the figure, install bolts and temporarily tighten them. For bolt length and positions, refer to the step 6.
- iii. Hammer dowel pin until the outer end becomes flush with surface.



6. Tighten bolts to the specified torque in order as shown in the figure.

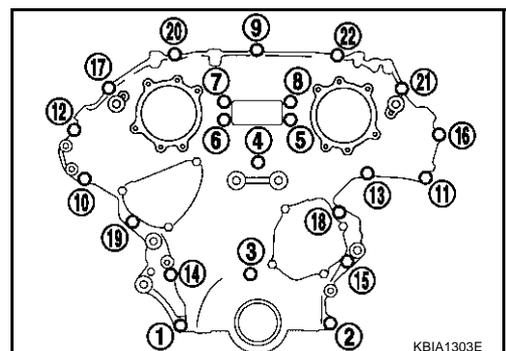
8 mm (0.31 in) dia. bolts : 1, 2

: **28.4 N·m (2.9 kg·m, 21 ft·lb)**

6 mm (0.24 in) dia. bolts : Except the above

: **12.7 N·m (1.3 kg·m, 9 ft·lb)**

- After tightening, retighten them to specified torque in numerical order as shown in the figure.

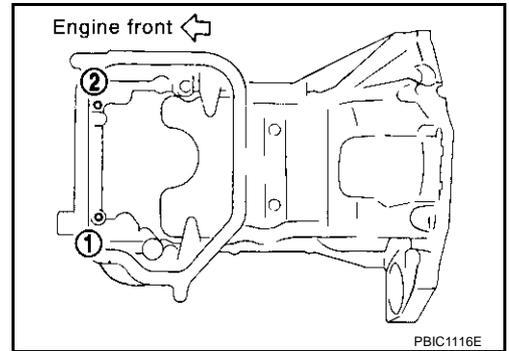


FRONT TIMING CHAIN CASE

[VQ35DE]

7. Install two mounting bolts in front of oil pan (upper) in numerical order as shown in the figure.

 : 17.2 N·m (1.8 kg-m, 13 ft-lb)

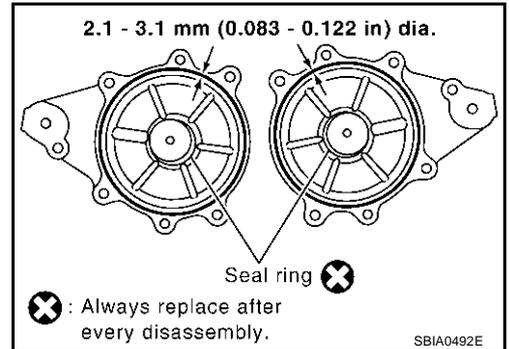


8. Install oil pan (lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).

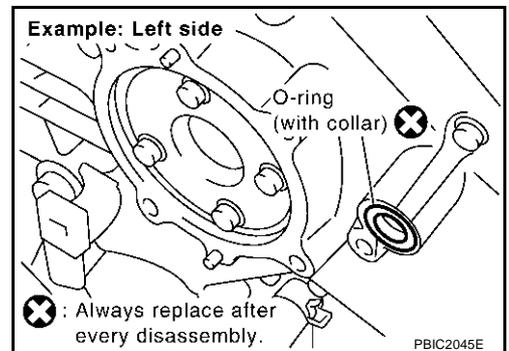
9. Install right and left intake valve timing control covers as follows:

- Install seal rings in shaft grooves.
- Apply liquid gasket to intake valve timing control covers with tube presser [SST: WS39930000 (-)].

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



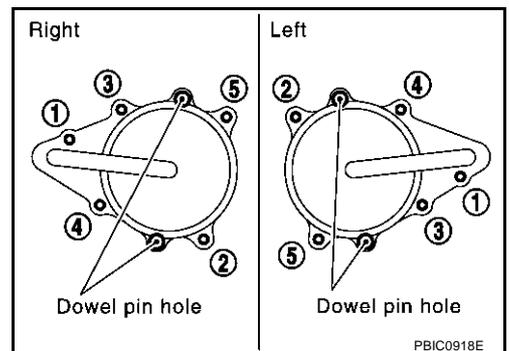
- Install collared O-ring in front timing chain case oil hole (left and right sides).



- Being careful not to move seal ring from the installation groove, align dowel pins on chain case with the holes to install intake valve timing control covers.

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

 : 11.3 N·m (1.2 kg-m, 8 ft-lb)



10. Install crankshaft pulley as follows:

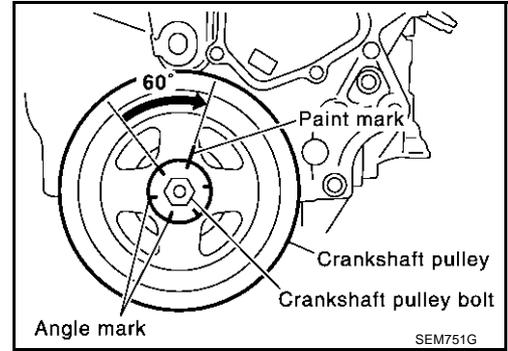
- Fix crankshaft using ring gear stopper [SST: KV10117700 (J-44716)].
- Install crankshaft pulley, taking care not to damage front oil seal.
 - When press-fitting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
- Tighten bolt.

 : 44.1 N·m (4.5 kg-m, 33 ft-lb)

FRONT TIMING CHAIN CASE

[VQ35DE]

- d. Put a paint mark on crankshaft pulley aligning with angle mark on crankshaft pulley bolt. Then, further retighten bolt by "60" degrees (equivalent to one graduation).



11. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
12. For the following operations, perform steps in the reverse order of removal.

NOTE:

If hydraulic pressure inside 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.

INSPECTION AFTER INSTALLATION

- Before starting engine, check the levels of engine coolant, lubrications and working fluid. If less than required quantity, fill to the specified level.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of engine coolant, engine oil and 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

TIMING CHAIN

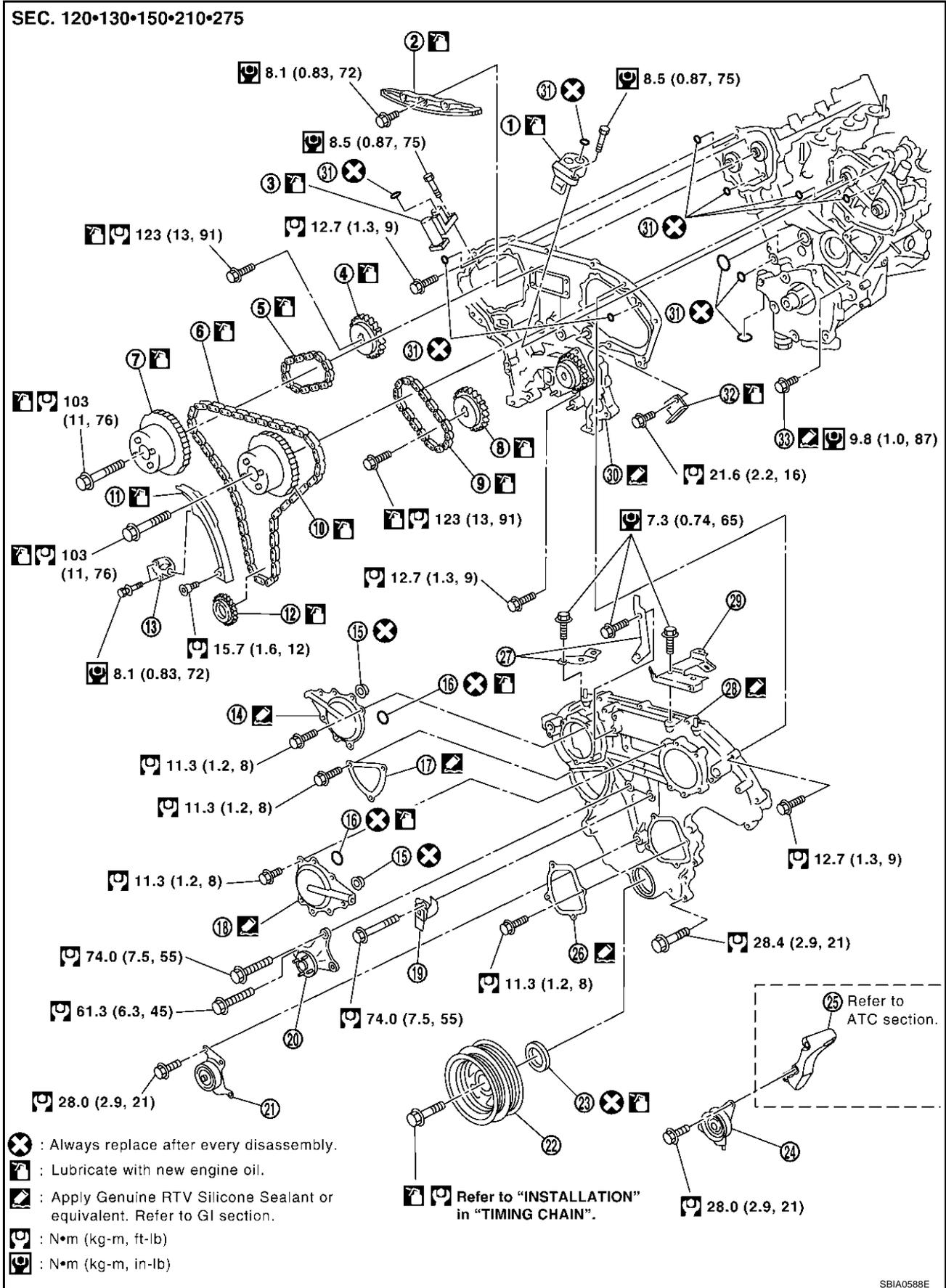
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Removal and Installation

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|---------------------------------------|---------------------------------------|---------------------------------------|
| 1. Timing chain tensioner (secondary) | 2. Internal chain guide | 3. Timing chain tensioner (secondary) |
| 4. Camshaft sprocket (EXH) | 5. Timing chain (secondary) | 6. Timing chain (primary) |
| 7. Camshaft sprocket (INT) | 8. Camshaft sprocket (EXH) | 9. Timing chain (secondary) |
| 10. Camshaft sprocket (INT) | 11. Slack guide | 12. Crankshaft sprocket |
| 13. Timing chain tensioner (primary) | 14. Intake valve timing control cover | 15. Collared O-ring |
| 16. O-ring | 17. Chain tensioner cover | 18. Intake valve timing control cover |
| 19. Water hose clamp | 20. Idler pulley bracket | 21. Idler pulley |
| 22. Crankshaft pulley | 23. Front oil seal | 24. Idler pulley |
| 25. A/C compressor bracket | 26. Water pump cover | 27. Bracket |
| 28. Front timing chain case | 29. Bracket | 30. Rear timing chain case |
| 31. O-ring | 32. Tension guide | 33. Water drain plug (front side) |

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-52, "FRONT TIMING CHAIN CASE"](#) .

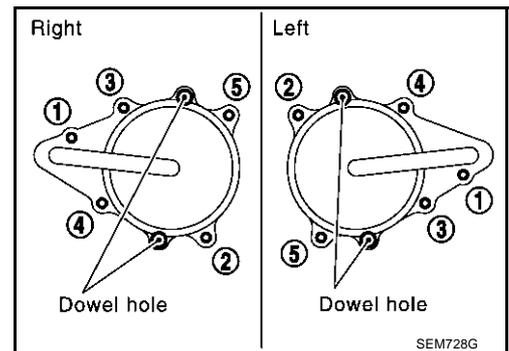
REMOVAL

1. Place vehicle onto lift.
2. Remove front tire.
3. Disconnect negative battery terminal.
4. Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#) .
5. Remove air cleaner case assembly. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#) .
6. Remove front and rear engine undercover with power tool.
7. Drain engine coolant from radiator. Refer to [CO-11, "Changing Engine Coolant"](#) .
8. Drain engine oil from oil pan. Refer to [LU-9, "Changing Engine Oil"](#) .
9. Remove engine harnesses.
10. Remove intake manifold collectors (upper and lower) with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#) .
11. Remove radiator cooling fan assembly. Refer to [CO-16, "Removal and Installation of Cooling Fan"](#) .
12. Remove A/C compressor from bracket with piping connected, and temporarily secure it aside. Refer to [ATC-151, "Components"](#) .
13. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [PS-31, "POWER STEERING OIL PUMP"](#) .
14. Remove power steering oil pump bracket. Refer to [PS-31, "POWER STEERING OIL PUMP"](#) .
15. Remove alternator. Refer to [SC-23, "CHARGING SYSTEM"](#) .
16. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
17. Remove right and left intake valve timing control covers with power tool.

- Loosen bolts in reverse order as shown in the figure.
- Use seal cutter [SST: KV10111100 (J-37228)] or an equivalent tool to cut liquid gasket for removal.

CAUTION:

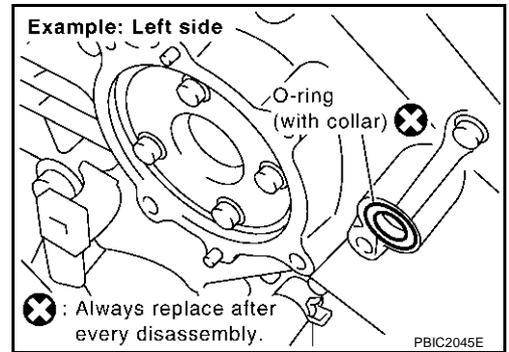
Shaft is internally jointed with intake camshaft sprocket center hole. When removing, keep it horizontal until it is completely disconnected.



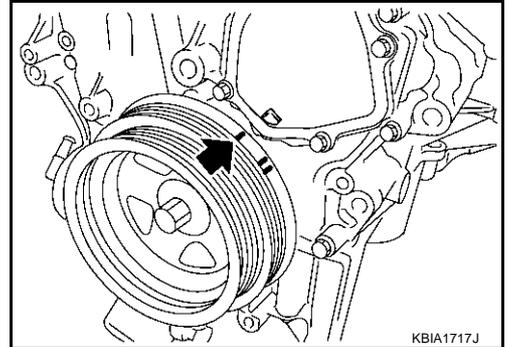
TIMING CHAIN

[VQ35DE]

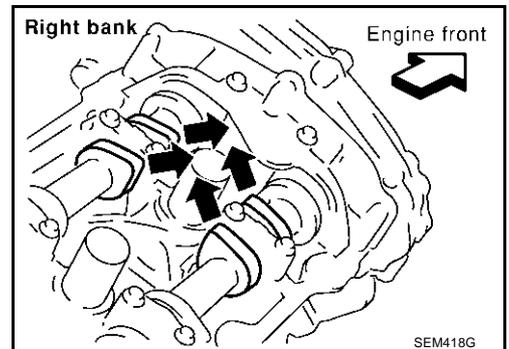
18. Remove collared O-ring from front timing chain case (left and right side).



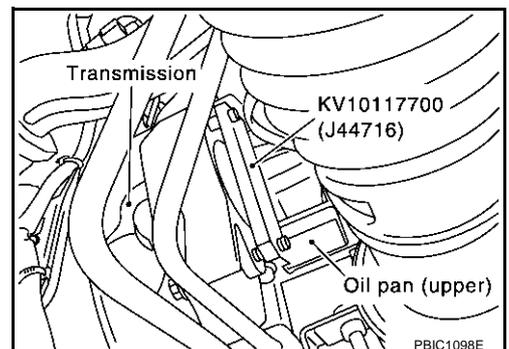
19. Remove right and left rocker covers. Refer to [EM-49, "ROCKER COVER"](#) .
20. Obtain compression TDC of No. 1 cylinder as follows:
- a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



- b. Make sure intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.
- If not, turn crankshaft one revolution (360°) and align as shown.



21. Remove crankshaft pulley with the following procedure:
- a. Remove rear cover plate (2WD) or starter motor (AWD) and set ring gear stopper (SST) as shown in the figure. Refer to [SC-10, "STARTING SYSTEM"](#) .



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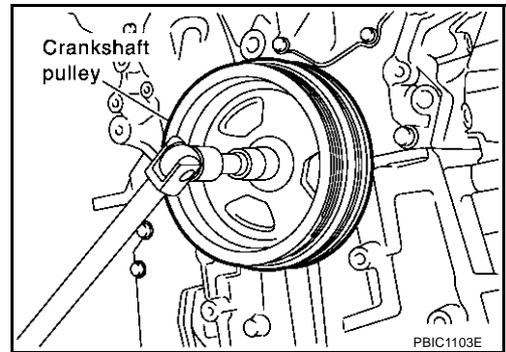
TIMING CHAIN

[VQ35DE]

- b. Loosen crankshaft pulley bolt and locate bolt seating surface as 10 mm (0.39 in) from its original position.

CAUTION:

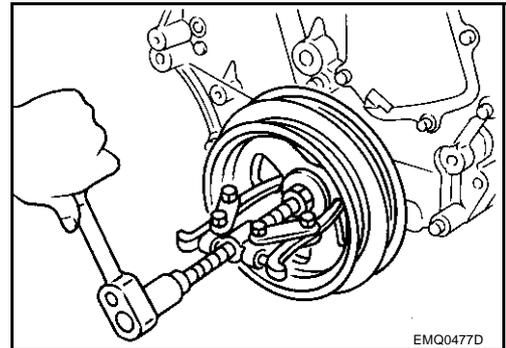
Do not remove crankshaft pulley bolt as it will be used as a supporting point for suitable puller.



- c. Place suitable puller tab on holes of crankshaft pulley, and pull crankshaft pulley through.

CAUTION:

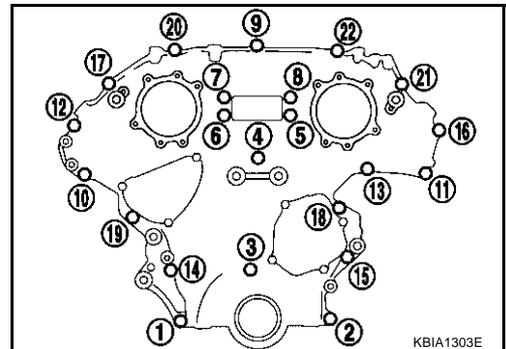
Do not put suitable puller tab on crankshaft pulley periphery, as this will damage internal damper.



22. Remove oil pans (upper and lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).

23. Remove front timing chain case.

- a. Loosen mounting bolts with power tool in reverse order as shown in the figure.



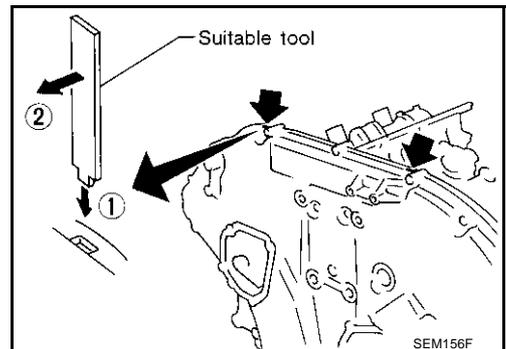
- b. Insert suitable tool into the notch at the top of front timing chain case as shown (1) in the figure.

- c. Pry off case by moving tool as shown (2) in the figure.

- Use seal cutter [SST: KV10111100 (J-37228)] or an equivalent tool to cut liquid gasket for removal.

CAUTION:

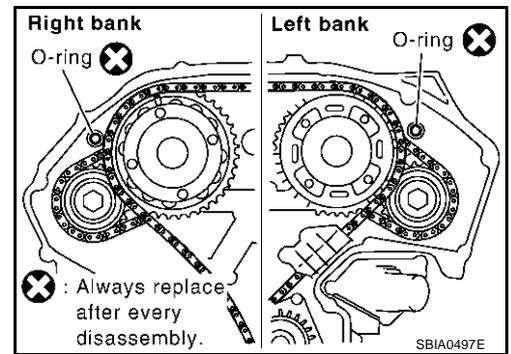
- Do not use screwdrivers or something similar.
- After removal, handle it carefully so it does not tilt, cant, or warp under a load.



TIMING CHAIN

[VQ35DE]

24. Remove O-rings from rear timing chain case.



25. Remove water pump cover and chain tensioner cover from front timing chain case.

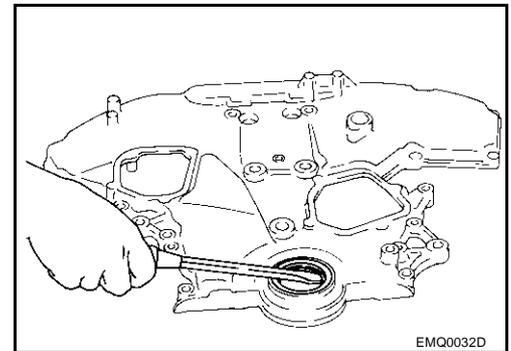
- Use seal cutter [SST: KV10111100 (J-37228)] or an equivalent tool to cut liquid gasket for removal.

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

- Use screwdriver for removal.

CAUTION:

Be careful not to damage front timing chain case.



27. Remove timing chain tensioner (primary) as the following:

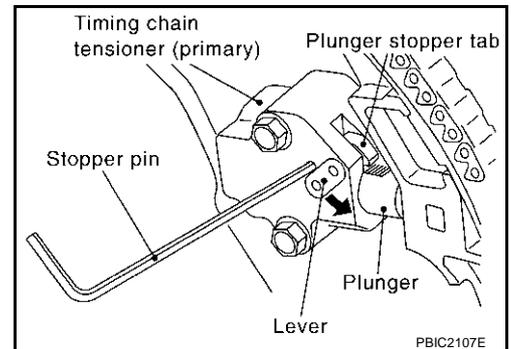
a. Pull lever down and release plunger stopper tab.

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

b. Insert stopper pin into tensioner body hole to hold lever, and keep the tab released.

NOTE:

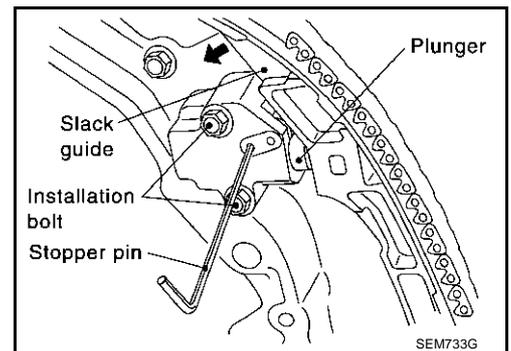
An Allen wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.



c. Insert plunger into tensioner body by pressing slack guide.

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

e. Remove mounting bolts and remove timing chain tensioner (primary).



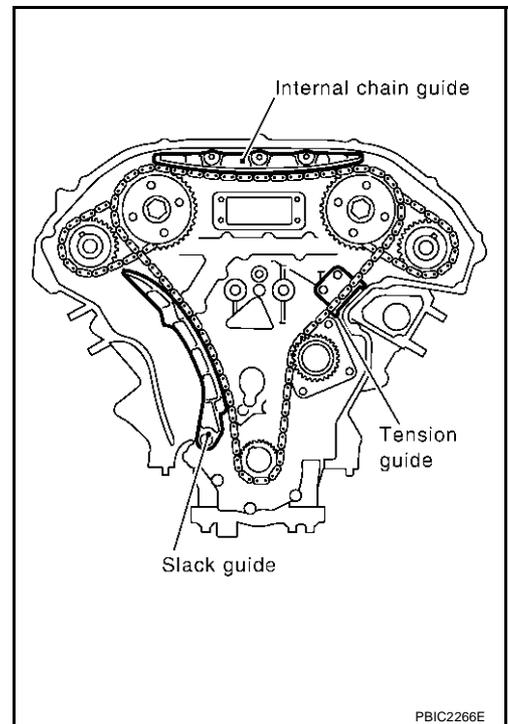
TIMING CHAIN

[VQ35DE]

28. Remove internal chain guide, tension guide and slack guide.

NOTE:

Tension guide can be removed after removing timing chain (primary).



29. Remove timing chain (primary), tension guide and crankshaft sprocket.

CAUTION:

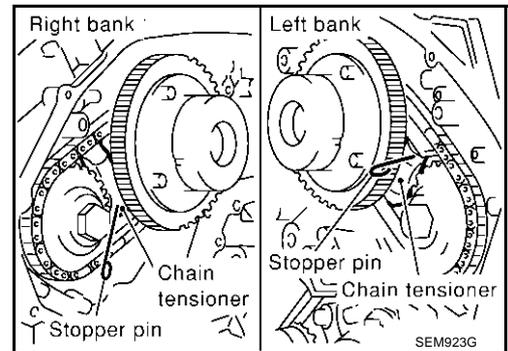
After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.

30. Remove timing chain (secondary) and camshaft sprockets as the following:

- a. Attach a suitable stopper pin to right and left camshaft chain tensioners (for secondary timing chains).

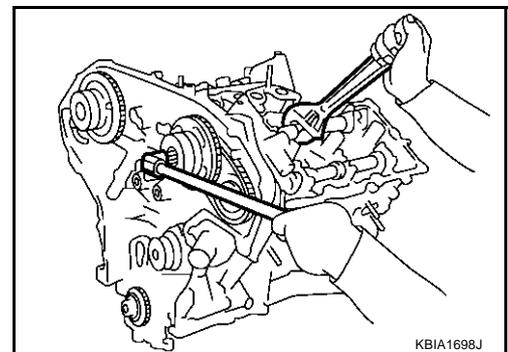
NOTE:

For removal and installation of secondary chain tensioner, refer to [EM-80, "CAMSHAFT"](#). (Removing No. 1 camshaft bracket is required.)



- b. Remove intake and exhaust camshaft sprocket bolts.

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



- c. Remove timing chain (secondary) together with camshaft sprockets.

- Turn camshaft slightly to secure slackness of timing chain on timing chain tensioner (secondary) side.

TIMING CHAIN

[VQ35DE]

- 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.

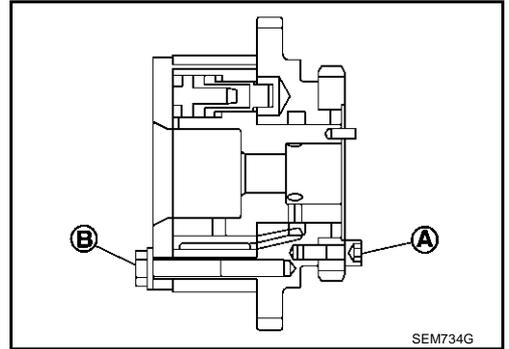
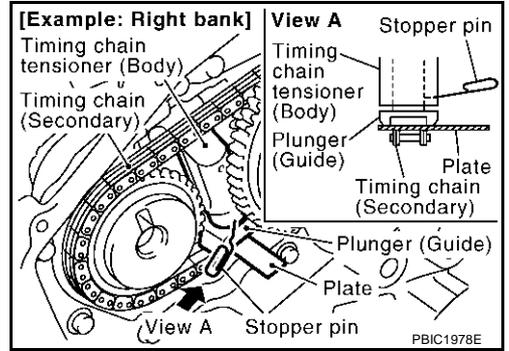
NOTE:

Camshaft sprocket (INT) is two-for-one structure of primary and secondary sprockets.

- When handling camshaft sprocket (INT), be careful of the following:

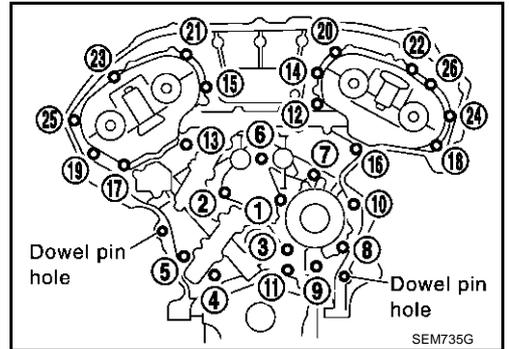
CAUTION:

- Handle carefully to avoid any shock to camshaft sprocket.
- Do not disassemble. (Do not loosen bolts "A" and "B" as shown in the figure).



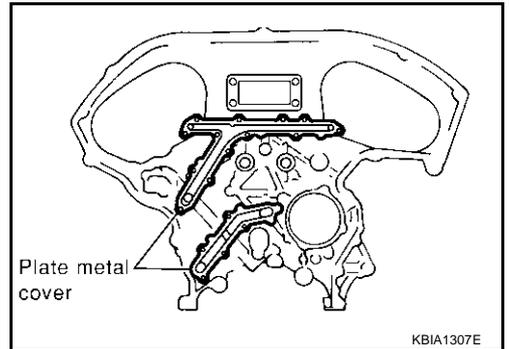
31. Remove rear timing chain case as follows:

- Loosen and remove mounting bolts in reverse order as shown in the figure.
- Cut sealant using a seal cutter [SST: KV10111100 (J-37228)] or an equivalent tool and remove rear timing chain case.



CAUTION:

- Do not remove plate metal cover of engine oil passage.
- After removing chain case, do not apply any load which affects flatness.

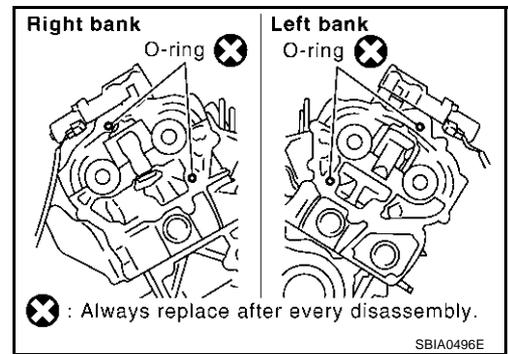


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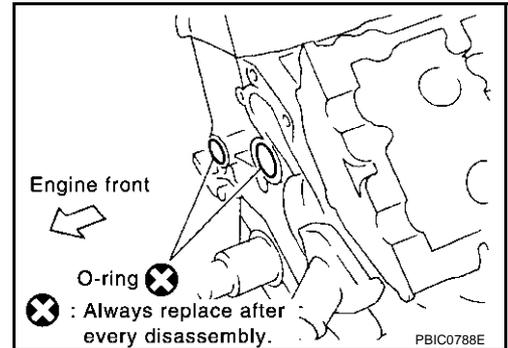
TIMING CHAIN

[VQ35DE]

32. Remove O-rings from cylinder head.



33. Remove O-rings from cylinder block.



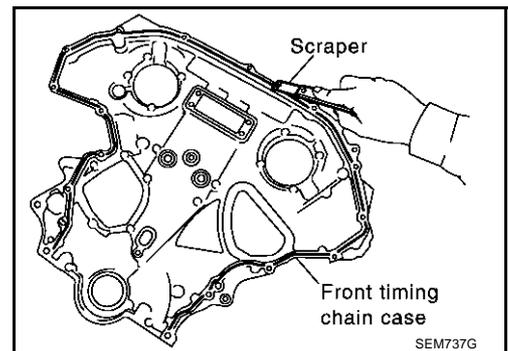
34. Remove timing chain tensioners (secondary) from cylinder head as the following, if necessary.

- a. Remove No. 1 camshaft brackets. Refer to [EM-80, "REMOVAL"](#).
- b. Remove timing chain tensioners (secondary) with stopper pin attached.

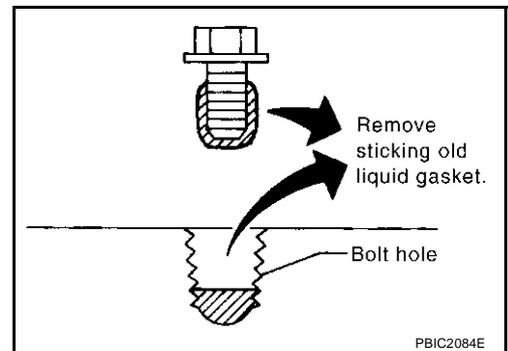
35. Use a scraper to remove all traces of liquid gasket from front and rear timing chain cases, and opposite mating surfaces.

CAUTION:

Be careful not to allow gasket fragments to enter oil pan.



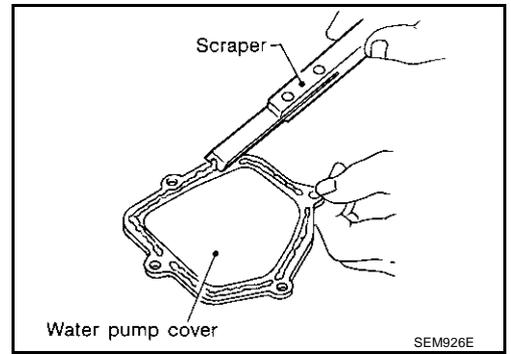
- Remove old liquid gasket from the bolt hole and thread.



TIMING CHAIN

[VQ35DE]

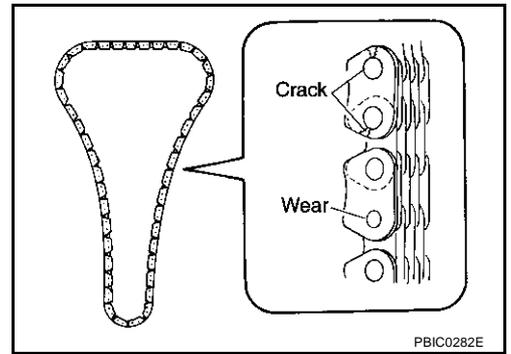
36. Use a scraper to remove all traces of liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.



INSPECTION AFTER REMOVAL

Timing Chain

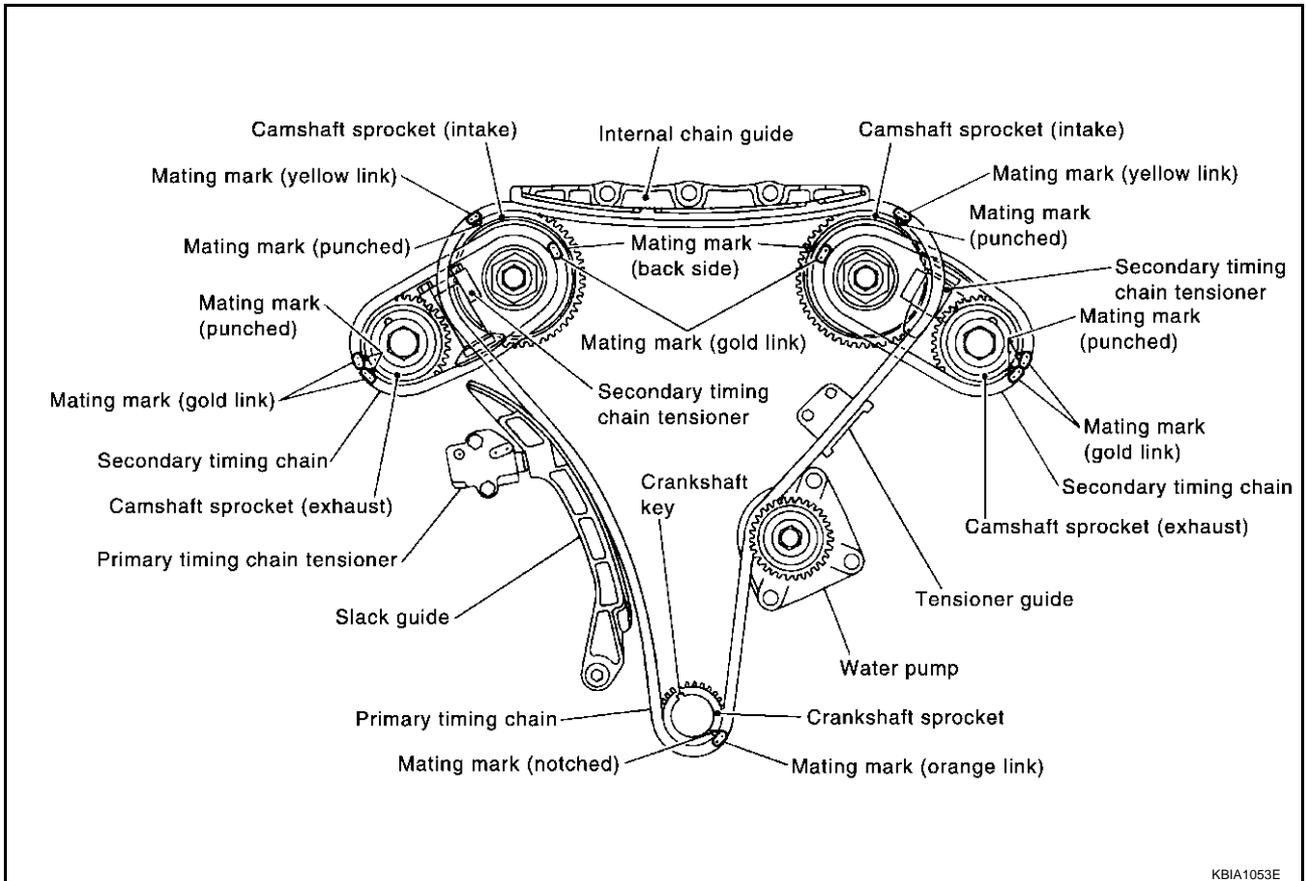
Check for cracks and any excessive wear at link plates and roller links of timing chain. Replace timing chain as necessary.



INSTALLATION

NOTE:

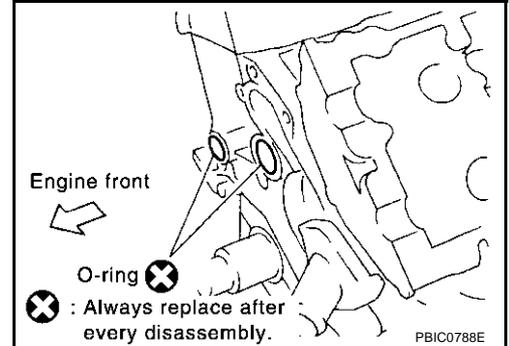
The below figure shows the relationship between the mating mark on each timing chain and that on the corresponding sprocket, with the components installed.



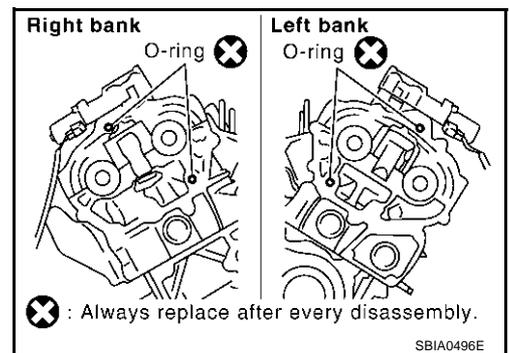
TIMING CHAIN

[VQ35DE]

1. Install timing chain tensioners (secondary) to cylinder head as the following if removed. Refer to [EM-85, "INSTALLATION"](#).
 - a. Install chain tensioners with stopper pin attached and new O-rings.
 - b. Install No. 1 camshaft brackets. Refer to [EM-85, "INSTALLATION"](#).
2. Install new O-rings onto cylinder block.



3. Install new O-rings to cylinder head.

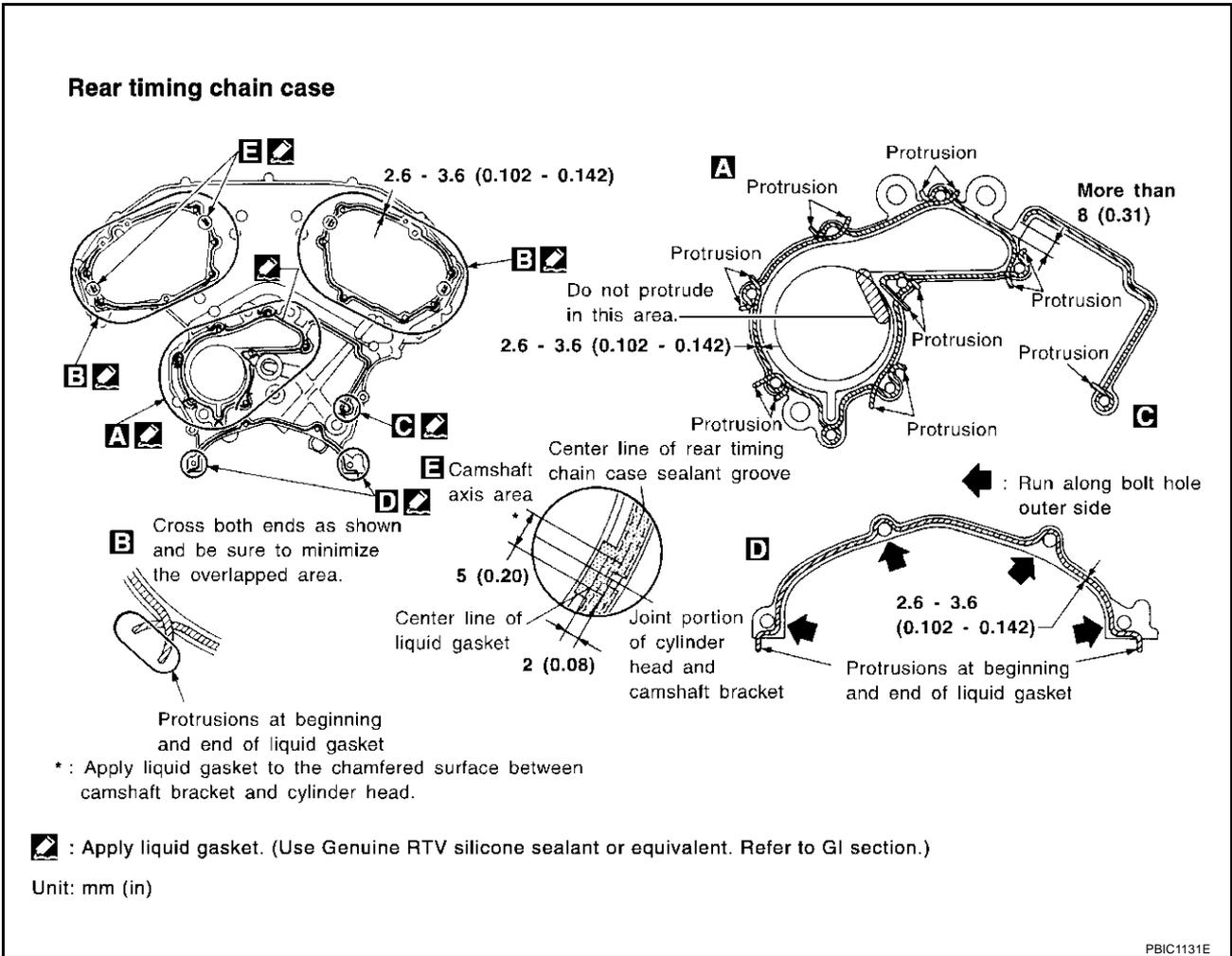


4. Apply liquid gasket to rear timing chain case back side as shown with tube presser [SST: WS39930000 (–)].
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

CAUTION:

- For "A" in the figure, completely wipe out liquid gasket extended on a portion touching at engine coolant.

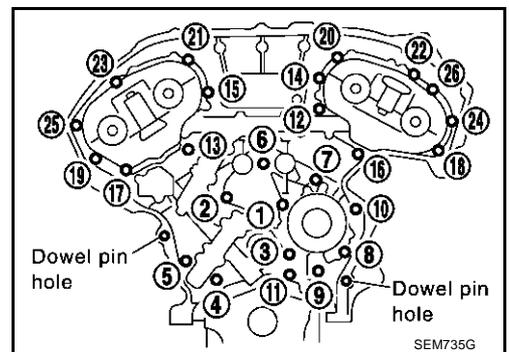
- Apply liquid gasket on installation position of water pump and cylinder head very completely.



- Align rear timing chain case and water pump assembly with dowel pins (right and left) on cylinder block and install case.
 - Make sure O-rings stay in place during installation to cylinder block and cylinder head.

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

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
: 12.7 N·m (1.3 kg·m, 9 ft·lb)	



- After all bolts are temporarily tightened, retighten them to the specification in the numerical order as shown in the figure.
 - If RTV Silicone Sealant protrudes, wipe it off immediately.

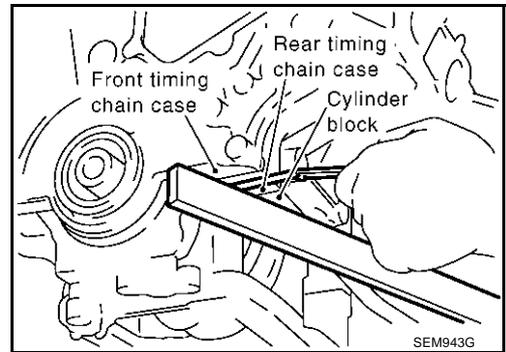
TIMING CHAIN

[VQ35DE]

6. After installing rear timing chain case, check surface height difference between following parts on oil pan mounting surface.

Standard (Rear timing chain case to cylinder block):
-0.24 to 0.14 mm (-0.0094 to 0.0055 in)

- If not within standard, repeat above installation procedure.



7. Position crankshaft so No. 1 piston is set at TDC on the compression stroke.

- Make sure that dowel pin hole, dowel pin and crankshaft key are located as shown.

NOTE:

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

Camshaft dowel pin hole (intake side)

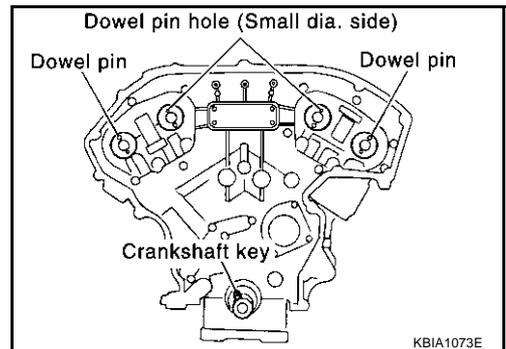
: At cylinder head upper face side in each bank.

Camshaft dowel pin (exhaust side)

: At cylinder head upper face side in each bank.

Crankshaft key

: At cylinder head side of right bank.



CAUTION:

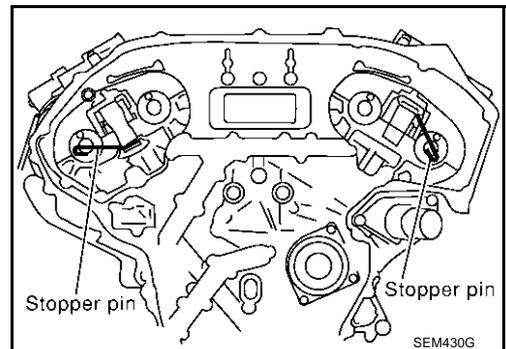
Hole on small dia. side must be used for intake side dowel pin hole. Do not misidentify (ignore big dia. side).

8. Install timing chains (secondary) and camshaft sprockets.

CAUTION:

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

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



TIMING CHAIN

[VQ35DE]

b. Install timing chains (secondary) and camshaft sprockets.

- Align the mating marks on secondary timing chain (gold link) with the ones on intake and exhaust camshaft sprockets (stamped), and install them.

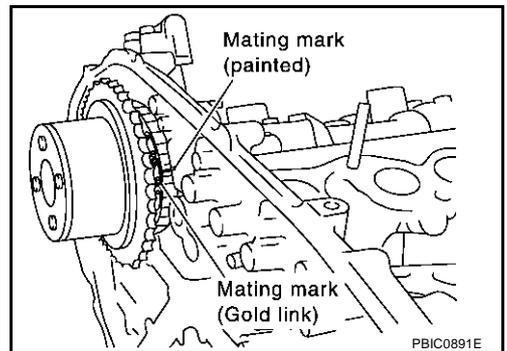
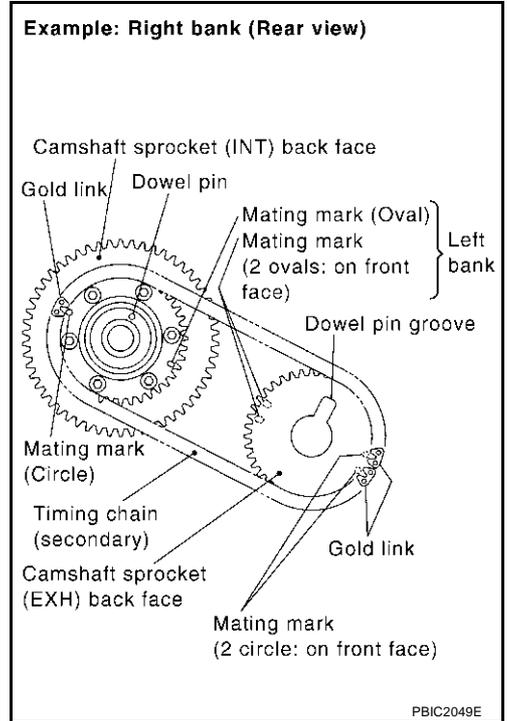
NOTE:

- Mating marks for intake camshaft sprocket are on the back side of secondary camshaft sprocket.
- 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.

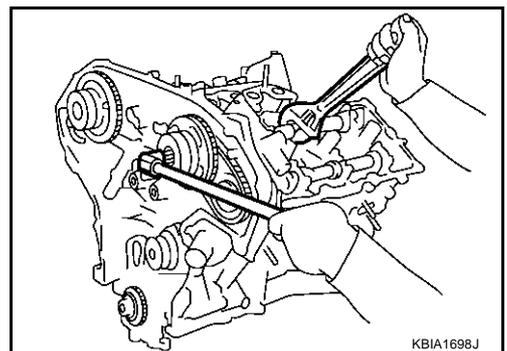
Left bank : use oval type.

- Align dowel pin and pin hole on camshaft with the groove and dowel pin on sprocket, and install them.
- On the intake side, align the pin hole on the small diameter side of 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 the 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.
- Mounting 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.



9. After confirming the mating marks are aligned, tighten camshaft sprocket mounting bolts.

- Secure camshaft using a wrench at the hexagonal portion to tighten mounting bolts.

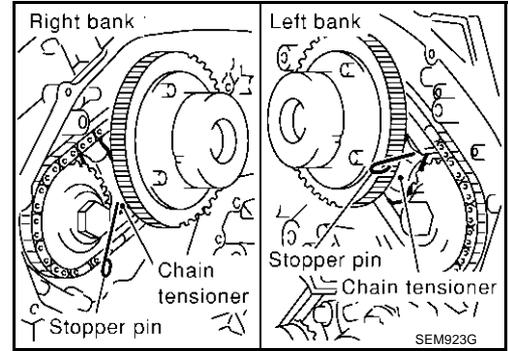


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TIMING CHAIN

[VQ35DE]

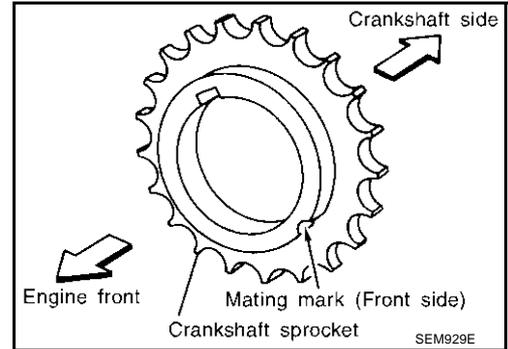
10. Pull stopper pins out from timing chain tensioners (secondary).



11. Install primary timing chain as follows:

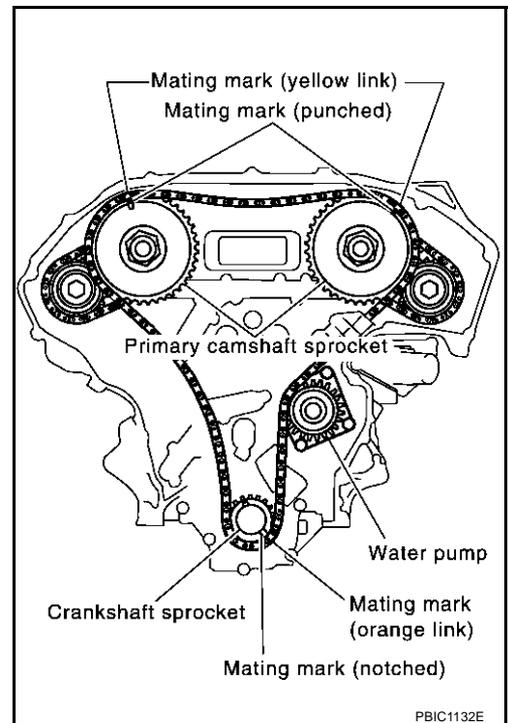
a. Install crankshaft sprocket.

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



b. Install primary timing chain.

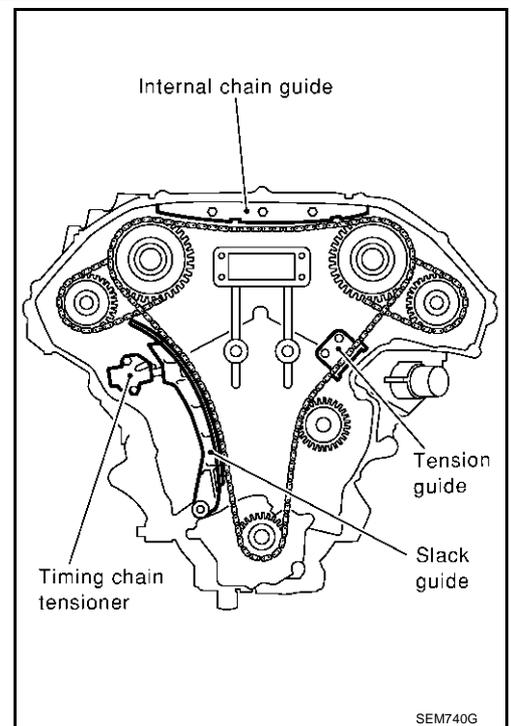
- Install primary timing chain so the mating mark (punched) on camshaft sprocket is aligned with the yellow link on timing chain, while the mating mark (notched) on crankshaft sprocket is aligned with the orange one on timing chain, as shown.
- When it is difficult to align mating marks of primary timing chain with each sprocket, gradually turn 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 secondary timing chains.



TIMING CHAIN

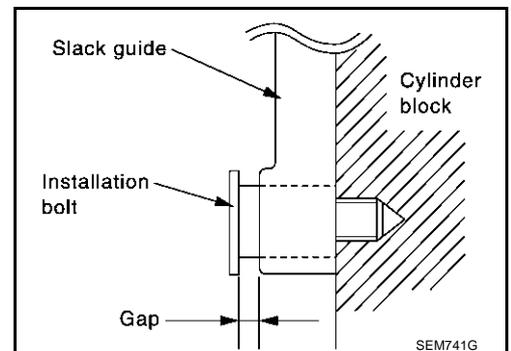
[VQ35DE]

12. Install internal chain guide and timing chain tensioner (primary).
13. Install slack guide.

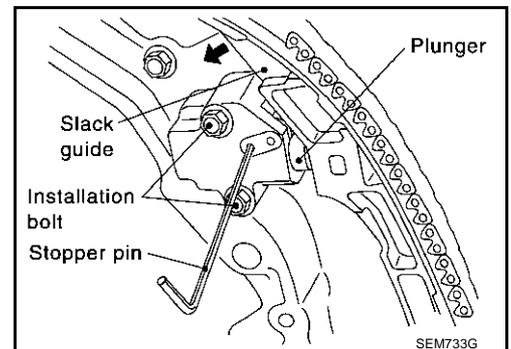


CAUTION:

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



14. Install chain tensioner for slack guide.
 - When installing chain tensioner, push in sleeve and keep it pressed in with stopper pin.
 - Remove any dirt and foreign materials completely from the back and the mounting surfaces of chain tensioner.
 - After installation, pull out stopper pin by pressing slack guide.

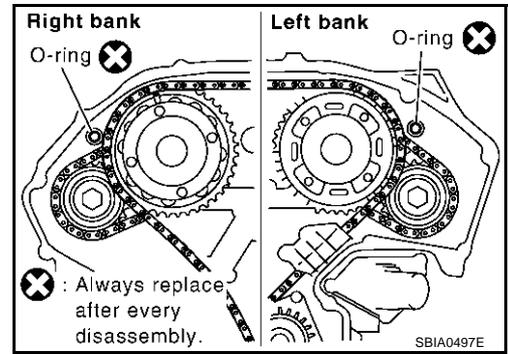


15. Reconfirm that the mating marks on sprockets and timing chain have not slipped out of alignment.

TIMING CHAIN

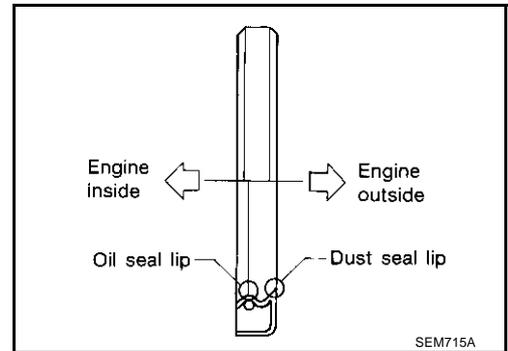
[VQ35DE]

16. Install new O-rings on rear timing chain case.

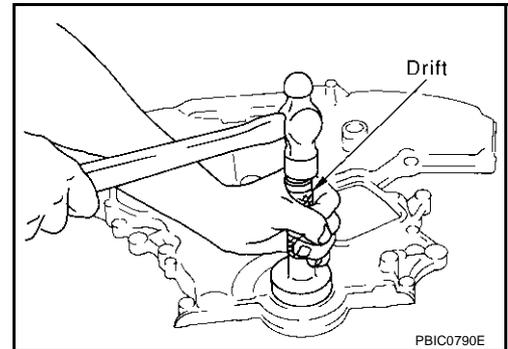


17. Install front oil seal on front timing chain case.

- Apply new engine oil to the oil seal edges.
- Install it so that each seal lip is oriented as shown in the figure.

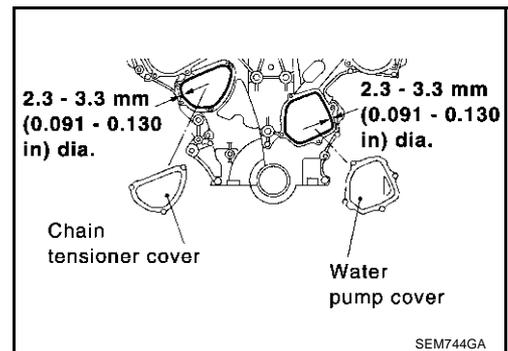


- Using suitable drift, press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



18. Install water pump cover and chain tensioner cover to front timing chain case.

- Apply liquid gasket to front timing chain case front side as shown in the figure with tube presser [SST: WS39930000 (-)].
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

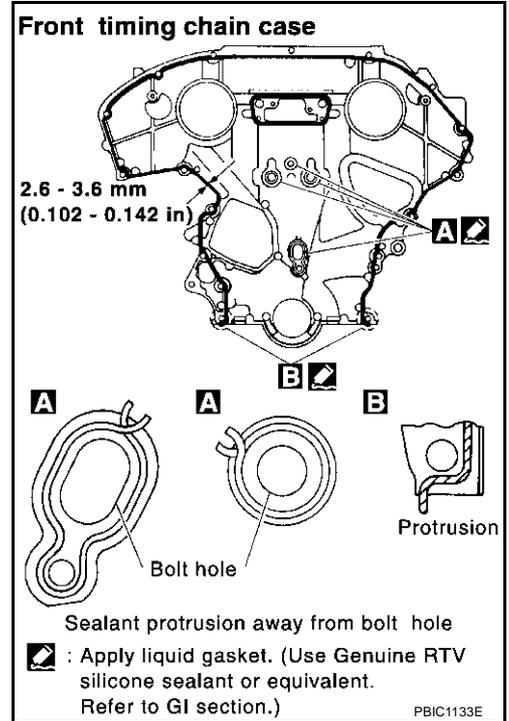


TIMING CHAIN

[VQ35DE]

19. Install front timing chain case as follows:

- Apply liquid gasket to front timing chain case back side as shown in the figure with tube presser [SST: WS39930000 (-)]. **Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**
- Install dowel pin on rear timing chain case into dowel pin hole on front timing chain case.



c. Tighten bolts to the specified torque in order as shown in the figure.

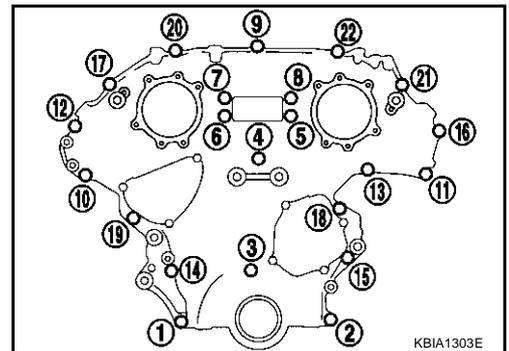
8 mm (0.31 in) dia. bolts : 1, 2

⌚ : 28.4 N·m (2.9 kg·m, 21 ft·lb)

6 mm (0.24 in) dia. bolts : Except the above

⌚ : 12.7 N·m (1.3 kg·m, 9 ft·lb)

d. After tightening, retighten them to specified torque in numerical order as shown in figure.



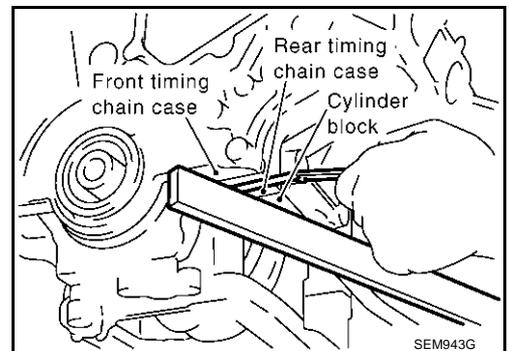
20. After installing front timing chain case, check the surface height difference between the following parts on the oil pan mounting surface.

Standard

Front timing chain case to rear timing chain case:

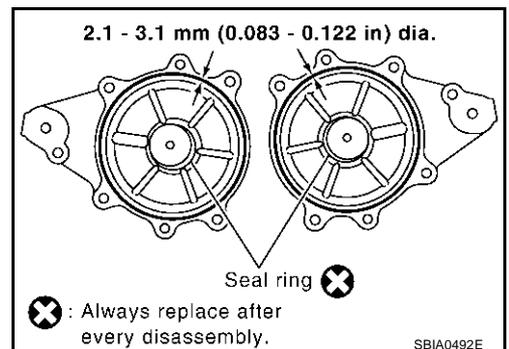
-0.14 to 0.14 mm (-0.005 to 0.0055 in)

- If not within specification, repeat the installation procedure.



21. Install right and left intake valve timing control covers as follows:

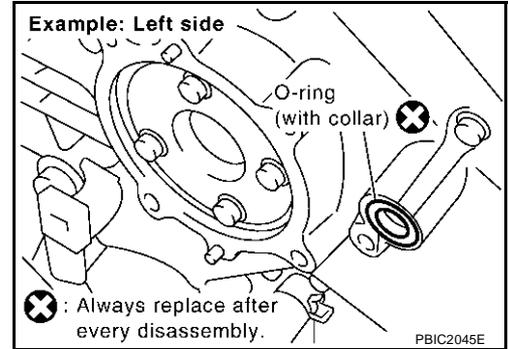
- Install seal rings in shaft grooves.
- Apply liquid gasket to intake valve timing control covers as shown in the figure with tube presser [SST: WS39930000 (-)]. **Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**



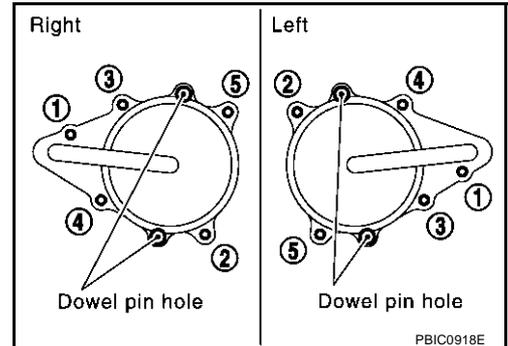
TIMING CHAIN

[VQ35DE]

- c. Install collared O-ring in front cover engine oil hole (left and right sides).



- d. Being careful not to move seal ring from the installation groove, align dowel pins on chain case with the holes to install intake valve timing control covers.
- e. Tighten bolts in the numerical order as shown in the figure.

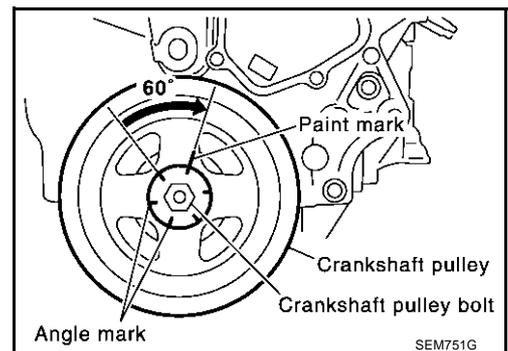


22. Install crankshaft pulley as follows:

- a. Fix crankshaft using ring gear stopper [SST: KV10117700 (J-44716)].
- b. Install crankshaft pulley, taking care not to damage front oil seal.
- When press-fitting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
- c. Tighten bolt.

 : 44.1 N·m (4.5 kg·m, 33 ft·lb)

- d. Put a paint mark on crankshaft pulley aligning with angle mark on crankshaft pulley bolt. Then, further retighten bolt by “60” degrees (equivalent to one graduation).



23. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
24. For the following operations, perform steps in the reverse order of removal.

NOTE:

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

INSPECTION AFTER INSTALLATION

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

TIMING CHAIN

[VQ35DE]

- Warm up engine thoroughly to make sure there is no leakage of engine coolant, engine oil and 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

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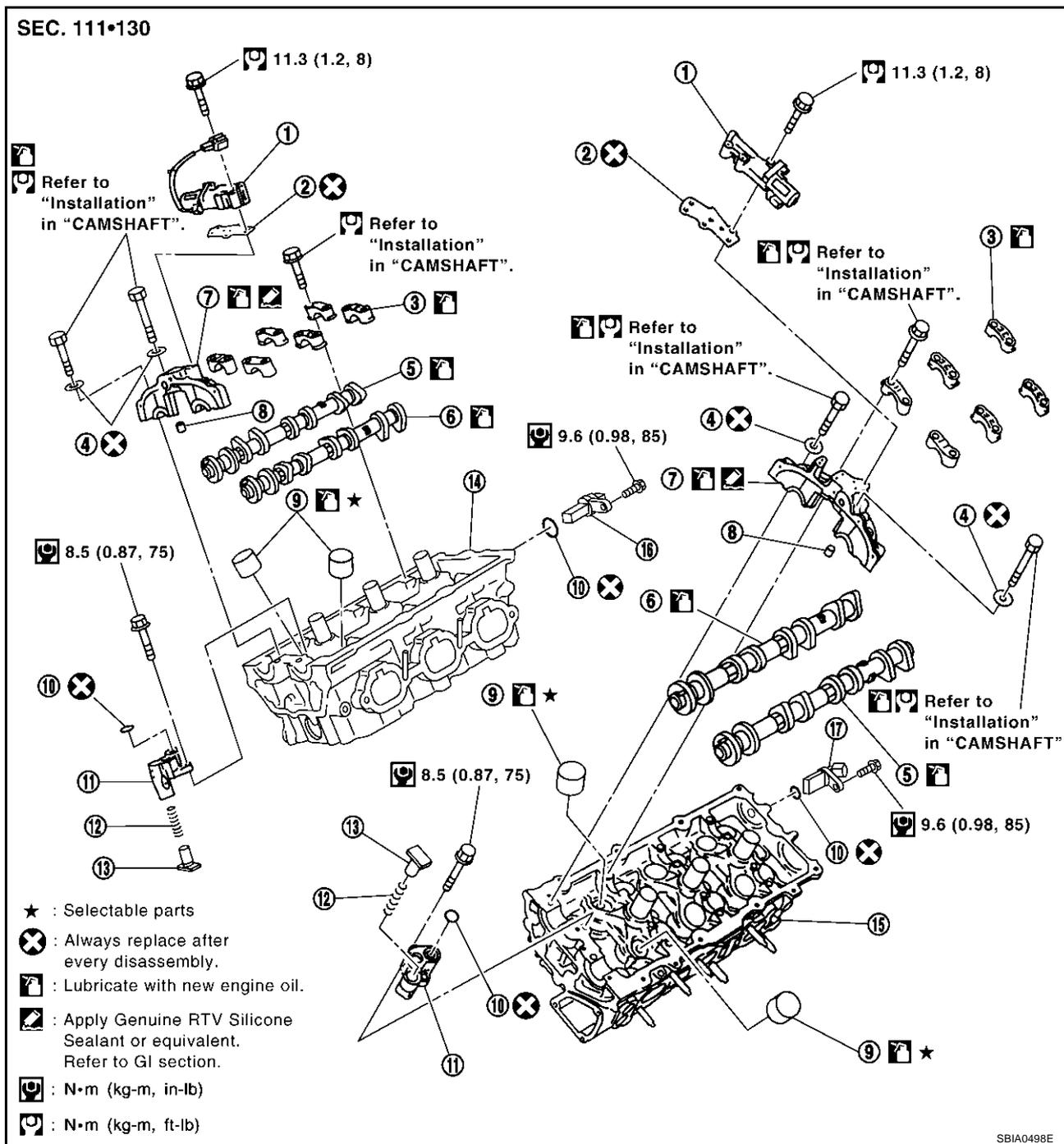
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CAMSHAFT

Removal and Installation



- | | | |
|--|--|--------------------------------------|
| 1. Intake valve timing control valve | 2. Gasket | 3. Camshaft bracket (No. 2 to No. 4) |
| 4. Seal washer | 5. Camshaft (EXH) | 6. Camshaft (INT) |
| 7. Camshaft bracket (No. 1) | 8. Dowel pin | 9. Valve lifter |
| 10. O-ring | 11. Chain tensioner | 12. Spring |
| 13. Plunger | 14. Cylinder head (RH bank) | 15. Cylinder head (LH bank) |
| 16. Camshaft position sensor (PHASE) (RH bank) | 17. Camshaft position sensor (PHASE) (LH bank) | |

REMOVAL

1. Remove front timing chain case, camshaft sprocket, timing chain and rear timing chain case. Refer to [EM-61, "TIMING CHAIN"](#).

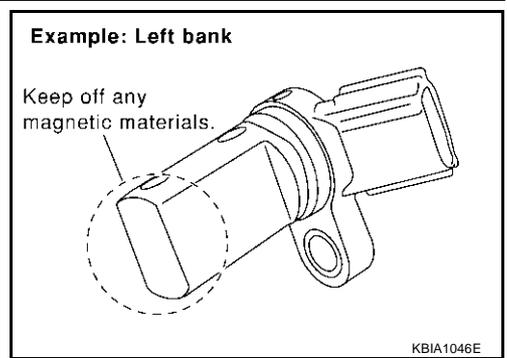
CAMSHAFT

[VQ35DE]

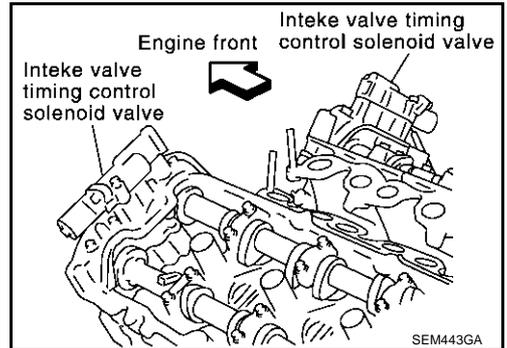
2. If necessary, remove camshaft position sensor (PHASE) (RH and LH banks) from cylinder head back side.

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.

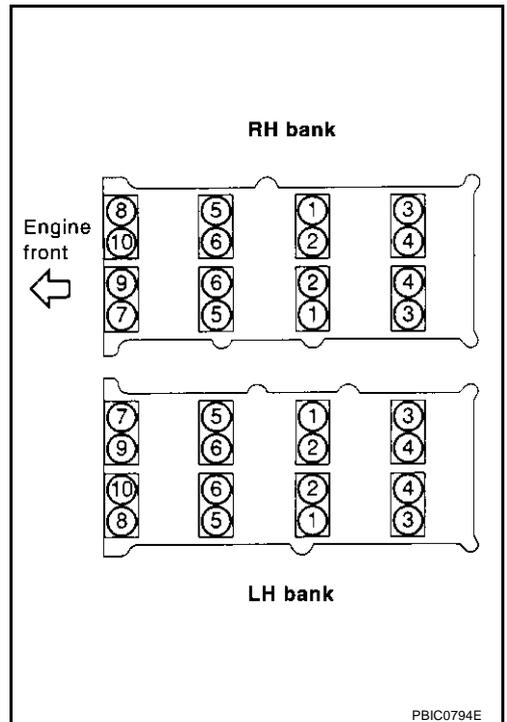


3. Remove intake valve timing control solenoid valve from No.1 camshaft bracket.



4. Remove intake and exhaust camshaft brackets.

- Mark the camshafts, camshaft brackets, and bolts so they are placed in the same position and direction for installation.
- Equally loosen the camshaft bracket bolts in several steps in the reverse order as shown in the figure.



5. Remove camshaft.
6. Remove valve lifter.
- Identify installation positions, and store them without mixing them up.

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CAMSHAFT

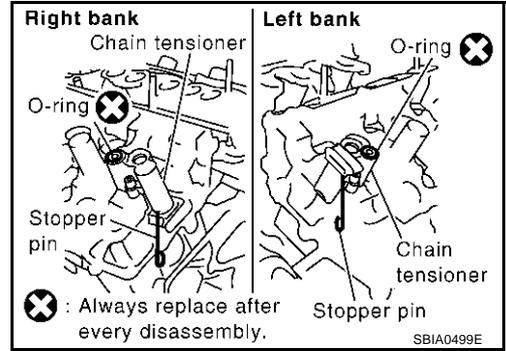
[VQ35DE]

7. Remove secondary timing chain tensioner from cylinder head.

- Remove chain tensioner with its stopper pin attached.

NOTE:

Stopper pin was attached when secondary timing chain was removed.



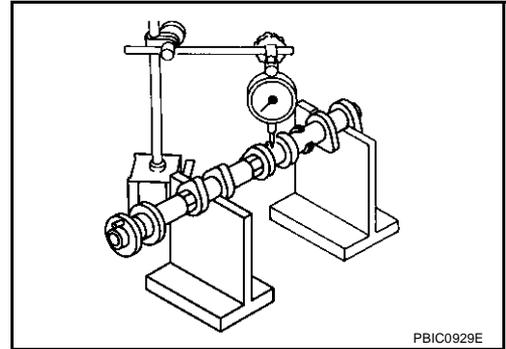
INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put V block on precise flat bed, and support No. 2 and No. 4 journal of camshaft.
2. Set dial gauge vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure camshaft runout on dial gauge. (Total indicator reading)

Standard : Less than 0.05 mm (0.0020 in)

4. If it exceeds the limit, replace camshaft.



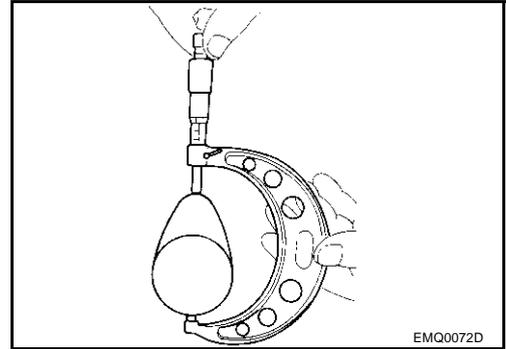
Camshaft Cam Height

1. Measure camshaft cam height.

**Standard cam height (intake and exhaust)
: 44.865 - 45.055 mm (1.7663 - 1.7738 in)**

**Cam wear limit
: 0.2 mm (0.008 in)**

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



Camshaft Journal Clearance

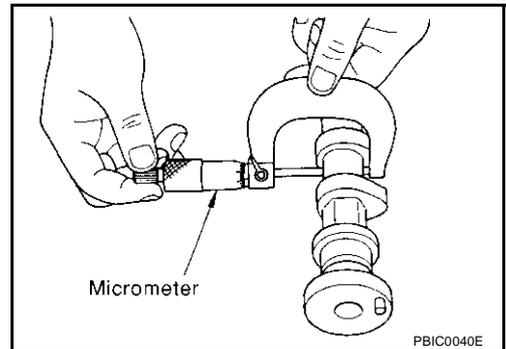
Outer Diameter of Camshaft Journal

Measure outer diameter of camshaft journal.

Standard outer diameter:

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)



Inner Diameter of Camshaft Bracket

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

Standard inner diameter:

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)

Calculation of Camshaft Journal Clearance

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

Standard:

No. 1 : 0.045 - 0.086 mm (0.0018 - 0.0034 in)

No. 2, 3, 4 : 0.035 - 0.076 mm (0.0014 - 0.0030 in)

Limit : 0.15 mm (0.0059 in)

When out of the limit, replace either or both camshaft and cylinder head.

NOTE:

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

Camshaft End Play

- Install dial indicator in thrust direction on front end of camshaft. Measure 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.

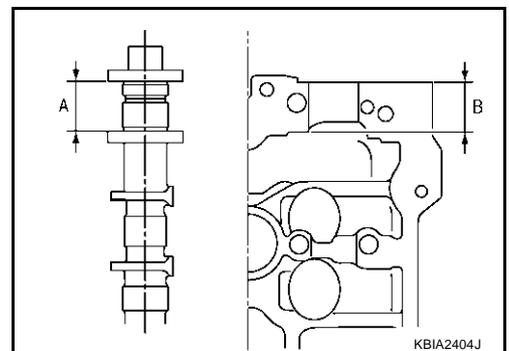
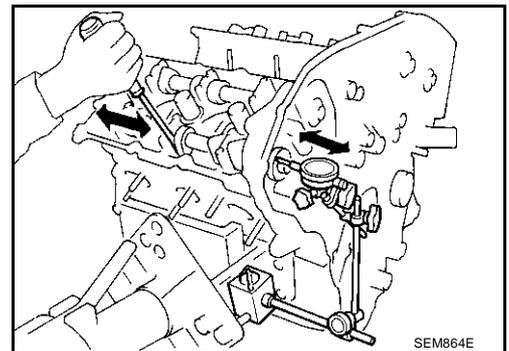
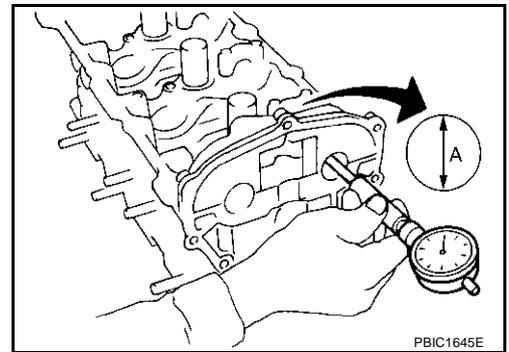
- Dimension "A" for camshaft No. 1 journal

Standard : 27.500 - 27.548 mm (1.0827 - 1.0846 in)

- Dimension "B" for cylinder head No. 1 journal

Standard : 27.360 - 27.385 mm (1.0772 - 1.0781 in)

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



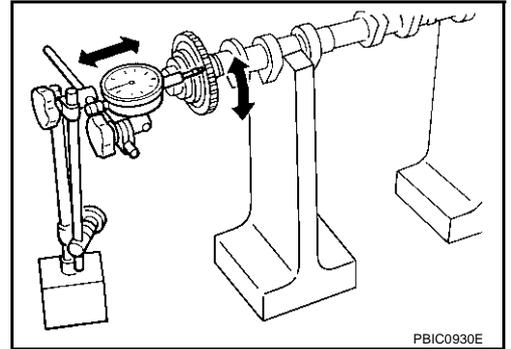
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Camshaft Sprocket Runout

- Put V block on precise flat bed, and support No. 2 and No.4 journal of camshaft.
- Using dial gauge and measure camshaft sprocket runout. (Total indicator reading)

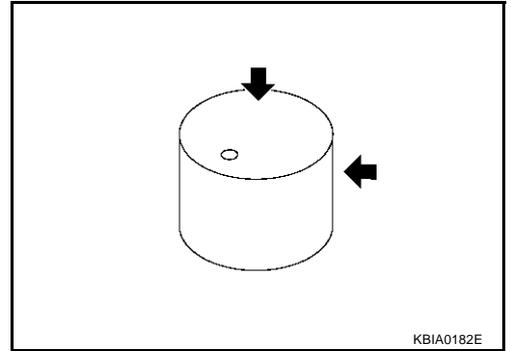
Limit : 0.15 mm (0.0059 in)

- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

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



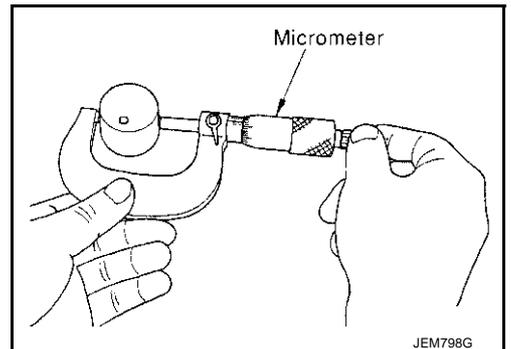
Valve Lifter Clearance

Outer Diameter of Valve Lifter

Measure outer diameter at 1/2 height of valve lifter with micrometer since valve lifter is in barrel shape.

Valve lifter outer diameter (Intake and exhaust)

: 33.977 - 33.987 mm (1.3377 - 1.3381 in)



Valve Lifter Hole Diameter

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

Standard (Intake and exhaust)

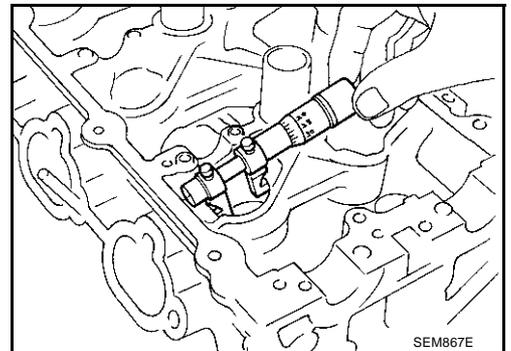
: 34.000 - 34.016 mm (1.3386 - 1.3392 in)

Calculation of Valve Lifter Clearance

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

Standard (Intake and exhaust)

: 0.013 - 0.039 mm (0.0005 - 0.0015 in)

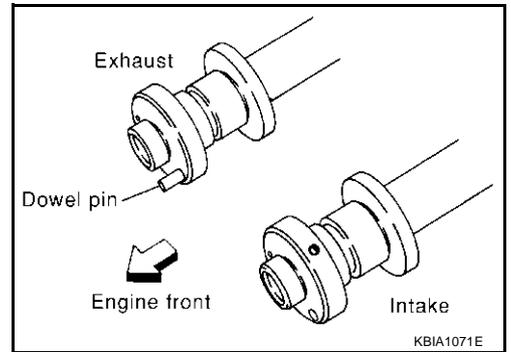
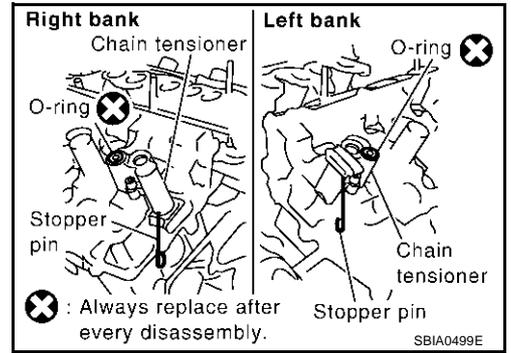


When out of specified range, referring to each specification of outer and inner diameter, replace either or both valve lifter and cylinder head.

INSTALLATION

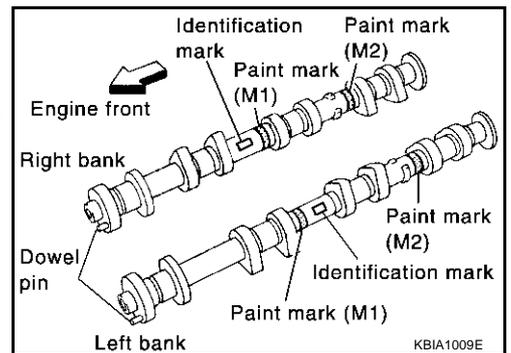
1. Install secondary chain tensioners on both sides of cylinder head.
 - Install chain tensioner with its stopper pin attached.
 - Install tensioner with sliding part facing downward on right-side cylinder head, and with sliding part facing upward on left-side cylinder head.
 - Install new O-ring as shown in the figure.

2. Install valve lifter.
 - 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 the new camshafts for proper placement and direction.

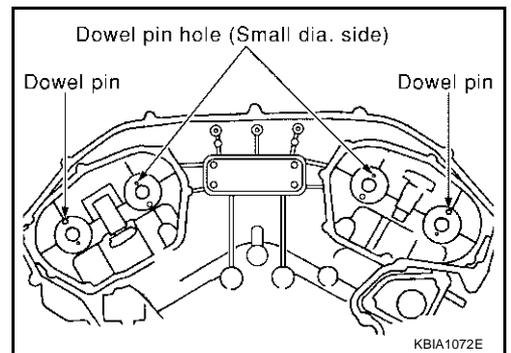
Bank	INT/EXH	Dowel pin	Paint marks		Identification mark
			M1	M2	
RH	INT	No	Pink	No	RE
	EXH	Yes	No	Orange	RE
LH	INT	No	Pink	No	LH
	EXH	Yes	No	Orange	LH



- Install camshaft so that dowel pin hole and dowel pin on front end face are positioned as shown in the figure. (No. 1 cylinder TDC on its compression stroke)

NOTE:

Large- and small-pin holes are located on front end face of intake camshaft, at intervals of 180°. Face small dia. side pin hole upward (in cylinder head upper face direction).

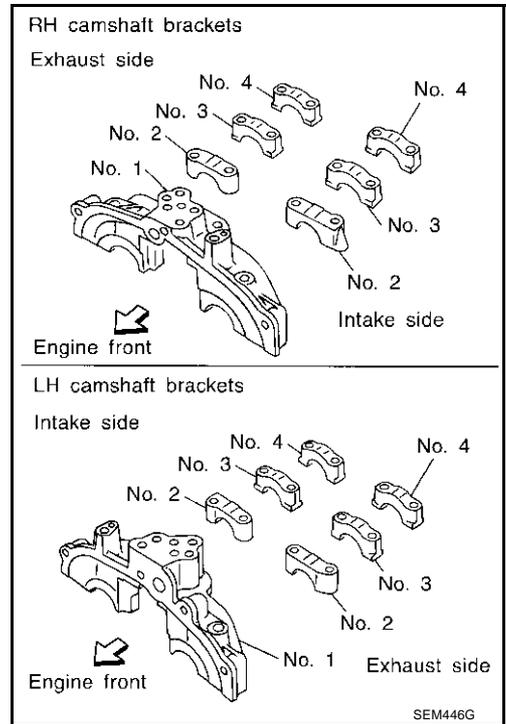


CAMSHAFT

[VQ35DE]

4. Install camshaft brackets.

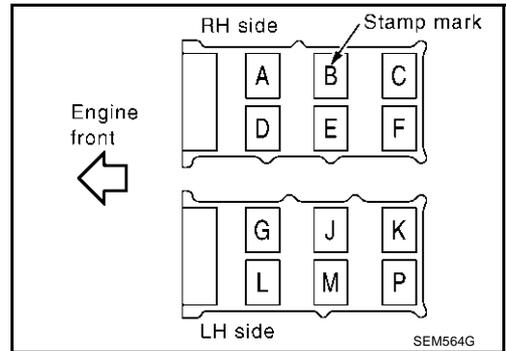
- Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
- Install camshaft bracket in original position and direction as shown in the figure.



- Install No. 2 to 4 camshaft brackets aligning the stamp marks as shown in the figure.

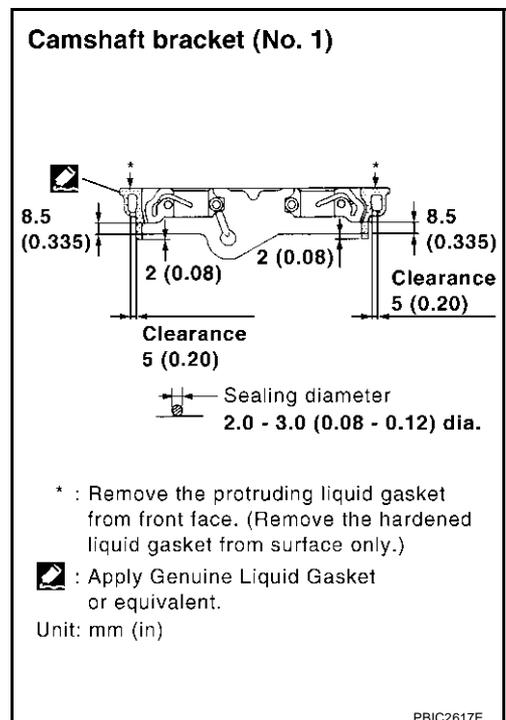
NOTE:

There are no identification marks indicating left and right for No. 1 camshaft bracket.



- Apply sealant to mating surface of No. 1 camshaft bracket as shown in the figure on RH and LH banks.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



CAMSHAFT

[VQ35DE]

5. Tighten the camshaft brackets in the following steps, in numerical order as shown the figure.
 - a. Tighten No. 7 to 10, then tighten No. 1 to 6 in order as shown.

 : 1.96 N-m (0.20 kg-m, 1 ft-lb)

- b. Tighten all bolts in numerical order as shown.

 : 5.88 N-m (0.60 kg-m, 4 ft-lb)

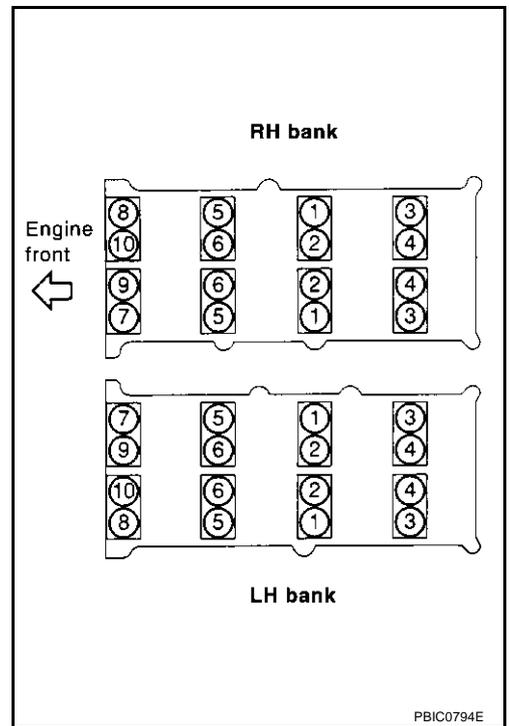
- c. Tighten all bolts in the numerical order as shown.

 : 10.4 N-m (1.1 kg-m, 8 ft-lb)

CAUTION:

After tightening mounting bolts of No. 1 camshaft brackets, be sure to wipe off excessive liquid gasket from the parts list below.

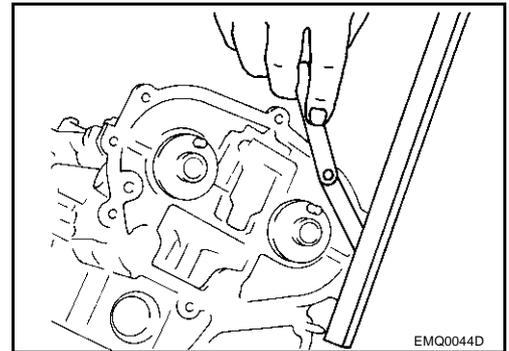
- Mating surface of rocker cover
- Mating surface of rear timing chain case



6. Measure difference in levels between front end faces of No. 1 camshaft bracket and cylinder head.

Standard : -0.14 to 0.14 mm (-0.0055 to 0.0055 in)

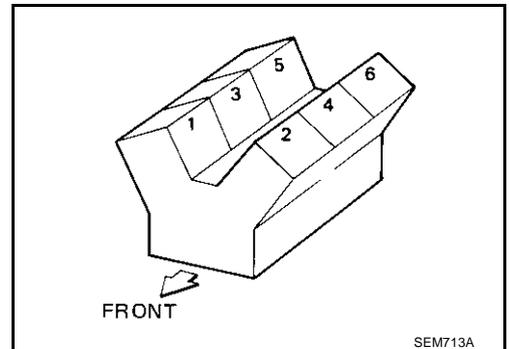
- If measurement is outside the specified range, re-install camshaft and camshaft bracket.



7. Inspect and adjust valve clearance. Refer to [EM-87, "Valve Clearance"](#).
8. Install in the reverse order of removal after this step.

Valve Clearance 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 RH and LH rocker covers with power tool. Refer to [EM-49, "ROCKER COVER"](#).

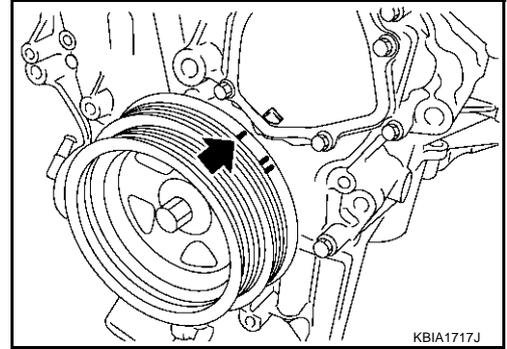
CAMSHAFT

[VQ35DE]

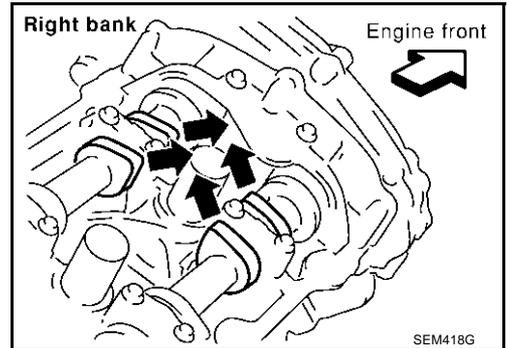
2. Measure valve clearance as below:

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

- Align crankshaft pulley timing mark (grooved line without color) with timing indicator.



- Make sure No. 1 cylinder intake and exhaust cam nose is facing in direction as shown in the figure.
- If not, rotate crankshaft pulley 360° clockwise (when viewed from front).

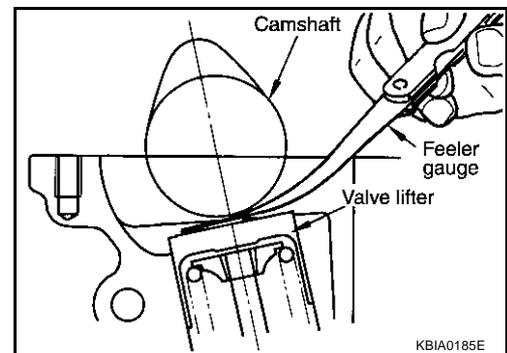
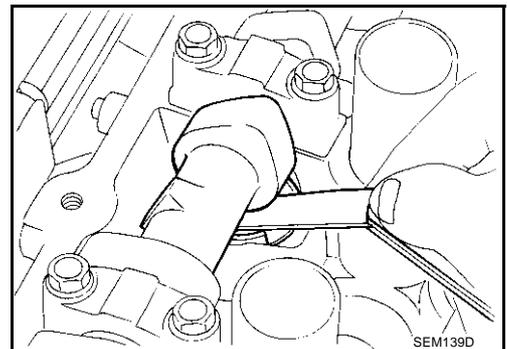


b. Using a feeler gauge, measure valve clearance.

Valve clearance standard:

Cold	Intake	: 0.26 - 0.34 mm (0.010 - 0.013 in)
	Exhaust	: 0.29 - 0.37 mm (0.011 - 0.015 in)
Hot*	Intake	: 0.304 - 0.416 mm (0.012 - 0.016 in)
	Exhaust	: 0.308 - 0.432 mm (0.012 - 0.016 in)

*: Approximately 80°C (176°F) (Reference data)

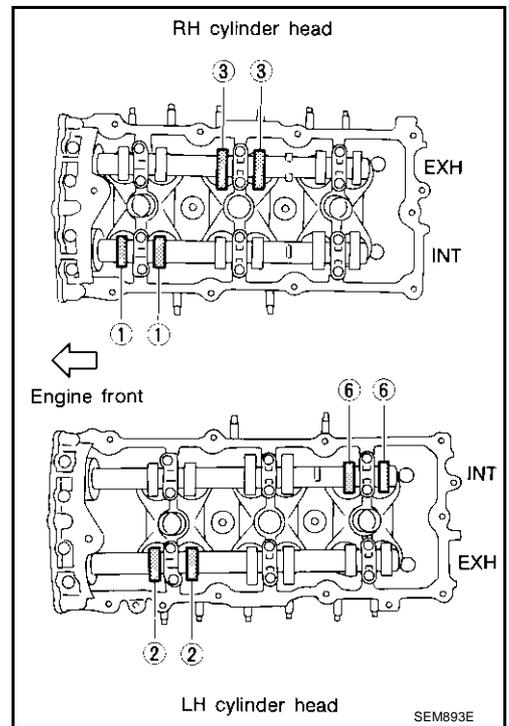


CAMSHAFT

[VQ35DE]

● No. 1 cylinder at compression TDC

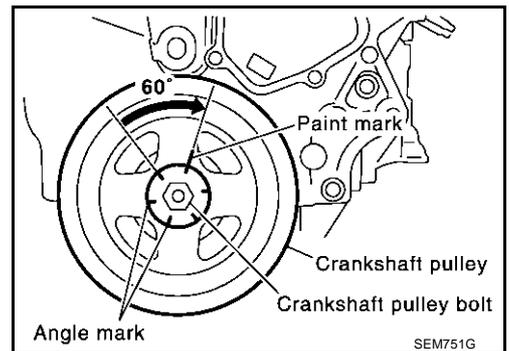
Measuring position (RH bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 1 cylinder at TDC	EXH		×	
	INT	×		
Measuring position (LH bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 1 cylinder at TDC	INT			×
	EXH	×		



- c. Rotate crankshaft by 240° clockwise (when viewed from front) to align No. 3 cylinder at TDC of its compression stroke.

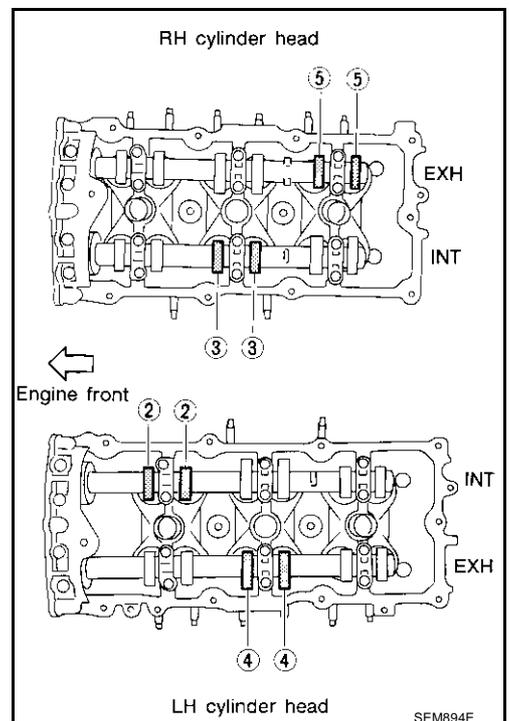
NOTE:

Crankshaft pulley mounting bolt flange has a stamped line every 60°. They can be used as a guide to rotation angle.



● No. 3 cylinder at compression TDC

Measuring position (RH bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 3 cylinder at TDC	EXH			×
	INT		×	
Measuring position (LH bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 3 cylinder at TDC	INT	×		
	EXH		×	



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CAMSHAFT

[VQ35DE]

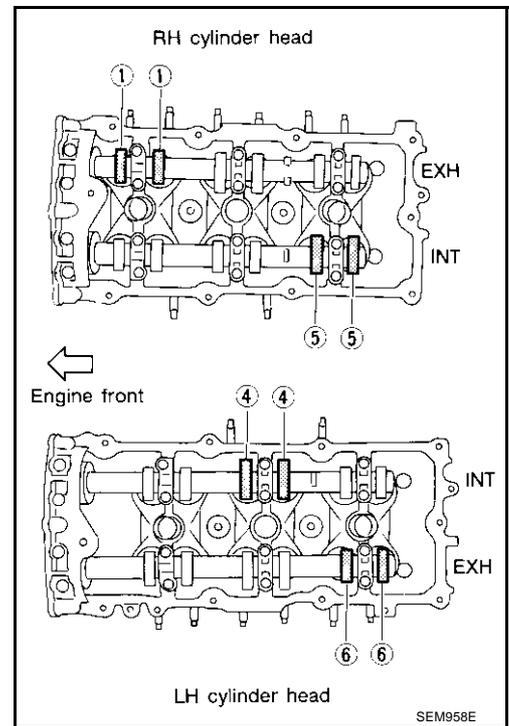
- d. Turn crankshaft pulley clockwise by 240° from the position of No. 5 cylinder at compression TDC.

Measuring position (RH bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 5 cylinder at TDC	EXH	×		
	INT			×
Measuring position (LH bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 5 cylinder at TDC	INT		×	
	EXH			×

CAUTION:

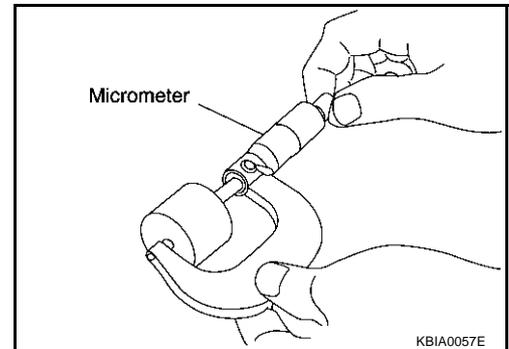
If inspection was carried out with cold engine, make sure values with fully warmed up engine are still within specifications.

3. For measurements that are outside the specified range, perform adjustment below.



ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
 - The specified valve lifter thickness is the dimension at normal temperatures. Ignore dimensional differences caused by temperature. Use the specifications for hot engine condition to adjust.
1. Remove camshaft. Refer to [EM-80, "REMOVAL"](#).
 2. Remove the valve lifters at the locations that are outside the standard.
 3. Measure the center thickness of the removed valve lifters with a micrometer.



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

- Valve lifter thickness calculation:
 Thickness of replacement valve lifter = t1+ (C1 - C2)
 t1 = Thickness of removed valve lifter
 C1 = Measured valve clearance
 C2= Standard valve clearance:

Intake : 0.30 mm (0.012 in)*

Exhaust : 0.33 mm (0.013 in)*

***: Approximately 20°C (68°F)**

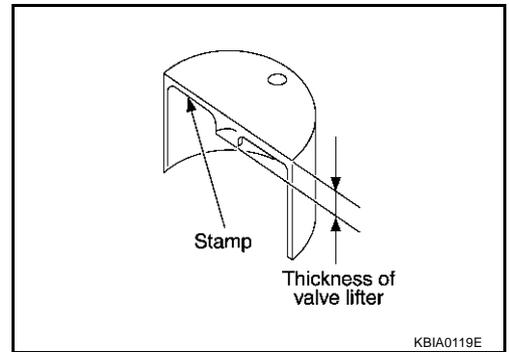
CAMSHAFT

[VQ35DE]

- Thickness of a new valve lifter can be identified by stamp marks on the reverse side (inside the cylinder). Stamp mark 788U or 788R indicates 7.88 mm (0.3102 in) in thickness.

NOTE:

2 types of stamp marks are used for parallel setting and for manufacturer identification.



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-147, "Available Valve Lifter"](#).

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

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 - 0.016)

*: Approximately 80°C (176°F)

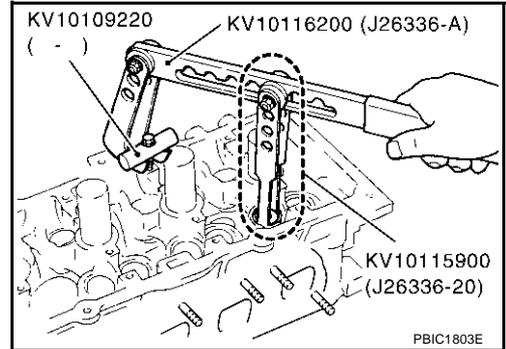
OIL SEAL

PFP:00100

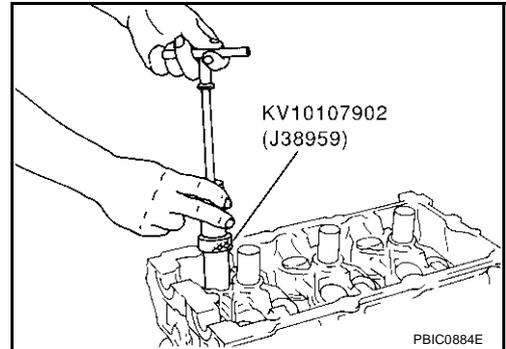
Removal and Installation of Valve Oil Seal REMOVAL

ABS004X4

1. Remove camshaft relating to valve oil seal to be removed. Refer to [EM-80, "CAMSHAFT"](#) .
2. Remove valve lifters. Refer to [EM-80, "CAMSHAFT"](#) .
3. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent the valve from dropping into cylinder.
4. Using valve spring compressor, attachment and adapter (SST), remove valve collet with magnet hand. Then remove valve spring and valve spring seat.



5. Remove valve oil seal using valve oil seal puller (SST).



INSTALLATION

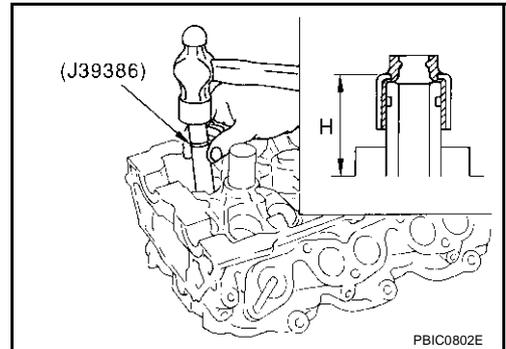
1. Apply engine oil on new valve oil seal joint and seal lip.
2. Using valve oil seal drift (SST), press fit valve seal to height "H" shown in figure.

NOTE:

Dimension "H": Height measured before valve spring seat installation

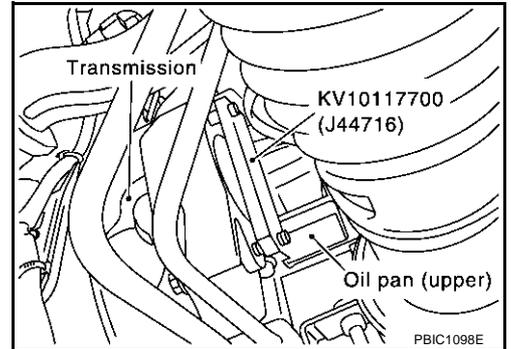
Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)

3. Perform steps in the reverse order of removal for the following operations.

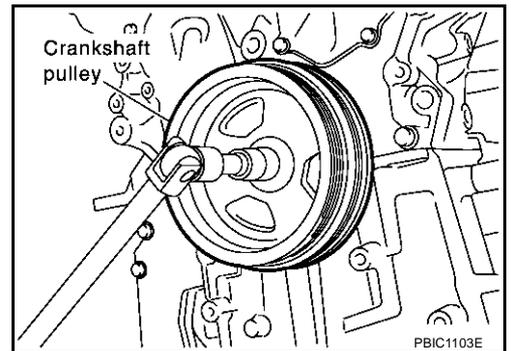


Removal and Installation of Front Oil Seal REMOVAL

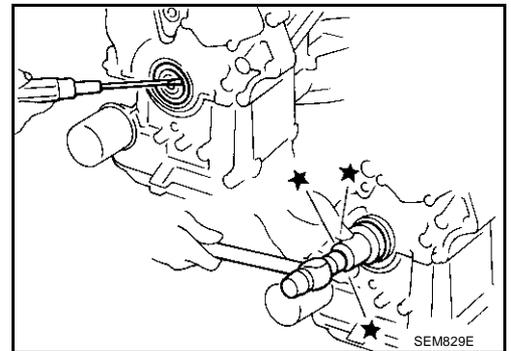
1. Remove the following parts:
 - Front engine undercover (With power tool)
 - Drive belt; Refer to [EM-15, "DRIVE BELTS"](#) .
2. Remove rear cover plate (2WD) or starter motor (AWD) and set ring gear stopper (SST).



3. Remove crankshaft pulley



4. Remove front oil seal using a suitable tool.
CAUTION:
Be careful not to damage front timing chain case and crankshaft.



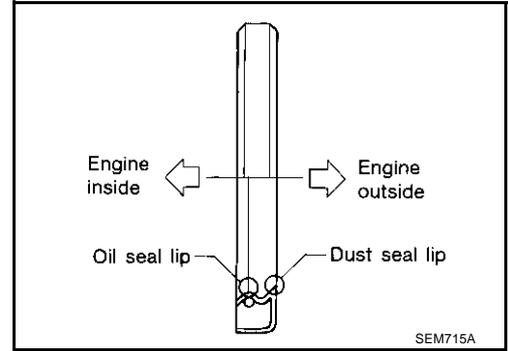
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INSTALLATION

1. Apply engine oil on new front oil seal.
2. Using a suitable drift, press fit until the height of front oil seal is level with the mounting surface.
 - Suitable drift: outer diameter 59 mm (2.32 in), inner diameter 49 mm (1.93 in).

CAUTION:

Press fit straight and avoid causing burrs or tilting oil seal.



3. Perform steps in the reverse order of removal for the following operations.

Removal and Installation of Rear Oil Seal

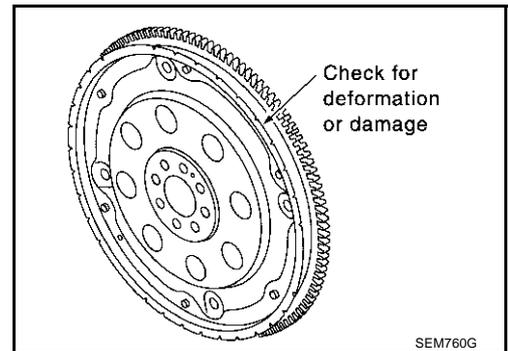
ABS004X6

REMOVAL

1. Remove oil pan (upper). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).
2. Remove transmission assembly. Refer to [AT-269, "TRANSMISSION ASSEMBLY"](#).
3. Remove drive plate with power tool. Fix crankshaft with a ring gear stopper [SST: KV1011770 (J-44716)], and remove mounting bolts.
 - Loosen mounting bolts in diagonal order.

CAUTION:

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



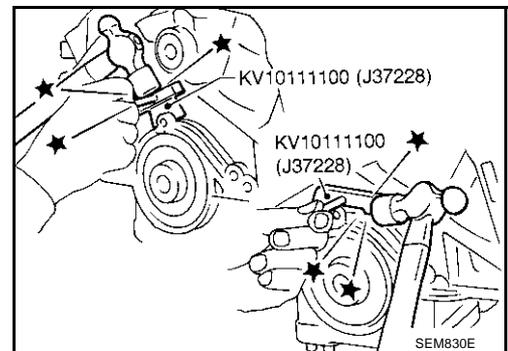
4. Use a seal cutter (SST) to cut away liquid gasket and remove rear oil seal retainer.

CAUTION:

Be careful not to damage mounting surface.

NOTE:

Rear oil seal and retainer form a single part and are handled as an assembly.



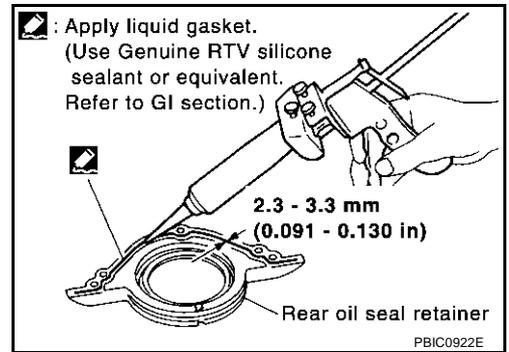
INSTALLATION

1. Remove old liquid gasket on mating surface of cylinder block and oil pan using scraper.

OIL SEAL

[VQ35DE]

2. Apply new engine oil to the oil and dust seal lips.
3. Apply liquid gasket to rear oil seal retainer with tube presser [SST: WS39930000 (-)] as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
 - Assembly should be done within 5 minutes after coating.



4. Install rear oil seal retainer to cylinder block.
5. Perform steps in the reverse order of removal for the following operations.

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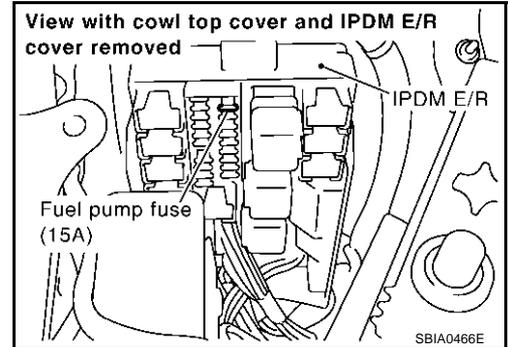
CYLINDER HEAD

PFP:11041

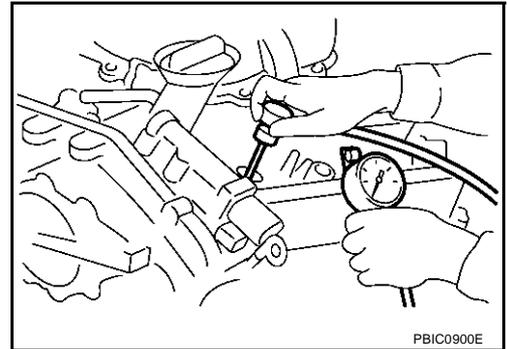
On-Vehicle Service CHECKING COMPRESSION PRESSURE

ABS004X7

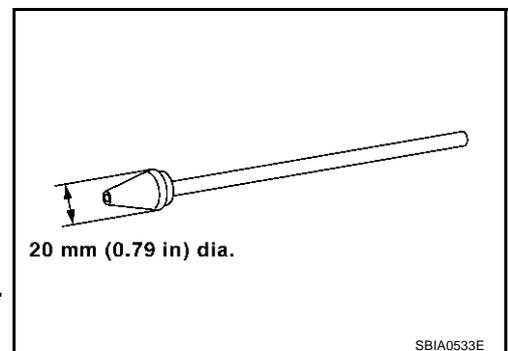
1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-65, "FUEL PRESSURE RELEASE"](#).
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.



4. Remove engine cover with power tool. Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#).
5. Remove ignition coil and spark plug from each cylinder. Refer to [EM-40, "IGNITION COIL"](#) and [EM-41, "SPARK PLUG \(PLATINUM-TIPPED TYPE\)"](#).
6. Connect engine tachometer (not required in use of CONSULT-II).
7. Install compression gauge with compression gauge adapter (commercial service tool) onto spark plug hole.



- Use compression gauge 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.
8. With accelerator pedal fully depressed, 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.



Unit: kPa (kg/cm², psi) /rpm

Standard	Minimum	Deference limit between cylinders
1,275 (13.0, 185) / 300	981 (10.0, 142) / 300	98 (1.0, 14) / 300

CAUTION:

Always use a fully charged 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 cylinder to re-check it for compression.

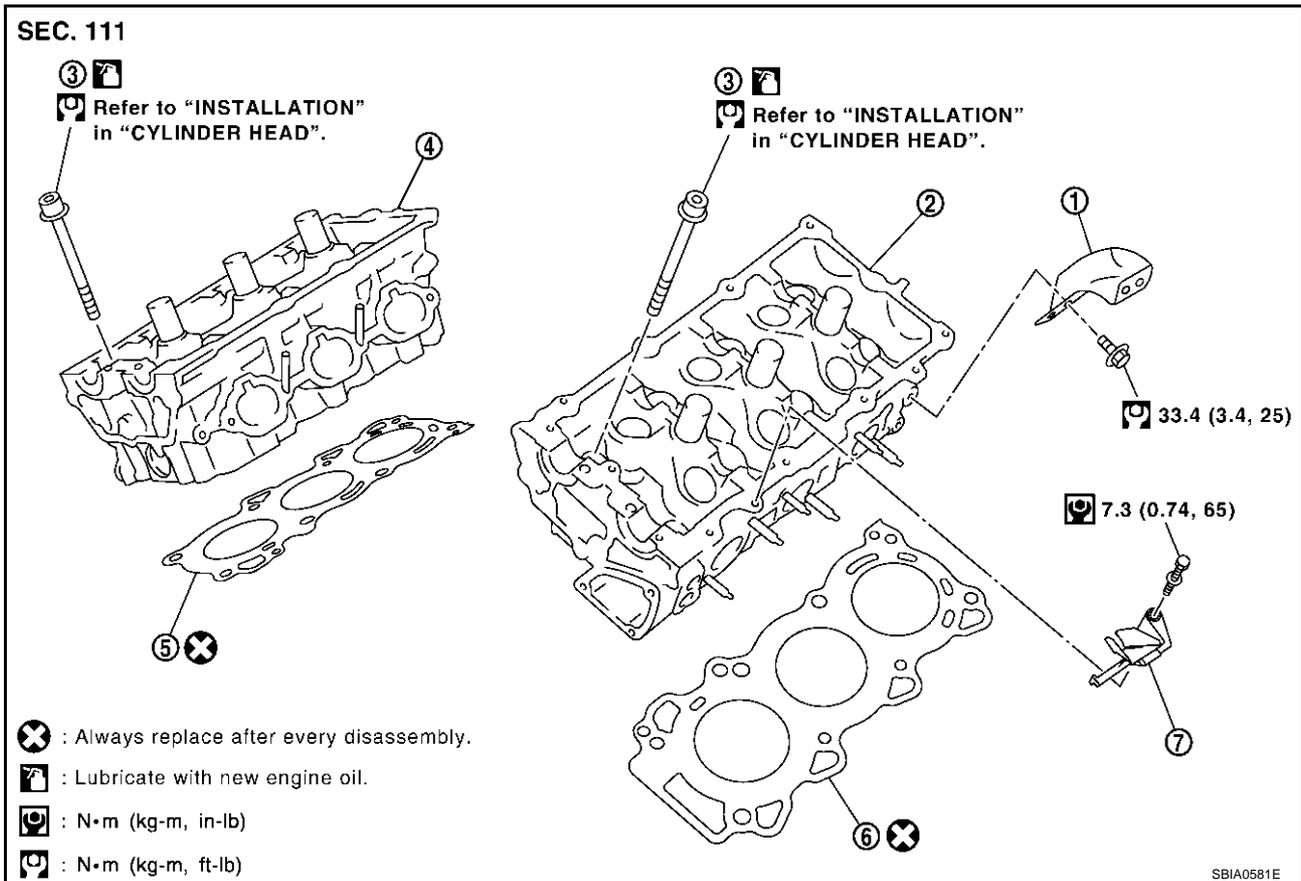
CYLINDER HEAD

[VQ35DE]

- If the added engine oil improves the compression, the 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, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.
 - If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, the gaskets are leaking. In such a case, replace the cylinder head gaskets.
9. After inspection is completed, install removed parts.
 10. Start engine, and confirm that engine runs smoothly.
 11. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-91, "TROUBLE DIAGNOSIS"](#).

Removal and Installation

ABS004X8



1. Engine rear lower slinger
2. Cylinder head (left bank)
3. Cylinder head bolt
4. Cylinder head (right bank)
5. Cylinder head gasket (right bank)
6. Cylinder head gasket (left bank)
7. Oil level gauge guide

REMOVAL

1. Remove camshaft. Refer to [EM-80, "CAMSHAFT"](#).

NOTE:

It is also possible to perform the following steps 2 and 3 just before removing camshaft.

2. Temporarily fit the front suspension member to support engine.

CAUTION:

Temporary fitting means the status that engine is adequately stable though the hoist is released from hanging.

NOTE:

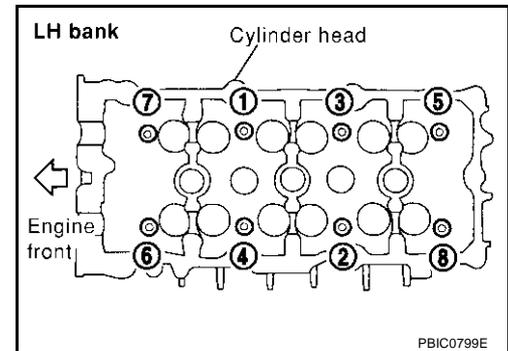
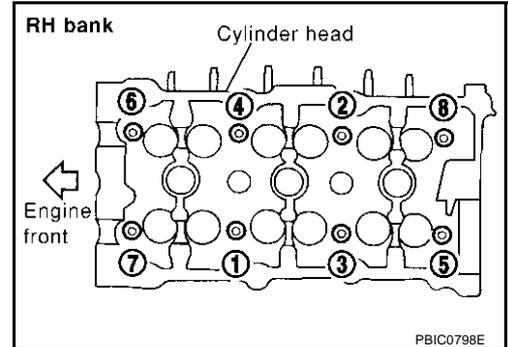
At the time of the start of this procedure the front suspension member is removed, and cylinder head is hanged by the hoist with engine slinger installed.

3. Release the hoist from hanging, then remove the engine slinger.
4. Remove the following components and related parts:

CYLINDER HEAD

[VQ35DE]

- Fuel tube and fuel injector assembly. Refer to [EM-43, "FUEL INJECTOR AND FUEL TUBE"](#) .
 - Intake manifold. Refer to [EM-23, "INTAKE MANIFOLD"](#) .
 - Exhaust manifold. Refer to [EM-25, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#) .
 - Water inlet and thermostat assembly. Refer to [CO-25, "WATER INLET AND THERMOSTAT ASSEMBLY"](#) .
 - Water outlet and water piping. Refer to [CO-27, "WATER OUTLET AND WATER PIPING"](#) .
5. Remove cylinder head loosening bolts with power tool in reverse order shown in the figure and using cylinder head bolt wrench (commercial service tool).



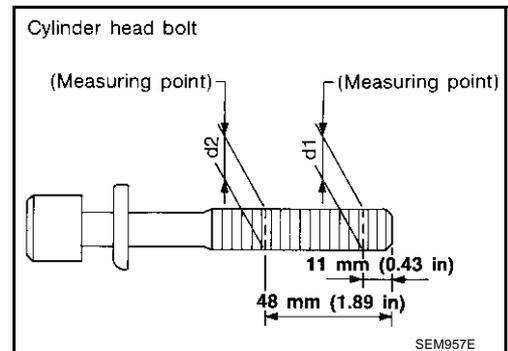
INSPECTION AFTER REMOVAL

Outer Diameter of Cylinder Head Bolts

- Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between d1 and d2 exceeds the limit, replace 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 checking. Refer to [EM-137, "CYLINDER BLOCK DISTORTION"](#) .

1. Using scraper, 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.

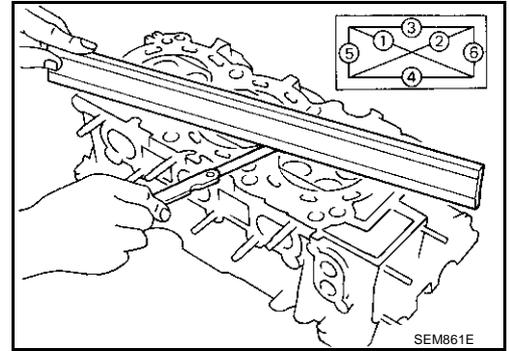
CYLINDER HEAD

[VQ35DE]

- At each of several locations on bottom surface of cylinder head, measure distortion in six directions.

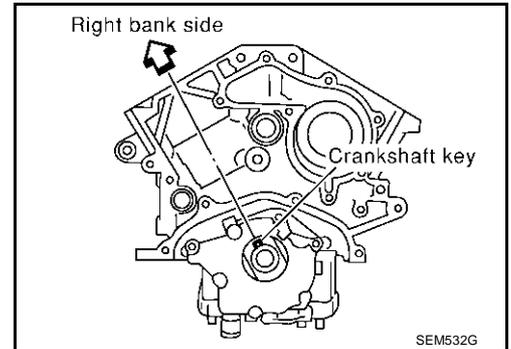
Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder head.



INSTALLATION

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



- Install cylinder head follow the steps below to tighten cylinder head bolts in the order shown in figure.

- Tighten all bolts.

: 98.1 N·m (10 kg·m, 72 ft·lb)

- Completely loosen.

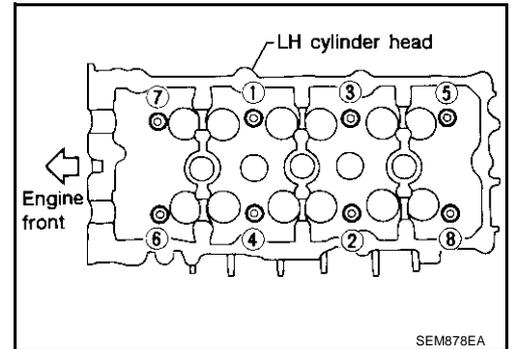
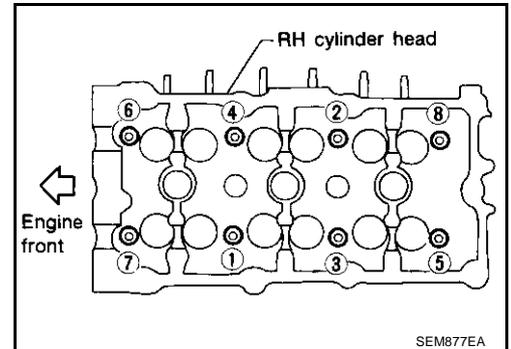
: 0 N·m (0 kg·m, 0 ft·lb)

CAUTION:

In step "b", loosen bolts in the reverse order of that indicated in figure.

- Tighten all bolts.

: 39.2 N·m (4.0 kg·m, 29 ft·lb)



CYLINDER HEAD

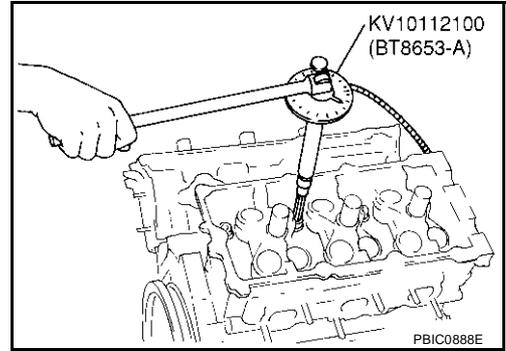
[VQ35DE]

- d. Turn all bolts "90" degrees clockwise (angle tightening).
- e. Turn all bolts "90" degrees clockwise again [target: 90 degrees (angle tightening)].

CAUTION:

Check and confirm the tightening angle by using angle wrench (SST) and cylinder head bolt wrench (commercial service tool). Avoid judgment by visual inspection without the SST.

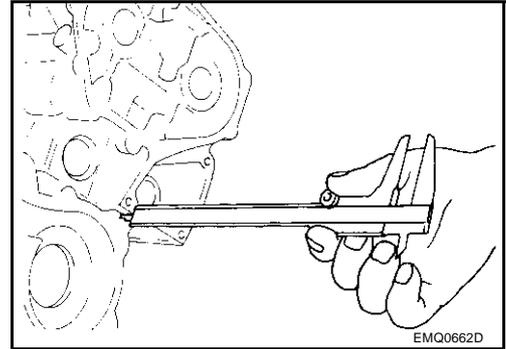
- Check tightening angle indicated on angle wrench (SST) indicator plate.



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)

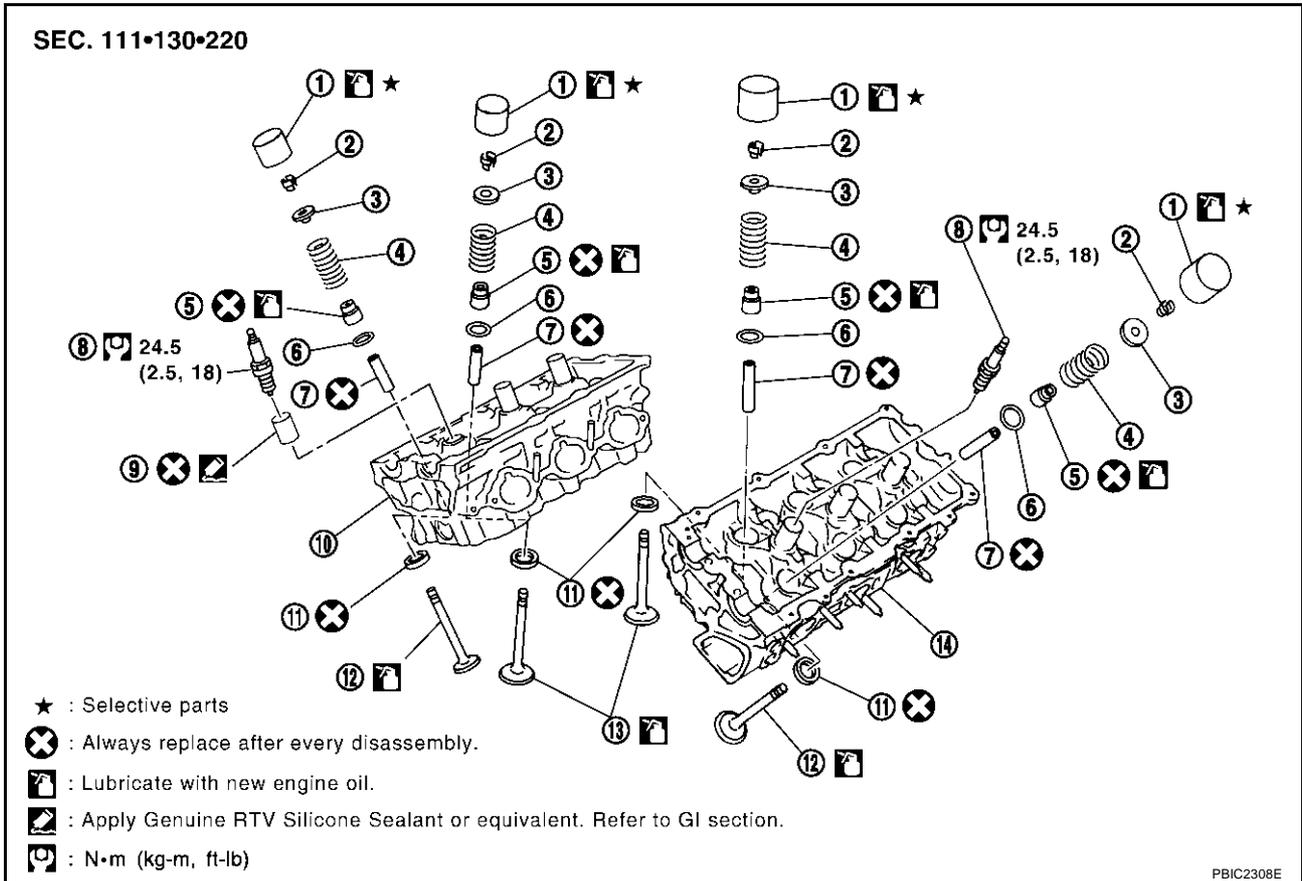
- If measurement is outside the specified range, re-install cylinder head.



5. Perform steps in reverse order of removal for the following operations.

Disassembly and Assembly

ABS004X9



PBIC2308E

- | | | |
|-----------------|-------------------|--------------------------|
| 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

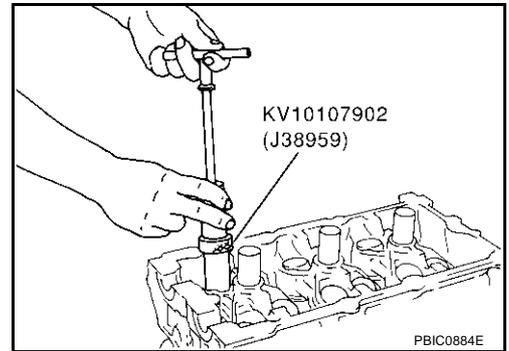
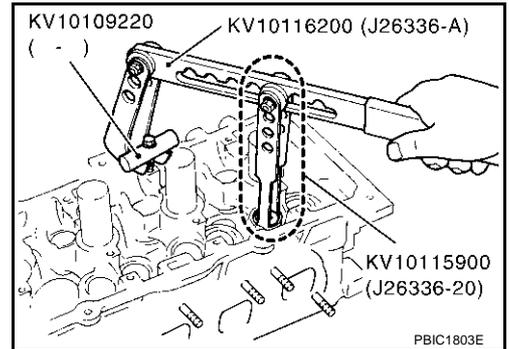
1. Remove spark plug with spark plug wrench (commercial service tool).
2. Remove valve lifter.
 - Mark position on valve lifter for assembly.
3. Remove valve collet.
 - Compress valve spring with valve spring compressor, attachment and adapter (SST). Remove valve collet with magnet hand.
4. Remove valve spring retainer and valve spring.
5. Push valve stem to combustion chamber side, and remove valve.
 - Inspect valve guide clearance before removal. Refer to [EM-103, "VALVE GUIDE CLEARANCE"](#).
 - Mark position on valve for assembly.
6. Remove valve oil seals using valve oil seal puller (SST).
7. Remove valve spring seat.
8. If valve seat must be replaced, refer to [EM-104, "VALVE SEAT CONTACT"](#).
9. If valve guide must be replaced, refer to [EM-103, "VALVE GUIDE CLEARANCE"](#).
10. Remove spark plug tube, as necessary.
 - Using a pair of pliers, pull spark plug tube out of cylinder head.

CAUTION:

When working, take care not to damage valve lifter holes.

CAUTION:

- Take care not to damage cylinder head.
- Once removed, a spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.



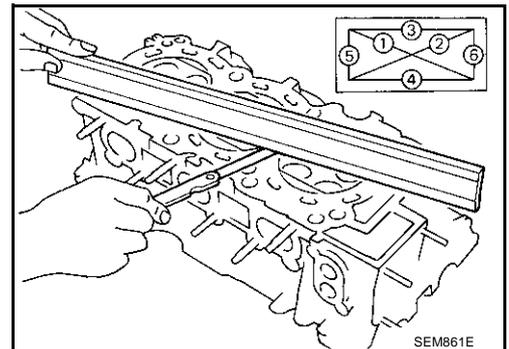
Inspection After Disassembly CYLINDER HEAD DISTORTION

ABS004XA

- At each of several locations on bottom surface of cylinder head, measure distortion in six directions.

Limit : 0.1 mm (0.004 in)

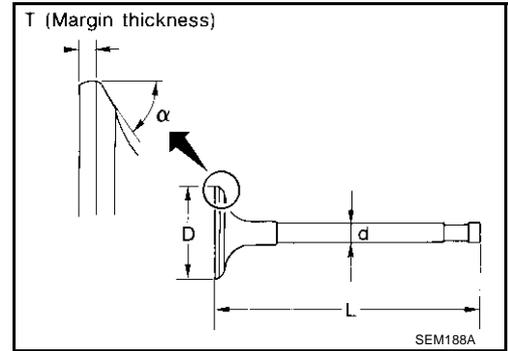
- If it exceeds the limit, replace cylinder head.



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VALVE DIMENSIONS

Check dimensions of each valve. For dimensions, refer to [EM-145](#), "[VALVE](#)".



VALVE GUIDE CLEARANCE

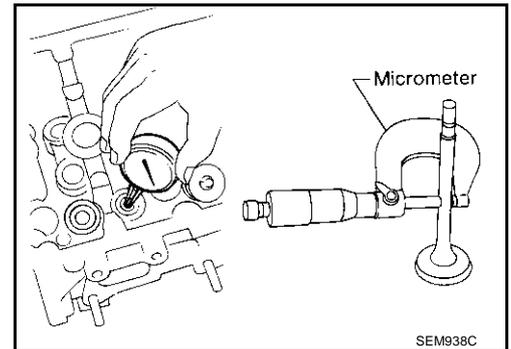
Valve Stem Diameter

Measure inner diameter of valve guide with inside 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 inner diameter of valve guide with inside micrometer.

Standard

Intake and Exhaust : 6.000 - 6.018 mm (0.2362 - 0.2369 in)

Exhaust

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)

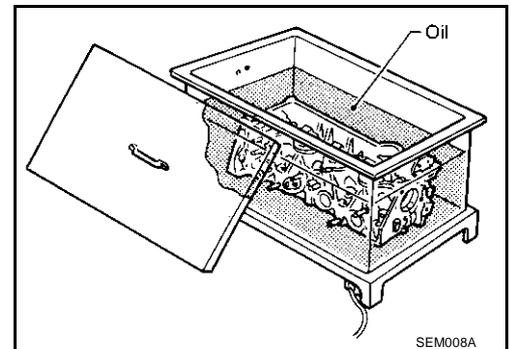
Exhaust : 0.09 mm (0.004 in)

- If it exceeds the limit, replace valve guide.

VALVE GUIDE REPLACEMENT

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

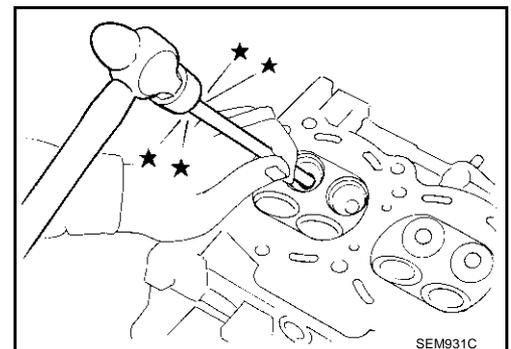
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



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 suitable tool.

CAUTION:

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

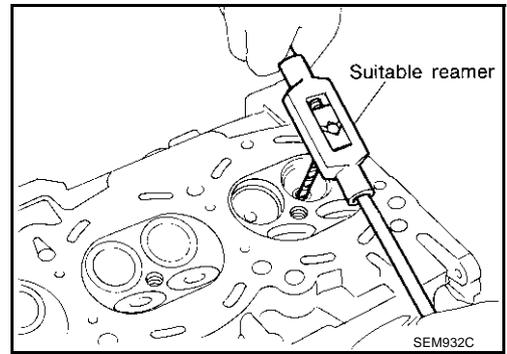


CYLINDER HEAD

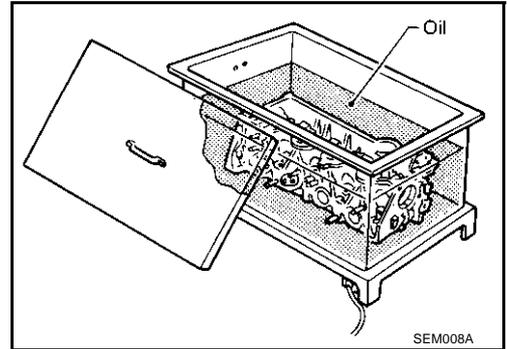
[VQ35DE]

3. Using valve guide reamer, ream cylinder head valve guide hole.

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



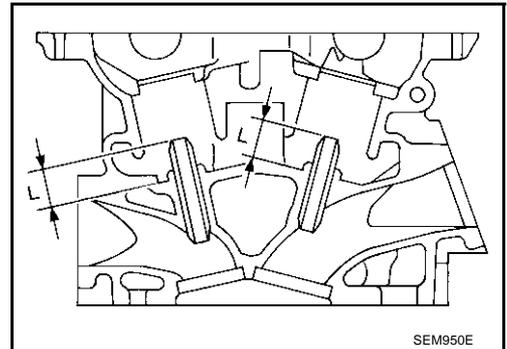
4. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



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

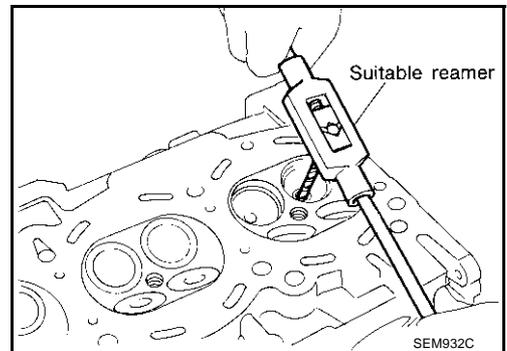
Projection "L"
Intake and exhaust
: 12.6 - 12.8 mm (0.496 - 0.504 in)

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



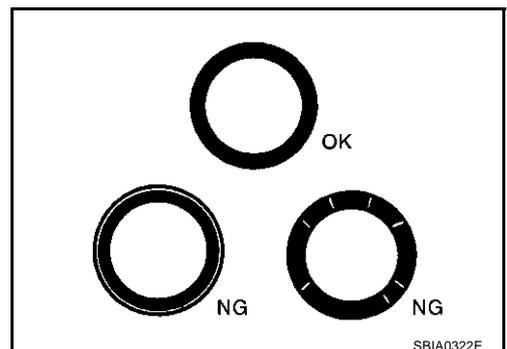
6. Using valve guide reamer, apply reamer finish to valve guide.

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.



VALVE SEAT REPLACEMENT

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

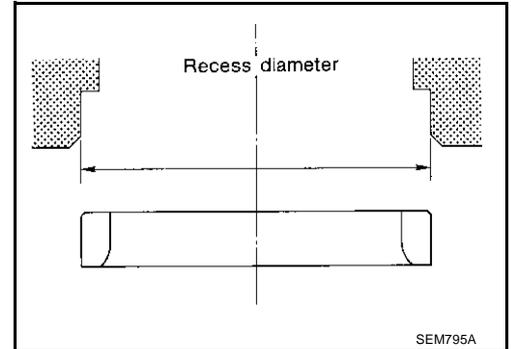
1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
2. Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]

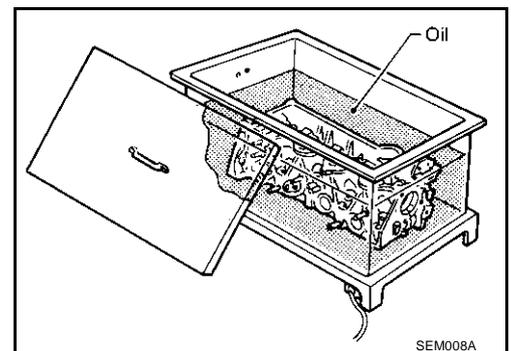
Intake: 38.500 - 38.516 mm (1.5157 - 1.5164 in)

Exhaust: 32.700 - 32.716 mm (1.2874 - 1.2880 in)

- Be sure to ream in circles concentric to the 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.

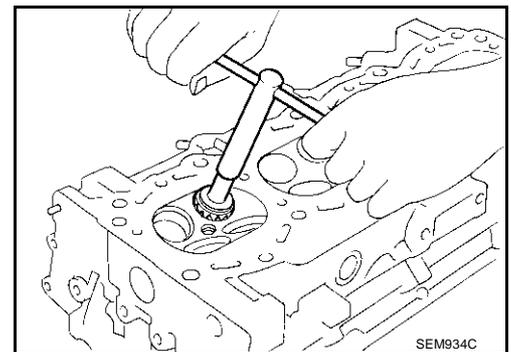
CAUTION:

- Avoid directly touching cold valve seats.
- Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.

5. Using valve seat cutter set (commercial service tool) or valve seat grinder, finish the seat to the specified dimensions. Refer to [EM-149, "Valve Seat"](#).

CAUTION:

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



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

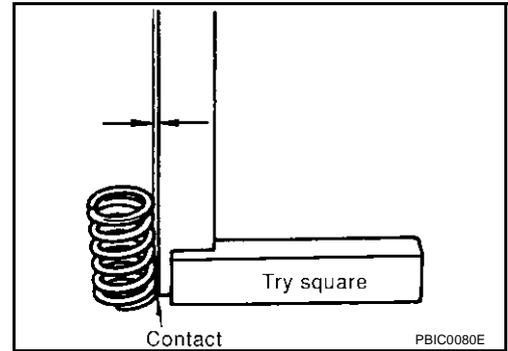
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VALVE SPRING SQUARENESS

- 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 : Less than 2.0 mm (0.079 in)

- If it exceeds the limit, replace valve spring.



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

Check valve spring pressure at specified spring height.

Standard:

Intake and exhaust

Free height:

45.62 mm (1.7961 in)

Installation height:

37.00 mm (1.4567 in)

Installation load:

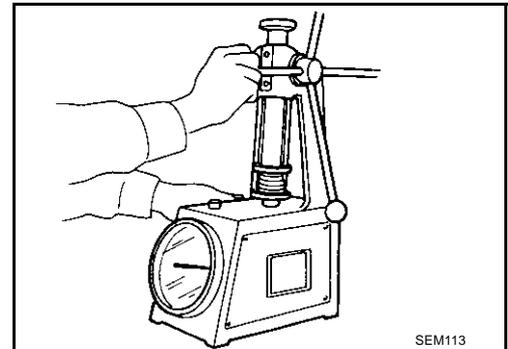
184 - 208 N (18.8 - 21.2 kg, 41.4 - 46.8 lb)

Height during valve open:

27.80 mm (1.0945 in)

Load with valve open:

407 - 459 N (41.5 - 46.8 kg, 91.5 - 103.2 lb)



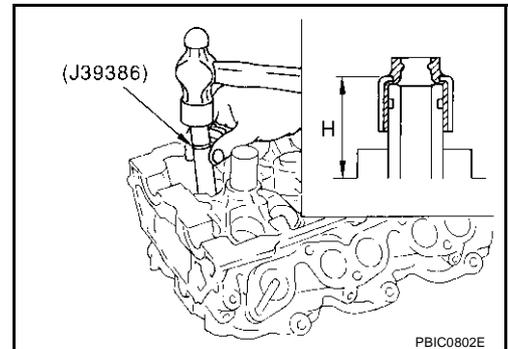
ASSEMBLY

1. When valve guide is removed, install it. Refer to [EM-103, "VALVE GUIDE CLEARANCE"](#).
2. When valve seat is removed, install it. Refer to [EM-104, "VALVE SEAT CONTACT"](#).
3. Install valve oil seals.
 - Install with valve oil seal drift (SST) to match dimension in illustration.

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.

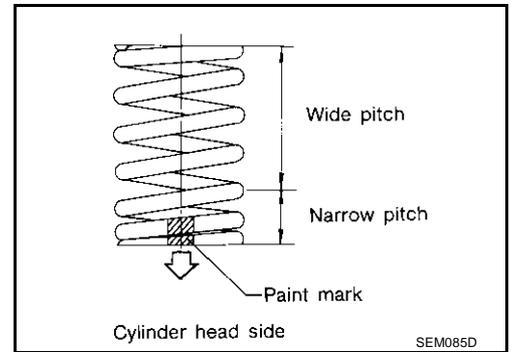


5. Install the valves.
 - Larger diameter valves are for intake side.

CYLINDER HEAD

[VQ35DE]

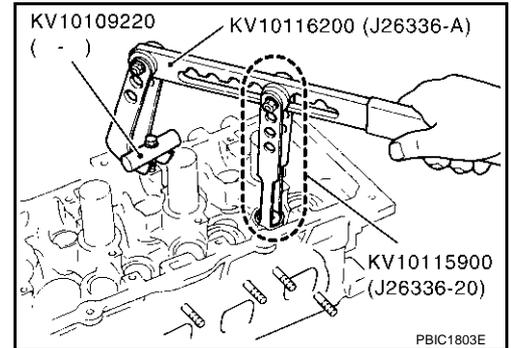
6. Install valve spring (uneven pitch type).
 - Install smaller pitch end (paint mark) to cylinder head side (valve spring seat side).
7. Install valve spring retainer.



8. Install valve collet.
 - Compress valve spring with valve spring compressor, attachment and adapter (SST). Install valve collet with magnet hand.

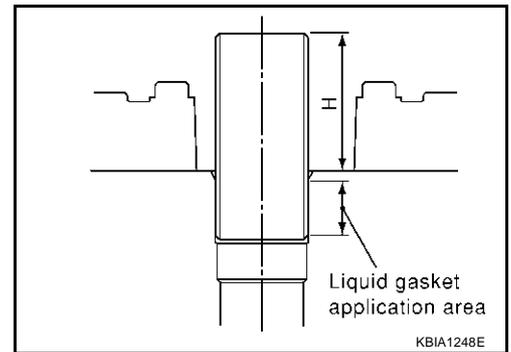
CAUTION:
When working, take care not to damage valve lifter holes.

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



10. Install spark plug tube.
 - Press-fit spark plug tube following procedure below.
 - a. Remove old liquid gasket adhering to cylinder-head mounting hole.
 - b. Apply liquid gasket to area within approximately 12 mm (0.47 in) from edge of spark plug tube press-fit side.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .
 - c. Using a drift, press-fit spark plug tube so that its height "H" is as specified in the figure.



Standard press-fit height "H":
: 38.55 - 38.65 mm (1.5177 - 1.5217 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.

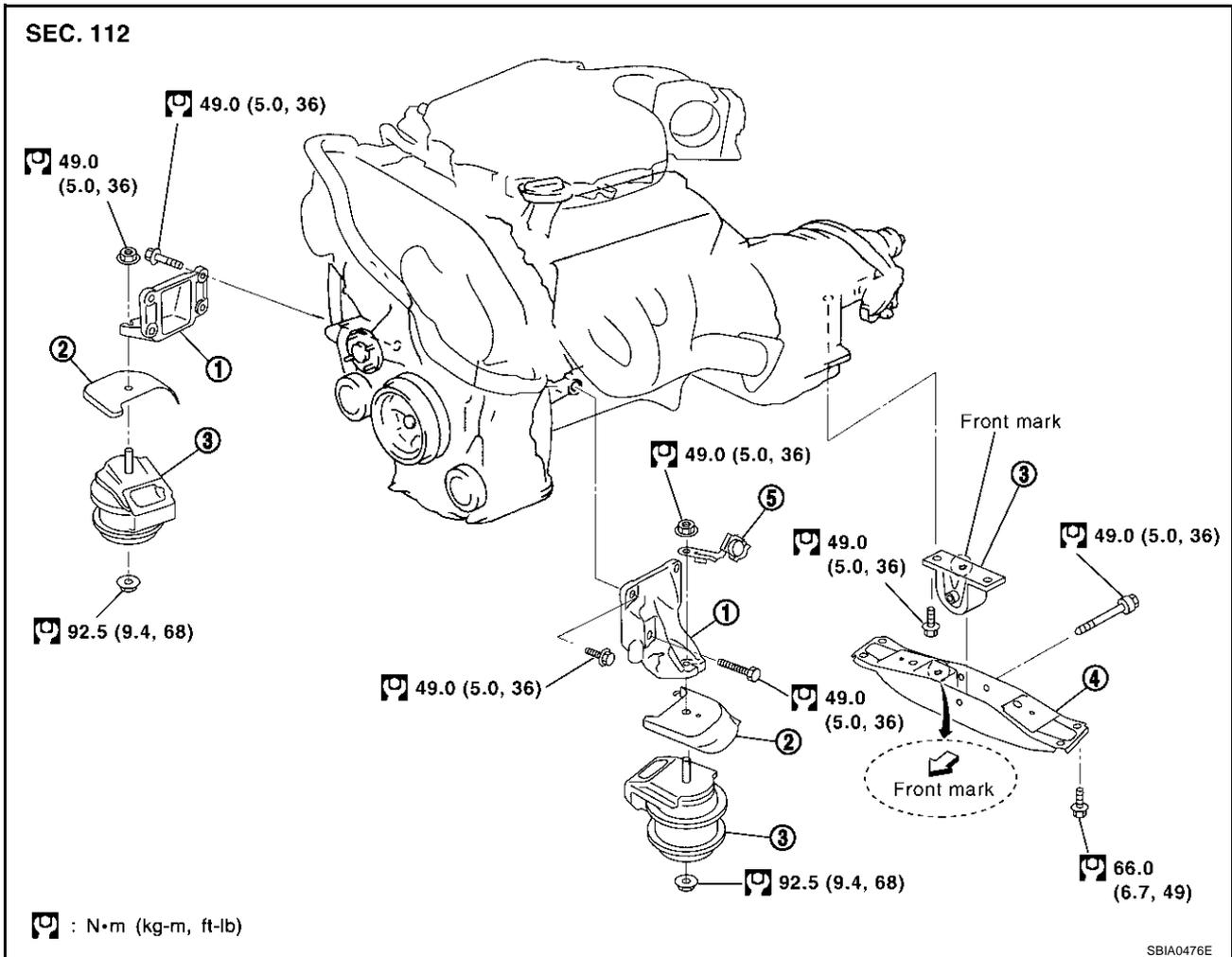
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ENGINE ASSEMBLY

PFP:10001

Removal and Installation 2WD MODEL

ABS008GN



- | | | |
|----------------------------|--------------------|------------------------------|
| 1. Engine mounting bracket | 2. Heat insulator | 3. Engine mounting insulator |
| 4. Rear member | 5. Harness bracket | |

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 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-point lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-42, "Garage Jack and Safety Stand"](#).

REMOVAL**Outline**

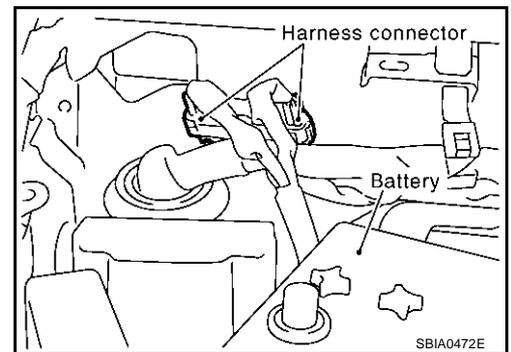
At first, remove engine and transmission assembly with suspension member downward. Then separate engine from transmission.

Preparation

1. Release fuel pressure. Refer to [EC-65, "FUEL PRESSURE RELEASE"](#) .
2. Disconnect both battery terminals.
3. Remove engine cover (Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#)), battery cover and LH/RH front tire.
4. Remove front and rear engine undercover and front cross bar with power tool.
5. Drain engine coolant from radiator drain plug. Refer to [CO-11, "Changing Engine Coolant"](#) .
6. Remove cowl top cover RH. Refer to [EI-24, "COWL TOP"](#) .
7. Remove air duct and air cleaner case assembly. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#) .
8. Remove radiator upper and lower hoses. Refer to [CO-14, "RADIATOR"](#) .

Engine Room

1. Disconnect heater hose from vehicle-side, and fit a plug onto hose end to prevent engine coolant leak.
2. Disconnect grounding wire (between vehicle to LH cylinder head).
3. Disconnect battery plus cable at vehicle side and temporarily fasten it on engine.
4. Disconnect engine room harness connectors shown in the figure.



5. Disconnect A/C piping from A/C compressor, and temporarily fasten it on vehicle with a rope.
6. Disconnect two body ground cables.
7. Disconnect brake booster vacuum hose.
8. Disconnect fuel feed hose and EVAP hose.

CAUTION:

Fit plugs onto disconnected hoses to prevent fuel leak.

9. Remove power steering oil pump reservoir tank and piping from vehicle, and temporarily secure them on engine. Refer to [PS-31, "POWER STEERING OIL PUMP"](#) .

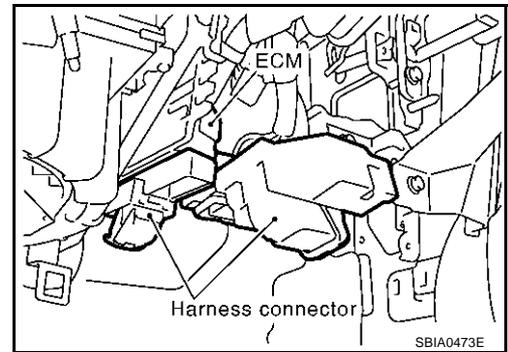
CAUTION:

When temporarily securing, keep them upright to avoid a fluid leak.

Passenger Room Side

1. Follow procedure below to disconnect engine room harness connectors at passenger room side, and temporarily secure them on engine.

- a. Remove passenger-side kicking plate, dash side finisher, and glove box. Refer to [EI-37, "BODY SIDE TRIM"](#) and [IP-10, "INSTRUMENT PANEL ASSEMBLY"](#).
- b. Disconnect engine room harness connectors at unit sides ECM and other.
- c. Disengage intermediate fixing point. Pull out engine room harnesses to engine room side, and temporarily secure them on engine.



CAUTION:

- When pulling out harnesses, take care not to damage harnesses and connectors.
- After temporarily securing, cover connectors with vinyl or similar material to protect against foreign material adhesion.

Vehicle Underbody

1. Remove A/T fluid cooler hoses and power steering oil pump oil cooler hoses.
2. Remove exhaust front tube. Refer to [EX-3, "EXHAUST SYSTEM"](#).
3. Disconnect steering lower joint, and release steering shaft. Refer to [PS-12, "STEERING COLUMN"](#).
4. Separate transmission and propeller shaft. Refer to [PR-7, "REAR PROPELLER SHAFT"](#).
5. Disengage shift control linkage at selector lever side. Then, temporarily secure it on transmission, so that it does not sag.
6. Remove rear plate cover from upper oil pan. Then, remove bolts fixing drive plate to torque converter.
7. Remove bolts fixing transmission to lower rear side of upper oil pan.
8. Remove front stabilizer. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
9. Remove LH and RH tie-rod ends from steering knuckle. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
10. Remove lower ends of LH and RH struts from lower arms. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
11. Remove LH and RH lower arms from suspension member. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).

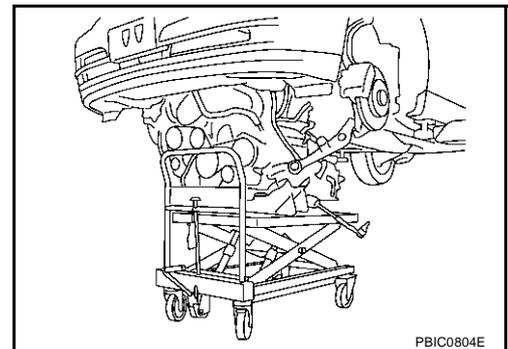
Removal Work

1. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a transmission jack. Securely support bottom of suspension member and transmission.

CAUTION:

Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.

2. Remove rear member mounting bolt.
3. Remove suspension member mounting bolt and nut. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
4. Carefully lower jack to remove engine, transmission, and suspension member assembly. When performing work, observe the following:



CAUTION:

- Confirm there is no interference with vehicle.
- Make sure all connection points have been disconnected.
- Keep in mind the center of vehicle gravity changes. If necessary, use jack(s) to support vehicle at rear jacking point(s) to prevent it from falling off the lift.

Separation Work

1. Install engine slingers into front of right bank cylinder head and rear of left bank cylinder head.

Slinger bolts:

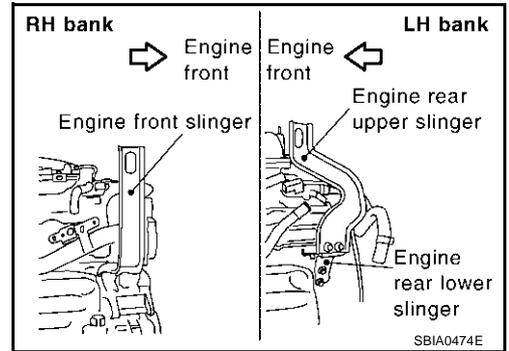
 : 28.0 N·m (2.9 kg-m, 21 ft-lb)

2. Remove power steering oil pump from engine side. Refer to [PS-31, "POWER STEERING OIL PUMP"](#).
3. Remove engine mounting insulator under side nut with power tool.
4. Lift with hoist and separate engine and transmission assembly from suspension member.

CAUTION:

- Before and during this lifting, always check if any harnesses are left connected.
- Avoid damage to and oil/grease smearing or spills onto engine mounting insulator.

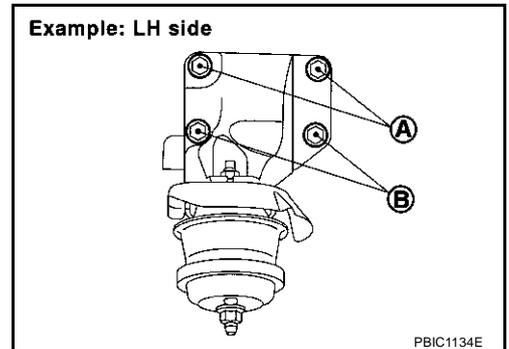
5. Remove alternator. Refer to [SC-23, "CHARGING SYSTEM"](#).
6. Remove starter motor. Refer to [SC-10, "STARTING SYSTEM"](#).
7. Separate engine from transmission assembly. Refer to [AT-269, "TRANSMISSION ASSEMBLY"](#).
8. Remove engine mounting insulator and bracket with power tool.



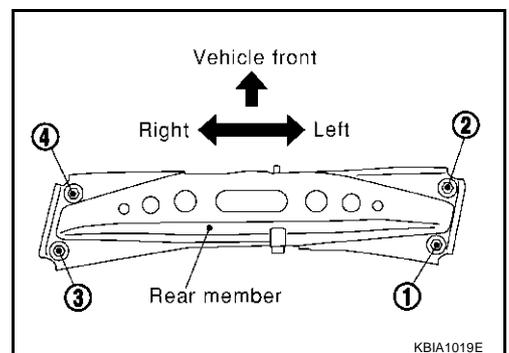
INSTALLATION

Install in the reverse order of removal paying attention to the following.

- For a location with a positioning pin, insert it securely into hole of mating part.
- For a part with a specified installation orientation, refer to component figure in [EM-108, "2WD MODEL"](#).
- When installing engine mounting bracket on cylinder block, tighten two upper bolts (shown as A in figure) first. Then tighten two lower bolts (shown as B in figure). (LH and RH sides)



- Tighten rear member mounting bolts in numerical order shown in figure.

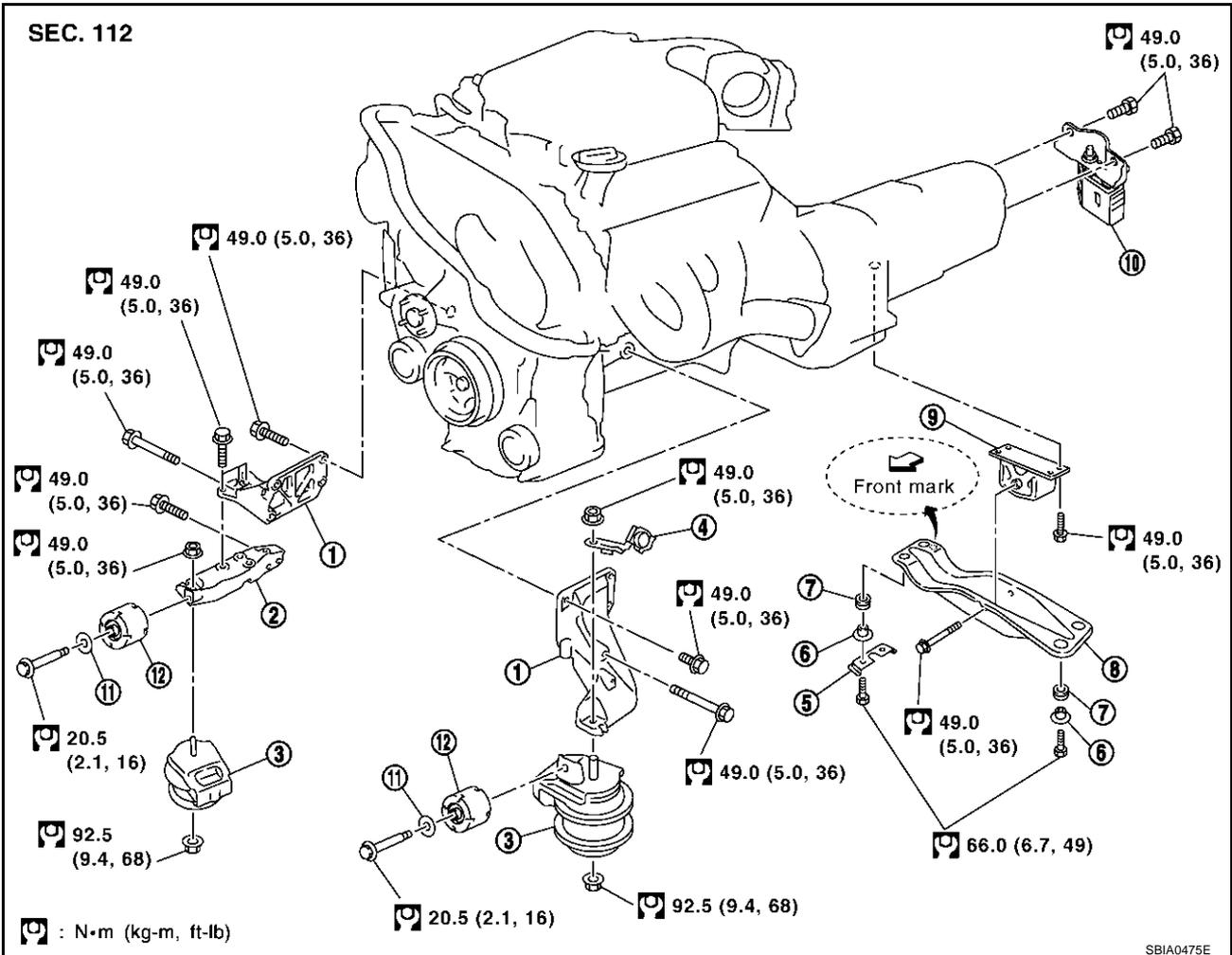


INSPECTION AFTER INSTALLATION

- 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	—
Exhaust gas	—	Leakage	—

AWD MODEL



- | | | |
|----------------------------|------------------------------------|------------------------------|
| 1. Engine mounting bracket | 2. Engine mounting bracket (Lower) | 3. Engine mounting insulator |
| 4. Harness bracket | 5. Heat insulator | 6. Caller |
| 7. Rubber bush | 8. Rear member | 9. Engine mounting insulator |
| 10. Dynamic damper | 11. Washer | 12. Dynamic damper |

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 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-point lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-42, "Garage Jack and Safety Stand"](#).

REMOVAL

Outline

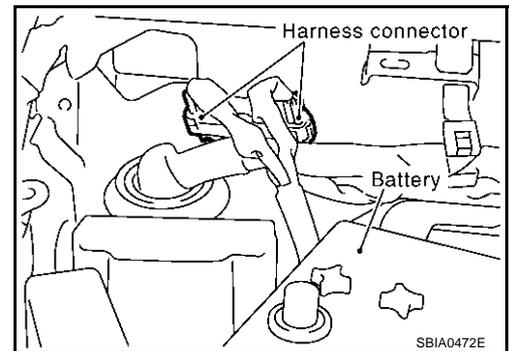
At first, remove engine and transmission assembly with suspension member downward. Then separate engine from transmission.

Preparation

1. Release fuel pressure. Refer to [EC-65, "FUEL PRESSURE RELEASE"](#) .
2. Disconnect both battery terminals.
3. Remove engine cover (Refer to [EM-19, "INTAKE MANIFOLD COLLECTOR"](#)), battery cover and LH/RH front tire.
4. Remove front and rear engine undercover and front cross bar with power tool.
5. Drain engine coolant from radiator drain plug. Refer to [CO-11, "Changing Engine Coolant"](#) .
6. Remove cowl top cover RH. Refer to [EI-24, "COWL TOP"](#) .
7. Remove air duct and air cleaner case assembly. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#) .
8. Remove radiator upper and lower hoses. Refer to [CO-14, "RADIATOR"](#) .

Engine Room

1. Disconnect heater hose from vehicle-side, and fit a plug onto hose end to prevent engine coolant leak.
2. Disconnect grounding wire (between vehicle to LH cylinder head).
3. Disconnect battery positive cable at vehicle side and temporarily fasten it on engine.
4. Disconnect engine room harness connectors shown in the figure.



5. Disconnect A/C piping from A/C compressor, and temporarily fasten it on vehicle with a rope.
6. Disconnect two body ground cables.
7. Disconnect brake booster vacuum hose.
8. Disconnect fuel feed hose and EVAP hose.

CAUTION:

Fit plugs onto disconnected hoses to prevent fuel leak.

9. Remove power steering oil pump reservoir tank and piping from vehicle, and temporarily secure them on engine. Refer to [PS-31, "POWER STEERING OIL PUMP"](#) .

CAUTION:

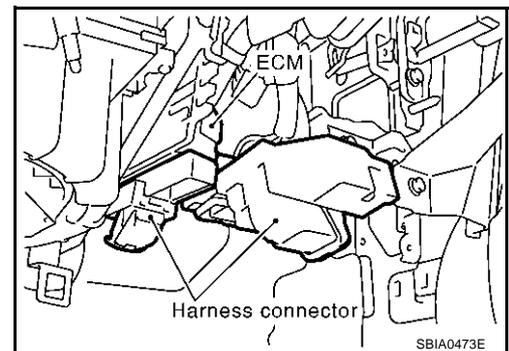
When temporarily securing, keep them upright to avoid a fluid leak.

Passenger Room Side

1. Follow procedure below to disconnect engine room harness connectors at passenger room side, and temporarily secure them on engine.
 - a. Remove passenger-side kicking plate, dash side finisher, and glove box. Refer to [EI-37, "BODY SIDE TRIM"](#) and [IP-10, "INSTRUMENT PANEL ASSEMBLY"](#) .
 - b. Disconnect engine room harness connectors at unit sides ECM and other.
 - c. Disengage intermediate fixing point. Pull out engine room harnesses to engine room side, and temporarily secure them on engine.

CAUTION:

- **When pulling out harnesses, take care not to damage harnesses and connectors.**
- **After temporarily securing, cover connectors with vinyl or similar material to protect against foreign material adhesion.**



Vehicle Underbody

1. Remove A/T fluid cooler hoses and power steering oil pump oil cooler hoses.
2. Remove exhaust front tube. Refer to [EX-3, "EXHAUST SYSTEM"](#).
3. Disconnect steering lower joint, and release steering shaft. Refer to [PS-12, "STEERING COLUMN"](#).
4. Separate transmission and propeller shaft. Refer to [PR-7, "REAR PROPELLER SHAFT"](#).
5. Disengage shift control linkage at selector lever side. Then, temporarily secure it on transmission, so that it does not sag.
6. Remove rear plate cover from upper oil pan. Then, remove bolts fixing drive plate to torque converter.
7. Remove bolts fixing transmission to lower rear side of upper oil pan.
8. Remove LH and RH tie-rod ends from steering knuckle. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
9. Remove lower ends of LH and RH struts from lower arms. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
10. Remove LH and RH lower arms from suspension LH member. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
11. Remove LH and RH front drive shafts from LH and RH knuckles. Refer to [FAX-12, "FRONT DRIVE SHAFT"](#).

Removal Work

1. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a transmission jack. Securely support bottom of suspension member and transmission.

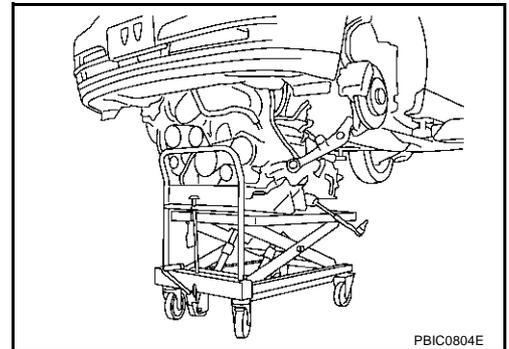
CAUTION:

Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.

2. Remove rear member mounting bolt.
3. Remove suspension member mounting bolt and nut. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
4. Carefully lower jack to remove engine, transmission, and suspension member assembly. When performing work, observe the following:

CAUTION:

- Confirm there is no interference with vehicle.
- Make sure all connection points have been disconnected.
- Keep in mind the center of vehicle gravity changes. If necessary, use jack(s) to support vehicle at rear jacking point(s) to prevent it from falling off the lift.

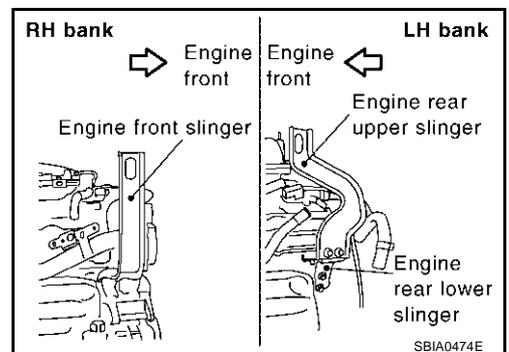


Separation Work

1. Install engine slingers into front of RH bank cylinder head and rear of LH bank cylinder head.

Slinger bolts:

: 28.0 N-m (2.9 kg-m, 21 ft-lb)



2. Remove power steering oil pump from engine side. Refer to [PS-31, "POWER STEERING OIL PUMP"](#).
3. Remove engine mounting insulator RR under side nut with power tool.
4. Lift with hoist and separate engine and transmission assembly from suspension member.

CAUTION:

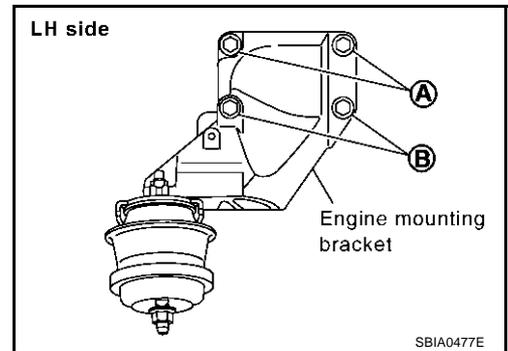
- Before and during this lifting, always check if any harnesses are left connected.

- **Avoid damage to and oil/grease smearing or spills onto engine mounting insulator.**
- 5. Remove front drive shaft LH and RH. Refer to [FAX-12, "FRONT DRIVE SHAFT"](#) .
- 6. Remove alternator. Refer to [SC-23, "CHARGING SYSTEM"](#) .
- 7. Remove starter motor. Refer to [SC-10, "STARTING SYSTEM"](#) .
- 8. Remove front propeller shaft from front final drive assembly side. Refer to [PR-4, "FRONT PROPELLER SHAFT"](#) .
- 9. Separate engine from transmission assembly. Refer to [AT-269, "TRANSMISSION ASSEMBLY"](#) .
- 10. Remove engine mounting FR insulator and engine mounting bracket with power tool.
- 11. Remove front final drive assembly from oil pan (upper). Refer to [FFD-10, "FRONT FINAL DRIVE ASSEMBLY"](#) .

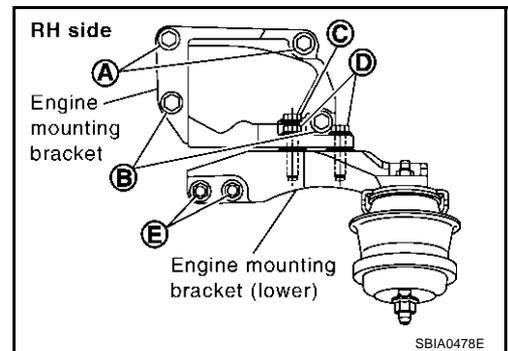
INSTALLATION

Install in the reverse order of removal paying attention to the following.

- For a location with a positioning pin, insert it securely into hole of mating part.
- For a part with a specified installation orientation, refer to component figure in [EM-113, "AWD MODEL"](#) .
- When installing engine mounting bracket on cylinder block, tighten two upper bolts (shown as A in figure) first. Then tighten two lower bolts (shown as B in figure). (LH and RH sides)



- Install engine mounting bracket (lower) paying attention to the following.
 - a. Temporarily tighten mounting bolts (shown as C, D and E in figure).
 - b. Tighten mounting bolts to the specified torque with following mounting surfaces touched.
- Engine mounting bracket to engine mounting bracket (lower) (shown as C and D in figure).
- Front final drive to engine mounting bracket (lower) (shown as E in figure).



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

ENGINE ASSEMBLY

[VQ35DE]

Fuel	—	Leakage	—
Exhaust gas	—	Leakage	—

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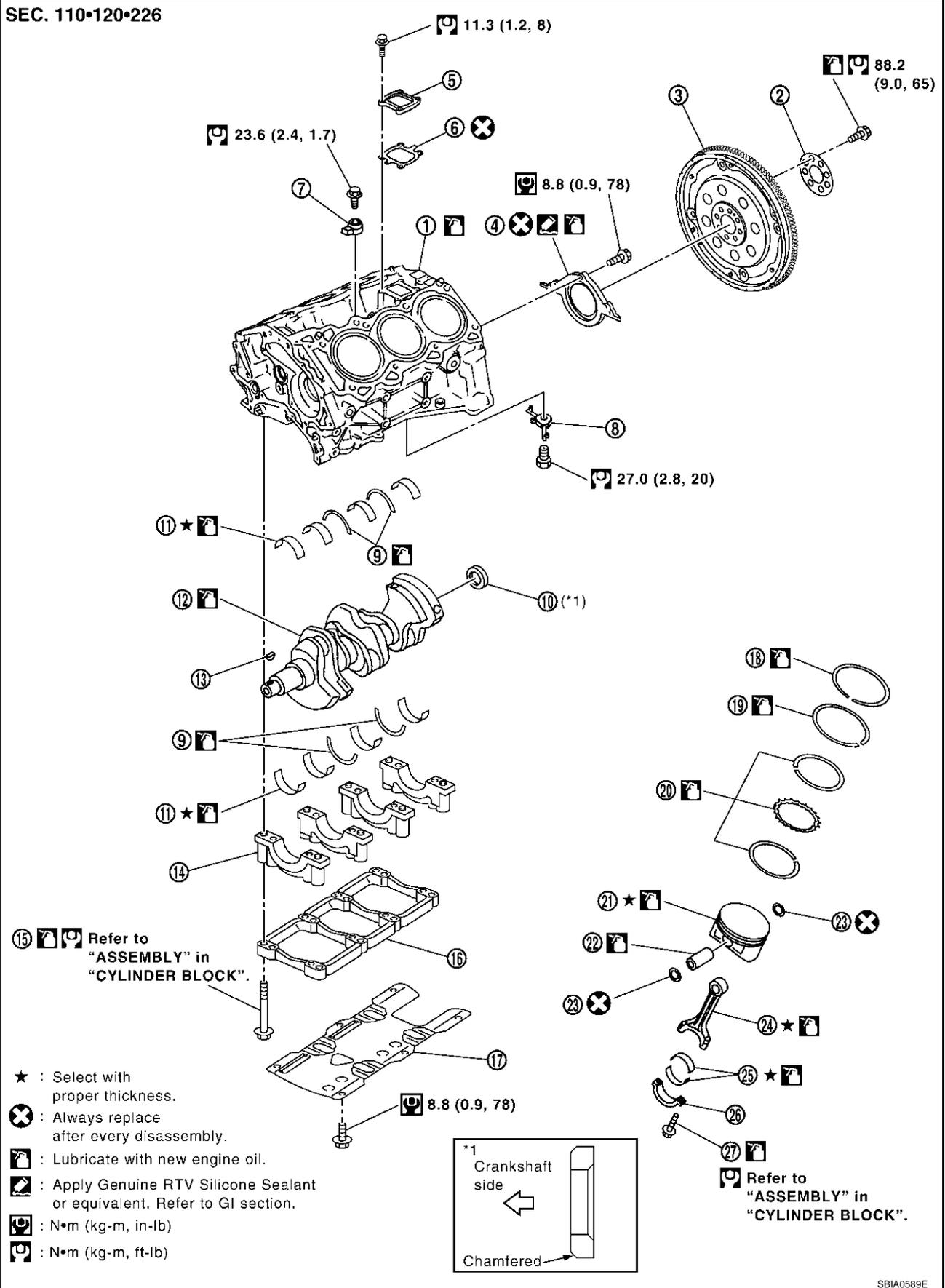
CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

ABS004XH

SEC. 110•120•226

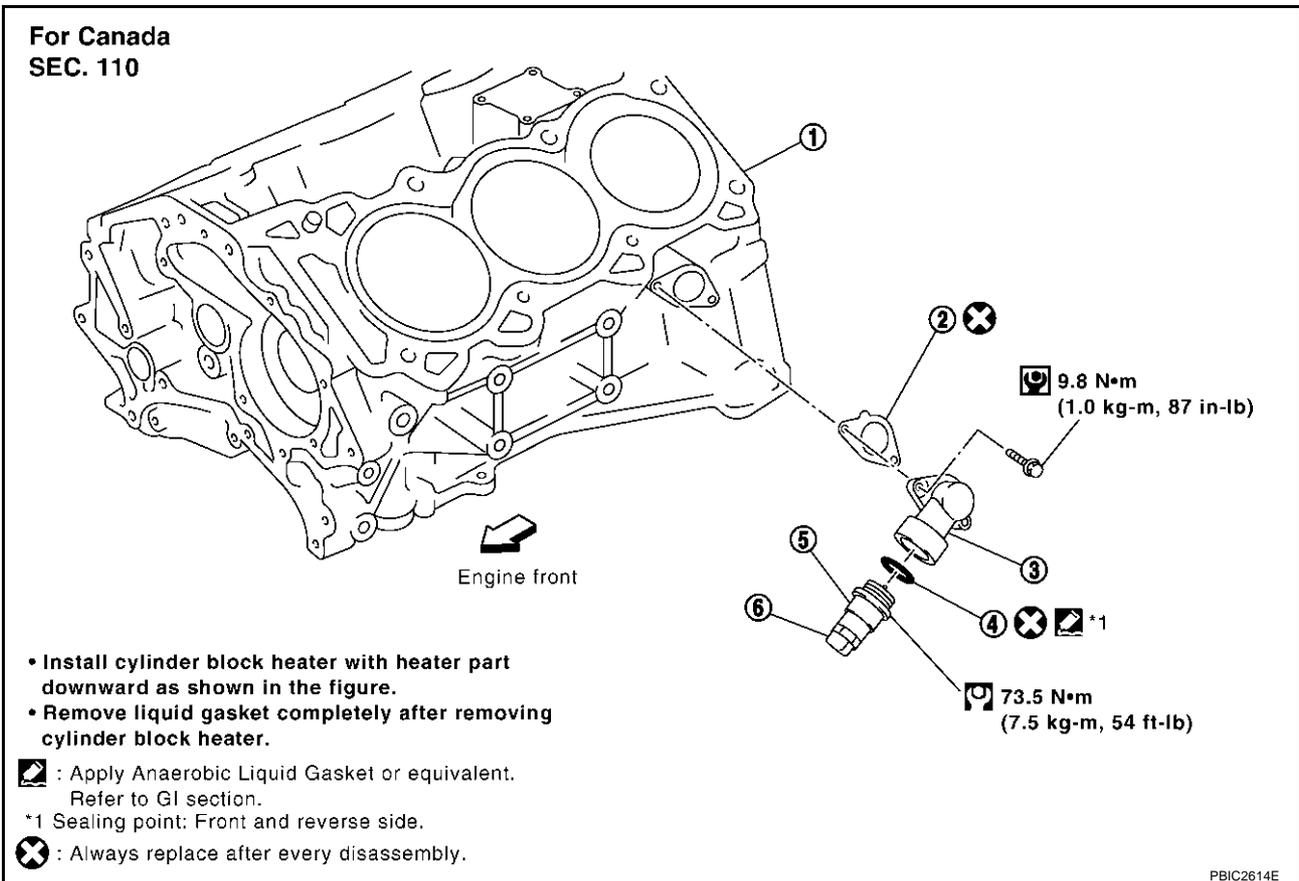


SBIA0589E

CYLINDER BLOCK

[VQ35DE]

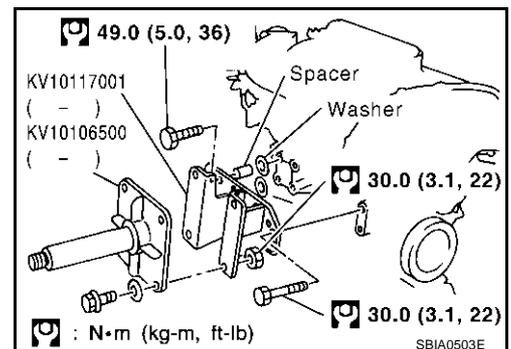
- | | | |
|----------------------------|--------------------------------|---------------------------|
| 1. Cylinder block | 2. Reinforcement plate | 3. Drive plate |
| 4. Rear oil seal retainer | 5. Cover | 6. Gasket |
| 7. Knock sensor | 8. Oil jet | 9. Thrust bearing |
| 10. Pilot converter | 11. Main bearing | 12. Crankshaft |
| 13. Key | 14. Main bearing cap | 15. Main bearing cap bolt |
| 16. Main bearing beam | 17. Baffle plate (2WD model) | 18. Top ring |
| 19. Second ring | 20. Oil ring | 21. Piston |
| 22. Piston pin | 23. Snap ring | 24. Connecting rod |
| 25. Connecting rod bearing | 26. Connecting rod bearing cap | 27. Connecting rod bolt |



- | | | |
|-------------------|--------------------------|----------------------------|
| 1. Cylinder block | 2. Gasket | 3. Water connector |
| 4. Gasket | 5. Cylinder block heater | 6. Connector protector cap |

DISASSEMBLY

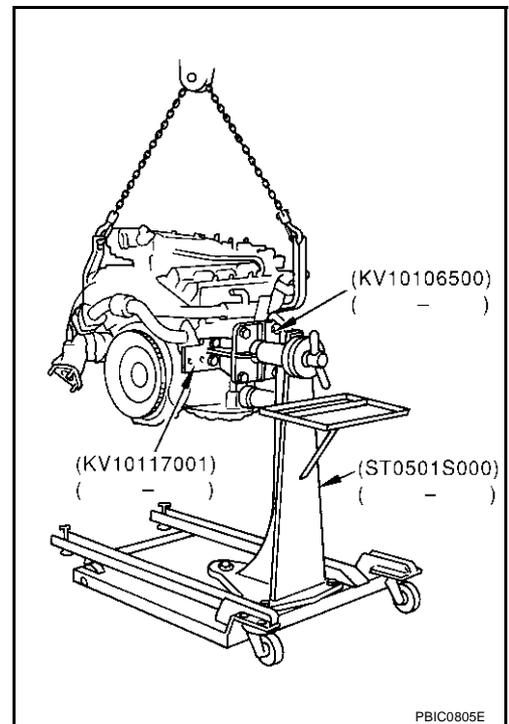
1. Remove engine assembly from vehicle, and separate transmission from engine. Refer to [EM-108, "ENGINE ASSEMBLY"](#).
2. Remove engine mounting bracket. Refer to [EM-108, "ENGINE ASSEMBLY"](#).
3. Remove RH exhaust manifold. Refer to [EM-25, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).
4. Install engine sub-attachment with engine stand shaft (SST) to right side of cylinder block.
 - Use spacer to engine rear side.



CYLINDER BLOCK

[VQ35DE]

5. Lift engine, and mount it onto the engine stand (SST).



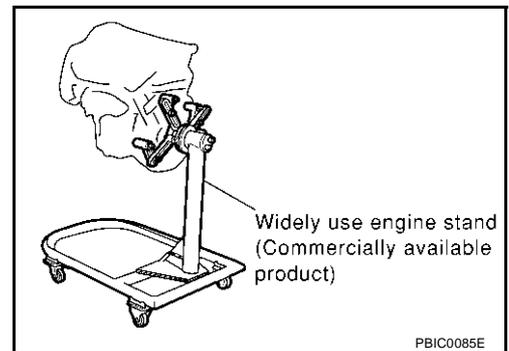
- A commercial engine stand can be used.

CAUTION:

Use an engine stand that has a load capacity [approximately 220 kg (441 lb) or more] large enough for supporting the engine weight.

NOTE:

This example is an engine stand for holding at transmission mounting side with the drive plate removed.

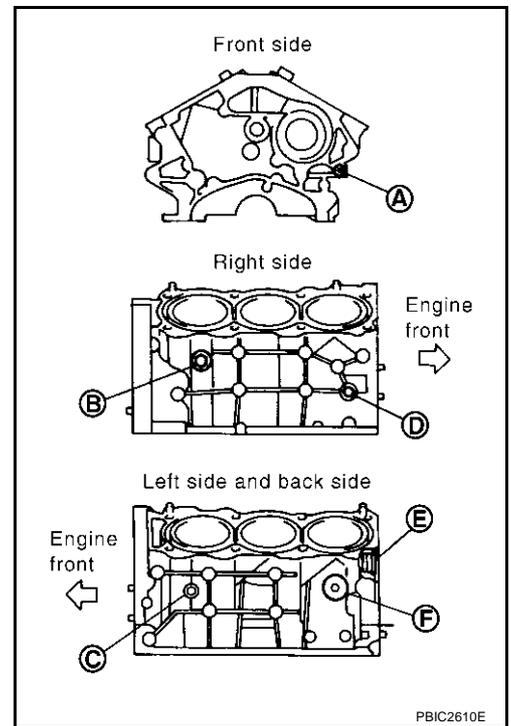


6. Drain engine oil. Refer to [LU-9, "Changing Engine Oil"](#).

CYLINDER BLOCK

[VQ35DE]

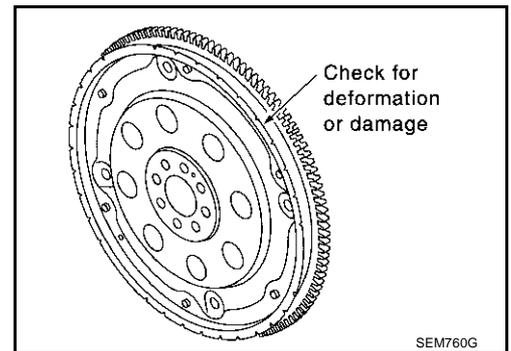
7. Drain engine coolant by removing water drain plugs from cylinder block both sides at "B" and "C" and cylinder block front side at "A" as shown in the figure.



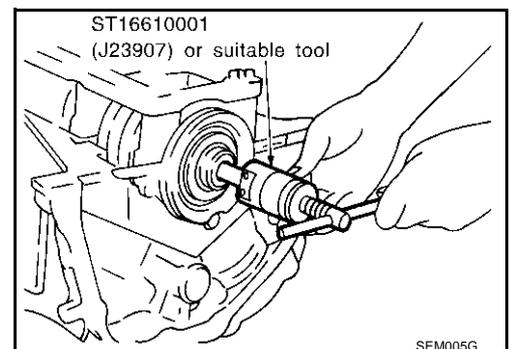
8. Remove cylinder head. Refer to [EM-96, "CYLINDER HEAD"](#).
9. Remove knock sensor.
- CAUTION:**
Carefully handle the sensor avoiding shocks.
10. Remove drive plate with power tool. Fix crankshaft with a ring gear stopper [SST: KV1011770 (J-44716)], and remove mounting bolts.
- Loosen mounting bolts in diagonal order.

CAUTION:

- Do not disassemble drive plate.
- Never place the 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.



11. Remove pilot converter using pilot bushing puller (SST) or suitable tool as necessary.



CYLINDER BLOCK

[VQ35DE]

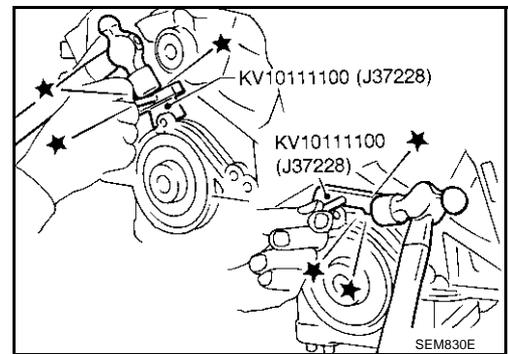
12. Use a seal cutter (SST) to cut away liquid gasket and remove rear oil seal retainer.

CAUTION:

- Be careful not to damage mounting surface.
- If rear oil seal retainer is removed, replace it with a new one.

NOTE:

Rear oil seal and retainer make up a single part and are removed as an assembly.

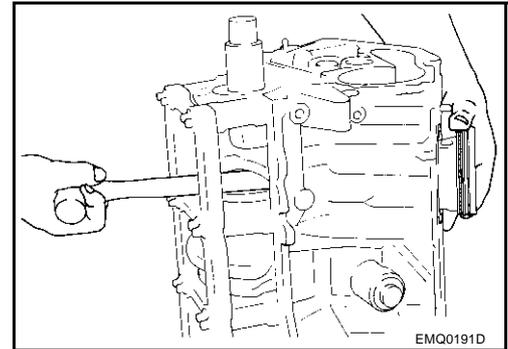


13. Remove baffle plate from main bearing beam (2WD model).

14. Remove piston and connecting rod assembly.

- Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-134, "CONNECTING ROD SIDE CLEARANCE"](#).

- a. Position the crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
- b. Remove connecting rod cap.
- c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.
15. Remove the connecting rod bearings from connecting rod and connecting rod cap.



CAUTION:

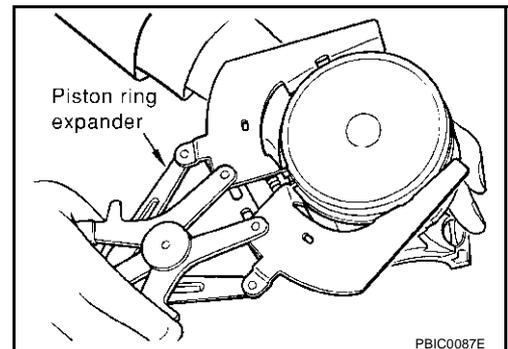
When removing them, note the installation position. Keep them in the correct order.

16. Remove the piston rings from piston.

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

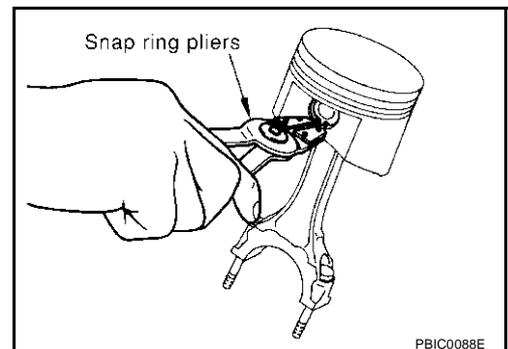
CAUTION:

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



17. Remove piston from connecting rod as follows.

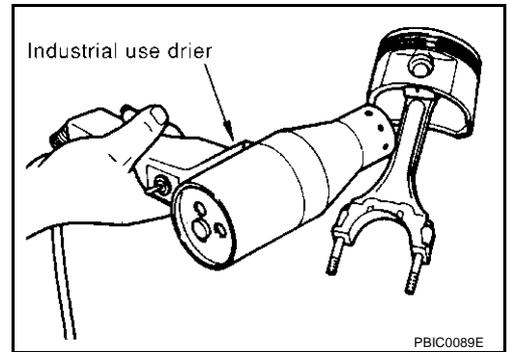
- a. Using a snap ring pliers, remove snap ring.



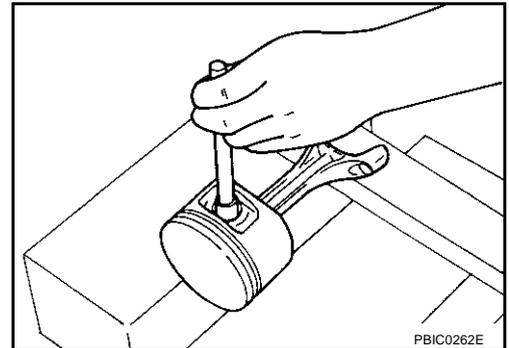
CYLINDER BLOCK

[VQ35DE]

- 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).

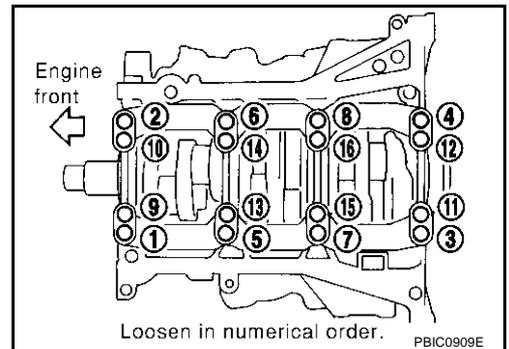


18. Remove main bearing cap bolt.

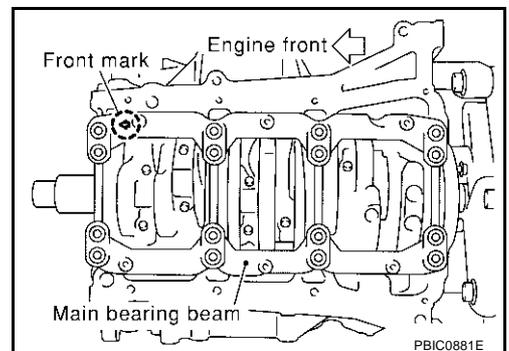
NOTE:

Use TORX socket (size E14).

- Before loosening main bearing cap bolts, measure crankshaft end play. Refer to [EM-134, "CRANKSHAFT END PLAY"](#).
- Loosen them in the numerical order shown in the figure in several different steps.



19. Remove main bearing beam.



20. Remove main bearing cap.

- Using main bearing cap bolts, remove main bearing cap while shaking it back-and-forth.

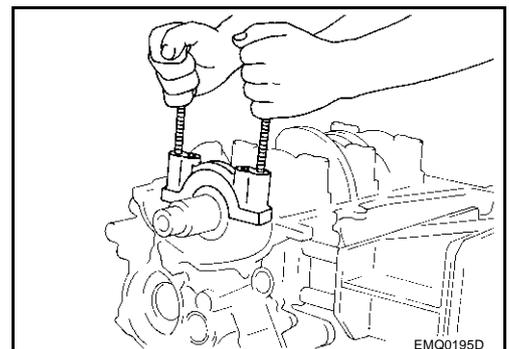
21. Remove crankshaft.

22. Remove main bearings and thrust bearings from cylinder block and main bearing cap.

CAUTION:

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

23. Remove oil jet.



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ASSEMBLY

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

CAUTION:

Use a goggles to protect your eye.

2. Install each water drain plug to cylinder block as shown in the figure.

- Apply liquid gasket to the thread of water drain plugs.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

Water drain plug (front) "A":

: 9.8 N·m (1.0 kg-m, 87 in-lb)

Water drain plug (RH) "B":

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

Water drain plug (LH) "C":

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

3. Install each plug to cylinder block as shown in the figure if removed.

- Apply liquid gasket to the thread of plugs and install plugs with new gaskets.

Use Genuine High Strength Thread Locking Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

Plug (RH) "D":

: 12.3 N·m (1.3 kg-m, 9 ft-lb)

Plug (rear) "E":

: 62 N·m (6.3 kg-m, 46 ft-lb)

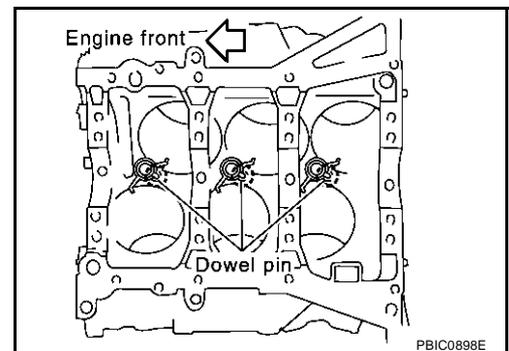
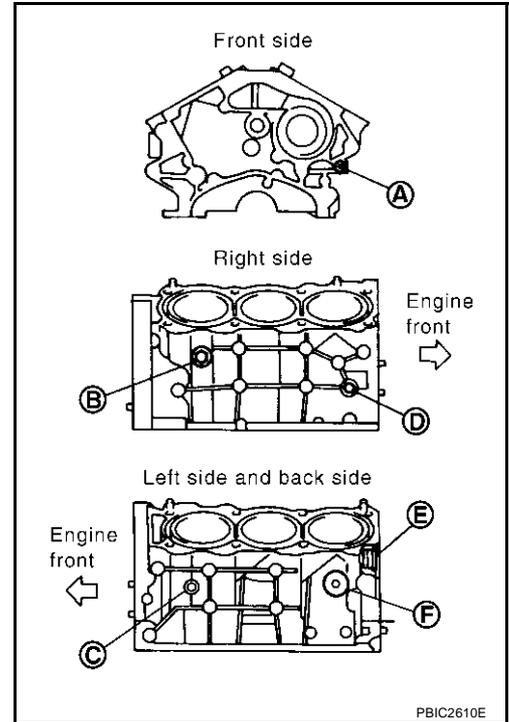
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

Plug (LH) "F":

: 62 N·m (6.3 kg-m, 46 ft-lb)

4. Install oil jet.

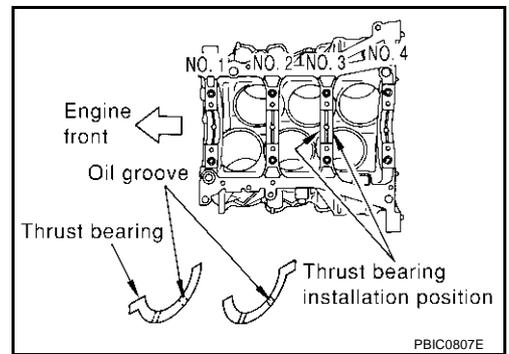
- Insert oil jet dowel pin into the cylinder block dowel pin hole, and tighten the mounting bolts.



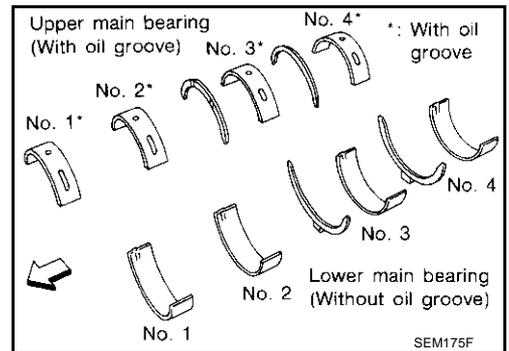
CYLINDER BLOCK

[VQ35DE]

5. Install the main bearings and the thrust bearings.
 - a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block and main bearing cap.
 - b. Install the thrust bearings to the both sides of the No. 3 journal housing on cylinder block and main bearing cap.
 - Install the thrust bearings with the oil groove facing to the crankshaft arm (outside).
 - Install bearing with a projection on one end on cylinder block, and bearing with a projection at center on cap. Align each projection with mating notch.



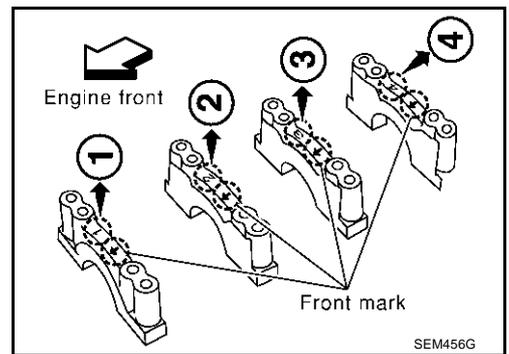
- c. Install the main bearings paying attention to the direction.
 - The main bearing with an oil hole and groove goes on cylinder block. The one without them goes on main bearing cap.
 - Before installing the bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
 - When installing, align the bearing stopper to the notch.
 - Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



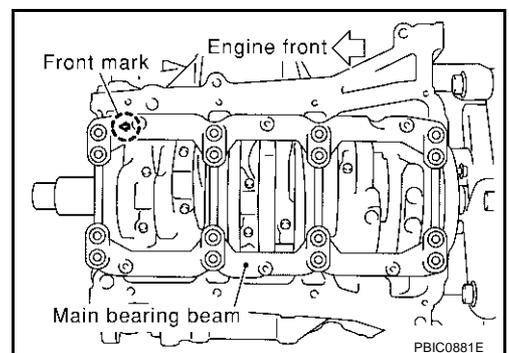
6. Install crankshaft to cylinder block.
 - While turning crankshaft by hand, make sure it turns smoothly.
7. Install main bearing cap.
 - Main bearing caps are identified by identification mark cast on them. For installation, face front mark to front side.

NOTE:

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

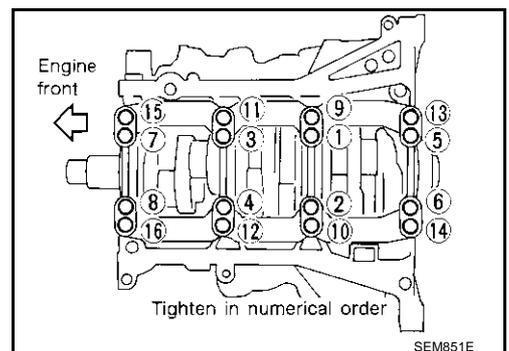


8. Install main bearing beam.
 - Install main bearing beam with front mark facing downward (oil pan side).
 - Install main bearing beam with front mark facing front of engine.
9. Inspect outer diameter of main bearing cap bolt. Refer to [EM-142, "OUTER DIAMETER OF MAIN BEARING CAP BOLT"](#).



10. Install main bearing cap bolt.
 - a. Apply new engine oil to threads and seat surfaces of mounting bolts.
 - b. Tighten bolts in numerical order with tightening torque in several different steps.

 : 35.3 N·m (3.6 kg-m, 26 ft-lb)



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CYLINDER BLOCK

[VQ35DE]

- c. Turn all bolts another "90" degrees clockwise (Angle tightening).

CAUTION:

Use an angle wrench [SST: KV10112100 (BT8653-A)] to check tightening angle. Do not make judgment by visual inspection.

- After installing mounting bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-134. "CRANKSHAFT END PLAY"](#).

11. Inspect outer diameter of connecting rod bolt. Refer to [EM-142. "OUTER DIAMETER OF CONNECTING ROD BOLT"](#).

12. Install piston to connecting rod.

- a. Using a snap ring pliers (commercial service tool), install a new snap ring to the groove of the piston rear side.

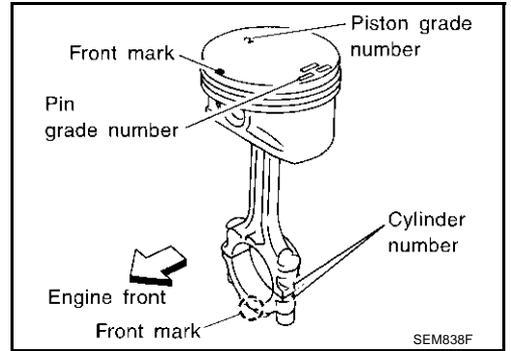
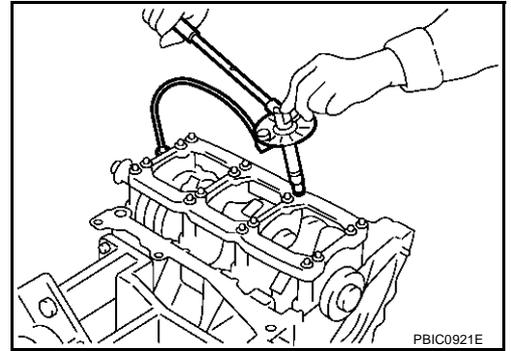
- Insert it fully into groove to install.

- b. Install piston to connecting rod.

- Using an industrial 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 crown and the cylinder number on connecting rod are positioned as shown in the figure.

- c. Install a new snap ring to the groove of the piston front side.

- Insert it fully into groove to install.
- After installing, make sure connecting rod moves smoothly.



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

CAUTION:

Be careful not to damage piston.

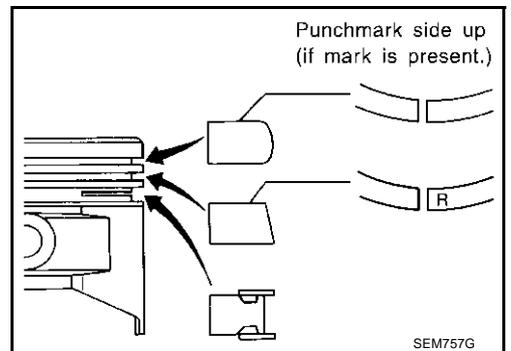
- If there is stamped mark on ring, mount it with marked side up.

NOTE:

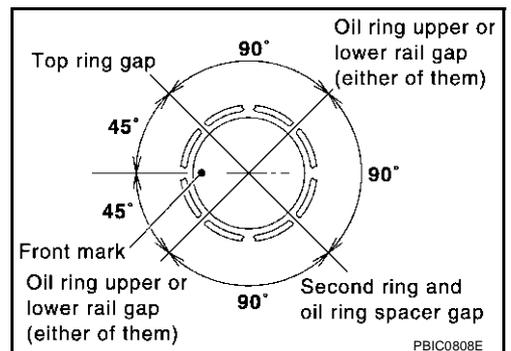
If there is no stamp on ring, no specific orientation is required for installation.

Stamped mark:

- Top ring : —
- Second ring : "R"



- Position each ring with the gap as shown in the figure referring to the piston front mark.

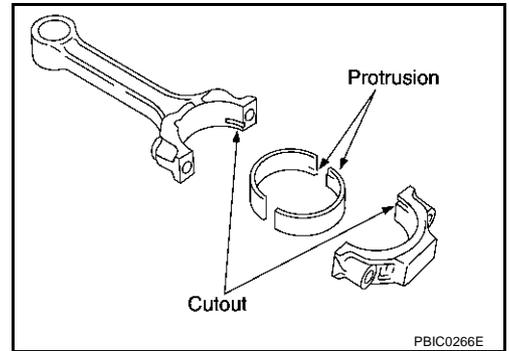


CYLINDER BLOCK

[VQ35DE]

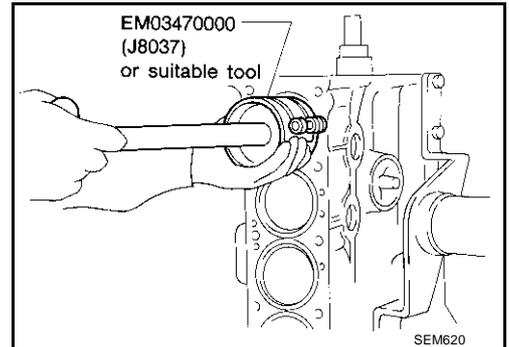
14. Install the connecting rod bearings to connecting rod and connecting rod cap.

- When installing the 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 the connecting rod bearing stopper protrusion with the cutout of the connecting rod to install.
- Check the oil hole on the connecting rod and that on the corresponding bearing are aligned.



15. Install piston and connecting rod assembly to crankshaft.

- Position the crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number on connecting rod to install.
- Using a piston ring compressor (SST) or suitable tool, install piston with the front mark on the piston crown facing the front of engine.

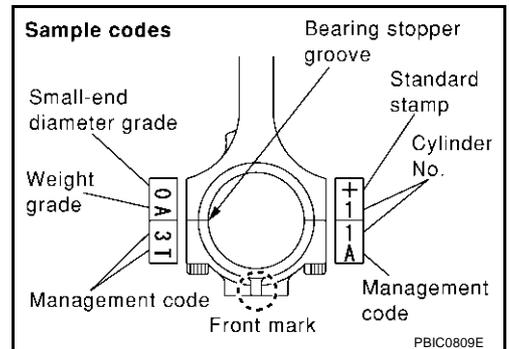


CAUTION:

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

16. Install connecting rod cap.

- Match the stamped cylinder number marks on connecting rod with those on the cap to install.
- Be sure that front mark on connecting rod cap is facing front of engine.



17. Tighten the connecting rod bolt as follows.

- Apply engine oil to the threads and seats of the connecting rod bolts.
- Tighten bolts.

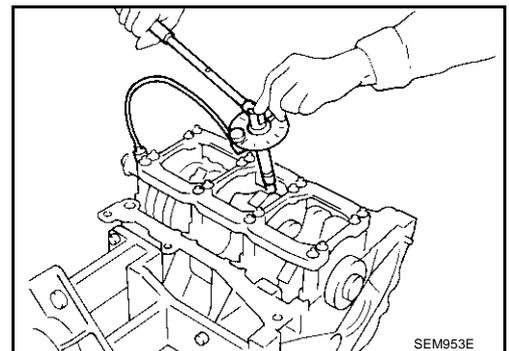
 : 19.6 N·m (2.0 kg-m, 14 ft-lb)

- Then tighten all bolts "90" degrees clockwise (Angle tightening).

CAUTION:

Always use an angle wrench [SST: KV10112100 (BT8653-A)]. Avoid tightening based on visual check alone.

- After tightening the bolt, make sure that the crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-134, "CONNECTING ROD SIDE CLEARANCE"](#)



18. Install baffle plate to main bearing beam.

CYLINDER BLOCK

[VQ35DE]

19. Install rear oil seal retainer to cylinder block.

- Apply new engine oil to the oil and dust seal lips.
- Apply liquid gasket to rear oil seal retainer using tube presser [SST: WS39930000 (-)] as shown in the figure.

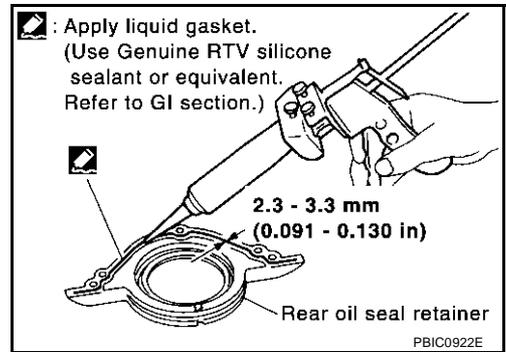
Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .

CAUTION:

Replace with the new parts.

NOTE:

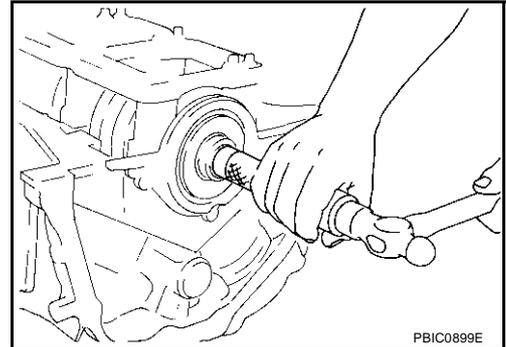
Rear oil seal with rear oil seal retainer.



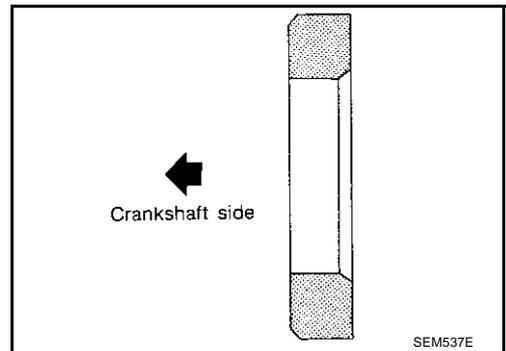
20. Install pilot converter using suitable tool.

- Outer diameter of drift.

Pilot converter : Approx. 33 mm (1.30 in)

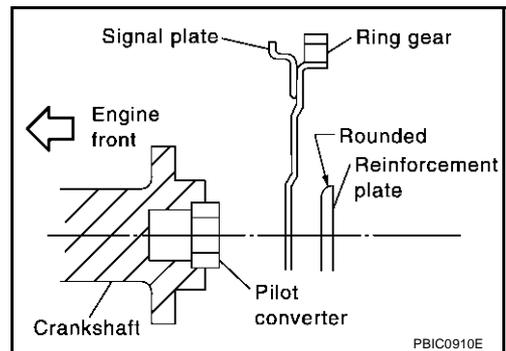


- Press-fit pilot converter with its chamfer facing crankshaft as shown in the figure.



21. Install drive plate.

- Install drive plate and reinforcement plate as shown in figure.
- Secure crankshaft using a ring gear stopper [SST: KV1011770 (J44716)].
- Tighten the installation bolts crosswise over several times.



CYLINDER BLOCK

[VQ35DE]

22. Install knock sensor.

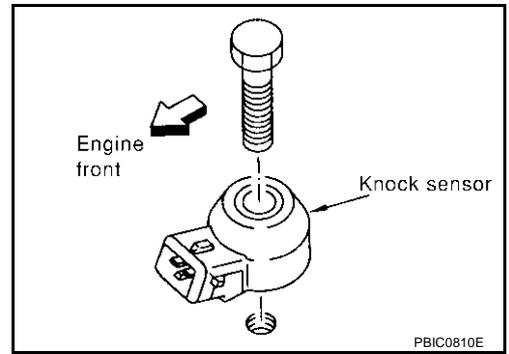
- Install knock sensor so that connector faces front of engine.
- After installing knock sensor, connect harness connector, and lay it out to rear of engine.

CAUTION:

- Do not tighten mounting 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.



23. Install followings in reverse order of removal.

How to Select Piston and Bearing DESCRIPTION

ABS004XI

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 inner diameter and crankshaft pin outer diameter determine connecting rod bearing selection.
Between cylinder block and piston	Piston and piston pin assembly (The piston is available together with piston pin as an assembly.)	Piston grade (piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)
*Between piston and connecting rod	—	—	—

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

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

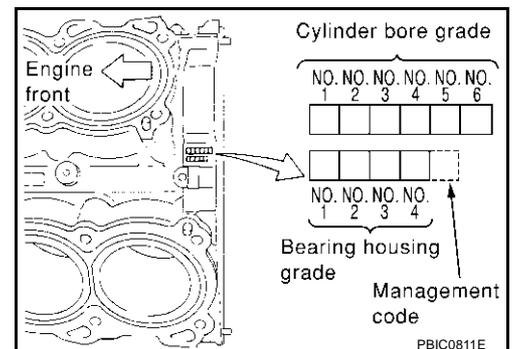
HOW TO SELECT PISTON

When New Cylinder Block is Used

Check cylinder bore grade ("1", "2", or "3") on rear side of cylinder block, and select a piston of the same grade.

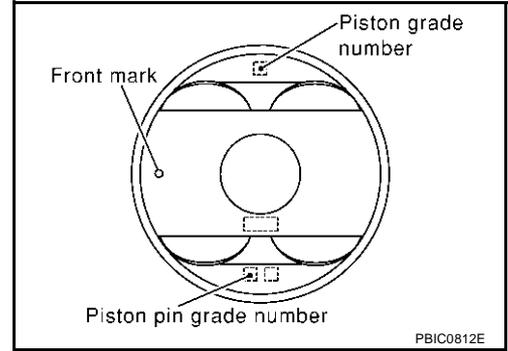
NOTE:

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



Piston Selection Table

Unit: mm (in)

Grade	1	2 (or no mark)	3
Inner diameter of cylinder bore	95.500 / 95.510 (3.7598 / 3.7602)	95.510 / 95.520 (3.7602 / 3.7606)	95.520 / 95.530 (3.7606 / 3.7610)
Outer diameter of piston	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:

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

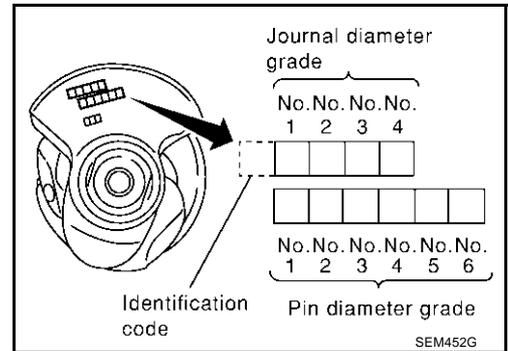
HOW TO SELECT CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used

Check pin diameter grade number ("0", "1", or "2") stamped in front of crankshaft, and select connecting rod bearing of same grade number.

NOTE:

There is no grading for connecting rod big end inner diameter.



When Crankshaft and Connecting Rod are Reused

1. Measure dimensions of the big end inner diameter of connecting rod and outer diameter of crankshaft pin individually.
2. Confirm the big end inner diameter of connecting rod is within the standard value.
3. Apply the measured dimension to the "Connecting Rod Bearing Selection Table".
4. Determine the grade of crankshaft pin diameter grade by comparing the measurement with the values under the crankshaft pin outer diameter of the "Connecting Rod Bearing Selection Table".
5. Select connecting rod bearing of the same grade.

CYLINDER BLOCK

[VQ35DE]

Connecting Rod Bearing Selection Table

Unit: mm (in)

Connecting rod big end inner diameter	55.000 - 55.013 (2.1654 - 2.1659)
---------------------------------------	-----------------------------------

Unit: mm (in)

Crankshaft pin outer diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
51.968 - 51.974 (2.0460 - 2.0462)	0	1.500 - 1.503 (0.0591 - 0.0592)	STD 0	Black
51.962 - 51.968 (2.0457 - 2.0460)	1	1.503 - 1.506 (0.0592 - 0.0593)	STD 1	Brown
51.956 - 51.962 (2.0455 - 2.0457)	2	1.506 - 1.509 (0.0593 - 0.0594)	STD 2	Green

Undersize Bearings Usage Guide

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

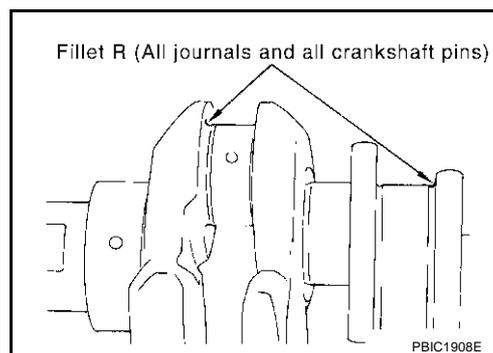
CAUTION:

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

Bearing undersize table

Unit: mm (in)

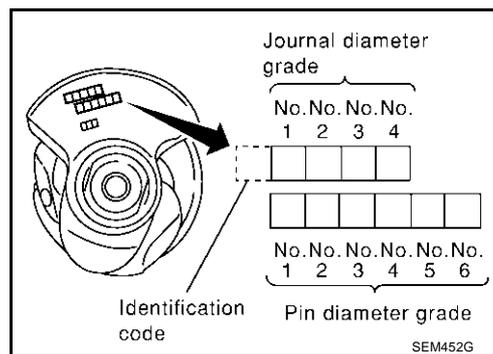
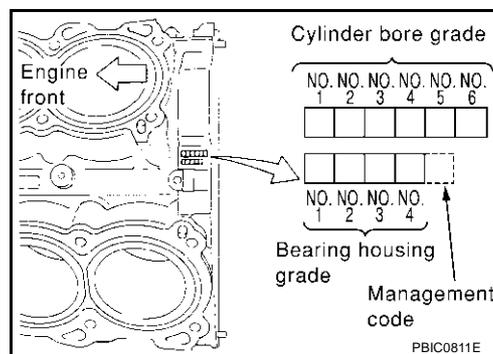
Size	Thickness
US 0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)



HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft are Used

- "Main Bearing Selection Table" rows correspond to bearing housing grade on rear left side of cylinder block.
- Apply journal diameter grade stamped on crankshaft front side to column in "Main Bearing Selection Table".
- Find sign (main bearing grade) at crossing of row and column in "Main Bearing Selection Table".



CYLINDER BLOCK

[VQ35DE]

When Cylinder Block and Crankshaft are Reused

1. Measure inner diameter of cylinder block main bearing housing and outer diameter of crankshaft journal.
2. Find measured dimension in "Cylinder block bearing housing inner diameter" row of "Main Bearing Selection Table".
3. Find the measured dimension in "Crankshaft main journal diameter" column in the following 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 bearing housing inner diameter Unit: mm (in)		Crankshaft main journal diameter Unit: mm (in)		Hole 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
Mark	Axle diameter	63.993 - 63.994 (2.5194 - 2.5194)	63.994 - 63.995 (2.5194 - 2.5195)	63.995 - 63.996 (2.5195 - 2.5195)	63.996 - 63.997 (2.5195 - 2.5196)	63.997 - 63.998 (2.5196 - 2.5196)	63.998 - 63.999 (2.5196 - 2.5196)	63.999 - 64.000 (2.5196 - 2.5197)	64.000 - 64.001 (2.5197 - 2.5197)	64.001 - 64.002 (2.5197 - 2.5198)	64.002 - 64.003 (2.5198 - 2.5198)	64.003 - 64.004 (2.5198 - 2.5198)	64.004 - 64.005 (2.5198 - 2.5199)	64.005 - 64.006 (2.5199 - 2.5199)	64.006 - 64.007 (2.5199 - 2.5200)	64.007 - 64.008 (2.5200 - 2.5200)	64.008 - 64.009 (2.5200 - 2.5200)	64.009 - 64.010 (2.5200 - 2.5201)	64.010 - 64.011 (2.5201 - 2.5201)	64.011 - 64.012 (2.5201 - 2.5202)	64.012 - 64.013 (2.5202 - 2.5202)	64.013 - 64.014 (2.5202 - 2.5202)	64.014 - 64.015 (2.5202 - 2.5203)	64.015 - 64.016 (2.5203 - 2.5203)	64.016 - 64.017 (2.5203 - 2.5203)		
A	59.975 - 59.974 (2.3612 - 2.3612)	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	
B	59.974 - 59.973 (2.3612 - 2.3611)	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
C	59.973 - 59.972 (2.3611 - 2.3611)	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
D	59.972 - 59.971 (2.3611 - 2.3611)	0	1	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
E	59.971 - 59.970 (2.3611 - 2.3610)	0	1	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
F	59.970 - 59.969 (2.3610 - 2.3610)	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
G	59.969 - 59.968 (2.3610 - 2.3609)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
H	59.968 - 59.967 (2.3609 - 2.3609)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
J	59.967 - 59.966 (2.3609 - 2.3609)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
K	59.966 - 59.965 (2.3909 - 2.3608)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
L	59.965 - 59.964 (2.3608 - 2.3608)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
M	59.964 - 59.963 (2.3608 - 2.3607)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
N	59.963 - 59.962 (2.3607 - 2.3607)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
P	59.962 - 59.961 (2.3607 - 2.3607)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
R	59.961 - 59.960 (2.3607 - 2.3606)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
S	59.960 - 59.959 (2.3606 - 2.3606)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
T	59.959 - 59.958 (2.3606 - 2.3605)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
U	59.958 - 59.957 (2.3605 - 2.3605)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
V	59.957 - 59.956 (2.3605 - 2.3605)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
W	59.956 - 59.955 (2.3605 - 2.3604)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
X	59.955 - 59.954 (2.3604 - 2.3604)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
Y	59.954 - 59.953 (2.3604 - 2.3603)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
4	59.953 - 59.952 (2.3603 - 2.3603)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
7	59.952 - 59.951 (2.3603 - 2.3603)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2

PBIC0814E

CYLINDER BLOCK

[VQ35DE]

Main Bearing Grade Table (All Journals)

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color (UPR/LWR)	Remarks
0	2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
2	2.006 - 2.009 (0.0790 - 0.0791)		Green	
3	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
4	2.012 - 2.015 (0.0792 - 0.0793)		Blue	
5	2.015 - 2.018 (0.0793 - 0.0794)		Pink	
6	2.018 - 2.021 (0.0794 - 0.0796)		Purple	
7	2.021 - 2.024 (0.0796 - 0.0797)		White	
01	UPP	2.003 - 2.006 (0.0789 - 0.0790)	Brown/Black	Grade is different for upper and lower bearings.
	LWR	2.000 - 2.003 (0.0787 - 0.0789)		
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)	Green/Brown	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)		
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)	Yellow/Green	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)		
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue/Yellow	
	LWR	2.009 - 2.012 (0.0791 - 0.0792)		
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink/Blue	
	LWR	2.012 - 2.015 (0.0792 - 0.0793)		
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple/Pink	
	LWR	2.015 - 2.018 (0.0793 - 0.0794)		
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White/Purple	
	LWR	2.018 - 2.021 (0.0794 - 0.0796)		

Undersize Bearing Usage Guide

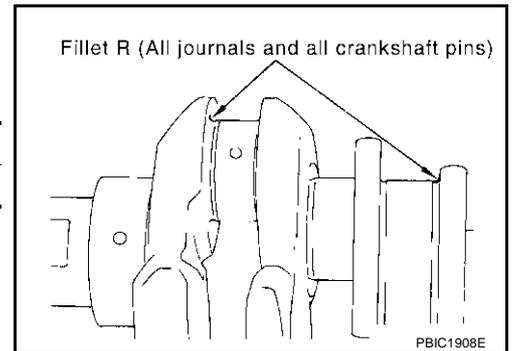
- Use undersize (US) bearing when oil clearance with standard size main bearing is not within specification.
- When using undersize (US) bearing, measure the bearing inner diameter with bearing installed, and grind journal until oil clearance falls within specification.

CAUTION:

**Keep fillet R [1.5 mm (0.059 in)] when grinding crankshaft journal in order to use undersize bearing (All journals).
Bearing undersize table**

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)



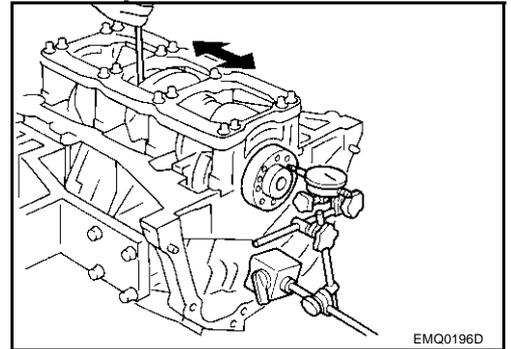
Inspection After Disassembly CRANKSHAFT END PLAY

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

Standard : 0.10 - 0.25 mm (0.0039 - 0.0098 in)

Limit : 0.30 mm (0.0118 in)

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



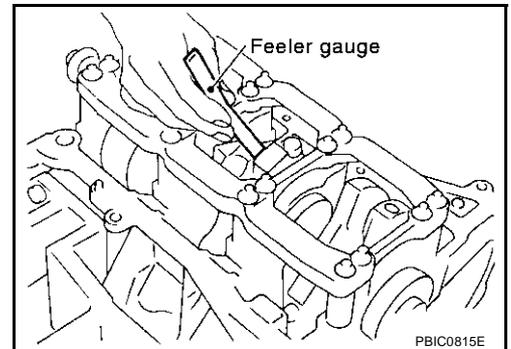
CONNECTING ROD SIDE CLEARANCE

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

Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)

Limit : 0.40 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.

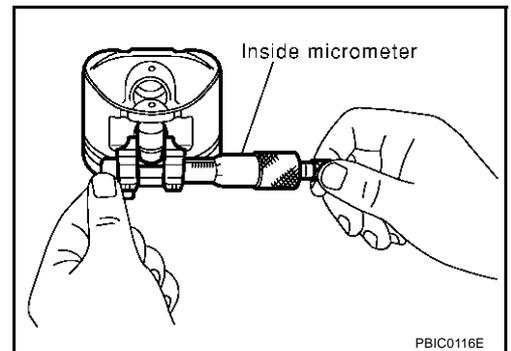


PISTON AND PISTON PIN OIL CLEARANCE

Inner Diameter of Piston Pin

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

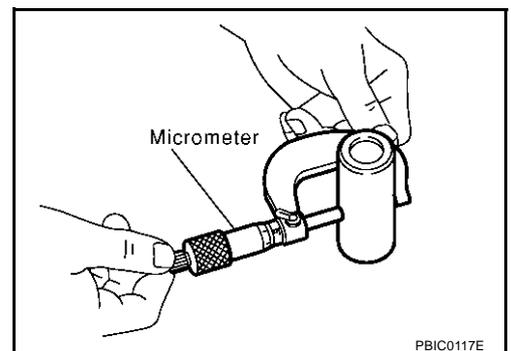
Standard : 21.993 - 22.005 mm (0.8659 - 0.8663 in)



Outer Diameter of Piston Pin

Measure outer diameter of piston pin with a micrometer.

Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)



Piston and Piston Pin Oil Clearance

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

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

- If clearance exceeds specification, replace piston/piston pin assembly with reference to specification of each parts.
- When replacing piston/piston pin assembly, refer to [EM-138, "PISTON TO CYLINDER BORE CLEARANCE"](#).

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)

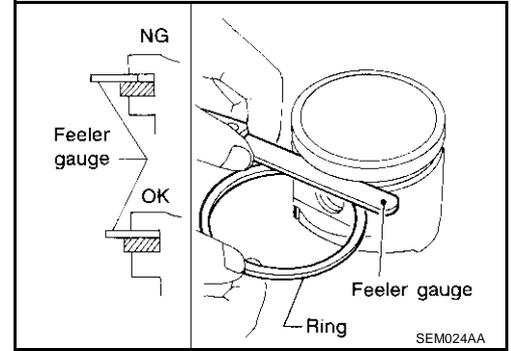
2nd ring : 0.030 - 0.070 mm (0.0012 - 0.0028 in)

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 (0.004 in)



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

PISTON RING END GAP

- Check if inner diameter of cylinder bore is within specification. Refer to [EM-138, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- Insert piston ring until middle of cylinder with piston, and measure gap.

Standard:

Top ring : 0.23 - 0.33 mm (0.0091 - 0.0130 in)

2nd ring : 0.33 - 0.48 mm (0.0130 - 0.0189 in)

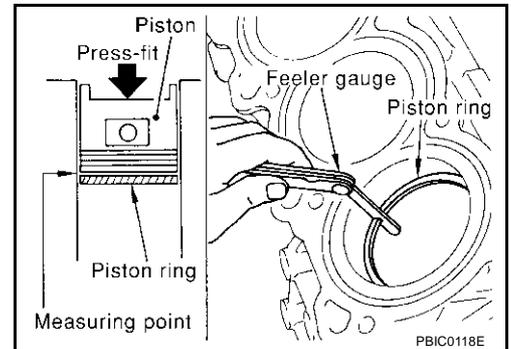
Oil ring : 0.20 - 0.50 mm (0.0079 - 0.0197 in)

Limit:

Top ring : 0.54 mm (0.0213 in)

2nd ring : 0.80 mm (0.0315 in)

Oil ring : 0.95 mm (0.0374 in)



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

CONNECTING ROD BEND AND TORSION

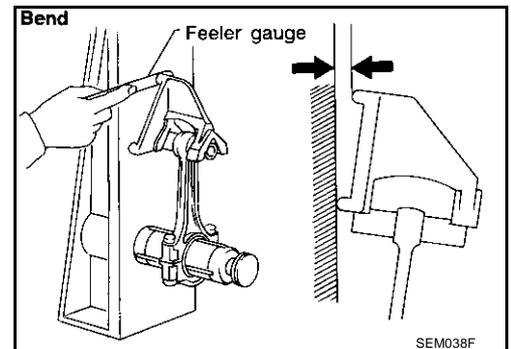
- Check with connecting rod aligner.

Bend:

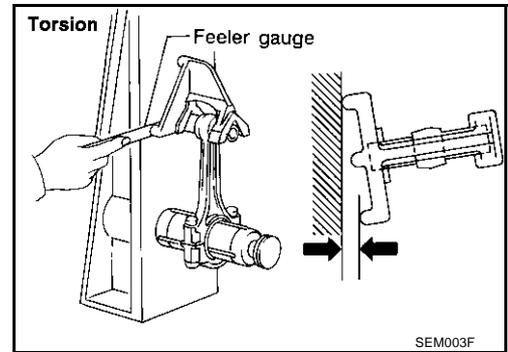
Limit: 0.15 mm (0.0059 in) per 100 mm (3.94 in) length

Torsion:

Limit: 0.30 mm (0.0118 in) per 100 mm (3.94 in) length



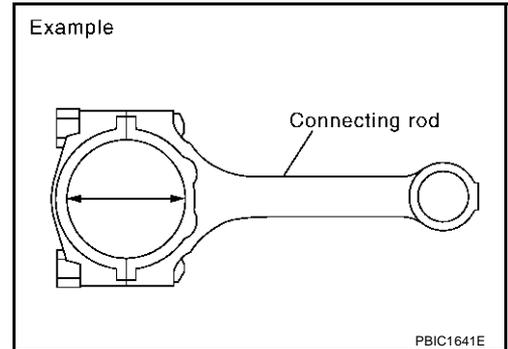
- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BEARING HOUSING DIAMETER (BIG END)

Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod bolt to the specified torque, measure the connecting rod big end inner diameter using an inside micrometer. Refer to [EM-124, "ASSEMBLY"](#) for the tightening procedure.

Standard : 55.000 - 55.013 mm (2.1654 - 2.1659 in)

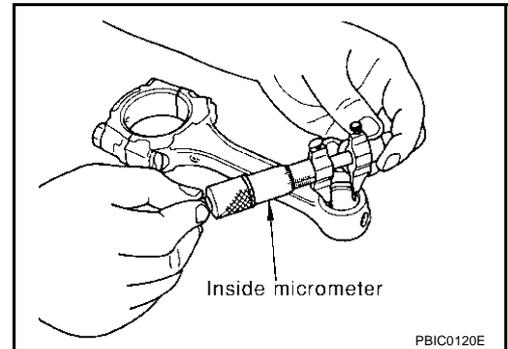


CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

Inner Diameter of Connecting Rod (Small End)

Measure inner diameter of bushing.

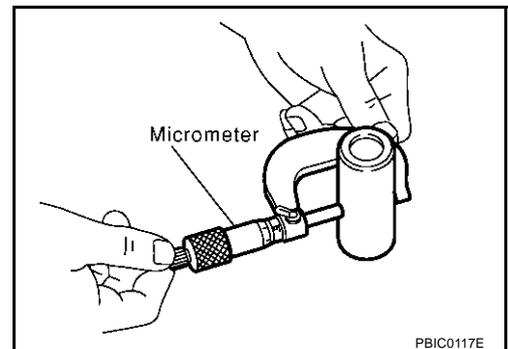
Standard : 22.000 - 22.012 mm (0.8661 - 0.8666 in)



Outer Diameter of Piston Pin

Measure outer diameter of piston pin.

Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)



Connecting Rod Bushing Oil Clearance (Small End)

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

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

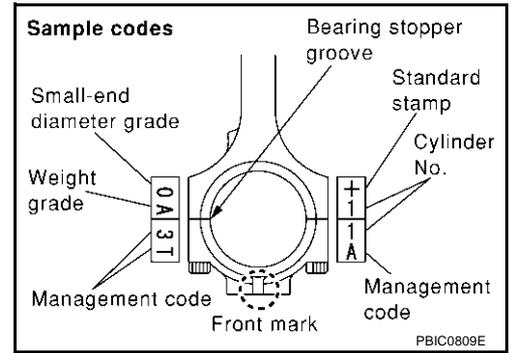
Limit : 0.030 mm (0.0012 in)

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

CYLINDER BLOCK

[VQ35DE]

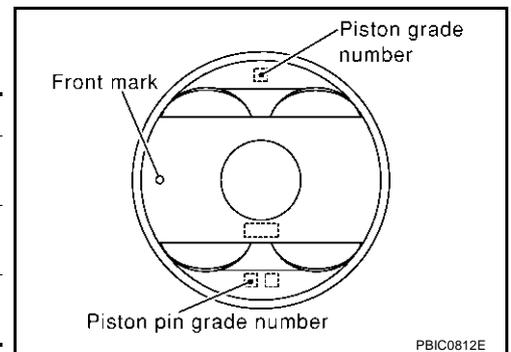
- If replacing piston and piston pin assembly, refer to [EM-138, "PISTON TO CYLINDER BORE CLEARANCE"](#) .
- If replacing the connecting rod assembly, refer to [EM-140, "CONNECTING ROD BEARING OIL CLEARANCE"](#) .



Factory installed parts grading:
Service parts apply only to grade "0".

Grade	Unit: mm (in)	
	0	1
Piston pin 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 a scraper, remove gasket on cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

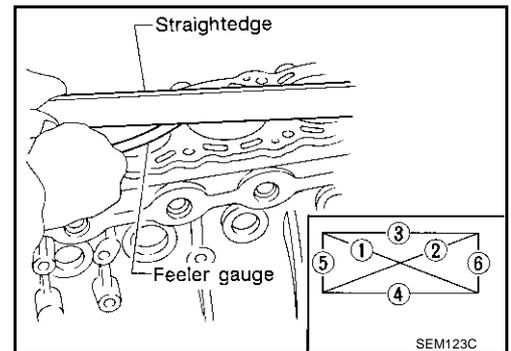
CAUTION:

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

- Measure the distortion on the block upper face at some different points in 6 directions.

Limit : 0.10 mm (0.0039 in)

- If out of the distortion limit, replace cylinder block.



INNER DIAMETER OF MAIN BEARING HOUSING

- Install the main bearing caps and main bearing beam with the main bearings removed, and tighten the mounting bolts to the specified torque. Refer to [EM-124, "ASSEMBLY"](#) for the tightening procedure.

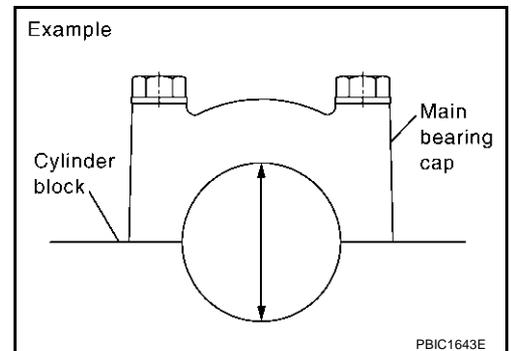
- Using a bore gauge, measure the inner diameter of the main bearing housing.

Standard : 63.993 - 64.017 mm (2.5194 - 2.5203 in)

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

NOTE:

Cylinder block cannot be replaced as single part, because it is machined together with main bearing caps.



PISTON TO CYLINDER BORE CLEARANCE

Inner Diameter of Cylinder Bore

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

Standard inner diameter:

95.500 - 95.530 mm (3.7598 - 3.7610 in)

Wear limit:

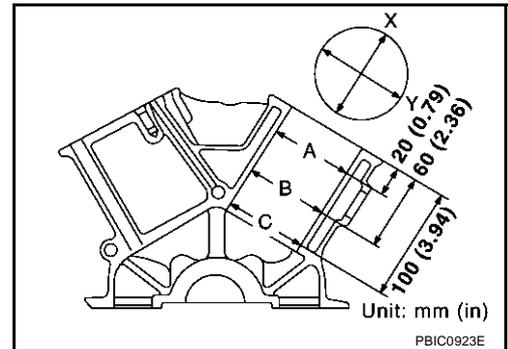
0.20 mm (0.0079 in)

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

Limit: 0.015 mm (0.0006 in)

Taper (Difference between "A" and "C"):

Limit: 0.010 mm (0.0004 in)



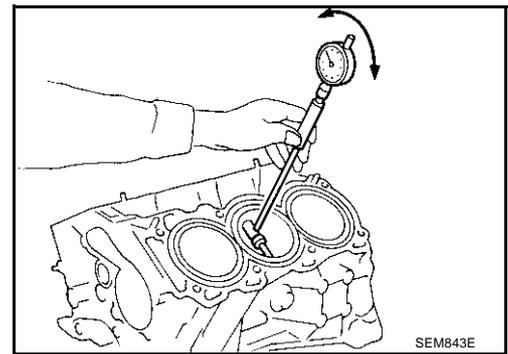
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or re-bore the inner wall.
- An oversize piston is provided. When using an oversize piston, re-bore the cylinder so that the clearance of the piston-to-cylinder bore satisfies the standard.

CAUTION:

When using oversize piston, use it for all cylinders with oversize piston rings.

Oversize (Service) : 0.20 mm (0.0079 in)

- When using an oversize piston, use it for all cylinders with oversize piston rings.



Outer Diameter of Piston

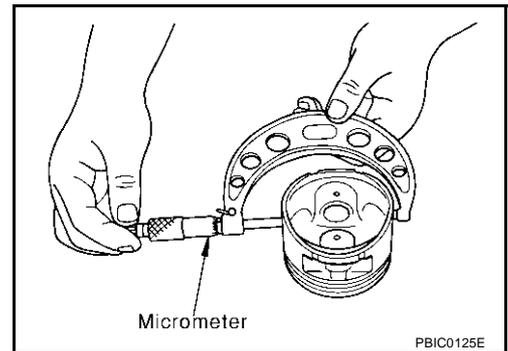
Measure piston skirt outer diameter using micrometer.

Measure point

: Distance from the top 41.0 mm (1.614 in)

Standard

: 95.480 - 95.510 mm (3.7590 - 3.7602 in)



Piston-to-Cylinder Bore Clearance

- Calculate by outer diameter of piston skirt and inner diameter of cylinder (direction "X", position "B").
(Clearance) = (Inner diameter of cylinder) – (Outer diameter of piston skirt).

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

Limit : 0.08 mm (0.0031 in)

- If it exceeds the limit, replace piston/piston pin assembly. Refer to [EM-129, "HOW TO SELECT PISTON"](#).

Re-boring Cylinder Bore

1. Cylinder bore size is determined by adding piston-to-cylinder bore clearance to piston diameter "A".

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 main bearing caps and main bearing beam, 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 specified piston-to-cylinder bore clearance.
5. Measure finished cylinder bore for out-of-round and taper.

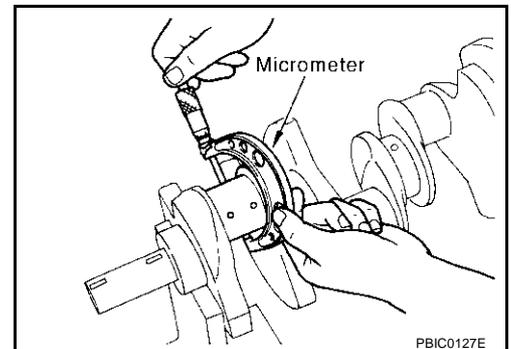
NOTE:

Measurement should be done after cylinder bore cools down.

OUTER DIAMETER OF CRANKSHAFT JOURNAL

Measure outer diameter of crankshaft journals.

Standard : 59.951 - 59.975 mm (2.3603 - 2.3612 in) dia.



OUTER DIAMETER OF CRANKSHAFT PIN

Measure outer diameter of crankshaft pin.

Standard : 51.956 - 51.974 mm (2.0455 - 2.0462 in) dia.

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Using a micrometer, measure the dimensions at "4" different points shown in the figure on each journal and pin.
- 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".

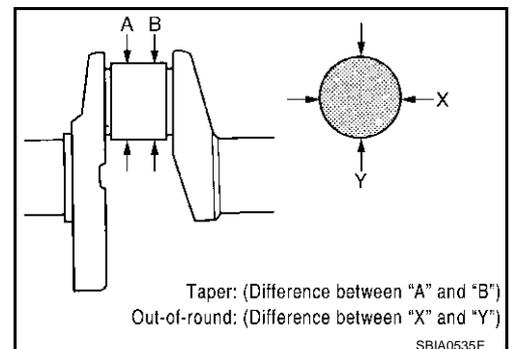
Standard

Taper (Difference between "A" and "B")

: Less than 0.002 mm (0.0001 in)

Out-of-round (Difference between "X" and "Y")

: Less than 0.002 mm (0.0001 in)

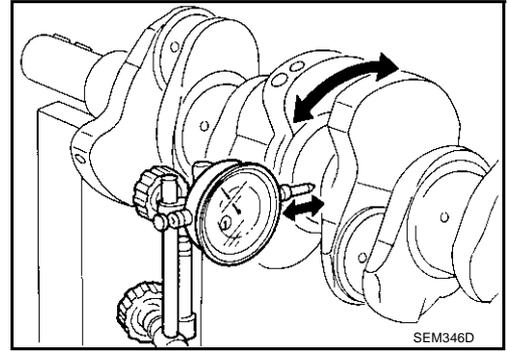


CRANKSHAFT RUNOUT

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

Standard : Less than 0.025 mm (0.0010 in)

Limit : Less than 0.10 mm (0.0039 in)



CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

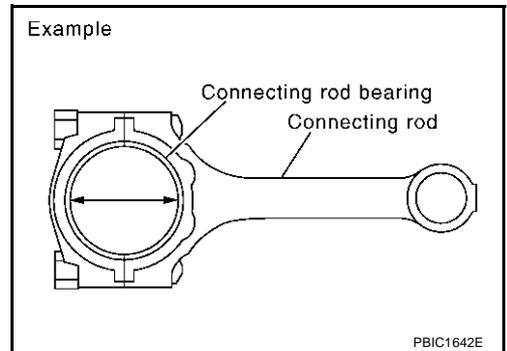
- Install the connecting rod bearings to connecting rod and connecting rod bearing cap, and tighten the connecting rod bolts to the specified torque. Using an inside micrometer measure the inner diameter of connecting rod bearing. Refer to [EM-124, "ASSEMBLY"](#) for the tightening procedure.

(Oil clearance) = (Inner diameter of connecting rod bearing) – (Outer diameter of crankshaft pin)

Standard : 0.034 - 0.059 mm (0.0013 - 0.0023 in)
(actual clearance)

Limit : 0.070 mm (0.0028 in)

- If clearance cannot be adjusted within the standard, grind crankshaft pin and use undersized bearing. Refer to [EM-130, "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 the connecting rod bearings to connecting rod and connecting rod bearing cap, and tighten the connecting rod bolts to the specified torque. Refer to [EM-124, "ASSEMBLY"](#) for the tightening procedure.

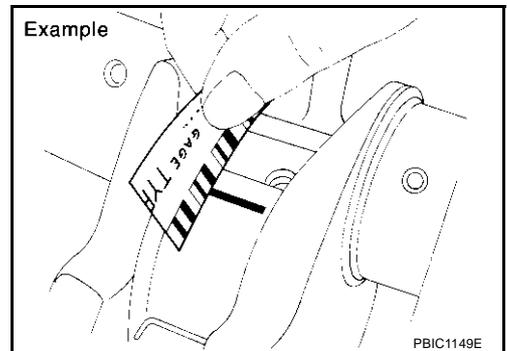
CAUTION:

Never rotate crankshaft.

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

NOTE:

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



MAIN BEARING OIL CLEARANCE

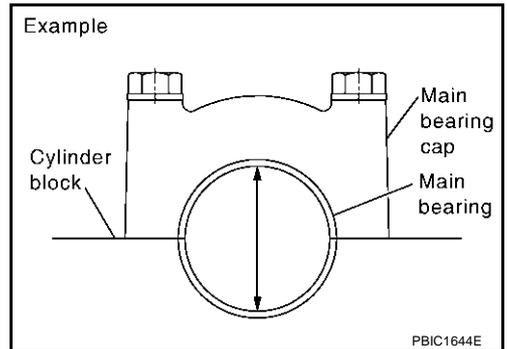
Method by Calculation

- Install the main bearings to cylinder block and main bearing cap. Measure the main bearing inner diameter with the bearing cap bolt tightened with main bearing beam to the specified torque. Refer to [EM-124, "ASSEMBLY"](#) for the tightening procedure.
(Oil clearance) = (Inner diameter of main bearing) – (Outer diameter of crankshaft journal)

Standard : 0.035 - 0.045 mm (0.0014 - 0.0018 in)
(actual clearance)

Limit : 0.065 mm (0.0026 in)

- If the measured value exceeds the limit, select main bearings referring to the main bearing inner diameter and crankshaft journal outer diameter, so that the oil clearance satisfies the standard. Refer to [EM-131, "HOW TO SELECT MAIN BEARING"](#).



Method of Using Plastigage

- Remove engine oil and dust on the crankshaft 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 bearing to cylinder block and main bearing cap, and tighten the main bearing bolts with main bearing beam to the specified torque. Refer to [EM-124, "ASSEMBLY"](#) for the tightening procedure.

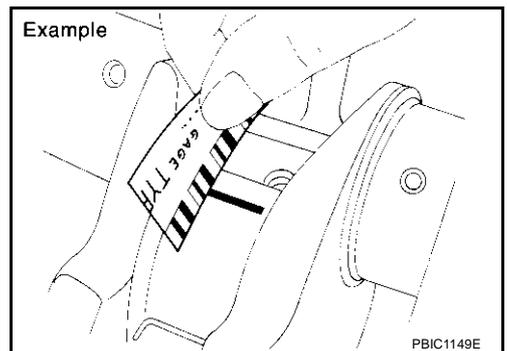
CAUTION:

Never rotate crankshaft.

- Remove bearing cap and bearings, and using the scale on the plastigage bag, measure the plastigage width.

NOTE:

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

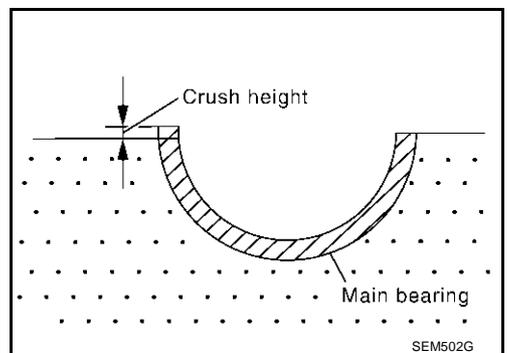


CRUSH HEIGHT OF MAIN BEARING

- When the main bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [EM-124, "ASSEMBLY"](#) for the tightening procedure.

Standard : There must be crush height.

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

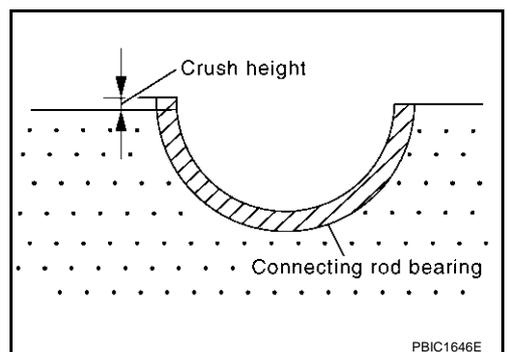


CRUSH HEIGHT OF CONNECTING ROD BEARING

- When the 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-124, "ASSEMBLY"](#) for the tightening procedure.

Standard : There must be crush height.

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

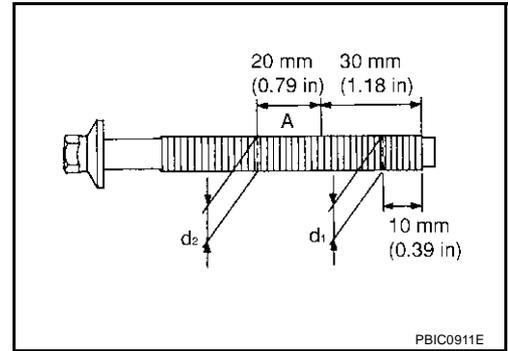


OUTER DIAMETER OF MAIN BEARING CAP BOLT

- Measure outer diameters (“d1”, “d2”) at two positions shown in the figure.
- Measure “d2” at a point within block “A”.

Limit : 0.11 mm (0.0051 in)

- When the value of “d1” - “d2” exceeds the limit (a large difference in dimensions), replace the bolt with a new one.



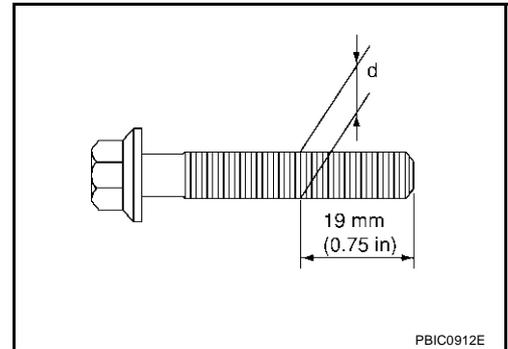
OUTER DIAMETER OF CONNECTING ROD BOLT

- Measure outer diameter “d” at position shown in the figure.

Standard : 7.90 - 8.00 mm (0.3110 - 0.3150 in)

Limit : 7.75 mm (0.3051 in)

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

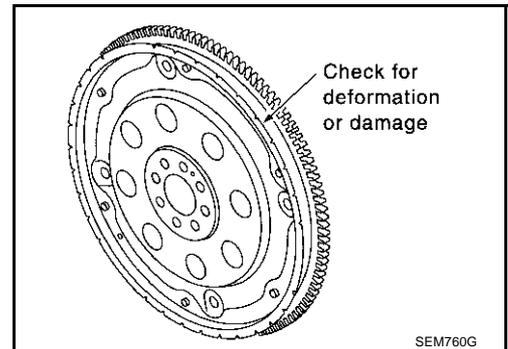


DRIVE PLATE

- Check drive plate and signal plate for deformation or damage.

CAUTION:

- Do not disassemble drive plate.
- Never place drive plate with signal plate facing down.
- When handling signal plate, take care not to damage or scratch it.
- Handle signal plate in a manner that prevents it from becoming magnetized.
- If anything is found, replace drive plate.

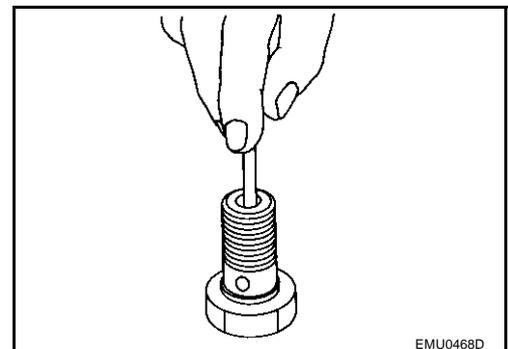


OIL JET

- 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 a clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.
- If it is not satisfied, replace oil jet relief valve.



SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

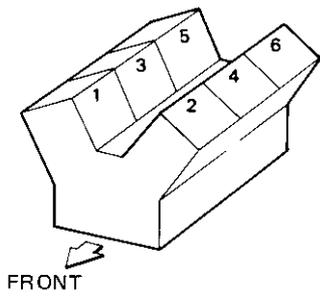
SERVICE DATA AND SPECIFICATIONS (SDS)

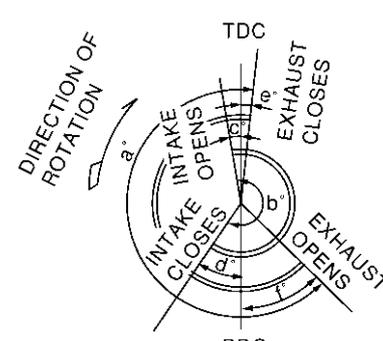
PFP:00100

Standard and Limit GENERAL SPECIFICATIONS

ABS004XK

Cylinder arrangement		V-6
Displacement cm ³ (cu in)		3,498 (213.45)
Bore and stroke mm (in)		95.5 x 81.4 (3.76 x 3.205)
Valve arrangement		DOHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		10.3
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	 <p style="text-align: right; font-size: small;">SEM713A</p>
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Valve timing (Intake valve timing control - "OFF")	 <p style="text-align: right; font-size: small;">PBIC0187E</p>
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Unit: degree					
a	b	c	d	e	f
240	238	- 6	64	8	52

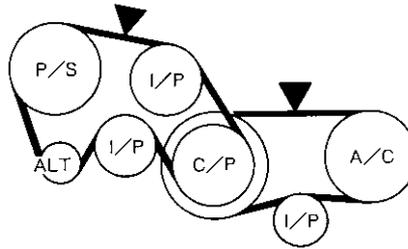
SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

DRIVE BELT

Items	Deflection adjustment		Unit: mm (in)	Tension adjustment*		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator and power steering oil pump belt	7 (0.28)	4 - 5 (0.16 - 0.20)	3.5 - 4.5 (0.138 - 0.177)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
Air conditioner compressor belt	12 (0.47)	9 - 10 (0.35 - 0.39)	8 - 9 (0.31 - 0.35)	196 (20, 44)	348 - 436 (35.5 - 44.5, 78 - 98)	470 - 559 (48 - 57, 106 - 126)
Applied pushing force	98 N (10 kg, 22 lb)			—		

SEC.117



KBIA1731J

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

INTAKE MANIFOLD COLLECTOR, INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit	
Surface distortion	Intake manifold collector upper	0.1 (0.004)
	Intake manifold collector lower	0.1 (0.004)
	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)

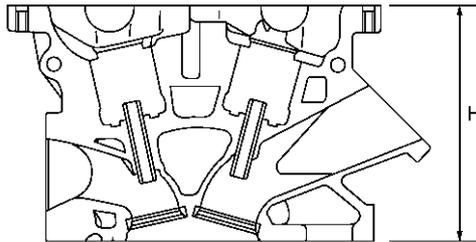
SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

CYLINDER HEAD

Unit: mm (in)

Items	Standard	Limit
Head surface distortion	0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height "H"	126.3 - 126.5 (4.972 - 4.980)	

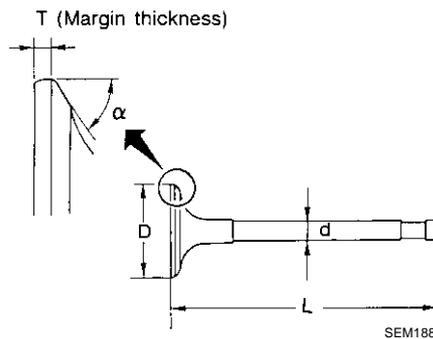


PBIC0924E

VALVE

Valve Dimensions

Unit: mm (in)



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	96.37 (3.7941)
	Exhaust	93.90 (3.6968)
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 margin "T" limit		More than 0.5 (0.020)
Valve stem end surface grinding limit		Less than 0.2 (0.008)

Valve Clearance

Unit: mm (in)

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)

SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

Valve Spring

Free height	mm (in)	45.62 (1.7961)
Pressure	N (kg, lb) at height mm (in)	Installation 184 - 208 (18.8 - 21.2, 41.4 - 46.8) at 37.0 (1.4567)
		Valve open 407 - 459 (41.5 - 46.8, 91.5 - 103.2) at 27.8 (1.0945)
Out-of-square	mm (in)	Limit Less than 2.0 (0.079)

Valve Lifter

Unit: mm (in)

Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Lifter guide inner diameter	34.000 - 34.016 (1.3386 - 1.3392)
Clearance between lifter and lifter guide	0.013 - 0.039 (0.0005 - 0.0015)

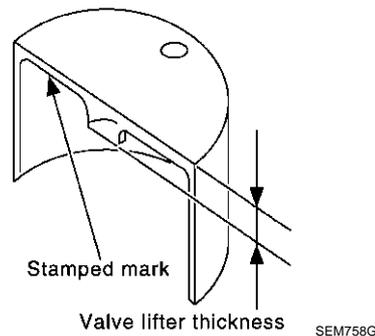
SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

Available Valve Lifter

Unit: mm (in)

Identification Mark	Thickness
788U or 788R	7.88 (0.3102)
790U or 790R	7.90 (0.3110)
792U or 792R	7.92 (0.3118)
794U or 794R	7.94 (0.3126)
796U or 796R	7.96 (0.3134)
798U or 798R	7.98 (0.3142)
800U or 800R	8.00 (0.3150)
802U or 802R	8.02 (0.3157)
804U or 804R	8.04 (0.3165)
806U or 806R	8.06 (0.3173)
808U or 808R	8.08 (0.3181)
810U or 810R	8.10 (0.3189)
812U or 812R	8.12 (0.3197)
814U or 814R	8.14 (0.3205)
816U or 816R	8.16 (0.3213)
818U or 818R	8.18 (0.3220)
820U or 820R	8.20 (0.3228)
822U or 822R	8.22 (0.3236)
824U or 824R	8.24 (0.3244)
826U or 826R	8.26 (0.3252)
828U or 828R	8.28 (0.3260)
830U or 830R	8.30 (0.3268)
832U or 832R	8.32 (0.3276)
834U or 834R	8.34 (0.3283)
836U or 836R	8.36 (0.3291)
838U or 838R	8.38 (0.3299)
840U or 840R	8.40 (0.3307)

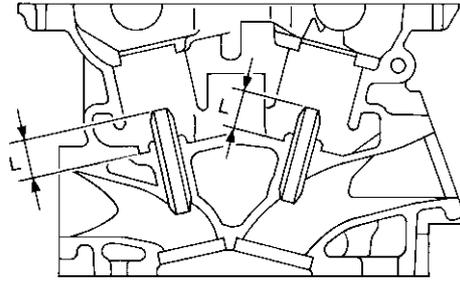


SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

Valve Guide

Unit: mm (in)



SEM950E

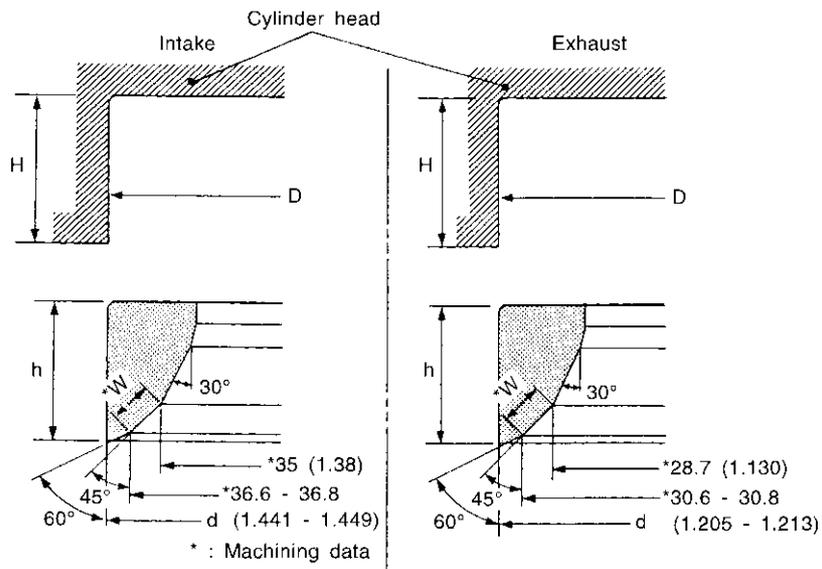
Items		Standard	0.2 (0.008) Oversize (Service)
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	—
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.0035)
Projection length "L"		12.6 - 12.8 (0.496 - 0.504)	

SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

Valve Seat

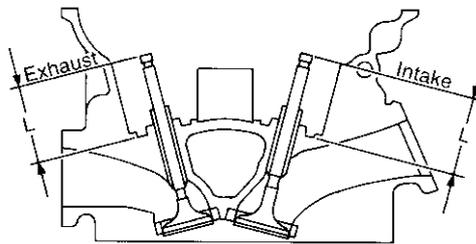
Unit: mm (in)



Contacting width (W); 1.09 - 1.31 (0.0429 - 0.0516)

Contacting width (W); 1.29 - 1.51 (0.0508 - 0.0594)

SEM021EB



SEM621F

Items		Standard	Oversize [0.5 (0.020)] (Service)
Cylinder head seat recess diameter "D"	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter "d"	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Items		Standard	Service
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.05 - 5.15 (0.1988 - 0.2028)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth "H"		5.9 - 6.1 (0.232 - 0.240)	
Depth "L"	Intake	41.07 - 41.67 (1.6169 - 1.6405)	
	Exhaust	41.00 - 41.60 (1.6142 - 1.6378)	

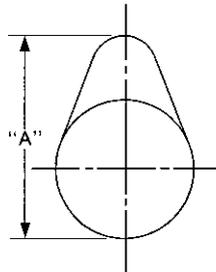
SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Items		Standard	Limit
Camshaft journal to bearing 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)	
Inner diameter of camshaft bearing	No. 1	26.000 - 26.021 (1.0236 - 1.0244)	—
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)	—
Outer diameter of camshaft journal	No. 1	25.935 - 25.955 (1.0211 - 1.0218)	—
	No. 2, 3, 4	23.445 - 23.465 (0.9230 - 0.9238)	—
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)



SEM671

Camshaft cam height "A"	Intake and exhaust	44.865 - 45.055 (1.7663 - 1.7738)	0.2 (0.008)
Camshaft runout [TIR*]		Less than 0.05 (0.0020)	—
Camshaft sprocket runout [TIR*]		—	0.15 (0.0059)

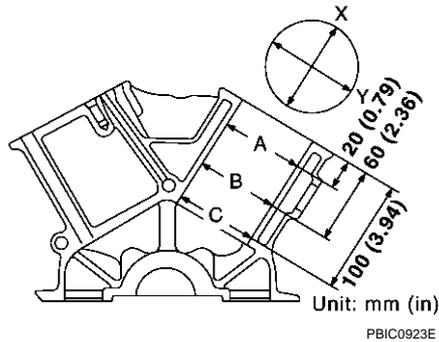
*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

CYLINDER BLOCK

Unit: mm (in)



Surface flatness		Standard		0.03 (0.0012)
		Limit		0.10 (0.0039)
Inner diameter of main bearing housing		Standard		63.993 - 64.017 (2.5194 - 2.5203)
Cylinder bore	Inner diameter	Standard	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
		Wear limit		0.20 (0.0079)
Out-of-round (Difference between "X" and "Y")		Limit		0.015 (0.0006)
Taper (Difference between "A" and "C")		Limit		0.010 (0.0004)
Main journal inner diameter grade (Without bearing)		Grade No. A		63.993 - 63.994 (2.5194 - 2.5194)
		Grade No. B		63.994 - 63.995 (2.5194 - 2.5195)
		Grade No. C		63.995 - 63.996 (2.5195 - 2.5195)
		Grade No. D		63.996 - 63.997 (2.5195 - 2.5196)
		Grade No. E		63.997 - 63.998 (2.5196 - 2.5196)
		Grade No. F		63.998 - 63.999 (2.5196 - 2.5196)
		Grade No. G		63.999 - 64.000 (2.5196 - 2.5197)
		Grade No. H		64.000 - 64.001 (2.5197 - 2.5197)
		Grade No. J		64.001 - 64.002 (2.5197 - 2.5198)
		Grade No. K		64.002 - 64.003 (2.5198 - 2.5198)
		Grade No. L		64.003 - 64.004 (2.5198 - 2.5198)
		Grade No. M		64.004 - 64.005 (2.5198 - 2.5199)
		Grade No. N		64.005 - 64.006 (2.5199 - 2.5199)
		Grade No. P		64.006 - 64.007 (2.5199 - 2.5200)
		Grade No. R		64.007 - 64.008 (2.5200 - 2.5200)
		Grade No. S		64.008 - 64.009 (2.5200 - 2.5200)
		Grade No. T		64.009 - 64.010 (2.5200 - 2.5201)
Grade No. U		64.010 - 64.011 (2.5201 - 2.5201)		
Grade No. V		64.011 - 64.012 (2.5201 - 2.5202)		
Grade No. W		64.012 - 64.013 (2.5202 - 2.5202)		
Grade No. X		64.013 - 64.014 (2.5202 - 2.5202)		
Grade No. Y		64.014 - 64.015 (2.5202 - 2.5203)		
Grade No. 4		64.015 - 64.016 (2.5203 - 2.5203)		
Grade No. 7		64.016 - 64.017 (2.5203 - 2.5203)		
Difference in inner diameter between cylinders		Standard		Less than 0.03 (0.0012)

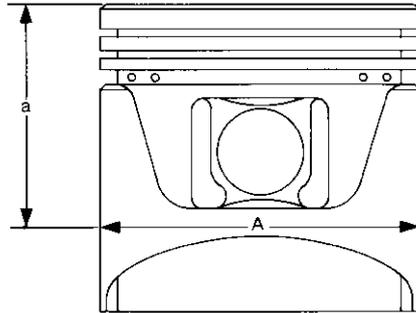
SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



SEM882E

Piston skirt diameter "A"	Standard	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)
		Grade No. 2	95.490 - 95.500 (3.7594 - 3.7598)
		Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)
		Oversize 0.20 (0.0079) (Service)	95.680 - 95.710 (3.7669 - 3.7681)
"a" dimension			41.0 (1.614)
Piston pin hole diameter		Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)
		Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)
Piston 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	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.54 (0.0213)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.80 (0.0315)
	Oil (rail ring)	0.20 - 0.50 (0.0079 - 0.0197)	0.95 (0.0374)

Piston Pin

Unit: mm (in)

Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)
Interference fit of piston pin to piston		0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing oil clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)
	Limit	0.030 (0.0012)

SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

CONNECTING ROD

Unit: mm (in)

Center distance		144.15 - 144.25 (5.6752 - 5.6791)	A
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)	
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)	EM
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)	C
Connecting rod big end inner diameter (Without bearing)		55.000 - 55.013 (2.1654 - 2.1659)	
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)	
	Limit	0.40 (0.0157)	D

*: After installing in connecting rod

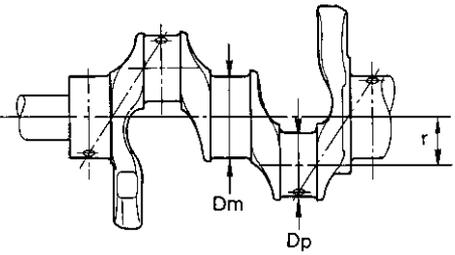
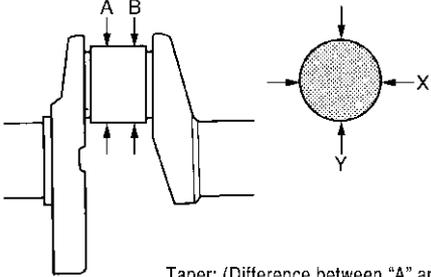
A
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SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

CRANKSHAFT

Unit: mm (in)

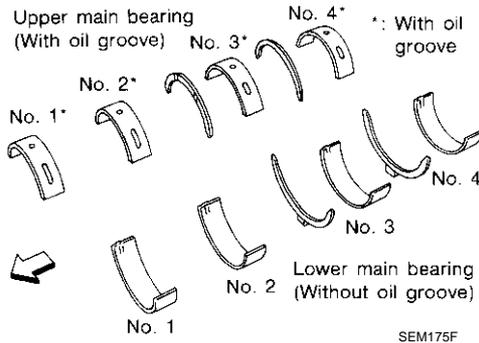
Main journal dia. "Dm" grade	Grade No. A	59.975 - 59.974 (2.3612 - 2.3612)
	Grade No. B	59.974 - 59.973 (2.3612 - 2.3611)
	Grade No. C	59.973 - 59.972 (2.3611 - 2.3611)
	Grade No. D	59.972 - 59.971 (2.3611 - 2.3611)
	Grade No. E	59.971 - 59.970 (2.3611 - 2.3610)
	Grade No. F	59.970 - 59.969 (2.3610 - 2.3610)
	Grade No. G	59.969 - 59.968 (2.3610 - 2.3609)
	Grade No. H	59.968 - 59.967 (2.3609 - 2.3609)
	Grade No. J	59.967 - 59.966 (2.3609 - 2.3609)
	Grade No. K	59.966 - 59.965 (2.3609 - 2.3608)
	Grade No. L	59.965 - 59.964 (2.3608 - 2.3608)
	Grade No. M	59.964 - 59.963 (2.3608 - 2.3607)
	Grade No. N	59.963 - 59.962 (2.3607 - 2.3607)
	Grade No. P	59.962 - 59.961 (2.3607 - 2.3607)
	Grade No. R	59.961 - 59.960 (2.3607 - 2.3606)
	Grade No. S	59.960 - 59.959 (2.3606 - 2.3606)
	Grade No. T	59.959 - 59.958 (2.3606 - 2.3605)
	Grade No. U	59.958 - 59.957 (2.3605 - 2.3605)
Grade No. V	59.957 - 59.956 (2.3605 - 2.3605)	
Grade No. W	59.956 - 59.955 (2.3605 - 2.3604)	
Grade No. X	59.955 - 59.954 (2.3604 - 2.3604)	
Grade No. Y	59.954 - 59.953 (2.3604 - 2.3603)	
Grade No. 4	59.953 - 59.952 (2.3603 - 2.3603)	
Grade No. 7	59.952 - 59.951 (2.3603 - 2.3603)	
Pin journal dia. "Dp"	Grade No. 0	51.968 - 51.974 (2.0460 - 2.0462)
	Grade No. 1	51.962 - 51.968 (2.0457 - 2.0460)
	Grade No. 2	51.956 - 51.962 (2.0445 - 2.0457)
Center distance "r"		40.36 - 40.44 (1.5890 - 1.5921)
Taper (Difference between "A" and "B")	Standard	Less than 0.002 (0.0001)
Out-of-round (Difference between "X" and "Y")		Less than 0.002 (0.0001)
Crankshaft runout [TIR*]	Standard	Less than 0.025 (0.0010)
	Limit	Less than 0.10 (0.0039)
Crankshaft end play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)
 <p>SEM645</p>		 <p>Taper: (Difference between "A" and "B") Out-of-round: (Difference between "X" and "Y")</p> <p>SBIA0535E</p>

*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

AVAILABLE MAIN BEARING



Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color (UPR/LWR)	Remarks
0	2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
2	2.006 - 2.009 (0.0790 - 0.0791)		Green	
3	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
4	2.012 - 2.015 (0.0792 - 0.0793)		Blue	
5	2.015 - 2.018 (0.0793 - 0.0794)		Pink	
6	2.018 - 2.021 (0.0794 - 0.0796)		Purple	
7	2.021 - 2.024 (0.0796 - 0.0797)		White	
01	UPP	2.003 - 2.006 (0.0789 - 0.0790)	Brown/Black	Grade is different for upper and lower bearings.
	LWR	2.000 - 2.003 (0.0787 - 0.0789)		
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)	Green/Brown	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)		
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)	Yellow/Green	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)		
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue/Yellow	
	LWR	2.009 - 2.012 (0.0791 - 0.0792)		
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink/Blue	
	LWR	2.012 - 2.015 (0.0792 - 0.0793)		
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple/Pink	
	LWR	2.015 - 2.018 (0.0793 - 0.0794)		
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White/Purple	
	LWR	2.018 - 2.021 (0.0794 - 0.0796)		

Undersize

Unit: mm (in)

Items	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	Grind so that bearing clearance is the specified value.

SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ35DE]

CONNECTING ROD BEARING

Grade number	Thickness "T" mm (in)	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

Undersize

Unit: mm (in)

Items	Thickness	Crank pin journal diameter "Dp"
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

BEARING OIL CLEARANCE

Unit: mm (in)

Main bearing oil clearance	Standard	0.035 - 0.045 (0.0014 - 0.0018)*
	Limit	0.065 (0.0026)
Connecting rod bearing oil clearance	Standard	0.034 - 0.059 (0.0013 - 0.0023)*
	Limit	0.070 (0.0028)

*: Actual clearance

PRECAUTIONS

PF0:00001

Precautions for Drain Engine Coolant

ABS0099M

Drain engine coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

ABS0099N

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

Precautions for Removal and Disassembly

ABS0099O

- When instructed to use special service tools, 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 where noted in the step.

Precautions for Inspection, Repair and Replacement

ABS0099P

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

Precautions for Assembly and Installation

ABS0099Q

- 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 systems for leakage.

Parts Requiring Angular Tightening

ABS0061O

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

PRECAUTIONS

[VK45DE]

ABS0099R

Precautions for Liquid Gasket REMOVAL OF LIQUID GASKET SEALING

- After removing mounting bolts and nuts, separate the mating surface using seal cutter (SST) and remove old liquid gasket sealing.

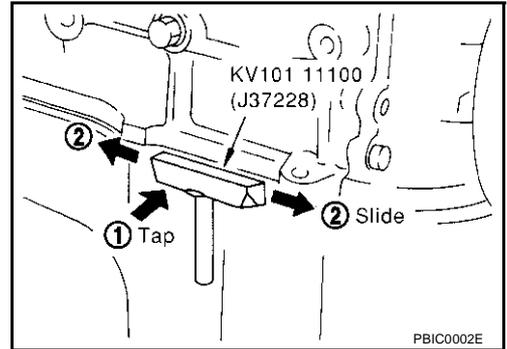
CAUTION:

Be careful not to damage the mating surfaces.

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

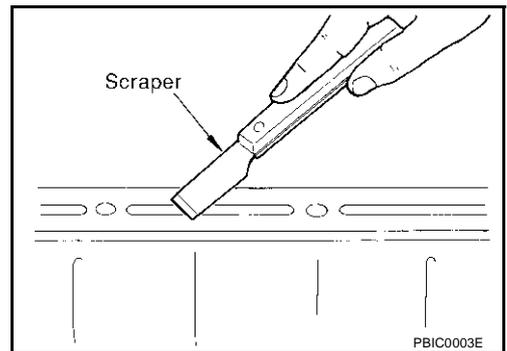
CAUTION:

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



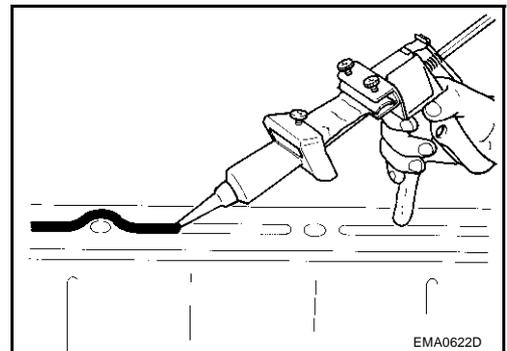
LIQUID GASKET APPLICATION PROCEDURE

- 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, mounting bolts, and bolt holes.
- Wipe liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



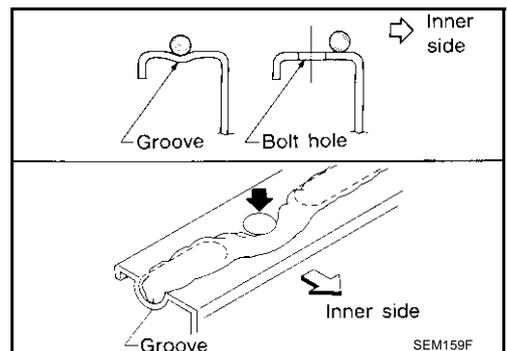
- Attach liquid gasket tube to tube presser [SST: WS39930000 (-)].

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



- 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 gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten 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

[VK45DE]

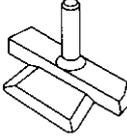
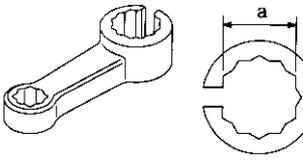
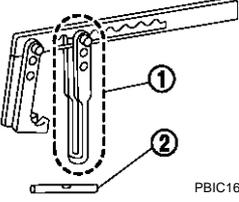
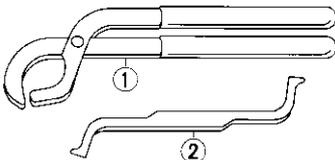
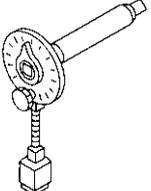
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PREPARATION

Special Service Tools

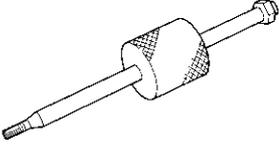
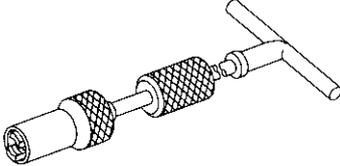
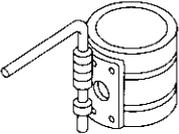
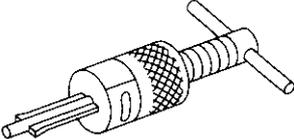
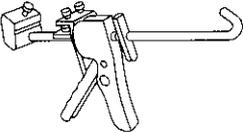
ABS006I2

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 (J37228) Seal cutter  S-NT046	Removing oil pan and front cover C D
KV10117200 (J-38365) Heated oxygen sensor wrench  S-NT636	Loosening or tightening heated oxygen sensors a: 22 mm (0.87 in) E F
EG15050500 (J45402) Compression gauge adapter  ZZA1225D	Inspection of compression pressure G H
KV10116200 (J26336-A) Valve spring compressor 1. KV10115900 (J26336-20) Attachment 2. KV10109230 (—) Adapter  PBIC1650E	Disassembling valve mechanism Part (1) is a component of KV10116200 (J26336-A), but part (2) is not so. I J
KV101151S0 (J38972) Lifter stopper set 1. KV10115110 (J38972-1) Camshaft pliers 2. KV10115120 (J38972-2) Lifter stopper  S-NT041	Changing valve lifter shims K L M
KV10112100 (BT8653-A) Angle wrench  S-NT014	Tightening bolts for bearing cap, cylinder head, etc. in angle N

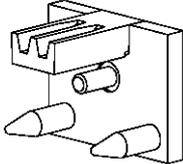
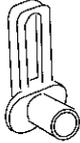
PREPARATION

[VK45DE]

Tool number (Kent-Moore No.) Tool name	Description
KV10114700 (J38139) Main bearing cap remover	Removing crankshaft main bearing cap  <p style="text-align: center;">ZZA0023D</p>
KV10107902 (J38959) Valve oil seal puller	Removing valve oil seal  <p style="text-align: center;">S-NT011</p>
KV10115600 (J38958) Valve oil seal drift	Installing valve oil seal Use side A. a: 20 (0.79) dia. d: 8 (0.31) dia. b: 13 (0.51) dia. e: 10.7 (0.421) dia. c: 10.3 (0.406) dia. f: 5 (0.20) dia. Unit: mm (in)
EM03470000 (J8037) Piston ring compressor	Installing piston assembly into cylinder bore  <p style="text-align: center;">S-NT044</p>
ST16610001 (J23907) Pilot bushing puller	Removing crankshaft pilot bushing  <p style="text-align: center;">S-NT045</p>
WS39930000 (—) Tube presser	Pressing the tube of liquid gasket  <p style="text-align: center;">S-NT052</p>

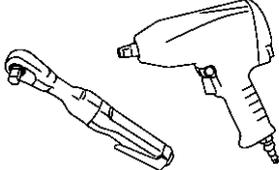
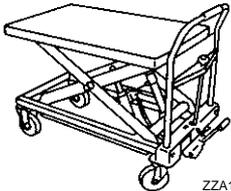
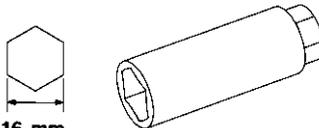
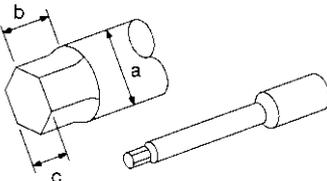
PREPARATION

[VK45DE]

Tool number (Kent-Moore No.) Tool name	Description	A
— (J-45476) Ring gear stopper	 Removing and installing crankshaft pulley PBIC1655E	EM
— (J-45488) Quick connector release	 Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210) PBIC0198E	C D E

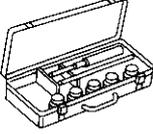
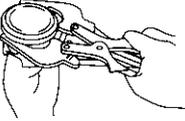
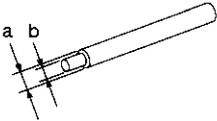
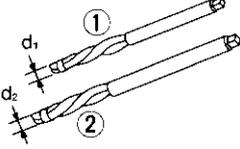
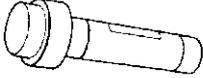
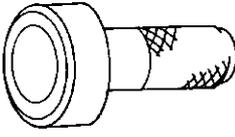
Commercial Service Tools

ABS00613

(Kent-Moore No.) Tool name	Description	G
Power tool	 Loosening bolts and nuts PBIC0190E	H I
Manual lift table caddy	 Removing and installing engine ZZA1210D	J K
Spark plug wrench	 Removing and installing spark plug S-NT047	L M
(J24239-01) Cylinder head bolt wrench	 Loosening and tightening cylinder head bolt, and use with angle wrench [SST: KV10112100 (BT8653-A)] a: 13 (0.51) dia. b: 12 (0.47) c: 10 (0.39) Unit: mm (in) NT583	

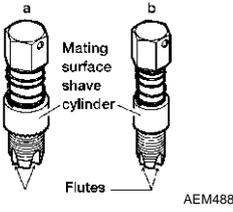
PREPARATION

[VK45DE]

(Kent-Moore No.) Tool name	Description
Valve seat cutter set  S-NT048	Finishing valve seat dimensions
Piston ring expander  S-NT030	Removing and installing piston ring
Valve guide drift  S-NT015	Removing and installing valve guide Intake & Exhaust: a: 9.5 mm (0.374 in) dia. b: 5.5 mm (0.217 in) dia.
Valve guide reamer  S-NT016	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide Intake & Exhaust: d1 : 6.0 mm (0.236 in) dia. d2 : 10.2 mm (0.402 in) dia.
Front oil seal drift  ZZA0012D	Installing front oil seal
Rear oil seal drift  ZZA0025D	Installing rear oil seal

PREPARATION

[VK45DE]

(Kent-Moore No.) Tool name	Description	A
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner	 <p>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 dia.) for zirconia heated oxygen sensor b: J-43897-12 (12 mm dia.) for titania heated oxygen sensor</p>	EM C
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)	 <p>Lubricating heated oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>	D E

F

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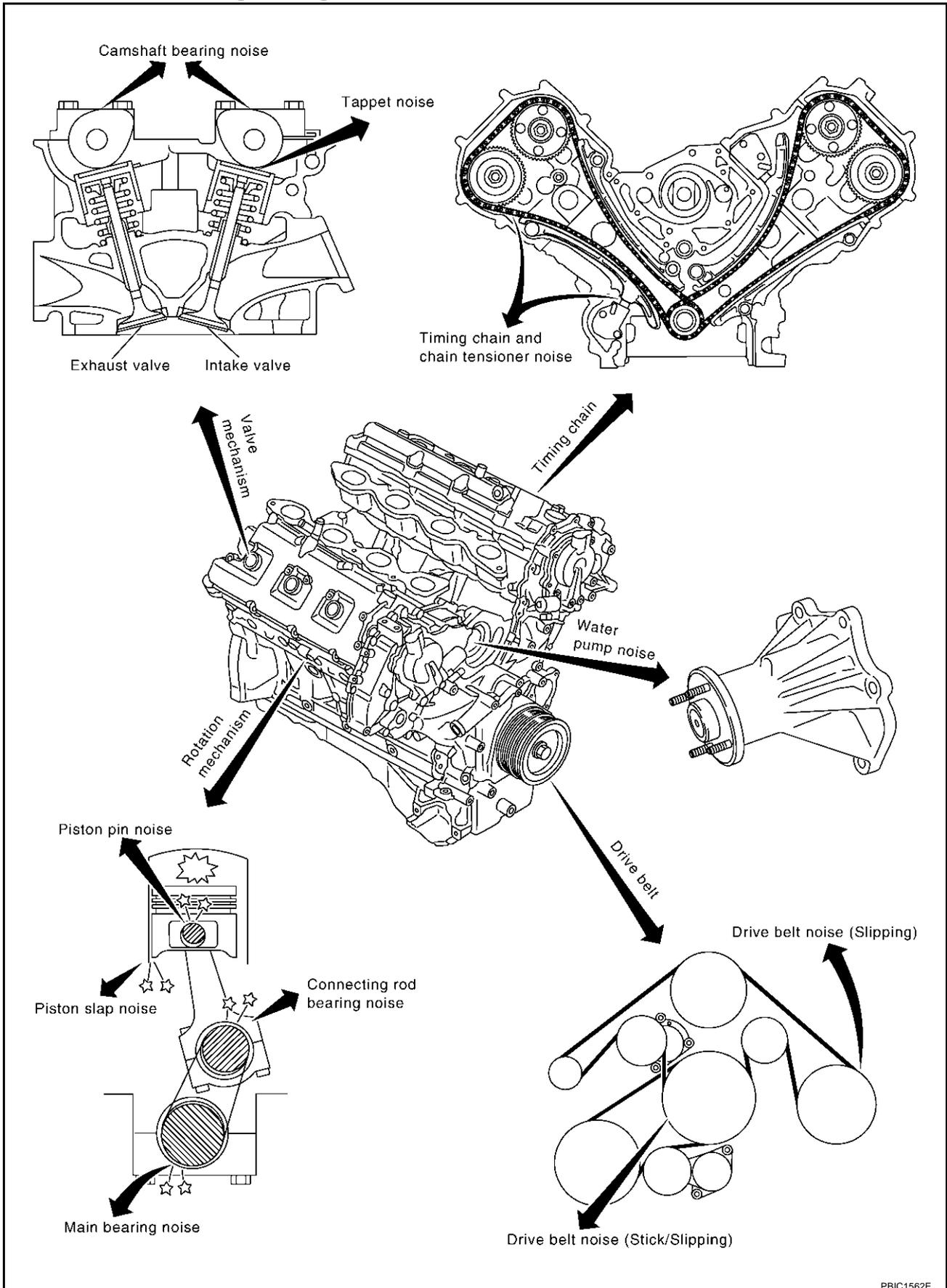
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NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

[VK45DE]

ABS00615

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

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-208
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-206 EM-205
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin clearance Connecting rod bushing oil clearance	EM-246 EM-248
	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-250 EM-247 EM-247 EM-248
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-248 EM-253
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-253 EM-252
Front of engine Timing chain cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-195 EM-192
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-167
	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-47 , "WATER PUMP"

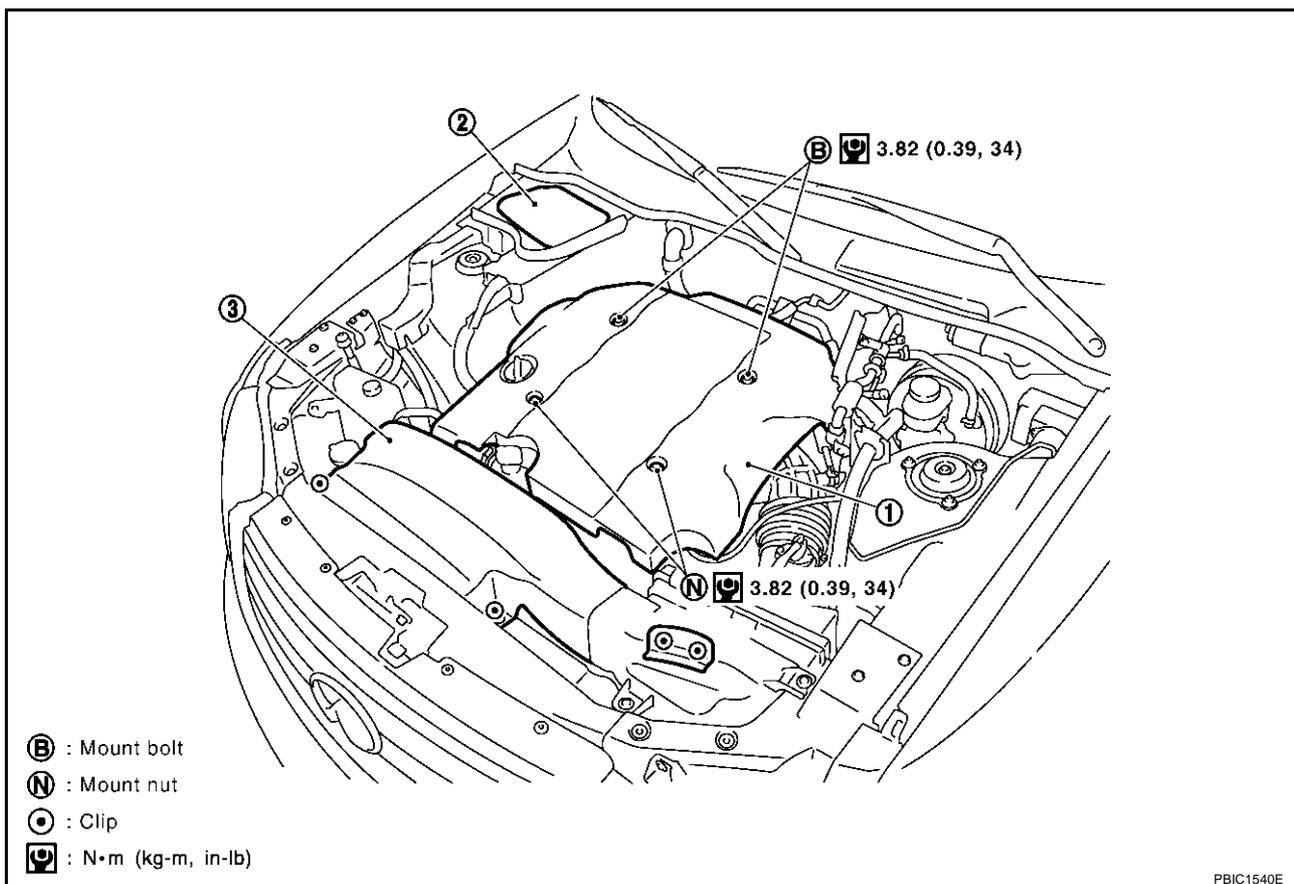
A: Closely related B: Related C: Sometimes related —: Not related

ENGINE ROOM COVER

PFP:14049

Removal and Installation

ABS00616



1. Engine cover

2. Battery cover

3. Air duct (inlet)

REMOVAL**CAUTION:**

Do not damage or scratch cover when installing or removing.

- Major parts and inspection points under each cover are as follows; (numbered as in illustration)
 - 1** : Upper side of engine assembly and power steering reservoir tank
 - 2** : Relay and battery
 - 3** : Engine assembly front side, drive belts and cooling fan

INSTALLATION

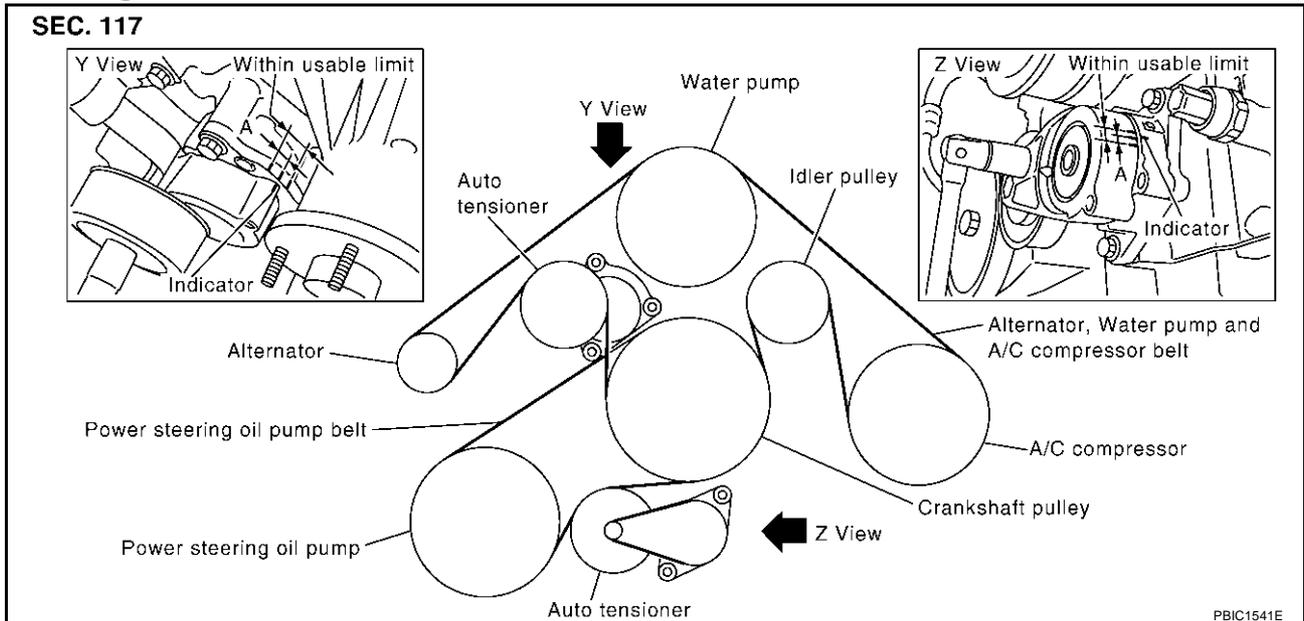
Install in the reverse order of removal.

DRIVE BELTS

PF02117

Checking Drive Belts

ABS00617



WARNING:

Be sure to perform when engine is stopped.

- Remove air duct (inlet) when inspecting drive belt for alternator, water pump and A/C compressor.
- Remove engine front undercover with power tool when inspecting power steering oil pump belt.
- Make sure that indicator (single line notch) of each auto tensioner is within the allowable working range (between three line notches).

NOTE:

- Check auto tensioner indication when engine is cold.
- When new drive belt is installed, the range should be "A".
- The indicator notch is located on the moving side of auto tensioner for alternator, water pump and A/C compressor belt, while it is found on the fixed side for power steering oil pump belt.
- Visually check entire belt for wear, damage or cracks.
- If indicator is out of allowable working range or belt is damaged, replace belt.

Tension Adjustment

ABS00618

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

Removal and Installation

REMOVAL

ABS00619

Alternator, Water Pump and A/C Compressor Belt

1. Remove air duct (inlet) and engine front undercover (with power tool).
2. With box wrench, and while securely holding the hexagonal part in pulley center of auto tensioner, move wrench handle in the direction of arrow (loosening direction of tensioner).

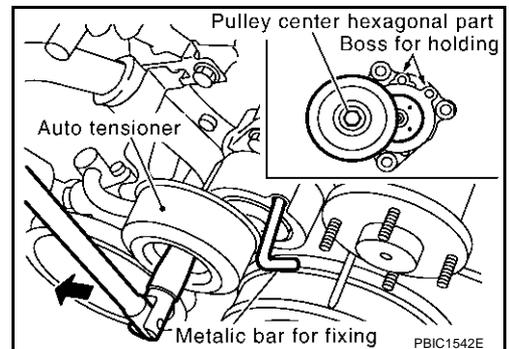
CAUTION:

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

3. Under the above condition, insert a metal bar of approximately 6 mm (0.24 in) in diameter (hexagonal bar wrench shown as example in the figure) through the holding boss to lock auto tensioner pulley arm.

- Leave auto tensioner pulley arm locked until belt is installed again.

4. Remove alternator, water pump and A/C compressor belt.



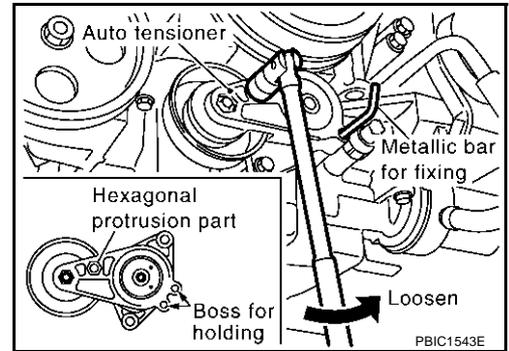
Power Steering Oil Pump Belt

1. Remove air duct (inlet) and engine front undercover with power tool.
2. Remove alternator, water pump and A/C compressor belt. Refer to [EM-167, "Alternator, Water Pump and A/C Compressor Belt"](#) .
3. While securely holding the hexagonal protrusion part of auto tensioner pulley with box wrench, move wrench handle in the direction of arrow (loosening direction of tensioner).

CAUTION:

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

4. Under the above condition, insert a metal bar of approximately 6 mm (0.24 in) in diameter (hexagonal bar wrench shown as example in the figure) through the holding boss to lock auto tensioner pulley arm.
 - Leave auto tensioner pulley arm locked until belt is installed again.
5. Remove power steering oil pump belt.

**INSTALLATION****Power Steering Oil Pump Belt**

Install in the reverse order of removal paying attention to the following.

CAUTION:

Make sure belt is securely installed around all pulleys.

- Unlock auto tensioner pulley arm to give tension to belt.
- Rotate crankshaft pulley several turns clockwise to equalize belt tension between pulleys.
- Make sure belt tension is within the allowable working range, using indicator notch on auto tensioner. Refer to [EM-167, "Checking Drive Belts"](#) .

Alternator, Water Pump and A/C Compressor Belt

Install in the reverse order of removal paying attention to the following.

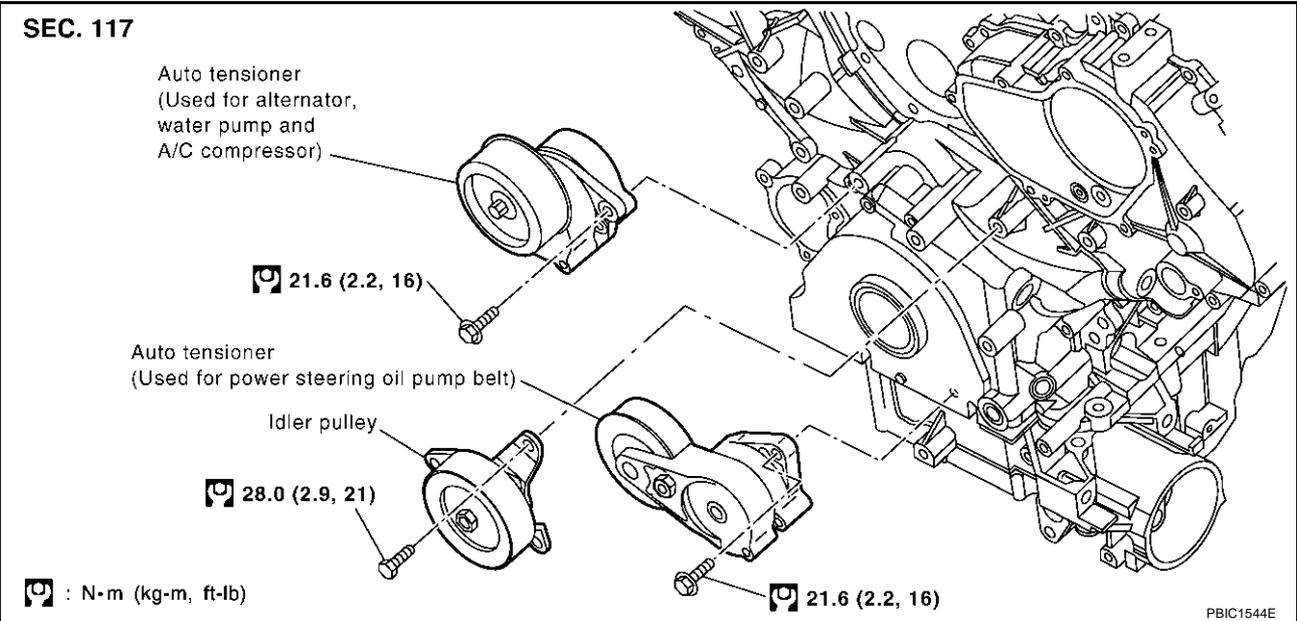
CAUTION:

Make sure belt is securely installed around all pulleys.

- Unlock auto tensioner pulley arm to give tension to belt.
- Rotate crankshaft pulley several turns clockwise to equalize belt tension between pulleys.
- Make sure belt tension is within the allowable working range, using indicator notch on auto tensioner. Refer to [EM-167, "Checking Drive Belts"](#) .

Drive Belt Auto Tensioner and Idler Pulley

ABS0061A

**REMOVAL**

1. Remove air duct (inlet) and engine front undercover with power tool.
2. Remove drive belts. Refer to [EM-167, "Removal and Installation"](#) .
 - Keep auto tensioner pulley arm locked after belt is removed.
3. Remove auto tensioner and idler pulley (with power tool).
 - Keep auto tensioner pulley arm locked to install or remove auto tensioner.

INSTALLATION

Install in the reverse order of removal.

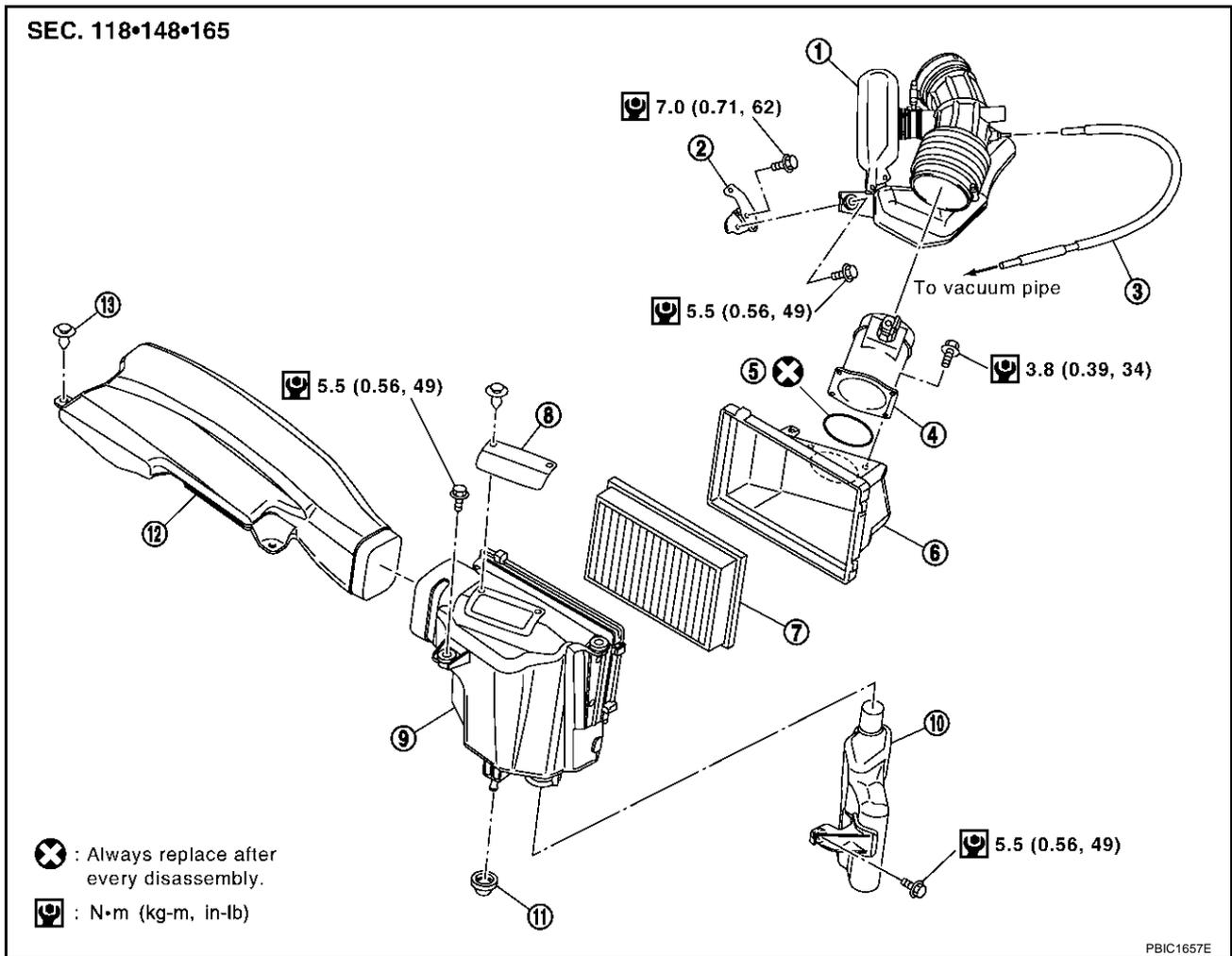
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AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

ABS0061B



- | | | |
|------------------------------------|---------------------|----------------------|
| 1. Air duct and resonator assembly | 2. Bracket | 3. Vacuum hose |
| 4. Mass air flow sensor | 5. O-ring | 6. Air cleaner case |
| 7. Air cleaner filter | 8. Cover | 9. Air cleaner case |
| 10. Resonator | 11. Mounting rubber | 12. Air duct (inlet) |
| 13. Clip | | |

REMOVAL

- Remove engine cover with power tool. Refer to [EM-166, "Removal and Installation"](#).
- Disconnect harness connector from mass air flow sensor.
- Remove air duct (inlet), air cleaner case and mass air flow sensor assembly, air duct and resonator assembly.
 - Add marks as necessary for easier installation.
- Remove mass air flow sensor from air cleaner case.

CAUTION:

Handle mass air flow sensor with following cares.

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

INSTALLATION

Install in the reverse order of removal paying attention to the following.

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

CHANGING AIR CLEANER FILTER

1. Remove air duct (inlet), air cleaner case and mass air flow sensor assembly.
2. Remove air cleaner filter from air cleaner case.

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INTAKE MANIFOLD

[VK45DE]

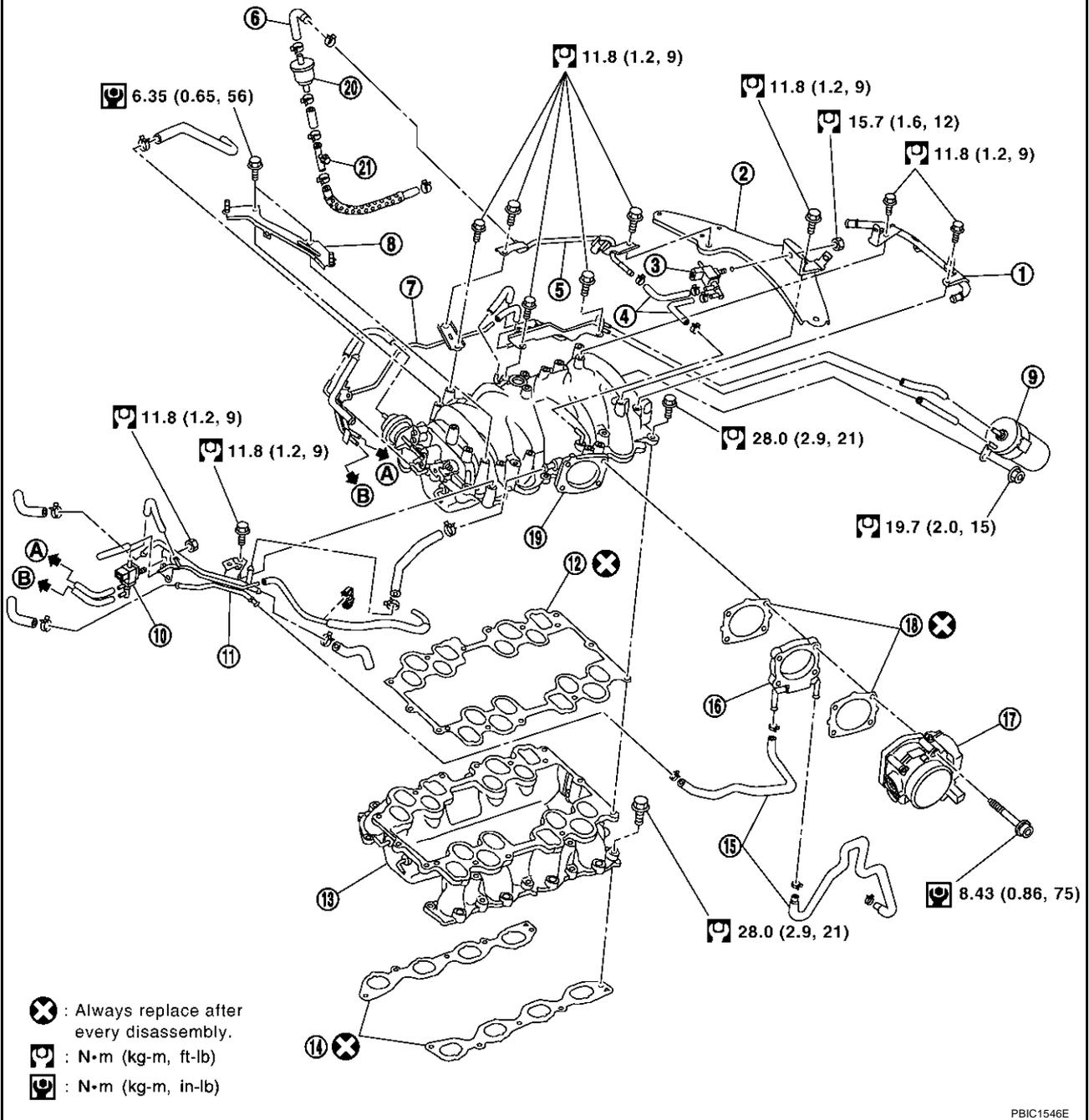
INTAKE MANIFOLD

PF14003

Removal and Installation

ABS0061C

SEC. 118•140•163•211•223



PB1C1546E

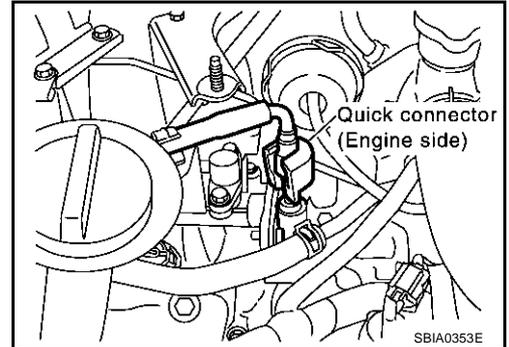
- | | | |
|---------------------------------|--|---|
| 1. PCV tube | 2. Engine cover rear bracket | 3. EVAP canister purge control solenoid valve |
| 4. EVAP hose | 5. EVAP tube | 6. EVAP hose |
| 7. Vacuum gallery | 8. Engine cover front bracket | 9. Vacuum tank |
| 10. VIAS control solenoid valve | 11. Water gallery | 12. Gasket |
| 13. Intake manifold lower | 14. Gasket | 15. Water hose |
| 16. Intake manifold adapter | 17. Electric throttle control actuator | 18. Gasket |
| 19. Intake manifold upper | 20. Resonator | 21. EVAP service port |

REMOVAL

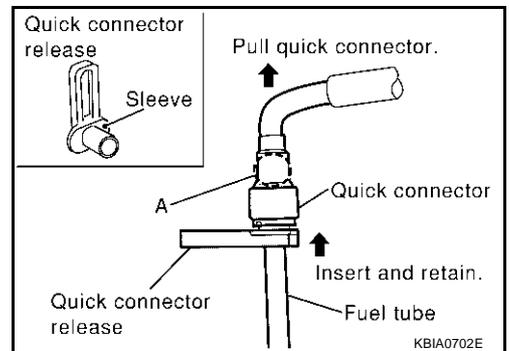
WARNING:

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

1. Remove engine cover with power tool. Refer to [EM-166, "Removal and Installation"](#) .
2. Release fuel pressure. Refer to [EC-705, "FUEL PRESSURE RELEASE"](#) .
3. Remove air duct (inlet), air cleaner case and mass air flow sensor assembly, air duct and resonator assembly. Refer to [EM-170, "Removal and Installation"](#) .
4. Disconnect fuel tube quick connector on engine side (The same apply to the quick connector on vehicle side excepting quick connector cap).



- Using tool of quick connector release [SST: J-45488], perform the following steps to disconnect quick connector.



- a. Remove quick connector cap (engine side only).
- b. With the sleeve side of quick connector release facing quick connector, install quick connector release onto fuel tube.
- c. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold the quick connector release on that position.

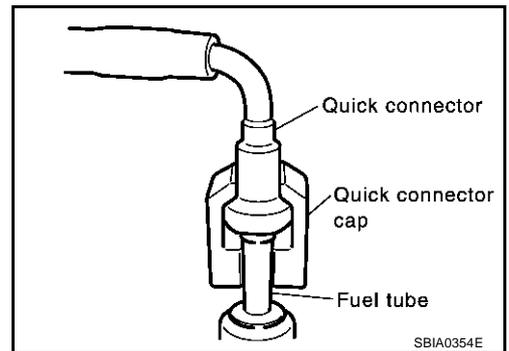
CAUTION:

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

- d. Draw and pull out quick connector straight from fuel tube.

CAUTION:

- Pull quick connector holding A position in illustration.
- 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.



5. Remove or disconnect harnesses, brackets, vacuum hose, vacuum gallery and PCV hose and tube from intake manifold upper.
6. Remove electric throttle control actuator loosening fixing bolts diagonally.

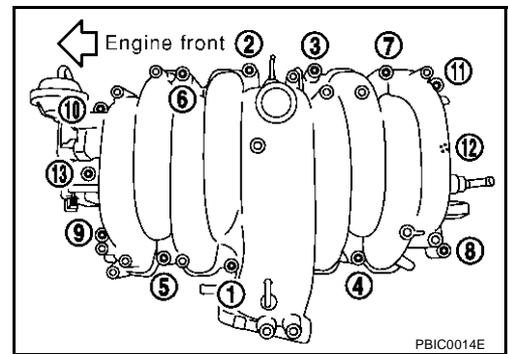
CAUTION:

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

INTAKE MANIFOLD

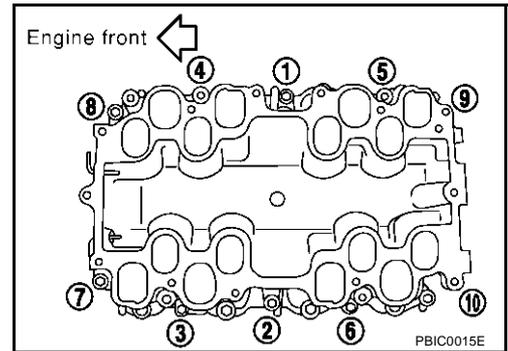
[VK45DE]

- Loosen bolts in reverse order of illustration to remove intake manifold upper assembly with power tool.



- Remove fuel injectors and fuel tube assembly. Refer to [EM-186, "Removal and Installation"](#).
- Loosen bolts in reverse order of illustration to remove intake manifold lower assembly with power tool.

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



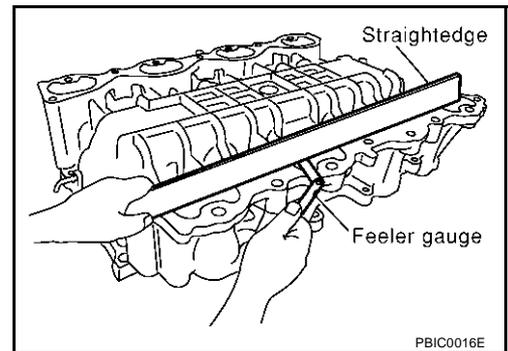
INSPECTION AFTER REMOVAL

Surface Distortion

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

Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace intake manifold lower or intake manifold upper.



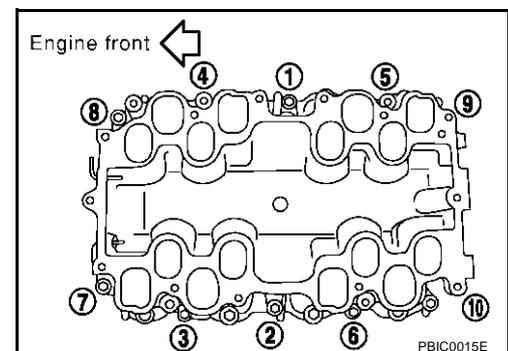
INSTALLATION

Install in the reverse order of removal paying attention to the following:

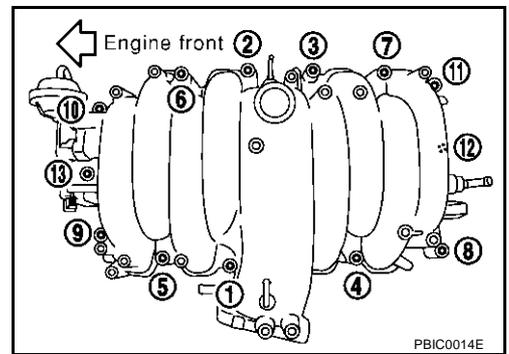
Tightening Intake Manifold Lower Bolts

- Tighten in numerical order as shown in the figure.

NOTE:
No.7 and 8 have longer bolt length than others.



Tightening Intake Manifold Upper Bolts



- Tighten in numerical order as shown in the figure.

NOTE:

No.1 to 4 have longer bolt length than others.

Installation of Electric Throttle Control Actuator

- Install intake manifold adapter gasket and electric throttle control actuator gasket so that three protrusions for installation identification do not face downward.
- Tighten fixing bolts of electric throttle control actuator equally and diagonally in several steps.
- After installation perform procedure in [EM-176, "INSPECTION AFTER INSTALLATION"](#).

Connecting Water Hose

- Install water hose so that its overlap width for connection is between 27 mm (1.06 in) and 32 mm (1.26 in) (target: 27 mm, 1.06 in).

Connecting Vacuum Tube

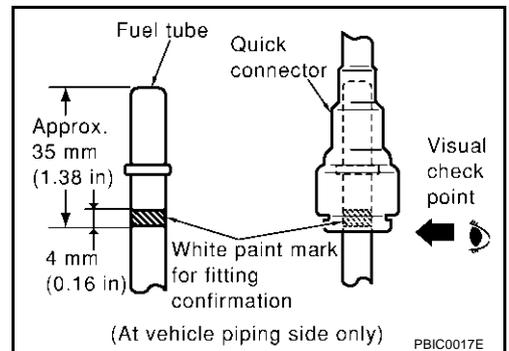
- Refer to [EC-677, "Vacuum Hose Drawing"](#).

Connecting Quick Connector of Fuel Tube

- Install quick connector as follows. (The steps are the same for quick connectors on both engine side and vehicle side excepting quick connector cap.)

1. Make sure no foreign substances are deposited in and around tube and quick connector, and no damage on them.
2. Thinly apply new engine oil around the fuel tube from tip end to the spool end.
3. Align center to insert quick connector straightly into fuel tube.

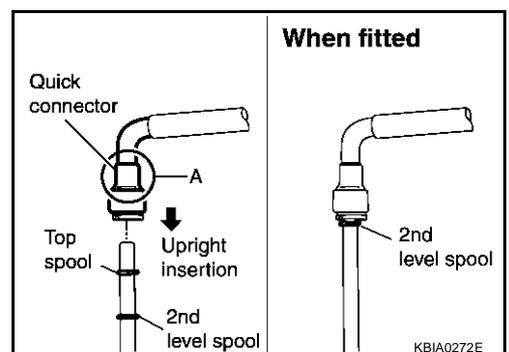
- Insert until the paint mark for engagement identification (white) goes completely inside quick connector so that you cannot see it from the straight side of the connected part. Use a mirror to check this where it is not possible to view directly from the straight side, such as quick connector on vehicle side.



- Insert fuel tube into quick connector until top spool is completely inside quick connector, and 2nd level spool exposes right below quick connector on engine side.

CAUTION:

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



INTAKE MANIFOLD

[VK45DE]

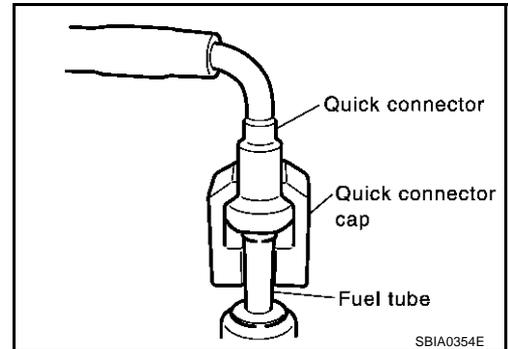
- To avoid misidentification of engagement with a similar sound, be sure to perform the next step.

4. Pull quick connector by hand holding A position. Make sure it is completely engaged (connected) so that it does not come out from fuel tube.

NOTE:

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

5. Install quick connector cap on quick connector joint (on engine side only).
6. Install fuel hose and tube to hose clamps.



INSPECTION AFTER INSTALLATION

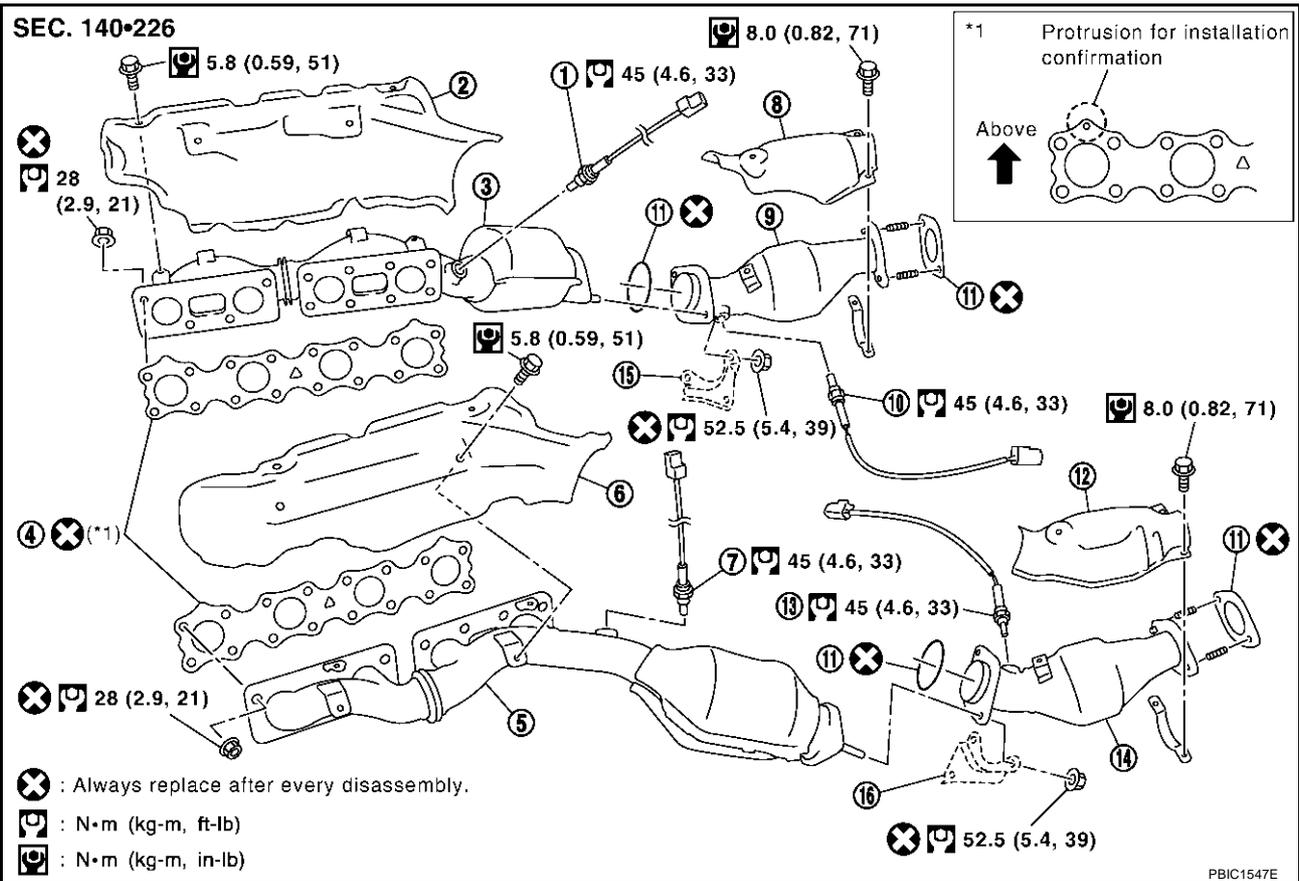
- After installing fuel tubes, make sure there is no fuel leakage at connections in the following steps.
 - Apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then check for fuel leaks at connections.
 - Start the engine and rev it up and check for fuel leaks at connections.
- Perform procedures for "Throttle Valve Closed Position Learning" after finishing repairs. Refer to [EC-703, "Throttle Valve Closed Position Learning"](#) .
- If electric throttle control actuator is replaced, perform procedures for "Idle Air Volume Learning" after finishing repairs. Refer to, [EC-703, "Idle Air Volume Learning"](#) .

EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

Removal and Installation

ABS006ID



- | | | |
|-------------------------------------|---------------------------------------|--|
| 1. Heated oxygen sensor 1 (bank 2) | 2. Exhaust manifold cover (RH bank) | 3. Exhaust manifold (RH bank) |
| 4. Gasket | 5. Exhaust manifold (LH bank) | 6. Exhaust manifold cover (LH bank) |
| 7. Heated oxygen sensor 1 (bank 1) | 8. Three way catalyst cover (RH bank) | 9. Three way catalyst (RH bank) |
| 10. Heated oxygen sensor 2 (bank 2) | 11. Gasket | 12. Three way catalyst cover (LH bank) |
| 13. Heated oxygen sensor 2 (bank 1) | 14. Three way catalyst (LH bank) | 15. Mounting bracket |
| 16. Mounting bracket | | |

REMOVAL

WARNING:

Perform the work, when the exhaust and cooling system have completely cooled down.

1. Remove air duct (inlet), air cleaner case and mass air flow sensor assembly, air duct and resonator assembly.
2. Drain engine coolant from the radiator. Refer to [CO-35, "ENGINE COOLANT"](#) .
3. Remove engine front and rear undercovers with power tool.
4. Disconnect radiator upper hose.
5. Remove the lower radiator shroud. Refer to [CO-38, "RADIATOR"](#) .
6. Remove the radiator shroud.
7. Disconnect A/T fluid cooler hoses.
 - Install blind plug to avoid leakage of A/T fluid.
8. Remove radiator. Refer to [CO-38, "RADIATOR"](#) .
9. Remove drive belts. Refer to [EM-167, "DRIVE BELTS"](#) .
10. Remove heated oxygen sensors.
 - Follow below steps to remove each heated oxygen sensor.
 - a. Remove engine cover with power tool.

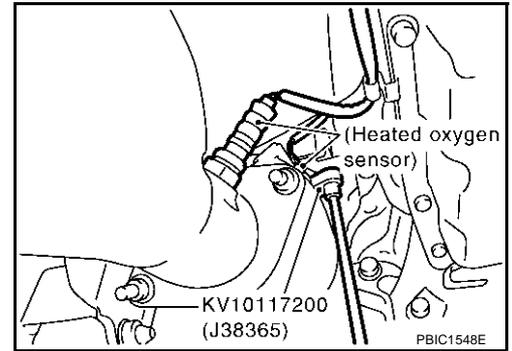
EXHAUST MANIFOLD AND THREE WAY CATALYST

[VK45DE]

- b. Remove harness connector of each heated oxygen sensor, and harness from bracket and middle clamp.
- c. Using heated oxygen sensor wrench (SST), remove both left and right heated oxygen sensor 1 and 2 on both LH and RH bank.

CAUTION:

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

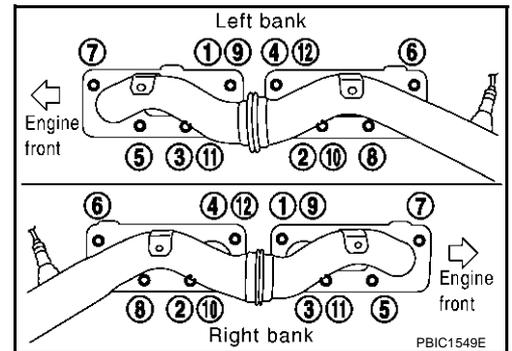


11. Remove front cross bar. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
12. Remove exhaust manifold (LH bank) in below steps.
 - a. Disconnect A/C piping from A/C compressor, then remove A/C compressor with power tool. Refer to [ATC-151, "Components"](#).
 - b. Remove exhaust front tube with power tool. Refer to [EX-3, "EXHAUST SYSTEM"](#).
 - c. Remove steering lower joint to enable steering shaft to move freely. Refer to [PS-19, "POWER STEERING GEAR AND LINKAGE"](#).
 - d. Remove three way catalyst.
 - e. Remove exhaust manifold cover.
 - f. Loosen nuts in reverse order of illustration to remove exhaust manifold with power tool.

NOTE:

Exclude No. 9 to No. 12 in removal.

13. Remove exhaust manifold (RH bank) in below steps.
 - a. Remove alternator harness bracket.
 - b. Remove alternator and bracket.
 - c. Remove exhaust front tube with power tool. Refer to [EX-3, "EXHAUST SYSTEM"](#).
 - d. Remove three way catalyst.
 - e. Remove exhaust manifold cover.
 - f. Loosen nuts in reverse order of illustration to remove exhaust manifold with power tool.



NOTE:

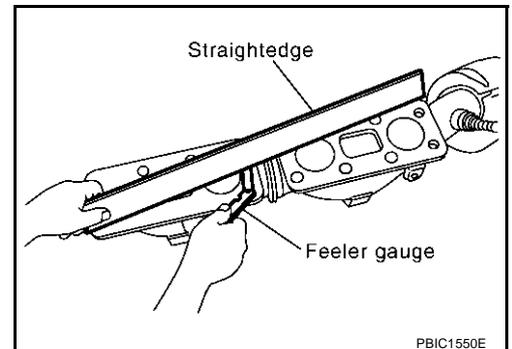
Exclude No. 9 to No. 12 in removal.

INSPECTION AFTER REMOVAL

Surface Distortion

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

Limit : 0.3 mm (0.012 in)
- If it exceeds the limit, replace exhaust manifold.



INSTALLATION

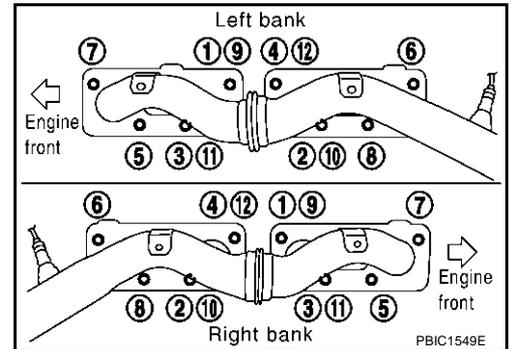
Install in the reverse order of removal paying attention to the following:

Exhaust Manifold Gasket

- Install exhaust manifold gasket with its directional protrusion set upward. Refer to illustration of components on former page.

Tightening Exhaust Manifold Nuts

- Install exhaust manifold in the numerical order shown in the figure.
- Tighten nuts No. 1 to No. 4 in two steps. The numerical order No. 9 to No. 12 shown second steps.



Installation of Heated Oxygen Sensors

CAUTION:

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

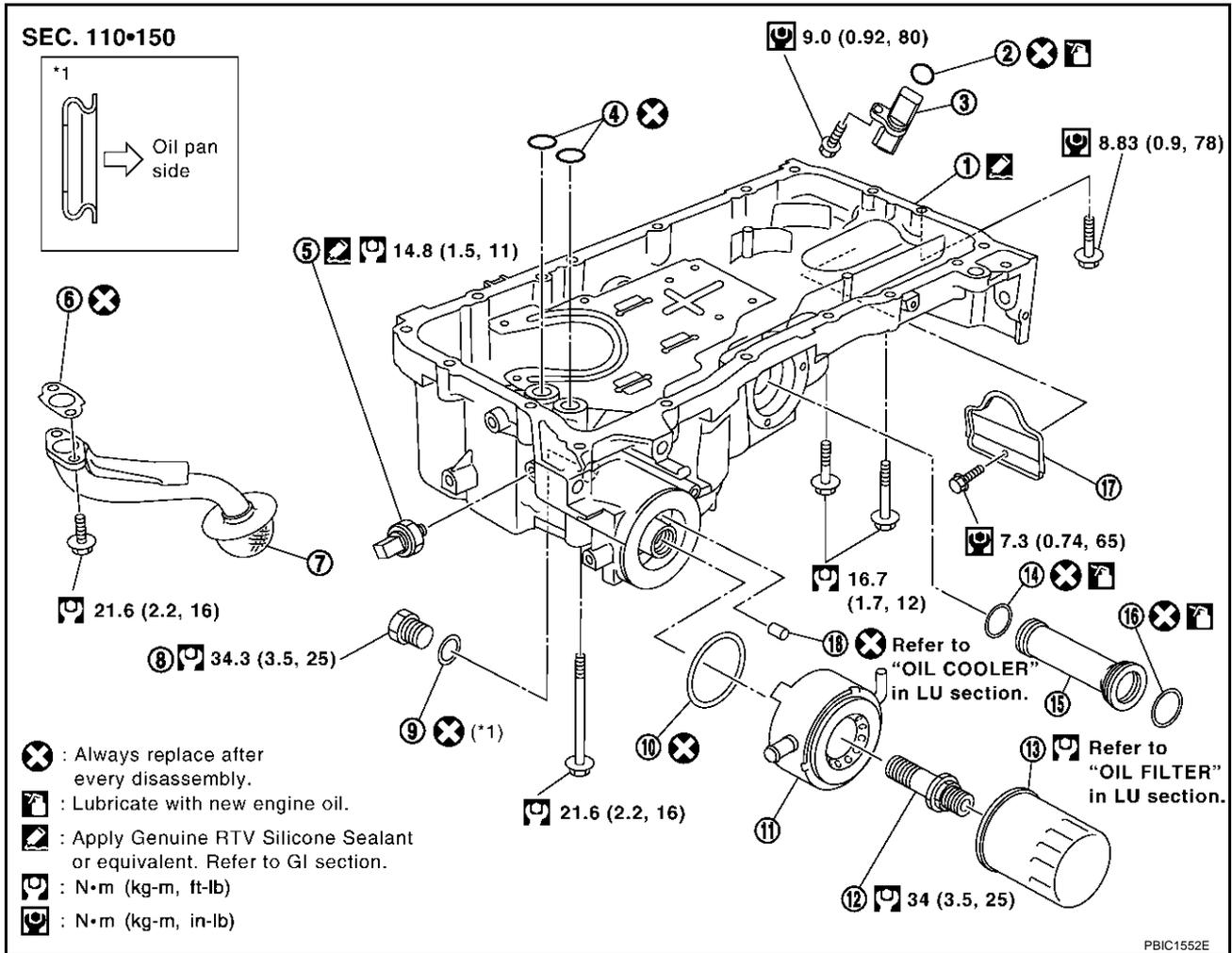
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OIL PAN AND OIL STRAINER

PFP:11110

Removal and Installation

ABS006IE



- | | | |
|-----------------|------------------------|-------------------------------------|
| 1. Oil pan | 2. O-ring | 3. Crankshaft position sensor (POS) |
| 4. O-ring | 5. Oil pressure switch | 6. Gasket |
| 7. Oil strainer | 8. Drain plug | 9. Washer |
| 10. O-ring | 11. Oil cooler | 12. Connector bolt |
| 13. Oil filter | 14. O-ring | 15. Axle pipe |
| 16. O-ring | 17. Rear plate cover | 18. Relief valve |

REMOVAL

WARNING:

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

1. Remove front tire.
2. Remove engine hood.
3. Remove engine front and rear undercovers and engine cover with power tool.
4. Drain engine oil. Refer to [LU-26, "Changing Engine Oil"](#).
5. Remove drive belts. Refer to [EM-167, "Removal and Installation"](#).
6. Remove auto tensioner of power steering oil pump belt. Refer to [EM-169, "Drive Belt Auto Tensioner and Idler Pulley"](#).
7. Move power steering oil pump and remove power steering oil pump bracket.
8. Remove oil filter and oil cooler. Refer to [LU-27, "OIL FILTER"](#) and [LU-28, "OIL COOLER"](#).
9. Remove A/C compressor fitting bolts, and install A/C compressor temporarily on vehicle side with ropes or equivalent.

10. Disconnect harness of lower side of oil pan from oil pan.
11. Remove crankshaft position sensor (POS) from transmission.

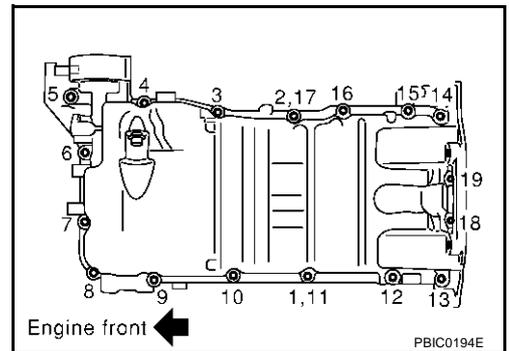
CAUTION:

- Do not drop or shock it.
- Do not disassemble it.
- Do not let steel powders contact magnetic parts of sensor tips.
- Do not leave where magnetically effected.

12. Install engine slinger and hang engine assembly to secure position. Refer to [EM-227, "Removal and Installation"](#) .
13. Remove front suspension member with power tool. Refer to [FSU-17, "FRONT SUSPENSION MEMBER"](#) .
14. Remove front final drive assembly. Refer to [FFD-10, "FRONT FINAL DRIVE ASSEMBLY"](#) .
15. Remove oil pan in the order shown below.
 - a. Remove rear plate cover.
 - b. Remove transmission joint bolts which pierce oil pan.
 - c. Loosen oil pan bolts with power tool in reverse order of illustration to remove.

NOTE:

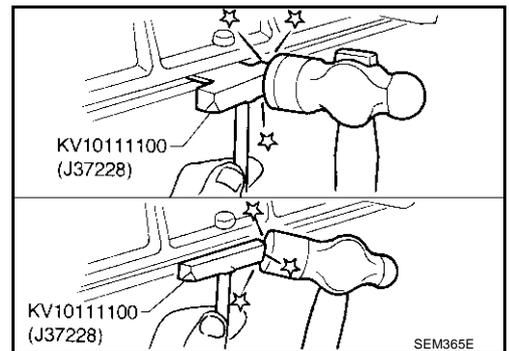
Exclude No. 11 and No. 17 in removal.



- d. Insert seal cutter (SST) between oil pan and cylinder block. Slide seal cutter by tapping on the side of the seal cutter with a hammer. Remove oil pan.

CAUTION:

Exercise care not to damage mating surface.



16. As necessary, pull axle pipe from oil pan.
 - Hold pipes and pull them out to LH drive shaft installing side.
17. Remove oil strainer.

INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSTALLATION

1. Install oil strainer.

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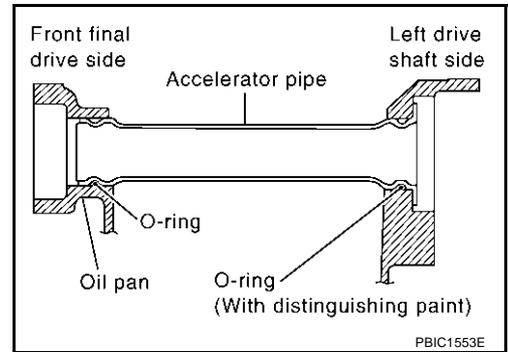
OIL PAN AND OIL STRAINER

[VK45DE]

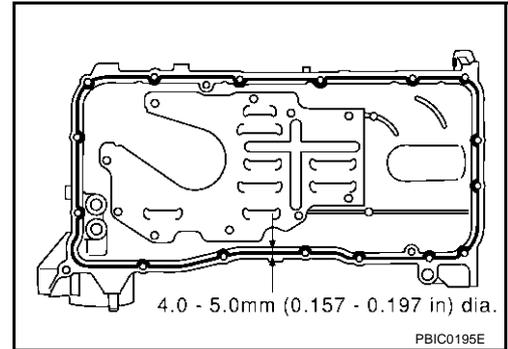
2. Install axle pipe to oil pan, if removed.
 - Lubricate O-ring groove of axle pipe, O-ring, and O-ring joint of oil pan with new engine oil.
 - Right/left O-ring diameters differ from each other. O-ring with identification paint mark is installed on LH drive shaft installing side.
 - Install axle pipe to oil pan from LH side.

CAUTION:

Insert it with care to prevent O-ring from sliding.



3. Install oil pan in the order below.
 - a. Apply liquid gasket thoroughly as in illustration. **Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS".**
 - b. Install new O-ring to oil pump and timing chain case side.



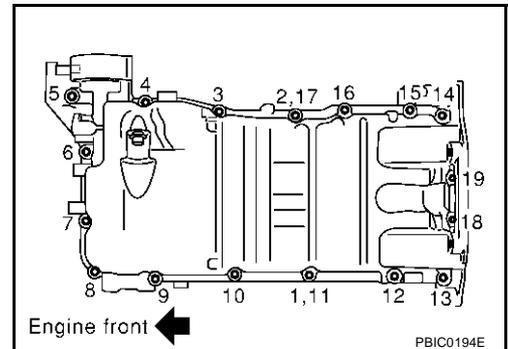
- c. Tighten bolts in numerical order as shown.
 - Tighten bolts No. 1 and No. 2 in two steps. The numerical order No. 11 and No. 17 shown second steps.

NOTE:

Refer to the below for locating bolts.

- M6 × 30 mm (1.18 in) : No. 18, 19**
- M8 × 100 mm (3.94 in) : No. 5, 9**
- M8 × 45 mm (1.77 in) : Except the above**

- d. Tighten transmission joint bolts. Refer to [AT-272, "Removal and Installation \(AWD Models\)"](#) .
 - e. Install rear plate cover.
 4. Install oil pan drain plug.
 - Refer to illustration of components of former page for installation direction of washer.
 5. Install in the reverse order of removal after this step.
 - Pour engine oil at least 30 minutes after oil pan is installed.



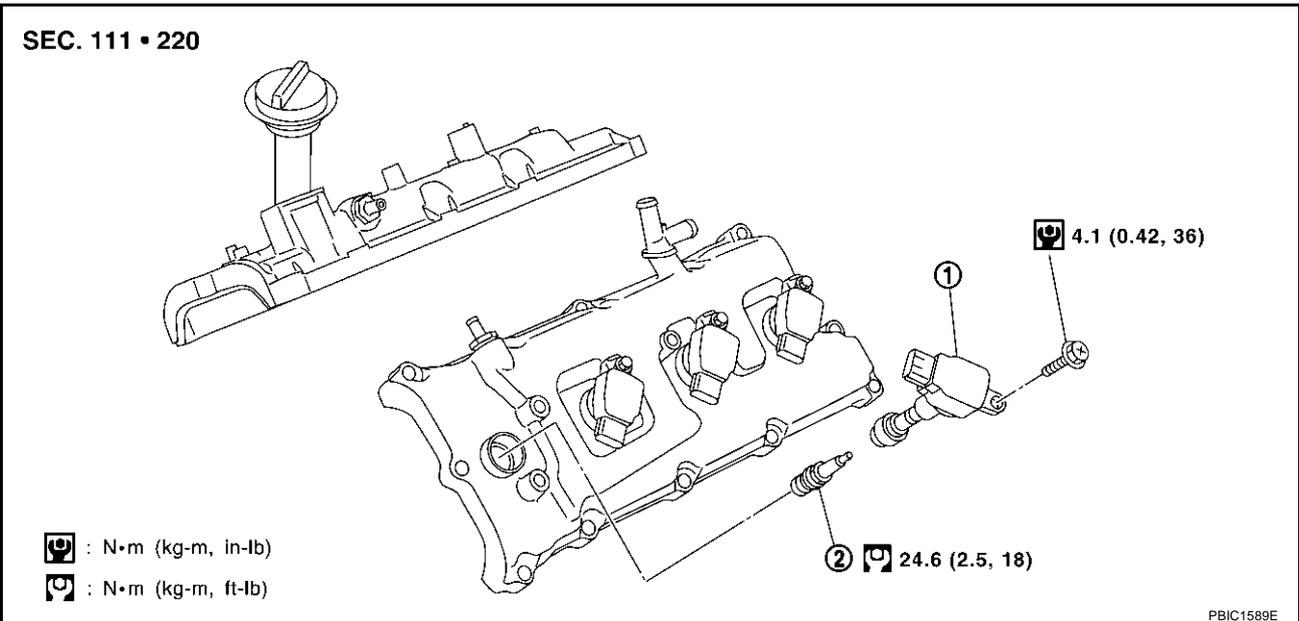
INSPECTION AFTER INSTALLATION

- Inspection engine oil level. Refer to [LU-25, "ENGINE OIL LEVEL"](#) .
- Start the engine, and check there is no leak of engine oil. Refer to [LU-25, "ENGINE OIL"](#) .

IGNITION COIL

Removal and Installation

ABS006IF



1. Ignition coil

2. Spark plug

REMOVAL

1. Remove engine cover with power tool. Refer to [EM-166, "Removal and Installation"](#) .
2. Remove air duct (inlet), air cleaner case and mass air flow sensor assembly, air duct and resonator assembly. Refer to [EM-170, "AIR CLEANER AND AIR DUCT"](#) .
3. Disconnect harness connector from ignition coil.
4. Remove ignition coil.

CAUTION:

Do not shock it.

INSTALLATION

Install in the reverse order of removal.

SPARK PLUG (PLATINUM-TIPPED TYPE)

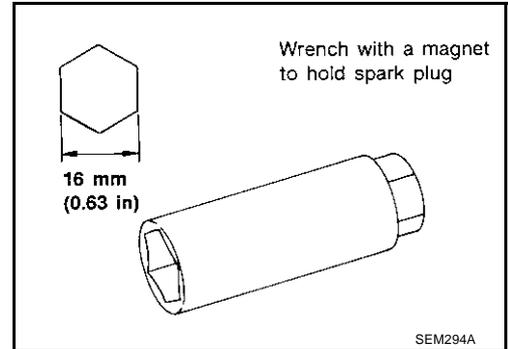
PFP:22401

Removal and Installation

ABS006/G

REMOVAL

1. Remove engine cover with power tool. Refer to [EM-166, "ENGINE ROOM COVER"](#) .
2. Remove air duct (inlet), air cleaner case and mass air flow sensor assembly, air duct and resonator assembly. Refer to [EM-170, "AIR CLEANER AND AIR DUCT"](#) .
3. Disconnect harness connector from ignition coil.
4. Remove ignition coil. Refer to [EM-183, "Removal and Installation"](#) .
5. Remove spark plug with spark plug wrench (commercial service tool).



INSPECTION AFTER REMOVAL

- Use standard type spark plug for normal condition.

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:

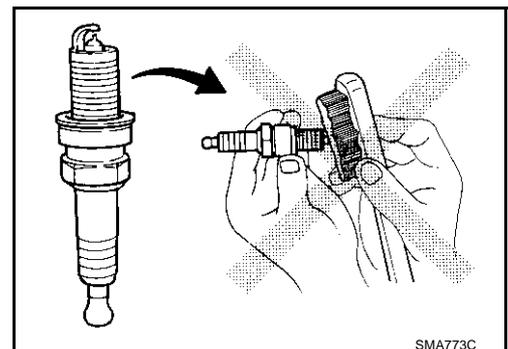
- Do not drop or shock spark plug.
- Do not use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

Cleaner air pressure:

Less than 588 kPa (5.9 bar, 6 kg/cm² , 85 psi)

Cleaning time:

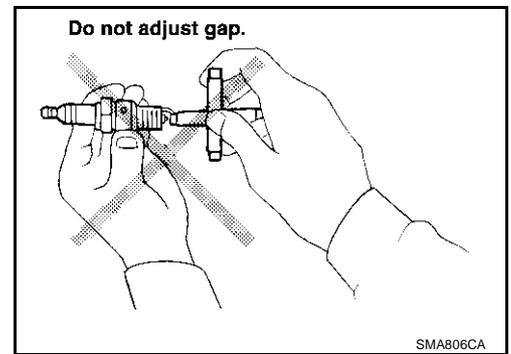
Less than 20 seconds



SPARK PLUG (PLATINUM-TIPPED TYPE)

[VK45DE]

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



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INSTALLATION

Install in the reverse order of removal.

Spark plug :

 : 24.6 N·m (2.5 kg-m, 18 ft-lb)

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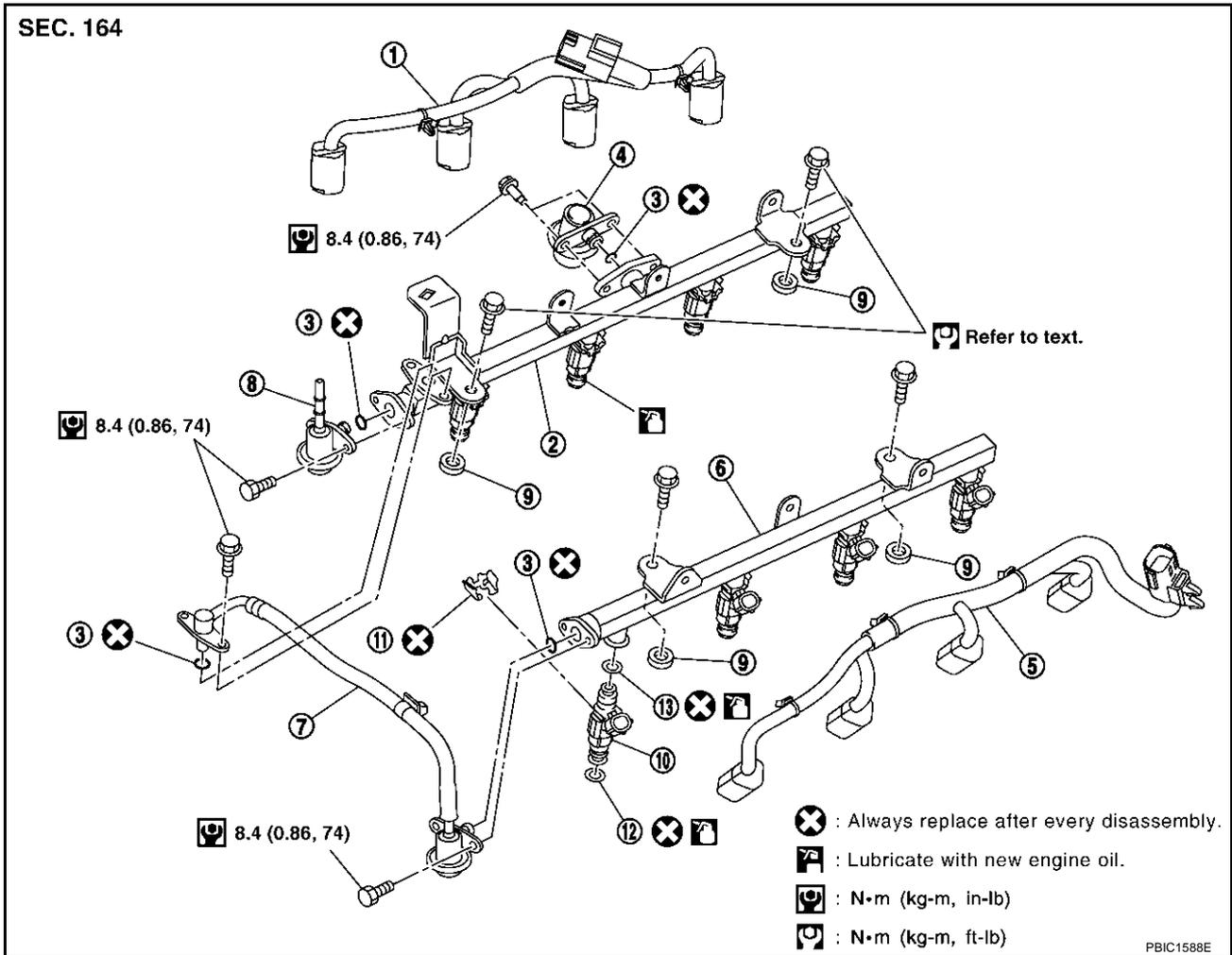
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FUEL INJECTOR AND FUEL TUBE

PFP:16600

Removal and Installation

ABS006IH



- | | | |
|---------------------------------------|-----------------------------------|--------------------|
| 1. Fuel injector sub harness (RH) | 2. Fuel tube (RH) | 3. O-ring |
| 4. Fuel damper (RH) | 5. Fuel injector sub harness (LH) | 6. Fuel tube (LH) |
| 7. Fuel damper and fuel hose assembly | 8. Fuel feed damper | 9. Spacer |
| 10. Fuel injector | 11. Clip | 12. O-ring (Green) |
| 13. O-ring (Black) | | |

CAUTION:

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

REMOVAL

1. Release fuel pressure. Refer to [EC-705. "FUEL PRESSURE RELEASE"](#).
2. Remove intake manifold upper with power tool. Refer to [EM-172. "Removal and Installation"](#).
3. Disconnect fuel injector sub harness connectors.
4. Disconnect fuel damper and fuel hose assembly from fuel tube RH and LH.

CAUTION:

- While hoses are disconnected, plug them to prevent fuel from draining,
 - Do not separate fuel damper and fuel hose.
5. Remove fuel injectors with fuel tube assembly.

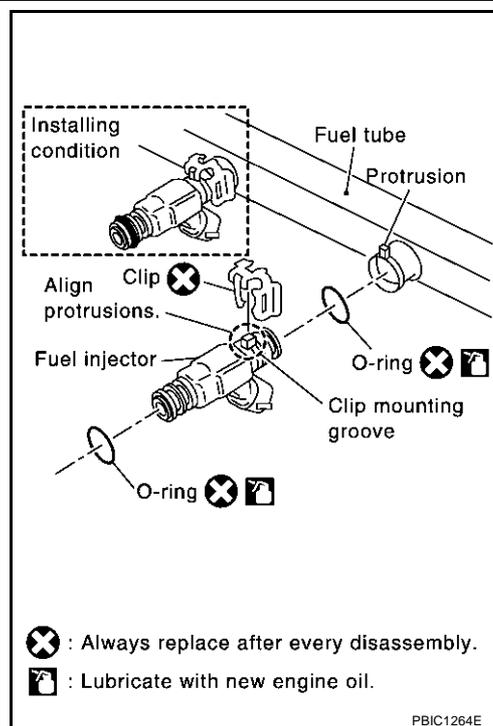
FUEL INJECTOR AND FUEL TUBE

[VK45DE]

6. Remove fuel injector from fuel tube with following procedure.
 - a. Open and remove clip.
 - b. Remove fuel injector from the 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 injectors.
- Do not disassemble fuel injectors.



7. Remove fuel damper (RH) and fuel feed damper.

INSTALLATION

1. Install fuel damper (RH) and fuel feed damper.

- When handling O-rings, be careful of the following:

CAUTION:

- Handle O-ring with bare hands. Never 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.
- Insert fuel damper (RH) and fuel feed damper straight into fuel tube (RH).
 - Tighten mounting bolts evenly in turn.
 - After tightening mounting bolts, make sure that there is no gap between flange and fuel tube (RH).
2. Install O-rings to fuel injector paying attention to the items below.

CAUTION:

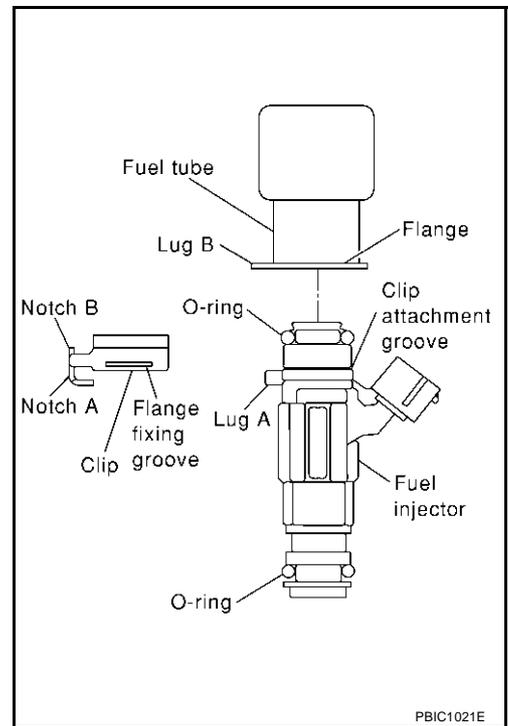
- Upper and lower O-ring are different. Be careful not to confuse them.

Fuel tube side : Black

Nozzle side : Green

- Handle O-ring with bare hands. Never wear gloves.
- Lubricate O-ring with new engine oil.
- 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.

3. Install fuel injector to fuel tube with the following procedure.
 - a. Insert clip into clip mounting groove on fuel injector.
 - Insert clip so that lug "A" of fuel injector matches notch "A" of the 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 lug "B" of fuel tube matches notch "B" of the 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. Install fuel tube and fuel injector assembly to intake manifold.

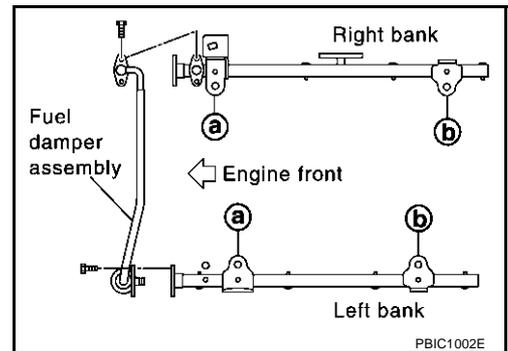
CAUTION:

Be careful not to let tip of injector nozzle come in contact with other parts.

- Tighten fuel tube assembly mounting bolts "a" to "b" in illustration and in two steps.

 **1st step** : 10.1 N·m (1.0 kg·m, 7 ft·lb)

 **2nd step** : 23.5 N·m (2.4 kg·m, 17 ft·lb)



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

INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

After installing fuel tubes, make sure there is no fuel leakage at connections in the following steps.

1. Apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then check for fuel leaks at connections.
2. Start the engine and rev it up and check for fuel leaks at connections.

NOTE:

Use mirrors for checking on invisible points.

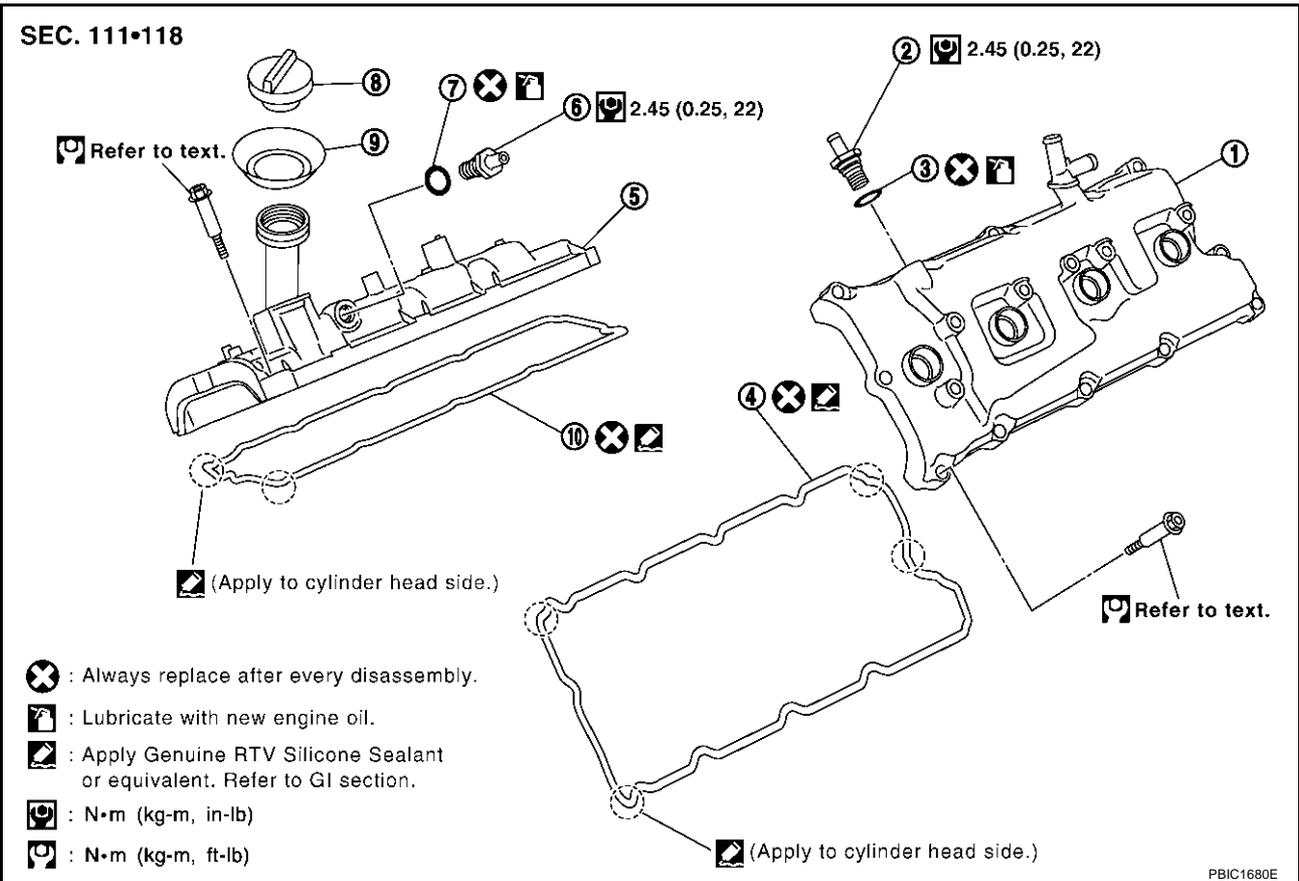
CAUTION:

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

ROCKER COVER

Removal and Installation

ABS006II



- | | | |
|--------------------------------------|------------------------------|----------------------|
| 1. Rocker cover (left bank) | 2. PCV control valve | 3. O-ring |
| 4. Rocker cover gasket (left bank) | 5. Rocker cover (right bank) | 6. PCV control valve |
| 7. O-ring | 8. Oil filler cap | 9. Oil catcher |
| 10. Rocker cover gasket (right bank) | | |

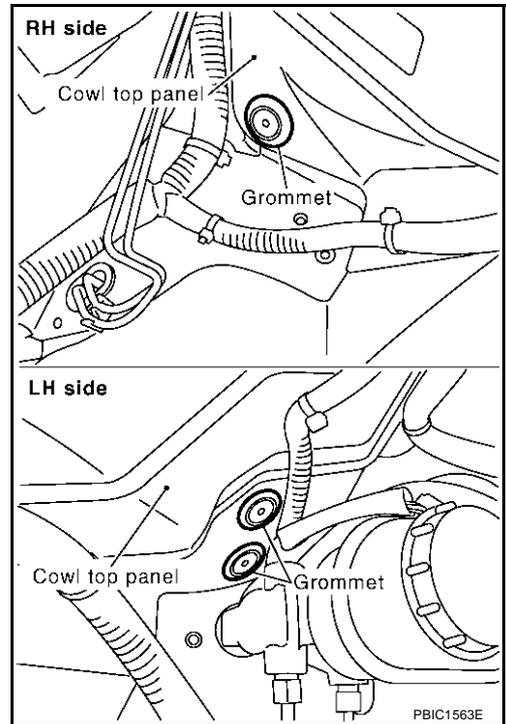
REMOVAL

1. Refer to the following for removal works related to left bank.
 - a. Remove engine cover with power tool. Refer to [EM-166, "Removal and Installation"](#) .
 - b. Remove air duct (inlet), air cleaner case and mass air flow sensor assembly, air duct and resonator assembly. Refer to [EM-170, "AIR CLEANER AND AIR DUCT"](#) .
 - c. Move harness on upper rocker cover and its peripheral aside.
 - d. Remove electric throttle control actuator loosening fixing bolts diagonally.
 - e. Remove ignition coil. Refer to [EM-183, "Removal and Installation"](#) .
 - f. Remove PCV hose from PCV control valve.
2. Refer to the following for removal works related to right bank.
 - a. Remove engine cover with power tool. Refer to [EM-166, "Removal and Installation"](#) .
 - b. Move harness on upper rocker cover and its peripheral aside.
 - c. Remove ignition coil [EM-183, "Removal and Installation"](#) .
 - d. Remove PCV hose from PCV control valve.

ROCKER COVER

[VK45DE]

3. Remove grommets from RH and LH cowl top panel.
 - Remove RH side grommet in order below.
 - Remove battery. Refer to [SC-4, "BATTERY"](#).
 - Remove battery tray.
 - Remove grommet.



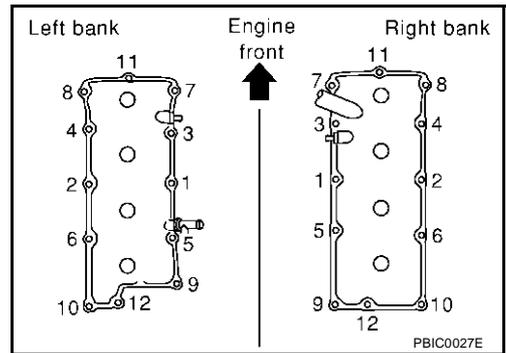
4. Loosen bolts in reverse order shown in the figure (with power tool).

CAUTION:

Do not hold oil filler neck (right bank) not to damage it.

NOTE:

Loosen No. 10 bolt of the right bank and No. 10 and No. 12 bolts of the left bank from cowl top panel hole with using a tool.



INSTALLATION

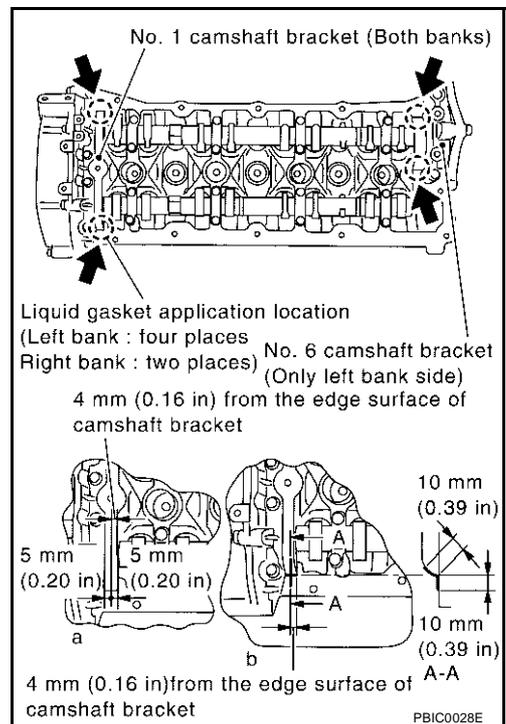
1. Apply liquid gasket to joint part of cylinder head and camshaft bracket following the below steps.

NOTE:

Illustration shows an example of left-bank side (zoomed in shows No.1 camshaft bracket). Apply only to No. 1 camshaft bracket for right-bank side.

- a. Refer to illustration "a" to apply liquid gasket to joint part of No.1 and No. 6 camshaft bracket and cylinder head.
- b. Refer to illustration "b" to apply liquid gasket in 90 degrees to illustration "a".

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



ROCKER COVER

[VK45DE]

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

CAUTION:

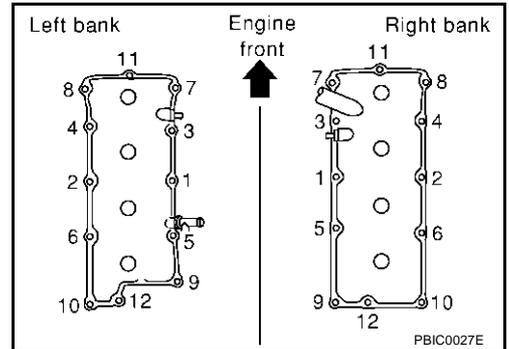
Do not hold oil filler neck (right bank) not to damage it.

NOTE:

Tighten No. 10 bolt of the right bank and No. 10 and No. 12 bolts of the left bank from cowl top panel hole with using a tool.

 **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)



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

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TIMING CHAIN

[VK45DE]

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| 1. Camshaft sprocket (left bank EXH) | 2. Camshaft sprocket (left bank INT) | 3. Camshaft sprocket (right bank INT) |
| 4. Camshaft sprocket (right bank EXH) | 5. Front cover | 6. Intake valve timing control solenoid valve (right bank) |
| 7. O-ring | 8. Seal ring | 9. Intake valve timing control position sensor (right bank) |
| 10. O-ring | 11. Intake valve timing control cover (right bank) | 12. Intake valve timing control position sensor (left bank) |
| 13. O-ring | 14. Intake valve timing control cover (left bank) | 15. Seal ring |
| 16. Intake valve timing control solenoid valve (left bank) | 17. O-ring | 18. Oil level gauge |
| 19. Oil level gauge guide | 20. O-ring | 21. Crankshaft pulley bolt |
| 22. Crankshaft pulley | 23. Front oil seal | 24. Chain tensioner cover |
| 25. Camshaft position sensor (PHASE) | 26. O-ring | 27. Oil pump drive spacer |
| 28. Oil pump assembly | 29. Crankshaft sprocket | 30. O-ring |
| 31. O-ring | 32. Timing chain tension guide (right bank) | 33. Timing chain slack guide (right bank) |
| 34. Timing chain (right bank) | 35. Timing chain (left bank) | 36. Chain tensioner (left bank) |
| 37. Chain tensioner (right bank) | 38. Timing chain slack guide (left bank) | 39. Timing chain tension guide (right bank) |
| 40. O-ring | | |

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REMOVAL

- Remove engine assembly from vehicle. Refer to [EM-227, "Removal and Installation"](#).
- Remove the following components and related parts:
 - Drive belt auto tensioner and idler pulley; Refer to [EM-169, "Drive Belt Auto Tensioner and Idler Pulley"](#).
 - Thermostat housing and hose; Refer to [CO-49, "Removal and Installation"](#).
 - Oil pan and oil strainer; Refer to [EM-180, "Removal and Installation"](#).
 - Ignition coil; Refer to [EM-183, "Removal and Installation"](#).
 - Rocker cover; Refer to [EM-189, "Removal and Installation"](#).

- If necessary, remove intake valve timing control position sensor (right and left) and camshaft position sensor (PHASE) from intake valve timing control cover and front cover.

CAUTION:

- Handle components and parts carefully to avoid dropping and shocks.
- Do not disassemble.

- If necessary, remove intake valve timing control solenoid valve from intake valve timing control cover.

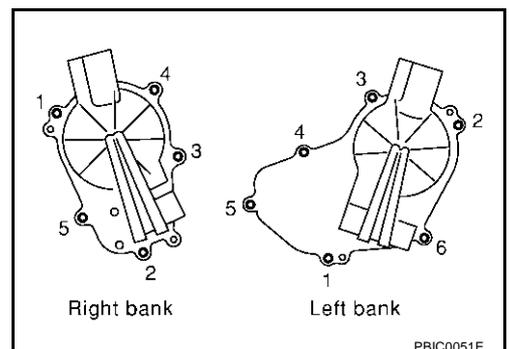
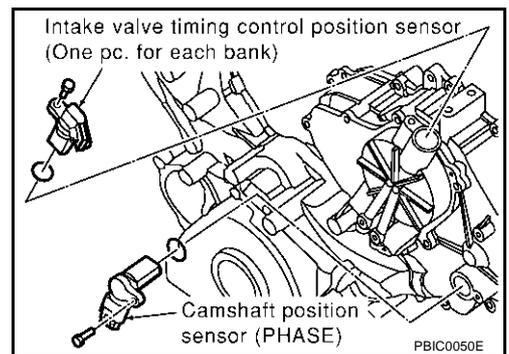
CAUTION:

- Handle components and parts carefully to avoid dropping and shocks.
- Do not disassemble.

- Remove intake valve timing control cover as follows:
 - Loosen and remove fixing bolts in the reverse order of shown in the figure.
 - Use seal cutter [SST: KV10111100 (J37228)] or the equivalent to cut liquid gasket for removal.

CAUTION:

- Exercise care not to damage mating surfaces.
- Pull out cover keeping levelness without an angle, as inner part of cover is engaged with the center of intake cam sprocket.

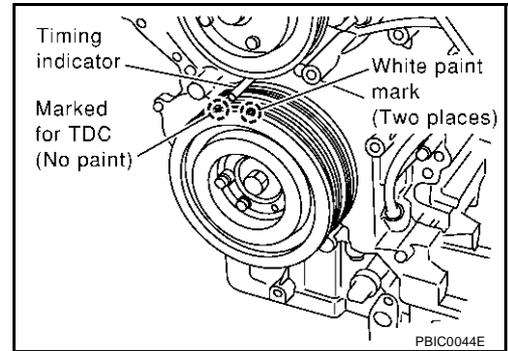


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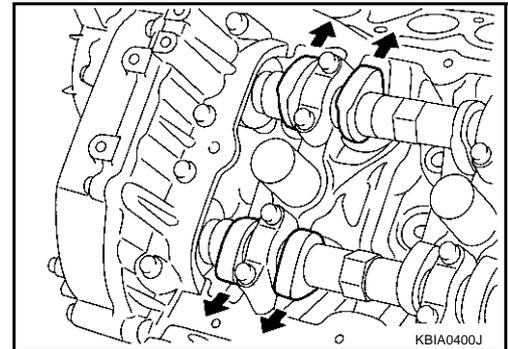
TIMING CHAIN

[VK45DE]

6. Obtain compression TDC of No. 1 cylinder as follows:
 - a. Turn crankshaft pulley clockwise to align the TDC identification notch (without paint mark) with timing indicator on front cover.



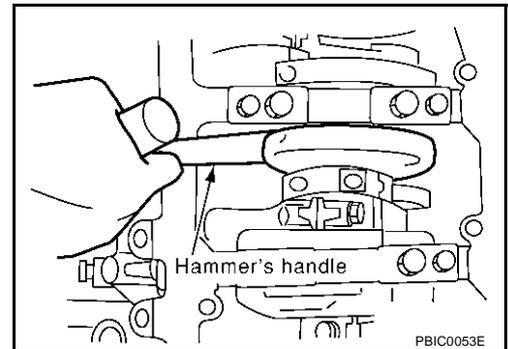
- b. At this time, make sure the both intake and exhaust cam noses of No. 1 cylinder (top front on left bank) face outside.
 - If they do not face outside, turn crankshaft pulley once more.



7. Remove crankshaft pulley as follows:
 - a. Lock crankshaft with a hammer handle or similar tool to loosen fixing bolts.
 - b. Pull crankshaft pulley with both hands to remove it.

CAUTION:

- Do not remove fixing bolt. Keep loosened fixing bolt in place to protect removed crankshaft pulley from dropping.
- Do not remove balance weight (inner hexagon bolt) at the front of crankshaft pulley.



8. Remove front cover as follows:
 - a. Loosen and remove fixing bolts in the reverse order of shown in the figure.
 - b. Use seal cutter [SST: KV10111100 (J37228)] or the equivalent to cut liquid gasket for removal.

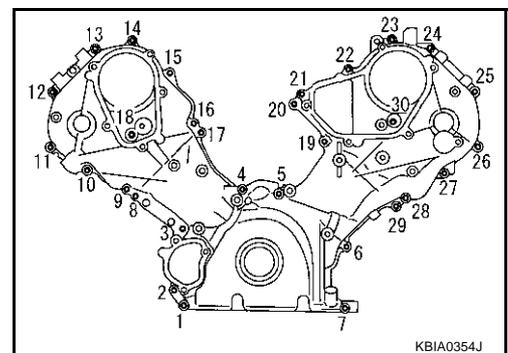
CAUTION:

Exercise care not to damage mating surfaces.

- b. Use seal cutter [SST: KV10111100 (J37228)] or the equivalent to cut liquid gasket for removal.
9. Remove the front oil seal from front cover using a suitable tool.
 - Use screwdriver for removal.

CAUTION:

Exercise care not to damage front cover.



TIMING CHAIN

[VK45DE]

10. Remove oil pump drive spacer.

- Install bolts into two bolt holes [M6 x pitch 1.0 mm (0.04 in)] on front surface. Using a small puller, pull spacer off from crankshaft.

NOTE:

The center-to-center dimension between the two bolt holes is 33 mm (1.30 in).

11. Remove oil pump. Refer to [LU-30, "Removal and Installation"](#).
12. Remove chain tensioner on left bank.

NOTE:

To remove timing chain and associated parts, start with those on left bank. The procedure for removing parts on right bank is omitted because it is the same as that for left bank.

a. Press tab in the direction of arrow (or turn lever in the direction of arrow) to unlock the locking with the groove that stops tensioner plunger from returning.

- Lightly press tensioner plunger to release the tension of spring for this operation.

b. Push in tensioner plunger to align the hole on lever and that on pump main body.

- Pushing in tensioner too far does not allow the holes to align. Therefore, push in plunger to the degree at which the start of stopper groove and tab engages.

c. Insert a stopper pin [hard wire with approx. 0.5 mm (0.020 in) diameter or a similar tool] to fix plunger. With plunger fixed, remove chain tensioner.

13. Remove chain tensioner guide and slack guide.

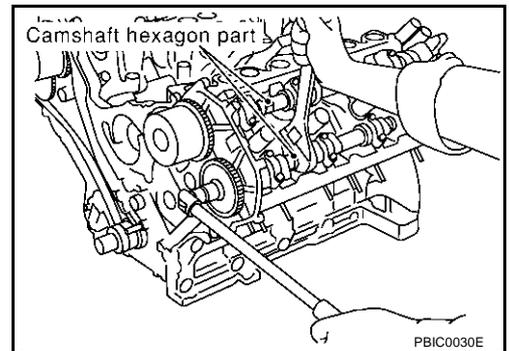
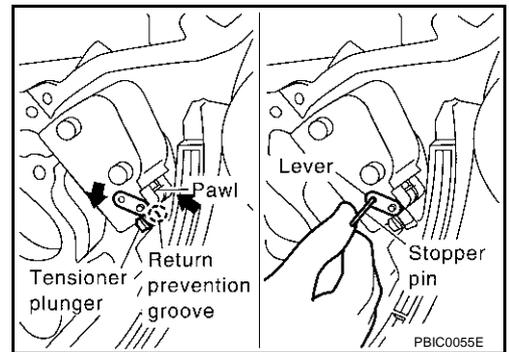
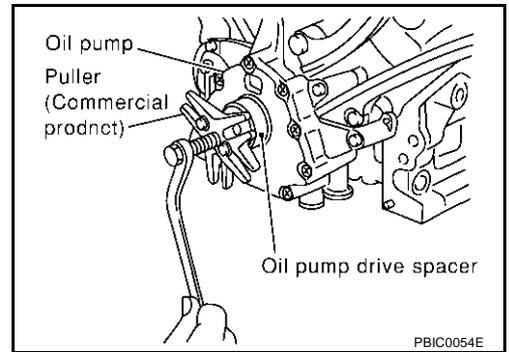
14. Remove timing chain and crankshaft sprocket.

15. With hexagonal part of camshaft locked with wrench, loosen bolts securing camshaft sprocket to remove camshaft sprocket.

CAUTION:

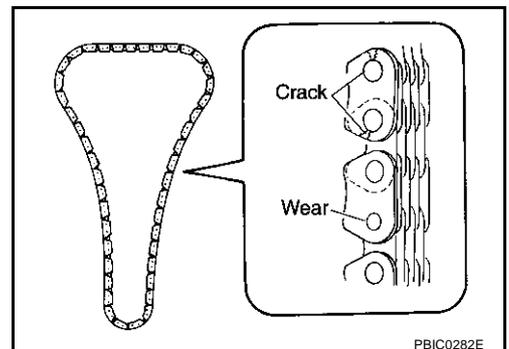
To avoid interference between valves and pistons, do not turn crankshaft or camshaft with timing chain is disconnected.

16. Using the same procedure as for left bank, remove timing chain and associated parts on right side.



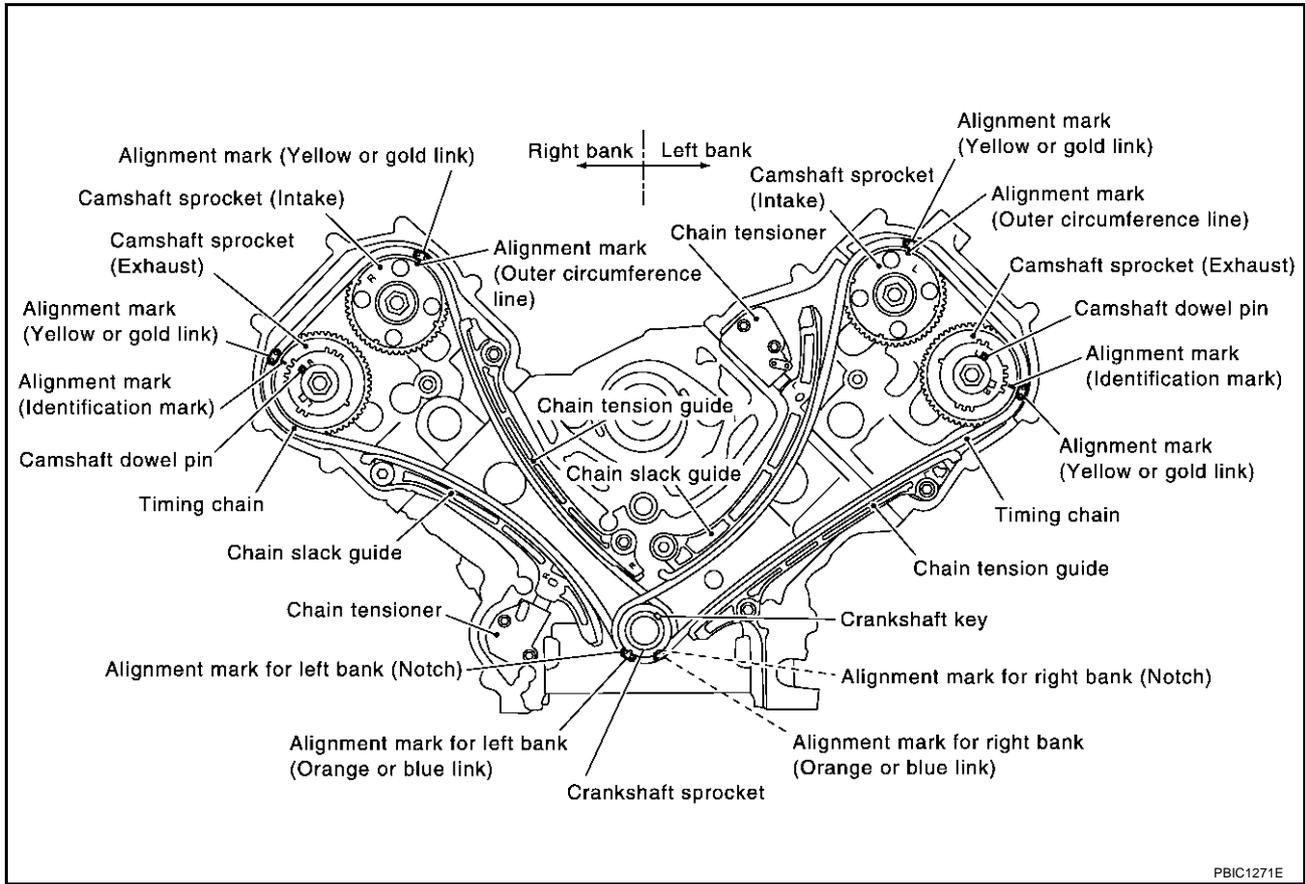
INSPECTION AFTER REMOVAL

Check for cracks and any excessive wear at link plates. Replace chain if necessary.



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INSTALLATION



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NOTE:

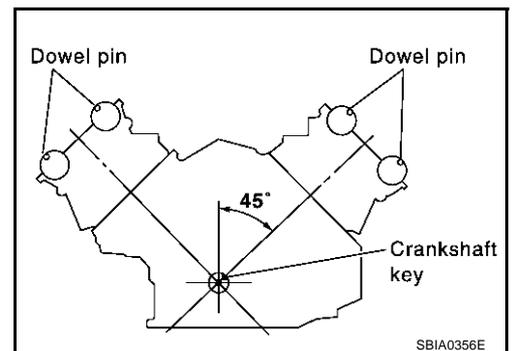
- The above figure shows the relationship between the mating mark on each timing chain and that on the corresponding sprocket, with the components installed.
- Parts with an identification mark (R or L) should be installed on the corresponding bank according to the mark.

Parts with an identification mark:

- Intake camshaft sprocket
- Dowel pin groove of exhaust camshaft sprocket (camshaft sprocket is same part both banks)
- Chain tension guide
- Chain slack guide

- Because of parallel manufacture, there are two types of mark (link colors) for timing chain.
- To install timing chain and associated parts, start with those on right bank. The procedure for installing parts on left bank is omitted because it is the same as that for installation on right bank.

1. Make sure the crankshaft key and dowel pin of each camshaft are facing in the direction indicated.



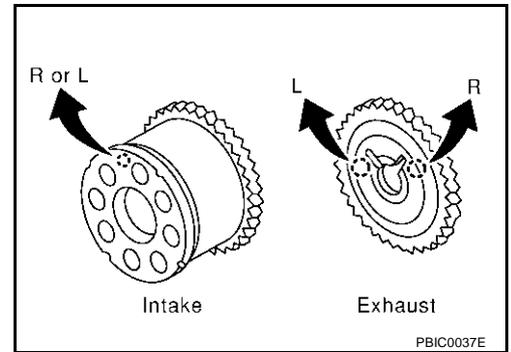
SBIA0356E

TIMING CHAIN

[VK45DE]

2. Install camshaft sprockets.

- Install onto correct side by checking with identification mark on surface.
- Install exhaust side camshaft sprocket by selectively using the groove of dowel pin according to the bank. (Common part used for both banks.)
- Lock the hexagonal part of camshaft in the same way as for removal, and tighten fixing bolts.

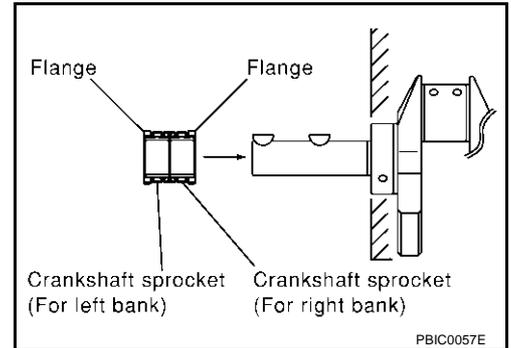


3. Install crankshaft sprockets for both banks.

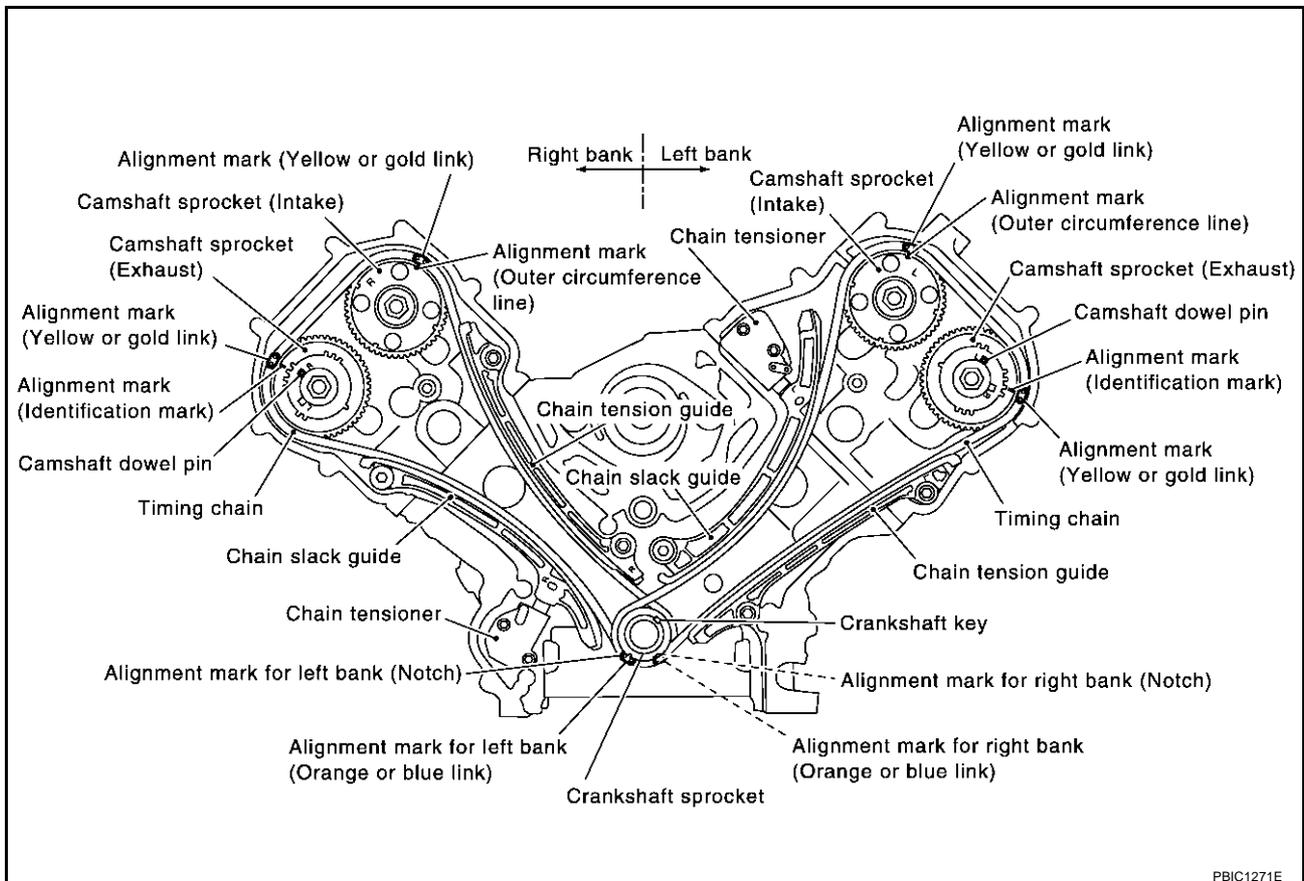
- Install each crankshaft sprocket so that its flange side (the larger diameter side without teeth) faces in the direction shown in figure.

NOTE:

The same parts are used but facing directions are different.



4. Install timing chains and associated parts.



- Align the mating mark on each sprocket and the timing chain for installation.

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.

CAUTION:

For the above reason, after the mating marks are aligned, keep them aligned by holding them with a hand.

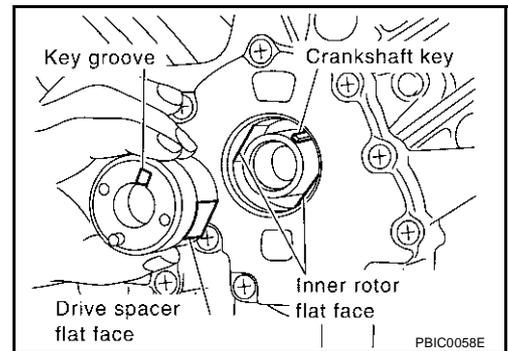
- Install slack guides and tension guides onto correct side by checking with identification mark on surface.
- Install chain tensioner with plunger fixed as described in its removal.

CAUTION:

- Before and after the installation of chain tensioner, make sure that the mating mark on timing chain is not out of alignment.
- After installing chain tensioner, remove the stopper pin to release tensioner. Make sure tensioner is released.
- To avoid chain-link skipping of timing chain, never move crankshaft or camshafts until front cover is installed.

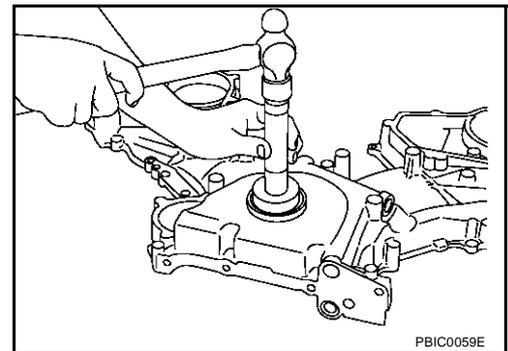
5. In the same way as for right bank, install timing chain and associated parts on left side.
6. Install oil pump.
7. Install oil pump drive spacer as follows:

- a. Insert oil pump drive spacer according to the directions of crankshaft key and the two flat surfaces of oil pump inner rotor.
 - If the positional relationship does not allow the insertion, rotate oil pump inner rotor with a finger to allow the spacer.
- b. After confirming that the position of each part is in correct condition to allow for the spacer, force fit the spacer by lightly tapping with a plastic hammer until it contacts and does not go further.



8. Install front oil seal onto front cover.

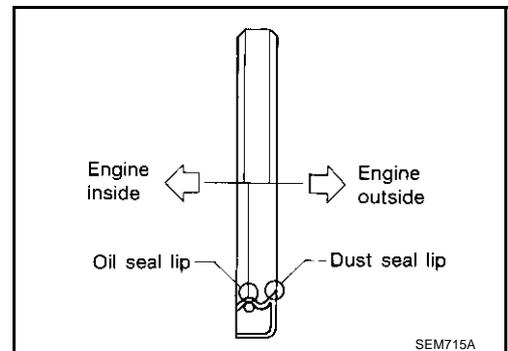
- Using oil seal drift or drift with 54 mm (2.13 in) diameter, force fit the seal until it levels with the front end surface of front cover.



- Install new oil seal in the direction shown in the figure.

CAUTION:

Be careful not to scratch or make burrs on circumference of oil seal.

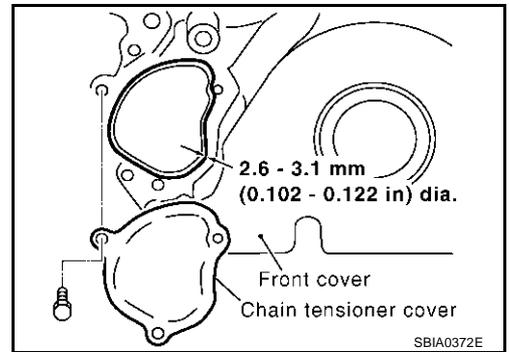


TIMING CHAIN

[VK45DE]

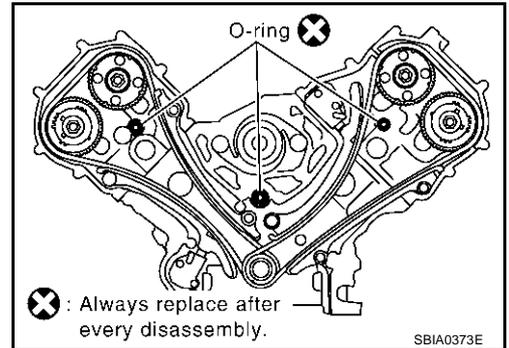
9. Install chain tensioner cover onto front cover.

- Apply liquid gasket as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



10. Install front cover as follows:

a. Install new O-rings onto RH and LH cylinder heads and cylinder block.

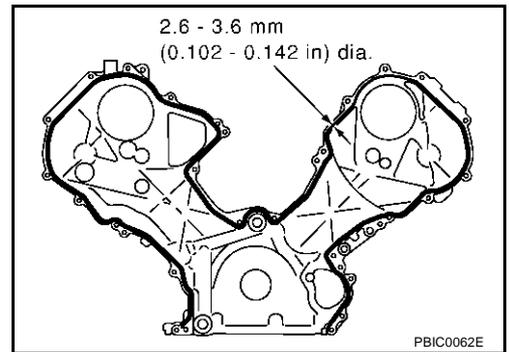


b. Apply liquid gasket as shown in the figure.

- **Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

c. Check again that the timing mating mark on timing chain and that on each sprocket are aligned. Then, install front cover.

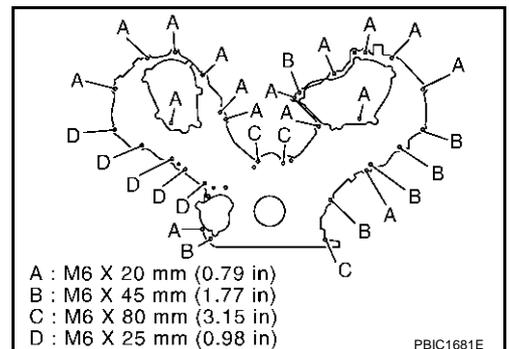
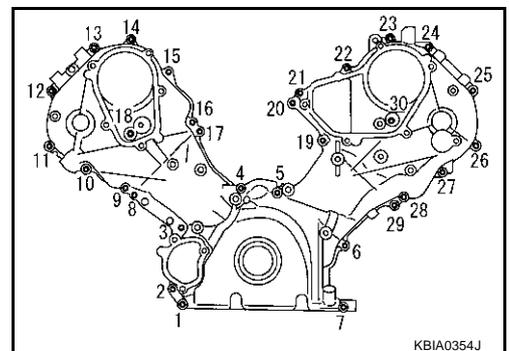
CAUTION:
 Be careful to avoid interference with the front end of oil pump drive spacer. Such interference may damage front oil seal.



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

e. After tightening, re-tighten to the specified torque.

CAUTION:
 Be sure to wipe off any excessive liquid gasket leaking onto surface mating with oil pan.



11. Install intake valve timing control cover as follows:

TIMING CHAIN

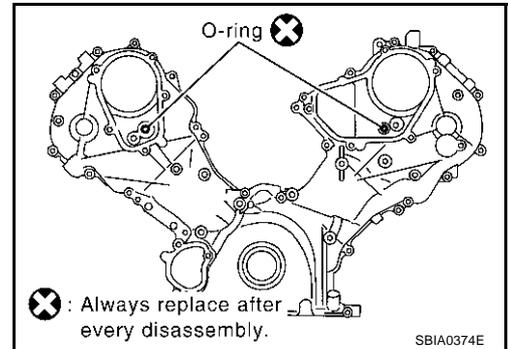
[VK45DE]

- a. At the back of intake valve timing control cover, install new seal rings (three for each) to the area to be inserted into intake camshaft sprocket.

CAUTION:

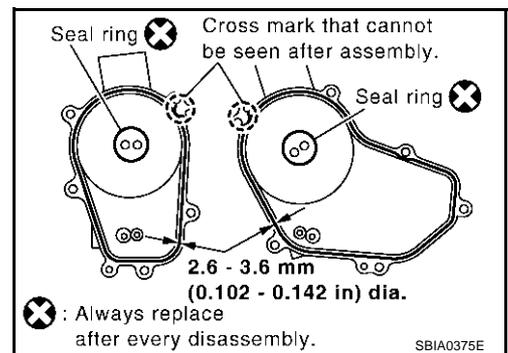
Do not spread seal ring excessively to avoid breaks and deformation.

- b. On the side of front cover, install new O-ring (one for each bank).

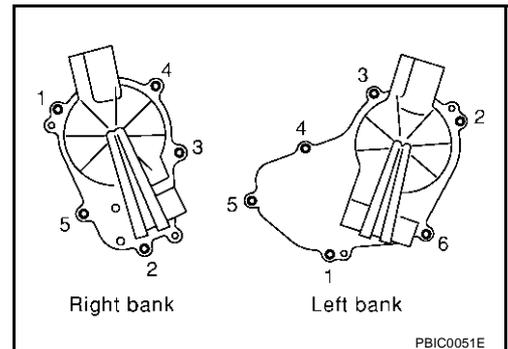


- c. Apply liquid gasket as shown in the figure.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



- d. Tighten fixing bolts in the numerical order shown in the figure.



12. Install intake valve timing control position sensor, intake valve timing control solenoid valve and camshaft position sensor (PHASE) to intake valve timing control cover and front cover.

- Be sure to tighten bolts with flanges completely seated.

13. Install crankshaft pulley.

- Install according to the dowel pin of oil pump drive spacer.
- Lightly tapping its center with plastic hammer, insert pulley.

CAUTION:

Do not tap pulley on the side surface where belt is installed (outer circumference).

14. Tighten fixing bolt of crankshaft pulley.

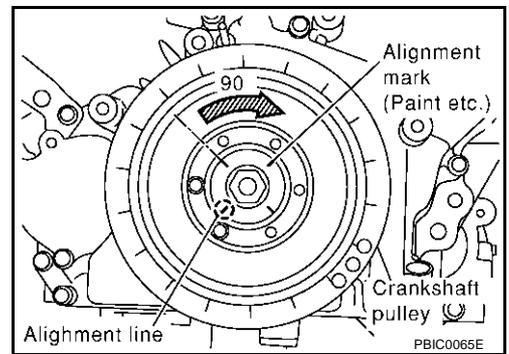
- Lock crankshaft with a hammer handle or similar tool to tighten fixing bolt.
- Perform the following steps for angular tightening:

- Apply engine oil onto threaded parts of bolt and seating area.
- Tighten bolt 93.1 N·m (9.5 kg·m, 69 ft·lb).

TIMING CHAIN

[VK45DE]

- c. Select one most visible notch of the four on bolt flange. Corresponding to the selected notch, put a mating mark (such as paint) on crankshaft pulley.
- d. Tighten further by 90 degrees. (Angle tightening)
 - Check the tightening angle by referencing to the notches. The angle between two notches is 90 degrees.



15. Rotate crankshaft pulley in normal direction (clockwise when viewed from engine front) to check for interference among parts.
16. For the following operations, perform steps in the reverse order of removal.

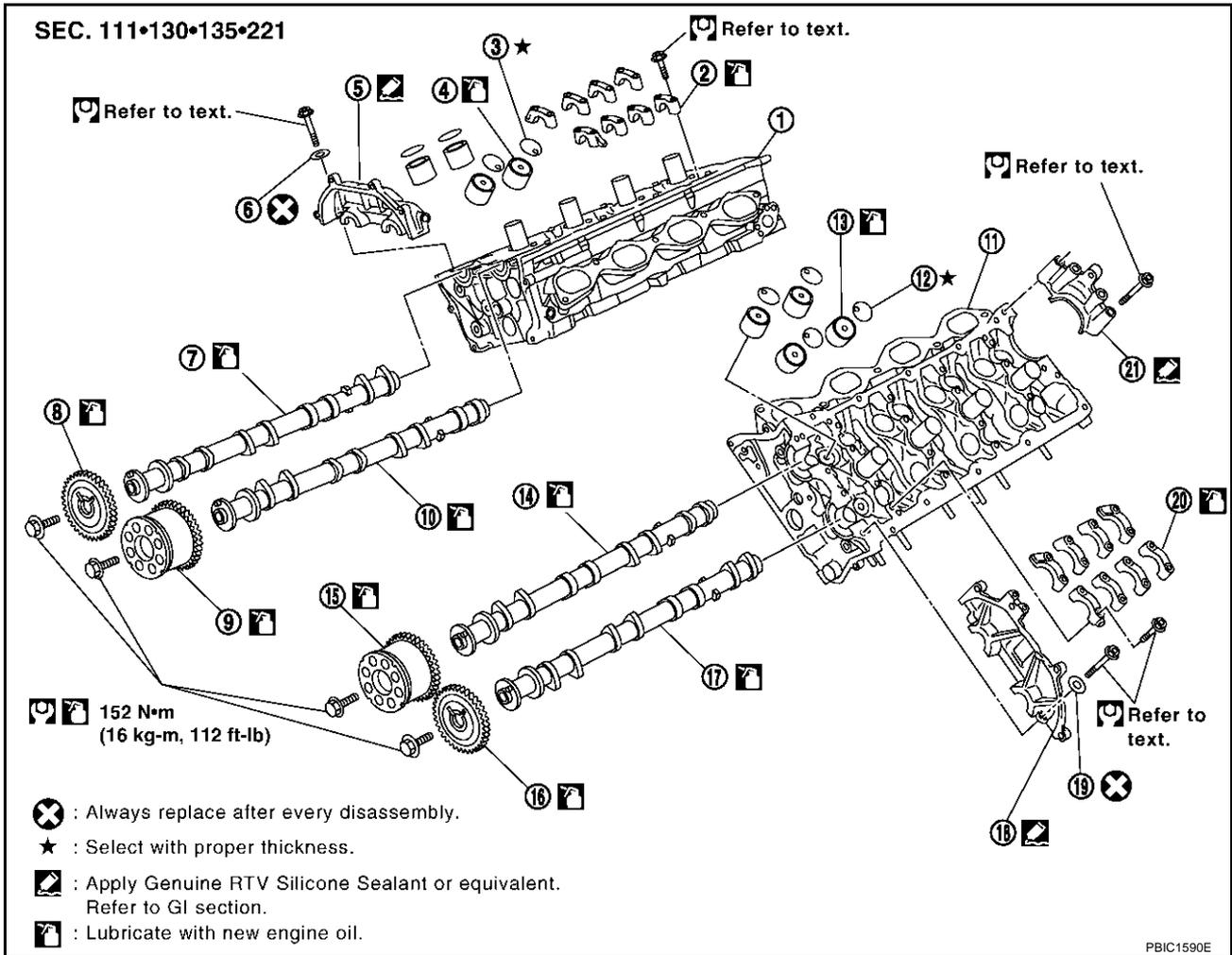
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CAMSHAFT

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Removal and Installation

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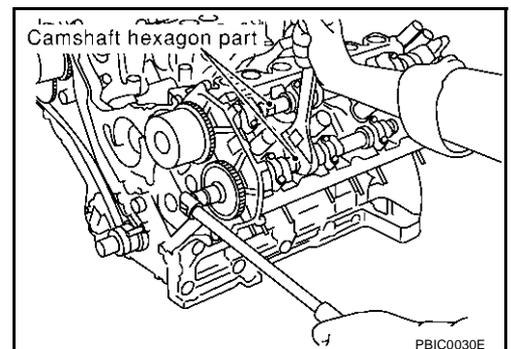
- | | | |
|---------------------------------|---------------------------------------|--------------------------------------|
| 1. Cylinder head (right bank) | 2. Camshaft bracket (No. 2, 3, 4, 5) | 3. Adjusting shim |
| 4. Valve lifter | 5. Camshaft bracket (No. 1) | 6. Washer |
| 7. Camshaft (exhaust) | 8. Camshaft sprocket (exhaust) | 9. Camshaft sprocket (intake) |
| 10. Camshaft (intake) | 11. Cylinder head (left bank) | 12. Adjusting shim |
| 13. Valve lifter | 14. Camshaft (intake) | 15. Camshaft sprocket (intake) |
| 16. Camshaft sprocket (exhaust) | 17. Camshaft (exhaust) | 18. Camshaft bracket (No. 1) |
| 19. Washer | 20. Camshaft bracket (No. 2, 3, 4, 5) | 21. Camshaft bracket (intake, No. 6) |

REMOVAL

- Remove timing chain.
Refer to [EM-192, "Removal and Installation"](#).
- With hexagonal part of camshaft locked with wrench, loosen bolts securing camshaft sprocket to remove camshaft sprocket.

CAUTION:

To avoid interference between valves and pistons, do not turn crankshaft or camshaft with timing chain disconnected.

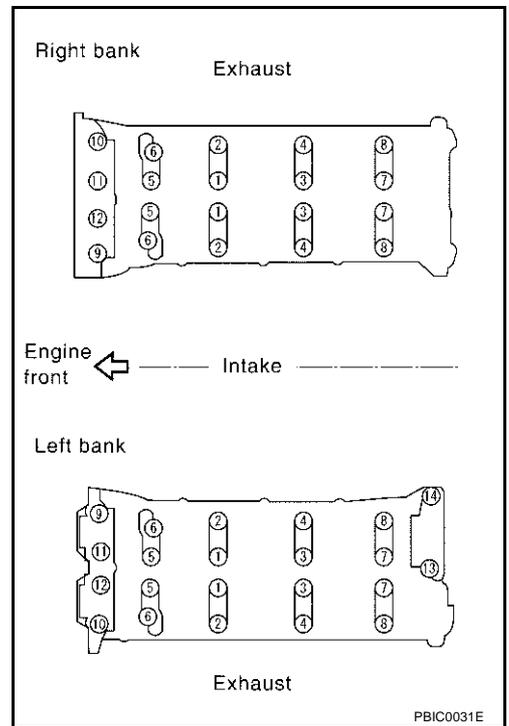


CAMSHAFT

[VK45DE]

3. Loosen fixing bolts in the reverse order of shown in figure to remove camshaft brackets.
 - Lightly tapping with plastic hammer, remove No. 1 camshaft bracket and No. 6 camshaft bracket.

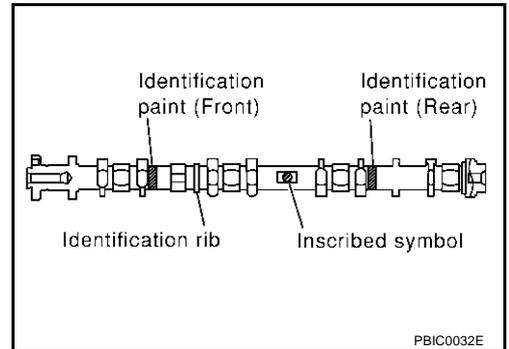
NOTE:
The bottom surface of each bracket will be stuck to cylinder head because of liquid gasket.
4. Remove camshaft.
5. Remove adjusting shims and valve lifters if necessary.
 - Correctly identify location where each part is installed. Keep parts in an organized way to avoid mixing them up.



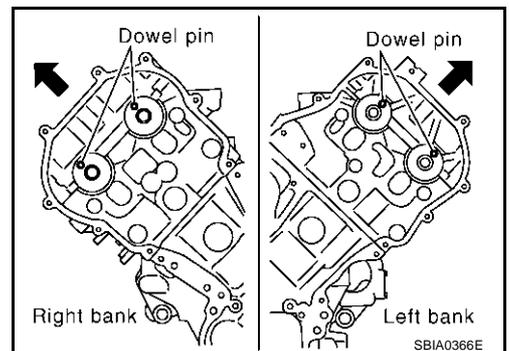
INSTALLATION

1. Install valve lifters and adjusting shims if removed.
 - Install removed parts in the same locations as before.
2. Install camshafts. Refer to the table below for identification of right and left bank, and intake and exhaust.

Bank	INT EXH	Identifica- tion paint (front)	Identifica- tion paint (rear)	Identifica- tion rib	Identifica- tion symbol
RH	INT	Blue	—	Yes.	RH
	EXH	—	Orange	Yes.	RH
LH	INT	Blue	—	No.	LH
	EXH	—	Orange	No.	LH



- Install so that dowel pin at the front of camshaft face is in the direction shown in the figure.

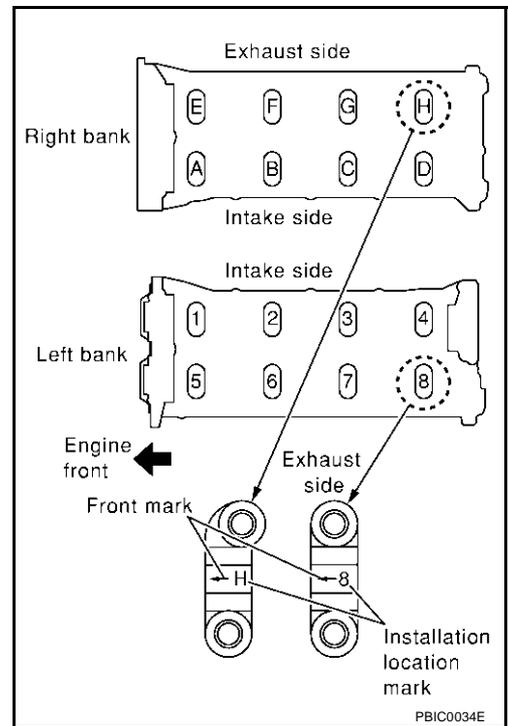


CAMSHAFT

[VK45DE]

3. Install camshaft brackets.

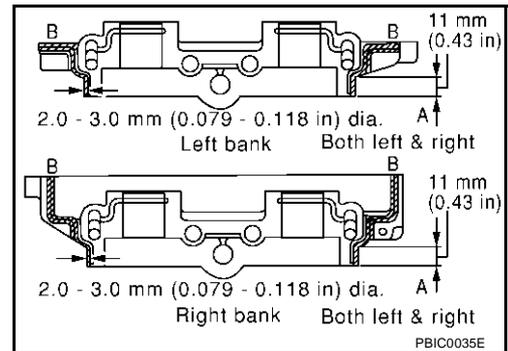
- Install by referring to installation location mark on upper surface and front mark.
- Install so that installation location mark can be correctly read when viewed from the side of left exhaust bank.



- Apply liquid gasket to No.1 camshaft bracket as in illustration. 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" and "B" (both on right and left sides).
- Remove completely any excess of liquid gasket inside bracket.

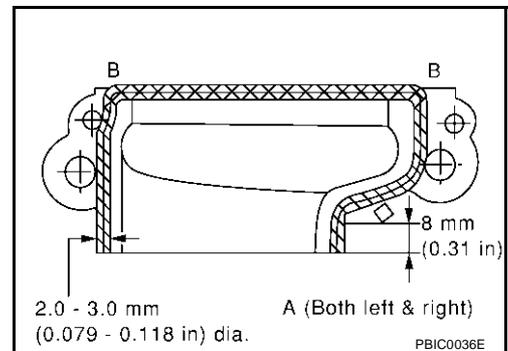


- Apply liquid gasket to No. 6 camshaft bracket on left bank intake as in illustration.

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" and "B" (both on right and left sides).
- Remove completely any excess of liquid gasket inside bracket.



CAMSHAFT

[VK45DE]

4. Tighten fixing bolts of camshaft brackets as follows:
 - a. Tighten No. 9 to 12 in the numerical order as shown.

 : 1.96 N-m (0.2 kg-m, 1 ft-lb)
 - b. Tighten No. 1 to 8 in the numerical order as shown.

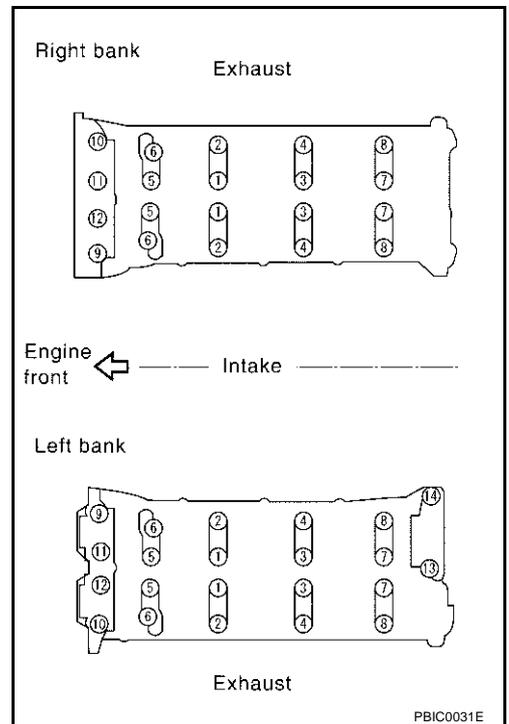
 : 1.96 N-m (0.2 kg-m, 1 ft-lb)
 - c. Tighten No. 13 to 14 in the numerical order as shown. (Left bank only)

 : 1.96 N-m (0.2 kg-m, 1 ft-lb)
 - d. Tighten all bolts in the numerical order as shown.

 : 5.88 N-m (0.6 kg-m, 4 ft-lb)
 - e. Tighten No. 1 to 12 in the numerical order as shown.

 : 10.41 N-m (1.1 kg-m, 8 ft-lb)
 - f. Tighten No. 13 to 14 in the numerical order as shown. (Left bank only)

 : 31.35 N-m (3.2 kg-m, 23 ft-lb)

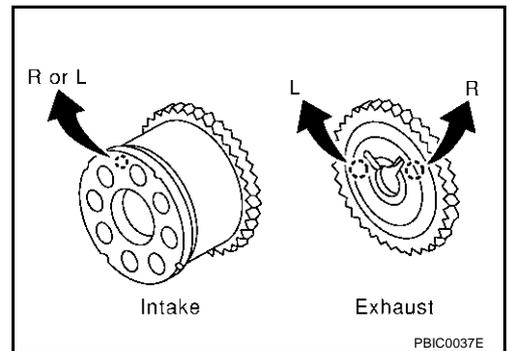


CAUTION:

After tightening fixing bolts of camshaft brackets, be sure to wipe off excessive liquid gasket from the parts listed below.

- Mating surface of rocker cover
- Mating surface of front cover

5. Install camshaft sprockets.
 - Install by checking with identification mark on surface.
 - Install exhaust-side camshaft sprocket by selectively using the groove of dowel pin according to the bank. (Common part used for both banks.)
 - Lock the hexagonal part of camshaft in the same way as for removal, and tighten fixing bolts.



6. For the following operations, perform steps in the reverse order of removal.
7. Check and adjust valve clearances. Refer to [EM-208. "Valve Clearance"](#).

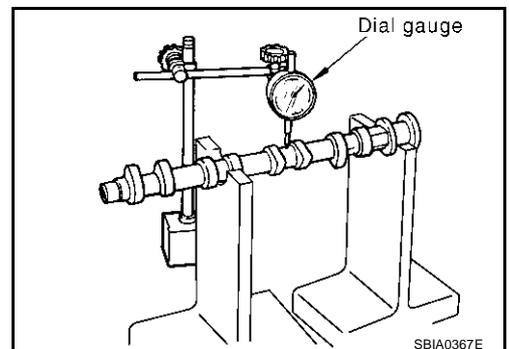
INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put V block on precise flat bed, and support No. 2 and No. 5 journal of camshaft.
2. Set dial gauge vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure camshaft runout on dial gauge.

Standard : Less than 0.02 mm (0.0008 in)

- If it exceeds the specification, replace camshaft.



Camshaft Cam Height

- Measure camshaft cam height.

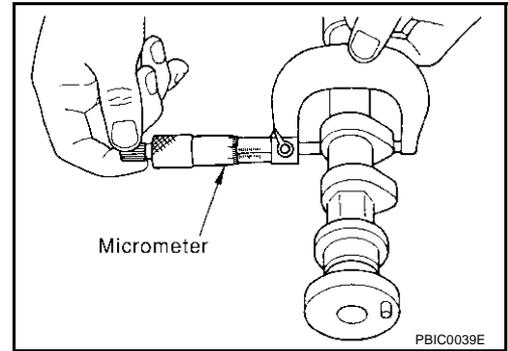
Standard cam height:

Intake : 44.865 - 45.055 mm (1.7663 - 1.7738 in)

Exhaust : 43.925 - 44.115 mm (1.7293 - 1.7368 in)

Cam wear limit : 0.2 mm (0.008 in)

- If wear is beyond the specifications, replace camshaft.



Camshaft Journal Clearance

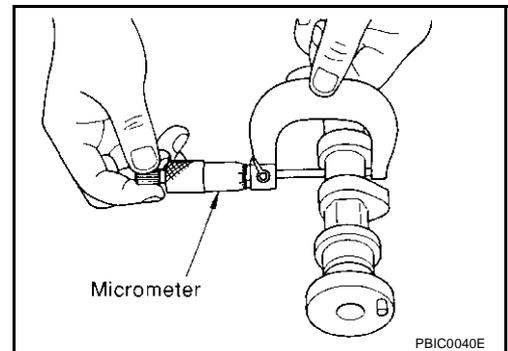
Outer Diameter of Camshaft Journal

- Measure outer diameter of camshaft journal.

Standard outer diameter:

No. 1 : 25.938 - 25.955 mm (1.0212 - 1.0218 in)

No. 2, 3, 4, 5 : 25.953 - 25.970 mm (1.0218 - 1.0224 in)



Inner Diameter of Camshaft Bracket

- Tighten camshaft bracket bolt with specified torque.
- Using inside micrometer, measure inner diameter of camshaft bracket.

Standard:

26.000 - 26.021 mm (1.0236 - 1.0244 in)

Calculation of Camshaft Journal Clearance

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

Standard:

No. 1 : 0.045 - 0.083 mm (0.0018 - 0.0033 in)

No. 2, 3, 4, 5 : 0.030 - 0.068 mm (0.0012 - 0.0027 in)

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

NOTICE:

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

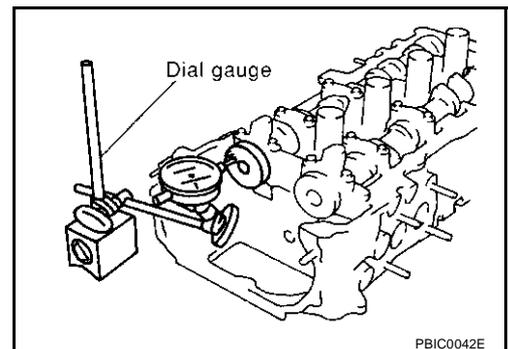
Camshaft End Play

- Install dial gauge in thrust direction on front end of camshaft. Measure end play when camshaft is moved forward/backward (in direction to axis).

Standard:

0.115 - 0.188 mm (0.0045 - 0.0074 in)

- When out of the specified range, replace with new camshaft and measure again.
- When out of the specified range again, replace with new cylinder head.

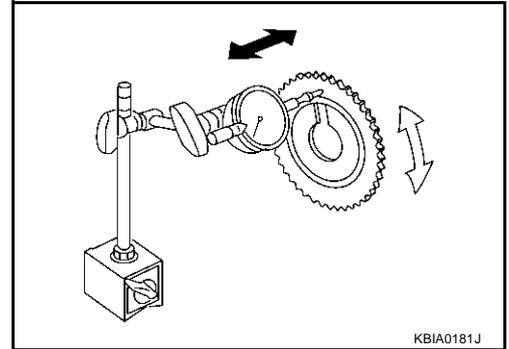


Camshaft Sprocket Runout

1. Install camshaft in cylinder head.
2. Install camshaft sprocket to camshaft.
3. Measure camshaft sprocket runout.

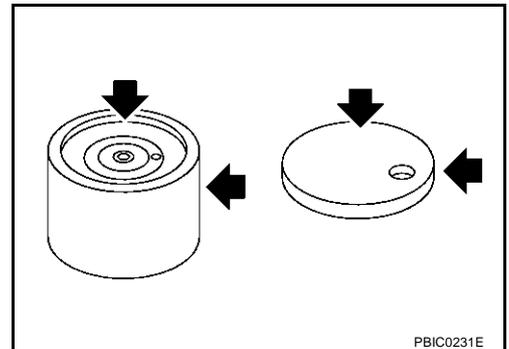
Runout : Less than 0.15 mm (0.0059 in)

- If it exceeds the specification, replace camshaft sprocket.

**Valve Lifter and Adjusting Shim**

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

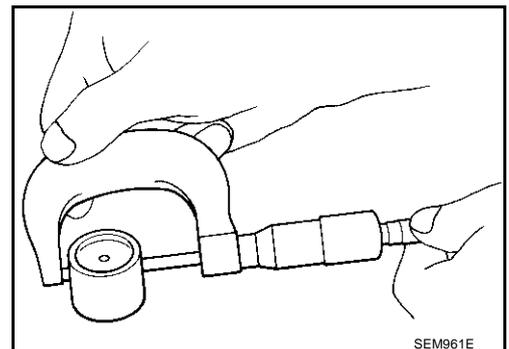
- If anything above is found, replace valve lifter or adjusting shim.

**Valve Lifter Clearance**

Outer Diameter of Valve Lifter

- Measure outer diameter of valve lifter.

Standard : 33.965 - 33.975 mm (1.3372 - 1.3376 in)



Valve Lifter Hole Diameter

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

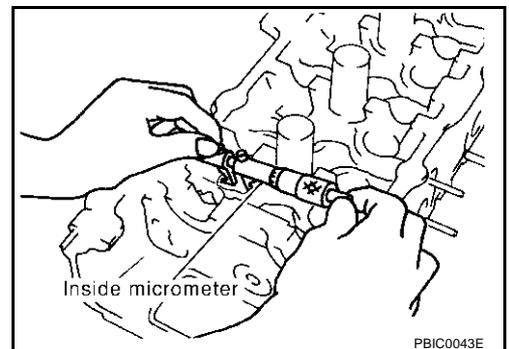
**Standard:
34.000 - 34.016 mm (1.3386 - 1.3392 in)**

Calculation of Valve Lifter Clearance

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

**Standard:
0.025 - 0.051 mm (0.0010 - 0.0020 in)**

- When out of specified range, referring to each specification of outer and inner diameter, replace either or both valve lifter and cylinder head.

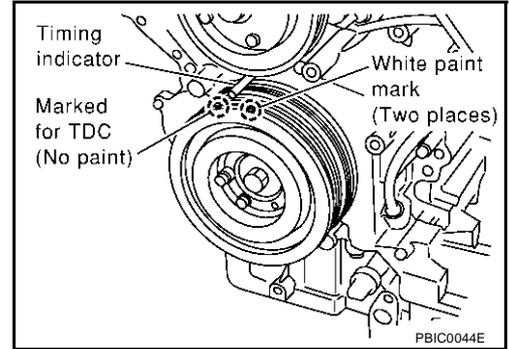


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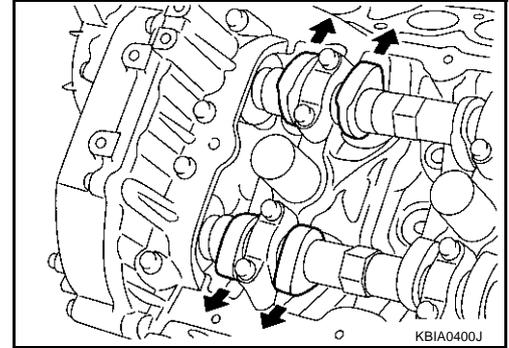
Valve Clearance INSPECTION

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

1. Warm up engine. Then stop it.
2. Remove engine cover, battery cover and air duct (inlet). Refer to [EM-166, "Removal and Installation"](#) .
3. Remove RH and LH rocker covers with power tool. Refer to [EM-189, "Removal and Installation"](#) .
4. Turn crankshaft pulley in normal direction (clockwise when viewed from engine front) to align TDC identification notch (without paint mark) with timing indicator.



5. At this time, make sure the both intake and exhaust cam noses of No. 1 cylinder (top front on left bank) face outside.
 - If they do not face outside, turn crankshaft pulley once more.

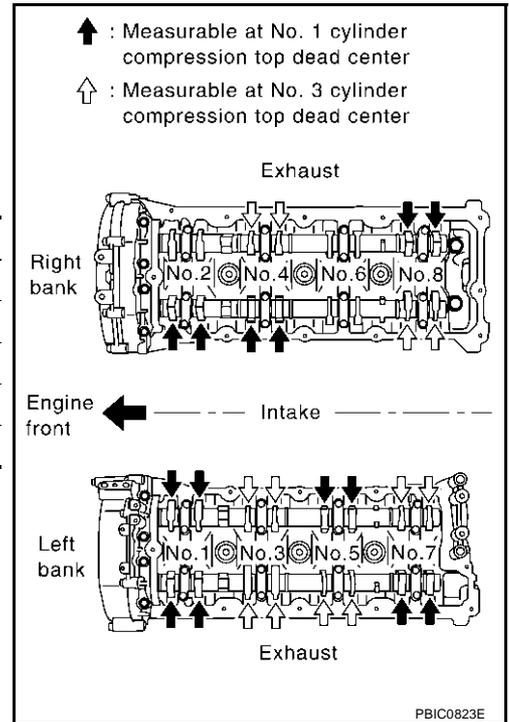


6. By referring to the figure, measure valve clearances at locations marked "x" as shown in the table below (locations indicated with black arrow in figure) with a thickness gauge.

NOTE:

Firing order 1-8-7-3-6-5-4-2

- No.1 cylinder compression TDC



Measuring position (RH bank)		No.2 CYL	No.4 CYL	No.6 CYL	No. 8 CYL
No. 1 cylinder at TDC	EXH				×
	INT	×	×		
Measuring position (LH bank)		No.1 CYL	No. 3 CYL	No. 5 CYL	No. 7 CYL
No. 1 cylinder at TDC	INT	×		×	
	EXH	×			×

CAMSHAFT

[VK45DE]

- Use a fine thickness gauge.

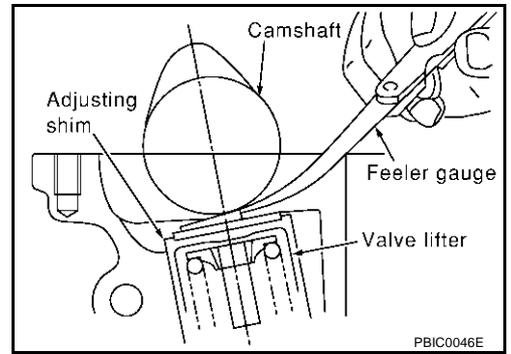
Valve clearance standard:

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

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

CAUTION:

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

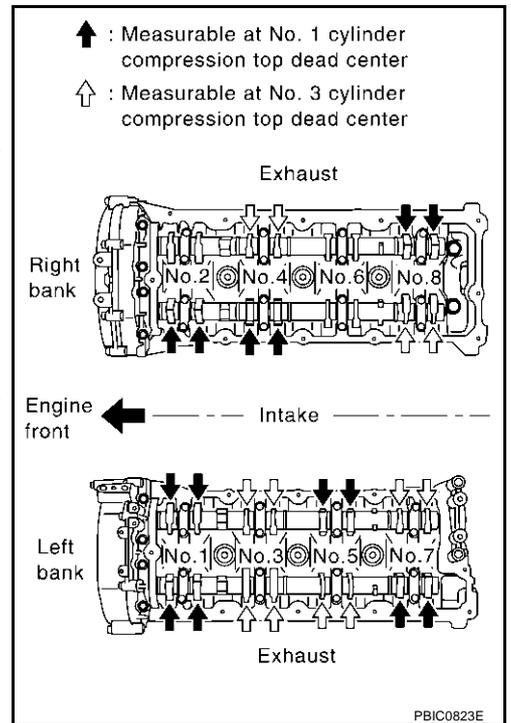


7. Turn crankshaft pulley clockwise by 270 degrees from the position of No. 1 cylinder compression TDC to obtain No. 3 cylinder compression TDC.

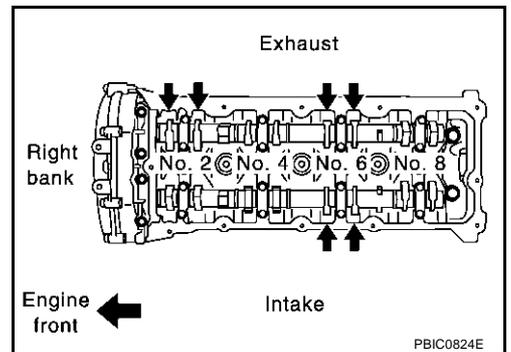
8. By referring to the figure, measure valve clearances at locations marked "x" as shown in the table below (locations indicated with white arrow in figure)

- No.3 cylinder compression TDC

Measuring position (RH bank)		No.2 CYL	No.4 CYL	No.6 CYL	No. 8 CYL
No. 3 cylinder at TDC	EXH		×		
	INT				×
Measuring position (LH bank)		No.1 CYL	No. 3 CYL	No. 5 CYL	No. 7 CYL
No. 3 cylinder at TDC	INT		×		×
	EXH		×	×	



9. Turn crankshaft pulley clockwise by 90 degrees from the position of No. 3 cylinder compression TDC (clockwise by 360 degrees from the position of No. 1 cylinder compression TDC) to measure intake and exhaust valve clearances of No. 6 cylinder and exhaust valve clearance of No.2 cylinder.



10. If out of specifications, adjust as follows:

ADJUSTMENT

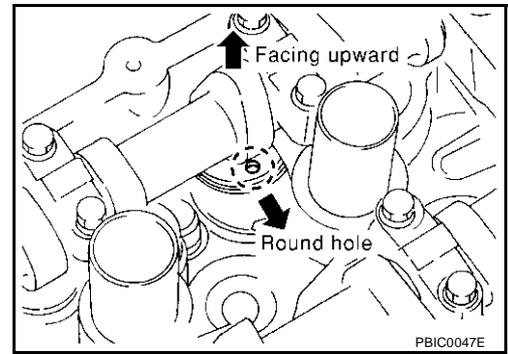
NOTE:

Adjust valve clearance while engine is cold.

CAMSHAFT

[VK45DE]

1. Turn crankshaft to position cam nose on camshaft of valve that must be adjusted upward.
2. Thoroughly wipe off engine oil around adjusting shim using a rag.
3. Using a extra-fine screwdriver, turn the round hole of the adjusting shim in the direction of the arrow.

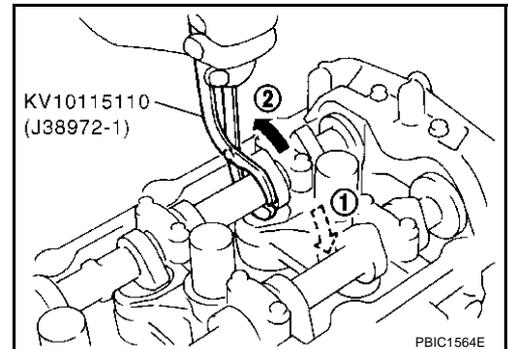


4. Install lifter stopper [SST: 10115120 (J38972-2)] as follow.
 - a. Except exhaust side of No. 7 and No. 8 cylinder;
 - i. Place camshaft pliers (SST) around camshaft as shown in figure.
 - Before placing camshaft pliers, rotate cam lobe toward center of cylinder head [See (1) in figure] to simplify shim removal later.

CAUTION:

Be careful not to damage cam surface with camshaft pliers.

- ii. Rotate camshaft pliers [See (2) in figure] so that valve lifter is pushed down.



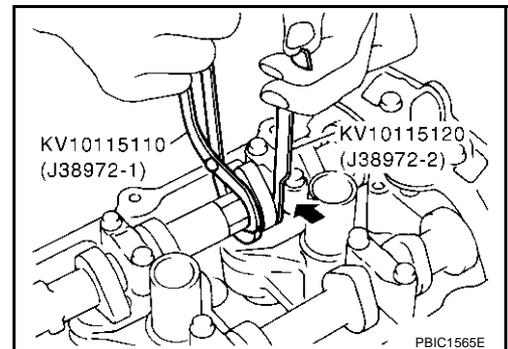
- iii. Place lifter stopper (SST) between camshaft and the edge of the valve lifter to retain valve lifter.

CAUTION:

● Lifter stopper must be placed as close to camshaft bracket as possible.

● Be careful not to damage cam surface with lifter stopper.

- iv. Remove camshaft pliers.



- b. Exhaust side of No.7 and No. 8 cylinder;

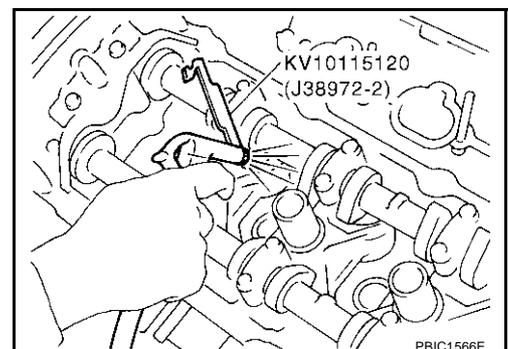
NOTE:

Exhaust side of No. 7 and No. 8 cylinder does not have space for installing camshaft pliers [SST: KV10115110 (J38972-1)]. therefore, install lifter stopper [SST: KV10115120 (J38972-2)] according to the following instructions.

- i. Turn crankshaft to press cam nose to the adjusting part of valve lifter.
 - ii. Install lifter stopper [SST: KV10115120 (J38972-2)], and then turn crankshaft slowly 180 degrees clockwise.
5. Blow air into the hole to separate adjusting shim from valve lifter.

CAUTION:

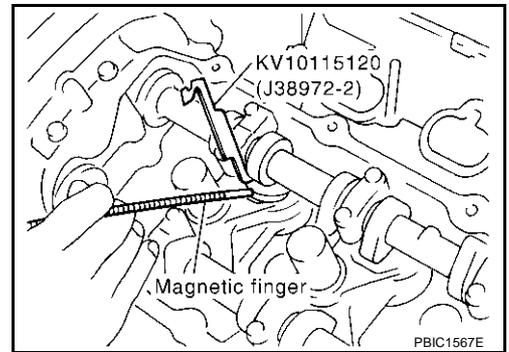
When blowing, use goggles to protect your eye.



CAMSHAFT

[VK45DE]

6. Remove adjusting shim using a small screwdriver and a magnetic finger.



7. Determine replacement adjusting shim size following formula.
- Using a micrometer determine thickness of removed shim with measured at center.
 - Calculate thickness of new adjusting shim so valve clearance comes within specified values (Cold value).
R = Thickness of removed shim
N = Thickness of new shim
M = Measured valve clearance

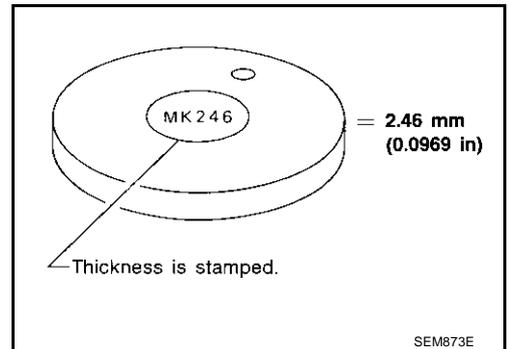
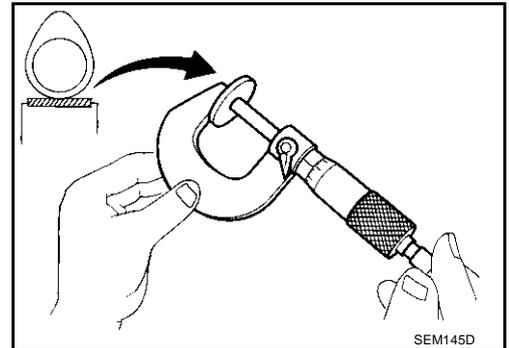
Intake : $N = R + [M - 0.30 \text{ mm (0.0118 in)}]^*$

Exhaust : $N = R + [M - 0.33 \text{ mm (0.0130 in)}]^*$

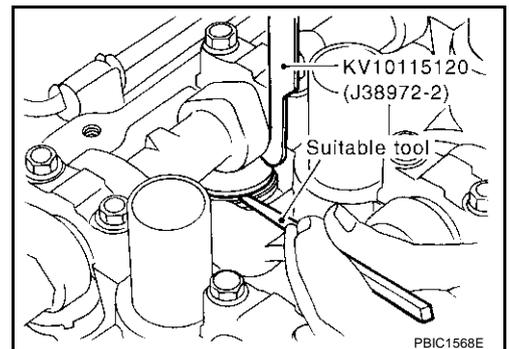
***: Approximately 20° C (68° F)**

Shims are available in 64 sizes from 2.32 mm (0.0913 in) to 2.95 mm (0.1161 in) in steps of 0.01 mm (0.0004 in).

- Select new shim with thickness as close as possible to calculated value.



8. Install new shim using a suitable tool.
- **Install with the surface on which the thickness is stamped facing down.**

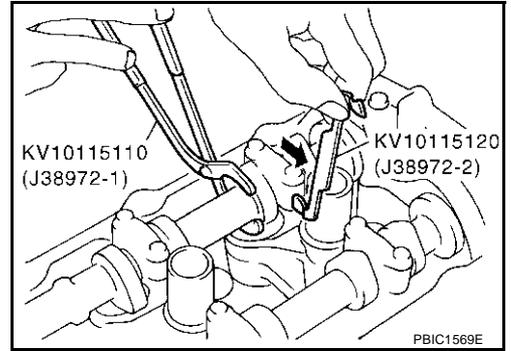


9. Remove lifter stopper as follow.
- a. Except exhaust side of No. 7 and No. 8 cylinder;

CAMSHAFT

[VK45DE]

- i. Place camshaft pliers (SST) as mentioned in steps 4.
- ii. Remove lifter stopper (SST).
- iii. Remove camshaft pliers (SST).
- b. Exhaust side of No. 7 and No. 8 cylinder.
 - i. Turn crankshaft slowly 180 degrees counter-clockwise. then remove lifter stopper (SST).
 - ii. Turn crankshaft to position cam nose on camshaft of valve that must be adjusted upward.
- 10. Recheck valve clearance. (Cold value)
- 11. Finally check valve clearance with warmed up engine. (Hot value)



Valve clearance:

Unit: mm (in)

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

*: Approximately 20°C (68°F)

OIL SEAL

PF0:00100

Removal and Installation of Valve Oil Seal

ABS006IM

1. Remove camshaft relating to valve oil seal to be removed. Refer to [EM-202, "CAMSHAFT"](#) .
2. Remove adjusting shims and valve lifters. Refer to [EM-202, "CAMSHAFT"](#) .
 - Correctly identify location where each part is installed. Keep parts in an organized way to avoid mixing them up.
3. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent the valve from dropping into the cylinder.
4. Remove valve collet.
 - Compress valve spring with valve spring compressor, attachment and adapter (SST). Remove valve collet with magnet driver.

CAUTION:

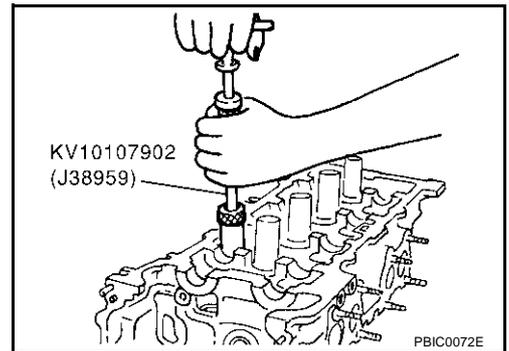
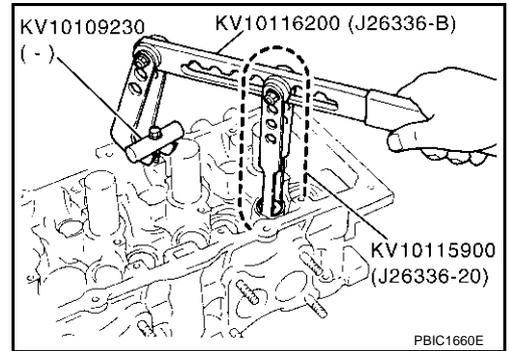
When working, take care not to damage valve lifter holes.

5. Remove valve spring retainer and valve spring.

CAUTION:

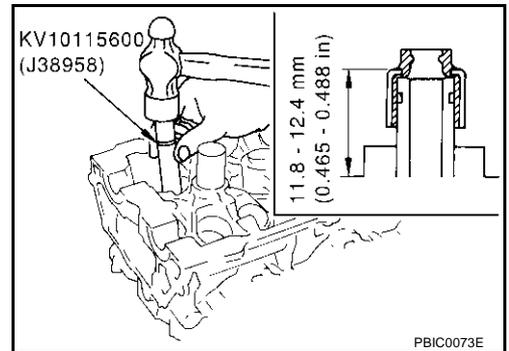
Do not remove valve spring seat from valve spring.

6. Remove valve oil seal using valve oil seal puller (SST).



INSTALLATION

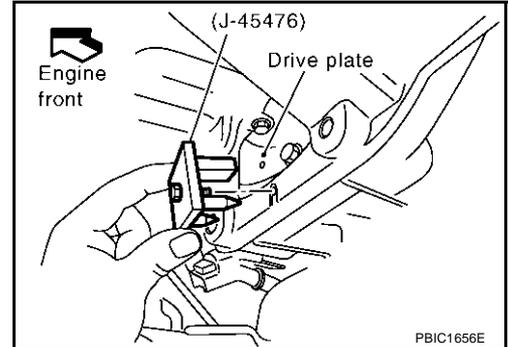
1. Apply engine oil on new valve oil seal joint and seal lip.
2. Install valve oil seal.
 - Install with valve oil seal drift (SST) to match dimension in illustration.
3. Perform steps in the reverse order of removal for the following operations.



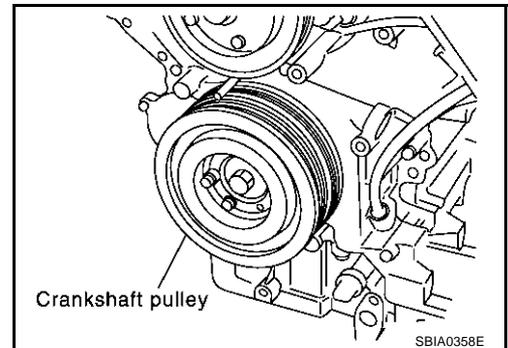
Removal and Installation of Front Oil Seal

REMOVAL

- Remove the following parts:
 - Radiator; Refer to [CO-38, "RADIATOR"](#)
 - Drive belt; Refer to [EM-167, "DRIVE BELTS"](#) .
 - Cooling fan; Refer to [CO-45, "COOLING FAN"](#) .
 - Rear plate cover; Refer to [EM-180, "OIL PAN AND OIL STRAINER"](#) .
- Set ring gear stopper (SST).



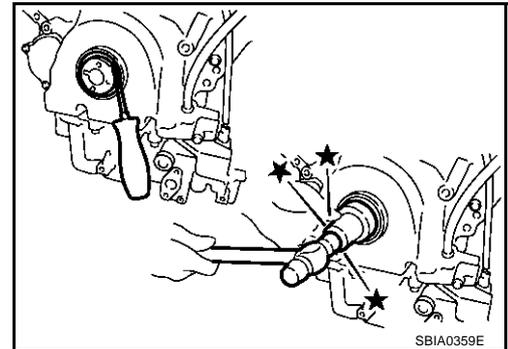
- Remove crankshaft pulley.



- Remove front oil seal using a suitable tool.

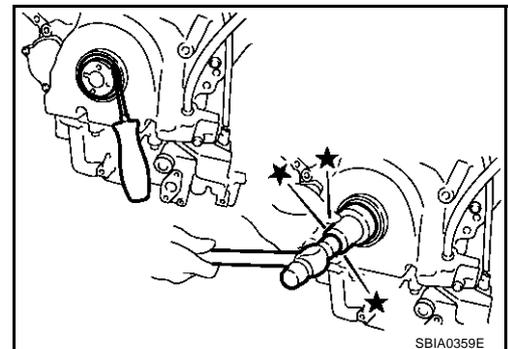
CAUTION:

Be careful not to damage front cover and oil pump drive spacer.



INSTALLATION

- Install front oil seal onto front cover.
 - Apply engine oil on new front oil seal.
 - Using oil seal drift or drift with 54 mm (2.13 in) diameter (commercial service tool), force fit the front oil seal until it levels with the front end surface of front cover.



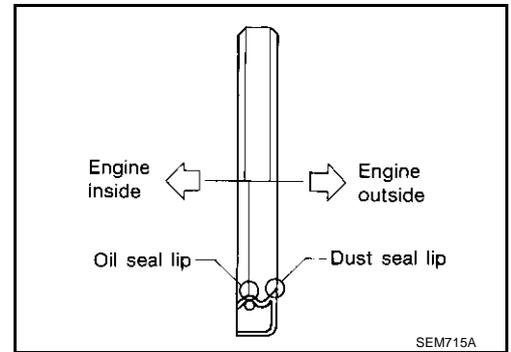
OIL SEAL

[VK45DE]

- Install new front oil seal in the direction shown in the figure.

CAUTION:

Be careful not to scratch or make burrs on circumference of front oil seal.



2. Perform steps in the reverse order of removal for the following operations.

Removal and Installation of Rear Oil Seal

ABS00610

REMOVAL

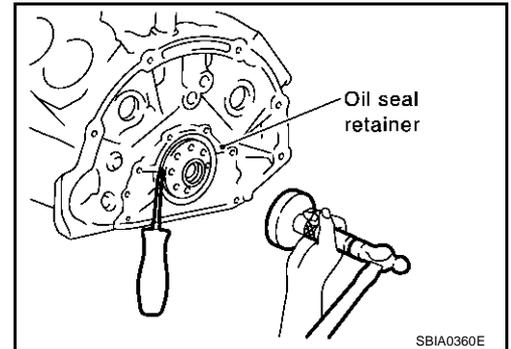
1. Remove transmission (with transfer) assembly. Refer to [AT-272, "Removal and Installation \(AWD Models\)"](#).
 - a. Remove drive plate.
 - Holding crankshaft pulley mounting bolts, lock crankshaft to remove bolts fixing drive plate.
 - Loosen fixing bolts diagonally.
2. Remove rear oil seal using a suitable tool.

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.

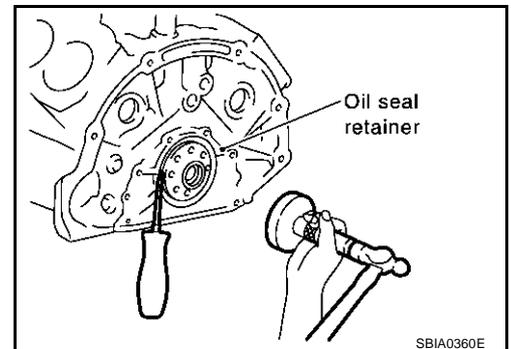
CAUTION:

Be careful not to damage crankshaft and oil seal retainer surface.



INSTALLATION

1. Install rear oil seal to oil seal retainer.
 - Tap until flattened with front edge of oil seal retainer. Do not damage or scratch outer circumference of rear oil seal.



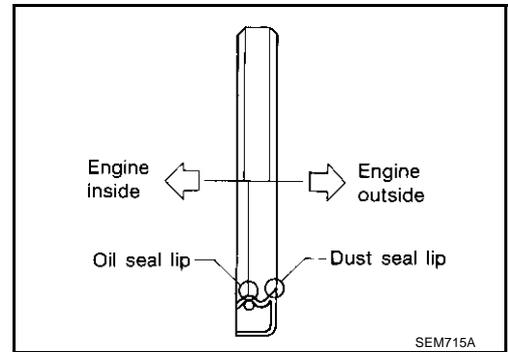
OIL SEAL

[VK45DE]

- Install new oil seal in the direction shown in the figure.

CAUTION:

Be careful not to scratch or make burrs on circumference of rear oil seal.



2. Perform steps in the reverse order of removal for the following operations.

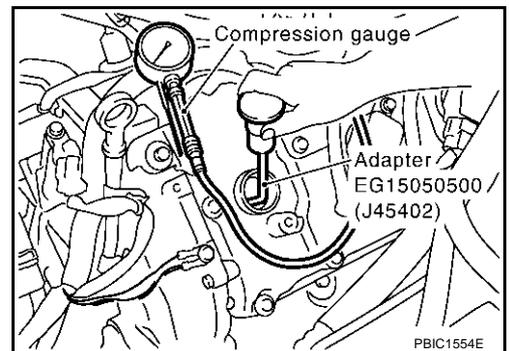
CYLINDER HEAD

PF11041

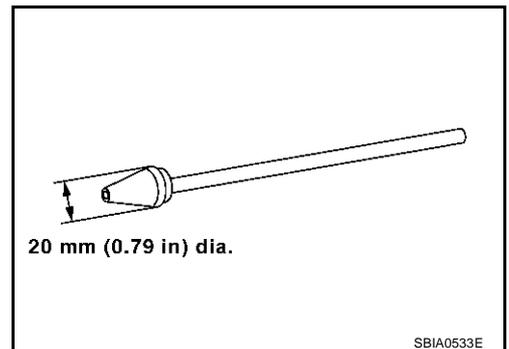
On-Vehicle Service

CHECKING COMPRESSION PRESSURE

1. Remove engine cover (with power tool).
Refer to [EM-166, "Removal and Installation"](#) .
2. Warm up engine thoroughly. Then, stop it.
3. Release fuel pressure.
 - a. Remove fuel pump fuse, and start engine.
Refer to [EC-705, "FUEL PRESSURE RELEASE"](#) for fuel pump fuse location.
 - b. After engine stalls, crank it two or three times to release all fuel pressure.
 - Let fuel pump fuse removed until the end of step 7.
4. Remove ignition coil and spark plug from each cylinder.
Refer to [EM-183, "Removal and Installation"](#) and [EM-184, "Removal and Installation"](#) .
5. Connect engine tachometer (not required in use of CONSULT-II).
6. Install compression gauge with adapter (SST or commercial service tool) onto spark plug hole.
 - Use compression gauge adapter (SST) which is required on No. 7 and No. 8 cylinders.



- Use compression gauge adapter (if no SST is used) 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 engine rpm. Perform these steps to check each cylinder.



Unit: kPa (kg/cm², psi) /rpm

Standard	Minimum	Deference limit between cylinders
1,320 (13.5, 191) / 300	1,130 (11.5, 164) / 300	98 (1.0, 14) / 300

CAUTION:

Always use a fully charged 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, the 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, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, the gaskets are leaking. In such a case, replace the cylinder head gaskets.

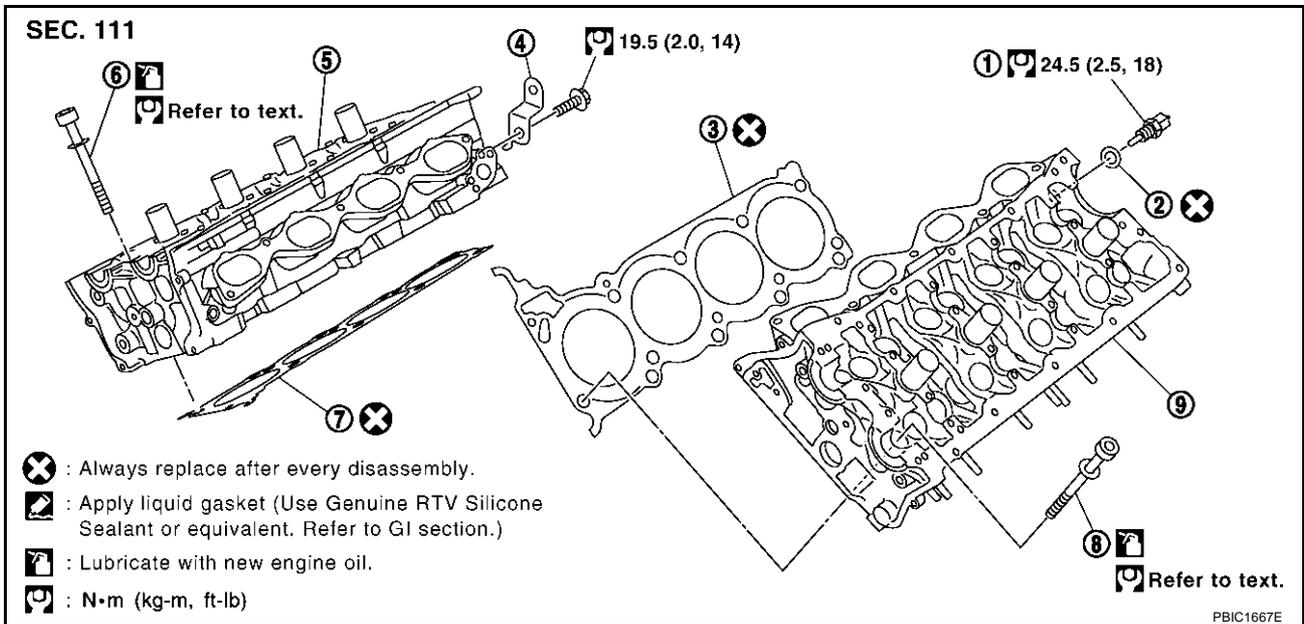
CYLINDER HEAD

[VK45DE]

8. Install removed parts in the reverse order of removal.
9. Start engine, and confirm that engine runs smoothly.
10. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-732, "TROUBLE DIAGNOSIS"](#).

Removal and Installation

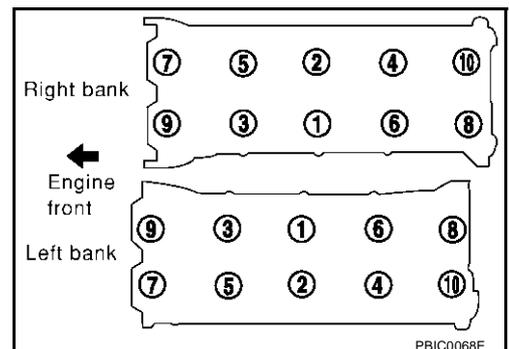
ABS0061Q



- | | | |
|--------------------------------------|-------------------------------|-------------------------------------|
| 1. Engine coolant temperature sensor | 2. Washer | 3. Cylinder head gasket (left bank) |
| 4. Harness bracket | 5. Cylinder head (right bank) | 6. Cylinder head bolt |
| 7. Cylinder head gasket (right bank) | 8. Cylinder head bolt | 9. Cylinder head (left bank) |

REMOVAL

1. Remove engine assembly from vehicle. Refer to [EM-227, "Removal and Installation"](#).
2. Remove the following components and related parts:
 - Auto tensioner of drive belts and idler pulley; Refer to [EM-169, "Drive Belt Auto Tensioner and Idler Pulley"](#).
 - Thermostat housing and hose; Refer to [CO-49, "Removal and Installation"](#).
 - Oil pan and oil strainer; Refer to [EM-180, "Removal and Installation"](#).
 - Intake manifold upper and intake manifold lower; Refer to [EM-172, "Removal and Installation"](#).
 - Fuel damper and fuel hose assembly, fuel tube and fuel injector assembly; Refer to [EM-186, "Removal and Installation"](#).
 - Ignition coil; Refer to [EM-183, "Removal and Installation"](#).
 - Rocker cover; Refer to [EM-189, "Removal and Installation"](#).
 - Exhaust manifold; Refer to [EM-177, "Removal and Installation"](#).
3. Remove crankshaft pulley, front cover, oil pump, and timing chain. Refer to [EM-192, "Removal and Installation"](#).
4. Remove camshaft sprockets and camshafts. Refer to [EM-202, "Removal and Installation"](#).
5. Remove cylinder head loosening bolts in reverse order shown in the figure, and using cylinder head bolt wrench (commercial service tool).



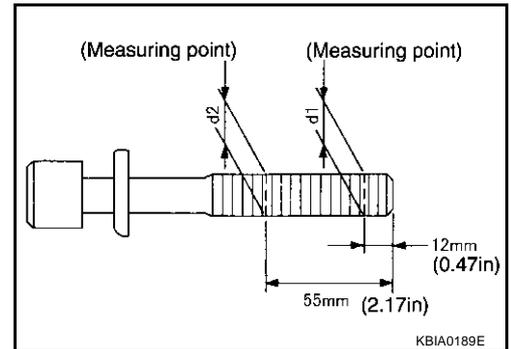
INSPECTION AFTER REMOVAL

Outer Diameter of Cylinder Head Bolts

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

Limit (d1 - d2) : 0.18 mm (0.0071 in)

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



INSTALLATION

1. Install cylinder head gasket.
2. Follow the steps below to tighten fixing bolts in the numerical order shown in the figure to install cylinder head.

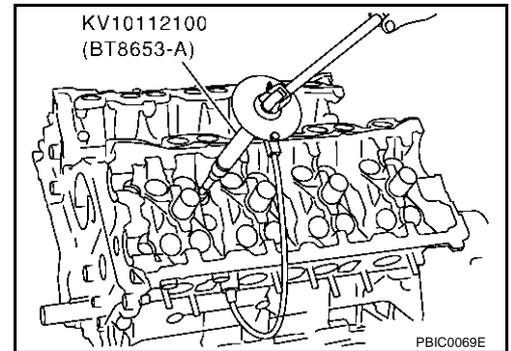
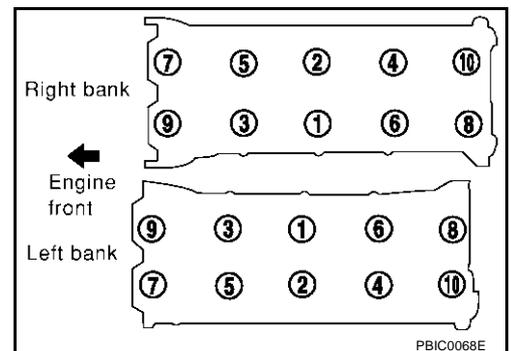
CAUTION:

- If cylinder head bolts are re-used, check their outer diameters before installation. Refer to [EM-219, "Outer Diameter of Cylinder Head Bolts"](#).
- In step "c", loosen bolts in the reverse order of that indicated in figure.

- a. Apply engine oil to threads and seating surface of bolts.
- b. Tighten all bolts to 98.1 N·m (10 kg-m, 72 ft-lb).
- c. Completely loosen all bolts.
- d. Tighten all bolts to 44.1 N·m (4.5 kg-m, 33 ft-lb).
- e. Turn all bolts 60 degrees clockwise. (Angle tightening)
- f. Turn all bolts 60 degrees clockwise again. (Angle tightening)

CAUTION:

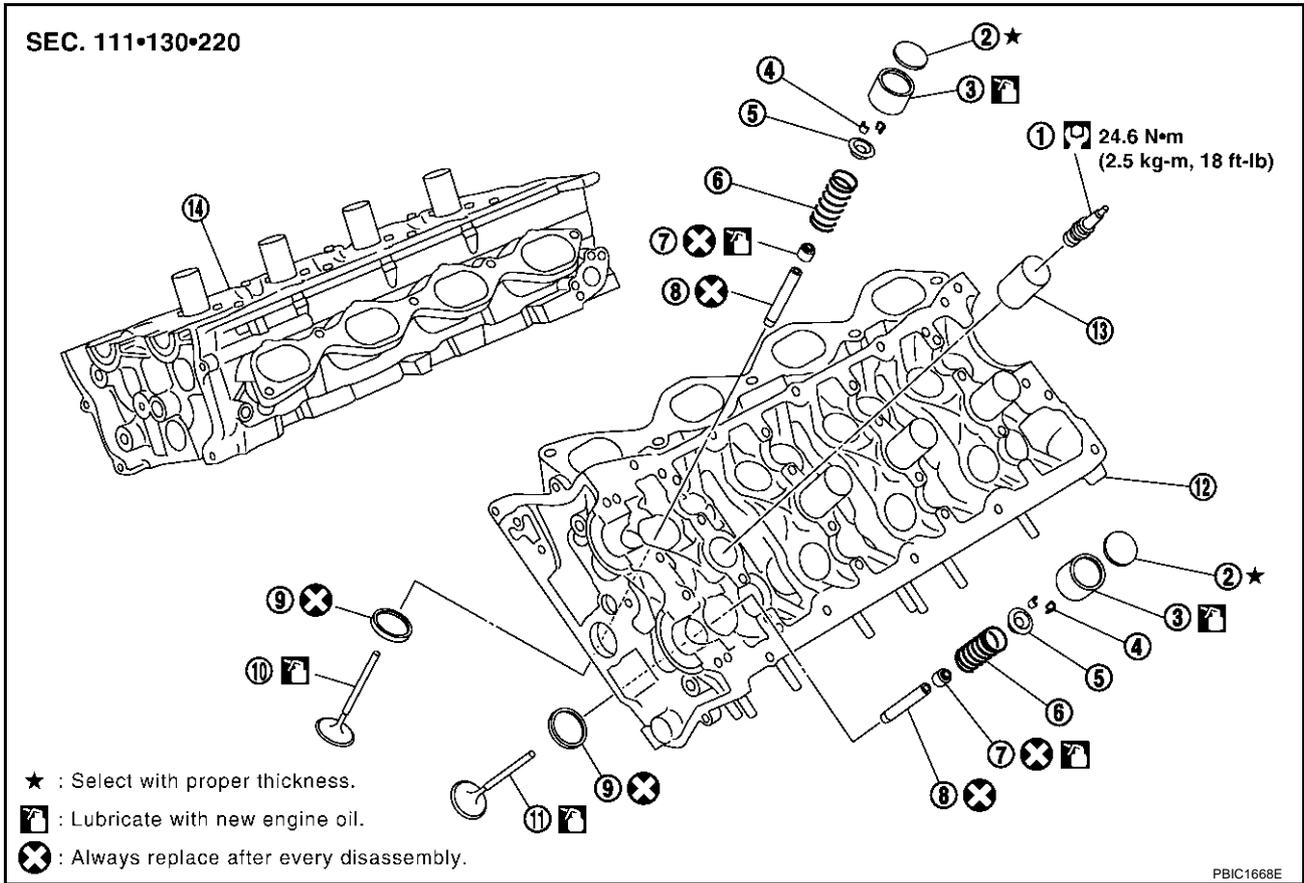
Check and confirm the tightening angle by using angle wrench (SST) and cylinder head bolt wrench (commercial service tool). Avoid judgment by visual inspection without the SST.



3. Install the following in reverse order of removal.

A
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Disassembly and Assembly



- | | | |
|---------------------|--------------------------------|--|
| 1. Spark plug | 2. Adjusting shim | 3. Valve lifter |
| 4. Valve collet | 5. Valve spring retainer | 6. Valve spring (with valve spring seat) |
| 7. Valve oil seal | 8. Valve guide | 9. Valve seat |
| 10. Valve (INT) | 11. Valve (EXH) | 12. Cylinder head (left bank) |
| 13. Spark plug tube | 14. Cylinder head (right bank) | |

DISASSEMBLY

- Remove spark plug with spark plug wrench.
- Remove adjusting shim and valve lifter.
 - Confirm installation point and keep parts in an organized way to avoid mixing them up.
- Remove valve collet.
 - Compress valve spring with valve spring compressor, attachment and adapter (SST). Remove valve collet with magnet driver.

CAUTION:

When working, take care not to damage valve lifter holes.

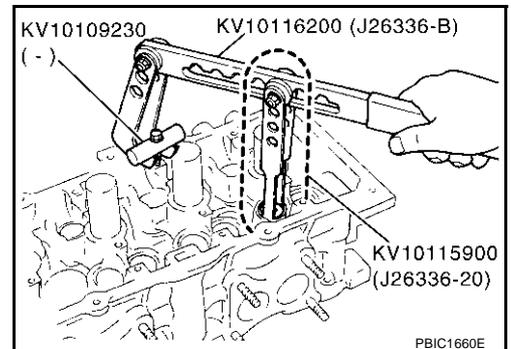
- Remove valve spring retainer and valve spring.

CAUTION:

Do not remove valve spring seat from valve spring.

- Push valve stem to combustion chamber side, and remove valve.

- Inspect valve guide clearance before removal. Refer to [EM-222, "VALVE GUIDE CLEARANCE"](#).
- Confirm installation point and keep parts in an organized way to avoid mixing then up.



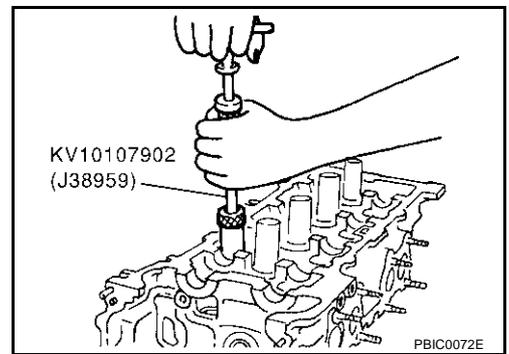
CYLINDER HEAD

[VK45DE]

6. Remove valve oil seal with valve oil seal puller (SST).
7. If valve seat must be replaced, refer to [EM-225, "VALVE SEAT REPLACEMENT"](#) .
8. If valve guide must be replaced, refer to [EM-223, "VALVE GUIDE REPLACEMENT"](#) .
9. Remove spark plug tube, as necessary.
 - Using a pair of pliers, pull spark plug tube out of cylinder head.

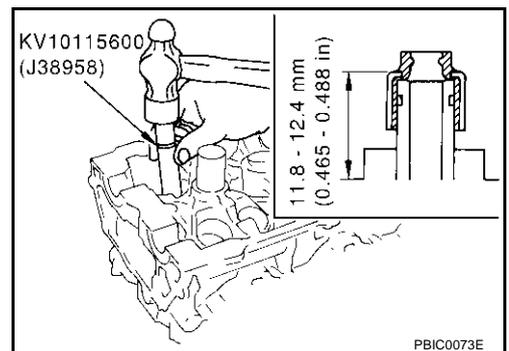
CAUTION:

- Take care not to damage cylinder head.
- Once removed, a spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.

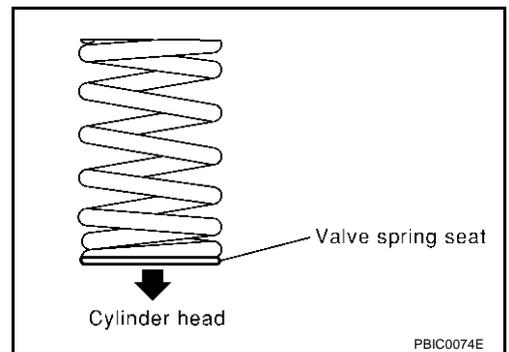


ASSEMBLY

1. When valve guide is removed, install it. Refer to [EM-223, "VALVE GUIDE REPLACEMENT"](#) .
2. When valve seat is removed, install it. Refer to [EM-225, "VALVE SEAT REPLACEMENT"](#) .
3. Install valve oil seal.
 - Install with valve oil seal drift (SST) to match dimension in illustration.
4. Install valve.
 - Install larger diameter to intake side.



5. Install valve spring.
 - Install smaller pitch (valve spring seat side) to cylinder head side.
6. Install valve spring retainer.

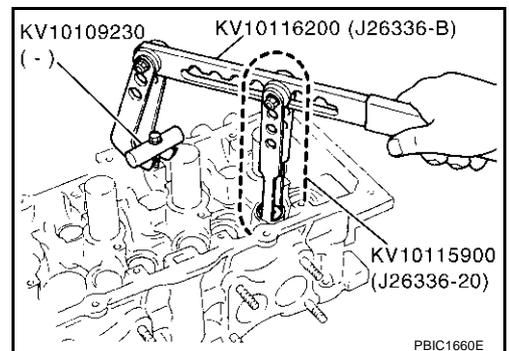


7. Install valve collet.
 - Compress valve spring with valve spring compressor, attachment and adapter (SST). Install valve collet with magnet hand.

CAUTION:

When working, take care not to damage valve lifter holes.

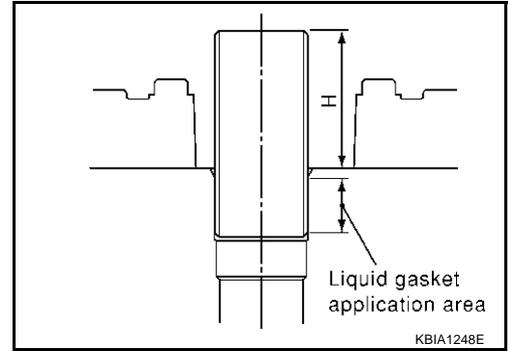
- Tap stem edge lightly with plastic hammer after installation to check its installed condition.
8. Install valve lifter and adjusting shim.



CYLINDER HEAD

[VK45DE]

9. Install spark plug tube.
 - Press-fit spark plug tube following procedure below.
 - a. Remove old liquid gasket adhering to cylinder-head mounting hole.
 - b. Apply liquid gasket to area within approximately 12 mm (0.47 in) from edge of spark plug tube press-fit side.
 - Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
 - c. Using a drift, press-fit spark plug tube so that its height "H" is as specified in the figure.



Standard press-fit height "H" :
: 38.4 - 39.4 mm (1.512 - 1.551 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.

10. Install spark plug with spark plug wrench.

Inspection After Disassembly CYLINDER HEAD DISTORTION

ABS006IS

1. Wipe off oil and remove water scale (like deposit), gasket, sealer, carbon, etc. with scraper.

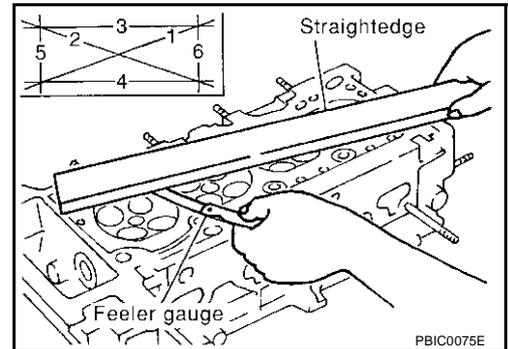
CAUTION:

Use utmost care not to allow gasket debris to enter passages for oil or water.

2. At each of several locations on bottom surface of cylinder head, measure distortion in six directions.

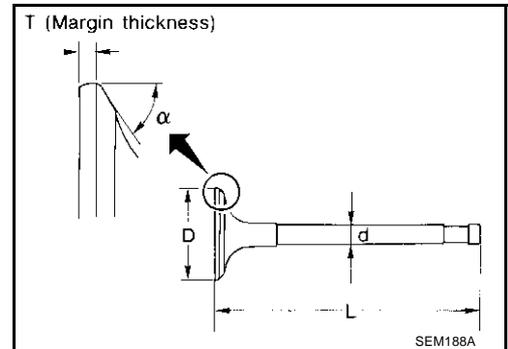
Limit : 0.1mm (0.004 in)

- If it exceed the limit, replace cylinder head.



VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to [EM-256. "Valve Dimensions"](#).
- If dimensions are out of the standard, replace valve.



VALVE GUIDE CLEARANCE

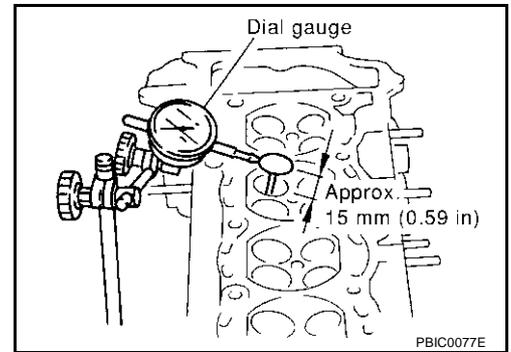
Perform this inspection before removing valve guide.

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

CYLINDER HEAD

[VK45DE]

Intake : 0.020 - 0.046 mm (0.0008 - 0.0018 in)
Exhaust : 0.030 - 0.056 mm (0.0012 - 0.0022 in)

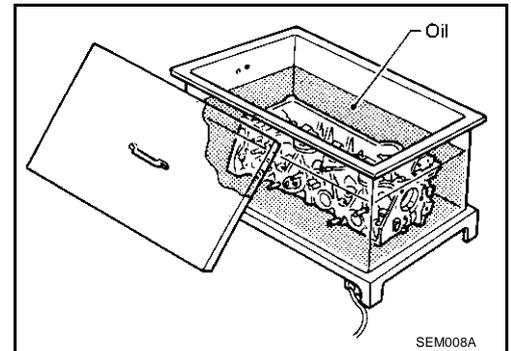


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VALVE GUIDE REPLACEMENT

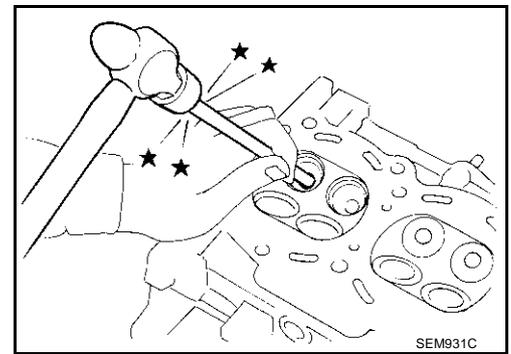
When valve guide is removed, replace with oversized (0.2 mm, 0.008 in) valve guide.

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 suitable tool.

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

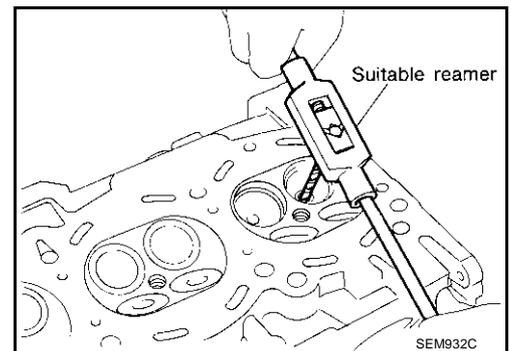


3. Ream cylinder head valve guide hole.

Valve guide hole diameter (for service parts)

Intake and exhaust

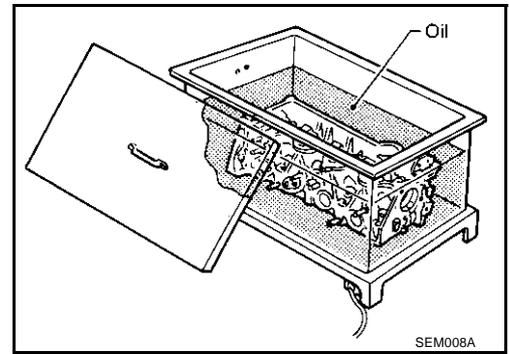
: 10.175 - 10.196 mm (0.4006 - 0.4014 in)



CYLINDER HEAD

[VK45DE]

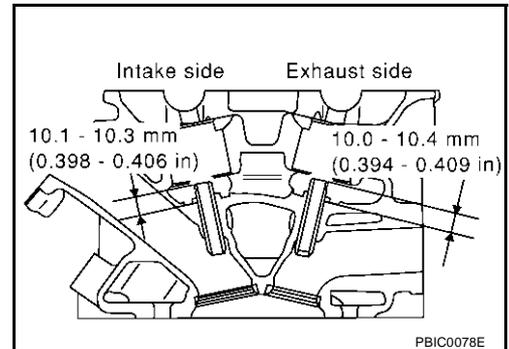
- Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



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

CAUTION:

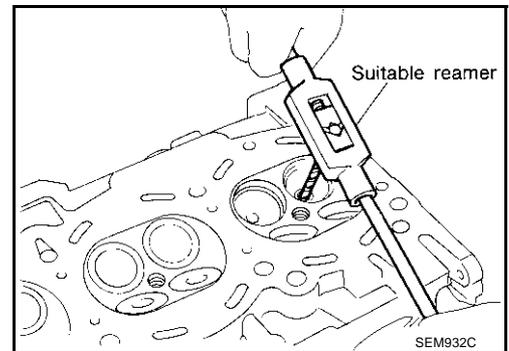
Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.



- Using valve guide reamer (commercial service tool), apply reamer finish to valve guide.

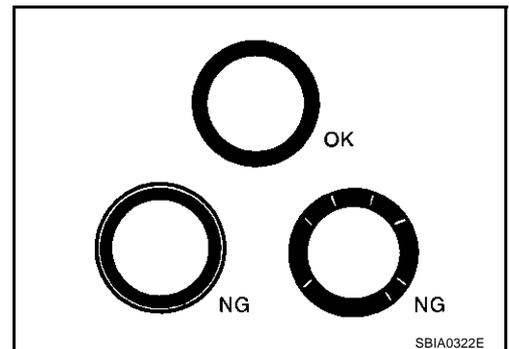
Standard

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.



VALVE SEAT REPLACEMENT

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

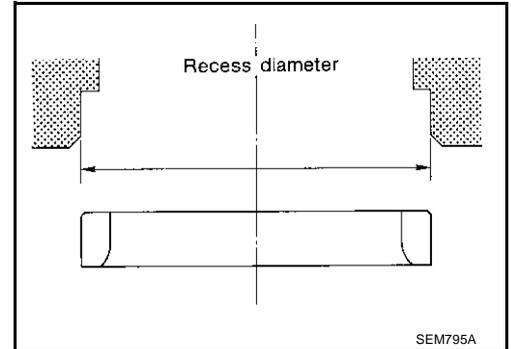
1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
2. Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]:

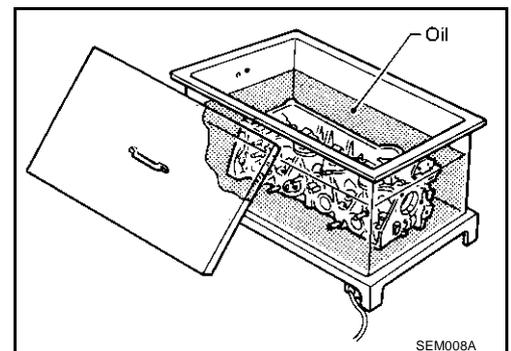
Intake : 37.500 - 37.516 mm (1.4764 - 1.4770 in)

Exhaust : 32.700 - 32.716 mm (1.2874 - 1.2880 in)

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



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



4. Provide valve seats cooled well with dry ice. Force fit valve seat into cylinder head.

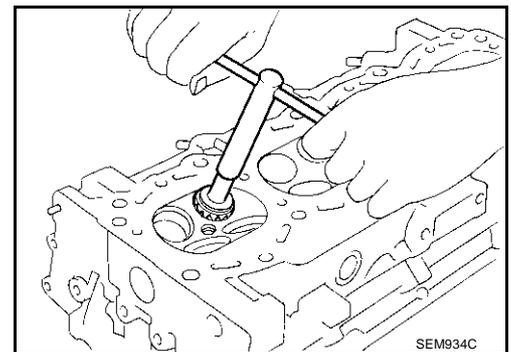
CAUTION:

- Avoid directly touching cold valve seats.
- Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.

5. Using valve seat cutter set and valve seat grinder (commercial service tool), finish the seat to the specified dimensions.

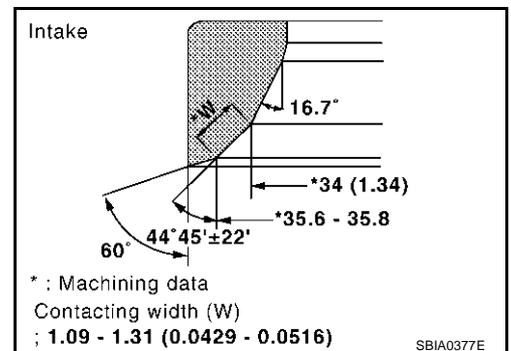
CAUTION:

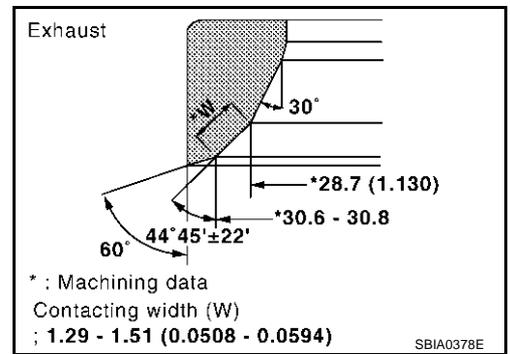
When using valve seat cutter, firmly grip the cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on with the cutter or cutting many different times may result in stage valve seat.



Grind to obtain the dimensions indicated in figure.

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



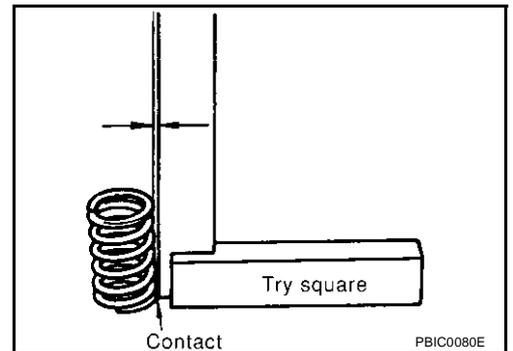


VALVE SPRING SQUARENESS

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

Limit : Less than 2.2 mm (0.087 in)

- If it exceeds the limit, replace valve spring.



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

Check valve spring pressure at specified spring height.

Standard:

Intake and exhaust

Free height:

51.28 - 51.48 mm (2.0189 - 2.0268 in)

Installation height:

33.8 mm (1.331 in)

Installation load:

165 - 189 N (16.8 - 19.3 kg, 37- 42 lb)

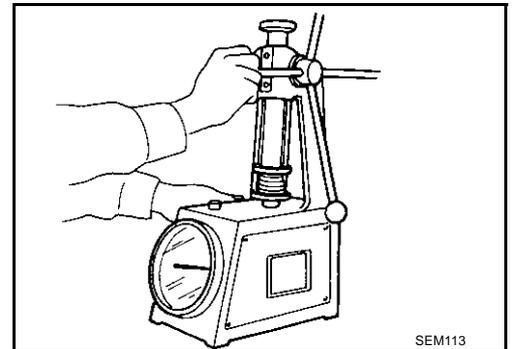
Height during valve open:

24.4 mm (0.961 in)

Load with valve open:

290 - 330 N (29.6 - 33.7 kg, 65 - 74 lb)

- If the dimensions exceed the standard, replace the valve spring.

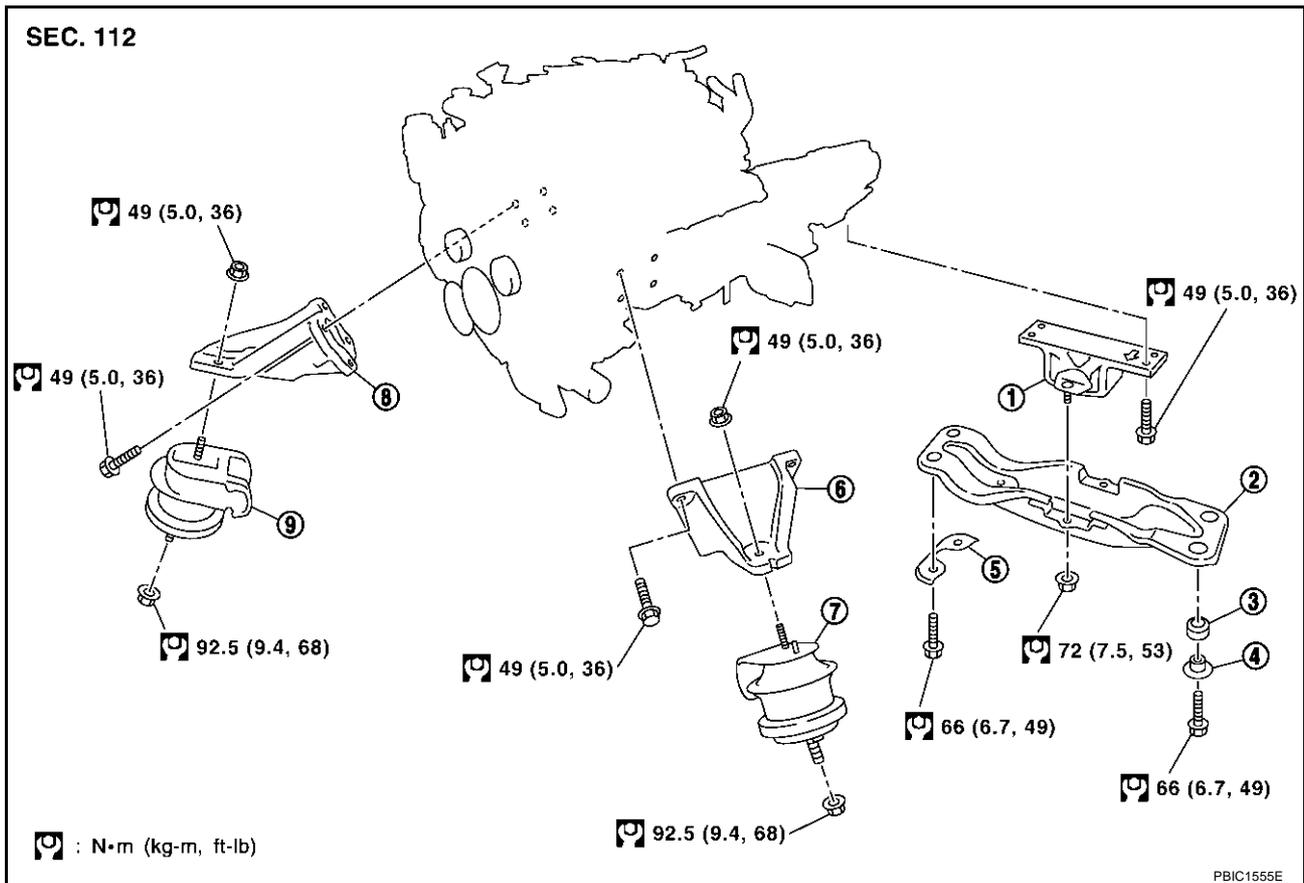


ENGINE ASSEMBLY

PFP:10001

Removal and Installation

ABS006IT



- | | | |
|-----------------------------------|-------------------------------|---------------------------------|
| 1. Rear engine mounting insulator | 2. Rear member | 3. Grommet |
| 4. Collar | 5. Plate | 6. LH engine mounting bracket |
| 7. LH engine mounting insulator | 8. RH engine mounting bracket | 9. RH engine mounting insulator |

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 un instructed operations.
- Do not start working until exhaust system and engine 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-point lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-42. "Garage Jack and Safety Stand"](#).

REMOVAL

Preparation

1. Release fuel pressure. Refer to [EC-705. "FUEL PRESSURE RELEASE"](#).
2. Remove engine cover and front and rear engine undercovers with power tool.
3. Drain engine coolant from radiator drain plug. Refer to [CO-35. "Changing Engine Coolant"](#).
4. Remove the following parts:

- Engine hood
- Air duct (inlet)
- Air duct and air cleaner case assembly
- Drive belts; Refer to [EM-167, "DRIVE BELTS"](#) .
- Radiator assembly and hoses; Refer to [CO-38, "RADIATOR"](#) .

Engine Room LH

1. Disconnect engine room harness from the engine side and set it aside for easier work.
2. Disconnect heater hoses, and install plugs to avoid leakage of engine coolant.
3. Disconnect wire bonding exhaust manifold cover to vehicle.
4. Disconnect vacuum hose between vehicle and engine and set it aside.
5. Remove A/C compressor piping. Refer to [ATC-151, "Components"](#) .

Engine Room RH

1. Disconnect fuel hose at the engine side connection.
 - For disconnection/connection of quick connector, refer to [EM-172, "Removal and Installation"](#) .
2. Disconnect engine room harness from the engine side and set it aside for easier work.
3. Disconnect wire bonding exhaust manifold cover to vehicle.
4. Disconnect vacuum hose between vehicle and engine and set it aside.
5. Disconnect reservoir tank for power steering from engine and move it aside for easier work.

Vehicle Underbody

1. Remove front cross bar. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#) .
2. Disconnect power steering oil pump from engine. Move it from its location and secure with a rope for easier work. Refer to [PS-33, "Removal and Installation \(VK45DE Models\)"](#) .
3. Remove pipe of A/T fluid cooler for automatic transmission.
4. Remove exhaust front tube and center tube with power tool. Refer to [EX-3, "EXHAUST SYSTEM"](#) .
5. Remove RH and LH transverse link mounting bolts and nuts. Refer to [FSU-14, "TRANSVERSE LINK"](#) .
6. Disconnect stabilizer connecting rod lower. Refer to [FSU-9, "Removal and Installation"](#) .
7. Remove A/T control rod. Refer to [AT-233, "SHIFT CONTROL SYSTEM"](#) .
8. Remove rear plate cover, then remove drive plate to torque converter connecting bolts. Refer to [AT-272, "Removal and Installation \(AWD Models\)"](#) .
9. Disconnect steering lower joint, and release steering shaft. Refer to [PS-19, "Removal and Installation"](#) .
10. Remove rear propeller shaft mounting bolts. Refer to [PR-8, "Removal and Installation"](#) .
 - After disconnection, plug the opening on transmission side.
11. Remove front drive shaft (both side). Refer to [FAX-12, "FRONT DRIVE SHAFT"](#) .
12. Remove front propeller shaft. Refer to [PR-4, "FRONT PROPELLER SHAFT"](#) .
13. Remove three way catalyst (both side). Refer to [EM-177, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#) .

Removal Work

1. Install engine slingers into left bank cylinder head and right bank cylinder head.

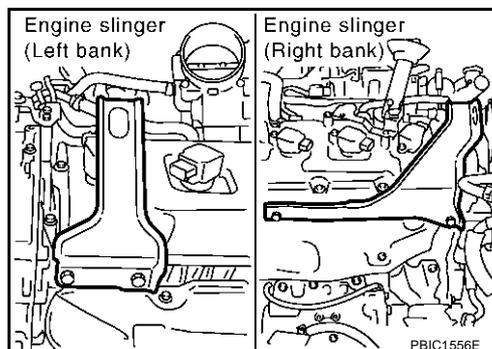
Slinger bolts:

 :33.4 N·m (3.4 kg·m, 25 ft·lb)

2. Lift with hoist and secure the engine in position.
3. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a transmission jack. Securely support bottom of suspension member and transmission.

CAUTION:

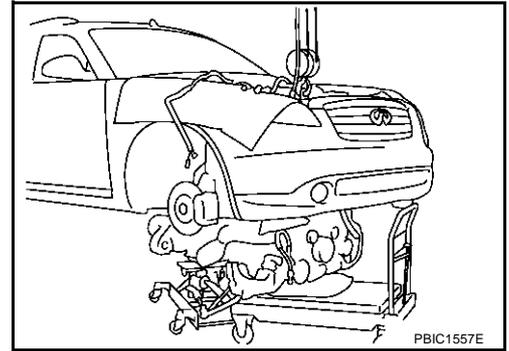
- Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.



4. Remove front suspension member mounting nuts with power tool. Refer to [FSU-9, "Removal and Installation"](#).
5. Remove engine assembly from vehicle, avoiding interference with vehicle body, move lower side.

CAUTION:

- Before and during this lifting, always check if any harnesses are left connected.
- Avoid damage to oil/grease smearing or spills onto engine mount insulator.



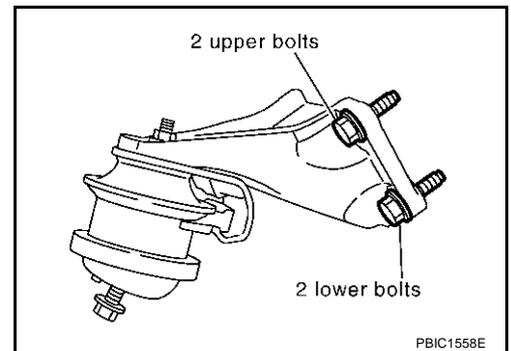
Separation Work

1. Remove engine mounting insulator under side nut with power tool.
 2. Lift with hoist and separate engine and transmission assembly from suspension member.
- CAUTION:**
- Before and during this lifting, always check if any harnesses are left connected.
 - Avoid damage to and oil/grease smearing or spills onto engine mounting insulator.
3. Remove alternator. Refer to [SC-34, "Removal and Installation"](#).
 4. Remove starter motor. Refer to [SC-17, "Removal and Installation"](#).
 5. Separate engine from transmission assembly. Refer to [AT-272, "Removal and Installation \(AWD Models\)"](#).
 6. Remove engine mounting insulator and bracket with power tool.

INSTALLATION

Install in the reverse order of removal.

- Where positioning pin is used, be sure to securely insert it into the hole of mating part.
- When installing front engine mount bracket to cylinder block, first tighten two bolts on upper side. Then, tighten two bolts on lower side. (The same applies to both right and left.)



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:

ENGINE ASSEMBLY

[VK45DE]

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	—
Exhaust gas	—	Leakage	—

CYLINDER BLOCK

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Disassembly and Assembly

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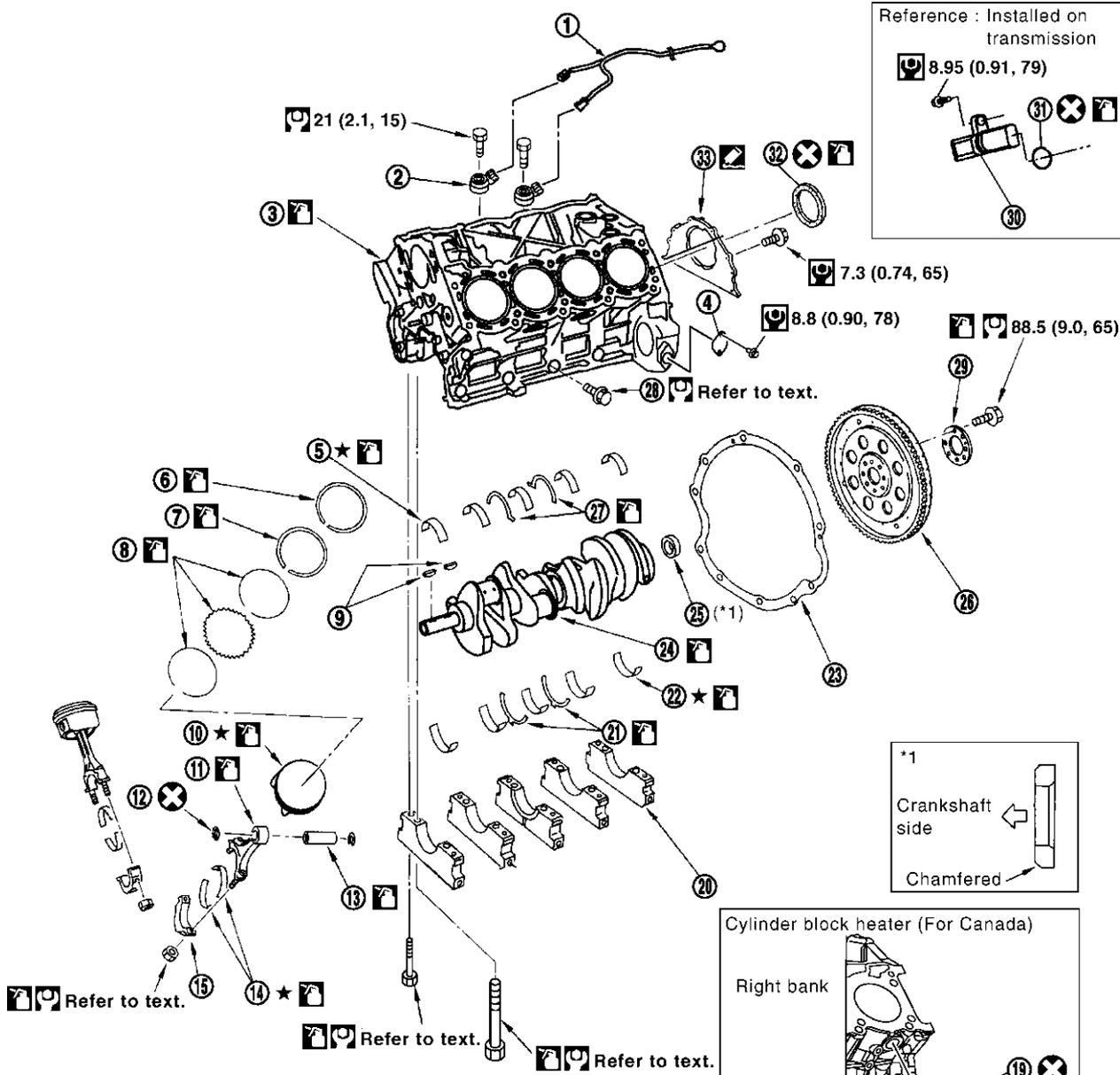
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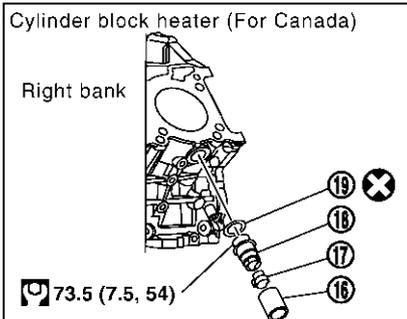
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- ⊗ : Always replace after every disassembly.
- Ⓜ : N•m (kg-m, ft-lb)
- Ⓝ : N•m (kg-m, in-lb)
- ★ : Select with proper thickness.
- 🛢 : Lubricate with new engine oil.
- 🛡 : Apply Genuine RTV Silicone Sealant or equivalent. Refer to GI section.



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- | | | |
|-----------------------------|--------------------|-------------------|
| 1. Knock sensor sub harness | 2. Knock sensor | 3. Cylinder block |
| 4. Cover | 5. Main bearing | 6. Top ring |
| 7. Second ring | 8. Oil ring | 9. Crankshaft key |
| 10. Piston | 11. Connecting rod | 12. Snap ring |

13. Piston pin	14. Connecting rod bearing	15. Connecting rod bearing cap
16. Block heater protector	17. Connector cap	18. Cylinder block heater
19. Gasket	20. Main bearing cap	21. Thrust bearing
22. Main bearing	23. Rear plate	24. Crankshaft
25. Pilot convertor	26. Drive plate	27. Thrust bearing
28. Side bolt	29. Reinforcement plate	30. Crankshaft position sensor (POS)
31. O-ring	32. Rear oil seal	33. Rear oil seal retainer

DISASSEMBLY

NOTE:

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

1. Remove engine assembly. Refer to [EM-227, "ENGINE ASSEMBLY"](#) .
2. Remove the parts that may restrict installation of engine to widely use engine stand.

NOTE:

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

- a. Remove transmission with transfer (with power tool). Refer to [AT-272, "Removal and Installation \(AWD Models\)"](#) .
- b. Remove front suspension member (with power tool). Refer to [FSU-17, "FRONT SUSPENSION MEMBER"](#) .
- c. Remove front final drive assembly (with power tool). Refer to [FFD-10, "FRONT FINAL DRIVE ASSEMBLY"](#) .
- d. Remove drive plate.
 - Holding crankshaft pulley mounting bolts, lock crankshaft to remove bolts fixing drive plate.
 - Loosen fixing 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.**
- e. Remove engine rear plate.
3. Lift the engine with hoist to install it onto widely use engine stand.

CAUTION:

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

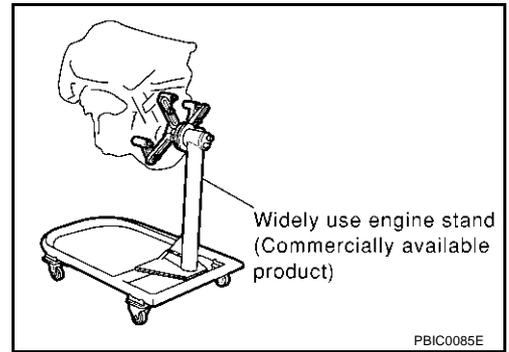
- If the load capacity of the stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning the stand.
 - Remove intake manifold upper and intake manifold lower. Refer to [EM-172, "INTAKE MANIFOLD"](#) .
 - Remove exhaust manifold. Refer to [EM-177, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#) .
 - Remove fuel tube and fuel injector assembly. Refer to [EM-186, "FUEL INJECTOR AND FUEL TUBE"](#) .
 - Remove A/C compressor fitting bolts and brackets (with power tool). Refer to [ATC-151, "Components"](#) .
 - Remove ignition coil. Refer to [EM-183, "IGNITION COIL"](#) .
 - Remove rocker cover. Refer to [EM-189, "ROCKER COVER"](#) .
 - Other removable brackets.

NOTE:

The figure shows an example of widely use engine stand that can hold mating surface of transmission with drive plate and rear plate removed.

CAUTION:

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



4. Drain engine oil and engine coolant from inside of engine.
5. Remove the following components and associated parts (The parts listed in step 3 are not included here.)

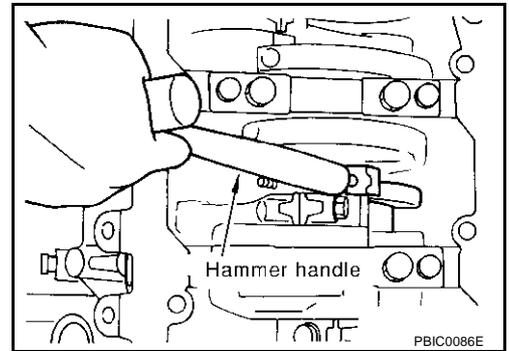
- Oil pan and oil strainer; Refer to [EM-180, "OIL PAN AND OIL STRAINER"](#) .
- Crankshaft pulley, front cover and timing chain; Refer to [EM-192, "TIMING CHAIN"](#) .
- Camshaft; Refer to [EM-202, "CAMSHAFT"](#) .
- Cylinder head; Refer to [EM-217, "CYLINDER HEAD"](#) .

6. Remove knock sensor.

CAUTION:

Carefully handle the sensor, avoiding shocks.

7. Remove the piston and connecting rod assembly as follows.
 - Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-246, "CONNECTING ROD SIDE CLEARANCE"](#) .



- a. Position the crankshaft pin corresponding to the connecting rod to be removed onto the bottom dead center.
- b. Remove the connecting rod cap.
- c. Using a hammer handle or similar tool, push the piston and connecting rod assembly out to the cylinder head side.
8. Remove the connecting rod bearings.

CAUTION:

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

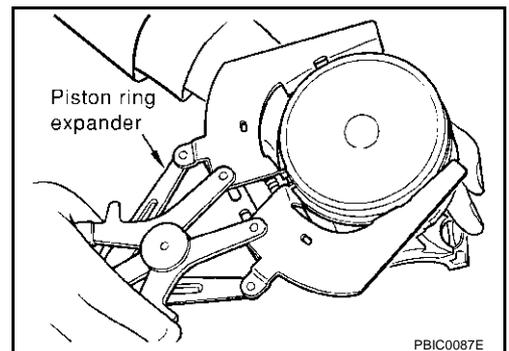
9. Remove the piston rings from the piston.
 - Use a piston ring expander (commercial service tool).

CAUTION:

When removing the piston rings, be careful not to damage the piston.

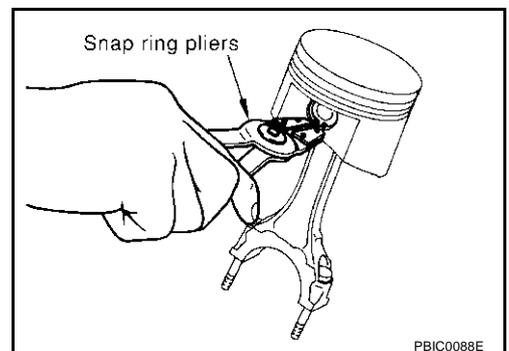
Be careful not to damage piston rings by expanding them excessively.

- Before removing the piston rings, check the piston ring side clearance. Refer to [EM-247, "PISTON RING SIDE CLEARANCE"](#) .



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

- a. Using a snap ring pliers (commercial service tool), remove the snap ring.

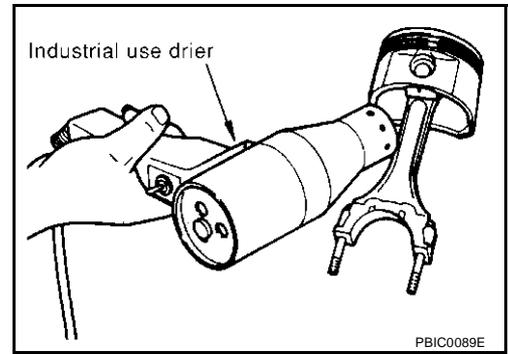


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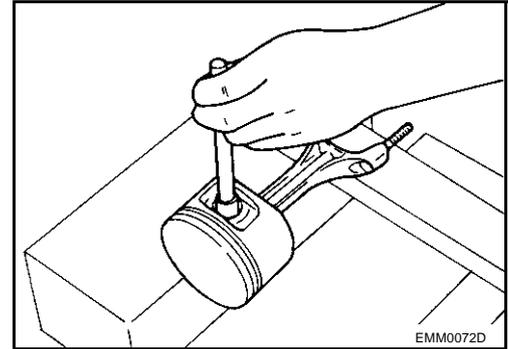
CYLINDER BLOCK

[VK45DE]

- 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 (0.8 in).



11. Remove the rear oil seal retainer from the cylinder block.
- Insert a minus-head screwdriver or similar tool between the rear end of the crankshaft counter weight and rear oil seal retainer, and separate the liquid gasket to remove.

CAUTION:

Be careful not to damage the mating surface.

12. Using a minus-head screwdriver or similar tool, and lever off the rear oil seal from the rear oil seal retainer.

13. Remove the main bearing cap as follows:

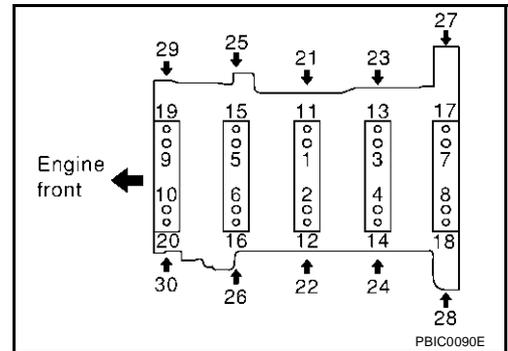
- Before loosening the main bearing cap bolts, measure the crankshaft side clearance.
Refer to [EM-245, "CRANKSHAFT END PLAY"](#) .

- Loosen bolts in several different steps.

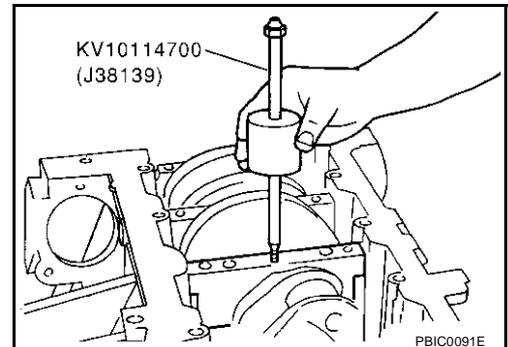
- a. Remove the cover attached to the rear left side of the cylinder block (next to the starter motor housing).

NOTE:

Bolts (No. 27 shown in the figure) are installed on the inside of the cover.



- b. Loosen the side bolts (M10) starting from 30 to 21 to remove.
- c. Loosen the main bearing cap sub bolts (M9) starting from 20 to 11 to remove.
- d. Loosen the main bearing cap bolts (M12) starting from 10 to 1 to remove.
- e. Using a main bearing cap remover (SST), remove the main bearing cap.

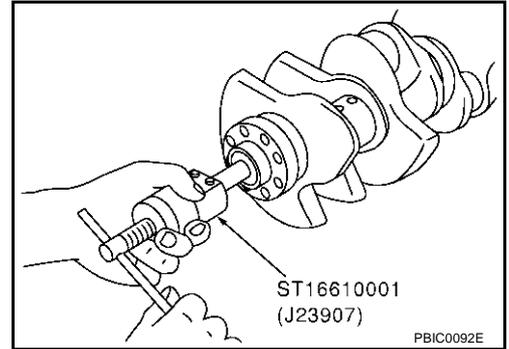


14. Remove the crankshaft.

CYLINDER BLOCK

[VK45DE]

15. Remove the main bearings and thrust bearings from the cylinder block and main bearing caps.
 - When removing them, note the installation position. Keep them in the correct order.
16. If the pilot converter must be removed, remove it from the rear end of the crankshaft using a pilot bearing puller (SST).
 - Removal and installation without the engine stand is possible.



ASSEMBLY

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

CAUTION:

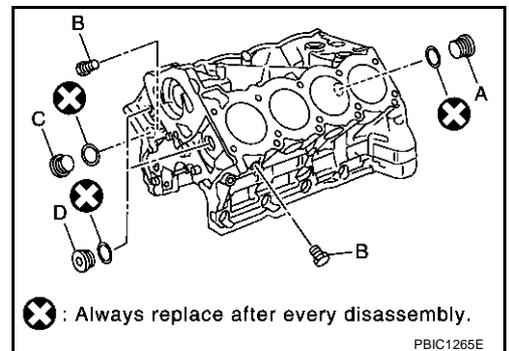
Use a goggles to protect your eye.

2. Install each plug to the cylinder block. (Only screwed-type plugs are shown in the figure.)

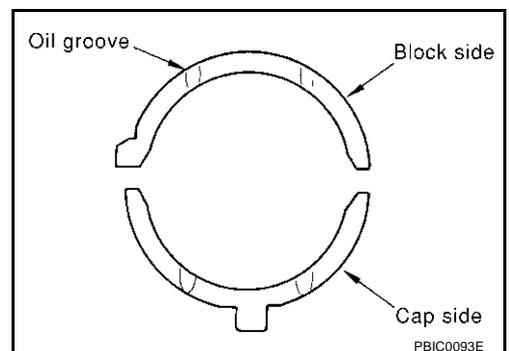
- Apply liquid gasket. Use **Genuine Thread Sealant or equivalent. Refer to [GL-48. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

- Replace the copper washers with new ones.
- Tighten each plug as specified below.

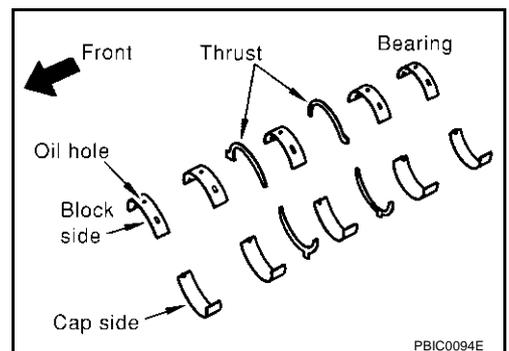
Part	Washer	Tightening torque
A	Yes	53.9 N·m (5.5 kg·m, 40 ft·lb)
B	No	19.6 N·m (2.0 kg·m, 15 ft·lb)
C	Yes	62.7 N·m (6.4 kg·m, 46 ft·lb)
D	Yes	62.7 N·m (6.4 kg·m, 46 ft·lb)



3. Install the main bearings and the thrust bearings.
 - a. Remove dust, dirt, and oil on the bearing mating surfaces of the cylinder block and the main bearing caps.
 - b. Install the thrust bearings to the both sides of the No. 3 journal housing on the cylinder block and main bearing caps
 - Install the thrust bearings with the oil groove facing the crankshaft arm (outside).
 - Install the thrust bearings with a protrusion in the center on the main bearing caps.



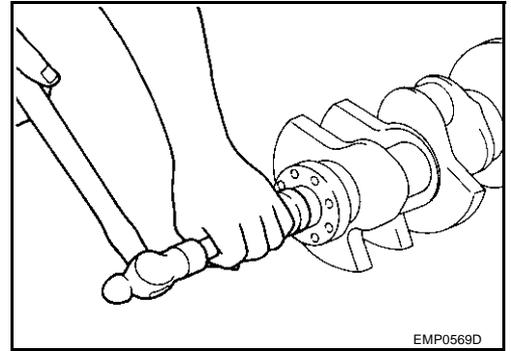
- c. Install the main bearings paying attention to the direction.
 - Install the one with oil holes onto the cylinder block and the one without oil holes onto the main bearing cap.
 - Before installing the bearings, apply engine oil to the bearing surface (inside). Do not apply oil to the back surface, but thoroughly clean it.
 - When installing, align the bearing stopper to the notch.
 - Insure the oil holes on cylinder block and those on the corresponding bearing are aligned.



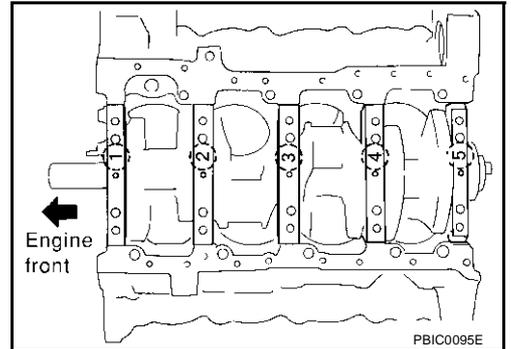
CYLINDER BLOCK

[VK45DE]

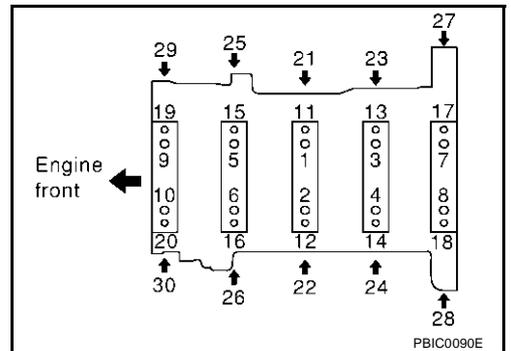
4. Install the pilot converter to the crankshaft.
 - Using a drift approximately 35 mm (1.38 in) in outer diameter, drive the pilot converter until its front end contacts the crankshaft.
 - Press-fit the pilot converter with its chamfering side facing the crankshaft. (Refer to "Component parts illustration on former page".)
 - It is acceptable to install it without the engine stand.
5. Install the crankshaft to the cylinder block.
 - While turning the crankshaft by hand, make sure it turns smoothly.



6. Install the main bearing caps.
 - Align the identification number to the journal position to install.
 - Install the upper side of the identification number facing the front of the engine. (The number shall be read correctly from the rear of the engine.)
 - Using a plastic hammer or similar tool, tap them lightly to seat them on the installation position.



7. Follow the bellow steps to tighten each main bearing cap bolts.
 - a. Apply engine oil to threads and seating surface of bolts, and tighten all bolts temporarily.
 - b. Tighten main bearing cap bolt (M12) to 39.2 N·m (4.0 kg·m, 29 ft·lb) in order of 1 to 10.
 - c. Tighten main bearing cap sub bolt (M9) to 29.4 N·m (3.0 kg·m, 22 ft·lb) in order of 11 to 20.

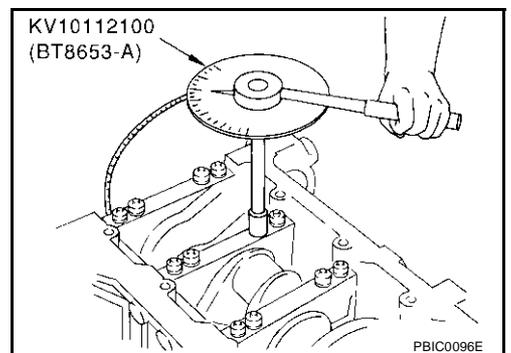


- d. Tighten main bearing cap bolt (M12) to 40 degrees in order of 1 to 10.

CAUTION:

Measure tighten angle in step "d" and "e" with angle wrench (SST). Do not measure visually.

- e. Tighten main bearing cap sub bolt (M9) to 30 degrees in order of 11 to 20.
- f. Tighten side bolt (M10) to 49 N·m (5.0 kg·m, 36 ft·lb) in order of 21 to 30.
- g. Install cover of cylinder block left-rear side (next to starter motor housing).



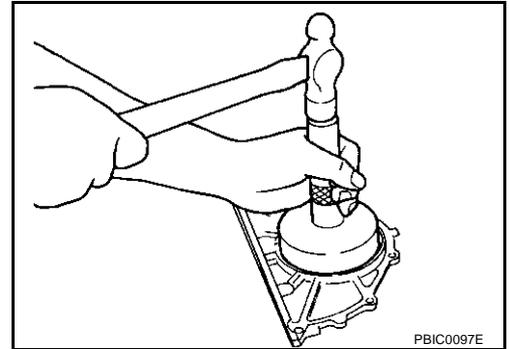
- Rotate crankshaft by hands after bolts are tightened. Check if it rotates smoothly.
- Check the crankshaft side clearance. Refer to [EM-245. "CRANKSHAFT END PLAY"](#).

CYLINDER BLOCK

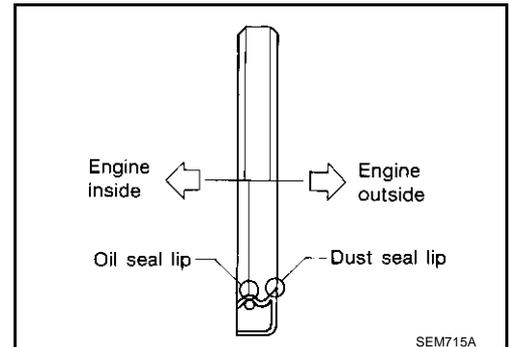
[VK45DE]

8. Install rear oil seal to rear oil seal retainer.

- Tap until flattened with front edge of rear oil seal retainer. Do not damage or scratch outer circumference of oil seal.

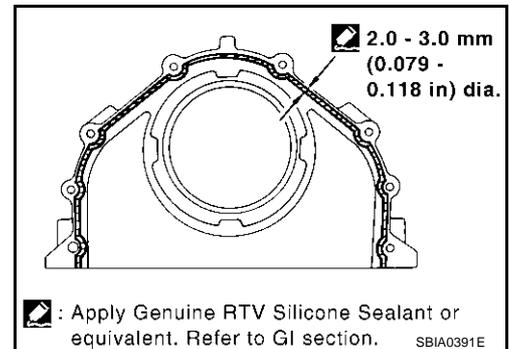


- Install new rear oil seal in the direction shown in the figure.



9. Install rear oil seal retainer.

- Apply liquid gasket thoroughly to rear oil seal retainer. **Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-48. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**
- Apply new engine oil on lips of rear oil seal. Do not touch.



10. Install the piston to the connecting rod.

a. Using a snap ring pliers, install the snap ring to the grooves of the piston rear side.

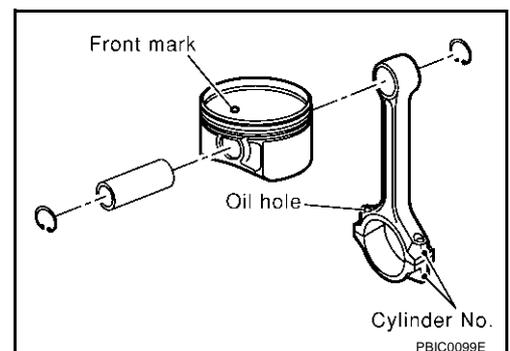
- Insert it fully into groove to install.

b. Install the piston to the connecting rod.

- Using an industrial drier or similar tool, heat the piston until the 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 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 snap rings to the front of the piston.

- After installing, make sure the connecting rod moves smoothly.



CYLINDER BLOCK

[VK45DE]

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

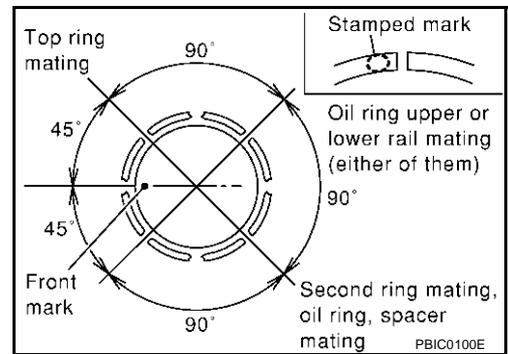
CAUTION:

Be careful not to damage the piston.

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

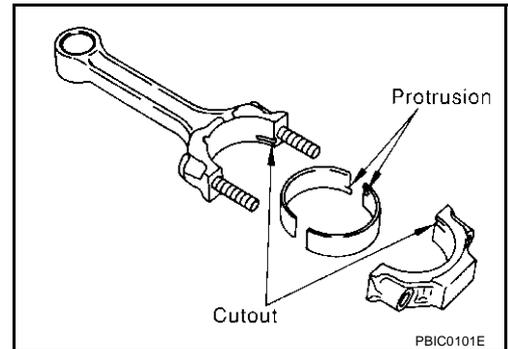
Stamped mark

Top ring : R
Second ring : 2R



12. Install the connecting rod bearings to the connecting rod and the connecting rod cap.

- When installing the connecting rod bearings, apply engine oil to the bearing surface (inside). Do not apply oil to the back surface, but thoroughly clean it.
- When installing, align the connecting rod bearing stopper protrusion with the cutout of the connecting rod to install.
- Check the oil holes on the connecting rod and those on the corresponding bearing are aligned.



13. Install the piston and connecting rod assembly to the crankshaft.

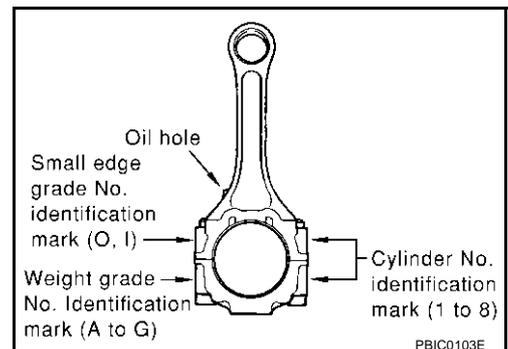
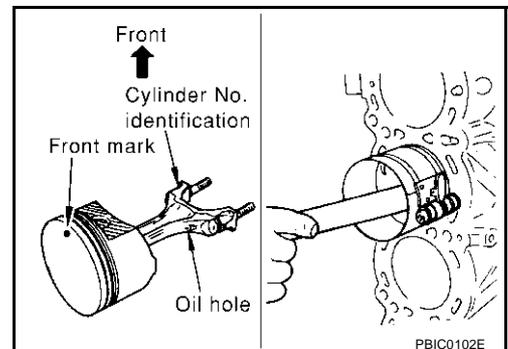
- Position the crankshaft pin corresponding to the connecting rod to be installed onto the bottom dead center.
- Apply engine oil sufficiently to the cylinder bore, piston, and crankshaft pin.
- Match the cylinder position with the cylinder No. on the connecting rod to install.
- Using a piston ring compressor [SST: EM03470000 (J8037)], install the piston with the front mark on the piston crown facing the front of the engine.

CAUTION:

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

14. Install the connecting rod cap.

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



CYLINDER BLOCK

[VK45DE]

15. Tighten the connecting rod nuts as follows:

- Apply engine oil to the threads and seats of the connecting rod bolts and nuts.
- Tighten nuts to 14.7 N·m (1.5 kg·m, 11 ft·lb).
- Put mating (with paint) on each nut and connecting rod cap, all in the same direction (when using a protractor).
- Then all nuts 60 degrees clockwise (angle tightening).

CAUTION:

Always use either an angle wrench (SST) or protractor. Avoid tightening based on visual check alone.

- After tightening the nuts, make sure that the crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-246, "CONNECTING ROD SIDE CLEARANCE"](#)

16. Install 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 it with its connector facing the rear side.
- Do not tighten the mounting bolts while holding the connector.
- Make sure that the knock sensor does not interfere with other parts.
- Install the sub-harness with its shorter branch line to the RH bank.

CAUTION:

If any impact by dropping is applied to the knock sensor, replace it with new one.

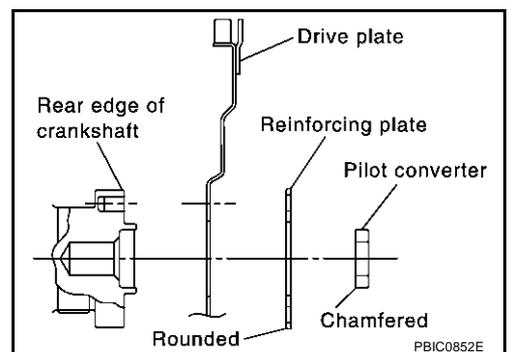
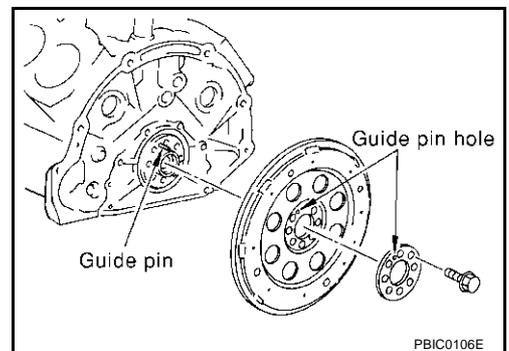
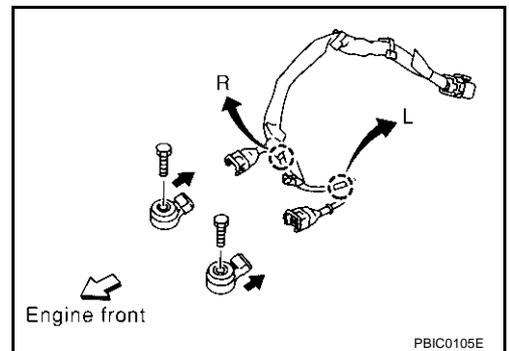
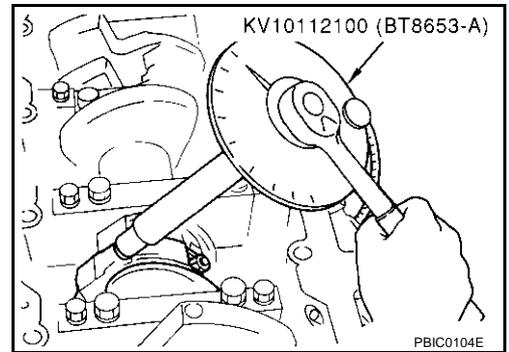
17. Install the following in reverse order of removal.

18. Remove engine assembly from engine stand.

19. Install drive plate.

- Align guide pin of crankshaft rear end with pin holes of each parts to install.

- Install drive plate, reinforcement plate and pilot converter (if not installed in step 4) as shown in figure.
- Face chamfered or rounded edge side to crankshaft.



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CYLINDER BLOCK

[VK45DE]

ABS006IV

How to Select Piston and Bearing DESCRIPTION

Connecting points	Connecting parts	Selection items	Selection methods
Between cylinder block to crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft to connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Connecting rod bearing grade = crankshaft pin grade (outer diameter of pin). No grade exists for inner diameter of connecting rod large end.
Between cylinder block to piston	Piston and piston pin assembly. The piston is available together with piston pin as an assembly.	Piston grade (piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)
*Between piston to connecting rod	—	—	—

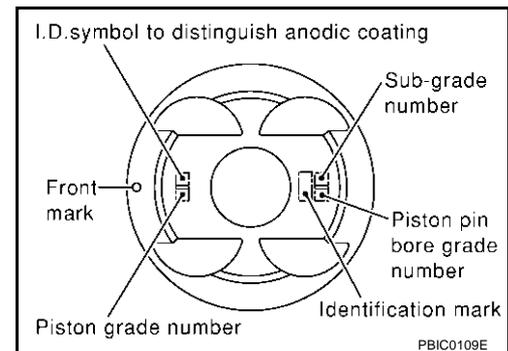
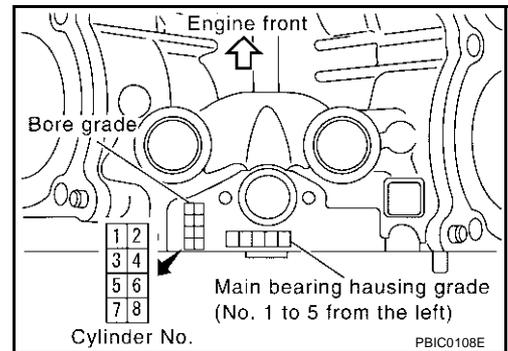
*For the service parts, the grade for fitting cannot be selected between a piston pin and a connecting rod. (Only 0 grade is available.) The information at the shipment from the plant is described as a reference.

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

HOW TO SELECT PISTON

Piston Selective Fitting When New Cylinder Block is Used:

- Check the cylinder bore grade on the rear upper side between cylinder block banks, and select the piston of the same grade.



When Cylinder Block is Reused:

1. Measure the cylinder block bore inner diameter.

CYLINDER BLOCK

[VK45DE]

- Determine the bore grade by comparing the measurement with the values under the "Cylinder bore inner diameter" of the piston selection table. Select the piston of the same grade.

Piston Selection Table

Unit: mm (in)

Grade number (Mark)	1	2	3
Inner diameter of cylinder bore	93.000-93.010 (3.6614-3.6618)	93.010-93.020 (3.6618-3.6622)	93.020-93.030 (3.6622-3.6626)
Outer diameter of piston	92.980-92.990 (3.6606-3.6610)	92.990-93.000 (3.6610-3.6614)	93.000-93.010 (3.6614-3.6618)

NOTE:

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

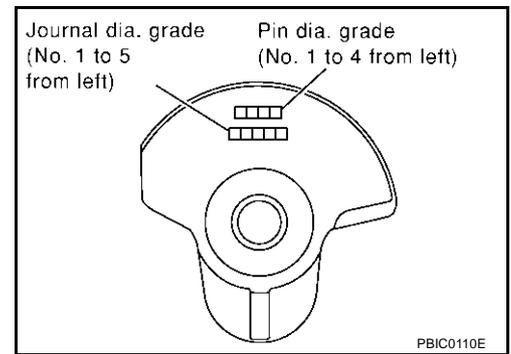
HOW TO SELECT CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used:

- Compare the pin diameter grade of the crankshaft front surface with the values of the selection table of connecting rod bearing.

NOTE:

There is no grading for connecting rod big end.



When Crankshaft and Connecting Rod are Reused:

- Measure the pin outer diameter of the crankshaft.
- Compare the measurement with the values of the selection table of connecting rod bearing.

Connecting Rod Bearing Selection Table

Unit: mm (in)

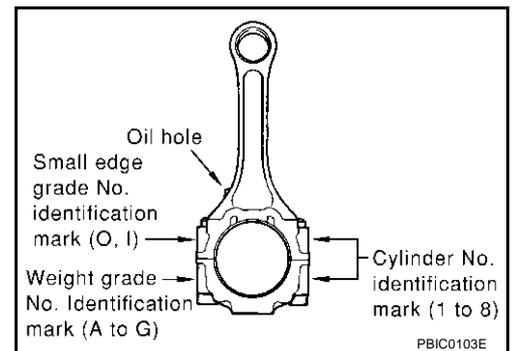
Connecting rod big end inner diameter	55.000 - 550.13 (2.1654 - 2.1659)
---------------------------------------	-----------------------------------

Unit: mm (in)

Crankshaft pin outer diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
51.968 - 51.974 (2.0460 - 2.0462)	0	1.500 - 1.503 (0.0591 - 0.0592)	STD 0	No color
51.962 - 51.968 (2.0457 - 2.0460)	1	1.503 - 1.506 (0.0592 - 0.0593)	STD 1	Brown
51.956 - 51.962 (2.0455 - 2.0457)	2	1.506 - 1.509 (0.0593 - 0.0594)	STD 2	Green

NOTE:

(At shipment from the plant) For an engine, all the connecting rod assemblies are in the same weight class. For service parts, no weight grades can be selected.



Under Size Bearings Usage Guide

- When the specified oil clearance is not obtained with standard size connecting rod bearings, use under-size (US) bearings.

CYLINDER BLOCK

[VK45DE]

- When using undersize bearings, measure the bearing inner diameters with bearings installed, and grind the crankshaft pin so that the oil clearance satisfies the standard.

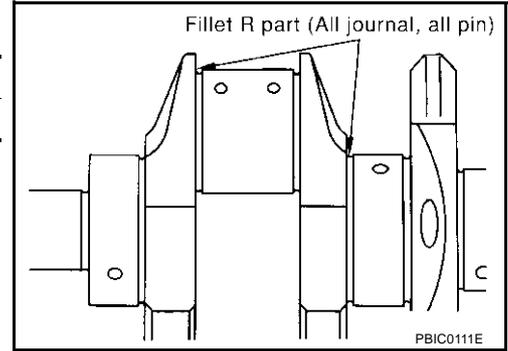
Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)

CAUTION:

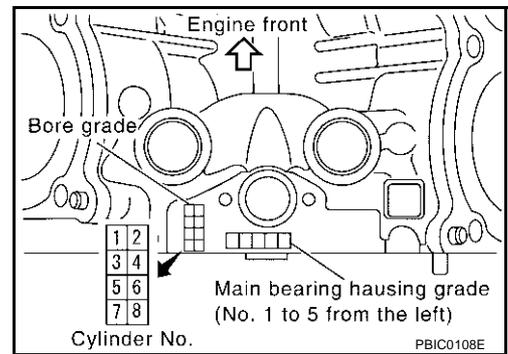
In grinding the crankshaft pin to use undersize bearings, do not damage the fillet R (All crankshaft pins).



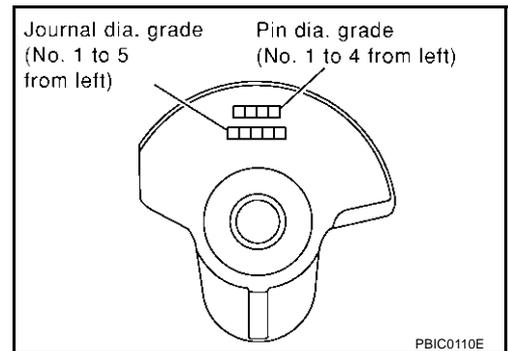
HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft are Used:

- Apply main bearing housing grade on upper rear side between cylinder block banks to row in main bearing selection table.



- Apply journal diameter grade on crankshaft front to column in main bearing selection table.



- Find sign at crossing of row and column in main bearing selection table.

CAUTION:

- Initial clearance for No.1, 5 journal and No. 2, 3, 4 journal is different. Use two different selection lists for each part.
 - No.1, 5 journal and No. 2, 3, 4 journal have the same signs but different measures. Do not confuse.
- Apply sign at crossing in above step 3 to main bearing grade table.

NOTE:

- Grade list applies to all journals.
- Service parts is available as a set of both upper and lower.

When Cylinder Block and Crankshaft are Reused:

- Measure inner diameter of cylinder block main bearing housing and outer diameter of crankshaft journal.
- Apply measurement in above step 1 to main bearing selection table.
- Follow step 3 and later in "When new cylinder block and crankshaft are used".

CYLINDER BLOCK

[VK45DE]

Main Bearings Selection Table (No. 1 and No. 5 Journal)

I.D. mark	Outer diameter Unit : mm (in)	Cylinder block main bearing housing inner diameter		Crankshaft journal outer diameter		I.D. mark		Inner diameter Unit : mm (in)																			
		A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	1	2		
G	63.964 - 63.963 (2.5183 - 2.5182)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	
H	63.963 - 63.962 (2.5182 - 2.5182)	1	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5
J	63.962 - 63.961 (2.5182 - 2.5181)	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	
K	63.961 - 63.960 (2.5181 - 2.5181)	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	56	
L	63.960 - 63.959 (2.5181 - 2.5181)	12	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56
M	63.959 - 63.958 (2.5181 - 2.5180)	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56
N	63.958 - 63.957 (2.5180 - 2.5180)	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	56	56
P	63.957 - 63.956 (2.5180 - 2.5179)	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	56	56
R	63.956 - 63.955 (2.5179 - 2.5179)	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	
S	63.955 - 63.954 (2.5179 - 2.5179)	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	67	
T	63.954 - 63.953 (2.5179 - 2.5178)	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	67	67
U	63.953 - 63.952 (2.5178 - 2.5178)	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	6	67	67
V	63.952 - 63.951 (2.5178 - 2.5178)	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	6	6	67	67
W	63.951 - 63.950 (2.5178 - 2.5177)	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	6	6	67	67	67
X	63.950 - 63.949 (2.5177 - 2.5177)	34	34	34	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	
Y	63.949 - 63.948 (2.5177 - 2.5176)	34	34	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	
1	63.948 - 63.947 (2.5176 - 2.5176)	34	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	78	78
2	63.947 - 63.946 (2.5176 - 2.5176)	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	7	78	78
3	63.946 - 63.945 (2.5176 - 2.5175)	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	7	7	78	78
4	63.945 - 63.944 (2.5175 - 2.5175)	4	45	45	45	5	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	7	7	7	78	78
5	63.944 - 63.943 (2.5175 - 2.5174)	45	45	45	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	7	7	7	7	7	78	78
6	63.943 - 63.942 (2.5174 - 2.5174)	45	45	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	7	7	7	7	7	7	78	78
7	63.942 - 63.941 (2.5174 - 2.5174)	45	5	5	5	56	56	56	6	6	6	6	6	67	67	67	7	7	7	7	7	7	7	7	7	78	78
9	63.941 - 63.940 (2.5174 - 2.5173)	5	5	5	56	56	56	6	6	6	6	6	6	67	67	67	7	7	7	7	7	7	7	7	7	78	78

PBIC0112E

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CYLINDER BLOCK

[VK45DE]

Main Bearings Selection Table (No. 2, 3 and 4 Journal)

I.D. mark	Outer diameter Unit : mm (in)	Cylinder block main bearing housing inner diameter	Crankshaft journal outer diameter	I.D. mark																								
				A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	1	2	
				68.944 - 68.945 (2.7143 - 2.7144)	68.945 - 68.946 (2.7144 - 2.7144)	68.946 - 68.947 (2.7144 - 2.7144)	68.947 - 68.948 (2.7144 - 2.7145)	68.948 - 68.949 (2.7145 - 2.7145)	68.949 - 68.950 (2.7145 - 2.7146)	68.950 - 68.951 (2.7146 - 2.7146)	68.951 - 68.952 (2.7146 - 2.7146)	68.952 - 68.953 (2.7146 - 2.7147)	68.953 - 68.954 (2.7147 - 2.7147)	68.954 - 68.955 (2.7147 - 2.7148)	68.955 - 68.956 (2.7148 - 2.7148)	68.956 - 68.957 (2.7148 - 2.7148)	68.957 - 68.958 (2.7148 - 2.7149)	68.958 - 68.959 (2.7149 - 2.7149)	68.959 - 68.960 (2.7149 - 2.7150)	68.960 - 68.961 (2.7150 - 2.7150)	68.961 - 68.962 (2.7150 - 2.7150)	68.962 - 68.963 (2.7150 - 2.7151)	68.963 - 68.964 (2.7151 - 2.7151)	68.964 - 68.965 (2.7151 - 2.7152)	68.965 - 68.966 (2.7152 - 2.7152)	68.966 - 68.967 (2.7152 - 2.7152)	68.967 - 68.968 (2.7152 - 2.7153)	
A	63.964 - 63.963 (2.5183 - 2.5182)	0	0	01	01	1	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
B	63.963 - 63.962 (2.5182 - 2.5182)	0	01	01	01	1	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
C	63.962 - 63.961 (2.5182 - 2.5181)	01	01	01	1	1	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
D	63.961 - 63.960 (2.5181 - 2.5181)	01	01	1	1	1	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
E	63.960 - 63.959 (2.5181 - 2.5181)	01	1	1	1	1	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
F	63.959 - 63.958 (2.5181 - 2.5180)	1	1	1	1	1	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
G	63.958 - 63.957 (2.5180 - 2.5180)	1	1	1	1	1	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
H	63.957 - 63.956 (2.5180 - 2.5179)	1	1	1	1	1	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
J	63.956 - 63.955 (2.5179 - 2.5179)	12	12	12	2	2	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
K	63.955 - 63.954 (2.5179 - 2.5179)	12	12	2	2	2	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
L	63.954 - 63.953 (2.5179 - 2.5178)	12	2	2	2	2	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
M	63.953 - 63.952 (2.5178 - 2.5178)	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
N	63.952 - 63.951 (2.5178 - 2.5178)	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
P	63.951 - 63.950 (2.5178 - 2.5177)	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
R	63.950 - 63.949 (2.5177 - 2.5177)	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
S	63.949 - 63.948 (2.5177 - 2.5176)	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
T	63.948 - 63.947 (2.5176 - 2.5176)	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
U	63.947 - 63.946 (2.5176 - 2.5176)	3	3	3	3	3	3	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
V	63.946 - 63.945 (2.5176 - 2.5175)	3	3	3	3	3	3	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
W	63.945 - 63.944 (2.5175 - 2.5175)	3	3	3	3	3	3	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
X	63.944 - 63.943 (2.5175 - 2.5174)	3	3	3	3	3	3	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
Y	63.943 - 63.942 (2.5174 - 2.5174)	3	3	3	3	3	3	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
1	63.942 - 63.941 (2.5174 - 2.5174)	3	3	3	3	3	3	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
2	63.941 - 63.940 (2.5174 - 2.5173)	4	4	4	4	4	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7

PBIC0113E

Main Bearings Grade Table (All Journals)

Unit: mm (in)

Grade number	Thickness	Identification color (UPR/LWR)	Remarks
0	2.483 - 2.486 (0.0978 - 0.0979)	Black	Grade and color are the same for upper and lower bearings.
1	2.486 - 2.489 (0.0979 - 0.0980)	Brown	
2	2.489 - 2.492 (0.0980 - 0.0981)	Green	
3	2.492 - 2.495 (0.0981 - 0.0982)	Yellow	
4	2.495 - 2.498 (0.0982 - 0.0983)	Blue	
5	2.498 - 2.501 (0.0983 - 0.0985)	Pink	
6	2.501 - 2.504 (0.0985 - 0.0986)	Purple	
7	2.504 - 2.507 (0.0986 - 0.0987)	White	
8	2.507 - 2.510 (0.0987 - 0.0988)	Red	

CYLINDER BLOCK

[VK45DE]

01	UPR	2.483 - 2.486 (0.0978 - 0.0979)	Black/Brown	Grade and color are different for upper and lower bearings.
	LWR	2.486 - 2.489 (0.0979 - 0.0980)		
12	UPR	2.486 - 2.489 (0.0979 - 0.0980)	Brown/Green	
	LWR	2.489 - 2.492 (0.0980 - 0.0981)		
23	UPR	2.489 - 2.492 (0.0980 - 0.0981)	Green/Yellow	
	LWR	2.492 - 2.495 (0.0981 - 0.0982)		
34	UPR	2.492 - 2.495 (0.0981 - 0.0982)	Yellow/Blue	
	LWR	2.495 - 2.498 (0.0982 - 0.0983)		
45	UPR	2.495 - 2.498 (0.0982 - 0.0983)	Blue/Pink	
	LWR	2.498 - 2.501 (0.0983 - 0.0985)		
56	UPR	2.498 - 2.501 (0.0983 - 0.0985)	Pink/Purple	
	LWR	2.501 - 2.504 (0.0985 - 0.0986)		
67	UPR	2.501 - 2.504 (0.0985 - 0.0986)	Purple/White	
	LWR	2.504 - 2.507 (0.0986 - 0.0987)		
78	UPR	2.504 - 2.507 (0.0986 - 0.0987)	White/Red	
	LWR	2.507 - 2.510 (0.0987 - 0.0988)		

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Use Undersize Bearing Usage Guide

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

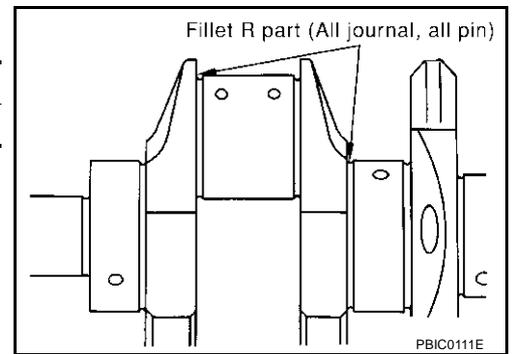
Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.618 - 2.626 (0.1031 - 0.1034)

CAUTION:

Do not damage fillet R when grinding crankshaft journal in order to use undersized bearing (All journals).



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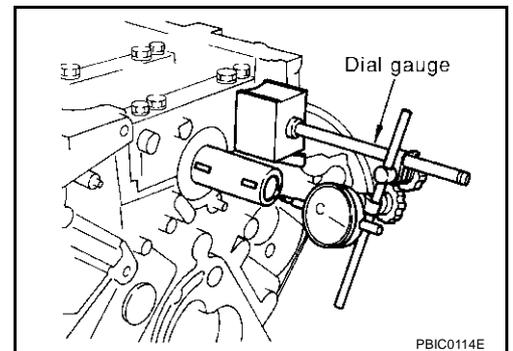
Inspection After Disassembly CRANKSHAFT END PLAY

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

Standard : 0.10 - 0.25 mm (0.0039 - 0.0098 in)

Limit : 0.30 mm (0.0118 in)

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



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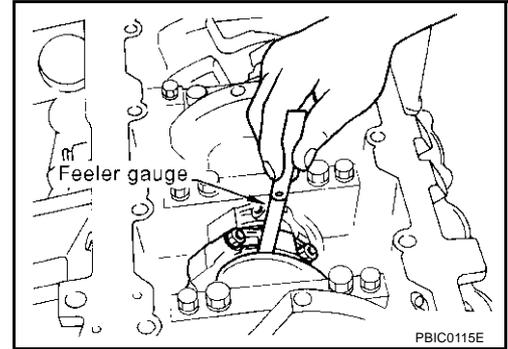
CONNECTING ROD SIDE CLEARANCE

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

Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)

Limit : 0.40 mm (0.0157 in)

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

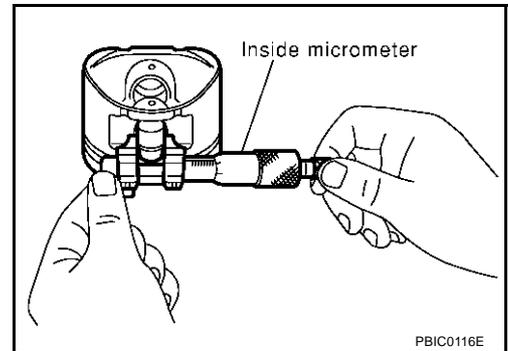


PISTON AND PISTON PIN CLEARANCE

Inner Diameter of Piston Pin

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

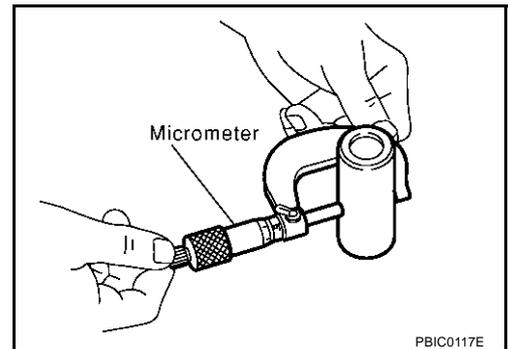
Standard : 21.993 - 22.005 mm (0.8659 - 0.8663 in)



Outer Diameter of Piston Pin

- Measure outer diameter of piston pin with a micrometer.

Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)

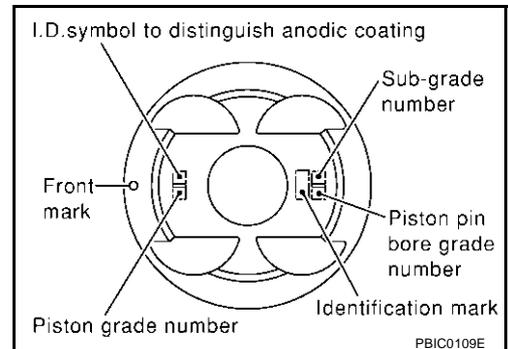


Piston and Piston Pin Clearance

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

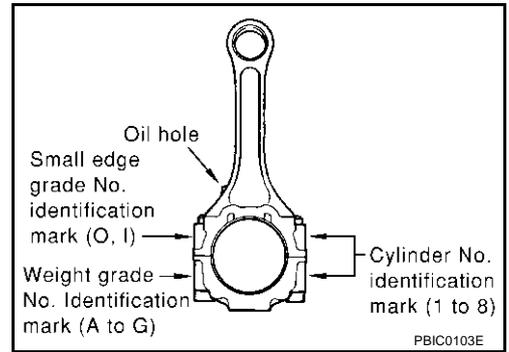
Standard : 0.002 - 0.006 mm (0.0001 - 0.0002 in)

- If clearance exceeds specification, replace either or both of piston/piston pin assembly and connecting rod assembly with reference to specification of each part.
- Refer to piston selection table to replace piston/piston pin assembly. Refer to [EM-240, "HOW TO SELECT PISTON"](#).
- Refer to connecting rod bearing selection table to replace connecting rod. Refer to [EM-241, "HOW TO SELECT CONNECTING ROD BEARING"](#).



NOTE:

- The connecting rod small end grade and piston pin hole (piston pin) grade are provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only 0 grade is available.)
- Refer to [EM-248, "CONNECTING ROD BUSHING OIL CLEARANCE \(SMALL END\)"](#) for the values for each grade at the plant.



PISTON RING SIDE CLEARANCE

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

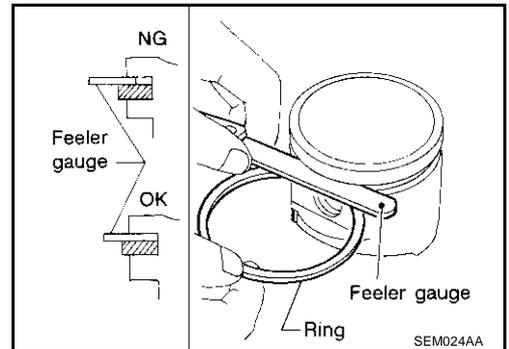
Standard:

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

Limit:

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

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



PISTON RING END GAP

- Check if inner diameter of cylinder bore is within specification. Refer to [EM-250, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- Insert piston ring until middle of cylinder with piston, and measure gap.

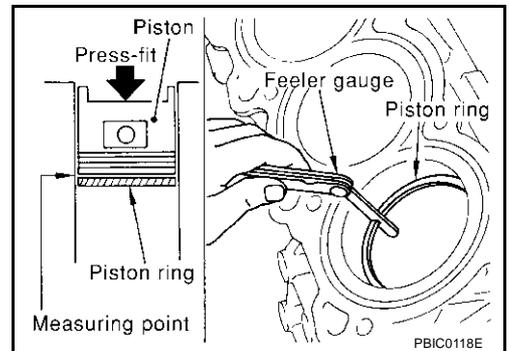
Standard:

Top ring	0.22 - 0.32 mm (0.0087 - 0.0126 in)
2nd ring	0.22 - 0.32 mm (0.0087 - 0.0126 in)
Oil ring	0.20 - 0.60 mm (0.0079 - 0.0236 in)

Limit:

Top ring	0.56 mm (0.0220 in)
2nd ring	0.52 mm (0.0205 in)
Oil ring	0.96 mm (0.0378 in)

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



CONNECTING ROD BEND AND TORSION

- Check with connecting rod aligner.

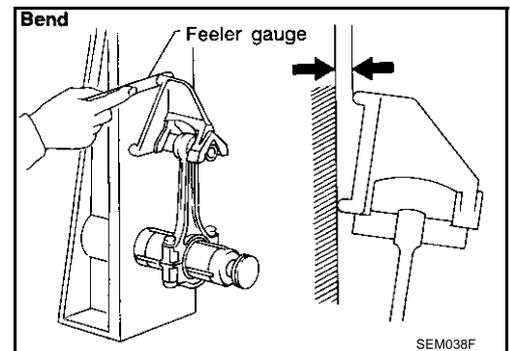
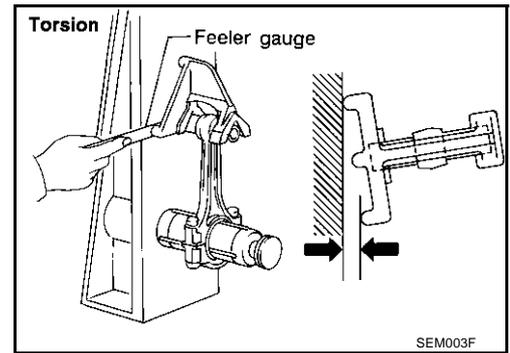
Bend:

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.

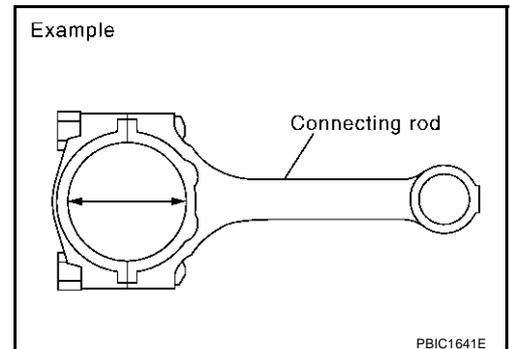


CONNECTING ROD BEARING (BIG END)

- Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod nut to the specified torque, measure the connecting rod large end inner diameter using an inside micrometer. Refer to [EM-235, "ASSEMBLY"](#).

Standard : 55.000 - 55.013 mm (2.1654 - 2.1659 in)

- If it exceeds the standard, replace the connecting rod.

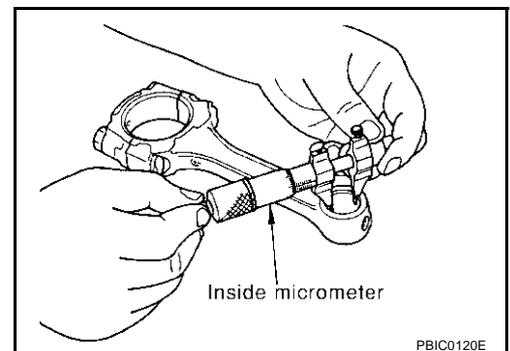


CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

Inner Diameter of Connecting Rod (Small End)

- Measure inner diameter of bushing.

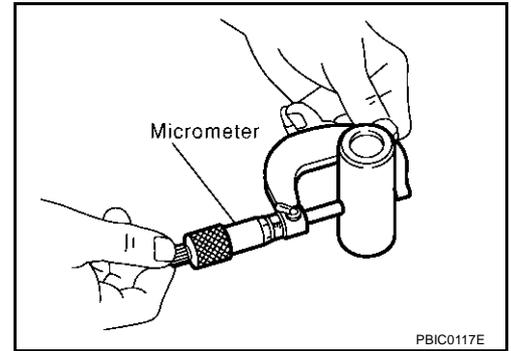
Standard : 22.000 - 22.012 mm (0.8661 - 0.8666 in)



Outer Diameter of Piston Pin

- Measure outer diameter of piston pin.

Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)

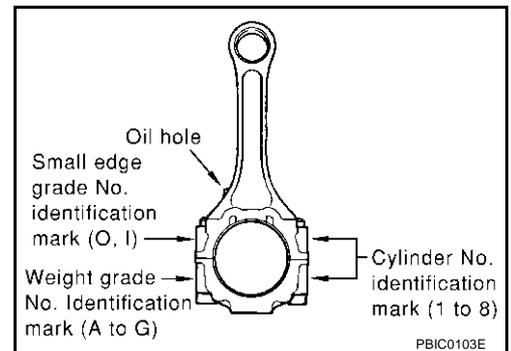


Connecting Rod Bushing Oil Clearance (Small End)

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

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

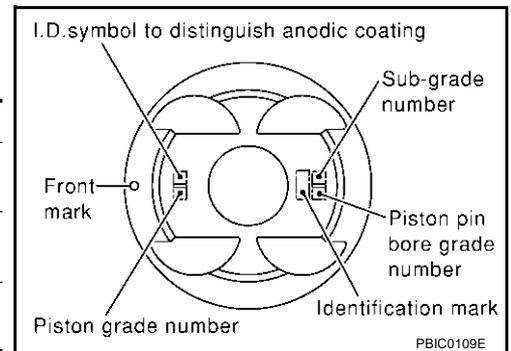
- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, refer to the Table for Selective Fitting for Piston to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Refer to [EM-240, "HOW TO SELECT PISTON"](#).



Factory installed parts grading:

- Service parts apply only to grade 0.

Grade	Unit: mm (in)	
	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 outer diameter	21.989 - 21.995 (0.8657 - 0.8659)	21.995 - 22.001 (0.8659 - 0.8662)
Piston pin bore diameter	21.993 - 21.999 (0.8659 - 0.8661)	21.999 - 22.005 (0.8661 - 0.8663)



CYLINDER BLOCK DISTORTION

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

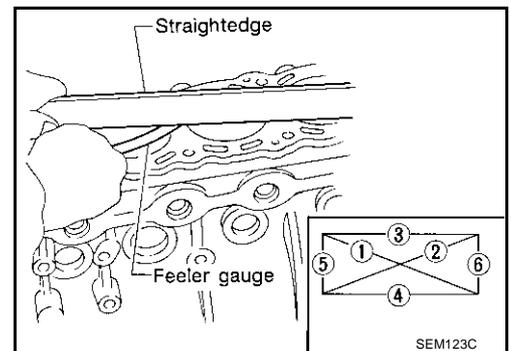
CAUTION:

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

- Measure the distortion on the block upper face at some different points in 6 directions.

Limit : 0.1 mm (0.004 in)

- If out of the distortion limit, replace the cylinder block.



INNER DIAMETER OF MAIN BEARING HOUSING

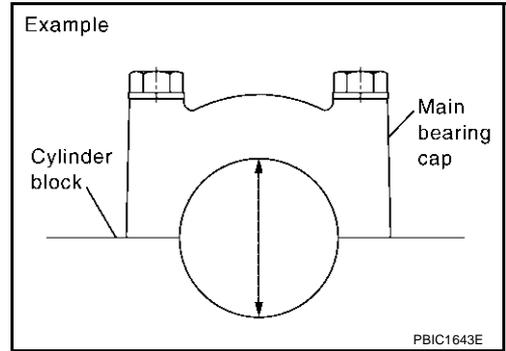
- Install the main bearing caps with the main bearings removed, and tighten the mounting bolts to the specified torque. Refer to [EM-235, "ASSEMBLY"](#).
- Using a bore gauge, measure the inner diameter of the main bearing housing.

Standard : 68.944 - 68.968 mm (2.7143 - 2.7153 in)

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

NOTE:

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



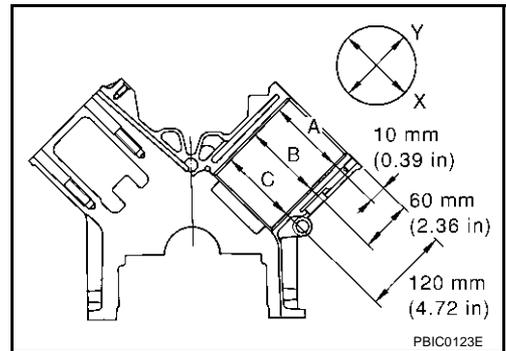
PISTON TO CYLINDER BORE CLEARANCE

Inner Diameter of Cylinder Bore

- Using a bore gauge, measure cylinder bore for wear, out-of-round and taper at 6 different points on each cylinder. (X and Y directions at A, B and C)

NOTE:

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



Standard inner diameter

: 93.000 - 93.030 mm (3.6614 - 3.6626 in)

Wear limit:

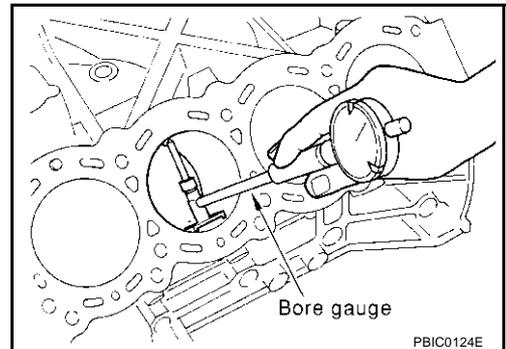
: 0.20 mm (0.0079 in)

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

: 0.015 mm (0.0006 in)

Taper limit (Difference between A and C)

: 0.010 mm (0.0004 in)



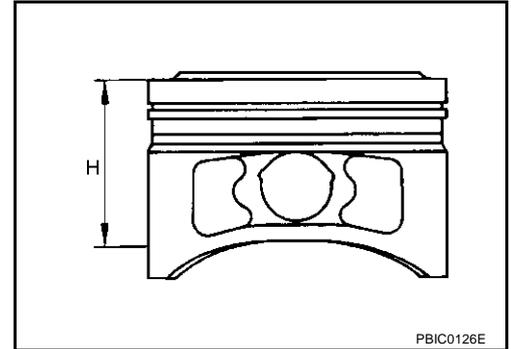
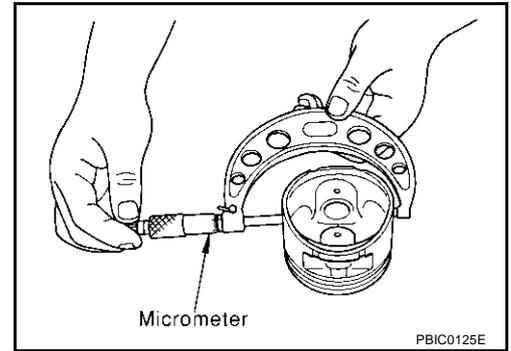
- If the measured value exceeds the repair limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or bore the inner wall.
- An oversize piston is provided. When using an oversize piston, hone the cylinder so that the clearance between the piston and cylinder satisfies the standard.

Oversize (OS) : 0.2 mm (0.0079 in)

- If oversize piston is used, use it for all cylinders with oversize piston rings.

Outer Diameter of Piston

- Measure piston skirt diameter.
Standard : 92.980 - 93.010 mm (3.6606 - 3.6618 in)
- Measure point "H" (Distance from the top): 42 mm (1.65 in)



Piston to Cylinder Bore Clearance

- Calculate by outer diameter of piston skirt and inner diameter of cylinder (direction X, position B).
 (Clearance) = (Inner diameter of cylinder) – (Outer diameter of piston skirt)
Standard : 0.010 - 0.030 mm (0.0004 - 0.0012 in)
Limit : 0.08 mm (0.0031 in)
- If it exceeds the limit, replace piston/piston pin assembly.

Re-boring Cylinder Bore

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

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

where,

D: Bored diameter

A: Piston diameter as measured

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

C: Honing allowance 0.02 mm (0.0008 in)

2. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.

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 specified piston-to-bore clearance.

5. Measure finished cylinder bore for out-of-round and taper.

NOTE:

Measurement should be done after cylinder bore cools down.

OUTER DIAMETER OF CRANKSHAFT JOURNAL

- Measure outer diameter of crankshaft journals.

Standard : 63.940 - 63.964 mm (2.5173 - 2.5183 in)

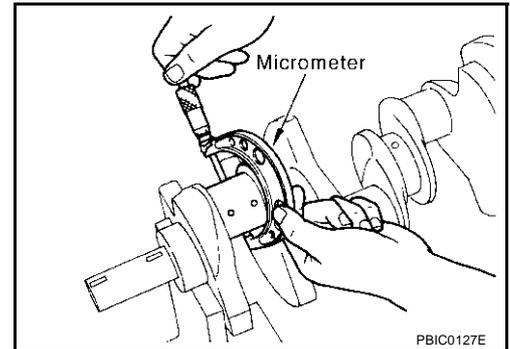
- If it is out of standard, measure the main bearing oil clearance. then use the undersize bearing. Refer to [EM-253, "MAIN BEARING OIL CLEARANCE"](#) .

OUTER DIAMETER OF CRANKSHAFT PIN

- Measure outer diameter of crankshaft pin.

Standard : 51.956 - 51.974 mm (2.0455 - 2.0462 in)

- If it is out of standard, measure the connecting rod bearing oil clearance. then use the undersize bearing. Refer to [EM-253, "CONNECTING ROD BEARING OIL CLEARANCE"](#) .



OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Using a micrometer, measure the dimensions at 4 different points shown in the figure on each journal and pin.
- Out-of-roundness is indicated by the difference in dimension between X and Y at A and B.
- Taper is indicated by the difference in dimension between A and B at X and Y.

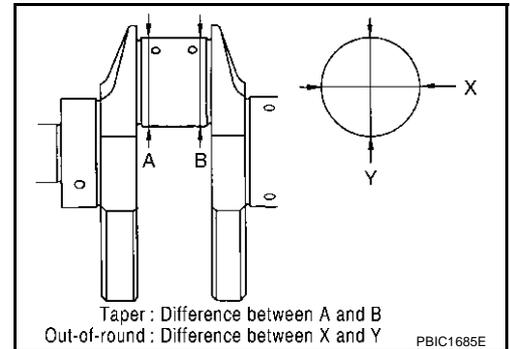
Limit:

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

: 0.002 mm (0.0001 in)

Taper (Difference between A and B)

: 0.002 mm (0.0001 in)



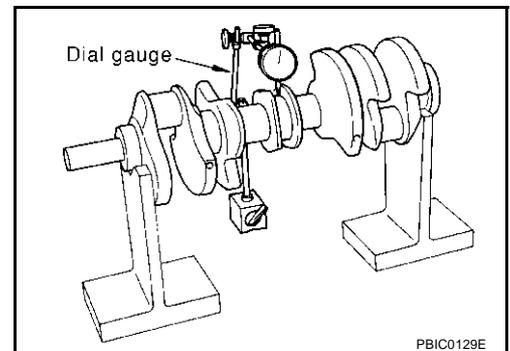
- If the measured value exceeds the standard, correct or replace the crankshaft.
- If corrected, measure the bearing oil clearance of the corrected journal or pin. Then select the main bearing or connecting rod bearing. Refer to [EM-253, "MAIN BEARING OIL CLEARANCE"](#) or [EM-253, "CONNECTING ROD BEARING OIL CLEARANCE"](#) .

CRANKSHAFT RUNOUT

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

Limit: : 0.10 mm (0.0039 in)

- If it exceeds the limit, replace the crankshaft.



CONNECTING ROD BEARING OIL CLEARANCE

Method of Measurement

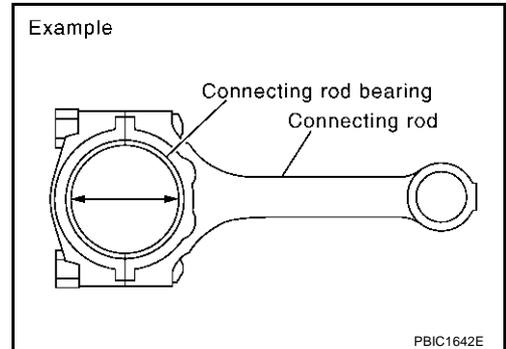
- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod nut to the specified torque. Refer to [EM-235, "ASSEMBLY"](#).
Using an inside micrometer measure the inner diameter of connecting rod bearing.

(Oil clearance) = (Inner diameter of connecting rod bearing) – (Outer diameter of crankshaft pin)

Standard : 0.020 - 0.045 mm (0.0008 - 0.0018 in)

Limit : 0.055 mm (0.0022 in)

- If clearance cannot be adjusted within the standard, grind crankshaft pin and use undersized bearing. Refer to [EM-241, "HOW TO SELECT CONNECTING ROD BEARING"](#).



Method of Using Plastigage

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

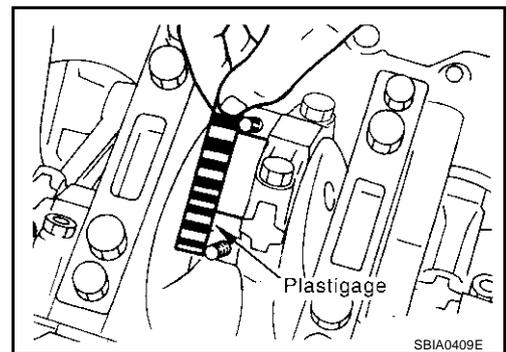
CAUTION:

Never rotate the crankshaft.

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

NOTE:

The procedure when the measured value exceeds the repair limit is same as that described in "Method of Measurement."



MAIN BEARING OIL CLEARANCE

Method of Measurement

- Install the main bearings to the cylinder block and main bearing cap. Measure the main bearing inner diameter with the bearing cap bolt tightened to the specified torque. Refer to [EM-235, "ASSEMBLY"](#).

(Oil clearance) = (Inner diameter of main bearing) – (Outer diameter of crankshaft journal)

Standard:

No. 1 and 5 journals : 0.001 - 0.011 mm (0.00004 - 0.0004 in)

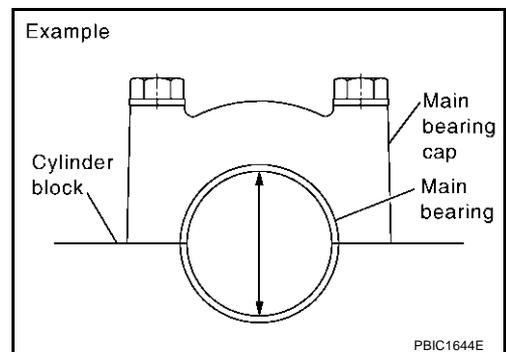
No. 2, 3 and 4 journals : 0.007 - 0.017 mm (0.0003 - 0.0007 in)

Limit:

No.1 and 5 journals : 0.021 mm (0.0008 in)

No. 2, 3 and 4 journals : 0.027 mm (0.0011 in)

- If the measured value exceeds the repair limit, select main bearings referring to the main bearing inner diameter and crankshaft journal outer diameter, so that the oil clearance satisfies the standard. Refer to [EM-242, "HOW TO SELECT MAIN BEARING"](#).



Method of Using Plastigage

- Remove oil and dust on the crankshaft 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 the main bearings to the cylinder block and main bearing cap, and tighten the main bearing bolts to the specified torque.

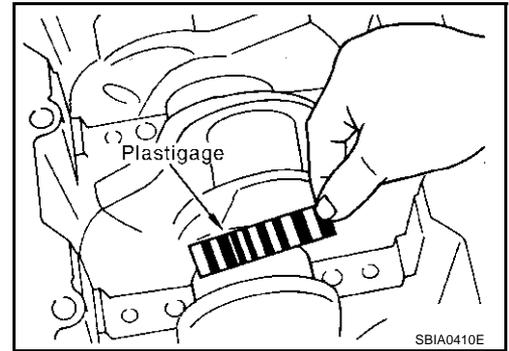
CAUTION:

Never rotate the crankshaft.

- Remove the bearing cap and bearings, and using the scale on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the repair limit is same as that described in "Method of Measurement".

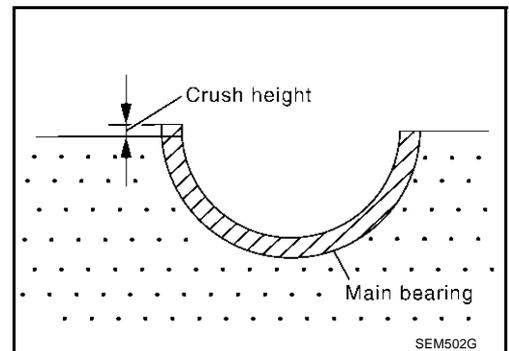


CRUSH HEIGHT OF MAIN BEARING

- When the bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [EM-235, "ASSEMBLY"](#) for the tightening procedure.

Standard : There must be crush height

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

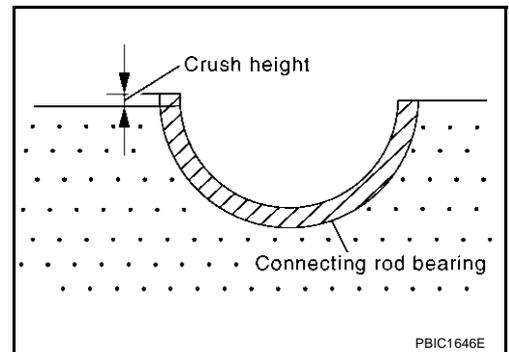


CRUSH HEIGHT OF CONNECTING ROD BEARING

- When the 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-235, "ASSEMBLY"](#) for the tightening procedure.

Standard : There must be crush height.

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



SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

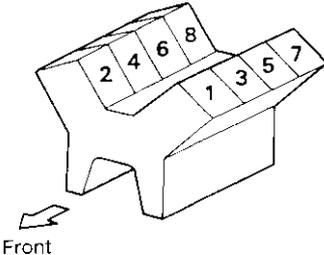
SERVICE DATA AND SPECIFICATIONS (SDS)

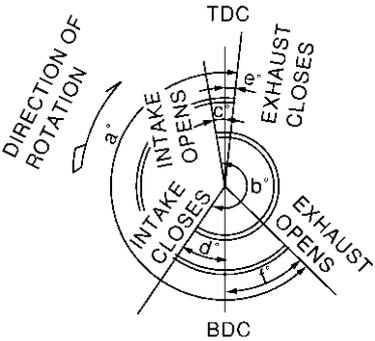
PFP:00030

Standard and Limit GENERAL SPECIFICATIONS

ABS006IX

Cylinder arrangement		V-8
Displacement cm ³ (cu in)		4,494 (274.22)
Bore and stroke mm (in)		93 x 82.7 (3.66 x 3.256)
Valve arrangement		DOHC
Firing order		1-8-7-3-6-5-4-2
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		5
Compression ratio		10.5
Compression pressure kPa (kg/cm ² , psi)/300 rpm	Standard	1,320 (13.5, 191)
	Minimum	1,130 (11.5, 164)
	Differential limit between cylinders	98 (1.0, 14)

Cylinder number	 <p style="text-align: center;">SEM957C</p>
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Valve timing	 <p style="text-align: center;">PBIC0187E</p>
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Unit: degree

a	b	c	d	e	f
228	240	0	60	0	48

INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

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

DRIVE BELTS

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

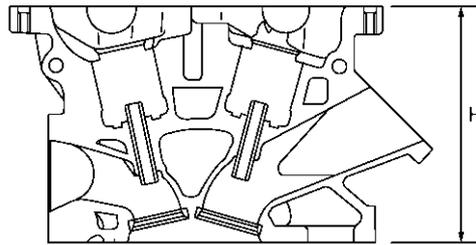
SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

CYLINDER HEAD

Unit: mm (in)

	Limit
Head surface distortion	0.1 (0.004)



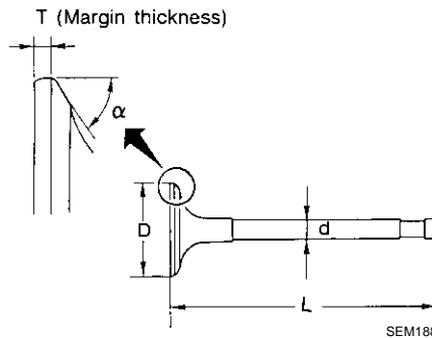
Nominal cylinder head height:
H = 126.4 mm (4.98 in)

PBIC0183E

VALVE

Valve Dimensions

Unit: mm (in)



Valve head diameter "D"	Intake	36.0 - 36.3 (1.417 - 1.429)
	Exhaust	31.2 - 31.5 (1.228 - 1.240)
Valve length "L"	Intake	96.57 (3.8020)
	Exhaust	94.50 (3.720)
Valve stem diameter "d"	Intake	5.972 - 5.980 (0.2351 - 0.2354)
	Exhaust	5.962 - 5.970 (0.2347 - 0.2350)
Valve seat angle " α "	Intake	45°15' - 45°45'
	Exhaust	
Valve margin "T"	Intake	1.15 - 1.45 (0.0453 - 0.0571)
	Exhaust	1.85 - 2.15 (0.0728 - 0.0846)

Valve Clearance

Unit: mm (in)

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

*: Approximately 20°C (68 °F)

SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

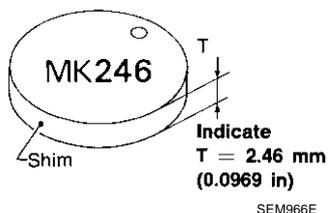
Available Shims

Thickness mm (in)	Identification mark	
2.32 (0.0913)	232	A
2.33 (0.0917)	233	EM
2.34 (0.0921)	234	
2.35 (0.0925)	235	
2.36 (0.0929)	236	C
2.37 (0.0933)	237	
2.38 (0.0937)	238	D
2.39 (0.0941)	239	
2.40 (0.0945)	240	
2.41 (0.0949)	241	E
2.42 (0.0953)	242	
2.43 (0.0957)	243	
2.44 (0.0961)	244	F
2.45 (0.0965)	245	
2.46 (0.0969)	246	G
2.47 (0.0972)	247	
2.48 (0.0976)	248	
2.49 (0.0980)	249	H
2.50 (0.0984)	250	
2.51 (0.0988)	251	I
2.52 (0.0992)	252	
2.53 (0.0996)	253	
2.54 (0.1000)	254	J
2.55 (0.1004)	255	
2.56 (0.1008)	256	K
2.57 (0.1012)	257	
2.58 (0.1016)	258	
2.59 (0.1020)	259	L
2.60 (0.1024)	260	
2.61 (0.1028)	261	
2.62 (0.1031)	262	M
2.63 (0.1035)	263	
2.64 (0.1039)	264	
2.65 (0.1043)	265	
2.66 (0.1047)	266	
2.67 (0.1051)	267	
2.68 (0.1055)	268	
2.69 (0.1059)	269	
2.70 (0.1063)	270	
2.71 (0.1067)	271	
2.72 (0.1071)	272	
2.73 (0.1075)	273	
2.74 (0.1079)	274	

SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

Thickness mm (in)	Identification mark
2.75 (0.1083)	275
2.76 (0.1087)	276
2.77 (0.1091)	277
2.78 (0.1094)	278
2.79 (0.1098)	279
2.80 (0.1102)	280
2.81 (0.1106)	281
2.82 (0.1110)	282
2.83 (0.1114)	283
2.84 (0.1118)	284
2.85 (0.1122)	285
2.86 (0.1126)	286
2.87 (0.1130)	287
2.88 (0.1134)	288
2.89 (0.1138)	289
2.90 (0.1142)	290
2.91 (0.1146)	291
2.92 (0.1150)	292
2.93 (0.1154)	293
2.94 (0.1157)	294
2.95 (0.1161)	295



Valve Spring

Free height mm (in)	51.28 - 51.48 (2.0189 - 2.0268)	
Pressure N (kg, lb) at height mm (in)	Installation	165 - 189 (16.8 - 19.3, 37 - 42) at 33.8 (1.331)
	Valve open	290 - 330 (29.6 - 33.7, 65 - 74) at 24.4 (0.961)
Out-of-square mm (in)	Less than 2.2 (0.087)	

Valve Lifter

Unit: mm (in)

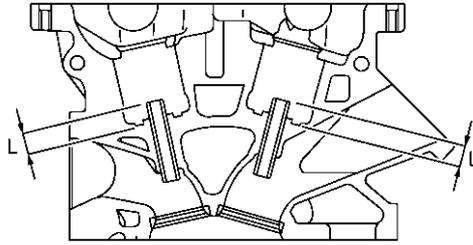
	Standard
Valve lifter outer diameter	33.965 - 33.975 (1.3372 - 1.3776)
Lifter guide inner diameter	34.000 - 34.016 (1.3386 - 1.3392)
Clearance between lifter and lifter guide	0.025 - 0.051 (0.0010 - 0.0020)

SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

Valve Guide

Unit: mm (in)



PBIC0184E

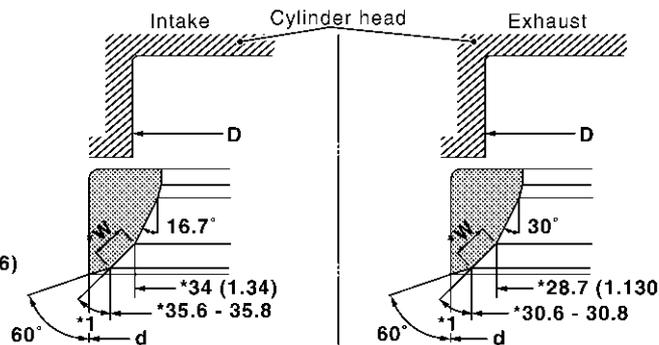
		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Standard			
Stem to guide clearance	Intake	0.020 - 0.046 (0.0008 - 0.0018)	
	Exhaust	0.030 - 0.056 (0.0012 - 0.0022)	
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)

* : Machining data
*1 : 44°45'±22'

Contacting width (W)
; 1.09 - 1.31 (0.0429 - 0.0516)



Contacting width (W)
; 1.29 - 1.51 (0.0508 - 0.0594)

SBIA0380E

		Standard	Service
Cylinder head seat recess diameter (D)	Intake	37.000 - 37.016 (1.4567 - 1.4573)	37.500 - 37.516 (1.4764 - 1.4770)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	Intake	37.097 - 37.113 (1.4605 - 1.4611)	37.597 - 37.613 (1.4802 - 1.4808)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)

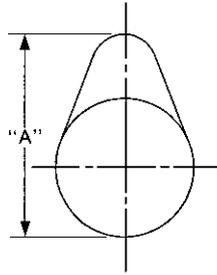
SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

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



SEM671

Cam height "A"	Intake	44.865 - 45.055 (1.7663 - 1.7738)
	Exhaust	43.925 - 44.115 (1.7293 - 1.7368)
Outer diameter of camshaft journal	No. 1	25.938 - 25.955 (1.0212 - 1.0218)
	No. 2, 3, 4, 5	25.953 - 25.970 (1.0218 - 1.0224)
Inner diameter of camshaft bracket		26.000 - 26.021 (1.0236 - 1.0244)
Camshaft journal clearance	No. 1	0.045 - 0.083 (0.0018 - 0.0033)
	No. 2, 3, 4, 5	0.030 - 0.068 (0.0012 - 0.0027)
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)
Camshaft sprocket runout [TIR*]		Less than 0.15 (0.0059)

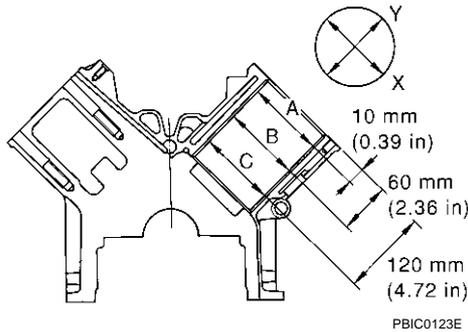
*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

CYLINDER BLOCK

Unit: mm (in)



Surface flatness	Limit			0.1 (0.004)
Inner diameter of main bearing housing	Standard			68.944 - 68.968 (2.7143 - 2.7153)
Cylinder bore	Inner diameter	Standard	Grade No. 1	93.000 - 93.010 (3.6614 - 3.6618)
			Grade No. 2	93.010 - 93.020 (3.6618 - 3.6622)
			Grade No. 3	93.020 - 93.030 (3.6622 - 3.6626)
		Wear limit	0.2 (0.0079)	
Out-of-round (Difference between X and Y)			Limit	0.015 (0.0006)
Taper (Difference between A and C)			Limit	0.010 (0.0004)
Main journal inner diameter grade (Without bearing)	Grade No. A			68.944 - 68.945 (2.7143 - 2.7144)
	Grade No. B			68.945 - 68.946 (2.7144 - 2.7144)
	Grade No. C			68.946 - 68.947 (2.7144 - 2.7144)
	Grade No. D			68.947 - 68.948 (2.7144 - 2.7145)
	Grade No. E			68.948 - 68.949 (2.7145 - 2.7145)
	Grade No. F			68.949 - 68.950 (2.7145 - 2.7146)
	Grade No. G			68.950 - 68.951 (2.7146 - 2.7146)
	Grade No. H			68.951 - 68.952 (2.7146 - 2.7146)
	Grade No. J			68.952 - 68.953 (2.7146 - 2.7147)
	Grade No. K			68.953 - 68.954 (2.7147 - 2.7147)
	Grade No. L			68.954 - 68.955 (2.7147 - 2.7148)
	Grade No. M			68.955 - 68.956 (2.7148 - 2.7148)
	Grade No. N			68.956 - 68.957 (2.7148 - 2.7148)
	Grade No. P			68.957 - 68.958 (2.7148 - 2.7149)
	Grade No. R			68.958 - 68.959 (2.7149 - 2.7149)
	Grade No. S			68.959 - 68.960 (2.7149 - 2.7150)
	Grade No. T			68.960 - 68.961 (2.7150 - 2.7150)
	Grade No. U			68.961 - 68.962 (2.7150 - 2.7150)
	Grade No. V			68.962 - 68.963 (2.7150 - 2.7151)
	Grade No. W			68.963 - 68.964 (2.7151 - 2.7151)
Grade No. X			68.964 - 68.965 (2.7151 - 2.7152)	
Grade No. Y			68.965 - 68.966 (2.7152 - 2.7152)	
Grade No. 1			68.966 - 68.967 (2.7152 - 2.7152)	
Grade No. 2			68.967 - 68.968 (2.7152 - 2.7153)	
Difference in inner diameter between cylinders			Standard	Less than 0.03 (0.0012)

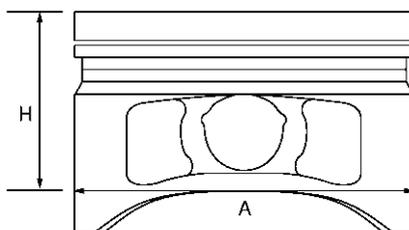
SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



PBIC0188E

Piston skirt diameter "A"	Standard	Grade No. 1	92.980 - 92.990 (3.6606 - 3.6610)
		Grade No. 2	92.990 - 93.000 (3.6610 - 3.6614)
		Grade No. 3	93.000 - 93.010 (3.6614 - 3.6618)
		0.20 (0.0079) oversize (Service)	93.180 - 93.210 (3.6685 - 3.6697)
"H" dimension			42 (1.65)
Piston pin bore 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	Standard		0.010 - 0.030 (0.0004 - 0.0012)
	Limit		0.08 (0.0031)

Piston Ring

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.22 - 0.32 (0.0087 - 0.0126)	0.56 (0.0220)
	2nd	0.22 - 0.32 (0.0087 - 0.0126)	0.52 (0.0205)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.96 (0.0378)

Piston Pin

Unit: mm (in)

Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)
Interference fit of piston pin to piston		0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)

SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

CONNECTING ROD

Unit: mm (in)

Center distance		146.95 - 147.05 (5.79 - 5.79)	
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	22.000 - 22.006 (0.8661 - 0.8664)	
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)	
Connecting rod big end inner diameter (without bearing)		55.000 - 55.013 (2.1654 - 2.1659)	
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)	
	Limit	0.40 (0.0157)	

*: After installing in connecting rod

CRANKSHAFT

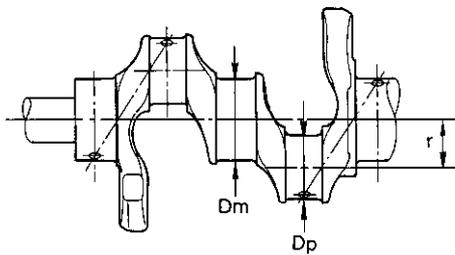
Unit: mm (in)

Main journal dia. "Dm" grade (No. 1 and 5)	Grade No. G	63.963 - 63.964 (2.5182 - 2.5183)	
	Grade No. H	63.962 - 63.963 (2.5182 - 2.5182)	
	Grade No. J	63.961 - 63.962 (2.5181 - 2.5182)	
	Grade No. K	63.960 - 63.961 (2.5181 - 2.5181)	
	Grade No. L	63.959 - 63.960 (2.5181 - 2.5181)	
	Grade No. M	63.958 - 63.959 (2.5180 - 2.5181)	
	Grade No. N	63.957 - 63.958 (2.5180 - 2.5180)	
	Grade No. P	63.956 - 63.957 (2.5179 - 2.5180)	
	Grade No. R	63.955 - 63.956 (2.5179 - 2.5179)	
	Grade No. S	63.954 - 63.955 (2.5179 - 2.5179)	
	Grade No. T	63.953 - 63.954 (2.5178 - 2.5179)	
	Grade No. U	63.952 - 63.953 (2.5178 - 2.5178)	
	Grade No. V	63.951 - 63.952 (2.5178 - 2.5178)	
	Grade No. W	63.950 - 63.951 (2.5177 - 2.5178)	
	Grade No. X	63.949 - 63.950 (2.5177 - 2.5177)	
	Grade No. Y	63.948 - 63.949 (2.5176 - 2.5177)	
	Grade No. 1	63.947 - 63.948 (2.5176 - 2.5176)	
	Grade No. 2	63.946 - 63.947 (2.5176 - 2.5176)	
	Main journal dia. "Dm" grade (No. 2, 3 and 4)	Grade No. 3	63.945 - 63.946 (2.5175 - 2.5176)
Grade No. 4		63.944 - 63.945 (2.5175 - 2.5175)	
Grade No. 5		63.943 - 63.944 (2.5174 - 2.5175)	
Grade No. 6		63.942 - 63.943 (2.5174 - 2.5174)	
Grade No. 7		63.941 - 63.942 (2.5174 - 2.5174)	
Grade No. 9		63.940 - 63.941 (2.5173 - 2.5174)	
Grade No. A		63.963 - 63.964 (2.5182 - 2.5183)	
Grade No. B		63.962 - 63.963 (2.5182 - 2.5182)	
Grade No. C		63.961 - 63.962 (2.5181 - 2.5182)	
Grade No. D		63.960 - 63.961 (2.5181 - 2.5181)	
Grade No. E		63.959 - 63.960 (2.5181 - 2.5181)	
Grade No. F		63.958 - 63.959 (2.5180 - 2.5181)	
Grade No. G		63.957 - 63.958 (2.5180 - 2.5180)	
Grade No. H		63.956 - 63.957 (2.5179 - 2.5180)	
Grade No. J		63.955 - 63.956 (2.5179 - 2.5179)	
Grade No. K		63.954 - 63.955 (2.5179 - 2.5179)	
Grade No. L		63.953 - 63.954 (2.5178 - 2.5179)	
Grade No. M		63.952 - 63.953 (2.5178 - 2.5178)	
Grade No. N		63.951 - 63.952 (2.5178 - 2.5178)	
Grade No. P	63.950 - 63.951 (2.5177 - 2.5178)		
Grade No. R	63.949 - 63.950 (2.5177 - 2.5177)		
Grade No. S	63.948 - 63.949 (2.5176 - 2.5177)		
Grade No. T	63.947 - 63.948 (2.5176 - 2.5176)		
Grade No. U	63.946 - 63.947 (2.5176 - 2.5176)		
Grade No. V	63.945 - 63.946 (2.5175 - 2.5176)		
Grade No. W	63.944 - 63.945 (2.5175 - 2.5175)		
Grade No. X	63.943 - 63.944 (2.5174 - 2.5175)		
Grade No. Y	63.942 - 63.943 (2.5174 - 2.5174)		
Grade No. 1	63.941 - 63.942 (2.5174 - 2.5174)		
Grade No. 2	63.940 - 63.941 (2.5173 - 2.5174)		

SERVICE DATA AND SPECIFICATIONS (SDS)

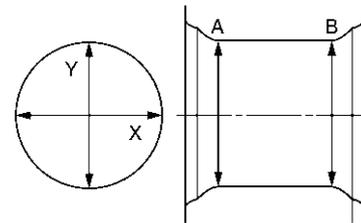
[VK45DE]

Pin journal dia. "Dp"	Grade No. 0	51.968 - 51.974 (2.0460 - 2.0462)
	Grade No. 1	51.962 - 51.968 (2.0457 - 2.0460)
	Grade No. 2	51.956 - 51.962 (2.0455 - 2.0457)
Center distance "r"		41.31 - 41.39 (1.6264 - 1.6295)
Out-of-round (Difference between X and Y)	Limit	0.002 (0.0001)
Taper (Difference between A and B)	Limit	0.002 (0.0001)
Runout [TIR*]	Limit	0.10 (0.0039)
Crankshaft end play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)



SEM645

Out-of-round : Difference between X and Y.
Taper : Difference between A and B.

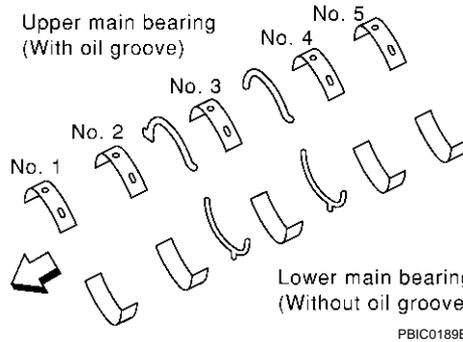


PBIC1686E

*: Total indicator reading

MAIN BEARING

Unit: mm (in)



PBIC0189E

Grade number	Thickness	Identification color (UPR/LWR)	Remarks
0	2.483 - 2.486 (0.0978 - 0.0979)	Black	Grade and color are the same for upper and lower bearings.
1	2.486 - 2.489 (0.0979 - 0.0980)	Brown	
2	2.489 - 2.492 (0.0980 - 0.0981)	Green	
3	2.492 - 2.495 (0.0981 - 0.0982)	Yellow	
4	2.495 - 2.498 (0.0982 - 0.0983)	Blue	
5	2.498 - 2.501 (0.0983 - 0.0985)	Pink	
6	2.501 - 2.504 (0.0985 - 0.0986)	Purple	
7	2.504 - 2.507 (0.0986 - 0.0987)	White	
8	2.507 - 2.510 (0.0987 - 0.0988)	Red	

SERVICE DATA AND SPECIFICATIONS (SDS)

[VK45DE]

01	UPR	2.483 - 2.486 (0.0978 - 0.0979)	Black/Brown	Grade and color are different for upper and lower bearings.
	LWR	2.486 - 2.489 (0.0979 - 0.0980)		
12	UPR	2.486 - 2.489 (0.0979 - 0.0980)	Brown/Green	
	LWR	2.489 - 2.492 (0.0980 - 0.0981)		
23	UPR	2.489 - 2.492 (0.0980 - 0.0981)	Green/Yellow	
	LWR	2.492 - 2.495 (0.0981 - 0.0982)		
34	UPR	2.492 - 2.495 (0.0981 - 0.0982)	Yellow/Blue	
	LWR	2.495 - 2.498 (0.0982 - 0.0983)		
45	UPR	2.495 - 2.498 (0.0982 - 0.0983)	Blue/Pink	
	LWR	2.498 - 2.501 (0.0983 - 0.0985)		
56	UPR	2.498 - 2.501 (0.0983 - 0.0985)	Pink/Purple	
	LWR	2.501 - 2.504 (0.0985 - 0.0986)		
67	UPR	2.501 - 2.504 (0.0985 - 0.0986)	Purple/White	
	LWR	2.504 - 2.507 (0.0986 - 0.0987)		
78	UPR	2.504 - 2.507 (0.0986 - 0.0987)	White/Red	
	LWR	2.507 - 2.510 (0.0987 - 0.0988)		

A
EM
C
D
E
F
G
H
I
J
K
L
M

Undersize

Unit: mm (in)

Undersize	Thickness	Main journal diameter
0.25 (0.0098)	2.618 - 2.626 (0.1031 - 0.1034)	Grind so that bearing clearance is the specified value.

Bearing Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	No.1 and 5	0.001 - 0.011 (0.00004 - 0.0004)
		No.2, 3 and 4	0.007 - 0.017 (0.0003 - 0.0007)
	Limit	No.1 and 5	0.021 (0.0008)
		No.2, 3 and 4	0.027 (0.0011)

CONNECTING ROD BEARING

Grade number	Thickness "T" mm (in)	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	No color
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

Undersize

Unit: mm (in)

Undersize	Thickness	Crank pin journal diameter "Dp"
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

Bearing Clearance

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.020 - 0.045 (0.0008 - 0.0018)
	Limit	0.055 (0.0022)

