SECTION EM
ENGINE MECHANICAL

CONTENTS

QR

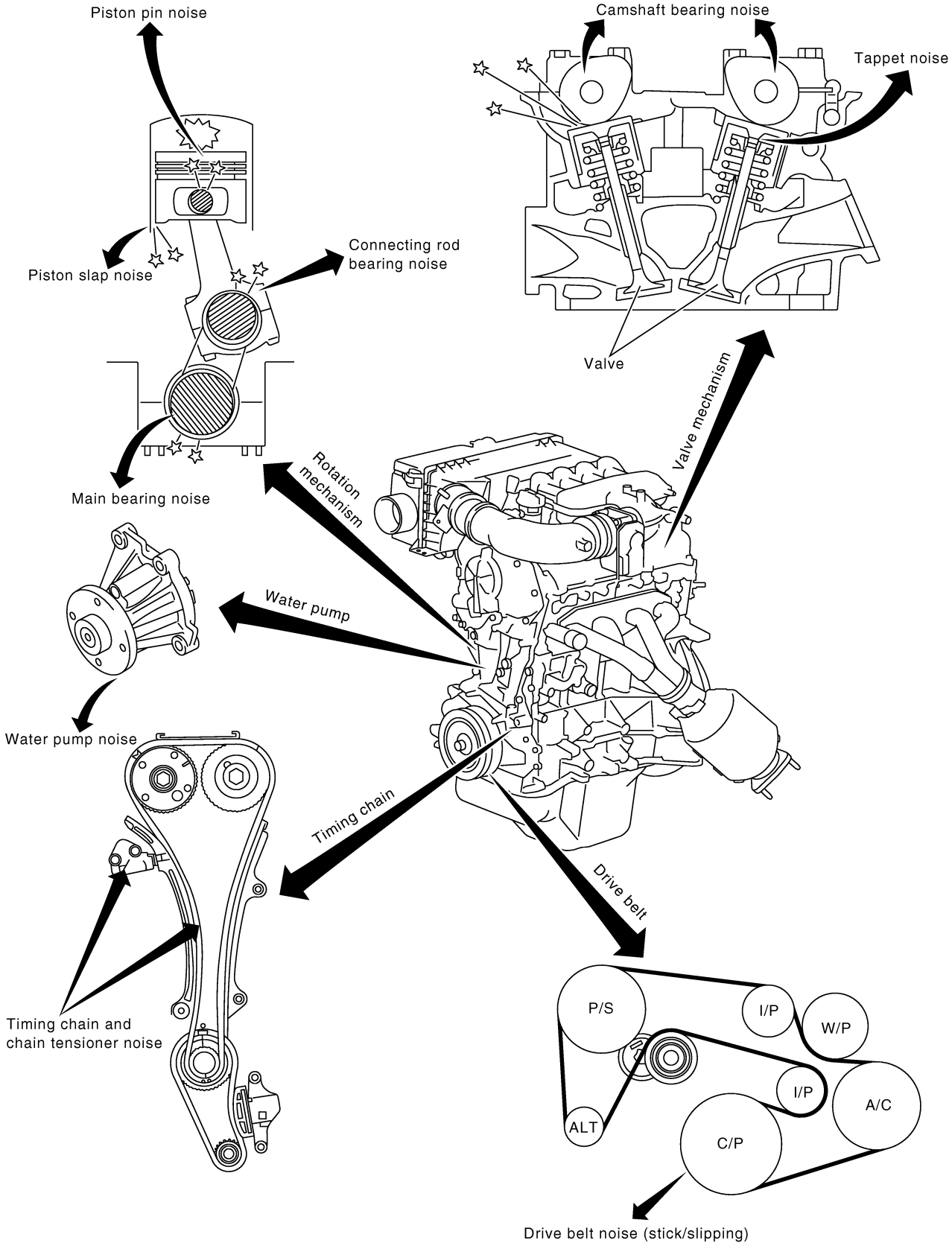
VQ

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting — Engine Noise

EBS00NHK

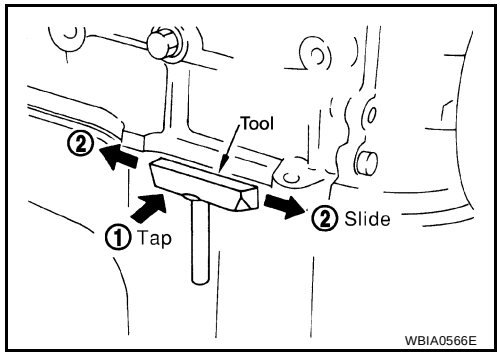


PBIC2983E

Tool number : KV10111100 (J-37228)

CAUTION:

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



INSTALLATION

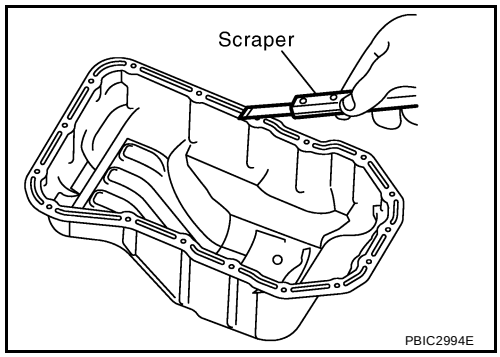
1. Install oil pan with the following procedure:

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

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

CAUTION:

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



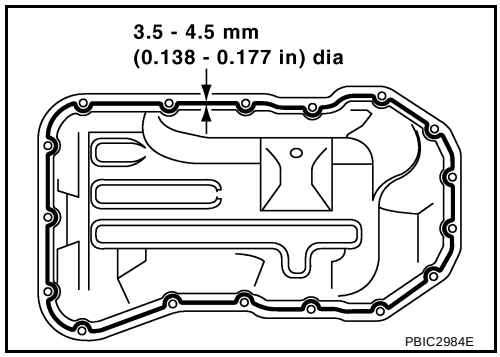
b. Apply a continuous bead of liquid gasket using Tool as shown.

Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-47, "Recommended Chemical Products and Sealants" .

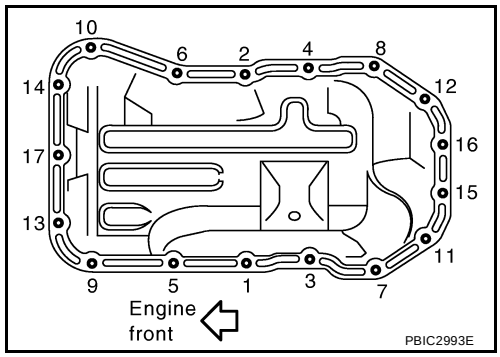
CAUTION:

Attaching should be done within 5 minutes after coating.



c. Tighten bolts in numerical order as shown.

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



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

NOTE:

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

INSPECTION AFTER INSTALLATION

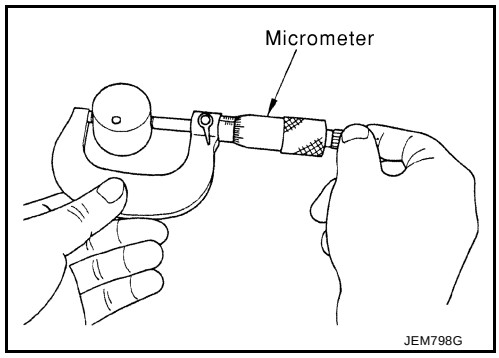
1. Check the engine oil level, and adjust the level. Refer to LU-6, "ENGINE OIL LEVEL" .

Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

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

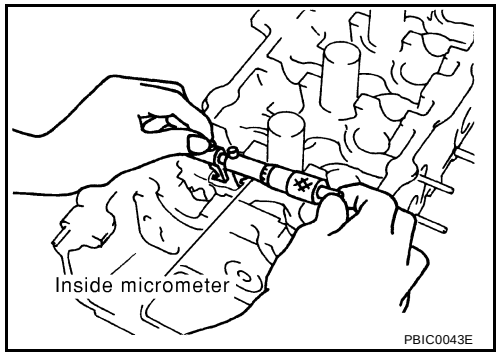
Standard : 33.965 - 33.980 mm (1.3372 - 1.3378 in)



VALVE LIFTER HOLE DIAMETER

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

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



VALVE LIFTER CLEARANCE

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

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

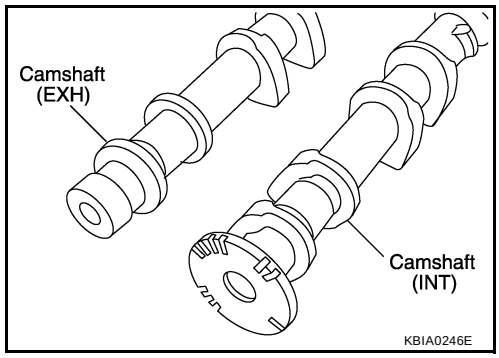
- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

INSTALLATION

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

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

Exhaust : Cone end shape

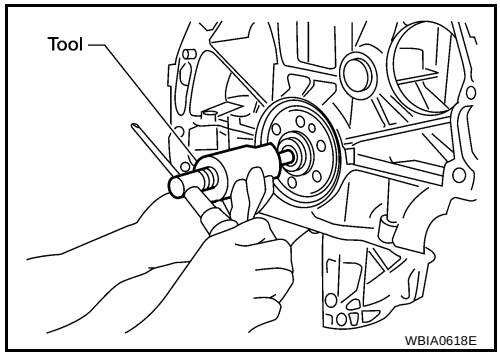


10. Remove oil pressure sensor using a suitable tool.

CAUTION:
Do not drop or shock oil pressure sensor.

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

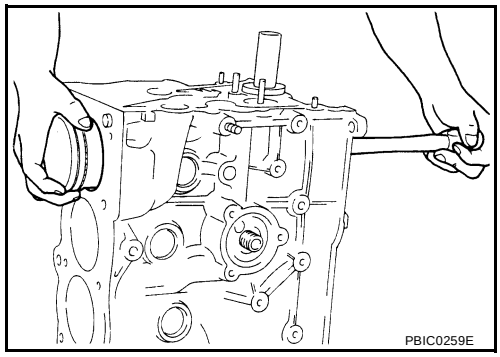
Tool number : ST16610001 (J-23907)



12. Remove piston and connecting rod assembly with the following procedure:
- Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-91, "CONNECTING ROD SIDE CLEARANCE" .

13. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
14. Remove connecting rod cap.
15. Push piston and connecting rod assembly out to the cylinder head side using suitable tool.

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

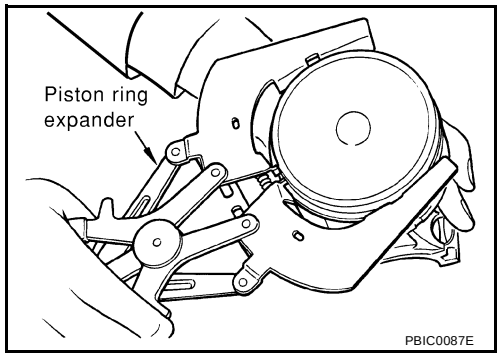


16. Remove connecting rod bearings.

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

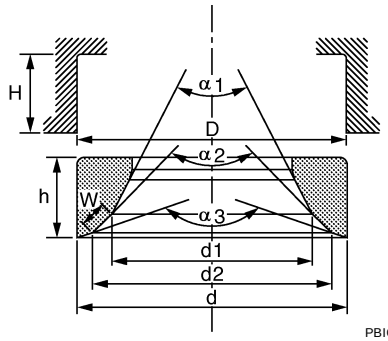
17. Remove piston rings form piston; using piston ring expander or suitable tool.
- Before removing piston rings, check the piston ring side clearance. Refer to EM-92, "PISTON RING SIDE CLEARANCE" .

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



Valve Seat

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter “D”	Intake	36.500 - 36.516 (1.4370 - 1.4376)	37.000 - 37.016 (1.4567 - 1.4573)
	Exhaust	31.500 - 31.516 (1.2402 - 1.2408)	32.000 - 32.016(1.2598 - 1.2605)
Valve seat outer diameter “d”	Intake	36.597 - 36.613 (1.4408 - 1.4415)	37.097 - 37.113 (1.4605 - 1.4611)
	Exhaust	31.600 - 31.616 (1.2441 - 1.2447)	32.100 - 32.116 (1.2638 - 1.2644)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.084 - 0.116 (0.0033 - 0.0046)	
Diameter “d1”*1	Intake	33.5 (1.319)	
	Exhaust	28.0 (1.102)	
Diameter “d2”*2	Intake	35.1 - 35.3 (1.382 - 1.390)	
	Exhaust	29.9 - 30.1 (1.177 - 1.185)	
Angle “α1”	Intake	60°	
	Exhaust	60°	
Angle “α2”	Intake	88°45′ - 90°15′	
	Exhaust	88°45′ - 90°15′	
Angle “α3”	Intake	120°	
	Exhaust	120°	
Contacting width “W”*3	Intake	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.25 - 1.55 (0.0492 - 0.0610)	
Height “h”	Intake	5.9 - 6.0 (0.232 - 0.236)	5.0 - 5.1 (0.197 - 0.201)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.91 - 5.01 (0.1933 - 0.1972)
Depth “H”		6.0 (0.236)	

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

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

*3 : Machining data

INSTALLATION

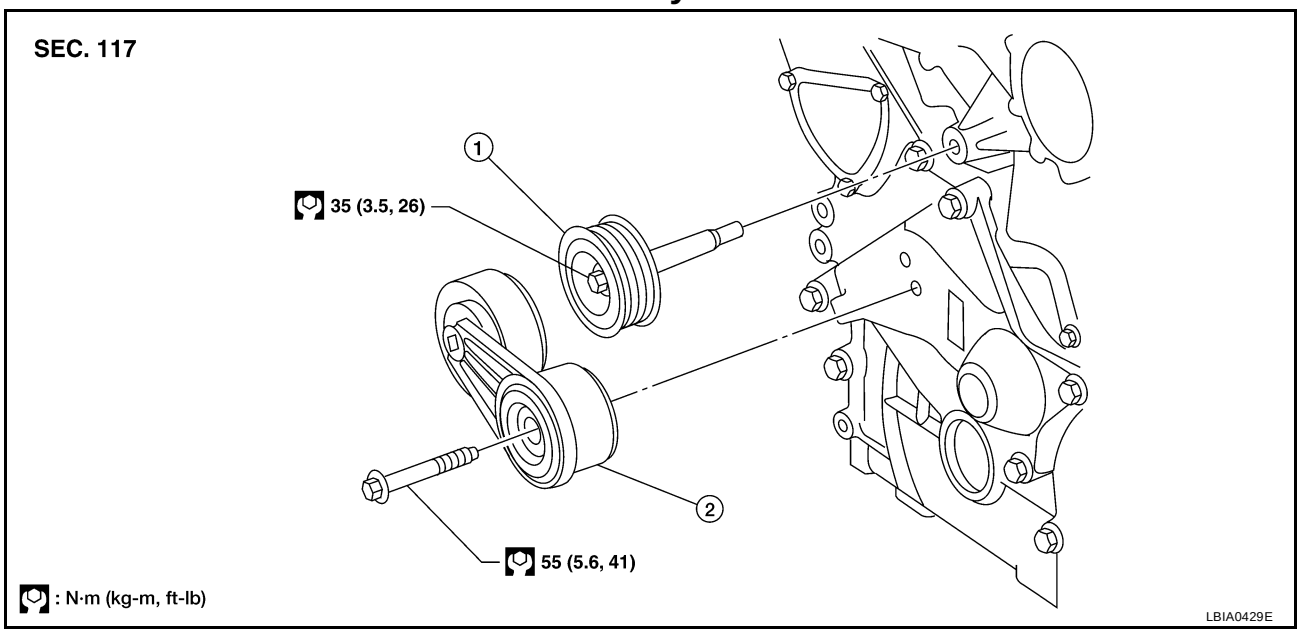
Installation is in the reverse order of removal.

CAUTION:

Make sure belt is securely installed around all pulleys.

Drive Belt Auto-Tensioner and Idler Pulley

EBS00P4J



1. Idler pulley
2. Drive belt auto-tensioner

REMOVAL

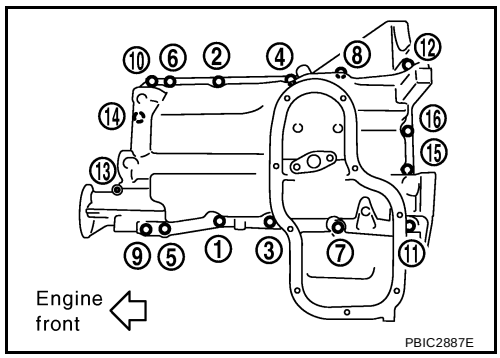
1. Remove the air duct and resonator assembly (inlet). Refer to EM-124, "REMOVAL" .
2. Remove the drive belt. Refer to EM-122, "Removal" .
3. Remove the radiator cooling fan assembly. Refer to CO-38, "REMOVAL" .
4. Remove the drive belt auto-tensioner and idler pulley using power tool.

INSTALLATION

Installation is in the reverse order of removal.

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

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



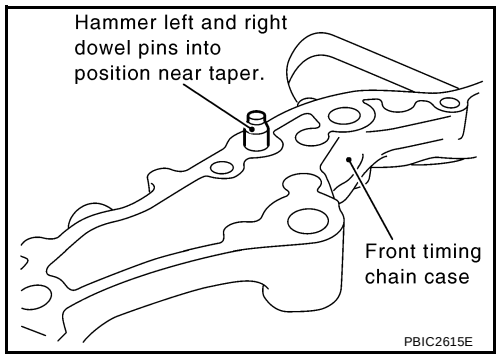
e. Tighten transmission joint bolts. Refer to MT-16, "REMOVAL" (FS5R30A), MT-65, "REMOVAL" (FS6R31A) (4X2), MT-67, "REMOVAL" (FS6R31A) (4X4), AT-248, "REMOVAL" (A/T) (4X2), AT-250, "REMOVAL" (A/T) (4X4).
2. Install oil strainer to oil pan (upper).
3. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

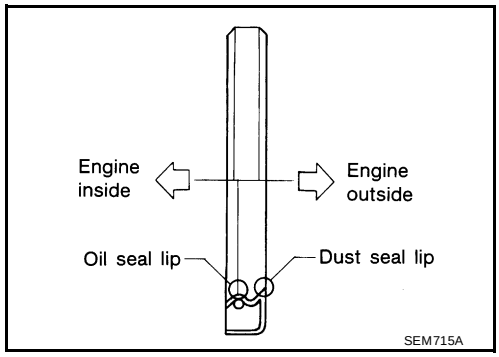
1. Check engine oil level and adjust engine oil. Refer to LU-18, "ENGINE OIL" .
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to LU-18, "ENGINE OIL" .

INSTALLATION

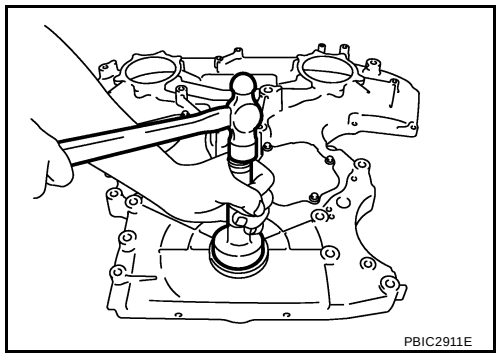
1. Hammer dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.



2. Install new front oil seal on the front timing chain case.
   - Apply new engine oil to both oil seal lip and dust seal lip.
   - Install it so that each seal lip is oriented as shown.



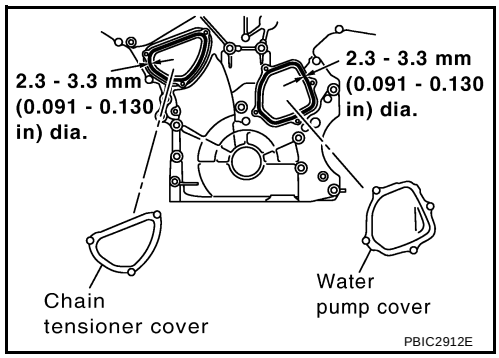
   - Press-fit oil seal until it becomes flush with front timing chain case end face using suitable drift [outer diameter: 60 mm (2.36 in)].
   - Make sure the garter spring is in position and seal lip is not inverted.



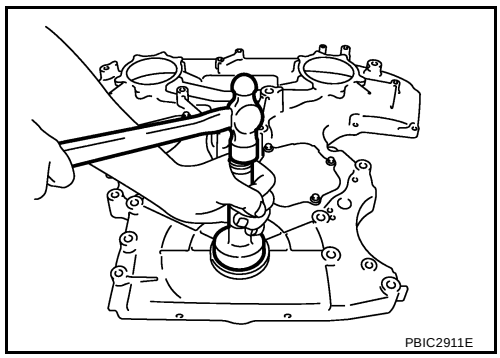
3. Install water pump cover and chain tensioner cover to front timing chain case, if removed.
   - Apply a continuous bead of liquid gasket using Tool to front timing chain case as shown.

     Tool number : WS39930000 (—)

     Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-47, "Recommended Chemical Products and Sealants".



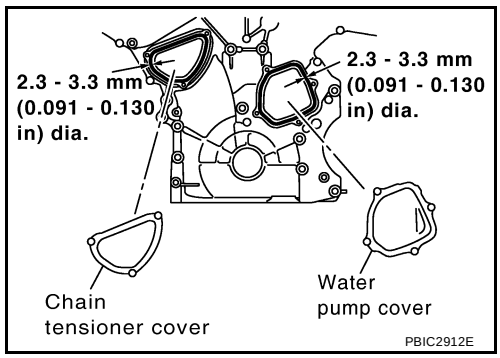
- Press-fit oil seal until it becomes flush with front timing chain case end face using suitable drift [outer diameter: 60 mm (2.36 in)].
- Make sure the garter spring is in position and seal lip is not inverted.



12. Install water pump cover and chain tensioner cover to front timing chain case.
    - Apply a continuous bead of liquid gasket using Tool to front timing chain case as shown.

      Tool number : WS39930000 (—)

      Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-47, "Recommended Chemical Products and Sealants" .

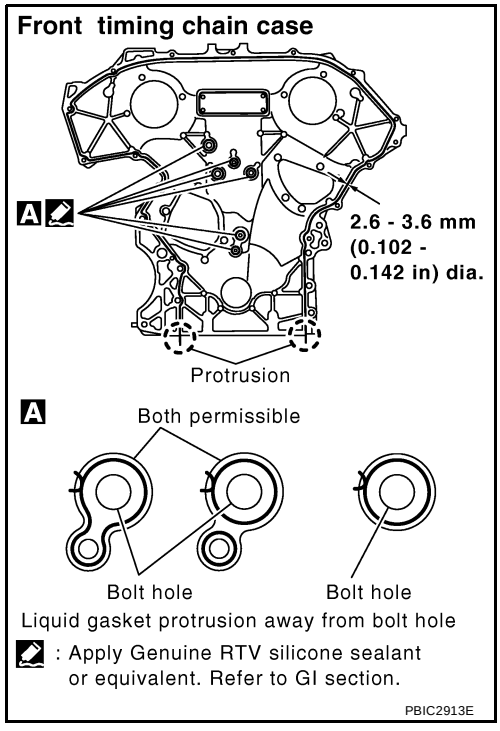


13. Install front timing chain case as follows:

a. Apply a continuous bead of liquid gasket using Tool to front timing chain case back side as shown.

Tool number : WS39930000 (—)

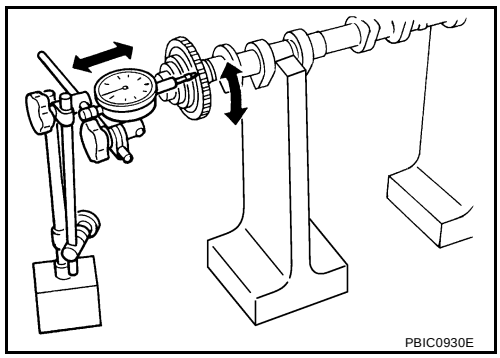
Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-47, "Recommended Chemical Products and Sealants" .



2. Measure the camshaft sprocket runout with dial indicator. (Total indicator reading)

Limit : 0.15 mm (0.0059 in)

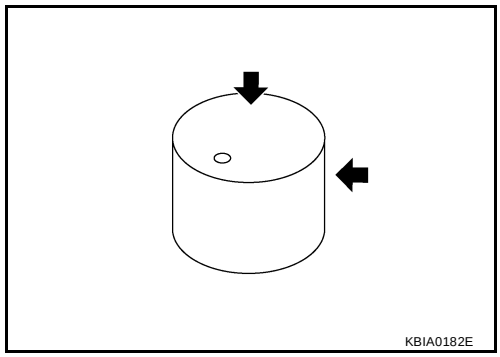
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to EM-246, "Available Valve Lifter" .



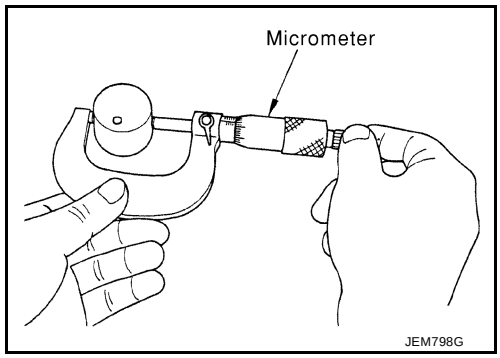
Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

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

Standard (Intake and exhaust)

: 33.977 - 33.987 mm (1.3377 - 1.3381 in)

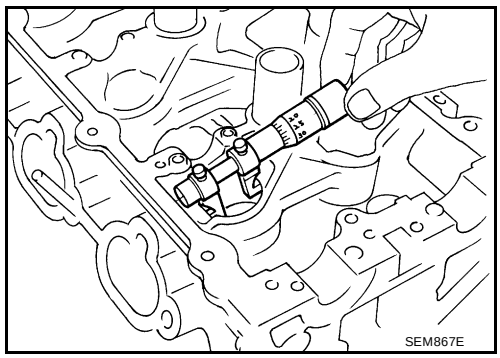


VALVE LIFTER HOLE DIAMETER

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

Standard (Intake and exhaust)

: 34.000 - 34.016 mm (1.3386 - 1.3392 in)



VALVE LIFTER CLEARANCE

- (Valve lifter clearance) = (Valve lifter hole diameter) – (Valve lifter outer diameter), Refer to EM-192, "Valve Clearance" .

Standard (Intake and exhaust)

: 0.013 - 0.039 mm (0.0005 - 0.0015 in)

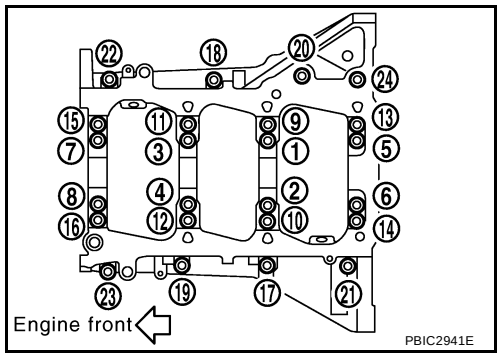
i. Apply new engine oil to threads and seat surfaces of the bolts.

ii. Tighten M8 bolts in numerical order as shown from No. 17 to 24.

Bolts 17 - 24 : 22.1 N·m (2.3 kg-m, 16 ft-lb)

CAUTION:
Wipe off completely any protruding liquid gasket on rear oil seal installation surface.

NOTE:
There are more processes to complete the tightening bolts. However stop procedure here to install rear oil seal.



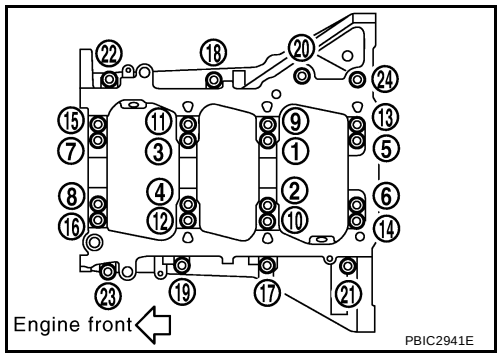
c. Install rear oil seal. Refer to EM-199, "INSTALLATION" .

d. Restart tightening of lower cylinder block bolts as follows:

i. Tighten M10 bolts in numerical order as shown from No. 1 to 16.

NOTE:
Use TORX socket (size E14) for bolts No. 1 to 16 (M10 bolt).

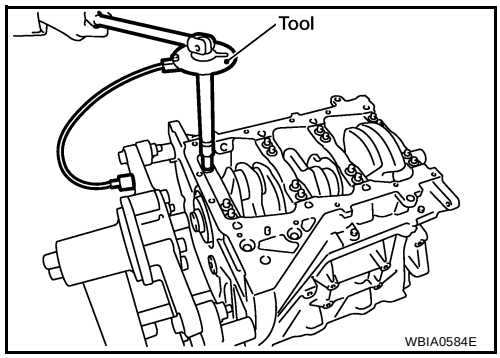
Bolts 1 - 16 : 35.3 N·m (3.6 kg-m, 26 ft-lb)



ii. Turn M10 bolts 90° clockwise in numerical order from No. 1 to 16 using Tool.

Tool number : KV10112100 (BT-8653-A)

CAUTION:
Use angle wrench Tool to check tightening angle. Do not make judgement by visual inspection.



- After installing the bolts, make sure that crankshaft can be rotated smoothly by hand.
- Wipe off completely any protruding liquid gasket on front side of the engine.
- Check the crankshaft end play. Refer to EM-232, "CRANKSHAFT END PLAY" .

8. Inspect the outer diameter of connecting rod bolt. Refer to EM-241, "CONNECTING ROD BOLT OUTER DIAMETER" .

9. Install piston to connecting rod as follows:

a. Install new snap ring to the groove of piston rear side using suitable tool.
- Insert it fully into groove to install.

b. Install piston to connecting rod.
- Using industrial use drier or similar tool, heat piston until piston pin can be pushed in by hand without excess force [approx. 60° to 70 °C (140° to 158 °F)]. From the front to the rear, insert piston pin into piston and connecting rod.