

# ENGINE MECHANICAL

## SECTION **EM**

EM

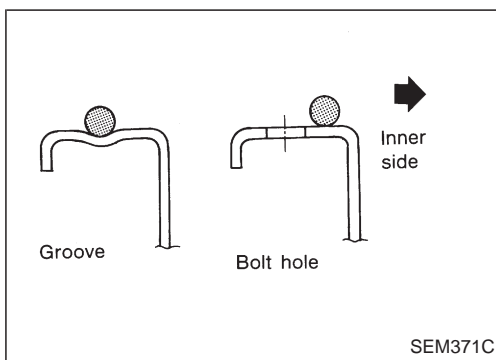
### CONTENTS

<b>PRECAUTIONS</b> .....	1	<b>CHARGE AIR COOLERS</b> .....	27
Parts Requiring Angular Tightening .....	1	<b>CYLINDER HEAD</b> .....	28
Liquid Gasket Application Procedure .....	1	Removal .....	29
<b>PREPARATION</b> .....	2	Disassembly .....	30
<b>NOISE, VIBRATION AND HARSHNESS (NVH)</b>		Inspection .....	31
<b>TROUBLESHOOTING</b> .....	6	Assembly .....	37
NVH Troubleshooting Chart — Engine Noise .....	7	Installation .....	37
<b>OUTER COMPONENT PARTS</b> .....	8	<b>VALVE CLEARANCE</b> .....	40
<b>COMPRESSION PRESSURE</b> .....	10	Checking .....	40
Measurement of Compression Pressure .....	10	Adjusting .....	41
<b>OIL PAN</b> .....	13	<b>ENGINE REMOVAL</b> .....	43
Removal .....	13	Removal .....	44
Installation .....	14	Installation .....	44
<b>TIMING BELT</b> .....	15	<b>CYLINDER BLOCK</b> .....	45
Removal .....	15	Disassembly .....	46
Inspection .....	17	Inspection .....	46
Installation .....	18	Assembly .....	53
<b>OIL SEAL REPLACEMENT</b> .....	20	<b>SERVICE DATA AND SPECIFICATIONS (SDS)</b> .....	56
<b>TURBOCHARGER</b> .....	23	General Specifications .....	56
Removal and Installation .....	23	Inspection and Adjustment .....	56
Inspection .....	24		

## PRECAUTIONS

### 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 cylinder head bolts.



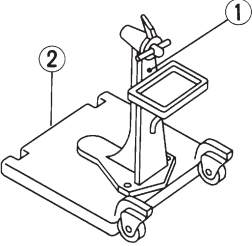
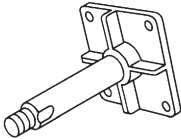
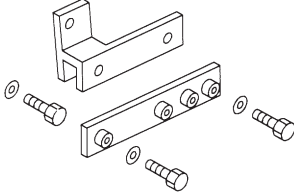
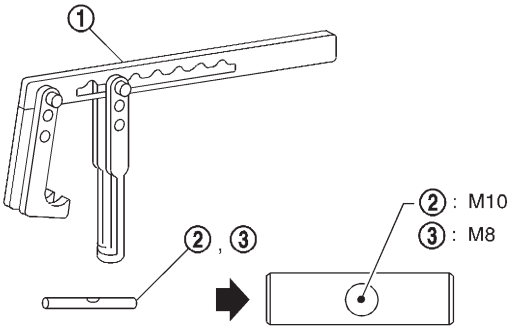
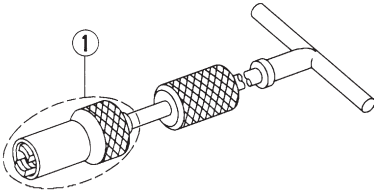
### Liquid Gasket Application Procedure

- Before applying liquid gasket, use a scraper to remove all traces of old liquid gasket from mating surface.**
- Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)**
  - Be sure liquid gasket is specified width (for oil pan) 3.5 to 4.5 mm (0.138 to 0.177 in) for gasoline engine.
  - Be sure liquid gasket is 2.0 to 3.0 mm (0.079 to 0.118 in) wide in areas except oil pan for TB and RD series engines and 2.5 to 3.5 mm (0.098 to 0.138 in) for TD series engine.
- 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.**

# PREPARATION

## SPECIAL SERVICE TOOLS

\* Special tool or commercial equivalent

Tool number Tool name	Description
ST0501S000* Engine stand assembly ① ST05011000 Engine stand ② ST05012000 Base	 <p style="text-align: right;">Disassembling and assembling</p> <p>NT042</p>
KV10106500* Engine stand shaft	 <p>NT028</p>
KV1011070 Engine sub-attachment	 <p>NT582</p>
KV101092S0 Valve spring compressor ① KV10109210 Compressor ② KV10109220 Adapter	 <p style="text-align: right;">Disassembling and assembling valve components</p> <p>NT718</p>
KV10107902 Valve oil seal puller ① KV10116100 Valve oil seal puller adapter	 <p>NT605</p>

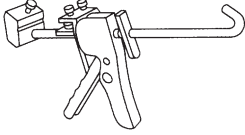
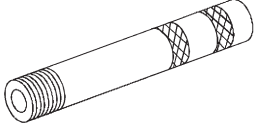
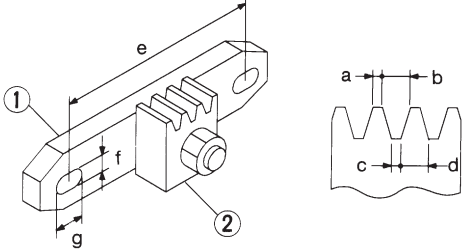
# PREPARATION

\* Special tool or commercial equivalent

Tool number Tool name	Description	
KV101151S0 Lifter stopper set ① KV10115110 Camshaft pliers ② KV10115120 Lifter stopper		Changing shims
EM03470000* Piston ring compressor		Installing piston assembly into cylinder bore
ST16610001* Pilot bushing puller		Removing crankshaft pilot bushing
KV10109300 Puller holder		<b>a = 68 mm (2.68 in)</b> <b>b = 8 mm (0.31 in) dia.</b>
① ED19601000 Compression gauge ② ED19600600 Compression gauge adapter (for glow plug hole) ③ ED19600700 Compression gauge adapter (for injector hole)		Checking compression pressure
KV11100300 Nozzle holder socket		

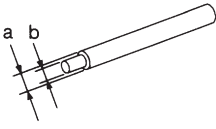
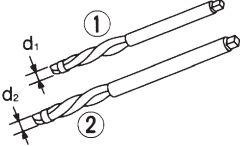
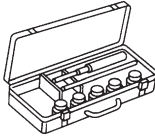
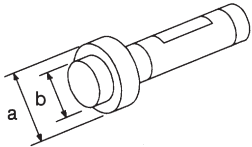
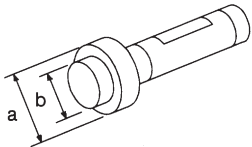
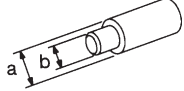
# PREPARATION

\* Special tool or commercial equivalent

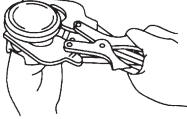
Tool number Tool name	Description
WS39930000* Tube presser	Pressing the tube of liquid gasket    NT052
KV10107501 Valve oil seal drift	  NT741
KV111033S0 Engine stopper ① KV10105610 Stopper plate ② KV10105630 Stopper gear	Preventing crankshaft from rotating    NT616  <b>a: 3 (0.12)</b> <b>b: 6.4 (0.252)</b> <b>c: 2.8 (0.110)</b> <b>d: 6.6 (0.260)</b> <b>e: 119 (4.69)</b> <b>f: 12 (0.47)</b> <b>g: 18 (0.71)</b> Unit: mm (in)

# PREPARATION

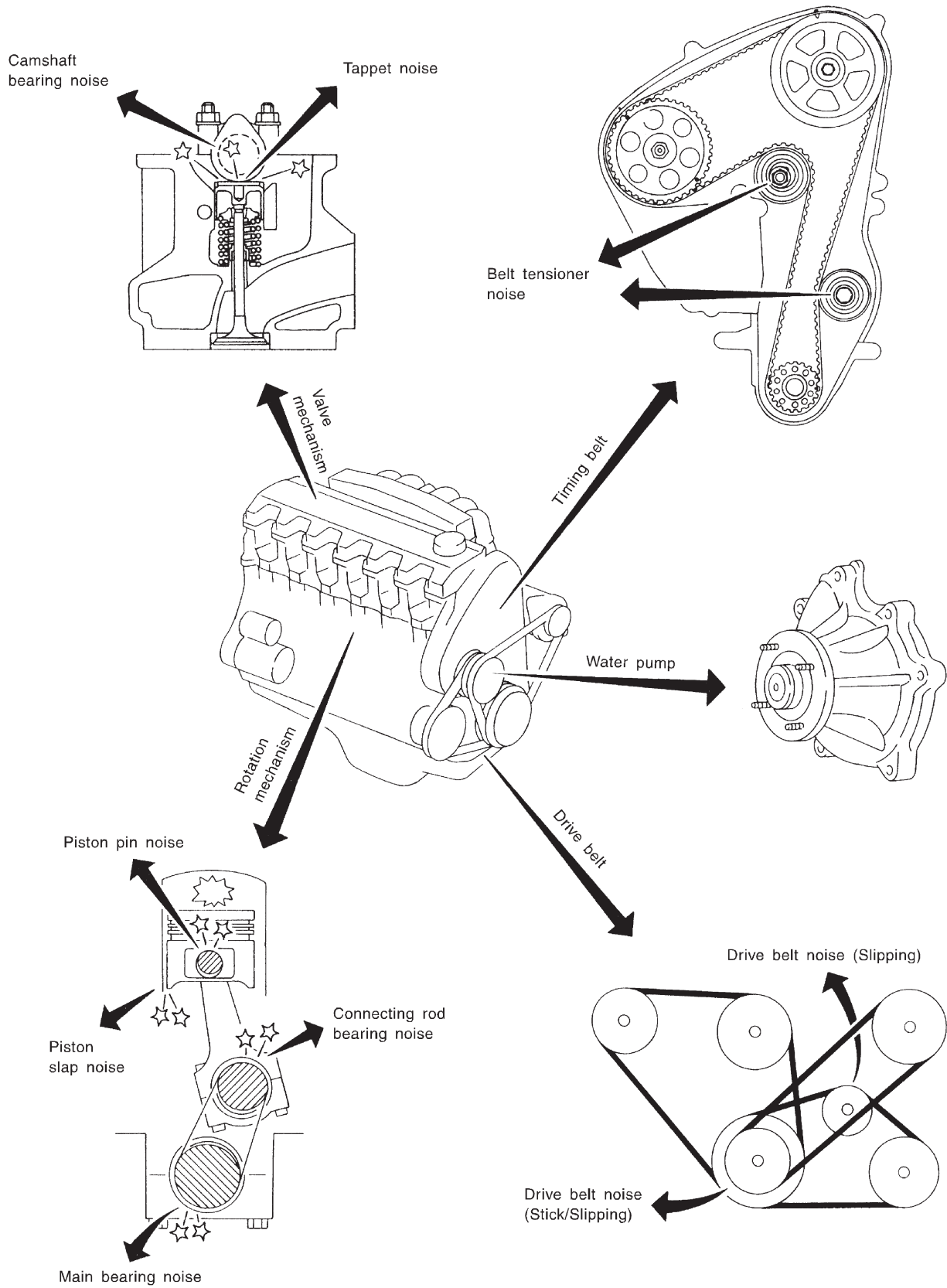
## COMMERCIAL SERVICE TOOLS

Tool name	Description
Valve guide drift  NT015	 <p>Removing and installing valve guide</p> <p><b>Intake &amp; Exhaust</b>  <b>TB and TD engines</b>                      a = 11.5 mm (0.453 in) dia.                      b = 7.6 mm (0.299 in) dia.</p> <p><b>RD engine</b>                      a = 11.5 mm (0.453 in) dia.                      b = 6.5 mm (0.256 in) dia.</p>
Valve guide reamer  NT016	 <p>Reaming valve guide ① or hole for oversize valve guide ②</p> <p><b>Intake &amp; Exhaust</b>  <b>TB engine</b>                      d<sub>1</sub> = 8.0 mm (0.315 in) dia.                      d<sub>2</sub> = 12.2 mm (0.480 in) dia.</p> <p><b>RD engine</b>                      d<sub>1</sub> = 7.000 mm (0.2756 in) dia.                      d<sub>2</sub> = 11.19 mm (0.4406 in) dia.</p> <p><b>TD engine</b>                      d<sub>1</sub> = 8.0 mm (0.315 in) dia.</p>
Valve seat cutter set  NT048	 <p>Finishing valve seat dimensions</p>
Front oil seal drift  NT049	 <p>Installing front oil seal</p> <p><b>TB engine</b>                      a = 80 mm (3.15 in) dia.                      b = 58 mm (2.28 in) dia.</p> <p><b>RD engine</b>                      a = 52 mm (2.05 in) dia.                      b = 41 mm (1.61 in) dia.</p>
Rear oil seal drift  NT049	 <p>Installing rear oil seal</p> <p>a = 100 mm (3.94 in) dia.                      b = 78 mm (3.07 in) dia.</p>
Piston pin drift  NT074	 <p>Removing and installing piston pin</p> <p>a = 22.5 mm (0.886 in) dia.                      b = 12.5 mm (0.492 in) dia.</p>

## PREPARATION

Tool name	Description
Piston ring expander	<p>Removing and installing piston ring</p>  <p>NT030</p>

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING





# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

## NVH Troubleshooting Chart — Engine Noise

Use the chart below to help you find the cause of the problem.

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-41
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-37
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-47, 53
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-48, 49
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-52, 53
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-51
Timing belt cover	Whine or hissing	C	A	—	A	A	—	Timing belt noise (too tight)	Loose timing belt Belt contacting case	EM-18
	Clatter	A	B	—	C	A	—	Timing belt noise (too loose)		
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Other drive belts (Sticking or slipping)	Drive belts deflection	*1
	Creaking	A	B	A	B	A	B	Other drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	*2

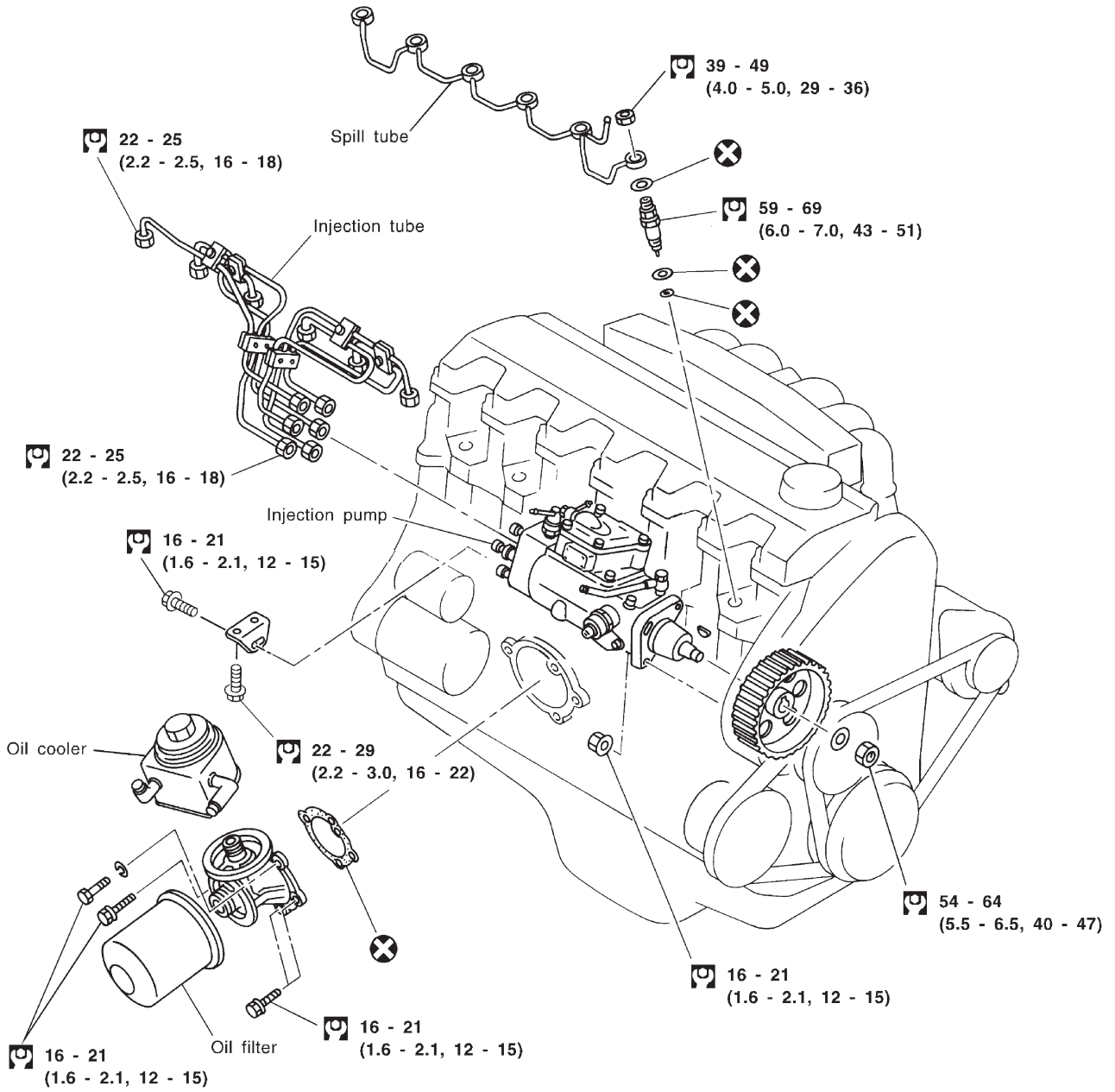
A: Closely related B: Related C: Sometimes related —: Not related


\*1: MA section ("Checking Drive Belts", "ENGINE MAINTENANCE")

\*2: LC section ("Water Pump Inspection", "ENGINE COOLING SYSTEM")

# OUTER COMPONENT PARTS

SEC. 150•185•186•213

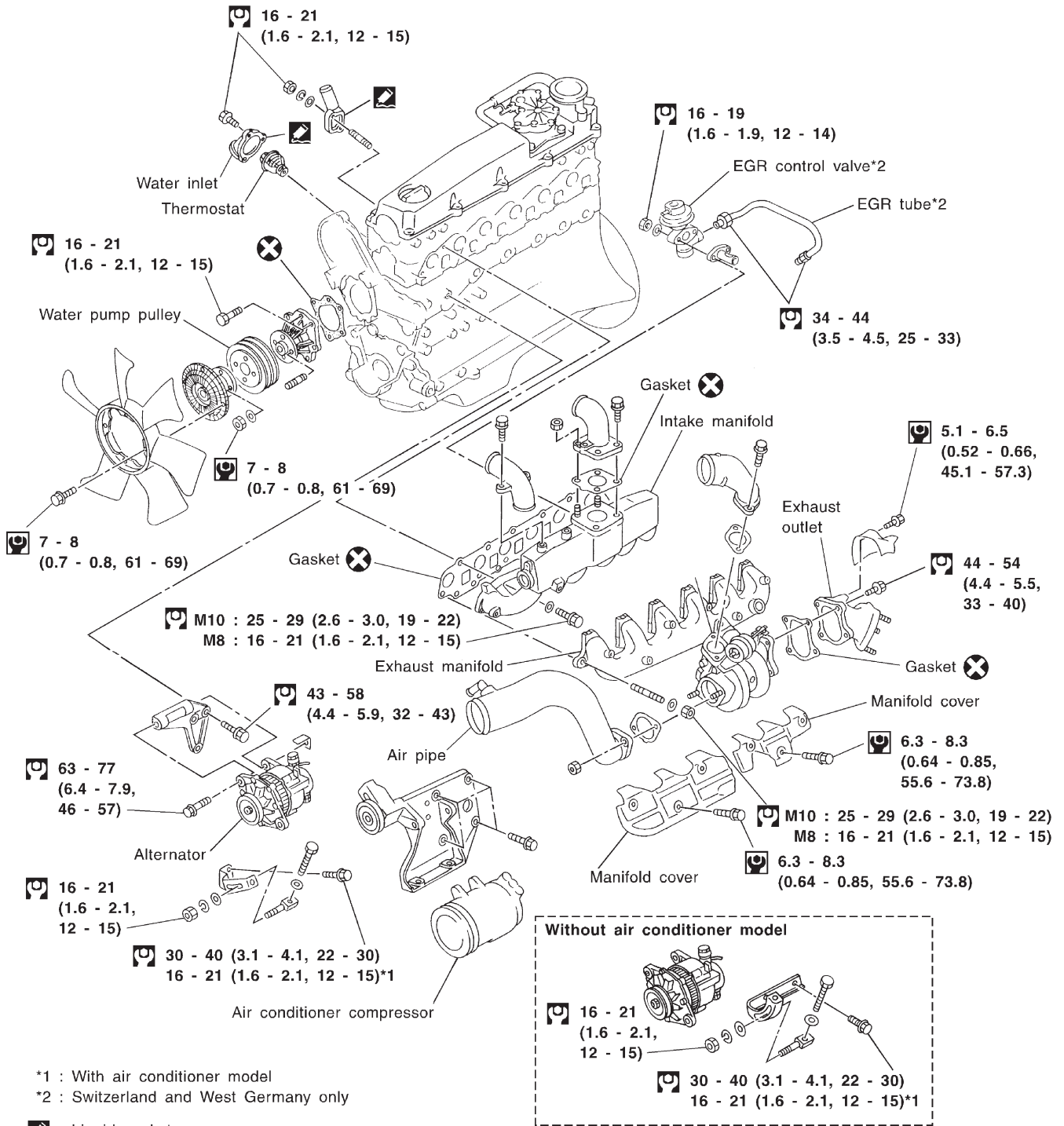


 : N·m (kg-m, ft-lb)

SEM780F

# OUTER COMPONENT PARTS

SEC. 120•144•147•210•211•230

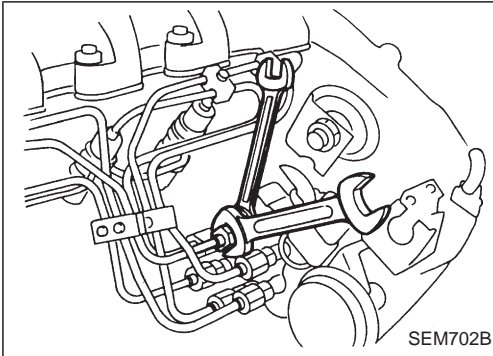


\*1 : With air conditioner model  
\*2 : Switzerland and West Germany only

- : Liquid gasket
- : N·m (kg-m, in-lb)
- : N·m (kg-m, ft-lb)

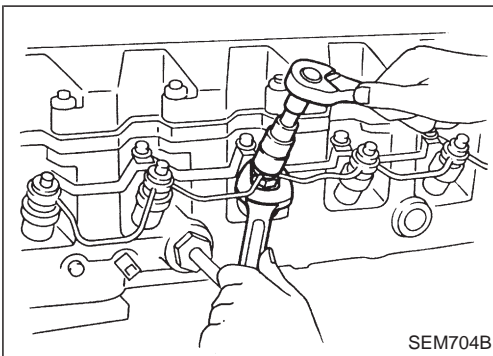
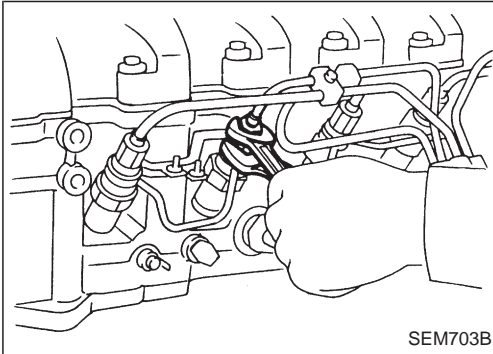
SEM781F

## COMPRESSION PRESSURE

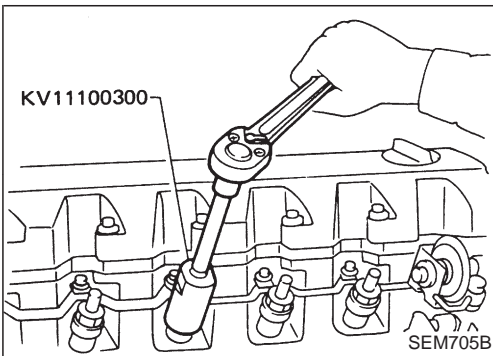


### Measurement of Compression Pressure

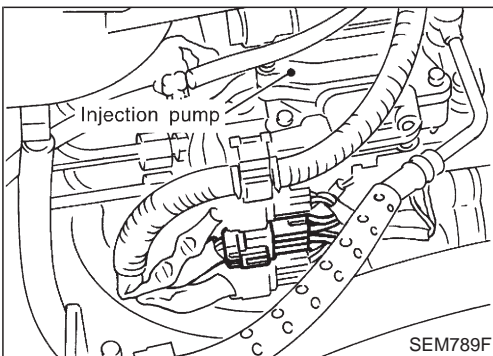
1. Warm up engine sufficiently.
2. Disconnect injection tube on nozzle side and loosen injection tubes on pump side. Release clamps on injection tubes.
  - Use two wrenches to prevent delivery holder on pump side from loosening.



3. Remove spill-tube assembly.
  - To prevent spill tube from breaking, remove it by gripping nozzle holder.



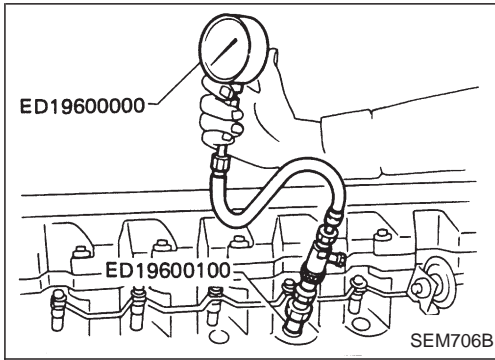
4. Remove all injection nozzles using Tool or a suitable tool.



5. Turn ignition switch OFF and disconnect harness connector (black colored) at injection pump.

## COMPRESSION PRESSURE

### Measurement of Compression Pressure (Cont'd)



6. Fit compression gauge adapter to cylinder head.

7. Crank engine and read gauge indication.

**Crank speed: 200 rpm**

**Compression pressure:**

**Standard**

**3,040 kPa (30.4 bar, 31 kg/cm<sup>2</sup>, 441 psi)**

**Limit**

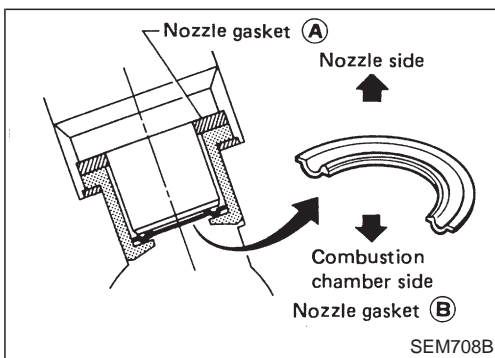
**2,452 kPa (24.5 bar, 25 kg/cm<sup>2</sup>, 356 psi)**

**Differential limit between cylinders**

**490 kPa (4.9 bar, 5 kg/cm<sup>2</sup>, 71 psi)**

8. If the pressure appears low, pour about 3 ml (0.11 Imp fl oz) of engine oil through nozzle holes and repeat test. For indications of test, refer to the following table.

Gauge indication during tests	Trouble diagnosis
<p>First reading</p> <p>Second reading</p> <p>Increased reading</p> <p>SEM857</p>	<ul style="list-style-type: none"> <li>● Piston rings are worn or damaged.</li> </ul>
<p>Same reading maintained</p> <p>SEM858</p>	<ul style="list-style-type: none"> <li>● If two adjacent cylinders are low, gasket is damaged.</li> <li>● Valve is sticking.</li> <li>● Valve seat or valve contact surface is incorrected.</li> </ul>



9. Replace nozzle gaskets and install injection nozzles.

**New nozzle gasket installation direction is as shown.**

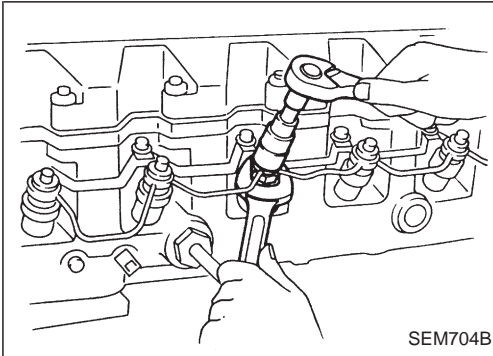
**Nozzle to cylinder head:**

**☞: 59 - 69 N·m**

**(6.0 - 7.0 kg-m, 43 - 51 ft-lb)**


## COMPRESSION PRESSURE

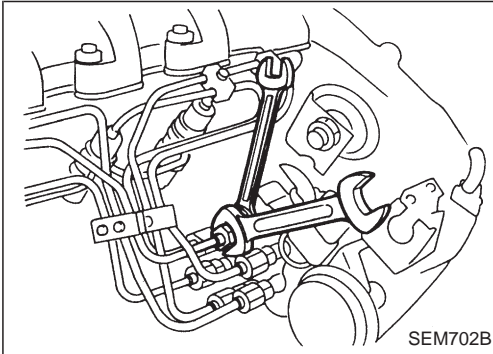
### Measurement of Compression Pressure (Cont'd)



10. Install spill tube by holding nozzle holder.

**Spill tube nut:**

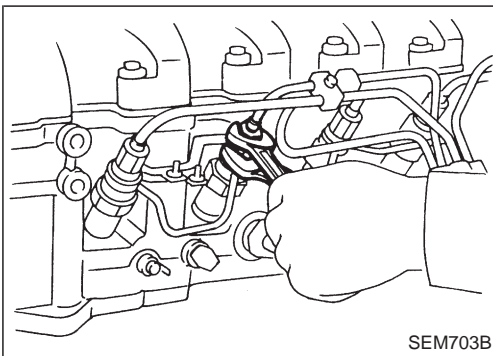
: 39 - 49 N·m  
(4 - 5 kg-m, 29 - 36 ft-lb)



11. Install injection tubes using two wrenches as shown.

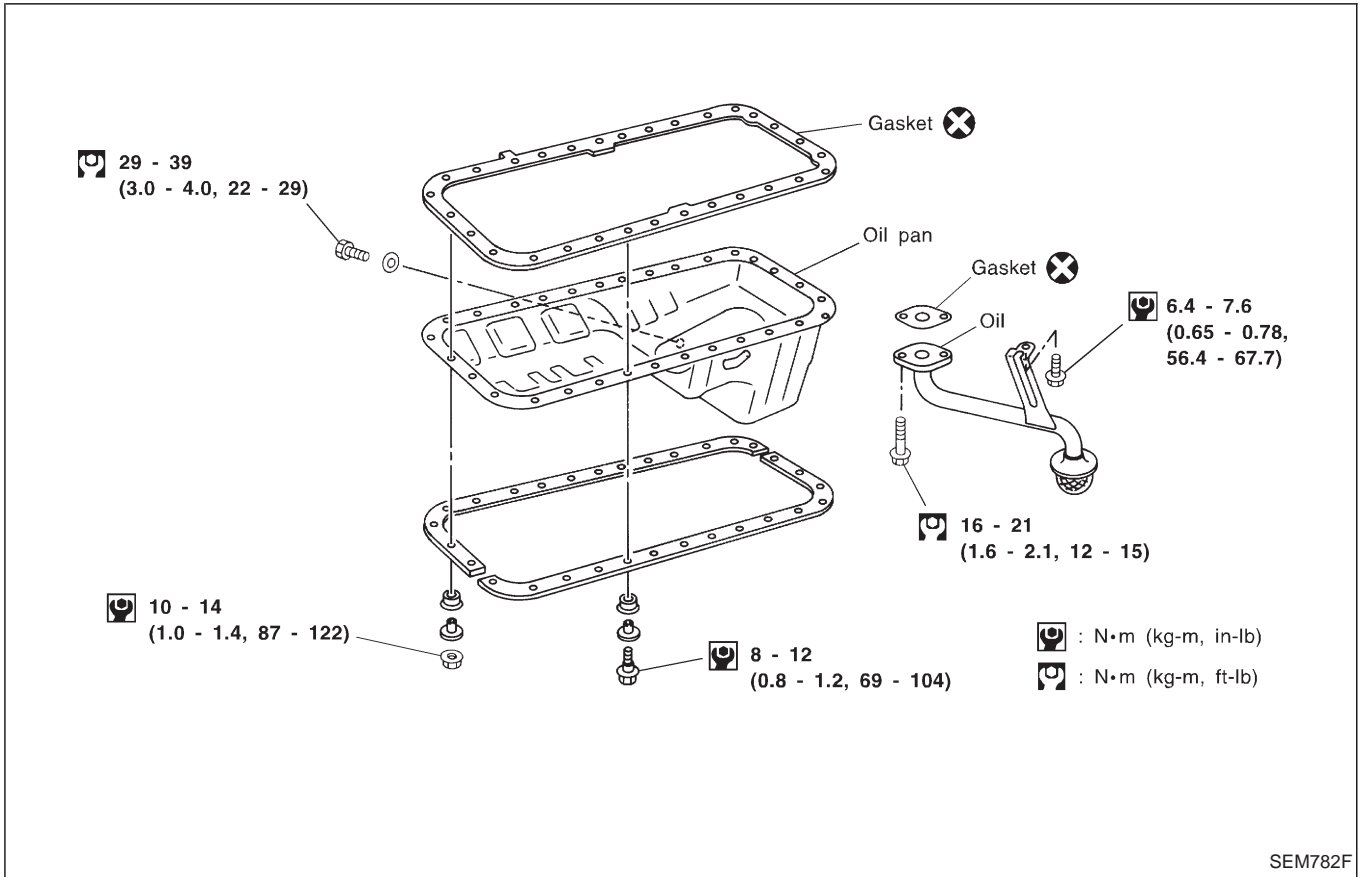
**Injection tube:**

: 22 - 25 N·m  
(2.2 - 2.5 kg-m, 16 - 18 ft-lb)

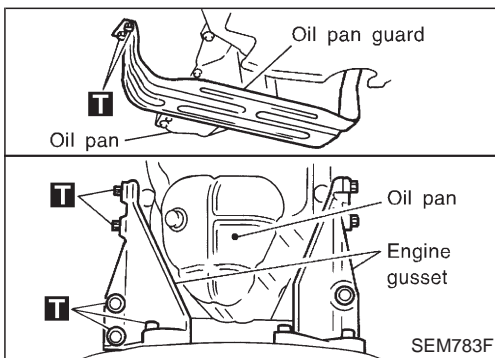


12. Initialize the ECM.  
Refer to EC section ("HOW TO ERASE DTC").

# OIL PAN

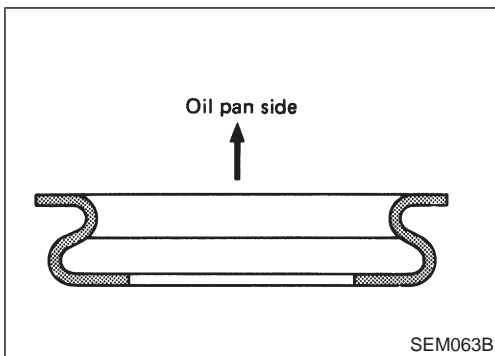


SEM782F



## Removal

1. Remove oil pan guard.



2. Drain engine oil.

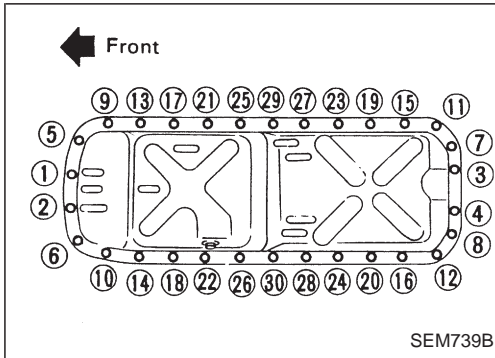
- When installing drain plug washer, ensure it faces in correct direction.
- Discard oil drain plug washer and install a new one.

### Drain plug:

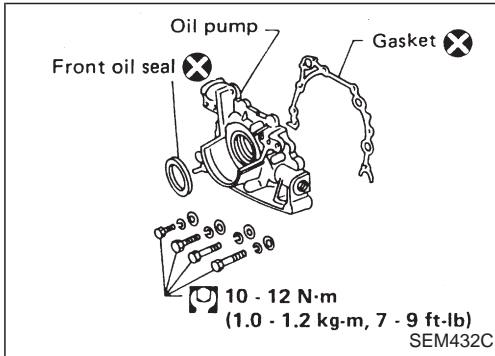
**29 - 39 N·m (3.0 - 4.0 kg-m, 22 - 29 ft-lb)**

# OIL PAN

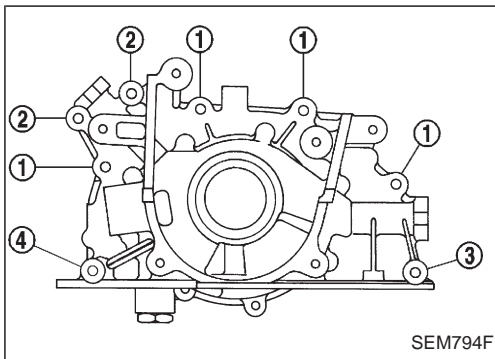
## Removal (Cont'd)



3. Remove engine gussets and oil pan bolts.
  - Remove bolts/nuts in numerical order shown in figure, alternating left and right ones toward the center.



4. Remove oil pump assembly.



## Installation

**Always install with new oil seal.**

1. Install oil pump assembly.

Location	Bolt length mm (in)
①	20 (0.79)
②	35 (1.38)
③	45 (1.77)
④	55 (2.17)

2. Install oil pan. Tighten bolts in the order shown in the figure.
  - **Always replace oil pan gaskets with new ones when reassembling.**
  - **Install oil pan gasket after cleaning the contacting surface.**
  - **Oil pan bolts/nuts:**

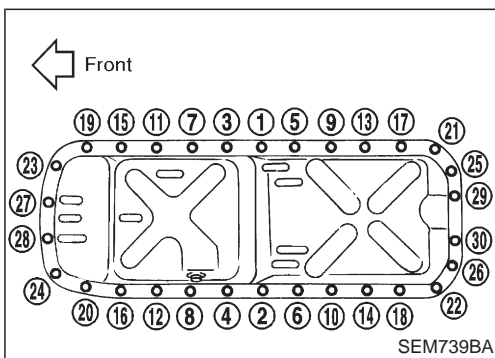
**Bolt**

☐ : 8 - 12 N·m (0.8 - 1.2 kg-m, 69 - 104 in-lb)

**Nut**

☐ : 10 - 14 N·m (1.0 - 1.4 kg-m, 87 - 122 in-lb)

3. Install engine gusset and oil pan guard.

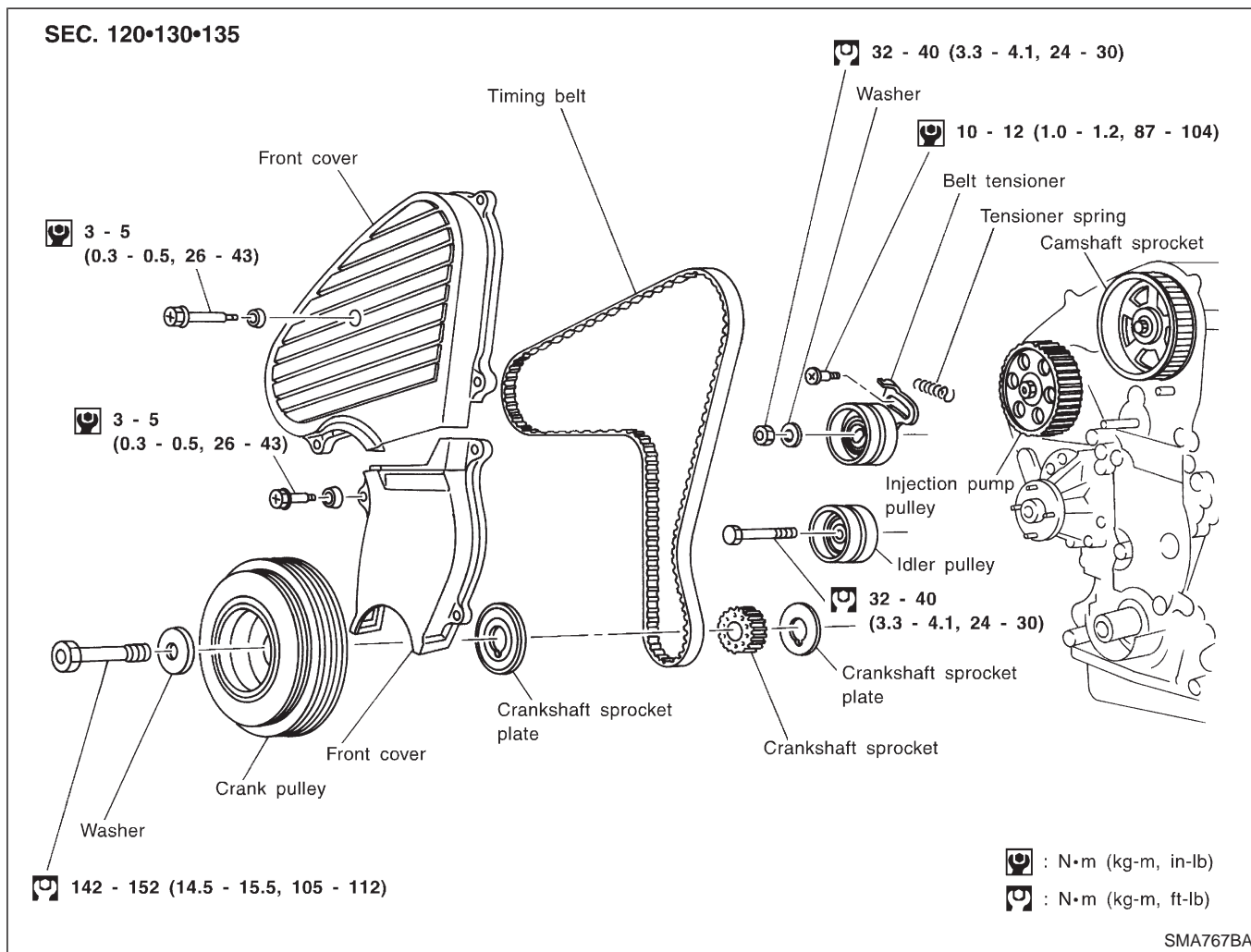




# TIMING BELT

## CAUTION:

- Do not bend or twist timing belt.
- After removing timing belt, do not turn crankshaft and camshaft separately because valves will strike piston heads.
- Make sure that timing belt, camshaft sprocket, crankshaft sprocket, idler pulley, injection pump pulley and belt tensioner are clean and free from oil and water.
- Align white lines on timing belt with punch mark on camshaft sprocket, crankshaft sprocket and injection pump pulley.
- Installation should be carried out when engine is cold.

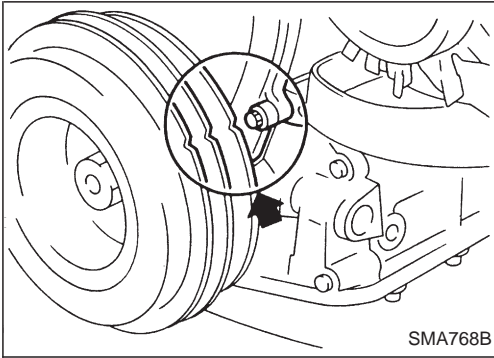


## Removal

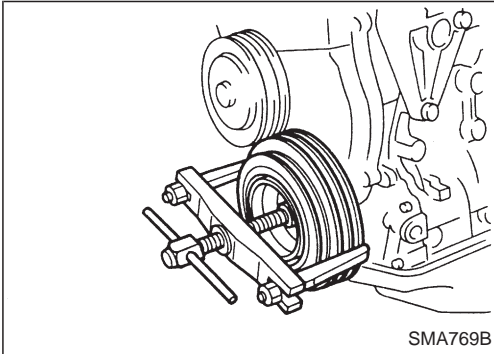
1. Remove radiator shroud.
2. Remove the following belts.
  - Power steering drive belt
  - A/C compressor drive belt
  - Alternator drive belt
3. Remove cooling fan coupling and water pump pulley.

## TIMING BELT

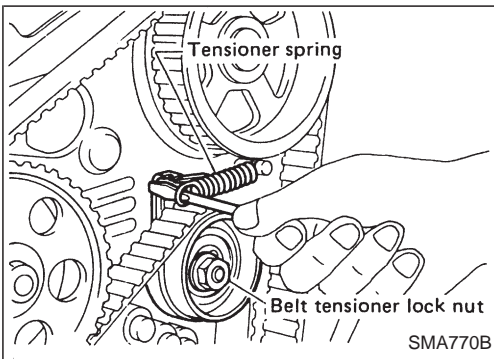
### Removal (Cont'd)



4. Set No. 1 cylinder at bottom dead center (BDC) on its expansion stroke, as shown.



5. Remove the starter motor and wipe off the liquid gasket remaining on the connecting part.
6. Install the ring gear stopper using the bolt holes for fixing the starter motor.
7. Remove crankshaft pulley using puller.  
**Be sure to securely attach puller jaws. Attach jaws only to the rear side of pulley.**
8. Remove front cover.

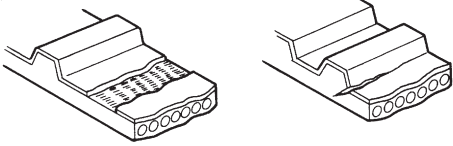
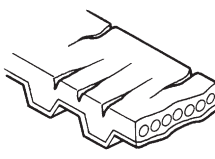
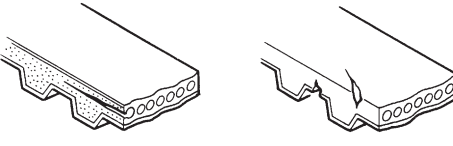
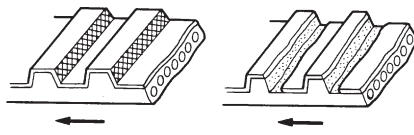


9. Remove tensioner spring and loosen belt tensioner lock nut.
10. Remove timing belt.  
**After removing timing belt, do not turn crankshaft and camshaft separately, because valves will strike piston heads.**

# TIMING BELT

## Inspection

Visually check the condition of timing belt.  
Replace if any abnormality is found.

Item to check	Problem	Cause
Tooth is broken/tooth root is cracked.	 <p style="text-align: right;">SEM394A</p>	<ul style="list-style-type: none"> <li>● Camshaft jamming</li> <li>● Distributor jamming</li> <li>● Damaged camshaft/crankshaft oil seal</li> </ul>
Back surface is cracked/worn.	 <p style="text-align: right;">SEM395A</p>	<ul style="list-style-type: none"> <li>● Tensioner jamming</li> <li>● Overheated engine</li> <li>● Interference with belt cover</li> </ul>
Side surface is worn.	 <ul style="list-style-type: none"> <li>● Belt corners are worn and round.</li> <li>● Wicks are frayed and coming out.</li> </ul> <p style="text-align: right;">SEM396A</p>	<ul style="list-style-type: none"> <li>● Improper installation of belt</li> <li>● Malfunctioning crankshaft pulley plate/timing belt plate</li> </ul>
Teeth are worn.	 <p style="text-align: center;">Rotating direction</p> <ul style="list-style-type: none"> <li>● Canvas on tooth face is worn down.</li> <li>● Canvas on tooth is fluffy, rubber layer is worn down and faded white, or weft is worn down and invisible.</li> </ul> <p style="text-align: right;">SEM397A</p>	<ul style="list-style-type: none"> <li>● Poor belt cover sealing</li> <li>● Coolant leakage at water pump</li> <li>● Camshaft not functioning properly</li> <li>● Distributor not functioning properly</li> <li>● Excessive belt tension</li> </ul>
Oil/Coolant or water is stuck to belt.	—	<ul style="list-style-type: none"> <li>● Poor oil sealing of each oil seal</li> <li>● Coolant leakage at water pump</li> <li>● Poor belt cover sealing</li> </ul>

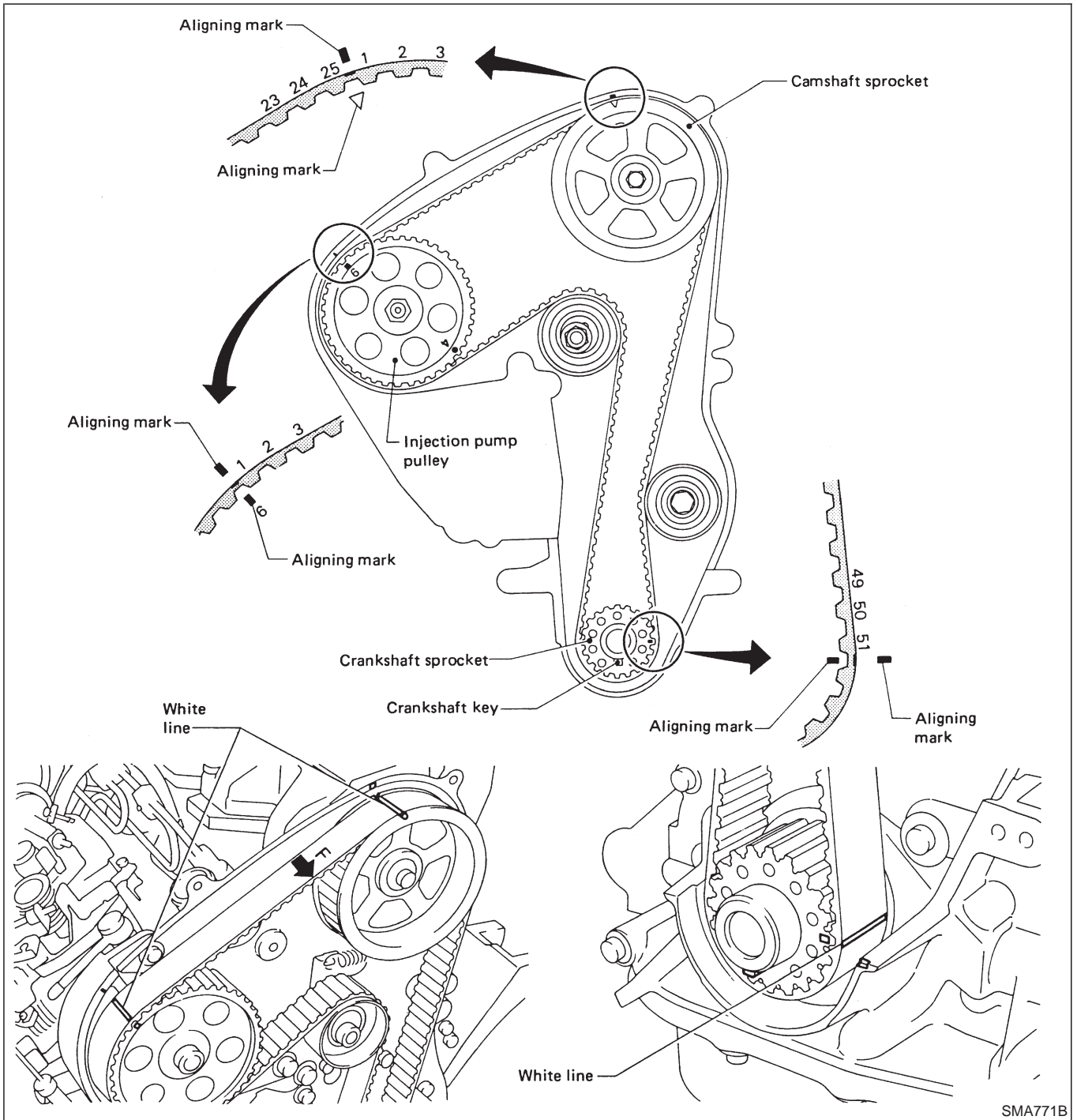
# TIMING BELT

## Installation

1. Confirm that No. 1 cylinder is set at BDC on its expansion stroke as follows:

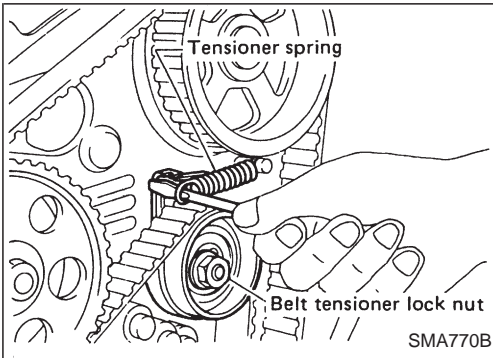
**Confirm that crankshaft key is at the bottom.**

2. Set timing belt.
  - a. **Ensure timing belt, sprockets and pulleys are clean and free from oil or water. Do not bend or twist timing belt too much.**
  - b. **Align white lines on timing belt with matching mark on camshaft sprocket, crankshaft sprocket and injection pump pulley.**
  - c. **Point arrow on timing belt toward front.**



## TIMING BELT

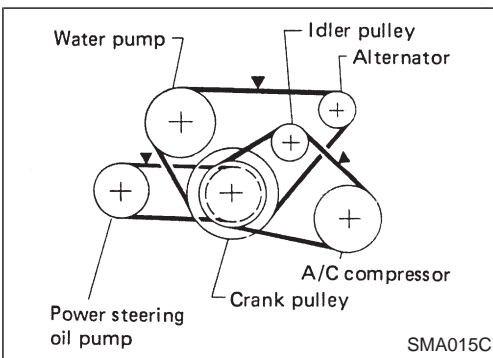
### Installation (Cont'd)



3. Install tensioner spring and tighten belt tensioner lock nut.  
⚙️: **32 - 40 N·m**  
**(3.3 - 4.1 kg-m, 24 - 30 ft-lb)**

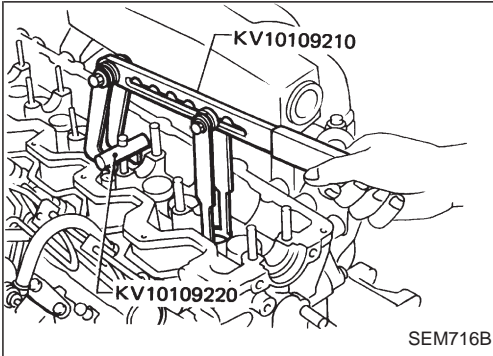
4. Install front cover.
5. Install crankshaft pulley.
6. Install water pump pulley and cooling fan coupling.
7. Apply liquid gasket to the connecting surface and install the starter motor.

**Use Genuine Liquid Gasket or equivalent.**



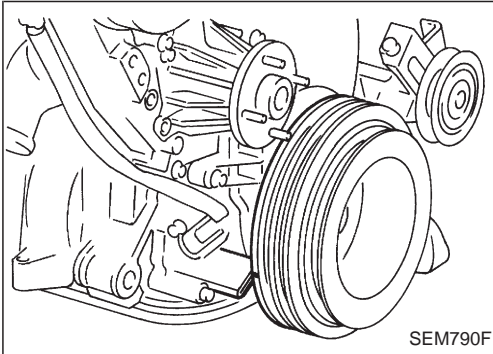
8. Install drive belts and check drive belt deflections by pushing midway between pulleys.  
Refer to MA section ("Checking Drive Belts").

# OIL SEAL REPLACEMENT



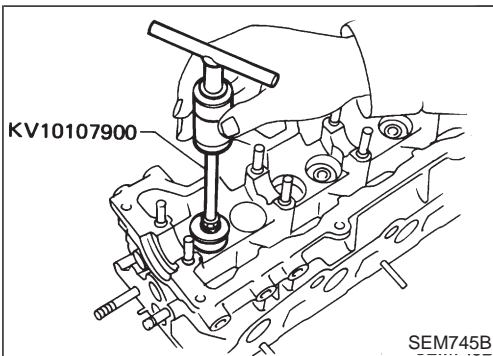
## VALVE OIL SEAL

1. Remove timing belts.
2. Remove camshaft sprocket and back covers.
3. Remove camshaft brackets by loosening bracket nuts from center to outside in two or three stages.
4. Remove camshaft oil seals and camshaft.

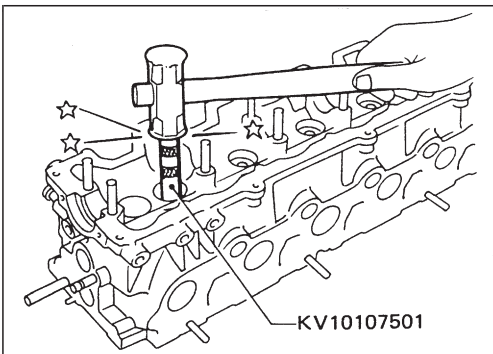


5. Remove valve lifters and mark order No. on each lifter.
6. Replace valve oil seal according to the following procedure.  
**When replacing valve oil seal, set the corresponding piston at TDC. Failure to do so causes the valve to drop into the cylinder.**

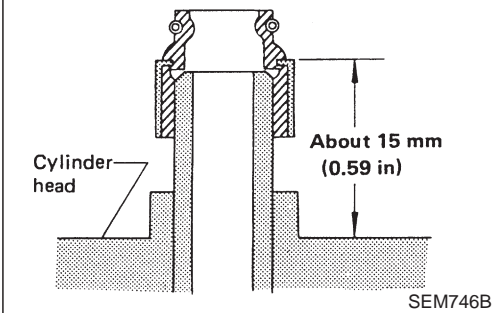
- 1) Set No. 1 cylinder at TDC.



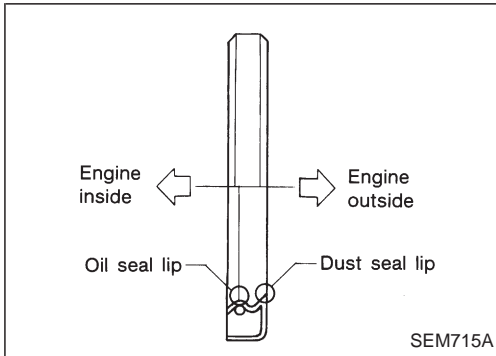
- 2) Remove valve springs and valve oil seals for No. 1 and No. 6 cylinders. Valve spring seats should not be removed.



- 3) Install new valve oil seals for No. 1 and No. 6 cylinders as illustrated. Reinstall valve springs. (narrow pitch side toward cylinder head)
- 4) Install valve spring retainers on intake valves and valve rotators on exhaust valves, and remount valve assembly.
- 5) Set No. 2 cylinder at TDC.
- 6) Replace valve oil seals for No. 2 and No. 5 cylinders according to steps 2) and 3).
- 7) Set No. 3 cylinder at TDC.
- 8) Replace valve oil seals for No. 3 and No. 4 cylinders according to steps 2) and 3).
- 9) Install valve lifters in original positions.

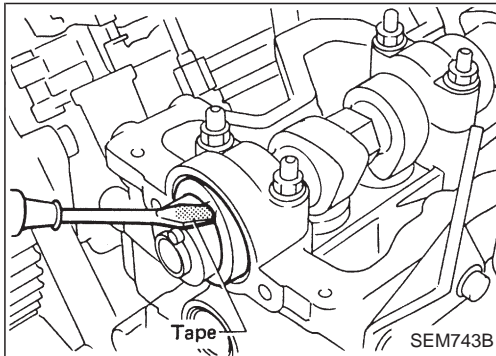


# OIL SEAL REPLACEMENT



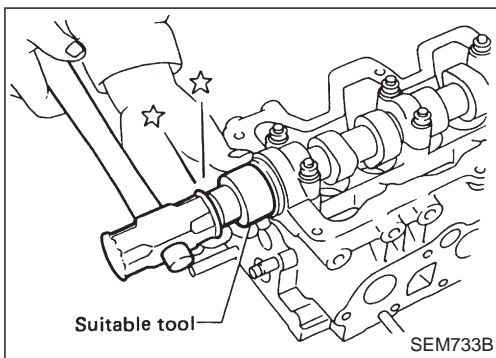
## CAMSHAFT AND CRANKSHAFT OIL SEAL INSTALLING DIRECTION AND MANNER

- When installing camshaft and crankshaft oil seals, be careful to install them correctly, as shown in the figure.
- Apply engine oil to oil seal lip, outer face, camshaft and bracket.
- Wipe off excess oil after installing oil seal.

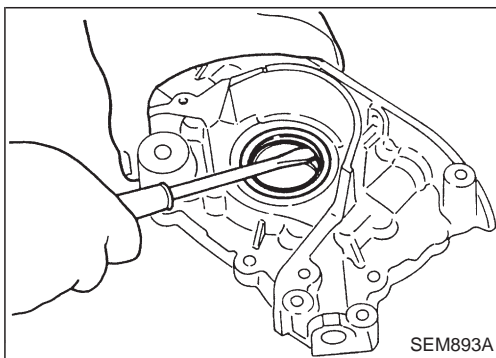


## CAMSHAFT OIL SEALS

1. Remove timing belts, sprockets and back covers.
2. Pull out oil seal with a suitable tool.

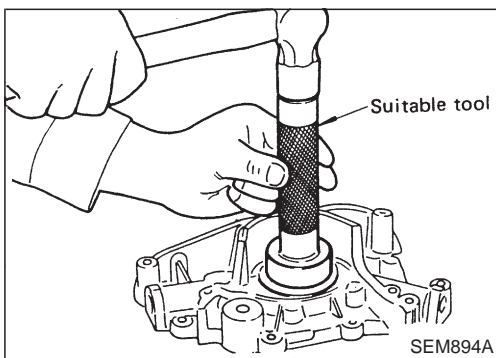


3. Install new oil seals with a suitable tool.



## CRANKSHAFT FRONT OIL SEAL

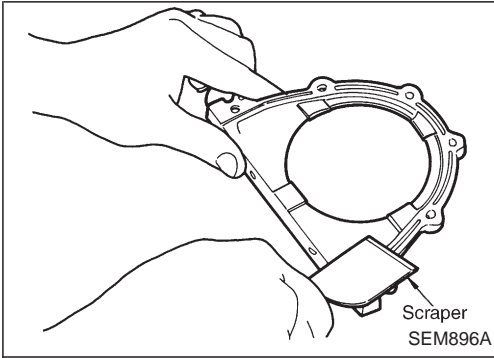
1. Remove valve timing belt and crankshaft sprocket.
2. Remove oil pan and oil pan gasket.
3. Remove oil pump assembly.
4. Remove front oil seal with a suitable tool.



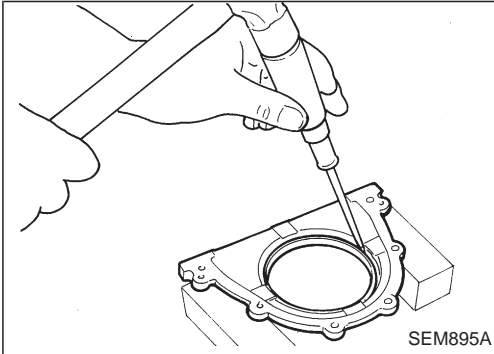
5. Apply engine oil to new oil seal and install oil seal using a suitable tool.

# OIL SEAL REPLACEMENT

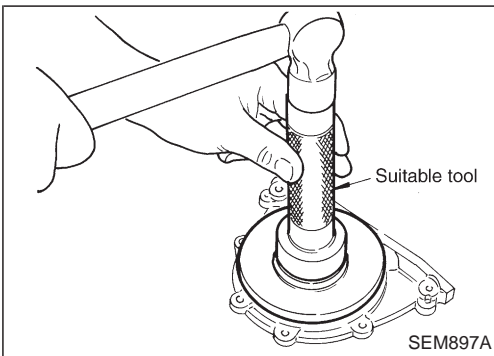
## CRANKSHAFT REAR OIL SEAL



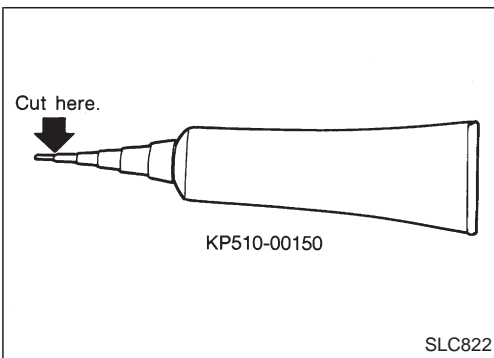
1. Remove transmission assembly. (Refer to "REMOVAL AND INSTALLATION" in MT section.)
2. Remove clutch cover assembly.
3. Remove flywheel and rear plate.
4. Remove oil pan and oil pan gasket.
5. Remove oil seal retainer assembly.
6. Remove traces of liquid gasket using a scraper.



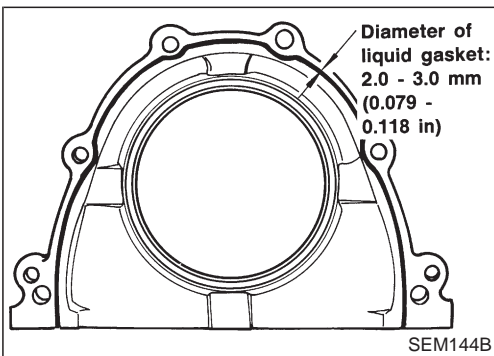
7. Remove rear oil seal from retainer.



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



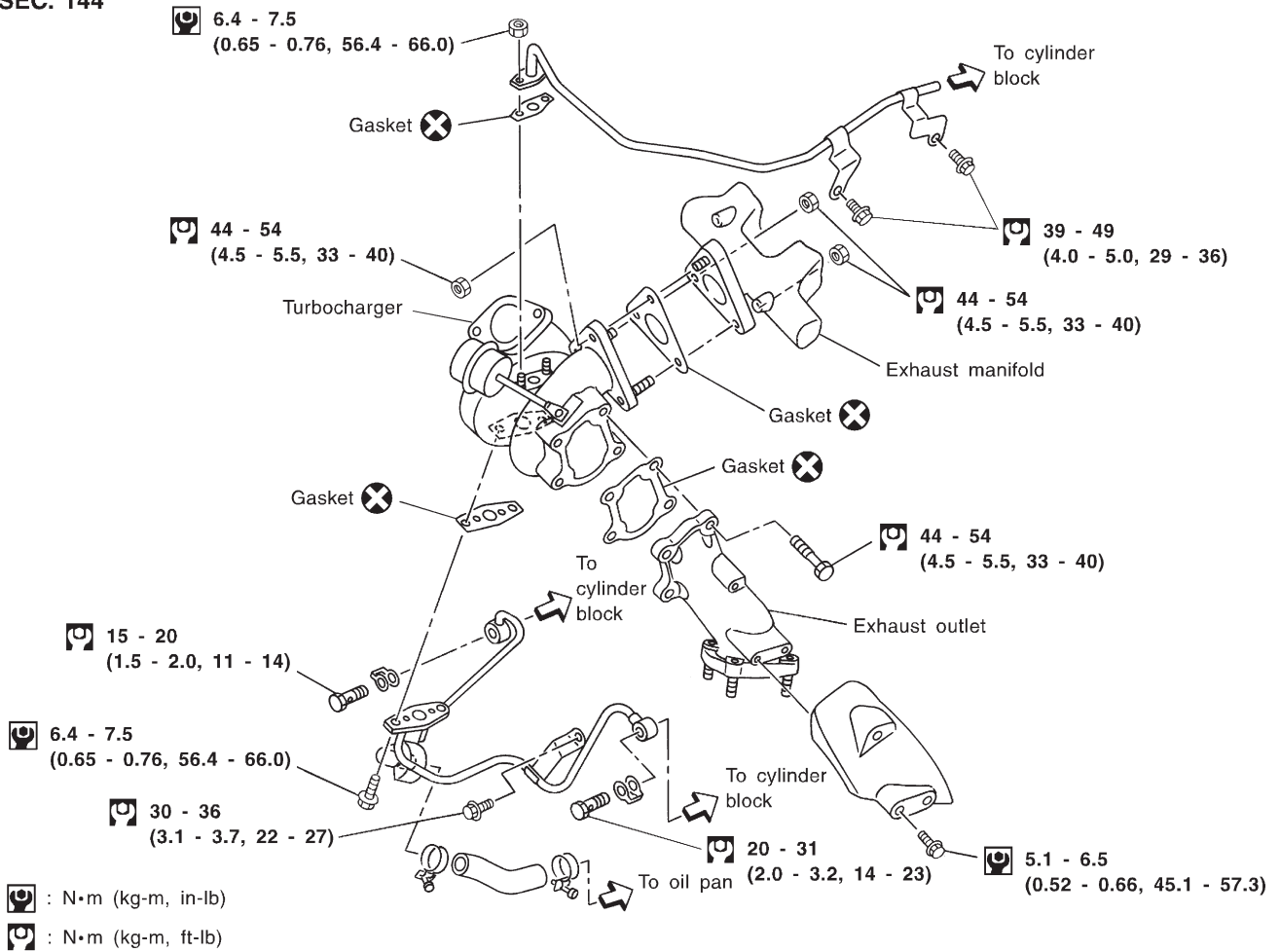
9. Apply a continuous bead of liquid gasket to rear oil seal retainer.
  - a. Coat of liquid gasket should be maintained within 2.0 to 3.0 mm (0.079 to 0.118 in) dia. range.
  - b. Attach oil seal retainer to cylinder block within five minutes after coating.
  - c. Wait at least 30 minutes before refilling engine oil or starting engine.
  - d. Use Genuine Liquid Gasket or equivalent.





# TURBOCHARGER

SEC. 144



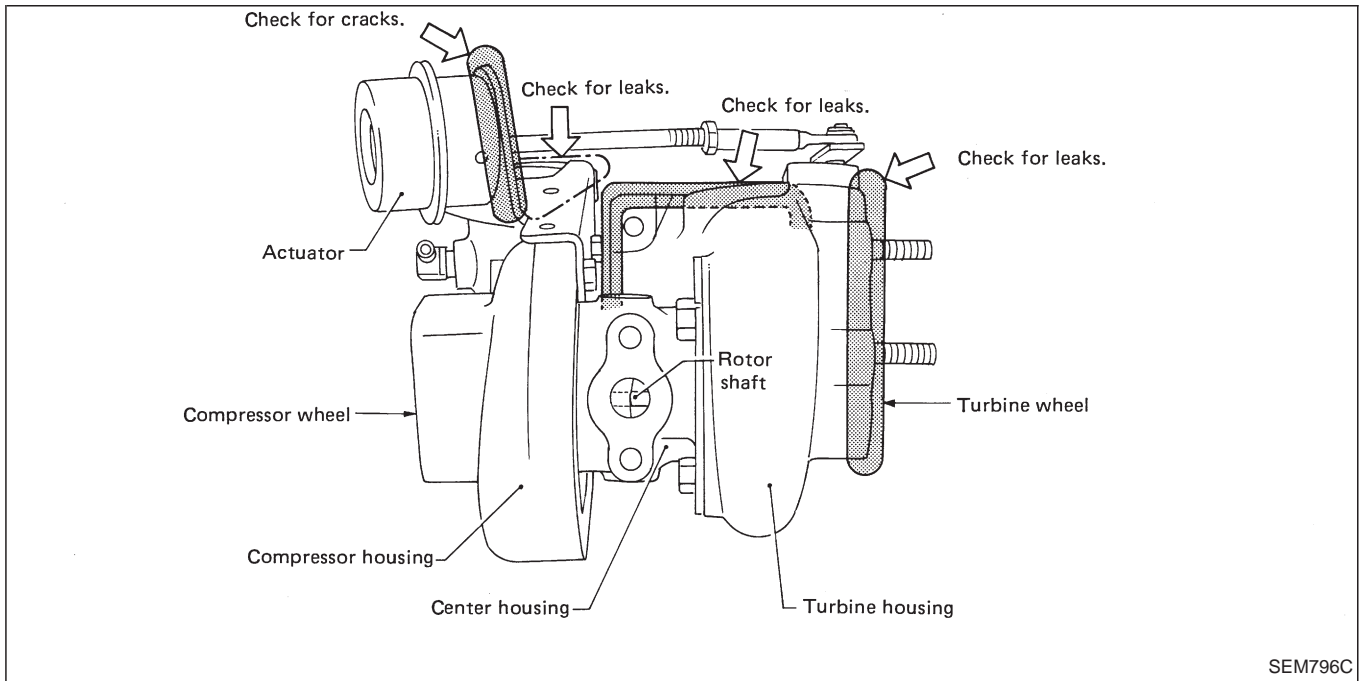
SEM784F

## Removal and Installation

1. Drain engine coolant.
2. Remove the following:
  - Air duct and hoses
  - Air intake pipe
  - EGR pipe
  - Heat shield plates
  - Intake manifold
  - Front (exhaust) tube
  - Oil tube and water tube
3. Remove exhaust manifold with turbocharger from cylinder head.
4. When installing turbocharger to exhaust manifold, securely tighten nuts and lock the nuts.
  - **Turbocharger should not be disassembled.**

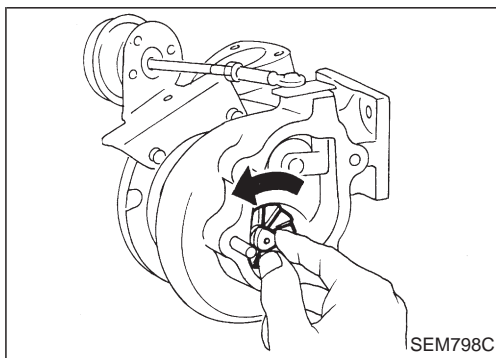
# TURBOCHARGER

## Inspection



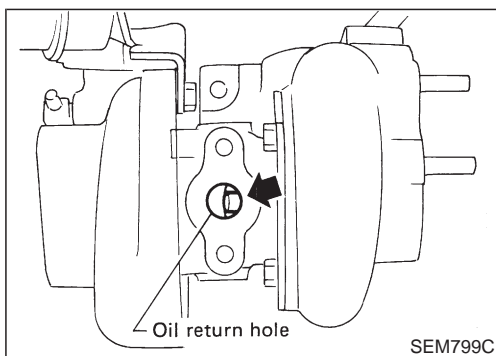
## OIL AND WATER TUBES

Check tubes for clogging.



## ROTOR SHAFT

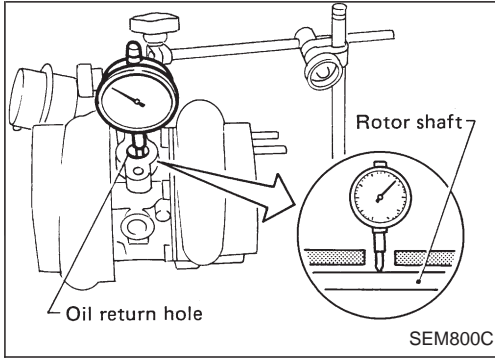
1. Check rotor shaft for smooth rotating.



2. Check rotor shaft for carbon deposits.

# TURBOCHARGER

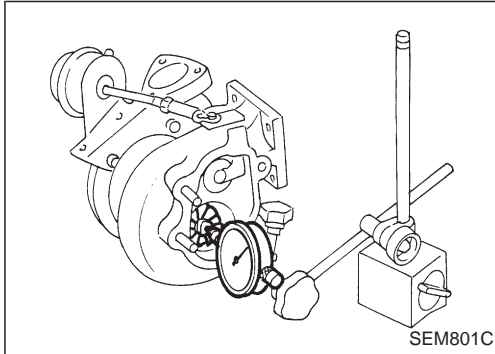
## Inspection (Cont'd)



3. Measure runout of rotor shaft.

**Runout (Total indicator reading):**

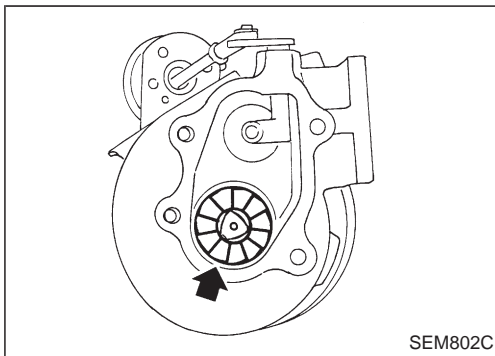
**0.056 - 0.127 mm (0.0022 - 0.0050 in)**



4. Measure end play of rotor shaft.

**End play:**

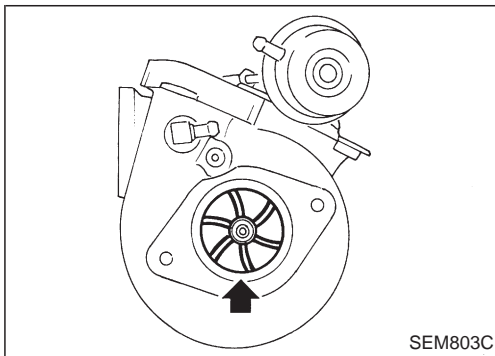
**0.013 - 0.097 mm (0.0005 - 0.0038 in)**



## TURBINE WHEEL

Check turbine wheel for the following:

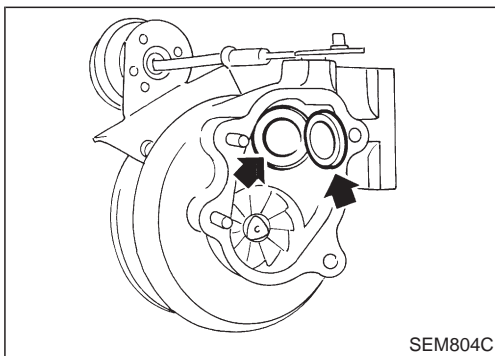
- Oil
- Carbon deposits
- Deformed fins
- Contact with turbine housing



## COMPRESSOR WHEEL

Check compressor wheel for the following:

- Oil
- Deformed fins
- Contact with compressor housing



## WASTEGATE VALVE

Remove rod pin and check wastegate valve for cracks, deformation and smooth movement.

Check valve seat surface for smoothness.

## TURBOCHARGER

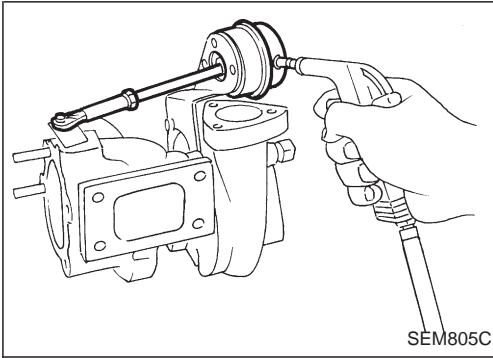
---

### Inspection (Cont'd)

#### WASTEGATE VALVE ACTUATOR

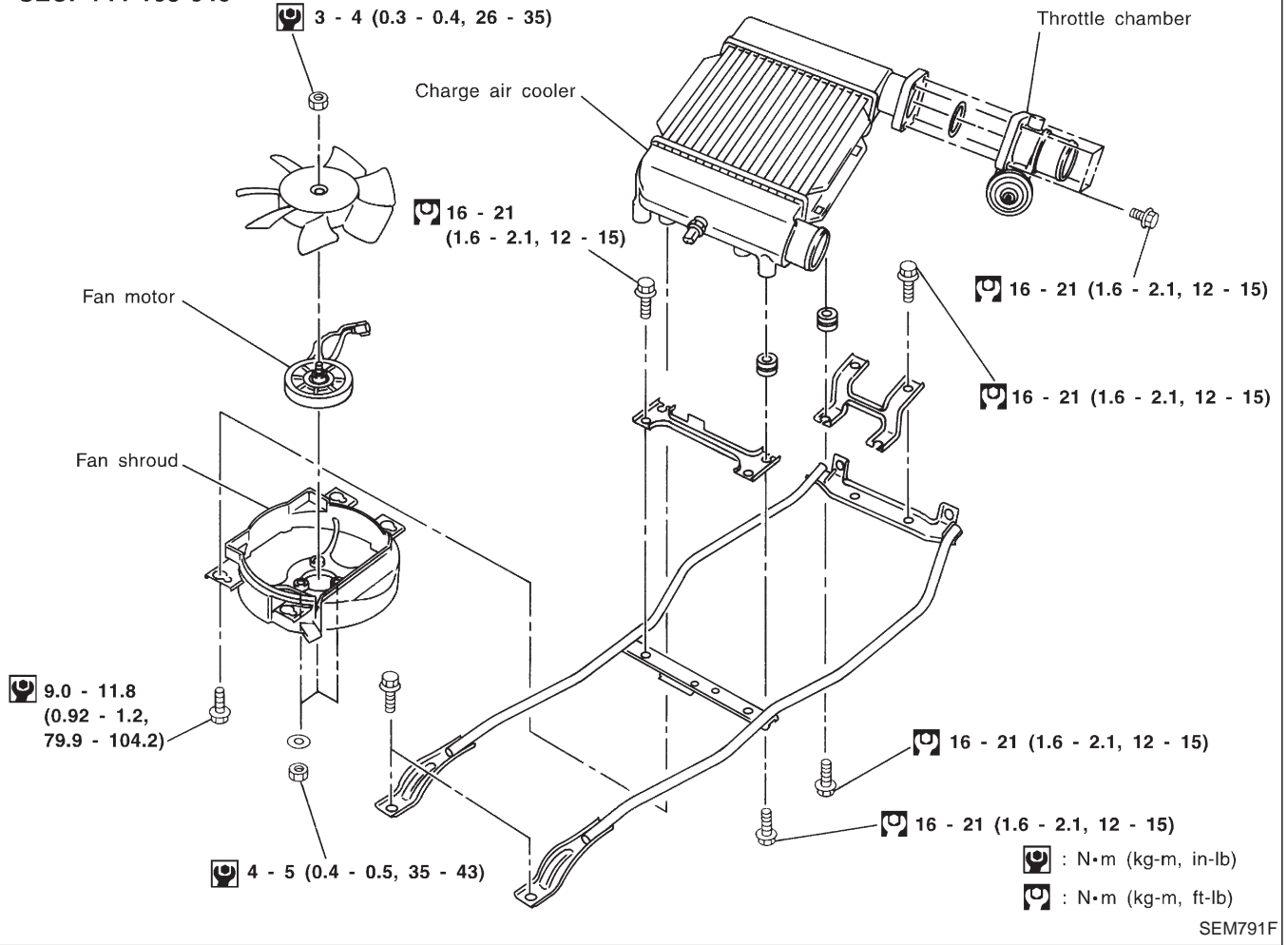
Apply air pressure to wastegate valve actuator and check it for smooth movement.

- Do not keep applying air pressure to the actuator.
- The air pressure should be in the range of 108 to 118 kPa (1.08 to 1.18 bar, 1.1 to 1.2 kg/cm<sup>2</sup>, 16 to 17 psi).



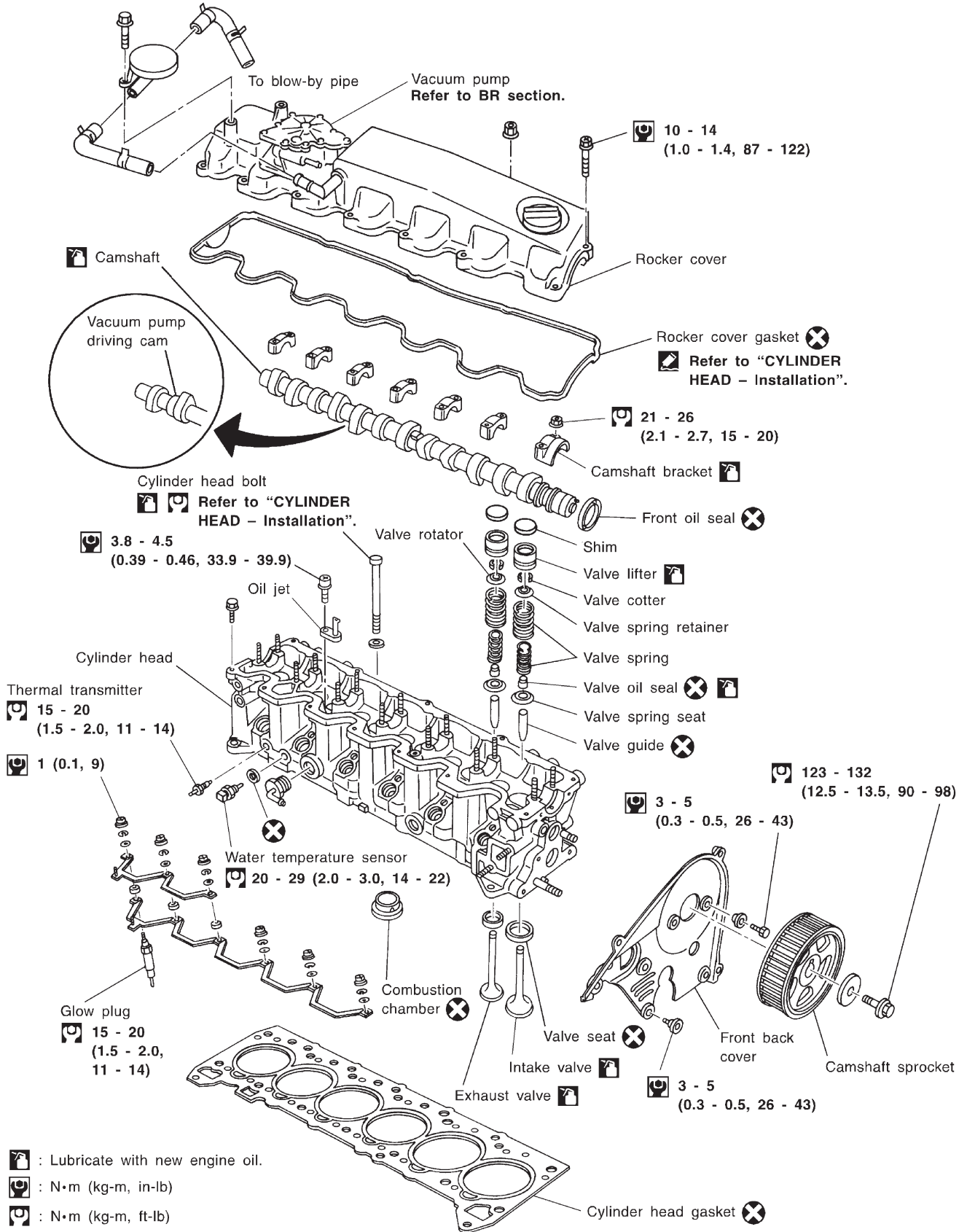
# CHARGE AIR COOLERS

SEC. 144•163•640



# CYLINDER HEAD

SEC. 111•118•130•135•210•252



SEM785F

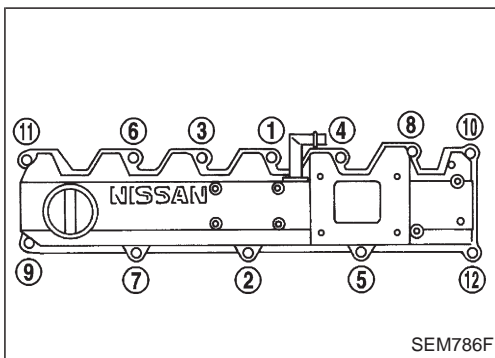
## CYLINDER HEAD

### CAUTION:

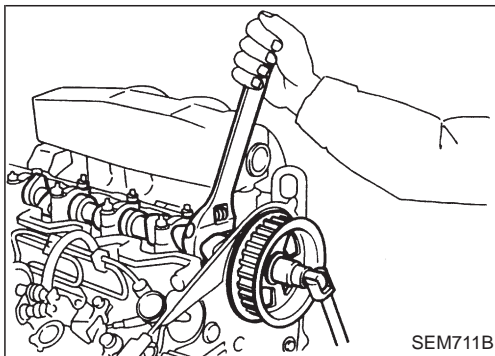
- When installing sliding parts such as camshaft and oil seal, be sure to apply new engine oil on their sliding surfaces.
- When tightening cylinder head bolts, apply new engine oil to thread portions and seat surfaces of bolts.

### Removal

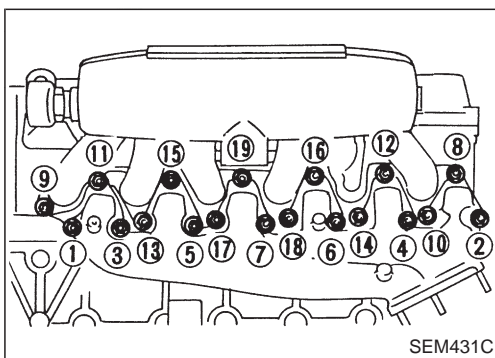
1. Remove charge air cooler assembly.
2. Set No. 1 cylinder at BDC on its expansion stroke.
3. Drain engine coolant from drain plugs on cylinder block and radiator.
4. Remove air cleaner and/or air duct.
5. Remove timing belt.



6. Remove rocker cover securing bolts/nuts in numerical order shown in figure.  
To install rocker cover, tighten bolts/nuts in reverse order of removal. Tighten in two or three stages.



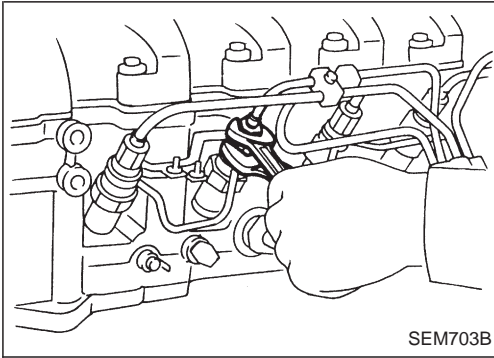
7. Remove camshaft sprocket, injection pump drive sprocket and back cover.
8. Disconnect exhaust manifold from exhaust tube.



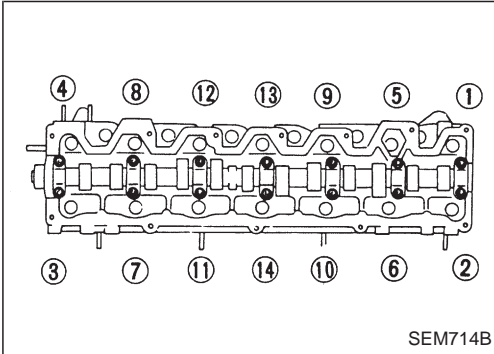
9. Remove intake and exhaust manifold.  
To install manifolds, tighten bolts/nuts in reverse order of removal. Tighten in two or three stages.

## CYLINDER HEAD

### Removal (Cont'd)

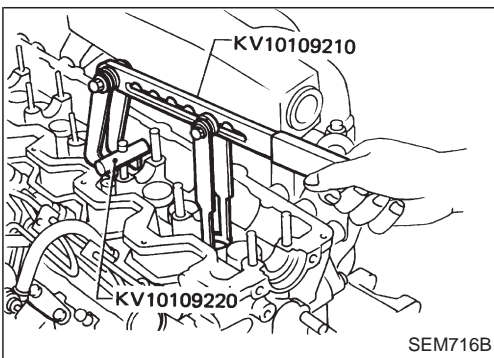


10. Remove fuel injection tube assembly and spill tube.
11. Remove cylinder head bolts in numerical order and remove cylinder head.



### Disassembly

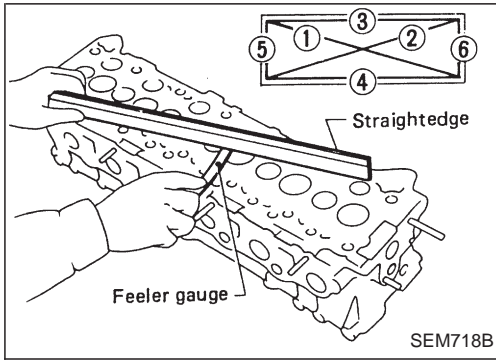
1. Remove following parts:
  - a. Thermostat housing
  - b. Engine slinger
  - c. Glow plate and glow plugs
2. Remove camshaft bracket securing nuts in numerical order shown in figure in two or three stages.  
To install camshaft bracket caps, tighten nuts in reverse order of removal. Tighten in two or three stages.
3. Remove camshaft and oil seal.
4. Remove valve lifters.



5. Remove valve component parts with tool.



# CYLINDER HEAD



## Inspection

### CYLINDER HEAD DISTORTION

Warpage of surface:

Less than 0.1 mm (0.004 in)

If beyond the specified limit, replace it or resurface it.

Resurfacing limit:

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

Amount of cylinder head resurfacing is "A".

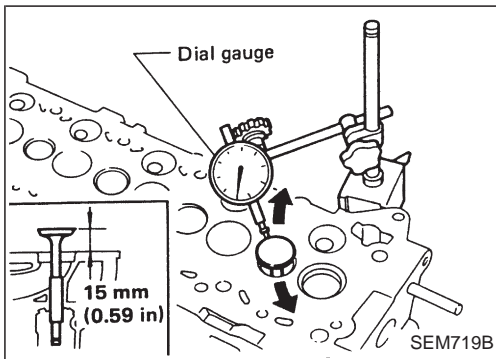
Amount of cylinder block resurfacing is "B".

The maximum limit is as follows:

$A + B = 0.1 \text{ mm (0.004 in)}$

Nominal cylinder head height:

139.9 - 140.1 mm (5.508 - 5.516 in)



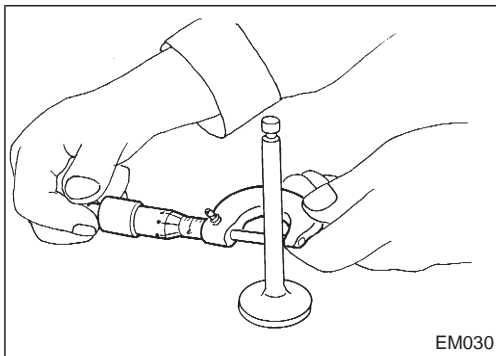
### VALVE GUIDE CLEARANCE

1. Insert the valve stem into the valve guide and move it back, forth and slide it.  
If valve stem makes a clatter and moves back and forth excessively out of line, or if it does not slide well, replace valve or valve guide, or both.
2. Install valve stem into the valve guide.
3. Measure the deflection.

Stem to guide deflection limit:

0.1 mm (0.004 in)

(Half of dial gauge reading)

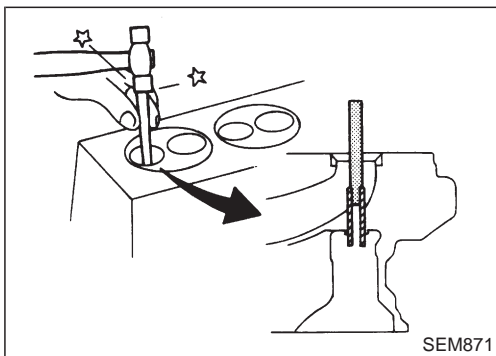


4. If it exceeds the limit, check valve to valve guide clearance.  
(1) Measure valve stem diameter and guide inner diameter.  
(2) Check that clearance is within the specification.

Valve to valve guide clearance limit:

0.1 mm (0.004 in)

- (3) If it exceeds the limit, replace valve or valve guide.

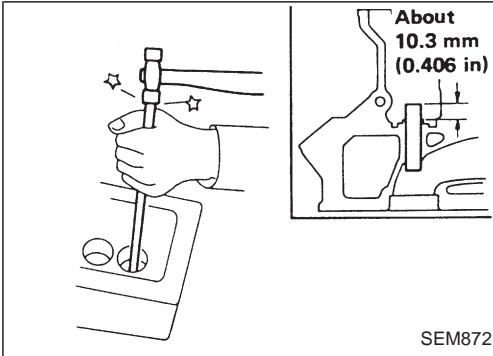


### VALVE GUIDE REPLACEMENT

1. Heat cylinder head 150 to 160°C (302 to 320°F) in oil.
2. Remove the guide with suitable tool.

## CYLINDER HEAD

### Inspection (Cont'd)



3. Drive in the new guide until it projects out 10.3 mm (0.406 in).
4. Ream the bore using suitable tool.

#### Reaming bore:

7.000 - 7.018 mm (0.2756 - 0.2763 in)

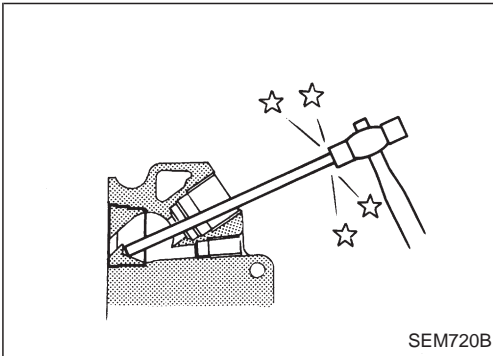
### COMBUSTION CHAMBER REPLACEMENT

Usually combustion chamber should not be removed.

However, if there are cracks or extensive damage, it should be replaced.

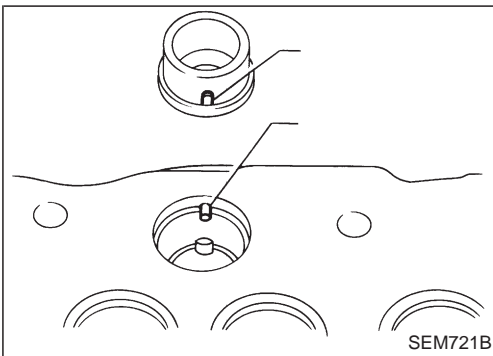
1. Remove glow plug connecting plate, glow plugs and injection nozzle.
2. Remove combustion chamber so that cylinder head will not be damaged.

**Be careful not to scratch inside of nozzle hole.**



3. Install combustion chamber.

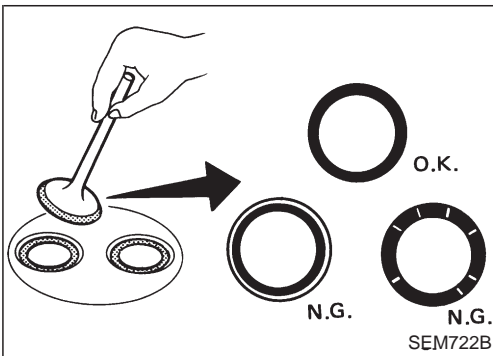
- (1) Heat cylinder head 150 to 160°C (302 to 320°F) in oil.
- (2) Align combustion chamber knock pin with cylinder head notch, and install it into cylinder head using a plastic-tip hammer.



### VALVE SEATS

1. Check valve and valve seat for contact.

Coat the valve face with prussian red lead. If contact is wrong, correct valve seat. If the valve red lead appears 360° around face, the valve stem and face are concentric. If not, repair or replace valve.

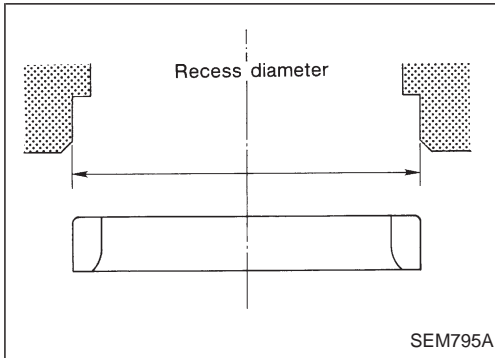


2. Check valve seats for any evidence of pitting on valve contact surface, and reseat or replace if worn out excessively. Correct valve seat surface.
  - **When repairing valve seat, check valve and valve guide for wear beforehand. If worn, replace them. Then correct valve seat.**
  - **Cut with both hands to uniform the cutting surface.**

## CYLINDER HEAD

### Inspection (Cont'd)

#### VALVE SEAT REPLACEMENT



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 the cylinder head recess.

**Reaming bore for service valve seat**

**[Oversize 0.5 mm (0.020 in)]:**

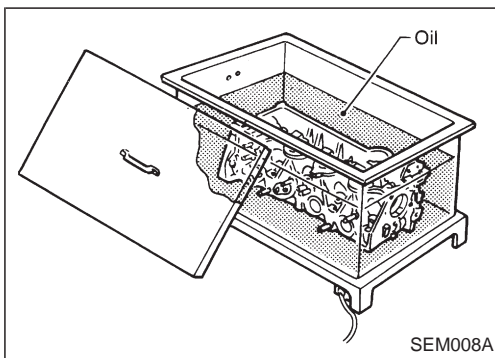
**Intake**

**40.954 - 40.932 mm (1.6124 - 1.6115 in)**

**Exhaust**

**34.954 - 34.932 mm (1.3761 - 1.3753 in)**

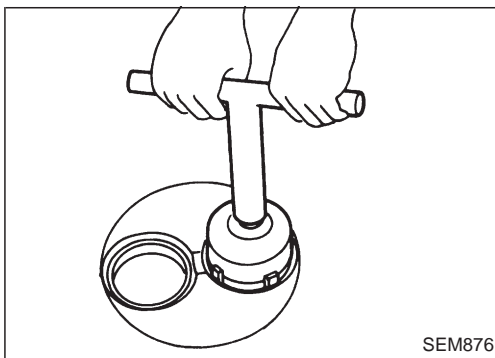
Reaming should be done to the concentric circles around the valve guide center so that valve seat will have the correct fit.



3. Heat cylinder head to a temperature of 150 to 160°C (302 to 320°F) and press fit seat until it seats on the bottom.

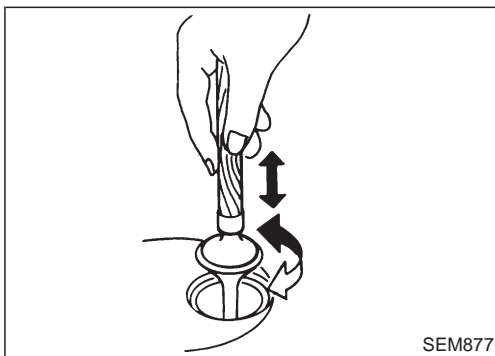
4. Install valve seat.

**When replacing valve seat, valve should also be replaced.**



5. Cut or grind valve seat using suitable tool at the specified dimensions as shown in SDS.

**The cutting should be done with both hands for uniform cutting.**

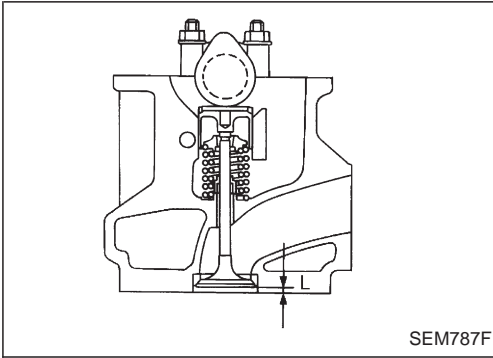


6. Apply small amount of fine grinding compound to valve contacting face and put valve into guide.

Lap valve against its seat until proper valve seating is obtained. Remove valve and then clean valve and valve seat.

## CYLINDER HEAD

### Inspection (Cont'd)

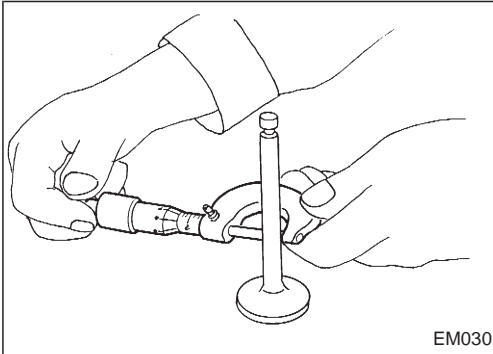


7. Measure distance from cylinder head surface to intake and exhaust valves. If specified distance is exceeded, replace valve(s) or valve seat(s).

**Specified distance: mm (in)**

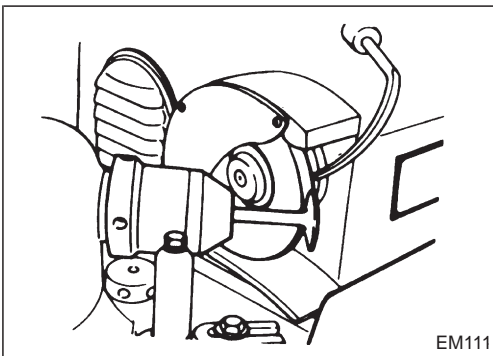
**Standard**

**-0.069 to 0.269 (-0.0027 to 0.0106)**



### VALVE DIMENSIONS

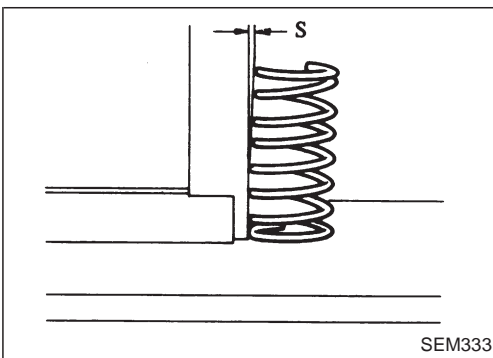
1. Check dimensions in each valve. For dimensions, refer to SDS.
2. Correct or replace any valve that is out of tolerance.



3. Valve face or valve stem end surface should be refaced by using a valve grinder.

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

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



### VALVE SPRING SQUARENESS

Check valve spring for squareness using a steel square and surface plate.

If spring is out-of-square "S" more than specified limit, replace with new one.

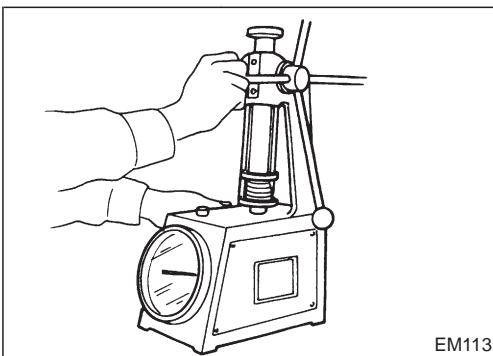
**Out-of-square:**

**Outer**

**Less than 1.9 mm (0.075 in)**

**Inner**

**Less than 1.6 mm (0.063 in)**



### VALVE SPRING PRESSURE LOAD

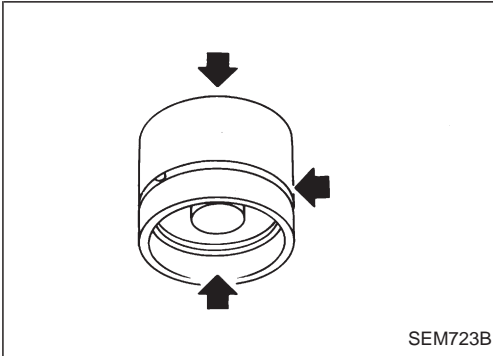
Measure the free length and the tension of each spring. If the measured value exceeds the specified limit, replace spring. Refer to SDS.

## CYLINDER HEAD

### Inspection (Cont'd)

#### VALVE LIFTER

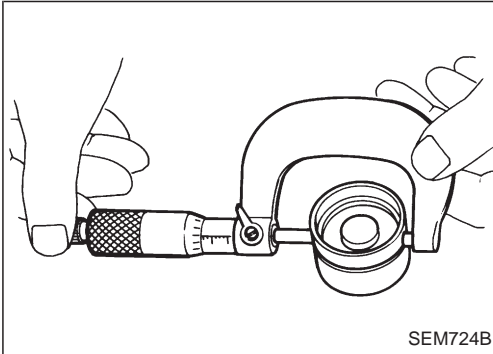
1. Check contact and sliding surfaces for wear or scratches.



2. Check diameter of a valve lifter.

**Outer diameter:**

**34.960 - 34.975 mm (1.3764 - 1.3770 in)**



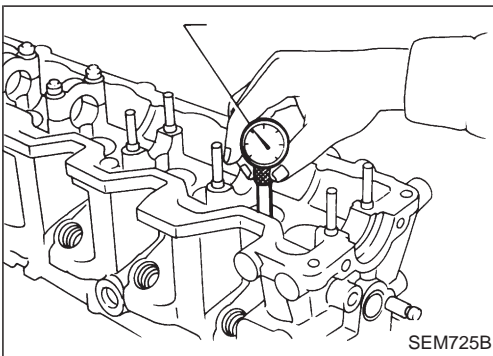
3. Check valve lifter guide bore.

**Bore diameter:**

**34.998 - 35.018 mm (1.3779 - 1.3787 in)**

**Standard clearance:**

**0.023 - 0.058 mm (0.0009 - 0.0023 in)**



If valve lifters are noisy, check valve lifter.

- (1) Depress plunger forcibly with your finger.

If it moves about 1 mm (0.04 in), it indicates air is inside valve lifter.

- (2) Reinstall valve lifter.

- (3) Bleed air by running engine at 2,400 rpm under no-load for about 20 minutes.

#### **CAUTION:**

**When camshaft is removed to install, remove or inspect hydraulic valve lifters, do not start engine for at least 30 minutes after reinstalling camshaft. (Wait until hydraulic valve lifters have reached their set lengths.) Before starting engine, rotate crankshaft by hand to ensure pistons do not interfere with valves.**

- (4) Next check to ensure all air is bled. [Refer to step (1) above.]

- (5) If there is still air, replace valve lifter.

## CYLINDER HEAD

### Inspection (Cont'd)

#### CAMSHAFT VISUAL CHECK

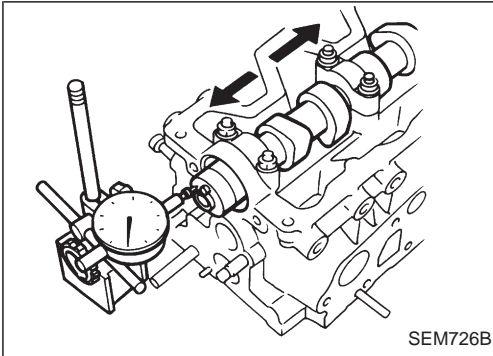
Check camshaft for scratches, seizure and wear.

#### CAMSHAFT END PLAY

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

**Camshaft end play:**

**0.065 - 0.169 mm (0.0026 - 0.0067 in)**



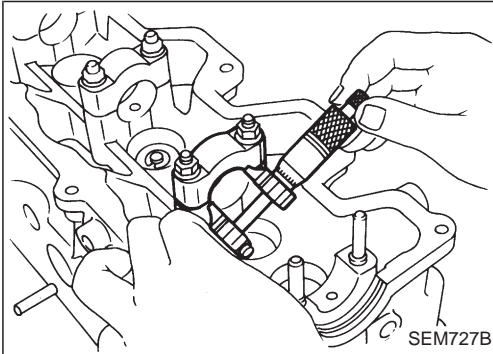
SEM726B

#### CAMSHAFT JOURNAL CLEARANCE

1. Measure the inner diameter of camshaft bearing.

**Standard inner diameter:**

**30.000 - 30.021 mm (1.1811 - 1.1819 in)**



SEM727B

2. Measure the outer diameter of camshaft journal.

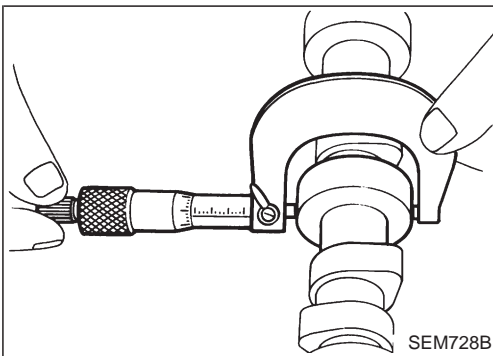
**Standard outer diameter:**

**29.935 - 29.955 mm (1.1785 - 1.1793 in)**

If the clearance is greater than the maximum, replace camshaft and/or cylinder head.

**Maximum clearance:**

**0.045 - 0.086 mm (0.0018 - 0.0034 in)**



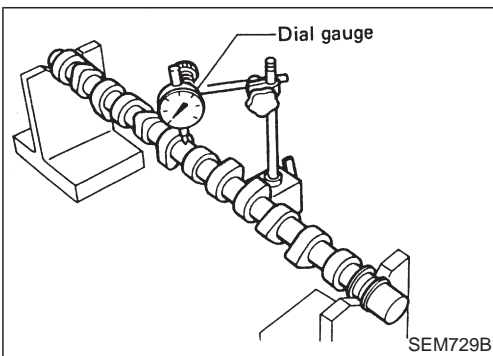
SEM728B

#### CAMSHAFT RUNOUT

**Camshaft runout [TIR (Total Indicator Reading)]:**

**Limit 0.02 mm (0.0008 in)**

If beyond the limit, replace.



SEM729B

#### CAMSHAFT CAM HEIGHT

**Standard cam height:**

**Intake**

**48.005 - 48.195 mm (1.8900 - 1.8974 in)**

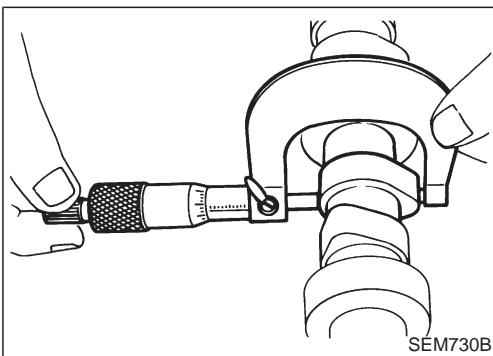
**Exhaust**

**49.505 - 49.695 mm (1.9490 - 1.9565 in)**

**Cam wear:**

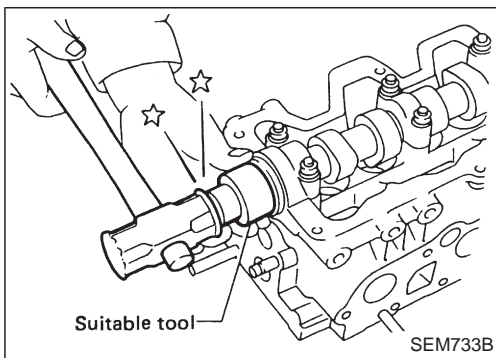
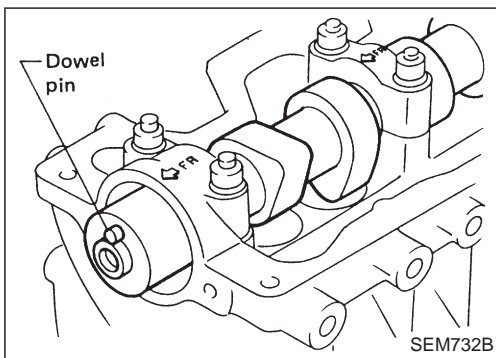
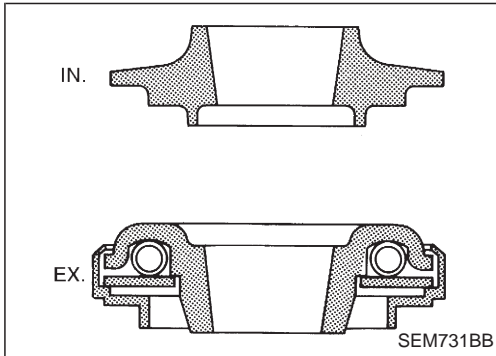
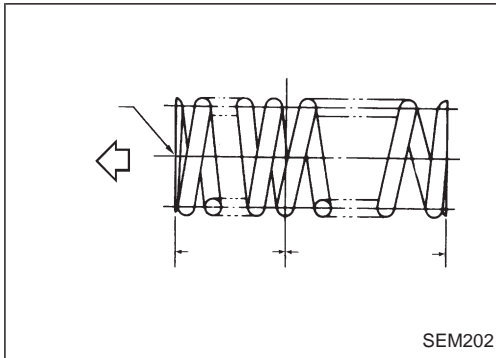
**Limit 0.15 mm (0.0059 in)**

If wear is beyond the limit, replace.



SEM730B

## CYLINDER HEAD



### Assembly

1. Install valve component parts.

**Install valve spring with its narrow pitch side toward cylinder head side.**

- a. When installing valve, apply engine oil on the valve stem and lip of valve oil seal.
- b. Check whether the valve face is free from foreign matter.

- c. Install valve spring retainers on the intake side and valve rotators on the exhaust side.

- d. Valve rotators cannot be disassembled.

2. Set camshaft.

**Set camshaft so that dowel pin faces up.**

3. Install cam bracket caps so that front mark faces forward.

**Cam bracket nut (Tighten in two or three stages):**

**□: 21 - 26 N·m**

**(2.1 - 2.7 kg·m, 15 - 20 ft·lb)**

4. Apply engine oil to new oil seal and install it.

### Installation

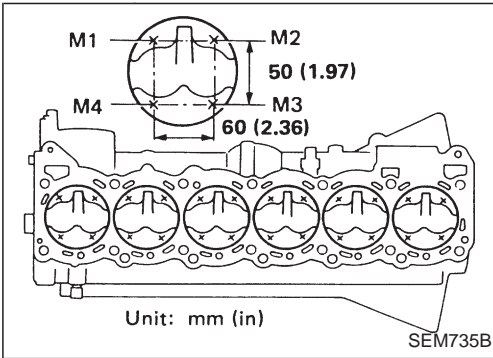
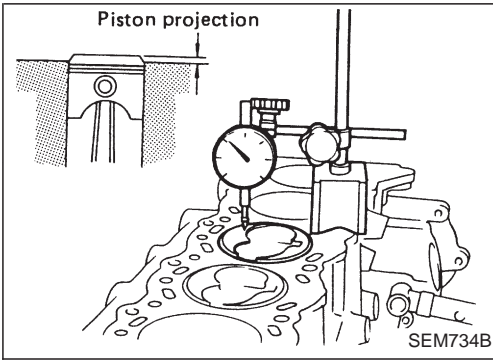
1. Install cylinder head gasket.

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

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

# CYLINDER HEAD

## Installation (Cont'd)



Step 1:

Measure piston projection.

- 1) Set dial gauge on cylinder block surface to zero.
- 2) Set dial gauge at measuring point of piston, being careful not to disturb its zero setting.

- 3) Set each piston at its Top Dead Center. With piston held in that position, measure its projections at four points, M1, M2, M3 and M4, and record measured values.

**Be sure to measure the projection at four points for every cylinder as shown.**

Step 2:

Calculate the average value of measured projections for each cylinder.

Step 3:

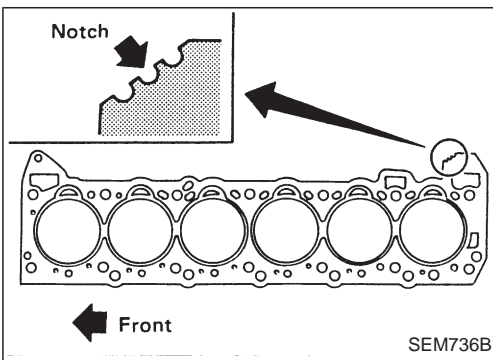
Calculate the average value of projections for all pistons.

Step 4:

Round off the average value.

Step 5:

Determine the gasket thickness, referring to chart A.



### Relation between piston projection and cylinder head gasket (Chart A)

Unit: mm (in)

Grade	Average values piston projections	Gasket thickness	Number of identifications
A	Less than 0.79 (0.0311)	1.42±0.05 (0.0559±0.0020)	1
B	0.79 - 0.875 (0.0311 - 0.0344)	1.50±0.05 (0.0591±0.0020)	2
C	More than 0.875 (0.0344)	1.58±0.05 (0.0622±0.0020)	3

Step 6:

Check to see if the average value of each projection in step 2 is larger than the max. value of the standard projection (of selected gasket) plus 0.08 mm (0.0031 in).

Step 7:

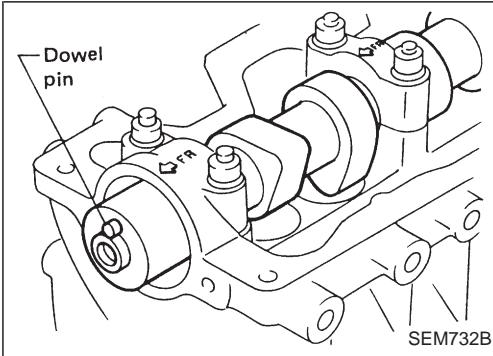
If it is, use gasket that is 1 grade thicker.

If it is not, use gasket that was selected in step 4.

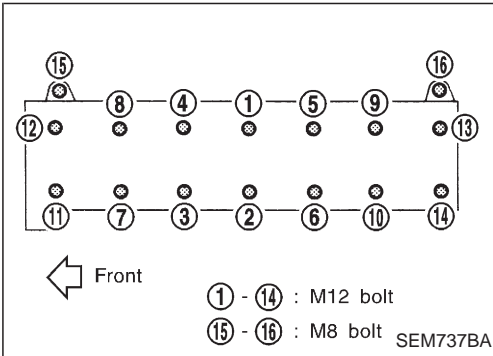


## CYLINDER HEAD

### Installation (Cont'd)



2. Install cylinder head.
  - (1) Make sure that No. 1 cylinder is at Bottom Dead Center.
  - (2) Make sure that No. 1 cam of camshaft is at BDC on its expansion stroke.



- (3) Tighten cylinder head bolts to the specified torque in the sequence as follows:

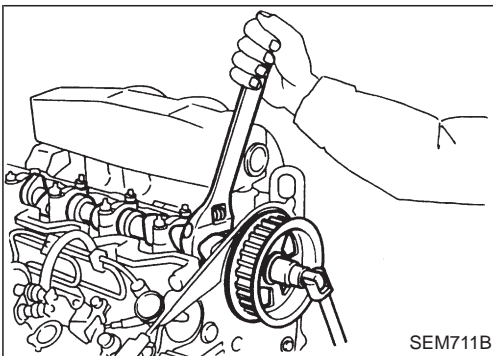
#### ● Tightening procedure.

##### M12 bolt

- 1st Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
- 2nd Tighten all bolts to 113 N·m (11.5 kg-m, 83 ft-lb).
- 3rd Loosen all bolts completely.
- 4th Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
- 5th Tighten all bolts to 108 to 118 N·m (11 to 12 kg-m, 80 to 87 ft-lb) or if you have an angle wrench, turn all bolts 89 to 92 degrees clockwise.

##### M8 bolt

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



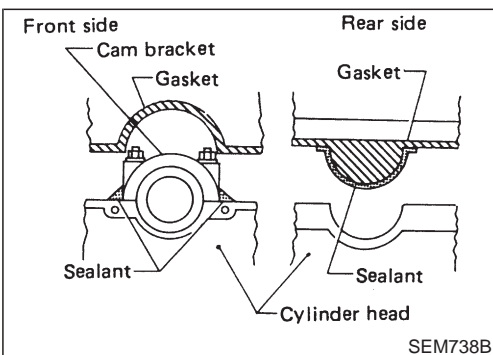
3. Install front back cover and camshaft pulley.

##### Front back cover:

- ☛ : 3 - 5 N·m  
(0.3 - 0.5 kg-m, 26 - 43 in-lb)

##### Camshaft pulley:

- ☛ : 123 - 132 N·m  
(12.5 - 13.5 kg-m, 90 - 98 ft-lb)



4. Install timing belt. Refer to "Replacing Timing Belt" in section MA.

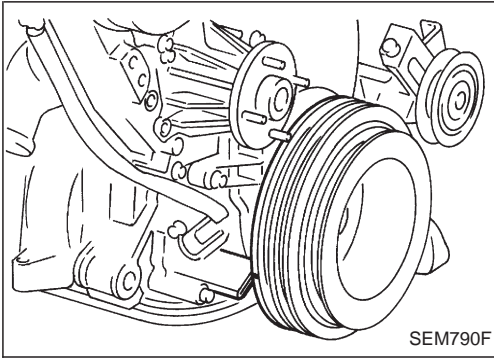
5. Install rocker cover. Refer to EM-30.

**Apply sealant to rocker cover gasket as shown.**

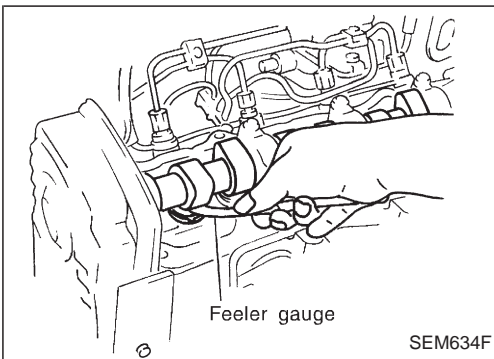
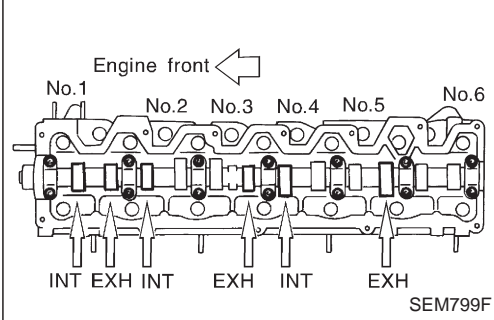
**Do not apply too much sealant.**

6. Install intake and exhaust manifold. Refer to EM-30.

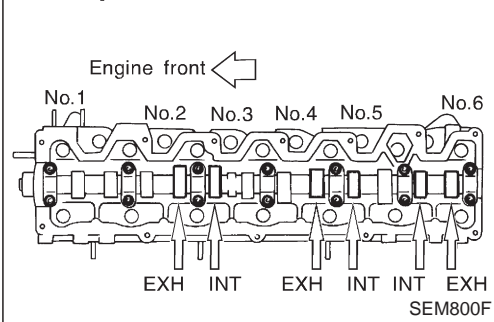
# VALVE CLEARANCE



## No. 1 cylinder at TDC



## No. 6 cylinder at TDC



## Checking

Check valve clearance while engine is warm and not running.

1. Remove rocker cover.
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. 6 are tight.

If not, turn crankshaft one revolution (360°) and align as described above.

3. Check only those valves shown in the figure.

	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH
No. 1 cylinder at TDC	○	○	○			○	○			○		

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

### Valve clearance for checking (Hot):

#### Intake

**0.28 - 0.38 mm (0.011 - 0.015 in)**

#### Exhaust

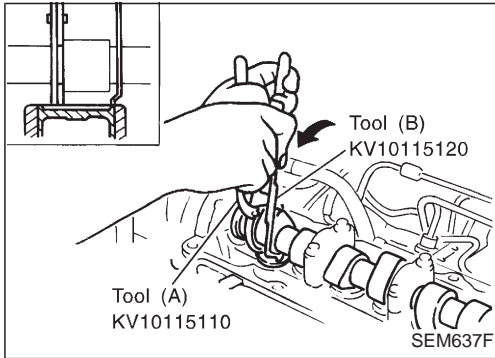
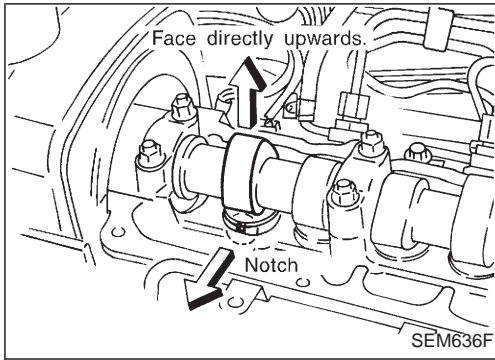
**0.32 - 0.42 mm (0.013 - 0.017 in)**

4. Turn crankshaft one revolution (360°) and align mark on crankshaft pulley with pointer.
5. Check only those valves shown in the figure.

	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH
No. 6 cylinder at TDC				○	○			○	○		○	○

- Use the same procedure as mentioned in step 4.
- 6. If all valve clearances are within specification, install the following parts:
  - Rocker cover

# VALVE CLEARANCE



## Adjusting

**Adjust valve clearance while engine is cold.**

1. Turn crankshaft. Position cam lobe upward on camshaft for valve that must be adjusted.

2. Place Tool (A) around camshaft as shown in figure.

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

**CAUTION:**

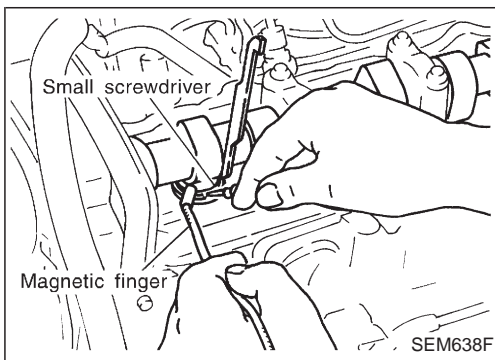
**Be careful not to damage cam surface with Tool (A).**

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

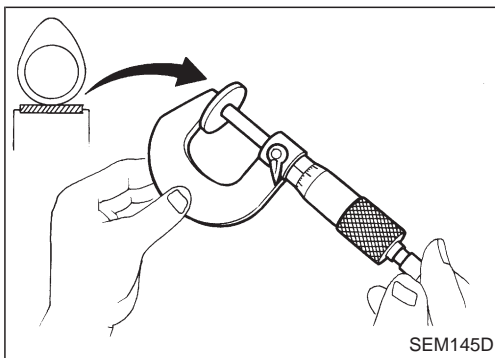
- Use a micrometer to determine thickness of removed shim.
- Calculate thickness of new adjusting shim so valve clearance comes within specified values.

R = Thickness of removed shim

N = Thickness of new shim

M = Measured valve clearance

S = Standard valve clearance



Unit: mm (in)

HOT	Intake	0.28 - 0.38 (0.0110 - 0.0150)
	Exhaust	0.32 - 0.42 (0.0126 - 0.0165)
COLD	Intake	0.26 - 0.34 (0.0102 - 0.0134)
	Exhaust	0.30 - 0.38 (0.0118 - 0.0150)

**Intake:**

$$N = R + [M - S]$$

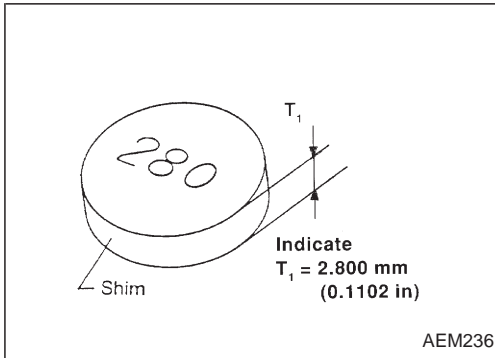
**Exhaust:**

$$N = R + [M - S]$$

Shims are available in 15 sizes from 2.20 mm (0.0866 in) to 2.90 mm (0.1142 in), in steps of 0.05 mm (0.0020 in).

## VALVE CLEARANCE

### Adjusting (Cont'd)



- Select the closest size shim to the calculated thickness. Refer to chart in SDS, EM-60.

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 explained in steps 2 and 3.
10. Remove Tool (B).
11. Remove Tool (A).
12. Recheck valve clearance.

#### Valve clearance:

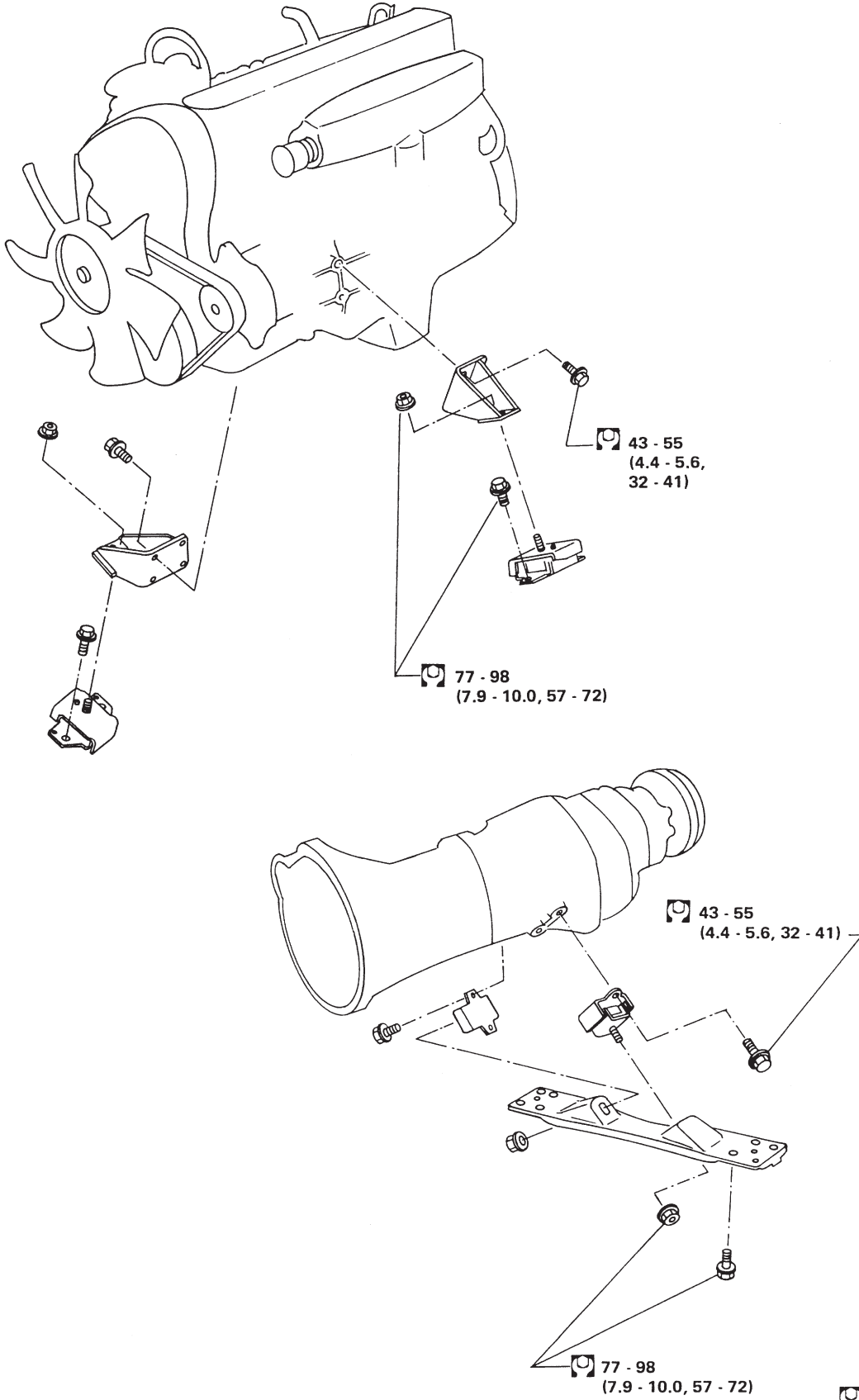
Unit: mm (in)


	For adjusting	
	Hot	Cold* (reference data)
Intake	0.28 - 0.38 (0.011 - 0.015)	0.26 - 0.34 (0.010 - 0.013)
Exhaust	0.32 - 0.42 (0.013 - 0.017)	0.30 - 0.38 (0.012 - 0.015)

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

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

# ENGINE REMOVAL



 : N·m (kg·m, ft·lb)

SEM433C

## ENGINE REMOVAL

---

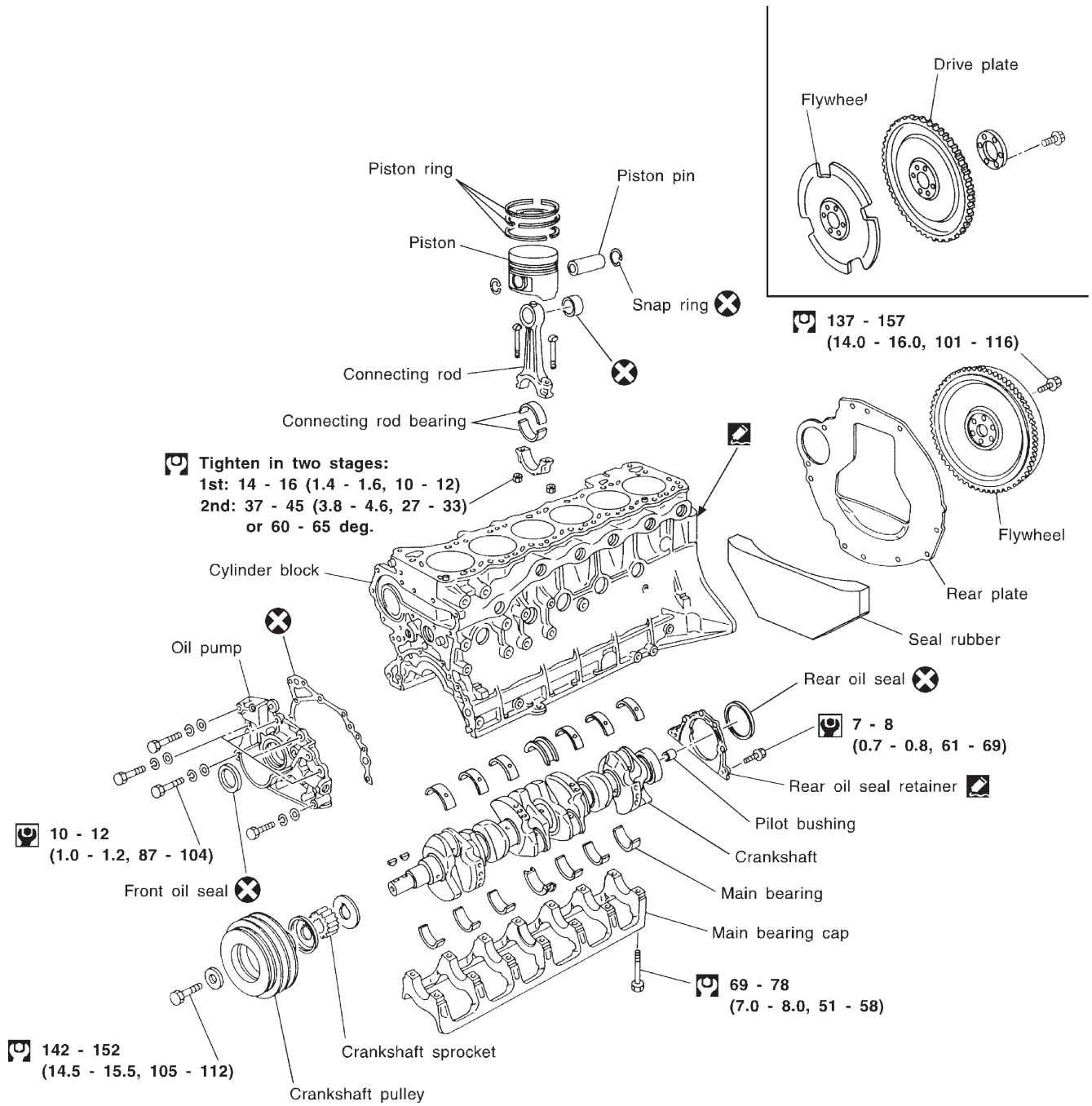
### Removal

1. Remove engine, transmission and transfer's undercovers, oil pan guard and hood.
2. Drain engine coolant.
3. Remove charge air cooler assembly.
4. Remove vacuum hoses, fuel tubes, harnesses, and connectors and so on.
5. Remove radiator assembly.
6. Remove drive belts.
7. Remove power steering oil pump, alternator and air conditioner compressor.
8. Remove starter motor assembly.
9. Remove front exhaust tube.
10. Remove transmission from vehicle.  
Refer to MT section.
11. Hoist engine with engine slingers and remove engine mounting bolts from both sides.
12. Remove engine from vehicle.

### Installation

- Install in reverse order of removal.

# CYLINDER BLOCK



- ⊗ : Liquid gasket
- ⊙ : N·m (kg-m, in-lb)
- ⊞ : N·m (kg-m, ft-lb)

SEM788F

# CYLINDER BLOCK

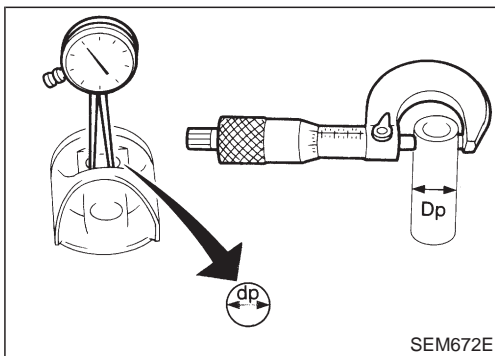
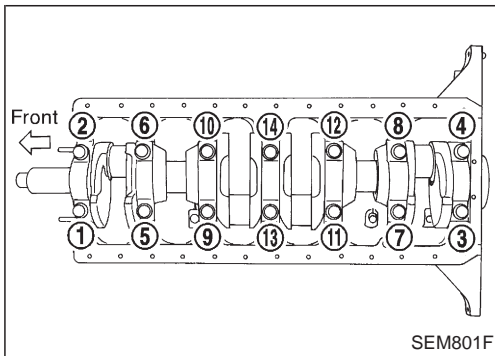
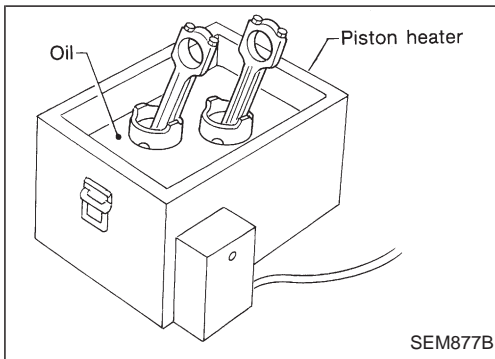
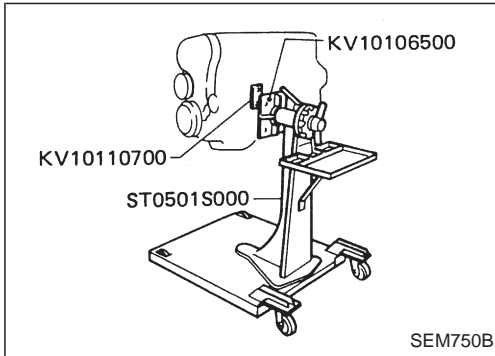
## CAUTION:

- When installing sliding parts such as bearings and pistons, apply engine oil to the sliding surfaces.
- Place removed parts, such as bearings and bearing caps, in their proper order and direction.
- When installing connecting rod bolts and main bearing cap bolts, apply new engine oil to threads and seating surfaces of nuts.
- Do not allow any magnetic materials to contact the ring gear teeth of drive plate.

## Disassembly

### PISTON AND CRANKSHAFT

1. Place engine on a work stand.
2. Remove timing belt and injection pump.
3. Drain coolant and remove water pump.
4. Remove front cover.
5. Drain oil.
6. Remove oil pan and oil pump.
7. Remove cylinder head.
8. Remove pistons with connecting rod.
  - To disassemble piston and connecting rod, remove snap ring first. Then heat piston to 60 to 70°C (140 to 158°F) and use piston pin press to remove pin.
  - **When piston rings are not replaced, make sure that piston rings are mounted in their original positions.**
  - **When replacing piston rings, if there is no punchmark, install with either side up.**
9. Remove bearing cap bolts and main bearing caps in the order shown, then remove crankshaft.
  - **Loosen bolts in two or three steps.**



## Inspection

### PISTON AND PISTON PIN CLEARANCE

1. Measure inner diameter of piston pin hole "dp".  
**Standard diameter "dp":**  
26.995 - 27.005 mm (1.0628 - 1.0632 in)



## CYLINDER BLOCK

### Inspection (Cont'd)

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

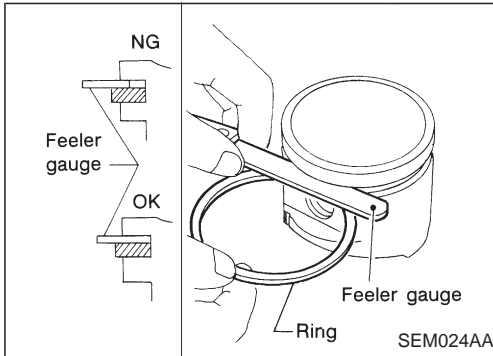
**Standard diameter "Dp":**

**26.994 - 27.000 mm (1.0628 - 1.0630 in)**

3. Calculate piston pin clearance.

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

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



### PISTON RING SIDE CLEARANCE

**Side clearance:**

**Top ring**

**0.060 - 0.093 mm (0.0024 - 0.0037 in)**

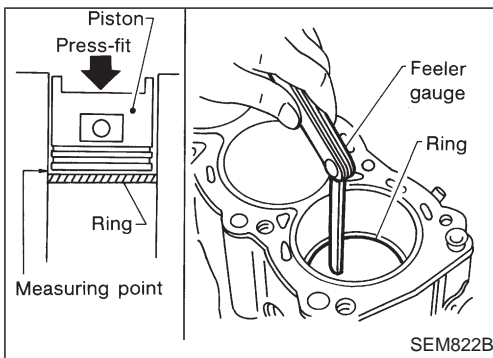
**2nd ring**

**0.040 - 0.073 mm (0.0016 - 0.0029 in)**

**Max. limit of side clearance:**

**0.1 mm (0.004 in)**

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



### PISTON RING END GAP

**End gap:**

**Top ring**

**0.20 - 0.28 mm (0.0079 - 0.0110 in)**

**2nd ring**

**0.20 - 0.46 mm (0.0079 - 0.0181 in)**

**Oil ring**

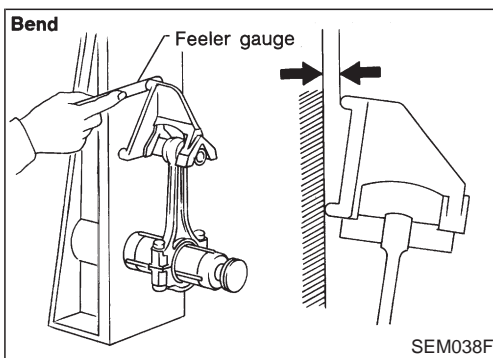
**0.30 - 0.56 mm (0.0118 - 0.0220 in)**

**Max. limit of ring gap:**

**0.4 mm (0.016 in)**

If out of specification, replace piston ring. If gap still exceeds maximum limit with new ring, rebore cylinder and use oversized piston and piston rings. Refer to SDS, EM-62.

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



### CONNECTING ROD BEND AND TORSION

**Bend:**

**Limit 0.025 mm (0.0010 in)**  
**per 100 mm (3.94 in) length**

**Torsion:**

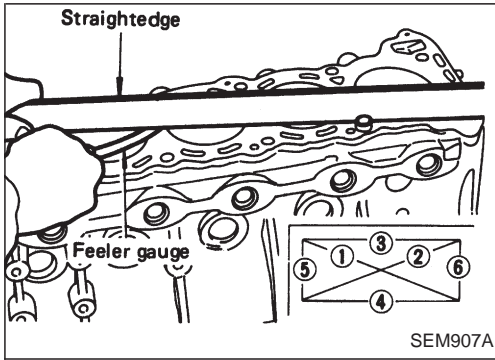
**Limit 0.025 mm (0.0010 in)**  
**per 100 mm (3.94 in) length**

If it exceeds the limit, replace connecting rod assembly.

## CYLINDER BLOCK

### Inspection (Cont'd)

#### CYLINDER BLOCK DISTORTION AND WEAR



1. Clean upper surface of cylinder block. Using a reliable straight-edge and feeler gauge, check the flatness of cylinder block surface.

- Check along six positions as shown in figure.

**Limit:**

**0.10 mm (0.0039 in)**

2. If out of specification, resurface it.

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

**Amount of cylinder head resurfacing is "A".**

**Amount of cylinder block resurfacing is "B".**

**The maximum limit is as follows:**

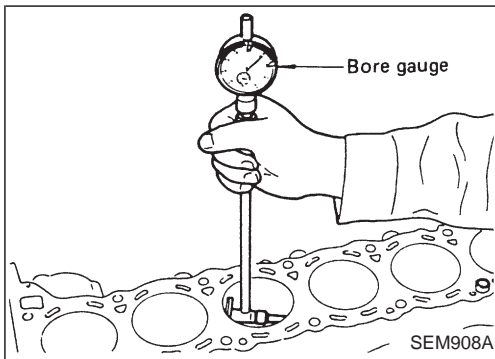
**A + B = 0.2 mm (0.008 in)**

**Nominal cylinder block height**

**from crankshaft center:**

**227.40 - 227.50 mm (8.9527 - 8.9567 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 "Db":**

**85.000 - 85.030 mm (3.3465 - 3.3476 in)**

**Wear limit:**

**0.20 mm (0.0079 in)**

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

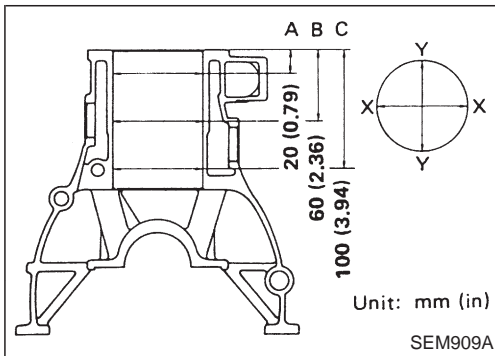
**Less than 0.015 mm (0.0006 in)**

**Taper (A - B or A - C):**

**Less than 0.010 mm (0.0004 in)**

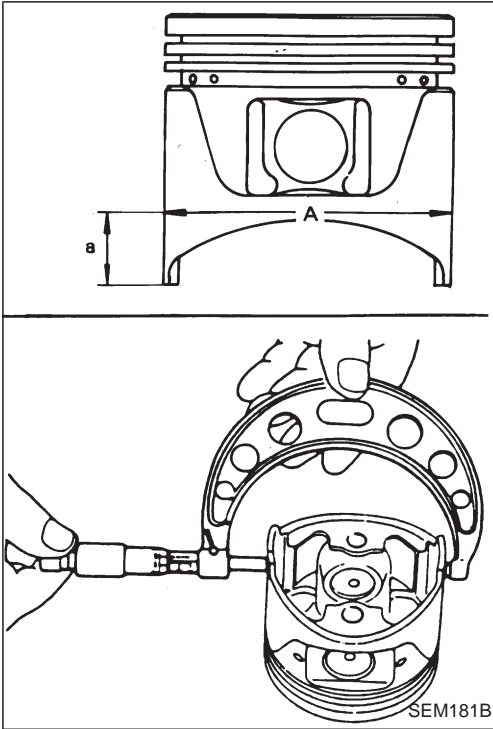
If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.

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



## CYLINDER BLOCK

### Inspection (Cont'd)



3. Measure piston skirt diameter.

**Piston diameter "A":**

**Refer to SDS, EM-61.**

**Measuring point "a" (Distance from the bottom):**  
**18 mm (0.71 in)**

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

**Piston-to-bore clearance "B" = Bore measurement**  
**"C" - Piston diameter "A":**

**0.025 - 0.045 mm (0.0010 - 0.0018 in)**

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

**Oversize pistons are available for service. Refer to SDS, EM-61.**

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

**Rebored size calculation:**

$$D = A + B - C$$

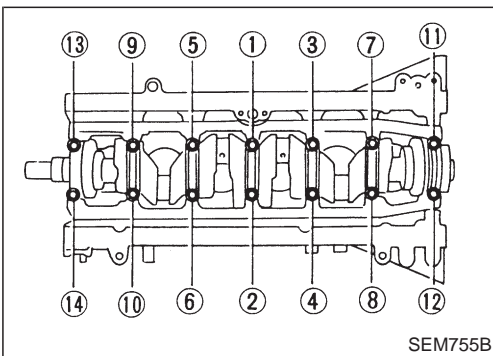
**where,**

**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 cap and tighten bolts to 90 to 100 N·m (9.2 to 10.2 kg·m, 67 to 74 ft·lb). This will prevent distortion of cylinder bores.

8. Cut cylinder bores.

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

- **Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so at a time.**

- 9.hone cylinders to obtain specified piston-to-bore clearance.

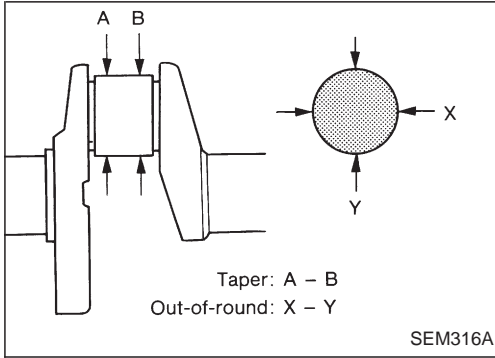
10. Measure finished cylinder bore for out-of-round and taper.

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

# CYLINDER BLOCK

## Inspection (Cont'd)

### CRANKSHAFT



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

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

##### Main journal

Less than 0.005 mm (0.0002 in)

##### Pin journal

Less than 0.0025 mm (0.0001 in)

#### Taper (A - B):

##### Main journal

Less than 0.005 mm (0.0002 in)

##### Pin journal

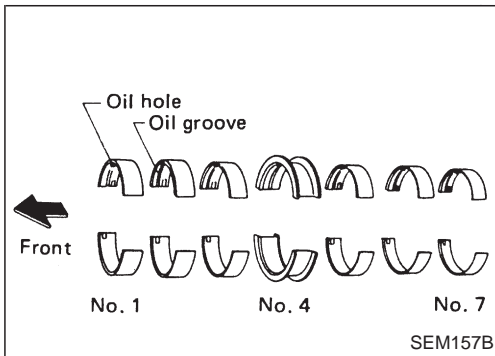
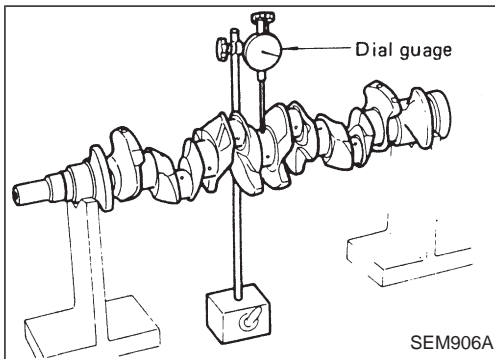
Less than 0.0025 mm (0.0001 in)

3. Measure crankshaft runout.

#### Runout (Total indicator reading):

Standard Less than 0.025 mm (0.0010 in)

Limit 0.05 mm (0.0020 in)



### BEARING CLEARANCE

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

#### Method A (Using bore gauge and micrometer)

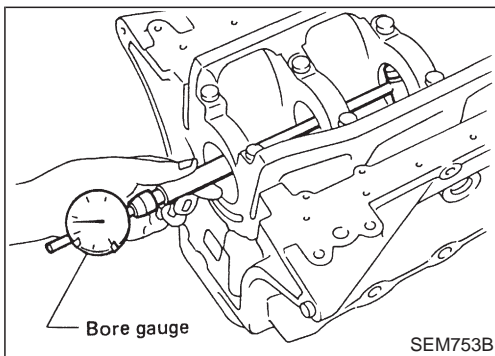
##### Main bearing

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

2. Install main bearing cap to cylinder block.

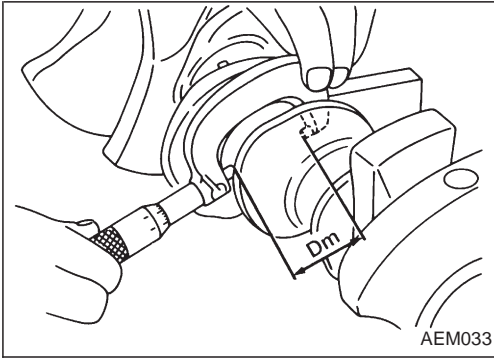
**Tighten all bolts in correct order in two or three stages. Refer to EM-54.**

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



# CYLINDER BLOCK

## Inspection (Cont'd)



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

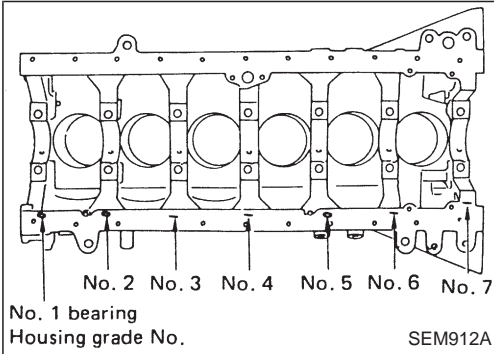
**Main bearing clearance = A - Dm:**

**Standard 0.036 - 0.063 mm (0.0014 - 0.0025 in)**

**Limit 0.12 mm (0.0047 in)**

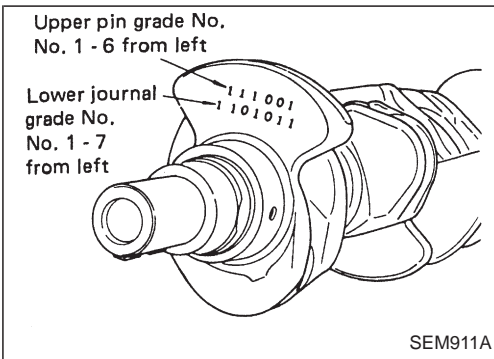
If it exceeds the limit, replace bearing.

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



- If crankshaft or cylinder block is replaced, select thickness of main bearings as follows:

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



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

### Main bearing grade number:

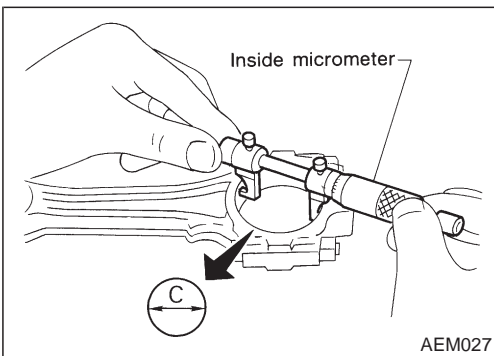
Main journal grade number	0	1	2	
Crankshaft journal grade number	0	0	1	2
	1	1	2	3
	2	2	3	4

**For example:**

**Main journal grade number: 1**

**Crankshaft journal grade number: 2**

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

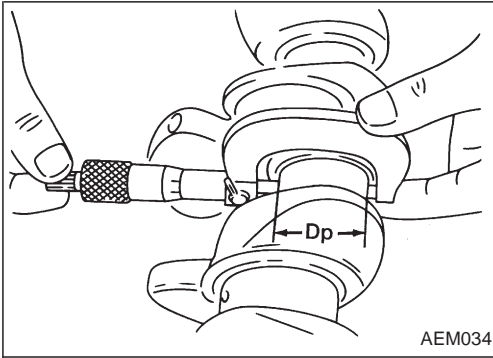


### Connecting rod bearing (Big end)

1. Install connecting rod bearing to connecting rod and cap.
  2. Install connecting rod cap to connecting rod.
- Tighten bolts to the specified torque. Refer to EM-20.**
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**

**0.014 - 0.054 mm (0.0006 - 0.0021 in)**

**Limit**

**0.090 mm (0.0035 in)**

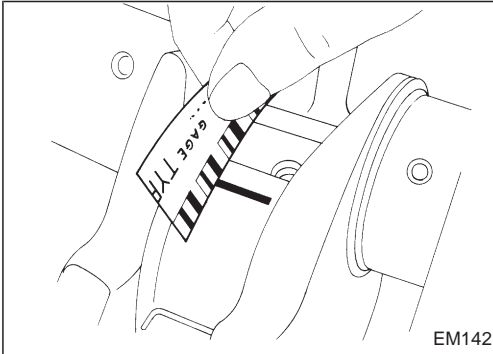
If it exceeds the limit, replace bearing.

- If it still exceeds the limit even with a new bearing, regrind crank pin and use undersized bearings.
- Refer to SDS for regrinding crankshaft and available service parts.

### Method B (Using plastigage)

#### CAUTION:

- Do not turn crankshaft or connecting rod while plastigage is being inserted.
- If incorrect bearing clearance exists, use a thicker or undersized main bearing to ensure specified clearance.



### CONNECTING ROD BUSHING CLEARANCE (Small end)

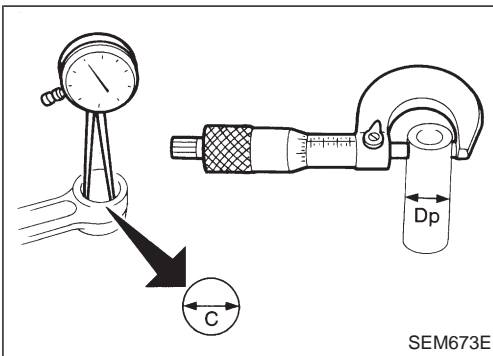
1. Measure inner diameter "C" of bushing.
2. Measure outer diameter "Dp" of piston pin.
3. Calculate connecting rod bushing clearance.

**Connecting rod bushing clearance = C - Dp**

**Standard:**

**0.025 - 0.044 mm (0.0010 - 0.0017 in)**

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



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

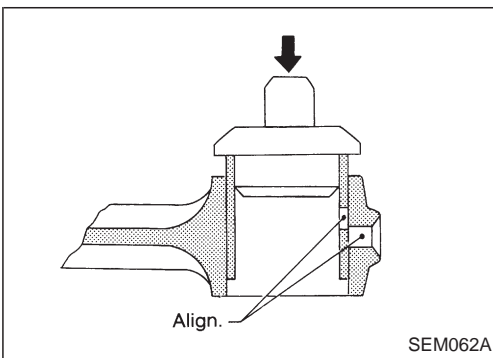
1. Drive in small end bushing until it is flush with end surface of rod.

**Be sure to align the oil holes.**

2. Ream the bushing so that clearance with piston pin is within specification.

**Clearance between connecting rod bushing and piston pin:**

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



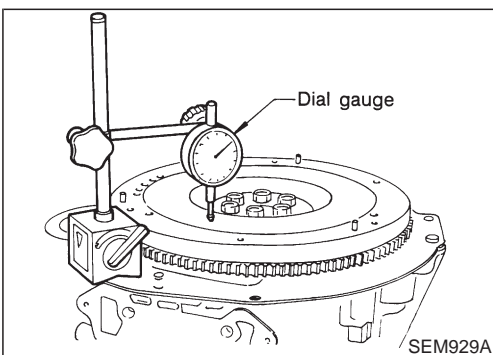
### FLYWHEEL/DRIVE PLATE RUNOUT

**Runout (Total indicator reading):**

**Less than 0.15 mm (0.0059 in)**

#### CAUTION:

- Be careful not to damage the ring gear teeth.
- Check the drive plate for deformation or cracks.
- Do not allow any magnetic materials to contact the ring gear teeth.
- Do not resurface drive plate. Replace as necessary.

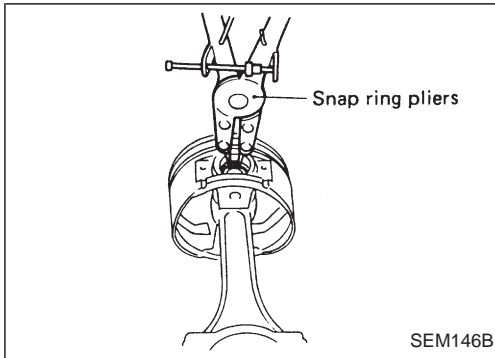


# CYLINDER BLOCK

## Assembly

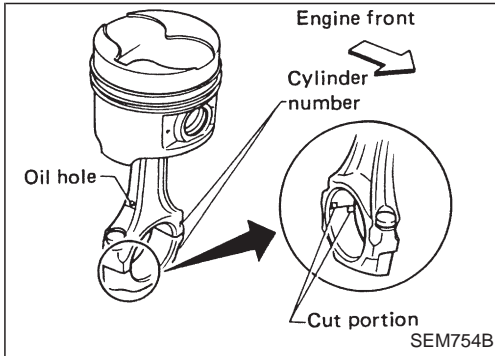
### PISTON

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



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

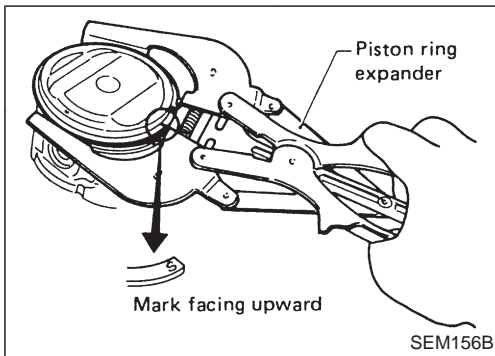
- Align the direction of piston and connecting rod.
- Numbers stamped on connecting rod and cap correspond to each cylinder.
- After assembly, make sure connecting rod swings smoothly.



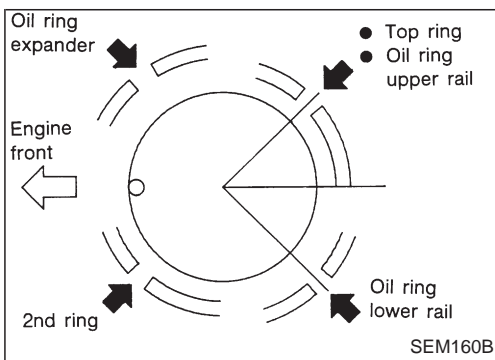
3. Set piston rings as shown.

### CAUTION:

- When piston rings are not replaced, make sure that piston rings are mounted in their original positions.
- Install new piston rings either side up if there is no punch-mark.



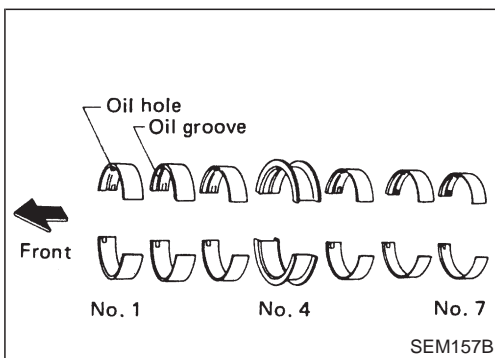
- Align piston rings so that end gaps are positioned as shown.



### CRANKSHAFT

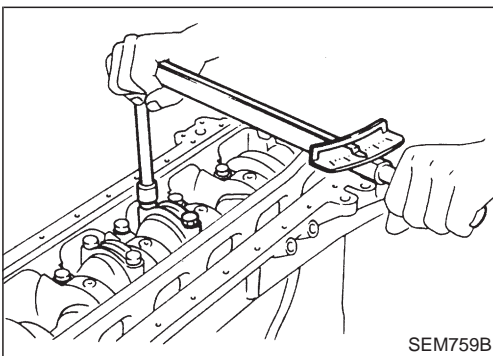
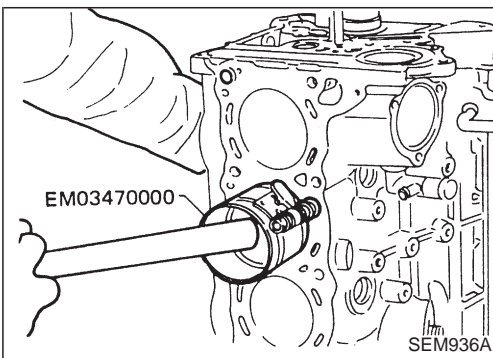
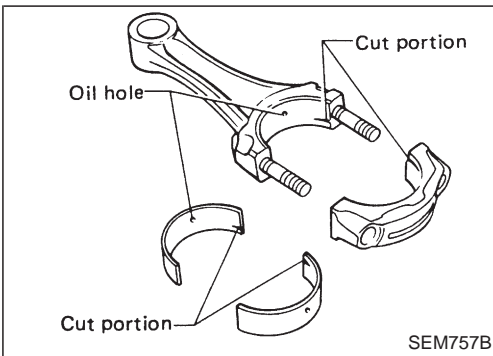
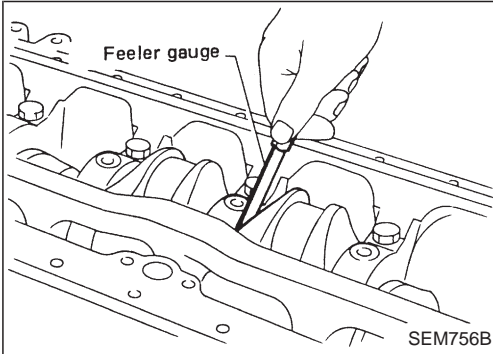
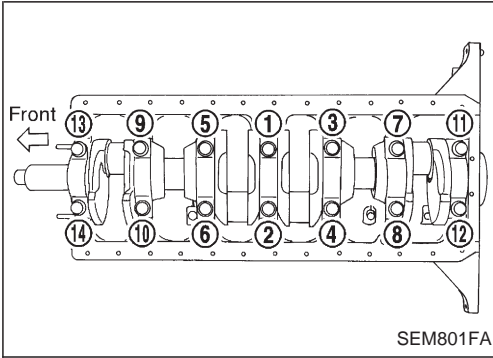
1. Set main bearings in their proper positions on cylinder block and main bearing cap.

- Confirm that correct main bearings are selected by using Method A or Method B. Refer to EM-52.
- Apply new engine oil to bearing surfaces.



## CYLINDER BLOCK

### Assembly (Cont'd)



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

- Apply new engine oil to the bolt thread and seat surface.
- Prior to tightening bearing cap bolts, shift crankshaft back and forth to properly seat the bearing cap.
- Tighten bearing cap bolts gradually in two or three steps. Start with center bearing and move outward as shown in figure.
- After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.

3. Measure crankshaft end play.

**Crankshaft end play:**

**Standard**

**0.050 - 0.18 mm (0.0020 - 0.0071 in)**

**Limit**

**0.30 mm (0.0118 in)**

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

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

- Confirm that correct bearings are selected. Refer to “Connecting rod bearing (Big end)”, EM-52.
- Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.
- Apply new engine oil to bearing surfaces, bolt threads and seating surfaces.

5. Install pistons with connecting rods.

a. Install them into corresponding cylinders with Tool.

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

b. Install connecting rod caps.

- Apply new engine oil to bolt threads and nut seating surfaces.

Tighten connecting rod cap nuts using the following procedure.

(1) Tighten to 14 to 16 N·m

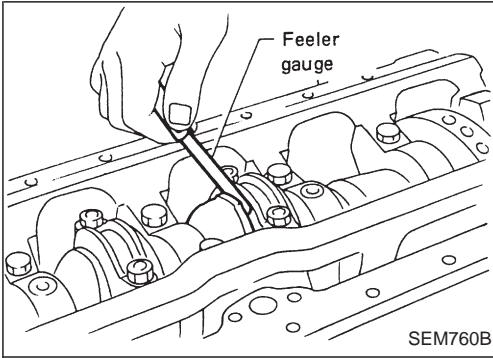
(1.4 to 1.6 kg-m, 10 to 12 ft-lb).

(2) Turn nuts 60 to 65° clockwise with an angle wrench. If an angle wrench is not available, tighten nuts to 37 to 45 N·m (3.8 to 4.6 kg-m, 27 to 33 ft-lb).



## CYLINDER BLOCK

### Assembly (Cont'd)



6. Measure connecting rod side clearance.

#### Connecting rod side clearance:

##### Standard

**0.20 - 0.30 mm (0.0079 - 0.0118 in)**

##### Limit

**0.40 mm (0.0157 in)**

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

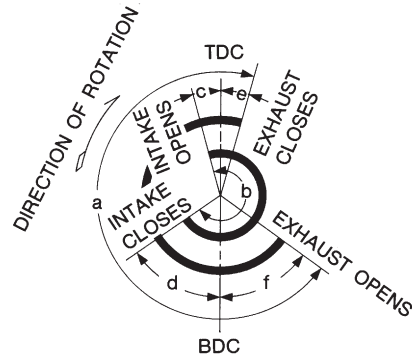
# SERVICE DATA AND SPECIFICATIONS (SDS)

## General Specifications

Cylinder arrangement	In-line 6	
Displacement	cm <sup>3</sup> (cu in)	2,826 (172.44)
Bore and stroke	mm (in)	85 x 83 (3.35 x 3.27)
Valve arrangement	OHC	
Firing order	1-5-3-6-2-4	
Number of piston rings		
Compression	2	
Oil	1	
Number of main bearings	7	
Compression ratio	21.8	

## VALVE TIMING

Without warm-up three way catalyst



EM120  
Unit: degree

a	b	c	d	e	f
248	220	7	33	8	60

## Inspection and Adjustment

### COMPRESSION PRESSURE

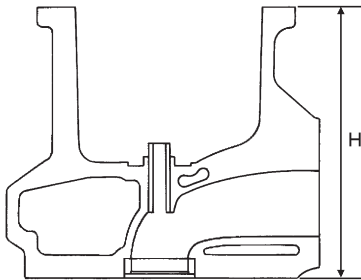
Unit: kPa (bar, kg/cm<sup>2</sup>, psi)/200 rpm

Compression pressure		
Standard	3,040 (30.4, 31, 441)	
Minimum	2,452 (24.5, 25, 356)	
Differential limit between cylinders	490 (4.9, 5, 71)	

### CYLINDER HEAD

Unit: mm (in)

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



SEM795F

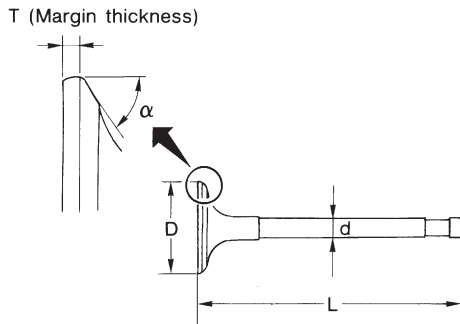
Nominal cylinder head height "H"	139.9 - 140.1 (5.508 - 5.516)
Resurfacing limit	0.1 (0.004)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### VALVE

Unit: mm (in)



SEM188A

Valve head diameter "D"	
Intake	39.0 - 39.3 (1.535 - 1.547)
Exhaust	32.0 - 32.3 (1.260 - 1.272)
Valve length "L"	
Intake	101.53 - 101.97 (3.9972 - 4.0146)
Exhaust	101.38 - 101.82 (3.9913 - 4.0087)
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	1.35 - 1.65 (0.0531 - 0.0650)
Exhaust	1.65 - 1.95 (0.0650 - 0.0768)
Valve margin "T" limit	More than 0.5 (0.020)
Valve stem end surface grinding limit	Less than 0.2 (0.008)

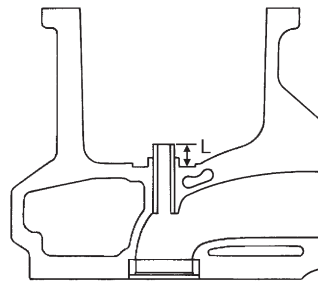
### Valve lifter

Unit: mm (in)

Valve lifter diameter	34.960 - 34.975 (1.3764 - 1.3770)
Lifter guide hole diameter	34.998 - 35.018 (1.3779 - 1.3787)
Clearance between lifter and lifter guide hole	0.023 - 0.058 (0.0009 - 0.0023)

### Valve guide

Unit: mm (in)



SEM796F

		Standard	Service
Valve guide	Outer diameter	Intake	11.023 - 11.034 (0.4340 - 0.4344)
		Exhaust	11.233 - 11.234 (0.4422 - 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	Interference fit of valve guide	Intake	10.975 - 10.996 (0.4321 - 0.4329)
		Exhaust	11.185 - 11.196 (0.4404 - 0.4408)
		Standard	Limit
Stem to guide clearance	Valve deflection limit	Intake	0.020 - 0.050 (0.0008 - 0.0020)
		Exhaust	0.040 - 0.070 (0.0016 - 0.0028)
Projection length "L"		0.2 (0.008)	
		10.2 - 10.4 (0.402 - 0.409)	

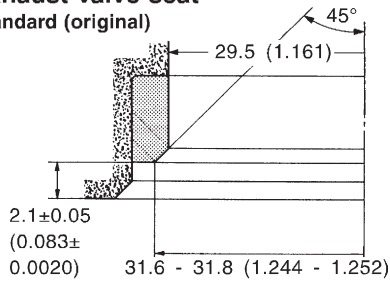
# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### Valve seat

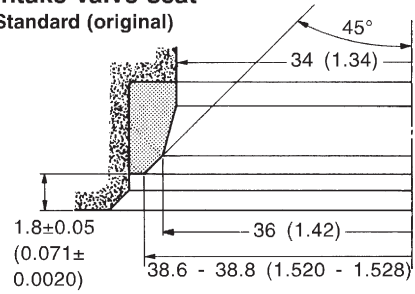
Unit: mm (in)

#### Exhaust valve seat Standard (original)



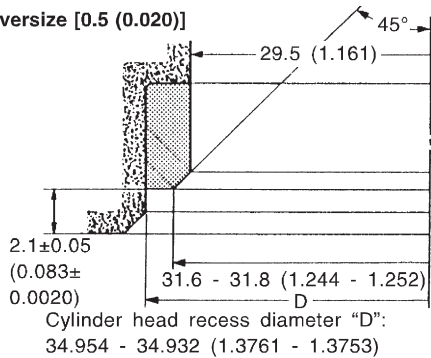
SEM788BA

#### Intake valve seat Standard (original)



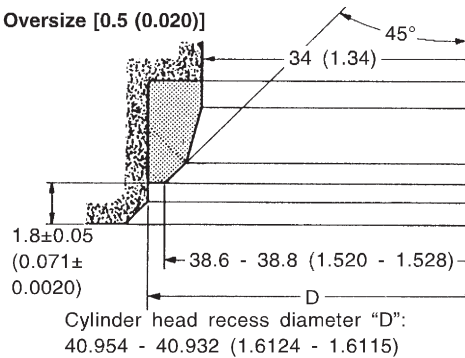
SEM773BA

#### Exhaust valve seat Oversize [0.5 (0.020)]



SEM790BA

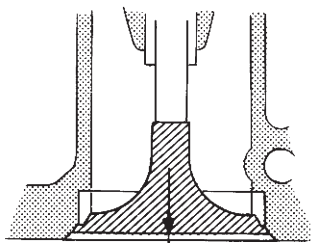
#### Intake valve seat Oversize [0.5 (0.020)]



SEM789BA

### Cylinder head to valve distance

Unit: mm (in)



Valve distance

SEM724C

	Standard
Intake	-0.069 to 0.269 (-0.0027 to 0.0106)
Exhaust	-0.069 to 0.269 (-0.0027 to 0.0106)

### Valve spring

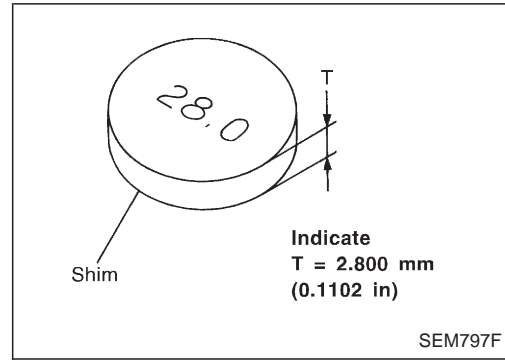
Free height	mm (in)
Outer	42.25 (1.6634)
Inner	36.57 (1.4398)
Pressure height/Load	mm/N (mm/kg, in/lb)
Outer	25.7/437.69 (25.7/44.63, 1.012/98.41)
Inner	22.2/233.21 (22.2/23.78, 0.874/52.43)
Out-of-square	mm (in)
Outer	1.9 (0.075)
Inner	1.6 (0.063)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### Available shim

Thickness mm (in)	Identification mark
2.90 (0.1142)	2.90
2.85 (0.1122)	2.85
2.80 (0.1102)	2.80
2.75 (0.1083)	2.75
2.70 (0.1063)	2.70
2.65 (0.1043)	2.65
2.60 (0.1024)	2.60
2.55 (0.1004)	2.55
2.50 (0.0984)	2.50
2.45 (0.0965)	2.45
2.40 (0.0945)	2.40
2.35 (0.0925)	2.35
2.30 (0.0906)	2.30
2.25 (0.0886)	2.25
2.20 (0.0866)	2.20



### Valve clearance

	For adjusting	
	Hot	Cold*
	Intake	0.28 - 0.38 (0.011 - 0.015)
Exhaust	0.32 - 0.42 (0.013 - 0.017)	0.30 - 0.38 (0.012 - 0.015)

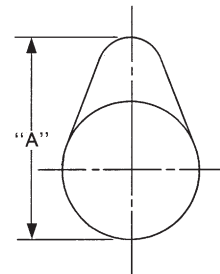
\*: At a temperature of approximately 20°C (68°F)

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

### CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard	Limit
Camshaft journal to bearing clearance	0.045 - 0.086 (0.0018 - 0.0034)	0.1 (0.004)
Inner diameter of camshaft bearing	30.000 - 30.021 (1.1811 - 1.1819)	—
Outer diameter of camshaft journal	29.935 - 29.955 (1.1785 - 1.1793)	—
Camshaft runout [TIR*]	—	0.02 (0.0008)
Camshaft sprocket runout [TIR*]	Less than 0.25 (0.0098)	—
Camshaft end play	0.065 - 0.169 (0.0026 - 0.0067)	0.20 (0.0079)



EM671

Cam height "A"	
Intake	48.005 - 48.195 (1.8900 - 1.8974)
Exhaust	49.505 - 49.695 (1.9490 - 1.9565)
Wear limit of cam height	0.15 (0.0059)
Valve lift	
Intake	8.27 (0.326)
Exhaust	9.43 (0.371)

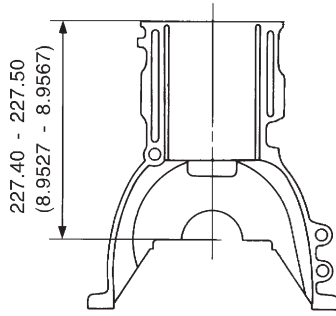
\*: Total indicator reading

# SERVICE DATA AND SPECIFICATIONS (SDS)

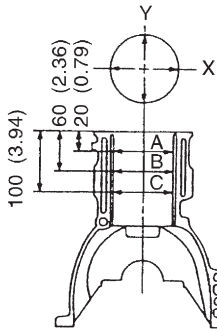
## Inspection and Adjustment (Cont'd)

### CYLINDER BLOCK

Unit: mm (in)



SEM964EA



SEM686DA

#### Surface flatness

Standard	Less than 0.03 (0.0012)
Limit	0.1 (0.004)

#### Cylinder bore

Inner diameter	
Standard	
Grade No. 1	85.000 - 85.010 (3.3465 - 3.3468)
Grade No. 2	85.010 - 85.020 (3.3468 - 3.3472)
Grade No. 3	85.020 - 85.030 (3.3472 - 3.3476)
Wear limit	0.20 (0.0079)

#### Out-of-round (X - Y)

Standard	Less than 0.015 (0.0006)
----------	--------------------------

#### Taper (A - B and A - C)

Standard	Less than 0.010 (0.0004)
----------	--------------------------

#### Difference in inner diameter between cylinders

Limit	Less than 0.05 (0.0020)
-------	-------------------------

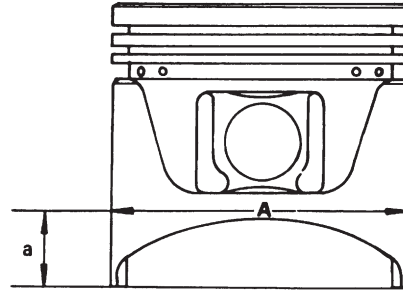
#### Main journal inner diameter

Grade No. 0	58.645 - 58.654 (2.3089 - 2.3092)
Grade No. 1	58.654 - 58.663 (2.3092 - 2.3096)
Grade No. 2	58.663 - 58.672 (2.3096 - 2.3099)

### PISTON, PISTON RING AND PISTON PIN

#### Piston

Unit: mm (in)



SEM750C

#### Piston skirt diameter "A"

##### Standard

Grade No. 1	84.960 - 84.970 (3.3449 - 3.3453)
Grade No. 2	84.970 - 84.980 (3.3453 - 3.3457)
Grade No. 3	84.980 - 84.990 (3.3457 - 3.3461)
0.50 (0.0197) over-size (Service)	85.460 - 85.490 (3.3646 - 3.3657)
1.00 (0.0394) over-size (Service)	85.960 - 85.990 (3.3842 - 3.3854)

"a" dimension	14.5 (0.571)
---------------	--------------

Piston clearance to cylinder block	0.030 - 0.050 (0.0012 - 0.0020)
------------------------------------	---------------------------------

Piston pin hole diameter	26.995 - 27.005 (1.0628 - 1.0632)
--------------------------	-----------------------------------

## SERVICE DATA AND SPECIFICATIONS (SDS)

### Inspection and Adjustment (Cont'd)

#### Piston ring

Unit: mm (in)	
Side clearance	
Top	
Standard	0.060 - 0.093 (0.0024 - 0.0037)
Limit	0.1 (0.004)
2nd	
Standard	0.040 - 0.073 (0.0016 - 0.0029)
Limit	0.1 (0.004)
Oil	
Standard	0.030 - 0.063 (0.0012 - 0.0025)
Limit	—
Ring gap	
Top	
Standard	0.20 - 0.28 (0.0079 - 0.0110)
Limit	1.0 (0.039)
2nd	
Standard	0.38 - 0.53 (0.0150 - 0.0209)
Limit	1.0 (0.039)
Oil	
Standard	0.30 - 0.56 (0.0118 - 0.0220)
Limit	1.0 (0.039)

#### CONNECTING ROD

Unit: mm (in)	
Center distance	140.0 (5.512)
Bend [per 100 (3.94)]	
Limit	0.025 (0.0010)
Torsion [per 100 (3.94)]	
Limit	0.025 (0.0010)
Connecting rod small end inner diameter	30.000 - 30.013 (1.1811 - 1.1816)
Piston pin bushing inner diameter*	27.025 - 27.038 (1.0640 - 1.0645)
Connecting rod big end inner diameter	
Grade No. 0	53.000 - 53.007 (2.0866 - 2.0869)
Grade No. 1	53.007 - 53.013 (2.0869 - 2.0871)
Side clearance	
Standard	0.20 - 0.30 (0.0079 - 0.0118)
Limit	0.40 (0.0157)

\*: After installing in connecting rod

#### Piston pin

Unit: mm (in)	
Piston pin outer diameter	26.994 - 27.000 (1.0628 - 1.0630)
Interference fit of piston pin to piston	0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing clearance	
Standard	0.025 - 0.044 (0.0010 - 0.0017)

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

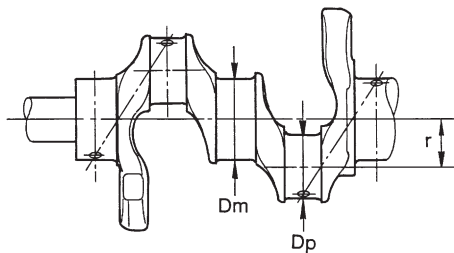
# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### CRANKSHAFT

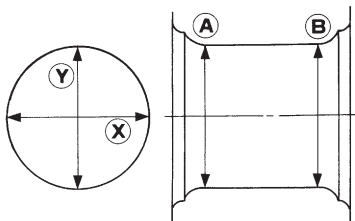
Unit: mm (in)

Main journal dia. "Dm"		
Grade No. 0	54.967 - 54.975 (2.1641 - 2.1644)	
Grade No. 1	54.959 - 54.967 (2.1637 - 2.1641)	
Grade No. 2	54.951 - 54.959 (2.1634 - 2.1637)	
Pin journal dia. "Dp"		
Grade No. 0	49.968 - 49.974 (1.9672 - 1.9675)	
Grade No. 1	49.961 - 49.968 (1.9670 - 1.9672)	
Center distance "r"		
	41.47 - 41.53 (1.6327 - 1.6350)	
Out-of-round (X - Y)		
Standard	Main journal	Less than 0.005 (0.0002)
	Pin journal	Less than 0.0025 (0.0001)
Taper (A - B)		
Standard	Main journal	Less than 0.005 (0.0002)
	Pin journal	Less than 0.0025 (0.0001)
Runout [TIR]		
Standard	Less than 0.025 (0.0010)	
Limit	Less than 0.05 (0.0020)	
Free end play		
Standard	0.05 - 0.18 (0.0020 - 0.0071)	
Limit	0.30 (0.0118)	



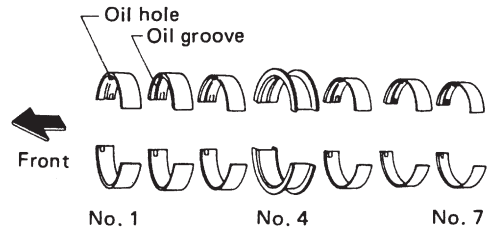
SEM645

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



EM715

### MAIN BEARING



SEM157B

### Standard

Unit: mm (in)

Grade number	Thickness "T"	Width "W"	Identification color
0	1.813 - 1.817 (0.0714 - 0.0715)	19.7 - 19.9 (0.776 - 0.783)	Black
1	1.817 - 1.821 (0.0715 - 0.0717)		Brown
2	1.821 - 1.825 (0.0717 - 0.0719)		—
3	1.825 - 1.829 (0.0719 - 0.0720)		Yellow
4	1.829 - 1.833 (0.0720 - 0.0722)		Blue

### Undersize

Unit: mm (in)

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

### CONNECTING ROD BEARING

#### Connecting rod bearing

#### Standard size

Unit: mm (in)

Grade number	Thickness "T"	Width "W"	Identification color
0	1.492 - 1.496 (0.0587 - 0.0589)	19.9 - 20.1 (0.783 - 0.791)	Black
1	1.496 - 1.500 (0.0589 - 0.0591)		Yellow
2	1.500 - 1.504 (0.0591 - 0.0592)		Brown



## SERVICE DATA AND SPECIFICATIONS (SDS)

### Inspection and Adjustment (Cont'd)

#### Undersize

Unit: mm (in)

Undersize	Thickness "T"	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.536 - 1.540 (0.0605 - 0.0606)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.556 - 1.560 (0.0613 - 0.0614)	
0.25 (0.0098)	1.621 - 1.625 (0.0638 - 0.0640)	

#### MISCELLANEOUS COMPONENTS

Unit: mm (in)

Camshaft sprocket runout limit [TIR]	0.1 (0.004)
Flywheel runout limit [TIR]	0.1 (0.004)
Drive plate runout limit [TIR]	0.1 (0.004)

#### Bearing clearance

Unit: mm (in)

##### Main bearing clearance

Standard	0.036 - 0.063 (0.0014 - 0.0025)
Limit	0.12 (0.0047)

##### Connecting rod bearing clearance

Standard	0.031 - 0.055 (0.0012 - 0.0022)
Limit	0.11 (0.0043)