

## SECTION **EM**

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### Precautions for Supplemental Restraint System “AIR BAG”

The Supplemental Restraint System “Air Bag” helps to reduce the risk or severity of injury to the driver and front passenger in a frontal collision. The Supplemental Restraint System consists of air bags (located in the center of the steering wheel and on the instrument panel on the passenger side), sensors, a control module, warning lamp, wiring harness and spiral cable. Information necessary to service the system safely is included in **section BF** of this Service Manual.

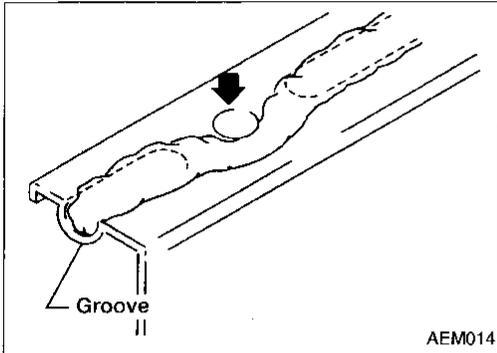
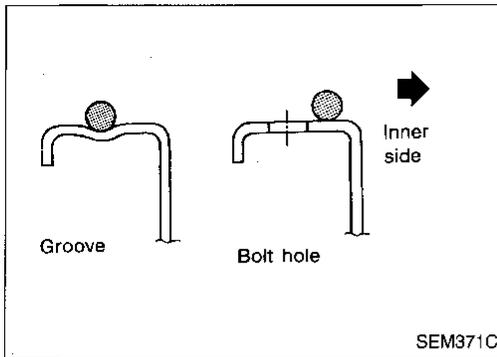
#### **WARNING:**

- **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.**
- **Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system.**
- **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 then coated with engine oil.
- The bolts and nuts which require the angular-tightening method are as follows:
  - (1) Cylinder head bolts
  - (2) Connecting rod cap nuts.

# PRECAUTIONS



## Liquid Gasket Application Procedure

- 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.
- 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 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.

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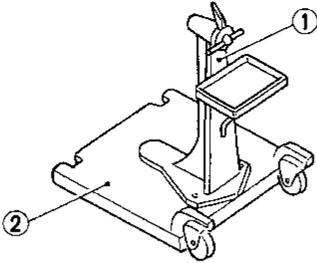
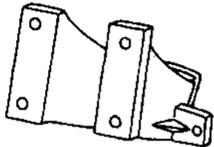
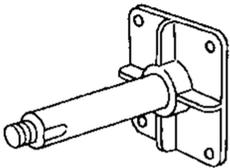
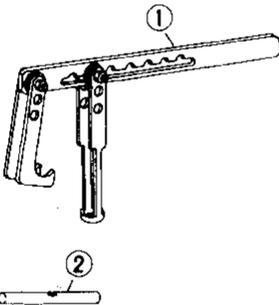
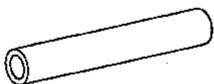
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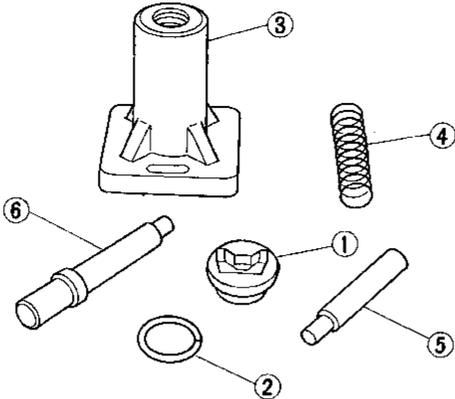
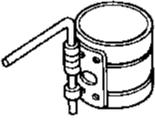
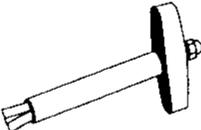
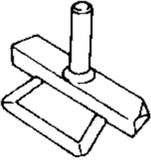
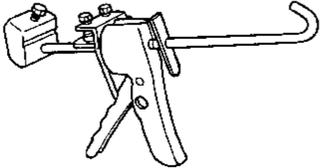
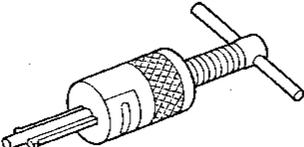
# PREPARATION

## 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
KV10116300 (J-38955) Valve oil seal drift		Installing valve oil seal

# PREPARATION

## Special Service Tools (Cont'd)

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	 <p style="text-align: right;">Disassembling and assembling piston with connecting rod</p>
EM03470000 (J8037) Piston ring compressor	 <p style="text-align: right;">Installing piston assembly into cylinder bore</p>
(J36467) Valve oil seal remover	 <p style="text-align: right;">Displacement valve oil seal</p>
KV10111100 (J37228) Seal cutter	 <p style="text-align: right;">Removing oil pan</p>
WS39930000 ( - ) Tube presser	 <p style="text-align: right;">Pressing the tube of liquid gasket</p>
ST16610001 (J23907) Pilot bushing puller	

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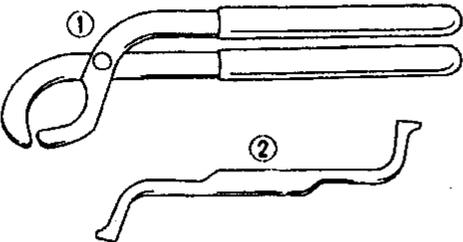
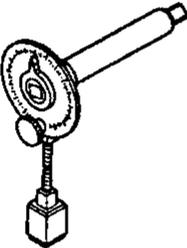
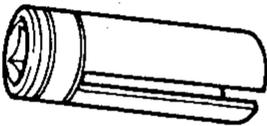
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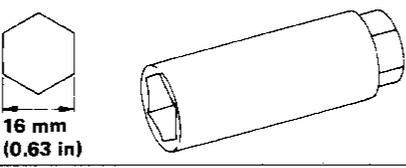
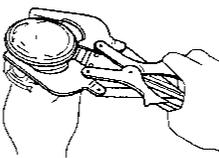
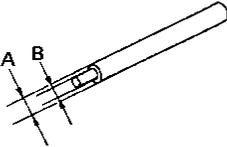
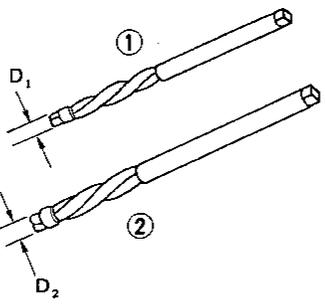
## PREPARATION

### Special Service Tools (Cont'd)

Tool number (Kent-Moore No.) Tool name	Description
ST10120000 (J-24239-01) Cylinder head bolt wrench	 <p style="text-align: right;">Loosening and tightening cylinder head bolt</p>
KV101151S0 Lifter stopper set ① KV10115110 Camshaft pliers ② KV10115120 Lifter stopper	 <p style="text-align: right;">Changing shims</p>
KV10112100 Angle wrench	 <p style="text-align: right;">Tightening bolts for bearing cap, cylin- der head, etc.</p>
(J36471) Oxygen sensor wrench	 <p style="text-align: right;">Loosening or tightening oxygen sensor</p>

# PREPARATION

## Commercial Service Tools

Tool name	Description							
Spark plug wrench	 <p style="text-align: center;">16 mm (0.63 in)</p>	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 <b>Diameter:</b> mm (in) <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>Intake &amp; Exhaust</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>10.5 (0.413)</td> </tr> <tr> <td>B</td> <td>6.6 (0.260)</td> </tr> </tbody> </table>		Intake & Exhaust	A	10.5 (0.413)	B	6.6 (0.260)
	Intake & Exhaust							
A	10.5 (0.413)							
B	6.6 (0.260)							
Valve guide reamer		Reaming valve guide (①) or hole for oversize valve guide (②) <b>Diameter:</b> mm (in) <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>Intake &amp; Exhaust</th> </tr> </thead> <tbody> <tr> <td>D<sub>1</sub></td> <td>7 (0.28)</td> </tr> <tr> <td>D<sub>2</sub></td> <td>11.175 (0.4400)</td> </tr> </tbody> </table>		Intake & Exhaust	D <sub>1</sub>	7 (0.28)	D <sub>2</sub>	11.175 (0.4400)
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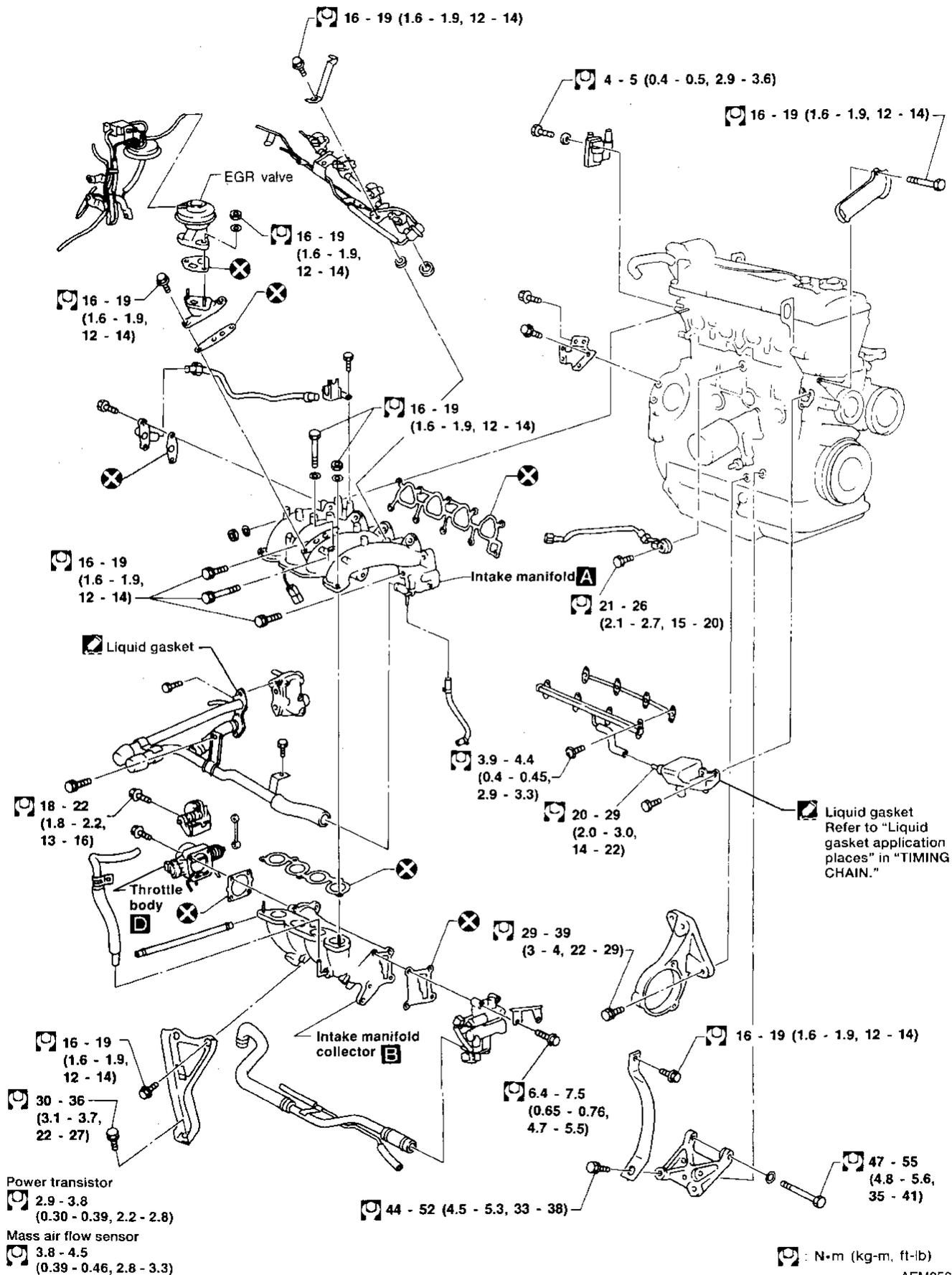
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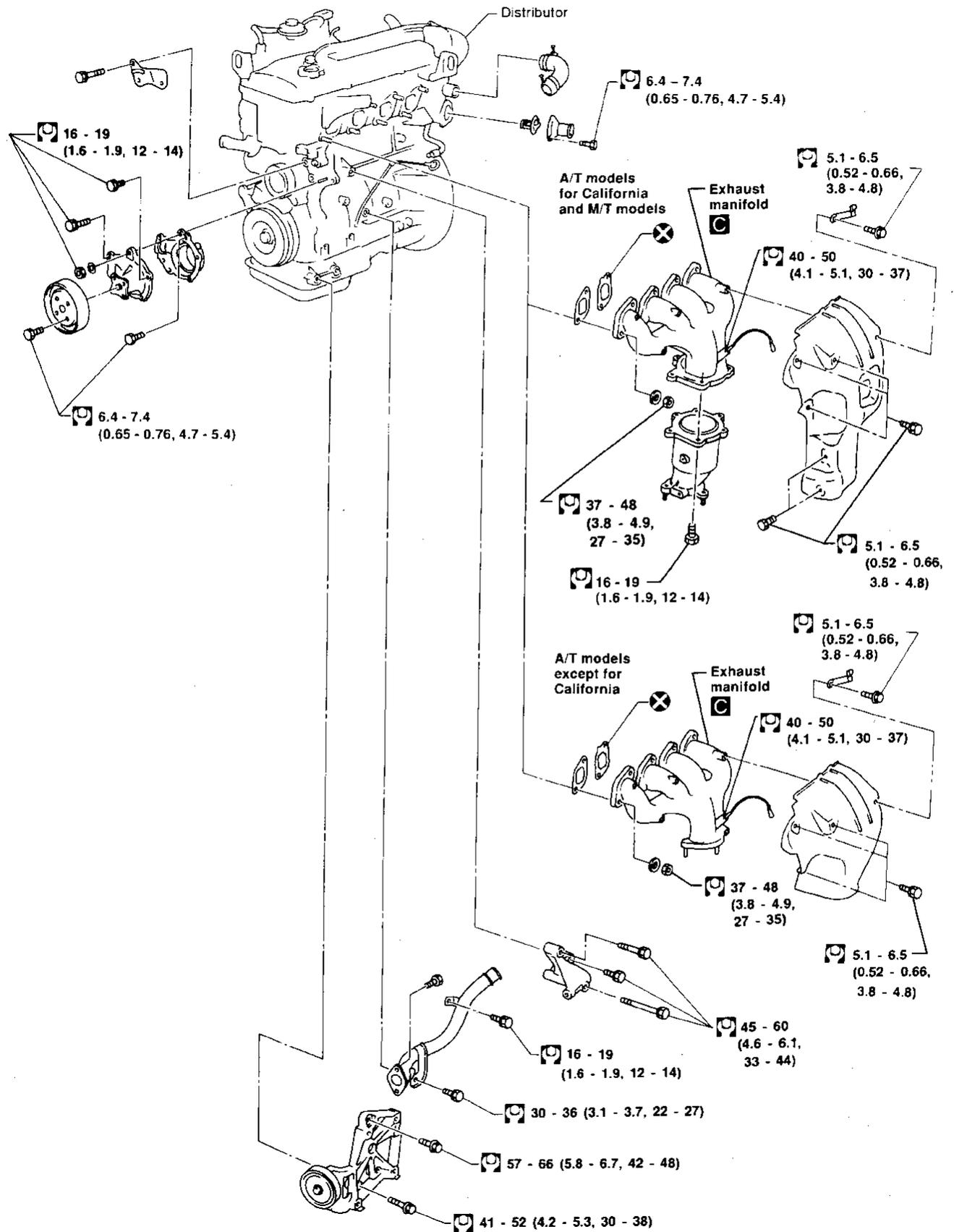
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# OUTER COMPONENT PARTS



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# OUTER COMPONENT PARTS



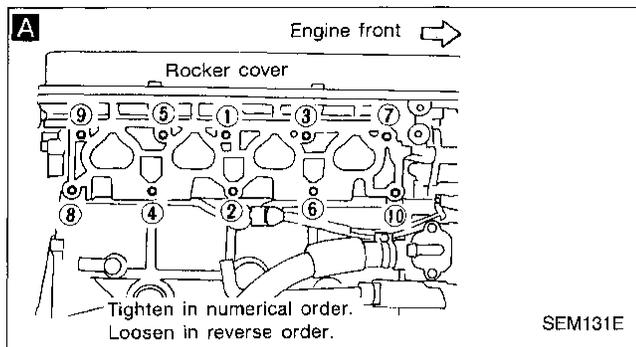
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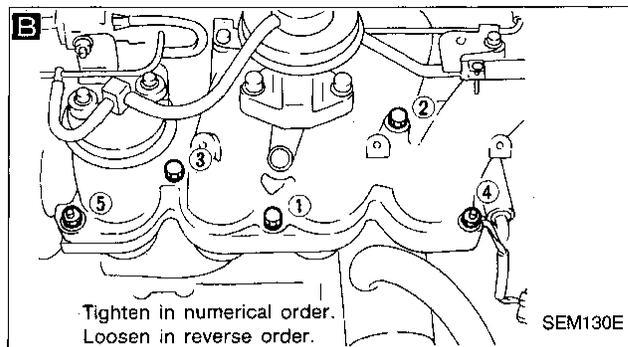
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# OUTER COMPONENT PARTS

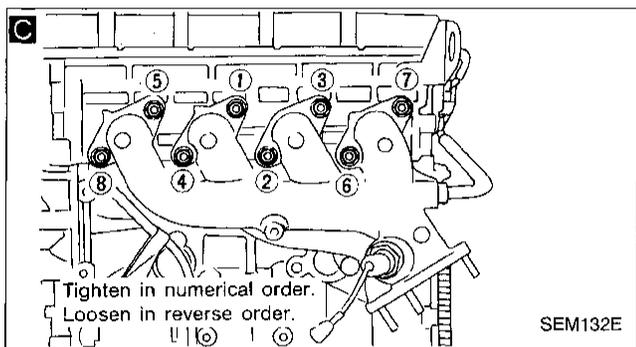
## Intake manifold tightening procedure



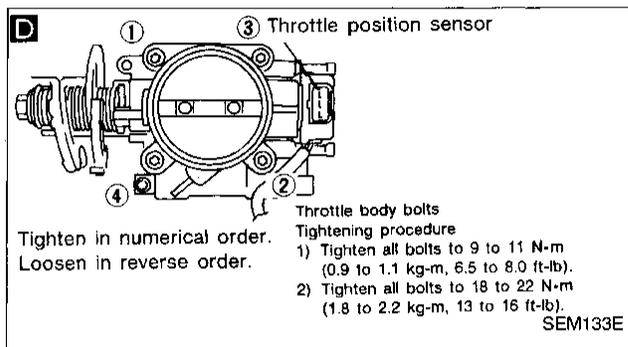
## Intake manifold collector tightening procedure



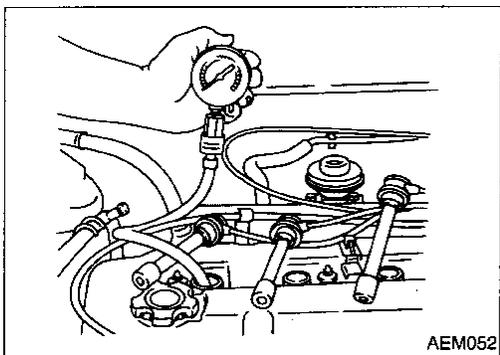
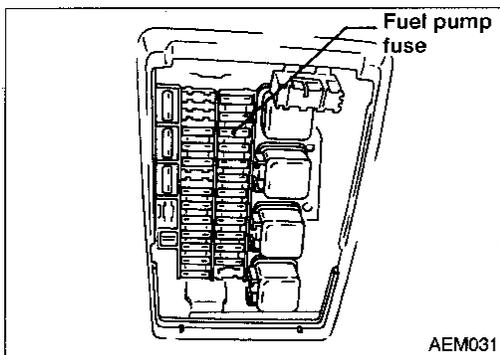
## Exhaust manifold tightening procedure



## Throttle body tightening procedure



# COMPRESSION PRESSURE



## Measurement of Compression Pressure

1. Warm up engine.
2. Turn ignition switch off.
3. Release fuel pressure.  
Refer to EF & EC section ("Releasing Fuel Pressure", "MULTI-PORT FUEL INJECTION SYSTEM INSPECTION").
4. Remove all spark plugs.
5. Disconnect distributor center cable.

6. Attach a compression tester to No. 1 cylinder.
  7. Depress accelerator pedal fully to keep throttle valve wide open.
  8. Crank engine and record highest gauge indication.
  9. Repeat the measurement on each cylinder as shown above.
- **Always use a fully-charged battery to obtain specified engine speed.**

Compression pressure: kPa (kg/cm<sup>2</sup>, psi)/rpm

Standard

1,226 (12.5, 178)/300

Minimum

1,030 (10.5, 149)/300

Difference limit between cylinders

98 (1.0, 14)/300

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 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 help compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.**

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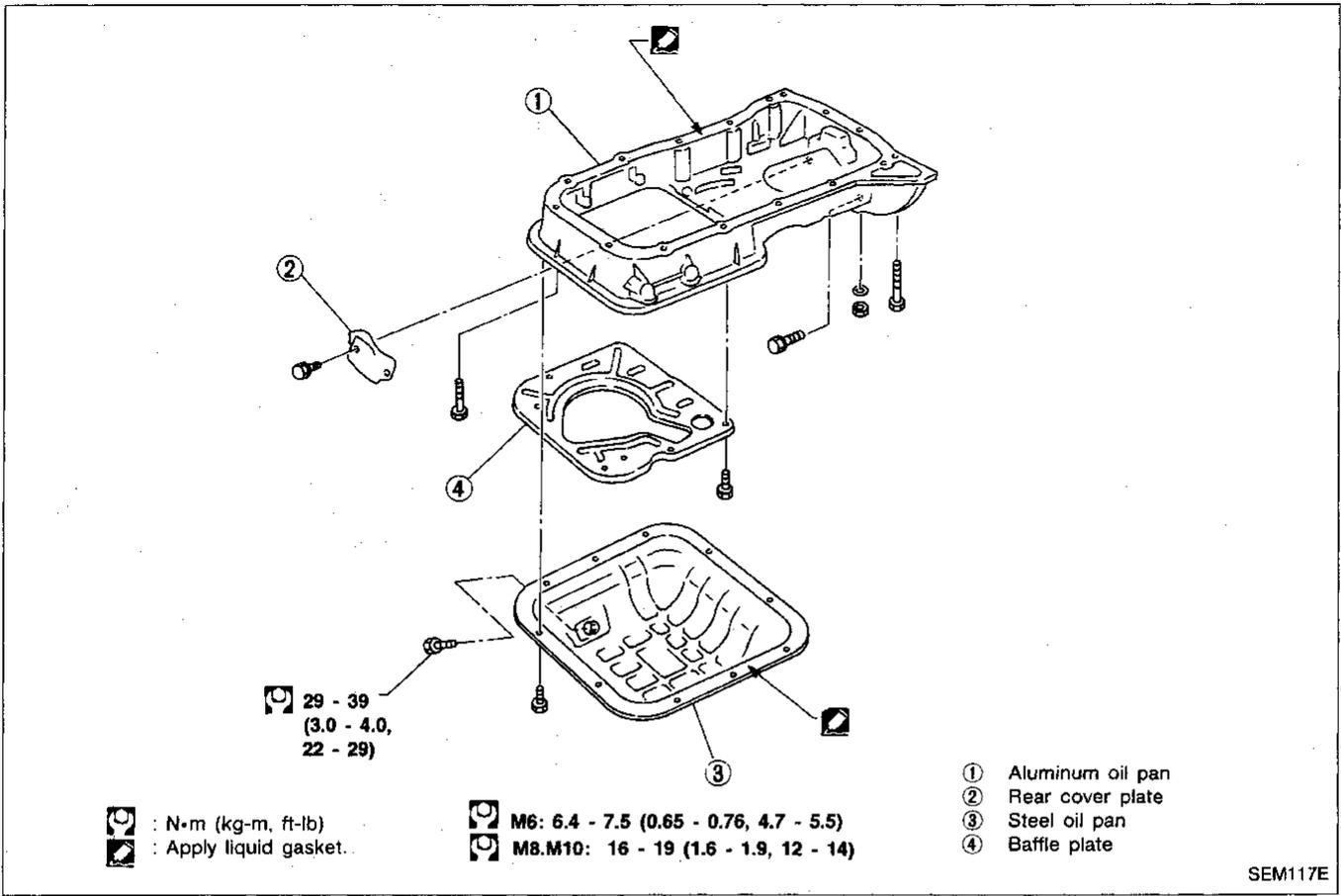
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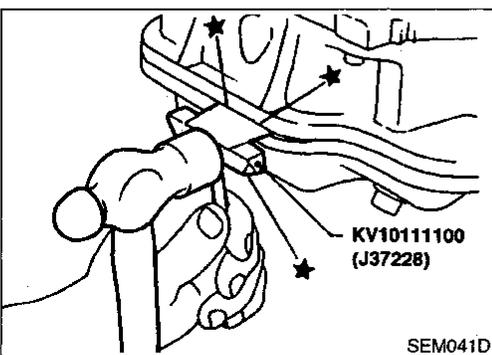
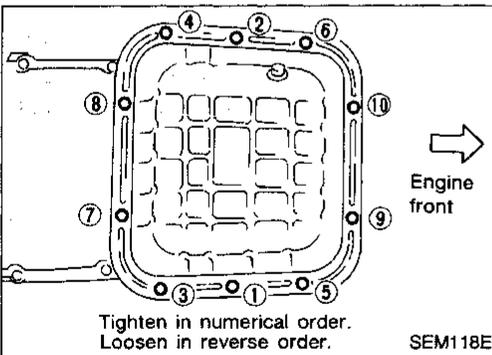
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# OIL PAN



## Removal

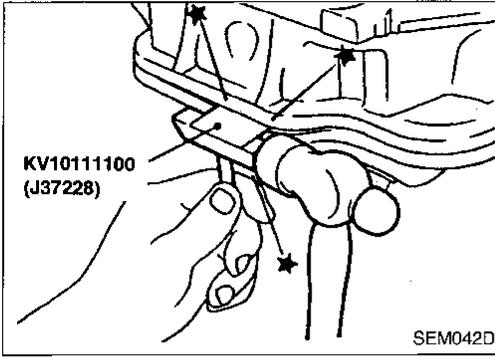
1. Remove engine under cover.
2. Drain engine oil.
3. Remove steel oil pan bolts.



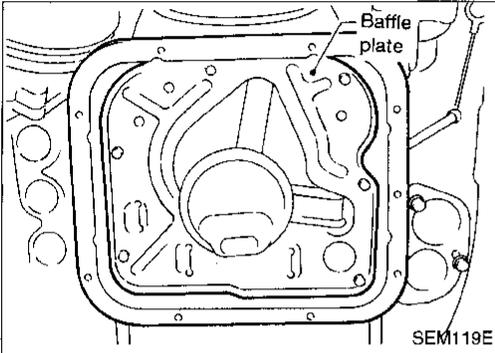
4. Remove steel oil pan.
  - (1) Insert Tool between aluminum oil pan and steel oil pan.
    - Be careful not to damage aluminum mating surface.
    - Do not insert screwdriver, or oil pan flange will be deformed.

# OIL PAN

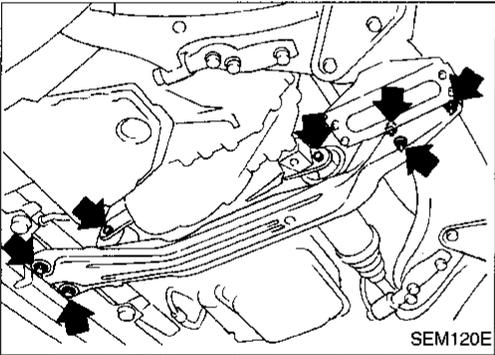
## Removal (Cont'd)



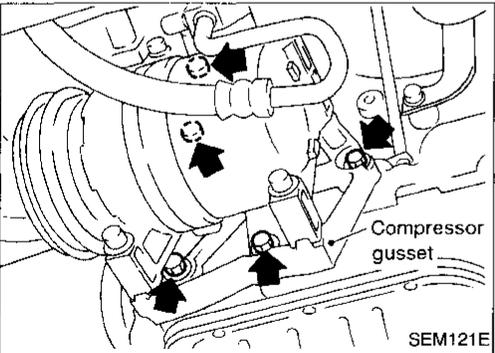
(2) Slide Tool by tapping on the side of the Tool with a hammer.



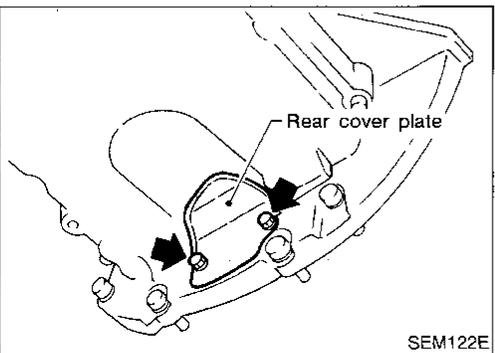
(3) Remove steel oil pan.  
5. Remove baffle plate.  
6. Remove oil strainer.



7. Remove front tube.  
8. Set a suitable transmission jack under transaxle and hoist engine with engine slinger.  
9. Remove center member.



10. Remove compressor gussets.



11. Remove rear cover plate.

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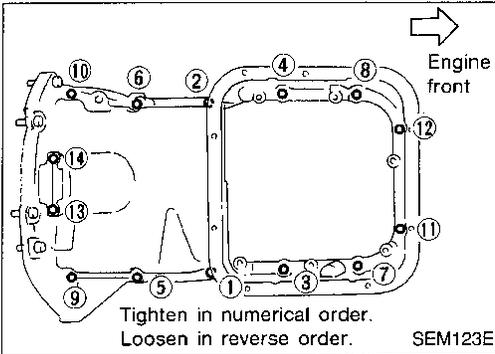
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### Removal (Cont'd)

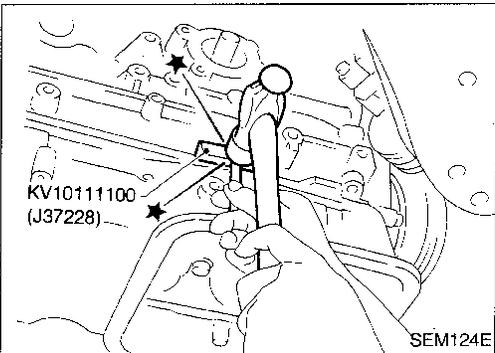
12. Remove aluminum oil pan nuts and bolts.



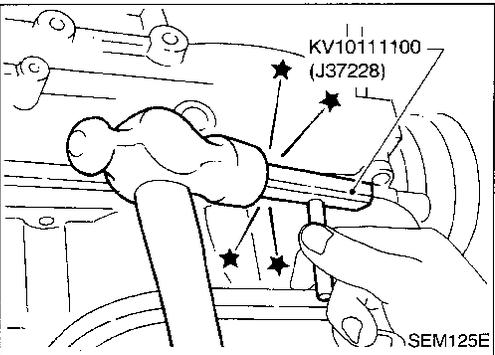
13. Remove aluminum oil pan.

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

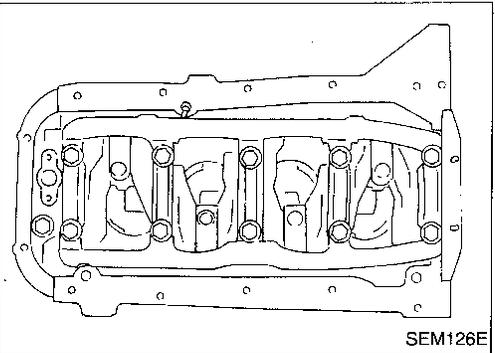
- Be careful not to damage aluminum mating surface.
- Do not insert screwdriver, or oil pan flange will be deformed.



(2) Slide Tool by tapping on the side of the Tool with a hammer.



(3) Remove aluminum oil pan.

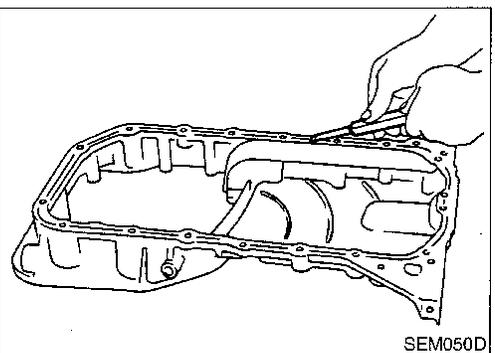


### Installation

1. Install aluminum oil pan.

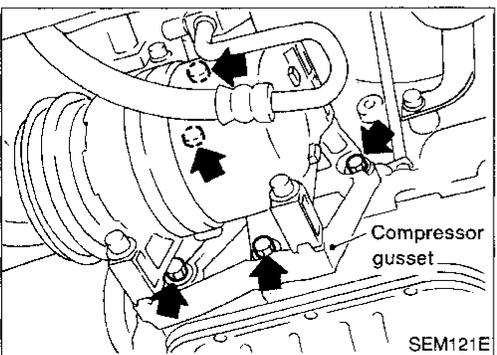
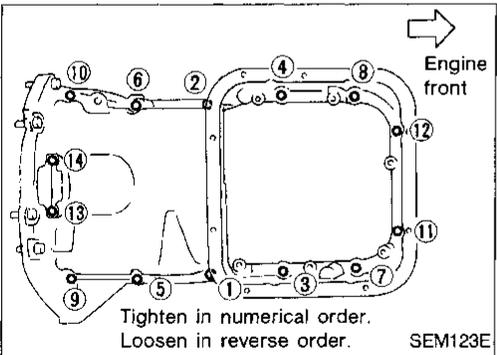
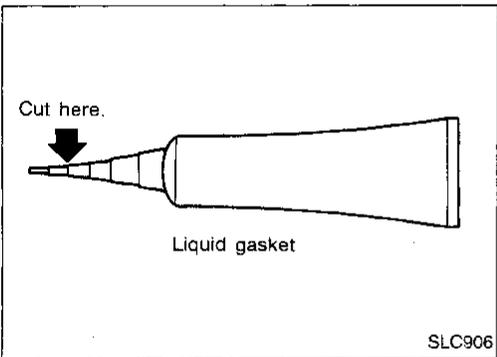
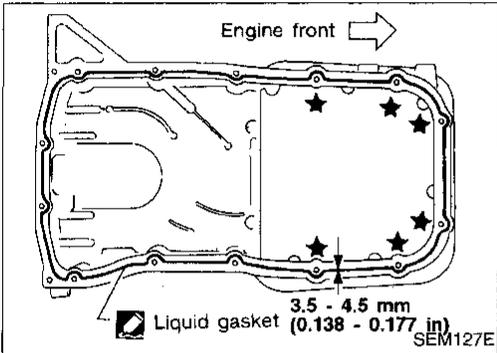
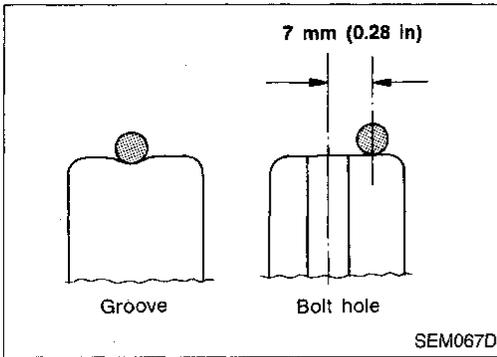
(1) Before installing aluminum oil pan, remove all traces of liquid gasket from mating surfaces using a scraper.

- Also remove traces of liquid gasket from mating surfaces of cylinder block, front cover and steel oil pan.



# OIL PAN

## Installation (Cont'd)



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

- Use Genuine Liquid Gasket or equivalent.

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

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

- Attaching should be done within 5 minutes after coating.

(3) Install aluminum oil pan.

- Install bolts in the reverse order of removal.

2. Install compressor gussets.
3. Install center member.
4. Install front tube.  
Install oil strainer baffle plate.

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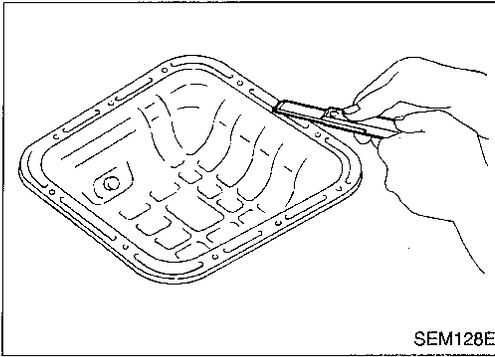
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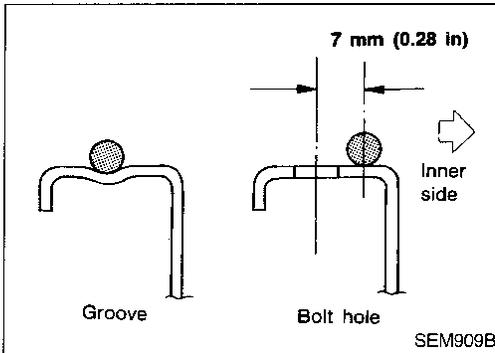
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# OIL PAN

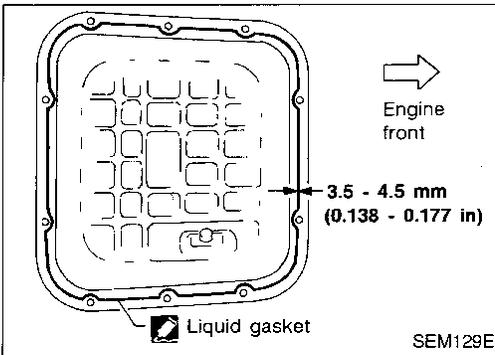
## Installation (Cont'd)



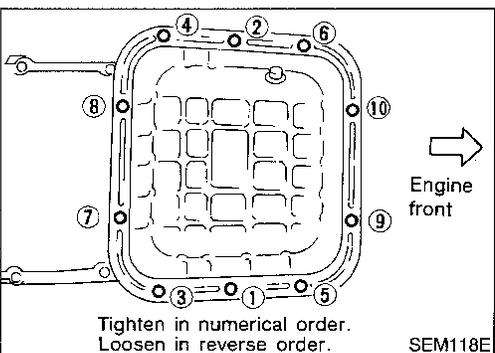
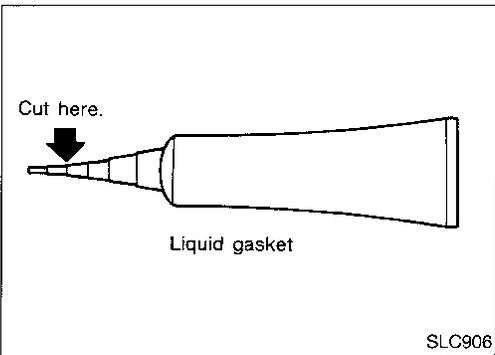
5. Install steel oil pan.
- (1) Before installing steel oil pan, remove all traces of liquid gasket from mating surfaces using a scraper.
  - Also remove traces of liquid gasket from mating surface of aluminum oil pan.



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



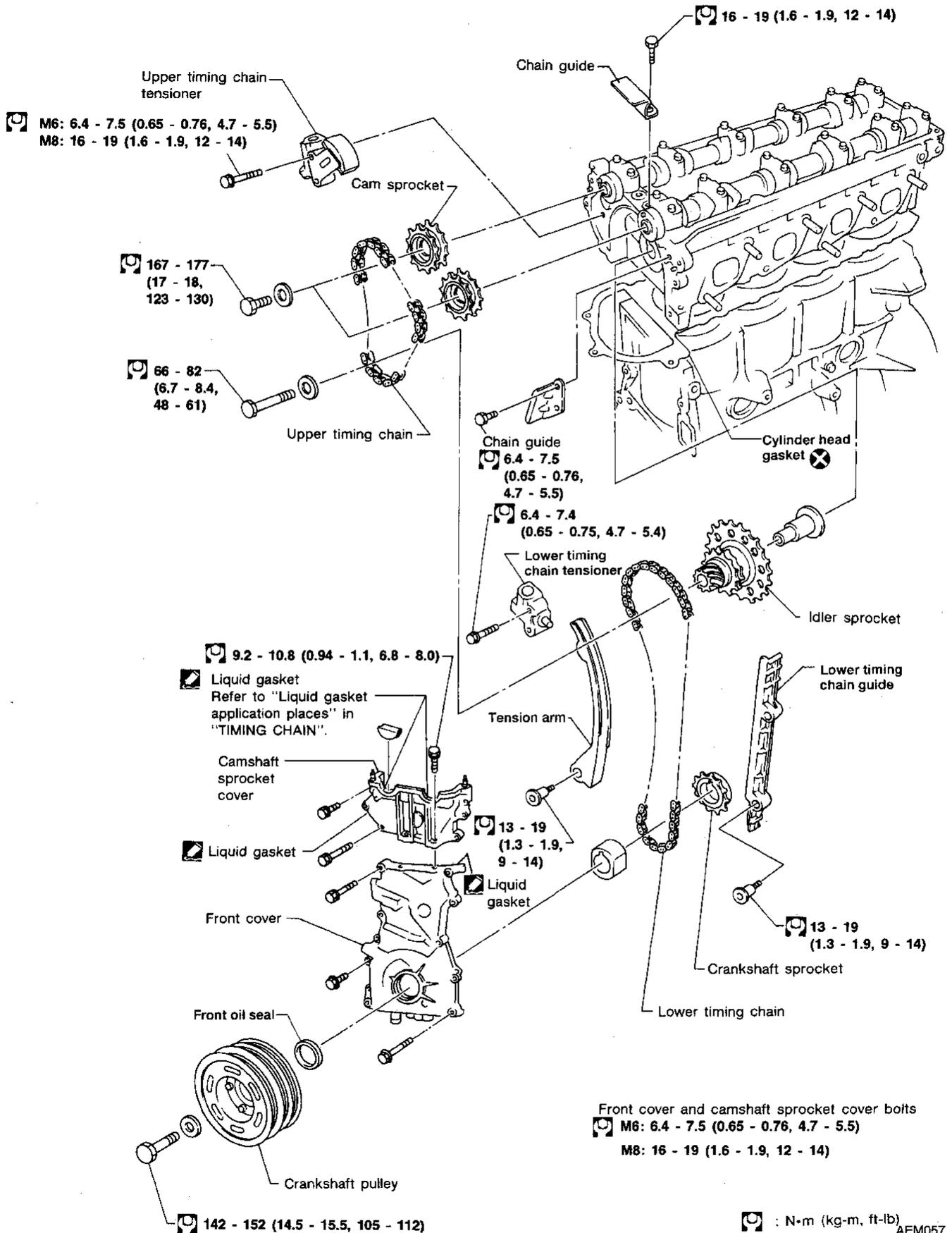
- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.
- Attaching should be done within 5 minutes after coating.



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

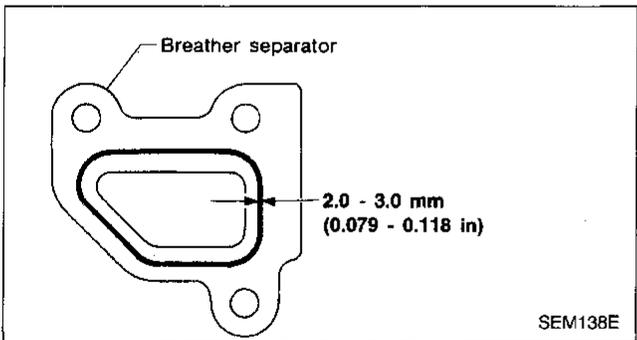
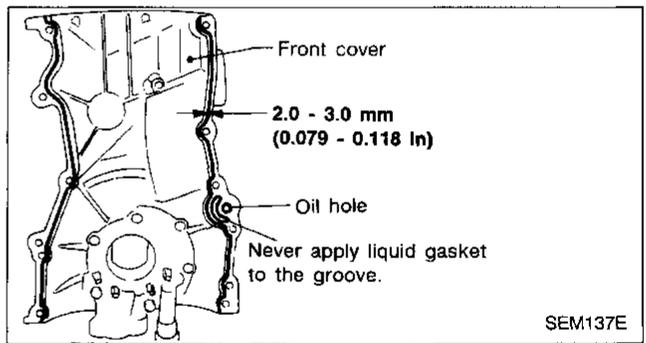
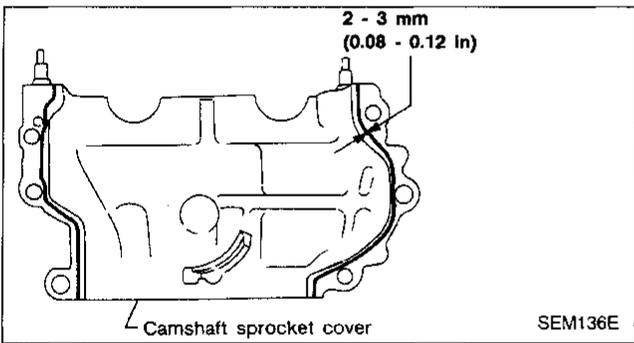
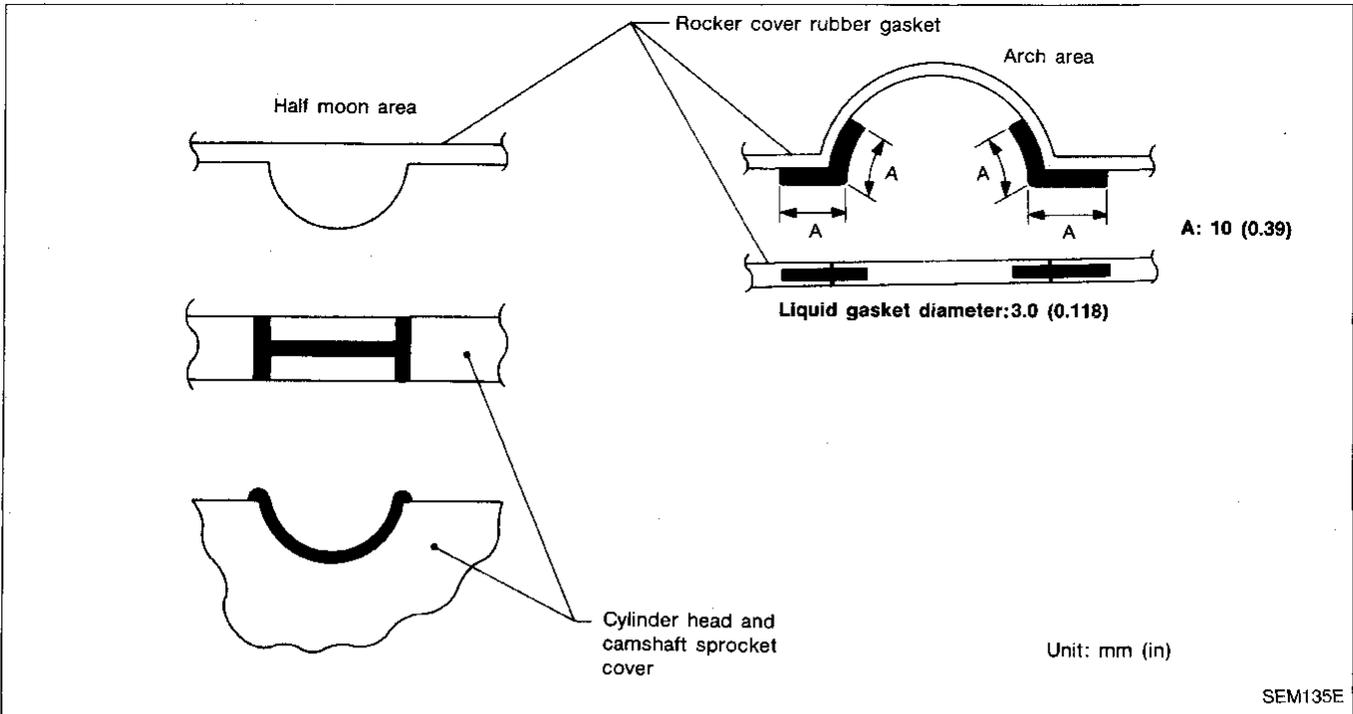
# TIMING CHAIN

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# TIMING CHAIN

## Liquid gasket application places



# TIMING CHAIN

## CAUTION:

- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing sliding parts such as 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.
- Before disconnecting fuel hose, release fuel pressure from fuel line.  
Refer to EF & EC section ("Releasing Fuel Pressure", "MULTIPOINT FUEL INJECTION SYSTEM INSPECTION").

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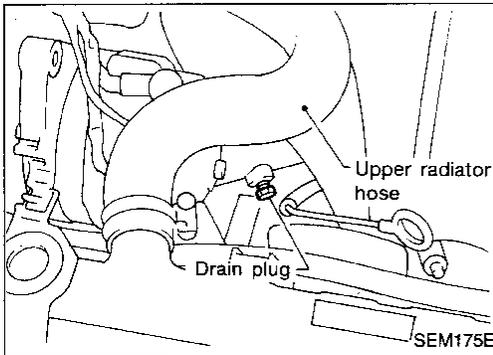
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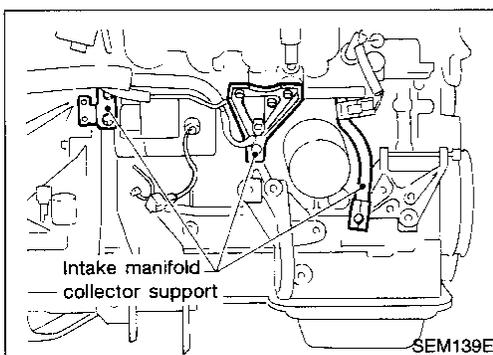
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## Removal

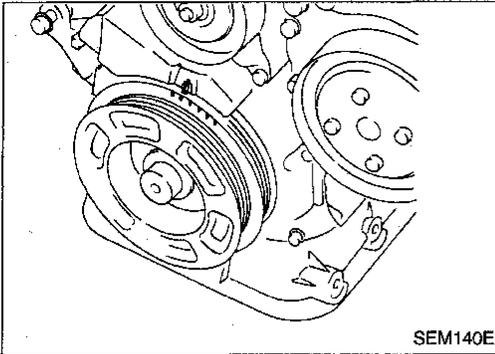
### UPPER TIMING CHAIN

1. Drain coolant from drain plug on water pipe and radiator drain cock. Refer to MA section ("Changing Engine Coolant", "ENGINE MAINTENANCE").
2. Remove vacuum hoses, fuel hoses, wires, harness and connectors and so on.
3. Remove the following parts.
  - Generator and bracket
  - Upper radiator hose
  - Air duct
  - Front exhaust tube
4. Remove intake manifold collector supports, intake manifold collector and exhaust manifold. Refer to EM-8.

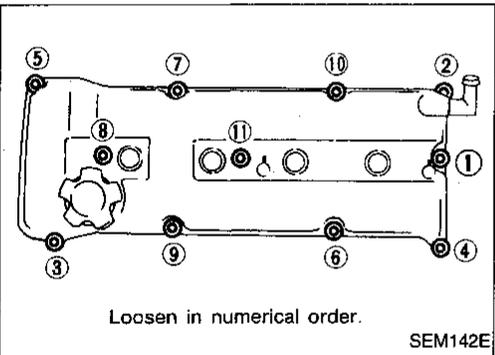
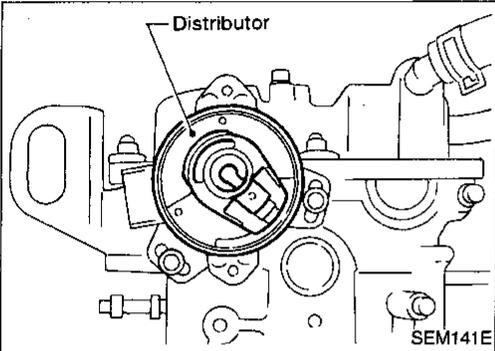


## TIMING CHAIN

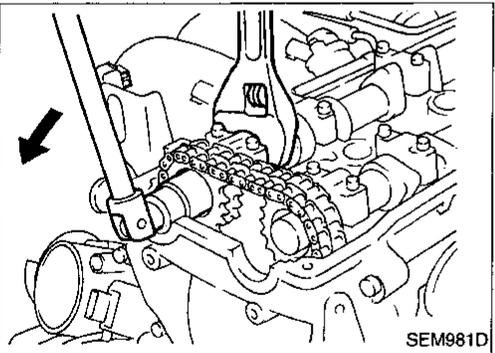
### Removal (Cont'd)



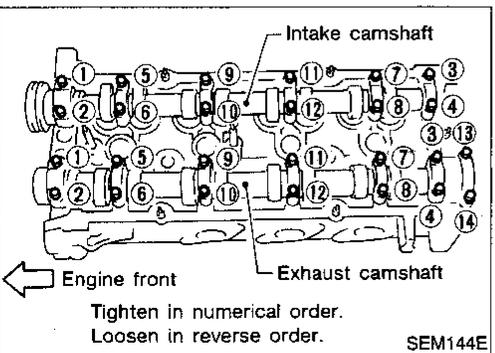
5. Set No. 1 piston at TDC on its compression stroke.
6. Remove distributor.
7. Set a suitable transmission jack under aluminum oil pan and remove front engine mounting.



8. Remove rocker cover.



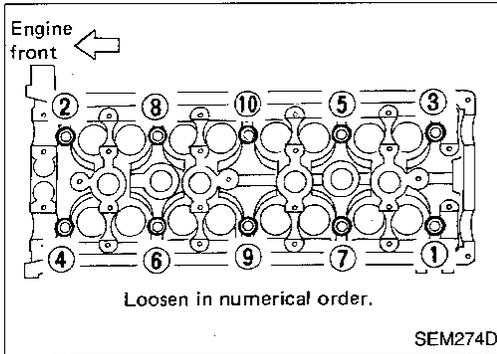
9. Remove cam sprocket.



10. Remove cam brackets and camshafts.
  - These parts should be reassembled in their original positions.

## TIMING CHAIN

### Removal (Cont'd)



11. Loosen cylinder head bolts.

- A warped or cracked cylinder head could result from removing in incorrect order.
- Cylinder head bolts should be loosened in two or three steps.

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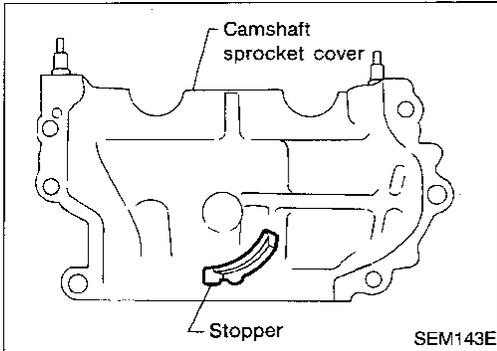
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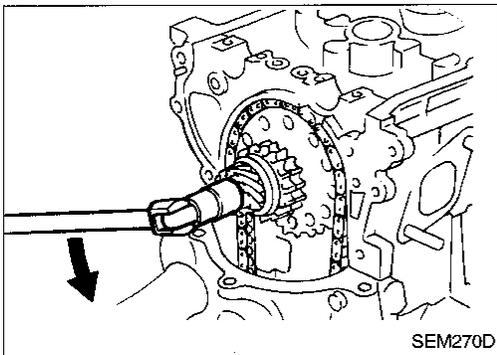


12. Remove cam sprocket cover.

- Upper timing chain will not be disengaged from idler sprocket. For this reason, a stopper need not be used.

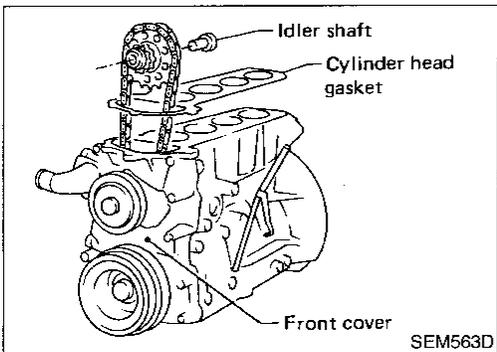
**Cast portion of cam sprocket cover is located on lower side of idler sprocket so upper timing chain need not be disengaged from idler sprocket.**

13. Remove upper chain tensioner and upper chain guides.



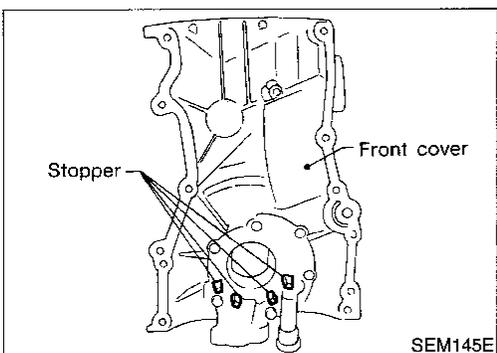
14. Remove upper timing chain.

15. Remove idler sprocket bolt.



16. Remove cylinder head with intake manifold, intake manifold collector and exhaust manifold assembly.

17. Remove cylinder head gasket.



- Lower timing chain will not be disengaged from crankshaft sprocket. For this reason, a stopper need not be used.

**Cast portion of front cover is located on lower side of crankshaft sprocket so lower timing chain need not be disengaged from idler sprocket.**

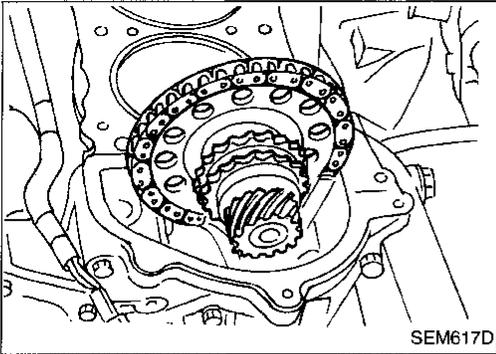
## TIMING CHAIN

### Removal (Cont'd)

#### LOWER TIMING CHAIN

1. Remove upper timing chain.

Refer to EM-19.



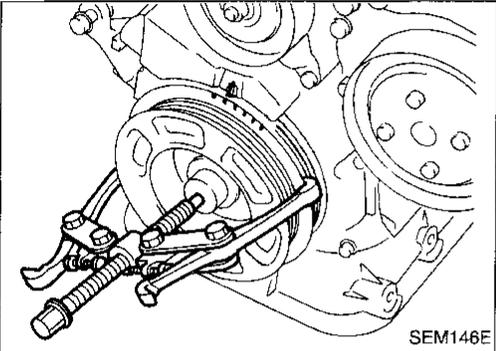
2. Remove oil pan.

Refer to EM-12.

3. Remove crankshaft pulley.

4. Remove front cover.

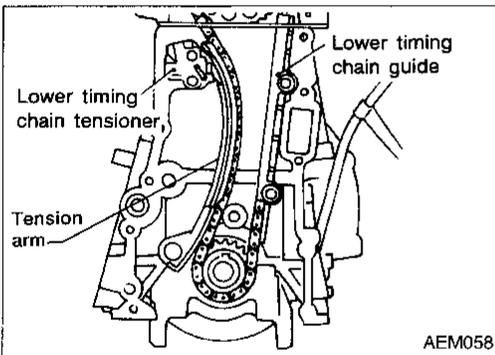
- Inspect for oil leakage from front oil seal. Replace seal if oil leak is present.



5. Remove the following parts.

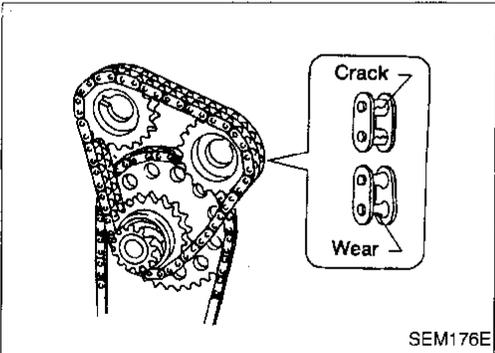
- Lower timing chain tensioner
- Tension arm
- Lower timing chain guide

6. Remove lower timing chain and idler sprocket.



### Inspection

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



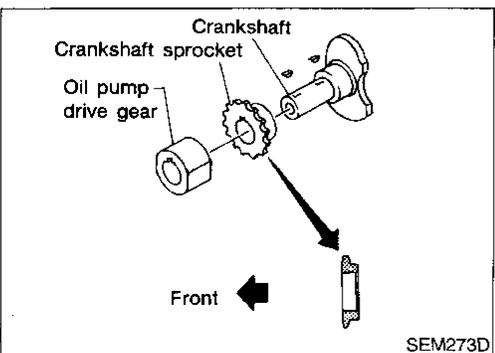
### Installation

#### LOWER TIMING CHAIN

1. Install crankshaft sprocket.

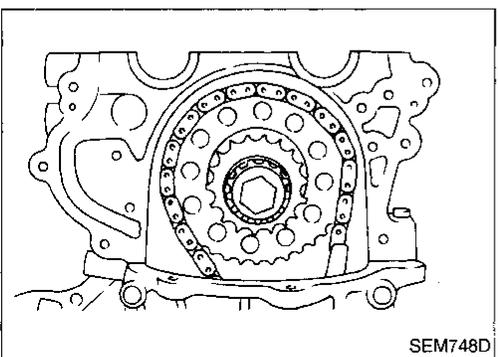
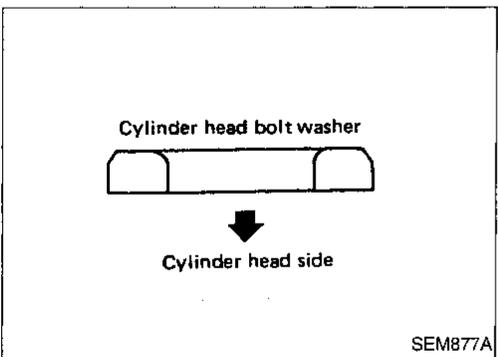
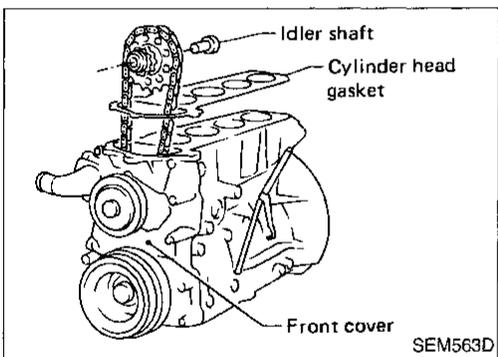
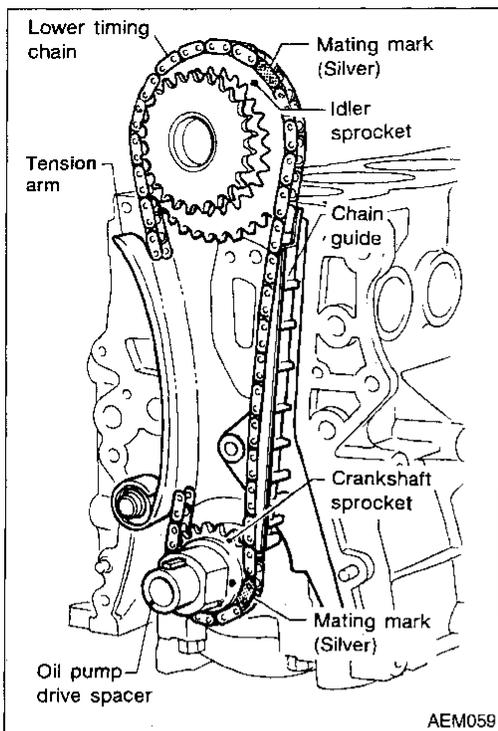
- Make sure that mating marks of crankshaft sprocket face front of engine.

2. Position crankshaft so that No. 1 piston is set at TDC.



## TIMING CHAIN

### Installation (Cont'd)



3. Install idler sprocket and lower timing chain.
  - **Set lower timing chain on the sprockets, aligning mating marks.**
4. Install tension arm and chain guide.
5. Install lower timing chain tensioner.

6. Install front cover.
  - **Apply a continuous bead of liquid gasket to front cover.**
  - **Be sure to install front oil seal.**
7. Install the following parts.
  - Crankshaft pulley
  - Oil strainer
  - Oil pan
  - New cylinder head gasket

8. Install cylinder head and temporarily tighten cylinder head bolts when installing front cover.
  - **Temporarily tighten cylinder head bolts. This is necessary to avoid damaging cylinder head gasket.**
  - **Be sure to install washers between bolts and cylinder head.**

### UPPER TIMING CHAIN

1. Install lower timing chain. Refer to EM-22.

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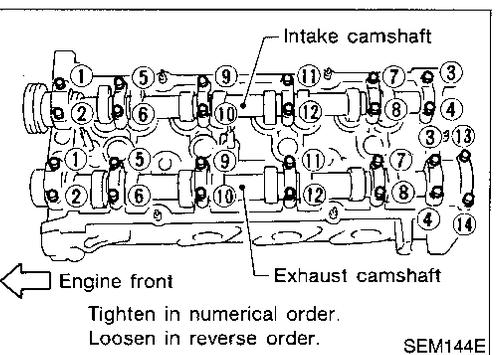
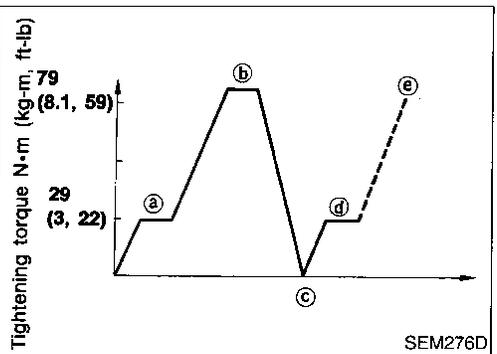
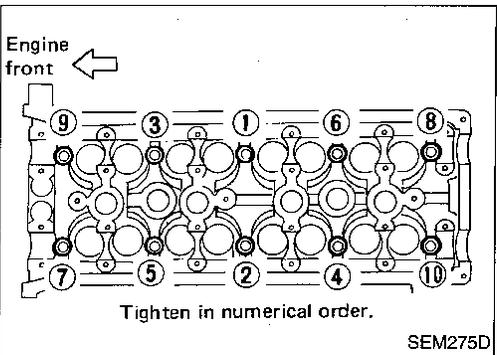
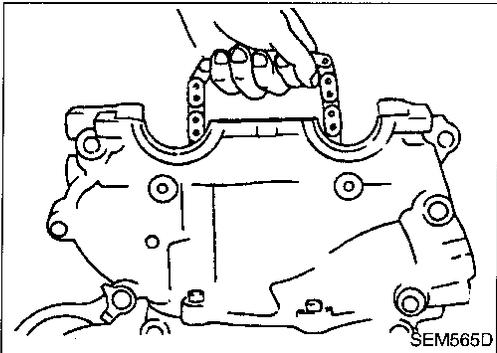
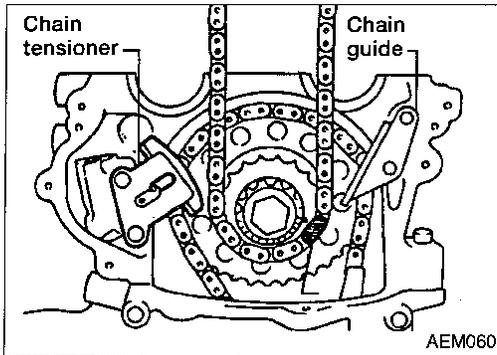
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## TIMING CHAIN

### Installation (Cont'd)



2. Install upper timing chain, chain tensioner and chain guide.
  - Set upper timing chain on the idler sprockets, aligning mating marks.

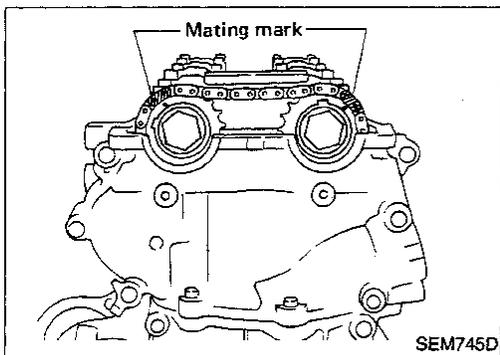
3. Install cam sprocket cover.
  - Apply a continuous bead of liquid gasket to cam sprocket cover.
  - Be careful not to damage cylinder head gasket.
  - Be careful upper timing chain does not slip or jump when installing cam sprocket cover.

4. Tighten cylinder head bolts.
  - Tightening procedure
    - a Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
    - b Tighten all bolts to 79 N·m (8.1 kg-m, 59 ft-lb).
    - c Loosen all bolts completely
    - d Tighten all bolts to 25 to 34 N·m (2.5 to 3.5 kg-m, 18 to 25 ft-lb).
    - e Turn all bolts 86 to 91 degrees clockwise, or if an angle wrench is not available, tighten bolts to 75 to 84 N·m (7.6 to 8.6 kg-m, 55 to 62 ft-lb).

5. Install camshafts and camshaft brackets.
  - Camshaft bracket bolts tightening procedure
    - a Tighten all bolts to 2 N·m (0.2 kg-m, 1.4 ft-lb).
    - b Tighten all bolts to 9.0 to 11.8 N·m (0.92 to 1.2 kg-m, 6.7 to 8.7 ft-lb).

# TIMING CHAIN

## Installation (Cont'd)



6. Install camshaft sprockets.
7. Install chain guide between both camshaft sprockets.

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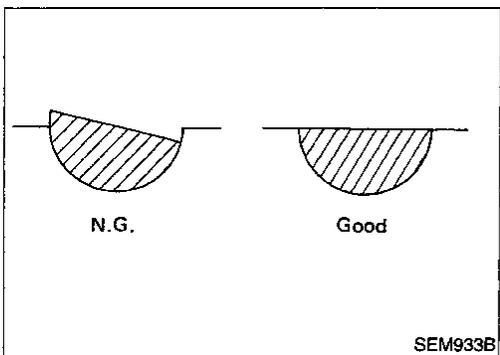
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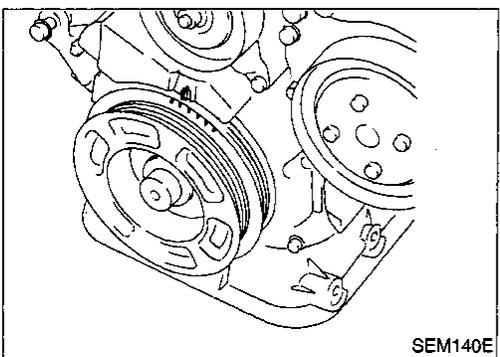
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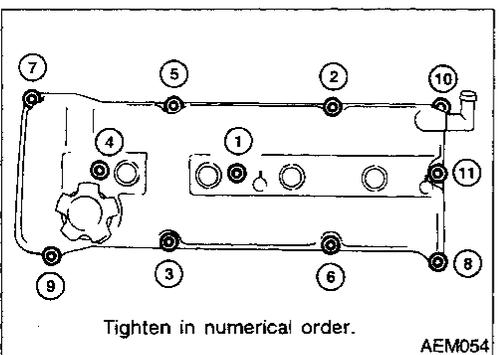
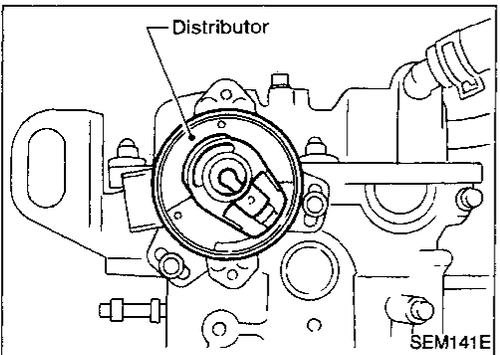
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8. Install rubber plugs as follows.
  - (1) Apply liquid gasket to rubber plugs.
  - (2) Install rubber plugs, then move them by hand to uniformly spread the gasket on cam sprocket cover surface.
- Mating surfaces of liquid gasket should be installed flush.



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



10. Install rocker cover.
  - **Tightening procedure**
    - a) Tighten nuts ①-⑤-⑥-④ in that order to to 4 N·m (0.4 kg-m, 2.9 ft-lb).
    - b) Tighten nuts ① to ⑪ as indicated in figure to 8 to 11 N·m (0.8 to 1.1 kg-m, 5.8 to 8.0 ft-lb).
11. Install all spark plugs with high-tension cords.
12. Install vacuum hoses, fuel tubes, wires, harness and connectors and so on.

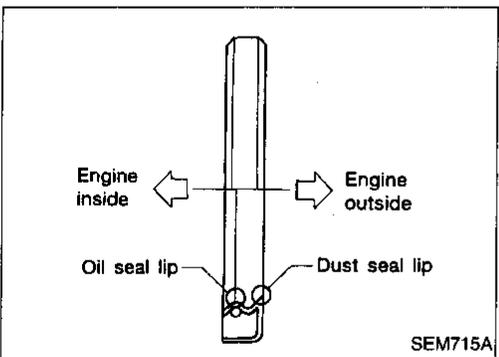
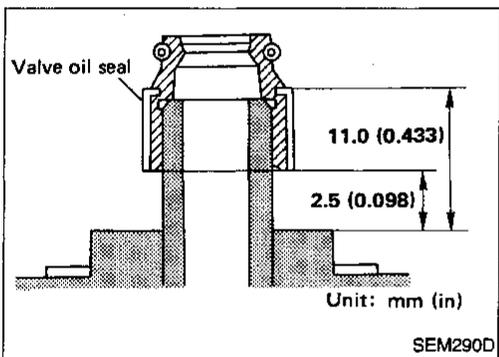
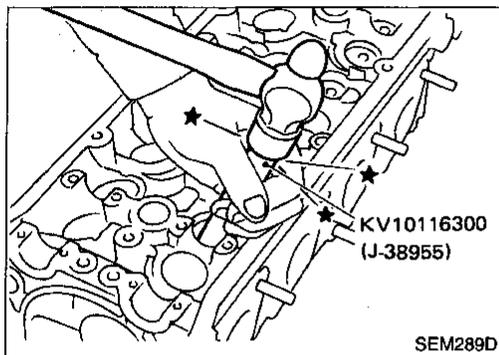
# OIL SEAL REPLACEMENT

## VALVE OIL SEAL

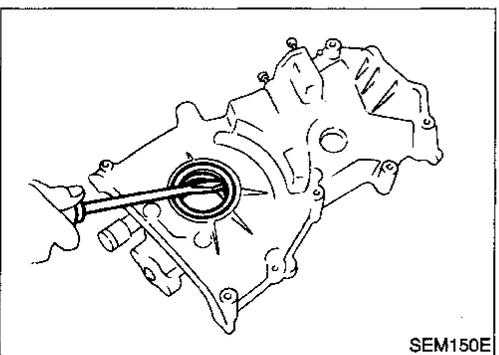
1. Remove rocker cover.
2. Remove camshaft. Refer to EM-19.
3. Remove valve spring and valve oil seal with Tool or a suitable tool.

**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.



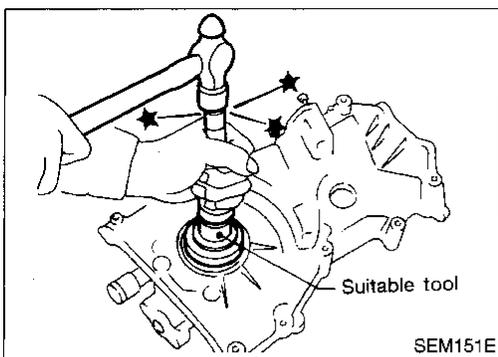
## OIL SEAL INSTALLING DIRECTION



## FRONT OIL SEAL

1. Remove radiator shroud and crankshaft pulley.
  2. Remove front oil seal.
- **Be careful not to scratch front cover.**

# OIL SEAL REPLACEMENT



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

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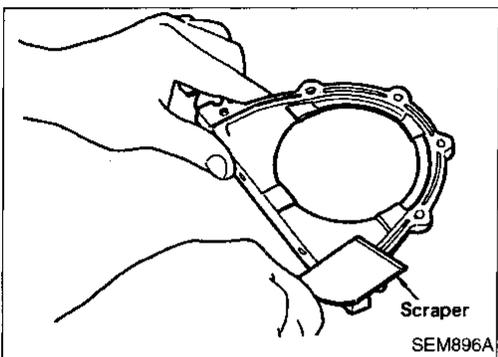
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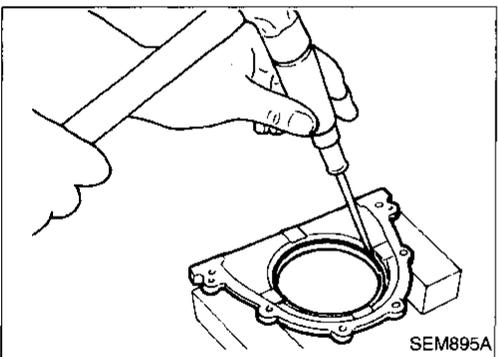
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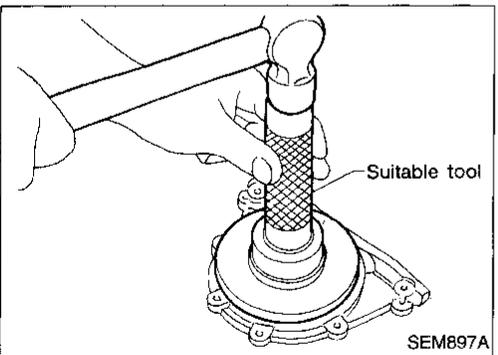


## REAR OIL SEAL

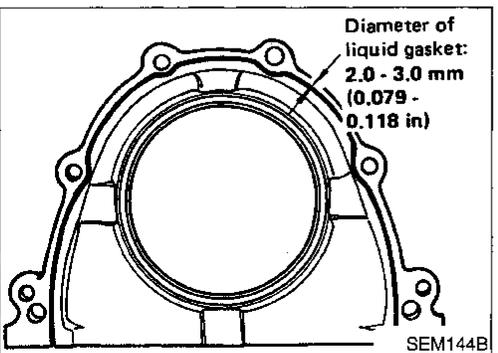
1. Remove drive plate or flywheel.
2. Remove rear oil seal retainer.
3. Remove traces of liquid gasket using scraper.



4. Remove rear oil seal from rear oil seal retainer.

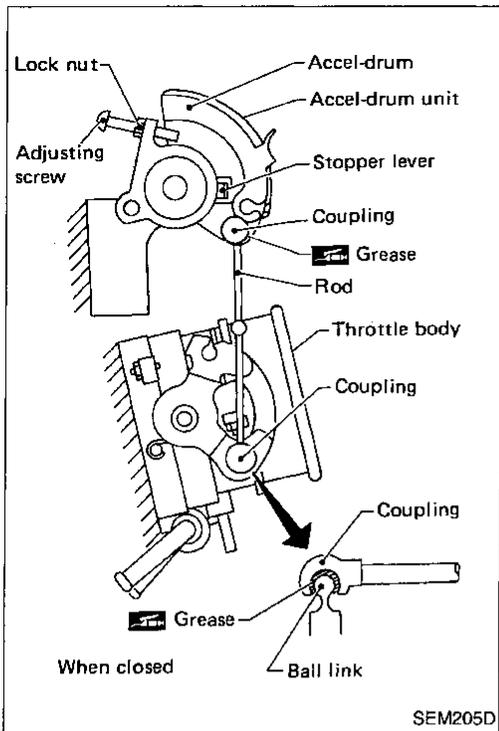


5. Apply engine oil to new oil seal and install it using a suitable tool.



6. Apply a continuous bead of liquid gasket to rear oil seal retainer.

# ACCEL-DRUM UNIT



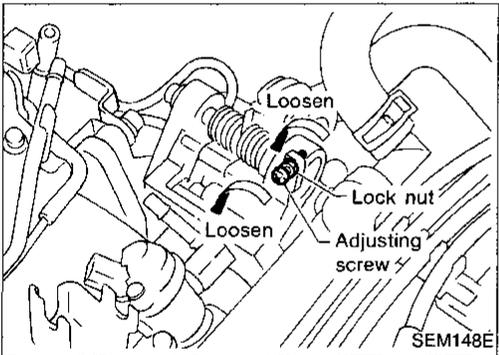
Adjust accel-drum unit whenever any of the following parts (new or old) are installed:

- Accel-drum unit
- Throttle body
- Rod (Always replace with a new one after removal.)

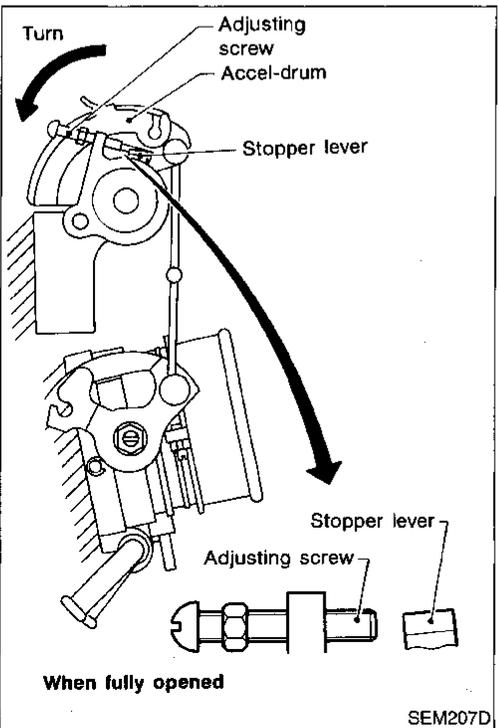
1. Install accel-drum unit and throttle body.
2. Apply grease all over the inside of the rod couplings.

**Use genuine Nissan grease or equivalent.**

3. Insert each one coupling to ball links of throttle body and accel-drum unit.

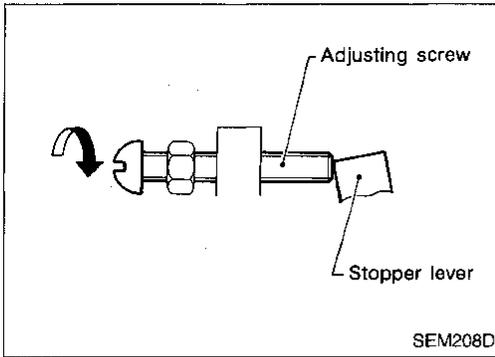


4. Loosen lock nut.
5. Loosen adjusting screw enough.



6. Manually turn accel-drum until throttle valve is fully open.
  - Check that stopper lever is not touching adjusting screw. If it is, loosen adjusting screw to maintain clearance between the two.

# ACCEL-DRUM UNIT



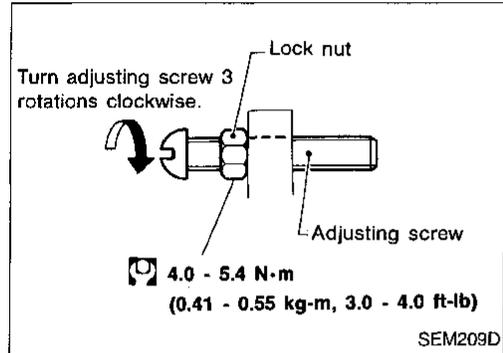
7. Turn adjusting screw until it touches stopper lever.
8. Back off accel-drum.

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9. Turn adjusting screw 3 rotations clockwise.
10. Tighten lock nut.

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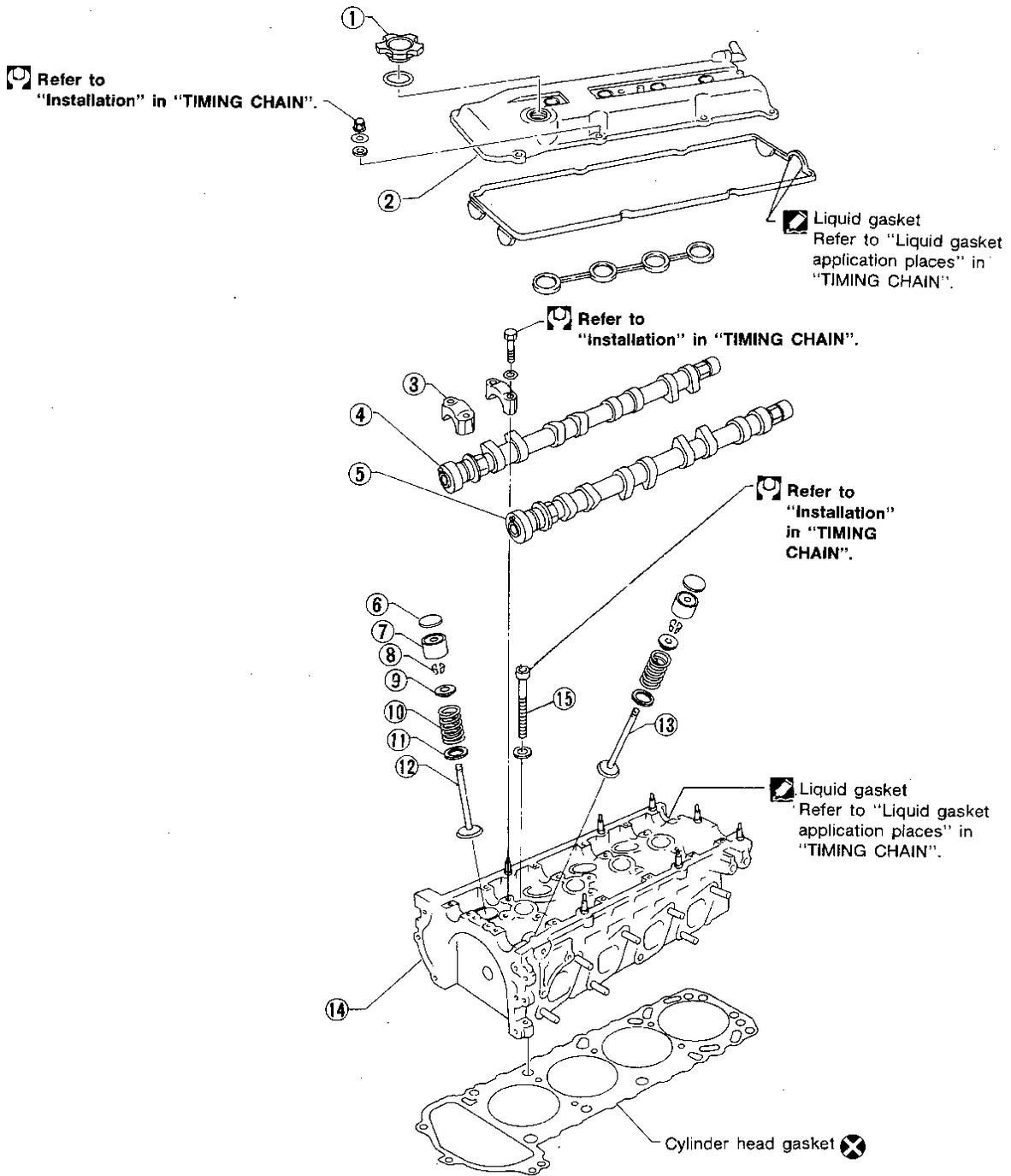
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# CYLINDER HEAD



- ① Oil filler cap
- ② Rocker cover
- ③ Camshaft bracket
- ④ Intake camshaft
- ⑤ Exhaust camshaft

- ⑥ Shim
- ⑦ Valve lifter
- ⑧ Valve cotter
- ⑨ Spring retainer
- ⑩ Valve spring

- ⑪ Spring seat
- ⑫ Intake valve
- ⑬ Exhaust valve
- ⑭ Cylinder head
- ⑮ Cylinder head bolt

SEM149E

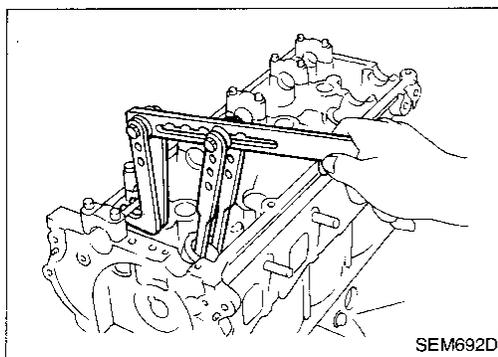
# CYLINDER HEAD

## 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, intake 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.

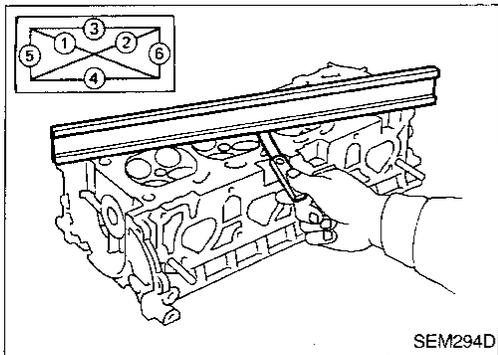
## Removal and Installation

- Removal and installation procedures are the same as those for timing chain. Refer to EM-19.



## Disassembly

1. Remove intake manifold, collector assembly and exhaust manifold. Refer to EM-8.
2. Remove valve components with Tool.
3. 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:

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

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

Nominal cylinder head height:

126.3 - 126.5 mm (4.972 - 4.980 in)

### CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.

## CYLINDER HEAD

### Inspection (Cont'd)

#### CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.

**Runout (Total indicator reading):**

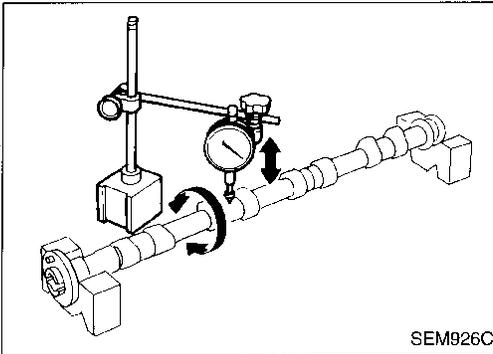
**Standard**

**Less than 0.02 mm (0.0008 in)**

**Limit**

**0.04 mm (0.0016 in)**

2. If it exceeds the limit, replace camshaft.



#### CAMSHAFT CAM HEIGHT

1. Measure camshaft cam height.

**Standard cam height:**

**Intake**

**42.415 - 42.605 mm (1.6699 - 1.6774 in)**

**Exhaust**

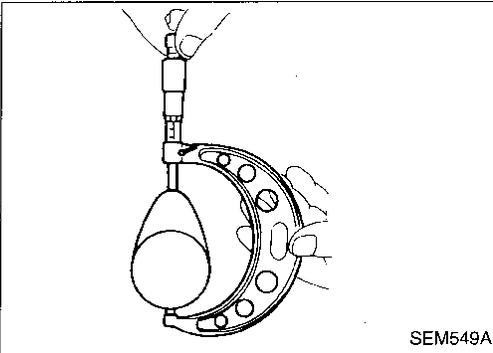
**42.415 - 43.005 mm (1.6699 - 1.6931 in)**

**Cam wear limit:**

**Intake & Exhaust**

**0.2 mm (0.008 in)**

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



#### CAMSHAFT JOURNAL CLEARANCE

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

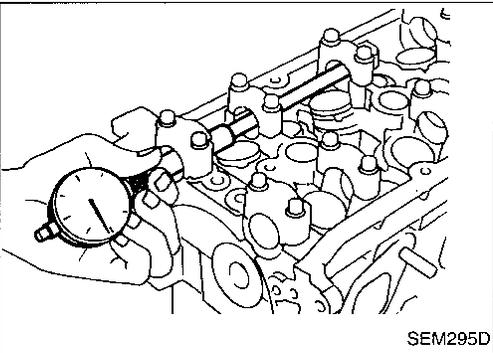
**Standard inner diameter:**

**#1 journal**

**28.000 - 28.025 mm (1.1024 - 1.1033 in)**

**#2 to #5 journals**

**24.000 - 24.025 mm (0.9449 - 0.9459 in)**



3. Measure outer diameter of camshaft journal.

**Standard outer diameter:**

**#1 journal**

**27.935 - 27.955 mm (1.0998 - 1.1006 in)**

**#2 to #5 journals**

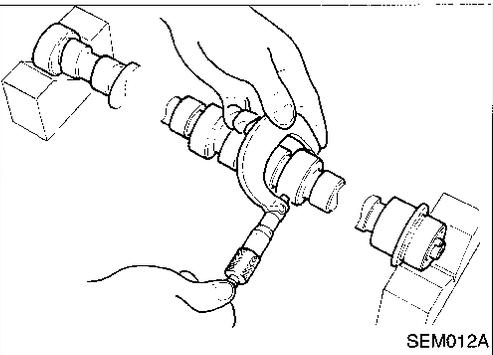
**23.935 - 23.955 mm (0.9423 - 0.9431 in)**

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

**Camshaft journal clearance:**

**Standard 0.045 - 0.090 mm (0.0018 - 0.0035 in)**

**Limit 0.12 mm (0.0047 in)**



#### CAMSHAFT END PLAY

1. Install camshaft and thermostat housing in cylinder head.
2. Measure camshaft end play.

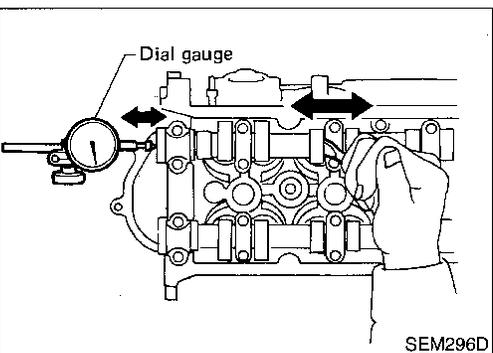
**Camshaft end play:**

**Standard**

**0.070 - 0.15 mm (0.0028 - 0.0059 in)**

**Limit**

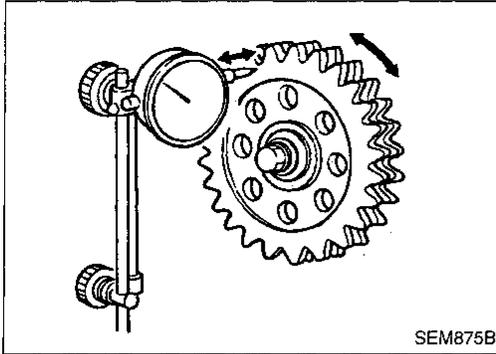
**0.20 mm (0.0079 in)**



# CYLINDER HEAD

## Inspection (Cont'd)

### CAMSHAFT SPROCKET RUNOUT

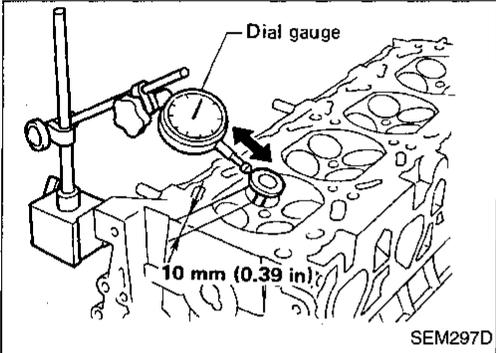


SEM875B

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.

GI  
MA  
EM

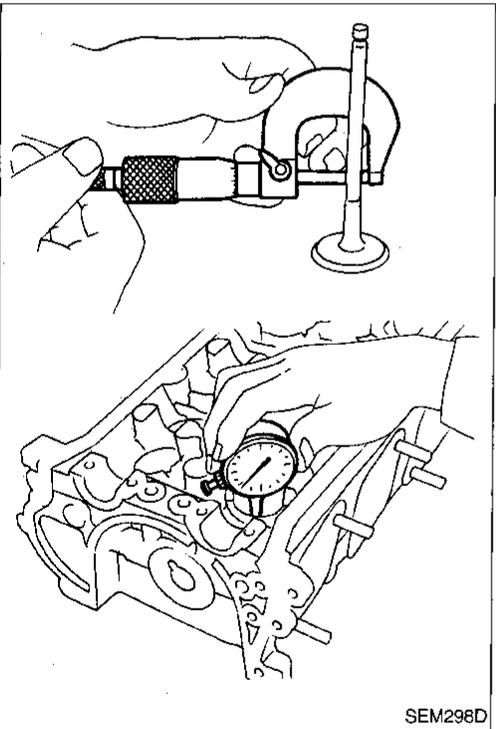
### VALVE GUIDE CLEARANCE



SEM297D

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

LC  
EF &  
EC  
FE



SEM298D

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)

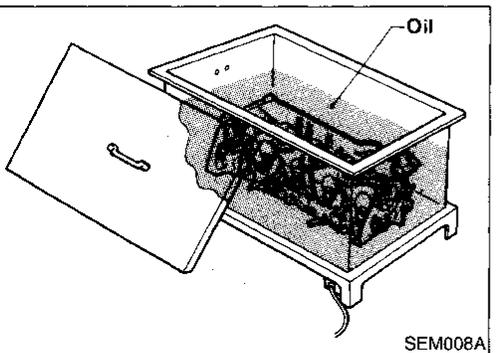
	Standard	Limit
Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)

CL  
MT  
AT  
FA

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

RA  
BR  
ST

### VALVE GUIDE REPLACEMENT



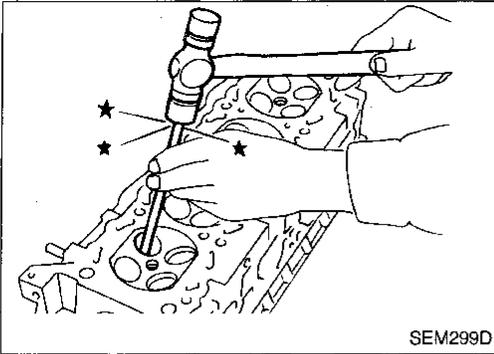
SEM008A

1. To remove valve guide, heat cylinder head to 120 to 140°C (248 to 284°F).

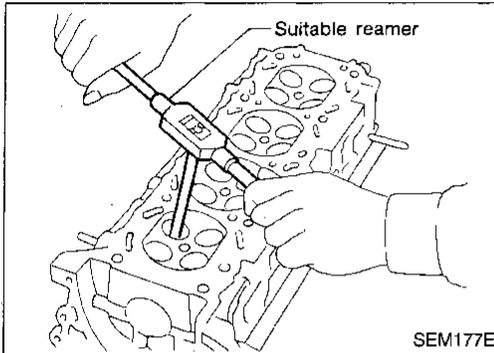
BF  
HA  
EL  
IDX

## CYLINDER HEAD

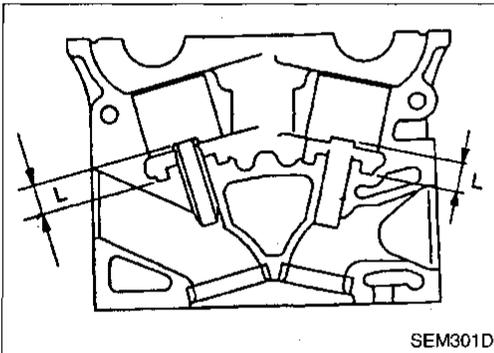
### Inspection (Cont'd)



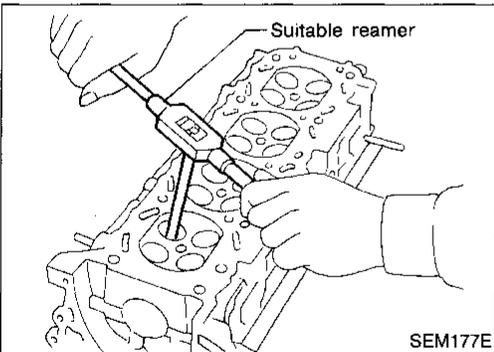
2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and suitable tool.



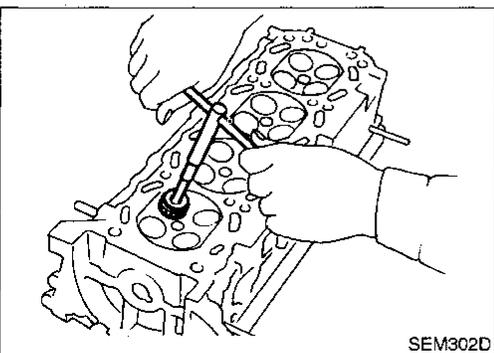
3. Ream cylinder head valve guide hole.  
**Valve guide hole diameter  
(for service parts):**  
Intake & Exhaust  
11.175 - 11.196 mm (0.4400 - 0.4408 in)



4. Heat cylinder head to 120 to 140°C (230 to 266°F) and press service valve guide onto cylinder head.  
**Projection "L":**  
13.3 - 13.9 mm (0.524 - 0.547 in)



5. Ream valve guide.  
**Finished size:**  
Intake & Exhaust  
7.000 - 7.018 mm (0.2756 - 0.2763 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.

# CYLINDER HEAD

## Inspection (Cont'd)

### 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 38.000 - 38.016 mm (1.4961 - 1.4967 in)**

**Exhaust 32.700 - 32.716 mm (1.2874 - 1.2880 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 120 to 140°C (248 to 284°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.
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.

#### Seat face angle "α":

**44°53' - 45°07'**

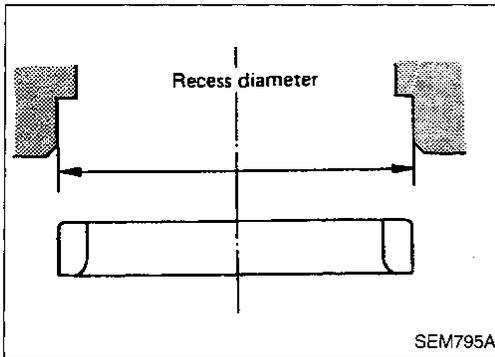
#### Contacting width "W":

**Intake**

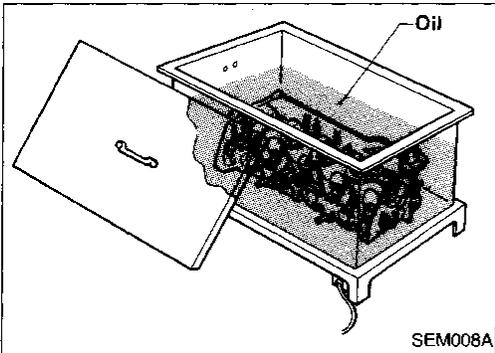
**1.48 - 1.63 mm (0.0583 - 0.0642 in)**

**Exhaust**

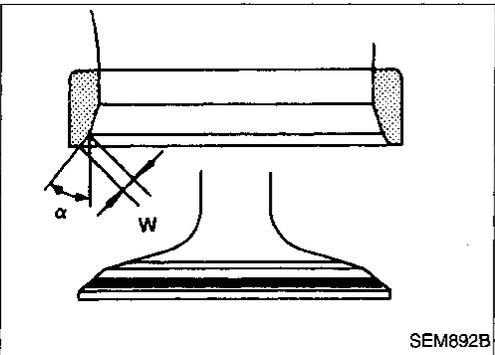
**1.8 - 2.0 mm (0.071 - 0.079 in)**



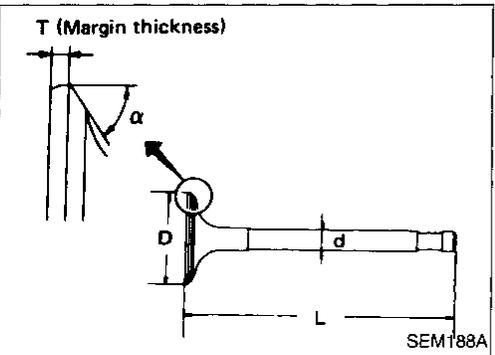
SEM795A



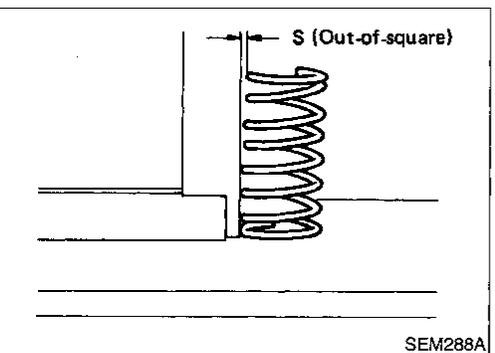
SEM008A



SEM892B



SEM188A



SEM288A

### 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.

### VALVE SPRING

#### Squareness

1. Measure "S" dimension.

#### Out-of-square:

**Less than 2.0 mm (0.079 in)**

2. If it exceeds the limit, replace spring.

## CYLINDER HEAD

### Inspection (Cont'd)

#### Pressure

Check valve spring pressure.

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

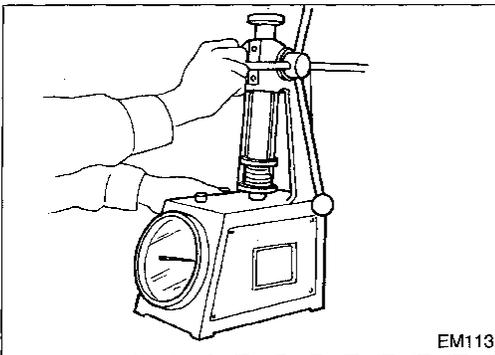
#### Standard

471.7 (48.1, 106.1) at 26.06 (1.0260)

#### Limit

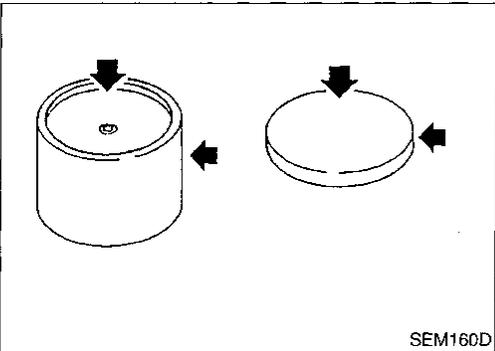
More than 421.31 (42.96, 94.73) at 26.06 (1.0260)

If it exceeds the limit, replace spring.



### VALVE LIFTER AND VALVE SHIM

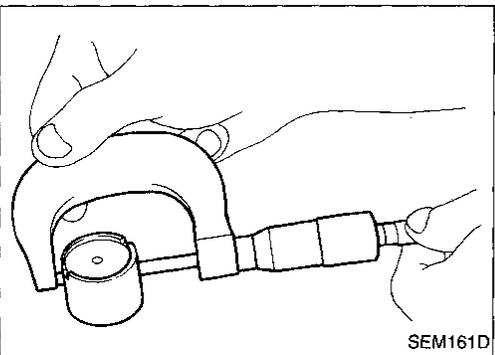
1. Visually check contact and sliding surfaces for wear or scratches.



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

**Valve lifter diameter:**

33.960 - 33.975 mm (1.3370 - 1.3376 in)

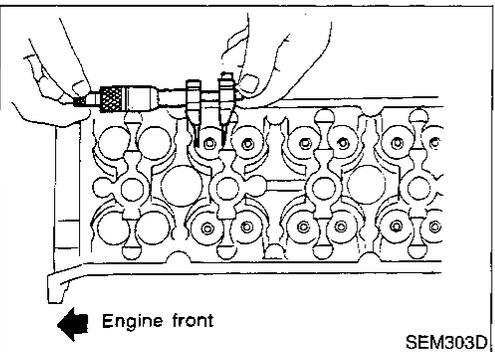


**Lifter guide bore diameter:**

34.000 - 34.021 mm (1.3386 - 1.3394 in)

**Valve lifter to valve lifter guide clearance:**

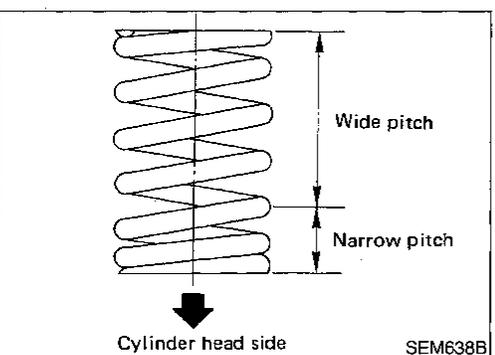
0.025 - 0.061 mm (0.0010 - 0.0024 in)



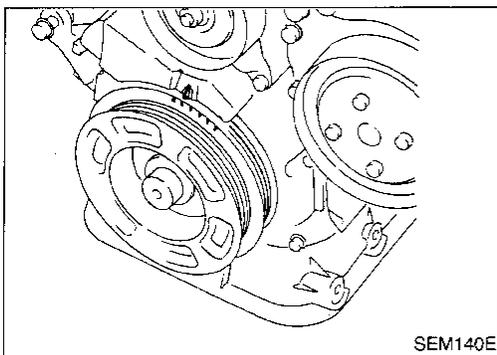
### Assembly

1. Install valve component parts.

- **Always use new valve oil seal. Refer to EM-26.**
- **Before installing valve oil seal, install 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.**



# CYLINDER HEAD

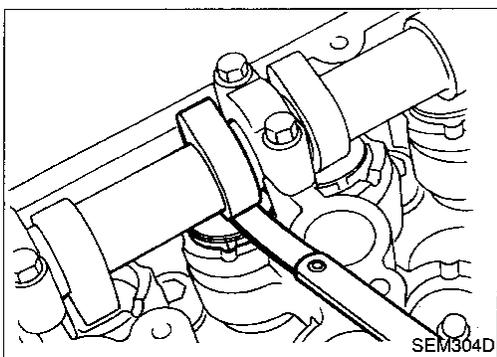
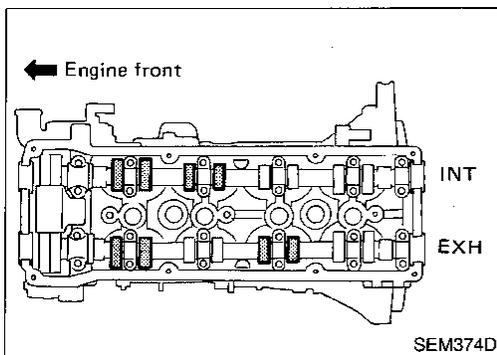


## Valve Clearance

### CHECKING

Check valve clearance while engine is warm but not running.

1. Remove rocker cover and all spark plugs.
2. 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.
3. 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.

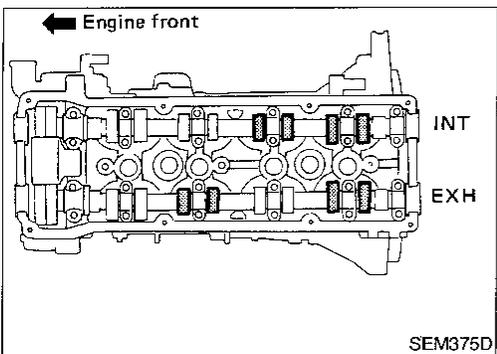
#### Valve clearance (Hot):

##### Intake

0.31 - 0.39 mm (0.012 - 0.015 in)

##### Exhaust

0.33 - 0.41 mm (0.013 - 0.016 in)



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

### ADJUSTING

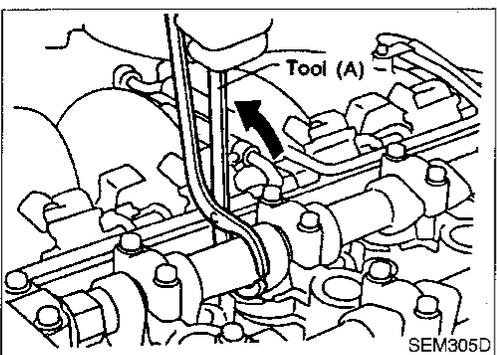
Adjust valve clearance while engine is cold.

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

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

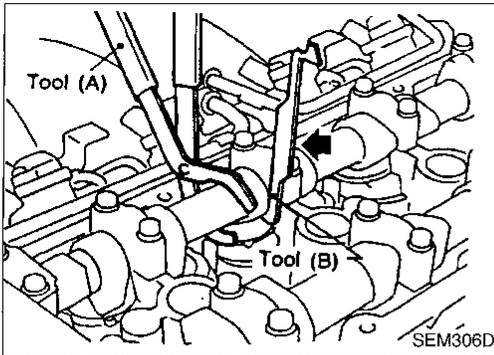
#### CAUTION:

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



## CYLINDER HEAD

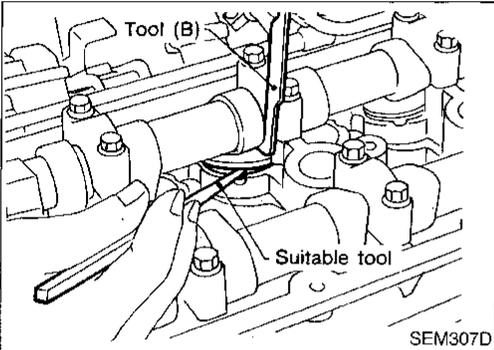
### Valve Clearance (Cont'd)



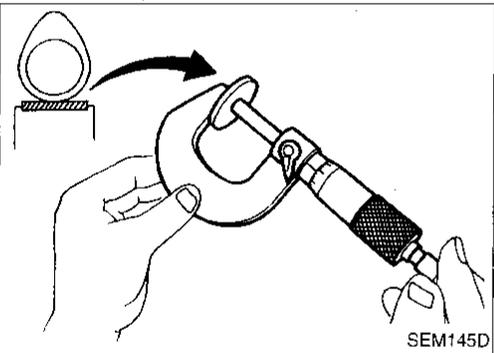
4. Place Tool (B) between camshaft and valve lifter to retain valve lifter.

#### 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

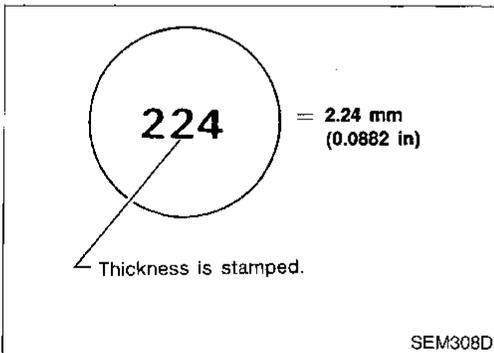
M = Measured valve clearance

**Intake:  $N = R + [M - 0.35 \text{ mm (0.0138 in)}]$**

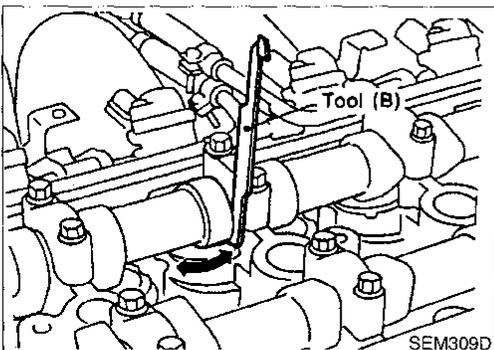
**Exhaust:  $N = R + [M - 0.37 \text{ mm (0.0146 in)}]$**

**Shims are available in 37 sizes from 1.96 mm (0.0772 in) to 2.68 mm (0.1055 in), in steps of 0.02 mm (0.0008 in).**

- Select new shim with thickness as close as possible to calculated value.
- Refer to EM-55.

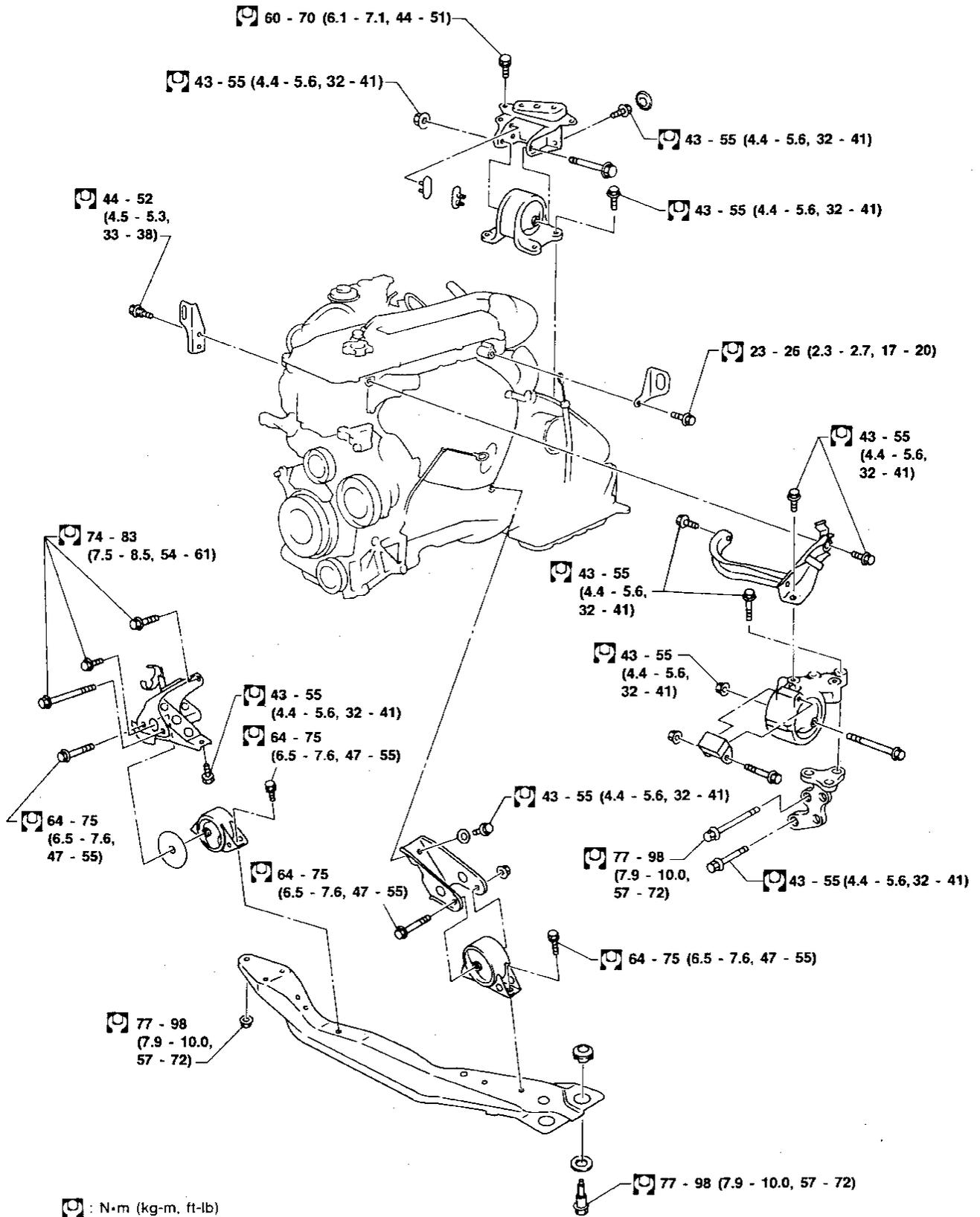


8. Install new shim using a suitable tool.
- **Install with the surface on which the thickness is stamped facing down.**



9. Place Tool (A) as mentioned in steps 2 and 3.
10. Remove Tool (B).
11. Remove Tool (A).
12. Recheck valve clearance. Refer to EM-37.

# ENGINE REMOVAL



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

# ENGINE REMOVAL

## WARNING:

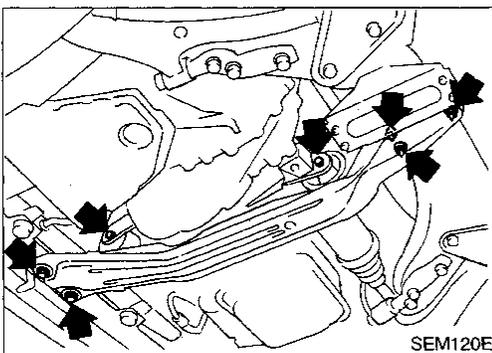
- a. Position vehicle on a flat and solid surface.
- b. Place chocks at front and back of rear wheels.
- c. Do not remove engine until exhaust system has completely cooled off.  
Otherwise, you may burn yourself and/or fire may break out in fuel line.
- d. For safety during subsequent steps, the tension of wires should be slackened against the engine.
- e. Before disconnecting fuel hose, release fuel pressure from fuel line.  
Refer to EF & EC section ("Releasing Fuel Pressure", "MULTIPOINT FUEL INJECTION SYSTEM INSPECTION").
- f. Before removing front axle from transaxle, place safety stands under designated front supporting points. Refer to GI section for lifting points and towing.
- g. Be sure to hoist engine and transaxle in a safe manner.
- h. 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

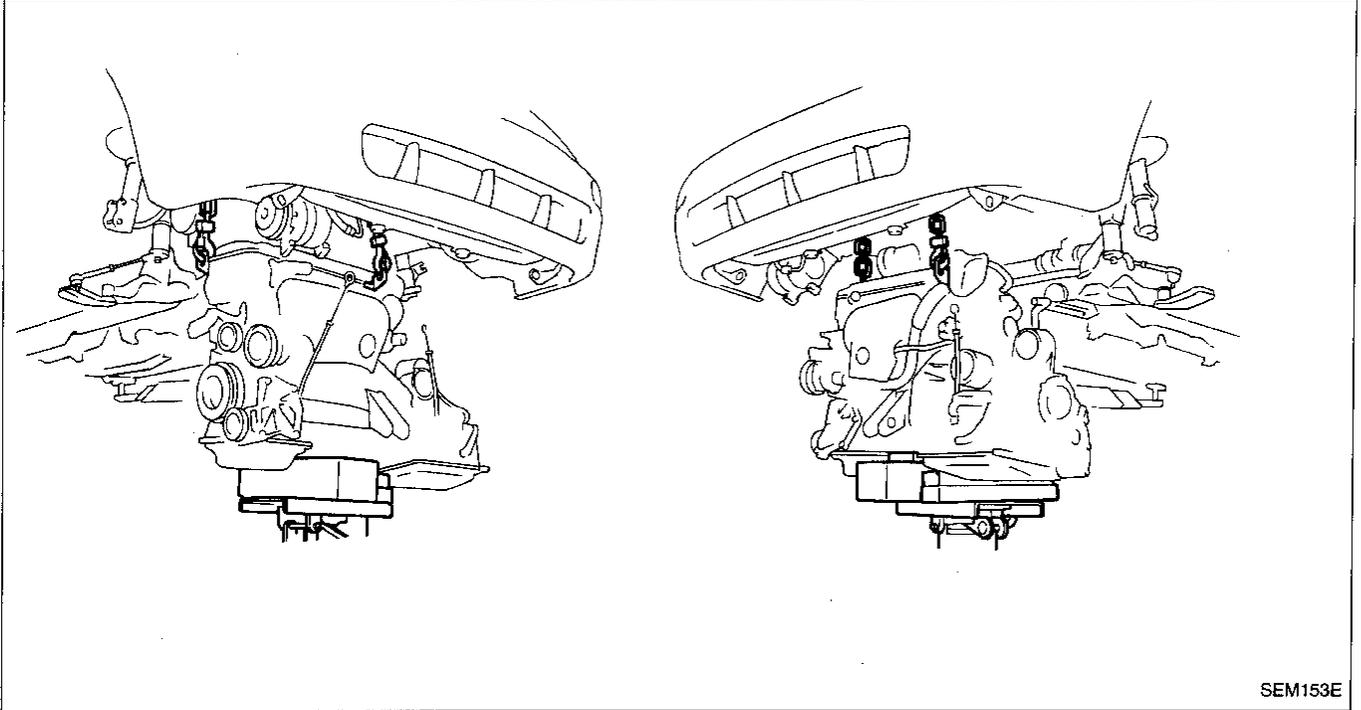
1. Remove engine under cover and hood.
2. Drain coolant from drain plug on water pipe, and radiator.
3. Remove vacuum hoses, fuel hoses, wires, harnesses and connectors and so on.
4. Remove front exhaust tube and drive shafts.
5. Remove drive belts.
6. Remove generator, compressor and power steering oil pump from engine.
7. Set a suitable transmission jack under transaxle. Hoist engine with engine slinger.
8. Remove RH and LH engine mountings and center member.
9. Remove front and rear engine mountings.



# ENGINE REMOVAL

## Removal (Cont'd)

10. Remove engine with transaxle as shown.

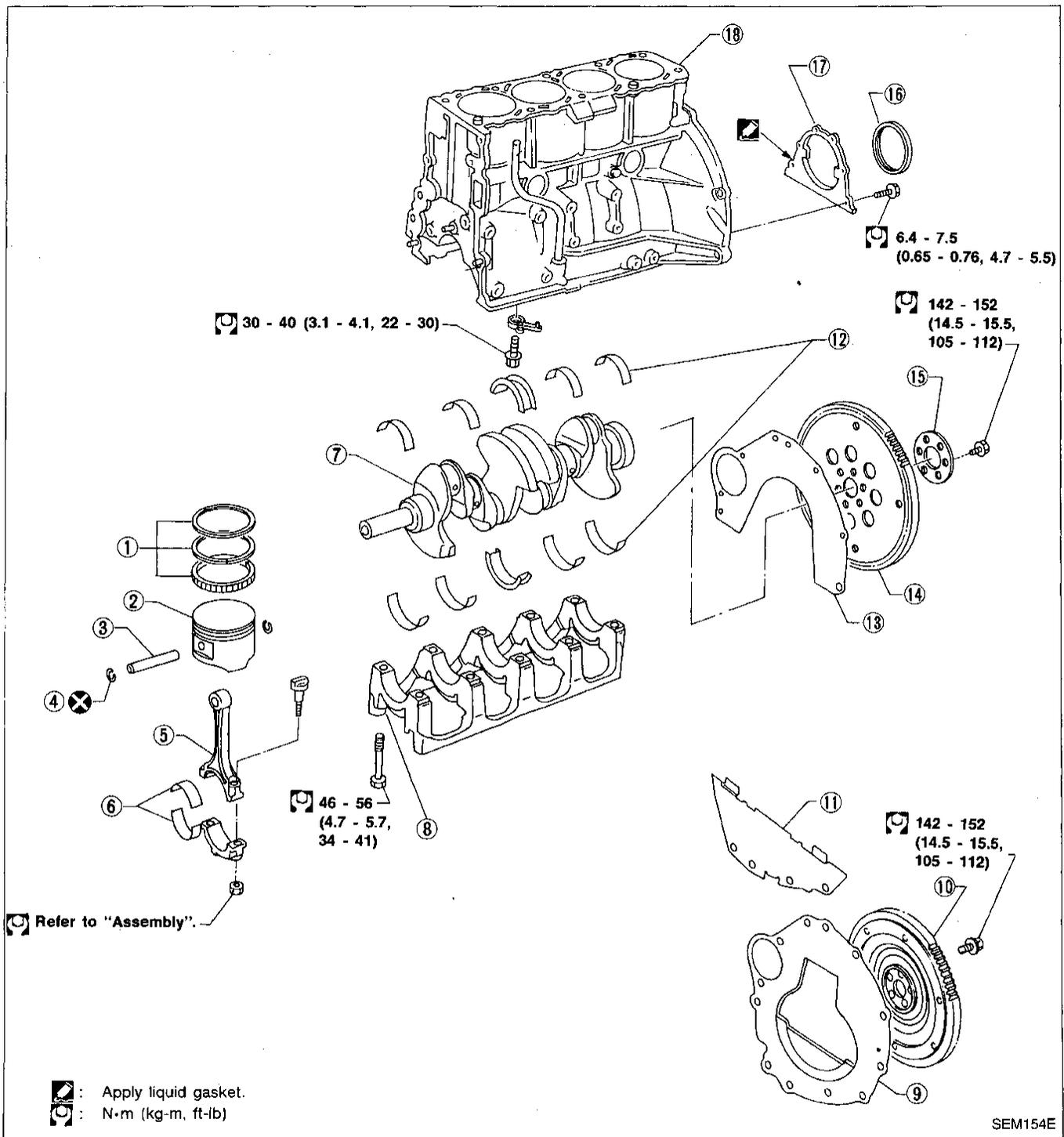


## Installation

Installation is in the reverse order of removal.

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

# CYLINDER BLOCK



SEM154E

- |                          |                    |                             |
|--------------------------|--------------------|-----------------------------|
| ① Piston rings           | ⑦ Crankshaft       | ⑬ Rear plate (A/T)          |
| ② Piston                 | ⑧ Main bearing cap | ⑭ Drive plate (A/T)         |
| ③ Piston pin             | ⑨ Rear plate (M/T) | ⑮ Drive plate reinforcement |
| ④ Snap ring              | ⑩ Flywheel (M/T)   | ⑯ Rear oil seal             |
| ⑤ Connecting rod         | ⑪ Dust cover (A/T) | ⑰ Rear oil seal retainer    |
| ⑥ Connecting rod bearing | ⑫ Main bearing     | ⑱ Cylinder block            |

# CYLINDER BLOCK

## 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.

GI

MA

EM

LC

EF &  
EC

FE

CL

MT

AT

FA

RA

BR

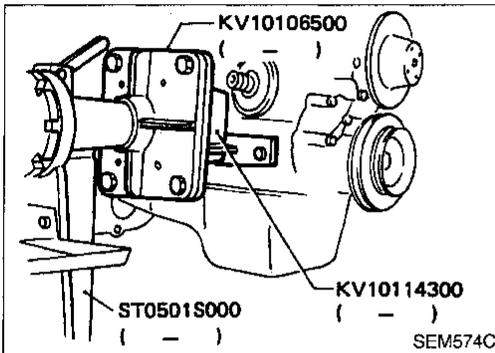
ST

BF

HA

EL

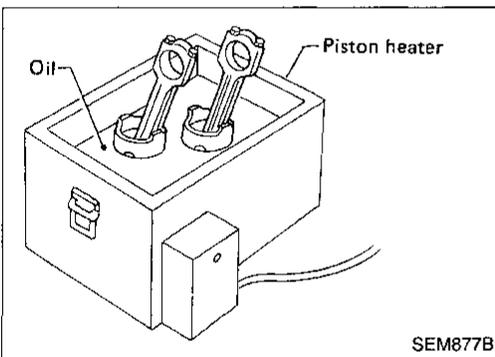
IDX



## Disassembly

### PISTON AND CRANKSHAFT

1. Place engine on a work stand.
2. Remove timing chain.  
Refer to EM-19.

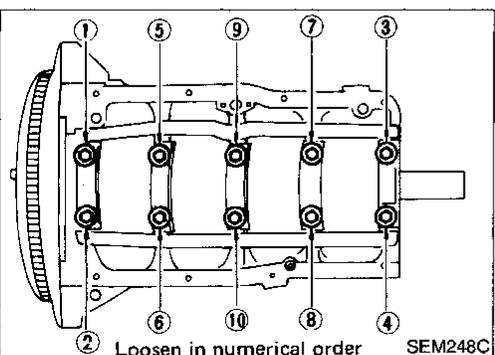
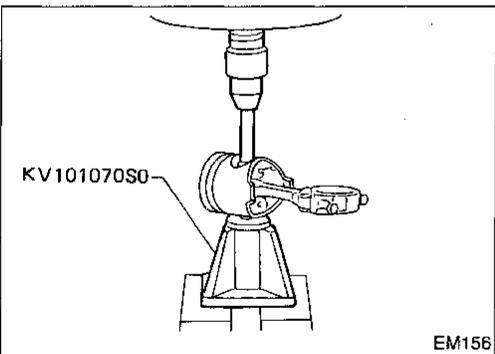


3. Remove pistons with connecting rods.

- 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.

## CAUTION:

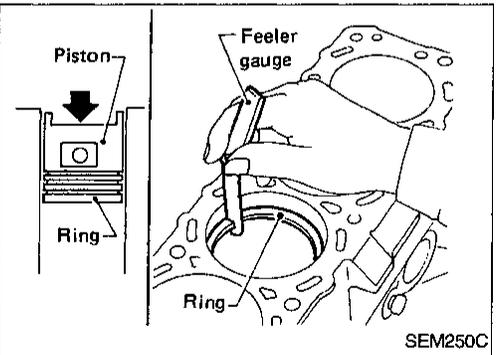
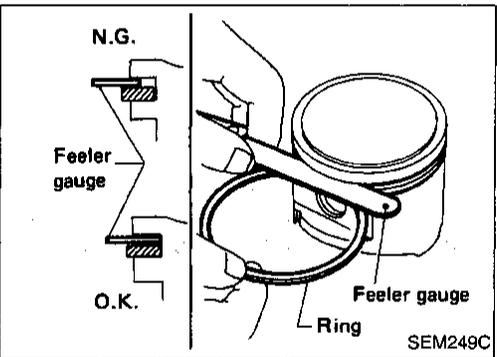
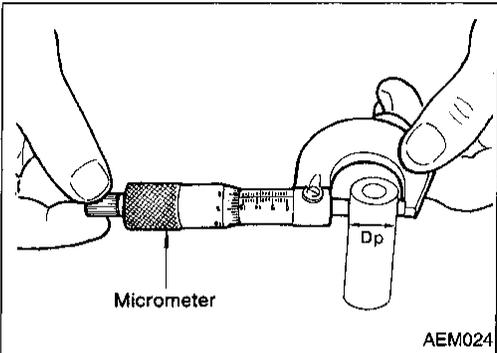
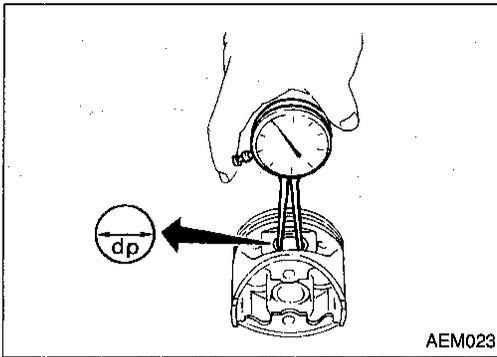
- When piston rings are not replaced, make sure that piston rings are mounted in their original positions.
- When piston rings are being replaced and no punchmark is present, piston rings can be mounted with either side up.



4. Remove main bearing beam and crankshaft.

- Before removing main bearing beam, measure crankshaft end play.
- Bolts should be loosened in two or three steps.

# CYLINDER BLOCK



## 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)

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**

0.040 - 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:**

0.1 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 - 0.52 mm (0.0110 - 0.0205 in)

**2nd ring**

0.45 - 0.69 mm (0.0177 - 0.0272 in)

**Oil ring**

0.20 - 0.69 mm (0.0079 - 0.0272 in)

**Max. limit of ring gap:**

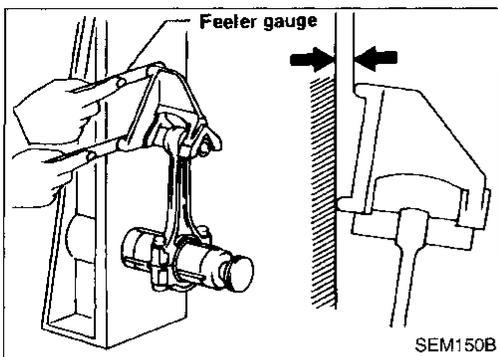
1.0 mm (0.039 in)

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 EM-59.

# CYLINDER BLOCK

## Inspection (Cont'd)



### CONNECTING ROD BEND AND TORSION

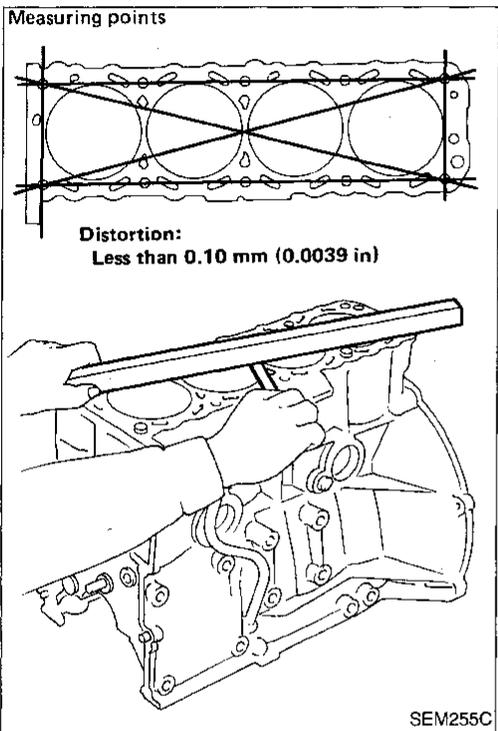
#### Bend:

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 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:

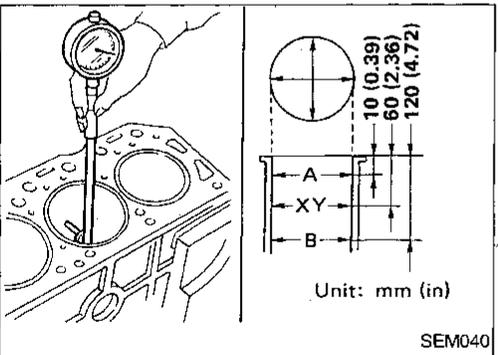
$$A + B = 0.2 \text{ mm (0.008 in)}$$

Nominal cylinder block height

from crankshaft center:

$$246.95 - 247.05 \text{ mm (9.7224 - 9.7264 in)}$$

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):

Less than 0.015 mm (0.0006 in)

#### Taper (A - B):

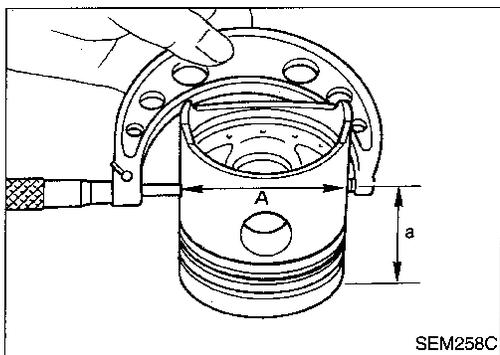
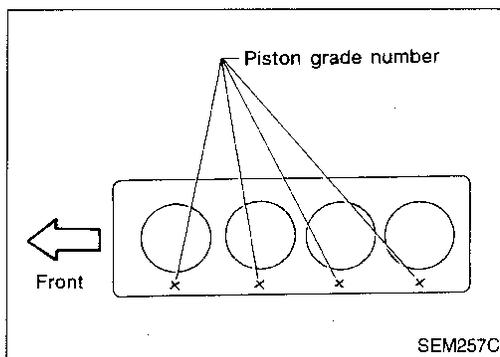
Less than 0.01 mm (0.0004 in)

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.

## CYLINDER BLOCK

### Inspection (Cont'd)



- 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 EM-59.**

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

**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 EM-59.**

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.

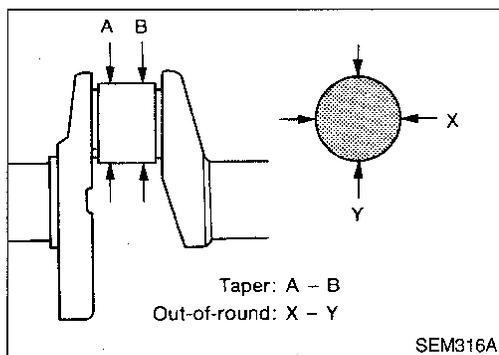
- **When any cylinder needs boring, all other cylinders must also be bored.**

- **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):**

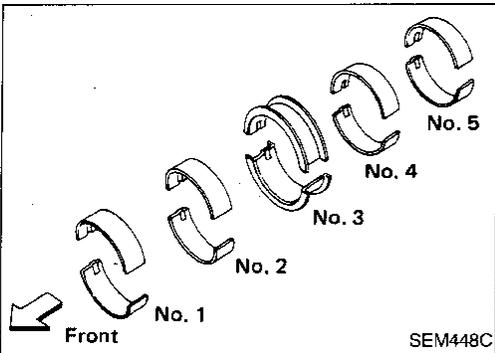
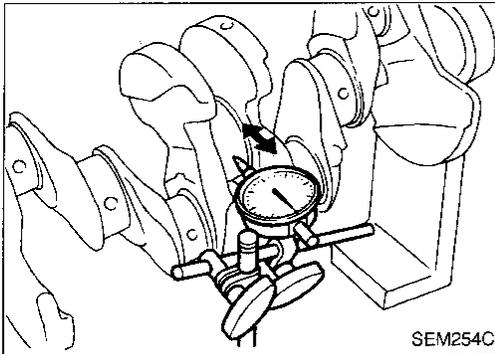
**Less than 0.002 mm (0.0001 in)**

# CYLINDER BLOCK

## Inspection (Cont'd)

3. Measure crankshaft runout.

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



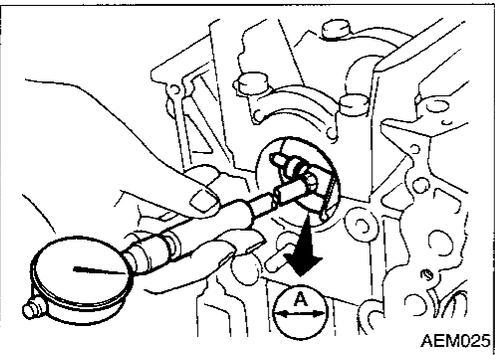
## BEARING CLEARANCE

- 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.
  2. Install main bearing cap to cylinder block.
- Tighten all bolts in correct order in two or three stages. Refer to EM-51.**
3. Measure inner diameter "A" of each main bearing.



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

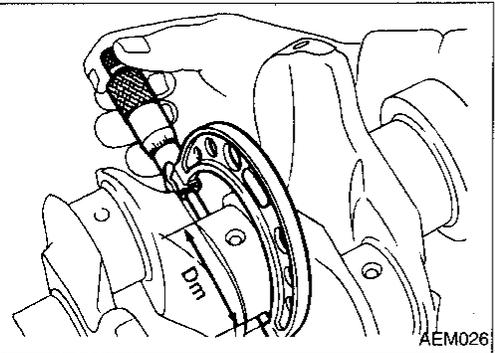
$$\text{Main bearing clearance} = A - Dm$$

#### Standard:

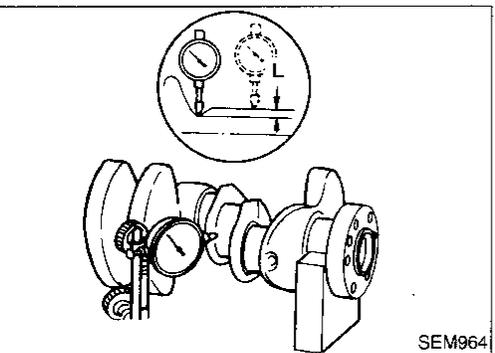
0.020 - 0.047 mm (0.0008 - 0.0019 in)

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.



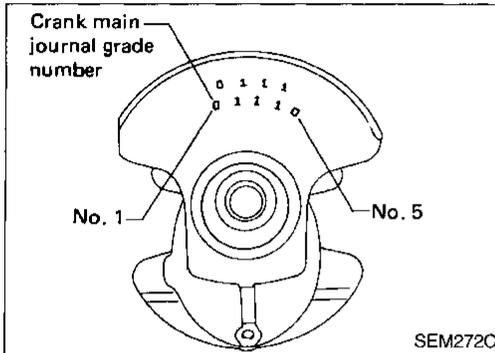
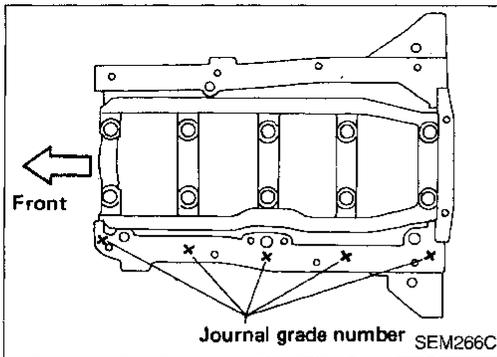
- a. When grinding crankshaft journal, confirm that "L" dimension in fillet roll is more than the specified limit.  
"L": 0.1 mm (0.004 in)
- b. Refer to EM-60 for grinding crankshaft and available service parts.



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

# CYLINDER BLOCK

## Inspection (Cont'd)



8. If crankshaft is reused, measure main bearing clearance and select 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. These numbers are punched in either Arabic or Roman numerals.

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

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

### Main bearing grade number:

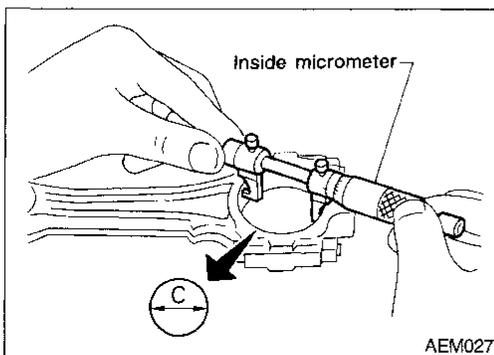
Crankshaft journal grade number	Main journal grade number		
	0	1	2
0	0	1	2
1	1	2	3
2	2	3	4

For example:

Main journal grade number: 1

Crankshaft journal grade number: 2

Main bearing grade number = 1 + 2 = 3



### Connecting rod bearing (Big end)

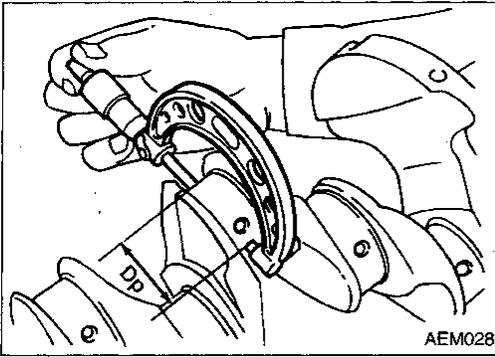
1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.

### Tighten bolts to the specified torque.

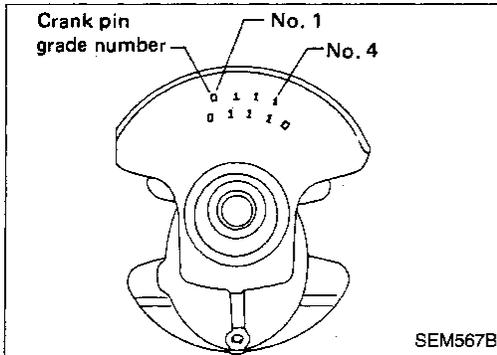
3. Measure inner diameter "C" of each bearing.

# CYLINDER BLOCK

## Inspection (Cont'd)



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 on EM-47.

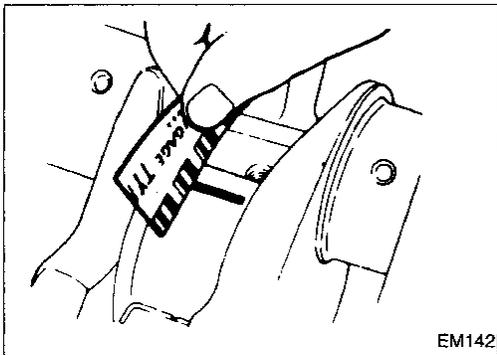


8. If crankshaft is replaced with a new one, select connecting rod bearing according to the following table.

### Connecting rod bearing grade number:

These numbers are punched in either Arabic or Roman numerals.

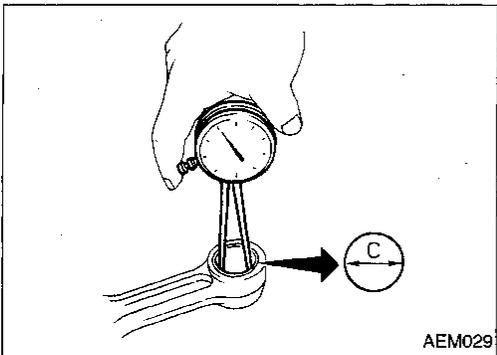
Crank pin grade number	Connecting rod bearing grade number
0	0
1	1
2	2



### Method B (Using plastigage)

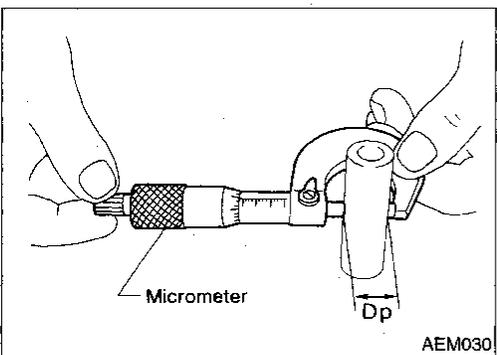
#### CAUTION:

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



### CONNECTING ROD BUSHING CLEARANCE (Small end)

1. Measure inner diameter "C" of bushing.



2. Measure outer diameter "Dp" of piston pin.
3. Calculate connecting rod bushing clearance.  
**C - Dp =**  
**0.005 - 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)

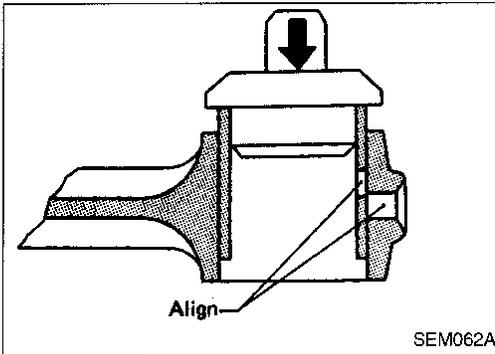
#### REPLACEMENT OF CONNECTING ROD BUSHING (Small end)

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

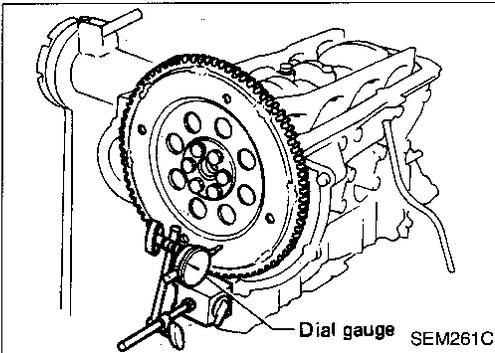
Runout (Total indicator reading):

Flywheel (M/T model)

Less than 0.15 mm (0.0059 in)

Drive plate (A/T model)

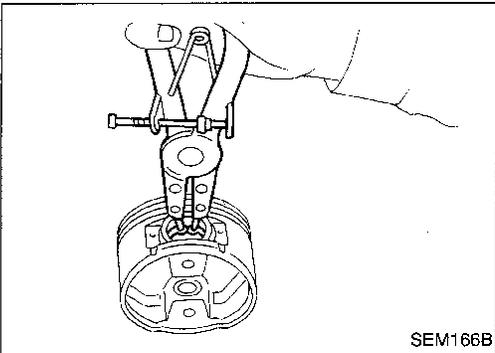
Less than 0.15 mm (0.0059 in)



### Assembly

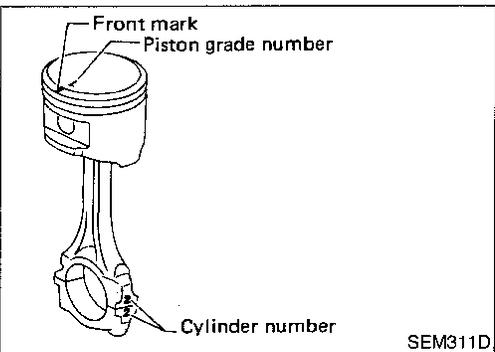
#### PISTON

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.

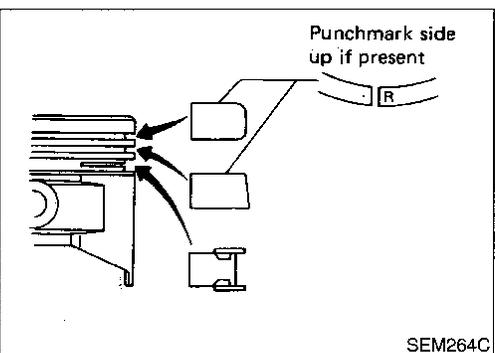
- **Align the direction of piston and connecting rod.**
- **Numbers stamped on connecting rod and cap correspond to each cylinder.**
- **After assembly, make sure connecting rod swings smoothly.**



3. Set piston rings as shown.

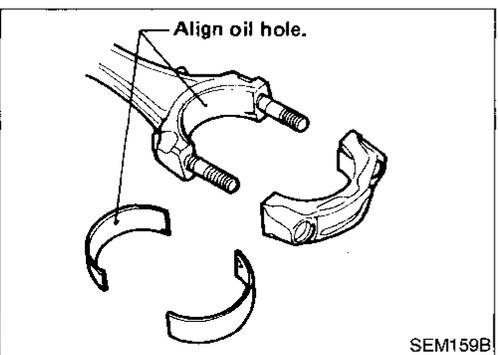
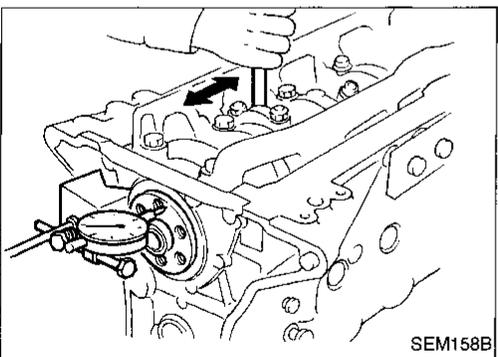
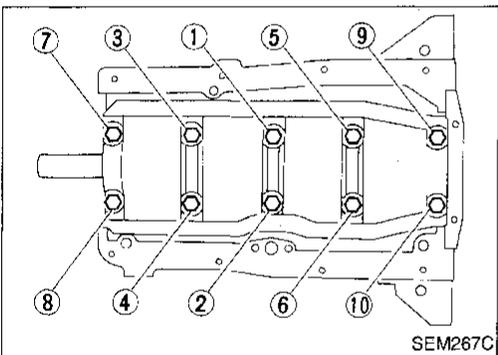
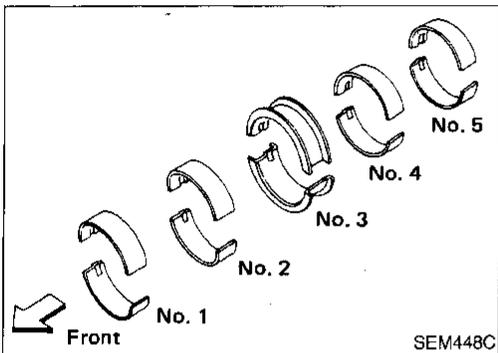
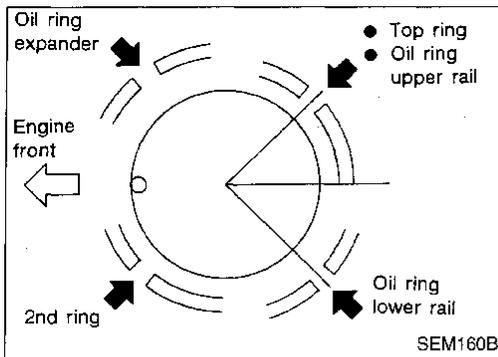
#### CAUTION:

- **When piston rings are not being 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.**



# CYLINDER BLOCK

## Assembly (Cont'd)



### 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 EM-46.

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.

4. Install connecting rod bearings in connecting rods and connecting rod caps.
  - Confirm that correct bearings are used. Refer to EM-48.
  - Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.

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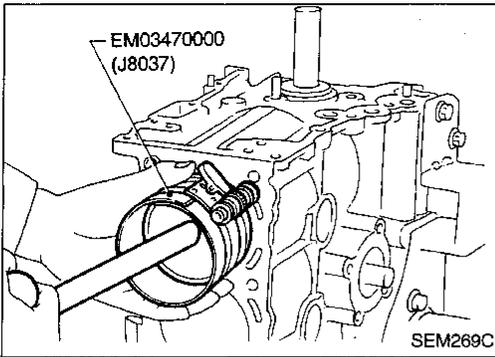
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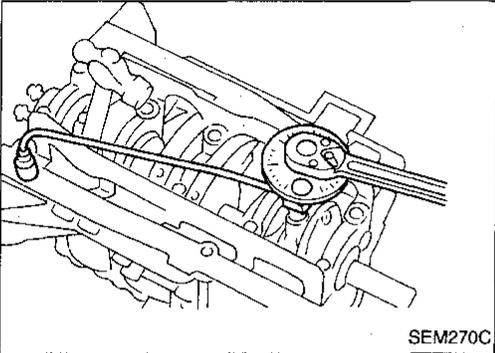
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## CYLINDER BLOCK

### Assembly (Cont'd)



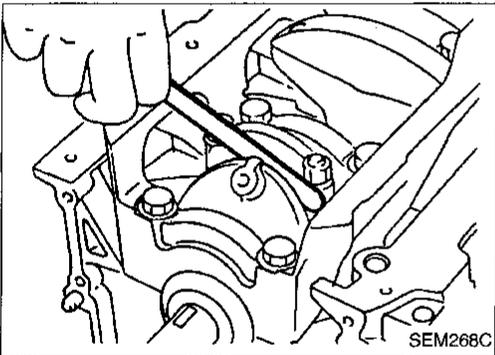
5. Install pistons with connecting rods.
  - a. Install them into corresponding cylinders with Tool.
    - **Be careful not to scratch cylinder wall by connecting rod.**
    - **Arrange so that front mark on piston head faces toward front of engine.**



- 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.

# SERVICE DATA AND SPECIFICATIONS (SDS)

## General Specifications

Cylinder arrangement	In-line 4	
Displacement	cm <sup>3</sup> (cu in)	2,389 (145.78)
Bore and stroke	mm (in)	89 x 96 (3.50 x 3.78)
Valve arrangement	D.O.H.C.	
Firing order	1-3-4-2	
Number of piston rings		
Compression	2	
Oil	1	
Number of main bearings	5	
Compression ratio	9.2	

## COMPRESSION PRESSURE

Unit: kPa (kg/cm<sup>2</sup>, psi)/300 rpm

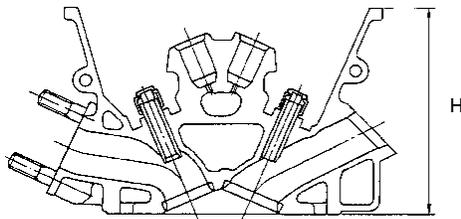
Compression pressure		
Standard	1,226 (12.5, 178)	
Minimum	1,030 (10.5, 149)	
Differential limit between cylinders	98 (1.0, 14)	

## Inspection and Adjustment

### CYLINDER HEAD

Unit: mm (in)

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

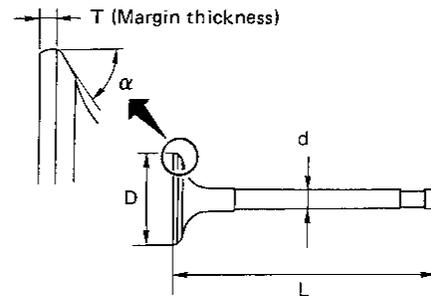


Nominal cylinder head height:  
H = 126.3 - 126.5 (4.972 - 4.980)

SEM956C

### VALVE

Unit: mm (in)



SEM188

Valve head diameter "D"		
Intake	36.5 - 36.7 (1.437 - 1.445)	
Exhaust	31.2 - 31.4 (1.228 - 1.236)	
Valve length "L"		
Intake	101.02 - 101.62 (3.9772 - 4.0008)	
Exhaust	98.52 - 99.72 (3.8787 - 3.9260)	
Valve stem diameter "d"		
Intake	6.965 - 6.980 (0.2742 - 0.2748)	
Exhaust	6.945 - 6.960 (0.2734 - 0.2740)	
Valve seat angle "α"		
Intake	45°15' - 45°45'	
Exhaust		
Valve margin "T"		
Intake	0.95 - 1.25 (0.0374 - 0.0492)	
Exhaust	1.15 - 1.45 (0.0453 - 0.0571)	
Valve margin "T" limit	More than 0.5 (0.020)	
Valve stem end surface grinding limit	Less than 0.2 (0.008)	

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### Valve spring

Free height	mm (in)	45.79 (1.8028)
Pressure N (kg, lb) at height mm (in)		471.7 (48.1, 106.1) at 26.06 (1.0260)
		421.31 (42.96, 94.73) at 26.06 (1.0260)
Out-of-square	mm (in)	Less than 2.0 (0.079)

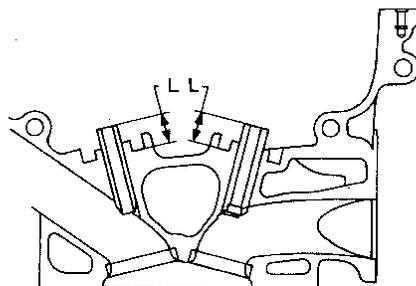
### Valve lifter

Unit: mm (in)

Valve lifter outer diameter	33.960 - 33.975 (1.3370 - 1.3376)
Lifter guide inner diameter	34.000 - 34.021 (1.3386 - 1.3394)
Clearance between lifter and filter guide	0.025 - 0.061 (0.0010 - 0.0024)

### Valve guide

Unit: mm (in)



SEM301D

		Standard	Service
Valve guide			
Outer diameter	Intake & Exhaust	11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
Valve guide			
Inner diameter (Finished size)	Intake	7.000 - 7.018 (0.2756 - 0.2763)	
	Exhaust	7.000 - 7.018 (0.2756 - 0.2763)	
Cylinder head valve guide hole diameter	Intake & Exhaust	10.975 - 10.996 (0.4321 - 0.4329)	11.175 - 11.196 (0.4400 - 0.4408)
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)	0.08 (0.0031)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
Valve deflection limit		0.2 (0.008)	
Projection length "L"		13.3 - 13.9 (0.524 - 0.547)	

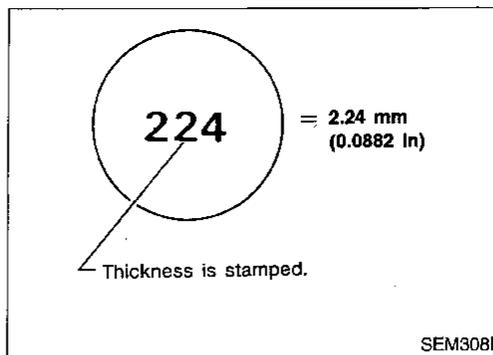
# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### Valve clearance adjustment

Unit: mm (in)

Valve clearance	
Intake	0.31 - 0.39 (0.012 - 0.015)
Exhaust	0.33 - 0.41 (0.013 - 0.016)



### Available shims

Thickness mm (in)	Identification mark
1.96 (0.0772)	196
1.98 (0.0780)	198
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

GI

MA

**EM**

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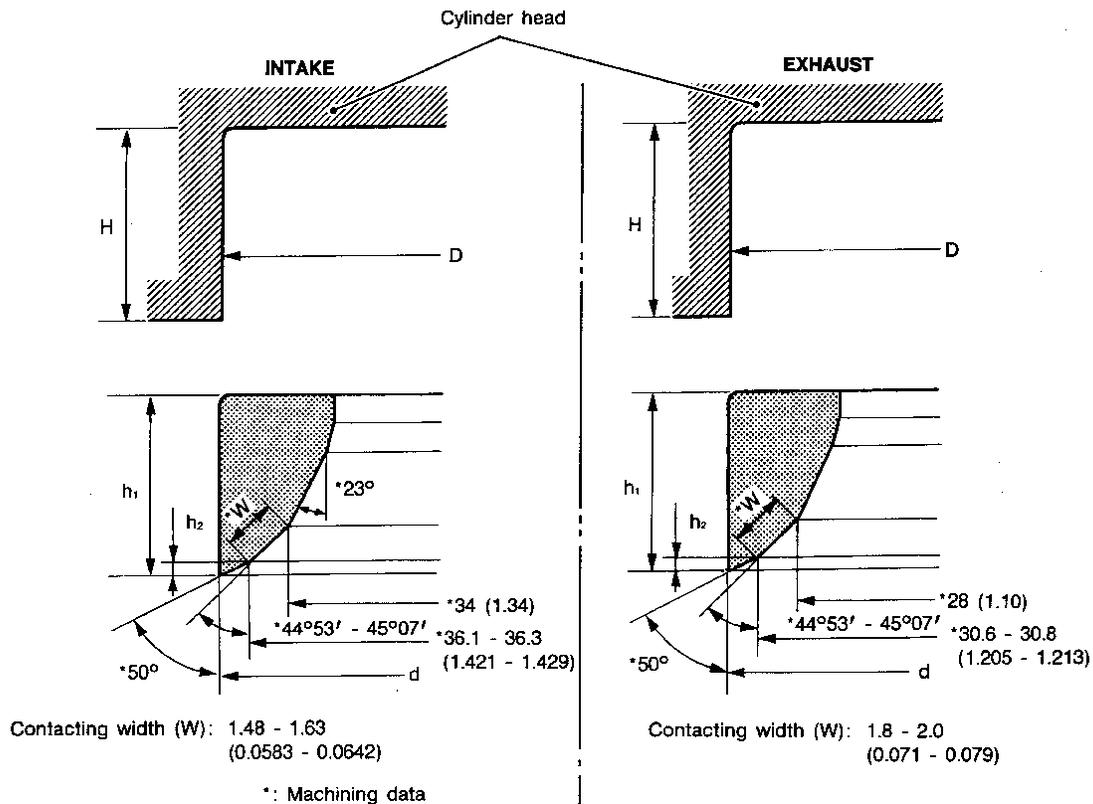
IDX

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### Valve seat

Unit: mm (in)



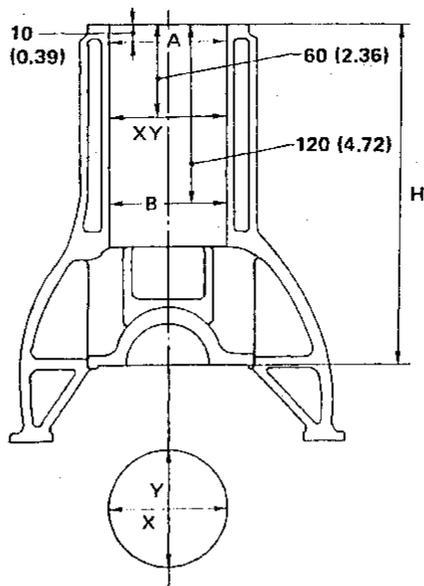
SEM179E

		Standard	Service
Cylinder head seat recess diameter (D)	In.	37.500 - 37.516 (1.4764 - 1.4770)	38.000 - 38.016 (1.4961 - 1.4967)
	Ex.	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
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.	37.580 - 37.596 (1.4795 - 1.4802)	38.080 - 38.096 (1.4992 - 1.4998)
	Ex.	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Depth (H)	In.	6.19 - 6.21 (0.2437 - 0.2445)	
	Ex.	6.1 - 6.3 (0.240 - 0.248)	
Height (h <sub>1</sub> )		5.9 - 6.0 (0.232 - 0.236)	
Height (h <sub>2</sub> )	In.	0.44 - 0.64 (0.0173 - 0.0252)	
	Ex.	0.53 - 0.73 (0.0209 - 0.0287)	

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### CYLINDER BLOCK



SEM447C

Unit: mm (in)

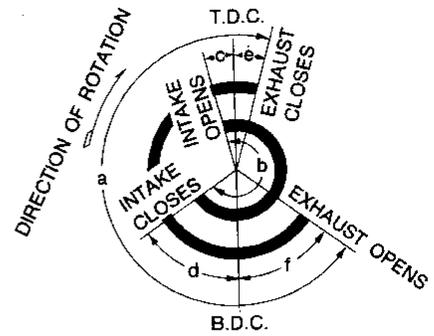
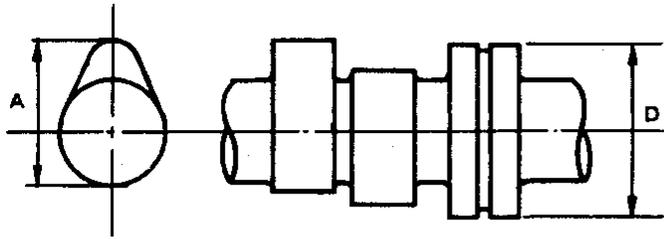
			Standard	Limit
Distortion			Less than 0.03 (0.0012)	0.1 (0.004)
Cylinder bore	Inner diameter	Grade 1	89.000 - 89.010 (3.5039 - 3.5043)	0.2 (0.008)
		Grade 2	89.010 - 89.020 (3.5043 - 3.5047)	
		Grade 3	89.020 - 89.030 (3.5047 - 3.5051)	
	Out-of-round (X - Y)		Less than 0.015 (0.0006)	—
Taper (A - B)		Less than 0.010 (0.0004)	—	
Difference in inner diameter between cylinders			Less than 0.03 (0.0012)	0.2 (0.008)
Cylinder block height : H (From crankshaft center)			246.95 - 247.05 (9.7224 - 9.7264)	0.2 (0.008)*

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

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### CAMSHAFT AND CAMSHAFT BEARING



SEM568A

EM120

Unit: mm (in)

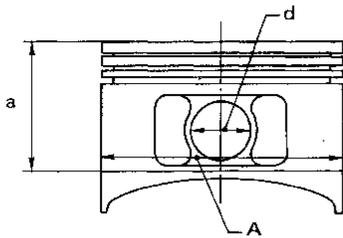
		Standard	Limit
Cam height (A)	Intake	42.415 - 42.605 (1.6699 - 1.6774)	—
	Exhaust	42.415 - 43.005 (1.6699 - 1.6931)	—
Wear limit of cam height		—	0.2 (0.008)
Camshaft journal to bearing clearance		0.045 - 0.090 (0.0018 - 0.0035)	0.12 (0.0047)
Inner diameter of camshaft bearing	#1 journal	28.000 - 28.025 (1.1024 - 1.1033)	—
	#2 to #5 journal	24.000 - 24.025 (0.9449 - 0.9459)	
Outer diameter of camshaft journal (D)	#1 journal	27.935 - 27.955 (1.0998 - 1.1006)	—
	#1 to #5 journal	23.935 - 23.955 (0.9423 - 0.9431)	
Camshaft runout*		Less than 0.02 (0.0008)	0.04 (0.0016)
Camshaft end play		0.07 - 0.15 (0.0028 - 0.0059)	0.20 (0.0079)
Valve timing (Degree on crankshaft)	a	248	—
	b	240	—
	c	-1	—
	d	61	—
	e	8	—
	f	60	—

\* Total indicator reading

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### PISTON, PISTON RING AND PISTON PIN Piston



SEM444C

Unit: mm (in)

Piston skirt diameter (A)	Standard	Grade No. 1	88.970 - 88.980 (3.5027 - 3.5031)
			Grade No. 2
		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)		

### Piston pin

Unit: mm (in)

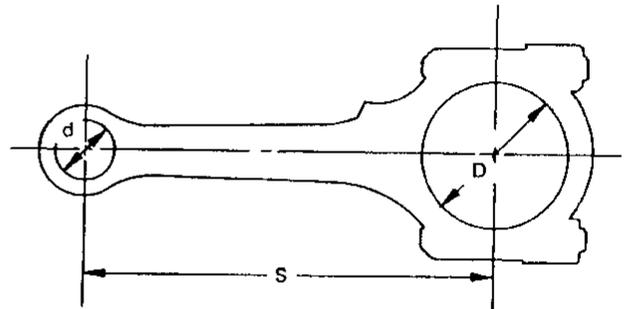
	Standard	Limit
Piston pin outer diameter	20.989 - 21.001 (0.8263 - 0.8268)	—
Interference fit of piston pin to piston pin hole	0 - 0.004 (0 - 0.0002)	—
Piston pin to connecting rod bearing clearance	0.005 - 0.017 (0.0002 - 0.0007)	0.023 (0.0009)

### Piston ring

Unit: mm (in)

		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 - 0.52 (0.0110 - 0.0205)	1.0 (0.039)
	2nd	0.45 - 0.69 (0.0177 - 0.0272)	1.0 (0.039)
	Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)	1.0 (0.039)

### CONNECTING ROD



SEM180E

Unit: mm (in)

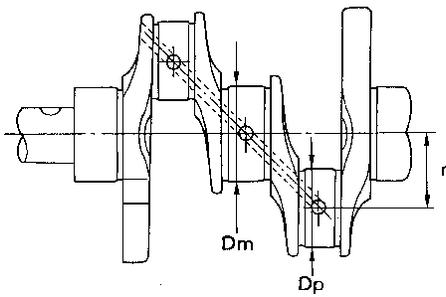
	Standard	Limit
Center distance (S)	164.95 - 165.05 (6.4941 - 6.4980)	—
Bend [per 100 mm (3.94 in)]	—	0.15 (0.0059)
Torsion [per 100 mm (3.94 in)]	—	0.30 (0.0118)
Piston pin bushing inner diameter (d)*	21.000 - 21.012 (0.8268 - 0.8272)	—
Connecting rod big end inner diameter (D)*	53.000 - 53.013 (2.0866 - 2.0871)	—
Side clearance	0.2 - 0.4 (0.008 - 0.016)	0.6 (0.024)

\* Without bearing

# SERVICE DATA AND SPECIFICATIONS (SDS)

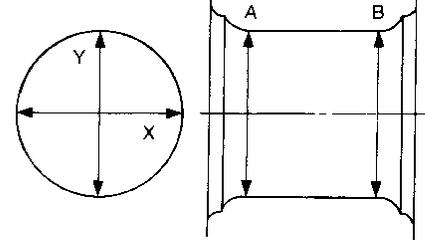
## Inspection and Adjustment (Cont'd)

### CRANKSHAFT



SEM394

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



EM715

Unit: mm (in)

Main journal diameter (Dm)	Grade	No. 0	59.967 - 59.975 (2.3609 - 2.3612)
		No. 1	59.959 - 59.967 (2.3606 - 2.3609)
		No. 2	59.951 - 59.959 (2.3603 - 2.3606)
Pin journal diameter (Dp)	Grade	No. 0	49.968 - 49.974 (1.9672 - 1.9675)
		No. 1	49.962 - 49.968 (1.9670 - 1.9672)
		No. 2	49.956 - 49.962 (1.9668 - 1.9670)
Center distance (r)		47.97 - 48.05 (1.8886 - 1.8917)	
		Standard	Limit
Taper of journal and pin [(A) - (B)]		Less than 0.002 (0.0001)	—
Out-of-round of journal and pin [(X) - (Y)]		Less than 0.005 (0.0002)	—
Runout [T.I.R.]*		Less than 0.04 (0.0016)	—
Free end play		0.05 - 0.18 (0.0020 - 0.0071)	0.3 (0.012)
Fillet roll		More than 0.1 (0.004)	

\* Total indicator reading

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### BEARING CLEARANCE

Unit: mm (in)

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

### AVAILABLE MAIN BEARING

#### Standard

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

#### Undersize (service)

Unit: mm (in)

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

### AVAILABLE CONNECTING ROD BEARING

#### Standard

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

#### Undersize (service)

Unit: mm (in)

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

### MISCELLANEOUS COMPONENTS

Unit: mm (in)

Camshaft sprocket runout [T.I.R.]*	Less than 0.12 (0.0047)
Flywheel runout [T.I.R.]*	Less than 0.15 (0.0059)
Drive plate runout [T.I.R.]*	Less than 0.15 (0.0059)

\* Total indicator reading