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PRECAUTIONS

PFP:00001

Precautions for Drain Coolant

EBS00LPN

- Drain coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS00LPO

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

Precautions for Removal and Disassembly

EBS00LPP

- 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.

Precautions for Inspection, Repair and Replacement

EBS00LPQ

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

Precautions for Assembly and Installation

EBS00LPR

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

Parts Requiring Angular Tightening

EBS00LPS

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

Precautions for Liquid Gasket REMOVAL OF LIQUID GASKET SEALING

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

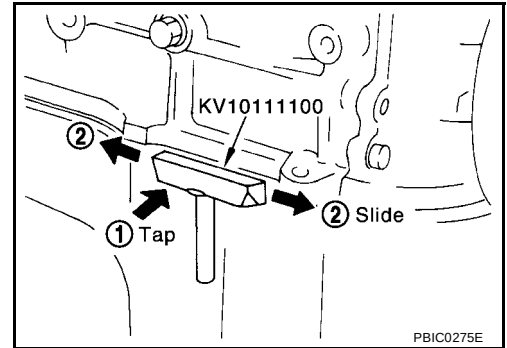
CAUTION:

Be careful not to damage the mating surfaces.

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

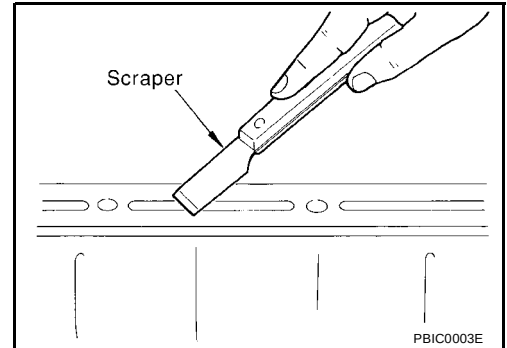
CAUTION:

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

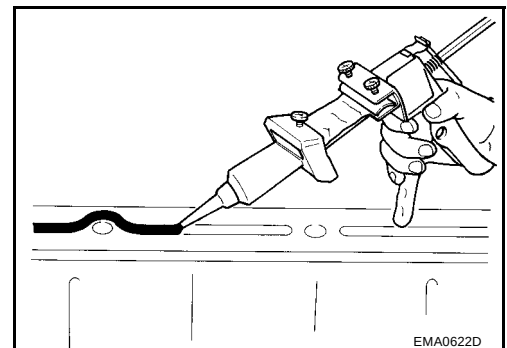


LIQUID GASKET APPLICATION PROCEDURE

- Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
- Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
- Wipe the gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.
- Attach the liquid gasket to the tube presser.
Use Genuine Liquid Gasket or equivalent.



- Apply the gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for the liquid gasket application, apply the gasket to the groove.
 - As for the bolt holes, normally apply the gasket inside the holes. If specified, it should be applied outside the holes. Make sure to read the text of service manual.
 - Within five minutes of gasket application, install the mating component.
 - If the liquid gasket protrudes, wipe it off immediately.
 - Do not retighten after the installation.
 - After 30 minutes or more have passed from the installation, fill the engine oil and coolant.

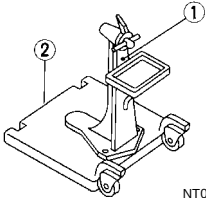
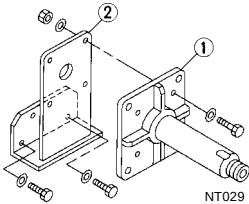
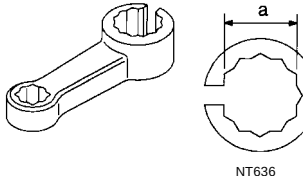
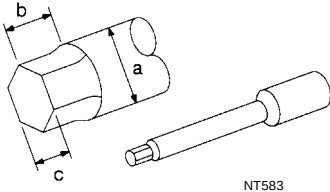
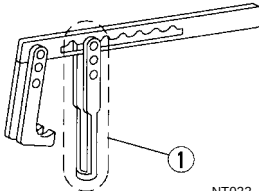
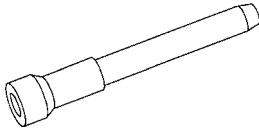
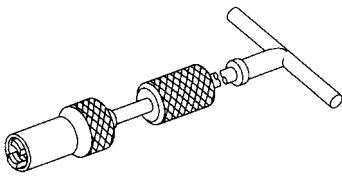


CAUTION:

If there are specific instructions in the service manual, observe them.

PREPARATION

Special Service Tools

Tool number Tool name	Description	EM
ST0501S000 Engine stand assembly 1. ST05011000 Engine stand 2. ST05012000 Base	 NT042	Disassembling and assembling
Engine attachment assembly 1. KV10106500 Engine attachment 2. KV10113300 Sub-attachment	 NT029	Overhauling engine
KV10114400 Heated oxygen sensor wrench	 NT636	Loosening or tightening heated oxygen sensor a: 22 mm (0.87 in)
ST10120000 Cylinder head bolt wrench	 NT583	Loosening and tightening cylinder head bolt a: 13 mm (0.51 in) dia. b: 12 mm (0.47 in) c: 10 mm (0.39 in)
KV10116200 Valve spring compressor 1. KV10115900 Attachment	 NT022	Disassembling valve mechanism
KV10115600 Valve oil seal drift	 NT024	Installing valve oil seal
KV10107902 Valve oil seal puller	 NT011	Removing valve oil seal

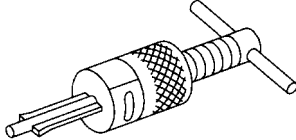
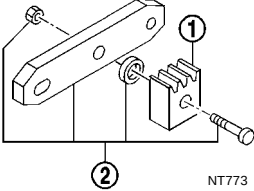
PREPARATION

[QG]

Tool number Tool name		Description
KV101151S0 Lifter stopper set 1. KV10115110 Camshaft pliers 2. KV10115120 Lifter stopper	 NT041	Changing shims
EM03470000 Piston ring compressor	 NT044	Piston assembly into cylinder bore
1. ST15243000 Valve seat drift 2. KV11103710 Adapter 3. KV11103720 Adapter	 PBIC1120E	Installing valve seat drift
KV10111100 Seal cutter	 NT046	Removing oil pan
WS39930000 Tube presser	 NT052	Pressing the tube of liquid gasket
KV10112100 Angle wrench	 NT014	Tightening bolts for bearing cap, cylinder head, etc. in angle

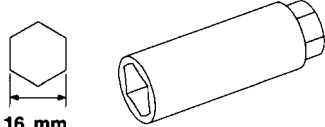
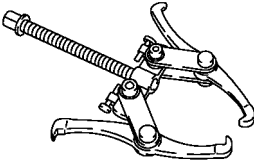
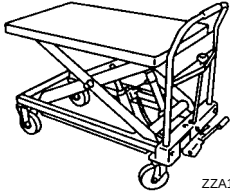
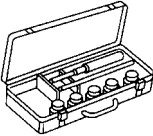
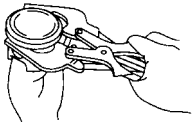
PREPARATION

[QG]

Tool number Tool name	Description	A
ST16610001 Pilot bushing puller	Removing pilot bushing	EM
		C
	NT045	
KV101056S0* Rear gear stopper 1. KV10105620 Adapter 2. KV10105610 Plate assembly	Preventing crankshaft from rotating	D
		E
	NT773	

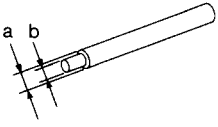
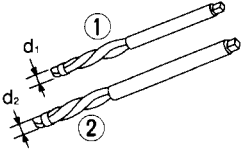
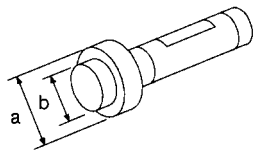
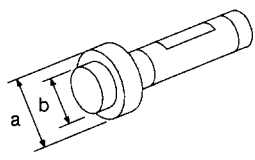
Commercial Service Tools

EBS00LPV

Tool name	Description	F
Spark plug wrench	Removing and installing spark plug	G
		H
	16 mm (0.63 in)	
	NT047	I
Crankshaft pulley puller	Removing crankshaft pulley	J
		K
	PBIC0887E	
Manual lift table caddy	Removing and installing engine	L
		M
	ZZA1210D	
Valve seat cutter set	Finishing valve seat dimensions	
		
	NT048	
Piston ring expander	Removing and installing piston ring	
		
	NT030	

PREPARATION

[QG]

Tool name		Description
Valve guide drift	 NT015	Removing and installing valve guide Intake & Exhaust: a: 9.5 mm (0.374 in) dia. b: 5.5 mm (0.217 in) dia.
Valve guide reamer	 NT016	Reaming valve guide 1 or hole for oversize valve guide 2 Intake & Exhaust: d1 : 5.5 mm (0.217 in) dia. d2 : 9.685 mm (0.3813 in) dia.
Front oil seal drift	 NT049	Installing front oil seal a: 50 mm (1.97 in) dia. b: 44 mm (1.73 in) dia.
Rear oil seal drift	 NT049	Installing rear oil seal a: 102 mm (4.02 in) dia. b: 90 mm (3.54 in) dia.

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting —Engine Noise

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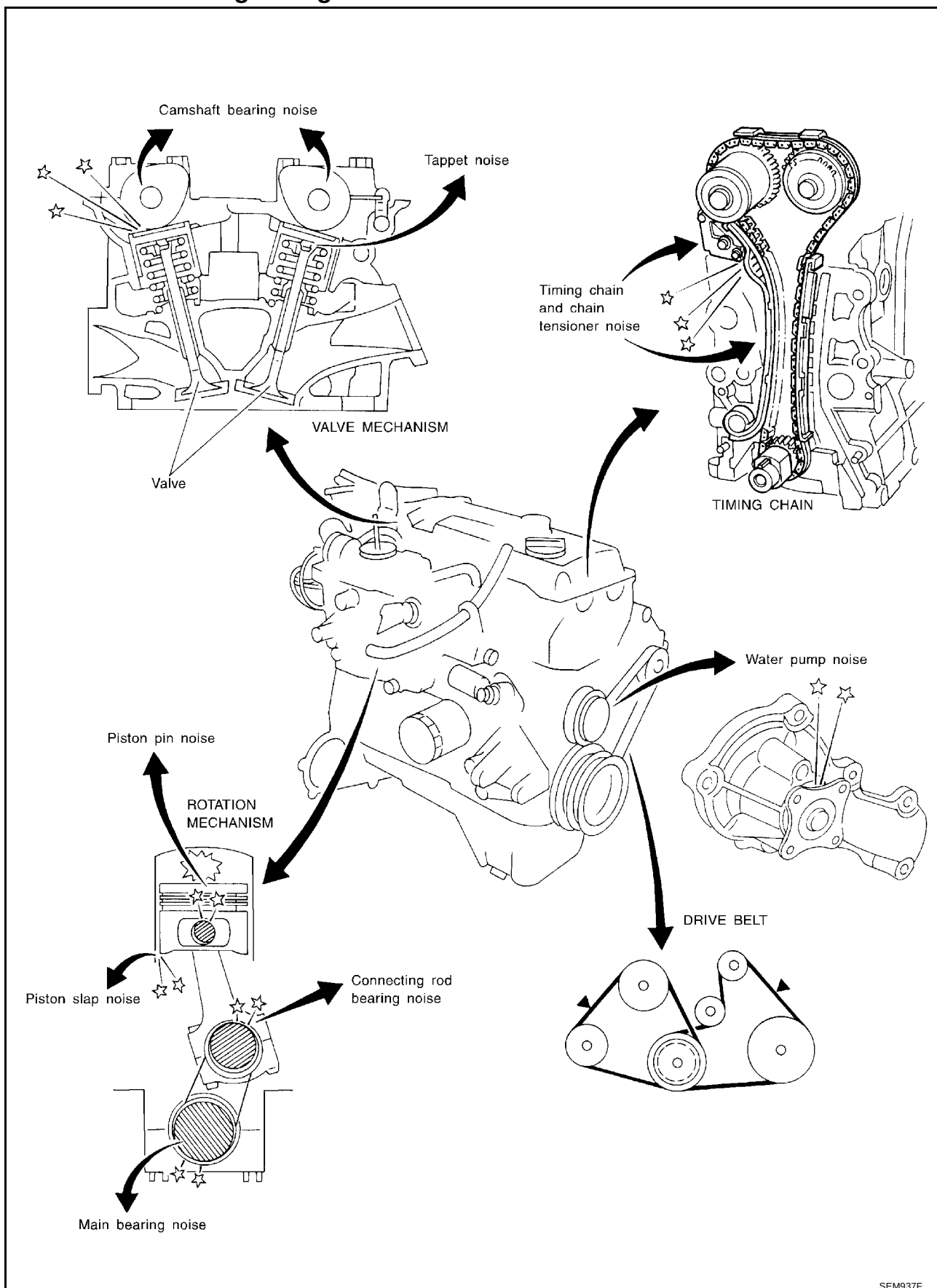
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SEM937F

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

EBS00LPX

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.

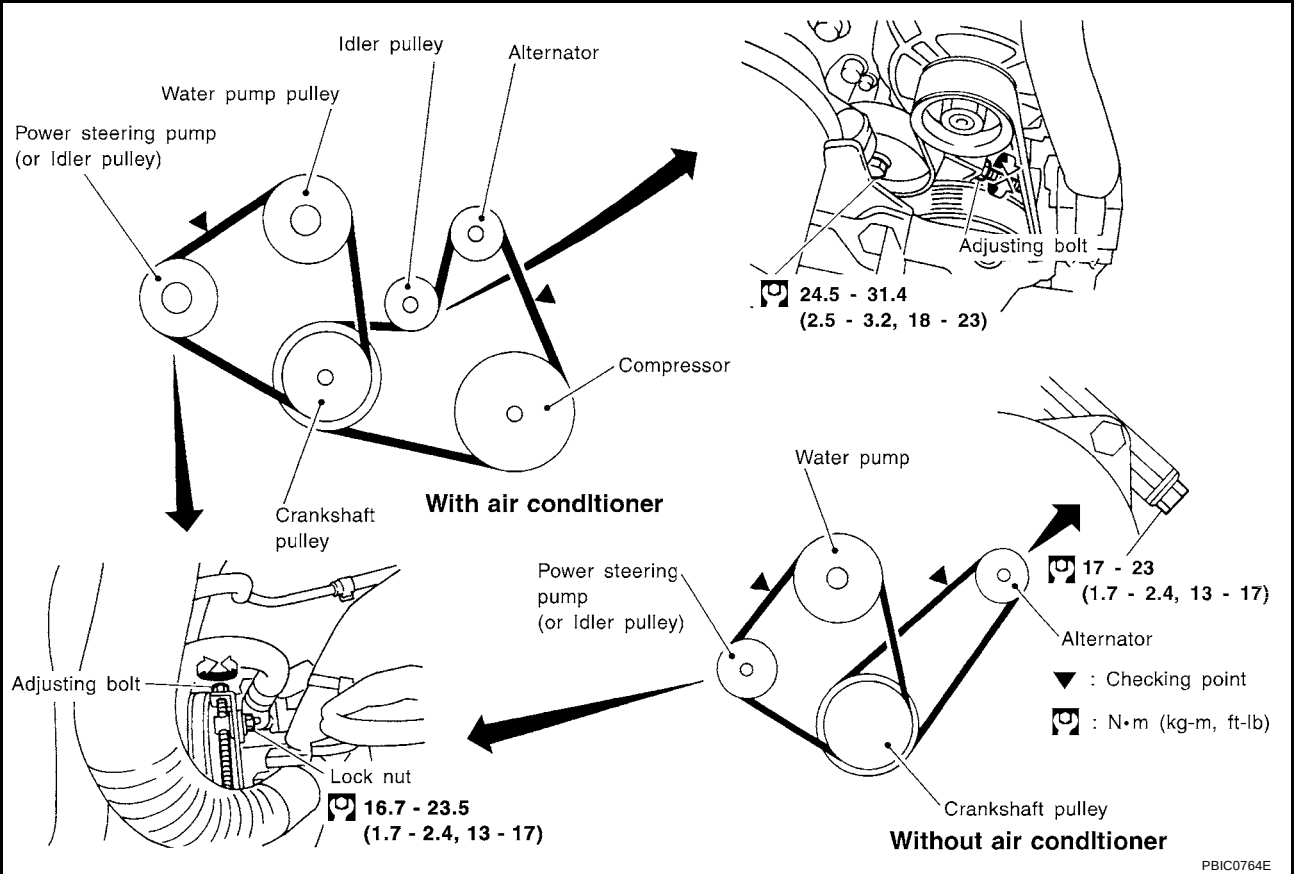
If necessary, repair or replace these parts.

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-42
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	● Camshaft journal clearance ● Camshaft runout	EM-39 EM-39
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	● Piston and piston pin clearance ● Connecting rod bushing clearance	EM-84 EM-87
	Slap or rap	A	—	—	B	B	A	Piston slap noise	● Piston-to-bore clearance ● Piston ring side clearance ● Piston ring end gap ● Connecting rod bend and torsion	EM-88 EM-85 EM-86 EM-86
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	● Connecting rod bushing clearance (Small end) ● Connecting rod bearing clearance (Big end)	EM-87 EM-87
	Knock	A	B	—	A	B	C	Main bearing noise	● Main bearing oil clearance ● Crankshaft runout	EM-91 EM-90
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-51 EM-47
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	● Drive belts deflection	EM-11
	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	LC-14

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

DRIVE BELTS

Checking Drive Belts



- Before inspecting the engine, make sure the engine has cooled down; wait approximately 30 minutes after the engine has been stopped.
- Visually inspect all belts for wear, damage, or cracks on contacting surfaces and edge areas.
- When measuring deflection, apply 98 N (10 kg, 22 lb) at the ▼ marked point.

CAUTION:

When measuring belt tension immediately after belt is installed, first set the tension to the standard. Then, rotate crankshaft for more than two turns in order to eliminate variance in belt deflection between the pulleys. Re-measure and adjust the tension to the standard.

		Deflection adjustment Unit: mm (in)		
		Used belt		New belt
		Limit	After adjustment	
Alternator	Without air conditioner compressor	10.2 (0.402)	6.5 - 7.0 (0.256 - 0.276)	5.5 - 6.1 (0.217 - 0.240)
	With air conditioner compressor	8.1 (0.319)	5.3 - 5.7 (0.209 - 0.224)	4.5 - 5.0 (0.177 - 0.197)
Power steering oil pump		7.1 (0.280)	4.4 - 4.9 (0.173 - 0.193)	3.9 - 4.4 (0.154 - 0.173)
Applied pushing force		98 N (10 kg, 22 lb)		

Tension Adjustment

Portion	Belt tightening method for adjustment
Power steering pump and water pump belt	Adjusting bolt on power steering pump
Alternator and air conditioner compressor belt	Adjusting bolt on idler pulley

CAUTION:

- When belt is replaced with a new one, tighten it a little stronger than current one to accommodate for insufficient adaptability with pulley grooves.
- When tension of belt being used exceeds "Retightening limit", adjust it to value for "Used belt".
- When installing belt, make sure that it is correctly engaged with pulley groove.
- Keep oil and water away from belt.
- Do not twist or bend belt excessively.
- When adjusting belt, remove snap retainer from adjusting bolt thread (to prevent the retainer from becoming pinched or missing).
- After adjustment, be sure to install snap retainer to adjusting bolt thread.

NOTE:

Snap retainer can prevent adjusting bolt from dropping due to vibration during driving.

POWER STEERING PUMP AND WATER PUMP BELT

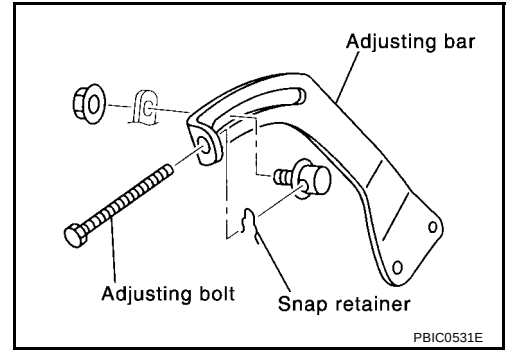
- Loosen lock nut (A) and power steering pump mounting nut (B).
- Turn adjusting bolt (C) to adjust. Refer to [EM-11, "Checking Drive Belts"](#).
- Tighten lock nut (A) and power steering pump mounting nut (B) in this order.

Nut A :

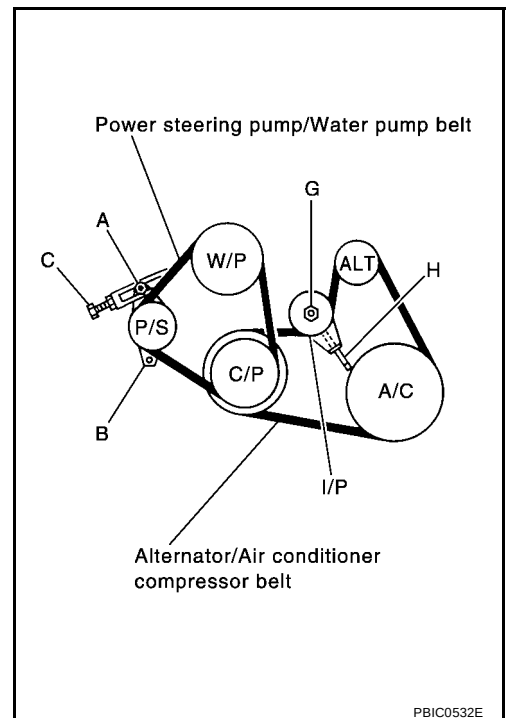
 : 16.7 - 23.5 N·m (1.7 - 2.4 kg-m, 13 - 17 ft-lb)

Nut B :

 : 26.5 - 36.3 N·m (2.7 - 3.7 kg-m, 20 - 26 ft-lb)



PBIC0531E



PBIC0532E

ALTERNATOR AND AIR CONDITIONER COMPRESSOR BELT

- Remove RH splash cover (with undercover attached).
- Loosen lock nut (G).
- Turn adjusting bolt (H) to adjust. Refer to [EM-11, "Checking Drive Belts"](#).
- Tighten lock nut (G).

Nut G :

 : 24.5 - 31.4 N·m (2.5 - 3.2 kg-m, 18 - 23 ft-lb)

Removal and Installation

REMOVAL

- Loosen each belt while referring to “Tension Adjustment”, and remove them one by one starting from the one in front.

INSTALLATION

1. Install belts to pulley in reverse order of removal.
2. Adjust belt tension.

CAUTION:

- When checking belt tension immediately after installation, first, adjust to specified value. Then, after turning crankshaft more than two turns, re-adjust to specified value to avoid variation in deflection between pulleys.
 - Tighten idler pulley lock nut by hand and measure tension without looseness.
3. Tighten each adjusting bolt and nut to the specified torque.
 4. Make sure that tension of each belt is within the standard.

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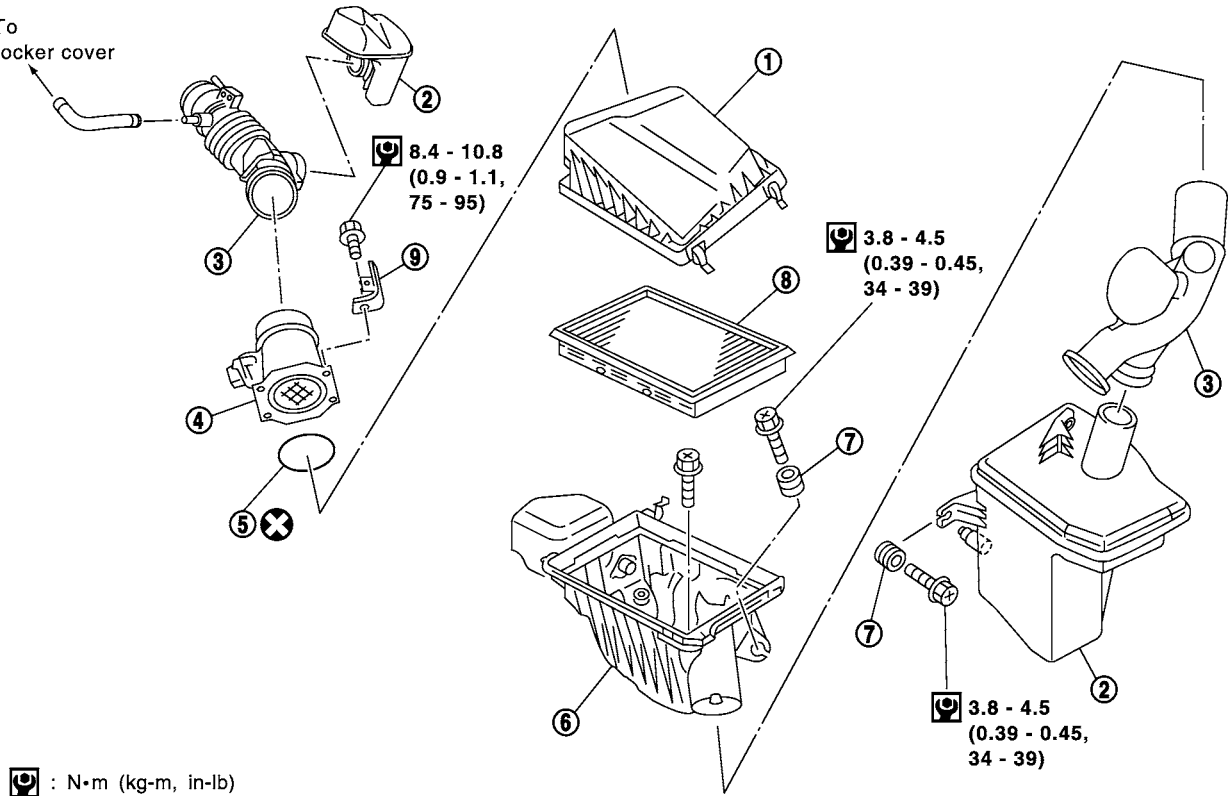
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AIR CLEANER AND AIR DUCT

Removal and Installation

SEC. 118•148•165

To
rocker cover



: N•m (kg-m, in-lb)

PBIC0533E

- | | | |
|-----------------------------|------------------------|-----------------------------|
| 1. Air cleaner case (upper) | 2. Resonator | 3. Air duct |
| 4. Mass air flow sensor | 5. O-ring | 6. Air cleaner case (lower) |
| 7. Grommet | 8. Air cleaner element | 9. Bracket |

REMOVAL

- Remove air cleaner case assembly, air duct and resonator.
 - Add marks as necessary for easier installation.
- Remove harness connector from mass air flow sensor.
- Remove mass air flow sensor.

CAUTION:

Handle mass air flow sensor with following cares.

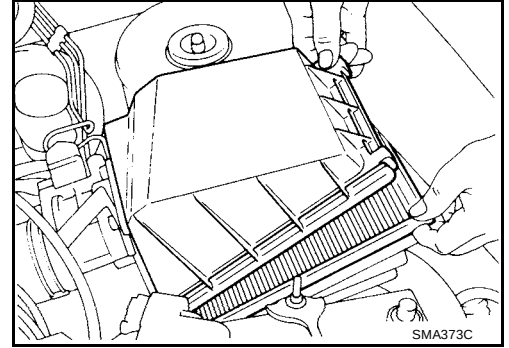
- Do not shock it.
 - Do not disassembly it.
 - Do not touch its sensor.
 - Do not deform mass air flow sensor's wire mesh.
- Remove left fender protector and resonator.

INSTALLATION

- Attach each joint aligning marks put at removal. Screw clamps firmly.
- Install in the reverse order of removal.

Changing Air Cleaner Element

The viscous paper type filter does not need cleaning between renewals.



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Removal and Installation

- | | | |
|--|------------------------------------|---|
| 1. Electric throttle control actuator | 2. Gasket | 3. Intake manifold collector |
| 4. EVAP canister purge volume control solenoid valve | 5. Vacuum hose | 6. Vacuum hose |
| 7. Hose clamp | 8. Intake manifold support (front) | 9. Harness bracket |
| 10. Vacuum hose | 11. Intake manifold | 12. PCV hose |
| 13. Gasket | 14. Vacuum hose | 15. Gasket |
| 16. Intake manifold support (rear) | 17. Harness bracket | 18. Intake manifold support (engine rear) |
| 19. Grounding wire | | |

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

1. Release fuel pressure.
Refer to [EC-34, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD), [EC-427, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
2. Remove air duct and air cleaner case.
Refer to [EM-14, "Removal and Installation"](#) .
3. Disconnect harness on engine top surface, and move it aside.
4. Disconnect fuel injector/fuel tube assembly from intake manifold, and move it aside.
 - It is not necessary to disconnect fuel hose.
5. Disconnect the following vacuum hoses.
6. Disconnect blow-by hose (between intake manifold collector and rocker cover).

INTAKE MANIFOLD

[QG]

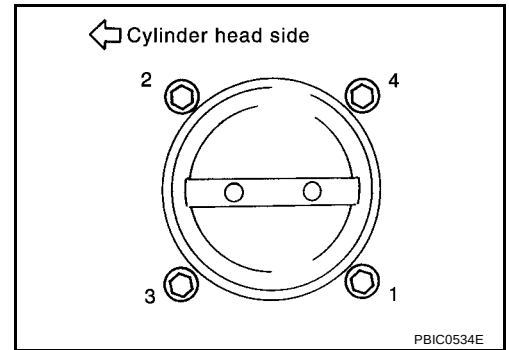
7. Loosen mounting bolts in reverse order shown in figure to remove electric throttle control actuator.

CAUTION:

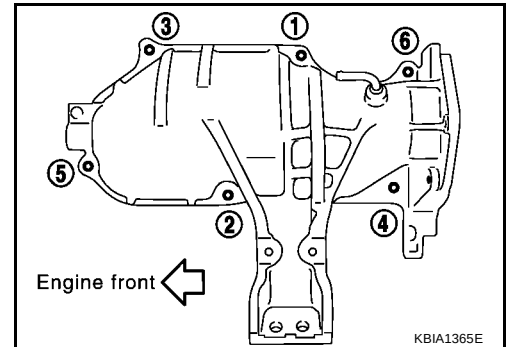
- Do not shock it.
- Do not disassembly and adjusting.

NOTE:

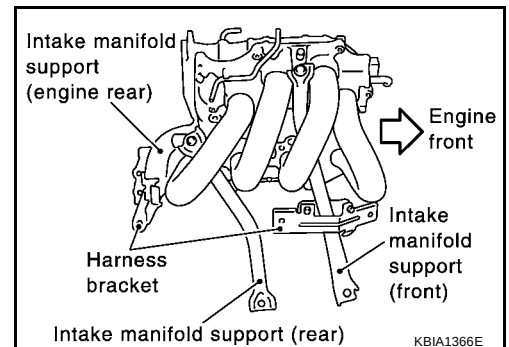
Remove intake manifold collector and electronic throttle control as a single assembly, then remove electronic throttle control itself.



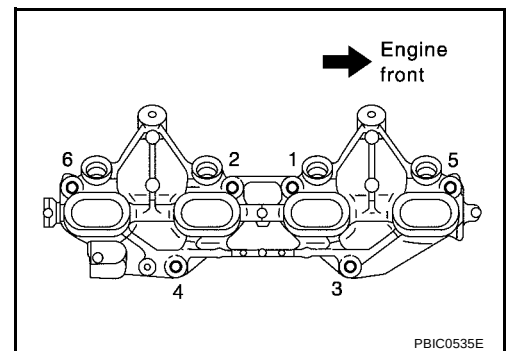
8. Remove bolt on cylinder head side of intake manifold collector.
9. Loosen intake manifold collector nuts and bolts in reverse of the order shown in the figure.
 - Do not remove intake manifold collector at this stage.



10. Move harness, which is fixed on intake manifold support, with bracket.
11. Remove intake manifold supports (rear, front, engine rear).



12. Loosen nuts and bolts in reverse order shown in the figure, and remove intake manifold from cylinder head.
13. Disconnect intake manifold collector from intake manifold, and pull out between engine and body.

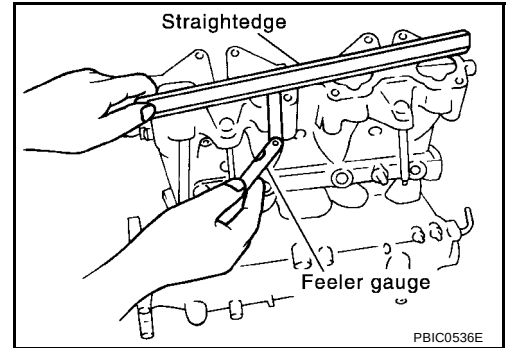


INSPECTION AFTER REMOVAL

Surface Distortion

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

Limit : 0.1 mm (0.004 in)

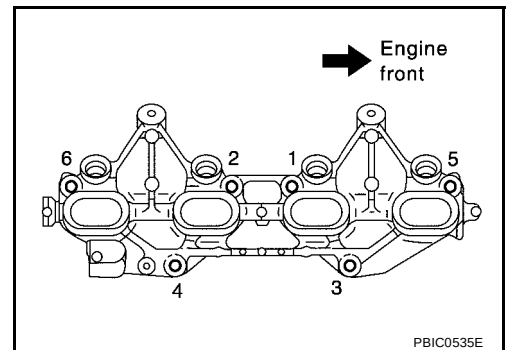


INSTALLATION

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

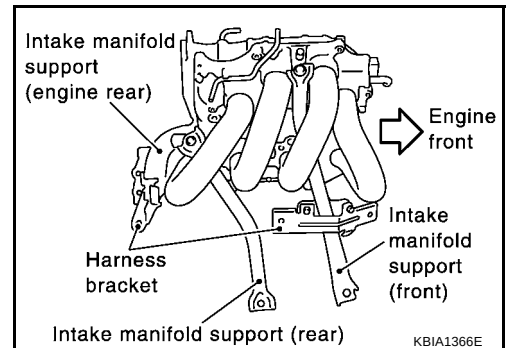
Tightening Intake Manifold

- Temporarily attach before installing intake manifold collector.
- Tighten in numerical order as shown in the figure.



Tightening Intake Manifold Collector

- Temporarily attach before installing intake manifold.
- Tighten in numerical order as shown in the figure.



Installation of Electric Throttle Control Actuator

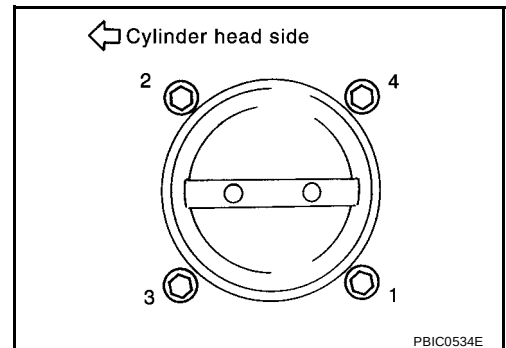
- Tighten mounting bolts for electric throttle control actuator in numerical order shown in figure.

⚙️ : 17.7 - 21.6 N·m (1.8 - 2.2 kg·m, 13 - 15 ft-lb)

CAUTION:

When electric throttle control actuator is replaced, perform idle air volume learning.

- Refer to BASIC SERVICE PROCEDURE, [EC-31, "Idle Air Volume Learning"](#) (WITH EURO-OBD), [EC-425, "Idle Air Volume Learning"](#) (WITHOUT EURO-OBD).



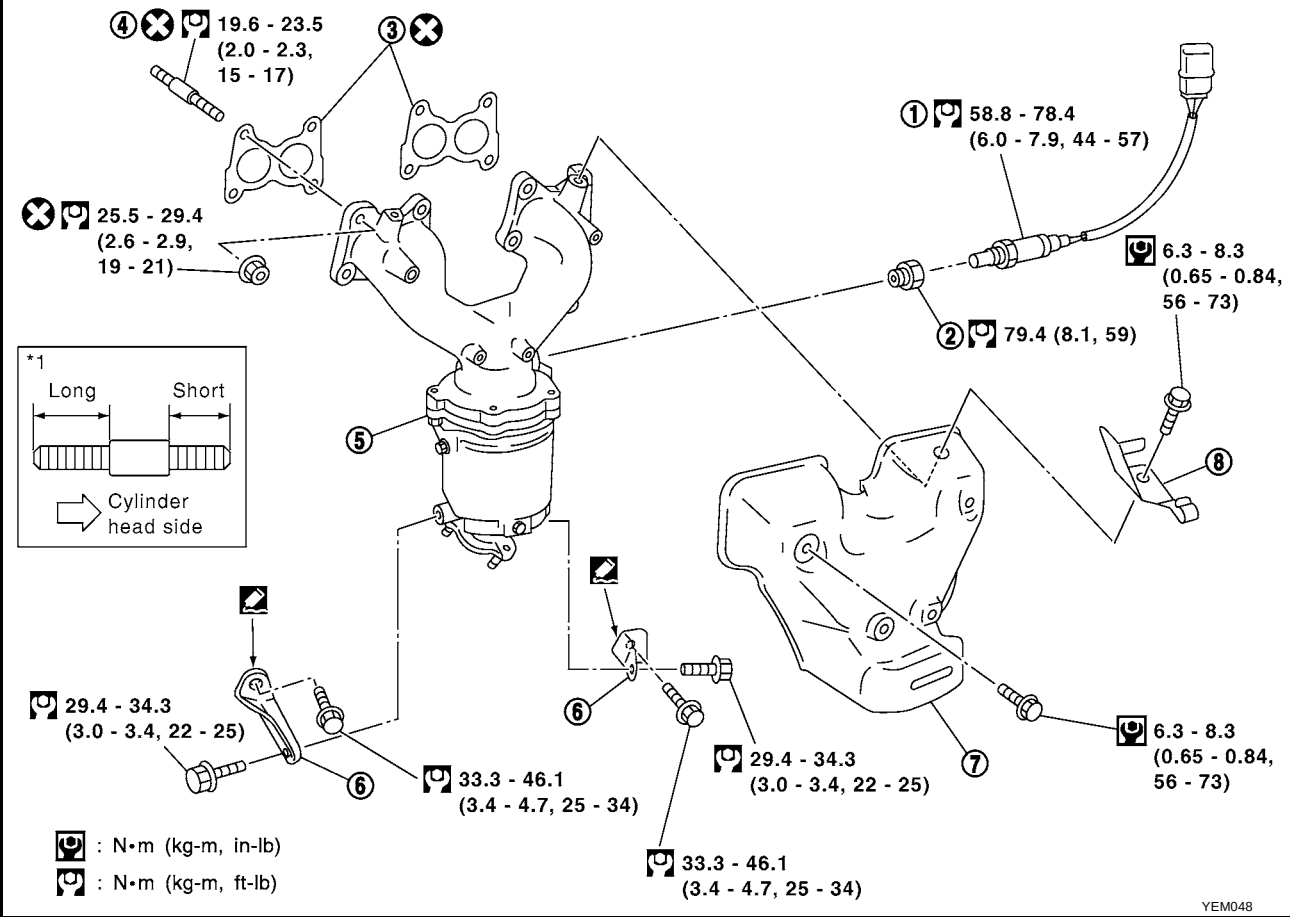
EXHAUST MANIFOLD AND CATALYTIC CONVERTER

PF14004

Removal and Installation

EBS00LQ4

SEC. 140•208•226



- | | | |
|---------------------------|--|------------|
| 1. Heated oxygen sensor 1 | 2. Ground nut | 3. Gasket |
| 4. Stud bolt | 5. Exhaust manifold and catalytic converter assembly | 6. Support |
| 7. Exhaust manifold cover | 8. Heated oxygen sensor harness bracket | |

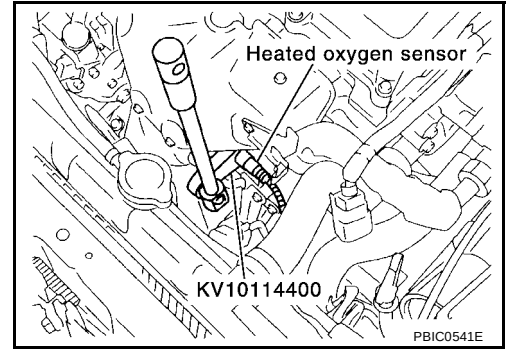
REMOVAL

- Remove undercover.
- Disconnect exhaust front tube from catalytic converter. Refer to FE-10, "Removal and Installation".
- Remove exhaust manifold support from both sides of catalytic converter.
- Disconnect heated oxygen sensor harness connector.
- Remove heated oxygen sensor.
 - Follow below steps to remove each heated oxygen sensor.

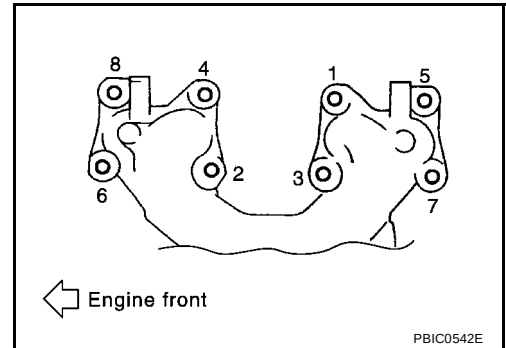
- Using heated oxygen sensor wrench, remove heated oxygen sensor.

CAUTION:

- Be careful not to damage heated oxygen sensor.
- When using heated oxygen sensor wrench, tighten to the middle of specified torque because length of tool may induce sight indication increase. (Do not tighten to the maximum specified torque)
- Do not over torque the heated oxygen sensor. Doing so may cause damage to the heated oxygen sensor, resulting in the MI coming on.



6. Remove exhaust manifold cover.
7. Loosen mounting nuts in reverse order shown in figure to remove exhaust manifold and catalytic converter assembly.

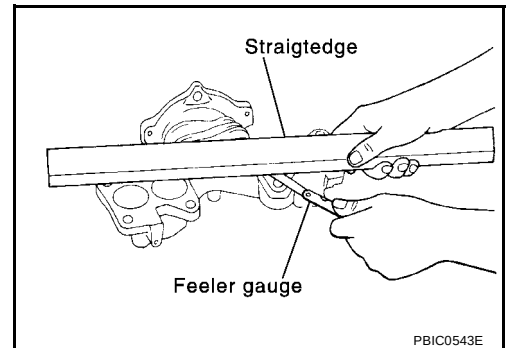


INSPECTION AFTER REMOVAL

Surface Distortion

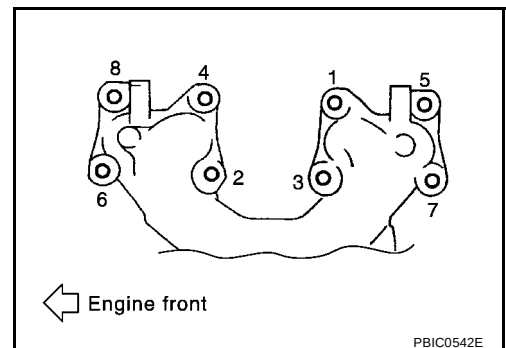
- Use a reliable straightedge and feeler gauge to check the flatness of exhaust manifold fitting surface.

Limit : 0.3 mm (0.012 in)



INSTALLATION

- Install in the reverse order of removal after this step.
- Tighten mounting nuts for exhaust manifold and catalytic converter assembly in order shown in figure.
- Before installing exhaust manifold support, apply liquid gasket to contact surface on engine side. Use Genuine Liquid Gasket or equivalent.



Installation of Heated Oxygen Sensor

CAUTION:

- Do not over torque the heated oxygen sensor. Doing so may cause damage to the heated oxygen sensor, resulting in the MI coming on.

Disassembly and Assembly

EBS00LQX

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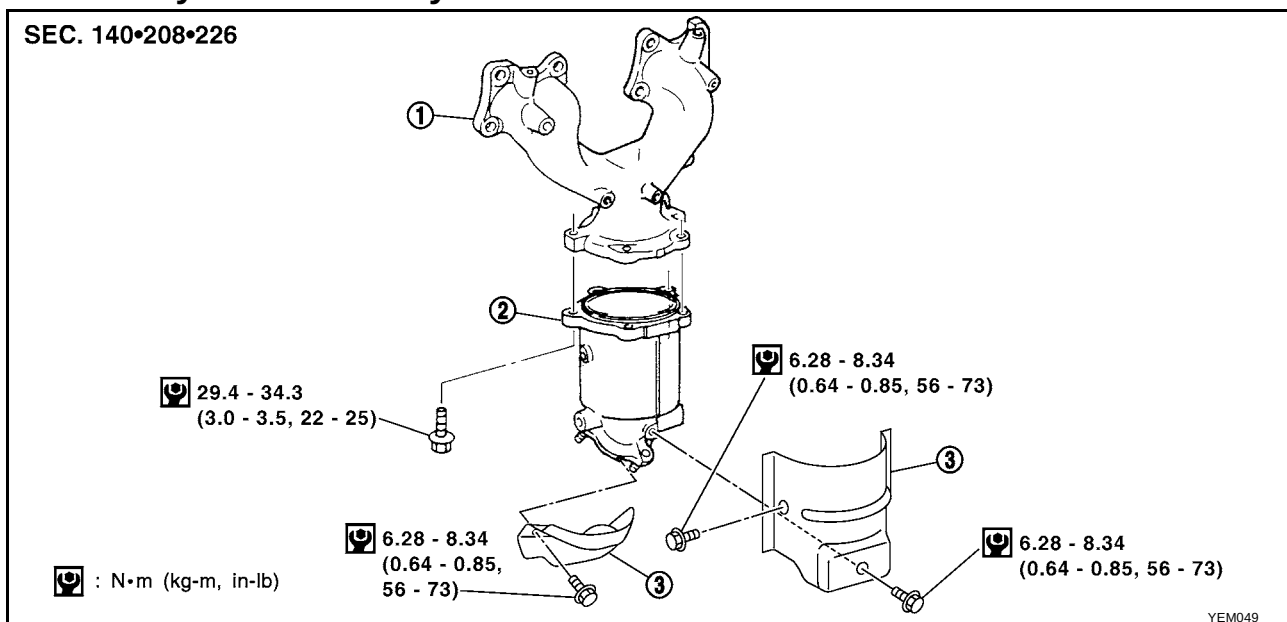
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DISASSEMBLY

1. Remove catalytic converter cover.
2. Disconnect exhaust manifold and catalytic converter.

CAUTION:

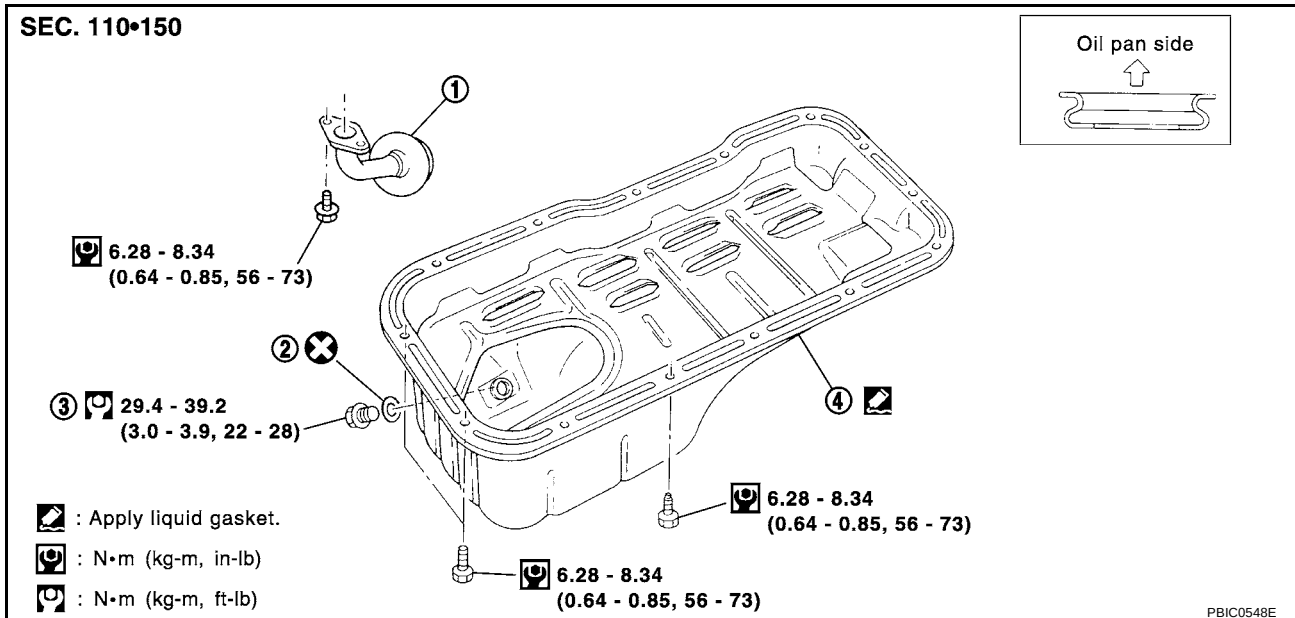
Be careful not to damage catalytic converter.

ASSEMBLY

- Assemble in reverse order of disassembly.

OIL PAN AND OIL STRAINER

Removal and Installation

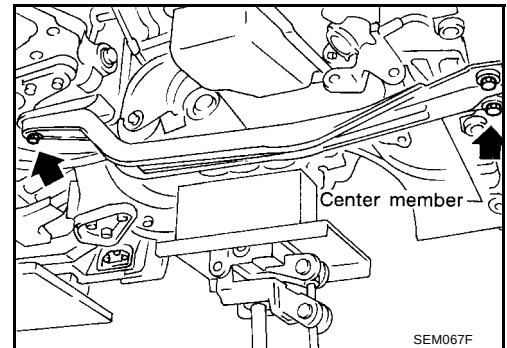


REMOVAL

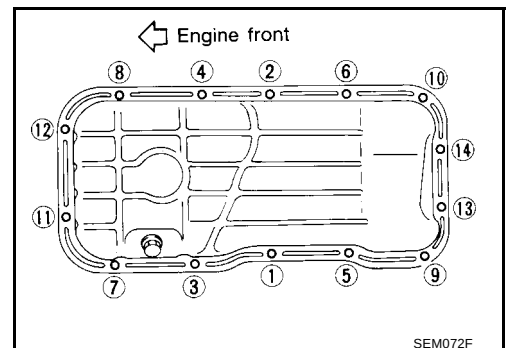
WARNING:

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

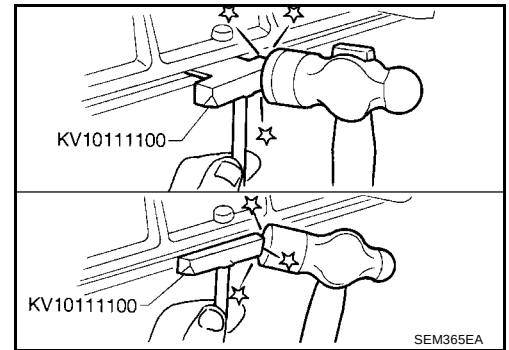
1. Remove undercover.
2. Drain engine oil. Refer to LC-8, "Changing Engine Oil".
3. Remove exhaust front tube. Refer to FE-10, "Removal and Installation".
4. Using a transmission jack, be sure to support the bottom of transaxle oil pan, and remove center member.
5. Remove gusset and engine rear plate (lower) [A/T vehicle].



6. Loosen and remove mounting nuts and bolts in reverse order shown in figure.



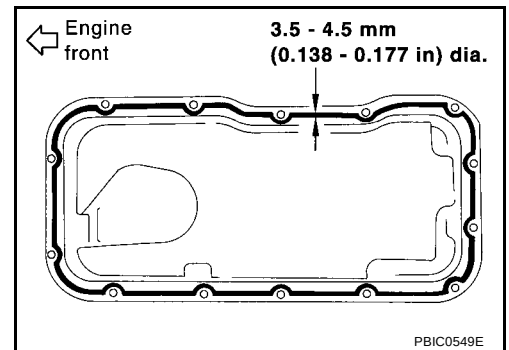
7. Insert Tool (Seal cutter) between oil pan and cylinder block. Slide tool by tapping on the side of the tool with a hammer. Remove oil pan.
8. Remove oil strainer.



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INSTALLATION

1. Install oil strainer.
- NOTE:**
Gasket and O-ring are not used for sealed area with oil pump.
2. Install oil pan drain plug.
 - Referring to "Components", install drain plug washer.
 3. Apply a continuous bead of liquid gasket to position shown in figure. Use Genuine Liquid Gasket or equivalent.



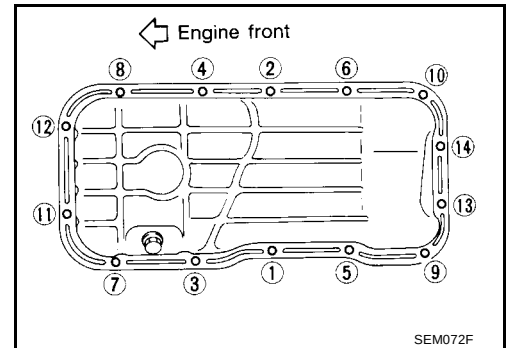
4. Tighten mounting nuts and bolts in order shown in figure.
 - Install mounting nuts and bolts as follows.

Mounting bolt:

[Shank length under head 10 mm (0.39 in)] : Nos. 1 - 10, 13, 14

[Shank length under head 12 mm (0.47 in)] : Nos. 11, 12

5. Install center member.
Refer to ENGINE ASSEMBLY, [EM-67, "Removal and Installation"](#).
6. Install remaining parts in the reverse order of removal.



INSPECTION AFTER INSTALLATION

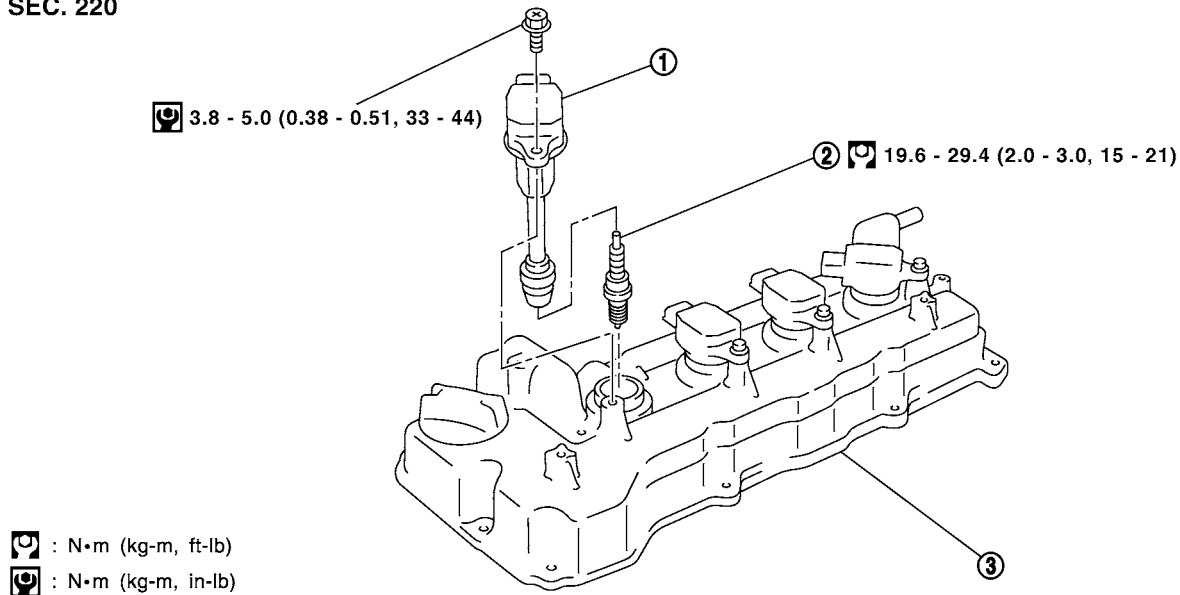
- Check for leakage of engine oil when engine is warmed.
- Pour engine oil or start engine at least 30 minutes after oil pan is installed.

IGNITION COIL

Removal and Installation

EBS00LQ7

SEC. 220



YEM050

1. Ignition coil

2. Spark plug

3. Rocker cover

REMOVAL

1. Remove ignition coil harness connector from ignition coil.
2. Remove ignition coil.

CAUTION:

- Do not shock it.
- Do not disassemble it.

INSTALLATION

- Install in the reverse order of removal.

SPARK PLUG (CONVENTIONAL)

[QG]

PFP:22401

EBS00LQ8

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SPARK PLUG (CONVENTIONAL)

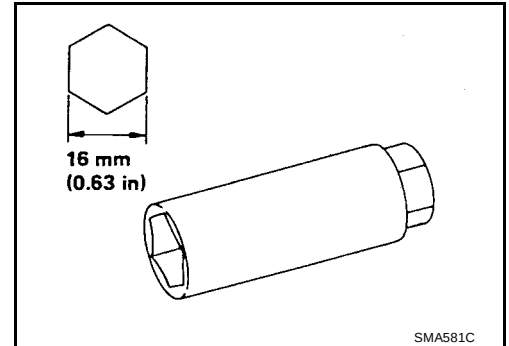
Removal and Installation

REMOVAL

1. Disconnect ignition coil harness connector from ignition coil.
2. Remove ignition coil.
3. Remove spark plugs with a spark plug wrench (commercial service tool).

Spark plug

Make	NGK	Champion
Standard type	LFR5A-11	REC10YC4
Hot type	LFR4A-11	—
Cold type	LFR6A-11	—

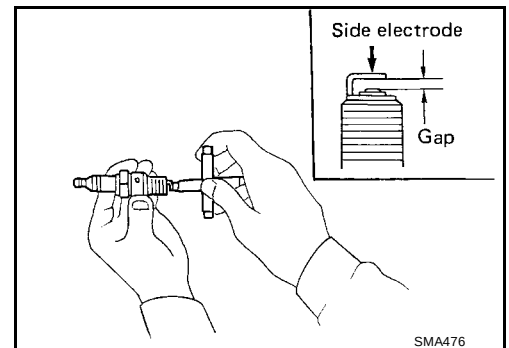


INSPECTION AFTER REMOVAL

Check spark plug gap. Adjust or replace if necessary.

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

- Use a wire brush for cleaning, if necessary.



INSTALLATION

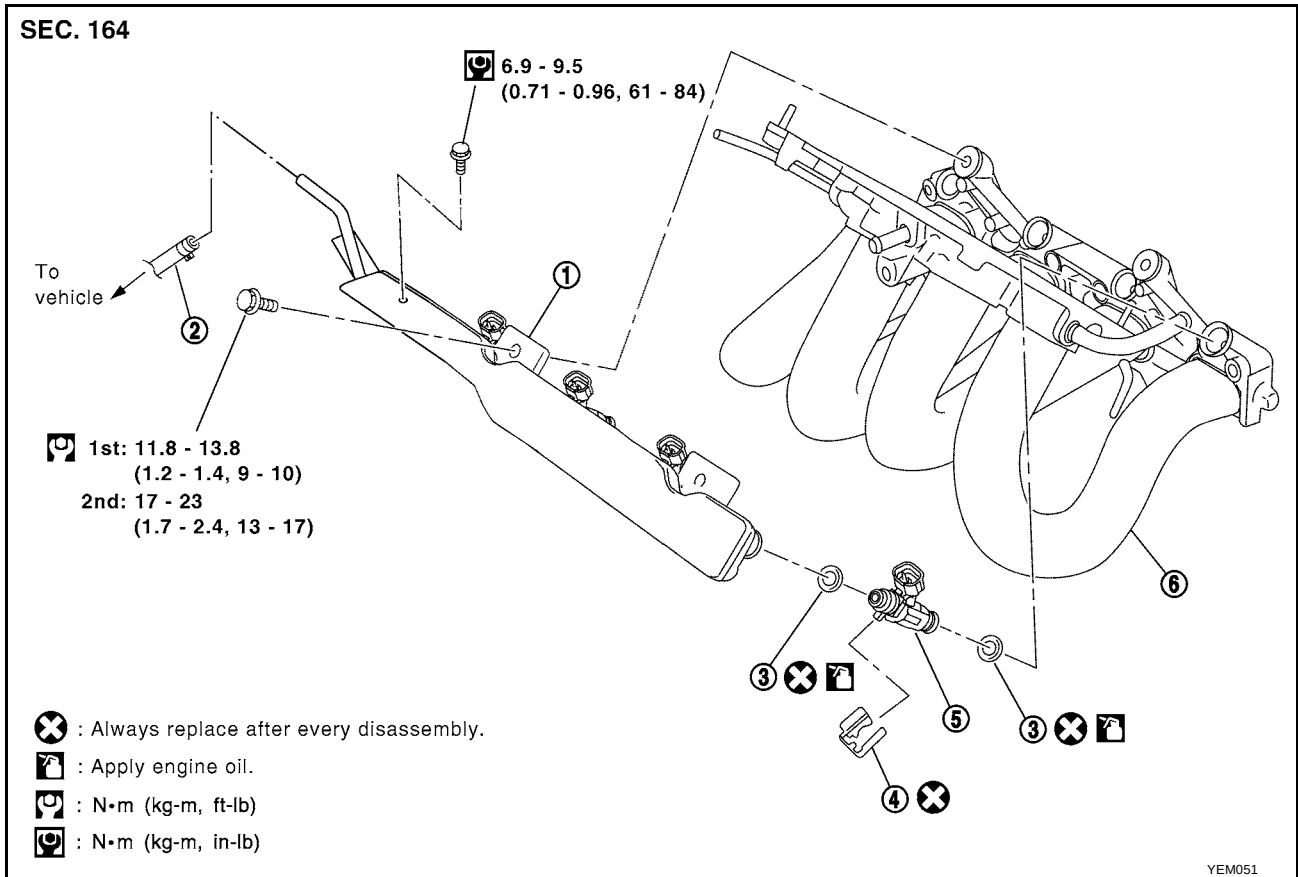
Install in the reverse order of removal, paying attention to the following.

Spark plug:

⚙️ : 19.6 - 29.4 N·m (2.0 - 3.0 kg-m, 15 - 21 ft-lb)

FUEL INJECTOR AND FUEL TUBE

Removal and Installation



CAUTION:

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

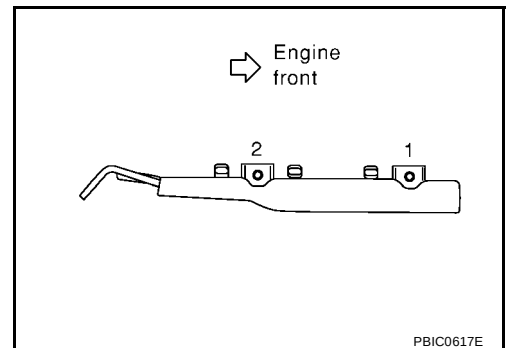
REMOVAL

1. Release fuel pressure. Refer to [EC-34, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD), [EC-427, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
2. Disconnect harness for fuel injector, and move it aside.
3. Remove fuel hose.

CAUTION:

After removal, install blind plug to fuel hose to prevent the fuel from draining.

4. Remove fuel tube and injector assembly with the following procedure:
 - a. Loosen mounting bolts in reverse order shown in figure.



- b. Pull out fuel injector/fuel tube assembly toward engine rear side.

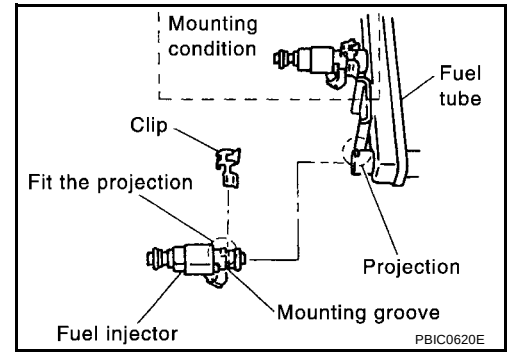
CAUTION:

Do not touch fuel injector nozzle with intake manifold or other parts.

5. Remove fuel injector from fuel tube.
 - Release clip and remove it.
 - Pull fuel injector straight out of fuel tube.

CAUTION:

- Be careful not to damage nozzle part.
- Avoid any impact such as a dropping.
- Do not disassemble or adjust it.



INSTALLATION

1. When installing O-ring to fuel injector, follow instructions described below.

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.
- Be careful not to scratch it with a tool or fingernails during installation. Also be careful not to twist or stretch O-ring. If O-ring is stretched while being attached, do not insert it into fuel tube immediately.
- Insert O-ring straight into fuel tube. Do not angle or twist it.

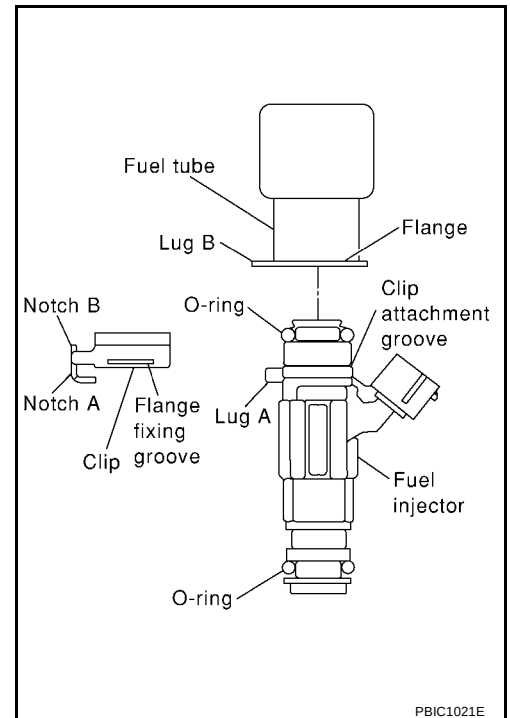
2. Install fuel injector to fuel tube with the following procedure.

- 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.



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

 **1st step : 11.8 - 13.8 N·m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)**

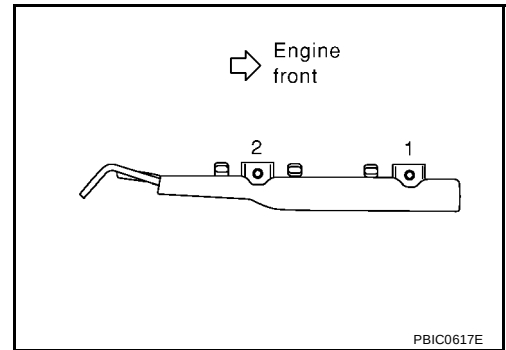
 **2nd step : 17 - 23 N·m (1.7 - 2.4 kg-m, 13 - 17 ft-lb)**

4. Install fuel feed hose.

CAUTION:

Install hose clamp avoiding interference with bulge, and securely tighten it

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

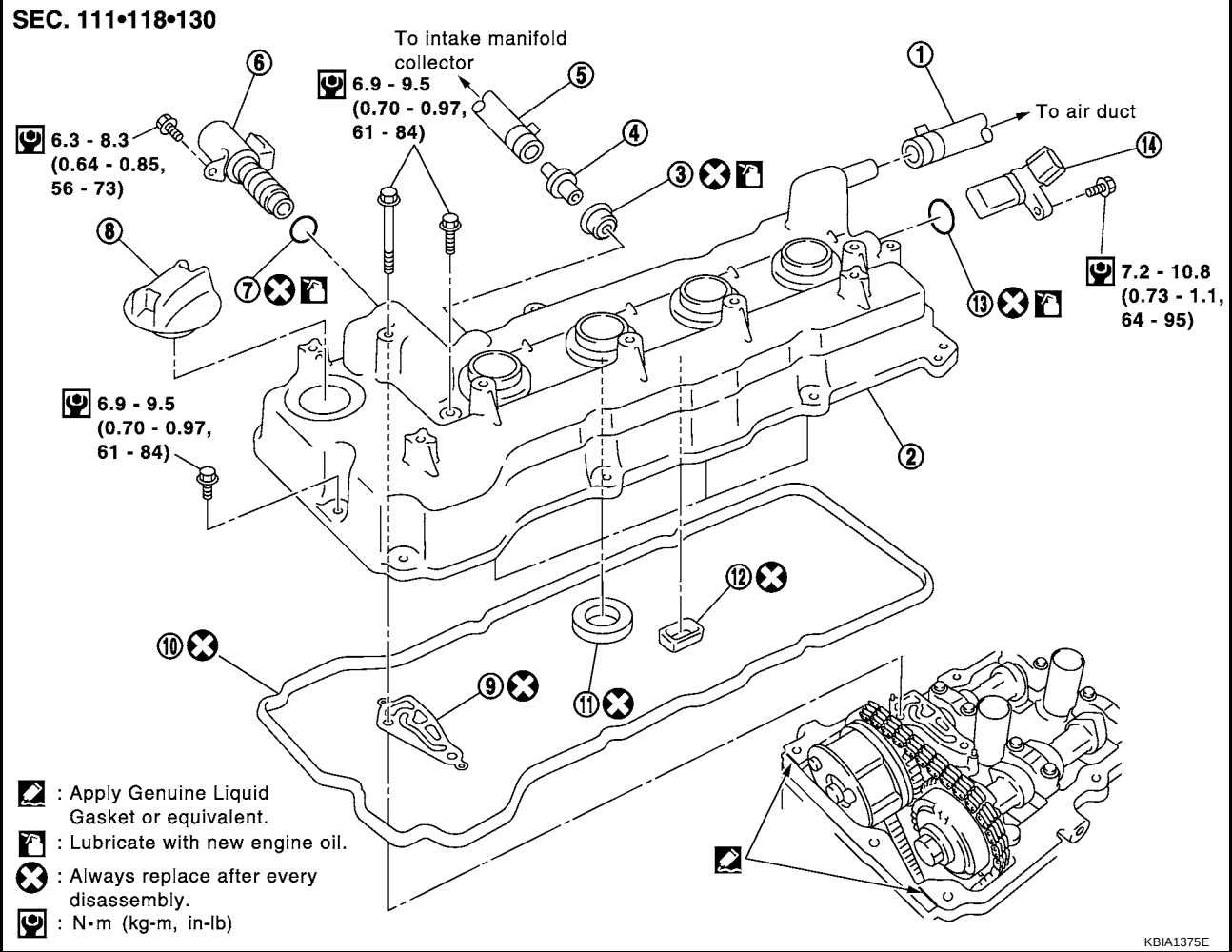


INSPECTION AFTER INSTALLATION

- Check for fuel leakage with following procedure.
 1. Turn ignition switch ON (do not start engine), and check connections for leakage by applying fuel pressure to fuel piping.
 2. Start engine, and re-check connections for fuel leakage by increasing engine speed.

ROCKER COVER

Removal and Installation



CAUTION:

Apply new engine oil when installing the parts that specified to do so in the figure.

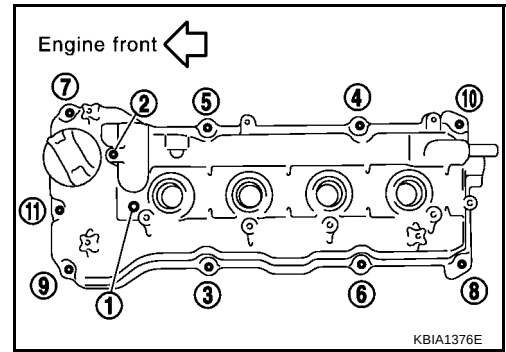
REMOVAL

1. Move harnesses on top surface and right side of rocker cover, and move them aside.
2. Remove ignition coil. Refer to [EM-24, "Removal and Installation"](#).
3. Disconnect PCV hoses on rocker cover side.
4. If necessary, remove PCV control valve.
5. If necessary, remove intake valve timing control solenoid valve and camshaft position sensor (PHASE).

CAUTION:

- Do not shock it.
- Do not disassemble it.
- Tip of camshaft position sensor (PHASE) generates strong magnetic fields. Keep it away from metal particles or objects affected by magnetic fields.

6. Loosen bolts in reverse order shown in the figure.



7. If replacement is necessary, remove rocker cover oil seal using flat-head screwdriver.

CAUTION:

Be careful not to damage rocker cover.

INSTALLATION

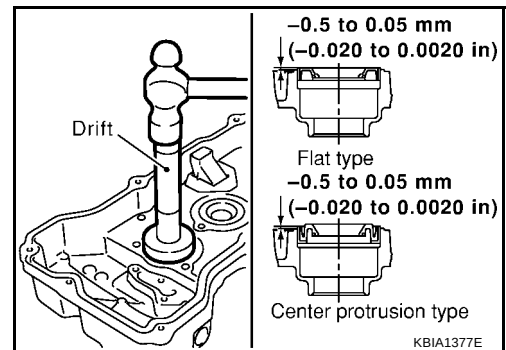
1. Install rocker cover oil seal.

- Using drift with outer diameter 97 mm (3.82 in) and inner diameter 83 mm (3.27 in) to 88 mm (3.46 in) (commercial service tool), press oil seal in.

NOTE:

There are 2 types of oil seal. If oil seal with flat bottom surface is pressed in, drift with any inner diameter can be used.

- Press oil seal in until it is flush with installation surface.

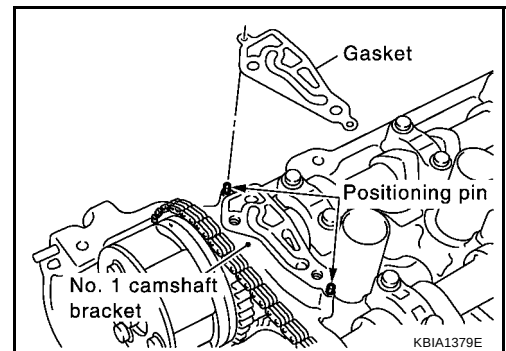


2. Install rocker cover in following steps.

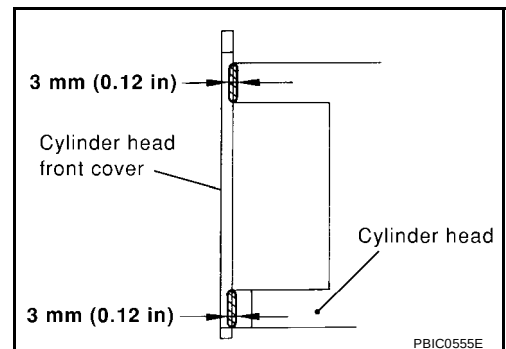
- a. Install gasket on top of No. 1 camshaft bracket.

- Position gasket aligning its shape with camshaft bracket side. Align positioning stopper pin with hole on gasket, and install.

- b. Install gasket (for circumference, square type) to installation groove of rocker cover.



- c. Apply liquid gasket to positions shown in figure, then install rocker cover.

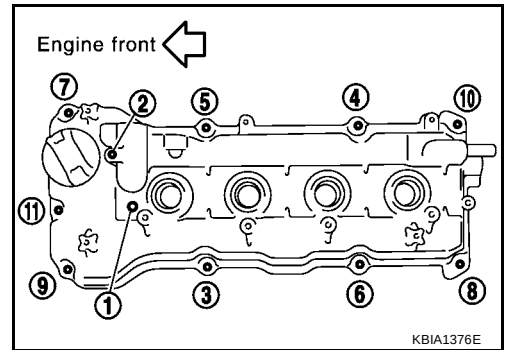


ROCKER COVER

[QG]

- d. Tighten mounting screws to specified torque in 2 or more steps in numerical order shown in figure.

Bolt length:	Bolt position
25 mm (0.98 in)	: 1
65 mm (2.56 in)	: 2
20 mm (0.79 in)	: Except the above (all circumference)

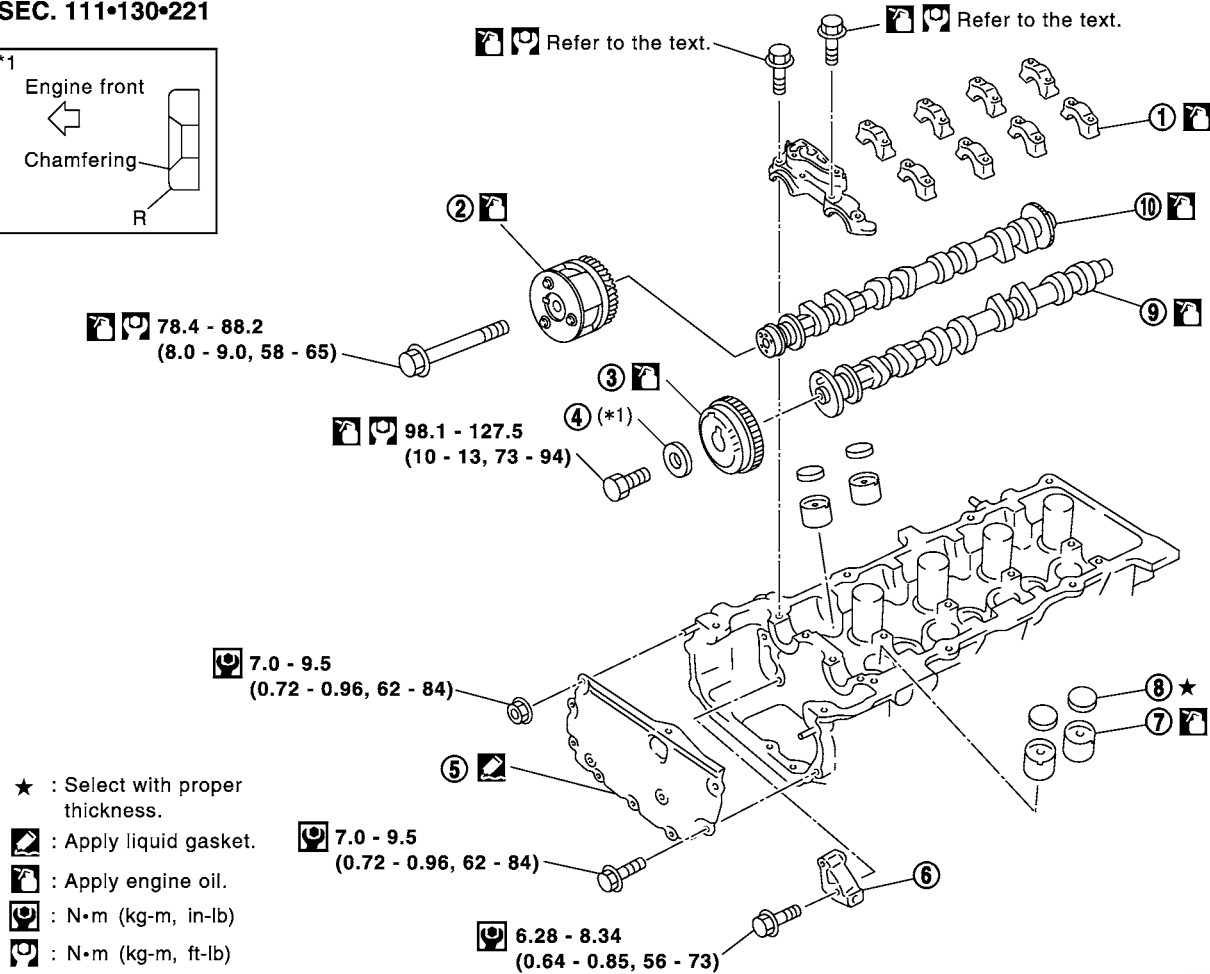
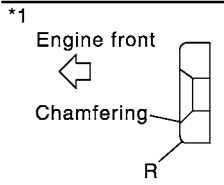


3. Install intake valve timing control solenoid valve and camshaft position sensor (PHASE).
 - Tighten bolt after fully inserting it into rocker cover.
4. Install PCV valve.
 - Insert until flange contacts grommet tightly.
5. Install remaining parts in the reverse order of removal.

CAMSHAFT

Removal and Installation

SEC. 111•130•221



PBIC0965E

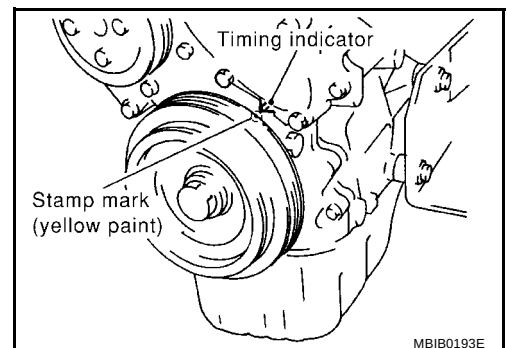
- | | | |
|---------------------|------------------------------------|----------------------------|
| 1. Camshaft bracket | 2. Camshaft sprocket (INT) | 3. Camshaft sprocket (EXH) |
| 4. Washer | 5. Cylinder head front cover | 6. Chain tensioner |
| 7. Valve lifter | 8. Adjusting shim (If so equipped) | 9. Camshaft (EXH) |
| 10. Camshaft (INT) | | |

CAUTION:

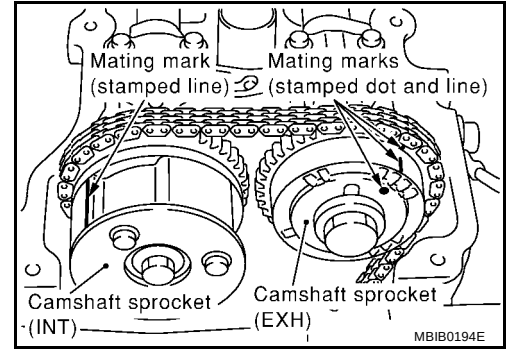
Prior to installation, apply engine oil to the parts marked in the figure.

REMOVAL

- Remove rocker cover. Refer to [EM-29, "ROCKER COVER"](#).
- Remove cylinder head front cover.
 - Move harness secured to front surface beforehand.
- Set No. 1 cylinder at TDC of its compression stroke.
 - Remove RH splash cover (integrated with undercover).
 - Rotate crankshaft pulley clockwise and align yellow paint mark with timing indicator.



- c. Confirm mating marks stamped on intake and exhaust sprockets are located as shown.
 - If not, rotate crankshaft pulley as shown and align them.
- d. Referring to mating marks on intake and exhaust camshaft sprockets, put paint mating marks on timing chain links.

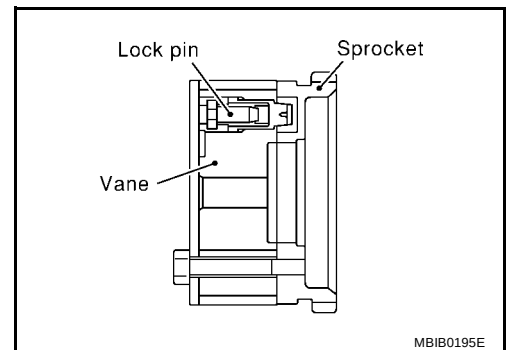


4. Set intake camshaft sprocket to most advanced position.

CAUTION:

Removal/installation of intake camshaft sprocket is required to maintain most advanced position because of following reasons. Therefore, follow procedure exactly.

- Sprocket and vane (camshaft in front) rotate and become offset within specific angle range.
- When engine is stationary, vane is located at most retarded position. Vane is fixed to sprocket by internal lock pin. Therefore, it does not rotate.
- If camshaft sprocket mounting bolts are turned under above circumstance, lock pin will be damaged by lateral load (shear stress). It may cause non-standard operation.
- Set intake camshaft sprocket to most advanced position as follows.



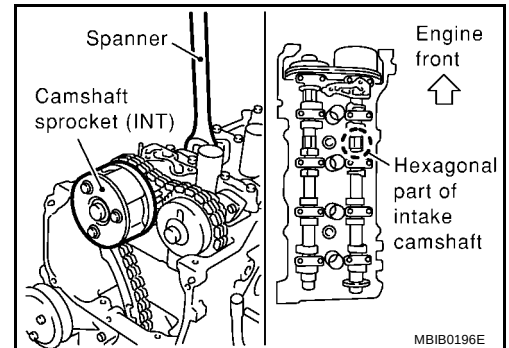
NOTE:

"Rotating direction" means direction viewed from engine front side.

CAUTION:

Do not remove chain tensioner before performing this step.

- a. Using a wrench, hold hexagonal part so that intake camshaft does not move.



- b. Using an air gun, apply air pressure to intake valve timing control solenoid valve advanced side oil passage on top surface of No. 1 camshaft bracket.

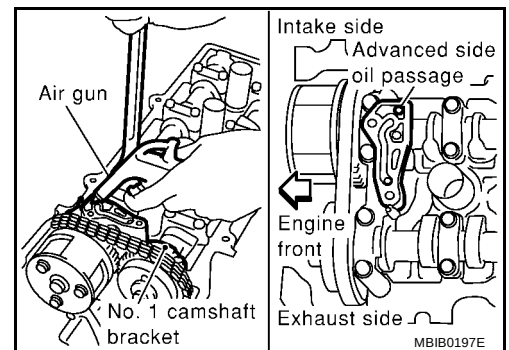
Compression pressure

: 300 kPa (3.00 bar, 3.06 kg/cm², 43.5 psi) or more

- Keep applying air pressure until step "d" is completed.

CAUTION:

- Be careful not to damage oil passage from interference of air gun tip.
- Thoroughly wipe off oil before applying air pressure. When applying air pressure, cover around air gun using a rag. Wear protective glasses if necessary.



- c. Slowly turn intake camshaft in direction A (counterclockwise: intake manifold side).
- Perform while applying air pressure.

CAUTION:

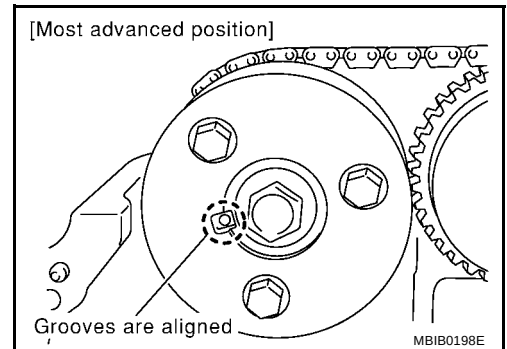
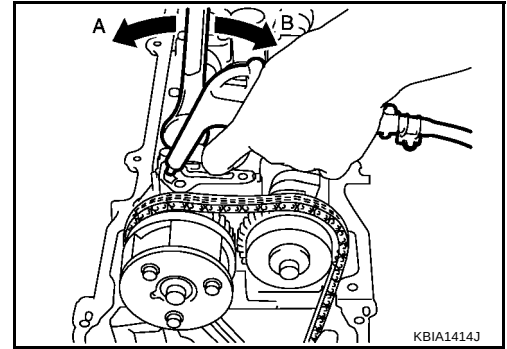
Be careful not to dislocate camshaft retaining spanner.

- d. During above step, operating click (a sound indicating internal lock pin is disengaged) is heard from inside of intake camshaft sprocket. After hearing it, slowly turn intake camshaft in direction B (clockwise: exhaust manifold side), and set to most advanced position.

- Perform while applying air pressure.
- When vane rotates solely against sprocket, lock pin is disengaged even if operating click is not heard.
- If lock pin is not disengaged, apply vibration by jiggling the camshaft with a spanner.
- If lock pin is not disengaged with above step, hit intake camshaft in front by using plastic hammer.

- e. The following status indicates that most advanced position is achieved: vane starts rotating on its own, then sprocket also starts rotating when camshaft is turned. When above status is achieved, this step is complete.

- Most advanced position is confirmed when stopper pin groove and lock pin breathing groove are aligned.



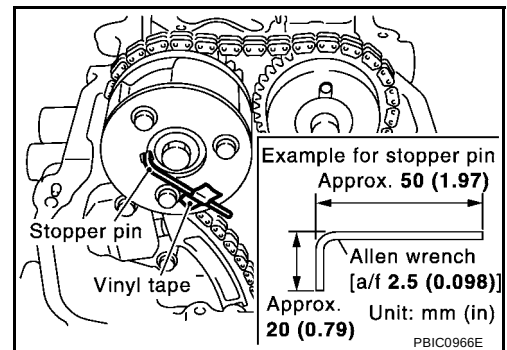
- f. Stop air, insert stopper pin [approximately 3 mm (0.12 in) dia., length of inserted part is approximately 15 mm (0.59 in)] into pinhole on camshaft sprocket to fix most advanced position.

NOTE:

In the figure, an Allen wrench [a/f 2.5 mm (0.091 in), short part: approximately 20 mm (0.79 in), long part: approximately 50 mm (1.97 in)] is used for stopper pin as an example.

CAUTION:

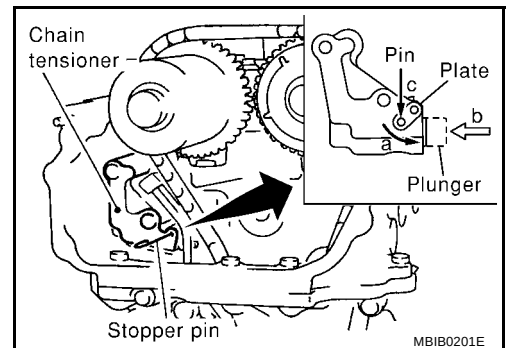
Load (spring reaction force) is not applied to stopper pin. Pin is easily detached. Therefore, secure it with vinyl tape to prevent detachment.



5. Remove chain tensioner.

- Remove in the following order.

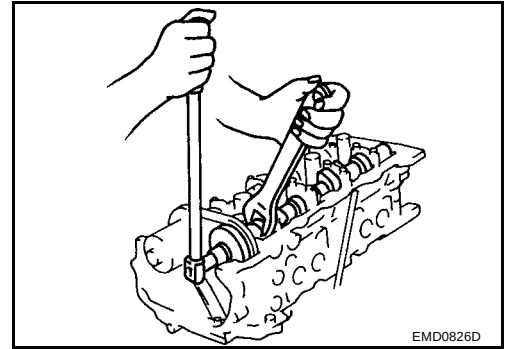
- Press plate down, and release stopper tab.
- Insert plunger into tensioner body until it stops.
- Secure plate by passing stopper pin (such as a hard wire) through plate hole and body hole. (Plunger is also secured.)
- Remove mounting bolts, and remove chain tensioner.



6. While holding hexagonal part of camshaft with a spanner, loosen mounting bolts and remove intake and exhaust camshaft sprockets.

CAUTION:

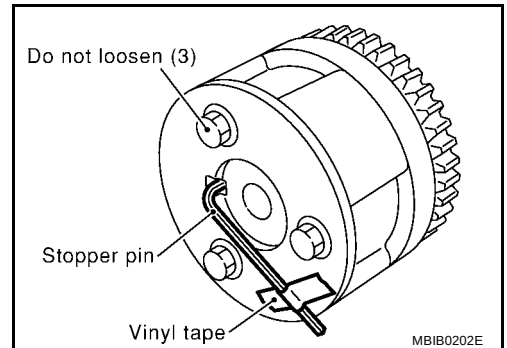
- Be careful that tool does not interfere with A/C piping.
- Avoid securing camshaft at other than hexagonal part and loosening mounting bolts by utilizing tension of timing chain.



- Handle intake camshaft sprocket, taking care of following.

CAUTION:

- Secure stopper pin with vinyl tape to prevent detachment.
- Avoid dropping it or subjecting it to impact.
- Do not disassemble. (Do not loosen 3 bolts on front surface.)



NOTE:

If stopper pin is detached and lock pin is engaged at most retarded position during removal, recover as follows.

- a. Reinstall stopper pin to intake camshaft, and tighten intake camshaft sprocket mounting bolts so that air does not leak.

CAUTION:

Tightening torque for mounting bolts must be minimum so that air does not leak, preventing damage on internal lock pin.

- b. Apply air pressure to disengage lock pin, and turn vane to most advanced position. (This step can be performed with timing chain removed.)
 - c. Reinstall stopper pin.
 - d. Remove intake camshaft sprocket from camshaft.
7. Remove camshaft brackets.

- Loosen mounting bolts in several steps in reverse order shown in figure.

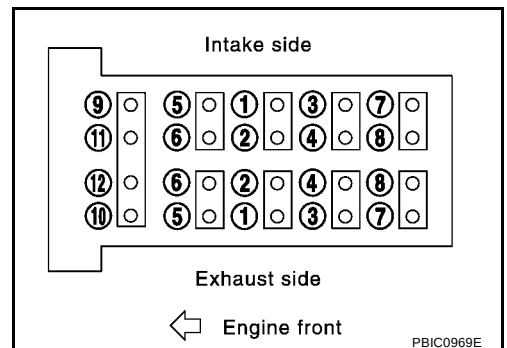
8. Remove camshaft.

CAUTION:

Be careful not to damage signal plate on rear end of intake camshaft and crankshaft.

9. Remove adjusting shims and valve lifters.

- Identify installation position of each valve. Arrange removed valves so they cannot be mixed up.



INSTALLATION

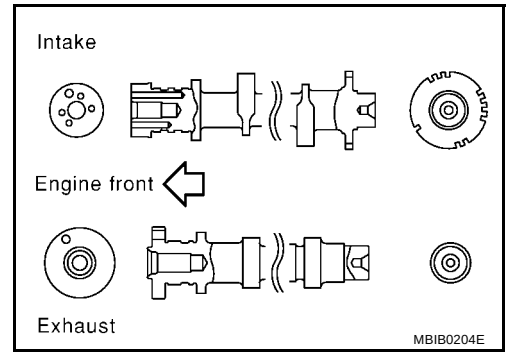
1. Install valve lifters and adjusting shims.
 - Install them in their original positions.
 - Install adjusting shim with its stamped mark facing downward (valve lifter side).

2. Install camshaft.

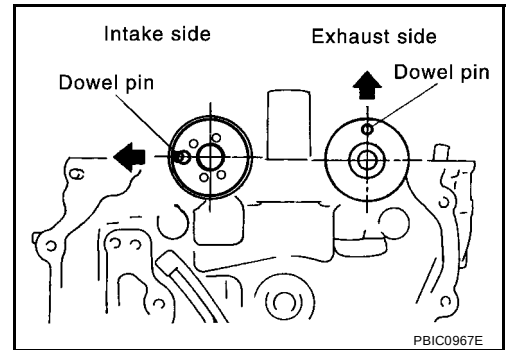
- Intake and exhaust camshafts are distinguished by checking difference between front and rear end shapes.

NOTE:

Some exhaust camshafts have a groove on the rear end.

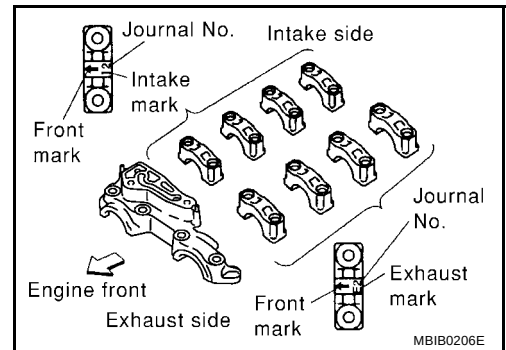


- Install camshafts so that dowel pins on their front ends are positioned as shown.



3. Install camshaft brackets.

- Completely remove any foreign material on back surfaces of camshaft brackets and top surface of cylinder head.
- Referring to marks on top surfaces of camshaft brackets, install them to their original positions and in their original directions.



4. Tighten camshaft bracket mounting bolts as follows:

- Different bolts are used depending on installation location. Refer to following and install appropriate bolts.

Bolt color:

1 to 10 in figure : black (reamer bolt)

11 and 12 in figure : gold

- First tighten bolts 9 through 12, then tighten bolts 1 through 8 in numerical order.

: 2.0 N·m (0.2 kg-m, 18 in-lb)

- Tighten in numerical order shown in figure.

: 5.9 N·m (0.6 kg-m, 52 in-lb)

- Tighten again in numerical order shown in figure.

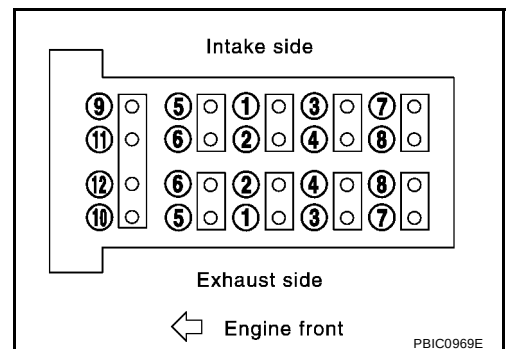
: 9.0 - 11.8 N·m (0.92 - 1.2 kg-m, 80 - 104 in-lb)

5. Install intake camshaft sprocket as follows.

- Before installation, make sure that stopper pin is inserted in intake camshaft sprocket.

NOTE:

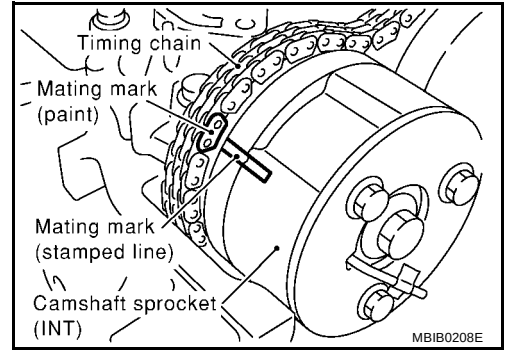
Service parts are provided with pin inserted.



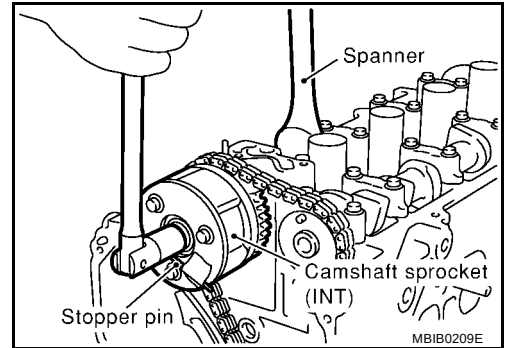
CAUTION:

Stopper pin is easily detached. Secure it with vinyl tape to prevent detachment.

- a. Install timing chain by aligning its mating mark (marked when timing chain is removed) with mark on camshaft sprocket.
 - Align dowel pin on camshaft front surface and pinhole on sprocket backside, then install.



- b. While holding hexagonal part of camshaft with a spanner, tighten intake camshaft sprocket mounting bolts.
 - Make sure that stopper pin is not detached.



6. Install exhaust camshaft sprocket as follows.

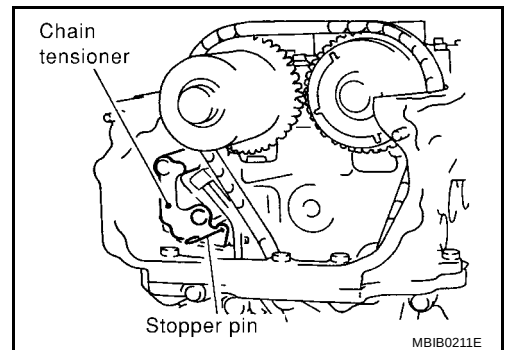
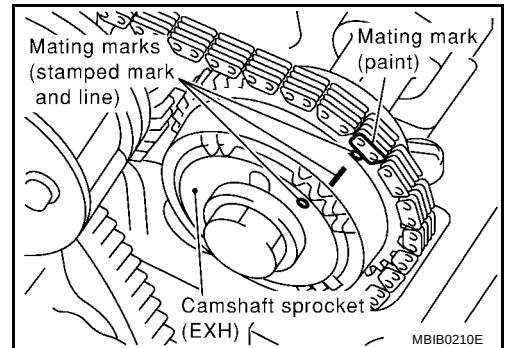
- a. Install timing chain by aligning its mating mark (marked when timing chain is removed) with mark on camshaft sprocket.
 - Align dowel pin on camshaft front surface and pinhole on sprocket, then install.
- b. While holding hexagonal part of camshaft with a spanner, tighten exhaust camshaft sprocket mounting bolts.

NOTE:

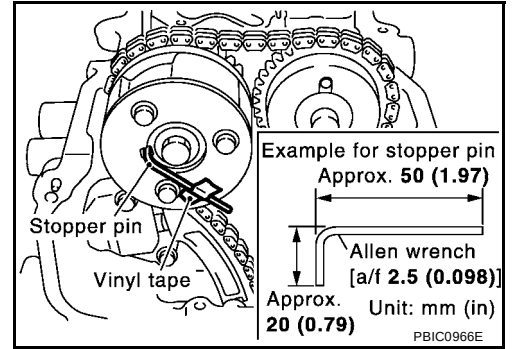
Tightening torque is different from intake side tightening torque.

- c. Make sure that mating marks on intake/exhaust camshaft sprockets and mating mark on timing chain are aligned.
7. Install chain tensioner.

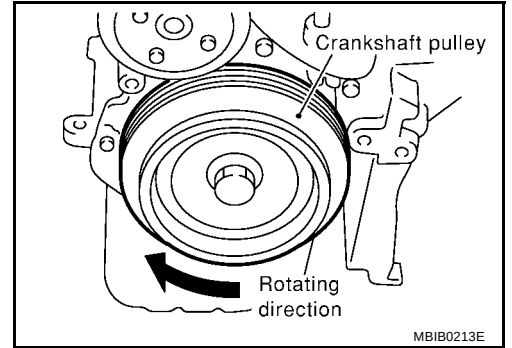
- Hold plate and plunger with a stopper pin, then install them.
- After installation, remove stopper pin and release plunger.
- Make sure again that mating marks on intake/exhaust camshaft sprockets and mating mark on timing chain are aligned.



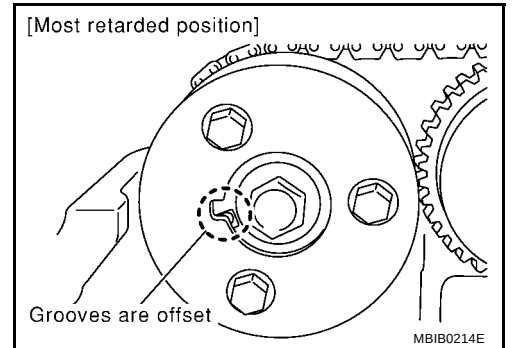
8. Remove stopper pin from intake camshaft sprocket.



9. Slowly turn crankshaft pulley clockwise to set intake camshaft sprocket to most retarded position.



- Sprocket begins turning after crankshaft does. Once sprocket starts turning, keep turning crankshaft until the vane (camshaft) also begins turning. Most retarded position should now be achieved.
- Most retarded position is confirmed when stopper pin groove is at a clockwise offset from lock pin breathing groove.
- While turning crankshaft slightly more counterclockwise, confirm that lock pin is engaged when vane and sprocket turn together.

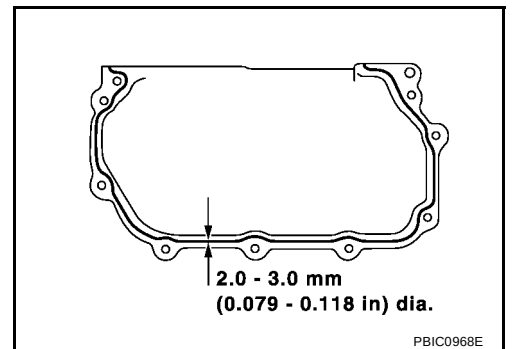


10. Install cylinder head front cover.

- Apply liquid gasket (Use Genuine Liquid Gasket or equivalent) continuously as shown in figure.
- Install it by aligning dowel pin on cylinder head.

11. Check and adjust valve clearance. Refer to [EM-42, "Valve Clearance"](#).

12. From this step, install in the reverse order of removal.



INSPECTION AFTER REMOVAL

Camshaft Runout

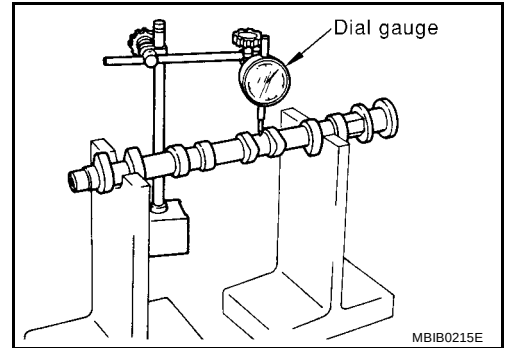
- Place a V-block on a surface plate to support No. 2 and No. 5 journals on camshaft.

CAUTION:

Do not support No. 1 journal (camshaft sprocket mounting side), because its diameter is different from that of the other 4 journals.

- Set a dial gauge vertically onto journal No. 3.
- Rotate the camshaft in one direction by hand and read indication on the gauge.
- A half of reading value is actual bend.

Standard : 0.02 mm (0.0008 in) or less

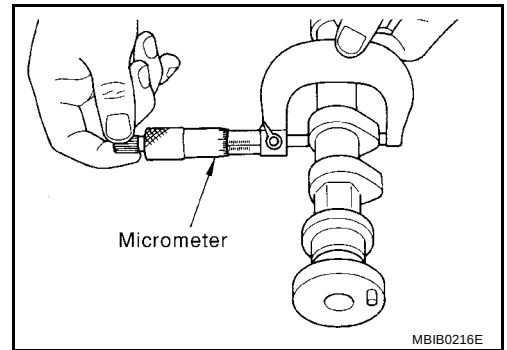


Camshaft Cam Height

- Measure with a micrometer.

Intake : 40.217 - 40.407 mm (1.5833 - 1.5908 in)

Exhaust : 38.965 - 39.155 mm (1.5341 - 1.5415 in)



Camshaft Journal Clearance

Outer Diameter of Camshaft Journal

- Measure with a micrometer.

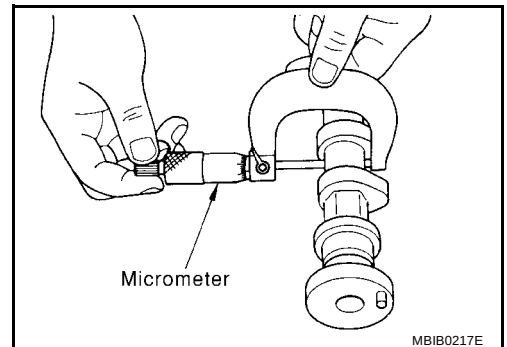
Standard

No. 1

: 27.935 - 27.955 mm (1.0998 - 1.1006 in) dia.

No. 2 to No. 5

: 23.935 - 23.955 mm (0.9423 - 0.9431 in) dia.



Inner Diameter of Camshaft Bracket

- Tighten camshaft bracket bolts to the specified torque.
- Using an inside micrometer, measure inner diameter of the camshaft bracket.

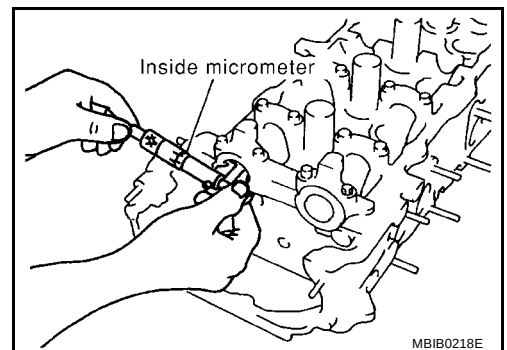
Standard

No. 1

: 28.000 - 28.021 mm (1.1024 - 1.1032 in) dia.

No. 2 to No. 5

: 23.985 - 24.006 mm (0.9443 - 0.9451 in) dia.



Calculation of Camshaft Journal Clearance

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

Standard

No. 1

: 0.045 - 0.086 mm (0.0018 - 0.0028 in)

No. 2 to No. 5

: 0.030 - 0.071 mm (0.0012 - 0.0028 in)

- If outside the standard, refer to standard of each unit part and replace camshaft or cylinder head as appropriate.

NOTE:

Camshaft bracket is machined with cylinder head. Replace them as cylinder head assembly.

Camshaft End play

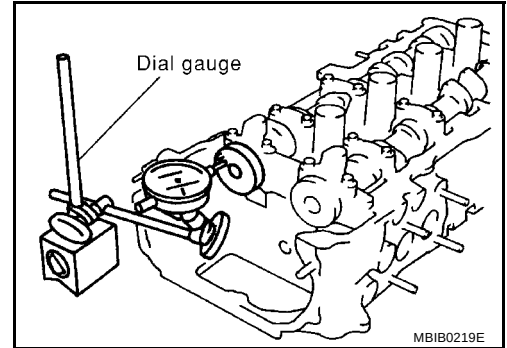
- Position a dial gauge onto front end of camshaft in thrust direction. Read indication of dial gauge while moving camshaft back and forth (axial direction).

Standard

Intake : 0.070 - 0.143 mm (0.0028 - 0.0056 in)

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

- If outside the standard, replace camshaft with new one. Then measure it again.
- If still outside the standard, replace cylinder head with new one.



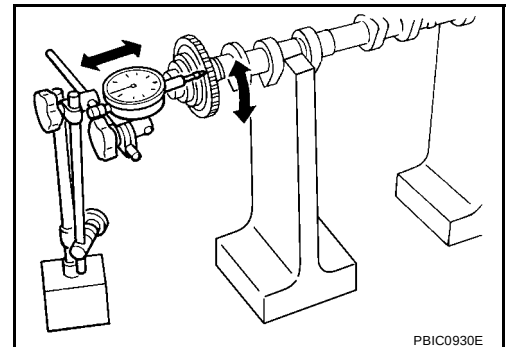
Camshaft Sprocket Runout

- Using a dial gauge, measure camshaft sprocket runout.

Limit:

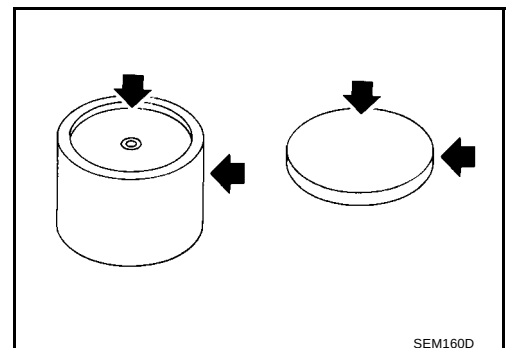
Intake : 0.2 mm (0.008 in)

Exhaust : 0.15 mm (0.0059 in)



Valve Lifter and Adjusting Shim (Shim type)

Check surfaces of valve lifter and shim for cracks and wear.

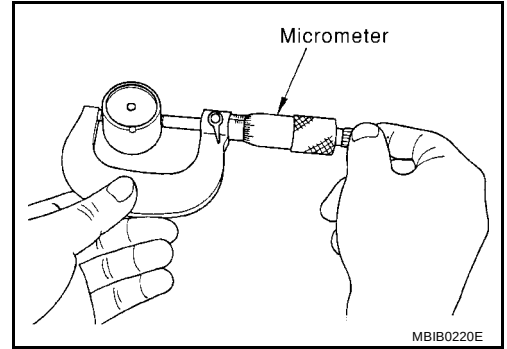


Valve Lifter Clearance

Outer Diameter of Valve Lifter

- Measure outer diameter with a micrometer.

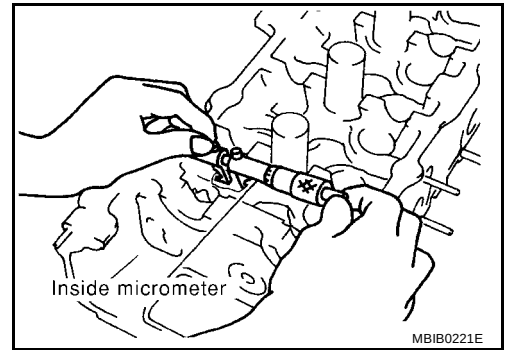
Standard : 29.960 - 29.975 mm (1.1795 - 1.1801 in) dia.



Valve Lifter Hole Diameter

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

Standard : 30.000 - 30.021 mm (1.1811 - 1.1819 in) dia.



Calculation of Valve Lifter Clearance

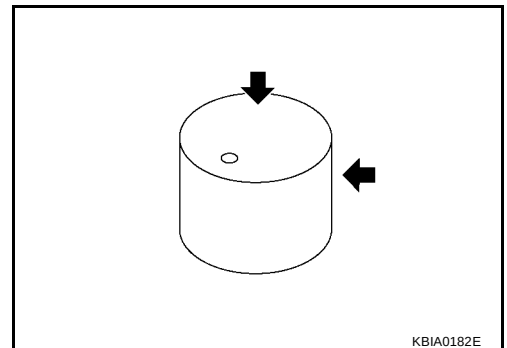
(Clearance) = (Valve lifter hole inner diameter) - (Valve lifter outer diameter)

Standard : 0.025 - 0.061 mm (0.0010 - 0.0024 in)

- If outside the standard, refer to standard of each OD and hole ID and then replace valve lifter or cylinder head as appropriate.

Valve Lifter (Shimless type)

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

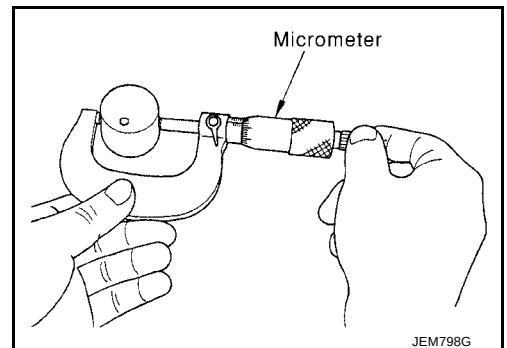


Valve Lifter Clearance

Outer Diameter of Valve Lifter

- Measure outer diameter of valve lifter.

**Valve lifter outer diameter (Intake and exhaust)
: 29.960 - 29.975 mm (1.1795 - 1.1801 in) dia.**



Valve Lifter Hole Diameter

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

Standard (Intake and exhaust)

: 30.000 - 30.021 mm (1.1811 - 1.1819 in) dia.

Calculation of Valve Lifter Clearance

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

Standard (Intake and exhaust)

: 0.025 - 0.061 mm (0.0010 - 0.0024 in)

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

Valve Clearance INSPECTION

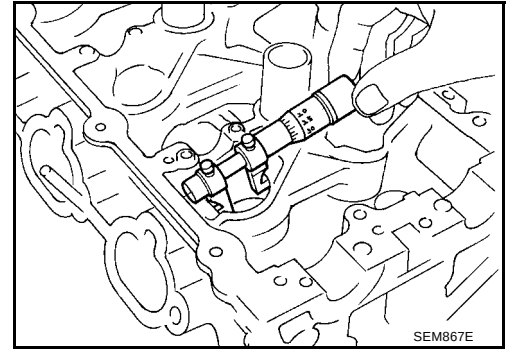
- The following procedure is applicable when: Components related to camshafts or valves are removed, installed, or replaced. Drivability concerns (poor starting, poor idling, noise) are caused by valve clearance aging.

- Warm up engine, and stop.
- Remove RH splash cover (integrated with undercover).
- Remove rocker cover. Refer to [EM-29, "ROCKER COVER"](#).
- Turn crankshaft pulley clockwise (viewed from front) to align yellow paint with timing indicator.
- At this point, confirm that both intake and exhaust cam noses on No. 1 cylinder face outward. (No. 1 cylinder is at TDC of its compression stroke.)

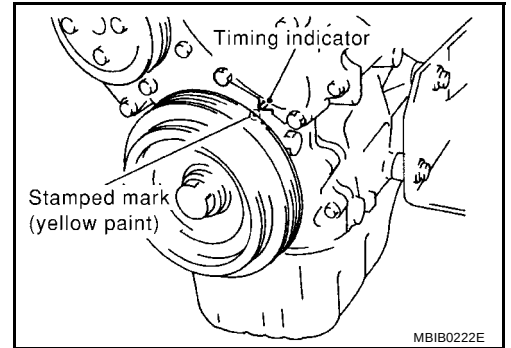
- If not, turn crankshaft pulley more.

NOTE:

Or, valves to be checked when No. 4 cylinder is at TDC of its compression stroke can be checked first following step 8.



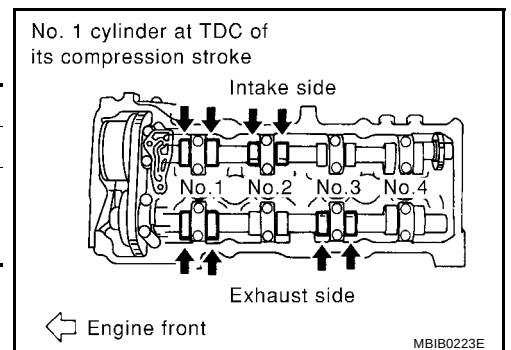
SEM867E



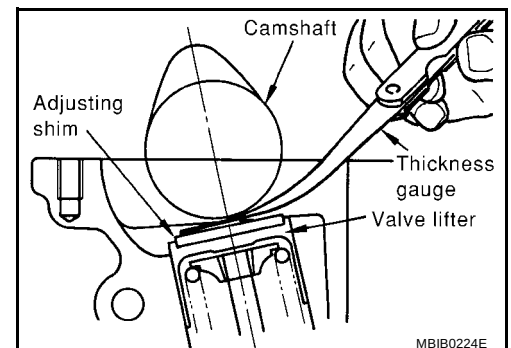
MBIB0222E

- Referring to figure, measure valve clearances of valves with × in table below using a thickness gauge.

Cylinder	No.1		No.2		No.3		No.4	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH
No. 1 cylinder at TDC of its compression stroke	×	×	×			×		



MBIB0223E



MBIB0224E

Valve clearance standard:

Hot	Intake	: 0.304 - 0.416 mm (0.012 - 0.016 in)
	Exhaust	: 0.348 - 0.472 mm (0.014 - 0.019 in)
Cold*	Intake	: 0.25 - 0.33 mm (0.010 - 0.013 in)
	Exhaust	: 0.32 - 0.40 mm (0.013 - 0.016 in)

*: Approximately 20°C (68°F) (Reference data)

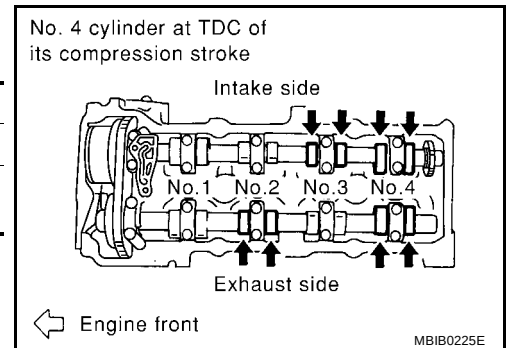
If an adjustment is done with cold engine, confirm reference values with hot engine are met.

Limit values with hot engine (reference)	Intake	: 0.21 - 0.47 mm (0.008 - 0.019 in)
	Exhaust	: 0.30 - 0.56 mm (0.012 - 0.022 in)

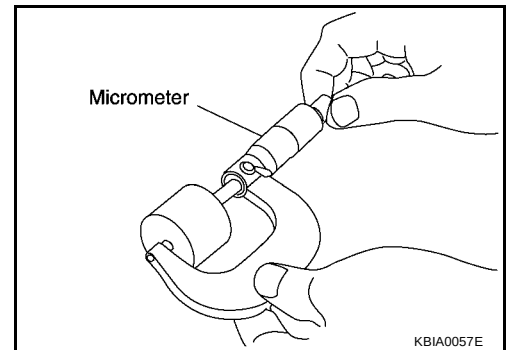
- Turn crankshaft pulley a full turn to position No. 4 cylinder at TDC of its compression stroke.
- Referring to figure, measure valve clearance of parts with × in table below.

Cylinder	No.1		No.2		No.3		No.4	
Valve	INT	EXH	INT	EXH	INT	EXH	INT	EXH
No. 4 cylinder at TDC of its compression stroke				×	×		×	×

- If outside the standard, adjust applicable valves as shown below.

**ADJUSTMENT (SHIMLESS TYPE)**

- 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.
- Remove camshaft. Refer to [EM-32, "Removal and Installation"](#).
 - Remove the valve lifters at the locations that are outside the standard.
 - Measure the center thickness of the removed valve lifters with a micrometer.

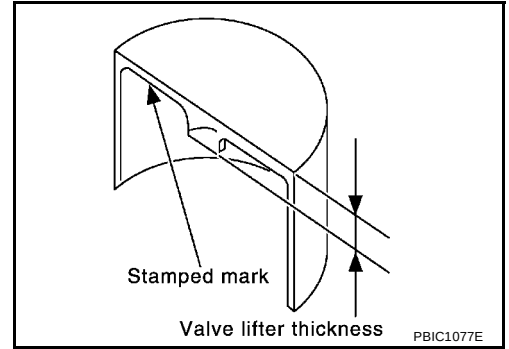


- Use the equation below to calculate valve lifter thickness for replacement.

- Valve lifter thickness calculation:
 Thickness of replacement valve lifter = $t_1 + (C_1 - C_2)$
 t_1 = Thickness of removed valve lifter
 C_1 = Measured valve clearance
 C_2 = Standard valve clearance:

Intake	: 0.36 mm (0.014 in)
Exhaust	: 0.37 mm (0.015 in)

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



Available thickness of valve lifter: 26 sizes with range 6.96 to 7.46 mm (0.2740 to 0.2937 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory).

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

Valve clearance:

Unit: mm (in)

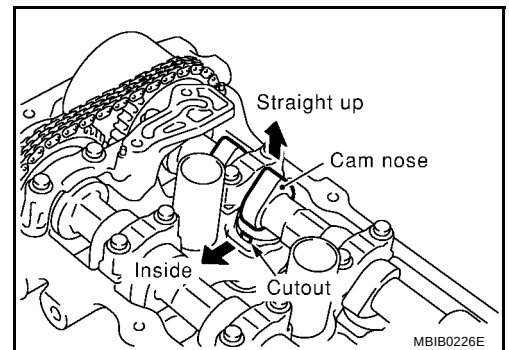
	Cold* (reference data)	Hot
Intake	0.24 - 0.32 (0.009 - 0.013)	0.32 - 0.40 (0.013 - 0.016)
Exhaust	0.26 - 0.34 (0.010 - 0.013)	0.33 - 0.41 (0.013 - 0.016)

*: Approximately 20°C (68°F)

ADJUSTMENT (SHIM TYPE)

- Remove adjusting shim for valves with incorrect valve clearance by following the procedure below:

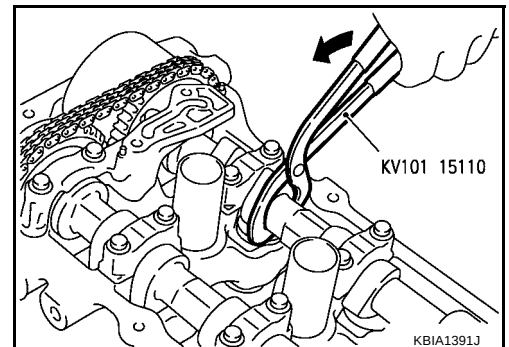
1. Using a rag, completely wipe off engine oil from surroundings of adjusting shim.
2. When removing adjusting shim from a cam, turn crankshaft clockwise (viewed from front) to make cam nose face straight up.
3. Turn valve lifter and adjusting shim to removal direction.
 - Using a slotted screwdriver with extra-thin tip, turn valve lifter cutout in direction shown by the arrow.



4. Using camshaft pliers (special service tool), pinch camshaft. Turn tool up in direction shown by the arrow with camshaft being a fulcrum. This will push down adjusting shim to allow valve spring to be compressed.

CAUTION:

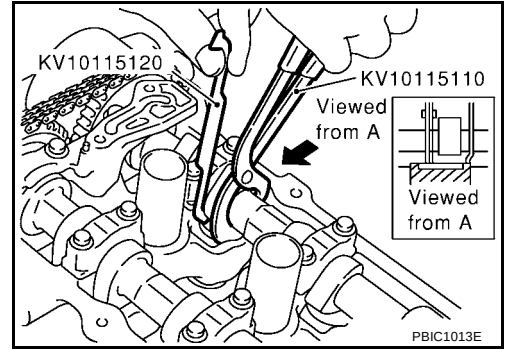
- Be careful not to damage camshaft and cylinder head.
- Be careful not to damage surroundings of valve lifter.



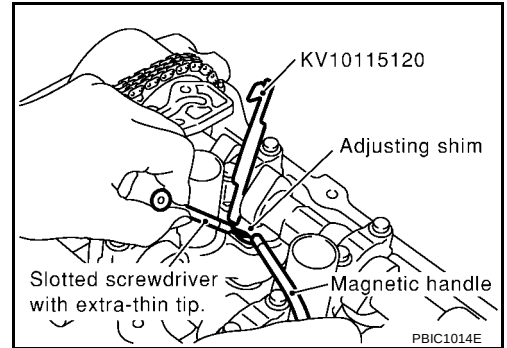
5. With valve spring compressed, securely place tip of lifter stopper (special service tool) onto surroundings of valve spring. Then remove camshaft pliers (special service tool).

CAUTION:

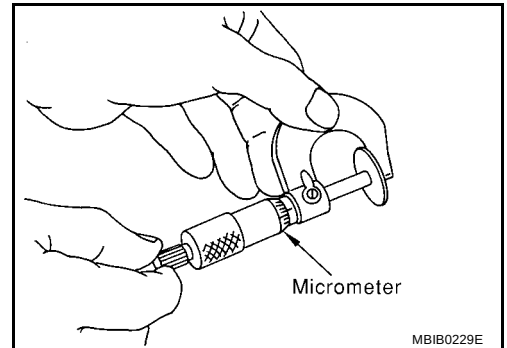
If camshaft pliers are suddenly turned back, lifter stopper may contact and damage camshaft journals. Turn back camshaft pliers carefully to remove.



6. Keep adjusting shim slightly up from valve lifter.
 - Insert a slotted screwdriver with extra-thin tip into cutout on valve lifter for this purpose.
7. Using a magnetic handle, remove adjusting shim.



8. Using a micrometer, measure thickness (t1) of removed adjusting shim at camshaft contact face (around center).



9. Use following formula to select proper replacement adjusting shim.
 - Formula to calculate adjusting shim thickness (unit: mm)
 $\text{Thickness of replacement valve lifter} = t1 + (C1 - C2)$
 $t1$ = Thickness of removed valve lifter
 $C1$ = Measured valve clearance
 $C2$ = Standard valve clearance:

Hot engine:

Intake : 0.37 mm (0.015 in)

Exhaust : 0.40 mm (0.016 in)

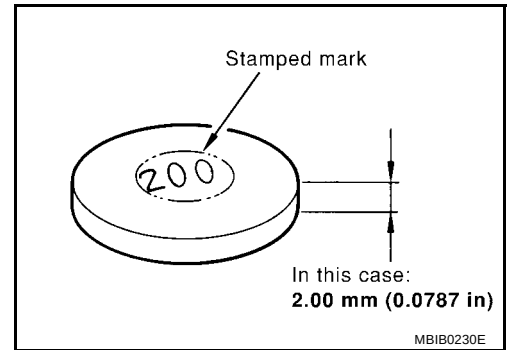
Reference values with cold engine:

Intake : 0.30 mm (0.012 in)

Exhaust : 0.35 mm (0.014 in)

- Thickness of new adjusting shim is indicated with stamped mark on its back.

Stamped mark	Thickness of shim
200	2.00 mm (0.0787 in)
202	2.02 mm (0.0795 in)
⋮	⋮
298	2.98 mm (0.1173 in)



Setting of adjusting shim thickness (at factory)

: Thickness 2.00 to 2.98 mm (0.0787 - 0.1173 in) [spacing of 0.02 mm (0.0008 in)] 50 types

10. Install selected adjusting shim to valve lifter.

CAUTION:

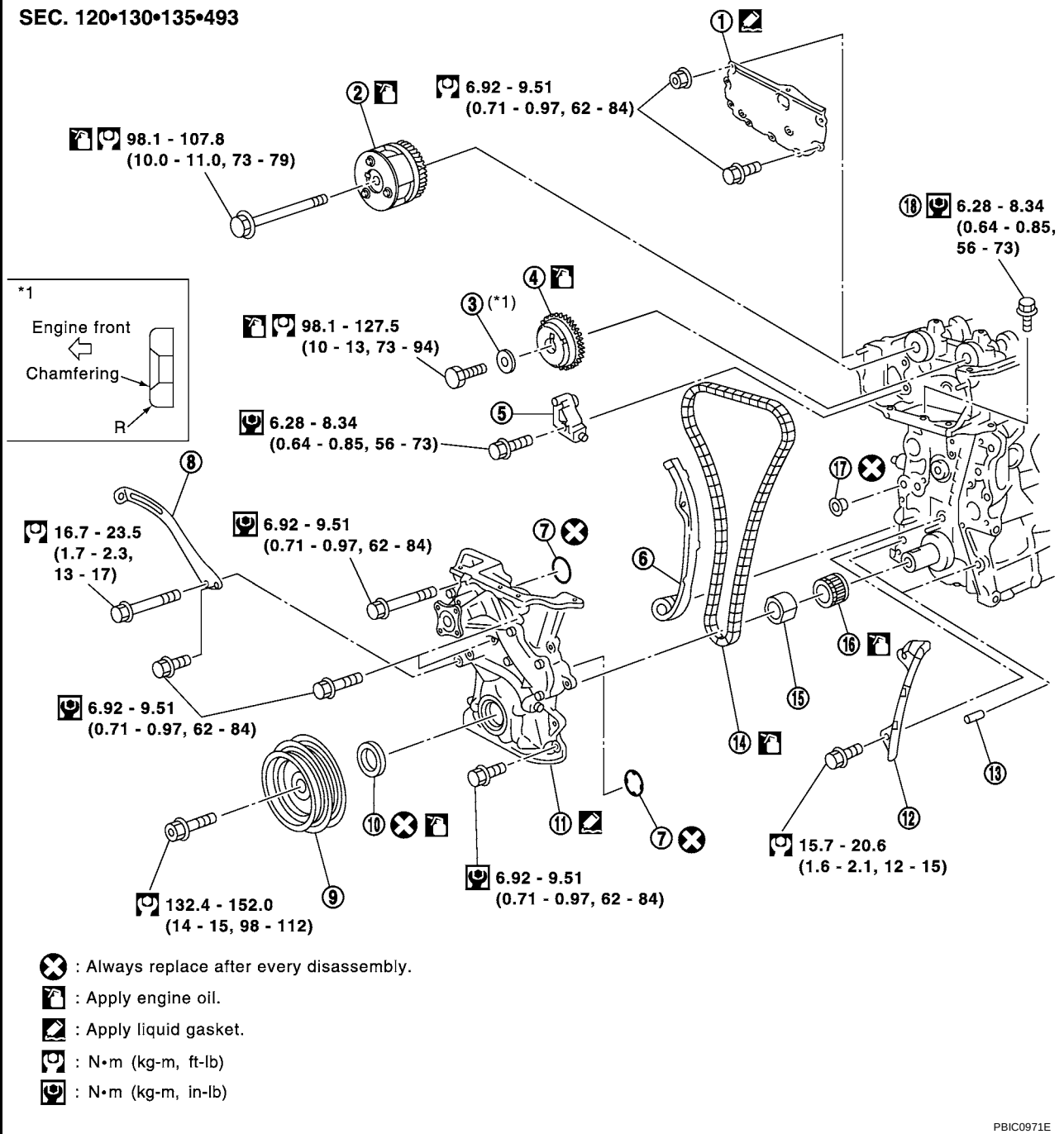
Install shim with its stamp mark facing the valve lifter.

11. Using camshaft pliers (special service tool), compress valve spring to remove lifter stopper (special service tool).
12. Turn crankshaft a couple of times by hand.
13. Check that valve clearance is within standards.

TIMING CHAIN

Removal and Installation

SEC. 120•130•135•493

**CAUTION:**

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

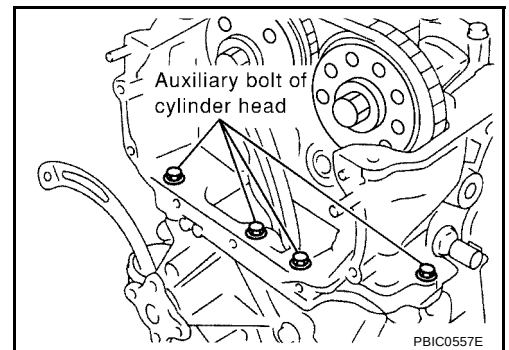
REMOVAL

1. Place vehicle on lift.

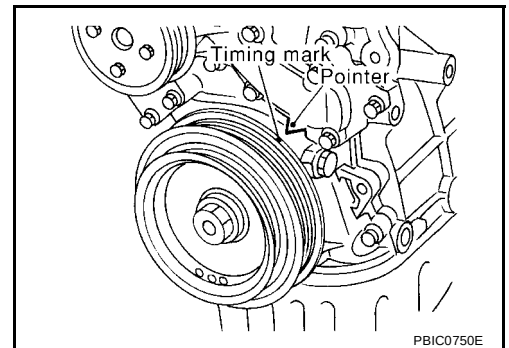
2. Disconnect battery ground cable.
3. Remove undercover, front RH wheel and RH splash cover.
4. Drain engine coolant from radiator and cylinder block. Refer to LC-17, "Changing Engine Coolant".
5. Drain engine oil from oil pan.
6. Remove drive belt. Refer to [EM-13, "Removal and Installation"](#).
7. Remove power steering pump from adjusting bar.
8. Remove alternator. SC-33, "Removal and Installation".
9. Remove ignition coils. Refer to [EM-24, "IGNITION COIL"](#).
10. Remove rocker cover. Refer to [EM-29, "Removal and Installation"](#).
11. Remove oil level gauge.
12. Remove exhaust front tube. Refer to FE-10, "Removal and Installation".
13. Remove center member.
14. Remove gusset.
15. Remove rear plate (lower) (A/T models).
16. Remove oil pan and oil strainer. Refer to [EM-22, "Removal and Installation"](#).
17. For safe operation, and to reduce load to mount insulator, install removed center member again.
18. Remove engine front-side (right side of vehicle) engine mount. Refer to [EM-67, "ENGINE ASSEMBLY"](#).
 - a. Remove any parts that cause difficulties for operation around mount, or perform transfer.
 - b. Support cylinder block bottom surface with a transmission jack.

CAUTION:

- When applying jack, use a wooden block to avoid damage to oil pan mounting surface.
 - While performing following operations, support engine front-side with jack.
- c. Separate engine mounting insulator and bracket.
 - d. Remove engine mounting bracket.
19. Remove cylinder head front cover.
 - Move harness which was previously fixed on front surface.
 20. Remove auxiliary bolts of cylinder head.



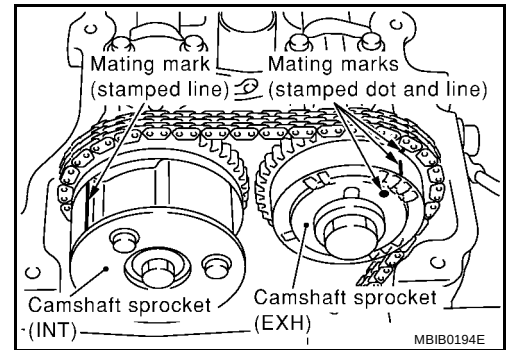
21. Set the No. 1 cylinder to the compression TDC.
 - a. Turn the crankshaft pulley clockwise, and align the timing indicator of the gear case to the timing mark of the crankshaft pulley.



TIMING CHAIN

[QG]

- b. Make sure that the camshaft sprocket mating mark is in the position shown in the figure.
- If the mating mark is not in position, turn the crankshaft pulley once more and position it.

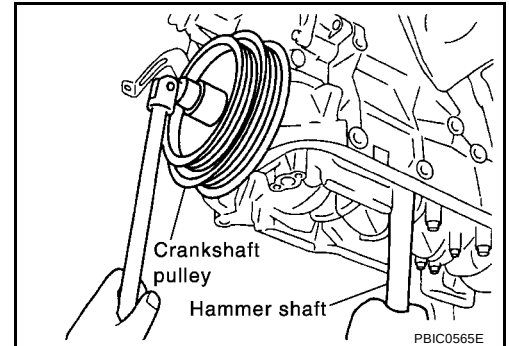


22. Remove crankshaft pulley with the following procedure:

- a. Secure crankshaft counter weight with handle of a hammer, and loosen crankshaft pulley bolts.

CAUTION:

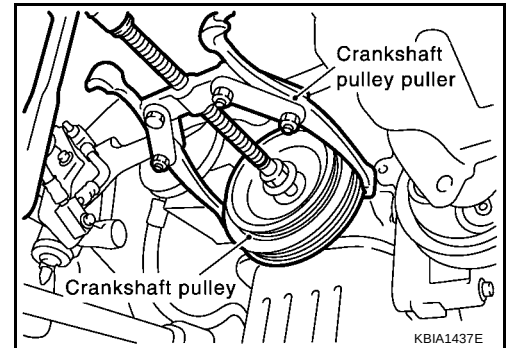
Take care to prevent foreign material from entering the engine.



- b. Remove crankshaft pulley using crankshaft pulley puller (commercial service tool).

CAUTION:

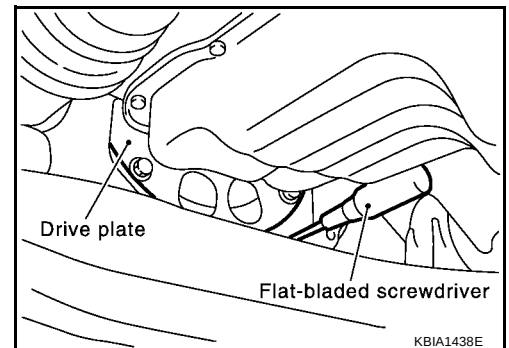
- Hook tab onto back of crankshaft pulley only.
- Do not remove crankshaft pulley bolt. Fully loosen, and then use it as support point.



NOTE:

If oil pan is not removed, remove crankshaft pulley as follows.

- Remove rear plate (lower).
- Engage drive plate ring gear with a flat-head screwdriver to fix crankshaft in position, and loosen crankshaft pulley bolt.
- Remove crankshaft pulley using crankshaft pulley puller (commercial service tool).



23. Remove water pump pulley and idler pulley bracket assembly.

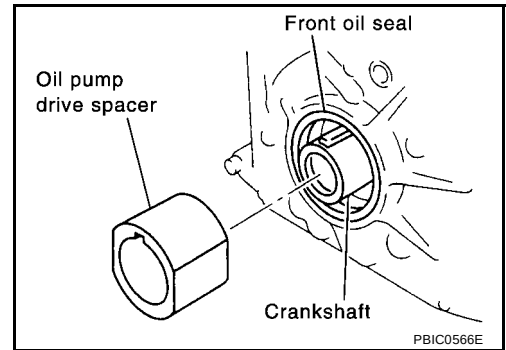
24. Remove front cover with the following procedure:

- a. To increase freedom of front cover posture during removal/installation, pull oil pump drive spacer out through front oil seal.
 - Pull it straight out using long-nose pliers or two flat-bladed screwdrivers.

CAUTION:

Be careful not to damage side of oil pump drive spacer and front oil seal lip.

- b. Remove power steering pump adjusting bar.



- c. Remove front cover carefully.

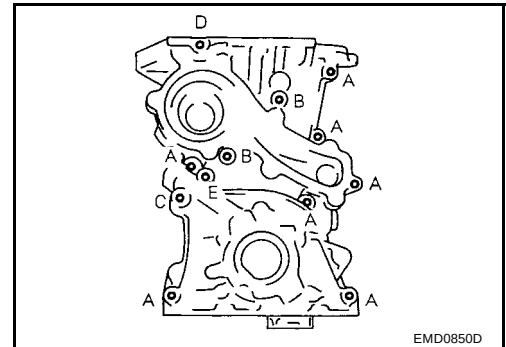
- Remove mounting bolts A - E shown in figure.

NOTE:

Bolts C and E have been removed in step b.

CAUTION:

- When removing, be careful not to damage or bend front end of cylinder head gasket. Also after peeling off contact face between front cover and gasket, their surfaces shall be smooth.
- If cylinder head gasket is damaged, replace it with new one.



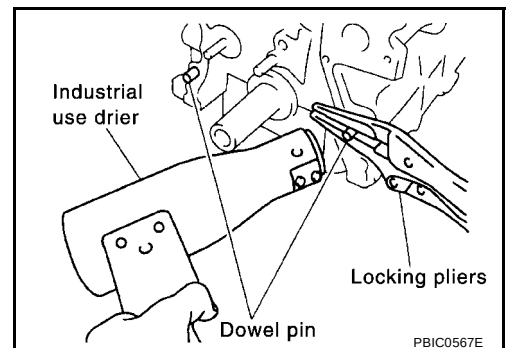
- d. Remove O-rings from front cover and cylinder block.

25. Pull two dowel pins for front cover out of cylinder block.

- Heat them with industrial dryer sufficiently, then pull them out using locking pliers.

NOTE:

This operation is performed as preparation operation for front cover installation. This operation can be performed after removal of timing chain.

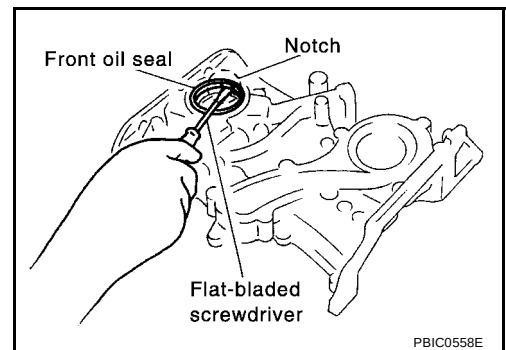


26. If front oil seal is need to be replaced, remove it from front cover.

- Insert a flat-bladed screwdriver in notch on oil seal mounting point, and lift oil seal to remove.

NOTE:

Remove timing chain and its related parts with the following procedure:



27. Secure intake camshaft sprocket in most advanced position. Refer to [EM-32, "REMOVAL"](#) .

NOTE:

Removal of timing chain and related parts is described in following steps.

28. Remove chain tensioner. Refer to [EM-32, "REMOVAL"](#) .

29. Remove camshaft sprocket. Refer to [EM-32, "REMOVAL"](#) .

CAUTION:

After this step is completed, do not rotate crankshaft and camshaft separately in order to prevent interference between valve and piston.

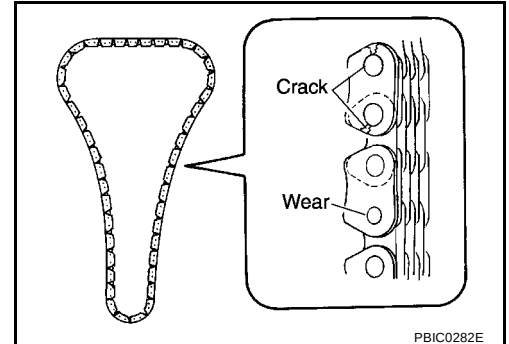
30. Remove timing chain, timing chain slack guide and tension guide.

31. Remove crankshaft sprocket.

INSPECTION AFTER REMOVAL

Timing Chain

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



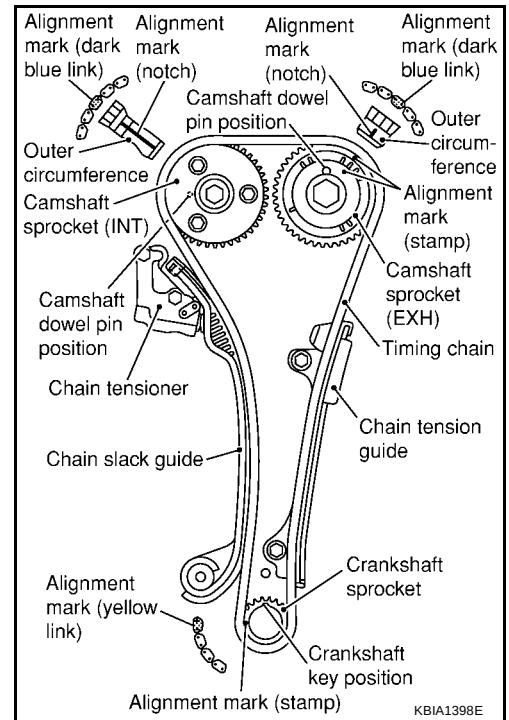
INSTALLATION

CAUTION:

- Use a scraper to completely remove all liquid gasket adhering to mounting surface. De-grease and clean with white gasoline.
- After installation, wipe off any protruding liquid gasket.

1. Install timing chain and its related parts with the following procedure:

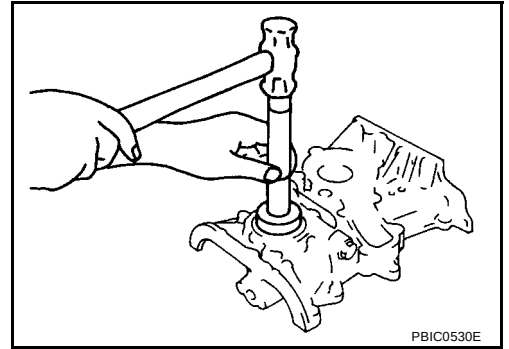
- For aligning positions for each sprocket and timing chain, and installed condition of their related parts, refer to figure.
 - Install each sprocket with its mating mark facing engine front side.
- Install timing chain and crankshaft sprocket.
 - Make sure that crankshaft key points straight up (No.1 cylinder is at TDC).
 - Hook timing chain on front end of camshaft so that it will not fall off.
 - Install timing chain slack guide and tension guide.
 - Install camshaft sprocket. Refer to [EM-35, "INSTALLATION"](#).



- Install chain tensioner. Refer to [EM-35, "INSTALLATION"](#).
- Make sure again that mating marks are properly aligned.
- Temporarily install oil pump drive spacer, crankshaft pulley, and crankshaft pulley mounting bolt so that crankshaft can be rotated.
- Rotate crankshaft clockwise several times to make sure it rotates normally. Refer to [EM-35, "INSTALLATION"](#).
- Rotate crankshaft clockwise several times, and check that there is no unusual condition.
- Remove parts temporarily installed in step f.

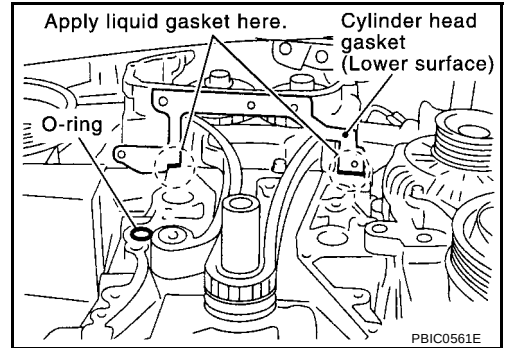
2. Install front oil seal to front cover.

- Install it so that identification letters on oil seal will face toward front side of the engine.
- Using an oil seal drift (commercial service tool), press oil seal in until it is flush with end surface of mounting position.
- Make sure that oil seal outer circumference is free from damage and burr.



3. Install front cover with the following procedure:

- Install O-ring to cylinder block.
- Using a flat-bladed screwdriver, apply a continuous bead of liquid gasket to contact surface between cylinder head gasket lower surface and cylinder block (2 locations shown in figure). Use Genuine Liquid Gasket or equivalent.

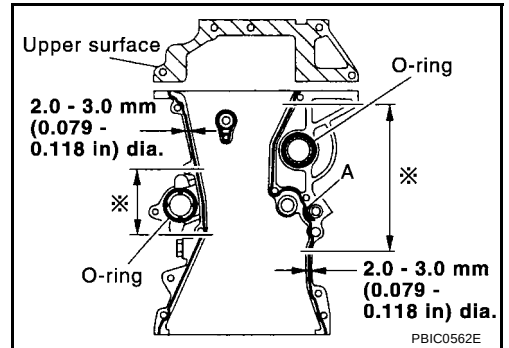


- Apply a continuous bead of liquid gasket to back surface of front cover (location shown in figure).

CAUTION:

- Do not apply liquid gasket to groove A shown in figure.
- Especially for locations indicated by * mark in figure, strictly observe application range of liquid gasket.

- Apply liquid gasket to top surface of front cover lightly and evenly. Use Genuine Liquid Gasket or equivalent.
- Install O-ring to back surface of front cover.

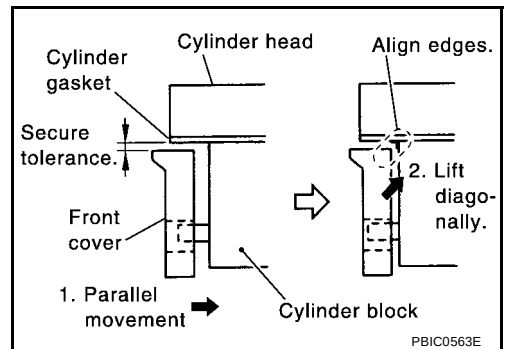


- With socket of oil pump inner rotor placed on crankshaft top surface (clearance between front cover top surface and cylinder head gasket lower surface is secured), move front cover close to cylinder block. (Right side in figure)

- Lift front cover at an angle and install it to mounting position so that front cover will come in contact with both cylinder head gasket lower surface and cylinder block front surface at the same time. (Right side in figure)

CAUTION:

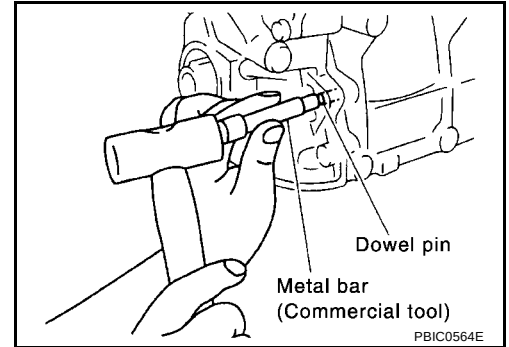
- During work, be sure not to damage cylinder head gasket.
- When installing, avoid discontinuous bead of liquid gasket caused by allowing it to adhere to an unnecessary area.



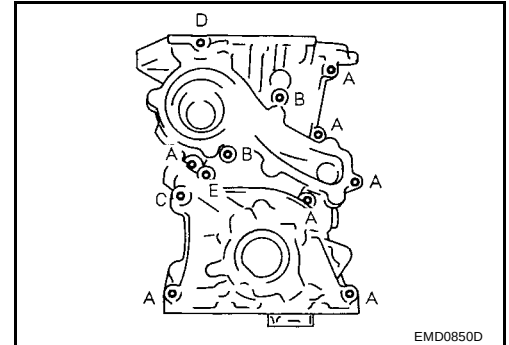
TIMING CHAIN

[QG]

- h. Install front cover with mounting bolts temporarily so that front cover will not move.
- i. Press fit dowel pin into cylinder block through front cover.



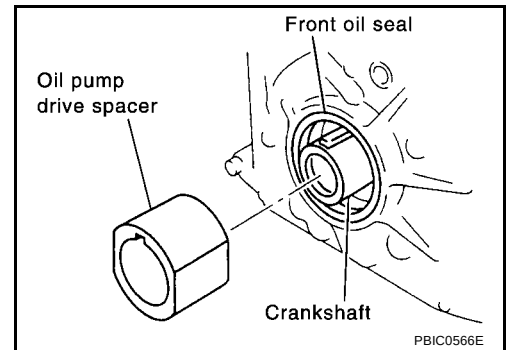
- j. Tighten front cover mounting bolts temporarily.
 - A [M6 x 20 mm (0.79 in)], B [M6 x 40 mm (1.57 in)], C [M8 x 70 mm (2.76 in)], D [M6 x 73 mm (2.87 in)]
 - Bolt C also secures power steering pump adjusting bar.
 - Bolt E [M6 x 12 mm (0.47 in)] is for installing power steering pump adjusting bar.
- k. Tighten cylinder head auxiliary bolts (M6) temporarily.
- l. Tighten front cover mounting bolts and cylinder head auxiliary bolts to specified torque.



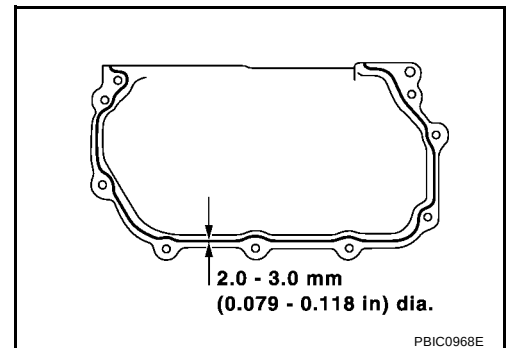
4. Install oil pump drive spacer.
 - When installing, align with flat of oil pump inner rotor.
 - If they are not aligned, rotate inner rotor with a flat-bladed screwdriver to align them.

CAUTION:

Be careful not to damage oil seal lips.



5. Install water pump pulley and idler pulley bracket assembly.
6. Install crankshaft pulley.
 - When installing it, make sure that front oil seal lip is not inverted and garter spring is in position.
 - For direction of mounting bolt washer, refer to "Component Parts Location".
 - With same procedure as "removal", secure crankshaft, and tighten mounting bolts.
7. Install cylinder head front cover.
 - Apply liquid gasket to cylinder head front cover.
 - Use Genuine Liquid Gasket or equivalent.
8. Install engine front mounting bracket.
9. Install remaining parts in the reverse order of removal.



INSPECTION AFTER INSTALLATION

- In order to allow liquid gasket to be cured, perform inspection at least 30 minutes after the last step in which parts sealed with liquid gasket are installed.
- With engine warmed up, check each part for engine oil leakage.

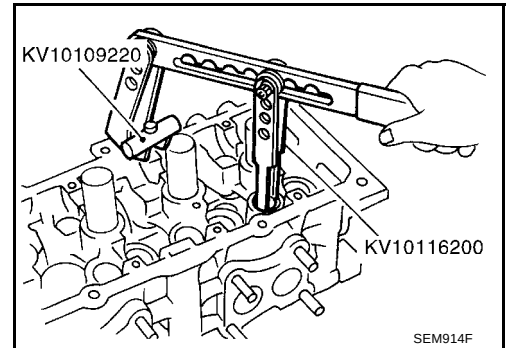
OIL SEAL

Removal and Installation of Valve Oil Seal
REMOVAL

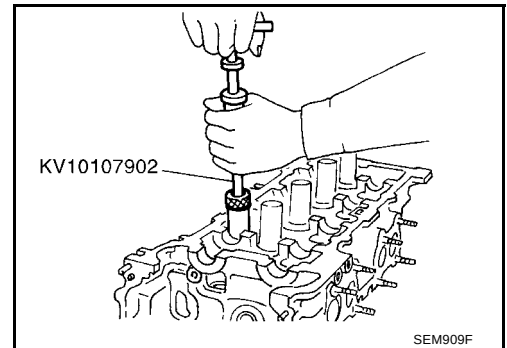
1. Remove camshaft. Refer to [EM-32, "CAMSHAFT"](#) .
2. Remove adjusting shim (if so equipped) and valve lifters. Refer to [EM-32, "CAMSHAFT"](#) .
3. To prevent valve from falling inside cylinder, turn crankshaft until cylinder with oil seal to be removed is at top dead center.

CAUTION:

When rotating crankshaft, be careful that timing chain is not caught by front cover.

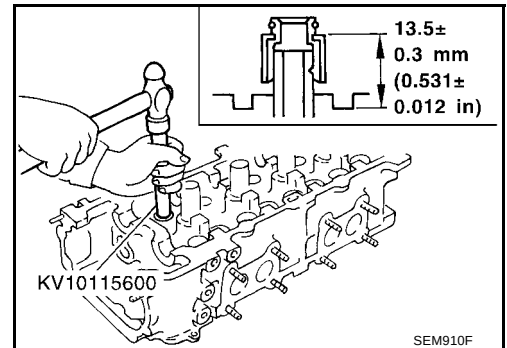


4. Using valve spring compressor (special service tool), remove valve collet. Then remove valve spring and valve spring retainer.
5. Remove valve oil seal using valve oil seal puller (special service tool).



INSTALLATION

1. Apply engine oil on new valve oil seal joint and seal lip.
2. Using valve oil seal drift (special service tool), press fit valve oil seal to height shown in figure.
3. Perform steps in the reverse order of removal for the following operations.



Removal and Installation of Front Oil Seal

REMOVAL

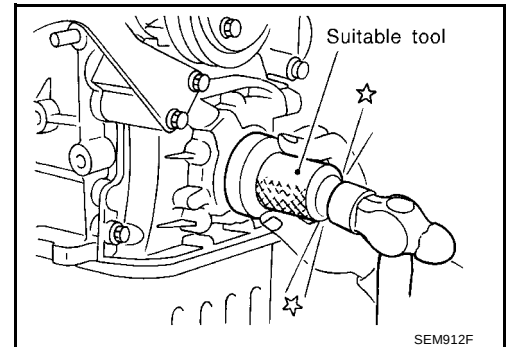
- Remove the following parts:
 - Undercover (with splash cover)
 - Drive belt; Refer to [EM-11, "DRIVE BELTS"](#).
 - Crankshaft pulley; Refer to [EM-47, "TIMING CHAIN"](#).
- Using flat-head screwdriver, remove front oil seal.

CAUTION:

Be careful not to damage front timing chain cover and crankshaft.

INSTALLATION

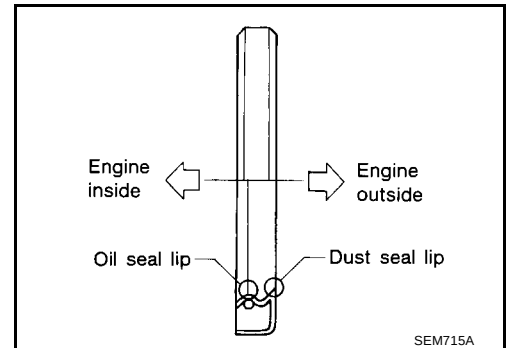
- Apply engine oil on new front oil seal.
- Using a suitable drift, press fit until the height of front oil seal is level with the mounting surface.
 - Suitable drift : outer diameter 50 mm (1.97 in), inner diameter 44 mm (1.73 in).



CAUTION:

- Be careful not to damage front cover and crankshaft.
- Press oil seal straight so that it is not curling up or inclined.

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



Removal and Installation of Rear Oil Seal

REMOVAL

- Remove transaxle assembly. Refer to MT-23, "Removal" (RS5F30A), MT-23, "Removal" (RS5F70A) and AT-411, "Removal" (AUTOMATIC TRANSAXLE).
- Remove drive plate. Refer to [EM-70, "CYLINDER BLOCK"](#).
- Using flat-head screwdriver, remove front oil seal.

CAUTION:

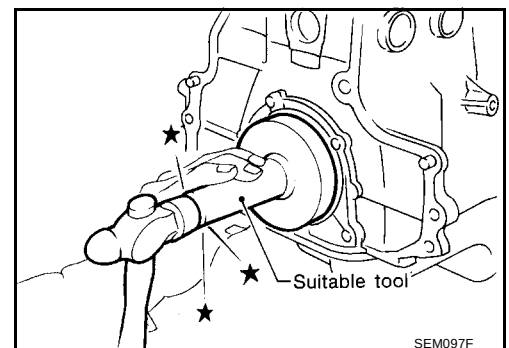
Be careful not to damage mounting surface.

INSTALLATION

- Using a suitable drift, press rear oil seal to rear oil seal retainer.
 - Suitable drift : outer diameter 102 mm (4.02 in), inner diameter 90 mm (3.54 in).

CAUTION:

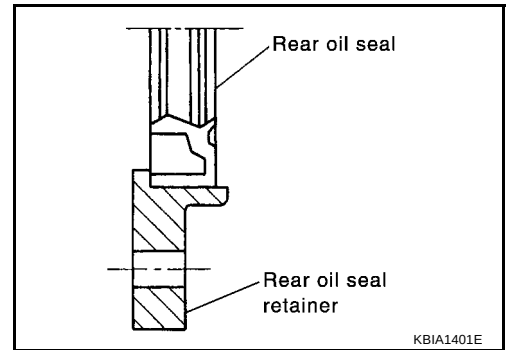
- Do not touch grease applied on oil seal lip
- Be careful not to damage rear oil seal retainer and crankshaft.
- Press in straight to avoid causing any burrs or tilting of oil seal.



OIL SEAL

[QG]

- Press rear oil seal into rear oil seal retainer so that it does not project from the end.



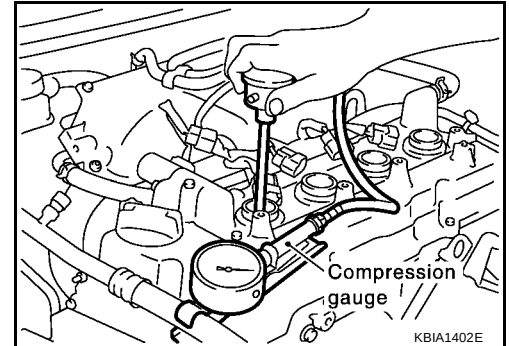
2. Perform steps in the reverse order of removal for the following operations.

CYLINDER HEAD

On-Vehicle Service

CHECKING COMPRESSION PRESSURE

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-34, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD), [EC-427, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
3. Remove ignition coil and spark plug from each cylinder. Refer to IGNITION COIL [EM-24, "Removal and Installation"](#) and SPARK PLUG [EM-25, "Removal and Installation"](#).
4. Connect engine tachometer (not required in use of CONSULT-II).
5. Disconnect fuel injector harness connector so that no fuel is injected.
6. Install compression tester with adapter onto spark plug hole.

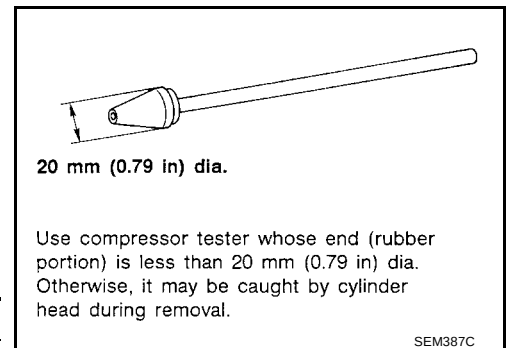


- Use compression gauge whose picking up end inserted to spark plug hole is smaller than 20 mm (0.79 in) in diameter. Otherwise, it may be caught by cylinder head during removal.
7. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and engine rpm. Perform these steps to check each cylinder.

Compression pressure

[kPa (bar, kg/cm², psi)/rpm]

Engine type	QG15DE	QG18DE
Standard	1,372 (13.72, 13.99, 198.9)	1,324 (13.24, 13.5, 192)
Limit	1,176 (11.76, 12.0, 170.5)	1,128 (11.28, 11.5, 164)
Difference limit among cylinders	98 (0.98, 1.0, 14)	98 (0.98, 1.0, 14)

**CAUTION:****Always use a fully charged battery to obtain specified engine speed.**

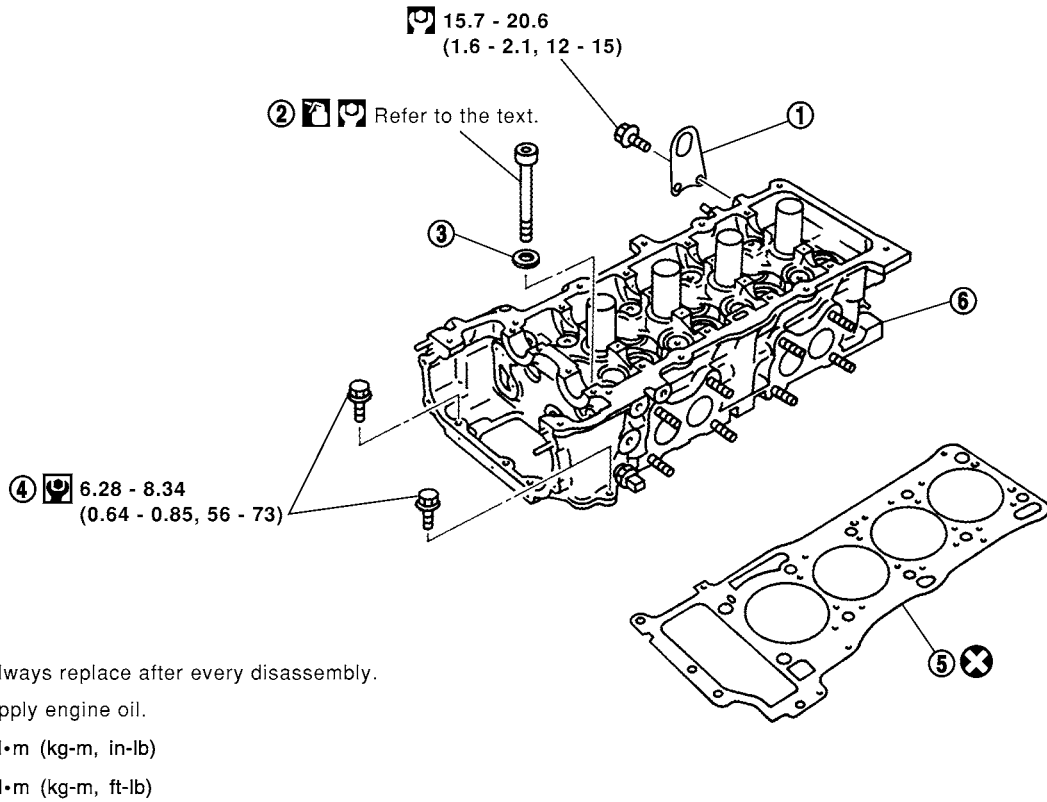
- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (Valve, valve seat, piston, piston ring, 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.

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

Removal and Installation

EBS00LQI

SEC. 111



PBIC0972E

- | | | |
|------------------------------------|-------------------------|---------------------------|
| 1. Rear engine slinger | 2. Cylinder head bolt | 3. Washer |
| 4. Auxiliary bolt of cylinder head | 5. Cylinder head gasket | 6. Cylinder head assembly |

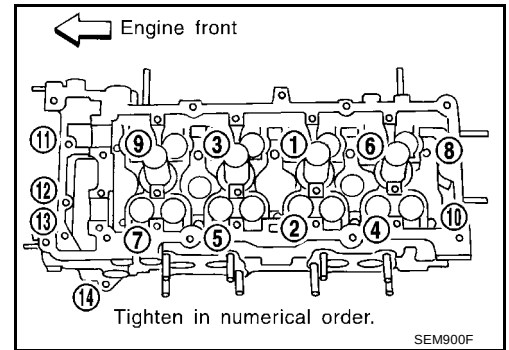
REMOVAL

1. Release fuel pressure. Refer to [EC-34, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD), [EC-427, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
2. Remove undercover.
3. Drain engine coolant. Refer to LC-17, "Changing Engine Coolant".
4. Remove the following components and related parts:
 - Intake manifold and intake manifold collector. Refer to [EM-16, "INTAKE MANIFOLD"](#).
 - Exhaust manifold and catalytic converter. Refer to [EM-19, "EXHAUST MANIFOLD AND CATALYTIC CONVERTER"](#).
 - Ignition coil. Refer to [EM-24, "IGNITION COIL"](#).
 - Rocker cover. Refer to [EM-29, "ROCKER COVER"](#).
 - Camshaft. Refer to [EM-32, "CAMSHAFT"](#).
 - Alternator bracket. Refer to SC-33, "Removal and Installation".

CYLINDER HEAD

[QG]

5. Remove cylinder head loosening bolts in reverse order shown in the figure.
6. Remove cylinder head gasket.



A

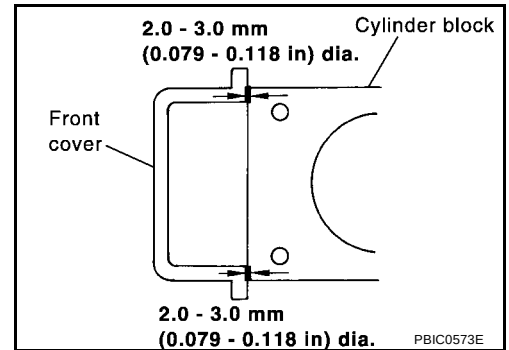
EM

C

D

INSTALLATION

1. Apply liquid gasket to positions shown in figure, then install cylinder head gasket.
 - Use Genuine Liquid Gasket or equivalent.



E

F

G

2. Install cylinder head assembly, tighten bolts (1) to (10) in numerical order shown in figure with the following procedure:

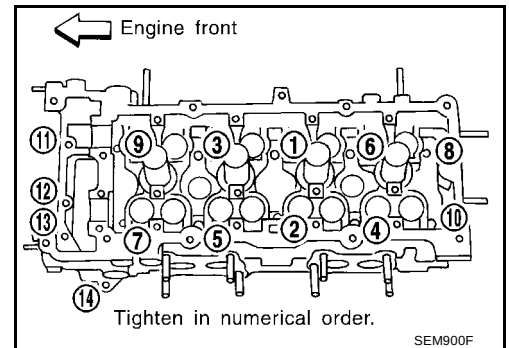
CAUTION:

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

- a. Apply new engine oil to threads and seating surface of mounting bolts.
- b. Tighten all bolts to 29.4 N·m (3.0 kg-m, 22 ft-lb).
- c. Tighten all bolts to 58.8 N·m (6.0 kg-m, 43 ft-lb).
- d. Completely loosen to 0 N·m (0 kg-m, 0 ft-lb).
- e. Tighten all bolts to 27.4 - 31.4 N·m (2.8 to 3.2 kg-m, 21 to 23 ft-lb).
- f. Turn all bolts 50 to 55 degrees (target: 50 degrees) clockwise.

CAUTION:

Check and confirm the tightening angle by using angle wrench (special service tool). Avoid judgment by visual inspection without the tool.



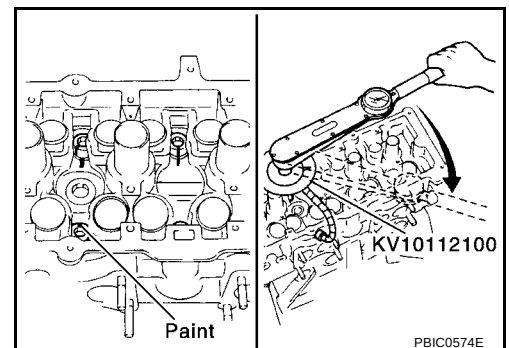
H

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J

K

L

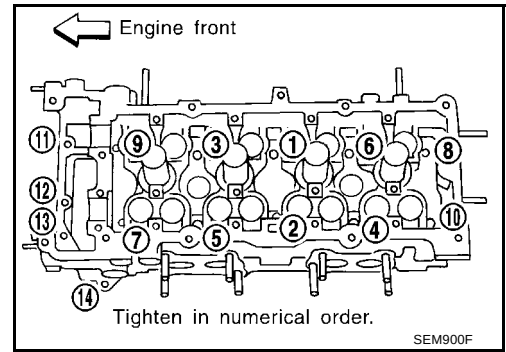


M

CYLINDER HEAD

[QG]

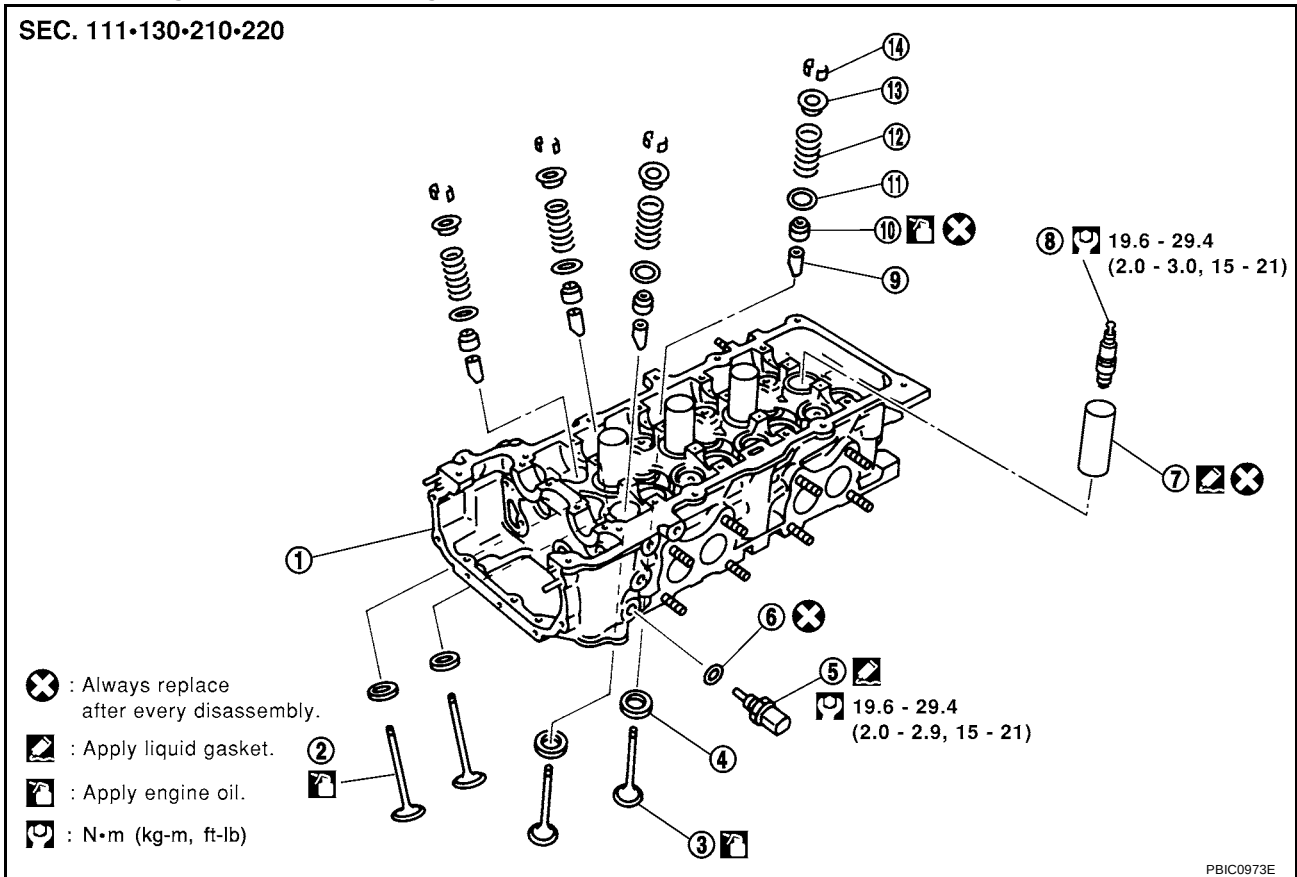
3. Tighten cylinder auxiliary bolts (11) to (14) in numerical order shown in figure.
 - Pay attention to shank length under bolt head. [11: 20 mm (0.79 in), 12 - 14: 25 mm (0.98 in)]



Disassembly and Assembly

EBS00LQJ

SEC. 111•130•210•220



PBIC0973E

- | | | |
|--------------------|--------------------------------------|------------------|
| 1. Cylinder head | 2. Valve (INT) | 3. Valve (EXH) |
| 4. Valve seat | 5. Engine coolant temperature sensor | 6. Copper washer |
| 7. Spark plug tube | 8. Spark plug | |

CAUTION:

- When installing camshafts, chain tensioners, oil seals or other sliding parts, lubricate contacting surface with new engine oil.
- Apply new engine oil to threads and seat surface when installing cylinder head, camshaft sprocket, crankshaft pulley and camshaft bracket.
- Attach tags to valve lifters so as not to mix them up.

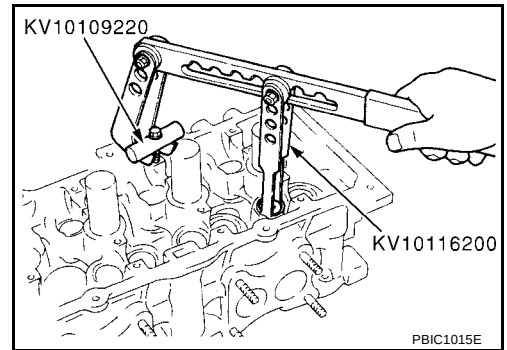
DISASSEMBLY

1. Remove adjusting shim (if so equipped) and valve lifter.
 - Confirm installation point.

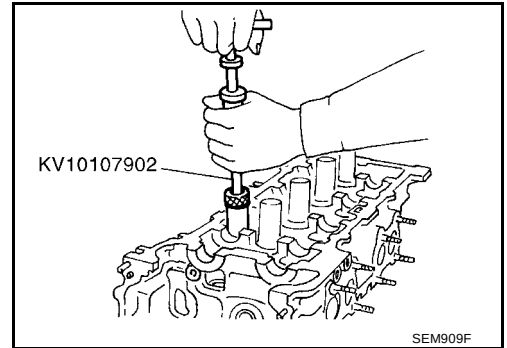
CYLINDER HEAD

[QG]

2. Remove valve collet.
 - Compress valve spring with valve spring compressor (special service tool). Remove valve collet with magnet driver.
3. Remove valve spring retainer and valve spring.
4. Push valve stem to combustion chamber side, and remove valve.
 - Inspect valve guide clearance before removal. Refer to [EM-63, "VALVE GUIDE CLEARANCE"](#) .
 - Confirm installation point.



5. Remove valve oil seal with valve oil seal puller (special service tool).
6. Remove valve spring seat.
7. When valve seat must be replaced, refer to [EM-64, "VALVE SEAT REPLACEMENT"](#) .
8. When valve guide must be replaced, refer to [EM-63, "VALVE GUIDE REPLACEMENT"](#) .
9. Remove spark plug with spark plug wrench (commercial service tool).
10. Remove engine coolant temperature sensor.



CAUTION:

Do not shock it.

11. Remove spark plug tube, as necessary.
 - Using a pair of pliers, pull spark plug tube out of cylinder head.

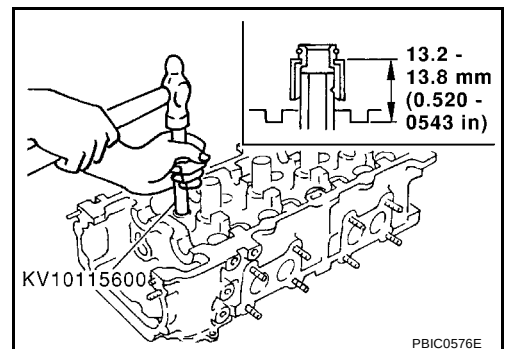
CAUTION:

● **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. Install valve guide. Refer to [EM-63, "VALVE GUIDE REPLACEMENT"](#) .
2. Install valve seat. Refer to [EM-64, "VALVE SEAT REPLACEMENT"](#) .
3. Install valve oil seal.
 - Install with valve oil seal drift (special service tool) to match dimension in illustration.
4. Install valve spring seat.
5. Install valve.
 - Install larger diameter to intake side.

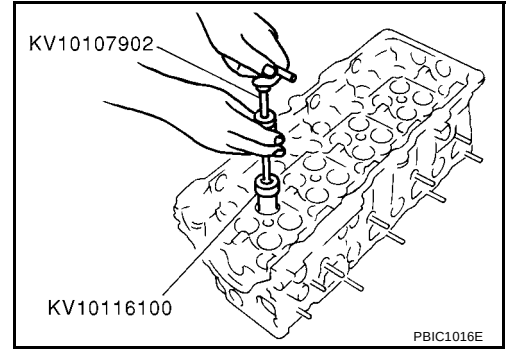


6. Install valve spring.
7. Install valve spring retainer.

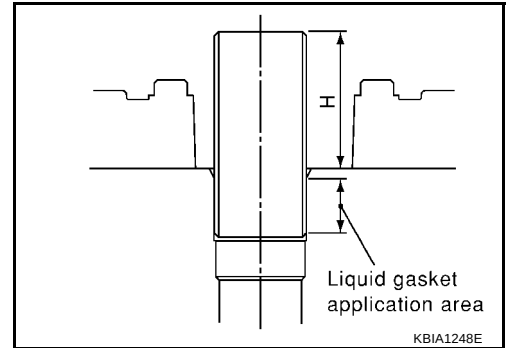
CYLINDER HEAD

[QG]

8. Install valve collet.
 - Compress valve spring with valve spring compressor (special service tool). Install valve collet with magnet hand.
 - Tap stem edge lightly with plastic hammer after installation to check its installed condition.
9. Install adjusting shim (if so equipped) and valve lifter.
10. Install engine coolant temperature sensor.
 - Apply Genuine Liquid Gasket or equivalent to the thread.



11. 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 15 mm (0.59 in) from edge of spark plug tube press-fit side.
 - Use Genuine Liquid Gasket or equivalent.
- 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" :
: 41.0 - 42.0 mm (1.61 - 1.65 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.
12. Install spark plug with spark plug wrench (commercial service tool).

Inspection After Disassembly CYLINDER HEAD DISTORTION

EBS00LQK

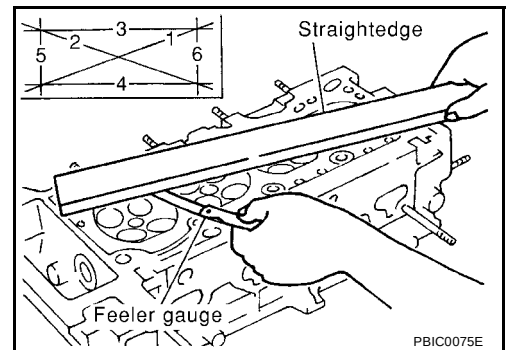
1. Wipe off oil and remove water scale (like deposit), gasket, sealer, carbon, etc with scraper.

CAUTION:

Use utmost care not to allow gasket debris to enter passages for oil or water.

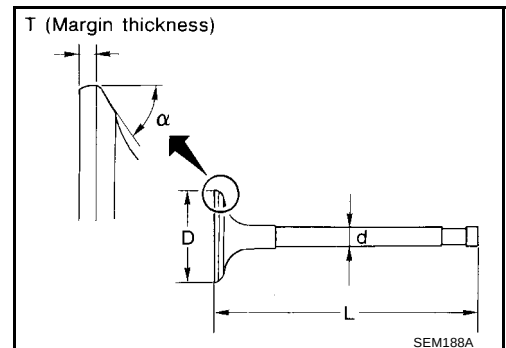
2. At each of several locations on bottom surface of cylinder head, measure distortion in six directions.

Limit : 0.1 mm (0.004 in)



VALVE DIMENSIONS

Check dimensions of each valve. For dimensions, refer to [EM-94](#), "VALVE".



VALVE GUIDE CLEARANCE

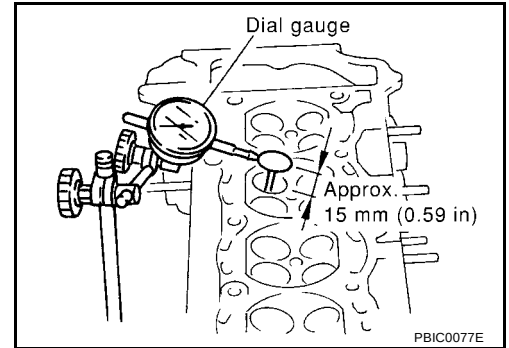
Perform this inspection before removing valve guide.

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.

Standard

Intake : 0.020 - 0.050 mm (0.0008 - 0.0020 in)

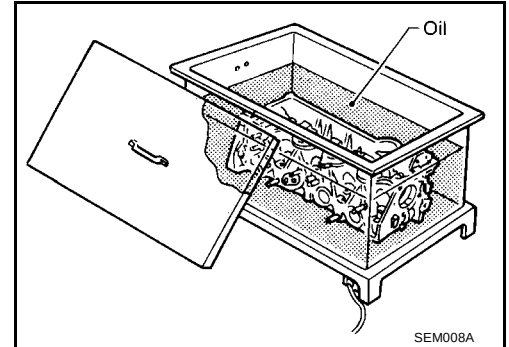
Exhaust : 0.040 - 0.070 mm (0.0016 - 0.0028 in)



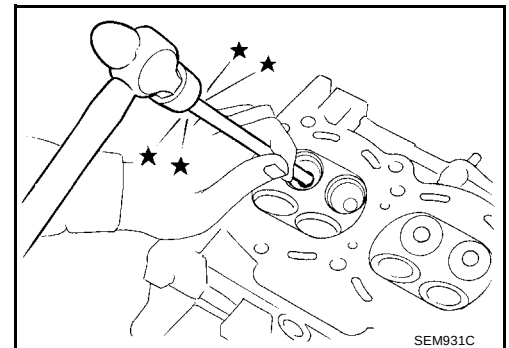
VALVE GUIDE REPLACEMENT

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.

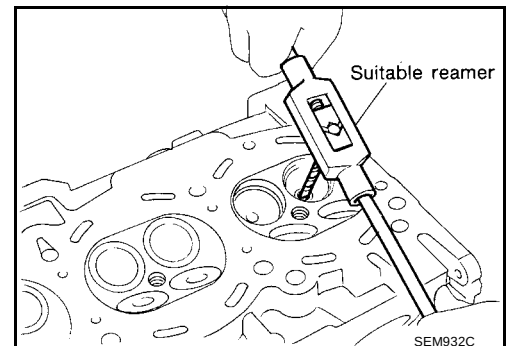


3. Ream cylinder head valve guide hole.

Valve guide hole diameter (for service parts):

Intake and exhaust

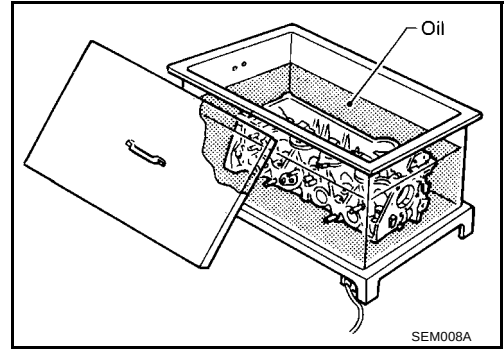
: 9.685 - 9.696 mm (0.3813 - 0.3817 in) dia.



CYLINDER HEAD

[QG]

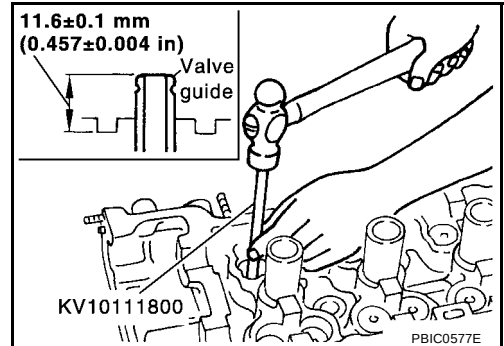
- Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



- 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.

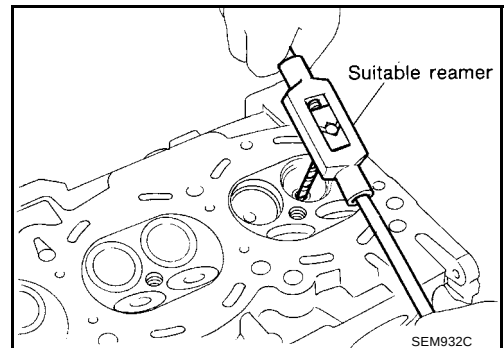


- Using valve guide reamer, apply reamer finish to valve guide.

Standard

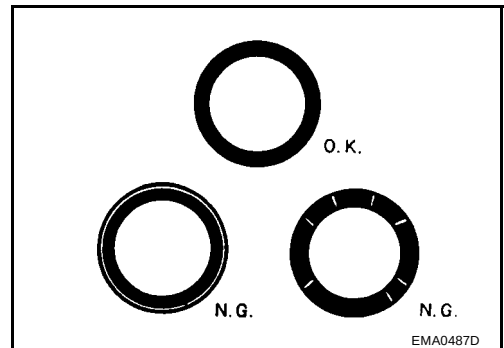
Intake and exhaust

: 5.500 - 5.515 mm (0.2165 - 0.2171 in) dia.



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 N.G 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.

- 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.

CYLINDER HEAD

[QG]

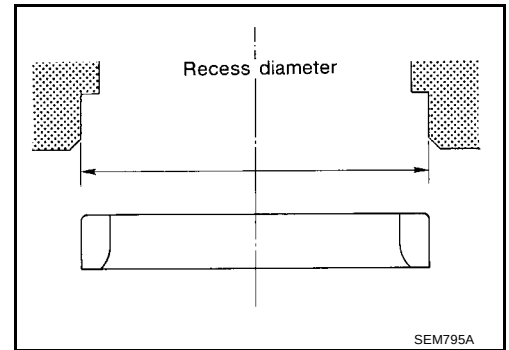
2. Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]:

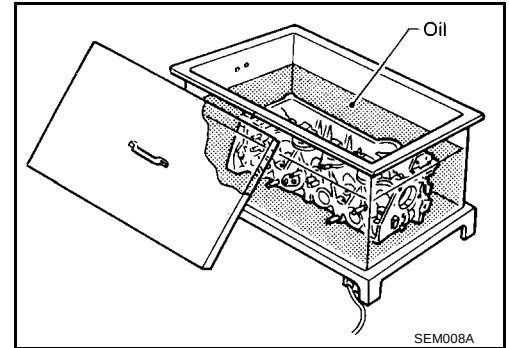
Intake : 31.5 mm (1.240 in)

Exhaust : 26.5 mm (1.043 in)

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



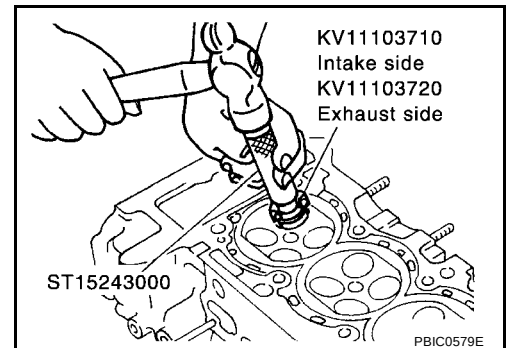
3. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



4. Provide valve seats cooled well with dry ice. Force fit valve seat into cylinder head.

CAUTION:

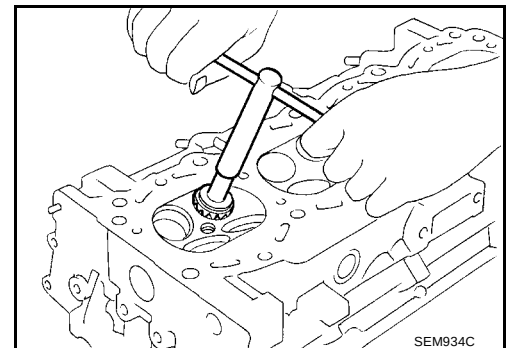
- Avoid directly touching cold valve seats.
- Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.



5. Using valve seat cutter set (commercial service tool) or valve seat grinder, finish the seat to the specified dimensions.

CAUTION:

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



CYLINDER HEAD

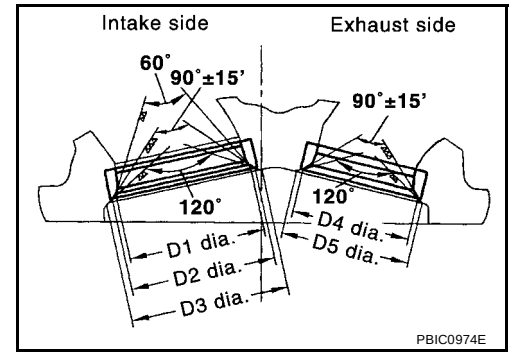
[QG]

Grind to obtain the dimensions indicated in figure.

Standard:

- D1 dia. : 27.8 - 28.0 mm (1.094 - 1.102 in)
- D2 dia. : 29.5 - 29.7 mm (1.161 - 1.169 in)
- D3 dia. : 31.9 - 32.1 mm (1.256 - 1.264 in)
- D4 dia. : 24.5 - 24.7 mm (0.965 - 0.972 in)
- D5 dia. : 26.2 - 26.4 mm (1.031 - 1.039 in)

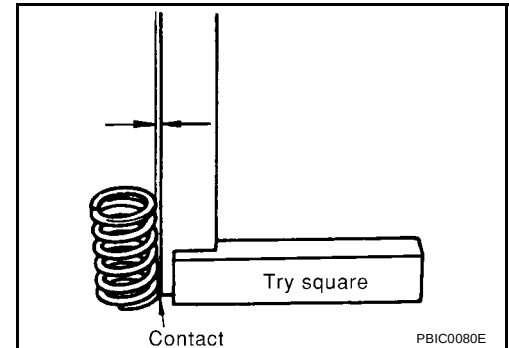
6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact.



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 : 1.8 mm (0.071 in)



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

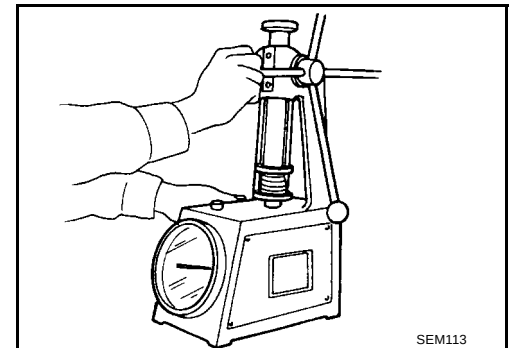
Check valve spring pressure with valve spring seat installed at specified spring height.

CAUTION:

Do not remove valve spring seat.

Standard:

- | | |
|--------------------------|--|
| Free height | 40.0 mm (1.575 in) |
| Installation height | 32.82 mm (1.2921 in) |
| Installation load | 147.5 - 166.3 N (15.04 - 16.96 kg, 33.2 - 37.4 lb) |
| Height during valve open | 23.64 mm (0.9307 in) |
| Load with valve open | 347.8 - 392.2 N (35.5 - 40.0 kg, 78.2 - 88.2 lb) |

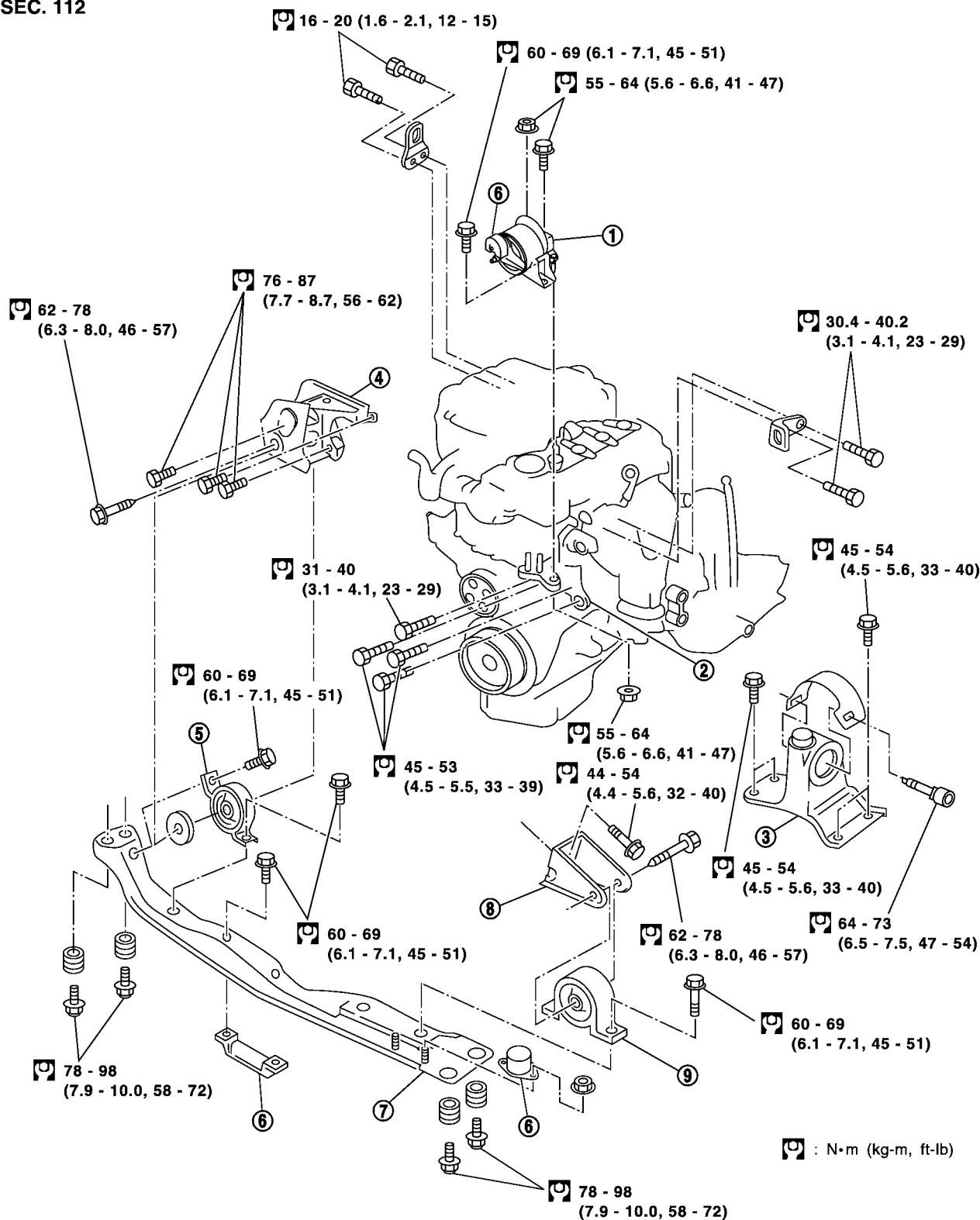


ENGINE ASSEMBLY

PFP:10001

Removal and Installation

EBS00LOY

SEC. 112

YFM017

- | | | |
|---------------------------------|----------------------------------|--|
| 1. RH engine mounting | 2. RH engine mounting bracket | 3. LH engine mounting |
| 4. Rear engine mounting bracket | 5. Rear engine mounting | 6. Dynamic damper (Specific models only) |
| 7. Center member | 8. Front engine mounting bracket | 9. Front engine mounting |

WARNING:

- Position vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Do not remove engine until exhaust system has completely cooled off, otherwise, you may burn yourself and/or fire may break out in fuel line.
- Before disconnecting fuel hose, release pressure.
Refer to EC-34 (WITH EURO-OBD), EC-428 (WITHOUT EURO-OBD).
- Be sure to lift engine and transaxle in a safe manner.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

- When lifting engine, be sure to clear surrounding parts. Use special care near accelerator wire casing, brake lines and brake master cylinder.
- When lifting the engine, always use engine slingers in a safe manner.
- When removing drive shaft, be careful not to damage grease seal of transaxle.
- Before separating engine and transaxle, remove crankshaft position sensor (POS) from the cylinder block assembly.
- Always be extra careful not to damage edge of crankshaft position sensor (POS), or signal plate teeth.

Engine cannot be removed separately from transaxle. Remove engine with transaxle as an assembly.

REMOVAL

1. Drain coolant from radiator and cylinder block. Refer to LC-17, "Chacking Engine Coolant".
2. Remove coolant reservoir tank and bracket.
3. Drain engine oil.
4. Remove battery and battery tray.
5. Remove air cleaner and air duct.
6. Remove drive belts.
7. Remove alternator and air conditioner compressor from engine.
8. Remove power steering oil pump from engine and position aside.

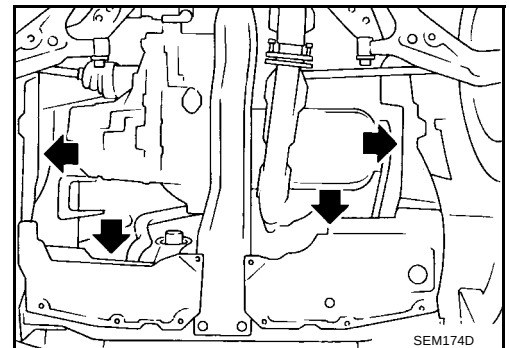
Power steering oil pump does not need to be disconnected from power steering tubes.

9. Remove the following parts:

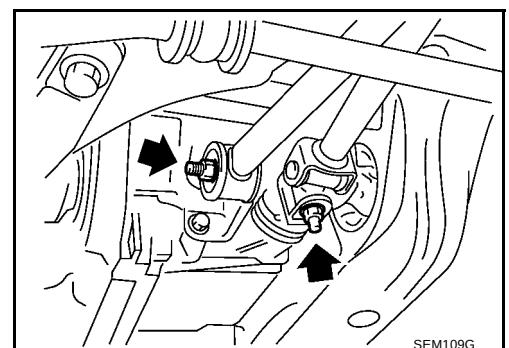
- RH and LH front tires
- Splash covers
- RH and LH brake caliper assemblies
Refer to BR-28, "Removal".

Brake hose does not need to be disconnected from brake caliper assembly. Never depress brake pedal.

- RH & LH drive shaft. Refer to AX-11, "Removal".
When removing drive shaft, be careful not to damage transaxle side grease seal.



- Disconnect control rod and support rod from transaxle. (M/T models.)
Refer to MT-26, "Removal".
- Disconnect control cable from transaxle. (A/T models.)
Refer to AT-411, "Removal".

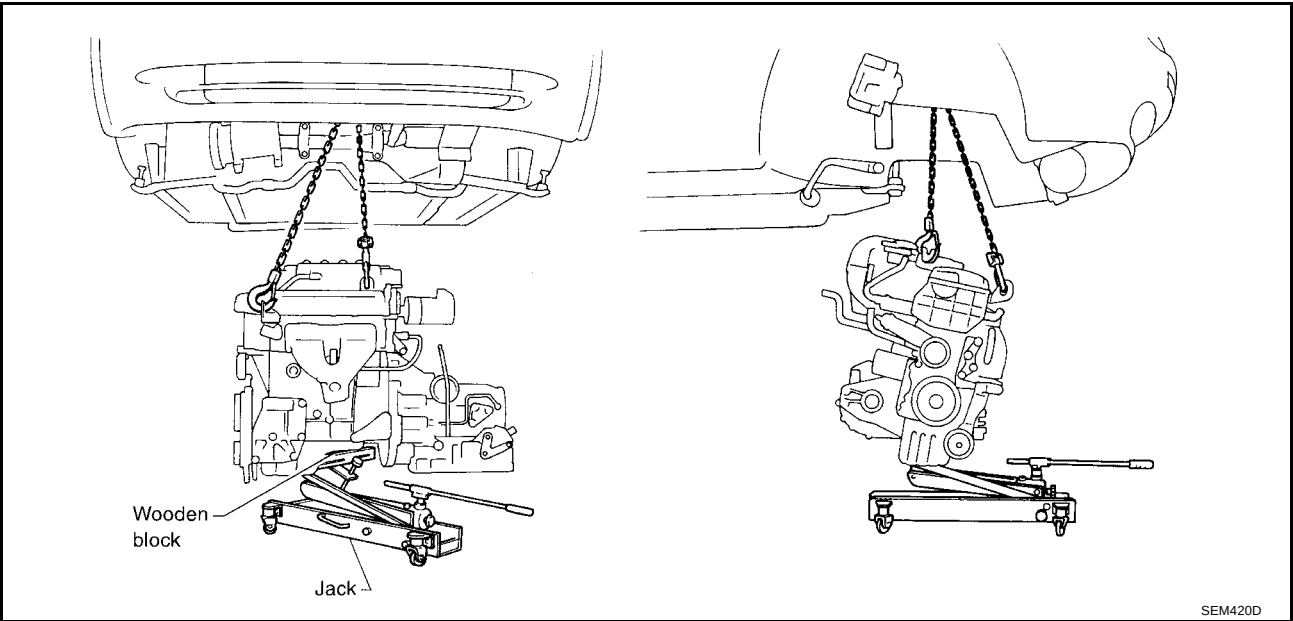
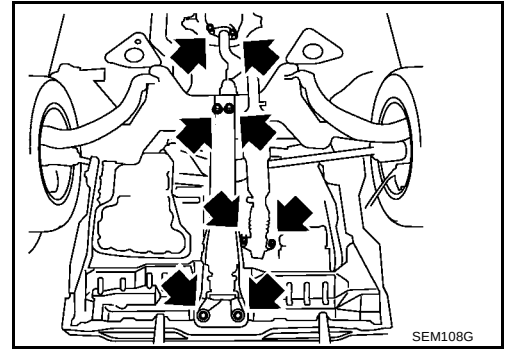


- Center member
- Front exhaust tube
- Stabilizer bar
- Cooling fan
- Radiator
- Disconnect wires, harness, pipes, hoses and so on.

10. Lift up engine slightly and disconnect or remove all engine mountings.

When lifting engine, be sure to clear surrounding parts. Use special care near brake tubes and brake master cylinder.

11. Remove engine with transaxle as shown.



INSTALLATION

- Install in reverse order of removal.

CYLINDER BLOCK

[QG]

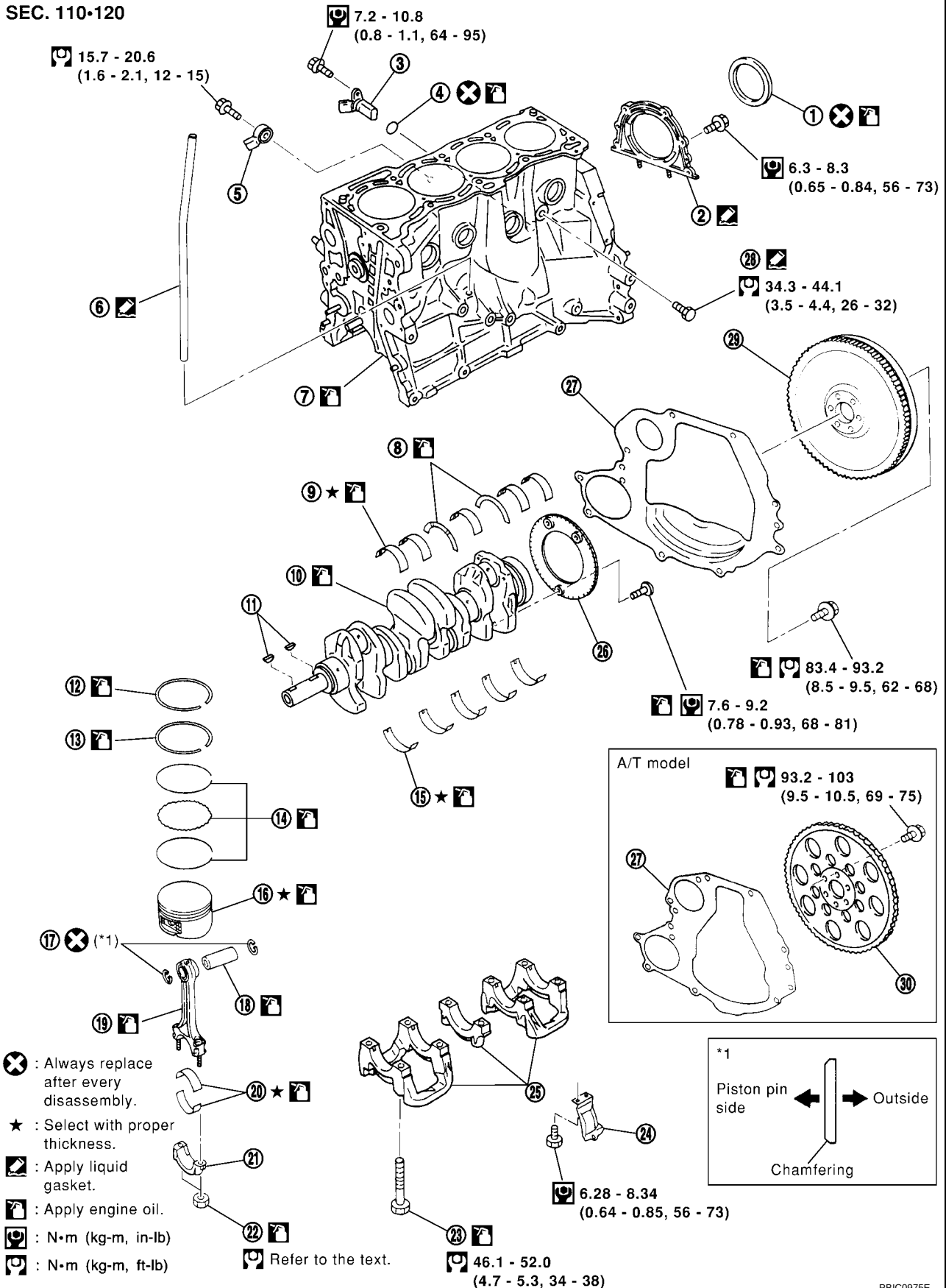
CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

EBS00LQM

SEC. 110-120



PBIC0975E

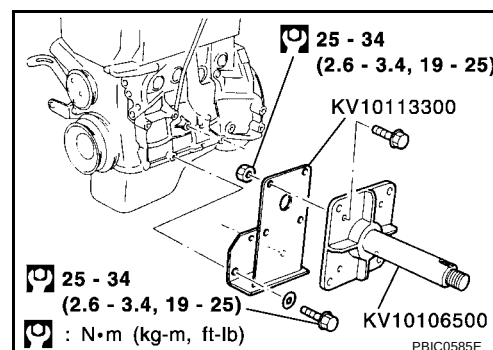
- | | | |
|------------------------|----------------------------|-------------------------------------|
| 1. Rear oil seal | 2. Rear oil seal retainer | 3. Crankshaft position sensor (POS) |
| 4. O-ring | 5. Knock sensor | 6. Oil level gauge guide |
| 7. Cylinder block | 8. Thrust bearing | 9. Main bearing |
| 10. Crankshaft | 11. Key | 12. Top ring |
| 13. 2nd ring | 14. Oil ring | 15. Main bearing |
| 16. Piston | 17. Snap ring | 18. Piston pin |
| 19. Connecting rod | 20. Connecting rod bearing | 21. Connecting rod cap |
| 22. Connecting rod nut | 23. Main bearing cap bolt | 24. Baffle plate |
| 25. Main bearing cap | 26. Signal plate | 27. Rear plate |
| 28. Coolant drain plug | 29. Flywheel (M/T models) | 30. Drive plate (A/T models) |

CAUTION:

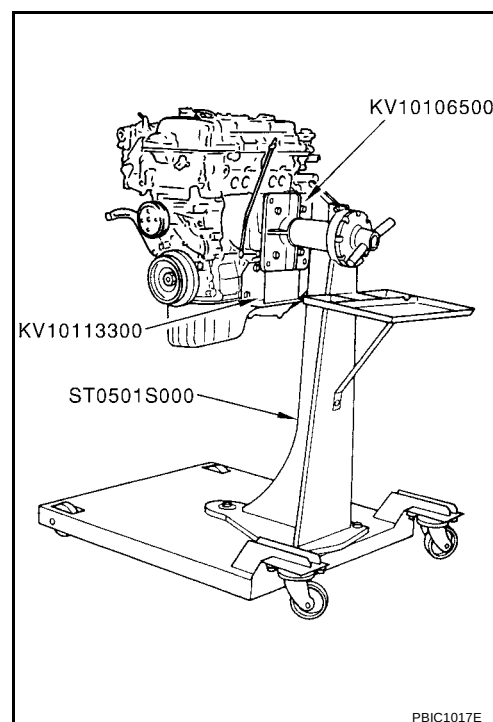
Apply new engine oil to parts marked in illustration before installation.

DISASSEMBLY

1. Remove engine and transaxle assembly from vehicle, and separate transaxle from engine. Refer to [EM-67, "ENGINE ASSEMBLY"](#).
2. Mount engine on an engine stand with the following procedure.
 - a. Remove exhaust manifold and catalytic converter. Refer to [EM-19, "EXHAUST MANIFOLD AND CATALYTIC CONVERTER"](#).
 - b. Remove engine front mounting bracket, alternator and air compressor bracket.
 - c. Install engine sub-attachment to left side of cylinder block.



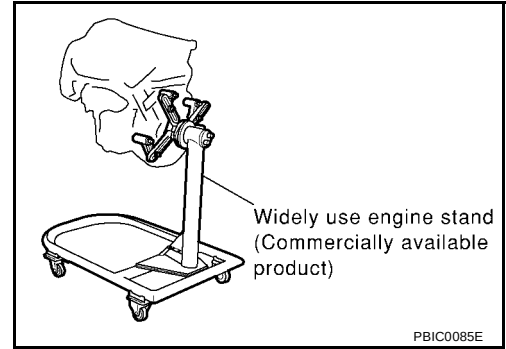
- d. Lift engine, and mount it onto the engine stand.



- A commercial engine stand can be used.

NOTE:

- This example is an engine stand for holding at transaxle mounting side with the flywheel or drive plate removed.



3. Drain engine oil and coolant from inside of engine.
4. Remove the following components and associated parts.
 - Fuel tube and injector assembly; Refer to [EM-26, "Removal and Installation"](#) .
 - Intake manifold and intake manifold collector assembly; Refer to [EM-16, "Removal and Installation"](#) .
 - Ignition coil; Refer to [EM-24, "Removal and Installation"](#) .
 - Rocker cover; Refer to [EM-29, "Removal and Installation"](#) .
 - Oil pan and oil strainer; Refer to [EM-22, "Removal and Installation"](#) .
 - Front cover and timing chain; Refer to [EM-47, "Removal and Installation"](#) .
 - Camshaft; Refer to [EM-32, "Removal and Installation"](#) .
 - Cylinder head assembly; Refer to [EM-58, "Removal and Installation"](#) .
 - Auxiliary brackets and oil filter

5. Remove knock sensor.

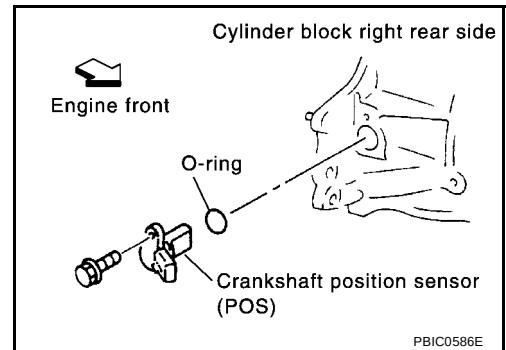
CAUTION:

Avoid impacts such as a dropping.

6. Remove crankshaft position sensor (POS).

CAUTION:

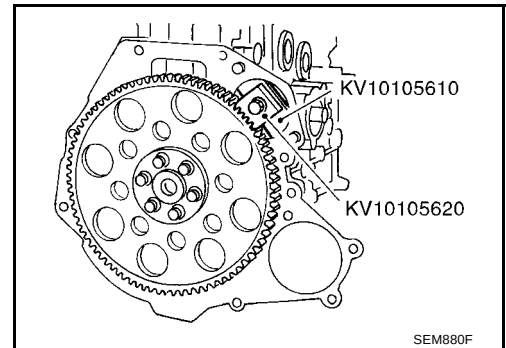
- Avoid impacts such as a dropping.
- Do not disassemble.
- Keep it away from metal particles.
- Do not place sensor close to magnetic materials.



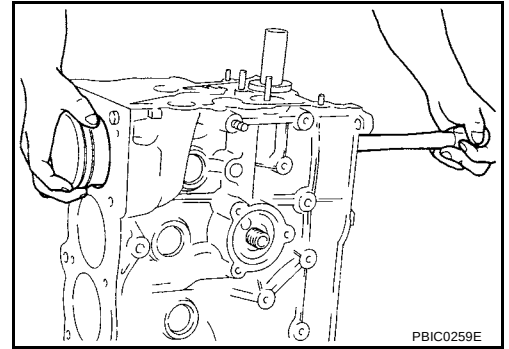
7. Remove flywheel (M/T models) or drive plate (A/T models). Fix crankshaft with a ring gear stopper (special service tool), and remove mounting bolts.
8. Remove rear plate.
9. Remove rear oil seal retainer.
 - Insert a flat-bladed screwdriver between main bearing cap and rear oil seal retainer to remove retainer.
10. Remove rear oil seal from rear oil seal retainer.
 - Punch out with a flat-bladed screwdriver.

CAUTION:

- Be careful not to damage rear oil seal retainer.



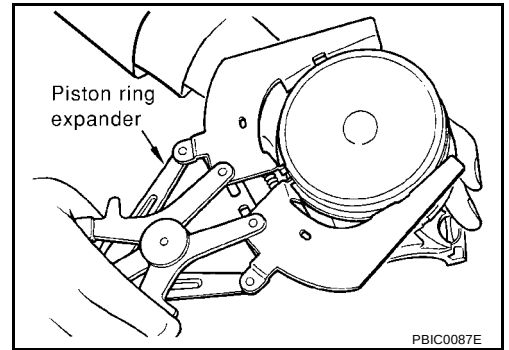
11. Remove the piston and connecting rod assembly.
 - Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-84, "CONNECTING ROD SIDE CLEARANCE"](#).
- a. Position the crankshaft pin corresponding to the connecting rod to be removed onto the bottom 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.
12. Remove the connecting rod bearings.



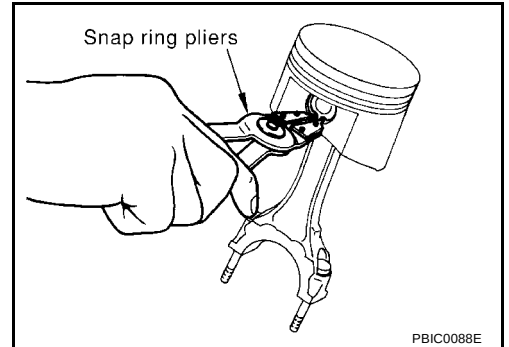
CAUTION:

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

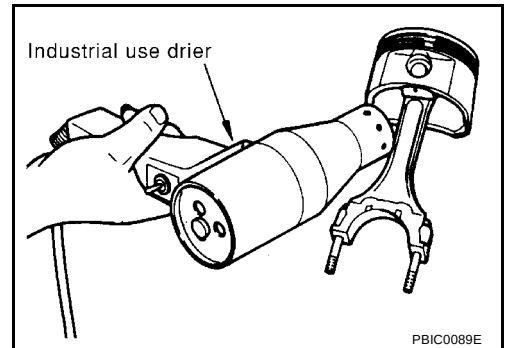
13. Remove the piston rings from the piston.
 - Before removing the piston rings, check the piston ring side clearance. Refer to [EM-85, "PISTON RING SIDE CLEARANCE"](#).
 - Use a piston ring expander (commercial service tool).
- CAUTION:**
- When removing the piston rings, be careful not to damage the piston.
 - Be careful not to damage piston rings by expanding them excessively.



14. Remove the piston from the connecting rod as follows:
 - a. Using a snap ring pliers, remove the snap ring.



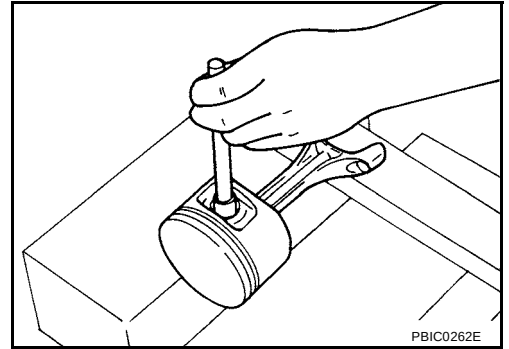
- b. Heat piston to 60 to 70°C (140 to 158°F) with drier or equivalent.



CYLINDER BLOCK

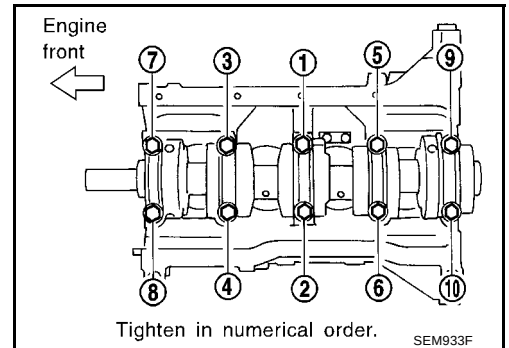
[QG]

- c. Push out piston pin with stick of outer diameter approximately 17 mm (0.67 in).



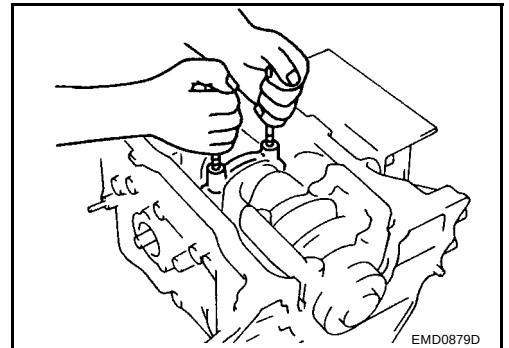
15. Remove main bearing cap bolts.

- Loosen main bearing cap bolts in several steps in reverse order shown in the figure, and remove them.
- Measure crankshaft side clearance before loosening main bearing cap bolts. Refer to [EM-84, "CRANKSHAFT SIDE CLEARANCE"](#).



16. Remove main bearing caps.

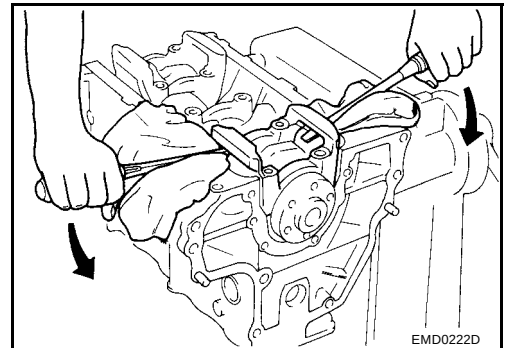
- Using main bearing cap bolts as shown, remove center main bearing cap while shaking it back-and-forth.



- To remove front and rear main bearing caps, lever them off using screwdriver or similar tool. Or, using a plastic hammer, tap them back-and-forth.

CAUTION:

Using shop cloth or wooden block, protect oil pan mounting surface on cylinder block, so that mounting surface is not damaged.



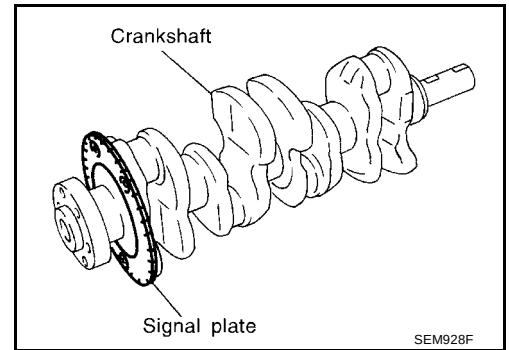
17. Remove crankshaft.

CAUTION:

- When placing crankshaft on ground, be careful not to damage signal plate.
- Never remove signal plate unless it is necessary.

NOTE:

If it is removed, positioning dowel pin (dowel pins for crankshaft and signal plate are specified as a single set) must be reinstalled.



18. Remove main bearing and thrust bearing from cylinder block and main bearing cap.

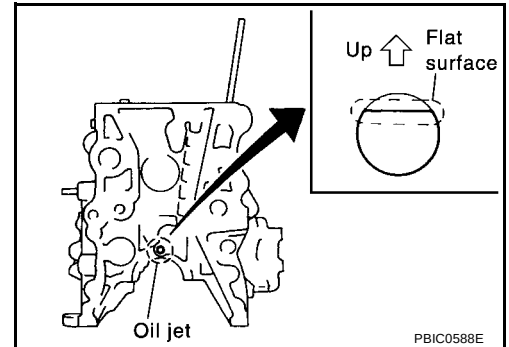
CAUTION:

Check mounting positions, and store them without mixing them up.

19. Remove baffle plate.

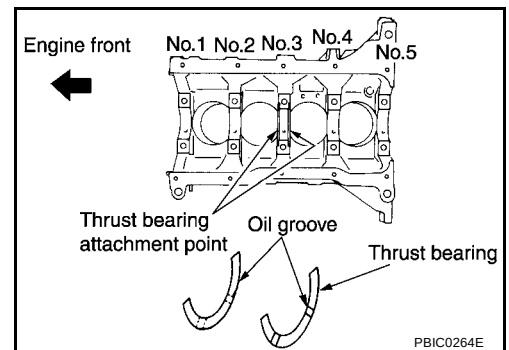
ASSEMBLY

1. Blow air sufficiently through engine coolant passage of cylinder block, oil passage, crank case and cylinder bore to remove foreign objects.
2. Install oil jet for timing chain lubrication.
 - Face its flat surface upward, and push it as far as it will go.
3. Install baffle plate.



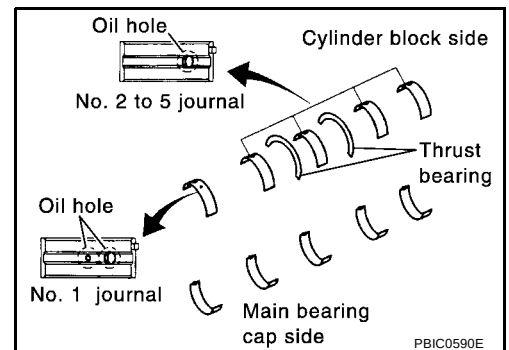
4. Install the main bearings and the thrust bearings.

- a. Remove dust, dirt, and oil on the bearing mating surfaces of the cylinder block and the lower cylinder block.
- b. Install the thrust bearings to the both sides of the No. 3 journal housing on the cylinder block.
 - Install the thrust bearings with the oil groove facing the crankshaft arm (outside).



c. Install the main bearings paying attention to the direction.

- The main bearing with an oil hole and groove goes on the cylinder block. The one without them goes on the lower cylinder block.
- Main bearings (cylinder block side) for journal No. 1 and for No. 2 to No. 5 are different.
- 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.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



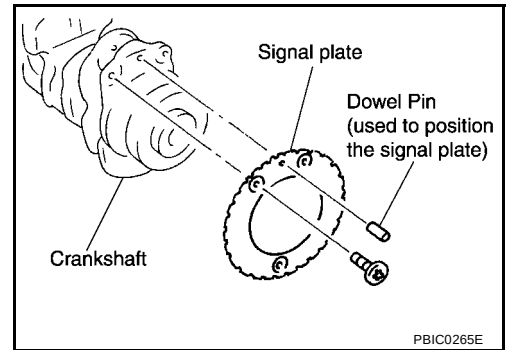
5. Install the signal plate to the crankshaft.
 - a. Position crankshaft and signal plate using a positioning dowel pin, and tighten mounting bolts.
 - b. Remove dowel pin.

CAUTION:

Be sure to remove dowel pin.

NOTE:

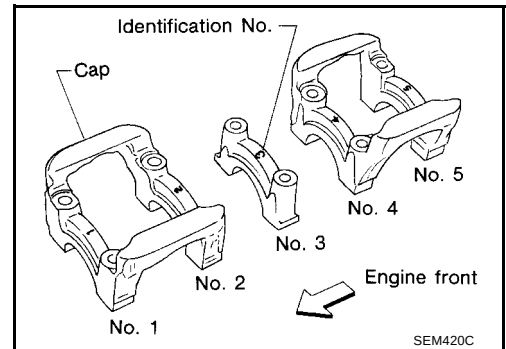
- Dowel pins of crankshaft and signal plate are provided as a set for each.
- If dowel pin is not available (when crankshaft and signal plate are reused), use M6 bolt [length under head: 10 mm (0.39 in) or longer] as its substitute.



6. Install the crankshaft to the cylinder block.
 - While turning the crankshaft by hand, check that it turns smoothly.
7. Install main bearing cap.
 - Main bearing cap is identified by identification paint No. made on it before it is removed.
 - Install it with arrow facing to front.

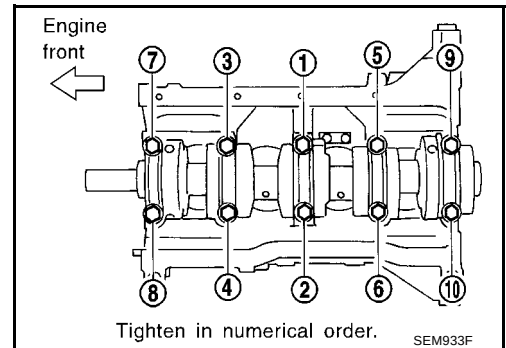
NOTE:

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

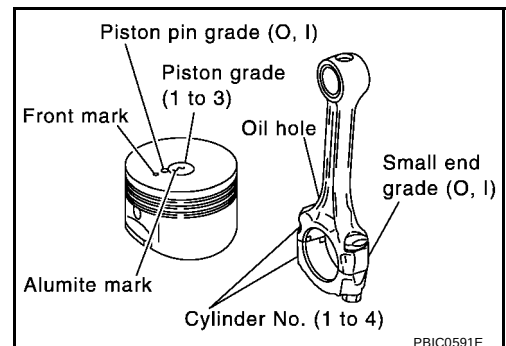


8. Tighten main bearing bolts in several steps in numerical order shown in the figure.

- Apply engine oil onto thread and seat of mounting bolt.
- After tightening bolts to specified torque, make sure that crankshaft rotates smoothly.
- Check crankshaft side clearance. Refer to [EM-84, "CRANK-SHAFT SIDE CLEARANCE"](#).



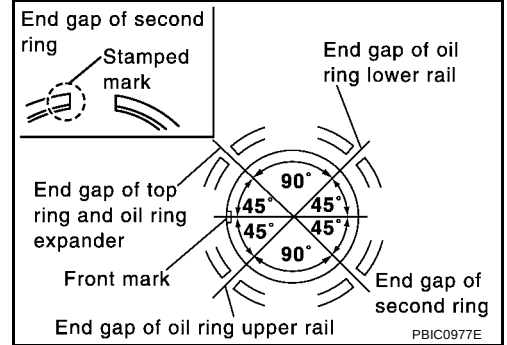
9. Install piston to connecting rod.
 - a. Using snap ring pliers, install snap ring to groove of piston rear side.
 - Install with chamfered side facing piston pin side. Refer to [EM-70, "Disassembly and Assembly"](#).
 - b. Install piston to connecting rod.
 - Using hot-air blower, heat piston to 60 to 70°C (140 to 158°F) so that piston pin can be easily inserted by hand. Insert piston pin into piston and connecting rod from front side of piston.
 - Assemble so that front mark on piston head and oil hole in connecting rod are positioned as shown in the figure.
 - c. Install snap ring to front side of piston.
 - Refer to step "a" to install snap ring.
 - After installation, make sure that connecting rod moves smoothly.



10. Install piston rings with piston ring expander (commercial service tool).

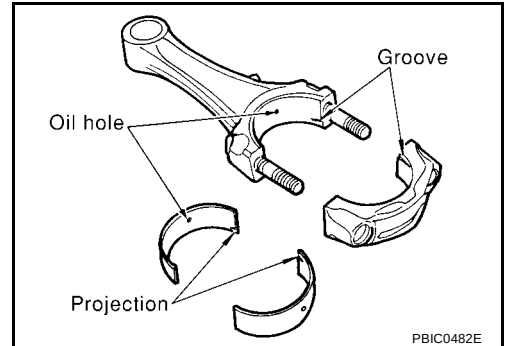
CAUTION:

- Be careful not to damage piston.
- When installing top ring, be careful not to break end gap step.
- Position end gaps of each piston ring to piston front mark as shown in figure, then install rings.
- Install top ring with stamp mark side facing upward.



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

- When installing the connecting rod bearings, apply engine oil to the bearing surface (inside). Do not apply oil to the back surface, but thoroughly clean it.
- When installing, align the connecting rod bearing stopper protrusion with the notch of the connecting rod to install.
- Check the oil holes on the connecting rod and those on the corresponding bearing are aligned.

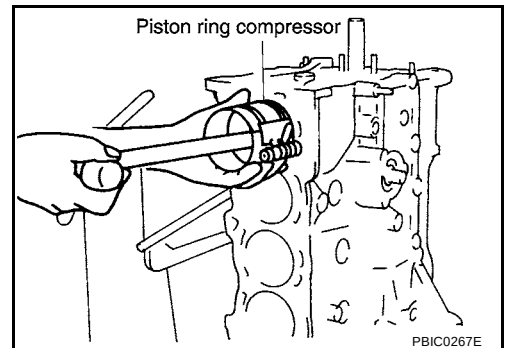


12. Install the piston and connecting rod assembly to the crankshaft.

- Position the crankshaft pin corresponding to the connecting rod to be installed onto the bottom dead center.
- Apply engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder No. on the connecting rod to install.
- Using a piston ring compressor, install the piston with the front mark on the piston crown facing the front of the engine.

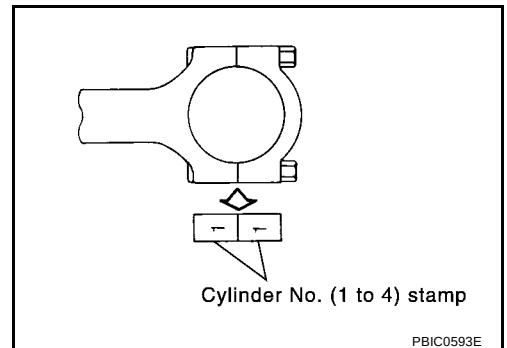
CAUTION:

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



13. Install the connecting rod cap.

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

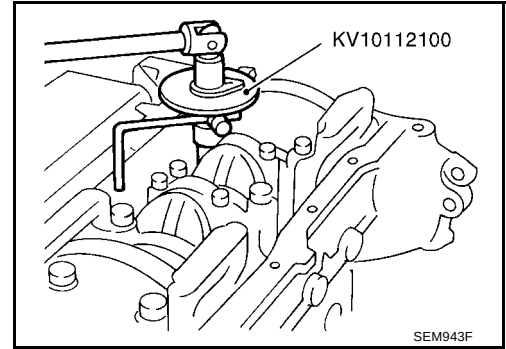


14. Tighten connecting rod nuts with the following procedure.
 - a. Lubricate connecting rod bolts and seat of nuts with new engine oil.
 - b. Tighten to a torque of 13.72 - 15.68 N·m (1.4 - 1.5 kg-m, 10.2 - 11.5 ft-lb)
 - c. Turn all nuts another 35 to 40 degrees (Target: 35 degrees).

CAUTION:

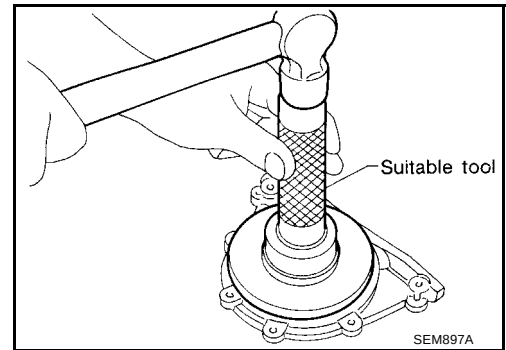
Always use angle wrench (special service tool). Avoid tightening based on visual check alone.

- After tightening nuts, make sure that crankshaft rotates smoothly.
- Check connecting rod side clearance. Refer to [EM-84, "CONNECTING ROD SIDE CLEARANCE"](#).

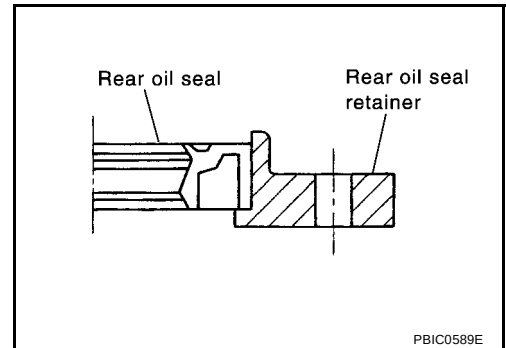


15. Install rear oil seal.

- Use an oil seal drift (commercial service tool) to press it in. At this time, be careful not to cause any scratches or burrs on circumference of oil seal.



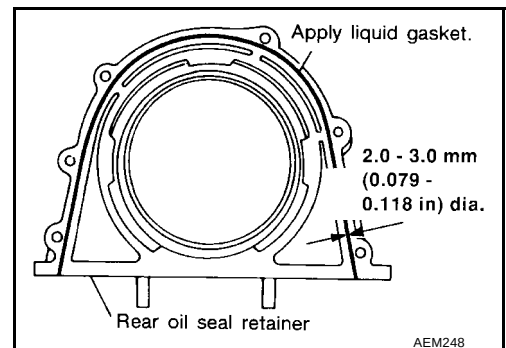
- Press oil seal into rear oil seal retainer until it does not project from end.



16. Install rear oil seal retainer.

- Apply continuous bead of liquid gasket to parts shown in figure.
- Install rear oil seal retainer by aligning it with dowel pins on cylinder block.

17. Install rear plate.

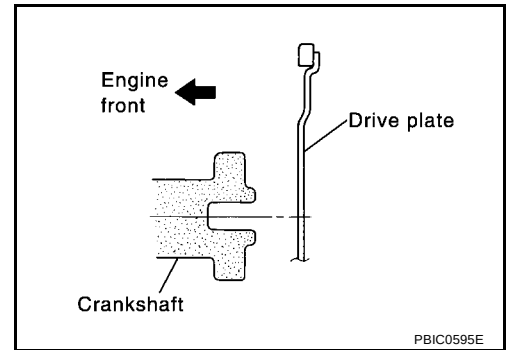


CYLINDER BLOCK

[QG]

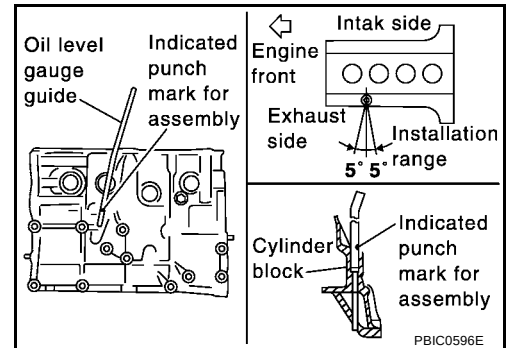
18. Install flywheel or drive plate.

- Install drive plate in direction shown in figure.
- Fix crankshaft with ring gear stopper (special service tool).
- Tighten mounting bolts diagonally in several steps.



19. Install oil level gauge guide.

- Press it in with punch mark for installing instruction in direction shown in figure.
- Apply locking agent to pressed position.

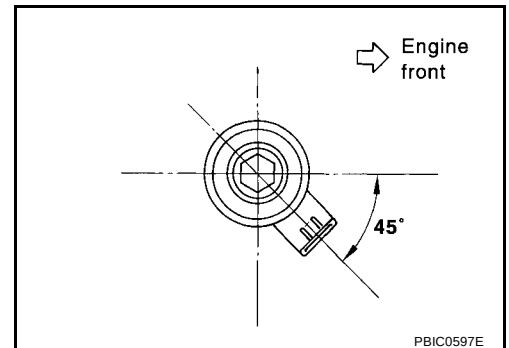


20. Install knock sensor.

- Install sensor with connector facing lower right by 45° as shown.

CAUTION:

- If any impact by dropping is applied to the knock sensor, replace it with new one.
- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of the knock sensor.
- Do not tighten the mounting bolts while holding the connector.
- Make sure that the knock sensor does not interfere with other parts.



21. Install crankshaft position sensor (POS).

- Tighten bolt after fully inserting crankshaft position sensor (POS) into cylinder block.

22. Tighten accessory brackets to the following tightening torque.

Power steering pump bracket:

: 16.7 - 23.5 N·m (1.7 - 2.4 kg-m, 13 - 17 ft-lb)

Alternator air conditioner compressor bracket:

: 33.3 - 46.1 N·m (3.4 - 4.7 kg-m, 25 - 34 ft-lb)

23. Assemble in the reverse order of disassembly.

How to Select Piston and Bearing

DESCRIPTION

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block to crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft to connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Connecting rod bearing grade = crankshaft pin grade (outer diameter of pin). No grade exists for inner diameter to 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	—	—	—

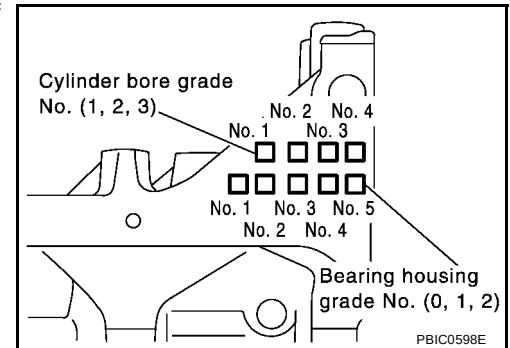
*For the service parts, the grade for fitting cannot be selected between a piston pin and a connecting rod. (Only 0 grade is available.) The information at the shipment from the plant is described as a reference.

- 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.

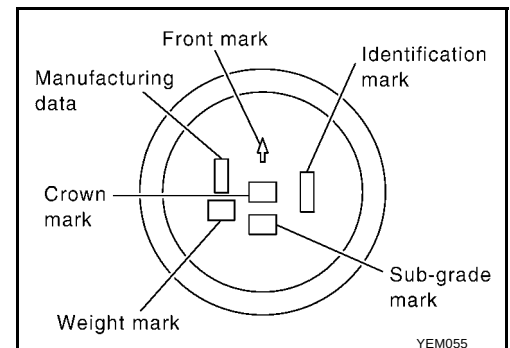
HOW TO SELECT PISTON

When New Cylinder Block is Used

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



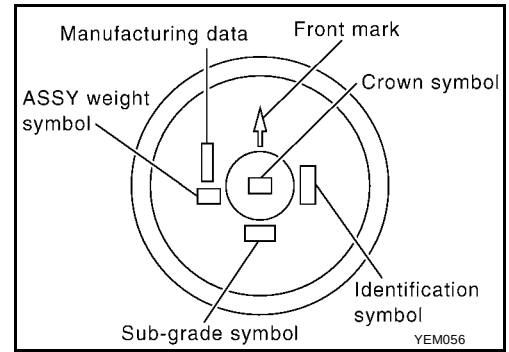
- QG15DE



CYLINDER BLOCK

[QG]

- QG18DE



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". Select the piston of the same grade.

Piston Selection Table

QG15DE

Unit: mm (in)

Grade number (Mark)	1	2 (or no punching)	3
Inner diameter of cylinder bore	73.600 - 73.610 (2.8976 - 2.8980)	73.610 - 73.620 (2.8980 - 2.8984)	73.620 - 73.630 (2.8984 - 2.8988)
Outer diameter of piston	73.575 - 73.585 (2.8966 - 2.8970)	73.585 - 73.595 (2.8970 - 2.8974)	73.595 - 73.605 (2.8974 - 2.8978)

QG18DE

Unit: mm (in)

Grade number (Mark)	1	2 (or no punching)	3
Inner diameter of cylinder bore	80.000 - 80.010 (3.1496 - 3.1500)	80.010 - 80.020 (3.1500 - 3.1504)	80.020 - 80.030 (3.1504 - 3.1508)
Outer diameter of piston	79.965 - 79.975 (3.1482 - 3.1486)	79.975 - 79.985 (3.1486 - 3.1490)	79.985 - 79.995 (3.1490 - 3.1494)

CAUTION:

No stamp mark is only applied to piston side.

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.)

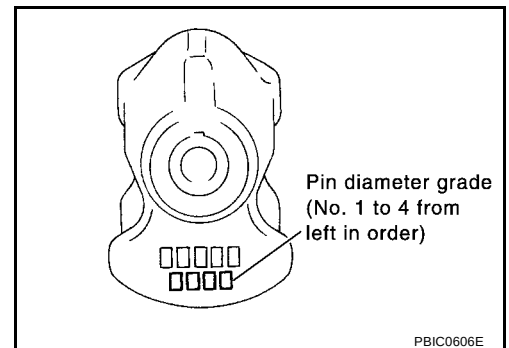
HOW TO SELECT CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used

- Compare the pin diameter grade (0, 1 or 2) of the crankshaft on 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

1. Confirm connecting rod big end inner diameter is within the standard.
2. Measure the pin outer diameter of the crankshaft.

CYLINDER BLOCK

[QG]

- Find measured dimension in "Crankshaft pin outer diameter" column in selective-fit service parts table, and select connecting rod bearing of same grade number.

Connecting Rod Bearing Selection Table

Unit: mm (in)

Connecting rod big end ID		43.000 - 43.013 (1.6929 - 1.6934)	
Crankshaft pin OD	Grade (punched)	0 (no punching)	
39.968 - 39.974 (1.5735 - 1.5738)	0	- Bearing grade No. - Bearing thickness - Oil clearance - Identification color	STD 0 1.503 - 1.506 (0.0592 - 0.0593) 0.014 - 0.039 (0.0006 - 0.0015) Black
39.962 - 39.968 (1.5733 - 1.5735)	1	- Bearing grade No. - Bearing thickness - Oil clearance - Identification color	STD 1 1.506 - 1.509 (0.0593 - 0.0594) 0.014 - 0.039 (0.0006 - 0.0015) Red
39.956 - 39.962 (1.5731 - 1.5733)	2	- Bearing grade No. - Bearing thickness - Oil clearance - Identification color	STD 2 1.509 - 1.512 (0.0594 - 0.0595) 0.014 - 0.039 (0.0006 - 0.0015) 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 the crankshaft pin so that the oil clearance satisfies the standard.

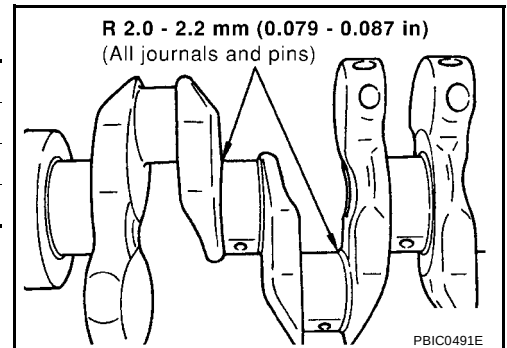
Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.08 (0.0031)	1.542 - 1.546 (0.0607 - 0.0609)
US 0.12 (0.0047)	1.562 - 1.566 (0.0615 - 0.0617)
US 0.25 (0.0098)	1.627 - 1.631 (0.0641 - 0.0642)

CAUTION:

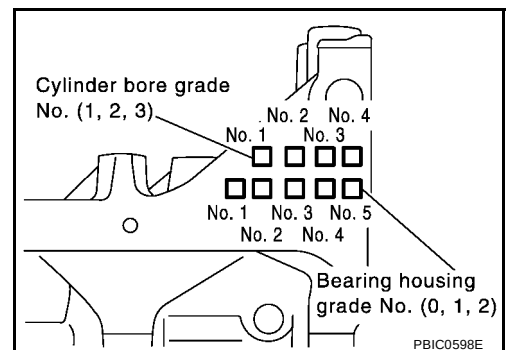
In grinding the crankshaft pin to use undersize bearings, keep the fillet R (All crankshaft pins).



HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft are Used

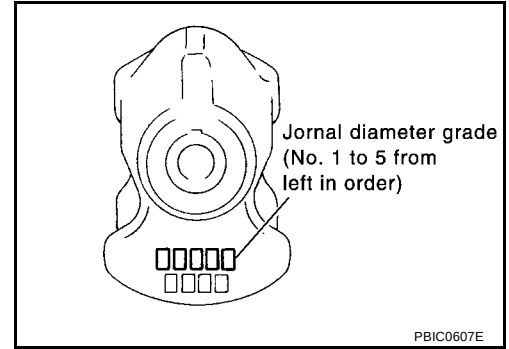
- Apply main bearing housing grade (0, 1 or 2) on bottom of cylinder block banks to row in main bearing selection table.



CYLINDER BLOCK

[QG]

2. Apply journal diameter grade (0, 1 or 2) on crankshaft front to column in main bearing selection table.
3. Select main bearing (STD 0 - 4) at the point where selected row and column meet in following main bearing selection table.



When Cylinder Block and Crankshaft are Reused

1. Measure dimension of main bearing housing on cylinder block.
2. Find measured dimension in "Cylinder block main bearing housing inner diameter" row in following main bearing selection table.
3. Measure crankshaft journal diameter.
4. Find measured dimension in "Crankshaft journal outer diameter" column in following main bearing selection table.
5. Select main bearing (STD 0 - 4) at the point where selected row and column meet in following main bearing selection table.

Main Bearing Selection Table

Unit: mm (in)

Connecting block main bearing housing ID			53.644 - 53.652 (2.1120 - 2.1123)	53.652 - 53.660 (2.1123 - 2.1126)	53.660 - 53.668 (2.1126 - 2.1129)
Crankshaft journal OD	Grade (punched)		0	1	2
49.956 - 49.964 (1.9668 - 1.9671)	0	- Bearing grade No. - Bearing thickness - Oil clearance - Identification color	STD 0 1.826 - 1.830 (0.0719 - 0.0720) 0.020 - 0.044 (0.0008 - 0.0017) Black	STD 1 1.830 - 1.834 (0.0720 - 0.0722) 0.020 - 0.044 (0.0008 - 0.0017) Red	STD 2 1.834 - 1.838 (0.0722 - 0.0724) 0.020 - 0.044 (0.0008 - 0.0017) Green
49.948 - 49.956 (1.9665 - 1.9668)	1	- Bearing grade No. - Bearing thickness - Oil clearance - Identification color	STD 1 1.830 - 1.834 (0.0720 - 0.0722) 0.020 - 0.044 (0.0008 - 0.0017) Red	STD 2 1.834 - 1.838 (0.0722 - 0.0724) 0.020 - 0.044 (0.0008 - 0.0017) Green	STD 3 1.838 - 1.842 (0.0724 - 0.0725) 0.020 - 0.044 (0.0008 - 0.0017) Yellow
49.940 - 49.948 (1.9661 - 1.9665)	2	- Bearing grade No. - Bearing thickness - Oil clearance - Identification color	STD 2 1.834 - 1.838 (0.0722 - 0.0724) 0.020 - 0.044 (0.0008 - 0.0017) Green	STD 3 1.838 - 1.842 (0.0724 - 0.0725) 0.020 - 0.044 (0.0008 - 0.0017) Yellow	STD 4 1.842 - 1.846 (0.0725 - 0.0727) 0.020 - 0.044 (0.0008 - 0.0017) Blue

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 the bearing inner diameter with bearing installed, and grind journal until oil clearance falls within specification.

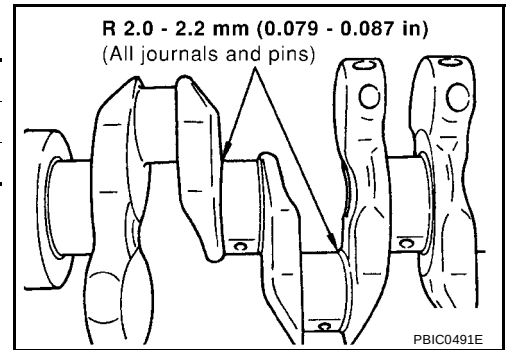
Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.960 - 1.964 (0.0722 - 0.0773)
US 0.50 (0.0197)	2.085 - 2.089 (0.0821 - 0.0822)

CAUTION:

Keep fillet R when grinding crankshaft journal in order to use undersize bearing (All journals).



EBS00LQO

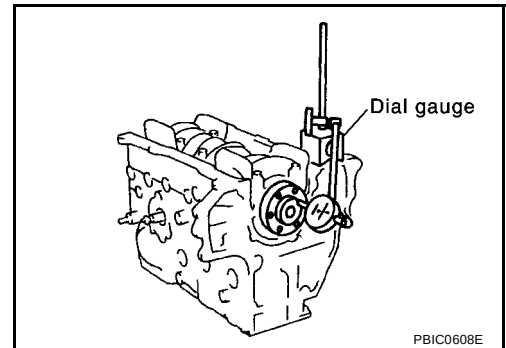
Inspection After Disassembly CRANKSHAFT SIDE CLEARANCE

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

Standard : 0.060 - 0.260 mm (0.0024 - 0.0102 in)

Limit : 0.3 mm (0.012 in)

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



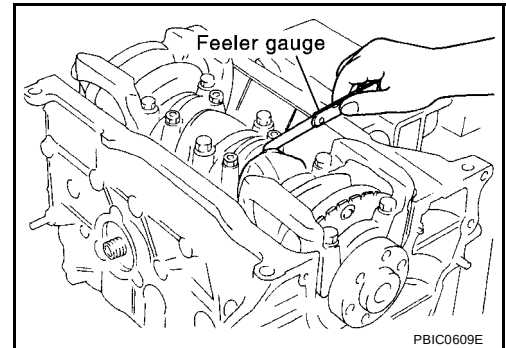
CONNECTING ROD SIDE CLEARANCE

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

Standard : 0.200 - 0.470 mm (0.0079 - 0.0185 in)

Limit : 0.5 mm (0.020 in)

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



PISTON AND PISTON PIN CLEARANCE

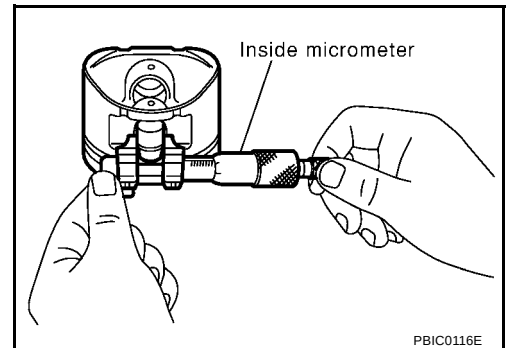
Inner Diameter of Piston Pin

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

Standard:

QG15DE : 18.987 - 18.999 mm (0.7475 - 0.7480 in)

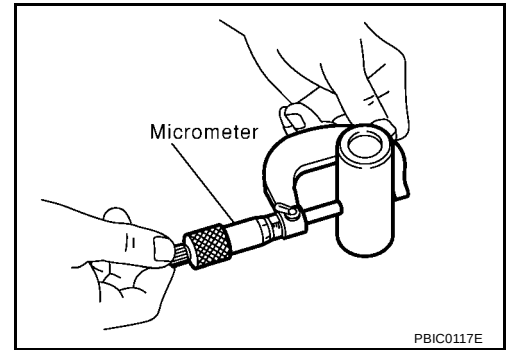
QG18DE : 18.993 - 18.999 mm (0.7478 - 0.7480 in)



Outer Diameter of Piston Pin

- Measure outer diameter of piston pin with a micrometer.

Standard : 18.989 - 19.001 mm (0.7476 - 0.7481 in)



Piston and Piston Pin Clearance

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

Standard:

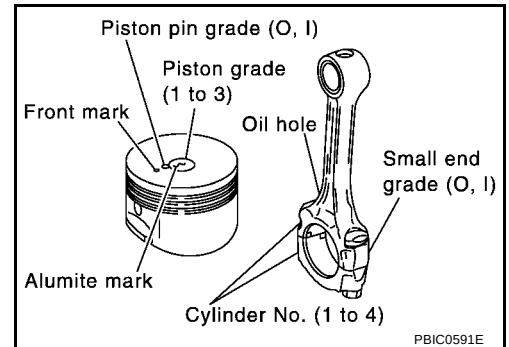
QG15DE : – 0.004 to 0 mm (– 0.0002 to 0 in)

QG18DE : 0.002 - 0.006 mm (0.0001 - 0.0002 in)

- If clearance exceeds specification, replace either or both of piston/piston pin assembly and connecting rod assembly with reference to specification of each parts.
- Refer to piston selection table to replace piston/piston pin assembly, refer to [EM-80, "HOW TO SELECT PISTON"](#).

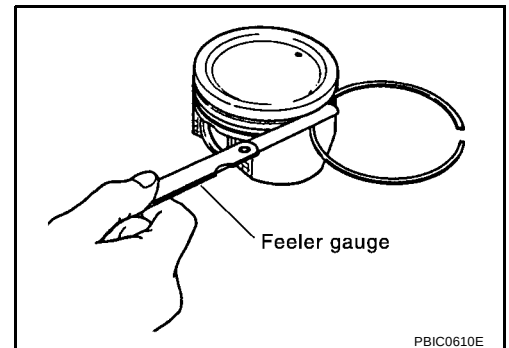
NOTE:

- Regarding marks on piston head, refer to [EM-80, "HOW TO SELECT PISTON"](#).
- 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.)



PISTON RING SIDE CLEARANCE

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



QG15DE**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 : 0.110 mm (0.0043 in)

2nd ring : 0.100 mm (0.0039 in)

QG18DE**Standard:**

Top ring : 0.040 - 0.080 mm (0.0016 - 0.0031 in)

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

Oil ring : 0.045 - 0.155 mm (0.0018 - 0.0061 in)

Limit:

Top ring : 0.110 mm (0.0043 in)

2nd ring : 0.100 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-88, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- Insert piston ring until middle of cylinder with piston, and measure gap.

Standard:

Top ring : 0.20 - 0.39 mm (0.0079 - 0.0154 in)

2nd ring : 0.32 - 0.56 mm (0.0126 - 0.0220 in)

Oil ring : 0.20 - 0.69 mm (0.0079 - 0.0272 in)

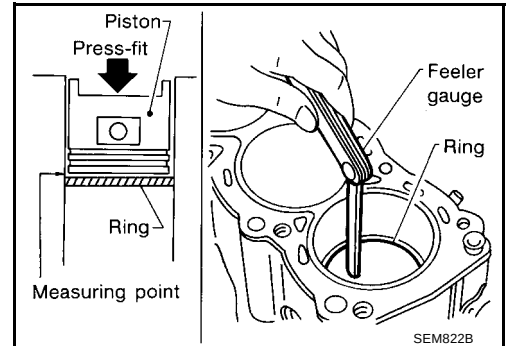
Limit:

Top ring : 0.54 mm (0.0213 in)

2nd ring : 0.67 mm (0.0264 in)

Oil ring : 0.95 mm (0.0374 in)

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

**CONNECTING ROD BEND AND TORSION**

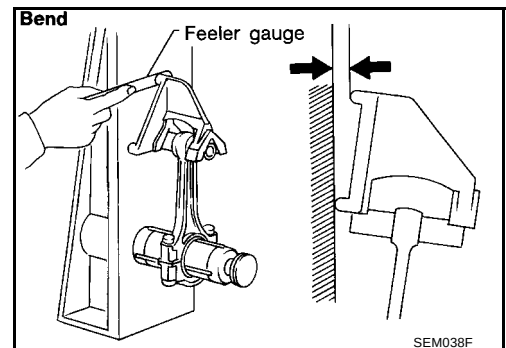
- Check with connecting rod aligner.

Bend:

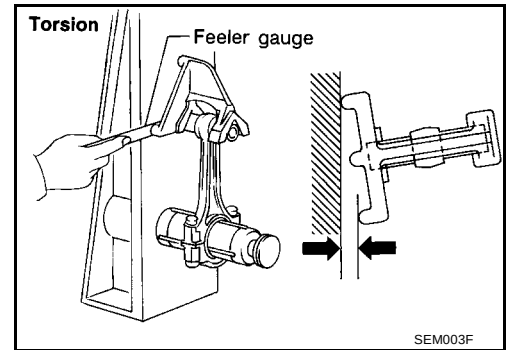
Limit : 0.15 mm (0.0059 in) per 100 mm (3.94 in) length

Torsion:

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



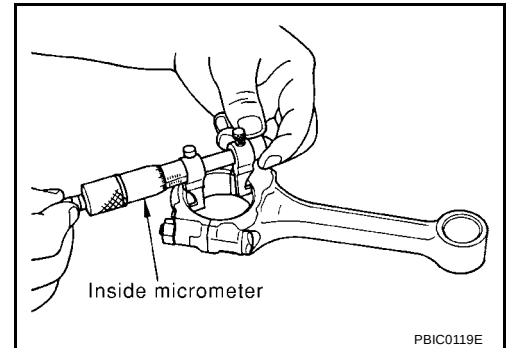
- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BEARING (BIG END)

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

Standard : 43.000 - 43.013 mm (1.6929 - 1.6934 in) dia.

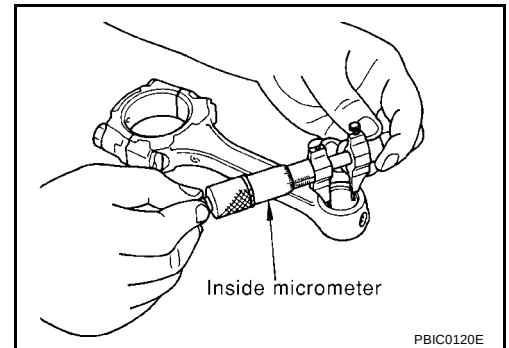


CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

Inner Diameter of Connecting Rod (Small End)

- Measure inner diameter of bushing.

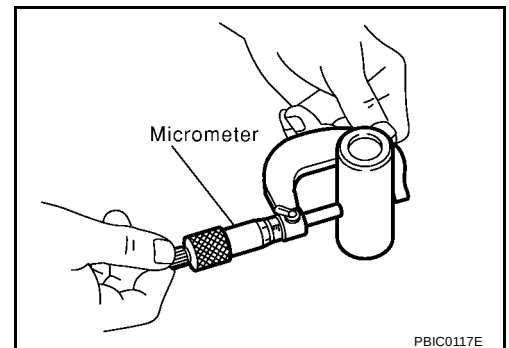
Standard : 19.000 - 19.012 mm (0.7480 - 0.7485 in) dia.



Outer Diameter of Piston Pin

- Measure outer diameter of piston pin.

Standard : 18.989 - 19.001 mm (0.7476 - 0.7481 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.

CYLINDER BLOCK

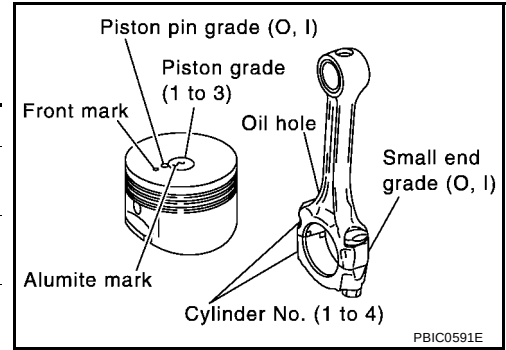
[QG]

- If replacing the piston and piston pin assembly, refer to the "Piston Selection Table" to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Refer to [EM-80, "HOW TO SELECT PISTON"](#).

Factory installed parts grading:

- Service parts apply only to grade 0.

Unit: mm (in)			
Grade	0	1	
Connecting rod small end inner diameter	19.000 - 19.006 (0.7480 - 0.7483)	19.006 - 19.012 (0.7483 - 0.7485)	
Piston pin outer diameter	18.989 - 18.995 (0.7476 - 0.7478)	18.995 - 19.001 (0.7478 - 0.7481)	
Piston pin hole diameter	QG15DE 18.987 - 18.993 (0.7475 - 0.7478)	18.993 - 18.999 (0.7478 - 0.7480)	
	QG18DE 18.993 - 18.996 (0.7478 - 0.7479)	18.996 - 18.999 (0.7479 - 0.7480)	



CYLINDER BLOCK DISTORTION

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

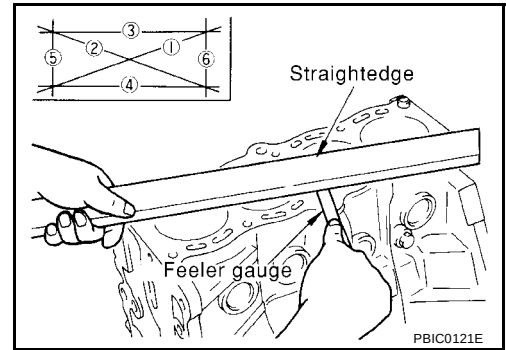
CAUTION:

Be careful not to allow gasket flakes to enter the oil or 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

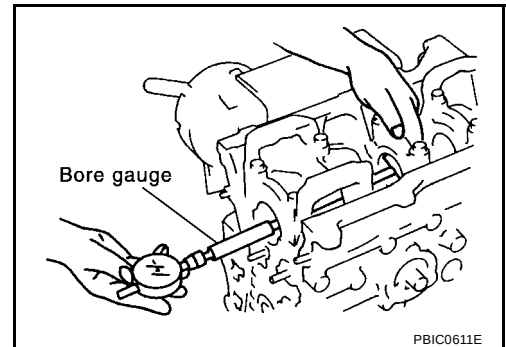
- Install the main bearing caps with the main bearings removed, and tighten the mounting bolts to the specified torque.
- Using a bore gauge, measure the inner diameter of the main bearing housing.

Standard : 53.644 - 53.668 mm (2.1120 - 2.1129 in) dia.

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

NOTE:

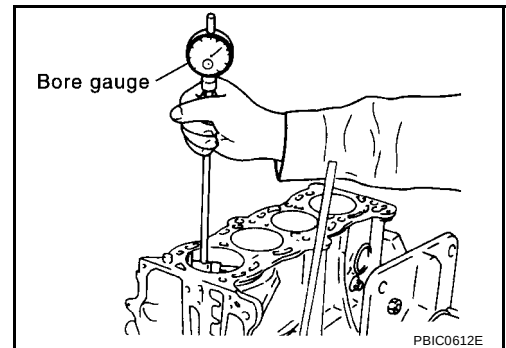
These components cannot be replaced as a single unit because they were processed together.



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:

QG15DE : 73.600 - 73.630 mm (2.8976 - 2.8988 in) dia.

QG18DE : 80.000 - 80.030 mm (3.1496 - 3.1508 in) dia.

Wear limit:

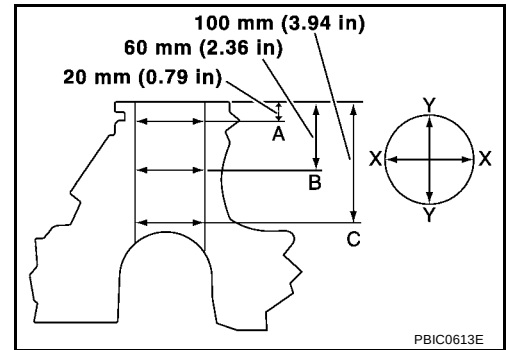
0.2 mm (0.008 in)

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

0.015 mm (0.0006 in)

Taper limit (Difference between A and C):

0.01 mm (0.0004 in)



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

Oversize (OS) : 0.25 mm (0.0098 in)
: 0.5 mm (0.0197 in)

Outer Diameter of Piston

- Measure piston skirt diameter.

QG15DE

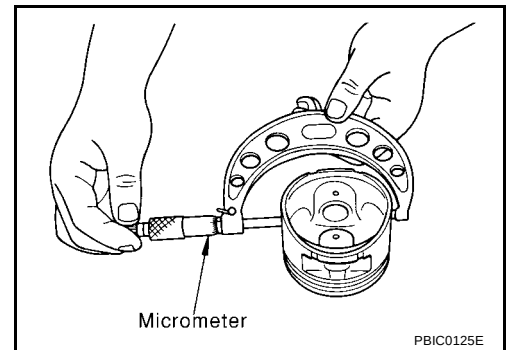
Measuring point : 43.6 mm (1.717 in) below piston head upper edge

Standard : 73.575 - 73.605 mm (2.8966 - 2.8978 in) dia.

QG18DE

Measuring point : 42.3 mm (1.665 in) below piston head upper edge

Standard : 79.965 - 79.995 mm (3.1482 - 3.1494 in) dia.



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).

QG15DE

Standard : 0.015 - 0.035 mm (0.0006 - 0.0014 in)

QG18DE

Standard : 0.025 - 0.045 mm (0.010 - 0.018 in)

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

Reboring Cylinder Bore

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

Rebored size calculation: $D = A + B - C$

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.
 - When any cylinder needs boring, all other cylinders must also be bored.
 - Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.
4. Hone cylinders to obtain specified piston-to-bore clearance.
5. Measure finished cylinder bore for out-of-round and taper.
 - Measurement should be done after cylinder bore cools down.

OUTER DIAMETER OF CRANKSHAFT JOURNAL

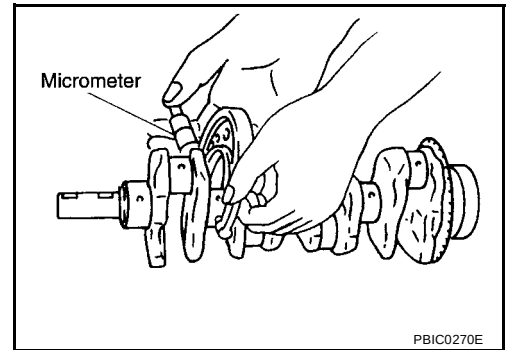
- Measure outer diameter of crankshaft journals.

Standard : 49.940 - 49.964 mm (1.9661 - 1.9671 in) dia.

OUTER DIAMETER OF CRANKSHAFT PIN

- Measure outer diameter of crankshaft pin.

Standard : 39.956 - 39.974 mm (1.5731 - 1.5738 in) dia.



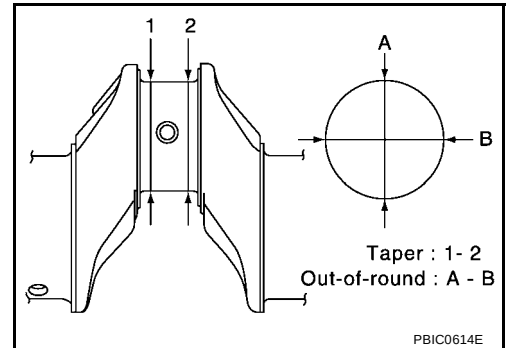
OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- 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 A and B at 1 and 2.
- Taper is indicated by the difference in dimension between 1 and 2 at A and B.

Limit:

Out-of-round (A - B) : 0.005 mm (0.0002 in)

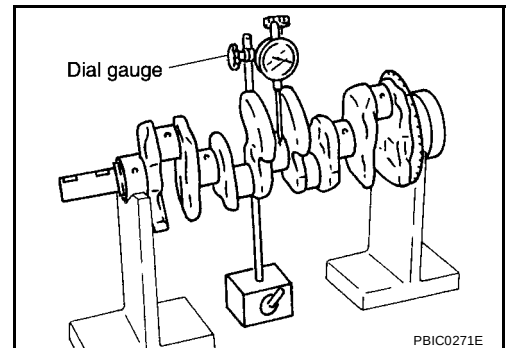
Taper (1 - 2) : 0.005 mm (0.0002 in)



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. (Total indicator reading)

Limit: : 0.10 mm (0.004 in)



OIL CLEARANCE OF CONNECTING ROD BEARING**Method of Measurement**

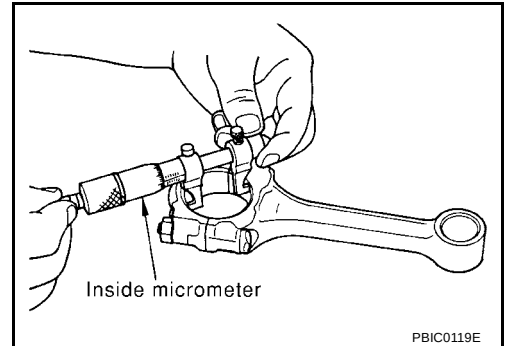
- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod bolts to the specified torque. Using an inside micrometer measure the inner diameter of connecting rod bearing.

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

Standard : 0.014 - 0.039 mm (0.0006 - 0.0015 in)

Limit : 0.10 mm (0.0039 in)

- If clearance cannot be adjusted within the standard, grind crankshaft pin and use undersized bearing. Refer to [EM-81, "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 cap, and tighten the connecting rod bolts to the specified torque.

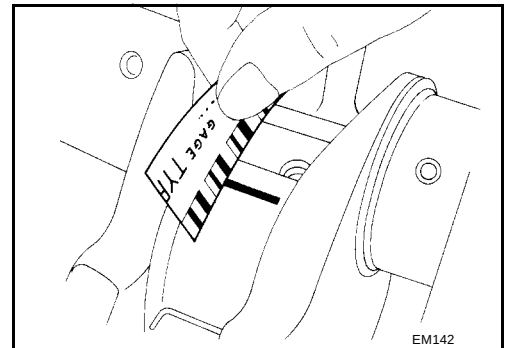
CAUTION:

Never rotate the crankshaft.

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

NOTE:

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

**OIL CLEARANCE OF MAIN BEARING****Method of Measurement**

- Install the main bearings to the cylinder block and bearing cap. Measure the main bearing inner diameter with the bearing cap bolt tightened to the specified torque.

(Oil clearance) = (Inner diameter of main bearing) – (Outer diameter of crankshaft journal)

Standard : 0.020 - 0.044 mm (0.0008 - 0.0017 in)

Limit : 0.1 mm (0.004 in)

- If the measured value exceeds the limit, select main bearings referring to the main bearing inner diameter and crankshaft journal outer diameter, so that the oil clearance satisfies the standard. Refer to [EM-82, "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.
- Tighten the main bearing bolts to the specified torque.

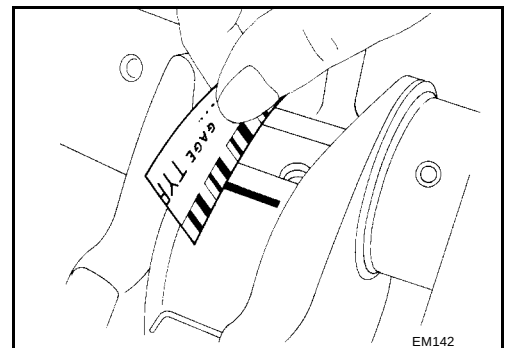
CAUTION:

Never rotate the crankshaft.

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

NOTE:

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

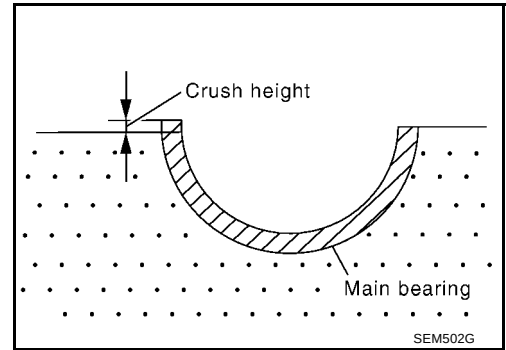


CRUSH HEIGHT OF MAIN BEARING

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

Standard : There must be crush height

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

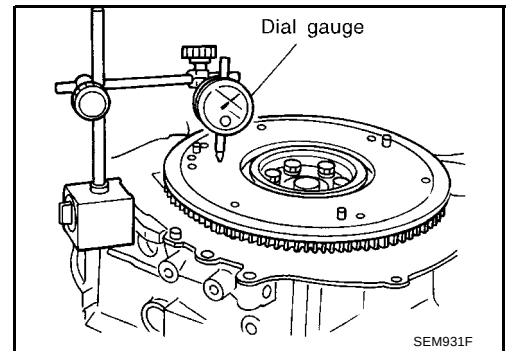


FLYWHEEL RUNOUT

- Measure deflection of contact surface with dial gauge.

Flywheel (M/T models)

Limit : 0.1 mm (0.004 in)



SERVICE DATA AND SPECIFICATIONS (SDS)

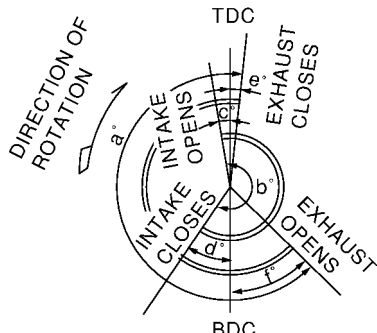
[QG]

PPF:00030

EBS00LQP

SERVICE DATA AND SPECIFICATIONS (SDS)

Standard and Limit GENERAL SPECIFICATIONS

Engine		QG15DE	QG18DE	
Classification		Gasoline		
Cylinder arrangement		4, in-line		
Displacement		cm ³ (cu in)	1,497 (91.35)	1,769 (107.94)
Bore and stroke		mm (in)	73.6 x 88.0 (2.898 x 3.465)	80.0 x 88.0 (3.150 x 3.465)
Valve arrangement		DOHC		
Firing order		1-3-4-2		
Number of piston rings	Compression	2		
	Oil	1		
Number of main bearings		5		
Compression ratio		9.9	9.5	
Compression pressure kPa (bar, kg/cm ² , psi) / 350 rpm	Standard	1,372 (13.72, 13.99, 198.9)	1,324 (13.24, 135, 192)	
	Minimum	1,176 (11.76, 12.0, 170.5)	1,128 (11.28, 11.5, 164)	
	Differential limit between cylinders	98 (0.98, 1.0, 14)		
Valve timing (Intake valve timing control - OFF)	 PBIC0187E			

Unit: degree

a	b	c	d	e	f
208	228	-8	56	-2	30

INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

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

DRIVE BELTS

Unit: mm (in)

		Deflection adjustment		
		Used belt		New belt
		Limit	After adjustment	
Alternator	Without air conditioner compressor	10.2 (0.402)	6.5 - 7.0 (0.256 - 0.276)	5.5 - 6.1 (0.217 - 0.240)
	With air conditioner compressor	8.1 (0.319)	5.3 - 5.7 (0.209 - 0.224)	4.5 - 5.0 (0.177 - 0.197)

SERVICE DATA AND SPECIFICATIONS (SDS)

[QG]

	Deflection adjustment		
	Used belt		New belt
	Limit	After adjustment	
Power steering oil pump	7.1 (0.280)	4.4 - 4.9 (0.173 - 0.193)	3.9 - 4.4 (0.154 - 0.173)
Applied pushing force	98 N (10 kg, 22 lb)		

SPARK PLUG

	Make	NGK	Champion
Type	Standard	LFR5A-11	REC10YC4
	Hot	LFR4A-11	—
	Cold	LFR6A-11	—
Plug gap	1.0 - 1.1 mm (0.039 - 0.043 in)		

CYLINDER HEAD

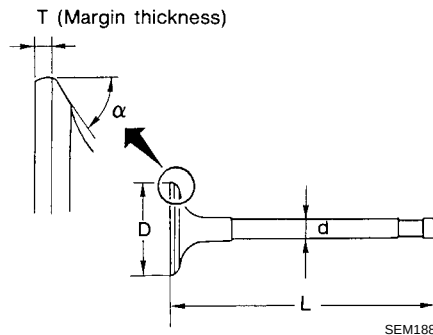
Unit: mm (in)

	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Height	117.9 (4.642)	—

VALVE

Valve Dimensions

Unit: mm (in)



		QG15DE	QG18DE
Valve head diameter "D"	Intake	28.9 - 29.2 (1.138 - 1.150)	29.9 - 30.2 (1.177 - 1.189)
	Exhaust	23.9 - 24.2 (0.941 - 0.953)	24.9 - 25.2 (0.980 - 0.992)
Valve length "L"	Intake	92.00 - 92.50 (3.6220 - 3.6417)	
	Exhaust	92.37 - 92.87 (3.6366 - 3.6563)	
Valve stem diameter "d"	Intake	5.465 - 5.480 (0.2152 - 0.2157)	
	Exhaust	5.445 - 5.460 (0.2144 - 0.2150)	
Valve seat angle " α "		44°15' - 44°45'	
Valve margin "T"		0.8 - 0.14 (0.031 - 0.055)	
Valve margin "T" limit		More than 0.5 (0.020)	
Valve stem end surface grinding limit		0.2 (0.008)	

Valve Clearance

Shim Type

Unit: mm (in)

	For adjusting		For checking
	Hot	Cold* (reference data)	Hot

SERVICE DATA AND SPECIFICATIONS (SDS)

[QG]

Intake	0.32 - 0.40 (0.013 - 0.016)	0.25 - 0.33 (0.010 - 0.013)	0.21 - 0.47 (0.008 - 0.019)
Exhaust	0.37 - 0.45 (0.015 - 0.018)	0.32 - 0.40 (0.013 - 0.016)	0.30 - 0.56 (0.012 - 0.022)

*: At a temperature of approximately 20°C (68°F)

Shimless Type

	Hot	Cold* (reference data)
Intake	0.32 - 0.40 (0.013 - 0.016)	0.25 - 0.33 (0.010 - 0.013)
Exhaust	0.37 - 0.45 (0.015 - 0.018)	0.32 - 0.40 (0.013 - 0.016)

*: At a temperature of approximately 20°C (68°F)

Available Shims

Thickness mm (in)	Identification mark
2.00 (0.0787)	200
2.02 (0.0795)	202
2.04 (0.0803)	204
2.06 (0.0811)	206
2.08 (0.0819)	208
2.10 (0.0827)	210
2.12 (0.0835)	212
2.14 (0.0843)	214
2.16 (0.0850)	216
2.18 (0.0858)	218
2.20 (0.0866)	220
2.21 (0.0870)	221
2.22 (0.0874)	222
2.23 (0.0878)	223
2.24 (0.0882)	224
2.25 (0.0886)	225
2.26 (0.0890)	226
2.27 (0.0894)	227
2.28 (0.0898)	228
2.29 (0.0902)	229
2.30 (0.0906)	230
2.31 (0.0909)	231
2.32 (0.0913)	232
2.33 (0.0917)	233
2.34 (0.0921)	234
2.35 (0.0925)	235
2.36 (0.0929)	236
2.37 (0.0933)	237
2.38 (0.0937)	238
2.39 (0.0941)	239
2.40 (0.0945)	240
2.41 (0.0949)	241
2.42 (0.0953)	242
2.43 (0.0957)	243
2.44 (0.0961)	244

SERVICE DATA AND SPECIFICATIONS (SDS)

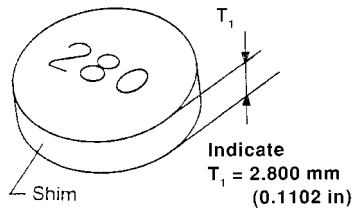
[QG]

Thickness mm (in)	Identification mark
2.45 (0.0965)	245
2.46 (0.0969)	246
2.47 (0.0972)	247
2.48 (0.0976)	248
2.49 (0.0980)	249
2.50 (0.0984)	250
2.51 (0.0988)	251
2.52 (0.0992)	252
2.53 (0.0996)	253
2.54 (0.1000)	254
2.55 (0.1004)	255
2.56 (0.1008)	256
2.57 (0.1012)	257
2.58 (0.1016)	258
2.59 (0.1020)	259
2.60 (0.1024)	260
2.61 (0.1028)	261
2.62 (0.1031)	262
2.63 (0.1035)	263
2.64 (0.1039)	264
2.65 (0.1043)	265
2.66 (0.1047)	266
2.68 (0.1055)	268
2.70 (0.1063)	270
2.72 (0.1071)	272
2.74 (0.1079)	274
2.76 (0.1087)	276
2.78 (0.1094)	278
2.80 (0.1102)	280
2.82 (0.1110)	282
2.84 (0.1118)	284
2.86 (0.1126)	286
2.88 (0.1134)	288
2.90 (0.1142)	290
2.92 (0.1150)	292
2.94 (0.1157)	294
2.96 (0.1165)	296

SERVICE DATA AND SPECIFICATIONS (SDS)

[QG]

Thickness mm (in)	Identification mark
2.98 (0.1173)	298



AEM236

Valve Spring

Free height	mm (in)	40.0 (1.57)
Pressure N (kg, lb) at height	mm (in)	147.5 - 166.3 (15.04 - 16.96, 33.2 - 37.4) at 23.64 (0.9307)
Out-of-square	mm (in)	Less than 1.80 (0.0709)

Valve Lifter

		Standard
Valve lifter outer diameter	mm (in)	29.960 - 29.975 (1.1795 - 1.1801)
Lifter guide inner diameter	mm (in)	30.000 - 30.021 (1.1811 - 1.1819)
Clearance between lifter and lifter guide	mm (in)	0.025 - 0.061 (0.0010 - 0.0024)

SERVICE DATA AND SPECIFICATIONS (SDS)

[QG]

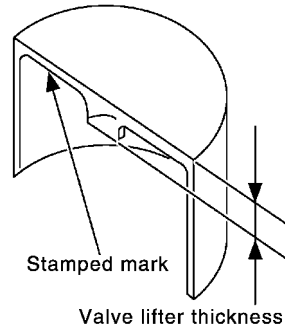
Available Valve Lifter (Shimless Type)

Thickness mm (in)	Identification Mark
3.000 (0.1181 in)	00
3.020 (0.1189 in)	02
3.040 (0.1197 in)	04
3.060 (0.1205 in)	06
3.080 (0.1213 in)	08
3.100 (0.1220 in)	10
3.120 (0.1228 in)	12
3.140 (0.1236 in)	14
3.160 (0.1244 in)	16
3.180 (0.1252 in)	18
3.200 (0.1260 in)	20
3.220 (0.1268 in)	22
3.240 (0.1276 in)	24
3.260 (0.1283 in)	26
3.280 (0.1291 in)	28
3.300 (0.1299 in)	30
3.320 (0.1307 in)	32
3.340 (0.1315 in)	34
3.360 (0.1323 in)	36
3.380 (0.1323 in)	38
3.400 (0.1339 in)	40
3.420 (0.1346 in)	42
3.440 (0.1354 in)	44
3.460 (0.1362 in)	46
3.480 (0.1370 in)	48
3.500 (0.1378 in)	50
3.520 (0.1386 in)	52
3.540 (0.1394 in)	54
3.560 (0.1402 in)	56
3.580 (0.1409 in)	58
3.600 (0.1417 in)	60
3.620 (0.1425 in)	62
3.640 (0.1433 in)	64
3.660 (0.1441 in)	66
3.680 (0.1449 in)	68

SERVICE DATA AND SPECIFICATIONS (SDS)

[QG]

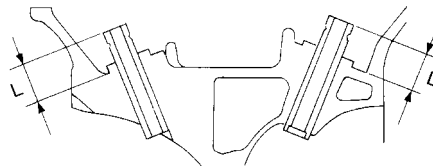
Thickness mm (in)	Identification Mark



PBIC1077E

Valve Guide

Unit: mm (in)



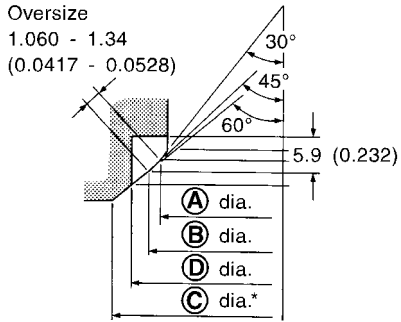
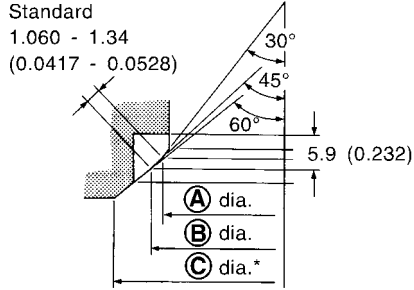
MEM096A

		Intake		Exhaust	
		Standard	Service	Standard	Service
Valve guide	Outer diameter	9.523 - 9.534 (0.3749 - 0.3754)	9.723 - 9.734 (0.3828 - 0.3832)	9.523 - 9.534 (0.3749 - 0.3754)	9.723 - 9.734 (0.3828 - 0.3832)
	Inner diameter (Finished size)	5.500 - 5.515 (0.2165 - 0.2171)		5.500 - 5.515 (0.2165 - 0.2171)	
Cylinder head valve guide hole diameter		9.475 - 9.496 (0.3730 - 0.3739)	9.685 - 9.696 (0.3813 - 0.3817)	9.475 - 9.496 (0.3730 - 0.3739)	9.685 - 9.696 (0.3813 - 0.3817)
Interference fit of valve guide		0.026 - 0.059 (0.0010 - 0.0023)	0.027- 0.049 (0.0011 - 0.0019)	0.026 - 0.059 (0.0010 - 0.0023)	0.027- 0.049 (0.0011 - 0.0019)
Stem to guide clearance		0.020 - 0.050 (0.0008 - 0.0020)		0.040 - 0.070 (0.0016 - 0.0028)	
Valve deflection limit (Dial gauge read- ing)		0.2 (0.008)			
Projection length “L”		11.5 - 11.7 (0.453 - 0.461)			

Valve Seat

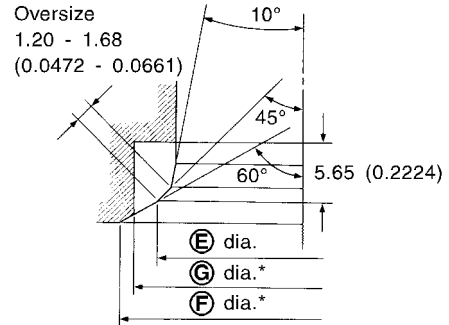
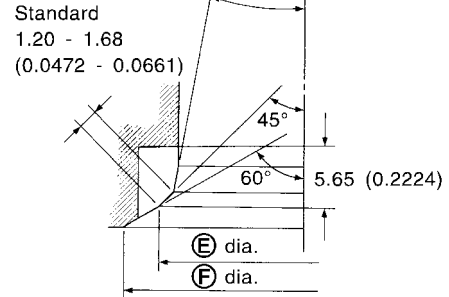
Unit: mm (in)

INTAKE



* Cylinder head machining data
SEM573DA

EXHAUST



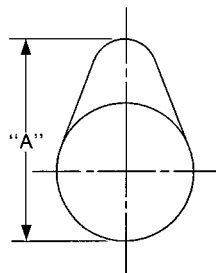
* Cylinder head machining data
SEM574DA

Dia.	QG15DE	QG18DE
A	26.8 - 27.0 (1.055 - 1.063)	27.8 - 28.0 (1.094 - 1.102)
B	28.5 - 28.7 (1.122 - 1.130)	29.5 - 29.7 (1.161 - 1.169)
C	30.2 - 30.4 (1.189 - 1.197)	31.9 - 32.1 (1.256 - 1.264)
D	30.500 - 30.516 (1.2008 - 1.2014)	31.500 - 31.516 (1.2402 - 1.2408)
E	23.5 - 23.7 (0.925 - 0.933)	24.5 - 24.7 (0.9646 - 0.9724)
F	25.2 - 25.4 (0.992 - 1.000)	26.500 - 26.516 (1.043 - 1.0439)
G	25.500 - 25.516 (1.0039 - 1.0046)	26.2 - 26.4 (1.031 - 1.039)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

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



SEM671

Cam height "A"	Intake	40.217 - 40.407 (1.5833 - 1.5908)
	Exhaust	39.205 - 39.395 (1.5435 - 1.5510)

SERVICE DATA AND SPECIFICATIONS (SDS)

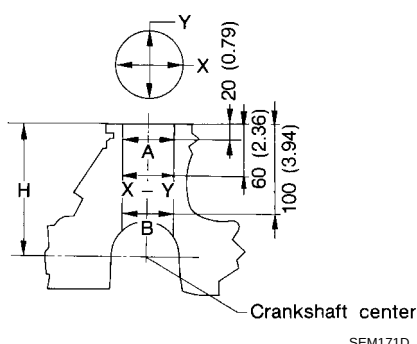
[QG]

	Standard
Outer diameter of camshaft journal	No. 1 27.935 - 27.955 (1.0998 - 1.1006) No. 2, 3, 4, 5 23.935 - 23.955 (0.9423 - 0.9431)
Inner diameter of camshaft bracket	No. 1 28.000 - 28.021 (1.1024 - 1.1032) No. 2, 3, 4, 5 24.000 - 24.021 (0.9449 - 0.9457)
Camshaft journal clearance	0.045 - 0.086 (0.0018 - 0.0034)
Camshaft end play	0.115 - 0.188 (0.0045 - 0.0074)

*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



			QG15DE	QG18DE	Limit
			Standard		
Surface flatness			Less than 0.03 (0.0012)		0.1 (0.004)
Height “H” (nominal)			213.95 - 214.05 (8.4232 - 8.4271)		—
Cylinder bore inner diameter	Standard	Grade No. 1	73.600 - 73.610 (2.8976 - 2.8980)	80.000 - 80.010 (3.1496 - 3.1500)	0.2 (0.008)
		Grade No. 2	73.610 - 73.620 (2.8980 - 2.8984)	80.010 - 80.020 (3.1500 - 3.1504)	
		Grade No. 3	73.620 - 73.630 (2.8984 - 2.8988)	80.020 - 80.030 (3.1504 - 3.1508)	
Out-of-round (X – Y)			Less than 0.015 (0.0006)		—
Taper (A – B)			Less than 0.01 (0.0004)		—
Difference in inner diameter between cylinders			0.05 (0.0020)		0.2 (0.008)

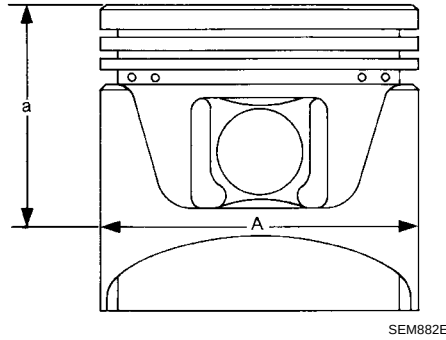
SERVICE DATA AND SPECIFICATIONS (SDS)

[QG]

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



			QG15DE	QG18DE
			Standard	
Piston skirt diameter "A"	Standard	Grade No. 1	73.575 - 73.585 (2.8966 - 2.8970)	79.965 - 79.975 (3.1482 - 3.1486)
		Grade No. 2	73.585 - 73.595 (2.8970 - 2.8974)	79.975 - 79.985 (3.1486 - 3.1490)
		Grade No. 3	73.595 - 73.605 (2.8974 - 2.8978)	79.985 - 79.995 (3.1490 - 3.1494)
0.5 (0.002) oversize (service)			74.075 - 74.105 (2.9163 - 2.9175)	80.215 - 80.245 (3.1581 - 3.1592)
1.0 (0.039) oversize (service)			74.575 - 74.605 (2.9360 - 2.9372)	80.465 - 80.495 (3.1679 - 3.1691)
"a" dimension			43.6 (1.717)	42.3 (1.665)
Piston pin hole inner diameter			18.987 - 18.999 (0.7475 - 0.7480)	18.993 - 18.999 (0.7478 - 0.7480)
Piston to bore clearance			0.015 - 0.035 (0.0006 - 0.0014)	0.025 - 0.045 (0.0010 - 0.0018)

Piston Ring

Unit: mm (in)

		Standard		Limit
		QG15DE	QG18DE	
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.040 - 0.080 (0.0016 - 0.0031)	0.110 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)		0.100 (0.0039)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	0.045 - 0.155 (0.0018 - 0.0061)	—
End gap	Top	0.20 - 0.39 (0.0079 - 0.0154)		0.54 (0.0213)
	2nd	0.32 - 0.56 (0.0126 - 0.0220)		0.67 (0.0264)
	Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)		0.95 (0.0374)

Piston Pin

Unit: mm (in)

		QG15DE	QG18DE
Piston pin outer diameter		18.989 - 19.001 (0.7476 - 0.7481)	
Piston pin to piston clearance		-0.004 to 0 (-0.0002 to 0)	0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)	
	Limit	0.023 (0.0009)	

SERVICE DATA AND SPECIFICATIONS (SDS)

[QG]

CONNECTING ROD

Unit: mm (in)

Center distance		140.45 - 140.55 (5.5295 - 5.5335)
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* (small end)		19.000 - 19.012 (0.7480 - 0.7485)
Connecting rod big end inner diameter		43.000 - 43.013 (1.6929 - 1.6934)
Side clearance	Standard	0.200 - 0.470 (0.0079 - 0.0185)
	Limit	0.50 (0.0197)

*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)

Main journal dia. "Dm"	Grade No. 0	49.956 - 49.964 (1.9668 - 1.9671)
	Grade No. 1	49.948 - 49.956 (1.9665 - 1.9668)
	Grade No. 2	49.940 - 49.948 (1.9661 - 1.9665)
Pin journal dia. "Dp"	Grade No. 0	39.968 - 39.974 (1.5735 - 1.5738)
	Grade No. 1	39.962 - 39.968 (1.5733 - 1.5735)
	Grade No. 2	39.956 - 39.962 (1.5731 - 1.5733)
Out-of-round (X - Y)	Standard	Less than 0.003 (0.0001)
	Limit	Less than 0.005 (0.0002)
Taper (A - B)	Standard	Less than 0.004 (0.0002)
	Limit	Less than 0.005 (0.0002)
Runout [TIR*]	Standard	Less than 0.04 (0.0016)
	Limit	Less than 0.05 (0.0020)
Free end play	Standard	0.060 - 0.260 (0.0024 - 0.0102)
	Limit	0.3 (0.012)

*: Total indicator reading

MAIN BEARING

Standard size

Unit: mm (in)

Grade No.	Thickness	Identification color
0	1.826 - 1.830 (0.0719 - 0.0720)	Black
1	1.830 - 1.834 (0.0720 - 0.0722)	Red
2	1.834 - 1.838 (0.0722 - 0.0724)	Green
3	1.838 - 1.842 (0.0724 - 0.0725)	Yellow
4	1.842 - 1.846 (0.0725 - 0.0727)	Blue

Undersize

Unit: mm (in)

	Thickness
0.25 (0.0098)	1.960 - 1.964 (0.0772 - 0.0773)
0.50 (0.0197)	2.085 - 2.089 (0.0821 - 0.0822)

Bearing Clearance

Unit: mm (in)

Main bearing clearance	Standard	0.020 - 0.044 (0.0008 - 0.0017)
	Limit	0.1 (0.004)

CONNECTING ROD BEARING**Standard Size**

Unit: mm (in)

Grade No.	Thickness	Identification color or number
0	1.503 - 1.506 (0.0592 - 0.0593)	Black
1	1.506 - 1.509 (0.0593 - 0.0594)	Red
2	1.509 - 1.512 (0.0594 - 0.0595)	Green

Undersize

Unit: mm (in)

Grade No.	Thickness	Identification color or number
0.08 (0.0031)	1.542 - 1.546 (0.0607 - 0.0609)	—
0.12 (0.0047)	1.562 - 1.566 (0.0615 - 0.0617)	—
0.25 (0.0098)	1.627 - 1.631 (0.0641 - 0.0642)	—

Bearing Clearance

Unit: mm (in)

Connecting rod bearing clearance	Standard	0.014 - 0.039 (0.0006 - 0.0015)
	Limit	0.1 (0.004)

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Flywheel runout [TIR*]	Less than 0.1 (0.004)
Camshaft sprocket runout [TIR*]	Less than 0.15 (0.0059)

*: Total indicator reading

Tightening Torque

EBS00LQQ

*1: Parts to be tightened in particular orders.

1)-: Order of tightening when tightening two or more times separately.

Unit: N·m (kg-m, ft-lb) / Unit: N·m (kg-m, in-lb)*2

Mass air flow sensor	8.4 - 10.8 (0.9 - 1.1, 75 - 95)*2
Resonator	3.8 - 4.5 (0.39 - 0.45, 34 - 39)*2
Air cleaner case lower	3.8 - 4.5 (0.39 - 0.46, 34 - 39)*2
Intake manifold	16.7 - 23.5 (1.7 - 2.4, 13 - 17)
Intake manifold collector	7.0 - 9.5 (0.71 - 0.97, 62 - 84)*2
Intake manifold support	16.7 - 23.5 (1.7 - 2.4, 13 - 17)
Electric throttle control actuator	17.7 - 21.6 (1.8 - 2.2, 13 - 15)
Exhaust manifold	25.5 - 29.4 (2.6 - 2.9, 19 - 21)
Exhaust manifold cover	6.3 - 8.3 (0.64 - 0.85, 56 - 73)*2
Heated oxygen sensor	58.8 - 78.4 (6.0 - 7.9, 44 - 57)
Ground nut	79.4 (8.1, 59)
Oil pan	6.28 - 8.34 (0.64 - 0.85, 56 - 73)*2
Oil pan drain plug	29.4 - 39.2 (3.0 - 3.9, 22 - 28)
Oil strainer	6.28 - 8.34 (0.64 - 0.85, 56 - 73)*2
Ignition coil	3.8 - 5.0 (0.38 - 0.51, 33 - 44)*2
Spark plug	19.6 - 29.4 (2.0 - 3.0, 15 - 21)
*1 Fuel tube	1) 11.8 - 13.8 (1.2 - 1.4, 9 - 10) 2) 17 - 23 (1.7 - 2.4, 13 - 17)
Rocker cover	6.9 - 9.5 (0.70 - 0.97, 61 - 84)*2

SERVICE DATA AND SPECIFICATIONS (SDS)

[QG]

Intake valve timing control solenoid valve	6.3 - 8.3 (0.64 - 0.85, 56 - 73)* ²	A
Camshaft position sensor (PHASE)	7.2 - 10.8 (0.73 - 1.1, 64 - 95) * ²	
Camshaft sprocket (INT)	78.4 - 88.2 (8.0 - 9.0, 58 - 65)	
Camshaft sprocket (EXH)	98.1 - 127.5 (10.0 - 13.0, 73 - 94)	EM
*1 Camshaft bracket	1) 2.0 (0.2, 18) * ² 2) 5.9 (0.6, 52) * ² 3) 9.0 - 11.8 (0.92 - 1.20, 80 - 104)* ²	C
Crankshaft pulley	132.4 - 152.0 (14.0 - 15.0, 98 - 112)	D
Front cover	6.92 - 9.51 (0.71 - 0.97, 62 - 84)* ²	
Timing chain tension guide	15.7 - 20.6 (1.6 - 2.1, 12 - 15)	
*1 Cylinder head	1) 29.4 (3.0, 22) 2) 58.8 (6.0, 43) 3) 0 (0.0, 0) 4) 27.4 - 31.4 (2.8 - 3.2, 21 - 23) 5) 50° - 55° (Angle tightening)	E F
Cylinder head front cover	6.92 - 9.5 (0.71 - 0.96, 62 - 84)* ²	G
Flywheel (M/T)	83.4 - 93.2 (8.5 - 9.5, 62 - 68)	
Drive plate (A/T)	93.2 - 103 (9.5 - 10.5, 69 - 75)	H
*1 Connecting rod bearing cap	1) 13.72 - 15.68 (1.4 - 1.5, 10.2 - 11.5) 2) 35° - 40° (Angle tightening)	
Knock sensor	15.7 - 20.6 (1.6 - 2.1, 12 - 15)	I
Crankshaft position sensor (POS)	7.2 - 10.8 (0.8 - 1.1, 64 - 95)* ²	
Rear oil seal retainer	6.3 - 8.3 (0.65 - 0.84, 56 - 73)* ²	J
Signal plate	7.6 - 9.2 (0.78 - 0.93, 68 - 81)* ²	

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