

ENGINE MECHANICAL

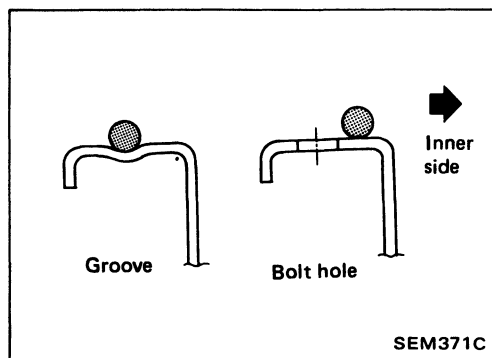
SECTION **EM**

EM

CONTENTS

PRECAUTION	EM- 2
PREPARATION	EM- 3
OUTER COMPONENT PARTS	EM- 6
COMPRESSION PRESSURE	EM- 8
OIL PAN	EM- 9
TIMING CHAIN	EM-11
OIL SEAL REPLACEMENT	EM-16
CYLINDER HEAD	EM-18
ENGINE REMOVAL	EM-32
CYLINDER BLOCK	EM-35
SERVICE DATA AND SPECIFICATIONS (S.D.S.)	EM-47

PRECAUTION

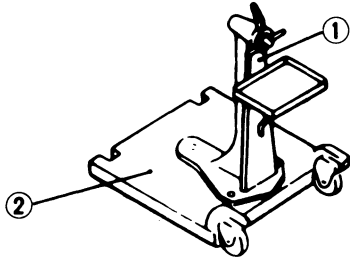
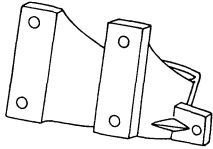
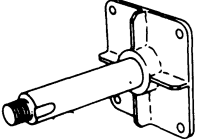
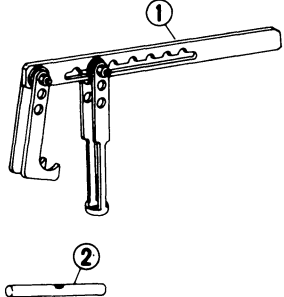
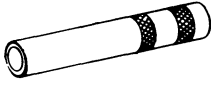


LIQUID GASKET APPLICATION PROCEDURE

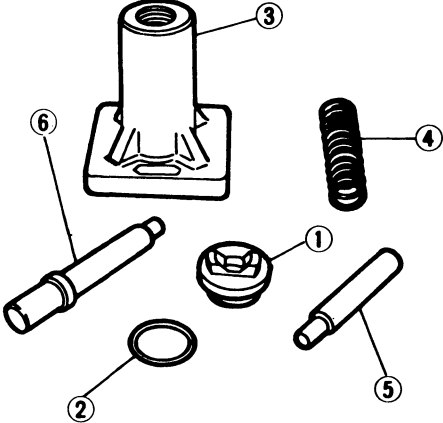
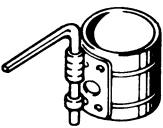
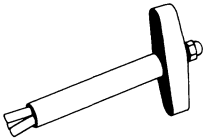
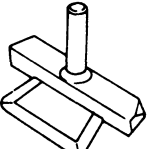
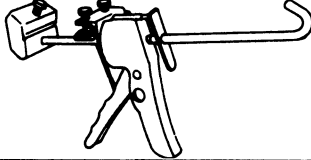
- Before applying liquid gasket, use a scraper to remove all traces of old liquid gasket from mating surface.
- Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)
 - Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide (for oil pan).
 - Be sure liquid gasket is 2.0 to 3.0 mm (0.079 to 0.118 in) wide (in areas except oil pan).
- Apply liquid gasket to inner sealing surface around hole perimeter area. (Assembly should be done within 5 minutes after coating.)
- Wait at least 30 minutes before refilling engine oil and engine coolant.

PREPARATION

SPECIAL SERVICE TOOLS

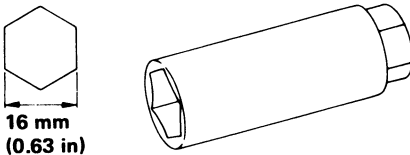
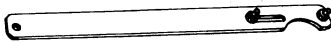
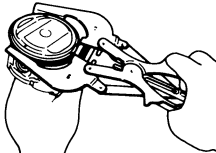
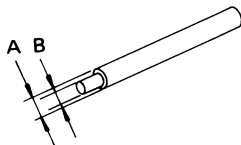
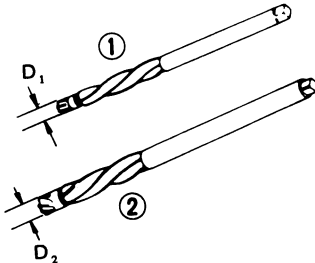
Tool number (Kent-Moore No.) Tool name	Description
ST0501S000 (-) Engine stand assembly ① ST05011000 (-) Engine stand ② ST05012000 (-) Base	 Disassembling and assembling
KV10114300 (-) Engine sub-attachment	
KV101065001 (-) Engine stand shaft	
KV101092S0 (-) Valve spring compressor ① KV10109210 (-) Compressor ② KV10109220 (-) Adapter	 Disassembling and assembling valve components
KV109B0010 (-) Valve oil seal drift	 Installing valve oil seal

PREPARATION

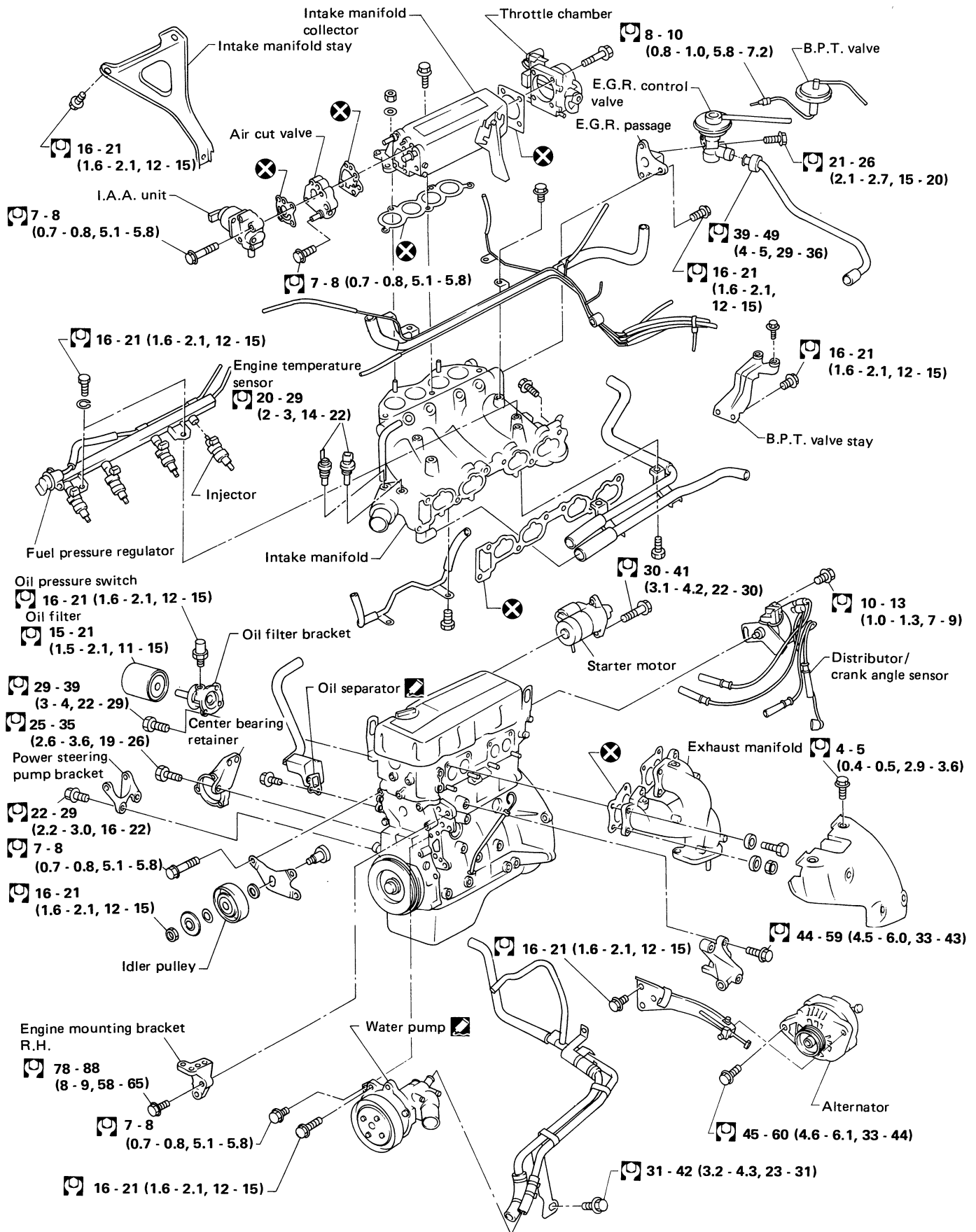
Tool number (Kent-Moore No.) Tool name	Description
KV10110300 (-) Piston pin press stand assembly ① KV10110310 (-) Cap ② KV10110330 (-) Spacer ③ ST13030020 (-) Press stand ④ ST13030030 (-) Spring ⑤ KV10110340 (-) Drift ⑥ KV10110320 (-) Center shaft	Disassembling and assembling piston with connecting rod 
EM03470000 (J8037) Piston ring compressor	Installing piston assembly into cylinder bore 
(J36467) Valve oil seal remover	Displacement valve oil seal 
KV10111100 (-) Seal cutter	Removing oil pan 
WS39930000 (-) Tube presser	Pressing the tube of liquid gasket 
ST16610001 (J23907) Pilot bushing puller	

PREPARATION

COMMERCIAL SERVICE TOOLS

Tool name	Description													
Spark plug wrench		Removing and installing spark plug												
Pulley holder		Holding camshaft pulley while tightening or loosening camshaft bolt												
Valve seat cutter set		Finishing valve seat dimensions												
Piston ring expander		Removing and installing piston ring												
Valve guide drift		Removing and installing valve guide <table><tr><td colspan="2">Diameter:</td><td>mm (in)</td></tr><tr><td></td><td>Intake</td><td>Exhaust</td></tr><tr><td>A</td><td>10.5 (0.413)</td><td>11.5 (0.453)</td></tr><tr><td>B</td><td>6.6 (0.260)</td><td>7.6 (0.299)</td></tr></table>	Diameter:		mm (in)		Intake	Exhaust	A	10.5 (0.413)	11.5 (0.453)	B	6.6 (0.260)	7.6 (0.299)
Diameter:		mm (in)												
	Intake	Exhaust												
A	10.5 (0.413)	11.5 (0.453)												
B	6.6 (0.260)	7.6 (0.299)												
Valve guide reamer		Reaming valve guide (①) or hole for oversize valve guide (②) <table><tr><td colspan="2">Diameter:</td><td>mm (in)</td></tr><tr><td></td><td>Intake</td><td>Exhaust</td></tr><tr><td>D₁</td><td>7 (0.28)</td><td>8 (0.31)</td></tr><tr><td>D₂</td><td>11.2 (0.441)</td><td>12.2 (0.480)</td></tr></table>	Diameter:		mm (in)		Intake	Exhaust	D ₁	7 (0.28)	8 (0.31)	D ₂	11.2 (0.441)	12.2 (0.480)
Diameter:		mm (in)												
	Intake	Exhaust												
D ₁	7 (0.28)	8 (0.31)												
D ₂	11.2 (0.441)	12.2 (0.480)												

OUTER COMPONENT PARTS



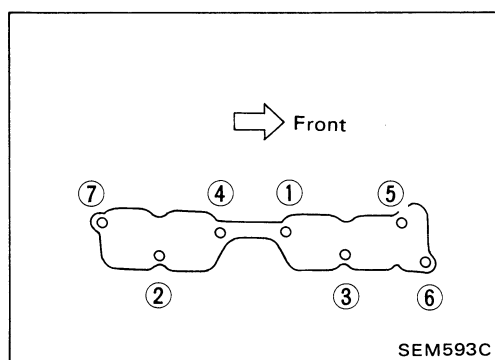
□ : N-m (kg-m, ft-lb)
SEM549C

OUTER COMPONENT PARTS

Tightening Procedure of each Part

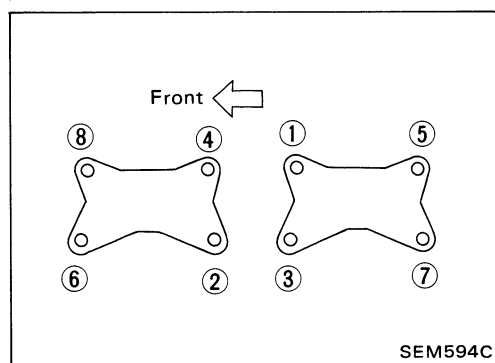
INTAKE MANIFOLD

: 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb)



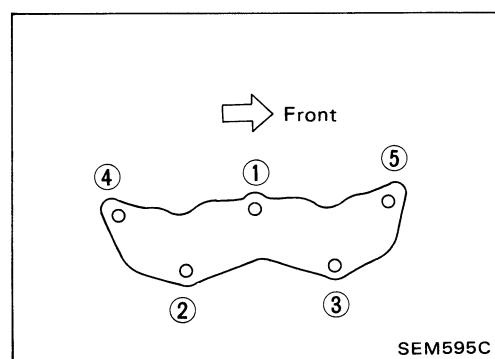
EXHAUST MANIFOLD

: 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb)



INTAKE MANIFOLD COLLECTOR

: 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb)



THROTTLE CHAMBER

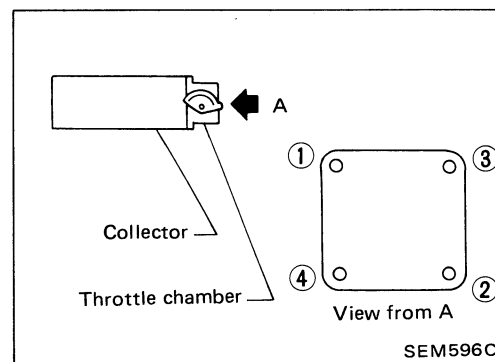
: Bolts should be tightened twice.

1st:

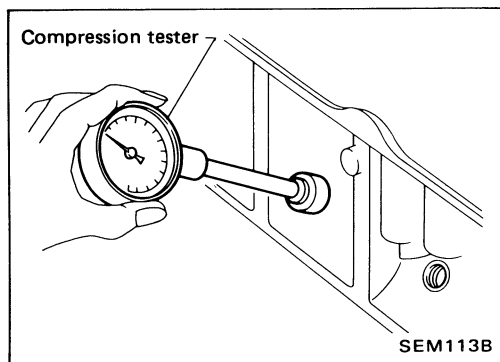
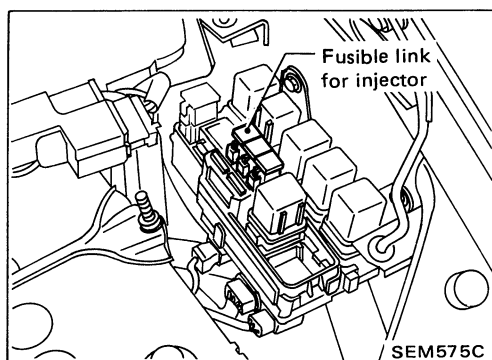
9 - 11 N·m (0.9 - 1.1 kg-m, 6.5 - 8.0 ft-lb)

2nd:

18 - 22 N·m (1.8 - 2.2 kg-m, 13 - 16 ft-lb)



COMPRESSION PRESSURE



Measurement of Compression Pressure

1. Warm up engine.
2. Turn ignition switch off.
3. Disconnect fusible link for injectors.
4. Remove all spark plugs.
5. Disconnect distributor center cable.
6. Attach a compression tester to No. 1 cylinder.
7. Depress accelerator pedal fully to keep throttle valve wide open.
8. Crank engine and record highest gauge indication.
9. Repeat the measurement on each cylinder as shown above.
- **Always use a fully-charged battery to obtain specified engine revolution.**

Compression pressure:

kPa (kg/cm², psi)/rpm

Standard

1,206 (12.3, 175)/250

Minimum

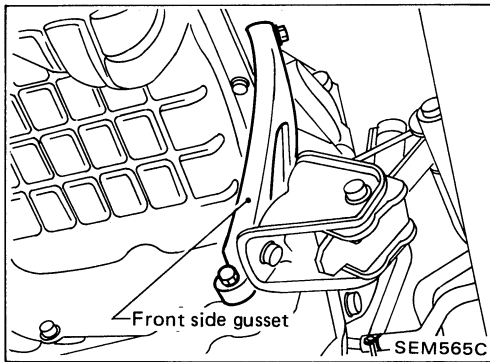
1,010 (10.3, 146)/250

Difference limit between cylinders

98 (1.0, 14)/250

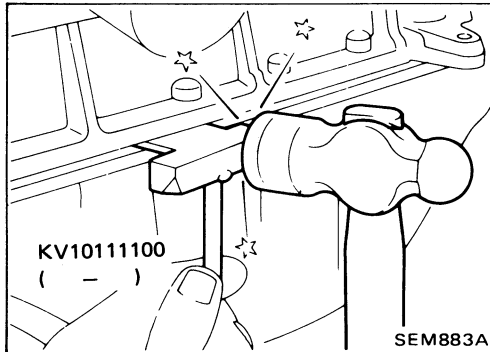
10. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through spark plug holes and retest compression.
- **If adding oil helps compression, piston rings may be worn or damaged. If so, replace piston rings after checking piston.**
- **If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. (Refer to S.D.S.) 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 help compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.**

OIL PAN

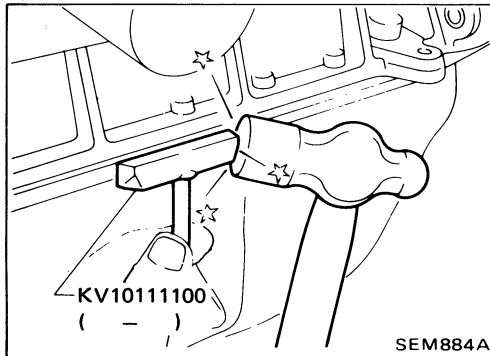


Removal

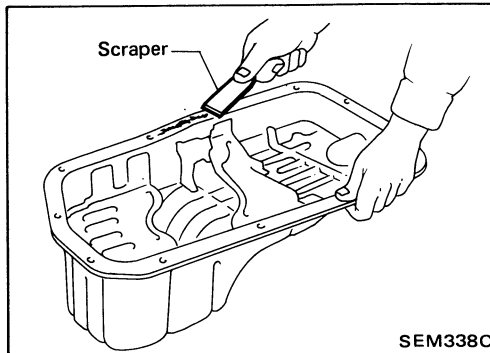
1. Remove the following parts:
 - Front exhaust tube
 - Front side gusset
 - Center member (2WD model)
2. Remove oil pan bolts.



3. Remove oil pan.
 - (1) Insert Tool between cylinder block and oil pan.
 - **Do not drive seal cutter into oil pump or rear oil seal retainer portion, or aluminum mating face will be damaged.**
 - **Do not insert screwdriver, or oil pan flange will be deformed.**

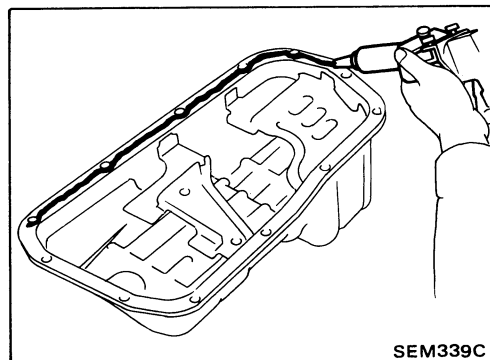


- (2) Slide Tool by tapping its side with a hammer, and remove oil pan.



Installation

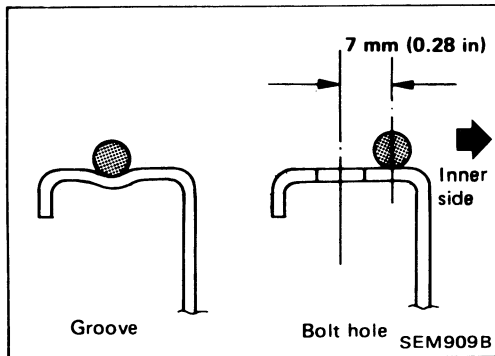
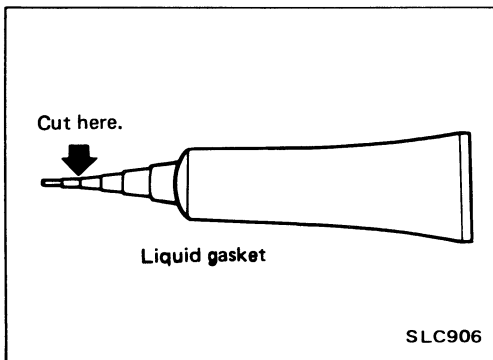
1. Before installing oil pan, remove all traces of liquid gasket from mating surface using a scraper.
 - Also remove traces of liquid gasket from mating surface of cylinder block.



2. Apply a continuous bead of liquid gasket to mating surface of oil pan.
 - **Use Genuine Liquid Gasket or equivalent.**

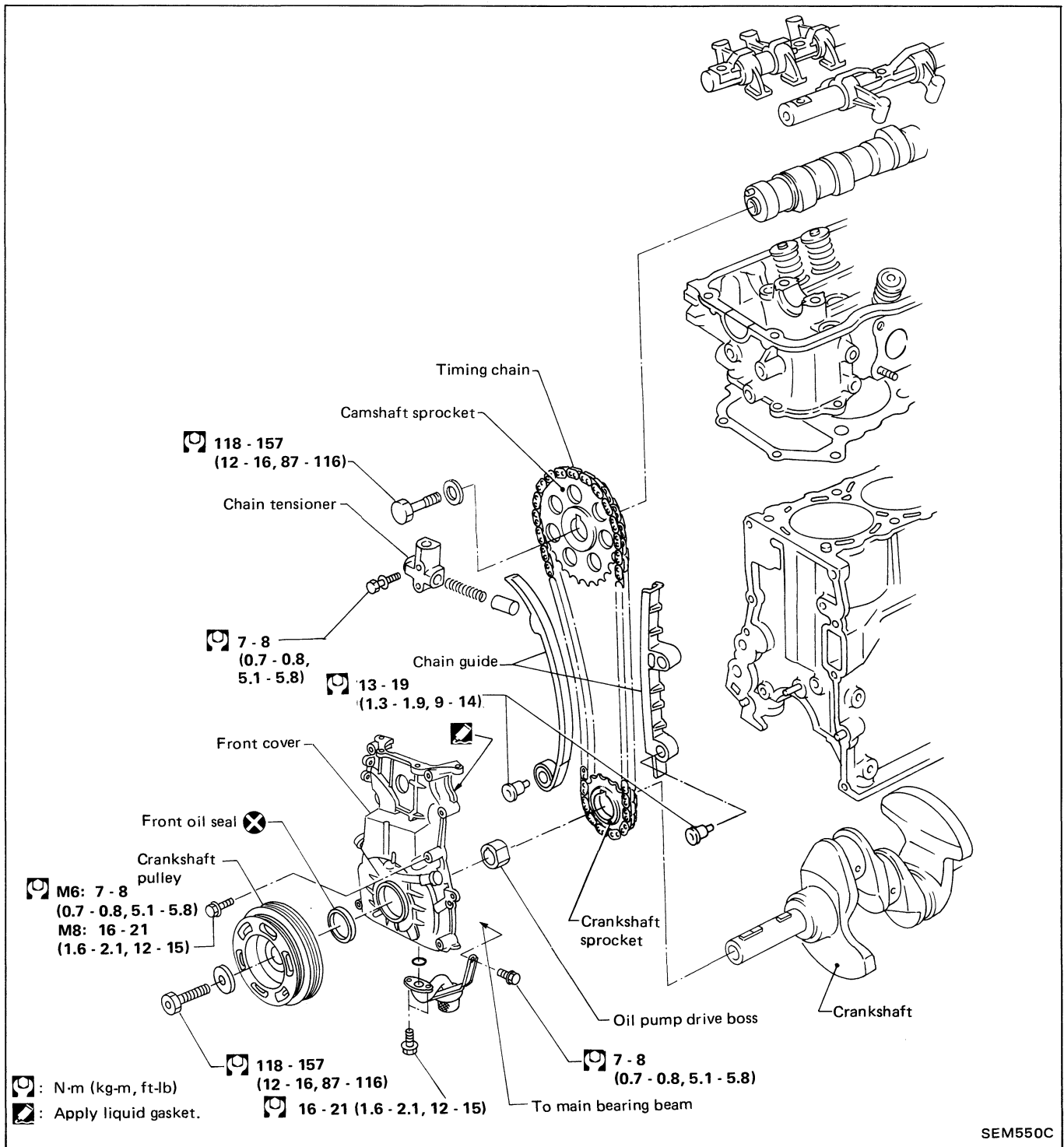
Installation (Cont'd)

- 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.**

TIMING CHAIN

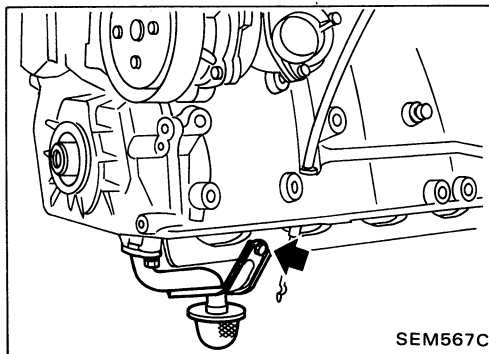
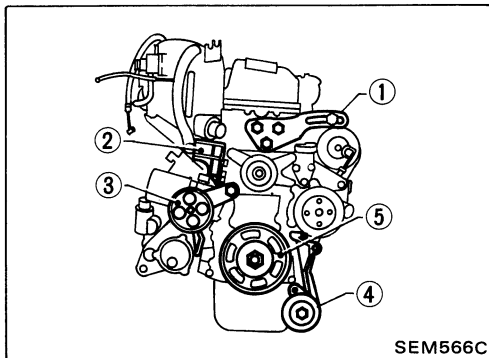
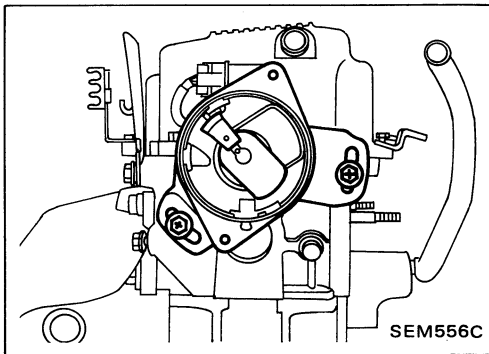
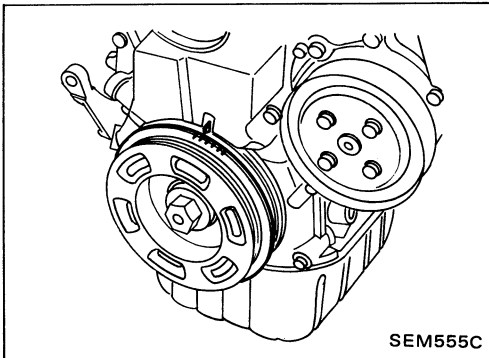


CAUTION:

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

Removal

1. Place wheel chocks at both front and back of rear wheels.
2. Place safety stands under designated front supporting points.
Remove front right side wheel.
3. Remove dust cover and under cover.
4. Drain engine oil.

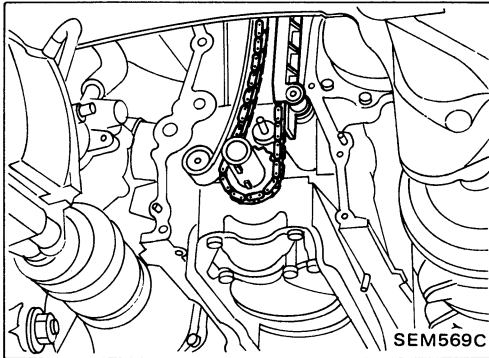
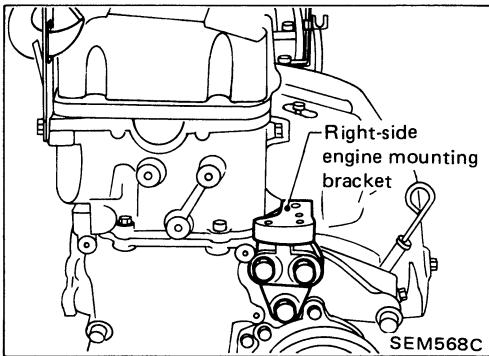


5. Set No. 1 piston at T.D.C. on its compression stroke.

6. Remove the alternator and compressor drive belts.
7. Remove the following parts.
 - ① Alternator and adjusting bar
 - ② Oil separator
 - ③ Power steering pump pulley, pump stay and bracket.
 - ④ Compressor and bracket.
 - ⑤ Crank shaft pulley and oil pump drive boss.

8. Remove oil pan. (Refer to OIL PAN.)
9. Remove oil strainer securing bolt.
10. Remove front cover securing bolts (cover to block and head to cover).

TIMING CHAIN



Removal (Cont'd)

11. Remove rocker cover.
12. Support engine with hoist or chain block.
13. Remove right-side engine mounting bracket and lower the engine.

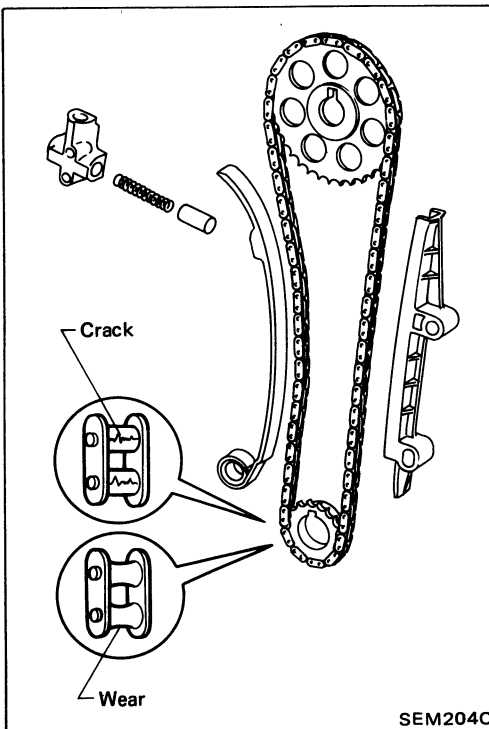
14. Remove front cover.

15. Remove the following parts:

- Chain tensioner
- Chain guides
- Timing chain and sprocket

Inspection

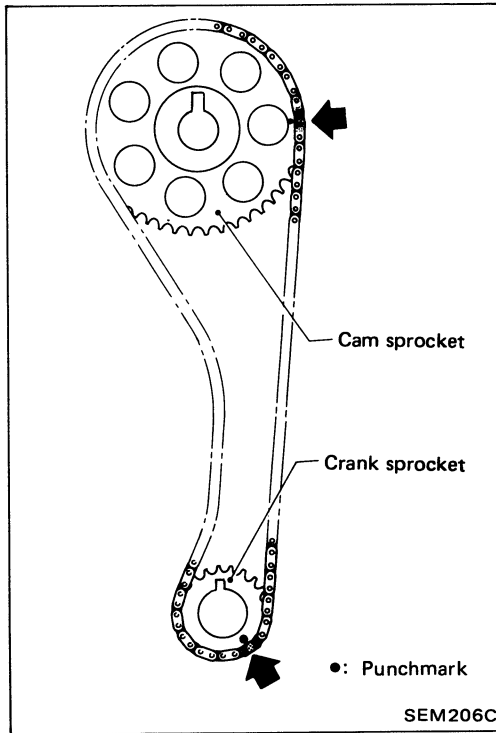
Check for cracks and excessive wear at roller links. Replace if necessary.



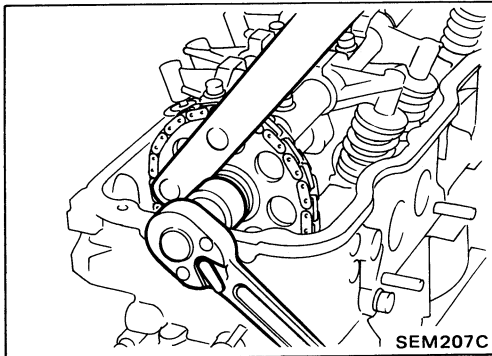
TIMING CHAIN

Installation

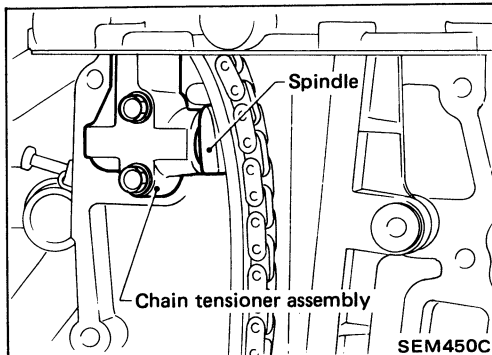
1. Install crankshaft sprocket.
 - **Make sure that mating marks of crankshaft sprocket face engine front.**



2. Install camshaft sprocket.
3. Confirm that No. 1 piston is set at T.D.C. on its compression stroke.
4. Install timing chain.
 - **Set timing chain by aligning its mating marks with those of crankshaft sprocket and camshaft sprocket.**



5. Tighten camshaft sprocket bolt.

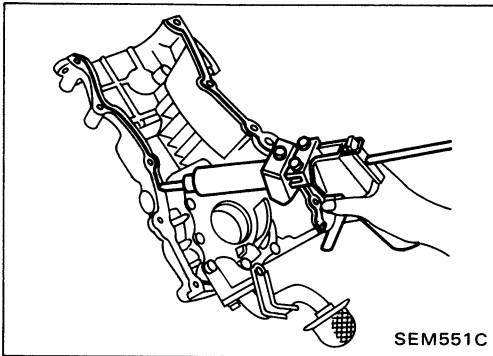


6. Install chain guide and chain tensioner.

TIMING CHAIN

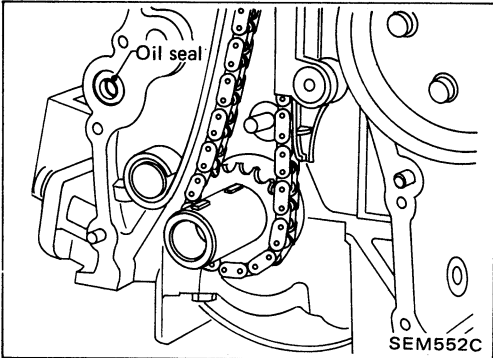
Installation (Cont'd)

7. Apply liquid gasket to front cover.



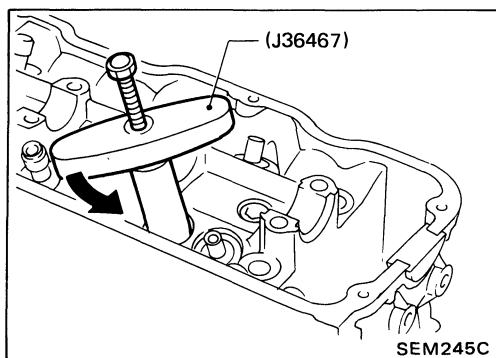
8. Install front cover.

- Be careful not to damage cylinder head gasket.
- Do not forget oil seal.



9. Install rubber plug onto cylinder head. (Refer to "Installation" of CYLINDER HEAD.)
10. Install oil pan. (Refer to OIL PAN.)
11. Install engine mounting.
12. Install any parts removed.

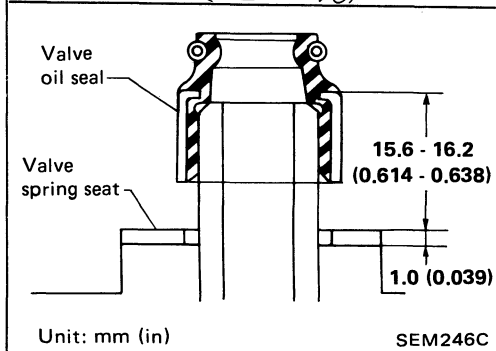
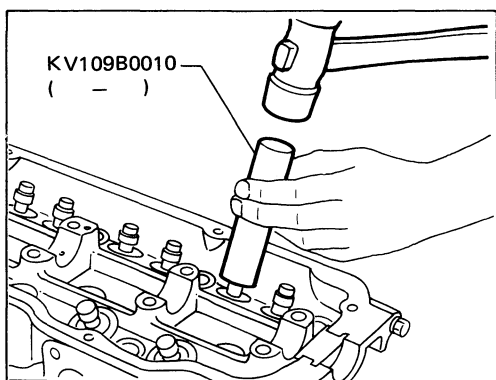
OIL SEAL REPLACEMENT



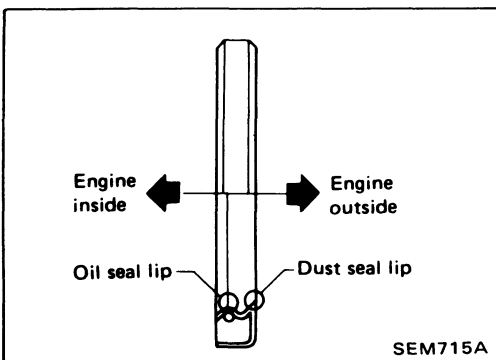
VALVE OIL SEAL

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

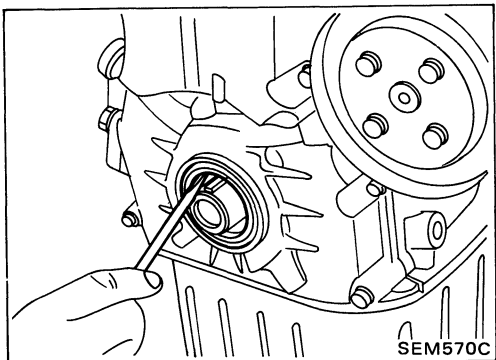
Piston concerned should be set at T.D.C. to prevent valve from falling.



4. Apply engine oil to new valve oil seal and install it with Tool. **Before installing valve oil seal, install valve spring seat.**



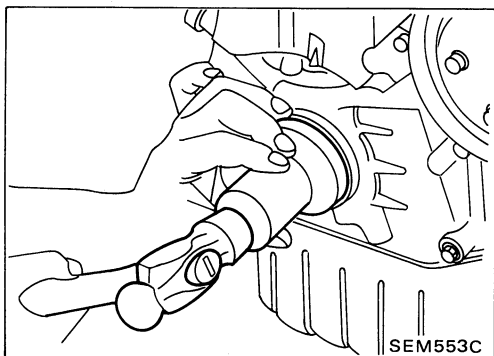
OIL SEAL INSTALLING DIRECTION



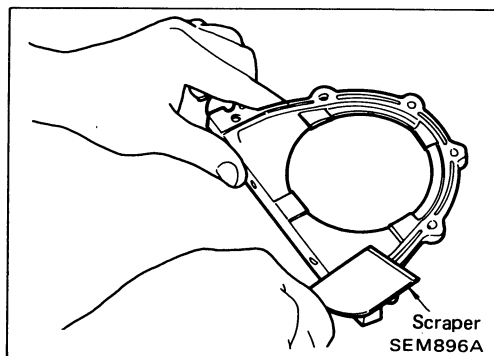
FRONT OIL SEAL

1. Remove crankshaft pulley.
 2. Remove front oil seal.
- Be careful not to damage crankshaft.**

OIL SEAL REPLACEMENT

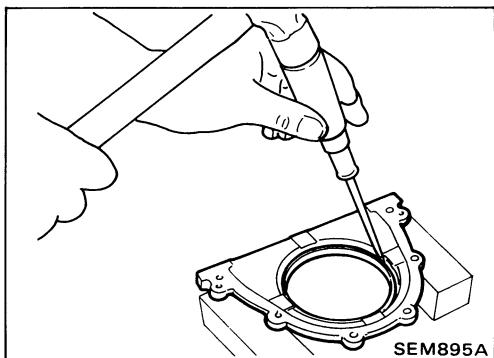


3. Apply engine oil to new oil seal and install it using suitable tool.

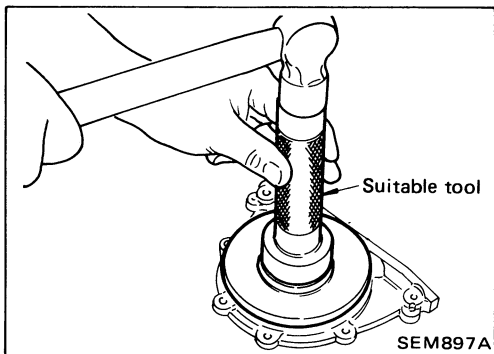


REAR OIL SEAL

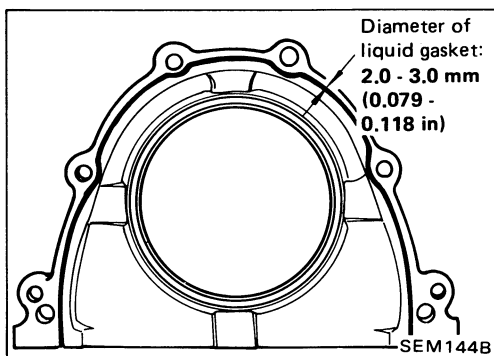
1. Remove transaxle.
2. Remove flywheel or drive plate.
3. Remove rear oil seal retainer.
4. Remove traces of liquid gasket using scraper.



5. Remove rear oil seal from retainer.

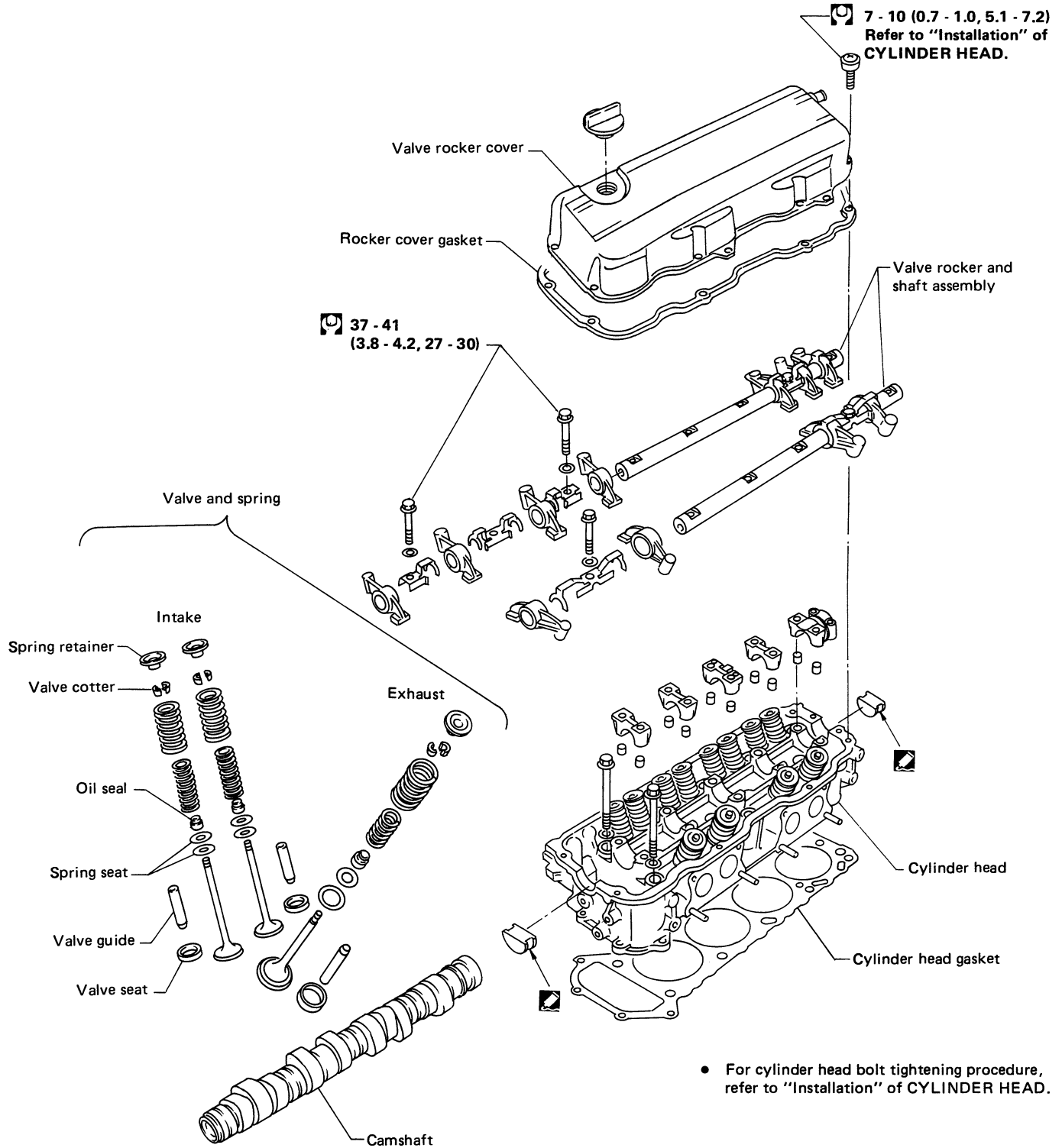


6. Apply engine oil to new oil seal and install it using suitable tool.



7. Apply liquid gasket to rear oil seal retainer.

CYLINDER HEAD



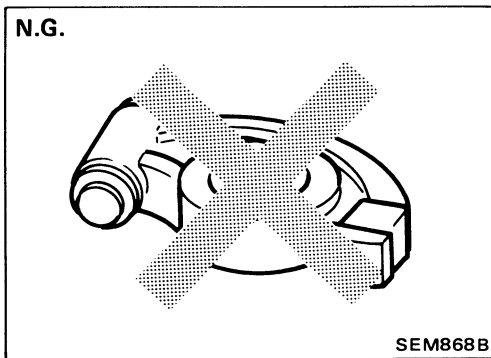
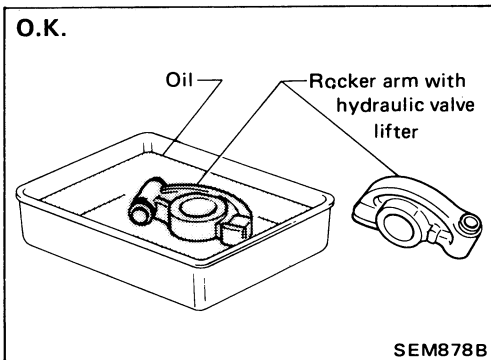
 : N·m (kg·m, ft·lb)

SEM554C

CYLINDER HEAD

CAUTION:

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



- Hydraulic valve lifters are installed in each rocker arm. If hydraulic valve lifter is kept on its side, even when installed in rocker arm, there is a possibility of air entering it. After removal, always set rocker arm straight up, or when laying it on its side, have it soak in new engine oil.

- Do not disassemble hydraulic valve lifter.
- Attach tags to valve lifters so as not to mix them up.

Removal

1. Drain coolant from radiator.
2. Relieve fuel pressure to zero.

Refer to EF & EC section "FUEL INJECTION CONTROL SYSTEM INSPECTION".

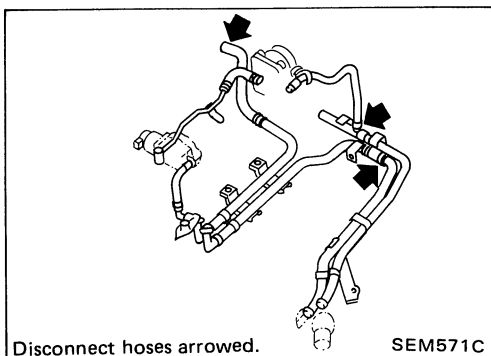
3. Remove the following parts:

- Exhaust manifold
- Air duct
- Intake manifold collector
- Intake manifold stay

4. Disconnect hoses.

- Vacuum gallery hoses, which are installed on intake manifold.
- Fuel tube hoses
- Air bleed hose for transfer (4WD model)

5. Disconnect water hoses as shown in figure.



CYLINDER HEAD

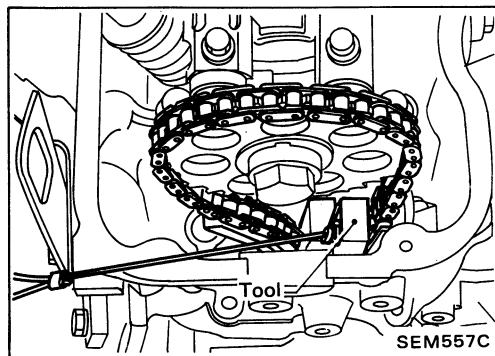
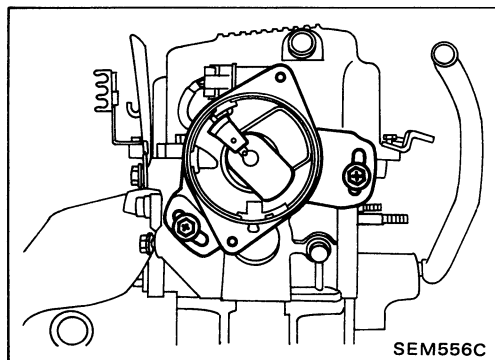
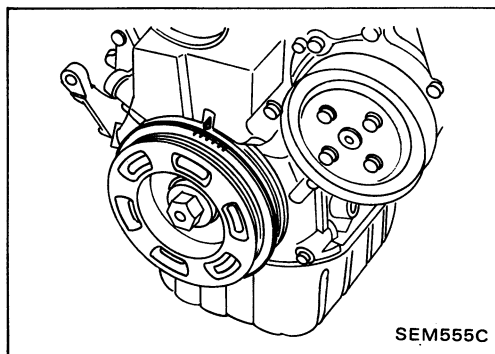
Removal (Cont'd)

6. Remove intake manifold.

7. Remove rocker cover.

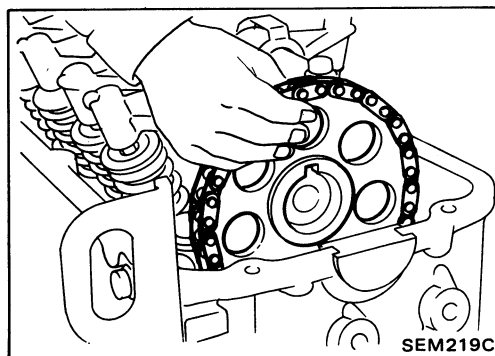
When removing rocker cover, do not knock rocker cover against rocker arms.

8. Set No. 1 piston at T.D.C. on its compression stroke.



9. Loosen camshaft sprocket bolt.

- Support timing chain by using Tool as shown in figure.

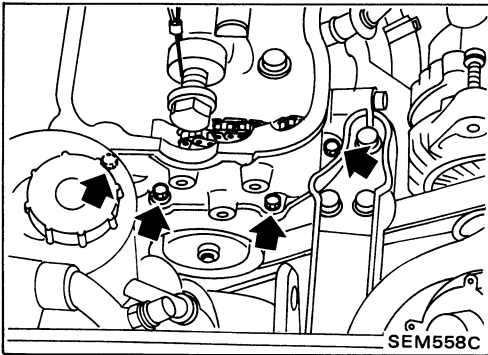


10. Remove camshaft sprocket.

CYLINDER HEAD

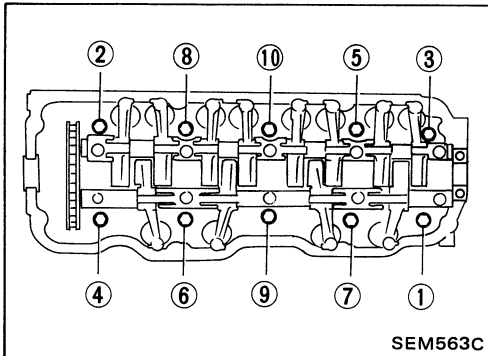
Removal (Cont'd)

11. Remove front cover tightening bolts to cylinder head.



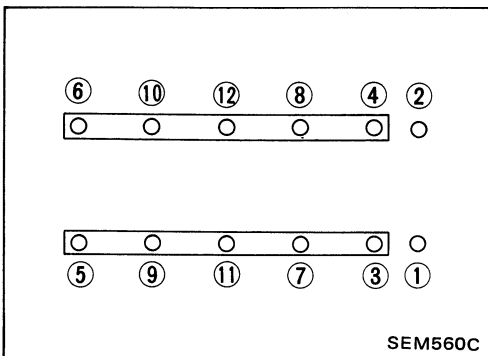
12. Remove cylinder head.

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

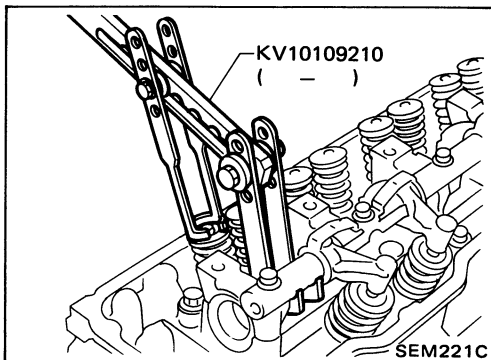


Disassembly

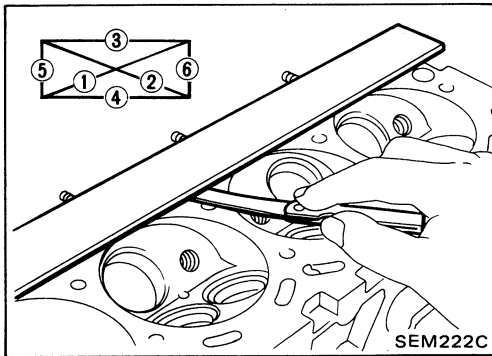
1. Remove rocker shaft assembly.
 - a. When loosening bolts, evenly loosen from outside in sequence.
 - b. Bolts should be loosened in two or three steps.
2. Remove camshaft.
 - Before removing camshaft, measure camshaft end play. (Refer to "Inspection".)



3. Remove valve components with Tool.
4. Remove valve oil seals. (Refer to OIL SEAL REPLACEMENT.)



CYLINDER HEAD



Inspection

CYLINDER HEAD DISTORTION

Head surface flatness:

Less than 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:

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

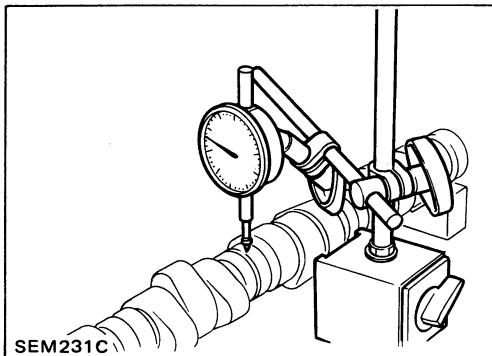
After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

Nominal cylinder head height:

98.8 - 99.0 mm (3.890 - 3.898 in)

CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.



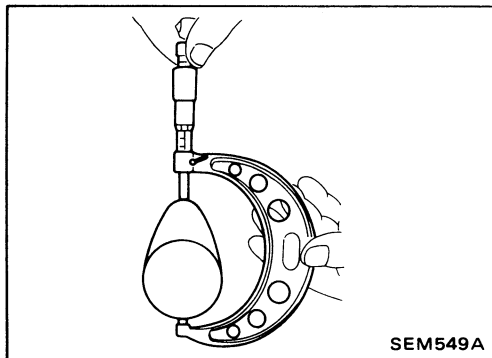
CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.

Runout (Total indicator reading):

0 - 0.02 mm (0 - 0.0008 in)

2. If it exceeds the limit, replace camshaft.



CAMSHAFT CAM HEIGHT

1. Measure camshaft cam height.

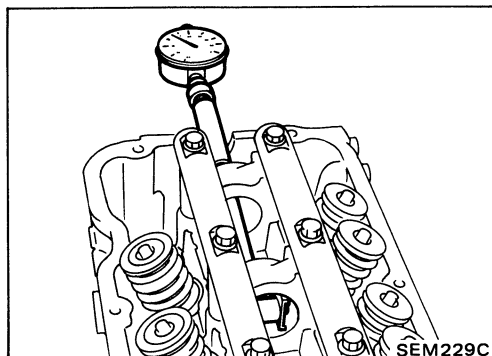
Standard cam height:

44.839 - 45.029 mm (1.7653 - 1.7728 in)

Cam wear limit:

0.2 mm (0.008 in)

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



CAMSHAFT JOURNAL CLEARANCE

1. Install camshaft bracket and rocker shaft and tighten bolts to the specified torque.
2. Measure inner diameter of camshaft bearing.

Standard inner diameter:

33.000 - 33.025 mm (1.2992 - 1.3002 in)

CYLINDER HEAD

Inspection (Cont'd)

3. Measure outer diameter of camshaft journal.

Standard outer diameter:

32.935 - 32.955 mm (1.2967 - 1.2978 in)

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

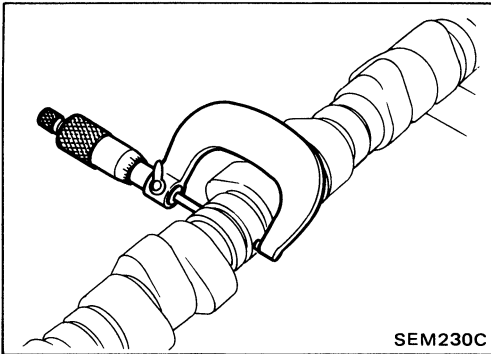
Camshaft journal clearance:

Standard

0.045 - 0.090 mm (0.0018 - 0.0035 in)

Limit

0.12 mm (0.0047 in)



CAMSHAFT END PLAY

1. Install camshaft in cylinder head.
2. Measure camshaft end play.

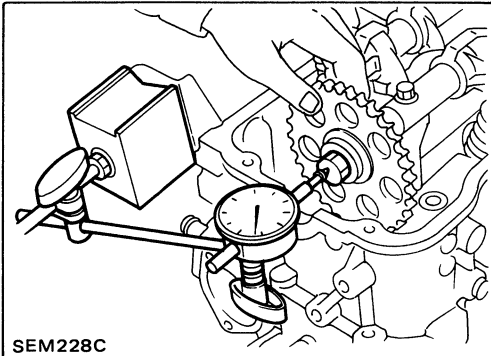
Camshaft end play:

Standard

0.07 - 0.15 mm (0.0028 - 0.0059 in)

Limit

0.2 mm (0.008 in)



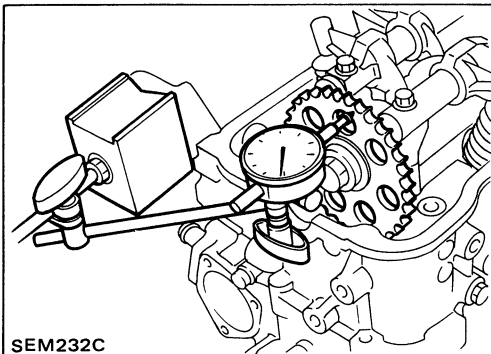
CAMSHAFT SPROCKET RUNOUT

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

Runout (Total indicator reading):

Limit 0.12 mm (0.0047 in)

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

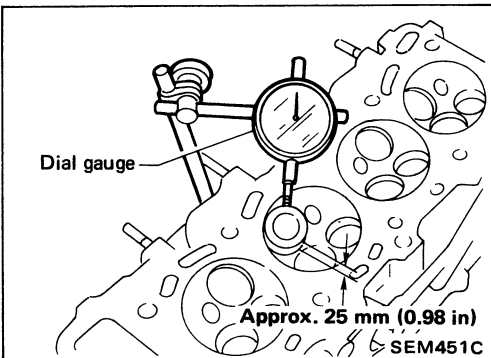


VALVE GUIDE CLEARANCE

1. Measure valve deflection in a right-angled direction with camshaft. (Valve and valve guide mostly wear in this direction.)

Valve deflection limit (Dial gauge reading):

0.15 mm (0.0059 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

0.020 - 0.053 mm

(0.0008 - 0.0021 in) (Intake)

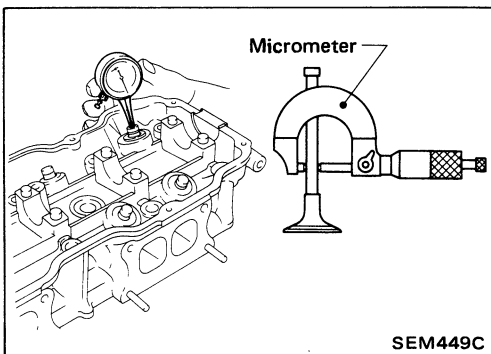
0.040 - 0.070 mm

(0.0016 - 0.0028 in) (Exhaust)

Limit

0.1 mm (0.004 in)

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

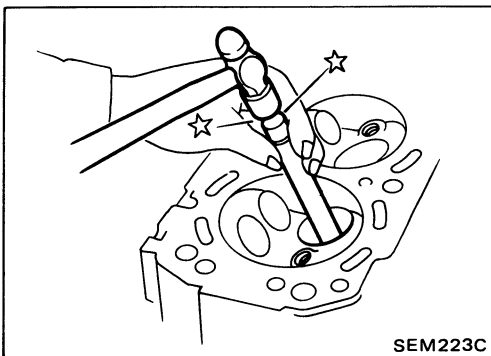
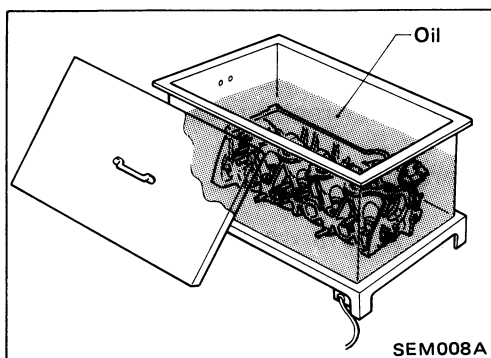


CYLINDER HEAD

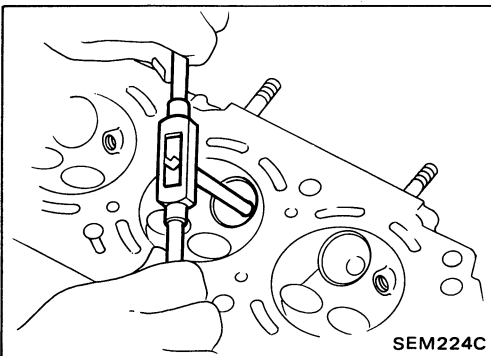
Inspection (Cont'd)

VALVE GUIDE REPLACEMENT

1. To remove valve guide, heat cylinder head to 150 to 160°C (302 to 320°F).



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



3. Ream cylinder head valve guide hole.

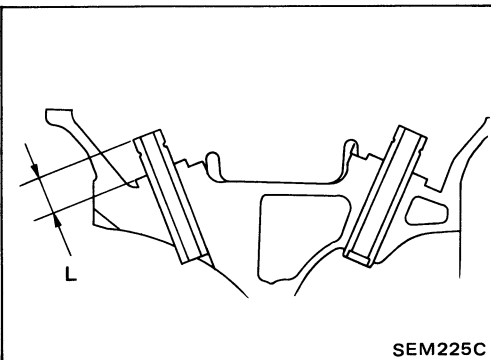
**Valve guide hole diameter
(for service parts):**

Intake

11.175 - 11.196 mm (0.4400 - 0.4408 in)

Exhaust

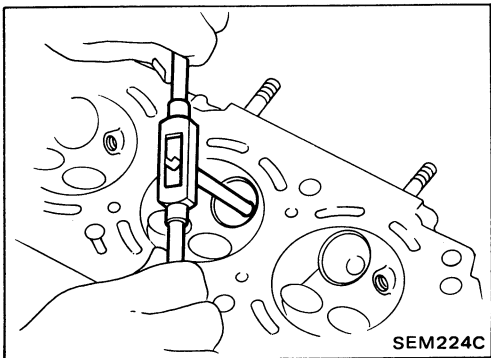
12.175 - 12.196 mm (0.4793 - 0.4802 in)



4. Heat cylinder head to 150 to 160°C (302 to 320°F) and press service valve guide onto cylinder head.

Projection "L":

14.9 - 15.1 mm (0.587 - 0.594 in)



5. Ream valve guide.

Finished size:

Intake

7.000 - 7.018 mm (0.2756 - 0.2763 in)

Exhaust

8.000 - 8.018 mm (0.3150 - 0.3157 in)

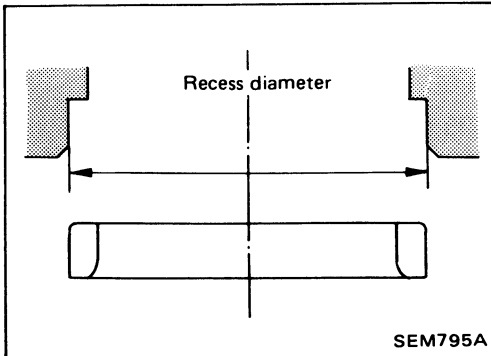
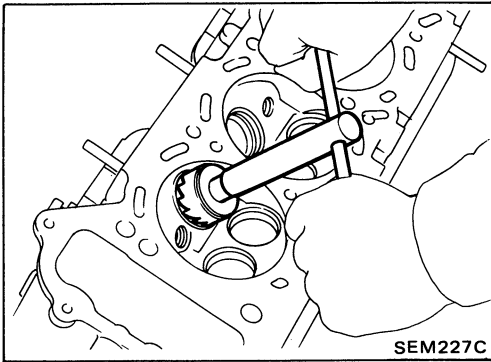
CYLINDER HEAD

Inspection (Cont'd)

VALVE SEATS

Check valve seats for any evidence of pitting at valve contact surface, and reseat 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)]:

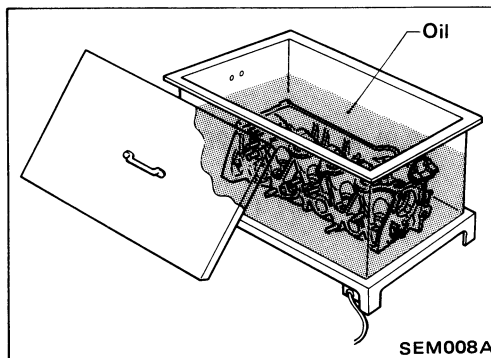
Intake

36.500 - 36.516 mm (1.4370 - 1.4376 in)

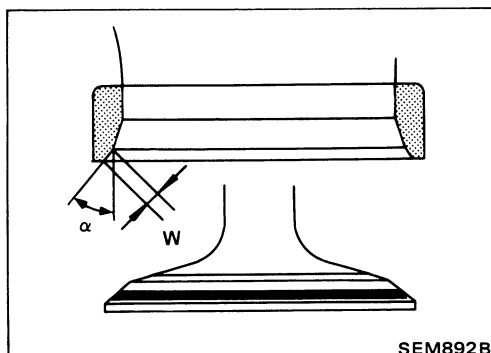
Exhaust

42.500 - 42.516 mm (1.6732 - 1.6739 in)

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



3. Heat cylinder head to 150 to 160°C (302 to 320°F).



4. Cut or grind valve seat using suitable tool at the specified dimensions as shown in S.D.S.
5. After cutting, lap valve seat with abrasive compound.
6. Check valve seating condition.

Seat face angle " α ":

45 deg.

Contacting width "W"

Intake

1.6 - 1.7 mm (0.063 - 0.067 in)

Exhaust

1.7 - 2.1 mm (0.067 - 0.083 in)

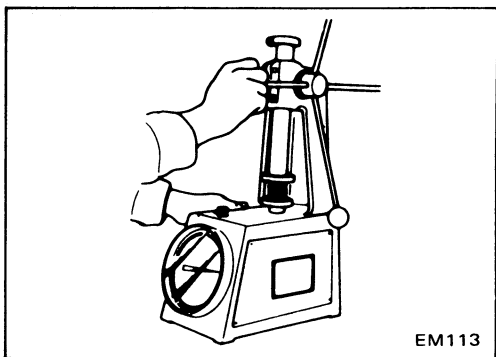
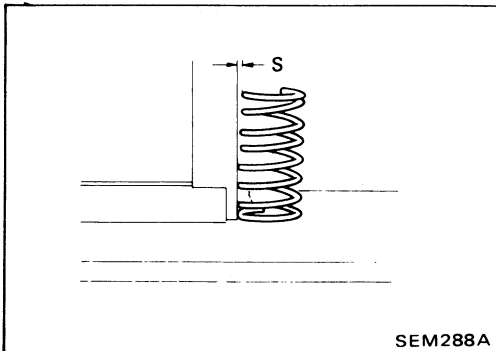
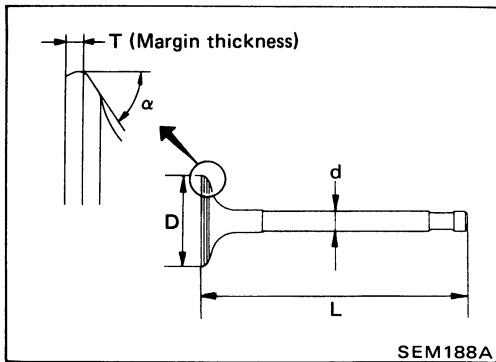
CYLINDER HEAD

Inspection (Cont'd)

VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to S.D.S. 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:

Outer

Intake

Less than 2.5 mm (0.098 in)

Exhaust

Less than 2.3 mm (0.091 in)

Inner

Intake

Less than 2.3 mm (0.091 in)

Exhaust

Less than 2.1 mm (0.083 in)

2. If it exceeds the limit, replace spring.

Pressure

Check valve spring pressure.

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

Standard

Outer

Intake

604.1 (61.6, 135.8) at 37.6 (1.480)

Exhaust

640.4 (65.3, 144.0) at 34.1 (1.343)

Inner

Intake

284.4 (29.0, 63.9) at 32.6 (1.283)

Exhaust

328.5 (33.5, 73.9) at 29.1 (1.146)

Limit

Outer

Intake

567.8 (57.9, 127.7) at 37.6 (1.480)

Exhaust

620.8 (63.3, 139.6) at 34.1 (1.343)

Inner

Intake

266.8 (27.2, 60.0) at 32.6 (1.283)

Exhaust

318.7 (32.5, 71.7) at 29.1 (1.146)

If it exceeds the limit, replace spring.

CYLINDER HEAD

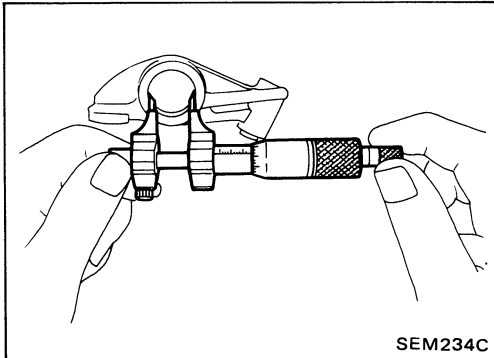
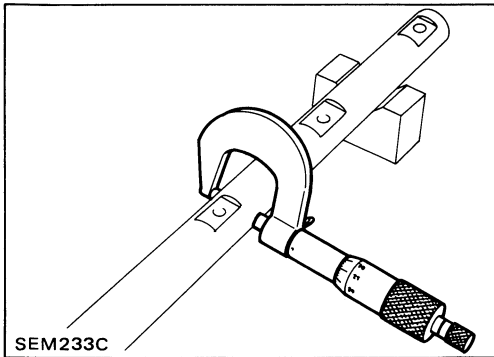
Inspection (Cont'd)

ROCKER SHAFT AND ROCKER ARM

1. Check rocker shafts for scratches, seizure and wear.
2. Check outer diameter of rocker shaft.

Diameter:

21.979 - 22.000 mm (0.8653 - 0.8661 in)



3. Check inner diameter of rocker arm.

Diameter:

22.012 - 22.029 mm (0.8666 - 0.8673 in)

Rocker arm to shaft clearance:

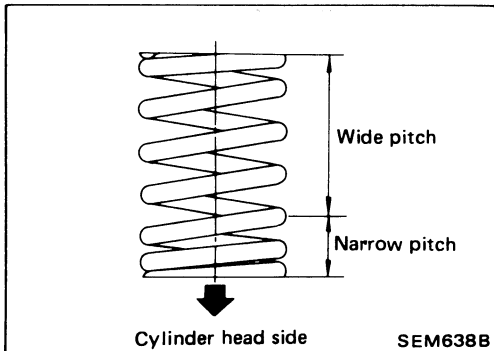
0.012 - 0.050 mm (0.0005 - 0.0020 in)

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

Assembly

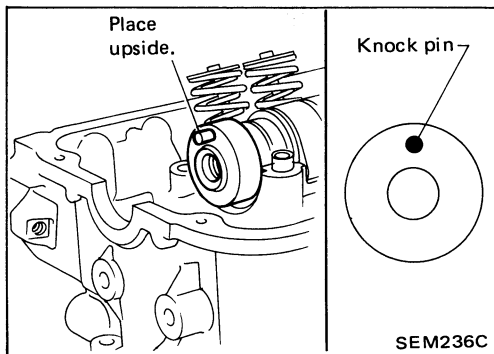
1. Install valve component parts.

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



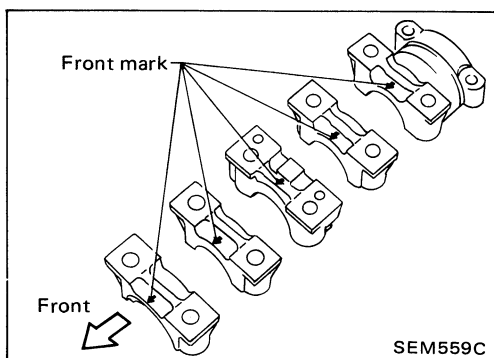
2. Mount camshaft onto cylinder head, placing knock pin at front end to top position.

Apply engine oil to camshaft when mounting onto cylinder head.



3. Install camshaft brackets.

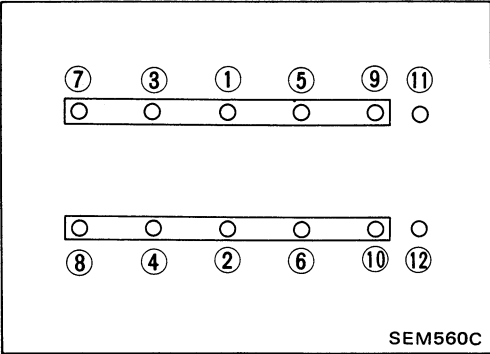
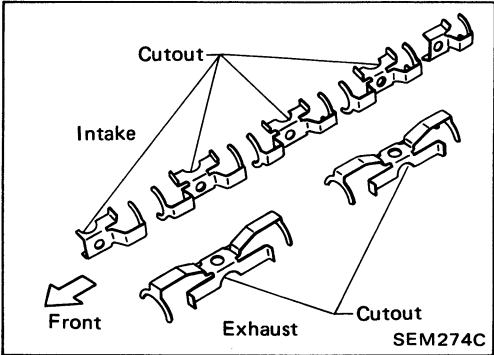
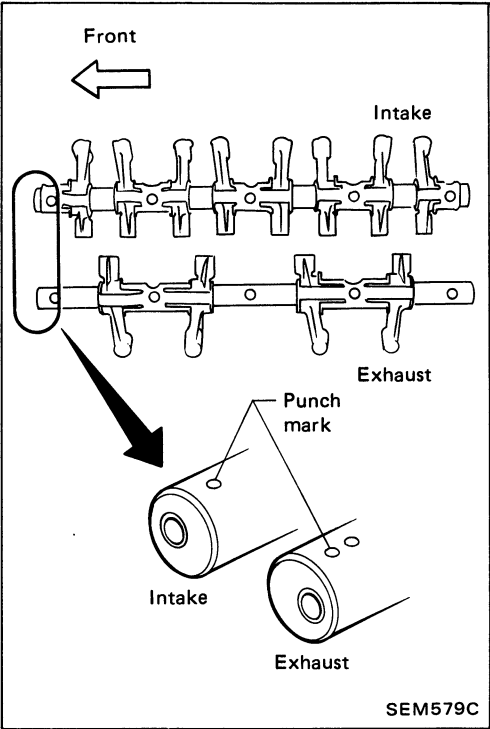
Front mark is punched on the camshaft bracket.



CYLINDER HEAD

Assembly (Cont'd)

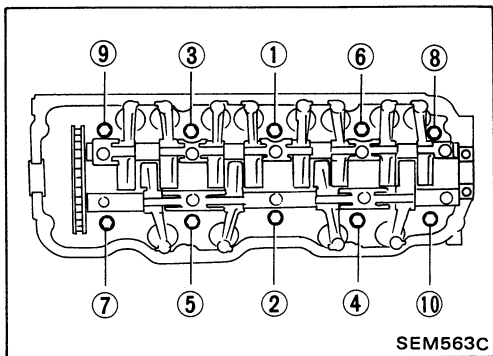
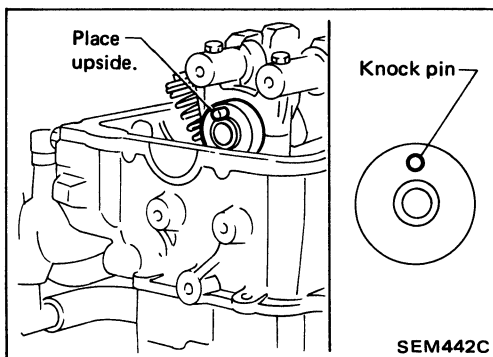
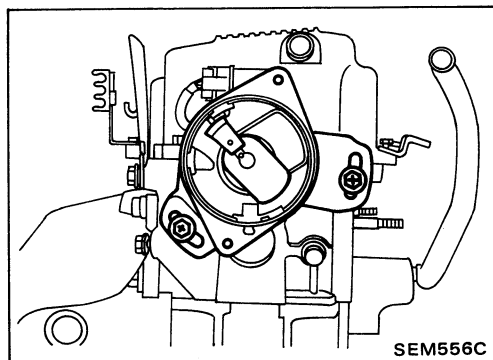
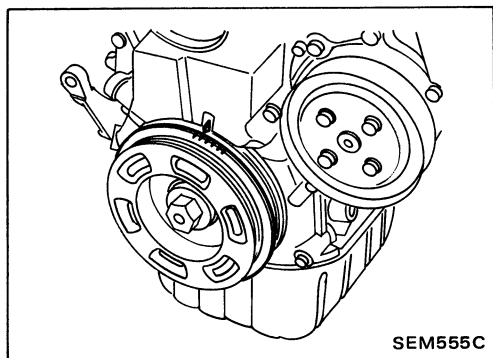
4. Install rocker shaft with rocker arms.



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

5. Tighten bolts as shown in figure at left.

CYLINDER HEAD



Installation

1. Set No. 1 piston at T.D.C. on its compression stroke as follows:

- (1) Align mark on crankshaft pulley with "0°" position and confirm that distributor rotor head is set as shown in figure.

(2) Confirm that knock pin on camshaft is set at the top.

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

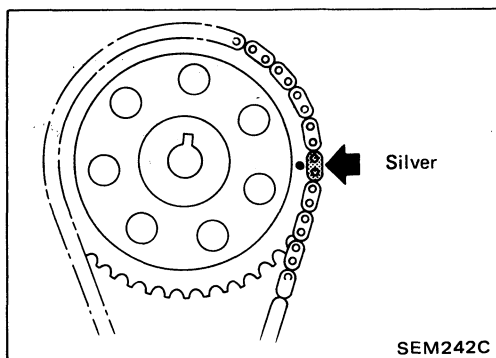
- **Do not rotate crankshaft and camshaft separately, or valves will hit piston heads.**

● Tightening procedure

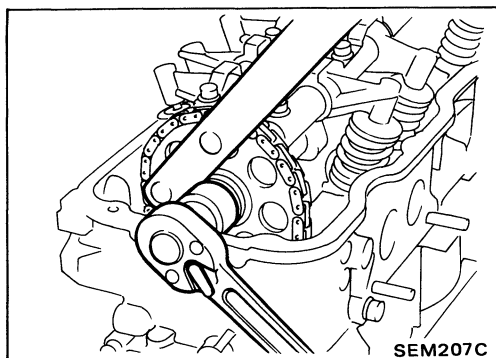
- (1) Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
- (2) Tighten all bolts to 78 N·m (8.0 kg-m, 58 ft-lb).
- (3) Loosen all bolts completely.
- (4) Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
- (5) Turn all bolts 80 to 85 degrees clockwise with an angle wrench, or if an angle wrench is not available, tighten all bolts to 74 to 83 N·m (7.5 to 8.5 kg-m, 54 to 61 ft-lb).

CYLINDER HEAD

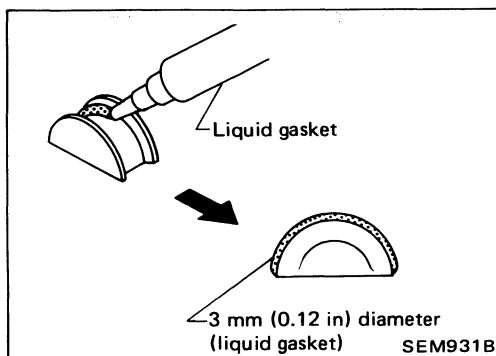
Installation (Cont'd)



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



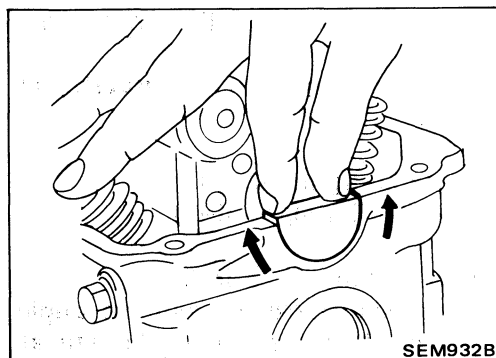
4. Tighten camshaft sprocket bolt.



5. Install rubber plugs as follows:

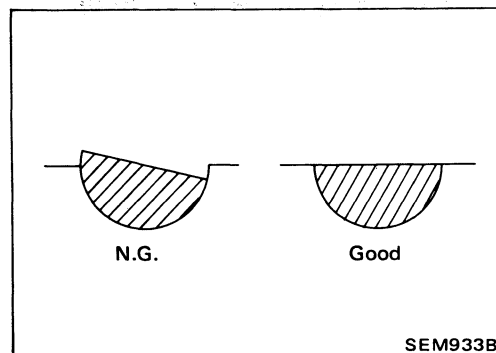
- (1) Apply liquid gasket to rubber plugs.

- Rubber plugs should be replaced with new ones.
- Rubber plugs should be installed within 5 minutes of applying liquid gasket.



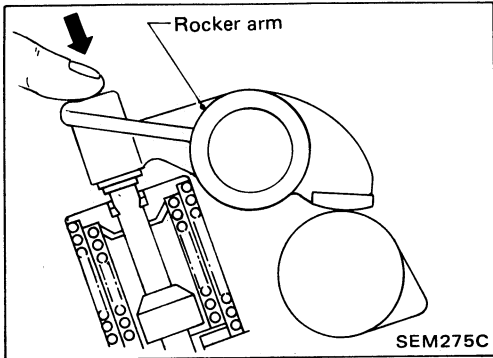
- (2) Install rubber plugs, then move them with your fingers to uniformly spread the gasket on cylinder head surface.

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



CYLINDER HEAD

Installation (Cont'd)



6. Check hydraulic valve lifter.

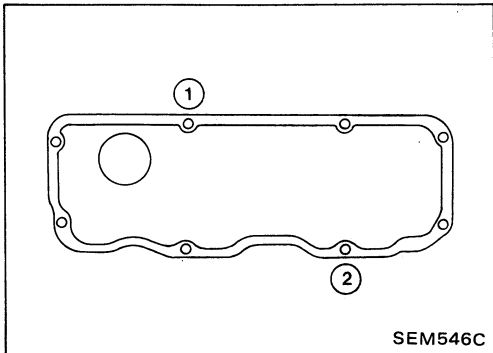
(1) Push hydraulic valve lifter forcefully with your finger.

● **Be sure to check it with rocker arm in its free position.**

(2) If valve lifter moves more than 1 mm (0.04 in), air may be inside of it.

(3) Bleed air off by running engine at 1,000 rpm under no-load for about 20 minutes (After completing installation of all parts).

(4) If hydraulic valve lifters are still noisy, replace them and bleed air off again in the same manner as in step (3).

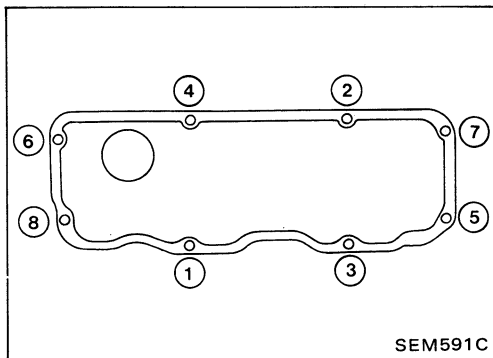


7. Install rocker cover.

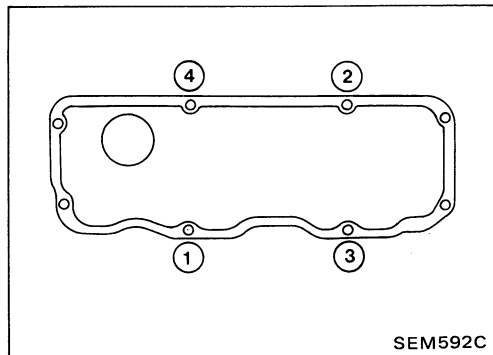
● When installing rocker cover, be sure to avoid interference between rocker cover and rocker arms.

8. Tighten bolts as shown below:

(1) Temporarily tighten 2 bolts to 3 N•m (0.3 kg-m, 2.2 ft-lb) in order as shown in figure.



(2) Tighten all bolts to 7 to 10 N•m (0.7 to 1.0 kg-m, 5.1 to 7.2 ft-lb) as shown in figure.



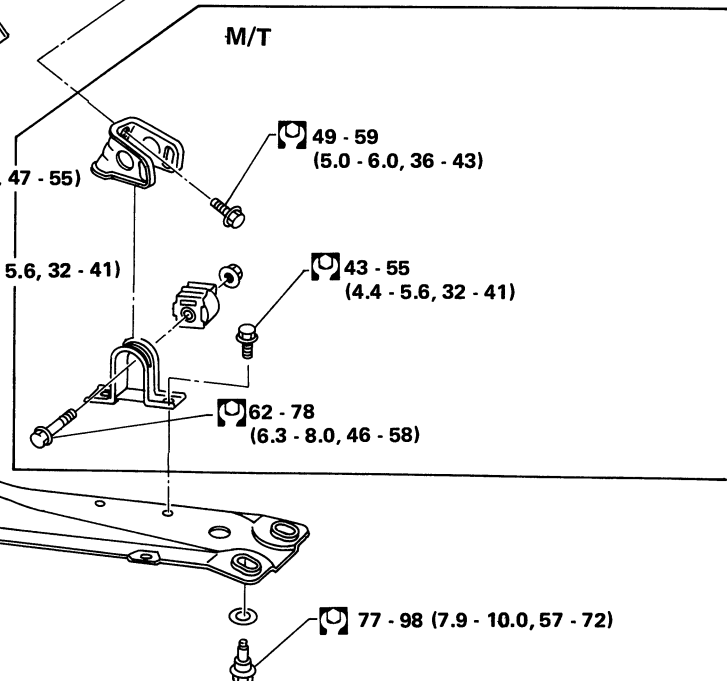
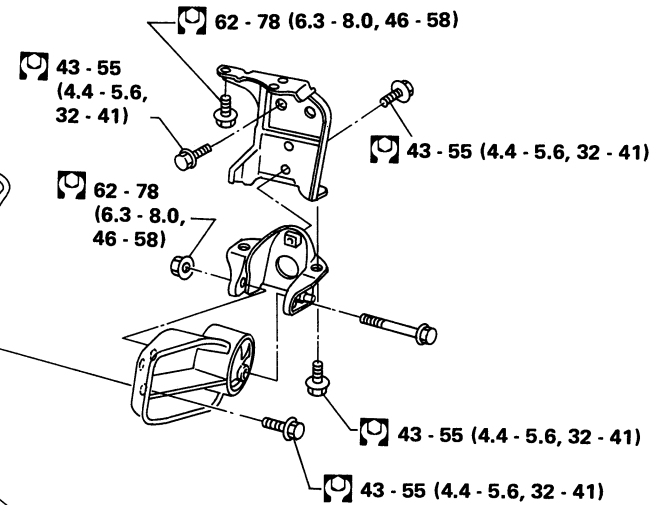
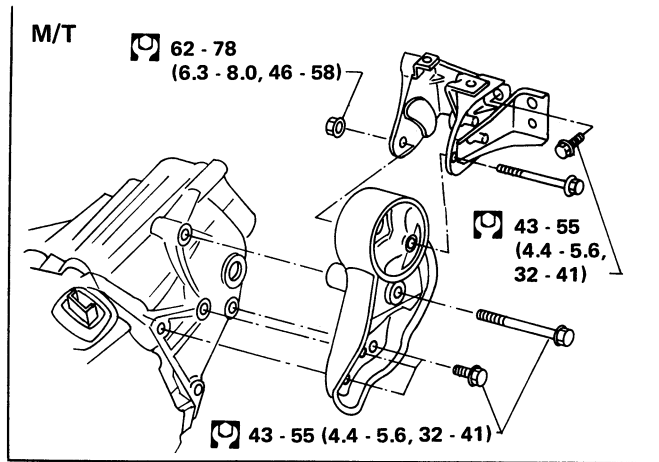
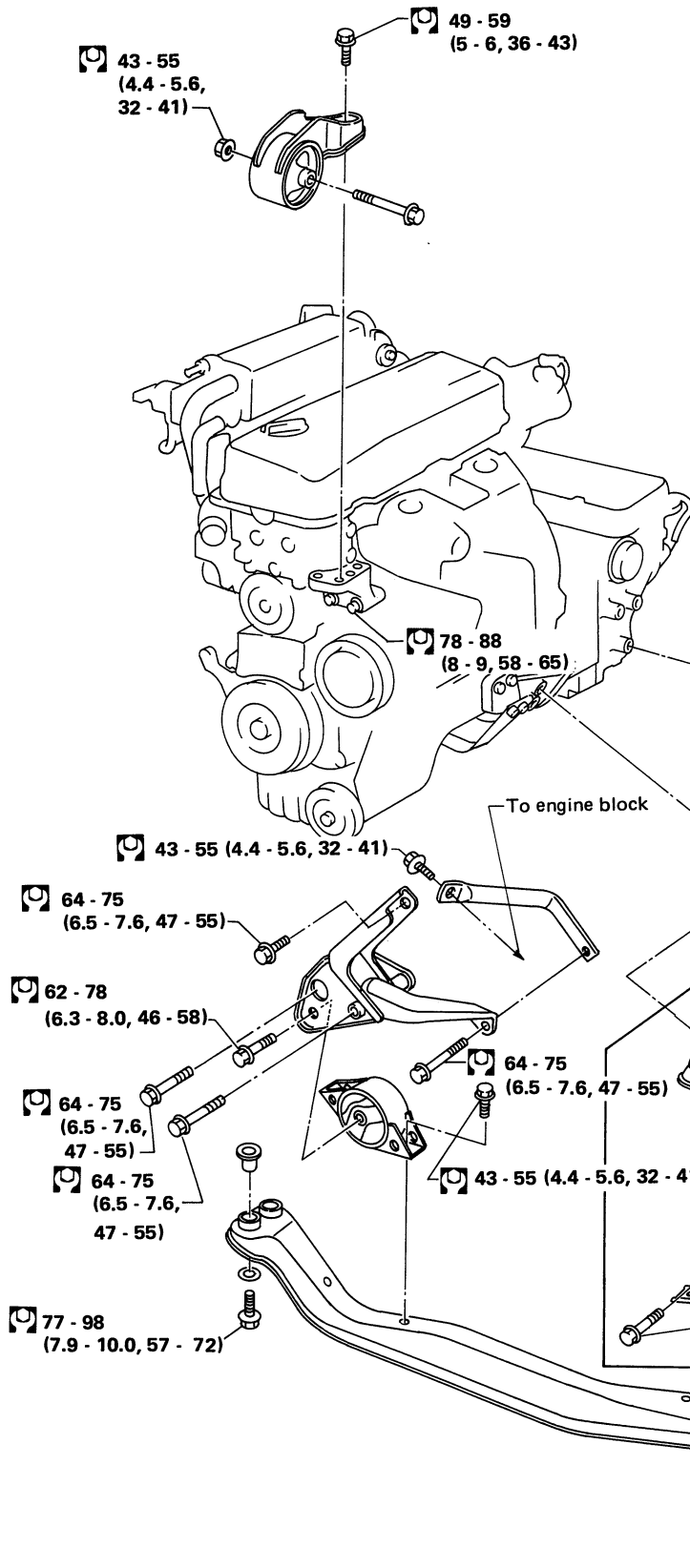
(3) Retighten 4 bolts to 7 to 10 N•m (0.7 to 1.0 kg-m, 5.1 to 7.2 ft-lb) as shown in figure.

9. Install any parts removed.

ENGINE REMOVAL

2WD model

A/T



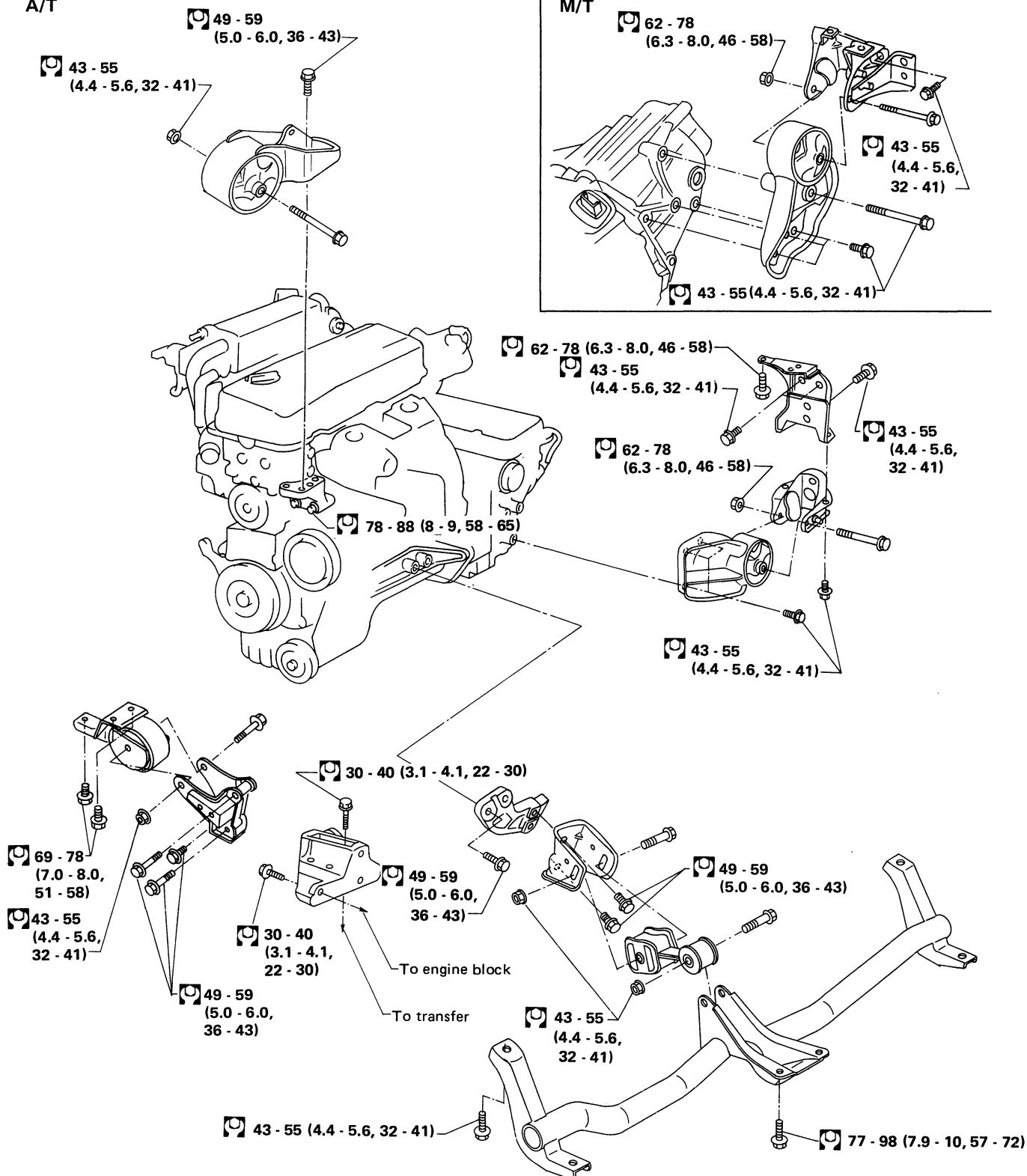
: N·m (kg·m, ft·lb)

SEM572C

ENGINE REMOVAL

4WD model

A/T



: N·m (kg·m, ft·lb)

SEM573C

ENGINE REMOVAL

WARNING:

- a. Situate vehicle on a flat and solid surface.
- b. 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.
- c. For safety during subsequent steps, the tension of wires should be slackened against the engine.
- d. Before disconnecting fuel hose, release fuel pressure from fuel line.
Refer to "Releasing Fuel Pressure" in section EF & EC.
- e. Before removing front axle from transaxle, place safety stands under designated front supporting points. Refer to GI section for lifting points and towing.
- 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:

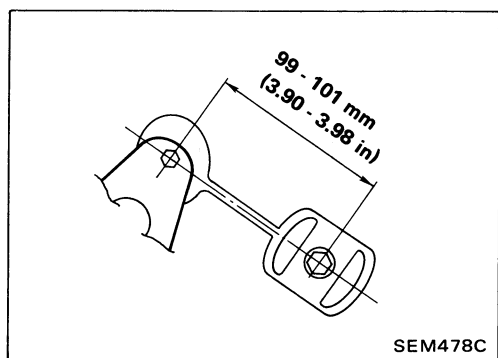
- When lifting engine, be careful not to strike adjacent parts, especially accelerator wire casing, brake lines, and brake master cylinder.
- In hoisting the engine, always use engine slingers in a safe manner.
- In removing drive shaft, be careful not to damage grease seal of transaxle.

Removal

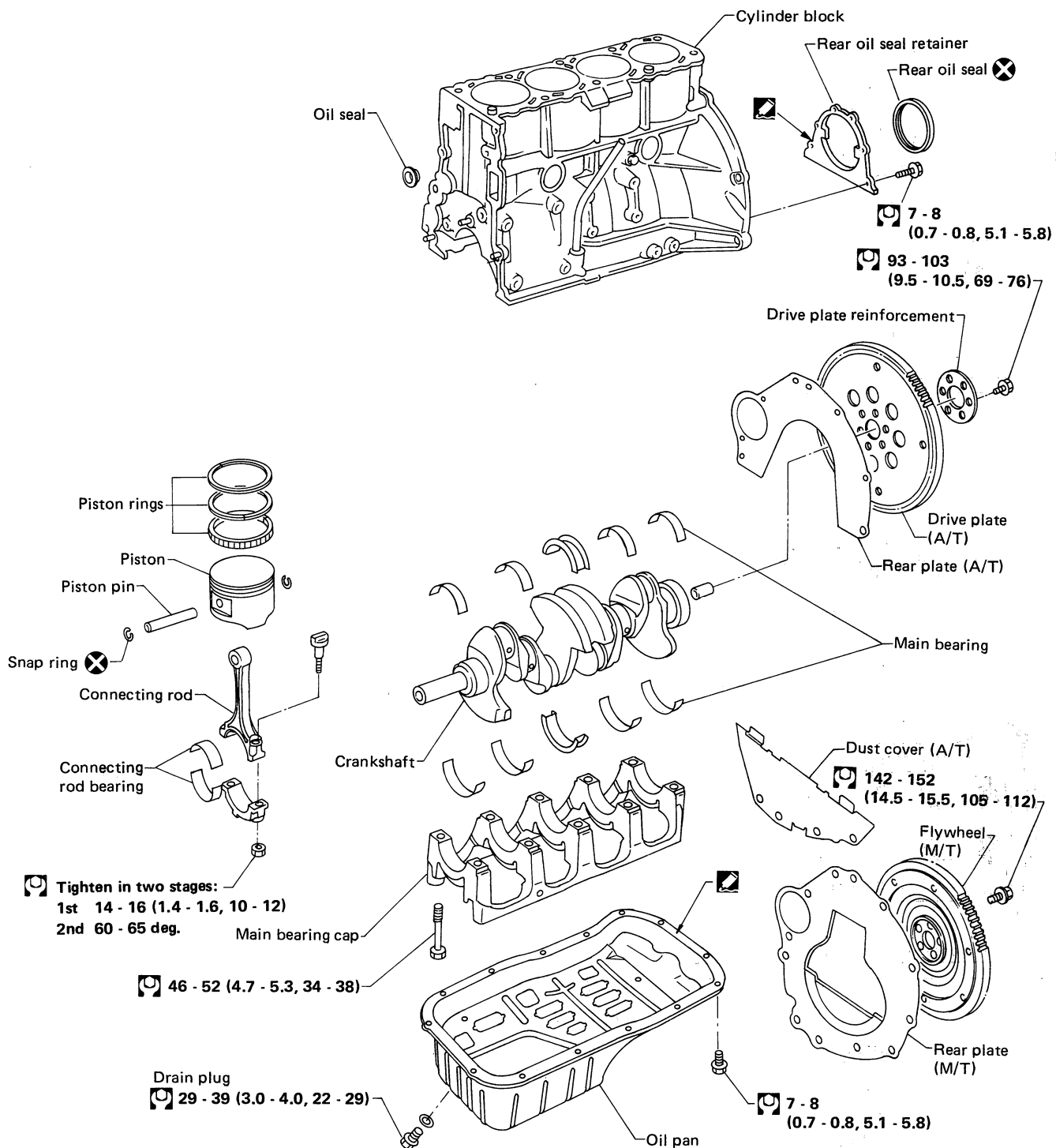
1. Drain coolant.
2. Disconnect adjacent wires, harness, pipes and hoses.
3. Remove the following parts:
 - Drive belts
 - Power steering pump
 - A/C compressor
 - Alternator and adjusting bar
 - Drive shafts
 - Propeller shaft (4WD model)
 - Front exhaust tube
4. Lift up engine slightly with engine slingers and disconnect or remove all engine mountings.
5. Support engine and transaxle assembly by placing suitable jacks under oil pan and transaxle.
6. Lower engine and transaxle assembly.
7. Remove engine from transaxle.

Installation

- When installing buffer rods, adjust the length between bolts of buffer rods as shown (4WD model).

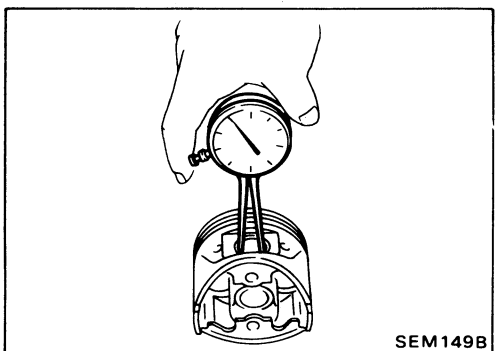
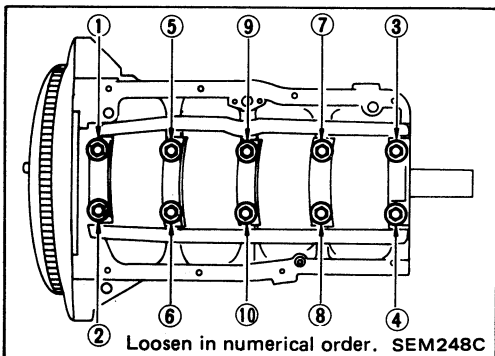
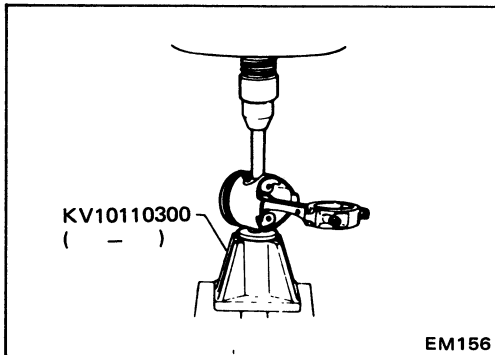
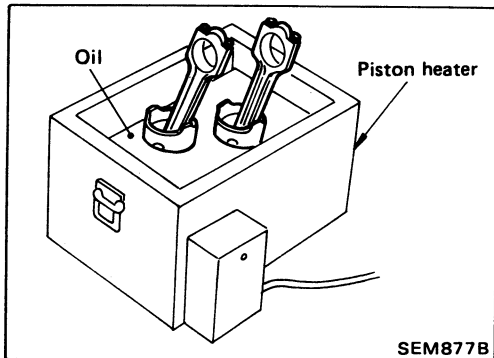
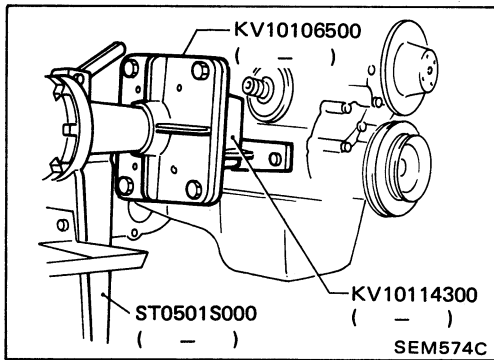


CYLINDER BLOCK



: N-m (kg-m, ft-lb)
 : Apply liquid gasket.

SEM564C



Disassembly

PISTON AND CRANKSHAFT

1. Place engine on a work stand.
2. Drain oil.
3. Remove oil pan.
4. Remove water pump.
5. Remove cylinder head.
6. Remove timing chain.
7. Remove pistons.
 - When disassembling piston and connecting rod, remove snap rings, then heat piston to 60 to 70°C (140 to 158°F) or use piston pin press stand at room temperature.
8. Remove main bearing beam and crankshaft.
 - Before removing main bearing beam, measure crankshaft end play.
 - Bolts should be loosened in two or three steps.

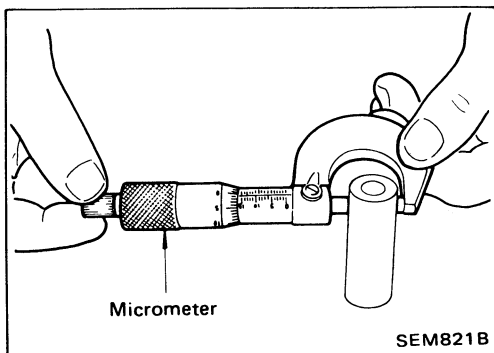
Inspection

PISTON AND PISTON PIN CLEARANCE

1. Measure inner diameter of piston pin hole "dp".
 - Standard diameter "dp":**
20.987 - 20.999 mm (0.8263 - 0.8267 in)

CYLINDER BLOCK

Inspection (Cont'd)



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

Standard diameter "Dp":

20.989 - 21.001 mm (0.8263 - 0.8268 in)

3. Calculate interference fit of piston pin to piston.

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

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

PISTON RING SIDE CLEARANCE

Side clearance:

Top ring

0.04 - 0.08 mm (0.0016 - 0.0031 in)

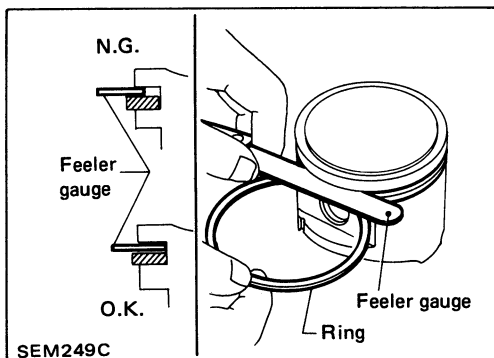
2nd ring

0.03 - 0.07 mm (0.0012 - 0.0028 in)

Max. limit of side clearance:

0.1 mm (0.004 in)

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



PISTON RING END GAP

End gap:

Top ring

0.28 - 0.43 mm (0.0110 - 0.0169 in)

2nd ring

0.45 - 0.60 mm (0.0177 - 0.0236 in)

(For rings punched with R or T.)

0.55 - 0.70 mm (0.0217 - 0.0276 in)

(For rings punched with N.)

Oil ring

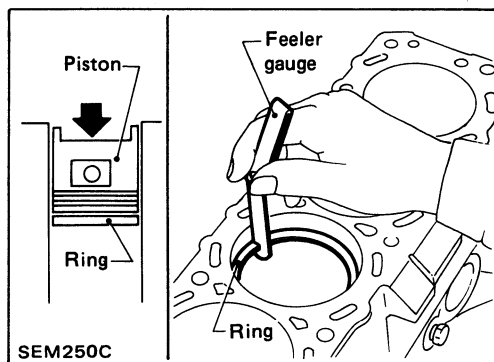
0.20 - 0.60 mm (0.0079 - 0.0236 in)

Max. limit of ring gap:

0.5 mm (0.020 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 S.D.S.



CONNECTING ROD BEND AND TORSION

Bend:

Limit 0.15 mm (0.0059 in)

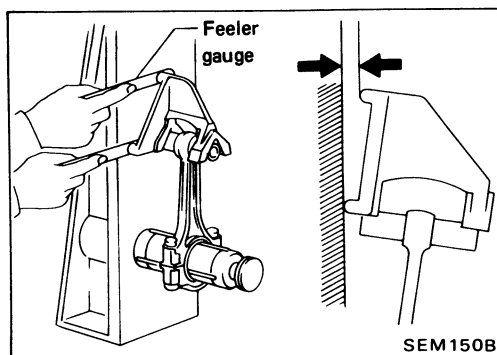
per 100 mm (3.94 in) length

Torsion:

Limit 0.30 mm (0.0118 in)

per 100 mm (3.94 in) length

If it exceeds the limit, replace connecting rod assembly.



CYLINDER BLOCK

Inspection (Cont'd)

CYLINDER BLOCK DISTORTION AND WEAR

1. Clean upper face of cylinder block 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:

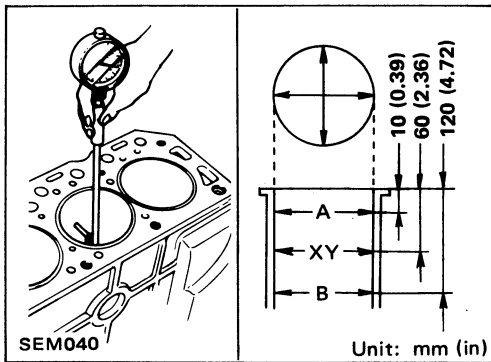
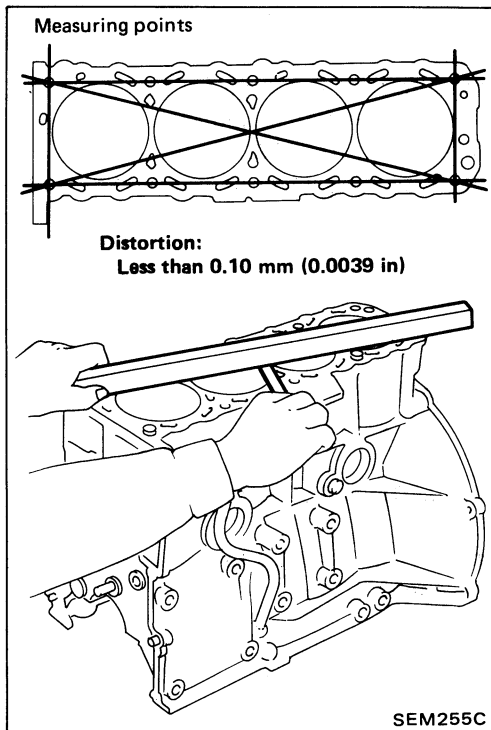
$A + B = 0.2 \text{ mm (0.008 in)}$

Nominal cylinder block height

from crankshaft center:

246.95 - 247.05 mm (9.7224 - 9.7264 in)

3. If necessary, replace cylinder block.



PISTON-TO-BORE CLEARANCE

1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper.

Standard inner diameter:

89.000 - 89.030 mm (3.5039 - 3.5051 in)

Wear limit:

0.2 mm (0.008 in)

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

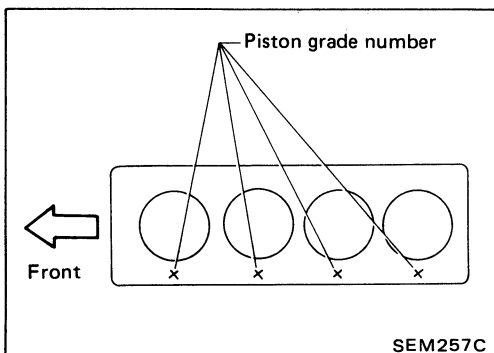
0.015 mm (0.0006 in)

Taper (A-B) limit:

0.015 mm (0.0006 in)

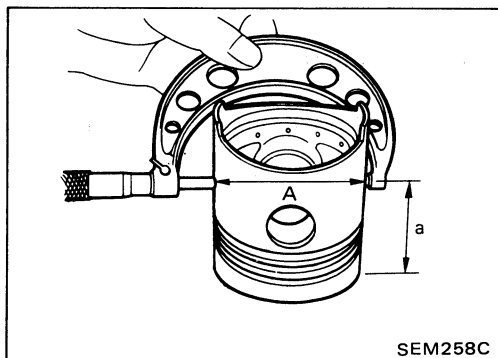
If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.

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.

CYLINDER BLOCK



Inspection (Cont'd)

3. Measure piston skirt diameter.

Piston diameter "A":

Refer to S.D.S.

Measuring point "a" (Distance from the top):

Approximately 52 mm (2.05 in)

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

Piston-to-bore clearance "B":

0.020 - 0.040 mm (0.0008 - 0.0016 in)

5. Determine piston oversize according to amount of cylinder wear.

Oversize pistons are available for service. Refer to S.D.S.

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.

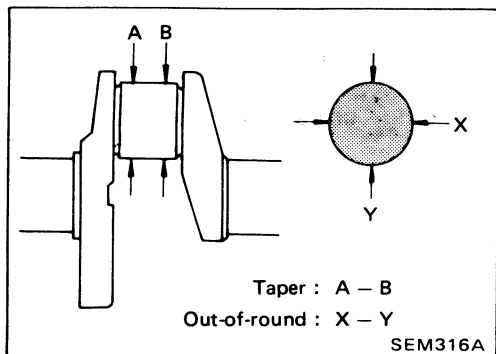
- **When any cylinder needs boring, all other cylinders must also be bored.**

- **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):

Main journal Less than 0.01 mm (0.0004 in)

Crank pin Less than 0.005 mm (0.0002 in)

Taper (A-B):

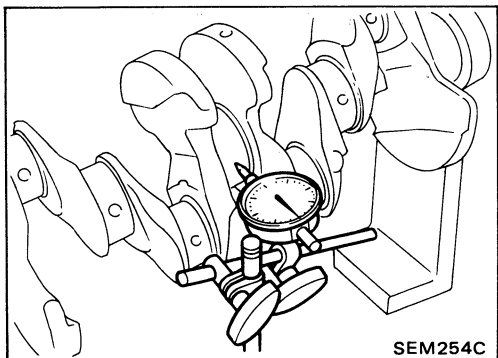
Main journal Less than 0.01 mm (0.0004 in)

Crank pin Less than 0.005 mm (0.0002 in)

3. Measure crankshaft runout.

Runout (Total indicator reading):

Less than 0.10 mm (0.0039 in)



CYLINDER BLOCK

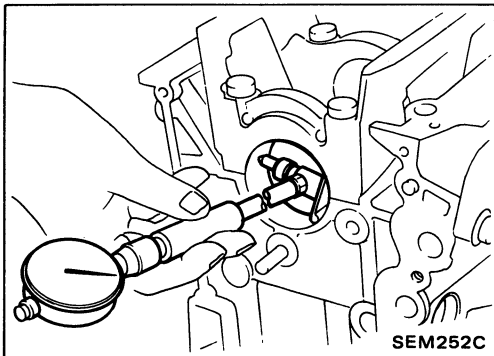
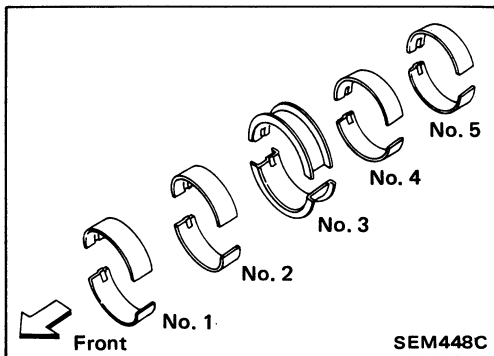
Inspection (Cont'd)

BEARING CLEARANCE

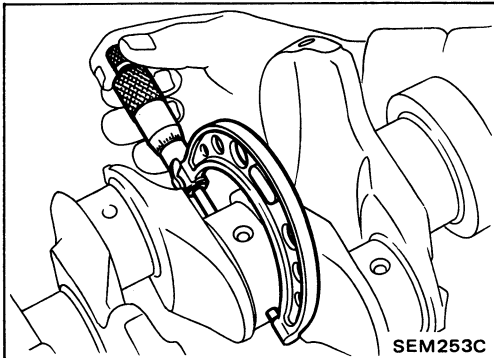
Method A (Using bore gauge and micrometer)

Main bearing

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



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



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

5. Calculate main bearing clearance.

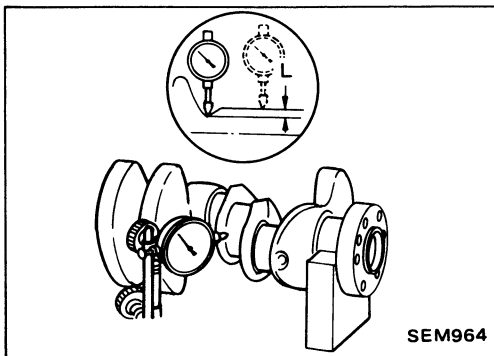
Main bearing clearance = A - Dm

Standard:

0.020 - 0.047 mm (0.0008 - 0.0019 in)

Limit: 0.1 mm (0.004 in)

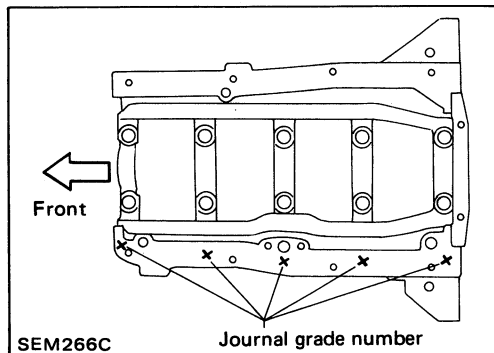
6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.



- 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 S.D.S. for grinding crankshaft and available service parts.



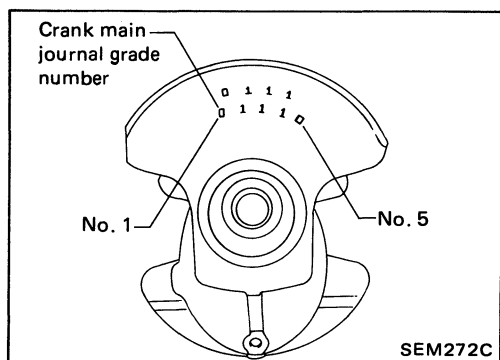
8. If crankshaft, is reused, measure main bearing clearance and thickness of main bearing.

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.

CYLINDER BLOCK

Inspection (Cont'd)



- b. Grade number of each crankshaft main journal is punched on crankshaft.

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

Main bearing grade number:

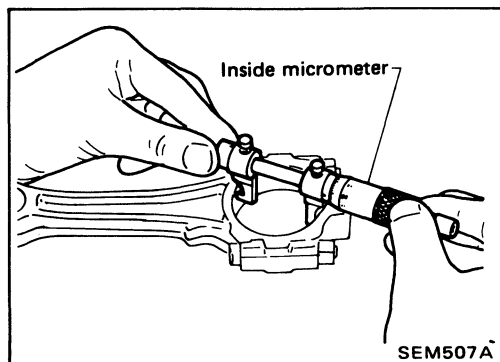
Main journal grade number Crankshaft journal grade number	Main journal grade number		
	0	1	2
0	0	1	2
1	1	2	3
2	2	3	4

For example:

Main journal grade number: 1

Crankshaft journal grade number: 2

Main bearing grade number = $1 + 2$
= 3

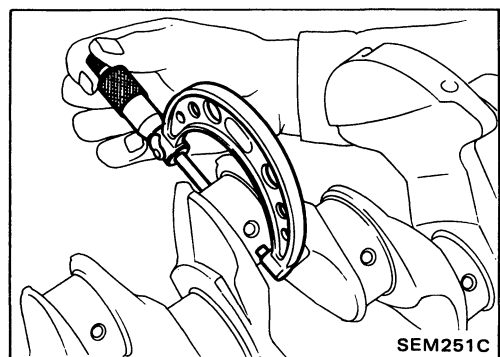


Connecting rod bearing (Big end)

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: 0.09 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"

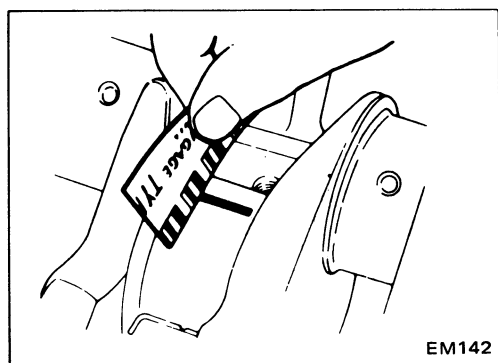
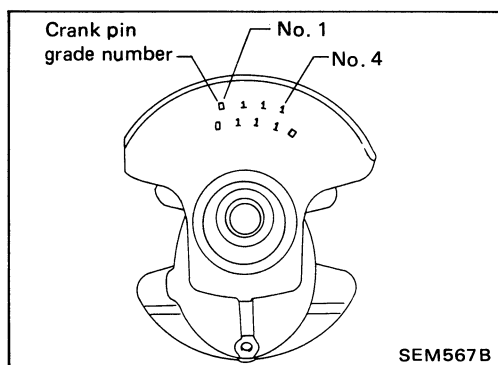
CYLINDER BLOCK

Inspection (Cont'd)

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

Connecting rod bearing grade number:

Crank pin grade number	Connecting rod bearing grade number
0	0
1	1
2	2



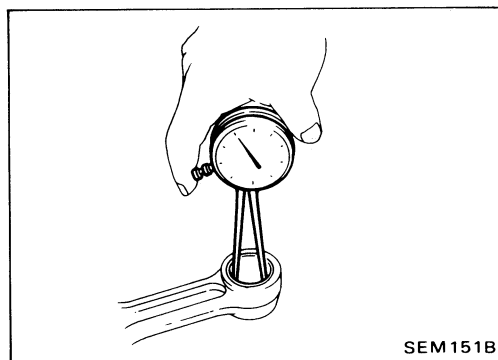
Method B (Using plastigauge)

CAUTION:

- Do not turn crankshaft or connecting rod while plastigauge 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.



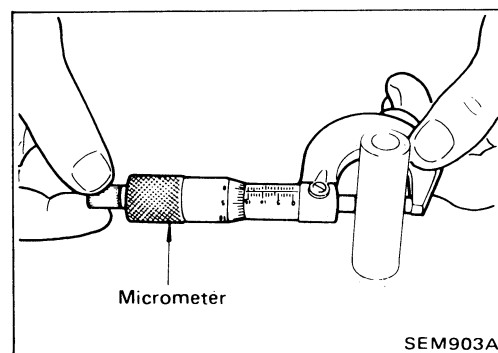
2. Measure outer diameter "Dp" of piston pin.
3. Calculate connecting rod bearing clearance.

$$C - Dp =$$

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

0.023 mm (0.0009 in) (Limit)

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



CYLINDER BLOCK

Inspection (Cont'd)

REPLACEMENT OF CONNECTING ROD BUSHING

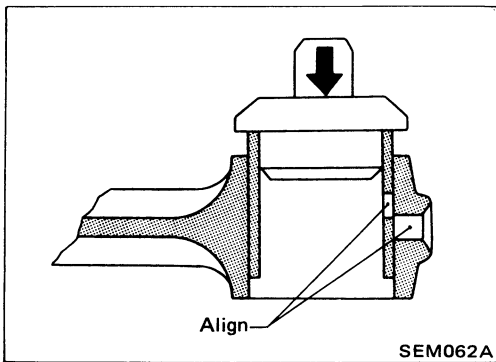
(Small end)

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

Be sure to align the oil holes.

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

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



FLYWHEEL/DRIVE PLATE RUNOUT

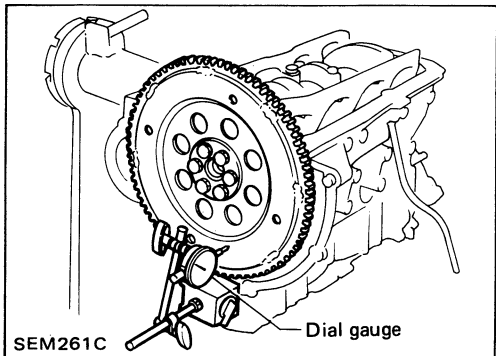
Runout (Total indicator reading):

Flywheel (M/T model)

Less than 0.1 mm (0.004 in)

Drive plate (A/T model)

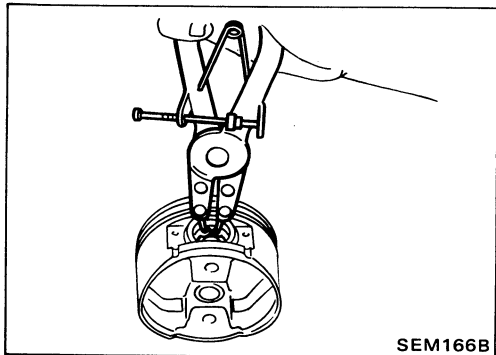
Less than 0.1 mm (0.004 in)



Assembly

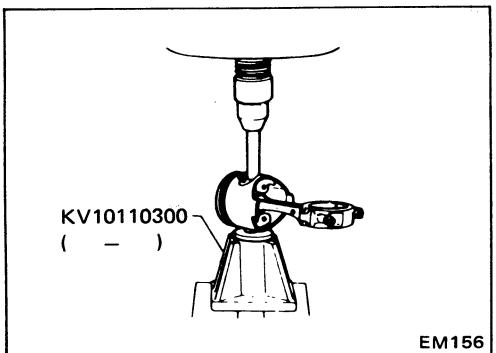
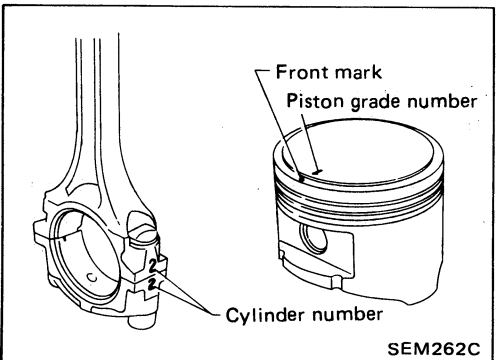
PISTON

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.

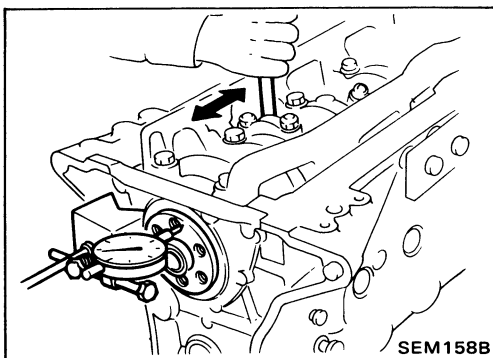
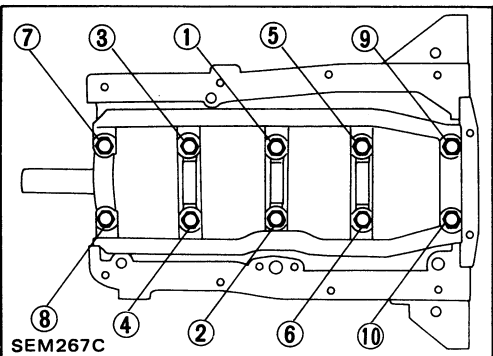
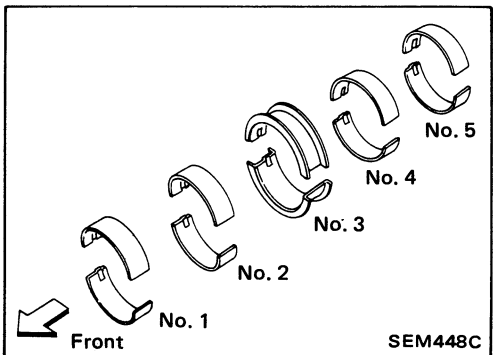
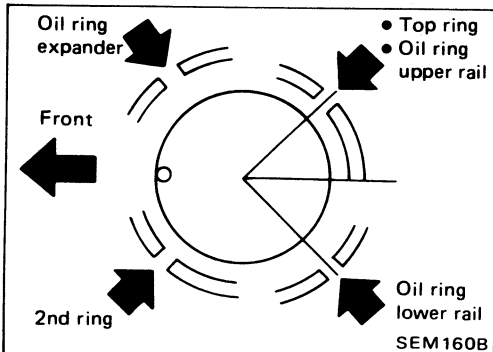
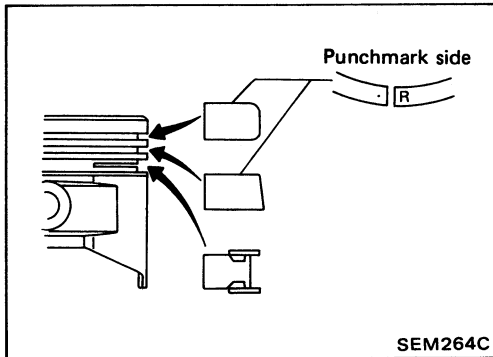
- **Align the direction of piston and connecting rod.**
- **Numbers stamped on connecting rod and cap correspond to each cylinder.**
- **After assembly, make sure connecting rod swings smoothly.**



CYLINDER BLOCK

Assembly (Cont'd)

3. Set piston rings as shown.



CRANKSHAFT

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

- Confirm that correct main bearings are used. Refer to "Inspection" of this section.

2. Install crankshaft and main bearing 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.
- 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

0.05 - 0.18 mm (0.0020 - 0.0071 in)

Limit

0.3 mm (0.012 in)

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

CYLINDER BLOCK

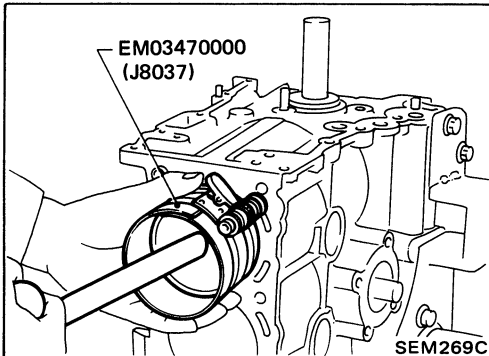
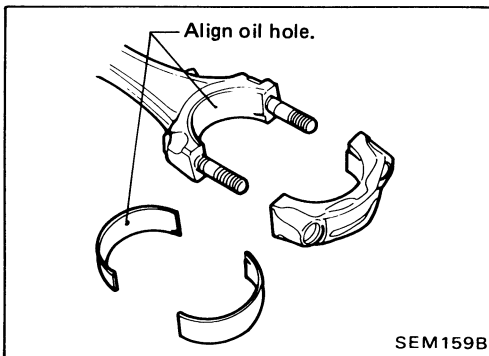
Assembly (Cont'd)

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

- Confirm that correct bearings are used.

Refer to "Inspection".

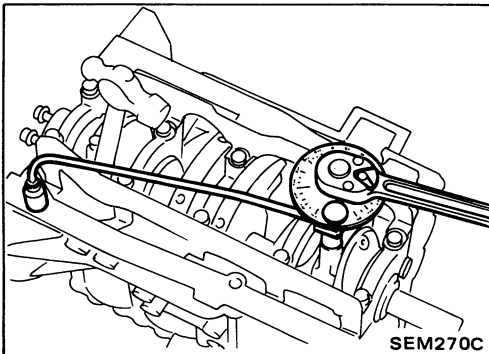
- Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.



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 bearing caps.

Tighten connecting rod bearing cap nuts to the specified torque.

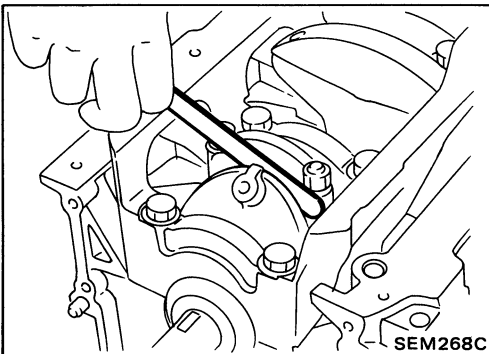
Connecting rod bearing nut:

- (1) Tighten to 14 to 16 N·m

(1.4 to 1.6 kg-m, 10 to 12 ft-lb).

- (2) Tighten bolts 60 to 65 degrees clockwise with an angle wrench, or if an angle wrench is not available, tighten them to

38 to 44 N·m (3.9 to 4.5 kg-m, 28 to 33 ft-lb).



6. Measure connecting rod side clearance.

Connecting rod side clearance:

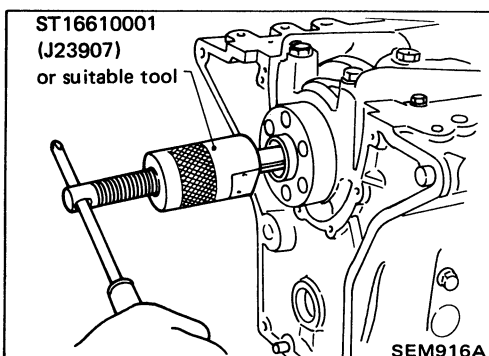
Standard

0.2 - 0.4 mm (0.008 - 0.016 in)

Limit

0.6 mm (0.024 in)

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



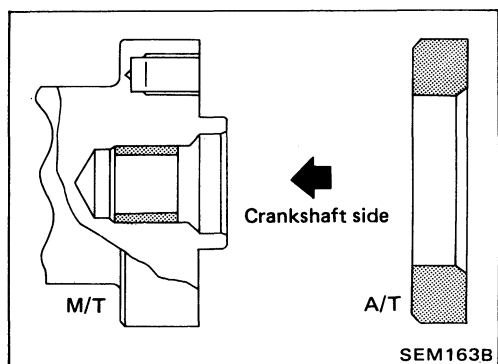
REPLACING PILOT BUSHING

1. Remove pilot bushing (M/T) or pilot convertor (A/T).

CYLINDER BLOCK

Assembly (Cont'd)

2. Install pilot bushing (M/T) or pilot convertor (A/T).



SERVICE DATA AND SPECIFICATIONS (S.D.S.)

General Specifications

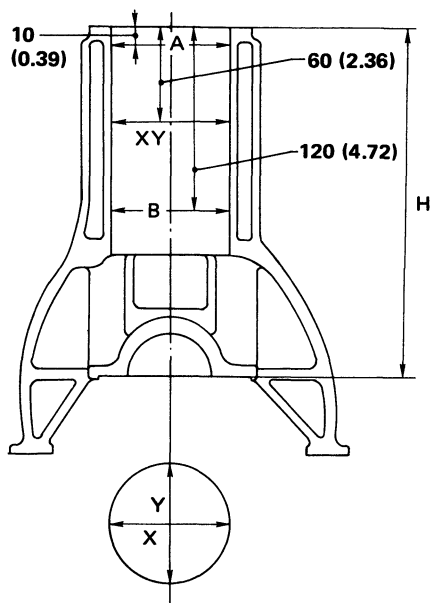
Engine model	KA24E
Cylinder arrangement	4, in-line
Displacement cm ³ (cu in)	2,389 (145.78)
Bore x stroke mm (in)	89 x 96 (3.50 x 3.78)
Valve arrangement	O.H.C.
Firing order	1-3-4-2
Number of piston rings	
Compression	2
Oil	1
Number of main bearings	5
Compression ratio	8.6

Unit: kPa (kg/cm², psi)/rpm

Compression pressure	
Standard	1,206 (12.3, 175)/250
Minimum	1,010 (10.3, 146)/250
Differential limit between cylinders	98 (1.0, 14)/250

Inspection and Adjustment

CYLINDER BLOCK



SEM447C

Unit: mm (in)

			Standard	Limit
Distortion			—	0.1 (0.004)
Cylinder bore	Inner diameter	Grade 1	89.000 - 89.010 (3.5039 - 3.5043)	0.2 (0.008)*
		Grade 2	89.010 - 89.020 (3.5043 - 3.5047)	
		Grade 3	89.020 - 89.030 (3.5047 - 3.5051)	
	Out-of-round (X-Y)		Less than 0.015 (0.0006)	—
	Taper (A-B)		Less than 0.010 (0.0004)	—
Difference in inner diameter between cylinders			Less than 0.05 (0.0020)	0.2 (0.008)
Piston-to-cylinder clearance			0.020 - 0.040 (0.0008 - 0.0016)	—
Cylinder block height (From crankshaft center)			246.95 - 247.05 (9.7224 - 9.7264)	0.2 (0.008)**

* Wear limit

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

CYLINDER HEAD

Unit: mm (in)

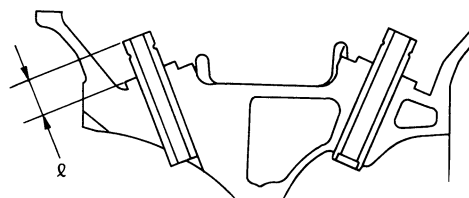
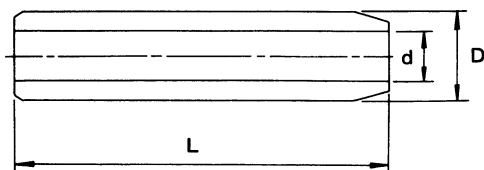
	Standard	Limit
Height (H)	98.8 - 99.0 (3.890 - 3.898)	0.2 (0.008) *
Surface distortion	0.03 (0.0012)	0.1 (0.004)

* Total amount of cylinder head resurfacing and cylinder block resurfacing

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

VALVE GUIDE



SEM571B

SEM225C

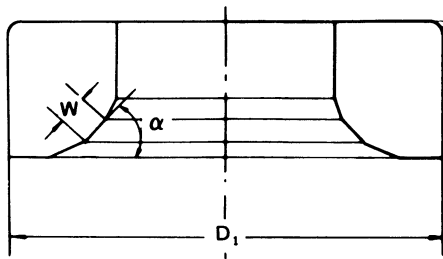
Unit: mm (in)

	Standard		Service		Limit
	Intake	Exhaust	Intake	Exhaust	
Length (L)	52.6 (2.071)	56.0 (2.205)	52.6 (2.071)	56.0 (2.205)	—
Outer diameter (D)	11.023 - 11.034 (0.4340 - 0.4344)	12.023 - 12.034 (0.4733 - 0.4738)	11.223 - 11.234 (0.4418 - 0.4423)	12.223 - 12.234 (0.4812 - 0.4817)	—
Inner diameter (d) (Finished size)	7.000 - 7.018 (0.2756 - 0.2763)	8.000 - 8.018 (0.3150 - 0.3157)	7.000 - 7.018 (0.2756 - 0.2763)	8.000 - 8.018 (0.3150 - 0.3157)	—
Cylinder head hole diameter	10.975 - 10.996 (0.4321 - 0.4329)	11.975 - 11.996 (0.4715 - 0.4723)	11.175 - 11.196 (0.4400 - 0.4408)	12.175 - 12.196 (0.4793 - 0.4802)	—
Interference fit	0.027 - 0.059 (0.0011 - 0.0023)				—
Stem to guide clearance	0.020 - 0.053 (0.0008 - 0.0021)	0.040 - 0.070 (0.0016 - 0.0028)	0.020 - 0.053 (0.0008 - 0.00209)	0.040 - 0.070 (0.0016 - 0.0028)	0.1 (0.004)
Tapping length (l)	14.9 - 15.1 (0.587 - 0.594)				—

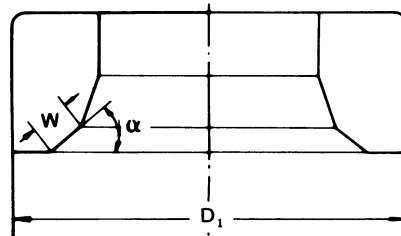
SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

Standard



Service



SEM177

SEM178

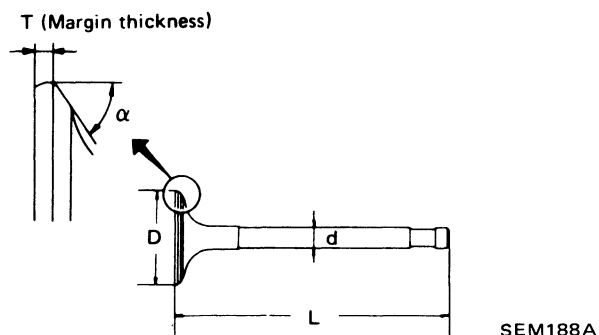
Unit: mm (in)

	Standard		Service	
	Intake	Exhaust	Intake	Exhaust
Cylinder head seat recess diameter	36.000 - 36.016 (1.4173 - 1.4179)	42.000 - 42.016 (1.6535 - 1.6542)	36.500 - 36.516 (1.4370 - 1.4376)	42.500 - 42.516 (1.6732 - 1.6739)
Valve seat outer diameter (D ₁)	36.080 - 36.096 (1.4205 - 1.4211)	42.080 - 42.096 (1.6567 - 1.6573)	36.580 - 36.596 (1.4402 - 1.4408)	42.580 - 42.596 (1.6764 - 1.6770)
Face angle (α)	45°	45°	45°	45°
Contacting width (W)	1.6 - 1.7 (0.063 - 0.067)	1.7 - 2.1 (0.067 - 0.083)	1.6 - 1.7 (0.063 - 0.067)	1.7 - 2.1 (0.067 - 0.083)

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

VALVE



Unit: mm (in)

		Standard	Limit
Valve head diameter (D)	In.	34.0 - 34.2 (1.339 - 1.346)	—
	Ex.	40.0 - 40.2 (1.575 - 1.583)	—
Valve length (L)	In.	119.9 - 120.2 (4.720 - 4.732)	—
	Ex.	120.67 - 120.97 (4.7508 - 4.7626)	—
Valve stem diameter (d)	In.	6.965 - 6.980 (0.2742 - 0.2748)	—
	Ex.	7.948 - 7.960 (0.3129 - 0.3134)	—
Valve face angle (α)	In.	45°30'	—
	Ex.	45°30'	—
Valve head margin (T)	In.	1.15 - 1.45 (0.0453 - 0.0571)	0.5 (0.020)
	Ex.	1.35 - 1.65 (0.0531 - 0.0650)	

VALVE SPRING

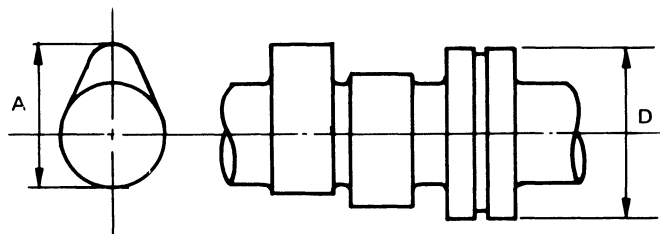
Unit: mm (in)

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

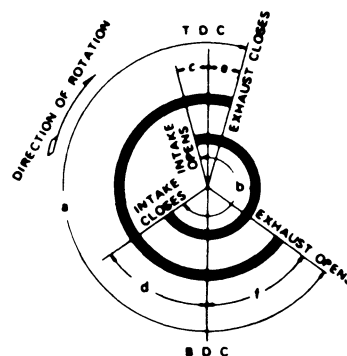
SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

CAMSHAFT AND CAMSHAFT BEARING



SEM568A



EM120

Unit: mm (in)

		Standard	Limit
Cam height (A)		44.839 - 45.029 (1.7653 - 1.7728)	—
Valve lift (h)		10.4 (0.409)	—
Wear limit of cam height		—	0.2 (0.008)
Camshaft journal to bearing clearance		0.045 - 0.090 (0.0018 - 0.0035)	0.12 (0.0047)
Inner diameter of camshaft bearing		33.000 - 33.025 (1.2992 - 1.3002)	—
Outer diameter of camshaft journal (D)		32.935 - 32.955 (1.2967 - 1.2974)	—
Camshaft runout		0 - 0.02 (0 - 0.0008)	—
Camshaft end play		0.07 - 0.15 (0.0028 - 0.0059)	0.2 (0.008)
Valve timing (Degree on crankshaft)	a	248	—
	b	240	—
	c	3	—
	d	57	—
	e	12	—
	f	56	—

ROCKER ARM AND ROCKER SHAFT

Unit: mm (in)

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

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

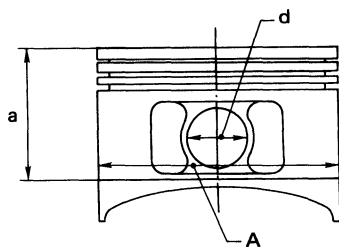
Inspection and Adjustment (Cont'd)

PISTON, PISTON RING AND PISTON PIN

Piston ring

Unit: mm (in)

Piston



SEM444C

Unit: mm (in)

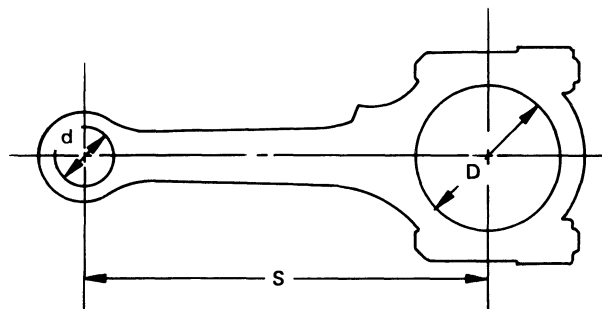
Piston skirt diameter (A)	Standard	Grade No. 1	88.970 - 88.980 (3.5027 - 3.5031)
		Grade No. 2	88.980 - 88.990 (3.5031 - 3.5035)
		Grade No. 3	88.990 - 89.000 (3.5035 - 3.5039)
	Service (Oversize)	0.5 (0.020)	89.470 - 89.500 (3.5224 - 3.5236)
		1.0 (0.039)	89.970 - 90.000 (3.5421 - 3.5433)
Dimension (a)		Approximately 52 (2.05)	
Piston pin hole diameter (d)		20.987 - 20.999 (0.8263 - 0.8267)	
Piston-to-cylinder bore clearance		0.020 - 0.040 (0.0008 - 0.0016)	

		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.1 (0.004)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
Ring gap	Top	0.28 - 0.43 (0.0110 - 0.0169)	0.5 (0.020)
	2nd	0.45 - 0.60 (0.0177 - 0.0236)*1 0.55 - 0.70 (0.0217 - 0.0276)*2	0.5 (0.020)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.5 (0.020)

*1: For rings punched with R or T.

*2: For rings punched with N.

CONNECTING ROD



SEM570A

Unit: mm (in)

Piston pin

Unit: mm (in)

	Standard	Limit
Piston pin outer diameter	20.989 - 21.001 (0.8263 - 0.8268)	—
Interference fit of piston pin to piston pin hole	0 - 0.004 (0 - 0.0002)	—
Piston pin to connecting rod bearing clearance	0.005 - 0.017 (0.0002 - 0.0007)	0.023 (0.0009)

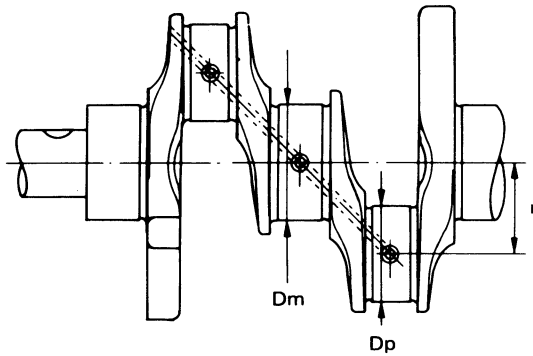
	Standard	Limit
Center distance (S)	164.95 - 165.05 (6.4941 - 6.4980)	—
Bend [per 100 mm (3.94 in)]	—	0.15 (0.0059)
Torsion [per 100 mm (3.94 in)]	—	0.3 (0.012)
Piston pin bushing inner diameter (d)*	21.000 - 21.012 (0.8268 - 0.8272)	—
Connecting rod big end inner diameter (D)*	53.000 - 53.013 (2.0866 - 2.0871)	—
Side clearance	0.2 - 0.4 (0.008 - 0.016)	0.6 (0.024)

* Without bearing

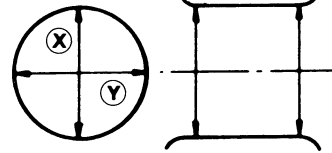
SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

CRANKSHAFT



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



EM715

SEM394

Unit: mm (in)

Main journal diameter (Dm)	Grade	No. 0	59.967 - 59.975 (2.3609 - 2.3612)	
		No. 1	59.959 - 59.967 (2.3606 - 2.3609)	
		No. 2	59.951 - 59.959 (2.3603 - 2.3606)	
Pin journal diameter (Dp)	Grade	No. 0	49.968 - 49.974 (1.9672 - 1.9675)	
		No. 1	49.962 - 49.968 (1.9670 - 1.9672)	
		No. 2	49.956 - 49.962 (1.9668 - 1.9670)	
Center distance (r)		47.97 - 48.03 (1.8886 - 1.8909)		
		Standard	Limit	
Taper of journal and pin [(A) - (B)]	Journal	—	0.01 (0.0004)	
	Pin	—	0.005 (0.0002)	
Out-of-round of journal and pin [(X) - (Y)]	Journal	—	0.01 (0.0004)	
	Pin	—	0.005 (0.0002)	
Runout [T.I.R.] *		—	0.10 (0.0039)	
Free end play		0.05 - 0.18 (0.0020 - 0.0071)		0.3 (0.012)
Fillet roil		More than 0.1 (0.004)		

* Total indicator reading

BEARING CLEARANCE

Unit: mm (in)

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

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

AVAILABLE MAIN BEARING

Standard

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

Undersize (service)

Unit: mm (in)

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

AVAILABLE CONNECTING ROD BEARING

Standard

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

Undersize (service)

Unit: mm (in)

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

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Camshaft sprocket runout [T.I.R.] *	Less than 0.12 (0.0047)
Flywheel runout [T.I.R.] *	Less than 0.1 (0.004)
Drive plate runout [T.I.R.] *	Less than 0.1 (0.004)

* Total indicator reading

ENGINE LUBRICATION & COOLING SYSTEMS

SECTION **LC**

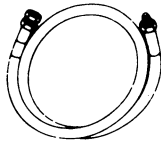
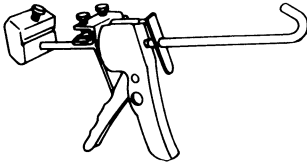
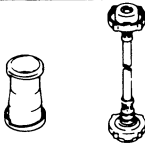
LC

CONTENTS

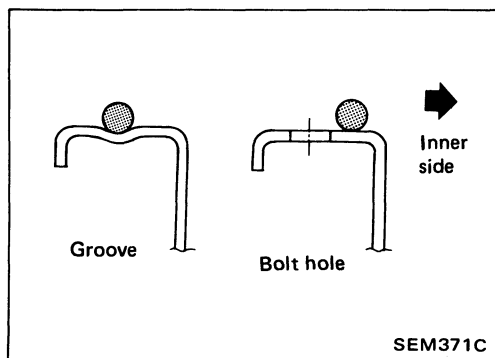
PREPARATION	LC- 2
PRECAUTION	LC- 3
ENGINE LUBRICATION SYSTEM	LC- 4
ENGINE COOLING SYSTEM	LC- 7
SERVICE DATA AND SPECIFICATIONS (S.D.S.)	LC-11

PREPARATION

SPECIAL SERVICE TOOLS

Tool number (Kent-Moore No.) Tool name	Description	
ST25051001 (J25695-1) Oil pressure gauge		
ST25052000 (J25695-2) Hose	Adapting oil pressure gauge to cylinder block	
EG17650301 (—) Radiator cap tester adapter	Pressing the tube of liquid gasket	
WS39930000 (—) Tube presser	Adapting radiator cap tester to radiator filler neck	

PRECAUTION

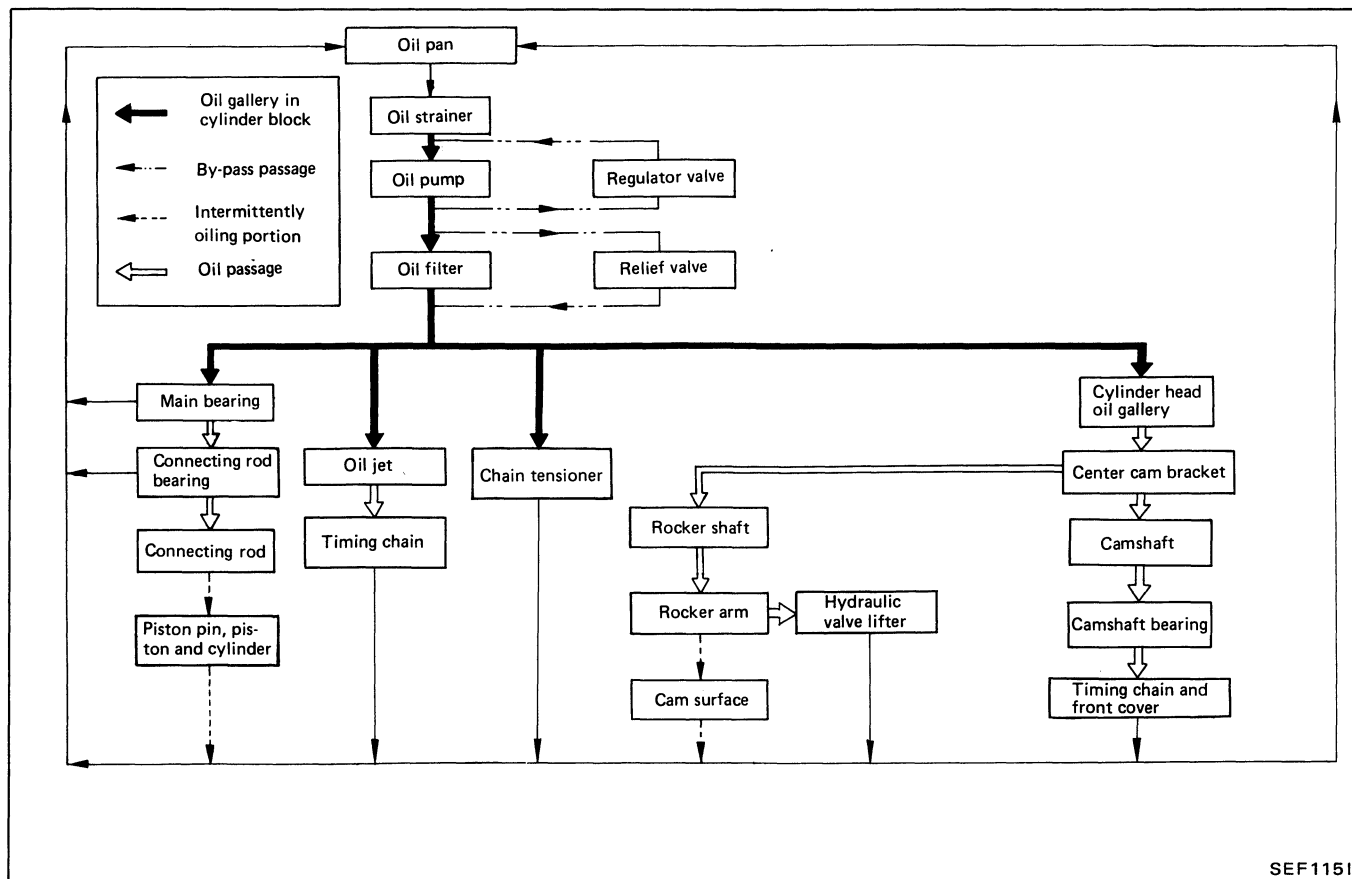


LIQUID GASKET APPLICATION PROCEDURE

- Before applying liquid gasket, use a scraper to remove all traces of old liquid gasket from mating surface.
- Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)
 - Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide (for oil pan).
 - Be sure liquid gasket is 2.0 to 3.0 mm (0.079 to 0.118 in) wide (in areas except oil pan).
- Apply liquid gasket to inner sealing surface around hole perimeter area.
(Assembly should be done within 5 minutes after coating.)
- Wait at least 30 minutes before refilling engine oil and engine coolant.

ENGINE LUBRICATION SYSTEM

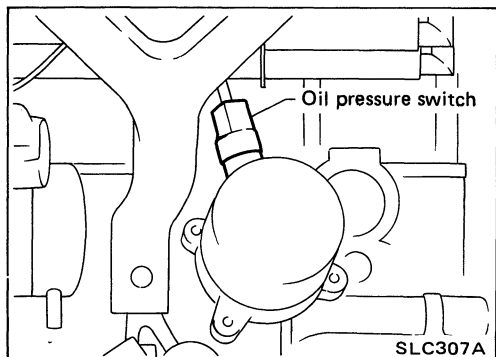
Lubrication Circuit



Oil Pressure Check

WARNING:

- Be careful not to burn yourself, as the engine and oil may be hot.
- Oil pressure check should be done in "Neutral" gear position.



1. Check oil level.
2. Remove oil pressure switch.

ENGINE LUBRICATION SYSTEM

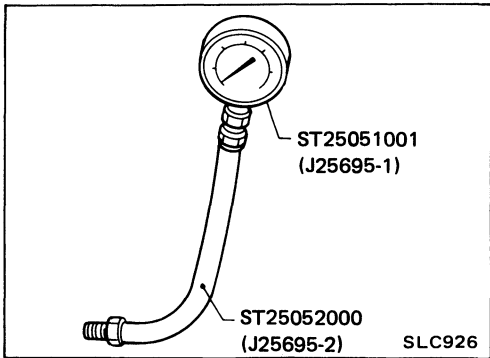
Oil Pressure Check (Cont'd)

3. Install pressure gauge.
4. Start engine and warm it up to normal operating temperature.
5. Check oil pressure with engine running under no-load.

Engine rpm	Approximate discharge pressure kPa (kg/cm ² , psi)
Idle speed	More than 78 (0.8, 11)
3,000	412 - 481 (4.2 - 4.9, 60 - 70)

If difference is extreme, check oil passage and oil pump for oil leaks.

6. Install oil pressure switch with sealant.

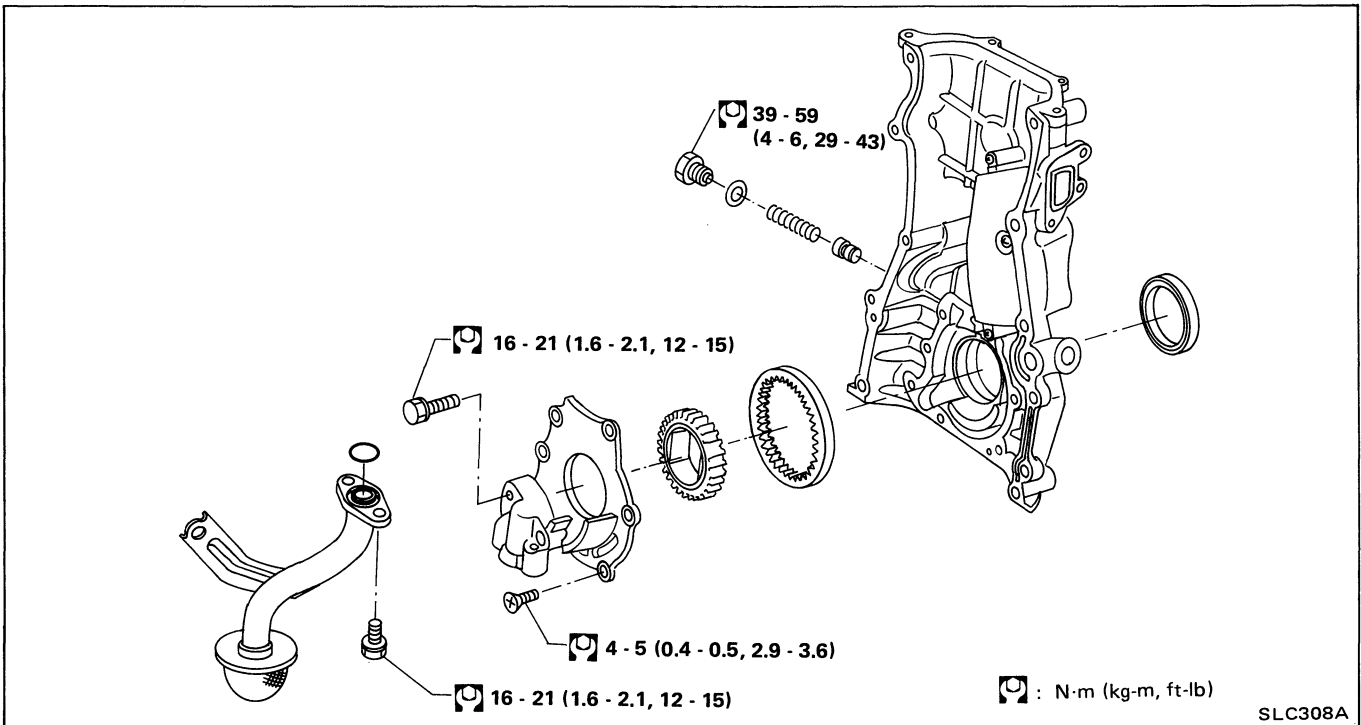


Oil Pump

REMOVAL

1. Drain oil.
2. Remove front cover. (Refer to EM section.)
3. Remove oil pump assembly.

DISASSEMBLY AND ASSEMBLY



- Always replace with new oil seal and gasket.
- When installing oil pump, apply engine oil to inner and outer gears.
- Be sure that O-ring is properly installed.

ENGINE LUBRICATION SYSTEM

Oil Pump (Cont'd)

INSPECTION

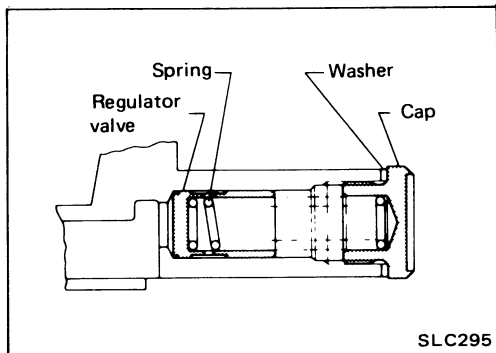
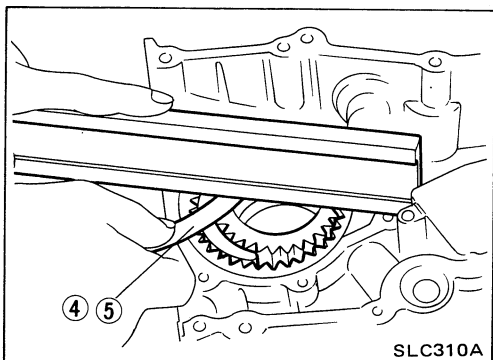
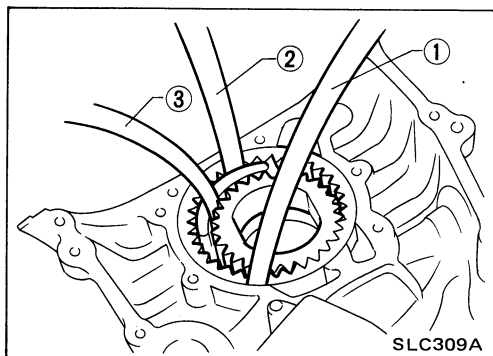
Using a feeler gauge, check the following clearances:

Standard clearance:

Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.22 - 0.33 (0.0087 - 0.0130)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)

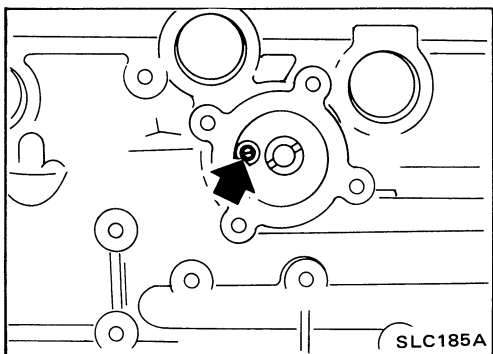
If any clearance exceeds the limit, replace gear set or entire oil pump assembly.



REGULATOR VALVE INSPECTION

1. Visually inspect components for wear and damage.
2. Check oil pressure regulator valve sliding surface and valve spring.
3. Coat regulator valve with engine oil and check to make sure that it falls smoothly into the valve hole by its own weight.

If damaged, replace regulator valve set or oil pump assembly.



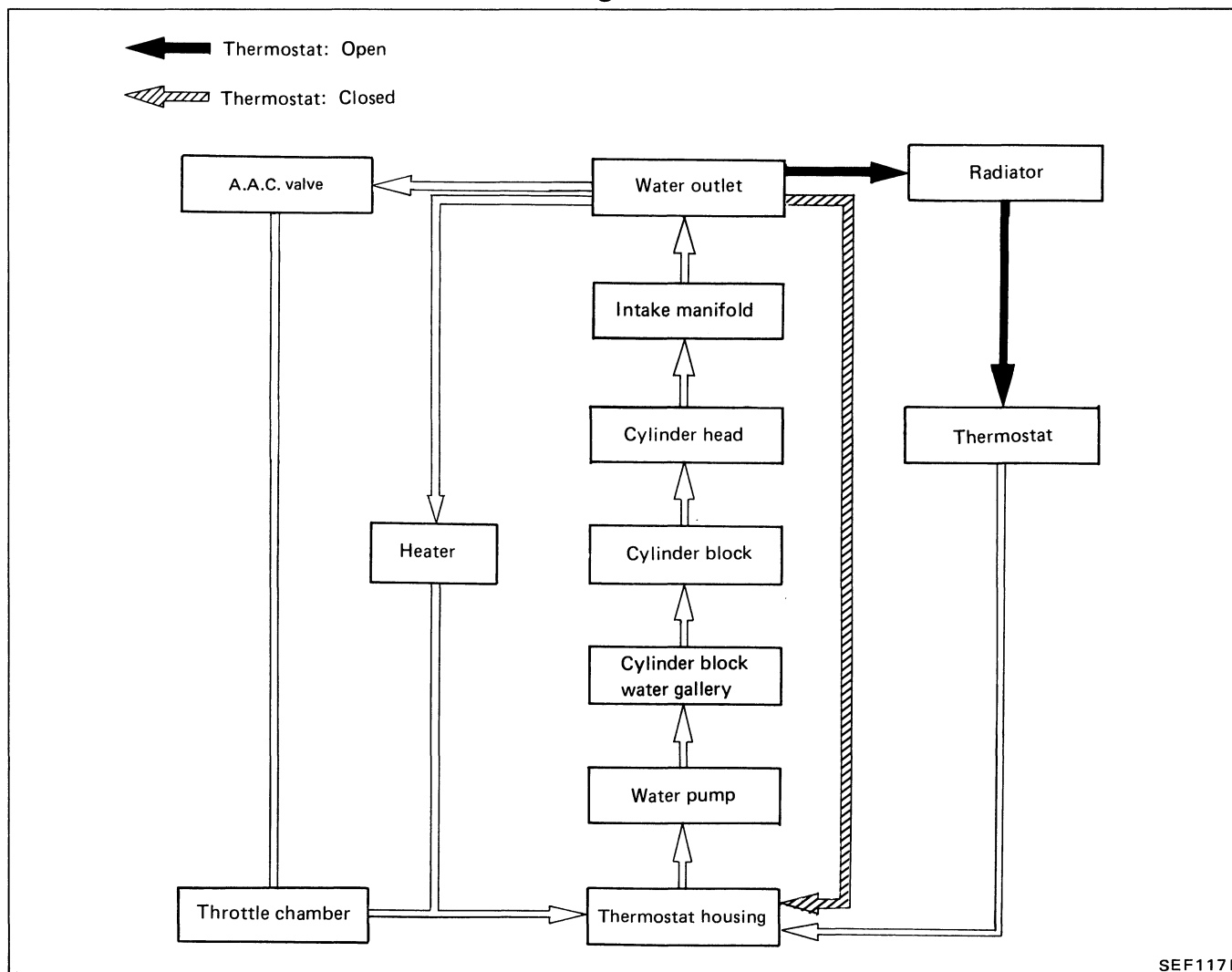
OIL PRESSURE RELIEF VALVE INSPECTION

Inspect oil pressure relief valve for movement, cracks and breaks by pushing the ball. If replacement is necessary, remove valve by prying it out with a suitable tool.

Install a new valve by tapping it in place.

ENGINE COOLING SYSTEM

Cooling Circuit



System Check

WARNING:

Never remove the radiator cap when the engine is hot; serious burns could be caused by high pressure fluid escaping from the radiator.

Wrap a thick cloth around the cap and carefully remove by turning it a quarter turn to allow built-up pressure to escape. Then continue to turn the cap until it can be removed safely.

CHECKING COOLING SYSTEM HOSES

Check hoses for improper attachment, leaks, cracks, damage, loose connections, chafing and deterioration.

ENGINE COOLING SYSTEM

System Check (Cont'd)

CHECKING COOLING SYSTEM FOR LEAKS

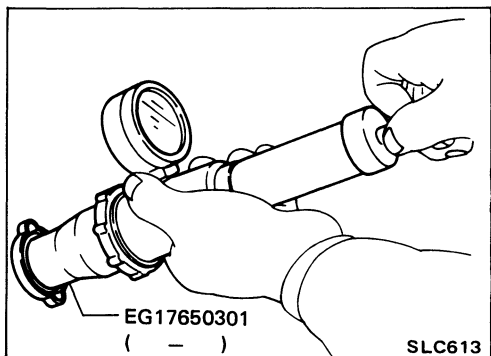
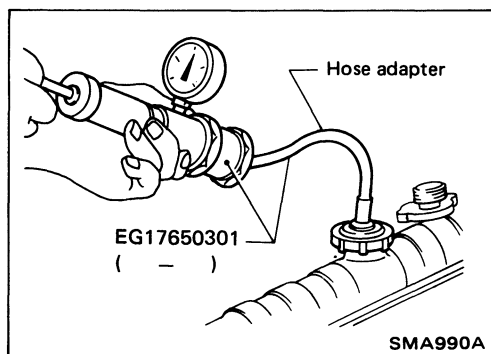
To check for leakage, apply pressure to the cooling system with a tester.

Testing pressure:

98 kPa (1.0 kg/cm², 14 psi)

CAUTION:

Higher than the specified pressure may cause radiator damage.

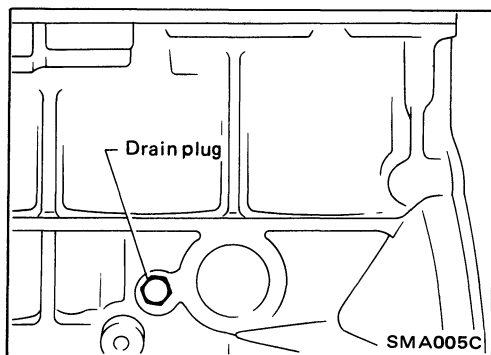


CHECKING RADIATOR CAP

To check radiator cap, apply pressure to cap with a tester.

Radiator cap relief pressure:

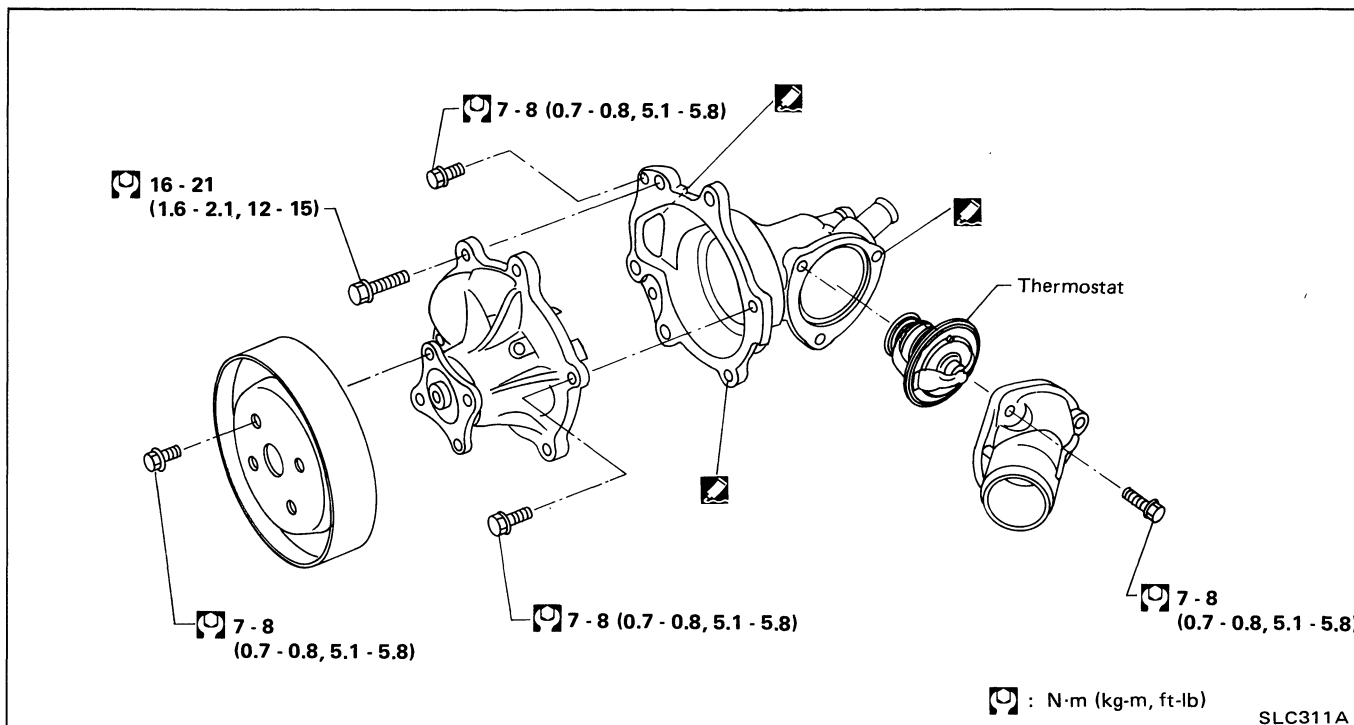
78 - 98 kPa (0.8 - 1.0 kg/cm², 11 - 14 psi)



Water Pump

REMOVAL AND INSTALLATION

Drain coolant from drain cocks on both cylinder block and radiator.

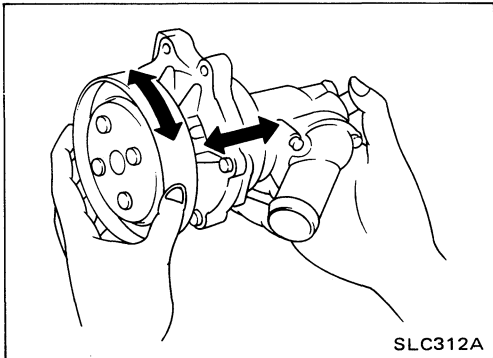


ENGINE COOLING SYSTEM

Water Pump (Cont'd)

CAUTION:

- When removing water pump assembly, be careful not to get coolant on timing belt.
- Water pump cannot be disassembled and should be replaced as a unit.
- To avoid damaging timing cover, make sure there is adequate clearance between it and the hose clamp.
- After installing water pump, connect hose and clamp securely, then check for leaks using radiator cap tester.



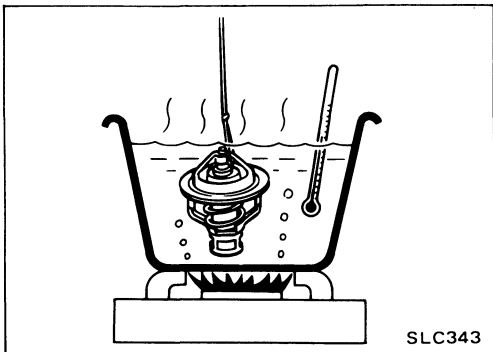
INSPECTION

1. Check for badly rusted or corroded vanes and body assembly.
2. Check for rough operation due to excessive end play.

Thermostat

INSPECTION

1. Check valve seating condition at ordinary room temperatures. It should seat tightly.



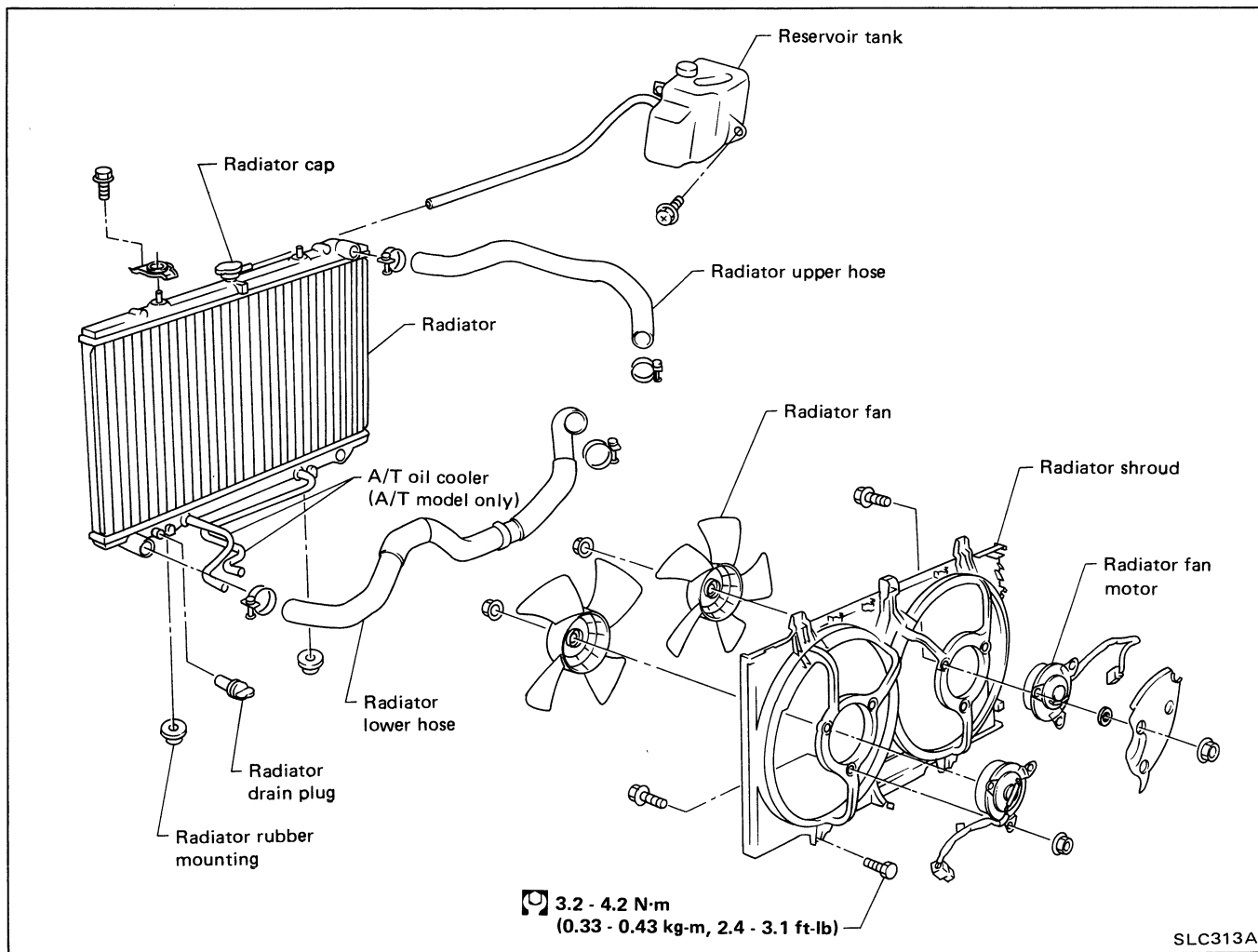
2. Check valve opening temperature and maximum valve lift.

		Standard
Valve opening temperature	°C (°F)	76.5 (170)
Maximum valve lift	mm/°C (in/°F)	8/90 (0.31/194)

3. Then check if valve is 5°C (9°F) below valve opening temperature.

- After installation, run engine for a few minutes, and check for leaks.
- Be careful not to spill coolant over engine compartment. Use a rag to absorb coolant.

Radiator REMOVAL AND INSTALLATION



Electric Cooling Fan Control System

Radiator fan and condenser fan are both controlled by E.C.C.S. control unit.
For details, refer to EF & EC section.

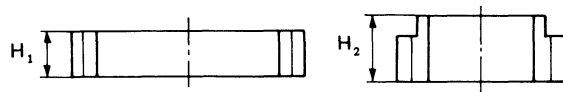
SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Engine Lubrication System

Oil pressure check

Engine rpm	Approximate discharge pressure kPa (kg/cm ² , psi)
Idle speed	More than 78 (0.8, 11)
3,000	412 - 481 (4.2 - 4.9, 60 - 70)

Oil pump



OUTER GEAR

INNER GEAR

SLC573

Unit: mm (in)

	H ₁	H ₂
Height	11.5 (0.453)	17.25 (0.6791)

Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.22 - 0.33 (0.0087 - 0.0130)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear side clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear side clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)

Engine Cooling System

Thermostat

	Standard
Valve opening temperature °C (°F)	76.5 (170)
Maximum valve lift mm/°C (in/°F)	8/90 (0.31/194)

Radiator

Unit: kPa (kg/cm², psi)

Cap relief pressure	78 - 98 (0.8 - 1.0, 11 - 14)
Leakage test pressure	98 (1.0, 14)

