

SECTION **EM**

CONTENTS

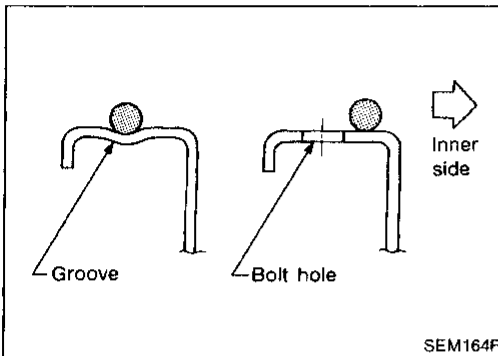
<p>PRECAUTIONS..... 2</p> <p style="padding-left: 20px;">Parts Requiring Angular Tightening 2</p> <p style="padding-left: 20px;">Liquid Gasket Application Procedure 2</p> <p>PREPARATION..... 3</p> <p style="padding-left: 20px;">Special Service Tools 3</p> <p style="padding-left: 20px;">Commercial Service Tools 6</p> <p>OUTER COMPONENT PARTS 7</p> <p>COMPRESSION PRESSURE.....10</p> <p style="padding-left: 20px;">Measurement of Compression Pressure.....10</p> <p>OIL PAN11</p> <p style="padding-left: 20px;">Removal.....11</p> <p style="padding-left: 20px;">Installation14</p> <p>TIMING CHAIN16</p> <p style="padding-left: 20px;">Removal.....17</p> <p style="padding-left: 20px;">Inspection21</p> <p style="padding-left: 20px;">Installation21</p> <p>OIL SEAL REPLACEMENT30</p>	<p>CYLINDER HEAD32</p> <p style="padding-left: 20px;">Removal.....33</p> <p style="padding-left: 20px;">Disassembly33</p> <p style="padding-left: 20px;">Inspection35</p> <p style="padding-left: 20px;">Assembly40</p> <p style="padding-left: 20px;">Installation44</p> <p>ENGINE REMOVAL.....45</p> <p style="padding-left: 20px;">Removal.....46</p> <p style="padding-left: 20px;">Installation47</p> <p>CYLINDER BLOCK.....48</p> <p style="padding-left: 20px;">Disassembly49</p> <p style="padding-left: 20px;">Inspection49</p> <p style="padding-left: 20px;">Assembly57</p> <p>SERVICE DATA AND SPECIFICATIONS (SDS).....60</p> <p style="padding-left: 20px;">General Specifications.....60</p> <p style="padding-left: 20px;">Inspection and Adjustment60</p>
---	--

GI
MA
EM
LC
EC
FE
CL
MT
AT
FA
RA
BR
ST
RS
BT
HA
EL
IDX

PRECAUTIONS

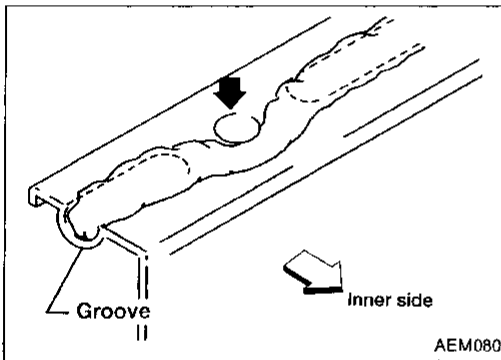
Parts Requiring Angular Tightening

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



Liquid Gasket Application Procedure

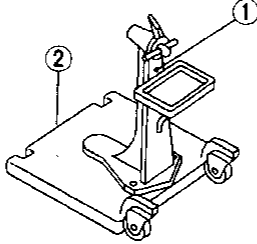
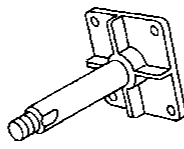
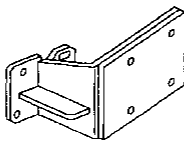
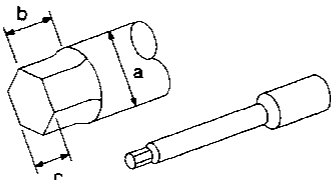
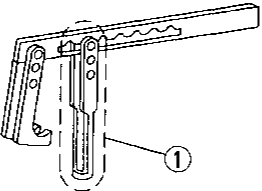
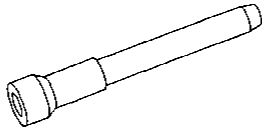
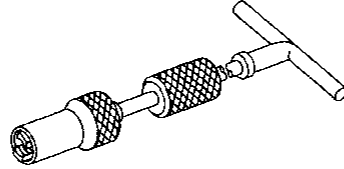
- a. Use a scraper to remove all traces of old liquid gasket from mating surfaces and grooves. Also, completely clean any oil from these areas.
- b. Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)
 - Be sure liquid gasket is 4.0 to 5.0 mm (0.157 to 0.197 in) wide (for oil pan).
 - Be sure liquid gasket is 2.0 to 3.0 mm (0.079 to 0.118 in) wide (in areas except oil pan).
- 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.



PREPARATION


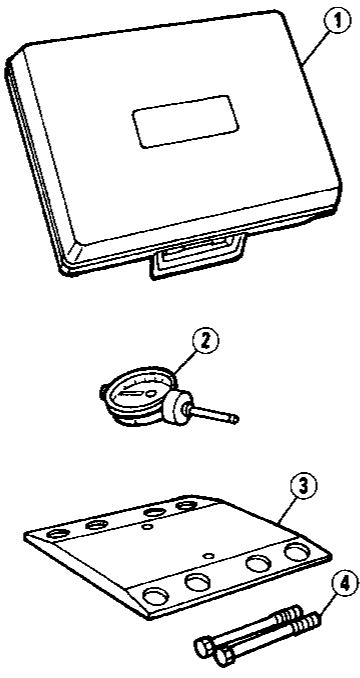
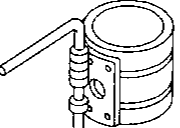
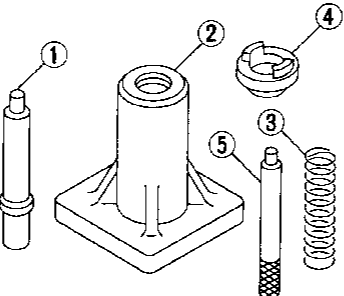
Special Service Tools

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

Tool number (Kent-Moore No.) Tool name	Description	
ST0501S000 (—) Engine stand assembly ① ST05011000 (—) Engine stand ② ST05012000 (—) Base	 NT042	Disassembling and assembling EM LC EC FE
KV10106500 (—) Engine stand shaft	 NT028	CL MT
KV10115300 (—) Engine sub-attachment	 NT008	AT FA
ST10120000 (J24239-01) Cylinder head bolt wrench	 NT583	Loosening and tightening cylinder head bolt a: 13 (0.51) dia. b: 12 (0.47) c: 10 (0.39) Unit: mm (in)
KV10116200 (J26336-A) Valve spring compressor ① KV10115900 (J26336-20) Attachment	 NT022	Disassembling valve mechanism ST RS
(J38958) Valve oil seal drift	 NT024	Installing valve oil seal BT HA
KV10107902 (J38959) Valve oil seal puller	 NT011	Displacement valve lip seal EL IDX

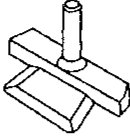
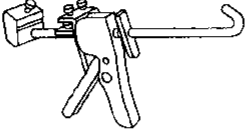
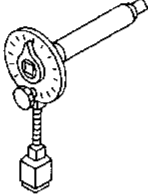
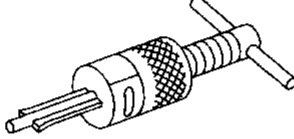
PREPARATION

Special Service Tools (Cont'd)

Tool number (Kent-Moore No.) Tool name	Description
KV10115700 (J38957) Dial gauge stand	<div style="text-align: right;">Adjusting shims</div>  <p style="text-align: left;">NT012</p>
(J38957-N) Valve shim gauge plate kit ① (J35772) Plastic case ② (J38957-8) Dial indicator ③ (J38957-1) Plate ④ Hex bolts	<div style="text-align: right;">Measuring valve shims</div>  <p style="text-align: left;">AEM168</p>
EM03470000 (J8037) Piston ring compressor	<div style="text-align: right;">Installing piston assembly into cylinder bore</div>  <p style="text-align: left;">NT044</p>
KV10107400 (J26365-12, J26365) Piston pin press stand ① KV10107310 (—) Center shaft ② ST13040020 (—) Stand ③ ST13040030 (—) Spring ④ KV10107320 (—) Cap ⑤ ST13040050 (—) Drift	<div style="text-align: right;">Disassembling and assembling piston pin</div>  <p style="text-align: left;">NT013</p>

PREPARATION

Special Service Tools (Cont'd)

Tool number (Kent-Moore No.) Tool name	Description	
KV10111100 (J37228) Seal cutter	 NT046	GI MA EM
WS39930000 (—) Tube presser	 NT052	LC EC
KV10112100 (BT-8653-A) Angle wrench	 NT014	FE CL MT
ST16610001 (J23907) Pilot bushing puller	 NT045	AT FA

RA

BR

ST

RS

BT

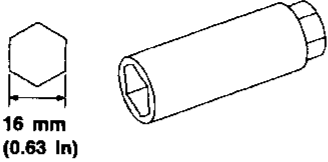
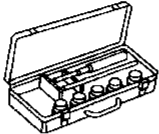
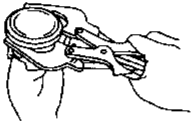
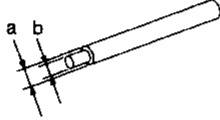
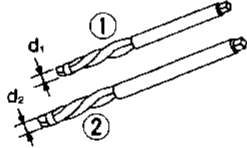
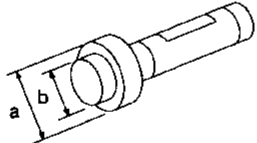
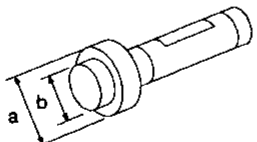
HA

EL

IDX

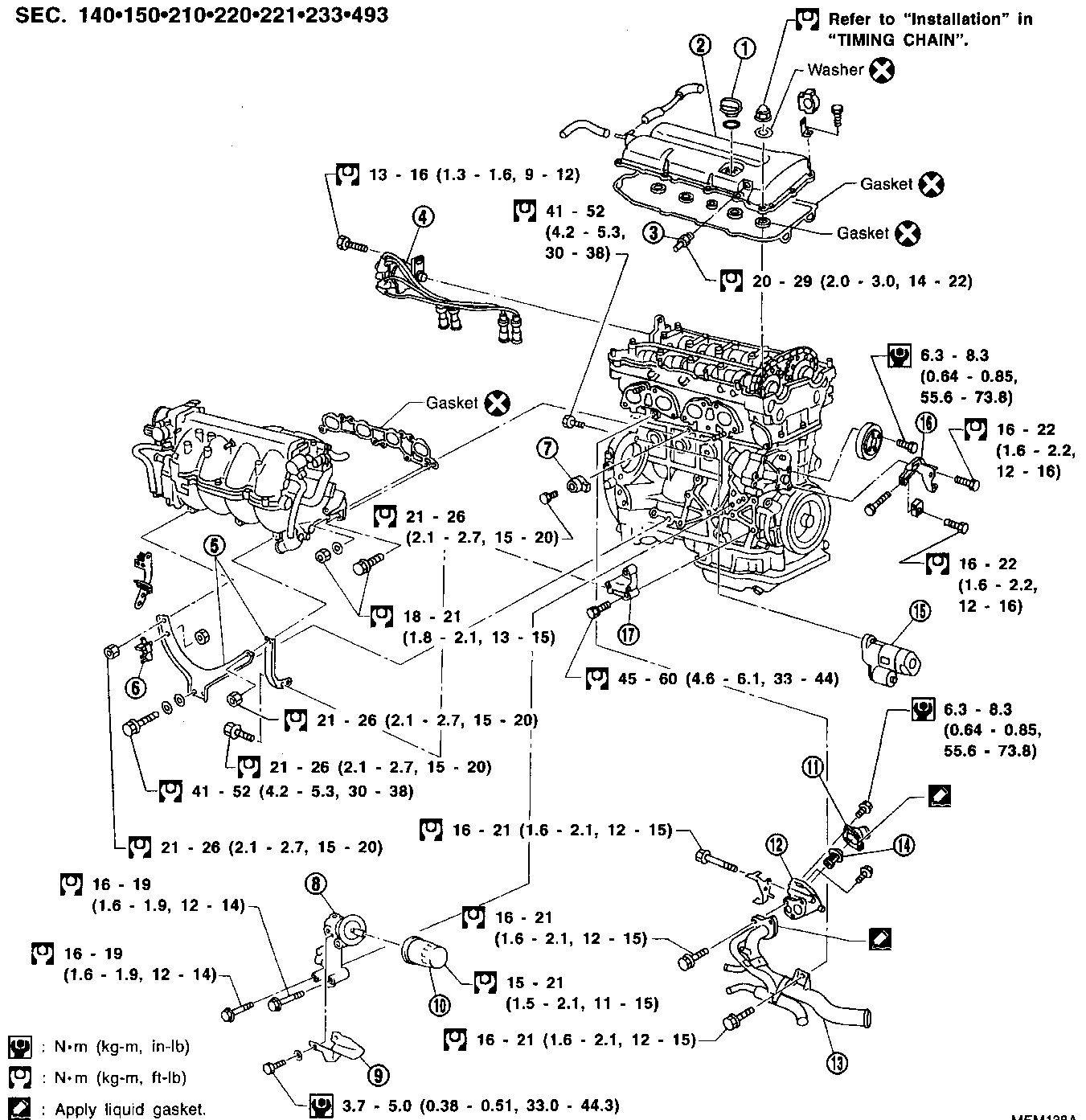
PREPARATION

Commercial Service Tools

Tool name	Description
Spark plug wrench	 <p style="text-align: center;">16 mm (0.63 in)</p> <p style="text-align: center;">NT047</p> <p style="text-align: right;">Removing and installing spark plug</p>
Valve seat cutter set	 <p style="text-align: center;">NT048</p> <p style="text-align: right;">Finishing valve seat dimensions</p>
Piston ring expander	 <p style="text-align: center;">NT030</p> <p style="text-align: right;">Removing and installing piston ring</p>
Valve guide drift	 <p style="text-align: center;">NT015</p> <p style="text-align: right;">Removing and installing valve guide</p> <p style="text-align: right;">Intake & Exhaust a = 9.5 mm (0.374 in) dia. b = 5.0 mm (0.197 in) dia.</p>
Valve guide reamer	 <p style="text-align: center;">NT016</p> <p style="text-align: right;">Reaming valve guide ① or hole for over-size valve guide ②</p> <p style="text-align: right;">Intake & Exhaust d₁ = 6.0 mm (0.236 in) dia. d₂ = 10.175 mm (0.4006 in) dia.</p>
Front oil seal drift	 <p style="text-align: center;">NT049</p> <p style="text-align: right;">Installing front oil seal</p> <p style="text-align: right;">a = 75 mm (2.95 in) dia. b = 45 mm (1.77 in) dia.</p>
Rear oil seal drift	 <p style="text-align: center;">NT049</p> <p style="text-align: right;">Installing rear oil seal</p> <p style="text-align: right;">a = 110 mm (4.33 in) dia. b = 80 mm (3.15 in) dia.</p>

OUTER COMPONENT PARTS

SEC. 140•150•210•220•221•233•493



- ① Oil filler cap
- ② Rocker cover
- ③ PCV valve
- ④ Camshaft position sensor, ignition coil and power transistor built into distributor
- ⑤ Intake manifold supports

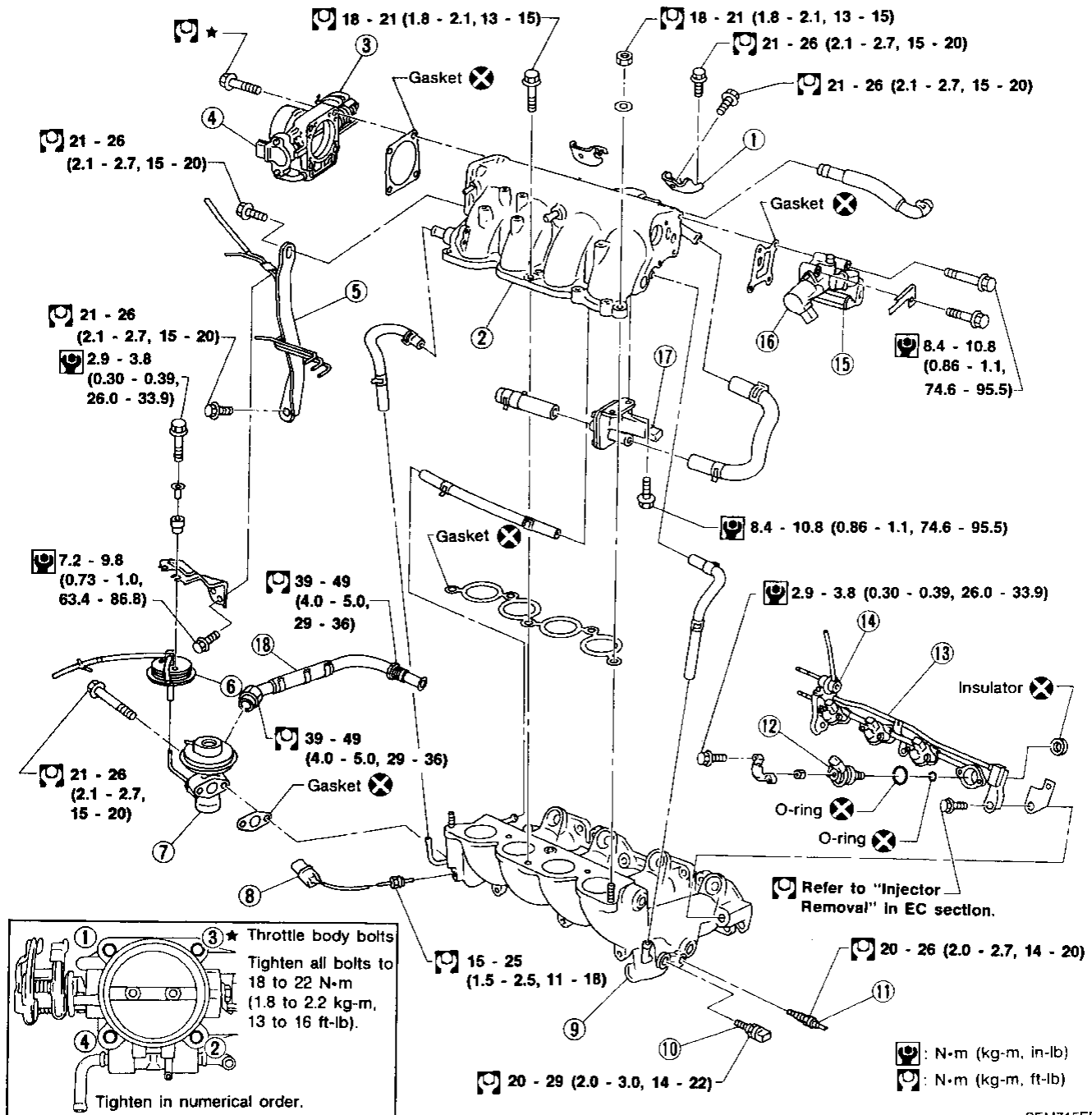
- ⑥ EGR & EVAP canister purge control solenoid valve
- ⑦ Knock sensor
- ⑧ Oil filter bracket
- ⑨ Oil catcher
- ⑩ Oil filter
- ⑪ Water inlet

- ⑫ Thermostat housing
- ⑬ Water pipe assembly
- ⑭ Thermostat
- ⑮ Starter motor
- ⑯ Power steering oil pump adjusting bar
- ⑰ Power steering oil pump bracket

MEM138A

OUTER COMPONENT PARTS

SEC. 140-146-147-148-163-164-210-226

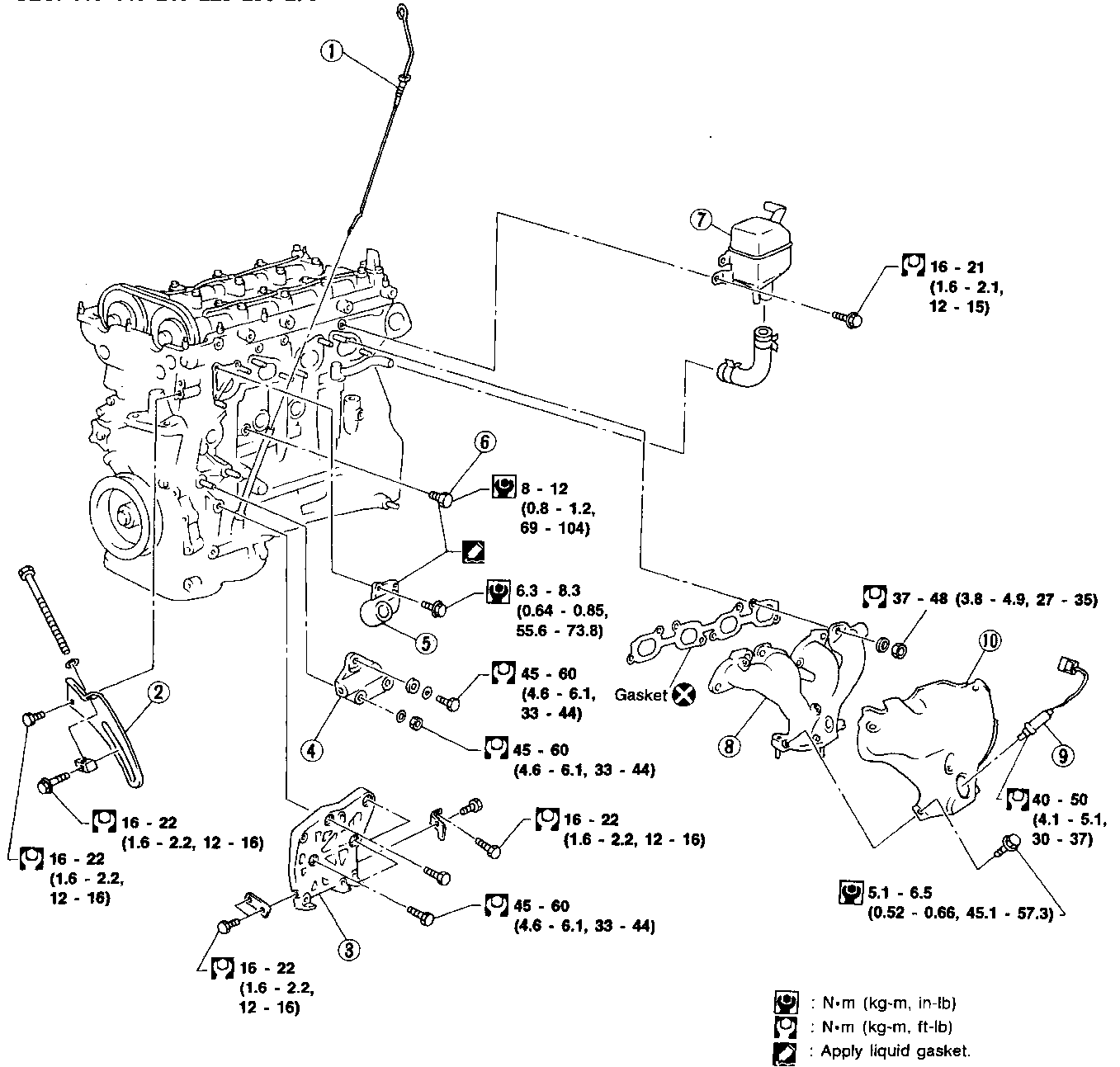


SEM715EB

- | | | |
|-------------------------------------|-------------------------------------|----------------------|
| ① Intake manifold collector support | ⑦ EGR valve | ⑬ Fuel tube assembly |
| ② Intake manifold collector | ⑧ EGR temperature sensor | ⑭ Pressure regulator |
| ③ Throttle body | ⑨ Intake manifold | ⑮ IACV-FICD valve |
| ④ Throttle position sensor | ⑩ Engine coolant temperature sensor | ⑯ IACV-AAC valve |
| ⑤ Intake manifold collector support | ⑪ Thermal transmitter | ⑰ IACV-air regulator |
| ⑥ EGRC-BPT valve | ⑫ Injector | ⑱ EGR tube |

OUTER COMPONENT PARTS

SEC. 118-140-210-226-230-275



- ① Oil level gauge
- ② Alternator adjusting bar
- ③ Compressor bracket
- ④ Alternator bracket

- ⑤ Water outlet
- ⑥ Drain plug
- ⑦ Oil separator

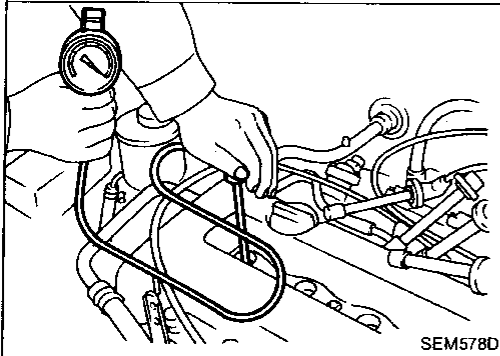
- ⑧ Exhaust manifold
- ⑨ Heated oxygen sensor
- ⑩ Exhaust manifold cover

SEM716EA

GI
MA
EM
LC
EC
FE
CL
MT
AT
FA
RA
BR
ST
RS
BT
HA
EL
IDX

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.



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 as shown above.

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

Compression pressure: kPa (kg/cm², psi)/300 rpm

Standard

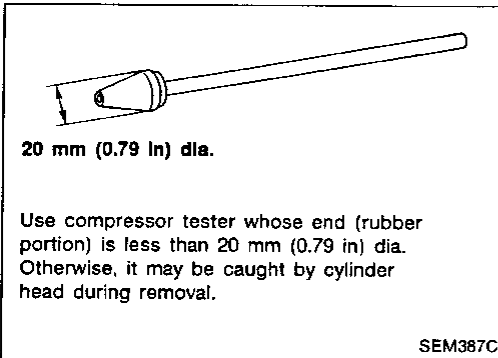
1,226 (12.5, 178)

Minimum

1,030 (10.5, 149)

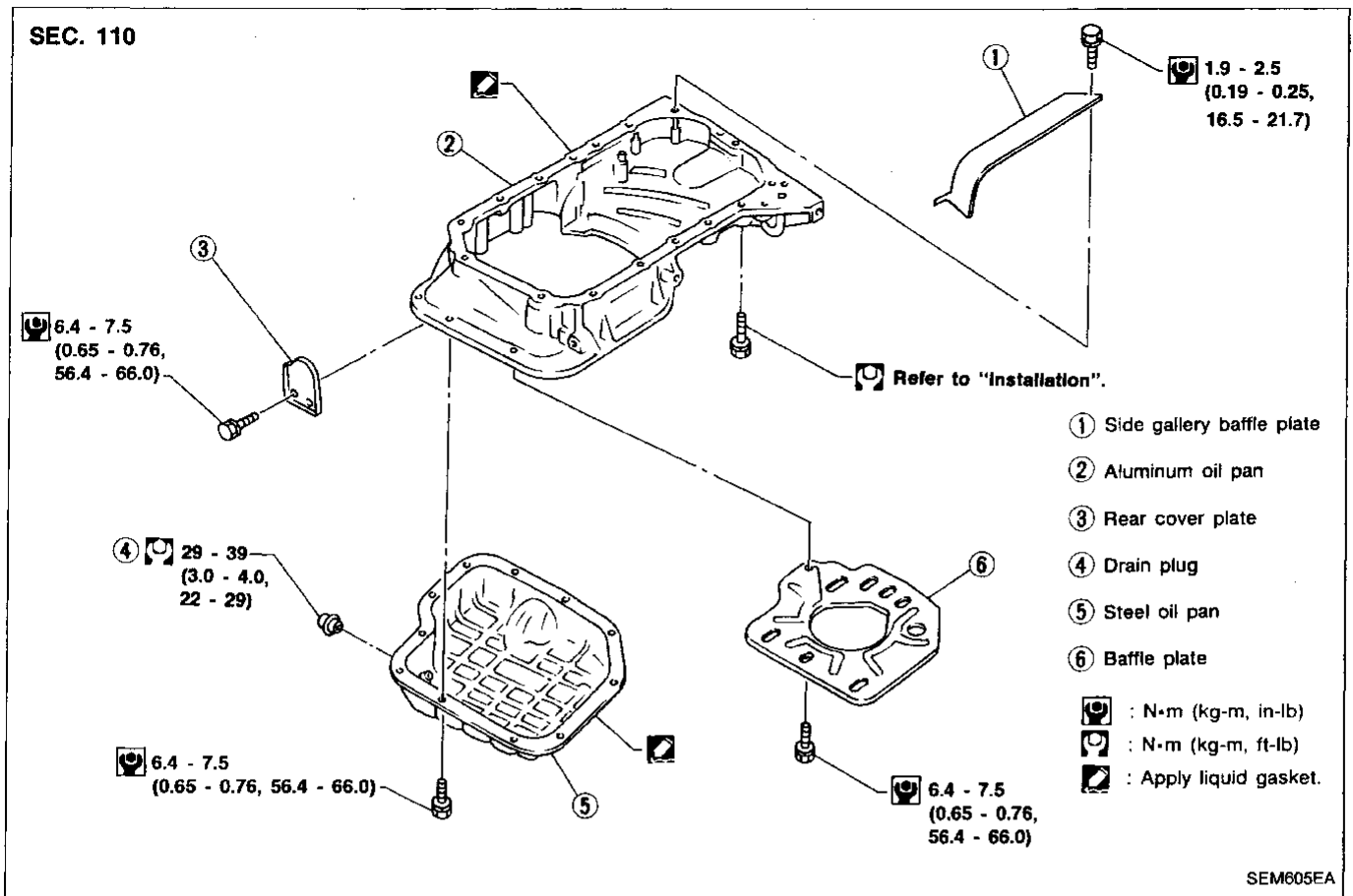
Difference limit between cylinders

98 (1.0, 14)



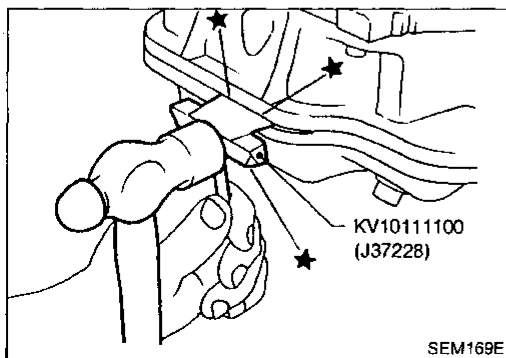
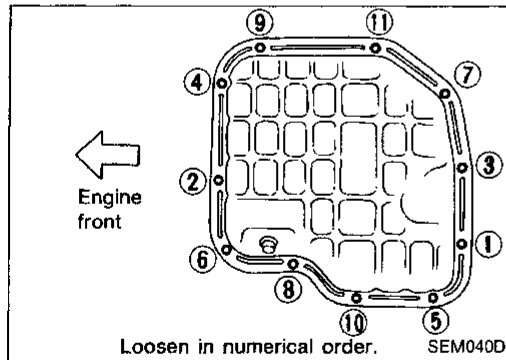
10. If compression in one or more cylinders is low:
 - a. Pour a small amount of engine oil into cylinders through spark plug holes.
 - b. Retest compression.
- **If adding oil improves cylinder compression, piston rings may be worn or damaged. If so, replace piston rings after checking piston.**
 - **If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. (Refer to SDS, EM-61 and EM-62.) 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.

OIL PAN



Removal

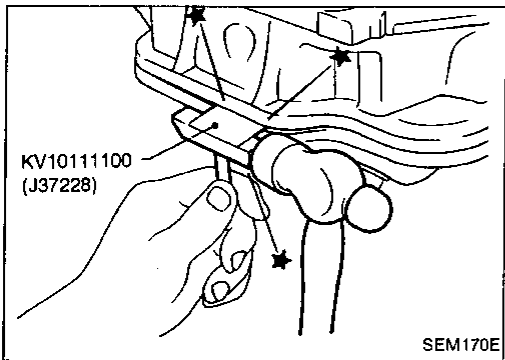
1. Remove engine under cover.
2. Drain engine oil.
3. Remove steel oil pan bolts.



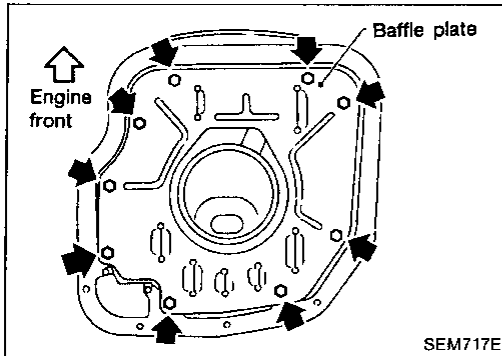
4. Remove steel oil pan.
 - a. Insert Tool between aluminum oil pan and steel oil pan.
 - Be careful not to damage aluminum mating surface.
 - Do not insert screwdriver, or oil pan flange will be deformed.

OIL PAN

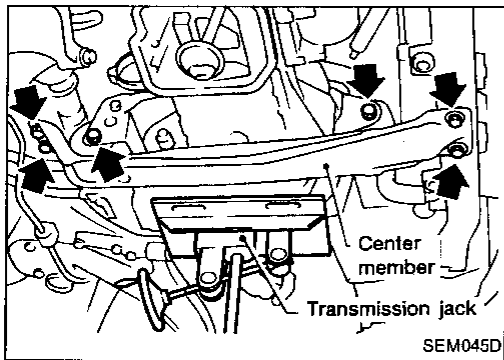
Removal (Cont'd)



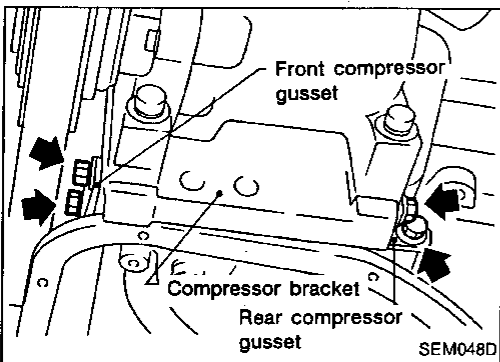
- b. Slide Tool by tapping on the side of the Tool with a hammer.
- c. Remove steel oil pan.



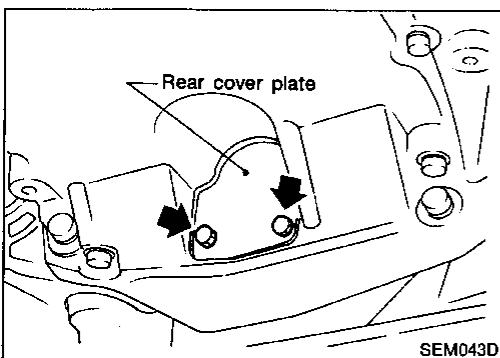
- d. Remove baffle plate.



5. Remove front exhaust tube.
6. Set a suitable transmission jack under transaxle and hoist engine with engine slinger.
7. Remove center member.
8. Remove A/T shift control cable. (A/T models only)



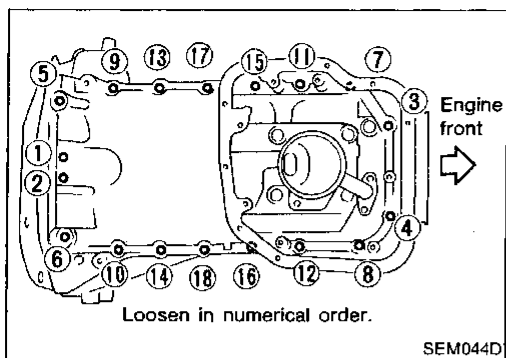
9. Remove compressor gussets.



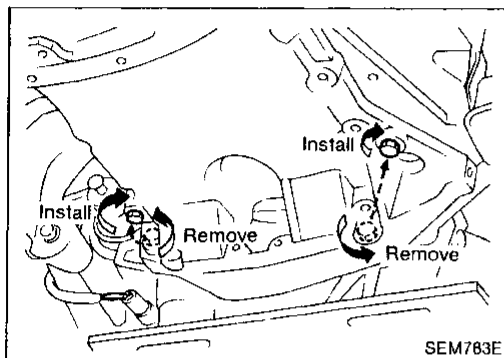
10. Remove rear cover plate.

OIL PAN

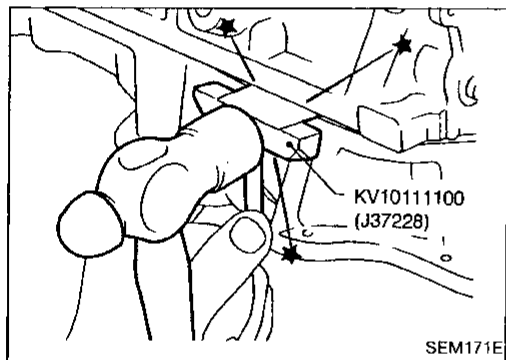
Removal (Cont'd)



11. Remove aluminum oil pan bolts.

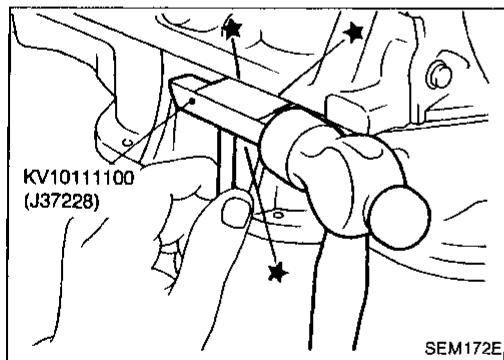


12. Remove the two engine-to-transaxle bolts and install them into vacant bolt holes as shown. Tighten the bolts to release aluminum oil pan from cylinder block.

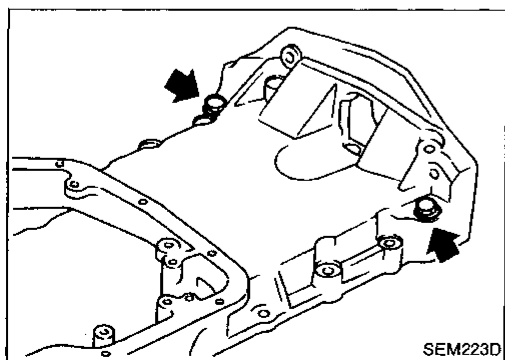


13. Remove aluminum oil pan.

- a. Insert Tool between cylinder block and aluminum oil pan.
- **Be careful not to damage aluminum mating surface.**
 - **Do not insert screwdriver, or oil pan flange will be deformed.**



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



14. Remove the two engine to transaxle bolts previously installed in aluminum oil pan.

GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

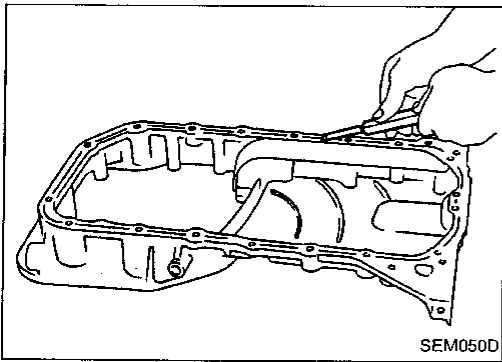
BT

HA

EL

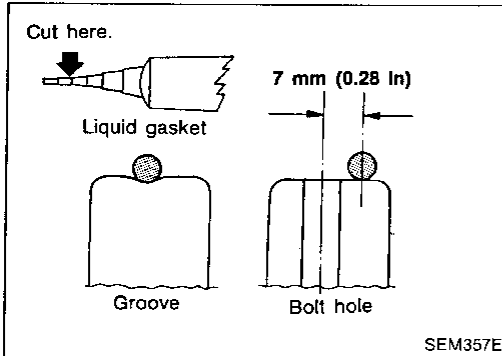
IDX

OIL PAN

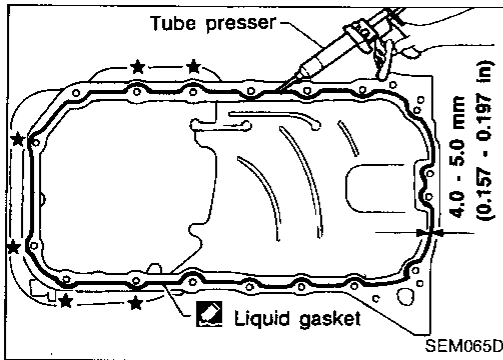


Installation

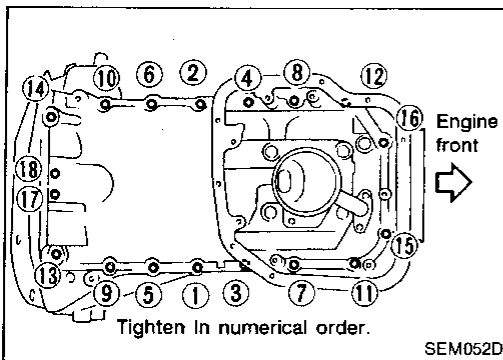
1. Install aluminum oil pan.
 - a. Use a scraper to remove all traces of liquid gasket from mating surfaces.
 - Remove traces of liquid gasket from mating surfaces of cylinder block and front cover.
 - Also remove old liquid gasket from the bolt holes and bolt threads.



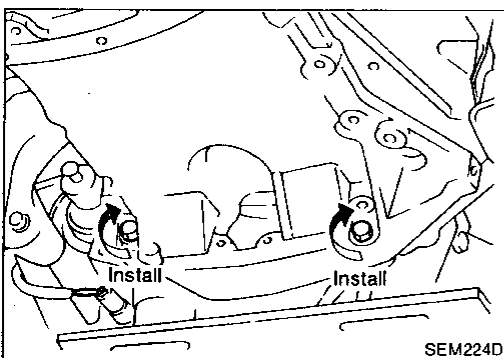
- b. Apply a continuous bead of liquid gasket to mating surface of aluminum oil pan.
 - Use Genuine Liquid Gasket or equivalent.
 - Apply to groove on mating surface.
 - Allow 7 mm (0.28 in) clearance around bolt holes.



- For areas marked with "★", apply liquid gasket around the outer side of the bolt hole as shown.
- Be sure liquid gasket diameter is 4.0 to 5.0 mm (0.157 to 0.197 in).
- Attaching should be done within 5 minutes after coating.



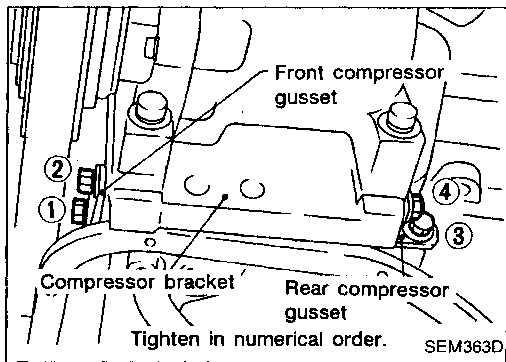
- c. Install aluminum oil pan.
 - Install bolts in the reverse order of removal.
 - ① - ⑱ bolts:
 - ⊕ : 16 - 19 N·m (1.6 - 1.9 kg-m, 12 - 14 ft-lb)
 - ⑲, ⑳ bolts:
 - ⊕ : 6.4 - 7.5 N·m (0.65 - 0.76 kg-m, 56.4 - 66.0 in-lb)



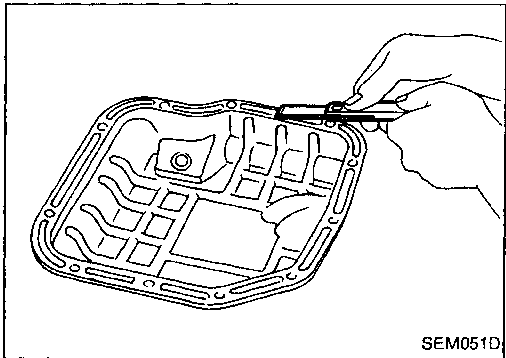
2. Install the two engine to transaxle bolts.
3. Install rear cover plate.

OIL PAN

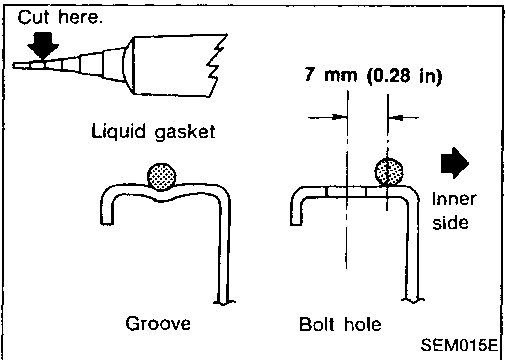
Installation (Cont'd)



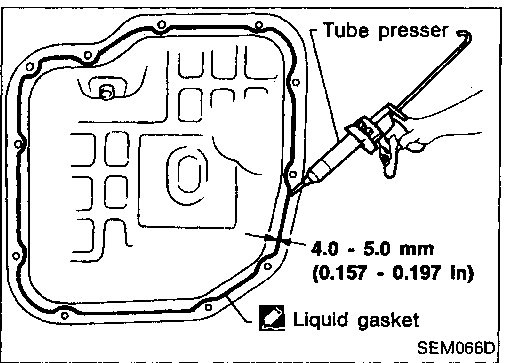
4. Install compressor gussets.
5. Install A/T shift control cable. (A/T models only)
6. Install center member.
7. Install front tube.
8. Install baffle plate.



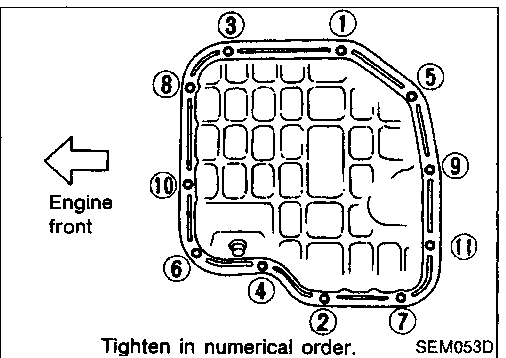
9. Install steel oil pan.
 - a. Use a scraper to remove all traces of liquid gasket from mating surfaces.
 - Also remove traces of liquid gasket from mating surface of aluminum oil pan.



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



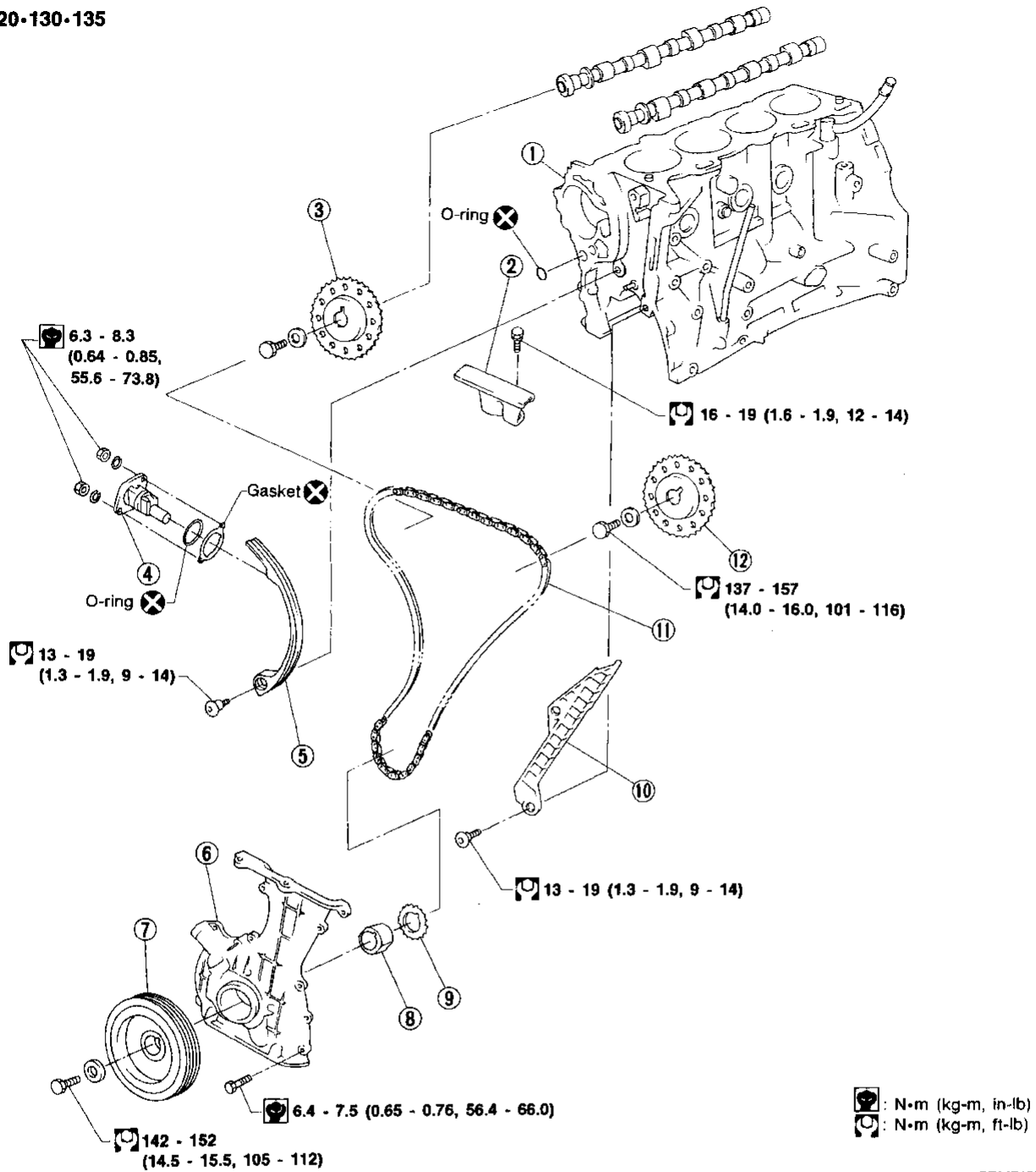
- Be sure liquid gasket diameter is 4.0 to 5.0 mm (0.157 to 0.197 in).
- Attaching should be done within 5 minutes after coating.



- c. Install steel oil pan.
 - Install bolts in the reverse order of removal together with heated oxygen sensor harness bracket.
 - Wait at least 30 minutes before refilling engine oil.

TIMING CHAIN

SEC. 120-130-135



SEM718EB

- | | | |
|------------------------|-------------------|------------------------|
| ① Cylinder block | ⑤ Chain guide | ⑨ Crankshaft sprocket |
| ② Chain guide | ⑥ Front cover | ⑩ Chain guide |
| ③ RH camshaft sprocket | ⑦ Crank pulley | ⑪ Timing chain |
| ④ Chain tensioner | ⑧ Oil pump spacer | ⑫ LH camshaft sprocket |

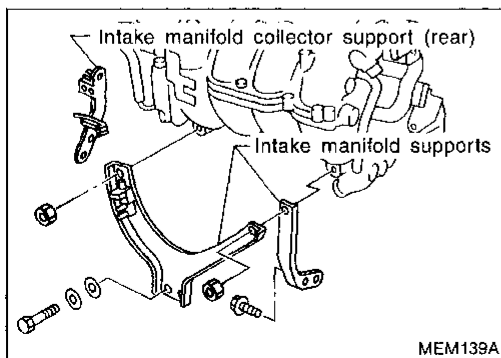
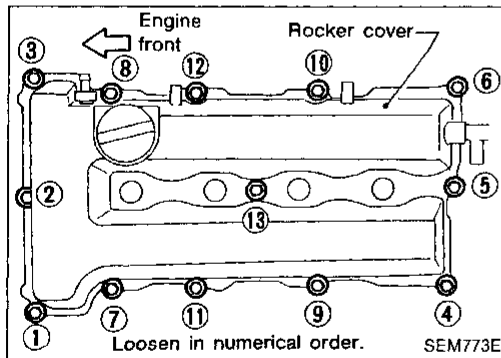
TIMING CHAIN

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.
- Do not spill engine coolant on drive belts.

Removal

1. Release fuel pressure.
Refer to EC section ("Fuel Pressure Release", "BASIC SERVICE PROCEDURE").
2. Remove engine under covers.
3. Remove front RH wheel and engine side cover.
4. Drain coolant by removing cylinder block drain plug and radiator drain cock. Refer to MA section ("Changing Engine Coolant", "ENGINE MAINTENANCE").
5. Remove radiator.
6. Remove air duct to intake manifold.
7. Remove drive belts and water pump pulley.
8. Remove alternator and power steering pump.
9. Disconnect the following parts:
 - Vacuum hoses
 - Fuel hoses
 - Wires
 - Harness
 - Connectors
10. Remove all spark plugs.

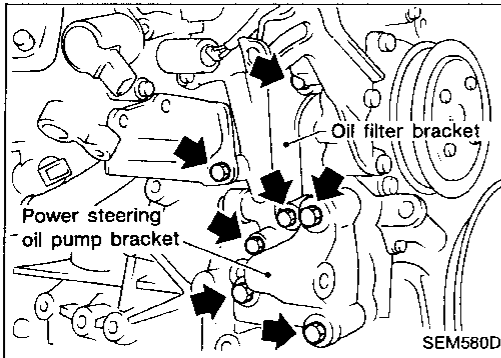


11. Remove rocker cover and oil separator.

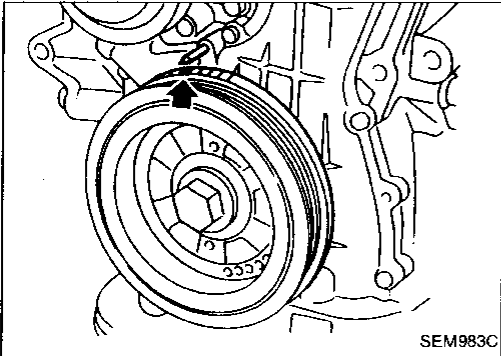
12. Remove intake manifold supports.

TIMING CHAIN

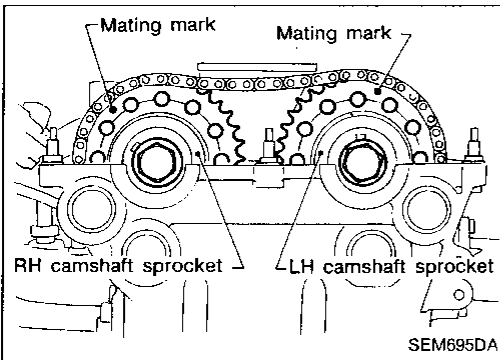
Removal (Cont'd)



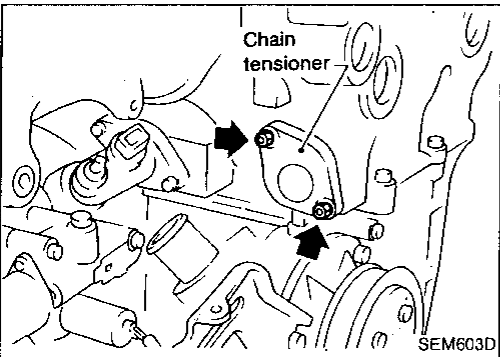
13. Remove oil filter bracket and power steering oil pump bracket.



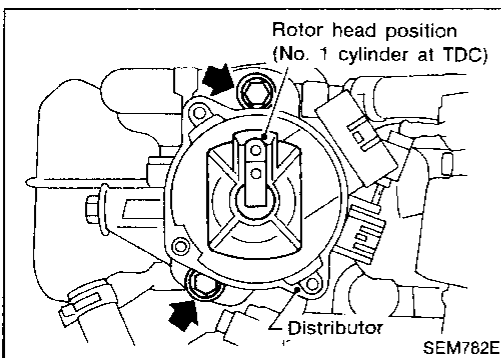
14. Set No. 1 piston at TDC on the compression stroke by rotating crankshaft.



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



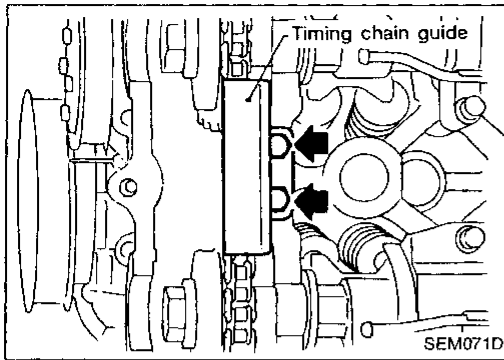
15. Remove chain tensioner.



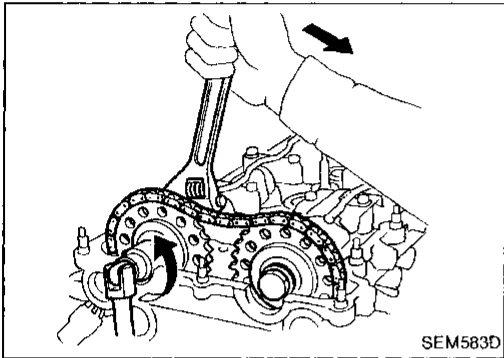
16. Remove distributor.
Do not turn rotor with distributor removed.

TIMING CHAIN

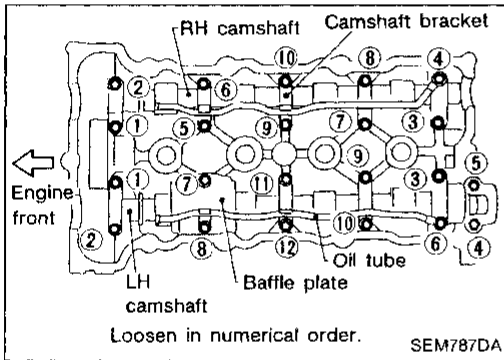
Removal (Cont'd)



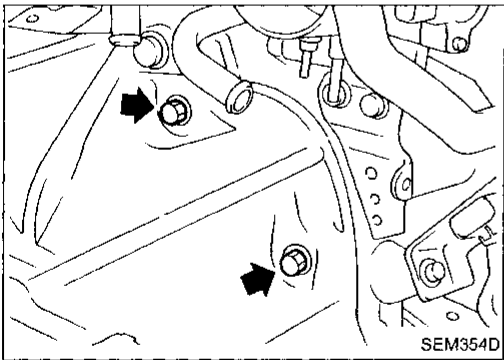
17. Remove timing chain guide.



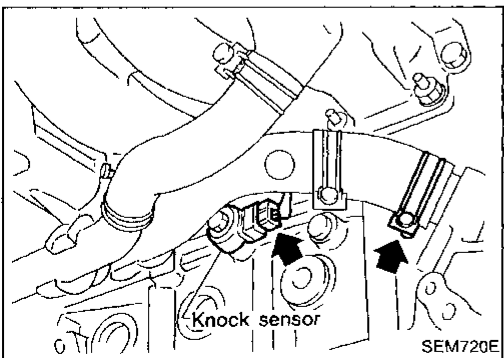
18. Remove camshaft sprockets.



19. Remove camshafts, camshaft brackets, oil tubes and baffle plate.



20. Remove starter motor.



21. Remove the following water hoses.

- Water hose for cylinder block.
- Water hoses from heater.

22. Remove knock sensor harness connector.

GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

BT

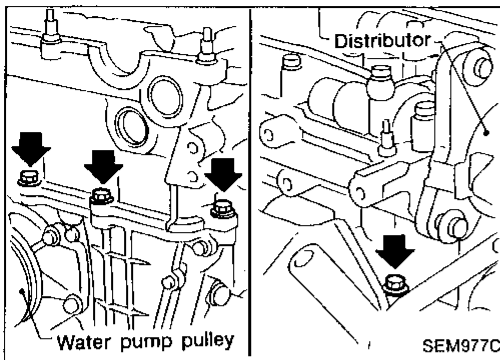
HA

EL

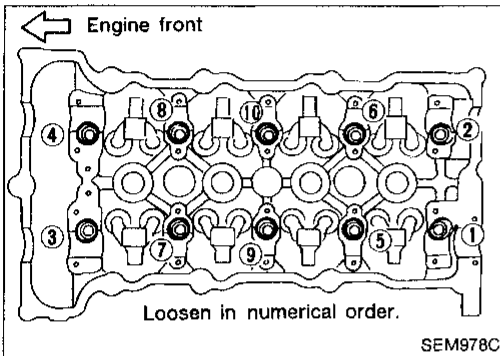
IDX

TIMING CHAIN

Removal (Cont'd)



23. Remove cylinder head outside bolts.



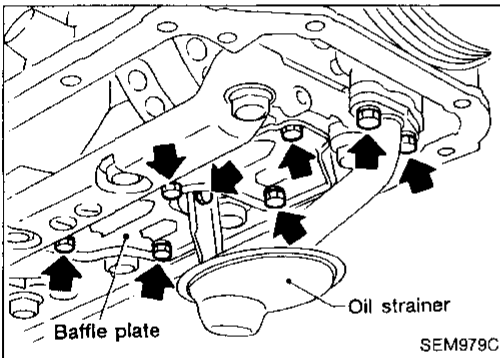
24. Remove cylinder head bolts.

● **Bolts should be loosened in two or three steps.**

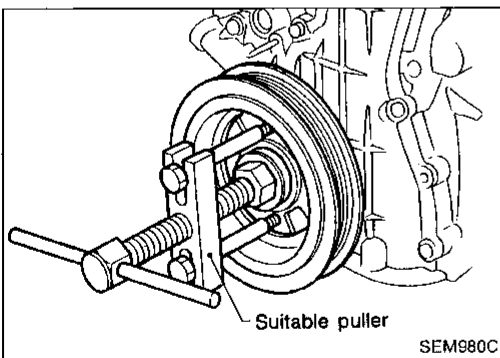
25. Remove cylinder head completely with intake and exhaust manifolds.

26. Remove oil pans.

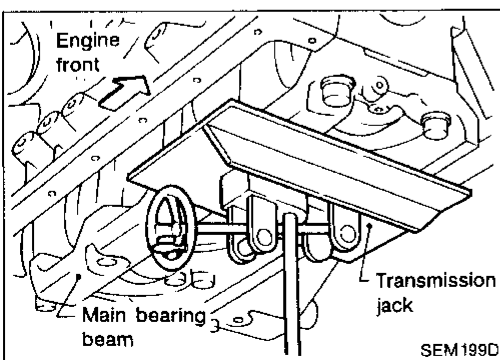
Refer to "Removal" in "OIL PAN" (EM-11).



27. Remove oil strainer and baffle plate.



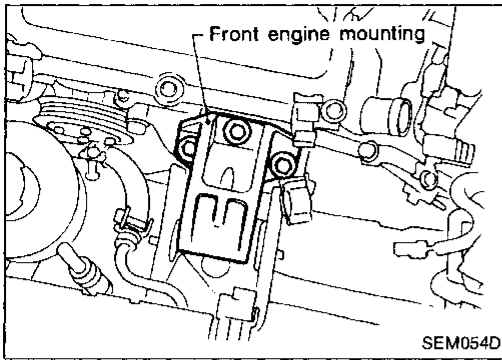
28. Remove crankshaft pulley.



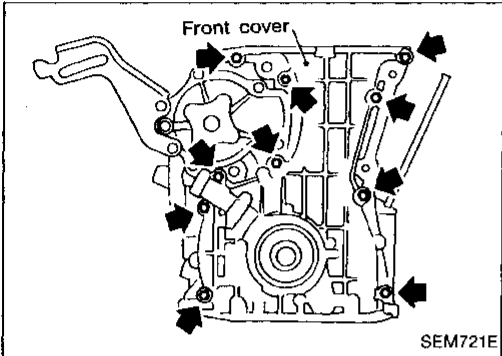
29. Set a suitable transmission jack under main bearing beam.

TIMING CHAIN

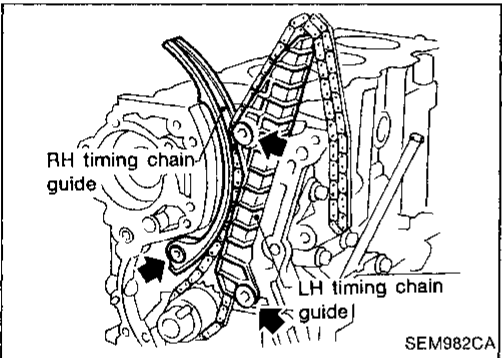
Removal (Cont'd)



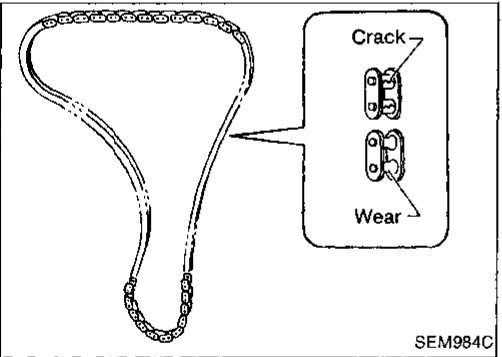
30. Remove front engine mounting.



31. Remove front cover.

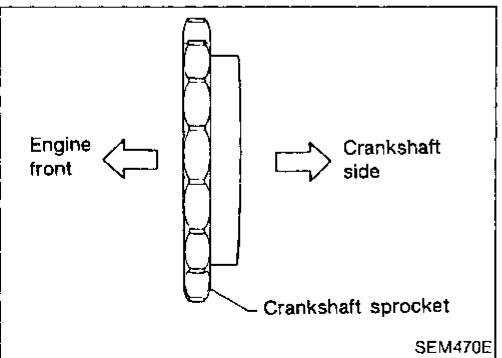


32. Remove timing chain guides and timing chain.



Inspection

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



Installation

1. Install crankshaft sprocket on crankshaft.

GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

BT

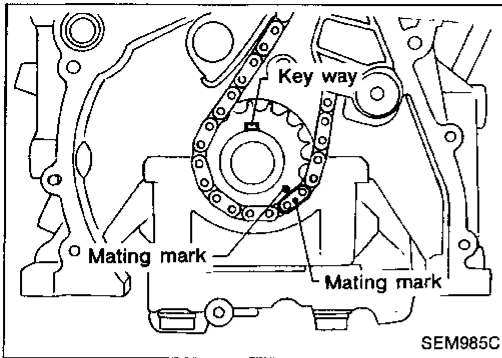
HA

EL

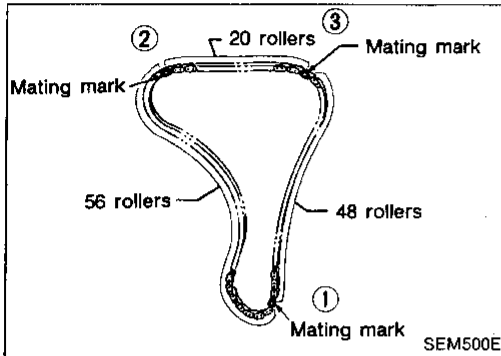
IDX

TIMING CHAIN

Installation (Cont'd)

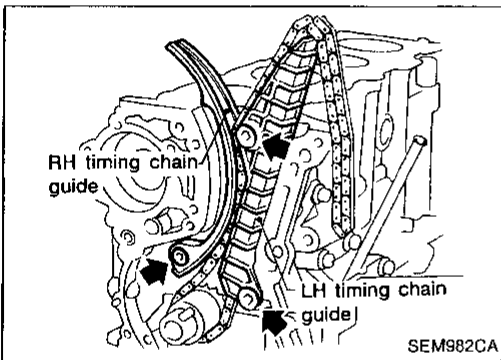


- Position crankshaft so that No. 1 piston is set at TDC (Key way at 12 o'clock, and mating mark at 4 o'clock approximately). Fit timing chain to crankshaft sprocket, with its mating mark in line with crankshaft sprocket mating mark.

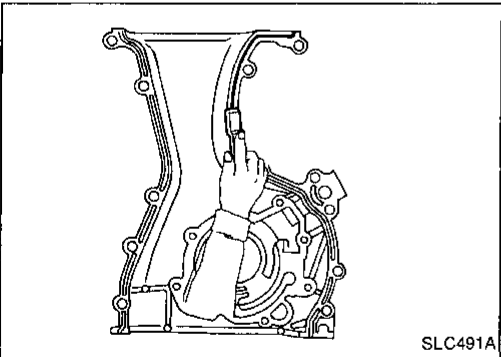


- Mating mark color on timing chain.

- ① : Gold
- ②, ③ : Silver

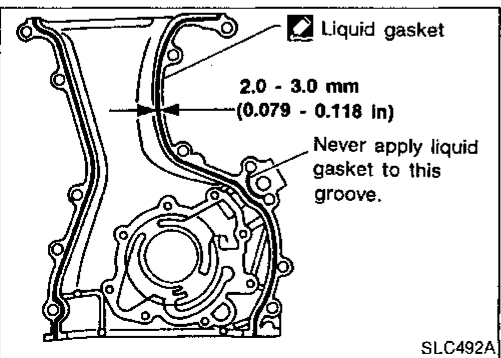


- Install timing chain and timing chain guides.



- 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.

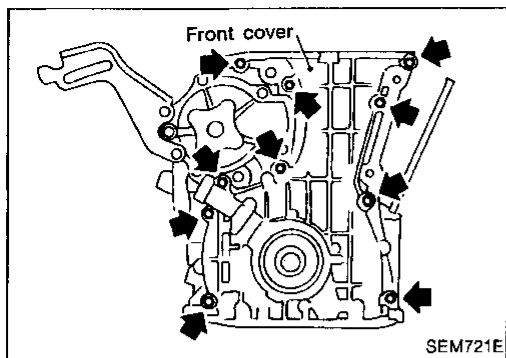


- Apply a continuous bead of liquid gasket to mating surface of front cover.

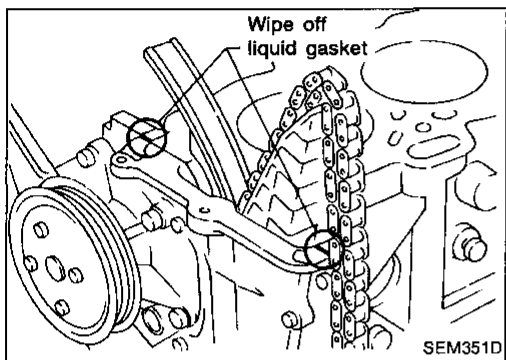
- Use Genuine Liquid Gasket or equivalent.

TIMING CHAIN

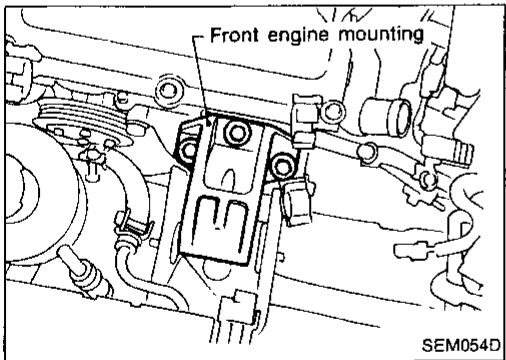
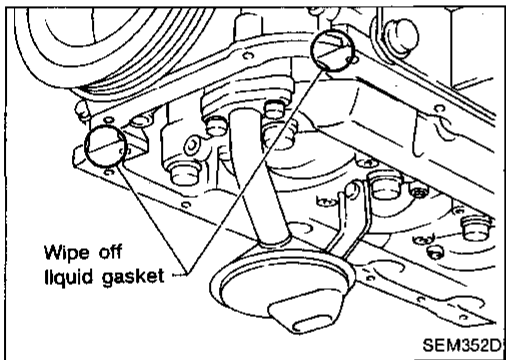
Installation (Cont'd)



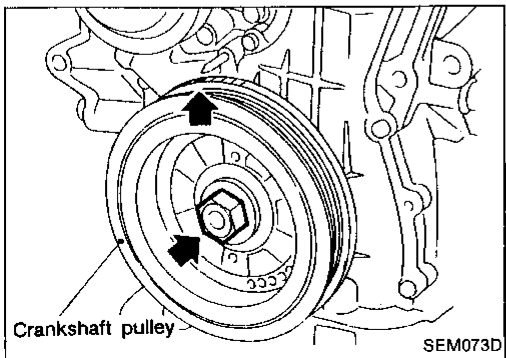
6. Install oil pump drive spacer and front cover.



• Wipe off excessive liquid gasket.



7. Install front engine mounting.



8. Install crankshaft pulley.

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

GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

BT

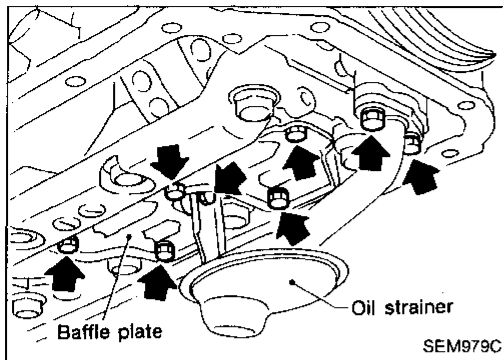
HA

EL

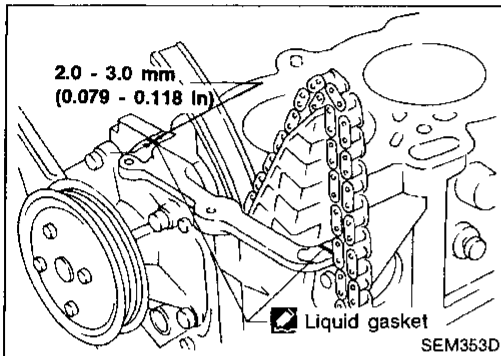
IDX

TIMING CHAIN

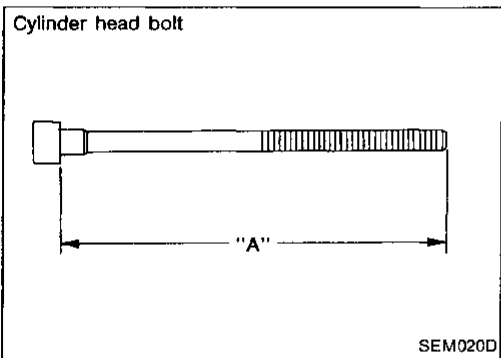
Installation (Cont'd)



10. Install oil strainer and baffle plate.
11. Install oil pan.
Refer to "Installation" in "OIL PAN" (EM-14).



12. Before installing cylinder head gasket, apply a continuous bead of liquid gasket to mating surface of cylinder block.



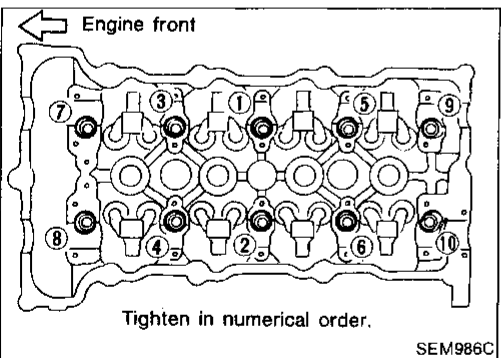
13. Install cylinder head completely with intake and exhaust manifolds.

CAUTION:

The cylinder head bolts can be reused providing dimension "A" is not exceeded.

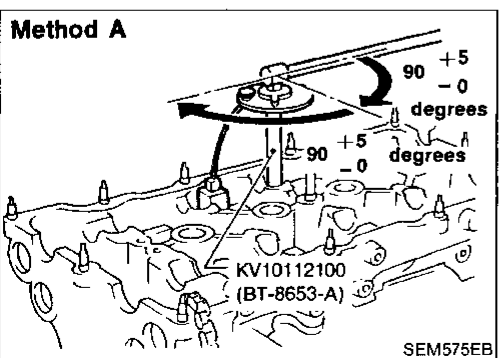
Dimension "A":

158.2 mm (6.228 in)



● Tightening procedure:

- a Tighten all bolts to 39 N·m (4.0 kg·m, 29 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 34 to 44 N·m (3.5 to 4.5 kg·m, 25 to 33 ft·lb).



- e Method A: Turn all bolts 90^{+5}_{-0} degrees clockwise with Tool or suitable angle wrench.

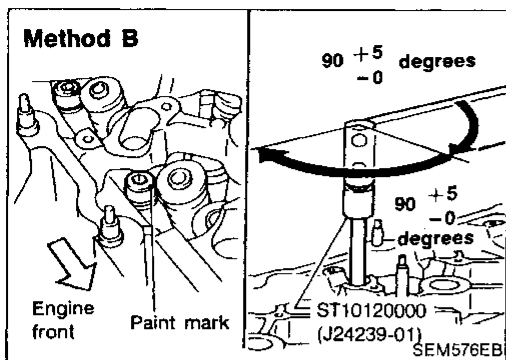
Method B: If angle wrench is not available, do the following. Mark the side of all bolts with paint marks facing the front of the engine. Then turn them 90^{+5}_{-0} degrees clockwise.

- f Turn all bolts 90^{+5}_{-0} degrees clockwise.
- g Ensure that paint mark on each bolt faces the rear of the engine. (Method B only)

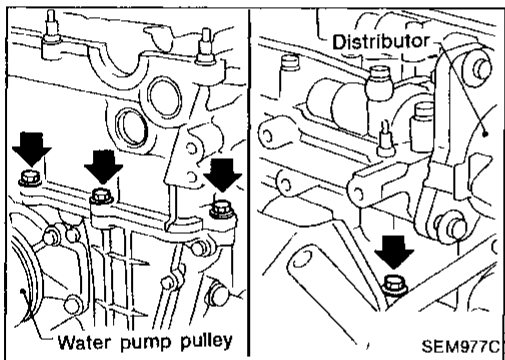
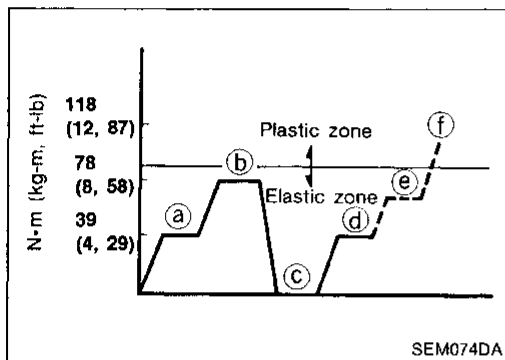
Do not turn any bolt 180 to 190 degrees clockwise all at once.

TIMING CHAIN

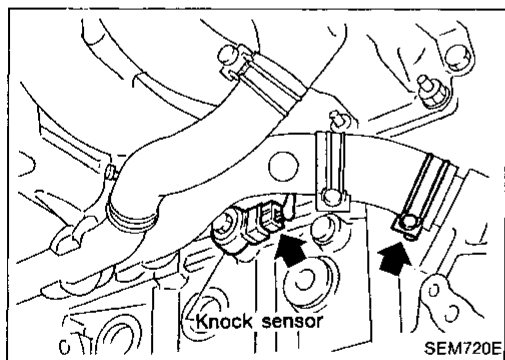
Installation (Cont'd)



	Tightening torque N-m (kg-m, ft-lb)
(a)	39 (4.0, 29)
(b)	78 (8.0, 58)
(c)	0 (0, 0)
(d)	34 - 44 (3.5 - 4.5, 25 - 33)
(e)	90 $^{+5}_{-0}$ degrees
(f)	90 $^{+5}_{-0}$ degrees

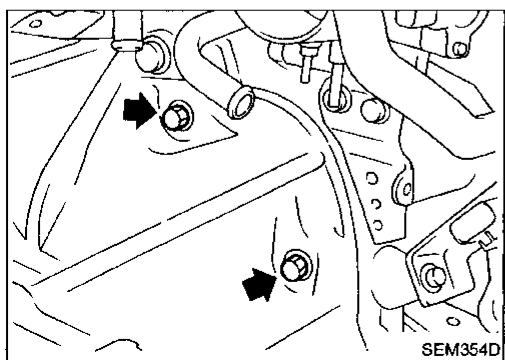


14. Install cylinder head outside bolts.



15. Install the following water hoses.

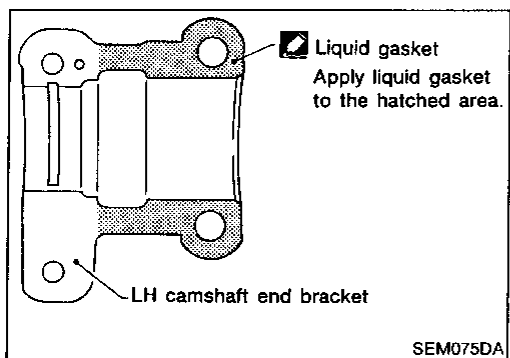
- Water hose for cylinder block.
 - Water hoses for heater.
16. Install knock sensor harness connector.



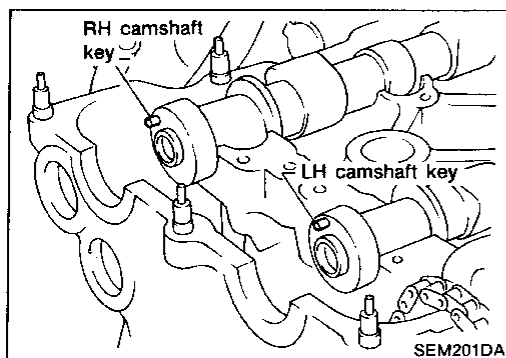
17. Install starter motor.

TIMING CHAIN

Installation (Cont'd)

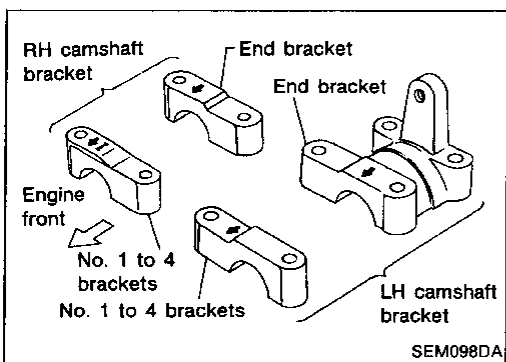


18. Before installing LH camshaft end bracket, remove all traces of liquid gasket from mating surface.
 - Also remove traces of liquid gasket from mating surface of cylinder head.
19. Apply a continuous bead of liquid gasket to mating surface of LH camshaft end bracket.
 - Use Genuine Liquid Gasket or equivalent.

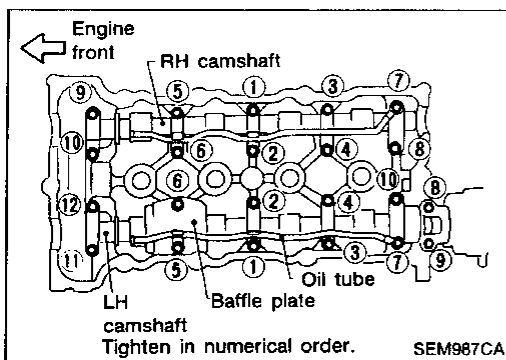


20. Install camshafts, camshaft brackets, oil tubes and baffle plate.
 - Position camshaft.
 - LH camshaft key at about 12 o'clock
 - RH camshaft key at about 10 o'clock

Apply engine oil to bearings and cam surfaces of camshafts before installing them.



- Position camshaft brackets as shown in the illustration.
- Apply engine oil to threads and seating surfaces of camshaft bracket bolts before installing them.



- **Tightening procedure**

STEP 1:

RH camshaft

Tighten bolts ⑨ - ⑩ in that order then tighten bolts ① - ⑧ in that order.

⊛: 2 N·m (0.2 kg-m, 17 in-lb)

LH camshaft

Tighten bolts ⑪ - ⑫ in that order then tighten bolts ① - ⑩ in that order.

⊛: 2 N·m (0.2 kg-m, 17 in-lb)

STEP 2:

Tighten bolts in the specified order.

⊛: 6 N·m (0.6 kg-m, 52 in-lb)

STEP 3:

Tighten bolts in the specified order.

⊛: 9.8 - 11.8 N·m

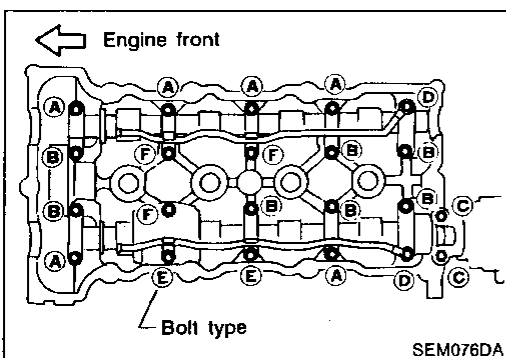
(1.0 - 1.2 kg-m, 87 - 104 in-lb)

... Bolt type A B D E F

⊛: 18 - 25 N·m

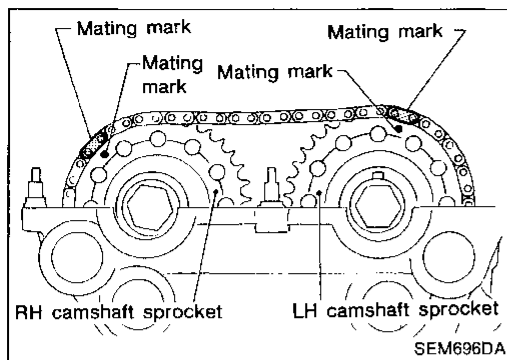
(1.8 - 2.6 kg-m, 13 - 19 ft-lb)

... Bolt type C



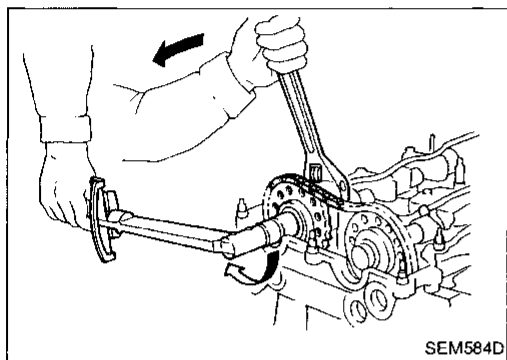
TIMING CHAIN

Installation (Cont'd)



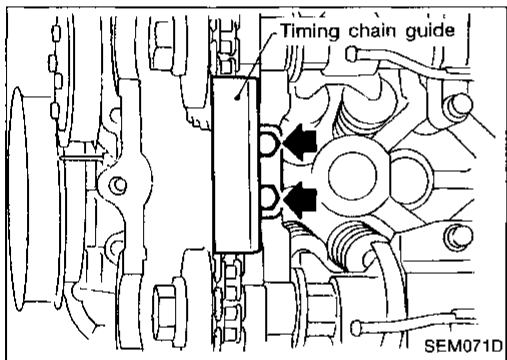
21. Install camshaft sprockets.

Line up mating marks on timing chain with mating marks on camshaft sprockets.

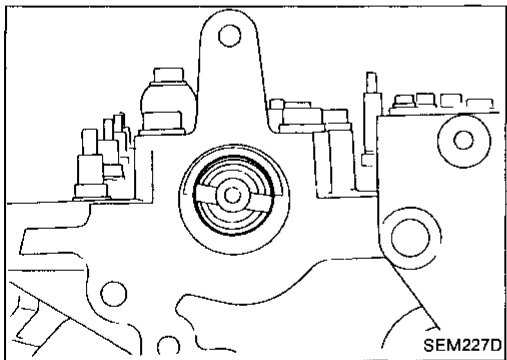


● Lock camshafts as shown in figure and tighten to specified torque.

: 137 - 157 N·m
(14.0 - 16.0 kg-m, 101 - 116 ft-lb)

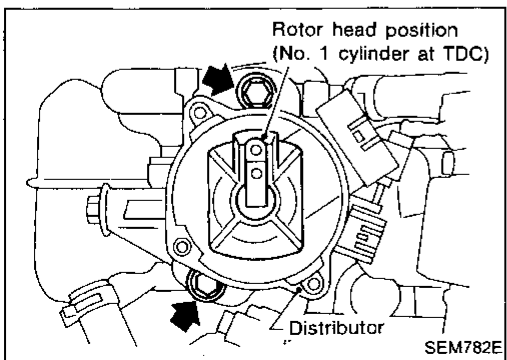


22. Install timing chain guide.



23. Install distributor.

● Make sure that position of camshaft is as shown in figure.

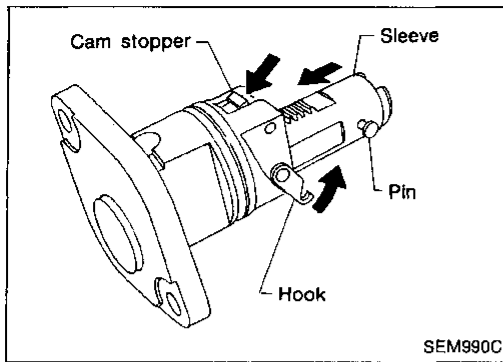


● Make sure that No. 1 piston is set at TDC and that distributor rotor is set at No. 1 cylinder spark position.

GI
MA
EM
LC
EC
FE
CL
MT
AT
FA
RA
BR
ST
RS
BT
HA
EL
IDX

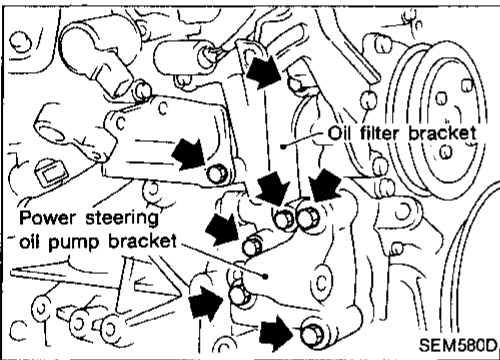
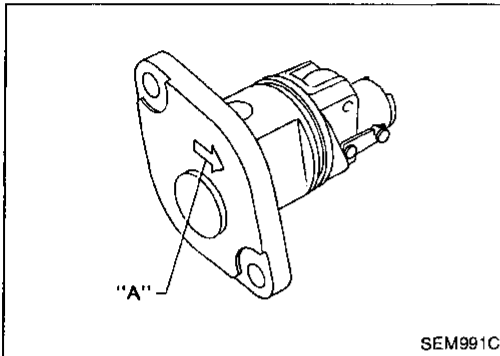
TIMING CHAIN

Installation (Cont'd)

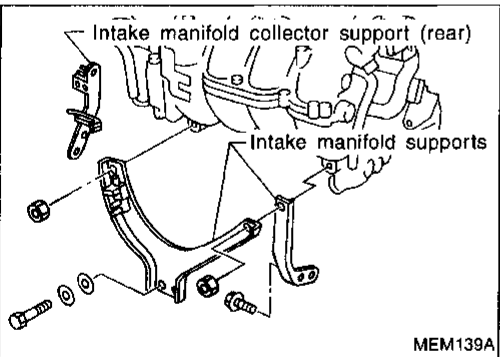


24. Install chain tensioner.

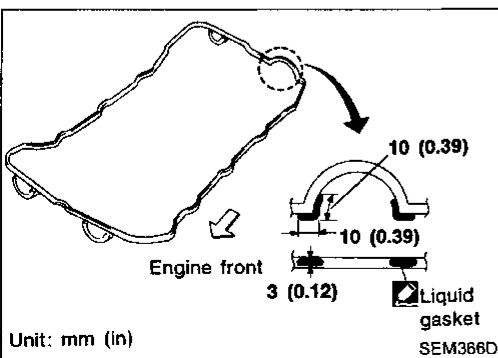
Make sure the camshaft sprockets are tightened completely. Press cam stopper down and "press-in" sleeve until hook can be engaged on pin. When tensioner is bolted in position the hook will release automatically. Ensure arrow "A" faces the front of the engine.



25. Install oil filter bracket and power steering oil pump bracket.



26. Install intake manifold supports.



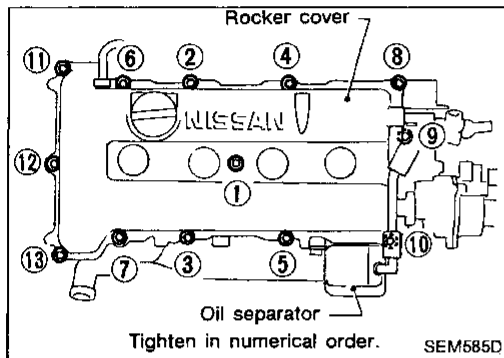
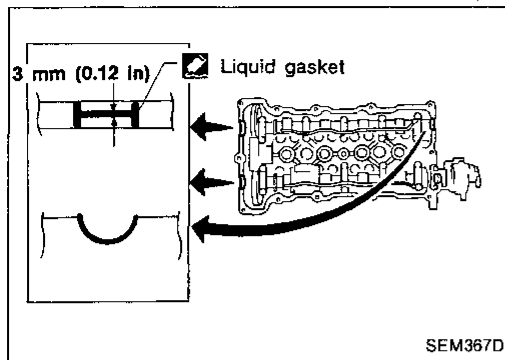
27. Remove liquid gasket from mating surface of rocker cover gasket to cylinder head before installing rocker cover.

28. Apply a continuous bead of liquid gasket to mating surface of rocker cover gasket and cylinder head.

- **Use Genuine Liquid Gasket or equivalent.**

TIMING CHAIN

Installation (Cont'd)



29. Install rocker cover and oil separator.

Rocker cover tightening procedure:

- (1) Tighten nuts ① - ⑩ - ⑪ - ⑬ - ⑧ in that order to 4 N·m (0.4 kg-m, 35 in-lb).
- (2) Tighten nuts ① to ⑬ as indicated in figure to 8 to 10 N·m (0.8 to 1.0 kg-m, 69 - 87 in-lb).

30. Install the following parts:

- Spark plugs and leads
 - Power steering pump
 - Alternator
 - Water pump pulley and drive belts.
For adjusting drive belt deflection, refer to MA section ("Checking Drive Belts", "ENGINE MAINTENANCE").
 - Radiator
Refit hoses and refill with coolant.
Refer to MA section ("REFILLING ENGINE COOLANT", "Changing Engine Coolant").
 - Front RH wheel
 - Engine under covers
31. Connect the following:
- Vacuum hoses
 - Fuel hoses
 - Wire, Harnesses and connectors
 - Air duct to intake manifold

GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

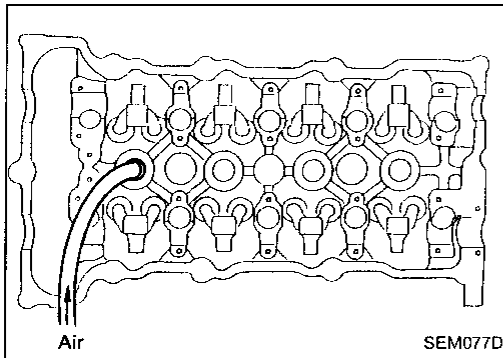
BT

HA

EL

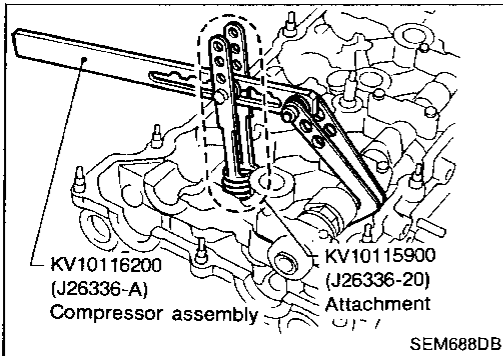
IDX

OIL SEAL REPLACEMENT



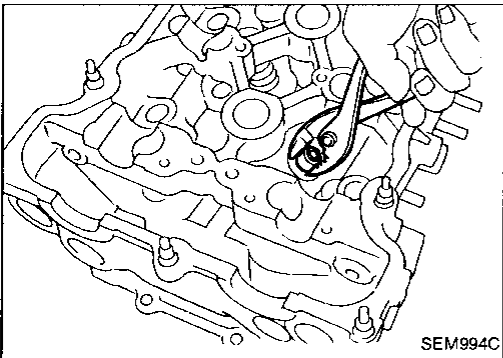
VALVE OIL SEAL

1. Remove accelerator cable.
2. Remove rocker cover and oil separator.
3. Remove camshafts and sprockets. Refer to "Removal" in "TIMING CHAIN" (EM-17).
4. Remove spark plugs.
5. Install air hose adapter into spark plug hole and apply air pressure to hold valves in place. Apply a pressure of 490 kPa (5 kg/cm², 71 psi).
6. Remove rocker arm, rocker arm guide and shim.

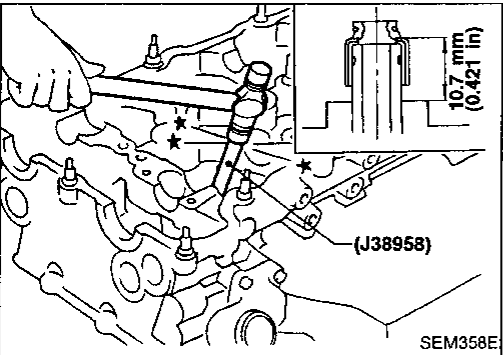


7. Remove valve spring with Tool.

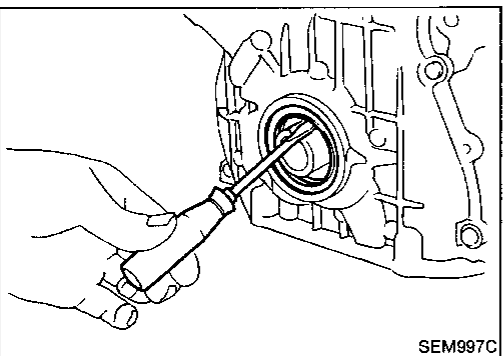
Piston concerned should be set at TDC to prevent valve from falling.



8. Remove valve oil seal.



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

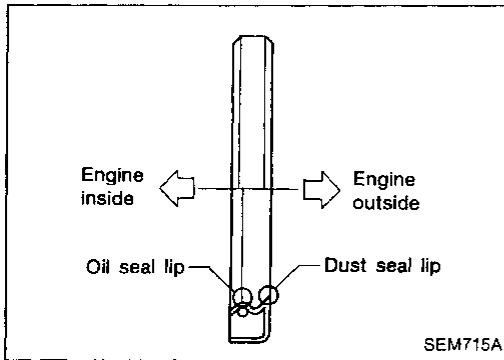


FRONT OIL SEAL

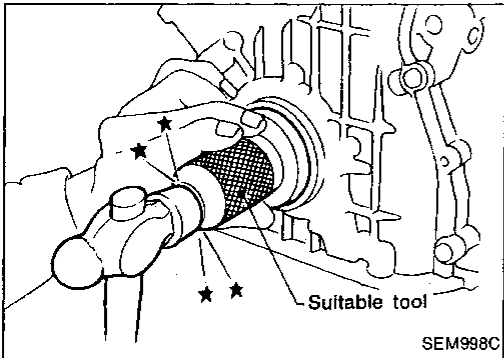
1. Remove the following parts:
 - Engine under cover
 - Front RH wheel and engine side cover
 - Drive belts
 - Crankshaft pulley
2. Remove front oil seal.

Be careful not to scratch front cover.

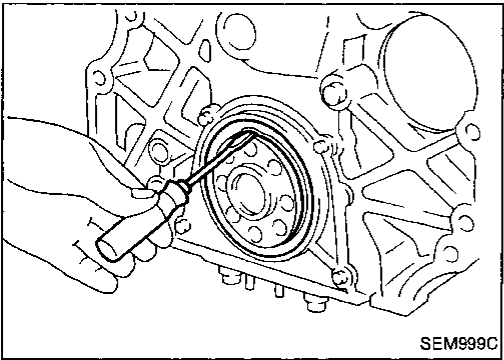
OIL SEAL REPLACEMENT



- Install new oil seal in the direction shown.



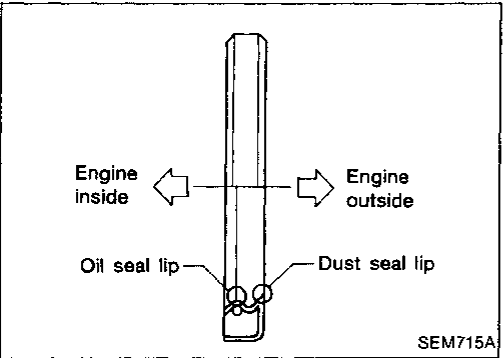
3. Apply engine oil to new oil seal and install it using a suitable tool.



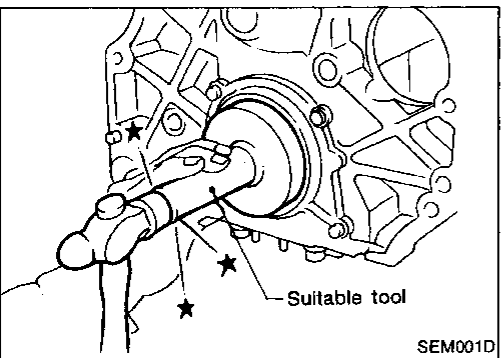
REAR OIL SEAL

1. Remove transaxle. (Refer to MT or AT section.)
2. Remove flywheel or drive plate.
3. Remove rear oil seal.

Be careful not to scratch rear oil seal retainer.



- Install new oil seal in the direction shown.



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

GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

BT

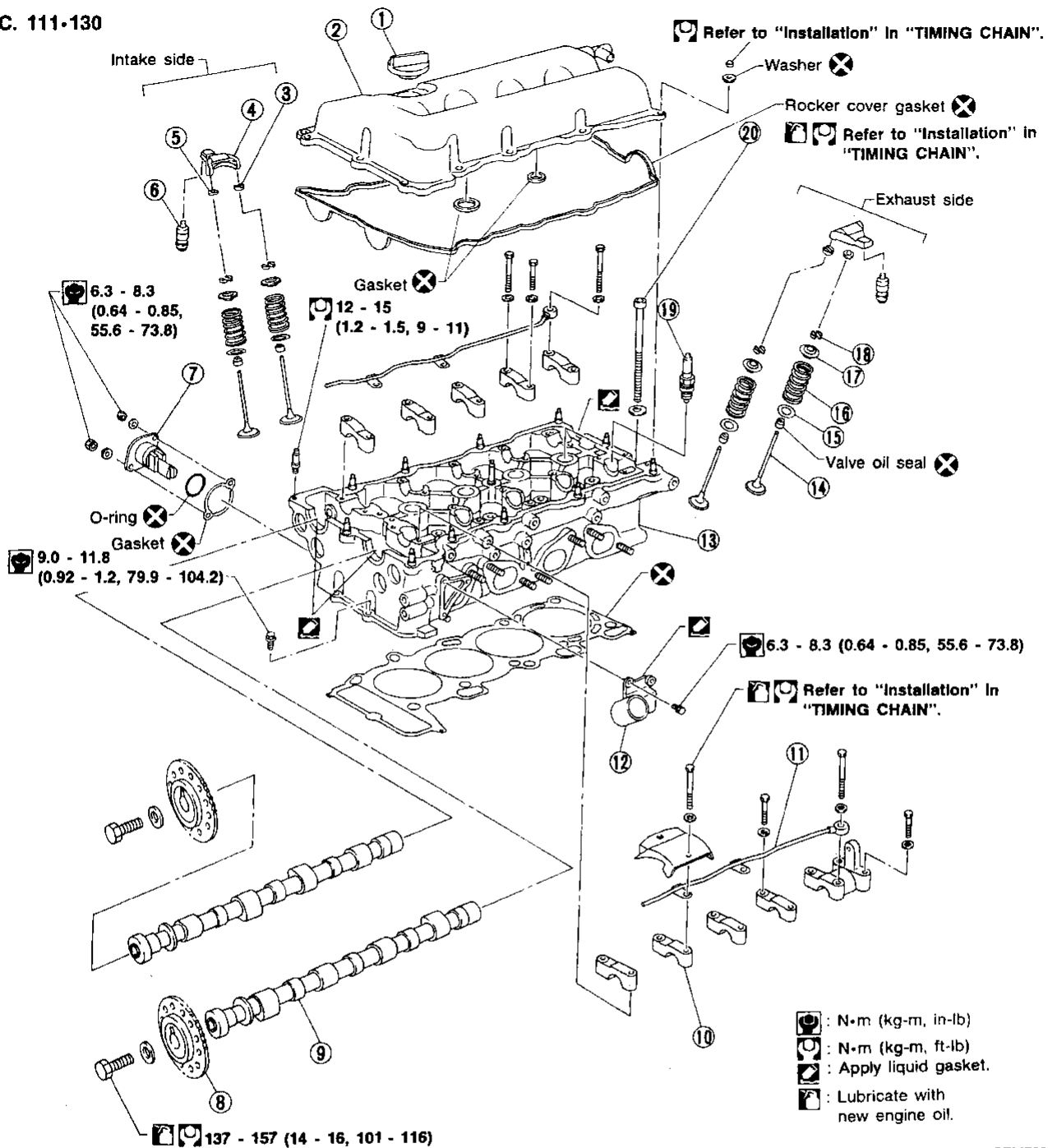
HA

EL

IDX

CYLINDER HEAD

SEC. 111-130



SEM722EE

- ① Oil filler cap
- ② Rocker cover
- ③ Rocker arm guide
- ④ Rocker arm
- ⑤ Shim
- ⑥ Hydraulic lash adjuster
- ⑦ Chain tensioner

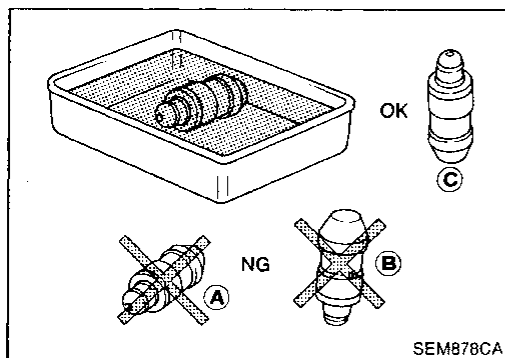
- ⑧ Camshaft sprocket
- ⑨ Camshaft
- ⑩ Camshaft bracket
- ⑪ Oil tube
- ⑫ Water outlet
- ⑬ Cylinder head
- ⑭ Valve

- ⑮ Valve spring seat
- ⑯ Valve spring
- ⑰ Valve spring retainer
- ⑱ Valve collet
- ⑲ Spark plug
- ⑳ Cylinder head bolt

CYLINDER HEAD

CAUTION:

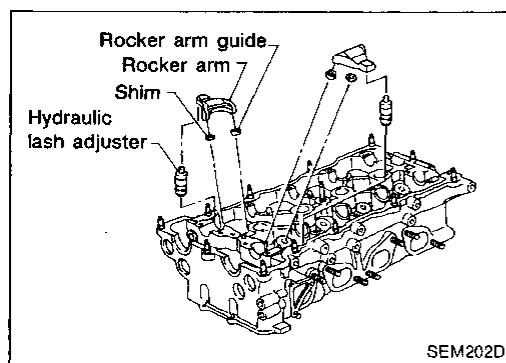
- When installing rocker arms, camshaft and oil seal, lubricate contacting surfaces with new engine oil.
- When tightening cylinder head bolts, camshaft sprocket bolts and camshaft bracket bolts, lubricate bolt threads and seat surfaces with new engine oil.



- If a hydraulic lash adjuster is kept on its side, there is a risk of air entering it. When hydraulic lash adjusters are removed, stand them straight up or soak them in new engine oil.
- Do not disassemble hydraulic lash adjusters.
- Attach tags to lash adjusters so as not to mix them up.

Removal

- This removal procedure is the same as for timing chain. Refer to EM-17.

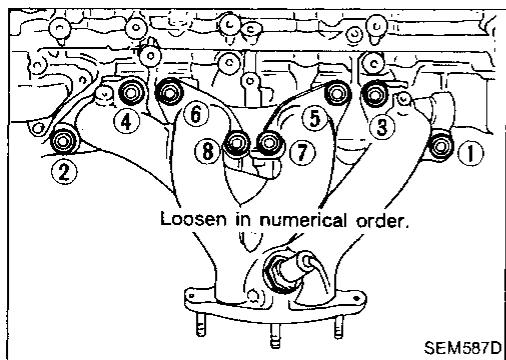


Disassembly

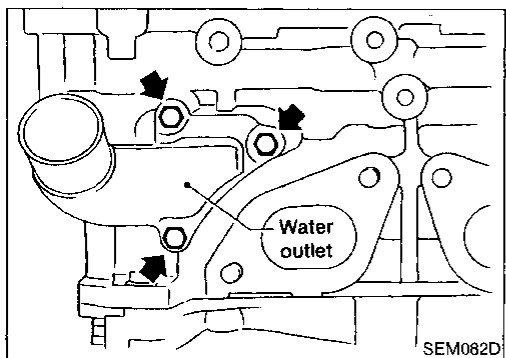
1. Remove rocker arms, shims, rocker arm guides and hydraulic lash adjusters from cylinder head.

CAUTION:

Keep parts in order so that they can be installed in their original positions during assembly. (Install parts in their original positions.)



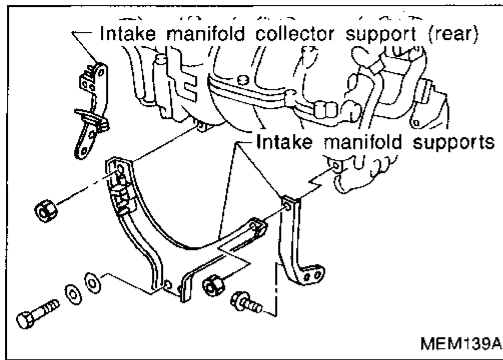
2. Remove crankcase ventilation oil separator.
3. Remove EGR tube.
4. Remove exhaust manifold cover.
5. Remove exhaust manifold.



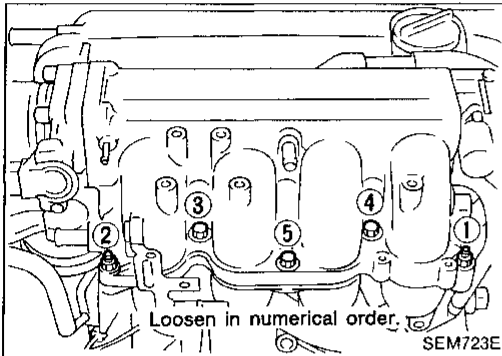
6. Remove water outlet.

CYLINDER HEAD

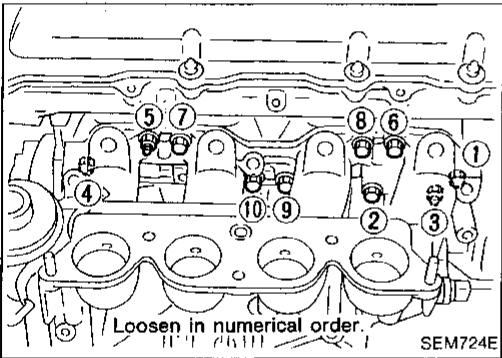
Disassembly (Cont'd)



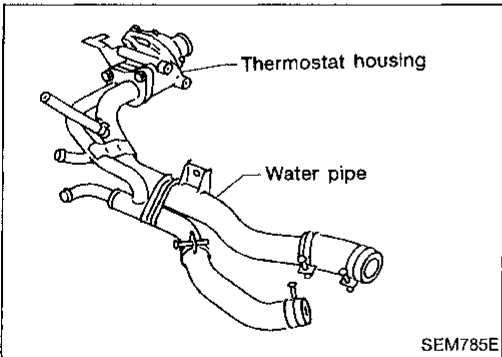
7. Remove intake manifold supports and intake manifold collector supports (both on rear and upper sides).



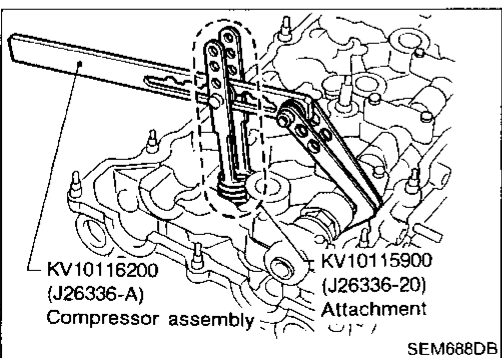
8. Remove intake manifold collector from intake manifold.



9. Remove fuel tube assembly. Refer to EC section ("Injector Removal and Installation", "BASIC SERVICE PROCEDURE").
10. Remove power steering oil pump bracket and oil filter bracket.
11. Remove intake manifold.



12. Remove thermostat housing with water pipe.

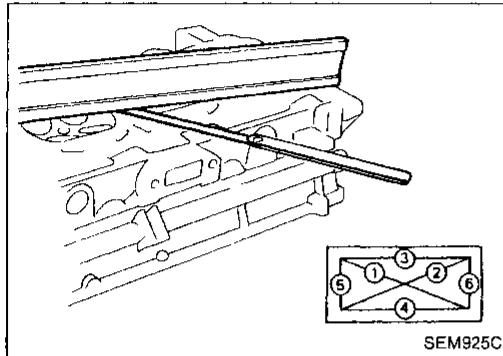
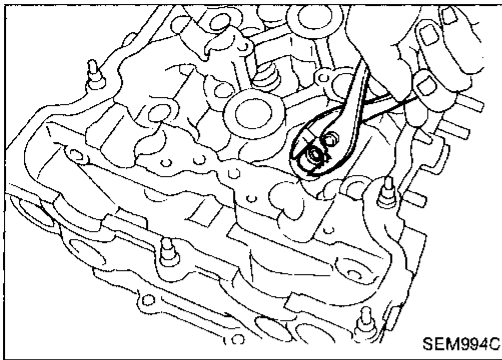


13. Remove valve components with Tool.

CYLINDER HEAD

Disassembly (Cont'd)

14. Remove valve oil seal with a suitable tool.



Inspection

CYLINDER HEAD DISTORTION

Clean surface of cylinder head.

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

Head surface flatness:

Standard

Less than 0.03 mm (0.0012 in)

Limit

0.1 mm (0.004 in)

If beyond the specified limit, replace or resurface.

Resurfacing limit:

The resurfacing limit of cylinder head is determined by the cylinder block resurfacing in an engine.

Amount of cylinder head resurfacing is "A".

Amount of cylinder block resurfacing is "B".

The maximum limit is as follows:

$$A + B = 0.2 \text{ mm (0.008 in)}$$

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

Nominal cylinder head height:

136.9 - 137.1 mm (5.390 - 5.398 in)

CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.

GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

BT

HA

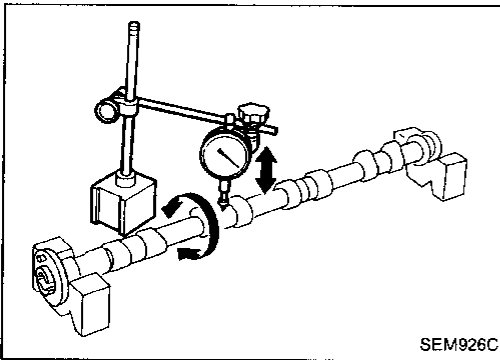
EL

IDX

CYLINDER HEAD

Inspection (Cont'd)

CAMSHAFT RUNOUT



1. Measure camshaft runout at the center journal.

Runout (Total indicator reading):

Standard

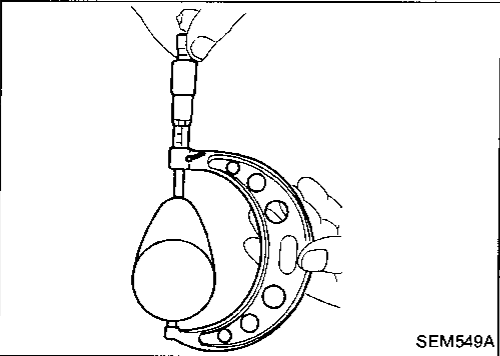
Less than 0.02 mm (0.0008 in)

Limit

0.1 mm (0.004 in)

2. If it exceeds the limit, replace camshaft.

CAMSHAFT CAM HEIGHT



1. Measure camshaft cam height.

Standard cam height:

Intake & Exhaust

37.920 - 38.110 mm (1.4929 - 1.5004 in)

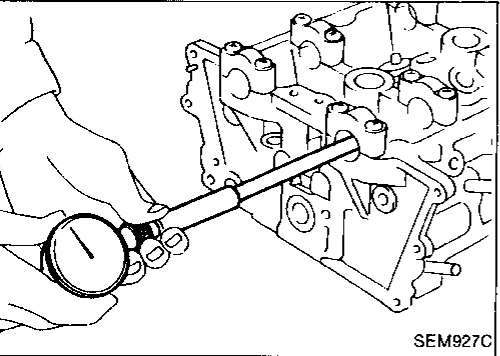
Cam wear limit:

Intake & Exhaust

0.2 mm (0.008 in)

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

CAMSHAFT JOURNAL CLEARANCE



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

2. Measure inner diameter of camshaft bearing.

Standard inner diameter:

28.000 - 28.021 mm (1.1024 - 1.1032 in)

3. Measure outer diameter of camshaft journal.

Standard outer diameter:

27.935 - 27.955 mm (1.0998 - 1.1006 in)

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

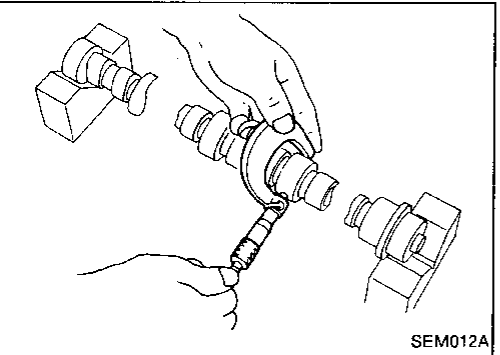
Camshaft journal clearance:

Standard

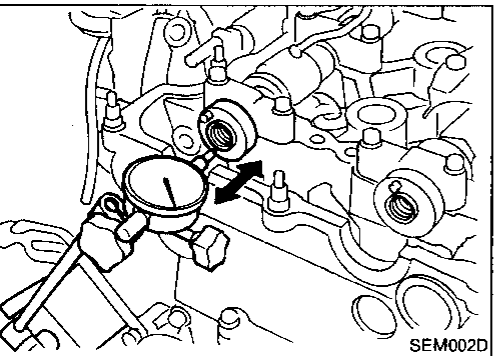
0.045 - 0.086 mm (0.0018 - 0.0034 in)

Limit

0.12 mm (0.0047 in)



CAMSHAFT END PLAY



1. Install camshaft in cylinder head.

2. Measure camshaft end play.

Camshaft end play:

Standard

0.055 - 0.139 mm (0.0022 - 0.0055 in)

Limit

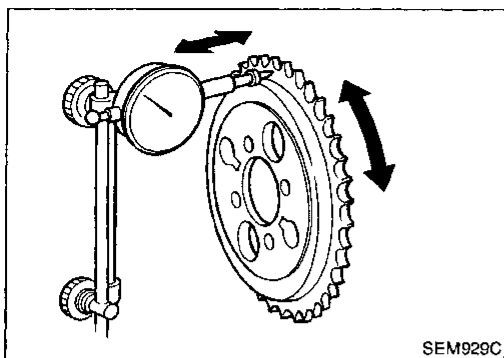
0.20 mm (0.0079 in)

CYLINDER HEAD

Inspection (Cont'd)

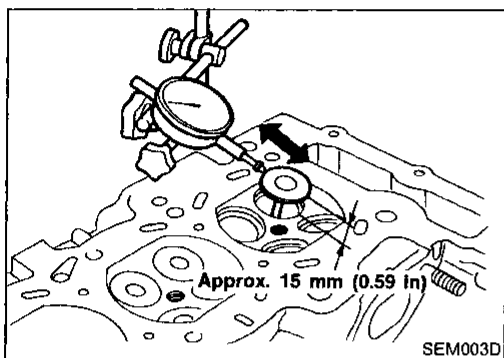
CAMSHAFT SPROCKET RUNOUT

1. Install sprocket on camshaft.
2. Measure camshaft sprocket runout.
Runout (Total indicator reading):
Less than 0.25 mm (0.0098 in)
3. If it exceeds the limit, replace camshaft sprocket.

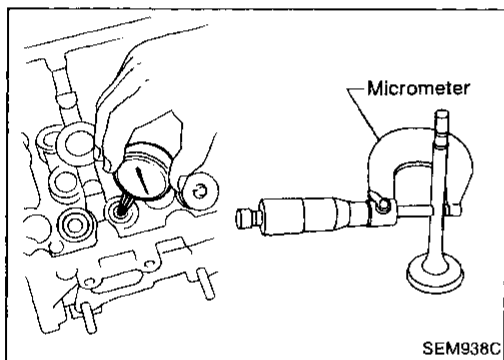


VALVE GUIDE CLEARANCE

1. Measure valve deflection in a parallel direction with rocker arm. (Valve and valve guide mostly wear in this direction.)
Valve deflection limit (Dial gauge reading):
Intake & Exhaust
0.2 mm (0.008 in)

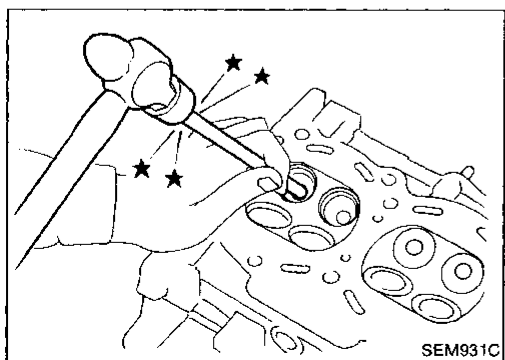
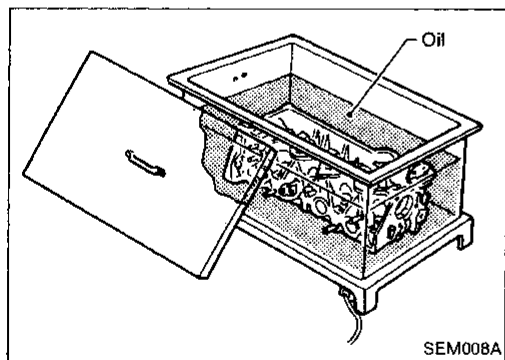


2. If it exceeds the limit, check valve to valve guide clearance.
 - a. Measure valve stem diameter and valve guide inner diameter.
 - b. Check that clearance is within specification.
Valve to valve guide clearance:
Standard
Intake 0.020 - 0.053 mm (0.0008 - 0.0021 in)
Exhaust 0.040 - 0.073 mm (0.0016 - 0.0029 in)
Limit
Intake & Exhaust 0.1 mm (0.004 in)
- c. If it exceeds the limit, replace valve or valve guide.



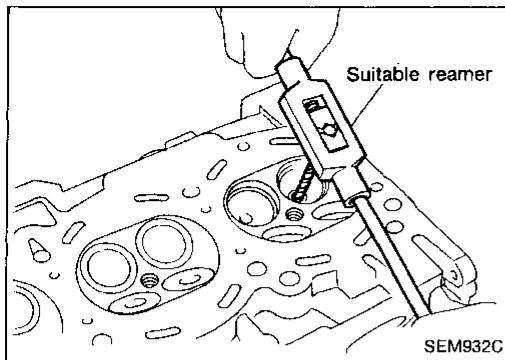
VALVE GUIDE REPLACEMENT

1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F).
2. Press out valve guide or use a hammer and suitable tool.

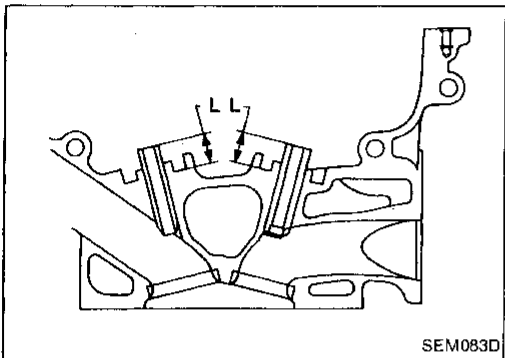


CYLINDER HEAD

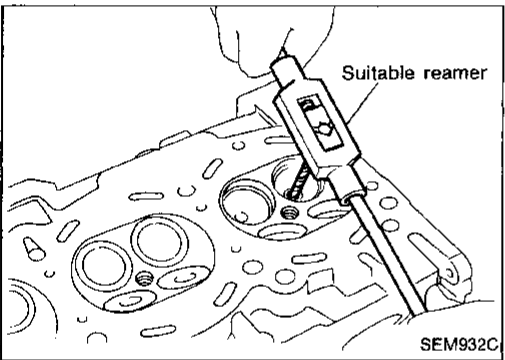
Inspection (Cont'd)



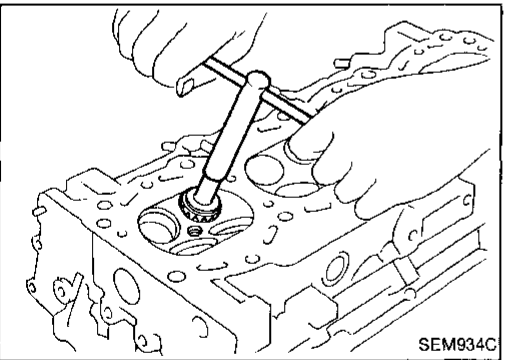
3. Ream cylinder head valve guide hole.
Valve guide hole diameter
(for service parts):
Intake & Exhaust
10.175 - 10.196 mm (0.4006 - 0.4014 in)



4. Heat cylinder head to 110 to 130°C (230 to 266°F) and press service valve guide onto cylinder head.
Projection "L":
14.0 - 14.2 mm (0.551 - 0.559 in)



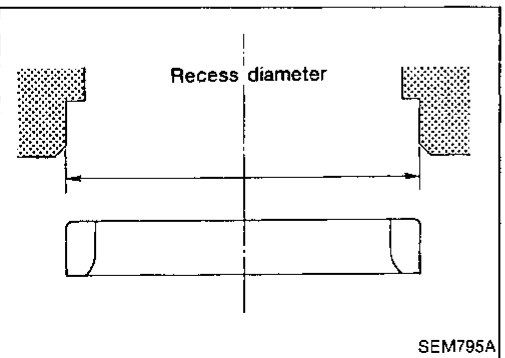
5. Ream valve guide.
Finished size:
Intake & Exhaust
6.000 - 6.018 mm (0.2362 - 0.2369 in)



VALVE SEATS

Check valve seats for any evidence of pitting at valve contact surface. Reset or replace if it has worn out excessively.

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



REPLACING VALVE SEAT FOR SERVICE PARTS

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

Reaming bore for service valve seat

Oversize [0.5 mm (0.020 in)]:

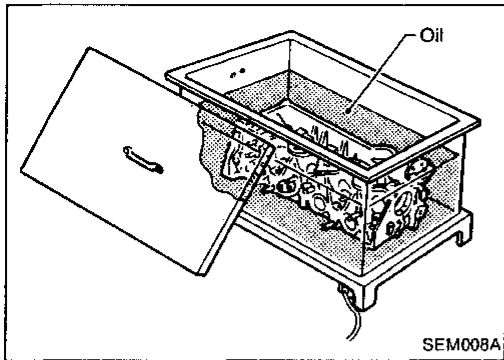
Intake 35.500 - 35.516 mm (1.3976 - 1.3983 in)

Exhaust 31.500 - 31.516 mm (1.2402 - 1.2408 in)

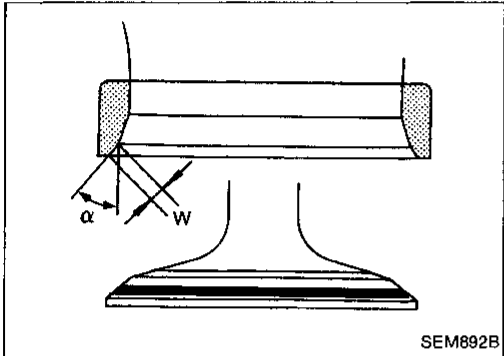
Be sure to ream in circles concentric to the valve guide center. This will enable valve seat to fit correctly.

CYLINDER HEAD

Inspection (Cont'd)



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



5. Cut or grind valve seat using a suitable tool at the specified dimensions as shown in SDS (EM-62).
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.

Seat face angle " α ":
44°53' - 45°07'

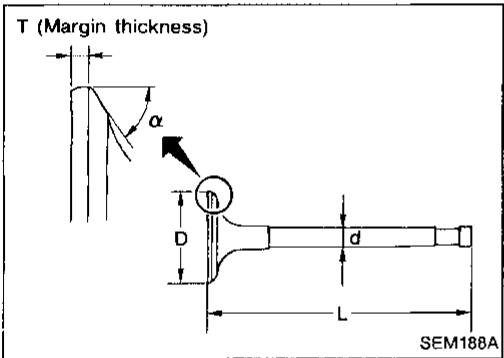
Contacting width "W":

Intake

1.05 - 1.35 mm (0.0413 - 0.0531 in)

Exhaust

1.25 - 1.55 mm (0.0492 - 0.0610 in)

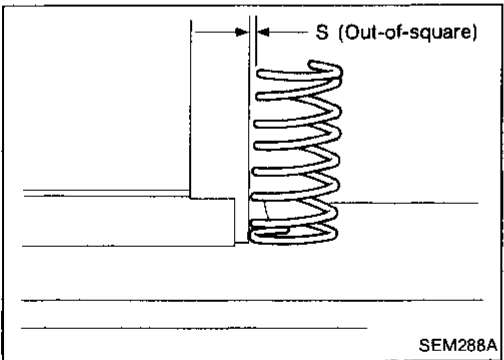


VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to SDS (EM-61).

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.



VALVE SPRING

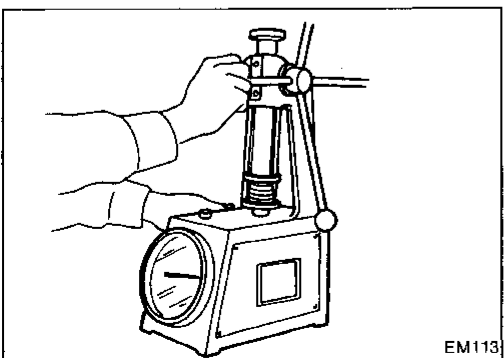
Squareness

1. Measure dimension "S".

Out-of-square "S":

Less than 2.2 mm (0.087 in)

2. If it exceeds the limit, replace spring.



Pressure

Check valve spring pressure.

Pressure: N (kg, lb) at height mm (in)

Standard

569.00 - 641.57 (58.02 - 65.42,

127.93 - 144.25) at 30.0 (1.181)

Limit

More than 549.2 (56.0, 123.5) at 30.0 (1.181)

If it exceeds the limit, replace spring.

GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

BT

HA

EL

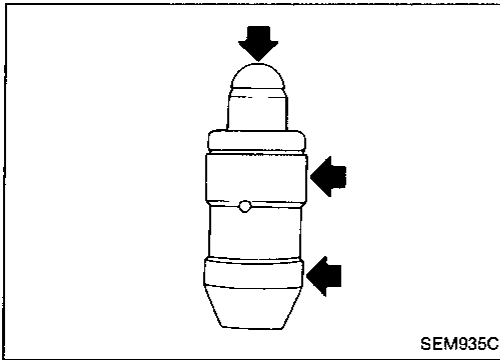
IDX

CYLINDER HEAD

Inspection (Cont'd)

HYDRAULIC LASH ADJUSTER

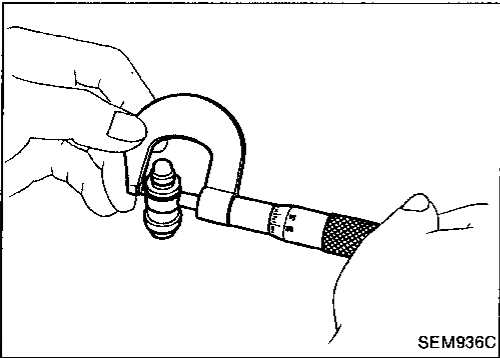
1. Check contact and sliding surfaces for wear or scratches.



2. Check diameter of lash adjuster.

Outer diameter:

16.980 - 16.993 mm (0.6685 - 0.6690 in)



3. Check lash adjuster guide inner diameter.

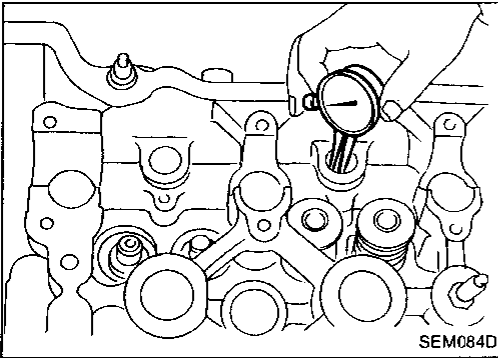
Inner diameter:

17.000 - 17.020 mm (0.6693 - 0.6701 in)

Standard clearance between lash adjuster and

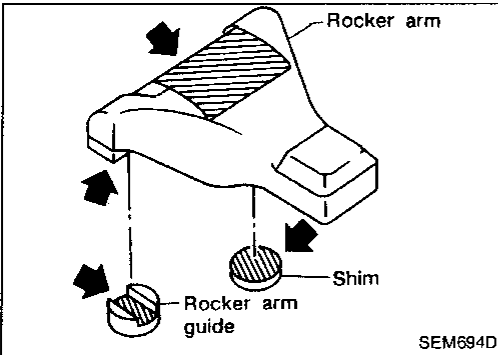
adjuster guide:

0.007 - 0.040 mm (0.0003 - 0.0016 in)



ROCKER ARM, SHIM AND ROCKER ARM GUIDE

Check contact and sliding surfaces of rocker arms, shims and rocker arm guides for wear or scratches.

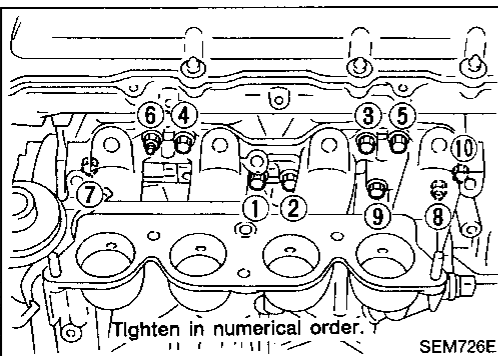


Assembly

1. Install intake manifold.

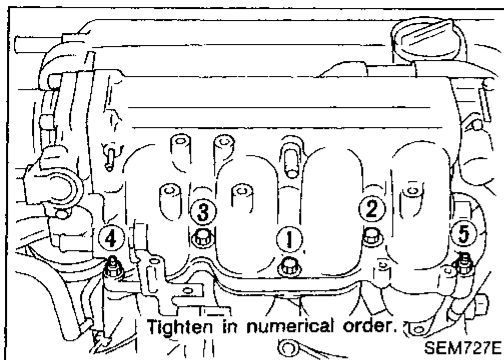
2. Install fuel tube assembly.

Refer to EC section ("Injector Removal and Installation", "BASIC SERVICE PROCEDURE").

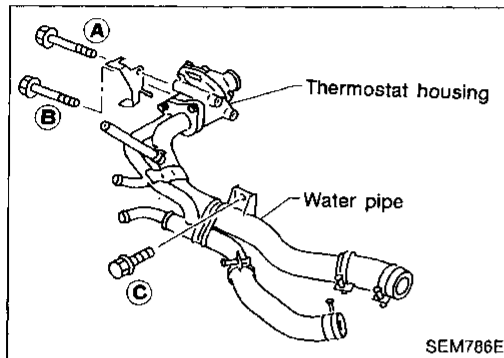


CYLINDER HEAD

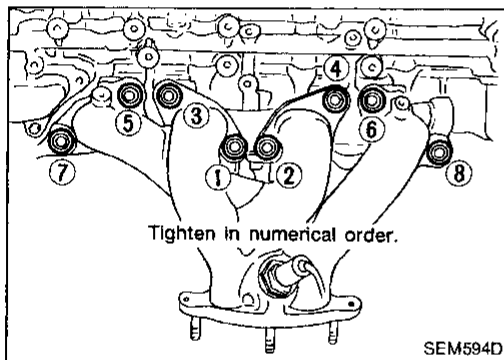
Assembly (Cont'd)



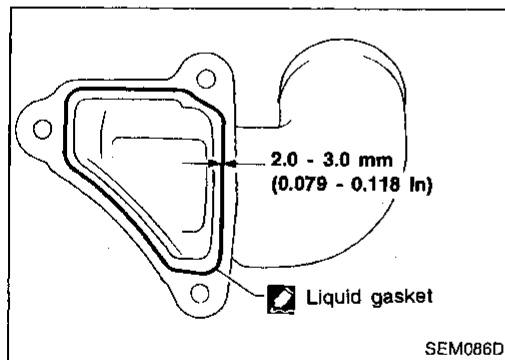
3. Install intake manifold collector to intake manifold.
4. Install oil filter bracket and power steering oil pump bracket.



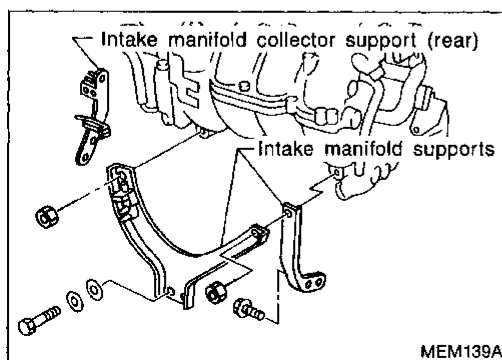
5. Install thermostat housing with water pipe.
 - Tightening procedure:
 - 1) Tighten bolt **A** to 2 - 5 N·m (0.2 - 0.5 kg-m, 17 - 43 in-lb).
 - 2) Tighten bolt **C** to 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb).
 - 3) Tighten bolt **A** to 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb).
 - 4) Tighten bolt **B** to 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb).



6. Install exhaust manifold.
 - Tighten exhaust manifold bolts in numerical order.
7. Install exhaust manifold cover.



8. Install water outlet.
 - a. Before installing water outlet, remove all traces of liquid gasket from mating surface using a scraper.
 - Also remove traces of liquid gasket from mating surface of cylinder head.
 - b. Apply a continuous bead of liquid gasket to mating surface of water outlet.
 - **Use Genuine Liquid Gasket or equivalent.**



9. Install intake manifold supports and intake manifold collector supports.
10. Install EGR tube.
11. Install crankcase ventilation oil separator.

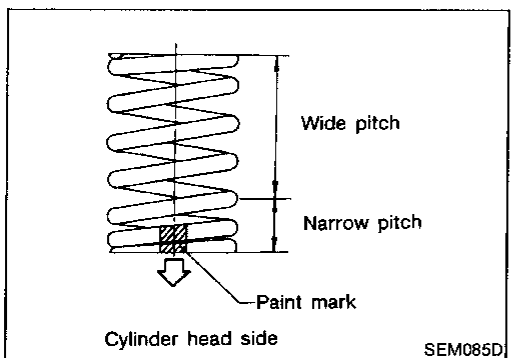
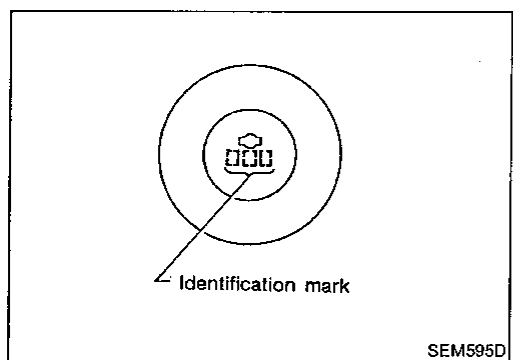
CYLINDER HEAD

Assembly (Cont'd)

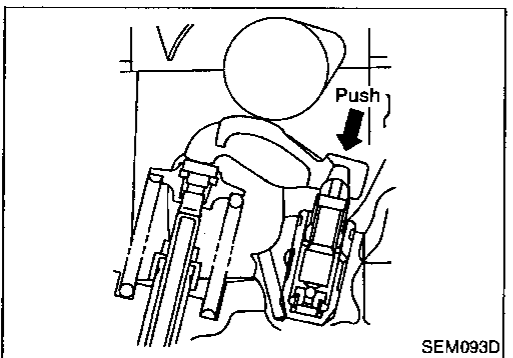
12. Install valve component parts.

- Install valves, noting their identification marks as indicated in the table below.

	Identification mark
Intake valve	53J
Exhaust valve	64Y

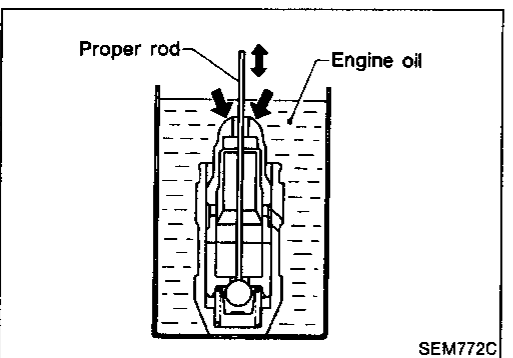


- Always use new valve oil seal.
- Refer to OIL SEAL REPLACEMENT (EM-30).
- Before installing valve oil seal, install valve spring seat.
- Install valve spring (uneven pitch type) with its narrow pitched side toward cylinder head side (paint mark).
- After installing valve component parts, tap valve stem tip with plastic hammer to assure a proper fit.



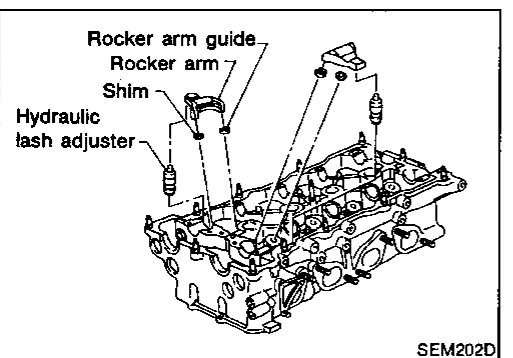
13. Check hydraulic lash adjusters.

- Push rocker arm at hydraulic lash adjuster location, and see if rocker arm moves. If it moves at least 1 mm (0.04 in), it indicates that there is air in the high pressure chamber. Noise will be emitted from hydraulic lash adjuster if engine is started without bleeding air.



- Remove hydraulic lash adjuster and dip in a container filled with engine oil. While pushing plunger as shown in figure, lightly push check ball using a thin rod. Air is completely bled when plunger no longer moves.

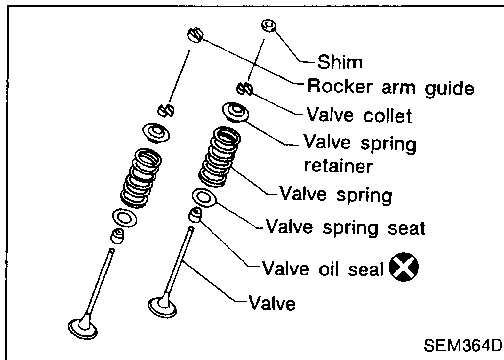
Air cannot be bled from this type of lash adjuster by running the engine.



- Remove camshafts, rocker arms and shims. For future reference, identify each shim with the cylinder it was removed from. Since the shims are reusable, it may not be necessary to replace all of the existing shims.

CYLINDER HEAD

Assembly (Cont'd)

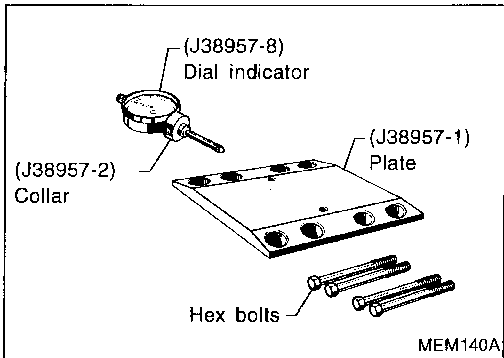


15. Before attempting any measurement, make sure the valve, valve spring, collet, retainer and rocker arm guide are properly installed in the head.

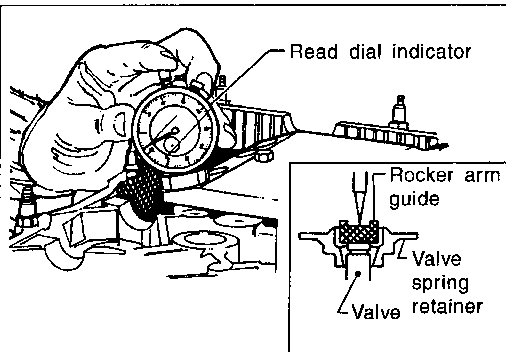
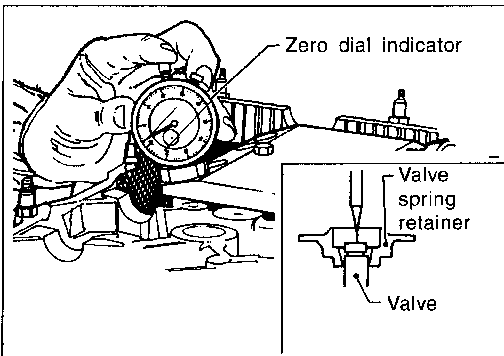
- Always replace rocker arm guide with a new one.

CAUTION:

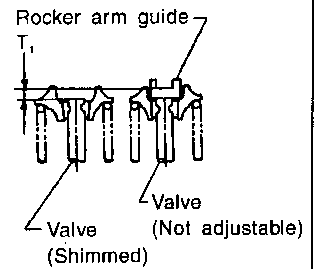
Install parts in their original positions.



16. Install the J38957-1 gauge plate into the tapped holes at the cam journals and secure it to the head using two of the hex bolts supplied with the kit. (The two remaining bolts are spares.)



Valve pair



17. Place the J38957-2 collar on the J38957-8 dial indicator. Make sure the dished side of the collar is facing "up" (toward the dial indicator). Secure the collar to the dial indicator by tightening the set screw in the collar.

18. Place the indicator and collar over #1 cylinder intake valve, shim side. Slide the tip of the dial indicator through the access hole and place it on the end of the valve stem. While resting the dial indicator collar on the gauge plate, "zero" the dial indicator.

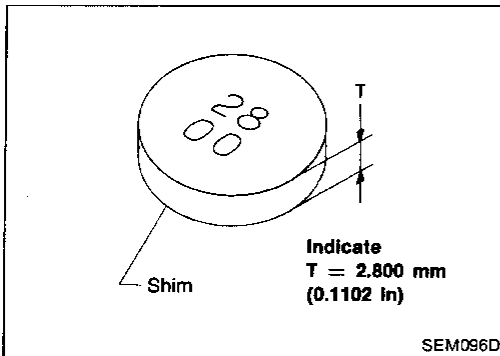
19. Move the dial indicator and collar to the adjacent hole in the gauge plate and place the tip of the indicator in the center of the rocker arm guide. Write down the dial indicator reading. This measured distance between the valve stem end and the contact surface of the rocker arm guide is the " T_1 " dimension.

20. Match the measured " T_1 " dimension (in inches) to the available shim chart (in millimeters) located in the SDS section of the service manual. (The " T_1 " dimension is equivalent to the thickness and size designation of the valve shim.) Select the closest size shim to the measured " T_1 " dimension. For example, if the measured " T_1 " dimension is 0.1154 in use a 2.925 mm shim. Shims are available

CYLINDER HEAD

Assembly (Cont'd)

in 17 different thicknesses ranging from 2.800 mm (0.1102 in) to 3.200 mm (0.1260 in) and increase in increments of 0.025 mm (0.0010 in), Refer to PARTS CATALOG for appropriate part numbers.



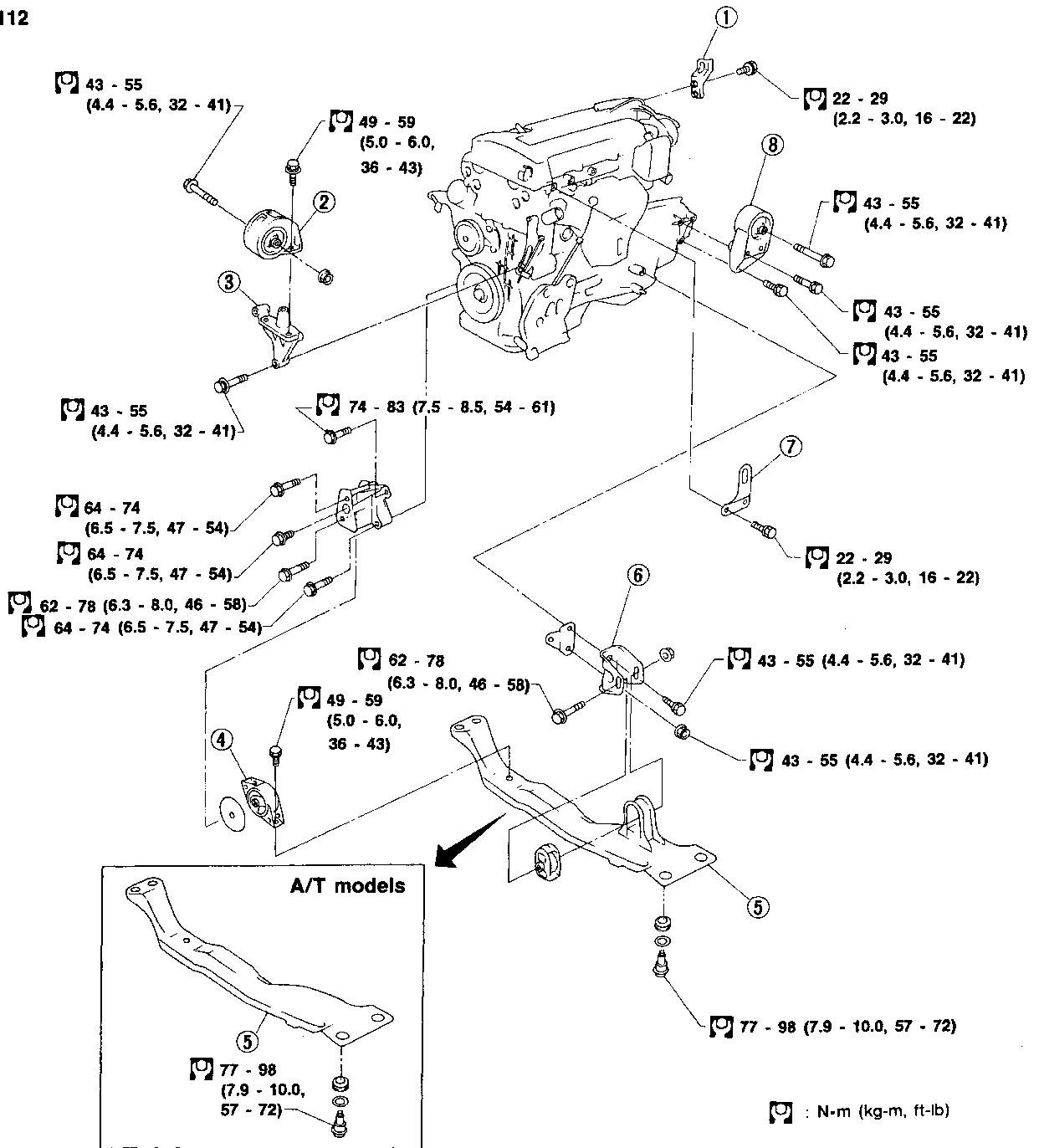
21. Repeat this procedure on the remaining cylinders.

Installation

- This installation is the same procedure as those for timing chain. Refer to "Installation" in "TIMING CHAIN" (EM-21).

ENGINE REMOVAL

SEC. 112



SEM687DA

- | | | |
|--------------------------------------|--------------------|-------------------------------------|
| ① Rear engine slinger | ④ Rear insulator | ⑦ Front engine slinger |
| ② Front engine mounting (Fluid type) | ⑤ Center member | ⑧ Rear engine mounting (Fluid type) |
| ③ Mounting bracket | ⑥ Mounting bracket | |

GI
MA
EM
LC
EC
FE
CL
WT
AT
FA
RA
BR
ST
RS
BT
HA
EL
IDX

ENGINE REMOVAL

WARNING:

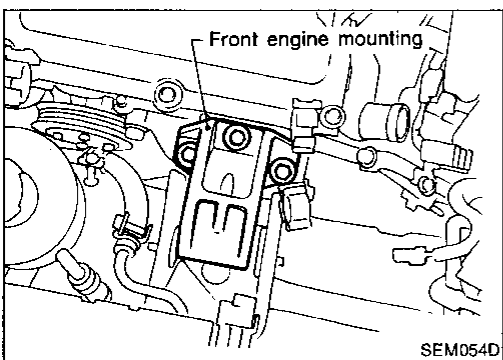
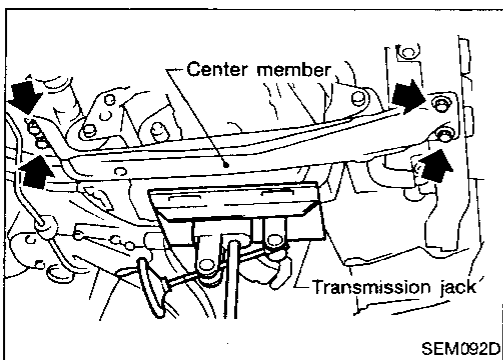
- Position vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Do not remove engine until exhaust system has completely cooled off.
Otherwise, you may burn yourself and/or fire may break out in fuel line.
- Before disconnecting fuel hose, release fuel pressure from fuel line. Refer to EC section (“Fuel Pressure Release”, “BASIC SERVICE PROCEDURE”).
- Before removing front axle from transaxle, place safety stands under designated front supporting points. Refer to GI section (“Garage Jack and Safety Stand”, “LIFTING POINTS AND TOW TRUCK TOWING”).
- Be sure to hoist engine and transaxle in a safe manner.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

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

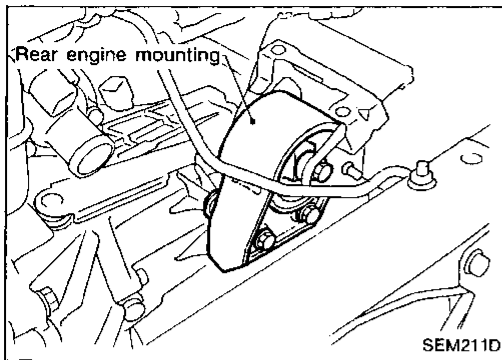
Removal

1. Remove engine under cover and hood.
2. Drain coolant from both cylinder block, and radiator.
3. Drain engine oil from drain plug of oil pan.
4. Remove vacuum hoses, fuel hoses, wires, harness and connectors and so on.
5. Remove exhaust tubes, ball joints and drive shafts.
6. Remove radiator and fans.
7. Remove drive belts.
8. Remove alternator, compressor and power steering oil pump from engine.
9. Set a suitable transmission jack under transaxle. Hoist engine with engine slinger.
10. Remove center member.
11. Remove engine mounting bolts from both sides and then slowly lower transmission jack.

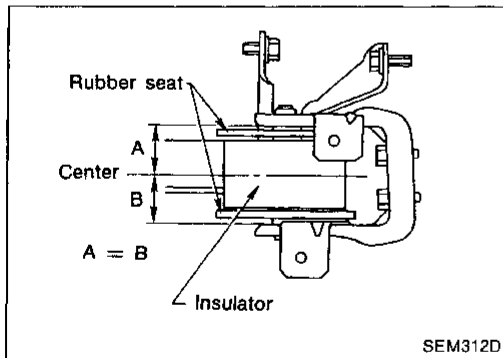
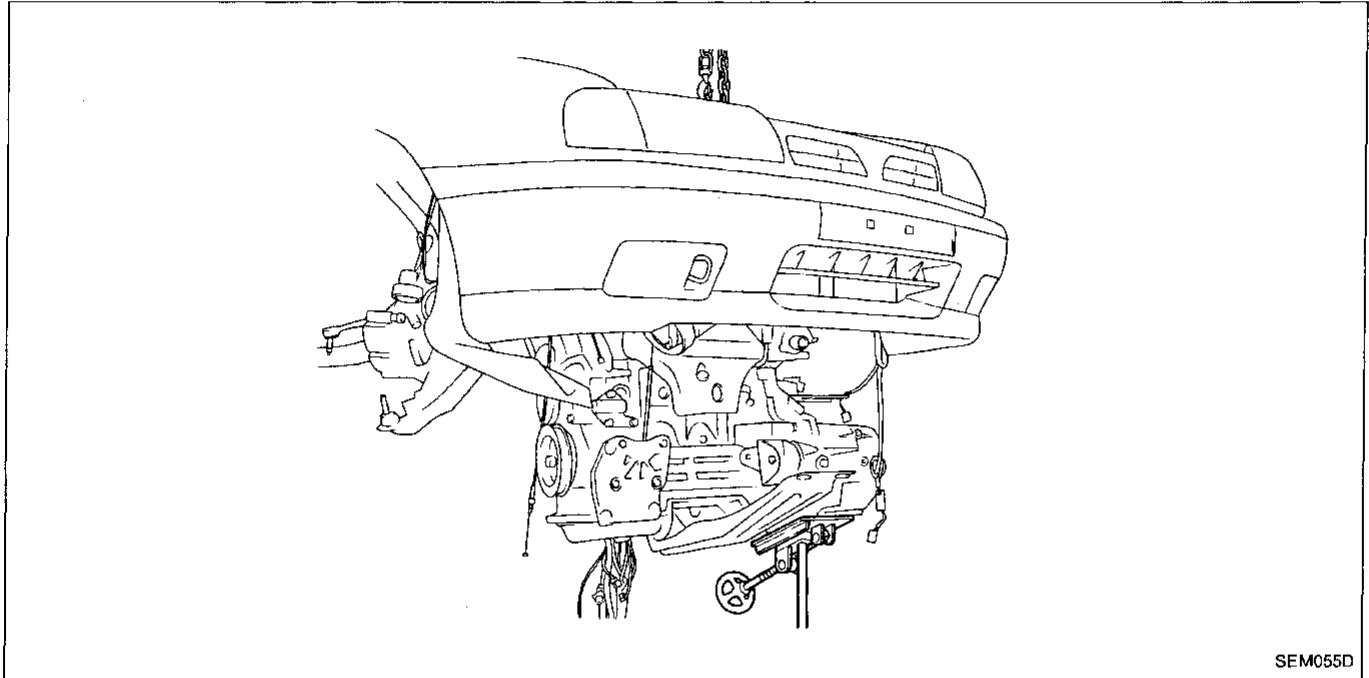


ENGINE REMOVAL

Removal (Cont'd)

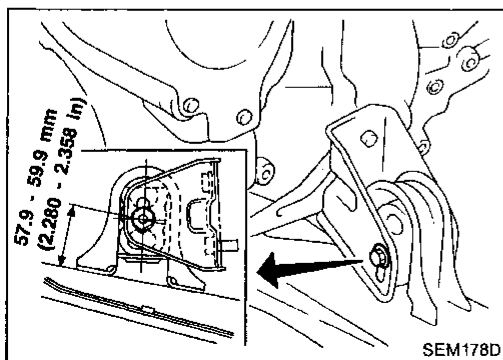


12. Remove engine with transaxle as shown.



Installation

1. Install engine mounting bracket and fixing bolts. **Be sure that insulators are correctly positioned on the brackets.**
2. Carefully lower the engine onto engine mounting insulators.

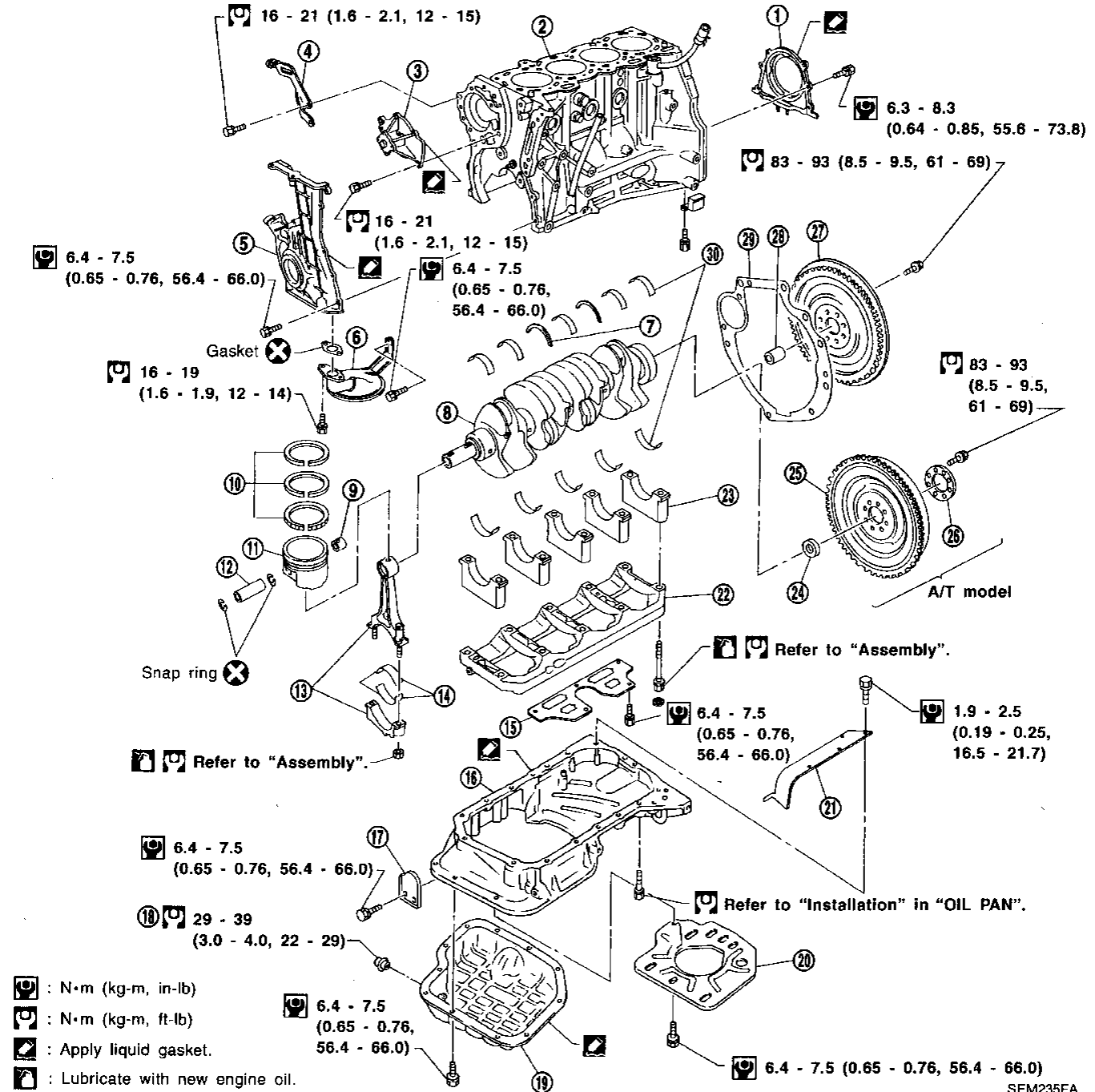


When installing the engine, adjust the height of the engine mounting as shown. (For M/T)

3. Installation is in the reverse order of removal.

CYLINDER BLOCK

SEC. 110-120-150



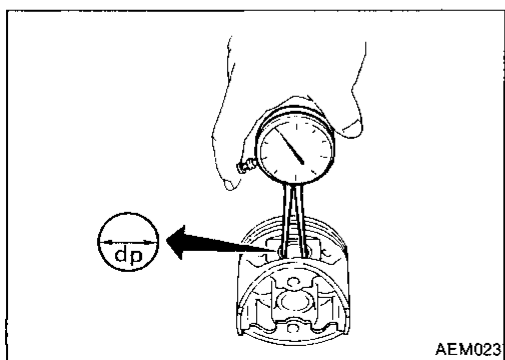
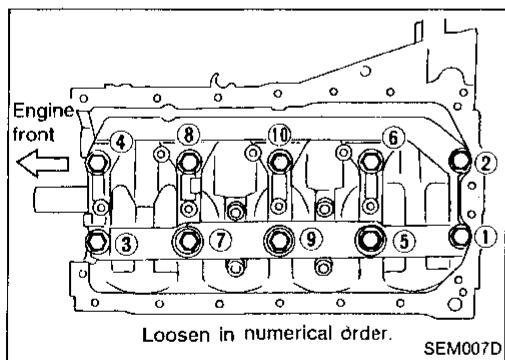
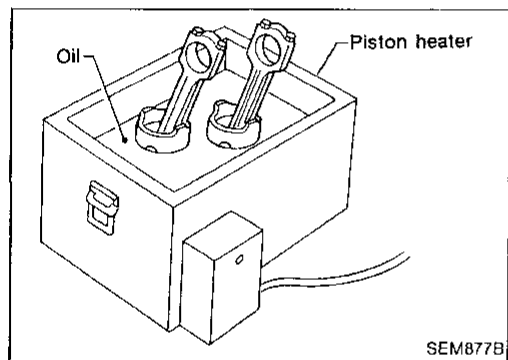
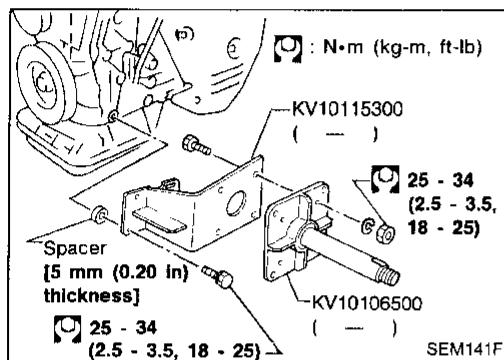
SEM235FA

- | | | |
|---|--------------------------|-----------------------------|
| ① Rear oil seal retainer | ⑪ Piston | ⑳ Side gallery baffle plate |
| ② Cylinder block | ⑫ Piston pin | ㉑ Main bearing beam |
| ③ Water pump | ⑬ Connecting rod | ㉒ Main bearing cap |
| ④ Power steering oil pump adjusting bar | ⑭ Connecting rod bearing | ㉓ Pilot converter |
| ⑤ Front cover with oil pump | ⑮ Baffle plate | ㉔ Drive plate |
| ⑥ Oil strainer | ⑯ Aluminum oil pan | ㉕ Drive plate reinforcement |
| ⑦ Thrust bearing | ⑰ Rear cover plate | ㉖ Flywheel |
| ⑧ Crankshaft | ⑱ Drain plug | ㉗ Pilot bushing |
| ⑨ Connecting rod bushing | ㉀ Steel oil pan | ㉘ Rear plate |
| ⑩ Piston rings | ㉁ Baffle plate | ㉙ Main bearing |

CYLINDER BLOCK

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.



Disassembly

PISTON AND CRANKSHAFT

1. Place engine on a work stand.
2. Remove cylinder head and timing chain. Refer to "Removal" in "TIMING CHAIN" (EM-17).
3. Remove oil pan. Refer to "Removal" in "OIL PAN" (EM-11).
4. Remove pistons with connecting rods.
 - To disassemble piston and connecting rod, first remove snap rings. Heat piston to 60 to 70°C (140 to 158°F) then use piston pin press to remove pin.
 - **When piston rings are not replaced, make sure that piston rings are mounted in their original positions.**
 - **When replacing piston rings, if there is no punchmark, install with either side up.**
5. Remove rear oil seal retainer.
6. Remove bearing beam, bearing cap and crankshaft.
 - **Before removing bearing cap, measure crankshaft end play. Refer to EM-58.**
 - **Bolts should be loosened in two or three steps.**

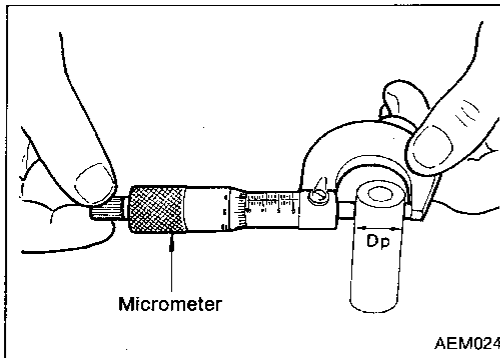
Inspection

PISTON AND PISTON PIN CLEARANCE

1. Measure inner diameter of piston pin hole "dp".
Standard diameter "dp":
21.987 - 21.999 mm (0.8656 - 0.8661 in)

CYLINDER BLOCK

Inspection (Cont'd)



2. Measure outer diameter of piston pin "Dp".

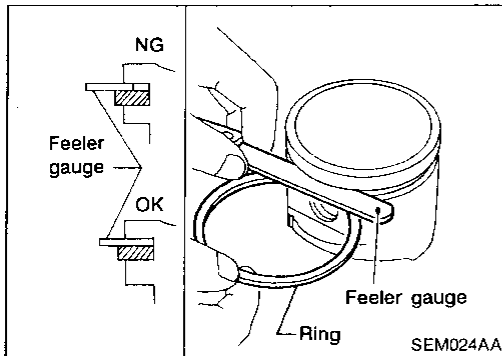
Standard diameter "Dp":

21.989 - 22.001 mm (0.8657 - 0.8662 in)

3. Calculate piston pin clearance.

$dp - Dp = -0.004$ to 0 mm (-0.0002 to 0 in)

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



PISTON RING SIDE CLEARANCE

Side clearance:

Top ring

0.045 - 0.080 mm (0.0018 - 0.0031 in)

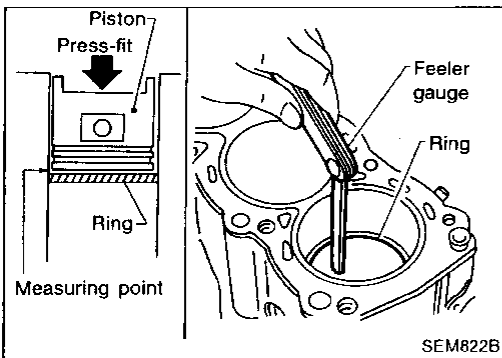
2nd ring

0.030 - 0.065 mm (0.0012 - 0.0026 in)

Max. limit of side clearance:

0.2 mm (0.008 in)

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



PISTON RING END GAP

End gap:

Top ring 0.20 - 0.30 mm (0.0079 - 0.0118 in)

2nd ring 0.35 - 0.50 mm (0.0138 - 0.0197 in)

Oil ring 0.20 - 0.60 mm (0.0079 - 0.0236 in)

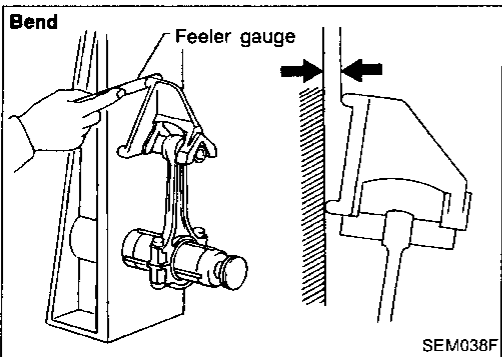
Max. limit of ring gap:

1.0 mm (0.039 in)

If out of specification, replace piston ring. If gap still exceeds the limit even with a new ring, do the following. Rebore cylinder and use over-sized piston and piston rings.

Refer to SDS (EM-65).

- When replacing the piston, inspect 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:

Limit 0.15 mm (0.0059 in)

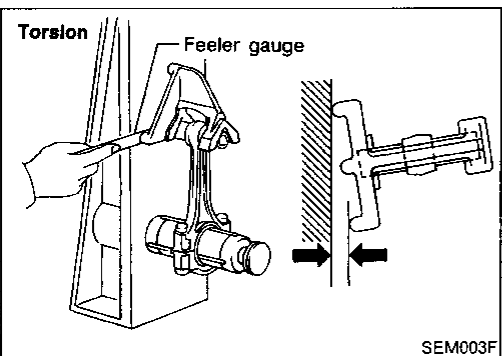
per 100 mm (3.94 in) length

Torsion:

Limit 0.30 mm (0.0118 in)

per 100 mm (3.94 in) length

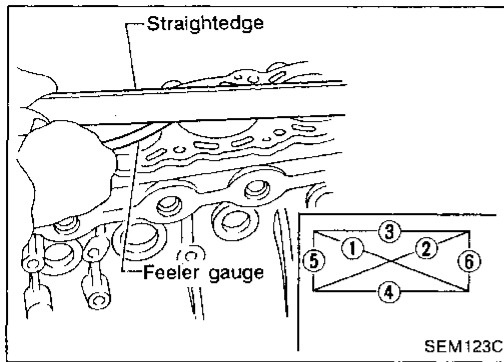
If it exceeds the limit, replace connecting rod assembly.



CYLINDER BLOCK

Inspection (Cont'd)

CYLINDER BLOCK DISTORTION AND WEAR



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

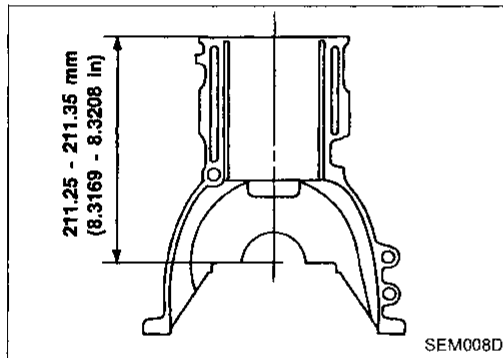
Standard:

Less than 0.03 mm (0.0012 in)

Limit:

0.10 mm (0.0039 in)

2. If out of specification, resurface it.
The resurfacing limit is determined by cylinder head resurfacing in engine.



Amount of cylinder head resurfacing is "A".
Amount of cylinder block resurfacing is "B".

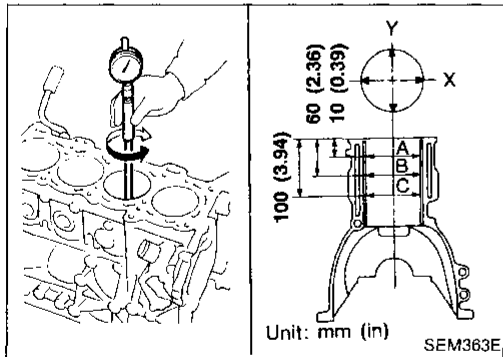
The maximum limit is as follows:

A + B = 0.2 mm (0.008 in)

**Nominal cylinder block height
from crankshaft center:**

211.25 - 211.35 mm (8.3169 - 8.3208 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:

86.000 - 86.030 mm (3.3858 - 3.3870 in)

Wear limit: 0.20 mm (0.0079 in)

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

Out-of-round (X - Y) standard:

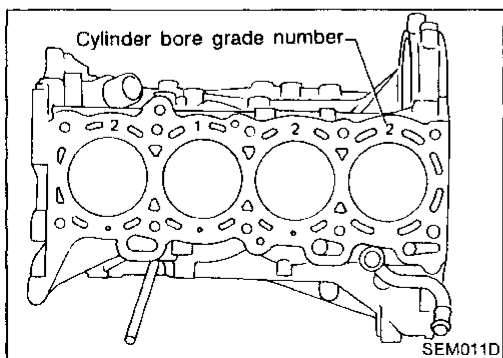
Less than 0.015 mm (0.0006 in)

Taper (A - B and A - C) standard:

Less than 0.010 mm (0.0004 in)

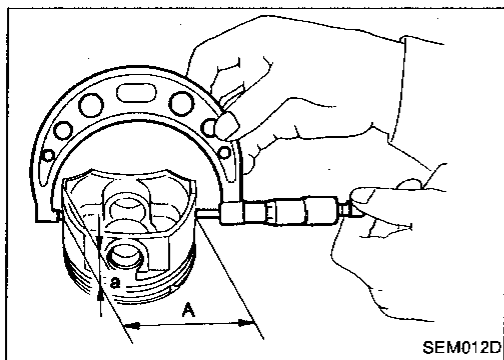
2. Check for scratches and seizure. If seizure is found, hone it.

- If cylinder block or piston is replaced, match piston grade with grade number on cylinder block upper surface.



CYLINDER BLOCK

Inspection (Cont'd)



3. Measure piston skirt diameter.
Piston diameter "A": Refer to SDS (EM-65).
Measuring point "a" (Distance from the bottom):
14.0 mm (0.551 in)
4. Check that piston-to-bore clearance is within specification.
Piston-to-bore clearance "B":
0.010 - 0.030 mm (0.0004 - 0.0012 in)
5. Determine piston oversize according to amount of cylinder wear.

Oversize pistons are available for service. Refer to SDS (EM-65).

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

Rebored size calculation:

$$D = A + B - C$$

where,

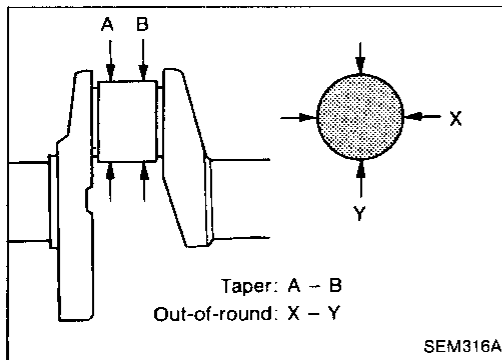
D: Bored diameter

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 to the specified torque.
 - **Otherwise, cylinder bores may be distorted in final assembly.**
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 in diameter at a time.**
- 9.hone cylinders to obtain specified piston-to-bore clearance.
10. Measure finished cylinder bore for out-of-round and taper.
 - **Measurement should be done after cylinder bore cools down.**



CRANKSHAFT

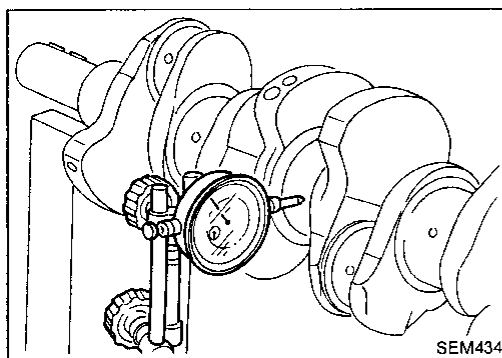
1. Check crankshaft main and pin journals for score, wear or cracks.
2. With a micrometer, measure journals for taper and out-of-round.

Out-of-round (X - Y):

Less than 0.005 mm (0.0002 in)

Taper (A - B):

Less than 0.005 mm (0.0002 in)



3. Measure crankshaft runout.
Runout (Total indicator reading):
Limit 0.05 mm (0.0020 in)

CYLINDER BLOCK

Inspection (Cont'd)

BEARING CLEARANCE

- Use either of the following two methods, however, method "A" gives more reliable results and is preferred.

Method A (Using bore gauge & micrometer)

Main bearing

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

2. Install main bearing cap and main bearing beam to cylinder block.

Tighten all bolts in correct order in two or three stages.

3. Measure inner diameter "A" of each main bearing.

4. Measure outer diameter "Dm" of each crankshaft main journal.

5. Calculate main bearing clearance.

Main bearing clearance = A - Dm

Standard: 0.004 - 0.022 mm (0.0002 - 0.0009 in)

Limit: 0.050 mm (0.0020 in)

- If it exceeds the limit, replace bearing.
- If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.

- a. When grinding crankshaft journal, confirm that "L" dimension in fillet roll is more than the specified limit.

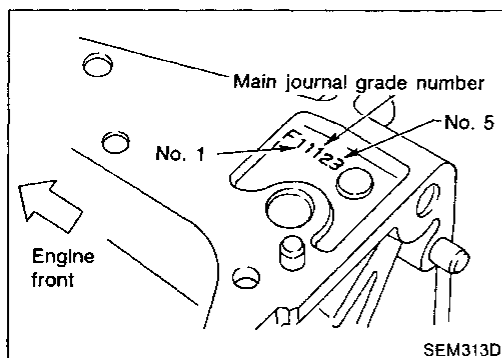
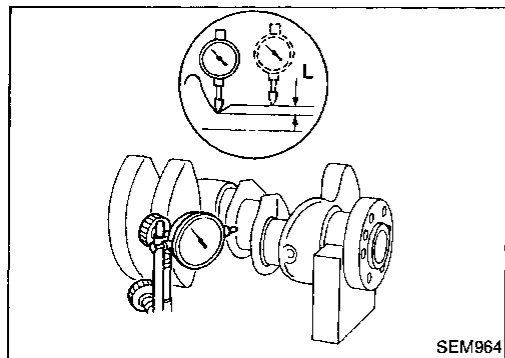
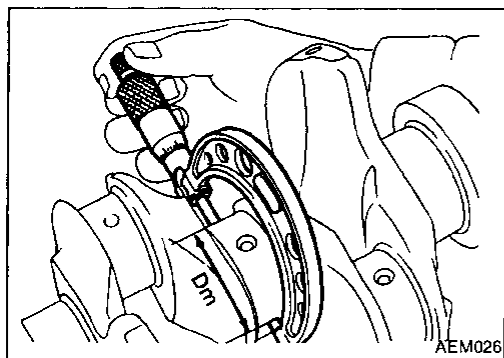
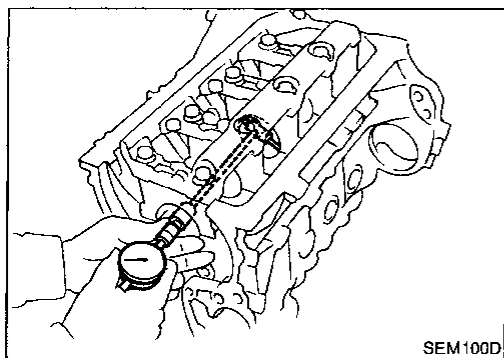
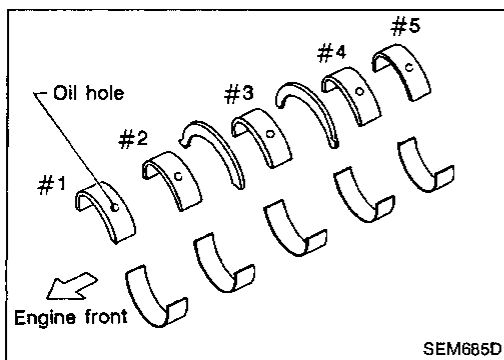
"L": 0.1 mm (0.004 in)

- b. Refer to SDS for grinding crankshaft and available service parts.

6. If crankshaft is reused, measure main bearing clearances and select thickness of main bearings.

If crankshaft is replaced with a new one, 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.



CYLINDER BLOCK

Inspection (Cont'd)

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

How to select main bearings (Identification mark and color)

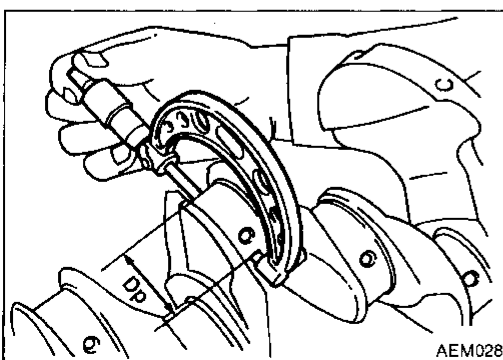
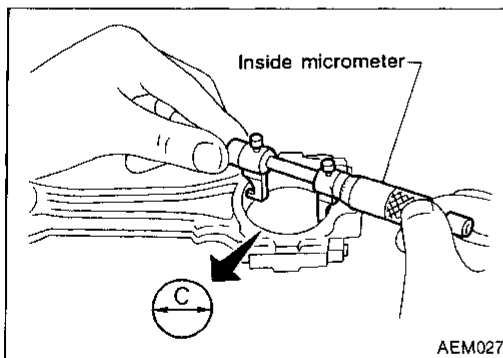
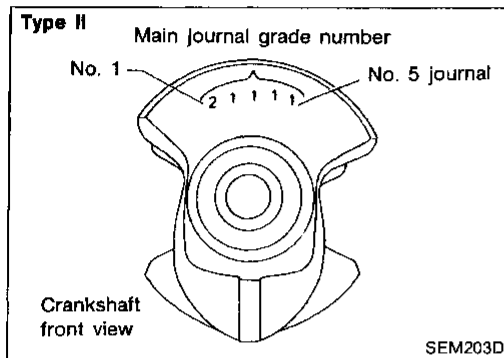
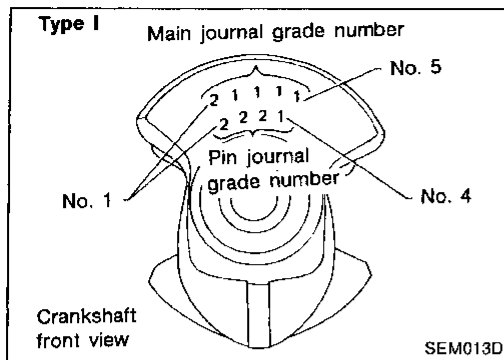
Crankshaft main journal grade number	Cylinder block main journal grade number			
	0	1	2	3
0	0 (A, Black)	1 (B, Brown)	2 (C, Green)	3 (D, Yellow)
1	1 (B, Brown)	2 (C, Green)	3 (D, Yellow)	4 (E, Blue)
2	2 (C, Green)	3 (D, Yellow)	4 (E, Blue)	5 (F, Pink)
3	3 (D, Yellow)	4 (E, Blue)	5 (F, Pink)	6 (G, No color)

For example:

Main journal grade number: 1

Crankshaft journal grade number: 2

**Main bearing grade number = 1 + 2
= 3 (D, Yellow)**



Connecting rod bearing (Big end)

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

4. Measure outer diameter "Dp" of each crankshaft pin journal.
5. Calculate connecting rod bearing clearance.
Connecting rod bearing clearance = C - Dp
Standard: 0.020 - 0.045 mm (0.0008 - 0.0018 in)
Limit: 0.090 mm (0.0035 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. Refer to step 5 of "BEARING CLEARANCE — Main bearing" (EM-53).

CYLINDER BLOCK

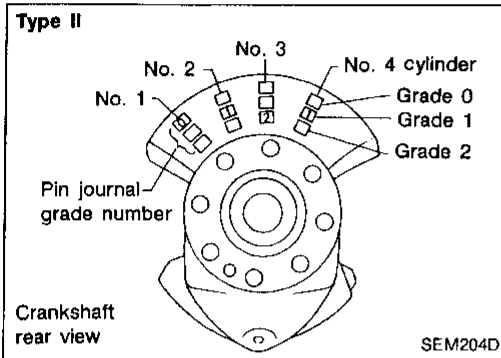
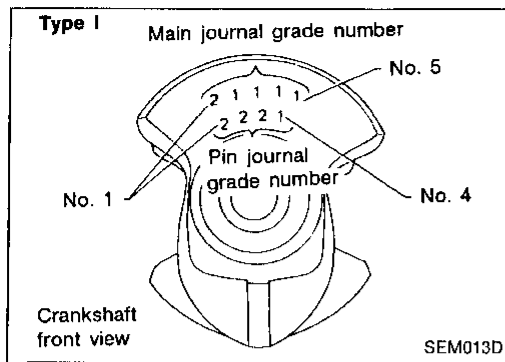
Inspection (Cont'd)

8. If crankshaft is replaced with a new one, 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	1
2	2

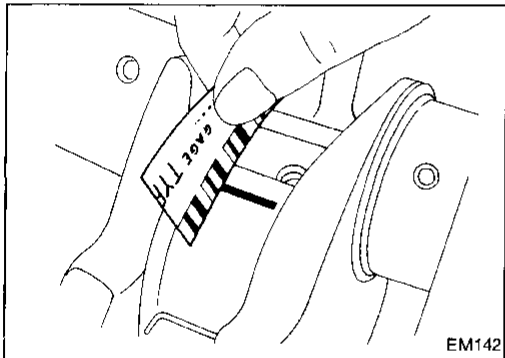


Identification color:

Grade 0; No color

Grade 1; Black

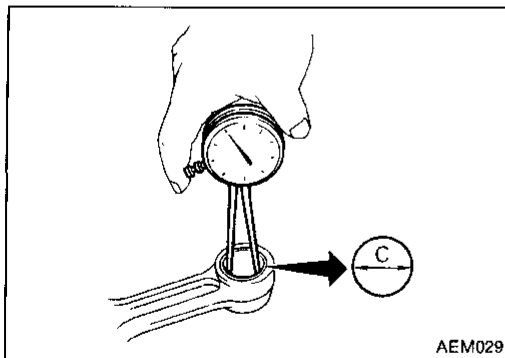
Grade 2; Brown



Method B (Using plastigage)

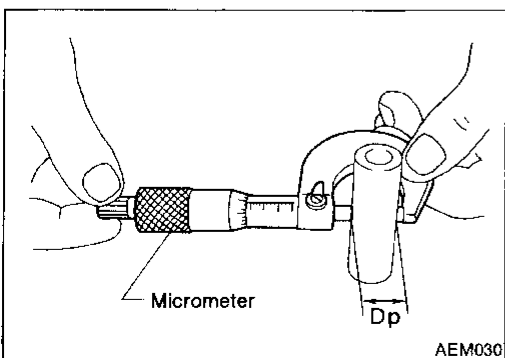
CAUTION:

- 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. If incorrect bearing clearance exists, use a thicker or undersized main bearing to ensure specified clearance.



CONNECTING ROD BUSHING CLEARANCE (Small end)

1. Measure inner diameter "C" of bushing.



- Measure outer diameter "Dp" of piston pin.
- Calculate connecting rod bushing clearance.

$$\text{Connecting rod bushing clearance} = C - Dp$$

Standard:

0.005 - 0.017 mm (0.0002 - 0.0007 in)

Limit:

0.023 mm (0.0009 in)

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

CYLINDER BLOCK

Inspection (Cont'd)

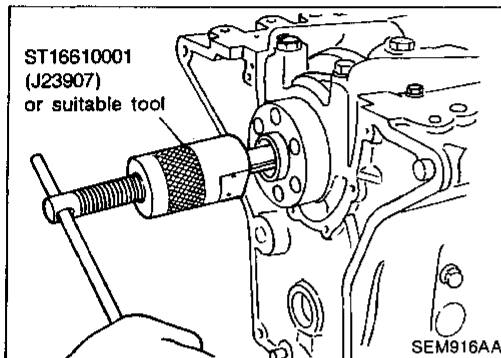
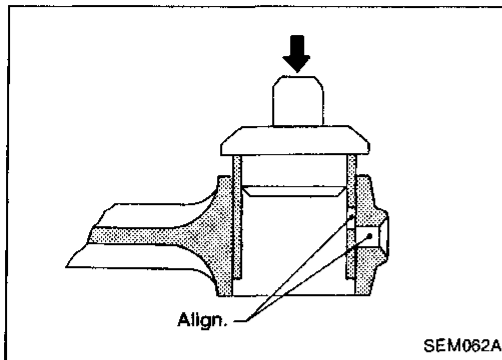
REPLACEMENT OF CONNECTING ROD BUSHING (Small end)

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

Be sure to align the oil holes.

2. After driving in small end bushing, ream the bushing. This is to ensure the clearance between connecting rod bushing and piston pin is the specified value.

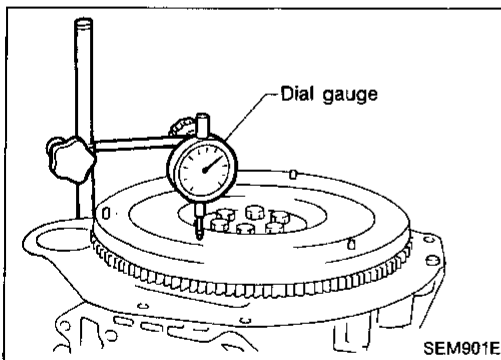
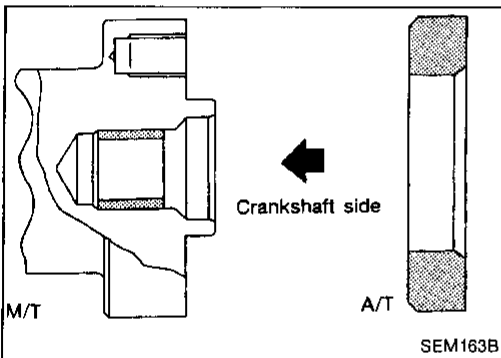
Clearance between connecting rod bushing and piston pin: 0.005 - 0.017 mm (0.0002 - 0.0007 in)



REPLACEMENT OF PILOT BUSHING (M/T) OR PILOT CONVERTER (A/T)

1. Remove pilot bushing or pilot converter using Tool or suitable tool.

2. Install pilot bushing or pilot converter as shown.



FLYWHEEL/DRIVE PLATE RUNOUT

Runout (Total indicator reading):

Flywheel (M/T model)

Less than 0.10 mm (0.0039 in)

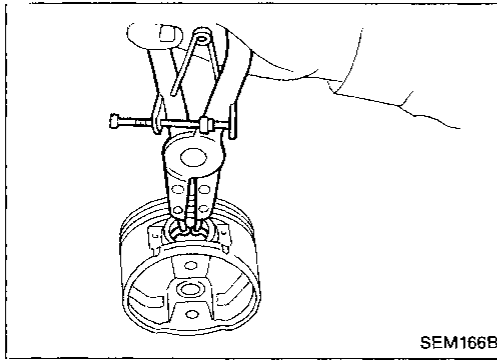
Drive plate (A/T model)

Less than 0.20 mm (0.0079 in)

CAUTION:

- The signal plate is built into the flywheel assembly. Be careful not to damage the signal plate, especially the teeth.
- Check the drive plate for deformation or cracks.
- Never place the flywheel assembly with the signal plate facing down.
- Keep any magnetized objects away from the signal plate.
- Do not allow any magnetic materials to contact the signal plate teeth.
- Do not surface flywheel. Replace as necessary.

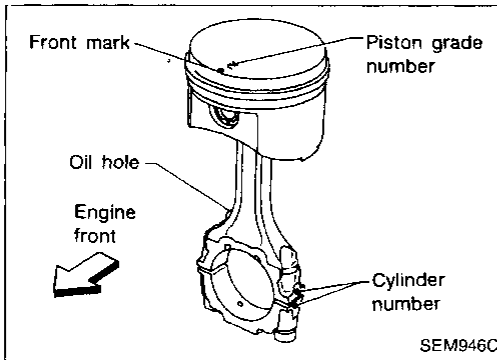
CYLINDER BLOCK



Assembly

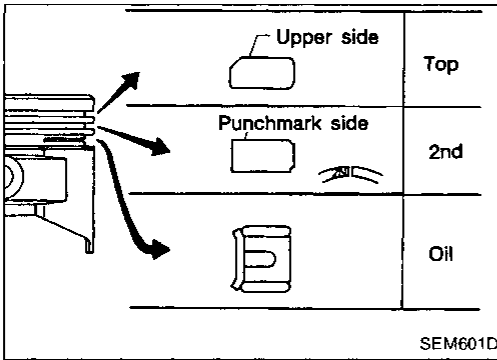
PISTON

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



2. Heat piston to 60 to 70°C (140 to 158°F) and assemble piston, piston pin, connecting rod and new snap ring.

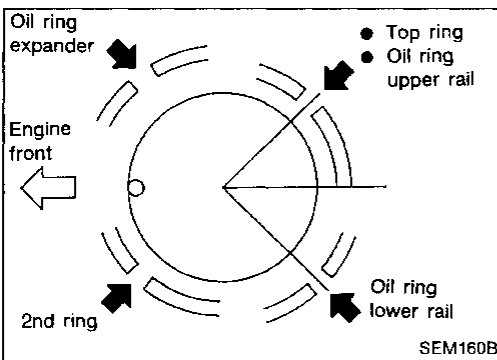
- Align the direction of piston and connecting rod.
- Numbers stamped on connecting rod and cap correspond to each cylinder.
- After assembly, make sure connecting rod swings smoothly.



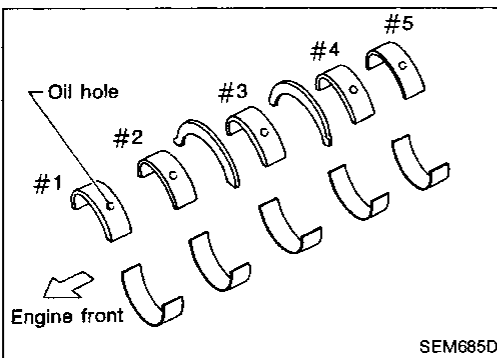
3. Set piston rings as shown.

CAUTION:

- When piston rings are not replaced, make sure that piston rings are mounted in their original positions.
- When replacing piston rings, those without punchmarks can be mounted with either side up.



- Align piston rings so that end gaps are positioned as shown in the figure.



CRANKSHAFT

1. Set main bearings in their proper positions on cylinder block and main bearing cap.
- Confirm that correct main bearings are used. Refer to "Inspection" of this section.
 - Apply new engine oil to bearing surfaces.

GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

BT

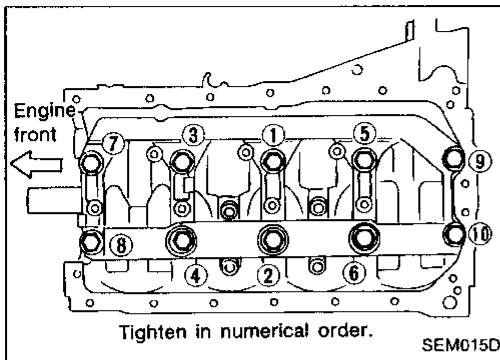
HA

EL

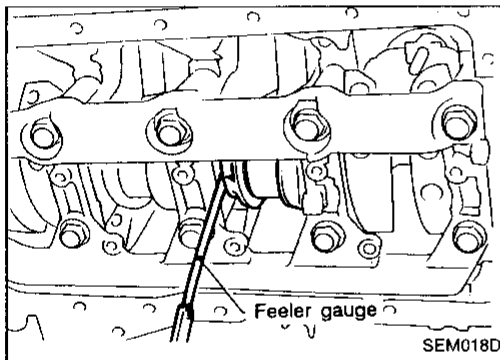
IDX

CYLINDER BLOCK

Assembly (Cont'd)



2. Install crankshaft, main bearing caps and beam and tighten bolts to the specified torque.
 - Prior to tightening bearing cap bolts, place bearing cap in its proper position. This can be done by shifting crankshaft in the axial direction.
 - Lubricate threads and seat surfaces of the bolts with new engine oil.
 - Tightening procedure
 - (1) Tighten bolts to 26 to 32 N·m (2.7 to 3.3 kg-m, 20 to 24 ft-lb).
 - (2) Turn bolts 75 to 80 degrees clockwise with angle wrench.
 - (3) Loosen bolts completely.
 - (4) Tighten bolts to 32 to 38 N·m (3.3 to 3.9 kg-m, 24 to 28 ft-lb).
 - (5) Turn bolts 45 to 50 degrees clockwise with angle wrench. If angle wrench is not available, tighten bolts to 73 to 82 N·m (7.4 to 8.4 kg-m, 54 to 61 ft-lb).
 - After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.



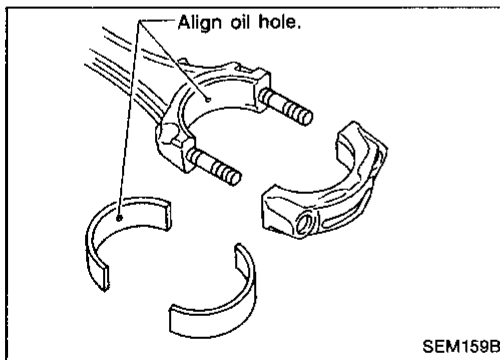
3. Measure crankshaft end play.

Crankshaft end play:

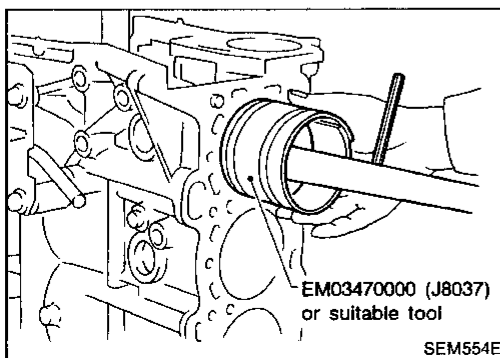
Standard
0.10 - 0.26 mm (0.0039 - 0.0102 in)

Limit
0.30 mm (0.0118 in)

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



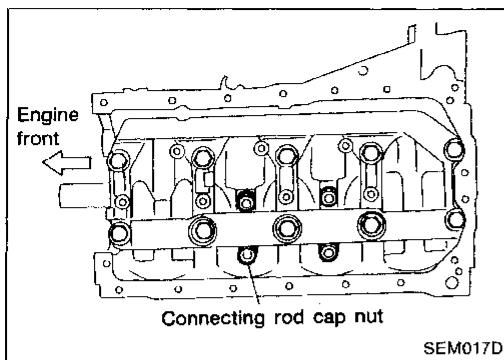
4. Install connecting rod bearings in connecting rods and connecting rod caps.
 - Confirm that correct bearings are used. Refer to "Inspection".
 - Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.
 - Apply new engine oil to bolt threads and bearing surfaces.



5. Install pistons with connecting rods.
 - a. Install them into corresponding cylinders with Tool.
 - Be careful not to scratch cylinder wall by connecting rod.
 - Arrange so that front mark on piston head faces toward front of engine.
 - Apply new engine oil to piston rings and sliding surface of piston.

CYLINDER BLOCK

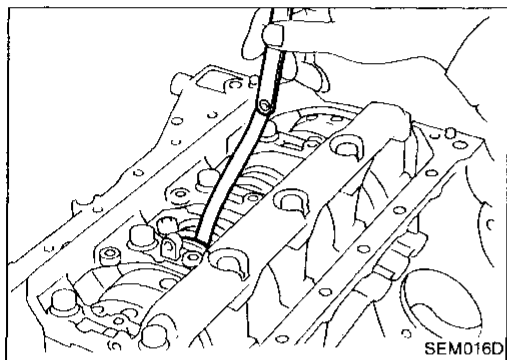
Assembly (Cont'd)



- b. Install connecting rod caps.
Tighten connecting rod cap nuts to the specified torque.
- Lubricate threads and seat surfaces of the bolts with new engine oil.

Tightening procedure:

- 1) Tighten nuts to 14 to 16 N·m (1.4 to 1.6 kg-m, 10 to 12 ft-lb).
- 2) Turn nuts 60 to 65 degrees clockwise with angle wrench. If angle wrench is not available, tighten nuts to 38 to 44 N·m (3.9 to 4.5 kg-m, 28 to 33 ft-lb).



6. Measure connecting rod side clearance.

Connecting rod side clearance:

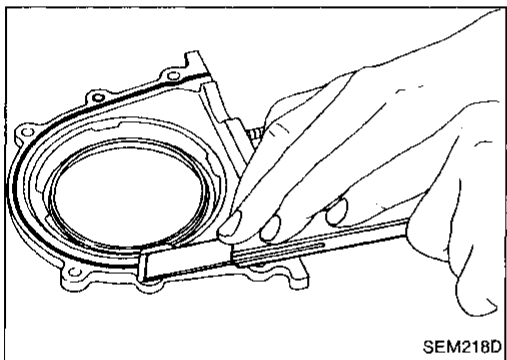
Standard

0.20 - 0.35 mm (0.0079 - 0.0138 in)

Limit

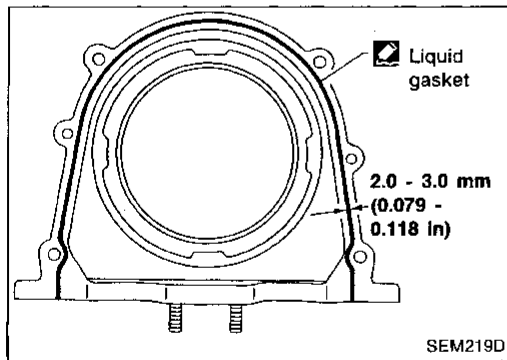
0.50 mm (0.0197 in)

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



7. Install rear oil seal retainer.

- a. Use a scraper to remove all traces of liquid gasket from mating surfaces.
- Also remove traces of liquid gasket from mating surface of cylinder block.



- b. Apply a continuous bead of liquid gasket to mating surface of rear oil seal retainer.
- Use Genuine Liquid Gasket or equivalent.

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specifications

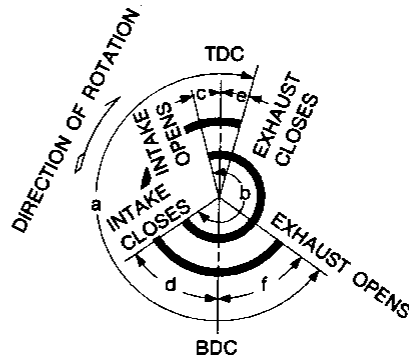
Cylinder arrangement	In-line 4	
Displacement	cm ³ (cu in)	1,998 (121.92)
Bore and stroke	mm (in)	86 x 86 (3.39 x 3.39)
Valve arrangement	DOHC	
Firing order	1-3-4-2	
Number of piston rings		
Compression	2	
Oil	1	
Number of main bearings	5	
Compression ratio	9.5	

COMPRESSION PRESSURE

Unit: kPa (kg/cm², psi)/300 rpm

Compression pressure		
Standard	1,226 (12.5, 178)	
Minimum	1,030 (10.5, 149)	
Differential limit between cylinders	98 (1.0, 14)	

Valve timing



EM120
Unit: degree

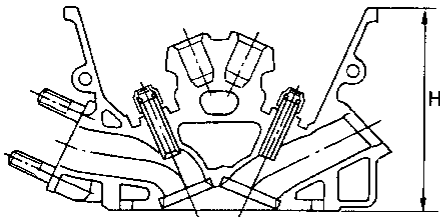
a	b	c	d	e	f
240°	240°	13°	47°	3°	57°

Inspection and Adjustment

CYLINDER HEAD

Unit: mm (in)

	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)



Nominal cylinder head height :
H = 136.9 - 137.1 (5.390 - 5.398)

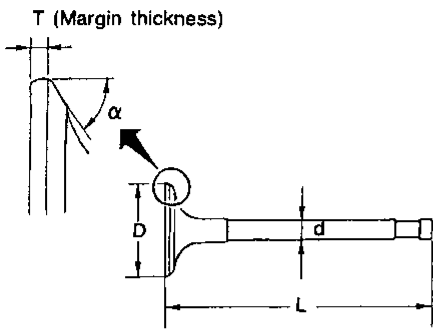
SEM956C

SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

VALVE

Unit: mm (in)



SEM188

Valve head diameter "D"

Intake	34.0 - 34.3 (1.339 - 1.350)
Exhaust	30.0 - 30.3 (1.181 - 1.193)

Valve length "L"

Intake	101.19 - 101.61 (3.9839 - 4.0004)
Exhaust	102.11 - 102.53 (4.0201 - 4.0366)

Valve stem diameter "d"

Intake	5.965 - 5.980 (0.2348 - 0.2354)
Exhaust	5.945 - 5.960 (0.2341 - 0.2346)

Valve seat angle "α"

Intake	45°15' - 45°45'
Exhaust	

Valve margin "T"

Intake	1.1 (0.043)
Exhaust	1.3 (0.051)

Valve margin "T" limit

More than 0.5 (0.020)

Valve stem end surface grinding limit

Less than 0.2 (0.008)

Valve clearance

Intake	0 (0)
Exhaust	0 (0)

Valve spring

Free height	mm (in)	49.36 (1.9433)	
Pressure N (kg, lb) at height mm (in)	Standard	569.00 - 641.57 (58.02 - 65.42, 127.93 - 144.25) at 30.0 (1.181)	
		Limit	549.2 (56.0, 123.5) at 30.0 (1.181)
		Out-of-square	mm (in)

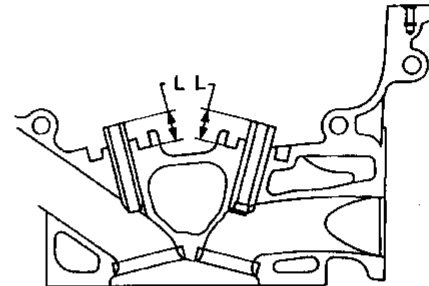
Hydraulic lash adjuster (HLA)

Unit: mm (in)

HLA outer diameter	16.980 - 16.993 (0.6685 - 0.6690)
HLA guide inner diameter	17.000 - 17.020 (0.6693 - 0.6701)
Clearance between HLA and HLA guide	0.007 - 0.040 (0.0003 - 0.0016)

Valve guide

Unit: mm (in)



SEM083D

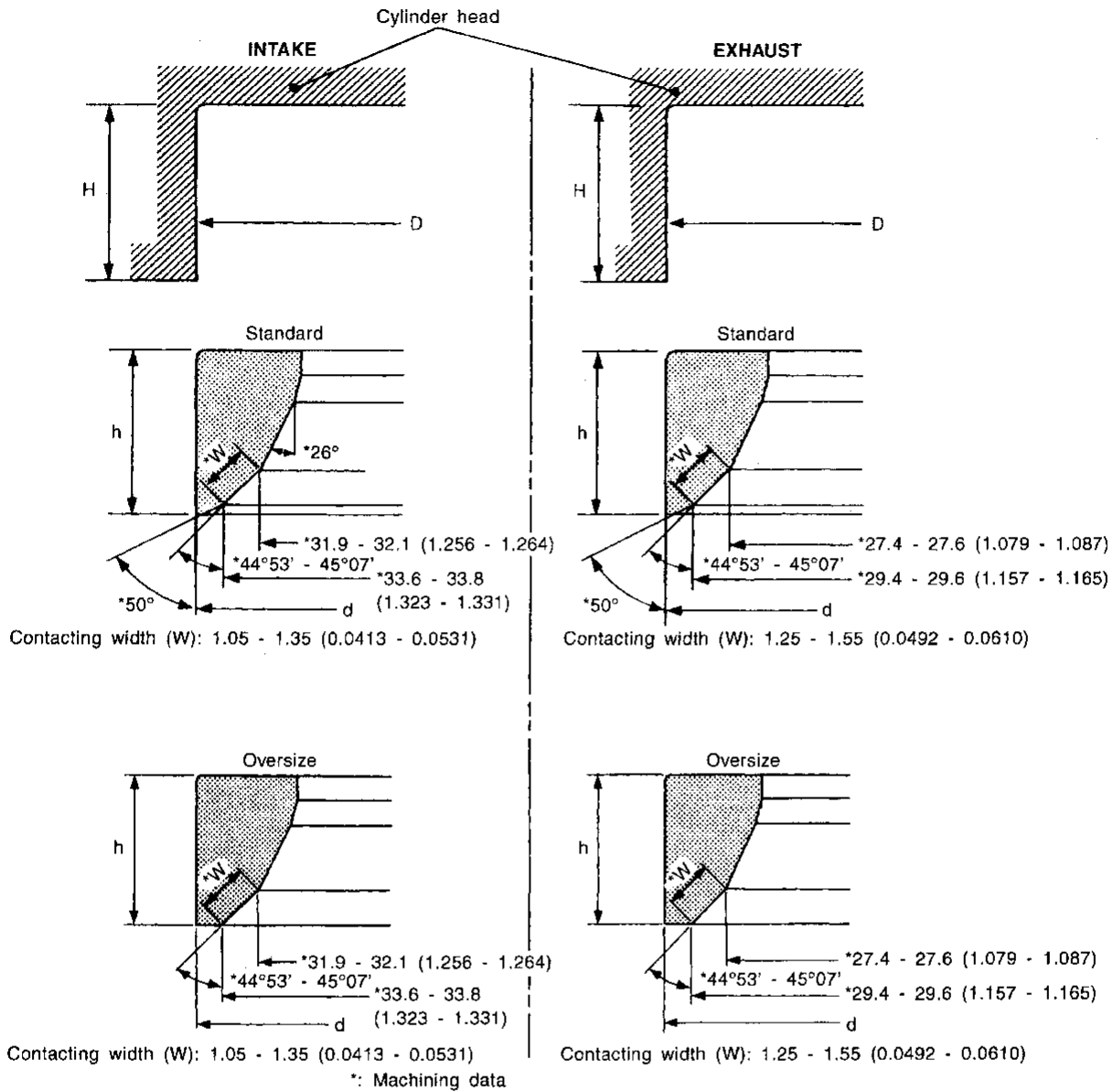
		Standard	Service
Valve guide	Outer diameter	Intake	10.023 - 10.034 (0.3946 - 0.3950)
		Exhaust	10.223 - 10.234 (0.4025 - 0.4029)
Valve guide	Inner diameter (Finished size)	Intake	6.000 - 6.018 (0.2362 - 0.2369)
		Exhaust	6.000 - 6.018 (0.2362 - 0.2369)
Cylinder head valve guide hole diameter	Intake	9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
	Exhaust	9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	Limit
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
Valve deflection limit		0.2 (0.008)	
Projection length "L"		14.0 - 14.2 (0.551 - 0.559)	

SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

Valve seat

Unit: mm (in)



SEM243F

		Standard	Service
Cylinder head seat recess diameter (D)	In.	35.000 - 35.016 (1.3780 - 1.3786)	35.500 - 35.516 (1.3976 - 1.3983)
	Ex.	31.000 - 31.016 (1.2205 - 1.2211)	31.500 - 31.516 (1.2402 - 1.2408)
Valve seat interference fit	In.	0.064 - 0.096 (0.0025 - 0.0038)	
	Ex.	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	In.	35.080 - 35.096 (1.3811 - 1.3817)	35.580 - 35.596 (1.4008 - 1.4014)
	Ex.	31.080 - 31.096 (1.2236 - 1.2242)	31.580 - 31.596 (1.2433 - 1.2439)
Depth (H)	In.	6.25 (0.2461)	
	Ex.	6.25 (0.2461)	
Height (h)	In.	6.2 - 6.3 (0.244 - 0.248)	5.4 - 5.5 (0.213 - 0.217)
	Ex.		5.32 - 5.42 (0.209 - 0.213)

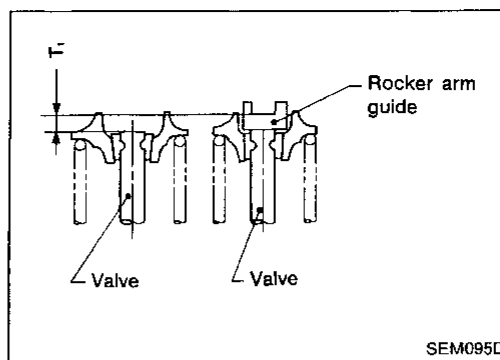
SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

Valve clearance adjustment

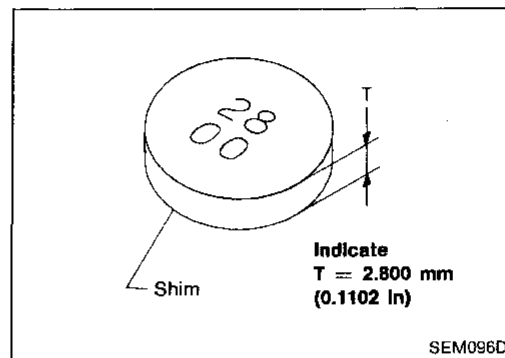
Unit: mm (in)

Valve clearance	
Intake	0 (0)
Exhaust	0 (0)
Valve clearance	
Adjustment valve limit [(T) - (T ₁)]	$-0.025 (-0.0010) \leq$ $[(T) - (T_1)] \leq 0.025 (0.0010)$



Available shim

Thickness mm (in)	Identification mark
2.800 (0.1102)	28 00
2.825 (0.1112)	28 25
2.850 (0.1122)	28 50
2.875 (0.1132)	28 75
2.900 (0.1142)	29 00
2.925 (0.1152)	29 25
2.950 (0.1161)	29 50
2.975 (0.1171)	29 75
3.000 (0.1181)	30 00
3.025 (0.1191)	30 25
3.050 (0.1201)	30 50
3.075 (0.1211)	30 75
3.100 (0.1220)	31 00
3.125 (0.1230)	31 25
3.150 (0.1240)	31 50
3.175 (0.1250)	31 75
3.200 (0.1260)	32 00



GI

MA

EM

LC

EC

FE

CL

MT

AT

FA

RA

BR

ST

RS

BT

HA

EL

IDX

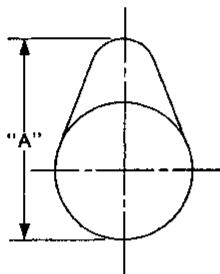
SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard	Limit
Camshaft journal to bearing clearance	0.045 - 0.086 (0.0018 - 0.0034)	0.12 (0.0047)
Inner diameter of camshaft bearing	28.000 - 28.021 (1.1024 - 1.1032)	—
Outer diameter of camshaft journal	27.935 - 27.955 (1.0998 - 1.1006)	—
Camshaft runout [TIR*]	Less than 0.02 (0.0008)	0.1 (0.004)
Camshaft sprocket runout [TIR*]	Less than 0.25 (0.0098)	—
Camshaft end play	0.055 - 0.139 (0.0022 - 0.0055)	0.20 (0.0079)



EM671

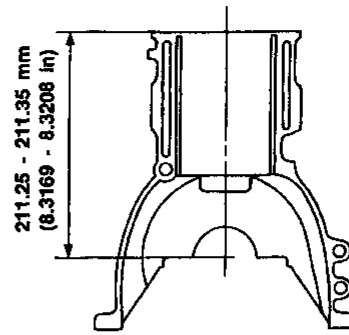
Cam height "A"

Intake	37.920 - 38.110 (1.4929 - 1.5004)	
Exhaust	37.920 - 38.110 (1.4929 - 1.5004)	
Wear limit of cam height	0.2 (0.008)	
Valve lift		
Intake	9.2 (0.362)	
Exhaust	9.2 (0.362)	

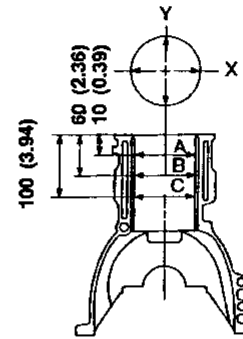
*Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



SEM964E



SEM686D

Surface flatness		
Standard		Less than 0.03 (0.0012)
Limit		0.10 (0.0039)
Cylinder bore		
Inner diameter		
Standard		
Grade No. 1	86.000 - 86.010	(3.3858 - 3.3862)
Grade No. 2	86.010 - 86.020	(3.3862 - 3.3866)
Grade No. 3	86.020 - 86.030	(3.3866 - 3.3870)
Wear limit	0.20 (0.0079)	
Out-of-round (X - Y)	Less than 0.015 (0.0006)	
Taper (A - B and A - C)	Less than 0.010 (0.0004)	
Difference in inner diameter between cylinders		
Limit	Less than 0.05 (0.0020)	
Main journal inner diameter		
Grade No. 0	58.944 - 58.950	(2.3206 - 2.3209)
Grade No. 1	58.950 - 58.956	(2.3209 - 2.3211)
Grade No. 2	58.956 - 58.962	(2.3211 - 2.3213)
Grade No. 3	58.962 - 58.968	(2.3213 - 2.3216)

SERVICE DATA AND SPECIFICATIONS (SDS)

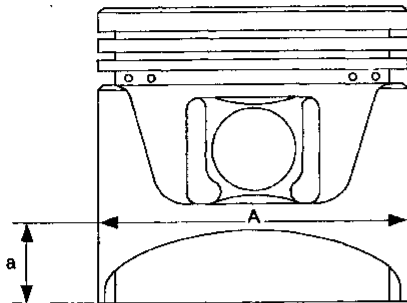
Inspection and Adjustment (Cont'd)

PISTON, PISTON RING AND PISTON PIN

Piston ring

Available piston

Unit: mm (in)



SEM750C

Piston skirt diameter "A"

Standard	
Grade No. 1	85.980 - 85.990 (3.3850 - 3.3854)
Grade No. 2	85.990 - 86.000 (3.3854 - 3.3858)
Grade No. 3	86.000 - 86.010 (3.3858 - 3.3862)
0.20 (0.0079) over-size (Service)	86.180 - 86.210 (3.3929 - 3.3941)
"a" dimension	14.0 (0.551)
Piston clearance to cylinder block	0.010 - 0.030 (0.0004 - 0.0012)
Piston pin hole diameter	21.987 - 21.999 (0.8656 - 0.8661)

Unit: mm (in)

Side clearance			
Top			
Standard		0.045 - 0.080 (0.0018 - 0.0031)	
Limit		0.2 (0.008)	
2nd			
Standard		0.030 - 0.065 (0.0012 - 0.0026)	
Limit		0.2 (0.008)	
Ring gap			
Top			
Standard		0.20 - 0.30 (0.0079 - 0.0118)	
Limit		1.0 (0.039)	
2nd			
Standard		0.35 - 0.50 (0.0138 - 0.0197)	
Limit		1.0 (0.039)	
Oil			
Standard		0.20 - 0.60 (0.0079 - 0.0236)	
Limit		1.0 (0.039)	

Piston pin

Unit: mm (in)

Piston pin outer diameter	21.989 - 22.001 (0.8657 - 0.8662)
Interference fit of piston pin to piston	-0.004 to 0 (-0.0002 to 0)
Piston pin to connecting rod bushing clearance	
Standard	0.005 - 0.017 (0.0002 - 0.0007)
Limit	0.023 (0.0009)

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

SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

CONNECTING ROD

Unit: mm (in)

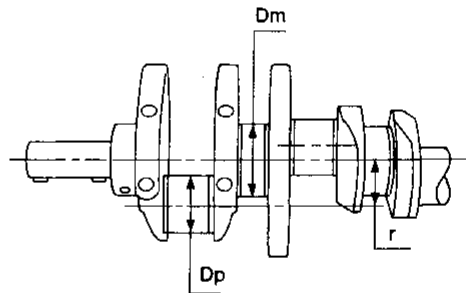
Center distance	136.30 (5.3661)
Bend [per 100 (3.94)]	
Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	
Limit	0.3 (0.012)
Connecting rod small end inner diameter	24.980 - 25.000 (0.9835 - 0.9843)
Piston pin bushing inner diameter*	22.000 - 22.012 (0.8661 - 0.8666)
Connecting rod big end inner diameter	51.000 - 51.013 (2.0079 - 2.0084)
Side clearance	
Standard	0.20 - 0.35 (0.0079 - 0.0138)
Limit	0.5 (0.020)

*After installing in connecting rod

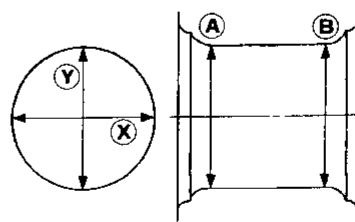
CRANKSHAFT

Unit: mm (in)

Main journal dia. "Dm"	
Grade No. 0	54.974 - 54.980 (2.1643 - 2.1646)
Grade No. 1	54.968 - 54.974 (2.1641 - 2.1643)
Grade No. 2	54.962 - 54.968 (2.1639 - 2.1641)
Grade No. 3	54.956 - 54.962 (2.1636 - 2.1639)
Pin journal dia. "Dp"	
Grade No. 0	47.968 - 47.974 (1.8885 - 1.8887)
Grade No. 1	47.962 - 47.968 (1.8883 - 1.8885)
Grade No. 2	47.956 - 47.962 (1.8880 - 1.8883)
Center distance "r"	42.96 - 43.04 (1.6913 - 1.6945)
Out-of-round (X - Y)	
Standard	Less than 0.005 (0.0002)
Taper (A - B)	
Standard	Less than 0.005 (0.0002)
Runout [TIR]	
Standard	Less than 0.025 (0.0010)
Limit	0.05 (0.0020)
Free end play	
Standard	0.10 - 0.26 (0.0039 - 0.0102)
Limit	0.30 (0.0118)



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

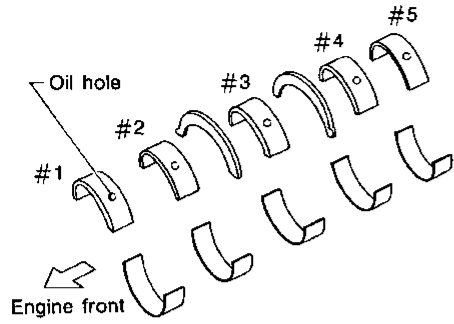


SEM954C

SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

AVAILABLE MAIN BEARING



SEM685D

Main bearing (Standard)

Unit: mm (in)			
Grade number	Thickness "T"	Width "W"	Identification color (mark)
0	1.977 - 1.980 (0.0778 - 0.0780)	18.9 - 19.1 (0.744 - 0.752)	Black (A)
1	1.980 - 1.983 (0.0780 - 0.0781)		Brown (B)
2	1.983 - 1.986 (0.0781 - 0.0782)		Green (C)
3	1.986 - 1.989 (0.0782 - 0.0783)		Yellow (D)
4	1.989 - 1.992 (0.0783 - 0.0784)		Blue (E)
5	1.992 - 1.995 (0.0784 - 0.0785)		Pink (F)
6	1.995 - 1.998 (0.0785 - 0.0787)		No color (G)

Main bearing (Undersize)

Unit: mm (in)		
Undersize	Thickness "T"	Main journal diameter "Dm"
0.25 (0.0098)	2.109 - 2.117 (0.0830 - 0.0833)	Grind so that bearing clearance is the specified value.

AVAILABLE CONNECTING ROD BEARING

Connecting rod bearing

Standard size

Unit: mm (in)			
Grade number	Thickness "T"	Width "W"	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	16.9 - 17.1 (0.665 - 0.673)	No color (A)
1	1.503 - 1.506 (0.0592 - 0.0593)		Black (B)
2	1.506 - 1.509 (0.0593 - 0.0594)		Brown (C)

Undersize

Unit: mm (in)		
Undersize	Thickness "T"	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.541 - 1.549 (0.0607 - 0.0610)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.561 - 1.569 (0.0615 - 0.0618)	
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	

Bearing clearance

Unit: mm (in)	
Main bearing clearance	
Standard	0.004 - 0.022 (0.0002 - 0.0009)
Limit	0.05 (0.0020)
Connecting rod bearing clearance	
Standard	0.020 - 0.045 (0.0008 - 0.0018)
Limit	0.09 (0.0035)

MISCELLANEOUS COMPONENTS

Unit: mm (in)	
Camshaft sprocket runout limit [TIR]	0.25 (0.0098)
Flywheel runout limit [TIR]	0.1 (0.004)
Drive plate runout limit [TIR]	0.2 (0.008)