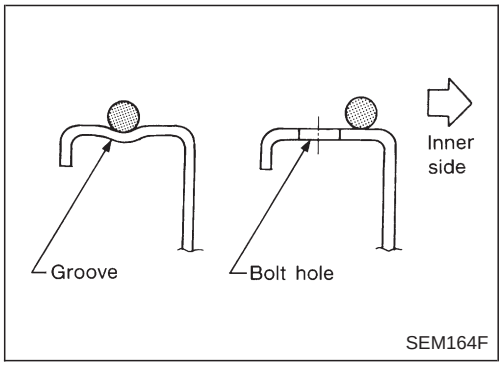
ENGINE MECHANICAL

SECTION EM

CONTENTS

Parts Requiring Angular Tightening

- Use an angle wrench for the final tightening of the following engine parts:
  (1) Cylinder head bolts
  (2) Connecting rod cap nuts for gasoline engines
- 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.

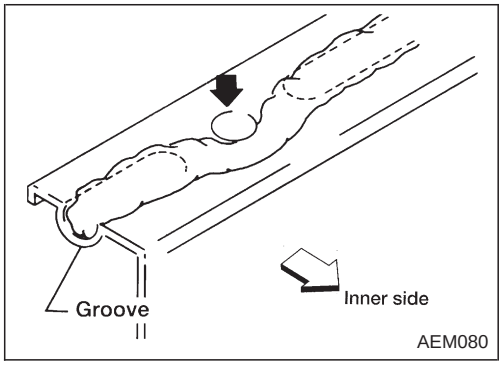


Liquid Gasket Application Procedure

a. Use a scraper to remove all traces of old liquid gasket from mating surfaces and grooves. Also, completely clean any oil from these areas.

b. Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)

- **For oil pan, be sure liquid gasket diameter is 3.5 to 4.5 mm (0.138 to 0.177 in) for gasoline engines.**
- **For areas except oil pan, be sure liquid gasket diameter is 2.0 to 3.0 mm (0.079 to 0.118 in) for gasoline engines and 2.5 to 3.5 mm (0.098 to 0.138 in) for diesel engines.**



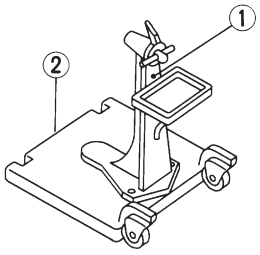
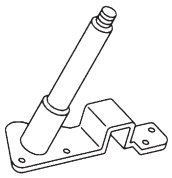
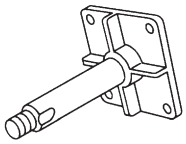
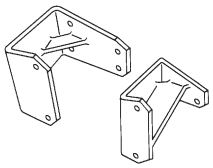
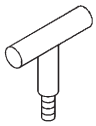
c. Apply liquid gasket around the inner side of bolt holes (unless otherwise specified).

d. Assembly should be done within 5 minutes after coating.

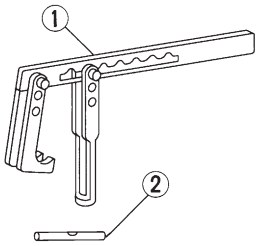
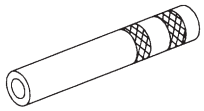
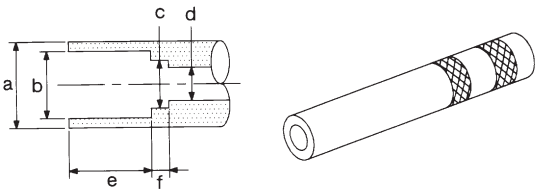
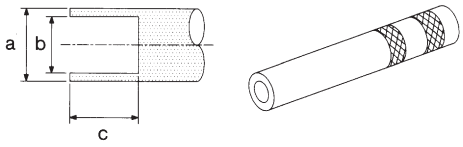
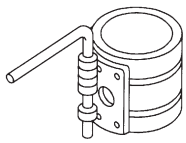
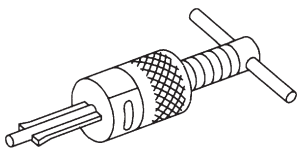
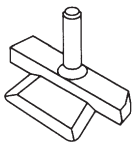
e. Wait at least 30 minutes before refilling engine oil and engine coolant.

Special Service Tools

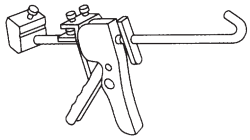
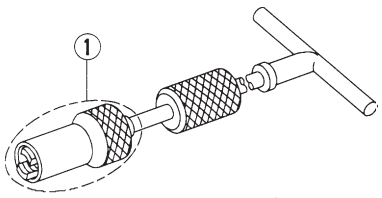
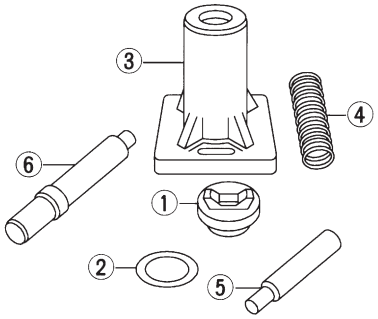
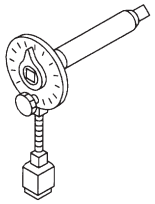
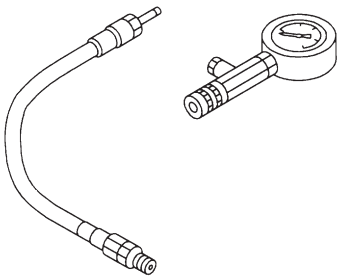
*: Special tool or commercial equivalent

Tool number Tool name	Description	Engine application	
		KA	TD
ST0501S000* Engine stand assembly ① ST05011000 Engine stand ② ST05012000 Base	 NT042 Disassembling and assembling	X	X
KV10105001* Engine attachment	 NT031	X	—
KV10106500* Engine attachment	 NT028	—	X
KV11103200* Engine sub-attachment	 NT246	—	X
KV10111200* Adapter	 NT687 Disassembling and assembling valve components	—	X

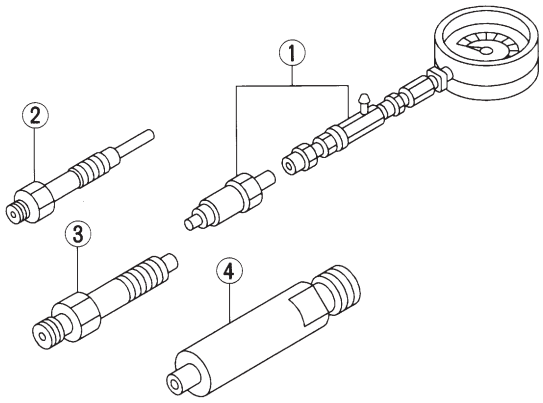
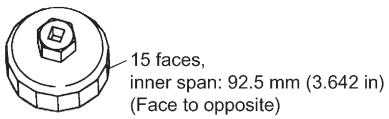
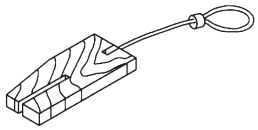
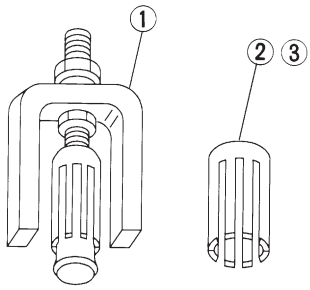
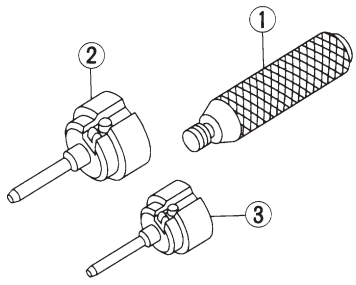
Special Service Tools (Cont'd)

Tool number Tool name	Description		Engine application	
			KA	TD
KV101092S0* Valve spring compressor ① KV10109210 Compressor ② KV10109220 Adapter	 NT021	Disassembling and assembling valve components	X	X
KV109B0010 Valve oil seal drift	 NT027	Installing valve oil seal	X	—
KV11105300 Valve oil seal drift	 NT602	Installing valve oil seal **a: 20 (0.79) dia.** **b: 14.6 (0.575) dia.** **c: 13.3 (0.524) dia.** **d: 8.5 (0.335) dia.** **e: 17.5 (0.689)** **f: 4.5 (0.177)** Unit: mm (in)	—	X
KV11105400* Valve guide drift	 NT637	Installing valve guide **a: 20 (0.79) dia.** **b: 12.2 (0.480) dia.** **c: 16 (0.63)** Unit: mm (in)	—	X
EM03470000* Piston ring compressor	 NT044	Installing piston assembly into cylinder bore	X	X
ST16610001* Pilot bushing puller	 NT045	Removing crankshaft pilot bushing	X	X
KV10111100 Seal cutter	 NT046	Removing oil pan	X	X

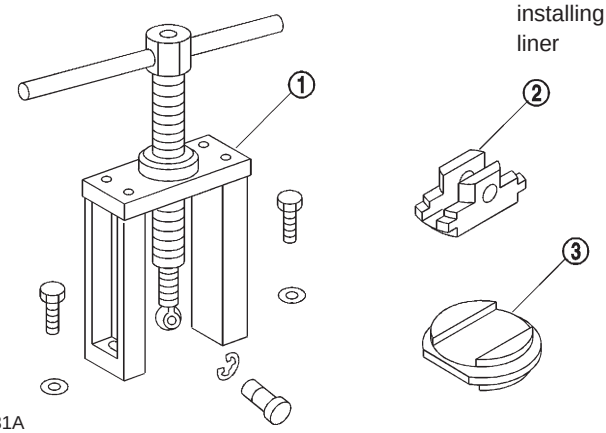
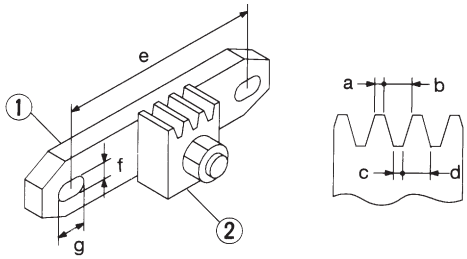
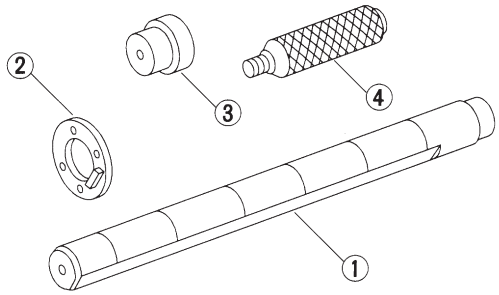
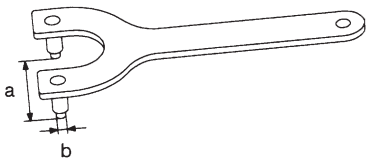
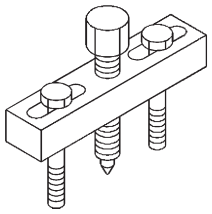
Special Service Tools (Cont'd)

Tool number Tool name	Description		Engine application	
			KA	TD
WS39930000* Tube presser	 NT052	Pressing the tube of liquid gasket	X	X
KV10107902* Valve oil seal puller ① KV10116100 Valve oil seal puller adapter	 NT605	Disassembling valve oil seal	—	X
KV10110300 Piston pin press stand assembly ① KV10110310 Cap ② KV10110330 Spacer ③ ST13030020 Press stand ④ ST13030030 Spring ⑤ KV10110340 Drift ⑥ KV10110320 Center shaft	 NT036	Disassembling and assembling piston with connecting rod	X	—
KV10112100 Angle wrench	 NT014	Tightening bolts for bearing cap, cylinder head, etc.	X	X
EG15060000 Compression gauge and adapter	 NT238		X	—

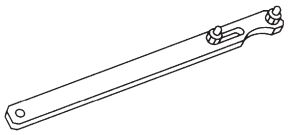
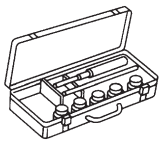
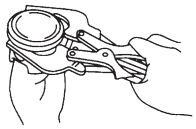
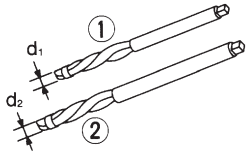
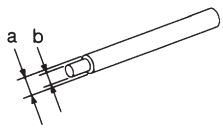
Special Service Tools (Cont'd)

Tool number Tool name	Description	Engine application	
		KA	TD
① ED19601000 Compression gauge ② ED19600600 Compression gauge adapter (for glow plug hole) ③ ED19600700 Compression gauge adapter (for injector hole) ④ ED19600800 Compression gauge adapter (Useless)	Checking compression pressure  NT625	—	X
KV10106001* Oil filter wrench	Removing oil filter  NT690	—	X
KV10105800* Chain stopper	 NT010	X	—
① KV11101110 Valve seat remover ② KV11103610 Adapter (Intake) ③ KV11103620 Adapter (Exhaust)	Removing valve seat  NT251A	—	X
① ST15243000 Valve seat drift ② KV11103810 Adapter (Intake) ③ KV11103820 Adapter (Exhaust)	Installing valve seat  NT252A	—	X

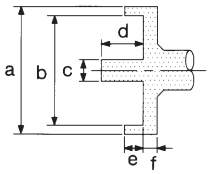
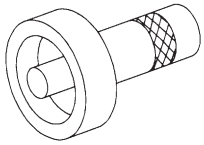
Special Service Tools (Cont'd)

Tool number Tool name	Description		Engine application	
			KA	TD
① KV11104010 Cylinder liner tool ② KV11104110 Adapter for removing ③ KV11104030 Adapter for installing	 NT681A	Removing and installing cylinder liner	—	X
KV111033S0 Engine stopper ① KV11103310 Stopper plate ② KV10105630 Stopper gear	 NT616	Preventing crankshaft from rotating **a: 3 (0.12)** **b: 6.4 (0.252)** **c: 2.8 (0.110)** **d: 6.6 (0.260)** **e: 119 (4.69)** **f: 12 (0.47)** **g: 18 (0.71)** Unit: mm (in)	—	X
KV111045S0 Cam bushing replacer set ① KV11104510 Replacer bar ② KV11104520 Guide plate ③ KV11104530 Adapter (1st bushing) ④ ST15243000 Drift	 NT610	Removing cam bushing or installing cam bushing	—	X
KV10109300* Pulley holder	 NT628	Preventing drive gear from rotating **a: 68 mm (2.68 in)** **b: 8 mm (0.31 in) dia.**	—	X
KV11103000* Injection pump drive gear puller	 NT676	Removing drive gear	—	X

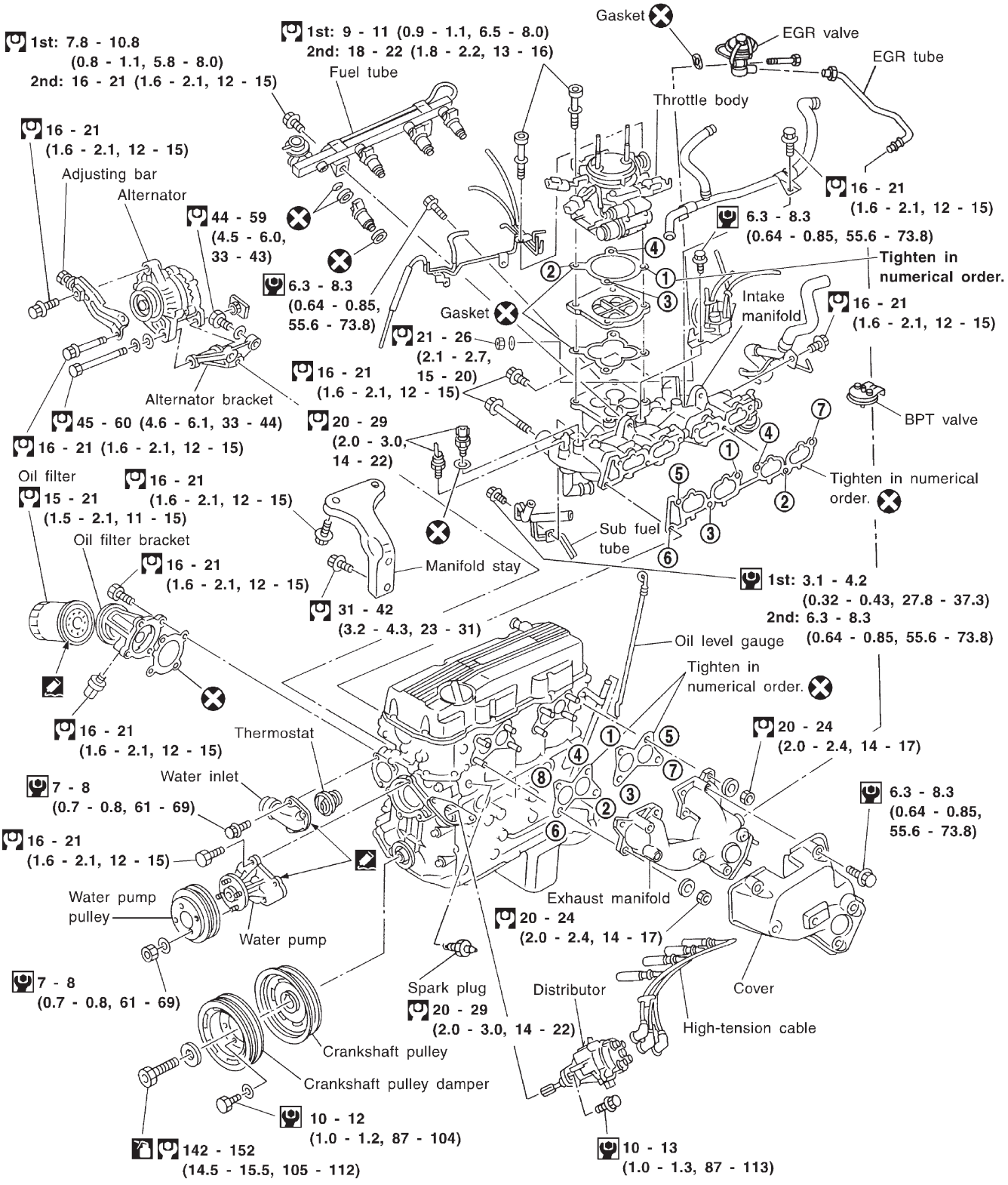
Commercial Service Tools

Tool name	Description		Engine application	
			KA	TD
Pulley holder	 NT035	Holding camshaft pulley while tightening or loosening camshaft bolt	X	—
Valve seat cutter set	 NT048	Finishing valve seat dimensions	X	X
Piston ring expander	 NT030	Removing and installing piston ring	X	X
Valve guide reamer	 NT016	Reaming valve guide inner ① or hole for oversize valve guide ② Diameter (Intake/Exhaust) KA24E **d_1: 7.000 - 7.018 (0.2756 - 0.2763)/ 8.000 - 8.018 (0.3150 - 0.3157)** **d_2: 11.175 - 11.196 (0.4400 - 0.4408)/ 12.175 - 12.196 (0.4793 - 0.4802)** NA20S and Z24S **d_1: 8.000 - 8.018 (0.3150 - 0.3157)** **d_2: 12.175 - 12.196 (0.4793 - 0.4802)** QD32 and TD27 **d_1: 8.000 - 8.015 (0.3150 - 0.3156)** **d_2: —** Unit: mm (in)	X	X
Valve guide drift	 NT015	Removing and installing valve guide Diameter (Intake/Exhaust) KA24E **a: 10.5 (0.413)/11.5 (0.453)** **b: 6.6 (0.260)/7.6 (0.299)** NA20S **a: 11.5 (0.453)** **b: 6.5 (0.256)** Z24S, QD32 and TD25 **a: 11.5 (0.453)** **b: 7.6 (0.299)** Unit: mm (in)	X	X

Commercial Service Tools (Cont'd)

Tool name	Description		Engine application	
			KA	TD
Rear oil seal drift	 NT608		Installing rear oil seal **a: 98 (3.86) dia.** **b: 86 (3.39) dia.** **c: 15.9 (0.626) dia.** **d: 33 (1.30)** **e: 14.5 (0.571)** **f: 10.5 (0.413)** Unit: mm (in)	X	—

SEC. 120•140•147•150•163•164•210•220•221•230•231

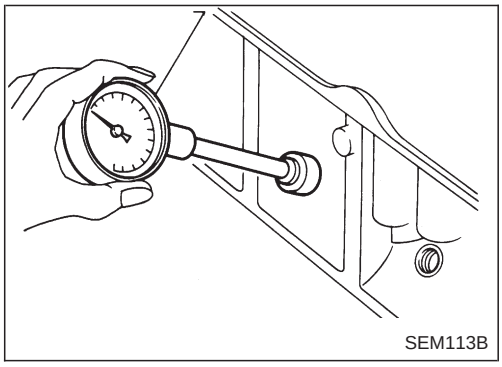


: N•m (kg-m, in-lb)
: N•m (kg-m, ft-lb)
: Lubricate with new engine oil.
: Apply liquid gasket.

SEM811F

Measurement of Compression Pressure

1. Warm up engine.
2. Turn ignition switch OFF.
3. Release fuel pressure.
   Refer to EC section (''Fuel Pressure Release'', ''BASIC SERVICE PROCEDURE'').
4. Remove all spark plugs.
5. Disconnect distributor center cable.


SEM113B

6. Attach a compression tester to No. 1 cylinder.
7. Depress accelerator pedal fully to keep throttle valve wide open.
8. Crank engine and record highest gauge indication.
9. Repeat the measurement on each cylinder.

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

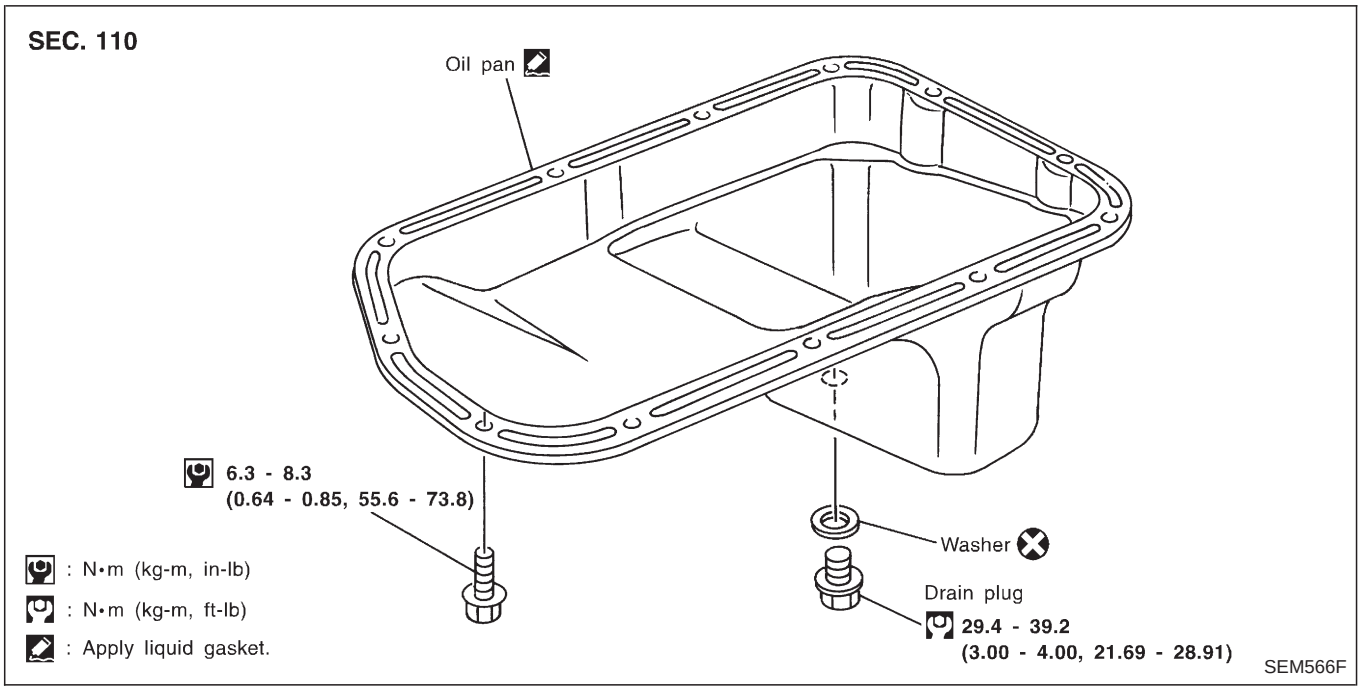
Compression pressure:
kPa (bar, kg/cm^2, psi)/rpm
Standard
1,324 (13.24, 13.5, 192)/300
Minimum
981 (9.8, 10, 142)/300
Difference limit between cylinders
98 (0.98, 1.0, 14)/300

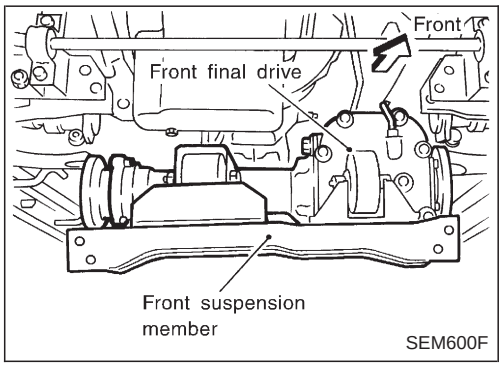
10. If compression in one or more cylinders is low:

a. Pour a small amount of engine oil into cylinders through spark plug holes.
b. Retest compression.

- **If adding oil helps compression, piston rings may be worn or damaged. If so, replace piston rings after checking piston.**
- **If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. (Refer to SDS.) If valve or valve seat is damaged excessively, replace them.**
- **If compression stays low in two cylinders that are next to each other:**

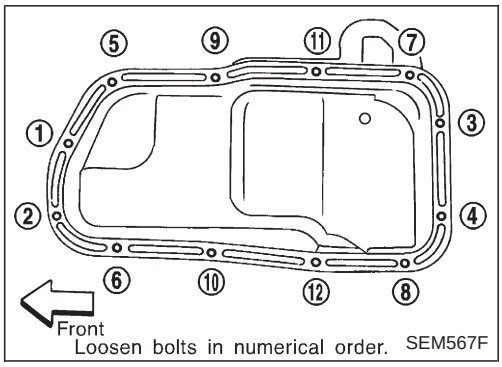
a. The cylinder head gasket may be leaking, or
b. Both cylinders may have valve component damage. Inspect and repair as necessary.



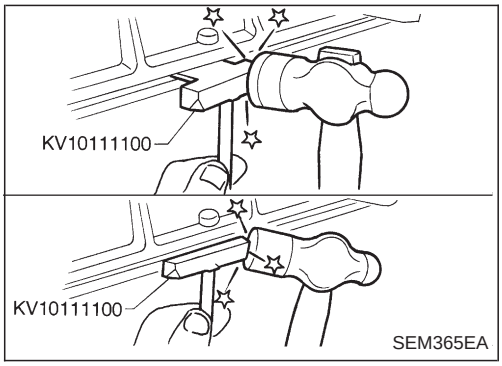


Removal

1. Raise vehicle and support it with safety stands.
2. Remove engine under cover.
3. Drain engine oil.
4. Remove front final drive together with differential mounting member. Refer to PD section (''Removal and Installation'', ''Front final drive'') — 4WD models only.
5. Remove front suspension member bolt (RH & LH).



6. Remove oil pan bolts.



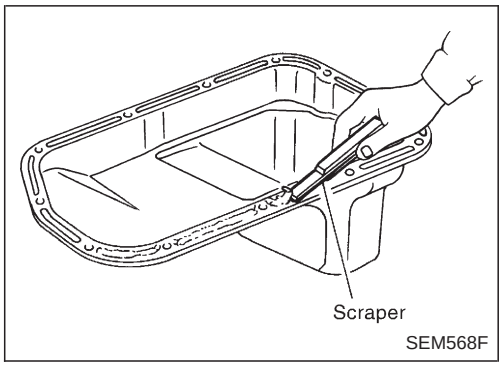
7. Remove oil pan.

a. Insert Tool between cylinder block and oil pan.

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

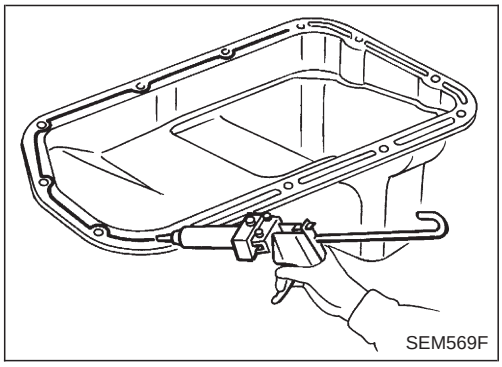
b. Slide Tool by tapping on the side of the Tool with a hammer.

8. Pull out oil pan from front side.

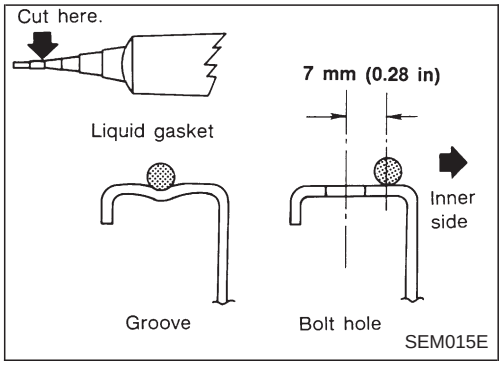


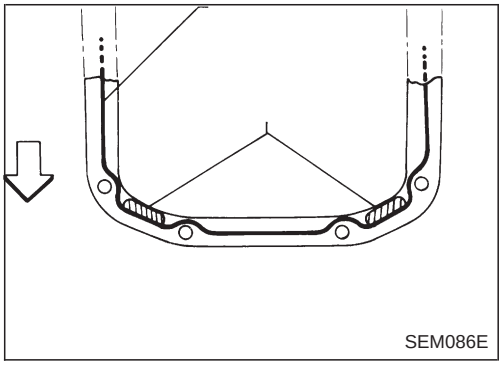
Installation

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

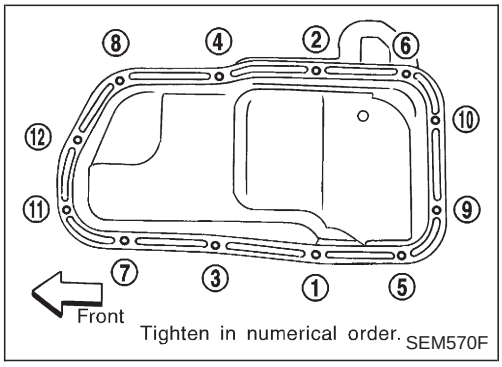


2. Apply a continuous bead of liquid gasket to mating surface of oil pan.
- **Use Genuine Liquid Gasket or equivalent.**
- **Apply to groove on mating surface.**
- **Allow 7 mm (0.28 in) clearance around bolt hole.**

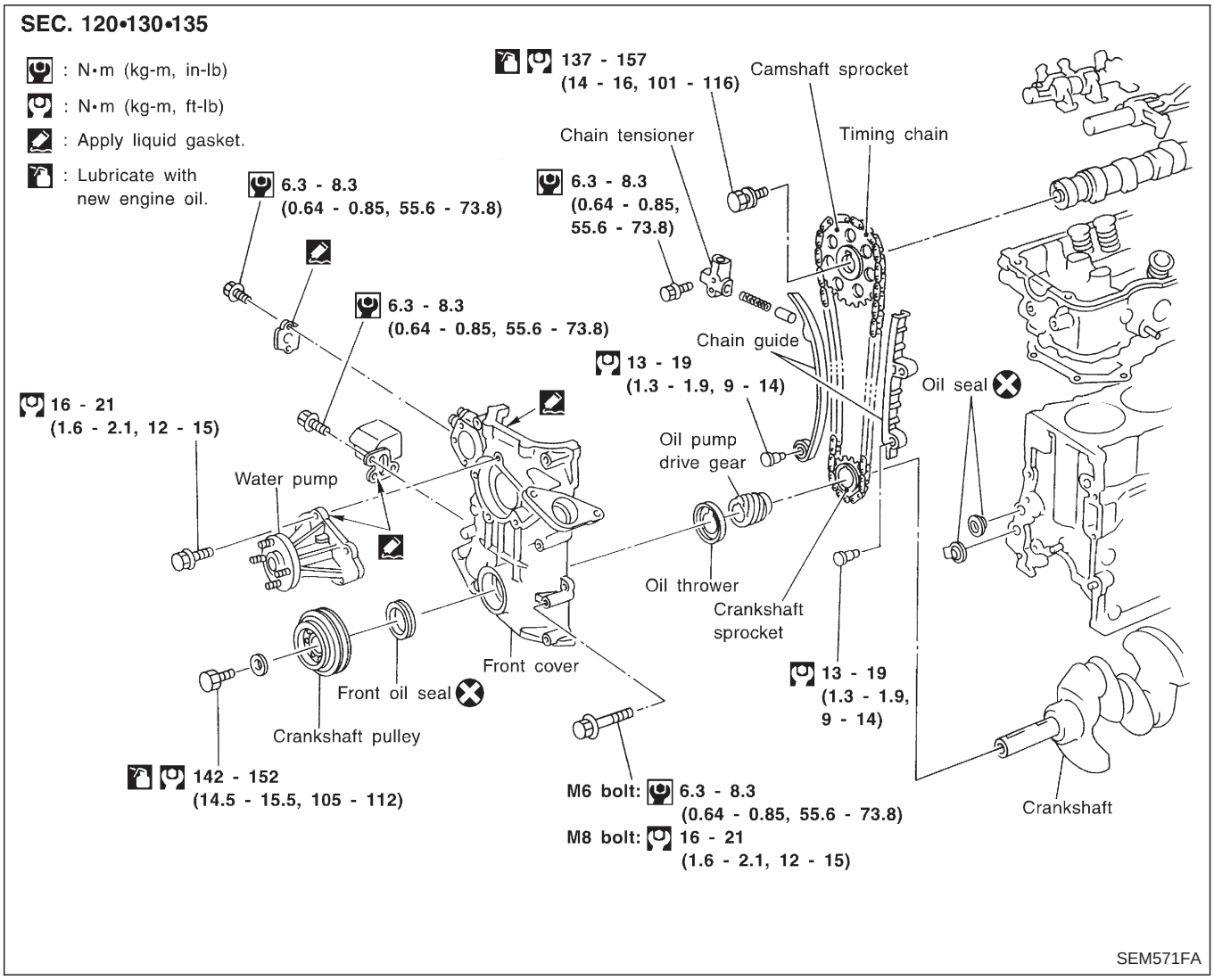




- **Be sure liquid gasket diameter is 3.5 to 4.5 mm (0.138 to 0.177 in).**
- **Attaching should be done within 5 minutes after coating.**



3. Install oil pan.
- **Tighten oil pan bolts in numerical order.**
  : 6.3 - 8.3 N·m (0.64 - 0.85 kg-m, 55.6 - 73.8 in-lb)
- **Wait at least 30 minutes before refilling engine oil.**
4. Install parts in reverse order of removal.



CAUTION:

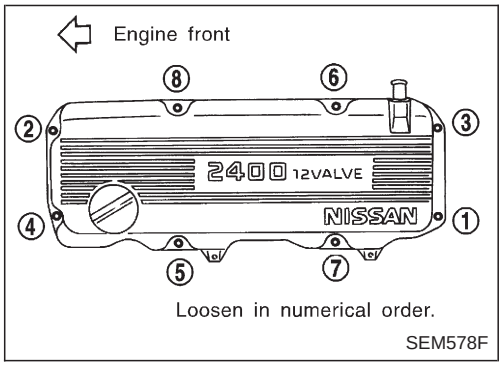
- **After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.**
- **When installing rocker arms, camshafts, chain tensioner, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.**
- **Apply new engine oil to bolt threads and seat surfaces when installing cylinder head, camshaft sprockets, crankshaft pulley, and camshaft brackets.**

Removal

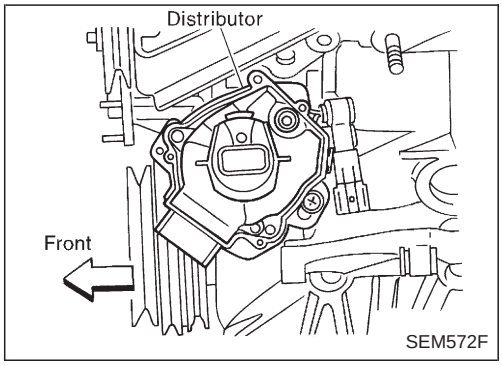
1. Disconnect battery terminal.
2. Remove air cleaner and air intake duct.
3. Drain coolant by removing cylinder block drain plug and radiator drain cock.
4. Remove heater hose and radiator hoses.
5. Remove radiator with shroud and cooling fan.
6. Remove the following belts.
   - Power steering drive belt
   - Compressor drive belt
   - Alternator drive belt
7. Remove accel control wire.
8. Disconnect exhaust manifold from exhaust front tube.

Removal (Cont'd)

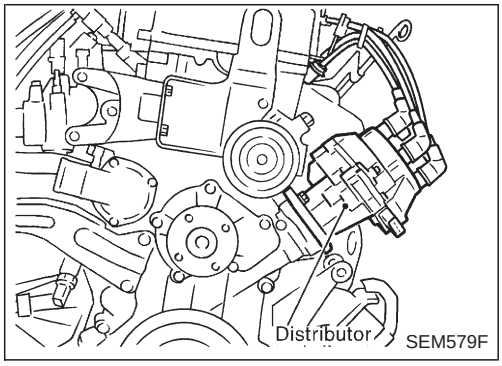
9. Remove PCV hoses from rocker cover.
10. Remove alternator and bracket.
11. Remove power steering oil pump and bracket from engine.
12. Remove vacuum hoses, fuel hoses, wires, harness, connectors and so on.
13. Remove all high tension wires.



14. Remove rocker cover.
- Loosen bolts in numerical order as shown in figure.

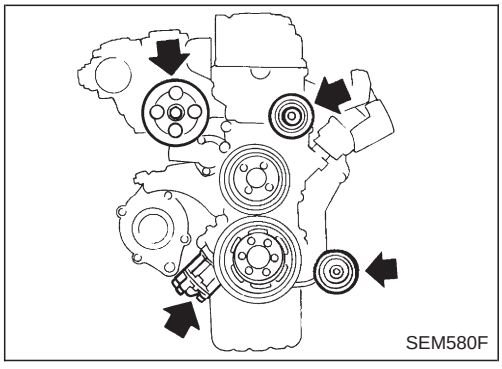


15. Remove all spark plugs.
16. Set No. 1 piston at TDC on its compression stroke.



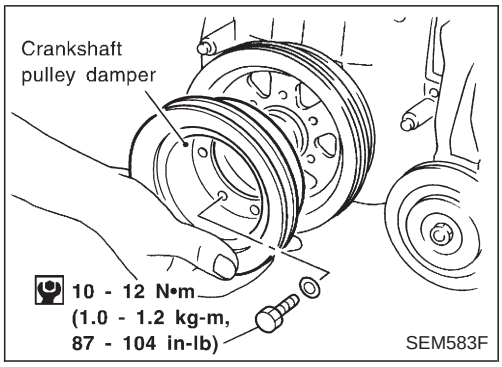
17. Remove distributor.

Do not turn rotor with distributor removed.

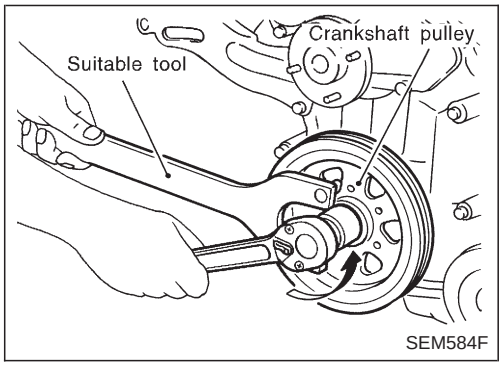


18. Remove the following parts.
- Power steering pump, idler pulley and power steering pump brackets
- Compressor idler pulley
- Oil pump with pump drive spindle

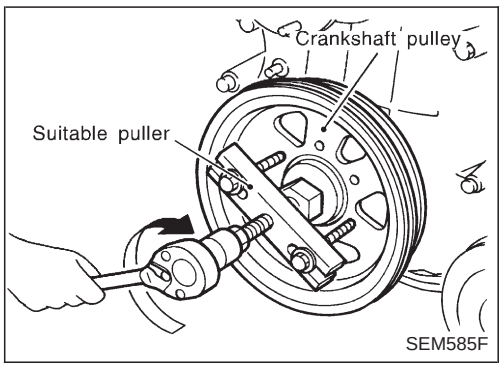
Removal (Cont'd)



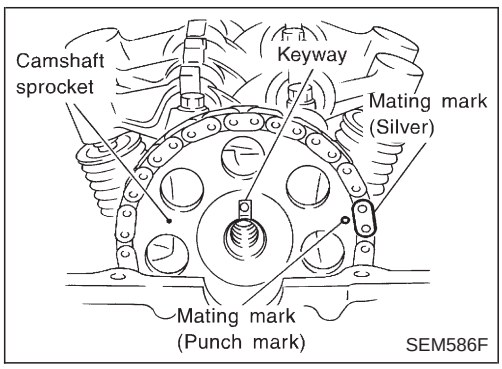
19. Remove crankshaft pulley damper.



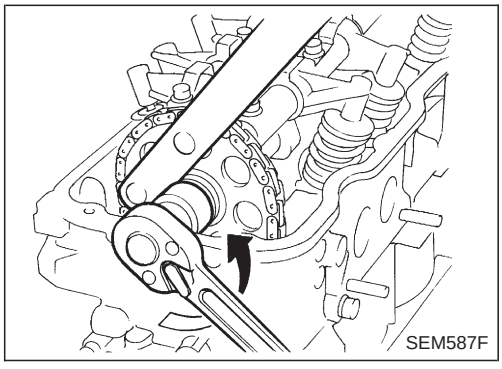
20. Loosen crankshaft pulley bolt.



21. Remove crankshaft pulley with a suitable puller.

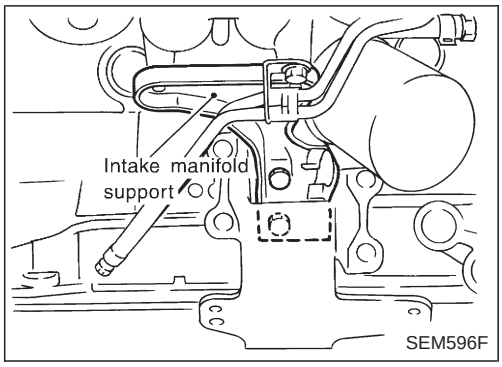


- **Rotate crankshaft until key way on camshaft sprocket is in top position.**

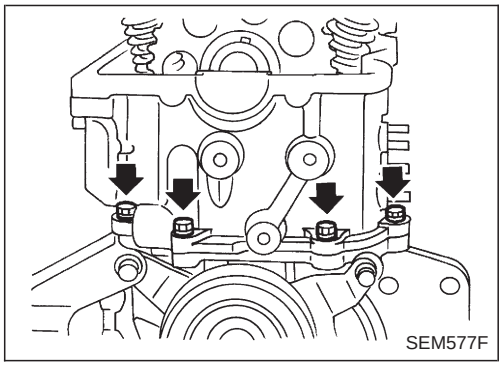


22. Remove camshaft sprockets bolt.

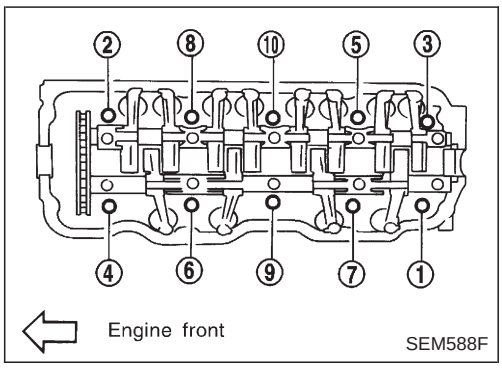
Removal (Cont'd)



23. Remove the bolt securing intake manifold to intake manifold support.

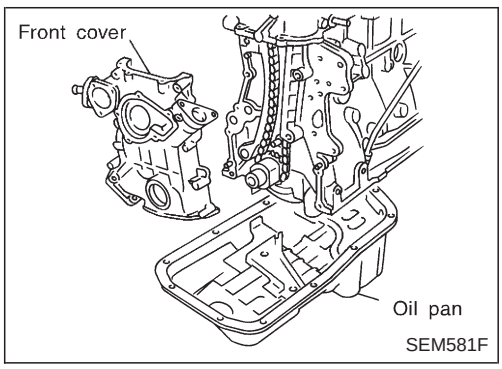


24. Remove front timing cover to cylinder head bolts.

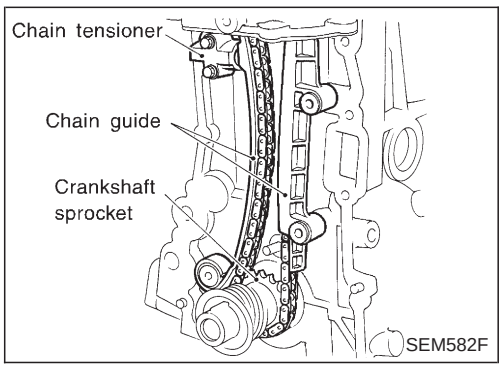


25. Remove cylinder head bolts.
- **Loosen in numerical order.**
- **A warped or cracked cylinder head could result from removing in incorrect order.**
- **Loosen cylinder head bolts in two or three steps.**

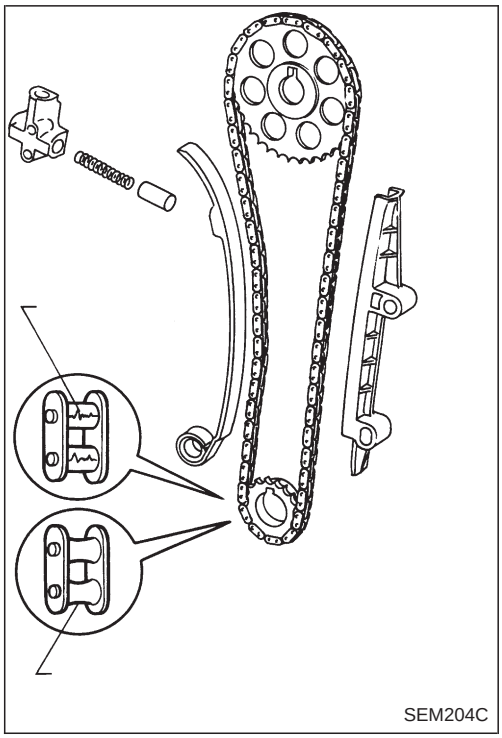
26. Remove cylinder head with intake and exhaust manifolds.



27. Remove oil pan. (Refer to OIL PAN, EM-11.)
28. Remove front cover.
- Inspect for oil leakage at front oil seal. Replace seal if oil leak is present.

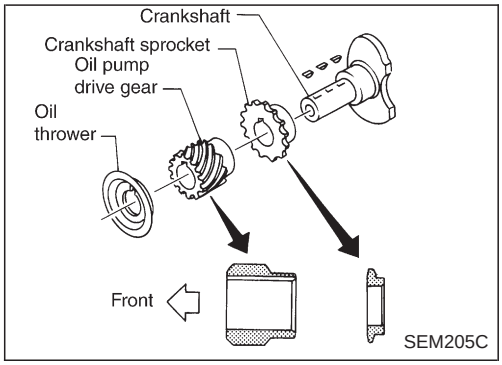


29. Remove the following parts.
- Chain tensioner
- Chain guides
- Timing chain and camshaft sprocket
- Oil thrower, oil pump drive gear and crankshaft sprocket


SEM204C

Inspection

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

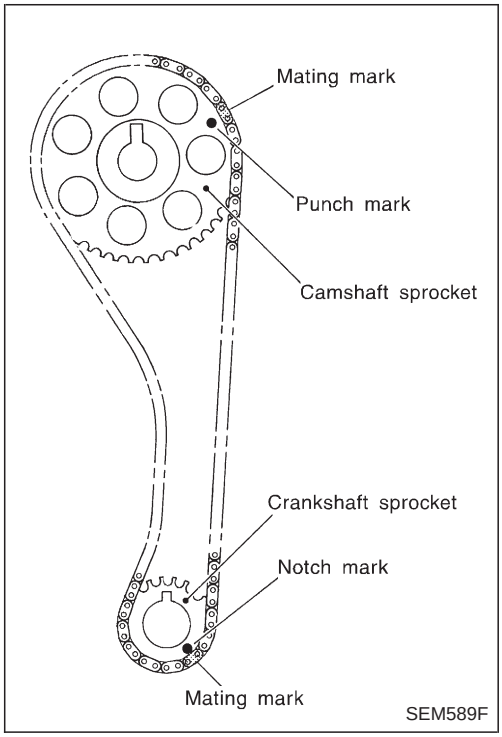


SEM205C

Installation

1. Install crankshaft sprocket, oil pump drive gear and oil thrower.

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

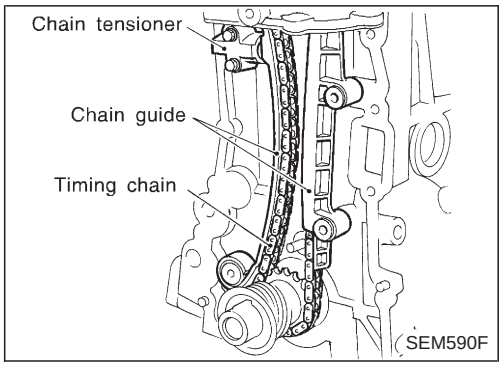


SEM589F

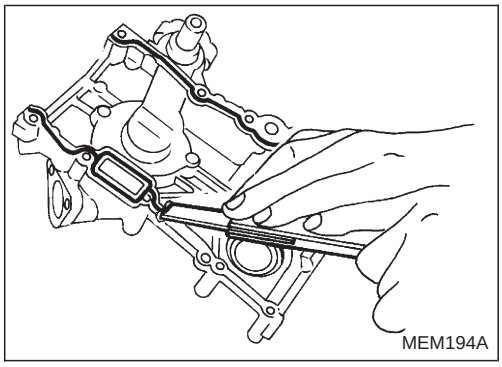
2. Position crankshaft so that No. 1 piston is set at TDC (Keyway at 12 o'clock) fit timing chain to crankshaft sprocket so that mating mark is in line with mating mark on crankshaft sprocket.
3. Temporarily install cylinder head with new gasket. Position camshaft so that keyway is set at 12 o'clock.

- **Set timing chain by aligning its mating marks with those of crankshaft sprocket and camshaft sprocket.**

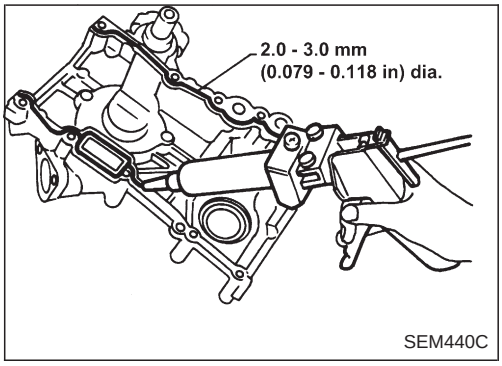
Installation (Cont'd)



4. Install timing chain and timing chain guides and chain tensioner.

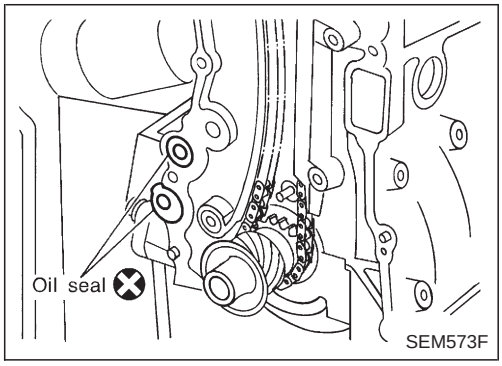


5. Before installing front cover, remove all traces of liquid gasket from mating surface using a scraper.
- **Also remove traces of liquid gasket from mating surface of cylinder block.**



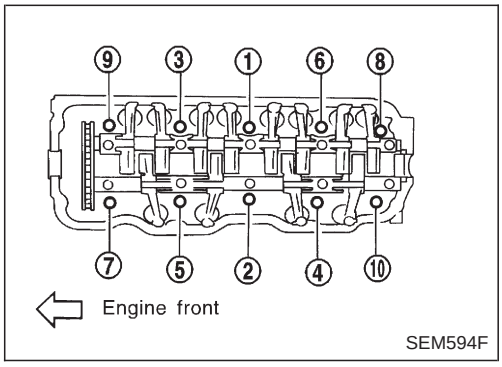
6. Apply a continuous bead of liquid gasket to front cover.
- **Use Genuine Liquid Gasket or equivalent.**
- **Be sure to install new front oil seal in the right direction. Refer to EM-22.**

7. Apply lithium grease to sealing lip of crankshaft oil seal.



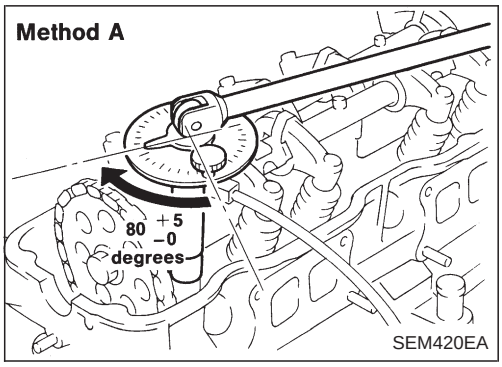
8. Install front cover.
- **Be careful not to damage cylinder head gasket.**
- **Be careful not to damage front oil seal when installing front cover.**

9. Install oil pan. (Refer to OIL PAN, EM-11.)



10. Tighten cylinder head bolts.
- ⓐ **Tighten all bolts to 29 N·m (3 kg-m, 22 ft-lb).**
- ⓑ **Tighten all bolts to 78 N·m (8 kg-m, 58 ft-lb).**
- ⓒ **Loosen all bolts completely.**
- ⓓ **Tighten all bolts to 25 to 34 N·m (2.5 to 3.5 kg-m, 18 to 25 ft-lb).**

Installation (Cont'd)

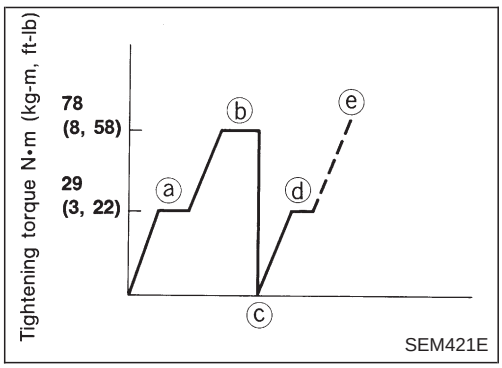


SEM420EA

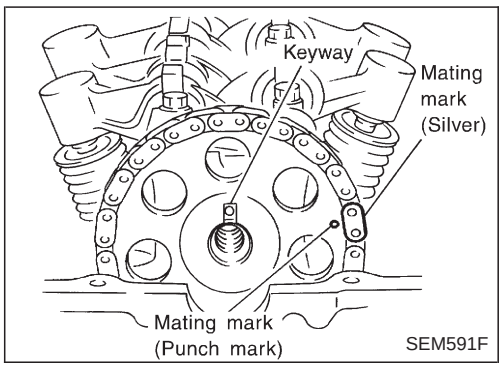
ⓔ **Method A:** **Turn all bolts 80^{+5}_{-0} degrees clockwise with an angle wrench.**

Method B: **If an angle wrench is not available, tighten all bolts to 74 to 83 N·m (7.5 to 8.5 kg-m, 54 to 61 ft-lb).**

	Tightening torque N·m (kg-m, ft-lb)
ⓐ	29 (3, 22)
ⓑ	78 (8, 58)
ⓒ	0 (0, 0)
ⓓ	29±5 (3±0.5, 21.7±3.6)
ⓔ	80^{+5}_{-0} degrees or 78±5 (8.0±0.5, 57.9±3.6)

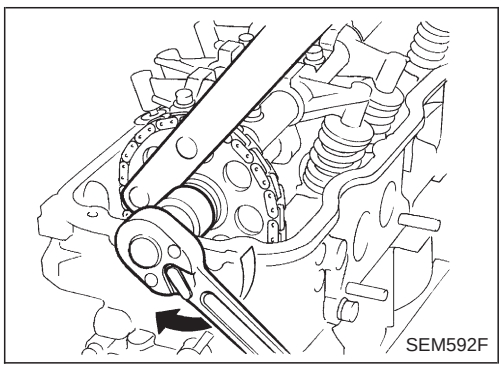


SEM421E

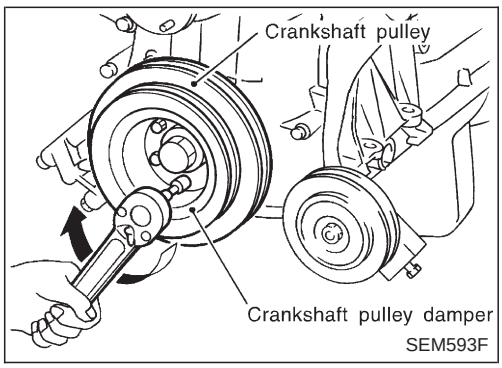


SEM591F

11. Install camshaft sprockets.
Line up mating mark on timing chain with mating mark on camshaft sprocket.


SEM592F

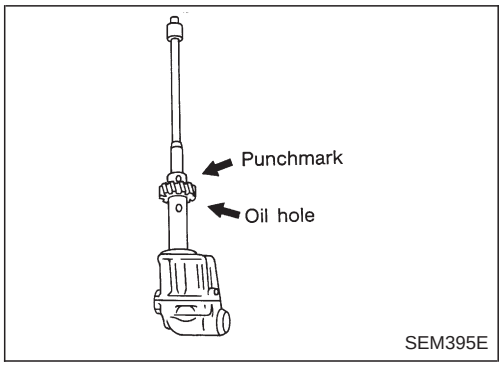
- Lock camshafts as shown in figure and tighten to specified torque.
  : 137 - 157 N·m (14.0 - 16.0 kg-m, 101 - 116 ft-lb)



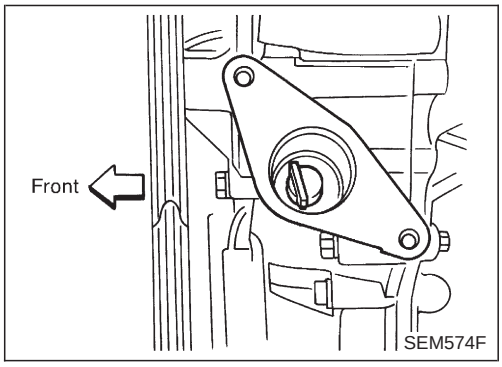
SEM593F

12. Install crankshaft pulley and crankshaft pulley damper.

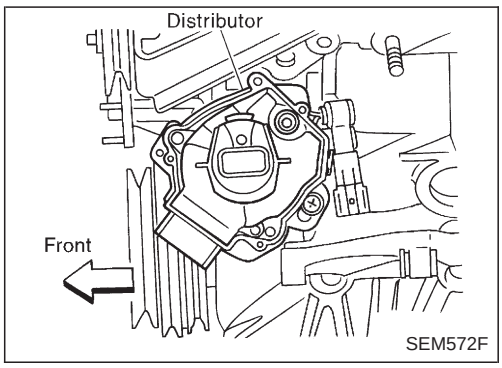
Installation (Cont'd)



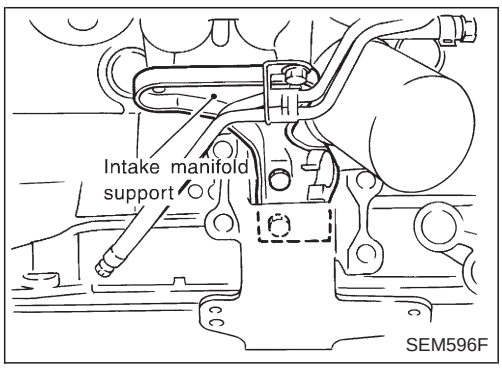
13. Install oil pump and distributor driving spindle with new gasket in front cover.
a. Assemble oil pump and driving spindle, aligning punchmark on driving spindle with oil hole.



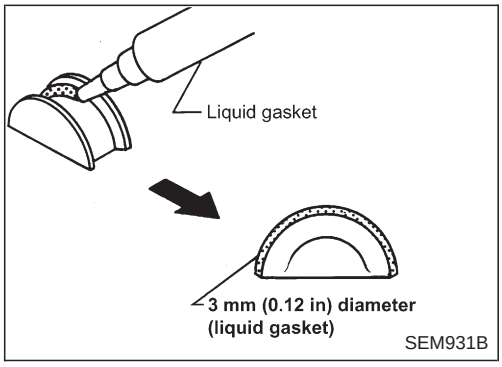
b. Make sure that driving spindle is set as shown in figure.



14. Install distributor.
15. Make sure that No. 1 piston is set at TDC and that distributor rotor is set at No. 1 cylinder spark position.

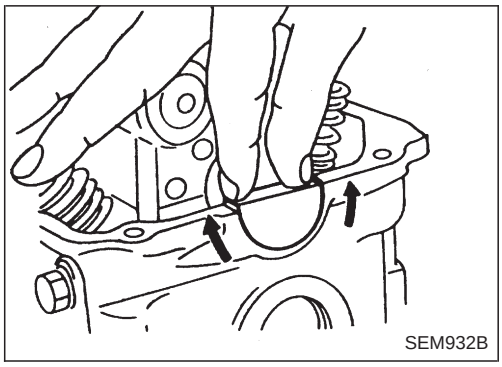


16. Install cylinder head outside bolts.
17. Install intake manifold support.



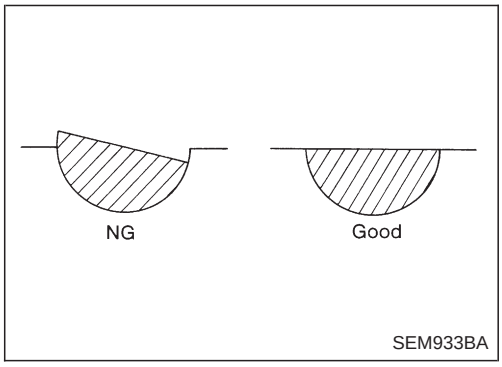
18. Install rubber plugs as follows:
a. Apply liquid gasket to rubber plugs.
- **Rubber plugs should be replaced with new ones.**
- **Rubber plugs should be installed within 5 minutes of applying liquid gasket.**

Installation (Cont'd)

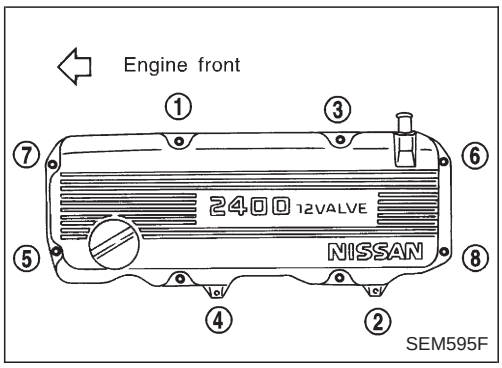

SEM932B

b. Install rubber plugs, then move them with your fingers to uniformly spread the gasket on cylinder head surface.

- **Rubber plugs should be installed flush with the surface.**
- **Do not start the engine for 30 minutes after installing rocker cover.**
- **Wipe clean excessive liquid gasket from cylinder head top surface.**



SEM933BA



SEM595F

19. Install rocker cover.

Rocker cover tightening procedure:

(1) Tighten bolts ① - ② in that order to 3 N·m (0.3 kg-m, 26 in-lb).

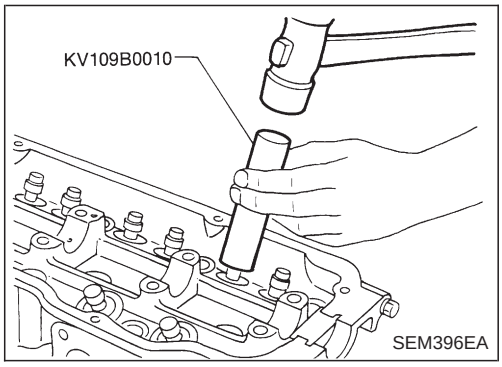
(2) Tighten nuts ④ - ③ - ② - ① - ⑧ - ⑦ - ⑥ - ⑤ - ④ - ③ - ② - ① in that order to 7 to 11 N·m (0.7 to 1.1 kg-m, 61 to 95 in-lb).

20. Install parts in the reverse order of removal.

Valve Oil Seal

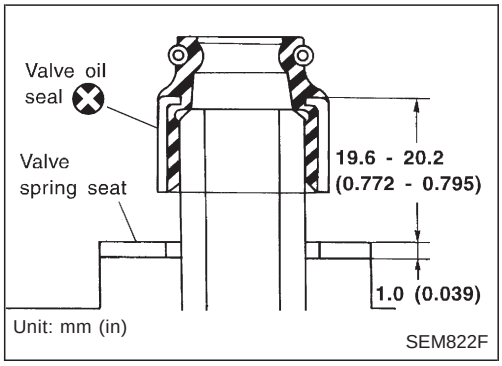
1. Remove rocker cover.
2. Remove rocker shaft assembly. (Refer to ‘‘Disassembly’’, ‘‘CYLINDER HEAD’’, EM-27.)
3. Remove valve spring and valve oil seal with Tool or suitable tool.

- **Piston concerned should be set at TDC to prevent valve from falling.**



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

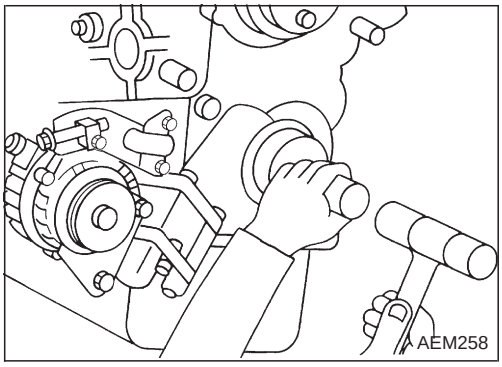
- **Before installing valve oil seal, install valve spring seat.**



Front Oil Seal

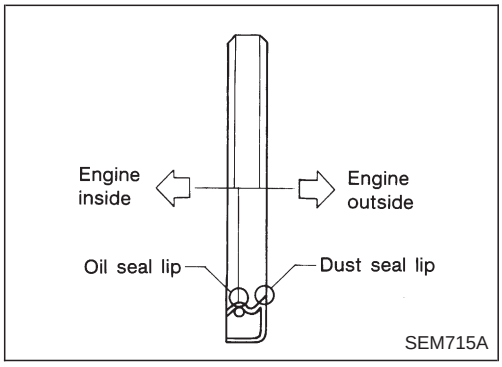
1. Remove radiator shroud and crankshaft pulley.
2. Remove front oil seal.

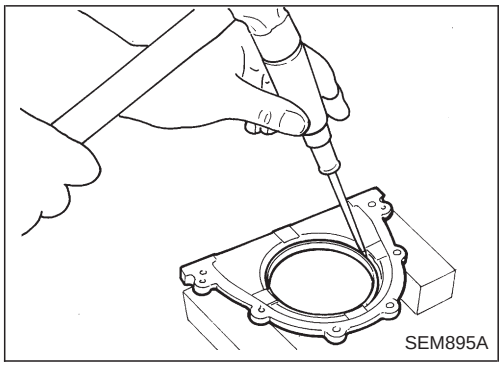
- **Be careful not to scratch front cover.**



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

- **Install new oil seal in the direction shown.**

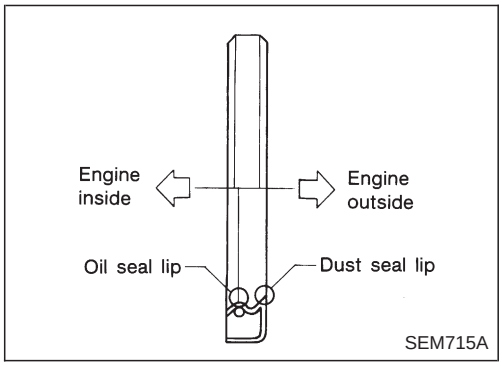



SEM895A

Rear Oil Seal

1. Remove flywheel.
2. Remove rear oil seal retainer.
3. Remove rear oil seal from retainer.

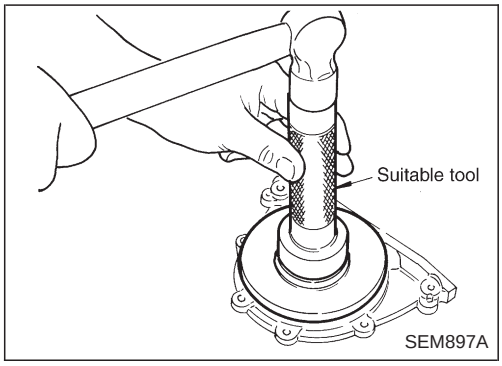
- **Be careful not to scratch rear oil seal retainer.**



SEM715A

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

- **Install new oil seal in the direction shown.**

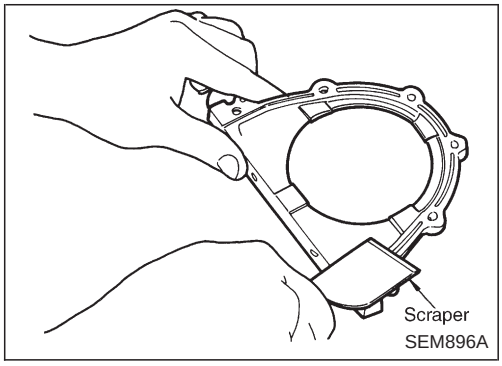


SEM897A

5. Install rear oil seal retainer.

a. Before installing rear oil seal retainer, remove all traces of liquid gasket from mating surface using a scraper.

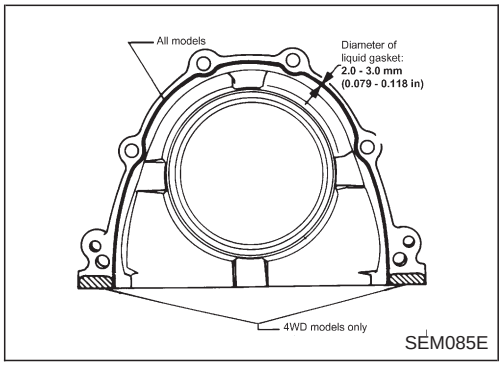
- **Also remove traces of liquid gasket from mating surface of cylinder block.**



SEM896A

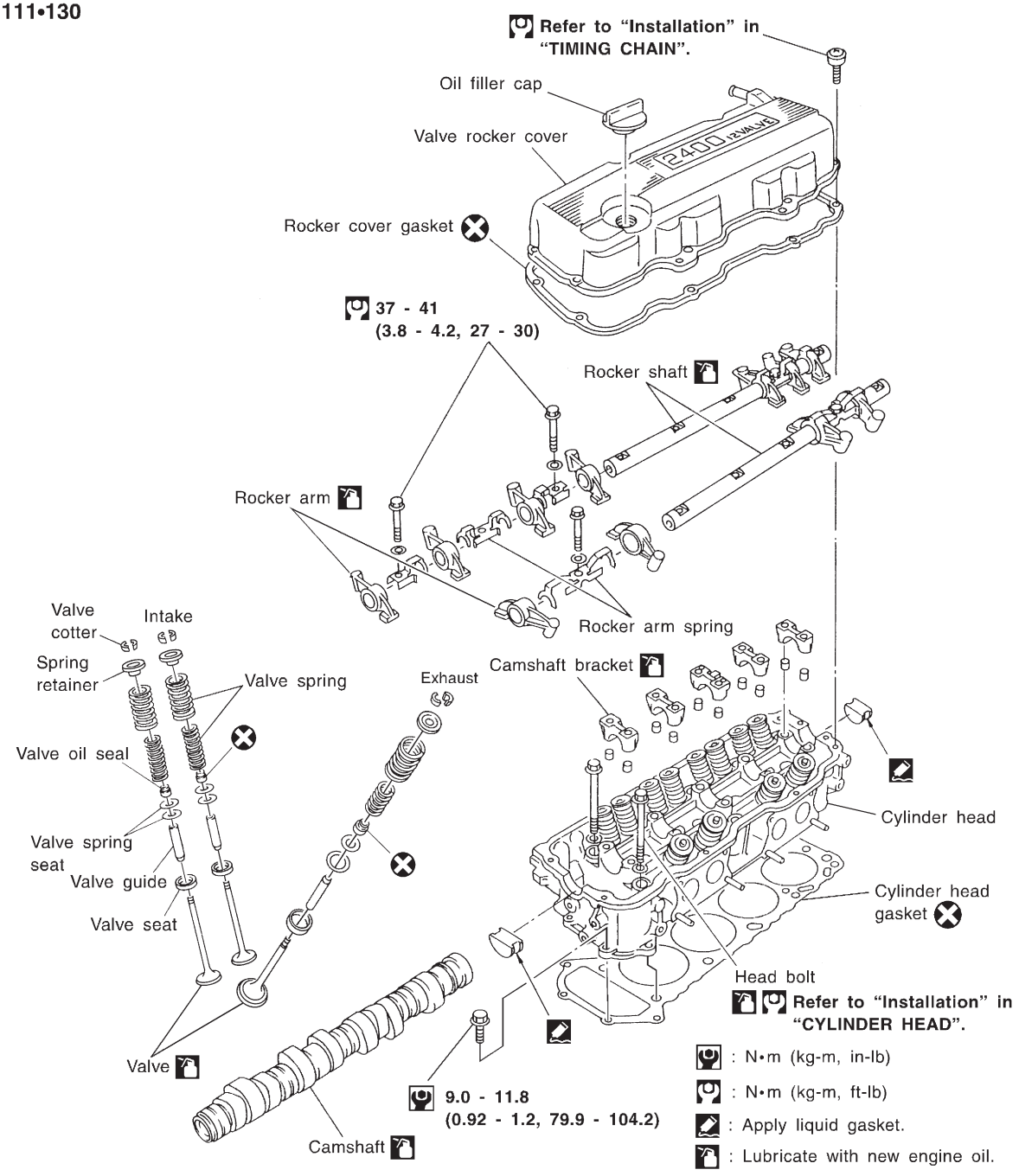
b. Apply a continuous bead of liquid gasket to mating surface of rear oil seal retainer.

- **Use Genuine Liquid Gasket or equivalent.**
- **Apply around inner side of bolt holes.**



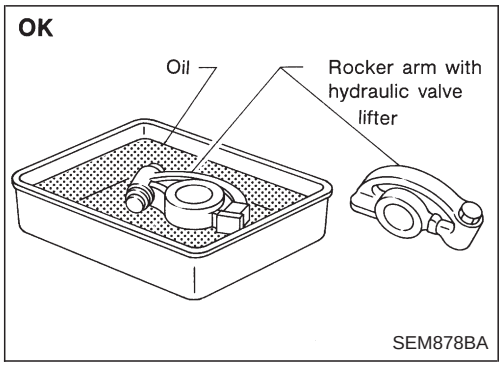
SEM085E

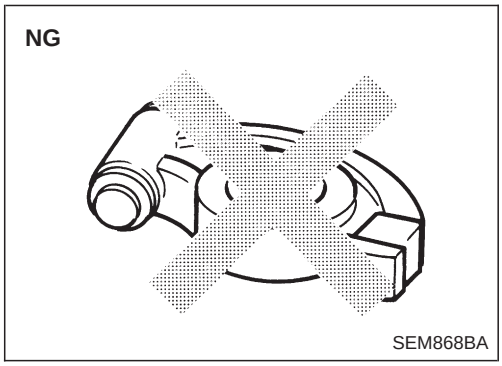
SEC. 111•130



SEM814F

Rear Oil Seal





CAUTION:

- **When installing rocker arms, camshaft and oil seal, lubricate contacting surfaces with new engine oil.**
- **When tightening cylinder head bolts and rocker shaft bolts, lubricate bolt threads and seat surfaces with new engine oil.**
- **Hydraulic valve lifters are installed in each rocker arm. If hydraulic valve lifter is kept on its side, even when installed in rocker arm, there is a risk of air entering it. When rocker arms are removed, stand them straight up or soak them in new engine oil.**
- **Do not disassemble hydraulic valve lifter.**
- **Attach tags to valve lifters so as not to mix them up.**

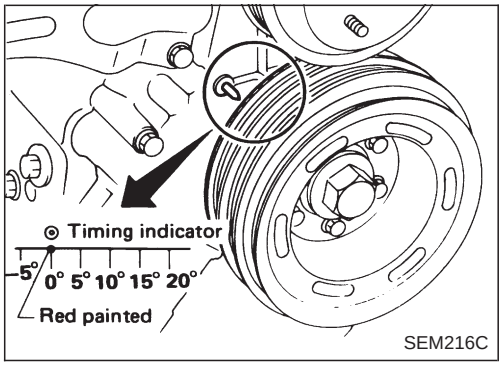
Removal

1. Release fuel pressure. Refer to EC section (''Fuel Pressure Release'').
2. Drain coolant from radiator and drain plug of block.
3. Remove the following parts.

- Power steering drive belt
- Power steering pump, idler pulley and power steering brackets
- Vacuum hoses of swirl control valve and pressure control solenoid valve
- Accelerator wire bracket

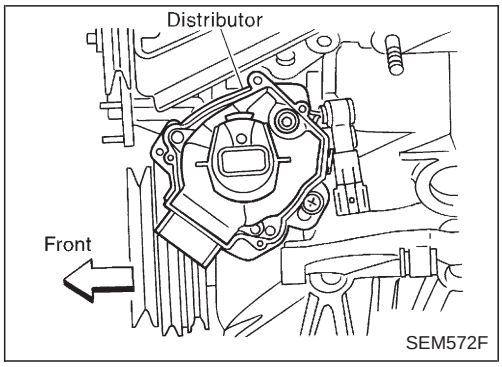
4. Remove bolts which hold intake manifold collector to intake manifold.
5. Remove bolts which hold intake manifold to cylinder head while raising collector upwards.
6. Remove exhaust manifold cover and exhaust manifold.
7. Remove rocker cover.

- **When removing rocker cover, do not hit rocker cover against rocker arm.**

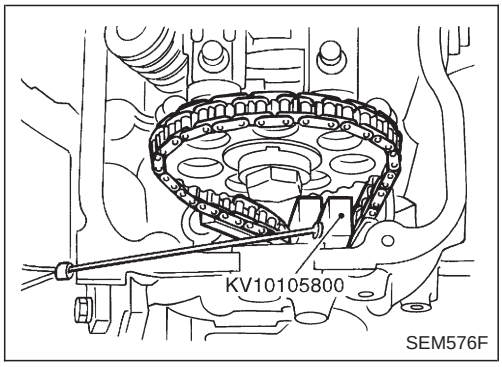


8. Set No. 1 piston at TDC on its compression stroke.

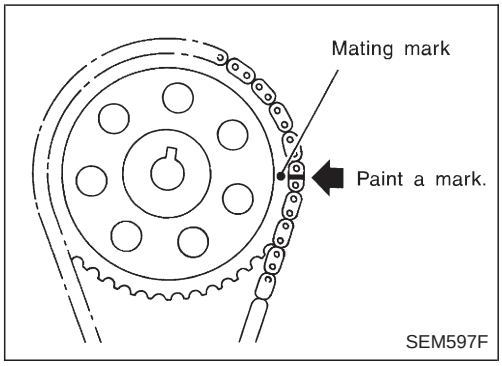
Removal (Cont'd)



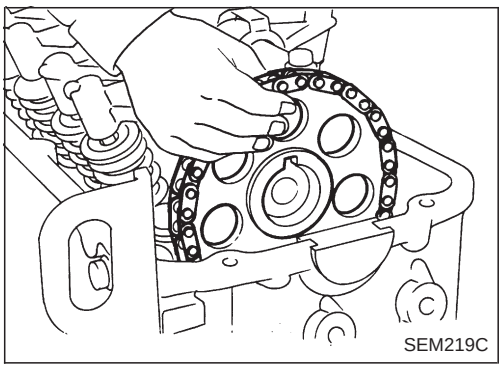
- Make sure No. 1 cylinder is at TDC by looking at the distributor rotor position.



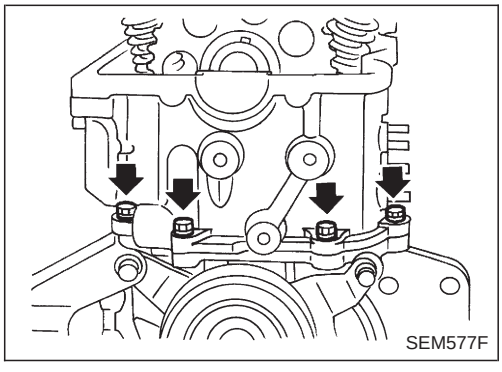
9. Loosen camshaft sprocket bolt.
- Support timing chain by using Tool as shown in figure.



10. Apply paint marks to timing chain matched with mating marks of camshaft sprockets.

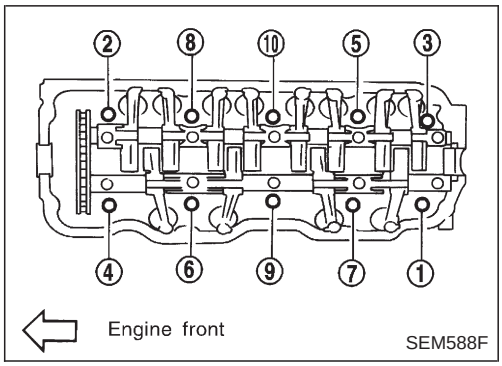


11. Remove camshaft sprocket.



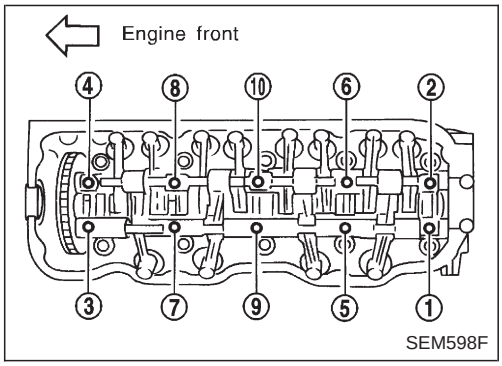
12. Remove front timing cover to cylinder head bolts.

Removal (Cont'd)



13. Remove cylinder head.
- **Loosen in numerical order.**
- **A warped or cracked cylinder head could result from removing in incorrect order.**
- **Loosen cylinder head bolts in two or three steps.**

Disassembly

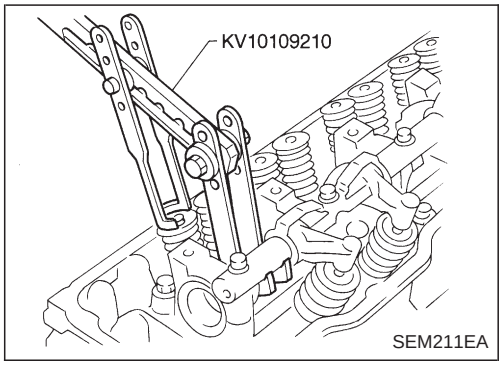


1. Remove rocker shaft assembly.

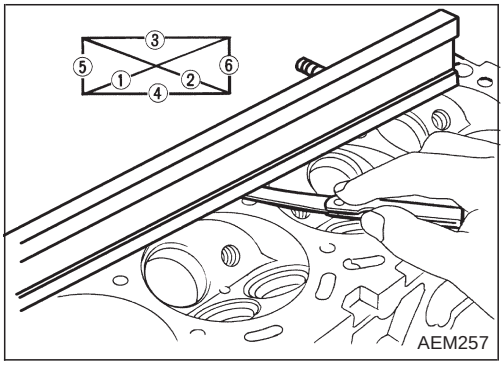
a. When loosening bolts, evenly loosen from outside in sequence.

b. Bolts should be loosened in two or three steps.

2. Remove camshaft.
- **Before removing camshaft, measure camshaft end play. (Refer to ''Inspection''.)**



3. Remove valve components with Tool.
4. Remove valve oil seals. (Refer to ''OIL SEAL REPLACEMENT'', EM-22.)



Inspection

CYLINDER HEAD DISTORTION

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

Head surface flatness: mm (in)
Standard
Less than 0.03 (0.0012)
Limit
0.1 (0.004)

If beyond the specified limit, replace or resurface.

Resurfacing limit:

The limit for cylinder head resurfacing is determined by the cylinder block resurfacing.

Amount of cylinder head resurfacing is ''A''

Amount of cylinder block resurfacing is ''B''

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

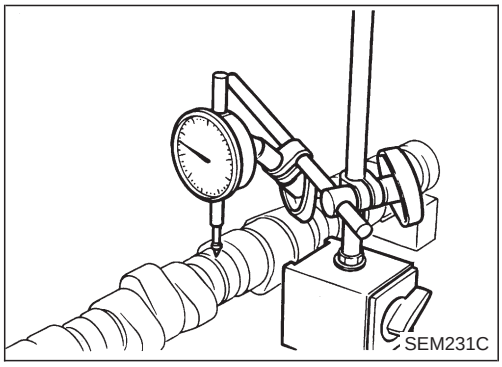
After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

Inspection (Cont'd)

Nominal cylinder head height:
98.8 - 99.0 mm (3.890 - 3.898 in)

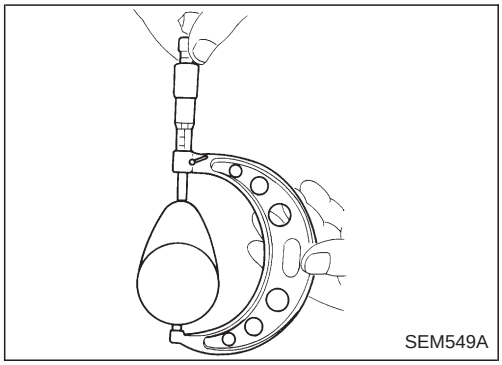
CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.


SEM231C

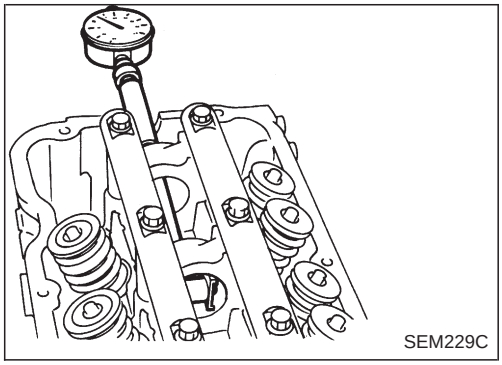
CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.
   Runout (Total indicator reading):
   0 - 0.02 mm (0 - 0.0008 in)
2. If it exceeds the limit, replace camshaft.


SEM549A

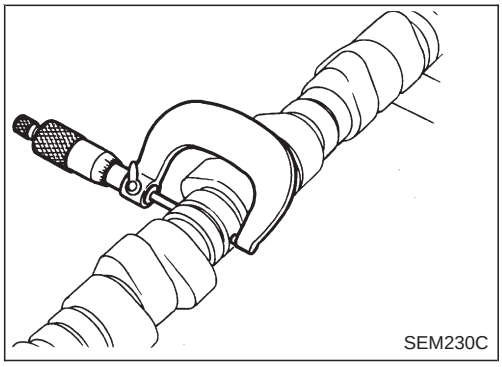
CAMSHAFT CAM HEIGHT

1. Measure camshaft cam height.
   Standard cam height:
   44.43 - 44.58 mm (1.7492 - 1.7551 in)
   Cam height wear limit:
   0.2 mm (0.008 in)
2. If wear is beyond the limit, replace camshaft.


SEM229C

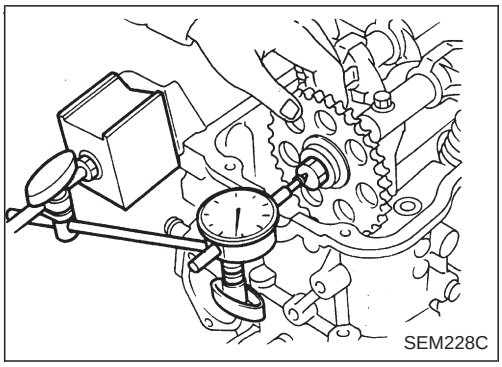
CAMSHAFT JOURNAL CLEARANCE

1. Install camshaft bracket and rocker shaft and tighten bolts to the specified torque.
2. Measure inner diameter of camshaft bearing.
   Standard inner diameter:
   33.000 - 33.025 mm (1.2992 - 1.3002 in)


SEM230C

3. Measure outer diameter of camshaft journal.
   Standard outer diameter:
   32.935 - 32.955 mm (1.2967 - 1.2974 in)
4. If clearance exceeds the limit, replace camshaft and/or cylinder head.
   Camshaft journal clearance: mm (in)
   Standard
   0.045 - 0.090 (0.0018 - 0.0035)
   Limit
   0.12 (0.0047)

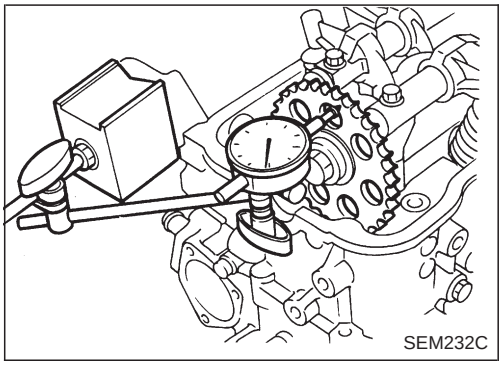
Inspection (Cont'd)


SEM228C

CAMSHAFT END PLAY

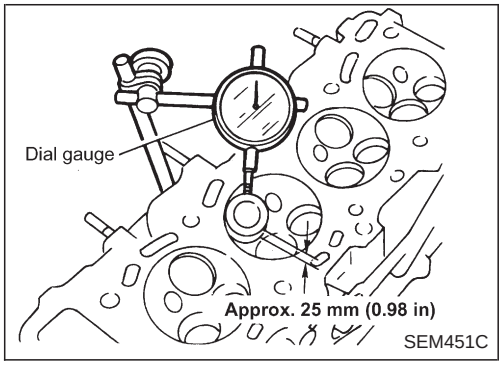
1. Install camshaft in cylinder head.
2. Measure camshaft end play.
   Camshaft end play: mm (in)
   Standard
   0.07 - 0.15 (0.0028 - 0.0059)
   Limit
   0.2 (0.008)
3. If end play exceeds the limit, replace camshaft and remeasure camshaft end play.

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


SEM232C

CAMSHAFT SPROCKET RUNOUT

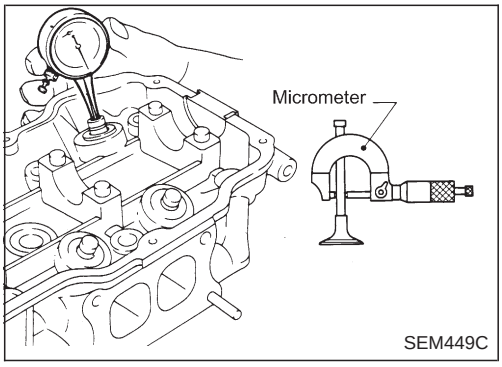
1. Install sprocket on camshaft.
2. Measure camshaft sprocket runout.
   Runout (Total indicator reading):
   Limit 0.12 mm (0.0047 in)
3. If it exceeds the limit, replace camshaft sprocket.



SEM451C

VALVE GUIDE CLEARANCE

1. Measure valve deflection as shown in illustration. (Valve and valve guide mostly wear in this direction.)
   Valve deflection limit (Dial gauge reading):
   0.15 mm (0.0059 in)



SEM449C

2. If it exceeds the limit, check valve to valve guide clearance.

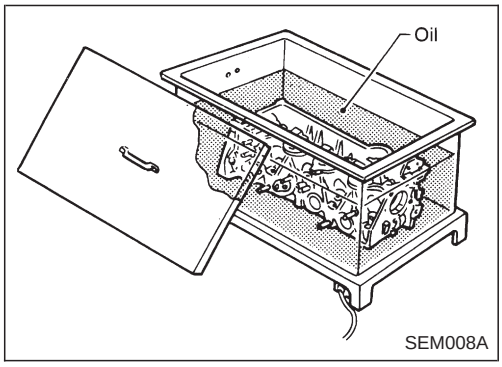
a. Measure valve stem diameter and valve guide inner diameter.

b. Check that clearance is within specification.
   Valve to valve guide clearance = valve guide inner diameter − valve stem diameter: mm (in)
   Standard
   Intake
   0.020 - 0.053 (0.0008 - 0.0021)
   Exhaust
   0.040 - 0.070 (0.0016 - 0.0028)
   Limit 0.1 (0.004)

Inspection (Cont'd)

c. If it exceeds the limit, replace valve and remeasure clearance.

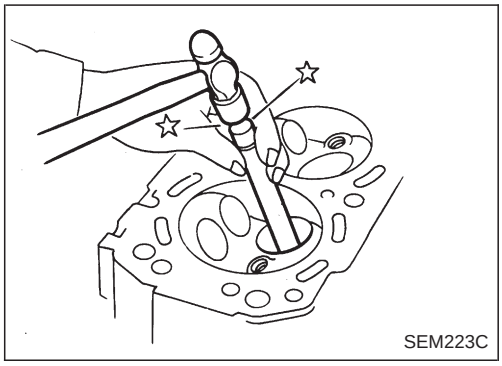
- If clearance still exceeds the limit after replacing valve, replace the valve guide.



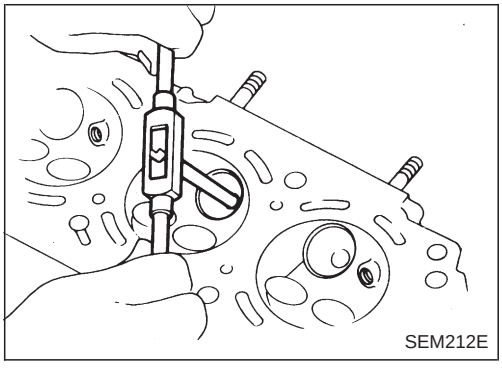
SEM008A

VALVE GUIDE REPLACEMENT

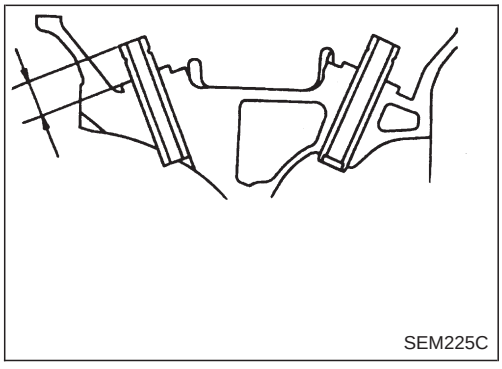
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F).


SEM223C

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

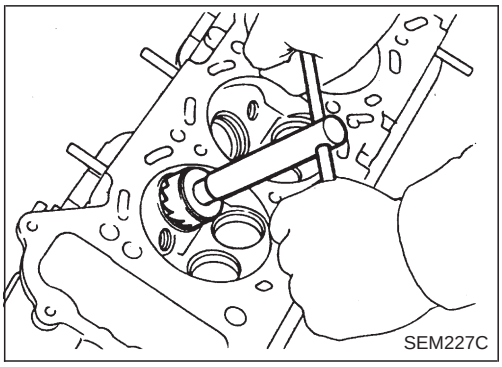

SEM212E

3. Ream cylinder head valve guide hole.
   Valve guide hole diameter (for service parts): mm (in)
   Intake
   11.175 - 11.196 (0.4400 - 0.4408)
   Exhaust
   12.175 - 12.196 (0.4793 - 0.4802)


SEM225C

4. Heat cylinder head to 110 to 130°C (230 to 266°F) and press service valve guide onto cylinder head.
   Projection "L":
   14.9 - 15.1 mm (0.587 - 0.594 in)
5. Ream valve guide.
   Finished size: mm (in)
   Intake
   7.000 - 7.018 (0.2756 - 0.2763)
   Exhaust
   8.000 - 8.018 (0.3150 - 0.3157)

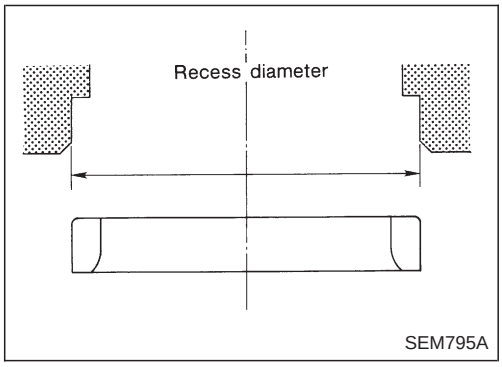
Inspection (Cont'd)


SEM227C

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.**

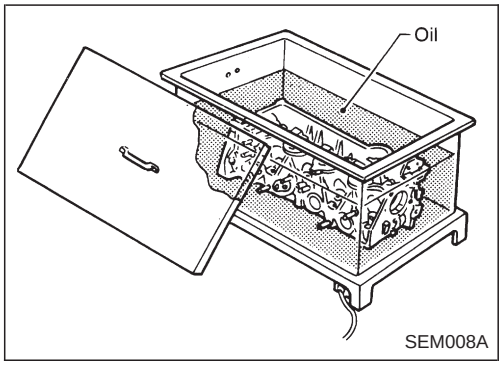


SEM795A

REPLACING VALVE SEAT FOR SERVICE PARTS

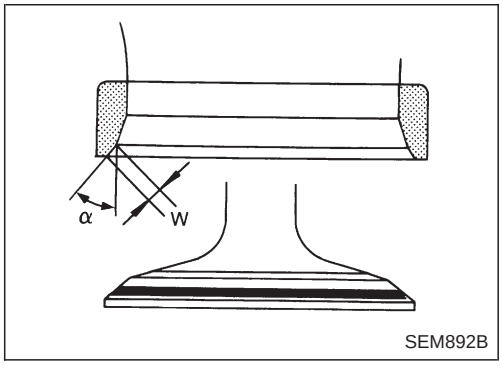
1. Bore out old seat until it collapses. Set machine depth stop so that boring cannot contact bottom face of seat recess in cylinder head.
2. Ream cylinder head recess.
   Reaming bore for service valve seat
   Oversize [0.5 (0.020)]: mm (in)
   Intake 36.500 - 36.516 (1.4370 - 1.4376)
   Exhaust 42.500 - 42.516 (1.6732 - 1.6739)

Use the valve guide center for reaming to ensure valve seat will have the correct fit.



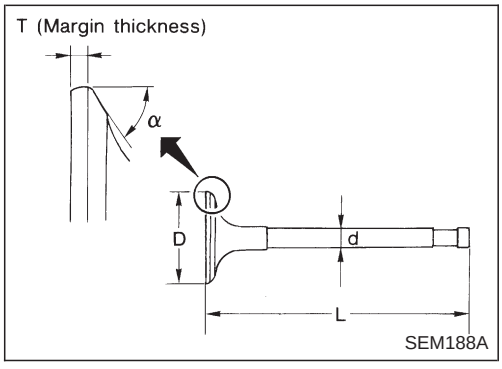
SEM008A

3. Heat cylinder head to 110 to 130°C (230 to 266°F).
4. Press fit valve seat until it seats on the bottom.



SEM892B

5. Cut or grind valve seat using suitable tool of the specified dimensions. Refer to SDS, EM-92.
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.
   Seat face angle "α":
   45 deg.
   Contacting width "W": mm (in)
   Intake
   1.6 - 1.7 (0.063 - 0.067)
   Exhaust
   1.7 - 2.1 (0.067 - 0.083)

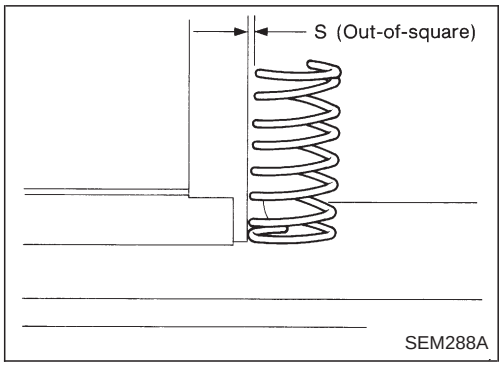


SEM188A

VALVE DIMENSIONS

Check dimensions of each valve. Refer to SDS, EM-93.
When valve head has been worn down to 0.5 mm (0.020 in) in margin thickness, replace valve.
Grinding allowance for valve stem tip is 0.2 mm (0.008 in) or less.

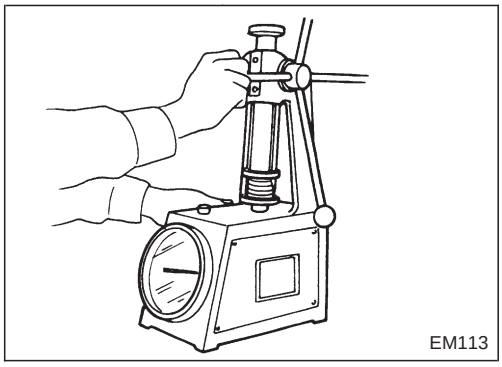
Inspection (Cont'd)



VALVE SPRING

Squareness

1. Measure dimension "S".
   Out-of-square "S": mm (in)
   Outer
   Intake Less than 2.5 (0.098)
   Exhaust Less than 2.3 (0.091)
   Inner
   Intake Less than 2.3 (0.091)
   Exhaust Less than 2.1 (0.083)
2. If it exceeds the limit, replace spring.



Pressure

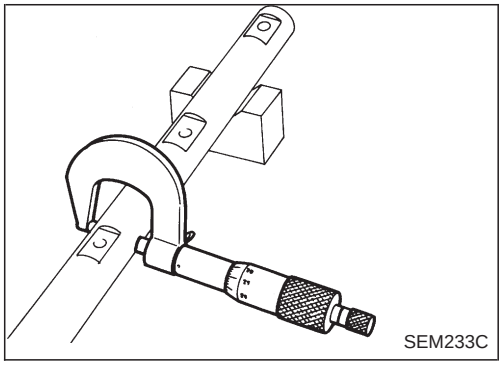
Check valve spring pressure at specified spring height.

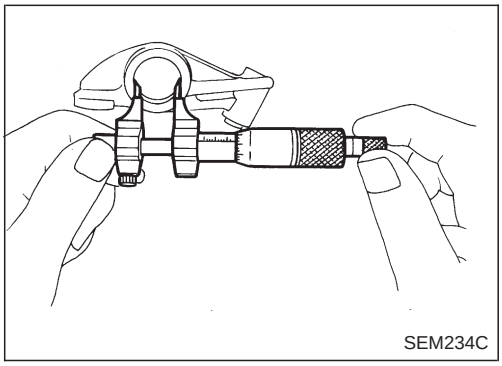
Pressure: N (kg, lb) at height mm (in)
Standard
Outer
Intake 604.1 (61.6, 135.8) at 37.6 (1.480)
Exhaust 640.4 (65.3, 144.0) at 34.1 (1.343)
Inner
Intake 284.4 (29.0, 63.9) at 32.6 (1.283)
Exhaust 328.5 (33.5, 73.9) at 29.1 (1.146)
Limit
Outer
Intake 567.8 (57.9, 127.7) at 37.6 (1.480)
Exhaust 620.8 (63.3, 139.6) at 34.1 (1.343)
Inner
Intake 266.8 (27.2, 60.0) at 32.6 (1.283)
Exhaust 318.7 (32.5, 71.7) at 29.1 (1.146)

If it exceeds the limit, replace spring.

ROCKER SHAFT AND ROCKER ARM

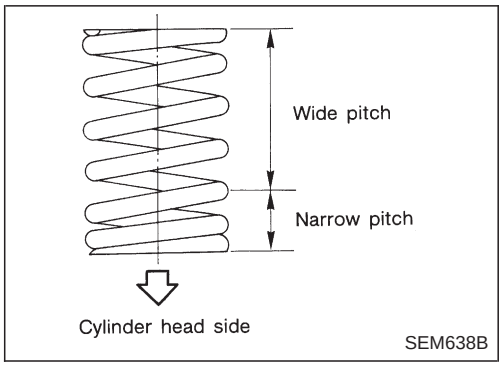
1. Check rocker shafts for scratches, seizure and wear.
2. Check outer diameter of rocker shaft.
   Diameter:
   21.979 - 22.000 mm (0.8653 - 0.8661 in)





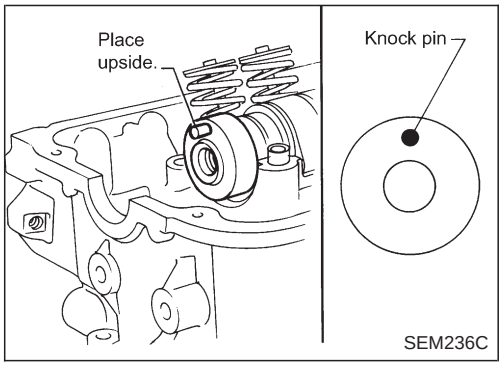
3. Check inner diameter of rocker arm.
   Diameter:
   22.012 - 22.029 mm (0.8666 - 0.8673 in)
   Rocker arm to shaft clearance:
   0.012 - 0.050 mm (0.0005 - 0.0020 in)

- **Keep rocker arm with hydraulic valve lifter standing to prevent air from entering hydraulic valve lifter when checking.**

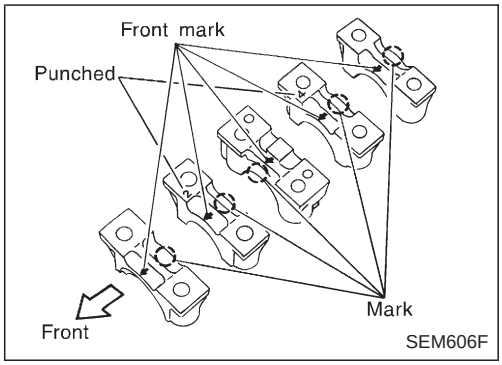


Assembly

1. Install valve component parts.
- **Always use new valve oil seal. Refer to OIL SEAL REPLACEMENT.**
- **Before installing valve oil seal, install inner valve spring seat.**
- **Install outer valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side.**
- **After installing valve component parts, use plastic hammer to lightly tap valve stem tip to assure a proper fit.**

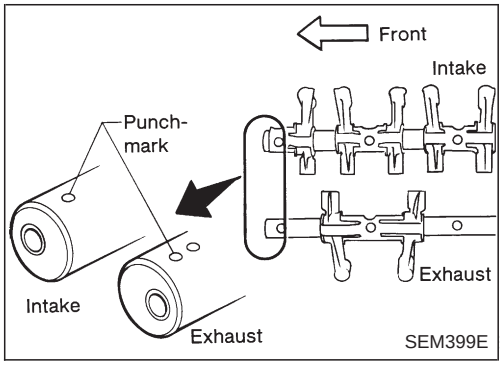


2. Install camshaft, placing knock pin towards front of engine and in the top position.
- **Apply engine oil to camshaft when mounting onto cylinder head.**

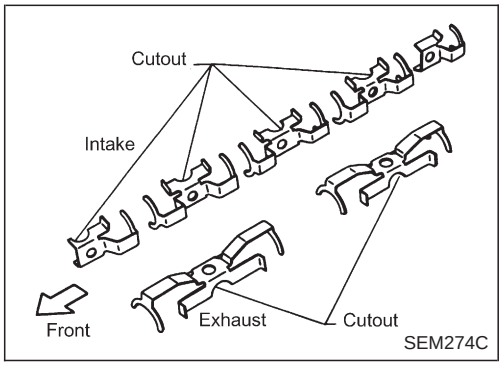


3. Install camshaft brackets.
- **Front mark is punched on the camshaft bracket.**

Location (from front side)	Identification	
	Mark	Punched
No. 1	51	—
No. 2	52	2
No. 3	53	—
No. 4	52	4
No. 5	55	—



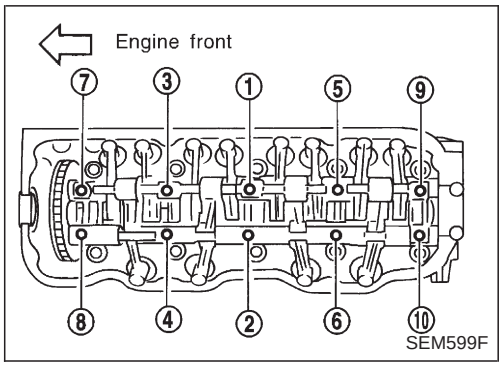
4. Install rocker shaft with rocker arms.



- Install retainer with cutout facing direction shown in figure at left.

Assembly (Cont'd)

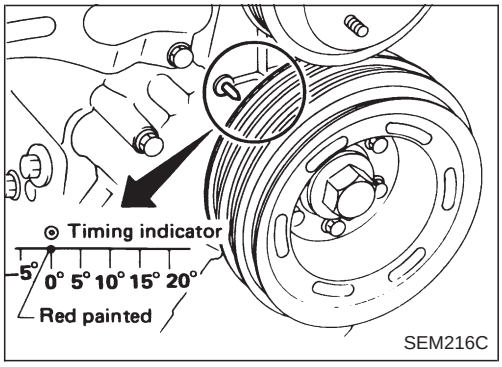
5. Tighten bolts as shown in figure at left.



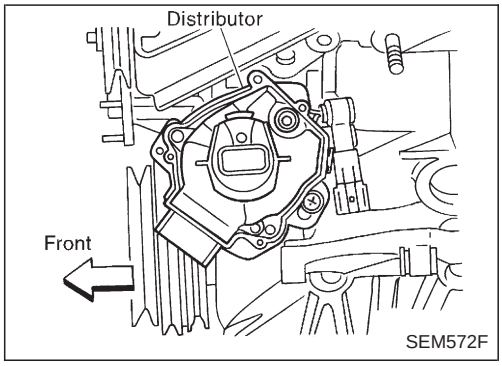
SEM599F

Installation

1. Set No. 1 piston at TDC on its compression stroke as follows:
a. Align mark on crankshaft pulley with "0°" position and confirm that distributor rotor head is set as shown in figure.

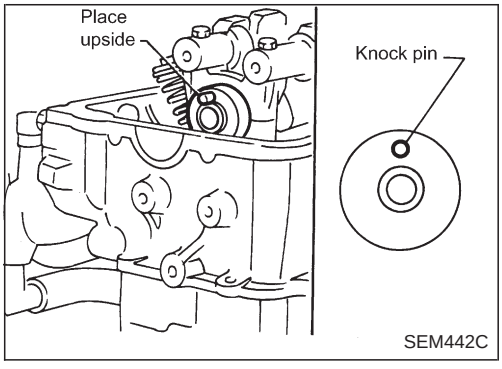


SEM216C



SEM572F

b. Confirm that knock pin on camshaft is set at the top.

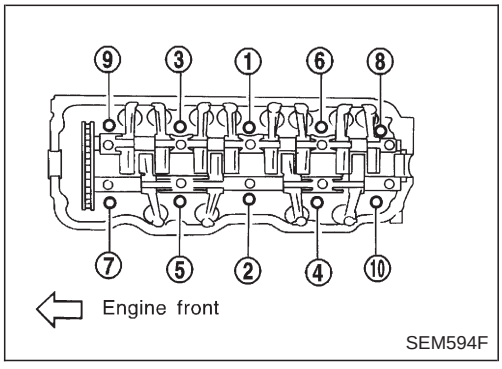


SEM442C

2. Install cylinder head with new gasket and tighten cylinder head bolts in numerical order.

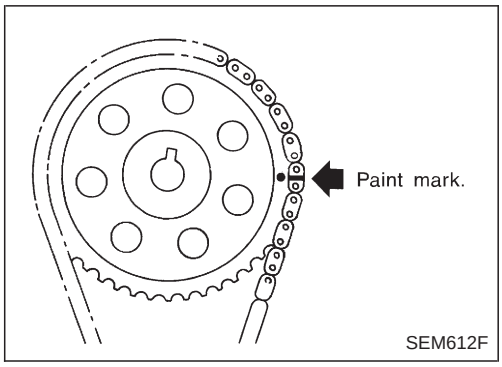
- **Do not rotate crankshaft and camshaft separately, or valves will hit piston heads.**
- **Tightening procedure**

a. Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
b. Tighten all bolts to 78 N·m (8.0 kg-m, 58 ft-lb).
c. Loosen all bolts completely.
d. Tighten all bolts to 25 to 34 N·m (2.5 to 3.5 kg-m, 18 to 25 ft-lb).
e. Turn all bolts 80^{+5}_{-0} degrees clockwise with an angle wrench. If an angle wrench is not available, tighten all bolts to 74 to 83 N·m (7.5 to 8.5 kg-m, 54 to 61 ft-lb).

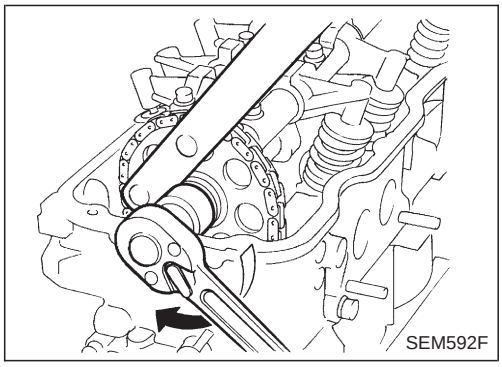


SEM594F

Installation (Cont'd)

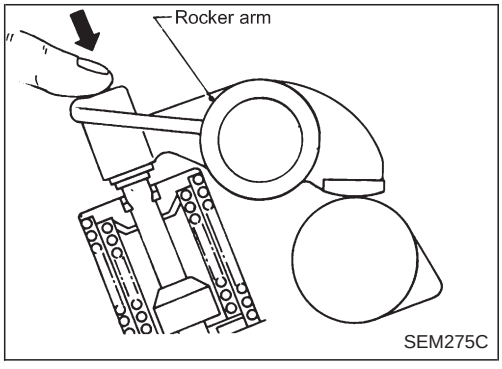


3. Set chain on camshaft sprocket by aligning each mating mark. Then install camshaft sprocket to camshaft.



4. Tighten camshaft sprocket bolt.

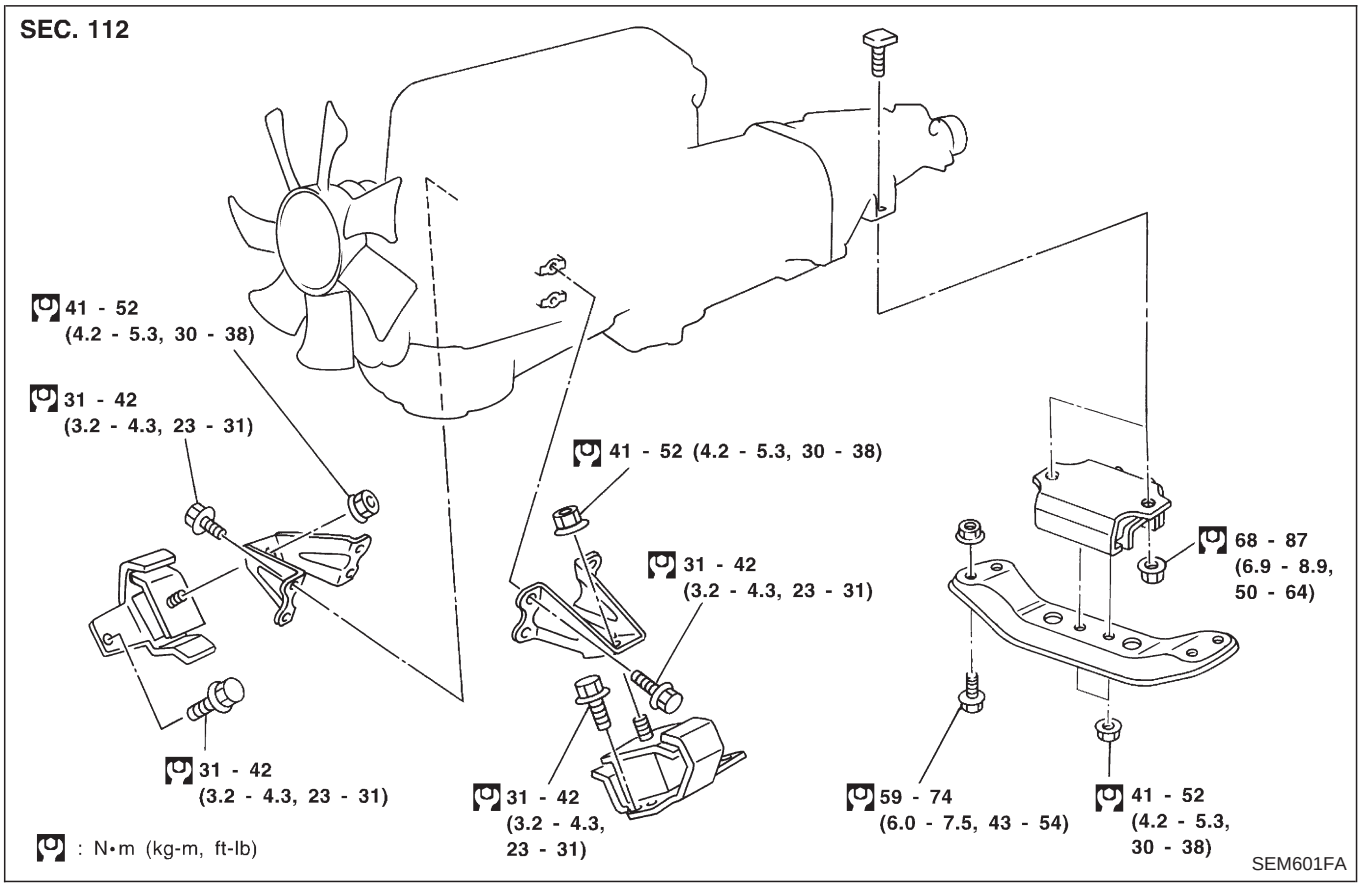
5. Install rubber plugs. Refer to TIMING CHAIN, EM-21.



6. Check hydraulic valve lifter.
a. Push hydraulic valve lifter forcefully with your finger.
- **Be sure to check it with rocker arm in its free position.**

b. If valve lifter moves more than 1 mm (0.04 in), air may be inside of it.
c. Bleed air off by running engine at 1,000 rpm under no-load for about 20 minutes.
d. If hydraulic valve lifters are still noisy, replace them and bleed air off again in the same manner as in step c.
7. Install rocker cover. Refer to TIMING CHAIN, EM-21.
- **Be sure to avoid interference between rocker cover and rocker arm.**

8. Install intake and exhaust manifolds. Refer to ''OUTER COMPONENT PARTS'', EM-9.

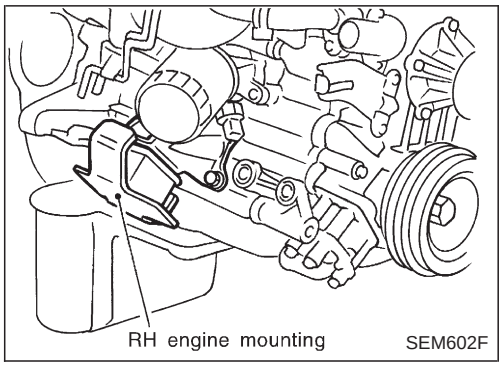


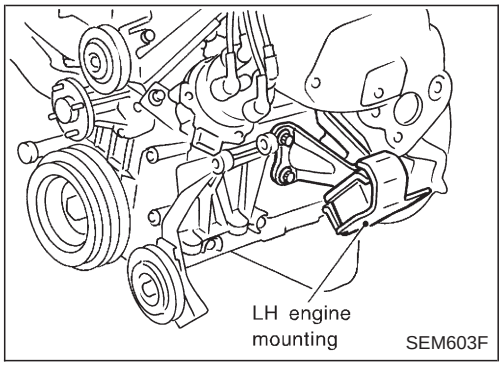
WARNING:

- **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 fuel pressure. Refer to EC section (''Fuel Pressure Release'').**
- **Be sure to hoist engine and transmission in a safe manner.**
- **For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.**

CAUTION:

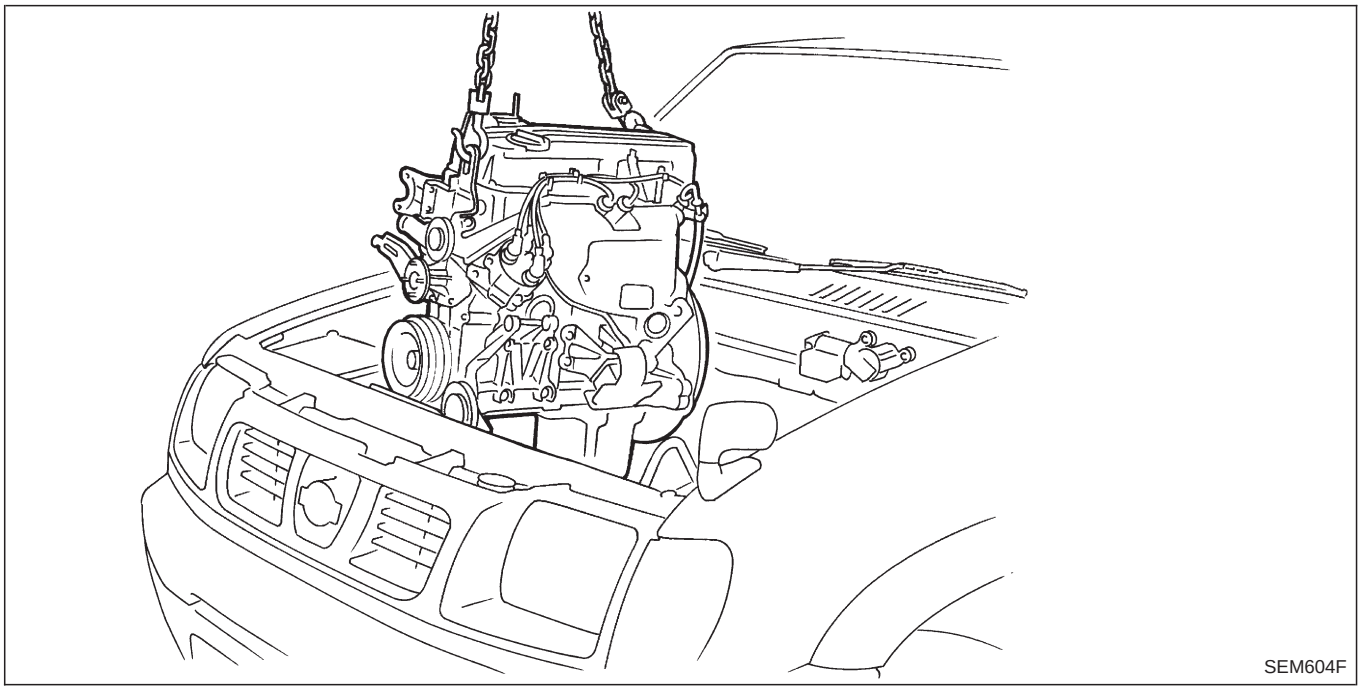
- **When lifting engine, be sure to clear surrounding parts. Take special care near accelerator wire casing, brake lines and brake master cylinder.**
- **In lifting the engine, always use engine slingers in a safe manner.**
- **For 4WD models, apply sealant between engine and transmission. Refer to MT section (''Removal and Installation'').**





Removal

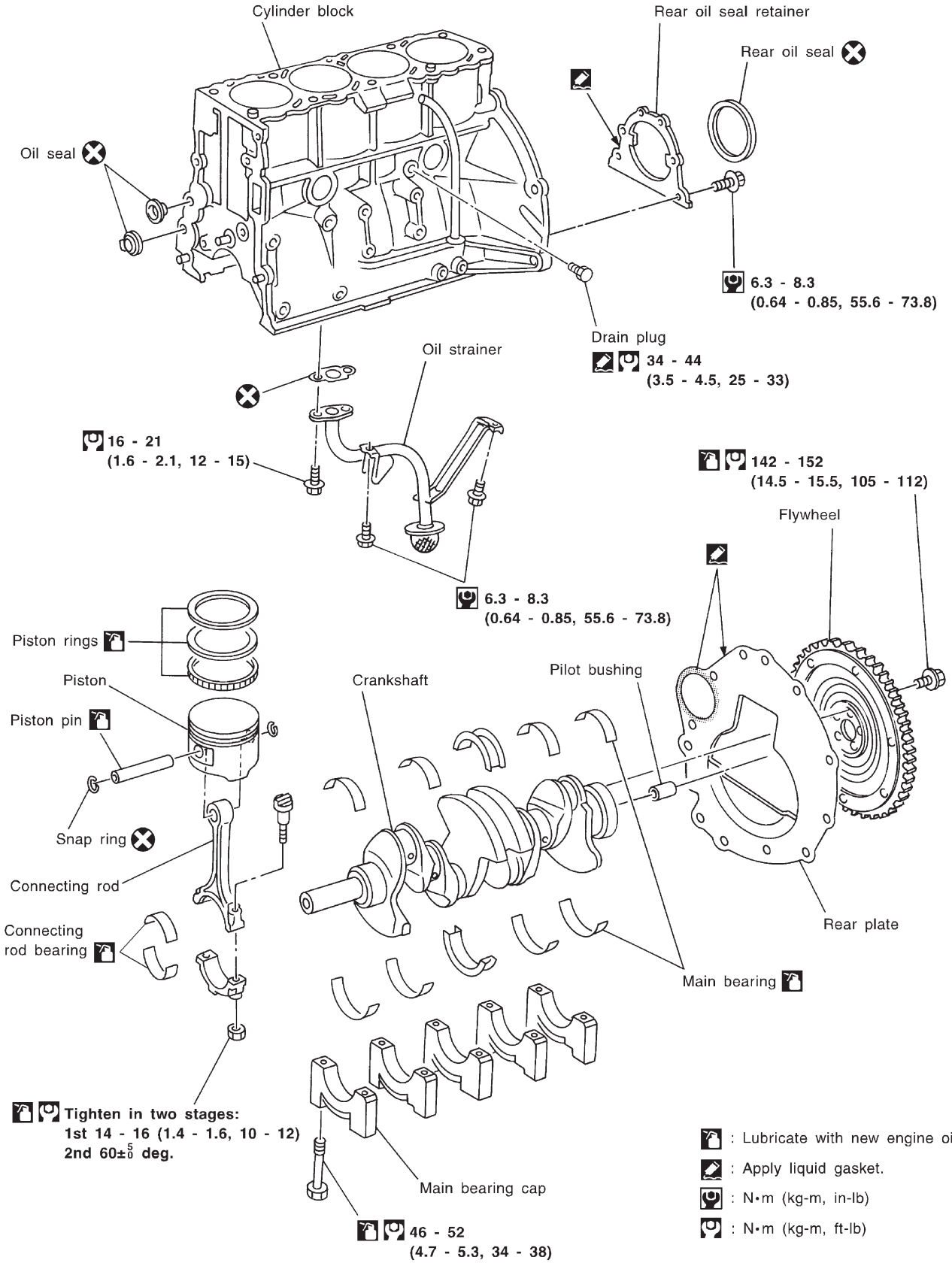
1. Drain coolant from engine block and radiator. Refer to MA section (“Changing Engine Coolant”, “ENGINE MAINTENANCE”).
2. Release fuel pressure. Refer to EC section (“Fuel Pressure Release”).
3. Remove negative battery cable.
4. Remove hood. Refer to BT section.
5. Remove power steering drive belt, alternator drive belt and A/C compressor drive belt.
6. Remove radiator. Refer to LC section (“Radiator”, “ENGINE COOLING SYSTEM”).
7. Remove exhaust manifold heat shield.
8. Disconnect exhaust system from exhaust manifold.
9. Discharge refrigerant. Refer to HA section (“R-134a Service Procedure”, “SERVICE PROCEDURES”).
10. Disconnect refrigerant lines. Refer to HA section (“Refrigerant Lines”, “SERVICE PROCEDURES”).
11. Disconnect accelerator wire, vacuum hoses, electrical connectors, heater hoses and vacuum booster hose.
12. Remove four power steering pump bolts.
13. Remove transmission. Refer to MT section (“Removal”, “REMOVAL AND INSTALLATION”).
14. Remove LH and RH engine mounts.
15. Remove engine.



Installation

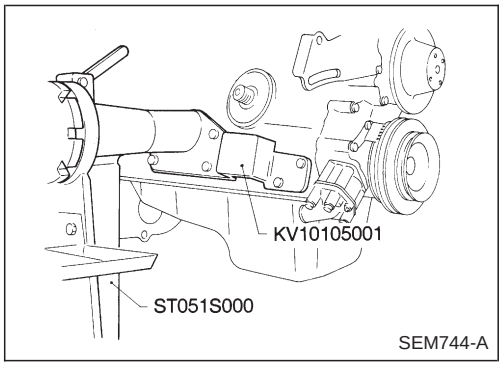
- Install in reverse order of removal.

SEC. 110•120•135•150•210



SEM812F

CAUTION:
- **When installing sliding parts (bearings, pistons, etc.), lubricate contacting surfaces with new engine oil.**
- **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 ring gear teeth of flywheel or drive plate.**

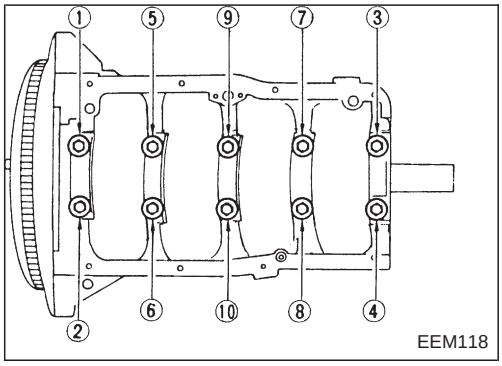


SEM744-A

Disassembly

PISTON AND CRANKSHAFT

1. Remove intake manifold.
2. Place engine on a work stand.
3. Drain coolant and oil.
4. Remove oil pan.
5. Remove water pump.
6. Remove timing chain.
7. Remove cylinder head.
8. Remove pistons with connecting rod.



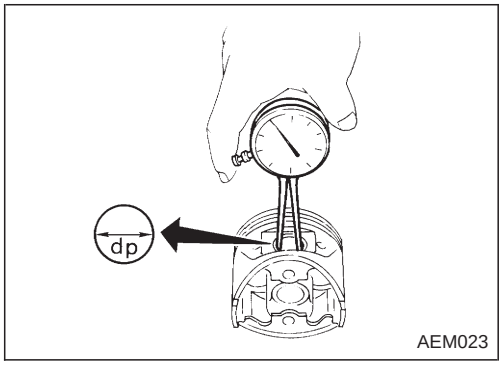
EEM118

9. Remove bearing caps and crankshaft.
- **Before removing bearing caps, measure crankshaft end play. Refer to EM-47.**
- **Bolts should be loosened in two or three steps.**

Inspection

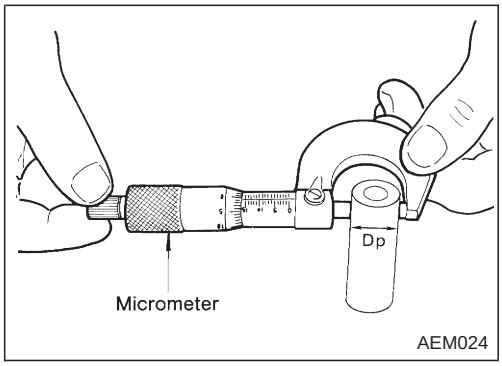
PISTON AND PISTON PIN CLEARANCE

1. Measure inner diameter of piston pin hole ‘‘dp’’.
   Standard diameter ‘‘dp’’:
   21.002 - 21.008 mm (0.8268 - 0.8271 in)



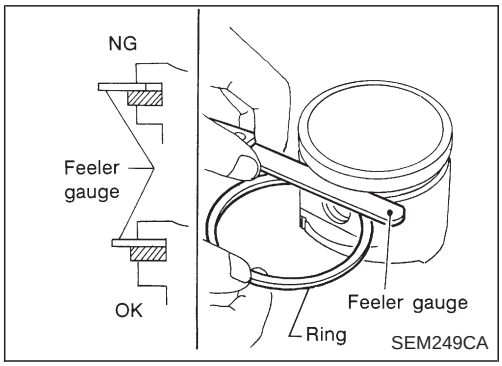
AEM023

2. Measure outer diameter of piston pin ‘‘Dp’’.
   Standard diameter ‘‘Dp’’:
   20.993 - 20.998 mm (0.8265 - 0.8267 in)
3. Calculate piston pin clearance.
   dp − Dp = 0.008 - 0.012 mm (0.0003 - 0.0005 in)
   If it exceeds the above value, replace piston assembly with pin.



AEM024

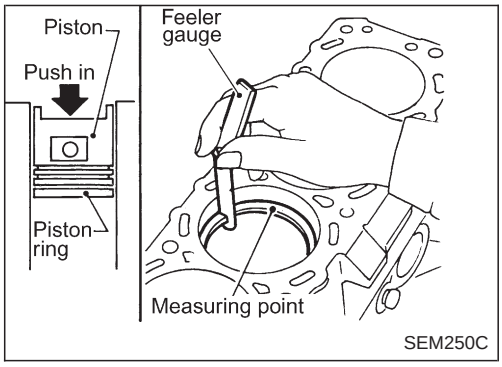
Inspection (Cont'd)



PISTON RING SIDE CLEARANCE

Side clearance: mm (in)
Top ring 0.01 - 0.03 (0.0004 - 0.0012)
2nd ring 0.03 - 0.07 (0.0012 - 0.0028)
Oil ring 0.085 - 0.115 (0.0033 - 0.0045)
Max. limit of side clearance:
0.1 mm (0.004 in)

If out of specification, replace piston ring.
If clearance exceeds maximum limit with new ring, replace piston.

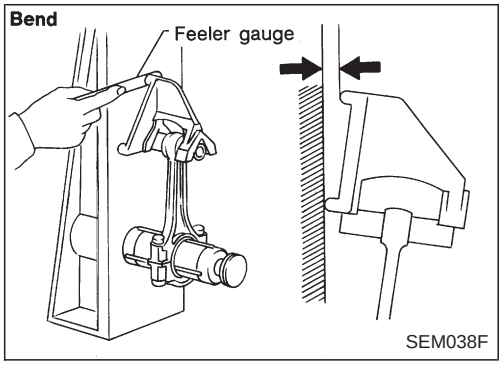


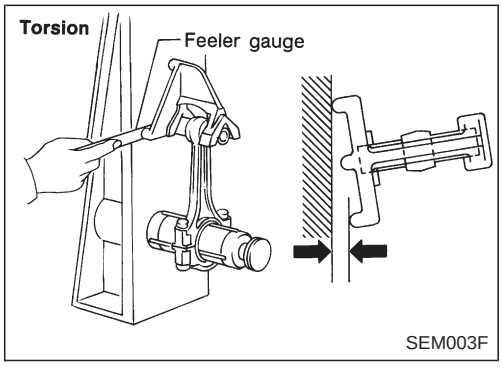
PISTON RING END GAP

End gap: mm (in)
Top ring
0.28 - 0.43 (0.0110 - 0.0169)
2nd ring
0.45 - 0.60 (0.0177 - 0.0236)
(R or T is punched on the ring.)
0.55 - 0.70 (0.0217 - 0.0276)
(N is punched on the ring.)
Oil ring
0.20 - 0.60 (0.0079 - 0.0236)
Max. limit of ring gap:
0.5 mm (0.020 in)

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 SDS, EM-95.

- When replacing the piston, check cylinder block surface for scratches or seizure. If scratches or seizure are found, hone or replace the cylinder block.



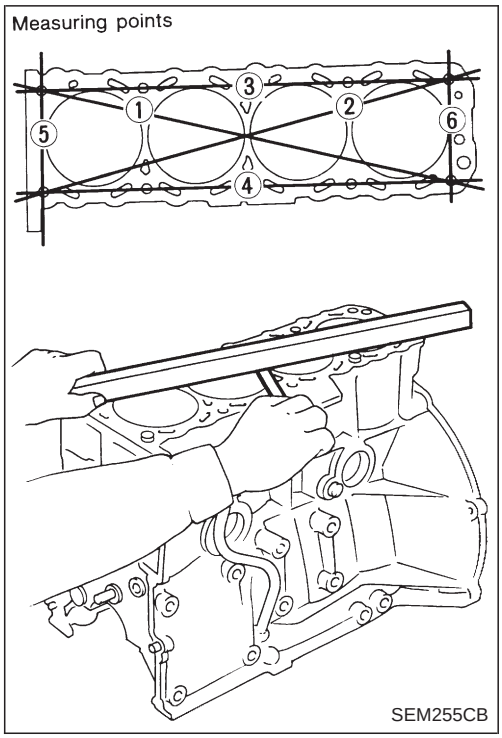


CONNECTING ROD BEND AND TORSION

Bend: mm (in)
Limit 0.15 (0.0059) per 100 (3.94) length
Torsion: mm (in)
Limit 0.3 (0.012) per 100 (3.94) length

If it exceeds the limit, replace connecting rod assembly.

Inspection (Cont'd)

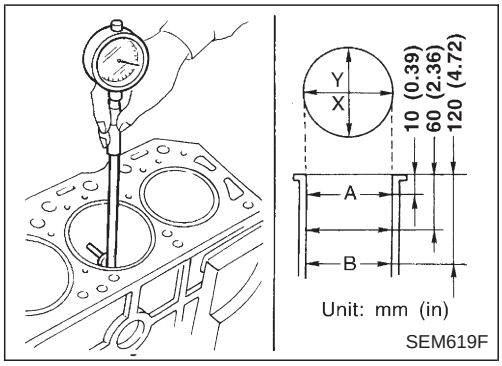


CYLINDER BLOCK DISTORTION AND WEAR

1. Clean upper face 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.
   Limit:
   0.1 mm (0.004 in)
2. If out of specification, resurface it.
   The limit for cylinder block resurfacing is determined by cylinder head resurfacing.

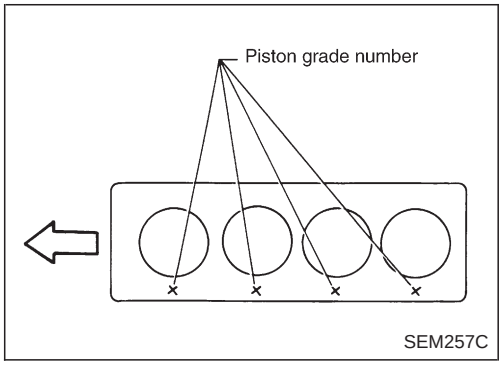
Amount of cylinder head resurfacing is ''A''
Amount of cylinder block resurfacing is ''B''
The maximum limit is as follows:
A + B = 0.2 mm (0.008 in)
Nominal cylinder block height from crankshaft center:
246.95 - 247.05 mm (9.7224 - 9.7264 in)

3. If necessary, replace cylinder block.

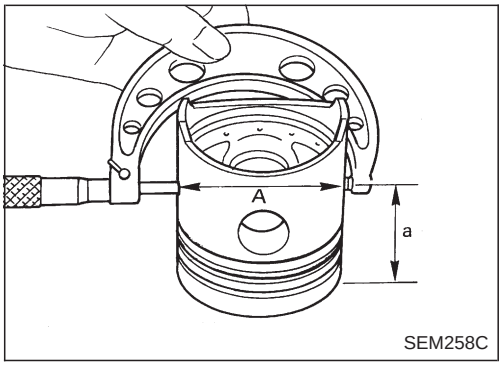


PISTON-TO-BORE CLEARANCE

1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper.
   Standard inner diameter:
   Refer to SDS, EM-91.
   Wear limit: 0.2 mm (0.008 in)
   Out-of-round (X − Y) standard: 0.015 mm (0.0006 in)
   Taper (A − B) standard: 0.010 mm (0.0004 in)
   If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.
2. Check for scratches and seizure. If seizure is found, hone it.



- **If cylinder block and piston are replaced, match piston grade with grade number on cylinder block upper surface.**



3. Measure piston skirt diameter.
   Piston diameter ''A'':
   Refer to SDS, EM-95.
   Measuring point ''a'' (Distance from the top):
   Approximately 52 mm (2.05 in)
4. Check that piston-to-bore clearance is within specification.
   Piston-to-bore clearance ''B'':
   0.020 - 0.040 mm (0.0008 - 0.0016 in)
5. Determine piston oversize according to amount of cylinder wear.

Oversize pistons are available for service. Refer to SDS, EM-95.

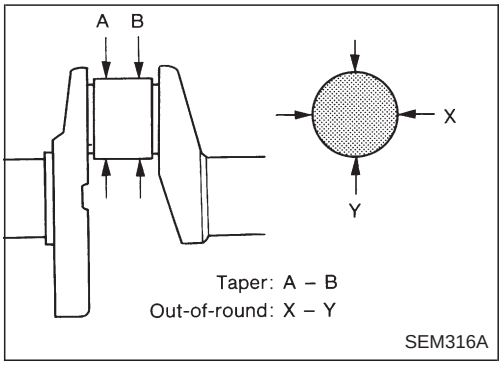
Inspection (Cont'd)

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.

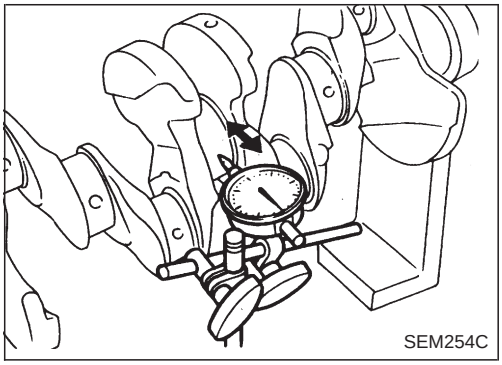
- **When any cylinder needs boring, all other cylinders must also be bored.**
- **Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so at a time.**

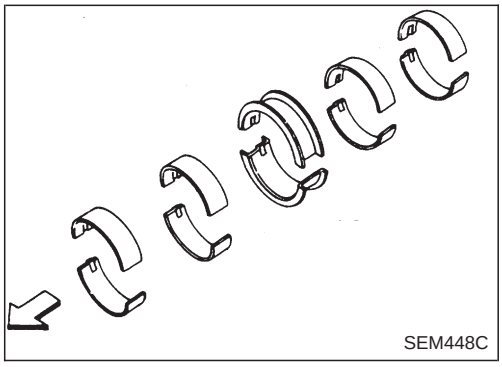
9. Hone cylinders to obtain specified piston-to-bore clearance.
10. Measure finished cylinder bore for out-of-round and taper.

- **Measurement should be done after cylinder bore cools down.**



SEM316A


SEM254C


SEM448C

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 (X − Y): mm (in)
   Main journal Less than 0.01 (0.0004)
   Crank pin Less than 0.005 (0.0002)
   Taper (A − B): mm (in)
   Main journal Less than 0.01 (0.0004)
   Crank pin Less than 0.005 (0.0002)
3. Measure crankshaft runout.
   Runout (Total indicator reading):
   Less than 0.10 mm (0.0039 in)

BEARING CLEARANCE

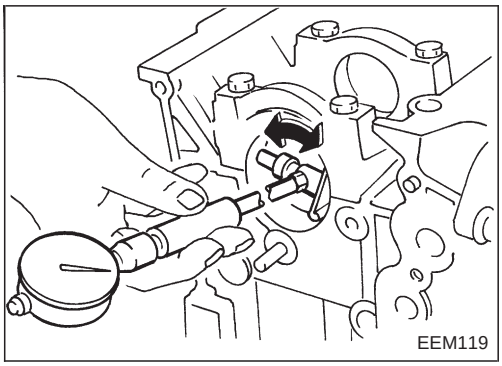
- Use Method A or Method B. Method A is preferred because it is more accurate.

Method A (Using bore gauge and micrometer)

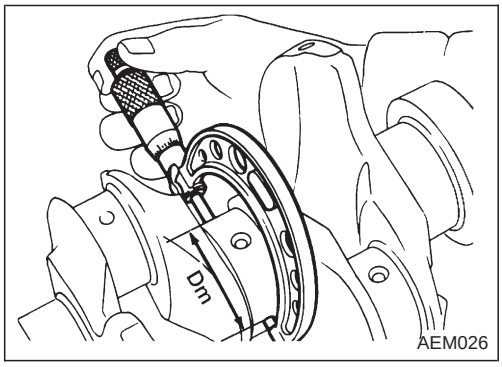
Main bearing

1. Set main bearings in their proper positions on cylinder block and main bearing cap.

Inspection (Cont'd)

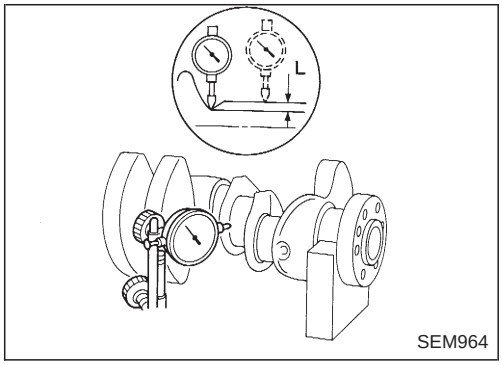

EEM119

2. Install main bearing cap to cylinder block.
- **Tighten all bolts in correct order in two or three stages.**
3. Measure inner diameter ''A'' of each main bearing.



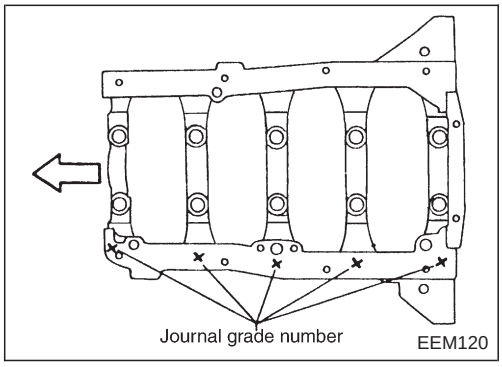
AEM026

4. Measure outer diameter ''Dm'' of each crankshaft main journal.
5. Calculate main bearing clearance.
   Main bearing clearance = A − Dm
   Standard:
   0.020 - 0.047 mm (0.0008 - 0.0019 in)
   Limit:
   0.1 mm (0.004 in)
6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.



SEM964

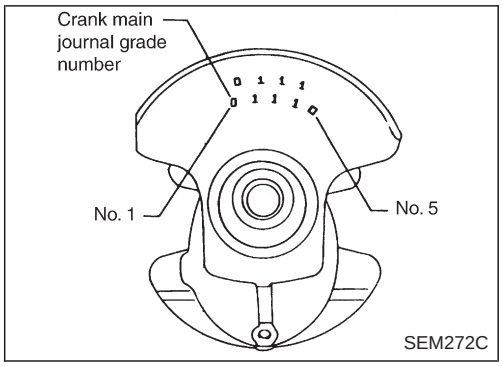
a. When grinding crankshaft journal, confirm that ''L'' dimension in fillet roll is more than the specified limit.
   ''L'': 0.1 mm (0.004 in)
b. Refer to SDS for grinding crankshaft and available service parts.



EEM120

8. If crankshaft is reused, measure main bearing clearance and select thickness of main bearing.
   If crankshaft or cylinder block 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.

Inspection (Cont'd)

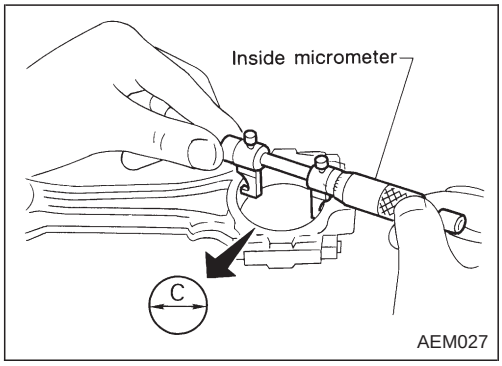


b. Grade number of each crankshaft main journal is punched on crankshaft. These numbers are punched in either Arabic or Roman numerals.
c. Select main bearing with suitable thickness according to the following example or table.

For example:
Main journal grade number: 1
Crankshaft journal grade number: 2
Main bearing grade number = 1 + 2
= 3 (Yellow)

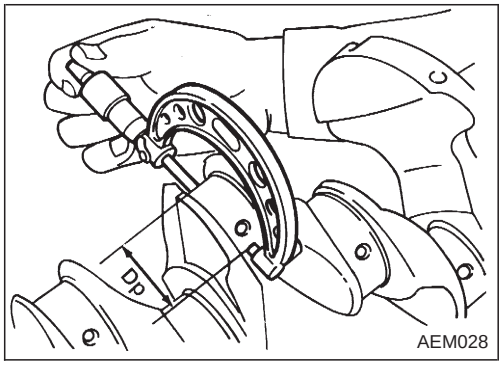
Main bearing grade number and identification color:

		Main journal grade number		
		0	1	2
Crankshaft journal grade number	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)



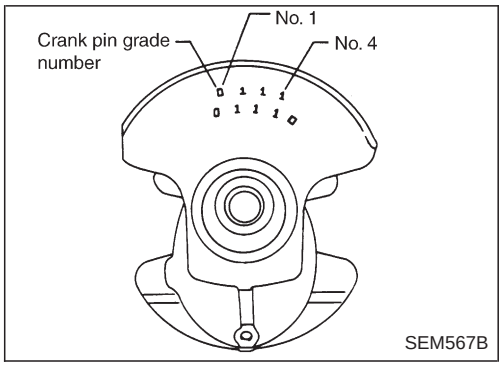
Connecting rod bearing (Big end)

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: mm (in)
Standard
0.010 - 0.035 (0.0004 - 0.0014)
Limit
0.09 (0.0035)
6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing. Refer to step 7 of ''BEARING CLEARANCE — Main bearing''.

Inspection (Cont'd)

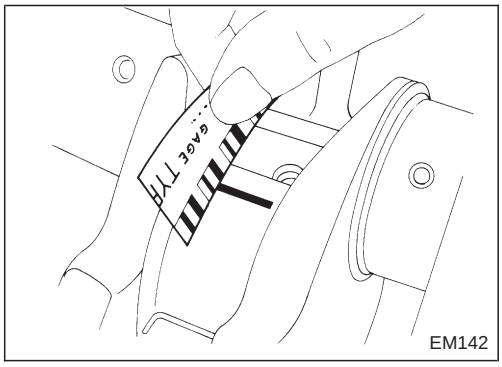


8. If crankshaft is replaced, select connecting rod bearing according to the following table.

Connecting rod bearing grade number:

These numbers are punched in either Arabic or Roman numerals.

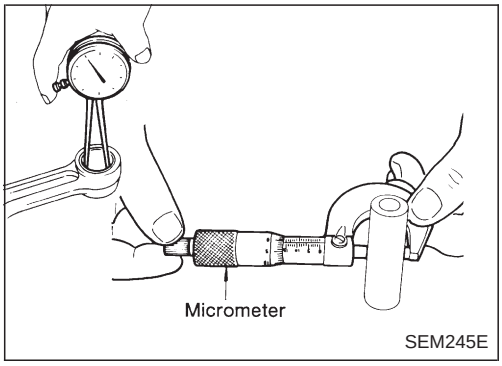
Crank pin grade number	Connecting rod bearing grade number
0	0
1 or I	1
2 or II	2



Method B (Using plastigage)

CAUTION:

- **Do not turn crankshaft or connecting rod while plastigage is being inserted.**
- **When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. Then if excessive bearing clearance exists, use a thicker main bearing or undersized bearing so that the specified bearing clearance is obtained.**



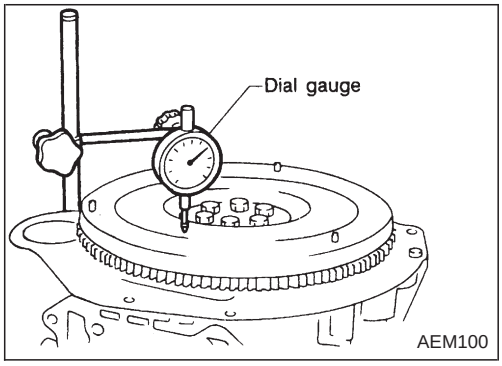
CONNECTING ROD BUSHING CLEARANCE (Small end)

1. Measure inner diameter "C" of bushing.
2. Measure outer diameter "Dp" of piston pin.
3. Calculate connecting rod bushing clearance.

C − Dp =

−0.015 to −0.033 mm (−0.0006 to −0.0013 in) (Standard)

If out of specification, replace connecting rod assembly and/or piston set with pin.



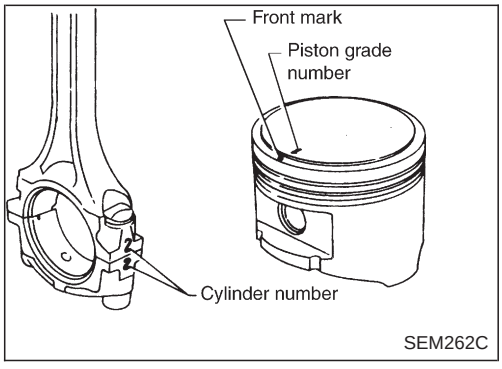
FLYWHEEL RUNOUT

Runout (Total indicator reading):

Flywheel Less than 0.1 mm (0.004 in)

CAUTION:

Do not allow any magnetic materials to contact the ring gear teeth.



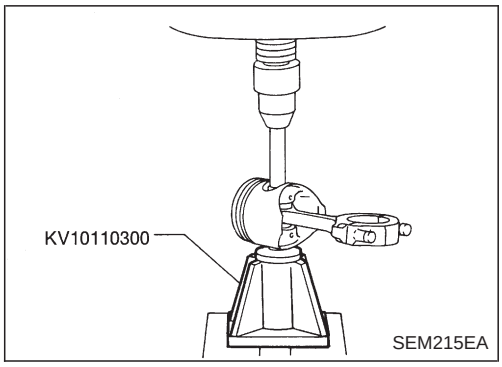
Assembly

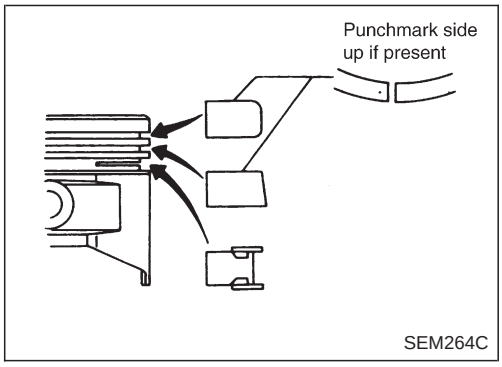
PISTON

1. Heat piston to 60 to 70°C (140 to 158°F) and assemble piston, piston pin and connecting rod.

- **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.**

Assembly (Cont'd)

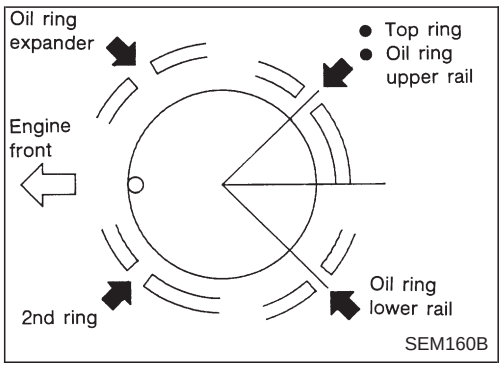




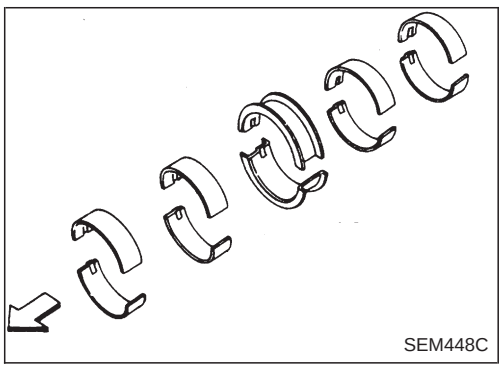
2. Set piston rings as shown.

CAUTION:

- **When piston rings are not replaced, make sure that piston rings are mounted in their original positions.**
- **When piston rings are being replaced and no punchmark is present, piston rings can be mounted with either side up.**



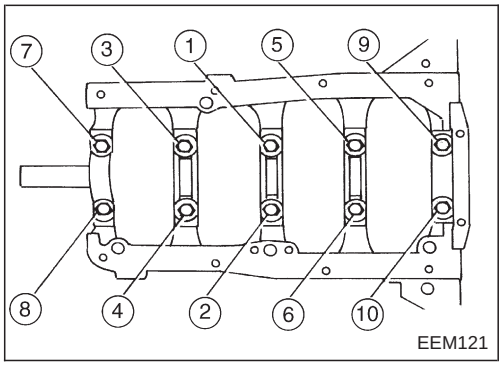
3. Align piston rings so that end gaps are positioned as shown.



CRANKSHAFT

1. Set main bearings in their proper positions on cylinder block and main bearing caps.

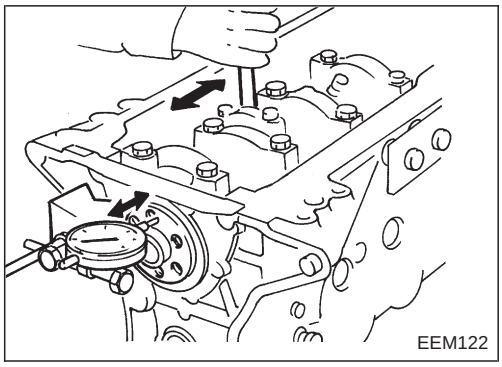
- **Confirm that correct main bearings are used. Refer to EM-42.**
- **Apply new engine oil to bearing surfaces.**



2. Install crankshaft and main bearing caps and tighten bolts to the specified torque.

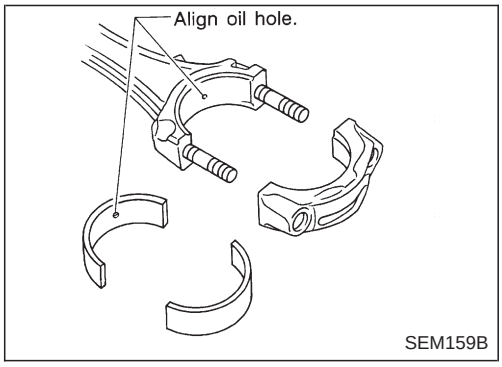
- **Apply new engine oil to the bolt threads and seat surface.**
- **Prior to tightening bearing cap bolts, place bearing cap in its proper position by shifting crankshaft in the axial direction.**
- **Tighten bearing cap bolts gradually in two or three stages. Start with center bearing and move outward as shown in figure.**
- **After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.**

Assembly (Cont'd)


EEM122

3. Measure crankshaft end play.
   Crankshaft end play: mm (in)
   Standard
   0.05 - 0.18 (0.0020 - 0.0071)
   Limit
   0.3 (0.012)

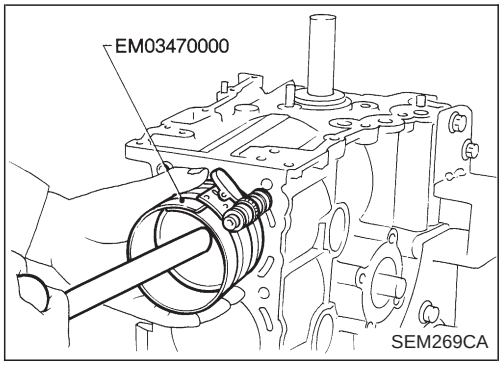
If beyond the limit, replace bearing with a new one.



SEM159B

4. Install connecting rod bearings in connecting rods and connecting rod caps.

- **Confirm that correct bearings are used. Refer to EM-45.**
- **Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.**
- **Apply new engine oil to bearing surfaces, bolt threads and seating surfaces.**

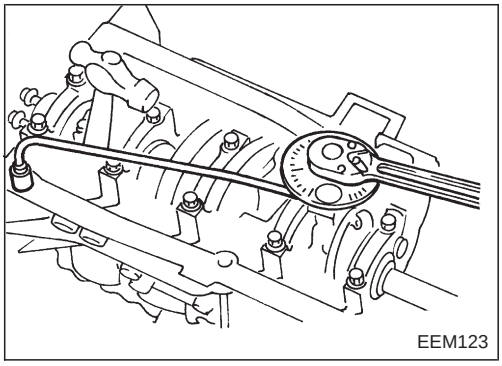


SEM269CA

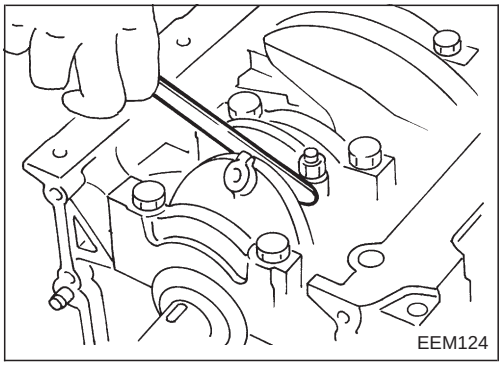
5. Install pistons with connecting rods.

a. Install them into corresponding cylinders with Tool.

- **Arrange so that front mark on piston head faces toward front of engine.**
- **Make sure connecting rod does not scratch cylinder wall.**
- **Make sure connecting rod bolts do not scratch crankshaft journals.**
- **Apply new engine oil to piston rings and sliding surface of piston.**


EEM123

b. Install connecting rod bearing caps.
   Tighten connecting rod bearing cap nuts using the following procedure.
   Connecting rod bearing nut:
   (1) Tighten to 14 to 16 N·m (1.4 to 1.6 kg-m, 10 to 12 ft-lb).
   (2) Tighten bolts 60^{+5}_{-0} degrees clockwise with an angle wrench.
   If an angle wrench is not available, tighten them to 38 to 44 N·m (3.9 to 4.5 kg-m, 28 to 33 ft-lb).

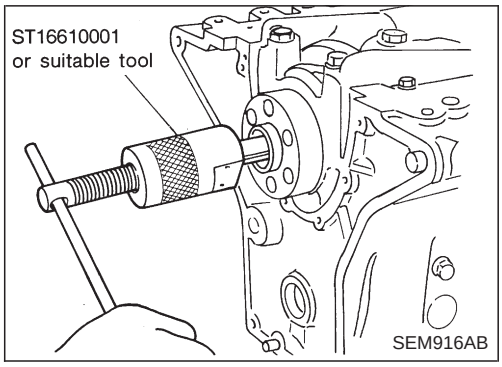

EEM124

6. Measure connecting rod side clearance.
   Connecting rod side clearance: mm (in)
   Standard
   0.2 - 0.4 (0.008 - 0.016)
   Limit
   0.6 (0.024)

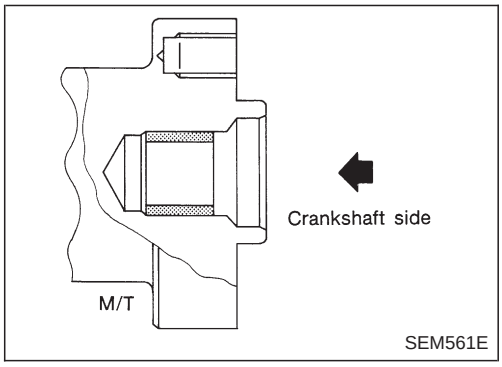
If beyond the limit, replace connecting rod and/or crankshaft.

Assembly (Cont'd)

REPLACING PILOT BUSHING

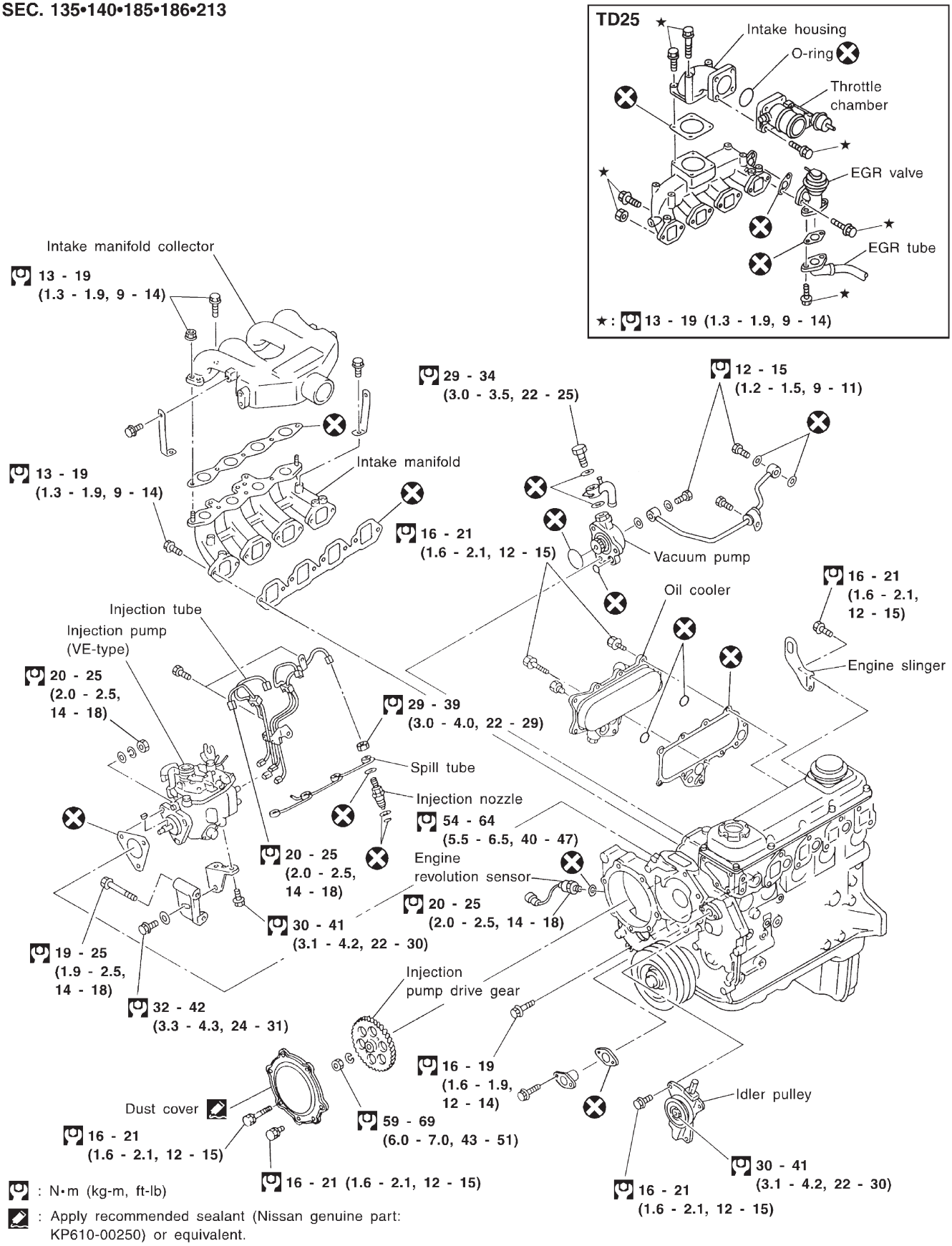


1. Remove pilot bushing.



2. Install pilot bushing.

SEC. 135•140•185•186•213

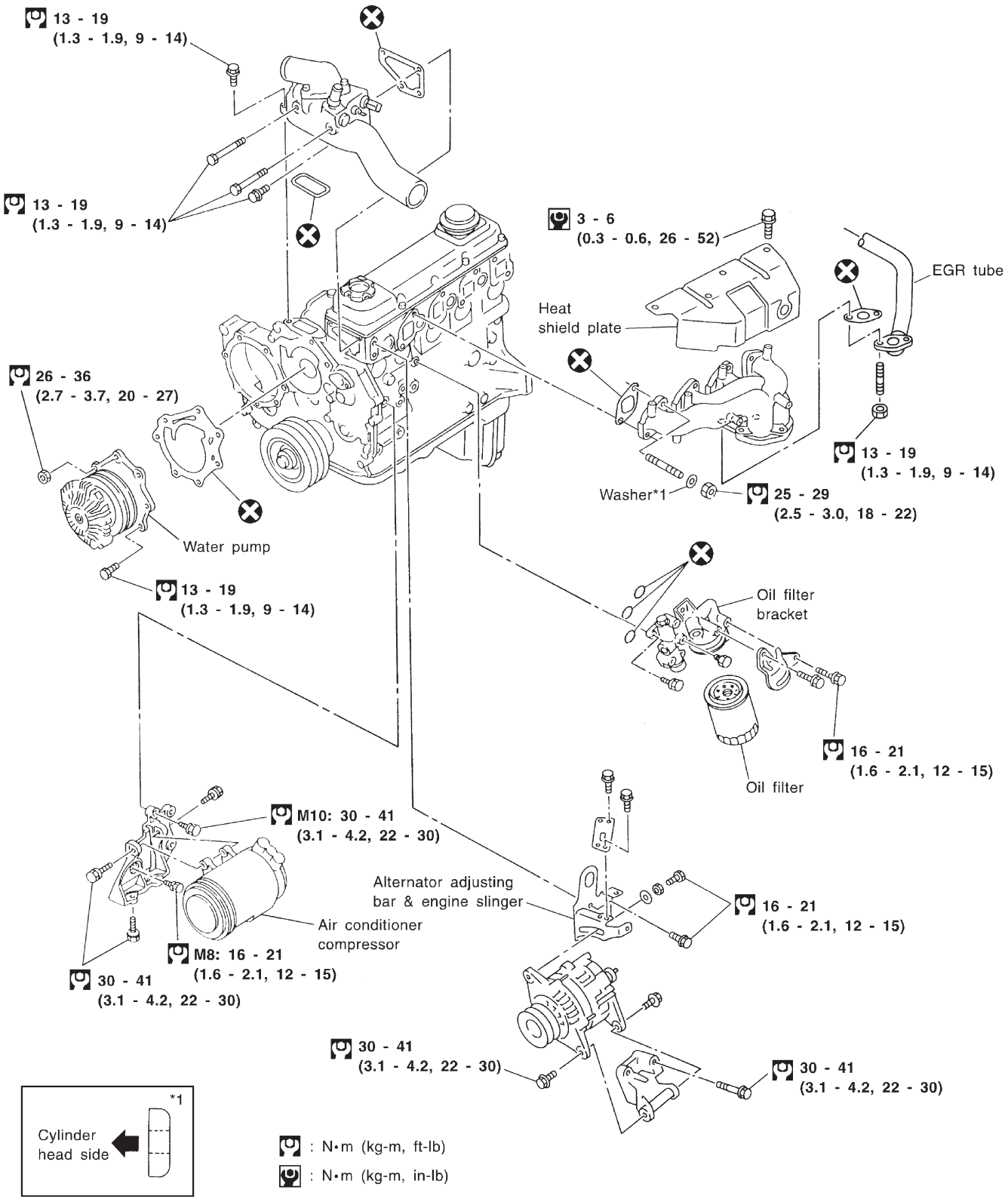


: N•m (kg-m, ft-lb)

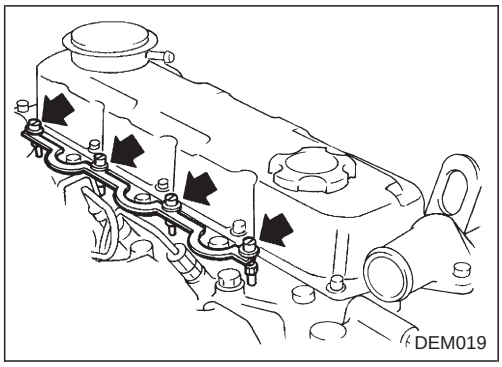
: Apply recommended sealant (Nissan genuine part: KP610-00250) or equivalent.

DEM105N

SEC. 140•150•208•230•275

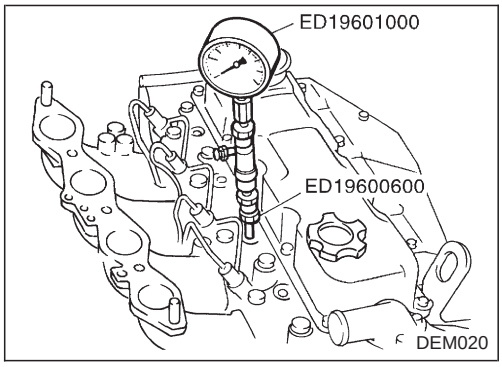


DEM106N

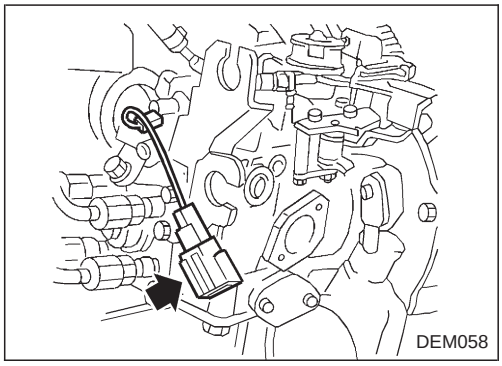


Measurement of Compression Pressure

1. Warm up engine.
2. Stop engine. Remove glow plate and glow plugs.



3. Fit compression gauge adapter to cylinder head.
   Compression gauge adapter:
   : 15 - 20 N·m (1.5 - 2.0 kg-m, 11 - 14 ft-lb)



4. Disconnect fuel cut solenoid wire connector.
5. Crank engine, then read gauge indication.

- **Engine compression measurement should be made as quickly as possible.**

Compression pressure:

Unit: kPa (bar, kg/cm^2, psi)/200 rpm

Standard	2,942 (29.4, 30, 427)
Minimum	2,452 (24.5, 25, 356)
Differential limit between cylinders	294 (2.9, 3, 43)

6. If cylinder compression in one or more cylinders is low, pour a small quantity of engine oil into cylinders through the glow holes and retest compression.

- **If adding oil helps the compression pressure, chances are that piston rings are worn or damaged.**
- **If pressure stays low, valve may be sticking or seating improperly.**
- **If cylinder compression in any two adjacent cylinders is low, and if adding oil does not help the compression, there is leakage past the gasketed surface.**
  Oil and water in combustion chambers can result from this problem.

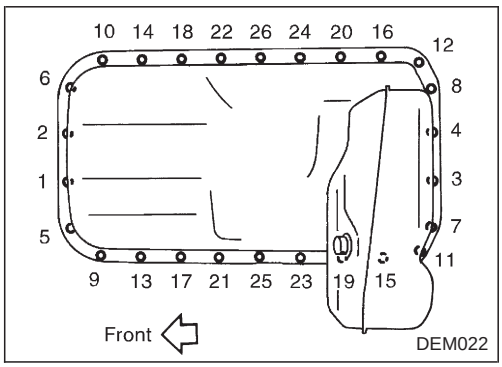
Removal

Removal order and points		Applied model	
		2WD	4WD
1	Remove undercover.	○	○
2	Drain engine oil.	○	○
3	Remove front propeller shaft from front differential carrier.	—	○
4	Remove front drive shaft fixing bolts (RH & LH).	—	○
5	Remove front suspension crossmember.	○	○
6	Remove differential front mounting bolts (RH & LH) and rear mounting bolts.	—	○
7	Remove front differential carrier.	—	○

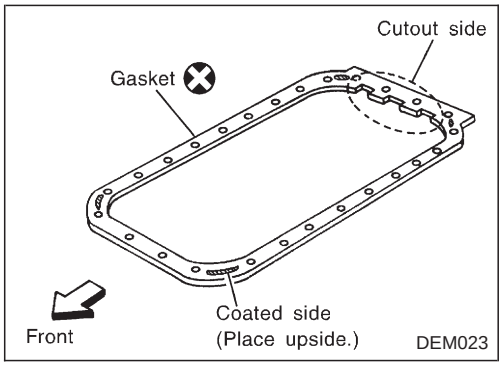
Removal order and points		Applied model	
		2WD	4WD
8	Remove front differential carrier mounting bracket.	—	○
9	Remove transmission to rear engine mounting bracket nuts (RH & LH).	○	○
10	Remove engine mounting bolts or nuts (RH & LH).	○	○
11	Lift up engine. If necessary, disconnect exhaust tube.	○	○
12	Remove oil pan.	○	○

WARNING:
- **Place vehicle on a flat and solid surface.**
- **Place chocks at front and rear of rear wheels.**
- **You should not remove oil pan until exhaust system and cooling system have completely cooled off.**
  Otherwise, you may burn yourself and/or fire may break out in the fuel line.
- **When removing front and/or rear engine mounting bolts or nuts, lift up slightly engine for safety work.**

CAUTION:
- **In lifting engine, be careful not to hit against adjacent parts, especially against accelerator wire casing end, brake tube and brake master cylinder.**
- **For tightening torque, refer to EM-71, MT and PD sections.**



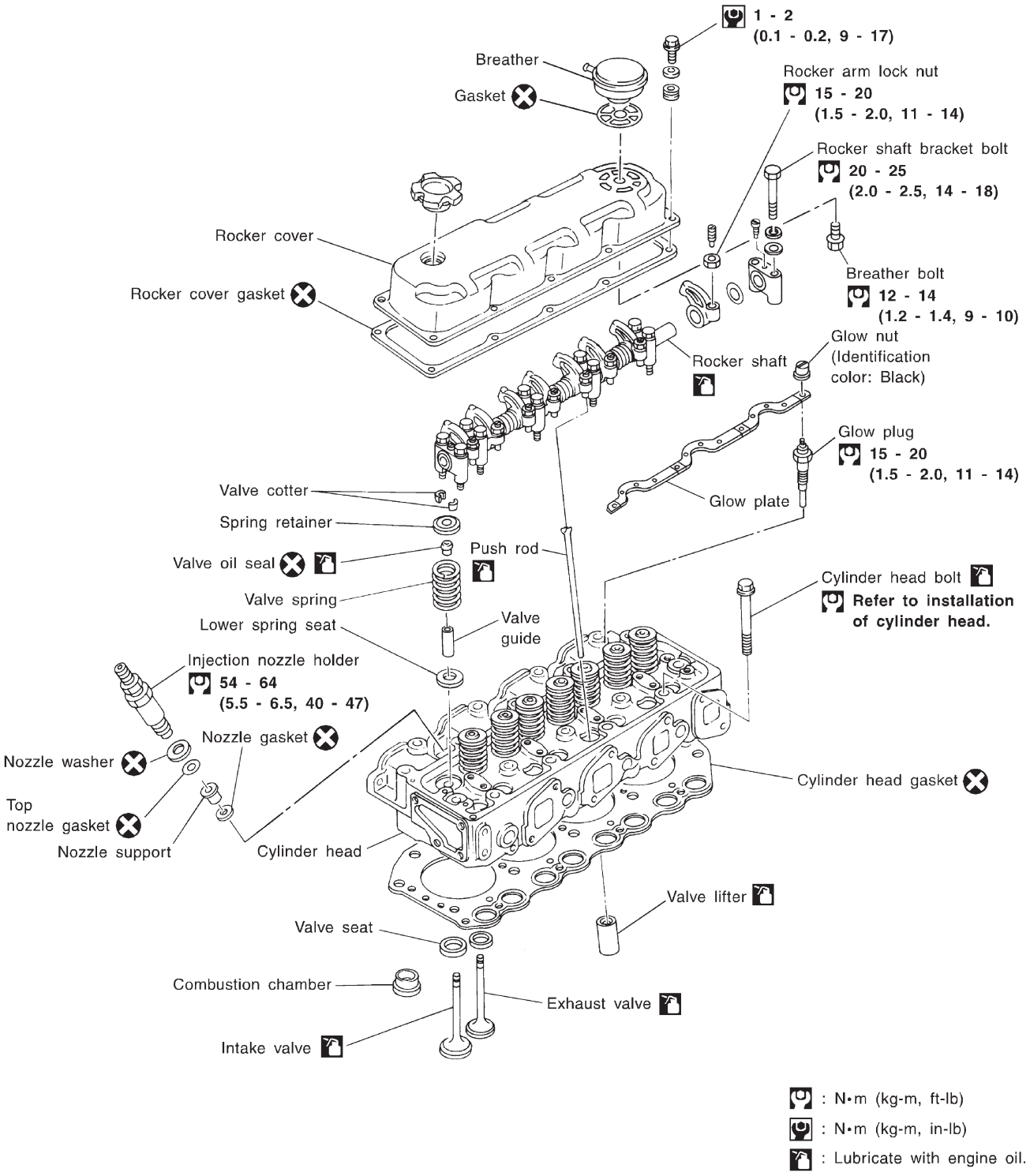
Remove oil pan bolts in order shown.



Installation

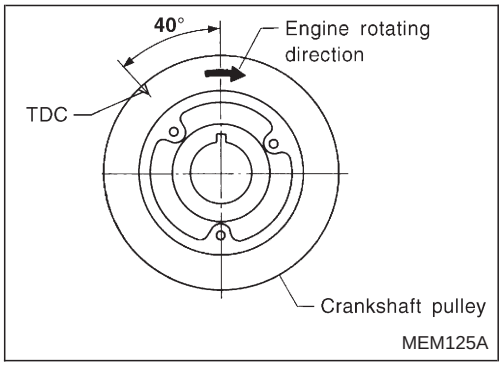
1. Install the oil pan gasket with the coated surface facing the cylinder block and the notch facing the rear of the engine.
2. Tighten all bolts in reverse order of removal. For tightening torque of oil pan and correct installing direction of drain plug washer, refer to EM-71.

SEC. 111•130•185•220



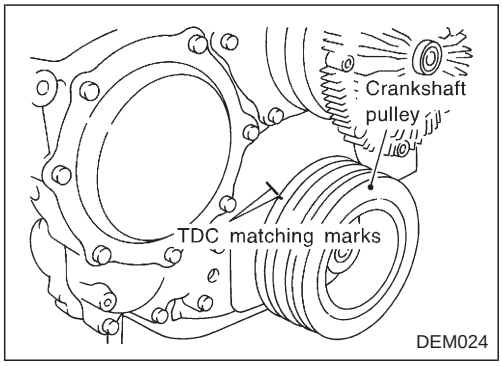
DEM110

CAUTION:
- **When installing sliding parts such as rocker arms, camshaft and oil seal, be sure to apply new engine oil on their sliding surfaces.**
- **When tightening cylinder head bolts and rocker shaft bolts, apply new engine oil to thread portions and seat surfaces of bolts.**

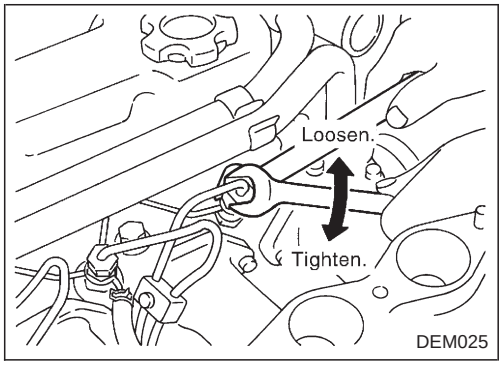


Removal

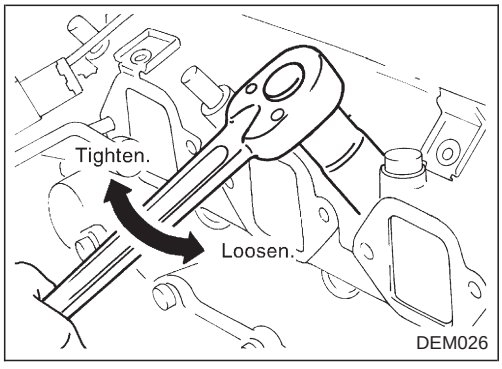
1. Set No. 1 cylinder at TDC (top dead center) on its compression stroke.
2. Drain engine coolant from drain plugs on cylinder block and radiator.
3. Remove air cleaner and/or air duct.
4. Remove alternator adjusting bolt.
5. Disconnect exhaust manifold from front exhaust tube.
6. Disconnect radiator outlet hose and thermostat housing water inlet hose.
7. Remove air intake housing.



8. Remove fuel injection tube assembly and spill tube.

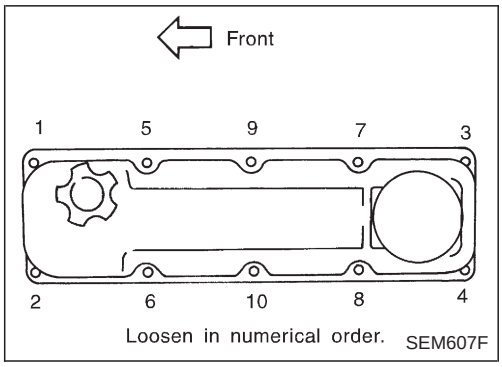


9. Remove injection nozzle holder and top nozzle gasket using deep socket wrench.

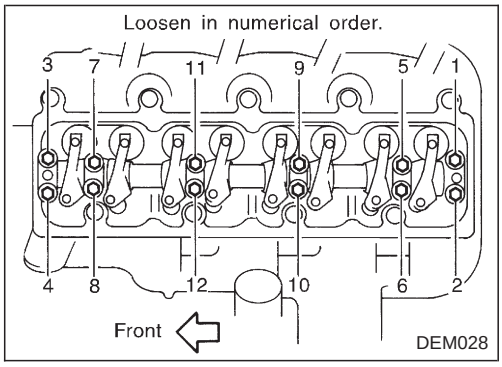


Removal (Cont'd)

10. Remove rocker cover.

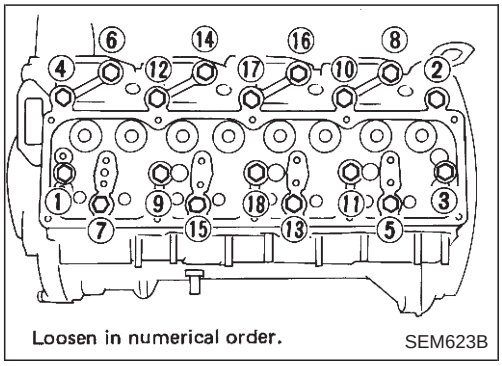


11. Remove rocker shaft with rocker arms.
12. Remove push rods.



13. Remove cylinder head bolts in numerical order and remove cylinder head.

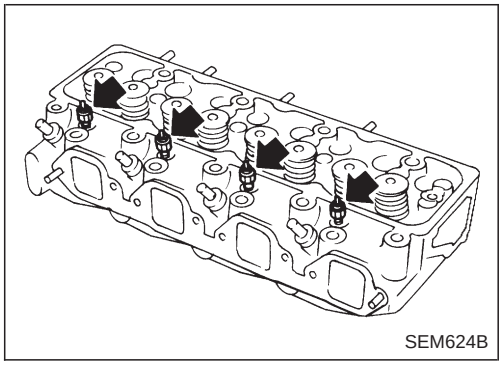
Head warpage or cracking could result from removing in incorrect order.



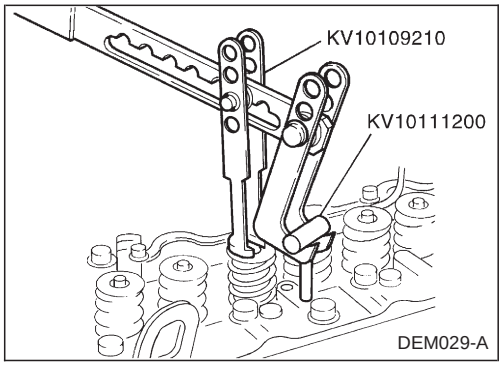
Disassembly

1. Remove following parts:

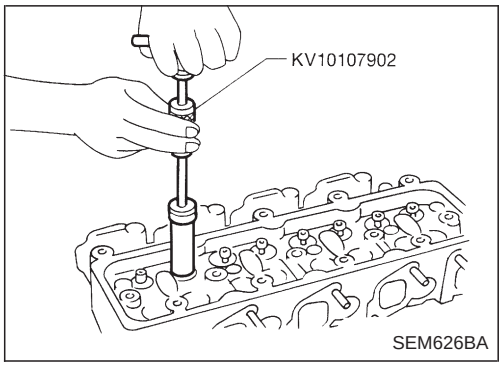
a. Intake manifold
b. Exhaust manifold
c. Thermostat housing
d. Alternator adjusting bar & engine slinger
e. Glow plate and glow plugs



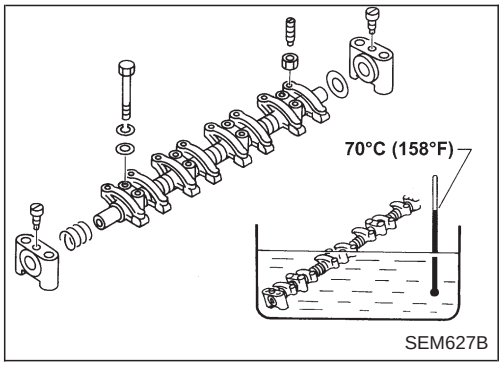
2. Remove valve component parts with Tool.



Disassembly (Cont'd)



3. Remove valve oil seals with Tool.



4. Disassemble rocker shaft assembly.
a. Remove rocker shaft lock bolt.
b. Remove valve rocker and rocker shaft bracket.

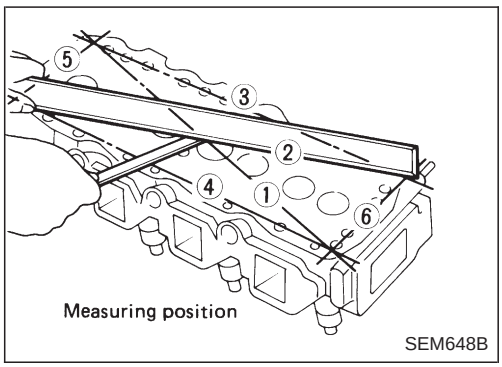
If it is difficult to remove rocker shaft bracket, immerse rocker shaft assembly in oil of 70°C (158°F) for a few minutes and then remove bracket.

Inspection

CYLINDER HEAD DISTORTION

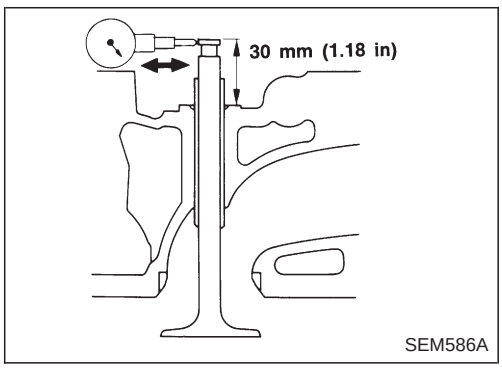
Cylinder head distortion: mm (in)
Standard
Less than 0.07 (0.0028)
Limit
0.2 (0.008)

If beyond the specified limit, correct with a surface grinder. Cylinder head height should be greater than 89.7 mm (3.531 in) after surface has been ground.

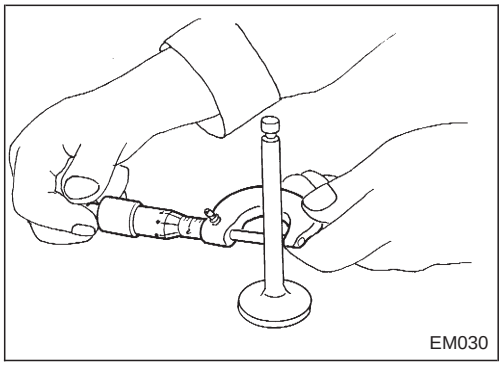


VALVE GUIDE CLEARANCE

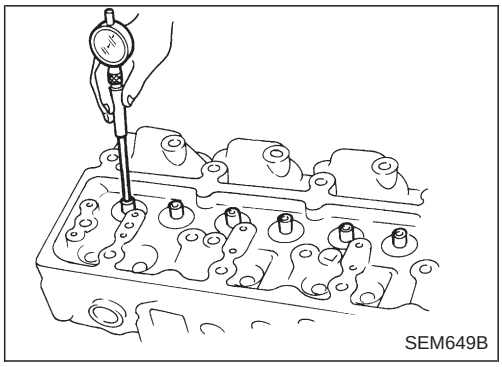
- **Valve guide clearance should be measured parallel with rocker arm. (Generally, a large amount of wear occurs in this direction.)**
  Stem to guide clearance: mm (in)
  Limit
  Intake 0.15 (0.0059)
  Exhaust 0.20 (0.0079)
  Maximum allowable deflection
  (Dial indicator reading)
  Intake 0.30 (0.0118)
  Exhaust 0.40 (0.0157)



- **To determine the correct replacement part, measure valve stem diameter and valve guide inner diameter.**
  Valve stem diameter: mm (in)
  Standard
  Intake
  7.962 - 7.977 (0.3135 - 0.3141)
  Exhaust
  7.945 - 7.960 (0.3128 - 0.3134)



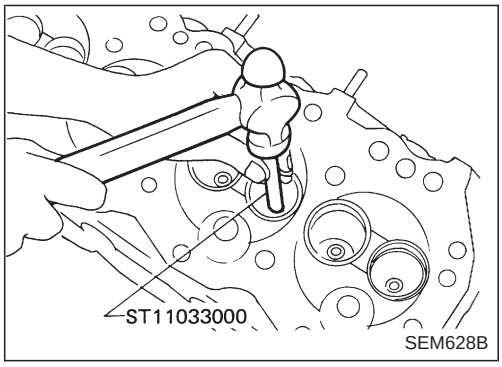
Inspection (Cont'd)


SEM649B

Valve guide inner diameter:
8.000 - 8.015 mm (0.3150 - 0.3156 in)

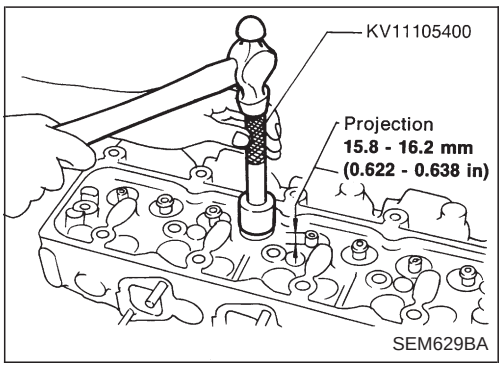
VALVE GUIDE REPLACEMENT

1. 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.



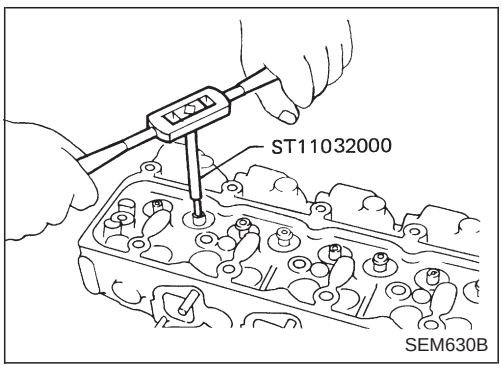
SEM628B

2. Press service valve guide onto cylinder head using suitable tool until the guide projects out 15.8 to 16.2 mm (0.622 to 0.638 in).



SEM629BA

3. Ream valve guide.
Finished size:
8.000 - 8.015 mm (0.3150 - 0.3156 in)

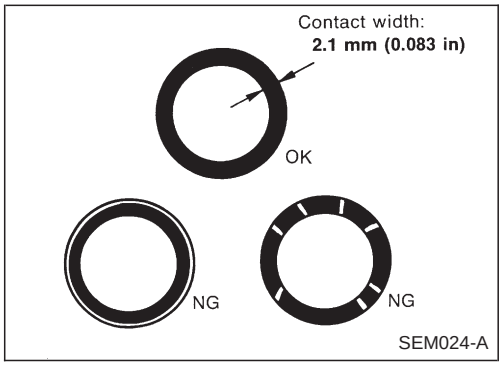


SEM630B

VALVE SEATS

Check valve for any evidence of pitting at valve contact surface, and reseat or replace if worn out excessively.

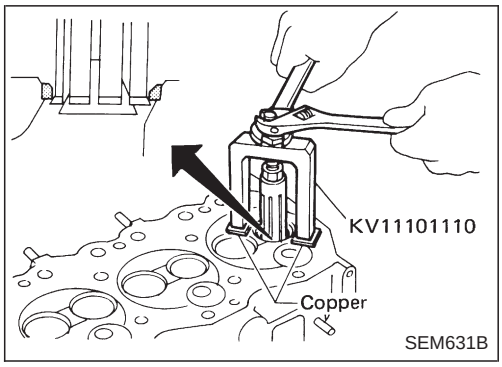
- **When repairing valve seats, check valve and valve guide for wear beforehand. If worn, replace them. Then correct valve seat.**
- **The cutting should be done with both hands for uniform cutting.**



SEM024-A

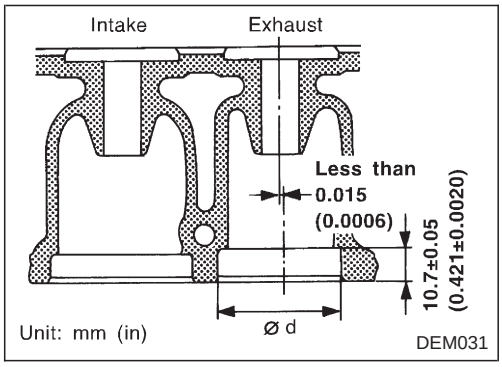
Inspection (Cont'd)

REPLACING VALVE SEAT FOR SERVICE PARTS



1. Bore out old seat until it collapses or remove valve seats with Tool.

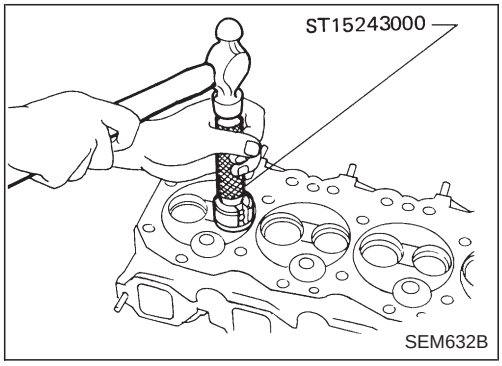
Place a copper seat between contact surface of Tool and cylinder head.



2. If the valve seat for the exhaust side is oversized, machine its mating area (on the cylinder head side) to the dimensions indicated in the table below. Refer to the figure at the left for machining procedures.

Unit: mm (in)

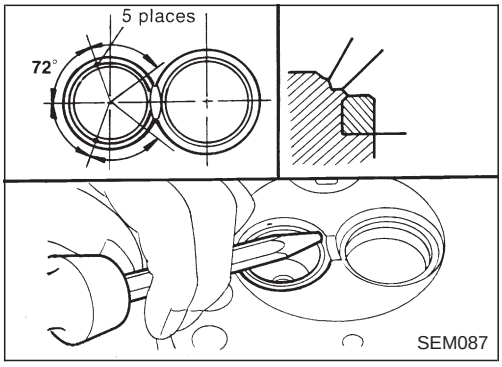
Oversized valve seat	Bore diameter "d"
	TD25
0.2 (0.008)	38.695 - 38.710 (1.5234 - 1.5240)
0.4 (0.016)	38.895 - 38.910 (1.5313 - 1.5319)



3. Place new valve seats on dry ice and allow them to cool for five minutes.

WARNING:
Do not touch cooled valve seats with bare hand.

4. Heat cylinder head to 80°C (176°F).
5. Install cooled valve seats on cylinder head with Tool.

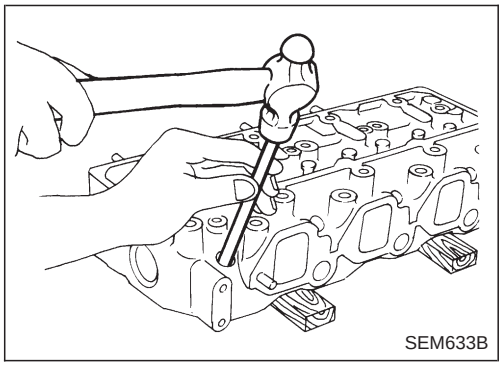


6. Stake exhaust valve seat at five places with punch.

When staking valve seat, select different places than those staked before.

Inspection (Cont'd)

7. Cut or grind valve seat using suitable tool at the specified dimensions as shown in SDS, EM-100.
8. After cutting, lap valve seat with a lapping compound.
9. Check contact condition of valve seat.


SEM633B

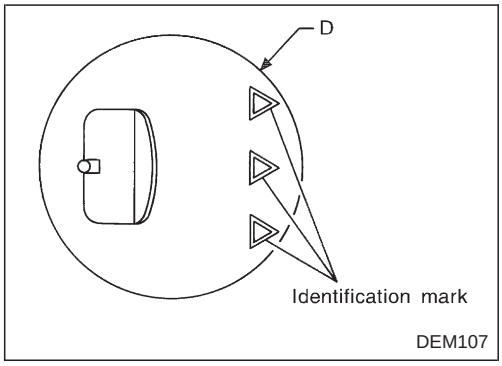
COMBUSTION CHAMBER

Check combustion chamber for cracks and other damage. If necessary, replace.

REPLACING COMBUSTION CHAMBER

Usually combustion chamber should not be removed.

1. Remove combustion chamber so that cylinder head cannot be damaged.



DEM107

2. Install combustion chamber.

Identification of combustion chambers

Identification mark (on combustion chamber)	Outer diameter "D" mm (in)	Engine
3 places	37 (1.46)	TD25

(1) Cool combustion chamber with dry ice for approximately 5 to 10 minutes.

WARNING:

Do not touch cooled combustion chamber with bare hand.

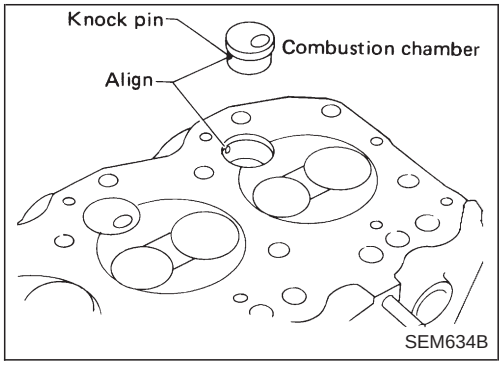
(2) Align combustion chamber knock pin with cylinder head notch, and drive in combustion chamber with a soft hammer.

3. Check amount of protrusion of combustion chamber.

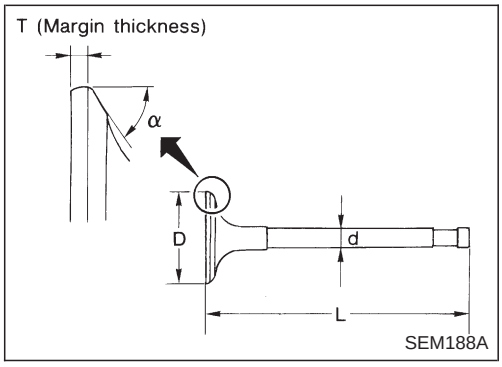
Protrusion:

Standard

−0.05 to 0.10 mm (−0.0020 to 0.0039 in)



SEM634B



SEM188A

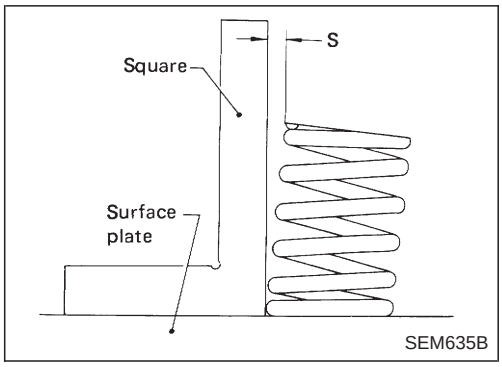
VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to SDS.

When valve head has been worn down to 0.5 mm (0.020 in) in margin thickness, replace the valve.

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

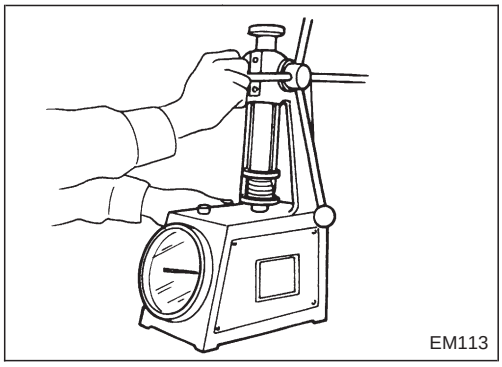
Inspection (Cont'd)



VALVE SPRING SQUARENESS

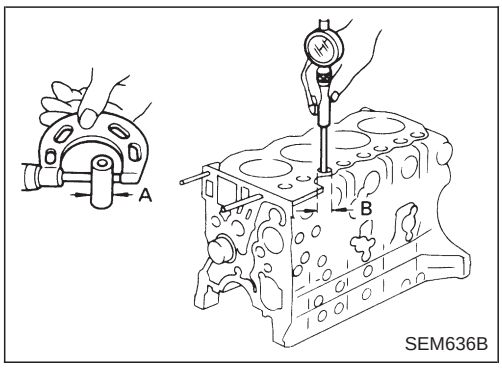
Align the valve spring with a square. Rotate the spring to measure any gap between the top of the spring and the square.

Out-of-square "S":
Less than 2.3 mm (0.091 in)



VALVE SPRING PRESSURE LOAD

Refer to SDS, EM-99.

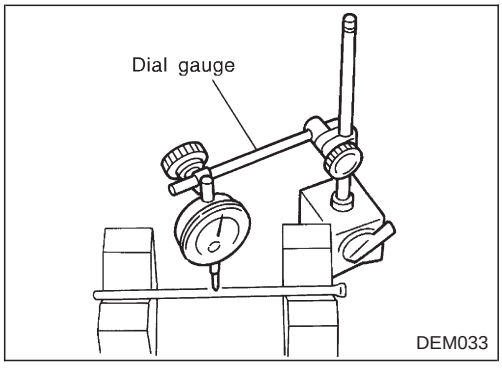


VALVE LIFTER AND PUSH ROD

Valve lifter

1. Check valve lifters for excessive wear on the face.
2. Replace with new ones if worn beyond repair.

a. Valve lifter end should be smooth.
b. Valve lifter to lifter hole clearance: mm (in)
Standard
0.030 - 0.073 (0.0012 - 0.0029)
Limit
Less than 0.20 (0.0079)
Valve lifter outer diameter "A":
Standard
25.960 - 25.970 mm (1.0220 - 1.0224 in)
Cylinder block valve lifter hole diameter "B":
Standard
26.000 - 26.033 mm (1.0236 - 1.0249 in)



Push rod

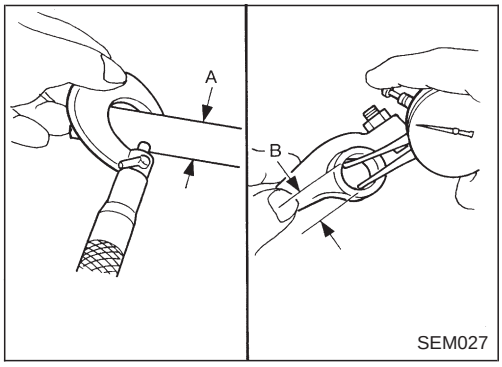
1. Inspect push rod for excessive wear on the face.
2. Replace if worn or damaged beyond repair.
3. Check push rod for bend using a dial gauge.

Maximum allowable bend
(Total indicator reading):
Less than 0.5 mm (0.020 in)

Inspection (Cont'd)

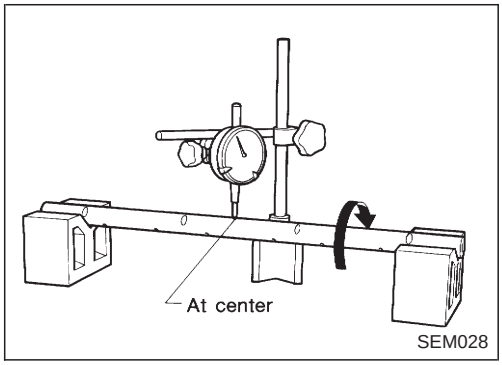
ROCKER SHAFT AND ROCKER ARM

1. Check valve rockers, brackets and rocker shafts for scoring, wear or distortion. Replace if necessary.



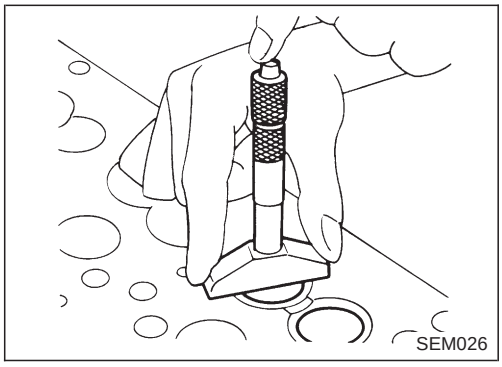
2. Check clearance between valve rockers and rocker shaft. If specified clearance is exceeded, replace affected valve rockers or shafts.

Specified clearance: mm (in)
Standard
0.014 - 0.056 (0.0006 - 0.0022)
Limit
Less than 0.15 (0.0059)
Rocker shaft outer diameter ''A'':
Standard
19.979 - 20.000 mm (0.7866 - 0.7874 in)
Rocker arm inner diameter ''B'':
Standard
20.014 - 20.035 mm (0.7880 - 0.7888 in)



3. Check rocker shaft bend at its center. If bend is within specified limit, straighten it; and if it is greater than specified limit, replace rocker shaft.

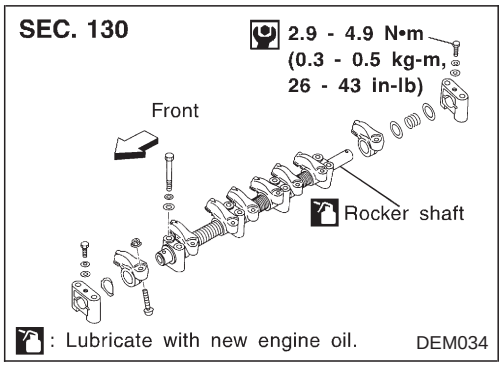
Rocker shaft bend
(Total indicator reading):
Limit
Less than 0.3 mm (0.012 in)



MEASURING CYLINDER HEAD TO VALVE DISTANCE

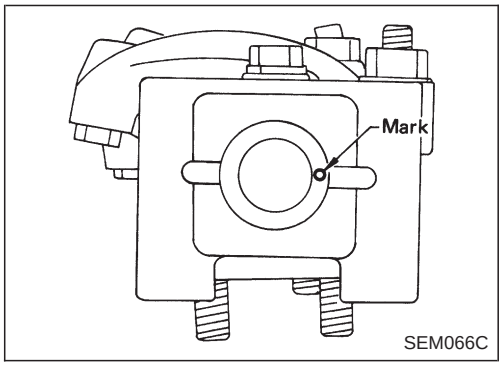
Measure distance from cylinder head surface to intake and exhaust valves. If specified distance is exceeded, replace valve(s) or valve seat(s).

Specified distance: mm (in)
Standard
Intake and Exhaust
0.7 - 1.3 (0.028 - 0.051)
Limit
Less than 1.7 (0.067)
for intake and exhaust valves

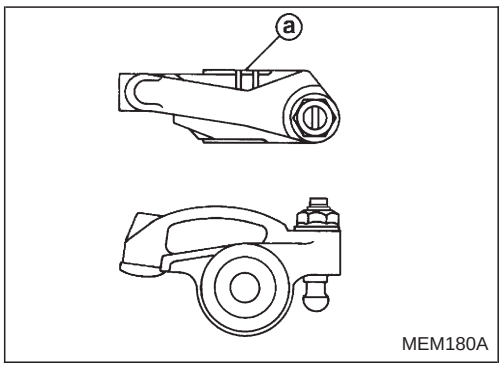


Assembly

1. Assemble rocker shaft component parts.



- **Face punch mark toward the front of the engine.**



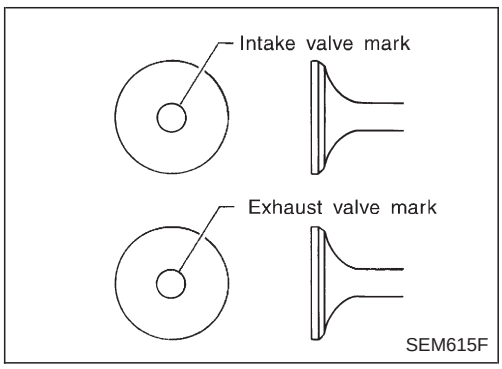
Identification of rocker arms

Identification mark (At area (a) on rocker arm)	For use with
Two ridges	Intake
No ridge	Exhaust

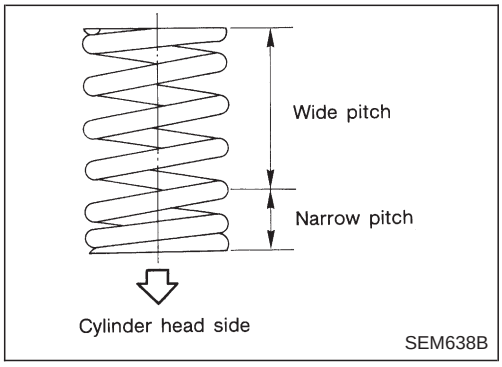
2. Install valve component parts.

Identification of valves

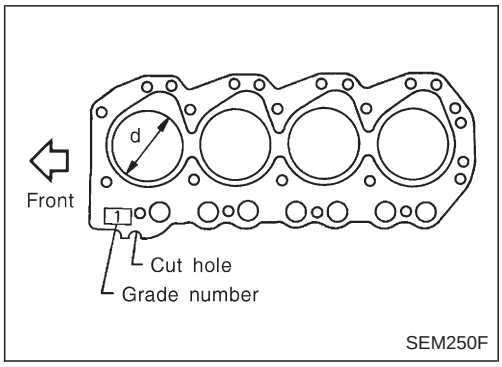
Identification mark (on intake and exhaust valve)		Engine
Intake valve	Exhaust valve	
2	B	TD25



- **Always use new valve oil seal. (Refer to EM-68.)**



- **Install valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side.**



Installation

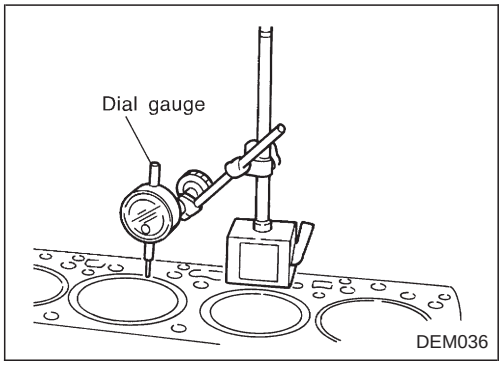
1. Install cylinder head gasket.

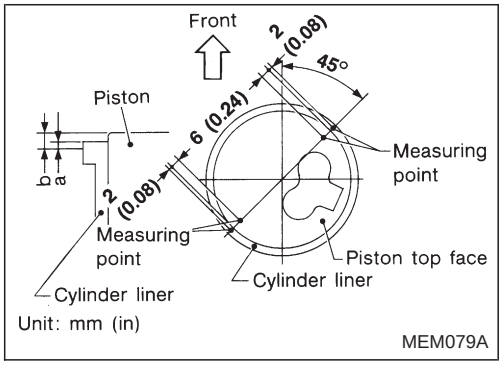
Identification of cylinder head gaskets

Identification cut hole (on cylinder head gasket)	Inner diameter "d" mm (in)	Engine
2	94.4 (3.717)	TD25

a. When replacing only cylinder head gasket, install same grade gasket as the one formerly used.

b. When replacing or repairing cylinder block, cylinder head, piston, connecting rod and crankshaft, select gasket as follows:





● **Selecting gasket thickness**

(1) Measure piston projection from cylinder block surface.

a. Measure the projection a and a′ (cylinder liner height above cylinder block) at two points in each cylinder.

b. Measure the projection b and b′ (piston height above cylinder block) at two points, when the piston is at the top dead center position.

c. Calculate the piston height projection above cylinder liner b - a (b′ - a′).

d. Average the two projections (piston height above cylinder liner) for each cylinder H_L.

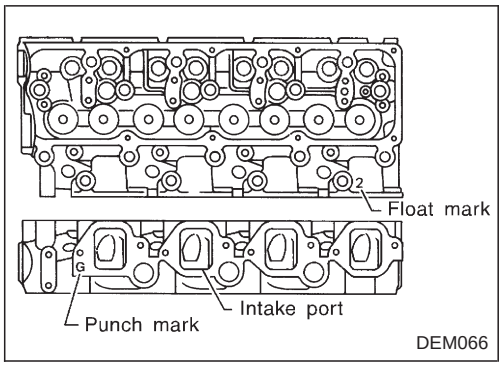
(2) Select suitable cylinder head gasket which conforms to the largest amount of projection of the four pistons.

Unit: mm (in)

Average values piston projections H_L	Gasket thickness		Gasket grade number
	New parts	In assembly	
Less than 0.168 (0.0066)	1.35 (0.0531)	1.20 (0.0472)	2
0.168 - 0.218 (0.0066 - 0.0086)	1.40 (0.0551)	1.25 (0.0492)	3
More than 0.218 (0.0086)	1.45 (0.0571)	1.30 (0.0512)	4

Make sure that No. 1 piston is at TDC on its compression stroke.

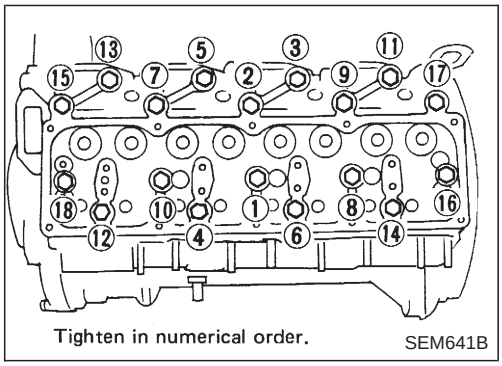
Installation (Cont'd)



2. Install cylinder head.

Cylinder head identification mark

Identification number (on cylinder head)		Engine
Float mark	Punch mark	
2	L	TD25



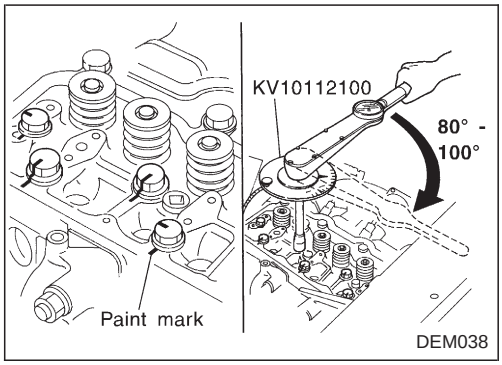
3. Apply oil to the thread portion and seat surface of bolts and tighten cylinder head bolts using Tool.

CAUTION:

- **Tightening procedure**

  1st: Tighten bolts to 39 - 44 N·m (4.0 - 4.5 kg-m, 29 - 33 ft-lb).

  2nd: Tighten bolts to 59 - 64 N·m (6.0 - 6.5 kg-m, 43 - 47 ft-lb).



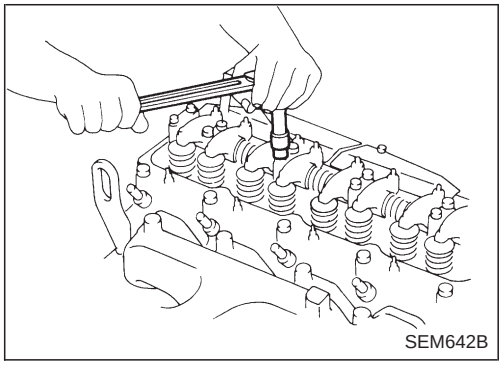
3rd:

(1) Mark exhaust side of cylinder head and cylinder head bolts with paint as shown.

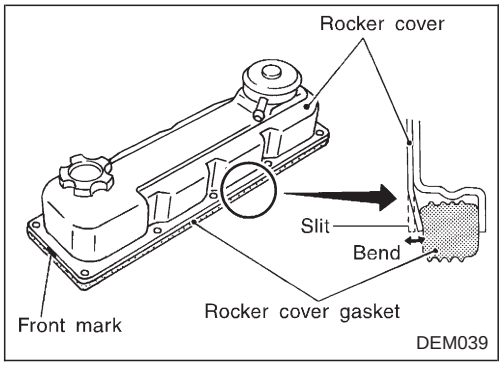
(2) Turn all bolts 90±10 degrees clockwise.

(3) Check that the paint mark of each bolt is facing the front of the vehicle.

- **Always check the bolt tightening angle with an angle wrench or protractor. Do not check visually.**



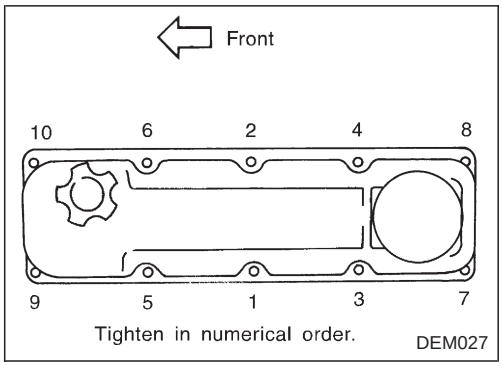
4. Apply engine oil and install push rods.
5. Install rocker shaft assembly.
   Adjust intake and exhaust valve clearance tentatively.
   Refer to ''Adjusting Intake and Exhaust Valve Clearance'', ''ENGINE MAINTENANCE'' in MA section.

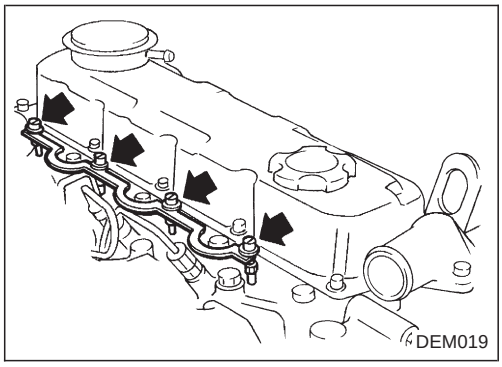


6. Install rocker cover.

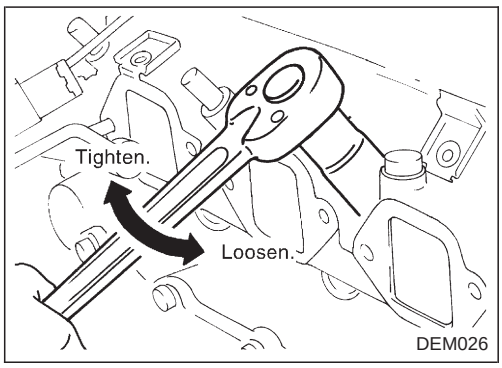
- Be sure the ''F'' mark on rocker cover plate faces upward and is at the front end.
- When replacing rocker cover gasket, bend slit of rocker cover baffle plate a little to hold the gasket. Do not twist gasket.
- **Tighten all bolts in numeral sequence (as shown in the figure at left) to the specified torque.**

Installation (Cont'd)

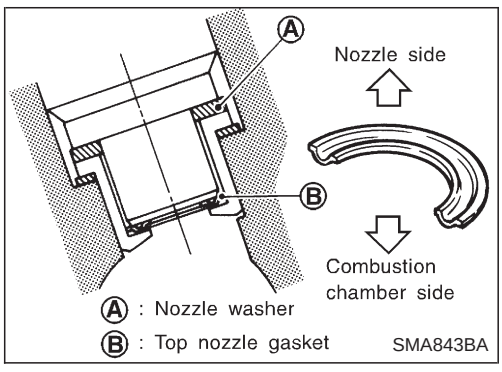


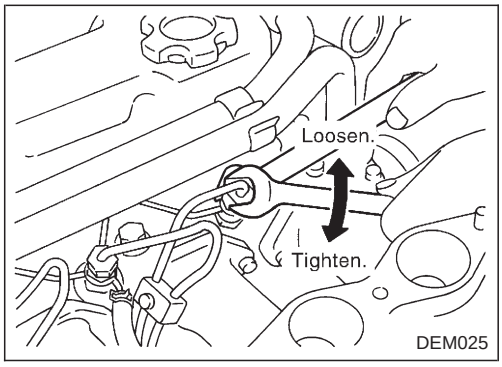


7. Install glow plugs and glow plate.



8. Install new top nozzle gasket, nozzle washer and injection nozzle.
- **Always replace nozzle gasket and washer.**

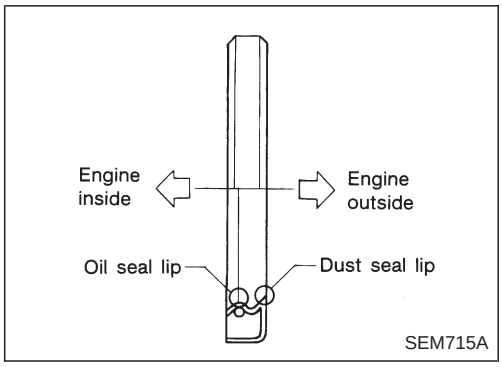




9. Install spill tube and injection tube.

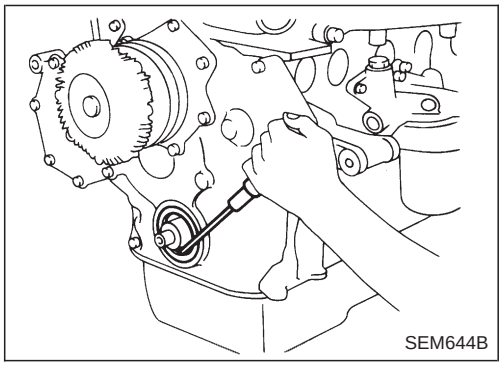
Installation (Cont'd)

10. Connect thermostat housing water inlet hose and radiator hose.
11. After assembling all disassembled parts, fill radiator and engine with new coolant up to filler opening.



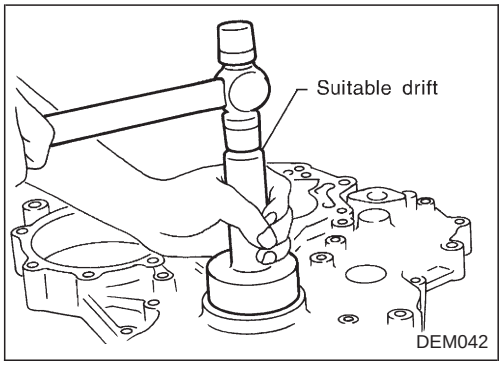
OIL SEAL INSTALLING DIRECTION

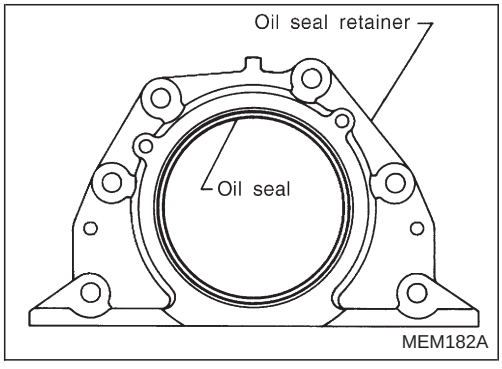
- When installing a new front or rear seal, make sure its mounting direction is correct.



CRANKSHAFT FRONT OIL SEAL

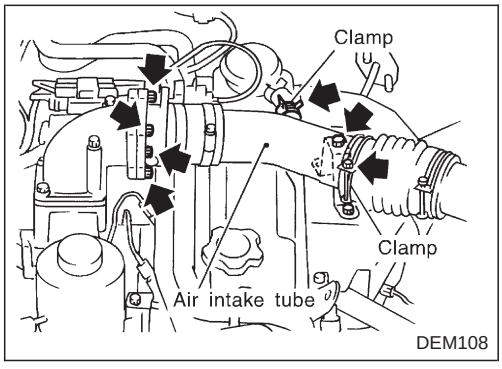
1. Remove radiator shroud.
2. Remove cooling fan.
3. Remove drive belts.
4. Remove crankshaft pulley.
5. Remove crankshaft oil seal.
- Be careful not to damage sealing surfaces of crankshaft.
6. Coat new oil seal with engine oil and install it in place.
- Press the oil seal until it contacts with the front cover.





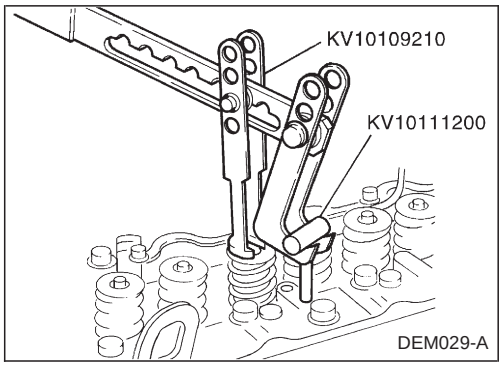
CRANKSHAFT REAR OIL SEAL

1. Dismount transmission.
2. Remove clutch cover assembly.
3. Remove flywheel and rear plate.
4. Remove oil pan and oil pan gasket.
5. Remove oil seal retainer assembly and retainer gasket.
- **Replace oil seal and retainer assembly as a single unit (mono-block type combined with oil seal).**
6. Coat oil seal with engine oil and install new oil seal retainer assembly in place.

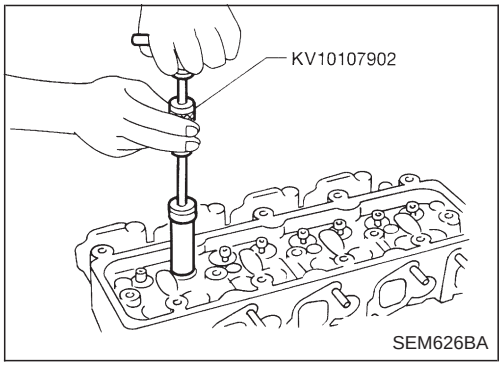


VALVE STEM OIL SEAL

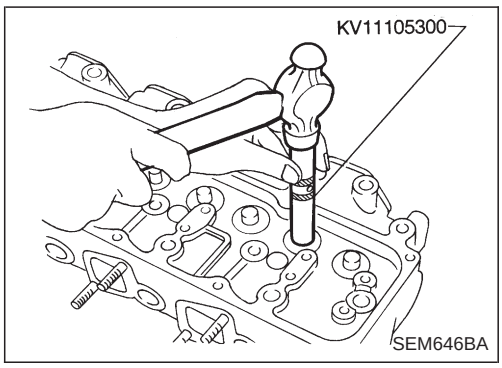
1. Remove following parts.
- Throttle chamber and air intake tube



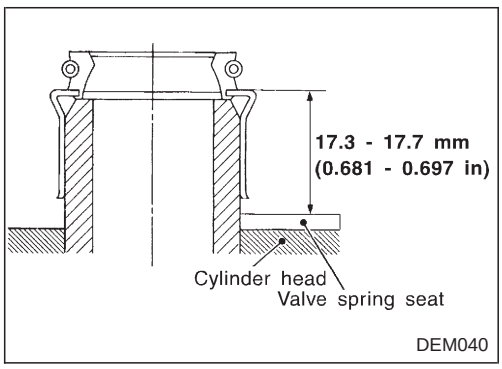
2. Remove rocker cover.
3. Remove rocker shaft assembly.
4. Remove valve spring.

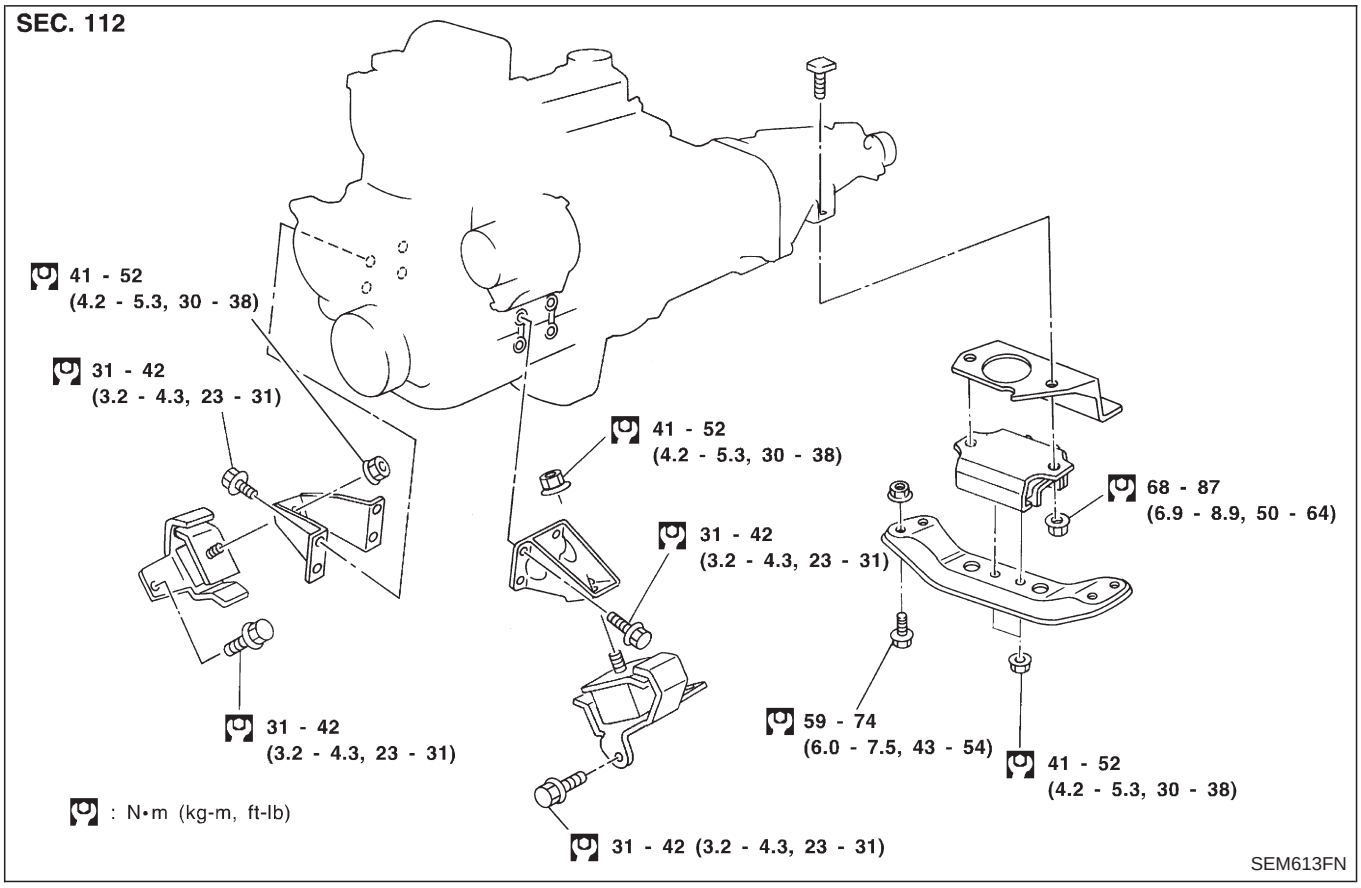


5. Remove valve oil seals.



6. Apply engine oil to valve oil seal and install it in place.



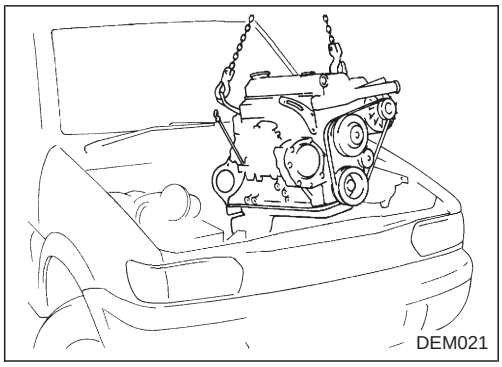


WARNING:

- **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.
- **Be sure to hoist engine and transmission 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. Take special care near accelerator wire casing, brake lines and brake master cylinder.**
- **In lifting the engine, always use engine slingers in a safe manner.**
- **For 4WD models, apply sealant between engine and transmission. Refer to MT section (''Removal and Installation'').**



Removal

1. Remove engine undercover and hood.
2. Drain engine coolant.
3. Remove vacuum hoses, fuel tubes, wires, harnesses and connectors and so on.
4. Remove radiator, shroud and cooling fan.
5. Remove drive belts.
6. Remove power steering oil pump and air conditioner compressor.
7. Remove front exhaust tube.
8. Remove transmission from vehicle.

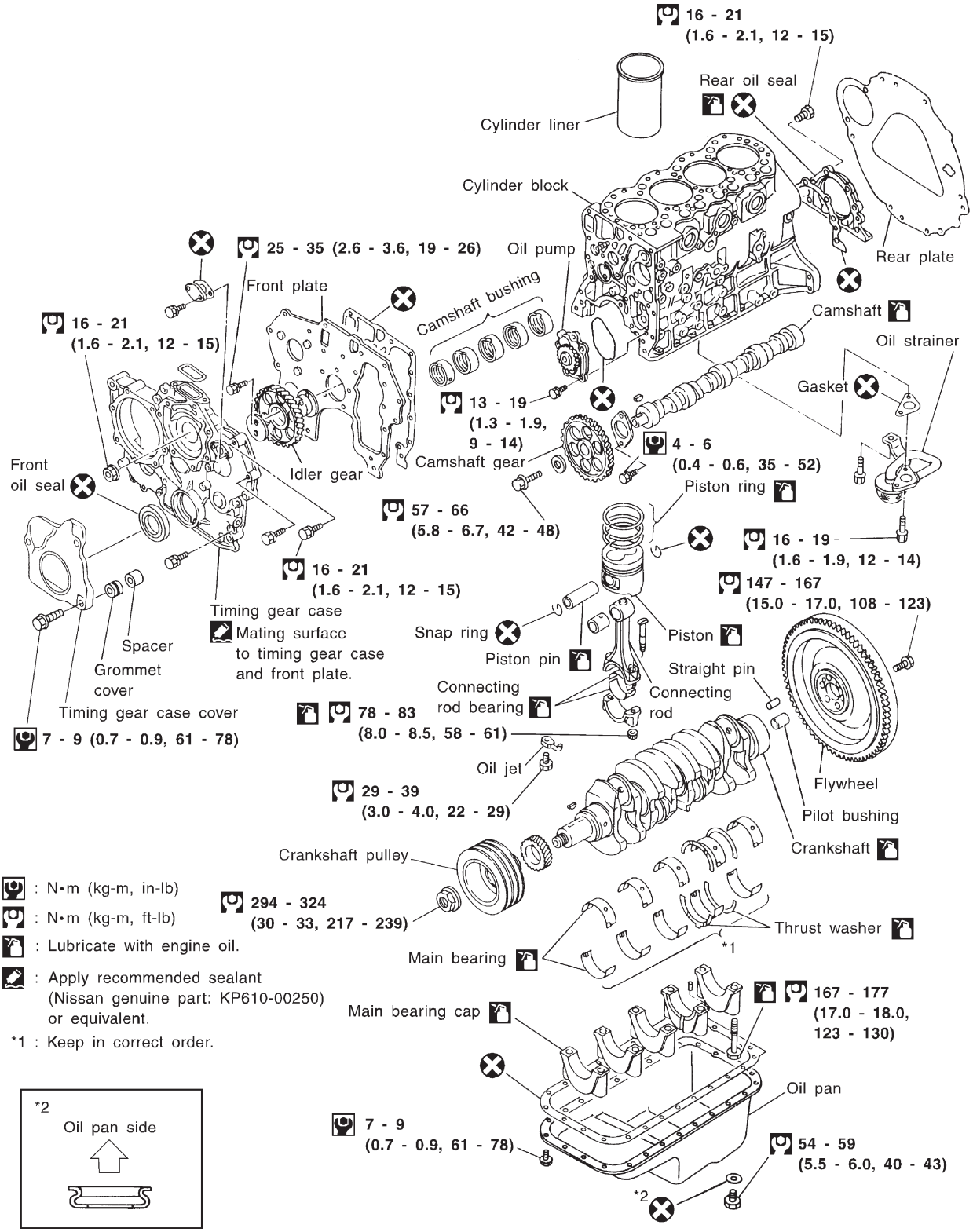
Refer to MT section.

9. Install engine slingers.
10. Hoist engine with engine slingers and remove engine mounting bolts from both sides.
11. Remove engine from vehicle.

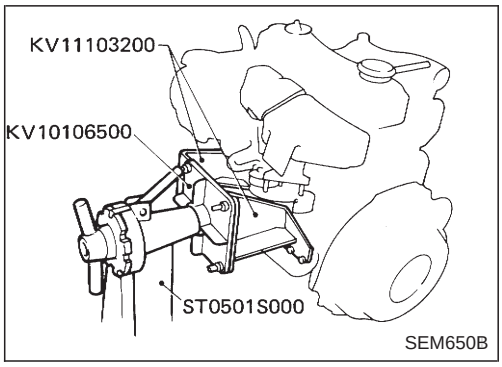
Installation

- Install in reverse order of removal.

SEC. 110•120•130•135•150•313



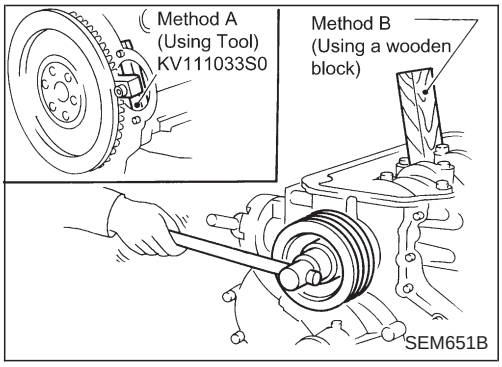
DEM065-A



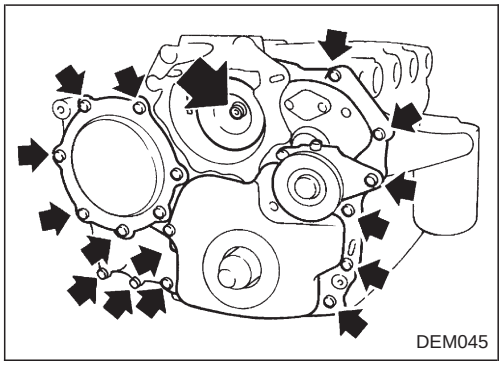
Disassembly

PISTON AND CRANKSHAFT

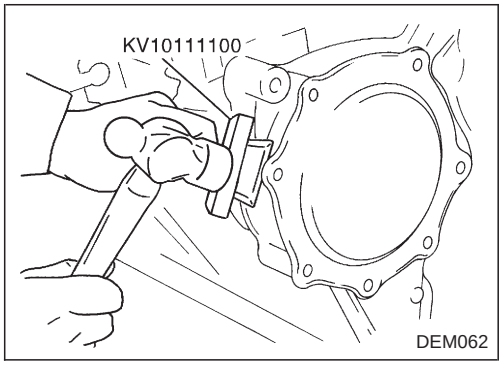
1. Remove oil filter.
2. Place engine on work stand.
3. Drain coolant and oil.
4. Remove drive belts.
5. Remove cylinder head.
6. Remove oil pan.



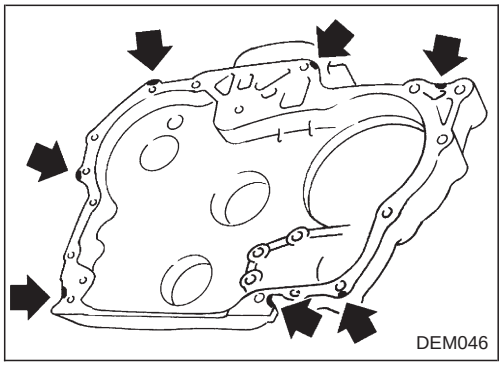
7. Remove crankshaft pulley.



8. Remove water pump.
9. Remove timing gear case.

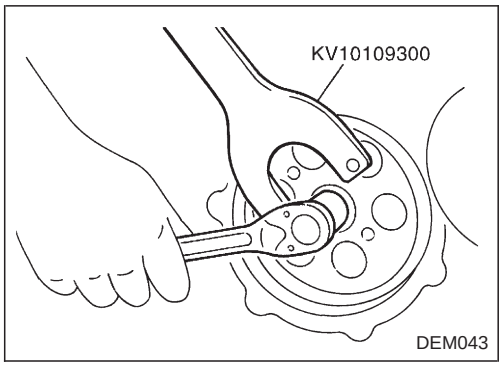


- Remove dust cover with a seal cutter.

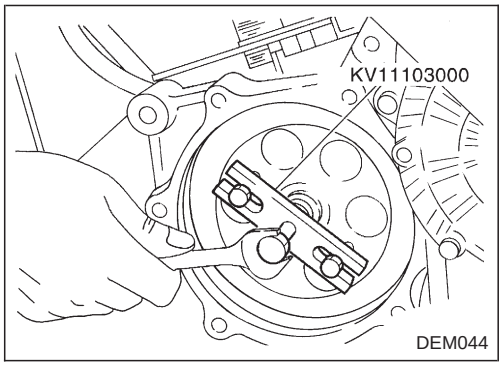


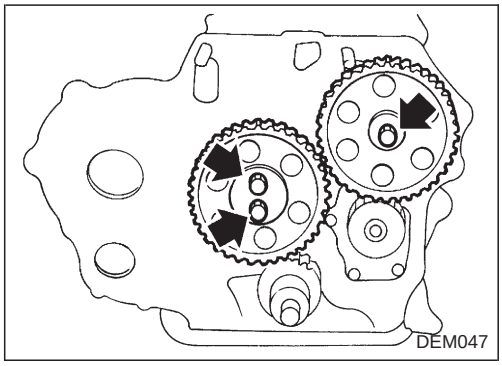
- **If the timing case is hard to remove due to liquid gasket, pry it off with a suitable tool at the cutout section.**

Disassembly (Cont'd)

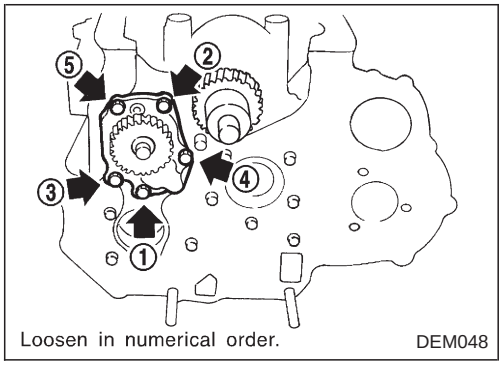


10. Remove injection pump gear.
- Be careful not to lose the woodruff key during injection pump removal.





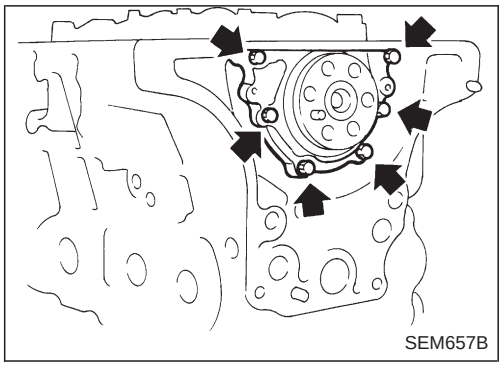
11. Remove idler gear and idler gear shaft.
12. Remove camshaft gear, camshaft and valve lifters.



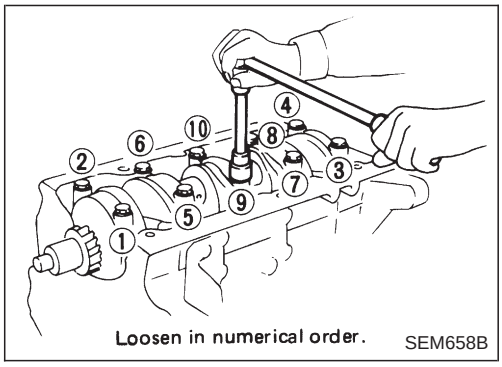
13. Remove oil pump assembly.

14. Remove crankshaft gear.
15. Remove flywheel and rear plate.
16. Remove connecting rod caps.
17. Remove pistons.
- Remove the connecting rod in such a way that it does not interfere with oil jet.

Disassembly (Cont'd)

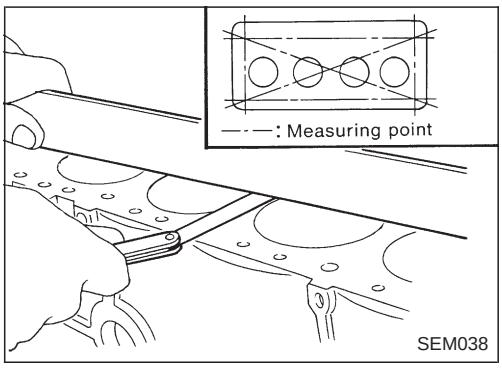

SEM657B

18. Remove rear oil seal retainer assembly.



SEM658B

19. Remove bearing cap and crankshaft.
Place the bearings and caps in their proper order.



SEM038

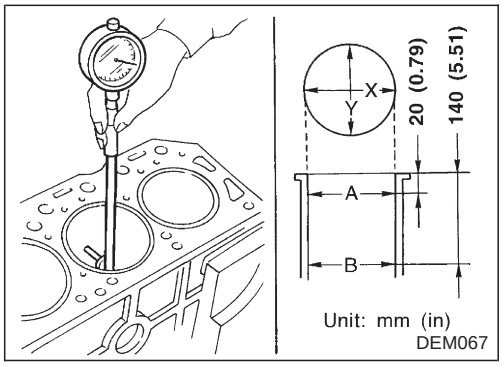
Inspection and Replacement

CYLINDER BLOCK DISTORTION

If beyond the specified limit, replace it.

Cylinder block distortion: mm (in)
Standard
Less than 0.05 (0.0020)
Limit
0.2 (0.008)

- Remove all traces of gasket from the cylinder block. Do not allow pieces of the gasket to enter the oil and cooling water passages during gasket removal.



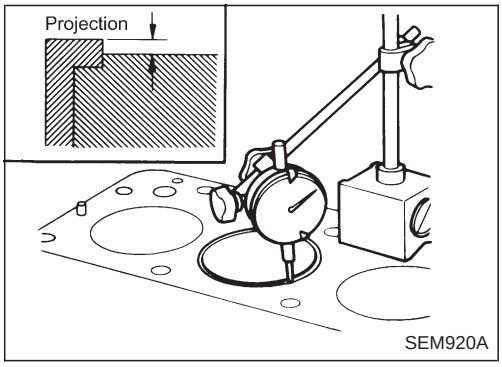
DEM067

CYLINDER LINER WEAR

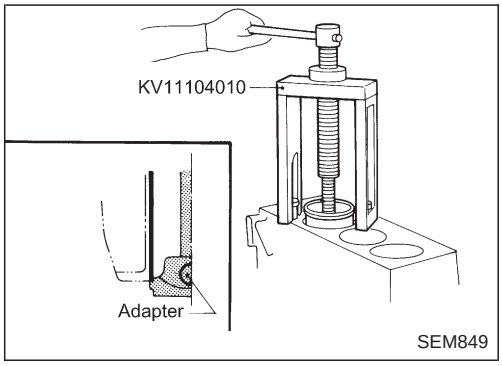
1. Measure cylinder liner bore for out-of-round and taper with a bore gauge. If beyond the limit, replace cylinder liner.
Standard inside diameter:
92.900 - 92.930 mm (3.6575 - 3.6587 in)
Refer to SDS, EM-102.
Wear limit:
0.20 mm (0.0079 in)
Out-of-round (X − Y) standard:
0.020 mm (0.0008 in)
Taper (A − B) standard:
0.020 mm (0.0008 in)

Inspection and Replacement (Cont'd)

2. Check for scratches or seizure. If seizure is found, replace cylinder liner.



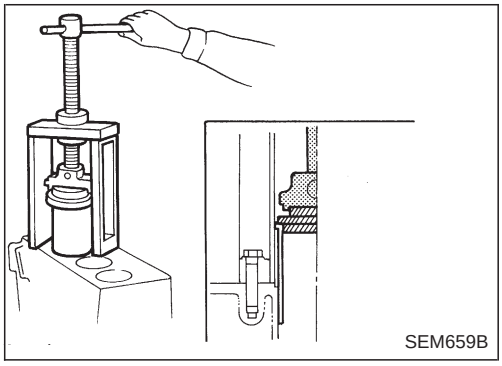
3. Check amount of projection of cylinder liner.
   Cylinder liner projection:
   Standard
   0.02 - 0.09 mm (0.0008 - 0.0035 in)
   Deviation of each cylinder:
   Less than 0.05 mm (0.0020 in)



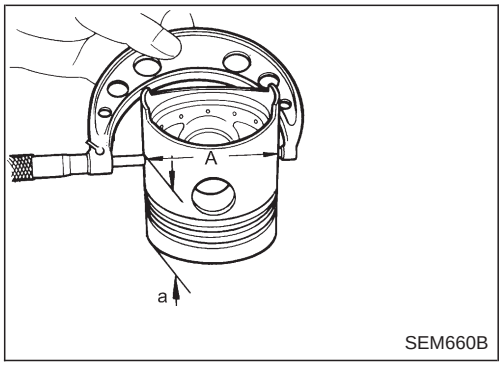
CYLINDER LINER

Replacement

1. Remove cylinder liner with Tool.



2. Install cylinder liner with Tool.
3. Check amount of projection of cylinder liner.



PISTON TO CYLINDER WALL CLEARANCE

1. Measure piston and cylinder bore diameter.
   Piston diameter "A":
   Refer to SDS, EM-103.
   Measuring point "a"
   (Distance from the top): mm (in)
   70 (2.76)
2. Check that piston clearance is within the specification.
   Piston clearance:
   0.05 - 0.07 mm (0.0020 - 0.0028 in)

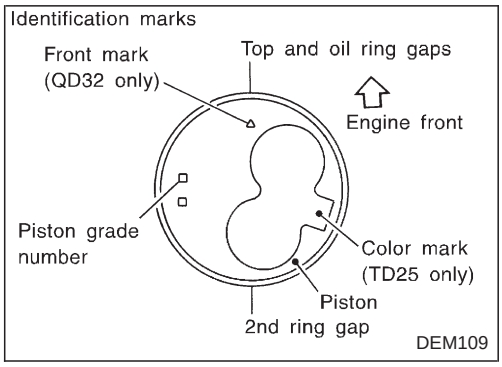
Inspection and Replacement (Cont'd)

Combination of piston and cylinder bore

Use the same piston grade in one engine.

Cylinder bore grade number	Piston grade number		
	1	2	3
1	OK	NG	NG
2	Possible	OK	NG
3	Possible	Possible	OK

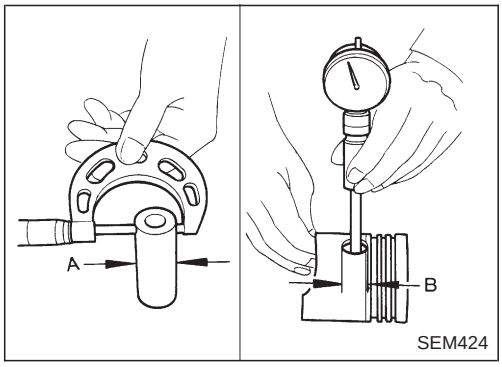
Refer to SDS, EM-102, for finding cylinder bore grade number.



PISTON AND PISTON PIN CLEARANCE

Check clearance between pistons and piston pins.

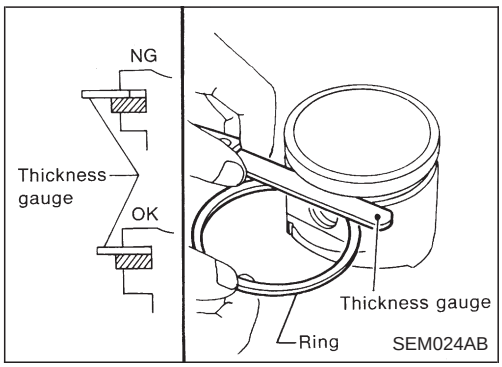
Clearance (A − B): mm (in)
- **Standard**
  - **−0.003 to 0.012 (−0.0001 to 0.0005)**
- **Limit**
  - **Less than 0.10 (0.0039)**



PISTON RING SIDE CLEARANCE

Side clearance: mm (in)
- **Top ring**
  - **0.06 - 0.10 (0.0024 - 0.0039)**
- **2nd ring**
  - **0.04 - 0.08 (0.0016 - 0.0031)**
- **Oil ring**
  - **0.02 - 0.06 (0.0008 - 0.0024)**

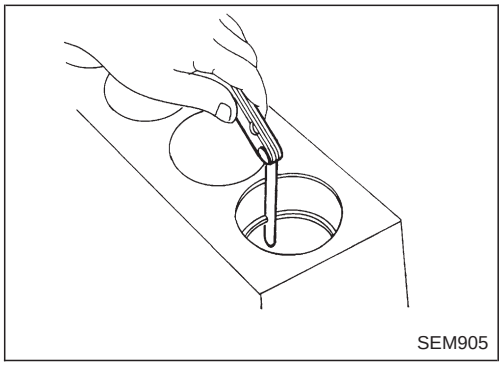
Max. limit of side clearance: mm (in)
- **Top ring 0.50 (0.0197)**
- **2nd ring 0.30 (0.0118)**
- **Oil ring 0.15 (0.0059)**



PISTON RING GAP

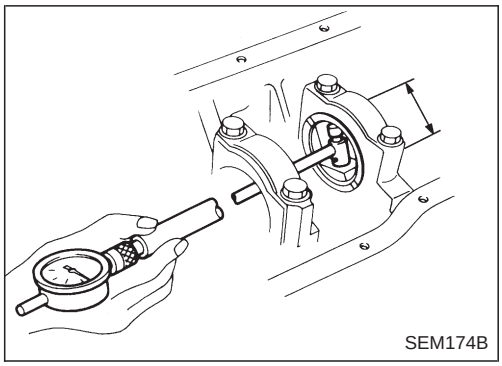
Standard ring gap: mm (in)
- **Top ring**
  - **0.30 - 0.45 (0.0118 - 0.0177)**
- **2nd ring**
  - **0.20 - 0.35 (0.0079 - 0.0138)**
- **Oil ring**
  - **0.15 - 0.35 (0.0059 - 0.0138)**

Max. limit of ring gap:
- **1.5 mm (0.059 in)**

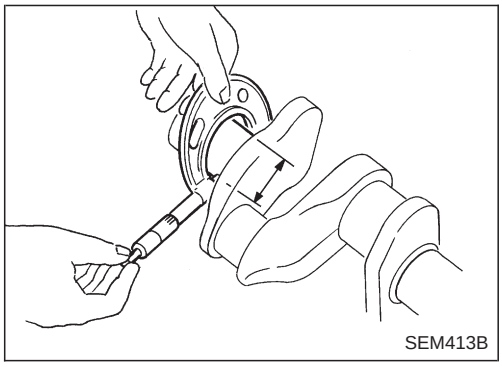


Inspection and Replacement (Cont'd)

MAIN BEARING CLEARANCE


SEM174B

1. Install main bearings to cylinder block and main bearing cap.
2. Install main bearing cap to cylinder block.
- **Apply engine oil to the thread portion and seating surface of bolts.**
- **Tighten all bolts with specified torque in correct order and in two or three stages. Refer to EM-88.**
3. Measure inside diameter ''A'' of main bearing.

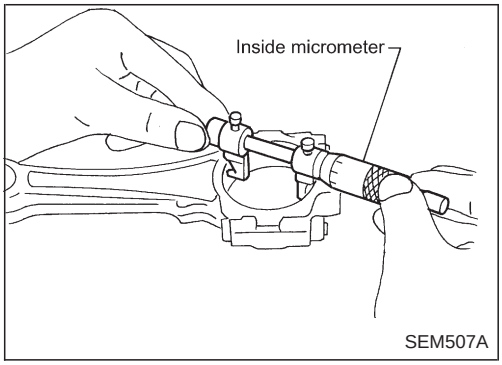

SEM413B

4. Measure outside diameter ''Dm'' of main journal in crankshaft.
5. Calculate main bearing clearance.
   Main bearing clearance = A − Dm
   Standard:
   0.035 - 0.087 mm (0.0014 - 0.0034 in)
   Limit:
   Less than 0.15 mm (0.0059 in)

CONNECTING ROD BEARING CLEARANCE

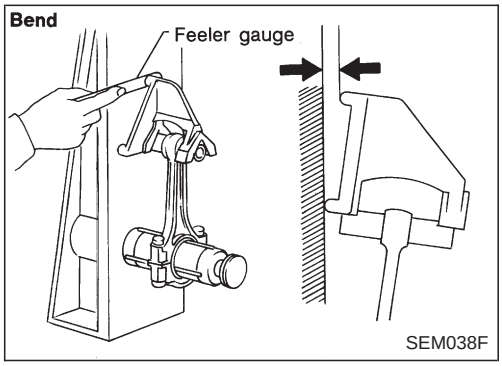
1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod and tighten with specified torque.

Apply engine oil to the thread portion of bolts and seating surface of nuts.



SEM507A

3. Measure inside diameter ''A'' of bearing.
4. Measure outside diameter ''Dp'' of pin journal in crankshaft.
5. Calculate connecting rod bearing clearance.
   Connecting rod bearing clearance = A − Dp
   Standard:
   0.035 - 0.081 mm (0.0014 - 0.0032 in)
   Limit:
   Less than 0.15 mm (0.0059 in)

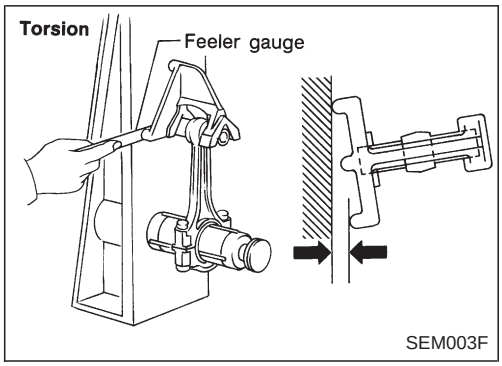


SEM038F

CONNECTING ROD BEND AND TORSION

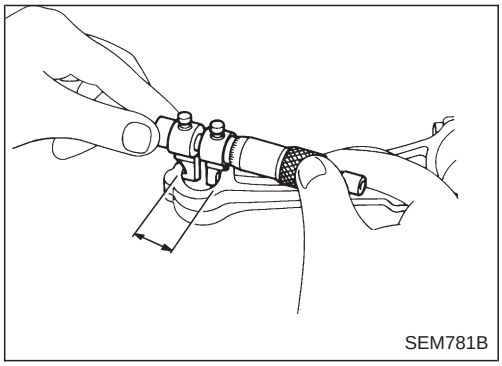
Bend and torsion: mm (in)
Limit
0.075 (0.0030) per 100 (3.94) length

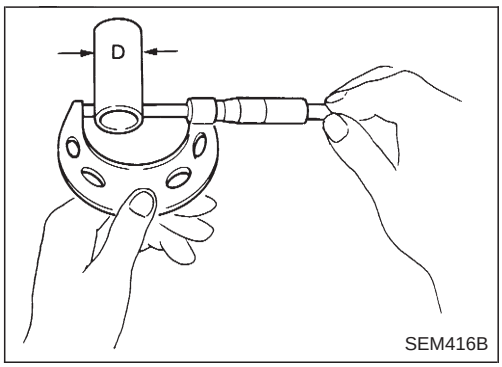
Inspection and Replacement (Cont'd)



CONNECTING ROD SMALL END BUSHING CLEARANCE

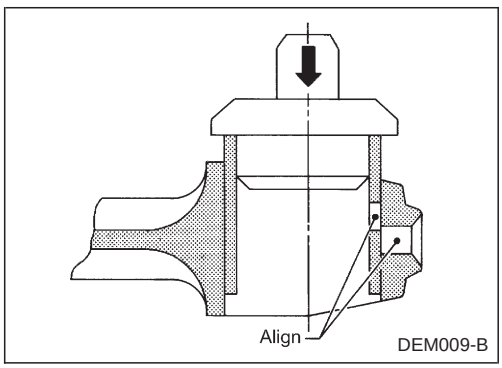
1. Measure inside diameter ''A'' of connecting rod small end bushings.





2. Measure outside diameter ''D'' of piston pin.
3. Calculate connecting rod small end bushing clearance.
   Connecting rod small end bushing clearance = A − D
   Standard:
   0.025 - 0.045 mm (0.0010 - 0.0018 in)
   Limit:
   0.15 mm (0.0059 in)

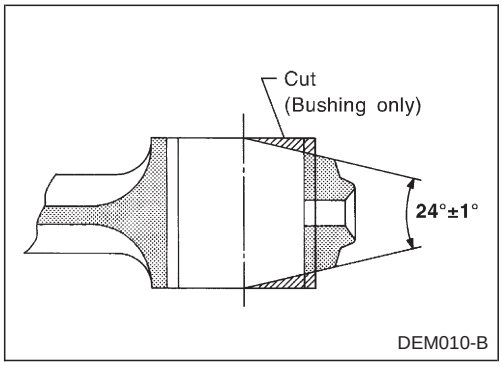
REPLACEMENT OF CONNECTING ROD SMALL END BUSHING



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

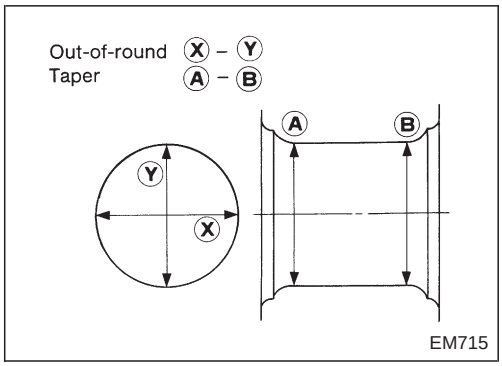
Be sure to align the oil holes.

2. After driving in the small end bushing, ream the bushing.
   Small end bushing inside diameter: mm (in)
   Finished size
   30.025 - 30.038 (1.1821 - 1.1826)
3. Machine the bushing to match the tapered surface of the connecting rod small end.
4. Remove burrs from the machined bushing.



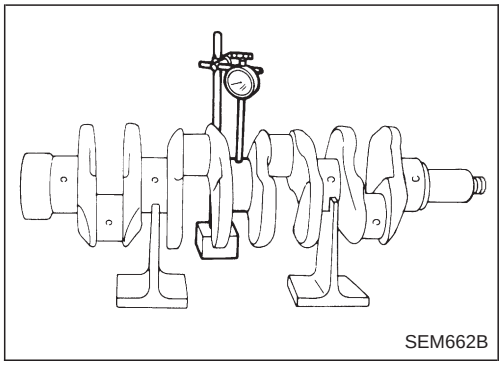
Inspection and Replacement (Cont'd)

CRANKSHAFT



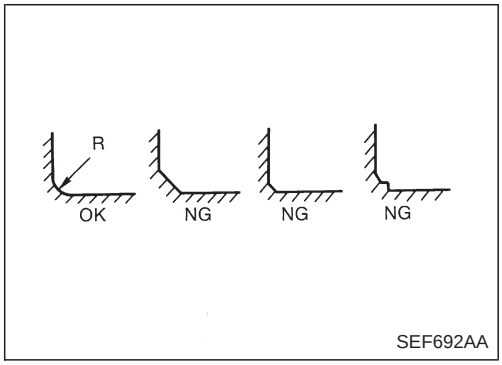
1. Check crankshaft journals and pins for score, bias, wear or cracks. If faults are minor, correct with fine crocus cloth.
2. Check journals and pins with a micrometer for taper and out-of-round.

Out-of-round (X − Y): mm (in)
Standard
Less than 0.01 (0.0004)
Limit
0.02 (0.0008)
Taper (A − B): mm (in)
Standard
Less than 0.01 (0.0004)
Limit
0.02 (0.0008)



3. Check crankshaft runout.

Runout [TIR (Total Indicator Reading)]: mm (in)
Standard
0 - 0.03 (0 - 0.0012)
Limit
0.10 (0.0039)



RESURFACING OF CRANKSHAFT JOURNAL AND CRANK PIN

When using undersize main bearings and connecting rod bearings, the crankshaft journals or crank pins must be finished to match the bearings.

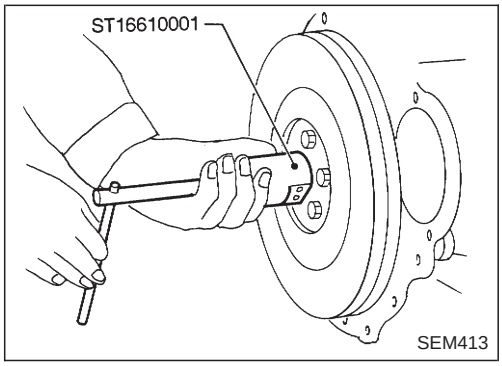
R: Crank journal 3.0 mm (0.118 in)
Crank pin 3.5 mm (0.138 in)

CAUTION:

- **At the same time make sure that the surface width does not increase.**
- **Do not attempt to cut counterweight of crankshaft.**

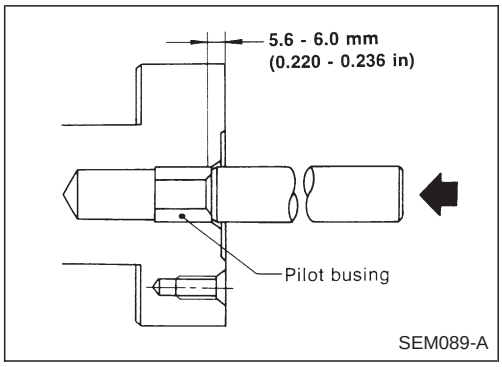
CRANKSHAFT PILOT BUSHING

Replacement

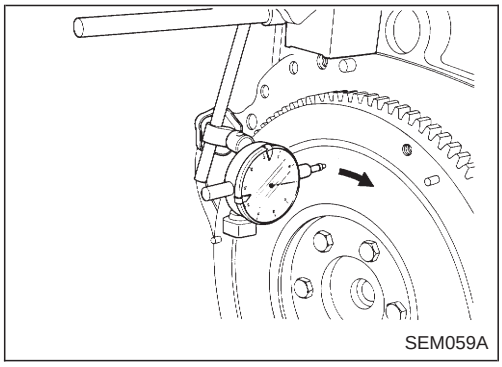


1. Pull out bushing with Tool.

Inspection and Replacement (Cont'd)

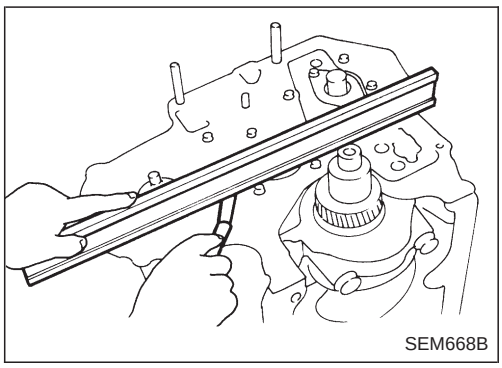


2. Insert pilot bushing until distance between flange end and bushing is specified value.
   Distance:
   Approx. 5.6 - 6.0 mm (0.220 - 0.236 in)



FLYWHEEL RUNOUT

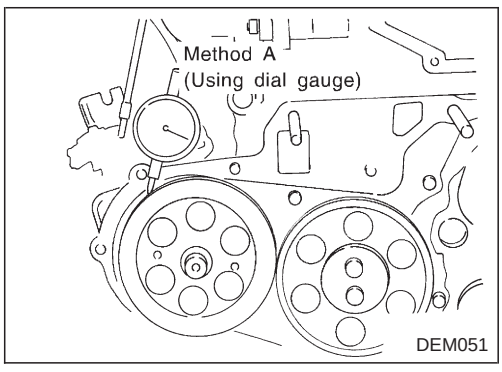
Runout (Total indicator reading):
Less than 0.15 mm (0.0059 in)



FRONT PLATE

Check front plate for warpage. If not within the limit, make flat or replace front plate.

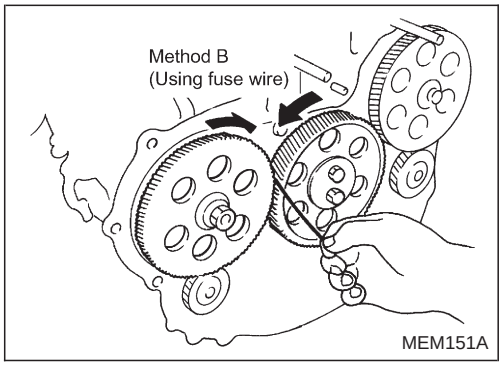
Warpage limit:
0.2 mm (0.008 in)



GEAR TRAIN

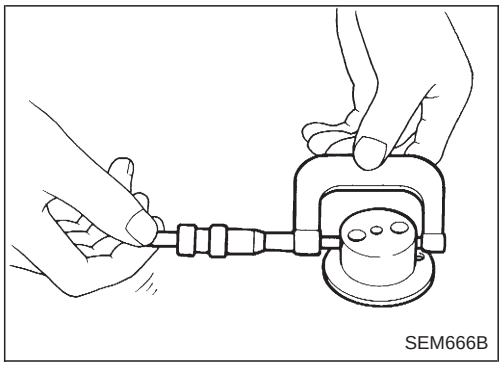
Camshaft drive gear, injection pump drive gear, oil pump gear, idler gear and crankshaft gear

1. If gear tooth and key have scratches or are excessively worn, replace gear and key.
2. Check gear train backlash before disassembling and after assembling.
   Method A (Using dial gauge)
   Method B (Using fuse wire)
   If beyond the limit, replace gear.
   Backlash: mm (in)
   Standard
   0.07 - 0.11 (0.0028 - 0.0043)
   Limit
   0.20 (0.0079)

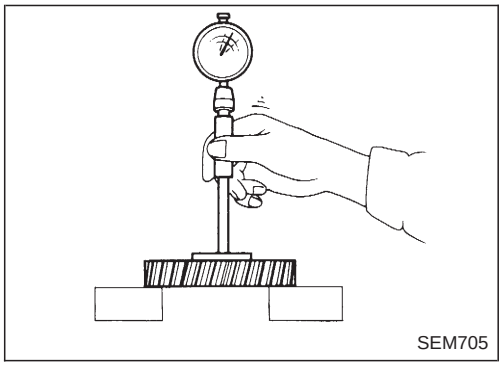


Inspection and Replacement (Cont'd)

IDLER GEAR BUSHING CLEARANCE


SEM666B

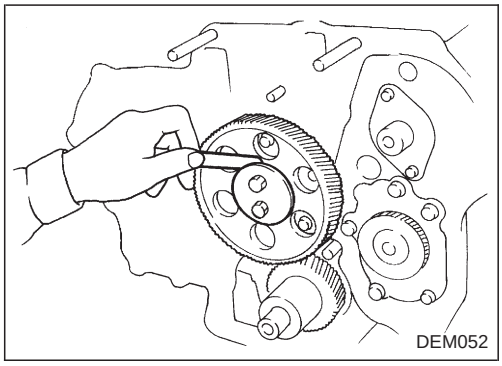
1. Measure idler gear shaft outer diameter.


SEM705

2. Measure idler gear bushing inner diameter.
3. Calculate idler gear bushing clearance.

Bushing clearance: mm (in)
Standard
0.025 - 0.061 (0.0010 - 0.0024)
Limit
0.20 (0.0079)

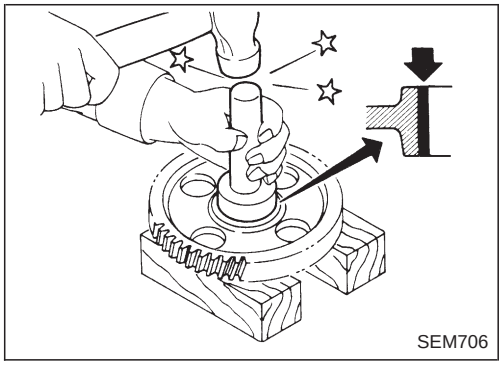
IDLER GEAR END PLAY


DEM052

Measure idler gear end play between gear plate and gear.

Idler gear end play: mm (in)
Standard
0.03 - 0.14 (0.0012 - 0.0055)
Limit
Less than 0.3 (0.012)

REPLACEMENT OF IDLER GEAR BUSHING


SEM706

1. Use a suitable tool to replace bushing.
2. Ream idler gear bushing.

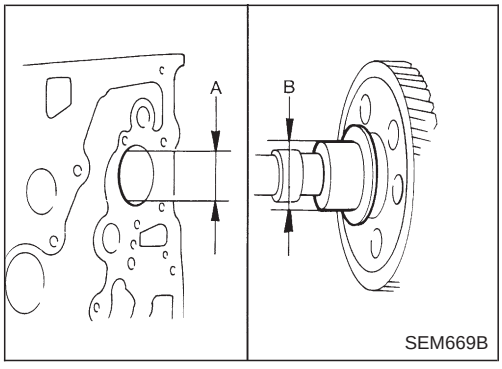
Finished size:
42.00 - 42.02 mm (1.6535 - 1.6543 in)

Idler gear shaft

Install idler gear shaft so that oil hole of shaft faces upward.

CAMSHAFT AND CAMSHAFT BUSHING

Camshaft bushing clearance



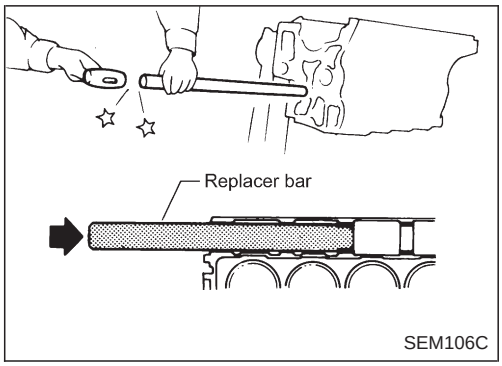
SEM669B

Measure inside diameter of camshaft bushing and outside diameter of camshaft journal with a suitable gauge.

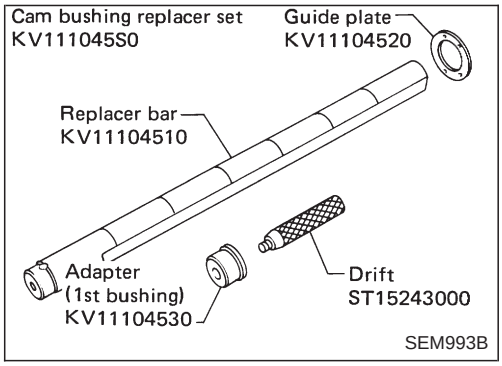
Clearance between camshaft and bushing
(A − B): mm (in)
Standard
0.020 - 0.109 (0.0008 - 0.0043)
Limit
Less than 0.15 (0.0059)

Inspection and Replacement (Cont'd)

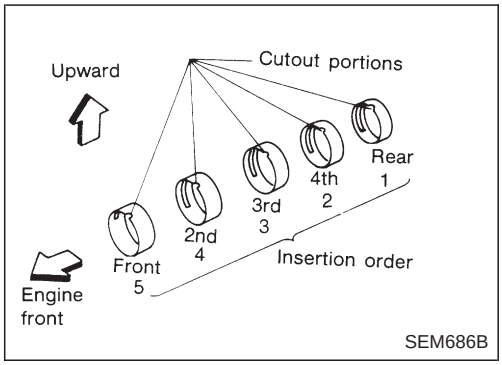
REPLACING CAMSHAFT BUSHING



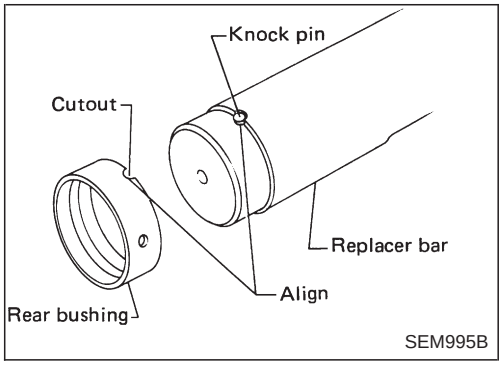
1. Using Tool, remove camshaft bushings from the engine. Some bushings must be broken in order to remove.



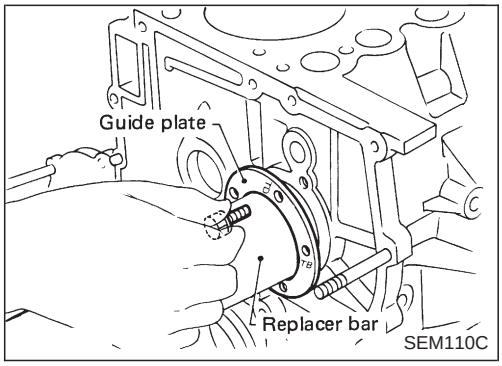
2. Using Tool, install camshaft bushings as follows:



(1) Install camshaft bushings in the order of ''rear'', ''4th'', ''3rd'', ''2nd'' and ''front''. All bushings must be installed from the front.
(2) Face the cutout upward and toward the front of the engine during installation.



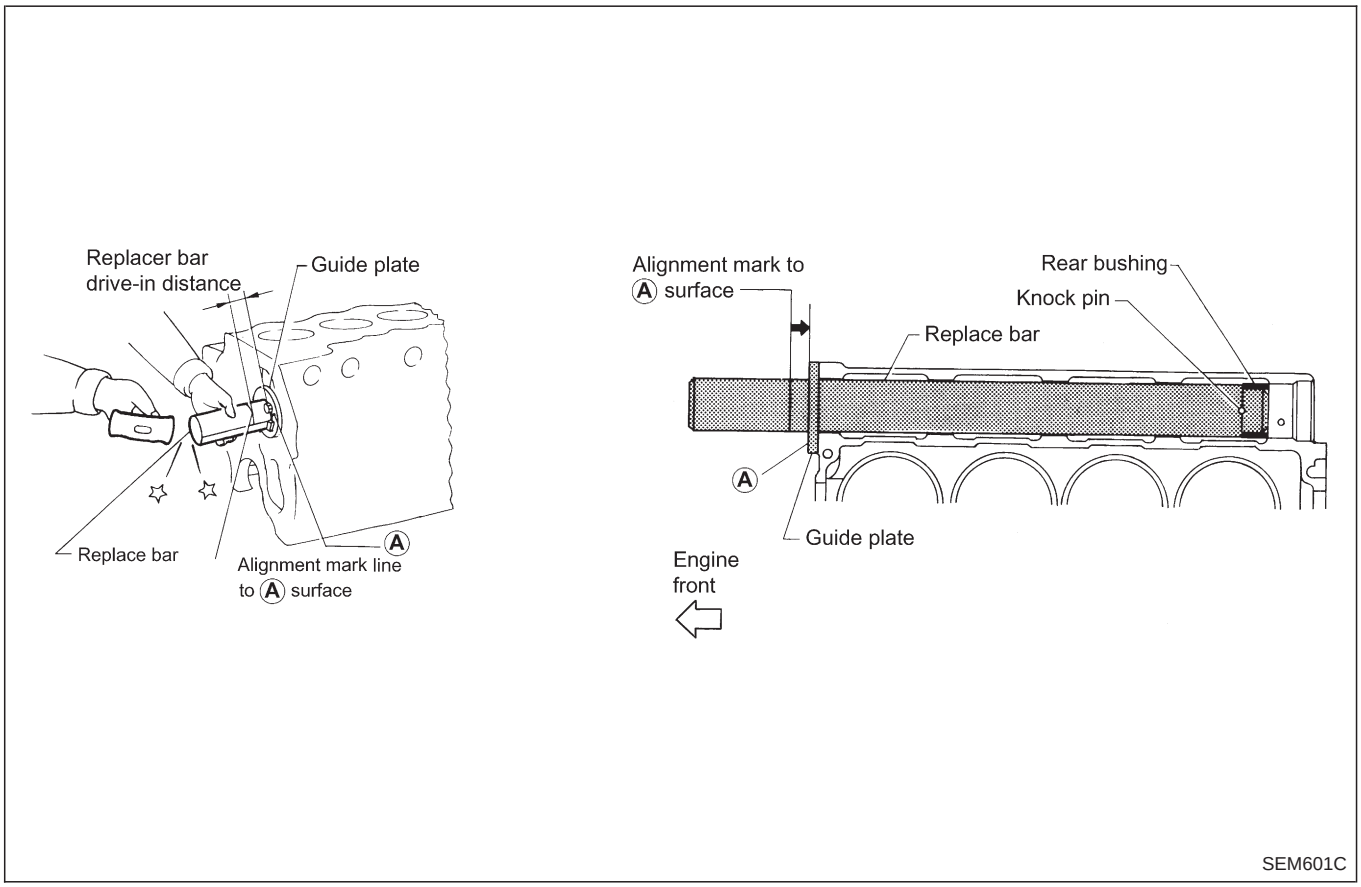
(3) Rear camshaft bushing
- Align the cutout of rear bushing with knock pin of replacer bar before installation.



- Insert rear bushing with replacer bar into the engine.
  Install guide plate with bolt holes (on the ''TD'' mark side) facing upper side of cylinder block. Tighten bolts.

Inspection and Replacement (Cont'd)

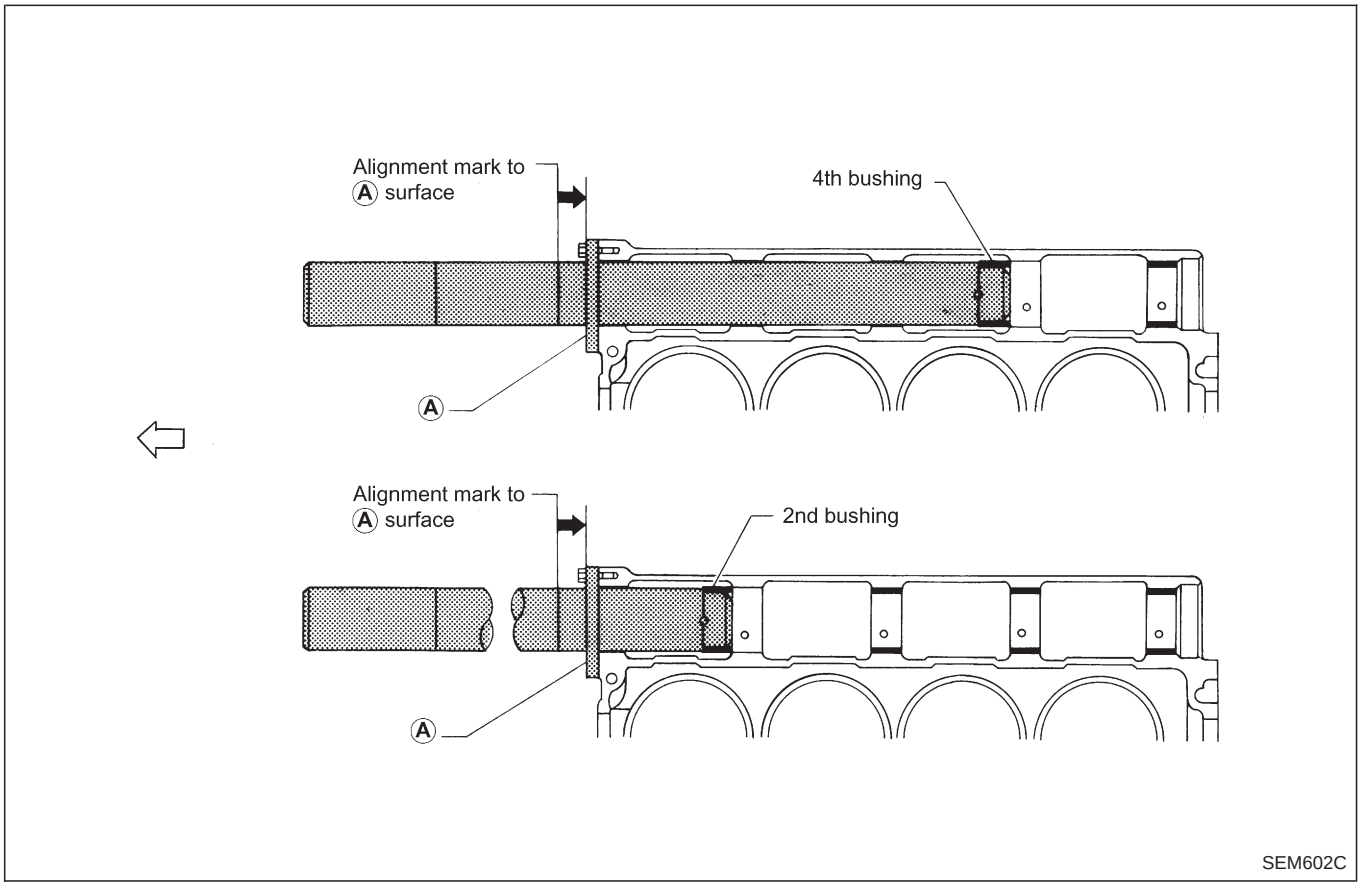
- Drive replacer bar until the alignment mark on replacer bar is aligned with the end of replacer guide.
  Remove replacer set.
  After installation, check that oil holes in camshaft bushings are aligned with oil holes in cylinder block.

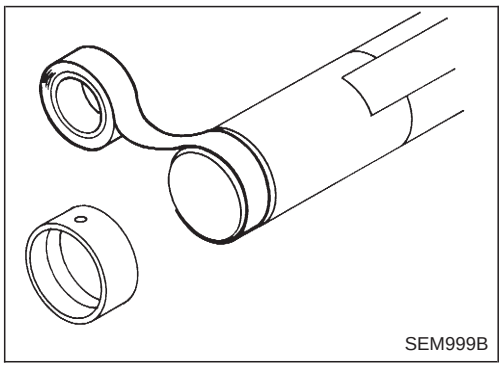


Inspection and Replacement (Cont'd)

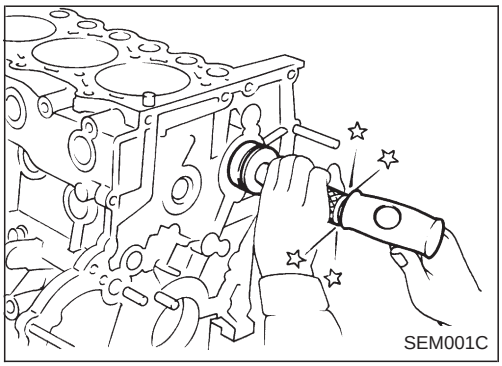
(4) 4th, 3rd and 2nd camshaft bushings

- Install in the same manner as rear camshaft bushing.





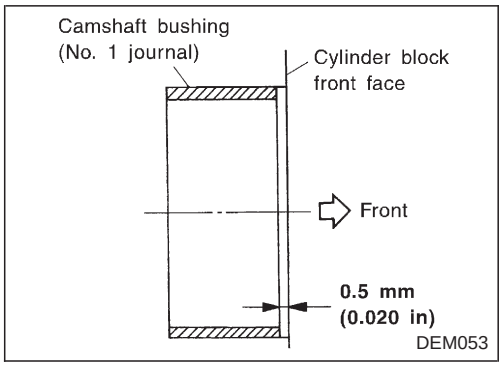
- When setting 4th through 2nd bushings on replacer bar, tape the bar to prevent movement.



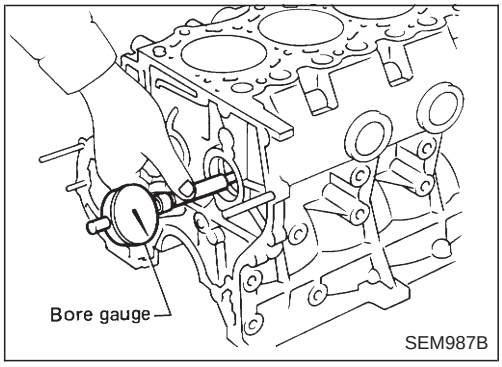
(5) Front camshaft bushing

- Using 1st bushing adapter, position front camshaft bushing so that oil hole in cylinder block is aligned with oil hole in bushing.

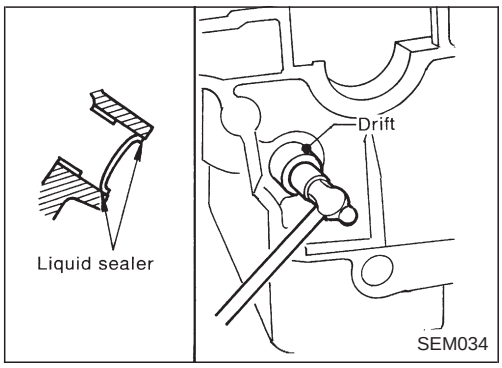
Inspection and Replacement (Cont'd)



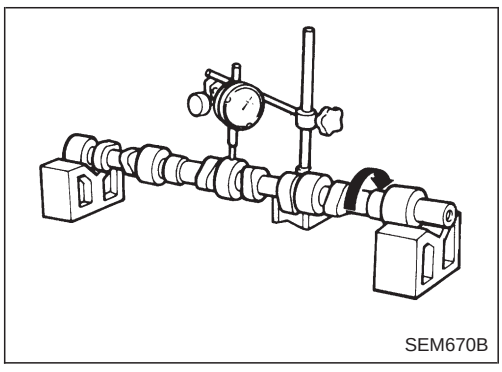
- Press the bushing until its front end is 0.5 mm (0.020 in) from the front surface of the cylinder block.



3. Check camshaft bushing clearance.
Refer to SDS, EM-101.



4. Install new welch plug into rear camshaft bushing hole with a drift.
Apply liquid sealer.

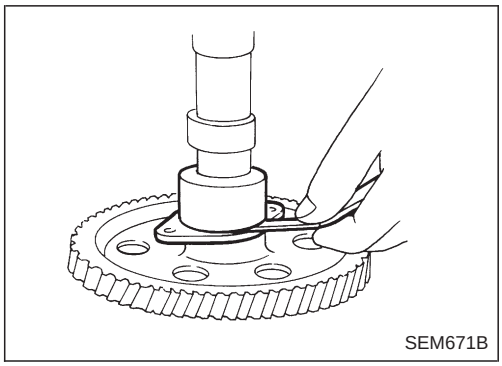


CAMSHAFT ALIGNMENT

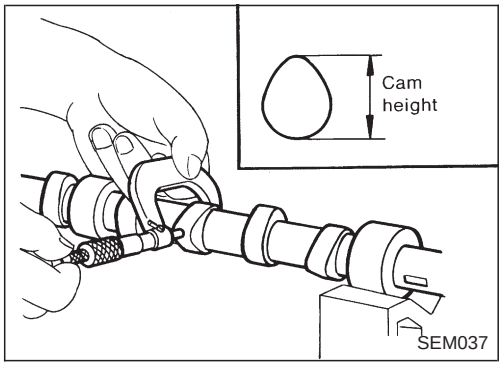
1. Check camshaft journal and cam surface for bend, wear or damage.
   If fault is beyond limit, replace.
2. Check camshaft bend at center journal.
   If bend is greater than specified limit, repair or replace camshaft.

Camshaft bend
(Total indicator reading): mm (in)
Standard
Less than 0.02 (0.0008)
Limit
Less than 0.06 (0.0024)

Inspection and Replacement (Cont'd)


SEM671B

3. Measure camshaft end play between locating plate and gear. If beyond the specified limit, replace camshaft locating plate.
   Camshaft end play: mm (in)
   Standard
   0.08 - 0.28 (0.0031 - 0.0110)
   Limit
   Less than 0.5 (0.020)



SEM037

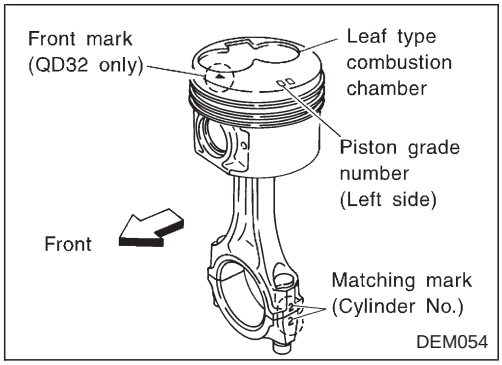
4. Measure camshaft cam height. If beyond the specified limit, replace camshaft.
   Cam height: mm (in)
   Standard
   Intake
   41.88 - 41.92 (1.6488 - 1.6504)
   Exhaust
   41.88 - 41.92 (1.6488 - 1.6504)
   Limit
   Intake
   Less than 41.40 (1.6299)
   Exhaust
   Less than 41.40 (1.6299)

Assembly

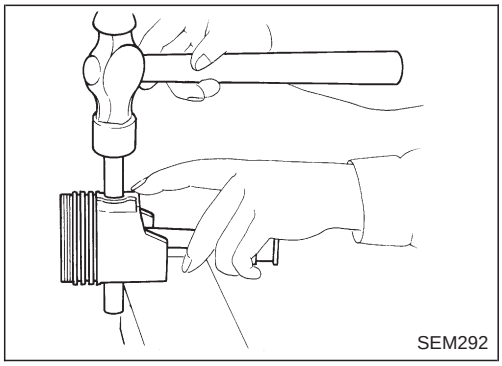
PISTON

Assemble pistons, piston pins, snap rings and connecting rods.

a. Numbers are stamped on the connecting rod and cap corresponding to each cylinder. Care should be taken to avoid a wrong combination including bearing.



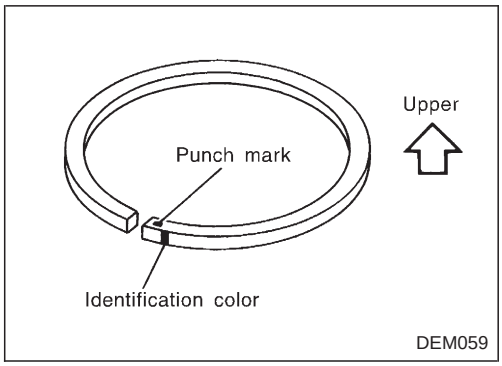
DEM054


SEM292

b. When inserting piston pin in connecting rod, heat piston with a heater or hot water [approximately 60 to 70°C (140 to 158°F)] and apply engine oil to pin and small end of connecting rod.

c. After assembling, ascertain that piston swings smoothly.

Assembly (Cont'd)

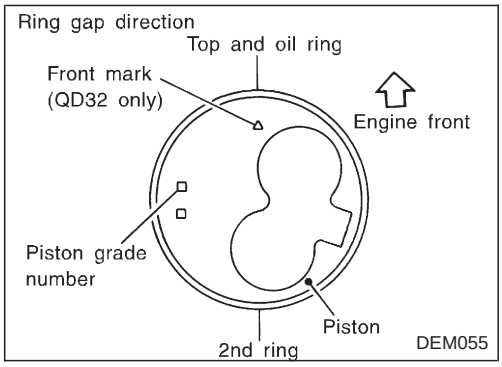


Install piston assembly.

CAUTION:

- **Stretch the piston rings only enough to fit them in the piston grooves.**
- **Always install new piston rings with the position marks facing up.**

	Identification color
Top ring	Yellow
2nd ring	Red



- **Install No. 1 piston ring in such a way that its gap faces the direction of the piston pin; and then install piston rings so that their gap positioned at 180° to one another.**

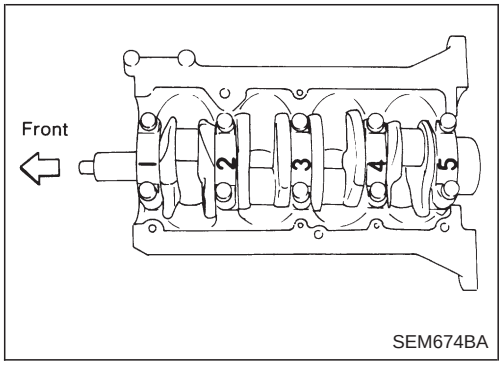
CRANKSHAFT

1. Install crankshaft.

(1) Set main bearings in the proper position on cylinder block.

a. If either crankshaft, cylinder block or main bearing is reused again, it is necessary to measure main bearing clearance.

b. Upper bearings have oil hole and oil groove, however lower bearings do not.



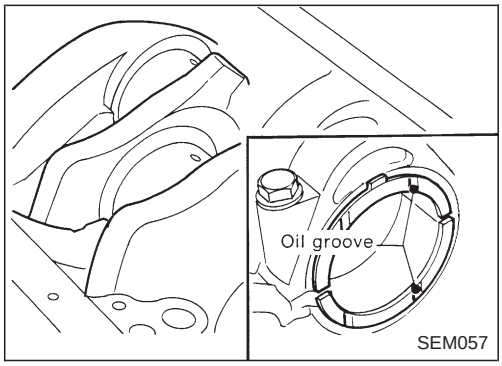
(2) Apply engine oil to crankshaft journal and pin and install crankshaft.

(3) Install main bearing caps.

a. Install main bearing cap with the number facing the front of vehicle.

b. Apply engine oil to main bearing cap and cylinder block contact surfaces.

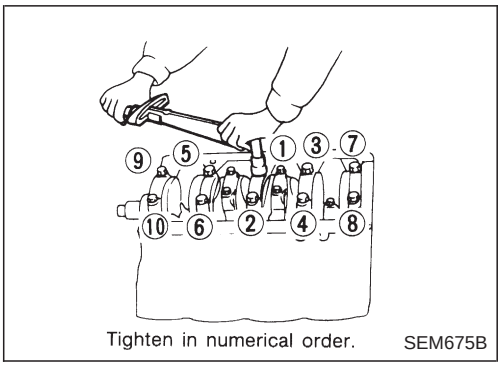
c. Install rear oil seal assembly. Apply engine oil to contact surface of rear end oil seal and crankshaft.



(4) Install crankshaft thrust washer at the 4th journal from front.

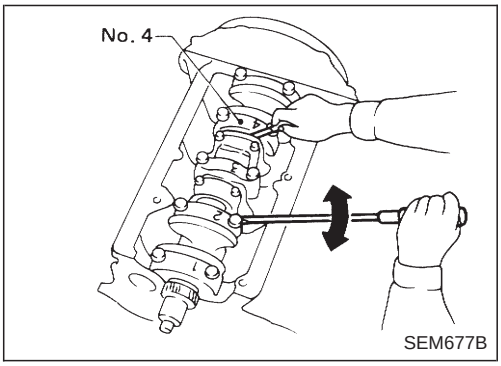
Install thrust washer so that oil groove can face crankshaft.

Assembly (Cont'd)



(5) Tighten main bearing cap bolts gradually in stages, starting from two to three separate stages, from center bearing and moving outward in sequence.

: 167 - 177 N·m (17.0 - 18.0 kg-m, 123 - 130 ft-lb)



(6) Measure crankshaft free end play at No. 4 bearing.

Crankshaft free end play: mm (in)

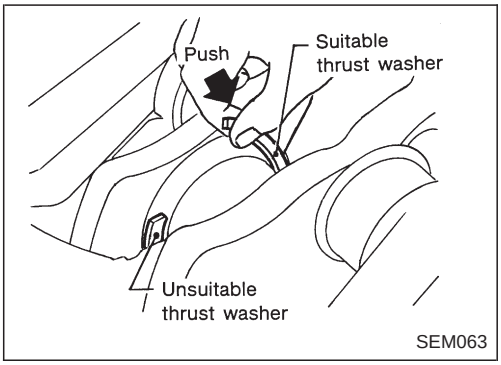
Standard

0.055 - 0.140 (0.0022 - 0.0055)

Limit

0.40 (0.0157)

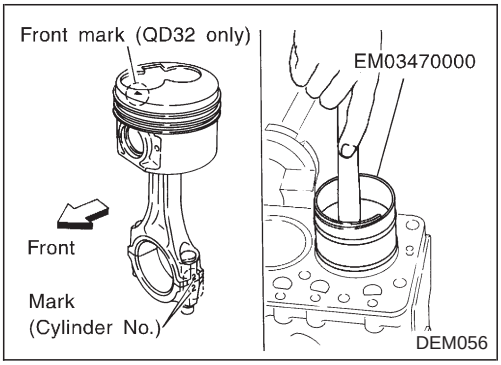
If beyond the limit, replace No. 4 main bearing thrust washer. Refer to SDS, EM-106.



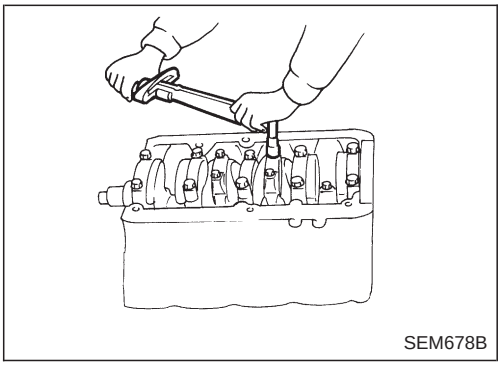
2. Install pistons with connecting rods.

(1) Install them into corresponding cylinder using Tool.

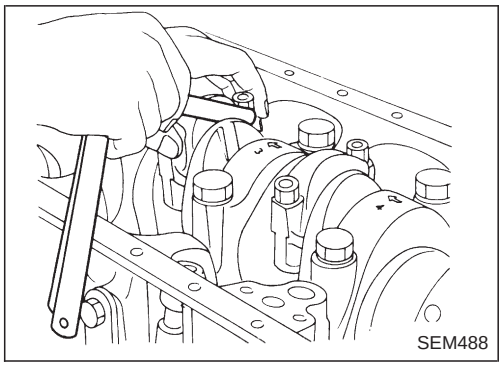
- **Be careful not to scratch cylinder wall with connecting rod.**
- **Insert the connecting rod. Do not allow the larger end to touch the oil jet.**
- **Apply engine oil to cylinder wall, piston and bearing.**
- **The leaf type combustion chamber on piston head must be at right side of engine.**



(2) Install connecting rod bearing caps.



Assembly (Cont'd)

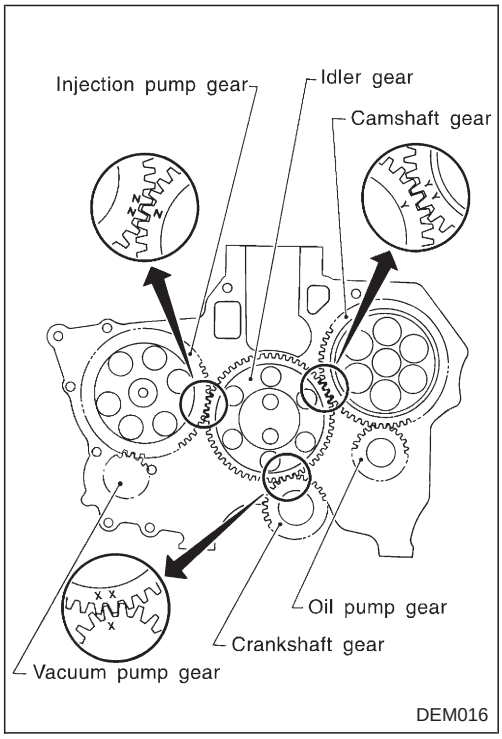

SEM488

3. Measure connecting rod side clearance.
   Connecting rod side clearance: mm (in)
   Standard
   0.10 - 0.22 (0.0039 - 0.0087)
   Limit
   0.22 (0.0087)

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

GEAR TRAIN

1. Set No. 1 piston at TDC on its compression stroke.
2. Align each gear mark and install gears.

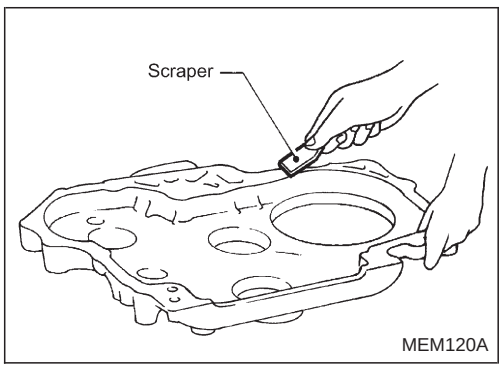


DEM016

TIMING GEAR CASE

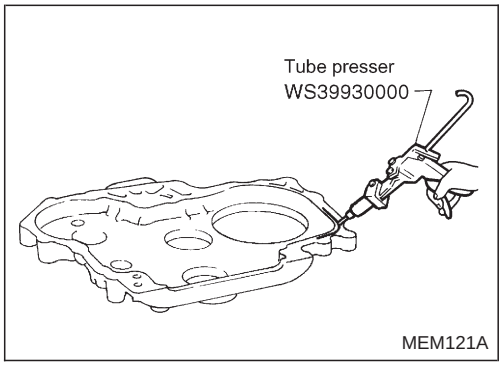
Installation

1. Before installing timing gear case, remove all traces of liquid gasket from mating surface using a scraper.
   Also remove traces of liquid gasket from mating surface of front plate.



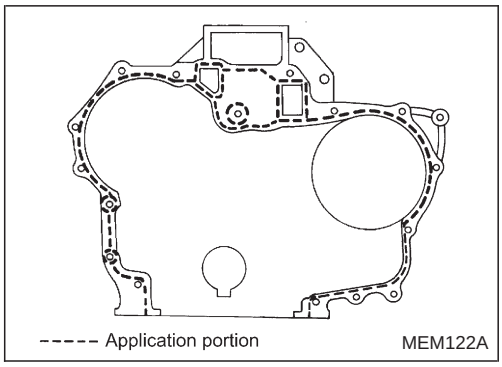
MEM120A

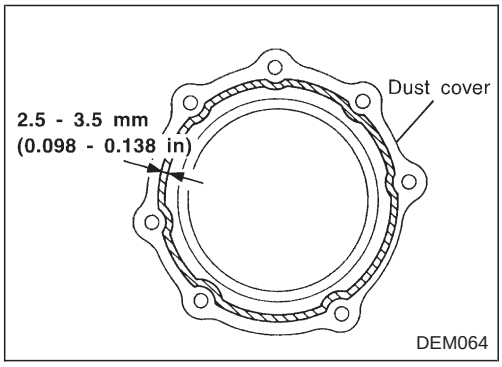
2. Apply a continuous bead of liquid gasket to mating surface of timing gear case and dust cover.

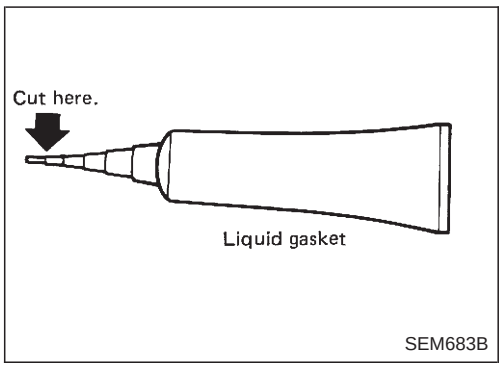


MEM121A

Assembly (Cont'd)







- **Be sure liquid gasket diameter is 2.5 to 3.5 mm (0.098 to 0.138 in).**
- **Attach timing gear case to front plate within 10 minutes after coating.**
- **Wait at least 30 minutes before refilling engine coolant or starting engine.**
- **Use Genuine Liquid Gasket or equivalent.**

General Specifications

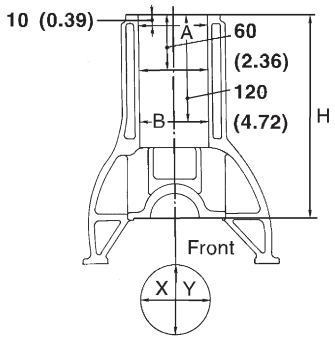
Cylinder arrangement		4, in-line
Displacement	cm^3 (cu in)	2,389 (145.78)
Bore x stroke	mm (in)	89 x 96 (3.50 x 3.78)
Valve arrangement		OHC
Firing order		1-3-4-2
Number of piston rings		
Compression		2
Oil		1
Number of main bearings		5
Compression ratio		8.6

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

Compression pressure	
Standard	1,324 (13.24, 13.5, 192)/300
Minimum	981 (9.8, 10, 142)/300
Differential limit between cylinders	98 (0.98, 1.0, 14)/300

Inspection and Adjustment

CYLINDER BLOCK



SEM618F

Unit: mm (in)

			Standard	Limit
Distortion			—	0.1 (0.004)
Cylinder bore	Inner diameter	Grade 1	89.000 - 89.010 (3.5039 - 3.5043)	0.2 (0.008)*
		Grade 2	89.010 - 89.020 (3.5043 - 3.5047)	
		Grade 3	89.020 - 89.030 (3.5047 - 3.5051)	
	Out-of-round (X − Y)		Less than 0.015 (0.0006)	—
	Taper (A − B)		Less than 0.010 (0.0004)	—
Difference in inner diameter between cylinders			Less than 0.05 (0.0020)	0.2 (0.008)
Piston-to-cylinder clearance			0.010 - 0.020 (0.0004 - 0.0008)	—
Cylinder block height (From crankshaft center)			246.95 - 247.05 (9.7224 - 9.7264)	0.2 (0.008)**

* Wear limit
** Total amount of cylinder head resurfacing and cylinder block resurfacing

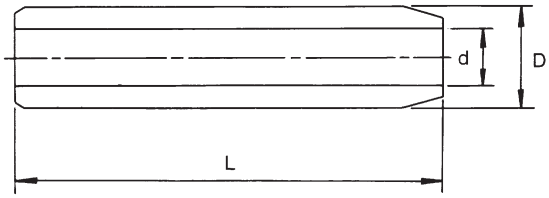
CYLINDER HEAD

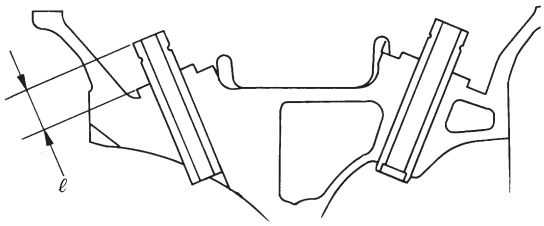
Unit: mm (in)

	Standard	Limit
Height (H)	98.8 - 99.0 (3.890 - 3.898)	0.2 (0.008)*
Surface distortion	0.03 (0.0012)	0.1 (0.004)

* Total amount of cylinder head resurfacing and cylinder block resurfacing

VALVE GUIDE



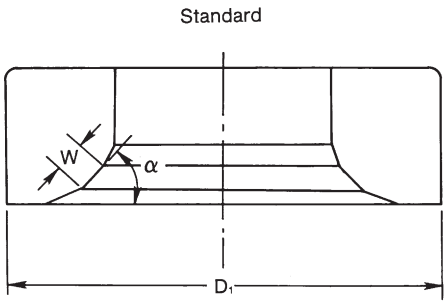


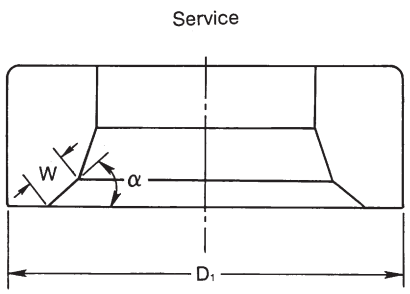
SEM401E

Unit: mm (in)

	Standard		Service		Limit
	Intake	Exhaust	Intake	Exhaust	—
Length (L)	52.6 (2.071)	56.0 (2.205)	52.6 (2.071)	56.0 (2.205)	—
Outer diameter (D)	11.023 - 11.034 (0.4340 - 0.4344)	12.023 - 12.034 (0.4733 - 0.4738)	11.223 - 11.234 (0.4418 - 0.4423)	12.223 - 12.234 (0.4812 - 0.4817)	—
Inner diameter (d) (Finished size)	7.000 - 7.018 (0.2756 - 0.2763)	8.000 - 8.018 (0.3150 - 0.3157)	7.000 - 7.018 (0.2756 - 0.2763)	8.000 - 8.018 (0.3150 - 0.3157)	—
Cylinder head hole diameter	10.975 - 10.996 (0.4321 - 0.4329)	11.975 - 11.996 (0.4715 - 0.4723)	11.175 - 11.196 (0.4400 - 0.4408)	12.175 - 12.196 (0.4793 - 0.4802)	—
Interference fit	0.027 - 0.059 (0.0011 - 0.0023)				—
Stem to guide clearance	0.020 - 0.053 (0.0008 - 0.0021)	0.040 - 0.070 (0.0016 - 0.0028)	0.020 - 0.053 (0.0008 - 0.0021)	0.040 - 0.070 (0.0016 - 0.0028)	0.1 (0.004)
Tapping length (ℓ)	14.9 - 15.1 (0.587 - 0.594)				

VALVE SEAT



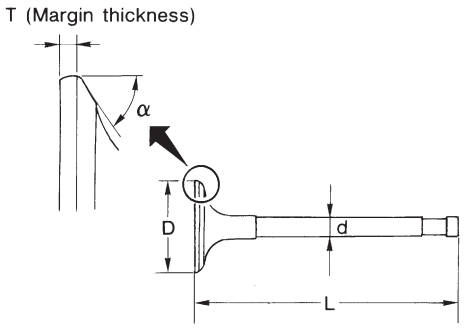


SEM402E

Unit: mm (in)

	Standard		Service	
	Intake	Exhaust	Intake	Exhaust
Cylinder head seat recess diameter	36.000 - 36.016 (1.4173 - 1.4179)	42.000 - 42.016 (1.6535 - 1.6542)	36.500 - 36.516 (1.4370 - 1.4376)	42.500 - 42.516 (1.6732 - 1.6739)
Valve seat outer diameter (D_1)	36.080 - 36.096 (1.4205 - 1.4211)	42.080 - 42.096 (1.6567 - 1.6573)	36.580 - 36.596 (1.4402 - 1.4408)	42.580 - 42.596 (1.6764 - 1.6770)
Face angle (α)	45°	45°	45°	45°
Contacting width (W)	1.6 - 1.7 (0.063 - 0.067)	1.7 - 2.1 (0.067 - 0.083)	1.6 - 1.7 (0.063 - 0.067)	1.7 - 2.1 (0.067 - 0.083)

VALVE



SEM188A

Unit: mm (in)

		Standard	Limit
Valve head diameter (D)	In.	34.0 - 34.2 (1.339 - 1.346)	—
	Ex.	40.0 - 40.2 (1.575 - 1.583)	—
Valve length (L)	In.	121.05 - 121.65 (4.7657 - 4.7894)	—
	Ex.	122.02 - 122.62 (4.8039 - 4.8275)	—
Valve stem diameter (d)	In.	6.965 - 6.980 (0.2742 - 0.2748)	—
	Ex.	7.948 - 7.960 (0.3129 - 0.3134)	—
Valve face angle (α)	In.	45°15′ - 45°45′	—
	Ex.	45°15′ - 45°45′	—
Valve head margin (T)	In.	1.15 - 1.45 (0.0453 - 0.0571)	0.5 (0.020)
	Ex.	1.35 - 1.65 (0.0531 - 0.0650)	
Valve clearance		0 (0)	

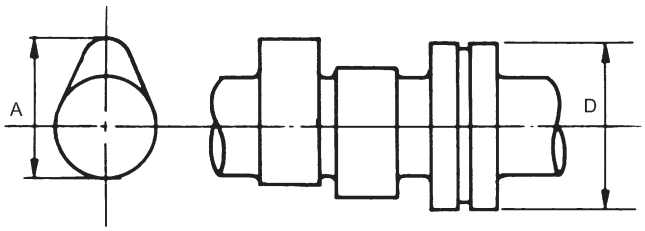
VALVE SPRING

Unit: mm (in)

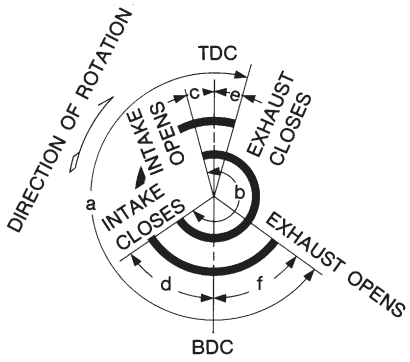
		Standard		Limit	
		Intake	Exhaust	Intake	Exhaust
Free height (H)	Outer	57.44 (2.2614)	53.21 (2.0949)	—	—
	Inner	53.34 (2.1000)	47.95 (1.8878)	—	—
Pressure N (kg, lb) at height	Outer	604.1 (61.6, 135.8) at 37.6 (1.480)	640.4 (65.3, 144.0) at 34.1 (1.343)	567.8 (57.9, 127.7) at 37.6 (1.480)	620.8 (63.3, 139.6) at 34.1 (1.343)
	Inner	284.4 (29.0, 63.9) at 32.6 (1.283)	328.5 (33.5, 73.9) at 29.1 (1.146)	266.8 (27.2, 60.0) at 32.6 (1.283)	318.7 (32.5, 71.7) at 29.1 (1.146)
Out-of-square	Outer	—	—	2.5 (0.098)	2.3 (0.091)
	Inner	—	—	2.3 (0.091)	2.1 (0.083)

Inspection and Adjustment (Cont'd)

CAMSHAFT AND CAMSHAFT BEARING



SEM568A



EM120

Unit: mm (in)

		Standard	Limit
Cam height (A)		44.43 - 44.58 (1.7492 - 1.7551)	—
Valve lift (h)		9.7 (0.382)	—
Wear limit of cam height		—	0.2 (0.008)
Camshaft journal to bearing clearance		0.045 - 0.090 (0.0018 - 0.0035)	0.12 (0.0047)
Inner diameter of camshaft bearing		33.000 - 33.025 (1.2992 - 1.3002)	—
Outer diameter of camshaft journal (D)		32.935 - 32.955 (1.2967 - 1.2974)	—
Camshaft runout		0 - 0.02 (0 - 0.0008)	—
Camshaft end play		0.07 - 0.15 (0.0028 - 0.0059)	0.2 (0.008)
Valve timing (Degree on crankshaft)	a	232	—
	b	232	—
	c	−5	—
	d	57	—
	e	11	—
	f	41	—

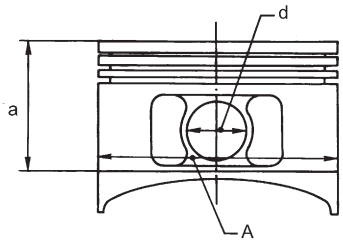
ROCKER ARM AND ROCKER SHAFT

Unit: mm (in)

Rocker arm to shaft clearance	0.012 - 0.050 (0.0005 - 0.0020)
Rocker shaft diameter	21.979 - 22.000 (0.8653 - 0.8661)
Rocker arm rocker shaft hole diameter	22.012 - 22.029 (0.8666 - 0.8673)

PISTON, PISTON RING AND PISTON PIN

Piston



SEM444C

Unit: mm (in)

Piston skirt diameter (A)	Standard	Grade No. 1	88.970 - 88.980 (3.5027 - 3.5031)
		Grade No. 2	88.980 - 88.990 (3.5031 - 3.5035)
		Grade No. 3	88.990 - 89.000 (3.5035 - 3.5039)
	Service (Oversize)	0.5 (0.020)	89.470 - 89.500 (3.5224 - 3.5236)
		1.0 (0.039)	89.970 - 90.000 (3.5421 - 3.5433)
Dimension (a)		Approximately 52 (2.05)	
Piston pin hole diameter (d)		21.002 - 21.008 (0.8268 - 0.8271)	
Piston-to-cylinder bore clearance		0.020 - 0.040 (0.0008 - 0.0016)	

Piston pin

Unit: mm (in)

	Standard
Piston pin outer diameter	20.993 - 20.998 (0.8265 - 0.8267)
Pin to piston pin hole clearance	0.008 - 0.012 (0.0003 - 0.0005)
Piston pin to connecting rod clearance	−0.015 to −0.033 (−0.0006 to −0.0013)

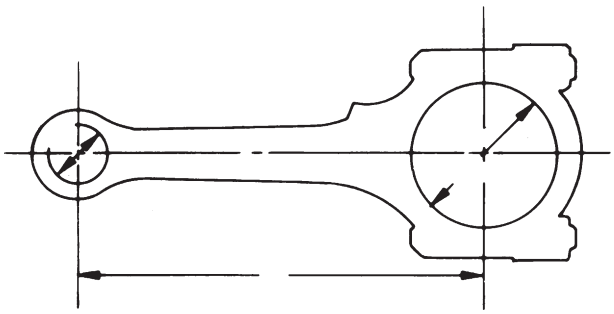
Piston ring

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.010 - 0.030 (0.0004 - 0.0012)	0.1 (0.004)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
	Oil	0.085 - 0.115 (0.0033 - 0.0045)*	0.1 (0.004)
Ring gap	Top	0.28 - 0.43 (0.0110 - 0.0169)	0.5 (0.020)
	2nd	0.45 - 0.60 (0.0177 - 0.0236)	0.5 (0.020)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.5 (0.020)

*: Riken-make

CONNECTING ROD

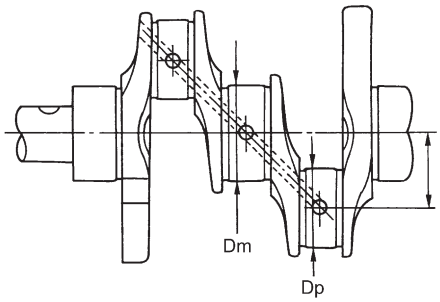


SEM216E

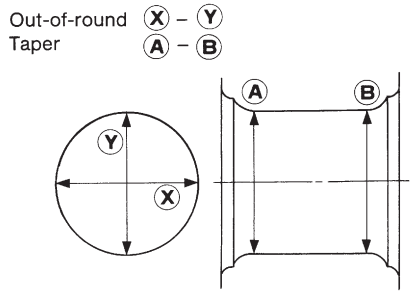
Unit: mm (in)

	Standard	Limit
Center distance (S)	164.95 - 165.05 (6.4941 - 6.4980)	—
Bend [per 100 mm (3.94 in)]	—	0.15 (0.0059)
Torsion [per 100 mm (3.94 in)]	—	0.3 (0.012)
Small end inner diameter (d)	20.965 - 20.978 (0.8254 - 0.8259)	—
Connecting rod big end inner diameter (D)	53.000 - 53.013 (2.0866 - 2.0871)	—
Side clearance	0.2 - 0.4 (0.008 - 0.016)	0.6 (0.024)

CRANKSHAFT



SEM394



EM715

Unit: mm (in)

Main journal diameter (Dm)	Grade	No. 0	59.967 - 59.975 (2.3609 - 2.3612)	
		No. 1	59.959 - 59.967 (2.3606 - 2.3609)	
		No. 2	59.951 - 59.959 (2.3603 - 2.3606)	
Pin journal diameter (Dp)	Grade	No. 0	49.968 - 49.974 (1.9672 - 1.9675)	
		No. 1	49.962 - 49.968 (1.9670 - 1.9672)	
		No. 2	49.956 - 49.962 (1.9668 - 1.9670)	
Center distance (r)			47.95 - 48.05 (1.8878 - 1.8917)	
			Standard	Limit
Taper of journal and pin [Ⓐ – Ⓑ]		Journal	—	0.01 (0.0004)
		Pin	—	0.005 (0.0002)
Out-of-round of journal and pin [Ⓧ – Ⓨ]		Journal	—	0.01 (0.0004)
		Pin	—	0.005 (0.0002)
Runout [TIR]*			—	0.10 (0.0039)
Free end play			0.05 - 0.18 (0.0020 - 0.0071)	0.3 (0.012)
Fillet roil			More than 0.1 (0.004)	

* Total indicator reading

BEARING CLEARANCE

Unit: mm (in)

	Standard	Limit
Main bearing clearance	0.020 - 0.047 (0.0008 - 0.0019)	0.1 (0.004)
Connecting rod bearing clearance	0.010 - 0.035 (0.0004 - 0.0014)	0.09 (0.0035)

AVAILABLE MAIN BEARING

Standard

Grade number	Thickness mm (in)	Identification color
0	1.821 - 1.825 (0.0717 - 0.0719)	Black
1	1.825 - 1.829 (0.0719 - 0.0720)	Brown
2	1.829 - 1.833 (0.0720 - 0.0722)	Green
3	1.833 - 1.837 (0.0722 - 0.0723)	Yellow
4	1.837 - 1.841 (0.0723 - 0.0725)	Blue

Undersize (service)

Unit: mm (in)

	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	1.952 - 1.960 (0.0769 - 0.0772)	Grind so that bearing clearance is the specified value.

AVAILABLE CONNECTING ROD BEARING

Standard

Grade number	Thickness mm (in)	Identification color
0	1.505 - 1.508 (0.0593 - 0.0594)	—
1	1.508 - 1.511 (0.0594 - 0.0595)	Brown
2	1.511 - 1.514 (0.0595 - 0.0596)	Green

Undersize (service)

Unit: mm (in)

	Thickness	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.540 - 1.548 (0.0606 - 0.0609)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.560 - 1.568 (0.0614 - 0.0617)	
0.25 (0.0098)	1.625 - 1.633 (0.0640 - 0.0643)	

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Camshaft sprocket runout	[TIR]*	Less than 0.12 (0.0047)
Flywheel runout	[TIR]*	Less than 0.1 (0.004)

* Total indicator reading

General Specifications

Engine model		TD25
Cylinder arrangement		In-line
Number of cylinders		4
Valve arrangement		OHV
Bore x stroke	mm (in)	92.9 x 92.0 (3.657 x 3.622)
Displacement	cm^3 (cu in)	2,494 (152.18)
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		5

Inspection and Adjustment

COMPRESSION PRESSURE

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

Standard	2,942 (29.4, 30, 427)/200
Minimum	2,452 (24.5, 25, 356)/200
Differential limit between cylinders	294 (2.9, 3, 43)/200

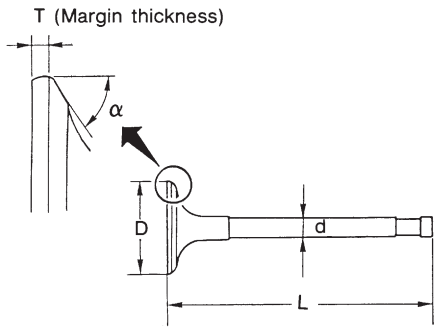
CYLINDER HEAD

Unit: mm (in)

	Standard	Limit
Head surface distortion	Less than 0.07 (0.0028)	0.2 (0.008)
Nominal cylinder head height	89.9 - 90.1 (3.539 - 3.547)	

VALVE

Unit: mm (in)



SEM188

Engine	TD25
Valve head diameter "D"	
Intake	41.4 - 41.6 (1.630 - 1.638)
Exhaust	36.9 - 37.1 (1.453 - 1.461)
Valve length "L"	
Intake	117 (4.61)
Exhaust	
Valve stem diameter "d"	
Intake	7.962 - 7.977 (0.3135 - 0.3141)
Exhaust	7.945 - 7.960 (0.3128 - 0.3134)
Valve seat angle "α"	
Intake	45° - 45°30′
Exhaust	
Valve margin "T" limit	0.5 (0.020)
Valve stem end surface grinding limit	0.2 (0.008)
Valve clearance (Hot)	
Intake	0.35 (0.0138)
Exhaust	

Inspection and Adjustment (Cont'd)

Valve guide

Unit: mm (in)

	Standard	Service
Valve guide outside diameter	12.033 - 12.044 (0.4737 - 0.4742)	—
Valve guide inner diameter (Finished size)	8.000 - 8.015 (0.3150 - 0.3156)	
Cylinder head valve guide hole diameter	12.00 - 12.011 (0.4724 - 0.4729)	—
Interference fit of valve guide	0.022 - 0.044 (0.0009 - 0.0017)	
	Standard	Max. tolerance
Stem to guide clearance		
Intake	0.023 - 0.053 (0.0009 - 0.0021)	0.15 (0.0059)
Exhaust	0.04 - 0.07 (0.0016 - 0.0028)	0.20 (0.0079)
Valve deflection limit		
Intake	0.30 (0.0118)	
Exhaust	0.40 (0.0157)	

Valve spring

Free length mm (in)	
Painted red	53.4 (2.102)
Pressure height mm/N (mm/kg, in/lb)	
Painted red	31.8/713.9 - 788.5 (31.8/72.8 - 80.4, 1.252/160.5 - 177.3)
Assembled height mm/N (mm/kg, in/lb)	
Standard	42.3/314.8 - 361.9 (42.3/32.1 - 36.9, 1.665/70.8 - 81.4)
Limit	42.3/270.7 (42.3/27.6, 1.665/60.9)
Out-of-square mm (in)	2.3 (0.091)

VALVE LIFTER AND PUSH ROD

Unit: mm (in)

	Standard	Limit
Valve lifter outer diameter	25.960 - 25.970 (1.0220 - 1.0224)	—
Cylinder block valve lifter hole diameter	26.000 - 26.033 (1.0236 - 1.0249)	—
Valve lifter to lifter hole clearance	0.030 - 0.073 (0.0012 - 0.0029)	0.20 (0.0079)
Push rod bend (TIR)*	Less than 0.3 (0.012)	0.5 (0.020)

*: Total indicator reading

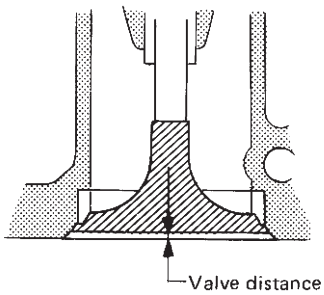
Rocker shaft and rocker arm

Unit: mm (in)

	Standard	Limit
Rocker shaft		
Outer diameter	19.979 - 20.00 (0.7866 - 0.7874)	—
Rocker shaft bend (TIR)	0 - 0.15 (0 - 0.0059)	Less than 0.30 (0.0118)
Rocker arm		
Inner diameter	20.014 - 20.035 (0.7880 - 0.7888)	—
Clearance between rocker arm and rocker shaft	0.014 - 0.056 (0.0006 - 0.0022)	0.15 (0.0059)

CYLINDER HEAD TO VALVE DISTANCE

Unit: mm (in)



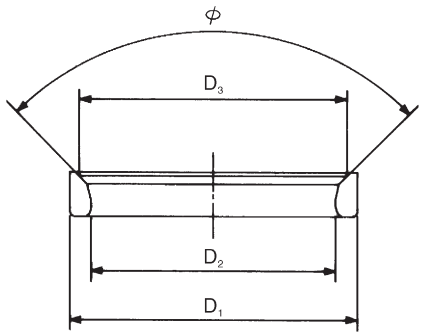
SEM724C

	Standard	Limit
Intake	0.7 - 1.3 (0.028 - 0.051)	1.70 (0.067)
Exhaust	0.7 - 1.3 (0.028 - 0.051)	1.70 (0.067)

Inspection and Adjustment (Cont'd)

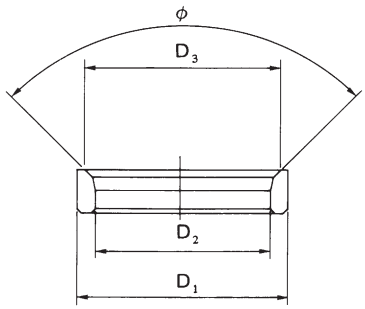
Valve seat

Unit: mm (in)



SEM258F

Intake	
Outer diameter "D_1"	42.535 - 42.545 (1.6746 - 1.6750)
Inner diameter "D_2"	35.9 - 36.1 (1.413 - 1.421)
Diameter of seat "D_3"	40.5 (1.594)
Cylinder head valve seat diameter	42.500 - 42.515 (1.6732 - 1.6738)
Valve seat face angle "ϕ"	89° - 90°



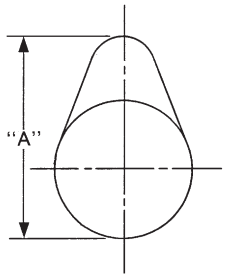
SEM953C

Exhaust	
Outer diameter "D_1"	
Standard	38.535 - 38.545 (1.5171 - 1.5175)
0.2 (0.008) Oversize (Service)	38.735 - 38.745 (1.5250 - 1.5254)
0.4 (0.016) Oversize (Service)	38.935 - 38.945 (1.5329 - 1.5333)
Inner diameter "D_2"	31.4 - 32.1 (1.236 - 1.264)
Diameter of seat "D_3"	36.0 (1.417)
Cylinder head valve seat diameter	
Standard	38.495 - 38.510 (1.5155 - 1.5161)
0.2 (0.008) Oversize	38.695 - 38.710 (1.5234 - 1.5240)
0.4 (0.016) Oversize	38.895 - 38.910 (1.5313 - 1.5319)
Valve seat face angle "ϕ"	89° - 90°

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard	Limit
Camshaft journal to bushing clearance [Oil clearance]	0.020 - 0.109 (0.0008 - 0.0043)	0.15 (0.0059)
Camshaft journal diameter		
Front	50.721 - 50.740 (1.9969 - 1.9976)	—
2nd	50.521 - 50.540 (1.9890 - 1.9898)	—
3rd	50.321 - 50.340 (1.9811 - 1.9819)	—
4th	50.121 - 50.140 (1.9733 - 1.9740)	—
Rear	49.921 - 49.940 (1.9654 - 1.9661)	—
Camshaft bend (Total indicator reading)	Less than 0.02 (0.0008)	0.06 (0.0024)
Camshaft end play	0.08 - 0.28 (0.0031 - 0.0110)	0.50 (0.0197)



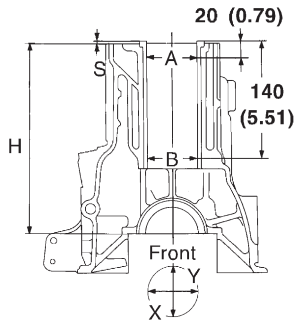
EM671

	Standard	Limit
Cam height "A"		
Intake & Exhaust	41.88 - 41.92 (1.6488 - 1.6504)	41.40 (1.6299)

Inspection and Adjustment (Cont'd)

CYLINDER BLOCK AND CYLINDER LINER

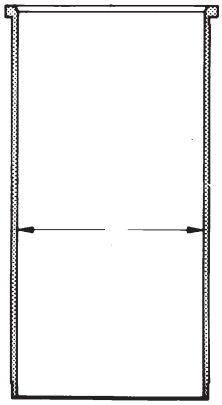
Unit: mm (in)



DEM057-N

Nominal cylinder block height "H" (From crankshaft center)	252.95 - 253.05 (9.9586 - 9.9626)
Surface flatness (Without cylinder liner)	
Standard	Less than 0.05 (0.0020)
Limit	0.2 (0.008)
Cylinder bore (Without cylinder liner)	
Inner diameter	
Standard	95.900 - 95.920 (3.7756 - 3.7764)
Cylinder bore	
Inner diameter	
Standard	
Grade No. 1	92.900 - 92.910 (3.6575 - 3.6579)
Grade No. 2	92.910 - 92.920 (3.6579 - 3.6583)
Grade No. 3	92.920 - 92.930 (3.6583 - 3.6587)
Wear limit	0.20 (0.0079)
Out-of-round (X − Y) standard	Less than 0.020 (0.0008)
Taper (A − B) standard	Less than 0.020 (0.0008)
Projection "S"	0.02 - 0.09 (0.0008 - 0.0035)
Deviation of each cylinder "S"	Less than 0.05 (0.0020)
Interference fit cylinder liner to block	−0.01 to 0.03 (−0.0004 to 0.0012)

Unit: mm (in)



SEM427

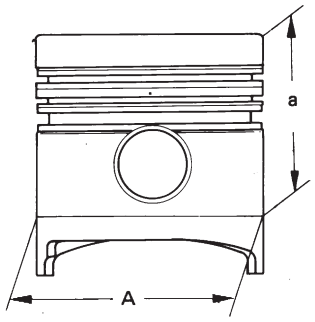
Cylinder liner diameter "D" (service)*	92.950 - 92.970 (3.6594 - 3.6602)

*: Before installing in cylinder block

PISTON, PISTON RING AND PISTON PIN

Available piston

Unit: mm (in)



SEM778A

Piston skirt diameter "A"	
Standard	
Grade No. 1	92.840 - 92.850 (3.6551 - 3.6555)
Grade No. 2	92.850 - 92.860 (3.6555 - 3.6559)
Grade No. 3*	92.860 - 92.870 (3.6559 - 3.6563)
"a" dimension	70 (2.76)
Piston pin hole diameter	29.997 - 30.005 (1.1810 - 1.1813)
Piston to cylinder liner clearance	0.05 - 0.07 (0.0020 - 0.0028)

*: Grade No. 3 piston is not provided as a service part.

Inspection and Adjustment (Cont'd)

Piston ring

Unit: mm (in)

		Standard	Limit
Side clearance			
Top		0.06 - 0.10 (0.0024 - 0.0039)	0.50 (0.0197)
2nd		0.04 - 0.08 (0.0016 - 0.0031)	0.30 (0.0118)
Oil		0.02 - 0.06 (0.0008 - 0.0024)	0.15 (0.0059)
Ring gap			
Top		0.30 - 0.45 (0.0118 - 0.0177)	1.5 (0.059)
2nd	QD & TD27	0.50 - 0.65 (0.0197 - 0.0256)	
	TD25	0.20 - 0.35 (0.0079 - 0.0138)	
Oil (rail ring)	QD & TD27	0.30 - 0.50 (0.0118 - 0.0197)	
	TD25	0.15 - 0.35 (0.0059 - 0.0138)	

Piston pin

Unit: mm (in)

Piston pin outer diameter	29.993 - 30.000 (1.1808 - 1.1811)
Piston pin to piston clearance	
Standard	−0.003 to 0.012 (−0.0001 to 0.0005)
Limit	0.10 (0.0039)
Piston pin to connecting rod clearance	
Standard	0.025 - 0.045 (0.0010 - 0.0018)
Limit	0.15 (0.0059)

CONNECTING ROD

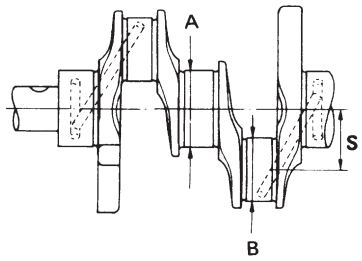
Unit: mm (in)

Center distance	156.975 - 157.025 (6.1801 - 6.1821)
Bend, torsion [per 100 (3.94)]	
Limit	0.075 (0.0030)
Piston pin bore dia.	30.025 - 30.038 (1.1821 - 1.1826)
Side clearance	
Standard	0.10 - 0.22 (0.0039 - 0.0087)
Limit	0.22 (0.0087)

Inspection and Adjustment (Cont'd)

CRANKSHAFT

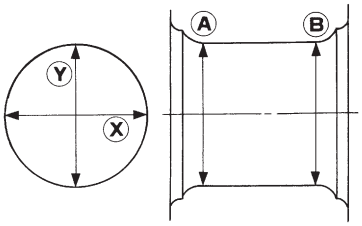
Unit: mm (in)



SEM100A

Journal diameter "A"	70.907 - 70.920 (2.7916 - 2.7921)
Pin diameter "B"	56.913 - 56.926 (2.2407 - 2.2412)
Center distance "S"	46.00 (1.8110)

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



EM715

Taper of journal and pin "A – B"	
Standard	0.01 (0.0004)
Limit	0.02 (0.0008)
Out-of-round of journal and pin "X – Y"	
Standard	0.01 (0.0004)
Limit	0.02 (0.0008)
Crankshaft bend	
Standard	0 - 0.03 (0 - 0.0012)
Limit	0.10 (0.0039)
Crankshaft end play	
Standard	0.055 - 0.14 (0.0022 - 0.0055)
Limit	0.40 (0.0157)

AVAILABLE MAIN BEARING

Bearing clearance

Unit: mm (in)

Main bearing clearance	
Standard	0.035 - 0.087 (0.0014 - 0.0034)
Limit	0.15 (0.0059)
Connecting rod bearing clearance	
Standard	0.035 - 0.081 (0.0014 - 0.0032)
Limit	0.15 (0.0059)

Main bearing undersize

Unit: mm (in)

	Crank journal diameter
Standard	70.907 - 70.920 (2.7916 - 2.7921)
Undersize	
0.25 (0.0098)	70.657 - 70.670 (2.7818 - 2.7823)
0.50 (0.0197)	70.407 - 70.420 (2.7719 - 2.7724)
0.75 (0.0295)	70.157 - 70.170 (2.7621 - 2.7626)
1.00 (0.0394)	69.907 - 69.920 (2.7522 - 2.7528)

AVAILABLE CONNECTING ROD BEARING

Connecting rod bearing undersize

Unit: mm (in)

	Crank pin journal diameter
Standard	56.913 - 56.926 (2.2407 - 2.2412)
Undersize	
0.25 (0.0098)	56.663 - 56.676 (2.2308 - 2.2313)
0.50 (0.0197)	56.413 - 56.676 (2.2210 - 2.2313)
0.75 (0.0295)	56.163 - 56.176 (2.2111 - 2.2116)
1.00 (0.0394)	55.913 - 55.926 (2.2013 - 2.2018)

Inspection and Adjustment (Cont'd)

AVAILABLE THRUST WASHER

Thrust washer undersize

Unit: mm (in)

	Thrust washer thickness
Standard	
Stamped mark A	2.275 - 2.325 (0.0896 - 0.0915)
B	2.300 - 2.350 (0.0906 - 0.0925)
C	2.325 - 2.375 (0.0915 - 0.0935)
Oversize	
0.20 (0.0079)	2.475 - 2.525 (0.0974 - 0.0994)
0.40 (0.0157)	2.675 - 2.725 (0.1053 - 0.1073)

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Gear train	
Backlash of each gear	0.07 - 0.11 (0.0028 - 0.0043)
Limit	0.20 (0.0079)
Flywheel	
Runout (Total indicator reading)	Less than 0.15 (0.0059)
Front plate	
Warpage limit	0.2 (0.008)