SECTION EM

CONTENTS

Supplemental Restraint System "AIR BAG"

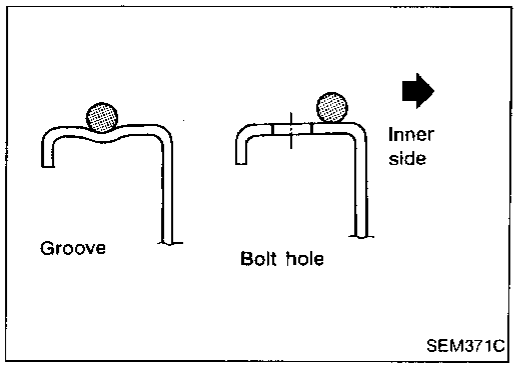
The Supplemental Restraint System "Air Bag" helps to reduce the risk or severity of injury to the driver in a frontal collision. The Supplemental Restraint System consists of an air bag (located in the center of the steering wheel), sensors, a diagnosis unit, warning lamp, wiring harness and spiral cable. Information necessary to service the system safely is included in the **BF section** of this Service Manual.

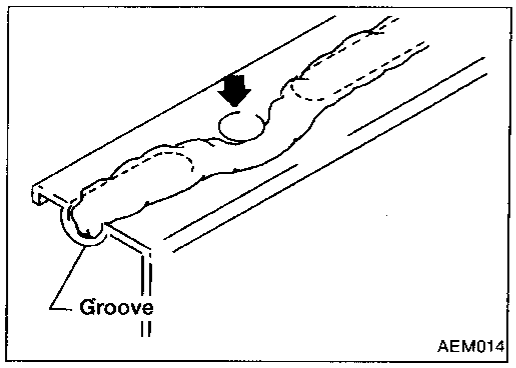
WARNING:

a. **To avoid rendering the SRS inoperative, which could lead to personal injury or death in the event of a severe frontal collision, all maintenance must be performed by an authorized NISSAN dealer.**
b. **Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system.**
c. **All SRS electrical wiring harnesses and connectors are covered with yellow outer insulation. Do not use electrical test equipment on any circuit related to the SRS "Air Bag".**

Parts Requiring Angular Tightening

- Some important engine parts are tightened using an angular-tightening method rather than a torque setting method.
- If these parts are tightened using a torque setting method, dispersal of the tightening force (axial bolt force) will be two or three times that of the dispersal produced by using the correct angular-tightening method.
- Although the torque setting values (described in this manual) are equivalent to those used when bolts and nuts are tightened with an angular-tightening method, they should be used for reference only.
- To assure the satisfactory maintenance of the engine, bolts and nuts must be tightened using an angular-tightening method.
- Before tightening the bolts and nuts, ensure that the thread and seating surfaces are clean and coated with engine oil.
- The bolts and nuts which require the angular-tightening method are as follows:
  (1) Cylinder head bolts
  (2) Main bearing cap bolts (SR engine only)
  (3) Connecting rod cap nuts.





Liquid Gasket Application Procedure

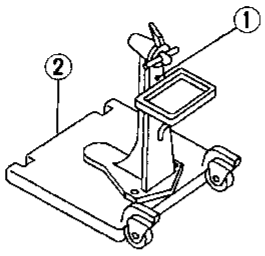
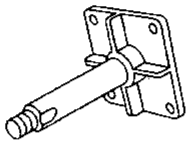
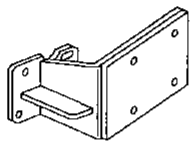
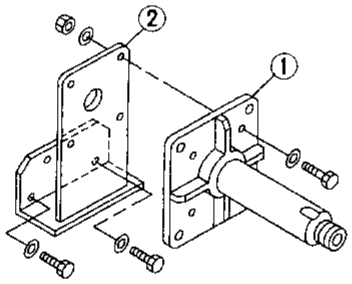
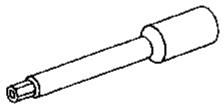
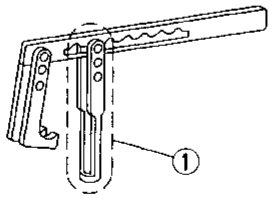
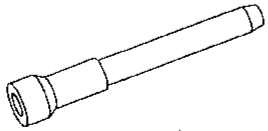
a. Before applying liquid gasket, use a scraper to remove all traces of old liquid gasket from mating surfaces and grooves, and then completely clean any oil stains from these portions.

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 SR engine and 3.5 to 4.5 mm (0.138 to 0.177 in) wide for GA engine (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).

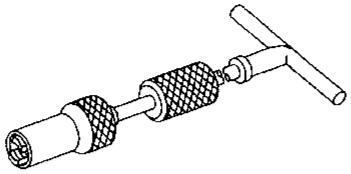
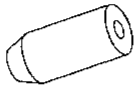
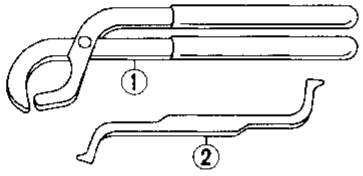
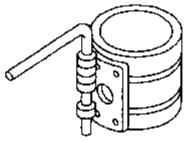
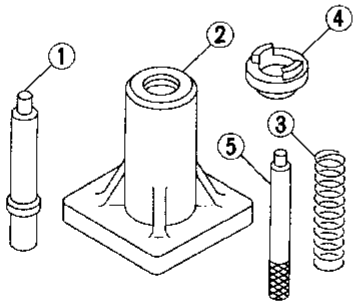
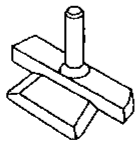
c. Apply liquid gasket to inner surface around hole perimeter area.
   (Assembly should be done within 5 minutes after coating.)

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

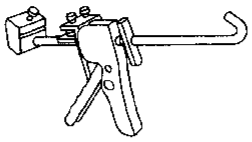
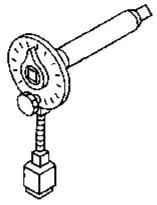
Special Service Tools

Tool number (Kent-Moore No.) Tool name	Description	Engine application	
		SR	GA
ST0501S000 (—) Engine stand assembly ① ST05011000 (—) Engine stand ② ST05012000 (—) Base	 NT042 Disassembling and assembling	X	X
KV10106500 (—) Engine stand shaft	 NT028	X	—
KV10115300 (—) Engine sub-attachment	 NT008	X	—
Engine attachment assembly ① KV10106500 (—) Engine attachment ② KV10113300 (—) Sub-attachment	 NT029 When overhauling engine	—	X
ST10120000 (J24239-01) Cylinder head bolt wrench	 NT019 Loosening and tightening cylinder head bolt	X	X
KV10116200 (J26336-A) Valve spring compressor ① KV10115900 (J26336-20) Attachment	 NT022 Disassembling valve mechanism	X	X
(J38958) Valve oil seal drift	 NT024 Installing valve oil seal	X	X

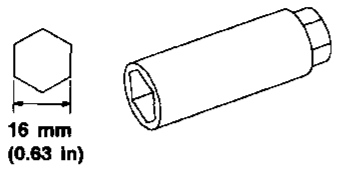
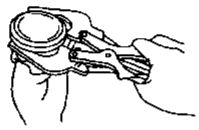
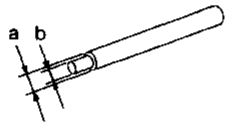
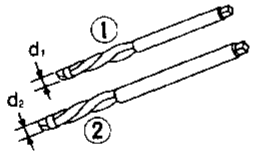
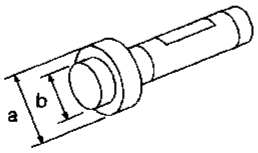
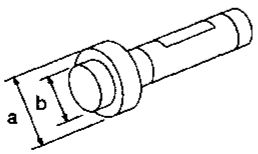
Special Service Tools (Cont'd)

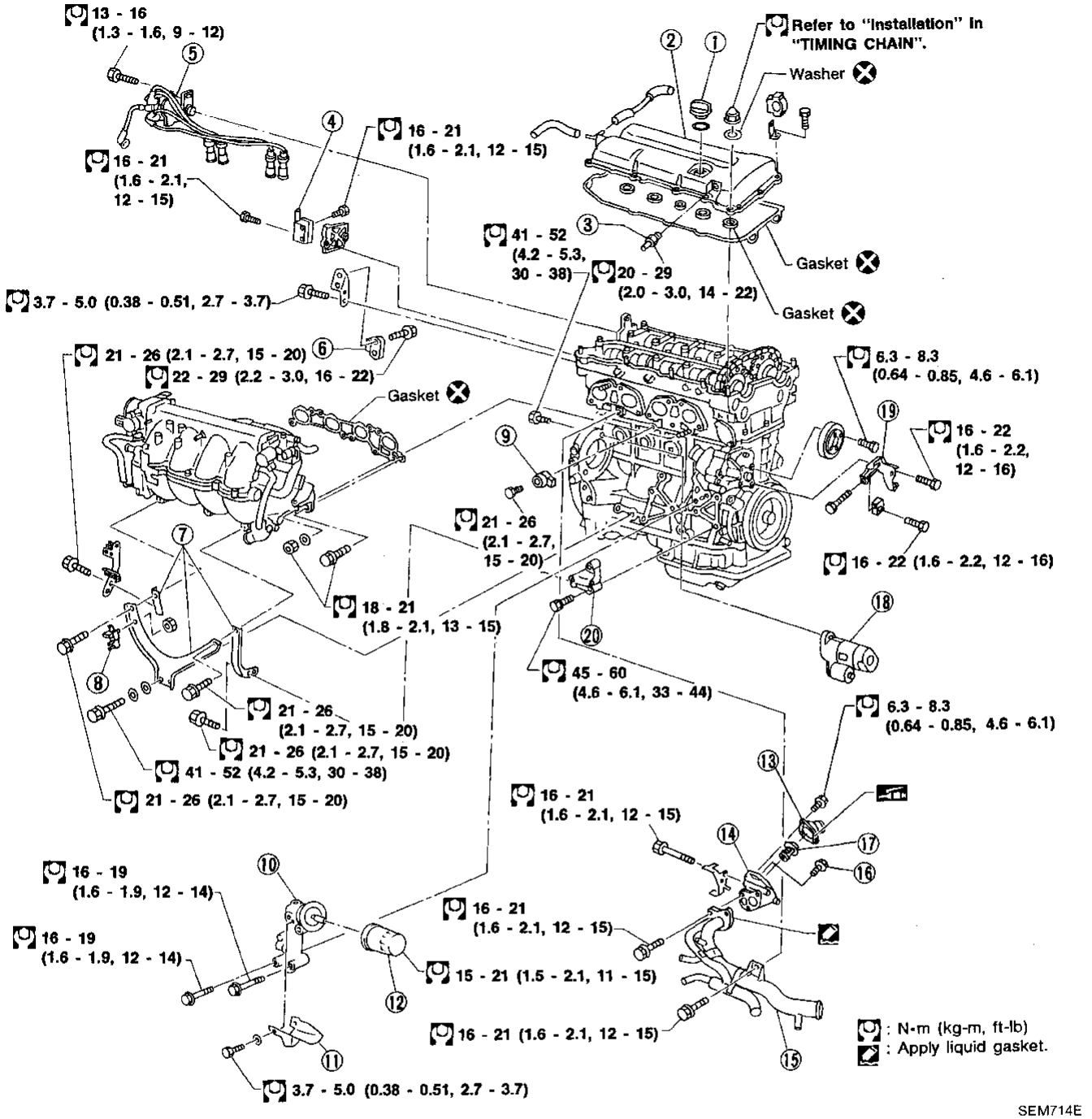
Tool number (Kent-Moore No.) Tool name	Description	Engine application SR	Engine application GA
KV10107902 (J38959) Valve oil seal puller	Displacement valve lip seal  NT011	X	X
KV10115700 (J38957) Dial gauge stand	Adjusting shims  NT012	X	—
KV101151S0 (J38972) Lifter stopper set ① KV10115110 (J38972-1) Camshaft pliers ② KV10115120 (J38972-2) Lifter stopper	Changing shims  NT041	—	X
EM03470000 (J8037) Piston ring compressor	Installing piston assembly into cylinder bore  NT044	X	X
KV10107400 (J26365-12, J26365) Piston pin press stand ① KV10107310 (—) Center shaft ② ST13040020 (—) Stand ③ ST13040030 (—) Spring ④ KV10107320 (—) Cap ⑤ ST13040050 (—) Drift	Disassembling and assembling piston pin  NT013	X	X
KV10111100 (J37228) Seal cutter	Removing oil pan  NT046	X	X

Special Service Tools (Cont'd)

Tool number (Kent-Moore No.) Tool name	Description		Engine application	
			SR	GA
WS39930000 (—) Tube presser	 NT052	Pressing the tube of liquid gasket	X	X
KV10112100 (—) Angle wrench	 NT014	Tightening bolts for bearing cap, cylinder head, etc.	X	X

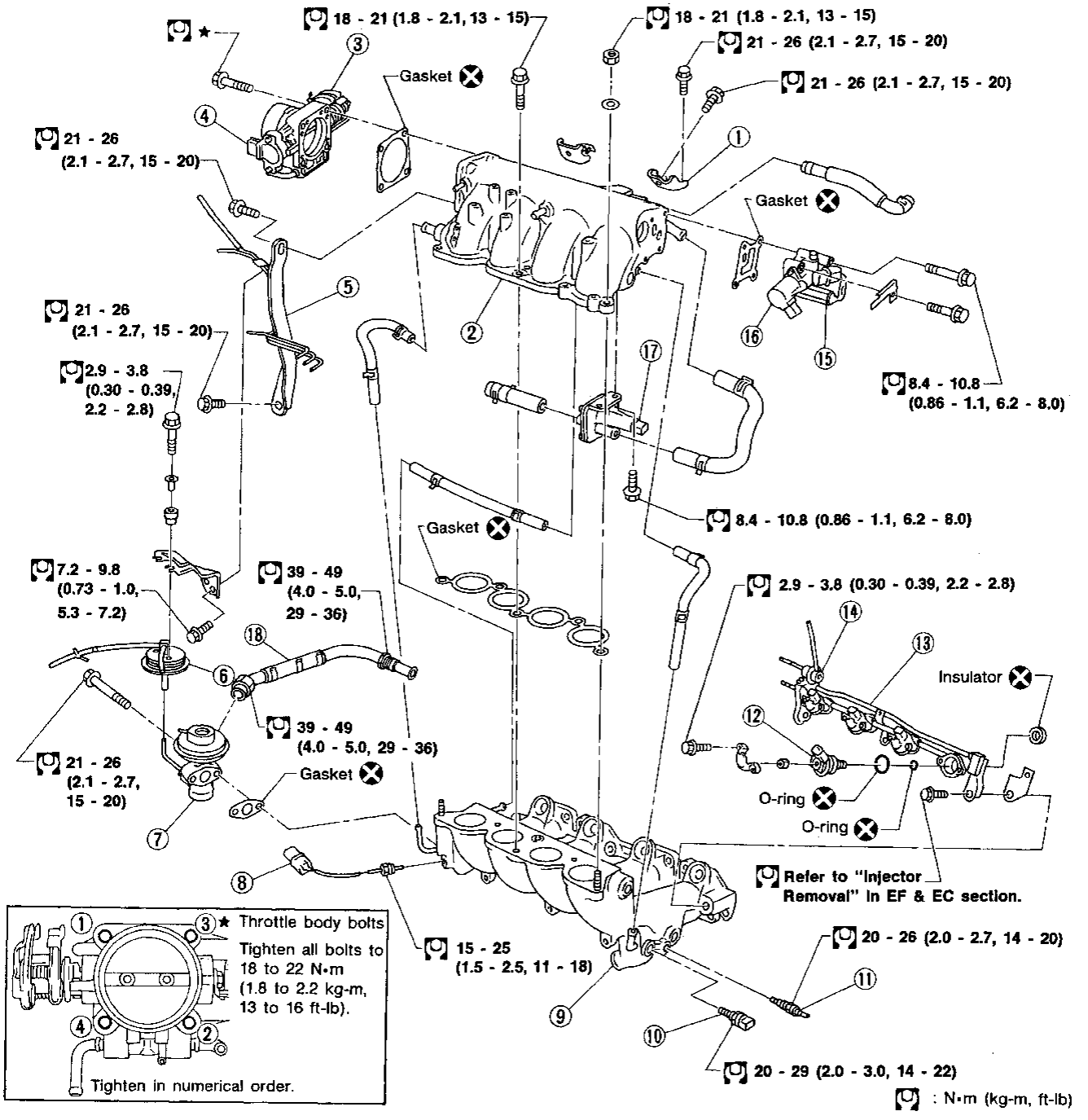
Commercial Service Tools

Tool name	Description		Engine application	
			SR	GA
Spark plug wrench	 NT047	Removing and installing spark plug	X	X
Valve seat cutter set	 NT048	Finishing valve seat dimensions	X	X
Piston ring expander	 NT030	Removing and installing piston ring	X	X
Valve guide drift	 NT015	Removing and installing valve guide SR20DE Intake & Exhaust a = 9.5 mm (0.374 in) dia. b = 5.0 mm (0.197 in) dia. GA16DE Intake & Exhaust a = 9.5 mm (0.374 in) dia. b = 5.5 mm (0.217 in) dia.	X	X
Valve guide reamer	 NT016	Reaming valve guide ① or hole for oversize valve guide ② SR20DE Intake & Exhaust d_1 = 6.0 mm (0.236 in) dia. d_2 = 10.175 mm (0.4006 in) dia. GA16DE Intake & Exhaust d_1 = 5.5 mm (0.217 in) dia. d_2 = 9.685 mm (0.3813 in) dia.	X	X
Front oil seal drift	 NT049	Installing front oil seal **a = 75 mm (2.95 in) dia.** **b = 45 mm (1.77 in) dia.**	X	X
Rear oil seal drift	 NT049	Installing rear oil seal **a = 110 mm (4.33 in) dia.** **b = 80 mm (3.15 in) dia.**	X	X



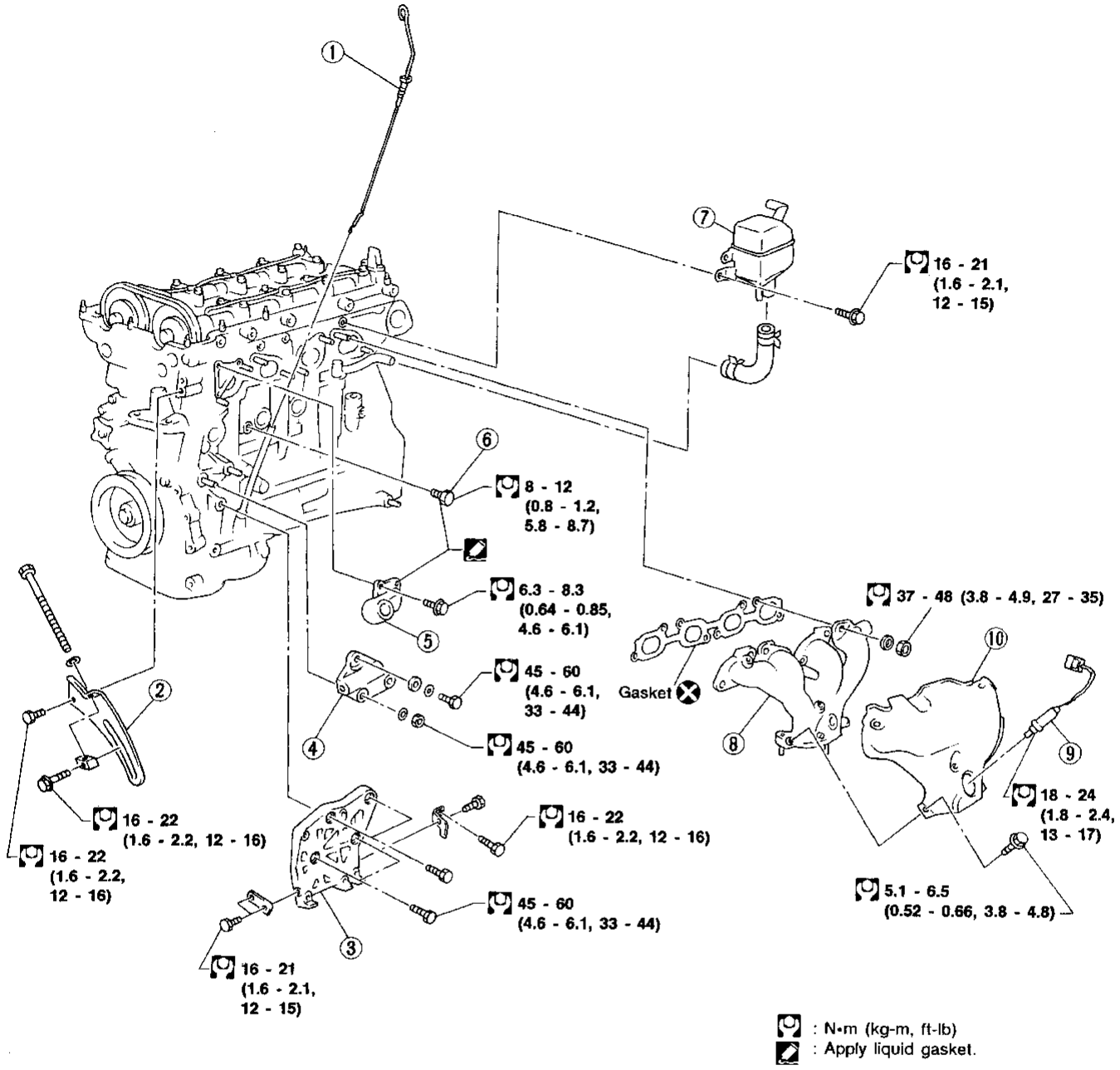
SEM714E

① Oil filler cap
② Rocker cover
③ PCV valve
④ Ignition coil
⑤ Camshaft position sensor built into distributor
⑥ Power transistor
⑦ Intake manifold supports
⑧ EGR & canister control solenoid valve
⑨ Knock sensor
⑩ Oil filter bracket
⑪ Oil catcher
⑫ Oil filter
⑬ Water inlet
⑭ Thermostat housing
⑮ Water pipe assembly
⑯ Air relief plug
⑰ Thermostat
⑱ Starter motor
⑲ Power steering oil pump adjusting bar
⑳ Power steering oil pump bracket



SEM715E

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

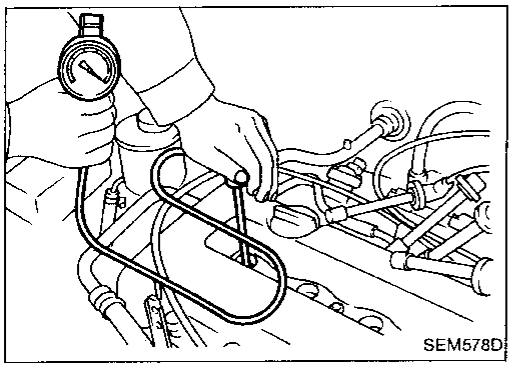


SEM716E

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

Measurement of Compression Pressure

1. Warm up engine.
2. Turn ignition switch off.
3. Release fuel pressure.
   Refer to "Releasing Fuel Pressure" in EF & EC section.
4. Remove all spark plugs.
5. Disconnect distributor center cable.

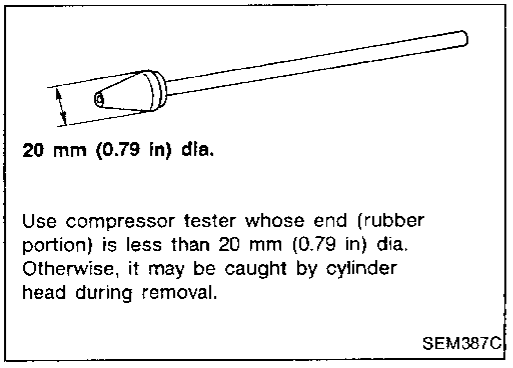

SEM578D

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/cm^2, psi)/300 rpm

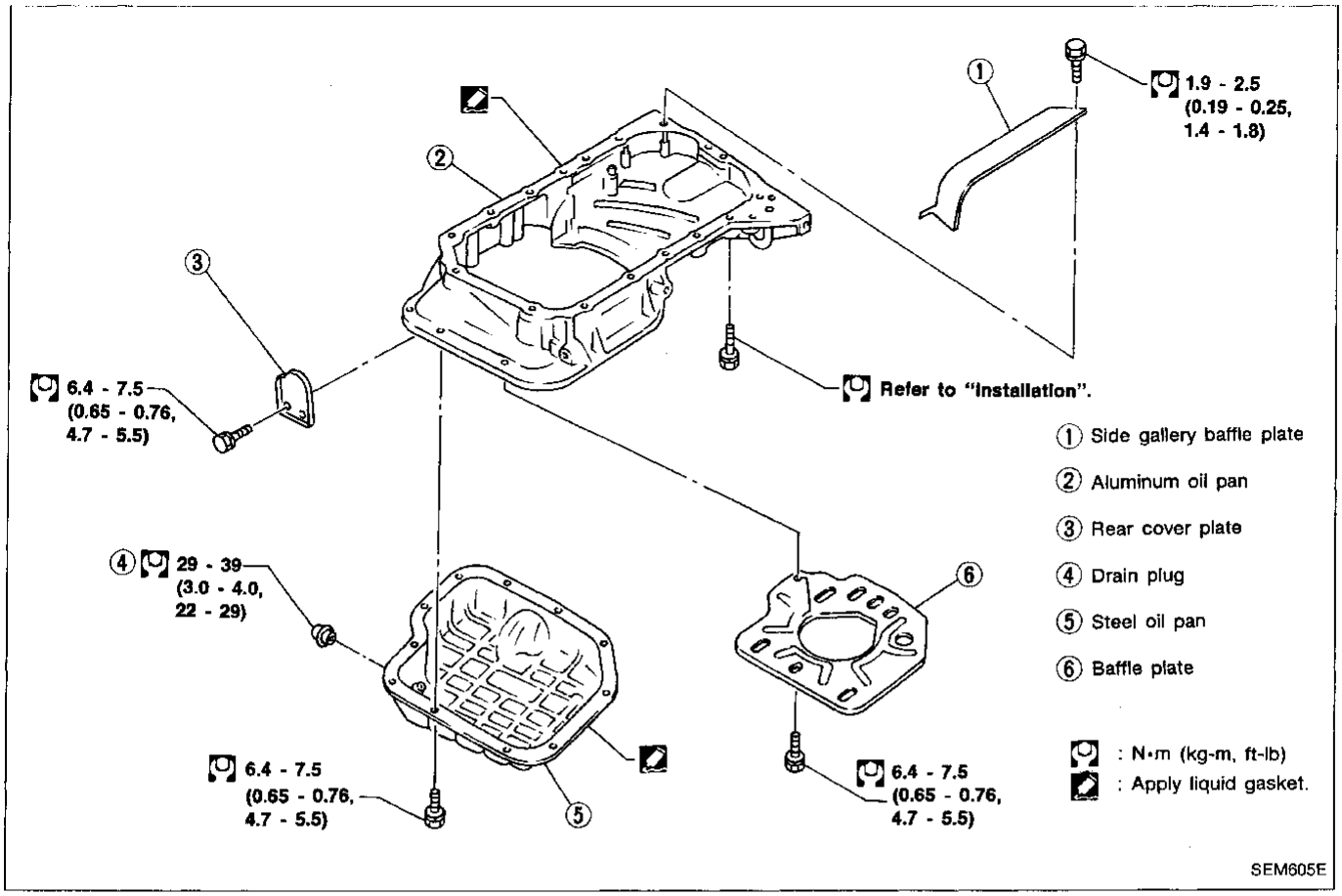
Standard
1,226 (12.5, 178)
Minimum
1,030 (10.5, 149)
Difference limit between cylinders
98 (1.0, 14)



Use compressor tester whose end (rubber portion) is less than 20 mm (0.79 in) dia. Otherwise, it may be caught by cylinder head during removal.
SEM387C

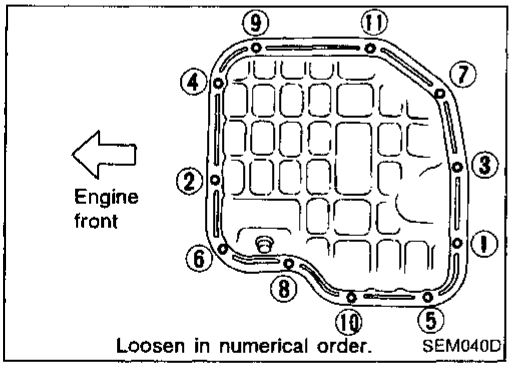
10. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through spark plug holes and retest compression.

- **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) If valve or valve seat is damaged excessively, replace them.**
- **If compression in any two adjacent cylinders is low and if adding oil does not improve compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.**

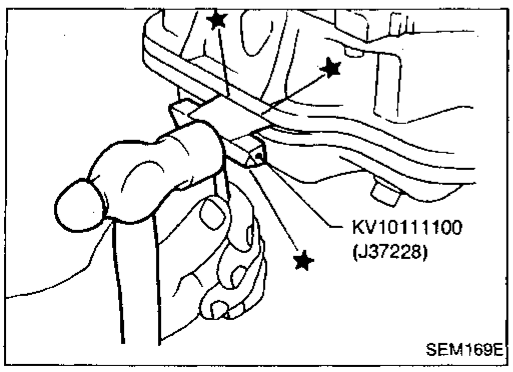


Removal

1. Remove engine under cover.
2. Drain engine oil.



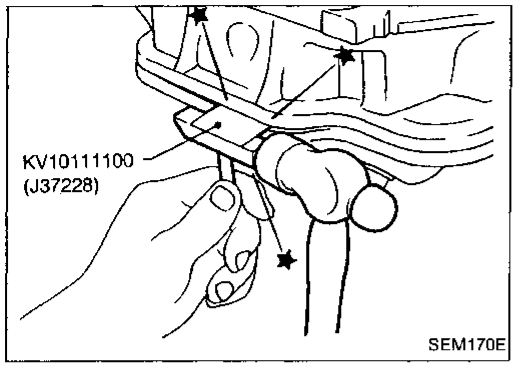
3. Remove steel oil pan bolts.



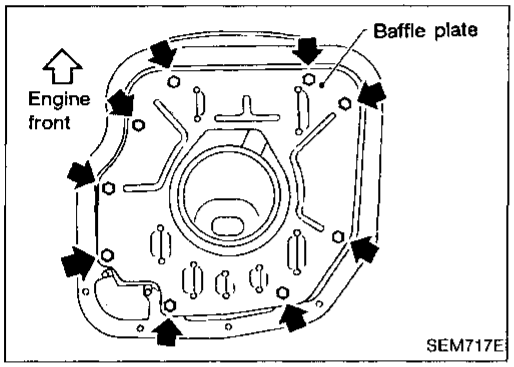
4. Remove steel oil pan.
(1) Insert Tool between aluminum oil pan and steel oil pan.

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

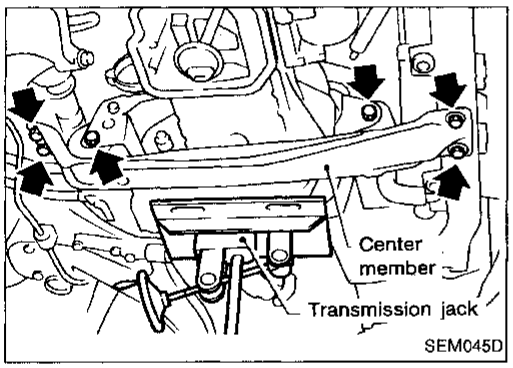
Removal (Cont'd)



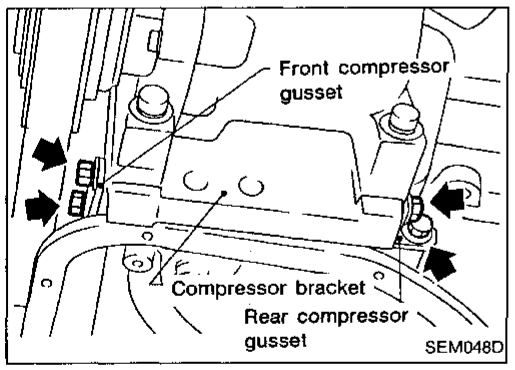
(2) Slide Tool by tapping on the side of the Tool with a hammer.
(3) Remove steel oil pan.



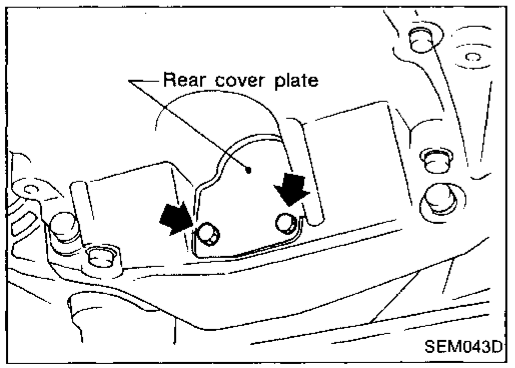
5. Remove baffle plate.



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

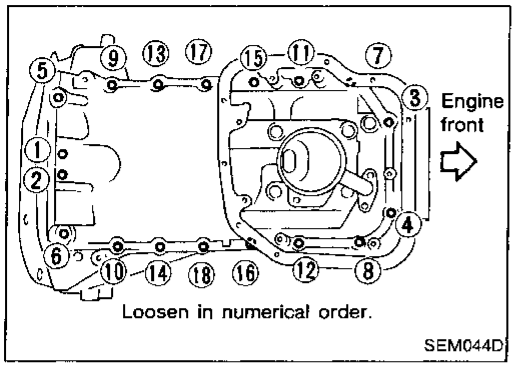


10. Remove compressor gussets.

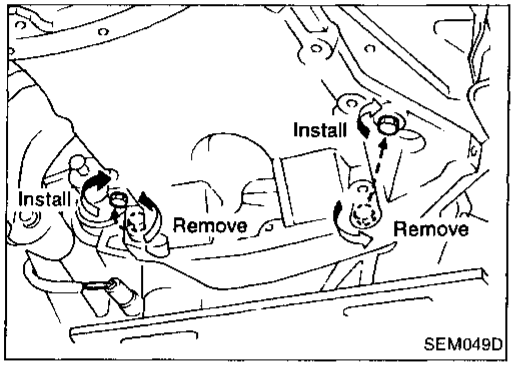


11. Remove rear cover plate.

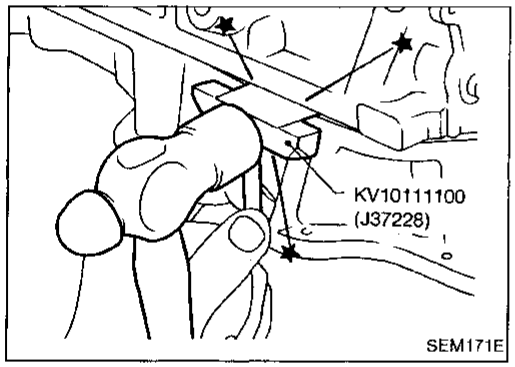
Removal (Cont'd)



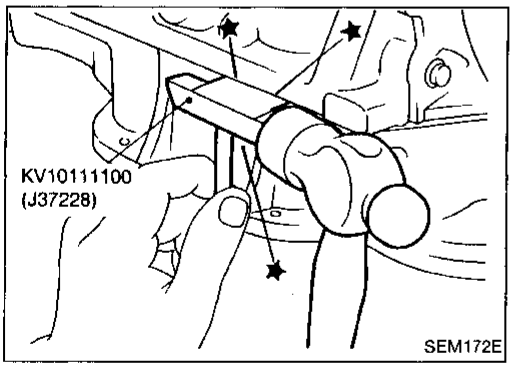
12. Remove aluminum oil pan bolts.



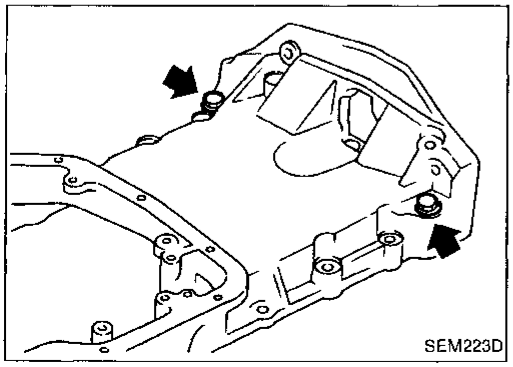
13. Remove the two engine to transaxle bolts and refit them into vacant holes as indicated. Tighten bolts to release aluminum oil pan from cylinder block.



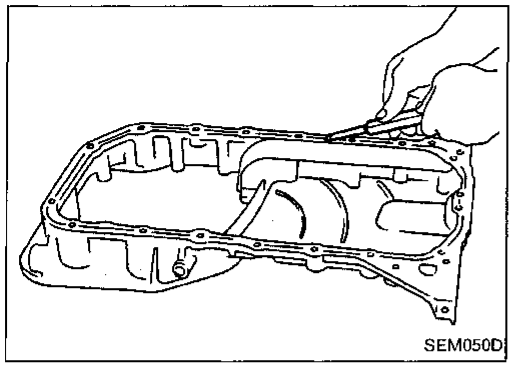
14. Remove aluminum oil pan.
(1) Insert Tool between cylinder block and aluminum oil pan.
- **Be careful not to damage aluminum mating surface.**
- **Do not insert screwdriver, or oil pan flange will be deformed.**



(2) Slide Tool by tapping on the side of the Tool with a hammer.
(3) Remove aluminum oil pan.



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

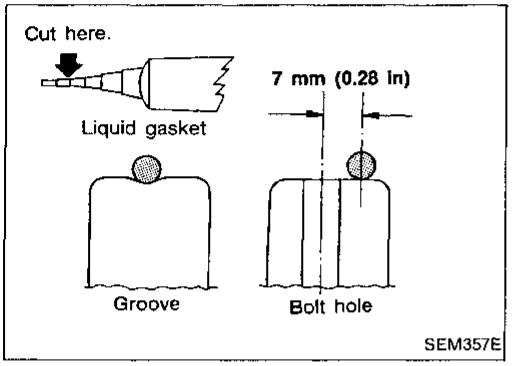

SEM050D

Installation

1. Install aluminum oil pan.

(1) Before installing aluminum oil pan, remove all traces of liquid gasket from mating surfaces using a scraper.

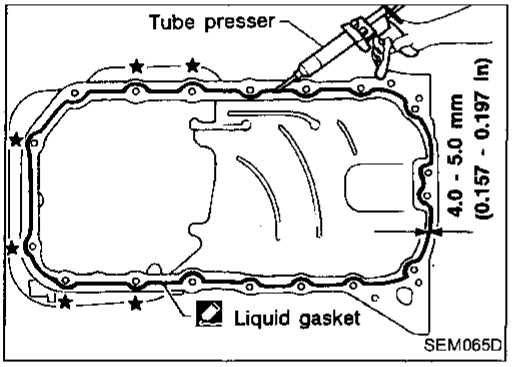
- Also remove traces of liquid gasket from mating surface of cylinder block and front cover.



SEM357E

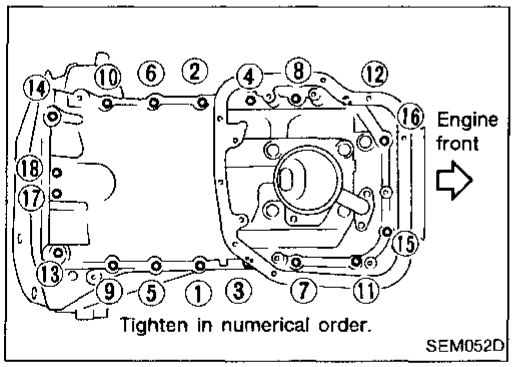
(2) Apply a continuous bead of liquid gasket to mating surface of aluminum oil pan.

- **Use Genuine Liquid Gasket or equivalent.**
- **Be sure liquid gasket is 4.0 to 5.0 mm (0.157 to 0.197 in) wide.**
- **Attaching should be done within 5 minutes after coating.**



SEM065D

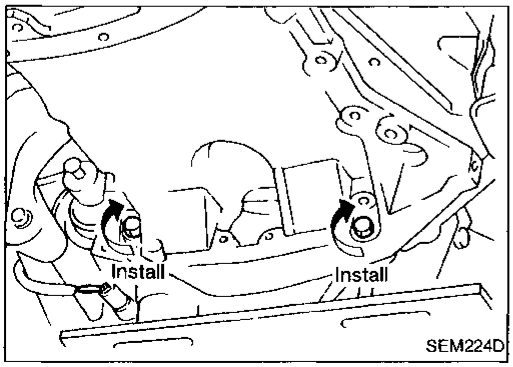
- **For areas marked with "★", apply liquid gasket to the outer side of the bolt hole.**



SEM052D

(3) Install aluminum oil pan.

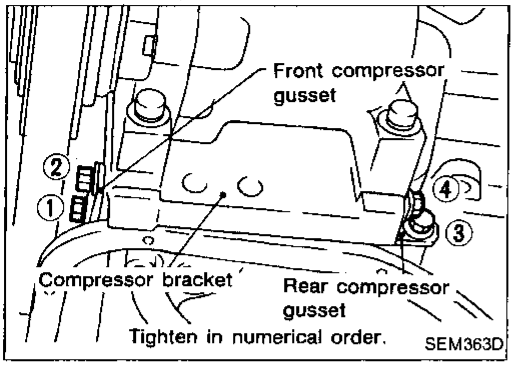
- Install bolts in the reverse order of removal.
  - **① - ⑯ bolts:**
    : 16 - 19 N·m (1.6 - 1.9 kg-m, 12 - 14 ft-lb)
  - **⑰, ⑱ bolts:**
    : 6.4 - 7.5 N·m (0.65 - 0.76 kg-m, 4.7 - 5.5 ft-lb)



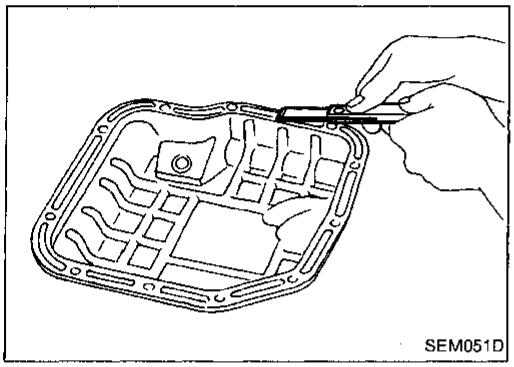
SEM224D

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

Installation (Cont'd)



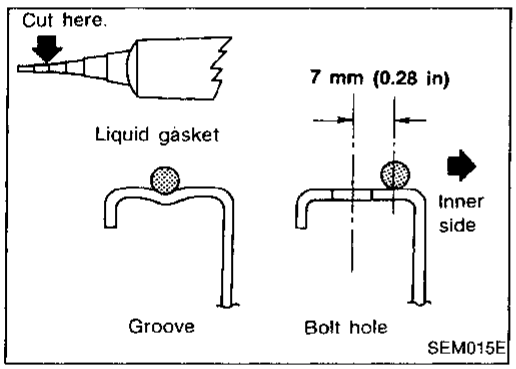
4. Install compressor gussets.
5. Install A/T shift control cable. (A/T only)
6. Install center member.
7. Install front tube.
8. Install baffle plate.



9. Install steel oil pan.

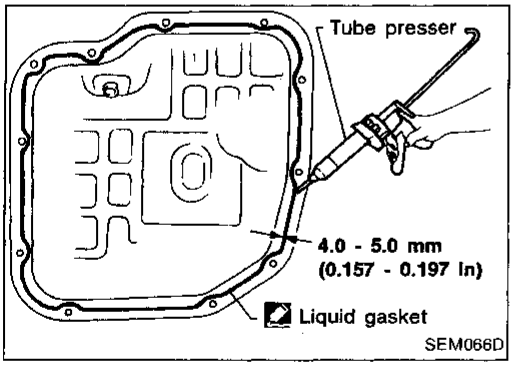
(1) Before installing steel oil pan, remove all traces of liquid gasket from mating surfaces using a scraper.

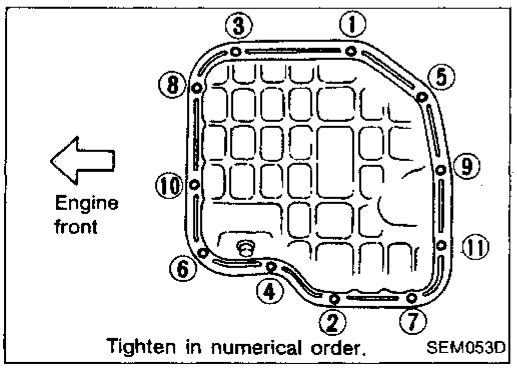
- Also remove traces of liquid gasket from mating surface of aluminum oil pan.



(2) Apply a continuous bead of liquid gasket to mating surface of steel oil pan.

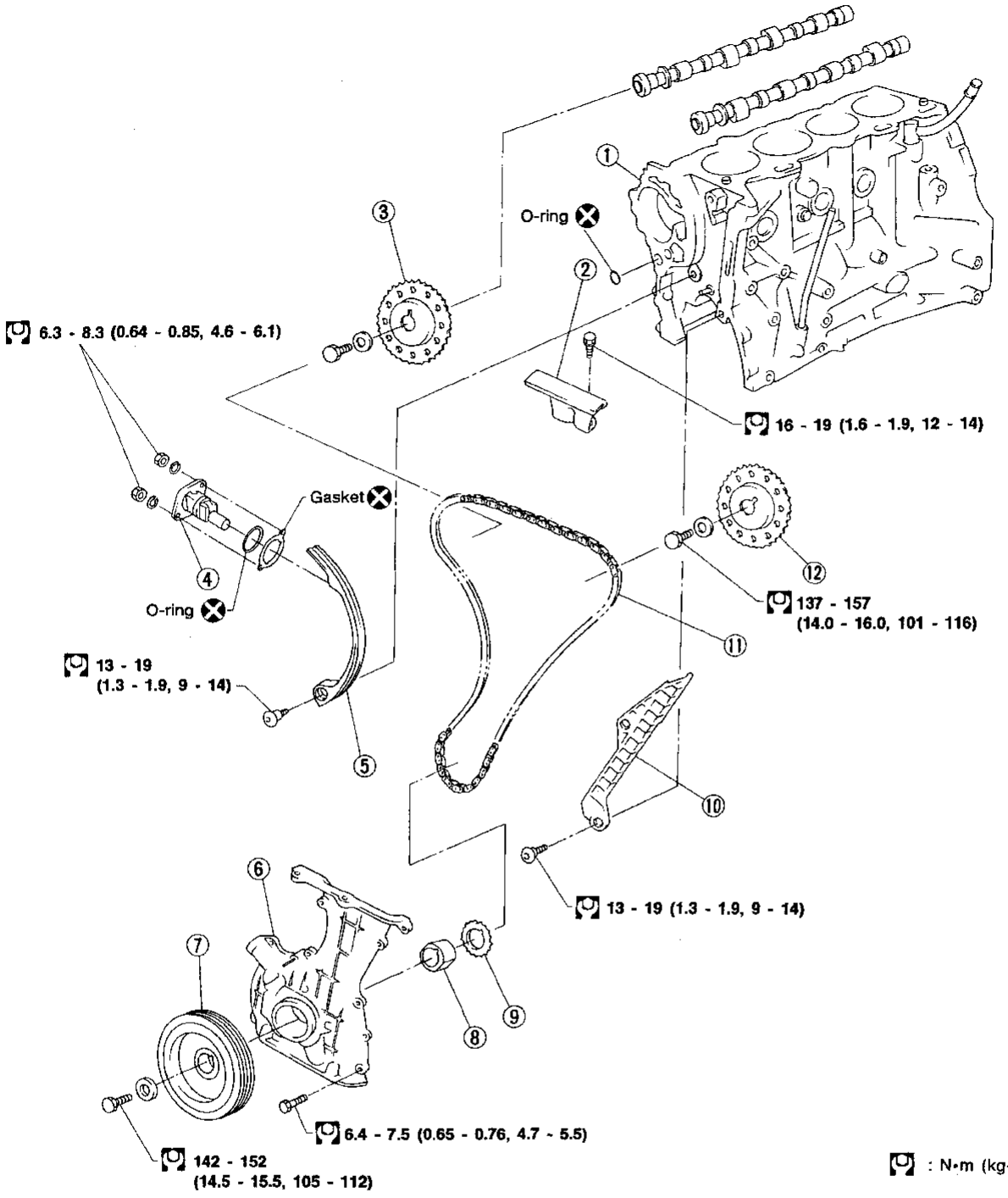
- **Use Genuine Liquid Gasket or equivalent.**
- **Be sure liquid gasket is 4.0 to 5.0 mm (0.157 to 0.197 in) wide.**
- **Attaching should be done within 5 minutes after coating.**





(3) 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.



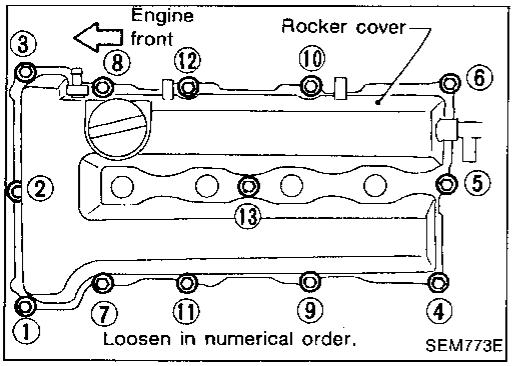
① Cylinder block
② Chain guide
③ RH camshaft sprocket
④ Chain tensioner
⑤ Chain guide
⑥ Front cover
⑦ Crank pulley
⑧ Oil pump spacer
⑨ Crankshaft sprocket
⑩ Chain guide
⑪ Timing chain
⑫ LH camshaft sprocket

CAUTION:

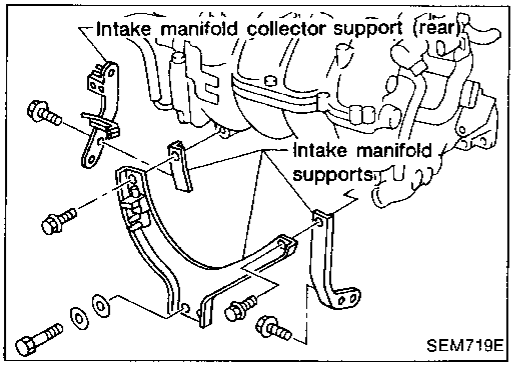
- **After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.**
- **When installing sliding parts such as rocker arms, camshafts, chain tensioner and oil seal, be sure to apply new engine oil on their sliding surfaces.**
- **When tightening cylinder head bolts, camshaft sprocket bolts, crankshaft pulley bolt and camshaft bracket bolts, apply new engine oil to thread portions and seat surfaces of bolts.**

Removal

1. Release fuel pressure.
   Refer to "Releasing Fuel Pressure" in EF & EC section.
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.
5. Remove radiator.
6. Remove air duct to intake manifold.
7. Remove drive belts and water pump pulley.
8. Remove alternator and power steering oil pump.
9. Remove vacuum hoses, fuel hoses, wires, harness, connectors and so on.
10. Remove all spark plugs.

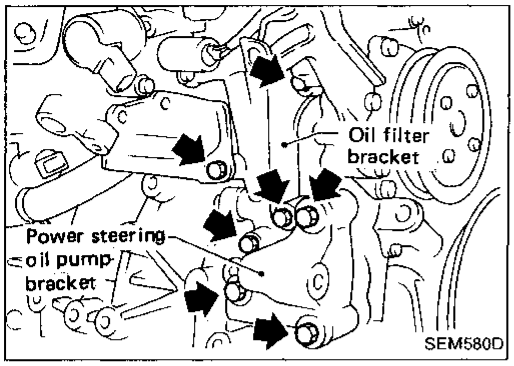


11. Remove rocker cover and oil separator.

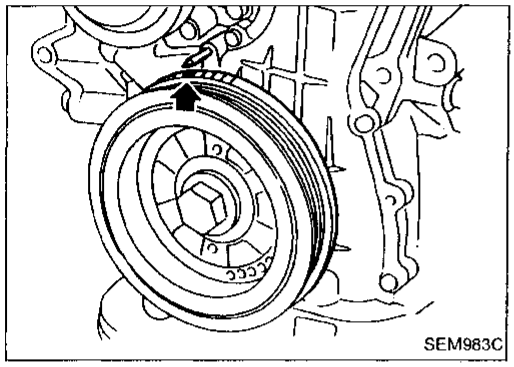


12. Remove intake manifold supports.

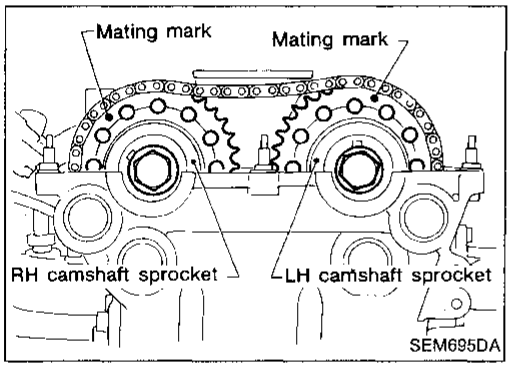
Removal (Cont'd)



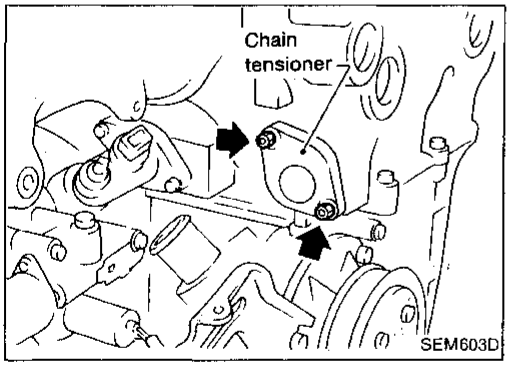
13. Remove oil filter bracket and power steering oil pump bracket.



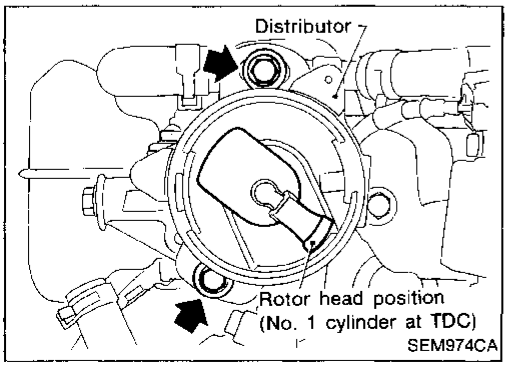
14. Set No. 1 piston at TDC on the compression stroke by rotating crankshaft.



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



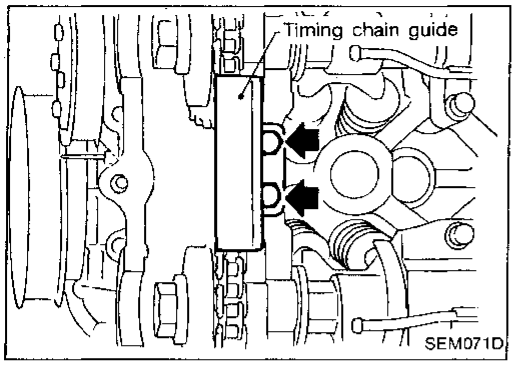
15. Remove chain tensioner.



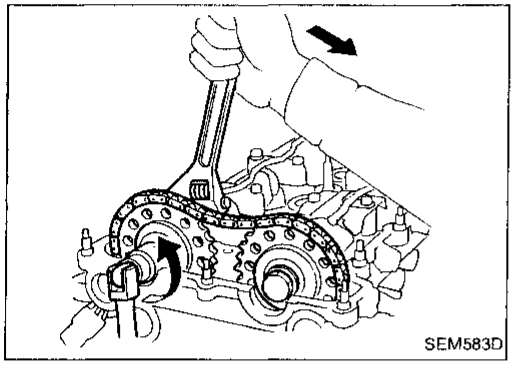
16. Remove distributor.

Do not turn rotor with distributor removed.

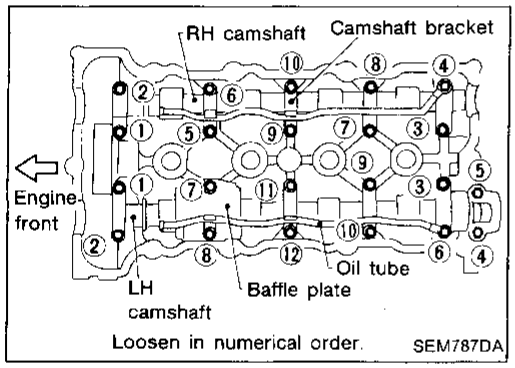
Removal (Cont'd)



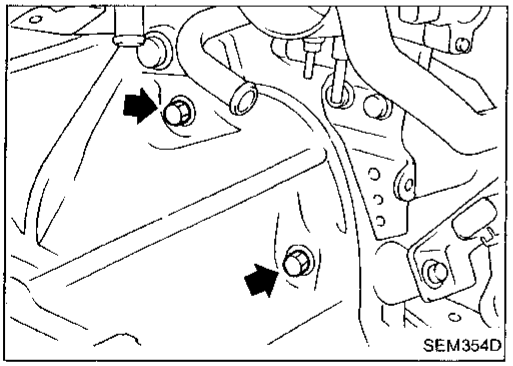
17. Remove timing chain guide.



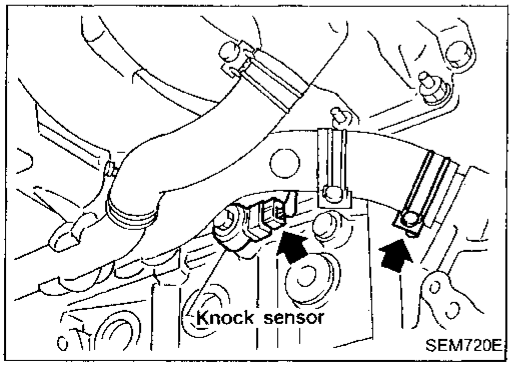
18. Remove camshaft sprockets.



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



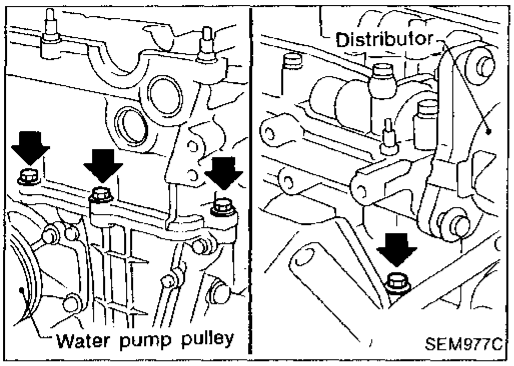
20. Remove starter motor.



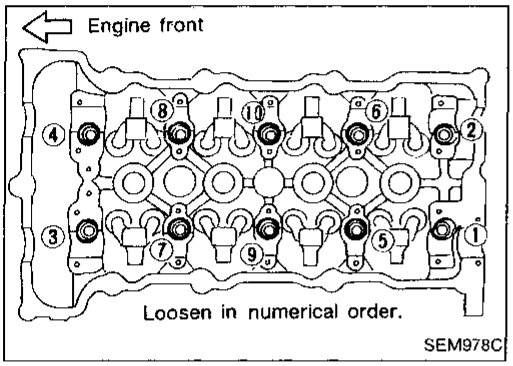
21. Remove the following water hoses.
- Water hose for cylinder block.
- Water hoses from heater.

22. Remove knock sensor harness connector.

Removal (Cont'd)

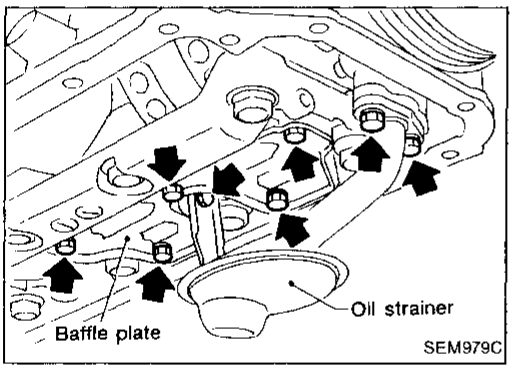


23. Remove cylinder head outside bolts.

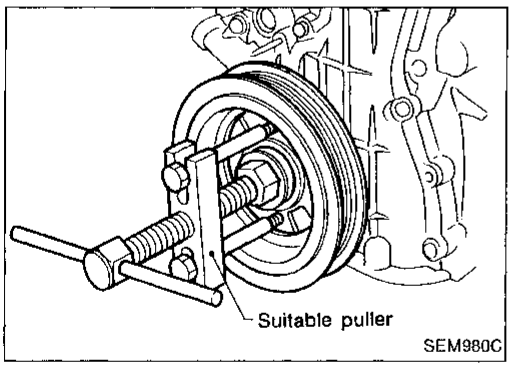


24. Remove cylinder head bolts.
- **Bolts should be loosened in two or three steps.**

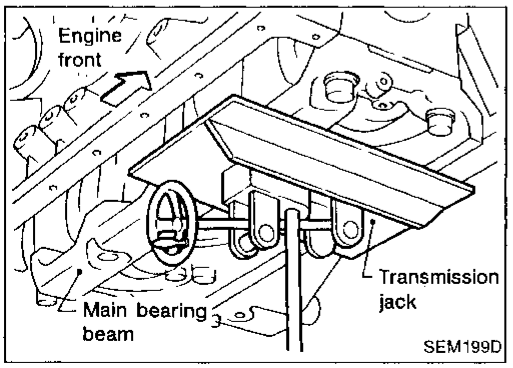
25. Remove cylinder head completely with intake and exhaust manifolds.
26. Remove oil pans.
Refer to "Removal" in "OIL PAN".



27. Remove oil strainer and baffle plate.

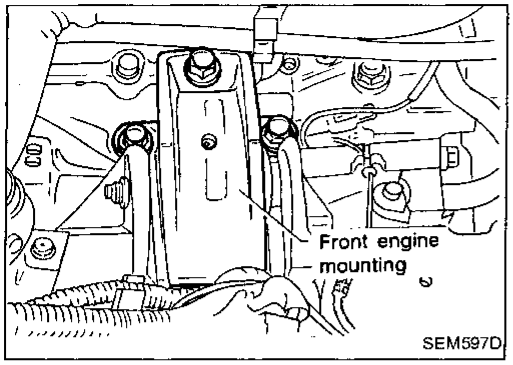


28. Remove crankshaft pulley.

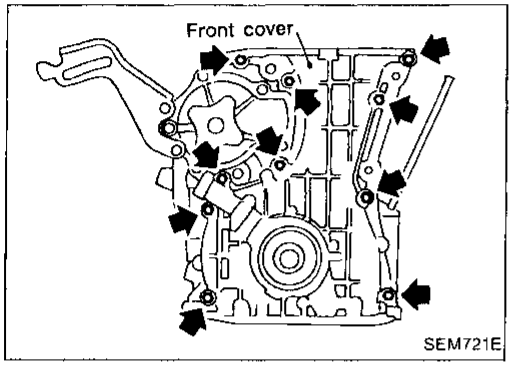


29. Set a suitable transmission jack under main bearing beam.

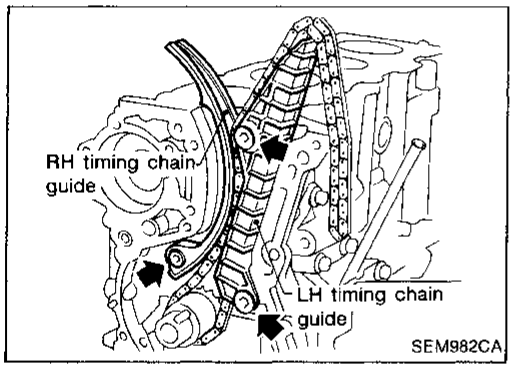
Removal (Cont'd)



30. Remove front engine mounting.



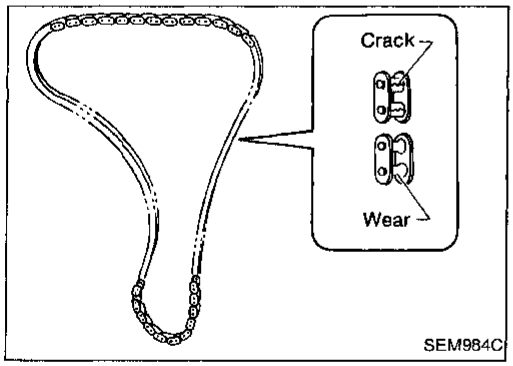
31. Remove front cover.



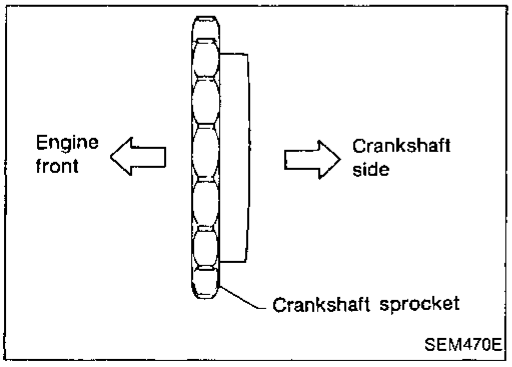
32. Remove timing chain guides and timing chain.

Inspection

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

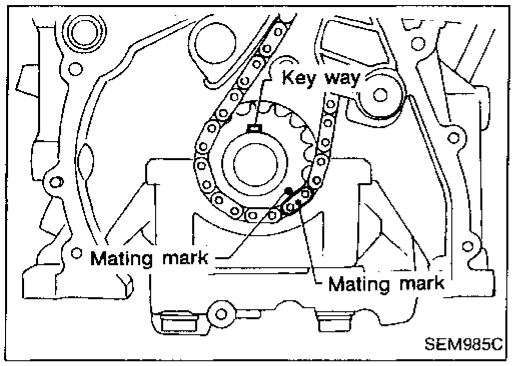


Installation

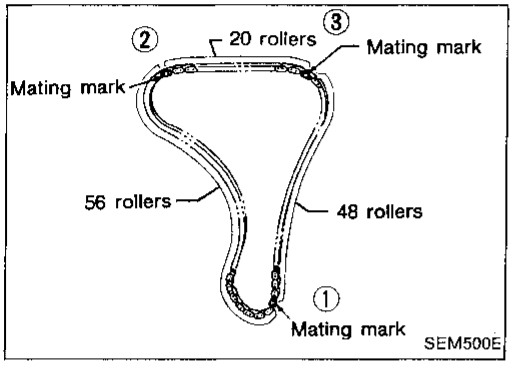


1. Install crankshaft sprocket on crankshaft.

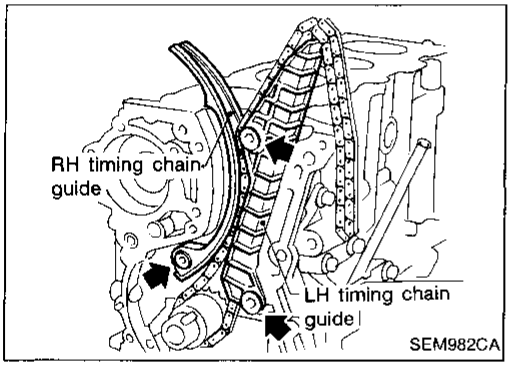
Installation (Cont'd)



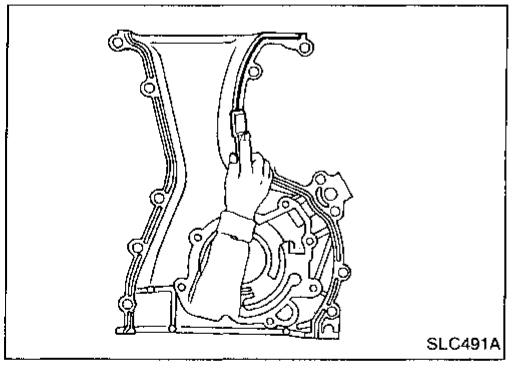
2. Position crankshaft so that No. 1 piston is set at TDC (Keyway at 12 o'clock-mating mark at 4 o'clock approx.) fit timing chain to crankshaft sprocket so that mating mark is in line with mating mark on crankshaft sprocket.



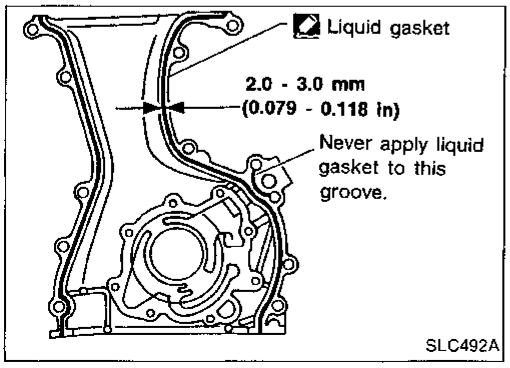
- Mating mark color on timing chain.
  ① : **Gold**
  ②, ③ : **Silver**



3. Install timing chain and timing chain guides.

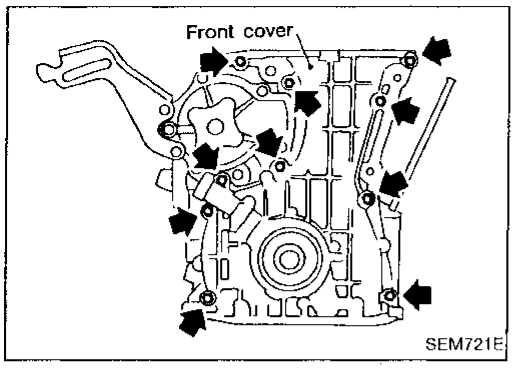


4. Before installing front cover, remove all traces of liquid gasket from mating surface using a scraper.
- Also remove traces of liquid gasket from mating surface of cylinder block.

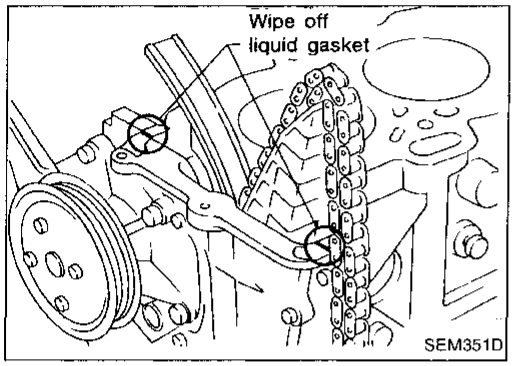


5. Apply a continuous bead of liquid gasket to mating surface of front cover.
- Use Genuine Liquid Gasket or equivalent.

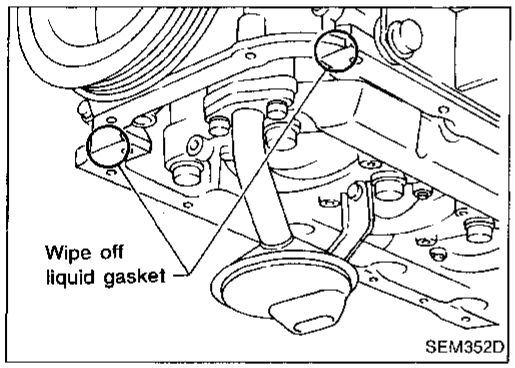
Installation (Cont'd)

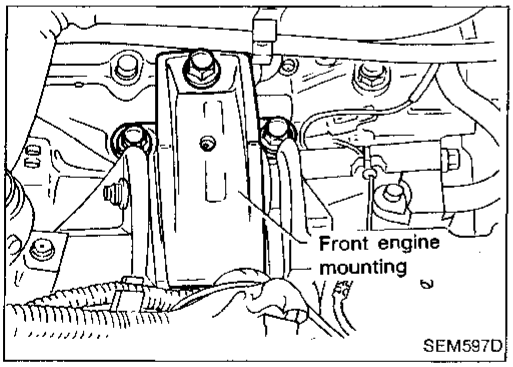


6. Install oil pump drive spacer and front cover.

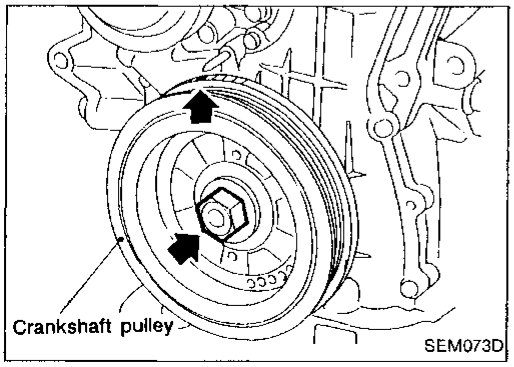


- Wipe off excessive liquid gasket.



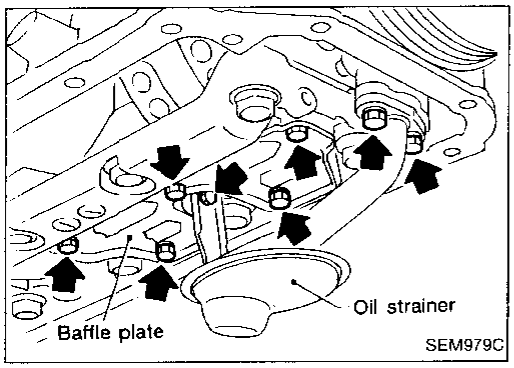


7. Install front engine mounting.

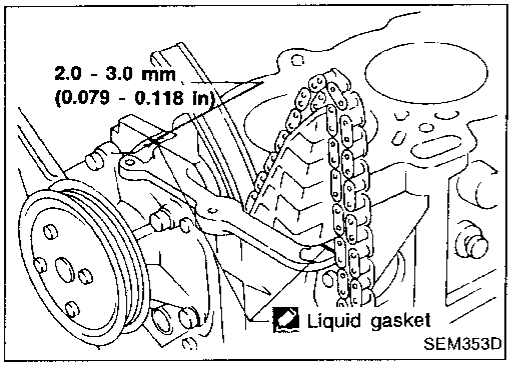


8. Install crankshaft pulley.
9. Set No. 1 piston at TDC on its compression stroke.

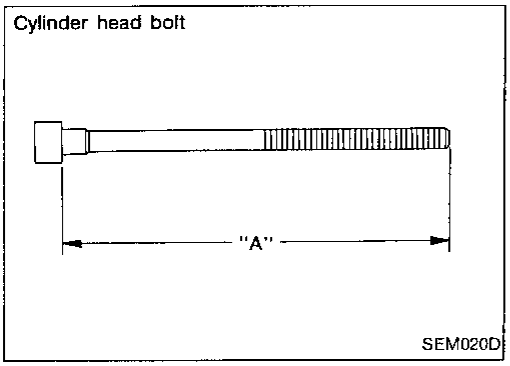
Installation (Cont'd)



10. Install oil strainer and baffle plate.
11. Install oil pan.
    Refer to "Installation" in "OIL PAN".



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

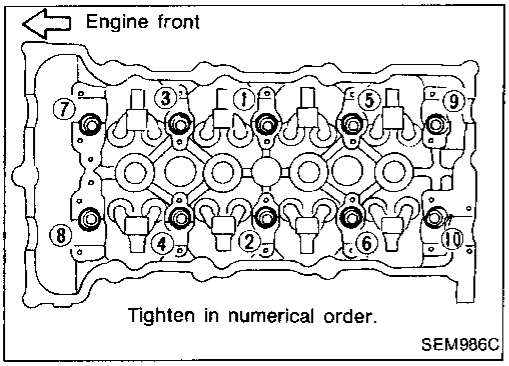


13. Install cylinder head completely with intake and exhaust manifolds.

CAUTION:

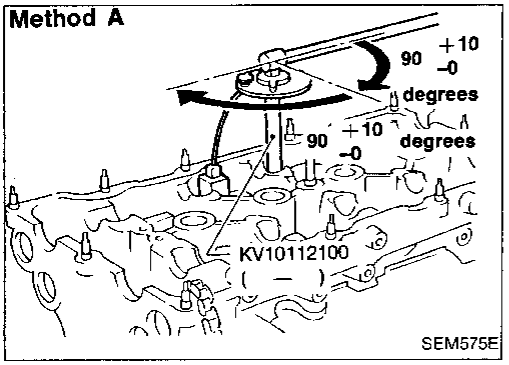
The cylinder head bolts can be reused providing dimension "A" is not exceeded.

Dimension "A":
158.2 mm (6.228 in)



- **Tightening procedure:**

ⓐ **Tighten all bolts to 39 N·m (4.0 kg-m, 29 ft-lb).**
ⓑ **Tighten all bolts to 78 N·m (8.0 kg-m, 58 ft-lb).**
ⓒ **Loosen all bolts completely.**
ⓓ **Tighten all bolts to 34 to 44 N·m (3.5 to 4.5 kg-m, 25 to 33 ft-lb).**



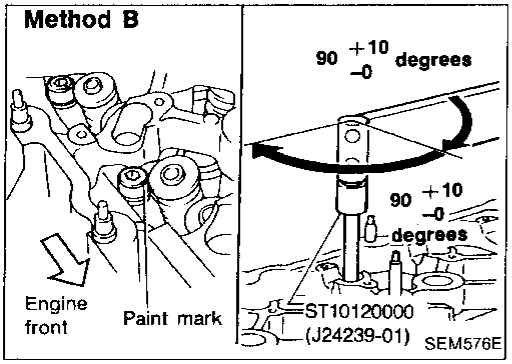
ⓔ **Method A: Turn all bolts 90 to 100 degrees clockwise with Tool or suitable angle wrench.**

Method B: If angle wrench is not available, mark the side of each cylinder head bolt with a paint mark facing the front of the engine, then turn all bolts 90 to 100 degrees clockwise.

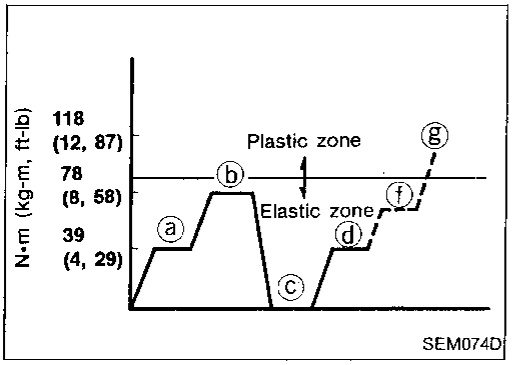
ⓕ **Turn all bolts 90 to 100 degrees clockwise.**
ⓖ **Ensure that paint mark on each bolt faces the rear of the engine. (Method B only)**

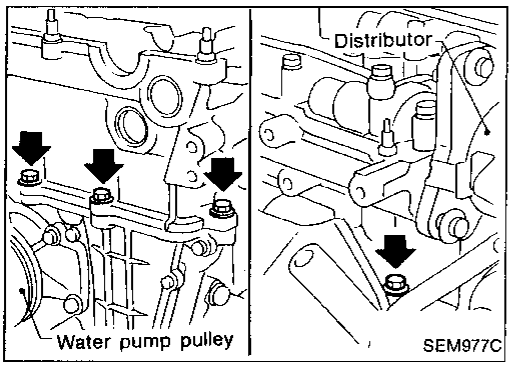
Do not turn any bolt 180 to 200 degrees clockwise all at once.

Installation (Cont'd)

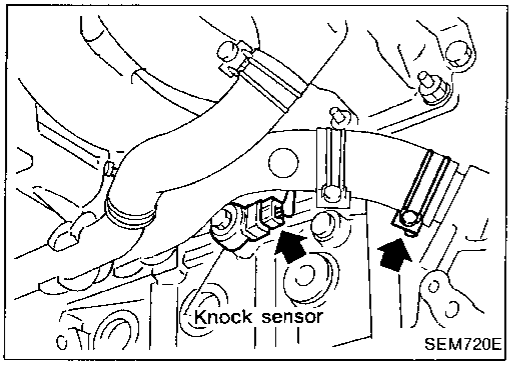


	Tightening torque N·m (kg-m, ft-lb)
ⓐ	39 (4.0, 29)
ⓑ	78 (8.0, 58)
ⓒ	0 (0, 0)
ⓓ	39 ± 5 (4.0 ± 0.5, 28.9 ± 3.6)
ⓔ	90^{+10}_{-0} degrees
ⓕ	90^{+10}_{-0} degrees



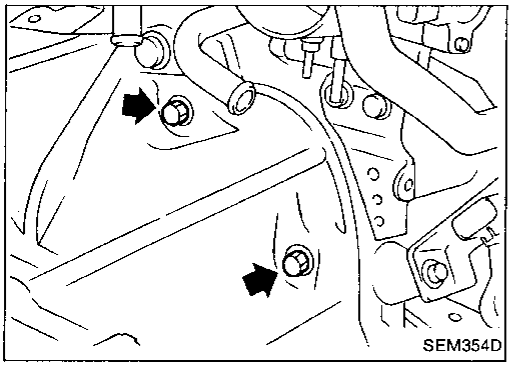


14. Install cylinder head outside bolts.



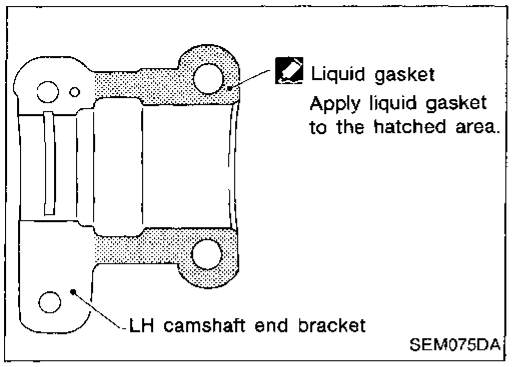
15. Install the following water hoses.
- Water hose for cylinder block.
- Water hoses for heater.

16. Install knock sensor harness connector.

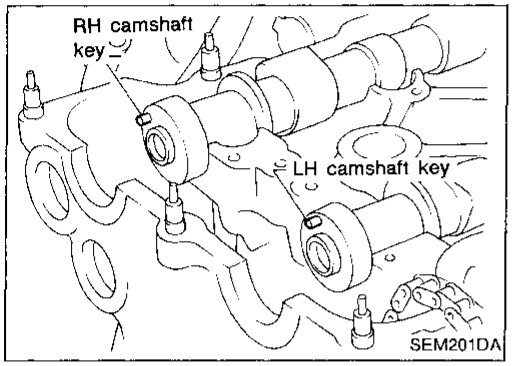


17. Install starter motor.

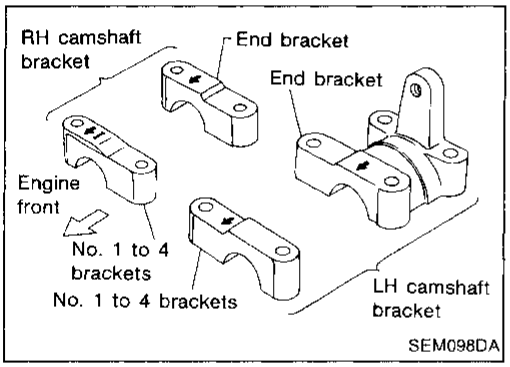
Installation (Cont'd)

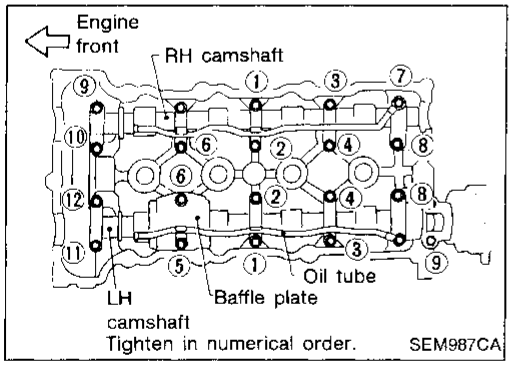


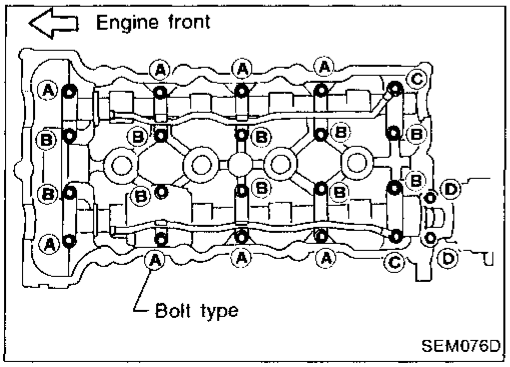
18. Before installing LH camshaft end bracket, remove all traces of liquid gasket from mating surface.
- Also remove traces of liquid gasket from mating surface of cylinder head.
19. Apply a continuous bead of liquid gasket to mating surface of LH camshaft end bracket.
- Use Genuine Liquid Gasket or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







- **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, 1.4 ft-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, 1.4 ft-lb)

STEP 2:

Tighten bolts in the specified order.

: 6 N·m (0.6 kg-m, 4.3 ft-lb)

STEP 3:

Tighten bolts in the specified order.

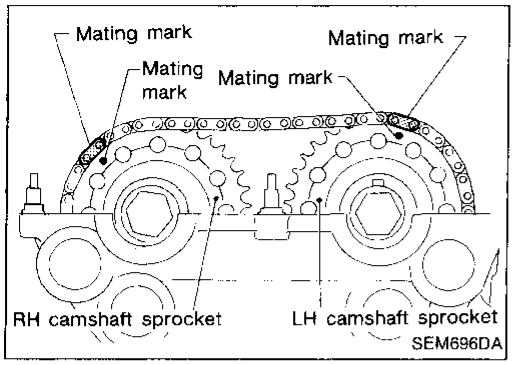
: 9.0 - 11.8 N·m (0.92 - 1.2 kg-m, 6.7 - 8.7 ft-lb)

... Bolt type Ⓐ Ⓑ Ⓒ

: 18 - 25 N·m (1.8 - 2.6 kg-m, 13 - 19 ft-lb)

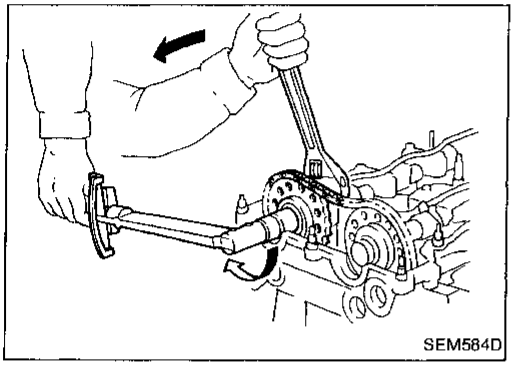
... Bolt type Ⓓ

Installation (Cont'd)



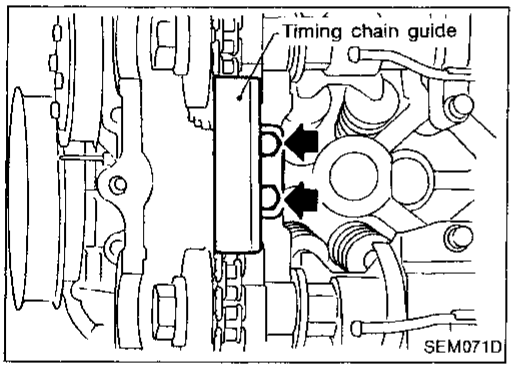
21. Install camshaft sprockets.

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

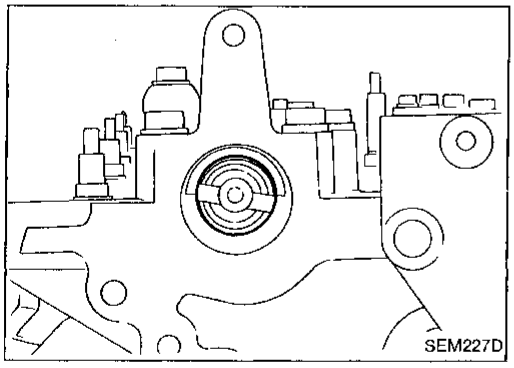


- Lock camshafts as shown in figure and tighten to specified torque.

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

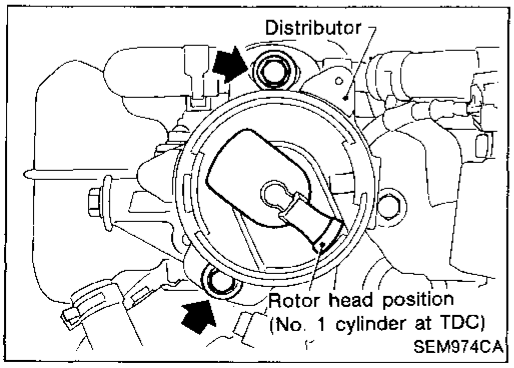


22. Install timing chain guide.



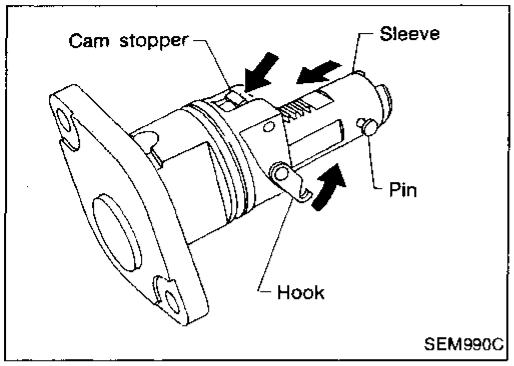
23. Install distributor.

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



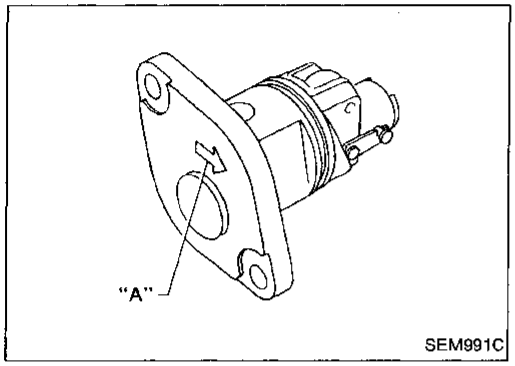
- **After installing, confirm that distributor rotor head is set as shown in figure.**

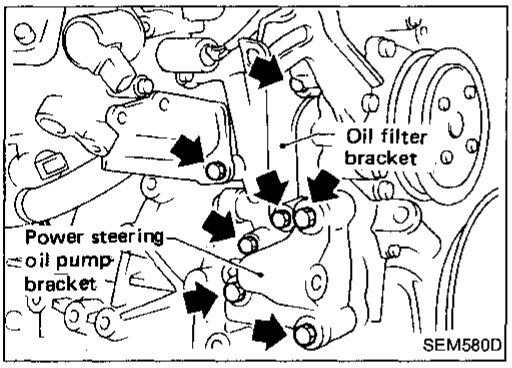
Installation (Cont'd)



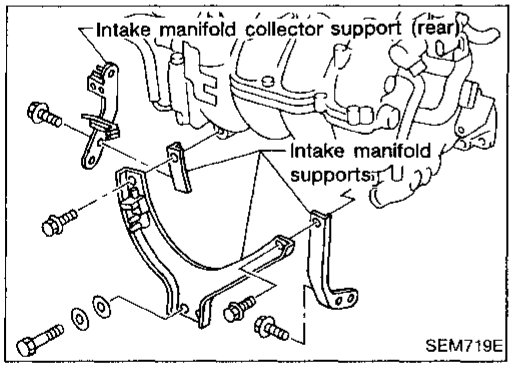
24. Install chain tensioner.

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.

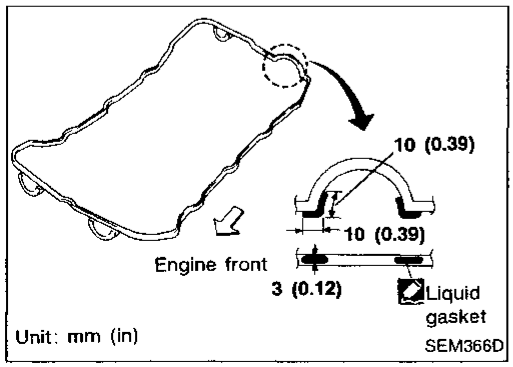




25. Install oil filter bracket and power steering oil pump bracket.



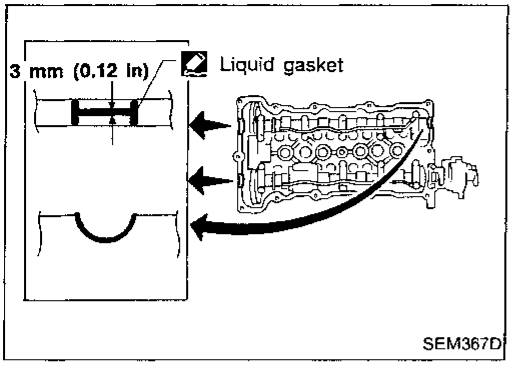
26. Install intake manifold supports.

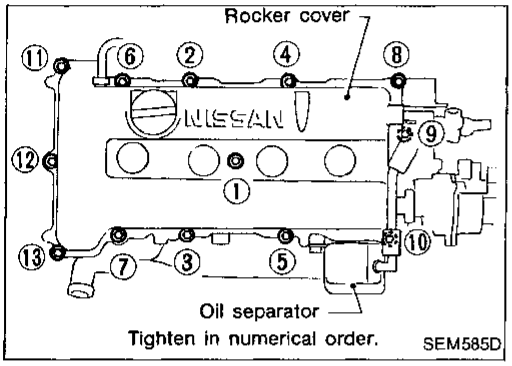


27. Before installing rocker cover, remove all traces of liquid gasket from mating surface of rocker cover gasket to cylinder head.
28. Apply a continuous bead of liquid gasket to mating surface of rocker cover gasket and cylinder head.

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

Installation (Cont'd)





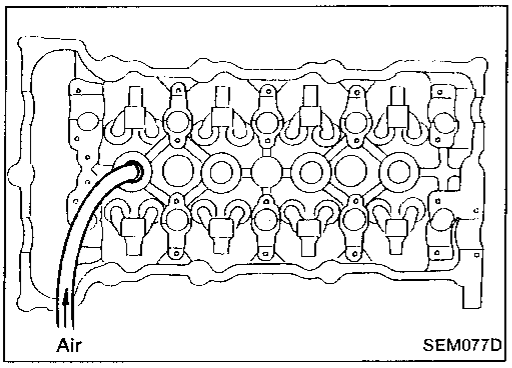
29. Install rocker cover and oil separator.

Rocker cover tightening procedure:

(1) Tighten nuts ① - ⑩ - ⑪ - ⑬ - ⑧ in that order to 4 N·m (0.4 kg-m, 2.9 ft-lb).

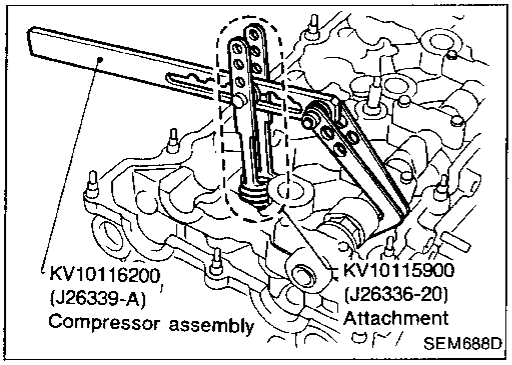
(2) Tighten nuts ① to ⑬ as indicated in figure to 8 to 10 N·m (0.8 to 1.0 kg-m, 5.8 to 7.2 ft-lb).

30. Refit spark plugs and leads.
31. Install vacuum hoses, fuel hoses, wires, harness, connectors and so on.
32. Install power steering oil pump and alternator.
33. Install water pump pulley and drive belts.
34. Refit air duct to intake manifold.
35. Install radiator.
36. Refit hoses and refill with coolant. (Refer to MA section.)
37. Install engine side cover and front RH wheel.
38. Install engine under covers.



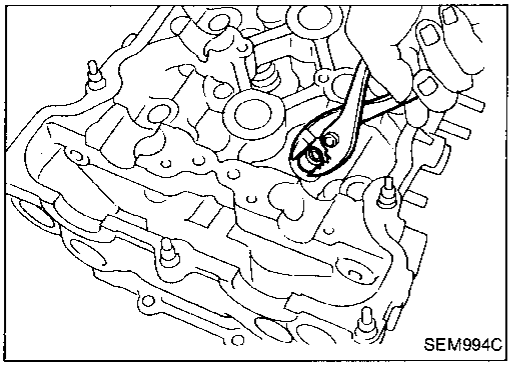
VALVE OIL SEAL

1. Remove accelerator cable.
2. Remove rocker cover and oil separator.
3. Remove camshafts and sprockets.
   Refer to "Removal" in "TIMING CHAIN".
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/cm^2, 71 psi).
6. Remove rocker arm, rocker arm guide and shim.

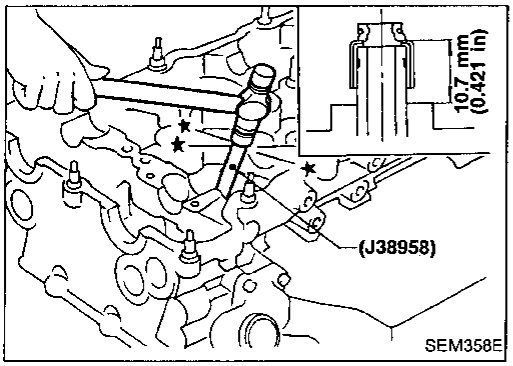


7. Remove valve spring with Tool.

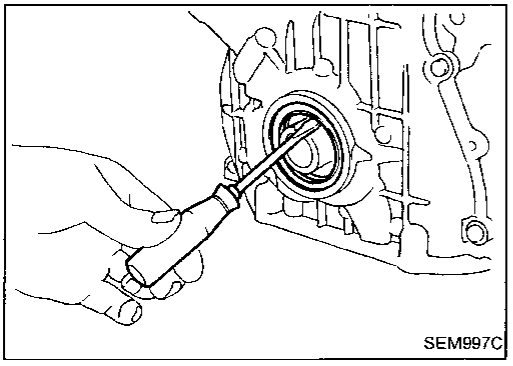
Piston concerned should be set at TDC to prevent valve from falling.



8. Remove valve oil seal.



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

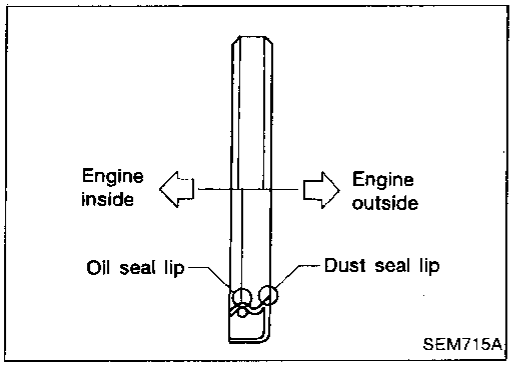


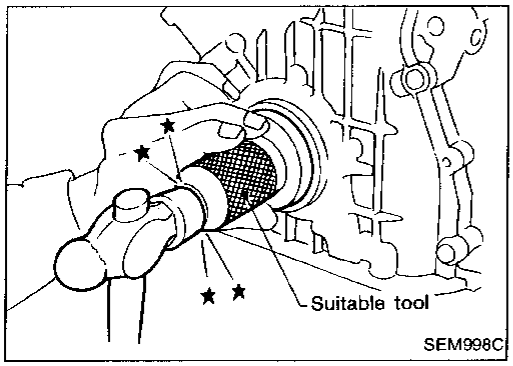
FRONT OIL SEAL

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.



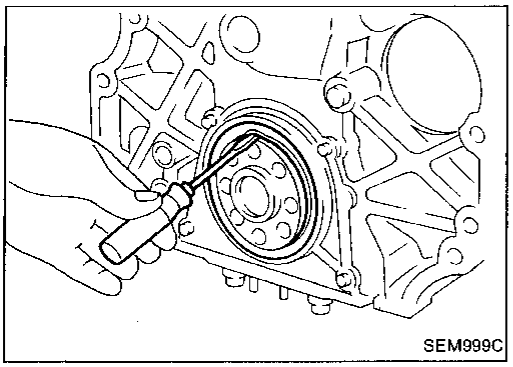


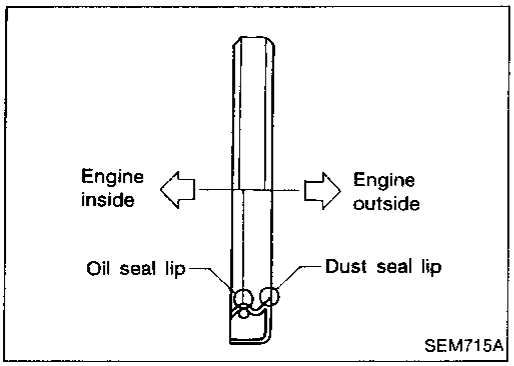
3. Apply engine oil to new oil seal and install it using a suitable tool.

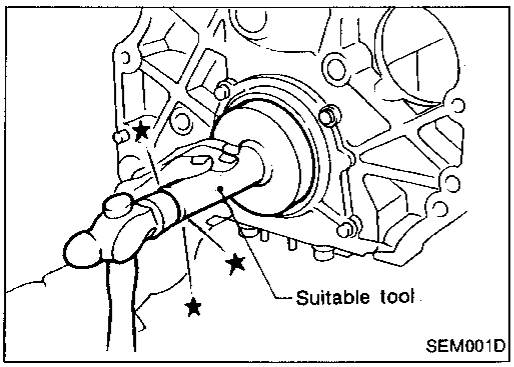
REAR OIL SEAL

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

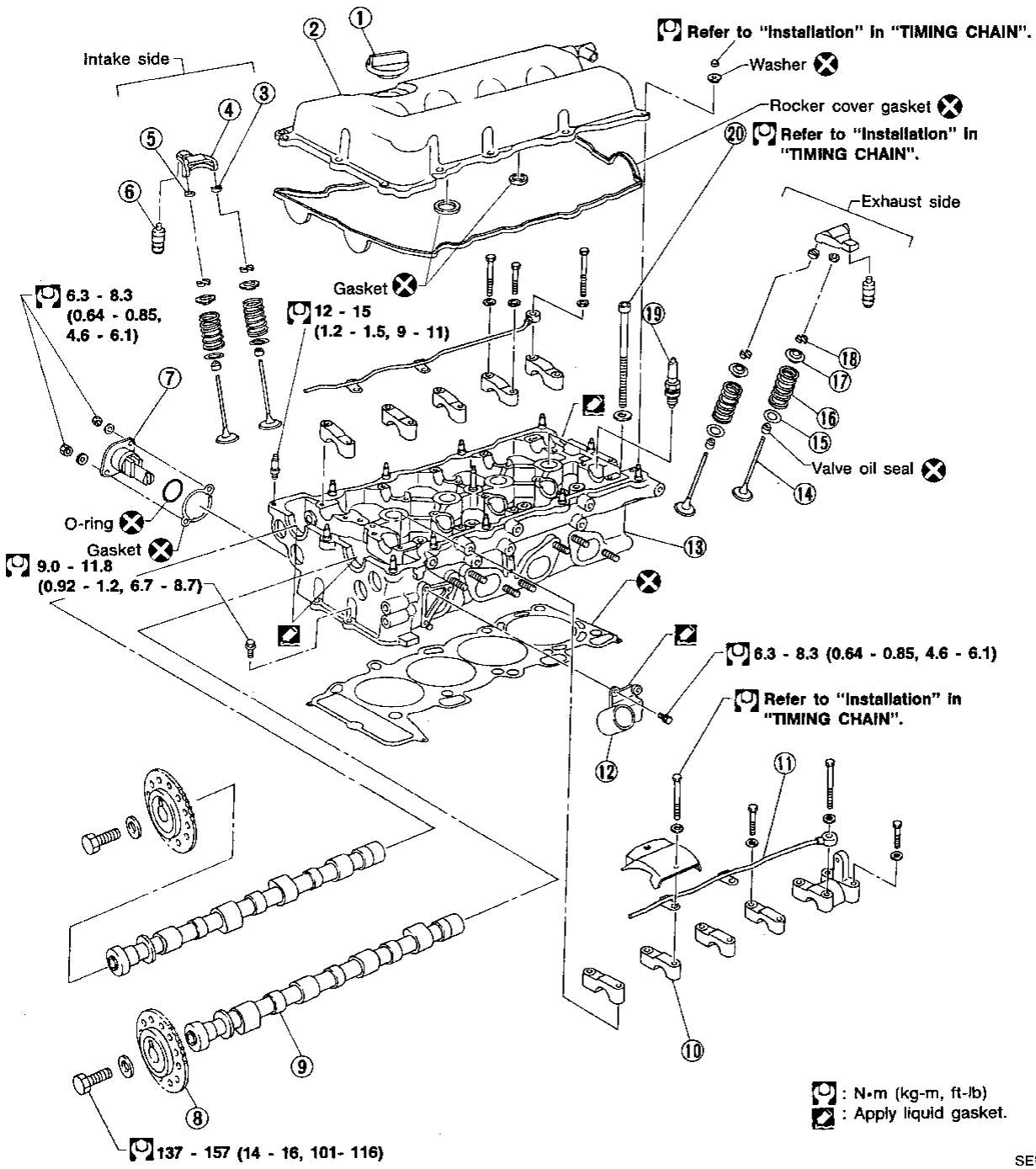
Be careful not to scratch rear oil seal retainer.







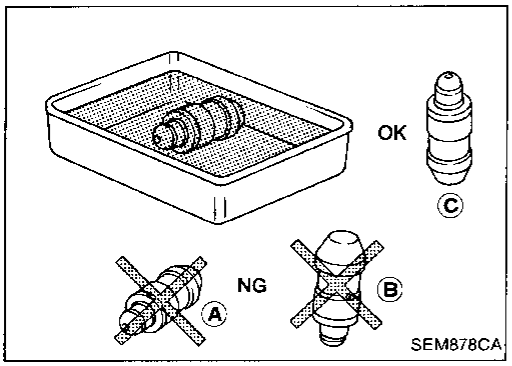
4. Apply engine oil to new oil seal and install it using a suitable tool.



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

CAUTION:

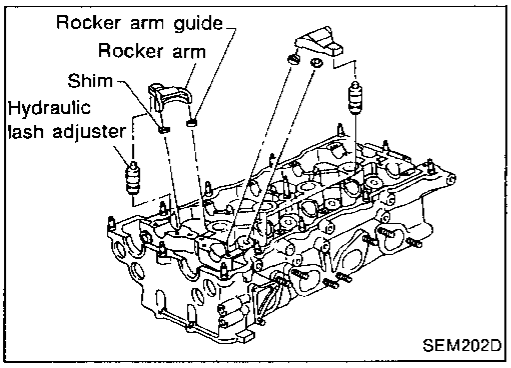
- **When installing sliding parts such as rocker arms, camshaft and oil seal, be sure to apply new engine oil on their sliding surfaces.**
- **When tightening cylinder head bolts, camshaft sprocket bolts and camshaft bracket bolts, apply new engine oil to thread portions and seat surfaces of bolts.**



- **If a hydraulic lash adjuster is kept on its side, there is a risk of air entering it. After removal, always set hydraulic lash adjuster straight up, or when laying it on its side, have it soak 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 is the same procedure as those for timing chain. Refer to "Removal" in "TIMING CHAIN".

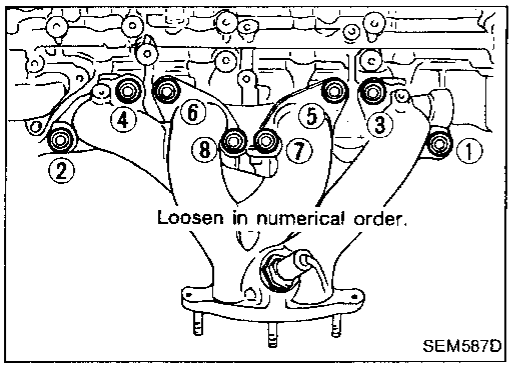


Disassembly

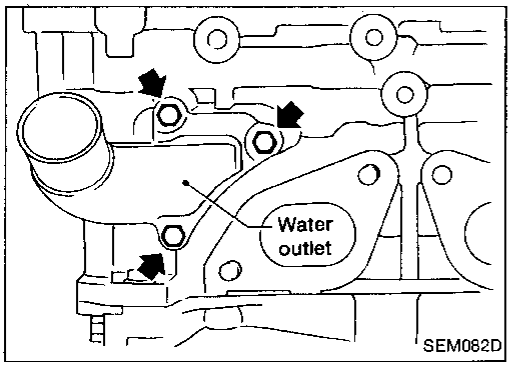
1. Remove rocker arms, shims, rocker arm guides and hydraulic lash adjusters from cylinder head.

CAUTION:

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

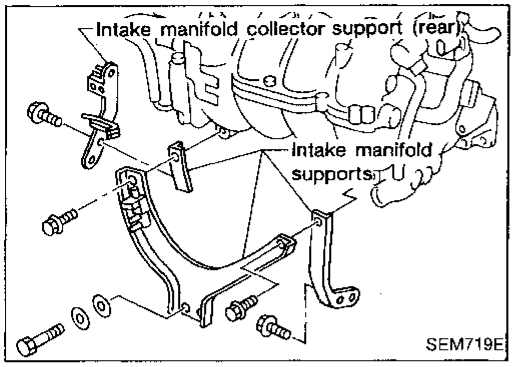


2. Remove crankcase ventilation oil separator.
3. Remove EGR tube.
4. Remove exhaust manifold cover.
5. Remove exhaust manifold.

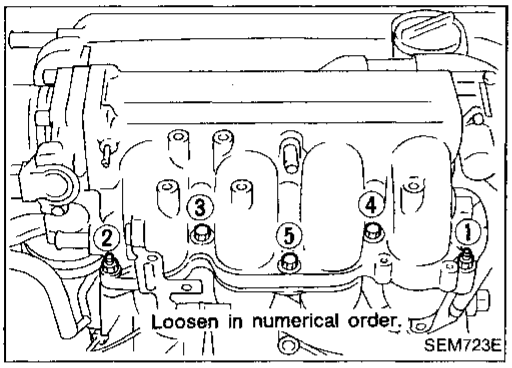


6. Remove water outlet.

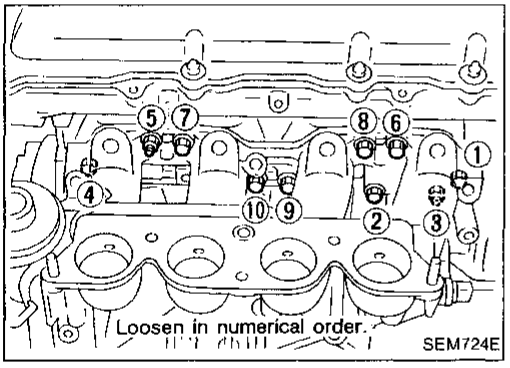
Disassembly (Cont'd)



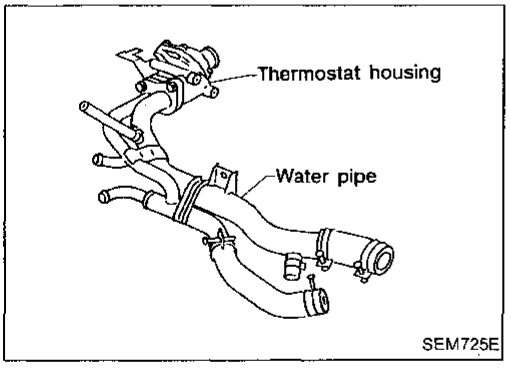
7. Remove intake manifold supports and intake manifold collector supports (both on rear and upper sides).



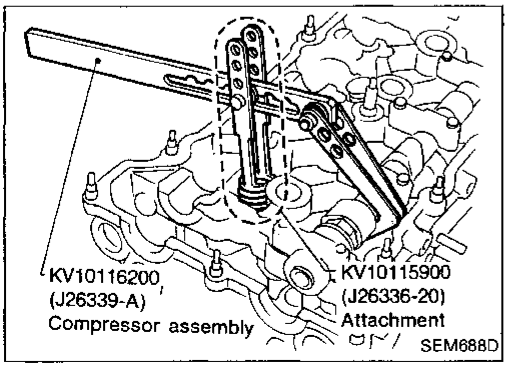
8. Remove intake manifold collector from intake manifold.



9. Remove fuel tube assembly.
   Refer to "Injector Removal and Installation" in EF & EC section.
10. Remove power steering oil pump bracket and oil filter bracket.
11. Remove intake manifold.

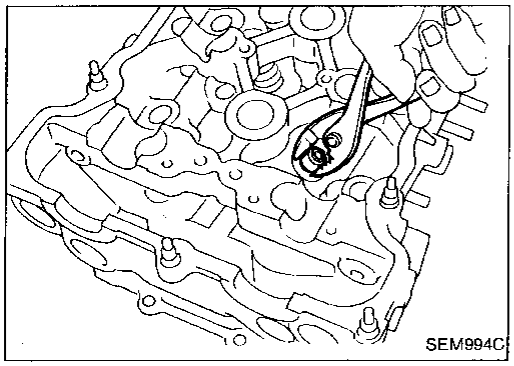


12. Remove thermostat housing with water pipe.

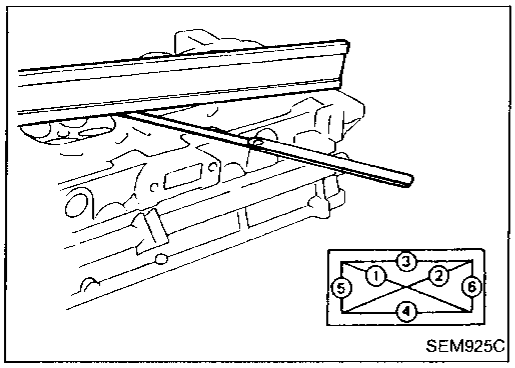


13. Remove valve components with Tool.

Disassembly (Cont'd)


SEM994C

14. Remove valve oil seal with a suitable tool.



SEM925C

Inspection

CYLINDER HEAD DISTORTION

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 mm (0.008 in)

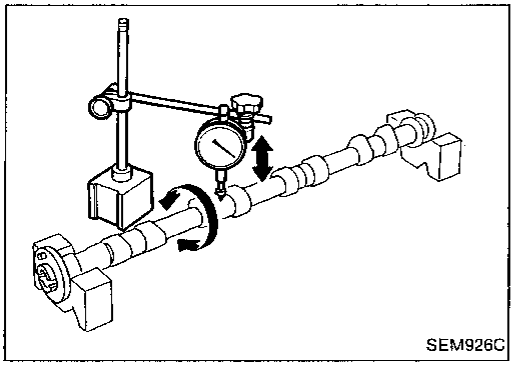
After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

Nominal cylinder head height:

136.9 - 137.1 mm (5.390 - 5.398 in)

CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.


SEM926C

CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.

Runout (Total indicator reading):

Standard

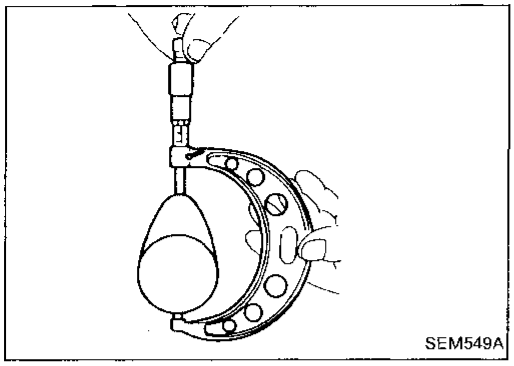
Less than 0.02 mm (0.0008 in)

Limit

0.1 mm (0.004 in)

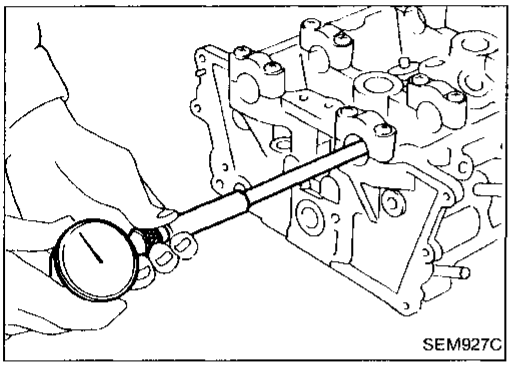
2. If it exceeds the limit, replace camshaft.

Inspection (Cont'd)


SEM549A

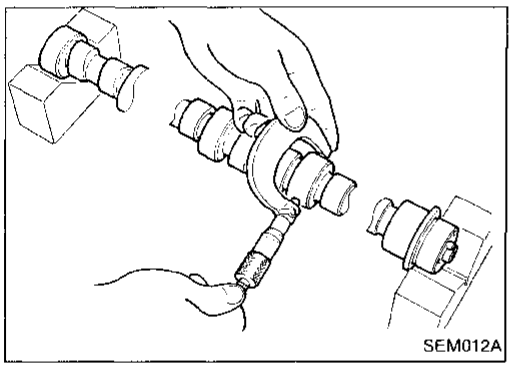
CAMSHAFT CAM HEIGHT

1. Measure camshaft cam height.
   Standard cam height:
   Intake
   38.408 - 38.598 mm (1.5121 - 1.5196 in)
   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.

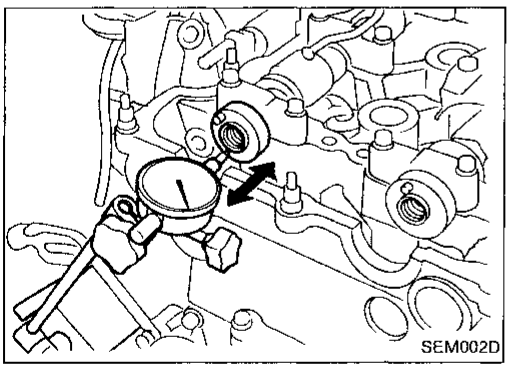

SEM927C

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)

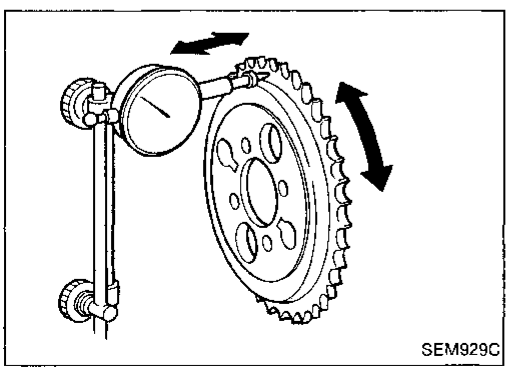

SEM012A

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)


SEM002D

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)

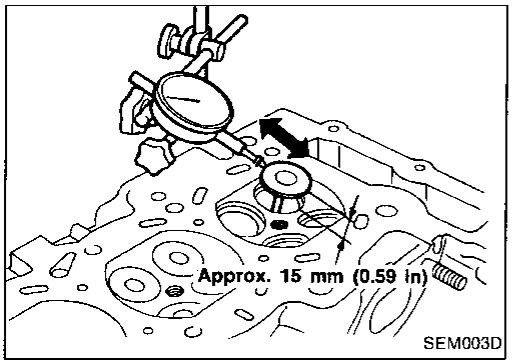

SEM929C

CAMSHAFT SPROCKET RUNOUT

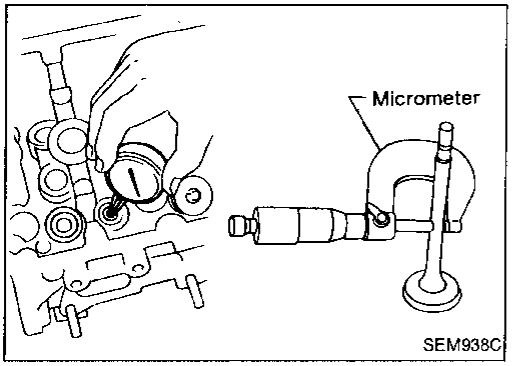
1. Install sprocket on camshaft.
2. Measure camshaft sprocket runout.
   Runout (Total indicator reading):
   Limit 0.25 mm (0.0098 in)
3. If it exceeds the limit, replace camshaft sprocket.

Inspection (Cont'd)

VALVE GUIDE CLEARANCE

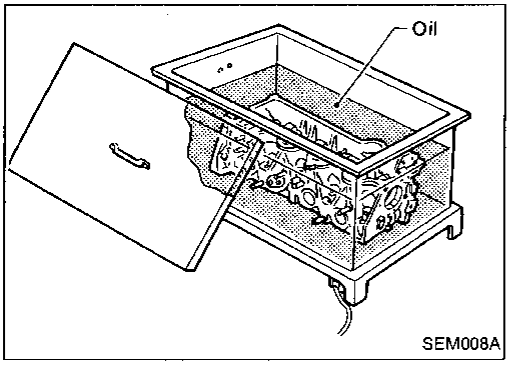


1. Measure valve deflection in a parallel direction with rocker arm. (Valve and valve guide mostly wear in this direction.)
   Valve deflection limit (Dial gauge reading):
   Intake & Exhaust
   0.2 mm (0.008 in)

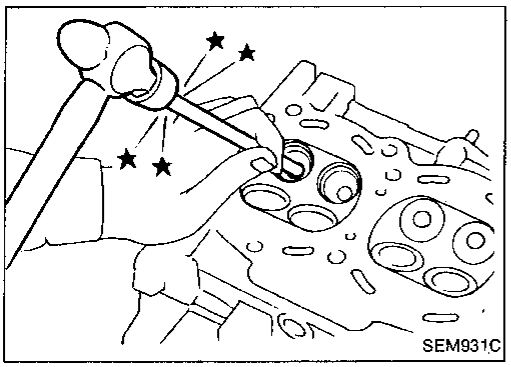


2. If it exceeds the limit, check valve to valve guide clearance.
   a. Measure valve stem diameter and valve guide inner diameter.
   b. Check that clearance is within specification.
      Valve to valve guide clearance:
      Standard
      Intake 0.020 - 0.053 mm (0.0008 - 0.0021 in)
      Exhaust 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.

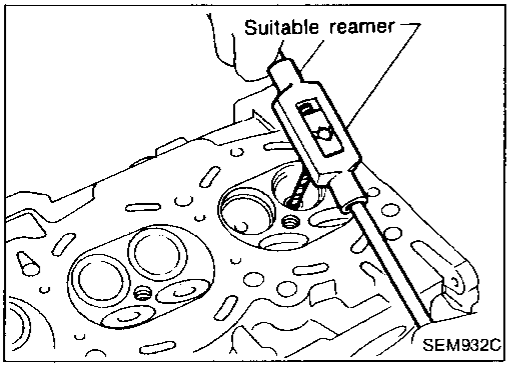
VALVE GUIDE REPLACEMENT



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

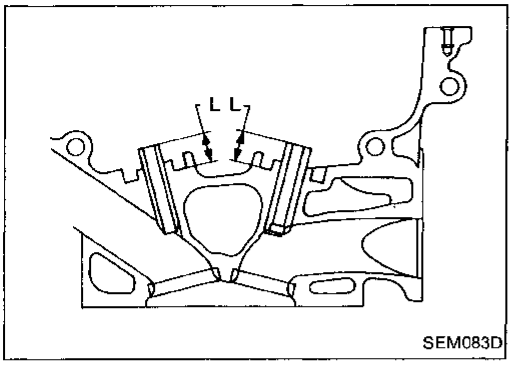


2. Press out valve guide or use a hammer and suitable tool.

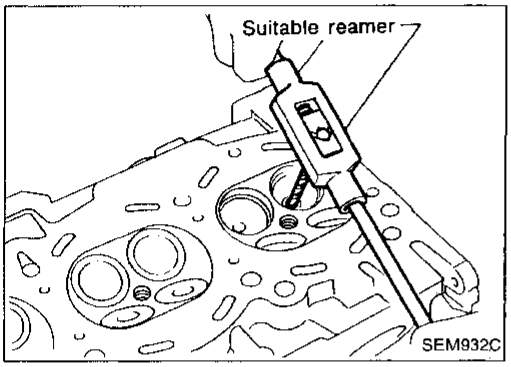


3. Ream cylinder head valve guide hole.
   Valve guide hole diameter
   (for service parts):
   Intake & Exhaust
   10.175 - 10.196 mm (0.4006 - 0.4014 in)

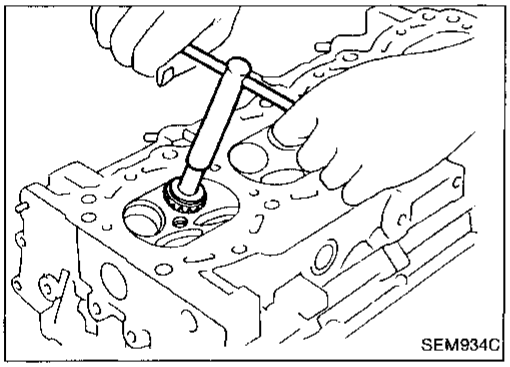
Inspection (Cont'd)



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)



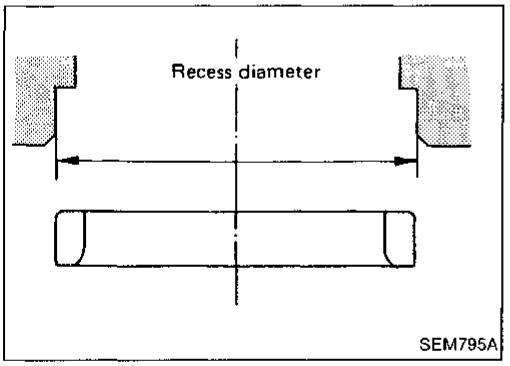
5. Ream valve guide.
   Valve guide inner diameter:
   Intake & Exhaust
   6.000 - 6.018 mm (0.2362 - 0.2369 in)



VALVE SEATS

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

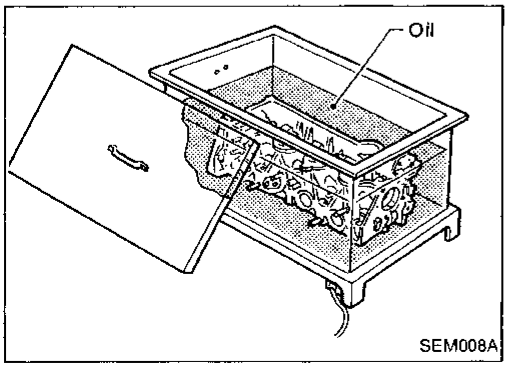
- **Before repairing valve seats, check valve and valve guide for wear. If they have worn, replace them. Then correct valve seat.**
- **Cut with both hands to uniform the cutting surface.**



REPLACING VALVE SEAT FOR SERVICE PARTS

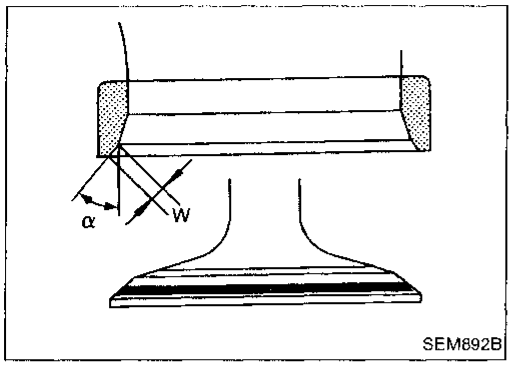
1. Bore out old seat until it collapses. The machine depth stop should be set so that boring cannot continue beyond the bottom face of the seat recess in cylinder head.
2. Ream cylinder head recess.
   Reaming bore for service valve seat
   Oversize [0.5 mm (0.020 in)]:
   Intake 35.500 - 35.516 mm (1.3976 - 1.3983 in)
   Exhaust 31.500 - 31.516 mm (1.2402 - 1.2408 in)

Reaming should be done in circles concentric to the valve guide center so that valve seat will have the correct fit.



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

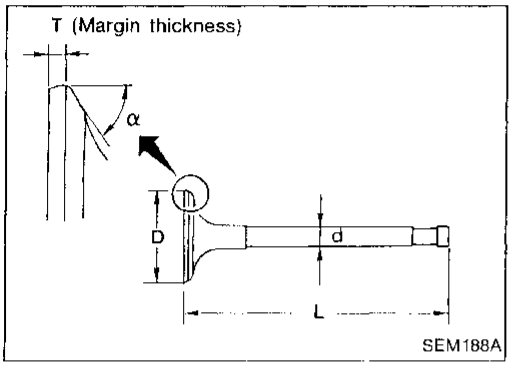
Inspection (Cont'd)



SEM892B

5. Cut or grind valve seat using a suitable tool at the specified dimensions as shown in SDS.
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
1.4 - 1.7 mm (0.055 - 0.067 in)
Exhaust
1.7 - 2.0 mm (0.067 - 0.079 in)

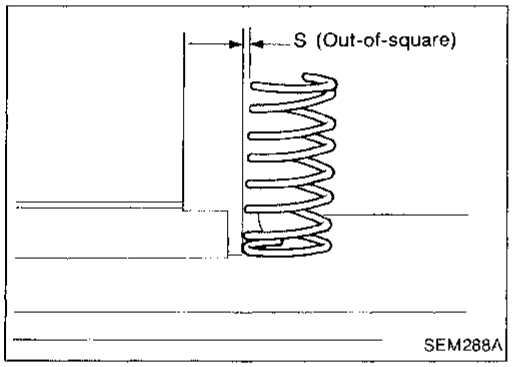


SEM188A

VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to SDS. When valve head has been worn down to 0.5 mm (0.020 in) in margin thickness, replace valve.

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



SEM288A

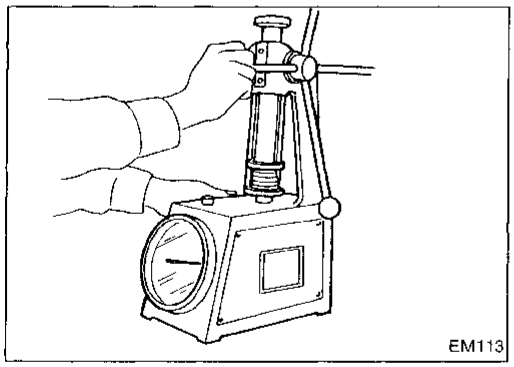
VALVE SPRING

Squareness

1. Measure "S" dimension.

Out-of-square:
Less than 2.2 mm (0.087 in)

2. If it exceeds the limit, replace spring.

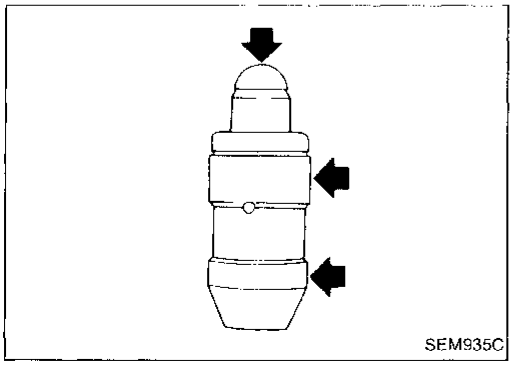

EM113

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)

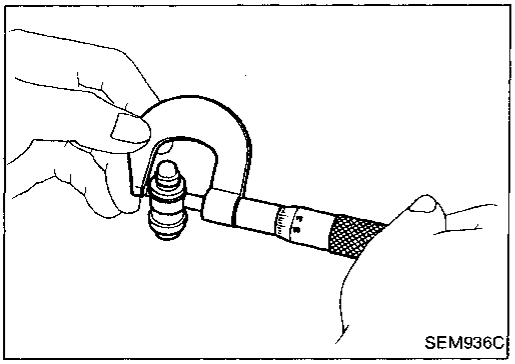
If it exceeds the limit, replace spring.


SEM935C

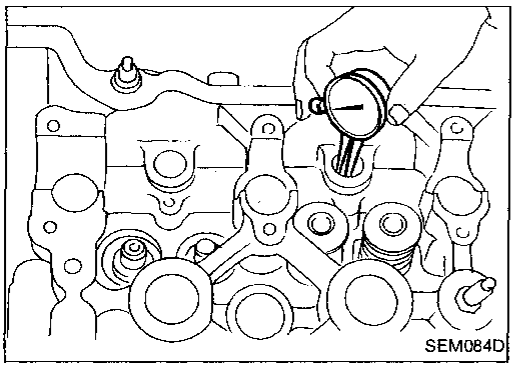
HYDRAULIC LASH ADJUSTER

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

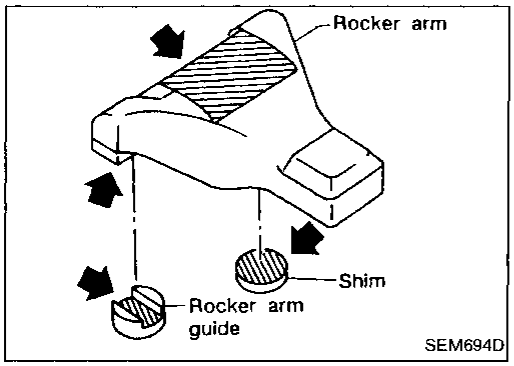
Inspection (Cont'd)



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)

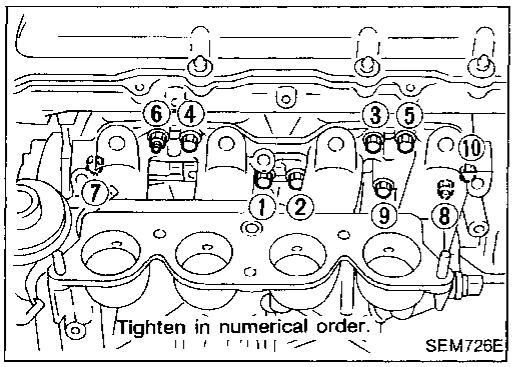


ROCKER ARM, SHIM AND ROCKER ARM GUIDE

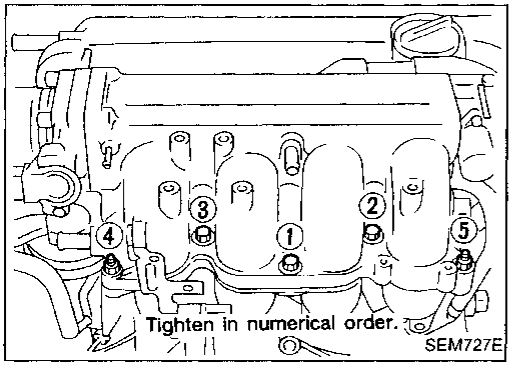
Check contact and sliding surfaces of rocker arms, shims and rocker arm guides for wear or scratches.

Assembly

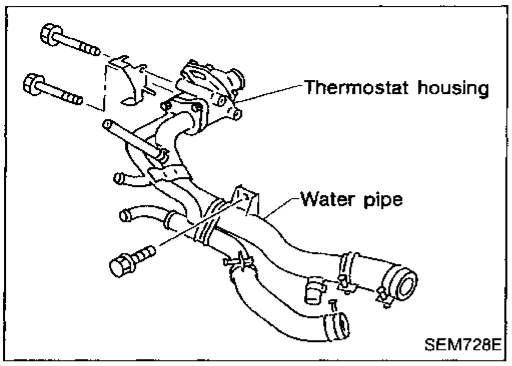
1. Install intake manifold.
2. Install fuel tube assembly.
   Refer to "Injector Removal and Installation" in EF & EC section.



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

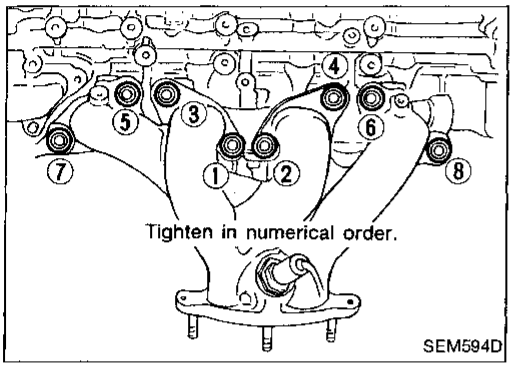


Assembly (Cont'd)

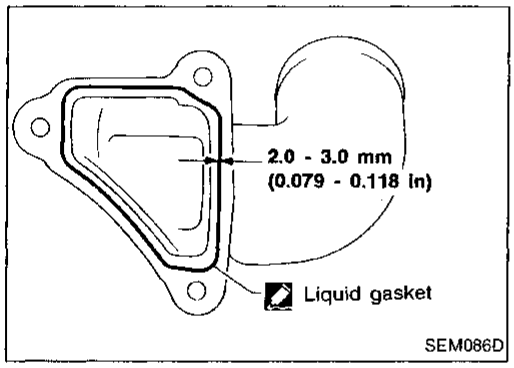


5. Install thermostat housing with water pipe.
- Tightening procedure:

(1) Tighten bolt Ⓐ to 2 - 5 N·m (0.2 - 0.5 kg-m, 1.4 - 3.6 ft-lb).
(2) Tighten bolt Ⓒ to 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb).
(3) Tighten bolt Ⓐ to 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb).
(4) Tighten bolt Ⓑ to 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb).



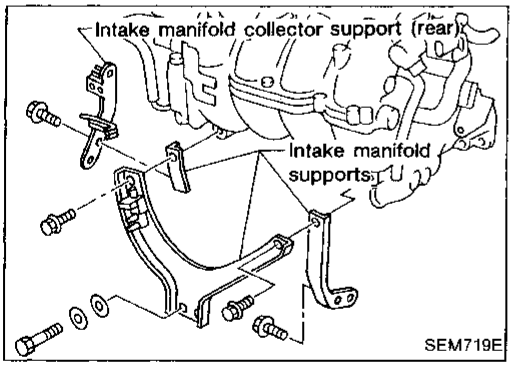
6. Install exhaust manifold.
7. Install exhaust manifold cover.



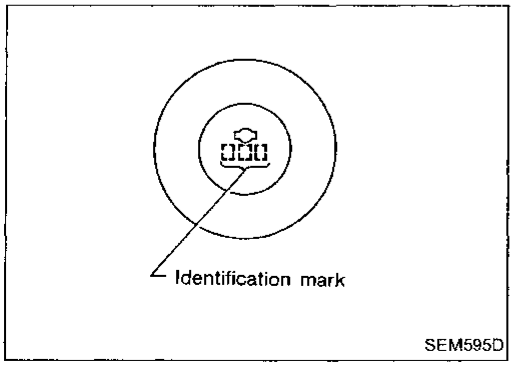
8. Install water outlet.

(1) 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.

(2) Apply a continuous bead of liquid gasket to mating surface of water outlet.
- **Use Genuine Liquid Gasket or equivalent.**



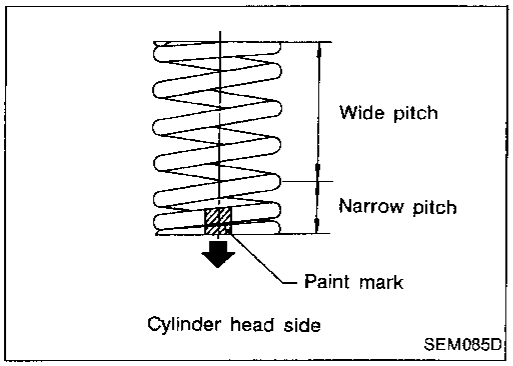
9. Install intake manifold supports and intake manifold collector supports.
10. Install EGR tube.
11. Install crankcase ventilation oil separator.



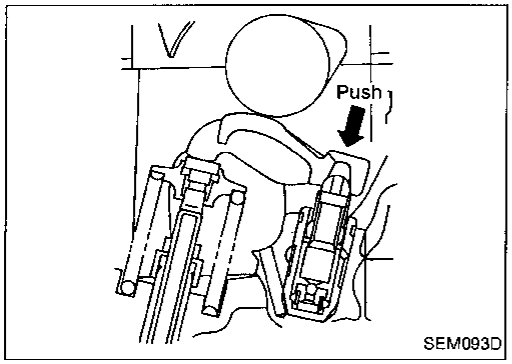
12. Install valve component parts.
- **Install valves, noting their identification marks as indicated in the table below.**

	Identification mark
Intake valve	53J
Exhaust valve	64Y

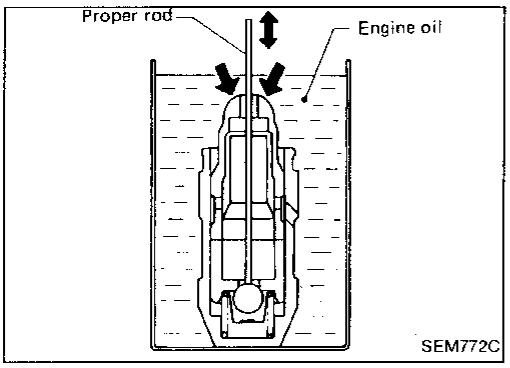
Assembly (Cont'd)



- **Always use new valve oil seal.**
  Refer to OIL SEAL REPLACEMENT.
- **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, use plastic hammer to lightly tap valve stem tip to assure a proper fit.**

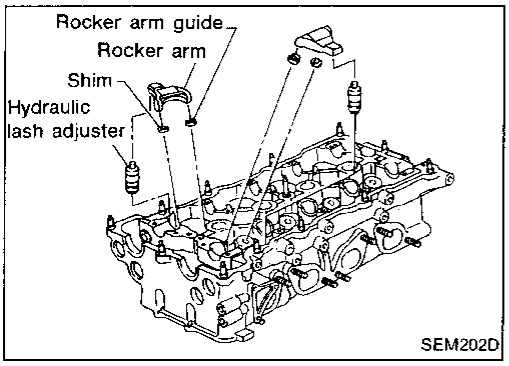


13. Check hydraulic lash adjusters.
(1) When rocker arm can be moved at least 1 mm (0.04 in) by pushing at hydraulic lash adjuster location, it indicates that there is air in the high pressure chamber.
Noise will be emitted from hydraulic lash adjuster if engine is started without bleeding air.



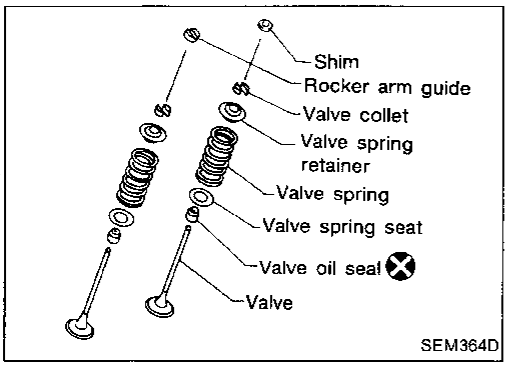
(2) Remove hydraulic lash adjuster and dip in a container filled with engine oil. While pushing plunger as shown in figure, lightly push check ball using a thin rod. Air is completely bled when plunger no longer moves.

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



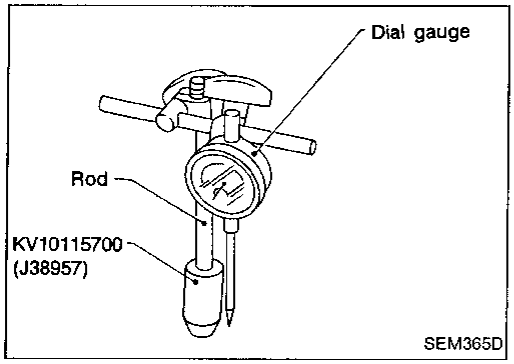
14. Install rocker arms, shims, rocker arm guides and hydraulic lash adjusters.

CAUTION:
Install all parts in their original positions.

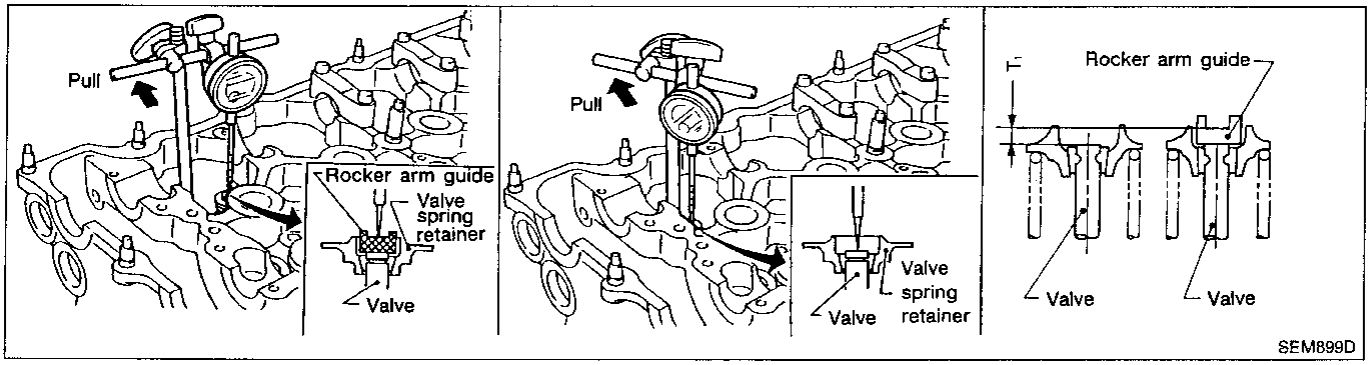


15. Select a suitable shim when replacing valve, cylinder head, shim, rocker arm guide and/or valve seat with new one(s), as follows:
1) Install valve component parts to cylinder head (Except shim).
- Always replace rocker arm guide with a new one.

Assembly (Cont'd)

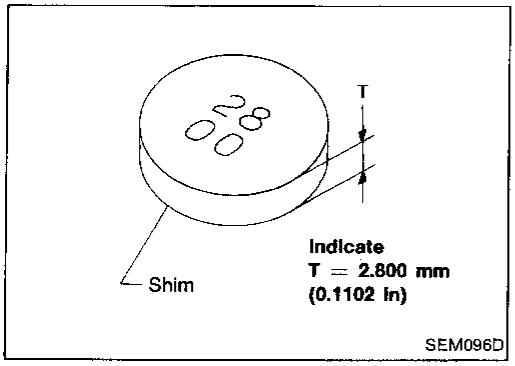


2) Remove hydraulic lash adjuster.
3) Install Tool* into hydraulic lash adjuster fixing hole.
   * Tool [KV10115700 (J38957)] is screwed into magnetic stand rod used with dial gauge.



4) Measure difference in level (T_1) between sliding surface of rocker arm guide against rocker arm and valve stem end on shim side with valve, valve spring, collet, retainer and rocker arm guide installed to the head (Except shim),

When measuring, lightly pull dial indicator rod toward you to eliminate play in Tool [KV10115700 (J38957)].

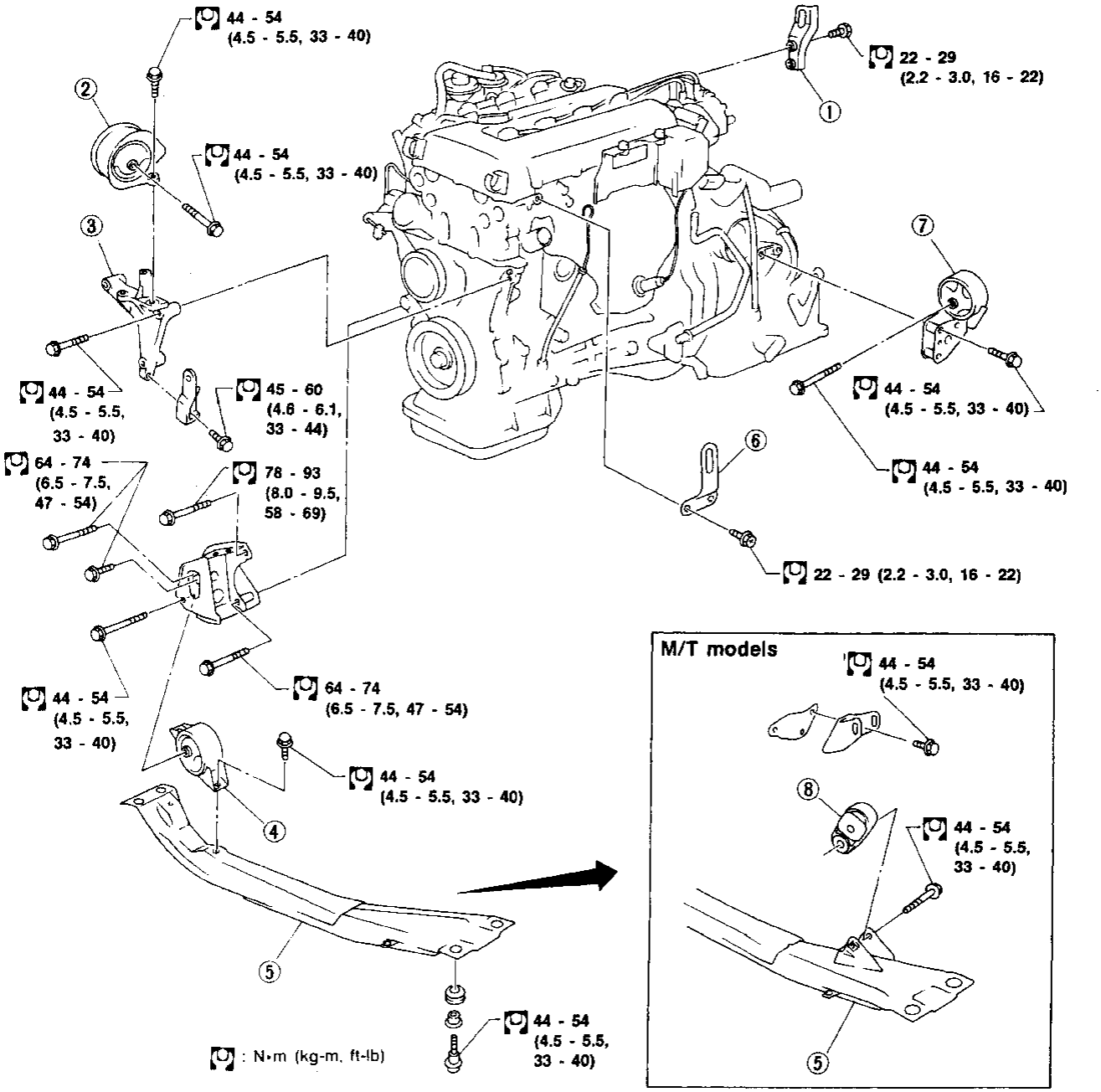


5) Select a shim having a thickness (T) that makes –0.025 mm (–0.0010 in) $\leqq$ [(T) – (T_1)] $\leqq$ 0.025 mm (0.0010 in).

- Shims are available in 17 different thicknesses ranging from 2.800 mm (0.1102 in) to 3.200 mm (0.1260 in) in increments of 0.025 mm (0.0010 in).

Installation

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



SEM596D

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

WARNING:

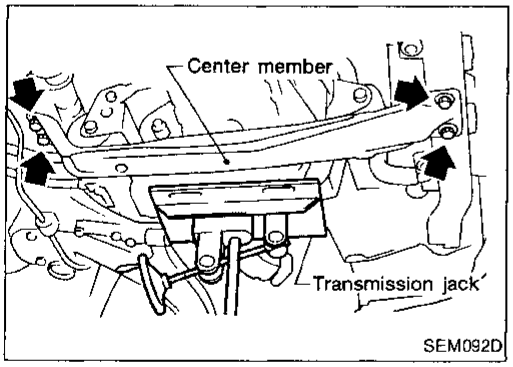
a. Situate vehicle on a flat and solid surface.
b. Place chocks at front and back of rear wheels.
c. Do not remove engine until exhaust system has completely cooled off.
Otherwise, you may burn yourself and/or fire may break out in fuel line.
d. For safety during subsequent steps, the tension of wires should be slackened against the engine.
e. Before disconnecting fuel hose, release fuel pressure from fuel line.
Refer to "Releasing Fuel Pressure" in EF & EC section.
f. Be sure to hoist engine and transaxle in a safe manner.
g. For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

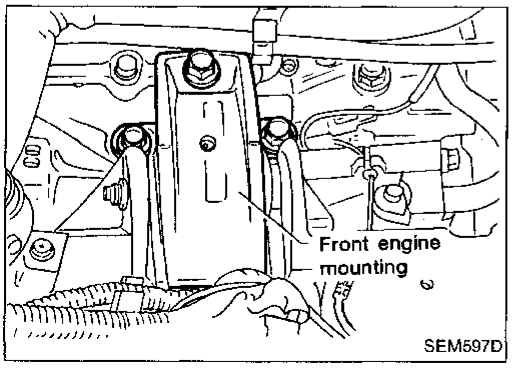
- **When lifting engine, be careful not to strike adjacent parts, especially accelerator wire casing, brake lines, and brake master cylinder.**
- **In hoisting the engine, always use engine slingers in a safe manner.**

Removal

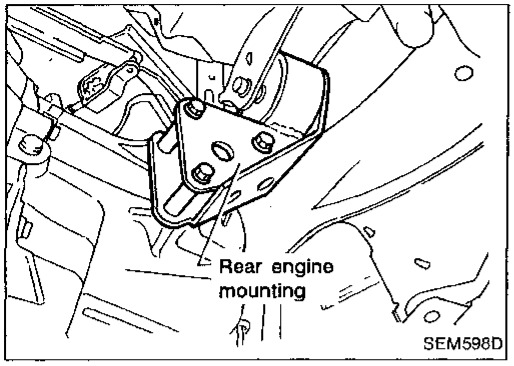
1. Remove engine under cover and hood.
2. Drain coolant from both cylinder block, and radiator.
3. Drain engine oil from drain plug of oil pan.
4. Remove vacuum hoses, fuel hoses, wires, harness and connectors and so on.
5. Remove exhaust tubes, ball joints and drive shafts.
6. Remove radiator and fans.
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.



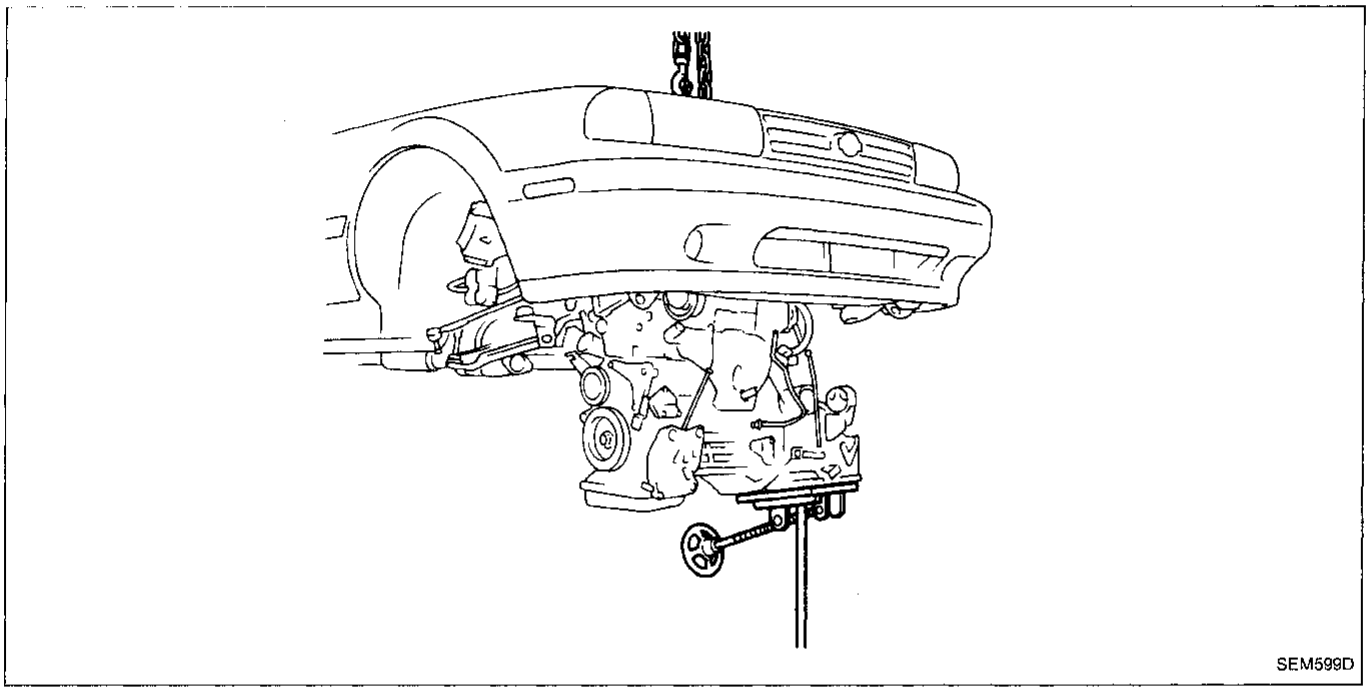
11. Remove engine mounting bolts from both sides and then slowly lower transmission jack.

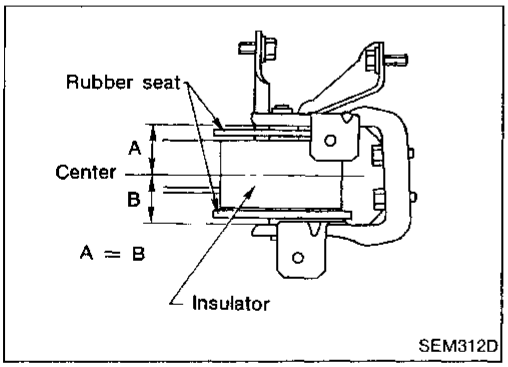


Removal (Cont'd)



12. Remove engine with transaxle as shown.



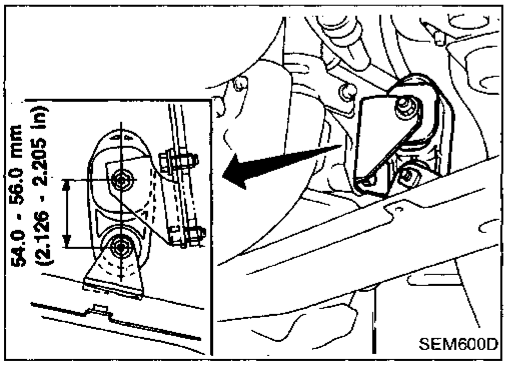


Installation

1. Install engine mounting bracket and fixing bolts.

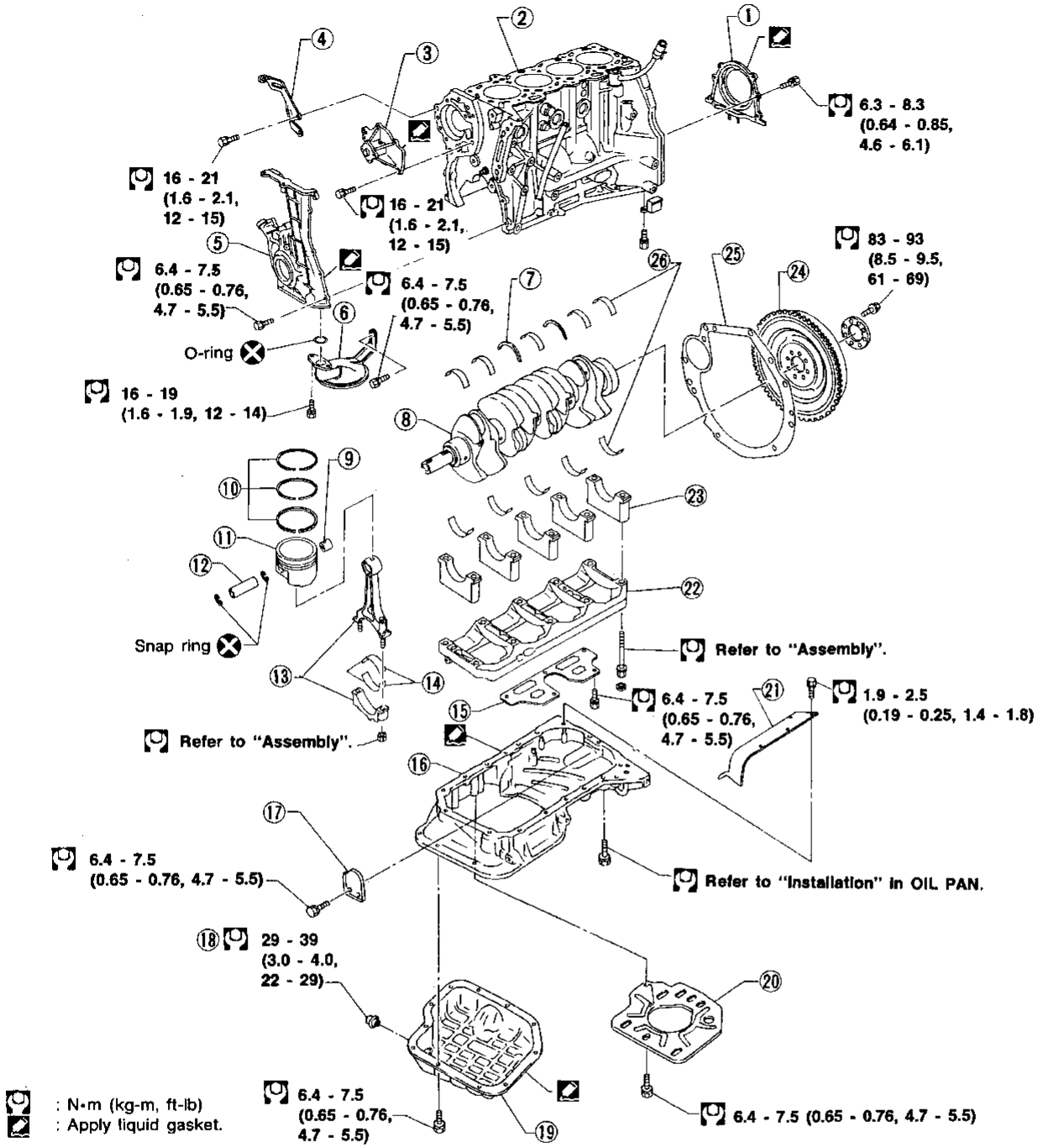
Be sure that insulators are correctly positioned on the brackets.

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.

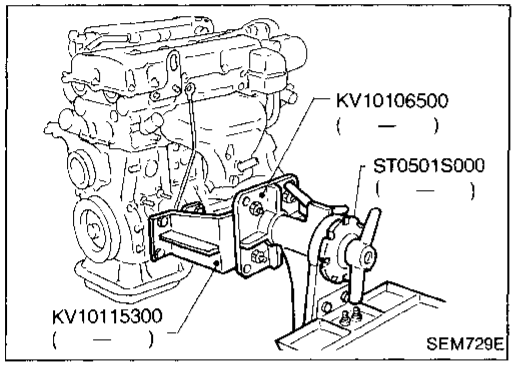


SEM501E

① Rear oil seal retainer
② Cylinder block
③ Water pump
④ Power steering oil pump adjusting bar
⑤ Front cover with oil pump
⑥ Oil strainer
⑦ Thrust bearing
⑧ Crankshaft
⑨ Connecting rod bushing
⑩ Piston rings
⑪ Piston
⑫ Piston pin
⑬ Connecting rod
⑭ Connecting rod bearing
⑮ Baffle plate
⑯ Aluminum oil pan
⑰ Rear cover plate
⑱ Drain plug
⑲ Steel oil pan
⑳ Baffle plate
㉑ Side gallery baffle plate
㉒ Main bearing beam
㉓ Main bearing cap
㉔ Flywheel or drive plate
㉕ Rear plate
㉖ Main bearing

CAUTION:

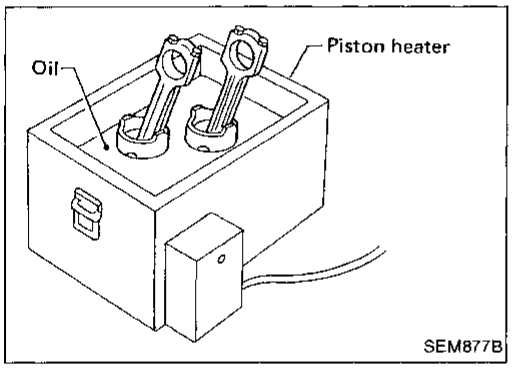
- **When installing sliding parts such as bearings and pistons, be sure to apply new engine oil on the sliding surfaces.**
- **Place removed parts such as bearings and bearing caps in their proper order and direction.**
- **When tightening connecting rod bolts and main bearing cap bolts, apply engine oil to thread portion of bolts and seating surface of nuts.**



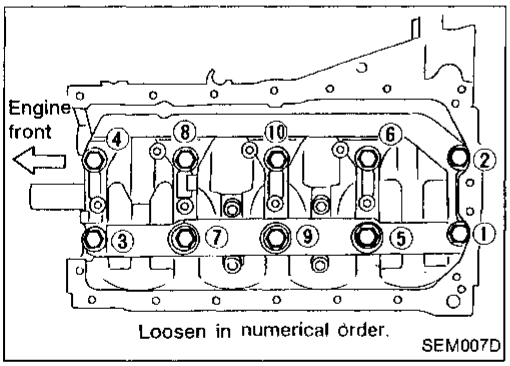
Disassembly

PISTON AND CRANKSHAFT

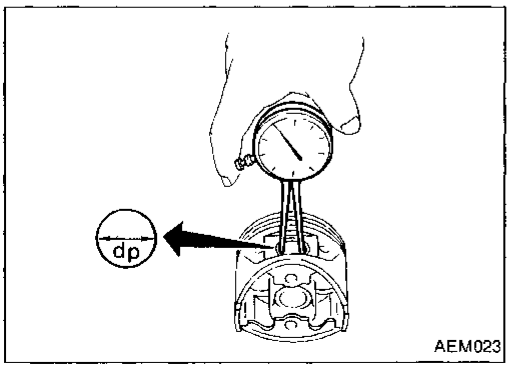
1. Place engine on a work stand.
2. Remove cylinder head.
   Refer to "Removal" in "TIMING CHAIN".
3. Remove oil pan.
   Refer to "Removal" in "OIL PAN".
4. Remove timing chain.
   Refer to "Removal" in "TIMING CHAIN".



5. Remove pistons with connecting rods.
   - When disassembling piston and connecting rod, remove snap ring first, then heat piston to 60 to 70°C (140 to 158°F) or use piston pin press stand at room temperature.
6. Remove rear oil seal retainer.



7. Remove bearing beam, bearing cap and crankshaft.
   - **Before removing bearing cap, measure crankshaft end play.**
   - **Bolts should be loosened in two or three steps.**

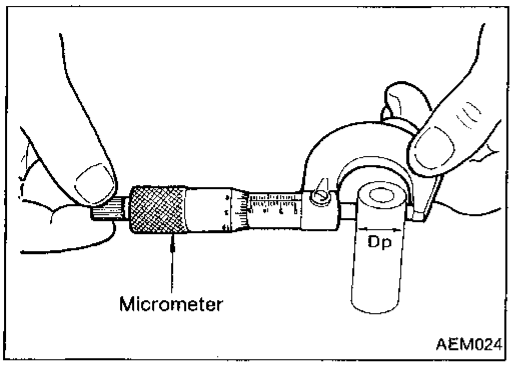


Inspection

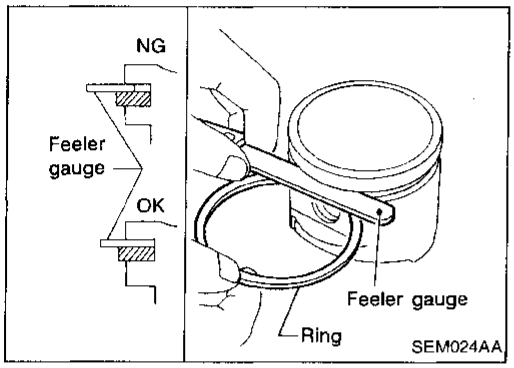
PISTON AND PISTON PIN CLEARANCE

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

Inspection (Cont'd)



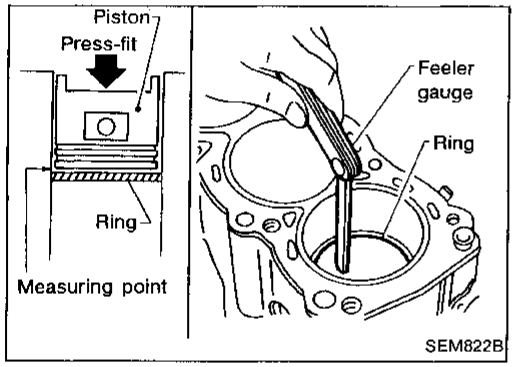
2. Measure outer diameter of piston pin "Dp".
   Standard diameter "Dp":
   21.989 - 22.001 mm (0.8657 - 0.8662 in)
3. Calculate piston pin clearance.
   dp – Dp = –0.004 to 0 mm (–0.0002 to 0 in)
   If it exceeds the above value, replace piston assembly with pin.



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.



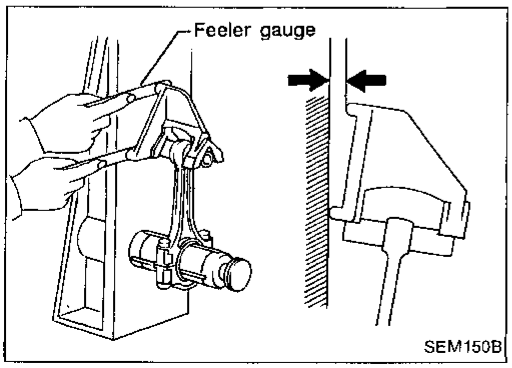
PISTON RING END GAP

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, rebore cylinder and use oversized piston and piston rings.

Refer to SDS.

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

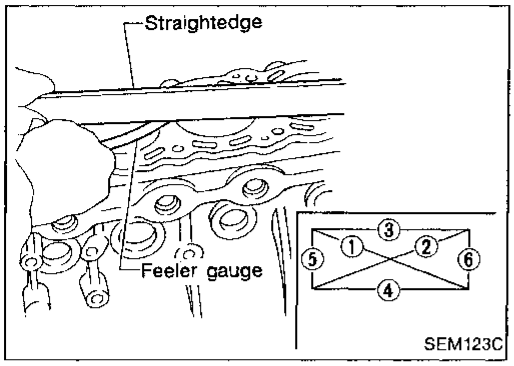


CONNECTING ROD BEND AND TORSION

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

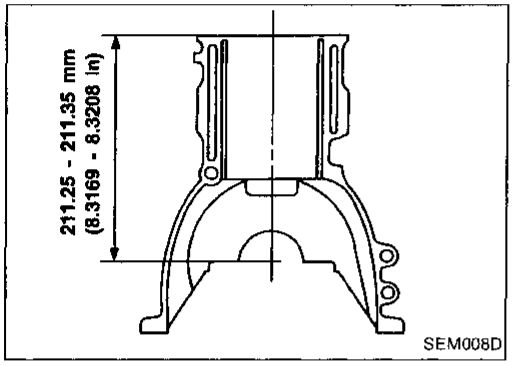
If it exceeds the limit, replace connecting rod assembly.

Inspection (Cont'd)



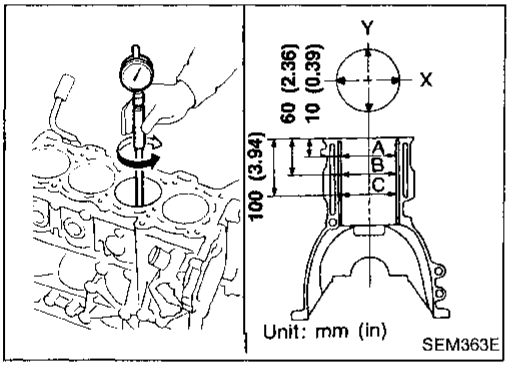
CYLINDER BLOCK DISTORTION AND WEAR

1. Clean upper face of cylinder block and measure the distortion.
   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.



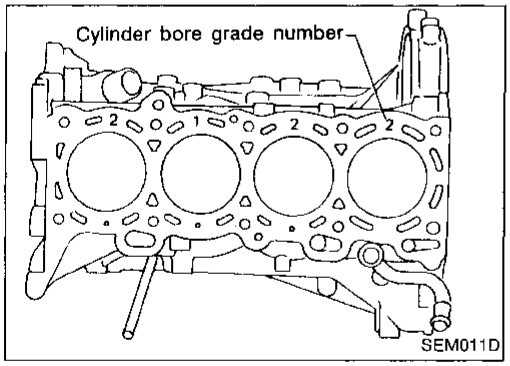
Amount of cylinder head resurfacing is "A".
Amount of cylinder block resurfacing is "B".
The maximum limit is as follows:
A + B = 0.2 mm (0.008 in)
Nominal cylinder block height from crankshaft center:
211.25 - 211.35 mm (8.3169 - 8.3208 in)

3. If necessary, replace cylinder block.

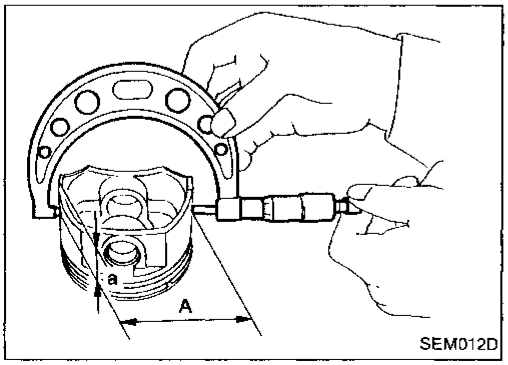


PISTON-TO-BORE CLEARANCE

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)
   Out-of-round (X – Y) standard: 0.015 mm (0.0006 in)
   Taper (A – B and A – C) standard: 0.010 mm (0.0004 in)
   If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.
2. Check for scratches and seizure. If seizure is found, hone it.



- **If both cylinder block and piston are replaced with new ones, select piston of the same grade number punched on cylinder block upper surface.**



3. Measure piston skirt diameter.
   Piston diameter "A": Refer to SDS.
   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.

Inspection (Cont'd)

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

Rebored size calculation:

D = A + B – C

where,

D: Bored diameter

A: Piston diameter as measured

B: Piston-to-bore clearance

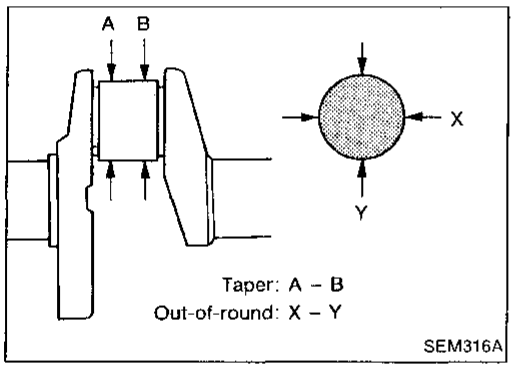
C: Honing allowance 0.02 mm (0.0008 in)

7. Install main bearing caps, and tighten to the specified torque to prevent distortion of cylinder bores 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

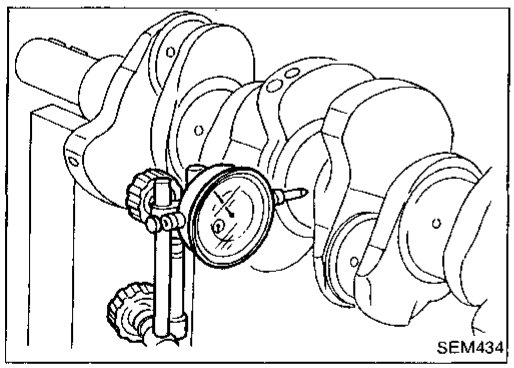
1. Check crankshaft main and pin journals for score, wear or cracks.
2. With a micrometer, measure journals for taper and out-of-round.

Out-of-round (X – Y):

Less than 0.005 mm (0.0002 in)

Taper (A – B):

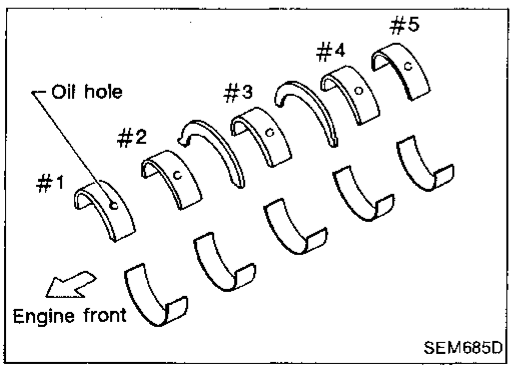
Less than 0.005 mm (0.0002 in)



3. Measure crankshaft runout.

Runout (Total indicator reading):

Less than 0.05 mm (0.0020 in)



BEARING CLEARANCE

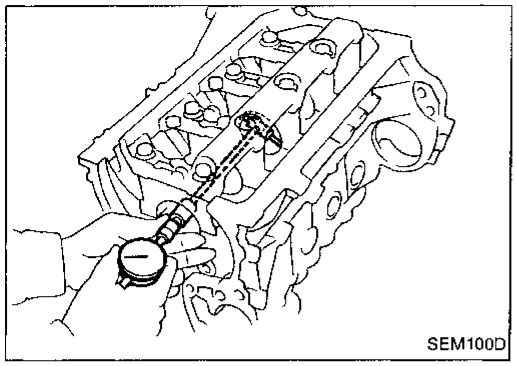
- Either of the following two methods may be used, however, method "A" gives more reliable results and is preferable.

Method A (Using bore gauge & micrometer)

Main bearing

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

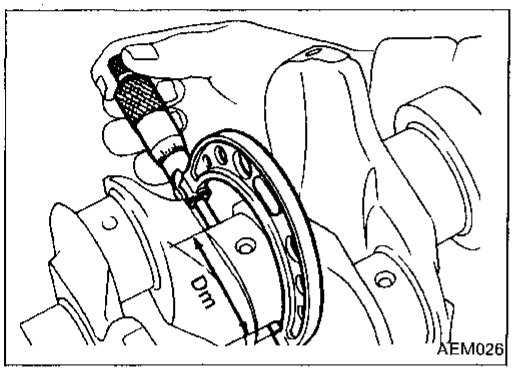
Inspection (Cont'd)


SEM100D

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

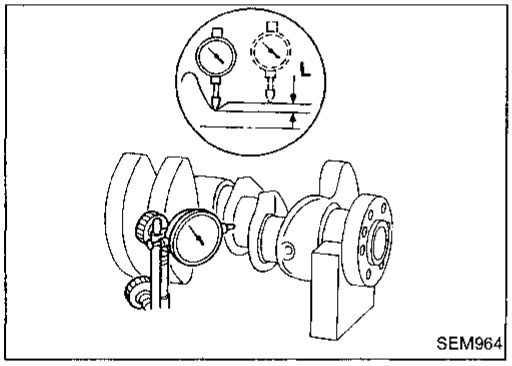
Tighten all bolts in correct order in two or three stages.

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



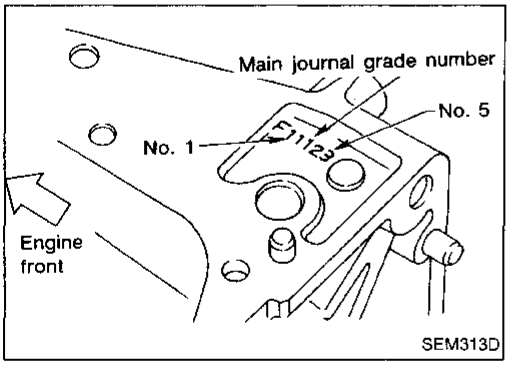
AEM026

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



SEM964

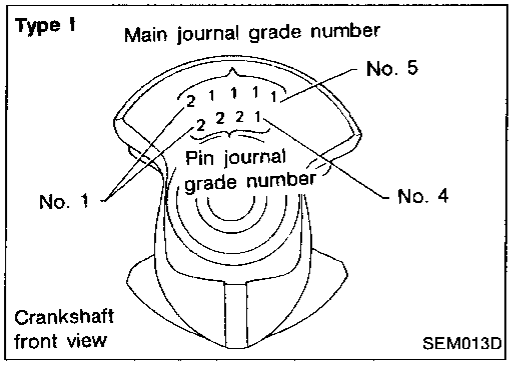
a. When grinding crankshaft journal, confirm that "L" dimension in fillet roll is more than the specified limit.
   "L": 0.1 mm (0.004 in)
b. Refer to SDS for grinding crankshaft and available service parts.

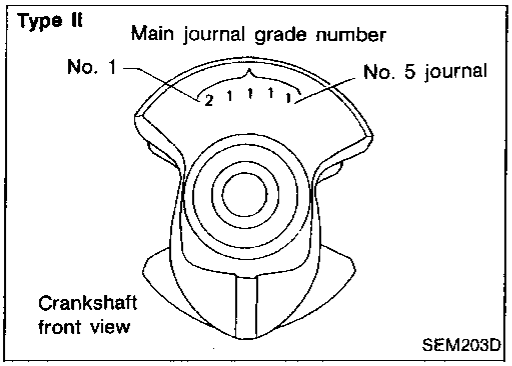


SEM313D

8. If crankshaft is reused, measure main bearing clearances and select thickness of main bearings.
   If crankshaft is replaced with a new one, it is necessary to select thickness of main bearings as follows:
a. Grade number of each cylinder block main journal is punched on the respective cylinder block. These numbers are punched in either Arabic or Roman numerals.

Inspection (Cont'd)



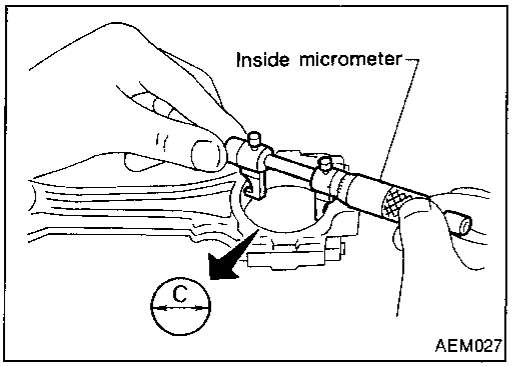


b. Grade number of each crankshaft main journal is punched on the respective crankshaft. These numbers are punched in either Arabic or Roman numerals.
c. Select main bearing with suitable thickness according to the following table.

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)

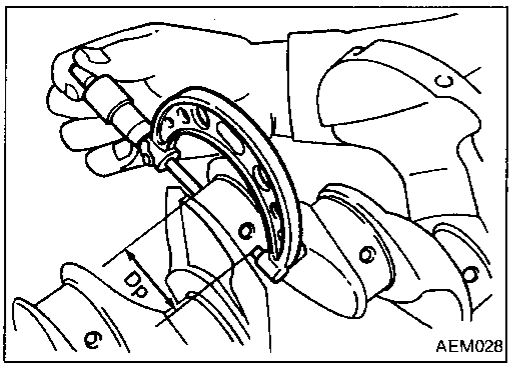


Connecting rod bearing (Big end)

1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.

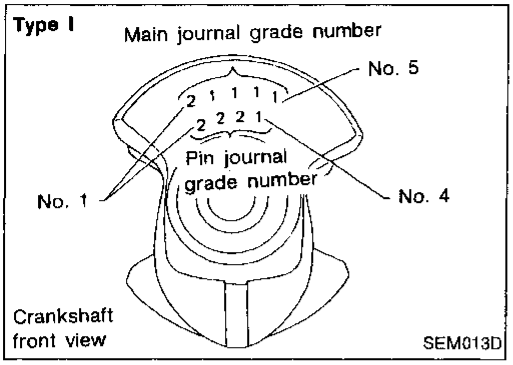
Tighten bolts to the specified torque.

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 7 of "BEARING CLEARANCE — Main bearing".

Inspection (Cont'd)

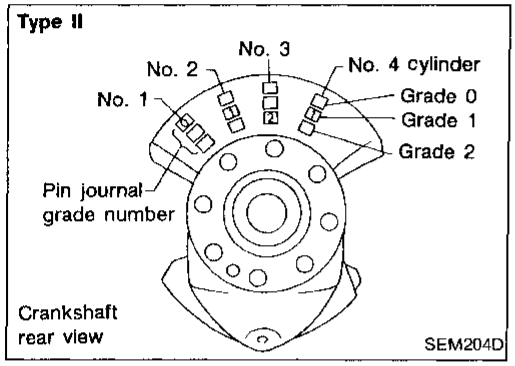


8. If crankshaft is replaced with a new one, select connecting rod bearing according to the following table.

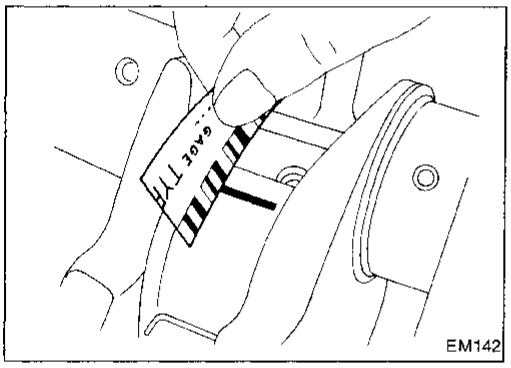
Connecting rod bearing grade number:

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



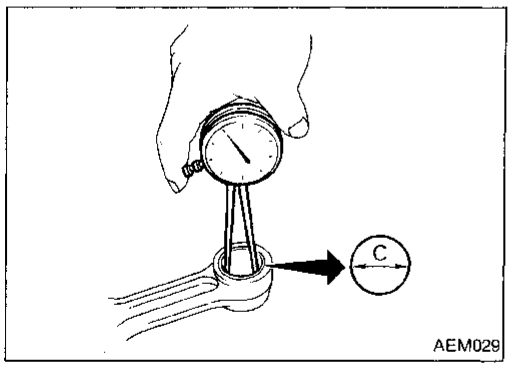
Method B (Using plastigage)

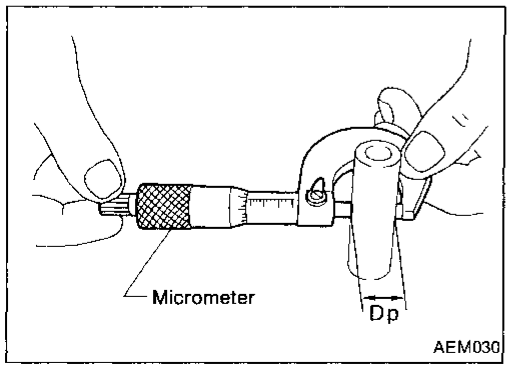
CAUTION:

- **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. Then if excessive bearing clearance exists, use a thicker main bearing or undersized bearing so that the specified bearing clearance is obtained.**

CONNECTING ROD BUSHING CLEARANCE (Small end)

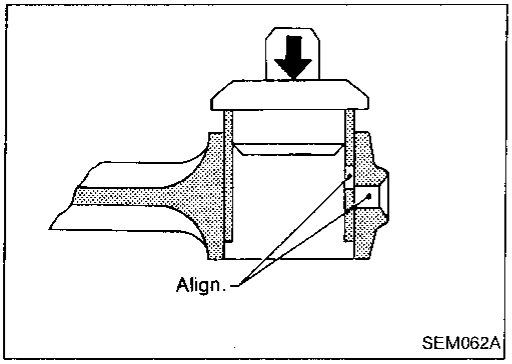
1. Measure inner diameter "C" of bushing.





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

Inspection (Cont'd)



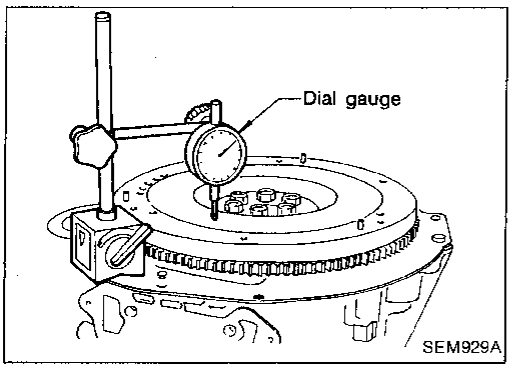
REPLACEMENT OF CONNECTING ROD BUSHING (Small end)

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

Be sure to align the oil holes.

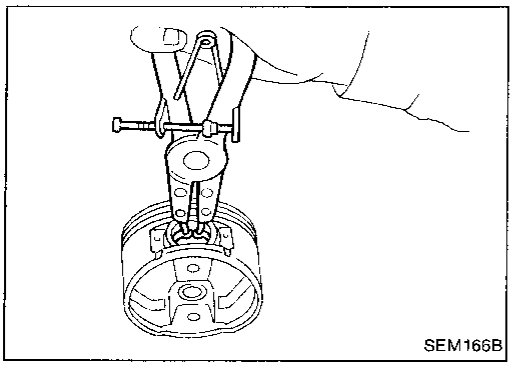
2. After driving in small end bushing, ream the bushing so that clearance between connecting rod bushing and piston pin is the specified value.

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



FLYWHEEL/DRIVE PLATE RUNOUT

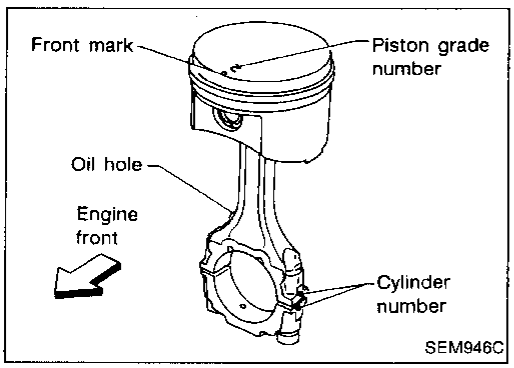
Runout (Total indicator reading):
Flywheel (M/T model)
Less than 0.10 mm (0.0039 in)
Drive plate (A/T model)
Less than 0.20 mm (0.0079 in)



Assembly

PISTON

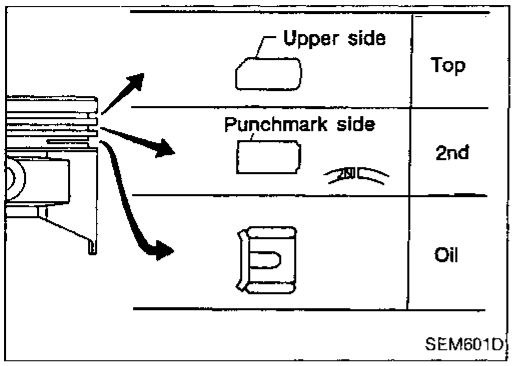
1. Install new snap ring on one side of piston pin hole.



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.**

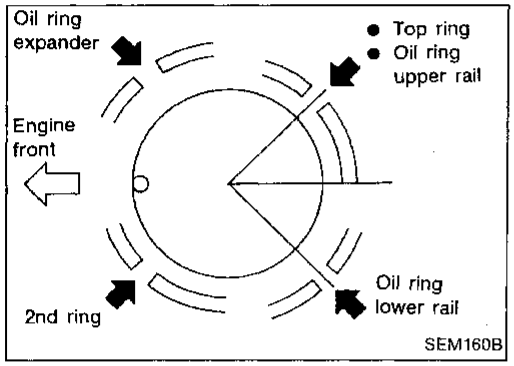
Assembly (Cont'd)



3. Set piston rings as shown.

CAUTION:

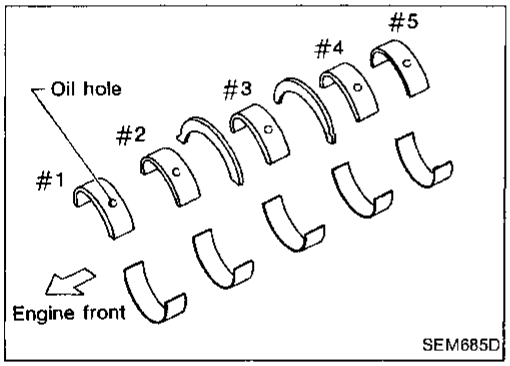
- **When piston rings are not replaced, make sure that piston rings are mounted in their original positions.**
- **When piston rings are being replaced and no punchmark is present, piston rings can be mounted with either side up.**



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.**

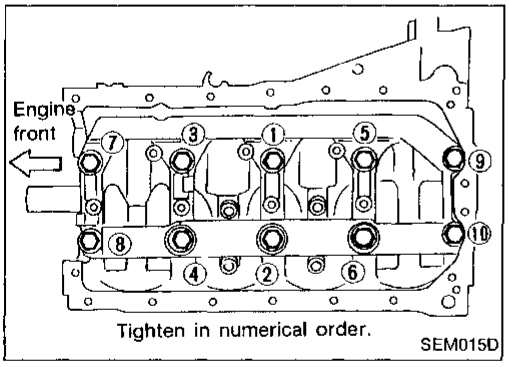


2. Install crankshaft, main bearing caps and beam and tighten bolts to the specified torque.

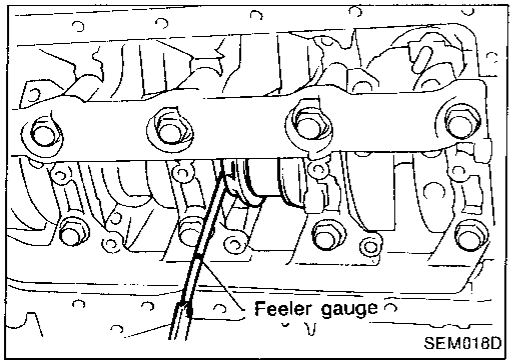
- **Prior to tightening bearing cap bolts, place bearing cap in its proper position by shifting crankshaft in the axial direction.**
- **Tightening procedure**

1) **Tighten bolts to 32 to 38 N·m (3.3 to 3.9 kg-m, 24 to 28 ft-lb).**
2) **Turn bolts 45 to 50 degrees clockwise or 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).**

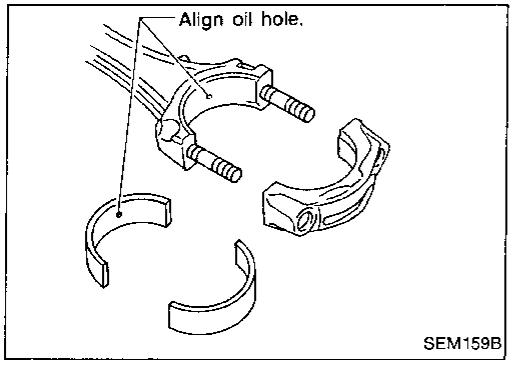
- **After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.**



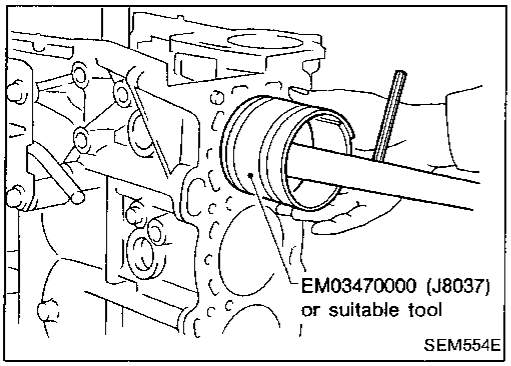
Assembly (Cont'd)



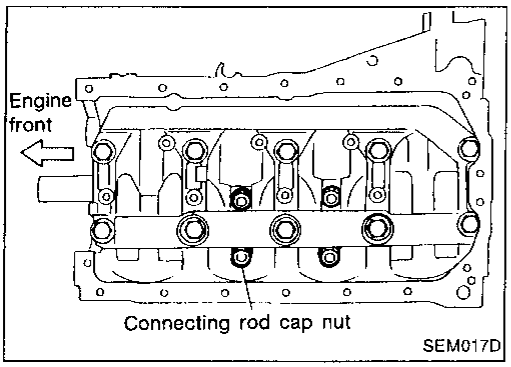
3. Measure crankshaft end play.
   Crankshaft end play:
   Standard
   0.10 - 0.26 mm (0.0039 - 0.0102 in)
   Limit
   0.30 mm (0.0118 in)
   If beyond the limit, replace thrust bearings with new ones.



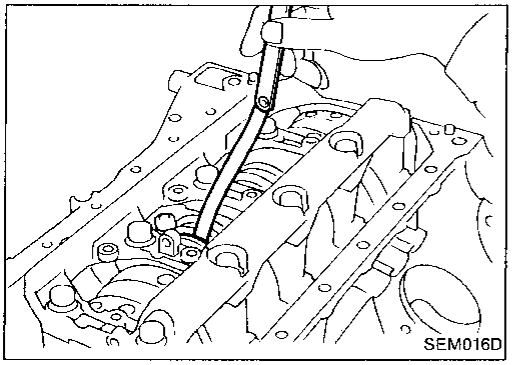
4. Install connecting rod bearings in connecting rods and connecting rod caps.
- **Confirm that correct bearings are used. Refer to "Inspection".**
- **Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.**



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.**

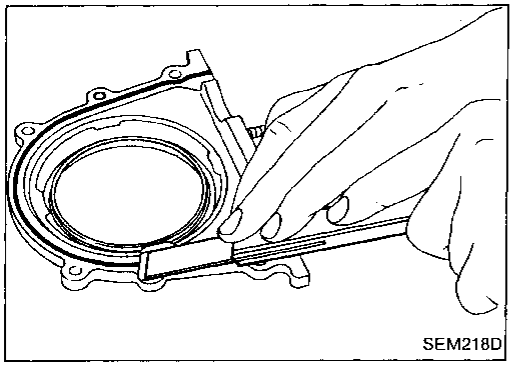


b. Install connecting rod caps.
Tighten connecting rod cap nuts to the specified torque.
   Tightening procedure:
   1) **Tighten nuts to 14 to 16 N·m (1.4 to 1.6 kg-m, 10 to 12 ft-lb).**
   2) **Turn nuts 60 to 65 degrees clockwise or if angle wrench is not available, tighten nuts to 38 to 44 N·m (3.9 to 4.5 kg-m, 28 to 33 ft-lb).**

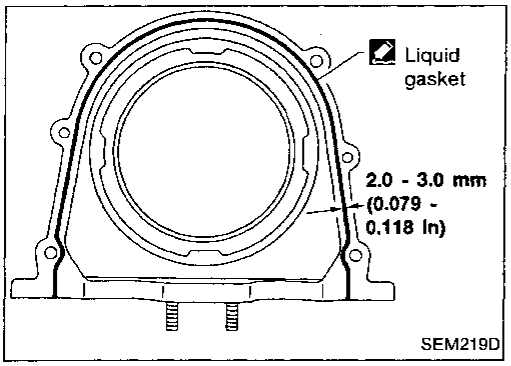


6. Measure connecting rod side clearance.
   Connecting rod side clearance:
   Standard
   0.20 - 0.35 mm (0.0079 - 0.0138 in)
   Limit
   0.50 mm (0.0197 in)
   If beyond the limit, replace connecting rod and/or crankshaft.

Assembly (Cont'd)


SEM218D

7. Install rear oil seal retainer.
(1) Before installing rear oil seal retainer, remove all traces of liquid gasket from mating surface using a scraper.
- Also remove traces of liquid gasket from mating surface of cylinder block.



SEM219D

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

General Specifications

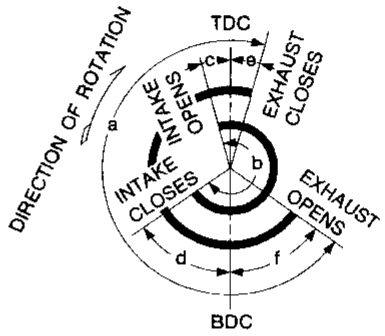
Cylinder arrangement		In-line 4
Displacement	cm^3 (cu in)	1,998 (121.92)
Bore and stroke	mm (in)	86 x 86 (3.39 x 3.39)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings		
Compression		2
Oil		1
Number of main bearings		5
Compression ratio		9.5

COMPRESSION PRESSURE

Unit: kPa (kg/cm^2, 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

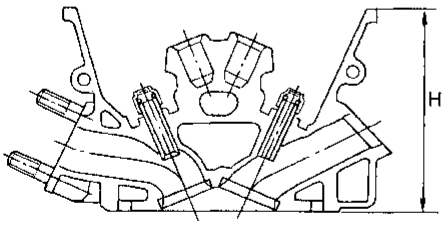
a	b	c	d	e	f
240°	240°	13°	47°	3°	57°

Inspection and Adjustment

CYLINDER HEAD

Unit: mm (in)

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



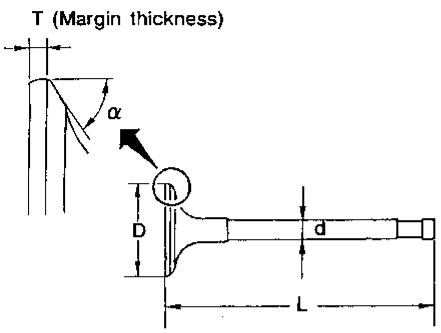
Nominal cylinder head height :
H = 136.9 - 137.1 (5.390 - 5.398)

SEM956C

Inspection and Adjustment (Cont'd)

VALVE

Unit: mm (in)



SEM188

Valve head diameter "D"	
Intake	34.0 - 34.2 (1.339 - 1.346)
Exhaust	30.0 - 30.2 (1.181 - 1.189)
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)	Less than 2.2 (0.087)

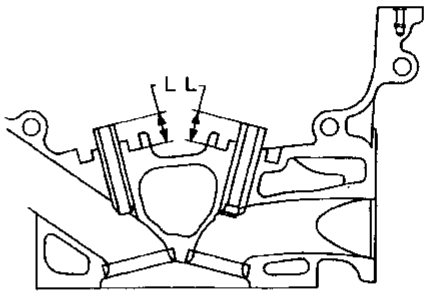
Hydraulic lash adjuster (HLA)

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)



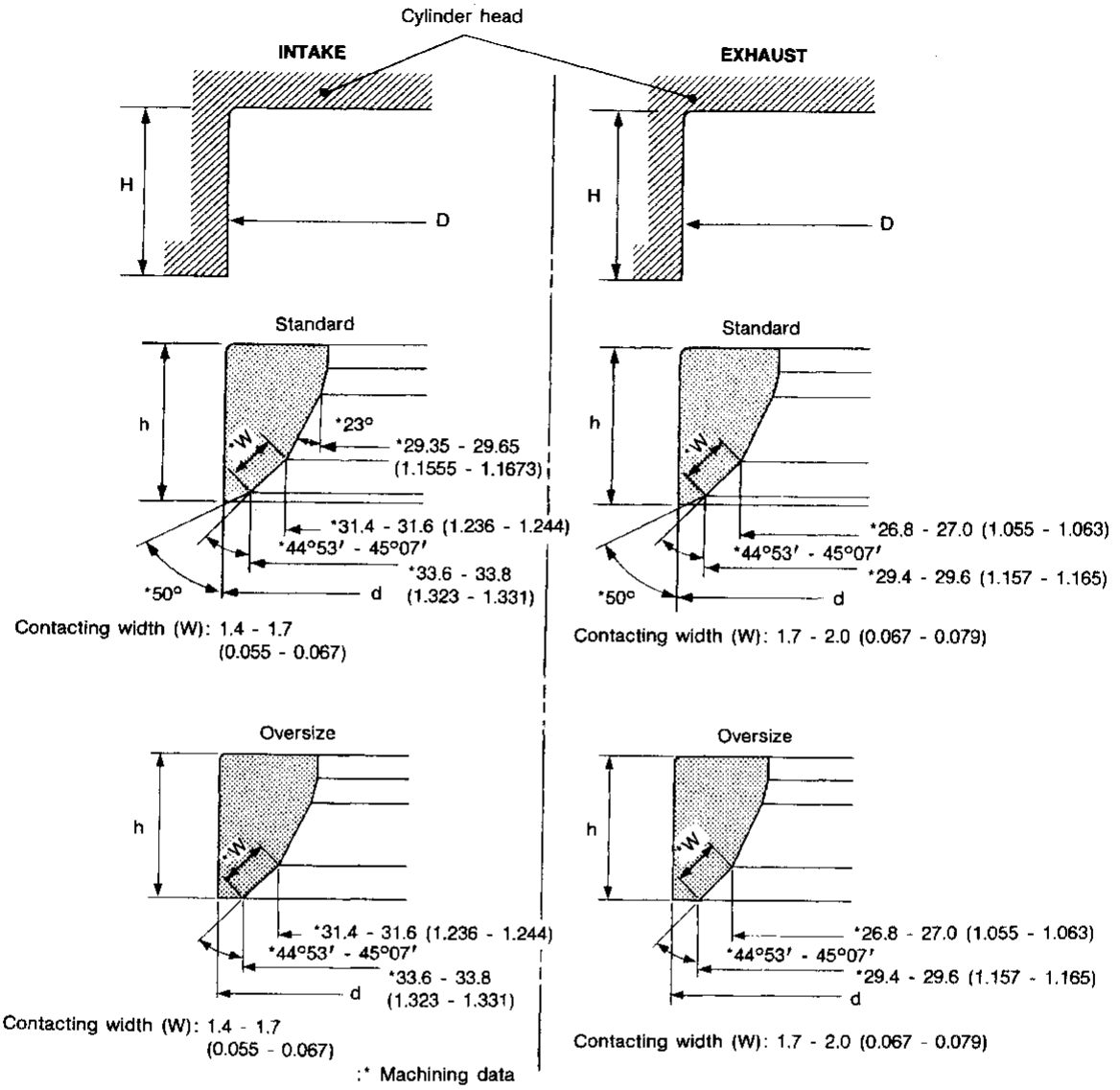
SEM083D

		Standard	Service
Valve guide Outer diameter	Intake	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Exhaust	10.023 - 10.034 (0.3946 - 0.3950)	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)	

Inspection and Adjustment (Cont'd)

Valve seat

Unit: mm (in)



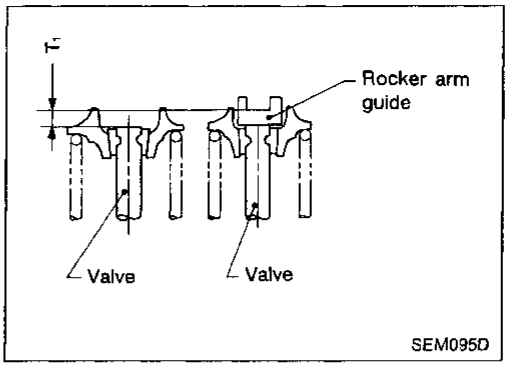
		Standard	Service
Cylinder head seat recess diameter (D)	In.	35.000 - 35.016 (1.3780 - 1.3786)	35.500 - 35.516 (1.3976 - 1.3983)
	Ex.	31.000 - 31.016 (1.2205 - 1.2211)	31.500 - 31.516 (1.2402 - 1.2408)
Valve seat interference fit	In.	0.064 - 0.096 (0.0025 - 0.0038)	
	Ex.	0.064 - 0.096 (0.0025 - 0.0038)	
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)		6.2 - 6.3 (0.244 - 0.248)	5.4 - 5.5 (0.213 - 0.217)

Inspection and Adjustment (Cont'd)

Valve clearance adjustment

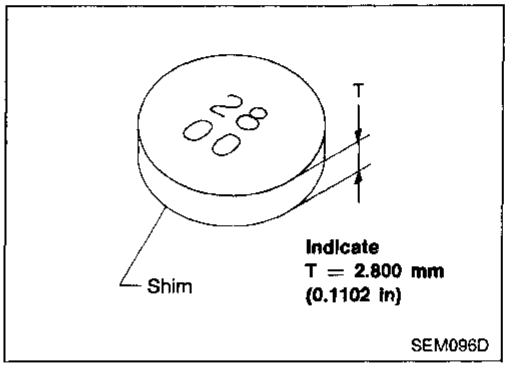
Unit: mm (in)

Valve clearance	
Intake	0 (0)
Exhaust	0 (0)
Valve clearance	
Adjustment valve limit [(T) – (T_1)]	–0.025 (–0.0010) ≦ [(T) – (T_1)] ≦ 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

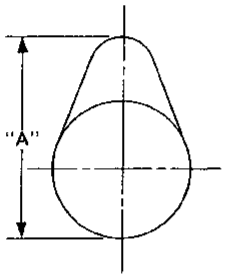


Inspection and Adjustment (Cont'd)

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)



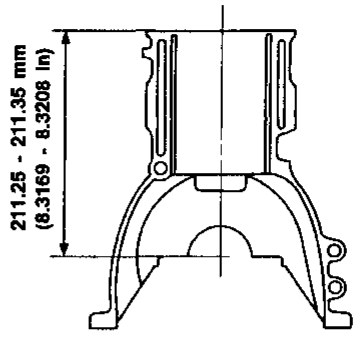
EM671

Cam height "A"	
Intake	38.408 - 38.598 (1.5121 - 1.5196)
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)

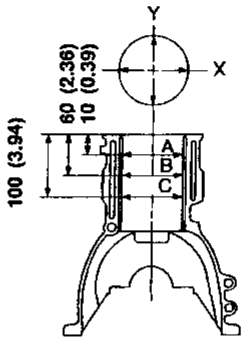
*Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



SEM964E



SEM686D

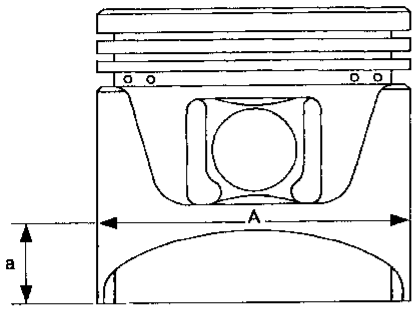
Surface flatness	
Standard	Less than 0.03 (0.0012)
Limit	0.10 (0.0039)
Cylinder bore	
Inner diameter	
Standard	
Grade No. 1	86.000 - 86.010 (3.3858 - 3.3862)
Grade No. 2	86.010 - 86.020 (3.3862 - 3.3866)
Grade No. 3	86.020 - 86.030 (3.3866 - 3.3870)
Wear limit	0.20 (0.0079)
Out-of-round (X – Y)	Less 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)

Inspection and Adjustment (Cont'd)

PISTON, PISTON RING AND PISTON PIN

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) oversize (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)

Piston ring

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 - 0.004 (0 - 0.0002)
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)

Inspection and Adjustment (Cont'd)

CONNECTING ROD

Unit: mm (in)

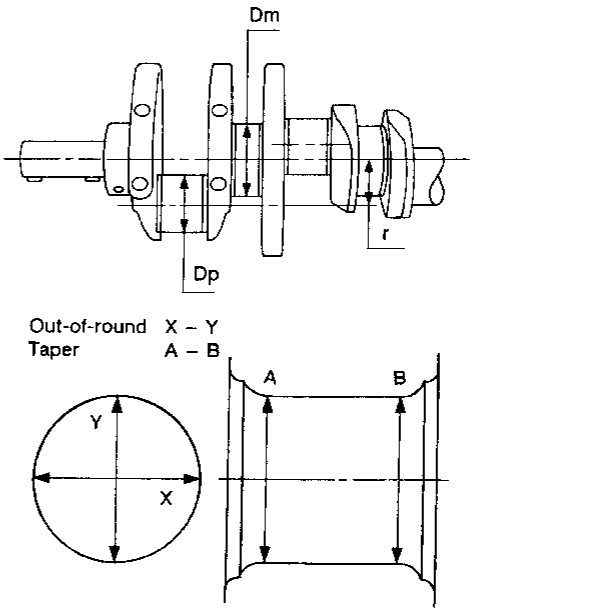
Center distance	136.30 (5.3661)
Bend, torsion [per 100 (3.94)]	
Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	
Limit	0.3 (0.012)
Connecting rod small end inner diameter	24.980 - 25.000 (0.9835 - 0.9843)
Piston pin bushing inner diameter*	22.000 - 22.012 (0.8661 - 0.8666)
Connecting rod big end inner diameter	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

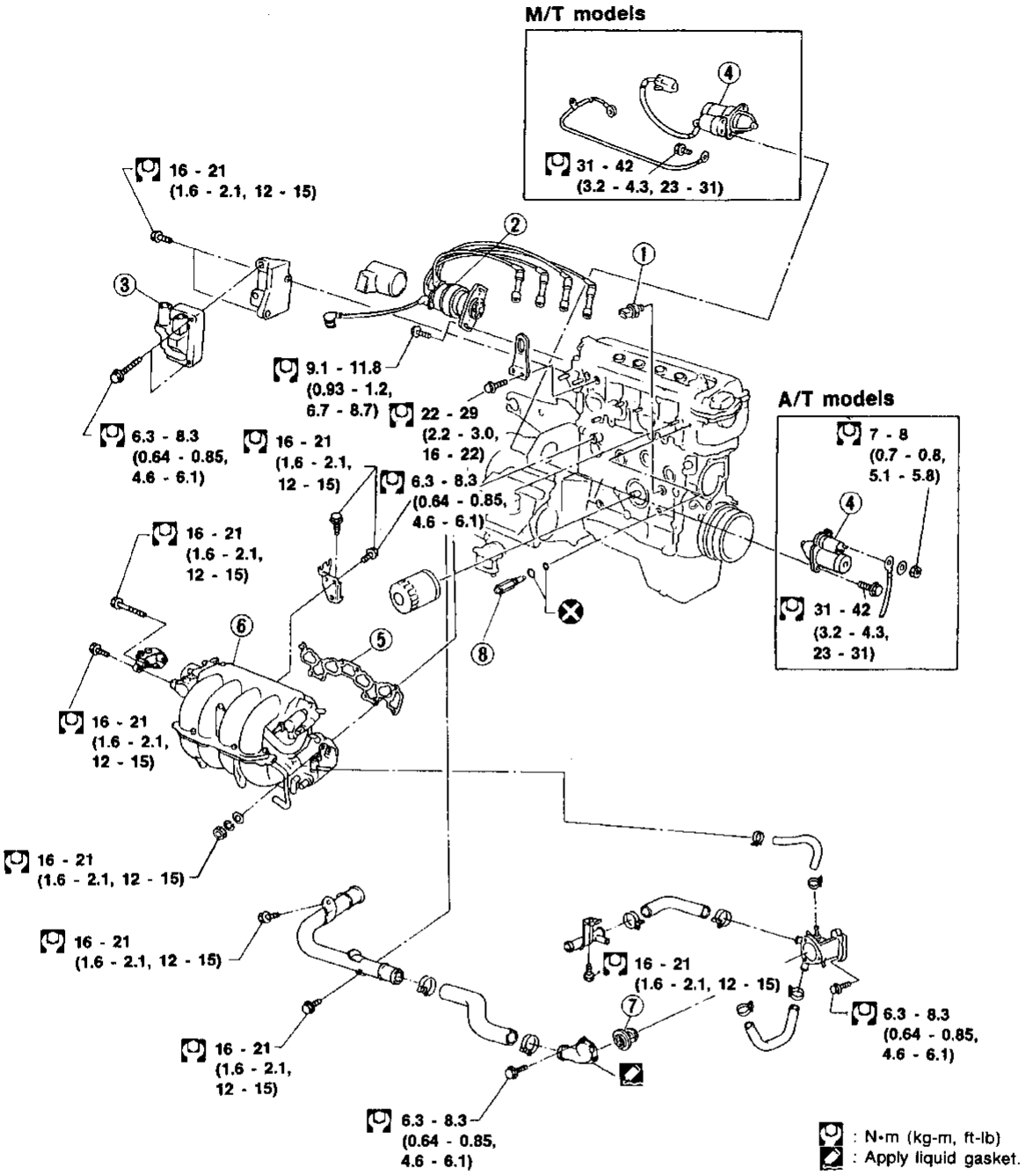
CRANKSHAFT

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	Less than 0.05 (0.0020)
Free end play	
Standard	0.10 - 0.26 (0.0039 - 0.0102)
Limit	0.30 (0.0118)

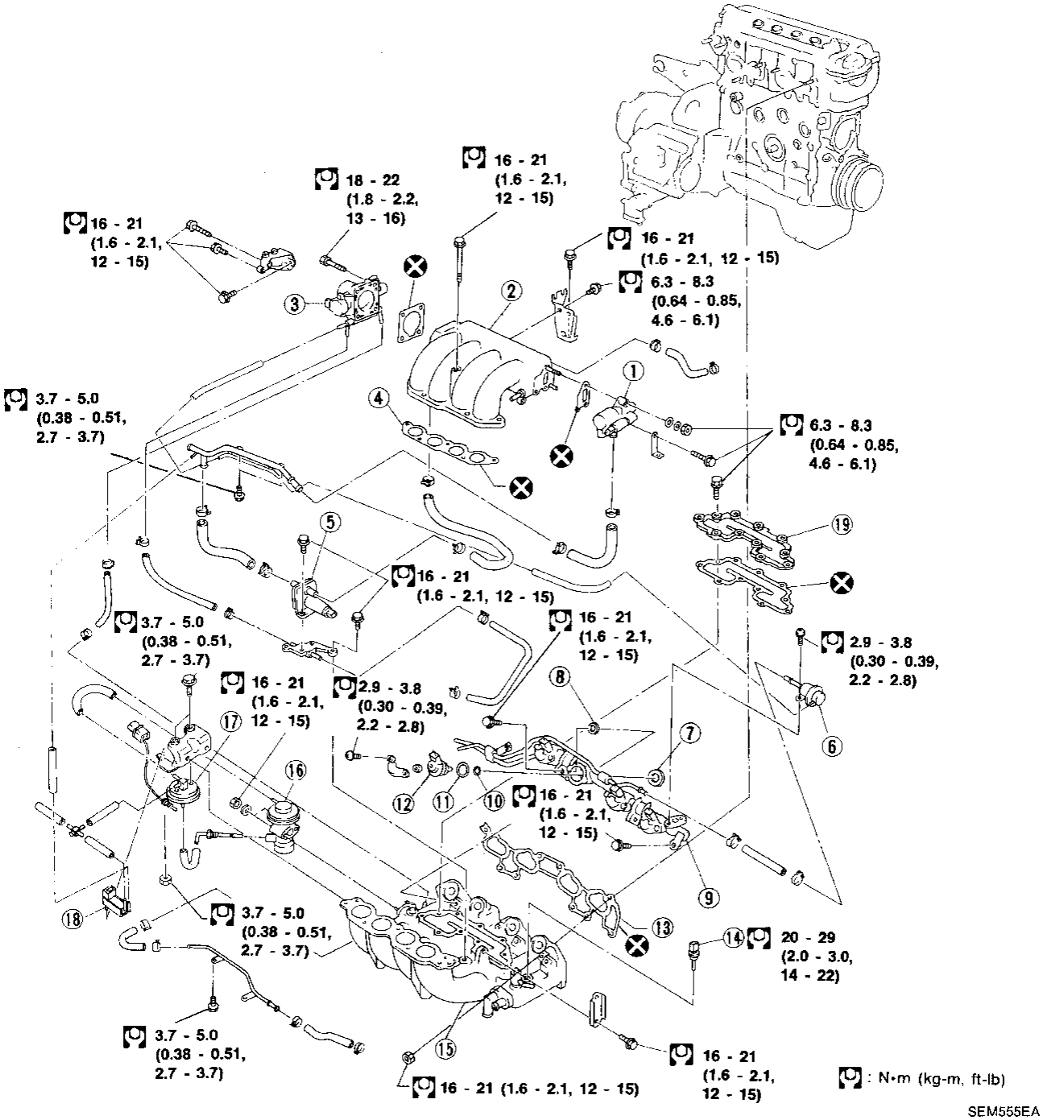


SEM954C

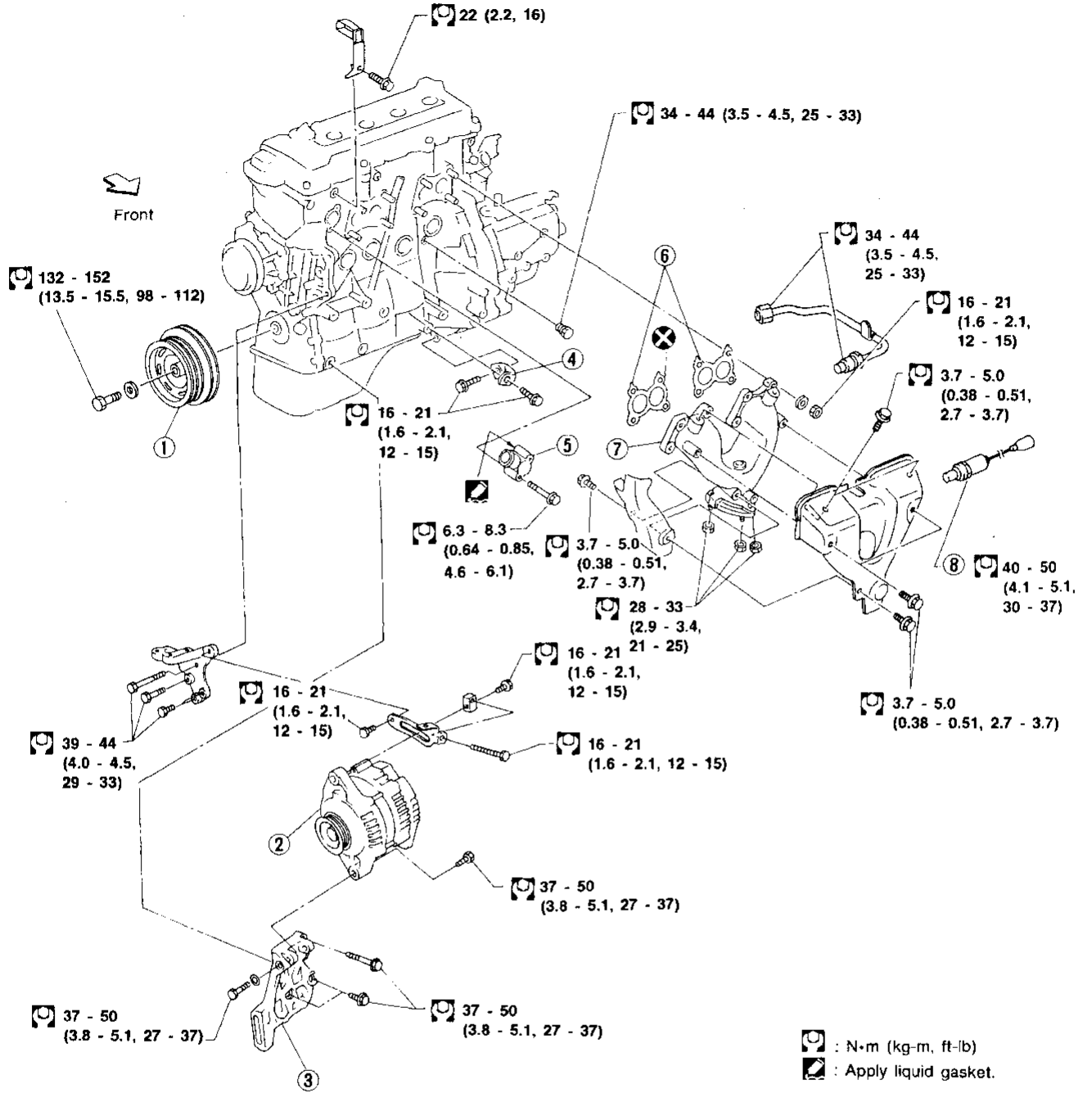


SEM541D

① Oil pressure switch
② Camshaft position sensor built into distributor
③ Ignition coil
④ Starter motor
⑤ Intake manifold gasket
⑥ Intake manifold assembly
⑦ Thermostat
⑧ VTC solenoid valve

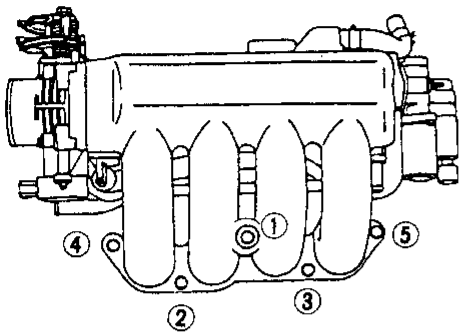


① Idle air adjusting unit
② Intake manifold collector
③ Throttle body
④ Collector gasket
⑤ IACV-air regulator
⑥ Fuel pressure regulator
⑦ Insulator
⑧ Insulator
⑨ Fuel gallery assembly
⑩ O-ring
⑪ O-ring
⑫ Fuel injector
⑬ Intake manifold gasket
⑭ Engine coolant temperature sensor
⑮ Intake manifold
⑯ EGR valve
⑰ EGRC-BPT valve
⑱ EGR & canister control solenoid valve
⑲ EGR passage



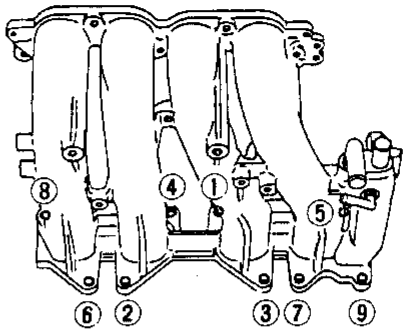
① Crankshaft pulley
② Alternator
③ Compressor bracket
④ Gusset
⑤ Water outlet
⑥ Exhaust manifold gasket
⑦ Exhaust manifold
⑧ Heated oxygen sensor (A/T models except for California) Oxygen sensor (A/T models for California and M/T models)

Intake manifold collector bolts tightening order



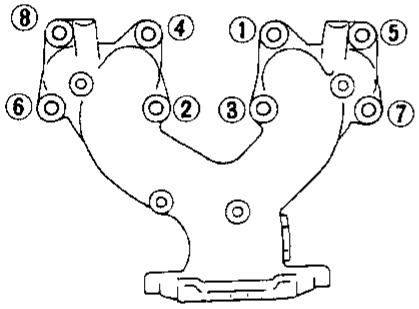
Tighten in numerical order.

Intake manifold bolts and nuts tightening order



Tighten in numerical order.

Exhaust manifold nuts tightening order

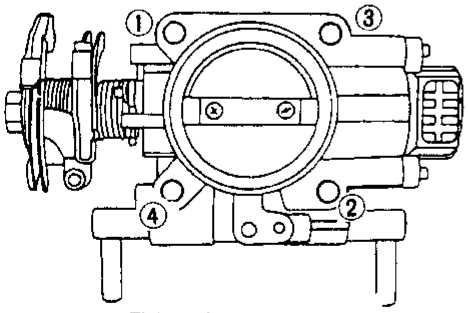


Tighten in numerical order.

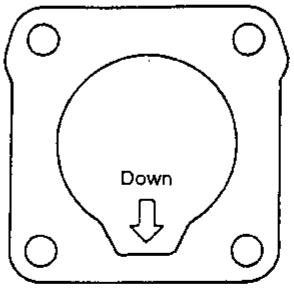
Throttle body bolts tightening procedure

1) **Tighten all bolts to 9 to 11 N·m (0.9 to 1.1 kg-m, 6.5 to 8.0 ft-lb).**
2) **Tighten all bolts to 18 to 22 N·m (1.8 to 2.2 kg-m, 13 to 16 ft-lb).**

- Make sure the direction of the gasket is as shown in figure.



Tighten in numerical order.

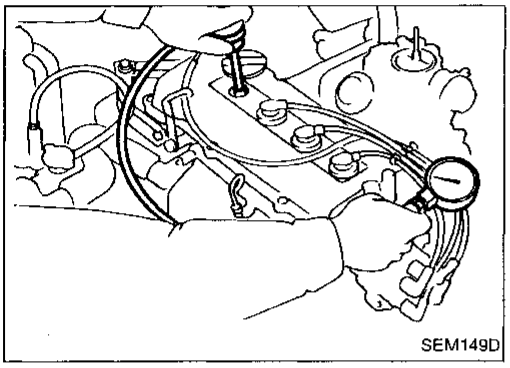


Gasket

SEM364EA

Measurement of Compression Pressure

1. Warm up engine.
2. Turn ignition switch off.
3. Release fuel pressure.
   Refer to "Releasing Fuel Pressure" in EF & EC section.
4. Remove all spark plugs.
5. Disconnect distributor center cable.



SEM149D

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/cm^2, psi)/rpm
Standard
1,324 (13.5, 192)/350
Minimum
1,128 (11.5, 164)/350
Difference limit between cylinders
98 (1.0, 14)/350

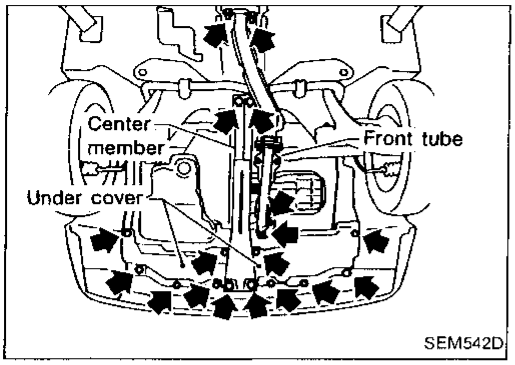
20 mm (0.79 in) dia.

Use compressor tester whose end (rubber portion) is less than 20 mm (0.79 in) dia. Otherwise, it may be caught by cylinder head during removal.

SEM387C

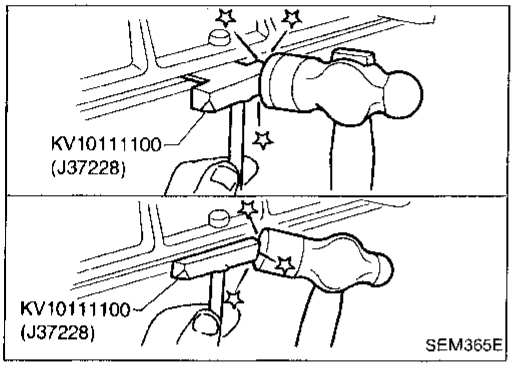
10. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through spark plug holes and retest compression.

- **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-111). If valve or valve seat is damaged excessively, replace them.**
- **If compression in any two adjacent cylinders is low and if adding oil does not improve compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.**



Removal

1. Remove undercovers.
2. Drain engine oil.
3. Remove center member.
4. Remove front exhaust tube.

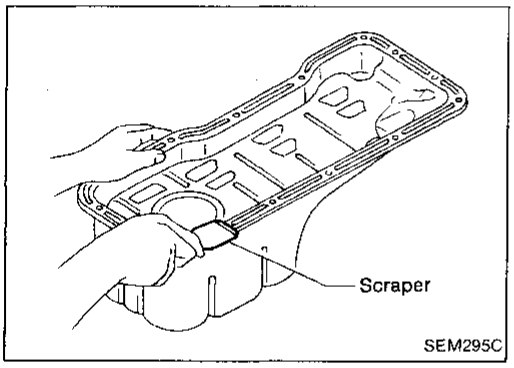


5. Remove oil pan.

(1) Insert Tool between cylinder block and oil pan.

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

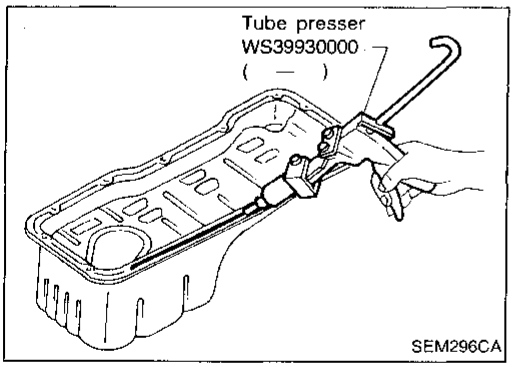
(2) Slide Tool by tapping its side with a hammer, and remove oil pan.



Installation

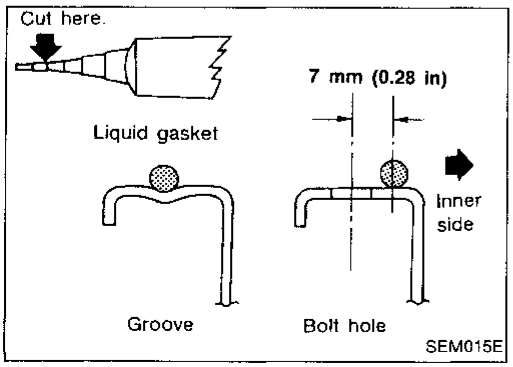
1. Before installing oil pan, remove all traces of liquid gasket from mating surface using a scraper.

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



2. Apply a continuous bead of liquid gasket to mating surface of oil pan.

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



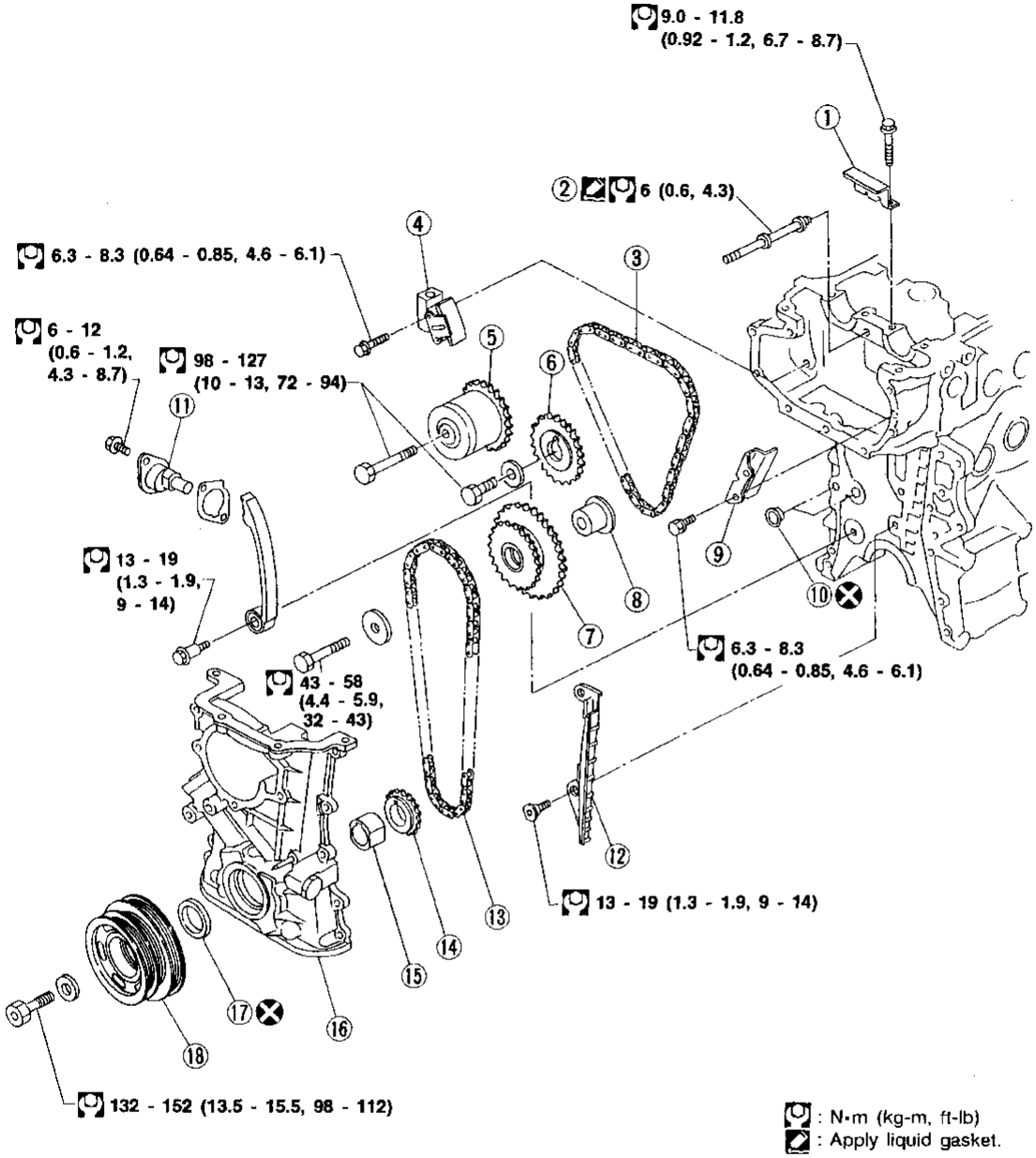
- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.

3. Apply liquid gasket to inner sealing surface as shown in figure.

- Attaching should be done within 5 minutes after coating.

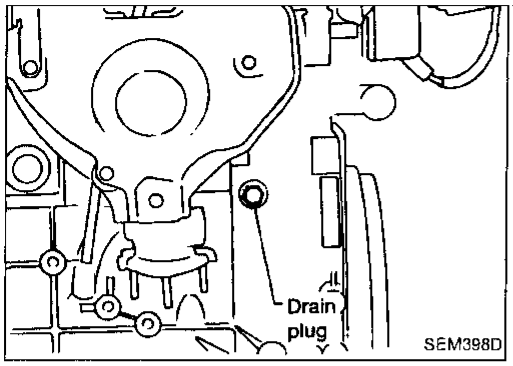
4. Install oil pan.

- Wait at least 30 minutes before refilling engine oil.



SEM543D

① Chain guide
② Cam sprocket cover gusset
③ Upper timing chain
④ Chain tensioner
⑤ VTC camshaft sprocket (Intake)
⑥ Camshaft sprocket (Exhaust)
⑦ Idler sprocket
⑧ Idler shaft
⑨ Chain guide
⑩ O-ring
⑪ Chain tensioner
⑫ Chain guide
⑬ Lower timing chain
⑭ Crankshaft sprocket
⑮ Oil pump drive spacer
⑯ Front cover
⑰ Oil seal
⑱ Crankshaft pulley

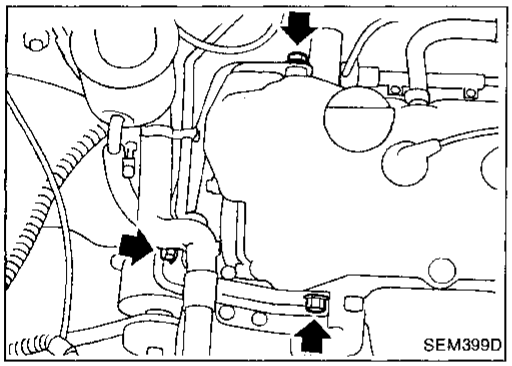


CAUTION:

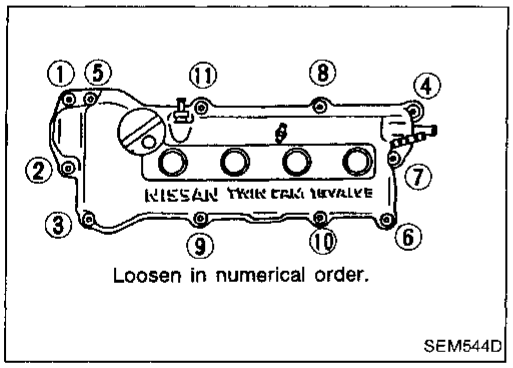
- **After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.**

Removal

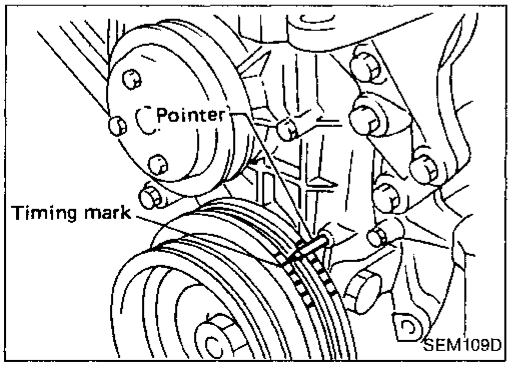
1. Drain engine coolant from radiator and cylinder block. Be careful not to spill coolant on drive belts.
2. Release fuel pressure. Refer to "Releasing Fuel Pressure" in EF & EC section.
3. Remove the following belts.
   - Power steering pump drive belt
   - Alternator drive belt
   - Air conditioner drive belt
4. Remove power steering pump bracket.
5. Remove air duct to intake manifold collector.
6. Remove front right-side wheel.
7. Remove front right-side splash cover.
8. Remove front undercovers.
9. Remove front exhaust tube.



10. Remove engine front mounting bracket.

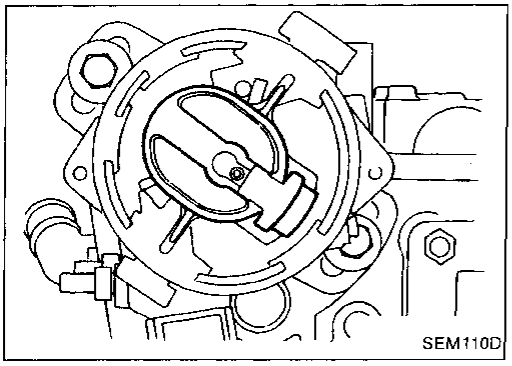


11. Remove rocker cover.
12. Remove distributor cap.
13. Remove all spark plugs.
14. Remove intake manifold support.



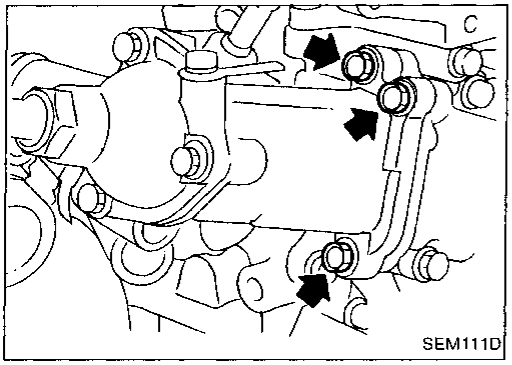
15. Set No. 1 piston at TDC on its compression stroke.

Removal (Cont'd)


SEM110D

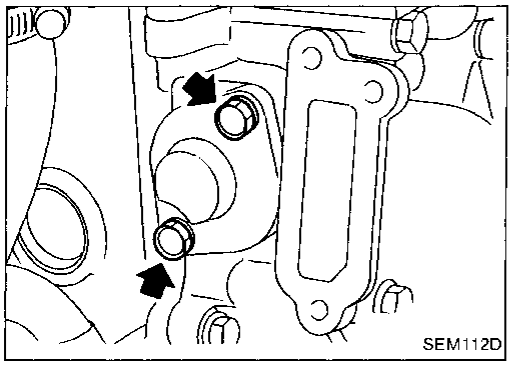
- Make sure No. 1 cylinder is at TDC by looking at distributor rotor position.

16. Remove distributor.
17. Remove cam sprocket cover and gusset.
18. Remove water pump pulley.

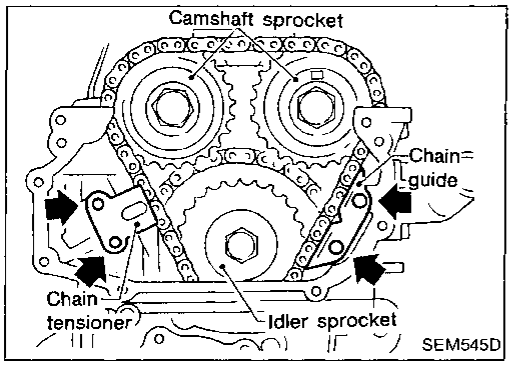


SEM111D

19. Remove thermostat housing.

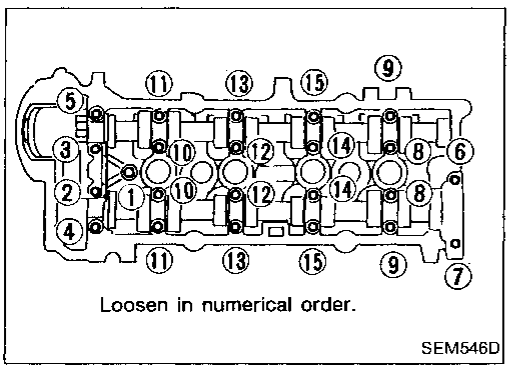

SEM112D

20. Remove chain tensioner.



SEM545D

21. Remove chain tensioner and chain guide.
22. Loosen idler sprocket bolt.
23. Remove camshaft sprocket bolts.
24. Remove camshaft sprockets.



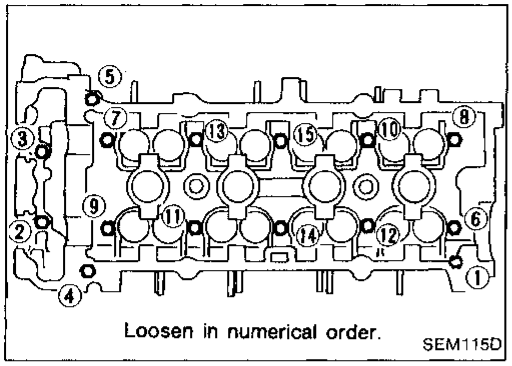
SEM546D

25. Remove camshaft brackets, distributor bracket and camshafts.

- **These parts should be reassembled in their original positions.**
- **Bolts should be loosened in two or three steps.**

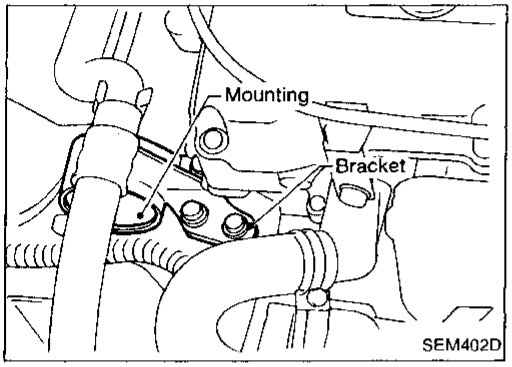
26. Remove idler sprocket bolt.

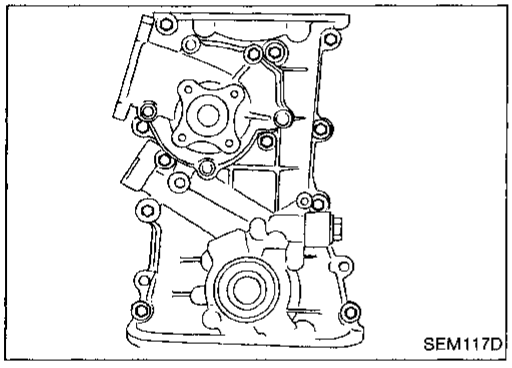
Removal (Cont'd)



27. Remove cylinder head with manifolds.
- **Head warpage or cracking could result from removing in incorrect order.**
- **Cylinder head bolts should be loosened in two or three steps.**

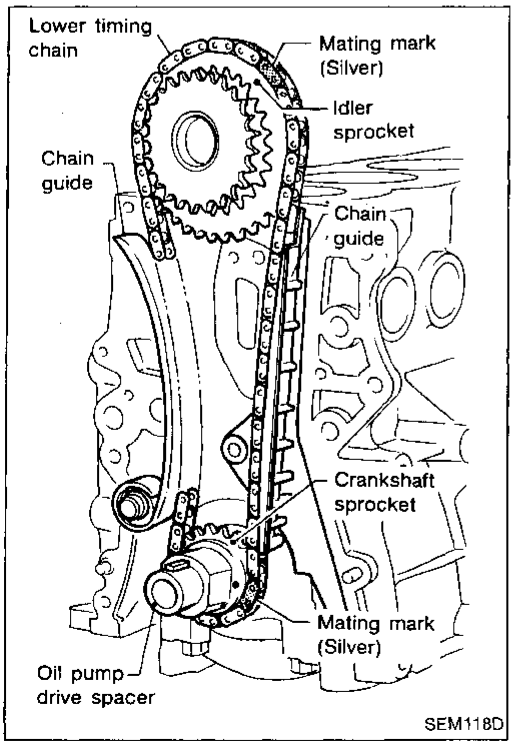
28. Remove idler sprocket shaft from rear side.
29. Remove upper timing chain.
30. Remove center member.
31. Remove oil pan. Refer to "Removal" in "OIL PAN" (EM-72).
32. Remove oil strainer.
33. Remove crankshaft pulley.
34. Support engine with a suitable jack.
35. Remove engine front mounting bracket.



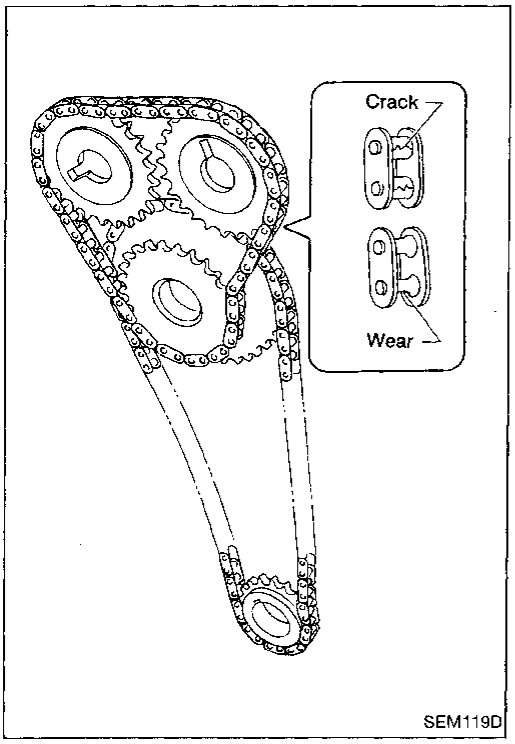


36. Remove front cover bolts and front cover as shown.

CAUTION:
One bolt is located on water pump.

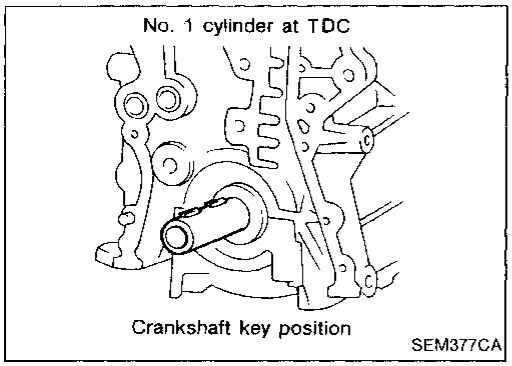


37. Remove idler sprocket.
38. Remove lower timing chain.
39. Remove oil pump drive spacer.
40. Remove chain guide.
41. Remove crankshaft sprocket.



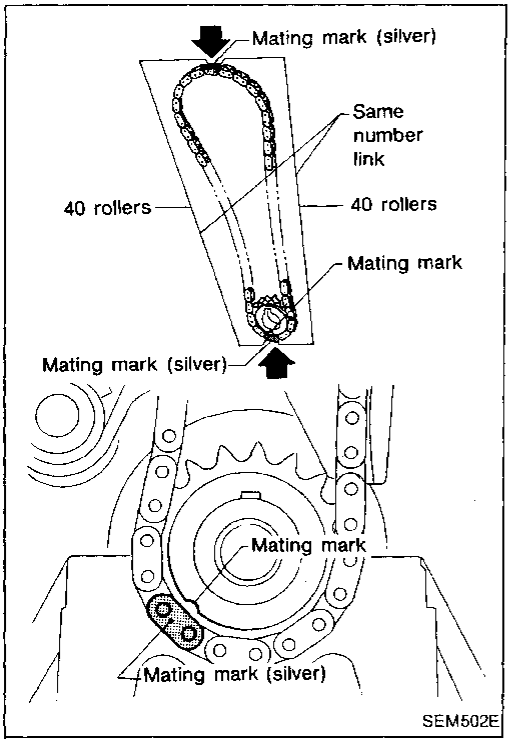
Inspection

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



Installation

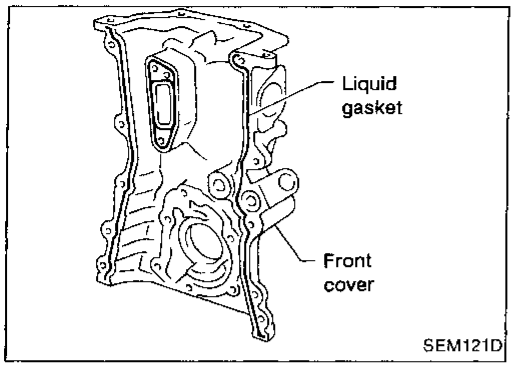
1. Confirm that No. 1 piston is set at TDC on its compression stroke.
2. Install chain guide.



3. Install crankshaft sprocket and lower timing chain.

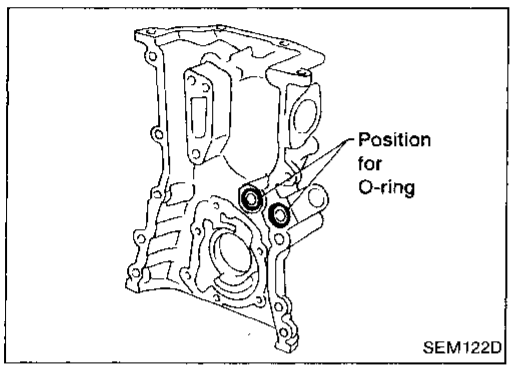
- **Set timing chain by aligning its mating mark with the one on crankshaft sprocket.**
- **Make sure sprocket's mating mark faces engine front.**
- **The number of links between the alignment marks (gold) are the same for the left and right sides, so either side can be used during alignment with the sprocket.**

Installation (Cont'd)

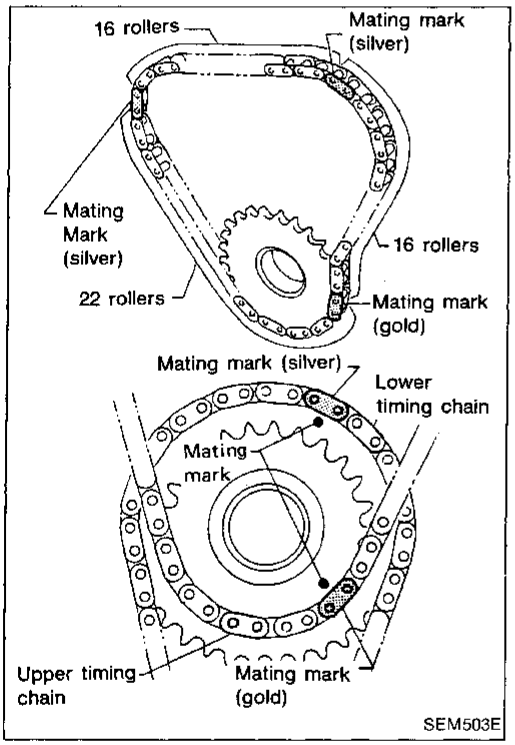


4. Apply liquid gasket to front cover.
5. Install front cover.

- **Check alignment of mating marks on chain and crankshaft sprocket.**
- **Align oil drive spacer with oil pump.**
- **Put chain to the side of chain guide so that chain does not make contact with water seal area of front cover.**
- **Make sure two O-rings are present.**
- **Be careful not to damage oil seal when installing front cover.**



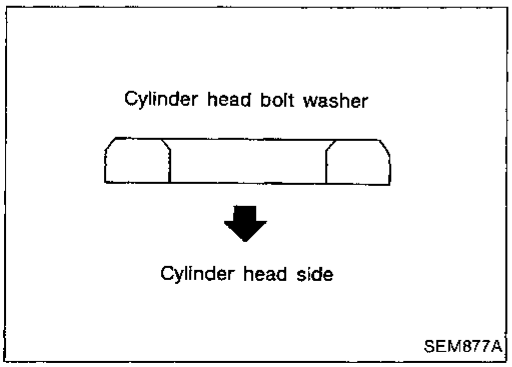
6. Install engine front mounting.
7. Install oil strainer.
8. Install oil pan. Refer to "Installation" in "OIL PAN" (EM-72).
9. Install crankshaft pulley.
10. Install center member.



11. Set idler sprocket by aligning the mating mark on the larger sprocket with the silver mating mark on the lower timing chain.
12. Install upper timing chain and set it by aligning the mating mark on the smaller sprocket with the silver mating marks on the upper timing chain.

- **Make sure sprocket's mating mark faces engine front.**

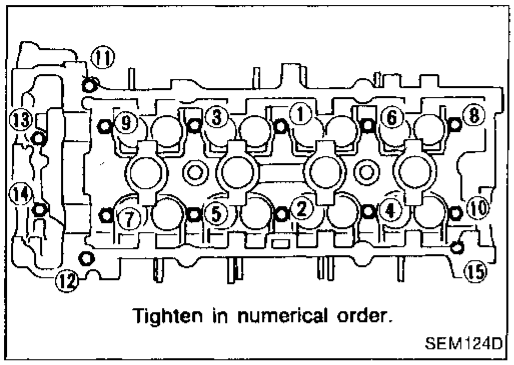
13. Install idler sprocket shaft from the rear side.

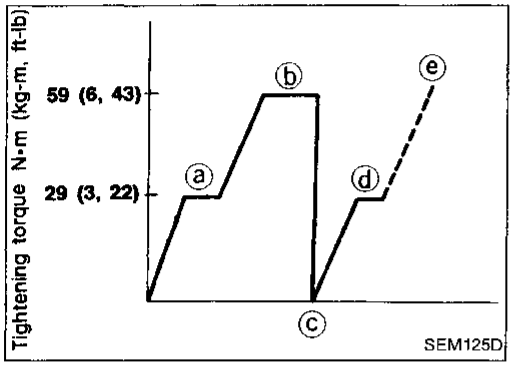


14. Install cylinder head with new gasket.

- **Be sure to install washers between bolts and cylinder head.**
- **Do not rotate crankshaft and camshaft separately, or valves will strike piston heads.**

Installation (Cont'd)

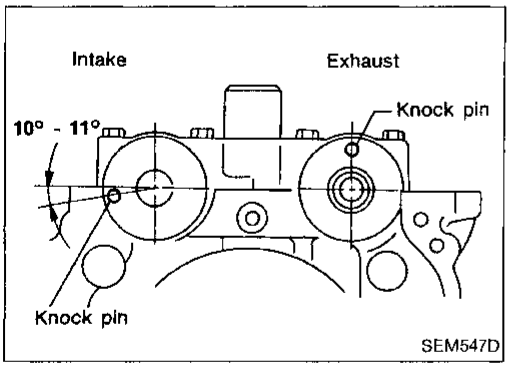




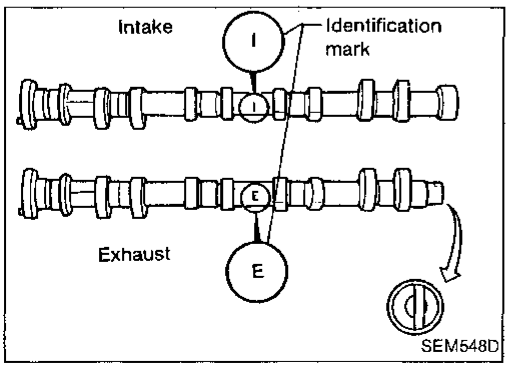
- **Tightening procedure**
- **ⓐ Tighten bolts to 29 N·m (3 kg-m, 22 ft-lb).**
- **ⓑ Tighten bolts to 59 N·m (6 kg-m, 43 ft-lb).**
- **ⓒ Loosen bolts completely.**
- **ⓓ Tighten bolts to 29 N·m (3 kg-m, 22 ft-lb).**
- **ⓔ Turn bolts 50 to 55 degrees clockwise or if angle wrench is not available, tighten bolts to 59±5 N·m (6±0.5 kg-m, 43.4±3.6 ft-lb).**
- **ⓕ Tighten bolts (⑪ - ⑮) to 6.3 to 8.3 N·m (0.64 to 0.85 kg-m, 4.6 to 6.1 ft-lb).**

	Tightening torque N·m (kg-m, ft-lb)				
	ⓐ	ⓑ	ⓒ	ⓓ	ⓔ, ⓕ
Bolts (① - ⑩)	29 (3, 22)	59 (6, 43)	0 (0, 0)	29 (3, 22)	50 - 55 degrees or 59±5 (6±0.5, 43.4±3.6)
Bolts (⑪ - ⑮)	—	—	—	—	6.3 - 8.3 (0.64 - 0.85, 4.6 - 6.1)

15. Install idler sprocket bolt.

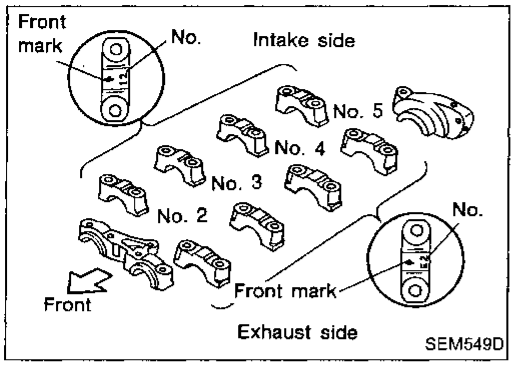


16. Install camshaft.
- **Make sure camshafts are aligned as shown in figure.**

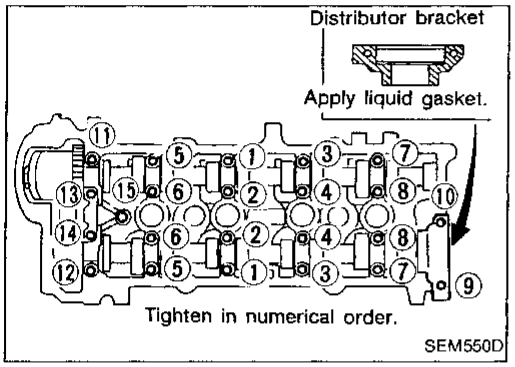


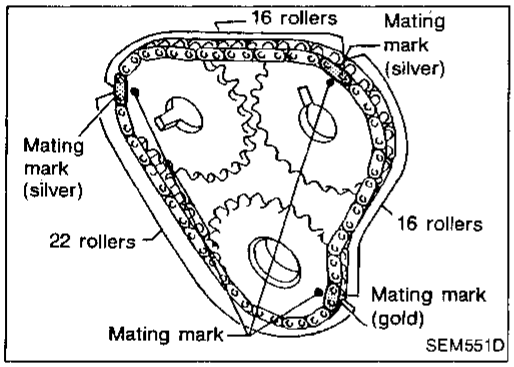
- **Identification marks are present on camshafts.**

Installation (Cont'd)



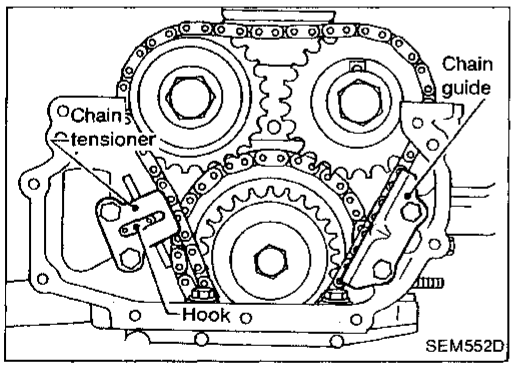
17. Install camshaft brackets and distributor bracket.
- **Make sure camshaft brackets are aligned as shown in figure.**
- **Apply liquid gasket to distributor bracket.**
- **Tighten camshaft bracket bolts gradually in two or three stages.**
- **If any part of valve assembly or camshaft is replaced, check valve clearance according to reference data.**
  After completing assembly check valve clearance. Refer to "Checking" and "Adjusting" in "VALVE CLEARANCE" (EM-92).
  Reference data valve clearance (Cold):
  Intake
  0.30 mm (0.012 in)
  Exhaust
  0.35 mm (0.014 in)



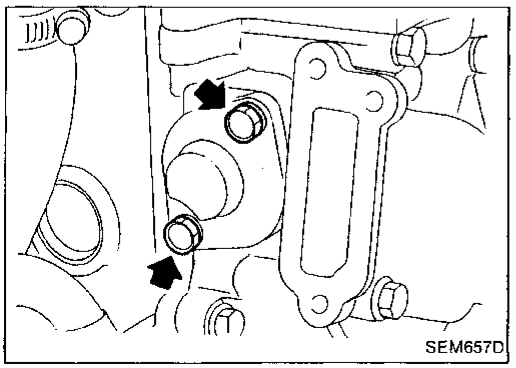


18. Assemble camshaft sprocket with chain.
- **Set timing chain by aligning mating marks with those of camshaft sprockets.**
- **Make sure sprocket's mating marks face engine front.**

19. Install camshaft sprocket bolts.



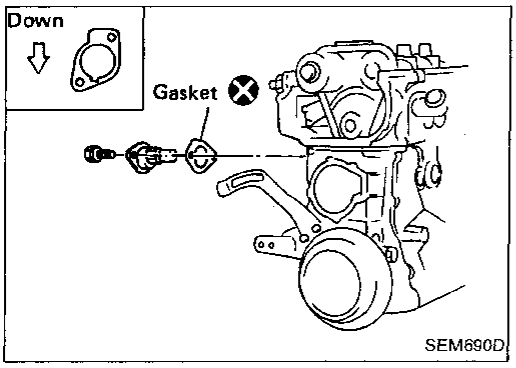
20. Install upper chain tensioner and chain guide.
- **Make sure that hook used to retain chain tensioner is released.**



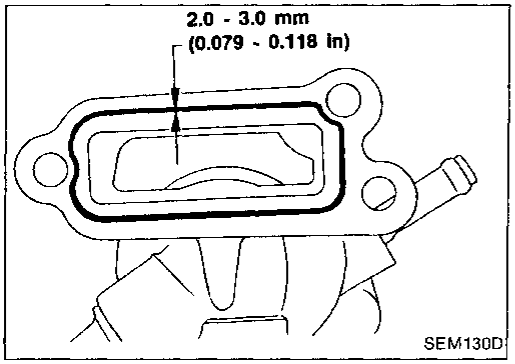
21. Install lower chain tensioner.

CAUTION:
- **Check no problems occur when engine is rotated.**
- **Make sure that No. 1 piston is set at TDC on its compression stroke.**

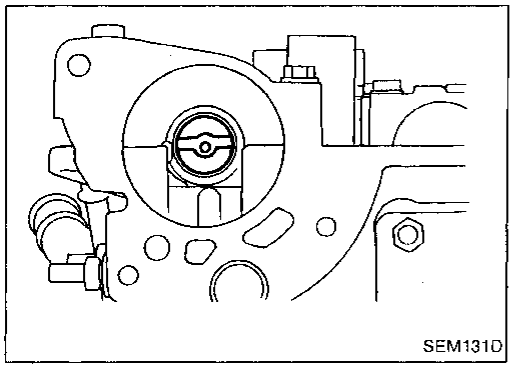
Installation (Cont'd)



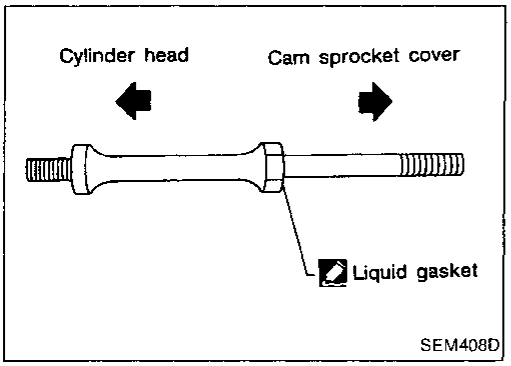
- **Make sure of the direction of the gasket before installing lower chain tensioner.**



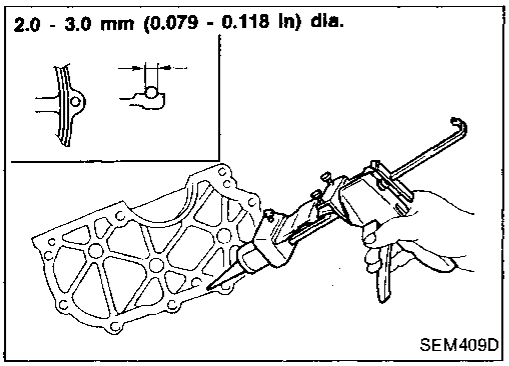
22. Apply liquid gasket to thermostat housing.
23. Install thermostat housing.
24. Install water pump pulley.



25. Install distributor.
- **Make sure that position of camshaft is as shown in figure.**

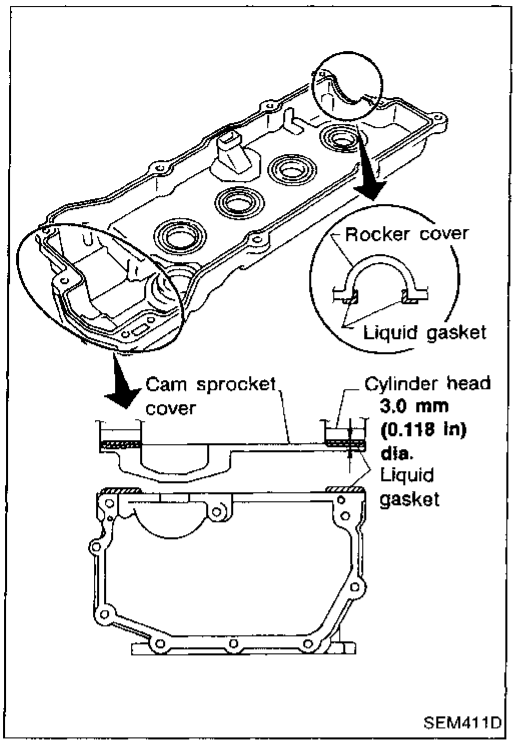


26. Install cam sprocket cover gusset and cam sprocket cover.
- Apply liquid gasket to cam sprocket cover gusset.

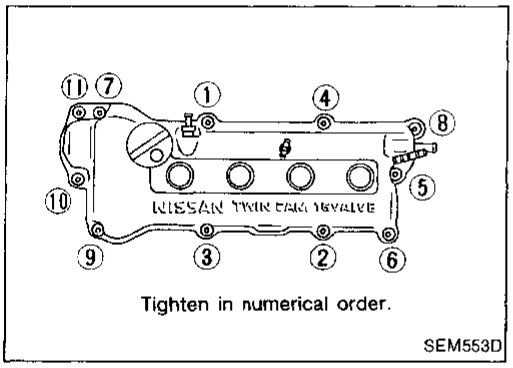


- Apply liquid gasket to cam sprocket cover.

Installation (Cont'd)



27. Apply liquid gasket to rocker cover and cylinder head.

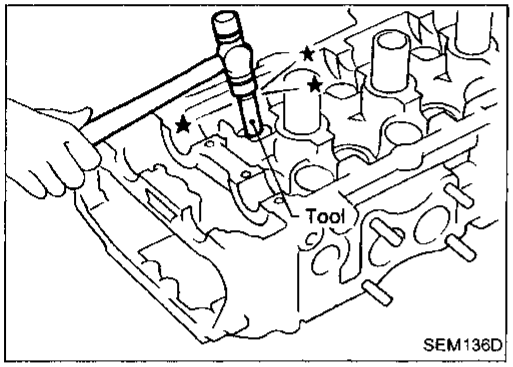


28. Install rocker cover.
29. Install all spark plugs.
30. Install engine front mounting bracket.
31. Install front exhaust tube.
32. Install front undercover.
33. Install front right splash cover.
34. Install front right wheel.
35. Install air cleaner.
36. Install power steering pump bracket.
37. Install the following belts.
- Alternator drive belt
- Power steering pump drive belt
- Air conditioner compressor drive belt

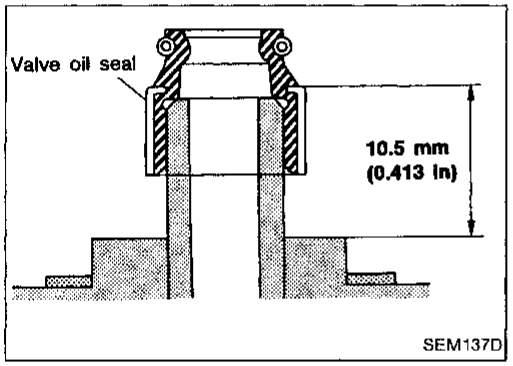
VALVE OIL SEAL

1. Remove rocker cover.
2. Remove camshaft.
3. Remove valve spring and valve oil seal with Tool or a suitable tool.

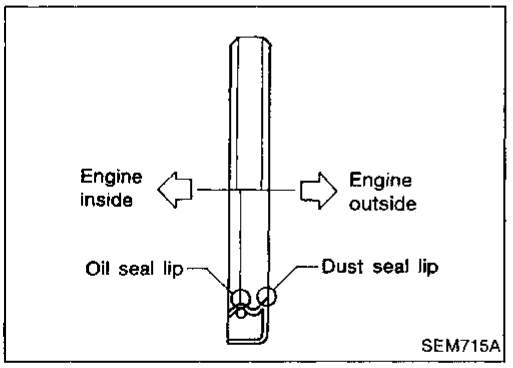
Piston concerned should be set at TDC to prevent valve from falling.



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



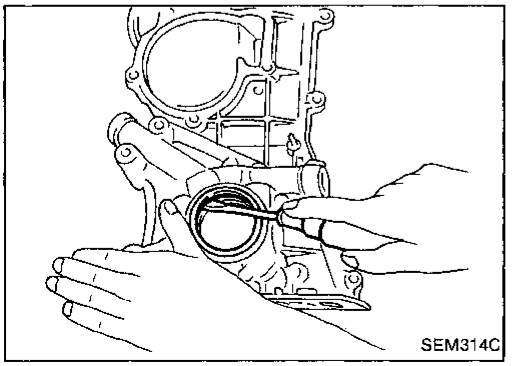
OIL SEAL INSTALLING DIRECTION

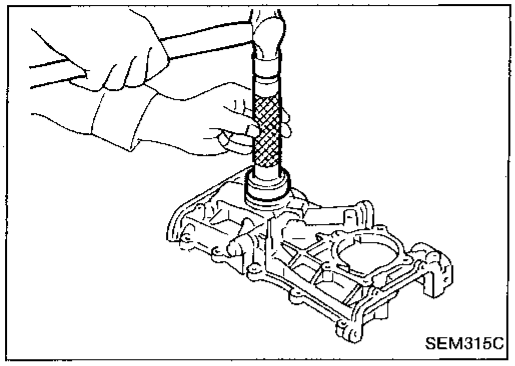


FRONT OIL SEAL

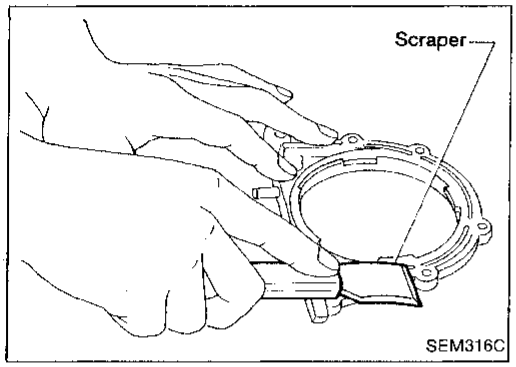
1. Remove front cover. Refer to "Removal" in "TIMING CHAIN" (EM-74).
2. Remove front oil seal from front cover.

Be careful not to damage oil seal retainer.




SEM315C

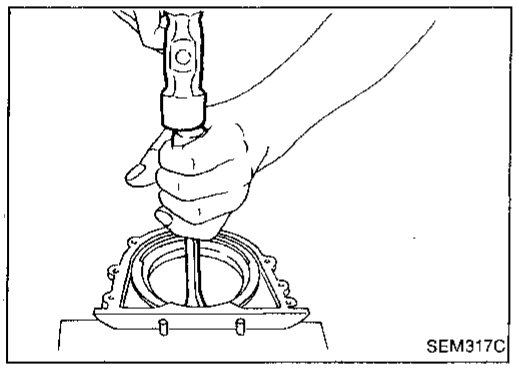
3. Apply engine oil to new oil seal and install it using a suitable tool.



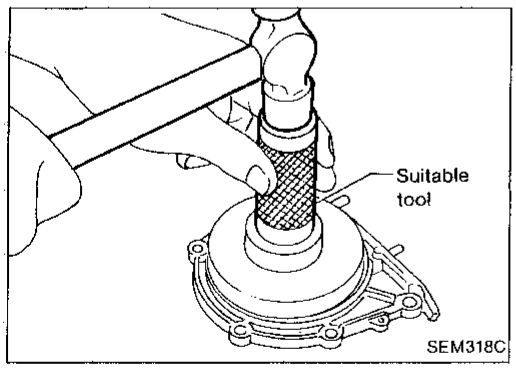
SEM316C

REAR OIL SEAL

1. Remove flywheel.
2. Remove rear oil seal retainer.
3. Remove traces of liquid gasket using scraper.

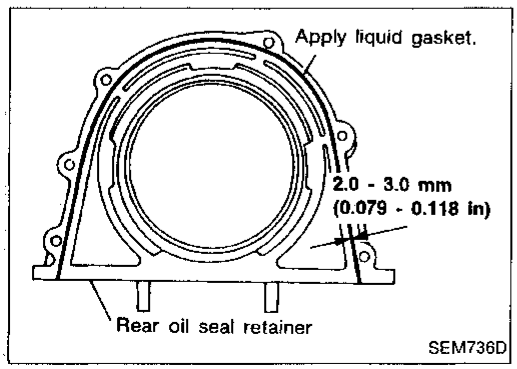

SEM317C

4. Remove seal from rear oil seal retainer.



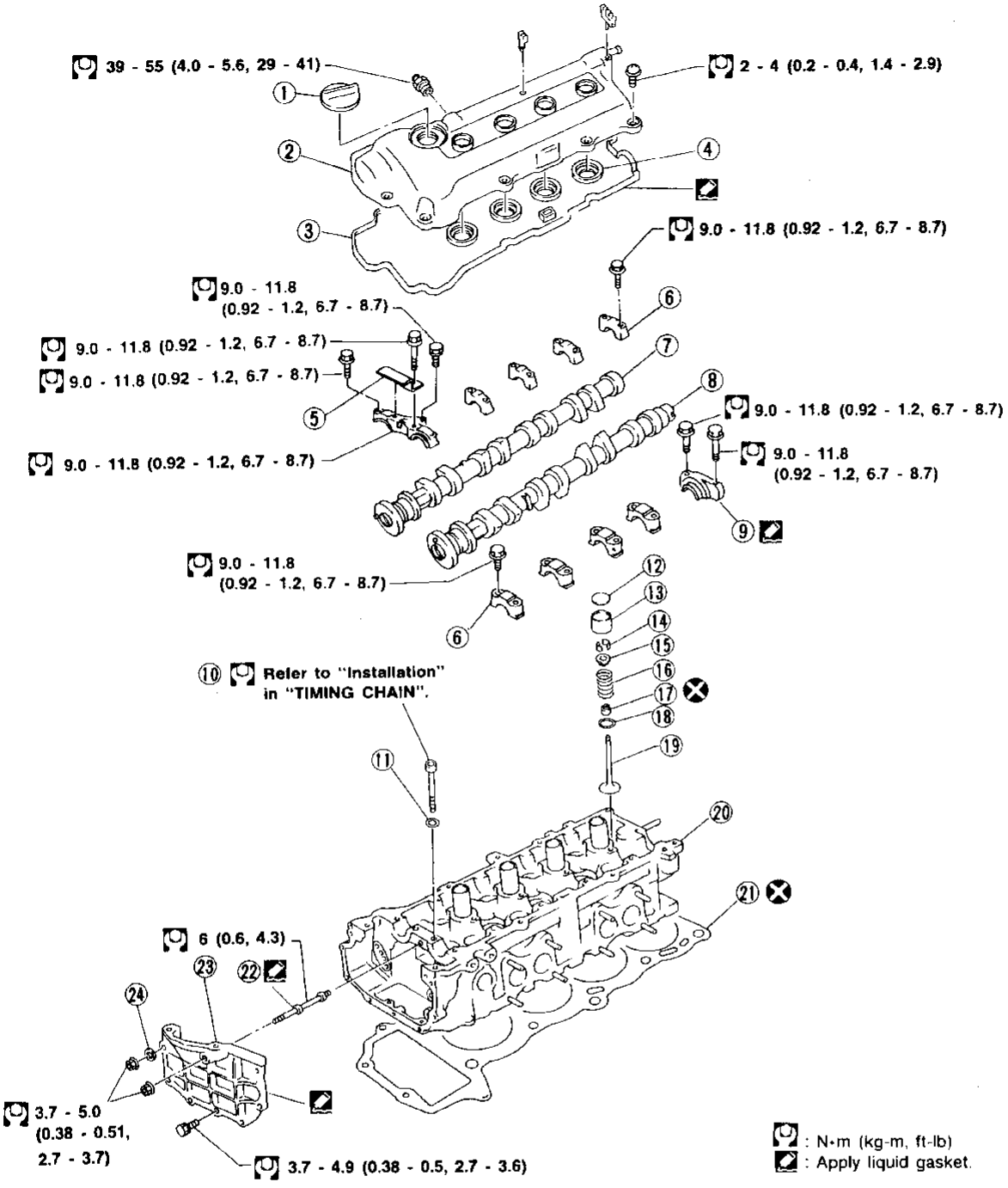
SEM318C

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



SEM736D

6. Apply liquid gasket to rear oil seal retainer.



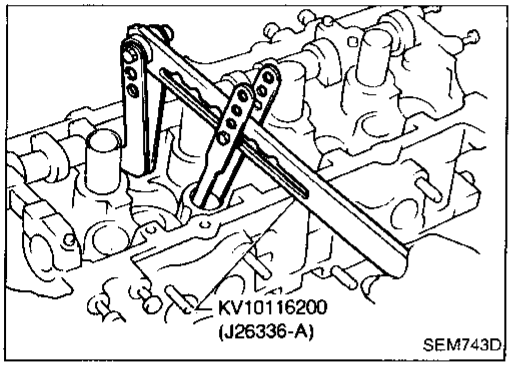
① Oil filler cap
② Rocker cover
③ Rocker cover gasket
④ Oil seal
⑤ Chain guide
⑥ Camshaft bracket
⑦ Intake camshaft
⑧ Exhaust camshaft
⑨ Distributor bracket
⑩ Cylinder head bolt
⑪ Washer
⑫ Shim
⑬ Valve lifter
⑭ Valve cotter
⑮ Valve spring retainer
⑯ Valve spring
⑰ Valve oil seal
⑱ Spring seat
⑲ Valve
⑳ Cylinder head
㉑ Cylinder gasket
㉒ Cam sprocket cover gusset
㉓ Cam sprocket cover
㉔ Washer

CAUTION:

- **When installing sliding parts such as camshaft and oil seal, be sure to apply new engine oil on their sliding surfaces.**
- **When tightening cylinder head bolts, camshaft sprocket bolts and camshaft bracket bolts, apply new engine oil to thread portions and seat surfaces of bolts.**
- **Attach tags to valve lifters so as not to mix them up.**

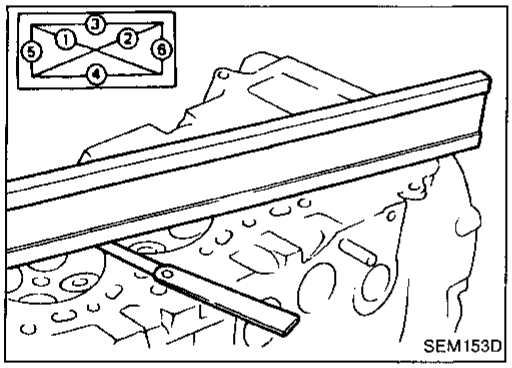
Removal

- This removal is the same procedure as those for timing chain. Refer to "Removal" in "TIMING CHAIN" (EM-74).



Disassembly

1. Remove valve components with Tool.
2. Remove valve oil seal with a suitable tool.



Inspection

CYLINDER HEAD DISTORTION

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 it or resurface it.

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 mm (0.008 in)

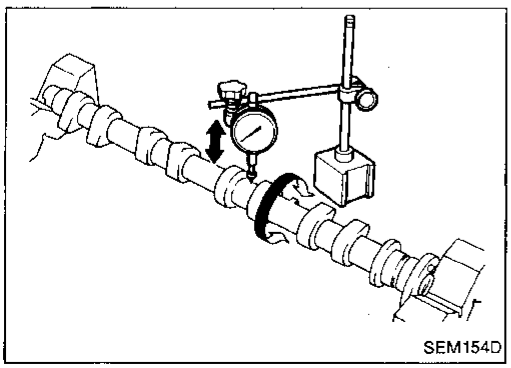
After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

Nominal cylinder head height:

117.8 - 118.0 mm (4.638 - 4.646 in)

CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.



CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.

Runout (Total indicator reading):

Standard:

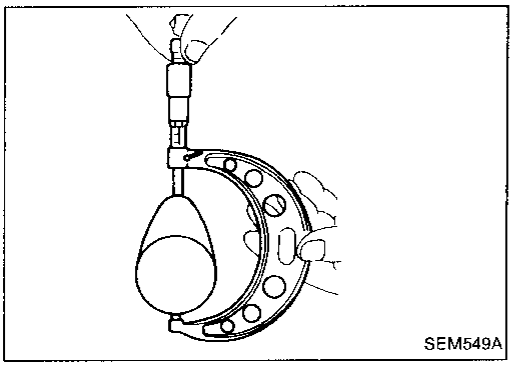
Less than 0.02 mm (0.0008 in)

Limit:

0.1 mm (0.004 in)

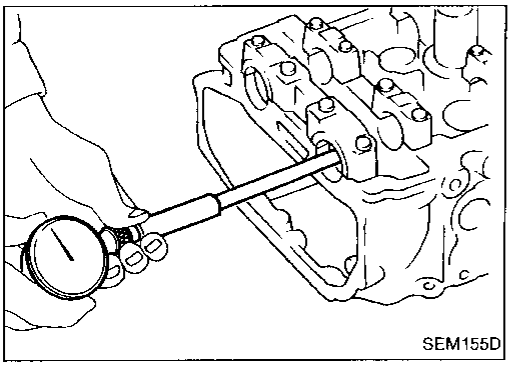
2. If it exceeds the limit, replace camshaft.

Inspection (Cont'd)


SEM549A

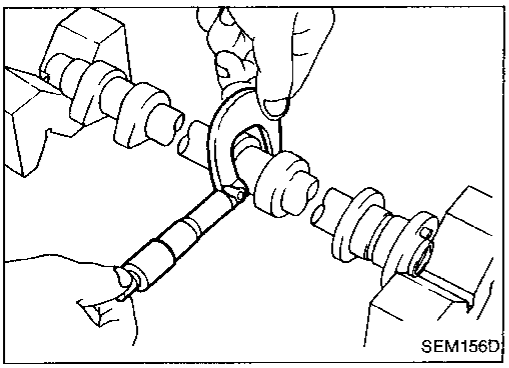
CAMSHAFT CAM HEIGHT

1. Measure camshaft cam height.
   Standard cam height:
   Intake
   40.60 - 40.79 mm (1.5984 - 1.6059 in)
   Exhaust
   39.880 - 40.070 mm (1.5701 - 1.5776 in)
   Cam wear limit:
   0.20 mm (0.0079 in)
2. If wear is beyond the limit, replace camshaft.

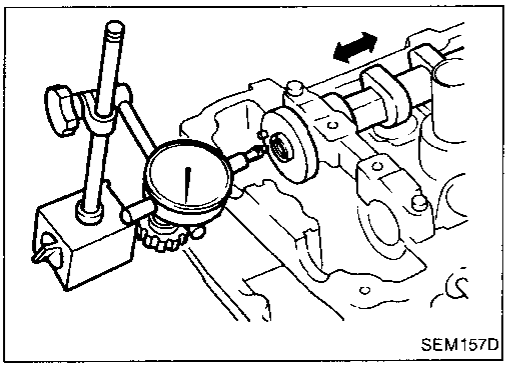

SEM155D

CAMSHAFT JOURNAL CLEARANCE

1. Install camshaft bracket and tighten bolts to the specified torque.
2. Measure inner diameter of camshaft bearing.
   Standard inner diameter:
   No. 1 bearing
   28.000 - 28.021 mm (1.1024 - 1.1032 in)
   No. 2 to No. 5 bearings
   24.000 - 24.021 mm (0.9449 - 0.9457 in)

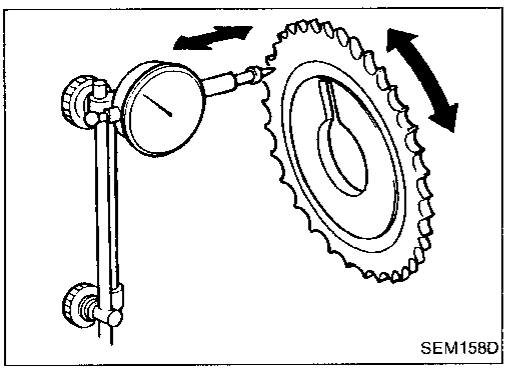

SEM156D

3. Measure outer diameter of camshaft journal.
   Standard outer diameter:
   No. 1 journal
   27.935 - 27.955 mm (1.0998 - 1.1006 in)
   No. 2 to No. 5 journals
   23.935 - 23.955 mm (0.9423 - 0.9431 in)
4. If clearance exceeds the limit, replace camshaft and/or cylinder head.
   Camshaft journal clearance:
   Standard 0.045 - 0.086 mm (0.0018 - 0.0034 in)
   Limit 0.15 mm (0.0059 in)


SEM157D

CAMSHAFT END PLAY

1. Install camshaft in cylinder head.
2. Measure camshaft end play.
   Camshaft end play:
   Standard
   0.070 - 0.143 mm (0.0028 - 0.0056 in)
   Limit
   0.20 mm (0.0079 in)

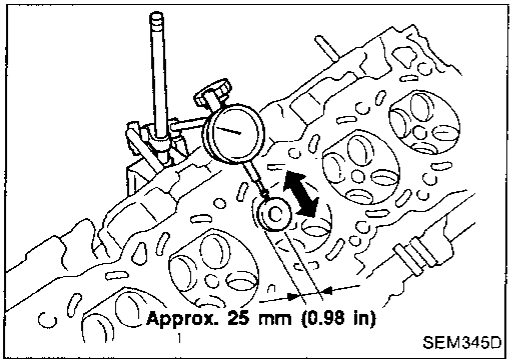

SEM158D

CAMSHAFT SPROCKET RUNOUT

1. Install sprocket on camshaft.
2. Measure camshaft sprocket runout.
   Runout (Total indicator reading):
   Limit 0.15 mm (0.0059 in)
3. If it exceeds the limit, replace camshaft sprocket.

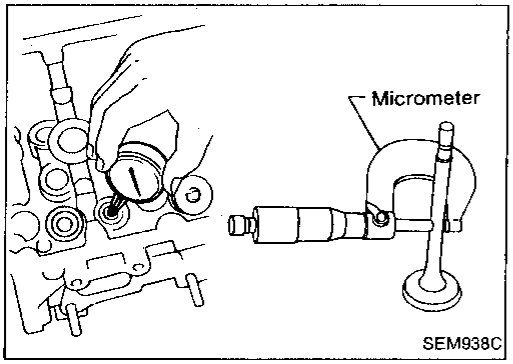
Inspection (Cont'd)

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.

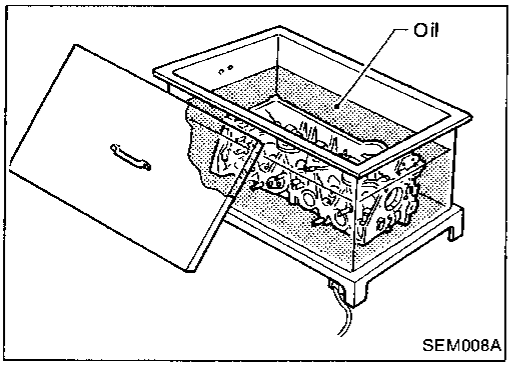
Valve to valve guide clearance:

Unit: mm (in)

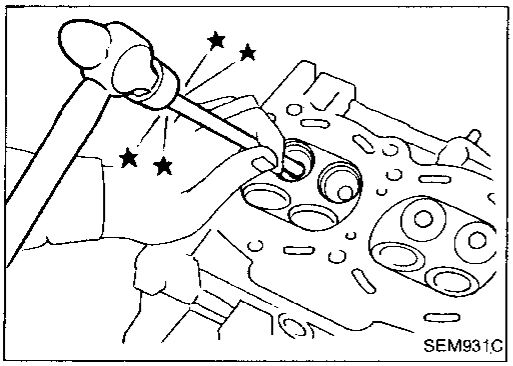
	Standard	Limit
Intake	0.020 - 0.050 (0.0008 - 0.0020)	0.1 (0.004)
Exhaust	0.040 - 0.070 (0.0016 - 0.0028)	0.1 (0.004)

c. If it exceeds the limit, replace valve or valve guide.

VALVE GUIDE REPLACEMENT

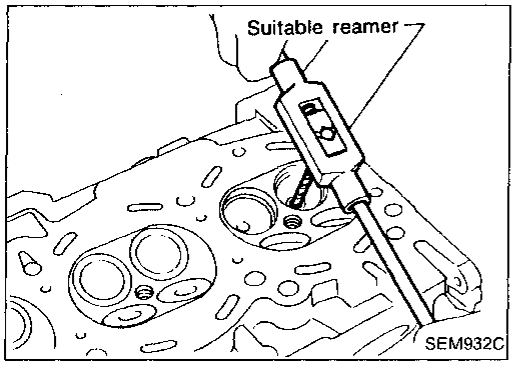


1. To remove valve guide, heat cylinder head to 110 to 120°C (230 to 248°F).

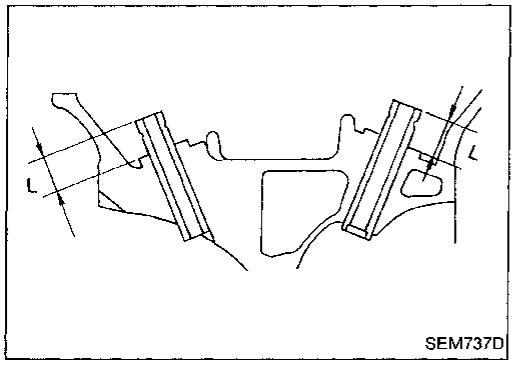


2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and suitable tool.

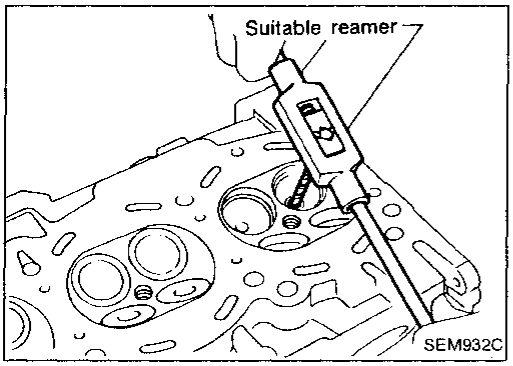
Inspection (Cont'd)



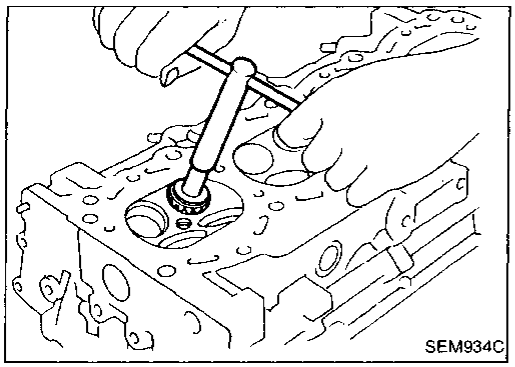
3. Ream cylinder head valve guide hole.
   Valve guide hole diameter
   (for service parts):
   Intake & Exhaust
   9.685 - 9.696 mm (0.3813 - 0.3817 in)



4. Heat cylinder head to 110 to 120°C (230 to 248°F) and press service valve guide into cylinder head.
   Projection "L":
   11.5 - 11.7 mm (0.453 - 0.461 in)



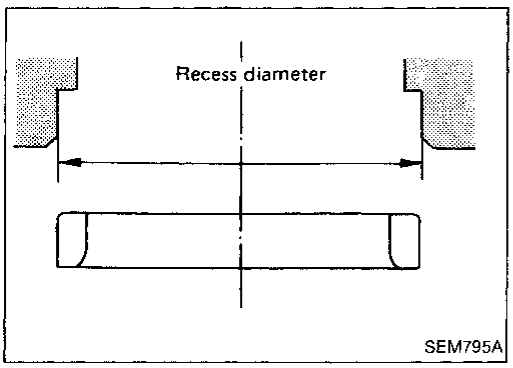
5. Ream valve guide.
   Finished size:
   Intake & Exhaust
   5.500 - 5.515 mm (0.2165 - 0.2171 in)



VALVE SEATS

Check valve seats for any evidence of pitting at valve contact surface, and 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.**
- **Cut with both hands to uniform the cutting surface.**

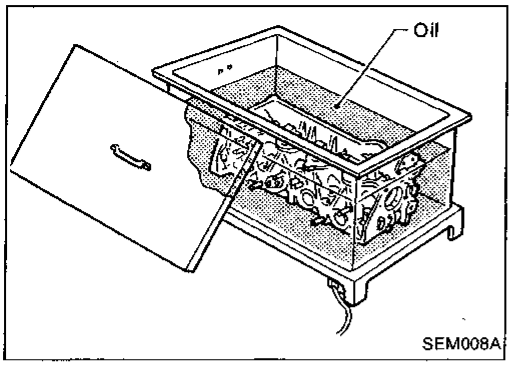


REPLACING VALVE SEAT FOR SERVICE PARTS

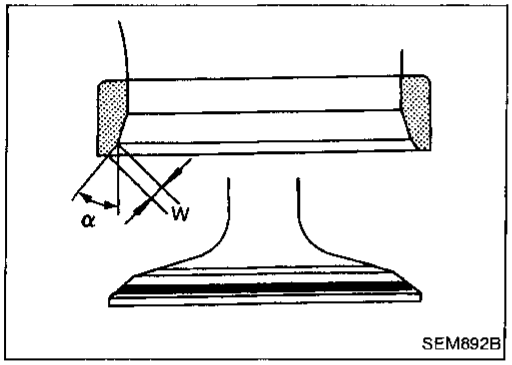
1. Bore out old seat until it collapses. The machine depth stop should be set so that boring cannot continue beyond the bottom face of the seat recess in cylinder head.
2. Ream cylinder head recess.
   Reaming bore for service valve seat
   Oversize [0.5 mm (0.020 in)]:
   Intake 31.500 - 31.516 mm (1.2402 - 1.2408 in)
   Exhaust 25.500 - 25.516 mm (1.0039 - 1.0046 in)

Reaming should be done in circles concentric to the valve guide center so that valve seat will have the correct fit.

Inspection (Cont'd)

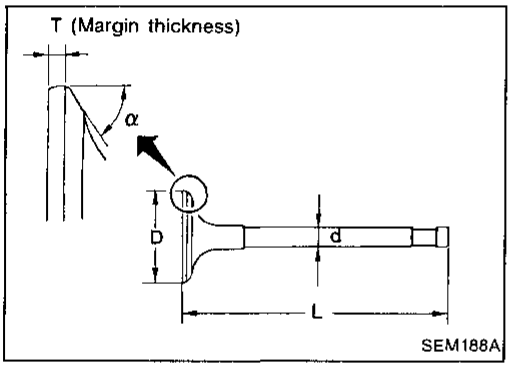


3. Heat cylinder head to 110 to 120°C (230 to 248°F).
4. Press fit valve seat until it seats on the bottom.



5. Cut or grind valve seat using suitable tool at the specified dimensions as shown in SDS (EM-111).
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.

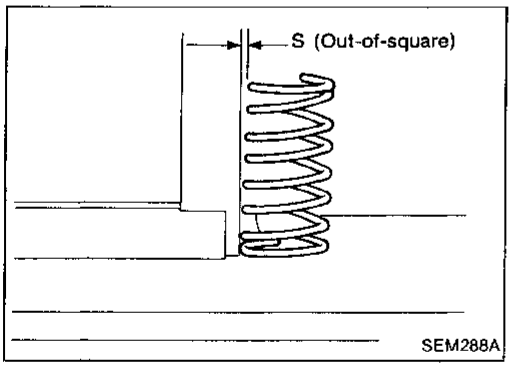
Seat face angle "α":
45°15' - 45°45'
Contacting width "W":
Intake
1.34 - 1.63 mm (0.0528 - 0.0642 in)
Exhaust
1.70 - 2.12 mm (0.0669 - 0.0835 in)



VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to SDS (EM-109).
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.



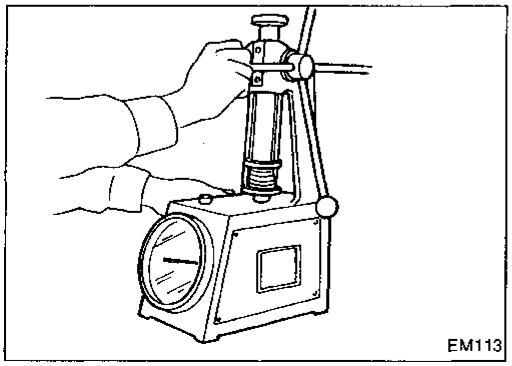
VALVE SPRING

Squareness

1. Measure "S" dimension.

Out-of-square:
Less than 1.80 mm (0.0709 in)

2. If it exceeds the limit, replace spring.



Pressure

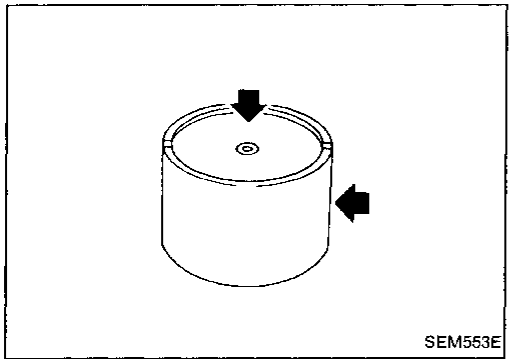
Check valve spring pressure.

Pressure: N (kg, lb) at height mm (in)
Standard
344.42 (35.12, 77.44) at 25.26 (0.9945)
Limit
More than 330.41 (33.69, 74.31) at 23.64 (0.9307)

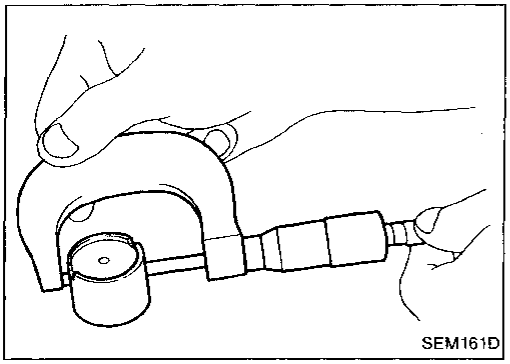
If it exceeds the limit, replace spring.

Inspection (Cont'd)

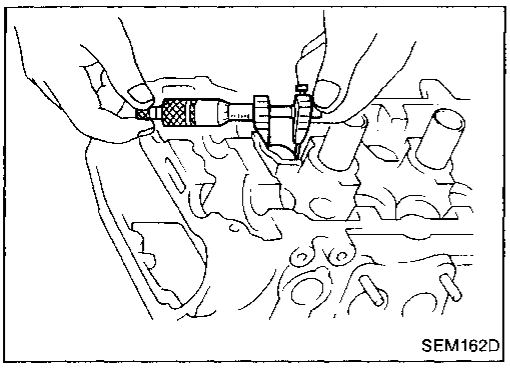
VALVE LIFTER


SEM553E

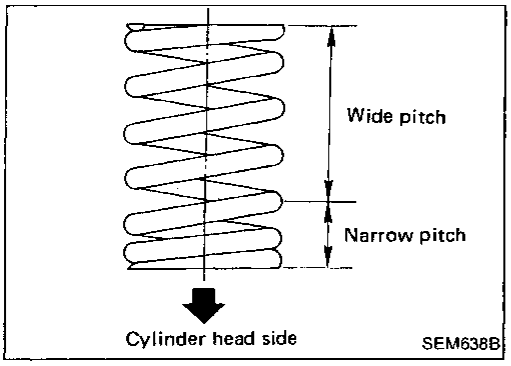
1. Check contact and sliding surfaces for wear or scratches.


SEM161D

2. Check diameter of valve lifter and valve lifter guide bore.
   Valve lifter diameter:
   29.960 - 29.975 mm (1.1795 - 1.1801 in)


SEM162D

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



SEM638B

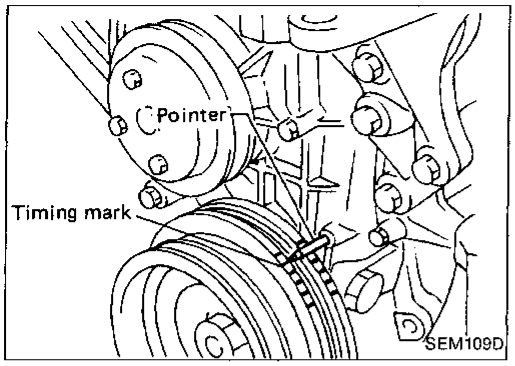
Assembly

1. Install valve component parts.

- **Always use new valve oil seal. Refer to OIL SEAL REPLACEMENT (EM-83).**
- **Before installing valve oil seal, install valve spring seat.**
- **After installing valve component parts, use plastic hammer to lightly tap valve stem tip to assure a proper fit.**
- **Install uneven pitch type spring with its narrow pitch side toward cylinder head. (Identification color side down, if present.)**

Installation

- This installation is the same procedure as those for timing chain. Refer to "Installation" in "TIMING CHAIN" (EM-77).

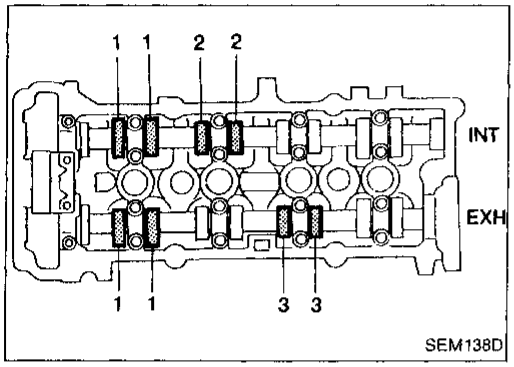


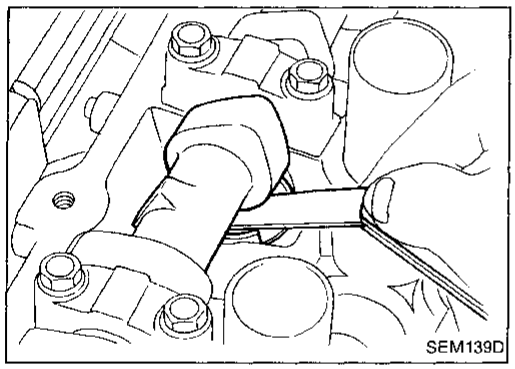
Checking

Check valve clearance while engine is warm and not running.

1. Remove rocker cover.
2. Remove all spark plugs.
3. Set No. 1 cylinder at TDC on its compression stroke.
- Align pointer with TDC mark on crankshaft pulley.
- Check that valve lifters on No. 1 cylinder are loose and valve lifters on No. 4 are tight.

  If not, turn crankshaft one revolution (360°) and align as above.
4. Check only those valves shown in the figure.





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

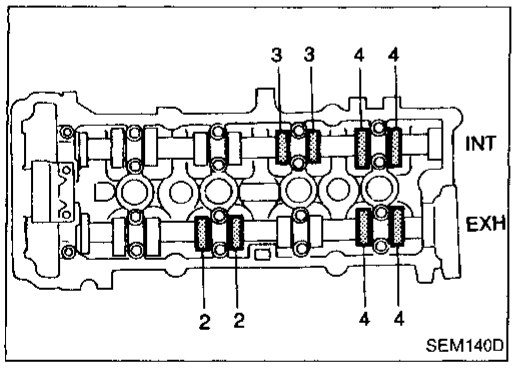
Valve clearance for checking (Hot):

Intake

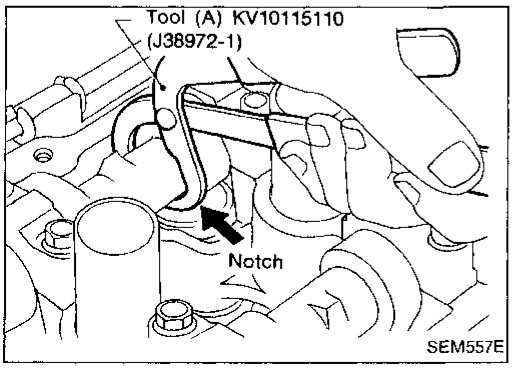
0.21 - 0.49 mm (0.008 - 0.019 in)

Exhaust

0.30 - 0.58 mm (0.012 - 0.023 in)



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



Adjusting

Adjust valve clearance while engine is cold.

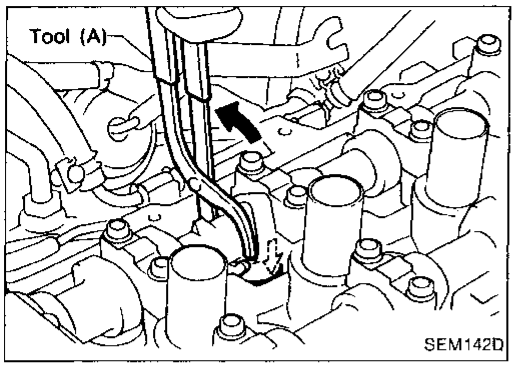
1. Turn crankshaft, to position cam lobe on camshaft of valve that must be adjusted upward.
2. Place Tool (A) around camshaft as shown in figure.

Before placing Tool (A), rotate notch toward center of cylinder head (See figure.), to simplify shim removal later.

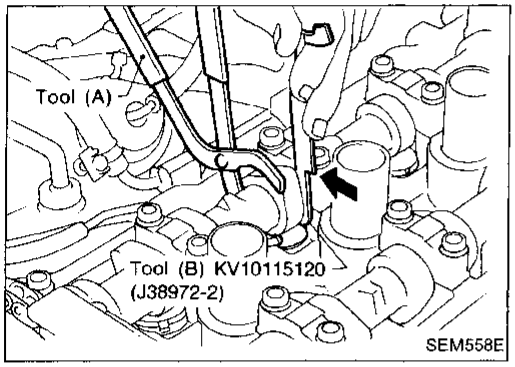
CAUTION:

Be careful not to damage cam surface with Tool (A).

Adjusting (Cont'd)



3. Rotate Tool (A) (See figure.) so that valve lifter is pushed down.

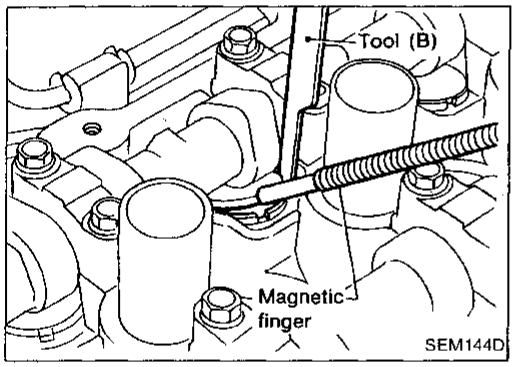


4. Place Tool (B) between camshaft and the edge of the valve lifter to retain valve lifter.

CAUTION:

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

5. Remove Tool (A).



6. Remove adjusting shim using a small screwdriver and a magnetic finger.
7. Determine replacement adjusting shim size following formula.

- Using a micrometer determine thickness of removed shim.
- Calculate thickness of new adjusting shim so valve clearance comes within specified values.

R = Thickness of removed shim
N = Thickness of new shim
M = Measured valve clearance

Intake:

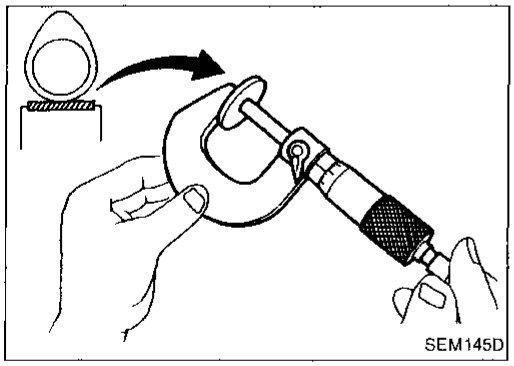
N = R + [M – 0.37 mm (0.0146 in)]

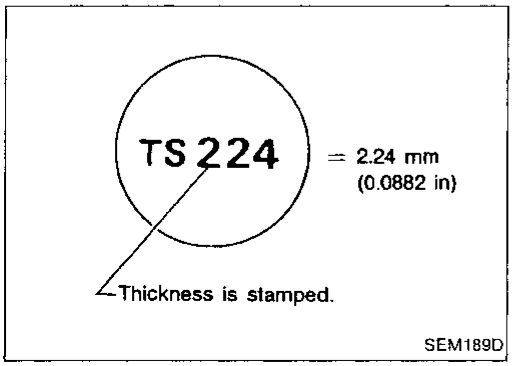
Exhaust:

N = R + [M – 0.40 mm (0.0157 in)]

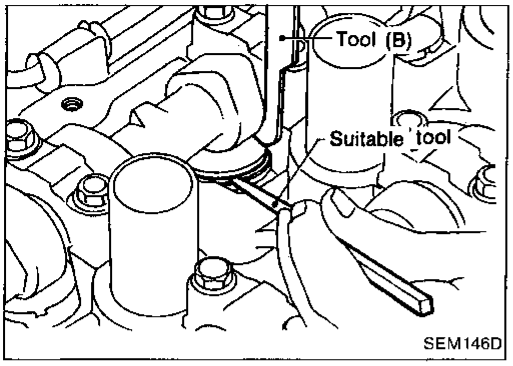
Shims are available in 50 sizes from 2.00 mm (0.0787 in) to 2.98 mm (0.1173 in), in steps of 0.02 mm (0.0008 in).

- Select new shim with thickness as close as possible to calculated value.

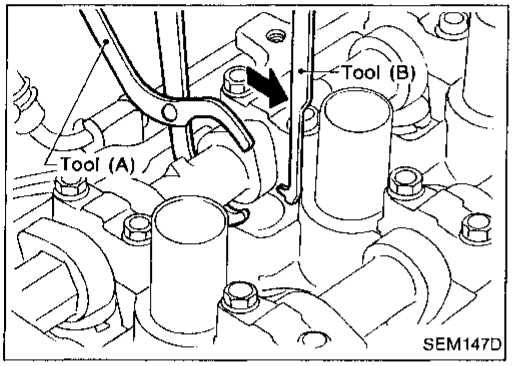




Adjusting (Cont'd)



8. Install new shim using a suitable tool.
- **Install with the surface on which the thickness is stamped facing down.**



9. Place Tool (A) as mentioned in steps 2 and 3.
10. Remove Tool (B).
11. Remove Tool (A).
12. Recheck valve clearance.

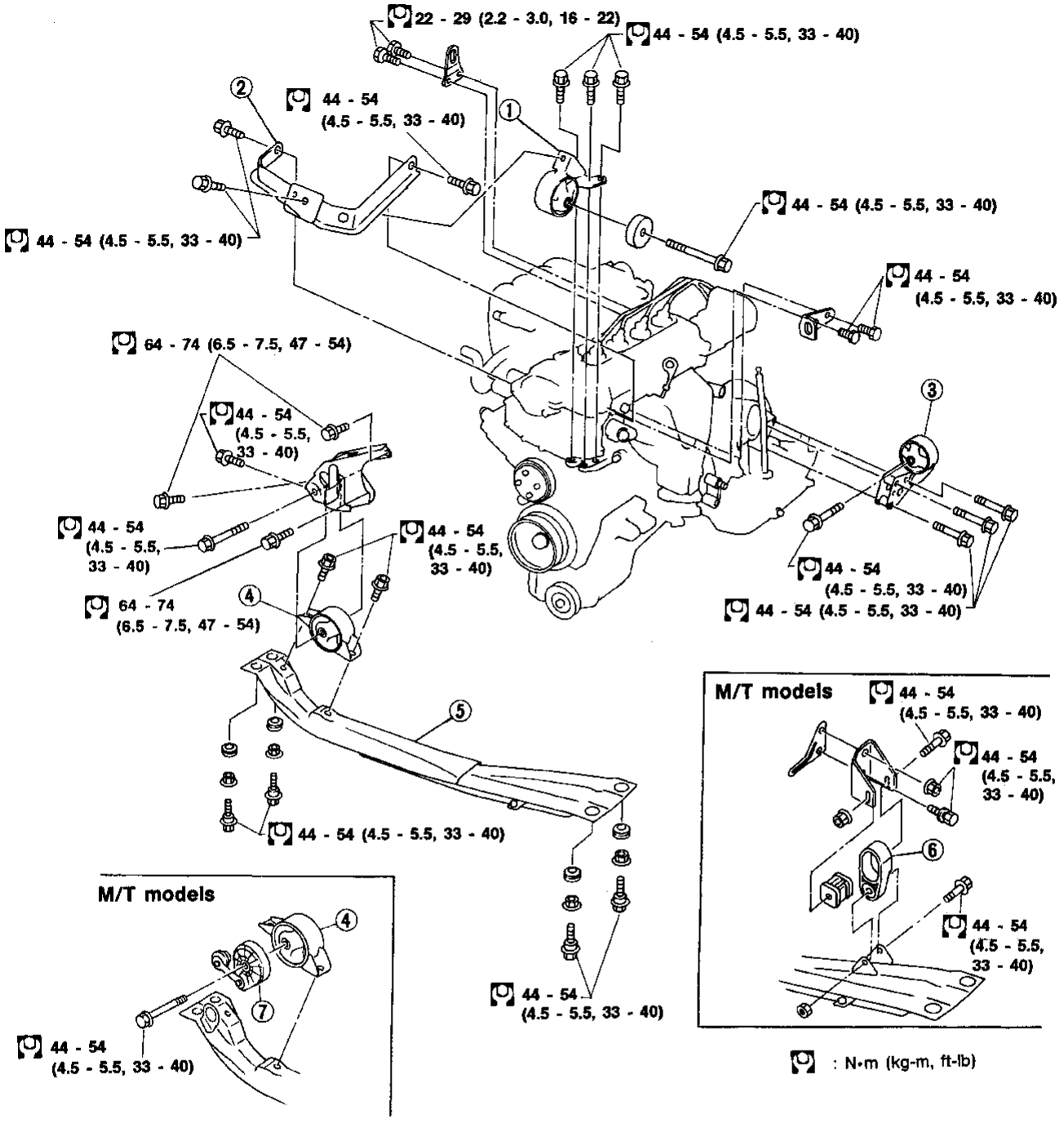
Valve clearance:

Unit: mm (in)

	For adjusting		For checking
	Hot	Cold*	Hot
Intake	0.32 - 0.40 (0.013 - 0.016)	0.25 - 0.33 (0.010 - 0.013)	0.21 - 0.49 (0.008 - 0.019)
Exhaust	0.37 - 0.45 (0.015 - 0.018)	0.32 - 0.40 (0.013 - 0.016)	0.30 - 0.58 (0.012 - 0.023)

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

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



SEM422D

① Engine front mounting
② Engine front mounting bracket
③ Engine rear mounting bracket
④ Rear mounting
⑤ Center member
⑥ Buffer
⑦ Roll damper

WARNING:

a. Situate vehicle on a flat and solid surface.
b. Place chocks at front and back of rear wheels.
c. 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.

d. For safety during subsequent steps, the tension of wires should be slackened against the engine.
e. Before disconnecting fuel hose, release fuel pressure from fuel line.
Refer to "Releasing Fuel Pressure" in EF & EC section.
f. Be sure to hoist engine and transaxle in a safe manner.
g. For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

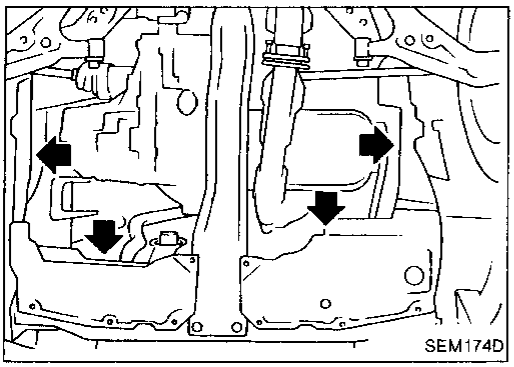
CAUTION:
- **When lifting engine, be careful not to strike adjacent parts, especially accelerator wire casing, brake lines, and brake master cylinder.**
- **In hoisting the engine, always use engine slingers in a safe manner.**
- **In removing drive shaft, be careful not to damage grease seal of transaxle.**

Engine cannot be removed separately from transaxle. Remove engine with transaxle.

Removal

1. Drain water.
2. Remove hood.
3. Remove battery.
4. Remove reservoir tank and bracket.
5. Remove drive belts.
6. Remove alternator, compressor and power steering oil pump from engine.
7. Remove the following parts:

- Right and left front tires


SEM174D

- Under covers
- Splash covers
- Brake caliper assembly

: 72 - 97 N·m (7.3 - 9.9 kg-m, 53 - 72 ft-lb)

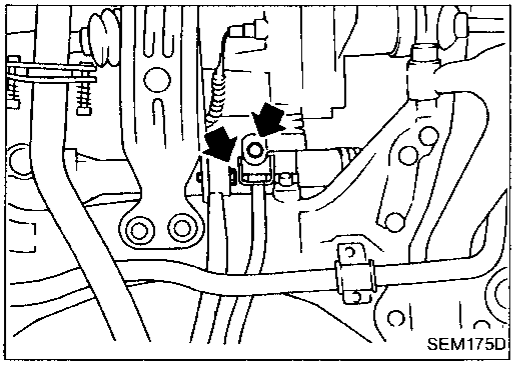
Brake hose does not need to be disconnected from brake caliper assembly. Never depress brake pedal.

- Disconnect tie-rod ball joint (RH & LH).

: 29 - 39 N·m (3.0 - 4.0 kg-m, 22 - 29 ft-lb)

- RH & LH drive shaft

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

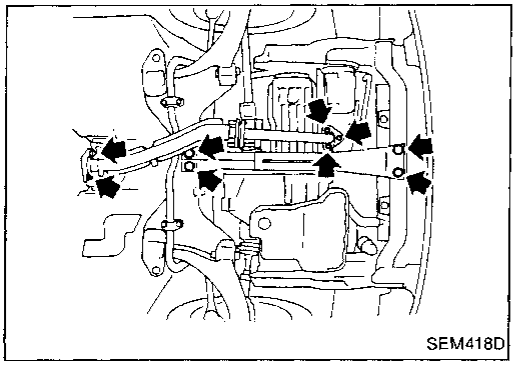

SEM175D

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

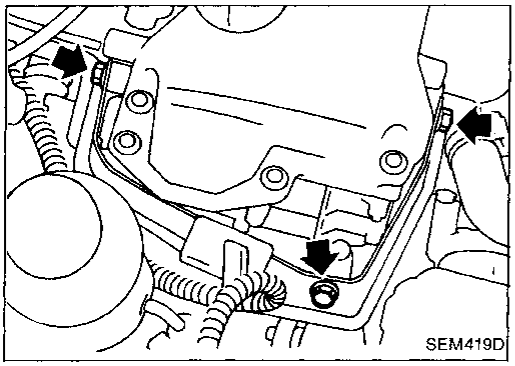
Control rod:
: 14 - 18 N·m (1.4 - 1.8 kg-m, 10 - 13 ft-lb)
Support rod:
: 36 - 49 N·m (3.7 - 5.0 kg-m, 27 - 36 ft-lb)

- Disconnect control cable from transaxle. (A/T model)

Removal (Cont'd)


SEM418D

- Center member
- Front exhaust tube
- Stabilizer
- Cooling fan
- Radiator


SEM419D

- Front mounting bracket
- Power steering pump from engine

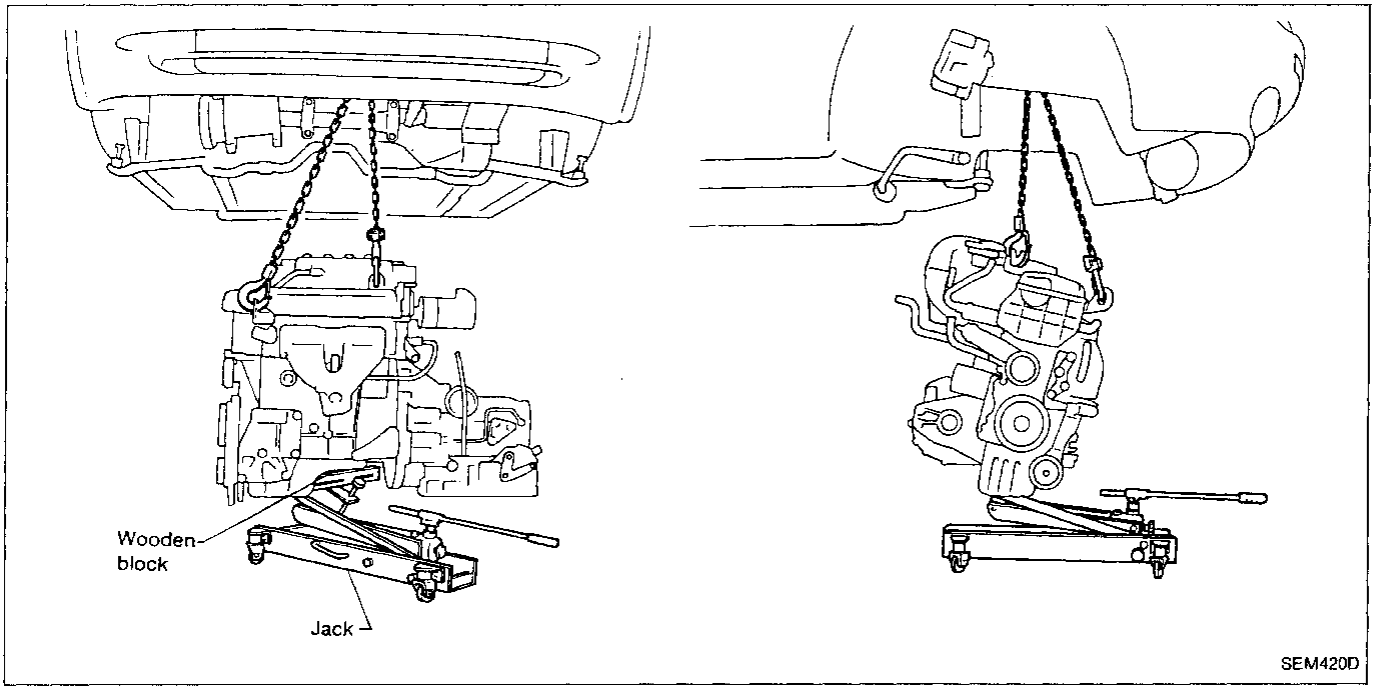
Power steering pump does not need to be disconnected from power steering tubes.

- Remove air duct and disconnect wires, harness, pipes, hoses and so on.

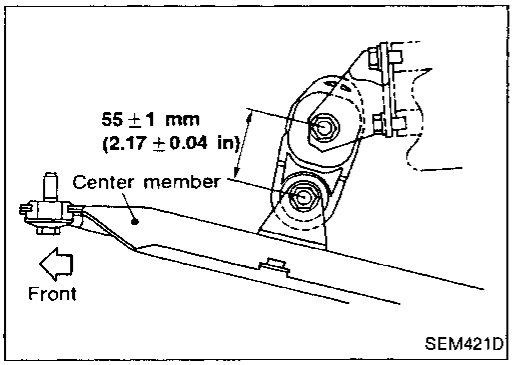
8. Lift up engine slightly and disconnect or remove all engine mountings.

When lifting engine, be careful not to hit it against adjacent parts, especially against brake tubes and brake master cylinder.

9. Remove engine with transaxle as shown.



SEM420D

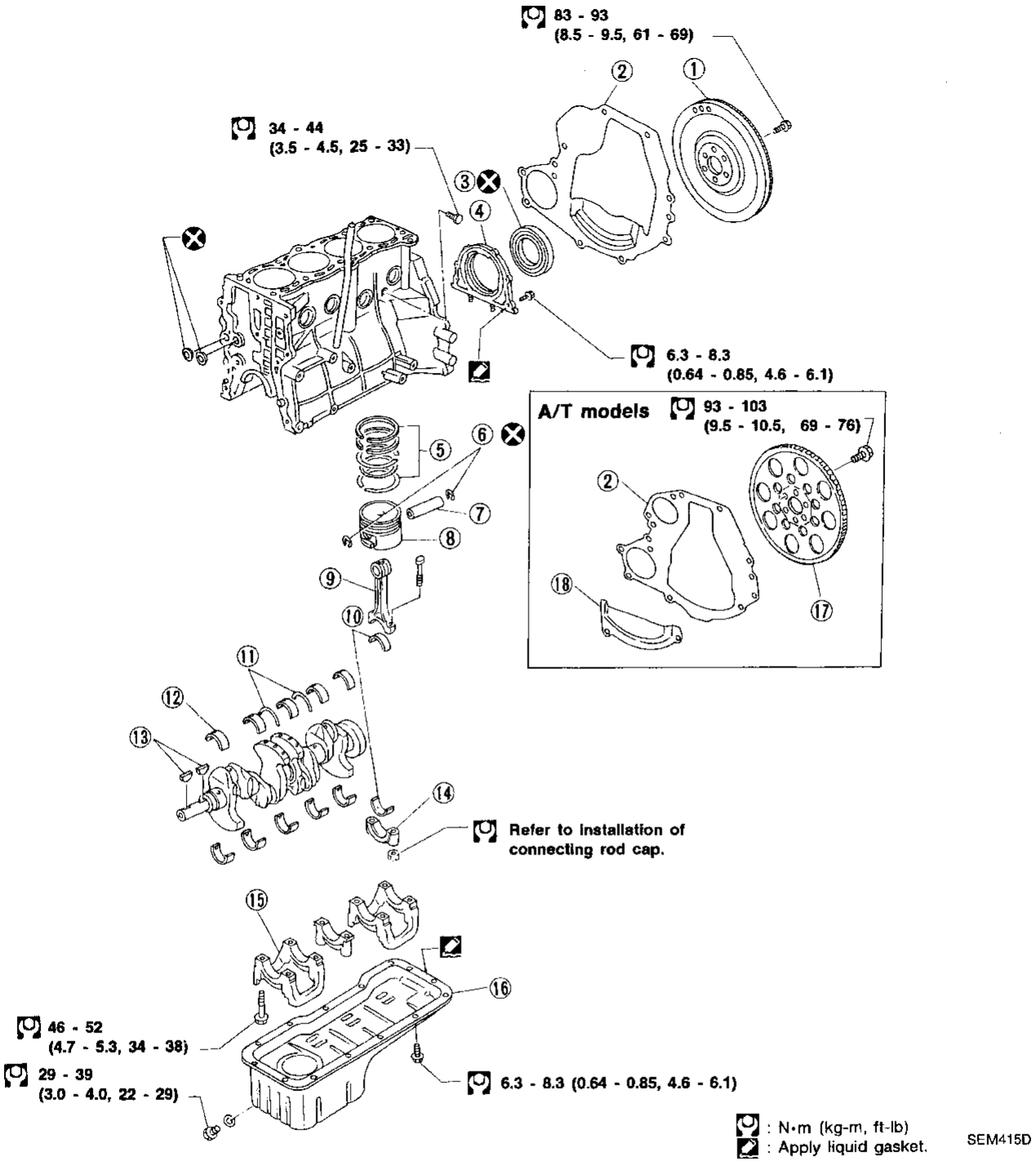


SEM421D

Installation

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

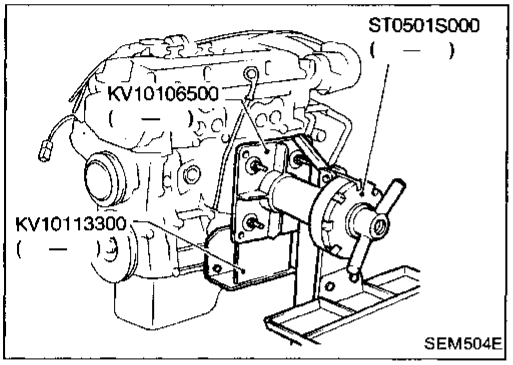
- Installation is in the reverse order of removal.



① Flywheel
② Rear plate
③ Rear oil seal
④ Rear oil seal retainer
⑤ Piston ring
⑥ Snap ring
⑦ Piston pin
⑧ Piston
⑨ Connecting rod
⑩ Connecting bearing
⑪ Thrust bearing
⑫ Main bearing
⑬ Key
⑭ Connecting rod cap
⑮ Bearing beam cap
⑯ Oil pan
⑰ Drive plate
⑱ Dust cover

CAUTION:

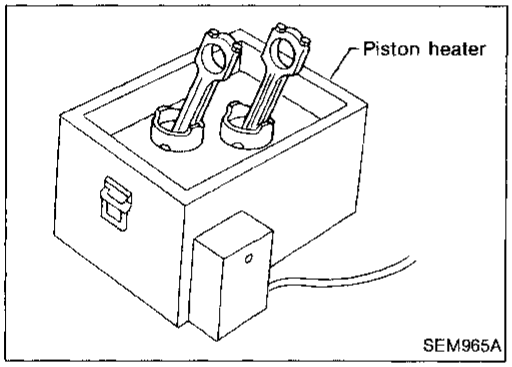
- **When installing sliding parts such as bearings and pistons, be sure to apply engine oil on the sliding surfaces.**
- **Place removed parts such as bearings and bearing caps in their proper order and direction.**
- **When tightening connecting rod bolts and main bearing cap bolts, apply engine oil to thread portion of bolts and seating surface of nuts.**



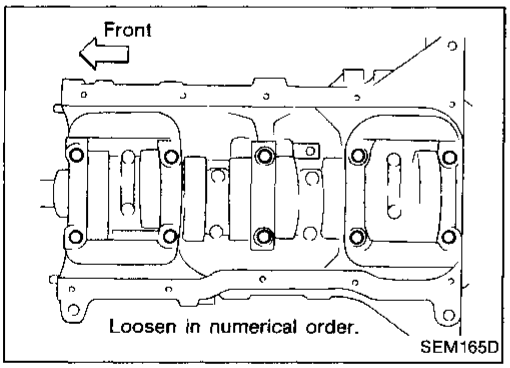
Disassembly

PISTON AND CRANKSHAFT

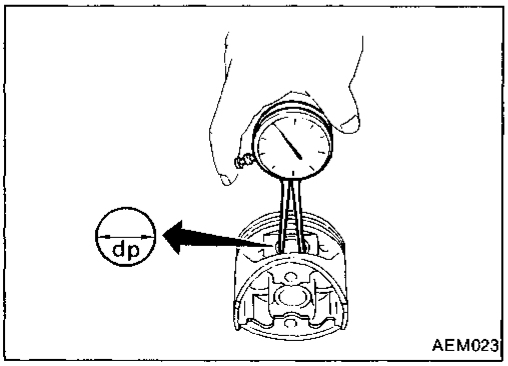
1. Place engine on a work stand.
2. Drain coolant and oil.
3. Remove timing chain.
   Refer to "Removal" in "TIMING CHAIN" (EM-74).



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



5. Remove bearing caps and crankshaft.
- **Before removing bearing caps, measure crankshaft end play.**
- **Bolts should be loosened in two or three steps.**

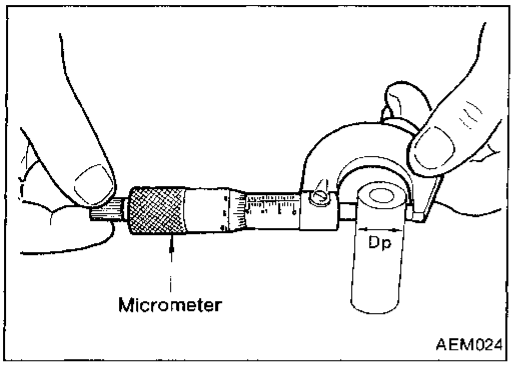


Inspection

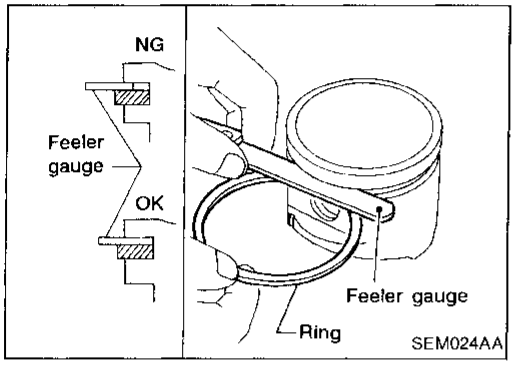
PISTON AND PISTON PIN CLEARANCE

1. Measure inner diameter of piston pin hole "dp".
   Standard diameter "dp":
   18.987 - 18.999 mm (0.7475 - 0.7480 in)

Inspection (Cont'd)



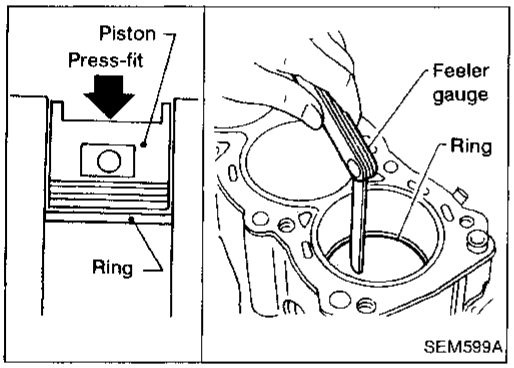
2. Measure outer diameter of piston pin "Dp".
   Standard diameter "Dp":
   18.989 - 19.001 mm (0.7476 - 0.7481 in)
3. Calculate piston pin clearance.
   dp – Dp = –0.004 to 0 mm (–0.0002 to 0 in)
   If it exceeds the above value, replace piston assembly with pin.



PISTON RING SIDE CLEARANCE

Side clearance:
Top ring
0.040 - 0.080 mm (0.0016 - 0.0031 in)
2nd ring
0.030 - 0.070 mm (0.0012 - 0.0028 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:

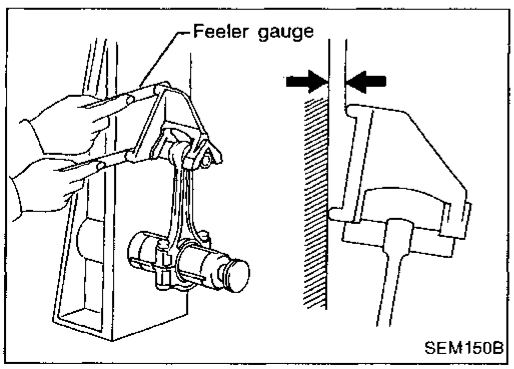
Top ring	**0.20 - 0.35 mm (0.0079 - 0.0138 in)**
2nd ring	**0.37 - 0.52 mm (0.0146 - 0.0205 in)**
Oil ring	**0.20 - 0.60 mm (0.0079 - 0.0236 in)**

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, rebore cylinder and use oversized piston and piston rings.

Refer to SDS (EM-113).

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



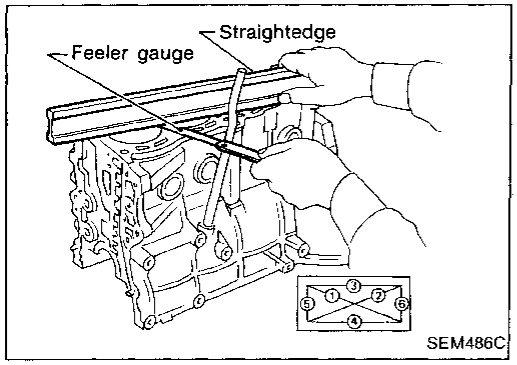
CONNECTING ROD BEND AND TORSION

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

If it exceeds the limit, replace connecting rod assembly.

Inspection (Cont'd)

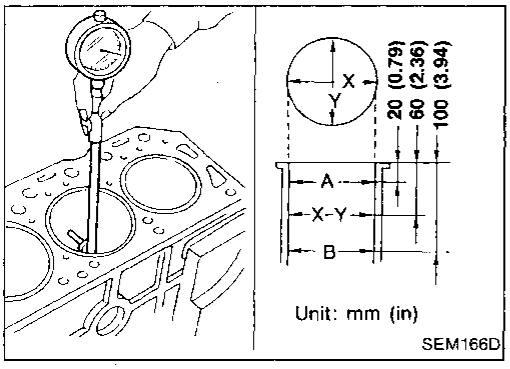
CYLINDER BLOCK DISTORTION AND WEAR



1. Clean upper face of cylinder block and measure the distortion.
   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.

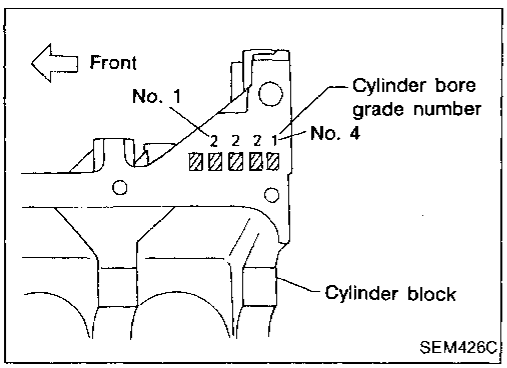
Amount of cylinder head resurfacing is "A".
Amount of cylinder block resurfacing is "B".
The maximum limit is as follows:
A + B = 0.2 mm (0.008 in)
Nominal cylinder block height from crankshaft center:
213.95 - 214.05 mm (8.4232 - 8.4271 in)

3. If necessary, replace cylinder block.



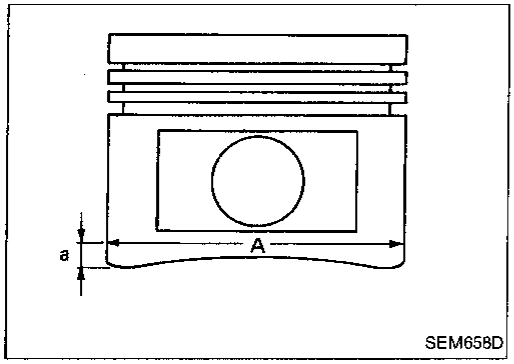
PISTON-TO-BORE CLEARANCE

1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper.
   Standard inner diameter:
   76.000 - 76.030 mm (2.9921 - 2.9933 in)
   Wear limit: 0.2 mm (0.008 in)
   If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.
   Out-of-round (X – Y) standard: 0.015 mm (0.0006 in)
   Taper (A – B) standard: 0.01 mm (0.0004 in)
2. Check for scratches and seizure. If seizure is found, hone it.



- **If both cylinder block and piston are replaced with new ones, select piston of the same grade number punched on cylinder block lower surface.**

Inspection (Cont'd)



3. Measure piston skirt diameter.
   Piston diameter "A":
   Refer to SDS (EM-54).
   Measuring point "a" (Distance from the bottom):
   9.5 mm (0.374 in)
4. Check that piston-to-bore clearance is within specification.
   Piston-to-bore clearance "B":
   0.015 - 0.035 mm (0.0006 - 0.0014 in)
5. Determine piston oversize according to amount of cylinder wear.

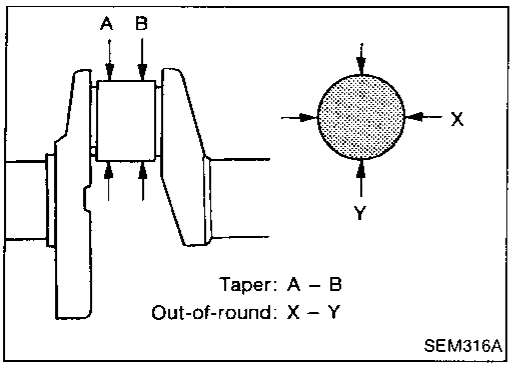
Oversize pistons are available for service. Refer to SDS (EM-113).

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 to prevent distortion of cylinder bores 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.**

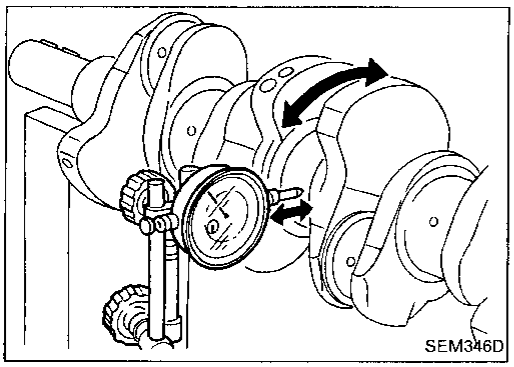
9. Hone cylinders to obtain specified piston-to-bore clearance.
10. Measure finished cylinder bore for out-of-round and taper.

- **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 0.002 mm (0.0001 in)



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

Inspection (Cont'd)

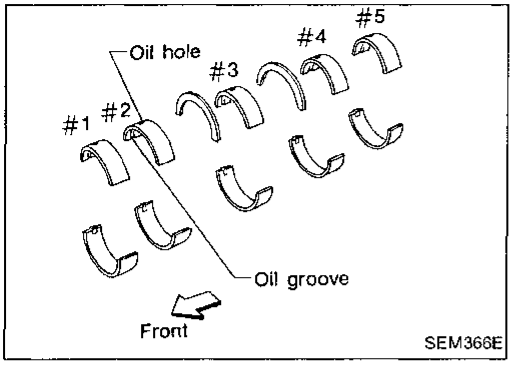
BEARING CLEARANCE

- Either of the following two methods may be used, however, method "A" gives more reliable results and is preferable.

Method A (Using bore gauge & micrometer)

Main bearing

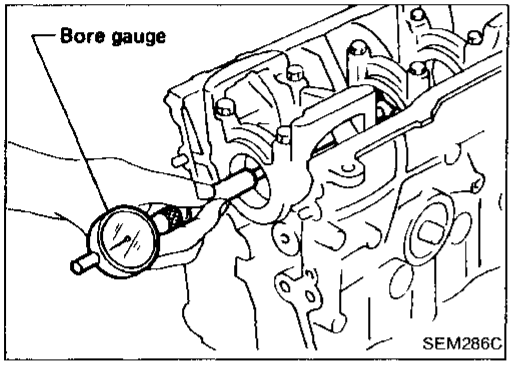
1. Set main bearings in their proper positions on cylinder block and main bearing cap.



2. Install main bearing cap to cylinder block.

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

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

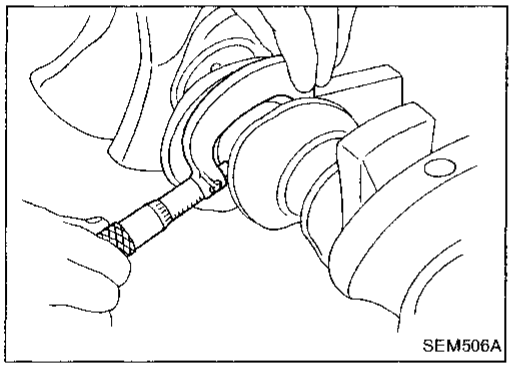


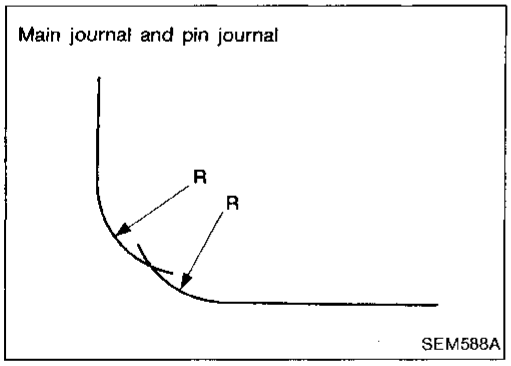
4. Measure outer diameter "Dm" of each main journal in crankshaft.
5. Calculate main bearing clearance.

   Main bearing clearance = A – Dm

   Standard: 0.018 - 0.042 mm (0.0007 - 0.0017 in)

   Limit: 0.1 mm (0.004 in)
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.





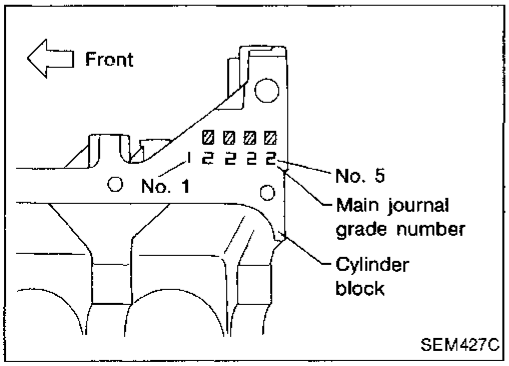
When grinding crank pin and crank journal:

a. Grind until clearance is within specified standard bearing clearance.

b. Fillets should be finished as shown in the figure.

R: 2.3 - 2.5 mm (0.091 - 0.098 in)

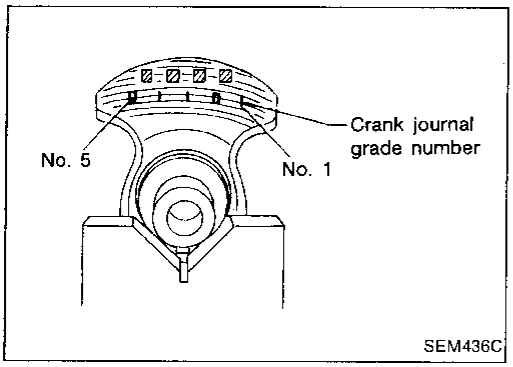
Refer to SDS (EM-114) for standard bearing clearance and available spare parts.



8. If crankshaft, cylinder block or main bearing is reused again, measure main bearing clearance. If crankshaft, cylinder block and main bearings are replaced with new ones, it is necessary to select thickness of main bearings as follows:

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

Inspection (Cont'd)

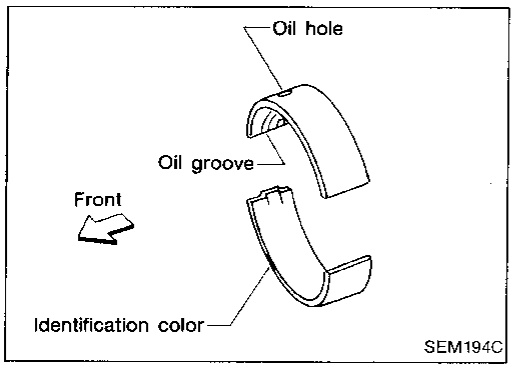


b. Grade number of each crankshaft main journal is punched on the respective crankshaft. These numbers are punched in either Arabic or Roman numerals.

c. Select main bearing with suitable thickness according to the following table.

Main bearing grade color:

Crankshaft journal grade number	Main journal grade number		
	0	1	2
0	Black	Brown	Green
1	Brown	Green	Yellow
2	Green	Yellow	Blue



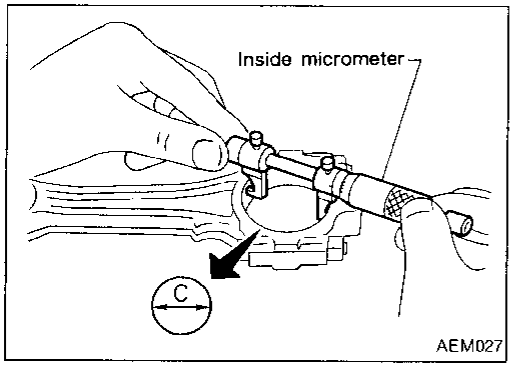
For example:
Main journal grade number: 1
Crankshaft journal grade number: 2
Main bearing grade number = 1 + 2 = Yellow

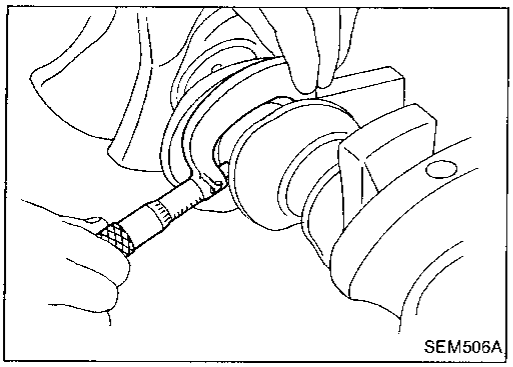
Connecting rod bearing (Big end)

1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.

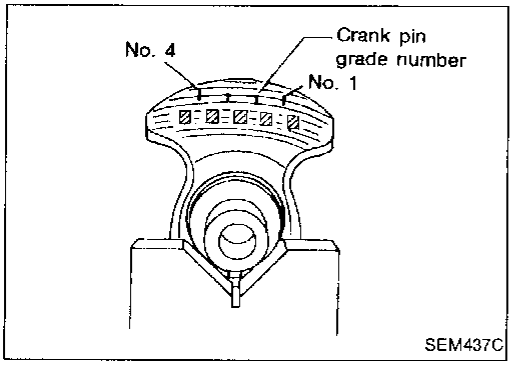
Tighten bolts to the specified torque.

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: 0.010 - 0.035 mm (0.0004 - 0.0014 in)
   Limit: 0.1 mm (0.004 in)
6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing. Refer to step 7 of "BEARING CLEARANCE — Main bearing" (EM-103).



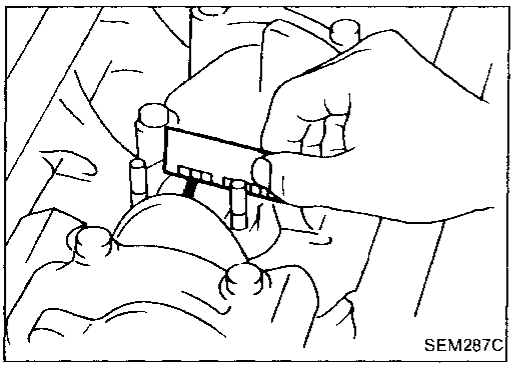
8. If bearing, crankshaft or connecting rod is replaced with a new one, select connecting rod bearing according to the following table.

Connecting rod bearing grade number:

These numbers are punched in either Arabic or Roman numerals.

Crank pin grade number	Connecting rod bearing grade color
0	—
1	Brown
2	Green

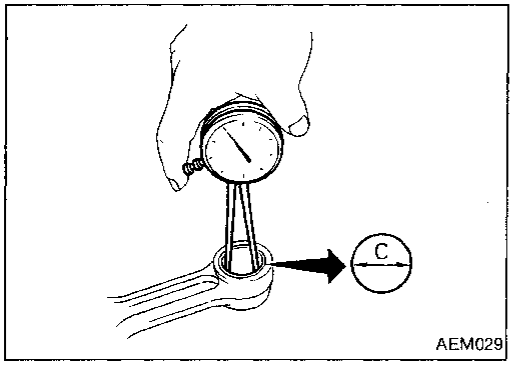
Inspection (Cont'd)


SEM287C

Method B (Using plastigage)

CAUTION:

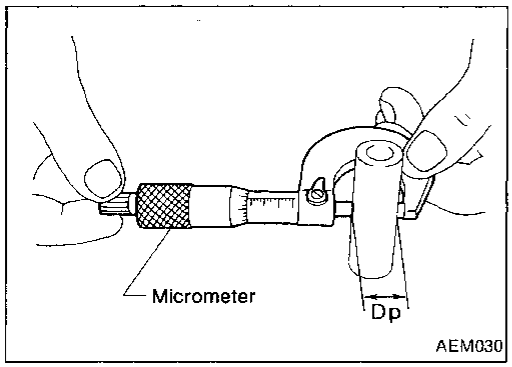
- **Do not turn crankshaft or connecting rod while plastigage is being inserted.**
- **When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. Then if excessive bearing clearance exists, use a thicker main bearing or undersized bearing so that the specified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



AEM029

CONNECTING ROD BUSHING CLEARANCE (Small end)

1. Measure inner diameter "C" of bushing.



AEM030

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

Connecting rod bushing clearance = C – Dp

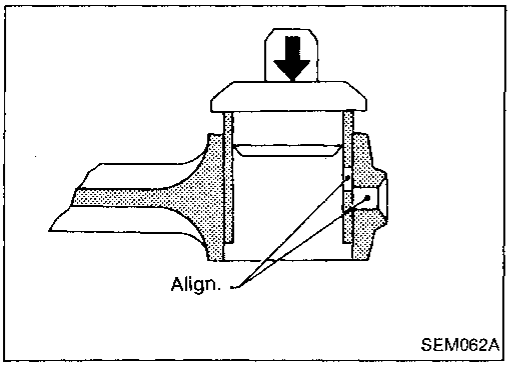
Standard:

0.005 - 0.017 mm (0.0002 - 0.0007 in)

Limit:

0.023 mm (0.0009 in)

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



SEM062A

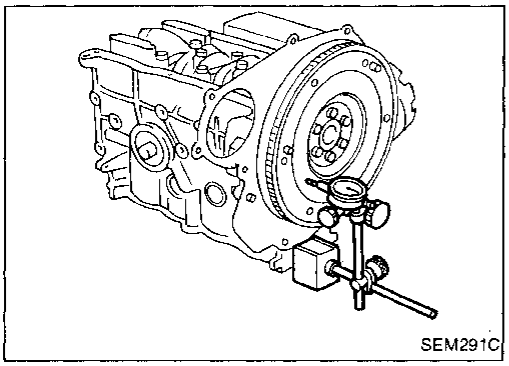
REPLACEMENT OF CONNECTING ROD BUSHING (Small end)

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 so that clearance between connecting rod busing and piston pin achieves specified value.

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


SEM291C

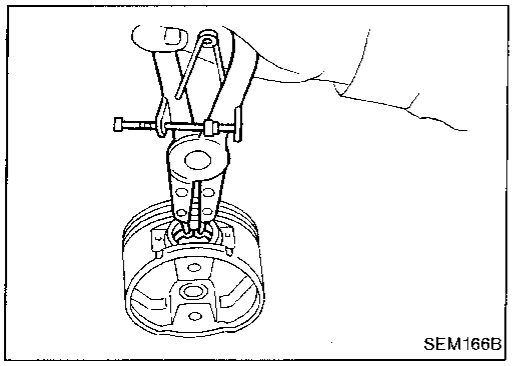
FLYWHEEL RUNOUT

Runout (Total indicator reading):

Flywheel

Less than 0.15 mm (0.0059 in)

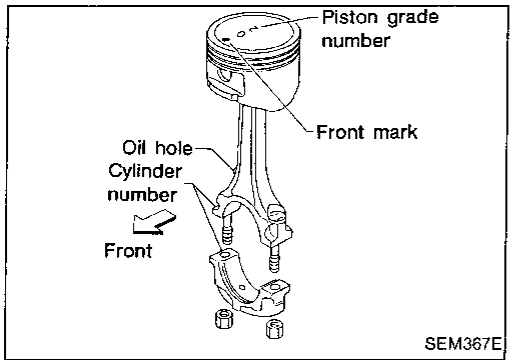
GI MA EM LC EF & EC FE CL MT AT FA RA BR ST BF HA EL IDX


SEM166B

Assembly

PISTON

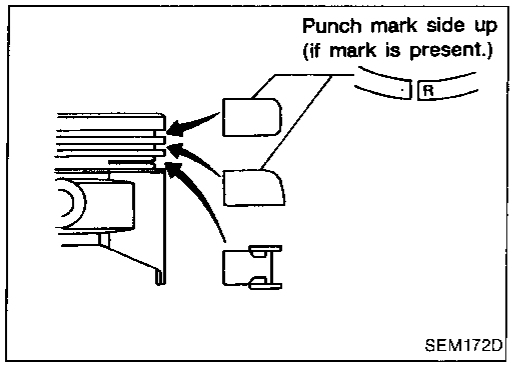
1. Install new snap ring on one side of piston pin hole.



SEM367E

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.**

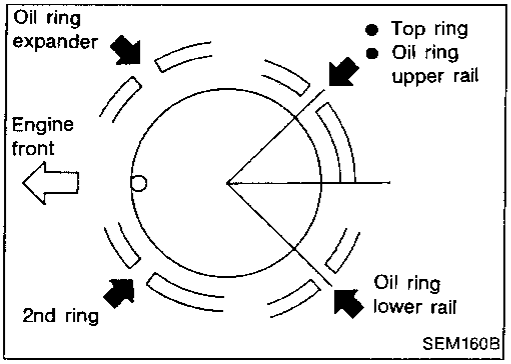


SEM172D

3. Set piston rings as shown.

CAUTION:

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

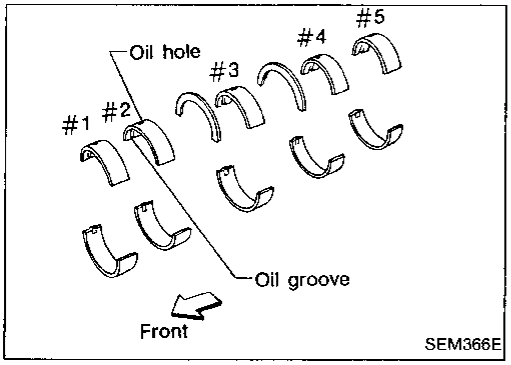


SEM160B

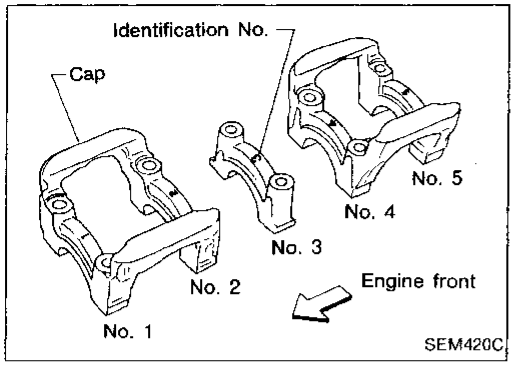
CRANKSHAFT

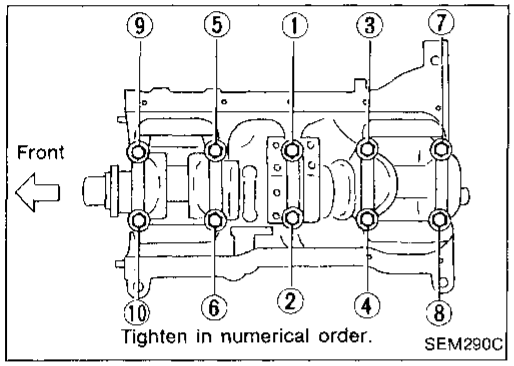
1. Set main bearings in their proper positions on cylinder block and main bearing cap.

- **Confirm that correct main bearings are used. Refer to "Inspection" (EM-102).**



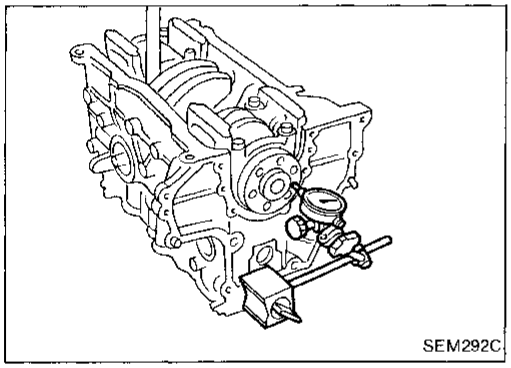
SEM366E





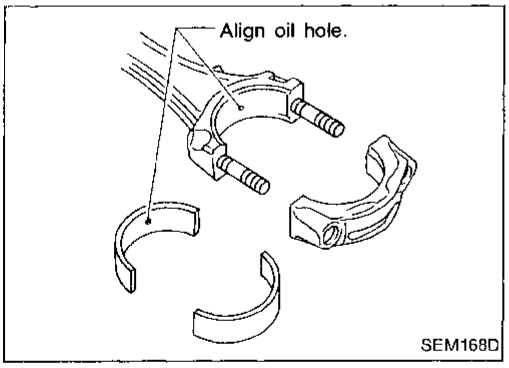
2. Install crankshaft and main bearing caps and tighten bolts to the specified torque.

- **Prior to tightening bearing cap bolts, place bearing cap in its proper position by shifting crankshaft in the axial direction.**
- **Tighten bearing cap bolts gradually in two or three stages. Start with center bearing and move outward sequentially.**
- **After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.**



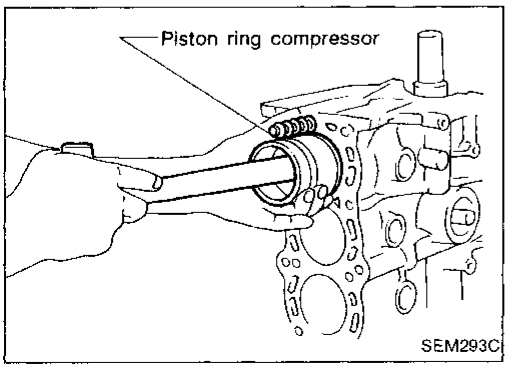
3. Measure crankshaft end play.

Crankshaft end play:
Standard
0.060 - 0.180 mm (0.0024 - 0.0071 in)
Limit
0.3 mm (0.012 in)
If beyond the limit, replace thrust bearing with a new one.



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

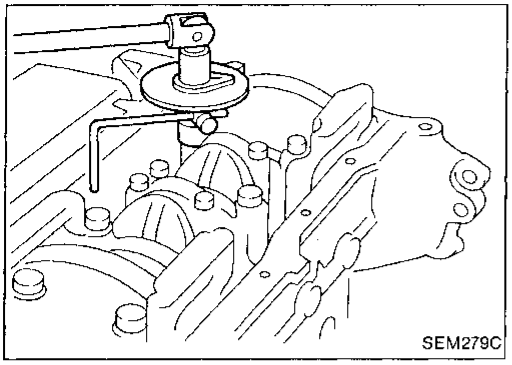
- Confirm that correct bearings are used. Refer to "Inspection" (EM-104).
- Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.



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.**

Assembly (Cont'd)

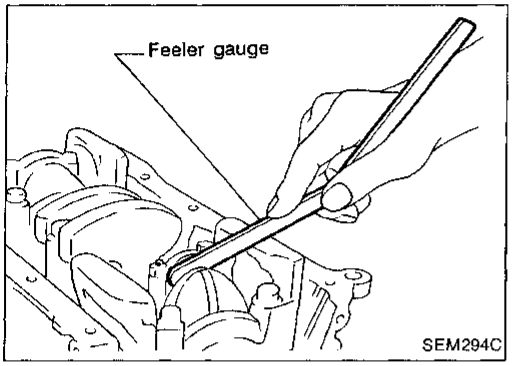


b. Install connecting rod caps.
Tighten connecting rod cap nuts to the specified torque.

: Connecting rod cap nuts

(1) Tighten to 14 to 16 N·m (1.4 to 1.6 kg-m, 10 to 12 ft-lb).

(2) Turn nuts to 35° to 40° degrees clockwise with an angle wrench. If an angle wrench is not available tighten nuts to 23 to 28 N·m (2.3 to 2.9 kg-m, 17 to 21 ft-lb).



6. Measure connecting rod side clearance.

Connecting rod side clearance:

Standard

0.200 - 0.470 mm (0.0079 - 0.0185 in)

Limit

0.52 mm (0.0205 in)

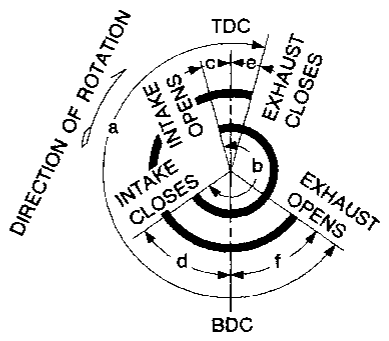
If beyond the limit, replace connecting rod and/or crankshaft.

General Specifications

GENERAL SPECIFICATIONS

Engine	GA16DE
Classification	Gasoline
Cylinder arrangement	4, in-line
Displacement cm^3 (cu in)	1,597 (97.45)
Bore × stroke mm (in)	76.0 x 88.0 (2.992 x 3.465)
Valve arrangement	DOHC
Firing order	1-3-4-2
Number of piston rings	
Compression	2
Oil	1
Number of main bearings	5
Compression ratio	9.5

Valve timing



EM120

Unit: degree

a	b	c	d	e	f
222	236	–2	58	0	42

Inspection and Adjustment

ENGINE COMPRESSION PRESSURE

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

Standard	1,324 (13.5, 192)
Minimum	1,128 (11.5, 164)
Difference limit between cylinders	98 (1.0, 14)

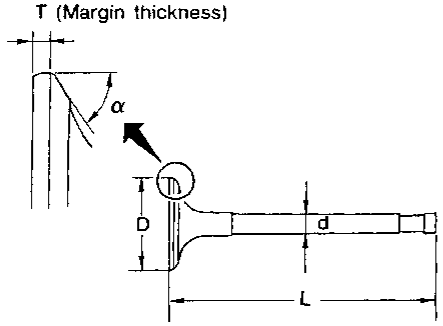
CYLINDER HEAD

Unit: mm (in)

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

VALVE

Unit: mm (in)



SEM188

Valve head diameter "D"	Intake	29.9 - 30.1 (1.177 - 1.185)
	Exhaust	23.9 - 24 (0.941 - 0.945)
Valve length "L"	Intake	92.00 - 92.5 (3.6220 - 3.6417)
	Exhaust	92.37 - 92.87 (3.6366 - 3.6563)
Valve stem diameter "d"	Intake	5.465 - 5.480 (0.2152 - 0.2157)
	Exhaust	5.445 - 5.460 (0.2144 - 0.2150)
Valve face angle "α"		45°15' - 45°45'
Valve margin "T" limit		0.9 - 1.1 (0.035 - 0.043)
Valve stem end surface grinding limit		0.2 (0.008)

Valve clearance

Unit: mm (in)

	For adjusting		For checking
	Hot	Cold* (reference data)	Hot
Intake	0.32 - 0.40 (0.013 - 0.016)	0.25 - 0.33 (0.010 - 0.013)	0.21 - 0.49 (0.008 - 0.019)
Exhaust	0.37 - 0.45 (0.015 - 0.018)	0.32 - 0.40 (0.013 - 0.016)	0.30 - 0.58 (0.012 - 0.023)

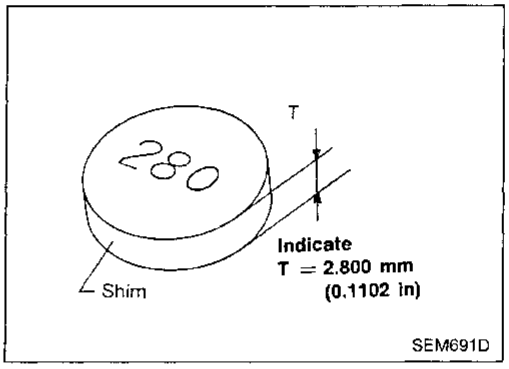
*: At a temperature of approximately 20°C (68°F)

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

Available shims

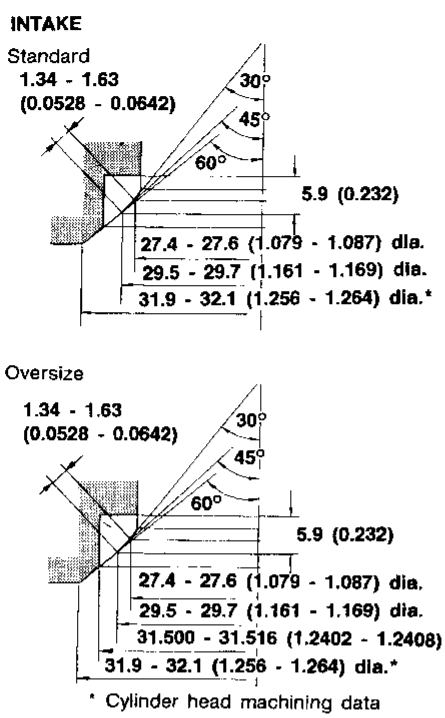
Thickness mm (in)	Identification mark
2.00 (0.0787)	200
2.02 (0.0795)	202
2.04 (0.0803)	204
2.06 (0.0811)	206
2.08 (0.0819)	208
2.10 (0.0827)	210
2.12 (0.0835)	212
2.14 (0.0843)	214
2.16 (0.0850)	216
2.18 (0.0858)	218
2.20 (0.0866)	220
2.22 (0.0874)	222
2.24 (0.0882)	224
2.26 (0.0890)	226
2.28 (0.0898)	228
2.30 (0.0906)	230
2.32 (0.0913)	232
2.34 (0.0921)	234
2.36 (0.0929)	236
2.38 (0.0937)	238
2.40 (0.0945)	240
2.42 (0.0953)	242
2.44 (0.0961)	244
2.46 (0.0969)	246
2.48 (0.0976)	248
2.50 (0.0984)	250
2.52 (0.0992)	252
2.54 (0.1000)	254
2.56 (0.1008)	256
2.58 (0.1016)	258
2.60 (0.1024)	260
2.62 (0.1031)	262
2.64 (0.1039)	264
2.66 (0.1047)	266
2.68 (0.1055)	268
2.70 (0.1063)	270
2.72 (0.1071)	272
2.74 (0.1079)	274
2.76 (0.1087)	276
2.78 (0.1094)	278
2.80 (0.1102)	280
2.82 (0.1110)	282
2.84 (0.1118)	284
2.86 (0.1126)	286

Thickness mm (in)	Identification mark
2.88 (0.1134)	288
2.90 (0.1142)	290
2.92 (0.1150)	292
2.94 (0.1157)	294
2.96 (0.1165)	296
2.98 (0.1173)	298

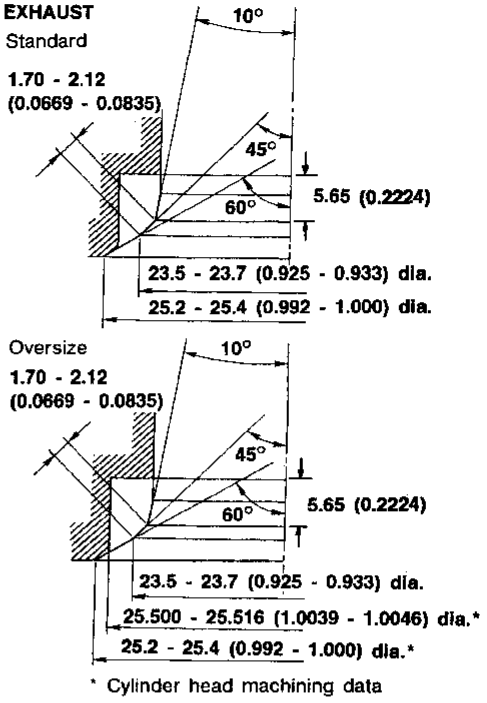


Valve seat

Unit: mm (in)



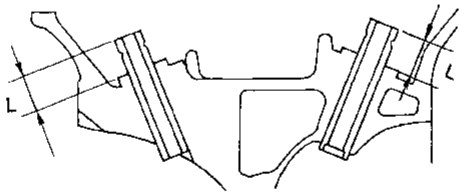
SEM378E



SEM379E

Valve guide

Unit: mm (in)



SEM737D

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

Inspection and Adjustment (Cont'd)

Valve spring

Free height	mm (in)	41.19 (1.6217)
Pressure N (kg, lb) at height mm (in)	Standard	344.42 (35.12, 77.44) at 25.26 (0.9945)
	Limit	330.41 (33.69, 74.31) at 23.64 (0.9307)
Out-of-square	mm (in)	Less than 1.80 (0.0709)

Valve lifter

Unit: mm (in)

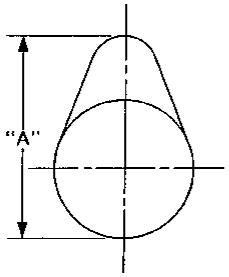
Valve lifter outside diameter	29.960 - 29.975 (1.1795 - 1.1801)
Lifter guide inside diameter	30.000 - 30.021 (1.1811 - 1.1819)
Clearance between lifter and lifter guide	0.025 - 0.061 (0.0010 - 0.0024)

CAMSHAFT AND CAMSHAFT BEARING

Camshaft

Unit: mm (in)

Cam height "A"	Intake	40.60 - 40.79 (1.5984 - 1.6059)
	Exhaust	39.88 - 40.07 (1.5701 - 1.5776)
Cam wear limit		0.20 (0.0079)



EM671

Camshaft bearing

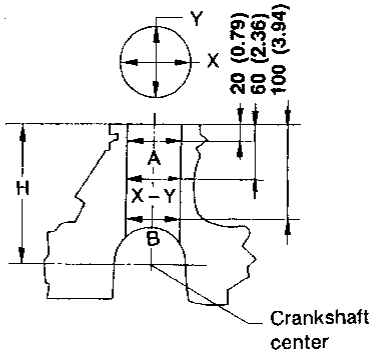
Unit: mm (in)

		Standard	Limit
Camshaft journal to bearing clearance		0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
Inner diameter of camshaft bearing	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2 to No. 5	24.000 - 24.021 (0.9449 - 0.9457)	
Outer diameter of camshaft journal	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2 to No. 5	23.935 - 23.955 (0.9423 - 0.9431)	
Camshaft runout [TIR*]		Less than 0.02 (0.0008)	0.1 (0.004)
Camshaft end play		0.070 - 0.143 (0.0028 - 0.0056)	0.20 (0.0079)

*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



SEM171D

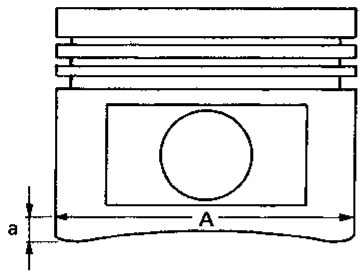
		Standard	Limit
Surface flatness		Less than 0.03 (0.0012)	0.1 (0.004)
Height "H" (nominal)		213.95 - 214.05 (8.4232 - 8.4271)	—
Standard Inner diameter	Grade No. 1	76.000 - 76.010 (2.9921 - 2.9925)	0.2 (0.008)
	Grade No. 2	76.010 - 76.020 (2.9925 - 2.9929)	
	Grade No. 3	76.020 - 76.030 (2.9929 - 2.9933)	
Out-of-round (X – Y)		Less than 0.015 (0.0006)	—
Taper (A – B)		Less than 0.010 (0.0004)	—
Difference in inner diameter between cylinders		0.05 (0.0020)	0.2 (0.008)

Inspection and Adjustment (Cont'd)

PISTON, PISTON RING AND PISTON PIN

Piston

Unit: mm (in)



SEM416D

Piston skirt diameter "A"	
Standard	
Grade No. 1	75.975 - 75.985 (2.9911 - 2.9915)
Grade No. 2	75.985 - 75.995 (2.9915 - 2.9919)
Grade No. 3	75.995 - 76.005 (2.9919 - 2.9923)
0.5 (0.020) oversize (service)	76.475 - 76.505 (3.0108 - 3.0120)
1.0 (0.039) oversize (service)	76.975 - 77.005 (3.0305 - 3.0317)
"a" dimension	9.5 (0.374)
Piston pin hole inner diameter	18.987 - 18.999 (0.7475 - 0.7480)
Piston pin outer diameter	18.989 - 19.001 (0.7476 - 0.7481)
Piston to bore clearance	0.015 - 0.035 (0.0006 - 0.0014)

Piston ring

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.2 (0.008)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	
End gap	Top	0.20 - 0.35 (0.0079 - 0.0138)	1.0 (0.039)
	2nd	0.37 - 0.52 (0.0146 - 0.0205)	
	Oil	0.20 - 0.60 (0.0079 - 0.0236)	

Piston pin

Unit: mm (in)

Piston pin outer diameter	18.989 - 19.001 (0.7476 - 0.7481)
Piston pin to piston clearance	– 0.004 to 0 (– 0.0002 to 0)
Piston pin to connecting rod, bushing clearance	0.005 - 0.017 (0.0002 - 0.0007)

CONNECTING ROD

Unit: mm (in)

Center distance	140.45 - 140.55 (5.5295 - 5.5335)
Bend limit [per 100 (3.94)]	0.15 (0.0059)
Torsion limit [per 100 (3.94)]	0.3 (0.012)
Connecting rod bushing inner diameter* (small end)	19.000 - 19.012 (0.7480 - 0.7485)
Connecting rod big end inner diameter	43.000 - 43.013 (1.6929 - 1.6934)
Side clearance	
Standard	0.20 - 0.47 (0.0079 - 0.0185)
Limit	0.52 (0.0205)

*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)

Main journal dia. "Dm"	
Grade No. 0	49.956 - 49.964 (1.9668 - 1.9671)
Grade No. 1	49.948 - 49.956 (1.9665 - 1.9668)
Grade No. 2	49.940 - 49.948 (1.9661 - 1.9665)
Pin journal dia. "Dp"	
Grade No. 0	39.968 - 39.974 (1.5735 - 1.5738)
Grade No. 1	39.962 - 39.968 (1.5733 - 1.5735)
Grade No. 2	39.956 - 39.962 (1.5731 - 1.5733)
Center distance "r"	43.95 - 44.05 (1.7303 - 1.7342)
Out-of-round (X – Y)	
Standard	Less than 0.005 (0.0002)
Taper (A – B)	
Standard	Less than 0.002 (0.0001)
Runout [TIR*]	
Standard	Less than 0.05 (0.0020)
Free end play	
Standard	0.060 - 0.180 (0.0024 - 0.0071)
Limit	0.3 (0.012)

*: Total indicator reading

Inspection and Adjustment (Cont'd)

MAIN BEARING

Standard

Grade No.	Thickness "T" mm (in)	Identification color
0	1.826 - 1.830 (0.0719 - 0.0720)	Black
1	1.830 - 1.834 (0.0720 - 0.0722)	Brown
2	1.834 - 1.838 (0.0722 - 0.0724)	Green
3	1.838 - 1.842 (0.0724 - 0.0725)	Yellow
4	1.842 - 1.846 (0.0725 - 0.0727)	Blue

Undersize

Unit: mm (in)

	Thickness "T"
0.25 (0.0098)	1.957 - 1.965 (0.0770 - 0.0774)
0.50 (0.0197)	2.082 - 2.090 (0.0820 - 0.0823)

AVAILABLE CONNECTING ROD BEARING

Connecting rod bearing

Unit: mm (in)

	Grade No.	Thickness	Identification color or number
Standard	0	1.505 - 1.508 (0.0593 - 0.0594)	—
	1	1.508 - 1.511 (0.0594 - 0.0595)	Brown
	2	1.511 - 1.514 (0.0595 - 0.0596)	Green
Undersize	0.08 (0.0031)	1.542 - 1.546 (0.0607 - 0.0609)	8
	0.12 (0.0047)	1.562 - 1.566 (0.0615 - 0.0617)	12
	0.25 (0.0098)	1.627 - 1.631 (0.0641 - 0.0642)	25

Bearing clearance

Unit: mm (in)

Main bearing clearance	
Standard	0.018 - 0.042 (0.0007 - 0.0017)
Limit	0.1 (0.004)
Connecting rod bearing clearance	
Standard	0.010 - 0.035 (0.0004 - 0.0014)
Limit All	0.1 (0.004)

MISCELLANEOUS COMPONENTS

Unit: mm (in)

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

*: Total indicator reading