SECTION EM
ENGINE MECHANICAL

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PRECAUTIONS

PFP:00001

Parts Requiring Angular Tightening

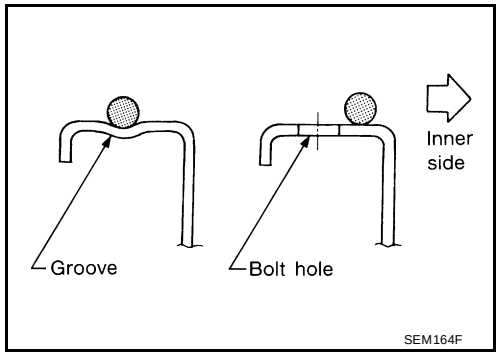
EBS0068U

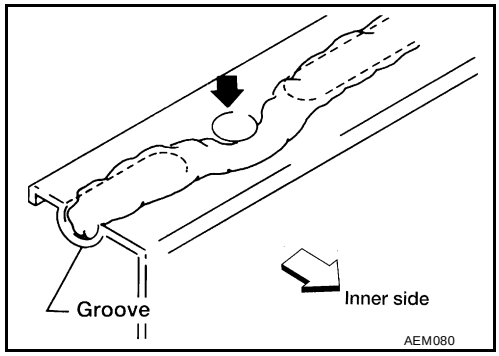
- Use an angle wrench for the final tightening of the following engine parts:
  - Cylinder head bolts
  - Main bearing cap bolts
  - Connecting rod cap nuts
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Liquid Gasket Application Procedure

EBS0068V

1. **Use a scraper to remove old RTV Silicone Sealant from mating surfaces and grooves. Also, completely clean any oil from these areas.**
2. **Apply a continuous bead of Genuine RTV Silicone Sealant or equivalent, to mating surfaces. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .**
   - **For oil pan, be sure RTV Silicone Sealant diameter is 3.5 to 4.5 mm (0.138 to 0.177 in).**
   - **For areas except oil pan, be sure RTV Silicone Sealant diameter is 2.0 to 3.0 mm (0.079 to 0.118 in).**
3. **Apply RTV Silicone Sealant around the inner side of bolt holes (unless otherwise specified).**
4. **Assembly should be done within 5 minutes after coating.**
5. **Wait at least 30 minutes before refilling engine oil and engine coolant.**





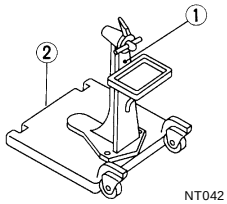
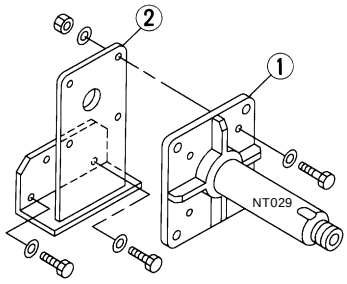
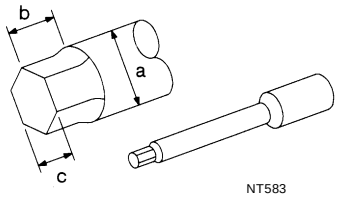
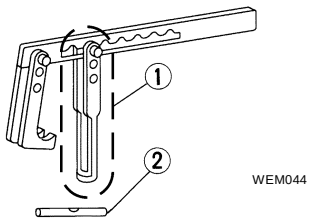
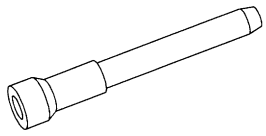
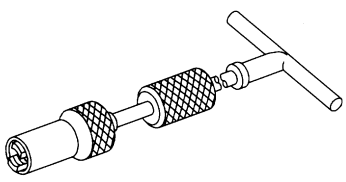
PREPARATION

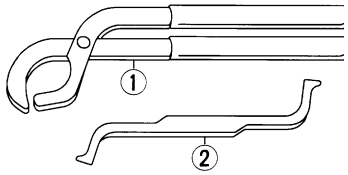
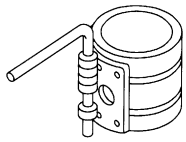
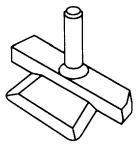
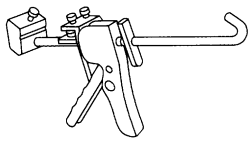
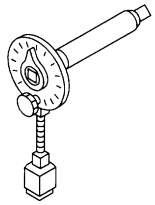
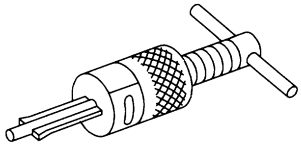
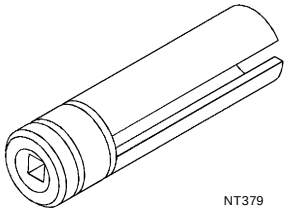
PFP:00002

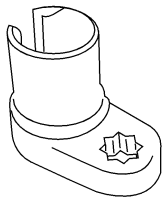
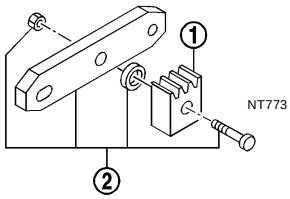
Special Service Tools

EBS0068W

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

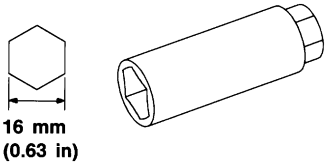
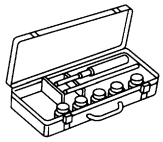
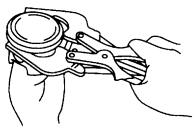
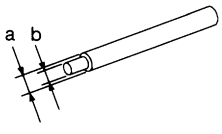
Tool number (Kent-Moore No.) Tool name	Description	
ST0501S000 (—) Engine stand assembly 1 ST05011000 (—) Engine stand 2 ST05012000 (—) Base	 NT042	Disassembling and assembling
Engine attachment assembly 1 KV10106500 (—) Engine attachment 2 KV10113300 (—) Sub-attachment	 NT029	Overhauling engine
ST10120000 (J24239-O1) Cylinder head bolt wrench	 NT583	Loosening and tightening cylinder head bolt **a: 13 mm (0.51 in) dia.** **b: 12 mm (0.47 in)** **c: 10 mm (0.39 in)**
KV10116200 (J26336-B) Valve spring compressor 1 KV10115900 (J26336-20) Attachment 2 KV10109220 (—) Adapter	 WEM044	Disassembling valve mechanism
KV10115600 (J38958) Valve oil seal drift	 NT024	Installing valve oil seal
KV10107902 (J-36467) Valve oil seal puller	 NT011	Displacement valve lip seal

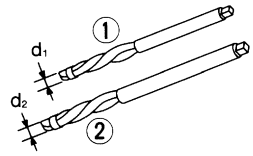
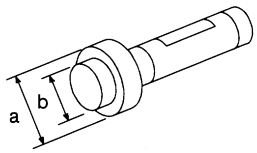
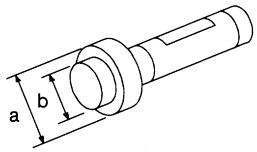
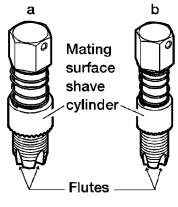
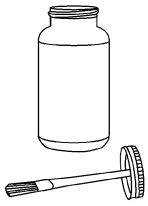
Tool number (Kent-Moore No.) Tool name	Description	
(J-45074) Valve shim lifter set 1. (45074-1) Camshaft pliers 2. (45074-2) Lifter holding tool	 NT041	Changing valve lifter shims
EM03470000 (J8037) Piston ring compressor	 NT044	Installing piston assembly into cylinder bore
KV10111100 (J37228) Seal cutter	 NT046	Removing oil pan
WS39930000 (—) Tube presser	 NT052	Pressing the tube of liquid gasket
KV10112100 (BT-8653-A) Angle wrench	 NT014	Tightening bolts for bearing cap, cylinder head, etc.
ST16610001 (J23907) Pilot bushing puller	 NT045	Removing pilot bushing
(J36471-A) Front (heated) oxygen sensor wrench	 NT379	Loosening or tightening heated oxygen sensor with 22 m (0.87 in) hexagon nut

Tool number (Kent-Moore No.) Tool name	Description
(J44626) Air fuel ratio (A/F) sensor wrench	 LEM054 Loosening or tightening air fuel ratio (A/F) sensor 1
KV101056S0 (—) Rear gear stopper 1 KV10105620 (—) Adapter 2 KV10105610 (—) Plate assembly	 NT773 Preventing crankshaft from rotating

Commercial Service Tools

EBS0068X

(Kent-Moore No.) Tool name	Description
Spark plug wrench	 16 mm (0.63 in) NT047 Removing and installing spark plug
Valve seat cutter set	 NT048 Finishing valve seat dimensions
Piston ring expander	 NT030 Removing and installing piston ring
Valve guide drift	 NT015 Removing and installing valve guide **Intake & Exhaust:** **a: 9.5 mm (0.374 in) dia.** **b: 5.5 mm (0.217 in) dia.**

(Kent-Moore No.) Tool name	Description
Valve guide reamer  NT016	Reaming valve guide **1** or hole for oversize valve guide **2** **Intake & Exhaust:** **d_1 : 5.5 mm (0.217 in) dia.** **d_2 : 9.685 mm (0.3813 in) dia.**
Front oil seal drift  NT049	Installing front oil seal **a: 52 mm (2.05 in) dia.** **b: 40 mm (1.57 in) dia.**
Rear oil seal drift  NT049	Installing rear oil seal **a: 103 mm (4.06 in) dia.** **b: 84 mm (3.31 in) dia.**
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner  AEM488	Reconditioning the exhaust system threads before installing a new oxygen sensor (Use with anti-seize lubricant shown below.) **a: J-43897-18 [18 mm dia.] for zirconium oxygen sensor** **b: J-43897-12 [12 mm dia.] for titania oxygen sensor**
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  AEM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

Noise, Vibration and Harshness (NVH) Troubleshooting

EBS0068Y

NVH TROUBLESHOOTING — ENGINE NOISE

Use the chart below to help you find the cause of the symptom.

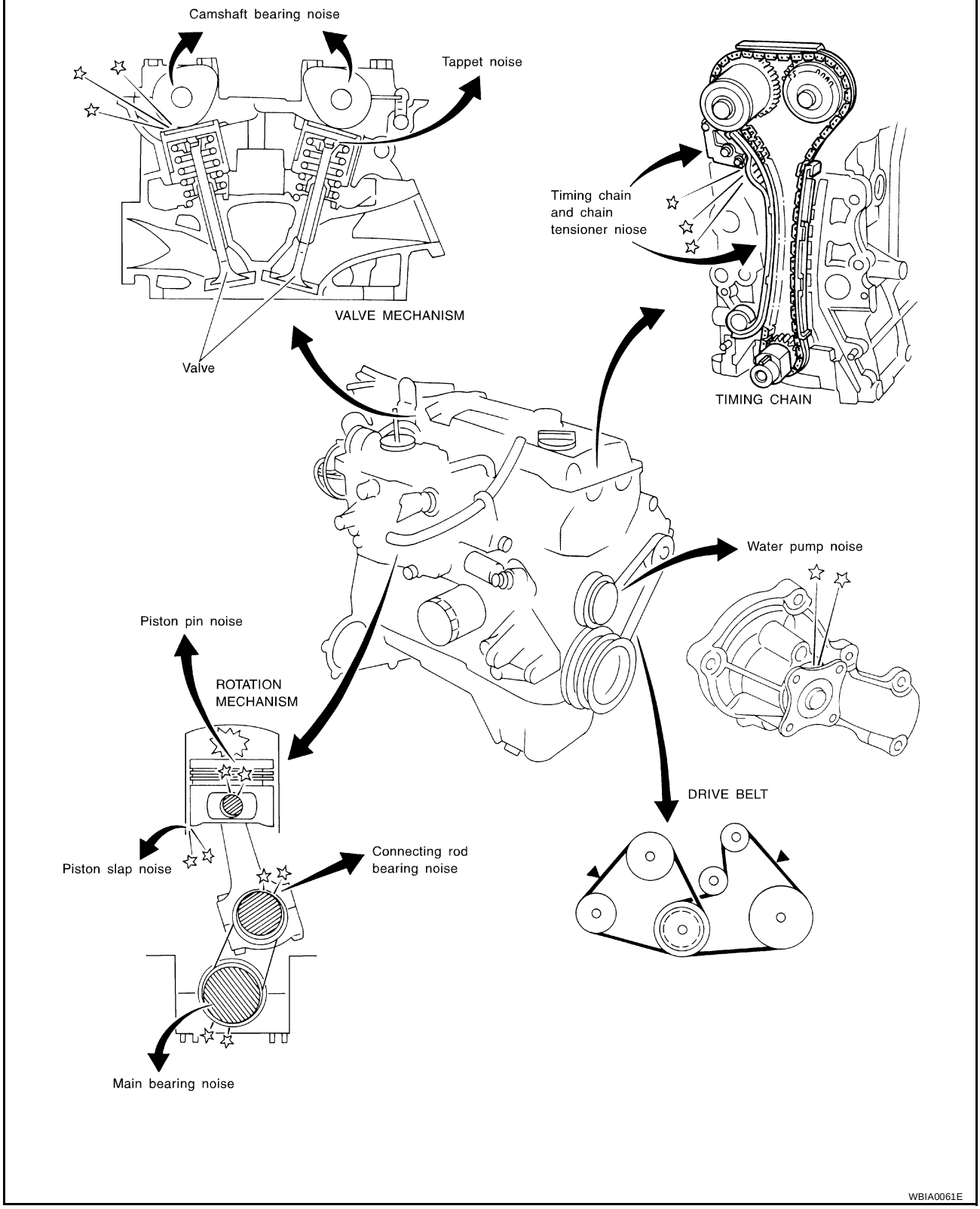
1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.
5. If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When start-ing	When idling	When racing	While driv-ing			
Top of Engine Rocker Cover Cyl-inder Head	Ticking or click	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-50, "CHECK-ING"
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clear-ance Camshaft runout	EM-40, "CAM-SHAFT JOURNAL CLEAR-ANCE", EM-42, "CAM-SHAFT SPROCKE T RUNOUT"

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When start-ing	When idling	When racing	While driv-ing			
Crank-shaft Pul-ley Cylinder Block (Side of Engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clear-ance Connecting rod bushing clearance	EM-60, "PISTON AND PIS-TON PIN CLEAR-ANCE", EM-67, "CON-NECTING ROD BUSHING CLEAR-ANCE (SMALL END)"
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-60, "PISTON AND PIS-TON PIN CLEAR-ANCE", EM-61, "PISTON PIN SIDE CLEAR-ANCE" , EM-61, "PISTON RING END GAP" EM-61, "CON-NECTING ROD BEND AND TORSION"
	Knock	A	B	C	B	B	B	Connect-ing rod bearing noise	Connecting rod bearing clearance (Big end) Connecting rod bushing clearance (Small end)	EM-66, "Connect-ing Rod Bearing (Big End)", EM-67, "CON-NECTING ROD BUSHING CLEAR-ANCE (SMALL END)"
	Knock	A	B	—	A	B	C	Main bear-ing noise	Main bearing oil clearance Crankshaft runout	EM-64, "Main bear-ing", EM-63, "CRANK-SHAFT"

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When start-ing	When idling	When racing	While driv-ing			
Front of Engine Timing Chain Cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain ten-sioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-28, "Inspec-tion"
Front of Engine	Squeak or fizzing	A	B	—	B	—	C	Other drive belts (stick-ing or slip-ping)	Drive belts deflection	MA-15, "Checking Drive Belts"
	Creaking	A	B	A	B	A	B	Other drive belts (slip-ping)	Idler pulley bearing opera-tion	
	Squall or creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-11, "Inspec-tion"

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


Camshaft bearing noise
Tappet noise
VALVE MECHANISM
Valve
Timing chain
and chain
tensioner niose
TIMING CHAIN
Water pump noise
Piston pin noise
ROTATION
MECHANISM
DRIVE BELT
Piston slap noise
Connecting rod
bearing noise
Main bearing noise
WBIA0061E

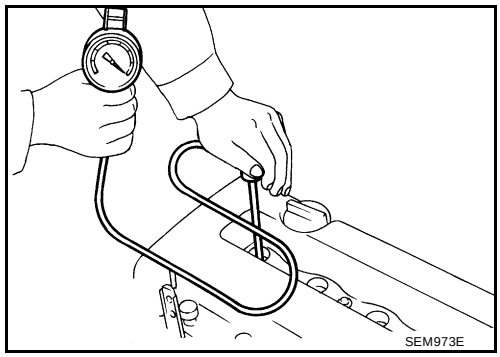
BASIC INSPECTION

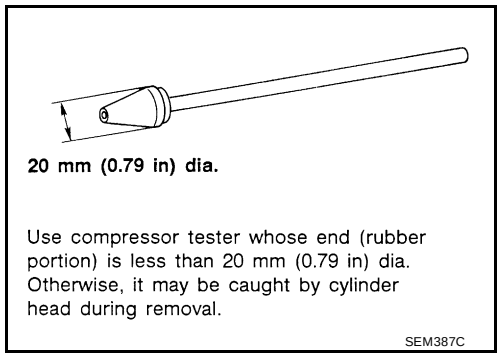
PFP:00013

Measurement of Compression Pressure

EBS0068Z

1. Warm up the engine.
2. Turn the ignition switch OFF.
3. Release the fuel pressure.
   Refer to EC-58, "FUEL PRESSURE RELEASE" [QG18DE (except Calif. CA Model)], or EC-623, "FUEL PRESSURE RELEASE" [QG18DE (Calif. CA Model)].
4. Remove the ignition coils.
5. Remove the spark plugs.
   - Clean the area around the spark plug with compressed air before removing the spark plug.
6. Attach a compression tester to No. 1 cylinder.





7. Depress the accelerator pedal fully to keep the throttle valve wide open.
8. Crank the engine and record highest gauge indication.
9. Repeat the measurement on each cylinder as shown above.
   - Always use a fully-charged battery to obtain specified engine speed.

Compression pressure	**: kPa (bar, kg/cm^2 , psi)/rpm**
Standard	**: 1,324 (13.24, 13.5, 192)/350**
Minimum	**: 1,157 (11.57, 11.5, 168)/350**
Maximum allowable difference between cylinders	**: 98 (0.98, 1.0, 14)/350**

10. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and retest compression.
    - If adding oil improves cylinder compression, piston rings may be worn or damaged. If so, replace piston rings after checking the piston and cylinder walls.
    - If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. Refer to EM-50, "CHECKING" , EM-44, "VALVE SEATS" . If valve or valve seat is damaged excessively, replace them.
    - If compression in any two adjacent cylinders is low and if adding oil does not improve compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.
11. Install spark plugs, ignition coils and fuel pump fuse.

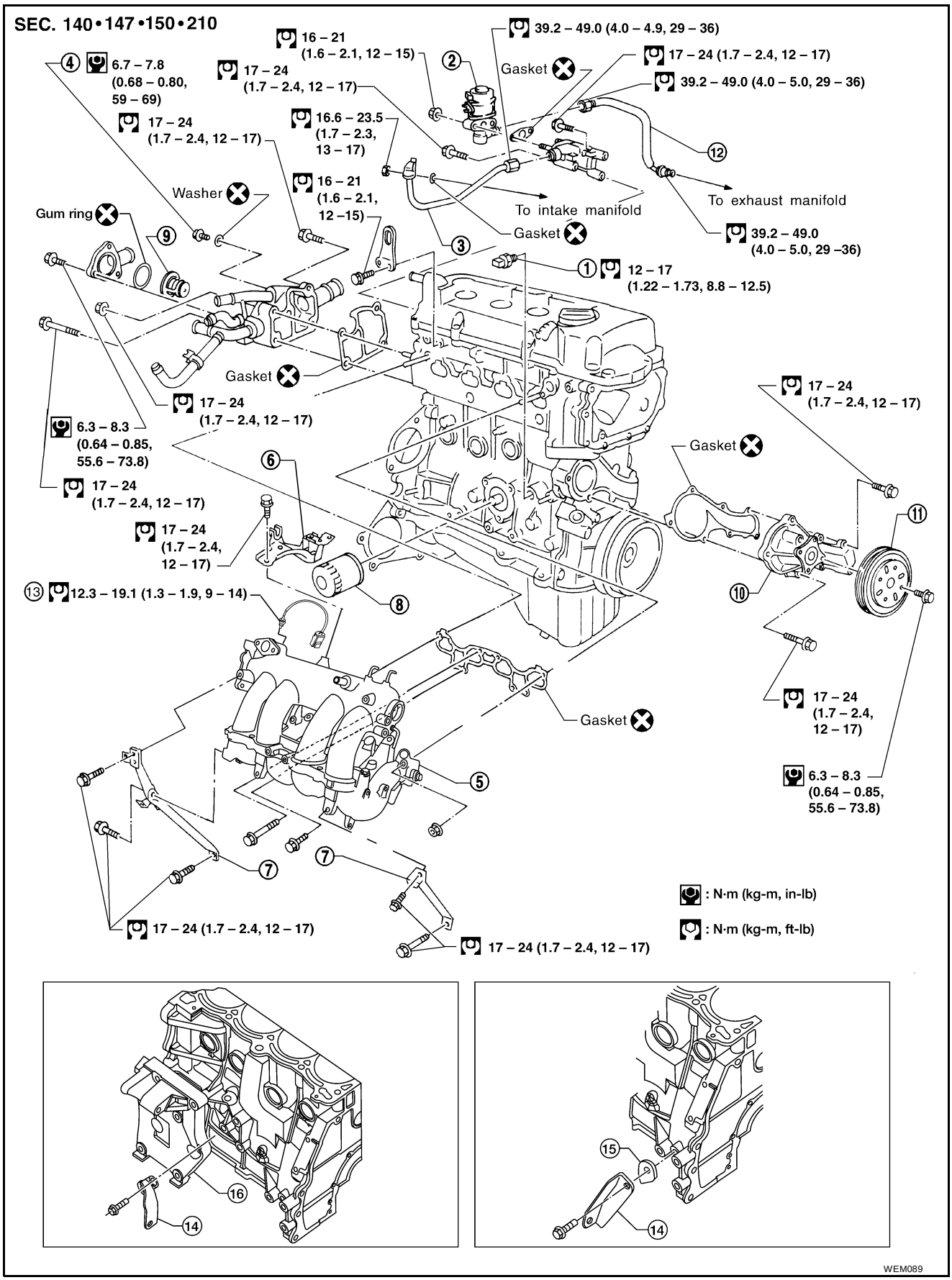
12. Erase DTC if any DTC appears. Refer to EC-73, "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION" [QG18DE (except Calif. CA Model)], or EC-637, "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION" [QG18DE (Calif. CA Model)].

OUTER COMPONENT PARTS

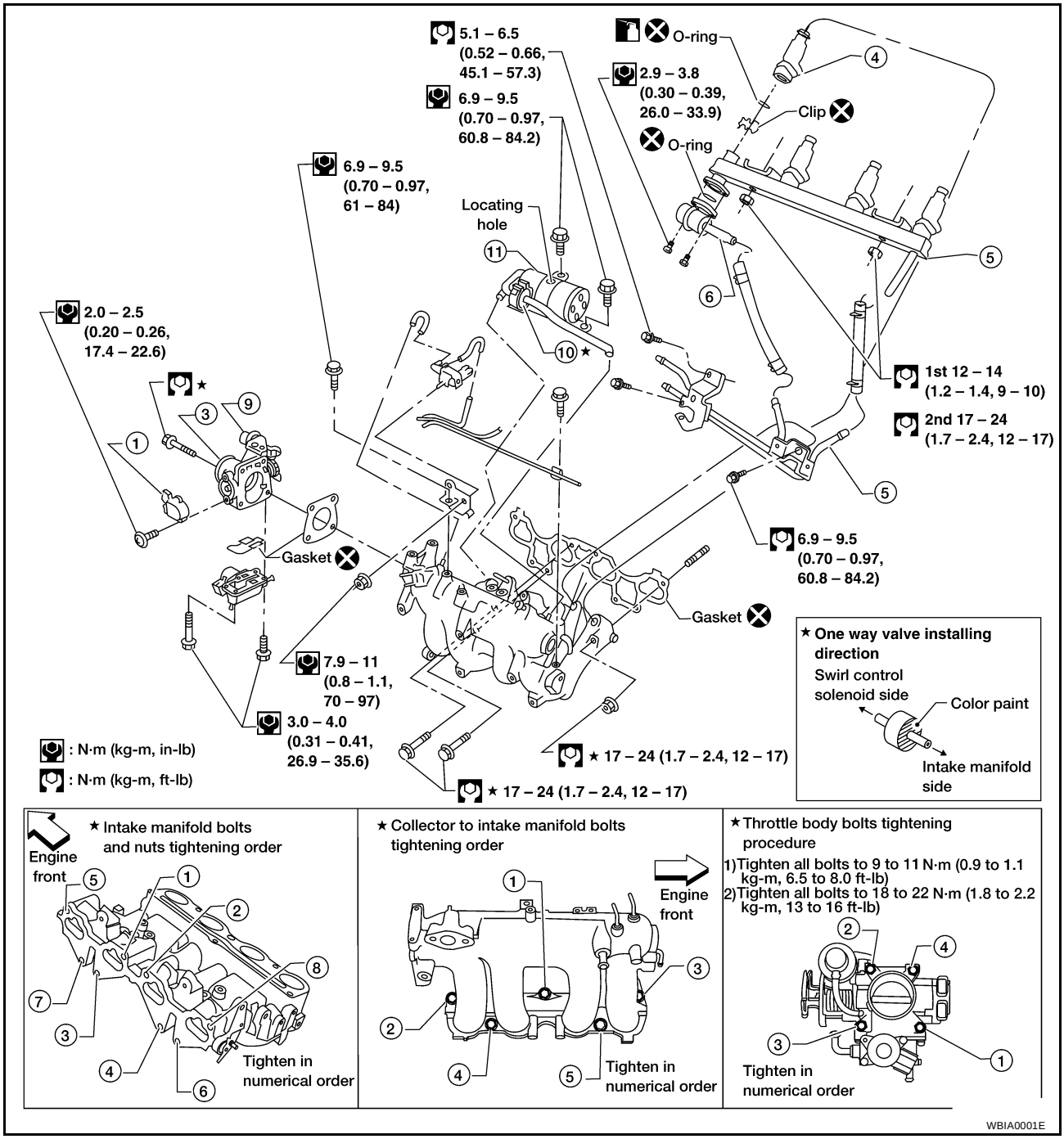
PFP:00100

Removal and Installation

EBS00690

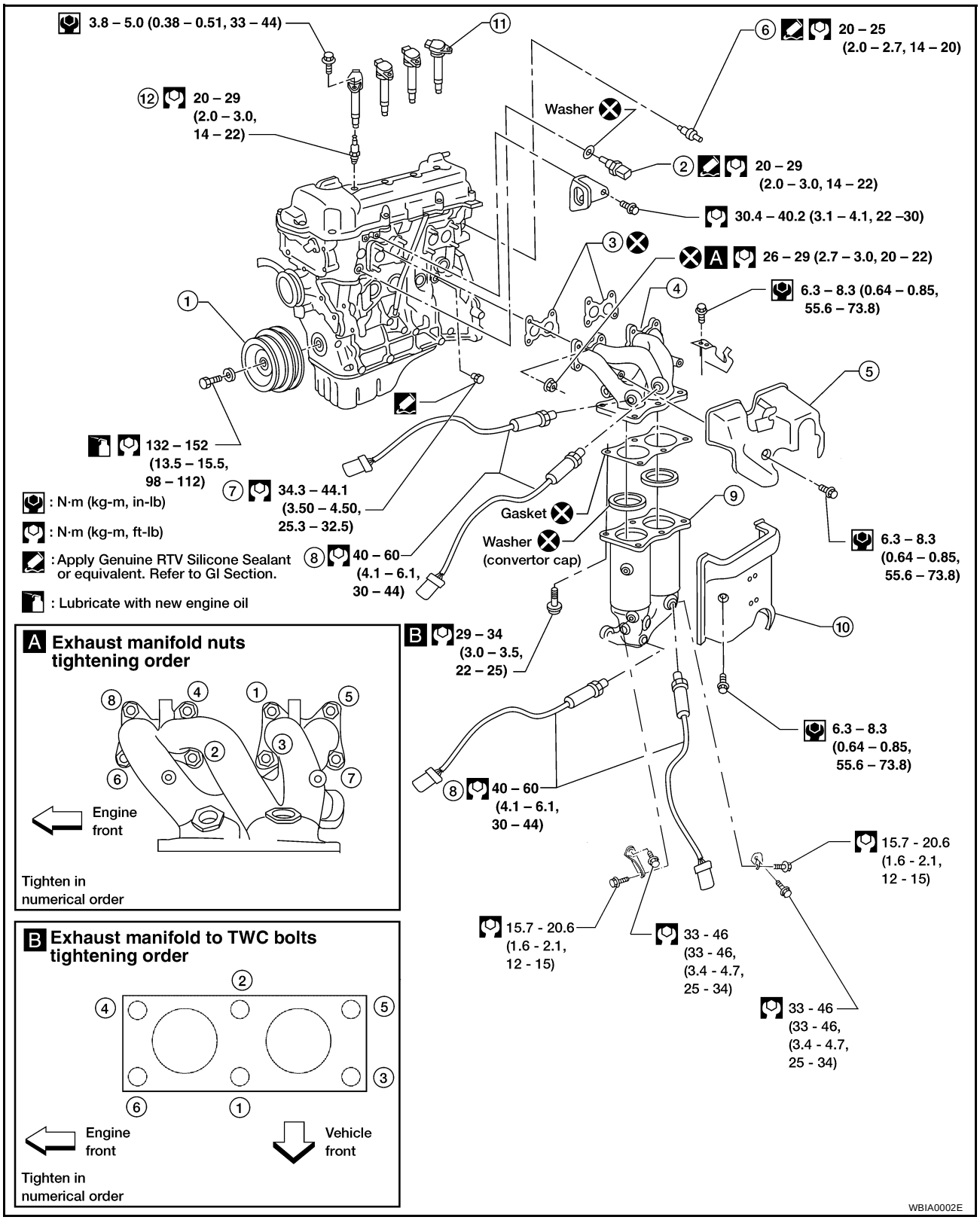


1. Oil pressure switch
2. EGR valve
3. EGR guide tube
4. Air relief plug
5. Intake manifold
6. Intake manifold upper support
7. Intake manifold rear supports
8. Oil filter
9. Thermostat
10. Water pump
11. Water pump pulley
12. EGR tube
13. EGR temperature sensor
14. Support container
15. Transmission gusset
16. Component bracket



1. Throttle position sensor
2. IACV-AAC valve
3. Throttle body
4. Injector
5. Injector tube
6. Pressure regulator
7. Intake manifold
8. Canister purge control valve
9. Throttle opener
10. One way valve
11. Vacuum tank

QG18DE (EXCEPT CALIF. CA MODEL)

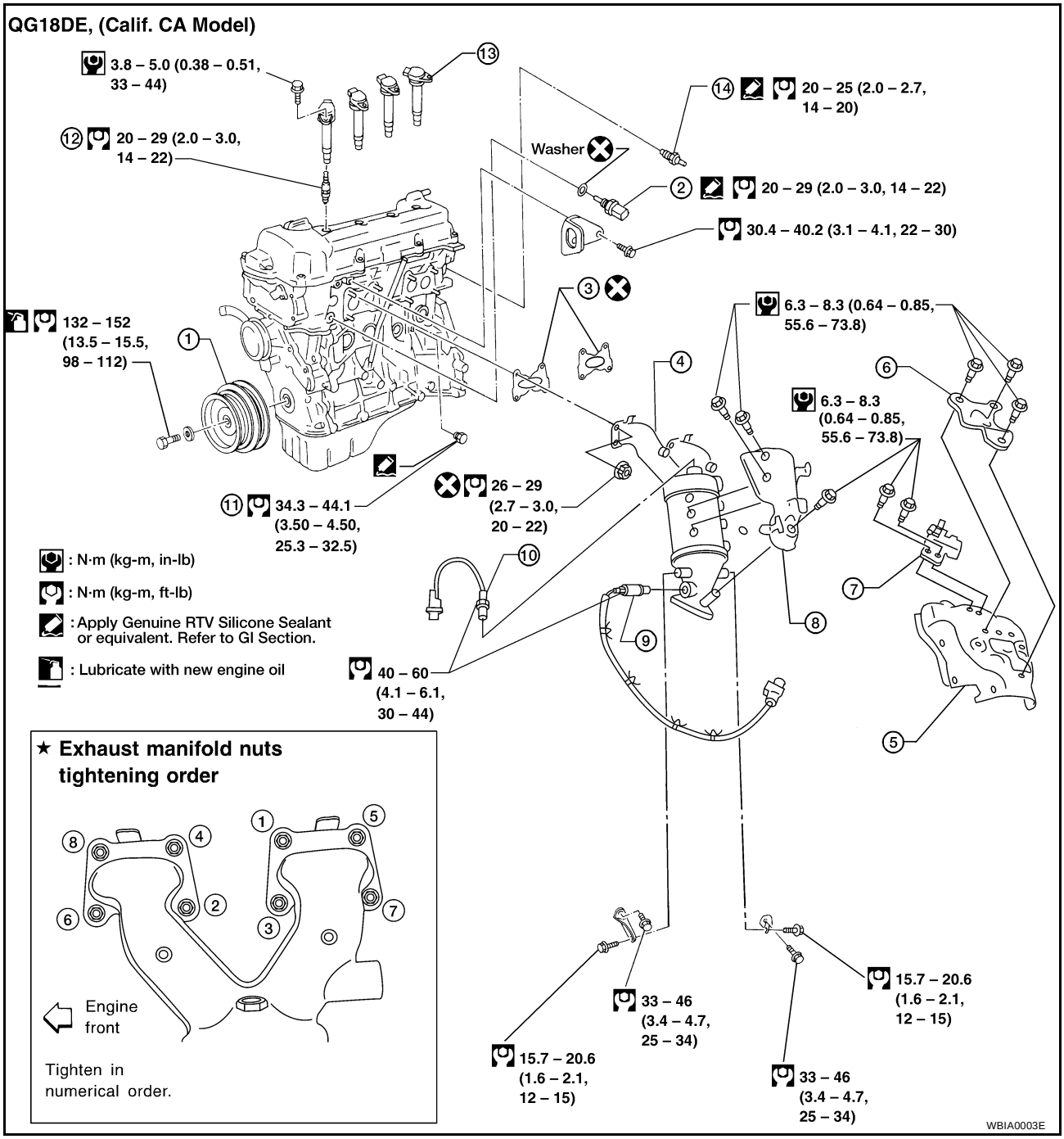


1.	Crankshaft pulley	2.	Engine coolant temperature sensor	3.	Gasket
4.	Exhaust manifold	5.	Exhaust manifold cover	6.	Thermal transmitter
7.	Water drain plug	8.	Heated oxygen sensor	9.	TWC (manifold)
10.	Converter cover	11.	Ignition coil	12.	Spark plug

QG18DE (CALIF. CA MODEL)

CAUTION:

If the Calif. CA Model's TWC (manifold three way catalyst) or ADS-TWC (adsorber pre-catalyst) replacement is necessary, always replace the TWC together with the ADS-TWC. Never replace these catalysts individually. The TWC and the ADS-TWC are only available together as a kit.



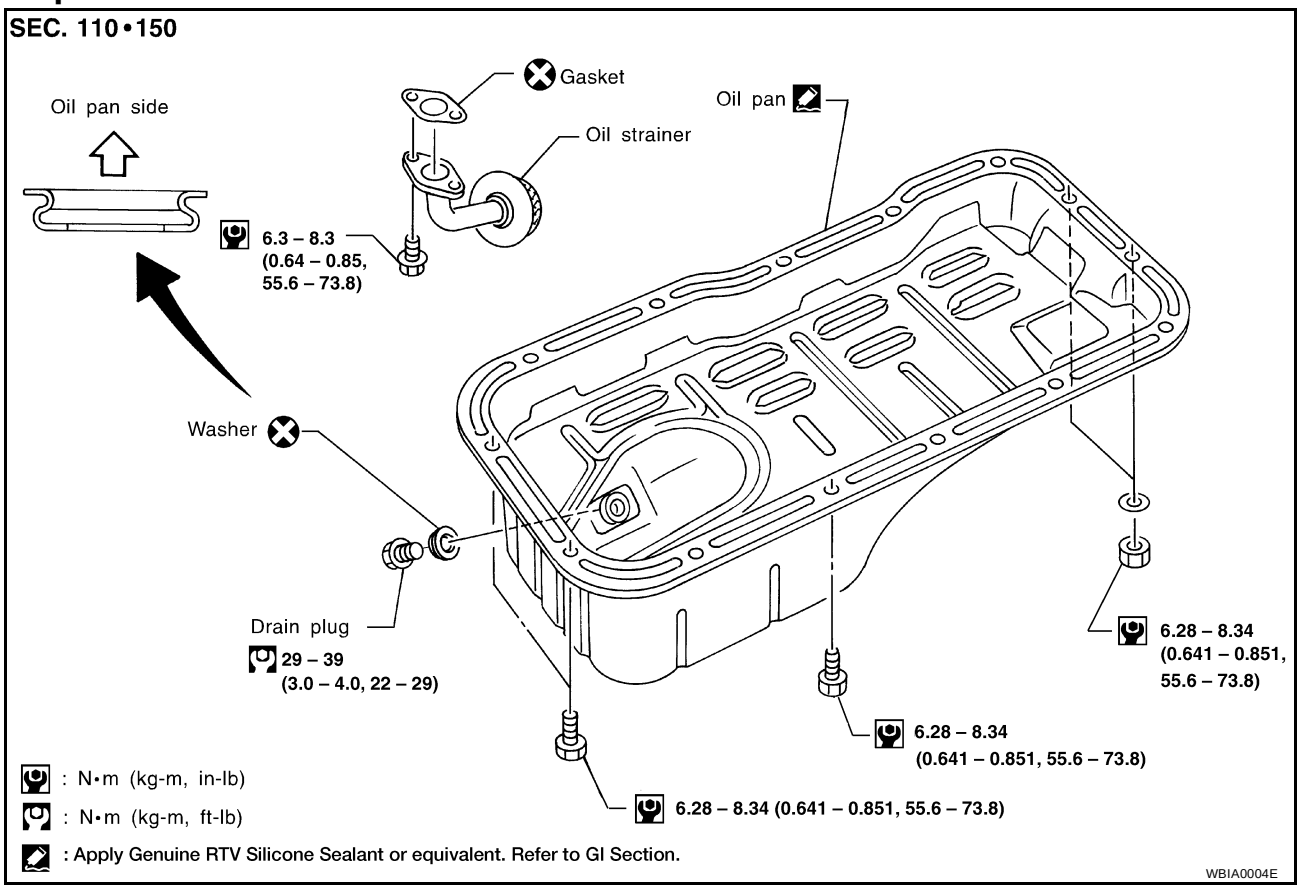
1. Crankshaft pulley	2. Engine coolant temperature sensor	3. Gasket
4. TWC (manifold)	5. TWC manifold cover	6. Air fuel ratio sensor cover
7. Sensor wire bracket	8. TWC cover	9. Heated oxygen sensor 1 (front)
10. Air fuel ratio (A/F) sensor 1	11. Water drain plug	12. Spark plug
13. Ignition coil	14. Thermal transmitter	

OIL PAN

PFP:11110

Components

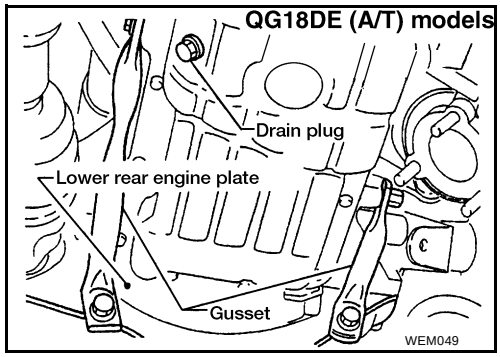
EBS00691

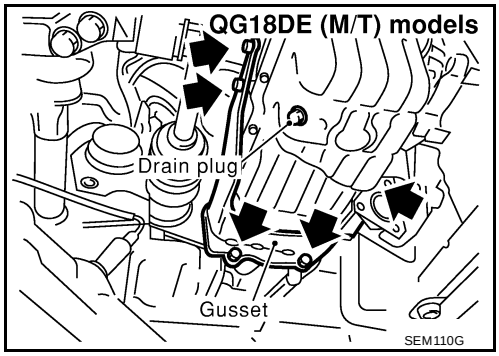


Removal

EBS00692

1. Remove engine RH side undercover splash shield.
2. Drain engine oil.
3. Remove front exhaust tube.
   Refer to EX-3, "Removal and Installation" .
4. Remove the exhaust manifold support.
5. Remove the engine gusset.





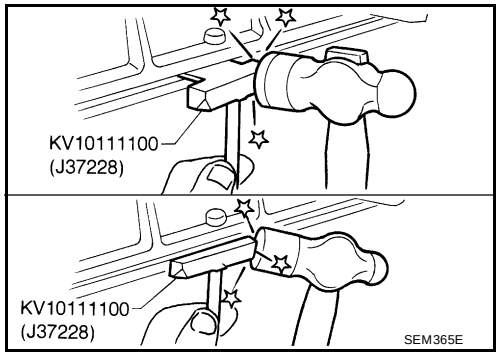
6. Remove rear plate cover (A/T models).
7. Remove oil pan.

a. Insert Tool between cylinder block and oil pan.

CAUTION:

- **Be careful not to damage aluminum mating face.**
- **Do not insert screwdriver, or oil pan flange will be damaged.**

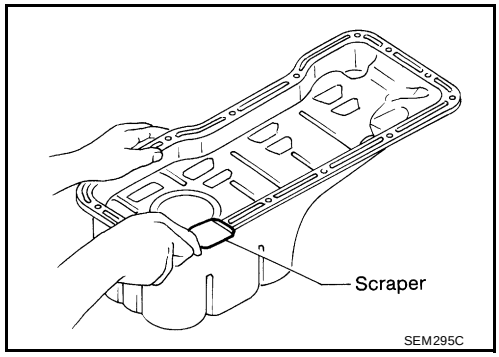
b. Slide Tool by tapping on the side of the Tool with a hammer.



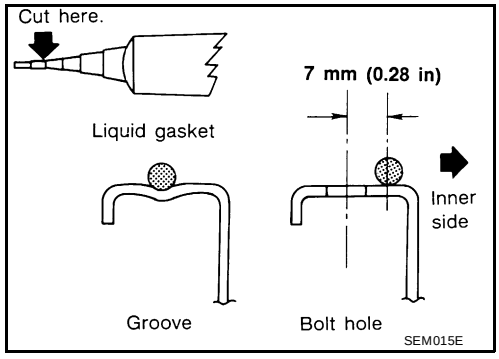
Installation

EBS00693

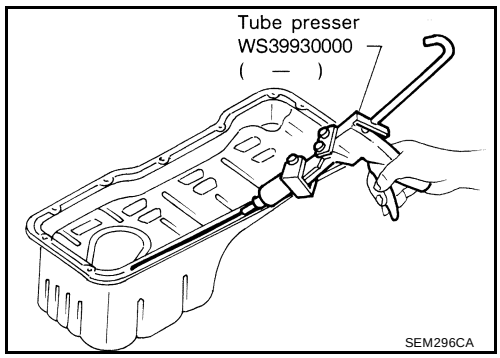
1. Use a scraper to remove old liquid gasket from mating surface of oil pan.
   - Also remove old liquid gasket from mating surface of cylinder block.



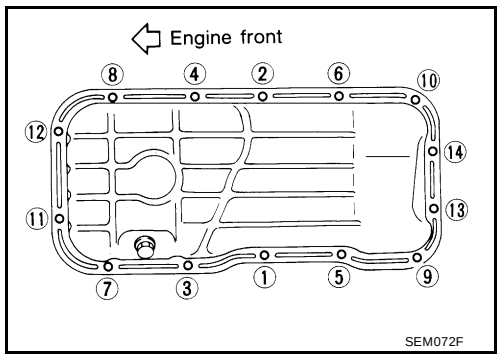
2. Apply a continuous bead of liquid gasket to mating surface of oil pan.
   - Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
   - Apply to groove on mating surface.
   - Allow 7 mm (0.28 in) clearance around bolt holes.



- Be sure the liquid gasket diameter is 3.5 to 4.5 mm (0.138 to 0.177 in).
- Installation should be done within 5 minutes after applying the liquid gasket.



3. Install oil pan.
   - Tighten oil pan nuts and bolts to specification, in the numerical order as shown.
   - Wait at least 30 minutes before refilling engine oil.



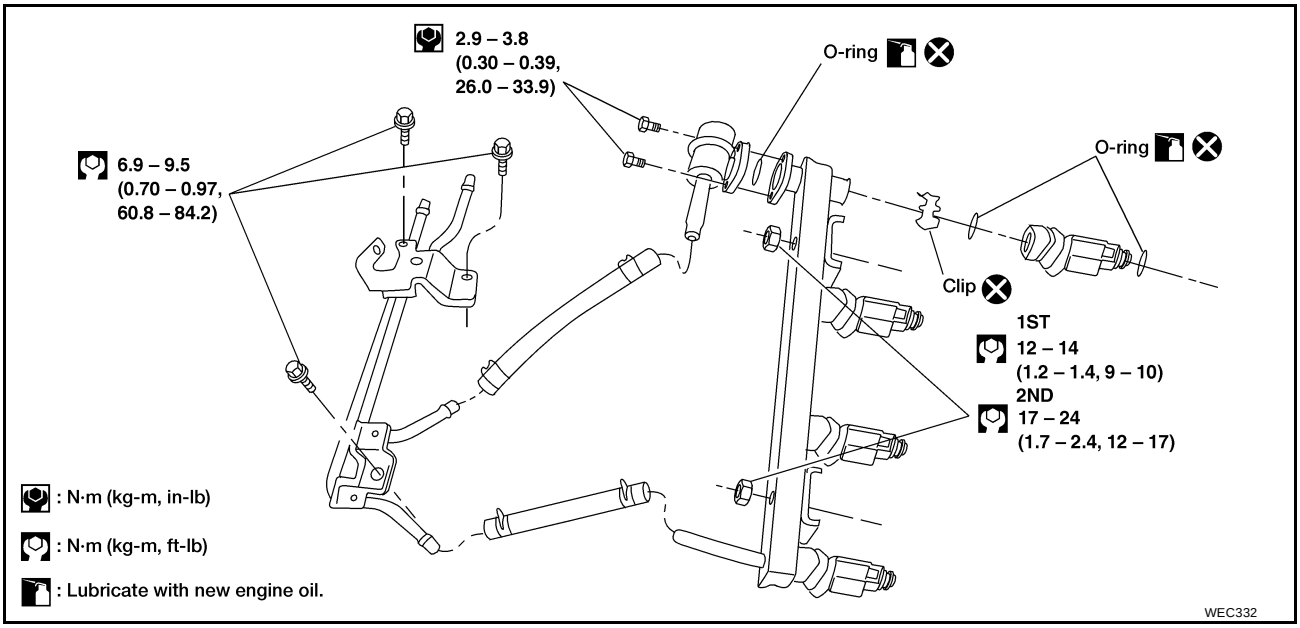
4. Install parts in reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Removal and Installation

EBS00694



CAUTION:

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

REMOVAL

1. Release the fuel pressure. Refer to EC-58, "FUEL PRESSURE RELEASE" (except Calif. CA), EC-623, "FUEL PRESSURE RELEASE" (Calif. CA).
2. Disconnect the accelerator cable and speed control cable (if equipped) from the throttle body.
3. Disconnect the intake manifold bracket.

   CAUTION:

   - **Prepare a container and a cloth to catch any spilled fuel.**
   - **This operation should be performed in a place free from any open flames.**
   - **While hoses are disconnected seal their openings with vinyl bag or similar material to prevent foreign material from entering them.**
4. Remove the PCV hose and bracket.
5. Disconnect the sub-harness for the fuel injectors.
6. Disconnect the fuel pressure regulator vacuum hose from the intake manifold collector.
7. Disconnect the fuel hoses from the fuel tube assembly.
8. Remove the fuel injectors from the fuel tube, as follows:
   - Release the clip, and remove the fuel injector.
   - Pull the fuel injector straight out of the fuel tube.
   - Be careful not to damage the nozzle.
   - Avoid any impact, such as dropping the fuel injector.
   - Do not disassemble or adjust the fuel injector.

INSTALLATION

1. Installation is in the reverse order of removal.

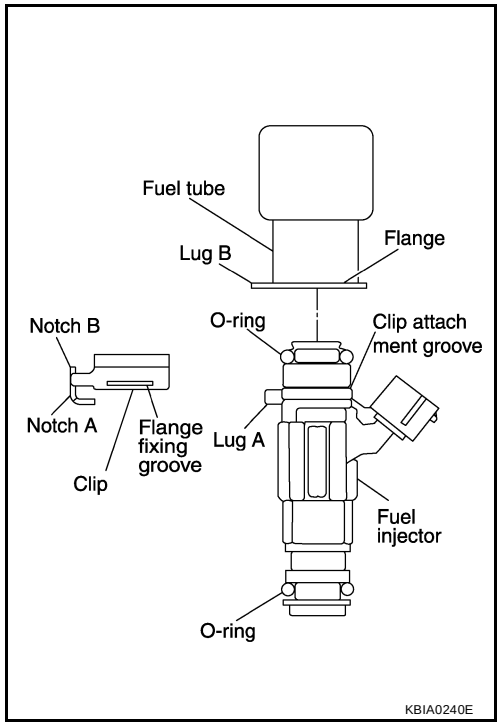
   CAUTION:

   - **Install new O-rings on the fuel injectors and the fuel pressure regulator.**
   - **Lubricate the new O-rings lightly with new engine oil.**
   - **Be careful not to scratch the injector during installation. Also be careful not to twist or stretch the O-ring. If the O-ring was stretched while it was installed, do no insert it into the fuel tube immediately.**

a. Install the fuel injector into the fuel tube with the following procedure:
   - Do not reuse the clip, replace it with a new one.
   - Insert the clip into the clip mounting groove on the fuel injector.
   - Insert clip so that projection A of fuel injector matches notch A of the clip.

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

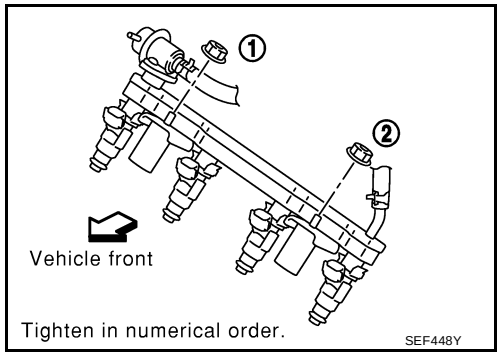
c. Install the fuel tube assembly with the following procedure:
   - Insert the tip of each fuel injector into the intake manifold.



   - Tighten the fuel tube mounting bolts in two stages in the numerical order shown.

Stage 1 : 12 - 13 N·m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)
Stage 2 : 17 - 23 N·m (1.7 - 2.4 kg-m, 13 - 17 ft-lb)

CAUTION:
- **After properly connecting fuel tube assembly to injector and fuel hose, check connection for fuel leakage.**



INSPECTION AFTER INSTALLATION

1. Start the engine and run it for a few minutes at idle.
2. Stop the engine and check for fuel leakage both visually and by odor of gasoline.

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

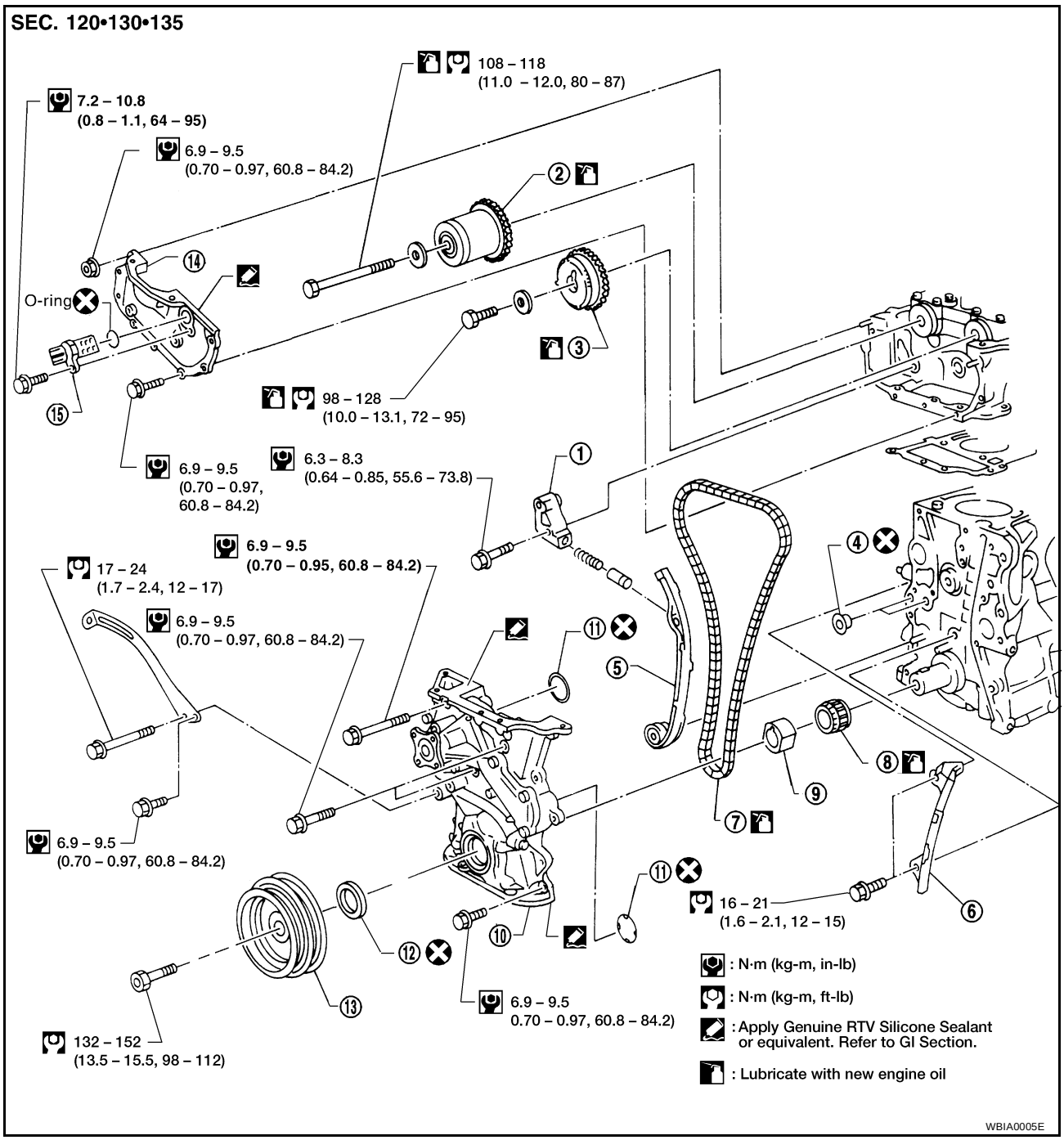
NOTE:
Use mirrors for checking for leaks at hard to see points of the fuel system.

TIMING CHAIN

PFP:13028

Components

EBS00695



1.	Chain tensioner	2.	Camshaft sprocket (Intake)	3.	Camshaft sprocket (Exhaust)
4.	O-ring	5.	Slack side timing chain guide	6.	Timing chain tension guide
7.	Timing chain	8.	Crankshaft sprocket	9.	Oil pump drive spacer
10.	Front cover	11.	O-ring	12.	Oil seal
13.	Crankshaft pulley	14.	Cylinder head front cover	15.	Camshaft position sensor (PHASE)

CAUTION:

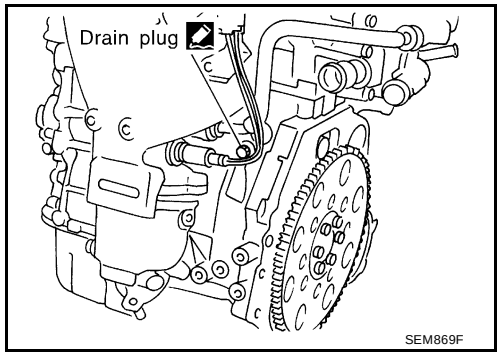
- **After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.**
- **When installing chain tensioner, oil seats, or other sliding parts, lubricate contacting surfaces with new engine oil.**

- **Apply new engine oil to bolt threads and seat surfaces when installing camshaft sprocket and crankshaft pulley.**
- **When removing oil pump assembly, remove camshaft position sensor (PHASE), then remove timing chain from engine.**
- **Be careful not to damage sensor edges.**

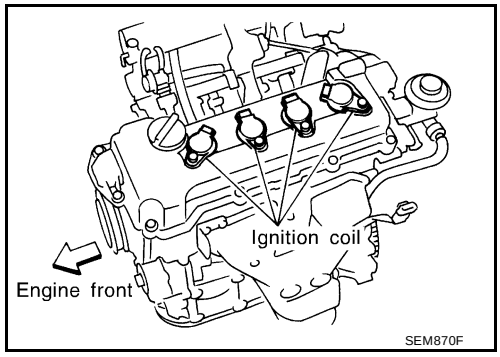
Removal

EBS00696

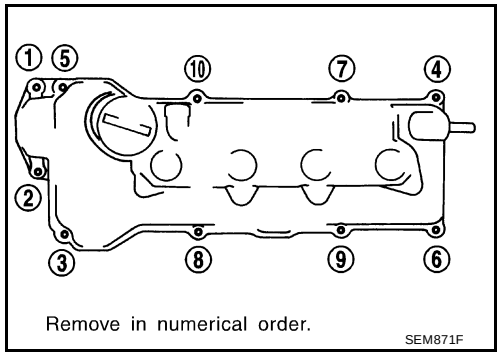
1. Drain engine coolant.
   Be careful not to spill coolant on drive belts.
2. Remove the following belts.
   - Power steering pump drive belt
   - Alternator drive belt
3. Remove front RH wheel.
4. Remove front/right-side splash undercover.
5. Remove front exhaust tube.
6. Disconnect vacuum hoses for:
   - EVAP canister
   - Brake power booster
   - Fuel pressure regulator



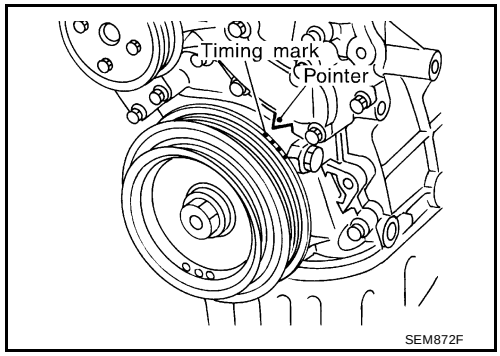
7. Remove ignition coils.
8. Remove spark plugs.



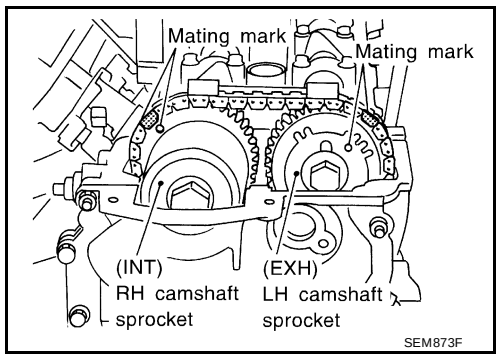
9. Remove rocker cover bolts in numerical order as shown in the figure.



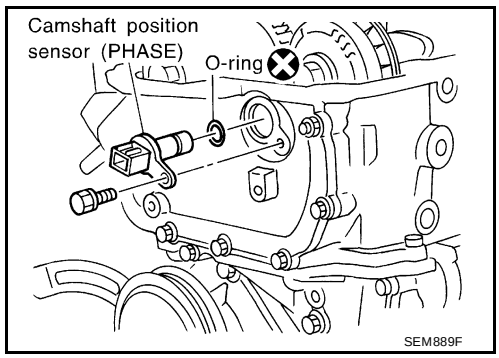
10. Set No. 1 piston at TDC on its compression stroke.



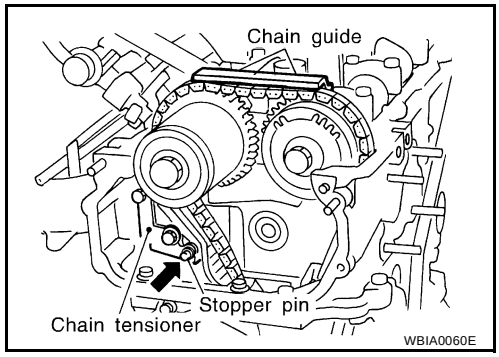
- Rotate crankshaft until mating mark on camshaft sprocket is set at position indicated in figure.



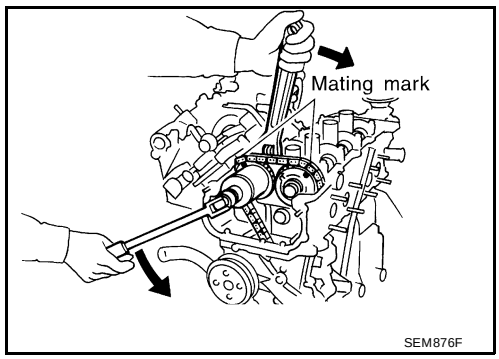
11. Remove camshaft position sensor (PHASE).
    - Do not allow any magnetic materials to contact the camshaft position sensor (PHASE).
    - Be careful not to damage sensor.
12. Remove cylinder head front cover.



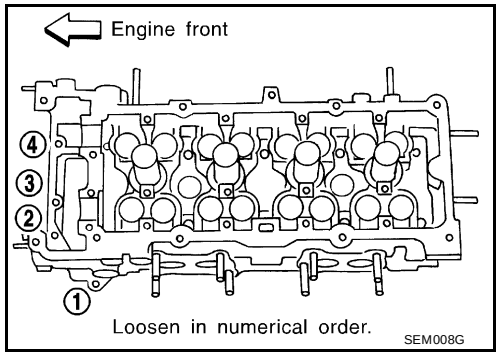
13. Remove timing chain guide from camshaft bracket.
14. Attach a suitable stopper pin to chain tensioner.
15. Remove chain tensioner.



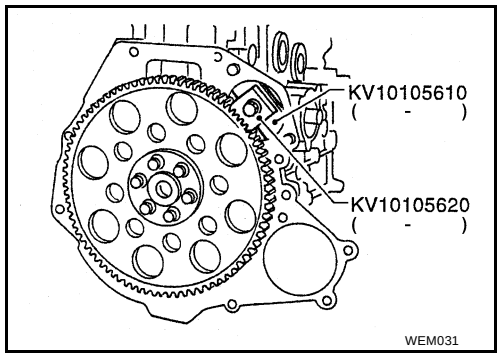
16. Remove camshaft sprocket bolts.
    - Apply paint to timing chain and cam sprockets for alignment during installation.
17. Remove camshaft sprockets.



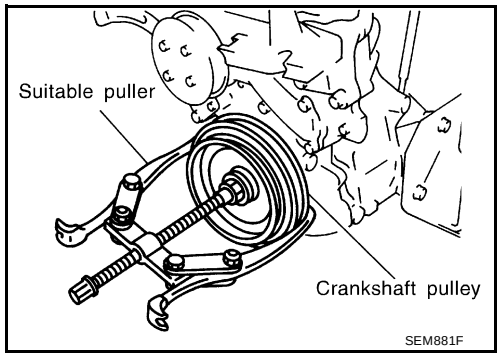
18. Remove cylinder head bolts at engine front side as shown.
19. Remove the oil pan. Refer to EM-19, "Removal" .



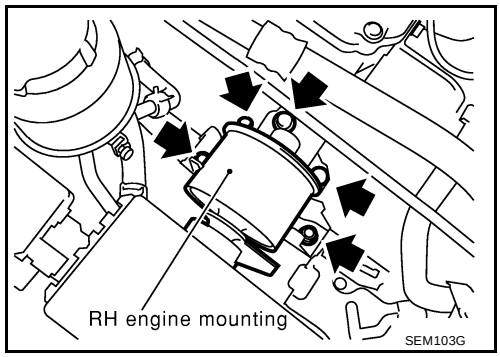
20. Remove starter motor, and set ring gear stopper using mounting bolt holes.



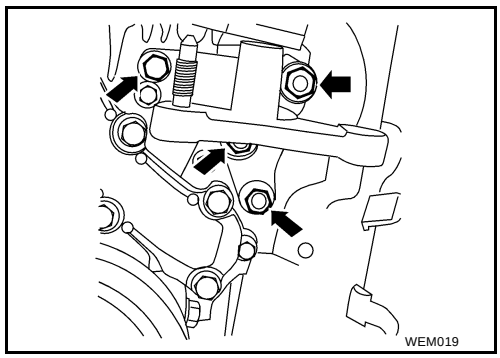
21. Remove crankshaft pulley bolt.
22. Remove crankshaft pulley with a suitable puller.
23. Support engine with a suitable hoist or jack.



24. Remove RH engine mounting.



25. Remove RH engine mounting bracket.
26. Remove idler pulley and bracket.

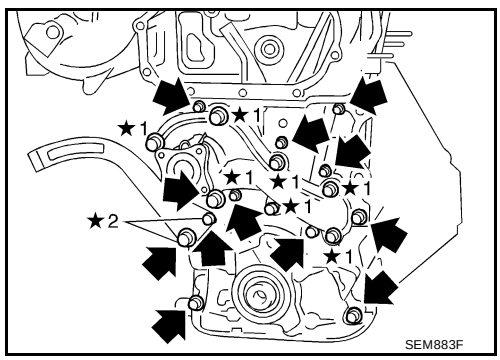


27. Remove water pump pulley and water pump.
28. Remove front cover bolts and front cover as shown.

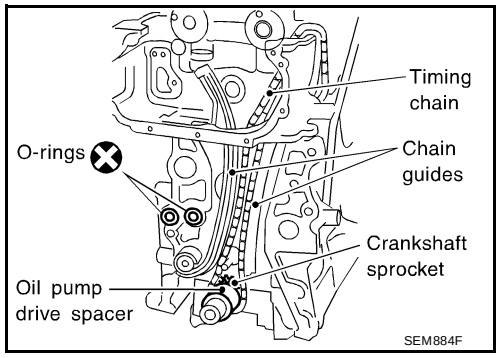
Bolt No. 1 : located on the water pump, removed to remove the water pump

Bolt No. 2 : located on the power steering pump adjusting bar, removed to remove the bar

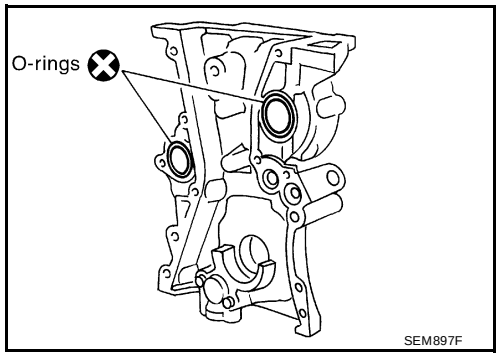
- Inspect for oil leakage at front oil seal. Replace the seal if any oil leak is present.



29. Remove timing chain.
30. Remove oil pump drive spacer.
31. Remove chain guides.
32. Remove crankshaft sprocket.



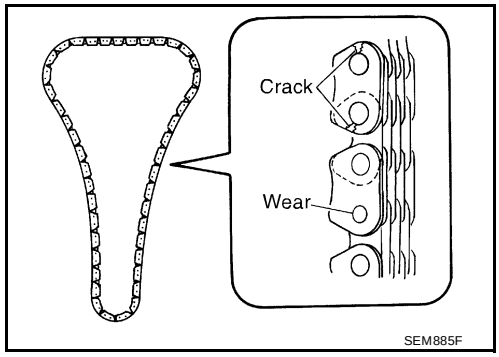
33. Remove O-rings from cylinder block and front cover.



Inspection

EBS00697

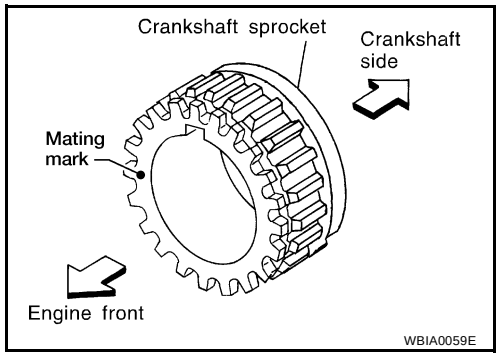
Check for cracks and excessive wear at roller links. Replace if necessary.



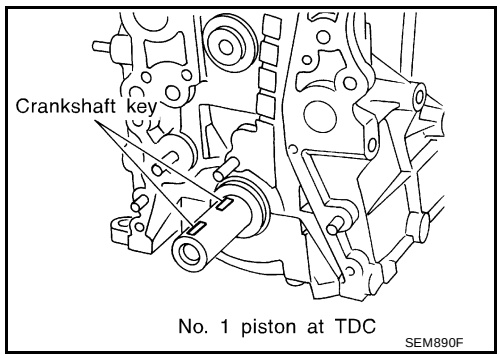
Installation

EBS00698

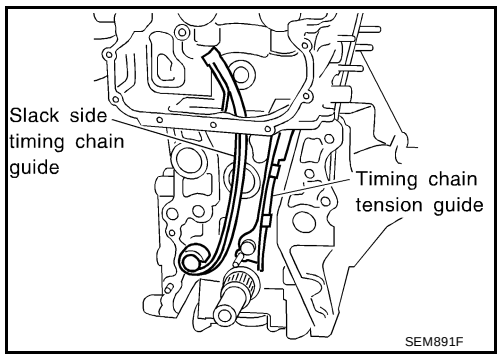
1. Install crankshaft sprocket on crankshaft.
   - Make sure mating marks on crankshaft sprocket face front of engine.



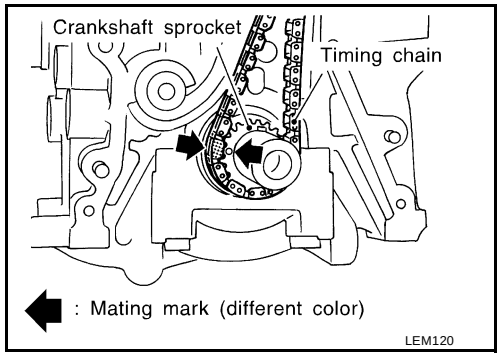
2. Position crankshaft so that No. 1 piston is at TDC and crankshaft key is at 12 o'clock.



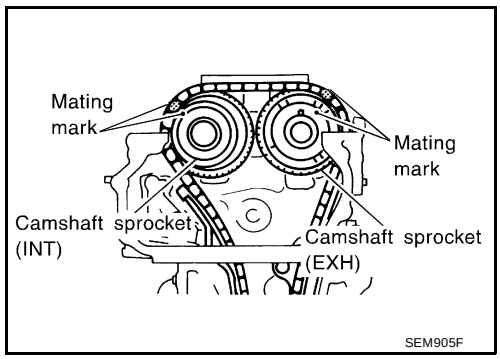
3. Install slack side timing chain guide and timing chain tension guide.



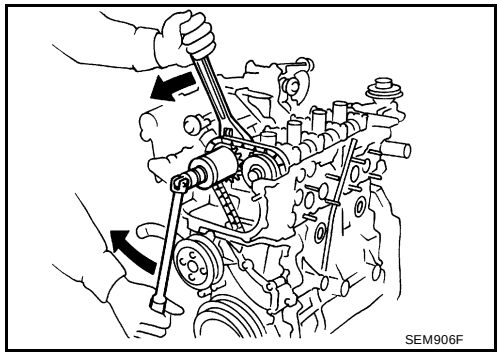
4. Install timing chain on crankshaft sprocket.
   - Set timing chain by aligning its mating mark with that on the crankshaft sprocket.
   - Make sure sprocket's mating mark faces engine front.



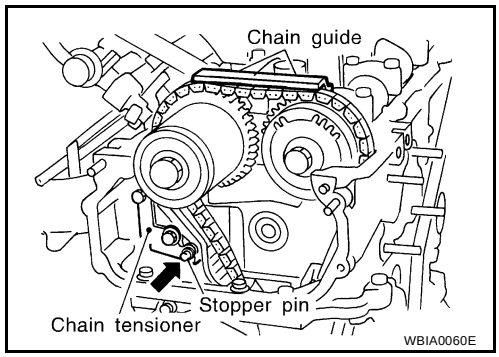
5. Install camshaft sprockets.
   - Set timing chain by aligning mating marks with those of camshaft sprockets.



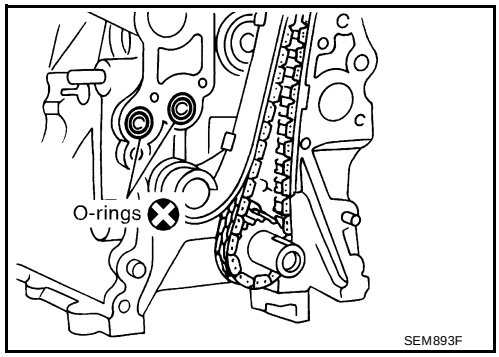
6. Install camshaft sprocket bolts to correct torque.
   - Apply new engine oil to bolt threads and seat surface.



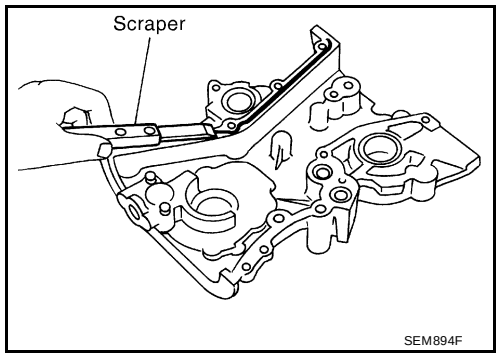
7. Install chain tensioner.
   - Before installing chain tensioner, insert a suitable pin into pin hole of chain tensioner.
   - After installing chain tensioner, remove the pin.
8. Install timing chain guide.



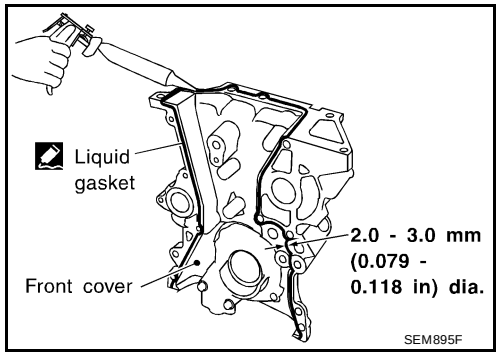
9. Install O-rings to cylinder block.



10. Before installing front cover, remove all traces of RTV silicone sealant from mating surface using a scraper.
    - Also remove traces of RTV silicone sealant from mating surface of cylinder block.



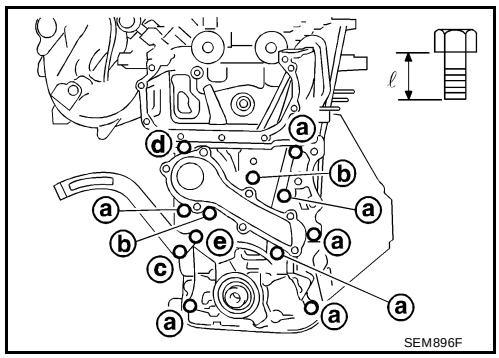
11. Apply a continuous bead of Genuine RTV Silicone Sealant or equivalent to mating surface of front cover. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS".
    - Check alignment of mating marks on chain and crankshaft sprocket.
    - Align oil drive spacer with oil pump.
    - Place timing chain to the side of chain guide. This prevents the chain from making contact with water seal area of front cover.



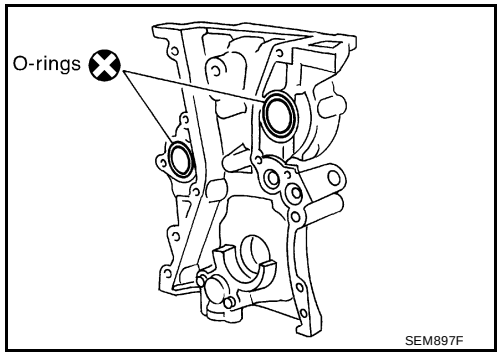
12. Install front cover.

Bolt No.	Tightening torque N·m (kg-m, in-lb)	"L" mm (in)
a	6.9 - 9.5 (0.70 - 0.97, 61 - 84)	20 (0.79)
b	6.9 - 9.5 (0.70 - 0.97, 61 - 84)	40 (1.57)
c	17 - 24 (1.7 - 2.4, 148 - 208*)	70 (2.76)
d	6.9 - 9.5 (0.70 - 0.97, 61 - 84)	72.8 (2.866)
e	6.9 - 9.5 (0.70 - 0.97, 61 - 84)	12 (0.47)

*: 12 - 17 ft-lb

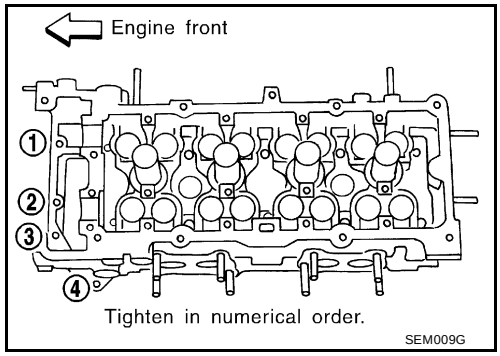


- Make sure two O-rings are present.
- Be careful not to damage oil seal when installing front cover.

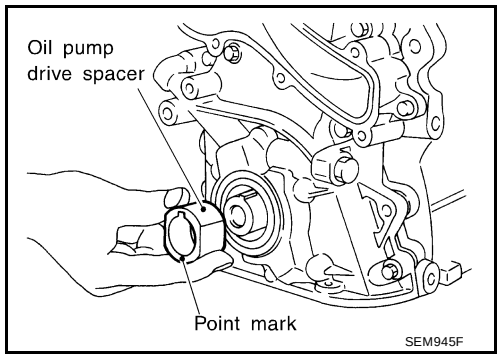


13. Install cylinder head bolts at engine front side as shown.
    - Tightening procedure:

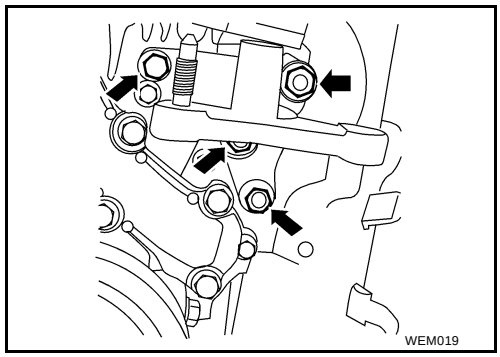
    Bolts No. 1 - 4 : 6.3 - 8.3 N·m (0.64 - 0.85 kg-m, 55.8 - 73.5 in-lb)



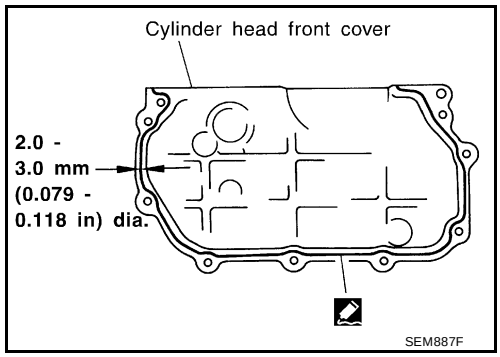
14. Install oil pump drive spacer.
15. Install water pump and water pump pulley.
    Refer to CO-10, "Removal and Installation" .
16. Install idler pulley and bracket.



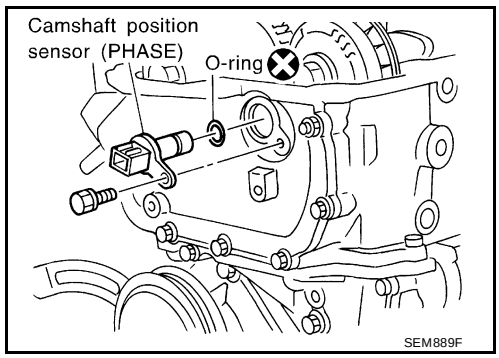
17. Install RH engine mounting bracket.
18. Install RH engine mounting.
19. Install oil pan. Refer to EM-20, "Installation" .
20. Install crankshaft pulley.
21. Remove ring gear stopper.
22. Install starter motor.



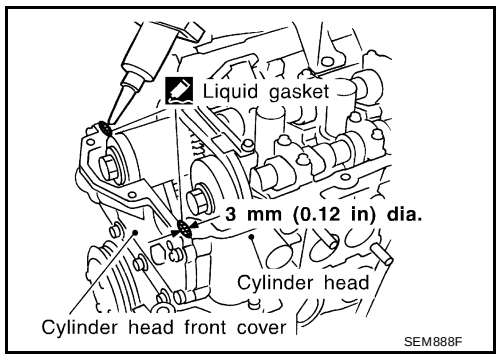
23. Install cylinder head front cover.
    - Apply RTV silicone sealant to cylinder head front cover.
    - Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



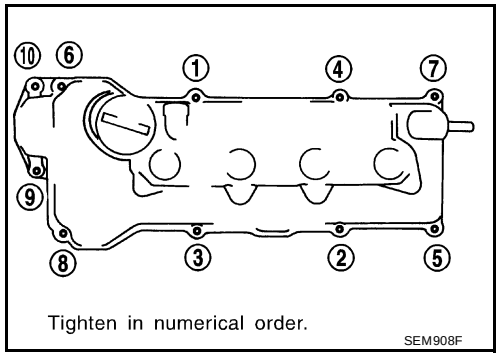
24. Install camshaft position sensor (PHASE).



25. Before installing rocker cover, apply a bead of Genuine RTV Silicone Sealant or equivalent, to mating surface of cylinder head as shown. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
26. Install rocker cover gasket into rocker cover.



27. Install the rocker cover and tighten the bolts in the numerical order as shown.
28. Install spark plugs.
29. Install ignition coils.
30. Install front exhaust tube.
31. Install front/right-side splash undercover.
32. Install front RH wheel.
33. Install drive belts.
    Adjusting drive belt deflection. Refer to MA-15, "Checking Drive Belts" .
34. Installation of the remaining parts is in reverse order of removal.



OIL SEAL

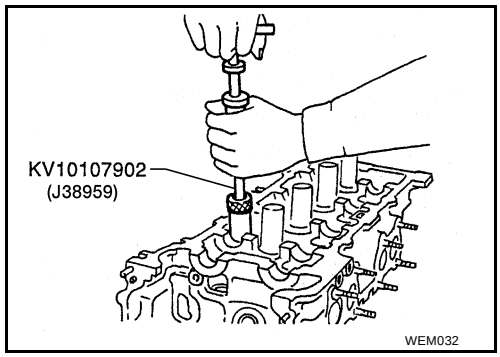
PFP:00100

Replacement

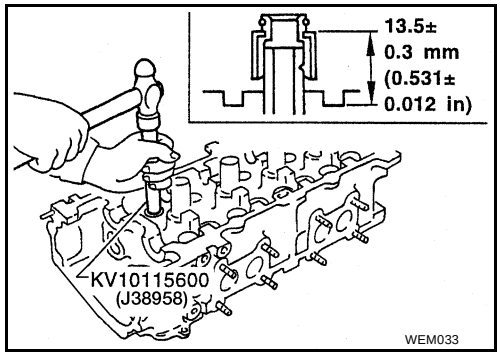
EBS00699

VALVE OIL SEAL

1. Remove rocker cover.
2. Remove camshaft.
3. Remove valve spring. Refer to EM-39, "Disassembly" .
4. Remove valve oil seal with Tool.
   Piston concerned should be set at TDC to prevent valve from falling into combustion chamber.

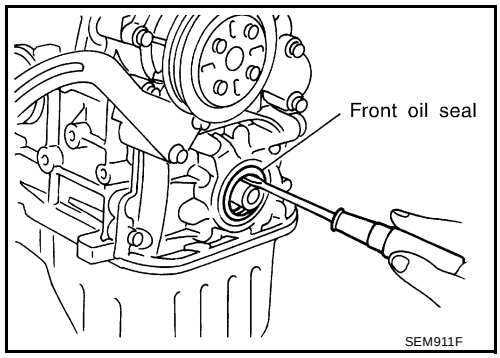


5. Apply new engine oil to new valve oil seal and install it with Tool.

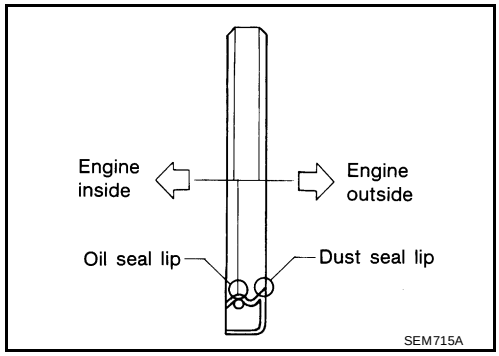


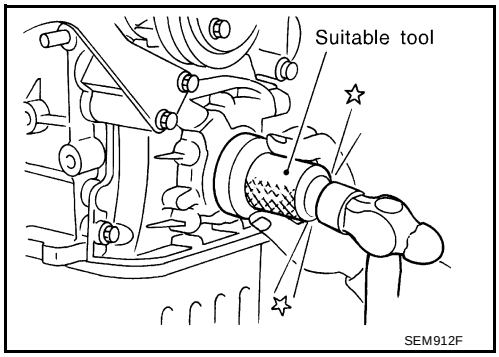
FRONT OIL SEAL

1. Remove the following parts:
   - Engine under cover
   - RH engine side cover
   - Generator and power steering drive belts
   - Crankshaft pulley
2. Remove front oil seal from front cover.
   - Be careful not to scratch front cover.



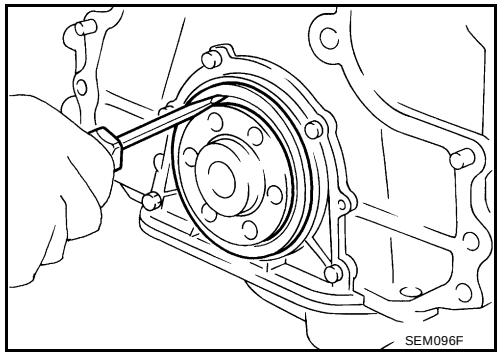
3. Apply new engine oil to new oil seal and install it using a suitable tool.
   - Install new oil seal in the direction shown.



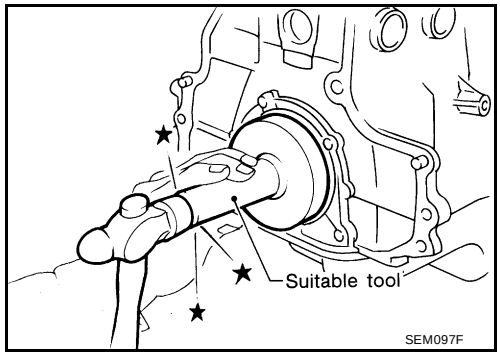


REAR OIL SEAL

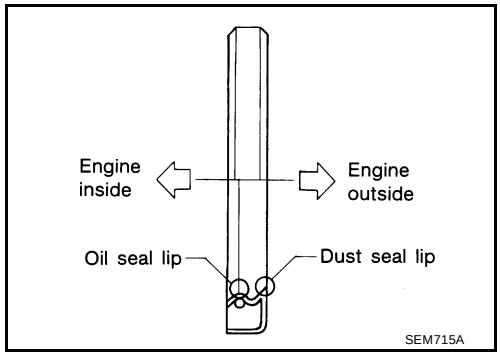
1. Remove the transaxle. Refer to MT-16, "Removal and Installation" (RS5F70A), MT-80, "Removal and Installation" (RS5F51A), MT-139, "Removal and Installation" (RS6F51H), or AT-266, "REMOVAL AND INSTALLATION" (RE4F03B), AT-663, "REMOVAL AND INSTALLATION" (RE4F04B).
2. Remove flywheel (MT) or drive plate (AT).
3. Remove rear oil seal.
   - Be careful not to scratch rear oil seal retainer.



4. Apply new engine oil to new oil seal and install it using a suitable tool.



   - Install new oil seal in the direction as shown.

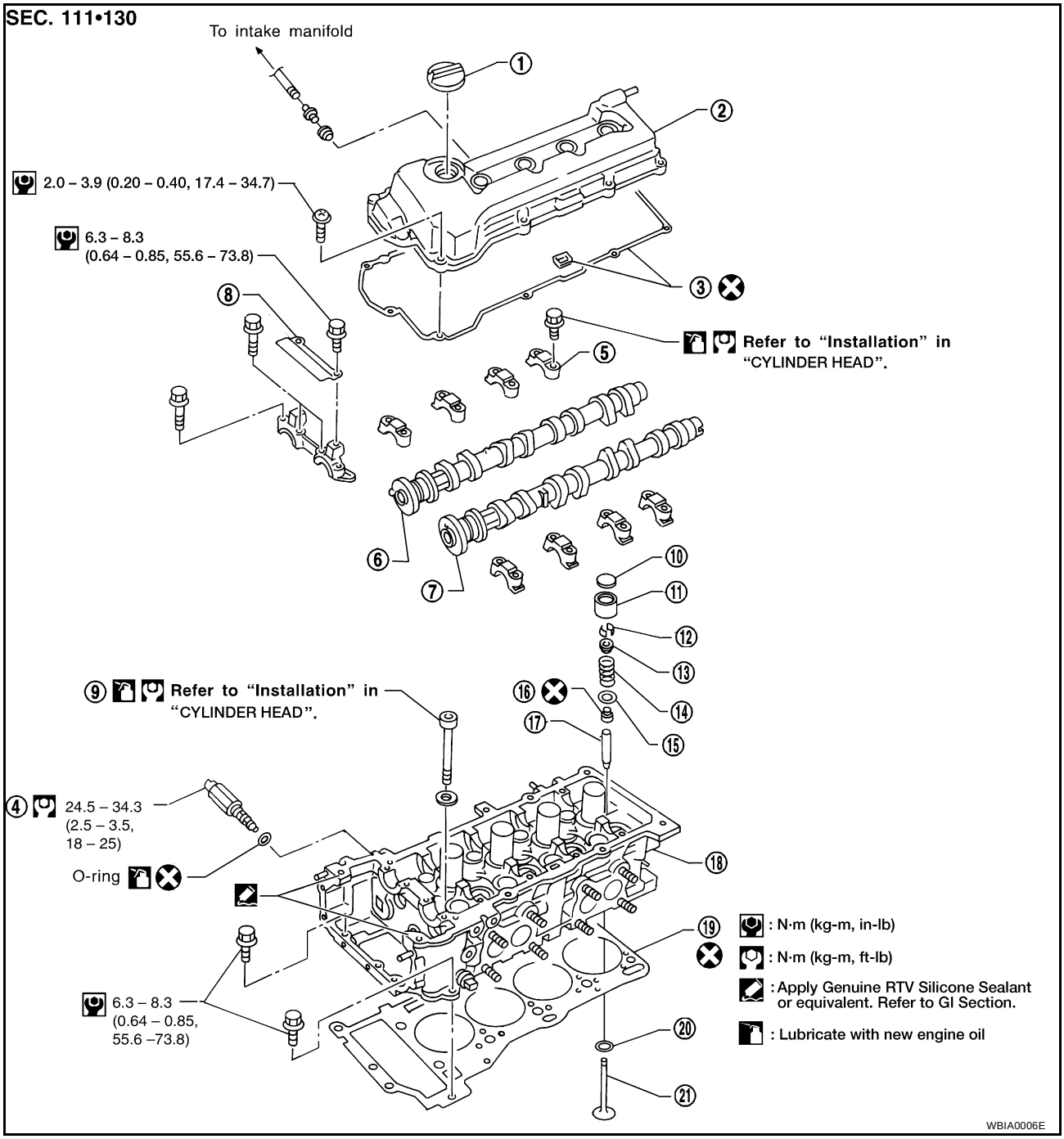


CYLINDER HEAD

PFP:11041

Components

EBS0069A



1.	Oil filler cap	2.	Rocker cover	3.	Rocker cover gasket
4.	Intake valve timing control solenoid	5.	Camshaft bracket	6.	Intake camshaft
7.	Exhaust camshaft	8.	Timing chain guide	9.	Cylinder head bolt
10.	Shim	11.	Valve lifter	12.	Valve cotter
13.	Valve spring retainer	14.	Valve spring	15.	Valve spring seat
16.	Valve oil seal	17.	Valve guide	18.	Cylinder head
19.	Cylinder head gasket	20.	Valve seat	21.	Valve

CAUTION:

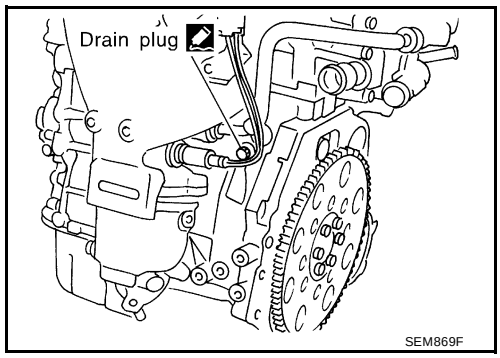
- **When installing camshaft and oil seal, lubricate contacting surfaces with new engine oil.**
- **When tightening cylinder head bolts, camshaft sprocket bolts and camshaft bracket bolts, lubricate bolt threads and seat surfaces with new engine oil.**

- **Attach tags to valve lifters so as not to mix them up.**

Removal

EBS0069B

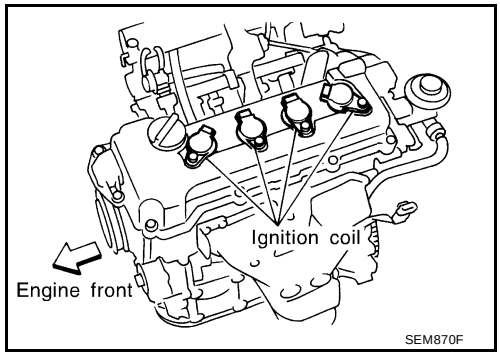
1. Drain engine coolant.
   Be careful not to spill coolant on drive belts.



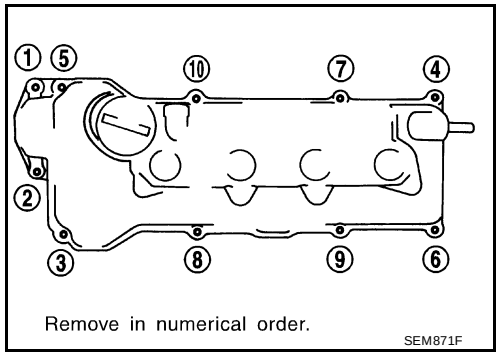
2. Release the fuel pressure.
   Refer to EC-58, "FUEL PRESSURE RELEASE" [QG18DE (except Calif. CA Model)], or EC-623, "FUEL PRESSURE RELEASE" [QG18DE (Calif. CA Model)].
3. Remove the air duct to intake manifold collector.
4. Remove the engine drive belts.
5. Remove the front splash undercovers.
6. Remove the front exhaust tube.
7. Before removing the intake manifold collector from the engine, the following parts should be disconnected to remove the intake manifold collector:
   - EGR tube
   - Fuel injector connectors
   - Ground harness
   - Breather pipe

   Harness connectors for:
   - IACV-AAC valve
   - Throttle position sensor
   - Throttle position switch
   - EGR temperature sensor
   - Water hoses from collector
   - Heater hoses
   - PCV hose

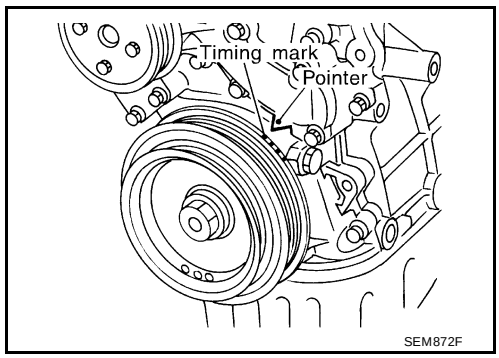
   Vacuum hoses for:
   - EVAP canister
   - Power brake booster
   - Fuel pressure regulator
8. Remove the intake manifold rear supports.
9. Remove the exhaust manifold.
10. Remove the ignition coils.
11. Remove the spark plugs.



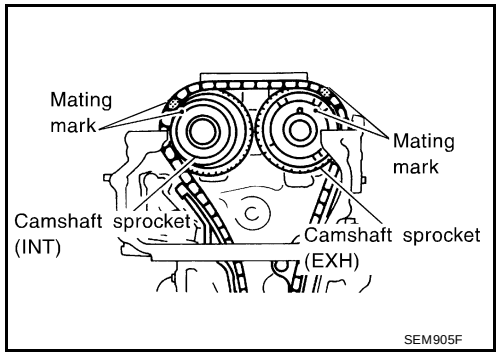
12. Remove the rocker cover bolts in numerical order as shown.



13. Set No. 1 piston at TDC on its compression stroke.



- Rotate crankshaft until mating mark on camshaft sprocket is set at position indicated in figure.

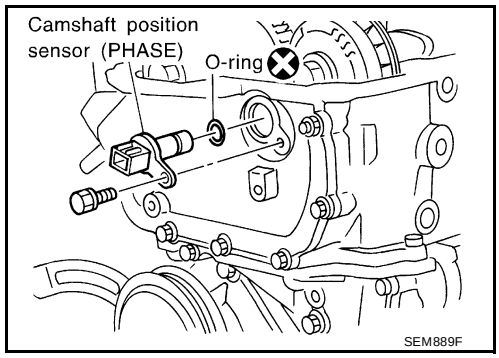


14. Remove camshaft position sensor (PHASE).

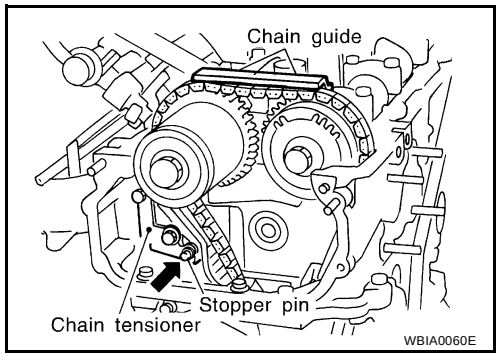
CAUTION:

- **Do not allow any magnetic materials to contact the camshaft position sensor (PHASE).**
- **Be careful not to damage sensor.**

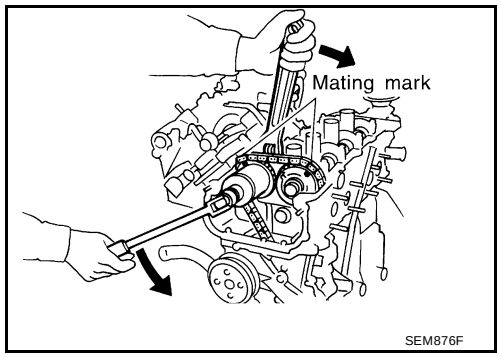
15. Remove intake valve timing control solenoid.
16. Remove cylinder head front cover.



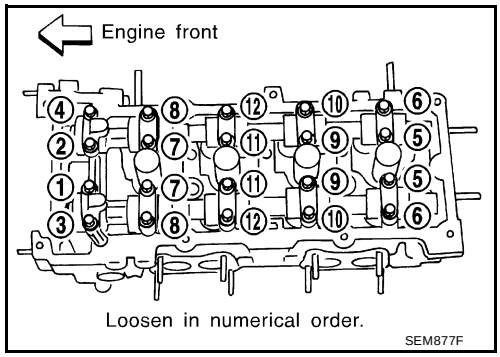
17. Remove timing chain guide from camshaft bracket.
18. Attach a suitable stopper pin to chain tensioner.
19. Remove chain tensioner.



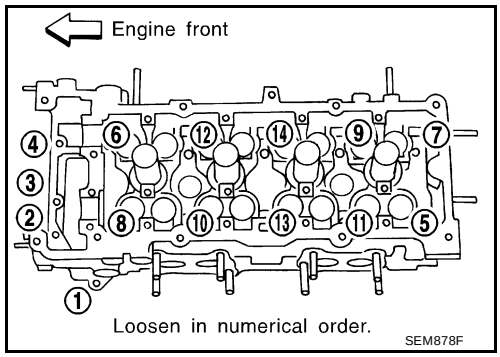
20. Remove camshaft sprocket bolts.
    - Apply paint to timing chain and cam sprockets for alignment during installation.
21. Remove camshaft sprockets.



22. Remove camshaft brackets and camshafts.
    - Apply I.D. marks to brackets to ensure correct reassembly.
    - Bolts should be loosened in two or three steps.



23. Remove cylinder head bolts.



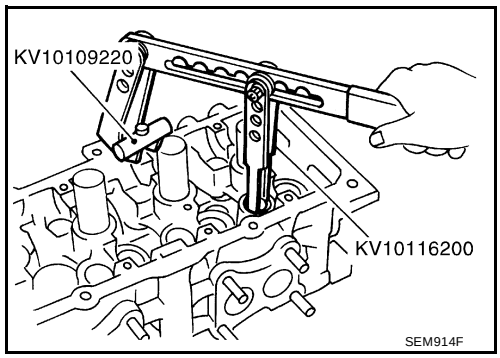
24. Remove cylinder head with intake manifold.

CAUTION:
- **Head warping or cracking could result from removing in incorrect order.**
- **Cylinder head bolts should be loosened in two or three steps.**

Disassembly

EBS0069C

1. Remove valve components using Tools as shown.



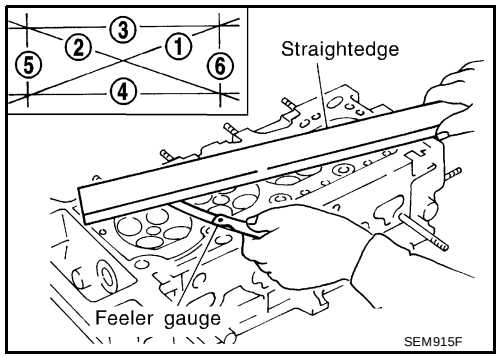
2. Remove valve oil seal with a suitable tool.

Inspection

EBS0069D

CYLINDER HEAD DISTORTION

- Clean surface of cylinder head.
- Use a reliable straightedge and feeler gauge to check the flatness of cylinder head mating surface.
- Check along six positions as shown.



Head Surface Flatness

Standard : Less than 0.03 mm (0.0012 in)

Limit : 0.1 mm (0.004 in)

If beyond the specified limit, replace or resurface it.
The limit for cylinder head resurfacing is determined by the amount of cylinder block resurfacing.
Amount of cylinder head resurfacing is "A".
Amount of cylinder block resurfacing is "B".

Maximum cylinder head resurfacing limit : A + B = 0.2 mm (0.008 in)

After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, replace cylinder head.

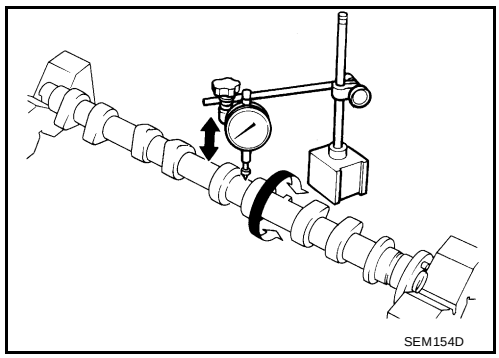
Nominal cylinder head height : 117.8 - 118.0 mm (4.638 - 4.646 in)

CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.

CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.



Runout TIR (total indicator reading)

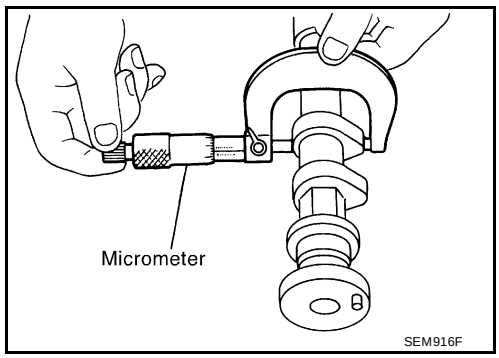
Standard : less than 0.02 mm (0.0008 in)

Limit : 0.1 mm (0.004 in)

2. If it exceeds the limit, replace camshaft.

CAMSHAFT CAM HEIGHT

1. Measure camshaft cam height.



Standard cam height

Intake : 40.565 - 40.755 mm (1.5970 - 1.6045 in)

Exhaust : 40.056 - 40.246 mm (1.5770 - 1.5845 in)

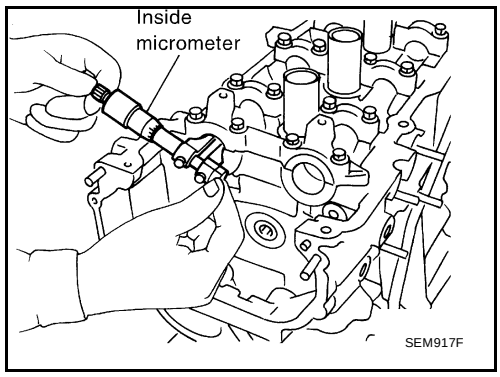
Cam wear limit : 0.20 mm (0.0079 in)

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

CAMSHAFT JOURNAL CLEARANCE

1. Install camshaft bracket and tighten bolts to the specified torque.

2. Measure inner diameter of camshaft bearing.



Standard inner diameter

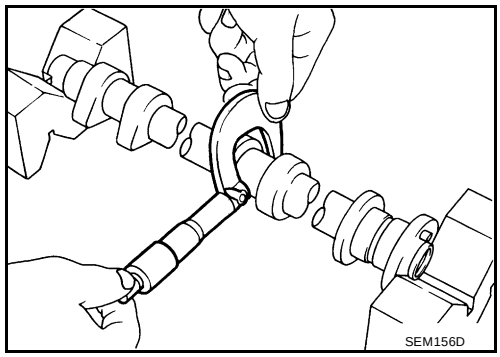
No. 1 bearing : 28.000 - 28.021 mm (1.1024 - 1.1032 in)

No. 2 to No. 5 bearings

Intake : 23.985 – 24.006 mm (0.9443 – 0.9451 in)

Exhaust : 24.000 - 24.021 mm (0.9449 - 0.9457 in)

3. Measure outer diameter of camshaft journal.



Standard outer diameter

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

No. 2 to No. 5 journals : 23.935 - 23.955 mm (0.9423 - 0.9431 in)

4. If clearance exceeds the limit, replace camshaft and/or cylinder head.

Camshaft journal clearance

Standard

Intake : 0.030 - 0.071 mm (0.0012 - 0.0028 in)

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

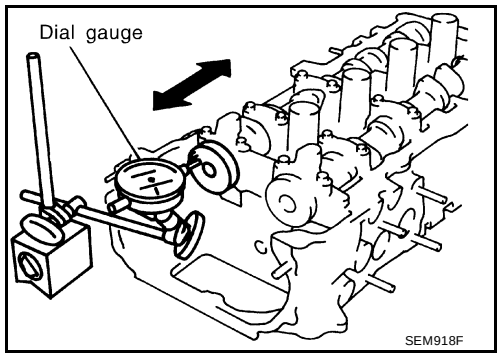
Limit

Intake : 0.135 mm (0.0053 in)

Exhaust : 0.150 mm (0.0059 in)

CAMSHAFT END PLAY

1. Install camshaft in cylinder head. Refer to EM-46, "Assembly" .
2. Measure camshaft end play.



Camshaft end play

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

Limit : 0.20 mm (0.0079 in)

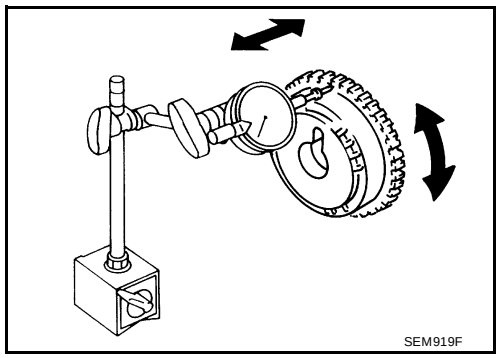
3. If limit is exceeded, replace camshaft and remeasure end play.
   - If limit is still exceeded after replacing camshaft, replace cylinder head.

CAMSHAFT SPROCKET RUNOUT

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

Runout (total indicator reading) : limit 0.15 mm (0.0059 in)

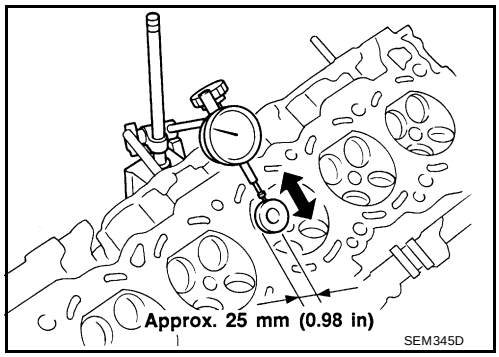
3. If it exceeds the limit, replace camshaft sprocket.



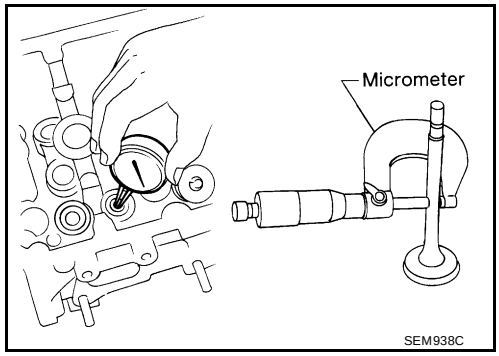
VALVE GUIDE CLEARANCE

1. Measure valve deflection as shown in figure. (Valve and valve guide wear the most in this direction.)

Valve deflection limit (dial gauge reading)
Intake & Exhaust : 0.2 mm (0.008 in)



2. If it exceeds the limit, check valve to valve guide clearance.
a. Measure valve stem diameter and valve guide inner diameter.
b. Calculate valve to valve guide clearance.
Valve stem to valve guide clearance = valve guide inner diameter – valve stem diameter.
c. Check that clearance is within specification.



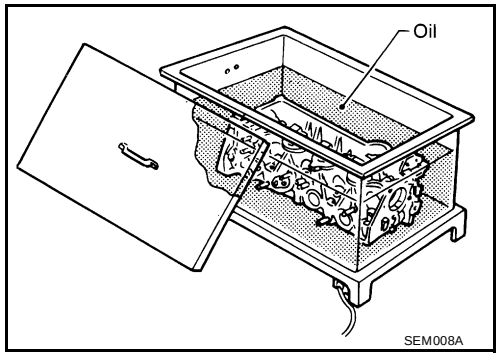
Unit: mm (in)

Valve	Standard	Limit
Intake	0.020 - 0.050 (0.0008 - 0.0020)	0.1 (0.004)
Exhaust	0.040 - 0.070 (0.0016 - 0.0028)	0.1 (0.004)

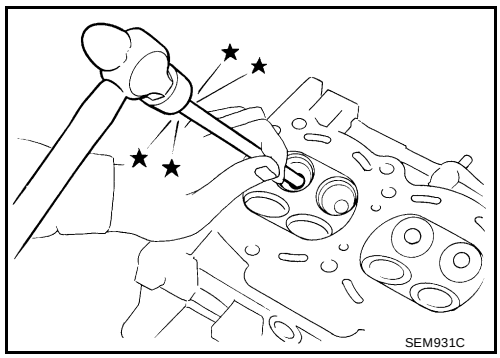
- If it exceeds the limit, replace valve and remeasure clearance.
- If limit is still exceeded after replacing valve, replace valve guide.

VALVE GUIDE REPLACEMENT

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



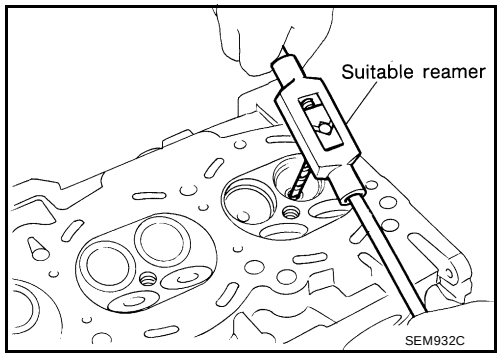
2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and suitable tool.



3. Ream cylinder head valve guide hole.

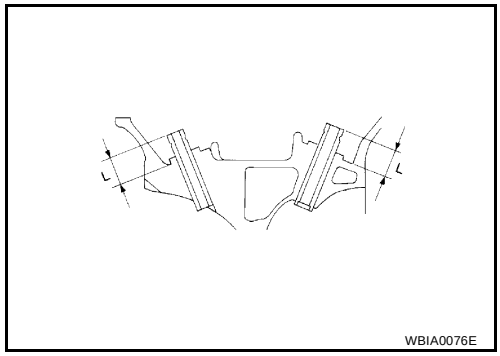
Valve guide hole diameter (for service parts)

Intake & Exhaust : 9.685 - 9.696 mm (0.3813 - 0.3817 in)



4. Heat cylinder head to 110° to 130°C (230° to 266°F) and press service valve guide into cylinder head.

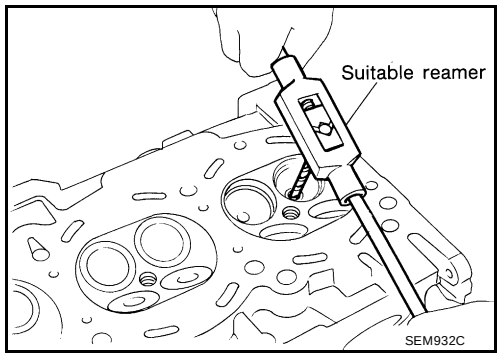
Projection "L" : 11.5 - 11.7 mm (0.453 - 0.461 in)



5. Ream valve guide.

Finished size

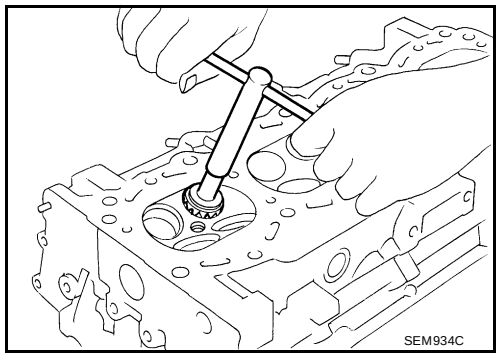
Intake & Exhaust : 5.500 - 5.515 mm (0.2165 - 0.2171 in)



VALVE SEATS

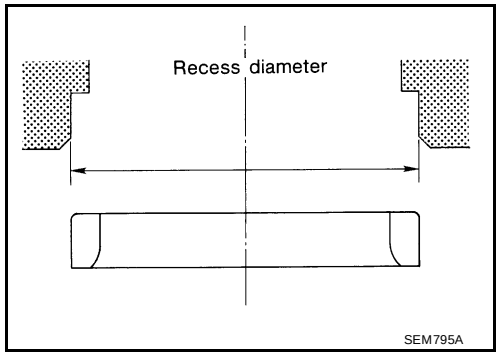
Check valve seats for pitting at contact surface. Resurface or replace if excessively worn.

- **Before repairing valve seats, check valve and valve guide for wear. If they have worn, replace them. Then correct valve seat.**
- **Use both hands to cut uniformly.**

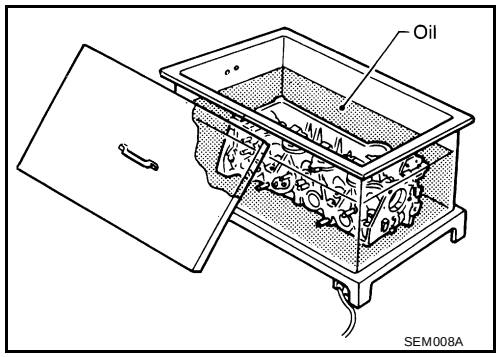


REPLACING VALVE SEAT FOR SERVICE PARTS

1. Bore out old seat until it collapses. Set machine depth stop so that boring cannot contact the bottom face of seat recess in cylinder head.
2. Ream cylinder head recess. Refer to EM-76, "VALVE SEAT" . Use the valve guide center for reaming to ensure valve seat will have the correct fit.

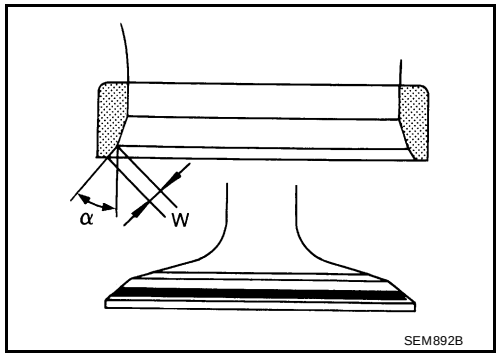


3. Heat cylinder head to 110° to 130°C (230° to 266°F).
4. Press fit valve seat until it seats on the bottom.
5. Cut or grind valve seat using suitable tool to the specified dimensions. Refer to EM-73, "Valve"
6. After cutting, lap valve seat with abrasive compound.



7. Check valve seating condition.

Seat face angle “α”	**: 44°53′ - 45°07′**
Contacting width “W”	
Intake	**: 1.06 - 1.34 mm (0.0417 - 0.0528 in)**
Exhaust	**: 1.34 - 1.63 mm (0.0528 - 0.0642 in)**

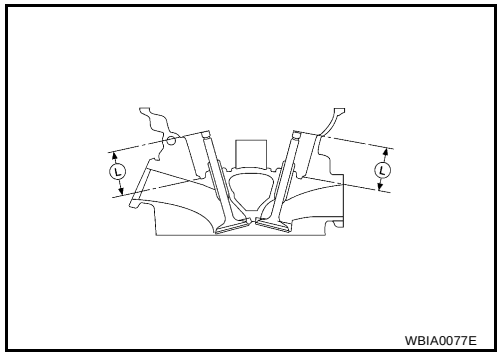


8. Use a depth gauge to measure the distance “L” between the mounting surface of the cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 above to correct it. If the distance is longer, replace the valve seat.

Valve seat resurface limit

Intake : 35.95 - 36.55 mm (1.4154 - 1.4390 in)

Exhaust : 35.92 - 36.52 mm (1.4142 - 1.4378 in)

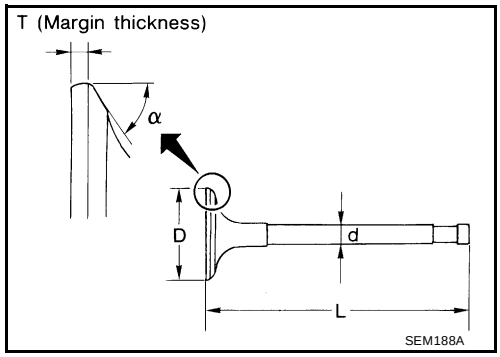


VALVE DIMENSIONS

Check dimensions of each valve. Refer to EM-73, "Valve" .

Valve head wear limit : 0.5 mm (0.020 in)

Valve stem tip grinding allowance : 0.2 mm (0.008 in)

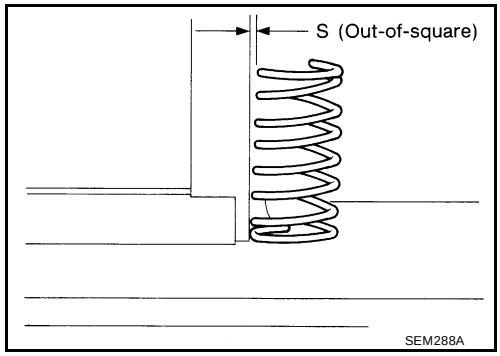


VALVE SPRING

Squareness

1. Measure dimension “S”.

Out-of-square “S” : Less than 1.75 mm (0.0689 in)



2. If it exceeds the limit, replace the spring.

Pressure

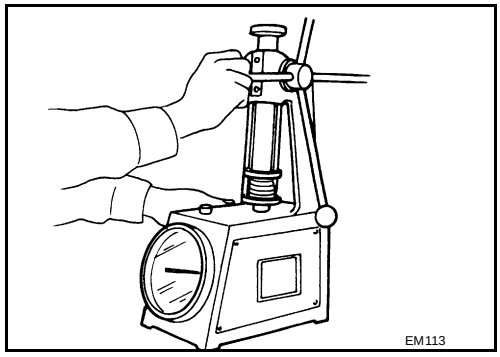
Check valve spring pressure at specified spring height.

Pressure

Standard : 370.0 N (37.73 kg, 83.19 lb) at 23.64 mm (0.9307 in)

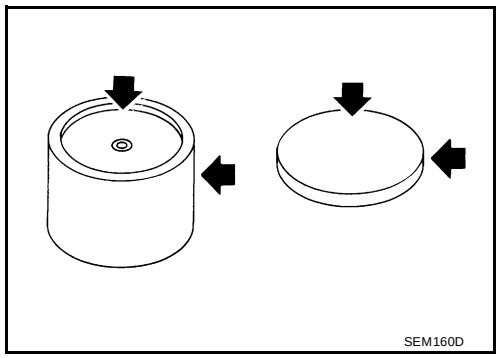
Limit : More than 347.8 N (35.46 kg, 78.19 lb) at 23.64 mm (0.9307 in)

If not within specification, replace the spring.



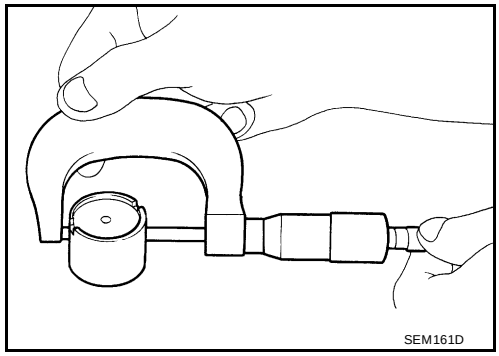
VALVE LIFTER AND VALVE SHIM

1. Check contact and sliding surfaces for wear or scratches.


SEM160D

2. Check diameter of valve lifter and valve lifter guide bore.

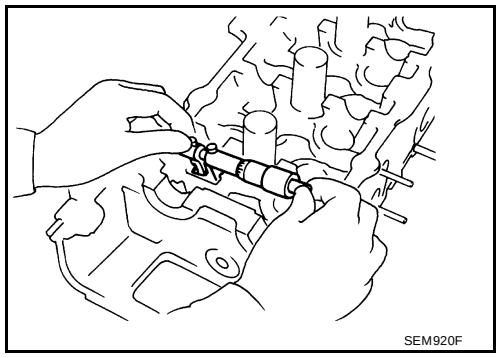
Valve lifter outside diameter **:29.960 - 29.975 mm (1.1795 - 1.1801 in)**


SEM161D

Lifter guide inside diameter **:30.000 - 30.021 mm (1.1811 - 1.1819 in)**

Clearance between valve lifter and valve lifter guide **:0.025 - 0.065 mm (0.0010 - 0.0026 in)**

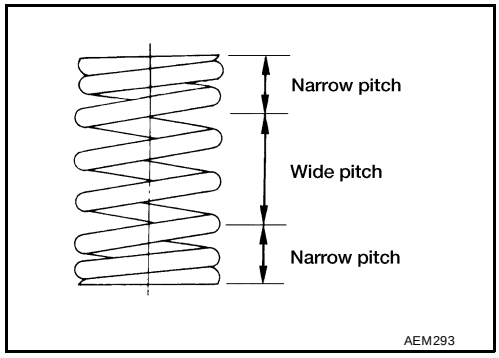
If it exceeds the limit, replace valve lifter or cylinder head which exceeds the standard diameter tolerance.


SEM920F

Assembly

EBS0069E

1. Install valve component parts.
   - Always use new valve oil seal. Refer to EM-33, "VALVE OIL SEAL" .
   - Before installing valve oil seal, install valve spring seat.
   - After installing valve components, tap valve stem tip with a plastic hammer to assure a proper fit.
   - Install valve spring (narrow pitch at both ends of spring) with either end toward cylinder head.

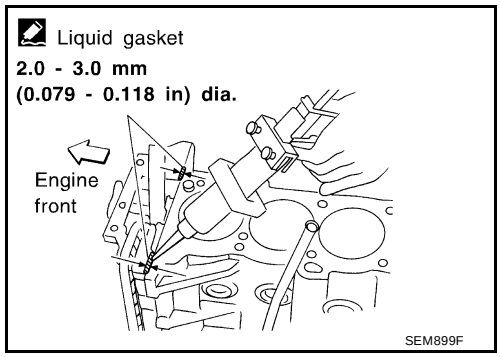


AEM293

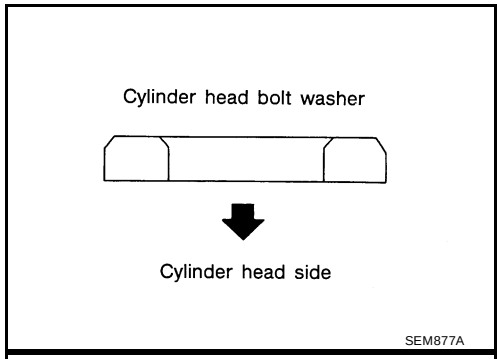
Installation

EBS0069F

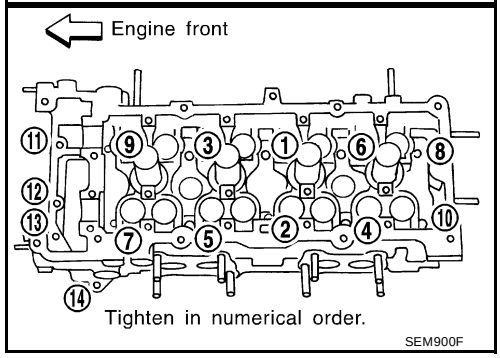
1. Before installing cylinder head gasket, apply a bead of Genuine RTV Silicone Sealant or equivalent, to mating surface of cylinder block as shown. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
2. Install the cylinder head gasket.
   - When installing the cylinder head with manifolds, use a new cylinder head gasket.



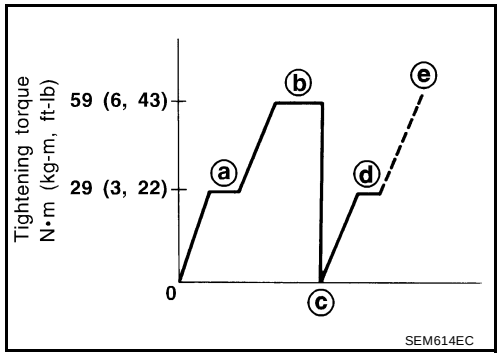
3. Install cylinder head with intake manifolds, tighten the bolts in 5 steps (a - e).
   - Be sure to install washers between bolts and cylinder head.
   - Do not rotate crankshaft and camshaft separately, or valves will strike piston heads.



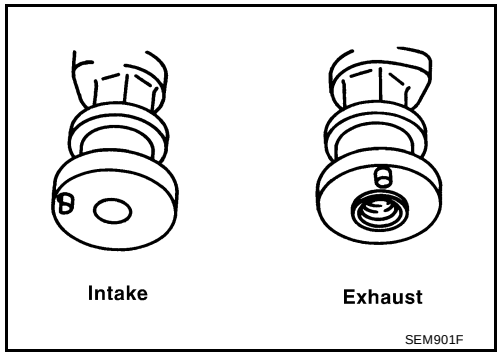
   - Apply new engine oil to cylinder head bolt threads and seat surfaces.



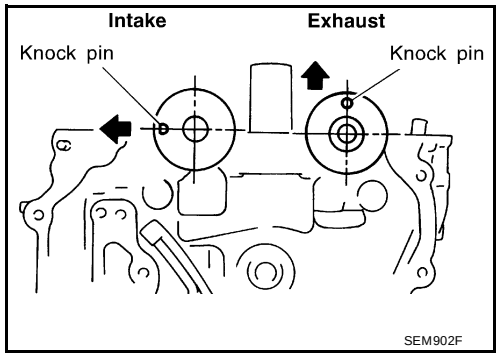
Head Bolts	Tightening torque N·m (kg-m, ft-lb)				
	step a	**step b**	**step c**	**step d**	**step e**
Bolts (**1** - **10**)	29 (3, 22)	59 (6, 43)	0 (0, 0) completely loosen	29 (3, 22)	50° - 55° degrees or 59 ± 4.9 (6 ± 0.5, 43 ± 3.6 ft-lb)
Bolts (**11** - **14**)	—	—	—	—	6.3 - 8.3 (0.64 - 0.85, 55.8 - 73.5 in-lb)



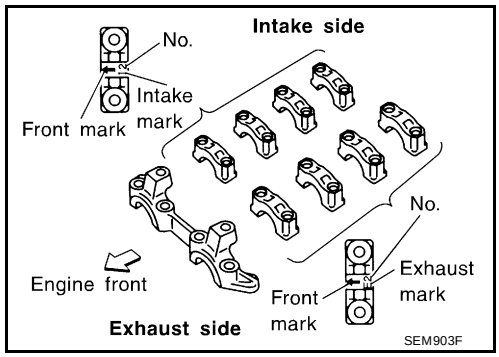
4. Install the camshafts as shown.



- Make sure camshafts are aligned as shown.

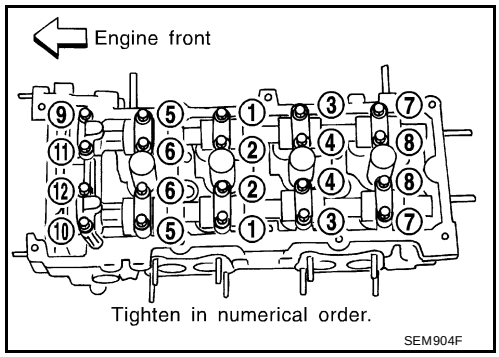


5. Install camshaft brackets.
   - Make sure camshaft brackets are aligned as marked during disassembly.
   - Apply new engine oil to bolt threads and seat surface.



   - Tighten the camshaft bracket bolts in three stages.

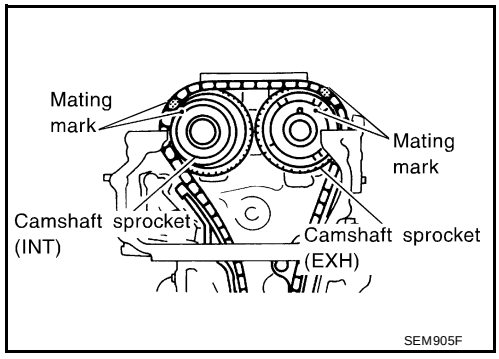
Stage 1 - bolts 9 - 12, then bolts 1 - 8	**: 2.0 N·m (0.204 kg-m, 17.7 in-lb)**
Stage 2 - bolts 1 - 12	**: 5.9 N·m (0.60 kg-m, 52.2 in-lb)**
Stage 3 - bolts 1 - 12	**: 9.0 - 11.8 N·m (0.91 - 11.8 kg-m, 79 - 104 in-lb)**



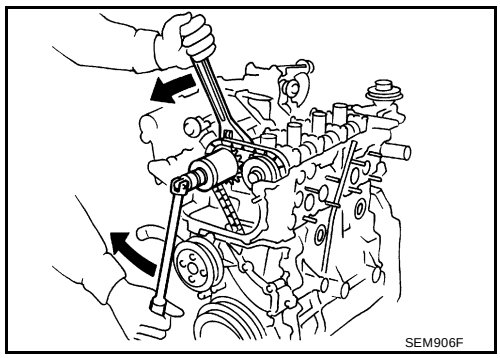
   - If any part of valve assembly or camshaft is replaced, check valve clearance according to reference data.
     After completing assembly check valve clearance. Refer to EM-73, "VALVE CLEARANCE" .

Reference - valve clearance (cold)	
Intake	**: 0.25 - 0.33 mm (0.010 - 0.013 in)**
Exhaust	**: 0.32 - 0.40 mm (0.013 - 0.016 in)**

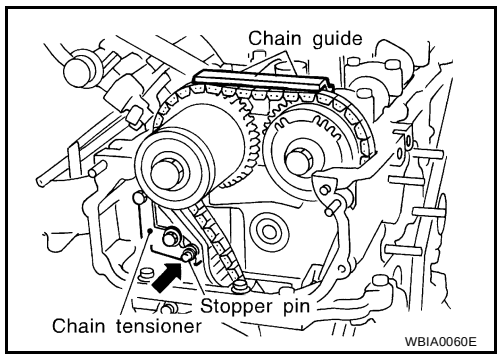
6. Install the camshaft sprockets.
   - Set timing chain by aligning mating marks with those of camshaft sprockets.



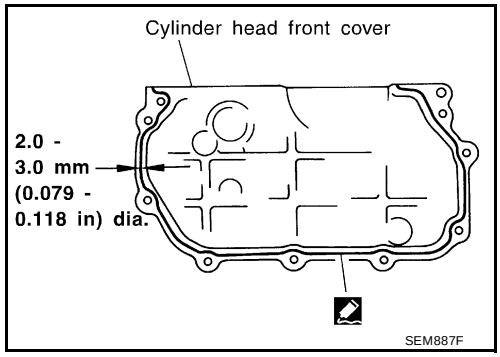
7. Install camshaft sprocket bolts to correct torque. Refer to EM-46, "Assembly" .
   - Apply new engine oil to bolt threads and seat surface.



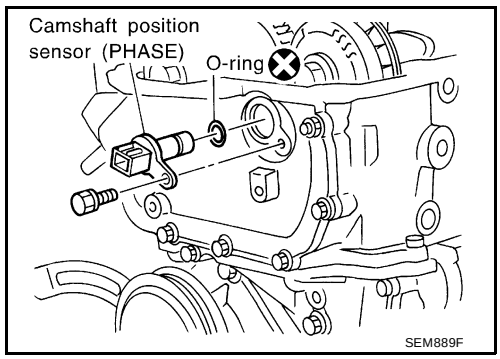
8. Install the chain tensioner.
   - Before installing the chain tensioner, insert a suitable pin into pin hole of thechain tensioner.
   - After installing chain tensioner, remove the pin.
9. Install timing chain guide.



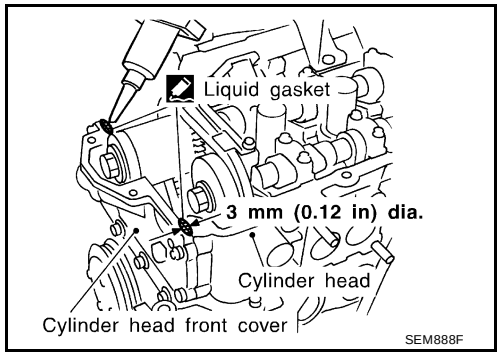
10. Install cylinder head front cover.
    - Apply RTV silicone sealant to cylinder head front cover.
    - Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



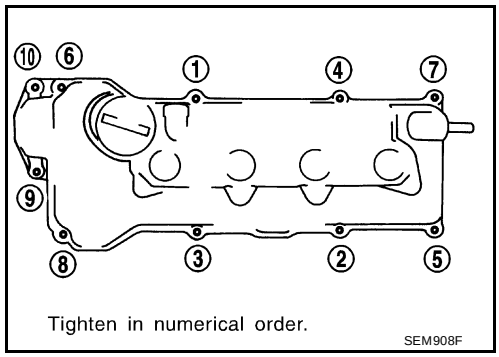
11. Install camshaft position sensor (PHASE).
12. Install intake valve timing control solenoid.



13. Before installing rocker cover, apply a bead of Genuine RTV Silicone Sealant or equivalent to mating surface of cylinder head as shown. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



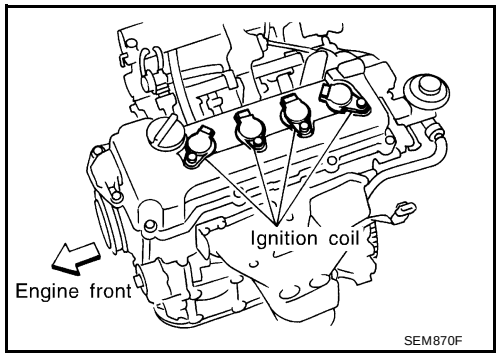
14. Install rocker cover with rocker cover gasket and tighten bolts in numerical order as shown in the figure.
15. Install spark plugs.
16. Install ignition coils.
17. Install exhaust manifold.
18. Install intake manifold rear supports.



19. Connect the following components.
    - EGR tube
    - Ignition coils
    - Fuel injector connectors
    - Ground harness
    - Breather pipe

    Harness connectors for:
    - IACV-AAC valve
    - Throttle position sensor
    - Throttle position switch
    - EGR temperature sensor
    - Water hoses from collector
    - Heater hoses
    - PCV hose

    Vacuum hoses for:
    - EVAP canister
    - Power brake booster
    - Fuel pressure regulator
20. Install front exhaust tube.
21. Install front engine side covers.
22. Install air duct to intake manifold collector.
23. Install drive belts.
    Adjust drive belt deflection. Refer to MA-15, "Checking Drive Belts" .
24. Install fuel pump fuse. Erase DTC if any DTC appears. Refer to EC-73, "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION" [QG18DE (except Calif. CA Model)], or EC-637, "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION" [QG18DE (Calif. CA Model)].



Valve Clearance

EBS0069G

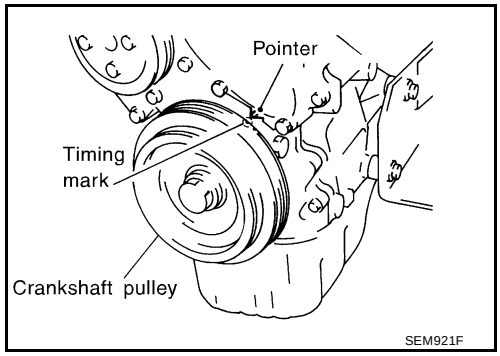
CHECKING

CAUTION:

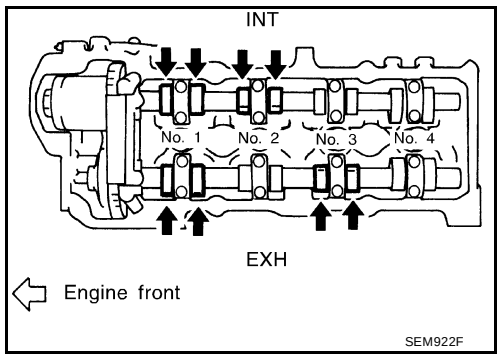
Check valve clearance while engine is warm and not running.

1. Remove the rocker cover.
2. Remove all of the spark plugs.

3. Set No. 1 cylinder at TDC on its compression stroke.
   - Align pointer with TDC mark on crankshaft pulley.
   - Check that valve lifters on No. 1 cylinder are loose and valve lifters on No. 4 are tight.
   - If not, turn crankshaft one revolution (360°) and align as described above.



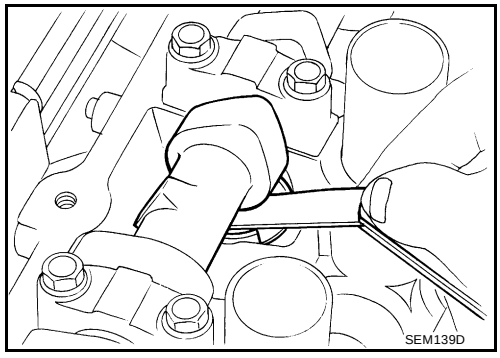
4. Check only those valves shown in the figure.



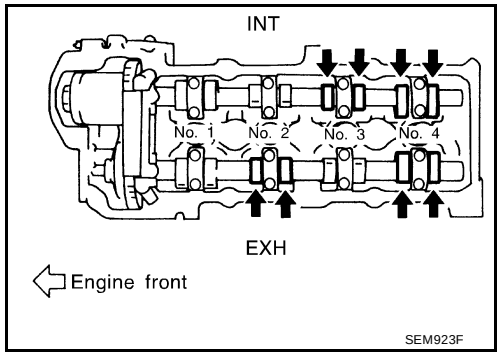
   - Using a feeler gauge, measure clearance between valve lifter and camshaft.
   - Record any valve clearance measurements which are out of specification. They will be used later to determine the required replacement adjusting shim.

Valve clearance for checking (hot)

Intake	**: 0.21 - 0.47 mm (0.008 - 0.019 in)**
Exhaust	**: 0.30 - 0.56 mm (0.012 - 0.022 in)**



5. Turn crankshaft one revolution (360°) and align mark on crankshaft pulley with pointer.
6. Check only those valves shown in the figure.
   - Use the same procedure as mentioned in step 4.
7. If all valve clearances are within specification, install the following parts:
   - Rocker cover
   - All spark plugs



ADJUSTING

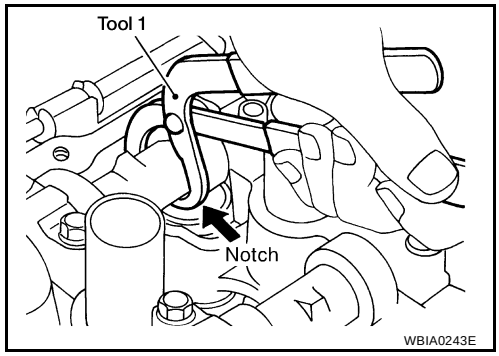
CAUTION:
Adjust valve clearance while engine is cold.

1. Turn crankshaft. Position cam lobe upward on camshaft for valve that must be adjusted.

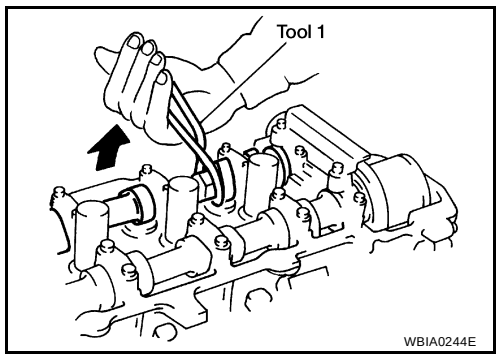
2. Place Tool 1 (45074-1) around camshaft as shown.

CAUTION:
Be careful not to damage cam surface with Tool 1 (45074-1).

NOTE:
Before placing Tool 1 (45074-1), rotate notch toward center of cylinder head as shown. This will simplify shim removal later.



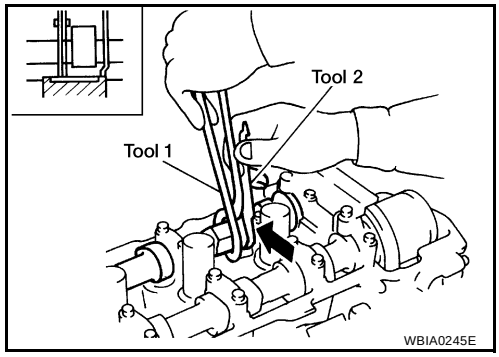
3. Rotate Tool 1 (45074-1) so that valve lifter is pushed down.



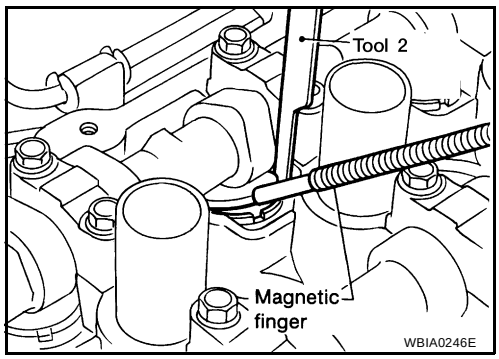
4. Place Tool 2 (45074-2) between camshaft and valve lifter to retain valve lifter.

CAUTION:
- **Tool 2 (45074-2) must be placed as close to camshaft bracket as possible.**
- **Be careful not to damage cam surface with Tool 2 (45074-2).**

5. Remove Tool 1 (45074-1).

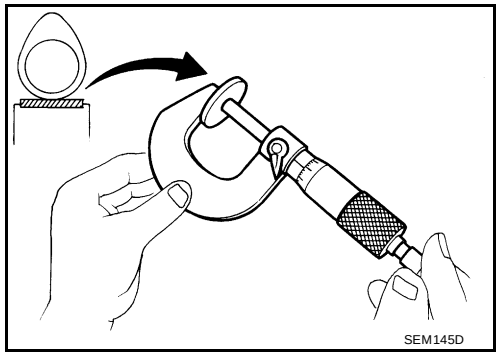


6. Remove adjusting shim using a small screwdriver and a magnetic finger.



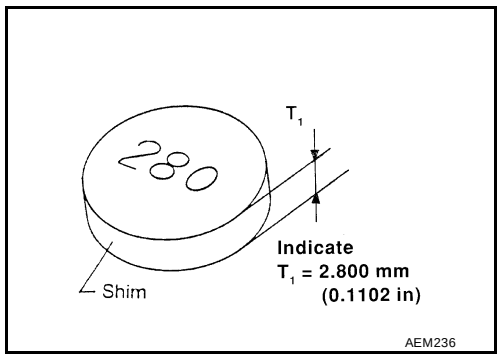
7. Determine replacement adjusting shim size using the following formula.
- Use a micrometer to determine thickness of removed shim.
- Calculate thickness of new adjusting shim so valve clearance comes within specified values.
  R = Thickness of removed shim
  N = Thickness of new shim
  M = Measured valve clearance

Intake : N = R + [M – 0.37 mm (0.0146 in)]
Exhaust : N = R + [M – 0.40 mm (0.0157 in)]



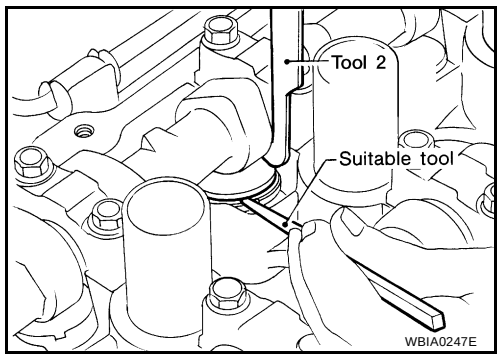
- Select the closest size shim to the calculated thickness. Refer to EM-74, "AVAILABLE SHIMS" .

  NOTE:
  Shims are available in 50 sizes from 2.00 mm (0.0787 in) to 2.98 mm (0.1173 in), in steps of 0.02 mm (0.0008 in).

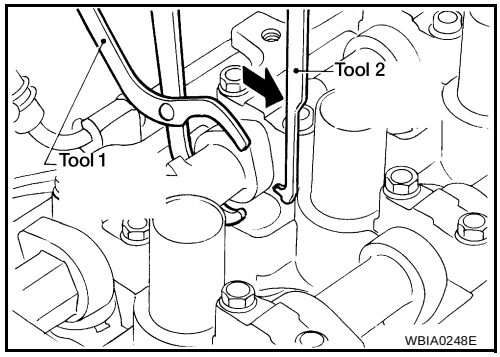


8. Install new shim using a suitable tool.

   CAUTION:
   Install the shim with the surface on which the thickness is stamped facing down.



9. Place Tool 1 (45074-1) as explained in steps 2 and 3.
10. Remove Tool 2 (45074-2).
11. Remove Tool 1 (45074-1).
12. Recheck the valve clearance.



Valve Clearance

Unit: mm (in)

Valve	For adjusting		For checking
	Hot	Cold* (reference data)	Hot
Intake	0.32 - 0.40 (0.013 - 0.016)	0.25 - 0.33 (0.010 - 0.013)	0.21 - 0.47 (0.008 - 0.019)
Exhaust	0.37 - 0.45 (0.015 - 0.018)	0.32 - 0.40 (0.013 - 0.016)	0.30 - 0.56 (0.012 - 0.022)

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

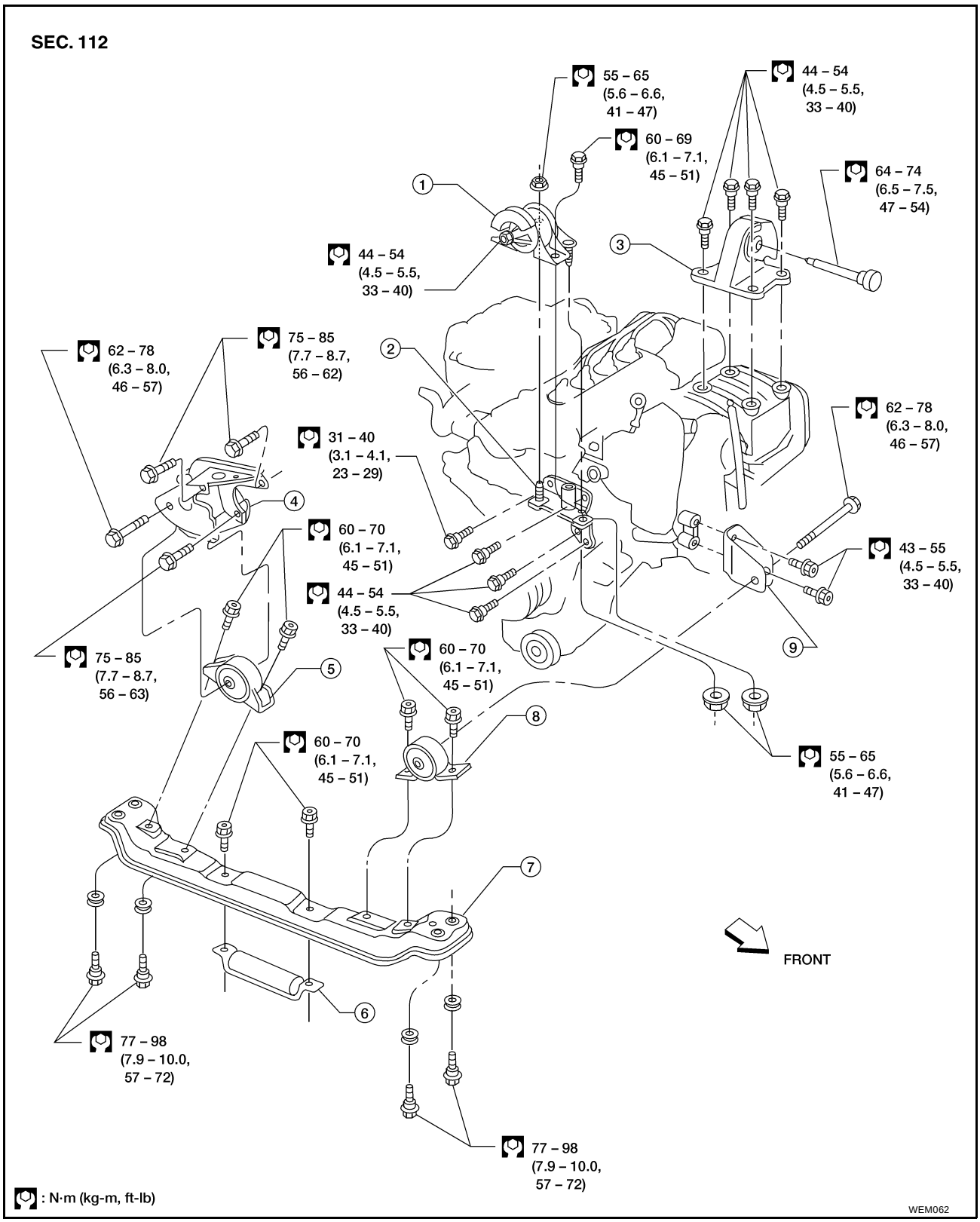
Whenever valve clearances are adjusted to cold specifications, check that the clearances satisfy hot specifications and adjust again if necessary.

ENGINE ASSEMBLY

PFP:10001

Removal and Installation

EBS0069H



1. RH engine mounting
2. RH engine mounting bracket
3. LH engine mounting
4. Rear engine mounting bracket
5. Rear engine mounting
6. Dynamic damper
7. Center member
8. Front engine mounting
9. Front engine mounting bracket

WARNING:

- **Position vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **Do not remove engine until exhaust system has completely cooled off, otherwise, you may burn yourself and/or fire may break out in fuel line.**
- **Before disconnecting fuel hose, release pressure.**
  Refer to EC-58, "FUEL PRESSURE RELEASE" [QG18DE (except Calif. CA Model)], or EC-623, "FUEL PRESSURE RELEASE" [QG18DE (Calif. CA Model)].
- **Be sure to lift engine and transaxle in a safe manner.**
- **For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.**

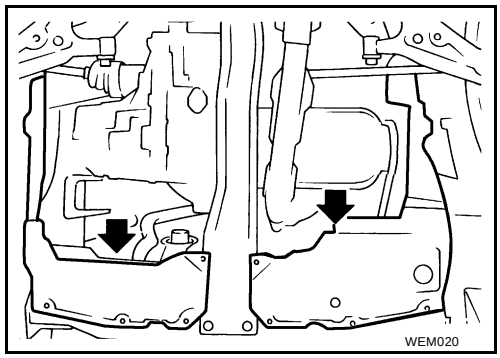
CAUTION:

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

REMOVAL

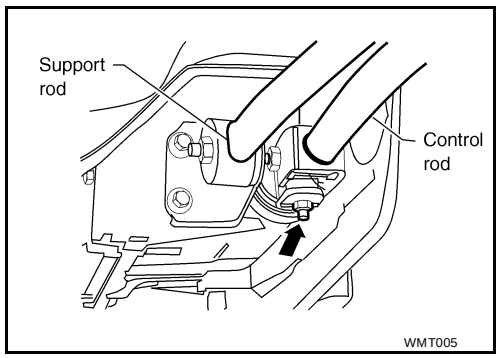
1. Refer to EC-58, "FUEL PRESSURE RELEASE" [QG18DE (except Calif. CA Model)], or EC-623, "FUEL PRESSURE RELEASE" [QG18DE (Calif. CA Model)].
2. Drain coolant from radiator and cylinder block. Refer to MA-15, "DRAINING ENGINE COOLANT" .
3. Remove coolant reservoir tank.
4. Drain engine oil.
5. Remove battery and battery tray.
6. Remove air cleaner and air duct.
7. Remove drive belts.
8. Remove generator and air conditioner compressor from engine.
9. Remove power steering oil pump from engine and position aside.
   - Power steering oil pump does not need to be disconnected from power steering tubes.
10. Remove the following parts:
    - RH and LH front tires
    - Front splash undercovers
    - RH and LH drive shaft. Refer to FAX-16, "Removal" .

      CAUTION:
      When removing drive shaft, be careful not to damage transaxle side grease seal.

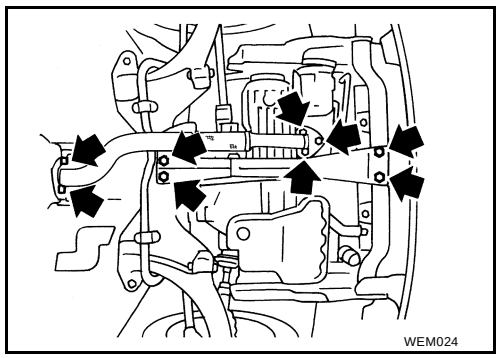


    - Disconnect control cable from transaxle (A/T models). Refer to AT-264, "Control Cable Adjustment" .

- Disconnect control rod and support rod from transaxle (M/T models).



- Center member
- Front exhaust tube



- Stabilizer bar
- Cooling fan
- Radiator
- EGR tube
- Fuel injector connectors
- Ground harness
- Breather pipe

Harness connectors for:

- IACV-AAC valve
- Throttle position sensor
- Throttle position switch
- EGR temperature sensor
- Heated oxygen sensors
- Water hoses from collector
- Heater hoses
- PCV hose
- Intake valve timing control solenoid

Vacuum hoses for:

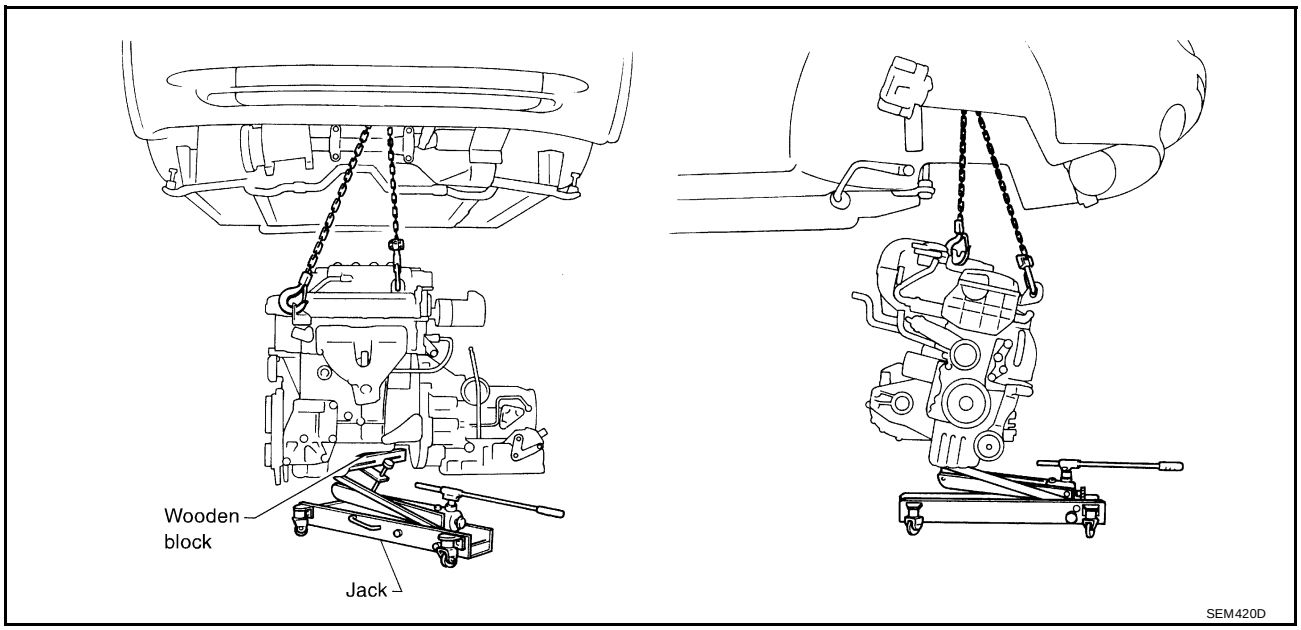
- EVAP canister
- Power brake booster
- Fuel pressure regulator

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

CAUTION:

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

12. Remove engine with transaxle as shown.



INSTALLATION

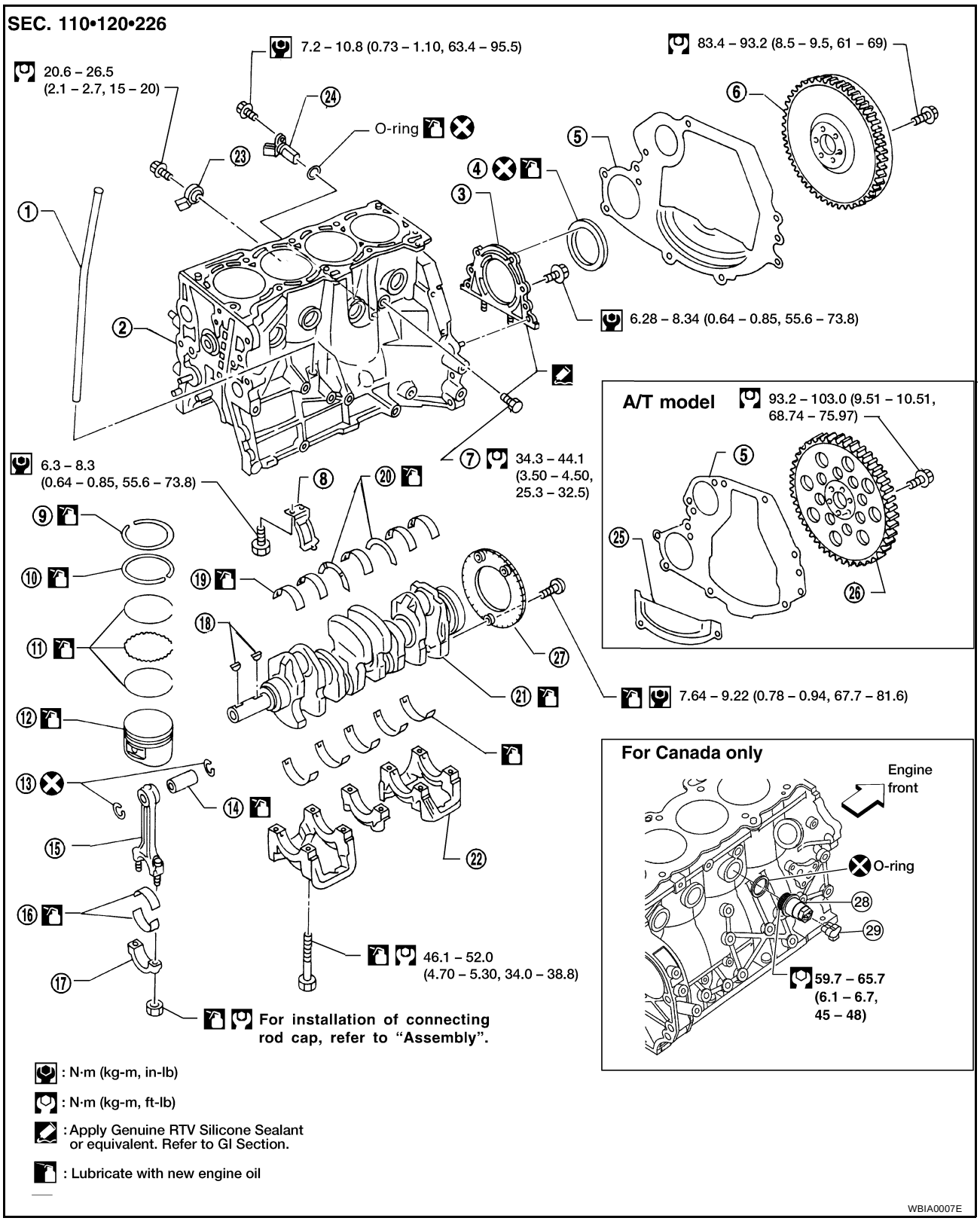
Installation is in the reverse order of removal.

CYLINDER BLOCK

PFP:11010

Components

EBS0069I



1. Oil level gauge guide
2. Cylinder block
3. Rear oil seal retainer
4. Rear oil seal
5. Rear plate
6. Flywheel
7. Drain plug
8. Baffle plate
9. Top ring
10. 2nd ring
11. Oil ring
12. Piston

13. Snap ring
14. Piston pin
15. Connecting rod
16. Connecting rod bearing
17. Connecting rod cap
18. Key
19. Main bearing
20. Thrust bearing
21. Crankshaft
22. Main bearing cap
23. Knock sensor
24. Crankshaft position sensor (POS)
25. Rear lower plate
26. Drive plate
27. Signal plate
28. Block heater (Canada only)
29. Connector protective cap (Canada only)

Removal and Installation

EBS0069J

CAUTION:

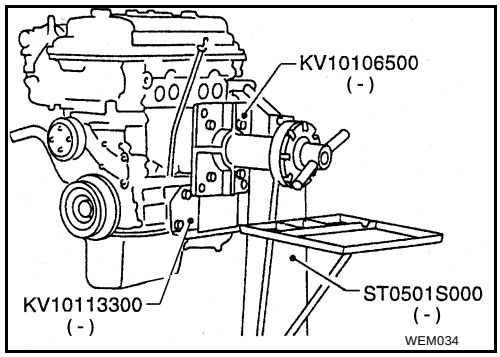
- **When installing sliding parts such as bearings and pistons, apply engine oil on the sliding surfaces.**
- **Place removed parts, such as bearings and bearing caps, in their proper order and direction.**
- **When installing connecting rod nuts and main bearing cap bolts, apply new engine oil to threads and seating surfaces.**
- **Do not allow any magnetic materials to contact the signal plate teeth of flywheel or drive plate, and rear plate.**
- **Remove the crankshaft position sensor (POS).**
- **Be careful not to damage sensor edges and signal plate teeth.**

Disassembly

EBS0069K

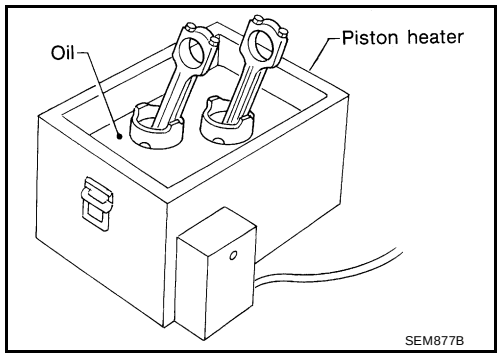
PISTON AND CRANKSHAFT

1. Place engine on a work stand.
2. Drain coolant and oil.
3. Remove timing chain.
   Refer to EM-25, "Removal" .

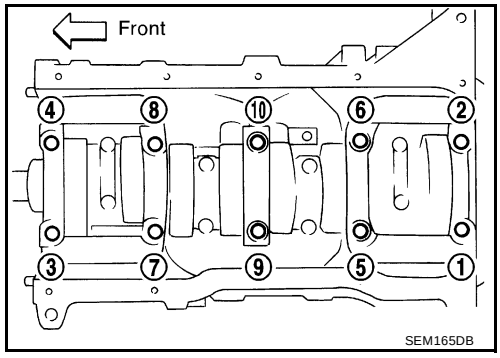


4. Remove pistons with connecting rod.
   - When disassembling piston and connecting rod, remove snap ring first. Then heat piston to 60 to 70°C (140 to 158°F) or use piston pin press stand at room temperature.

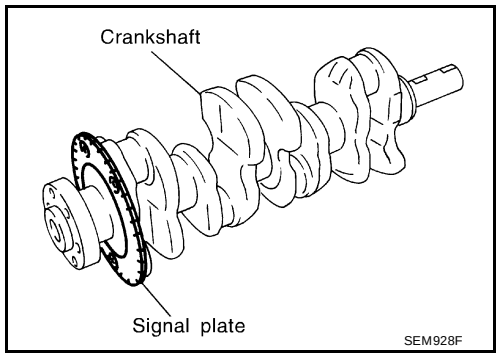
   CAUTION:
   - **When piston rings are not replaced, make sure that piston rings are mounted in their original positions.**
   - **When replacing piston rings, if there is no punch mark, install with either side up.**
5. Measure crankshaft end play. Refer to EM-63, "CRANKSHAFT" .



6. Loosen main bearing caps in numerical order as shown in figure.
   - Bolts should be loosened in two or three steps.
7. Remove bearing caps, main bearings and crankshaft.



8. Remove signal plate from crankshaft.



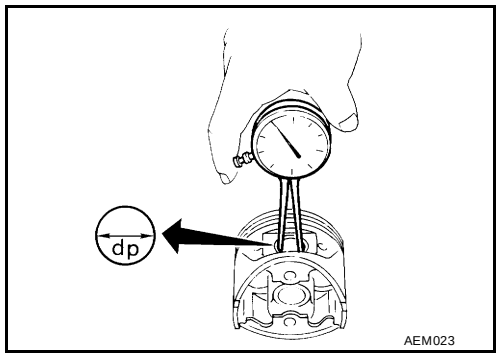
Inspection

EBS0069L

PISTON AND PISTON PIN CLEARANCE

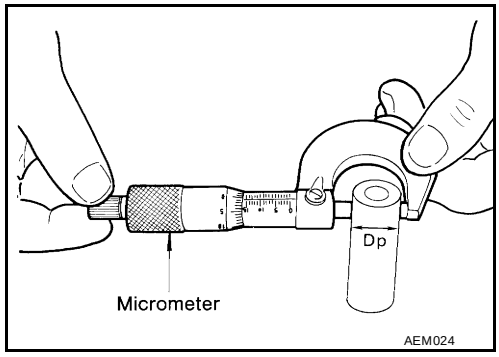
1. Measure inner diameter of piston pin hole “dp”.

Standard diameter “dp” :18.993 - 19.005 mm (0.7478 - 0.7482 in)



2. Measure outer diameter of piston pin “Dp”.

Standard diameter “Dp” :18.989 - 19.001 mm (0.7476 - 0.7481 in)



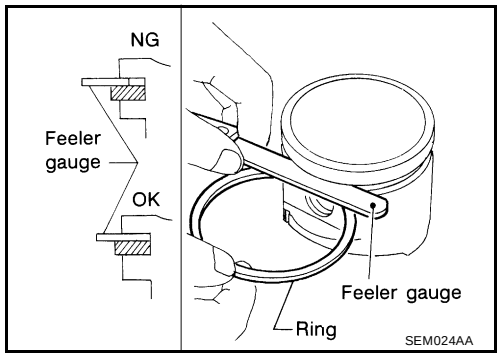
3. Calculate piston pin clearance.

Piston pin clearance = Dp – dp : 0.002 - 0.006 mm (0.0001 - 0.0002 in)

If it exceeds the specified value, replace piston assembly with pin.

PISTON PIN SIDE CLEARANCE

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



Side clearance

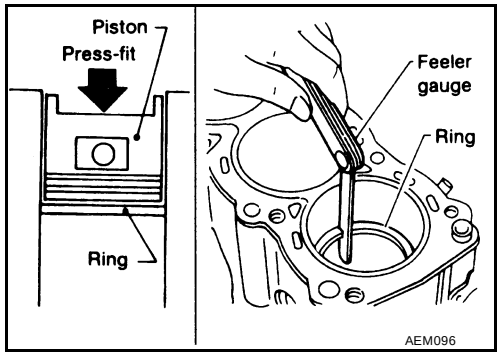
Top ring	**0.045 - 0.080 mm (0.0018 - 0.0031 in)**
2nd ring	**0.030 - 0.070 mm (0.0012 - 0.0028 in)**
Oil ring	**0.065 - 0.135 mm (0.0026 - 0.0053 in)**

Maximum limit of side clearance

All rings	**:0.2 mm (0.008 in)**

PISTON RING END GAP

If out of specification, replace piston ring. If gap exceeds maximum limit with a new ring, rebore cylinder and use oversized piston and piston rings.
Refer to EM-78, "Piston, Piston Ring and Piston Pin" .



End Gap

Top ring	**: 0.20 - 0.39 mm (0.0079 - 0.0154 in)**
2nd ring	**: 0.32 - 0.56 mm (0.0126 - 0.0220 in)**
Oil ring	**: 0.20 - 0.69 mm (0.0079 - 0.0272 in)**

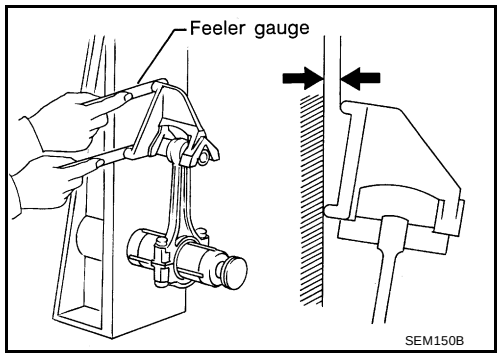
Maximum limit of ring gap

Top ring	**: 0.49 mm (0.0193 in)**
2nd ring	**: 0.64 mm (0.0252 in)**
Oil ring	**: 1.09 mm (0.0429 in)**

NOTE:
When replacing the piston, check the cylinder block surface for scratches or seizure. If scratches or seizure is found, hone or replace the cylinder block.

CONNECTING ROD BEND AND TORSION

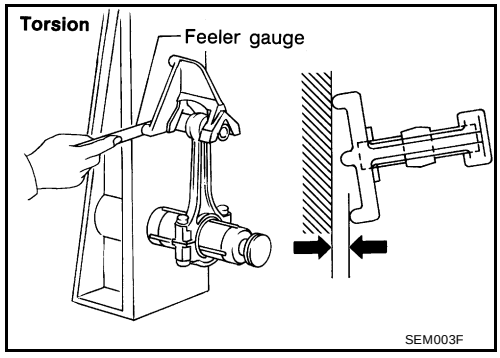
Measure the connecting rod bend and torsion limits using a feeler gauge as shown.



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

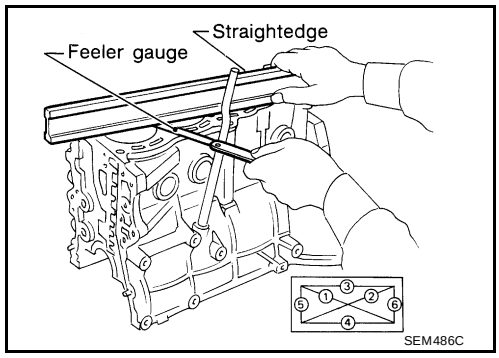
Torsion **:Limit 0.3 mm (0.012 in) per 100 mm (3.94 in) length**

If it exceeds the limit, replace connecting rod assembly.



CYLINDER BLOCK DISTORTION AND WEAR

Clean upper surface of cylinder block.
Use a reliable straightedge and feeler gauge to check the flatness of cylinder block surface. Check along six positions shown in figure.



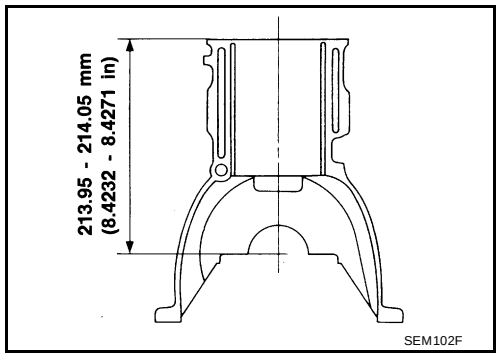
Block surface flatness

Standard : less than 0.03 mm (0.0012 in)

Limit : 0.10 mm (0.004 in)

If out of specification, resurface it.

The limit for cylinder block resurfacing is determined by the amount of cylinder head resurfacing.
Amount of cylinder head resurfacing is "A".
Amount of cylinder block resurfacing is "B".



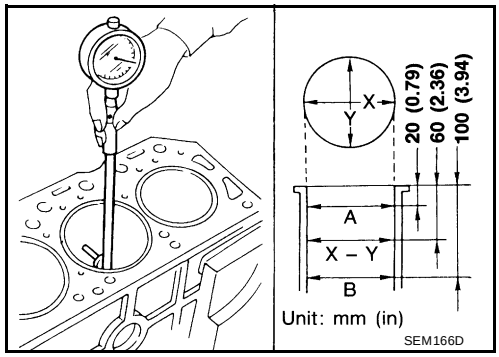
The maximum limit is :A + B = 0.2 mm (0.008 in)

Nominal cylinder block height from crankshaft center : 213.95 - 214.05 mm (8.4232 - 8.4271 in)

If necessary, replace cylinder block.

PISTON-TO-BORE CLEARANCE

1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper. The Y axis is in the longitudinal direction of the engine.



Standard inner diameter (Grade No. 1) : 80.000 - 80.010 mm (3.1496 - 3.1500 in)

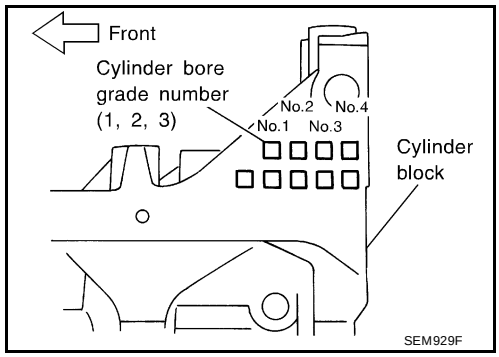
Wear limit :0.2 mm (0.008 in)

Out-of-round (X – Y) standard : less than 0.015 mm (0.0006 in)

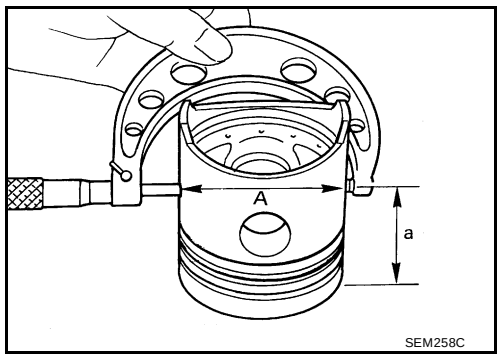
Taper (B – A) standard : less than 0.01 mm (0.0004 in)

If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.

2. Check for score and seizure. If seizure is found, hone it.
   - If cylinder block or piston is replaced, match piston grade with grade number on cylinder block lower surface.



3. Measure piston skirt diameter.



Piston diameter "A" **:Refer to EM-78, "Piston, Piston Ring and Piston Pin" .**

Measuring point "a" (distance from the top) **:42.3 mm (1.665 in)**

4. Check that piston-to-bore clearance is within specification.

Piston-to-bore clearance = cylinder bore measurement "B" – Piston diameter "A" **:0.025 - 0.045 mm (0.0010 - 0.0018 in)**

5. Determine piston oversize according to amount of cylinder wear.
   - Oversize pistons are available for service. Refer to EM-78, "Piston, Piston Ring and Piston Pin" .
6. Cylinder bore size is determined by adding piston-to-bore clearance to piston diameter "A".

Rebored size calculation

D = A + B – C

where:

D : bored diameter

A : piston diameter as measured

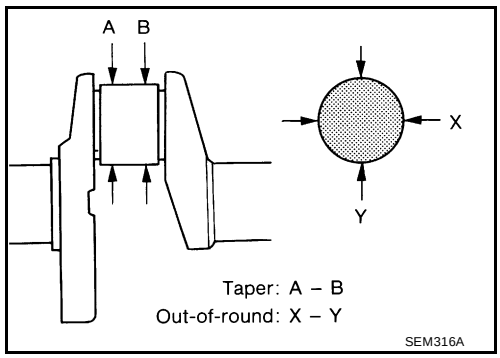
B : piston-to-bore clearance

C : honing allowance = 0.02 mm (0.0008 in)

7. Install main bearing caps and tighten bolts to the specified torque. This will prevent distortion of cylinder bores.
8. Cut cylinder bores.
   - When any cylinder needs boring, all other cylinders must also be bored.
   - Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so at a time.
9. Hone cylinders to obtain specified piston-to-bore clearance.
10. Measure finished cylinder bore for out-of-round and taper.
    - Measurement should be done after cylinder bore cools down.

CRANKSHAFT

1. Check crankshaft main and pin journals for score, wear or cracks.



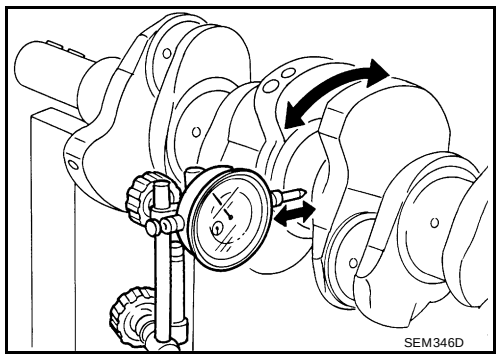
2. With a micrometer, measure journals for taper and out-of-round.

Out-of-round, Standard (X – Y) **:Less than 0.003 mm (0.0001 in)**

Taper, Standard (A – B) **Less than 0.004 mm (0.0002 in)**

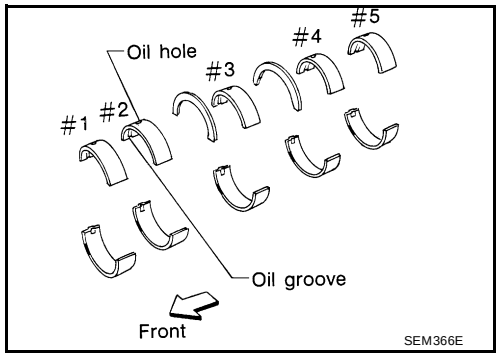
3. Measure crankshaft runout.

Runout standard (total indicator reading) **:Less than 0.04 mm (0.0016 in)**



BEARING CLEARANCE

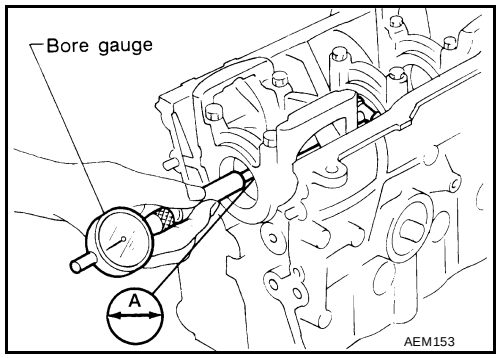
- Use Method A or Method B. Method A is preferred because it is more accurate.



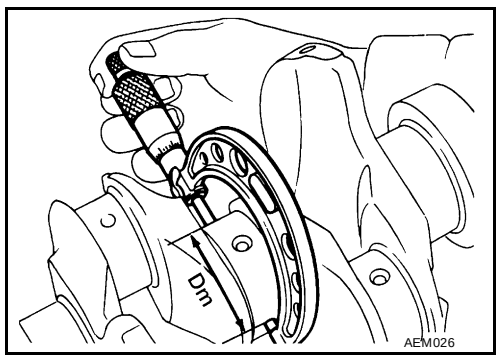
Method A (Using Bore Gauge and Micrometer)

Main bearing

1. Set main bearings in their proper positions on cylinder block and main bearing cap.
2. Install main bearing cap to cylinder block.
   Tighten all bolts in correct order in two or three stages. Refer to EM-68, "Assembly" .
3. Measure inner diameter “A” of each main bearing.



4. Measure outer diameter “Dm” of each main journal in crankshaft.



5. Calculate main bearing clearance.

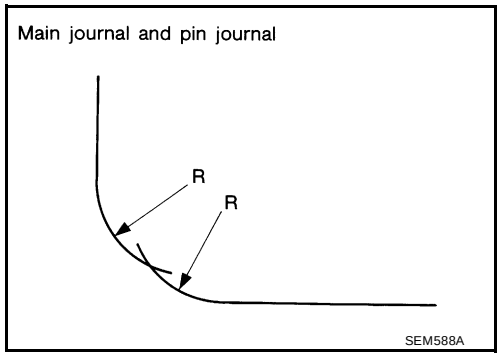
Main bearing clearance = A – Dm

Standard : **0.018 - 0.042 mm (0.0007 - 0.0017 in)**
Limit : **0.1 mm (0.004 in)**

If it exceeds the limit, replace bearing.
If clearance cannot be adjusted within standard of any bearing, grind crankshaft journal and use undersized bearing.
When grinding crank pin and crank journal:

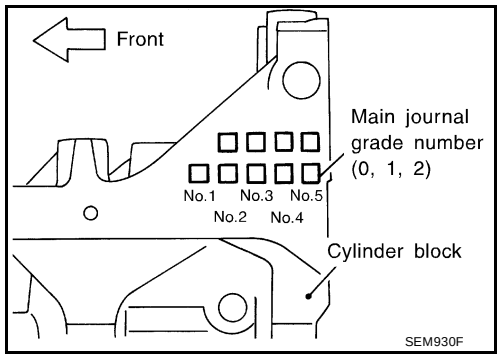
- Grind until clearance is within specified standard bearing clearance.
- Fillets should be finished as shown in the figure. R: 2.3 - 2.5 mm (0.091 - 0.098 in)

Refer to EM-80, "Bearing Clearance" for standard bearing clearance and available spare parts.

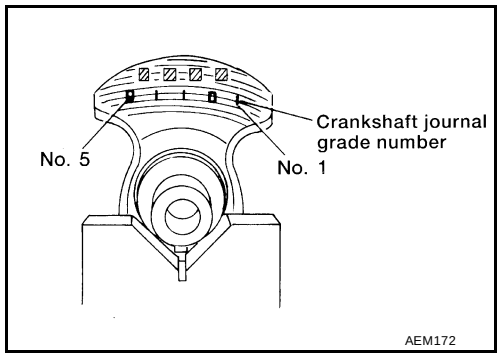


6. If the crankshaft is replaced, select thickness of main bearings as follows:

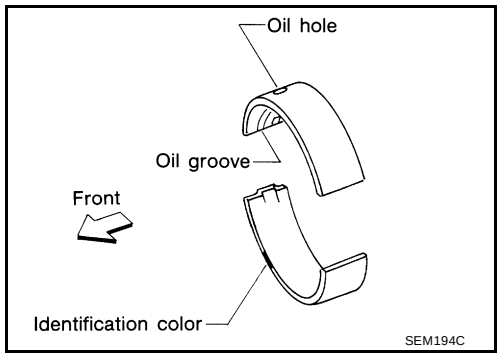
a. Grade number of each cylinder block main journal is punched on the respective cylinder block. These numbers are punched in either Arabic or Roman numerals.



b. Grade number of each crankshaft main journal is punched on the respective crankshaft. These numbers are punched in either Arabic or Roman numerals.



c. Select main bearing with suitable thickness according to the following table.
For example:
Cylinder block main journal grade number: 1
Crankshaft main journal grade number: 2
Main bearing grade number = 1 + 2 = 3 (Yellow)

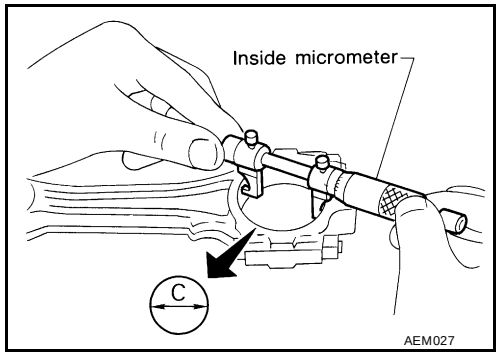


Main Bearing Grade Color

Crankshaft main journal grade number	Cylinder block main journal grade number		
	0	1 or I	2 or II
0	0 (Black)	1 (Brown)	2 (Green)
1 or I	1 (Brown)	2 (Green)	3 (Yellow)
2 or II	2 (Green)	3 (Yellow)	4 (Blue)

Connecting Rod Bearing (Big End)

1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.
   Tighten bolts to the specified torque.
3. Measure inner diameter “C” of each bearing.



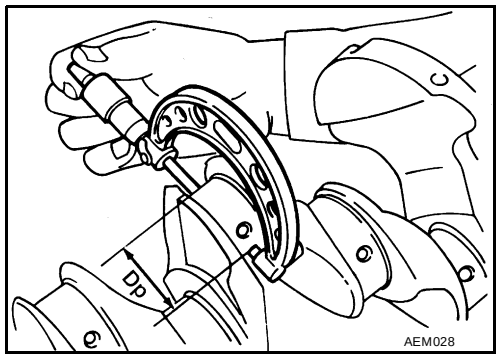
4. Measure outer diameter “Dp” of each crankshaft pin journal.
5. Calculate connecting rod bearing clearance.

   Connecting rod bearing clearance = C – Dp

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

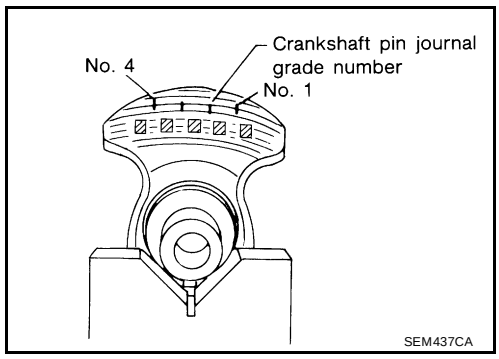
   Limit : 0.1 mm (0.004 in)

   If it exceeds the limit, replace bearing.
   If clearance cannot be adjusted using any standard bearing grade, grind crankshaft journal and use undersized bearing. Refer to EM-80, "Bearing Clearance" .



- If a new bearing, crankshaft or connecting rod is replaced, select connecting rod bearing according to the following table.

NOTE:
These numbers are punched in either Arabic or Roman numerals.



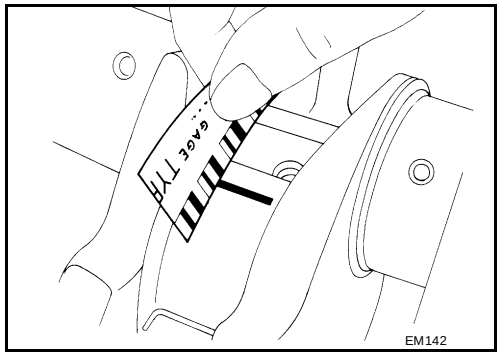
Connecting Rod Bearing Grade Number

Crankshaft pin journal grade number	Connecting rod bearing grade color
0	—
1or I	Brown
2 or II	Green

Method B (Using Plastigage)

CAUTION:

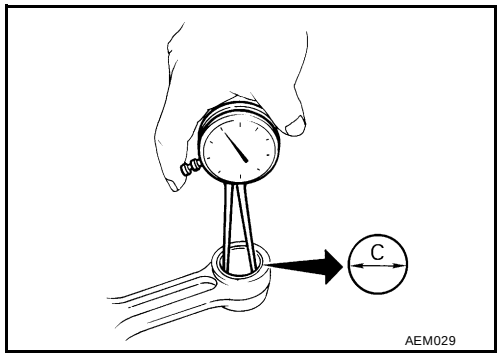
- **Do not turn crankshaft or connecting rod while Plastigage is being inserted.**
- **If incorrect bearing clearance exists, use a thicker or undersized main bearing to ensure specified clearance.**



EM142

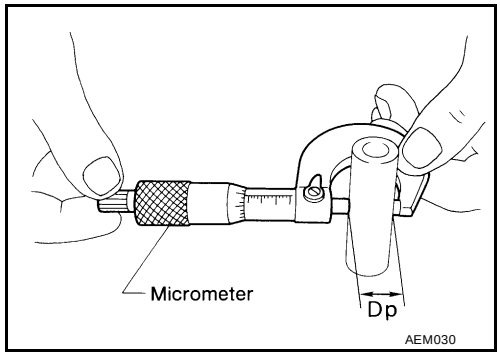
CONNECTING ROD BUSHING CLEARANCE (SMALL END)

1. Measure inner diameter “C” of bushing.



AEM029

2. Measure outer diameter “Dp” of piston pin.



AEM030

3. Calculate piston pin to connecting rod bushing clearance.

Piston pin to connecting rod bushing clearance = C – Dp

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

Limit **:0.023 mm (0.0009 in)**

If it exceeds the limit, replace connecting rod assembly or connecting rod bushing and/or piston pin.

REPLACEMENT OF CONNECTING ROD BUSHING (SMALL END)

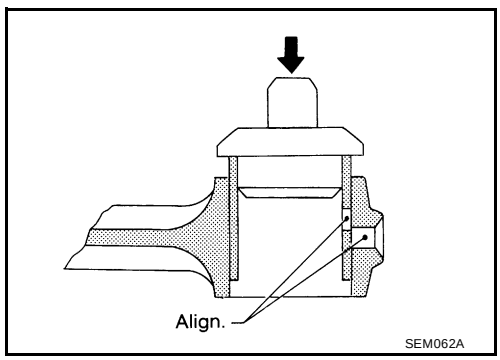
1. Drive in small end bushing until it is flush with end surface of rod.

CAUTION:

Be sure to align the oil holes.

2. Ream the bushing so that clearance with piston pin is within specification.

Piston pin to connecting rod bushing clearance	**:0.005 - 0.017 mm (0.0002 - 0.0007 in)**
Limit	**: 0.023 mm (0.0009 in)**



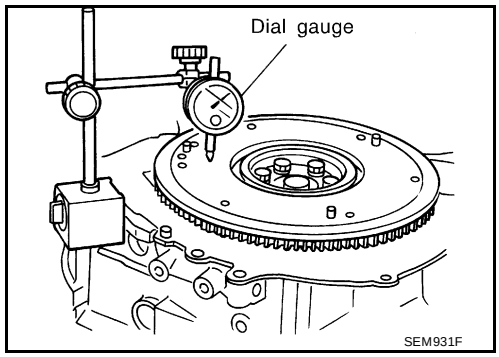
SEM062A

FLYWHEEL RUNOUT

Measure the flywheel runout using a dial gauge as shown.

Runout (total indicator reading)

Flywheel (M/T models) : less than 0.15 mm (0.0059 in)



CAUTION:

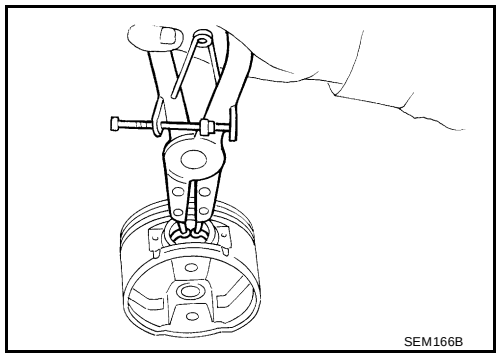
- **Do not allow any magnetic materials to contact the ring gear teeth and rear plate.**
- **Do not resurface the flywheel. Replace as necessary.**

Assembly

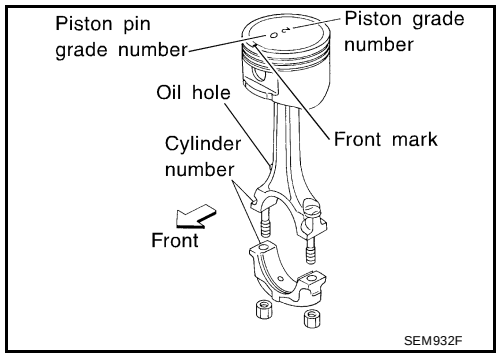
EBS0069M

PISTON

1. Install new snap ring on one side of piston pin hole.



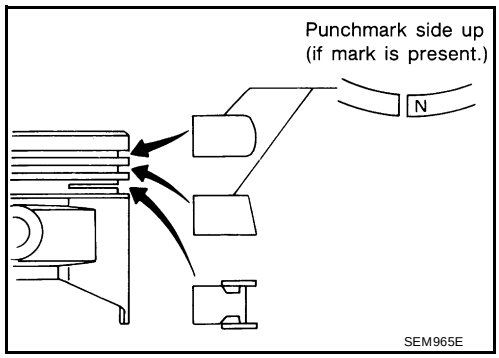
2. Heat piston to 60° to 70°C (140° to 158°F) and assemble piston, piston pin, connecting rod and new snap ring.
   - Align the direction of piston and connecting rod.
   - Numbers stamped on connecting rod and cap correspond to each cylinder.
   - After assembly, make sure connecting rod swings smoothly.



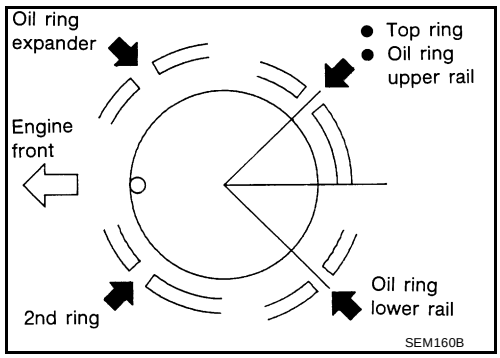
3. Set piston rings as shown.

CAUTION:

- **When piston rings are not replaced, make sure that piston rings are mounted in their original position.**
- **Install new piston rings either side up if there is no punch mark.**



- **Align piston rings so that end gaps are positioned as shown.**

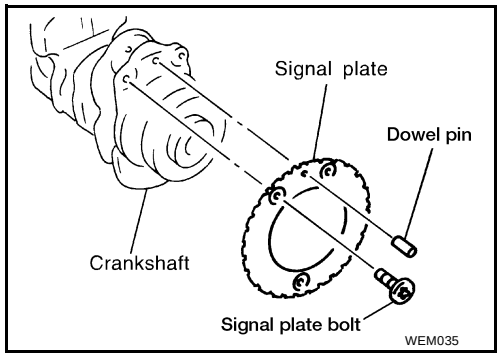


CRANKSHAFT

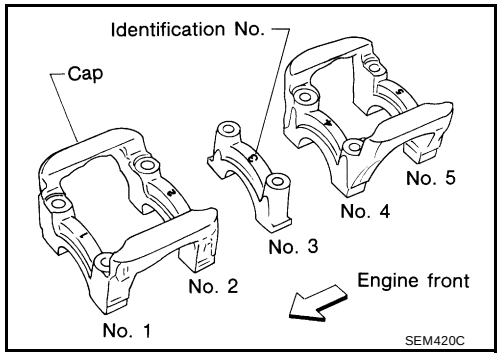
1. Install signal plate to crankshaft using dowel pin to properly position the signal plate. Remove the dowel pin after the signal plate bolts are tightened.

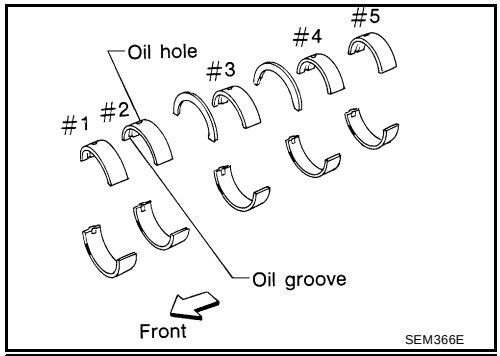
Signal plate bolt : **7.64 - 9.22 N·m (0.78 - 0.94 kg-m, 67.7 - 81.6 in-lb)**

Dowel pin diameter : **6 mm (3/16 in)**

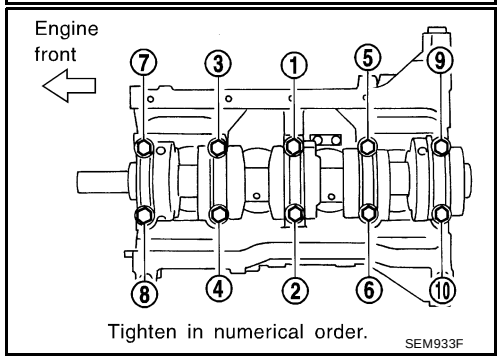


2. Set main bearings in their proper positions on cylinder block and main bearing cap.
   - Confirm that correct main bearings are selected by using Method A or Method B. Refer to EM-80, "Bearing Clearance" .
   - Apply new engine oil to bearing surfaces.





3. Install crankshaft and main bearing caps and tighten bolts to the specified torque.
   - Apply new engine oil to the bolt thread and seat surface.
   - Prior to tightening bearing cap bolts, shift crankshaft back and forth to properly seat the bearing caps.
   - Tighten bearing cap bolts gradually in two or three stages. Start with center bearing and move outward as shown in figure.
   - After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.



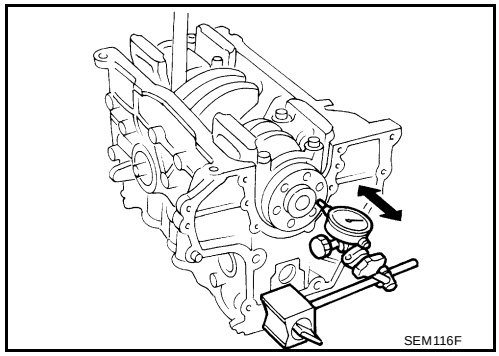
4. Measure crankshaft end play.

Crankshaft end play

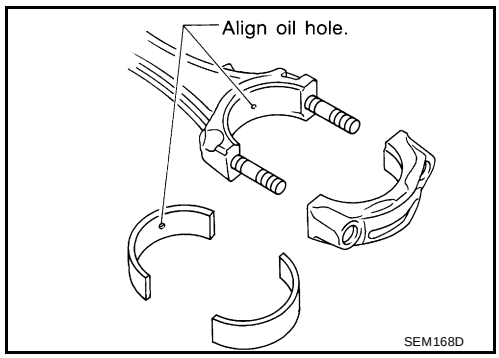
Standard : 0.060 - 0.220 mm (0.0024 - 0.0087 in)

Limit : 0.3 mm (0.012 in)

If beyond the limit, replace thrust bearing with new ones.

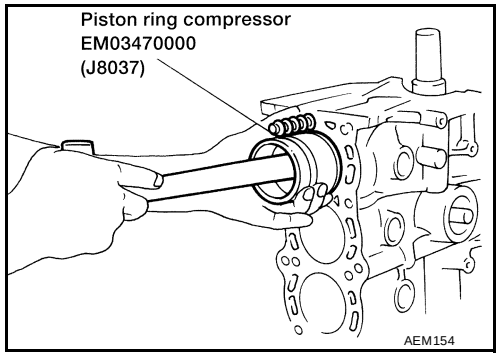


5. Install connecting rod bearings in connecting rods and connecting rod caps.
   - Confirm that correct bearings are used. Refer to EM-80, "Connecting Rod Bearing" .
   - Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.
   - Apply new engine oil to bolt threads and bearing surfaces.



6. Install pistons with connecting rods.

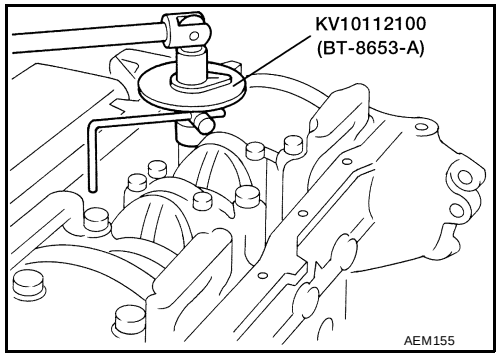
a. Install them into corresponding cylinders with Tool.
   - Make sure connecting rod does not scratch cylinder wall.
   - Make sure connecting rod bolts do not scratch crankshaft pin journals.
   - Arrange so that front mark on piston head faces engine.
   - Apply new engine oil to piston rings and sliding surface of piston.



b. Install connecting rod caps.
Apply new engine oil to bolt threads and nut seating surfaces.
Tighten connecting rod cap nuts in two stages:

Stage 1 : 13.72 - 15.68 N·m (1.399 - 1.599 kg-m, 10.120 - 11.566 ft-lb)

Stage 2 : 35° - 40° degrees clockwise, or 23 - 28 N·m (2.3 - 2.9 kg-m, 17 - 21 ft-lb)



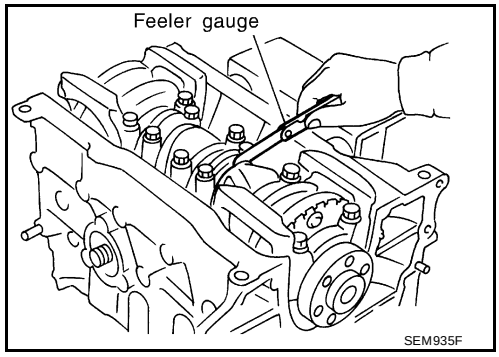
7. Measure connecting rod side clearance.

Connecting rod side clearance

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

Limit :0.52 mm (0.0205 in)

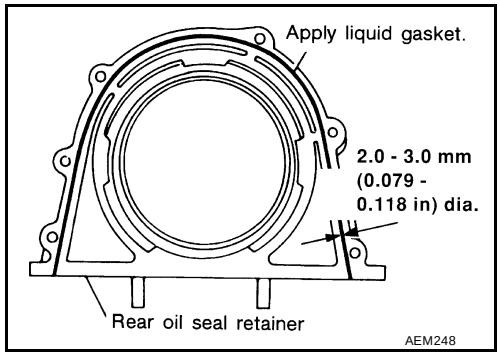
If beyond the limit, replace connecting rod and/or crankshaft.



8. Install rear oil seal retainer.

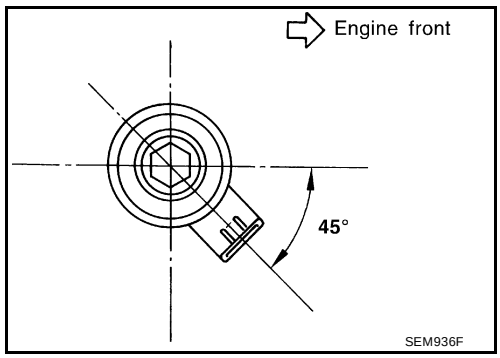
a. Before installing rear oil seal retainer, remove old liquid gasket from cylinder block and retainer.

b. Apply a continuous bead of liquid gasket to rear oil seal retainer.
- Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
- Apply around inner side of bolt holes.



9. Install the crankshaft position sensor (POS).

10. Install the knock sensor at the correct angle.



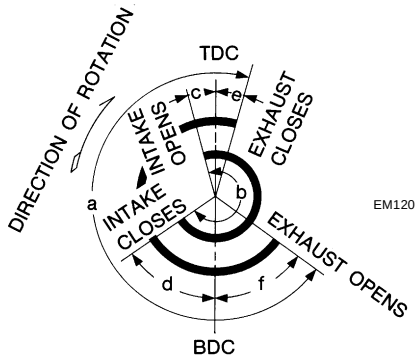
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

General Specifications

EBS0069N

Engine		QG18DE
Classification		Gasoline
Cylinder arrangement		4, in-line
Displacement cm^3 (cu in)		1,769 (107.94)
Bore × stroke mm (in)		80.0 x 88.0 (3.150 x 3.465)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		5
Compression ratio		9.5



	a	b	c	d	e	f
Valve timing	222°	234°	-3° (17°)	57° (37°)	4°	38°

( ): Intake valve timing control ON

Compression Pressure

EBS0069O

Unit: kPa (bar, kg/cm^2 , psi)/350 rpm

Standard	1,324 (13.24, 13.5, 192)
Minimum	1,157 (11.57, 11.5, 168)
Difference limit between cylinders	98 (0.98, 1.0, 14)

Cylinder Head

EBS0069P

Unit: mm (in)

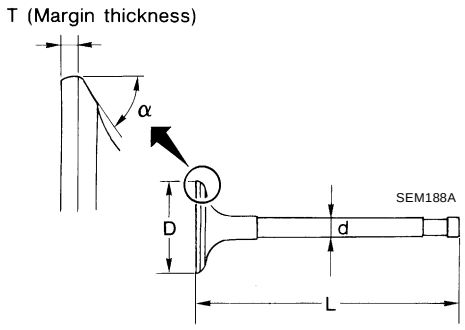
	Standard	Limit
Head surface flatness	Less than 0.03 (0.0012)	0.1 (0.004)
Height	117.8 - 118.0 (4.638 - 4.646)	—

Valve

VALVE

EBS0069Q

Unit: mm (in)



Valve head diameter “D”	Intake	29.9 - 30.2 (1.177 - 1.189)
	Exhaust	24.9 - 25.2 (0.980 - 0.992)
Valve length “L”	Intake	92.00 - 92.50 (3.6220 - 3.6417)
	Exhaust	92.37 - 92.87 (3.6366 - 3.6563)
Valve stem diameter “d”	Intake	5.465 - 5.480 (0.2152 - 0.2157)
	Exhaust	5.445 - 5.460 (0.2144 - 0.2150)
Valve face angle “α”		45°15′ - 45°45′
Valve margin “T” limit		1.05 - 1.35 (0.0413 - 0.0531)
Valve stem end surface grinding limit		0.2 (0.008)

VALVE SPRING

Free height mm (in)		41.19 (1.622)
Pressure N (kg, lb) at height mm (in)	Standard	370.0 (37.73, 83.19) at 23.64 (0.9307)
	Limit	347.8 (35.46, 78.19) at 23.64 (0.9307)
Out-of-square mm (in)		Less than 1.75 (0.0689)

VALVE LIFTER

Unit: mm (in)

Valve lifter outside diameter	29.960 - 29.975 (1.1795 - 1.1801)
Lifter guide inside diameter	30.000 - 30.021 (1.1811 - 1.1819)
Clearance between valve lifter and valve lifter guide	0.025 - 0.065 (0.0010 - 0.0026)

VALVE CLEARANCE

Unit: mm (in)

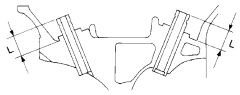
	For adjusting		For checking
	Hot	Cold* (reference data)	Hot
Intake	0.32 - 0.40 (0.013 - 0.016)	0.25 - 0.33 (0.010 - 0.013)	0.21 - 0.47 (0.008 - 0.019)
Exhaust	0.37 - 0.45 (0.015 - 0.018)	0.32 - 0.40 (0.013 - 0.016)	0.30 - 0.56 (0.012 - 0.022)

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

Whenever valve clearances are adjusted to cold specifications, check that the clearances satisfy hot specifications and adjust again if necessary.

VALVE GUIDE

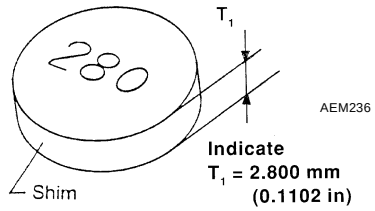
Unit: mm (in)



MEM096A

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

AVAILABLE SHIMS



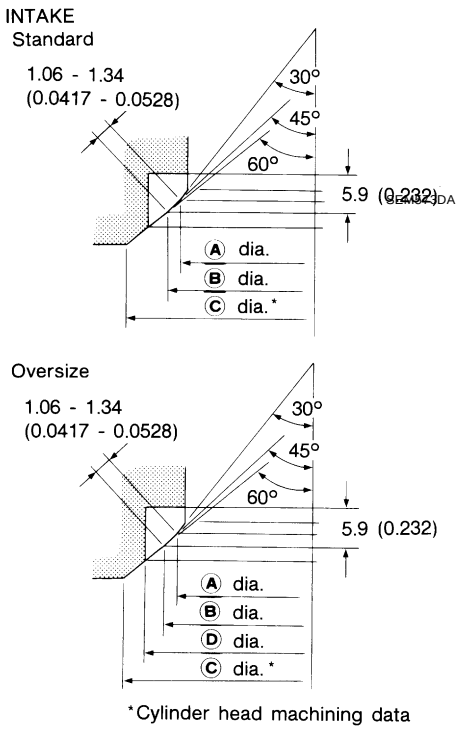
Thickness mm (in)	Identification mark
2.00 (0.0787)	200
2.02 (0.0795)	202
2.04 (0.0803)	204
2.06 (0.0811)	206
2.08 (0.0819)	208
2.10 (0.0827)	210
2.12 (0.0835)	212
2.14 (0.0843)	214
2.16 (0.0850)	216
2.18 (0.0858)	218
2.20 (0.0866)	220
2.21 (0.0870)	221

2.22 (0.0874)	222
2.23 (0.0877)	223
2.24 (0.0882)	224
2.25 (0.0885)	225
2.26 (0.0890)	226
2.27 (0.0893)	227
2.28 (0.0898)	228
2.29 (0.0901)	229
2.30 (0.0906)	230
2.31 (0.0909)	231
2.32 (0.0913)	232
2.33 (0.0917)	233
2.34 (0.0921)	234
2.35 (0.0925)	235
2.36 (0.0929)	236
2.37 (0.0933)	237
2.38 (0.0937)	238
2.39 (0.0940)	239
2.40 (0.0945)	240
2.41 (0.0948)	241
2.42 (0.0953)	242
2.43 (0.0956)	243
2.44 (0.0961)	244
2.45 (0.0964)	245
2.46 (0.0969)	246
2.47 (0.0972)	247
2.48 (0.0976)	248
2.49 (0.0980)	249
2.50 (0.0984)	250
2.51 (0.0988)	251
2.52 (0.0992)	252
2.53 (0.0996)	253
2.54 (0.1000)	254
2.55 (0.1003)	255
2.56 (0.1008)	256
2.57 (0.1011)	257
2.58 (0.1016)	258
2.59 (0.1019)	259
2.60 (0.1024)	260
2.61 (0.1027)	261
2.62 (0.1031)	262
2.63 (0.1035)	263
2.64 (0.1039)	264
2.65 (0.1043)	265
2.66 (0.1047)	266

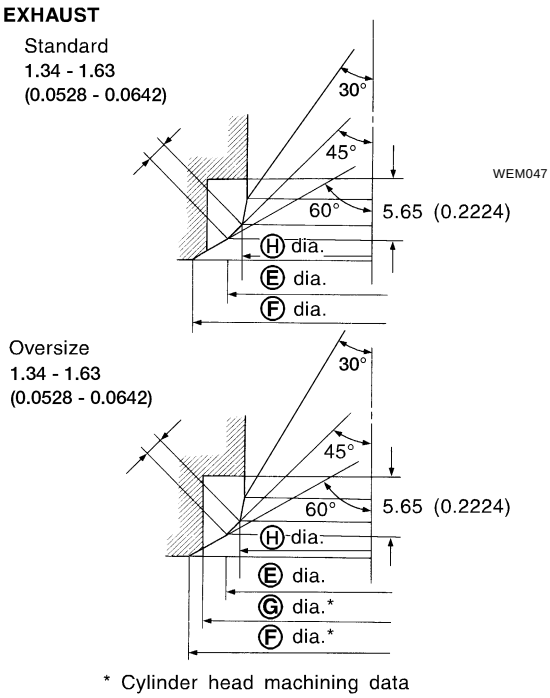
2.68 (0.1055)	268
2.70 (0.1063)	270
2.72 (0.1071)	272
2.74 (0.1079)	274
2.76 (0.1087)	276
2.78 (0.1094)	278
2.80 (0.1102)	280
2.82 (0.1110)	282
2.84 (0.1118)	284
2.86 (0.1126)	286
2.88 (0.1134)	288
2.90 (0.1142)	290
2.92 (0.1150)	292
2.94 (0.1157)	294
2.96 (0.1165)	296
2.98 (0.1173)	298

VALVE SEAT

Unit: mm (in)



*Cylinder head machining data

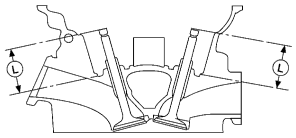


* Cylinder head machining data

Dia.	Specification	Dia.	Specification
A	27.8 - 28.0 (1.094 - 1.102)	E	24.5 - 24.7 (0.965 - 0.972)
B	29.5 - 29.7 (1.161 - 1.169)	F	26.500 - 26.516 (1.0433 - 1.0439)
C	31.9 - 32.1 (1.256 - 1.264)	G	26.2 - 26.4 (1.031 - 1.039)
D	31.500 - 31.516 (1.2402 - 1.2408)	H	22.4 - 22.6 (0.8819 - 0.8898)

VALVE SEAT RESURFACE LIMIT

Unit: mm (in)



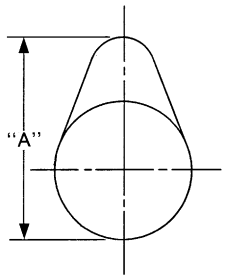
AEM343

Depth (L)	Intake	35.95 - 36.55 (1.4154 - 1.4390)
	Exhaust	35.92 - 36.52 (1.4142 - 1.4378)

Camshaft and Camshaft Bearing

EBS0069R

Unit: mm (in)



SEM671

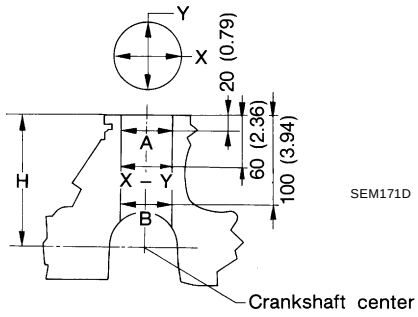
Cam height "A"	Intake	40.565 - 40.755 (1.5970 - 1.6045)	
	Exhaust	40.056 - 40.246 (1.5770 - 1.5845)	
Cam wear limit		0.20 (0.0079)	
		Standard	Limit
Camshaft journal to bearing clearance		Intake: 0.030 - 0.071 (0.0012 - 0.0028) Exhaust: 0.045 - 0.086 (0.0018 - 0.0034)	Intake: 0.135 (0.0053) Exhaust: 0.150 (0.0059)
Inner diameter of camshaft bearing	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2 to No. 5	Intake: 23.985 - 24.006 (0.9443 - 0.9451) Exhaust: 24.000 - 24.021 (0.9449 - 0.9457)	
Outer diameter of camshaft journal	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2 to No. 5	23.935 - 23.955 (0.9423 - 0.9431)	
Camshaft runout [TIR*]		Less than 0.02 (0.0008)	0.1 (0.004)
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	0.20 (0.0079)

*Total indicator reading

Cylinder Block

EBS0069S

Unit: mm (in)



SEM171D

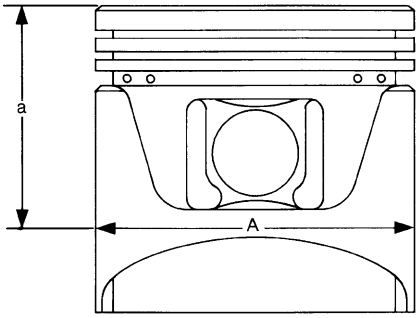
			Standard	Limit
Surface flatness			Less than 0.03 (0.0012)	0.1 (0.004)
Height “H” (nominal)			213.95 - 214.05 (8.4232 - 8.4271)	—
Cylinder bore inner diameter	Standard	Grade No. 1	80.000 - 80.010 (3.1496 - 3.1500)	0.2 (0.008)
		Grade No. 2	80.010 - 80.020 (3.1500 - 3.1504)	
		Grade No. 3	80.020 - 80.030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

Piston, Piston Ring and Piston Pin

PISTON

EBS0069T

Unit: mm (in)



SEM882E

Piston skirt diameter “A”	Standard	Grade No. 1	79.965 - 79.975 (3.1482 - 3.1486)
		Grade No. 2	79.975 - 79.985 (3.1486 - 3.1490)
		Grade No. 3	79.985 - 79.995 (3.1490 - 3.1494)
	0.25 (0.0098) oversize (service)		80.215 - 80.245 (3.1581 - 3.1592)
	0.5 (0.020) oversize (service)		80.465 - 80.495 (3.1679 - 3.1691)
“a” dimension			42.3 (1.665)
Piston pin hole inner diameter			18.993 - 19.005 (0.7478 - 0.7482)
Piston to bore clearance			0.025 - 0.045 (0.0010 - 0.0018)

PISTON RING

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.2 (0.008)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	
	Oil	0.065 - 0.135 (0.0026 - 0.0053)	
End gap	Top	0.20 - 0.39 (0.0079 - 0.0154)	0.49 (0.0193)
	2nd	0.32 - 0.56 (0.0126 - 0.0220)	0.64 (0.0252)
	Oil	0.20 - 0.69 (0.0079 - 0.0272)	1.09 (0.0429)

PISTON PIN

Unit: mm (in)

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

Connecting Rod

EBS0069U

Unit: mm (in)

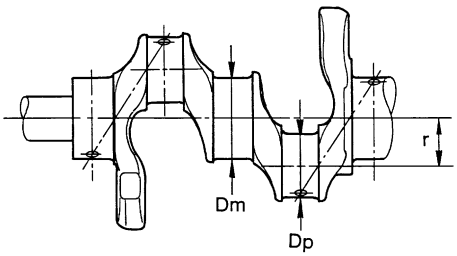
Center distance		140.45 - 140.55 (5.5295 - 5.5335)
Bend limit [per 100 (3.94)]		0.15 (0.0059)
Torsion limit [per 100 (3.94)]		0.3 (0.012)
Connecting rod bushing inner diameter* (small end)		19.000 - 19.012 (0.7480 - 0.7485)
Connecting rod big end inner diameter		43.000 - 43.013 (1.6929 - 1.6934)
Side clearance	Standard	0.200 - 0.470 (0.0079 - 0.0185)
	Limit	0.52 (0.0205)

*After installing in connecting rod

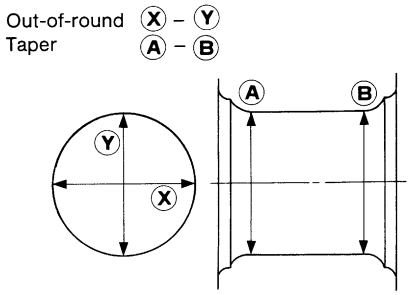
Crankshaft

EBS0069V

Unit: mm (in)



SEM645



SEM715

Main journal dia. “Dm”	Grade No. 0	49.956 - 49.964 (1.9668 - 1.9671)
	Grade No. 1	49.948 - 49.956 (1.9665 - 1.9668)
	Grade No. 2	49.940 - 49.948 (1.9661 - 1.9665)
Pin journal dia. “Dp”	Grade No. 0	39.968 - 39.974 (1.5735 - 1.5738)
	Grade No. 1	39.962 - 39.968 (1.5733 - 1.5735)
	Grade No. 2	39.956 - 39.962 (1.5731 - 1.5733)
Center distance “r”		43.95 - 44.05 (1.7303 - 1.7342)
Out-of-round (X – Y)	Standard	Less than 0.003 (0.0001)
	Limit	Less than 0.005 (0.0002)

Taper (A – B)	Standard	Less than 0.004 (0.0002)
	Limit	Less than 0.005 (0.0002)
Runout [TIR*]	Standard	Less than 0.04 (0.0016)
	Limit	Less than 0.05 (0.0020)
Free end play	Standard	0.060 - 0.220 (0.0024 - 0.0087)
	Limit	0.3 (0.012)

*: Total indicator reading

Main Bearing

EBS0069W

STANDARD

Grade No.	Thickness “T” mm (in)	Identification color
0	1.827 - 1.831 (0.0719 - 0.0720)	Black
1	1.831 - 1.835 (0.0720 - 0.0722)	Brown
2	1.835 - 1.839 (0.0722 - 0.0724)	Green
3	1.839 - 1.843 (0.0724 - 0.0725)	Yellow
4	1.843 - 1.847 (0.0725 - 0.0727)	Blue

UNDERSIZE

Unit: mm (in)

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

Connecting Rod Bearing

EBS0069X

STANDARD SIZE

Unit: mm (in)

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

UNDERSIZE

Unit: mm (in)

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

Bearing Clearance

EBS0069Y

Unit: mm (in)

Main bearing clearance	Standard	0.018 - 0.042 (0.0007 - 0.0017)
	Limit	0.1 (0.004)
Connecting rod bearing clearance	Standard	0.014 - 0.039 (0.0006 - 0.0015)
	Limit	0.1 (0.004)

Miscellaneous Components

EBS0069Z

Unit: mm (in)

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

*: Total indicator reading at measuring point 115 mm (4.53 in) from crankshaft center.

PRECAUTIONS

PFP:00001

Precautions for Draining Coolant

EBS006A0

- Drain coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS006A1

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

Precautions for Removal and Disassembly

EBS006A2

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

Precautions for Inspection, Repair and Replacement

EBS006A3

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

Precautions for Assembly and Installation

EBS006A4

- 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, follow the specifications.
- Always replace the old with a 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.
- Bleed the air trapped within the system after draining the coolant.
- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage or rattles.

Parts Requiring Angular Tightening

EBS006A5

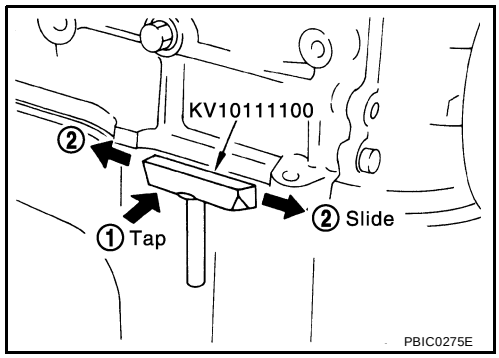
- Use an angle wrench for the final tightening of the following engine parts.
  - Cylinder head bolts
  - Lower cylinder block bolts
  - Connecting rod cap bolts
  - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)
- Do not use a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

Precautions for Liquid Gasket

EBS006A6

REMOVAL OF LIQUID GASKET SEALING

- After removing the mounting bolts and nuts, disconnect the component using a seal cutter.



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 sealant is applied to disconnect the component.

CAUTION:

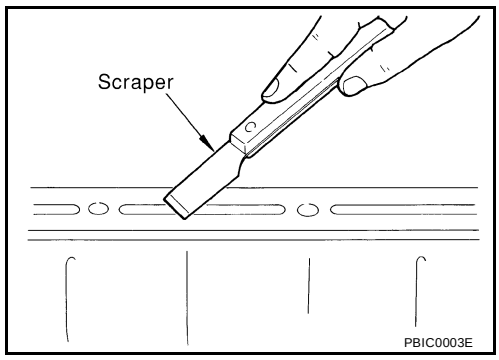
If for some unavoidable reason a tool such as a flat-bladed screwdriver is used, be careful not to damage the mating surfaces.

LIQUID GASKET APPLICATION PROCEDURE

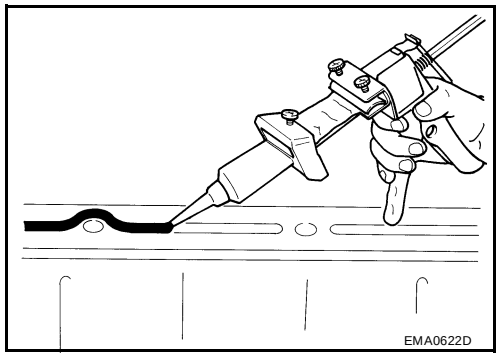
1. Using a scraper, remove the old RTV Silicone Sealant adhering to the gasket application surface and the mating surface.

- Remove the sealant completely from the groove of the gasket application surface, mounting bolts, and bolt holes.

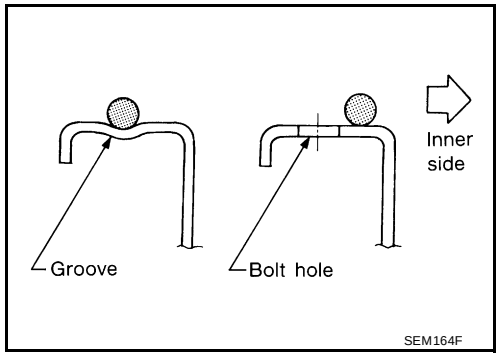
2. Thoroughly clean the gasket application surface and the mating surface and remove adhering moisture, grease and foreign materials.
3. Attach the sealant tube to the tube presser.
   Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



4. Apply the sealant without breaks to the specified location with the specified dimensions.



- If there is a groove for the sealant application, apply the sealant to the groove.
- As for the bolt holes, normally apply the sealant inside the holes. If specified, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of the sealant application, install the mating component.
- If the sealant protrudes, wipe it off immediately.
- Do not retighten after the installation.
- After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS" .



CAUTION:

Follow all specific instructions in this manual.

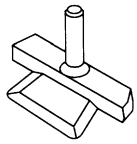
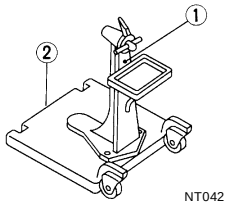
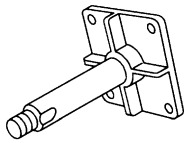
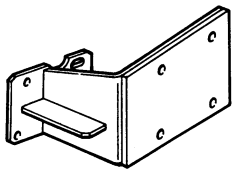
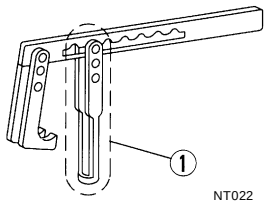
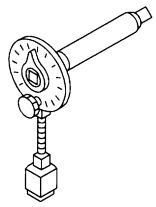
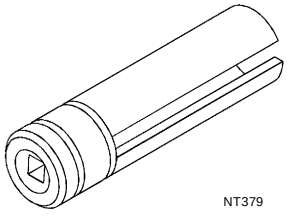
PREPARATION

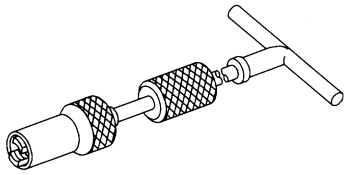
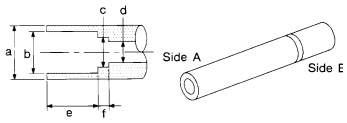
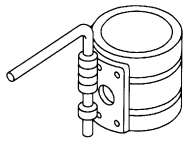
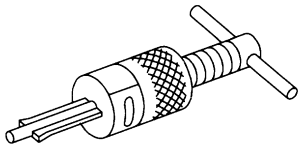
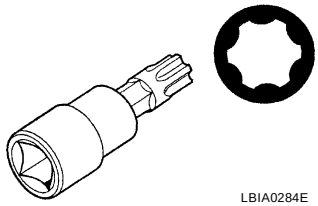
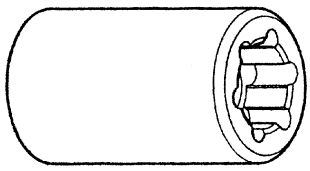
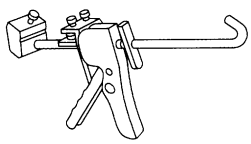
PFP:00002

Special Service Tools

EBS006A7

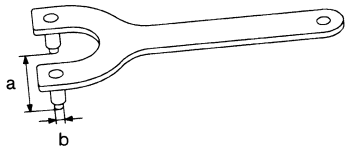
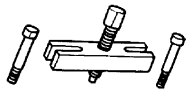
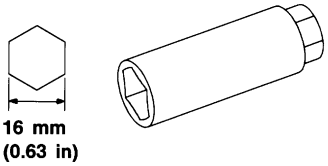
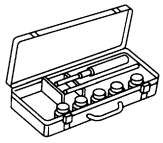
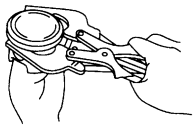
The actual shapes of the Kent-Moore tools may differ from those of the special service tools illustrated here.

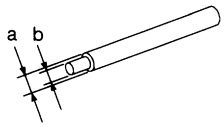
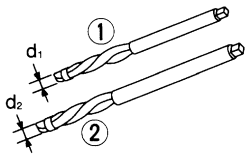
Tool number (Kent-Moore No.) Tool name		Description
KV10111100 (J-37228) Seal cutter	 S-NT046	Removing oil pan and timing chain case
ST0501S000 Engine stand assembly 1, ST05011000 (—) Engine stand 2, ST05012000 (—) Base	 NT042	Disassembling and assembling
KV10106500 (—) Engine stand shaft	 NT028	
KV10115300 (—) Engine sub-attachment	 ZZA1078D	
KV10116200 (J26336-B) Valve spring compressor 1, KV10115900 (J-26336-20) Attachment	 NT022	Disassembling valve mechanism
KV10112100 (BT8653-A) Angle wrench	 S-NT014	Tightening bolts for bearing cap, cylinder head, etc.
KV10117100 (J-36471-A) Heated oxygen sensor wrench	 NT379	Loosening or tightening heated oxygen sensors with 22 mm 80.87 in) hexagon nut

Tool number (Kent-Moore No.) Tool name	Description
KV10107902 (J-38959) Valve oil seal puller  S-NT011	Removing valve oil seal
KV10115600 (J-38958) Valve oil seal drift  S-NT603	Installing valve oil seal **Use side A.** **a: 20 (0.79) dia.** **d: 8 (0.31) dia.** **b: 13 (0.51) dia.** **e: 10.7 (0.421) dia.** **c: 10.3 (0.406) dia.** **f: 5 (0.20) dia.** Unit: mm (in)
EM03470000 (J-8037) Piston ring compressor  S-NT044	Installing piston assembly into cylinder bore
ST16610001 (J-23907) Pilot bushing puller  S-NT045	Removing crankshaft pilot bushing
(J-45737) TP50 Torx® plus bit  LBIA0284E	Removing and installing M/T flywheel bolts
(J-45816) E20 Torx® socket  LBIA0285E	Removing and installing A/T drive plate bolts
WS39930000 (—) Tube presser  S-NT052	Pressing the tube of liquid gasket

Commercial Service Tools

EBS006A8

(Kent-Moore No.) Tool name	Description
Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
Pulley holder  NT628	Crankshaft pulley removing and installing **a: 68 mm (2.68 in) dia.** **b: 8mm (0.31 in) dia.**
Crank puller  ZZA0010D	Crankshaft pulley removing
Spark plug wrench  S-NT047	Removing and installing spark plug
Valve seat cutter set  S-NT048	Finishing valve seat dimensions
Piston ring expander  S-NT030	Removing and installing piston ring

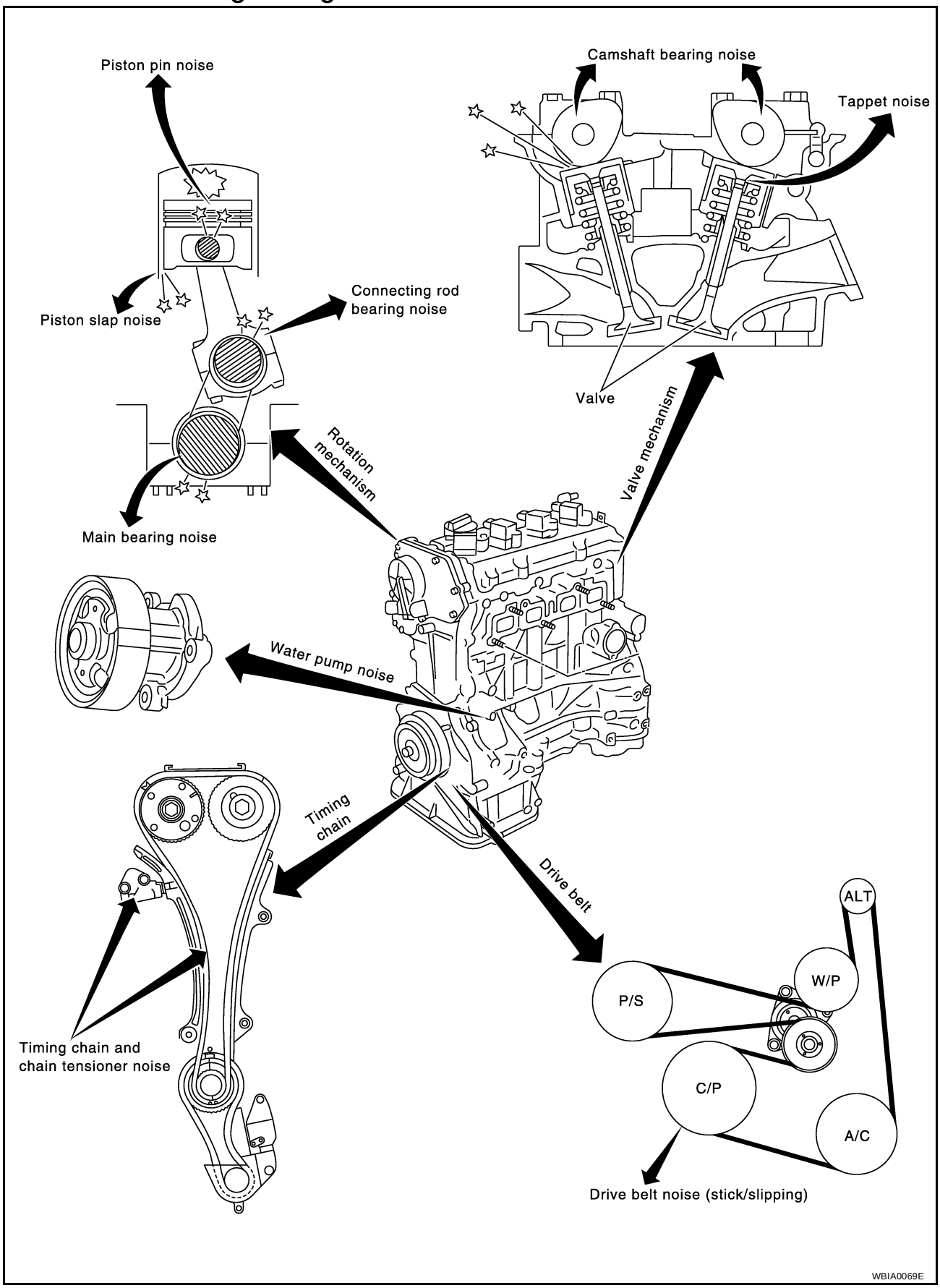
(Kent-Moore No.) Tool name	Description
Valve guide drift  S-NT015	Removing and installing valve guide **Intake & Exhaust:** **a: 9.5 mm (0.374 in) dia.** **b: 5.5 mm (0.217 in) dia.**
Valve guide reamer  S-NT016	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide **Intake & Exhaust:** **d_1 : 6.0 mm (0.236 in) dia.** **d_2 : 10.2 mm (0.402 in) dia.**
Oxygen sensor thread cleaner a: (J-43897-18) b: (J-43897-12)	Reconditioning the exhaust system threads before installing a new oxygen sensor (Use with anti-seize lubricant shown below.) **a: (18 mm 0.71in) for zirconia oxygen sensor** **b: (12 mm 0.47 in) for titania oxygen sensor**
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting — Engine Noise

EBS006A9



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

EBS006AA

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.
5. 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-118
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-114 EM-113
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-159 EM-159
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-158 EM-158 EM-158 EM-158
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-159 EM-159
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-164 EM-163
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-121
Front of engine	Squeaking or fizzing	A	B	—	B	—	B	Drive belts (Sticking or slipping)	Drive belts deflection	EM-89
	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-25

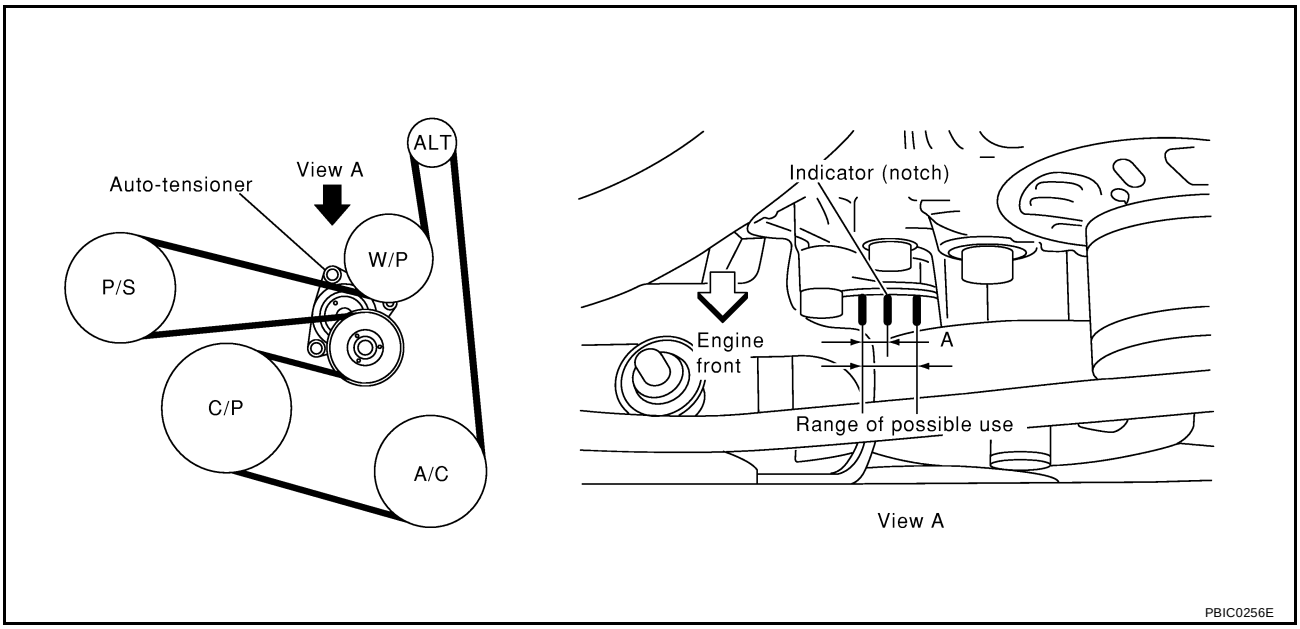
A: Closely related B: Related C: Sometimes related —: Not related

DRIVE BELTS

PFP:02117

Checking Drive Belts

EBS006AB



NOTE:
On vehicles not equipped with A/C, there is an idler pulley in the position for the drive belt routing.

WARNING:
Inspect the drive belt only when the engine is stopped.

- Make sure that the stamp mark of auxiliary drive belt auto-tensioner is within the usable range.

  NOTE:
  - Check the auto-tensioner indication when the engine is cold.
  - When the new drive belt is installed, the range should be A.
  - Visually check entire belt for wear, damage or cracks.
  - If the indicator is out of allowable use range or belt is damaged, replace the belt.

Tension Adjustment

EBS006AC

Belt tension is not manually adjustable, it is automatically adjusted by the auto-tensioner.

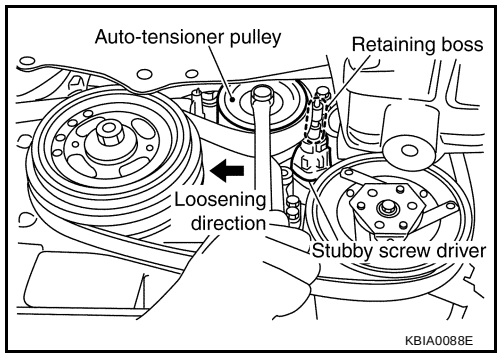
Removal and Installation

EBS006AD

REMOVAL

1. Remove front RH engine side cover.
2. With box wrench, and while securely holding the hexagonal part in pulley center of automatic tensioner, move the wrench handle in the direction of arrow (loosening direction of tensioner).

   CAUTION:
   Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.
3. Insert a rod approximately 6 mm (0.24 in) in diameter from the rear into the holding boss to hold the tensioner pulley.
   - Leave tensioner pulley arm locked until belt is installed again.
4. Loosen auxiliary drive belt from water pump pulley in sequence, and remove it.



INSTALLATION

1. With box wrench, and while securely holding the hexagonal part in pulley center of automatic tensioner, move the wrench handle in the direction of arrow [loosening direction of tensioner].

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

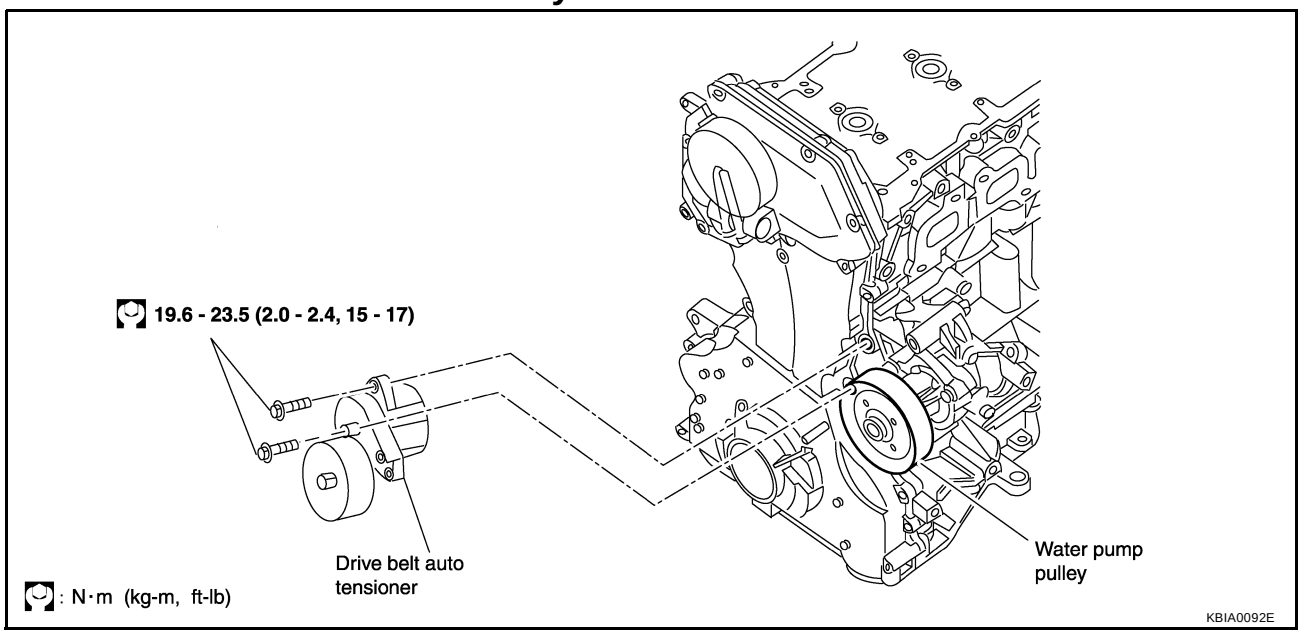
2. Insert a rod approximately 6 mm (0.24 in) in diameter through the rear of engine into holding boss to fix tensioner pulley.
3. Hook the auxiliary drive belt onto all of the pulleys except for the water pump pulley. Hook the drive belt onto water pump pulley last.

CAUTION:
Confirm belts are completely set on the pulleys.

4. Release tensioner, and apply tensions to belt.
5. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
6. Confirm tensions of belt at indicator is within the allowable use range. Refer to EM-89, "Checking Drive Belts" .

Removal and Installation of Auxiliary Drive Belt Auto-tensioner

EBS006AE



REMOVAL

1. Remove the front RH engine side cover.
2. Remove the auxiliary drive belt.
   - Keep the auto-tensioner pulley held back with a tool such as a short-length screwdriver.
3. Remove the alternator. Refer to SC-32, "Removal" .
4. Remove the auxiliary drive belt auto-tensioner.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:
Install the auxiliary drive belt auto-tensioner carefully so as not to damage the water pump pulley.

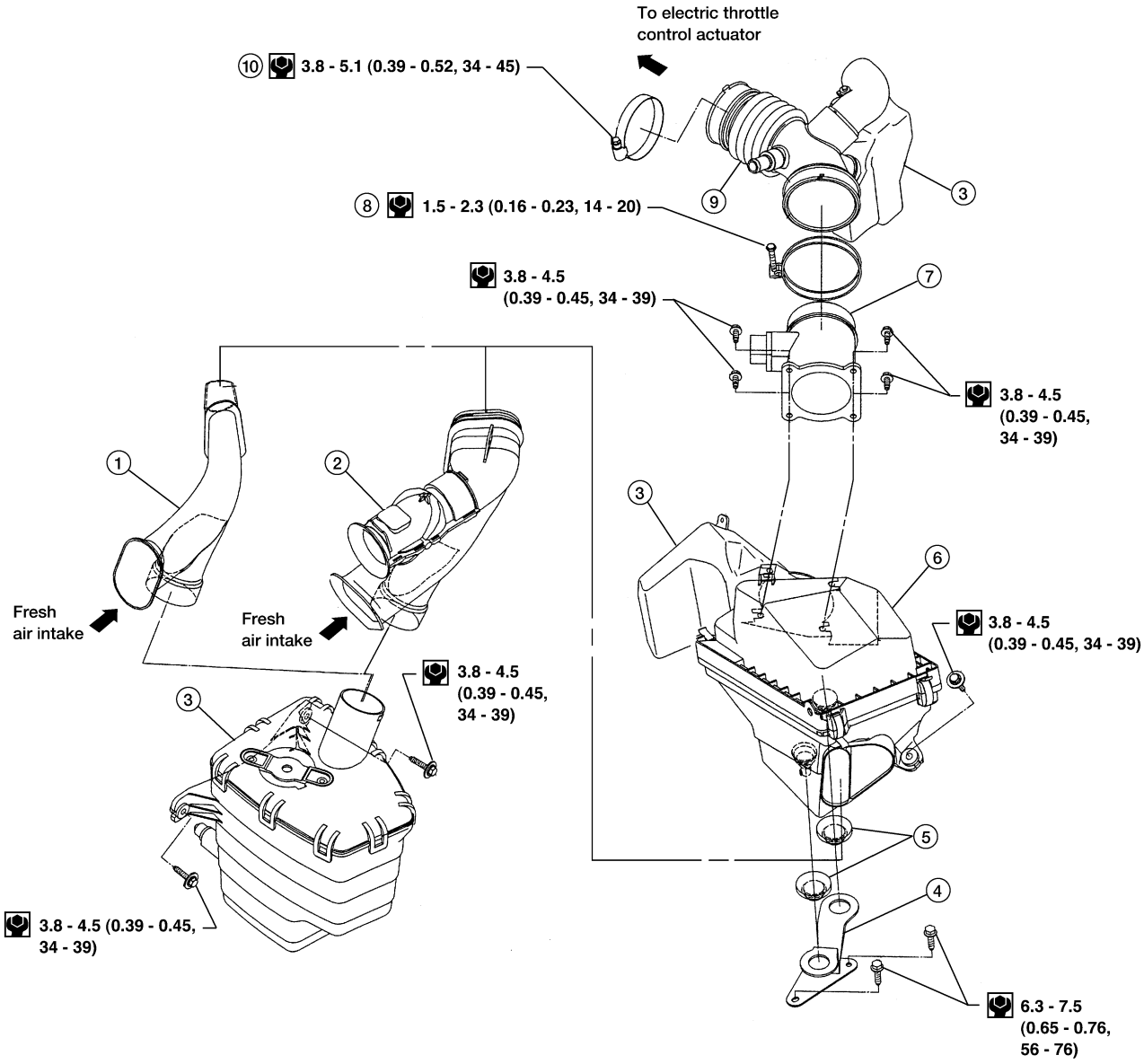
AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

EBS006AF

SEC. 165



: N·m (kg-m, in-lb)

LBIA0332E

1. Fresh air intake tube (SE-R Spec V models only)
2. Fresh air intake tube (all models except SE-R Spec V)
3. Resonator
4. Mounting bracket
5. Grommets
6. Air cleaner case (upper and lower)
7. Mass air flow sensor
8. Mass air flow sensor clamp
9. Air cleaner to electric throttle control actuator tube
10. Air cleaner to electric throttle control actuator tube clamp

REMOVAL

1. Disconnect the mass air flow sensor electrical connector.
2. Disconnect the tube clamp at the electric throttle control actuator.
3. Remove air cleaner to electric throttle control actuator tube and air cleaner case (upper) with the mass air flow sensor attached.
4. Remove mass air flow sensor from air cleaner case (upper), as necessary.

   CAUTION:
   Handle the mass air flow sensor with care:
   - **Do not shock it.**
   - **Do not disassemble it.**
   - **Do not touch the internal sensor.**
5. Remove the air cleaner element, as necessary and replace it with a new element.
6. Remove the air cleaner case (lower).

INSTALLATION

Installation is in the reverse order of removal.

- Attach each joint according to the alignment marks made during removal. Screw all clamps firmly.

CHANGING THE AIR CLEANER ELEMENT

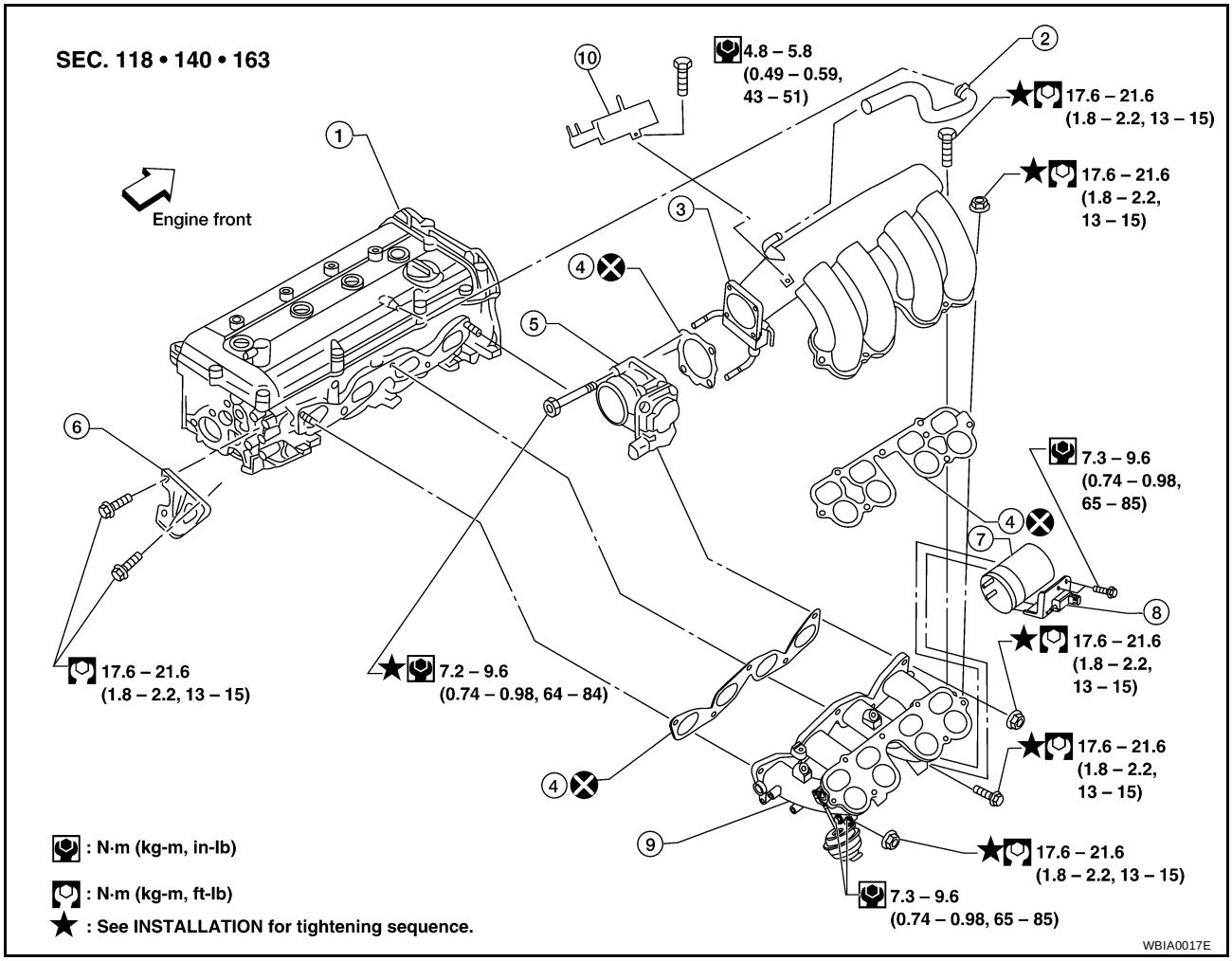
1. Unhook the air cleaner case side clips and raise the air cleaner case (upper).
2. Remove the air cleaner element.
3. Replace the air cleaner element with a new element and install the air cleaner case (upper).

INTAKE MANIFOLD

PFP:14003

Removal and Installation

EBS006AG



1. Cylinder head assembly	2. PCV hose	3. Intake manifold collector
4. Gasket	5. Electric throttle control actuator	6. Intake manifold support
7. Vacuum reservoir tank	8. VIAS control solenoid valve	9. Intake manifold
10. EVAP canister purge volume control solenoid		

REMOVAL

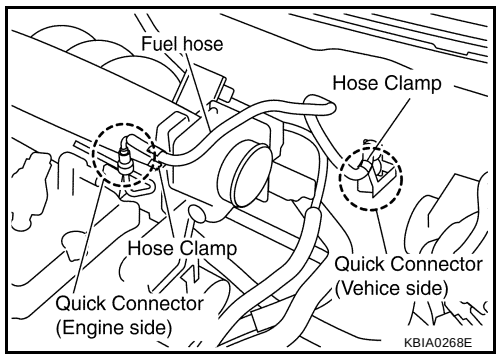
WARNING:

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

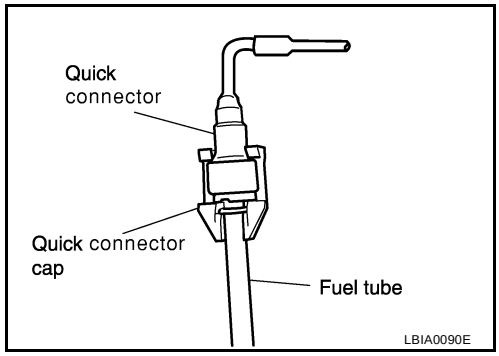
1. Disconnect the negative battery terminal.
2. Release the fuel pressure.
   Refer to EC-1255, "FUEL PRESSURE RELEASE" .
3. Drain coolant when engine is cooled. Refer to MA-15, "DRAINING ENGINE COOLANT" .
4. Disconnect the MAF sensor electrical connector.
5. Remove air cleaner case and air duct assembly.
   Refer to EM-91, "Removal and Installation" .
6. Disconnect the following components at the intake side:

a. PCV hose
b. EVAP canister purge volume control solenoid
c. Electric throttle control actuator
d. Brake booster vacuum hose

7. Disconnect the fuel quick connector on the engine side.
   - Using the quick connector release tool (hereinafter called “release tool”), perform the following steps to disconnect quick connector.



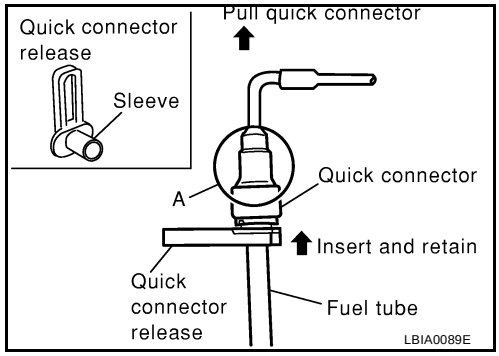
a. Remove quick connector cap.



b. With the sleeve side of release facing quick connector, install release tool onto fuel tube.

c. Insert release tool into quick connector until sleeve contacts and goes no further. Hold the release tool on that position.

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



d. Pull the quick connector straight out from the fuel tube.

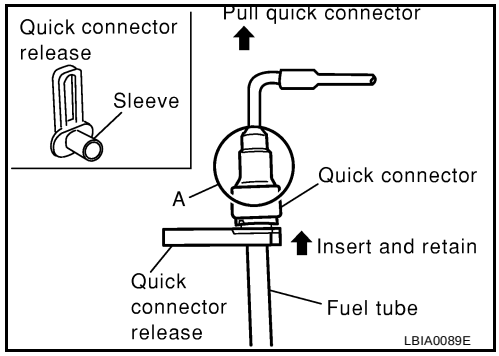
CAUTION:
- **Pull quick connector holding it at the "A" position, as shown in illustration.**
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Be sure to cover openings of disconnected pipes with plug or plastic bag to avoid fuel leakage and entry of foreign materials.**

8. If necessary, disconnect the fuel hose quick connector, on the vehicle piping side, using the quick connector release tool (here after called "release tool"). Perform the following steps to disconnect the vehicle piping side quick connector.

a. With the sleeve side of release facing quick connector, install release tool onto fuel tube.

b. Insert release tool into quick connector until sleeve contacts and goes no further. Hold the release tool on that position.

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



c. Pull the quick connector straight out off of the fuel tube.

CAUTION:
- **Pull the quick connector while holding it at the "A" position, as shown.**

- **Do not pull with lateral force applied or O-ring inside the quick connector may be damaged.**
- **Prepare a container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Be sure to cover the openings of disconnected pipes with plug or plastic bag to avoid fuel leakage and entry of foreign materials.**

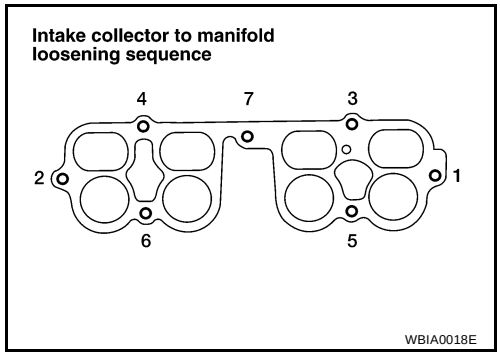
9. Loosen mounting bolts diagonally, and remove the electric throttle control actuator.

CAUTION:
Handle carefully to avoid any damage.

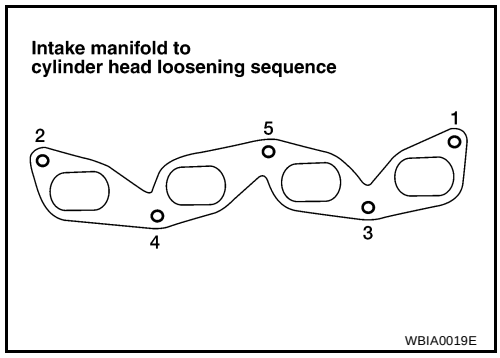
10. Disconnect intake manifold collector harness, and vacuum hose.

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

11. Remove intake manifold collector mounting bolts on the support.
12. Loosen the mounting bolts and nuts in the order shown to remove the intake manifold collector.



13. Loosen the bolts in the order shown to remove the intake manifold assembly.

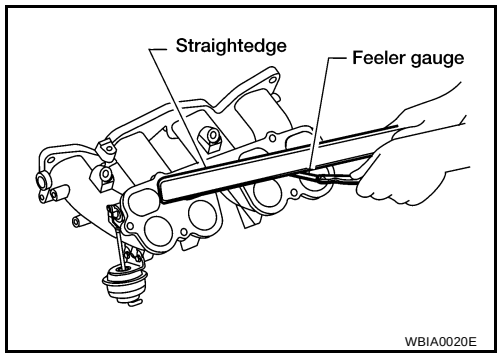


INSPECTION AFTER REMOVAL

Surface Distortion

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

Standard : 0.1 mm (0.004 in)



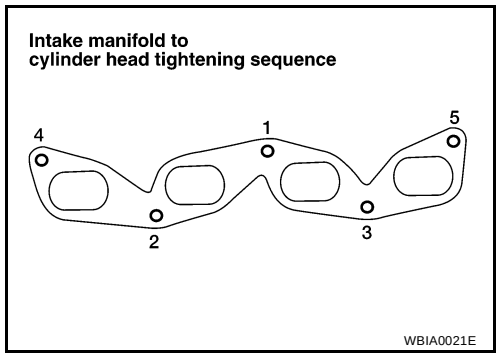
INSTALLATION

Installation is in the reverse order of removal. Pay attention to the following for installation.

Tightening Intake Manifold Bolts and Nuts

Install the intake manifold bolts and nuts in the numerical order of the tightening sequence as shown.

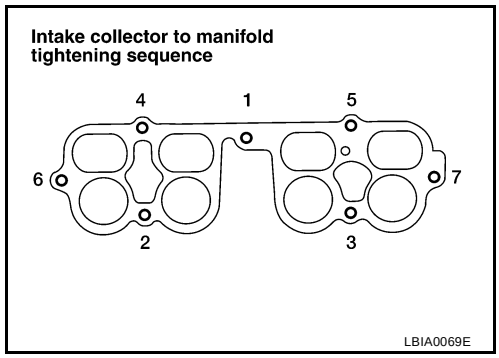
CAUTION:
After tightening No.5, retighten the No.1 mounting bolt to specification.



Tightening Intake Manifold Collector Bolts and Nuts

Tighten in numerical order as shown.

CAUTION:
After tightening No.7, retighten the No.1 mounting bolt to specification.



Installation of Electric Throttle Control Actuator

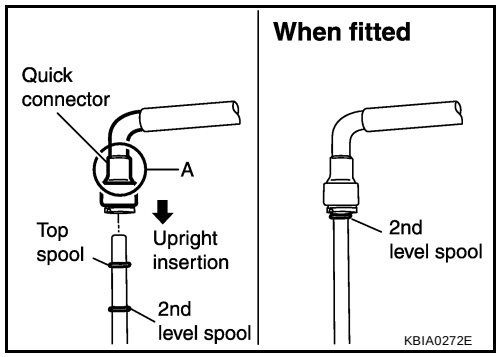
1. Tighten the mounting bolts of electric throttle control actuator equally and diagonally in several steps.

Electric throttle control actuator mounting bolts : 7.2 - 9.6 N·m (0.74 - 0.98 kg-m, 64 - 84 in-lb)

2. After installation, perform the procedure in EM-97, "INSPECTION AFTER INSTALLATION" .

Connecting Quick Connector on the Fuel Hose (Engine Side)

1. Make sure no foreign substances are deposited in and around the fuel tube and quick connector, and there is no damage to them.
2. Thinly apply new engine oil around the fuel tube tip end.
3. Align center to insert quick connector straight into fuel tube.
   - Insert fuel tube into quick connector until the top spool on fuel tubes is inserted completely and the second level spool is positioned slightly below the quick connector bottom end.

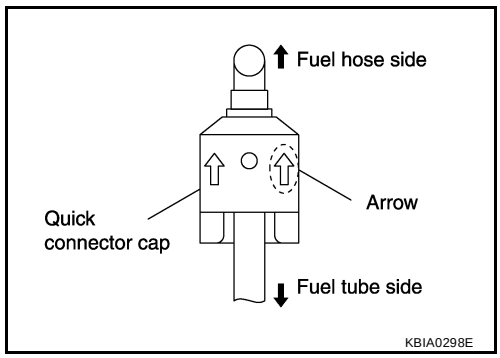


   CAUTION:
   - **Hold at position "A" as shown, when inserting the fuel tube into the quick connector.**
   - **Carefully align to center to avoid inclined insertion to prevent damage to the O-ring inside the quick connector.**
   - **Insert the fuel tube until you hear a “click” sound and actually feel the engagement.**
   - **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**
4. Before clamping the fuel hose with the hose clamp, pull the quick connector hard by hand, holding at the "A" position, as shown. Make sure it is completely engaged (connected) so that it does not come off of the fuel tube.

   NOTE:
   Recommended pulling force is 50 N (5.1 kg, 11.2 lb).

5. Install quick connector cap on quick connector joint.

- Direct arrow mark on quick connector cap to upper side (fuel hose side).

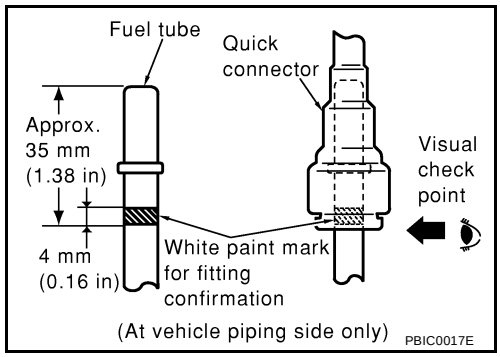


6. Install fuel hose to hose clamp.

Connecting Quick Connector on the Fuel Hose (Vehicle Piping Side)

1. Make sure no foreign substances are deposited in and around the fuel tube and quick connector, and there is no damage to them.
2. Thinly apply new engine oil around the fuel tube tip end.
3. Align center to insert quick connector straight into fuel tube.
   - Insert fuel tube into quick connector until the top spool on fuel tubes is inserted completely and the paint mark is positioned slightly below the quick connector bottom end.

   CAUTION:
   - **Carefully align to center to avoid inclined insertion to prevent damage to the O-ring inside the quick connector.**
   - **Insert the tube until you hear a “click” sound and actually feel the engagement.**
   - **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**



4. Before clamping the fuel hose with the hose clamp, pull the quick connector hard by hand. Make sure it is completely engaged (connected) so that it does not come off of the fuel tube.

   NOTE:
   Recommended pulling force to check the quick connector is properly engaged is 50 N (5.1 kg, 11.2 lb).
5. Install the fuel hose to the hose clamp.

INSPECTION AFTER INSTALLATION

1. Start the engine and run it for a few minutes with the engine at idle.
2. Stop the engine and check for fuel leakage both visually and by odor of gasoline.
   - Perform procedures for “Throttle Valve Closed Position Learning” after finishing repairs. Refer to EC-1253, "Throttle Valve Closed Position Learning" .
   - If electric throttle control actuator is replaced, perform procedures for “Idle Air Volume Learning” after finishing repairs. Refer to EC-1253, "Idle Air Volume Learning" .

   CAUTION:
   Do not touch engine immediately after stopping as engine is extremely hot.

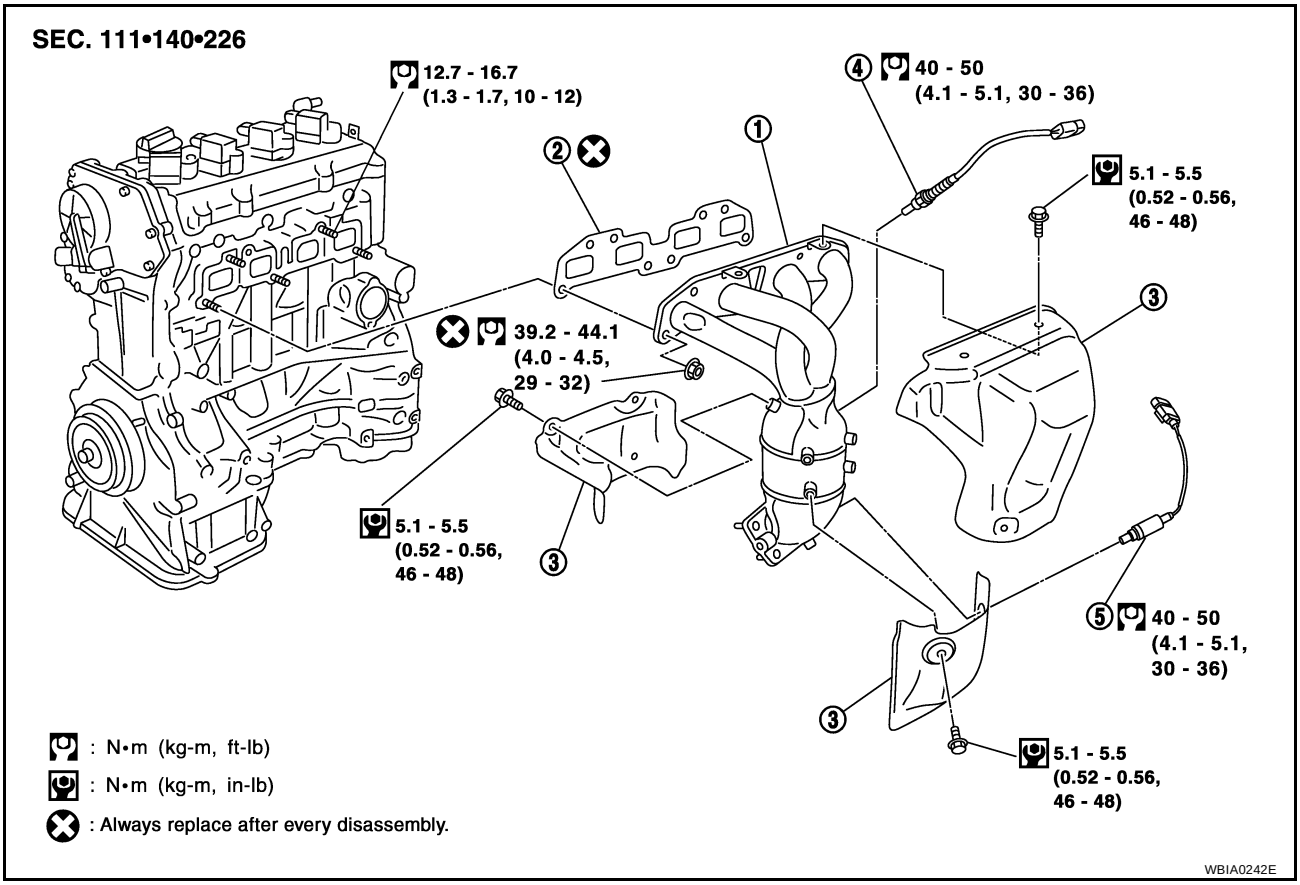
   NOTE:
   Use mirrors for checking on connections out of the direct line of sight.

EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

Removal and Installation

EBS006AH

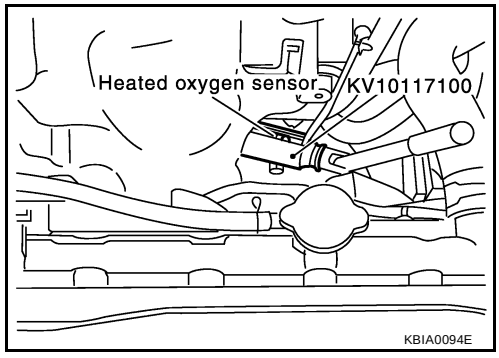


1. Exhaust manifold and three way catalyst assembly
2. Exhaust manifold gasket
3. Exhaust manifold covers (upper and lowers)
4. Heated oxygen sensor 1 (front)
5. Heated oxygen sensor 2 (rear)

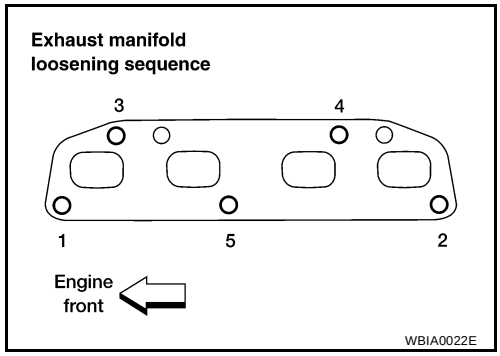
REMOVAL

1. Remove the engine undercover.
2. Disconnect the electrical connector of each heated oxygen sensor, and unhook the harness from the bracket and middle clamp on the cover.
3. Remove the heated oxygen sensors with Tool.

   CAUTION:
   - **Be careful not to damage heated oxygen sensor.**
   - **Discard any heated oxygen sensor which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; use a new one.**
4. Remove the lower exhaust manifold covers.
5. Remove the exhaust front tube. Refer to EX-3, "Removal and Installation" .
6. Remove the upper exhaust manifold cover.



7. Loosen the nuts in the sequence shown, on the exhaust manifold and three way catalyst.
8. Remove the exhaust manifold and three way catalyst assembly and gasket. Discard the gasket.

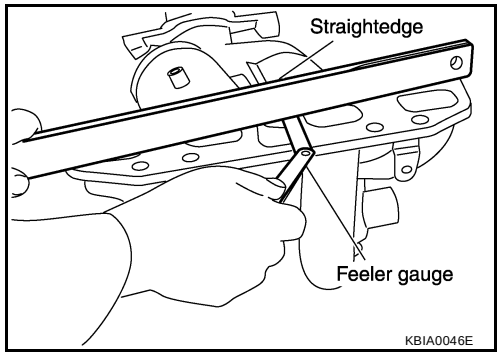


INSPECTION AFTER REMOVAL

Surface Distortion

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

Standard : 0.3 mm (0.012 in)

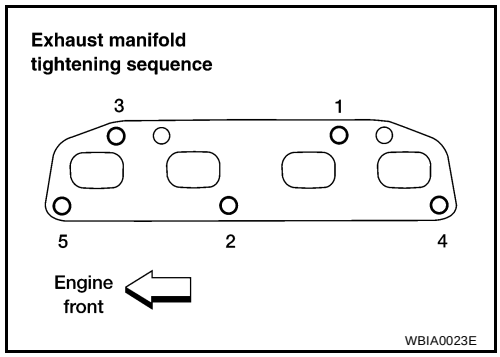


INSTALLATION

Installation is in the reverse order of removal. Pay attention to the following.

Tightening Exhaust Manifold Nuts

Tighten the nuts in the numerical order shown, to specification. After tightening No.5, retighten No.1 and then No.3 to specification.



Installation of Heated Oxygen Sensors

Clean the heated oxygen sensor threads with the Tool, then apply the anti-seize lubricant to the threads before installing the heated oxygen sensors.

CAUTION:

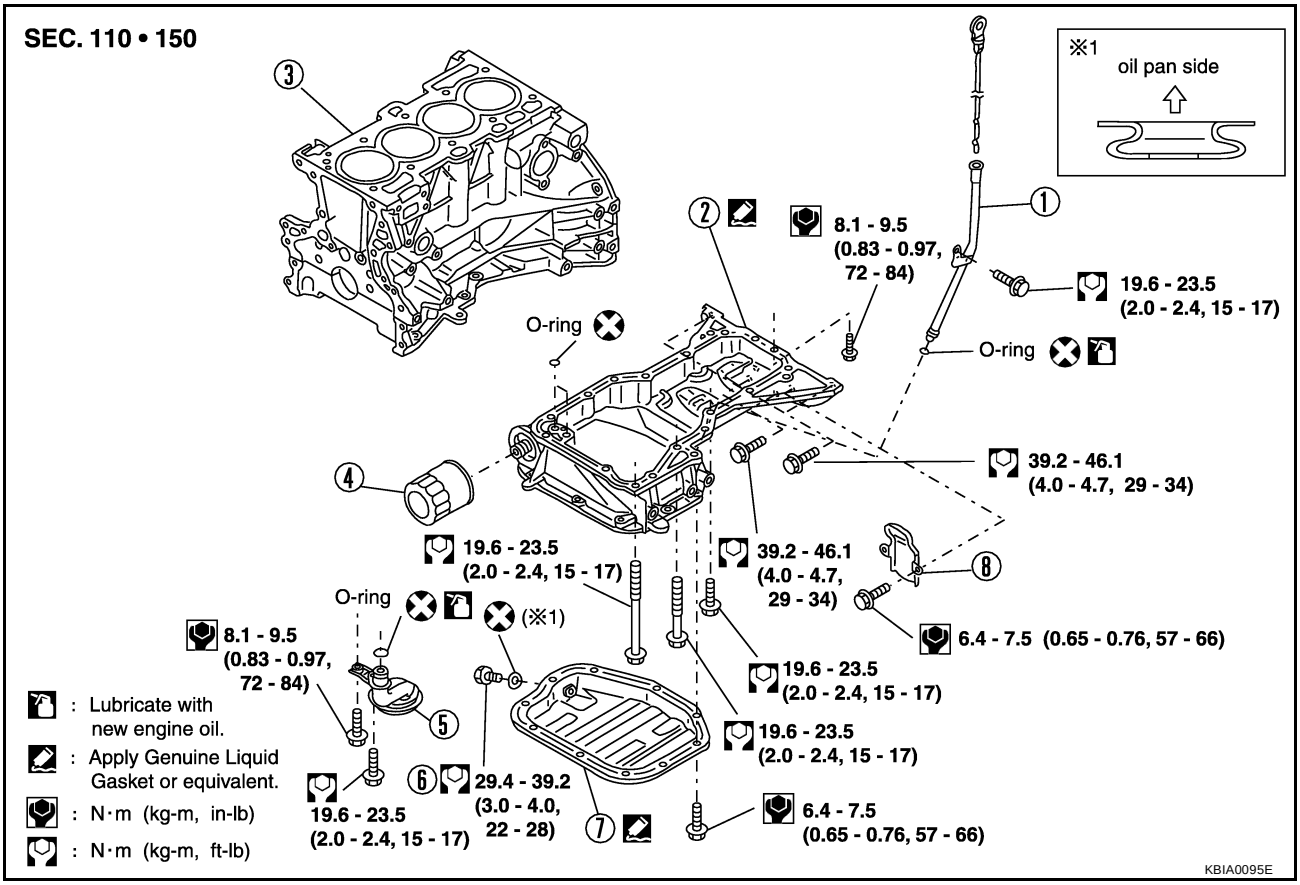
Do not over-tighten the heated oxygen sensors. Doing so may cause damage to the heated oxygen sensors, resulting in a malfunction and the MIL coming on.

OIL PAN AND OIL STRAINER

PFP:11110

Removal and Installation

EBS006AI



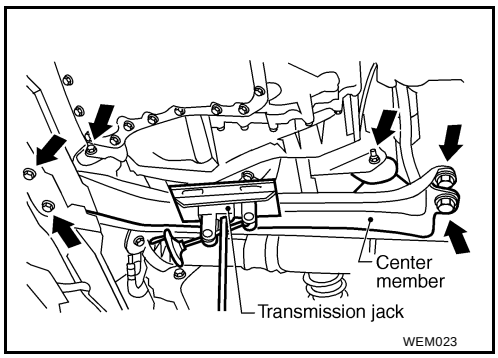
1. Oil level gauge tube
2. Oil pan, upper
3. Cylinder block
4. Oil filter
5. Oil pickup screen
6. Drain plug
7. Oil pan, lower
8. Rear plate cover

REMOVAL

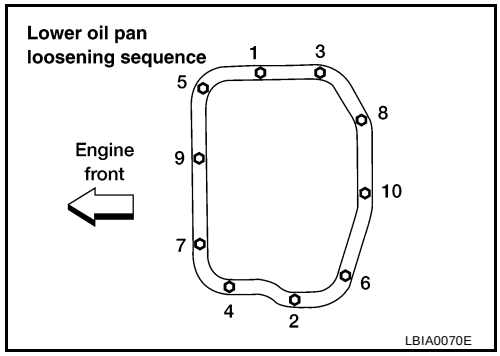
WARNING:

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

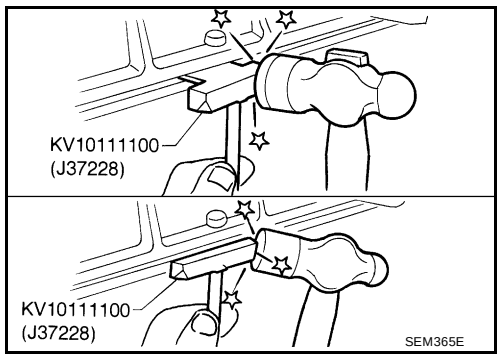
1. Remove the engine undercovers on both sides.
2. Drain engine oil. Refer to LU-17, "Changing Engine Oil" .
3. Remove the front exhaust tube. Refer to EX-3, "Removal and Installation" .
4. Set a suitable transmission jack under the transaxle. Lift the engine slightly from above by the engine slingers.
5. Remove the center member.
   - Remove the front and rear engine mount through bolts and center member bolts.
6. Disconnect the A/C compressor with piping connected from the mounting bracket and suspend with a strong wire. Refer to MTC-71, "Removal and Installation" .



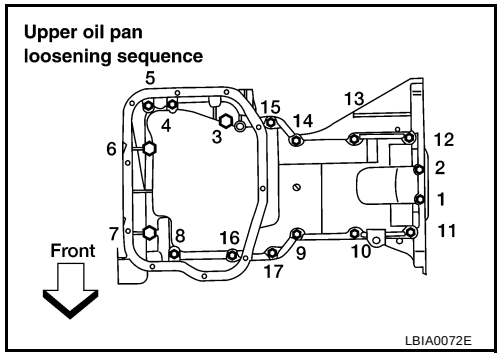
7. Remove the lower oil pan bolts. Loosen the bolts in the order shown.



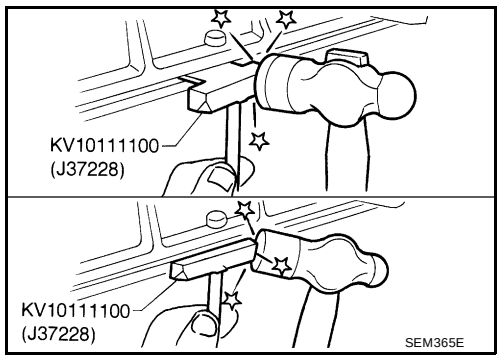
8. Insert the Tool (Seal cutter) between lower oil pan and the upper oil pan to separate them. Tap gently on the side to move the Tool around the pan; do not damage the mating surface.
9. Remove the lower oil pan.
10. Remove the oil pickup screen.
11. Remove rear plate cover, and four engine to transaxle bolts.



12. Loosen the upper oil pan bolts in the numerical order shown to remove the upper oil pan.



13. Insert the Tool (Seal cutter) between the upper oil pan and the cylinder block to separate them. Tap gently on the side to move the Tool around the pan; do not damage the mating surface.



14. Remove the upper oil pan.

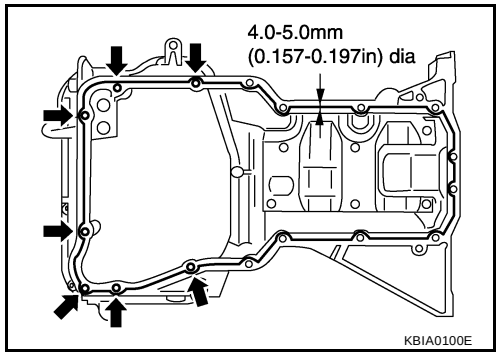
INSPECTION AFTER REMOVAL

Clean the oil pickup screen to remove any foreign material.

INSTALLATION

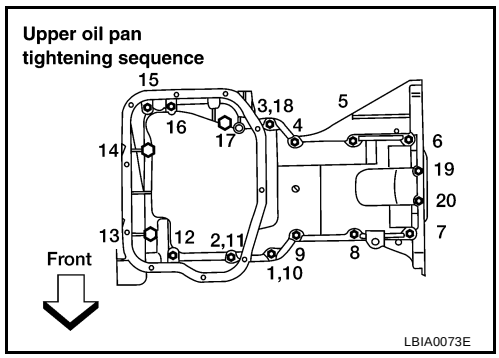
1. Installation is in the reverse order of removal. Pay attention to the following.

a. Apply Genuine RTV Silicone Sealant, or equivalent, to the upper oil pan. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" , and EM-82, "Precautions for Liquid Gasket" .
   - Install the two new O-rings in the upper oil pan.

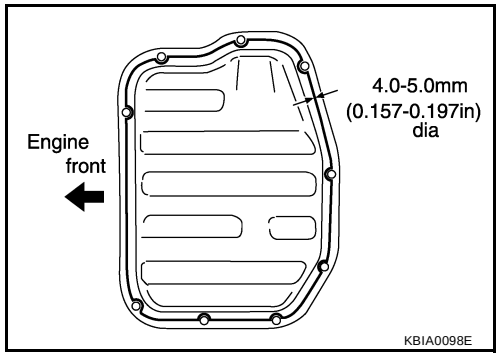


b. Tighten the upper oil pan bolts in the order as shown.
   - Bolt No.10,11,18 indicate a double tightening in the sequence of bolt No.s 1, 2, 3.

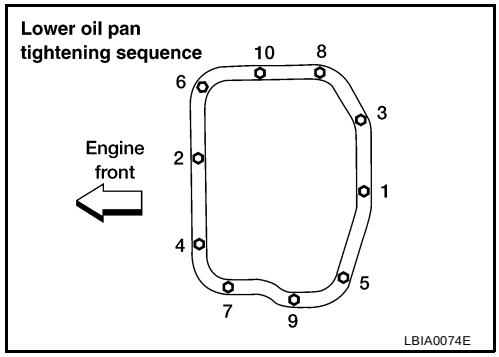
   NOTE:
   Refer below for specified bolt sizes:
   M6 × 20 mm (0.79 in): No.19, 20
   M8 × 25 mm (0.98 in): No.1, 3, 4, 9
   M8 x 45 mm (1.77 in): No.2, 5, 6, 7, 8, 17
   M8 x100 mm (3.97 in): No.12, 13, 14, 15, 16



c. Apply Genuine Silicone RTV Sealant, or equivalent to the lower oil pan. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" , and EM-82, "Precautions for Liquid Gasket" .



d. Tighten the lower oil pan bolts in the numerical order shown.
   - Wait at least 30 minutes after the oil pans are installed before filling the engine with oil.



INSPECTION AFTER INSTALLATION

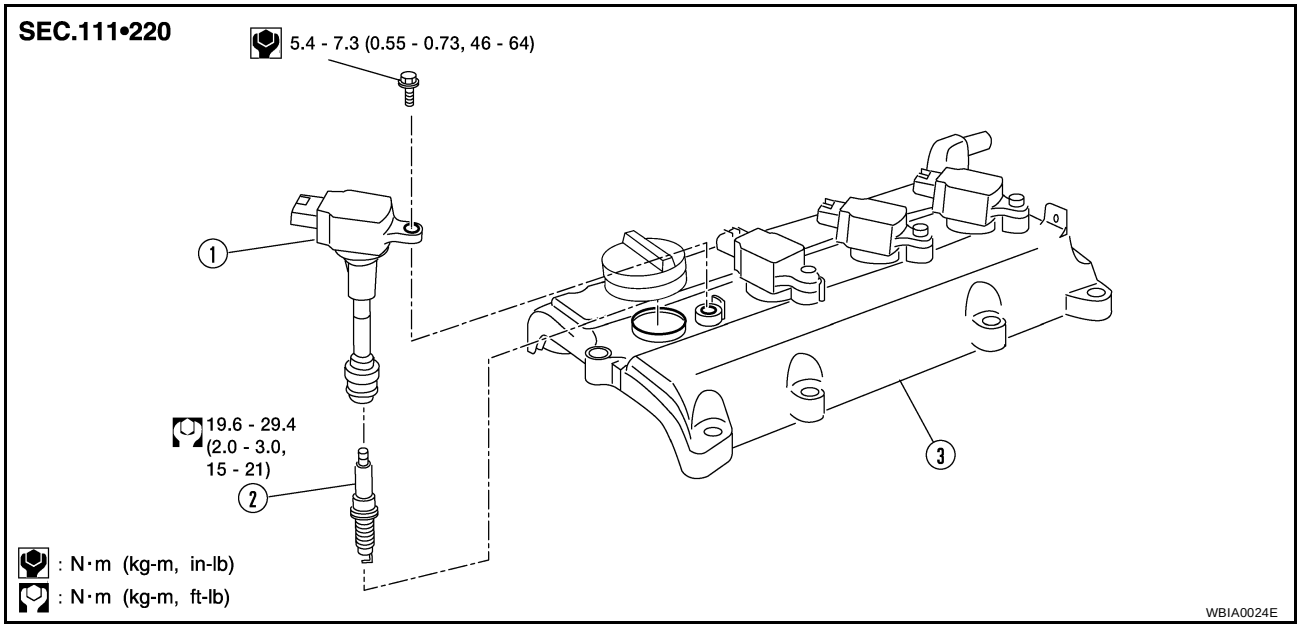
Check for any engine oil leaks with the engine at full operating temperature and running at idle.

IGNITION COIL

PFP:22448

Removal and Installation

EBS006AJ



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

REMOVAL

1. Remove the engine cover.
2. Disconnect the harness connector from the ignition coil.
3. Remove the ignition coil.

CAUTION:
Do not drop or shock it.

INSTALLATION

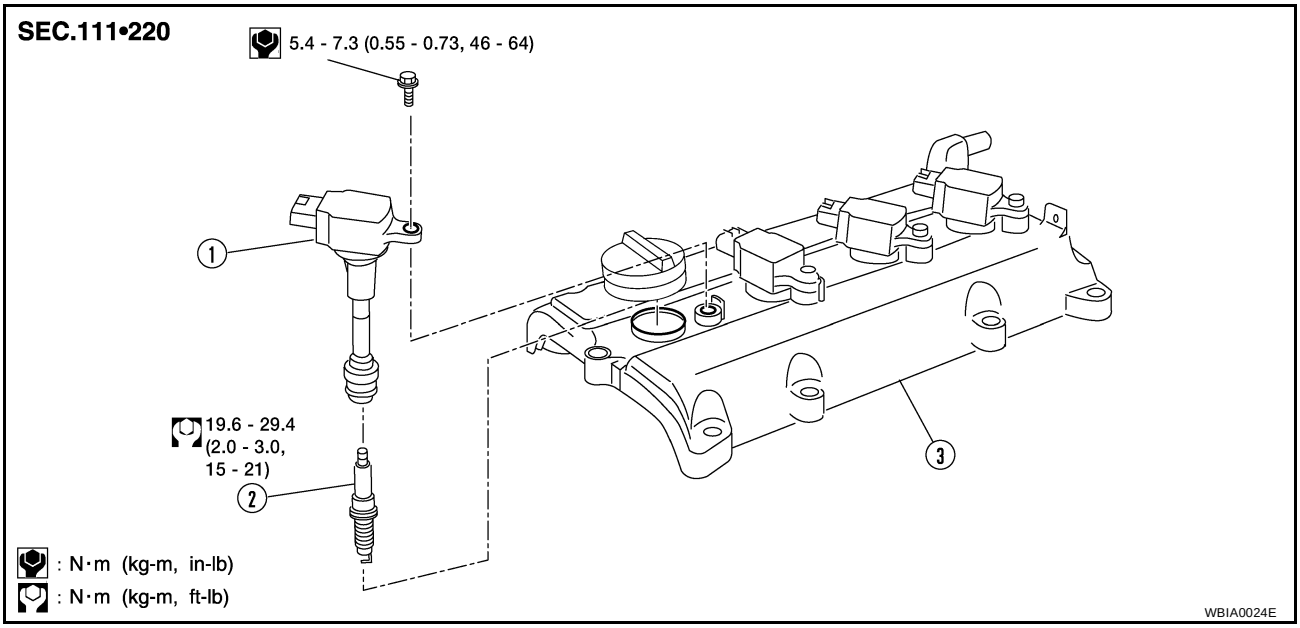
Installation is in the reverse order of removal.

SPARK PLUG

PFP:22401

Removal and Installation

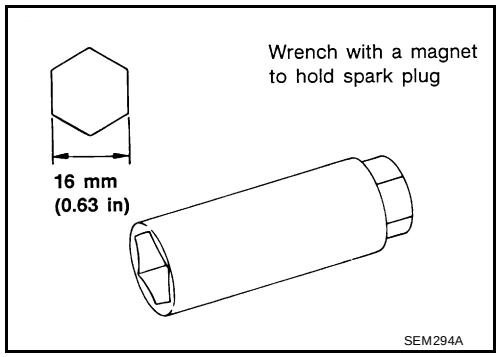
EBS006AK



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

REMOVAL

1. Remove the ignition coil. Refer to EM-103, "Removal and Installation" .
2. Remove the spark plug with a suitable spark plug wrench.



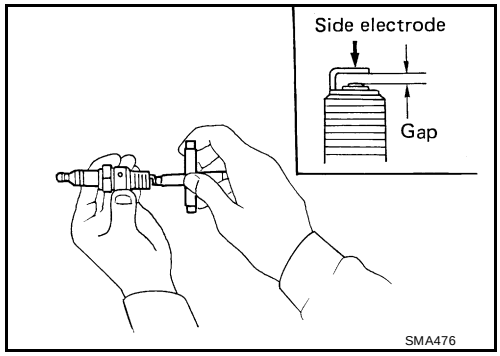
INSPECTION AFTER REMOVAL

Temperature range	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11

- Use standard type spark plug for normal conditions.
- The hot type spark plug is suitable when fouling occurs with the standard type spark plug under conditions such as:
  - frequent engine starts.
  - low ambient temperatures.
- The cold type spark plug is suitable when spark plug knock occurs with the standard type spark plug under conditions such as:
  - extended highway driving.
  - frequent high engine revolution.
- Check plug gap of each spark plug. Adjust or replace as necessary.

Gap : 1.0 - 1.1 mm (0.0039 - 0.043 in)

- Use a wire brush for cleaning if necessary.



INSTALLATION

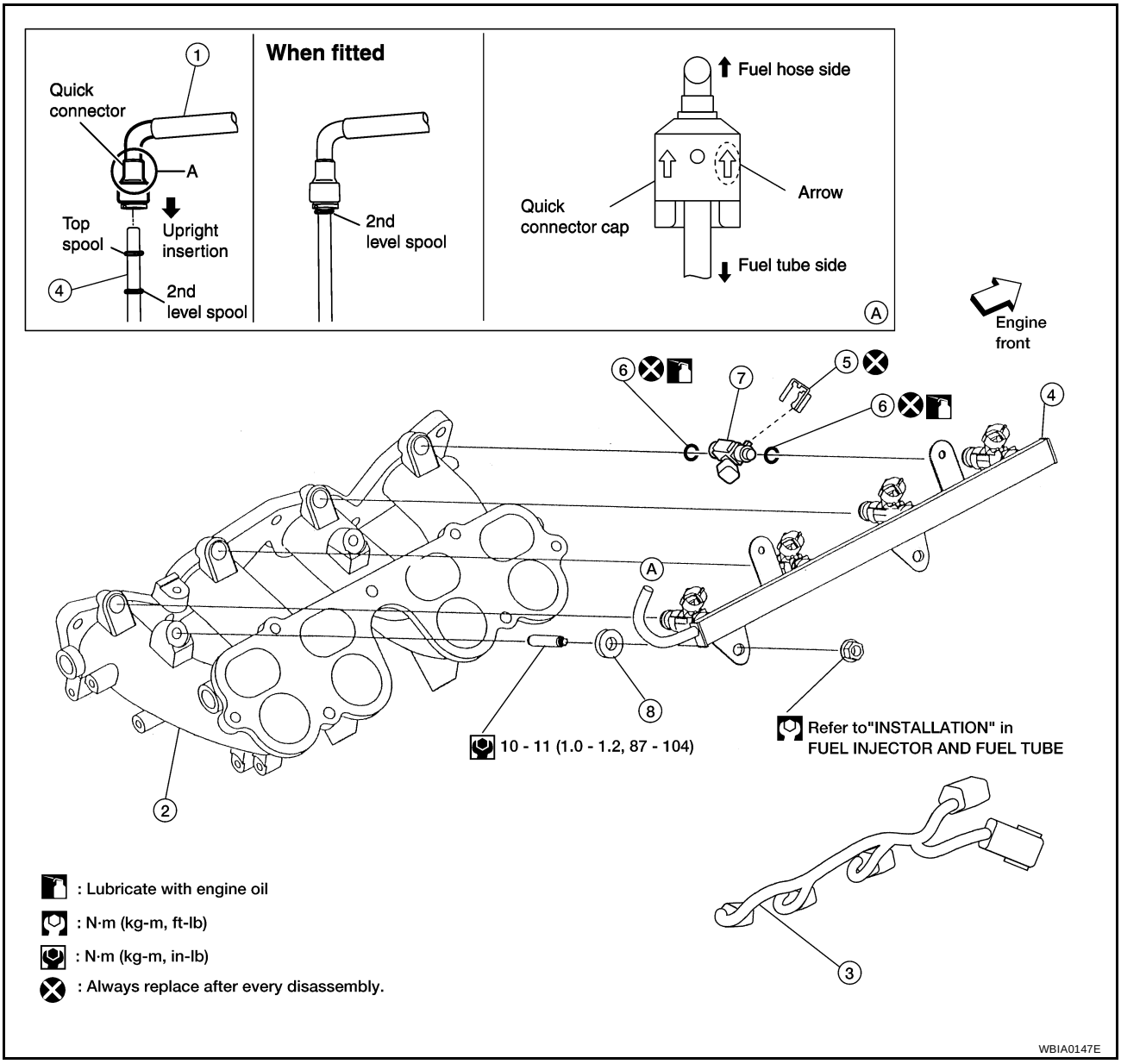
Installation is in the reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Removal and Installation

EBS006AL



1. Fuel hose
2. Quick connector cap
3. Sub-harness
4. Fuel tube
5. Clip
6. O-ring
7. Fuel injector
8. Insulator

CAUTION:

- **Apply new engine oil to parts before installing the parts, as shown above.**
- **Do not remove or disassemble parts unless instructed as shown in the figure.**

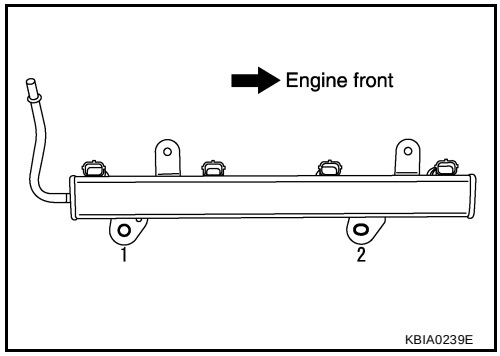
REMOVAL

1. Release the fuel pressure. Refer to EC-1255, "FUEL PRESSURE RELEASE" .
2. Remove the intake air duct. Refer to EM-91, "Removal and Installation" .
3. Partially drain the engine coolant. Refer to MA-15, "DRAINING ENGINE COOLANT" .
4. Remove the intake collector. Refer to EM-93, "INTAKE MANIFOLD" .
5. Disconnect the fuel hose quick connector at the fuel tube side.
   - For how to disconnect and connect the quick connector, refer to EM-93, "INTAKE MANIFOLD" .

CAUTION:

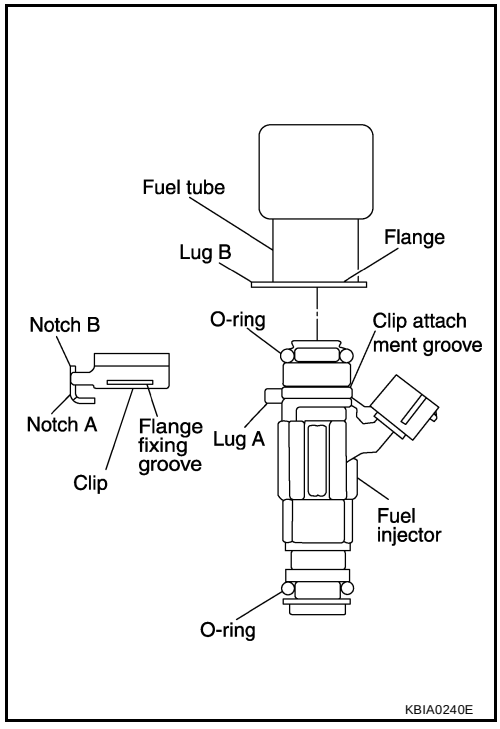
- **Prepare a container and cloth for catching any spilled fuel.**
- **This operation should be performed in a place that is free from any open flames.**
- **While hoses are disconnected seal their openings with vinyl bag or similar material to prevent foreign material from entering them.**

6. Disconnect sub-harness for injector at engine front side, and remove it from bracket.
7. Loosen the mounting bolts in the order as shown, then remove fuel tube and fuel injectors as an assembly.
8. Remove the fuel injectors from the fuel tube.
   - Release the clip and remove the fuel injector.
   - Pull fuel injector straight out of the fuel tube.
   - Be careful not to damage the nozzle.
   - Avoid any impact, such as dropping the fuel injector.
   - Do not disassemble or adjust the fuel injector.



INSTALLATION

1. Install new O-rings on the fuel injector.
   - Lubricate the O-rings lightly with new engine oil.
   - Be careful not to scratch it during installation. Also be careful not to twist or stretch the O-ring. If the O-ring was stretched while it is attached, do not insert it into the fuel tube immediately.
2. Install the fuel injector into the fuel tube with the following procedure:
   - Do not reuse the clip, replace it with a new one.
   - Insert the new clip into the clip mounting groove on fuel injector.
   - Insert the clip so that the projection on "Lug A" of fuel injector matches notch "A" of the clip.
3. Insert fuel injector into fuel tube with clip attached.
   - Insert it while matching it to the axial center.
   - Insert fuel injector so that the projection on "Lug B" of fuel injector matches notch "B" of the clip.
   - Make sure that fuel tube flange is securely fixed in flange fixing groove on the clip.
   - Make sure that installation is complete by checking that fuel injector does not rotate or come off.



4. Install fuel tube assembly.

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

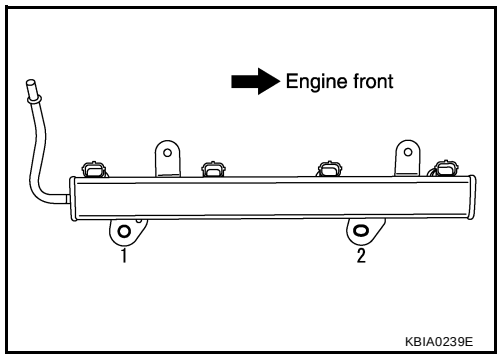
b. Tighten the mounting bolts in two steps in the numerical order shown.

Step 1 : 9.3 - 10.8 N·m (0.95 - 1.1 kg-m, 83 - 95 in-lb)

Step 2 : 20.6 - 26.5 N·m (2.1 - 2.7 kg-m, 16 - 19 ft-lb)

CAUTION:

- **After properly connecting fuel tube assembly to injector and fuel hose, check connection for fuel leakage.**



5. Connect the fuel hose quick connector. Refer to EM-93, "INTAKE MANIFOLD" .
6. Install the intake collector. Refer to EM-93, "INTAKE MANIFOLD" .
7. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

1. Start the engine and run it for a few minutes with engine at idle.
2. Stop the engine and check for fuel leakage both visually and by odor of gasoline.

CAUTION:
Do not touch the engine immediately after stopping as engine is extremely hot.

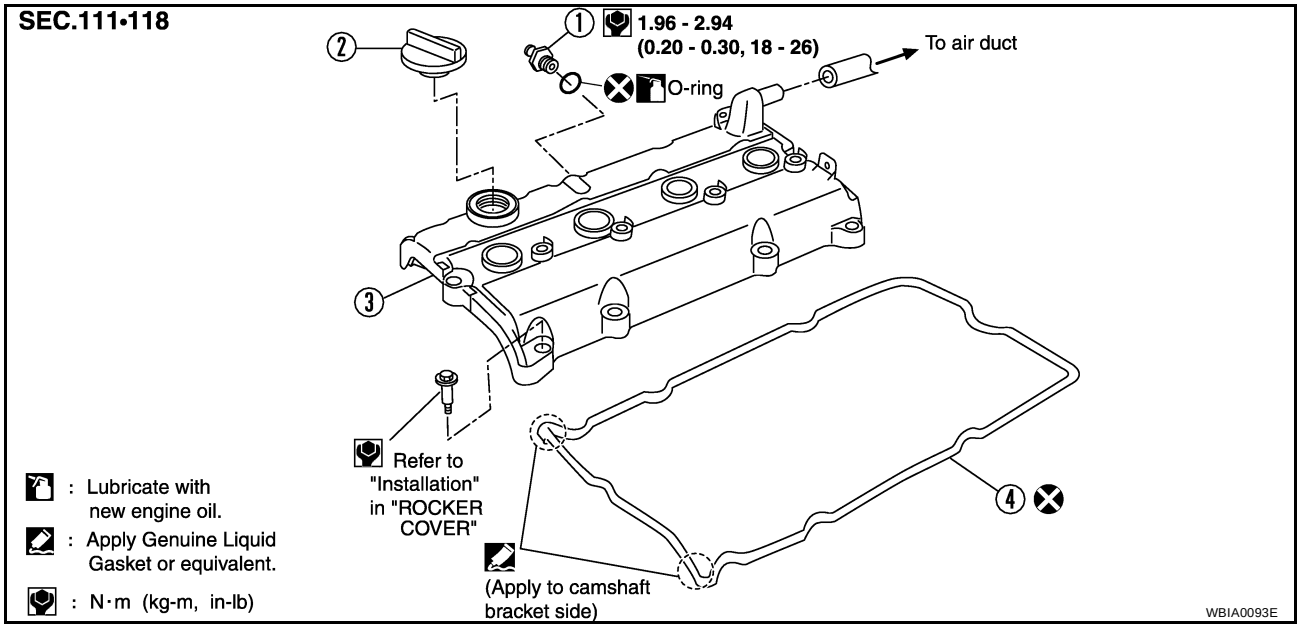
NOTE:
Use mirrors for checking on connections out of the direct line of sight.

ROCKER COVER

PFP:13264

Removal and Installation

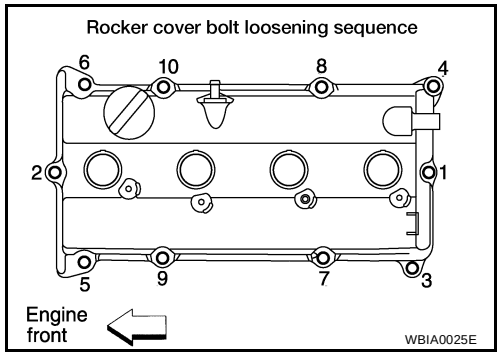
EBS006AM



1 PCV valve 2 Oil filler cap 3 Rocker cover
4 Rocker cover gasket

REMOVAL

1. Remove the ignition coils. Refer to EM-103, "Removal and Installation" .
2. Disconnect the PCV hose and breather hose from the rocker cover.
3. Loosen the bolts in the numerical order as shown.
4. Remove the rocker cover. Remove the oil filler cap and PCV valve if necessary, to transfer to the new rocker cover.



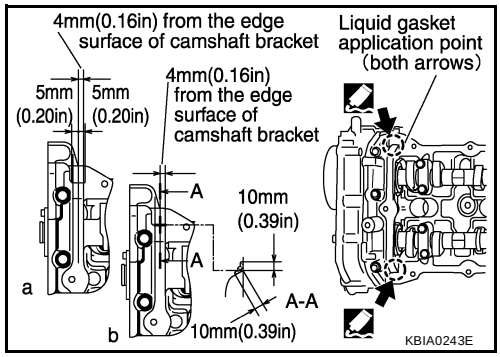
INSTALLATION

1. Apply liquid gasket to the joint part of the cylinder head and camshaft bracket following the steps below:

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

b. Refer to illustration “b” to apply liquid gasket in a 90° degree angle to the illustration “a”.

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



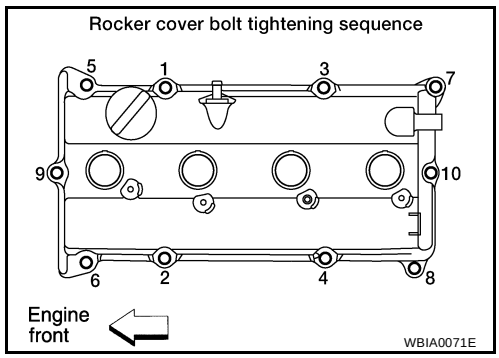
2. Install the rocker cover.

- The rocker cover gasket must be securely installed in the groove in the rocker cover.

3. Tighten the rocker cover bolts in two steps, in the numerical order as shown.

   Step 1 : 1.0 - 2.9 N·m (0.1 - 0.3 kg-m, 9 - 26 in-lb)

   Step 2 : 7.4 - 9.3 N·m (0.75 - 0.95 kg-m, 65 - 82 in-lb)



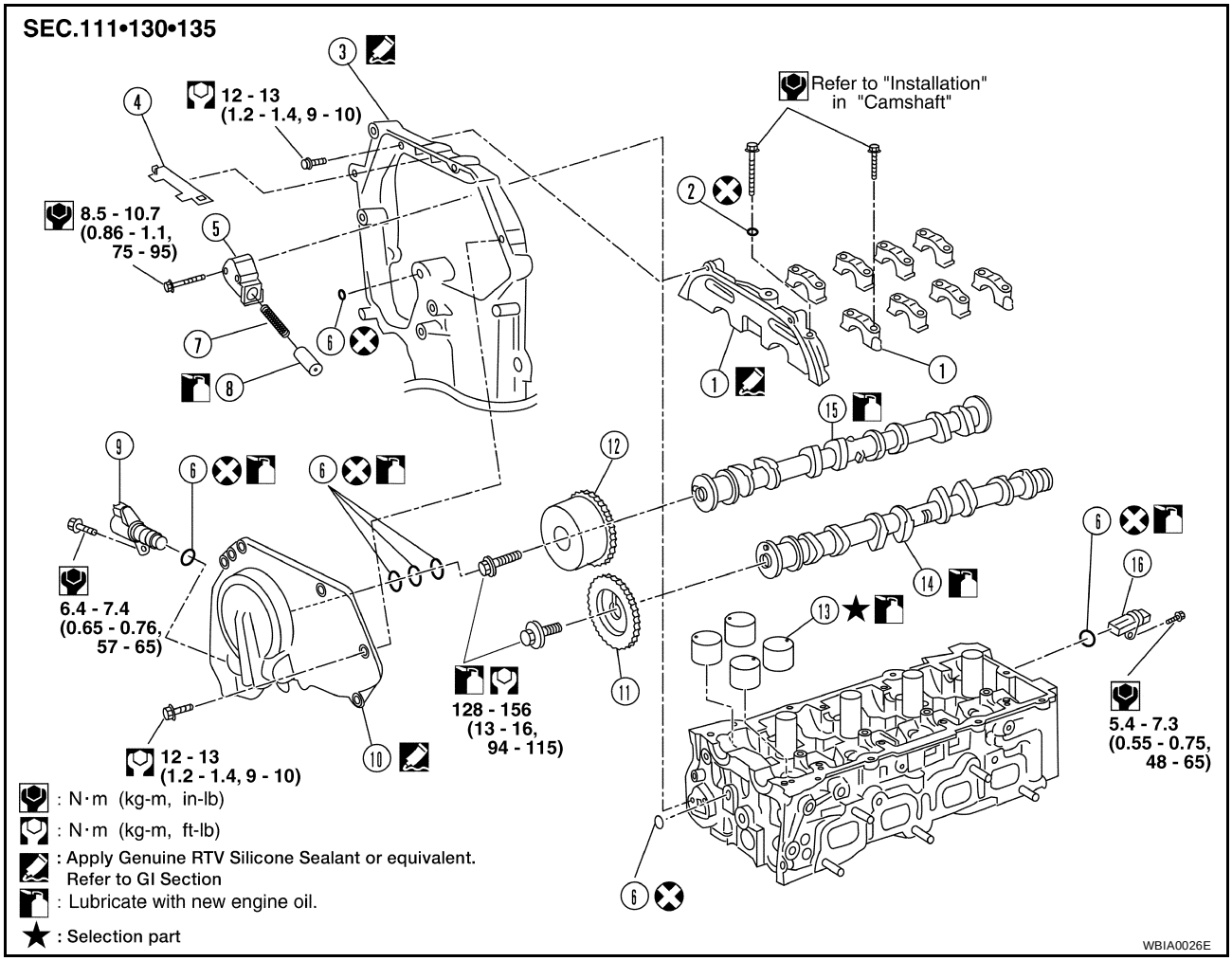
4. Connect the PCV hose and breather hose to the rocker cover. If necessary, install the oil filler cap and PCV valve and lubricate the PCV valve O-ring with new engine oil.
5. Install the ignition coils. Refer to EM-103, "Removal and Installation" .

CAMSHAFT

PFP:13001

Removal and Installation

EBS006AN

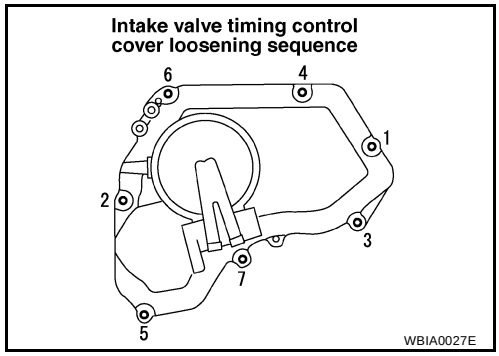


1. Camshaft brackets (1 - 5)	2. Washer	3. Front cover (partial view)
4. Chain guide	5. Chain tensioner	6. O-ring(s)
7. Chain tensioner spring	8. Chain tensioner plunger	9. IVTC solenoid valve
10. IVTC cover	11. Camshaft sprocket (EXH)	12. Camshaft sprocket (INT)
13. Valve lifter	14. Camshaft (EXH)	15. Camshaft (INT)
16. Camshaft position sensor (PHASE)		

REMOVAL

1. Remove the rocker cover. Refer to EM-109, "Removal and Installation" .
2. Remove the front right side tire and wheel.
3. Remove the RH splash shield.
4. Remove the auxiliary drive belt.
5. Remove the coolant overflow reservoir tank.
6. Disconnect the camshaft electrical connector.
7. Disconnect the ground electrical connections from the front cover.

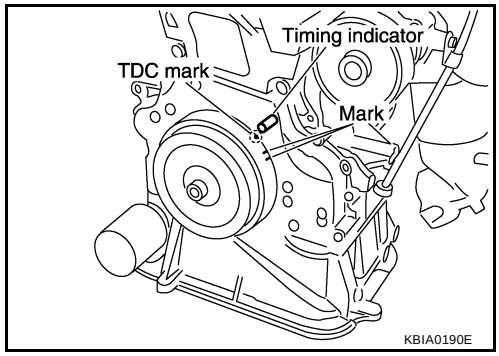
8. Remove the IVTC (intake valve timing control) cover by cutting the sealant using the Tool.
   - Loosen the bolts in the order shown.



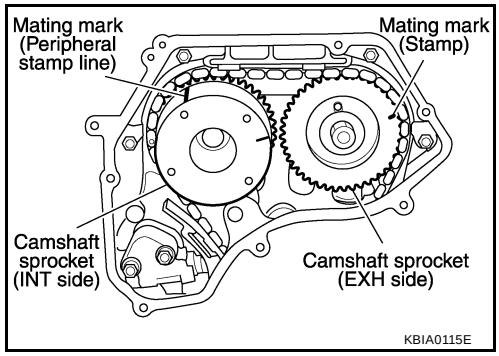
9. Set the No.1 cylinder at TDC on its compression stroke with the following procedure:

a. Open the access cover on RH undercover.

b. Rotate crankshaft pulley clockwise, and align mating marks for TDC with timing indicator on front cover, as shown.



c. At the same time, make sure that the mating marks on camshaft sprockets are lined up with the yellow links in the timing chain, as shown.
   - If not, rotate crankshaft pulley one more turn to line up the mating marks to the yellow links, as shown.



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

11. Remove camshaft sprockets with the following procedure.

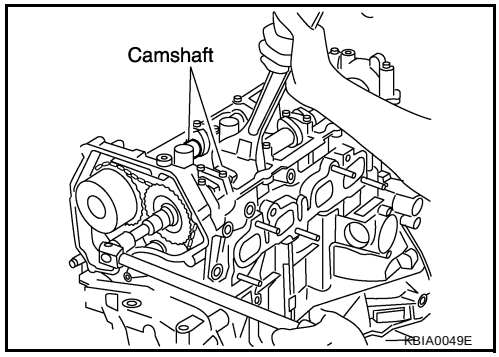
CAUTION:

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

NOTE:

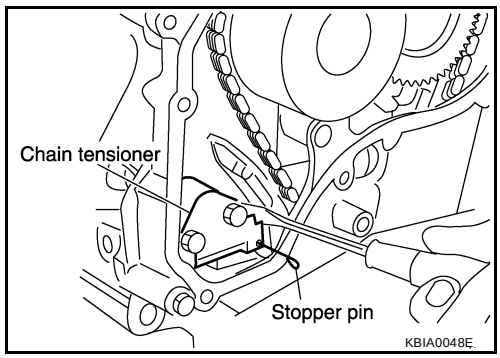
- Chain tension holding work is not necessary. Crank sprocket and timing chain do not disconnect structurally while front cover is attached.

a. Line up the mating marks on camshaft sprockets with the yellow links in the timing chain, and paint an indelible mating mark on the sprocket and timing chain link plate.

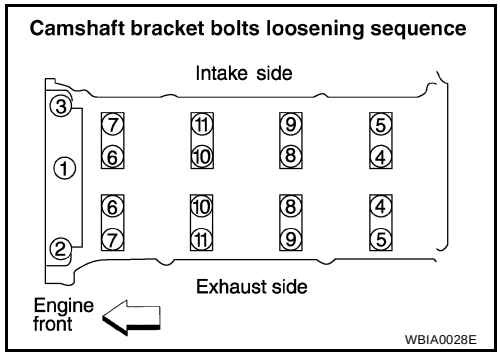


b. Push in the tensioner plunger and hold. Insert a stopper pin into the hole on tensioner body to hold the chain tensioner. Remove the timing chain tensioner.
   - Use a wire with 0.5 mm (0.02 in) diameter for a stopper pin.

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



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

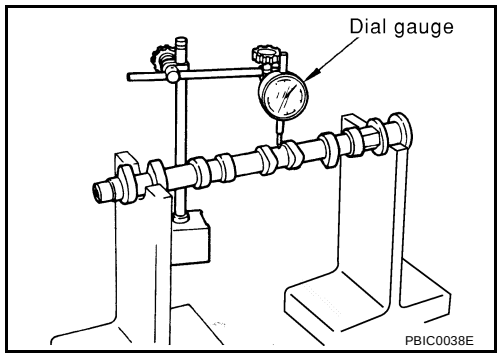


INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put the camshaft on a V-block supporting the No.2 and No.5 journals.
2. Set the dial gauge vertically on the No.3 journal.
3. Turn camshaft in one direction by hand, and measure the camshaft runout on the dial gauge total indicator reading.

Standard : Less than 0.04 mm (0.0016 in)



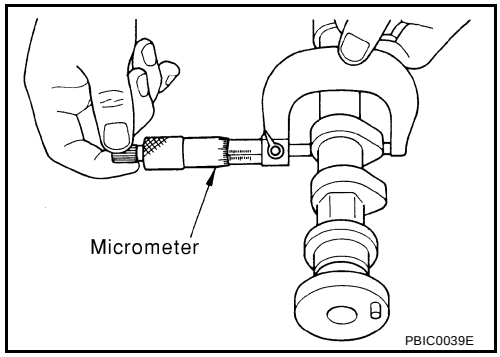
Camshaft Cam Height

1. Measure the camshaft cam height.

Standard intake cam height : 45.665 - 45.855 mm (1.7978 - 1.8053 in)

Standard exhaust cam height : 43.975 - 44.165 mm (1.7313 - 1.7388 in)

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

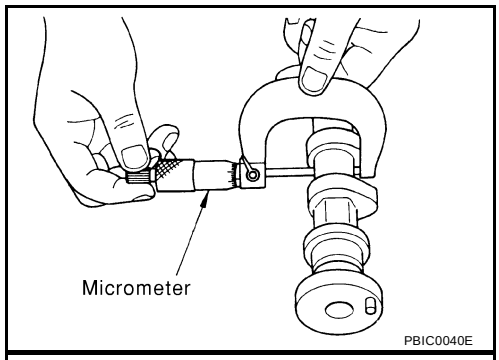


Camshaft Journal Clearance

- **Outer Diameter of Camshaft Journal**

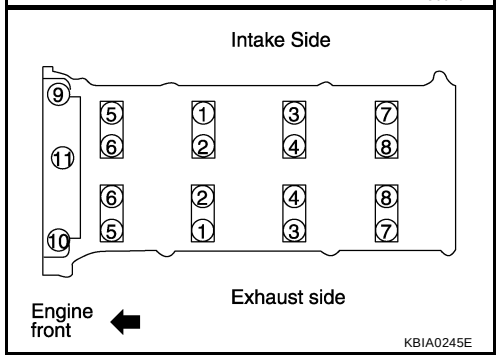
– Measure the outer diameter of the camshaft journal.

Standard No.1 outer diameter	**: 27.935 - 27.955 mm (1.0998 - 1.1006 in)**
Standard No.2, 3, 4, 5, outer diameter	**: 23.435 - 23.455 mm (0.9226 - 0.9234 in)**



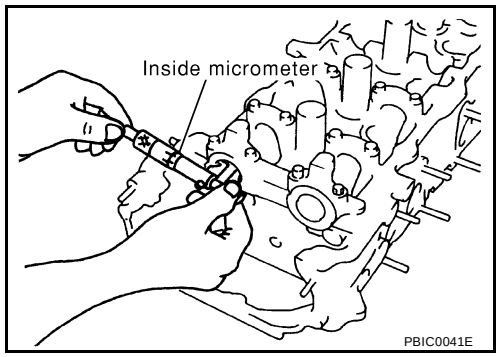
- **Inner Diameter of Camshaft Bracket**

– Tighten the camshaft bracket bolts to the specified torque following the tightening pattern as shown. Refer to Step 4 of EM-115, "INSTALLATION" , of "CAMSHAFT" for the specified torque sequence.



– Using inside micrometer, measure inner diameter of camshaft bracket.

Standard No.1	**: 28.000 - 28.021 mm (1.1024 - 1.1032 in)**
Standard No.2, 3, 4, 5	**: 23.500 - 23.521 mm (0.9252 - 0.9260 in)**



- **Calculation of Camshaft Journal Clearance**

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

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

– When out of the specified range above, replace either or both the camshaft and the cylinder head assembly.

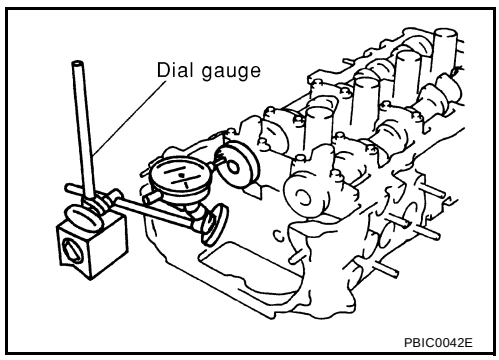
NOTE:
Inner diameter of the camshaft bracket is manufactured together with the cylinder head. If the camshaft bracket is out of specification, replace the whole cylinder head assembly.

Camshaft End Play

1. Install a dial gauge in the thrust direction on the front end of the camshaft. Measure the end play with the dial gauge while moving the camshaft forward and backward (in direction to axis).

Standard end play	**: 0.115 - 0.188 mm (0.0045 - 0.0074 in)**

2. If out of the specified range, replace with new camshaft and measure again.
3. If out of the specified range again, replace with new cylinder head assembly.



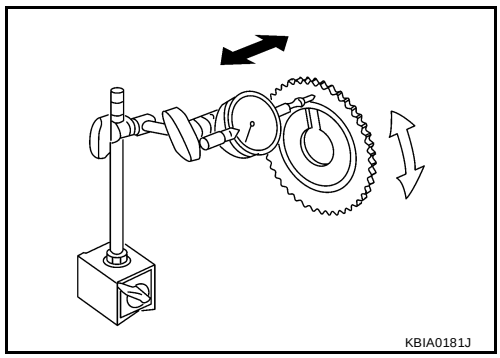
Camshaft Sprocket Runout

1. Install the camshaft in the cylinder head.
2. Install the camshaft sprocket on the camshaft.

3. Measure camshaft sprocket runout while turning the camshaft by hand.

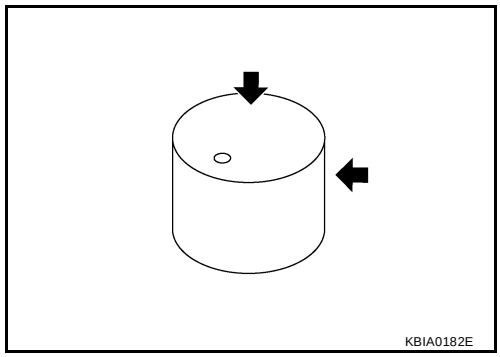
Runout : Less than 0.15 mm (0.0059 in)

4. If it exceeds the specification, replace camshaft sprocket.



Valve Lifter

Check if the surface of the valve lifter has any excessive wear or cracks, replace as necessary.



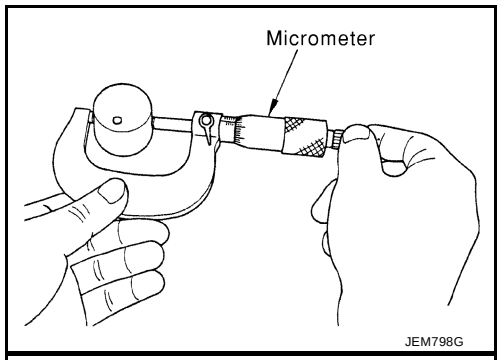
Valve Lifter Clearance

- **Outer Diameter of Valve Lifter**

– Measure the outer diameter of the valve lifter.

Valve lifter outer diameter : 33.965 - 33.980 mm (1.3372 - 1.3378 in)

– If out of the specified range, replace the valve lifter.



- **Valve Lifter Hole Diameter**

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

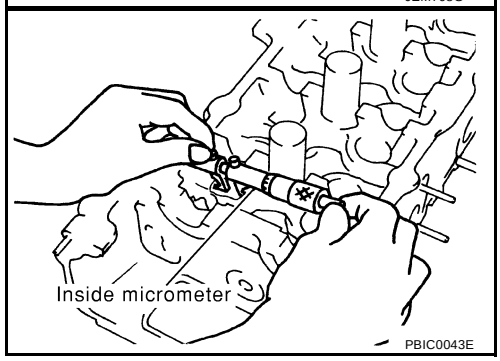
Standard : 34.000 - 34.021 mm (1.3386 - 1.3394 in)

– If out of the specified range, replace the cylinder head assembly.

- **Calculation of Valve Lifter Clearance**

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

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

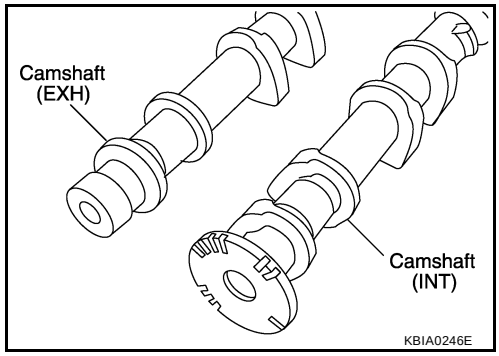


– If out of specified range, replace either or both valve lifter and cylinder head assembly.

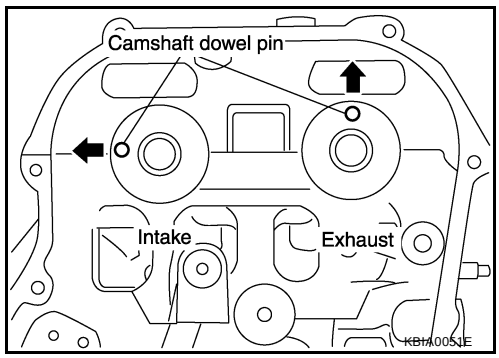
INSTALLATION

1. Install the valve lifter.
   - Install them in the same position from which they were removed.

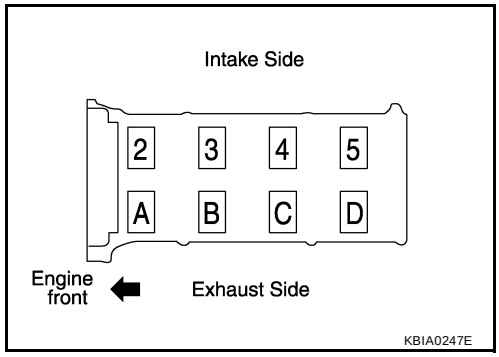
2. Install the camshafts.
   - The distinction between the intake and exhaust camshafts is in a difference of shapes of the back end:
     Intake: Signal plate for the camshaft position sensor (PHASE)
     Exhaust: Cone end shape



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

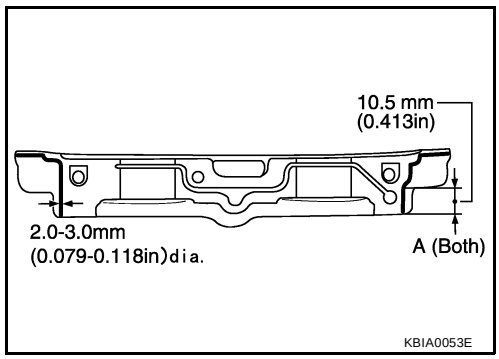


3. Install the camshaft brackets.
   - Install by referring to identification mark on upper surface mark.
   - Install so that identification mark can be correctly read when viewed from the exhaust side as shown.

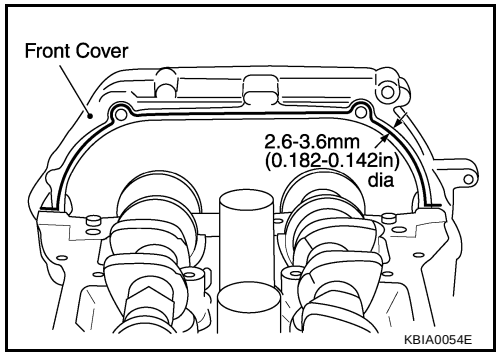


   - Install the No. 1 camshaft bracket as follows.
     Apply sealant to No.1 camshaft bracket as shown.
     Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .

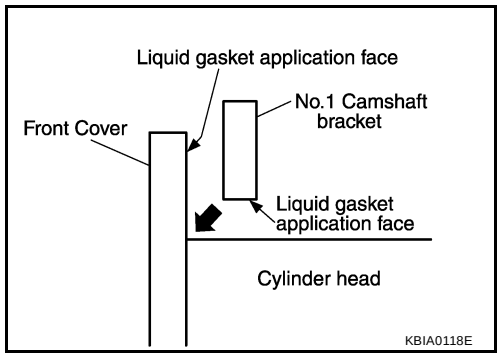
     CAUTION:
     After installation, be sure to wipe off any excessive sealant leaking from part “A” (both on right and left sides).



   - Apply sealant to camshaft bracket contact surface on the front cover backside.
   - Apply sealant to the outside of bolt hole on front cover.

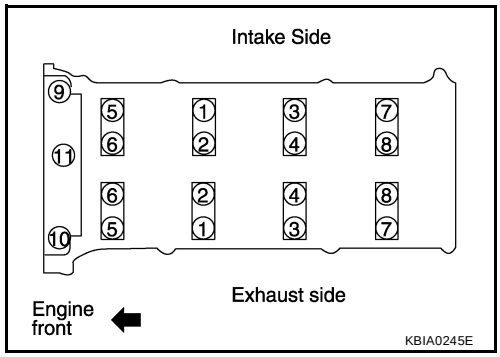


- Position the No.1 camshaft bracket near the mounting position, and install it without disturbing the sealant applied to the surfaces.



4. Tighten the camshaft bracket bolts in numerical order to specification.

Step 1 tighten bolts 9 - 11	**: 2.0 N·m (0.2 kg-m, 17 in-lb)**
Step 2 tighten bolts 1 - 8	**: 2.0 N·m (0.2 kg-m, 17 in-lb)**
Step 3 tighten bolts 1 - 11	**: 5.9 N·m (0.6 kg-m, 52 in-lb)**
Step 4 tighten blots 1 - 11	**: 9.0 to 11.8 N·m (0.92 to 1.2 kg-m, 80 to 104 in-lb)**

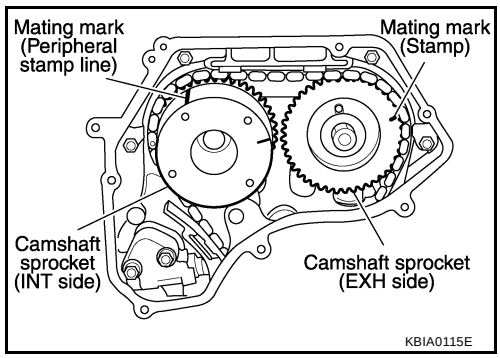


CAUTION:
After tightening fixing bolts of camshaft brackets, be sure to wipe off excessive sealant from the parts listed below.

- **mating surface of rocker cover**
- **mating surface of front cover, when installed without the front cover**

5. Install camshaft sprockets.
   - Install them by lining up the mating marks on each camshaft sprocket with the ones painted on the timing chain during removal.
   - Before installation of chain tensioner, it is possible to re-match the marks on timing chain with the ones on each sprocket.

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

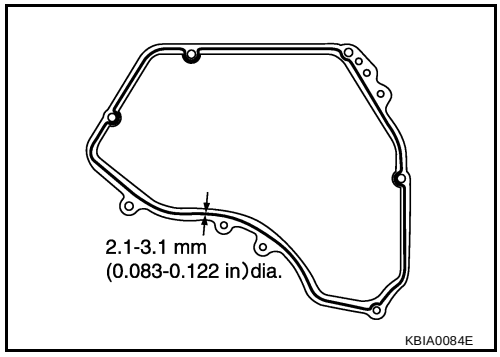


6. Install chain tensioner.

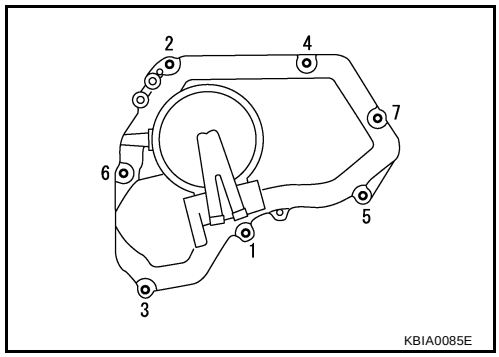
CAUTION:
After installation, pull the stopper pin off completely, and make sure that the tensioner is fully released.

7. Install chain guide.
8. Install IVTC (intake valve timing control) cover with the following procedure.

a. Install IVTC solenoid valve to intake valve timing control cover.
b. Install O-ring to front cover side.
c. Apply Genuine RTV Silicone Sealant to the positions shown in the figure. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .



d. Install IVTC cover.
   - Tighten the bolts in the numerical order as shown.



9. Check and adjust valve clearances. Refer to EM-118, "Valve Clearance" .

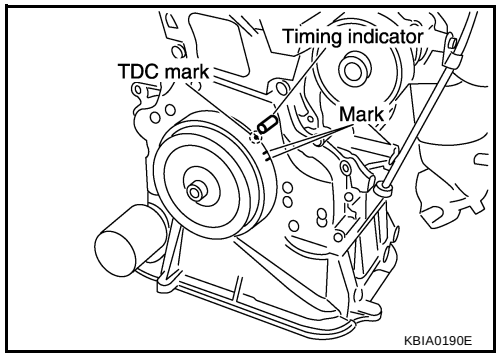
Valve Clearance

EBS006AO

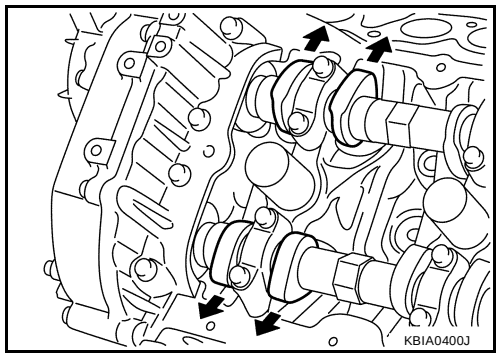
INSPECTION

NOTE:
Perform this inspection as follows after removal, installation, or replacement of the camshaft or any valve-related parts, or if there are any unusual engine conditions due to changes in valve clearance over time (starting, idling, and/or noise).

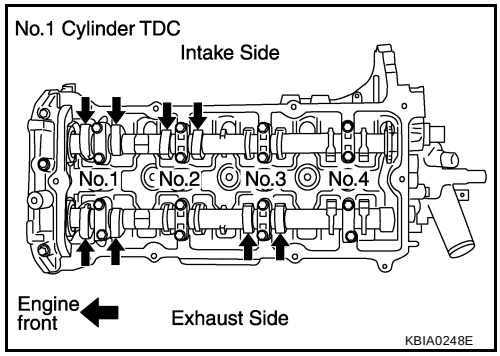
1. Warm up the engine, then stop it.
2. Remove front RH engine undercover.
3. Remove the rocker cover.
   Refer to EM-109, "Removal and Installation" .
4. Turn crankshaft pulley in normal direction (clockwise when viewed from front) to align TDC identification mark (without paint mark) with timing indicator.



5. At this time, check that the both intake and exhaust cam noses of No. 1 cylinder face outside.
   - If they do not face outside, turn crankshaft pulley once more.

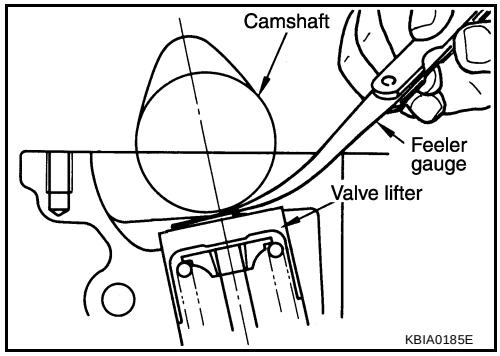


6. By referring to the figure, measure valve clearances at locations marked X as shown in the table below (locations indicated with black arrow in figure) with a feeler gauge.
   - No.1 cylinder compression TDC.



Cylinder	No.1		No.2		No.3		No.4	
Valve	INT	EXH	INT	EXH	INT	EXH	INT	EXH
Measurable	×	×	×			x		

   - Use a feeler gauge, measure clearance between valve and camshaft.



Valve clearance standard

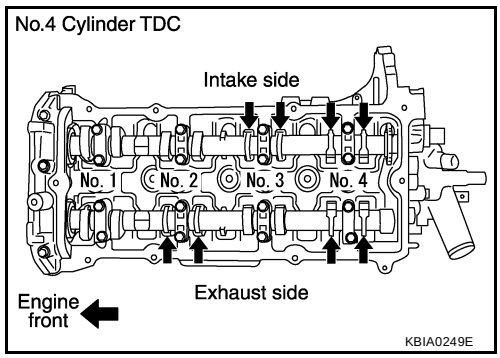
Hot	**Intake**	**: 0.32 - 0.40 mm (0.013 - 0.016 in)**
	Exhaust	**: 0.33 - 0.41 mm (0.013 - 0.016 in)**
Cold*	**Intake**	**: 0.24 - 0.32 mm (0.009 - 0.013 in)**
	Exhaust	**: 0.26 - 0.34 mm (0.010 - 0.013 in)**

***Reference data at approximately 20°C (68°F)**

CAUTION:

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

7. Turn crankshaft one complete revolution (360°) and align mark on crankshaft pulley with pointer.
8. By referring to the figure, measure valve clearances at locations marked X as shown in the table below (locations indicated with black arrow in figure).
   - No.4 cylinder compression TDC.



Cylinder	No.1		No.2		No.3		No.4	
Valve	INT	EXH	INT	EXH	INT	EXH	INT	EXH
Measurable				x	×		x	×

9. If out of specifications, adjust as follows.

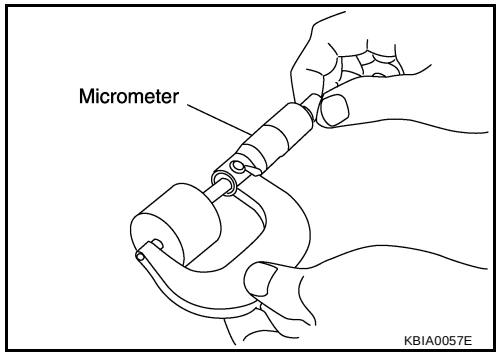
ADJUSTMENT

NOTE:

- Perform adjustment depending on selected head thickness of valve lifter.
- The specified valve lifter thickness is the dimension at normal temperatures. Ignore dimensional differences caused by temperature. Use the specifications for hot engine condition to adjust.

1. Remove camshaft. Refer to EM-111, "Removal and Installation" .
2. Remove the valve lifters at the locations that are outside the standard.

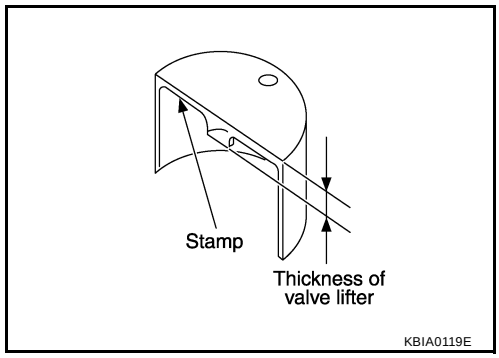
3. Measure the center thickness of the removed valve lifters with a micrometer.



4. Use the equation below to calculate valve lifter thickness for replacement.
   - Valve lifter thickness calculation.
     t = t1 + (C1 - C2)
     t = Thickness of replacement valve lifter.
     t1 = Thickness of removed valve lifter.
     C1 = Measured valve clearance.
     C2 = Standard valve clearance.

     Intake : 0.36 mm (0.0142 in)
     Exhaust : 0.37 mm (0.0146 in)

   - Thickness of a new valve lifter can be identified by stamp marks on the reverse side (inside the cylinder).
     Stamp mark 696 indicates a thickness of 6.96 mm (0.2740 in)
     Available thickness of valve lifter: 26 sizes with a range of 6.96 to 7.46 mm (0.2740 to 0.2937 in), in steps of 0.02 mm (0.0008 in), when assembled at the factory.



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

Valve clearance:

Unit: mm (in)

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

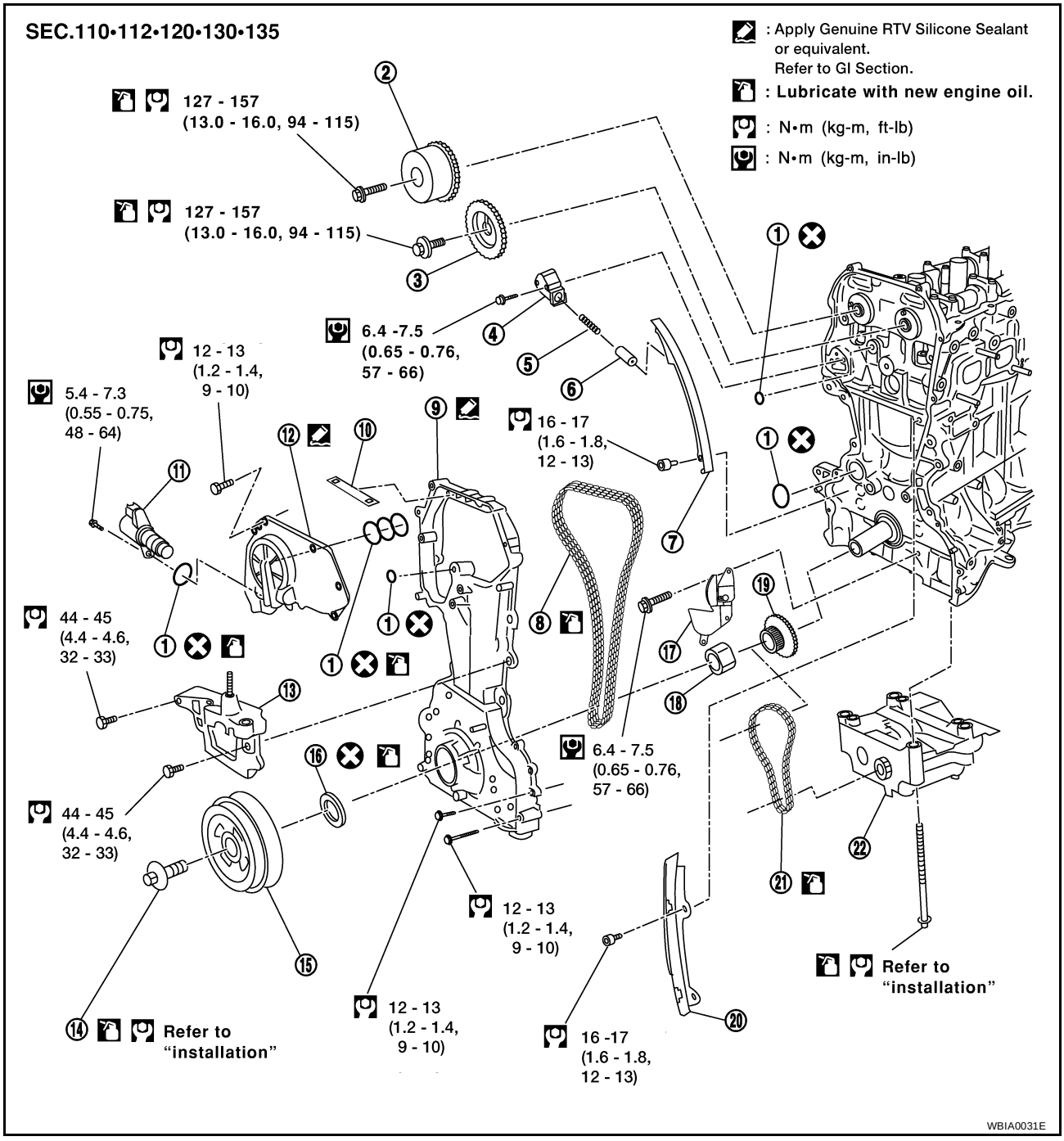
*: Reference data at approximately 20°C (68°F)

TIMING CHAIN

PFP:13028

Removal and Installation

EBS006AP



1. Oil rings	2. Camshaft sprocket (INT)	3. Camshaft sprocket (EXH)
4. Chain tensioner	5. Spring	6. Chain tensioner plunger
7. Timing chain slack guide	8. Timing chain	9. Front cover
10. Chain guide	11. IVTC solenoid valve	12. IVTC cover
13. Engine mounting bracket	14. Crankshaft pulley bolt	15. Crankshaft pulley
16. Front oil seal	17. Balancer unit timing chain tensioner	18. Oil pump drive spacer
19. Crankshaft sprocket	20. Timing chain tension guide	21. Balancer unit timing chain
22. Balancer unit		

CAUTION:

Apply new engine oil to parts indicated in the illustration before installation.

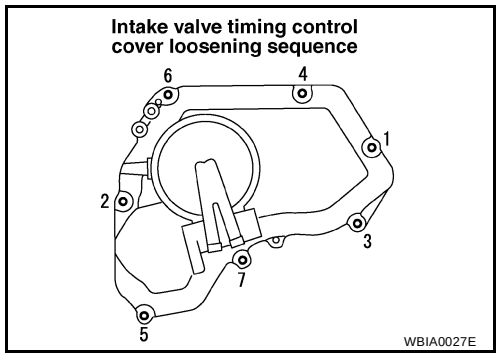
REMOVAL

1. Release the fuel pressure. Refer to EC-1255, "FUEL PRESSURE RELEASE" .
2. Remove the air cleaner and air duct assembly. Refer to EM-91, "Removal and Installation" .
3. Remove the spark plugs. Refer to EM-104, "Removal and Installation" .
4. Remove the rocker cover. Refer to EM-109, "Removal and Installation" .
5. Remove the coolant overflow reservoir tank.
6. Remove the auxiliary drive belt auto-tensioner. Refer to EM-90, "Removal and Installation of Auxiliary Drive Belt Auto-tensioner" .
7. Remove the alternator. Refer to SC-31, "Removal and Installation" .
8. Remove the strut tower brace.
9. Dismount and position aside the A/C compressor with the piping attached.
10. Dismount and position aside the power steering pump and reservoir tank with the piping attached.
11. Remove the upper and lower oil pan, and oil strainer. Refer to EM-100, "Removal and Installation" .
12. Remove the IVTC (intake valve timing control) cover.

a. Loosen bolts in the numerical order as shown.

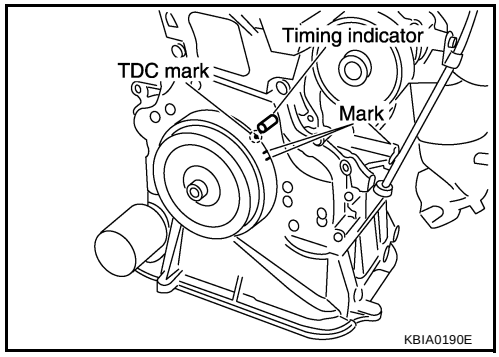
b. Remove the cover with suitable tool to cut the sealant.

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



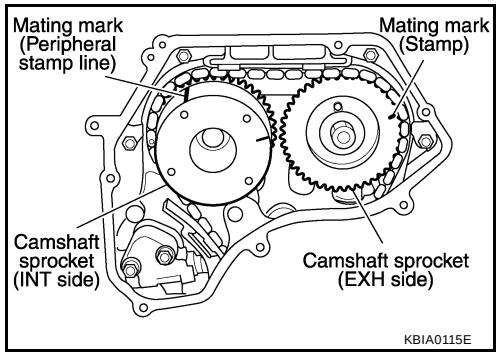
14. Set the No.1 cylinder at TDC on the compression stroke with the following procedure:

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



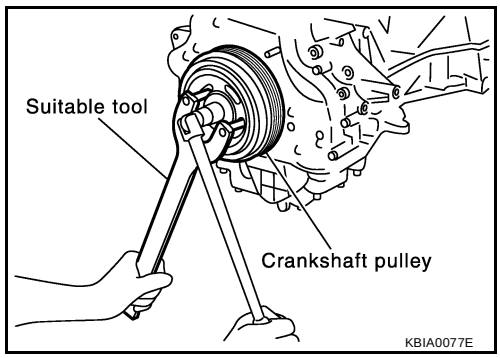
b. At the same time, make sure that the mating marks on the camshaft sprockets are lined up as shown.

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

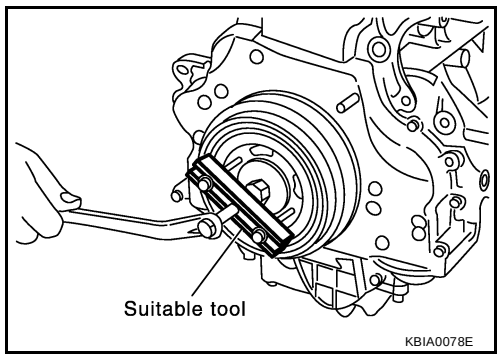


15. Remove crankshaft pulley with the following procedure:

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



b. Attach a pulley puller in the M 6 (0.24 in diameter) thread hole on crankshaft pulley, and remove crankshaft pulley.



16. Remove the front cover with the following procedure:

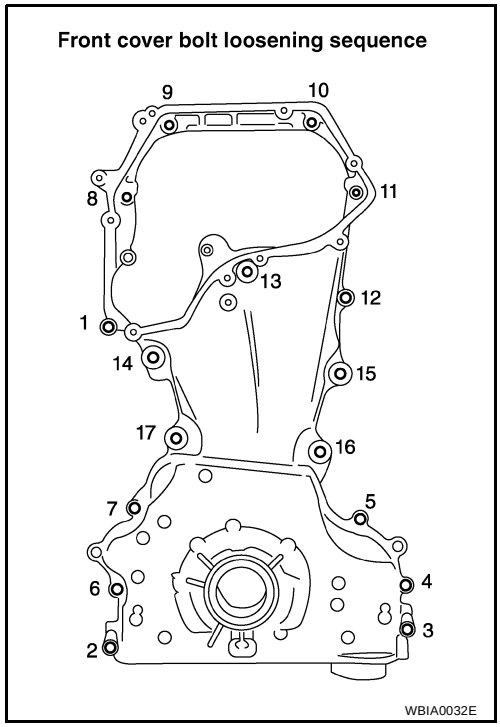
a. Loosen the mounting bolts in the numerical order as shown, and remove them.

b. Remove the front cover.

CAUTION:

Be careful not to damage the mounting surface.

17. If the front oil seal needs to be replaced, lift it out with a screwdriver to remove it.

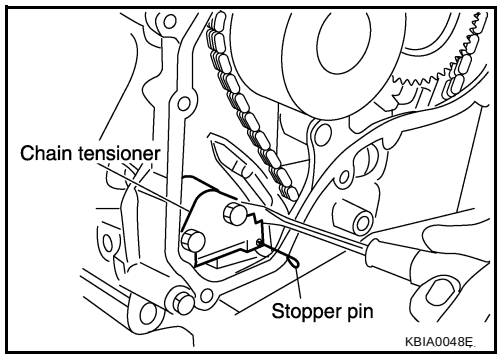


18. Remove timing chain with the following procedure:

a. Push in the tensioner plunger. Insert a stopper pin into the hole on the tensioner body to hold the chain tensioner.

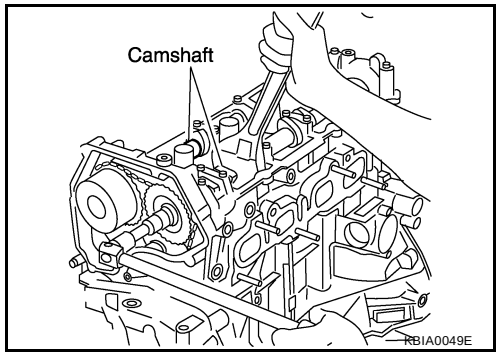
- Use a wire of 0.5 mm (0.02 in) diameter as a stopper pin.

b. Remove the chain tensioner.



c. Secure hexagonal part of the camshaft with a wrench and loosen the camshaft sprocket mounting bolt and remove the camshaft sprocket for both camshafts.

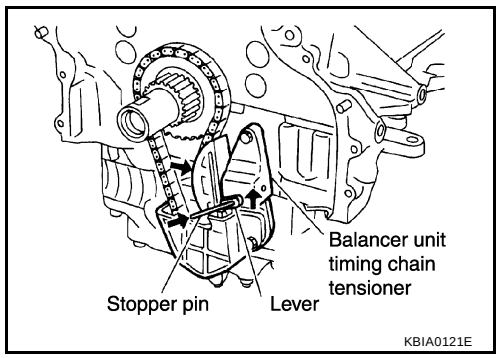
CAUTION:
Do not rotate the crankshaft or camshafts while the timing chain is removed. It can cause damage to the valve and piston.



19. Remove the chain slack guide, tension guide, timing chain, and oil pump drive spacer.
20. Remove the timing chain tensioner for the balancer unit with the following procedure:

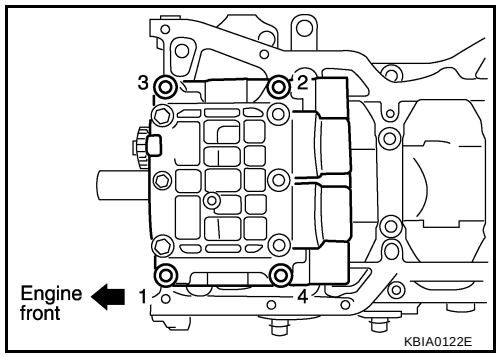
a. Lift the tensioner lever up, and release the ratchet claw.
b. Push tensioner sleeve in, and hold it.
c. Matching the hole on lever with the one on body, insert a stopper pin to secure tensioner sleeve.
d. Remove the timing chain tensioner for the balancer unit.

21. Remove timing chain for balancer unit and crankshaft sprocket.



22. Loosen mounting bolts in reverse order shown in the figure, and remove balancer unit.
    - Use Torx socket (size E14)

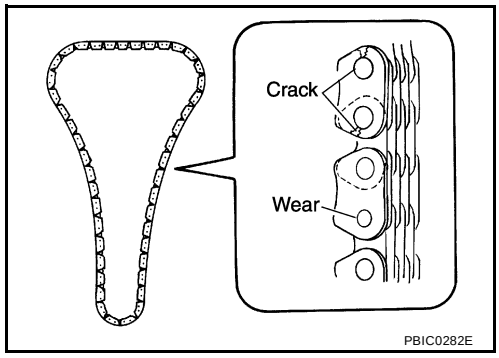
CAUTION:
Do not disassemble balancer unit.



INSPECTION AFTER REMOVAL

Timing Chain

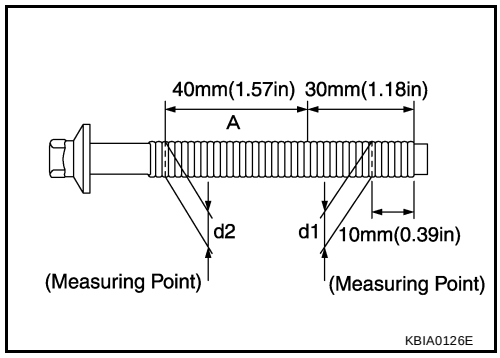
Check the timing chain for cracks or serious wear. If a defect is detected, replace it.



Balancer Unit Mounting Bolt Outer Diameter

- Measure outer diameters (d1, d2) at the two positions shown in the figure.
- Measure d2 within the range A.
- If the value difference (d1 - d2) exceeds the limit (a dimension difference is large), replace it with a new one.

Limit : 0.15 mm (0. 0059 in) or more



INSTALLATION

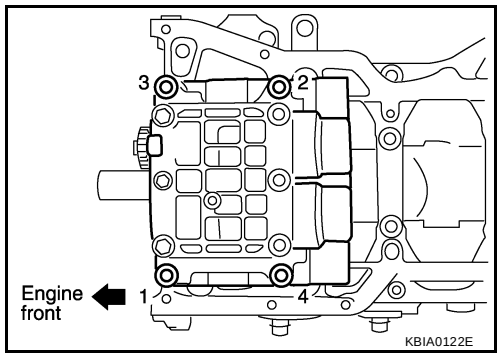
NOTE:

- There may be two color variations of the link marks (link colors) on the timing chain.
- There are 26 links between the gold/yellow mating marks on the timing chain; and 64 links between the camshaft sprocket gold/yellow link and the crankshaft sprocket orange/blue link, on the timing chain side without the tensioner.

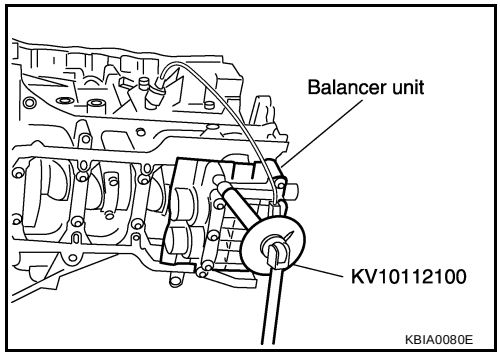
1. Make sure the crankshaft key points straight up.
2. Install the balancer unit and tighten the mounting bolts in the numerical order shown with the following procedure:

   CAUTION:
   When reusing a mounting bolt, check its outer diameter before installation. Refer to EM-125, "Balancer Unit Mounting Bolt Outer Diameter" .

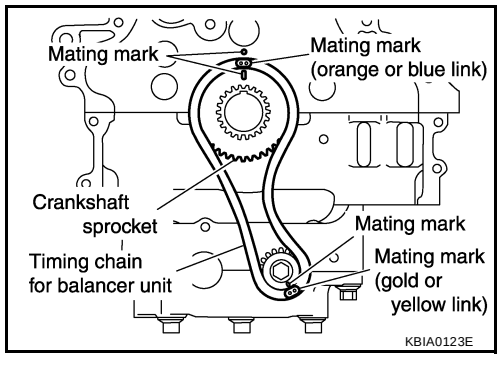
   a. Apply new engine oil to threads and seating surfaces of mounting bolts.
   b. Tighten them to 45.2 - 51.0 N·m (4.6 - 5.2 kg-m, 34 - 37 ft-lb).
   c. Turn them another 90° - 95° degrees (Target: 90° degrees).
   d. Fully loosen in the reverse order of tightening to 0 N·m (0 kg-m, 0 ft-lb).
   e. Tighten them to 45.2 - 51.0 N·m (4.6 - 5.2 kg-m, 34 - 37 ft-lb).
   f. Turn them another 90° - 95° degrees (Target: 90° degrees).



   CAUTION:
   Check tightening angle with an angle wrench or a protractor. Do not make judgment by visual check alone.



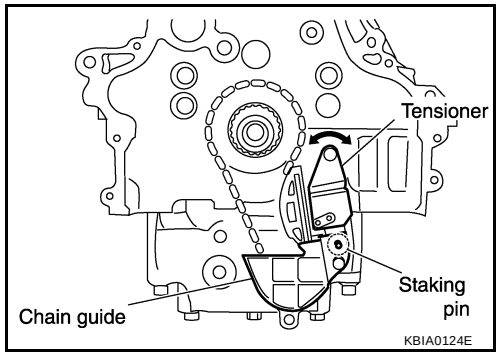
3. Install the crankshaft sprocket and timing chain for the balancer unit.
   - Make sure that the crankshaft sprocket is positioned with mating marks on the block and sprocket meeting at the top.
   - Install it by lining up mating marks on each sprocket and timing chain.



4. Install timing chain tensioner for balancer unit.

NOTE:
Chain guide and tensioner move freely with the caulking pin as the axle. Therefore, bolt hole position of the three points could be changed during removal. If points change, temporarily fix the two mounting bolts on the chain guide and move the tensioner to match the bolt holes.

- Be careful not to let mating marks of each sprocket and timing chain slip.
- After installation, make sure the mating marks have not slipped, then remove stopper pin and release tensioner.



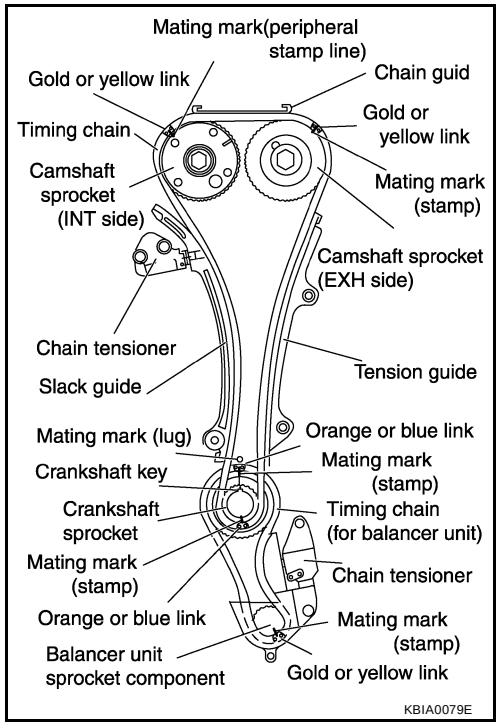
5. Install timing chain and related parts.

- Install by lining up mating marks on each sprocket and timing chain as shown.

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

CAUTION:
After the mating marks are aligned, keep them aligned by holding them with a hand.

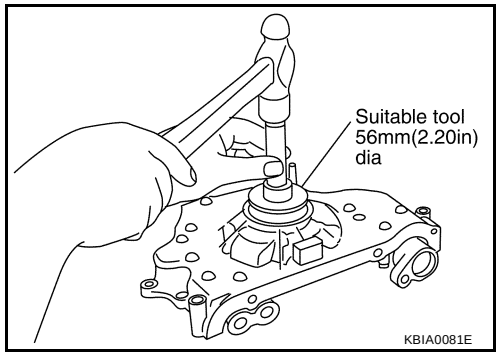
- Before and after installing chain tensioner, check again to make sure that mating marks have not slipped.
- After installing chain tensioner, remove stopper pin, and make sure the tensioner moves freely.
- To avoid skipped teeth, do not move crankshaft and camshaft until front cover is installed.



6. Install front oil seal to front cover.

- Using a drift of 56 mm (2.20 in) diameter, press oil seal in until it is flush with front end surface of front cover.

CAUTION:
Be careful not to cause damage to the circumference of the oil seal.



7. Install front cover with the following procedure:

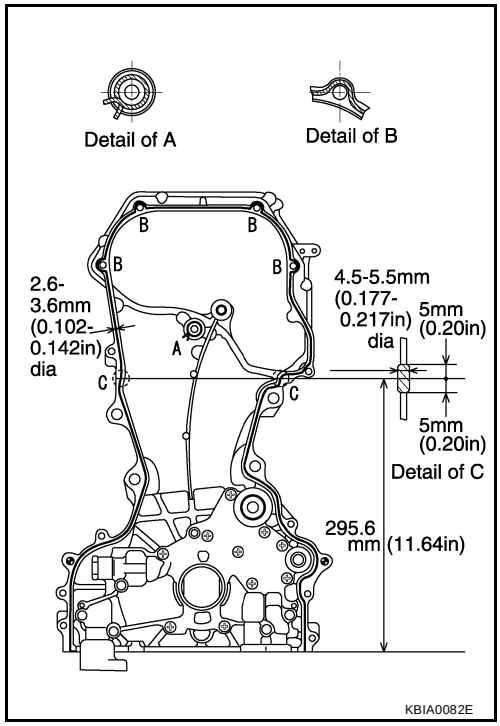
a. Install O-rings to cylinder head and cylinder block.

b. Apply Genuine RTV Silicone Sealant or equivalent, to positions specified in the figure. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .

c. Make sure the mating marks on the timing chain and each sprocket are still aligned. Then install the front cover.

CAUTION:

Be careful not to damage the front oil seal during installation with the front end of the crankshaft.



d. Tighten mounting bolts in the numerical order as shown.

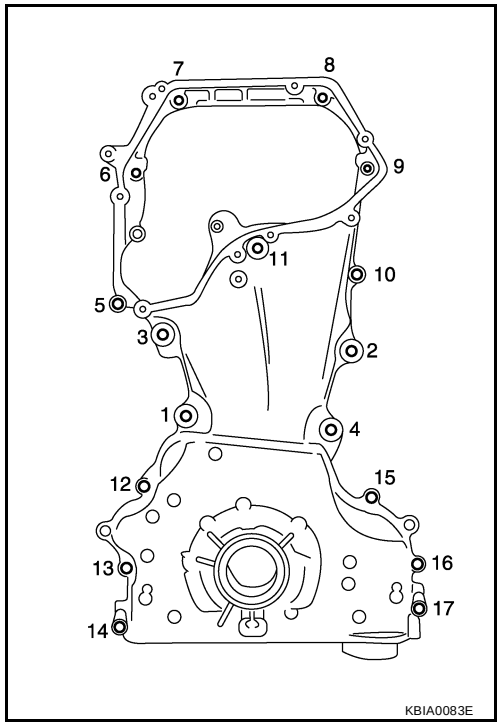
e. After all bolts are tightened, retighten them to the specified torque.

Front cover bolts : 12 - 13 N·m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)

CAUTION:

Wipe off any excess sealant leaking at the surface for installing the oil pan.

8. Install the chain guide between the camshaft sprockets.



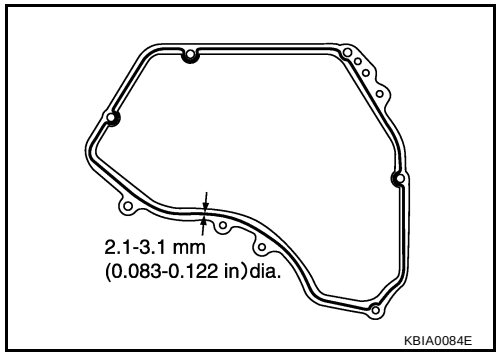
9. Install IVTC cover with the following procedure:

a. Install IVTC solenoid valves to IVTC cover.

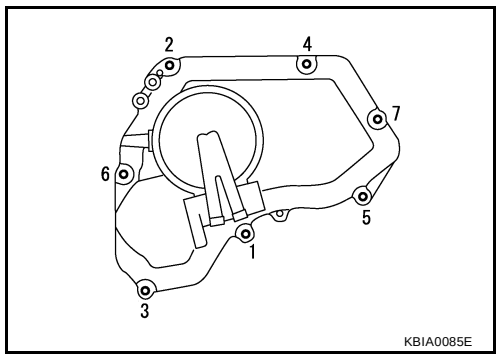
b. Install oil rings to the intake camshaft sprocket insertion points on IVTC backside cover.

c. Install O-ring to front cover.

d. Apply RTV Silicone Sealant to the positions as shown.



e. Tighten the mounting bolts in the numerical order as shown.



10. Insert crankshaft pulley by aligning with crankshaft key.
    - Tap its center with a plastic hammer to insert.
11. Tighten crankshaft pulley mounting bolts.
    - Secure crankshaft pulley with a pulley holder to tighten the bolt.
    - Perform angle tightening with the following procedure:

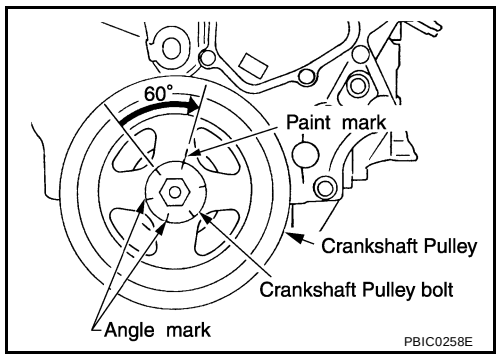
a. Apply new engine oil to threads and seat surfaces of mounting bolts.

b. Tighten the crankshaft pulley to initial specifications:·

Crankshaft pulley bolt initial tightening : 37.3 - 47.1 N·m (3.8 - 4.8 kg-m, 28 - 34 ft-lb)

c. Apply a paint mark on the front cover, mating with any one of six easy to recognize stamp marks on bolt flange.

d. Turn crankshaft pulley bolt another 60° to 66° degrees [Target: 60° degrees].
    - Check vertical mounting angle with movement of one stamp mark.



12. Installation of the remaining parts is in reverse order of removal.

CYLINDER HEAD

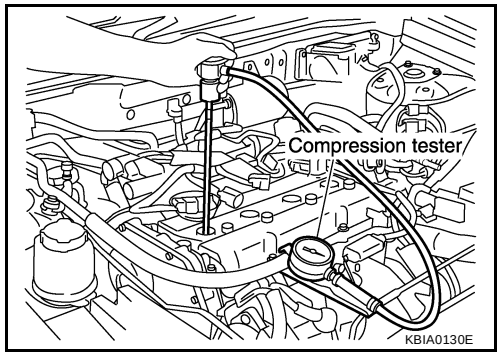
PFP:11041

On-Vehicle Service

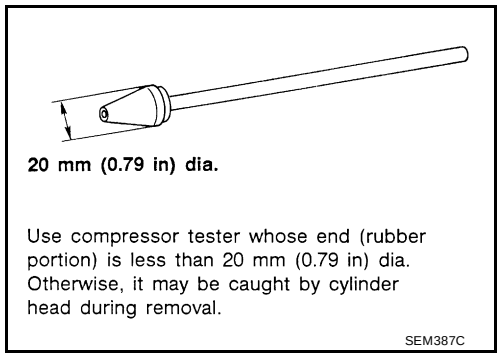
EBS006AQ

CHECKING COMPRESSION PRESSURE

1. Warm up the engine to full operating temperature.
2. Release the fuel pressure. Refer to EC-1255, "FUEL PRESSURE RELEASE" .
3. Remove the ignition coil and spark plug from each cylinder.
   Refer to EM-104, "Removal and Installation" .
4. Connect engine tachometer (not required in use of CONSULT-II).
5. Disconnect the fuel injector harness connector to avoid any residual fuel injection during the measurement.
6. Install the compression tester with the adapter into the spark plug hole.



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



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

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

Standard	Minimum	Difference limit between cylinders
1,250 (12.8, 182) / 250	1,060 (10.8, 154) / 250	100 (1.0, 14) / 250

CAUTION:

Always use a fully charged battery to obtain specified engine cranking speed.

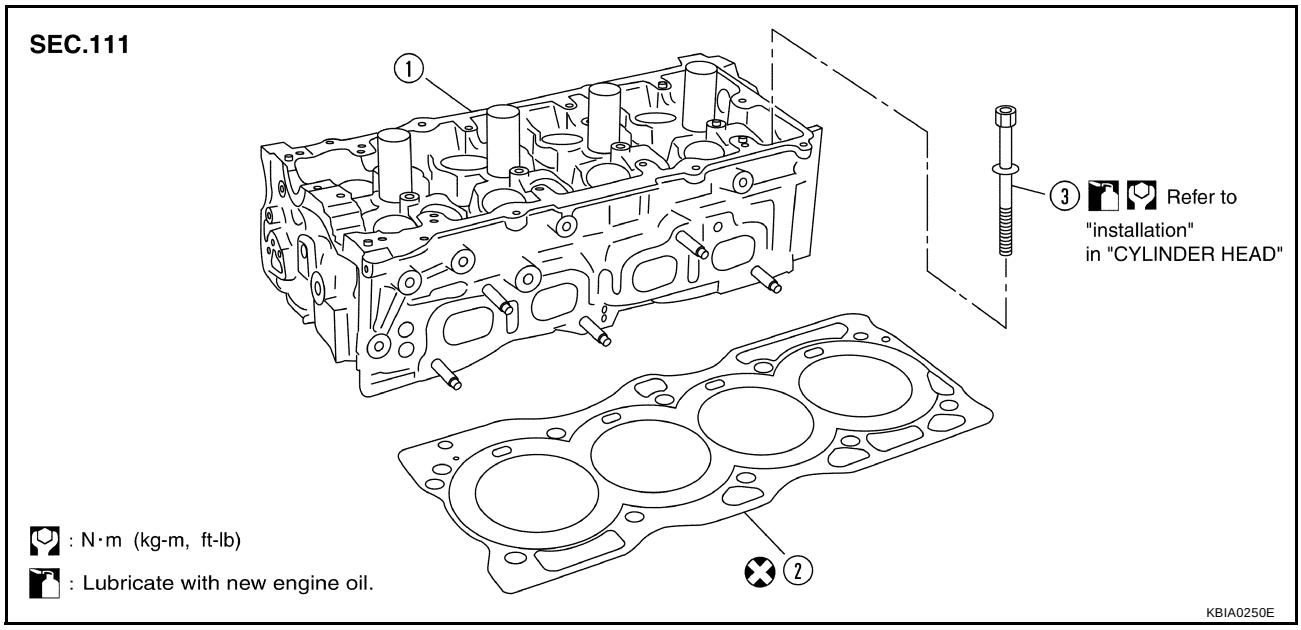
- If the engine speed is out of specified rpm range, check the battery. Check engine speed again with a fully charged battery.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure compression pressure again.
- If some cylinders have low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
  - If the added engine oil improves the compression, the piston rings may be worn or damaged. Check the piston rings and replace if necessary.
  - If the compression pressure remains at low level despite the addition of engine oil, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.

- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, the head gasket is leaking. In such a case, replace the cylinder head gasket.

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

Removal and Installation

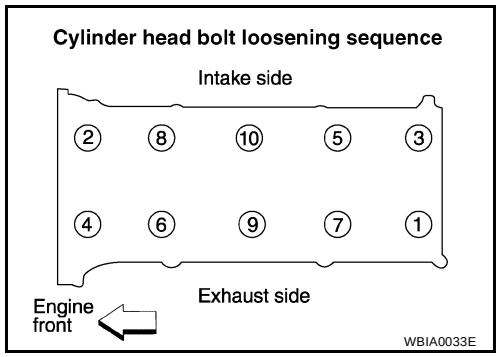
EBS006AR



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

REMOVAL

1. Release fuel pressure. Refer to EC-1255, "FUEL PRESSURE RELEASE" .
2. Remove the strut tower brace.
3. Drain engine coolant and engine oil.
4. Remove the engine undercovers.
5. Remove the timing chain. Refer to EM-121, "Removal and Installation" .
6. Remove the camshafts. Refer to EM-111, "CAMSHAFT" .
7. Remove the exhaust manifold.
8. Support the engine with suitable hoist and floor jack.
9. Remove cylinder head loosening bolts in the numerical order as shown.
10. If necessary to transfer to new cylinder head or remove for reconditioning, remove the intake manifold collector, intake manifold, and fuel tube assembly. Refer to EM-93, "Removal and Installation" .



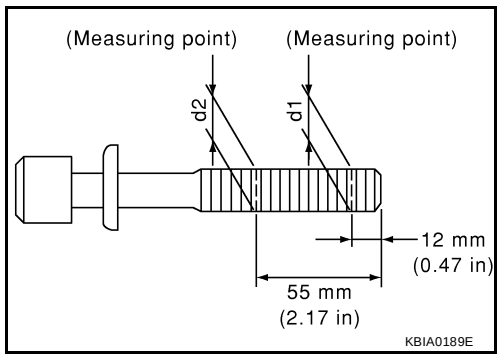
INSPECTION AFTER REMOVAL

Outer Diameter of Cylinder Head Bolts

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

  Limit (d1 - d2) : 0.23 mm (0.0091 in) or less

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

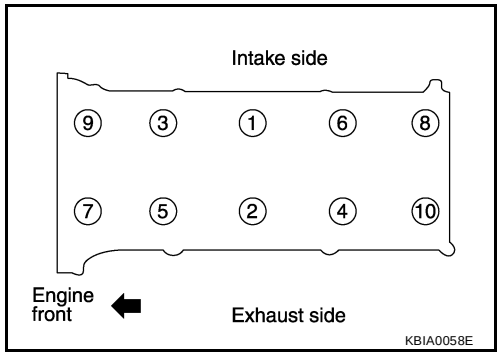


INSTALLATION

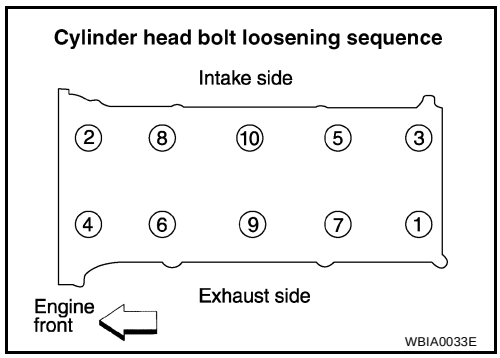
1. Install a new cylinder head gasket.
2. Follow the steps below to tighten the cylinder head bolts in the numerical order as shown.

   CAUTION:

   - **If cylinder head bolts are re-used, check their outer diameters before installation. Refer to EM-131, "Outer Diameter of Cylinder Head Bolts" .**



   - **In step “c”, loosen bolts in numerical order as shown.**

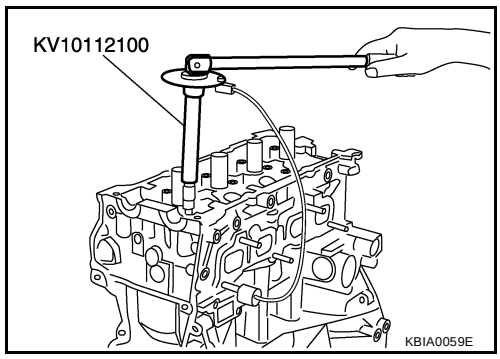


   a. Apply new engine oil to the threads and the seating surfaces of mounting bolts.
   b. Tighten all bolts in numerical order as shown to 98.1 N·m (10 kg-m, 72 ft-lb).
   c. Completely loosen all bolts in numerical order as shown.
   d. Retighten all bolts in numerical order as shown to 34.3 - 44.1 N·m (3.5 - 4.4 kg-m, 26 - 32 ft-lb).
   e. Turn all bolts in numerical order as shown 75° - 80° degrees (target: 75° degrees) clockwise.

      CAUTION:

      Check and confirm the tightening angle by using angle wrench or protractor. Avoid judgment by visual inspection without the tool.

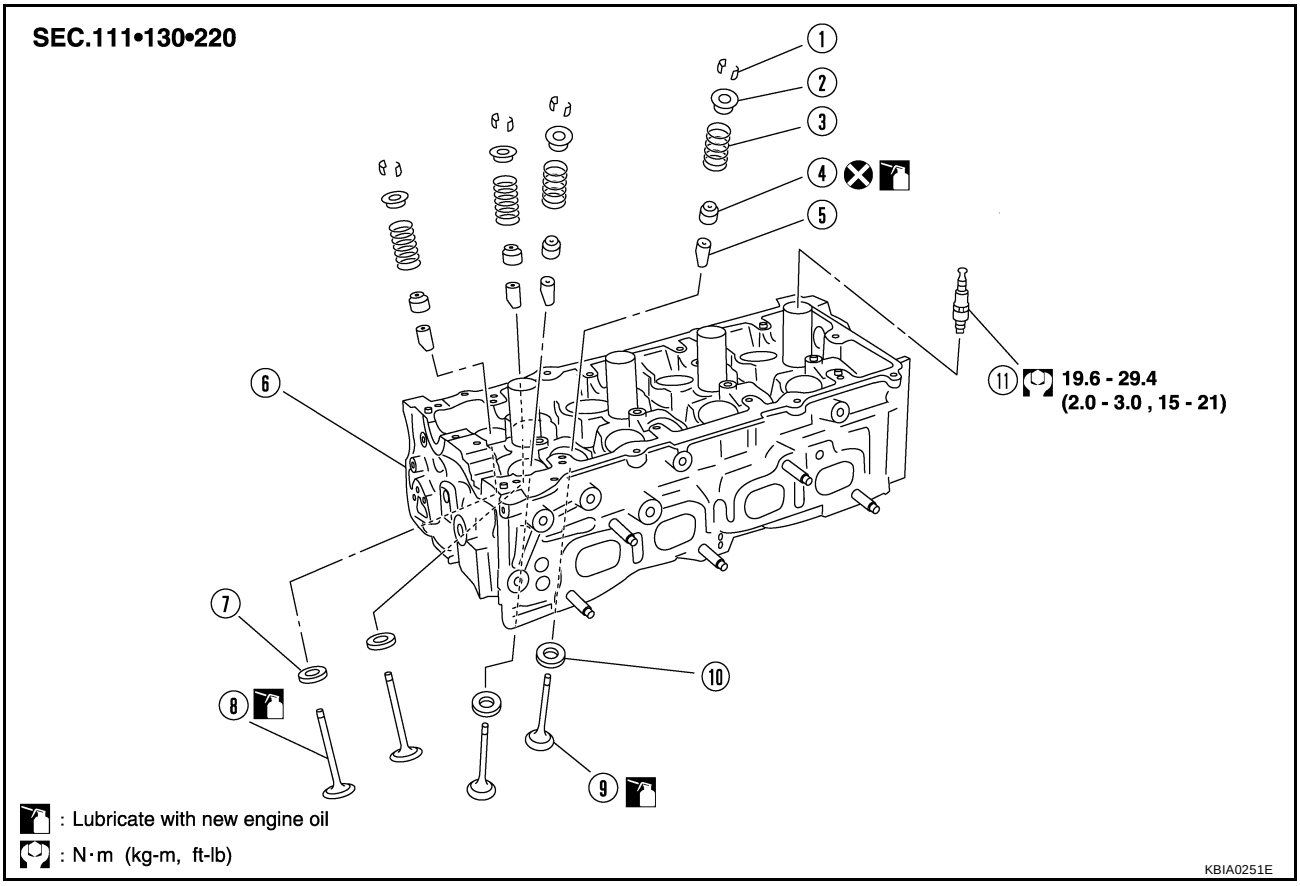
   f. Turn all bolts in numerical order as shown 75° to 80° degrees (target: 75° degrees) clockwise again.



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

Disassembly and Assembly

EBS006AS



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

CAUTION:

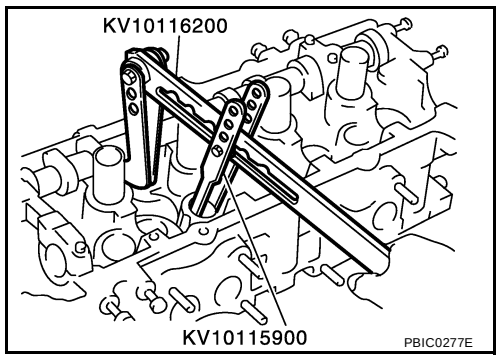
- **When installing camshafts, chain tensioners, oil seals or other sliding parts, lubricate contacting surfaces with new engine oil.**
- **Apply new engine oil to threads and seat surfaces when installing the cylinder head, camshaft sprocket, crankshaft pulley and camshaft bracket.**
- **Attach tags to valve lifters so all parts are assembled in their original position.**

DISASSEMBLY

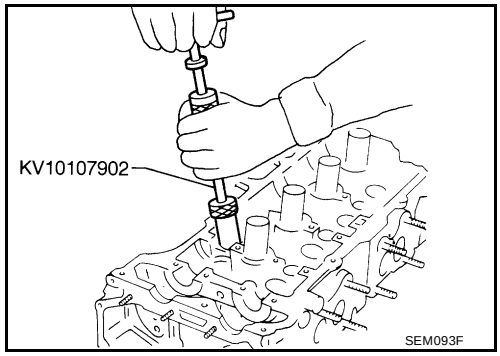
1. Remove the valve lifter.
   - Confirm installation point.
2. Remove the valve collet.
   - Compress valve spring with valve spring compressor. Remove valve collet with magnet driver.
3. Remove valve spring retainer and valve spring.

   CAUTION:

   Do not remove valve spring seat from valve spring.
4. Push valve stem to combustion chamber side, and remove valve.
   - Inspect valve guide clearance before removal. Refer to EM-134, "VALVE GUIDE CLEARANCE" .
   - Confirm installation point.

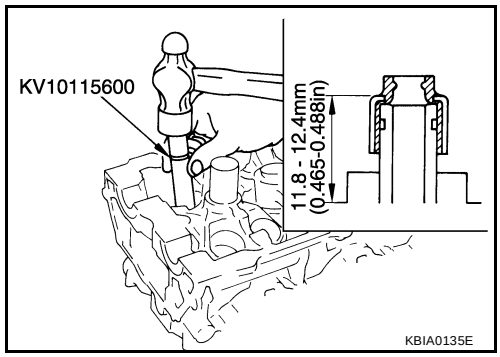


5. Remove valve oil seal with valve oil seal puller.
6. When valve seat must be replaced, refer to EM-136, "VALVE SEAT REPLACEMENT" .
7. When valve guide must be replaced, refer to EM-134, "VALVE GUIDE REPLACEMENT" .
8. Remove spark plug with spark plug wrench.

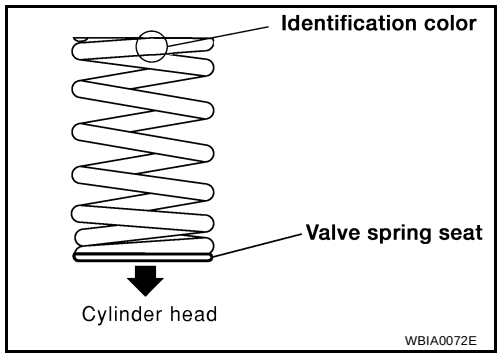


ASSEMBLY

1. Install valve guide. Refer to EM-134, "VALVE GUIDE REPLACEMENT" .
2. Install valve seat. Refer to EM-136, "VALVE SEAT REPLACEMENT" .
3. Install valve oil seal.
   - Install with valve oil seal drift to match dimension in illustration.
4. Install valve.
   - Install larger diameter to intake side.



5. Install valve spring.
   - Install smaller pitch (valve spring seat side) to cylinder head side.
   - Confirm the identification color of the valve spring:
     Intake: blue
     Exhaust: yellow
6. Install valve spring retainer.
7. Install valve collet.
   - Compress valve spring with valve spring compressor. Install valve collet with magnet wand.
   - Tap stem edge lightly with plastic hammer after installation to check its installed condition.
8. Install valve lifter.
9. Install spark plug.



Inspection After Disassembly

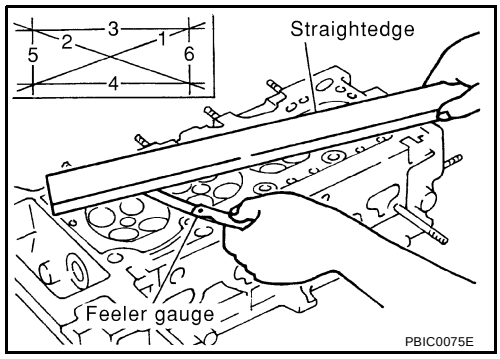
EBS006AT

CYLINDER HEAD DISTORTION

1. Wipe off oil and remove water scale deposits, old gasket, old sealer, and carbon with a scraper.

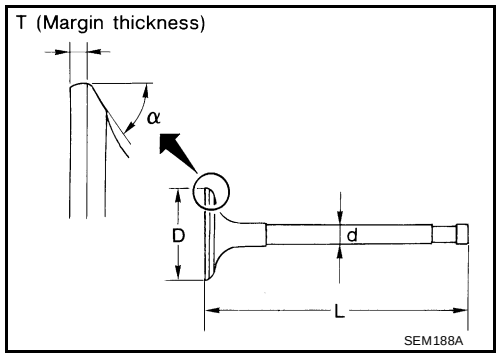
   CAUTION:
   Use care not to allow gasket debris to enter passages for oil or water.
2. At each of several locations on bottom surface of cylinder head, measure distortion in six directions.

   Standard : 0.1 mm (0.004 in) or less



VALVE DIMENSIONS

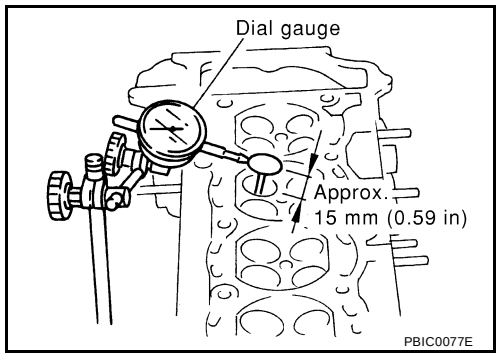
Check dimensions of each valve. Refer to EM-167, "VALVE" .



VALVE GUIDE CLEARANCE

NOTE:
Perform this inspection before removing the valve guide.

1. Make sure that the valve stem diameter is within the specification.
2. Push the valve out by approximately 15 mm (0.59 in) toward the combustion chamber side to measure the valve's run-out volume (in the direction of dial gauge) with dial gauge.
3. Half of the run-out volume accounts for the valve guide clearance.

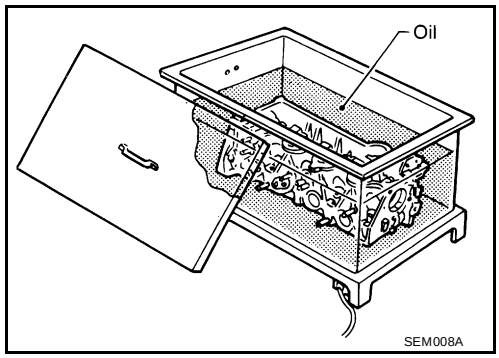


Intake run-out	**: 0.020 - 0.053 mm (0.0008 - 0.0021 in) or less**
Exhaust run-out	**: 0.030 - 0.063 mm (0.0012 - 0.0025 in) or less**

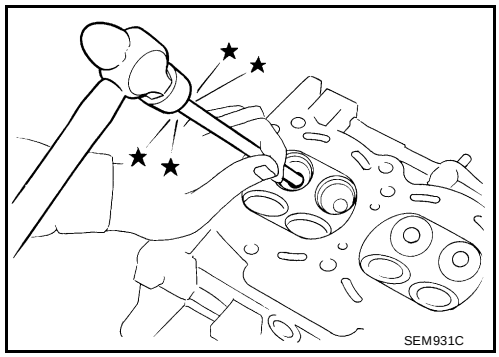
VALVE GUIDE REPLACEMENT

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

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

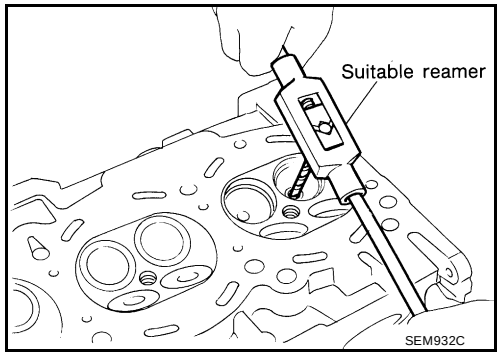


2. Drive out valve guide with a press [under a 20 kN (2.2 ton-force) pressure] or hammer and suitable tool.

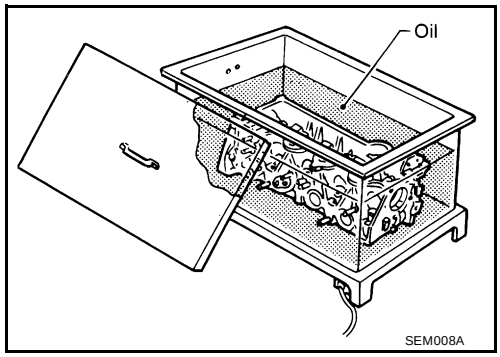


3. Ream cylinder head valve guide hole.

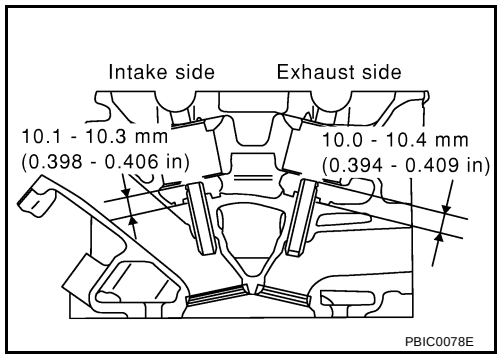
Valve guide hole diameter for intake and exhaust : **10.175 - 10.196 mm (0.4006 - 0.4014 in)**



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

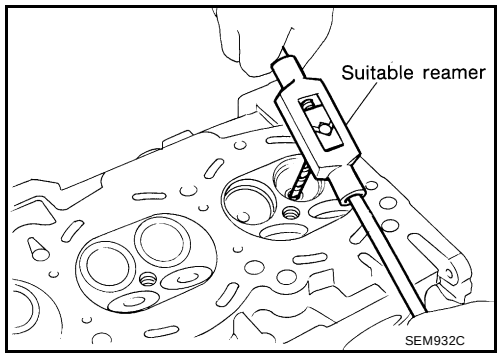


5. Press valve guide from camshaft side to dimensions as in illustration.



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

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

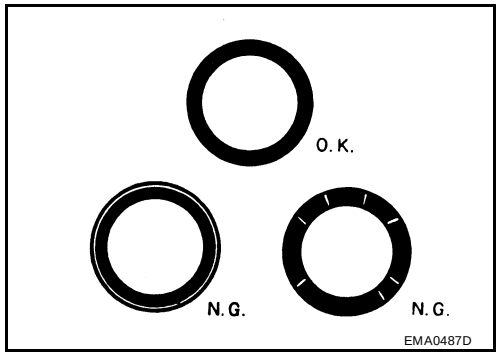


VALVE SEAT CONTACT

NOTE:
After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure:

1. Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the seat surface.

2. Check if the contact area band is continuous all around the circumference.
3. If not, grind to adjust valve fitting and check again. If the contacting surface still has N.G. conditions even after the re-check, replace the valve seat.



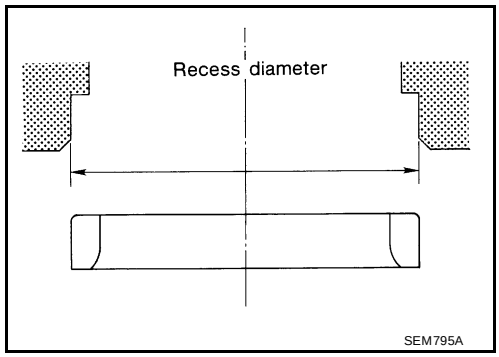
VALVE SEAT REPLACEMENT

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

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

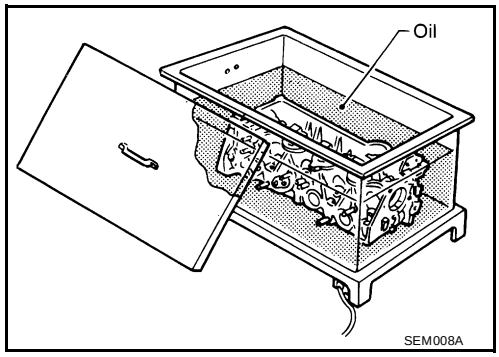
   Oversize : 0.5 mm (0.020 in)
   Intake : 37.000 - 37.016 mm (1.4567 - 1.4573 in)
   Exhaust : 32.000 - 32.016 mm (1.2598 - 1.2605 in)

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



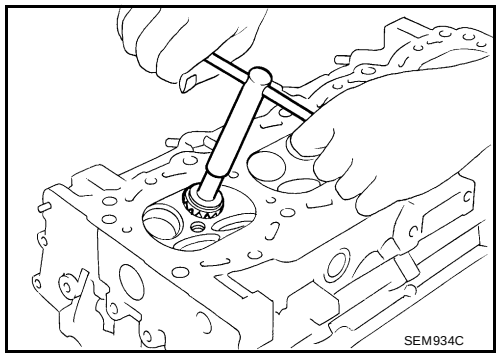
3. Heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil.
4. Provide valve seats cooled well with dry ice. Force fit valve seat into cylinder head.

   CAUTION:
   Avoid directly touching the cold valve seats.

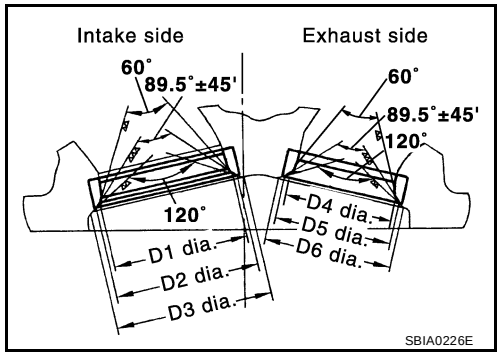


5. Using a valve seat cutter set or a valve seat grinder, finish the seat to the specified dimensions.

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



Grind to obtain the dimensions indicated as shown.



Standard

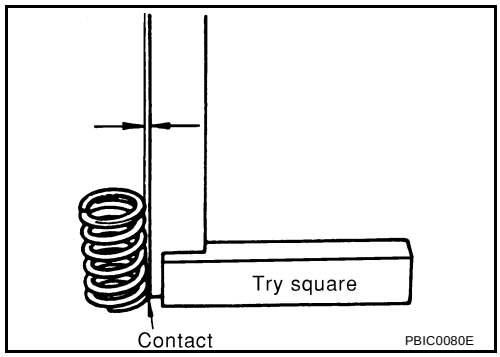
D1 dia. : 33.5 mm (1.3189 in)
D2 dia. : 35.1 - 35.3 mm (1.382 - 1.390 in)
D3 dia. : 39.0 - 39.2 mm (1.535 - 1.543 in)
D4 dia. : 28 mm (1.10 in)
D5 dia. : 29.9 - 30.1 mm (1.177- 1.185 in)
D6 dia. : 33.5 - 33.7 mm (1.319 - 1.327 in)

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

VALVE SPRING SQUARENESS

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

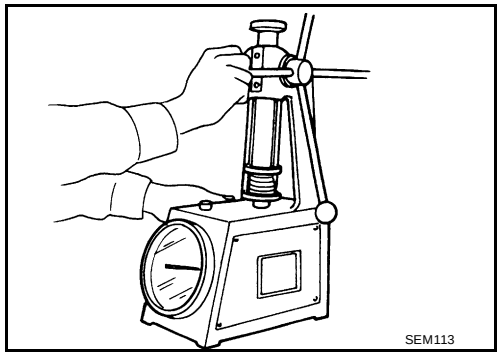
Limit : 1.9 mm (0.0748 in)



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

Check valve spring pressure with valve spring seat installed at specified spring height. Replace if not within specifications.

CAUTION:
Do not remove the valve spring seat.



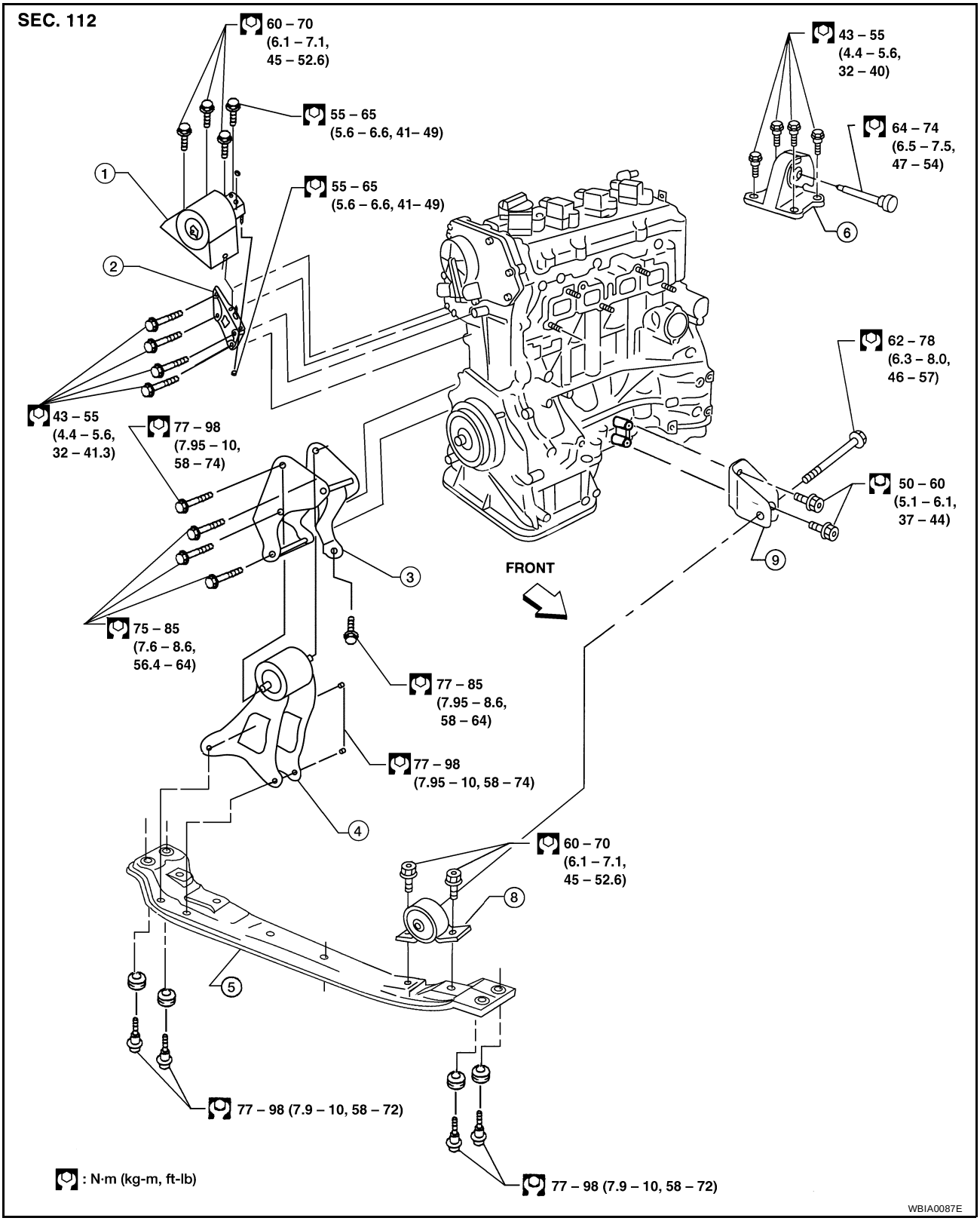
STANDARD	INTAKE (identification color: blue)	EXHAUST (identification color: yellow)
Free height	44.84 - 45.34 mm (1.7654 - 1.7850 in)	45.28 - 45.78 mm (1.7827 - 1.8024 in)
Installation height	35.30 mm (1.390 in)	35.30 mm (1.390 in)
Installation load	151 - 175 N (15.4 - 17.8 kg-force, 34 - 39 lb-force)	151 - 175 N (15.4 - 17.8 kg-force, 34 - 39 lb-force)
Height during valve open	24.94 mm (0.9819 in)	26.39 mm (1.0390 in)
Load with valve open	358 - 408 N (36.5 - 41.6 kg-force, 80 - 92 lb-force)	325 - 371 N (33.1 - 37.8 kg-force, 73-83 lb-force)

ENGINE ASSEMBLY

PFP:10001

Removal and Installation

EBS006AU



1. RH engine mount
2. RH engine mounting bracket
3. Rear engine mounting bracket
4. Rear engine mount
5. Center member
6. LH engine mount
7. Front engine mount
8. Front engine mounting bracket

WARNING:

- **Place chocks at the front and back of the rear wheels.**
- **For engines not equipped with slingers, attach proper slingers and bolts as described in the parts catalog.**

CAUTION:

- **Do not start working until the exhaust system and coolant are cool.**
- **If items or work required are not covered by the engine main body section, refer to the applicable sections.**
- **Use the correct supporting points for lifting and jacking. Refer to GI-38, "Lifting Points and Tow Truck Towing" .**
- **In removing the drive shaft, be careful not to damage the grease seals on the transaxle.**
- **Before separating the engine and transaxle, remove the crankshaft position sensor (POS) from the assembly.**
- **Be sure not to damage the edge of the crankshaft position sensor (POS) or the ring gear teeth.**

REMOVAL

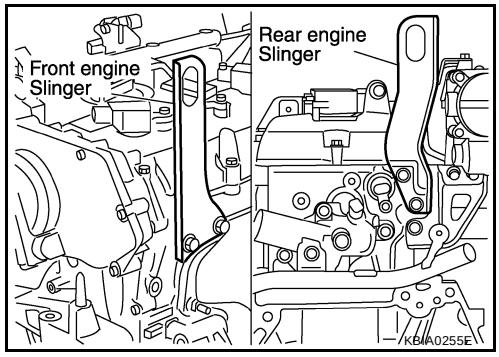
1. Release fuel pressure. Refer to EC-1255, "FUEL PRESSURE RELEASE" .
2. Disconnect the fuel rail at the fuel hose quick connector (engine side). Refer to EM-93, "INTAKE MANIFOLD" .
3. Drain the engine oil. Refer to LU-17, "Changing Engine Oil" .
4. Drain the engine coolant. Refer to MA-15, "DRAINING ENGINE COOLANT" .
5. Remove the engine hood assembly. Refer to EI-14, "Removal and Installation" .
6. Remove the battery, battery hold downs, and battery tray.
7. Disconnect the MAF sensor electrical connector.
8. Remove the air duct and air cleaner case assembly. Refer to EM-91, "Removal and Installation" .
9. Disconnect the heater hoses.
10. Remove the radiator and radiator fan assembly. Refer to CO-32, "Removal and Installation" .
11. Remove the alternator. Refer to SC-32, "Removal" .
12. Remove the left and right drive shafts. Refer to FAX-16, "Removal" .
13. Remove the engine undercovers.
14. Dismount the A/C compressor with piping connected and secure with wire to the radiator support.
15. Disconnect the transaxle shift control cables.
16. Disconnect the brake power booster vacuum hose.
17. Disconnect the following engine compartment electrical harness connectors:
    - Heated oxygen sensors
    - Starter assembly
    - Coolant temperature sensor
    - Camshaft position sensor (PHASE)
    - EVAP canister purge volume control solenoid
    - Backup lamp switch
    - Vehicle speed sensor
    - Electric throttle control actuator
    - Ignition coils
    - Fuel injector harness
    - Engine ground straps
    - Intake valve timing control solenoid
    - Transaxle sensors (A/T only)
    - Crankshaft position sensor (POS)
    - Knock sensor
    - Oil pressure switch
    - Swirl control valve

- Power steering pressure switch

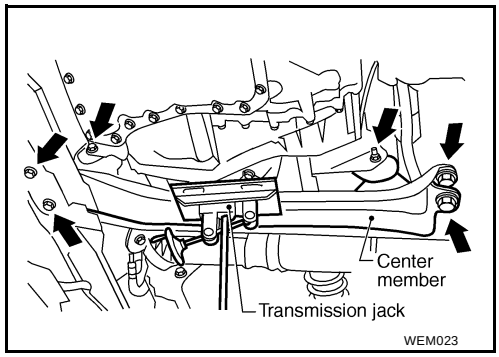
18. Remove clutch operating cylinder from transaxle, and move it aside (M/T models).
19. Remove engine coolant reservoir tank.
20. Remove front exhaust tube. Refer to EX-3, "Removal and Installation" .
21. Dismount the power steering pump with piping connected and position it aside with wire.
22. Install engine slingers into front left cylinder head and rear right cylinder head.
    - Use alternator bracket mounting bolt holes for the front slinger.
    - Use the proper slingers and bolts as described in the Parts Catalog.

    Slinger bolts - front : 51.0 - 64.7 N·m (5.2 - 6.5 kg-m, 38 - 47 ft-lb)

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

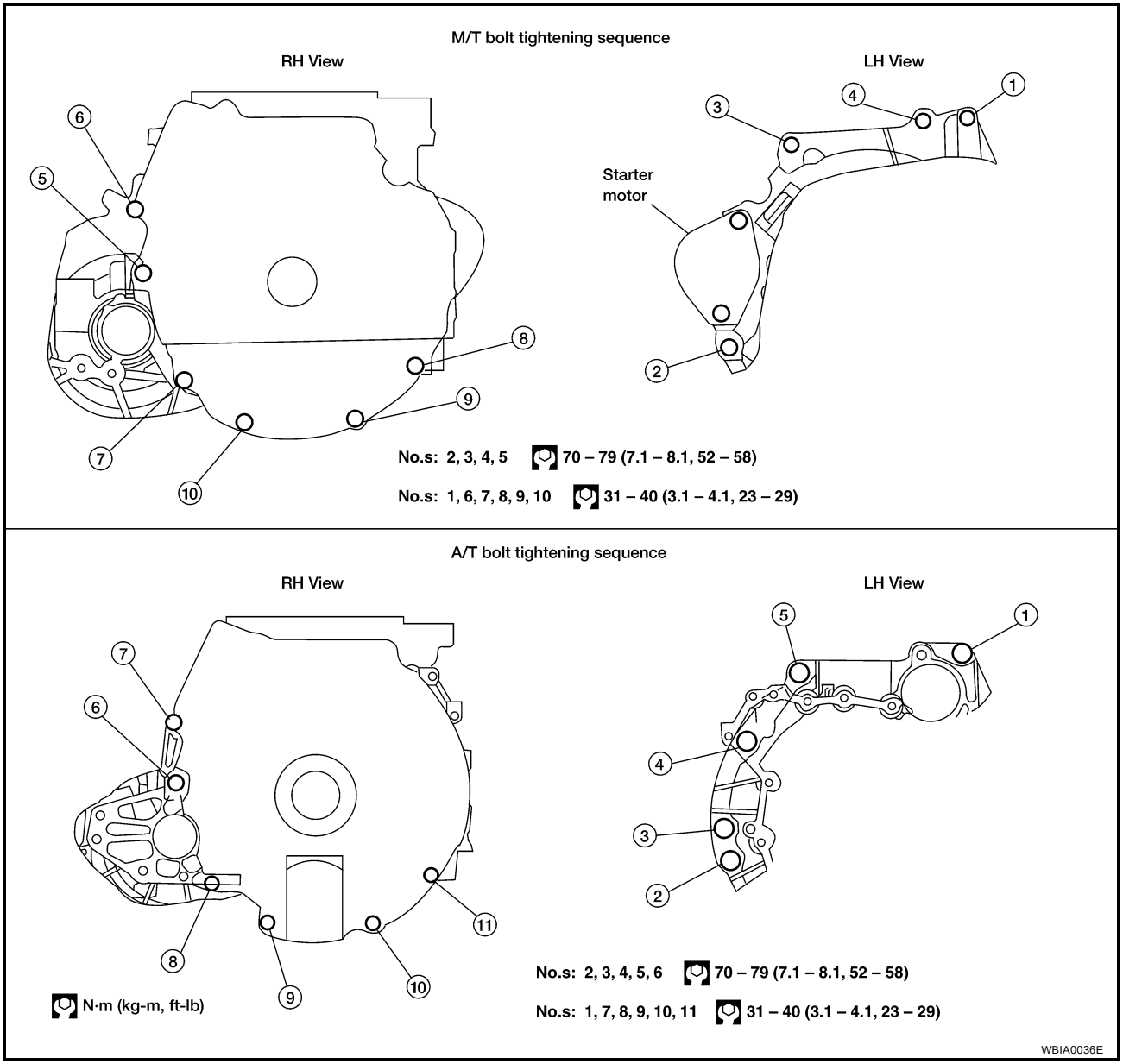


23. Support the engine/transaxle assembly with engine lifting equipment from the top and a suitable transmission jack under the engine/transaxle assembly, with the vehicle raised on a hoist.
24. Remove the center member.
    - Remove front and rear engine mounting insulator through-bolt and the center member bolts.
25. Remove RH engine mounting insulator.
26. Remove LH transaxle mounting insulator through-bolts.
27. Lower the engine/transaxle assembly from the engine compartment on the platform jack, steady it safely with the lifting equipment.
28. Remove the starter motor. Refer to SC-21, "Removal" .
29. Separate the engine and transaxle.



INSTALLATION

Installation is in the reverse order of removal.



- Do not allow oil to get on mounting insulators. Be careful not to damage mounting insulators.
- If parts have a direction mark (arrow) this indicates front of the vehicle, and the parts must be installed according to the identification mark.

INSPECTION AFTER INSTALLATION

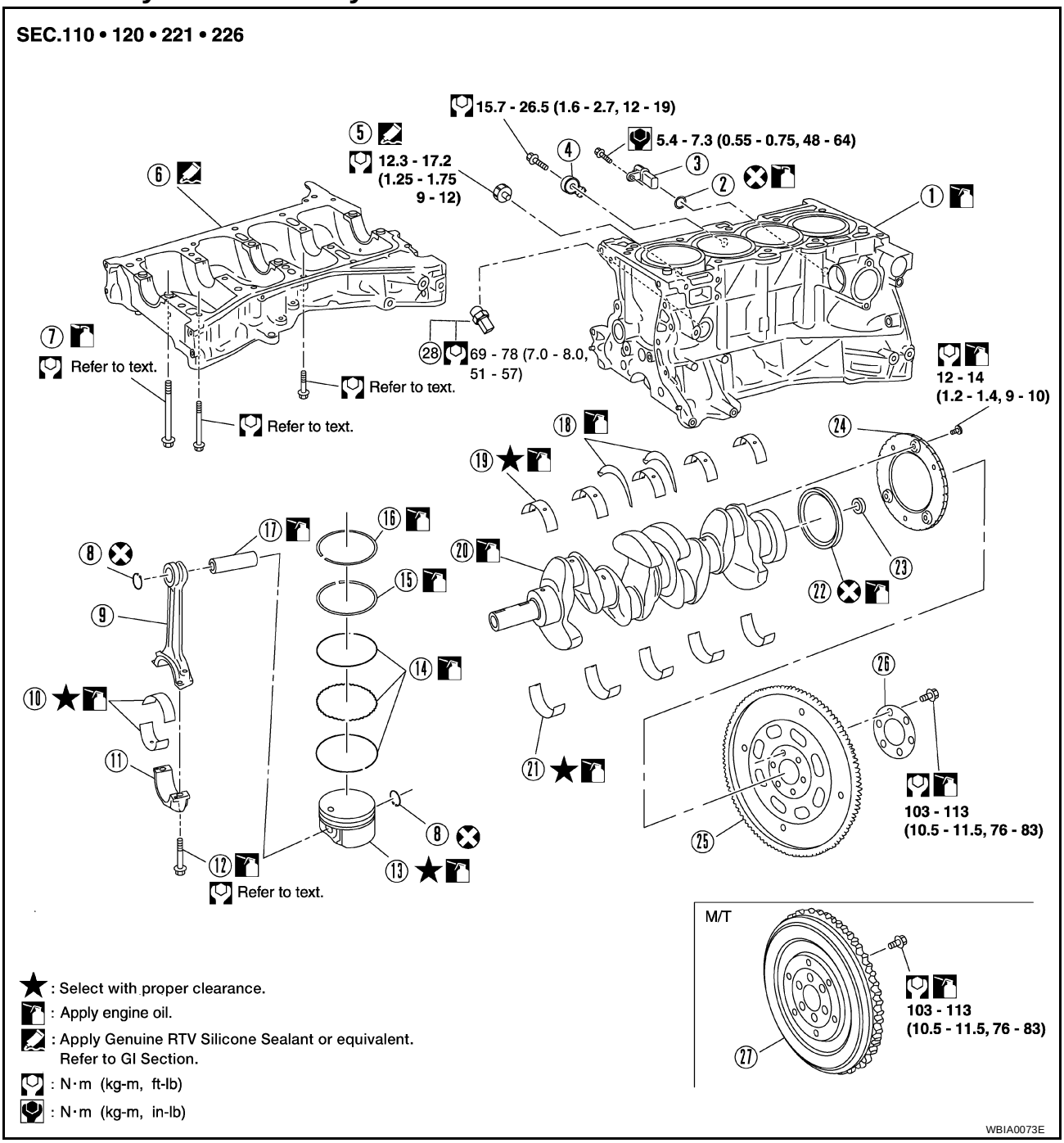
- Before starting engine, check the levels of engine coolant, lubricants, engine oil. If less than required quantity, fill to the specified level.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of coolant, lubricants, oil, fuel, and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines.

CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

EBS006AV



1. Cylinder block
2. O-ring
3. Crankshaft position sensor (POS)
4. Knock sensor
5. Oil pressure switch
6. Lower cylinder block
7. Lower cylinder block bolt
8. Snap ring
9. Connecting rod
10. Connecting rod bearing
11. Connecting rod bearing cap
12. Connecting rod bearing cap bolt
13. Piston
14. Oil ring
15. Second ring
16. Top ring
17. Piston pin
18. Main thrust bearing
19. Main bearing upper
20. Crankshaft
21. Main bearing lower
22. Crankshaft rear oil seal
23. Pilot converter (A/T only)
24. Crankshaft signal plate
25. Drive plate
26. Reinforcement plate
27. Flywheel
28. Cylinder block heater (if equipped)

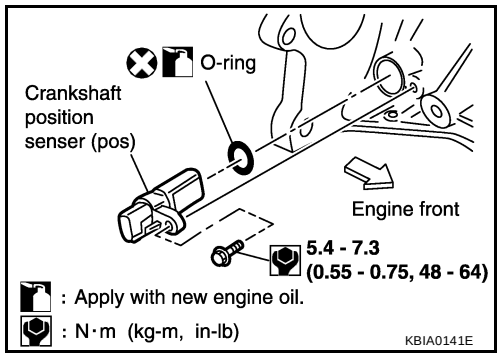
CAUTION:
Apply new engine oil to parts as indicated in the illustration before installation.

DISASSEMBLY

1. Remove the engine and transaxle as an assembly from the vehicle, and separate the transaxle from the engine. Refer to EM-138, "Removal and Installation" .
2. Mount the engine on a suitable engine stand.
3. Drain any remaining engine oil and coolant from the engine.
4. Remove the following components and associated parts.
   - Exhaust manifold and three way catalyst assembly. Refer to EM-98, "Removal and Installation" .
   - Intake manifold collector. Refer to EM-93, "Removal and Installation" .
   - Intake manifold and fuel tube assembly. Refer to EM-93, "Removal and Installation" .
   - Ignition coils. Refer to EM-103, "Removal and Installation" .
   - Rocker cover. Refer to EM-109, "Removal and Installation" .
   - Front cover, timing chain, and balancer unit. Refer to EM-121, "Removal and Installation" .
   - Cylinder head. Refer to EM-130, "Removal and Installation" .
5. Remove the knock sensor.

   CAUTION:
   Carefully handle the sensor and do not drop the sensor.
6. Remove crankshaft position sensor (POS).

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

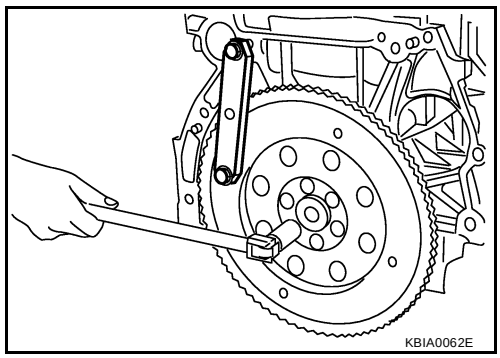


7. Remove the flywheel (M/T models) or drive plate (A/T models) using specified Tool. Hold the crankshaft with a stopper plate and remove the mounting bolts.

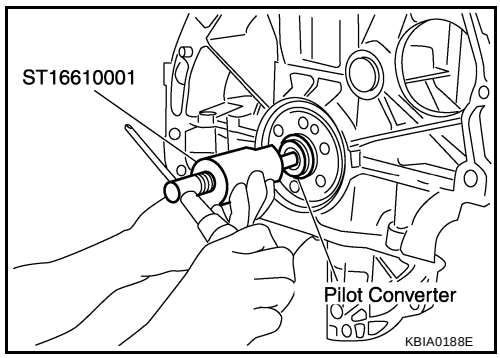
   Flywheel bolt Tool : J-45737
   Drive plate bolt Tool : J-45816

   CAUTION:
   Be careful not to damage the flywheel contact surface for the clutch disc.

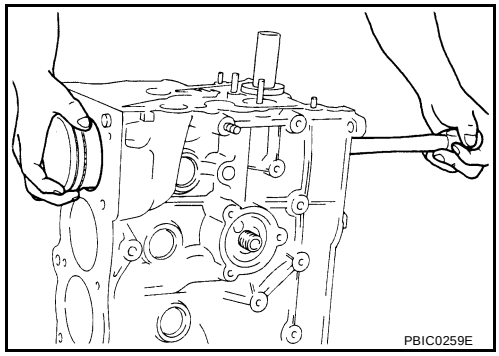
   NOTE:
   The flywheel two-block construction allows movement in response to transmission side pressure, or when twisted in its rotational direction, therefore, some amount of noise is normal.



8. Remove pilot converter using Tool (A/T models).



9. Remove the piston and connecting rod assemblies.



a. Position the crankshaft and corresponding connecting rod, to be removed, to the bottom dead center stroke.

b. Remove the connecting rod cap. Number the cap so it can be assembled in the same position.

c. Using a hammer handle or similar tool, push the piston and connecting rod assembly out of the top of the cylinder block. Number the piston and rod so it can be assembled in the same position.

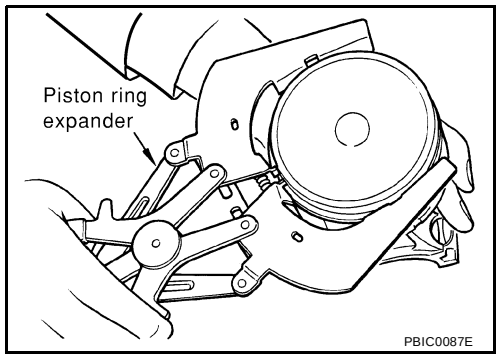
- Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-157, "CONNECTING ROD SIDE CLEARANCE" .

10. Remove the connecting rod bearings. If reusing, number them so they can be assembled in the same position and direction.

CAUTION:

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

11. Remove the piston rings from the piston.



- Use a piston ring expander.

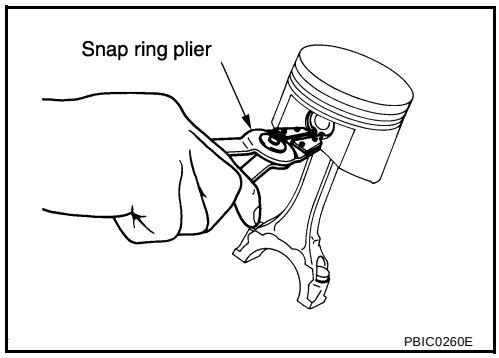
CAUTION:

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

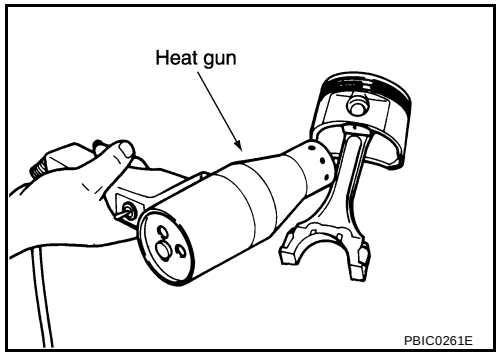
- Before removing the piston rings, check the piston ring side clearance. Refer to EM-158, "PISTON RING SIDE CLEARANCE" .

12. Remove the piston from the connecting rod as follows.

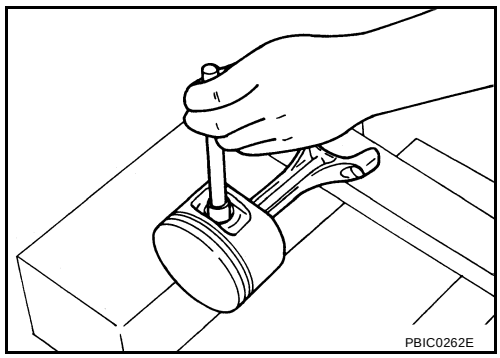
a. Using a snap ring pliers, remove the two snap rings.



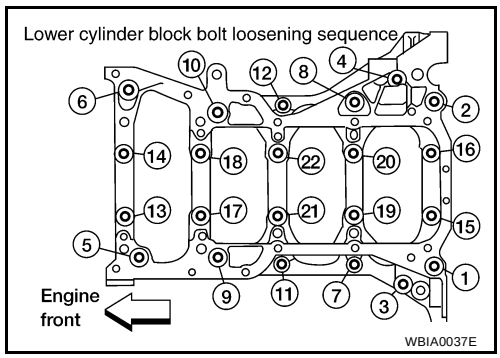
b. Heat the piston to 60° - 70°C (140° - 158°F) with a heat gun, or equivalent.



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

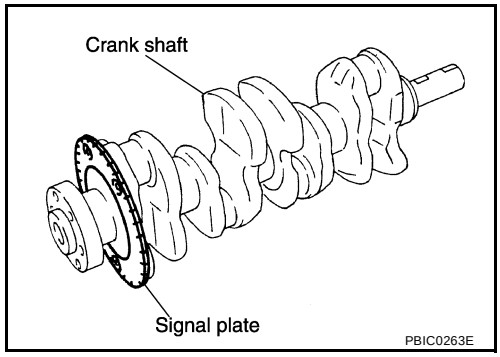


13. Remove the lower cylinder block mounting bolts.
    - Before loosening the lower cylinder block mounting bolts, measure the crankshaft side clearance. Refer to EM-156, "CRANKSHAFT SIDE CLEARANCE" .
    - Loosen them in the order shown to remove them.



14. Remove the lower cylinder block.
    - Using Tool (seal cutter) cut the Silicone RTV Sealant and remove the lower cylinder block from the cylinder block.

    CAUTION:
    Be careful not to damage the mounting surface.



15. Remove the crankshaft.

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

16. Pull the rear oil seal out of the rear end of the crankshaft.

    CAUTION:
    Do not to damage the crankshaft or cylinder block when removing the rear oil seal.

    NOTE:
    When replacing the rear oil seal without removing the cylinder block, use a screwdriver to pull it out from between crankshaft and block.

17. Remove the main bearings and thrust bearings from the cylinder block and lower cylinder block.

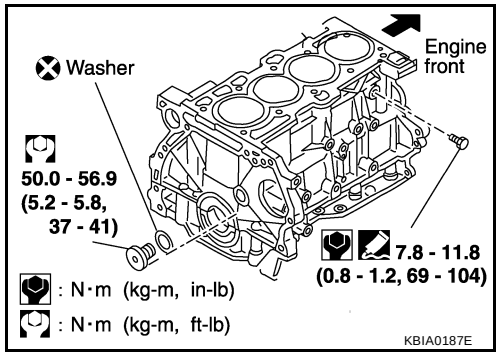
    CAUTION:
    Identify and number the bearings, if reusing them, so that they are assembled in the same position and direction.

ASSEMBLY

1. Using compressed air, clean out the coolant and oil passages in the cylinder block, the cylinder bore and the crankcase to remove any foreign material.

   CAUTION:
   Use approved safety glasses to protect your eyes.

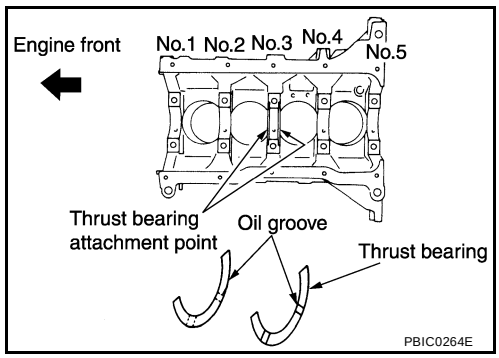
2. Install the drain plugs on the cylinder block.
   - Apply RTV Silicone Sealant.
     Use Genuine RTV Silicone Sealant, or equivalent. Refer to GI-44, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS" .
   - Replace the copper washers with new ones.



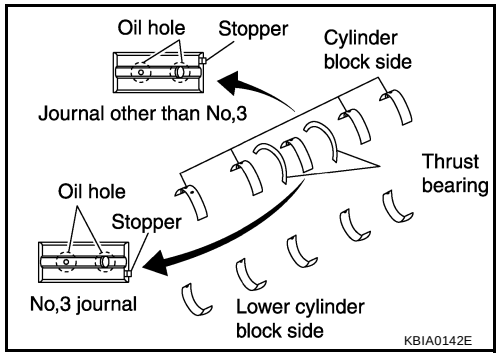
3. Install the main bearings and the thrust bearings.

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

b. Install the thrust bearings to both sides of the No. 3 main bearing journal on the cylinder block.
   - Install the thrust bearings with the oil groove facing the crankshaft arm (outside).



c. Install the main bearings paying attention to their position and direction.
   - The main bearing with an oil hole and groove goes on the cylinder block. The one without them goes on the lower cylinder block.
   - Only the main bearing (on the cylinder block) for No. 3 journal has different specifications.
   - Before installing the bearings, apply engine oil to the bearing friction surface (inside). Do not apply oil to the back surface, but thoroughly clean it.
   - When installing, align the bearing stopper to the notch.
   - Make sure that the oil holes on the cylinder block and those on the corresponding bearing are aligned.



4. Install the signal plate to the crankshaft.

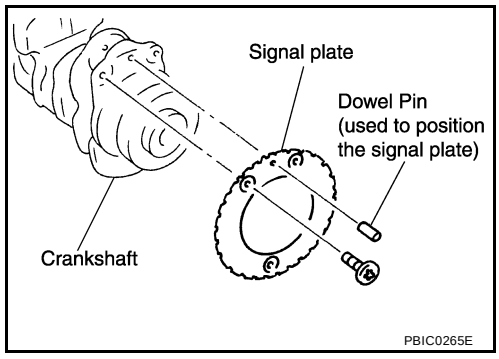
   Signal plate bolts : 12 - 14 N·m (1.22 - 1.43 kg-m, 9 - 10 ft-lb)

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

b. Remove the dowel pin.

   CAUTION:
   Be sure to remove dowel pin before installing the crankshaft.

   NOTE:
   Dowel pins for the crankshaft and signal plate are supplied as a set for each.

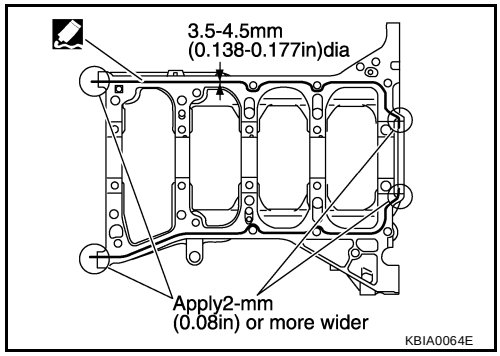


5. Install the crankshaft onto the cylinder block.
   - While turning the crankshaft by hand, check that it turns smoothly.

6. Install the lower cylinder block.
   - Apply Silicone RTV Sealant to positions shown in the figure.

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

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

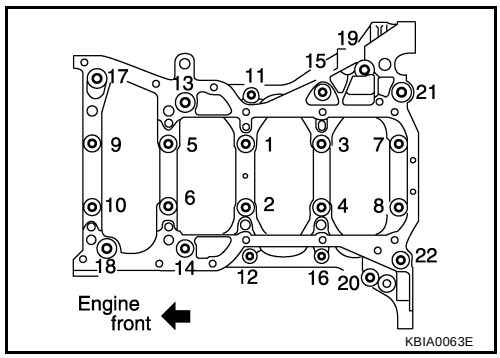


7. Tighten lower cylinder block mounting bolts in the numerical order shown and according to the following steps:

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

b. Tighten bolts No. 1 - 10 only in the order shown, to specification below.

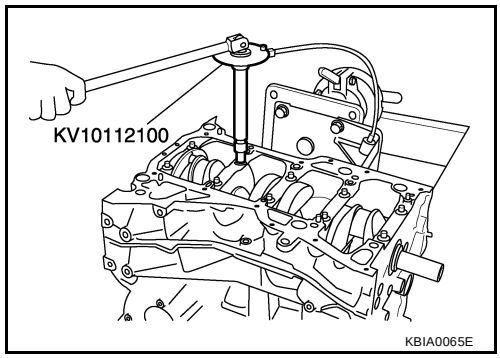
First tightening, bolts 1 - 10 only	**: 36.3 - 42.2 N·m (3.7 - 4.3 kg-m, 27 - 31 ft-lb)**



c. Tighten bolts No. 1 - 10 only in the order shown, to specification below.

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

Second tightening, bolts 1 - 10 only	**: 60° - 65° degrees rotation (target: 60° degrees)**

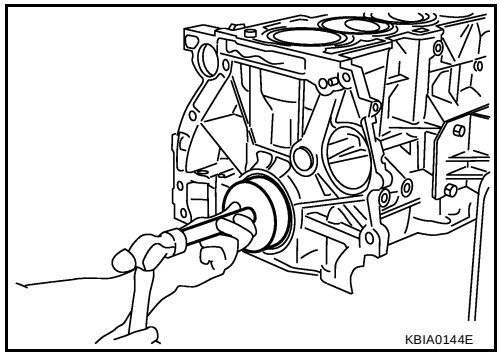


d. Tighten bolts No. 11 - 22 only in the order shown, to specification below.

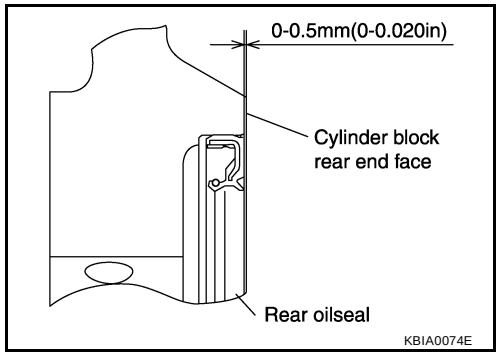
Third tightening, bolts 11 - 22 only	**: 22.6 - 27.5 N·m (2.3 - 2.8 kg-m, 17 - 20 ft-lb)**

- Wipe off completely any protruding RTV Silicone Sealant on the exterior of engine.
- Check crankshaft side clearance. Refer to EM-156, "CRANKSHAFT SIDE CLEARANCE" .
- After installing the mounting bolts, make sure that the crankshaft can be rotated smoothly by hand.

8. Install the rear oil seal.
   - Press the oil seal between cylinder block and crankshaft with a suitable drift.
   - Be careful not to touch the grease on the oil seal lip.
   - Be careful not to cause scratches or burrs when pressing in the rear oil seal.



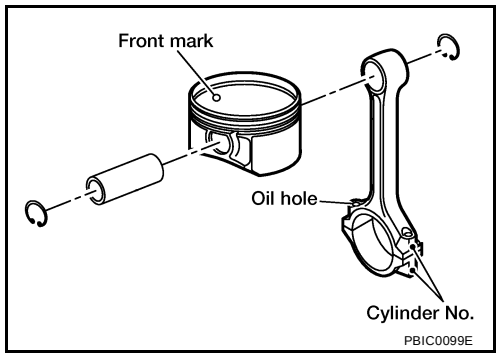
- Press in rear oil seal to the position shown in the figure.



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

a. Using a snap ring pliers, install the snap ring into the grooves of the piston's rear side.
   - Insert the piston pin snap ring fully into groove.

b. Install the piston to the connecting rod.
   - Using a heat gun, heat the piston [approximately 60° - 70° C (140° - 158° F)] until the piston pin can be pushed in by hand without excessive force. From the front to the rear, insert the piston pin into the piston and the connecting rod.
   - Assemble so that the front mark on the piston crown and the oil holes and the cylinder No. on the connecting rod are positioned as shown in the figure.



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

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

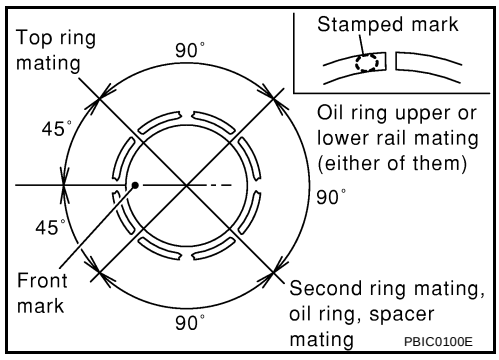
CAUTION:
Be careful not to damage the piston.

- Position each ring with the gap as shown in the figure, referencing the piston front mark as the starting point.
- Install the top ring and the second ring with the stamped surface facing upward.

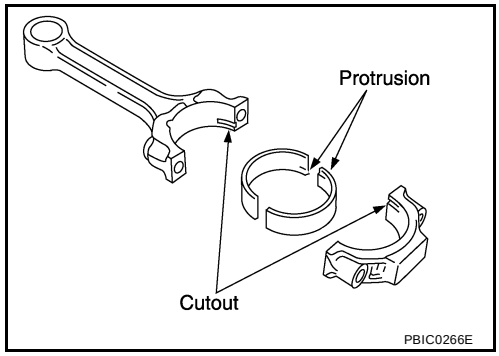
Stamp mark

Top ring : A

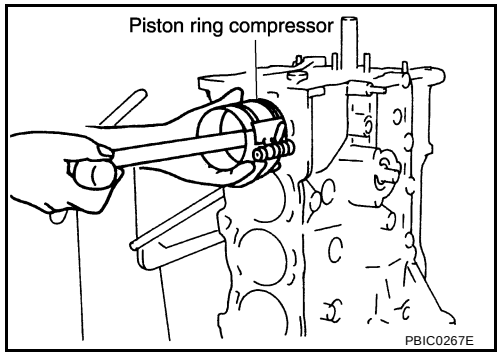
2nd ring : 2A



11. Install the connecting rod bearings to the connecting rod and the connecting rod cap. Assemble the components in their original positions.
   - When installing the connecting rod bearings, apply engine oil to the bearing friction surface (inside). Do not apply oil to the back surface, but thoroughly clean the back.
   - When installing, align the connecting rod bearing stopper protrusion with the notch of the connecting rod to install.
   - Check the oil holes on the connecting rod and those on the corresponding bearing are aligned.

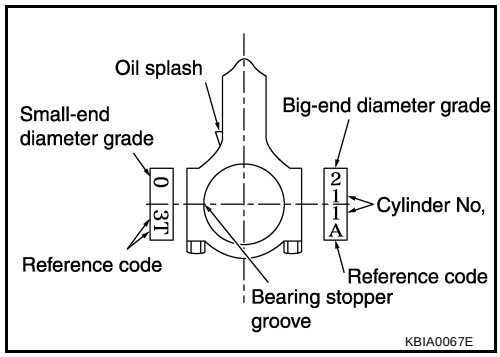


12. Install the piston and connecting rod assembly to the crankshaft. Assemble the components in their original positions.
    - Rotate the crankshaft so the pin corresponding to the connecting rod to be installed is at the bottom dead center position.
    - Apply engine oil sufficiently to the cylinder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



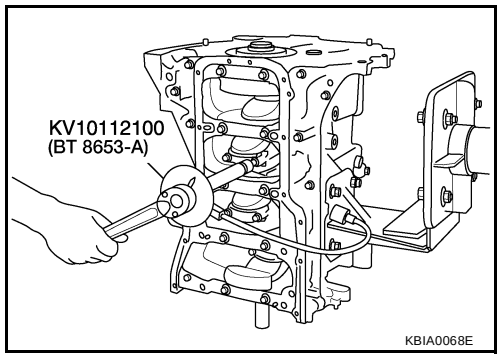
CAUTION:
Be careful not to damage the crankshaft pin, resulting from an interference of the connecting rod big end.

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



14. Tighten the connecting rod bolt as follows:
    Apply engine oil to the threads and seats of the connecting rod bolts.

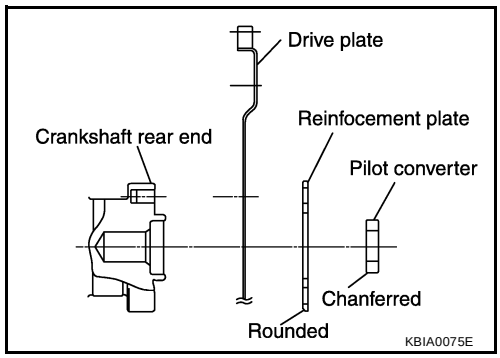
CAUTION:
Always use either an angle wrench or protractor. Avoid tightening based on visual check alone.



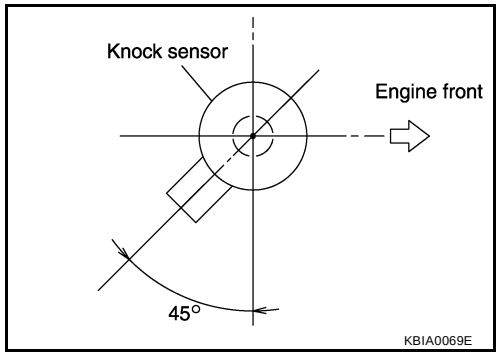
Stage 1 : 18.6 - 20.6 N·m (1.9 - 2.1 kg-m, 14 - 15 ft-lb)
Stage 2 : Rotate bolts 85° - 95° degrees (target 90° degrees)

- Check the connecting rod side clearance. Refer to EM-157, "CONNECTING ROD SIDE CLEARANCE".
- After tightening the bolts, make sure that the crankshaft rotates smoothly.

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



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



Knock sensor bolt : 15.7 - 26.5 N·m (1.6 - 2.7 kg-m, 12 - 19 ft-lb)

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

17. Install the crankshaft position sensor (POS).

Crankshaft position sensor bolt : 5.4 - 7.3 N·m (0.55 - 0.75 kg-m, 48 - 65 in-lb)

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

How to Select Piston and Bearing

EBS006AW

DESCRIPTION

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block to crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft to connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end inner diameter 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)
*Between piston to connecting rod	—	—	—

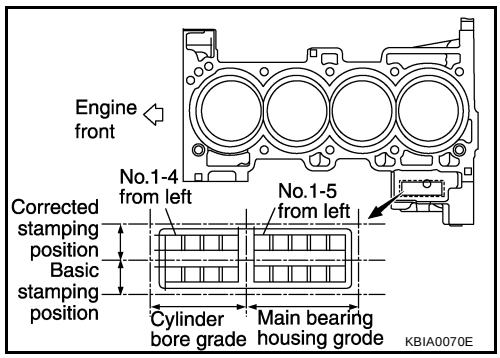
*For the service parts, the grade for fitting cannot be selected between a piston pin and a connecting rod. (Only 0 grade is available.)
The information at the shipment from the plant is described as a reference.

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

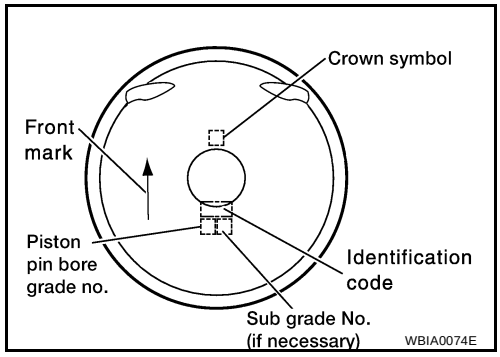
HOW TO SELECT A PISTON

When New Cylinder Block is Used:

- Check the cylinder bore grade on rear left side of cylinder block, and select a piston of the same grade.



- If there is a corrected stamp mark on the cylinder block, use it as a correct reference.



When a Cylinder Block is Reused:

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

Piston Selection Table

The piston is available together with piston pin as an assembly.

Unit: mm (in)

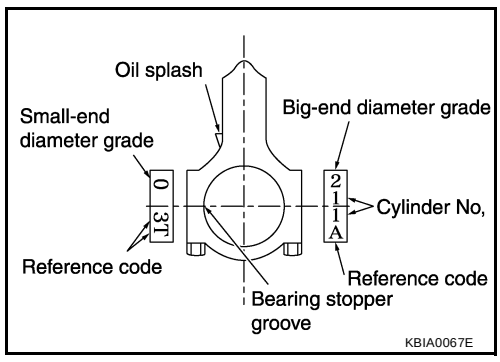
Grade number (Mark)	1	2 (or no mark)	3
Inner diameter of cylinder bore	89.000-89.010 (3.5039-3.5043)	89.010-89.020 (3.5043-3.5047)	89.020-89.030 (3.5047-3.5051)
Outer diameter of piston	88.980-88.990 (3.5031-3.5035)	88.990-89.000 (3.5035-3.5039)	89.000-89.010 (3.5039-3.5043)

NOTE:
The piston pin (piston pin bore) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. Only 0 grade is available.

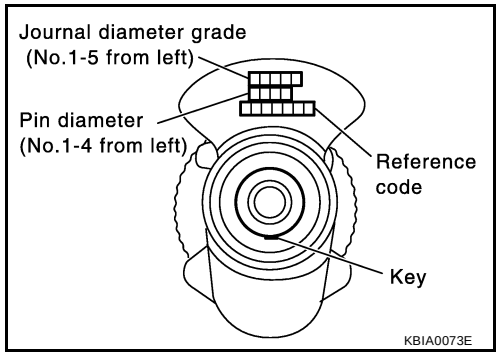
HOW TO SELECT A CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used:

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



2. Apply pin diameter grade stamped on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to connecting rod bearing grade table to select.



When Crankshaft and Connecting Rod are Reused:

1. Measure dimensions of the big end inner diameter of connecting rod and outer diameter of crankshaft pin individually.
2. Apply the dimension measured to the "Connecting Rod Bearing Selection Table" below.

Connecting Rod Bearing Selection Table

Connecting rod big end. inner diameter / Crankshaft pin outer diameter		Mark	0	1	2	3	4	5	6	7	8	9	A	B	C
		Inner diameter Unit: mm (in)	48.000 – 48.001 (1.8898 – 1.8898)	48.001 – 48.002 (1.8898 – 1.8898)	48.002 – 48.003 (1.8898 – 1.8899)	48.003 – 48.004 (1.8899 – 1.8899)	48.004 – 48.005 (1.8899 – 1.8900)	48.005 – 48.006 (1.8900 – 1.8900)	48.006 – 48.007 (1.8900 – 1.8900)	48.007 – 48.008 (1.8900 – 1.8901)	48.008 – 48.009 (1.8901 – 1.8901)	48.009 – 48.010 (1.8901 – 1.8902)	48.010 – 48.011 (1.8902 – 1.8902)	48.011 – 48.012 (1.8902 – 1.8902)	48.012 – 48.013 (1.8902 – 1.8903)
Mark	Outer diameter Unit: mm (in)														
A	44.974 – 44.973 (1.7706 – 1.7706)		0	0	0	0	0	0	0	0	1	1	1	1	1
B	44.973 – 44.972 (1.7706 – 1.7705)		0	0	0	0	0	0	0	1	1	1	1	1	1
C	44.972 – 44.971 (1.7705 – 1.7705)		0	0	0	0	0	0	1	1	1	1	1	1	1
D	44.971 – 44.970 (1.7705 – 1.7705)		0	0	0	0	0	1	1	1	1	1	1	1	1
E	44.970 – 44.969 (1.7705 – 1.7704)		0	0	0	0	1	1	1	1	1	1	1	1	2
F	44.969 – 44.968 (1.7704 – 1.7704)		0	0	0	1	1	1	1	1	1	1	1	2	2
G	44.968 – 44.967 (1.7704 – 1.7704)		0	0	1	1	1	1	1	1	1	1	2	2	2
H	44.967 – 44.966 (1.7704 – 1.7703)		0	1	1	1	1	1	1	1	1	2	2	2	2
J	44.966 – 44.965 (1.7703 – 1.7703)		1	1	1	1	1	1	1	1	2	2	2	2	2
K	44.965 – 44.964 (1.7703 – 1.7702)		1	1	1	1	1	1	1	2	2	2	2	2	2
L	44.964 – 44.963 (1.7702 – 1.7702)		1	1	1	1	1	1	2	2	2	2	2	2	2
M	44.963 – 44.962 (1.7702 – 1.7702)		1	1	1	1	1	2	2	2	2	2	2	2	2
N	44.962 – 44.961 (1.7702 – 1.7701)		1	1	1	1	2	2	2	2	2	2	2	2	3
P	44.961 – 44.960 (1.7701 – 1.7701)		1	1	1	2	2	2	2	2	2	2	2	3	3
R	44.960 – 44.959 (1.7701 – 1.7700)		1	1	2	2	2	2	2	2	2	2	3	3	3
S	44.959 – 44.958 (1.7700 – 1.7700)		1	2	2	2	2	2	2	2	2	3	3	3	3
T	44.958 – 44.957 (1.7700 – 1.7700)		2	2	2	2	2	2	2	2	3	3	3	3	3
U	44.957 – 44.956 (1.7700 – 1.7699)		2	2	2	2	2	2	2	3	3	3	3	3	3

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Connecting Rod Bearing Grade Table

Grade	0	1	2	3
Upper / Lower thickness mm (in)	1.499 / 1.495 (0.0590/0.0589)	1.503 / 1.499 (0.0592 / 0.0590)	1.507 / 1.503 (0.0593 / 0.0592)	1.511 / 1.507 (0.0595 / 0.0593)
Identification color	Black	Brown	Green	Yellow

Undersize Bearing Usage Guide

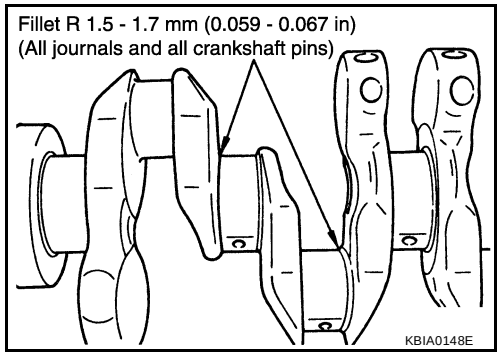
- When the specified oil clearance is not obtained with standard size connecting rod bearing, use undersize (U.S.) bearing.
- When using undersize bearing, measure the bearing inner diameter with bearing installed, and grind the crankshaft pin so that the oil clearance satisfies the standard.

Bearing Undersize Table

Unit: mm (in)

Size U.S.	Thickness
0.25 (0.0098)	1.624 - 1.632 (0.0639 - 0.0643)

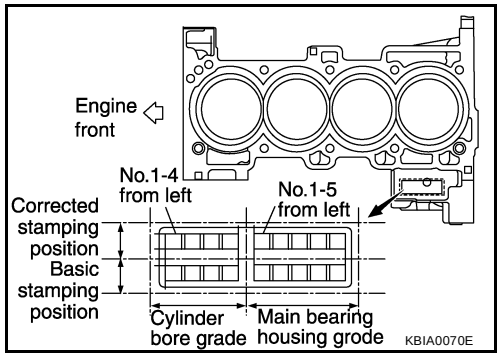
CAUTION:
In grinding the crankshaft pin to use undersize bearings, do not damage the fillet R (all journals and crankshaft pins).



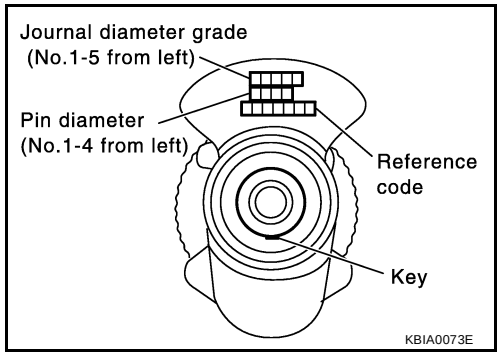
HOW TO SELECT A MAIN BEARING

When New Cylinder Block and Crankshaft are Used:

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



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



3. Find value at crossing of row and column in "Main Bearing Selection Table".

CAUTION:

There are two main bearing selection tables. One is for odd-numbered journals (1, 3, and 5) and the other is for even-numbered journals (2 and 4). Make certain to use the appropriate table. This is due to differences in the specified clearances.

4. Apply the symbol obtained to "Main Bearing Grade Table" to select.

NOTE:

Service parts are available as a set of both upper and lower.

When Cylinder Block and Crankshaft are Reused:

1. Measure inner diameter of cylinder block main bearing housing and outer diameter of crankshaft journal.
2. Apply measurement in above step 1 to the "Main Bearing Selection Table".
3. Follow steps 3 and 4 in “When New Cylinder Block and Crankshaft are Used”.

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

Cylinder block main bearing housing inner diameter / Crankshaft journal outer diameter		Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
		Inner diameter Unit: mm (in)	58.945 – 58.946 (2.3206 – 2.3207)	58.946 – 58.947 (2.3207 – 2.3207)	58.947 – 58.948 (2.3207 – 2.3208)	58.948 – 58.949 (2.3208 – 2.3208)	58.949 – 58.950 (2.3208 – 2.3209)	58.950 – 58.951 (2.3209 – 2.3209)	58.951 – 58.952 (2.3209 – 2.3209)	58.952 – 58.953 (2.3209 – 2.3210)	58.953 – 58.954 (2.3210 – 2.3210)	58.954 – 58.955 (2.3210 – 2.3211)	58.955 – 58.956 (2.3211 – 2.3211)	58.956 – 58.957 (2.3211 – 2.3211)	58.957 – 58.958 (2.3211 – 2.3212)	58.958 – 58.959 (2.3212 – 2.3212)	58.959 – 58.960 (2.3212 – 2.3213)	58.960 – 58.961 (2.3213 – 2.3213)	58.961 – 58.962 (2.3213 – 2.3213)	58.962 – 58.963 (2.3213 – 2.3214)	58.963 – 58.964 (2.3214 – 2.3214)	58.964 – 58.965 (2.3214 – 2.3215)	58.965 – 58.966 (2.3215 – 2.3215)	58.966 – 58.967 (2.3215 – 2.3215)	58.967 – 58.968 (2.3215 – 2.3216)
Mark	Outer diameter Unit: mm (in)																									
A	54.979 – 54.978 (2.1645 – 2.1645)		0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
B	54.978 – 54.977 (2.1645 – 2.1644)		0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
C	54.977 – 54.976 (2.1644 – 2.1644)		01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
D	54.976 – 54.975 (2.1644 – 2.1644)		01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
E	54.975 – 54.974 (2.1644 – 2.1643)		01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
F	54.974 – 54.973 (2.1643 – 2.1643)		1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
G	54.973 – 54.972 (2.1643 – 2.1642)		1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
H	54.972 – 54.971 (2.1642 – 2.1642)		1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
J	54.971 – 54.970 (2.1642 – 2.1642)		12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
K	54.970 – 54.969 (2.1642 – 2.1641)		12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
L	54.969 – 54.968 (2.1641 – 2.1641)		12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
M	54.968 – 54.967 (2.1641 – 2.1641)		2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
N	54.967 – 54.966 (2.1641 – 2.1640)		2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
P	54.966 – 54.965 (2.1640 – 2.1640)		2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
R	54.965 – 54.964 (2.1640 – 2.1639)		23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
S	54.964 – 54.963 (2.1639 – 2.1639)		23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
T	54.963 – 54.962 (2.1639 – 2.1639)		23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
U	54.962 – 54.961 (2.1639 – 2.1638)		3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67
V	54.961 – 54.960 (2.1638 – 2.1638)		3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7
W	54.960 – 54.959 (2.1638 – 2.1637)		3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7
X	54.959 – 54.958 (2.1637 – 2.1637)		34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7
Y	54.958 – 54.957 (2.1637 – 2.1637)		34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7
4	54.957 – 54.956 (2.1637 – 2.1636)		34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	7
7	54.956 – 54.955 (2.1636 – 2.1636)		4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	7	7

WBIA0095E

Main Bearing Selection Table (No.2 and 4 journals)

Cylinder block main bearing housing inner diameter / Crankshaft journal outer diameter	Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
Mark	Outer diameter Unit: mm (in)	Inner diameter Unit: mm (in)																							
		58.944 – 58.945 (2.3206 – 2.3207)	58.945 – 58.946 (2.3207 – 2.3207)	58.946 – 58.947 (2.3207 – 2.3207)	58.947 – 58.948 (2.3207 – 2.3208)	58.948 – 58.949 (2.3208 – 2.3208)	58.949 – 58.950 (2.3208 – 2.3209)	58.950 – 58.951 (2.3209 – 2.3209)	58.951 – 58.952 (2.3209 – 2.3209)	58.952 – 58.953 (2.3209 – 2.3210)	58.953 – 58.954 (2.3210 – 2.3210)	58.954 – 58.955 (2.3210 – 2.3211)	58.955 – 58.956 (2.3211 – 2.3211)	58.956 – 58.957 (2.3211 – 2.3211)	58.957 – 58.958 (2.3211 – 2.3212)	58.958 – 58.959 (2.3212 – 2.3212)	58.959 – 58.960 (2.3212 – 2.3213)	58.960 – 58.961 (2.3213 – 2.3213)	58.961 – 58.962 (2.3213 – 2.3213)	58.962 – 58.963 (2.3213 – 2.3214)	58.963 – 58.964 (2.3214 – 2.3214)	58.964 – 58.965 (2.3214 – 2.3215)	58.965 – 58.966 (2.3215 – 2.3215)	58.966 – 58.967 (2.3215 – 2.3215)	58.967 – 58.968 (2.3215 – 2.3216)
A	54.979 – 54.978 (2.1645 – 2.1645)	0	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3
B	54.978 – 54.977 (2.1645 – 2.1644)	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3
C	54.977 – 54.976 (2.1644 – 2.1644)	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3
D	54.976 – 54.975 (2.1644 – 2.1644)	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34
E	54.975 – 54.974 (2.1644 – 2.1643)	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34
F	54.974 – 54.973 (2.1643 – 2.1643)	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34
G	54.973 – 54.972 (2.1643 – 2.1642)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
H	54.972 – 54.971 (2.1642 – 2.1642)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
J	54.971 – 54.970 (2.1642 – 2.1642)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
K	54.970 – 54.969 (2.1642 – 2.1641)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
L	54.969 – 54.968 (2.1641 – 2.1641)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
M	54.968 – 54.967 (2.1641 – 2.1641)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
N	54.967 – 54.966 (2.1641 – 2.1640)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
P	54.966 – 54.965 (2.1640 – 2.1640)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
R	54.965 – 54.964 (2.1640 – 2.1639)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
S	54.964 – 54.963 (2.1639 – 2.1639)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
T	54.963 – 54.962 (2.1639 – 2.1639)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
U	54.962 – 54.961 (2.1639 – 2.1638)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
V	54.961 – 54.960 (2.1638 – 2.1638)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
W	54.960 – 54.959 (2.1638 – 2.1637)	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
X	54.959 – 54.958 (2.1637 – 2.1637)	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
Y	54.958 – 54.957 (2.1637 – 2.1637)	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
4	54.957 – 54.956 (2.1637 – 2.1636)	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
7	54.956 – 54.955 (2.1636 – 2.1636)	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67

WBIA0096E

Main Bearing Grade Table (All Journals)

Unit: mm (in)

Grade number	Thickness	Identification color (UPR / LWR)	Remarks
0	1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
2	1.979 - 1.982 (0.0779- 0.0780)	Green	
3	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
4	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
5	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
6	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
7	1.994 - 1.997 (0.0785 - 0.0786)	Orange	

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

Use Undersize Bearing Usage Guide

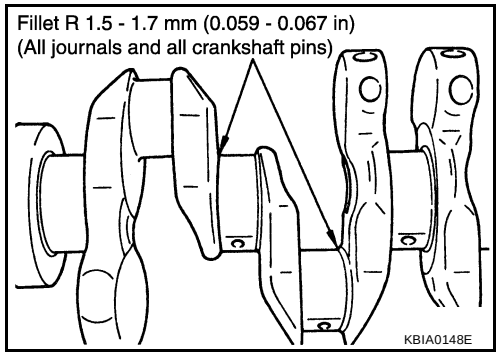
- Use undersize (U.S.) bearing when oil clearance with standard size main bearing is not within specification.
- When using undersize (U.S.) bearing, measure the bearing inner diameter with the bearing installed and grind journal until oil clearance falls within specification.

Bearing Undersize Table

Unit: mm (in)

Size U.S.	Thickness
0.25 (0.0098)	2.106 - 2.114 (0.0829 - 0.0832)

CAUTION:
Do not damage fillet R when grinding crankshaft journal in order to use an undersize bearing (all journals).



Inspection After Disassembly

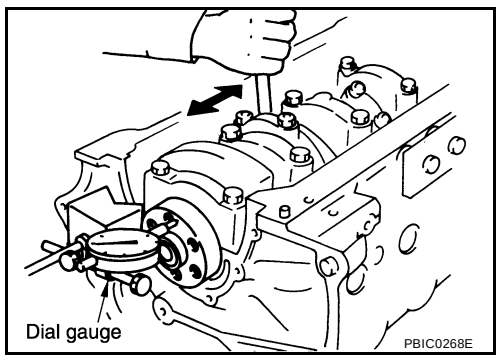
EBS006AX

CRANKSHAFT SIDE CLEARANCE

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

  Standard : 0.10 - 0.26 mm (0.0039 - 0.0102 in)
  Limit : 0.30 mm (0.0118 in)

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



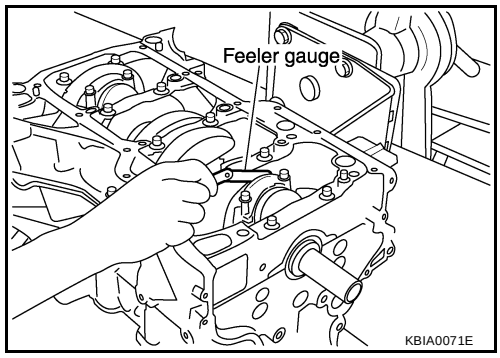
CONNECTING ROD SIDE CLEARANCE

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

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

  Limit : 0.50 mm (0.0197 in)

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

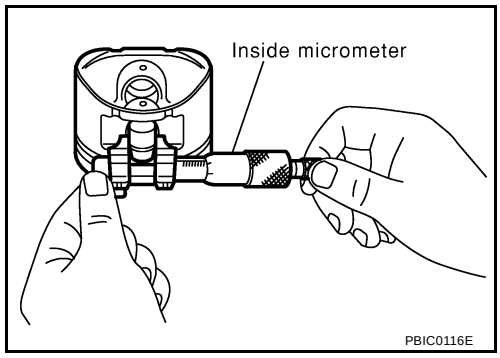


PISTON AND PISTON PIN CLEARANCE

Inner Diameter of Piston Pin

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

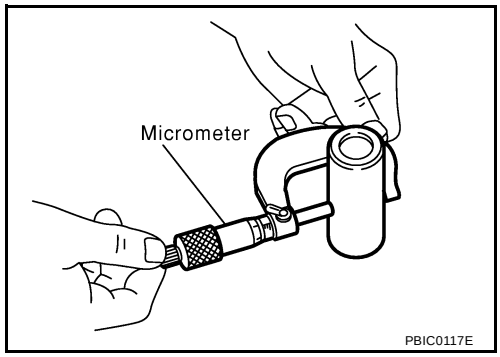
Standard : 19.993 - 20.005 mm (0.7871 - 0.7876 in)



Outer Diameter of Piston Pin

Measure outer diameter of piston pin with a micrometer.

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

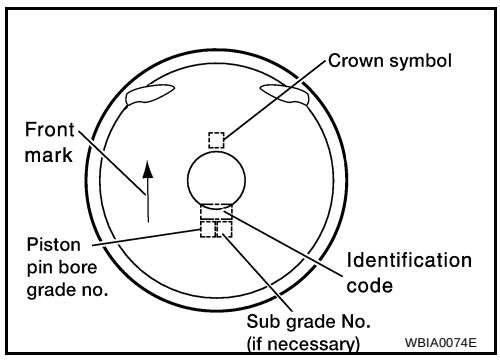


Piston and Piston Pin Clearance

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

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

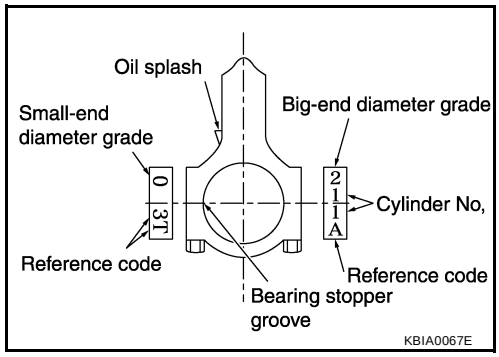
- If clearance exceeds specification, replace either or both of piston/piston pin assembly and connecting rod assembly with reference to specification of each parts.
- Refer to piston selection table to replace piston/piston pin assembly. Refer to EM-151, "HOW TO SELECT A PISTON" .
- Refer to connecting rod bearing selection table to replace connecting rod. Refer to EM-151, "HOW TO SELECT A CONNECTING ROD BEARING" .



NOTE:

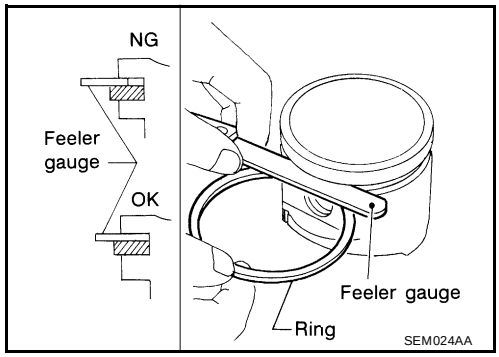
- The connecting rod small end grade and piston pin hole (piston pin) grade are provided only for the parts installed at the plant. For service parts, no grades can be selected. Only 0 grade is available.

- Refer to EM-159, "CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)" for the values for each grade at the plant.
- Regarding marks on piston head, Refer to EM-151, "HOW TO SELECT A PISTON" .



PISTON RING SIDE CLEARANCE

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



Standard

Top ring	**: 0.045 - 0.080 mm (0.0018 - 0.0031 in)**
2nd ring	**: 0.030 - 0.070 mm (0.0012 - 0.0028 in)**
Oil ring	**: 0.065 - 0.135 mm (0.0026 - 0.0053 in)**

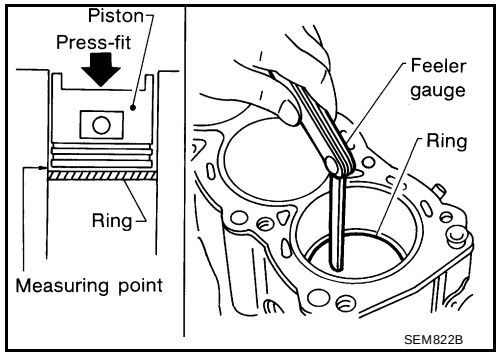
Limit

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

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

PISTON RING END GAP

- Check if inner diameter of cylinder bore is within specification. Refer to EM-161, "PISTON TO CYLINDER BORE CLEARANCE" .
- Insert piston ring until middle of cylinder with piston, and measure gap.



Standard

Top ring	**: 0.21 - 0.31 mm (0.0083 - 0.0122 in)**
2nd ring	**: 0.32 - 0.47 mm (0.0126 - 0.0185 in)**
Oil ring	**: 0.20 - 0.60 mm (0.0079 - 0.0236 in)**

Limit

Top ring	**: 0.54 mm (0.0213 in)**
2nd ring	**: 0.67 mm (0.0264 in)**
Oil ring	**: 0.95 mm (0.0374 in)**

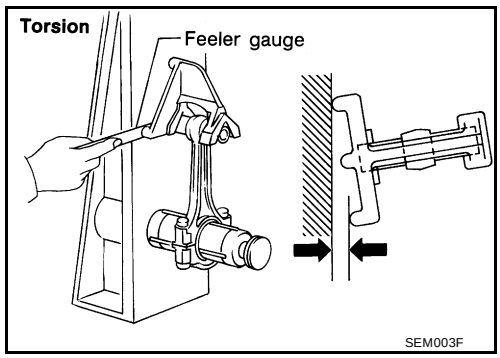
- If out of specification, replace piston ring. If gap still exceeds the limit even with a new ring, re-bore cylinder and use oversized piston and piston ring.

CONNECTING ROD BEND AND TORSION

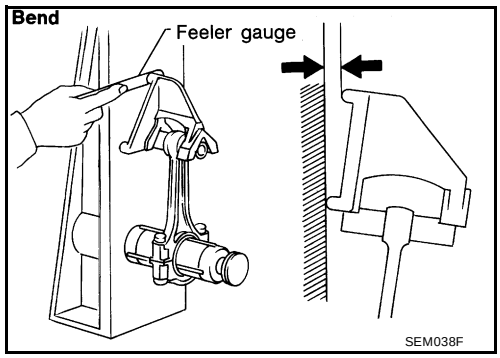
- Check with connecting rod aligner.

Bend limit : **0.15 mm (0.0059 in) per 100 mm (3.94 in) length**

Torsion limit : **0.30 mm (0.0118 in) per 100 mm (3.94 in) length**



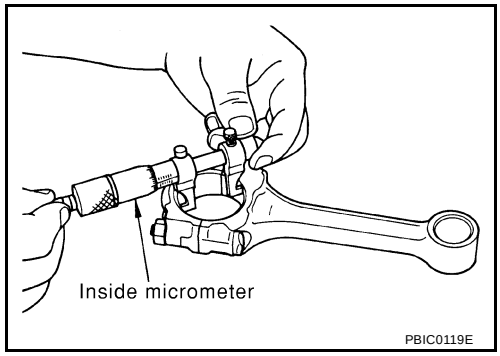
- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BEARING (BIG END)

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

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

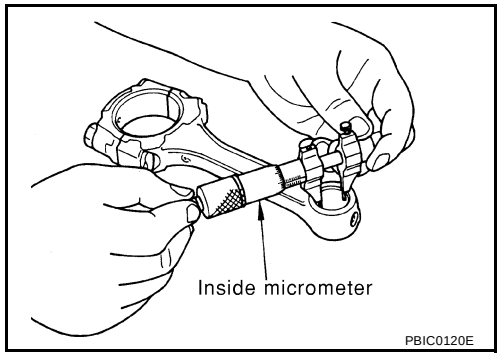


CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

Inner Diameter of Connecting Rod (Small End)

Measure inner diameter of bushing.

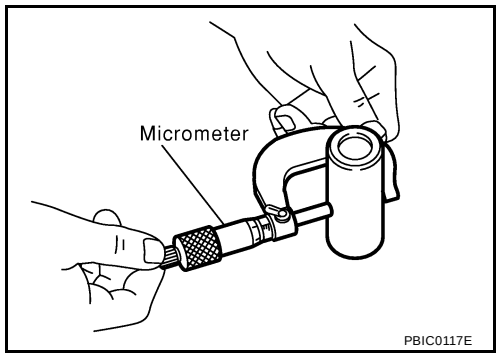
Standard : **20.000 - 20.012 mm (0.7874 - 0.7879 in)**



Outer Diameter of Piston Pin

Measure outer diameter of piston pin.

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

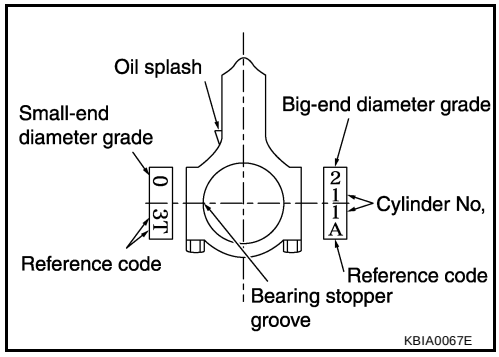


Connecting Rod Bushing Oil Clearance (Small End)

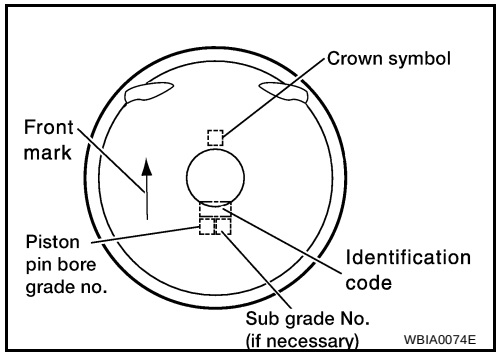
- (Connecting rod small end oil clearance) = (Inner diameter of connecting rod small end) – (Outer diameter of piston pin)

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

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



- If replacing the piston and piston pin assembly, refer to the "Piston Selection Table" to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Refer to EM-151, "HOW TO SELECT A PISTON" .



Factory Installed Parts Grading

Unit: mm (in)

Grade*	0	1
Connecting rod small end inner diameter	20.000 - 20.006 (0.7874 - 0.7876)	20.006 - 20.012 (0.7876 - 0.7879)
Piston pin outer diameter	19.989 - 19.995 (0.7870 - 0.7872)	19.995 - 20. 001 (0.7872 - 0.7874)
Piston pin bore diameter	19.993 - 19.999 (0.7871- 0.7874)	19.999 - 20.005 (0.7874 - 0.7876)

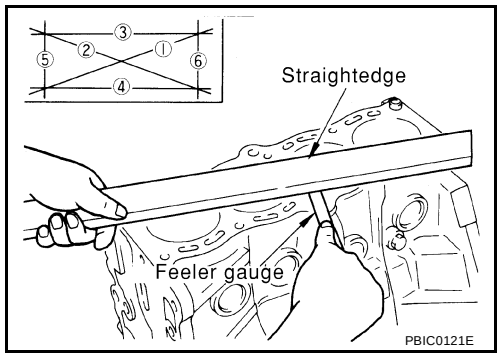
* Service parts apply only to grade 0.

CYLINDER BLOCK DISTORTION

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

  CAUTION:
  Be careful not to allow gasket debris to enter the oil or coolant passages.
- Measure the distortion on the block upper face at some different points in 6 directions.

  Limit : 0.1 mm (0.004 in)
- If out of the distortion limit, replace the cylinder block.

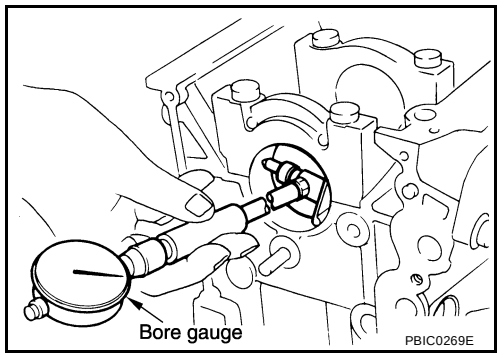


INNER DIAMETER OF MAIN BEARING HOUSING

- Install the main bearing caps with the main bearings removed and tighten the mounting bolts to the specified torque. Refer to EM-145, "ASSEMBLY" .
- Using a bore gauge, measure the inner diameter of the main bearing housing.

  Standard : 58.944 - 58.967 mm (2.3206 - 2.3215 in)
- If out of the standard, replace the cylinder block and lower cylinder block assembly.

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

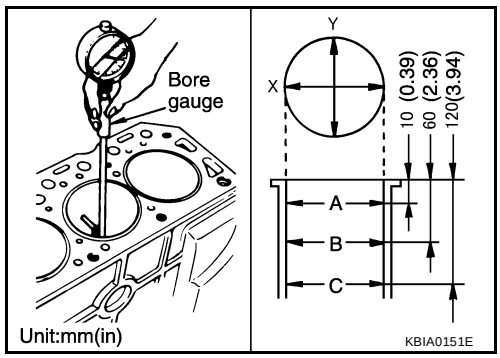


PISTON TO CYLINDER BORE CLEARANCE

Inner Diameter of Cylinder Bore

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

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



Standard inner diameter:	**89.000 - 89.030 mm (3.5039 - 3.5051 in)**
Wear limit:	**0.2 mm (0.008 in)**
Out-of-round (difference between, X – Y):	**0.015 mm (0.0006 in)**
Taper limit (difference between, C – A):	**0.01 mm (0.0004 in)**

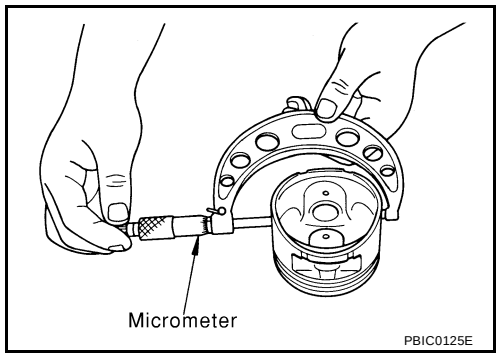
- If the measured value rebore exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone the inner wall.
- An oversize piston is provided. When using an oversize piston, rebore the cylinder so that the clearance of the piston cylinder satisfies the standard.

  Over size (OS) : 0.2 mm (0.008 in)

Outer Diameter of Piston

- Measure piston skirt diameter.

Standard : 88.980 - 89.010 mm (3.5031 - 3.5043 in)



- Measure point (distance from the top): 42 mm (1.65 in)

Piston to Cylinder Bore Clearance

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

Standard : 0.010 - 0.030 mm (0.0004 - 0.0012 in)
Limit : 0.08 mm (0.0031 in)

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

Reboring Cylinder Bore

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

Rebored size calculation: D = A + B - C
D : Bored diameter
A : Piston diameter as measured
B : Piston-to-bore clearance (standard value)
C : Honing allowance 0.02 mm (0.0008 in)

2. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.
   - When any cylinder needs boring, all other cylinders must also be bored.
   - Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.
4. Hone cylinders to obtain specified piston-to-bore clearance.
5. Measure finished cylinder bore for out-of-round and taper.
   - Measurement should be done after cylinder bore cools down.

OUTER DIAMETER OF CRANKSHAFT JOURNAL

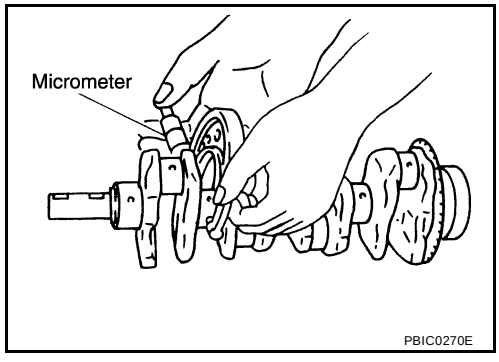
Measure outer diameter of crankshaft journals.

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

OUTER DIAMETER OF CRANKSHAFT PIN

Measure outer diameter of crankshaft pin.

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



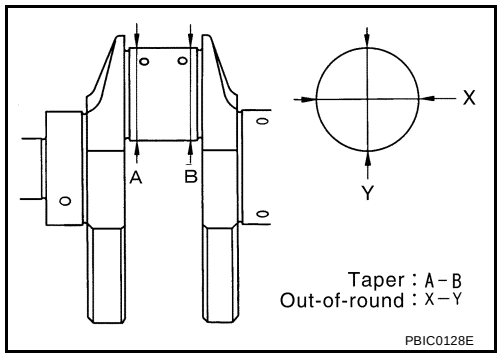
OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Using a micrometer, measure the dimensions at four different points shown in the figure on each journal and pin.
- Out-of-round is indicated by the difference in dimensions between "X" and "Y" at "A" and "B".
- Taper is indicated by the difference in dimension between "A" and "B" at "X" and "Y".

Limit

Out-of-round (X - Y) : 0.005 mm (0.0002 in)

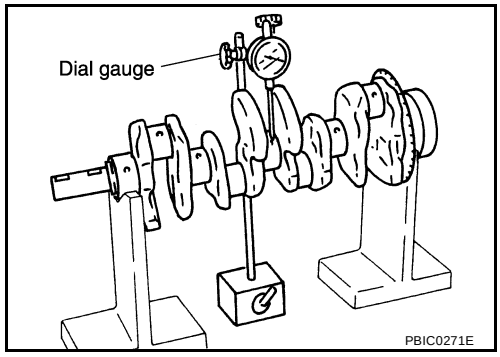
Taper (A - B) : 0.005 mm (0.0002 in)



CRANKSHAFT RUNOUT

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

Limit : 0.05 mm (0.002 in)



OIL CLEARANCE OF CONNECTING ROD BEARING

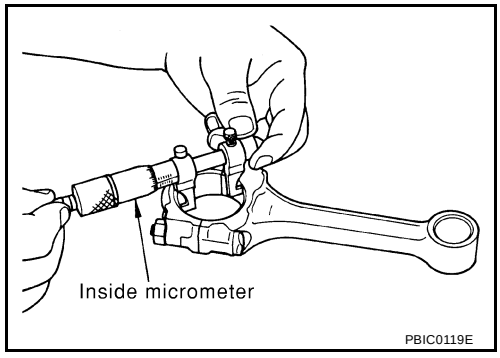
Method of Measurement

- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod bolts to the specified torque. Using an inside micrometer measure the inner diameter of connecting rod bearing.
  (Oil clearance) = (Inner diameter of connecting rod bearing) – (Outer diameter of crankshaft pin)

Standard : 0.028 - 0.045 mm (0.0011 - 0.0018 in)

Limit : 0.10 mm (0.0039 in)

- If clearance cannot be adjusted within the standard, grind crankshaft pin and use undersized bearing. Refer to EM-151, "HOW TO SELECT A CONNECTING ROD BEARING" .



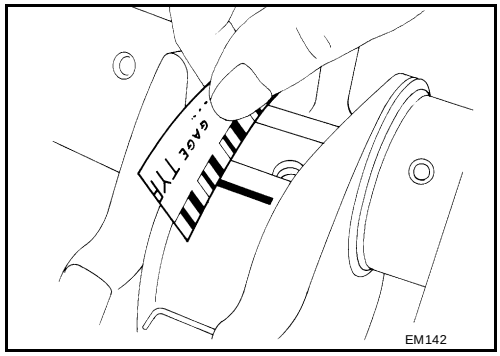
Method of Using Plastigage

- Remove oil and dust on the crankshaft pin and the surfaces of each bearing completely.
- Cut the Plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install the connecting rod bearings to the connecting rod cap, and tighten the connecting rod bolts to the specified torque.

CAUTION:
Never rotate the crankshaft.

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

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



OIL CLEARANCE OF MAIN BEARING

Method of Measurement

- Install the main bearings to the cylinder block and bearing cap. Measure the main bearing inner diameter with the bearing cap bolt tightened to the specified torque.
  (Oil clearance) = (Inner diameter of main bearing) – (Outer diameter of crankshaft journal)

  Standard

  No. 1, 3, and 5 journals : 0.012 - 0.022 mm (0.0005 - 0.0009 in)

  No. 2 and 4 journals : 0.018 - 0.028 mm (0.0007 - 0.0011 in)

  Limit : 0.1 mm (0.004 in)

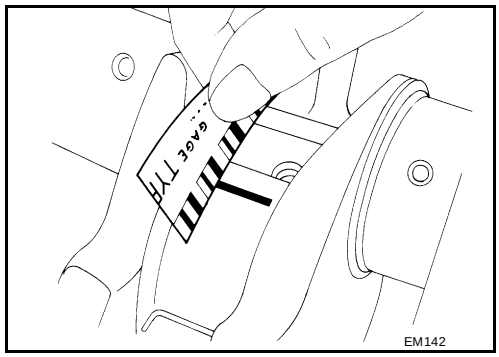
- If the measured value exceeds the limit, select main bearings referring to the main bearing inner diameter and crankshaft journal outer diameter, so that the oil clearance satisfies the standard. Refer to EM-153, "HOW TO SELECT A MAIN BEARING" .

Method of Using Plastigage

- Remove oil and dust on the crankshaft journal and the surfaces of each bearing completely.
- Cut the Plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Tighten the main bearing bolts to the specified torque.

  CAUTION:
  Never rotate the crankshaft.
- Remove the bearing cap and bearings, and using the scale on the Plastigage bag, measure the Plastigage width.

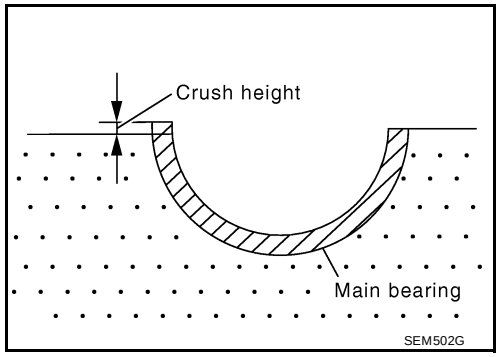
  NOTE:
  The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



CRUSH HEIGHT OF MAIN BEARING

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

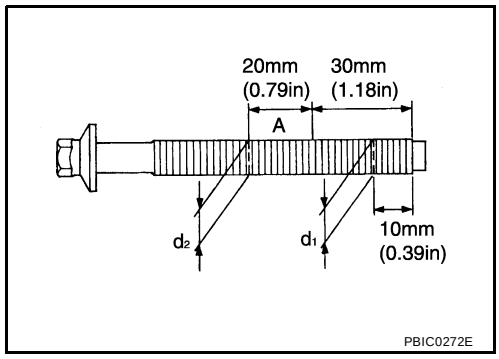
  Standard : there must be crush height
- If the standard is not met, replace main bearings.



OUTER DIAMETER OF LOWER CYLINDER BLOCK MOUNTING BOLT

- Perform only with M10 (0.39 in) bolts.
- Measure outer diameters (d1, d2) at two positions as shown.
- Measure d2 at a point within block A.
- When the value of d1- d2 exceeds the limit (a large difference in dimensions), replace the bolt with a new one.

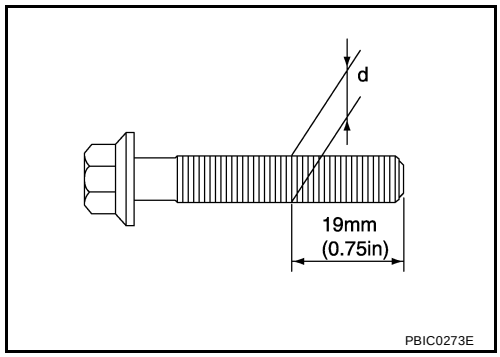
  Limit : 0.13 mm (0.0051 in) or more



OUTER DIAMETER OF CONNECTING ROD BOLT

- Measure outer diameter (d) at position shown in the figure.
- When “d” exceeds the limit (when it becomes thinner), replace the bolt with a new one.

Limit : 7.75 mm (0.3051 in) or less



MOVEMENT AMOUNT OF FLYWHEEL (M/T MODEL)

NOTE:

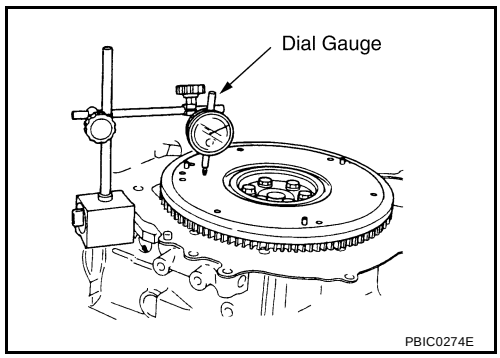
- Inspection for double mass flywheel only.
- Do not disassemble double mass flywheel.

Flywheel Deflection

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

Standard : 0.45 mm (0.0177 in) or less
Limit : 1.3 mm (0.051 in) or less

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

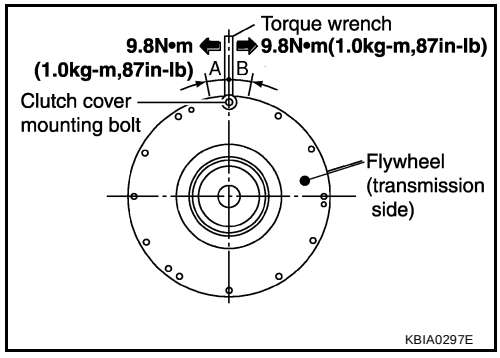


Movement Amount in Radial (Rotation) Direction

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 to keep it from loosening, tighten to 9.8 N·m (1 kg-m, 87 in-lb).
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (measurement standard points).
3. Apply a force of 9.8 N·m (1 kg-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 : 28.3 mm (1.114 in) or less

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



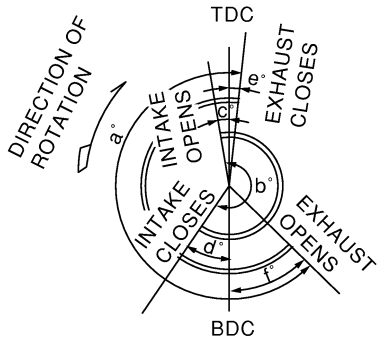
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

Standard and Limit

EBS006AY

GENERAL SPECIFICATIONS

Cylinder arrangement		4 in-line
Displacement cm^3 (cu in)		2,488 (151.82)
Bore and stroke mm (in)		89.0 x 100 (3.50 - 3.94)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		9.5
Compression pressure kPa (kg/cm^2 , psi) / 250 rpm	Standard	1,250 (12.8, 182)
	Minimum	1,060 (10.8, 154)
	Differential limit between cylinders	100 (1.0, 14)
Valve timing		

PBIC0187E

Unit: degree

a	b	c	d	e	f
224	244	0	64	3	41

INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

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

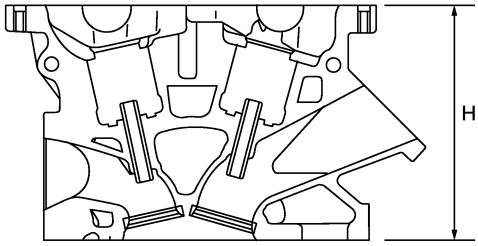
DRIVE BELTS

Tension of drive belts	Auto adjustment by auto-tensioner

CYLINDER HEAD

Unit: mm (in)

	Limit
Head surface distortion	0.1 (0.004)



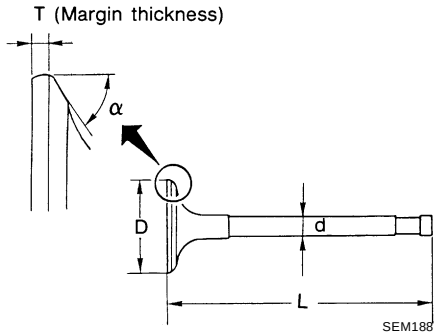
Nominal cylinder head height:
H = 129.4 mm (5.09 in)

PBIC0283E

VALVE

Valve Dimensions

Unit: mm (in)



SEM188

Valve head diameter “D”	Intake	35.5 - 35.8 (1.398 - 1.409)
	Exhaust	30.5 - 30.8 (1.201 - 1.213)
Valve length “L”	Intake	97.16 (3.8252)
	Exhaust	98.82 (3.8905)
Valve stem diameter “d”	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle “α”	Intake	45°15′ - 45°45′
	Exhaust	
Valve margin “T”	Intake	1.1 (0.043)
	Exhaust	1.3 (0.051)

Valve Clearance

Unit: mm (in)

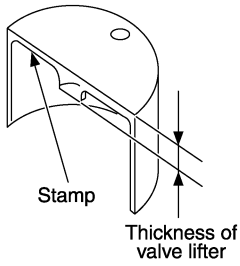
	Cold* (reference data)	Hot
Intake	0.24 - 0.32 (0.009 - 0.013)	0.32 - 0.40 (0.013 - 0.016)
Exhaust	0.26 - 0.34 (0.010 - 0.013)	0.33 - 0.41 (0.013 - 0.016)

*: Approximately 20°C (68 °F)

Available Valve Lifter

Thickness mm (in)	Identification mark
6.96 (0.2740)	696
6.98 (0.2748)	698
7.00 (0.2756)	700

Thickness mm (in)	Identification mark
7.02 (0.2764)	702
7.04 (0.2772)	704
7.06 (0.2780)	706
7.08 (0.2787)	708
7.10 (02795)	710
7.12 (0.2803)	712
7.14 (0.2811)	714
7.16 (0.2819)	716
7.18 (0.2827)	718
7.20 (0.2835)	720
7.22 (0.2843)	722
7.24(0.2850)	724
7.26 (0.2858)	726
7.28 (0.2866)	728
7.30(0.2874)	730
7.32 (0.2882)	732
7.34 (0.2890)	734
7.36 (0.2898)	736
7.38 (0.2906)	738
7.40 (0.2913)	740
7.42 (0.2921)	742
744 (0.2929)	744
7.46 (0.2937)	746



KBIA0119E

Valve Spring

Free height standard mm (in)	Intake	44.84 - 45.34 (1.7654 - 1.7850)
	Exhaust	45.28 - 45.78 (1.7827 - 1.8024)
Pressure standard N (kg, lb) at height mm (in)	Intake and Exhaust	151 - 175 (15.4 - 17.8, 34 - 39) at 35.30 (1.390)
Out-of-square mm (in)		1.9 (0.0748)

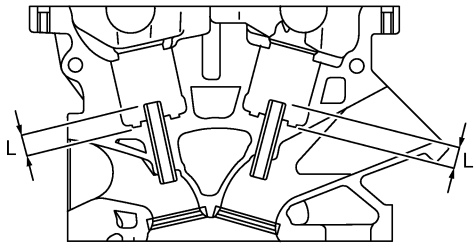
Valve Lifter

Unit: mm (in)

	Standard
Valve lifter outer diameter	33.965 - 33.980 (1.3372 - 1.3378)
Lifter guide inner diameter	34.000 - 34.021 (1.3386 - 1.3394)
Clearance between lifter and lifter guide	0.020 - 0.056 (0.0008 - 0.0022)

Valve Guide

Unit: mm (in)

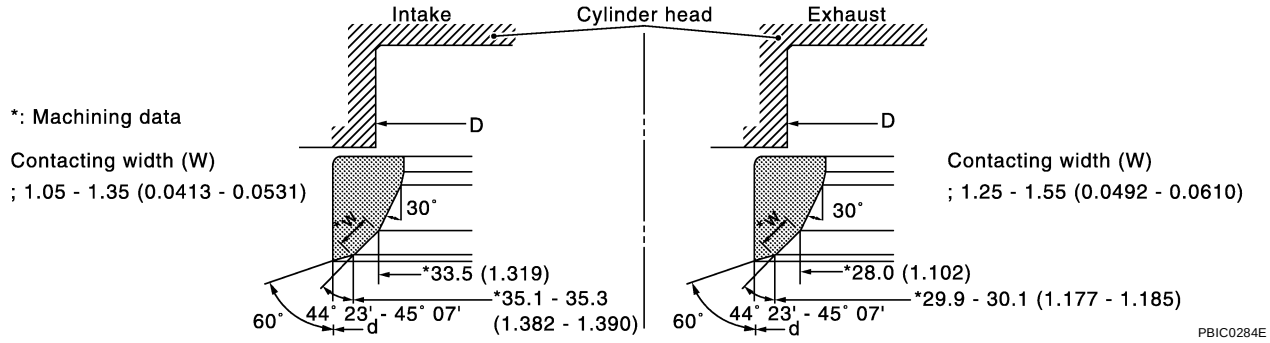


PBIC0184E

		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	
Projection length “L”	Intake	10.1 - 10.3 (0.398 - 0.406)	
	Exhaust	10.0 - 10.4 (0.394 - 0.409)	

Valve Seat

Unit: mm (in)



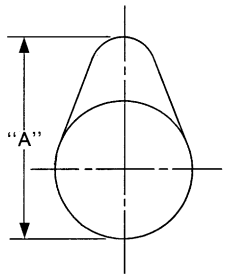
PBIC0284E

		Standard	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 interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.084 - 0.116 (0.0033 - 0.0046)	
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)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard
Camshaft runout [TIR*]	Less than 0.04 (0.0016)



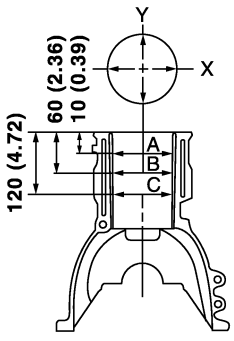
SEM671

Cam height "A"	Intake	45.665 - 45.855 (1.7978 - 1.8053)
	Exhaust	43.975 - 44.165 (1.7313 - 1.7388)
Outer diameter of camshaft journal		No. 1 27.935 - 27.955 (1.0998 - 1.1006) No. 2, 3, 4, 5 23.435 - 23.455 (0.9226 - 0.9234)
Inner diameter of camshaft bracket		No. 1 28.000 - 28.021 (1.1024 - 1.1032) No. 2, 3, 4, 5 23.500 - 23.521 (0.9252 - 0.9260)
Camshaft journal clearance		0.045 - 0.086 (0.0018 - 0.0034)
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)
Camshaft sprocket runout [TIR*]		Less than 0.15 (0.0059)

*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



PBIC0281E

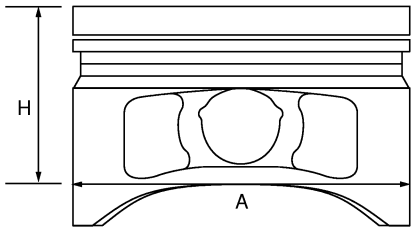
Surface flatness	Limit			0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 1	89.000 - 89.010 (3.5039 - 3.5043)
			Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)
			Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)
		Wear limit		0.2 (0.008)
Out-of-round (X – Y)				Less than 0.015 (0.0006)
Taper (C – A)				Less than 0.01 (0.0004)

Main journal inner diameter grade (Without bearing)	Grade No. A	58.944 - 58.945 (2.3206 - 2.3207)
	Grade No. B	58.945 - 58.946 (2.3207 - 2.3207)
	Grade No. C	58.946 - 58.947 (2.3207 - 2.3207)
	Grade No. D	58.947 - 58.948 (2.3207 - 2.3208)
	Grade No. E	58.948 - 58.949 (2.3208 - 2.3208)
	Grade No. F	58.949 - 58.950 (2.3208 - 2.3209)
	Grade No. G	58.950 - 58.951 (2.3209 - 2.3209)
	Grade No. H	58.951 - 58.952 (2.3209 - 2.3209)
	Grade No. J	58.952 - 58.953 (2.3209 - 2.3210)
	Grade No. K	58.953 - 58.954 (2.3210 - 2.3210)
	Grade No. L	58.954 - 58.955 (2.3210 - 2.3211)
	Grade No. M	58.955 - 58.956 (2.3211 - 2.3211)
	Grade No. N	58.956 - 58.957 (2.3211 - 2.3211)
	Grade No. P	58.957 - 58.958 (2.3211 - 2.3212)
	Grade No. R	58.958 - 58.959 (2.3212 - 2.3212)
	Grade No. S	58.959 - 58.960 (2.3212 - 2.3213)
	Grade No. T	58.960 - 58.961 (2.3213 - 2.3213)
	Grade No. U	58.961 - 58.962 (2.3213 - 2.3213)
	Grade No. V	58.962 - 58.963 (2.3213 - 2.3214)
	Grade No. W	58.963 - 58.964 (2.3214 - 2.3214)
	Grade No. X	58.964 - 58.965 (2.3214 - 2.3215)
	Grade No. Y	58.965 - 58.966 (2.3215 - 2.3215)
	Grade No. 4	58.966 - 58.967 (2.3215 - 2.3215)
	Grade No. 7	58.967 - 58.968 (2.3215 - 2.3216)
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

PISTON, PISTON RING, AND PISTON PIN

Available Piston

Unit: mm (in)



PBIC0188E

Piston skirt diameter “A”	Standard	Grade No. 1	88.980 - 88.990 (3.5031 - 3.5035)
		Grade No. 2	88.990 - 89.000 (3.5035 - 3.5039)
		Grade No. 3	89.000 - 89.010 (3.5039 - 3.5043)
		0.20 (0.0079) oversize (service)	89.180 - 89.210 (3.5110 - 3.5122)
“H” dimension			42 (1.65)
Piston pin bore diameter		Grade No. 0	19.993 - 19.999 (0.7871 - 0.7874)
		Grade No. 1	19.999 - 20.005 (0.7874 - 0.7876)
Piston clearance to cylinder block		Standard	0.010 - 0.030 (0.0004 - 0.0012)
		Limit	0.08 (0.0031)

Piston Ring

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.004)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.21- 0.31 (0.0083 - 0.0122)	0.54 (0.0213)
	2nd	0.32 - 0.47 (0.0126 - 0.0185)	0.67 (0.0264)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.95 (0.0374)

Piston Pin

Unit: mm (in)

Piston pin outer diameter	Grade No.0	19.989 - 19.995 (0.7870 - 0.7872)
	Grade No.1	19.995 - 20.001 (0.7872 - 0.7874)
Interference fit of piston pin to piston		0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)

CONNECTING ROD

Unit: mm (in)

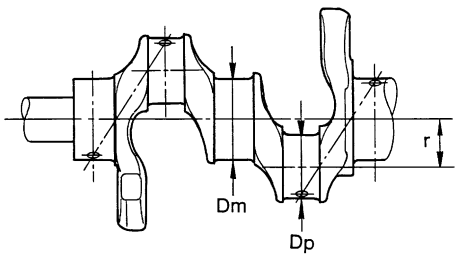
Center distance		143.00 - 143.10 (5.63 - 5.63)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end inner diameter		22.000 - 22.012 (0.7874 - 0.7879)
Connecting rod small end inner diameter*	Grade No. 0	20.000 - 20.006 (0.7874 - 0.7876)
	Grade No. 1	20.006 - 20.012 (0.7876 - 0.7879)
Connecting rod big end inner diameter		48.000 - 48.013 (1.8898 - 1.8903)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.50 (0.0197)
Connecting rod bearing housing	Grade No. 0	48.000 - 48.001 (1.8898 - 1.8898)
	Grade No. 1	48.001 - 48.002 (1.8898 - 1.8898)
	Grade No. 2	48.002 - 48.003 (1.8898 - 1.8899)
	Grade No. 3	48.003 - 48.004 (1.8899 - 1.8899)
	Grade No. 4	48.004 - 48.005 (1.8899 - 1.8899)
	Grade No. 5	48.005 - 48.006 (1.8899 - 1.8900)
	Grade No. 6	48.006 - 48.007 (1.8900 - 1.8900)
	Grade No. 7	48.007 - 48.008 (1.8900 - 1.8901)
	Grade No. 8	48.008 - 48.009 (1.8901 - 1.8901)
	Grade No. 9	48.009 - 48.010 (1.8901 - 1.8902)
	Grade No. A	48.010 - 48.011 (1.8902 - 1.8902)
	Grade No. B	48.011 - 48.012 (1.8902 - 1.8902)
	Grade No. C	48.012 - 48.013 (1.8902 - 1.8903)

*: After installing in connecting rod

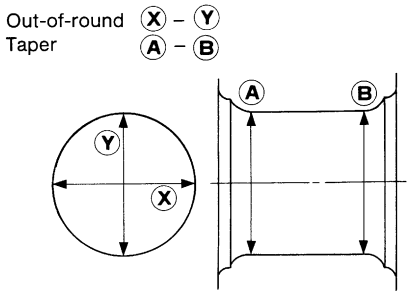
CRANKSHAFT

Unit: mm (in)

Pin journal “DP” grade	Grade No. A	44.974 - 44.973 (1.7706 - 1.7706)
	Grade No. B	44.973 - 44.972 (1.7706 - 1.7705)
	Grade No. C	44.972 - 44.971 (1.7705 - 1.7705)
	Grade No. D	44.971 - 44.970 (1.7705 - 1.7705)
	Grade No. E	44.970 - 44.969 (1.7705 - 1.7704)
	Grade No. F	44.969 - 44.968 (1.7704 - 1.7704)
	Grade No. G	44.968 - 44.967 (1.7704 - 1.7704)
	Grade No. H	44.967 - 44.966 (1.7704 - 1.7703)
	Grade No. J	44.966 - 44.965 (1.7703 - 1.7703)
	Grade No. K	44.965 - 44.964 (1.7703 - 1.7702)
	Grade No. L	44.964 - 44.963 (1.7702 - 1.7702)
	Grade No. M	44.963 - 44.962 (1.7702 - 1.7702)
	Grade No. N	44.962 - 44.961 (1.7702 - 1.7701)
	Grade No. P	44.961 - 44.960 (1.7701 - 1.7701)
	Grade No. R	44.960 - 44.959 (1.7701 - 1.7700)
	Grade No. S	44.959 - 44.958 (1.7700 - 1.7700)
	Grade No. T	44.958 - 44.957 (1.7700 - 1.7700)
	Grade No. U	44.957 - 44.956 (1.7700 - 1.7699)
Main journal “Dm” grade	Grade No. A	54.979 - 54.978 (2.1645 - 2.1645)
	Grade No. B	54.978 - 54.977 (2.1645 - 2.1644)
	Grade No. C	54.977 - 54.976 (2.1644 - 2.1644)
	Grade No. D	54.976 - 54.975 (2.1644 - 2.1644)
	Grade No. E	54.975 - 54.974 (2.1644 - 2.1643)
	Grade No. F	54.974 - 54.973 (2.1643 - 2.1643)
	Grade No. G	54.973 - 54.972 (2.1643 - 2.1642)
	Grade No. H	54.972 - 54.971 (2.1642 - 2.1642)
	Grade No. J	54.971 - 54.970 (2.1642 - 2.1642)
	Grade No. K	54.970 - 54.969 (2.1642 - 2.1641)
	Grade No. L	54.969 - 54.968 (2.1641 - 2.1641)
	Grade No. M	54.968 - 54.967 (2.1641 - 2.1641)
	Grade No. N	54.967 - 54.966 (2.1641 - 2.1640)
	Grade No. P	54.966 - 54.965 (2.1640 - 2.1640)
	Grade No. R	54.965 - 54.964 (2.1640 - 2.1639)
	Grade No. S	54.964 - 54.963 (2.1639 - 2.1639)
	Grade No. T	54.963 - 54.962 (2.1639 - 2.1639)
	Grade No. U	54.962 - 54.961 (2.1639 - 2.1638)
	Grade No. V	54.961 - 54.960 (2.1638 - 2.1638)
	Grade No. W	54.960 - 54.959 (2.1638 - 2.1637)
	Grade No. X	54.959 - 54.958 (2.1637 - 2.1637)
	Grade No. Y	54.958 - 54.957 (2.1637 - 2.1637)
	Grade No. 4	54.957 - 54.956 (2.1637 - 2.1636)
	Grade No. 7	54.956 - 54.955 (2.1636 - 2.1636)
Center distance “r”		49.60 - 50.04 (1.9528 - 1.9701)
Out-of-round (X – Y)	Standard	Less than 0.005 (0.0002)
Taper (A – B)	Standard	Less than 0.005 (0.0002)
Runout [TIR*]	Limit	Less than 0.05 (0.002)
Free end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (0.0118)



SEM645

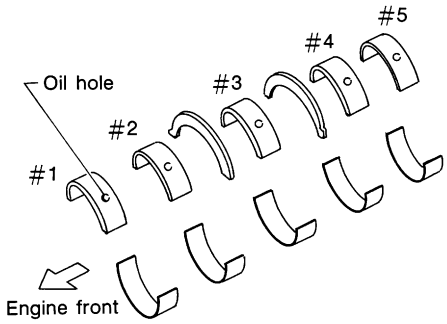


SEM715

*: Total indicator reading

MAIN BEARING

Unit: mm (in)



SEM685D

Grade number		Thickness	Identification color (UPR / LWR)	Remarks
0		1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1		1.976 - 1.979 (0.0778 - 0.0779)	Red	
2		1.979 - 1.982 (0.0779 - 0.0780)	Green	
3		1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
4		1.985 - 1.988 (0.0781 - 0.0783)	Blue	
5		1.988 - 1.991 (0.0783 - 0.0784)	Pink	
6		1.991 - 1.994 (0.0784 - 0.0785)	Purple	
7		1.994 - 1.997 (0.0785 - 0.0786)	Orange	
01	UPR	1.973 - 1.976 (0.0777 - 0.0778)	Black / Red	Grade and color are different for upper and lower bearings.
	LWR	1.976 - 1.979 (0.0778 - 0.0779)		
12	UPR	1.976 - 1.979 (0.0778 - 0.0779)	Red / Green	
	LWR	1.979 - 1.982 (0.0779 - 0.0780)		
23	UPR	1.979 - 1.982 (0.0779 - 0.0780)	Green / Yellow	
	LWR	1.982 - 1.985 (0.0780 - 0.0781)		
34	UPR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow / Blue	
	LWR	1.985 - 1.988 (0.0781 - 0.0783)		
45	UPR	1.985 - 1.988 (0.0781 - 0.0783)	Blue / Pink	
	LWR	1.988 - 1.991 (0.0783 - 0.0784)		
56	UPR	1.988 - 1.991 (0.0783 - 0.0784)	Pink / Purple	
	LWR	1.991 - 1.994 (0.0784 - 0.0785)		
67	UPR	1.991 - 1.994 (0.0784 - 0.0785)	Purple / Orange	
	LWR	1.994 - 1.997 (0.0785 - 0.0786)		

Undersize

Unit: mm (in)

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

Bearing Clearance

Unit: mm (in)

Main bearing clearance	Standard	No.1, 3, and 5	0.012 - 0.022 (0.0005 - 0.0009)
		No.2 and 4	0.018 - 0.028 (0.0007 - 0.0011)
	Limit		0.1 (0.004)

CONNECTING ROD BEARING

Unit: mm (in)

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

Undersize Bearing

Unit: mm (in)

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

Bearing Clearance

Unit: mm (in)

Connecting rod bearing clearance	Standard	0.028 - 0.045 (0.0011 - 0.0018)
	Limit	0.10 (0.0039)