

SECTION **EM**

ENGINE MECHANICAL

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PRECAUTIONS

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Precautions for Drain Coolant

EBS00SN4

- Drain coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS00SN5

- 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

EBS00SN6

- 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

EBS00SN7

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

Precautions for Assembly and Installation

EBS00SN8

- 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

EBS00SN9

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

Precautions for Liquid Gasket 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.

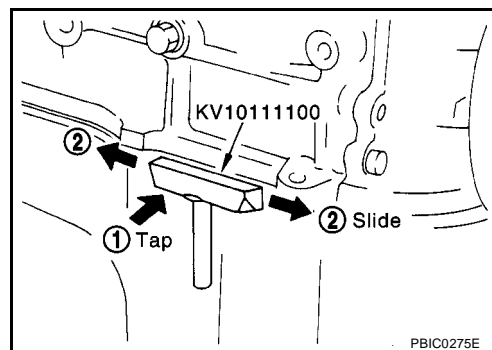
CAUTION:

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.

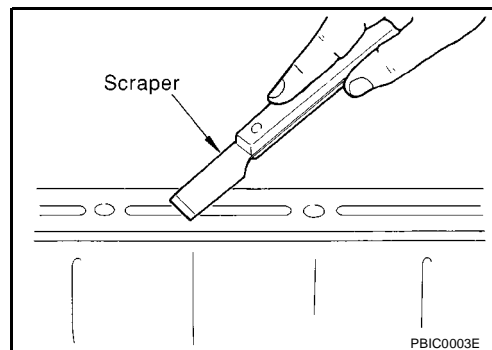
CAUTION:

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

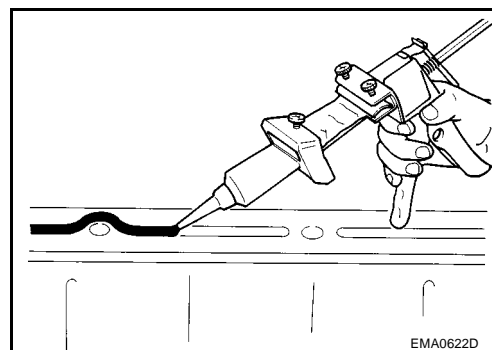


LIQUID GASKET APPLICATION PROCEDURE

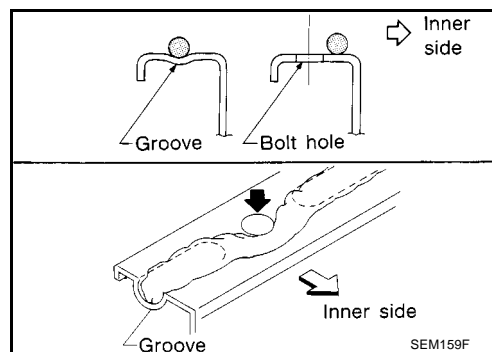
- Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
- Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
- Wipe the gasket application surface and the mating surface with 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. Occasionally, it should be applied outside the holes. Make sure to read this 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.

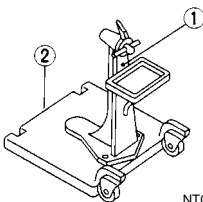
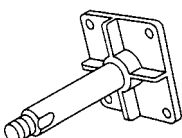
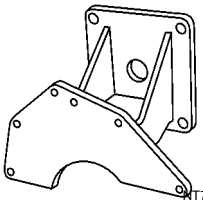
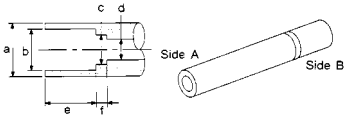
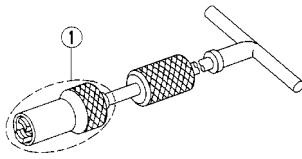
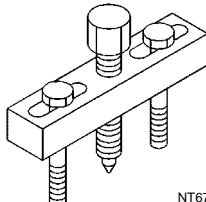


CAUTION:

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

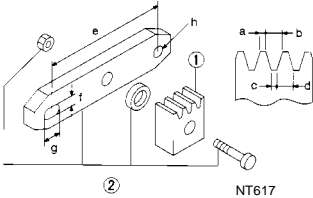
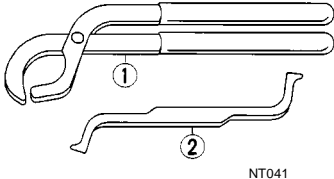
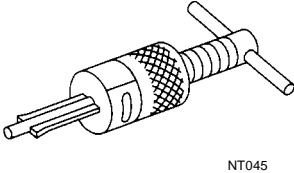
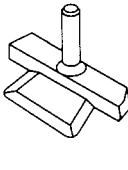
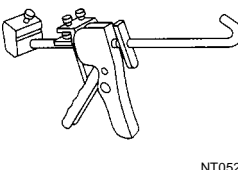
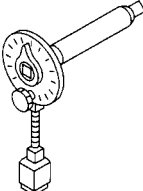
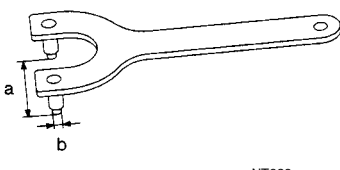
PREPARATION

Special Service Tools

Tool number Tool name	Description	
ST0501S000 Engine stand assembly 1 ST05011000 Engine stand 2 ST05012000 Base	 NT042	Disassembling and assembling
KV10106500 Engine stand shaft	 NT028	
KV11105900 Engine sub-attachment	 NT799	Used with KV10106500
KV10115600 Valve oil seal drift	 NT603	Installing valve oil seal Use side A. Side A a: 20 (0.79) dia. b: 13 (0.51) dia. c: 10.3 (0.406) dia. d: 8 (0.31) dia. e: 10.7 (0.421) f: 5 (0.20) Unit: mm (in)
KV10107902 Valve oil seal puller 1 KV10116100 Valve oil seal puller adapter	 NT605	Removing valve oil seal
KV11103000 Injection pump drive gear puller	 NT676	Removing crankshaft pulley

PREPARATION

[YD]

Tool number Tool name		Description
KV101056S0 Ring gear stopper 1 KV10105630 Adapter 2 KV10105610 Plate		Preventing crankshaft from rotating a: 3 (0.12) b: 6.4 (0.252) c: 2.8 (0.110) d: 6.6 (0.260) e: 107 (4.21) f: 14 (0.55) g: 20 (0.79) h: 14 (0.55) dia. Unit: mm (in)
KV101151S0 Lifter stopper set 1 KV10115110 Camshaft pliers 2 KV10115120 Lifter stopper		Changing valve lifter shims
ST16610001 Pilot bushing puller		Removing crankshaft pilot bushing
KV10111100 Seal cutter		Removing steel oil pan and rear timing chain case
WS39930000 Tube presser		Pressing the tube of liquid gasket
KV10112100 Angle wrench		Tightening bolts for bearing cap, cylinder head, etc.
KV10109300 Pulley holder		a: 68 mm (2.68 in) b: 8 mm (0.31 in) dia.

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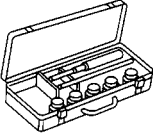
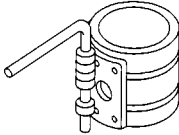
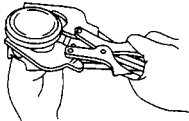
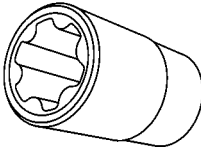

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PREPARATION

[YD]

Commercial Service Tools

EBS00SNC

Tool name		Description
Valve seat cutter set	 <p>NT048</p>	Finishing valve seat dimensions
Piston ring compressor	 <p>NT044</p>	Installing piston assembly into cylinder bore
Piston ring expander	 <p>NT030</p>	Removing and installing piston ring
TORX socket	 <p>NT807</p>	
Standard Universal	 <p>NT808</p>	

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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NVH Troubleshooting —Engine Noise

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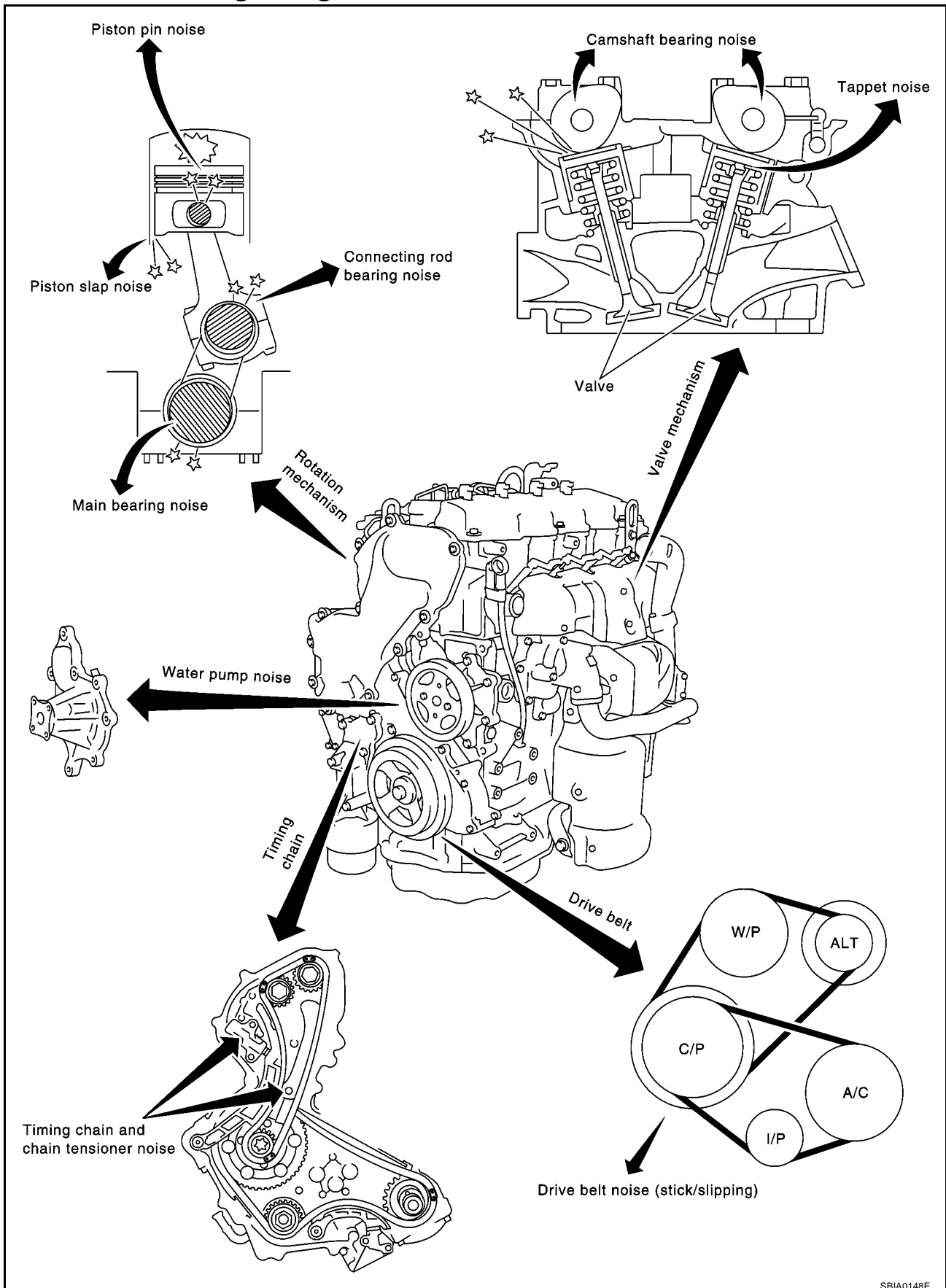
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NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

[YD]

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

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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-59
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft oil clearance Camshaft runout	EM-56 EM-55
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin clearance Connecting rod bushing oil clearance (Small end)	EM-106 EM-108
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-109 EM-106 EM-107 EM-107
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance (Small end) Connecting rod bearing oil clearance (Big end)	EM-108 EM-111
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-112 EM-111
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-63 EM-68
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-13
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-17

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

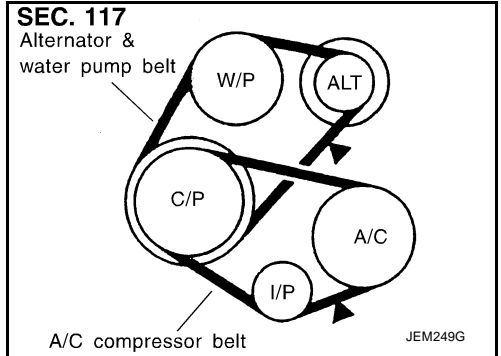
DRIVE BELTS

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



Belt Deflection:

Applied belt	Belt deflection with 98 N (10 kg, 22 lb) force applied* mm (in)		
	New	Adjusted	Limit for re-adjusting
Air conditioner compressor belt	4 - 5 (0.16 - 0.20)	6 - 7 (0.24 - 0.28)	8.5 (0.335)
Alternator and water pump belt	9.0 - 10.5 (0.354 - 0.413)	11.0 - 12.5 (0.433 - 0.492)	16.5 (0.650)

*: When engine is cold.

Tension Adjustment

EBS00SNG

- Adjust belts with the parts shown below.

Applied belt	Belt adjustment method
Air conditioner compressor belt	Adjusting bolt on idler pulley
Alternator water pump belt	Adjusting bolt on alternator


CAUTION:

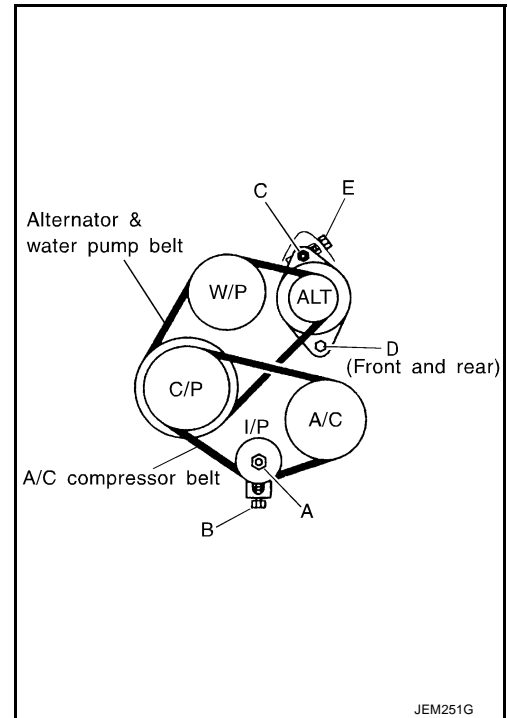
- When a new belt is installed as a replacement, adjust it to the value specified under "New" value because of insufficient adaptability with pulley grooves.
- If the belt deflection of the current belt is out of the "Limit for re-adjusting", adjust to the "Adjusted" value.
- When checking belt deflection immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust it to the specified value to avoid variation in deflection between pulleys.
- Make sure the belts are fully fitted into the pulley grooves during installation.
- Handle with care to avoid smearing the belts with oil or cooling water etc.
- Do not twist or bend the belts with strong force.

AIR CONDITIONER COMPRESSOR BELT

1. Remove RH splash cover (with undercover attached).
2. Loosen idler pulley lock nut (A).
3. Turn adjusting bolt (B) to adjust.
 - Refer to [EM-13, "Checking Drive Belts"](#) .
4. Tighten lock nut (A).

Nut A:


 : 31 - 39 N·m (3.1 - 4.0 kg-m, 23 - 28 ft-lb)



ALTERNATOR AND WATER PUMP BELT

1. Loosen adjusting lock nut (C).
2. Loosen alternator fixing bolts (D) (each on front and rear).
3. Turn adjusting bolt (E) to adjust.
 - Refer to [EM-13, "Tension Adjustment"](#) .
4. Tighten nut (C) and bolt (D) in this order.

Nut C:

 : 19 - 24 N·m (1.9 - 2.5 kg-m, 14 - 18 ft-lb)

Bolt D:

 : 44 - 57 N·m (4.4 - 5.9 kg-m, 32 - 42 ft-lb)

Removal and Installation

REMOVAL

1. Loosen each belt. Refer to [EM-13, "Tension Adjustment"](#) .
2. Remove air conditioner compressor belt.
3. Remove alternator and water pump belt.

INSTALLATION

1. Install each belt on pulley in reverse order of removal.
2. Adjust belt tension. Refer to [EM-13, "Tension Adjustment"](#) .
3. Tighten nuts and bolts provided for adjustment to the specified torque.
4. Check again that each belt tension is as specified.

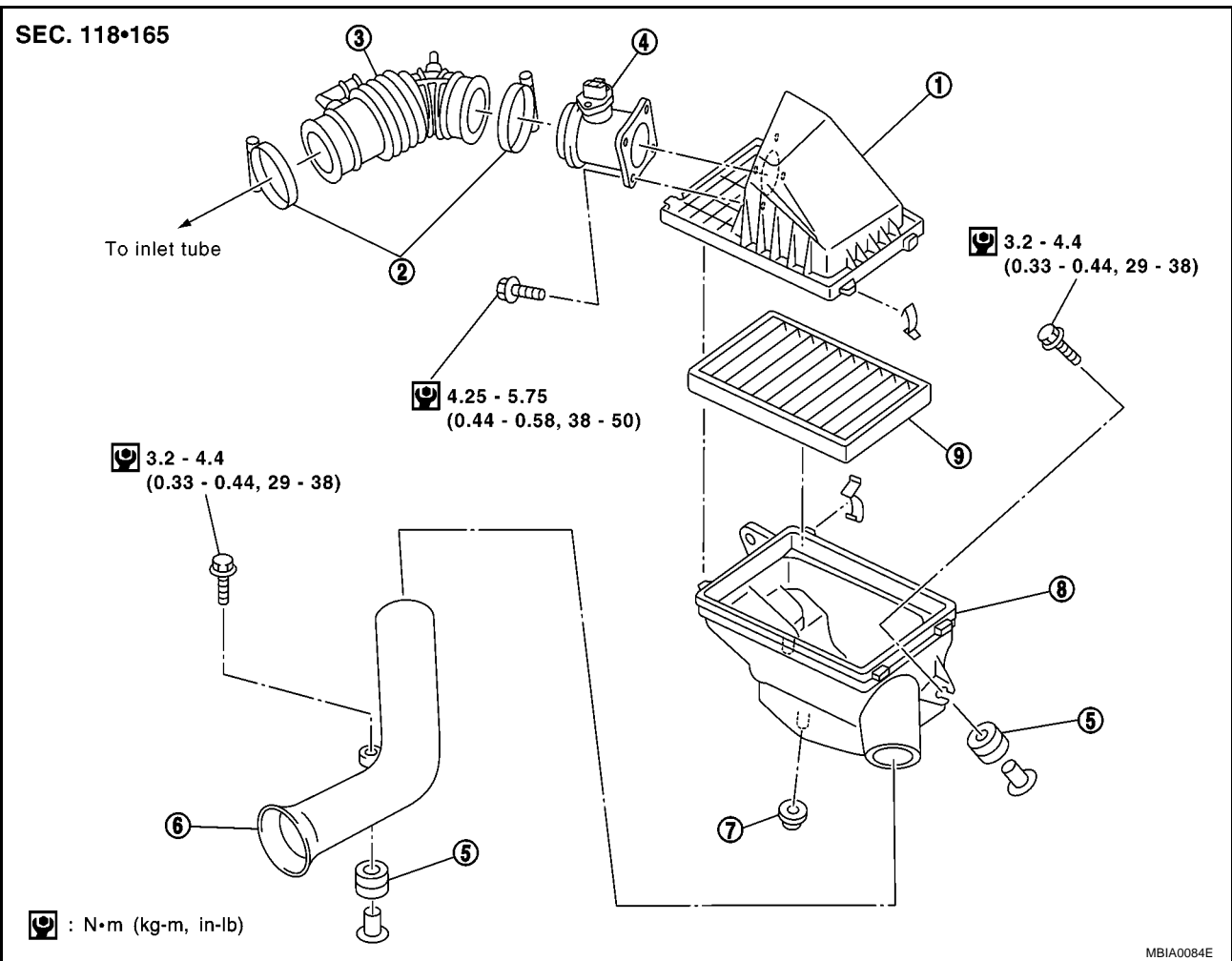
EBS00SNH

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

EBS00SNI



- | | | |
|-----------------------------|-----------------------------|------------------------|
| 1. Air cleaner case (upper) | 2. Clamp | 3. Air duct |
| 4. Mass air flow sensor | 5. Grommet | 6. Air duct side |
| 7. Mounting rubber | 8. Air cleaner case (lower) | 9. Air cleaner element |

REMOVAL

1. Remove mass air flow sensor harness clamp.
2. Remove harness connector from mass air flow sensor.
3. Remove air duct, air cleaner case/ mass air flow sensor.
- Add marks as necessary for easier installation.
4. Remove mass air flow sensor from air cleaner case.

CAUTION:

Handle mass air flow sensor with following cares.

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

INSTALLATION

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

CHANGING AIR CLEANER ELEMENT

1. Remove air cleaner case.

2. Remove clips and lift up air cleaner upper case.
3. Remove air cleaner element.

CHARGE AIR COOLER

Removal and Installation

A

EM

C

D

E

F

G

H

I

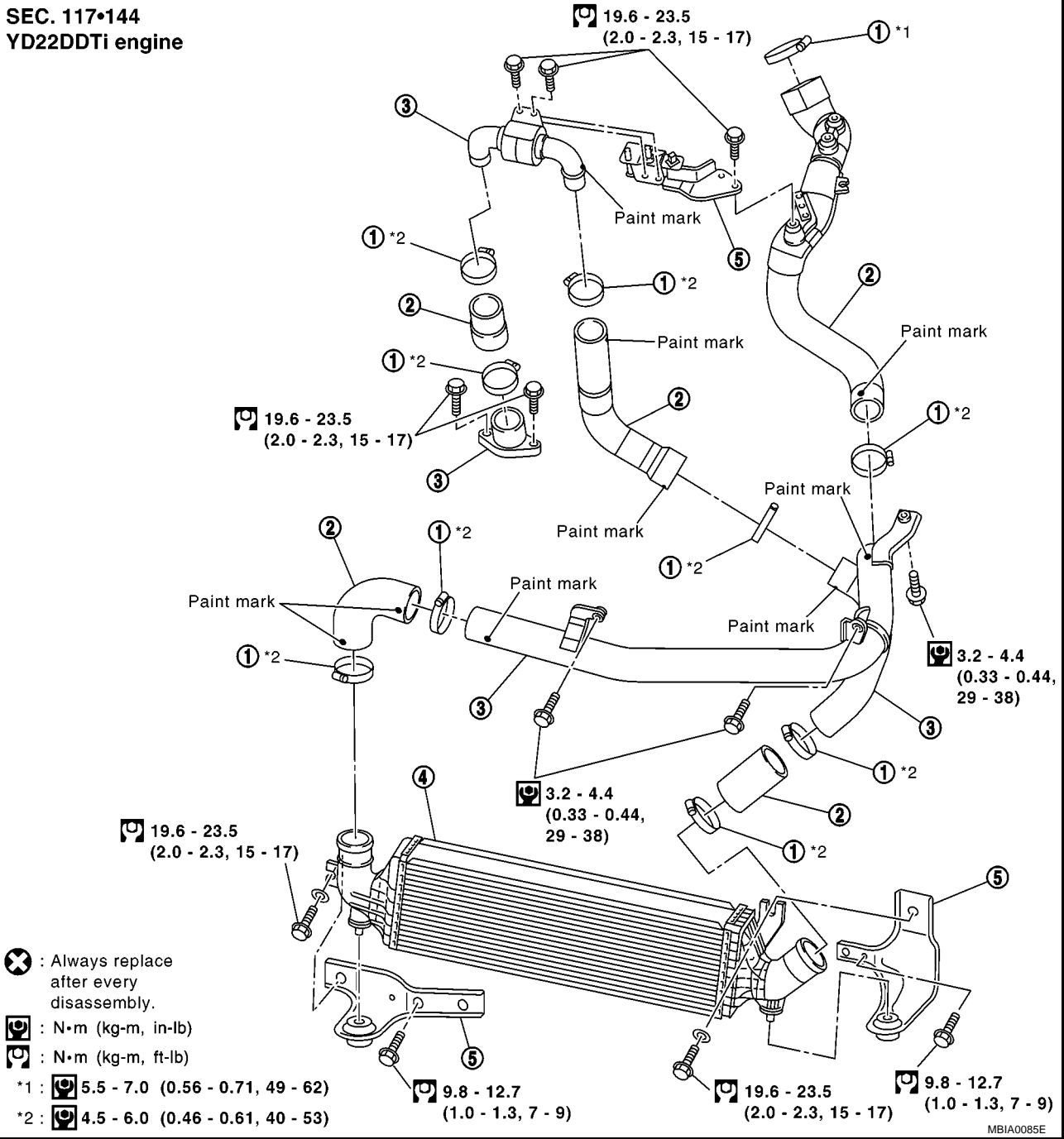
J

K

L

M

SEC. 117•144
YD22DDTi engine



1. Hose clamp
4. Charge air cooler

2. Air inlet hose
5. Bracket

3. Air inlet tube

REMOVAL

1. Remove front bumper.
2. Remove battery and tray (with fusible link and fuse box).
3. Remove air cleaner and air duct. Refer to [EM-15, "Removal and Installation"](#).
4. Remove air inlet hose and tube.
5. Remove charge air cooler.
6. Remove and install with bottom bracket as an assembly.

CAUTION:

When removing charge air cooler, close opening on turbocharger and on intake manifold with shop cloth or other suitable material.

INSPECTION AFTER REMOVAL

Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler if necessary.

- Be careful not to deform core fins.
- For cleaning procedure of charge air cooler core, refer to [CO-12. "Checking Radiator"](#).

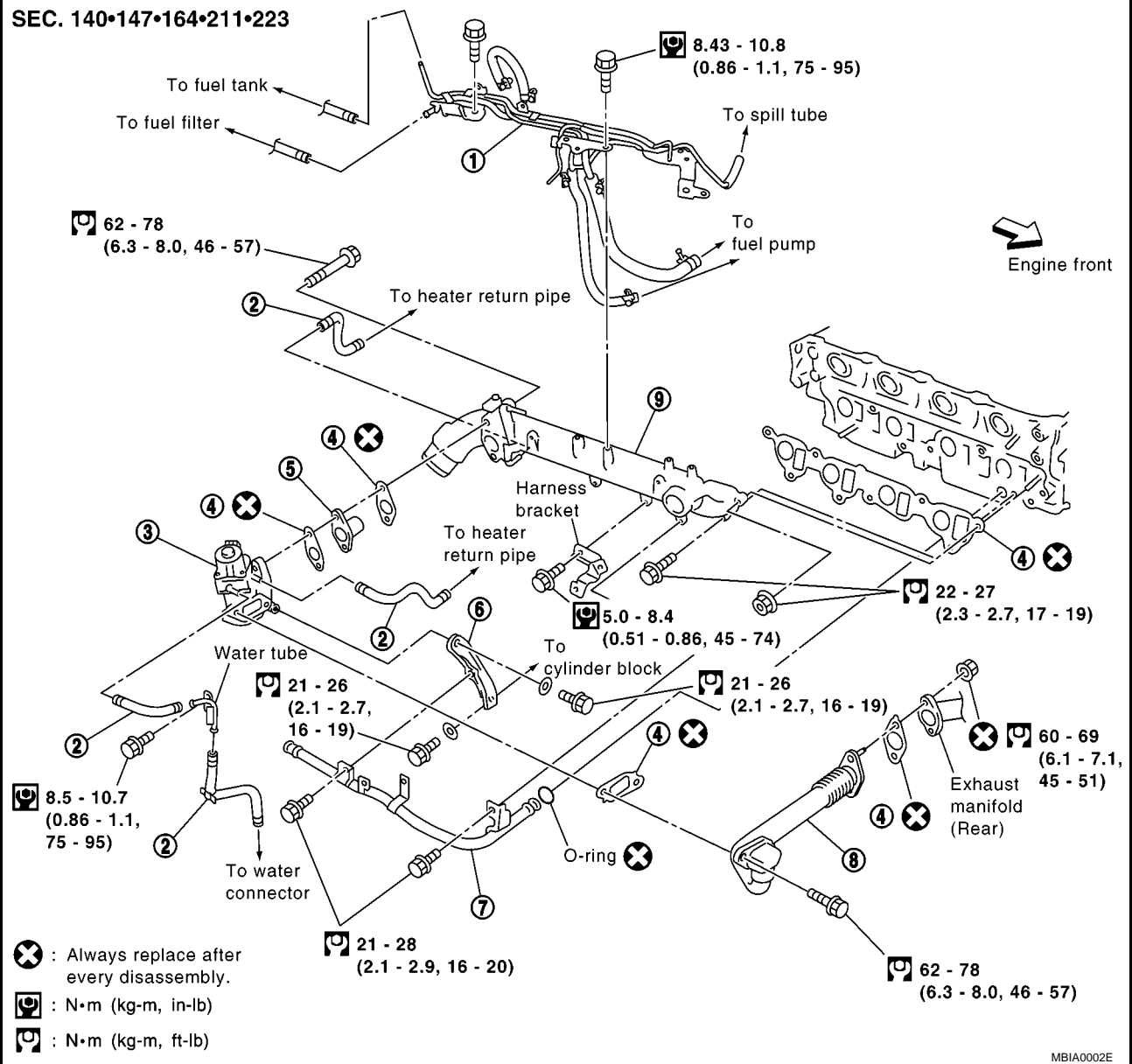
INSTALLATION

Pay attention to identification mark and direction when installing air inlet hose and tubes. Refer to [EM-17. "Removal and Installation"](#).

INTAKE MANIFOLD

Removal and Installation

SEC. 140•147•164•211•223



REMOVAL

WARNING:

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

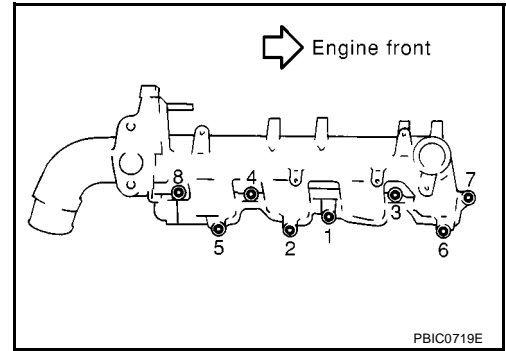
1. Drain engine coolant. Refer to [CO-8, "Changing Engine Coolant"](#).
2. Remove engine cover. Refer to [EM-52, "Removal and Installation"](#).
3. Remove air duct. Refer to [EM-15, "Removal and Installation"](#).
4. Remove air inlet hose and pipe. Refer to [EM-17, "Removal and Installation"](#).
5. Remove exhaust manifold cover.
6. Disconnect electronic EGR volume control valve water hoses and harness.
7. Disconnect heater hose.
8. Remove EGR tube.

9. Remove injection tube center. Refer to [EM-39, "Removal and Installation"](#).
10. Remove water pipe.
11. Remove fuel hose.
 - To prevent fuel from flowing out, plug the opening of the hose with a blind plug after disconnection.

CAUTION:

Be careful not to spill fuel in the engine component.

12. Loosen bolts and nuts in the reverse order of that shown in the figure.
13. Remove electronic EGR volume control valve from intake manifold.

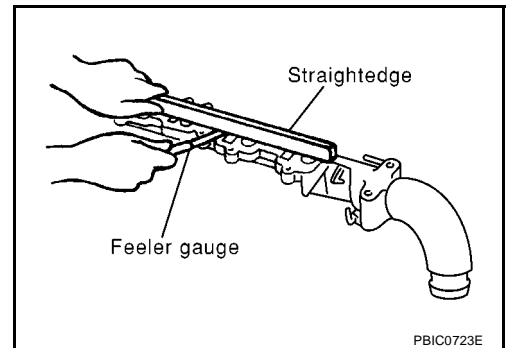


INSPECTION AFTER REMOVAL

Surface Distortion

- Check distortion on the mounting surface with a straightedge and feeler gauge.

Limit : 0.1 mm (0.004 in)



INSTALLATION

Following instructions below, install in reverse order of removal.

1. Install electronic EGR volume control valve.
 - **Handle with care avoiding any shocks.**
 - **Do not disassemble or adjust.**
2. Install intake manifold.
 - Tighten fixing bolts and nuts in numerical order as shown in the figure.
 - When stud bolts come off, install with the following torque.



: 10 - 11 N·m (1.0 - 1.2 kg-m, 87 - 104 in-lb)

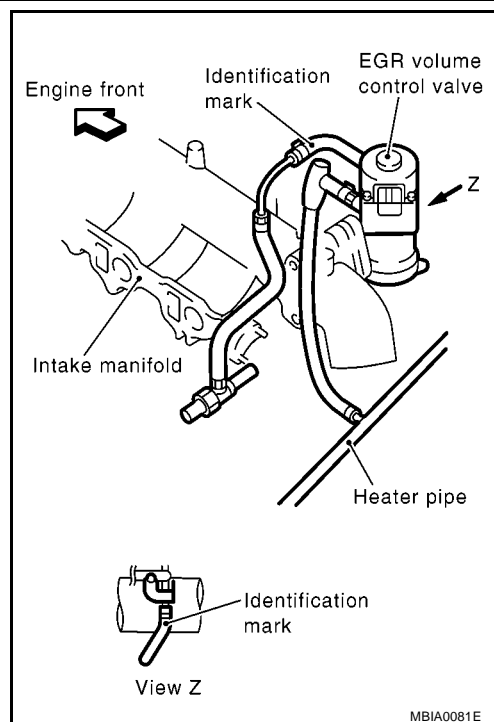
INTAKE MANIFOLD

[YD]

3. Install water hose.
 - Install water hose by referring to identification marks avoiding twisting.
 - When an insert stopper is not provided with the pipe, insert the hose up to dimension A. When the pipe is shorter than dimension A, insert hose fully until it reaches the end.

Dimension A : 25 - 30 mm (0.984 - 1.181 in)

- When an insert stopper is provided on the pipe side, insert the hose until it reaches the bulge.
 - When marking is provided on the pipe, insert hose until it covers half of the marking.
4. Install remaining parts in reverse order of removal.
 5. Before starting engine, bleed air from fuel piping. Refer to [FL-5, "Air Bleeding"](#).

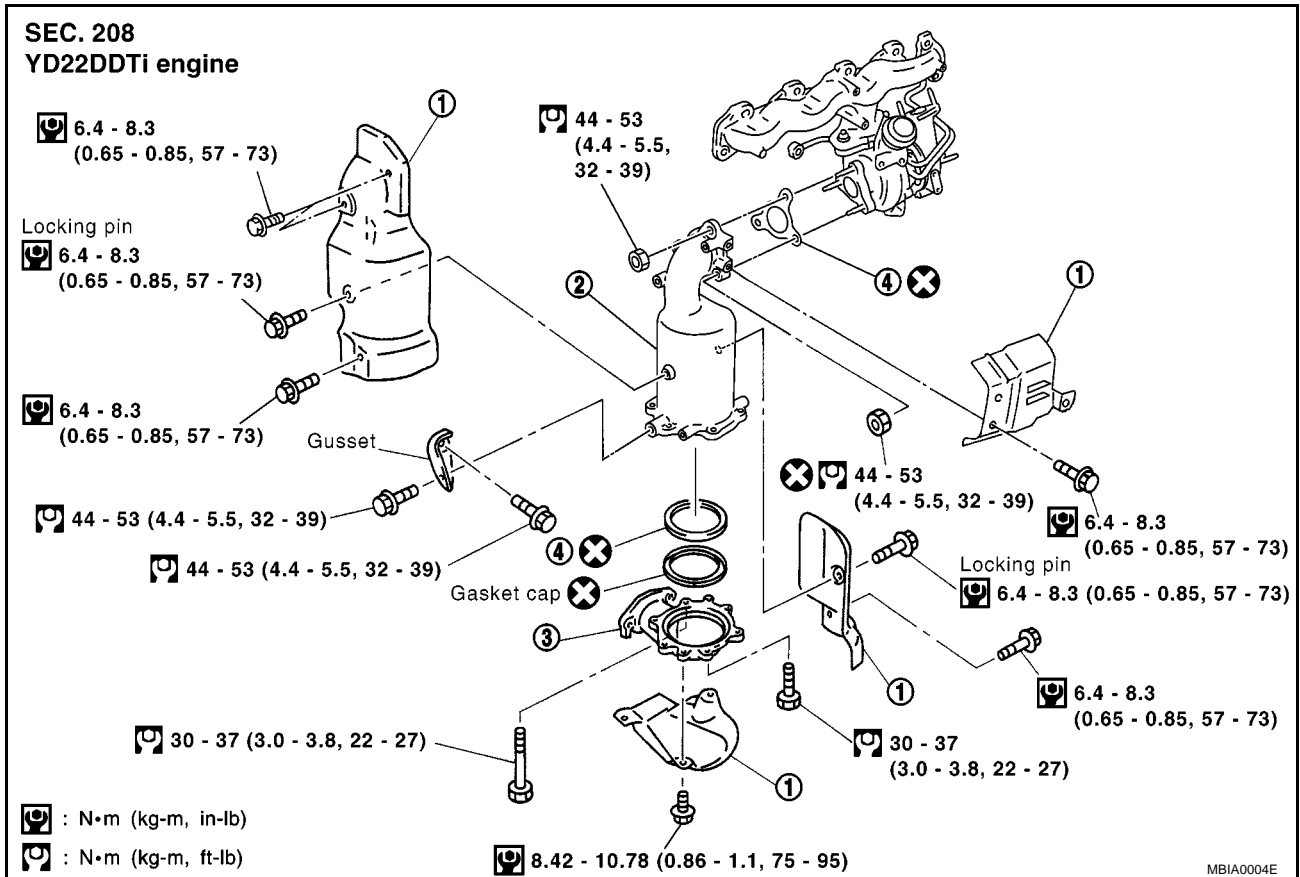


INSPECTION AFTER INSTALLATION

Start engine and increase engine speed to check for fuel leak.

CATALYST

Removal and Installation



1. Insulator

2. Catalyst

3. Catalyst rear diffuser

4. Gasket

REMOVAL

1. Remove engine undercover.
2. Drain engine coolant. Refer to [CO-8, "Changing Engine Coolant"](#).
3. Remove radiator upper and lower hoses.
4. Remove radiator and radiator fan. Refer to [CO-10, "Removal and Installation"](#).
5. Remove insulators.
6. Remove water inlet pipe.
7. Disconnect exhaust front tube.
8. Remove catalyst.

CAUTION:**Do not disassemble.**

Install two locking pins into both sides of the catalyst. Be careful not to confuse locking pins with insulator mounting bolts.

Catalyst locking pin

: Flange bolt (black)

Insulator mounting bolt

: Washer bolt (silver or yellow)

INSTALLATION

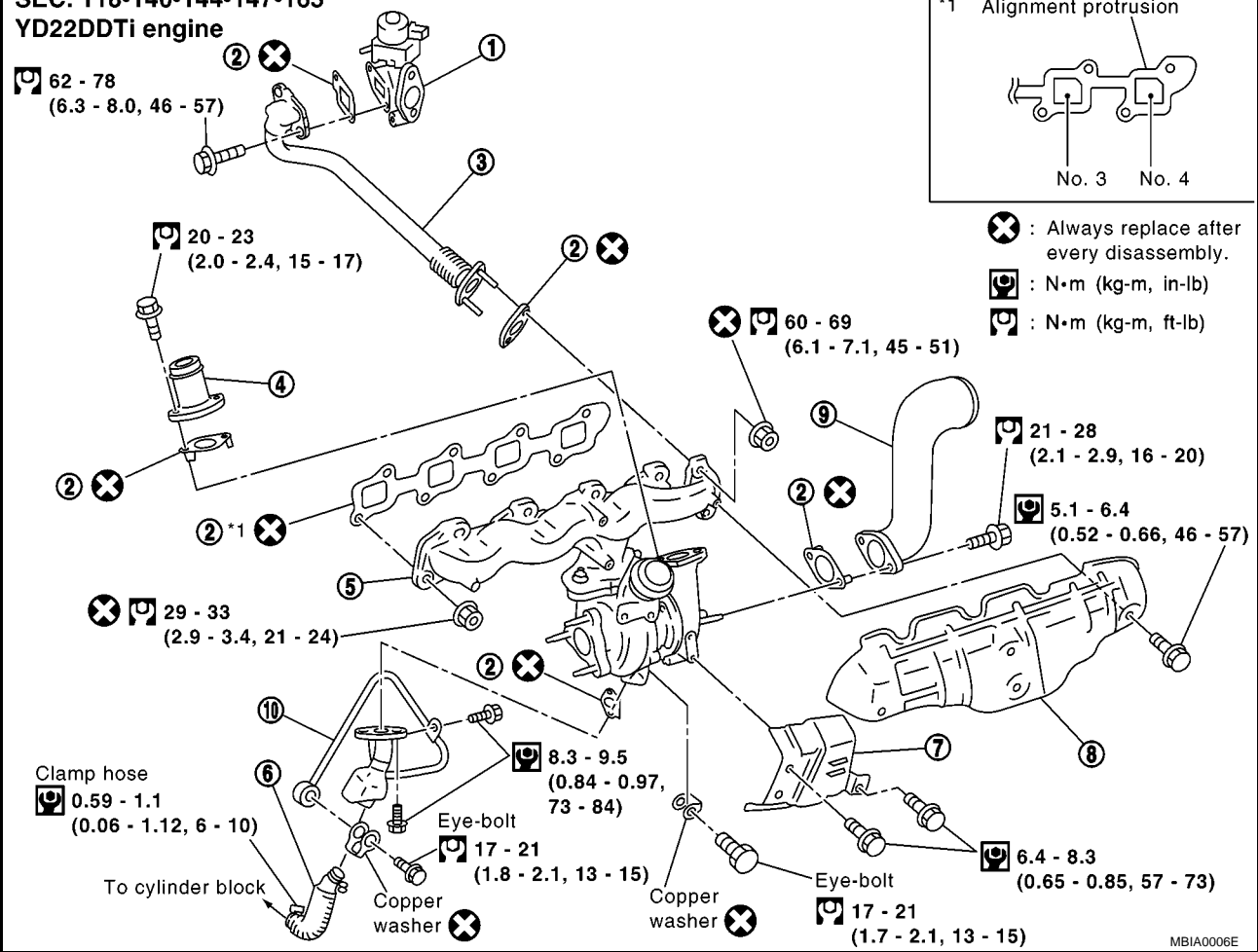
Install in reverse order of removal.

- Pushing gussets against the oil pan and the catalyst, temporarily tighten the mounting bolt. And then tighten it to the specified torque.

EXHAUST MANIFOLD AND TURBOCHARGER

Removal and Installation

SEC. 118•140•144•147•165
YD22DDTi engine



- | | | |
|--|---|--------------------|
| 1. Electronic EGR volume control valve | 2. Gasket | 3. EGR tube |
| 4. Air inlet pipe | 5. Exhaust manifold and turbocharger assembly | 6. Oil return hose |
| 7. Turbo insulator | 8. Exhaust manifold insulator | 9. Air inlet pipe |
| 10. Oil feed tube, oil return tube | | |

REMOVAL

1. Drain engine coolant. Refer to [CO-8, "Changing Engine Coolant"](#).
2. Remove engine cover. Refer to [EM-52, "Removal and Installation"](#).
3. Remove air duct and air inlet pipe. Refer to [EM-15, "Removal and Installation"](#).
4. Remove engine undercover.
5. Remove radiator upper and lower hoses. Refer to [CO-10, "Removal and Installation"](#).
6. Remove radiator and radiator fan. Refer to [CO-10, "Removal and Installation"](#).
7. Remove air inlet pipe.
8. Disconnect exhaust front tube.
9. Remove catalyst. Refer to [EM-22, "Removal and Installation"](#).
10. Remove exhaust manifold cover.
11. Remove insulator.
12. Each wiring and piping (disconnect/move)

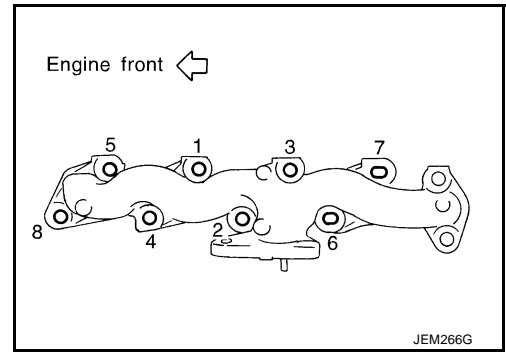
EXHAUST MANIFOLD AND TURBOCHARGER

[YD]

13. Loosen exhaust manifold mounting nuts in the reverse order specified in the figure.
14. Rotate the exhaust manifold and turbocharger assembly so that the rear side (EGR tube mounting side) faces upward. And then pull out the assembly from between the engine and the air conditioning piping.

CAUTION:

Be careful not to deform each turbocharger piping when pulling out the assembly.

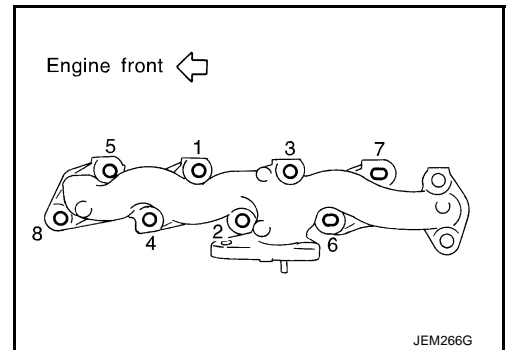


INSTALLATION

- When a stud bolt is pulled out, tighten it to the following torque:

 : 12.7 - 16.7 N·m (1.3 - 1.7 kg-m, 9 - 12 ft-lb)

- Tighten the exhaust manifold mounting nuts in the following procedure:
 1. Tighten the nuts in the order specified in the figure.
 2. Re-tighten the nuts 1 to 4.
 3. Install the gasket so that the alignment protrusion faces the No. 4 port.
 4. Install in reverse order of removal.



INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

Disassembly and Assembly

EBS00SNN

A

EM

C

D

E

F

G

H

I

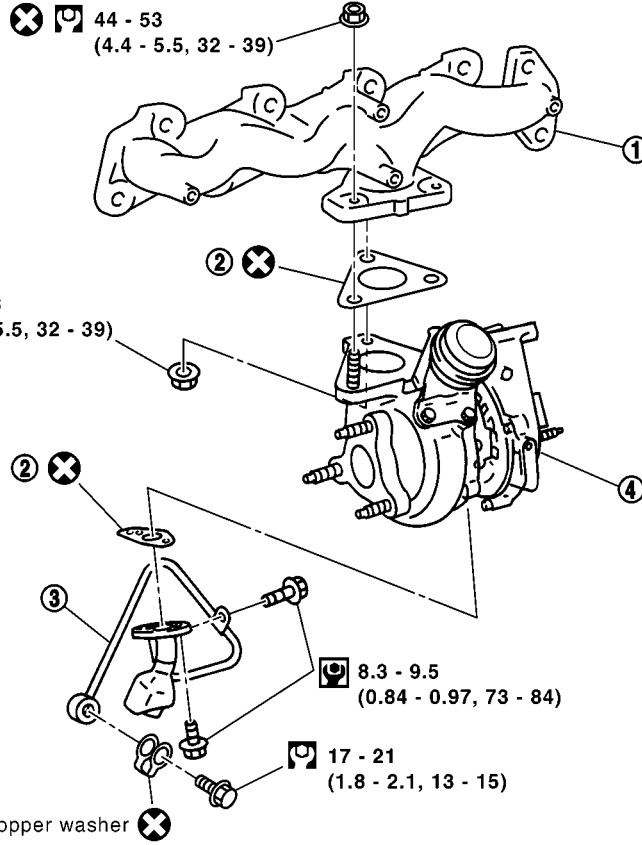
J

K

L

M

SEC. 140•144
YD22DDTi engine



⊗ : Always replace after every disassembly.

⊙ : N·m (kg-m, in-lb)

⊞ : N·m (kg-m, ft-lb)

Copper washer ⊗

MBIA0008E

1. Exhaust manifold
2. Gasket
3. Oil return tube
4. Turbocharger

REMOVAL

1. After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts to remove.

CAUTION:

Do not disassemble or adjust the turbocharger body.

2. When a stud bolt is pulled out, tighten it to the following torque:

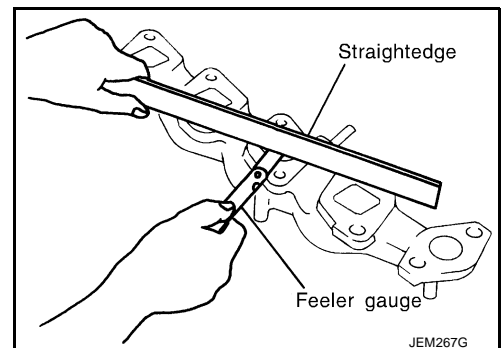
⊙ : 24 - 27 N·m (2.4 - 2.8 kg-m, 18 - 20 ft-lb)

INSPECTION AFTER REMOVAL

Surface Distortion

Check the distortion on the mounting surface in the six directions using a straightedge and a feeler gauge.

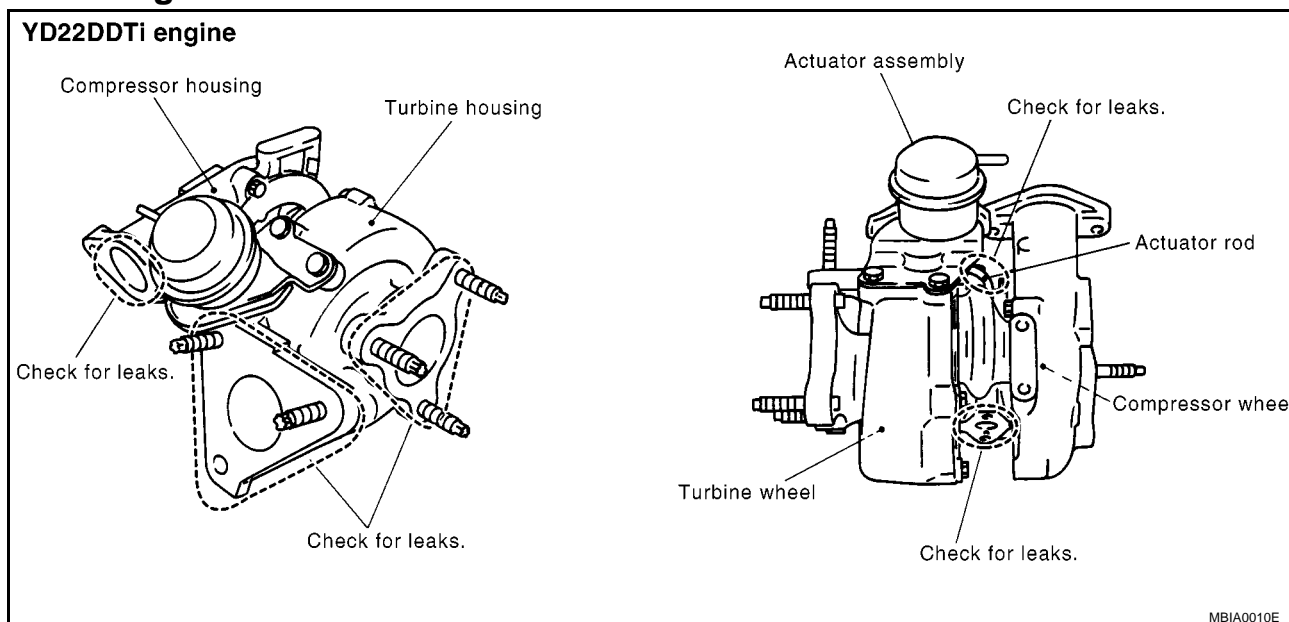
Limit : 0.3 mm (0.012 in)



JEM267G

Turbocharger

EBS00SNO



CAUTION:

When the compressor wheel turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary failure:

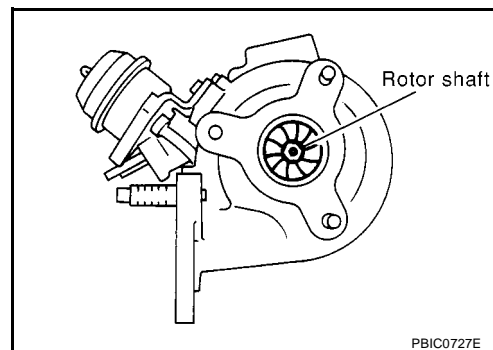
Suction side : Between turbocharger and air cleaner

Exhaust side : Between turbocharger and catalyst

ROTOR SHAFT CLEARANCE

- Check that the rotor shaft rotates smoothly without any resistance when it is rotated by your fingertips.
- Check that the rotor shaft is not loose when it is moved vertically or horizontally.

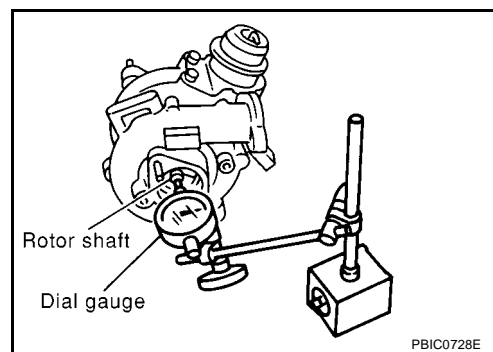
Standard : 0.086 - 0.117 mm (0.0034 - 0.0046 in)



ROTOR SHAFT END PLAY

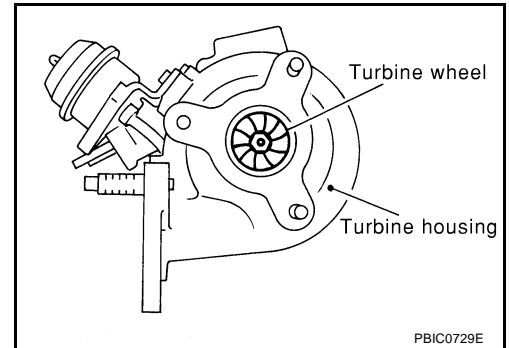
Place a dial gauge at the rotor shaft end in the axial direction to measure the end play.

Standard : 0.036 - 0.090 mm (0.0014 - 0.0035 in)



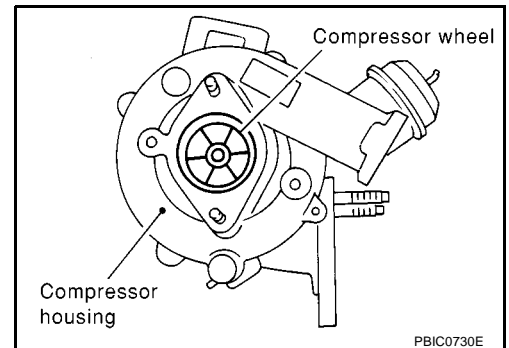
TURBINE WHEEL

- Check that there is no oil adhesion.
- Check that there is no carbon accumulation.
- Check that blades of the turbine wheel are not bent or broken.
- Check that the turbine wheel does not interfere with the turbine housing.



COMPRESSOR WHEEL

- Check that there is no oil adhesion inside the air inlet.
- Check that the compressor wheel does not interfere with the compressor housing.
- Check that the wheel is not bent or broken.

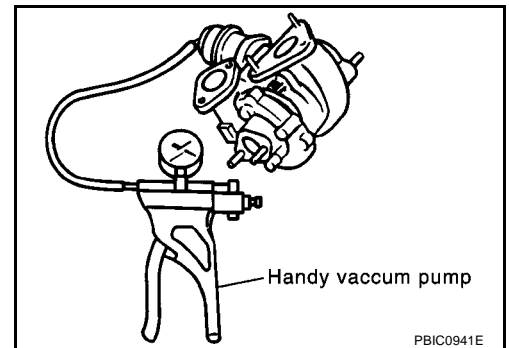


TURBOCHARGER BOOST CONTROL ACTUATOR

- Connect the handy vacuum pump to the actuator, and check that the rod strokes smoothly in compliance with the following pressure.
- Pressure to be applied at actuator part to move rod end as follows:

Standard (Pressure/rod stroke amount)

: 52.0 - 54.6 kPa (520 - 546 mbar, 390 - 410 mmHg,
15.306 - 16.094 inHg) / 0.2 mm (0.0079 in)
: 32.0 - 40.0 kPa (320 - 400 mbar, 240 - 300 mmHg, 9.42
- 11.78 inHg) / 5.0 mm (0.197 in)



TROUBLE DIAGNOSIS OF TURBOCHARGER

Preliminary check:

- Check that the engine oil level is between MIN and MAX of the dipstick. (When the engine oil amount is more than MAX, the oil flows into the inlet duct through the blow-by gas passage, and the turbocharger is misjudged failure.)
- Ask the customer if he/she always runs the vehicle in idle engine speed to cool the oil down after driving.
- Replace the turbocharger assembly when any malfunction is found after unit inspections specified in the table below.
- If no malfunction is found after the unit inspections, judge that the turbocharger body has no failure. Check the other parts again.

Inspection item	Inspection result	Symptom (when each inspection item meets each inspection result)			
		Oil leakage	Smoke	Noise	Insufficient power/ acceleration failure
Turbine wheel	Oil leaks	C	A	C	C
	Carbon is accumulated	C	A	B	B
	Friction with housing	C	B	A	B
	Blades are bent or broken			A	A
Compressor wheel	Inside the air inlet is seriously contaminated by oil.	B	B		
	Friction with housing	C	B	A	B
	Blades are bent or broken			A	A
After checking both turbine and compressor, inspect rotor shaft end play.	There is resistance when the rotor shaft is rotated by your fingertips.		C	C	B
	The rotor shaft sometimes does not rotate by your fingertips.				A
	There is too much play in the bearing.	C	C	B	C
Oil return port	Carbon or sludge is accumulated in the waste oil hole.	C	A	C	C

A: Large possibility

B: Medium possibility

C: Small possibility

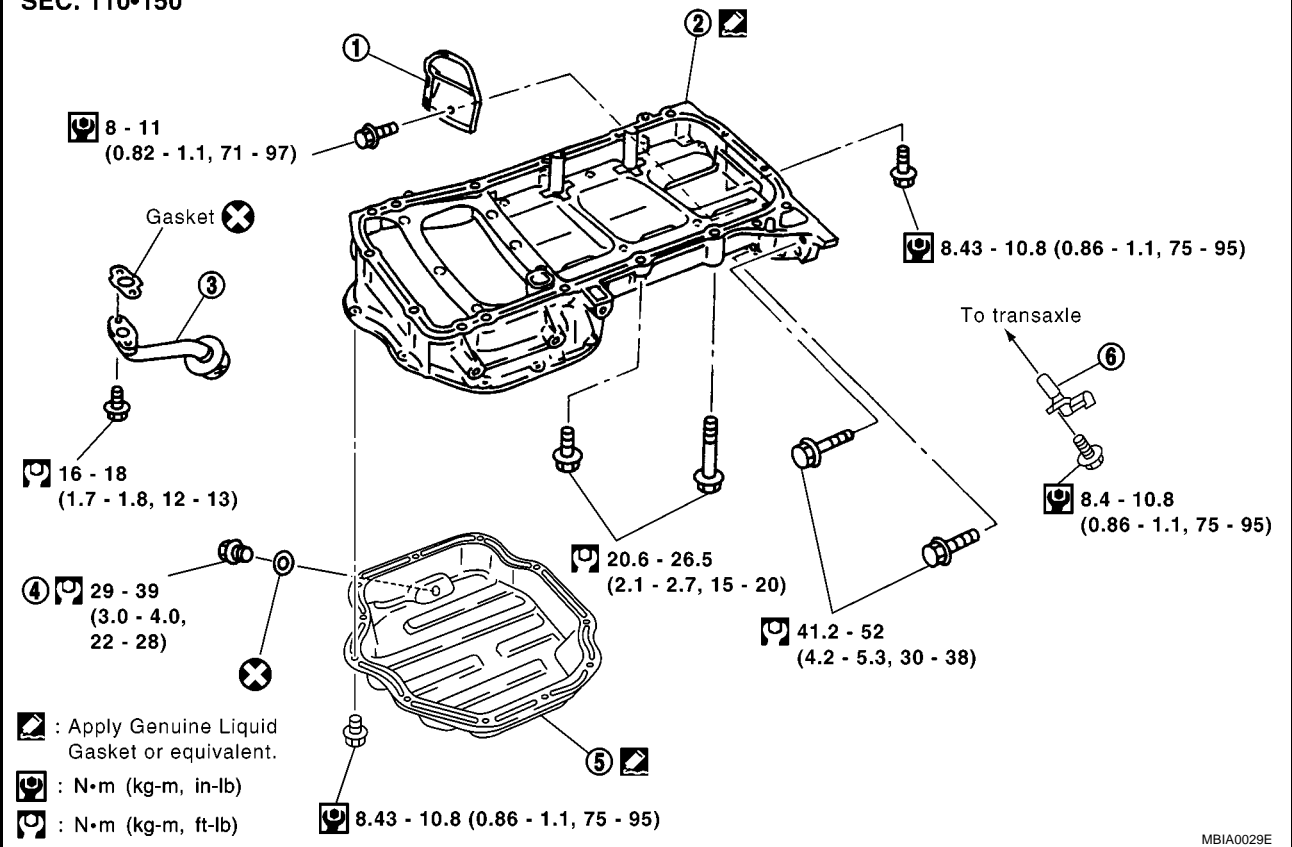
OIL PAN AND OIL STRAINER

PFP:11110

Removal and Installation

EBS00SNP

SEC. 110•150



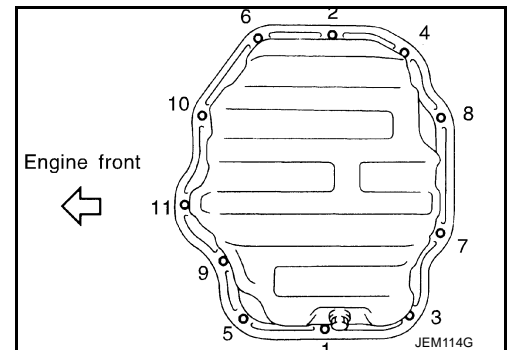
- | | | |
|---------------------|------------------|-------------------------------|
| 1. Rear plate cover | 2. Oil pan upper | 3. Oil strainer |
| 4. Drain plug | 5. Oil pan lower | 6. Crankshaft position sensor |

REMOVAL

WARNING:

To avoid the danger of being scalded, never drain the engine oil when the engine is hot.
When removing the transaxle, first remove the crankshaft position sensor from the assembly.
Be careful not to damage sensor edges and signal plate teeth.

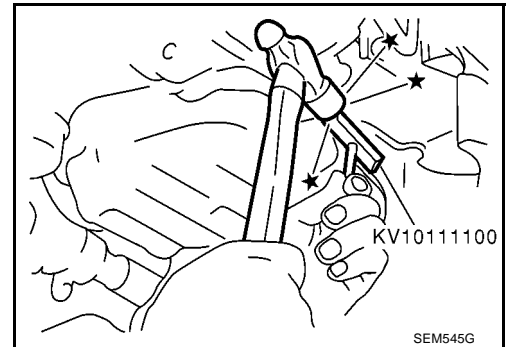
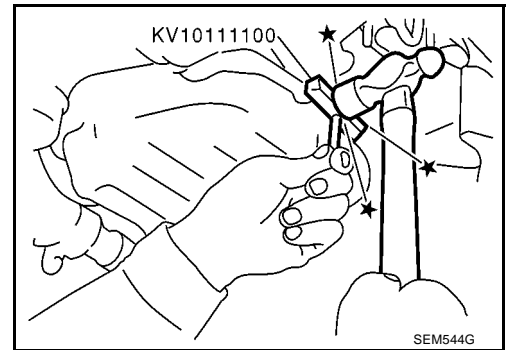
1. Remove engine undercover.
2. Drain engine oil. Refer to [LU-6, "Changing Engine Oil"](#).
3. Remove A/C compressor bracket.
4. Remove lower oil pan bolts. Loosen bolts in the reverse order of that shown in the figure.



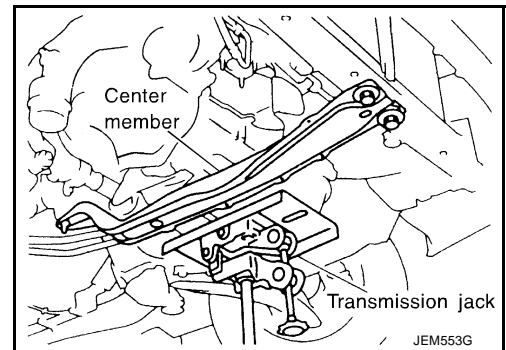
OIL PAN AND OIL STRAINER

[YD]

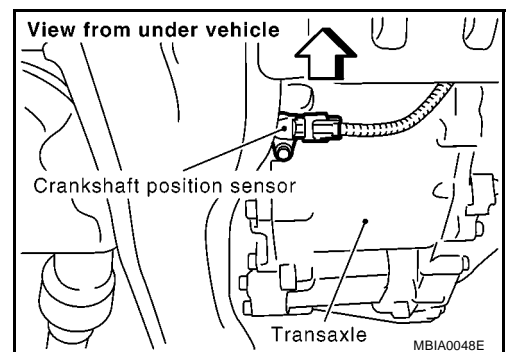
5. Remove lower oil pan.
- a. Insert Tool between upper oil pan and lower oil pan.
 - **Be careful not to damage aluminum mating surface.**
 - **Do not insert screwdriver, or oil pan flange will be deformed.**
- b. Slide Tool by tapping on the side of the Tool with a hammer.
- c. Remove lower oil pan.



6. Remove oil strainer.
7. Remove front exhaust tube and its support.
8. Set a suitable transmission jack under transaxle and hoist engine with engine slinger. Refer to [EM-89, "Removal and Installation"](#).
9. Remove front and rear engine mounting nuts and bolts.
10. Remove center member.



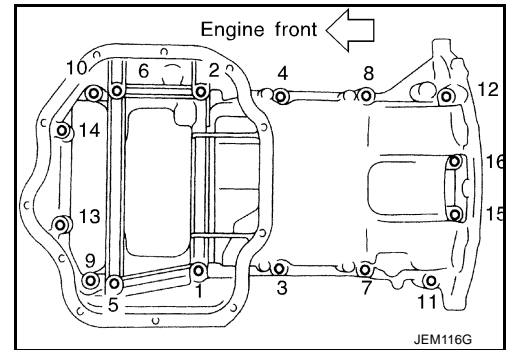
11. Remove crankshaft position sensor from transaxle.
12. Remove rear plate cover.



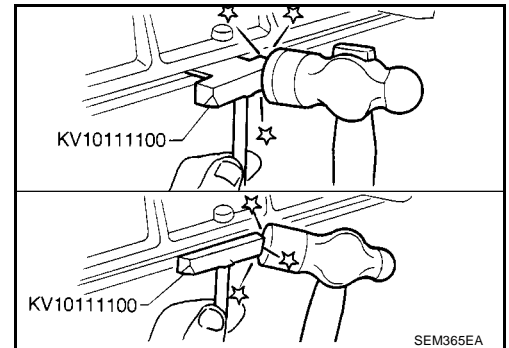
OIL PAN AND OIL STRAINER

[YD]

13. Remove catalyst rear diffuser. Refer to [EM-22, "Removal and Installation"](#).
14. Loosen bolts in reverse order of illustration to remove upper oil pan.



15. Remove four engine - to - transaxle bolts using a universal socket. (Commercial Service Tool).
16. Remove upper oil pan.
 - Insert Tool (Seal cutter) between upper oil pan and cylinder block. Slide tool by tapping on the side of the tool with a hammer. Remove oil pan.
 - **Be careful not to damage aluminum mating surface.**
 - **Do not insert screwdriver, or oil pan flange will be deformed.**
 - **Be careful to prevent No.15 and 16 bolts from falling into transaxle case.**

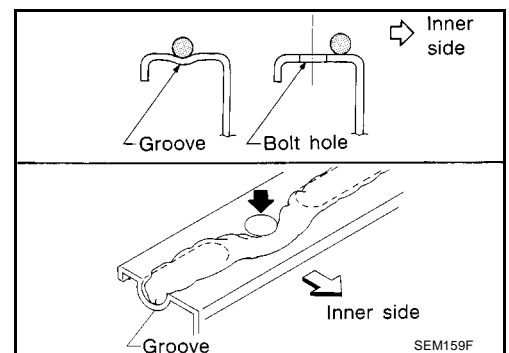
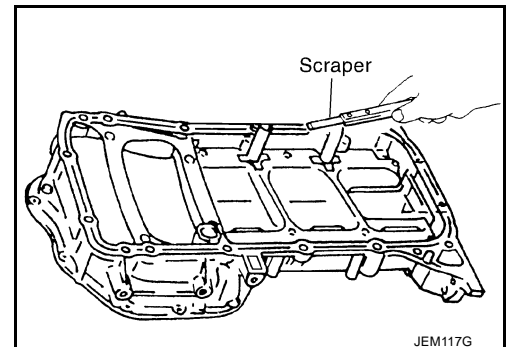


INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSTALLATION

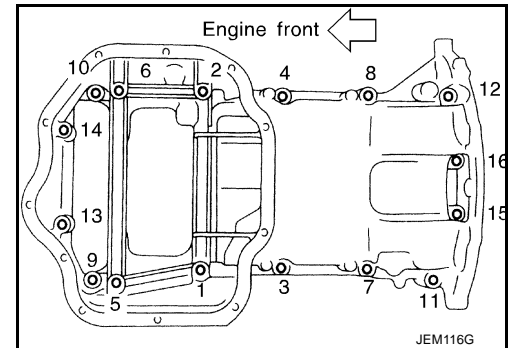
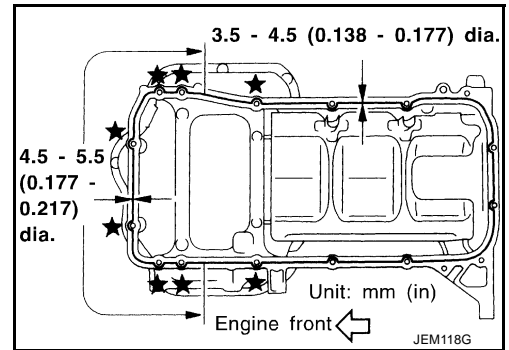
1. Install upper oil pan in the order below.
 - a. Use a scraper to remove old liquid gasket from mating surfaces.
 - **Also remove old liquid gasket from mating surface of cylinder block, front cover and lower oil pan.**
 - **Remove old liquid gasket from the bolt hole and thread.**
 - b. Apply a continuous bead of liquid gasket to mating surface of aluminum oil pan.
 - **Use Genuine Liquid Gasket or equivalent.**



OIL PAN AND OIL STRAINER

[YD]

- c. Apply Genuine Liquid Gasket or equivalent to areas shown in the figure.
 - At the 8 bolt holes marked ★, liquid gasket should be applied on the rims of the holes.
 - Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) or 4.5 to 5.5 mm (0.177 to 0.217 in) wide. (Be careful that the diameter of the liquid gasket bead is different around the front.)
 - Attaching should be done within 5 minutes after coating.
- d. Install upper oil pan.




- Tighten bolts in numerical order to specified torque.
- Bolt dimensions vary depending on the installation location. Refer to the following and use appropriate bolts.

M6 x 30 mm (1.18 in) : Bolt No. 15, 16

M8 x 25 mm (0.98 in) : Bolt No. 3, 4, 9, 10

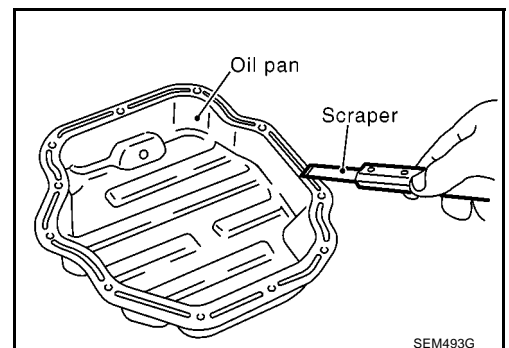
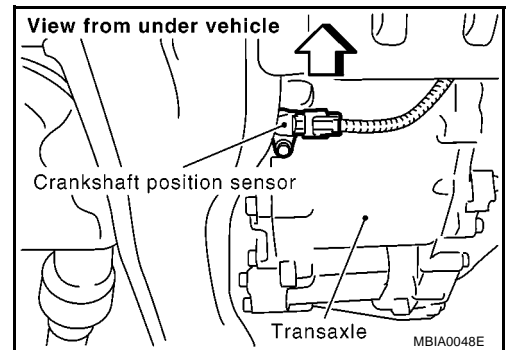
M8 x 60 mm (2.36 in) : Bolt No. 1, 2, 5, 6, 7, 8, 11, 12, 13, 14

- The shank length under the bolt neck above is the length of the threaded part (pilot portion not included).
2. Install the four engine-to-transaxle bolts. Refer to [EM-29, "Removal and Installation"](#).
 3. Install rear plate cover.
 4. Install A/C compressor bracket.

 : **57 - 65 N-m (5.9 - 6.7 kg-m, 43 - 48 ft-lb)**

5. Install drive belts.
6. Install center member.
7. install front and rear engine mounting insulator nuts and bolts.
8. Install crankshaft position sensor.
9. Install front exhaust tube and its support.
10. Install oil strainer.
11. Install lower oil pan.

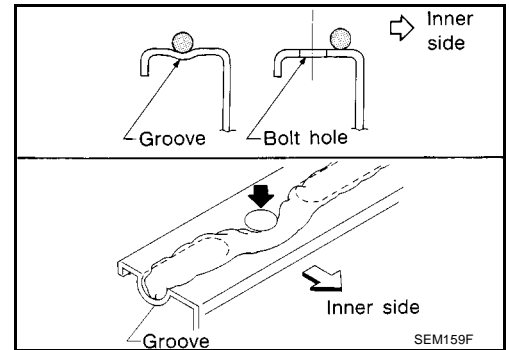
- a. Use a scraper to remove old liquid gasket from mating surfaces.
 - Also remove old liquid gasket from mating surface of upper oil pan.



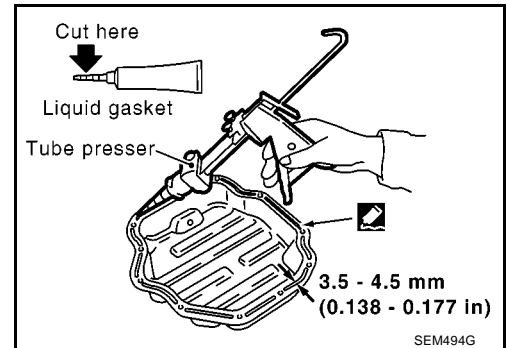
OIL PAN AND OIL STRAINER

[YD]

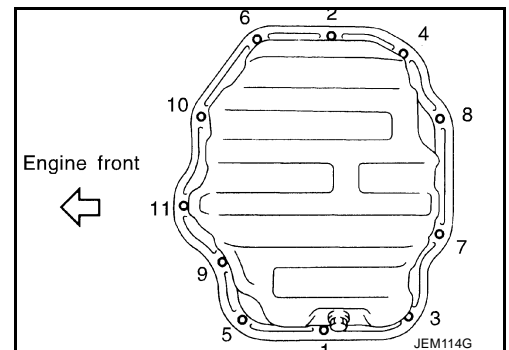
- b. Apply a continuous bead of liquid gasket to mating surface of lower oil pan.
- **Use Genuine Liquid Gasket or equivalent.**



- **Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.**
 - **Attaching should be done within 5 minutes after coating.**
12. Install oil pan drain plug.
- Refer to illustration of components parts for installation direction of washer.



13. Install in the reverse order of removal after this step.
- **Pour engine oil or start engine at least 30 minutes after oil pan is installed.**

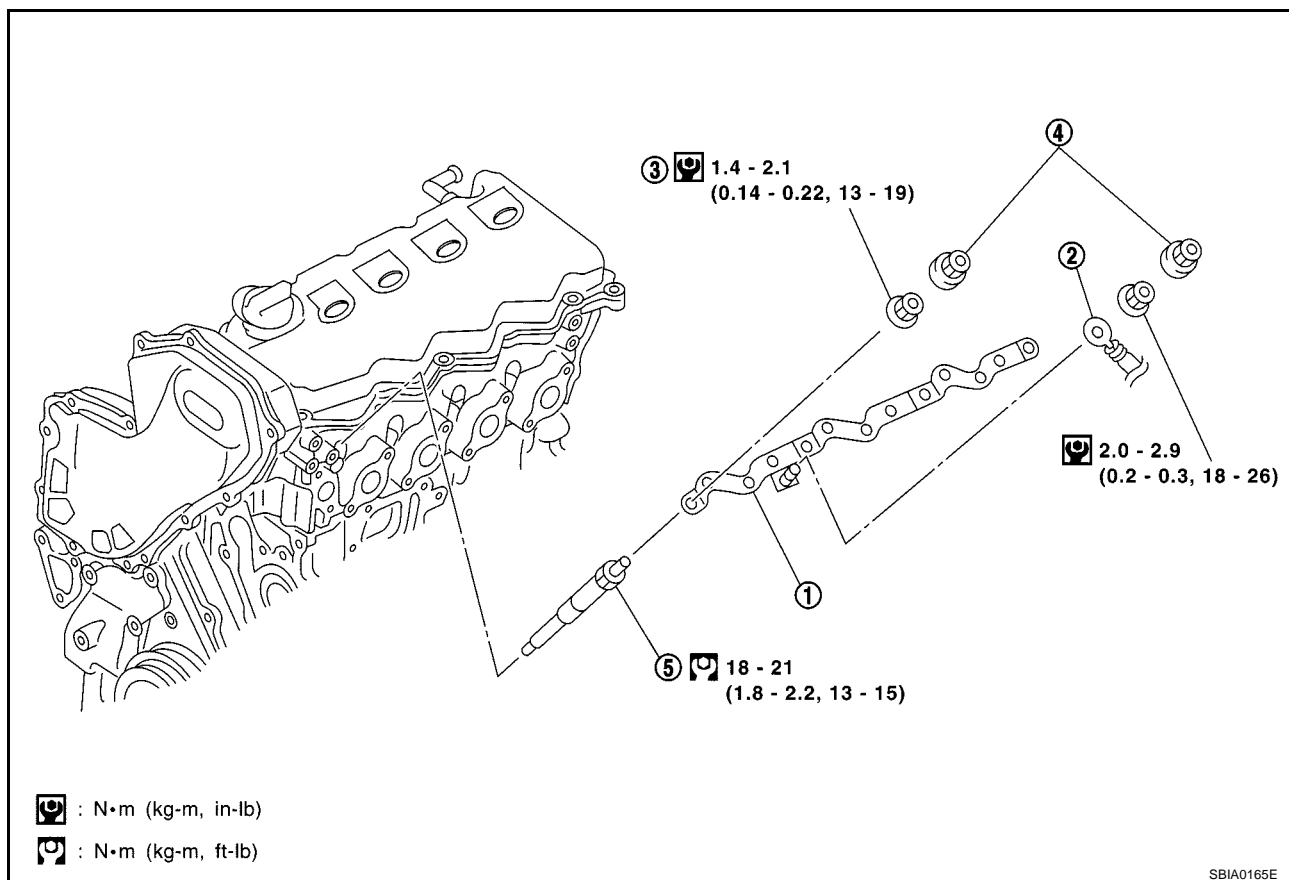


INSPECTION AFTER INSTALLATION

Check for leakage of engine oil when engine is warmed.

GLOW PLUG

Removal and Installation



- | | | |
|---------------|-----------------|-------------|
| 1. Glow plate | 2. Glow harness | 3. Glow nut |
| 4. Cap | 5. Glow plug | |

REMOVAL

CAUTION:

Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.

1. Disconnect harness connector from glow plate.
2. Remove glow nut to remove glow plate.
3. Remove glow plug.

CAUTION:

- When removing or installing, do not use such tools as an air impact wrench.
- Handle it carefully without giving any impact, even after removal. [As a guide, if it drops from height of 10 cm (3.94 in) or higher, always replace it.]

INSTALLATION

1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.
3. Install remaining parts in reverse order of removal.

VACUUM PUMP

Removal and Installation

A

EM

C

D

E

F

G

H

I

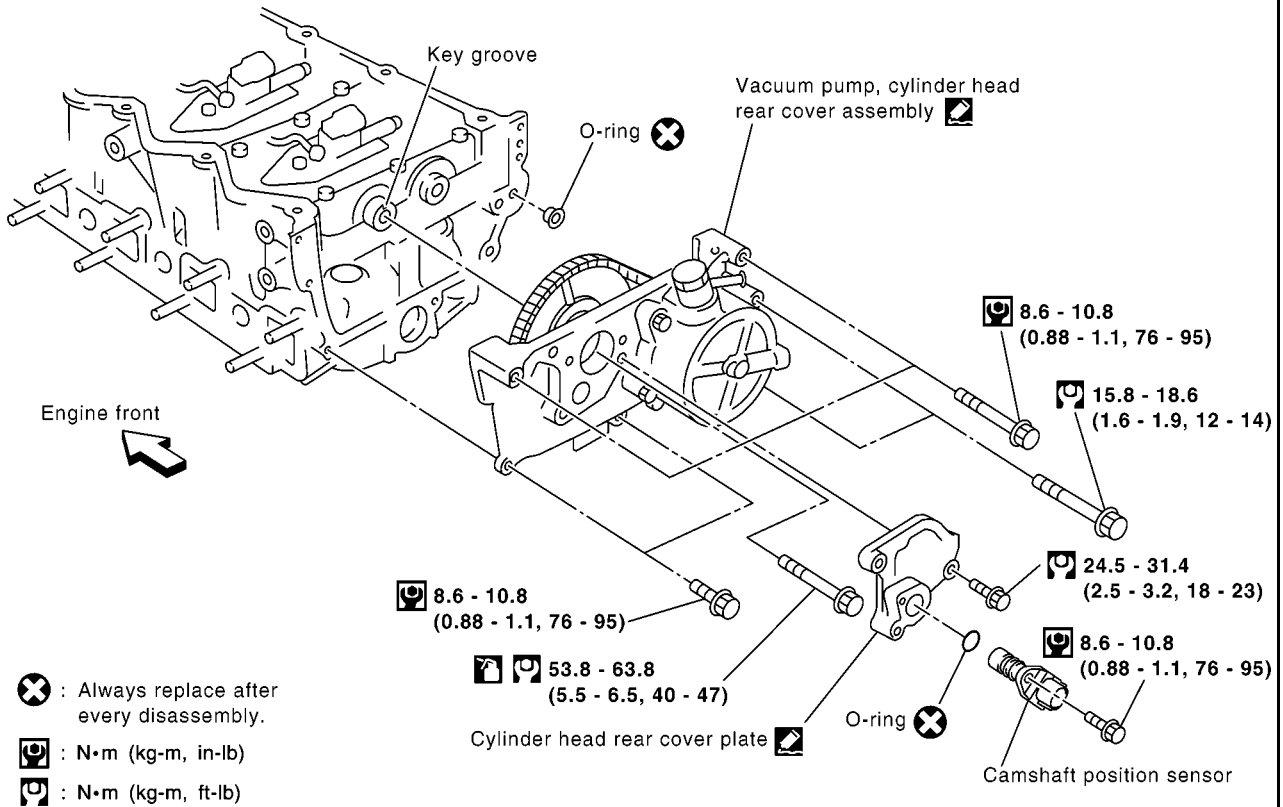
J

K

L

M

SEC. 130•135



MBIA0046E

INSPECTION BEFORE REMOVAL

1. Disconnect vacuum hose, and connect a vacuum gauge via 3-way connector.
 - Disconnect point where vacuum from vacuum pump can be measured directly and install 3-way connector.
2. Start engine and measure generated vacuum at idle speed.

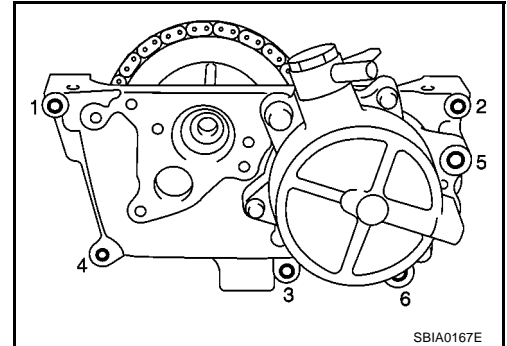
Standard : – 86.6 to – 101.3 kPa (– 866 to – 1,013 mbar, – 650 to – 760 mmHg, – 25.59 to – 29.92 inHg)

- If out of standard, check for air suction in vacuum route, and measure again.
- If still outside of standard, replace vacuum pump.

REMOVAL

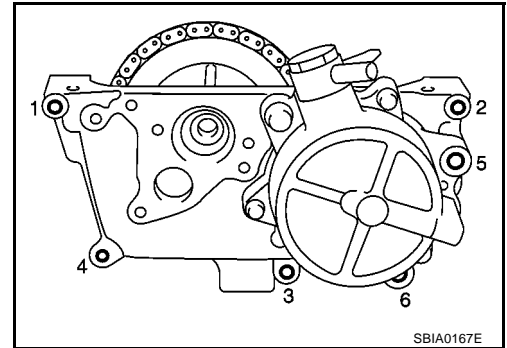
1. Drain engine coolant. Refer to [CO-8, "Changing Engine Coolant"](#).
2. Remove engine cover. Refer to [EM-52, "Removal and Installation"](#).
3. Remove air duct and air cleaner case. Refer to [EM-15, "Removal and Installation"](#).
4. Disconnect harness connector from fuel injector.
5. Remove injection tube. Refer to [EM-39, "INJECTION TUBE AND FUEL INJECTOR"](#).
6. Remove fuel injector oil seal.
7. Remove rocker cover. Refer to [EM-52, "Removal and Installation"](#).
8. Remove air inlet pipes. Refer to [EM-23, "Removal and Installation"](#).
9. Remove exhaust manifold cover.
10. Disconnect electronic EGR volume control valve water hose and harness.
11. Disconnect heater hose.
12. Remove EGR tube.
13. Disconnect vacuum hose from vacuum pump side.

14. Remove camshaft position sensor.
15. Remove cylinder head rear cover plate.
16. Loosen and remove the installation bolts in rear cam sprocket.
 - Loosen rear cam sprocket installation bolts by fixing the hexagonal portion of the camshaft.
17. Remove vacuum pump and cylinder head rear cover assembly.
 - Remove and install vacuum pump, sprocket, drive chain and chain guide as an assembly.
 - Loosen mounting bolts in reverse order shown in figure.
 - Do not remove any bolts not shown in figure. (Especially never remove M6 bolts on vacuum pump.)
 - Use seal cutter (special service tool) or other suitable tool to remove.



INSTALLATION

1. Install vacuum pump and cylinder head rear cover assembly onto cylinder head. Refer to [EM-35, "Removal and Installation"](#).
 - Camshaft sprocket and camshaft need mating angle when installing to cylinder head.
 - Apply Genuine Liquid Gasket or equivalent (Refer to [EM-6, "Precautions for Liquid Gasket"](#).) to area shown in the figure.
 - **Attaching should be done with in 5 minutes after coating.**
2. Tighten mounting bolts in order shown in the figure.
3. Install rear cam sprocket mounting bolts by fixing the hexagonal portion of the camshaft.
4. Tighten rear cam sprocket mounting bolts.
 - Check if the chain tension is excessive.

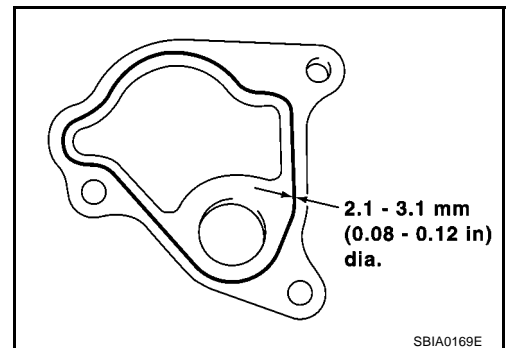


5. Install cylinder head rear cover plate.
 - Apply Genuine Liquid Gasket or equivalent (Refer to [EM-6, "Precautions for Liquid Gasket"](#).) to area shown in the figure.
 - **Attaching should be done with in 5 minutes after coating.**

CAUTION:

Never start engine with vacuum circuit being open. If engine is started and vehicle is running while vacuum pump is open (with vacuum hose disconnected), PCV flow rate will increase and engine may be damaged.

6. Install in reverse order of removal after this step.
 - When vacuum hose is connected, insert it securely by at least 15 mm (0.59 in).



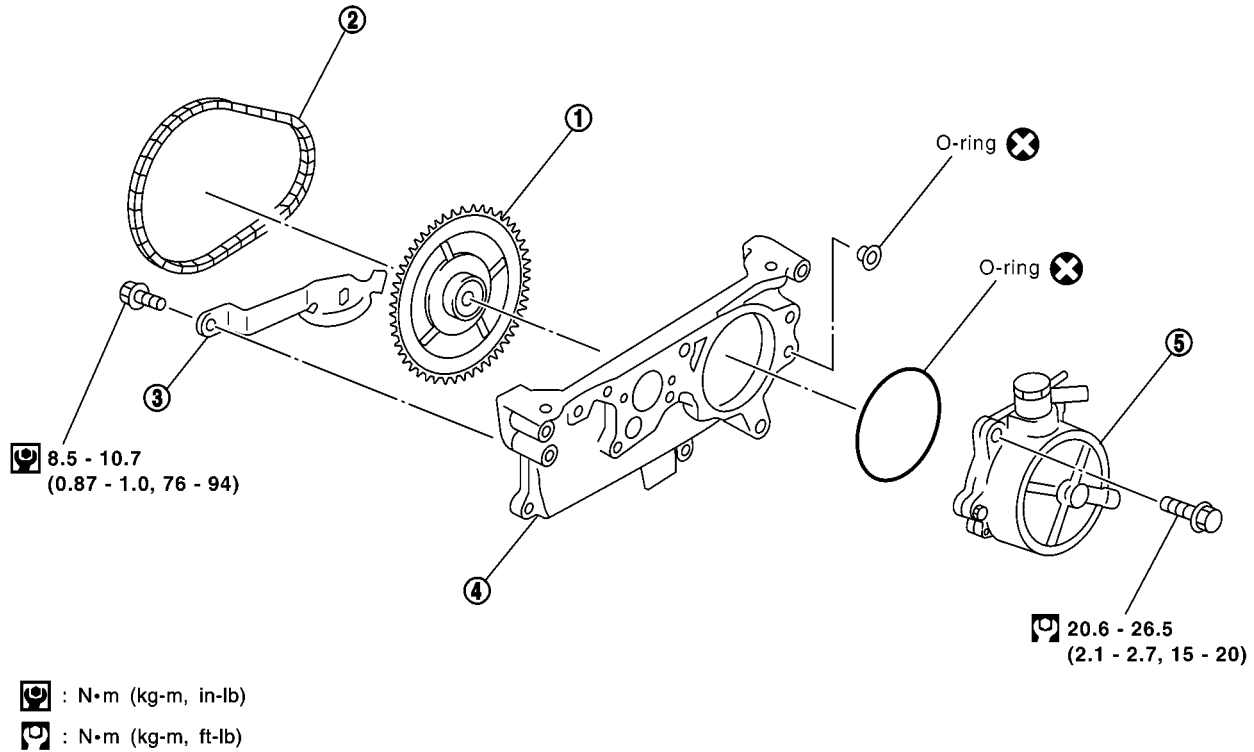
INSPECTION AFTER INSTALLATION

Check generated vacuum satisfies the specification at idle speed. Refer to [EM-35, "Removal and Installation"](#).

Disassembly and Assembly

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- | | | |
|-----------------------------|----------------|----------------|
| 1. Rear cam sprocket | 2. Drive chain | 3. Chain guide |
| 4. Cylinder head rear cover | 5. Vacuum pump | |

DISASSEMBLY

1. Push on chain guide lightly so that clearance between chain and chain guide part reaches 0 mm (0 in). Then loosen chain guide mounting bolts.
2. Remove chain from rear cam sprocket and vacuum pump sprocket.
3. Remove rear cam sprocket.
4. Remove vacuum pump.

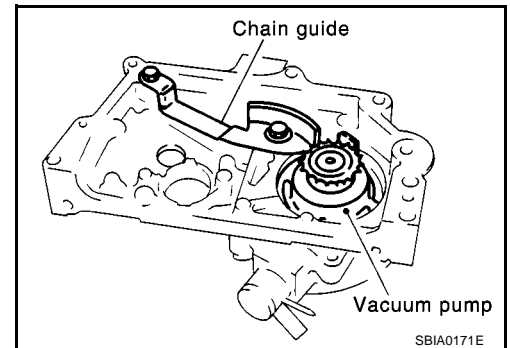
CAUTION:

Do not disassemble vacuum pump.

ASSEMBLY

Follow procedure below to install each part onto cylinder head rear cover.

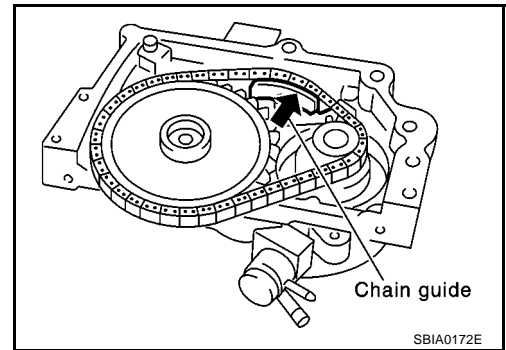
1. Install vacuum pump.
2. Temporarily fit chain guide.



VACUUM PUMP

[YD]

3. Install rear cam sprocket.
 - Sprocket can be installed in any direction.
4. Fit drive chain onto rear cam sprocket and vacuum pump sprocket.
5. Push on chain guide lightly so that clearance between chain and chain guide sliding part reaches 0 mm (0 in). Then tighten chain guide mounting bolts.

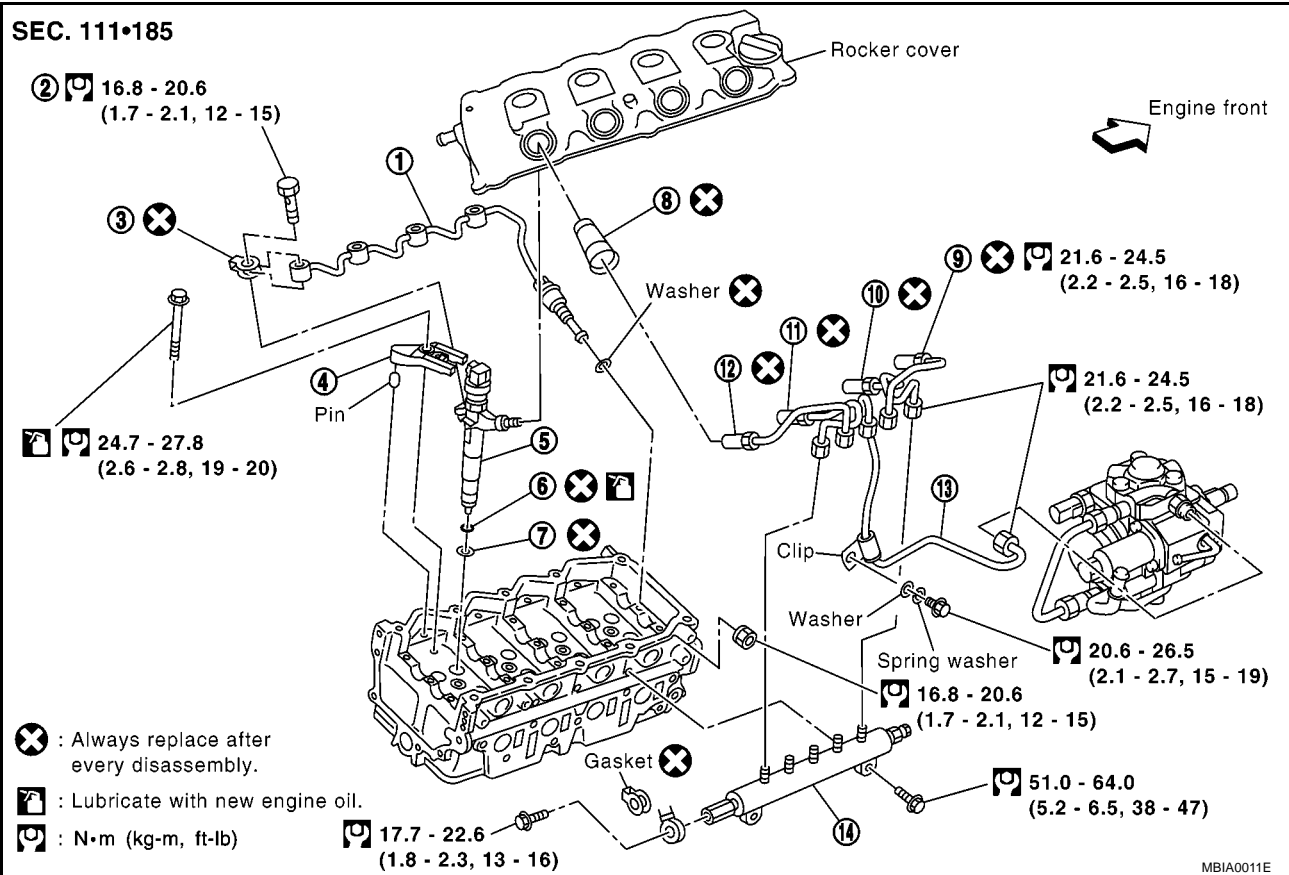


INJECTION TUBE AND FUEL INJECTOR

PFP:00018

Removal and Installation

EBS00SNT



CAUTION:

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

REMOVAL

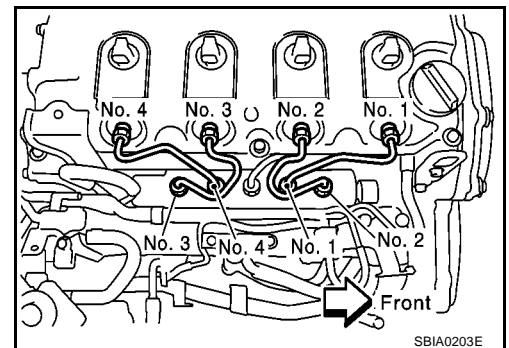
1. Remove engine cover. Refer to [EM-52, "Removal and Installation"](#).
2. Remove harness connector from fuel injector.
3. Remove spill hose.
4. Following steps below, remove injection tubes.
 - a. Put a paint mark or tag on injection tubes to identify each cylinder.
 - Use a fuel-resistant method.
 - b. Remove injection tubes in order of 2-1-4-3 individually.

CAUTION:

Be careful not to allow leaked fuel to contaminate engine compartment. Especially, ensure to keep engine mount insulator clear of fuel.

NOTE:

Removal procedure of fuel injector is shown right.

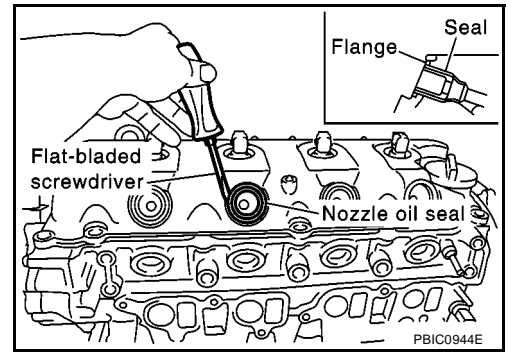


5. Remove nozzle oil seal.
 - Using a slotted screwdriver, pry flange to remove oil seal.

NOTE:

Nozzle oil seal seals between fuel injector and rocker cover. If only injection tube shall be removed and installed, nozzle oil seal replacement is not required.

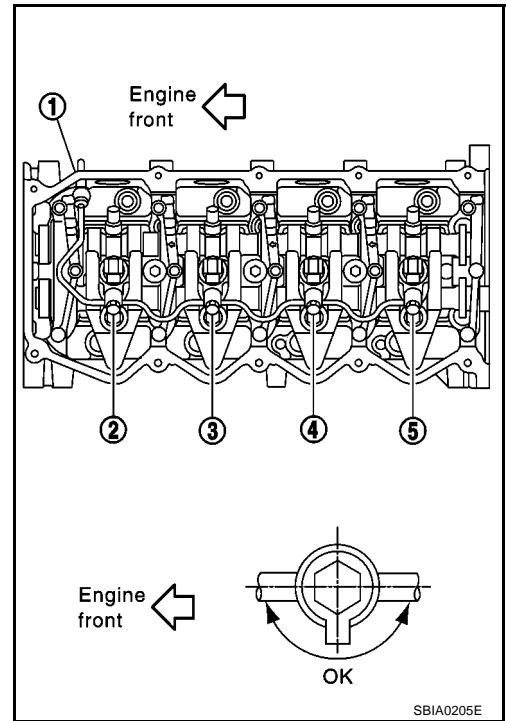
6. Remove rocker cover. Refer to [EM-52. "Removal and Installation"](#).



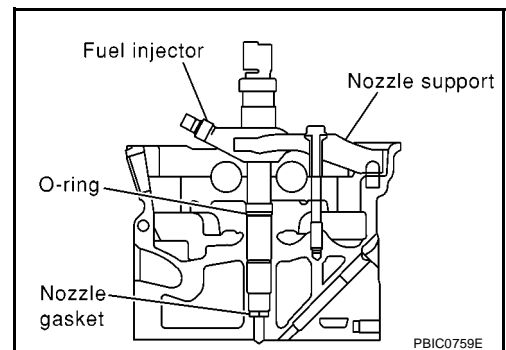
7. Remove spill tube mounting bolts and nut.
 - Loosen bolts and nut to the reverse order of the shown in the figure and remove then.
8. Following steps below, remove fuel injector.
 - a. Remove nozzle support.
 - b. Remove fuel injector. While rotating it to left and right, raise it to remove.

CAUTION:

- Handle fuel injector carefully without giving any impact.
- Do not disassemble fuel injector.



- c. If nozzle gasket remains in cylinder head, hook it with tip of a slotted screwdriver and pull it out.



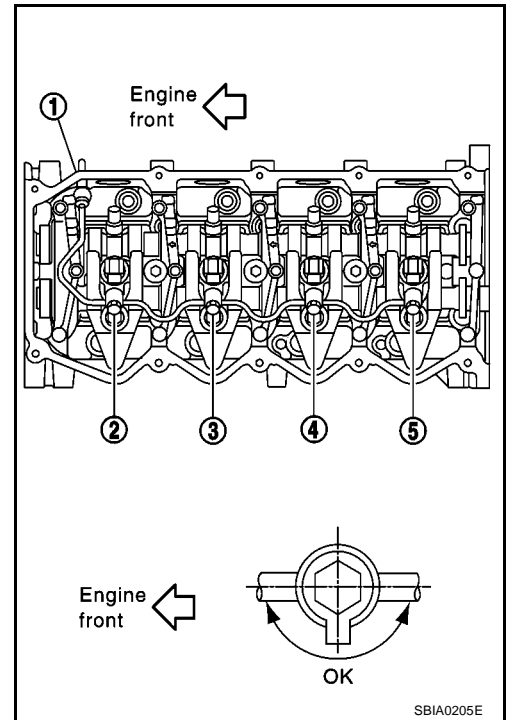
INSTALLATION

1. Following steps below, install fuel injector.
 - a. Install O-ring and nozzle gasket to fuel injector, and insert them into cylinder head.
 - b. Tighten injection tubes temporarily in the order of 3-4-1-2.
 - c. Be sure to fit nozzle support without looseness.
 - d. Tighten nozzle support bolts.
 - e. Loosen injection tubes in the order of 2-1- 4-3.

2. Connect spill tube.
 - Tighten fixing bolts and nut in the numerical order shown in the figure.

NOTE:

Connection of spill tube gasket may be broken, even if it is tightened to specified torque. It does not affect performance.



3. Carry out air tightness test for spill tube.
 - Connect a vacuum handy pump to spill connector. Check that vacuum is retained while applying following vacuum.

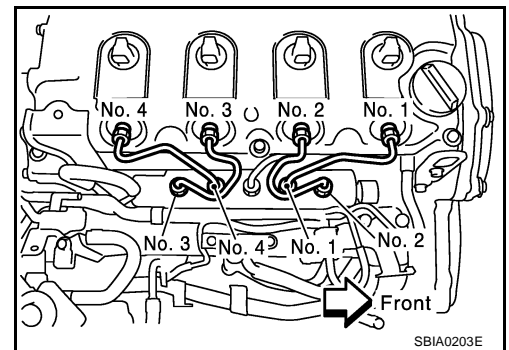
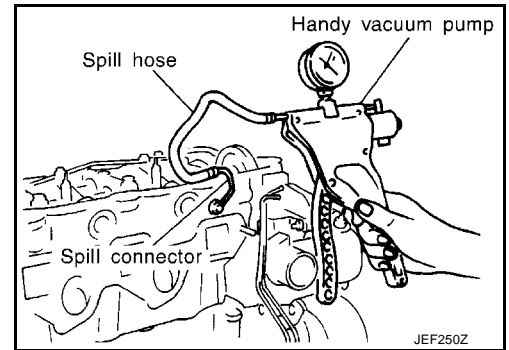
Standard : – 53.3 to – 66.7 kPa (– 533 to – 667 mbar, – 400 to – 500 mmHg, –15.75 to –19.69 inHg)

- If outside of standard, reconnect spill tube. (Replace gasket in this case.)
4. Install rocker cover. Refer to [EM-52, "Removal and Installation"](#) .
 5. Install nozzle oil seal.
 - Insert it straight until its flange fully contacts rocker cover.

CAUTION:

● **Check gutter spring in seal on fuel injector for missing.**

6. Connect injection tubes individually to each cylinder in order of 3-4-1-2.
7. Connect spill hose.
8. Install remaining parts in reverse order of removal.



INSPECTION AFTER INSTALLATION

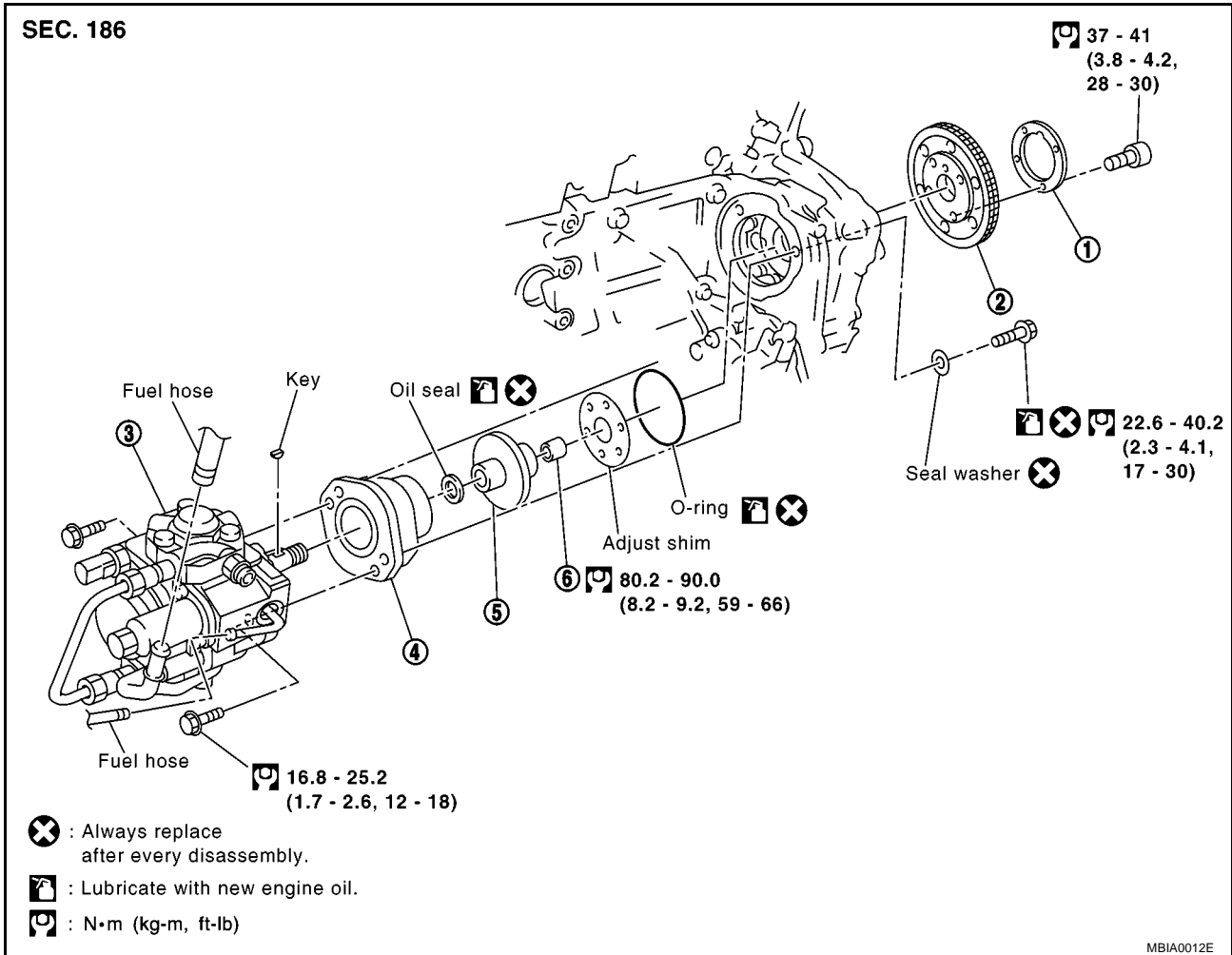
CONSULT-II service support has a force rail pressure increase function and can increase rail pressure to any given pressure. Check for fuel leaks visually by increasing internal pressure using this function.

FUEL PUMP

Removal and Installation

CAUTION:

- Before removing and installing fuel pump, be sure to remove sprocket. Do not loosen or remove installation nut in the center of fuel pump. If loosened or removed, replace fuel pump.
- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to parts marked in illustration before installation.



- | | | |
|-----------|-----------------------|-----------------|
| 1. Washer | 2. Fuel pump sprocket | 3. Fuel pump |
| 4. Spacer | 5. Coupling | 6. Sprocket nut |

REMOVAL

1. Remove coolant reservoir tank.
2. Remove RH engine mount insulator and bracket. Refer to [EM-89, "Removal and Installation"](#).
3. Pull power steering reservoir tank out of brackets to move power steering piping.

CAUTION:

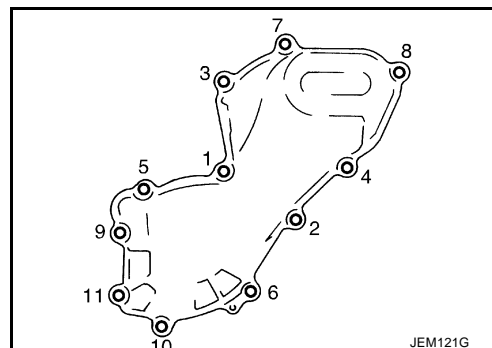
To avoid removing power steering reservoir tank out of brackets move it with power steering piping aside.

4. Remove RH front wheel.
5. Remove RH splash cover (combined with undercover)
6. Remove front exhaust tube.

7. Remove fuel hoses from fuel pump.
8. Remove the harness connector from the fuel pump.
9. Remove injection tube center.

10. Remove front chain case.

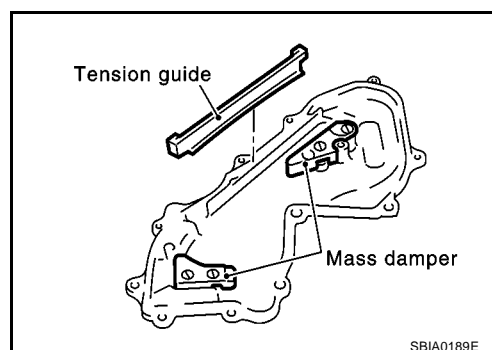
- Loosen fixing bolts in the reverse order of that shown in the figure and remove them.



- Remove No. 6, 10 and 11 bolts with the rubber washer as space is limited for pulling them out.

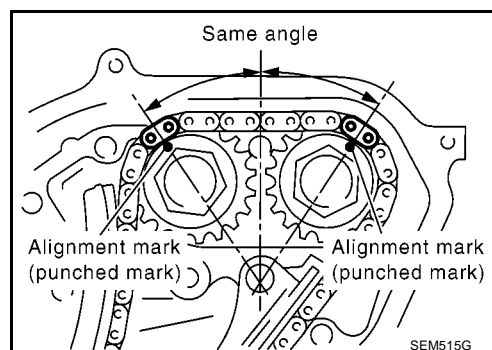
CAUTION:

- While front chain case is removed, cover openings to prevent entry of foreign material into engine.
- Do not remove two mass dampers on the back of cover.



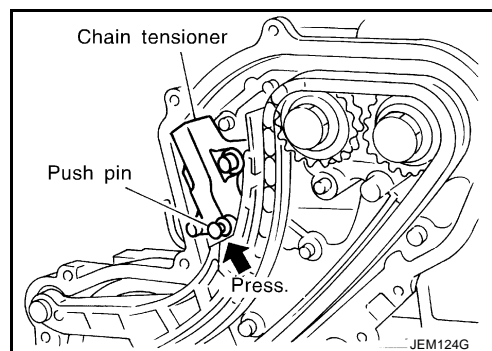
11. Set the No. 1 piston to TDC on its compression stroke.

- Turn crankshaft pulley clockwise so that the alignment mark (punched mark) on each camshaft sprocket is positioned as shown in the figure.
- No position indicator is provided on the crankshaft pulley.
- When installing, color coded links on the secondary timing chain can be used as alignment marks. Marking may not be necessary for removal; however, make alignment marks as required because the alignment mark on fuel pump sprocket may not be easy to see.



12. Remove chain tensioner.

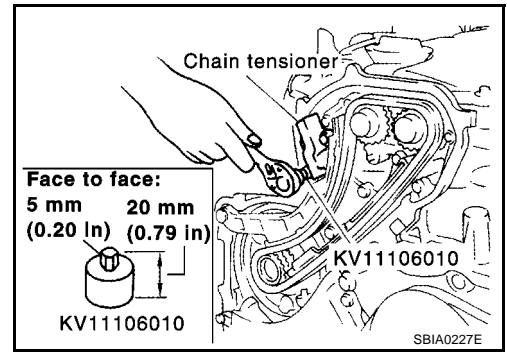
- a. Push the plunger of chain tensioner and keep it pressed with a push pin.



FUEL PUMP

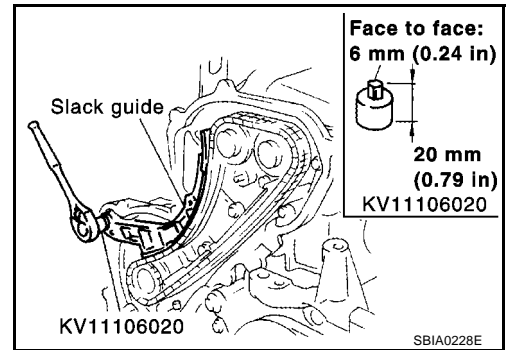
[YD]

- b. Using a hexagon-head wrench [face to face 5 mm (0.20 in) SST], remove bolts to remove chain tensioner.



13. Remove timing chain slack guide.

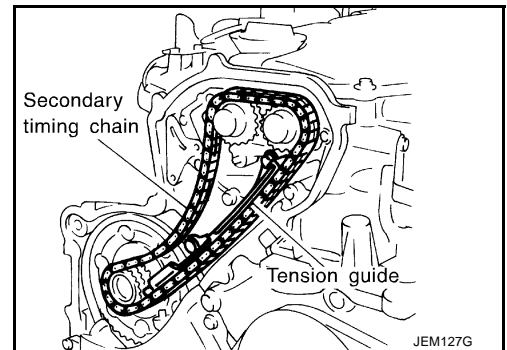
- Using a hexagon-head wrench [face to face 6 mm (0.24 in) SST], remove bolt to remove timing chain slack guide.



14. Remove timing chain tension guide.

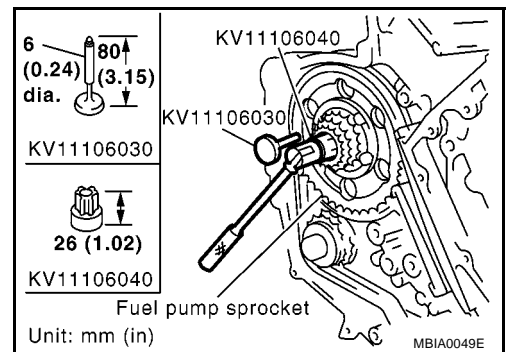
15. Remove secondary timing chain.

- Timing chain alone can be removed without removing sprockets.



16. Hold fuel pump sprocket and remove bolt.

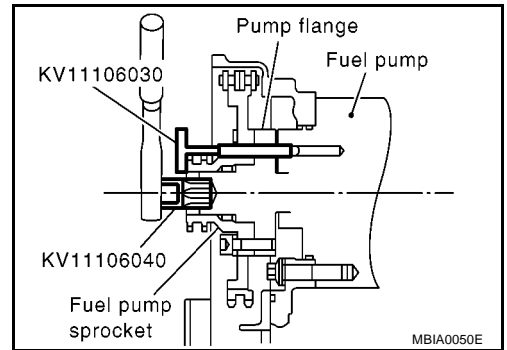
- Insert positioning stopper pin (SST) into the hole 6 mm (0.24 in) in the diameter on the fuel pump sprocket.
- Using a TORX wrench (SST), turn pump shaft little by little to adjust the position of fuel pump sprocket so that the holes align.
- Push positioning stopper pin (SST) through pump sprocket to fuel pump spacer to hold pump sprocket.



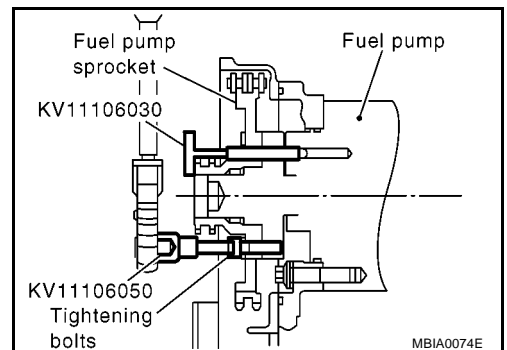
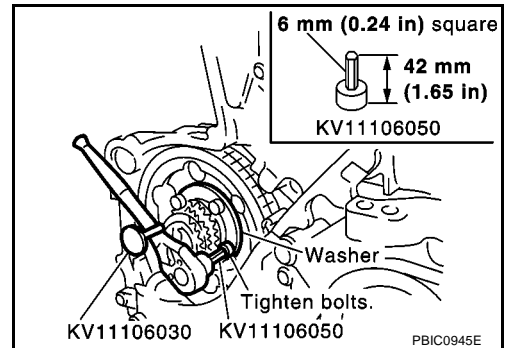
FUEL PUMP

[YD]

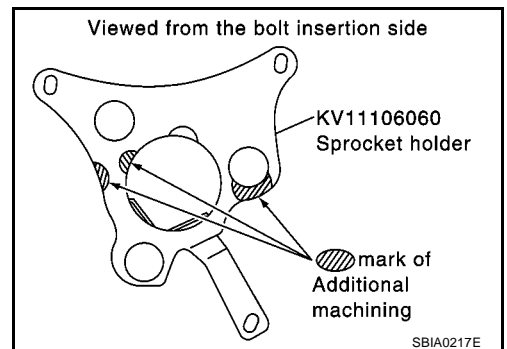
- Insert the positioning stopper pin until its flange contacts the fuel pump sprocket.
- Remove the TORX wrench (SST).



17. Using a hexagon-head wrench [face to face 6 mm (0.24 in) SST] remove tightening bolts of fuel pump sprocket and washer.



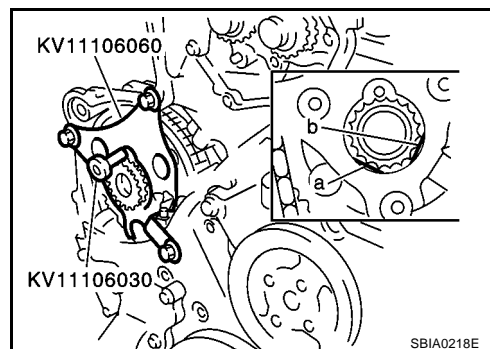
18. Using the sprocket holder (SST), hold the fuel pump sprocket to prevent falling.



FUEL PUMP

[YD]

- As for the sprocket holder, install fuel pump mounting bolt through hole of KV11106060 as shown in figure.
- When the sprocket holder is installed, if the positioning stopper pin interferes, pull out the stopper pin approximately 10 mm (0.39 in), then install it.
- After the sprocket holder is installed temporarily, insert the extension bar (SST) and TORX socket in the three holes. After positioning the holes, tighten the holder mounting bolts.

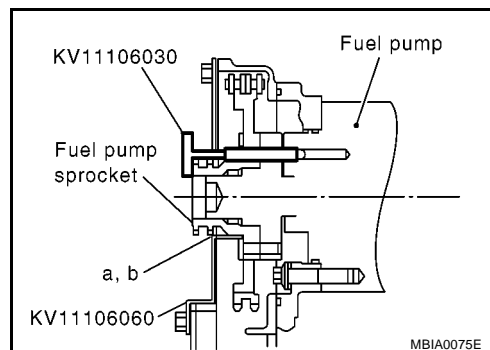


- The thread length of the sprocket holder mounting bolts should be approximately 15 mm (0.59 in).
- Make sure that the a- and b-faces of the sprocket holder contact the bottom side of the sprocket (small diameter side).

CAUTION:

Do not remove the sprocket holder until the fuel pump is installed.

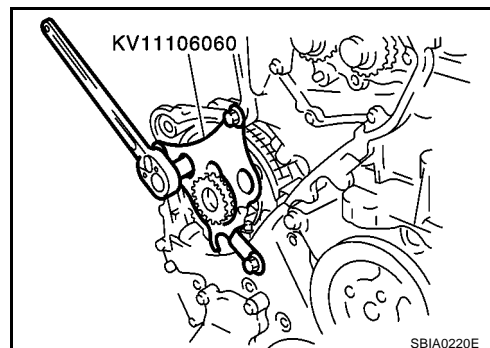
- After the sprocket holder is installed, pull out the positioning stopper pin (SST) from the fuel pump sprocket.



19. Using the extension bar [SST: whole length 43 mm (1.69 in)] and the TORX socket (Q6-E12: commercially available), remove the tightening bolts.

CAUTION:

Do not disassemble or adjust the fuel pump excepting the following.



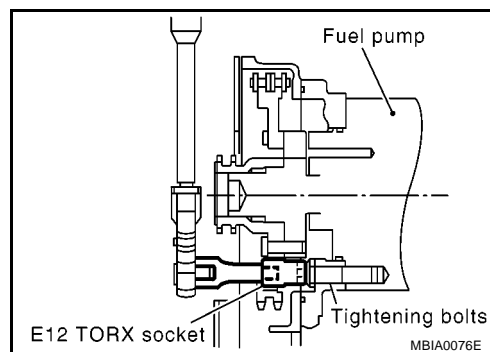
20. Remove the fuel pump toward the rear of the engine.

NOTE:

The seal washer of the tightening bolts cannot be reused.

CAUTION:

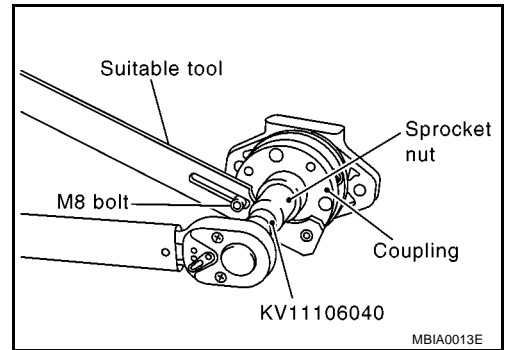
For removal, be careful not to drop the seal washer into the engine.



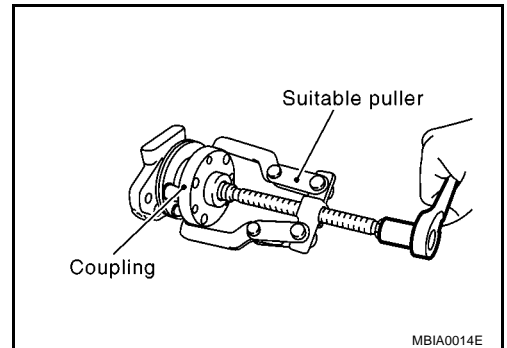
FUEL PUMP

[YD]

21. Remove adjusting shim.
22. Attach a suitable tool in the M8 bolt hole on coupling.
23. Loosen sprocket nut with the TORX wrench (SST).



24. Remove coupling with a suitable puller.

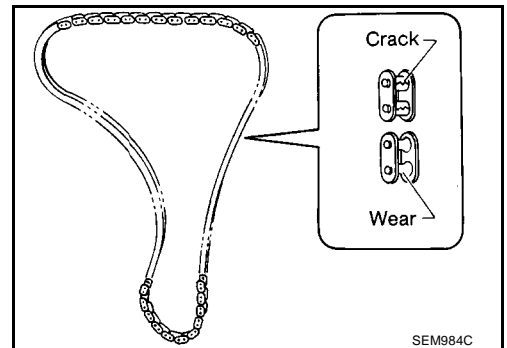


25. Remove spacer from fuel pump.

INSPECTION AFTER REMOVAL

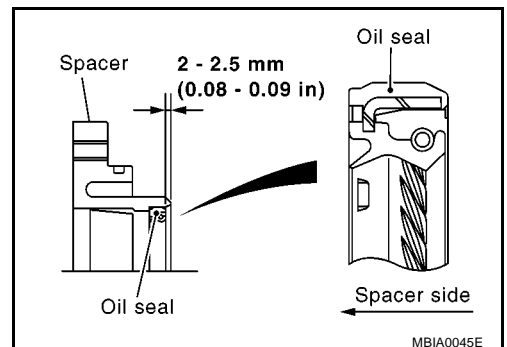
Timing Chain

Check for cracks and excessive wear at roller links. Replace chain if necessary.



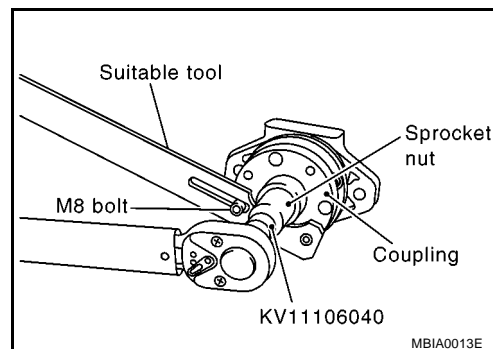
INSTALLATION

1. Install new oil seal to the spacer.
2. Install fuel pump to the spacer.



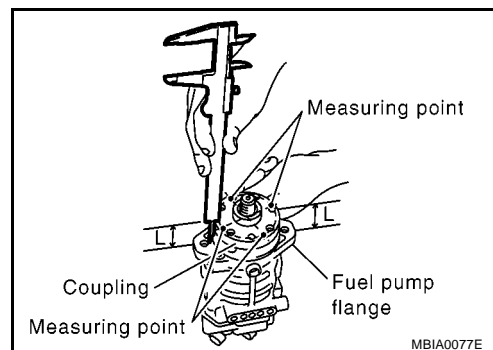
3. Install coupling to the fuel pump of spacer.

- Using the TORX wrench (SST), tighten the sprocket nut to fix the coupling.



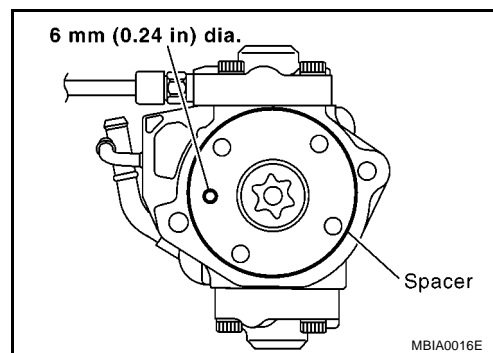
4. Install adjusting shim.

- For shim adjustment, measure dimension L (Distance between front surface of the coupling and the fuel pump flange) at 2 opposing points near the coupling bolt center. Use the average of these two measurements to select the shim grade that marked on adjusting shim.
- The shim adjustment is required only when the fuel pump is replaced.



Part No. of adjusting shim	Grade number	Measuring dimension L mm (in)
16614 8H800	0.5 t	39.23 - 39.77 (1.5445 - 1.5657)
16614 8H810	1.0 t	38.76 - 39.23 (1.5260 - 1.5445)
16614 8H860	1.2 t	38.57 - 38.76 (1.5185 - 1.5260)
16614 8H820	1.6 t	38.18 - 38.57 (1.5031 - 1.5185)

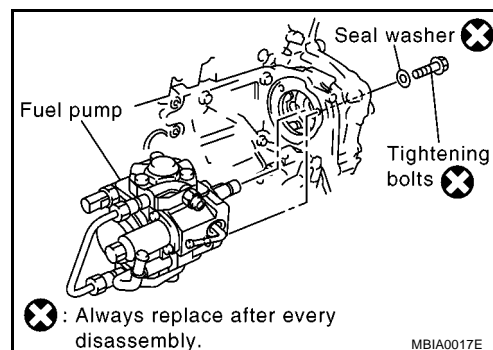
5. Before the fuel pump is installed, check that the notch of its spacer and the 6 mm (0.24 in) dia. hole on the body are aligned.



6. Insert the fuel pump to the mounting position from the rear side of the engine, and install the tightening bolts with seal washer.

CAUTION:

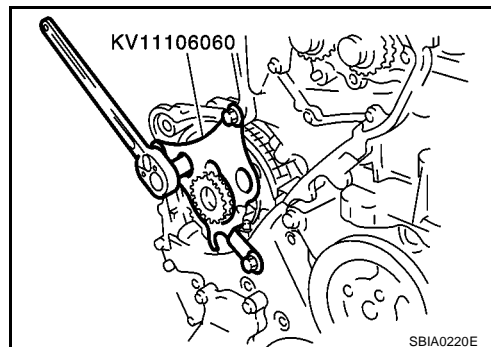
Be careful not to drop the seal washer into the engine.



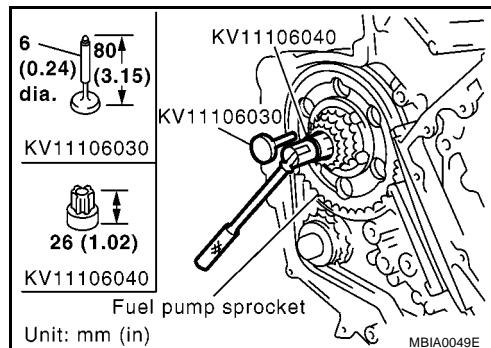
FUEL PUMP

[YD]

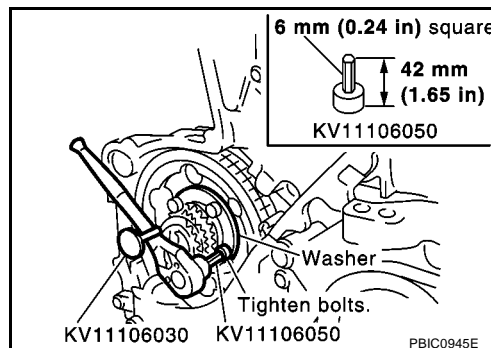
7. Using the extension bar (SST) and the TORX socket, tighten the mounting bolts of the fuel pump.
8. Remove the sprocket holder (SST).



9. Using the TORX wrench (SST), turn the pump shaft gradually to adjust the position of the flange. Then, insert the positioning stopper pin (SST) to the 6 mm (0.24 in) dia. hole of the fuel pump sprocket through the pump flange and the pump body.
10. Remove the TORX wrench (SST)



11. Using the hexagon wrench [face to face 6 mm (0.24 in) (SST)], tighten the sprocket tightening bolts.
 - When the washer of the fuel pump sprocket install it with the marking "F" facing the front of the engine.
12. Pull out the positioning stopper pin (SST).



FUEL PUMP

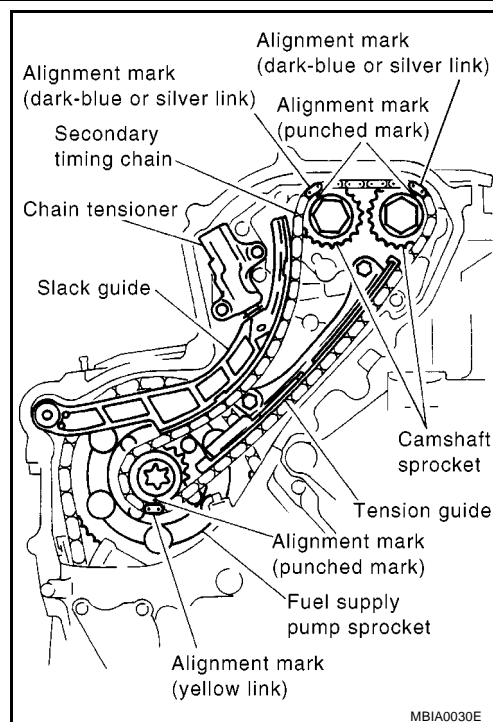
[YD]

13. Install secondary timing chain.

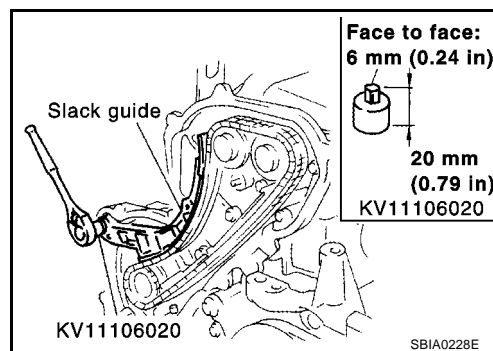
- When installing, match the alignment marks on sprockets with color coded alignment marks (colored links) on the chain.

14. Install timing chain tension guide.

- The upper bolt has a longer shank than the lower bolt.

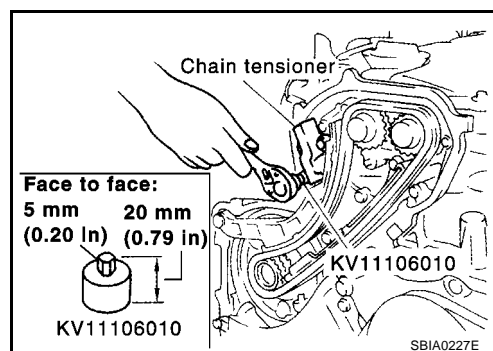


15. Using a hexagon-head wrench [face to face 6 mm (0.24 in) SST], install timing chain slack guide.



16. Install chain tensioner.

- Push the plunger of the chain tensioner. While holding it with a push pin, install the chain tensioner.
- Using a hexagon-head wrench [face to face 5 mm (0.20 in) SST], tighten bolts.
- Pull out the push pin, holding the plunger.
 - Check again that the alignment marks on the sprockets and the colored alignment marks on the timing chain are aligned.



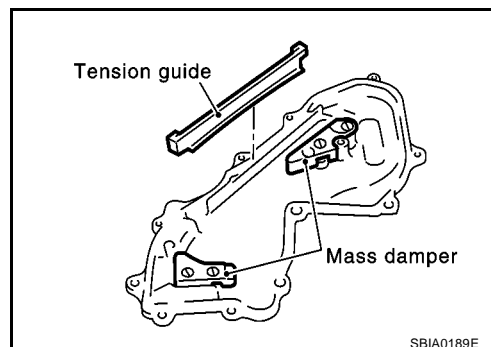
FUEL PUMP

[YD]

17. Install front chain case.

a. Install tension guide on the back surface of front chain case.

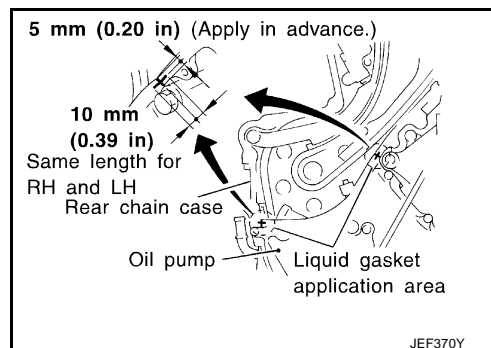
- Hold front chain case vertically when installing. Tension guide may come off if front chain case is tilted.



b. Apply Genuine Liquid Gasket or equivalent (Refer to [EM-6](#), "Precautions for Liquid Gasket" .) on both ends of arched area (locations where rear chain case is adjoined) as shown in the figure.

c. Install front chain case.

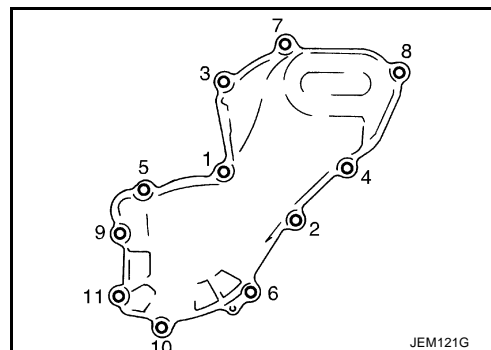
- When installing, align dowel pin on oil pump case with the pin hole.



- Install No. 6, 10 and 11 bolts with the rubber washer to the front chain case.

d. Tighten fixing bolts in the numerical order shown in the figure.

e. After tightening all the bolts, re-tighten in the same order.



18. Install injection tube center.

19. Install the harness connector to fuel pump.

20. Install fuel hoses to fuel pump.

21. Hereafter, install in the reverse order of removal.

ROCKER COVER

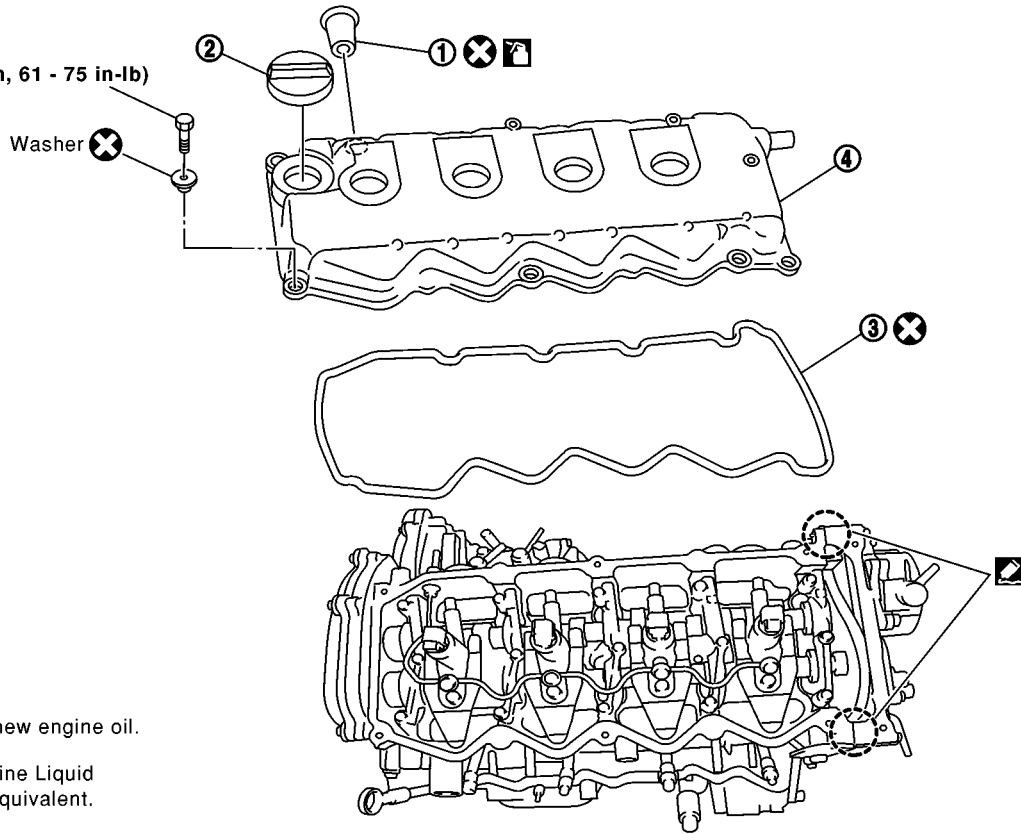
PFP:13264

Removal and Installation

EBS00SNV

SEC. 111•118

6.8 - 8.8
(0.7 - 0.9 kg-m, 61 - 75 in-lb)



: Apply with new engine oil.

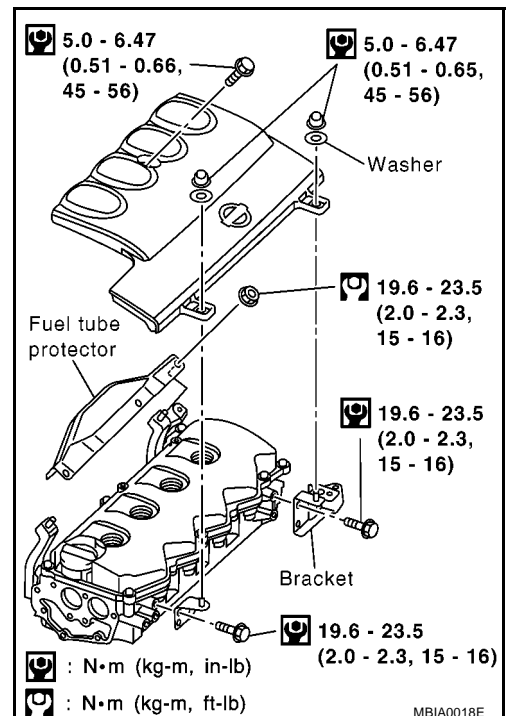
: Apply Genuine Liquid Gasket or equivalent.

PBIC0760E

1. Nozzle oil seal
2. Oil filler cap
3. Gasket
4. Rocker cover

REMOVAL

1. Remove engine cover. Refer to the figure at right.
2. Remove harness connector from fuel injector.
3. Remove injection tube. Refer to [EM-39, "Removal and Installation"](#).

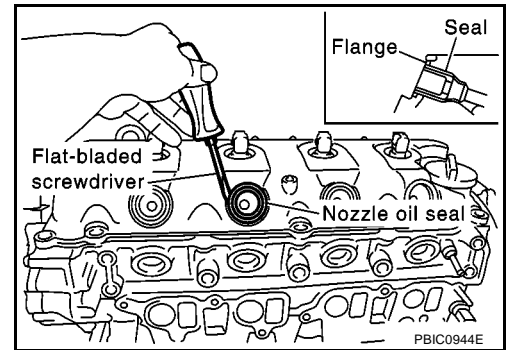


MBIA0018E

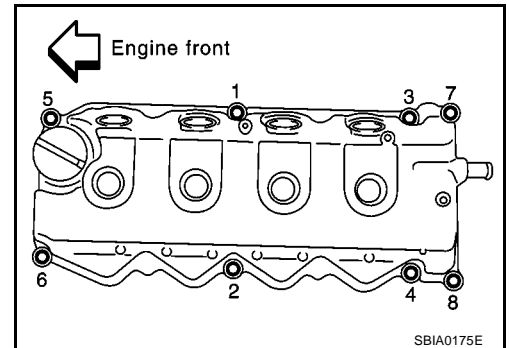
ROCKER COVER

[YD]

4. Remove fuel injector oil seal.
 - Using a slotted screwdriver, pry flange to remove oil seal.

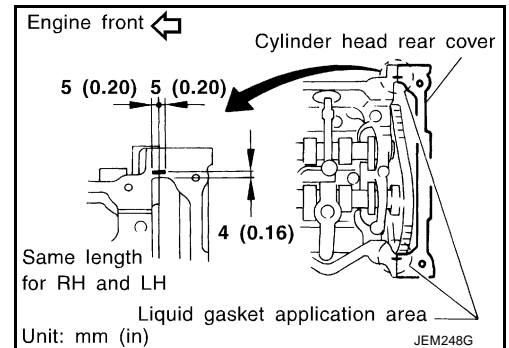


5. Remove rocker cover.
 - Loosen holding bolts in the reverse order of that shown in the figure and remove.

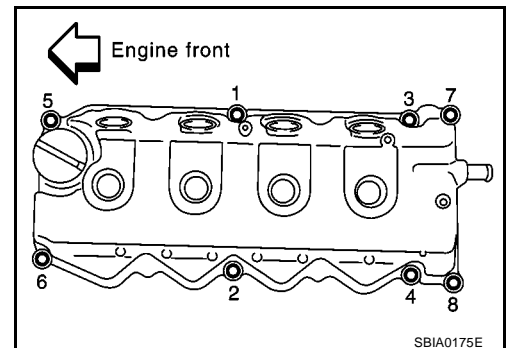


INSTALLATION

1. Apply 3.0 mm (0.118 in) dia. of Genuine Liquid Gasket or equivalent (Refer to [EM-6, "Precautions for Liquid Gasket"](#) .) on locations shown in the figure.



2. Tighten holding bolts in the numerical order shown in the figure.
 - Re-tighten to the same torque in the same order as above.
3. Install nozzle oil seal.
 - Insert it straight until flange fully contacts cylinder head.
4. Install remaining parts in reverse order removal.
5. Before starting engine, bleed air from fuel piping. Refer to [FL-5, "Air Bleeding"](#) .



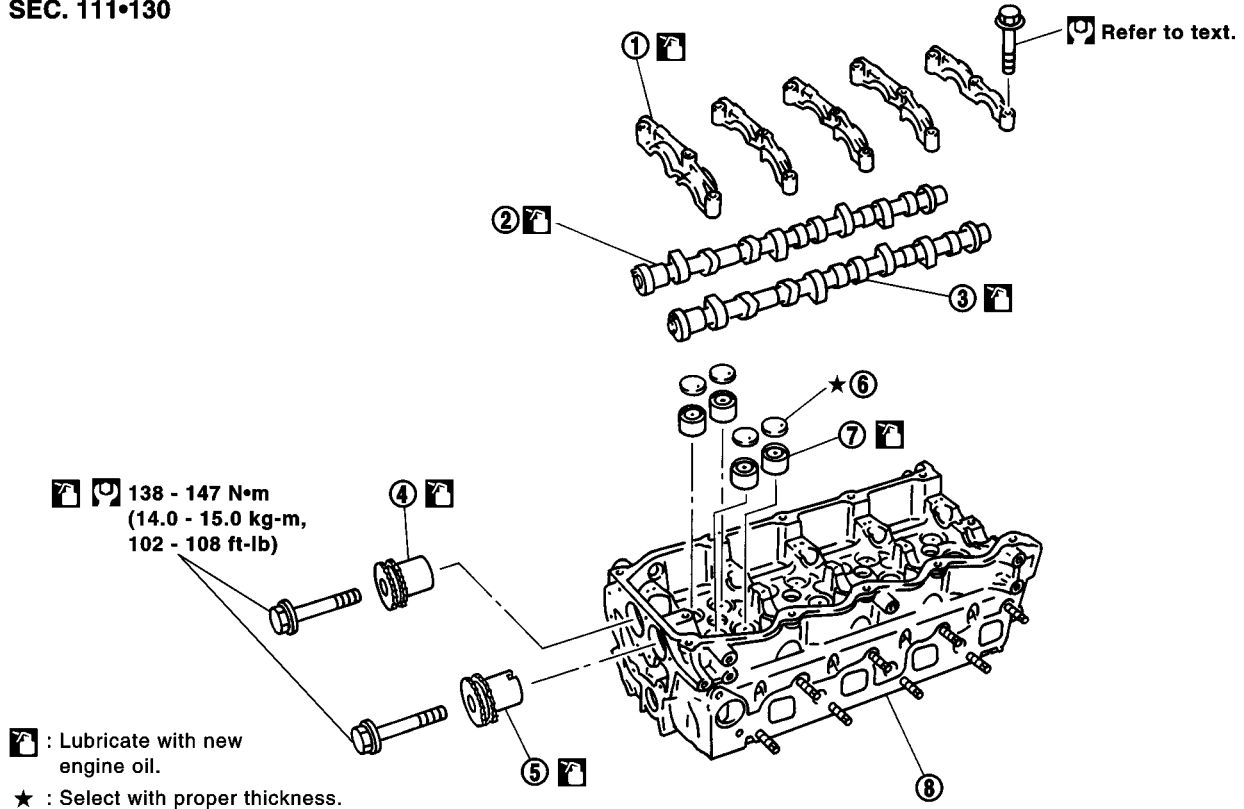
INSPECTION AFTER INSTALLATION

Start engine and increase engine speed to check for fuel leak.

CAMSHAFT

Removal and Installation

SEC. 111•130



SBIA0177E

- | | | |
|-----------------------------------|----------------------------------|-------------------------|
| 1. Camshaft bracket | 2. Camshaft (right side) | 3. Camshaft (left side) |
| 4. Camshaft sprocket (right side) | 5. Camshaft sprocket (left side) | 6. Adjusting shim |
| 7. Valve lifter | 8. Cylinder head | |

CAUTION:

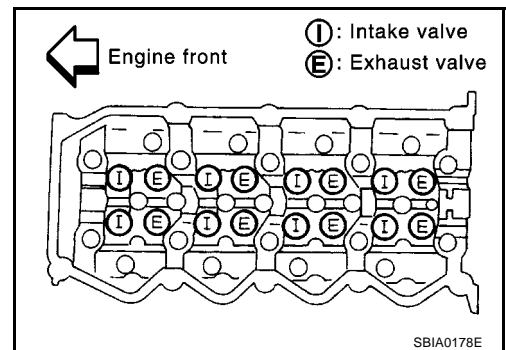
Apply new engine oil to parts marked in illustration before installation.

- This engine will have a different valve arrangement from normal DOHC 4-valve type engines. As both camshafts on this engine have intake and exhaust camshafts, in this chapter they are named as follows:

Camshaft (Right side) : Intake manifold side

Camshaft (Left side) : Exhaust manifold side

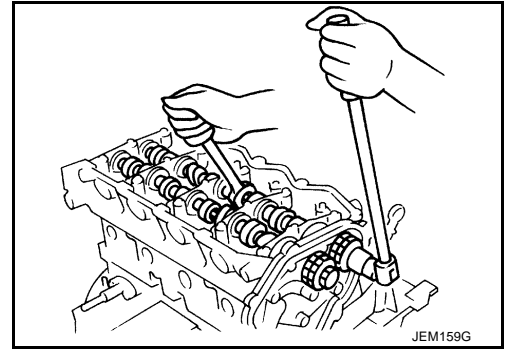
- Refer to the figure for intake and exhaust valve arrangement. (The camshafts have, alternately, either an intake valve or an exhaust valve.)



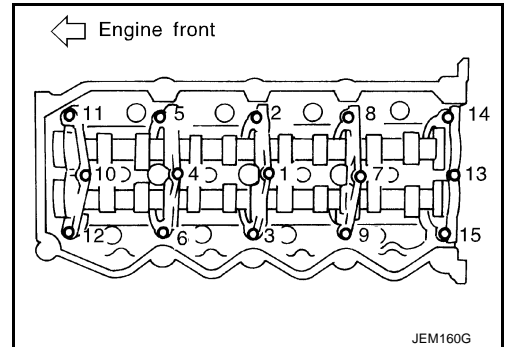
REMOVAL

1. Drain engine coolant. Refer to [CO-8, "Changing Engine Coolant"](#).
2. Remove air duct. Refer to [EM-15, "Removal and Installation"](#).
3. Remove rocker cover. Refer to [EM-52, "Removal and Installation"](#).
4. Remove vacuum pump. Refer to [EM-35, "Removal and Installation"](#).
5. Remove injection tube and fuel injector. Refer to [EM-39, "Removal and Installation"](#).
6. Remove secondary timing chain. Refer to [EM-63, "Removal and Installation"](#).

7. Set the No. 1 cylinder at TDC on its compression stroke.
8. Remove the camshaft stroke.
 - Loosen the camshaft gear installation bolt by fixing the hexagonal portion of the camshaft.



9. Remove the camshaft.
 - Place distinguishing marks on the right and left sides with paint.
 - Loosen and remove the installation bolt in reverse order shown in the figure.
10. Remove the adjusting shim and valve lifter.
 - Remove by taking notice of the installation position, and place outside engine in order to prevent confusion.



INSPECTION AFTER REMOVAL

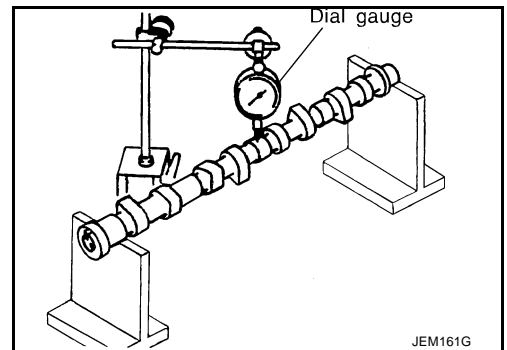
Visual Check of Camshaft

- Check the camshaft for one sided wear or scratches.
- Replace the camshaft if there are abnormalities.

Camshaft Runout

- Prepare V-block on a flat surface and secure camshaft journals No. 2 and No. 5.
- Set the dial gauge vertically on journal No. 3.
- Rotate camshaft in one direction by hand, then read needle movement on dial indicator. (Total indicator reading)

Limit : 0.02 mm (0.0008 in)



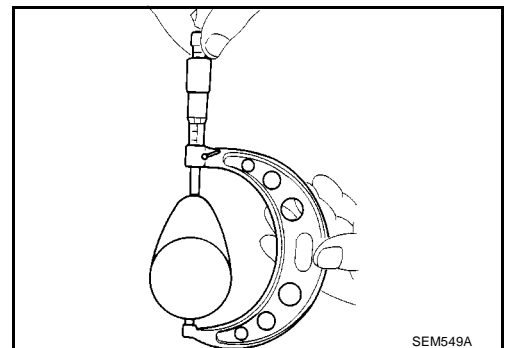
Height of Cam Nose

Measure by using a micrometer.

Standard:

Intake : 39.505 - 39.695 mm (1.5553 - 1.5628 in)

Exhaust : 39.905 - 40.095 mm (1.5711 - 1.5785 in)



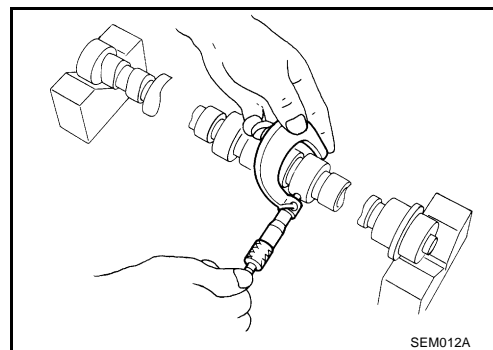
Camshaft Oil Clearance

Measure by using a micrometer.

Camshaft journal outer diameter:

Standard:

No. 1	: 30.435 - 30.455 mm (1.1982 - 1.1990 in)
No. 2, 3, 4, 5	: 23.935 - 23.955 mm (0.9423 - 0.9431 in)



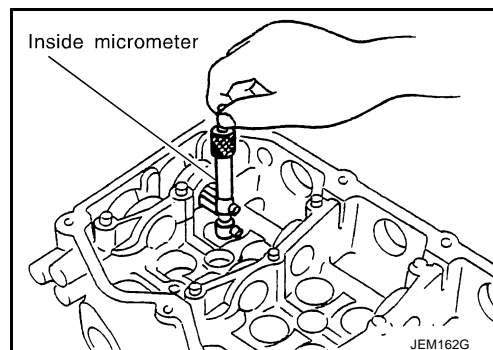
Camshaft Bracket Inner Diameter

- Install camshaft bracket and tighten bolts to the specified torque.
- Measure inner diameter of camshaft bracket using an inside micrometer.

Camshaft bracket inner diameter:

Standard:

No. 1	: 30.500 - 30.521 mm (1.2008 - 1.2016 in)
No. 2, 3, 4, 5	: 24.000 - 24.021 mm (0.9449 - 0.9457 in)



Camshaft Oil Clearance Calculations

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

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

- If it exceeds the standard value, refer to the standard value of each unit, then replace the camshaft and/or cylinder head.

NOTE:

As the camshaft bracket is manufactured with the cylinder head, it is impossible to replace only the camshaft bracket.

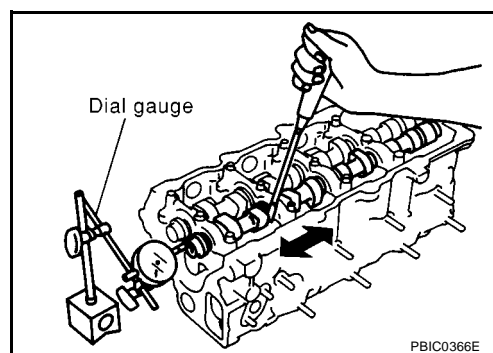
Camshaft End Play

- Set the dial gauge to the front end of the camshaft. Measure the end play by moving the camshaft in the direction of the axle.

Standard : 0.070 - 0.148 mm (0.0028 - 0.0058 in)

Limit : 0.24 mm (0.0094 in)

- If end play exceeds the limit, replace camshaft and measure camshaft end play again.
- If end play still exceeds the limit after replacing camshaft, replace cylinder head.



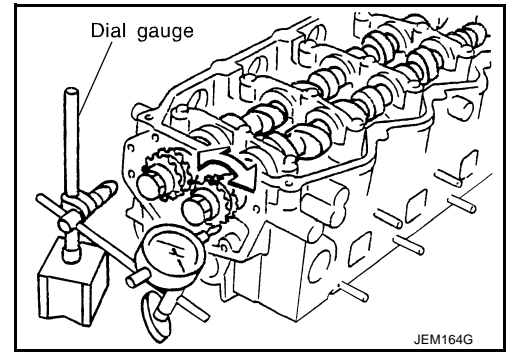
Camshaft Sprocket Runout

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

Runout (Total indicator reading):

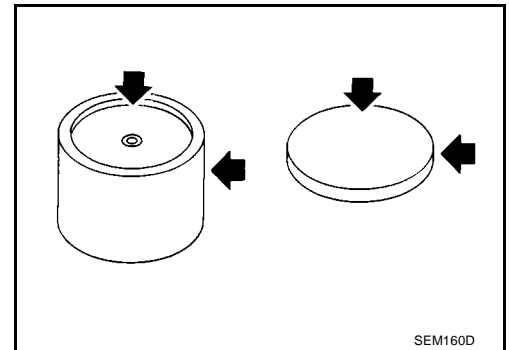
: Less than 0.15 mm (0.0059 in)

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



Visual Inspection of Valve Lifter and Adjusting Shim

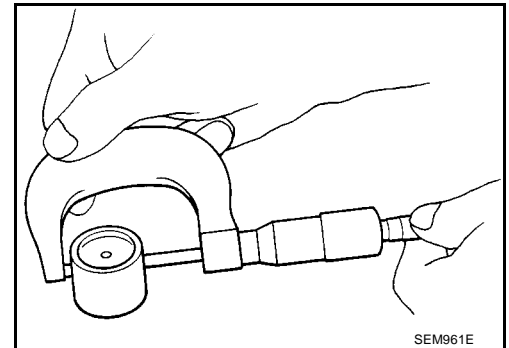
- Check lifter side for any signs of wear or damage. Replace if there are any abnormalities.
- Check cam nose contact and sliding surfaces for wear and scratches. Replace if there are any abnormalities.



Valve Lifter Outer Diameter

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

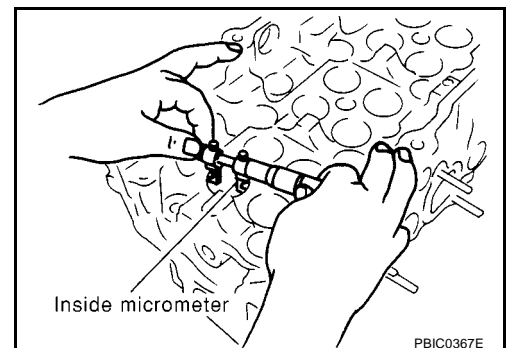
Standard : 29.960 - 29.975 mm (1.1795 - 1.1801 in)



Valve Lifter Bore Diameter

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

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



Valve Lifter Clearance Calculations

(Clearance) = (Valve lifter bore diameter) – (Valve lifter outer diameter)

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

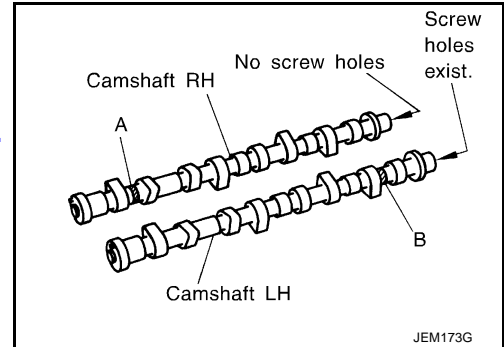
If it exceeds the standard value, refer to the outer diameter and bore diameter standard values and replace valve lifter and/or cylinder head.

INSTALLATION

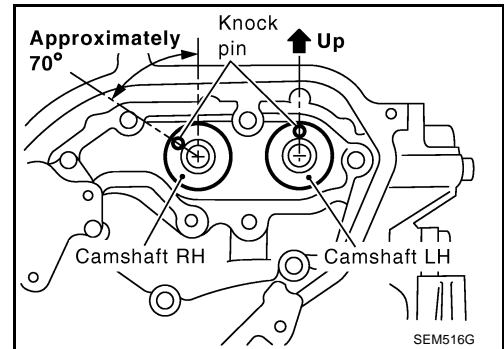
1. Install the valve lifter and adjusting shim.
 - Make sure that these are installed in the same position as before the removal process.
2. Install the camshaft.
 - Identify camshafts by the paint position and screw hole at the rear end.

Camshaft RH : Paint is at position A without screw hole.

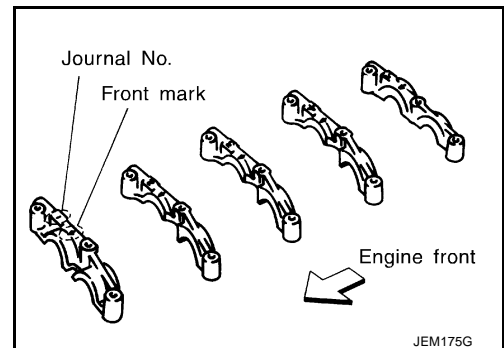
Camshaft LH : Paint is at position B with screw hole.



- Install so that dowel pins are positioned in the directions shown in the figure.



3. Install camshaft brackets.
 - Install correctly, identifying brackets by the journal No. and front mark on top surface.



4. Tighten bolts in the order shown in the figure according to the following procedure:

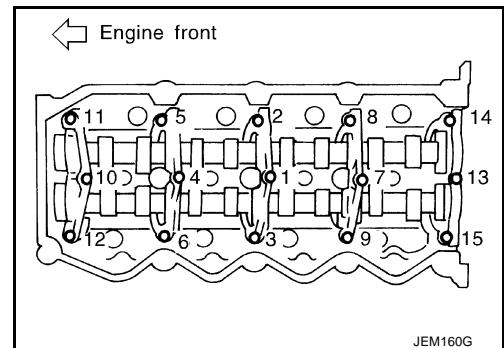
- a. Tighten to 1.96 N·m (0.2 kg-m, 17 in-lb).
 - Make sure camshaft thrusting parts (on rear side) securely fit in their mating parts on the cylinder head.
- b. Tighten to 5.88 N·m (0.6 kg-m, 52 in-lb).
- c. Tighten to 12 to 13 N·m (1.2 to 1.4 kg-m, 9 to 10 ft-lb).

5. Install camshaft sprockets.

- Camshaft sprockets are commonly used for RH and LH.
- Align camshaft sprocket and dowel pin on camshaft, and install.
- Holding the hexagonal part of camshaft with a wrench, tighten bolt securing camshaft sprocket.

6. Before installing spill tube after installing secondary timing chain, check and adjust valve clearance. Refer to [EM-59, "Valve Clearance"](#).

7. Hereafter, install in the reverse order of removal.



Valve Clearance INSPECTION

- When the camshaft or parts in connection with valves are removed or replaced, and a malfunction has occurred (poor starting, idling, or other malfunction) due to the mis adjustment of the valve clearance, inspect as follows.
- Inspect and adjust when the engine is cool (at normal temperature).
- Be careful of the intake and exhaust valve arrangement. The valve arrangement is different from that in a normal engine.

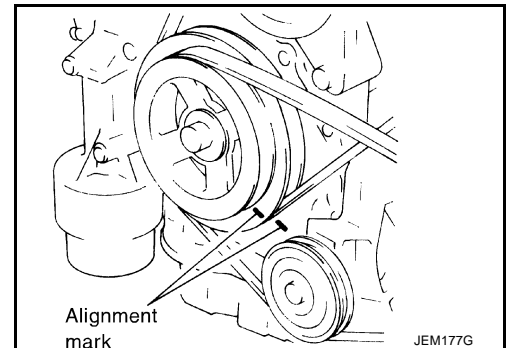
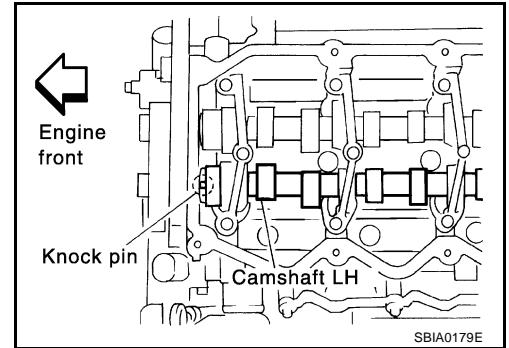
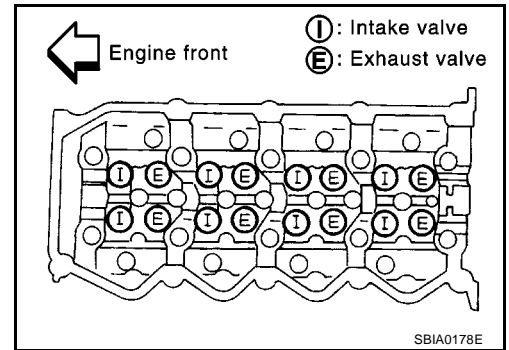
NOTE:

The camshafts have, alternately, either an intake valve or an exhaust valve. (Refer to illustration)

- Drain engine coolant. Refer to [CO-8, "Changing Engine Coolant"](#) .
- Remove air duct and air inlet pipe. Refer to [EM-15, "Removal and Installation"](#) .
- Remove rocker cover. Refer to [EM-52, "Removal and Installation"](#) .
- Remove vacuum pump. Refer to [EM-35, "Removal and Installation"](#) .
- Remove injection tube and fuel injector. Refer to [EM-39, "Removal and Installation"](#) .
- Remove secondary timing chain. Refer to [EM-63, "Removal and Installation"](#)

Check valve clearance while engine is cold and not running.

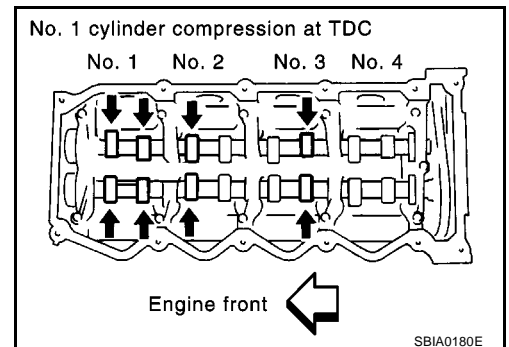
- Set the No. 1 piston to TDC on its compression stroke.
 - Turn crankshaft pulley clockwise so that the knock pin on camshaft LH faces straight above. (No position indicator, etc. is provided on the crankshaft pulley.)
- Put an alignment mark with paint, etc. on the crankshaft pulley and on the oil pump as an angle indicator.



- While referring to the figure, measure the valve clearance marked in the table below.

Measuring point	No. 1		No. 2		No. 3		No. 4	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH
When the No. 1 cylinder is in the TDC	X	X	X			X		

- The injection order is 1-3-4-2.



- Measure the valve clearance using a fine feeler gauge when the engine is cool (at normal temperature).

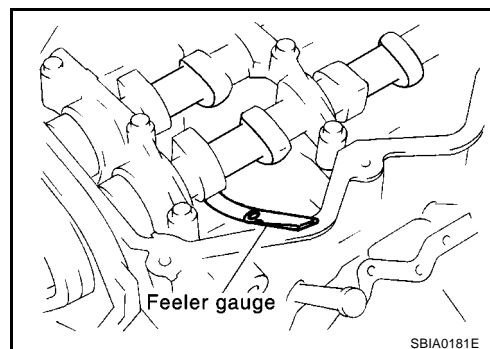
Valve clearance (Cold):

Standard:

Intake : 0.24 - 0.32 mm (0.0094 - 0.0126 in)

Exhaust : 0.26 - 0.34 mm (0.0102 - 0.0134 in)

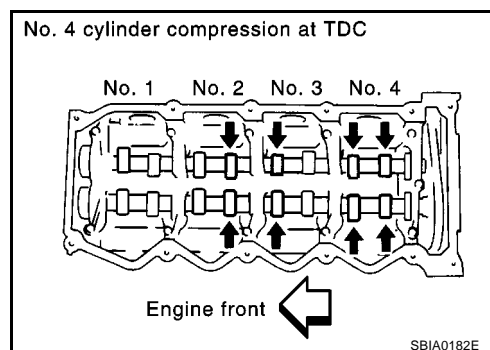
10. Set the No. 4 cylinder at TDC by rotating the crankshaft clockwise once.



11. While referring to the figure, measure the valve clearance marked in the table below.

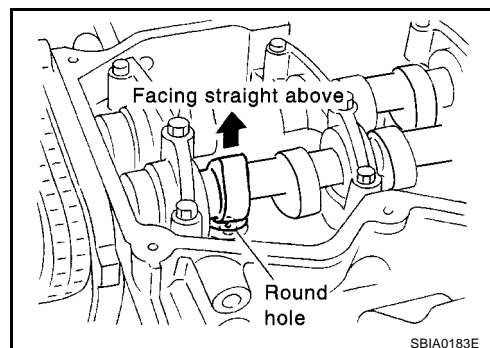
Measuring point	No. 1		No. 2		No. 3		No. 4	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH
When the No. 4 cylinder is in the TDC				X	X		X	X

12. If the valve clearance is outside the specification, adjust as follows.



ADJUSTMENTS

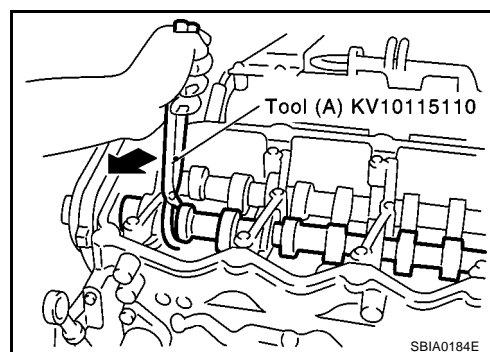
- Remove the adjusting shim for parts which are outside the specified valve clearance.
1. Remove the spill tube. Refer to [EM-39, "Removal and Installation"](#).
 2. Extract the engine oil on the upper side of the cylinder head (for the air blowing in step 7).
 3. Rotate the crankshaft to face the camshaft for adjusting shims that are to be removed upward.



4. Grip the camshaft with camshaft pliers, then using the camshaft as a support point, push the adjusting shim downward to compress the valve spring.

CAUTION:

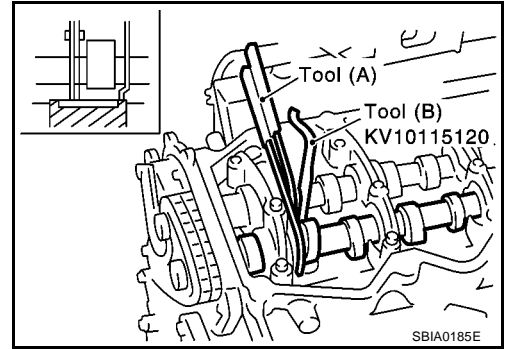
Do not damage the camshaft, cylinder head and the outer circumference of the valve lifter.



5. With the valve spring in a compressed state, remove the camshaft pliers by securely setting the outer circumference of the valve lifter with the end of the lifter stopper.
 - Hold the lifter stopper by hand until the shim is removed.

CAUTION:

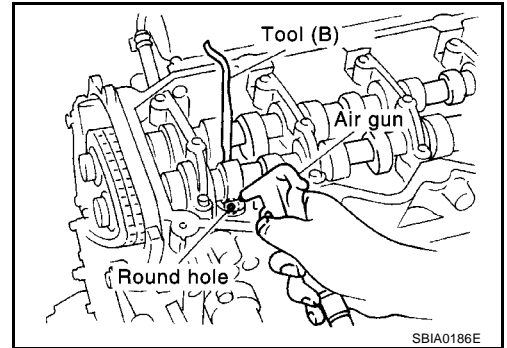
Do not retrieve the camshaft pliers forcefully, as the camshaft will be damaged.



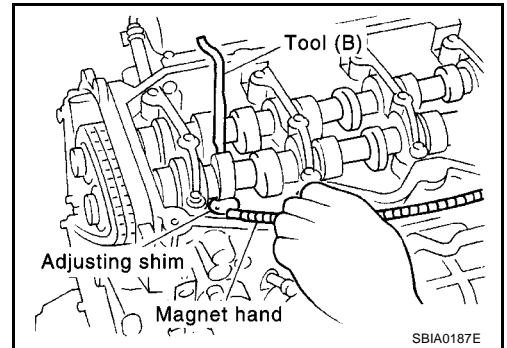
6. Move the rounded hole of the adjusting shim to the front with a very thin screwdriver or like that.
 - When the adjusting shim on the valve lifter will not rotate smoothly, restart from step 4 to release the end of the lifter stopper from touching the adjusting shim.
7. Remove the adjusting shim from the valve lifter by blowing air through the rounded hole of the shim with an air gun.

CAUTION:

To prevent any remaining oil from being blown around, thoroughly wipe the area clean and wear protective goggles.



8. Remove the adjusting shim by using a magnetic hand.



9. Measure the thickness of the adjusting shim using a micrometer.
 - Measure near the center of the shim (the part that touches the camshaft).
10. Select the new adjusting shim from the following methods.

Calculation method of the adjusting shim thickness:

R = Thickness of removed shim

N = Thickness of new shim

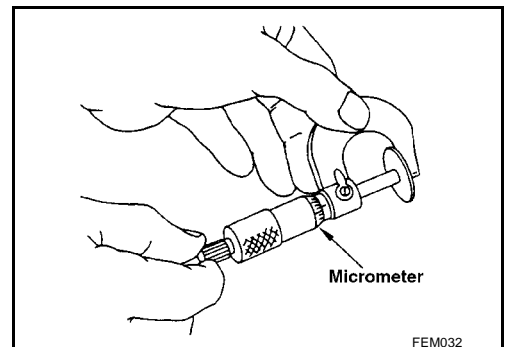
M = Measured valve clearance

Intake

$$N = R + [M - 0.28 \text{ mm (0.0010 in)}]$$

Exhaust

$$N = R + [M - 0.30 \text{ mm (0.0118 in)}]$$



- New adjusting shims have the thickness stamped on the rear side.

Stamped mark	Shim thickness mm (in)
2.10	2.10 (0.0827)
2.12	2.12 (0.0835)
.	.
.	.
.	.
2.74	2.74 (0.1079)

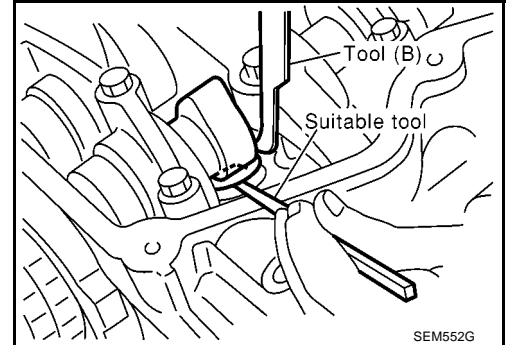
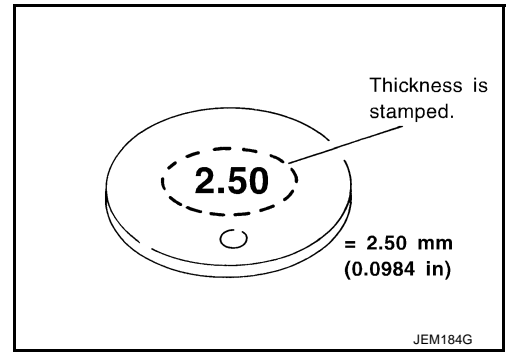
- Shims are available in 33 size from 2.10 mm (0.0827 in) to 2.74 mm (0.1079 in), in steps of 0.02 mm (0.0008 in).

11. Fit the selected adjusting shim to the valve lifter.

CAUTION:

Place the stamped side of the adjusting shim to the valve lifter.

12. Compress the valve spring using the camshaft pliers and remove the lifter stopper.
13. Rotate the crankshaft 2 to 3 turns by hand.
14. Confirm that the valve clearance is within the specification.



Valve clearance:

Item	Cold	Hot* (Reference data)
Intake	0.24 - 0.32 (0.0094 - 0.0126)	0.274 - 0.386 (0.0108 - 0.0152)
Exhaust	0.26 - 0.34 (0.0102 - 0.0134)	0.308 - 0.432 (0.0121 - 0.0170)

*: Approximately 80°C (176°F)

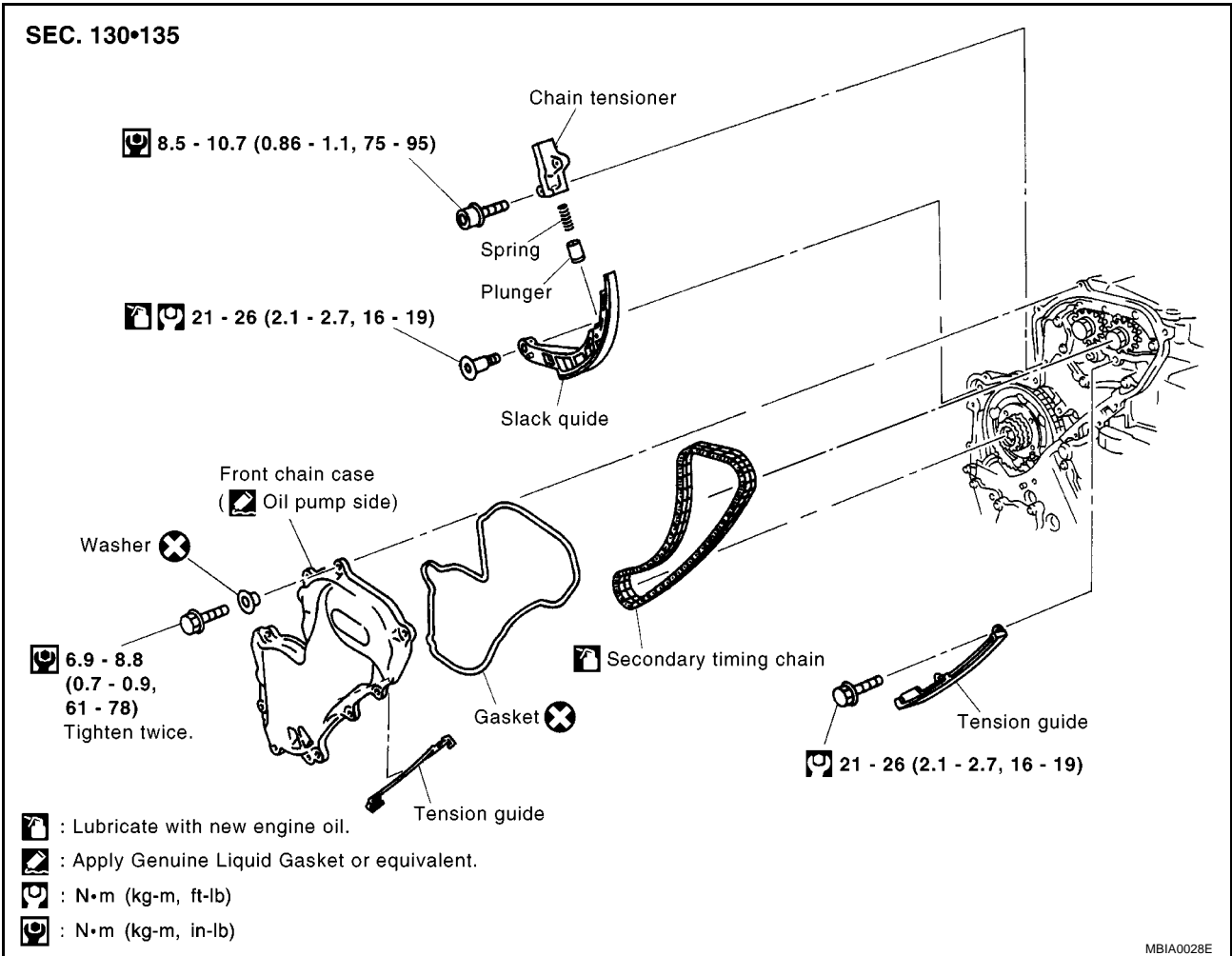
15. Install remaining parts in reverse order of removal.

SECONDARY TIMING CHAIN

Removal and Installation

CAUTION:

- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to parts marked in illustration before installation.



REMOVAL

- For preparative work for removing/installing secondary timing chain to remove/install fuel pump. Refer to [EM-42, "FUEL PUMP"](#).
 - To prepare for removing/installing secondary timing chain to remove/install camshaft. Refer to [EM-54, "Removal and Installation"](#).
- Remove coolant reservoir tank.
 - Remove RH engine mount insulator and bracket. Refer to [EM-89, "Removal and Installation"](#).
 - Pull power steering reservoir tank out of brackets to move power steering piping.

CAUTION:

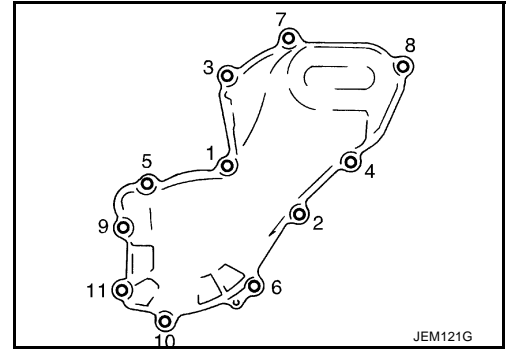
To avoid removing power steering reservoir tank out of brackets move it with power steering piping aside.

SECONDARY TIMING CHAIN

[YD]

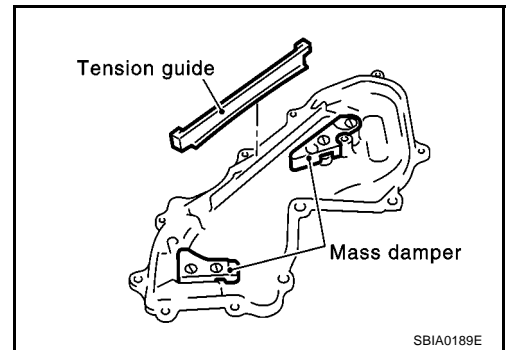
4. Remove front chain case.

- Move power steering fluid reservoir tank from the bracket.
- Loosen fixing bolts in the reverse order of that shown in the figure and remove them.
- Remove No. 6, 10 and 11 bolts with the rubber washer as space is limited for pulling them out.



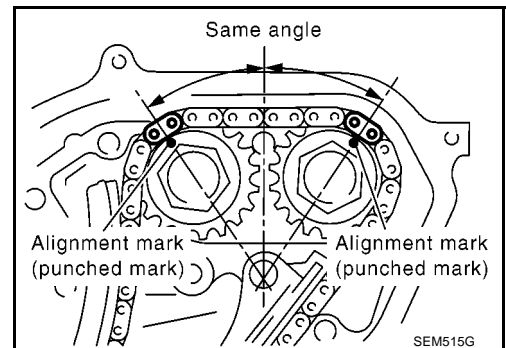
CAUTION:

- While front chain case is removed, cover openings to prevent entry of foreign material into engine.
- Do not remove two mass dampers on the back of cover.



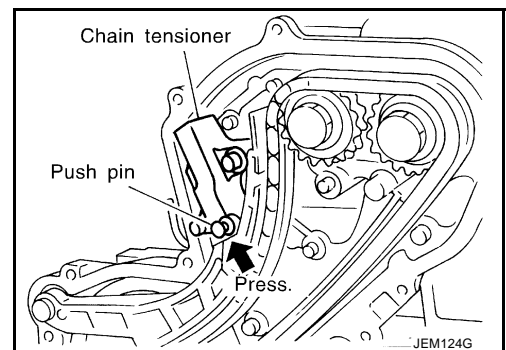
5. Set the No. 1 piston to TDC on its compression stroke.

- Turn crankshaft pulley clockwise so that the alignment mark (punched mark) on each camshaft sprocket is positioned as shown in the figure.
- No position indicator is provided on the crankshaft pulley.
- When installing, color coded links on the secondary timing chain can be used as alignment marks. Marking may not be necessary for removal; however, make alignment marks as required because the alignment mark on fuel supply pump sprocket may not be easy to see.



6. Remove chain tensioner.

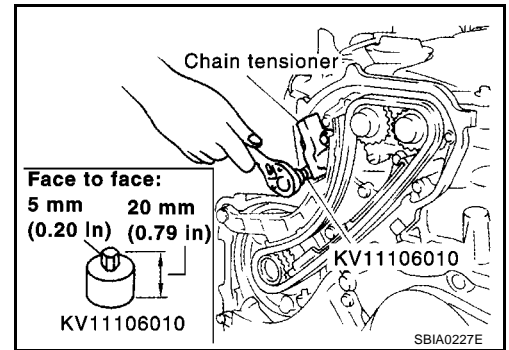
- a. Push the plunger of chain tensioner and keep it pressed with a push pin.



SECONDARY TIMING CHAIN

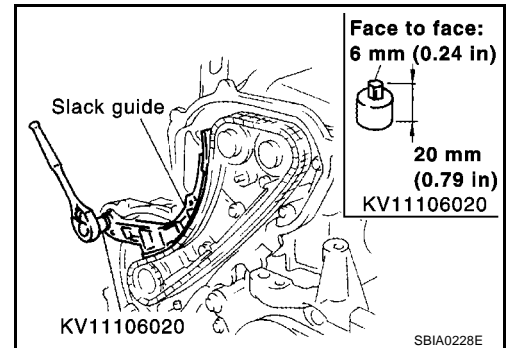
[YD]

- b. Using a hexagon-head wrench [face to face 5 mm, (0.20 in) SST], remove bolts to remove chain tensioner.



7. Remove timing chain slack guide.

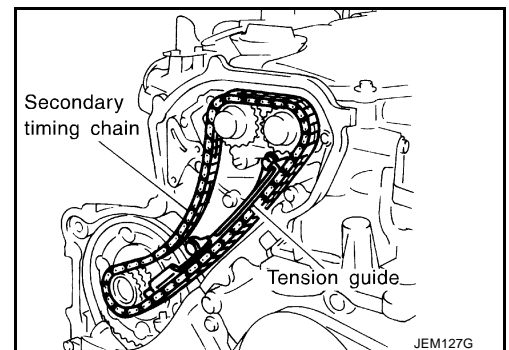
- Using a hexagon-head wrench [face to face 6 mm (0.24 in) SST], remove bolt to remove timing chain slack guide.



8. Remove timing chain tension guide.

9. Remove secondary timing chain.

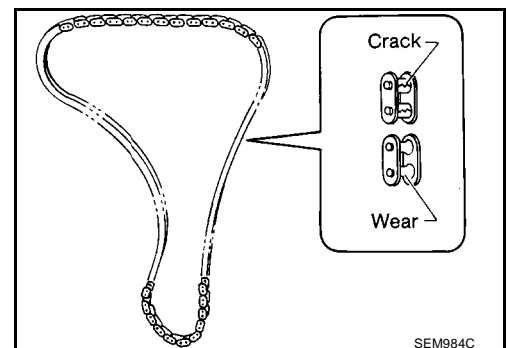
- Timing chain alone can be removed without removing sprockets.



INSPECTION AFTER REMOVAL

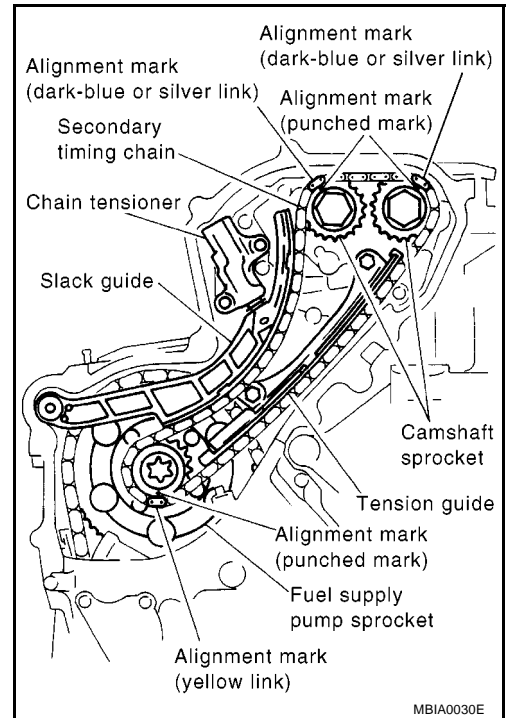
Timing Chain

Check for cracks and excessive wear at roller links. Replace chain if necessary.

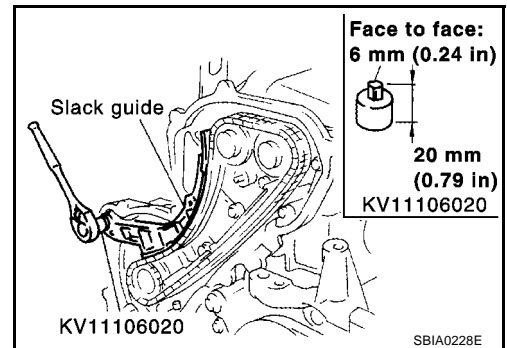


INSTALLATION

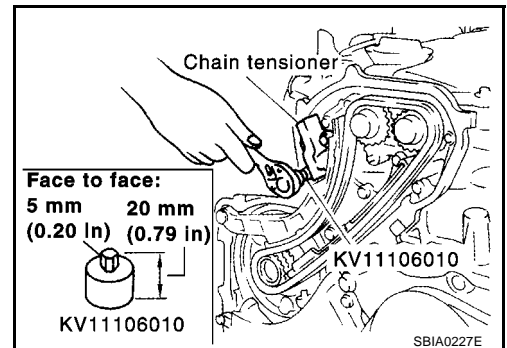
1. Install secondary timing chain.
 - When installing, match the alignment marks on sprockets with color coded alignment marks (colored links) on the chain.
2. Install timing chain tension guide.
 - The upper bolt has a longer shank than the lower bolt.



3. Using a hexagon-head wrench [face to face 6 mm (0.24 in) SST], install timing chain slack guide.



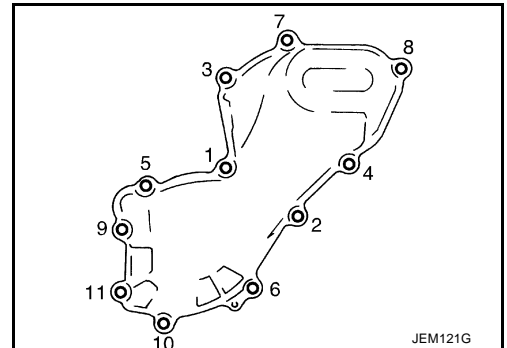
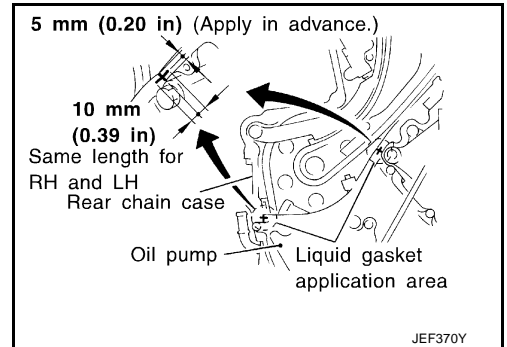
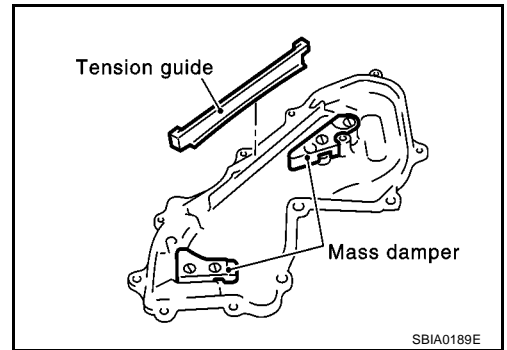
4. Install chain tensioner.
 - a. Push the plunger of the chain tensioner. While holding it with a push pin, install the chain tensioner.
 - b. Using a hexagon-head wrench [face to face 5 mm (0.20 in) SST], tighten bolts.
 - c. Pull out the push pin, etc. holding the plunger.
 - Check again that the alignment marks on the sprockets and the colored alignment marks on the timing chain are aligned.



SECONDARY TIMING CHAIN

[YD]

5. Install front chain case.
 - a. Install tension guide on the back surface of front chain case.
 - Hold front chain case vertically when installing. Tension guide may come off if front chain case is tilted.
 - b. Apply Genuine Liquid Gasket or equivalent (Refer to [EM-6](#), "[Precautions for Liquid Gasket](#)" .) on both ends of arched area (locations where rear chain case is adjoined) as shown in the figure.
 - c. Install front chain case.
 - When installing, align dowel pin on oil pump case with the pin hole.
 - Install No. 6, 10 and 11 bolts with the rubber washer to the front chain case.
- d. Tighten fixing bolts in the numerical order shown in the figure.
- e. After tightening all the bolts, re-tighten in the same order.
6. Hereafter, install in the reverse order of removal.



PRIMARY TIMING CHAIN

PFP:13028

Removal and Installation

EBS00SNZ

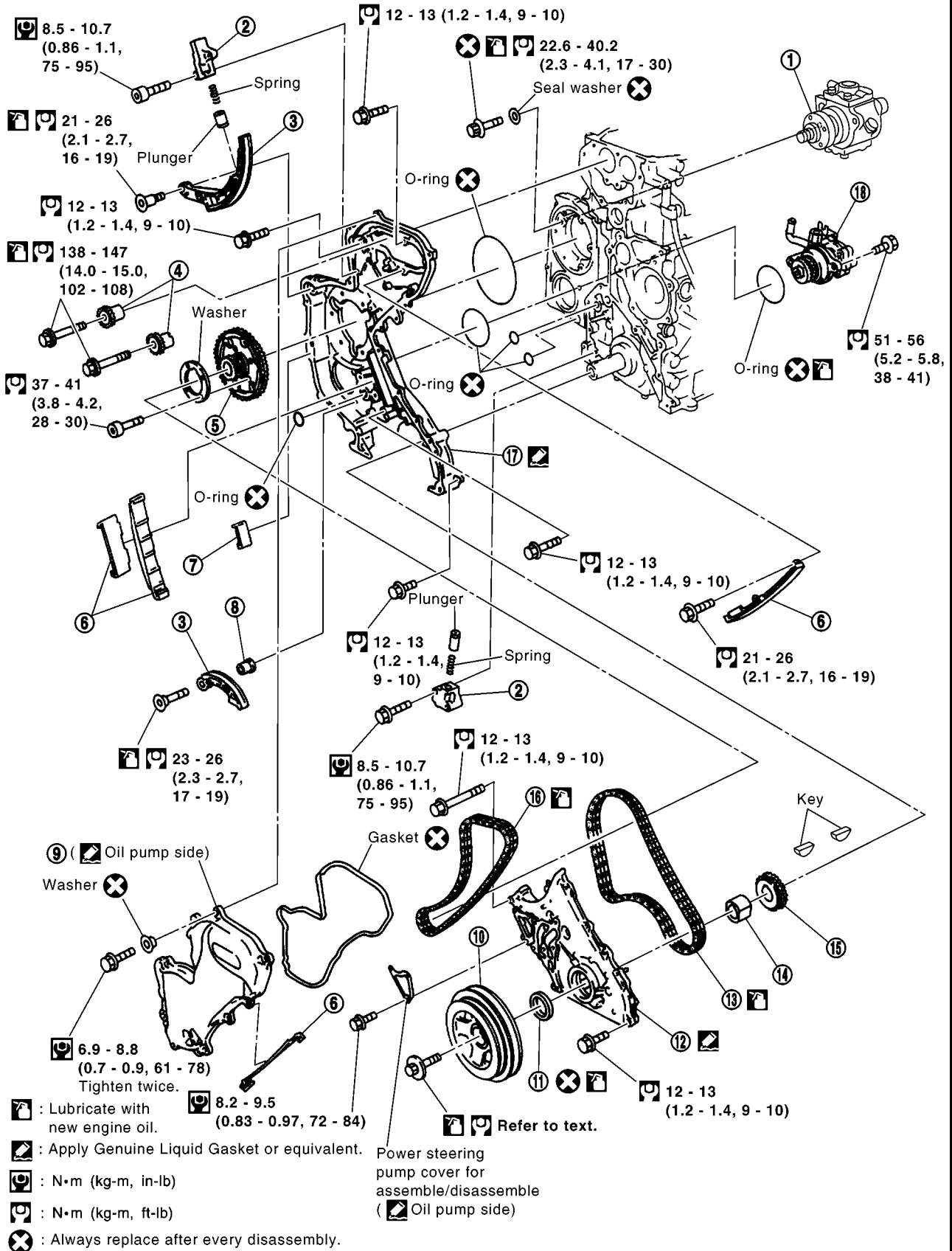
CAUTION:

- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to parts marked in illustration before installation.

PRIMARY TIMING CHAIN

[YD]

SEC. 120•130•135•186•490



MBIA0027E

- | | | |
|----------------------|-----------------------|------------------|
| 1. Fuel pump | 2. Chain tensioner | 3. Slack guide |
| 4. Camshaft sprocket | 5. Fuel pump sprocket | 6. Tension guide |

- | | | |
|----------------------------|----------------------------|-------------------------|
| 7. Chain guide | 8. Spacer | 9. Front chain case |
| 10. Crankshaft pulley | 11. Front oil seal | 12. Oil pump housing |
| 13. Primary timing chain | 14. Oil pump drive spacer. | 15. Crankshaft sprocket |
| 16. Secondary timing chain | 17. Rear chain case | 18. Power steering pump |

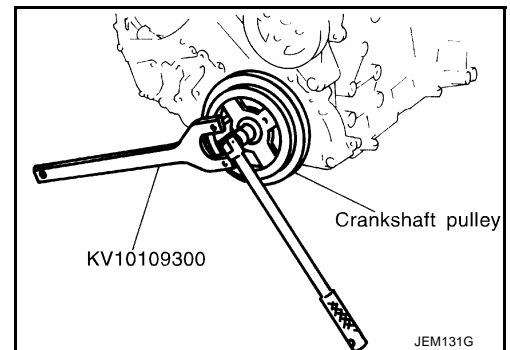
REMOVAL

1. Remove coolant reservoir tank.
2. Remove air cleaner and air duct. Refer to [EM-15, "Removal and Installation"](#).
3. Remove rocker cover. Refer to [EM-52, "Removal and Installation"](#).
4. Remove RH engine mount insulator and bracket. Refer to [EM-89, "Removal and Installation"](#).
5. Pull power steering reservoir tank out of brackets to move power steering piping.

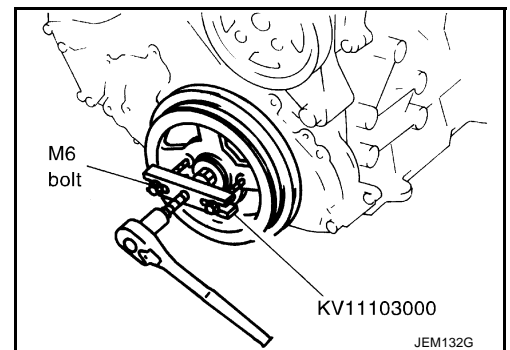
CAUTION:

To avoid removing power steering reservoir tank out of brackets move it with power steering piping aside.

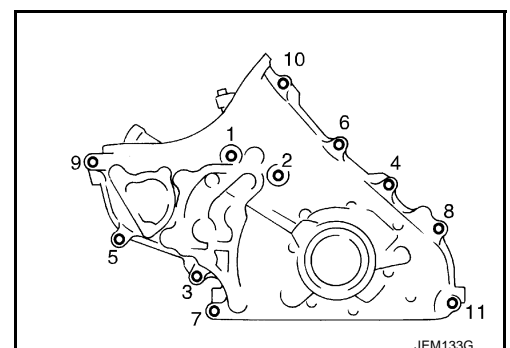
6. Remove oil pan. Refer to [EM-29, "Removal and Installation"](#).
7. Remove oil filter bracket. Refer to [LU-9, "Removal and Installation"](#).
8. Remove injection tube and fuel injector. Refer to [EM-39, "Removal and Installation"](#).
9. Remove secondary timing chain and associated parts. Refer to [EM-63, "Removal and Installation"](#).
10. When removing rear chain case, remove camshaft sprockets. Refer to [EM-54, "Removal and Installation"](#).
11. Remove crankshaft pulley.
 - a. Hold crankshaft pulley with the pulley holder (SST).
 - b. Loosen crankshaft pulley fixing bolt and pull out the bolt approximately 10 mm (0.39 in).



- c. Using pulley puller (SST), remove crankshaft pulley.
 - Use two M6 bolts with approx. 60 mm (2.36 in) shank length for securing crankshaft pulley.



12. Remove oil pump housing.
 - Loosen bolts in the reverse order of that shown in the figure and remove them.
 - Use seal cutter (SST) etc. for removal.
13. Remove front oil seal from oil pump housing.
 - Punch out the seal off from the back surface of the oil pump using a flat-bladed screwdriver.
 - **Be careful not to damage the oil pump housing.**



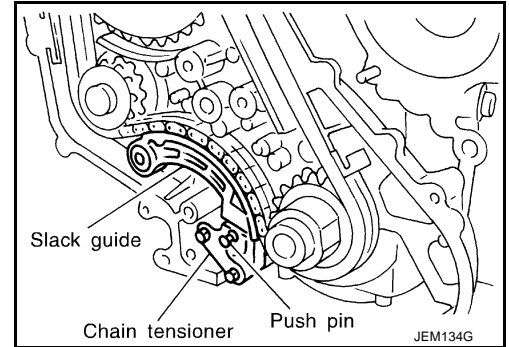
PRIMARY TIMING CHAIN

[YD]

14. Remove chain tensioner.

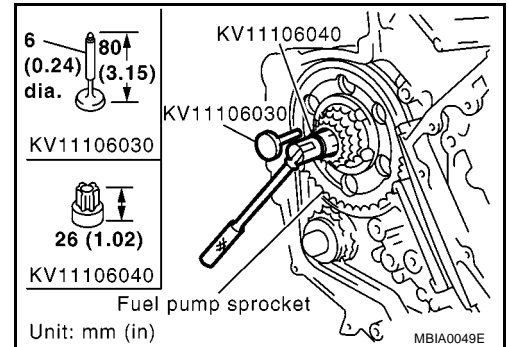
- When removing chain tensioner, push the sleeve of chain tensioner and keep it pressed with a push pin, etc.

15. Remove timing chain slack guide.

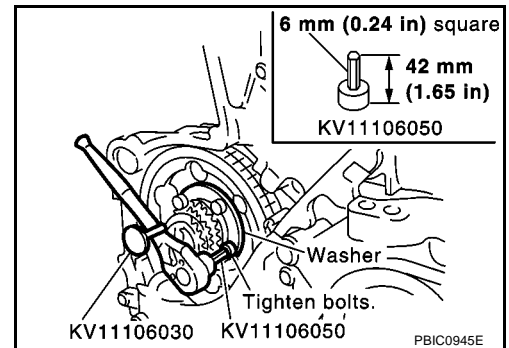


16. Hold fuel pump sprocket and remove bolt.

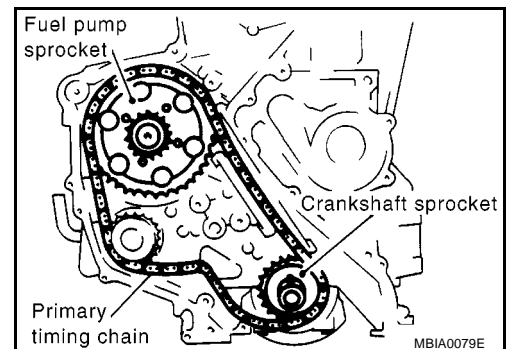
- Insert positioning stopper pin (SST) into the hole 6 mm (0.24 in) in the diameter on the fuel pump sprocket.
- Using a TORX wrench (SST), turn pump shaft little by little to adjust the position of fuel pump sprocket so that the holes align.



- Push positioning stopper pin (SST) through fuel pump sprocket to fuel pump body to hold pump sprocket, and remove bolt.



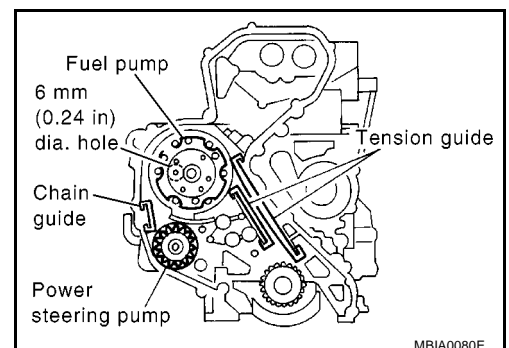
17. Remove primary timing chain with fuel pump sprocket and crankshaft sprocket.



18. Remove chain guide and tension guides.

19. Remove fuel pump.

20. Remove power steering pump.

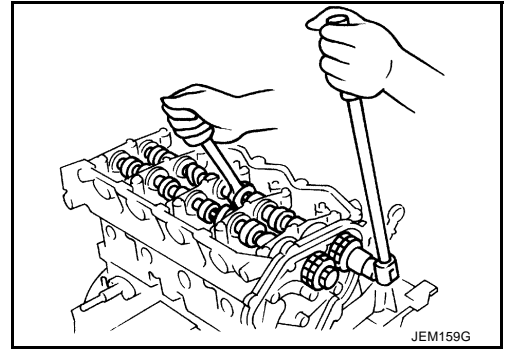


PRIMARY TIMING CHAIN

[YD]

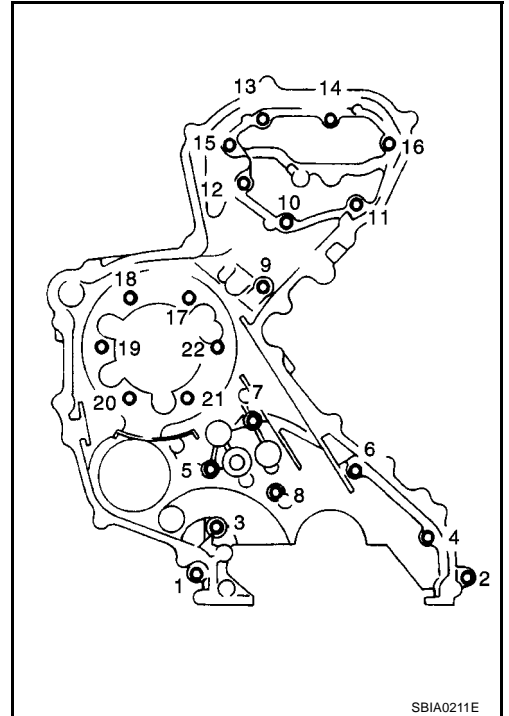
21. Remove camshaft sprockets.

- Loosen the camshaft sprockets installation bolts by fixing the hexagonal portion of the camshaft.



22. Remove rear chain case.

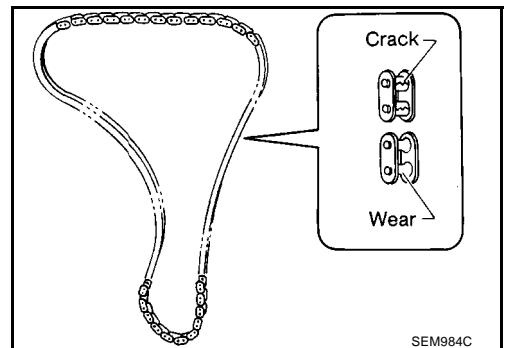
- Loosen fixing bolts in the reverse order of that shown in the figure and remove them.
- Use seal cutter (SST) for removal.



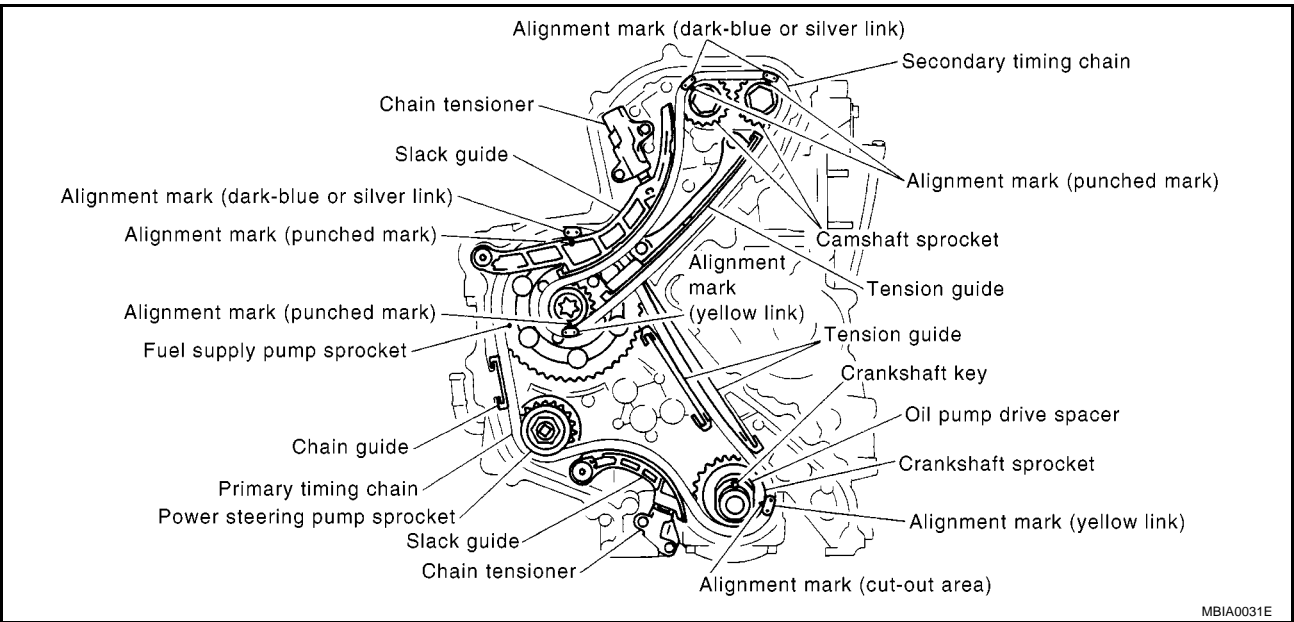
INSPECTION AFTER REMOVAL

Timing Chain

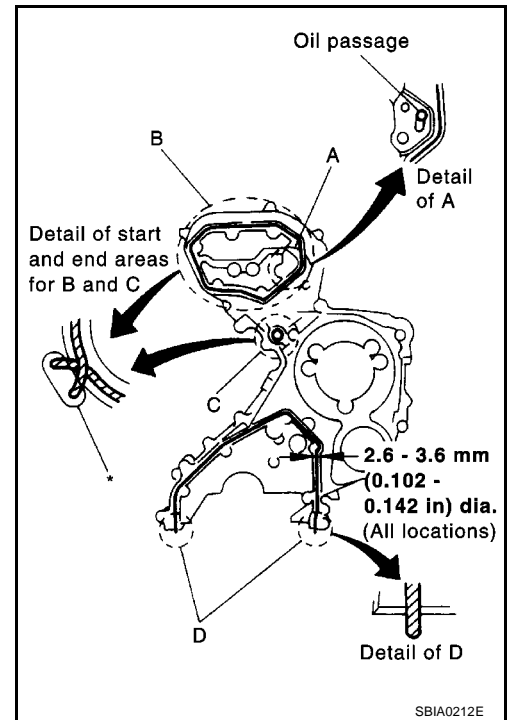
Check for cracks and excessive wear at roller links. Replace chain if necessary.



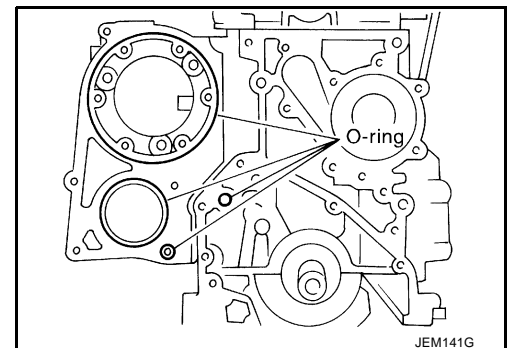
INSTALLATION



1. Install rear chain case.
 - a. Apply a continuous bead of Genuine Liquid Gasket or equivalent on locations shown in the figure. Refer to [EM-6, "Precautions for Liquid Gasket"](#).
 - A: Apply bead so that it does not protrude into the oil passage.
 - B, C: Minimize overlapping area of bead, by starting and ending at areas of bead as shown in the figure. Apply so that the portion marked * comes at an external location but cannot be viewed externally after engine assembly.
 - D: Leave the start and end areas of the bead slightly protruding from the case surface.



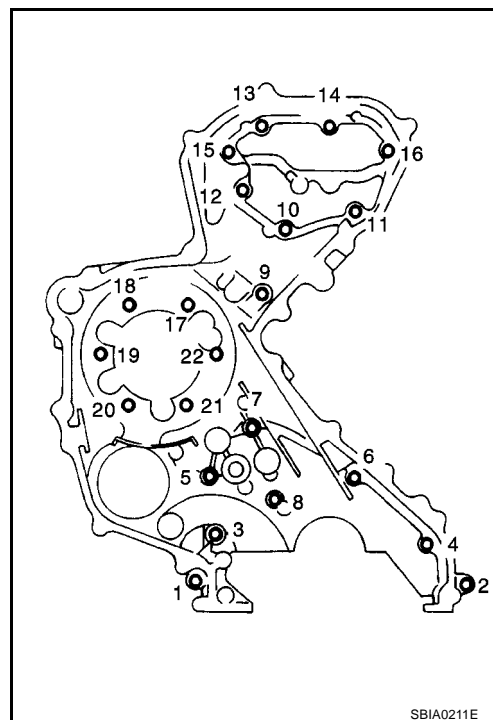
- b. Install four O-rings to the grooves of the cylinder block and fuel pump bracket.



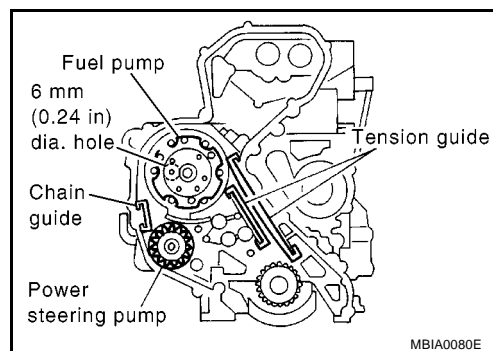
PRIMARY TIMING CHAIN

[YD]

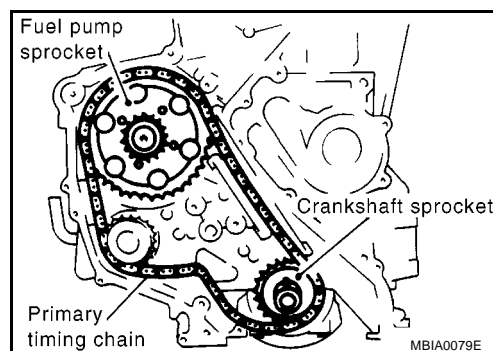
- c. Install rear chain case.
 - When installing, align the dowel pin with the pin hole.
- d. Tighten bolts in the numerical order shown in the figure.
 - Install the following four types of bolts, referring to the figure.
 - 16 mm (0.63 in) : Bolt No. 1, 2, 16, 17, 18, 19, 20, 21, 22**
 - 20 mm (0.79 in) : Bolt No. 3, 4, 6, 9, 10, 11, 13, 14**
 - 25 mm (0.98 in) : Bolt No. 12, 15**
 - 35 mm (1.38 in) : Bolt No. 5, 7, 8**
 - The shank length under the bolt neck above is the length of threaded part (pilot portion not included).
- e. After tightening all the bolts, re-tighten in the same order.



2. Install power steering pump.
3. Install fuel pump.
 - Before installing, make sure the notch on the fuel pump flange and the hole 6 mm (0.24 in) in diameter on the pump body are aligned.
4. Install chain guide and tension guides.
5. Install crankshaft sprocket, aligning it with the crankshaft key on the far side.

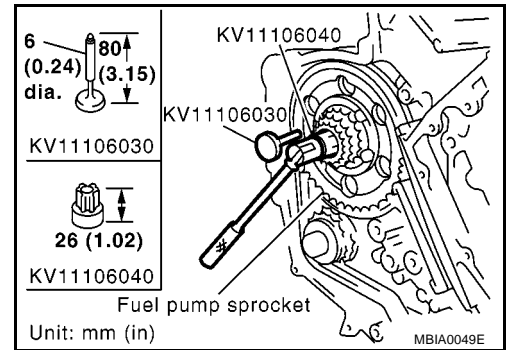


6. Install primary timing chain with fuel pump sprocket.
 - When installing, match the alignment marks on sprockets with color coded alignment marks (colored links) on the chain.
 - Install fuel pump sprocket washer with the surface marked "F" (front mark) facing the front of the engine.
7. Install timing chain onto power steering pump sprocket and through chain guide.



8. Use the positioning stopper pin (SST) to hold the fuel pump sprocket and install the bolt.

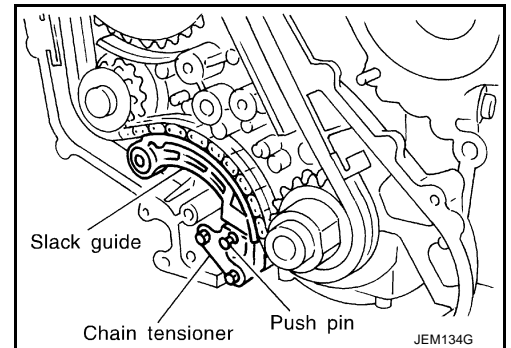
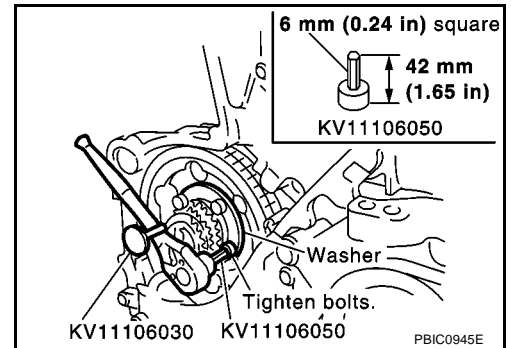
- Using a TORX wrench (SST), turn the pump shaft little by little to adjust the position of the pump flange. Insert positioning stopper pin (SST) into the hole 6 mm (0.24 in) in diameter on the fuel pump sprocket so that the stopper pin goes through the pump flange to the pump body. While the stopper pin is in place, install the bolt.



9. Install timing chain slack guide.

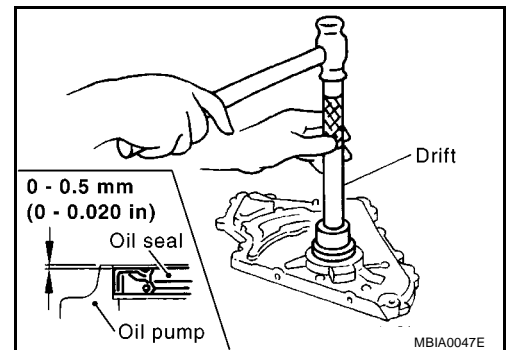
10. Install chain tensioner.

- Push the plunger of the chain tensioner. While keeping plunger pressed down with a push pin, etc., install the chain tensioner.
- After installation, pull out the push pin holding the plunger.
- **Check again that the alignment marks on the sprockets and the colored alignment marks on timing chain are aligned.**



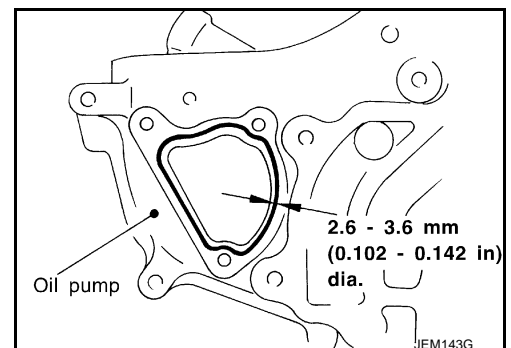
11. Install front oil seal to oil pump housing.

- Using a suitable drift [62 mm (2.44 in) dia.], force fit the seal until it hits the bottom.
- **Do not touch lips of oil seal. Make sure seal surfaces are free of foreign materials.**



12. Install chain case cover (for opening for power steering pump removal/installation) to oil pump.

- Apply a continuous bead of Genuine Liquid Gasket or equivalent as shown in the figure. Refer to [EM-6, "Precautions for Liquid Gasket"](#).
- Apply liquid gasket on oil pump-side surface.

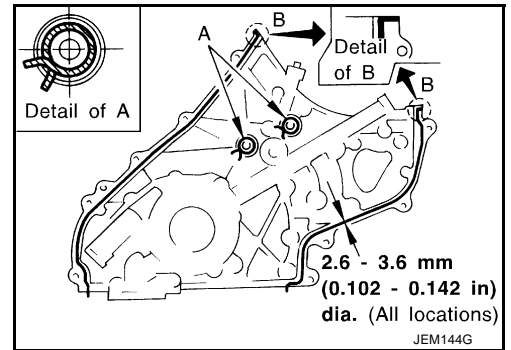


13. Install oil pump housing.

- Apply a continuous bead of Genuine Liquid Gasket or equivalent on locations shown in the figure. Refer to [EM-6, "Precautions for Liquid Gasket"](#).

A: Leave the start and end areas of the bead slightly protruding from the surface.

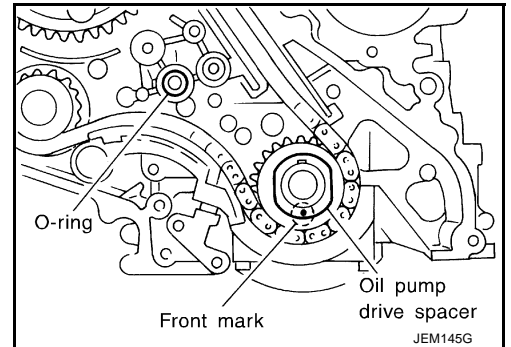
B: Apply liquid gasket along upper end surface of oil pump housing.



- Install oil pump drive spacer to crankshaft.

- Install with the front mark (punched mark) facing the front of the engine.

- Install O-ring into the groove of rear chain case.

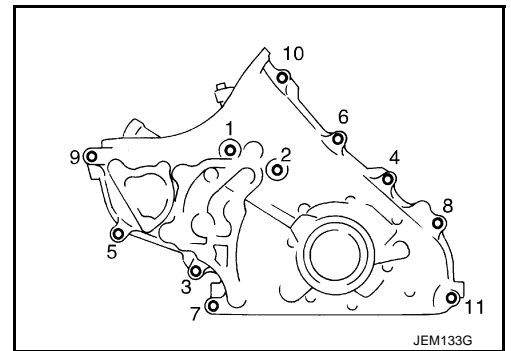


- Install oil pump housing.

- When installing, align the inner rotor in the direction of the two facing flats of the oil pump drive spacer.
- When installing, align the dowel pin with the pin hole.

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

- After tightening all the bolts, re-tighten in the same order.



14. Check gaps on upper oil pan mounting surface.

- Using straightedge and feeler gauge, measure gaps between the locations of the following parts:

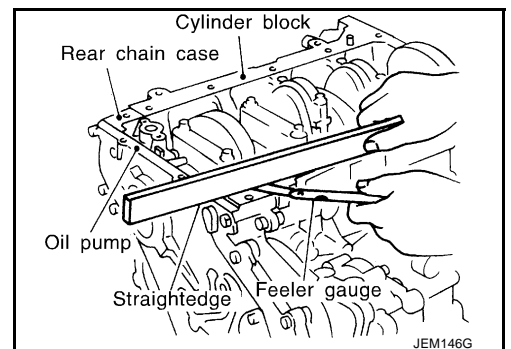
Oil pump housing and rear chain case:

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

Rear chain case and cylinder block:

Standard : - 0.25 to 0.13 mm (- 0.0098 to 0.0051 in)

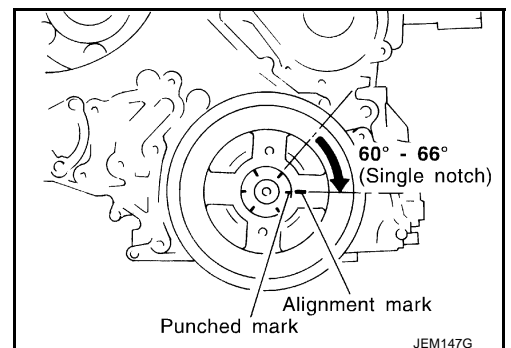
- If the measured value is out of the above range, install again.



15. Install crankshaft pulley.

- Install crankshaft pulley to crankshaft.
- Hold crankshaft pulley with the pulley holder (SST).
- Tighten bolt to 20 to 29 N-m (2.0 to 3.0 kg-m, 15 to 21 ft-lb).
- Put an alignment mark on crankshaft pulley that aligns with one of the punched marks on the bolt.
- Tighten fixing bolt another 60° - 66° [target: 60° (turn by one notch)].

- Install secondary timing chain and the associated parts. Refer to [EM-66, "INSTALLATION"](#).



PRIMARY TIMING CHAIN

[YD]

17. Install in the reverse order of removal hereafter.

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

CYLINDER HEAD

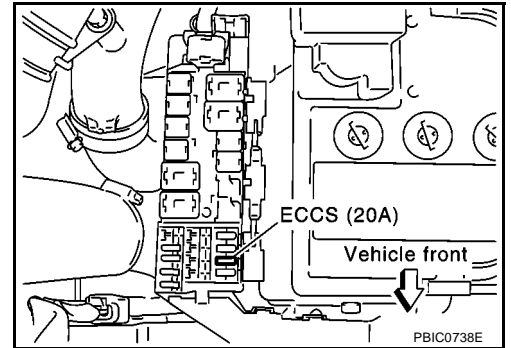
On-Vehicle Service

CHECKING COMPRESSION PRESSURE


1. Warm up engine thoroughly. Then, stop it.
2. Using CONSULT-II, make sure no error codes are indicated for self-diagnosis items. Refer to [EC-44, "Basic Inspection"](#).
 - Do not disconnect CONSULT-II until the end of this operation; it will be used to check engine rpm and for error detection at the end of this operation.
3. Disconnect the negative battery cable.
4. To prevent fuel from being injected during inspection, remove fuse [ECCS (20A)] from fuse box on the left side of engine compartment.
5. Remove glow plugs from all the cylinders. Refer to [EM-34, "Removal and Installation"](#).

CAUTION:

- Before removal, clean the surrounding area to prevent entry of any foreign materials into the engine.
- Carefully remove glow plugs to prevent any damage or breakage.
- Handle with care to avoid applying any shock to glow plugs.

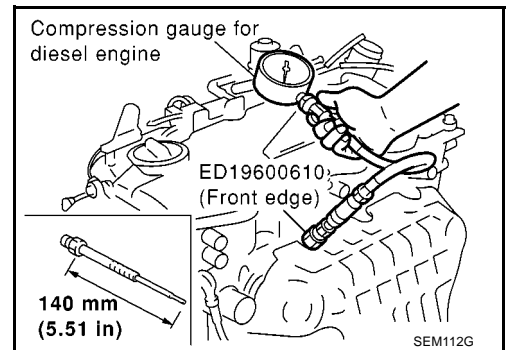


6. Install adapter to installation holes of glow plugs and connect compression gauge for diesel engine.

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

7. Connect battery negative terminal.
8. Set the ignition switch to "START" and crank. When gauge pointer stabilizes, read compression pressure and engine rpm. Repeat the above steps for each cylinder.
 - Always use a fully-charged battery to obtain specified engine speed.

Unit: kPa (bar, kg/cm², psi)/rpm



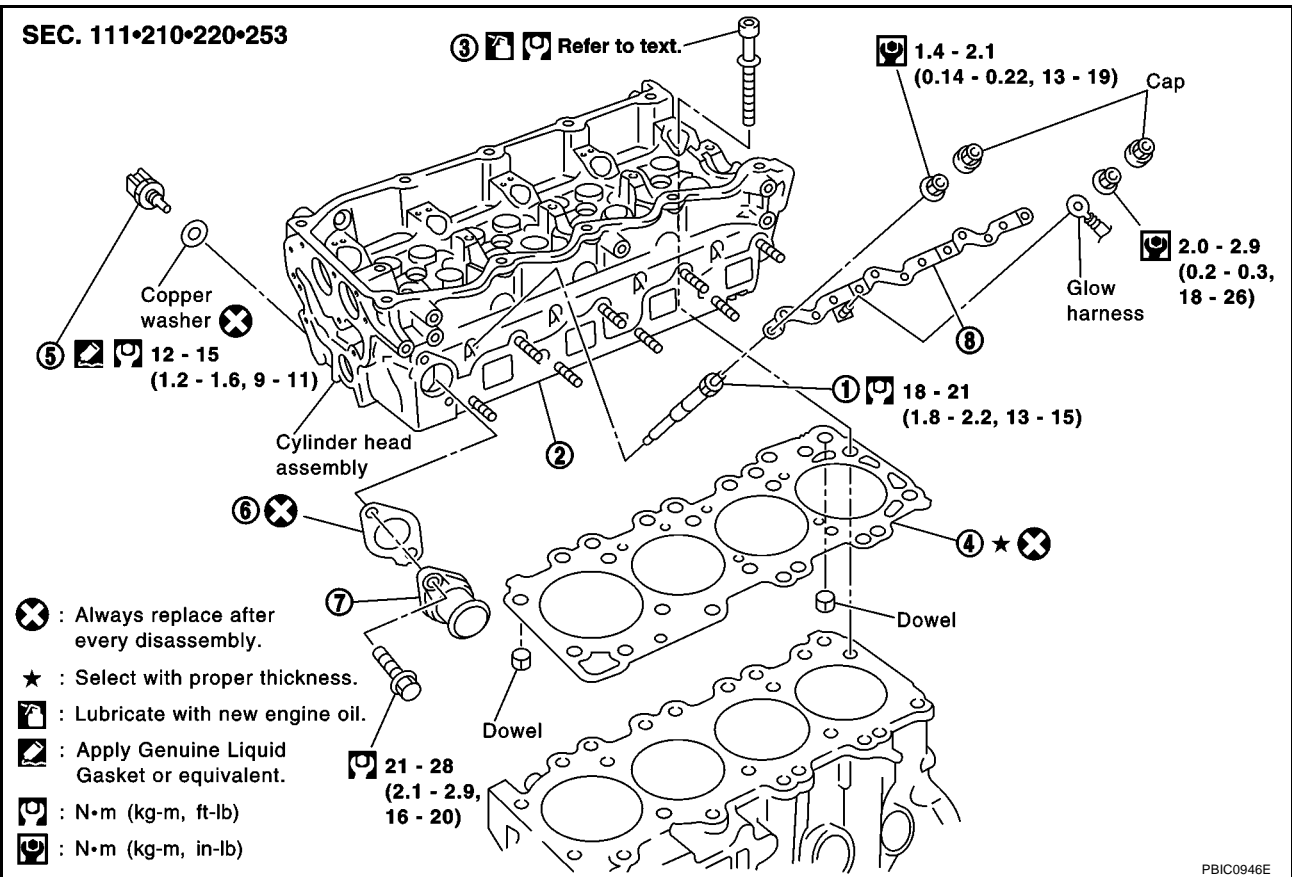
Standard	Minimum	Difference limit between cylinders
2,991 (29.99, 30.5, 434)/200	2,452 (24.52, 25.0, 356)/200	490 (4.90, 5.0, 71)/200

- When engine rpm is out of the specified range, check the specific gravity of battery liquid. Measure again under corrected conditions.
 - If engine rpm exceeds the limit, check valve clearance and combustion chamber components (valves, valve seats, cylinder head gaskets, piston rings, pistons, cylinder bores, cylinder block upper and lower surfaces) and measure again.
 - If compression pressure is low in some cylinders, apply engine oil from glow plug installation hole. Then check pressure again.
 - If compression pressure becomes normal after applying oil, piston ring may be worn or damaged. Check piston ring for malfunction. If any, replace piston ring.
 - If compression pressure is still low after applying oil, valve may be malfunctioning. Check valve for malfunction. If contact malfunction is found, replace valve or valve seat.
 - If compression pressure in adjacent two cylinders is low after applying oil, pressure may be leaking from gasket. In this case, replace cylinder head gasket.
9. Complete this operation as follows.
 - a. Turn the ignition switch to "OFF".
 - b. Disconnect negative battery cable.

- c. Install glow plug and install all the parts removed in step 4.
- d. Install fuse [ECCS (20A)].
- e. Connect negative battery cable.
- f. Using CONSULT-II make sure no error code is indicated for items of self-diagnosis.

Removal and Installation

EBS00S01



- | | | |
|-----------------|--------------------------------------|-----------------------|
| 1. Glow plug | 2. Cylinder head assembly | 3. Cylinder head bolt |
| 4. Gasket | 5. Engine coolant temperature sensor | 6. Gasket |
| 7. Water outlet | 8. Glow plate | |

CAUTION:

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

REMOVAL

1. Drain engine coolant. Refer to [CO-8, "Changing Engine Coolant"](#) .
2. Remove the following parts.
 - Rocker cover (Refer to [EM-52, "Removal and Installation"](#) .)
 - Air cleaner and air duct (Refer to [EM-15, "Removal and Installation"](#) .)
 - Vacuum pump (Refer to [EM-35, "Removal and Installation"](#) .)
 - Injection tube, spill tube and fuel injector (Refer to [EM-39, "Removal and Installation"](#) .)
 - Intake manifold (Refer to [EM-19, "Removal and Installation"](#) .)
 - Exhaust manifold and turbocharger (Refer to [EM-23, "Removal and Installation"](#) .)
 - Secondary timing chain (Refer to [EM-63, "Removal and Installation"](#) .)
 - Camshaft (Refer to [EM-54, "Removal and Installation"](#) .)

3. Remove cylinder head assembly.

- Loosen and remove mounting bolts in the reverse order shown in the figure.
- Lift up the cylinder head assembly to avoid interference with dowel pins located between the block and head, and remove cylinder head assembly.

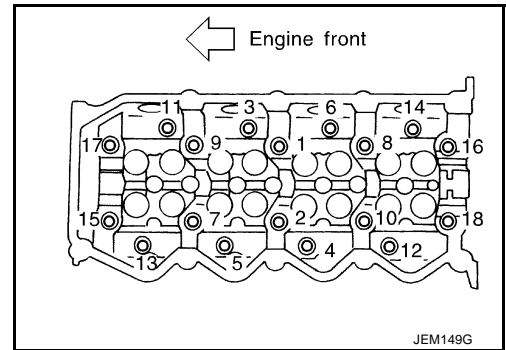
CAUTION:

Remove glow plug in advance to avoid damage as the tip of the glow plug projects from the bottom of the cylinder head, or, place wood blocks beneath both ends of the cylinder head to keep the cylinder bottom from any contact.

- For glow plug removal, the following shall be noted.

CAUTION:

- To avoid breakage, do not remove glow plug unless necessary.
- Perform continuity test with glow plug installed.
- Keep glow plug from any impact. (Replace if dropped from a height 10 cm (3.94 in) or higher.)
- Do not use air impact wrench.



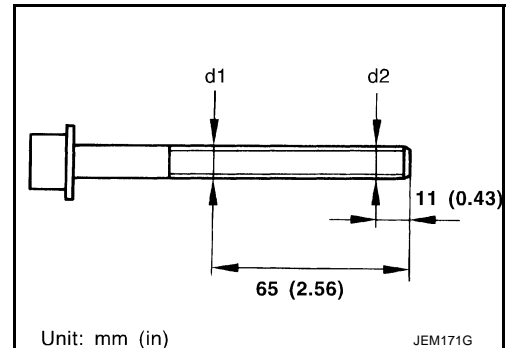
INSPECTION AFTER REMOVAL

Cylinder Head Bolt Deformation

- Using micrometer, measure the outer diameters d1 and d2 of bolt thread as shown in the figure.
- If the necking point can be identified, set it as measuring point d2.
- Calculate the difference between d1 and d2.

Limit : 0.15 mm (0.0059 in)

- If out of the limit, replace cylinder head bolt.

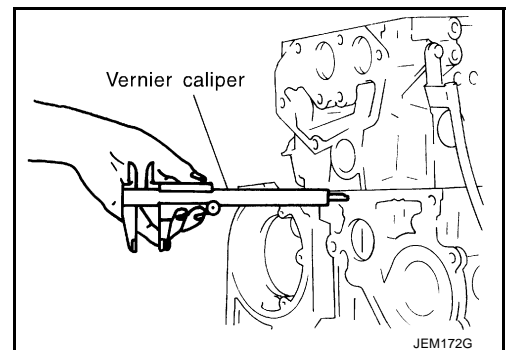


Cylinder Head-to-block Difference Check

- After installing cylinder head, measure dimension from the front end surface of cylinder block to that of cylinder head.

Standard : 23.53 - 24.07 mm (0.9264 - 0.9476 in)

- If the difference is out of the range, check fitting of dowel pins and cylinder head.

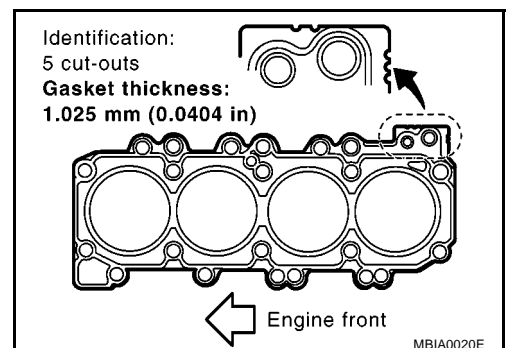


INSTALLATION

Before installation, remove old liquid gasket from mating surface of all liquid gasket applied parts.

1. Install cylinder head gasket.

- Cylinder head gasket to be installed is selected by its thickness through the following procedure.
 - When replacing gasket alone**
- Install a gasket with same thickness as that of the one removed.
- Identify the thickness of gasket by the number of cut-outs on the rear RH side.



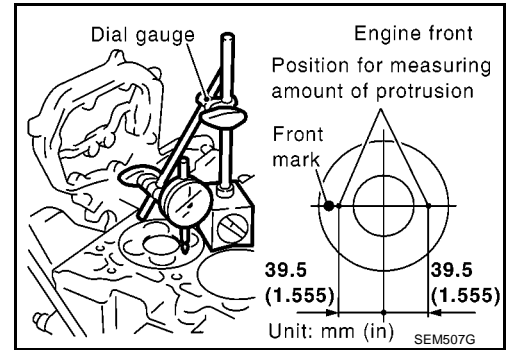
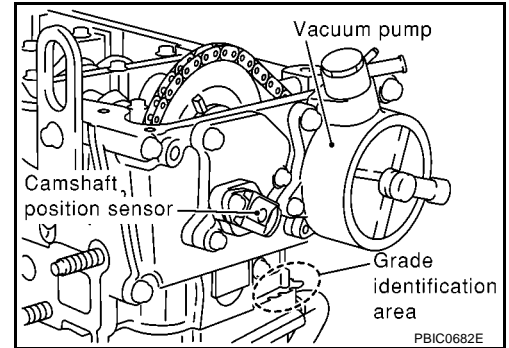
CYLINDER HEAD

[YD]

Gasket thickness* mm (in)	Number of grade	Number of cut-outs
0.900 (0.0354)	1	0
0.925 (0.0364)	2	1
0.950 (0.0374)	3	2
0.975 (0.0384)	4	3
1.000 (0.0394)	5	4
1.025 (0.0404)	6	5

*: Measured with head bolts tightened

- Gasket thickness can be identified at the location shown in the figure by the numbers of cut-outs before removal.



– When the following parts have been repaired/replaced:

- With cylinder block upper surface and/or crankshaft pin journal ground.
- With cylinder block, pistons, connecting rods, and/or crankshaft replaced.

- Set piston at a point close to TDC.
- Set a dial gauge at the location as shown in the figure. Turning crankshaft gradually, set the gauge scale to “0” where the piston protrusion is maximized.
- Move the dial gauge stand so that the tip of dial gauge can contact the cylinder block. Read the difference.
- Measure at two locations per cylinder, that is eight locations for four cylinders. Select gasket based on the maximum protrusion of eight measurements.

Piston protrusion mm (in)	Gasket thickness* mm (in)	Identification
		Number of cut-outs
Less than 0.255 (0.0100)	0.900 (0.0354)	0
Less than 0.255 - 0.280 (0.0100 - 0.0110)	0.925 (0.0364)	1
Less than 0.280 - 0.305 (0.0110 - 0.0120)	0.950 (0.0374)	2
Less than 0.305 - 0.330 (0.0120 - 0.0130)	0.975 (0.0384)	3
Less than 0.330 - 0.355 (0.0130 - 0.0140)	1.000 (0.0394)	4
More than 0.355 (0.0140)	1.025 (0.0404)	5

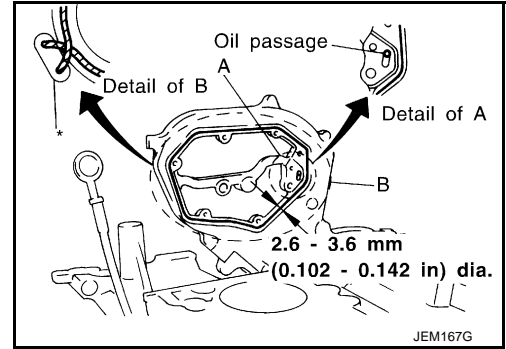
*: Measured with head bolts tightened

CYLINDER HEAD

[YD]

2. Apply a continuous bead of Genuine Liquid Gasket or equivalent on the surface shown in the figure.
 A: Apply bead so that it does not protrude into oil passage. Refer to [EM-6, "Precautions for Liquid Gasket"](#).
 B: Minimize the overlapping area of the bead, with start and end areas of bead as shown in the figure.

Apply so that the portion marked * comes at an external location but cannot be viewed externally after engine is assembled.



3. Install cylinder head assembly.

- Tighten bolts in numerical order as shown in the figure according to the following procedure:

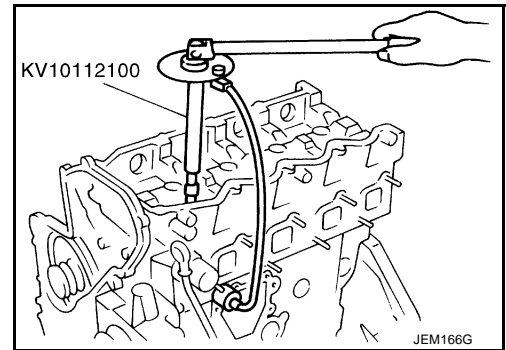
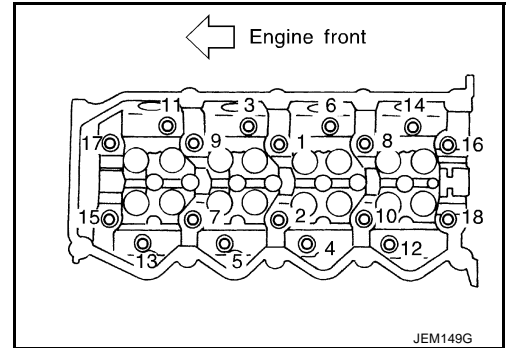
- a. Apply engine oil to bolt threads and seat surfaces.
- b. Tighten bolts to 35 to 44 N·m (3.5 to 4.5 kg-m, 26 to 32 ft-lb).
- c. Tighten 180° to 185° [target: 180°] (angular tightening).
- d. Loosen completely to 0 N·m (0 kg-m, 0 in-lb) in the reverse order of that shown in the figure.
- e. Tighten bolts to 35 to 44 N·m (3.5 to 4.5 kg-m, 26 to 32 ft-lb).
- f. Tighten 90° to 95° [target: 90°] (angular tightening)
- g. Tighten another 90° to 95° [target: 90°] (angular tightening).

- **When an angle wrench is not used, paint an alignment mark on the head of cylinder head bolt and cylinder head surface before tightening. Check the angle with a protractor.**

4. Install glow plug.

- **To avoid damage, glow plugs should be removed only when required.**
- **Handle with care to avoid applying shock. When dropped from approx. 100 mm (3.94 in) or higher, always replace with a new one.**
- Before installing, remove carbon depositing on mounting hole of glow plug with a reamer.

5. Install engine coolant temperature sensor and thermal transmitter.



Disassembly and Assembly

EBS00S02

A

EM

C

D

E

F

G

H

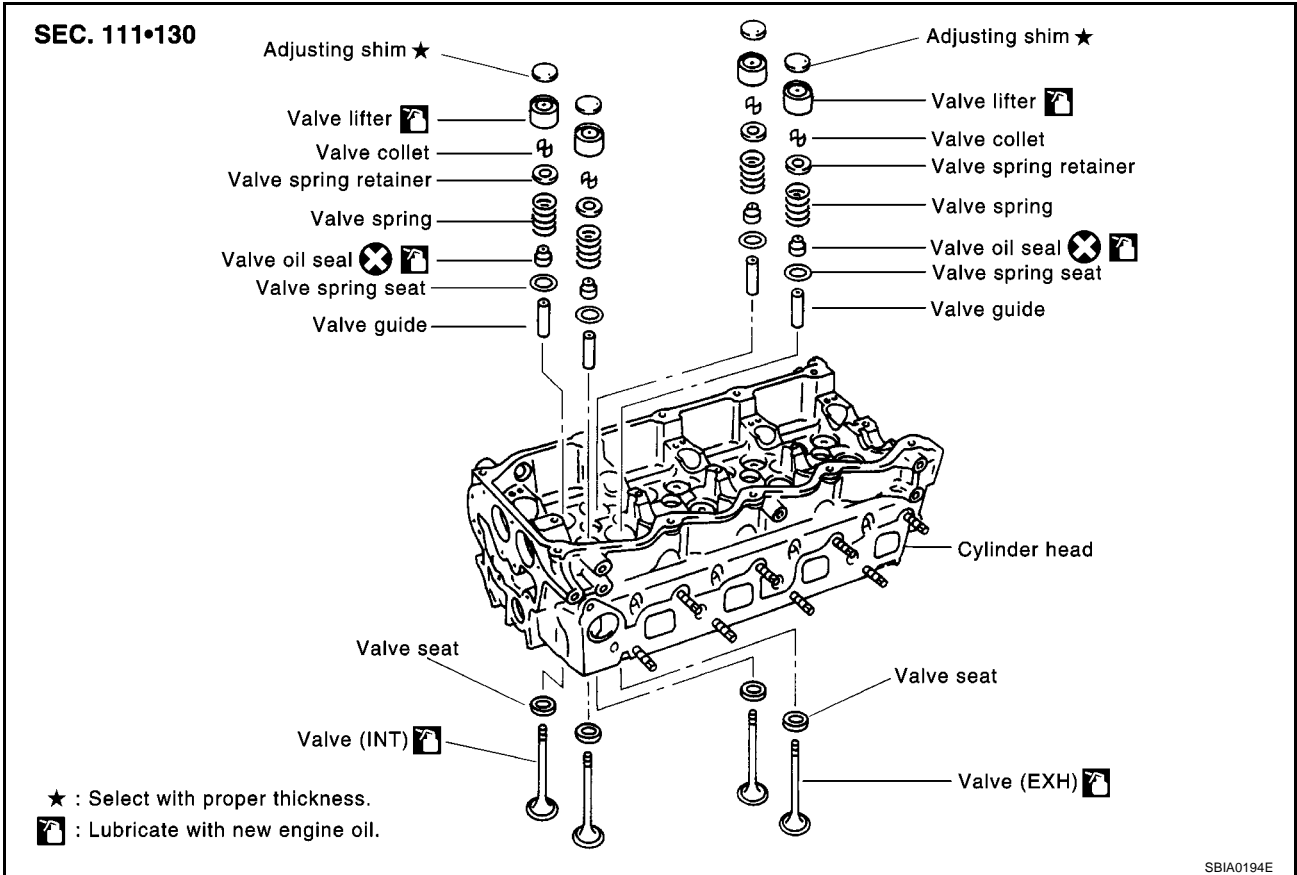
I

J

K

L

M

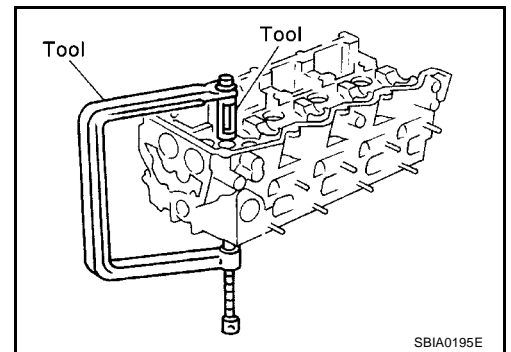


CAUTION:

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

DISASSEMBLY

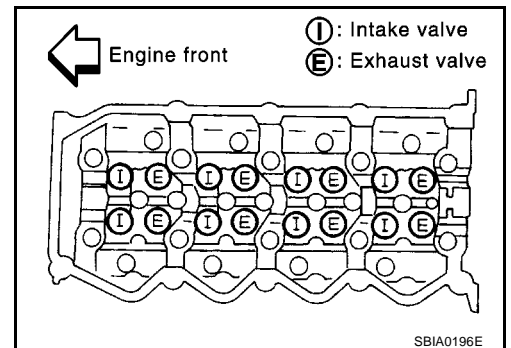
1. Remove adjusting shims and valve lifters.
 - Check the installation positions, and keep them to avoid being confused.
2. Remove valve.
 - Using valve spring compressor, compress valve spring. Using magnetic hand, remove valve collets.
3. Remove valve spring retainers and valve springs.
4. Remove valves as pressing valve stems toward combustion chamber.



- Before removing the valve, check the valve guide clearance. Refer to [EM-85, "Valve Guide Clearance"](#).
- Check installation positions, and keep them to avoid being confused.

NOTE:

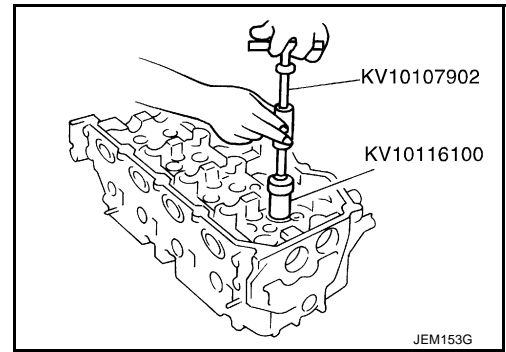
Refer to the figure for intake and exhaust valve positions. Intake and exhaust valve driving cams are provided alternately for each camshaft.



CYLINDER HEAD

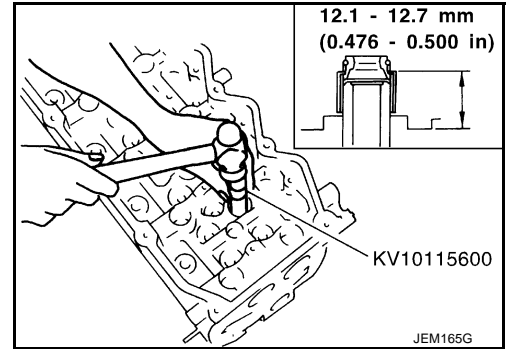
[YD]

5. Remove valve oil seals using valve oil seal puller.
6. Remove valve spring seats.
7. Before removing valve spring seats, perform valve seat contact check. Refer to [EM-86, "Valve Seat Contact"](#).
8. Before removing valve guides, perform valve guide clearance check. Refer to [EM-85, "Valve Guide Clearance"](#).



ASSEMBLY

1. Install valve guides. Refer to [EM-85, "Valve Guide Replacement"](#).
2. Install valve seats. Refer to [EM-86, "Valve Seat Replacement"](#).
3. Using valve oil seal drift, install valve oil seals referring to the dimension shown in the figure.
4. Install valve spring seats.
5. Install valves.
 - Install the valves with bigger outer diameter to intake valve side.
 - Note that valve layout here is different from that of conventional engine.
6. Install valve spring.
7. Install valve spring retainers.
8. Using valve spring compressor, compress valve springs. Then install valve collets using magnetic hand.
 - After installing valve collets, tap the stem end using a plastic hammer, and check the installation status.
9. Install valve lifters and adjusting shims to the same positions as before.

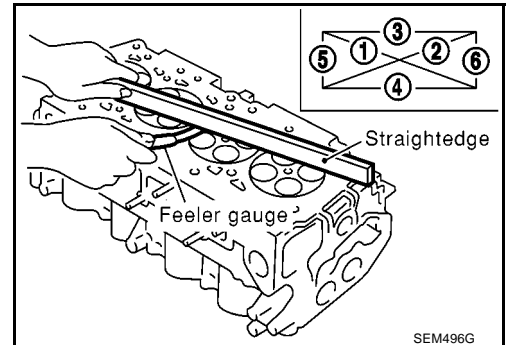


INSPECTION AFTER DISASSEMBLY

Cylinder Head Distortion

Using straightedge and feeler gauge, check the bottom of the cylinder head for distortion.

Limit : 0.04 mm (0.0016 in)

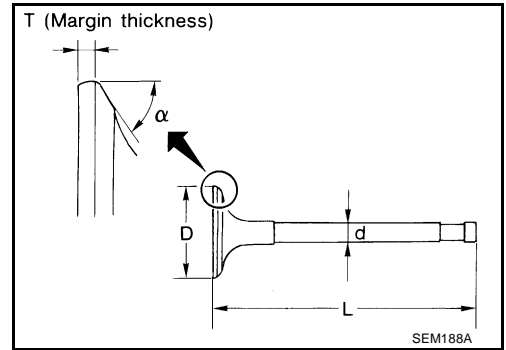


Valve Dimension

Check dimensions of each valve. For dimensions, refer to SDS, [EM-116, "VALVE"](#).

When valve head has been worn down to 1 mm (0.039 in) in margin thickness, replace valve.

Grinding allowance for valve stem tip is 0.2 mm (0.008 in) or less.



Valve Guide Clearance

- Perform the inspection before removing valve guides.
- Check that the valve stem diameter is within specifications.
- Push valve approximately 25 mm (0.98 in) toward combustion chamber, move valve toward dial indicator to measure valve movement.
- Valve guide clearance is 1/2 of movement on dial indicator.

Standard:

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

Exhaust : 0.040 - 0.073 mm (0.0016 - 0.0029 in)

Limit:

Intake : 0.08 mm (0.0031 in)

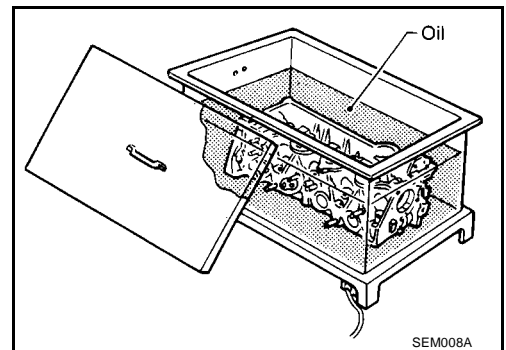
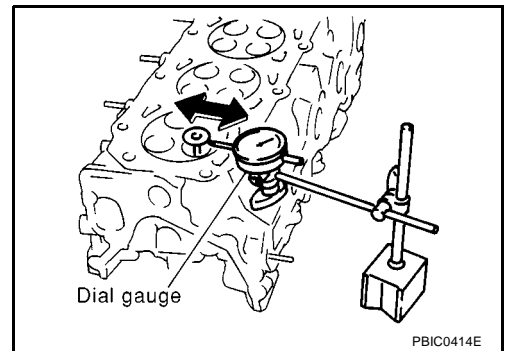
Exhaust : 0.10 mm (0.0039 in)

- If the measured value exceeds the limit, replace valve guide.

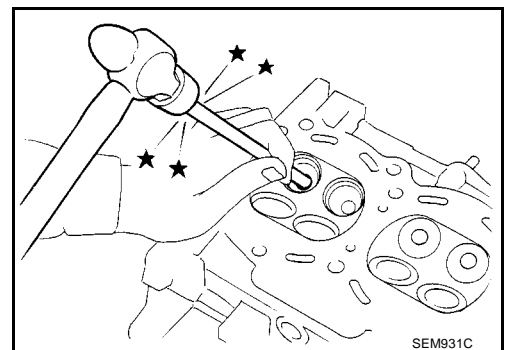
Valve Guide Replacement

- When removing valve guide, replace it with oversized [0.2 mm (0.0008 in)] valve guide.

1. Heat cylinder head to 110 to 130°C (230 to 266°F) in oil bath.

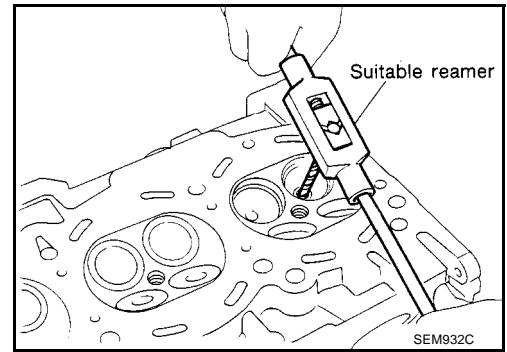


2. Using valve guide drift, tap valve guides out from the combustion chamber side.



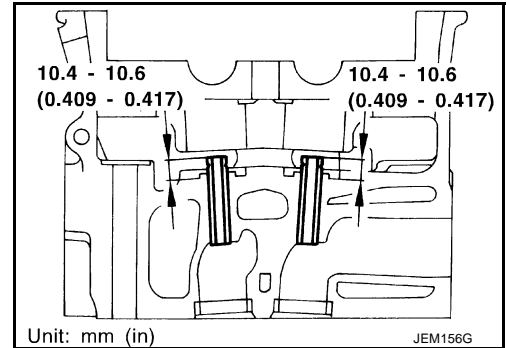
- Remove cylinder head valve guide hole.

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



- Heat cylinder head to 110 to 130°C (230 to 266°F) in oil bath.
- Using valve guide drift, press fit valve guides from camshaft side, referring to the dimension shown in the figure.

Projection "L" : 10.4 - 10.6 mm (0.409 - 0.417 in)

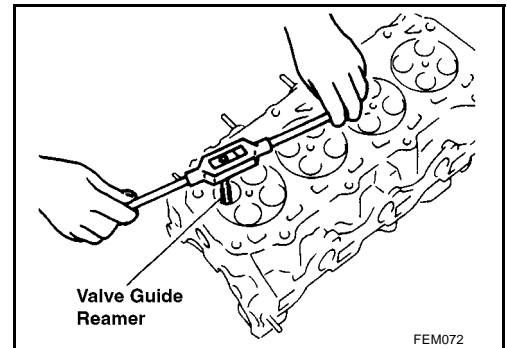


- Using valve guide reamer, perform reaming to the press-fitted valve guides.

Reaming specifications:

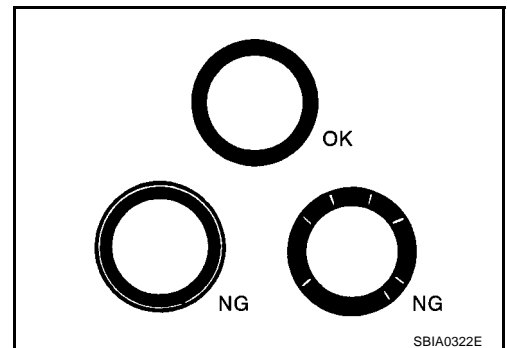
Intake and Exhaust

6.000 - 6.018 mm (0.2362 - 0.2369 in)



Valve Seat Contact

- Before starting this check, confirm that the dimension of valve guide and valves are as specified.
- Apply red lead primer on contacting surfaces of valves seat and of valve face to examine the conditions of contacting surfaces.
- Check that the paint on contacting surfaces is continuous along the entire circumference.
- If there are abnormal indications, grind the valve and check the contact again. If abnormal indications still persist, replace valve seat.



Valve Seat Replacement

- When removing valve seat, replace it with oversized [0.5 mm (0.020 in)] valve seat.
- Cut valve seat to make it thin, and pull it out.

CYLINDER HEAD

[YD]

- Machine cylinder head inner diameter at valve seat installation position.

Machining dimension:

Intake

30.500 - 30.516 mm (1.2008 - 1.2014 in)

Exhaust

29.500 - 29.516 mm (1.1614 - 1.1620 in)

- Heat cylinder head to approximately 110 to 130°C (230 to 266°F) in oil bath.
- After cooling valve seats sufficiently with dry ice, press fit it to cylinder head.

CAUTION:

Do not touch the cooled valve seats directly by hand.

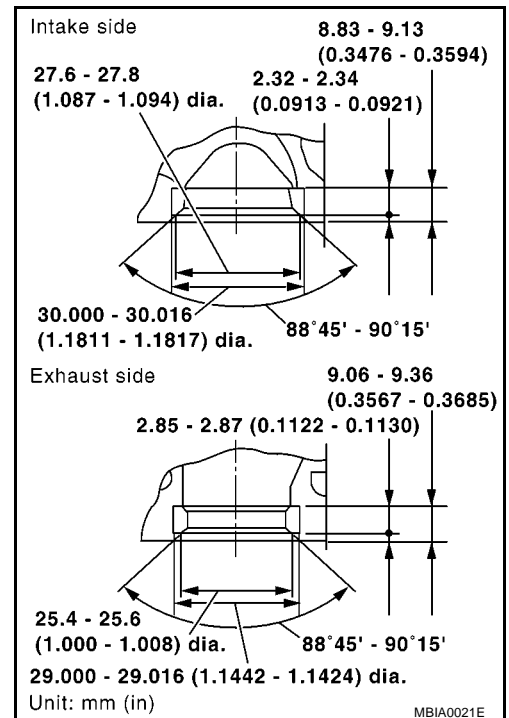
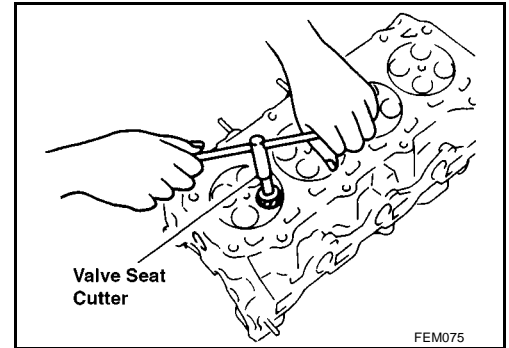
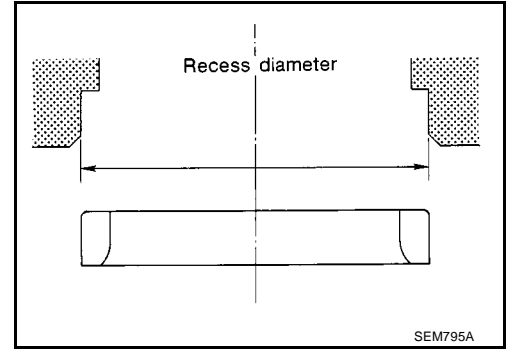
- Using valve seat cutter, finish processing referring to the dimensions shown in the figure.

CAUTION:

When using valve seat cutter, grasp cutter handle with both hands, press cutter onto contacting face all around, and cut thoroughly. If cutter is pressed unevenly or repeatedly, the valve seat surface may be damaged.

- Using compound, perform valve fitting.

- Check again to make sure that contacting status is satisfactory. For details, refer to [EM-86, "Valve Seat Contact"](#).



CYLINDER HEAD

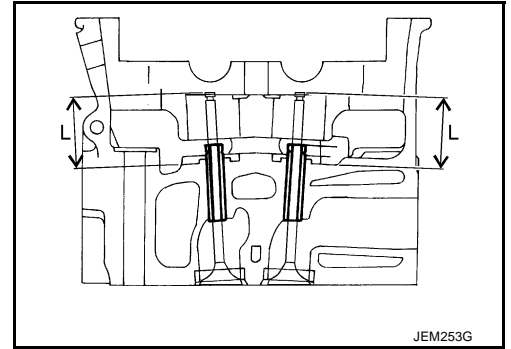
[YD]

8. Use a depth gauge to measure the distance between the mounting surface of the cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 above to adjust it. If it is longer, replace the valve seat with a new one.

Valve seat resurface limit "L":

Intake : 36.53 - 36.98 mm (1.4382 - 1.4559 in)

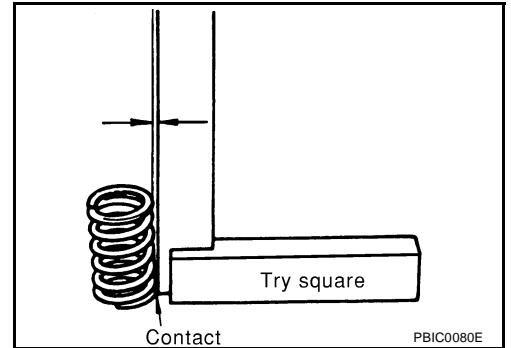
Exhaust : 36.53 - 37.01 mm (1.4382 - 1.4571 in)



Valve Spring Squareness

Position a straightedge to valve spring, turn the spring, and measure the maximum clearance value between top surface of spring and the straightedge.

Limit : 1.5 mm (0.059 in)



Valve Spring Dimensions and Valve Spring Pressure Load

Using valve spring tester, check the following.

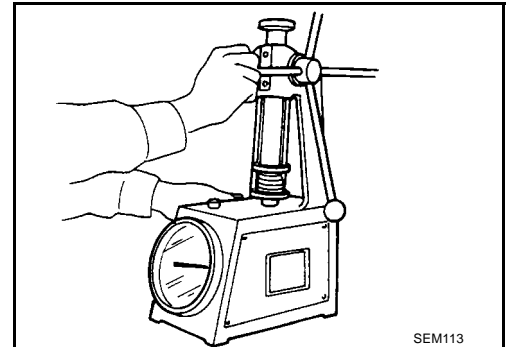
Free length : 44.74 mm (1.7614in)

Installation height : 32.82 mm (1.2921 in)

**Installation load : 184 - 208 N
(18.77 - 21.22 kg, 41.4 - 46.8 lb)**

Height during valve open : 24.82 mm (0.9772 in)

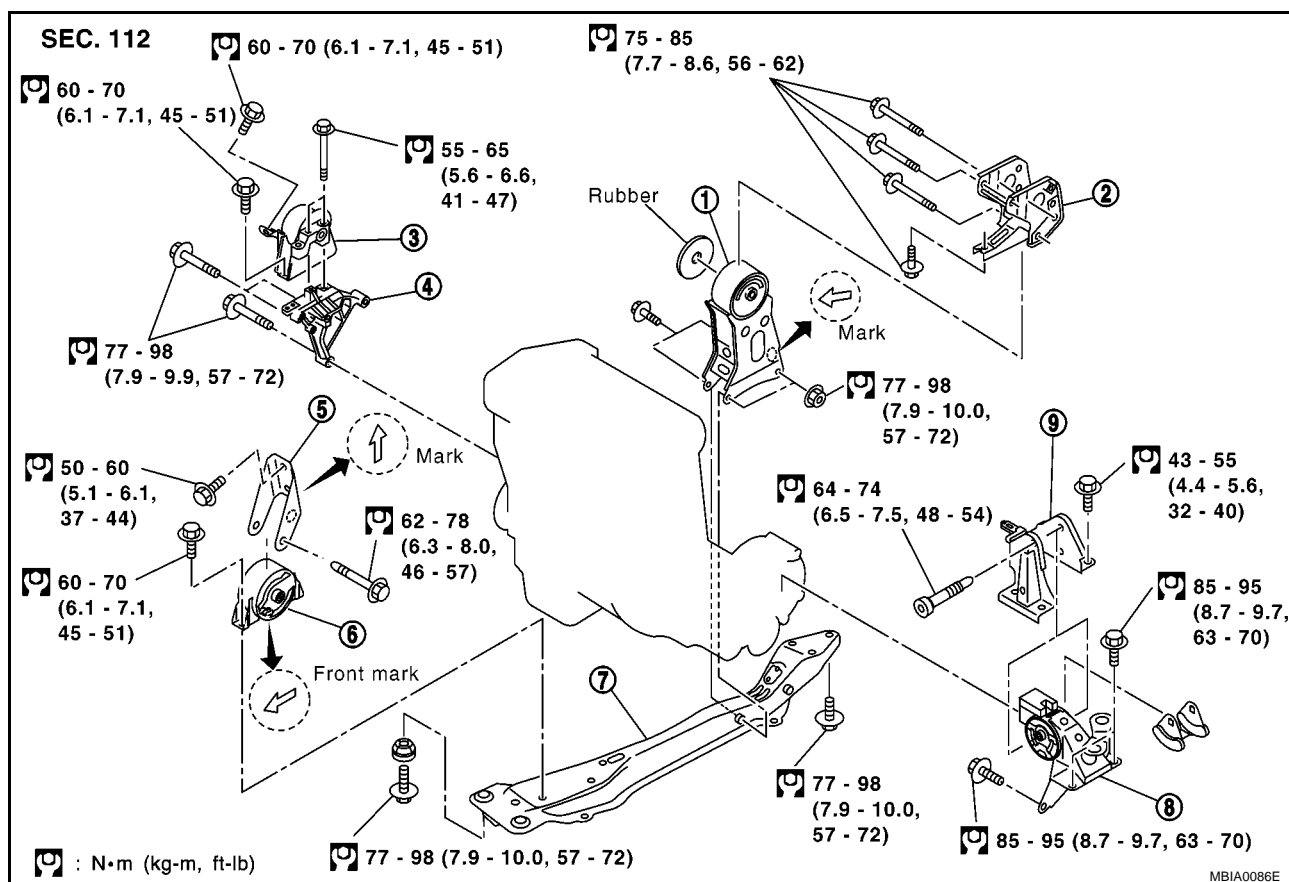
**Load with valve open : 320 - 360 N
(32.65 - 36.73 kg, 71.9 - 80.9 lb)**



ENGINE ASSEMBLY

Removal and Installation

FRS00.SQ3



- | | | |
|-----------------------------------|----------------------------------|------------------------------------|
| 1. Rear engine mounting insulator | 2. Rear engine mounting bracket | 3. RH engine mounting insulator |
| 4. RH engine mounting bracket | 5. Front engine mounting bracket | 6. Front engine mounting insulator |
| 7. Center member | 8. LH engine mounting insulator | 9. LH engine mounting bracket |

WARNING:

- Situate vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Do not start working until exhaust system and coolant are cool enough.
- If items or work required are not covered by the engine main body section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-39, "Garage Jack and Safety Stand"](#).

REMOVAL

Description of work

Remove engine, transaxle and transfer assembly with front suspension member from vehicle down ward. Separate suspension member, and then separate engine and transaxle.

Preparation

1. Remove engine hood.

2. Drain coolant from radiator drain plug.
3. Remove the following parts.
 - LH/RH undercover
 - LH/RH front wheel
 - Battery
 - Engine cover
 - Auxiliary drive belt; Refer to [EM-14, "Removal and Installation"](#) .
 - Air duct and air cleaner case assembly; Refer to [EM-15, "Removal and Installation"](#) .
 - Alternator
 - Radiator and radiator fan assembly; Refer to [CO-10, "Removal and Installation"](#) .
4. Disconnect engine room harness from the engine side and set it aside for easier work.
5. Disconnect all the body-side vacuum hoses and air hoses at engine side.

Engine room LH

6. Disconnect fuel feed and return hoses, and plug it to prevent fuel from draining.
7. Disconnect heater hose, and install plug it to prevent engine coolant from draining.
8. Remove clutch operating cylinder from transaxle, and move it aside.
9. Disconnect shift cable from transaxle.

Engine room RH

10. Remove engine coolant reservoir tank.
11. Remove air conditioner compressor with piping connected from engine. Temporarily secure it on body with a rope to avoid putting load on it.

Vehicle underbody

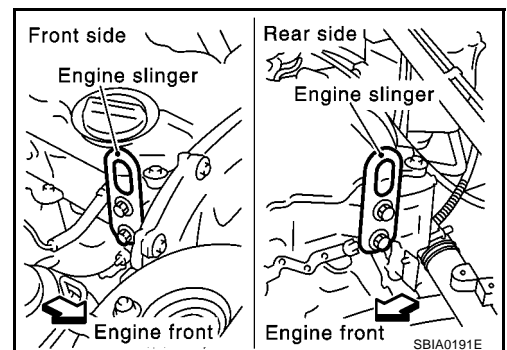
12. Remove exhaust front tube.
13. Remove steering shaft from steering gear.
14. Disconnect power steering fluid cooler piping at a point between body and engine.
15. Remove ABS sensor from brake caliper.
16. Remove brake caliper with piping connected from steering knuckle. Temporarily secure it on body with a rope to avoid load on it.
17. Remove LH/RH suspension from steering knuckle under strut.

Removal

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

Slinger bolts:

 : 30 - 37 N·m (3.0 - 3.8 kg-m, 22 - 27 ft-lb)

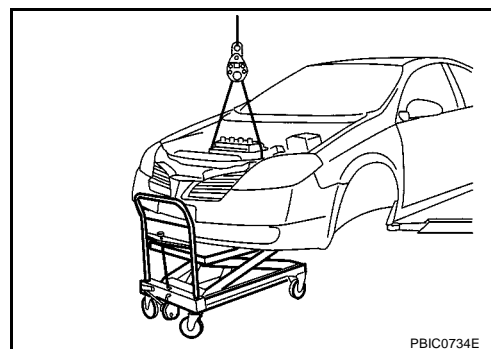


19. Lift with hoist and secure the engine in position.

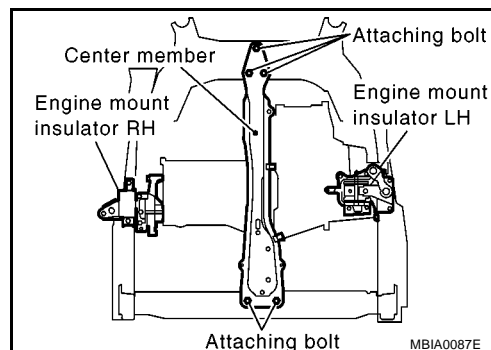
- Use a manual lift table caddy or equivalently rigid tool such as a jack or trestle. Securely support bottom of engine and transaxle, and simultaneously adjust hoist tension.

CAUTION:

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



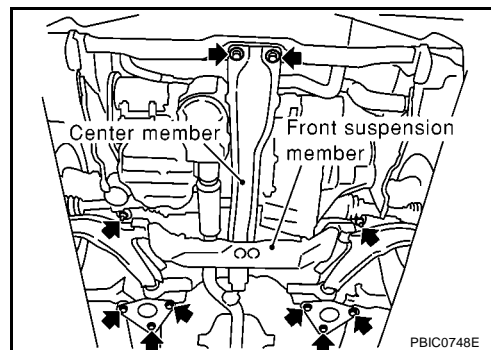
20. Remove RH engine mounting insulator.
21. Pull LH engine mounting through-bolt out.



22. Remove mounting bolts at front end of center member.
23. Remove front suspension member mounting bolts and nuts.
24. Remove engine, transaxle assembly with suspension member from vehicle downward by carefully operating supporting tools.

CAUTION:

- During the operation, make sure that no part interferes with body side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal operation, always be careful to prevent vehicle from falling off the lift due to changes in the center of gravity.
- If necessary, support vehicle by setting a jack or equivalent tool at the rear.



25. Remove power steering pump with piping connected from engine. Move it aside on suspension member.
26. Remove front engine mounting and rear engine mounting through-bolts to remove suspension member.
27. Remove starter motor.
28. Separate engine and transaxle.

INSTALLATION

Install in the reverse order of removal.

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

INSPECTION AFTER INSTALLATION

- Before starting engine check the levels of coolant, lubrications and working oils. If less than required quantity, fill to the specified level.
- Before starting engine, bleed air from fuel piping. Refer to [FL-5, "Air Bleeding"](#).
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of coolant, lubricants, working oil, fuel and exhaust gas.

- Bleed air from passages in pipes and tubes of applicable lines.

CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

EBS00S04

A

EM

C

D

E

F

G

H

I

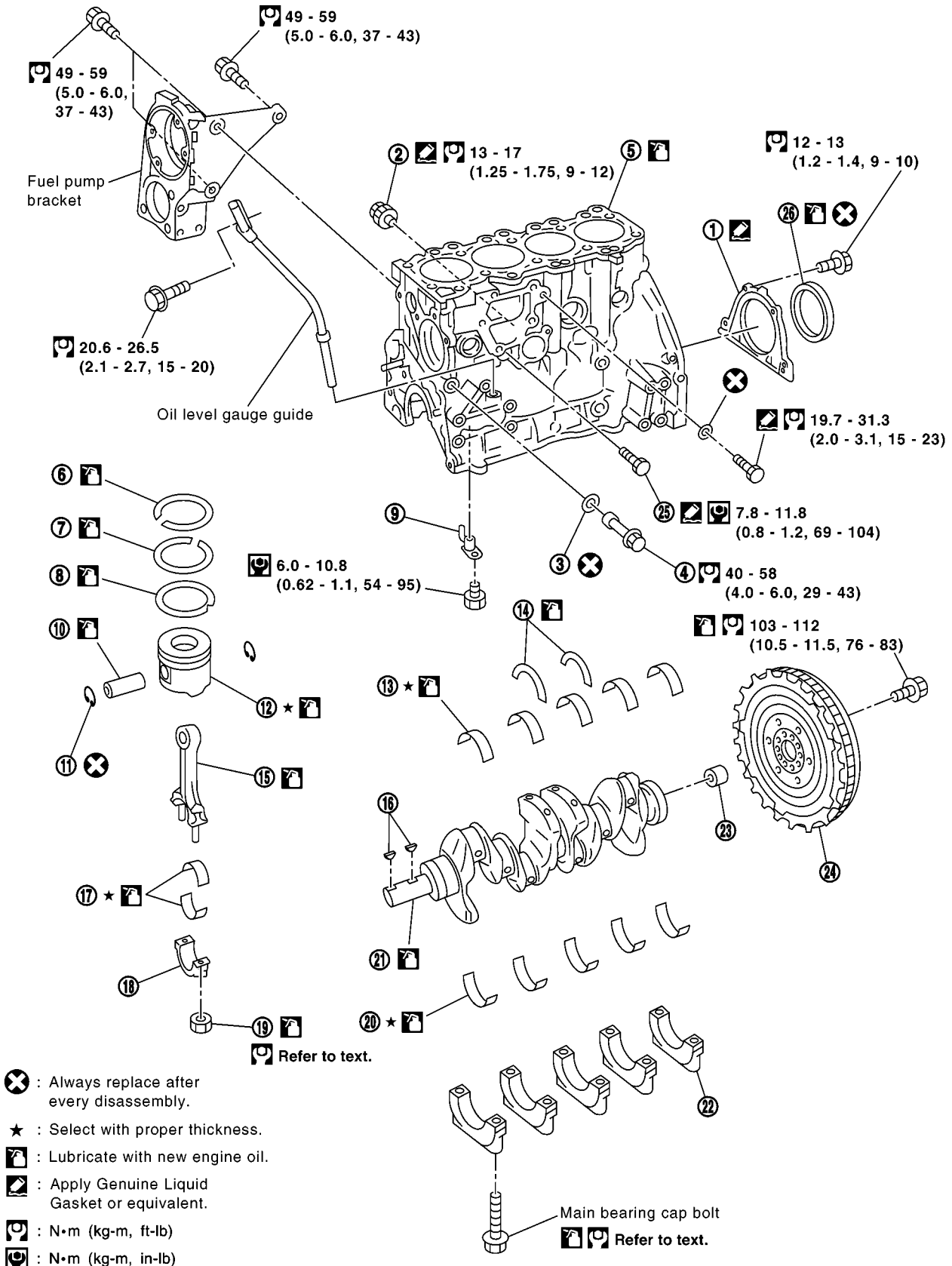
J

K

L

M

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MBIA0015E

CYLINDER BLOCK

[YD]

- | | | |
|---------------------------|----------------------------|------------------------|
| 1. Rear oil seal retainer | 2. Oil pressure switch | 3. Copper washer |
| 4. Oil jet relief valve | 5. Cylinder block | 6. Top ring |
| 7. Second ring | 8. Oil ring | 9. Oil jet |
| 10. Piston pin | 11. Snap ring | 12. Piston |
| 13. Main bearing | 14. Thrust bearing | 15. Connecting rod |
| 16. Key | 17. Connecting rod bearing | 18. Connecting rod cap |
| 19. Connecting rod nut | 20. Main bearing | 21. Crankshaft |
| 22. Main bearing cap | 23. Pilot bush | 24. Flywheel |
| 25. Drain plug | 26. Rear oil seal | |

CAUTION:

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

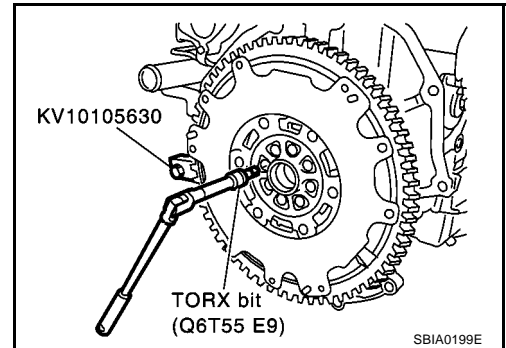
DISASSEMBLY

- Remove engine assembly from the vehicle, then separate engine and transaxle. Refer to [EM-89, "ENGINE ASSEMBLY"](#).
- Remove clutch cover and disk. Refer to [CL-15, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL"](#).
- Install engine to engine stand as follows.

- Remove flywheel.
- Secure ring gear with ring gear stopper, then loosen mounting bolts with TORX bit (size: Q6T55 E9, Commercial Service Tools) and remove them. As an alternative method hold the crankshaft pulley with a pulley holder (SST) to remove the flywheel.

CAUTION:

Do not disassemble flywheel.



- Install engine sub-attachment to the rear side of cylinder block.
 - Align knock pins on cylinder block with pin holes on attachment to install.

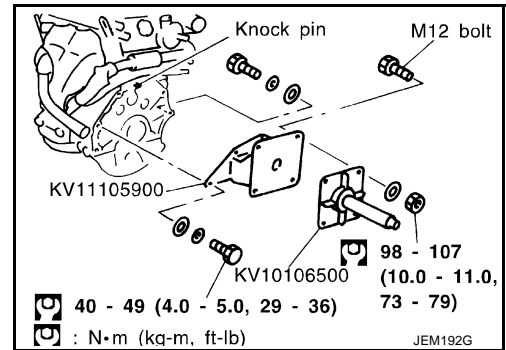
NOTE:

Installation bolts are part of engine sub-attachment.

- Install engine attachment.

NOTE:

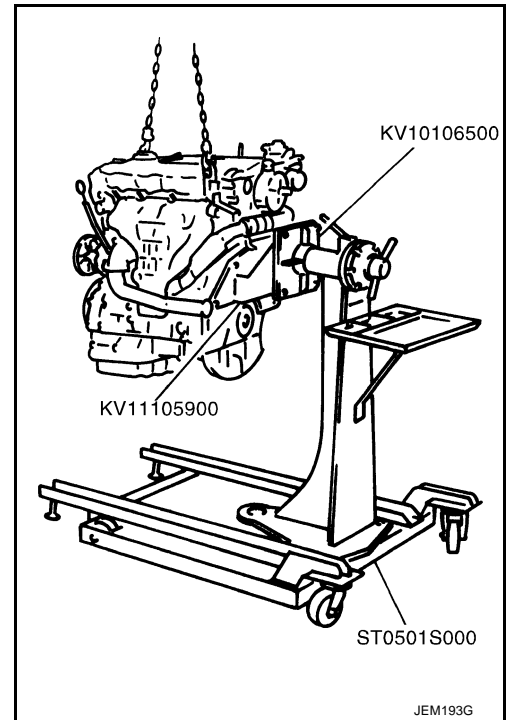
Use commercially available M12 (0.47 in) mounting bolts and nuts (4 sets) with strength grade of 9T (minimum).



- e. Hoist engine and install it to the engine stand.

NOTE:

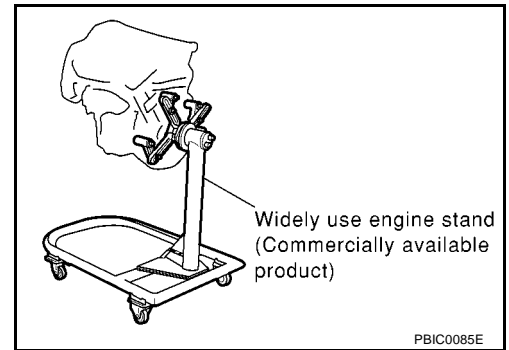
It is possible to set engine sub-attachment and engine attachment to engine stand at first, then install engine later.



- Commercial engine stand can be used.

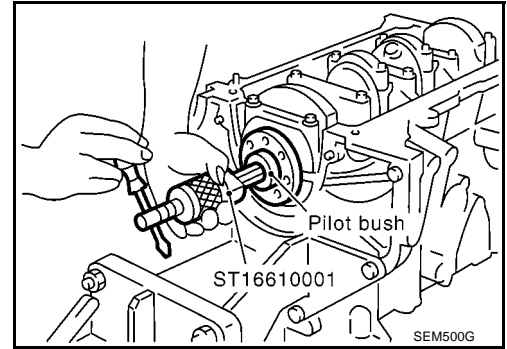
NOTE:

The figure shows an example of general-purpose engine stand that can hold mating surface of transmission with drive plate and rear plate removed.

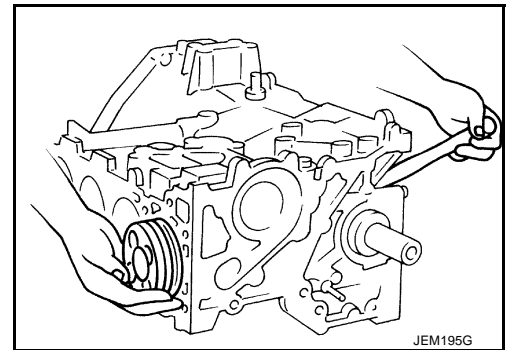


4. Drain engine oil and coolant from inside engine.
5. Remove the following parts and related parts. (Only major parts are listed.)
 - Intake manifold (Refer to [EM-19, "Removal and Installation"](#) .)
 - Exhaust manifold and turbocharger (Refer to [EM-23, "Removal and Installation"](#) .)
 - Rocker cover (Refer to [EM-52, "Removal and Installation"](#) .)
 - Injection tube and fuel injector (Refer to [EM-39, "Removal and Installation"](#) .)
 - Oil pan and oil strainer (Refer to [EM-29, "Removal and Installation"](#) .)
 - Water pump (Refer to [CO-17, "Removal and Installation"](#) .)
 - Thermostat and water piping (Refer to [CO-19, "Removal and Installation"](#) .)
 - Vacuum pump (Refer to [EM-35, "Removal and Installation"](#) .)
 - Secondary timing chain (Refer to [EM-63, "Removal and Installation"](#) .)
 - Primary timing chain (Refer to [EM-68, "Removal and Installation"](#) .)
 - Fuel pump (Refer to [EM-42, "Removal and Installation"](#) .)
 - Camshaft (Refer to [EM-54, "Removal and Installation"](#) .)
 - Cylinder head (Refer to [EM-79, "Removal and Installation"](#) .)
 - Oil cooler (Refer to [LU-12, "Removal and Installation"](#) .)
 - Accessory, accessory bracket and mount brackets
6. Remove fuel pump bracket.

7. If they need to be replaced, replace pilot bushing.
 - Using pilot bushing puller, remove the bushing from rear edge of crankshaft.



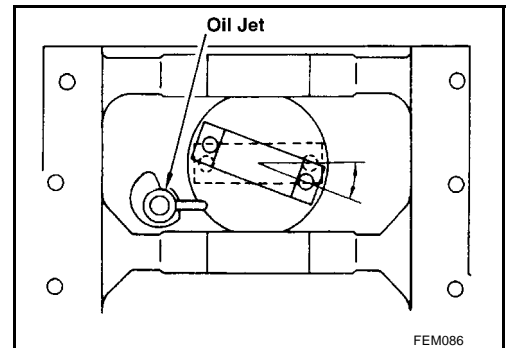
8. Remove rear oil seal retainer.
 - Insert a flat-bladed screwdriver between main bearing cap and rear oil seal retainer to remove retainer.
9. Remove rear oil seal from rear oil seal retainer.
 - Punch out with a flat-bladed screwdriver.
 - **Be careful not to damage rear oil seal retainer.**
10. Remove piston and connecting rod assembly.
 - Before removing piston and connecting rod assembly, check connecting rod side clearance. Refer to [EM-106, "CONNECTING ROD SIDE CLEARANCE"](#).
- a. Move crankshaft pin to be removed to approximately BDC.
- b. Remove connecting rod caps.
- c. Using the grip of a hammer, press the piston and connecting rod assembly out to cylinder head side.



CAUTION:

When removing the piston and connecting rod assembly, prevent the big end of the connecting rod from interfering with the oil jet.

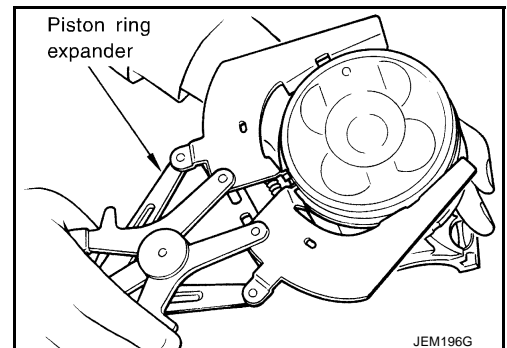
11. Remove connecting rod bearings from connecting rods and caps.
 - Keep them by cylinder to avoid confusion.



12. Remove piston rings from pistons using piston ring expander.

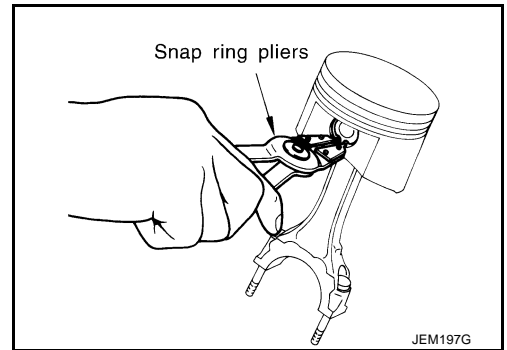
CAUTION:

- When removing, prevent pistons from being damaged.
- Do not expand piston rings excessively. This may damage the piston rings.

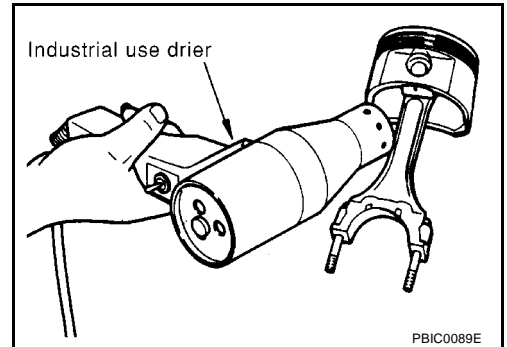


13. Remove pistons from connecting rods.

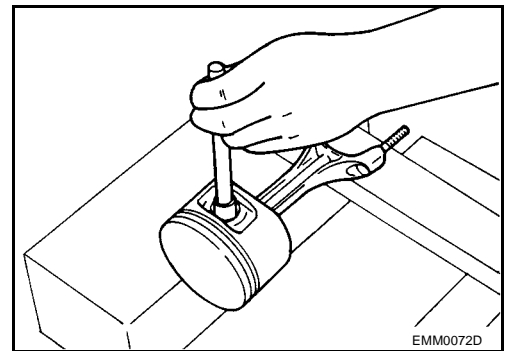
a. Using long nose pliers, remove snap rings.



b. Using industrial dryer, heat pistons up to 60 to 80°C (140 to 176°F).

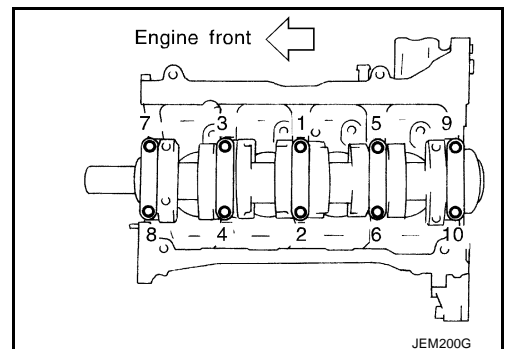


c. Using rod with outer diameter of 26 mm (1.02 in), press piston pins out.



14. Remove main bearing cap bolts.

- With a TORX socket (size: E-14, Commercial Service Tool), loosen main bearing cap bolts in several stages in the reverse order of that shown in the figure and remove them.
- Before loosening main bearing cap bolts, measure crankshaft side clearance. Refer to [EM-105, "CRANKSHAFT SIDE CLEARANCE"](#).



15. Remove main bearing caps.

- Using main bearing cap bolts, remove by rocking bearing cap back and forth.

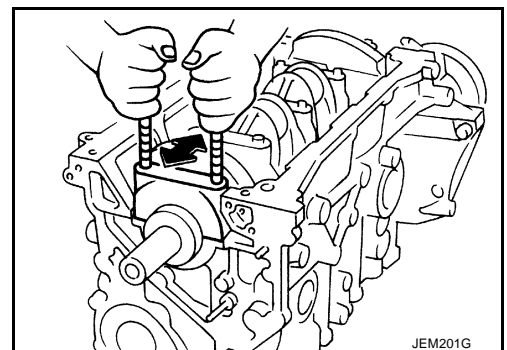
16. Remove crankshaft.

17. Remove main bearings and thrust bearings from cylinder block and main bearing caps.

- **Check the correct installation locations of removed parts. Store them so they do not get mixed up.**

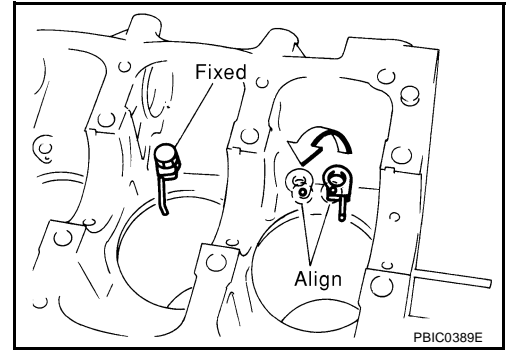
18. Remove oil jet.

19. Remove oil jet relief valve.

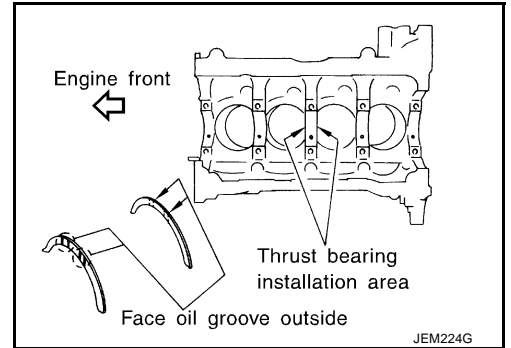


ASSEMBLY

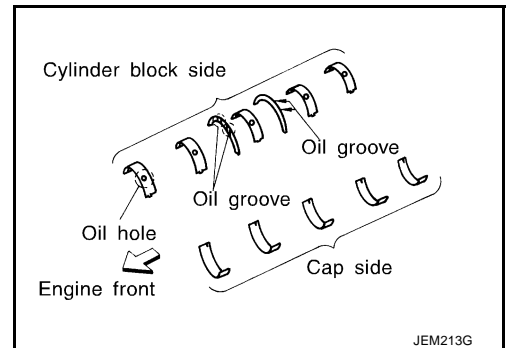
1. Blow air sufficiently to inside coolant passage, oil passage, crankcase and cylinder bore to remove foreign matter.
2. Install oil jet relief valve.
3. Install oil jet.
 - Align knock pin on back of oil jet with hole on block when installing oil jet.



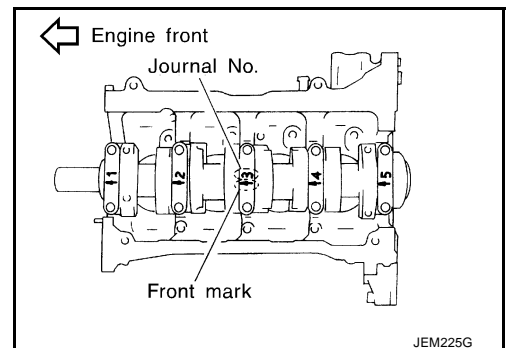
4. Install main bearings and thrust bearings.
 - a. Remove contamination, dust and oil from bearing mounting positions on cylinder block and main bearing caps.
 - b. Install thrust bearings on both sides of No. 3 housing on cylinder block.
 - Install thrust bearings with oil groove facing to crankshaft arm (outside).



- c. Being careful with the direction, install main bearings.
 - Install main bearings with the oil holes and grooves onto the cylinder block side, and those without oil holes and grooves onto the main cap side.
 - While installing bearings, apply engine oil to bearing surfaces (inside). Do not apply oil to rear surfaces, but clean them completely.
 - Align stopper notches on bearings to install them.
 - Check that the oil holes on the cylinder block body are mated with the oil hole positions on the bearings.



5. Install crankshaft to cylinder block.
 - Make sure crankshaft rotates smoothly by hand.
6. Install main bearing caps.
 - Identify main bearing caps by the punched mark. Install correctly matching the journal No. on the bearing cap and the journal with the front mark facing forward.
 - Main bearing caps are commonly processed with the cylinder block. Therefore, caps and cylinder block should be replaced as a set.

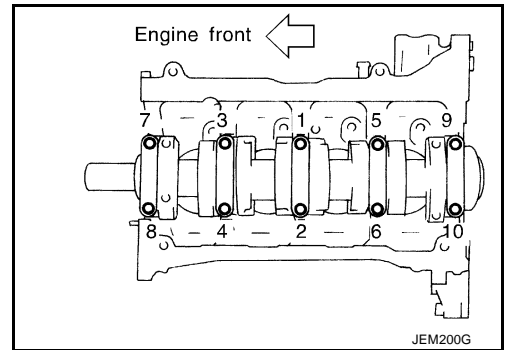


7. Check the main bearing cap bolts for deformation. Refer to [EM-112, "MAIN BEARING CAP BOLT DEFORMATION"](#).

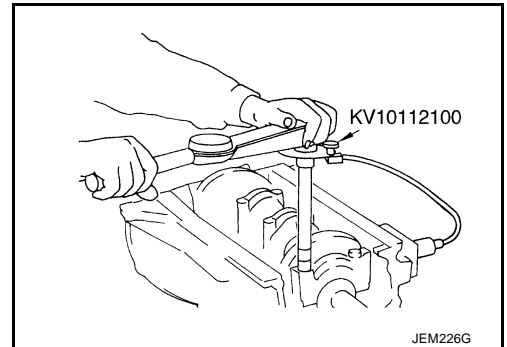
CYLINDER BLOCK

[YD]

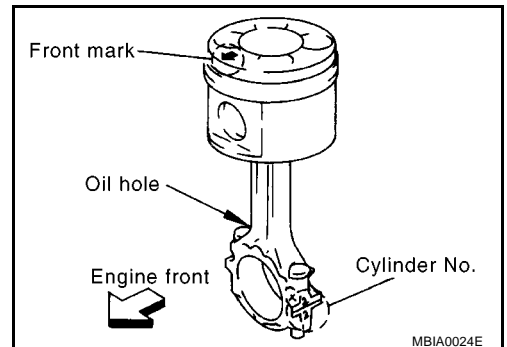
8. Tighten the main bearing cap bolts according to the following procedure:
 - a. Apply engine oil to the threaded part and seat surface of each bolt.
 - b. Tighten to 24 to 30 N·m (2.5 to 3.1 kg-m, 18 to 22 ft-lb) in the numerical order shown in the figure.
 - c. Put alignment marks (with paint) on each bolt and the main bearing cap, all in the same direction. (When using a protractor)



- d. Then, tighten 90° to 95° [target: 90°].
 - **Always use either an angle wrench (SST) or protractor during angular tightening. Avoid tightening based on visual checks alone.**
 - After tightening bolts to specified torque, make sure that crankshaft rotates smoothly.
 - Check crankshaft end side clearance. Refer to [EM-105, "CRANKSHAFT SIDE CLEARANCE"](#).
9. Check the outer diameter of connecting rod bolts. Refer to [EM-113, "CONNECTING ROD BOLT DEFORMATION"](#).



10. Install pistons to connecting rod.
 - a. Using long nose pliers, install snap rings to grooves on piston rear side.
 - Fit snap rings correctly into grooves.
 - b. Install pistons to connecting rods.
 - Using industrial dryer, heat pistons up to approx. 60 to 70°C (140 to 158°F) until piston pin can be pressed down by finger touch. Then insert piston pins into piston and connecting rod from front side of piston toward rear.
 - Assemble piston and connecting rod with front mark of piston crown and cylinder No. stamped on connecting rod being positioned as shown in the figure.
 - c. Install snap rings to front side of pistons.
 - Refer to above step a for precaution on snap ring installation.
 - After installation, check connecting rods for smooth movement.



11. Use piston ring expander to install piston rings.

CAUTION:

When installing, prevent piston from being damaged.

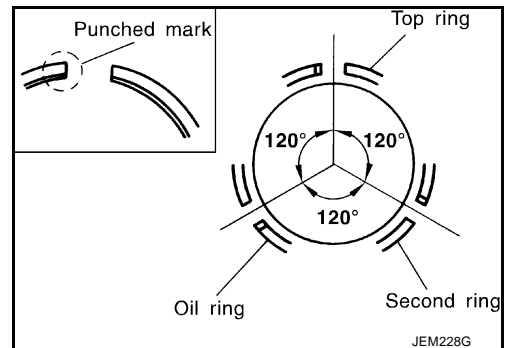
- Install top ring and second ring with stamped surfaces facing upward.

Identification stamp:

Top ring : RTop

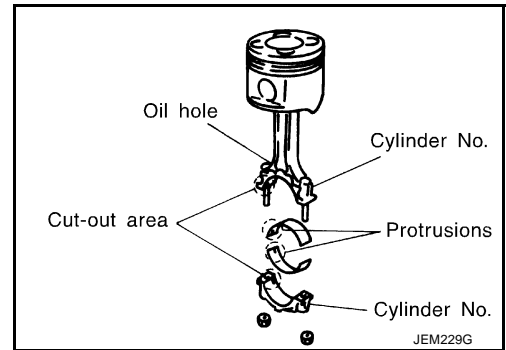
Second ring : R2ND

- Install rings so that three closed gap position 120° apart one another.
- Closed gaps do not need to face in a specific directions, as long as each are positioned 120° apart.



12. Install connecting rod bearings to connecting rods and caps.

- While installing connecting rod bearings, apply engine oil to bearing surfaces (inside). Do not apply oil to rear surfaces, but clean them completely.
- Align stoppers on connecting rod bearings with connecting rod stopper notches to install connecting rod bearings.

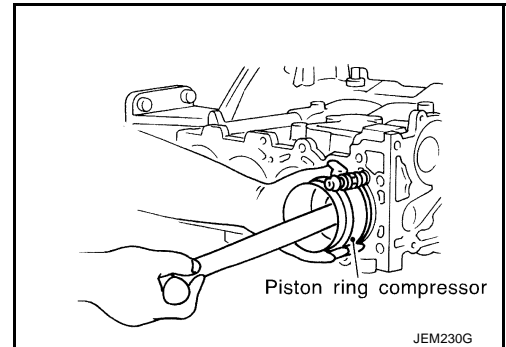


13. Install piston and connecting rod assembly to crankshaft.

- Move crankshaft pin to be assembled to BDC.
- Align cylinder position with cylinder No. on connecting rod to install piston and connecting rod assembly.
- Using piston ring compressor, install piston and connecting rod assembly with front mark on piston crown facing toward the front side of engine.

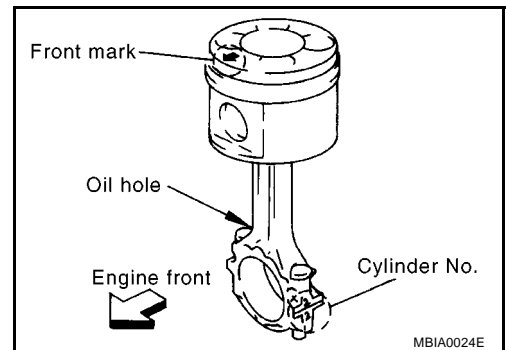
CAUTION:

When installing piston and connecting rod assembly, prevent the big end of connecting rod from interfering with oil jet.



14. Install connecting rod caps and mounting nuts.

- Align cylinder No. stamped on connecting rod with that on cap to install connecting rod cap.
- Make sure that the front mark on connecting rod cap faces towards the front of the engine.



15. Tighten connecting rod nuts according to the following procedure:

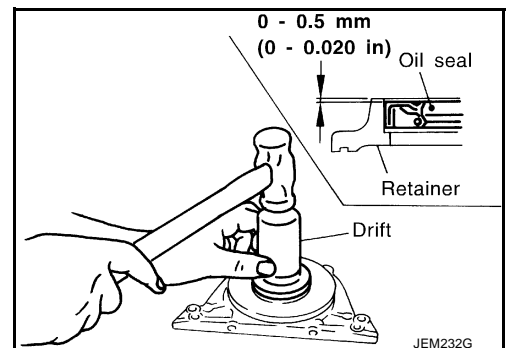
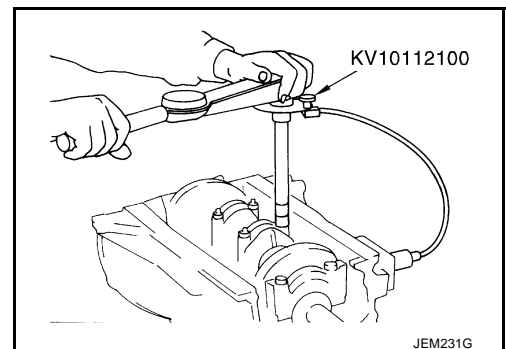
- Apply engine oil on bolt threads and seat surface of nuts.
- Tighten to 29 to 30 N·m (2.9 to 3.1 kg-m, 21 to 22 ft-lb).
- Loosen completely to 0 N·m (0 kg-m, 0 in-lb).
- Tighten to 19 to 20 N·m (1.9 to 2.1 kg-m, 14 to 15 ft-lb).
- Tighten 120° to 125° [target: 120°]. (angular tightening)

- **Always use either an angle wrench (SST) or protractor during angular tightening. Avoid tightening based on visual checks alone.**

- After tightening nuts, check that crankshaft rotates smoothly.
- Check connecting rod side clearance. Refer to [EM-106, "CONNECTING ROD SIDE CLEARANCE"](#).

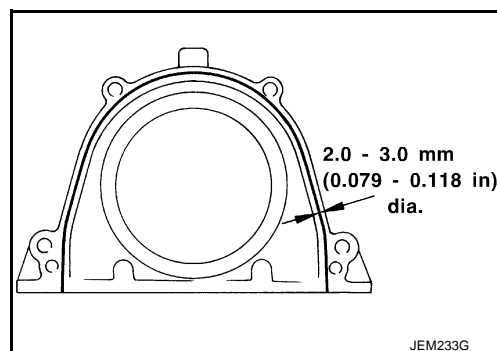
16. Force fit rear oil seal into rear oil seal retainer.

- Using a drift [105 mm (4.13 in) dia.], force fit so that the dimension is as specified in the figure.
- Avoid inclined fitting. Force fit perpendicularly.
- **Do not touch lips of oil seal. Make sure seal surfaces are free foreign materials.**



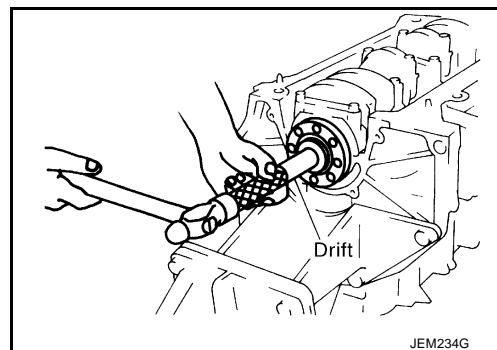
17. Install rear oil seal and retainer assembly.

- Apply a continuous bead of liquid gasket to rear oil seal and retainer assembly as shown in the figure.



18. Press fit pilot bushing into flywheel.

- Using drift with outer diameter of 19 mm (0.75 in), press fit pilot bushing until it stops.

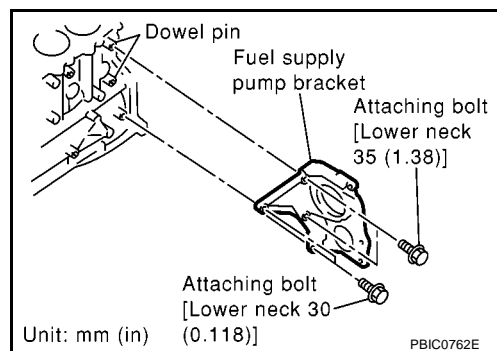


19. Install fuel supply pump bracket.

- Align the bracket with the dowel pins on the block to install.
- The two bolts used for dowel pins have a longer shanks than the other two.

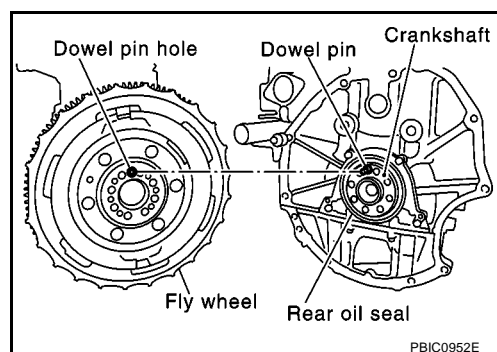
20. Install parts to the engine in the reverse order of disassembly.

21. Remove engine from engine stand in the reverse order of assembly.



22. Install flywheel.

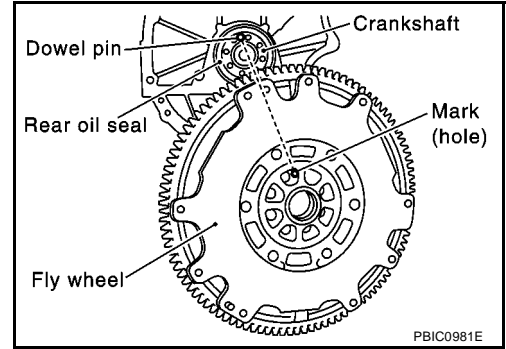
- When installing flywheel to crankshaft, be sure to correctly align crankshaft side dowel pin and flywheel side dowel pin-hole.



CYLINDER BLOCK

[YD]

- There is a mating mark on the clutch cover side, Refer it during installation.



- Holding ring gear with ring stopper (SST), tighten securing bolts with TORX bit (size: Q6T55 E9, Commercial Service Tool).
- Tighten bolts uniformly in a crisscross manner.

How to Select Piston and Bearing

EBS00S05

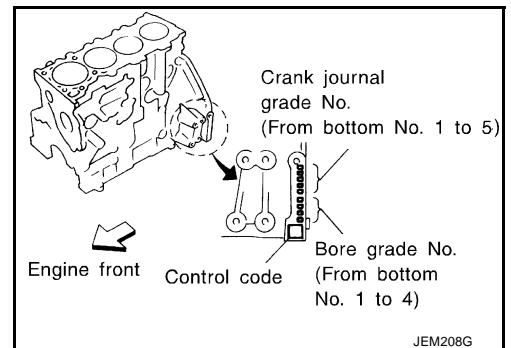
Selection points	Selection parts	Selection items	Selection methods
Between cylinder block to crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)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

- 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

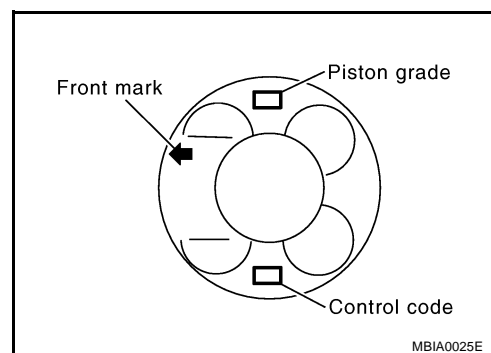
When Using New Cylinder Block

1. Identify the cylinder bore grade (No. 1, 2, or 3) on LH surface at the rear of cylinder block.
 2. Select the piston of the same grade.
- The part No. of piston is specified together with the piston pin as an assembly.



When Re-using an Old Cylinder Block

1. Measure cylinder block bore inner diameter.
2. Referring to "Cylinder block bore inner diameter" in "Piston Selection Table", determine the bore grade.
3. Select the piston of the same grade.

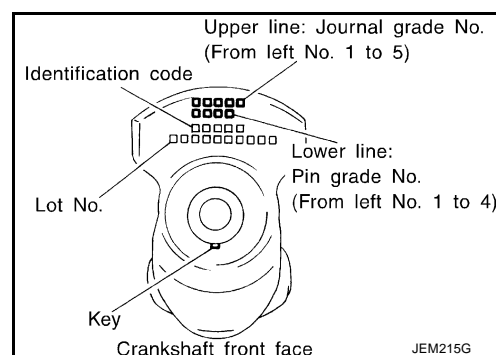
**Piston Selection Table**

Unit: mm (in)

Grade (punched)	1	2	3
Cylinder bore inner diameter	86.000 - 86.010(3.3858 - 3.3862)	86.010 - 86.020(3.3862 - 3.3866)	86.020 - 86.030(3.3866 - 3.3870)
Piston outer diameter	85.928 - 85.942(3.3830 - 3.3835)	85.938 - 85.952(3.3834 - 3.3839)	85.948 - 85.962(3.3838 - 3.3843)

HOW TO SELECT CONNECTING ROD BEARING**When Using a New Crankshaft and Connecting Rod**

1. Identify the pin diameter grade (No. 0, 1, or 2) on front surface of crankshaft.
2. Select the connecting rod bearings of the same grade.
 - There is no grading for the inner diameter of the big end of the connecting rod.

**When Re-using the Removed Crankshaft and Connecting Rod**

1. Measure the inner diameter of the big end of the connecting rod and make sure it is within the specified range.
2. Measure the outer diameter of the crankshaft pin.
3. Determine the crankshaft pin grade by comparing the measurement with the values under the column "Crankshaft pin outer diameter" of the table below.
4. Choose the bearings of the same grade.

Selection Table of connecting Rod Bearing

Unit: mm (in)

Connecting rod big end inner diameter		55.000 - 55.013 (2.1654 - 2.1659)	
Crankshaft pin outer diameter	Grade (punched)	0 (no punching)	
51.968 - 51.974 (2.0460 - 2.0462)	0	<ul style="list-style-type: none"> • Bearing grade No. • Bearing thickness • Oil clearance • Identification color 	STD 0 1.492 - 1.496 (0.0587 - 0.0589) 0.031 - 0.061 (0.0012 - 0.0024) Black

CYLINDER BLOCK

[YD]

51.961 - 51.968 (2.0457 - 2.0460)	1	<ul style="list-style-type: none"> ● Bearing grade No. ● Bearing thickness ● Oil clearance ● Identification color 	STD 1 1.496 - 1.500 (0.0589 - 0.0591) 0.031 - 0.061 (0.0012 - 0.0024) Brown
51.954 - 51.961 (2.0454 - 2.0457)	2	<ul style="list-style-type: none"> ● Bearing grade No. ● Bearing thickness ● Oil clearance ● Identification color 	STD 2 1.500 - 1.504 (0.0591 - 0.0592) 0.031 - 0.061 (0.0012 - 0.0024) Green

Under Size Bearing Usage

- If bearing clearance is out of specifications for connecting rod bearings in standard size, use under size bearings.
- When using under size bearings, measure bearing inner diameter with bearing installed, and grind crankshaft pins to adjust clearance to specification.

Connecting Rod Bearing Under Size list

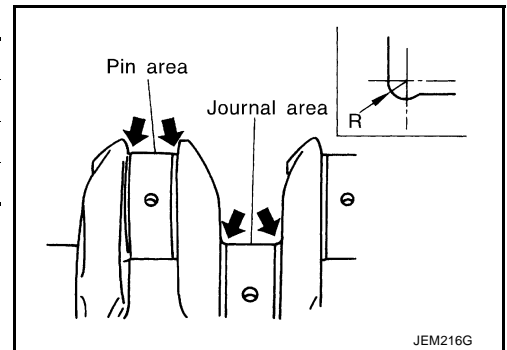
Unit: mm (in)

Size	Thickness
US 0.08 (0.0031)	1.536 - 1.540 (0.0605 - 0.0606)
US 0.12 (0.0047)	1.556 - 1.560 (0.0613 - 0.0614)
US 0.25 (0.0098)	1.621 - 1.625 (0.0638 - 0.0640)

CAUTION:

When grinding the crankshaft journal to use an under size bearing, avoid damaging the fillet R.

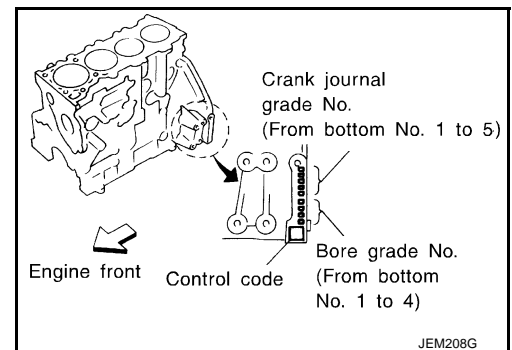
Standard dimension R : 1.5 - 1.7 mm (0.0591 - 0.0669 in)



HOW TO SELECT MAIN BEARING

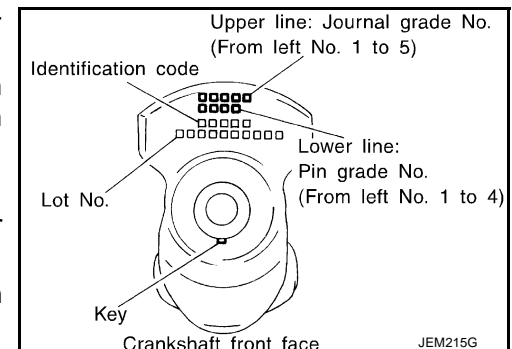
When Using a New Cylinder Block and Crankshaft

1. Identify the bearing housing grade (No. 0, 1, or 2) on LH surface at the rear of the cylinder block, and locate the applicable grade on the "Grade" row in the table below.
2. Identify the journal grade (No. 0, 1, or 2) on the front surface of the crankshaft, and locate the applicable grade under the "Grade" column on the table.
3. The main bearing to be used (STD 0 to STD 4) can be located in the cell where the row and column cross.



When Re-using Removed Cylinder Block and Crankshaft

1. Measure the inner diameter of cylinder block main bearing housing.
2. Locate the applicable cell where the measurement falls, on "Inner diameter of cylinder block main bearing housing" row on the table.
3. Measure the outer diameter of the crankshaft journal.
4. Locate the applicable cell where the measurement falls, under "Crankshaft journal outer diameter" column on the table.
5. The main bearing to be used (STD 0 to STD 4) can be located in the cell where the row and column cross.



CYLINDER BLOCK

[YD]

Main Bearing Grade Table

Unit: mm (in)

Inner diameter of cylinder block main bearing housing			66.654 - 66.663 (2.6242 - 2.6245)	66.663 - 66.672 (2.6245 - 2.6249)	66.672 - 66.681 (2.6249 - 2.6252)
Crankshaft journal outer diameter	Grade (punched)		0	1	2
62.967 - 62.975 (2.4790 - 2.4793)	0	<ul style="list-style-type: none"> Bearing grade No. Bearing thickness Oil clearance Identification color 	STD 0 1.816 - 1.820 (0.0715 - 0.0717) 0.039 - 0.066 (0.0015 - 0.0026) Black	STD 1 1.820 - 1.824 (0.0717 - 0.0718) 0.039 - 0.066 (0.0015 - 0.0026) red	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green
62.959 - 62.967 (2.4787 - 2.6790)	1	<ul style="list-style-type: none"> Bearing grade No. Bearing thickness Oil clearance Identification color 	STD 1 1.820 - 1.824 (0.0717 - 0.0718) 0.039 - 0.066 (0.0015 - 0.0026) red	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green	STD 3 1.828 - 1.832 (0.0720 - 0.0721) 0.039 - 0.066 (0.0015 - 0.0026) Yellow
62.951 - 62.959 (2.4784 - 2.4787)	2	<ul style="list-style-type: none"> Bearing grade No. Bearing thickness Oil clearance Identification color 	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green	STD 3 1.828 - 1.832 (0.0720 - 0.0721) 0.039 - 0.066 (0.0015 - 0.0026) Yellow	STD 4 1.832 - 1.836 (0.0721 - 0.0723) 0.039 - 0.066 (0.0015 - 0.0026) Blue

Under Size Bearing Usage

- If bearing clearance is out of specifications for connecting rod bearings in standard size, use under size bearings.
- When using under size bearings, measure bearing inner diameter with bearing installed, and grind crankshaft journals to adjust clearance to specification.

Main Bearing Under Size List

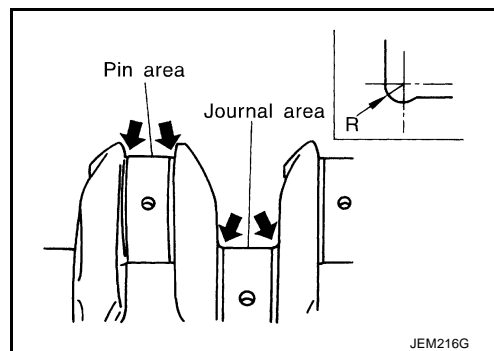
Unit: mm (in)

Size	Thickness
US 0.25(0.0098)	1.949 - 1.953 (0.0767 - 0.0769)

CAUTION:

When grinding crank journals to use undersize bearings, keep corners radius of fillet. (All journals)

Standard dimension R : 1.5 - 1.7 mm (0.0591 - 0.0669 in)



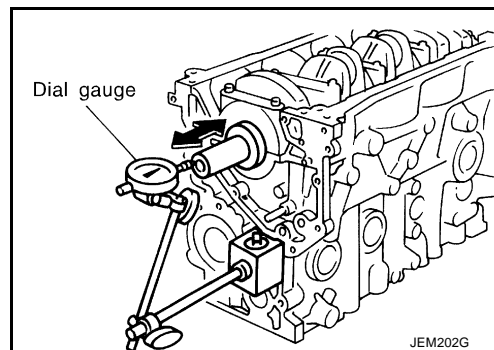
Inspection After Disassembly CRANKSHAFT SIDE CLEARANCE

- Using dial indicator, measure crankshaft travel amount by moving the crankshaft forward or backward.

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

Limit : 0.30 mm (0.0118 in)

- If the value exceeds the limit, replace thrust bearings with new ones and measure again.
If the measurement exceeds the limit again, replace crankshaft with a new one.



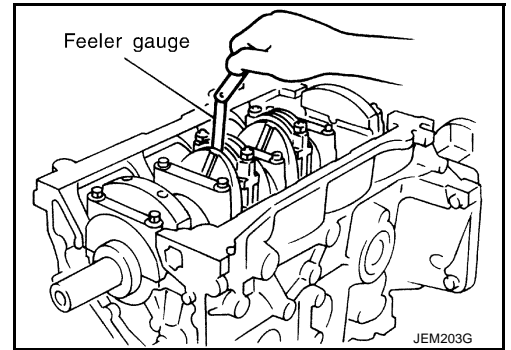
CONNECTING ROD SIDE CLEARANCE

- Using feeler gauge, measure side clearance between connecting rod and crankshaft arm.

Standard : 0.200 - 0.350 (0.0079 - 0.0138 in)

Limit : 0.4 mm (0.0157 in)

- If measured value exceeds the limit, replace connecting rod and repeat measurement.
If measured value still exceeds the limit, replace crankshaft.

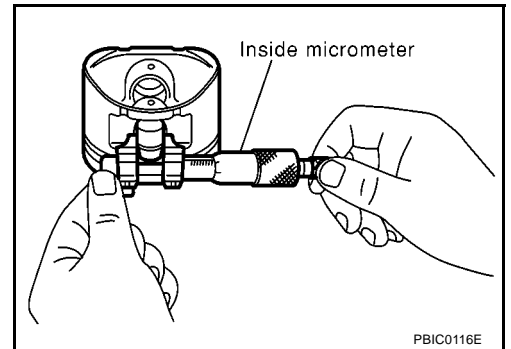


PISTON TO PISTON PIN CLEARANCE

Piston Pin Hole Inner Diameter

Using inside micrometer, measure piston pin hole inner diameter.

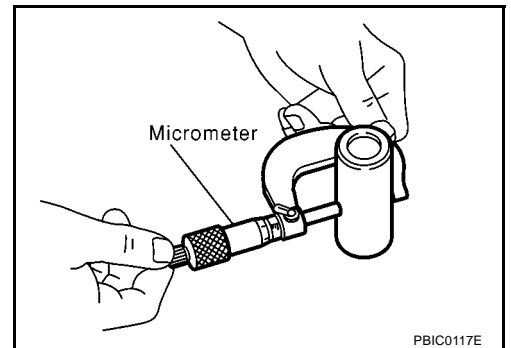
Standard : 28.003 - 28.009 mm (1.1025 - 1.1027 in)



Piston Pin Outer Diameter

Using micrometer, measure piston pin outer diameter.

Standard : 27.995 - 28.000 mm (1.1022 - 1.1024 in)



Calculation of Piston to Piston Pin Clearance

(Piston pin clearance) = (Piston pin hole inner diameter) – (Piston pin outer diameter)

Standard : 0.003 - 0.014 mm (0.0001 - 0.0006 in)

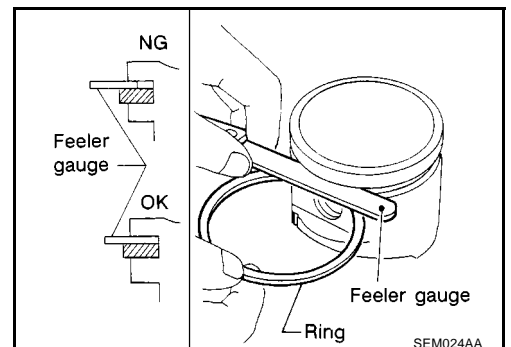
- If clearance is exceeds specification, replace either or both piston/piston pin assembly.

PISTON RING SIDE CLEARANCE

- Using feeler gauge, measure clearance between piston ring and piston ring groove.

Unit: mm (in)

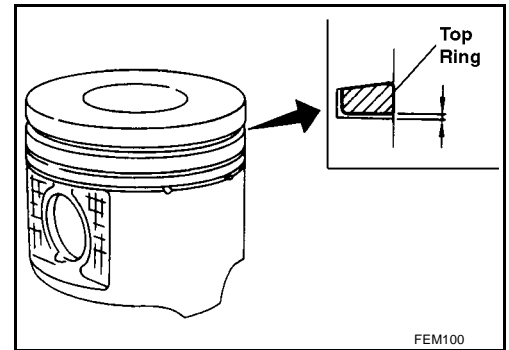
Item	Standard	Limit
Top ring	0.050 - 0.090 (0.0020 - 0.0035)	0.2 (0.008)
2nd ring	0.050 - 0.090 (0.0020 - 0.0035)	0.1 (0.004)
Oil ring	0.030 - 0.070 (0.0012 - 0.0028)	—



CYLINDER BLOCK

[YD]

- Align top ring and external surface of piston. Measure lower side clearance of top ring with top ring pressed onto upper side of ring groove.
- If side clearance exceeds the limit, replace piston ring.
- Check clearance again. If side clearance still exceeds the limit, replace piston.

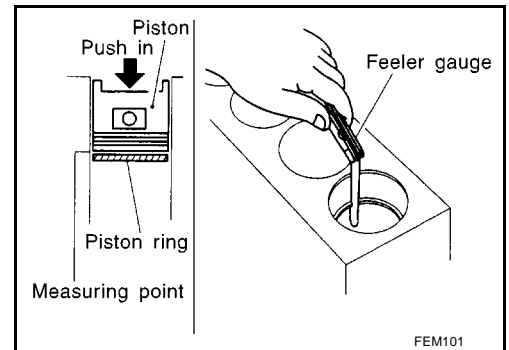


PISTON RING END GAP

- Check that cylinder bore diameter is within specifications. Refer to [EM-109, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- Using piston, press piston ring to cylinder mid point, and measure end gap.

Unit: mm (in)

Item	Standard	Limit
Top ring	0.20 - 0.30 (0.0079 - 0.0118)	1.0 (0.039)
2nd ring	0.31 - 0.51 (0.0122 - 0.0201)	
Oil ring	0.30 - 0.55 (0.0118 - 0.0217)	

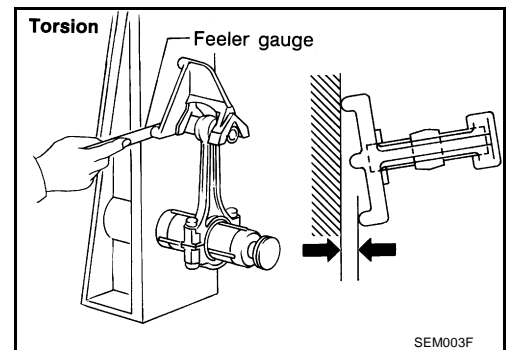
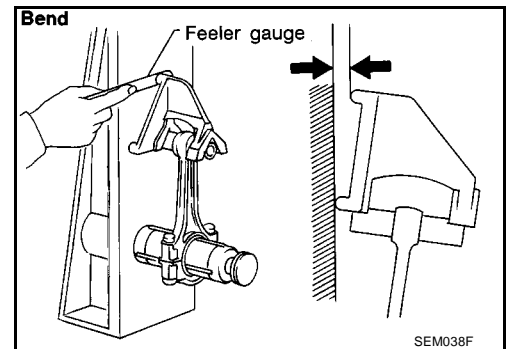


CONNECTING ROD BEND AND TORSION

Use connecting rod aligner to check bend and torsion.

Bend limit : 0.12 mm (0.0047 in)/100 mm (3.94 in)

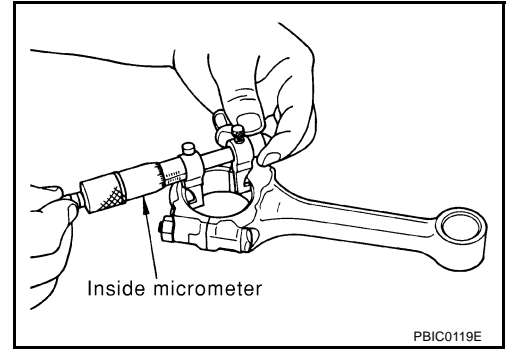
Torsion limit : 0.12 mm (0.0047 in)/100 mm (3.94 in)



CONNECTING ROD BIG END INNER DIAMETER

- Install connecting rod caps without connecting rod bearings and tighten connecting rod nuts to the specified torque. Using inside micrometer, measure connecting rod big end inner diameter.

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

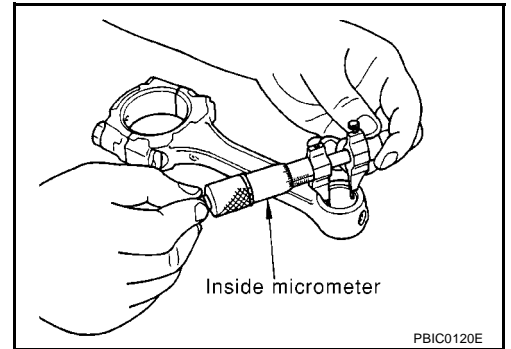


CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

Connecting Rod Small End Inner Diameter

Use inside micrometer to measure small end inner diameter.

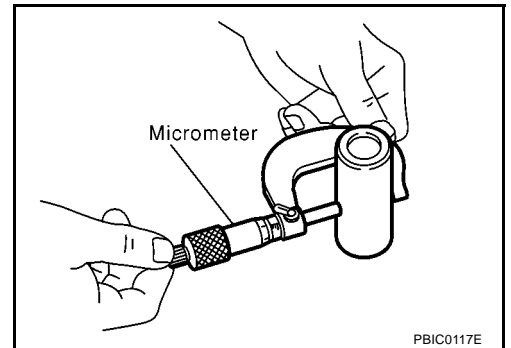
Standard : 28.026 - 28.038 mm (1.1034 - 1.1039 in)



Piston Pin Outer Diameter

Use micrometer to measure piston pin outer diameter.

Standard : 27.995 - 28.000 mm (1.1022 - 1.1024 in)



Calculation of Connecting Rod Bushing Clearance

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

Standard : 0.026 - 0.044 mm (0.0010 - 0.0017 in)

Limit : 0.057 mm (0.0022 in)

- If out of specifications, replace connecting rod and/or piston and piston pin assembly. Refer to [EM-103. "HOW TO SELECT CONNECTING ROD BEARING"](#).

CYLINDER BLOCK TOP SURFACE DISTORTION

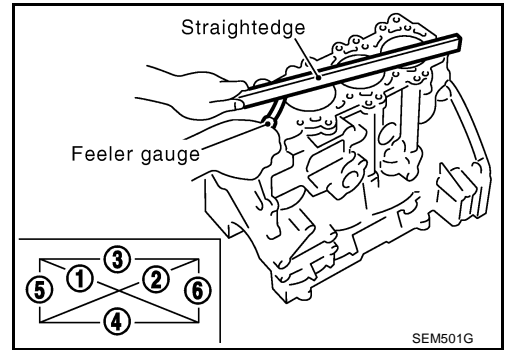
- Using scraper, remove gasket installed onto cylinder block surface. Remove contamination such as oil, scale, and carbon.

CAUTION:

Keep broken pieces of gasket clear of oil and coolant passages.

- Use straightedge and feeler gauge to check block upper surface for distortion.

Limit : 0.04 mm (0.0016 in)

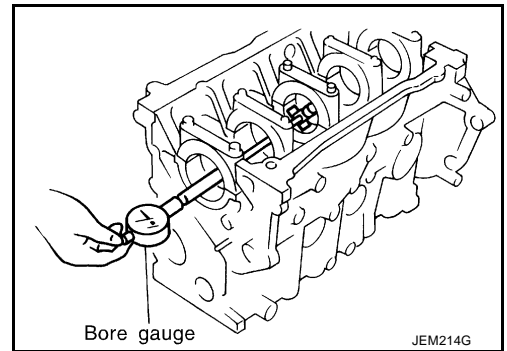


MAIN BEARING HOUSING INNER DIAMETER

- Without installing main bearings, install main bearing caps, and tighten bolts to the specified torque.
- Measure the inner diameter of main bearing housing with a bore gauge.

Standard : 66.654 - 66.681 mm (2.6242 - 2.6252 in)

- If the measurement is out of the specified range, replace cylinder block and main bearing caps.



PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

- Using bore gauge, measure cylinder inner diameters at 6 positions; top, middle, and bottom (C - A) in 2 directions (X, Y).

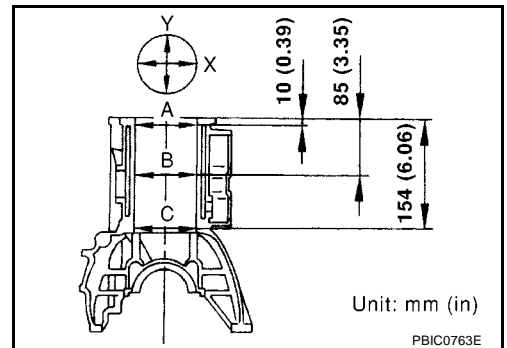
Cylinder inner diameter:

Standard : 86.000 - 86.030 mm (3.3858 - 3.5870 in)

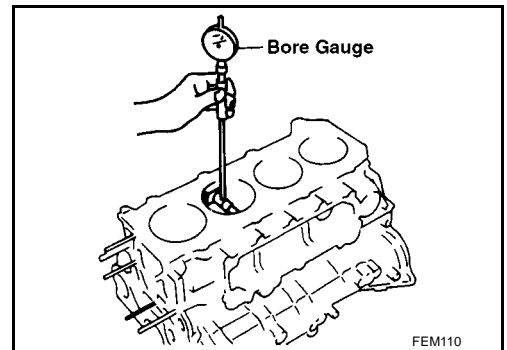
Wear limit : 0.07 mm (0.0028 in)

Out-of-round limit (X - Y) : 0.015 mm (0.0006 in)

Taper limit (C - A) : 0.010 mm (0.0004 in)



- If clearance exceeds the limit, or any flaws or seizures are found on inner surface of cylinder, hone or bore the applicable cylinder or redore all cylinder.

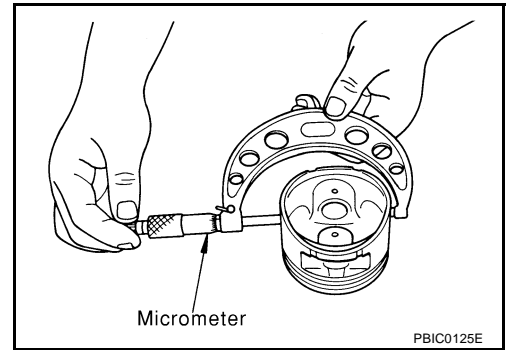


Piston Outer Diameter

Use micrometer to measure piston skirt outer diameter.

Piston skirt diameter:

Measurement position	: 11.0 mm (0.43 in)
	Distance from the bottom
Standard	: 85.928 - 85.962 mm (3.3830 - 3.3843 in)
0.25 (0.0098) O/S	: 86.188 - 86.202 (3.3932 - 3.3938)
0.50 (0.0197) O/S	: 86.438 - 86.452 (3.4031 - 3.4036)



Calculation of Piston Bore Clearance

- Calculate using piston skirt outer diameter and cylinder inner diameter (direction X, position B).
(Clearance) = (Cylinder inner diameter) – (Piston skirt outer diameter)

Specifications at room temperature [20°C (68°F)]:

0.058 - 0.082 mm (0.0023 - 0.0032 in)

- If out of specification, replace piston and piston pin assembly. Refer to [EM-102, "HOW TO SELECT PISTON"](#).

Reboring Cylinder

- Determine cylinder bore size by adding piston-to-cylinder bore clearance to piston diameter.

Rebore size calculation:

$$D = A + B - C$$

Where,

D: Rebored diameter

A: Piston diameter as measured

B: Piston-to-bore clearance

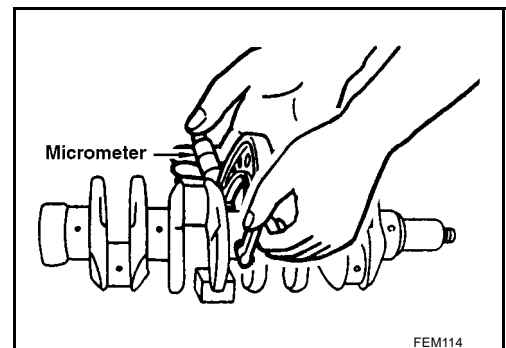
C: Honing allowance 0.02 mm (0.0008 in)

- Install main bearing caps and tighten bolts to specified torque. This will prevent distortion of cylinder bores.
- Cut cylinder bore.
 - 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 at a time.
- Hone cylinders to obtain specified piston-to-bore clearance.
- Measure finished cylinder bore for out-of-round and taper.
 - Measurement should be done after cylinder bore cools down.

CRANKSHAFT JOURNAL OUTER DIAMETER

Use micrometer to measure journal outer diameter.

Standard : 62.951 - 62.975 mm (2.4784 - 2.4793 in)



CRANKSHAFT PIN OUTER DIAMETER

Use micrometer to measure pin outer diameter.

Standard : 51.954 - 51.974 mm (2.0454 - 2.0462 in)

CRANKSHAFT OUT-OF-ROUND AND TAPER

- Using micrometer, measure each journal and pin at 4 points shown in the figure.
- Out-of-round value is indicated by difference in dimensions between directions X and Y at points A and B.
- Taper value is indicated by difference in dimensions between points A and B in directions X and Y.

Out-of-round:

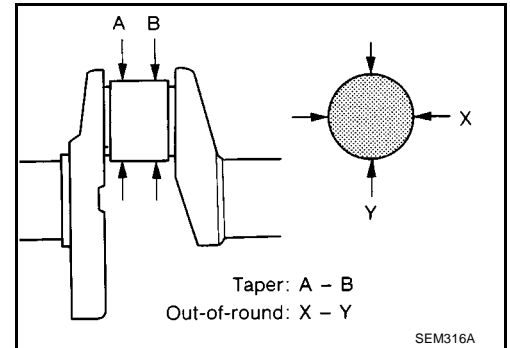
Standard : 0.003 mm (0.0001 in)

Limit : 0.005 mm (0.0002 in)

Taper:

Standard : 0.003 mm (0.0001 in)

Limit : 0.005 mm (0.0002 in)

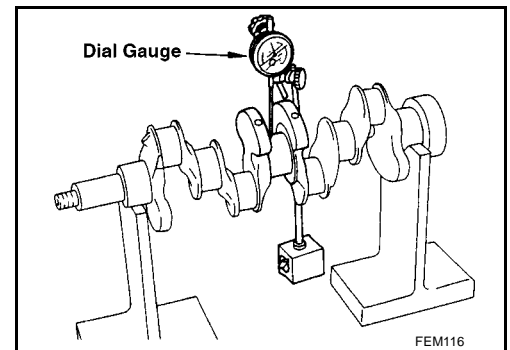


CRANKSHAFT RUNOUT

- Place V-block onto surface plate to support journals at both ends of crankshaft.
- Position dial indicator vertically onto No. 3 journal.
- Rotate crankshaft to read needle movement on dial indicator. (Total indicator reading)

Standard : 0.05 mm (0.0020 in)

Limit : 0.10 mm (0.0039 in)



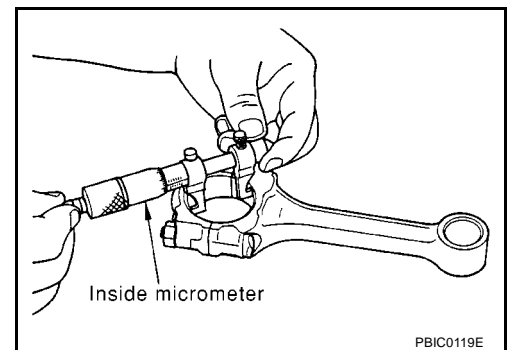
CONNECTING ROD BEARING OIL CLEARANCE

Method by Measurement

- Install connecting rod bearings to connecting rods and caps, and tighten connecting nuts to the specified torque. Use inside micrometer to measure connecting rod bearing inner diameter. (Bearing clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin outer diameter)

Standard : 0.031 - 0.061 mm (0.0012 - 0.0024 in)

- If out of specifications, check connecting rod big end inner diameter and crankshaft pin outer diameter, and select appropriate connecting rod bearing to adjust clearance to specifications. Refer to [EM-103, "HOW TO SELECT CONNECTING ROD BEARING"](#).



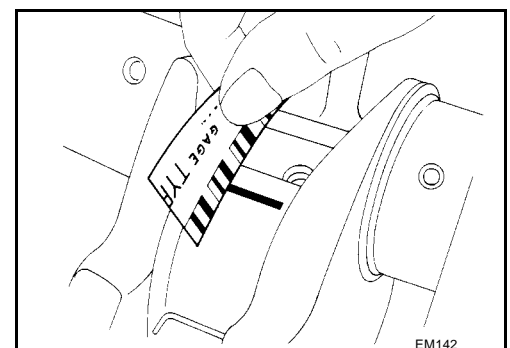
Method Using Plastigage

- Remove contamination such as oil, dust completely from crankshaft pins and each bearing surface.
- Cut plastigage slightly shorter than bearing width, place it in crankshaft direction, avoiding oil holes.
- Install connecting rod bearings to caps, and tighten connecting rod nuts to the specified torque.

CAUTION:

Never rotate crankshaft.

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



CAUTION:

If out of specification, take same action mentioned in “Method by measurement”.

MAIN BEARING OIL CLEARANCE

Method by Measurement

- Install main bearings to the cylinder block and bearing cap, and tighten the bolts to the specified torque. Then, measure the inner diameter of the main bearings.
(Bearing clearance) = (Bearing inner diameter) – (Crankshaft journal outer diameter)

Standard : 0.039 - 0.066 mm (0.0015 - 0.0026 in)

- If out of specification, check main bearing housing inner diameter and crankshaft journal outer diameter, and select appropriate main bearing to adjust clearance to specifications. Refer to [EM-104, "HOW TO SELECT MAIN BEARING"](#).

Method Using Plastigage

- Remove contamination such as oil and dust completely from crankshaft journals and each bearing surface.
- Cut plastigage slightly shorter than bearing width. place it in crankshaft turning direction, avoiding oil holes.
- Install main bearings and bearing cap and tighten to the specified torque.

CAUTION:

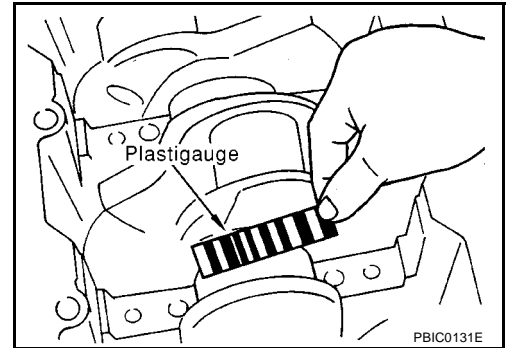
Never rotate crankshaft.

- Remove main bearings and bearings, and measure plastigage width using scale on plastigage bag.

CAUTION:

If out of specification, take same action mentioned in “Method by measurement”.

- Install main bearings to the cylinder block and bearing cap, and tighten the bolts to the specified torque. Then, measure the inner diameter of the main bearings.

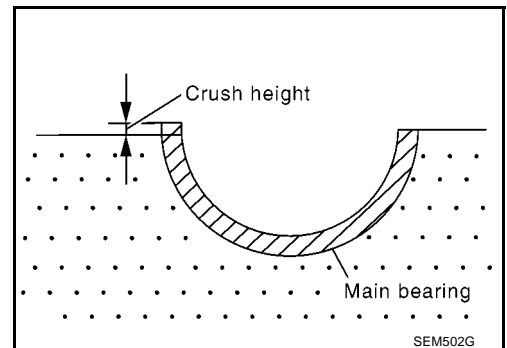


MAIN BEARING CRUSH HEIGHT

- 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 : Crush height must exist.

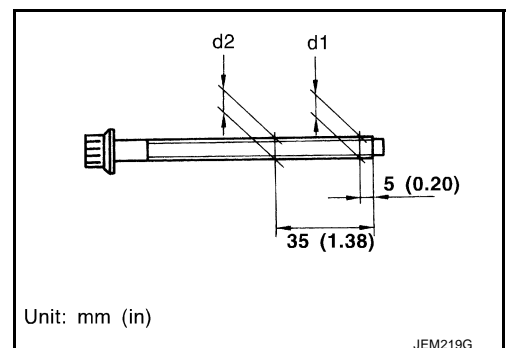
- If out of specification, replace main bearings.



MAIN BEARING CAP BOLT DEFORMATION

- Measure the outer diameter of threaded area, d1 and d2, at the points specified in the figure.
- When the necked point is identified at a point other than where specified, measure at the point as d2.
- Calculate the difference between d1 and d2.

Limit : 0.13 mm (0.0051 in)



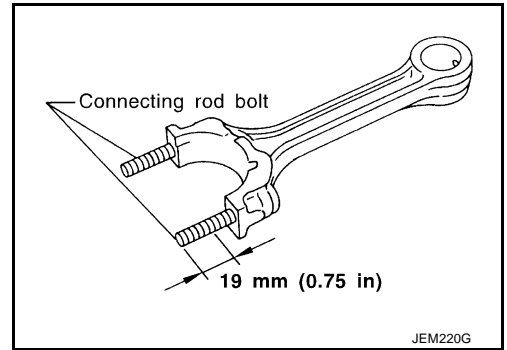
CONNECTING ROD BOLT DEFORMATION

- Install nuts to connecting rod bolts. Check that the nut can be screwed smoothly on bolt threads by hand to the last thread on the bolt.
- If the nut does not screw in smoothly, measure the outer diameter of the bolt thread at the point specified in the figure.
- If a necked point is identified, measure at that point.

Standard : 8.90 - 9.00 mm (0.3504 - 0.3543 in) dia.

Limit : 8.75 mm (0.3445 in) dia.

- If the measurement exceeds the limit, replace connecting rod bolts and nuts.

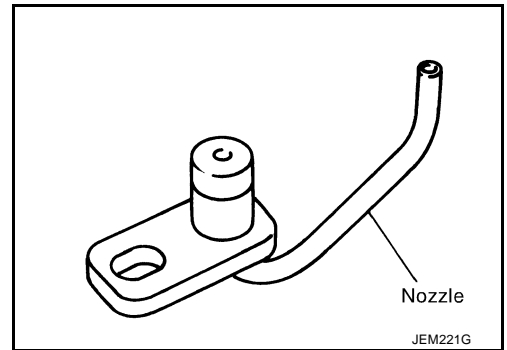


OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.

Standard : Deformation and damage.

- If it out of the standard, replace oil jet.



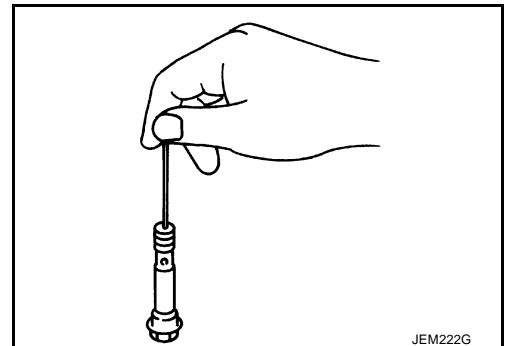
OIL JET RELIEF VALVE

- Using a clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.

Standard

: Valve moves smoothly with proper reaction force.

- If it is out of the standard, replace oil jet relief valve.



MOVEMENT AMOUNT OF FLYWHEEL

NOTE:

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

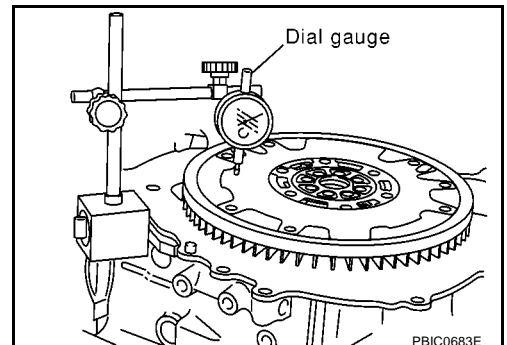
Flywheel Runout

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

Standard : 0.45mm (0.0177 in) or less

Limit : 1.3mm (0.051 in)

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

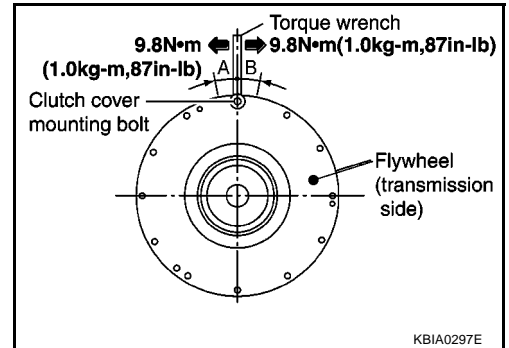


Movement Amount in Rotation Direction

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

Standard : 26.2 mm (1.031 in) or less

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



SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

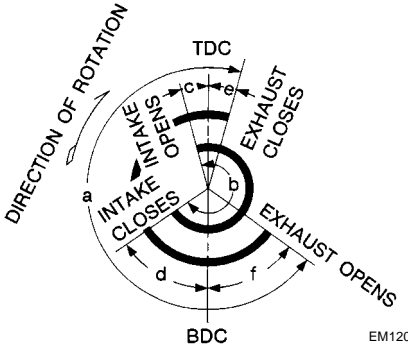
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

Standard and Limit GENERAL SPECIFICATIONS

EBS00S07

Cylinder arrangement		In-line 4
Displacement	Unit: cm ³ (cu in)	2,184 (133.27)
Bore and stroke	Unit: mm (in)	86 x 94 (3.39 x 3.70)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		5
Compression ratio		16.7
Compression pressure Unit: kPa (bar, kg/cm ² , psi)/200 rpm	Standard	2,991 (29.9, 30.5, 434)
	Minimum	2,452 (24.5, 25.0, 356)
	Differential limit between cylinders	490 (4.9, 5.0, 71)

Valve timing		
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Unit: degree

a	b	c	d	e	f
224	212	2	30	-2	46

INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

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

DRIVE BELTS

Belt Deflection:

Unit: mm (in)

Applied belt	Belt deflection with 98 N (10 kg, 22 lb) force applied*		
	New	Adjusted	Limit for re-adjusting
Air conditioner compressor belt	4 - 5 (0.16 - 0.20)	6 - 7 (0.24 - 0.28)	8.5 (0.335)
Alternator & water pump belt	9.0 - 10.5 (0.354 - 0.413)	11.0 - 12.5 (0.433 - 0.492)	16.5 (0.650)

*: When engine is cold.

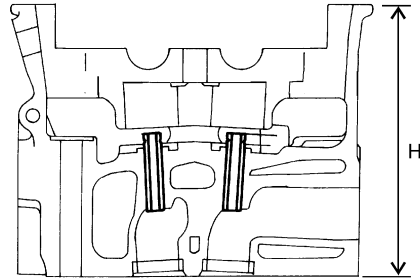
SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

CYLINDER HEAD

Unit: mm (in)

Item	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.04 (0.0016)



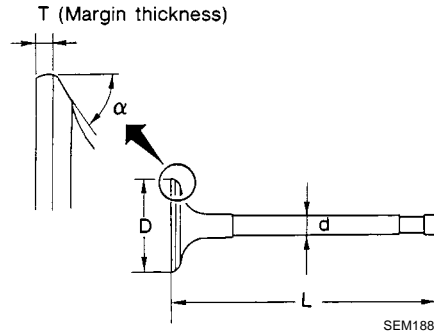
Nominal cylinder head height:
H = 153.9 - 154.1 mm (6.059 - 6.067 in)

JEM204G

VALVE

Valve

Unit: mm (in)



SEM188

Valve head diameter "D"	Intake	28.0 - 28.3 (1.102 - 1.114)
	Exhaust	26.0 - 26.3 (1.024 - 1.035)
Valve length "L"	Intake	106.72 (4.2016)
	Exhaust	106.36 (4.1874)
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.945 - 5.960 (0.2341 - 0.2346)
Valve seat angle "α"	Intake	45°15' - 45°45'
	Exhaust	
Valve margin "T"	Intake	1.38 (0.0543)
	Exhaust	1.48 (0.0583)
Valve margin "T" limit		More than 1.0 (0.039)
Valve stem end surface grinding limit		Less than 0.2 (0.008)

Valve Clearance

Unit: mm (in)

Item	Cold*1	Hot*2 (reference data)
Intake	0.24 - 0.32 (0.0094 - 0.0126)	0.274 - 0.386 (0.011 - 0.015)
Exhaust	0.26 - 0.34 (0.0102 - 0.0134)	0.308 - 0.432 (0.012 - 0.017)

*1: Approximately 20°C (68°F)

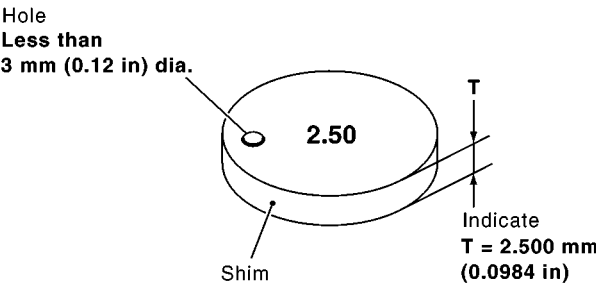
*2: Approximately 80°C (176°F)

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

Available Shims

Stamped mark	Thickness mm (in)
2.10	2.10 (0.0827)
2.12	2.12 (0.0835)
2.14	2.14 (0.0843)
2.16	2.16 (0.0850)
2.18	2.18 (0.0858)
2.20	2.20 (0.0866)
2.22	2.22 (0.0874)
2.24	2.24 (0.0882)
2.26	2.26 (0.0890)
2.28	2.28 (0.0898)
2.30	2.30 (0.0906)
2.32	2.32 (0.0913)
2.34	2.34 (0.0921)
2.36	2.36 (0.0929)
2.38	2.38 (0.0937)
2.40	2.40 (0.0954)
2.42	2.42 (0.0953)
2.44	2.44 (0.0961)
2.46	2.46 (0.0969)
2.48	2.48 (0.0976)
2.50	2.50 (0.0984)
2.52	2.52 (0.0992)
2.54	2.54 (0.1000)
2.56	2.56 (0.1008)
2.58	2.58 (0.1016)
2.60	2.60 (0.1024)
2.62	2.62 (0.1031)
2.64	2.64 (0.1039)
2.66	2.66 (0.1047)
2.68	2.68 (0.1055)
2.70	2.70 (0.1063)
2.72	2.72 (0.1071)
2.74	2.74 (0.1079)



SEM512G

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

Valve Spring

Free height	mm (in)	44.74 (1.7614)
Pressure	N (kg, lb) at height mm (in)	184 - 208 (18.77 - 21.22, 41.4 - 46.8) at 32.82 (1.2921)
Out-of-square	mm (in)	Limit 1.5 (0.059)
Height during valve open	mm (in)	24.82 (0.9772)
Load with valve open	N (kg, lb)	320 - 360 (32.65 - 36.73, 71.9 - 80.9)

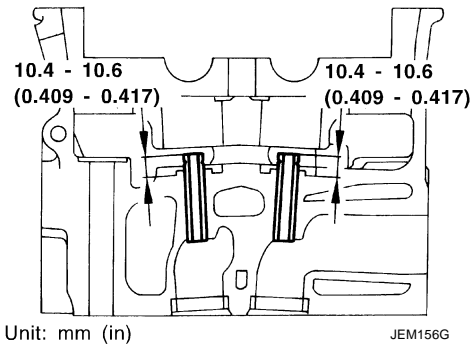
Valve Lifter

Unit: mm (in)

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

Valve Guide

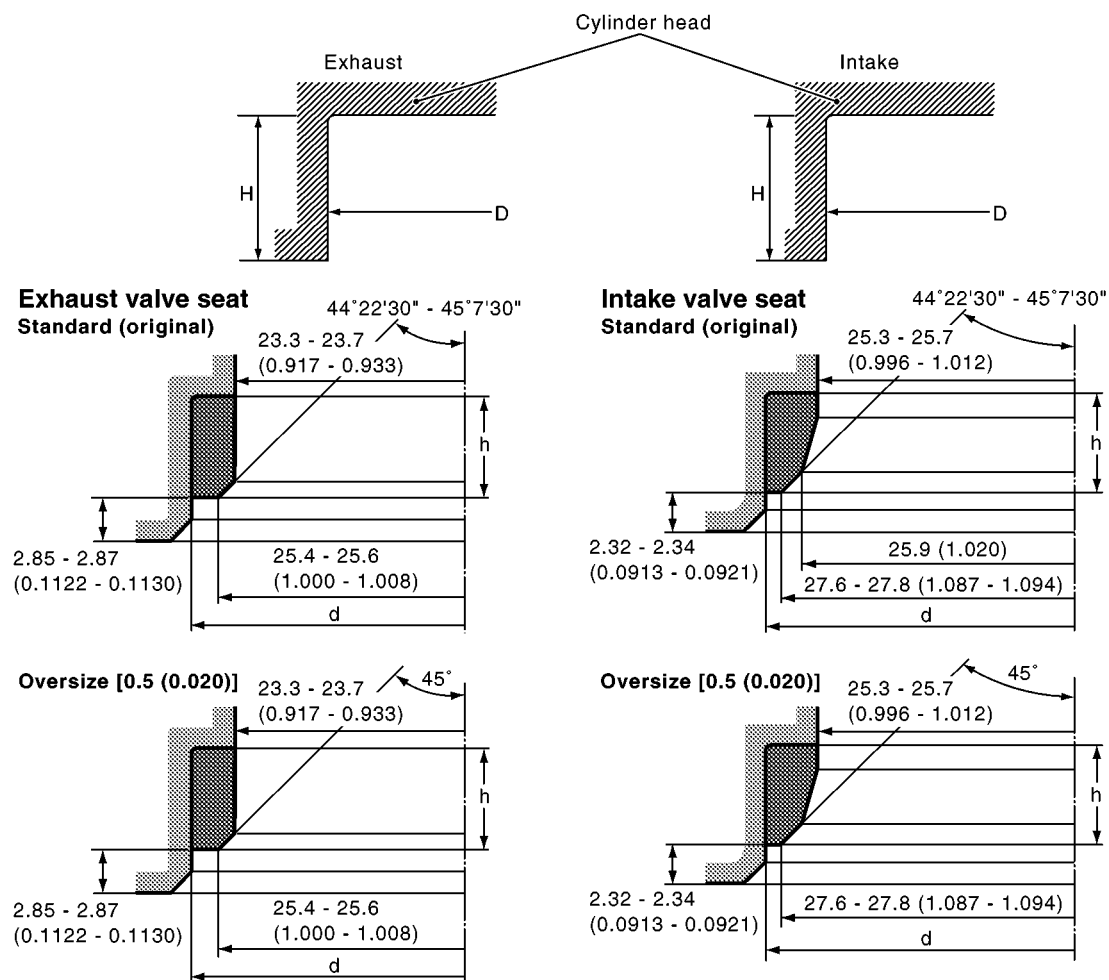
Unit: mm (in)



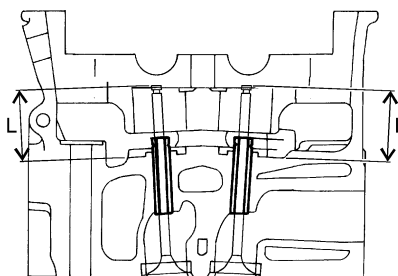
Item		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
Valve guide	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Item		Standard	Limit
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
Valve deflection limit		0.15 (0.0059)	
Projection length		10.4 - 10.6 (0.409 - 0.417)	

Valve Seat

Unit: mm (in)



SEM546G



JEM253G

Item		Standard	Service
Cylinder head seat recess diameter (D)	Intake	30.000 - 30.016 (1.1811 - 1.1817)	30.500 - 30.516 (1.2008 - 1.2014)
	Exhaust	29.000 - 29.016 (1.1417 - 1.1424)	29.500 - 29.516 (1.1614 - 1.1620)
Valve seat interference fit	Intake	0.064 - 0.100 (0.0025 - 0.0039)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	Intake	30.000 - 30.016 (1.1811 - 1.1817)	30.500 - 30.516 (1.2008 - 1.2014)
	Exhaust	29.000 - 29.016 (1.1442 - 1.1424)	29.500 - 29.516 (1.1614 - 1.1620)
Height (h)	Intake	7.0 - 7.1 (0.276 - 0.280)	6.60 - 6.70 (0.2598 - 0.2638)
	Exhaust	6.7 - 6.8 (0.264 - 0.268)	6.3 - 6.4 (0.248 - 0.252)

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

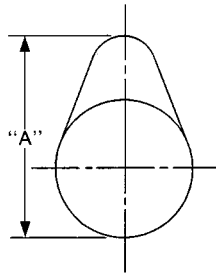
Depth (H)	Intake	8.83 - 9.13 (0.3476 - 0.3594)
	Exhaust	9.06 - 9.36 (0.3567 - 0.3685)
Projection (L)	Intake	36.53 - 36.98 (1.4382 - 1.4559)
	Exhaust	36.53 - 37.01 (1.4382 - 1.4571)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Item		Standard	Limit
Camshaft oil clearance		0.045 - 0.086 (0.0018 - 0.0034)	
Camshaft bracket inner diameter	No.1	30.500 - 30.521 (1.2008 - 1.2016)	—
	No. 2, 3, 4, 5	24.000 - 24.021 (0.9449 - 0.9457)	
Camshaft journal outer diameter	No. 1	30.435 - 30.455 (1.1982 - 1.1990)	
	No. 2, 3, 4, 5	23.935 - 23.955 (0.9423 - 0.9431)	
Camshaft runout [TIR*]		—	0.02 (0.0008)
Camshaft sprocket runout [TIR*]		Less than 0.15 (0.0059)	—
Camshaft end play		0.070 - 0.148 (0.0028 - 0.0058)	0.24 (0.0094)

*: Total indicator reading

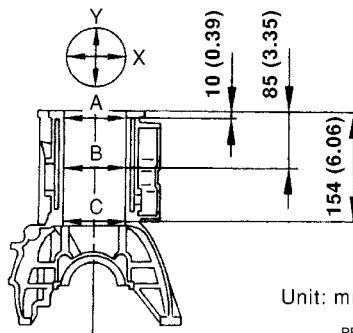


SEM671

Cam height "A"	Intake	39.505 - 39.695 (1.5553 - 1.5628)
	Exhaust	39.905 - 40.095 (1.5711 - 1.5785)
Wear limit of cam height		0.15 (0.0059)

CYLINDER BLOCK

Unit: mm (in)



Unit: mm (in)

PBIC0763E

Surface flatness	Standard			Less than 0.03 (0.0012)
	Limit			0.04 (0.0016)
Cylinder bore	Inner diameter	Standard	Grade No. 1	86.000 - 86.010 (3.3858 - 3.3862)
			Grade No. 2	86.010 - 86.020 (3.3862 - 3.3866)
			Grade No. 3	86.020 - 86.030 (3.3866 - 3.3870)
		Wear limit		0.07 (0.0028)

SERVICE DATA AND SPECIFICATIONS (SDS)

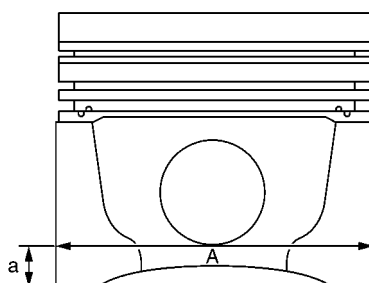
[YD]

Out-of-round (X - Y)		Less than 0.015 (0.0006)
Taper (C - A)		Less than 0.010 (0.0004)
Main journal inner diameter (Without bearing)		66.654 - 66.681 (2.6242 - 2.6252)
Difference in inner diameter between cylinders	Limit	Less than 0.05 (0.0020)

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



MBIA0026E

Piston skirt diameter “A”	Standard	Grade No. 1	85.928 - 85.942 (3.3830 - 3.3835)
		Grade No. 2	85.938 - 85.952 (3.3834 - 3.3839)
		Grade No. 3	85.948 - 85.962 (3.3838 - 3.3843)
		0.25 (0.0098) O/S (Service)	86.188 - 86.202 (3.3932 - 3.3938)
		0.50 (0.0197) O/S (Service)	86.438 - 86.452 (3.4031 - 3.4036)
“a” dimension			11.0 (0.43)
Piston pin bore diameter			28.003 - 28.009 (1.1025 - 1.1027)
Piston clearance to cylinder block			0.058 - 0.082 (0.0023 - 0.0032)

Piston Ring

Unit: mm (in)

Item		Standard	Limit
Side clearance	Top	0.050 - 0.090 (0.0020 - 0.0035)	0.2 (0.008)
	2nd	0.050 - 0.090 (0.0020 - 0.0035)	0.1 (0.004)
	Oil ring	0.030 - 0.070 (0.0012 - 0.0028)	—
End gap	Top	0.20 - 0.30 (0.0079 - 0.0118)	1.0 (0.039)
	2nd	0.31 - 0.51 (0.0122 - 0.0201)	1.0 (0.039)
	Oil (rail ring)	0.30 - 0.55 (0.0118 - 0.0217)	1.0 (0.039)

Piston Pin

Unit: mm (in)

Piston pin outer diameter		27.995 - 28.000 (1.1022 - 1.1024)
Interference fit of piston pin to piston		0.003 - 0.014 (0.0001 - 0.0006)
Piston pin to connecting rod bushing clearance	Standard	0.026 - 0.044 (0.0010 - 0.0017)
	Limit	0.057 (0.0022)

*: Values measured at ambient temperature of 20°C (68°F)

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

CONNECTNG ROD

Unit: mm (in)

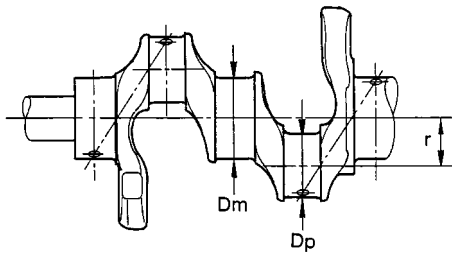
Center distance		157.5 (6.201)
Bend [per 100 (3.94)]	Limit	0.12 (0.0047)
Torsion [per 100 (3.94)]	Limit	0.12 (0.0047)
Connecting rod small end inner diameter		30.080 - 31.000 (1.1842 - 1.2205)
Piston pin bushing inner diameter*		28.026 - 28.038 (1.1034 - 1.1039)
Connecting rod big end inner diameter*		55.000 - 55.013 (2.1654 - 2.1659)
Side clearance	Standard	0.200 - 0.350 (0.0079 - 0.0138)
	Limit	0.4 (0.0157)

*: After installing in connecting rod

CRANKSHAFT

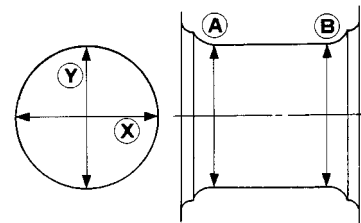
Unit: mm (in)

Main journal dia. "Dm"		62.951 - 62.975 (2.4784 - 2.4793)
Pin journal dia. "Dp"		51.954 - 51.974 (2.0454 - 2.0462)
Center distance "r"		46.97 - 47.03 (1.8492 - 1.8516)
Out-of-round (X - Y)	Standard	Less than 0.003 (0.0001)
	Limit	0.005 (0.0002)
Taper (A - B)	Standard	Less than 0.003 (0.0001)
	Limit	0.005 (0.0002)
Runout [TIR*]	Standard	0.05 (0.002.)
	Limit	0.10 (0.0039)
Side clearance	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)



SEM645

Out-of-round (X - Y)
Taper (A - B)



SEM715

*: Total indicator reading

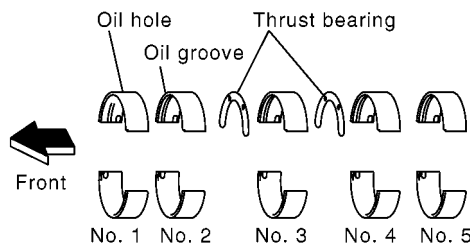
SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

AVAILABLE MAIN BEARING

Main bearing

Unit: mm (in)



SEM255G

Grade number	Thickness "T"	Width "W"	Identification color
0	1.816 - 1.820 (0.0715 - 0.0717)	19.9 - 20.1 (0.783 - 0.791)	Black
1	1.820 - 1.824 (0.0717 - 0.0718)		Red
2	1.824 - 1.828 (0.0718 - 0.0720)		Green
3	1.828 - 1.832 (0.0720 - 0.0721)		Yellow
4	1.832 - 1.836 (0.0721 - 0.0723)		Blue

Under size

Unit: mm (in)

Size	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	1.949 - 1.953 (0.0767 - 0.0769)	Grind so that bearing clearance is the specified value.

AVAILABLE CONNECTING ROD BEARING

Connecting Rod Bearing

Unit: mm (in)

Grade number	Thickness "T"	Width "W"	Identification color (mark)
0	1.492 - 1.496 (0.0587 - 0.0589)	22.9 - 23.1 (0.902 - 0.909)	Black
1	1.496 - 1.500 (0.0589 - 0.0591)		Brown
2	1.500 - 1.504 (0.0591 - 0.0592)		Green

Under size

Unit: mm (in)

Size	Thickness	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.536 - 1.540 (0.0605 - 0.0606)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.556 - 1.560 (0.0613 - 0.0614)	
0.25 (0.0098)	1.621 - 1.625 (0.0638 - 0.0640)	

MISCELLANEOUS COMPONENTS

Flywheel

Unit: mm (in)

Flywheel runout [TIR]*	Standard	0.45 (0.0177) or less
	Limit	1.3 (0.051)

*: Total indicator reading

Bearing Clearance

Unit: mm (in)

Main bearing clearance	Standard	0.039 - 0.066 (0.0015 - 0.0026)
	Limit	0.10 (0.0039)

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

Connecting rod bearing clearance	Standard	0.031 - 0.061 (0.0012 - 0.0024)
	Limit	0.09 (0.0035)

Tightening Torque

EBS00S08

*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

Alternator	Nut C	19 - 24 (1.9 - 2.5, 14 - 18)
	Nut D	44 - 57 (4.4 - 5.9, 32 - 42)
Idler pulley	Nut A	31 - 39 (3.1 - 4.0, 23 - 28)
Catalyst		44 - 53 (4.4 - 5.5, 32 - 39)
Catalyst rear diffuser		30 - 37 (3.0 - 3.8, 22 - 27)
Catalyst insulator		6.4 - 8.3 (0.65 - 0.85, 57 - 73)*2
Turbocharger		44.0 - 53.0 (4.4 - 5.5, 32 - 39)
Charge air cooler		19.6 - 23.5 (2.0 - 2.3, 15 - 13)
Air inlet tube		19.6 - 23.5 (2.0 - 2.3, 15 - 17)
EGR volume control valve		62.0 - 78.0 (6.3 - 8.0, 46 - 57)
EGR tube		60.0 - 69.0 (6.1 - 7.1, 45 - 51)
EGR support		21.0 - 26.0 (2.1 - 2.7, 16 - 19)
Exhaust manifold insulator		5.1 - 6.4 (0.52 - 0.66, 46 - 57)*2
*1 Exhaust manifold		29.0 - 33.0 (2.9 - 3.4, 21 - 24)
Engine cover		5.0 - 6.47 (0.51 - 0.66, 45 - 56)
*1 Rocker cover		1) 6.8 - 8.8 (0.7 - 0.9, 61 - 75)*2
		2) 6.8 - 8.8 (0.7 - 0.9, 61 - 75)*2
Oil pan lower		8.43 - 10.8 (0.86 - 1.1, 75 - 95) *2
Oil pan drain plug		29 - 39 (3.0 - 4.0, 22 - 28)
Oil strainer		16 - 18 (1.7 - 1.8, 12 - 13)
*1 Oil pan upper	M6 bolt	8.43 - 10.8 (0.86 - 1.1, 75 - 95)*2
	M8 bolt	20 - 23 (2.1 - 2.3, 15 - 16)
	M10 bolt	41.2 - 52 (4.2 - 5.3, 30 - 38)
Vacuum pump		20.6 - 26.5 (2.1 - 2.7, 15 - 20)
Cylinder head rear cover	M6 bolt	8.6 - 10.8 (0.87 - 1.1, 76 - 95) *2
	M8 bolt	15.8 - 18.6 (1.6 - 1.9, 12 - 14)
Injection tube	Nozzle side	21.6 - 24.5 (2.2 - 2.5, 16 - 18)
	Pump side	21.6 - 24.5 (2.2 - 2.5, 16 - 18)
Nozzle support		24.7 - 27.8 (2.6 - 2.8, 19 - 20)
Spill tube	Nozzle side	16.8 - 20.6 (1.7 - 2.1, 12 - 15)
	Cylinder head side	16.8 - 20.6 (1.7 - 2.1, 12 - 15)
Fuel rail		51.0 - 64.0 (5.2 - 6.5, 38 - 47)
Fuel pump		16.8 - 25.2 (1.7 - 2.6, 12 - 18)
Fuel pump sprocket		37.0 - 41.0 (3.8 - 4.2, 28 - 30)
Front chain case		6.9 - 8.8 (0.7 - 0.9, 61 - 78)*2
Chain tensioner		8.5 - 10.7 (0.86 - 1.1, 75 - 95)*2
Tensioner guide		21.0 - 26.0 (2.1 - 2.7, 16 - 19)
Slack guide (Primary timing chain)		23 - 26 (2.3 - 2.7, 17 - 19)

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

Slack guide (Secondary timing chain)	21-26 (2.1-2.7, 16-19)	A
Camshaft sprocket	138 - 147(14.0 - 15.0, 102 - 108)	
Fuel pump sprocket	37.0 - 41.0 (3.8 - 4.2, 28 - 30)	
*1 Oil pump housing	11.7 - 13.7 (1.2 - 1.4, 9 - 10)	EM
Power steering pump	51.0 - 56.0 (5.2 - 5.8, 38 - 41)	
*1 Rear chain case	12.0 - 13.0 (1.2 - 1.4, 19 - 10)	
Engine coolant temperature sensor	12.0 - 15.0 (1.2 - 1.6, 9- 11)	C
*1 Cylinder head	1) 35 - 44 (3.5 - 4.5, 26 - 32)	
	2) 180° to 185°	D
	3) 0 (0, 0)	
	4) 35 - 44 (3.5 - 4.5, 26 - 32)	
	5) 90° to 95°(angle tightening)	E
	6) 90° to 95°(angle tightening)	
Water outlet	21 - 28 (2.1 - 2.9, 16 - 20)	F
Glow plug	18.0 - 21.0 (1.8 - 2.2, 13 - 15)	
*1 Flywheel	103 - 112 (10.5 - 115, 76 - 83)	
Oil pressure switch	13.0 - 17.0 (1.25 - 1.75, 9 - 12)	G
Oil jet	6.0 - 10.8(0.62 - 1.1, 54 - 95)	
Oil jet relief valve	40 - 58 (4.0 - 6.0, 29 - 43)	H
Rear oil seal retainer	12.0 - 13.0 (1.2 - 1.4, 9 - 10)	

I

J

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PRECAUTIONS

Precautions for Drain Coolant

EBS00S17

Drain coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS00S18

- 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

EBS00S19

- 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

EBS00S1A

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

Precautions for Assembly and Installation

EBS00S1B

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

Parts Requiring Angular Tightening

EBS00S1C

- Use an angle wrench for the final tightening of the following engine parts.
 - Cylinder head bolts
 - Connecting rod cap bolts
 - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)
 - Double mass flywheel bolts
- 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

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

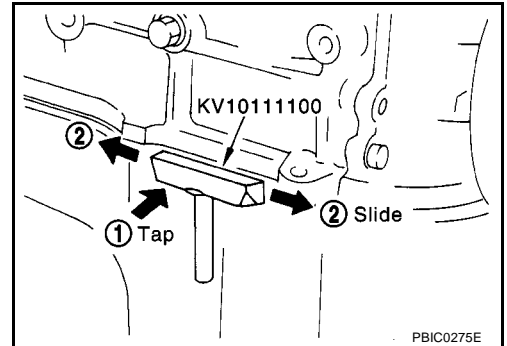
CAUTION:

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 liquid gasket applied area.

CAUTION:

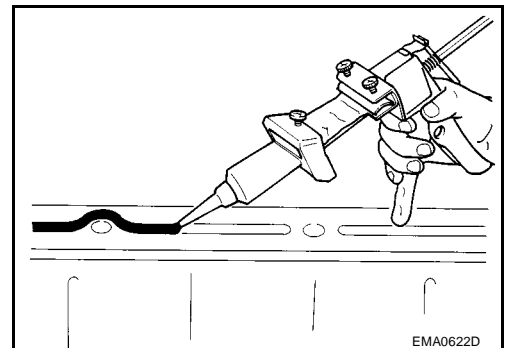
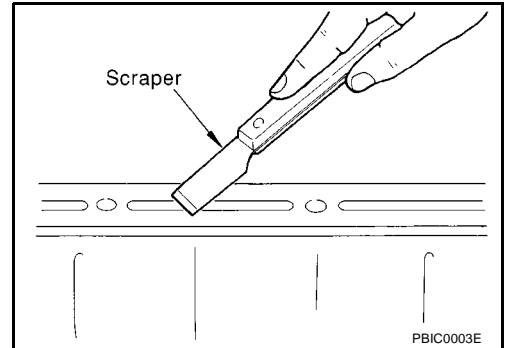
If for some unavoidable reason a tool such as a flat-bladed screwdriver is used, be careful not to damage the mating surfaces.



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.

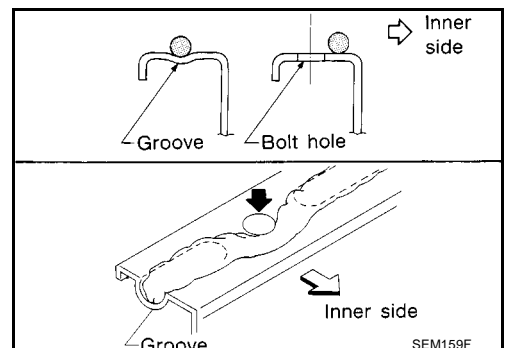
Use Genuine Liquid Gasket or equivalent.
- Apply the liquid gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for the liquid gasket application, apply the gasket to the groove.



- 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 instruction in this 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 instructions in this manual, observe them.



Cleanness & Safety

CLEANLINESS INSTRUCTIONS WHICH MUST BE FOLLOWED WHEN WORKING ON THE HIGH-PRESSURE DIRECT INJECTION SYSTEM

Risks Relating to Contamination

The system is very sensitive to contamination. The risks caused by the introduction of contamination are:

- Damage to or destruction of the high-pressure injection system,
- Seizing or leaking of a component.

All After-Sales Operations must be performed under very clean conditions. This means that no impurities (particles a few microns in size) should get into the system during dismantling or into the circuits via the fuel unions. The cleanliness principle must be applied from the filter through to the injectors.

SOURCES OF CONTAMINATION

Contamination is caused by:

- metal or plastic chips,
- paint,
- fibres:
 - of cardboard,
 - brushes,
 - paper,
 - clothing,
 - cloths,
- foreign bodies such as hairs,
- ambient air,
- etc.

CAUTION:

It is forbidden to clean the engine using a high pressure washer because of the risk of damaging connections. Furthermore, moisture may collect in the connectors and cause electrical connection problems.

PRECAUTIONS TO BE FOLLOWED BEFORE ANY WORK IS CARRIED OUT ON THE INJECTION SYSTEM

- Ensure that you have the plugs for the unions to be opened [bag of plugs sold by the Parts Stores - NISSAN part No. 19258 AW300 (RENAULT Part No. 77 01 206 381)]. Plugs are to be used once only. After use, they must be thrown away (once used they are soiled and cleaning is not sufficient to make them reusable). Unused plugs must be thrown away.
- Ensure that you have the resalable plastic bags for storing removed parts. Stored parts will therefore be less subject to the risk of impurities. The bags must be used only once, and after use they must be thrown away.
- Ensure that you have lint-free cleaning towels. The use of a normal cloth or paper for cleaning purposes is forbidden. These are not lint free and may contaminate the fuel circuit of the system. Each lint-free cloth should only be used once.

PRECAUTIONS TO BE FOLLOWED BEFORE OPENING THE FUEL CIRCUIT

- Use new thinner for each operation, (used thinner contains impurities). Pour it into a clean receptacle.
- For each operation, use a clean brush which is in good condition (the brush must not lose its hairs).
- Use a brush and thinner to clean the connections to be opened.
- Blow compressed air over the cleaned parts (tools, cleaned the same way as the parts, connections and injection system zone). Make sure that no bristles have been left behind.
- Wash your hands before and during the operation if necessary.
- When wearing leather protective gloves, cover them with latex gloves.

PRECAUTIONS TO BE FOLLOWED DURING THE OPERATION

- As soon as the circuit is open, all openings must be plugged to prevent impurities from entering the system. The plugs to be used are available [NISSAN Part No. 19258 AW300 (RENAULT Part No. 77 01 206 381)]. Do not reuse, under any circumstances, be reused.
- Close the resalable bag, even if it has to be reopened shortly afterwards. Ambient air carries impurities.
- All components removed from the injection system must be stored in a hermetically sealed plastic bag once the plugs have been inserted.
- The use of a brush, thinner, bellows, sponge or normal cloth is strictly forbidden once the circuit has been opened. These items are likely to allow impurities to enter the system.
- A new component replacing an old one must not be removed from its packaging until it is to be installed to the vehicle.

INSTRUCTIONS FOR INSTALLING THE PLUGS

NISSAN Part No. 19258 AW300
(RENAULT Part No. 77 01 206 381)

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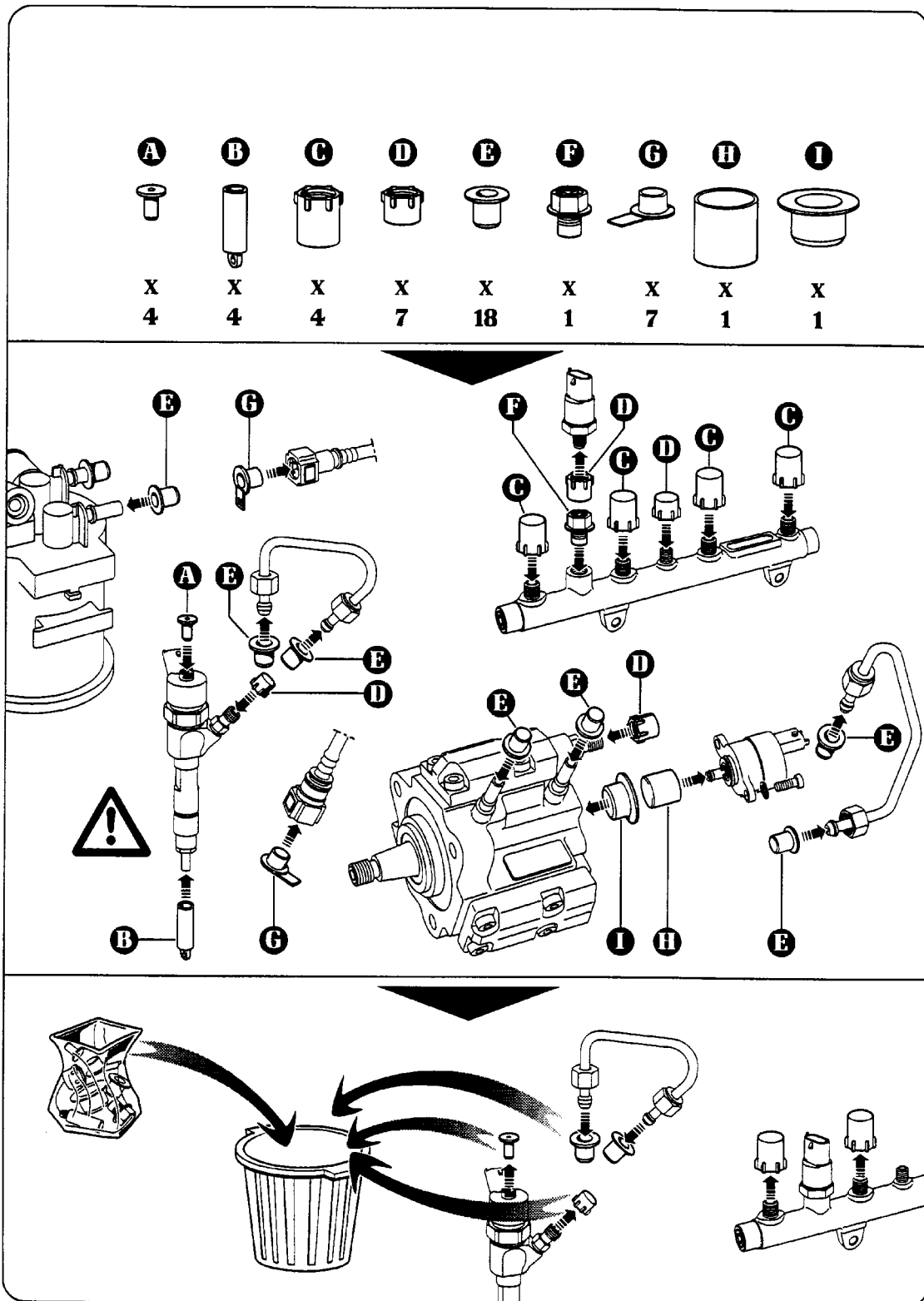
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MBIB0666E

POST-REPAIR CHECK

- Re-prime the circuit. To do this, turn the low-pressure pump over by switching on the ignition several times, or turn the low-pressure pump over with the diagnostic tool using the "Actuator Commands" menu.

PRECAUTIONS

[F9Q]

- After any operation, make sure that there are no diesel leaks. Run the engine at idle speed until the engine cooling fan starts up, then accelerate several times with no load.

CAUTION:

The engine must not run with diesel containing more than 10% diester.

The system injects the diesel fuel into the engine at a pressure of up to 135,042 kPa (1,350 bar, 1,377 kg/cm², 19,581 psi). Before any intervention, check that the injector rail is depressurized.

It is absolutely vital that you observe the tightening torque:

- of the high-pressure pipes
- of the cylinder head injector
- of the pressure sensor.

When the high-pressure pump, injectors and high pressure supply, output and return unions are removed or repaired, all openings should be installed with new blanking plugs of the correct size to prevent contamination entering.

WARNING:

All pipes removed must be replaced.

When replacing the high pressure pipe, follow the method below:

- remove the high pressure pipe, holding the filter rod on the injector with a lock-wrench
- install anti-contamination plugs
- loosen the high pressure rail
- install the new high pressure pipe
- offer up the unions by hand until they touch
- tighten the high pressure rail mountings to torque
- torque-tighten the union at the injector side
- tighten the high pressure rail connection to torque

Dismantling the interior components of the pump is prohibited.

The fuel return pipe installed to the injectors must be replaced when it is removed.

The diesel temperature sensor cannot be removed. It is part of the fuel return rail.

Loosening a high pressure pipe connection when the engine is running is prohibited.

INSPECTION FOR NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

Do not start and run the engine when the drive belt is not properly installed. Running the engine in such conditions may damage the pulley (damper pulley).

PREPARATION

[F9Q]

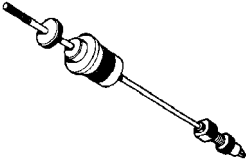
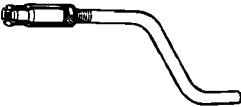
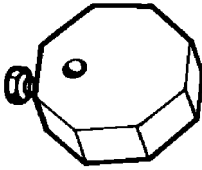
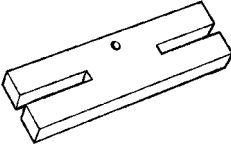
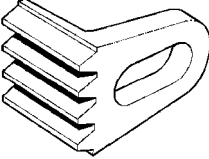
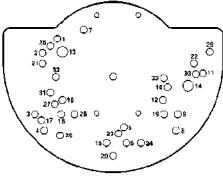
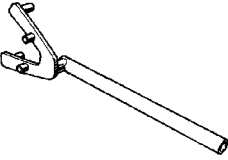
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A

PREPARATION

Special Service Tools

EBS00SB7

NISSAN tool number (RENAULT tool No.) Tool name		Description	EM
KV113B0020 (Emb. 880) Sliding hammer	 MBIB0358E	Pin extractor	C
KV113B0030 (Mot. 11) Crankshaft bearing remover	 MBIB0359E	Crankshaft bearing extractor	D
KV113B0040 (Mot. 251-01) Dial gauge stand set	 MBIB0360E	Gauge stand used with KV113B0050 (Mot. 252-01)	E
KV113B0050 (Mot. 252-01) Dial gauge stand set	 MBIB0361E	Thrust plate for measuring the protrusion of cylinder liners, used with KV113B0040 (Mot. 251-01)	F
KV113B0060 (Mot. 582-01) Ring gear stopper	 MBIB0363E	Flywheel immobilizing tool	G
KV113B0070 (Mot. 792-03) Engine sub-attachment	 MBIB0707E	Engine mounting plate for engine stand [with KV113B0420 (Mot. 995)]	H
KV113B0080 (Mot. 799-01) Camshaft pulley holder	 MBIB0368E	Tool for locking sprockets for the toothed timing belt	I

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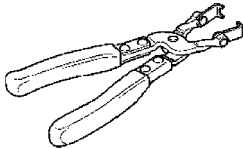
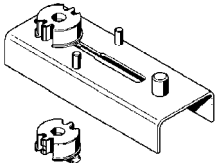
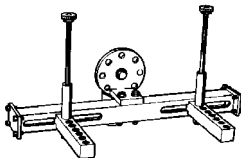
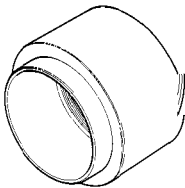
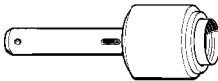
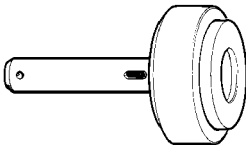
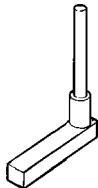
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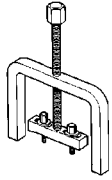

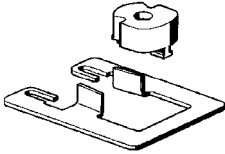
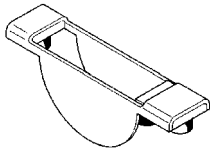
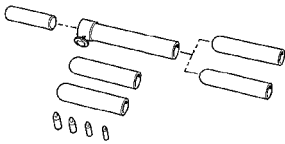
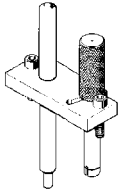
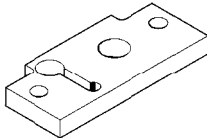
PREPARATION

[F9Q]

NISSAN tool number (RENAULT tool No.) Tool name	Description
KV113B0090 (Mot. 1335) Valve seal remover	Tool for removing valve stem seals  MBIB0370E
KV113B0140 (Mot. 1492) Bearing assembling set	Tool for installing connecting rod bearing shells  MBIB0374E
KV113B0200 (Mot. 1573) Cylinder head stand	Cylinder head support  MBIB0380E
KV113B0240 (Rou. 15-01) Shaft protector	Internal shaft protector 16 mm (0.63 in) dia.
KV113B0250 (Mot. 988-02) Seal drift	Tool for installing the camshaft seal at the timing end  MBIB0691E
KV113B0260 (Mot. 990-03) Seal drift	Tool for installing crankshaft seal, timing end  MBIB0692E
KV113B0270 (Mot. 991-01) Seal drift	Tool for installing crankshaft seal, flywheel end  MBIB0693E
KV113B0280 (Mot. 1054) TDC set rod	TDC setting rod  MBIB0694E

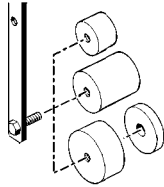
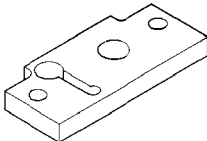
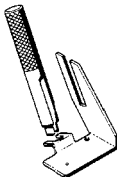
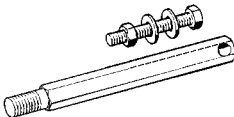
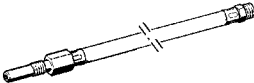
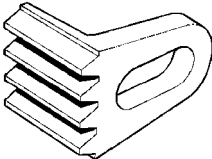
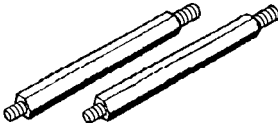
PREPARATION

[F9Q]

NISSAN tool number (RENAULT tool No.) Tool name		Description	A
KV113B0290 (Mot. 1423) Puller	 MBIB0696E	Tool for removing the crankshaft bearing cap	EM
KV113B0300 (Mot. 1485) KV113B0120 (Mot. 1485-01) Oil jet remover	 MBIB0372E	Tool for removing oil jet	C
KV113B0310 (Mot. 1492-01) Bearing assembling adapter	 MBIB0375E	Adaptation kit for installing the separable connecting rod bearing shells	D
KV113B0320 (Mot. 1493) Bearing insert	 MBIB0376E	Tool for installing main bearing shells	E
KV113B0330 (Mot. 1511) Valve seal drift	 MBIB0697E	Tool for installing valve stem seals	F
KV113B0340 (Mot. 1516) Oil jet insert	 MBIB0698E	Tool for installing oil jet orientated at 5°	G
KV113B0350 (Mot. 1516-01) Oil jet plate	 MBIB0699E	Plate for installing oil jet orientated at 3° [addition to KV113B0340 (Mot. 1516)]	H

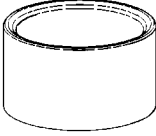
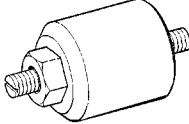
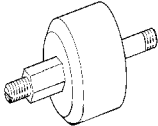

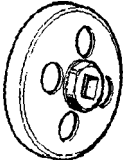
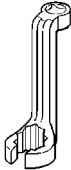
PREPARATION

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NISSAN tool number (RENAULT tool No.) Tool name		Description
KV113B0360 (Mot. 1543) Timing belt tension tool	 <p>MBIB0702E</p>	Timing belt pretensioning tool
KV113B0370 (Mot. 1516-02) Oil jet plate	 <p>MBIB0703E</p>	Plate for installing oil jet (orientated at 0°) [addition to KV113B0340 (Mot. 1516)]
KV113B0380 (Mot. 1551) Pipe insert	 <p>MBIB0704E</p>	Tool for installing the oil return pipe
KV113B0390 (Mot. 1575) Engine sub-attachment	 <p>MBIB0705E</p>	Engine mounting pin "N1" [addition to KV113B0070 (Mot. 792-03) for engine stand]
KV113B0400 (Mot. 1592) Compression gauge adapter	 <p>MBIB0712E</p>	Flexible end piece for taking pressure at end of compression
KV113B0410 (Mot. 1677) Ring gear stopper	 <p>MBIB0363E</p>	Flywheel immobilizing tool
KV113B0420 (Mot. 995) Engine sub-attachment	 <p>MBIB0708E</p>	Set of two pins adaptable to engine mounting plate KV113B0070 (Mot. 792-03)

PREPARATION

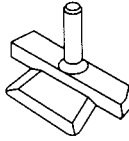
[F9Q]

NISSAN tool number (RENAULT tool No.) Tool name		Description	A
KV113B0430 (Mot. 1569) Piston insert	 MBIB0709E	Cone for installing the pistons in the cylinder block	EM
KV113B0440 (Mot. 1577) Crankshaft seal tool		Lip seal extractor 28 - 50 mm (1.10 - 1.97 in) dia.	C
KV113B0450 (Mot. 1578) Crankshaft seal tool		Lip seal extractor 50 - 75 mm (1.97 - 2.95 in) dia.	D
KV113B0460 (Mot. 1579) Crankshaft seal tool		Lip seal extractor 80 - 95 mm (3.15 - 3.74 in) dia.	E
KV113B0470 (Mot. 1635) Seal drift	 MBIB0710E	Tool for installing crankshaft seal, flywheel end	F
KV113B0480 (Mot. 1636) Seal drift	 MBIB0711E	Tool for installing crankshaft seal, timing end	G
KV113B0490 (Mot. 1505) Belt tension tool	 MBIB0984E	Timing belt adjusting tool	H
KV113C0020 (Mot. 1281-01) Oil filter wrench	 MBIB0369E	Removing and installing oil filter	I
KV113E0010 (Mot. 1566) Fuel spill tube spanner	 MBIB0379E	Tool for removing high pressure pipes	J

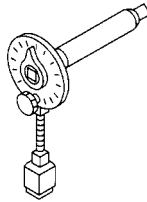
PREPARATION

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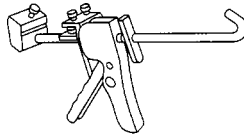
NISSAN tool number (RENAULT tool No.) Tool name	Description
KV10111100 (—) Seal cutter	Removing oil pan
KV10112100 (—) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle
WS39930000 (—) Tube presser	Pressing the tube of liquid gasket



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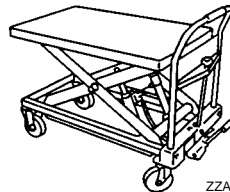


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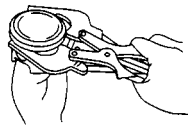
Commercial Service Tools

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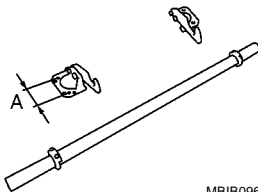
Tool name	Description
Manual lift table caddy	Removing and installing engine
Piston ring expander	Removing and installing piston ring
Engine support bar	Using with engine support chain A: Approx.12.5 mm (0.492 in)
Engine support chain	Using with engine support bar



ZZA1210D



NT030



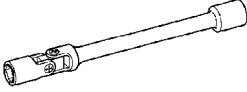
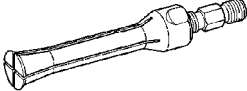
MBIB0961E



MBIB0962E

PREPARATION

[F9Q]

Tool name	Description
<p>Glow plug wrench</p>  <p>MBIB0387E</p>	<p>Articulated wrench for removing and installing the glow plugs</p>
<p>Main bearing wrench</p>  <p>MBIB0388E</p>	<p>Wrench for removing main bearings</p>
<p>Socket</p>	<p>Standard 22 mm (0.87 in) long socket 1/2" [12.7 mm (0.500 in) squared] for removing the oil pressure gauge.</p>
<p>Torx</p>	<p>Standard 1/2" 8 / 12 / 14 female torx socket [12.7 mm (0.500 in) squared].</p>

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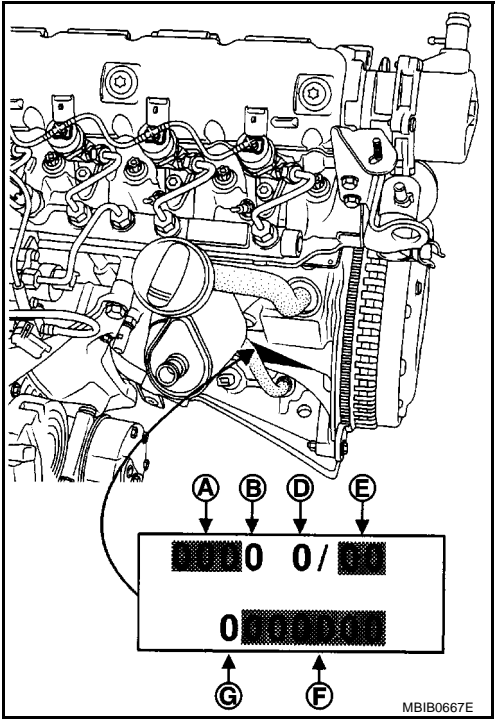
IDENTIFICATION INFORMATION

Engine Identification

The engine identification is stamped on the cylinder block. It includes:

- A: engine type
- B: engine approval letter
- D: identification
- E: engine suffix
- F: engine serial number
- G: engine assembly plant

Engine	Compression Ratio	Bore and Stroke mm (in)	Displacement cm ³ (cu in)
F9Q	19:1	80 × 93 (3.15 × 3.66)	1,870 (114.11)



NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

PPF:00003

NVH Troubleshooting —Engine Noise

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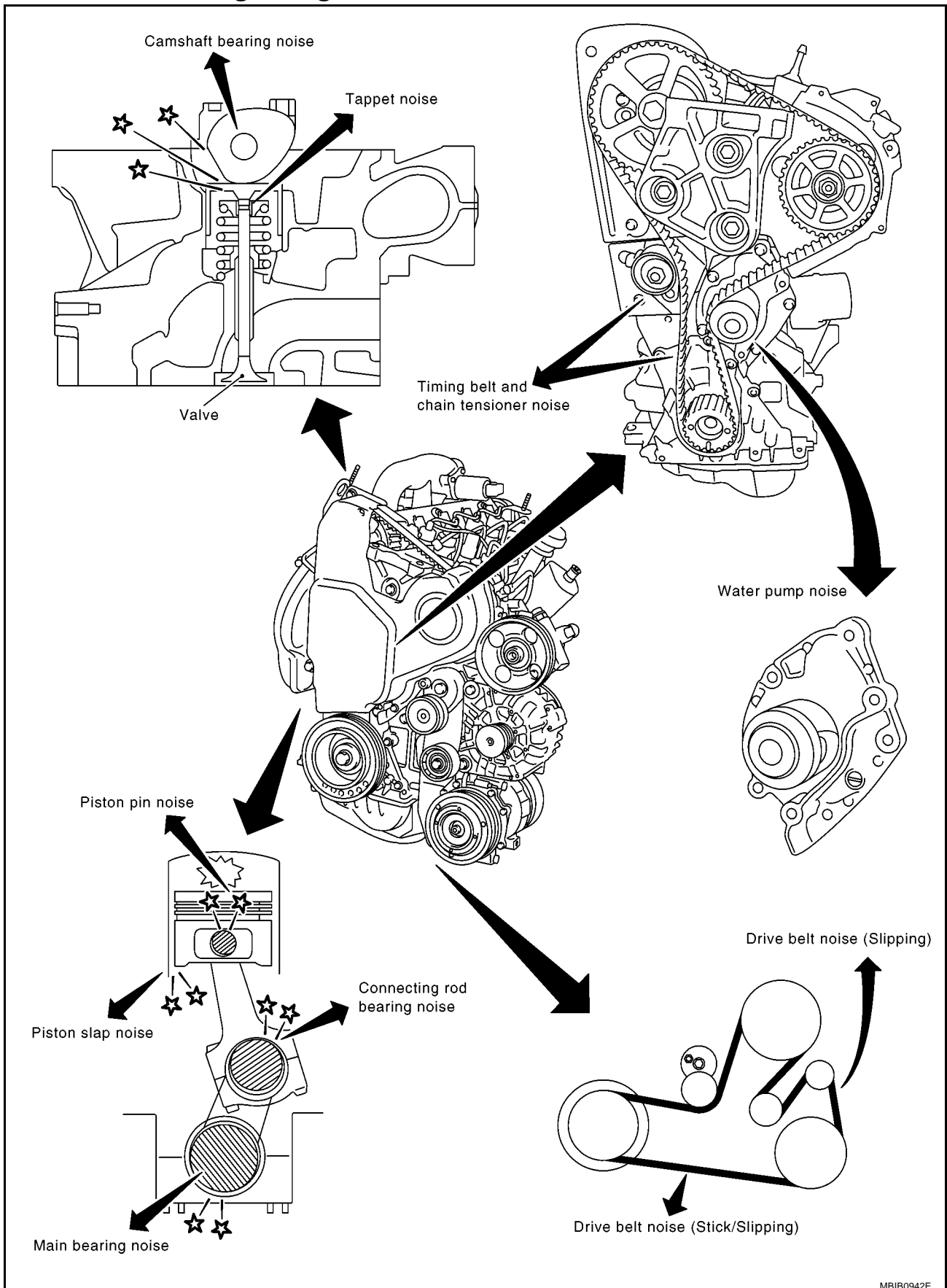
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L

M



MBIB0942E

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

[F9Q]

CAUTION:

Do not start and run the engine when the drive belt is not properly installed. Running the engine in such conditions may damage the pulley (damper pulley).

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

EBS00SK0

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.

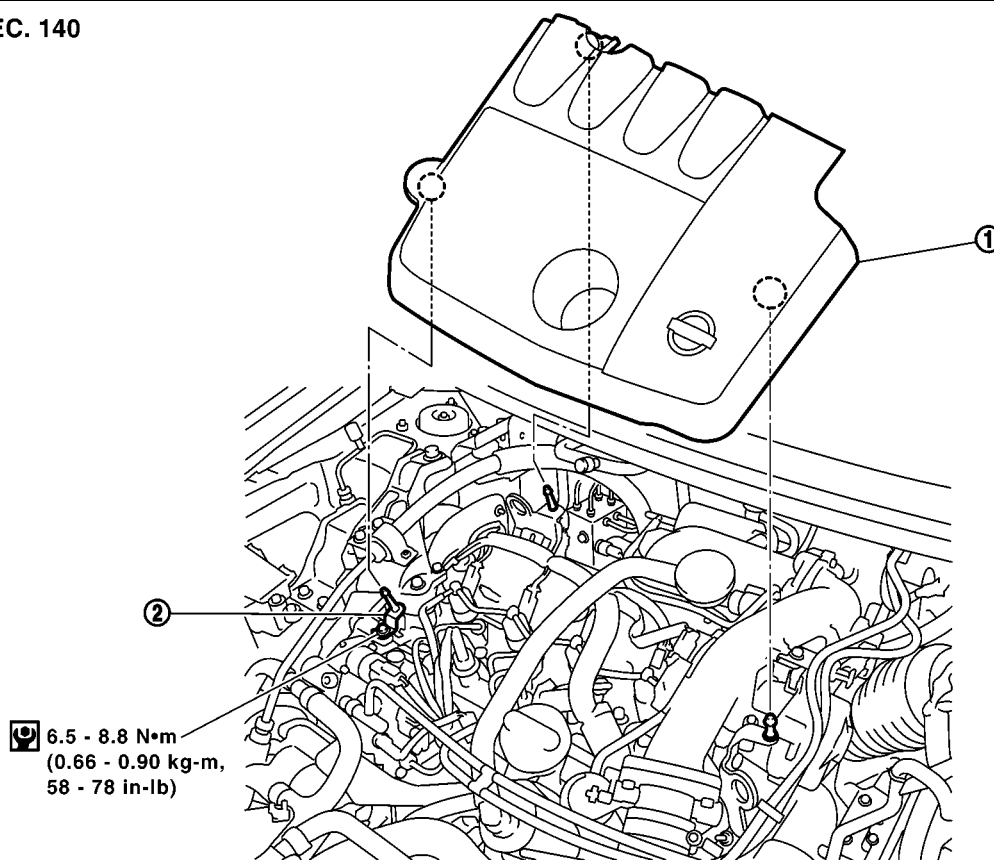
Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-223
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston ring end gap	EM-225
Front of engine Timing belt cover	Tapping or ticking	A	A	—	B	B	B	Timing belt tensioner noise	Timing belt tensioner operation	EM-213
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-218
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-30

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

ENGINE ROOM COVER

Removal and Installation

SEC. 140



1. Engine room cover

2. Engine room cover bracket

REMOVAL

- Remove engine room cover from engine room cover bracket.

CAUTION:

Do not damage or scratch cover when installing or removing.

INSTALLATION

- Install in the reverse order of removal.

NOTE:

Press on the until hearing the "click".

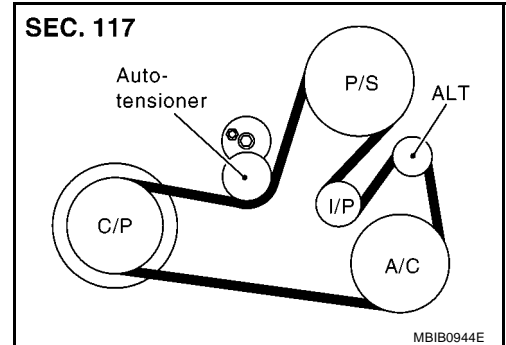
DRIVE BELTS

Checking Drive Belts

WARNING:

Be sure to perform when the engine is stopped.

- Inspect belts for cracks, fraying, wear and oil. If necessary, replace.



Tension Adjustment

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

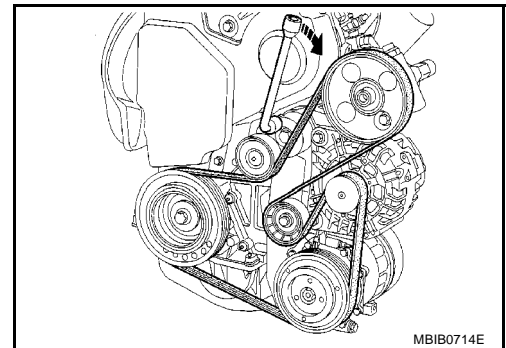
CAUTION:

- Keep oil and water away from belt.
- Do not twist or bend belt excessively.

Removal and Installation

REMOVAL

1. Remove engine undercover.
2. Remove RH front wheel.
3. Remove right side splash cover.
4. Remove drive belt by turning the spanner to the right to loosen the belt as shown.



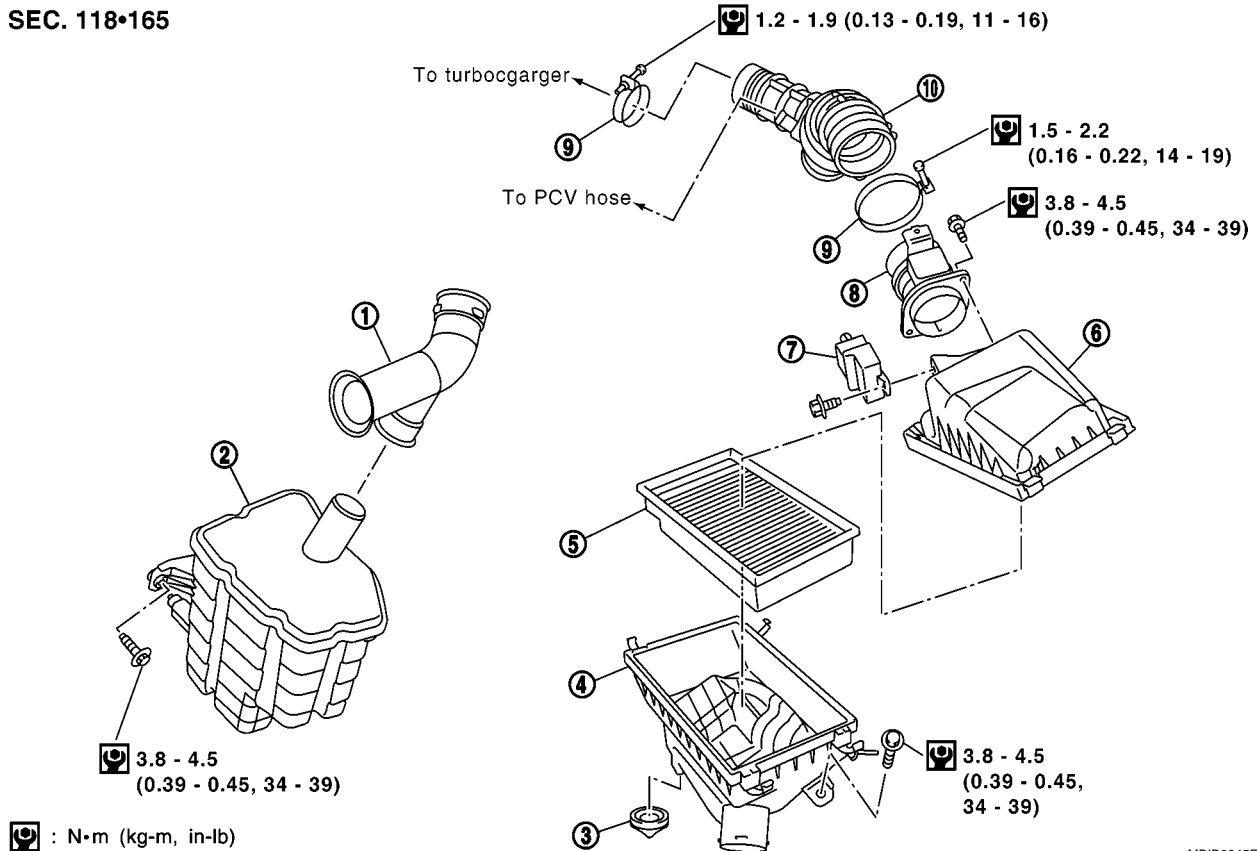
INSTALLATION

Install in the reverse order of removal.

AIR CLEANER AND AIR DUCT

Removal and Installation

SEC. 118•165



- | | | |
|-----------------------------|-------------------------|-----------------------------|
| 1. Air duct dust side | 2. Resonator | 3. Air cleaner mounting |
| 4. Air cleaner case (lower) | 5. Air cleaner filter | 6. Air cleaner case (upper) |
| 7. Glow relay | 8. Mass air flow sensor | 9. Clamp |
| 10. Air duct | | |

REMOVAL

1. Disconnect battery ground cable.
2. Remove engine room cover. Refer to [EM-141, "ENGINE ROOM COVER"](#).
3. Disconnect harness connector from the mass air flow sensor.
4. Remove glow relay connector.
5. Remove harness band and transaxle drain hose band.
6. Remove air duct from air cleaner case side.
7. Remove air cleaner case (upper).
8. Remove air cleaner filter, then remove air cleaner case (lower).
9. Remove air duct from turbocharger and PCV hose.
10. Remove mass air flow sensor from air cleaner case.

CAUTION:

Handle mass air flow sensor with care.

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

INSTALLATION

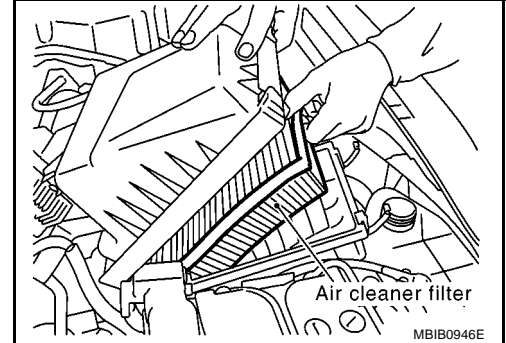
- Install in the reverse order of removal.

Changing Air Cleaner Filter

REMOVAL

EBS00S5C

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



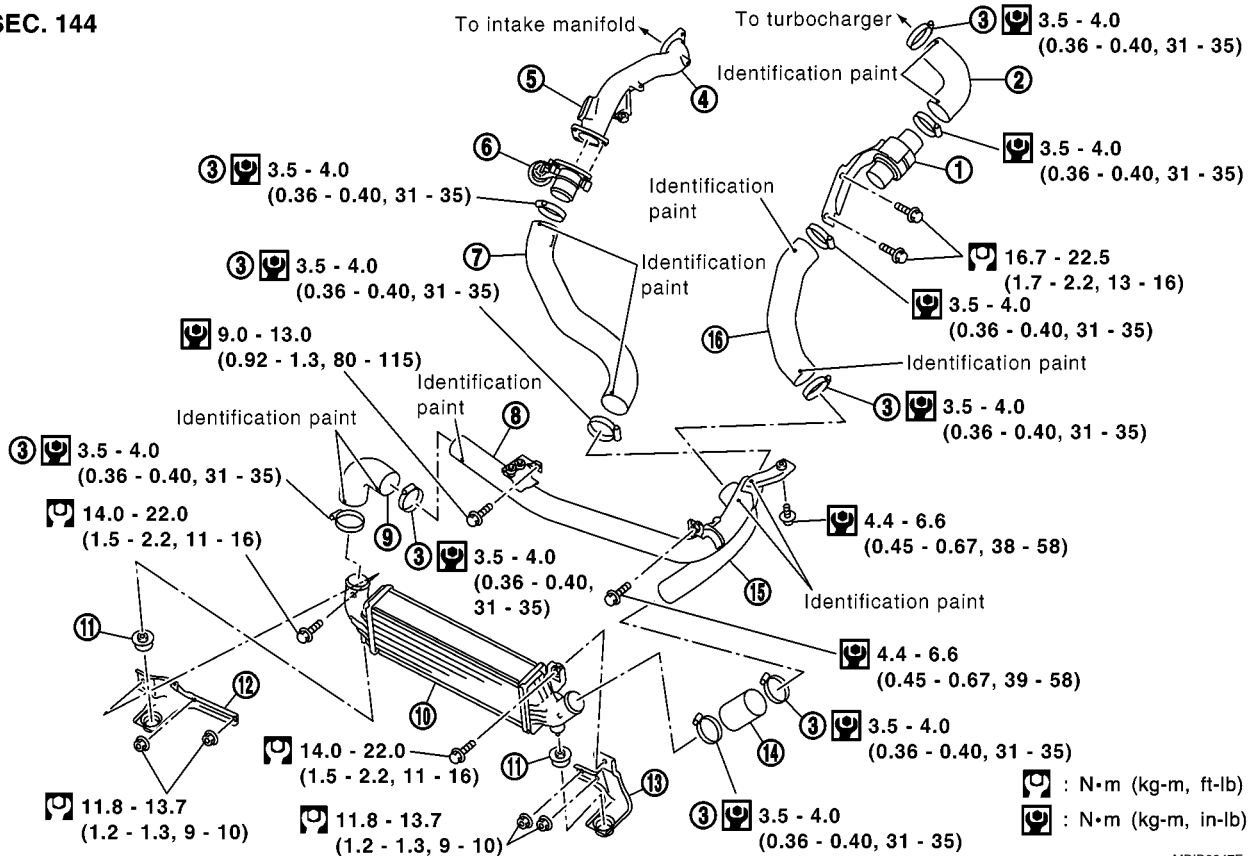
INSTALLATION

Install in the reverse order of removal.

CHARGE AIR COOLER

Removal and Installation

SEC. 144



- | | | |
|-----------------------|------------------------|--------------------|
| 1. Air inlet tube | 2. Air inlet hose | 3. Clamp |
| 4. Air inlet tube | 5. Air pressure sensor | 6. Shutter valve |
| 7. Air inlet hose | 8. Air inlet tube | 9. Air inlet hose |
| 10. Charge air cooler | 11. Rubber | 12. Bracket |
| 13. Bracket | 14. Air inlet hose | 15. Air inlet tube |
| 16. Air inlet hose | | |

REMOVAL

1. Remove front bumper assembly. Refer to BT section in P12 ESM "SM2E00-1P12E0E".
2. Remove air inlet tubes.
3. Remove charge air cooler.

CAUTION:

Do not damage charge air cooler core.

4. Remove and install with bottom brackets as an assembly.

INSPECTION AFTER REMOVAL

Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler if necessary.

- Be careful not to deform core fins.
- For cleaning procedure of charge air cooler core, refer to [CO-28, "Checking Radiator"](#).

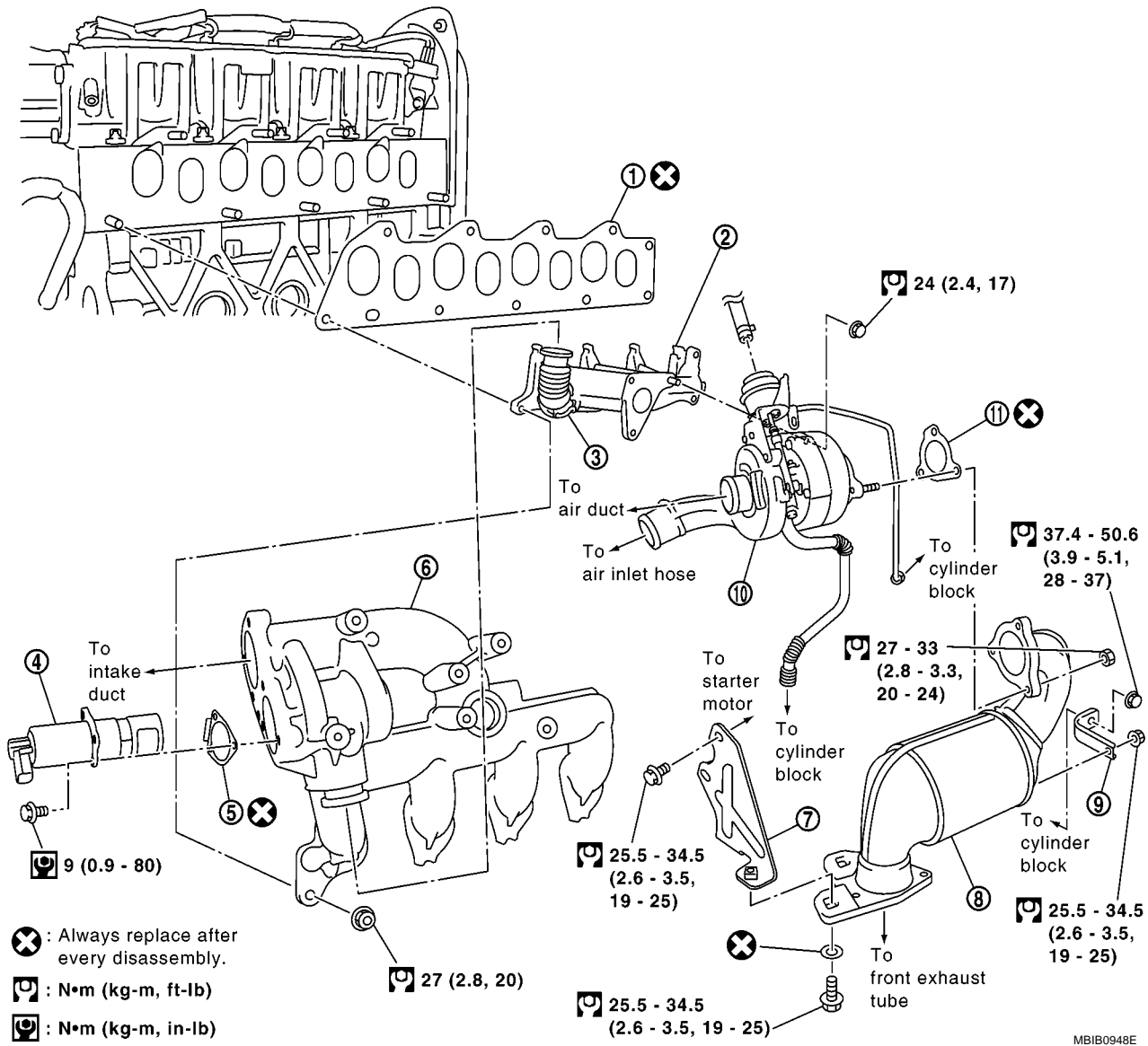
INSTALLATION

Install in the reverse order of removal.

Removal and Installation

EBS00SK5

SEC. 140•144•147•208



MBIB0948E

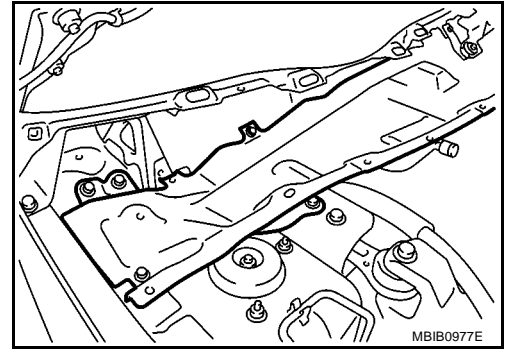
- | | | |
|----------------------|---------------------|--------------------|
| 1. Gasket | 2. Exhaust manifold | 3. EGR tube |
| 4. EGR control valve | 5. Gasket | 6. Intake manifold |
| 7. Bracket | 8. Catalyst | 9. Bracket |
| 10. Turbocharger | 11. Gasket | |

REMOVAL

1. Remove battery ground cable.
2. Remove engine undercover.
3. Remove wiper arms and wiper motor. Refer to [WW-12, "Removal and Installation for Wiper Motor and Linkage"](#) or [WW-33, "Removal and Installation for Wiper Motor and Linkage"](#) (with rain sensor).

INTAKE MANIFOLD, EXHAUST MANIFOLD, TURBO CHARGER, CATALYST [F9Q]

4. Remove brackets as shown.



5. Remove vacuum tank and hose.
6. Remove turbocharger assembly as follows:
 - a. Disconnect air duct from turbocharger. Refer to [EM-143, "AIR CLEANER AND AIR DUCT"](#).
 - b. Remove air inlet hose from turbocharger. Refer to [EM-145, "CHARGE AIR COOLER"](#).
 - c. Remove exhaust front tube. Refer to [EX-2, "Removal and Installation"](#).

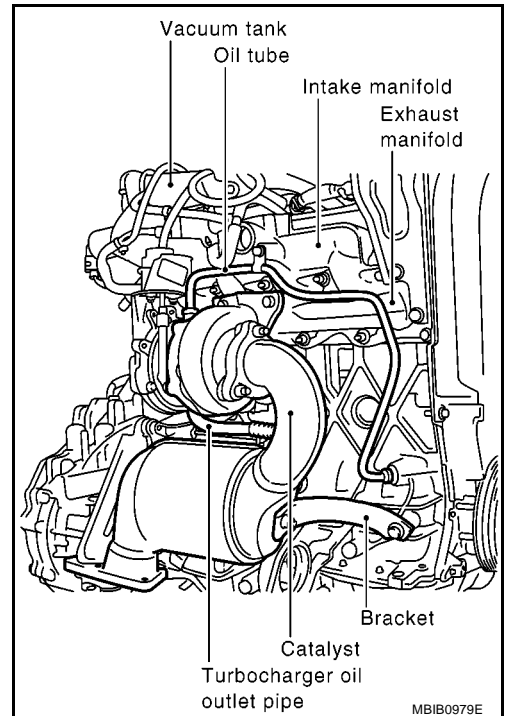
CAUTION:

Temporarily fix on vehicle side with rope or so to avoid putting stress on exhaust center tube.

- d. Remove catalyst mounting bolts and brackets.
- e. Remove turbocharger mounting bolts.
- f. Remove intake and exhaust manifold mounting bolts.
- g. Remove turbocharger oil outlet pipe and oil tube from cylinder block.
7. Rotate the intake and exhaust manifold, turbocharger assembly so that the rear side (EGR tube mounting side) faces upward. And then pull out the assembly from between the engine and the A/C compressor piping.

CAUTION:

Be careful not to deform each turbocharger piping when pulling out the assembly.



INSTALLATION

- Install in reverse order of removal.

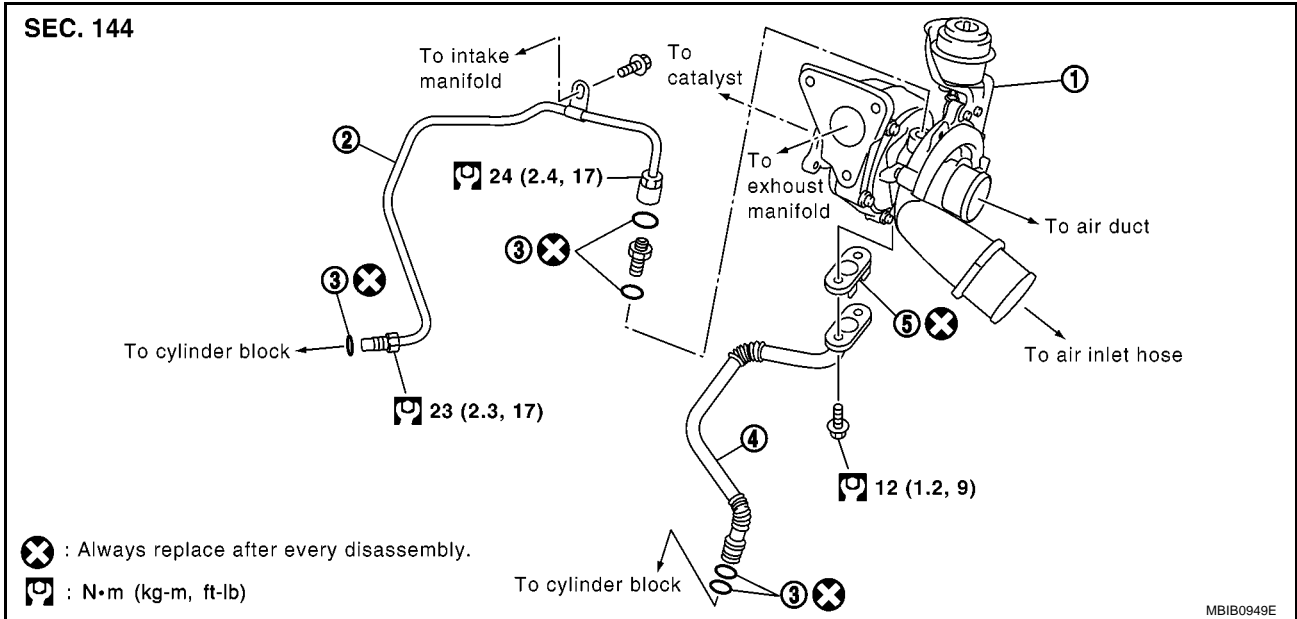
INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

INTAKE MANIFOLD, EXHAUST MANIFOLD, TURBO CHARGER, CATALYST [F9Q]

Disassembly and Assembly

EBS00SK6



- | | | |
|---------------------------------|-------------|-----------|
| 1. Turbocharger | 2. Oil tube | 3. O-ring |
| 4. Turbocharger oil outlet pipe | 5. Gasket | |

DISASSEMBLY

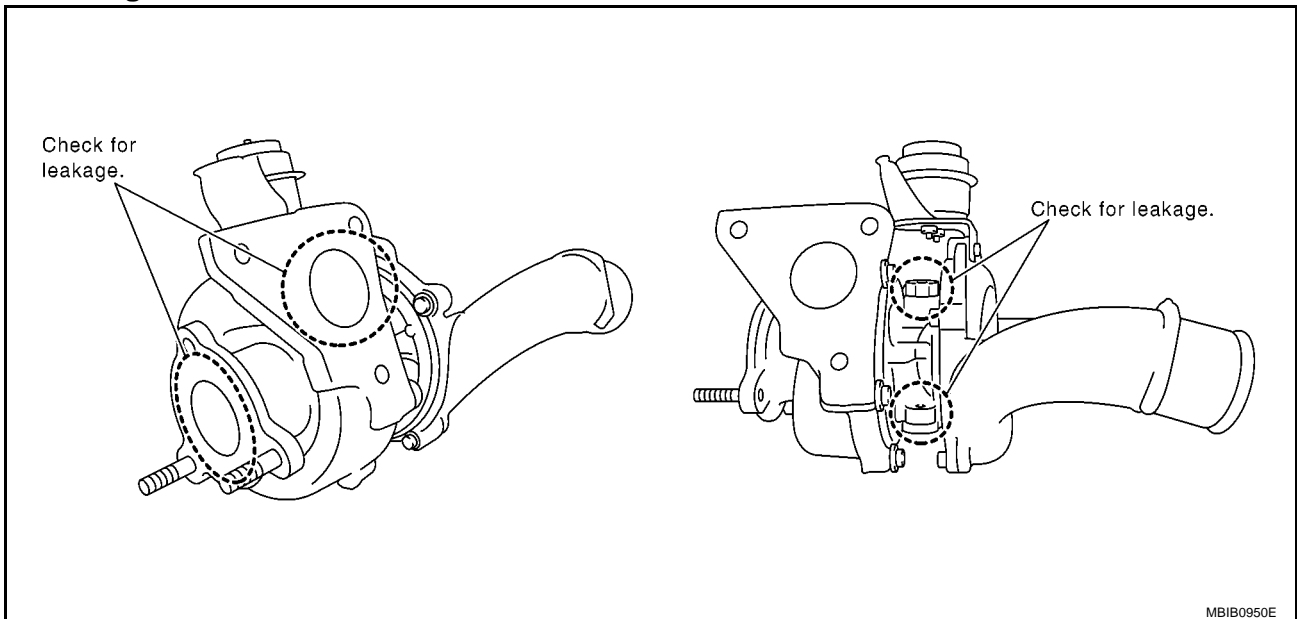
- After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts to remove.

CAUTION:

Do not disassemble or adjust the turbocharger body.

INSPECTION AFTER DISASSEMBLY

Turbocharger



CAUTION:

When the compressor wheel, turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary failure:

- Suction side** : Between turbocharger and air cleaner
- Exhaust side** : Between turbocharger and catalyst

INTAKE MANIFOLD, EXHAUST MANIFOLD, TURBO CHARGER, CATALYST

[F9Q]

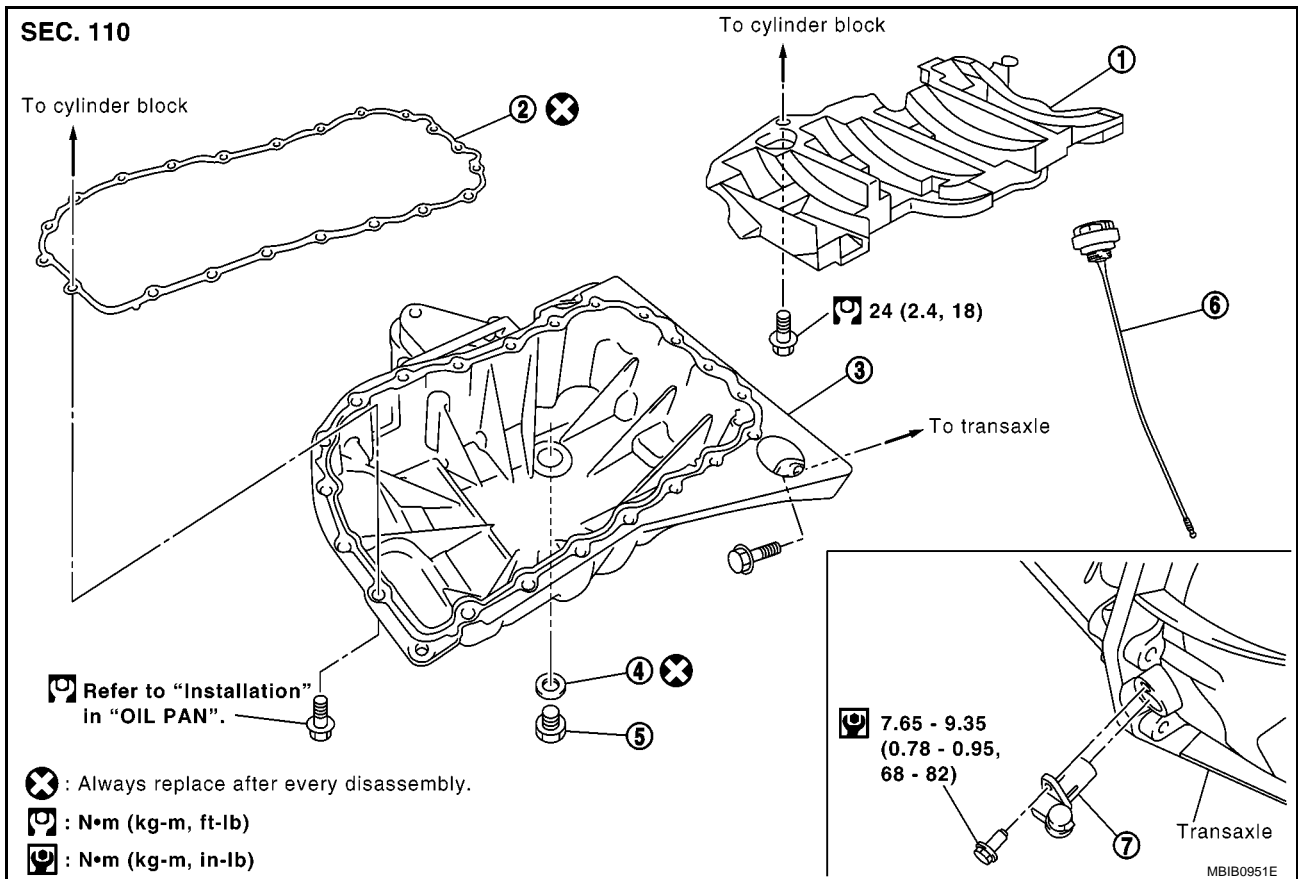
ASSEMBLY

- Install in the reverse order of removal.

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

OIL PAN

Removal and Installation



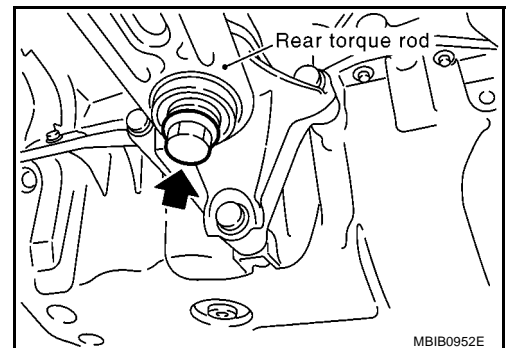
- | | | |
|-------------------------------|---------------|--|
| 1. Baffle plate | 2. Gasket | 3. Oil pan |
| 4. O-ring | 5. Drain plug | 6. Oil level gauge (with oil filler cap) |
| 7. Crankshaft position sensor | | |

CAUTION:

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

REMOVAL

1. Remove engine undercover.
2. Remove RH front wheel.
3. Remove right side splash cover.
4. Remove front drive shaft assembly RH side. Refer to [FAX-11, "FRONT DRIVE SHAFT"](#).
5. Remove rear torque rod mounting bolt as shown.



6. Drain engine oil. Refer to [LU-16, "Changing Engine Oil"](#).

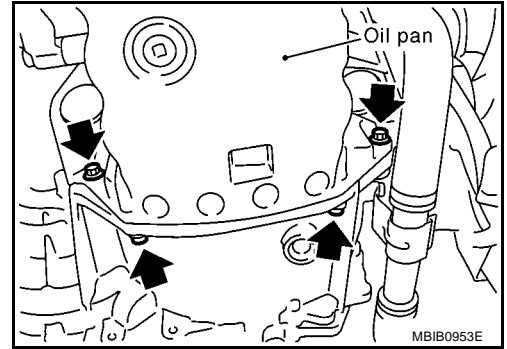
CAUTION:

Perform when engine is cold.

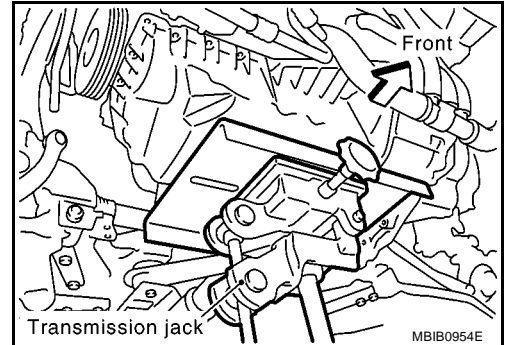
OIL PAN

[F9Q]

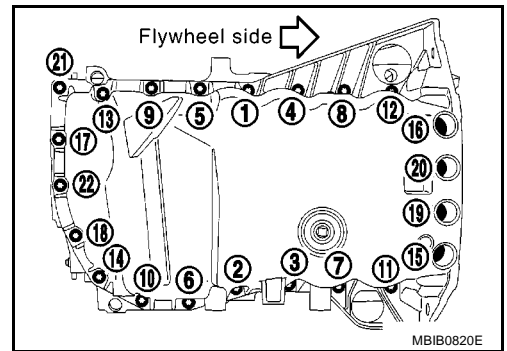
7. Remove oil pan and transaxle joint bolts.



8. Support the engine bottom of the oil pan with a transmission jack etc.



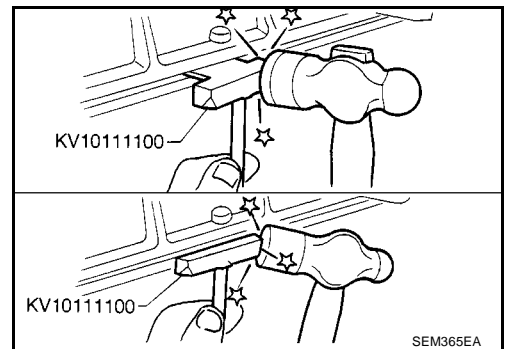
9. Remove oil pan bolts in the reverse order as shown.



- Insert seal cutter (special service tool) between oil pan and cylinder block. Slide tool by tapping on the side of the tool with a hammer.

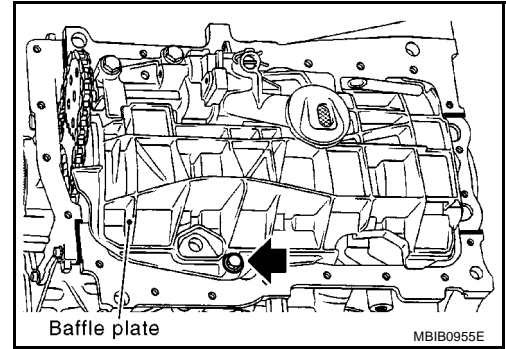
CAUTION:

Exercise care not to damage mating surface.



10. Remove oil pan.

11. Remove baffle plate mounting bolt, then remove baffle plate.



INSPECTION AFTER REMOVAL

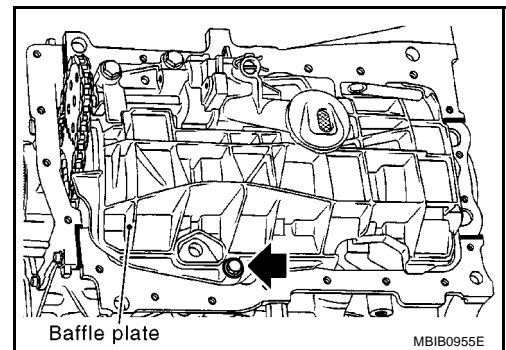
Clean oil pump assembly if any object attached.

INSTALLATION

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

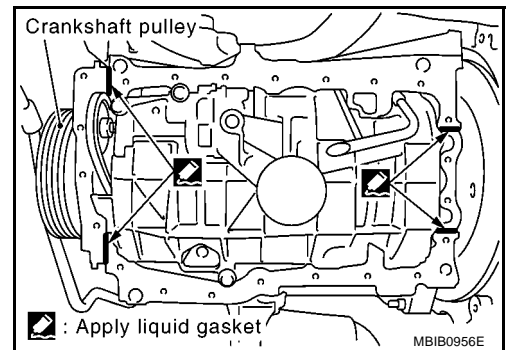
1. Install baffle plate.

 : 24 N·m (2.4 kg-m, 18 ft-lb)



2. Apply liquid gasket as shown.

- Use Genuine Liquid Gasket or equivalent.

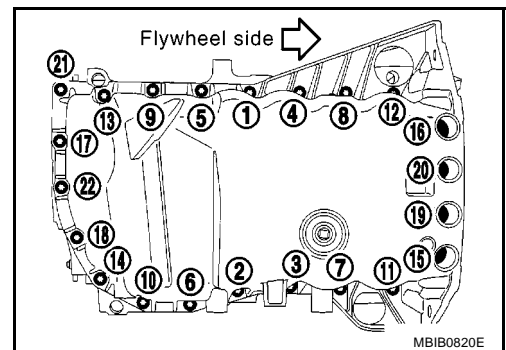


3. Install oil pan bolts in the numerical order as shown.

 **1st step: 8 N·m (0.8 kg-m, 6 ft-lb)**

 **2nd step: 15 N·m (1.5 kg-m, 11 ft-lb)**

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



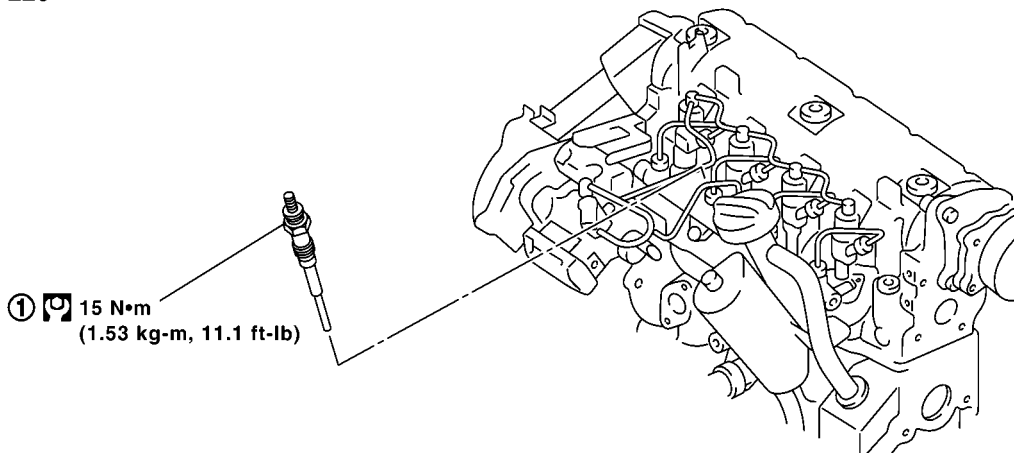
INSPECTION AFTER INSTALLATION

- Inspection the engine oil level. Refer to [LU-16, "ENGINE OIL"](#) .
- Start the engine, and make sure there is no leak of engine oil. Refer to [LU-16, "ENGINE OIL"](#) .

GLOW PLUG

Removal and Installation

SEC. 220



MBIB0957E

1. Glow plug

REMOVAL

CAUTION:

Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.

1. Disconnect battery ground cable.
2. Remove engine room cover. Refer to [EM-141, "ENGINE ROOM COVER"](#).
3. Disconnect harness from glow plug.
4. Remove glow plug.

CAUTION:

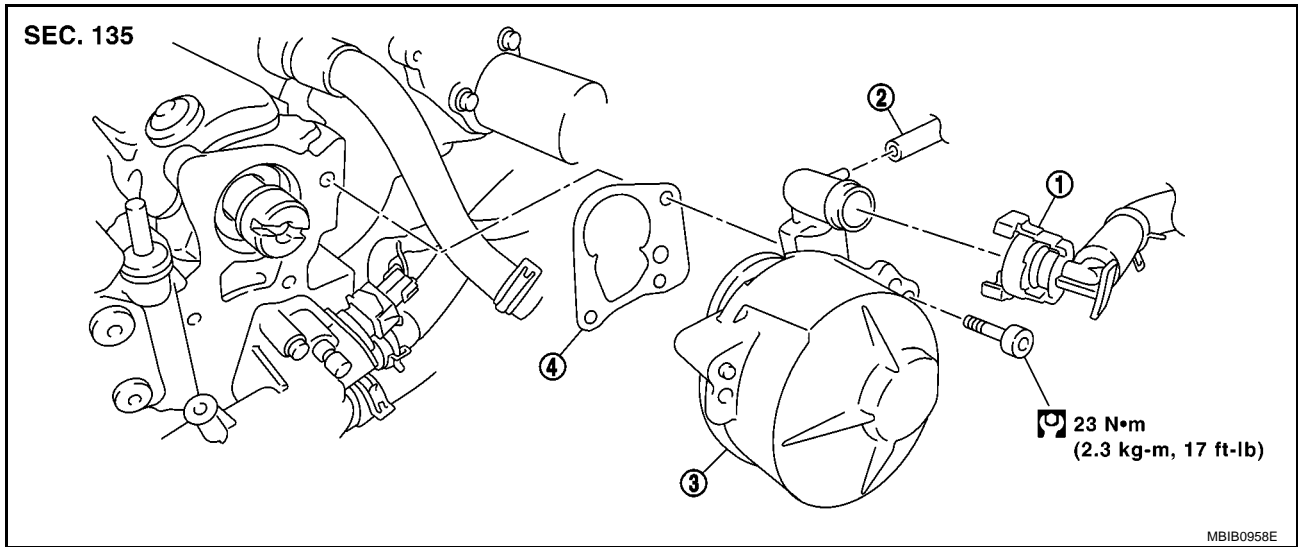
- When removing or installing, do not use such tools as an air impact wrench.
- Handle it carefully without giving any impact, even after removal. [As a guide, if it drops from height of 10 cm (3.94 in) or higher, always replace it.]

INSTALLATION

1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.
3. Install remaining parts in reverse order of removal.

VACUUM PUMP

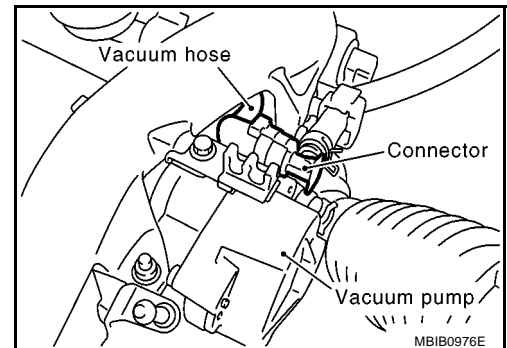
Removal and Installation



- | | | |
|--------------|----------------|----------------|
| 1. Connector | 2. Vacuum hose | 3. Vacuum pump |
| 4. Gasket | | |

REMOVAL

1. Remove engine room cover. Refer to [EM-141, "ENGINE ROOM COVER"](#).
2. Disconnect air duct from air cleaner case. Refer to [EM-143, "AIR CLEANER AND AIR DUCT"](#).
3. Disconnect vacuum hose and connector.
4. Remove vacuum pump.



INSTALLATION

- Install in the reverse order of removal.

ROCKER COVER

Removal and Installation

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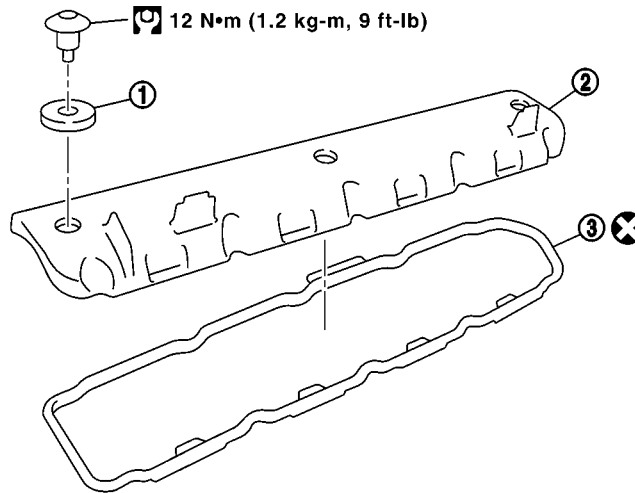
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M

SEC. 111



MBIB0959E

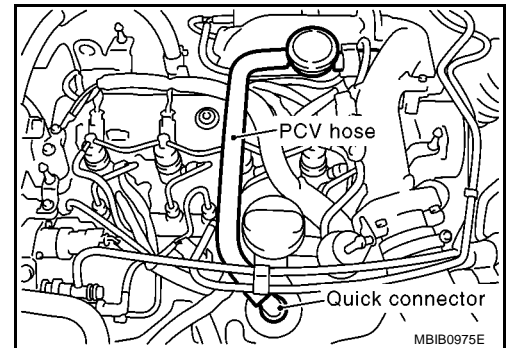
1. Washer

2. Rocker cover

3. Gasket

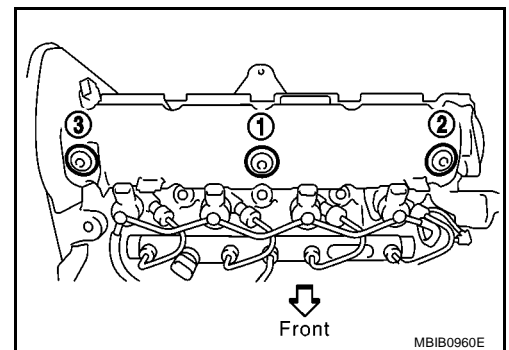
REMOVAL

1. Remove engine room cover. Refer to [EM-141, "ENGINE ROOM COVER"](#).
2. Disconnect PCV hose from quick connector side.
3. Remove fuel injector harness connectors and ground cable.
4. Disconnect camshaft position sensor harness.



MBIB0975E




5. Remove rocker cover.
 - Loosen holding bolts in the reverse order as shown in the figure and remove.

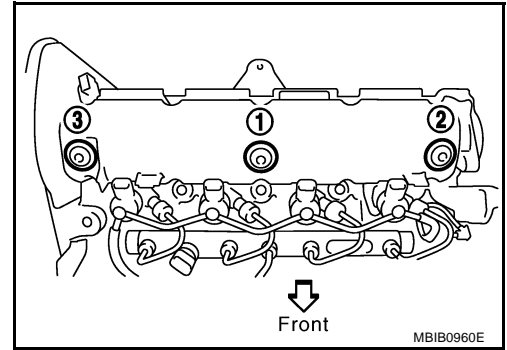


MBIB0960E

INSTALLATION

1. Tighten holding bolts in the numerical order as shown in the figure.

-  **1st step bolt (1) : 12 N·m (1.2 kg-m, 9 ft-lb)**
-  **2nd step bolt (2) and (3) : 12 N·m (1.2 kg-m, 9 ft-lb)**
-  **3rd step bolt (1) : 12 N·m (1.2 kg-m, 9 ft-lb)**



2. Install in the reverse order of removal after this steps.

TIMING BELT

Removal and Installation

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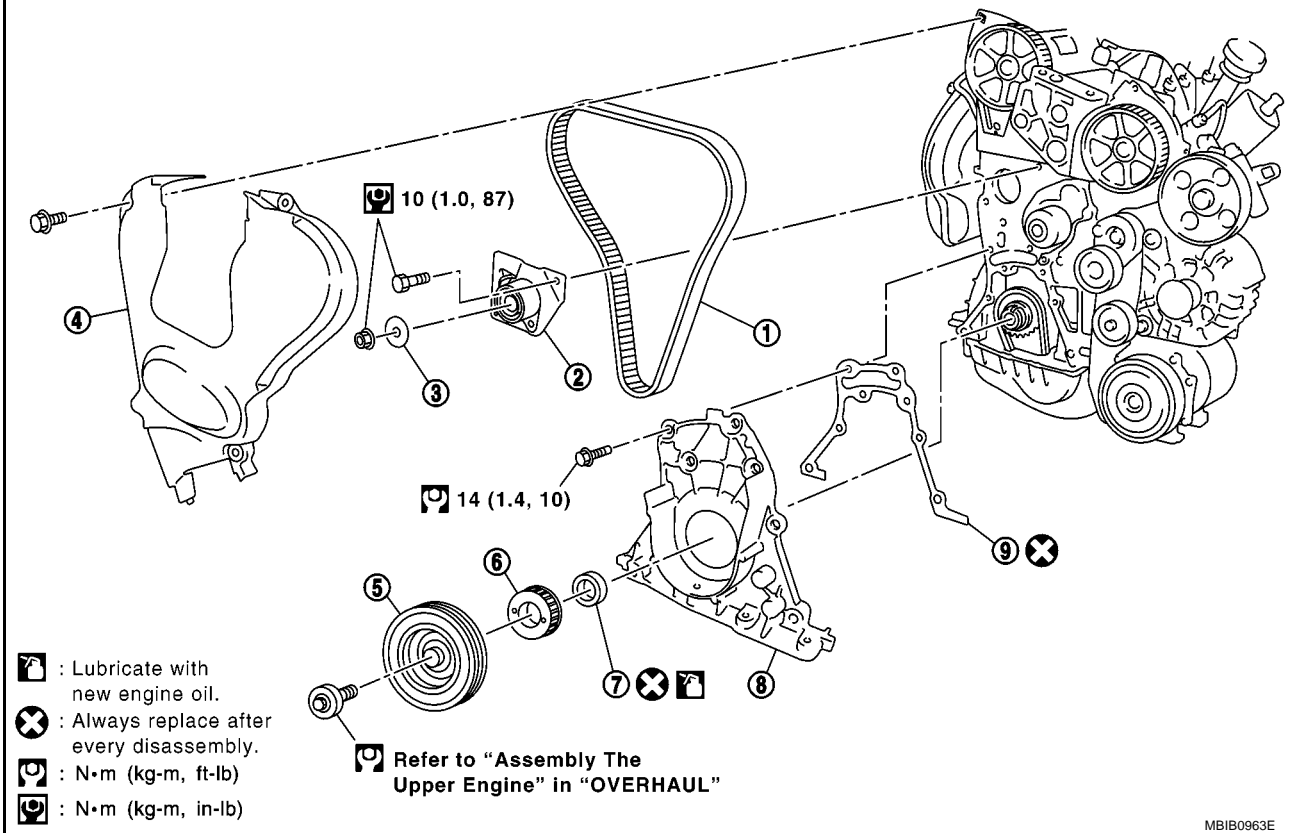
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SEC. 120•130•135



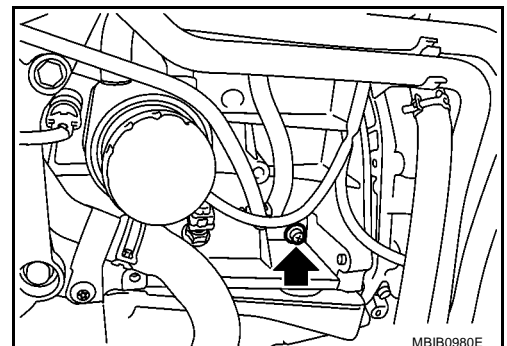
- | | | |
|----------------------------|--------------------------|------------------------|
| 1. Timing belt | 2. Timing belt tensioner | 3. Washer |
| 4. Front timing belt cover | 5. Crankshaft pulley | 6. Crankshaft sprocket |
| 7. Oil seal | 8. Front cover | 9. Gasket |

CAUTION:

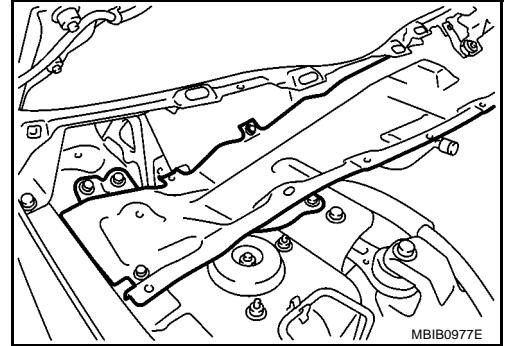
Apply new engine oil to parts marked in illustration before installation.

REMOVAL

- Remove the following parts.
 - Battery ground cable
 - Undercover
 - RH front wheel
- Remove right side splash cover.
- Remove engine room cover. Refer to [EM-141, "ENGINE ROOM COVER"](#).
- Remove front drive shaft RH side. Refer to [FAX-11, "FRONT DRIVE SHAFT"](#).
- Remove drive belt. Refer to [EM-142, "DRIVE BELTS"](#).
- Remove the TDC pin plug.



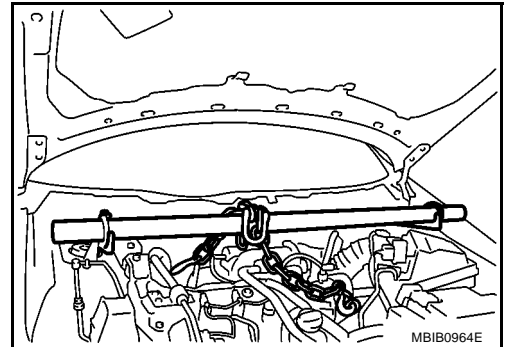
7. Remove baffle plate. Refer to [EM-150, "OIL PAN"](#).
8. Remove wiper arms and wiper motor. Refer to [WW-12, "Removal and Installation for Wiper Motor and Linkage"](#) or [WW-33, "Removal and Installation for Wiper Motor and Linkage"](#) (with rain sensor).
9. Remove bracket as shown.



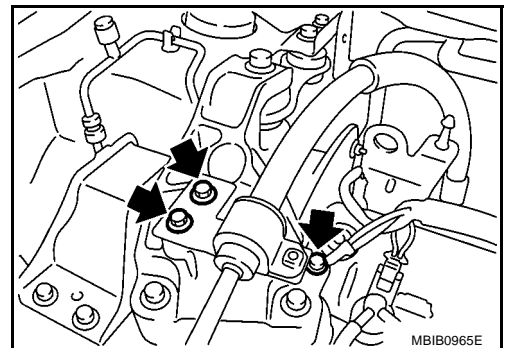
10. Set the engine support bar and chain (commercial service tool) or suitable tool, and secure the engine in position.
 - Support bottom of engine by setting a manual lift table caddy (commercial service tool) or equivalently tool.

CAUTION:

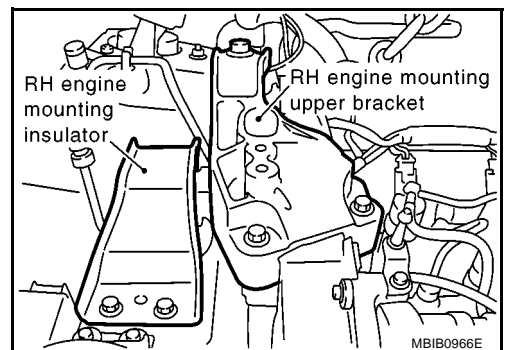
Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.



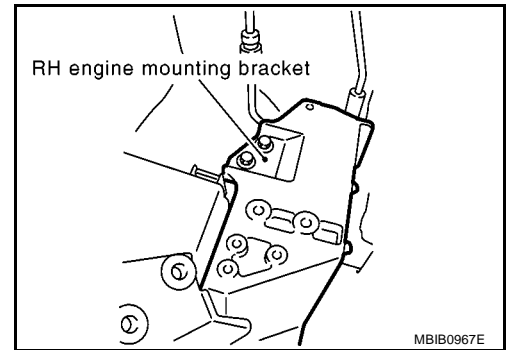
11. Remove power steering pump bracket mounting bolt and move the piping.
12. Remove ground cable.



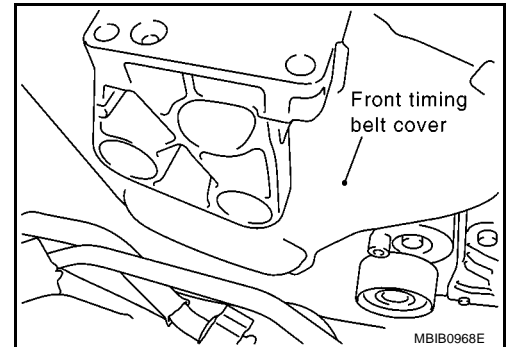
13. Remove RH engine mounting upper bracket bolts. Refer to [EM-164, "ENGINE ASSEMBLY"](#).
14. Remove RH engine mounting insulator.



15. Remove RH engine mounting bracket.

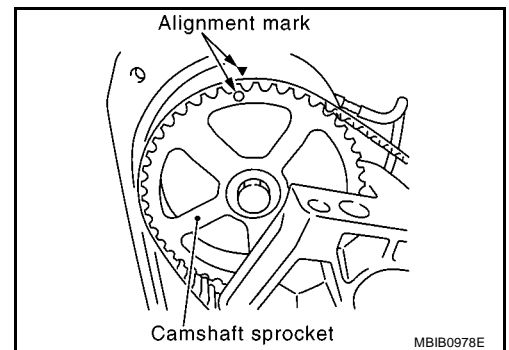


16. Remove front timing belt cover.



17. Obtain compression TDC of No.1 cylinder as follows:

- Rotate crankshaft pulley clockwise direction at the timing end.
- Once the mark on the camshaft pulley is located half a cog before the protecting metal sheet push on the TDC setting and [KV113B0280 (Mot. 1054)] until camshaft is lifted.



18. Remove crankshaft pulley as follows:

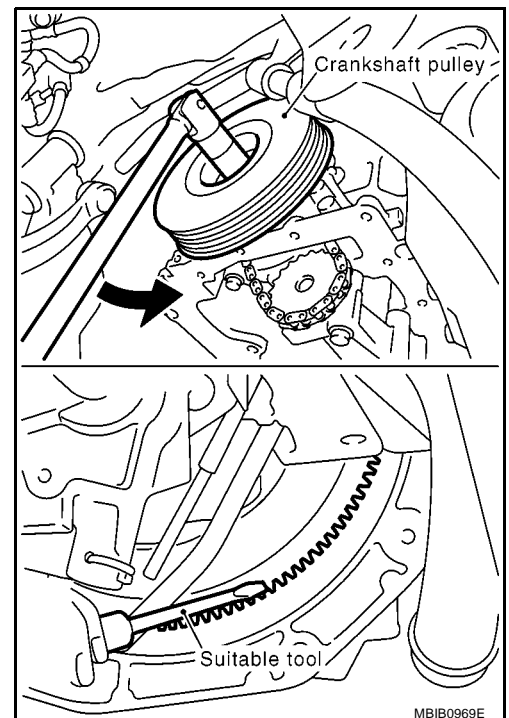
NOTE:

Use a pencil to mark the lower timing housing opposite the mark on the camshaft pulley.

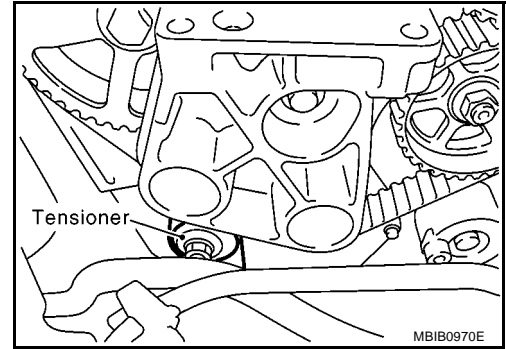
- Loosen the crankshaft pulley fixing bolts and pull crankshaft pulley with both hands to remove it. (At this time set a suitable tool to ring gear so that crankshaft cannot rotate.)

CAUTION:

- Be careful not to damage the signal plate teeth.
- Do not remove fixing bolts. Keep loosened fixing bolts in place to protect removed crankshaft pulley from dropping.



19. Slacken the timing belt by loosening the bolt of tensioner, then remove timing belt.



20. Remove crankshaft sprocket.
21. If necessary, remove front cover.

INSTALLATION

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

Front cover

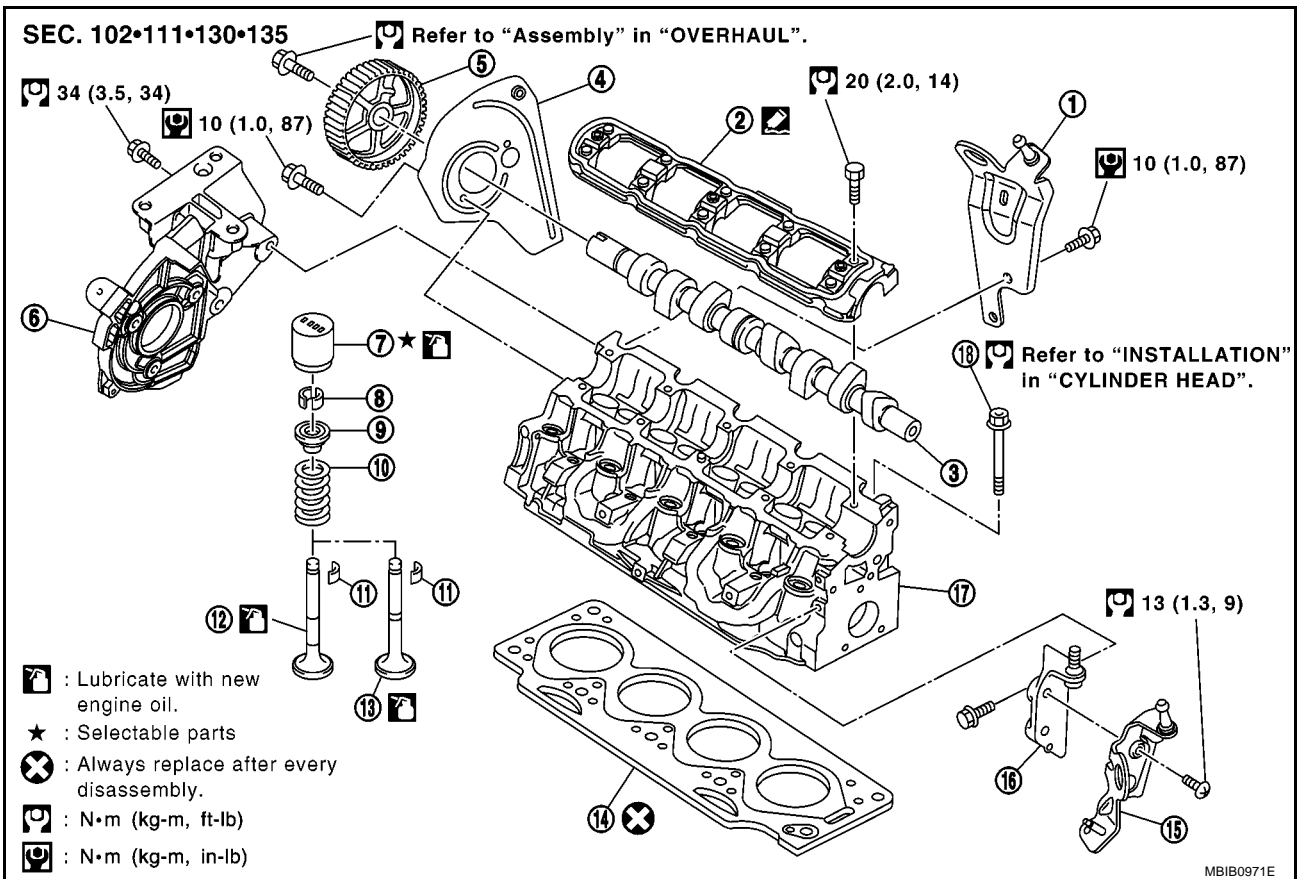
- Refer to [EM-203, "INSTALLATION OF LOWER ENGINE"](#) .

Timing Belt

- Refer to [EM-213, "TIMING ADJUSTMENT"](#) .

CYLINDER HEAD

Removal and Installation



- | | | |
|---------------------------|--------------------------|------------------------------------|
| 1. Front engine slinger | 2. Camshaft bearing beam | 3. Camshaft |
| 4. Timing belt rear cover | 5. Camshaft sprocket | 6. Cylinder head suspended bracket |
| 7. Shim | 8. Valve rotator | 9. Valve spring retainer |
| 10. Valve spring | 11. Valve cotter | 12. Exhaust valve |
| 13. Intake valve | 14. Cylinder head gasket | 15. Rear engine slinger |
| 16. Engine cover bracket | 17. Cylinder head | 18. Cylinder head bolt |

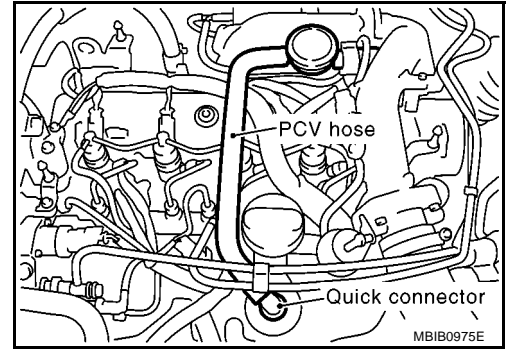
CAUTION:

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

REMOVAL

1. Remove the following parts.
 - Battery ground cable
 - Undercover
 - RH front wheel
2. Remove right side splash cover.
3. Remove engine room cover. Refer to [EM-141, "ENGINE ROOM COVER"](#) .
4. Drain engine coolant. Refer to [CO-25, "Changing Engine Coolant"](#) .
CAUTION:
Perform when engine is cold.
5. Remove air inlet tube from intake manifold. Refer to [EM-145, "CHARGE AIR COOLER"](#) .

6. Remove PCV hose as shown.

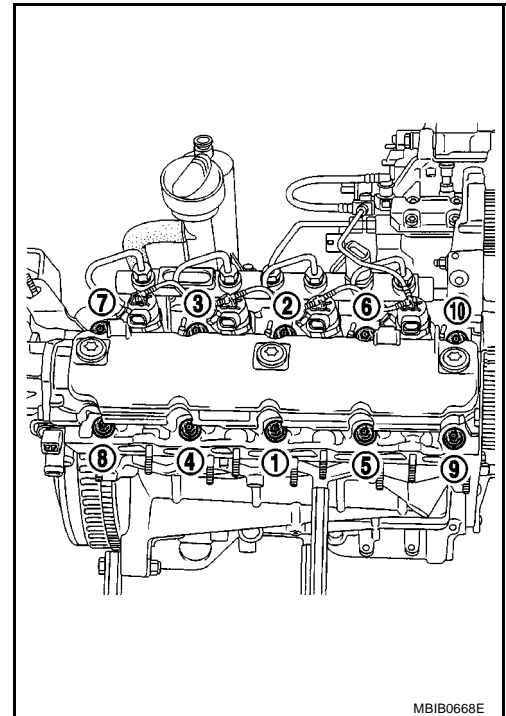


7. Remove radiator upper hose. Refer to [CO-27, "RADIATOR"](#) .
8. Disconnect fuel feed tube and return tube from fuel injection pump. Refer to EC-xx, "REMOVAL" in "Injector Rail" (F9Q).
9. Remove harnesses and connectors.
10. Remove heater hoses.
11. Remove turbocharger assembly. Refer to [EM-146, "INTAKE MANIFOLD, EXHAUST MANIFOLD, TURBO CHARGER, CATALYST"](#) .
12. Remove drive belt. Refer to [EM-142, "Removal and Installation"](#) .
13. Remove timing belt. Refer to [EM-157, "TIMING BELT"](#) .
14. Remove engine support bar.

CAUTION:

During the removal operation, always be careful to prevent engine moves downward from the vehicle.

15. Remove cylinder head bolts in the reverse order as shown.



16. Remove cylinder head assembly.

INSTALLATION

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

Cylinder Head Bolts

NOTE:

To obtain correct tightening of the bolts, remove any oil from the cylinder head securing holes using a syringe.

CYLINDER HEAD

[F9Q]

1. All cylinder head bolts must always be replaced after removal. There is no cylinder head retightening operation.
2. Tighten all the bolts to 30 N·m (3.1 kg-m, 22 ft-lb), then angle tighten to $100^{\circ} \pm 4^{\circ}$, in the sequence shown below.

CAUTION:

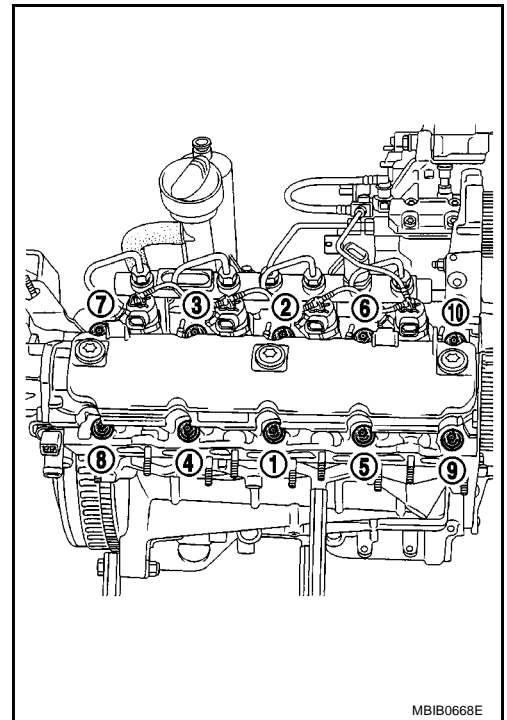
Use an angle wrench (special service tool) to check tightening angle. Do not make judgment by visual inspection.

3. Wait 3 minutes setting time.
4. Cylinder head tightening is carried out in stages, and the following procedure is applied successively to bolts 1-2 then 3-4, 5-6, 7-8 and 9-10.
5. Loosen bolts 1-2 until they are completely free.
6. Tighten bolts 1-2 to 25 N·m (2.6 kg-m, 18 ft-lb), then angle tighten to $213^{\circ} \pm 7^{\circ}$.

CAUTION:

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

7. Repeat the loosening and tightening operations for bolts 3-4, 5-6, 7-8 and 9-10.
 - There is no cylinder head retightening operation.



EBS00SKD

Disassembly and Assembly

DISASSEMBLY

- Refer to [EM-171, "CYLINDER HEAD"](#) .

INSPECTION AFTER DISASSEMBLY

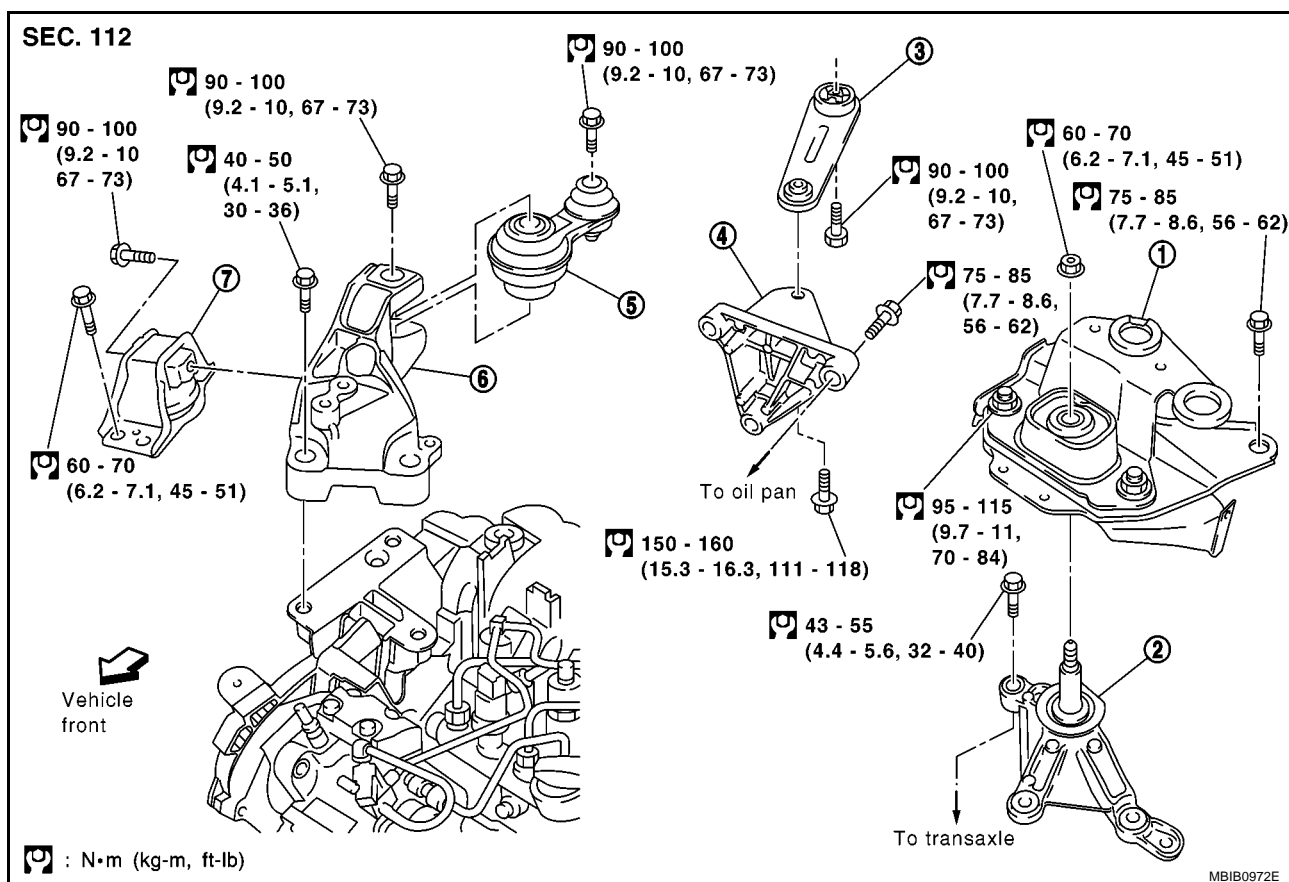
- Refer to [EM-175, "Inspection After Disassembly"](#) .

ASSEMBLY

- Refer to [EM-176, "CYLINDER HEAD"](#) .

ENGINE ASSEMBLY

Removal and Installation



1. LH engine front mounting insulator
2. LH engine mounting bracket
3. Rear torque rod
4. Engine rear mounting bracket
5. RH torque rod
6. RH engine mounting upper bracket
7. RH engine mounting insulator

WARNING:

- Situate vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Do not start working until exhaust system and coolant are cool enough.
- If items or work required are not covered by the engine main body section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to GI section in P12 ESM “SM2E00-1P12E0E”.

REMOVAL

Description of Work

Remove engine and transaxle assembly from vehicle down ward. Separate engine and transaxle.

Preparation

1. Remove the following parts.
 - Battery both cable

- Undercover
- RH/LH splash cover
- RH/LH front wheel

Engine Room

2. Drain engine coolant. Refer to [CO-25, "Changing Engine Coolant"](#) .

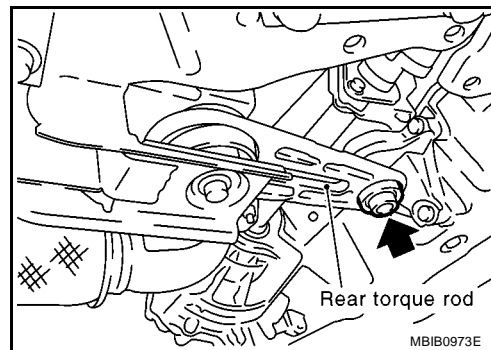
CAUTION:

Perform when engine is cold.

3. Remove engine room cover. Refer to [EM-141, "ENGINE ROOM COVER"](#) .
4. Remove fuel feed and return tubes. Refer to EC-xx, "REMOVAL" in "Injector Rail" (F9Q).
5. Remove charge air cooler inlet tubes. Refer to [EM-145, "CHARGE AIR COOLER"](#) .
6. Remove radiator upper hose. Refer to [CO-27, "RADIATOR"](#) .
7. Remove air cleaner case and air duct. Refer to [EM-143, "AIR CLEANER AND AIR DUCT"](#) .
8. Disconnect vacuum hose connector from vacuum pump. Refer to [EM-154, "VACUUM PUMP"](#) .
9. Remove harness connectors of engine LH side.
10. Remove ECM assembly.
11. Remove ECM tray.
12. Loosen transaxle control wire bracket. Refer to CL-xx, "PIPING" (F9Q).
13. Remove solenoid assembly from solenoid bracket.
14. Disconnect heater hoses from water outlet side.
15. Disconnect power steering pump from engine side. Refer to [PS-16, "Removal and Installation"](#) .
16. Remove transaxle negative harness.
17. Disconnect engine room harness from the engine side and set it aside for easier work.
18. Disconnect drain hose transaxle side.
19. Disconnect shift cable and select cable. Refer to MT-xx, "CONTROL LINKAGE" (F9Q).

Vehicle Underbody

20. Remove drive belt. Refer to [EM-142, "Removal and Installation"](#) .
21. Remove A/C compressor with piping connected from engine. Temporarily secure it on body with a rope to avoid putting load on it. Refer to [ATC-136, "With F9Q Engine"](#) .
22. Remove suspension crossbar. Refer to [FSU-12, "FRONT SUSPENSION MEMBER"](#) .
23. Remove engine rear torque rod mounting bolt.



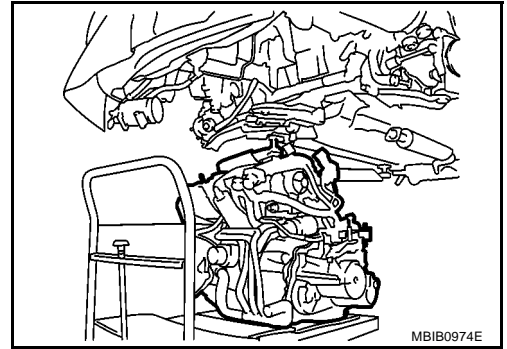
24. Remove exhaust front tube. Refer to [EX-2, "Removal and Installation"](#) .
25. Remove front RH and LH drive shafts. Refer to [FAX-11, "FRONT DRIVE SHAFT"](#) .

Removal

- Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a jack or trestle. Securely support bottom of engine and transaxle.

CAUTION:

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



26. Remove RH and LH engine mounting bolts.
27. Remove engine and transaxle assembly from vehicle downward by carefully operating supporting tools.

CAUTION:

- During the operation, make sure that no part interferes with body side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal operation, always be careful to prevent vehicle from falling off the lift due to changes in the center of gravity.
- If necessary, support vehicle by setting a jack or equivalent tool at the rear.

Separation Work

CAUTION:

During the operation, secure support the engine by placing a piece of wood under the engine oil pan, transaxle oil pan and suspended the engine slinger by baby crane (movable hoist) etc.

28. Remove starter motor. Refer to [SC-24, "Removal and Installation"](#).
29. Separate engine and transaxle.

INSTALLATION

Install in the reverse order of removal.

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

INSPECTION AFTER INSTALLATION

- Before starting engine check the levels of coolant, lubrications and working oils. If less than required quantity, fill to the specified level.
- Before starting engine, bleed air from fuel piping. Refer to [FL-7, "Air Bleeding"](#).
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of coolant, lubricants, working oil, fuel and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines.

OVERHAUL

[F9Q]

PFP:00000

EBS00SBJ

OVERHAUL

Tightening Torque UPPER ENGINE

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

Description	Tightening torques
Rocker cover bolt	*1
Camshaft bearing beam bolt	20 (2.0, 15)
Camshaft pulley bolt	60 (6.1, 44)
Cylinder head bolt	*1
Glow plug	15 (1.5, 11)
Front engine slinger	20 (2.0, 15)
Rear engine slinger	13 (1.3, 10)
Injector clamp bolt	30 (3.1, 22)
Vacuum pump mounting bolt	23 (2.3, 17)
Water outlet mounting bolt	8 (0.8, 71)*2
Camshaft position sensor bolt	9 (0.9, 80)*2
EGR control valve mounting bolt	9 (0.9, 80)*2
Intake and exhaust manifold nut	28 (2.9, 21)
Thermal unit mounting bolt	8 (0.8, 71)*2

*1: Refer to tightening procedure in the text.

LOWER ENGINE

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

Description	Tightening torques
Oil pressure switch	38 (3.9, 28)
Oil level sensor	30 (3.1, 22)
Crankshaft pulley bolt	20 (2.0, 15) + 115°±15° (Angle tightening)
Bolts on crankshaft bearing cap (tightening order: 3-4-2-5-1)	20 (2.0, 15) + 62°±4° (Angle tightening)
Connecting rod cap bolt	20 (2.0, 15) + 40°±6° (Angle tightening)
Oil pump bolt	24 (2.4, 18)
Front cover bolt	14 (1.4, 10)
Oil pan bolt	*1
Double mass flywheel bolt	30 (3.1, 22) + 56°±6° (Angle tightening)
Clutch bolt	20 (2.0, 15)
Bolt of water pump driven by the timing belt	10 (1.0, 87)*2
Timing belt tensioner plate bolt	10 (1.0, 87)*2
Timing belt tensioner nut	50 (5.1, 37)
Engine coolant inlet pipe mounting bolt	10 (1.0, 87)*2
Engine coolant pipe mounting bolt	40 (4.1, 30)
Alternator bracket bolt	50 (5.1, 37)
Power steering oil pump bolt	25 (2.6, 18)
A/C compressor bolt	25 (2.6, 18)
Alternator bolt	25 (2.6, 18)
TDC plug	20 (2.0, 15)
Turbocharger mounting nut	24 (2.4, 18)

Description	Tightening torques
Turbocharger oil inlet union (cylinder block end)	23 (2.3, 17)
Turbocharger oil inlet union (pipe end)	24 (2.4, 18)
Turbocharger oil inlet union (turbocharger end)	26 (2.7, 19)
Mounting bolts on turbocharger oil return pipe (turbocharger end)	12 (1.2, 9)
Exhaust stay bolt:	
— M8	24 (2.4, 18)
— M10	43 (4.4, 32)
Baffle plate mounting bolt	24 (2.4, 18)
Auto-tensioner mounting bolt	43 (4.4, 32)

*1: Refer to tightening procedure in the text.

Standard Replacement PREPARING USED ENGINE

EBS00SBK

The engine should be cleaned and drained (oil and water).

Leave on the used engine or include in the return box:

- Oil filter
- Oil pressure switch
- Water pump
- High pressure pump
- Rail
- Injector
- Glow plug
- Oil trap
- Oil level gauge (with oil filler cap)
- Vacuum pump
- Flywheel
- Clutch

Remember to remove:

- Coolant pipe
- Intake and exhaust manifold
- Alternator
- Power steering pump
- A/C compressor
- A/C compressor bracket
- Oil level sensor
- Cylinder head coolant outlet unit

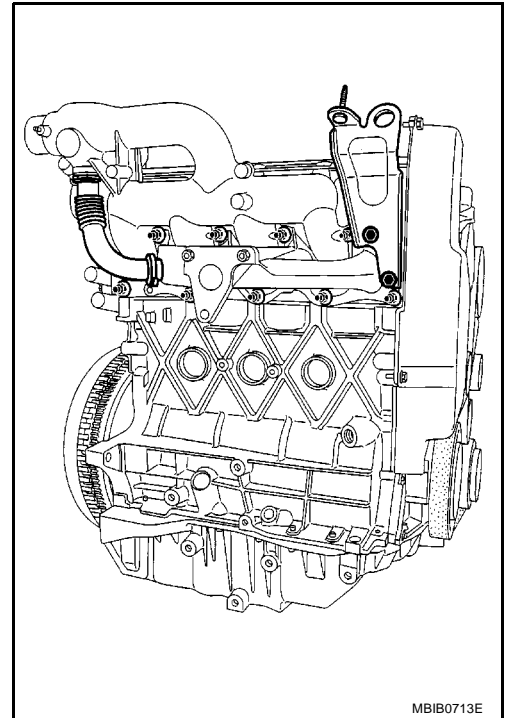
The used engine should be secured to the base under the same conditions as the overhauled engine:

- Plastic plug and cover installed
- Cardboard cover over the assembly

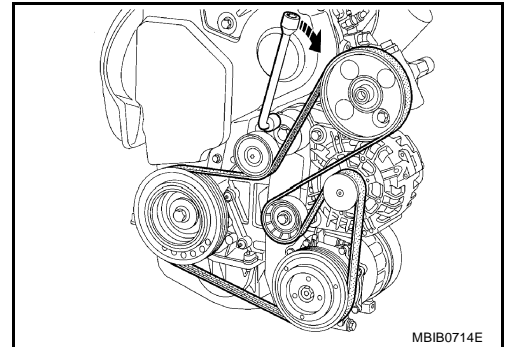
Disassembly of Upper Engine

DISASSEMBLY

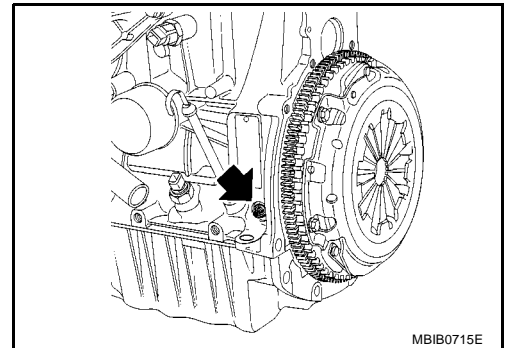
1. Engine installed with a water pump driven by the timing belt.
2. Remove the EGR tube.
3. Remove the front engine slinger.
4. Remove the intake and exhaust manifold.



5. Remove the drive belt by turning the spanner to the right to loosen the belt as shown.



6. Remove the TDC plug.



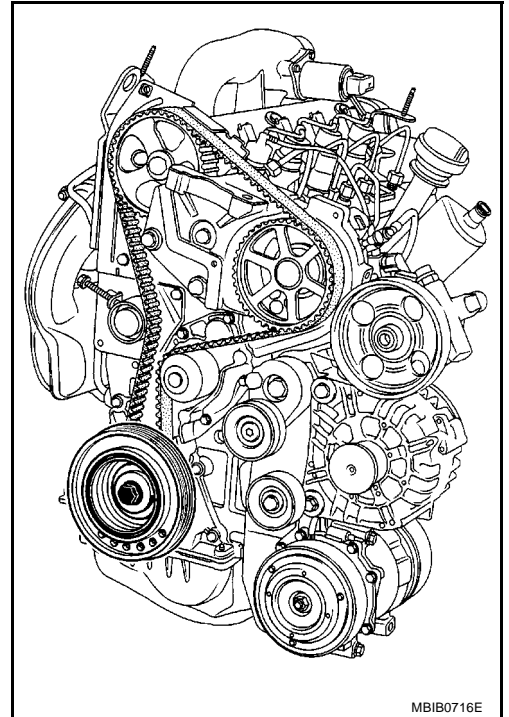
TIMING ADJUSTMENT

1. Rotate the crankshaft in clockwise direction at the timing end.
2. Once the mark on the camshaft pulley is located half a cog before the protecting metal sheet push on the TDC setting and Tool KV113B0280 (Mot. 1054) until camshaft is lifted.

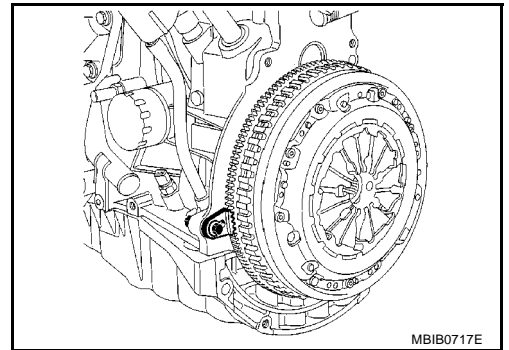
3. Remove the front timing belt cover.

NOTE:

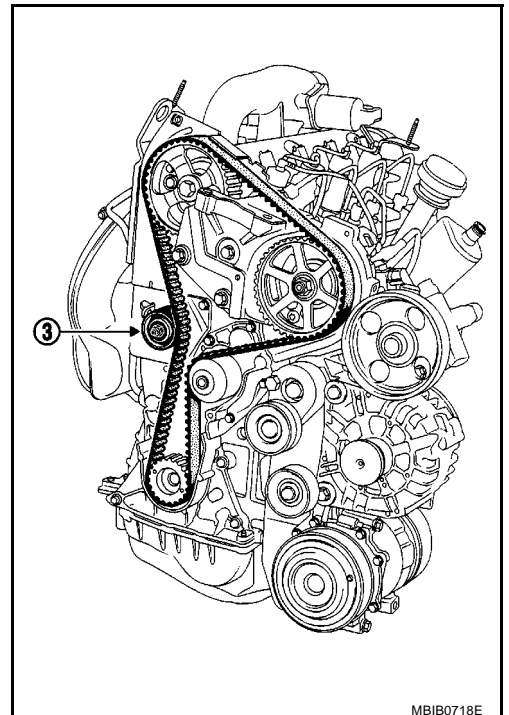
Use a pencil to mark the lower timing housing opposite the mark on the camshaft pulley.



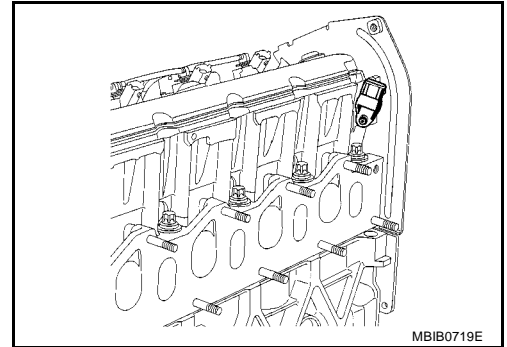
4. Remove the crankshaft pulley by using Tool KV113B0060 (Mot. 582-01) or KV113B0410 (Mot. 1677).



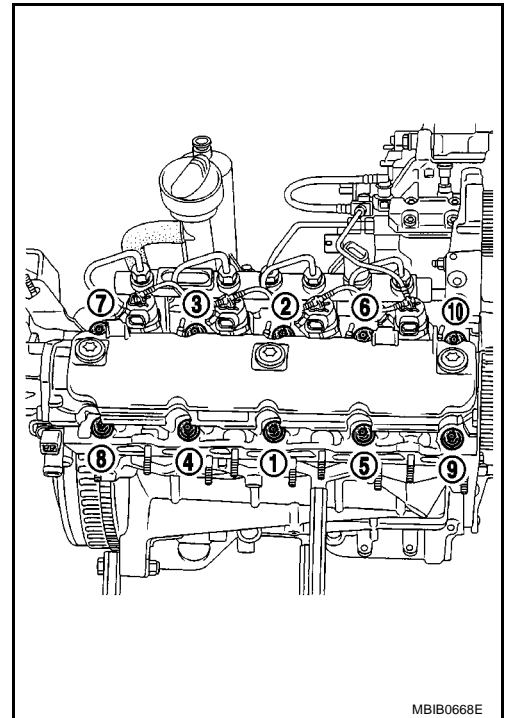
5. Relax the tensioner by loosening the nut (3), then remove the timing belt.



6. Remove the camshaft position sensor.

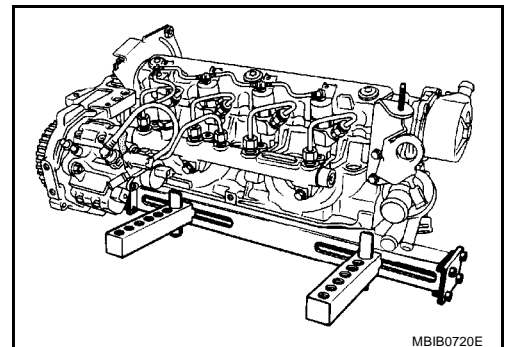


7. Remove the cylinder head bolts in the reverse order as shown, then remove the cylinder head.

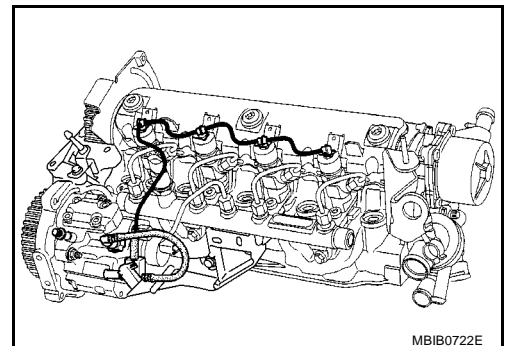


CYLINDER HEAD

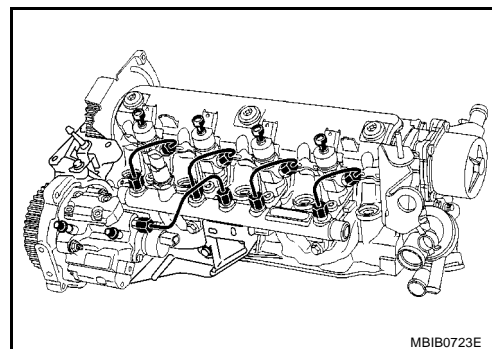
1. Place the cylinder head on Tool KV113B0200 (Mot. 1573).
- Pay strict attention to the instructions regarding cleanliness. Refer to [EM-127, "Cleanliness & Safety"](#).



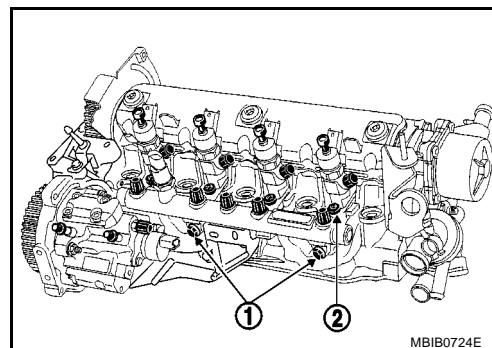
2. Remove the fuel return pipe.
- Install the cleanliness blanking plates on the high-pressure pump and the injector.



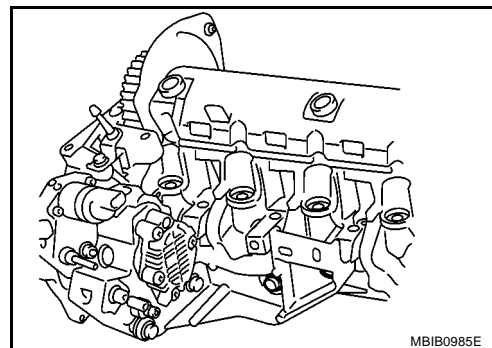
3. Remove the high-pressure fuel pipes using Tool KV113E0010 (Mot. 1566).
 - Install the cleanliness blanking plates on the high-pressure pump and the injectors.



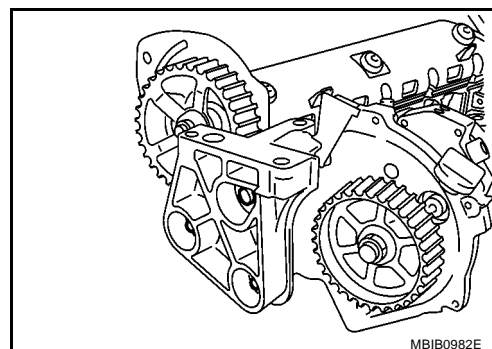
4. Remove the two common rail bolt (1).
5. Remove the injector mounting bracket bolt (2).
6. Remove the injector, installing cleanliness blanking plate on the injector nose.
7. Remove flame arrestor washer.



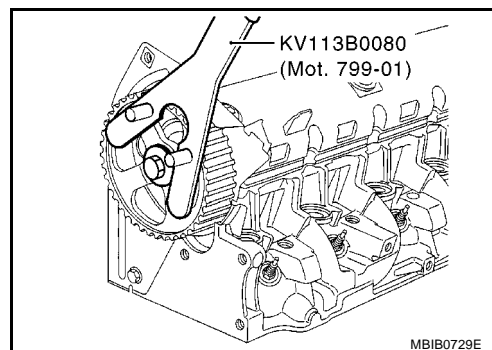
8. Remove the rear high-pressure pump support bolt.



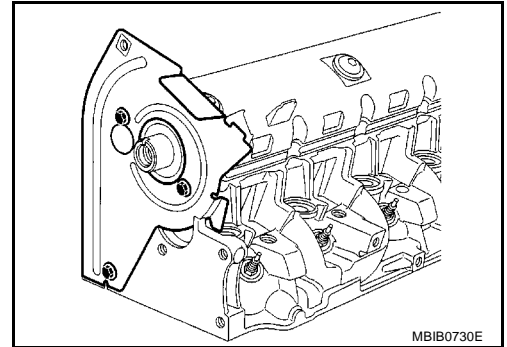
9. Remove the cylinder head suspended mounting support bolt.
10. Remove high-pressure pump and cylinder head suspended assembly from cylinder head.
 - If separate cylinder head suspended mounting and high-pressure pump, refer to EC-xx, " " (F9Q).



11. Remove the camshaft pulley bolt by blocking the pulley using Tool KV113B0070 (Mot. 799-01).

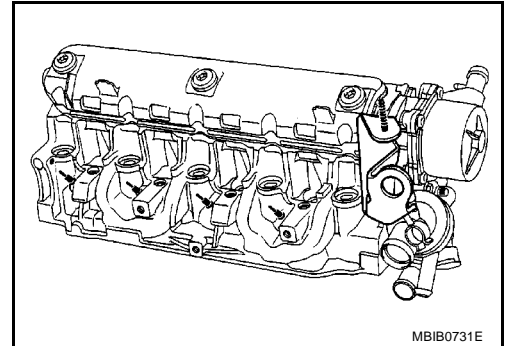


12. Remove the rear timing belt cover.



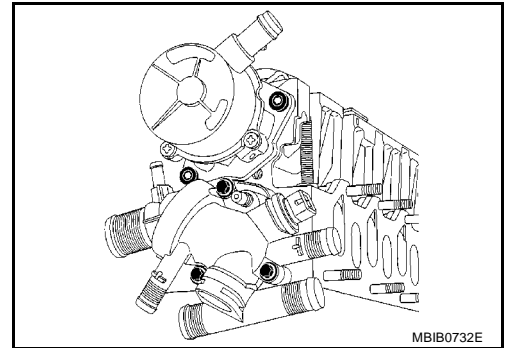
13. Remove the rear engine slinger.

14. Remove the glow plug using a 10 mm (0.39 in) articulated wrench.

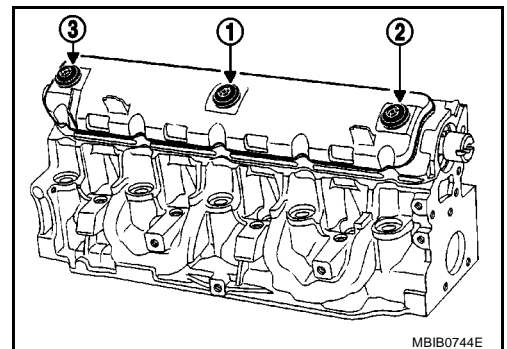


15. Remove the vacuum pump.

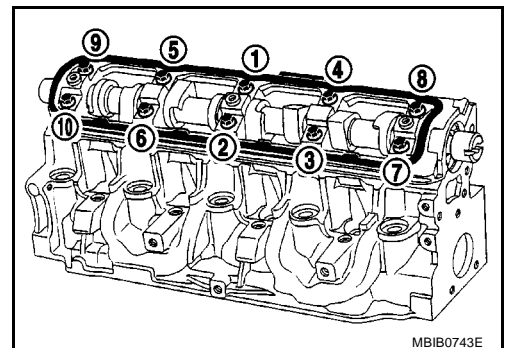
16. Remove the water outlet.



17. Remove the rocker cover bolts in the reverse order as shown.



18. Remove the camshaft bearing beam bolts in the reverse order as shown.



A

EM

C

D

E

F

G

H

I

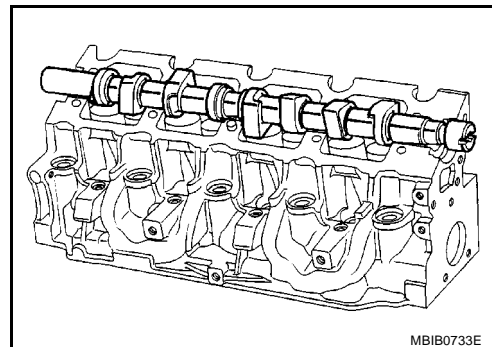
J

K

L

M

19. Remove the camshaft.



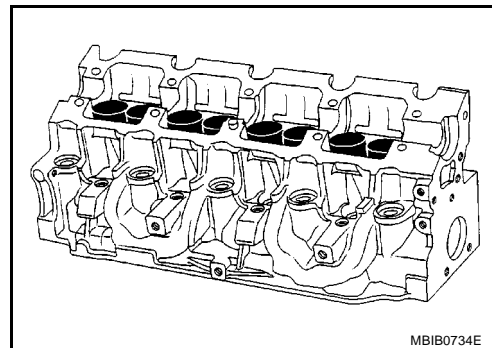
20. Remove the tappet, noting their position.

21. Compress the valve spring using the valve lifter.

22. Remove the key.

23. Remove the upper cup.

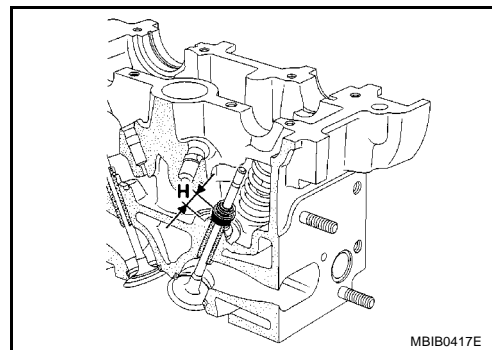
24. Remove the valve spring.



25. Remove the valve.

NOTE:

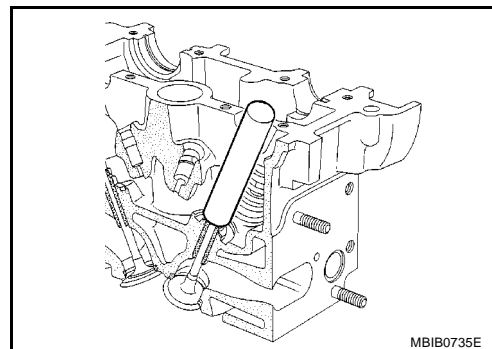
Before removing the valve and the valve stem seals, it is vital that you measure position "H" of one of the old seals in relation to the cylinder head using Tool KV113B0330 (Mot. 1511) or suitable tool.



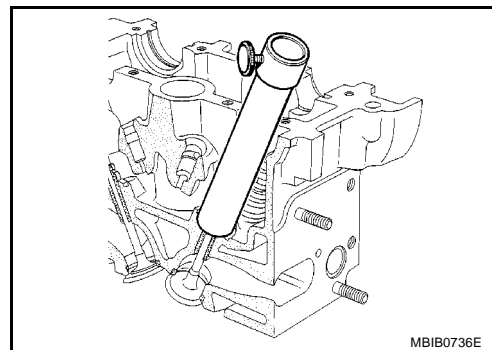
26. Install the push rod of Tool KV113B0330 (Mot. 1511) on the valve stem seal.

NOTE:

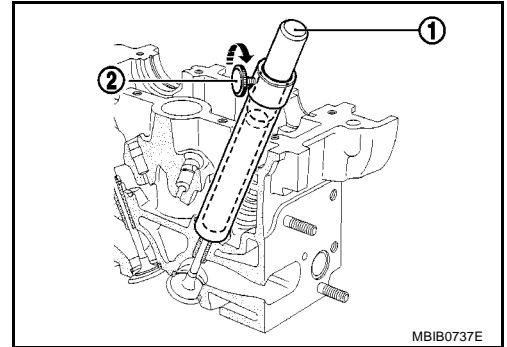
The inner diameter of the push rod must be identical to that of the valve. Moreover, the push rod must come into contact with the metallic upper section of the valve stem seal.



27. Install the guide tube above the push rod until it comes into contact with the cylinder head.



28. Insert sleeve (1) in the guide tube, until the sleeve comes into contact with the push rod.
29. Then block the sleeve using the wheel (2).
30. Remove the guide tube plus sleeve assembly, being careful not to loosen the tumble wheel.
31. Withdraw the push rod.
32. Remove the valve stem seal using pliers KV113B0090 (Mot. 1335).
33. Remove the lower cup.



EBS00SN3

Cleaning

It is very important not to scratch the mating surfaces of any aluminium components.

- Wear glove whilst carrying out this operation.
- Use suitable tool product to dissolve any part of the gasket remaining stuck.
- Apply the product to the section to be cleaned.
- Wait for about ten minutes, then remove using a wooden spatula.
- Do not allow this product to drip on to the paint work.

Great care should be taken when performing this operation, to prevent foreign objects entering the pipe taking oil under pressure to the camshaft (pipe in both the cylinder head and its cover) and the oil return pipe.

Inspection After Disassembly

GASKET FACE

EBS00SBN

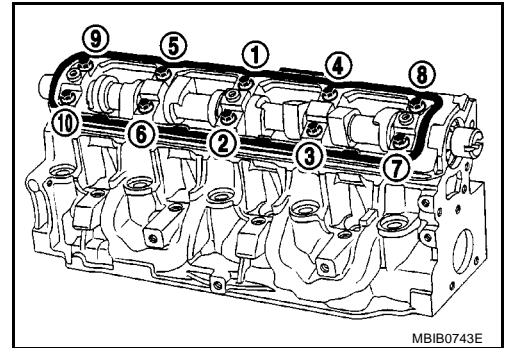
- Check for mating surface bow using a ruler and a set of shims.
- Maximum bow 0.05 mm (0.0020 in).

No regrinding of the cylinder head is permitted.

CAMSHAFT END PLAY

1. Install the camshaft.
2. Install camshaft bearing beam. Tighten bolts in the numerical order as shown.

 : 20 N·m (2.0 kg-m, 15 ft-lb)



3. Check the end play.

End play: 0.045 - 0.135 mm (0.0018 - 0.0053 in)

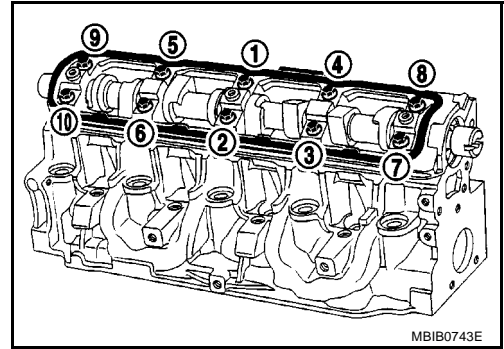
4. Remove the camshaft bearing beam and the camshaft.
5. Check that the cylinder head lubrication duct, camshaft bearing, and tappet are not obstructed.
6. Replace worn parts.

VALVE CLEARANCE

1. Install the tappet.
2. Install the camshaft.

3. Install camshaft bearing beam. Tighten bolts in the numerical order as shown.

 : 20 N·m (2.0 kg-m, 15 ft-lb)

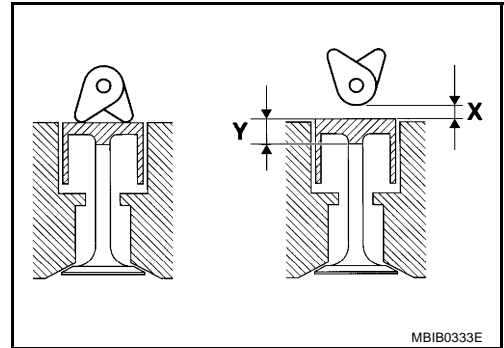


4. Place the valves of the cylinder concerned at the “end of exhaust - beginning of intake” position and check the clearance (X).

NOTE:

Dimension (Y) corresponds to the tappet thickness size (there are 25 sizes in the service parts).

Y	X
1	4
3	2
4	1
2	3



Compare the values noted with the specified values.

Clearance, under cold condition:

Intake : 0.15 - 0.25 mm (0.0059 - 0.0098 in)

Exhaust : 0.35 - 0.45 mm (0.0138 - 0.0177 in)

5. Remove the camshaft bearing beam.
6. Remove the camshaft.
7. Remove the tappet not within tolerance.

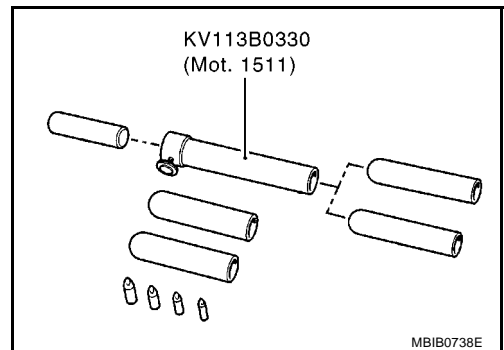
Assembly CYLINDER HEAD

EBS00SBO

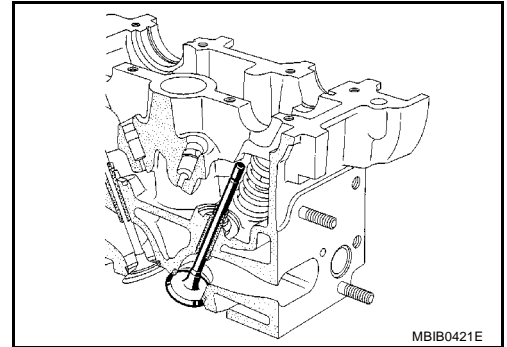
1. Install new valve, grind them gently into their respective seat.
2. Clean all the part thoroughly, mark them for identification purpose, then carry out the installing operation.
3. Lubricate the inside of the valve guide.
4. Install the valve spring collar ring.
 - The valve stem seal must be installed using Tool KV113B0330 (Mot. 1511) or suitable tool.

NOTE:

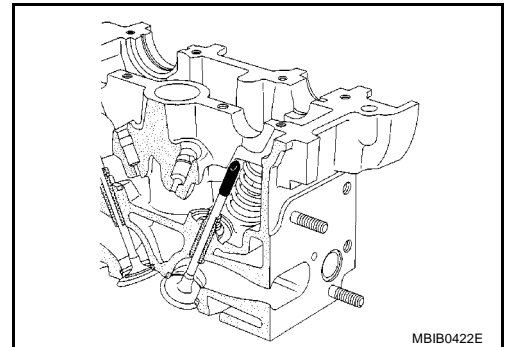
Do not lubricate the valve stem seals before installing them.



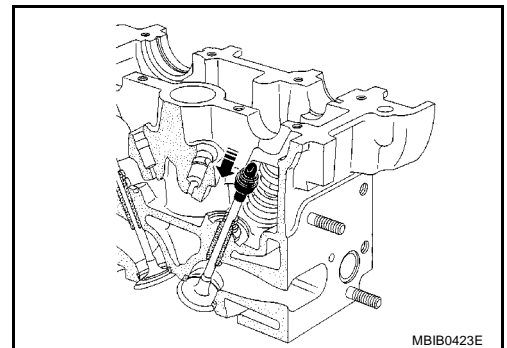
5. Installing new valve stem seals.
6. Place the valve in the cylinder head.



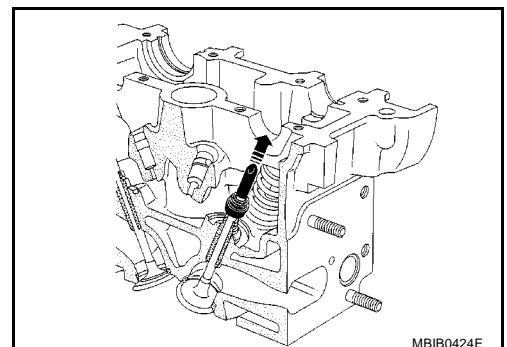
7. Place the barrel of Tool KV113B0330 (Mot. 1511) tool over the valve stem (the internal diameter of the barrel must be identical to the diameter of the valve stem).



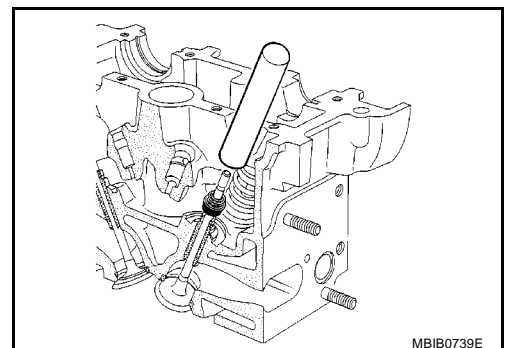
8. Keep the valve pressed against its seat.
9. Place the valve stem seal (not lubricated) over the tool barrel.



10. Push the valve stem seal past the tool barrel, then withdraw the barrel.



11. Place the push rod over the valve stem seal.



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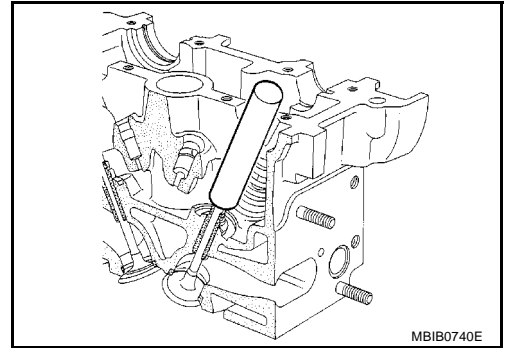
K

L

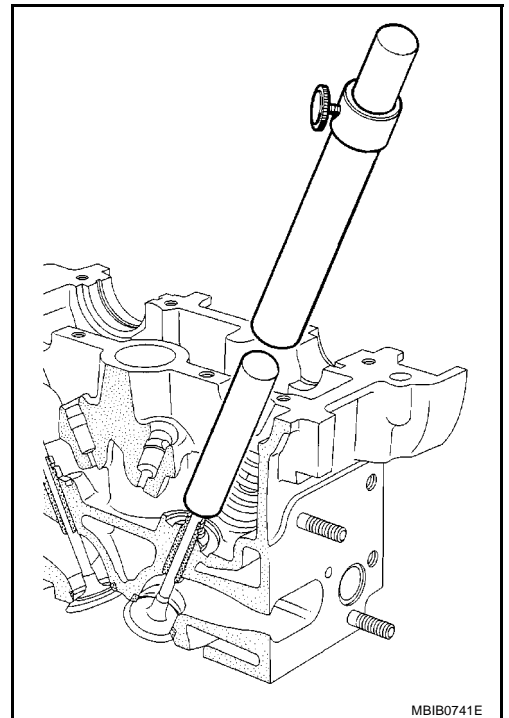
M

NOTE:

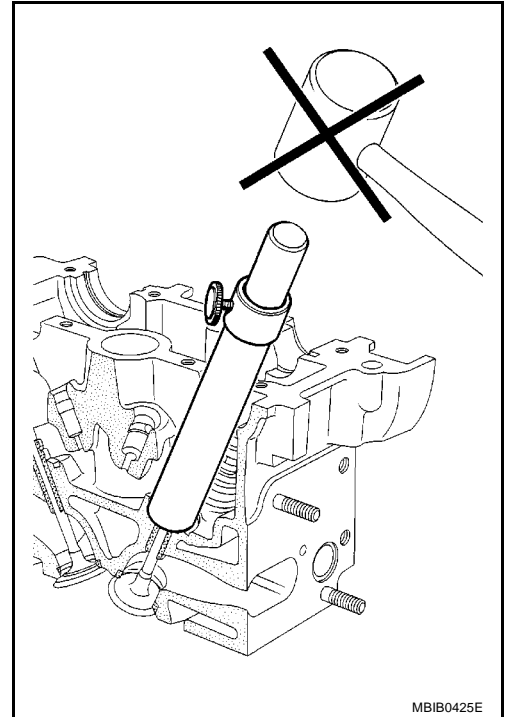
- The inner diameter of the push rod must be identical to the diameter of the valve stems.
- Moreover, the lower part of the push rod must be in contact with the upper section of the valve stem seal.



12. Place the guide tube and sleeve assembly over the push rod.



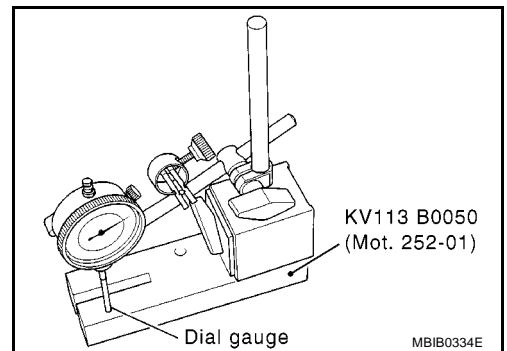
13. Push the valve stem seal down by tapping the top of the sleeve with the palm of your hand until the guide tube touches the cylinder head.



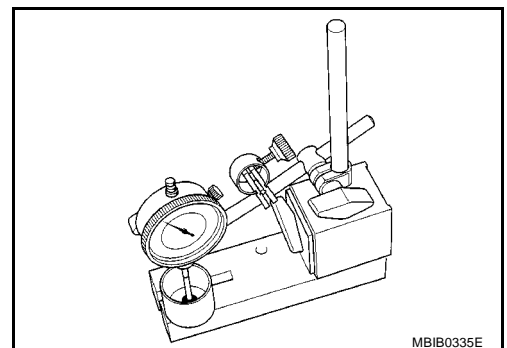
14. Repeat these operations for all the valve.
15. Position the spring.
16. Position the upper cup.
17. Compress the spring.
18. Install the pin.
19. Check the valve protrusion.

Protrusion: – 0.03 to 0.21 mm (– 0.0012 to 0.0083 in)

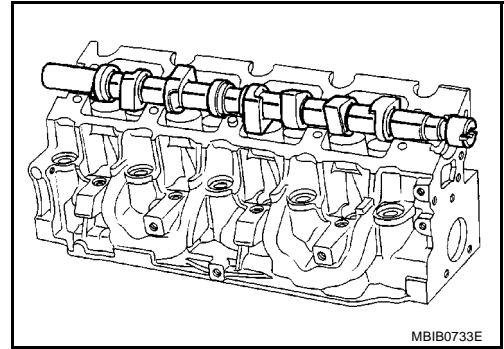
20. Set up the following assembly using Tool KV113B0050 (Mot. 252-01) and dial gauge, then calibrate the gauge.



21. Raise the gauge extension (without modifying the position of the magnetic support/gauge assembly), then slide in the tappet to be measured.



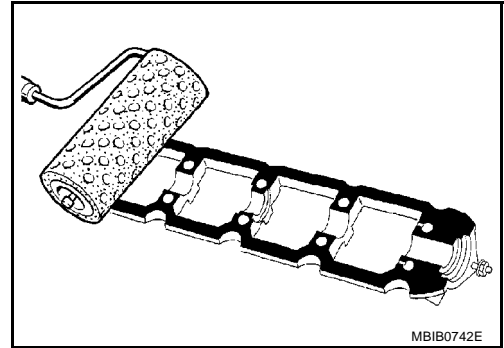
22. Note dimension (Y) and repeat the operation for the tappets where the valve clearance is not within tolerance.
23. Then select the various thicknesses of the tappet by referring to the "PARTS CATALOG" for the vehicle concerned.
24. Lubricate the camshaft bearing.
25. Degrees the mating surfaces, which must be clean, dry and free from grease (in particular, avoid finger marks).
26. Install the camshaft.



27. Using a stipple roller, apply locking sealant to the gasket face of the camshaft bearing beam until it turns "reddish" in color.

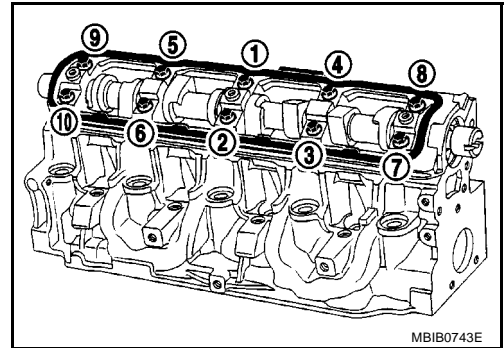
NOTE:

- Using a cloth, remove any locking sealant in the five camshaft beam bearing.
- Place one or two drops of locking sealant on the five beam mounting bolts on the intake and exhaust mounting end.




28. Install camshaft bearing beam. Tighten bolts in the numerical order as shown.

 : 20 N·m (2.0 kg-m, 15 ft-lb)

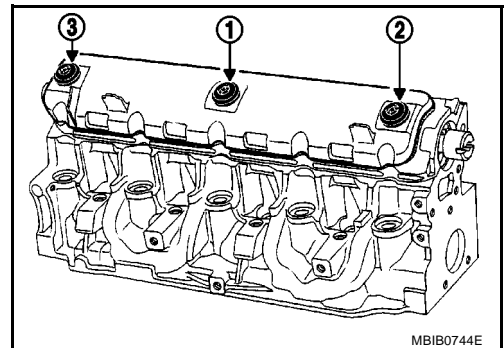


29. Degrees the mating surfaces of the rocker cover and the camshaft bearing beam. They must be clean, dry and free from grease (in particular, avoid finger mark).
30. Install the new seal on the rocker cover.
31. Install the rocker cover. Tighten mounting bolts to specified torque in the numerical order as shown.

 1st step bolt (1): 12 N·m (1.2 kg-m, 9 ft-lb)

 2nd step bolt (2) and (3): 12 N·m (1.2 kg-m, 9 ft-lb)

 3rd step bolt (1): 12 N·m (1.2 kg-m, 9 ft-lb)

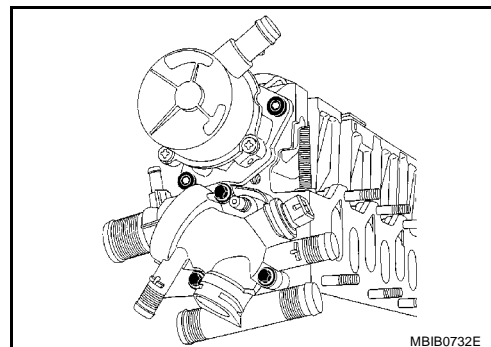


32. Install the water outlet installed with a new oil seal.

 : 8 N·m (0.8 kg-m, 71 in-lb)

33. Install the vacuum pump with a new gasket.

 : 23 N·m (2.3 kg-m, 17 ft-lb)



34. Install the front engine slinger.

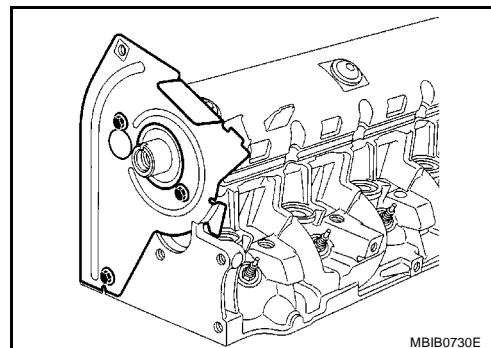
 : 13 N·m (1.3 kg-m, 10 ft-lb)

35. Install the glow plug using an articulated wrench of 10 mm (0.39 in).

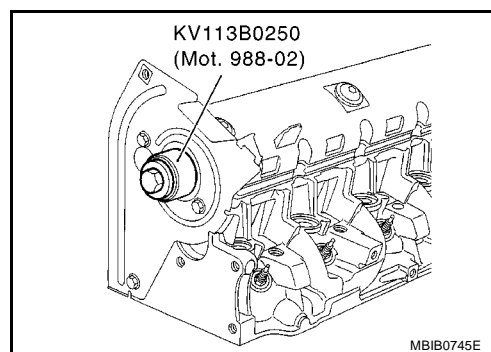
 : 15 N·m (1.5 kg-m, 11 ft-lb)

36. Install the rear timing belt cover by placing a drop of locking sealant on the bolt.

 : 10 N·m (1.0 kg-m, 87 in-lb)

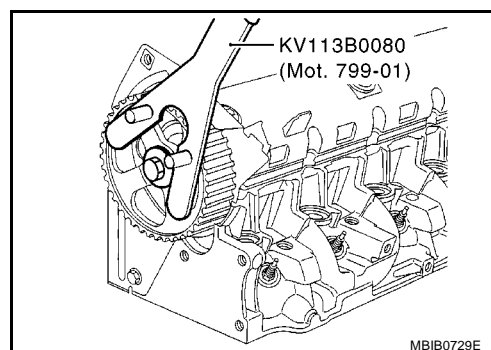


37. Install the camshaft seal (timing end) using Too KV113B0250 (Mot. 988-02).



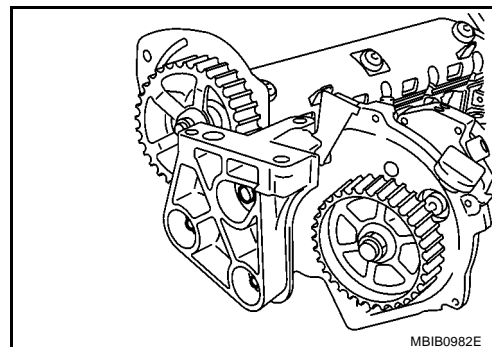
38. Install the camshaft pulley by blocking it using Tool KV113B0080 (Mot. 799-01).

 : 60 N·m (6.1 kg-m, 44 ft-lb)



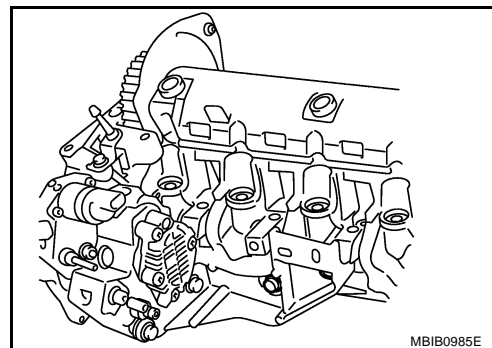
39. Install the cylinder head suspended mounting.

 : 35 N·m (3.6 kg-m, 26 ft-lb)



40. Tighten two bolts.

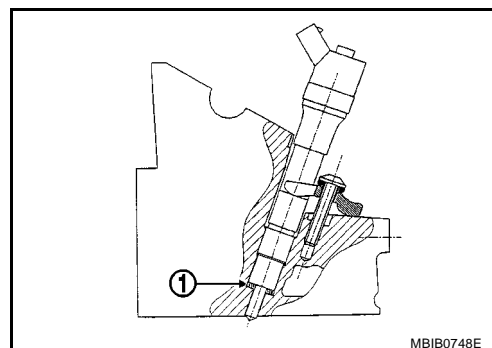
 : 30 N·m (3.1 kg-m, 22 ft-lb)



41. Change the washer (1) under the injector.

NOTE:

In order to install the high pressure pipe correctly, it is vital that the following installing sequence be complied with.

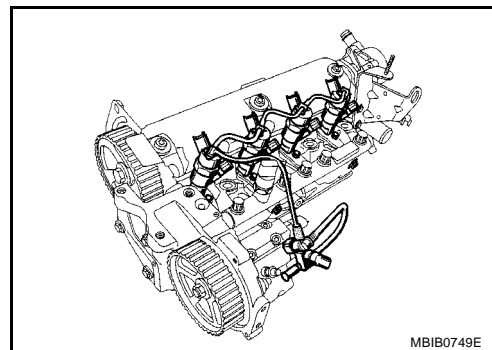


42. Install the injector.

43. Install the injector bracket without blocking them.

44. Install the two rail bolt without blocking them.

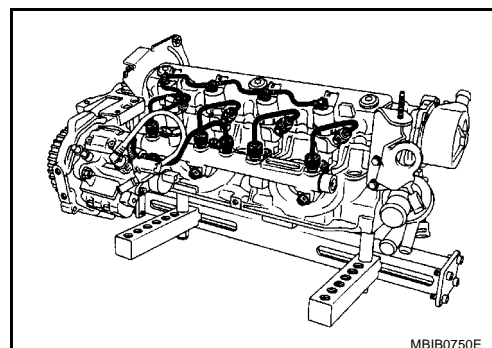
45. Install the new diesel return pipe.



46. Tighten the injector flange.

 : 20 N·m (2.0 kg-m, 15 ft-lb)

47. Install the high-pressure pipe.



48. Tighten the high-pressure pipe nuts at the injector end.

 : 25 N·m (2.6 kg-m, 18 ft-lb)

49. Tighten the high-pressure pipe nuts at the rail end.

 : 25 N·m (2.6 kg-m, 18 ft-lb)

50. Tighten the rail tightening bolt.

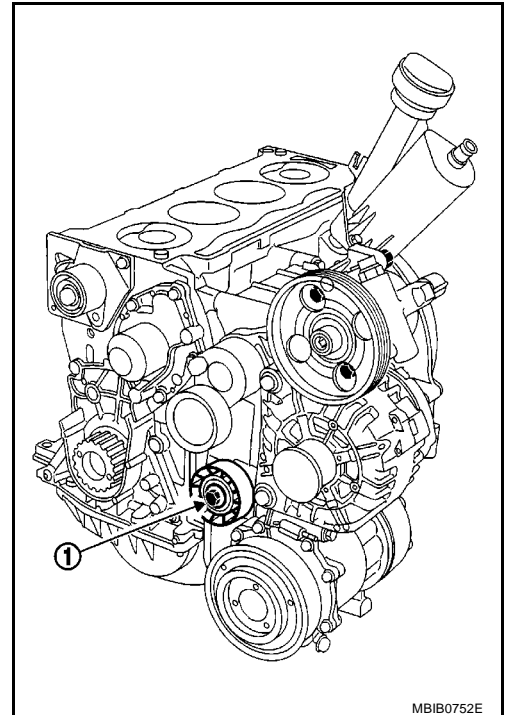
 : 22 N·m (2.2 kg-m, 16 ft-lb)

51. Tighten the pump/rail high-pressure pipe.

 : 25 N·m (2.6 kg-m, 18 ft-lb)

Disassembly The Lower Engine DIASSEMBLY

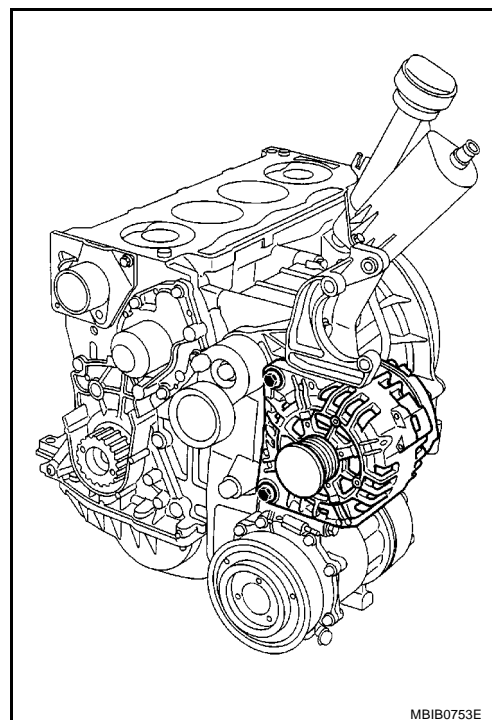
1. Engine installed with a water pump driven by the timing belt.
2. Remove the power steering pump.
3. Remove the idler pulley by removing bolt (1).



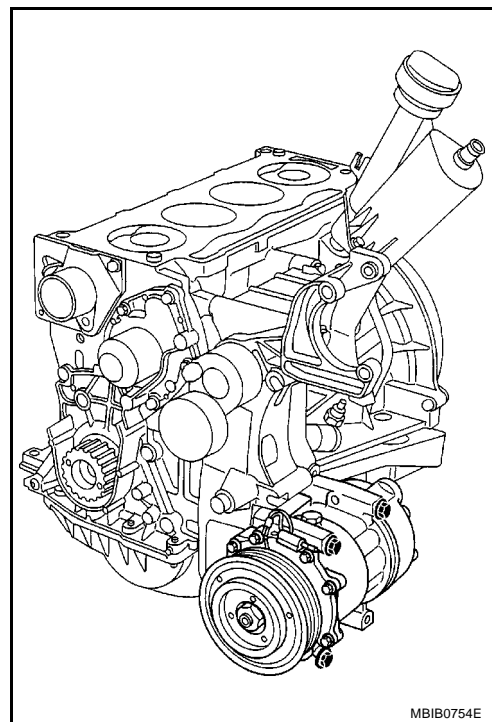
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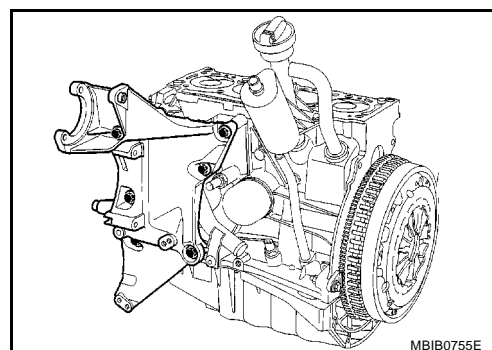
4. Remove the alternator.



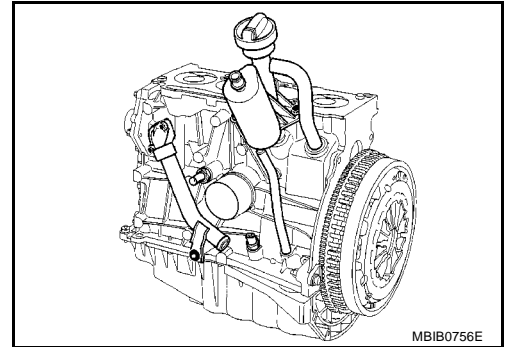
5. Remove the A/C compressor.



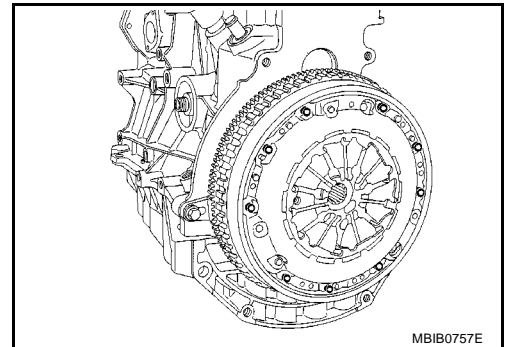
6. Remove the alternator bracket.



7. Remove the oil separator.
8. Remove the oil filter.
9. Remove the oil cooler.
10. Remove the oil pressure switch.
11. Remove the oil level sensor.
12. Remove the coolant hose.
13. Remove the water pump inlet pipe.

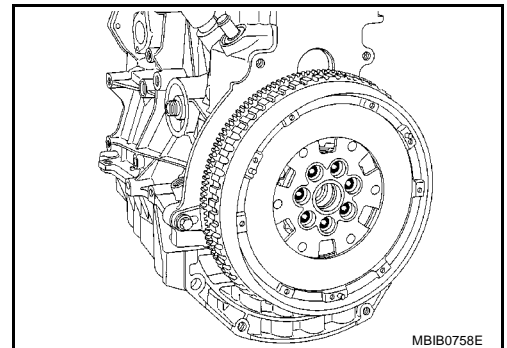


14. Remove the clutch.



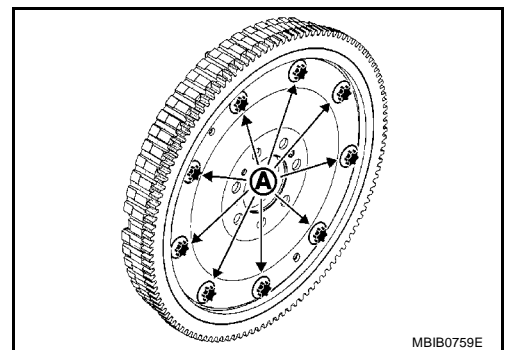
Checking the Flywheel and Friction Face

- It is essential to change the flywheel if the contact surface is "bluish" or if the friction face is "worn out".
15. Position Tool KV113B0060 (Mot. 582-01) or KV113B0410 (Mot. 1677).
 16. Remove the flywheel mounting bolts (these bolts must be replaced).
 17. Remove the flywheel.



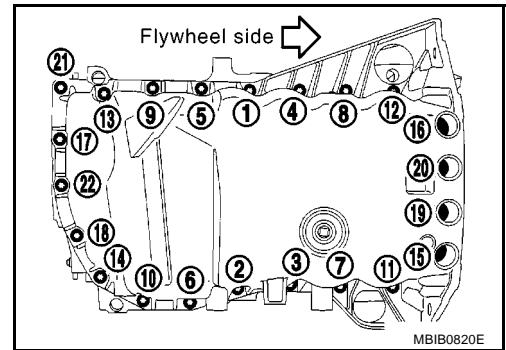
Special Notes Concerning Engines Installed With a Flexible Flywheel

- Under no circumstances should the bolts (A) be removed.

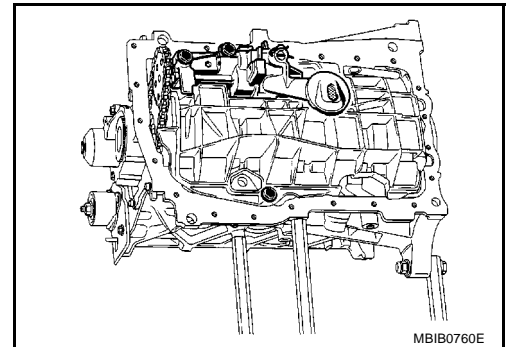


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18. Remove the oil pan bolts in the reverse order as shown.

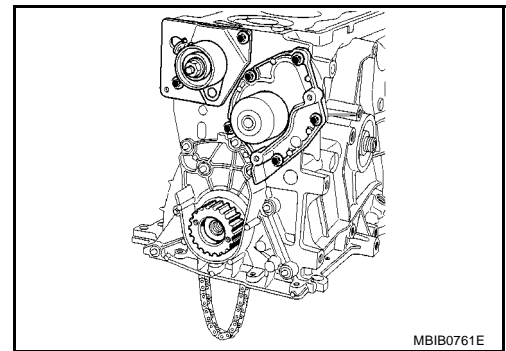


19. Remove the oil pump and the baffle plate.



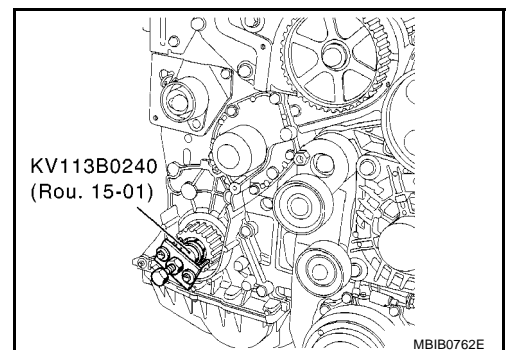
20. Remove the timing tensioner plate.

21. Remove the water pump.

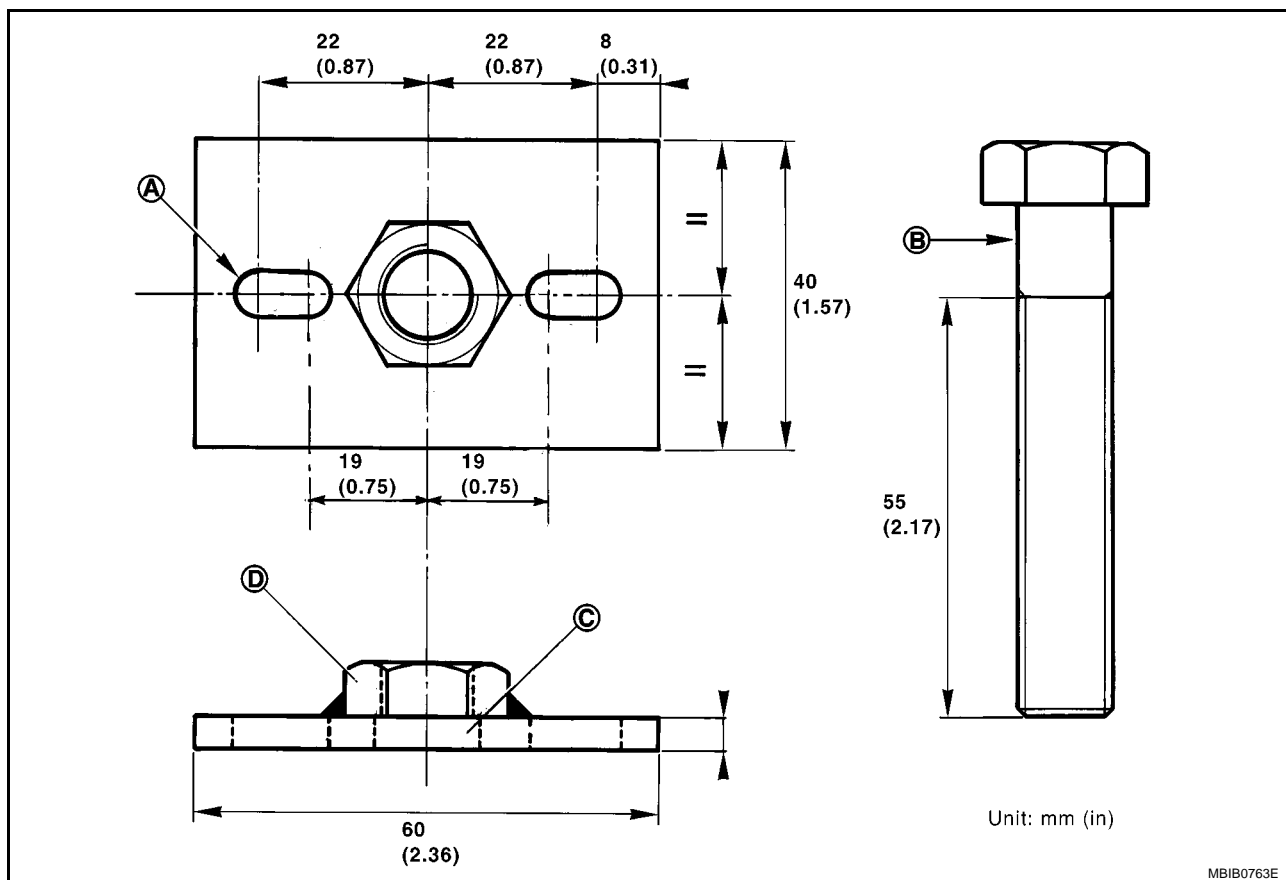


22. Remove the crankshaft sprocket.

23. If necessary, use the locally manufactured tool (see drawing on following page) with Tool KV113B0240 (Rou. 15-01).



- Drawing of locally manufactured tool (dimensions).



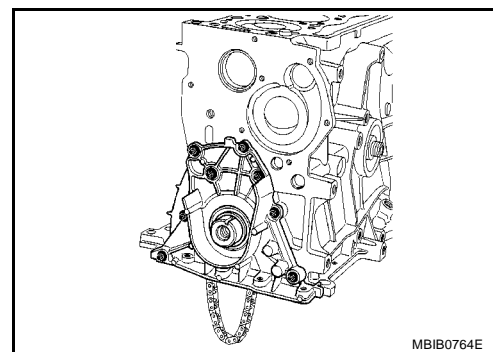
A: 6.5 mm (0.256 in)

B: 12 mm (0.47 in) dia. - pitch 1.75 mm (0.0689 in)

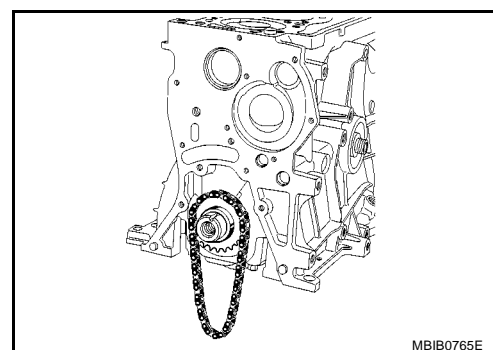
C: 13 mm (0.51 in) dia.

D: 12 mm (0.47 in) dia. - pitch 1.75 mm (0.0689 in) weld - on

24. Remove the front cover.

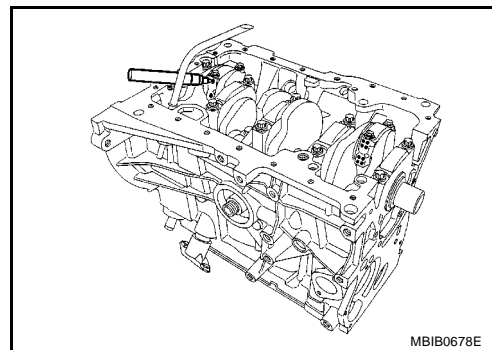


25. Remove the oil pump chain and the drive sprocket.



CAUTION:

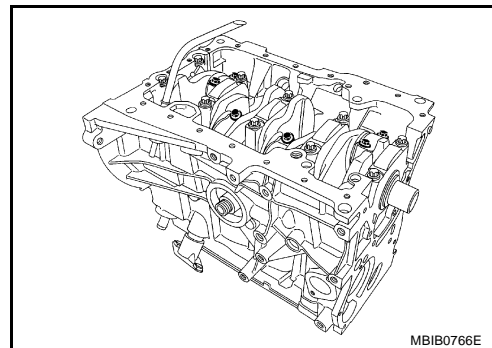
- Do not use a sharp point to mark the bearing caps in relation to their connecting rods to avoid starting a crack in the rod.
- Use a permanent marker pen.



26. Remove the bearing caps and the connecting rod/piston assembly.

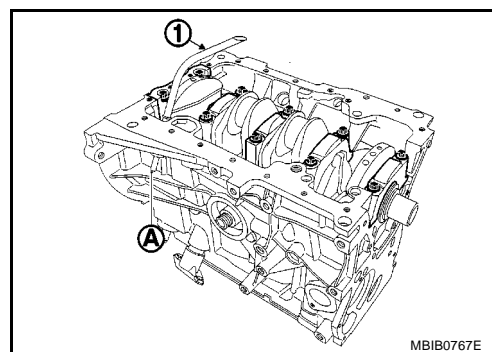
NOTE:

It is essential to mark the position of the crankshaft shell, as the category may be different for each bearing.

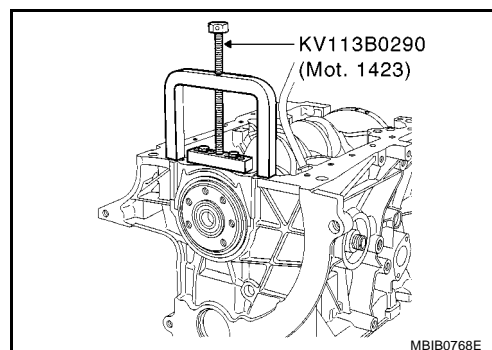


27. Remove the crankshaft bearing cap.

28. Remove oil return tube (1) from the decanter by tapping (A).



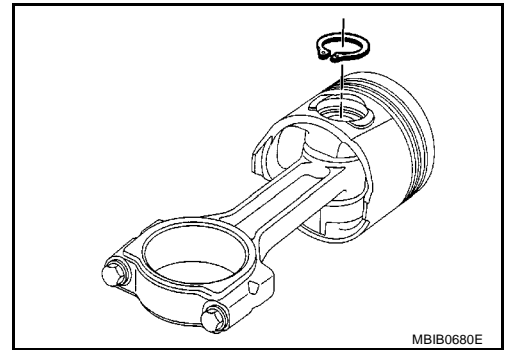
29. Extraction of No. 1 bearing, installed with bars of injected silicon paste, is made easier by using Tool KV113B0290 (Mot. 1423).
30. Remove the crankshaft.



PISTON PIN**NOTE:**

It is essential to mark the connecting rod to match it to its piston, because the piston height classes in the same engine may be different.

- To extract the piston pin, remove the snap ring using snap ring pliers, then release the pin.



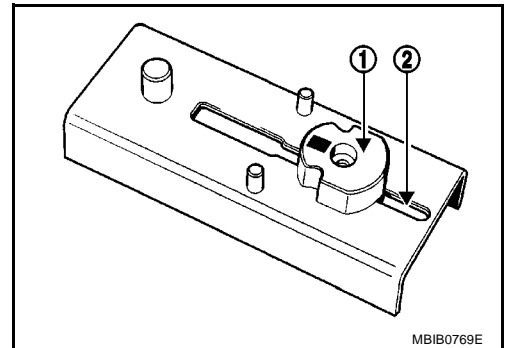
EBS00SBQ

Assembly of Lower Engine

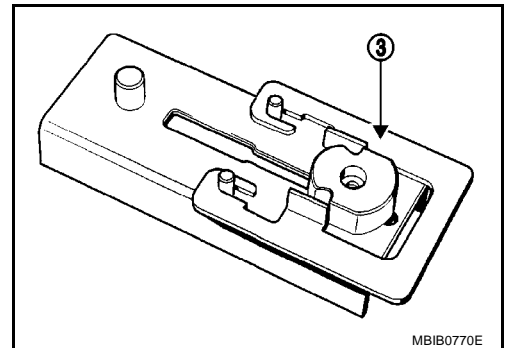
CONNECTING ROD BEARING

On the Connecting Rod Body

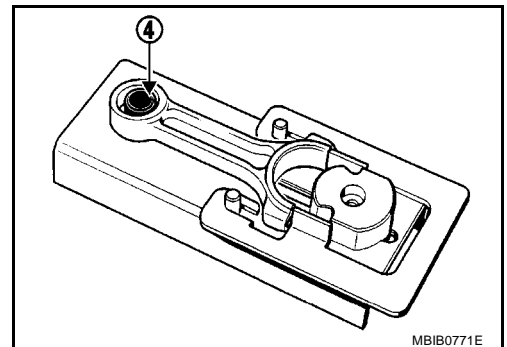
1. Slide the shell support (1) of Tool KV113B0310 (Mot. 1492-01) into the groove (2) on the base of Tool KV113B0140 (Mot. 1492).



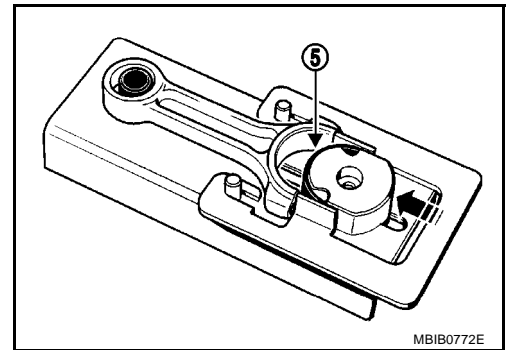
2. Install the guide (3) of Tool KV113B0310 (Mot. 1492-01) onto the base (as shown in the figure).



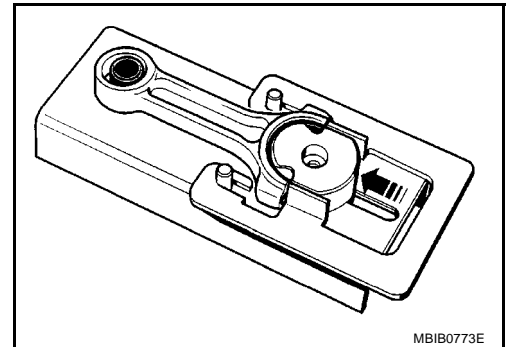
3. Lay the body of the connecting rod on the base of the tool (as shown in the figure).
4. Ensure that the lower part (4) of the small end of the connecting rod is in contact with the guide pin.



5. Install the shell (5) on the shell support, then push it in the direction of the arrow (as shown in the figure).

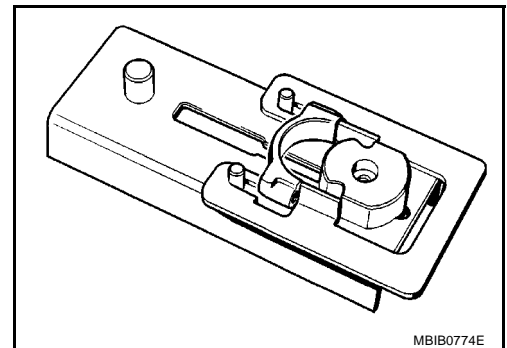


6. Bring the shell support up against the base of the connecting rod body.
7. Remove the connecting rod body support and repeat the operation for the remaining connecting rod bodies.

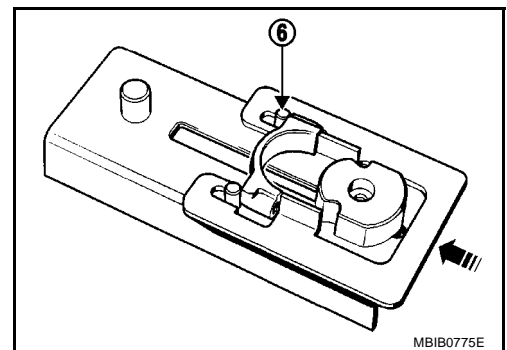


On the Connecting Rod Cap

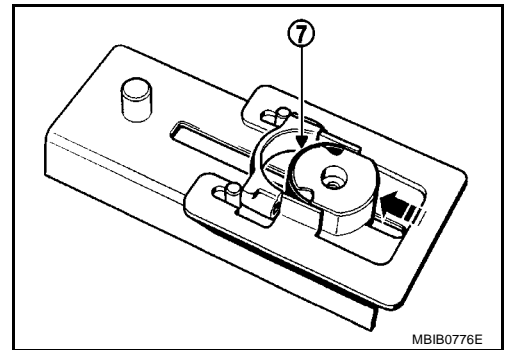
1. Install the connecting rod cap as shown in the figure.



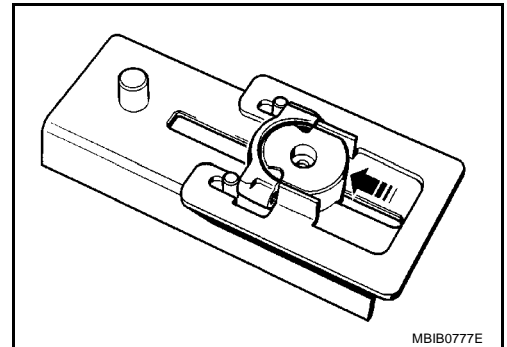
2. Push the guide (in the direction of the arrow) until the connecting rod cap is in contact with the pins (6) at the base of the tool.



3. Install the shell (7) on the shell support, then push it in the direction of the arrow (as shown in the figure).



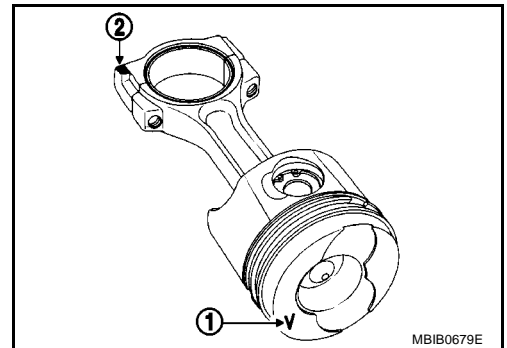
4. Bring the shell support up against the base of the connecting rod cap.
5. Remove the connecting rod cap support and repeat the operation for the remaining connecting rod caps.



CONNECTING ROD AND PISTON

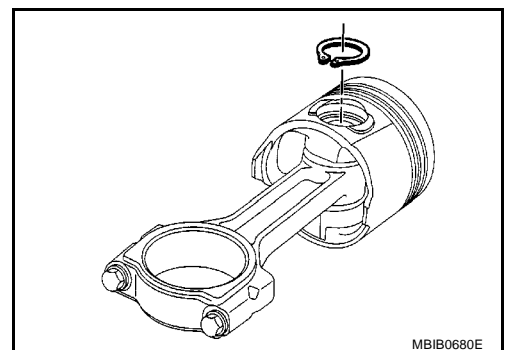
NOTE:

- You must ensure that you match the connecting rods to the piston and cylinder as previously determined.
 - Direction of installing of the connecting rod in relation to the piston.
1. Place the mark (1) engraved on the piston head downwards.
 2. Place the machined flat (2) of the connecting rod head upwards.



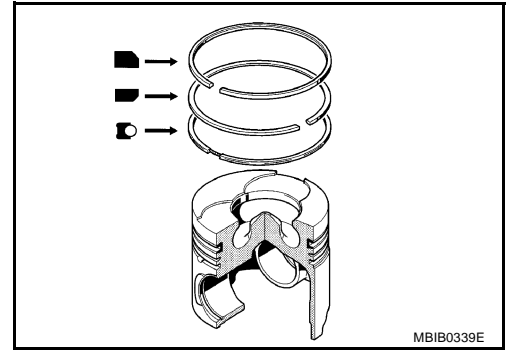
Direction for Installation the Snap Ring on the Piston

- Install the snap ring on the piston as shown.

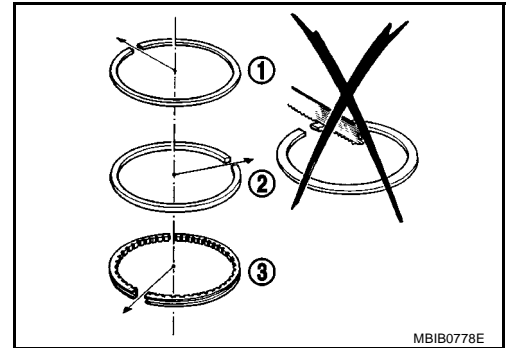


PISTON RINGS

1. The piston rings set to their original adjustment must be free within their channels.
2. Ensure the piston rings are installed in the correct orientation.



3. Install the piston rings such that the gaps are equally spaced around the piston.



OIL JET

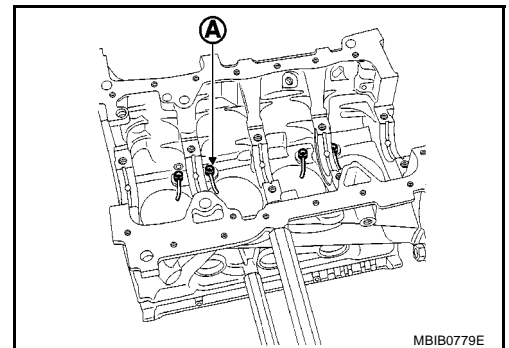
- There are various orientations for oil jets (0° , 3° and 5°).
- To be sure of obtaining the correct oil jet orientation when installing, their orientation must be marked before they are removed.
- To do that, use Tools KV113B00340 (Mot. 1516), KV113B0350 (Mot. 1516-01) and KV113B0370 (Mot. 1516-02).
- Then, try to install one of the three plates of these tools.
- Each plate corresponds to a precise oil jet orientation.

Orientation of oil jet (in degree)	Tool to be used for removal (marking the orientation) then for installing (application of the correct orientation)
0°	KV113B0350 (Mot. 1516-02)
3°	KV113B0370 (Mot. 1516-01)
5°	KV113B0340 (Mot. 1516)

REMOVAL AND INSTALLATION OF OIL JET

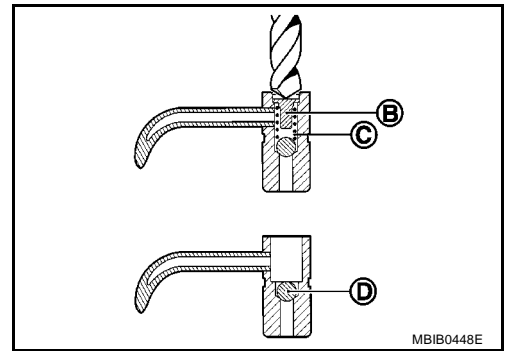
Removal

1. To remove the piston base oil jets (A), they must be drilled with a 7 mm (0.28 in) diameter drill. This is necessary in order to remove the spring stop (B) and the spring (C).

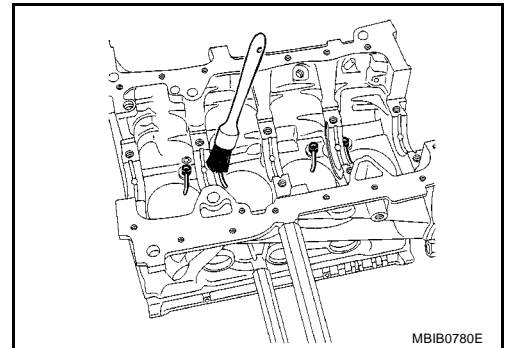


CAUTION:

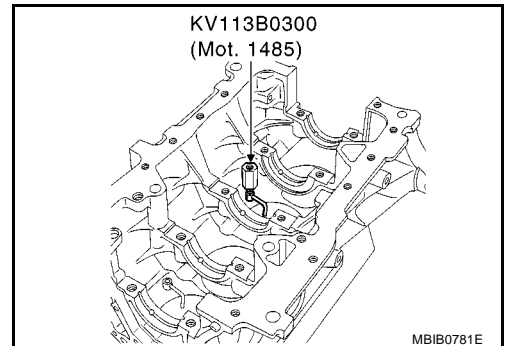
Do not remove the ball (D), to prevent swerve entering the cooling circuit.



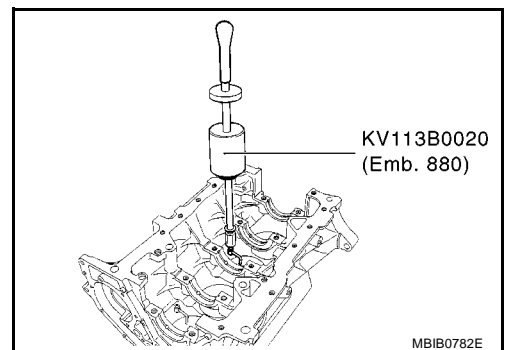
2. Remove the swerve using a brush.



3. Screw Tool KV113B0300 (Mot. 1485) or KV113B0120 (Mot. 1485-01) into the drilled out jets using a 6 mm (0.24 in) Allen key which is slid inside the tool.

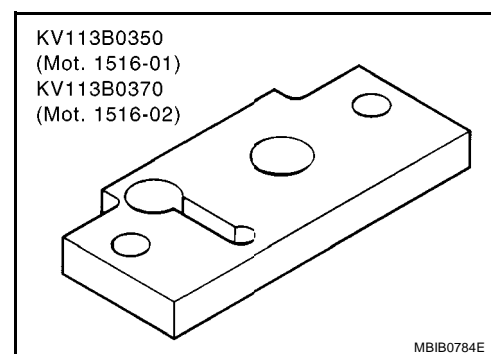
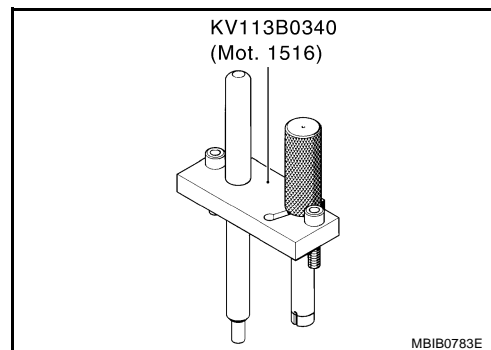


4. Screw Tool KV113B0020 (Emb. 880) to KV113B0300 (Mot. 1485) or KV113B0120 (Mot. 1485-01) and extract the jet.

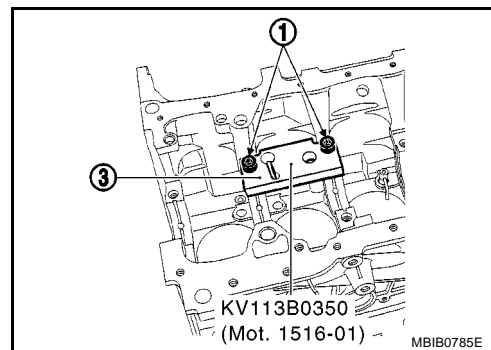


Installation

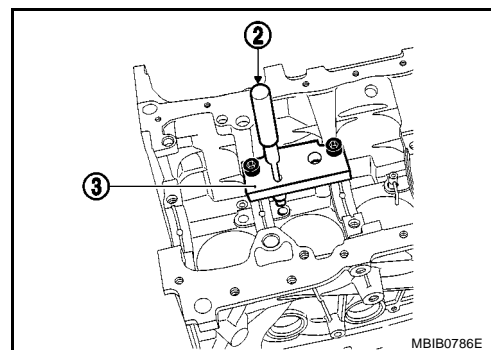
1. It is essential that the oil jets be installed with Tools KV113B0340 (Mot. 1516), KV113B0350 (Mot. 1516-01) and KV113B0370 (Mot. 1516-02).

**Installation of Oil Jets for No. 1 and 3 Cylinders**

1. Locate the plate (3) of Tool KV113B0350 (Mot. 1516-01) on the cylinder block (as shown in the illustration below) without tightening the two bolts (1) of Tool KV113B0340 (Mot. 1516) tool.



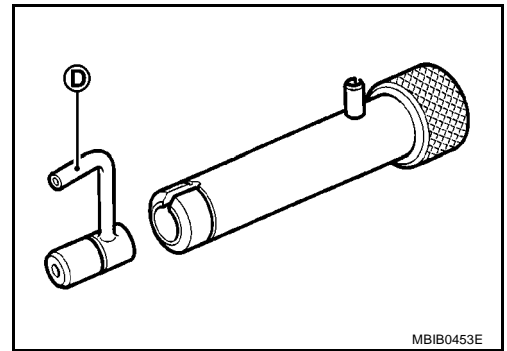
2. Position the guide rod (2) of Tool KV113B0340 (Mot. 1516) in the plate (3) and the end of the guide rod in the oil jet hole to centre the plate (3).



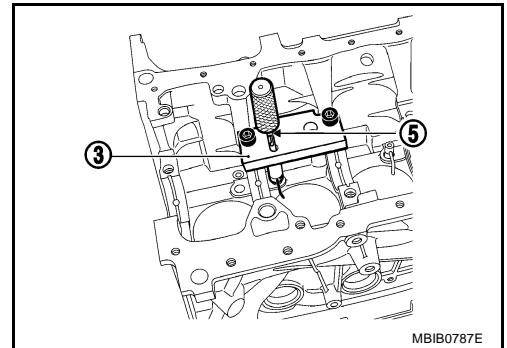
3. Tighten the two bolts (1), then remove the guide rod.
4. Insert the oil jet into the push rod.

NOTE:

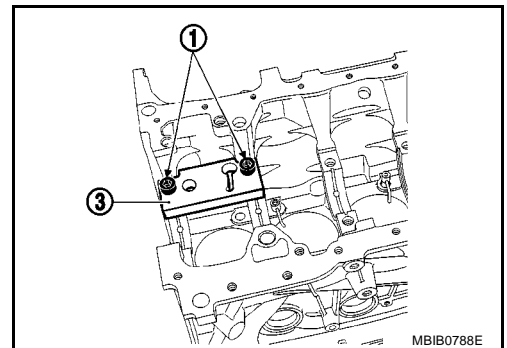
Check that the oil jet is correctly oriented, with the end of the oil jet (D) directed towards the center of the cylinder.



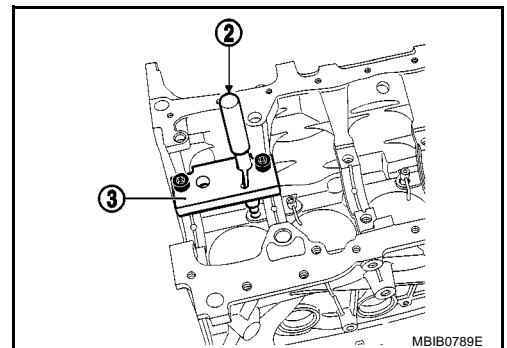
5. Install the push rod in place and instead of the guide rod.
6. With a hammer, tap the push rod until the shoulder (5) of the push rod comes into contact with the plate (3).

**Installation of Oil Jets for No. 2 and 4 Cylinders**

1. Locate the plate (3) of Tool KV113B0350 (Mot. 1516-01) tool on the cylinder block (as shown in the illustration below) without tightening the two bolts (1) of Tool KV113B0340 (Mot. 1516).



2. Position the guide rod (2) of Tool KV113B0340 (Mot. 1516) in the plate (3) and the end of the guide rod in the oil jet hole to centre the plate (3).

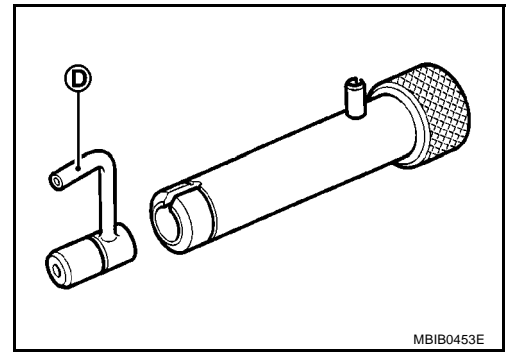


3. Tighten the two bolts (1), then remove the guide rod.

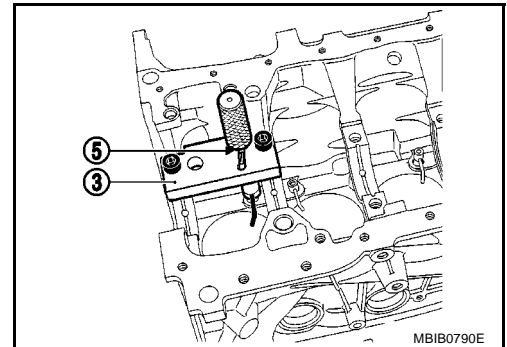
4. Insert the oil jet into the push rod.

NOTE:

Make sure that the oil jet is correctly oriented, with the end of the oil jet (D) directed towards the center of the cylinder.

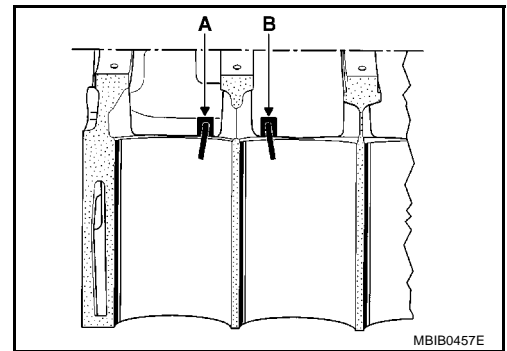


5. Install the push rod in place and instead of the guide rod.
6. With a hammer, tap the push rod until the shoulder (5) of the push rod comes into contact with the plate (3).



● Orientation of the oil jet

A	Orientation of the oil jets of cylinders 2 and 4
B	Orientation of the oil jets of cylinders 1 and 3

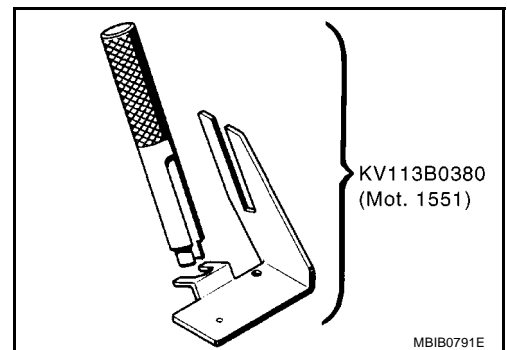


CLEAN THE LOWER ENGINE

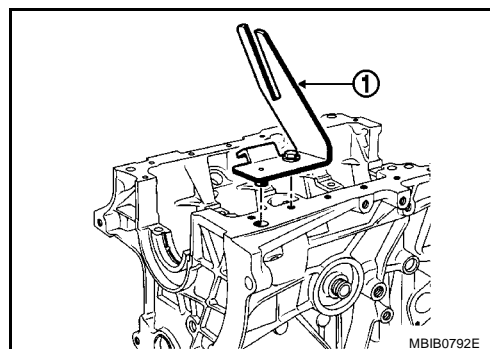
1. Clean the cylinder block.
2. Clean the crankshaft by passing a wire through the lubrication channels.

OIL RETURN PIPE

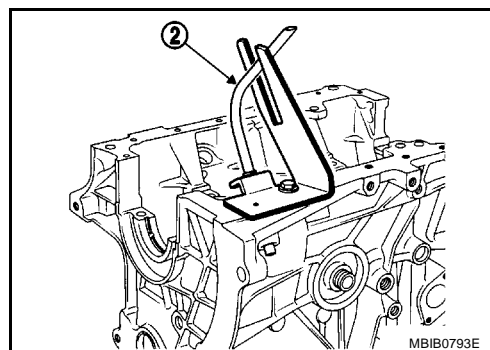
1. Install pipe using Tool KV113B0380 (Mot. 1551).



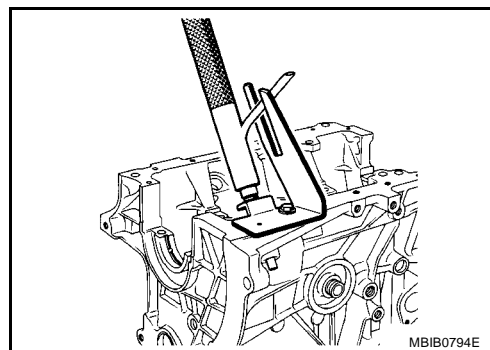
2. Install the base (1) of Tool KV113B0380 (Mot. 1551) on the cylinder block (as shown in the figure).



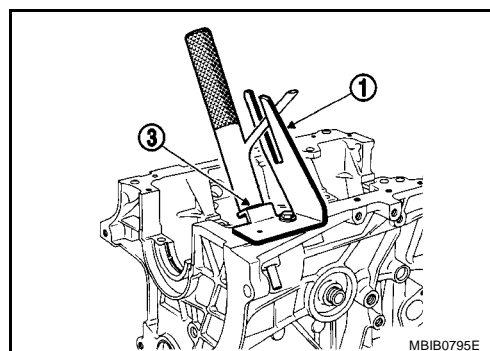
3. Slide the pipe (2) into the groove of the base of the tool.



4. Install the snap fastener on the pipe collar.



5. Tap the snap fastener using a hammer until the shoulder (3) touches the base (1) of Tool KV113B0380 (Mot. 1551).



A

EM

C

D

E

F

G

H

I

J

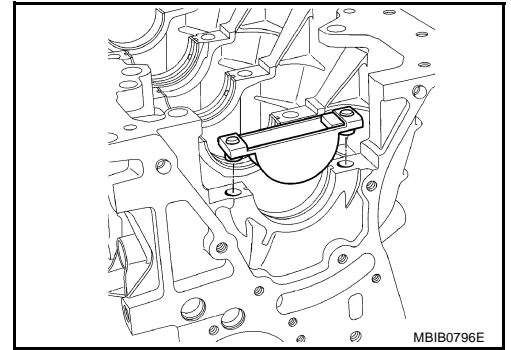
K

L

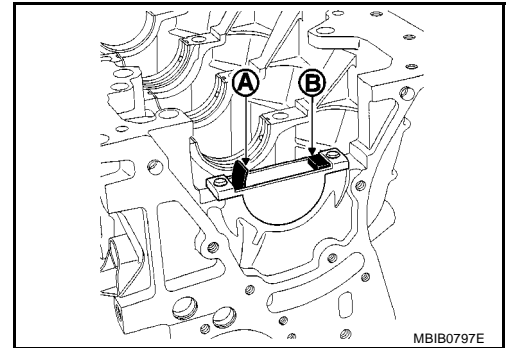
M

MAIN BEARING

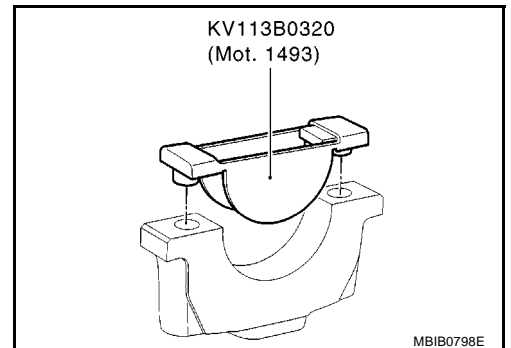
1. Set Tool KV113B0320 (Mot. 1493) on the cylinder block.



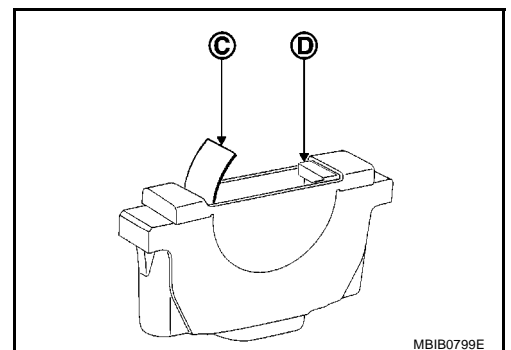
2. Install the grooved bearing shell in Tool KV113B0320 (Mot. 1493), then press at (A) until the bearing shell touches Tool KV113B0320 (Mot. 1493) at (B).

**Installation of Bearing Shells in the Bearing**

1. Set Tool KV113B0320 (Mot. 1493) on the bearing.

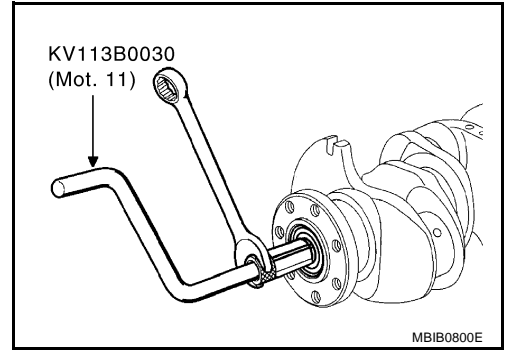


2. Install the non-grooved bearing shell in Tool KV113B0320 (Mot. 1493), then press at (C) until the bearing shell touches Tool KV113B0320 (Mot. 1493) at (D).

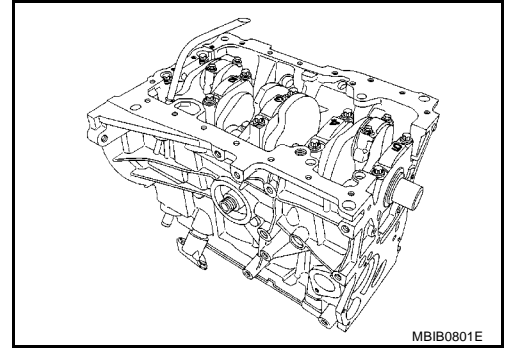


CRANKSHAFT

1. The crankshaft bearing is extracted using Tool KV113B0030 (Mot. 11).



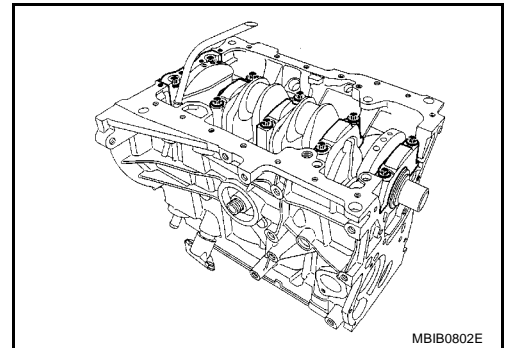
2. Install the lateral crankshaft shim.
3. Install the crankshaft.
4. Oil the main journal bearing with engine oil.
5. Install the crankshaft bearing cap except cap No. 1 (the cap numbered from 1 to 5 and position these number opposite the oil filter side).



6. Tighten the bolts to a torque of 20 N·m (2.0 kg-m, 15 ft-lb) plus an angle of $62^{\circ} \pm 4^{\circ}$ (tightening order 3-4-2-5-1).

CAUTION:

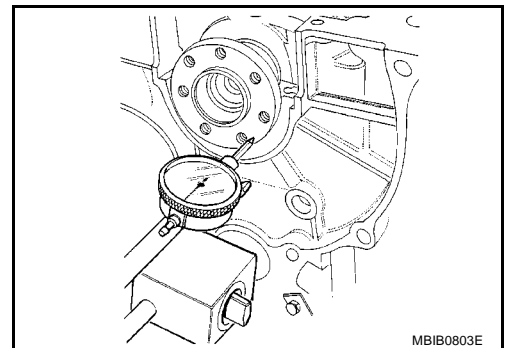
Use an angle wrench (special service tool) to check tightening angle. Do not make judgment by visual inspection.



7. Check the lateral clearance of the crankshaft.

Clearance: 0.067 - 0.233 mm (0.0026 - 0.0092 in)

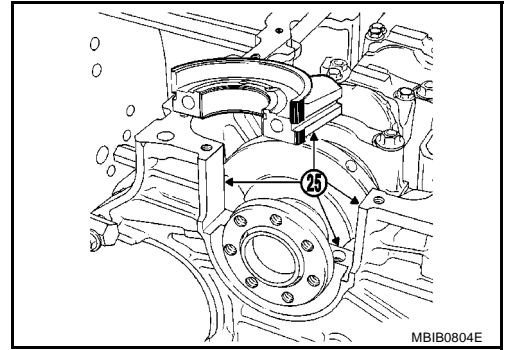
8. Make sure that the crankshaft rotates freely.



Installation of No. 1 Bearing**CAUTION:**

The mixture must be injected within approximately 5 minutes to prevent it from polymerizing in the syringe.

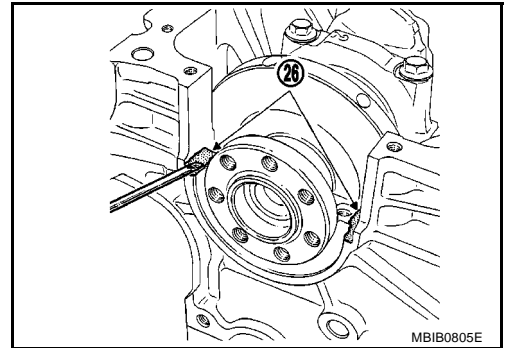
1. Clean the surface thoroughly at (25) of the cylinder block and the crankshaft cap, using a cloth soaked in cleaning thinner.
2. Allow to dry.



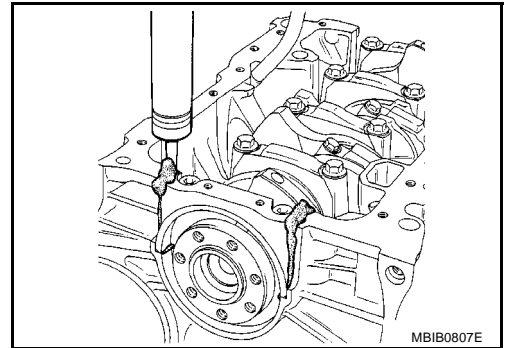
3. Coat the lower surfaces of the cylinder block at (26) with a thin layer of liquid gasket.
4. Install the crankshaft bearing cap and tighten it to a torque of 20 N·m (2.0 kg-m, 15 ft-lb) plus an angle of $62^{\circ} \pm 4^{\circ}$.

CAUTION:

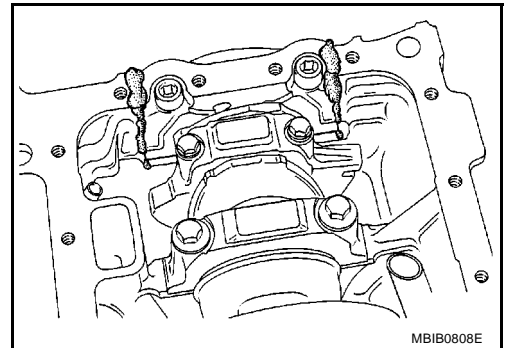
Use an angle wrench (special service tool) to check tightening angle. Do not make judgment by visual inspection.



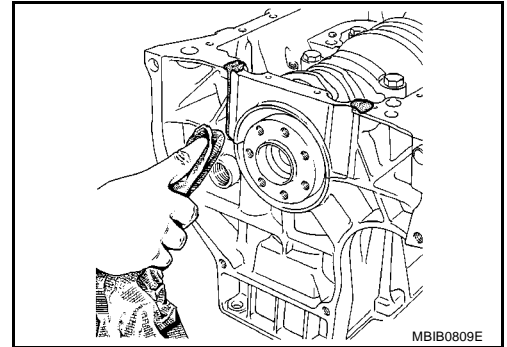
5. Insert the liquid gasket into the syringe and inject it into the grooves of the crankshaft bearing cap.
 - Use Genuine Liquid Gasket or equivalent.



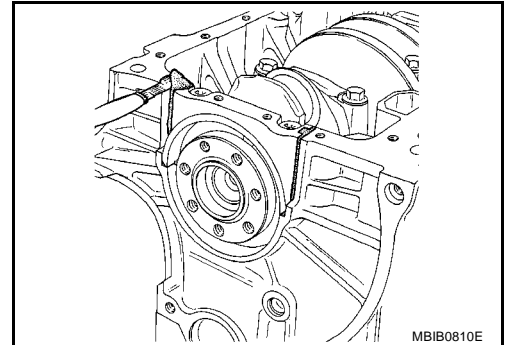
6. Allow the liquid gasket to flow out slightly on either side of the grooves of the crankshaft bearing cap, to ensure that the injected liquid gasket has totally filled the sealing groove.



7. Using a cloth, wipe off the excess liquid gasket, both inside and outside the cylinder block.



8. Allow to dry for a few moments and cut the excess off the gasket face.

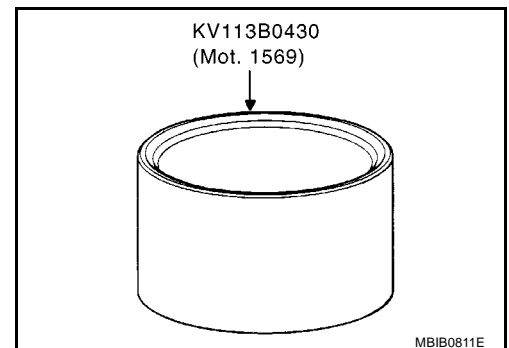


PISTON

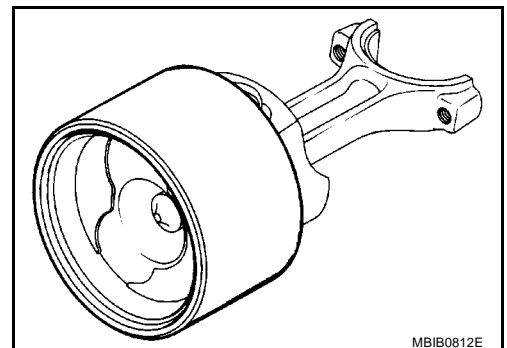
1. The pistons are installed using Tool KV113B0430 (Mot. 1569).

CAUTION:

Be careful not to damage the piston.



2. Apply engine oil to pistons.
3. Install the piston in the cone and allow the piston skirt to protrude from the Tool by approx. 1 to 2 cm (0.39 - 0.79 in).

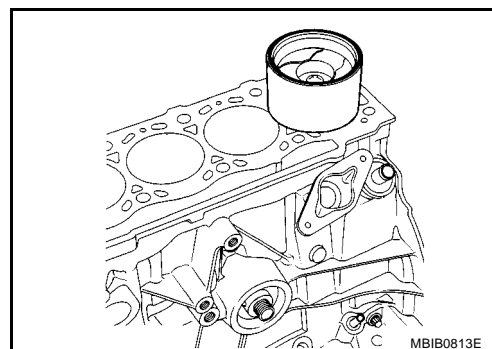


4. Install the assembled piston and connecting rod, installed with the Tool KV113B0430 (Mot. 1569), on the cylinder block. Then press the piston and connecting rod assembly into the jacket.

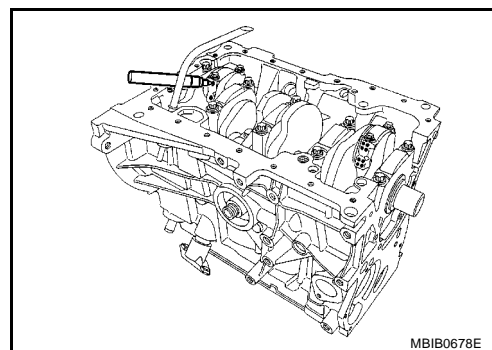
CAUTION:

Paying attention to the direction (the "V" towards the fly-wheel).

5. Install the connecting rod onto the oiled big end journal of the crankshaft.



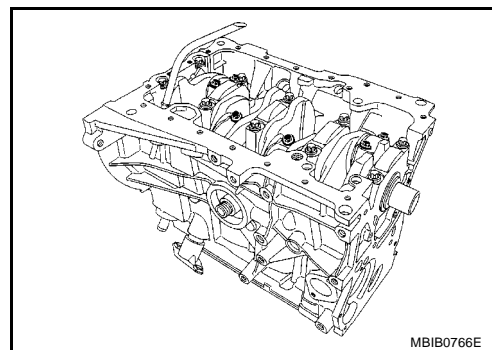
6. Install the connecting rod cap, ensuring they are correctly matched (marks made when dismantling).



7. Tighten the new bolts of the connecting rod caps to a torque of 20 N·m (2.0 kg-m, 15 ft-lb), then tighten to an angle of $40^\circ \pm 6^\circ$.

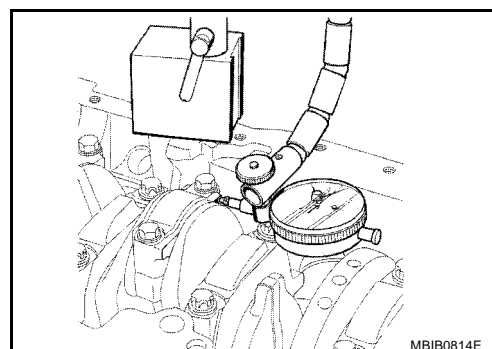
CAUTION:

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



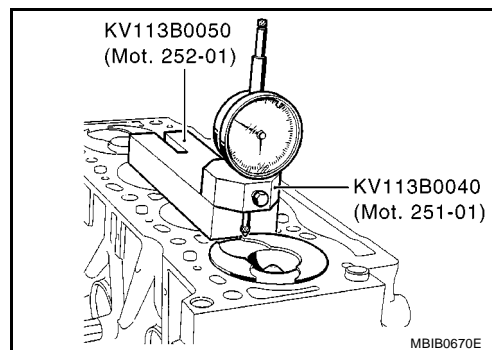
8. Check the lateral clearance of the connecting rod head.

Clearance: 0.22 - 0.482 mm (0.0087 - 0.0190 in)



INSPECTION OF PISTON PROTRUSION

1. Clean the piston head in order to eliminate any traces of deposits.
2. Turn the crankshaft one turn in its operating direction to bring piston No. 1 close to TDC.
3. Set Tool KV113B0050 (Mot. 252-01) on the piston.
4. Install Tool KV113B0040 (Mot. 251-01) equipped with a gauge on KV113B0050 (Mot. 252-01), and find TDC of the piston.



NOTE:

All measurements are to be carried out in the longitudinal axis of the engine, in order to eliminate any errors due to tilting of the piston.

WARNING:

The gauge detector must not be in the valve clearance.

5. Measure the piston protrusion.

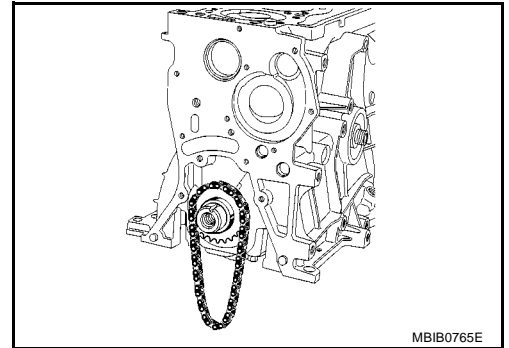
Protrusion: 0.50 - 0.62 mm (0.0197 - 0.0244 in)

NOTE:

To prevent any risk of piston/valve interference when the engine is running, the piston protrusion value must be less than 0.67 mm (0.0264 in).

INSTALLATION OF LOWER ENGINE

1. Install the oil pump chain.



Installation of Front Cover and Water Pump

There are two possible solutions:

2. Apply liquid gasket; the band (1) must be 1.75 mm (0.0689 in) wide and be applied as shown in the drawing below.

- Use Genuine Liquid Gasket or equivalent.

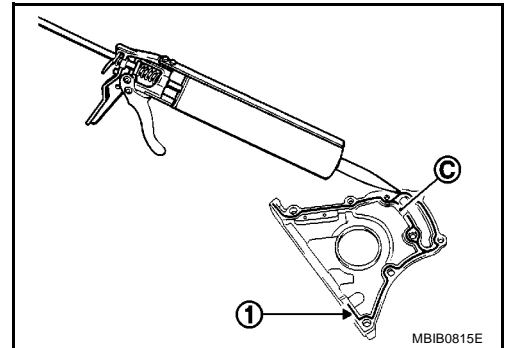
CAUTION:

Be careful not to obstruct the pipes (C).

3. Or it is performed with a seal consisting of a steel sheet coated with elastomer on both sides.

NOTE:

This type of seal projects from the plate. It should in no case be cut out, because the two projecting tabs provide sealing when the oil pan installed.



Oil Pump Chain Guide

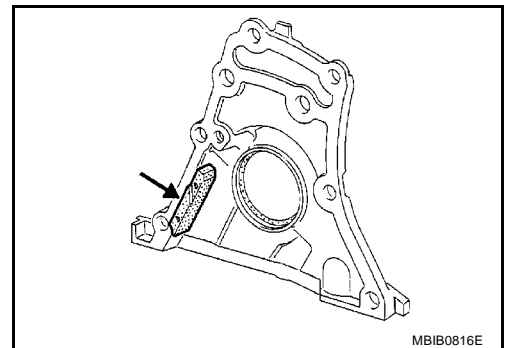
There are likewise two possible solutions:

4. For engines equipped with a water pump driven by the timing belt (water pump moved).

- In this case, check presence of oil pump chain guide.

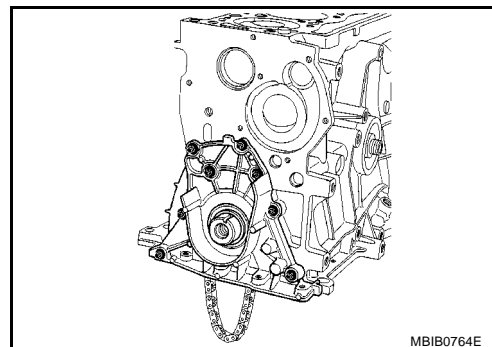
5. For engines equipped with a water pump driven by the drive belt (water pump moved).

- In this case, the oil pump chain guide is no longer of any case.



6. Install the front cover with a new gasket.

 : 14 N·m (1.4 kg-m, 10 ft-lb)



7. Engine installed with a water pump driven by the timing belt.

NOTE:

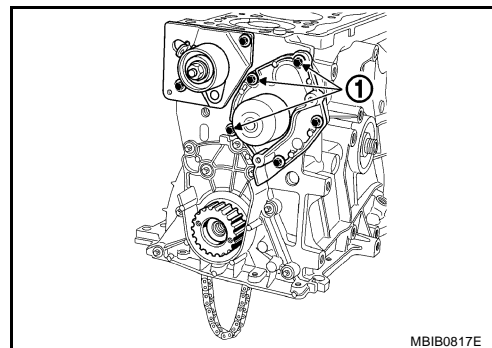
Put a drop of locking sealant on bolts (1).

8. Install the water pump installed with a new gasket.

 : 10 N·m (1.0 kg-m, 87 in-lb)

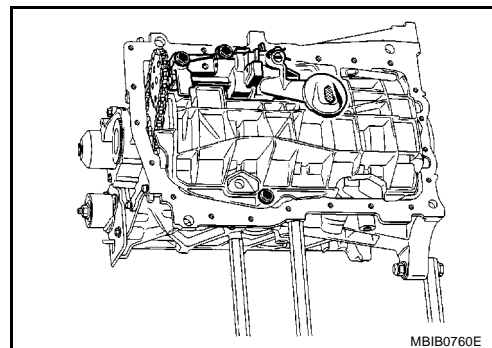
9. Install the timing belt tensioner support plate.

 : 10 N·m (1.0 kg-m, 87 in-lb)



10. Install the baffle plate and oil pump.

 : 24 N·m (2.4 kg-m, 18 ft-lb)



11. If sealing of the front cover has been performed with liquid gasket:

- Apply a drop of liquid gasket to (A) (on either side of bearing No. 1), and at the intersection of the front cover and the cylinder block at (B).

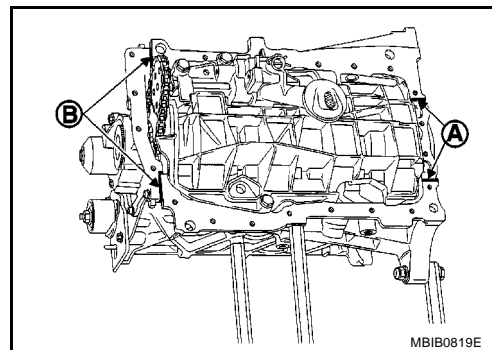
12. If sealing of the front cover has been performed with the gasket consisting of a steel sheet coated with elastomer:

- Apply a drop of liquid gasket to (A) (on either side of bearing No. 1).

NOTE:

For side (B), sealing will be implemented by the plate gasket.

This type of gasket projects from the plate and it should in no case be cut out, because the two projecting tabs provide sealing when the oil pan is installed.

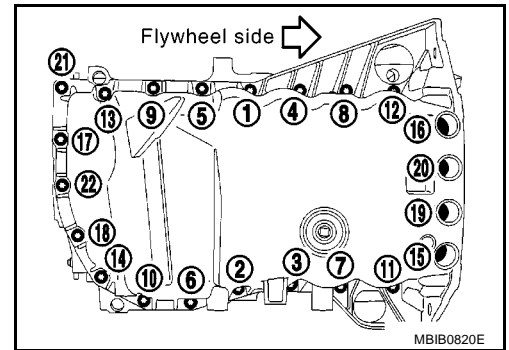


13. Install the oil pan with a new gasket.

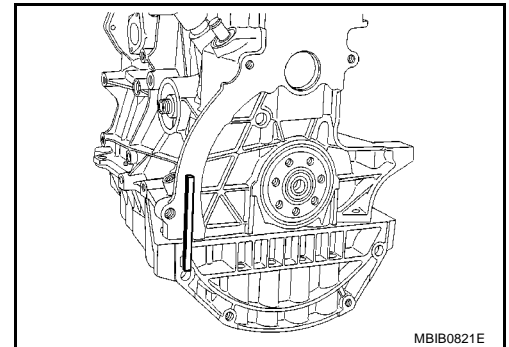
 **1st step: 8 N·m (0.8 kg-m, 6 ft-lb)**

 **2nd step: 15 N·m (1.5 kg-m, 11 ft-lb)**

14. The alignment of the cylinder block and the oil pan must be complied with on the flywheel side to prevent the clutch housing from being damaged when installing the transaxle.



15. Installing the crankshaft seal gasket.



CRANKSHAFT GASKETS

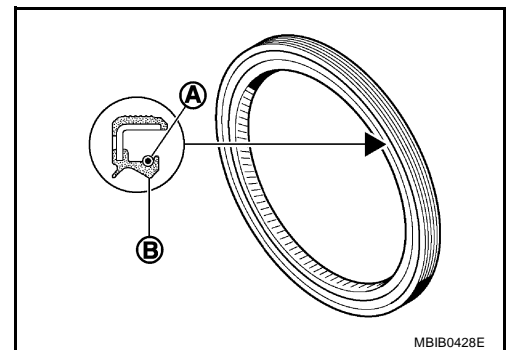
- Change of material on the engine elastomer seals (installed on the crankshaft).

General Information

- Installing and removing the new type elastomer seal from the engine requires new tools and precautions compared to the old type seal.
- The old and new type of seal can both be used on the same engine. They are not interchangeable. Old type seal must be replaced with old type seal (still available from the Parts Department), and a new type seal with a new type seal.
- An old type seal can be replaced with a new type seal in the case of a crankshaft replacement. This is possible if the engine is installing with one during its lifetime in series production.

INSTALLATION OF THE CRANKSHAFT SEAL GASKET

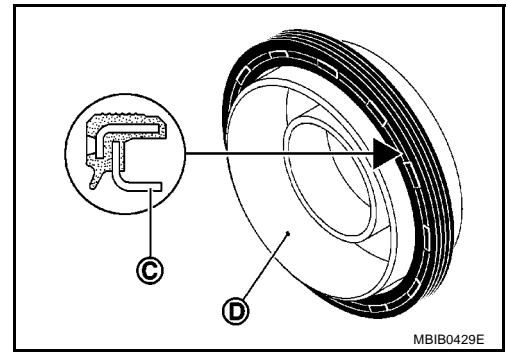
- The old elastomer seal is installed with a spring (A) and has a "V"-shaped sealing lip (B).



OVERHAUL

[F9Q]

- The new elastomer seal has a flat sealing lip (C) and a protector (D) which also assists in installing the seal to the engine.



Tool for installing old type elastomer seal

Tool for the crankshaft seal	
Timing end	Flywheel end
KV113B0260 (Mot. 990-03)	KV113B0270 (Mot. 991-01)

Tool for installing new type elastomer seal

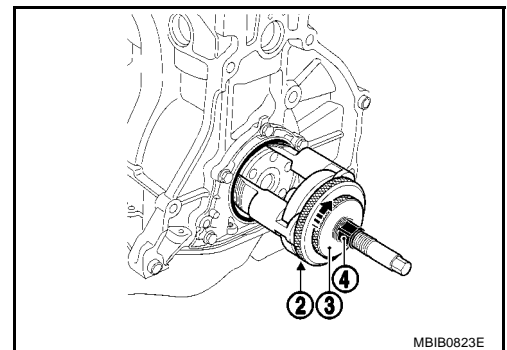
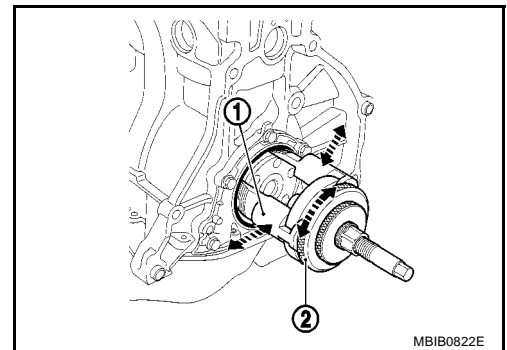
Tool for the crankshaft seal	
Timing end	Flywheel end
KV113B0480 (Mot. 1636)	KV113B0470 (Mot. 1635)

Tool for removing new type elastomer seal

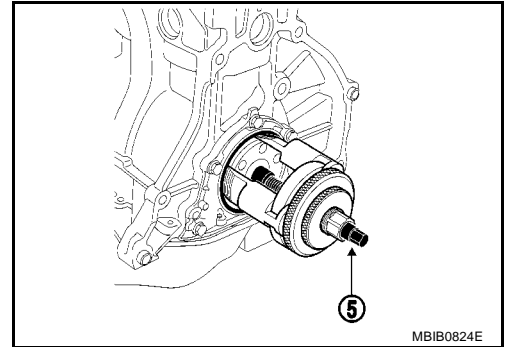
Tool for the crankshaft seal	
Timing end	Flywheel end
KV113B0440 (Mot. 1577)	KV113B0460 (Mot. 1579)

Removal of Crankshaft Seal

- This procedure is applicable for crankshaft seal.
- Install the extractor tool onto the shaft by adjusting plungers (1) to the shaft diameter with knurled back-plate (2).
- Tighten knurled back-plate (3) until it locks on knurled back-plate (2) to keep the plungers correctly adjusted on the shaft.
- Screw extractor tool into the seal using hexagon bar (4).



5. Extract the seal by tightening threaded rod (5).



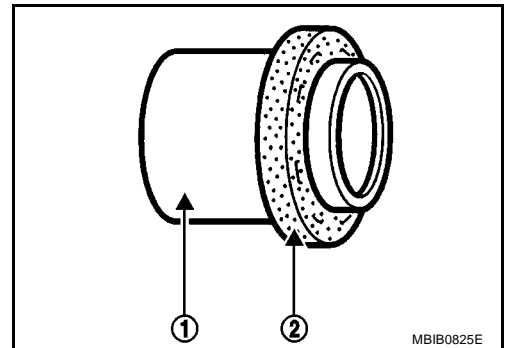
Installation of New Type Crankshaft Seal

CAUTION:

This type of seal is extremely fragile. Only touch the protector part (1) when handling the gasket. It is strictly forbidden to touch the seal (2). This is to ensure that there will be no oil leaks once the gasket is installed on the engine.

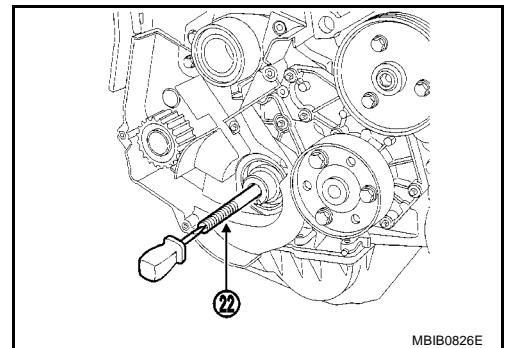
NOTE:

This new seal must be installed using the tooling mentioned previously.

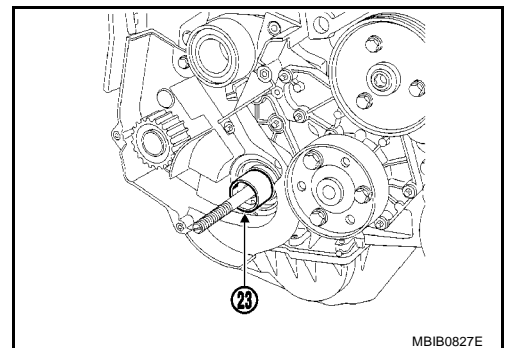


Crankshaft Seal (Timing End)

1. Screw the threaded rod (22) of Tool KV113B0480 (Mot. 1636) into the crankshaft.



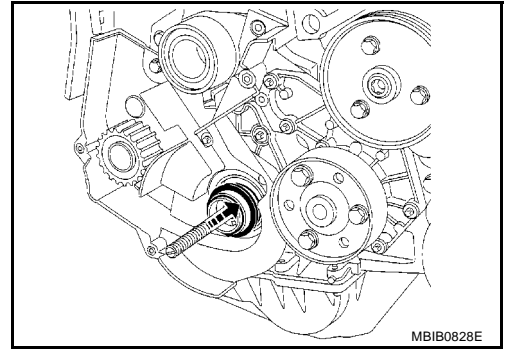
2. Install spacer (23) of Tool KV113B0480 (Mot. 1636) to the crankshaft.



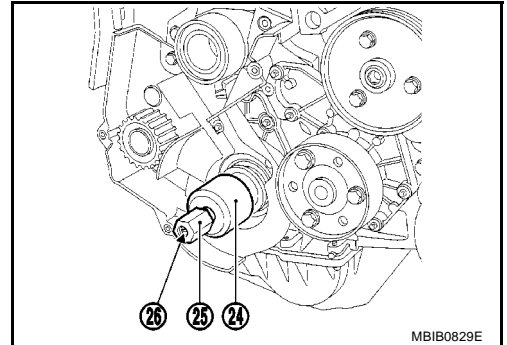
OVERHAUL

[F9Q]

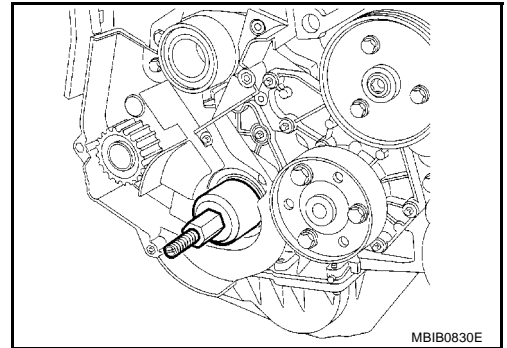
3. Install the protector complete with the seal onto the spacer, taking care not to touch the seal.



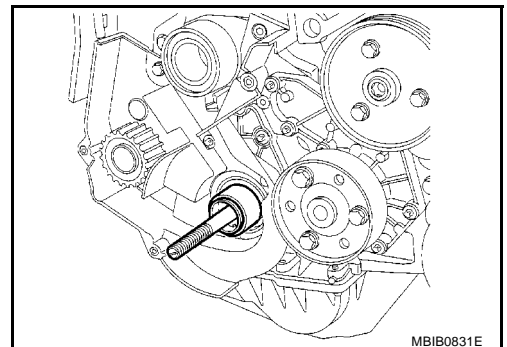
4. Install cup (24) and nut (25) (putting threaded hole (26) of the nut on the side facing away from the engine) of Tool KV113B0480 (Mot. 1636).



5. Tighten the nut until the cover touches the spacer.

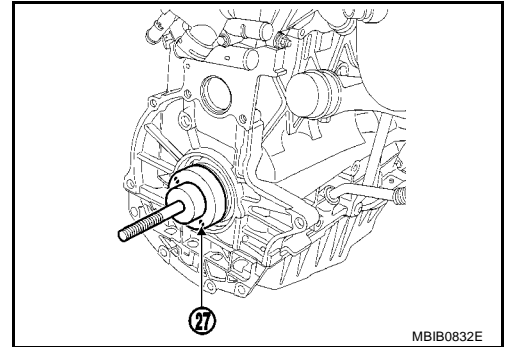


6. Remove the nut, the cup, the protector, the spacer and the threaded rod.

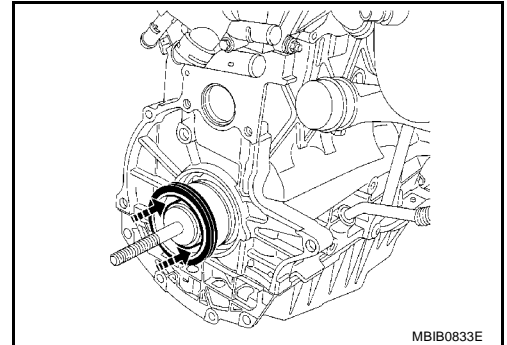


Crankshaft Seal (Flywheel End)

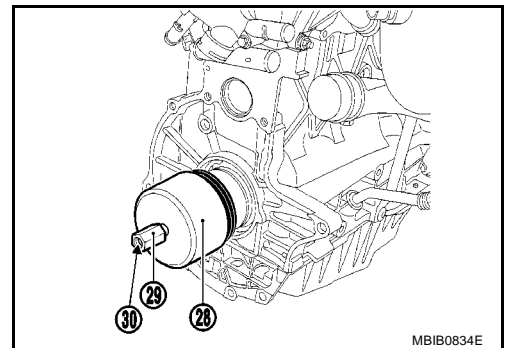
7. Install Tool KV113B0470 (Mot. 1635) on the crankshaft, attaching it with bolts (27).



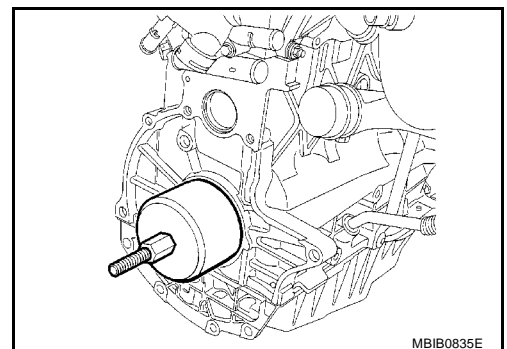
8. Install the protector complete with the seal onto Tool KV113B0470 (Mot. 1635), being careful not to touch the seal.



9. Install cup (28) and nut (29) [putting the threaded hole (30) of the nut on the side facing away from the engine] of Tool KV113B0470 (Mot. 1635).



10. Tighten the nut until the cup makes contact with the base plate of Tool KV113B0470 (Mot. 1635).



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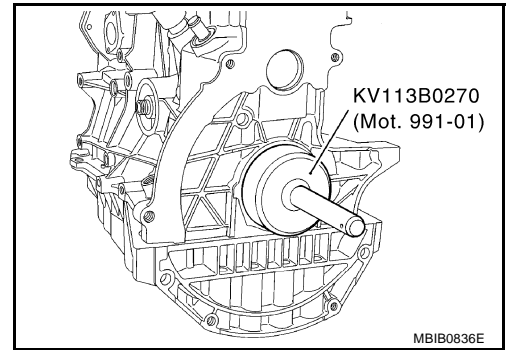
K

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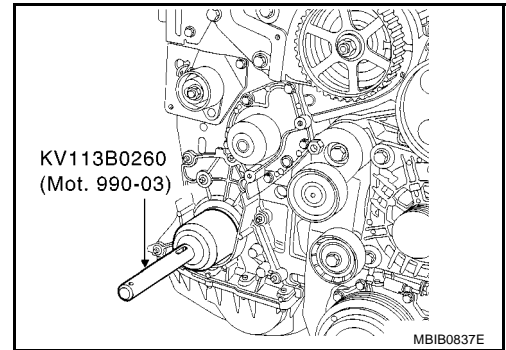
M

Installation of Old Type Crankshaft Seal

- For flywheel side, use Tool KV113B0270 (Mot. 991-01).



- For timing side, use Tool KV113B0260 (Mot. 990-03).



INSTALLATION OF FLYWHEEL

- Lock the flywheel with Tool KV113B0060 (Mot. 582-01) or KV113B0410 (Mot. 1677) depending on the cylinder block (large or small side).
- Install the flywheel, tightening the new bolts to a torque of 30 N·m (3.1 kg-m, 22 ft-lb), then tighten to an angle of $56^{\circ} \pm 6^{\circ}$ for a double mass flywheel 55 N·m (5.6kg-m, 41ft-lb) for a standard flywheel.

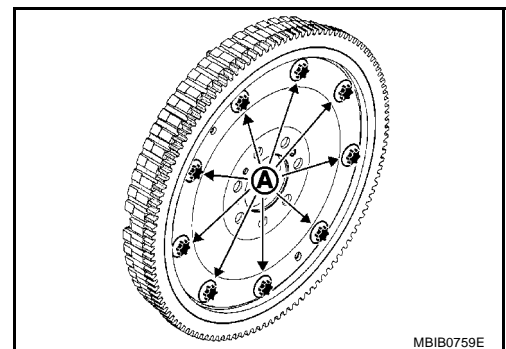
CAUTION:

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

- Flexible flywheel:

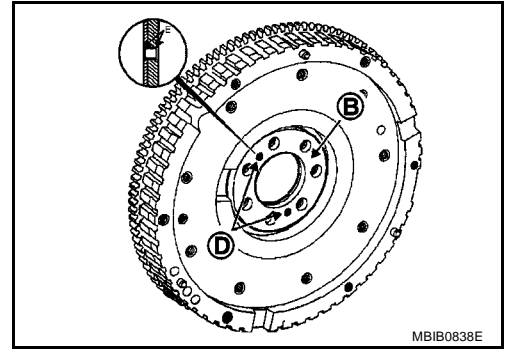
NOTE:

Under no circumstances should bolts (A) be removed.



NOTE:

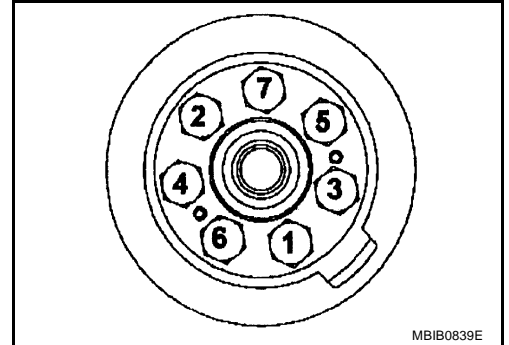
Install the flywheel without its shim (B) is strictly prohibited, the shim is usually joined to flexplate (C) (see the diagram opposite) by two pins (D).



4. It is essential to replace the flywheel mounting bolts.
 - Tighten the engine flywheel bolts in the numerical order as shown.

 : 65 N·m (6.6 kg-m, 48 ft-lb)

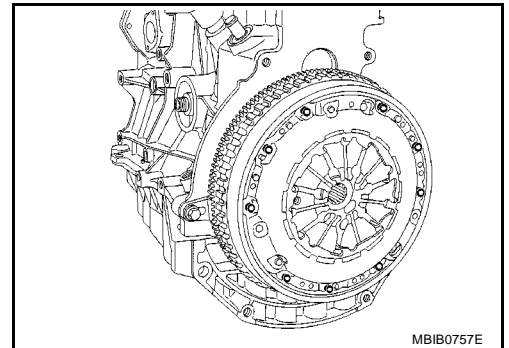
5. Proceed in the reverse order to removal.



6. Install the clutch.

 : 20 N·m (2.0 kg-m, 15 ft-lb)

7. Remove Tool KV113B0060 (Mot. 582-01) or KV113B0410 (Mot. 1677).



Installation of Lower Engine Assembly

1. Install the oil separator installed with a new seal.

 : 10 N·m (1.0 kg-m, 87 in-lb)

2. Install the oil cooler. Refer to [LU-20, "OIL COOLER"](#) .
3. Install the oil filter. Refer to [LU-18, "OIL FILTER"](#) .
4. Install the oil pressure switch.

 : 38 N·m (3.9 kg-m, 28 ft-lb)

5. Install the oil level sensor.

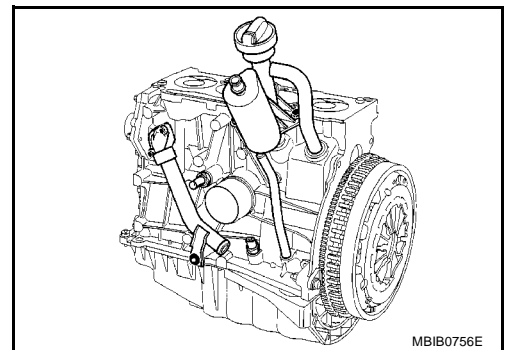
 : 30 N·m (3.1 kg-m, 22 ft-lb)

6. Install the water pipe.

 : 40 N·m (4.1 kg-m, 30 ft-lb)

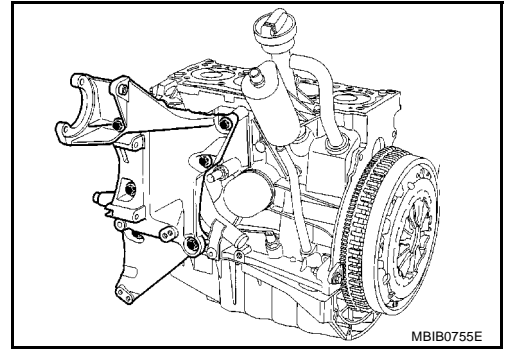
7. Install the water pump inlet pipe installed with a new seal.

 : 10 N·m (1.0 kg-m, 87 in-lb)



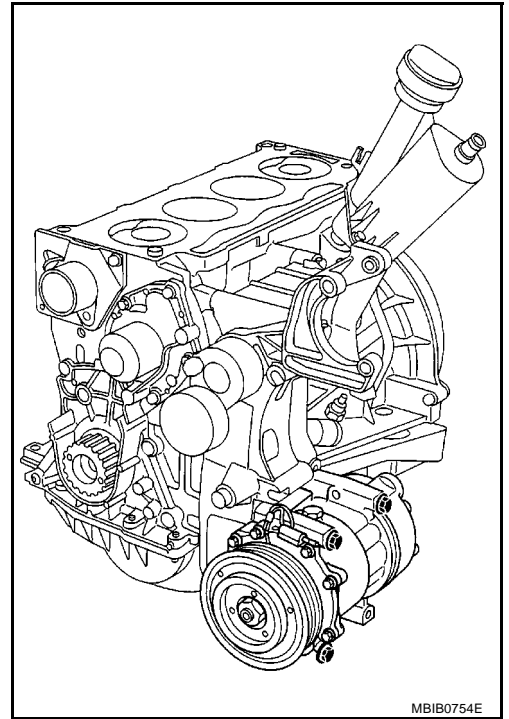
8. Install the alternator bracket.

 : 50 N·m (5.1 kg-m, 37 ft-lb)



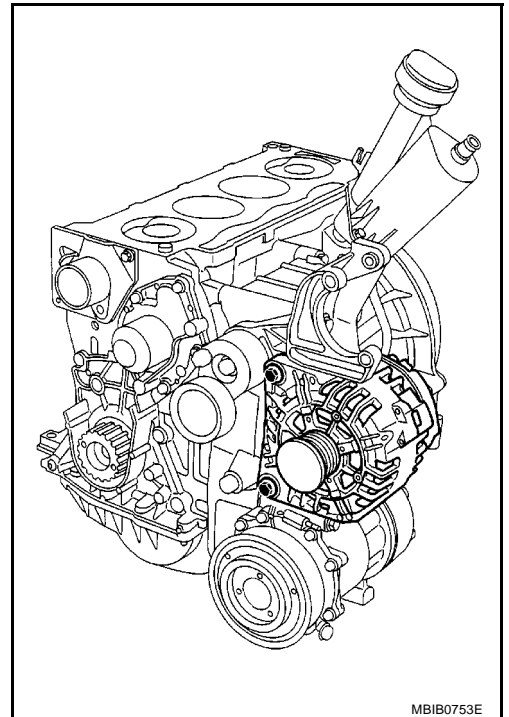
9. Install the A/C compressor.

 : 25 N·m (2.6 kg-m, 18 ft-lb)



10. Install the alternator.

 : 25 N·m (2.6 kg-m, 18 ft-lb)

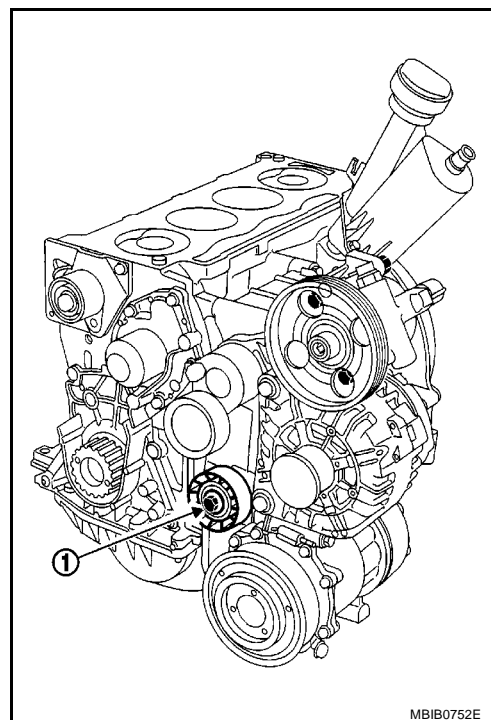


11. Install the power steering pump.

 : 25 N·m (2.6 kg-m, 18 ft-lb)

12. Install the idler pulley (1).

 : 25 N·m (2.6 kg-m, 18 ft-lb)



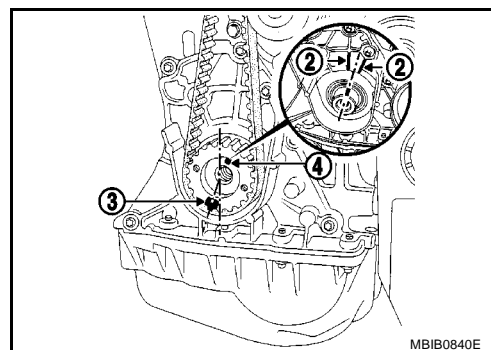
EBS00SBR

Assembly of Upper Engine INSTALLATION OF CYLINDER HEAD

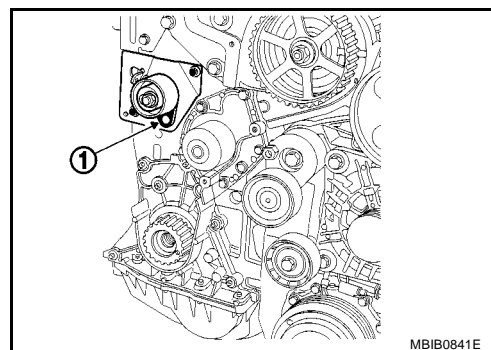
1. Position the pistons at mid-stroke.
2. Install the cylinder head gasket using the centring sockets of the cylinder block.
3. Tighten the cylinder head. Refer to [EM-162. "INSTALLATION"](#).

TIMING ADJUSTMENT

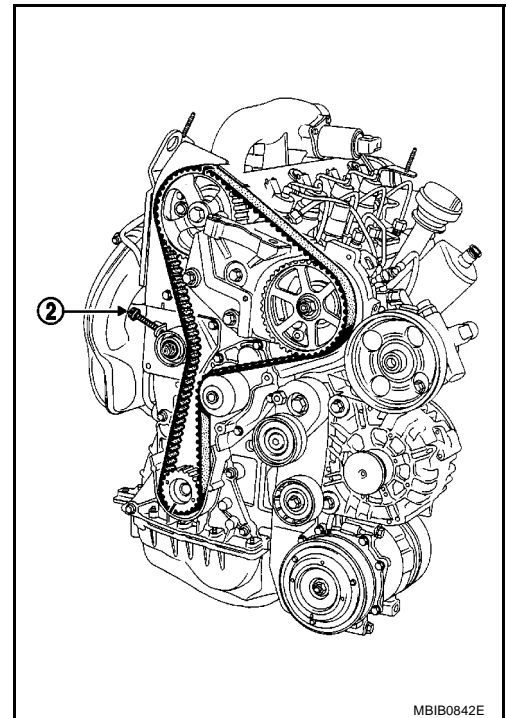
1. Make sure that Tool KV113B0280 (Mot. 1054) is in place.
2. The notch (4) in the crankshaft must be located in the middle of the two grooves (2) on the front cover. The mark (3) of the crankshaft timing sprocket should be moved to the left by one notch of the engine vertical axis.



3. Check that the tensioner is securely positioned on the pin (1).
4. Install the timing belt, aligning the mark on the belt with the marks on the camshaft and crankshaft sprocket.



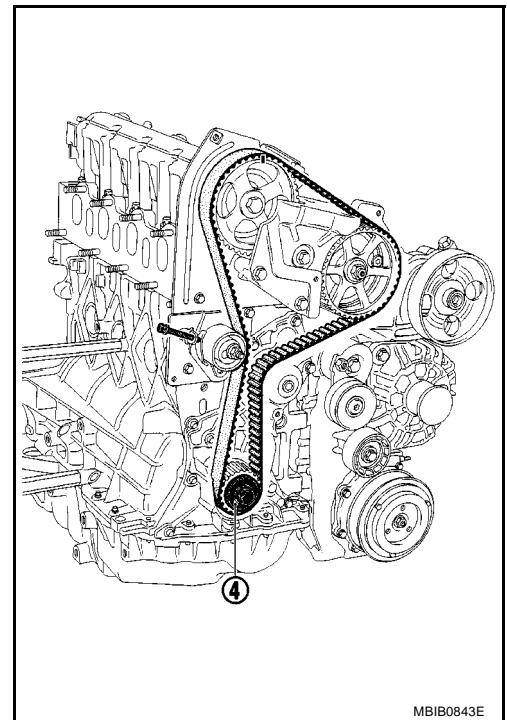
5. Place the tensioner against the belt by tightening bolt (2) on the tensioner mounting.



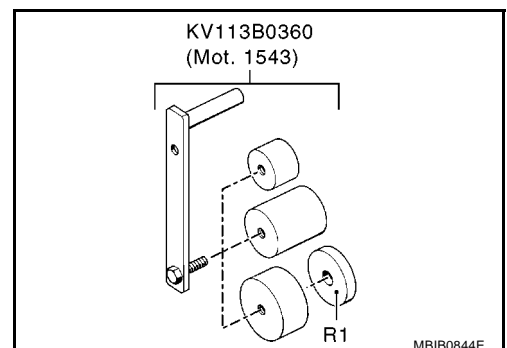
6. Remove Tool KV113B0280 (Mot. 1054).
7. Install the crankshaft pulley bolt.

CAUTION:

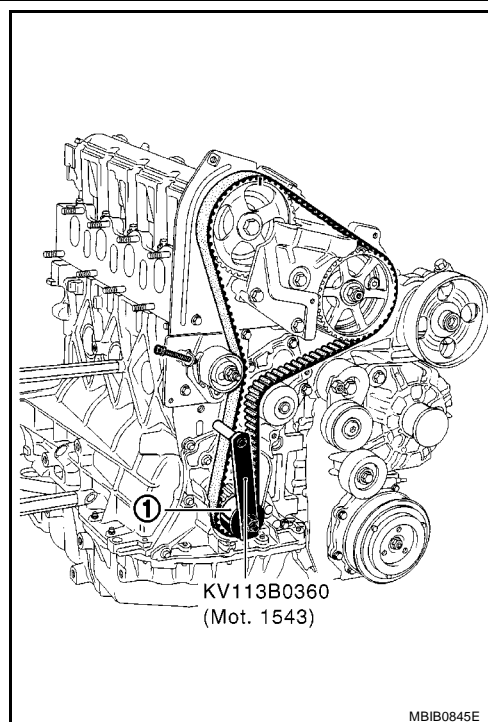
If the bolt is not installed with a washer, install the washer R1 (4) included in the Tool KV113B0360 (Mot. 1543).



- Do not forget to remove it again when installing the crankshaft pulley.

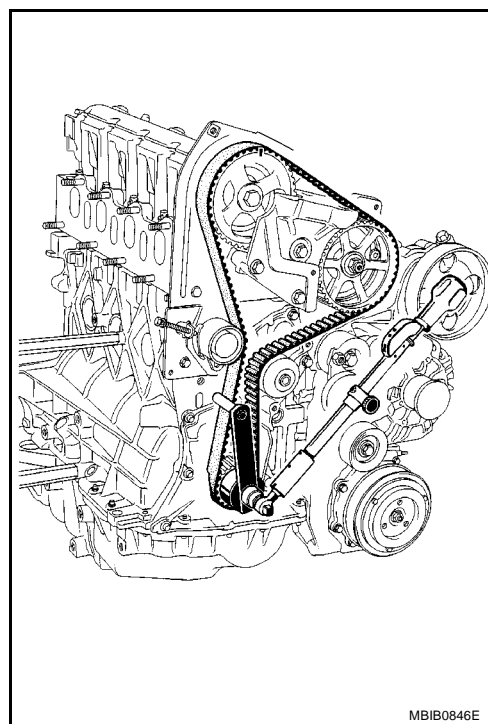


8. Install Tool KV113B0360 (Mot. 1543) and the cover numbered (1) on the crankshaft pulley bolt.



9. Apply pre-tension between the crankshaft timing sprocket and the tensioner using the Tool KV113B0360 (Mot. 1543) and the cover (1).

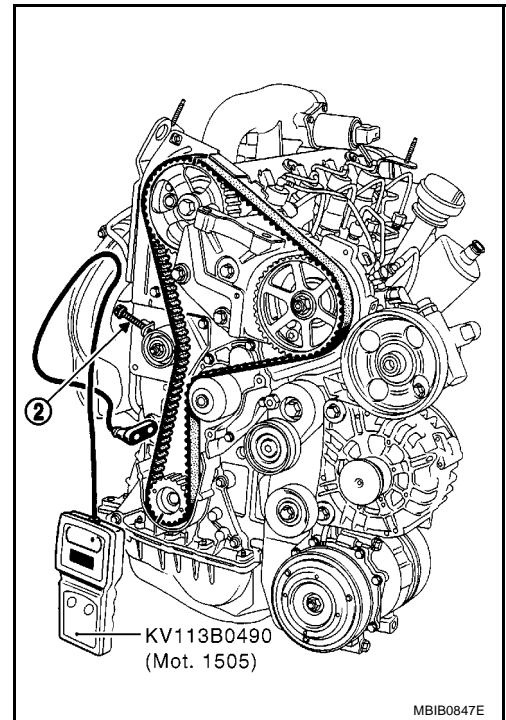
 : 11 N·m (1.1 kg-m, 8 ft-lb)



10. Install the sensor of Tool KV113B0490 (Mot. 1505) between the crankshaft sprocket and the tensioner.
11. Tension the belt by turning bolt (2) until the recommended installing value $95 \text{ Hz} \pm 3 \text{ Hz}$ is obtained.
12. Tighten the tensioner.

 : 10 N·m (1.0 kg-m, 87 in-lb)

13. Turn the crankshaft over four times.



Inspection After Installation of Timing Belt

- a. Install Tool KV113B0280 (Mot. 1054) and set the timing to its setting point, (begin to press on the pin a half-tooth before alignment of the mark on the camshaft pulley and that made by the operator on the lower timing housing, to avoid it falling into a crankshaft balance hole).
- b. Remove Tool KV113B0280 (Mot. 1054).
- c. Apply pretension between the crankshaft timing sprocket and the tensioner using the Tool KV113B0360 (Mot. 1543) and the cover (1).

 : 11 N·m (1.1 kg-m, 8 ft-lb)

- d. Position the sensor of Tool KV113B0490 (Mot. 1505).
- e. Inspect that the tension value is $90 \text{ Hz} \pm 3 \text{ Hz}$, otherwise readjust it.
- f. Tighten the tensioner nut.

 : 50 N·m (5.1 kg-m, 37 ft-lb)

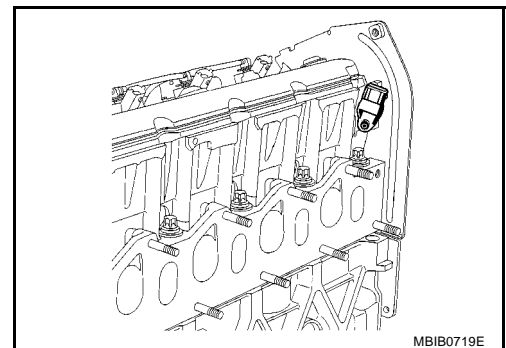
NOTE:

It is essential to tighten the tensioner nut to torque to avoid any loosening which may cause damage to the engine.

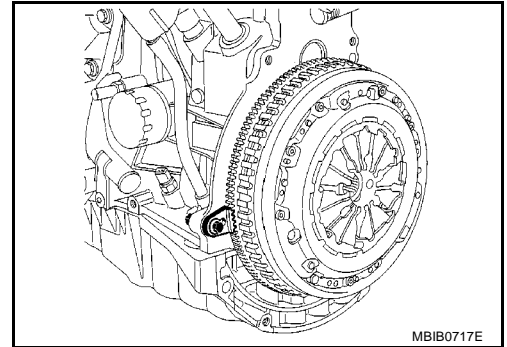
CAUTION:

Remove the washer R1 included in the Tool KV113B0360 (Mot. 1543) before installing the crankshaft pulley.

14. Install the camshaft position sensor.



15. Install Tool KV113B0060 (Mot. 582-01) or KV113B0410 (Mot. 1677).

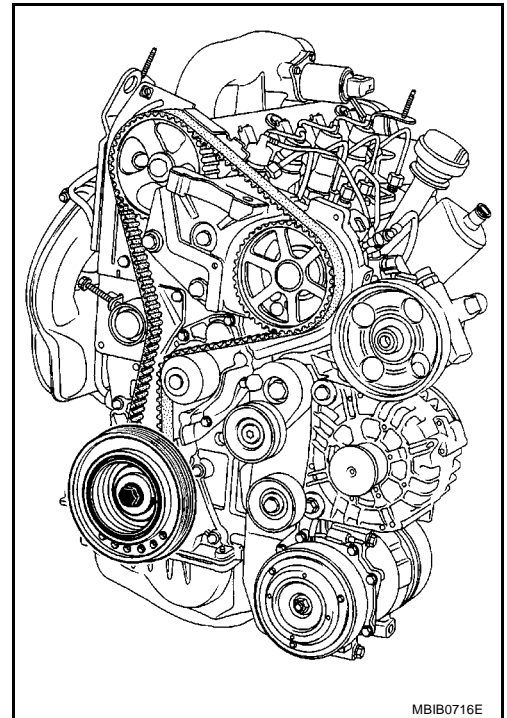


16. Install the crankshaft pulley by tightening the bolt to a torque of 20 N·m (2.0 kg-m, 15 ft-lb), then angle tighten to $115^{\circ} \pm 15^{\circ}$.

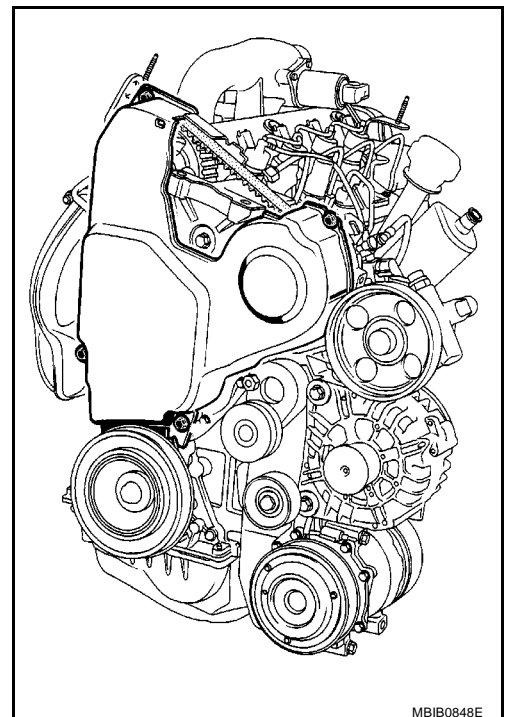
CAUTION:

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

17. Remove Tool KV113B0060 (Mot. 582-01) or KV113B0410 (Mot. 1677).



18. Install the front timing belt cover.



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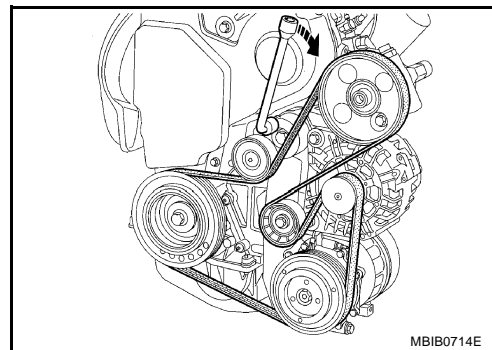
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DRIVE BELT

1. Install the drive belt.
2. Turn the wrench in a clockwise direction to install the belt as shown.
 - The engine must be turned through two revolutions to position the belt correctly.

**INSTALLATION OF UPPER ENGINE**

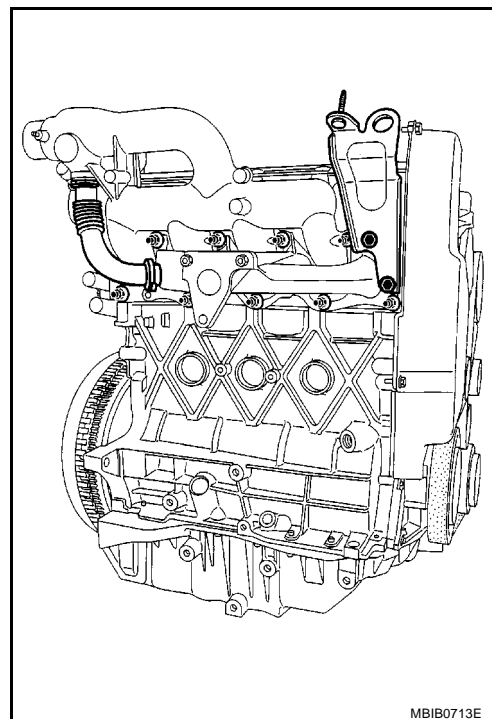
1. Install the intake and exhaust manifold installed with new seal.

 : 28 N·m (2.9 kg-m, 21 ft-lb)

2. Install the engine slinger.

 : 20 N·m (2.0 kg-m, 15 ft-lb)

3. Install the EGR tube.
4. Remove the engine from Tool KV113B0070 (Mot. 792-03).



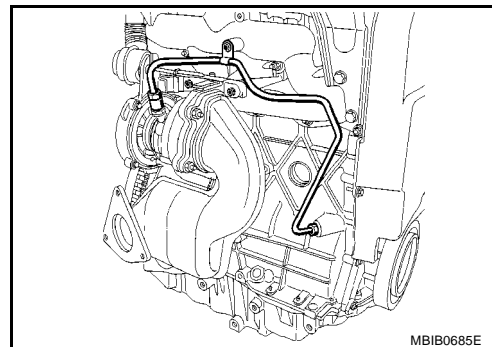
5. Install the turbocharger.

 : 24 N·m (2.4 kg-m, 18 ft-lb)

6. Install the oil tube.

 Cylinder block end: 23 N·m (2.3 kg-m, 17 ft-lb)

 Turbocharger end: 24 N·m (2.4 kg-m, 18 ft-lb)



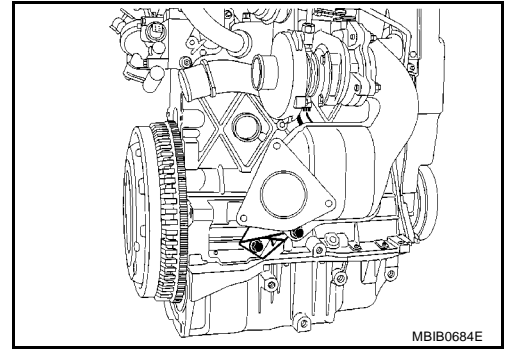
7. Install the turbocharger oil return pipe installed with new seal.

 : 12 N·m (1.2 kg-m, 9 ft-lb)

8. Install the exhaust stay.

 M8 bolt: 24 N·m (2.4 kg-m, 18 ft-lb)

 M10 bolt: 43 N·m (4.4 kg-m, 32 ft-lb)



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BASIC INSPECTION

Cylinder Head

CYLINDER HEAD TIGHTENING PROCEDURE

NOTE:

To obtain correct tightening of the bolts, remove any oil from the cylinder head securing holes using a syringe.

1. All cylinder head bolts must always be replaced after removal. There is no cylinder head retightening operation.
2. Tighten all the bolts to 30 N·m (3.1 kg·m, 22 ft·lb), then angle tighten to $100^{\circ} \pm 4^{\circ}$, in the sequence shown below.

CAUTION:

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

3. Wait 3 minutes setting time.
4. Cylinder head tightening is carried out in stages, and the following procedure is applied successively to bolts 1-2 then 3-4, 5-6, 7-8 and 9-10.
5. Loosen bolts 1-2 until they are completely free.
6. Tighten bolts 1-2 to 25 N·m (2.6 kg·m, 18 ft·lb), then angle tighten to $213^{\circ} \pm 7^{\circ}$.

CAUTION:

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

7. Repeat the loosening and tightening operations for bolts 3-4, 5-6, 7-8 and 9-10.

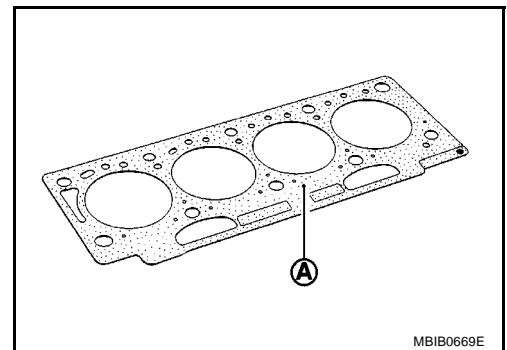
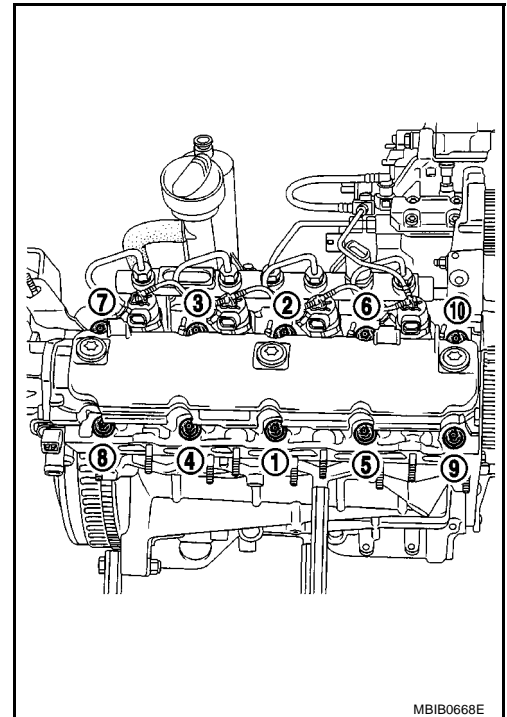
- There is no cylinder head retightening operation.

THICKNESS OF THE CYLINDER HEAD GASKET

The thickness of the cylinder head gasket is measured at (A):

- Thickness of the gasket when tightened

Thickness : 1.27 - 1.37 mm (0.0500 - 0.0539 in)



INSPECTION OF THE PISTON PROTRUSION

1. Clean the piston heads in order to eliminate any traces of deposits.
2. Turn the crankshaft one turn in its operating direction to bring piston No. 1 close to TDC.
3. Install Tool KV113B0040 (Mot. 251-01) equipped with a gauge on Tool KV113B0050 (Mot. 252-01), and find TDC.

NOTE:

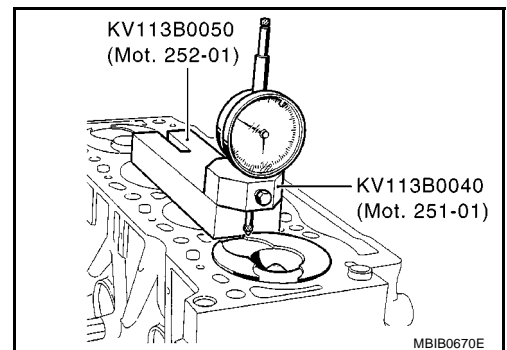
All measurements are to be carried out in the longitudinal axis of the engine, in order to eliminate any errors due to piston tilting.

WARNING:

The gauge detector must not be in the valve clearance.

4. Measure the piston protrusion.

Protrusion : 0.50 - 0.61 mm (0.0197 - 0.0240 in)

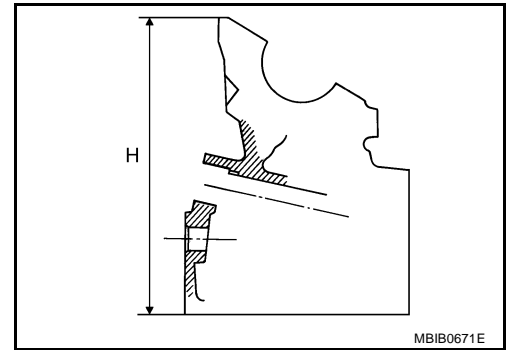


HEIGHT OF CYLINDER HEAD

H = 161.0 - 164.5 mm (6.34 - 6.48 in)

Gasket face deformation : 0.05 mm (0.0020 in)

No regrounding is authorized.



VALVE

Stem diameter:

Intake : 6.974 - 6.996 mm (0.2746 - 0.2754 in)

Exhaust : 6.960 - 6.982 mm (0.2740 - 0.2749 in)

Face angle:

Intake and exhaust : 90°

Head diameter:

Intake : 35.200 - 35.450 mm (1.3858 - 1.3957 in)

Exhaust : 32.500 - 32.750 mm (1.2795 - 1.2894 in)

Valve length:

Intake : 110.79 - 111.19 mm (4.3618 - 4.3776 in)

Exhaust : 110.59 - 110.99 mm (4.3539 - 4.3697 in)

Max. valve lift:

Intake : 8.866 mm (0.3491 in)

Exhaust : 10.344 mm (0.4072 in)

Protrusion of valves in relation to the cylinder head gasket face:

Intake and exhaust : -0.03 to 0.21 mm (-0.0012 to 0.0083 in)

Valve clearance settings:

Intake : 0.15 - 0.25 mm (0.0059 - 0.0098 in)

Exhaust : 0.35 - 0.45 mm (0.0138 - 0.0177 in)

VALVE SEAT

Seat angle (α):

Intake and exhaust : 89.5°

Mating surface width (X):

Intake and exhaust : 1.8 mm (0.071 in)

Seat outer diameter (D):

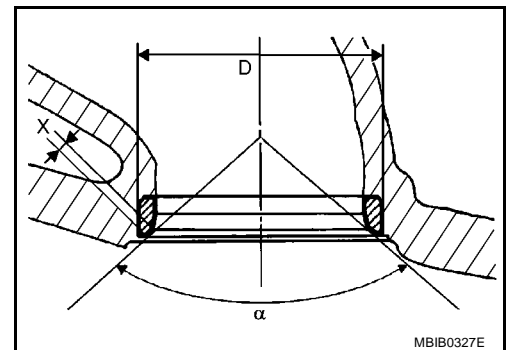
Intake : 36.967 - 39.983 mm (1.4554 - 1.4560 in)

Exhaust : 33.589 - 33.605 mm (1.3224 - 1.3230 in)

Diameter of the seat housing in the cylinder head:

Intake : 36.877 - 36.907 mm (1.4518 - 1.4530 in)

Exhaust : 33.500 - 33.529 mm (1.3189 - 1.3200 in)



VALVE GUIDE

Length:

Intake and exhaust : 38.10 - 38.40 mm (1.5000 - 1.5118 in)

Guide outer diameter:

Standard : 12.068 - 12.050 mm (0.4751 - 0.4744 in)

Guide inner diameter:

Intake and exhaust

Not machined : 6.30 - 6.42 mm (0.2480 - 0.2528 in)

Machined* : 7.000 - 7.022 mm (0.2756 - 0.2765 in)

* This dimension is measured with the guide installed in the cylinder head.

Diameter of the guide housing in the cylinder head:

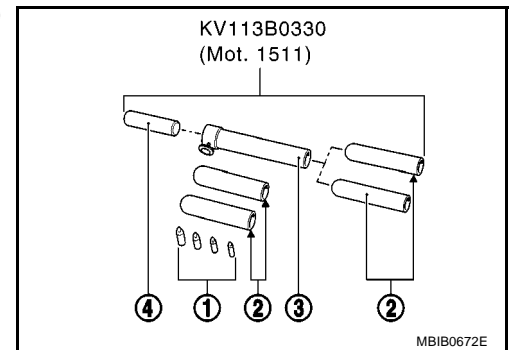
Standard : 11.95 - 11.98 mm (0.4705 - 0.4717 in)

The intake and exhaust guides have valve stem seals which must be replaced each time the valves are removed.

It is essential to install the valve stem seal using Tool KV113B0330 (Mot. 1511) or suitable tool.

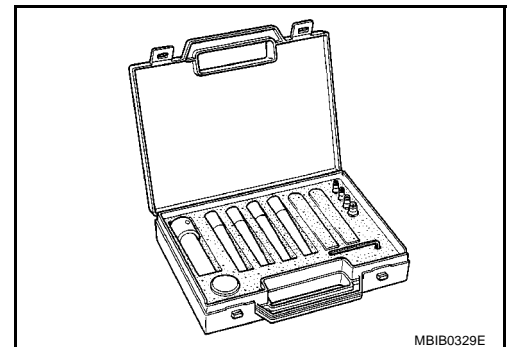
NOTE:

Do not lubricate the valve stem seals before installing them.



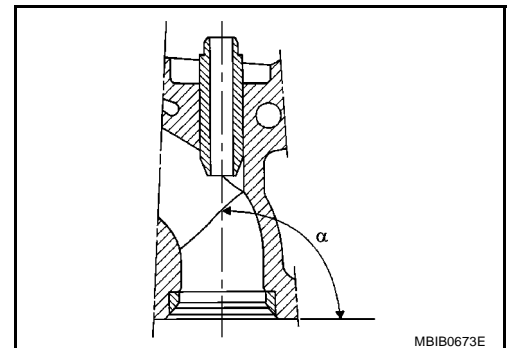
Tool KV113B0330 (Mot. 1511) consists of:

- Four cores (1)
- Four push rods (2)
- One guide tube (3)
- One sleeve (4)



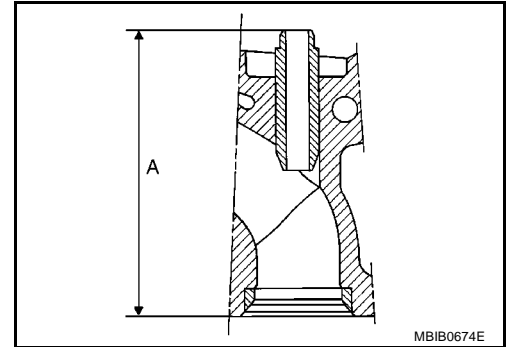
Angle of the intake and exhaust guides (in degrees)

Intake and exhaust : $\alpha = 90$



Position of the intake and exhaust valve guides:

Intake and exhaust "A" : 80.65 - 81.09 mm (3.1752 - 3.1925 in)



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VALVE SPRING

Free length : 44 - 48 mm (1.73 - 1.89 in)

Length under load:

270 N (27.5 kg, 60.7 lb) : 37.5 mm (1.476 in)

614 N (62.6 kg, 138.0 lb) : 27.5 mm (1.083 in)

Close-wound coils : 24.97 - 25.08 mm (0.9831 - 0.9874 in)

Diameter of wire : 3.87 - 3.93 mm (0.1524 - 0.1547 in)

Inner diameter : 21.4 - 21.6 mm (0.843 - 0.850 in)

Outer diameter : 29.5 mm (1.161 in)

PISTON

Outer diameter of tappet : 34.965 - 34.985 mm (1.3766 - 1.3774 in)

Diameter of the housing in the cylinder head : 35.000 - 35.039 mm (1.3780 - 1.3795 in)

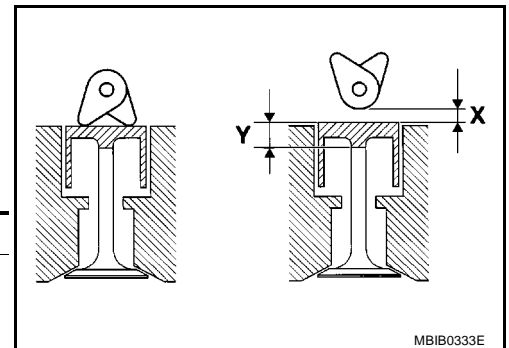
INSPECTION OF VALVE CLEARANCE

- Place the valves of the cylinder concerned at the "end of exhaust - beginning of inlet" position and check the clearance (X).

NOTE:

Dimension (Y) corresponding to the tappet thickness size (at the service parts there are 25 sizes).

Y	X
1	4
3	2
4	1
2	3



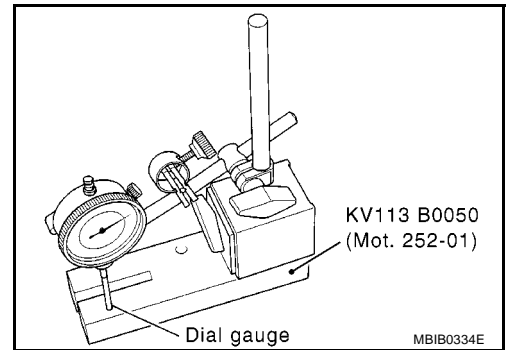
- Compare the values recorded with the values specified, then replace the tappets which are not within tolerance.

Clearance, when the engine is cold:

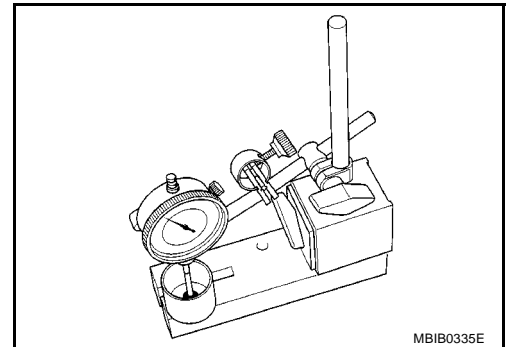
Intake : 0.15 - 0.25 mm (0.0059 - 0.0098 in)

Exhaust : 0.35 - 0.45 mm (0.0138 - 0.0177 in)

3. The camshaft must be removed to replace the tappets.
 - Determining dimension (Y)
4. Set up the following assembly using Tool KV113B0050 (Mot. 252-01) and dial gauge, then calibrate the gauge.



5. Raise the gauge extension (without modifying the position of the magnetic support/gauge assembly), then slide in the tappet to be measured.
6. Note dimension (Y) and repeat the operation for the tappet where the valve clearance is not within tolerance.
7. Refer to the "RARTS CATALOG" for the vehicle concerned to select the various thickness of the tappet.



CAMSHAFT

End play : 0.045 - 0.135 mm (0.0018 - 0.0053 in)

Number of bearings : 5

Timing diagram:

Intake opening retardation* : -3

Intake closing retard : 21

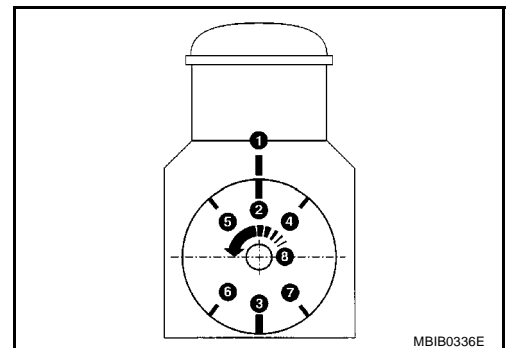
Exhaust opening advance : 46

Exhaust closing advance : -5**

* If the intake opening delay is negative, valve opening can be found ATDC.

** If the exhaust closing advance is negative, valve closing can be found BTDC.

1	Cylinder block TDC fixed mark
2	Flywheel TDC moving mark
3	Flywheel BDC moving mark
4	Intake opening retardation
5	Exhaust closing advance
6	Intake closing retardation
7	Exhaust opening advance
8	Direction of engine rotation (flywheel end)



Piston

- Installing the piston pin in the connecting rod and in the piston.
- The piston pin is retained by snap ring.

EBS00SBT

PISTON MARKING

1	Direction of installing of the piston: mark towards the flywheel
2	Height between the piston pin and the top of the piston (see table on following page)
3	Used by the supplier only
4	Used by the supplier only
5	Piston axis of symmetry
6	Piston pin hole axis
7	Offset between the hole of the pin (6) and the axis of symmetry of the piston (5): 0.5 mm (0.020 in)

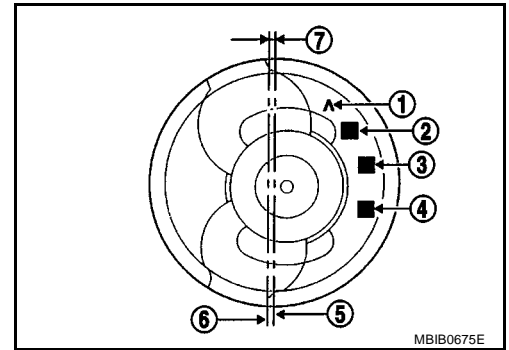


TABLE OF PISTON PIN HEIGHT

Mark on piston*	Piston pin height mm (in)
K	47.046 (1.8522)
L	47.088 (1.8539)
M	47.130 (1.8555)
N	47.172 (1.8572)
P	47.214 (1.8588)

- The tolerance on the piston pin heights is ± 0.02 mm (0.0008 in).

* The different piston pin heights are exclusively reserved for the engine assembly plant.
The service parts will only supply piston classes (height) L, M, N.

NOTE:

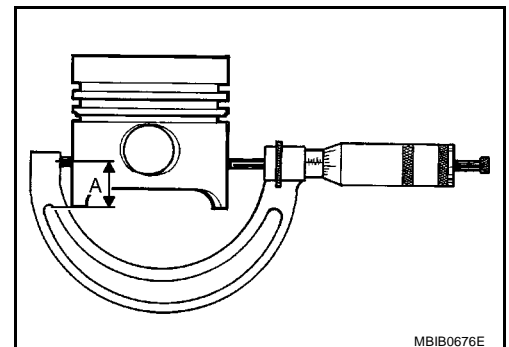
- If the engine is installed with a K class piston, an L class piston must be installed as a replacement.
- If the engine is installed with a P class piston, an N class piston must be installed as a replacement.

MEASURING THE PISTON DIAMETER

- The piston diameter is measured at height A = 39 mm (1.54 in).

Piston diameter:

79.8585 - 79.8735 mm (3.1440 - 3.1446 in)



PISTON RING

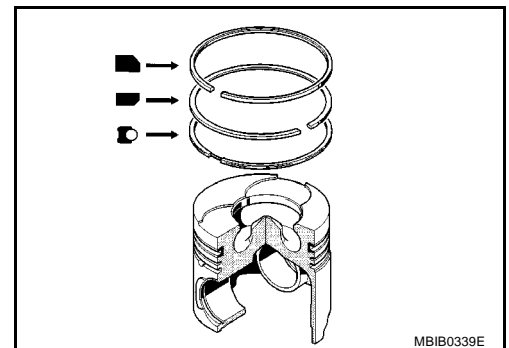
Thickness:

Top ring : 2.47 - 2.49 mm (0.0972 - 0.0980 in)

2nd ring : 2.47 - 2.49 mm (0.0972 - 0.0980 in)

Oil ring : 2.97 - 2.99 mm (0.1169 - 0.1177 in)

- The rings are supplied ready adjusted.



PISTON RING END GAP

End gap:

Top ring : 0.20 - 0.35 mm (0.0079 - 0.0138 in)

2nd ring : 0.70 - 0.90 mm (0.0276 - 0.0354 in)

Oil ring : 0.25 - 0.50 mm (0.0098 - 0.0197 in)

PISTON PIN

Piston pin:

Length : 59.5 - 60.0 mm (2.346 - 2.362 in)

Outer diameter : 27.995 - 28.000 mm (1.1022 - 1.1024 in)

Inner diameter : 12.8 - 13.1 mm (0.504 - 0.516 in)

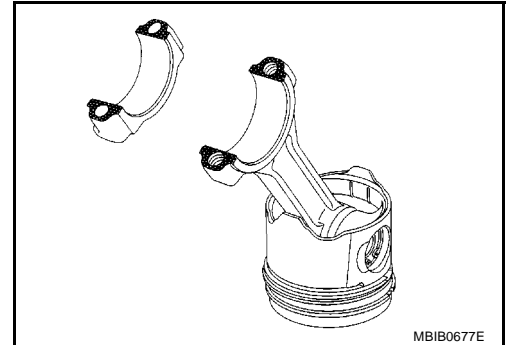
Connecting Rod

EBS00SBU

- The connecting rods are divisible.

WARNING:

- The bolt must be sealed with engine oil under the head and on the thread when the connecting rod are installed in the engine.
- Positioning of the connecting rod heads on the body is ensured by roughness on the crack.
- The occurrence of impacts or a foreign body between the body-head mating surfaces will lead to rapid failure of the connecting rod.



Lateral play of the connecting rod big end : 0.220 - 0.482 mm (0.0087 - 0.0190 in)

Diametrical play of the connecting rod big end : 0.027 - 0.086 mm (0.0011 - 0.0034 in)

Centre-to-centre distance between the connecting rod big end and small end : 139 mm (5.47 in)

Diameter of the big end : 51.587 - 51.606 mm (2.0310 - 2.0317 in)

Diameter of the small end:

(without ring) : 30.240 - 30.265 mm (1.1905 - 1.1915 in)

(with ring) : 28.013 - 28.025 mm (1.1029 - 1.1033 in)

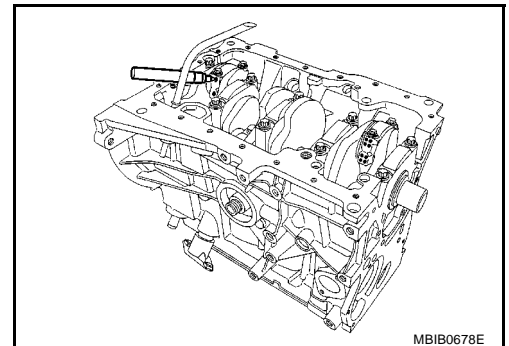
NOTE:

The connecting rod small end bushings cannot be replaced.

CAUTION:

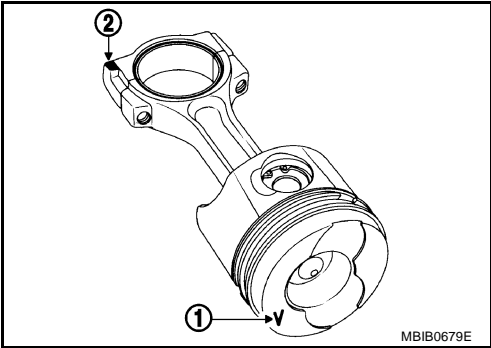
Do not use a sharp point to mark the bearing caps in relation to their connecting rods to avoid starting a crack in the rod. Use a permanent marker pen.

- The maximum weight difference for the connecting rod, piston and piston pin assemblies for the same engine must be 23 g (0.81 OZ).



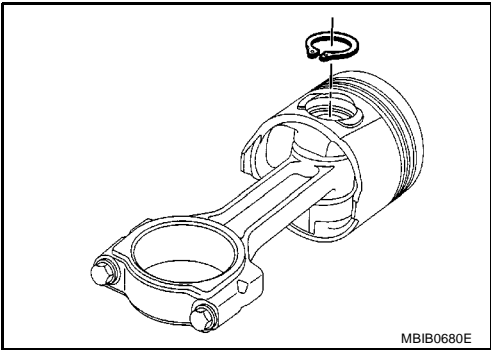
DIRECTION OF INSTALLATION OF THE CONNECTING ROD IN RELATION TO THE PISTON

- Place the mark (1) engraved on the piston head downwards and the machined flat (2) of the connecting rod head upwards.



DIRECTION OF INSTALLATION OF THE SNAP RING ON THE PISTON

- Install the snap ring on the piston as shown in figure.



Crankshaft
SPECIFICATIONS

- Number of main journal : 5
- Lateral crankshaft play : 0.067 - 0.233 mm (0.0026 - 0.0092 in)
- Diameter crankshaft play : 0.027 - 0.086 mm (0.0011 - 0.0034 in)

- Main bearing journal diameter shown on the crankshaft by paint mark.

Paint mark	Blue	Red
Journal diameter mm (in)	54.785 (2.1569) - 54.795 (2.1573)	54.795 (2.1573) - 54.805 (2.1577)

- Diameter of the crankshaft pin

Crankshaft pin diameter mm (in)	48.00 - 48.02 (1.8898 - 1.8905)
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NOTE:

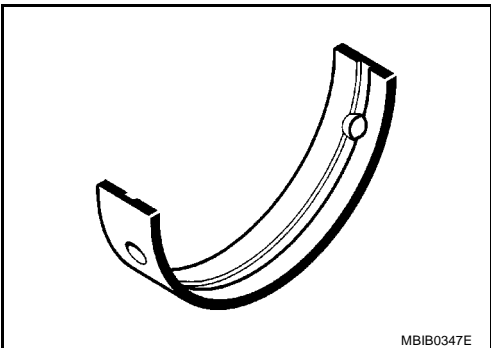
The lateral shim located on No. 2 bearing.

- No regrinding is authorized.

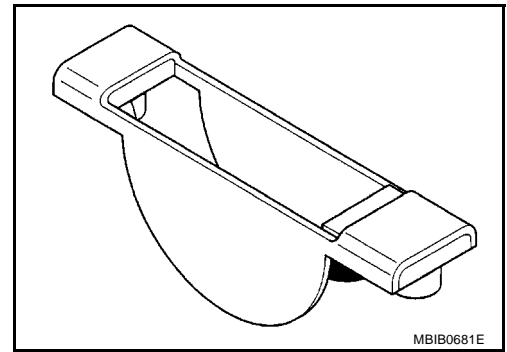
MAIN BEARING

Crankshaft Bearing Shell

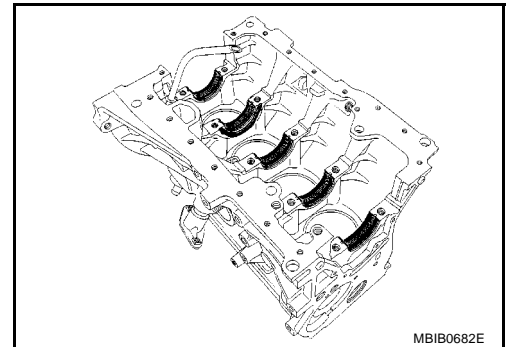
- The engine is installed with bearing shell without a locator notch.



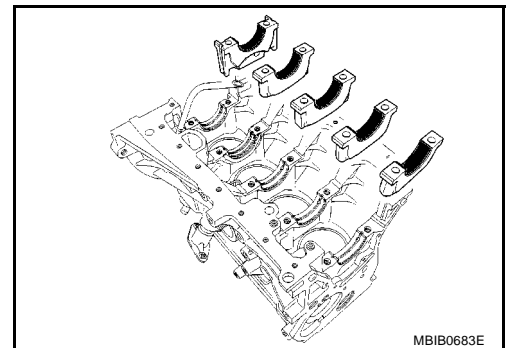
- The crankshaft bearing shell installed on the cylinder block and on the bearing using Tool KV113B0320 (Mot. 1493).



- Direction of the installing the cylinder block bearing installed with grooved bearing shell.

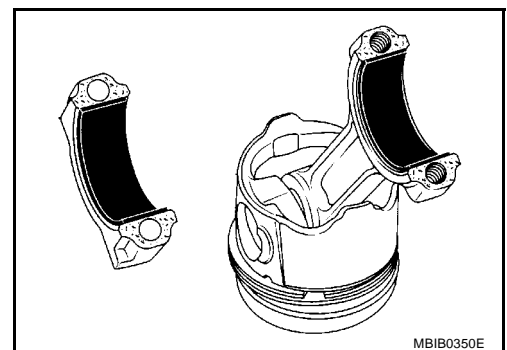


- Direction of the installed the bearing cap installed with non-grooved bearing shell.

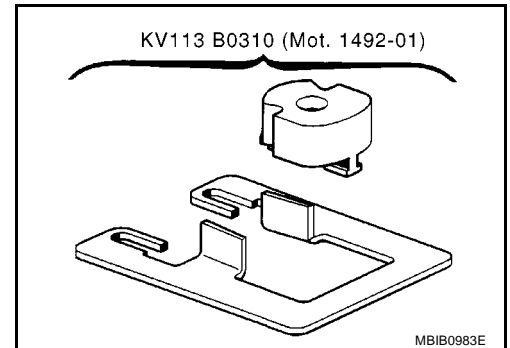
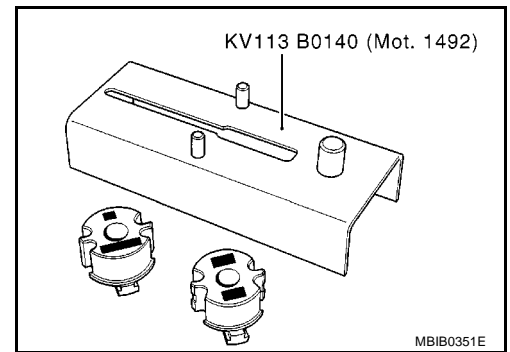


CONNECTING ROD BEARING

- The engine is installed with bearing shell without a locator notch.



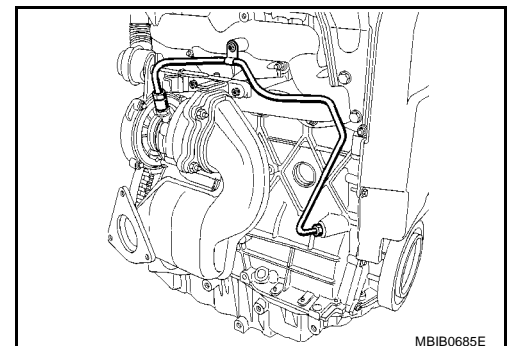
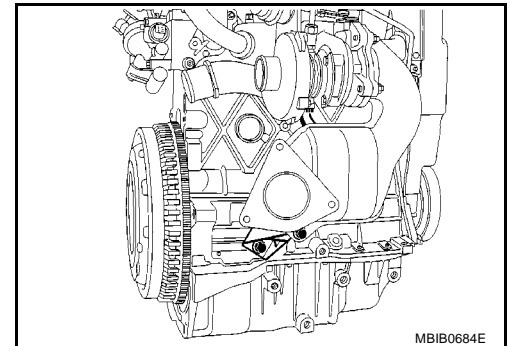
- The bearing shell install using Tool KV113B0140 (Mot. 1492) and KV113B0310 (Mot. 1492-01).



Cylinder Block

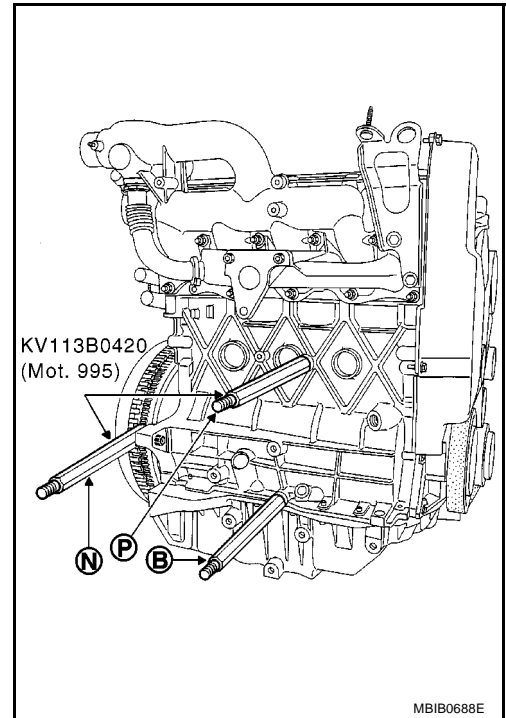
PRERARING THE ENGINE TO BE SET ON THE STAND

1. Before the engine is mounted on Tool KV113B0070 (Mot. 792-03), the engine's electrical harness must be removed and the engine oil drained.
2. Remove the stay between the cylinder block and the light-off catalyst.
3. Remove the turbocharger oil return pipe.
4. Remove the oil tube.
5. Remove the three turbocharger mounting nuts on the exhaust manifold.



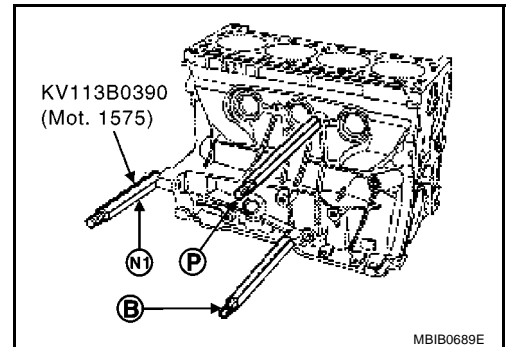
CONVENTIONAL CYLINDER BLOCK WITH A SMALL MATING FACE

- Install Tool KV113B0420 (Mot. 995) at (B), (N), (P) onto the cylinder block such that they install into holes (26, 12, 25) in Tool KV113B0070 (Mot. 792-03).



NEW CYLINDER BLOCK WITH A LARGE MATING FACE

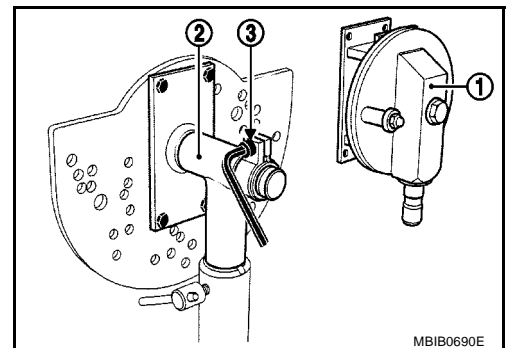
1. Install Tool KV113B0390 (Mot. 1575) at (B), (N1), (P) onto the cylinder block such that they install into holes (26, 12, 25) in Tool KV113B0070 (Mot. 792-03).



2. Change to engine mountings head used in engine repair. Replacement of head TS 126 (1) with head TS 127 (2).
3. Special feature of this new head:
 - Axis of rotation permanently lubricated
 - Variable locking of the head

CAUTION:

The clamping bolt (3) must be fully undone to release the head when there is no longer an engine resting on the support.



Parts To Be Replaced After Removal

- All the gaskets
- Flywheel bolts
- Metal oil return pipe from the decanter
- Crankshaft bearing bolts
- Camshaft pulley bolts
- Crankshaft pulley bolt
- Connecting rod cap bolt

EBS00SBX

- Injector holder copper washers
- Fuel return pipe
- Pipe plugs
- Coolant circuit rigid hose
- Belts
- Timing tensioner
- Oil jets

A

EM

Installation of Thread Insert

EBS00SBY

- Threaded hole on all engine component part can be repaired by using thread insert except on the camshaft bearing beam and the rocker cover.

C

D

E

F

G

H

I

J

K

L

M

