

# ENGINE MECHANICAL

## SECTION **EM**

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**EM**

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## PRECAUTIONS

### Parts Requiring Angular Tightening

- Tighten the following engine parts in an angular-tightening method, not in a torque-setting method. Otherwise, with the latter method, the dispersal of tightening force (axial bolt force) would be greater (two or three times).
- The bolts and nuts which require the angular-tightening method are as follows:
  - (1) Cylinder head bolts
  - (2) Main bearing cap bolts
  - (3) Connecting rod cap nuts
  - (4) Crankshaft pulley bolt
- Before tightening bolts and nuts, ensure thread and seat surfaces are clean and coated with engine oil.

### Supplemental Restraint System "AIR BAG"

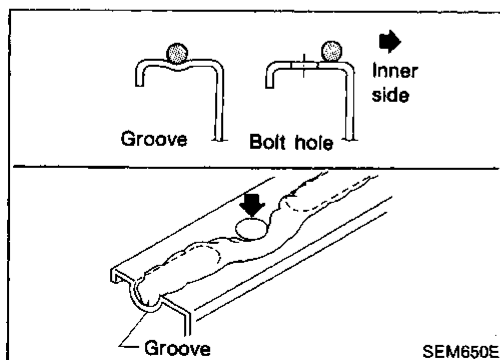
The Supplemental Restraint System "Air Bag", used along with a seat belt, helps to reduce the risk or severity of injury to the driver and front passenger in a frontal collision. The Supplemental Restraint System consists of air bag modules (located in the center of the steering wheel and on the instrument panel on the passenger side), a diagnosis sensor unit, warning lamp, wiring harness and spiral cable. Information necessary to service the system safely is included in the **BF section** of this Service Manual.

#### WARNING:

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

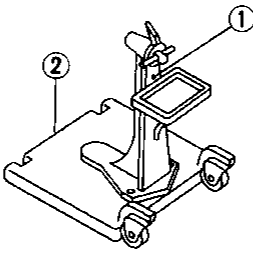
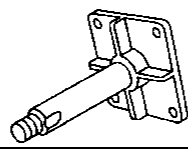
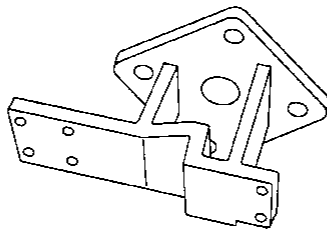
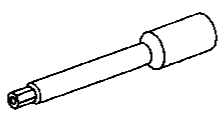
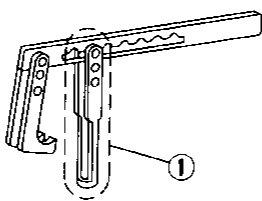
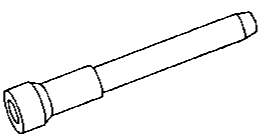
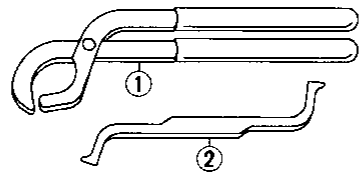
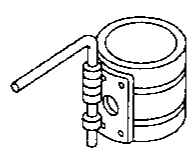
### Liquid Gasket Application Procedure

- Remove all traces of old liquid gasket from mating surfaces and grooves using a scraper. Then completely clean any oil stains from these portions.
- Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)
  - Be sure liquid gasket is 4.5 to 5.5 mm (0.177 to 0.217 in) wide (for oil pan).
  - Be sure liquid gasket is 2.6 to 3.6 mm (0.102 to 0.142 in) wide (for front timing chain case).
  - Be sure liquid gasket is 2.3 to 3.3 mm (0.091 to 0.130 in) wide (in areas except oil pan and front timing chain case).
- 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.




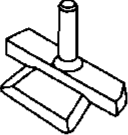
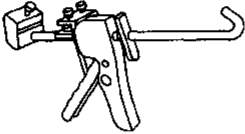
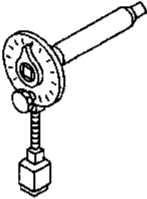
# PREPARATION

## Special Service Tools

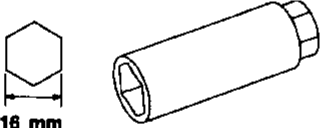

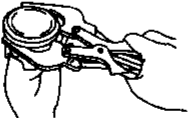
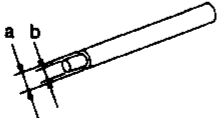
Tool number (Kent-Moore No.) Tool name	Description	
ST0501S000 ( — ) Engine stand assembly ① ST05011000 ( — ) Engine stand ② ST05012000 ( — ) Base	 NT042	Disassembling and assembling  GI  MA  <b>EM</b>  LC
KV10106500 ( — ) Engine stand shaft	 NT028	EC  FE
KV10117000 (J41262) Engine sub-attachment	 NT358	CL  MT
ST10120000 (J24239-01) Cylinder head bolt wrench	 NT019	Loosening and tightening cylinder head bolt  AT  FA
KV10116200 (J26336-A) Valve spring compressor ① KV10115900 (J26336-20) Attachment	 NT022	Disassembling valve mechanism  RA  BR
(J39386) Valve oil seal drift	 NT024	Installing valve oil seal  ST  BF
KV101151S0 (J38972) Lifter stopper set ① KV10115110 (J38972-1) Camshaft pliers ② KV10115120 (J38972-2) Lifter stopper	 NT041	Changing shims  HA  EL  BX
EM03470000 (J8037) Piston ring compressor	 NT044	Installing piston assembly into cylinder bore

## PREPARATION

### Special Service Tools (Cont'd)

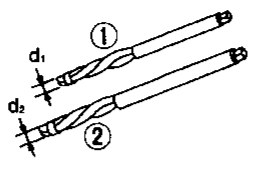
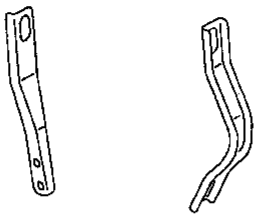
Tool number (Kent-Moore No.) Tool name	Description
ST16610001 (J23907) Pilot bushing puller	 Removing crankshaft pilot bushing NT045
KV10111100 (J37228) Seal cutter	 Removing oil pan and front timing chain case NT046
WS39930000 ( — ) Tube presser	 Pressing the tube of liquid gasket NT052
KV10112100 (BT8653-A) Angle wrench	 Tightening bolts for bearing cap, cylinder head, etc. NT014

### Commercial Service Tools

Tool name	Description
Spark plug wrench	 Removing and installing spark plug NT047
Valve seat cutter set	 Finishing valve seat dimensions NT048
Piston ring expander	 Removing and installing piston ring NT030
Valve guide drift	 Removing and installing valve guide NT015 <b>Intake &amp; Exhaust:</b> a = 9.5 mm (0.374 in) dia. b = 5.5 mm (0.217 in) dia.

# PREPARATION

## Commercial Service Tools (Cont'd)

Tool name	Description					
Valve guide reamer	 <p style="text-align: center;">NT016</p>	<p>Reaming valve guide ① or hole for over-size valve guide ②</p> <p><b>Intake &amp; Exhaust:</b>  <math>d_1 = 6.0 \text{ mm (0.236 in) dia.}</math>  <math>d_2 = 10.2 \text{ mm (0.402 in) dia.}</math></p>				
Engine slinger	 <p style="text-align: center;">NT359</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Front</td> <td style="width: 50%;">10005-31U00</td> </tr> <tr> <td>Rear</td> <td>10006-31U00</td> </tr> </table>	Front	10005-31U00	Rear	10006-31U00
Front	10005-31U00					
Rear	10006-31U00					

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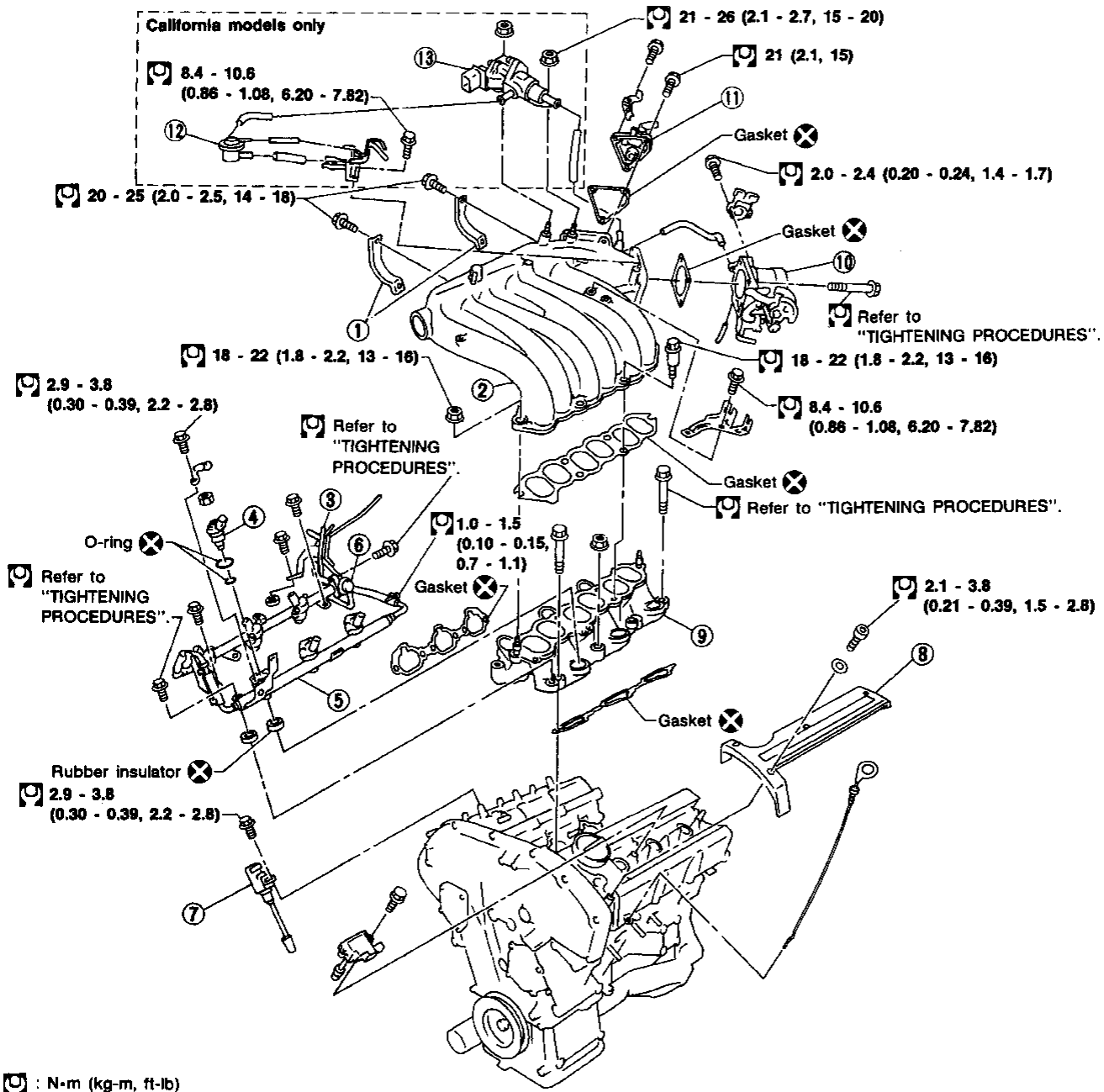
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# OUTER COMPONENT PARTS

SEC. 140-148-163-164-220



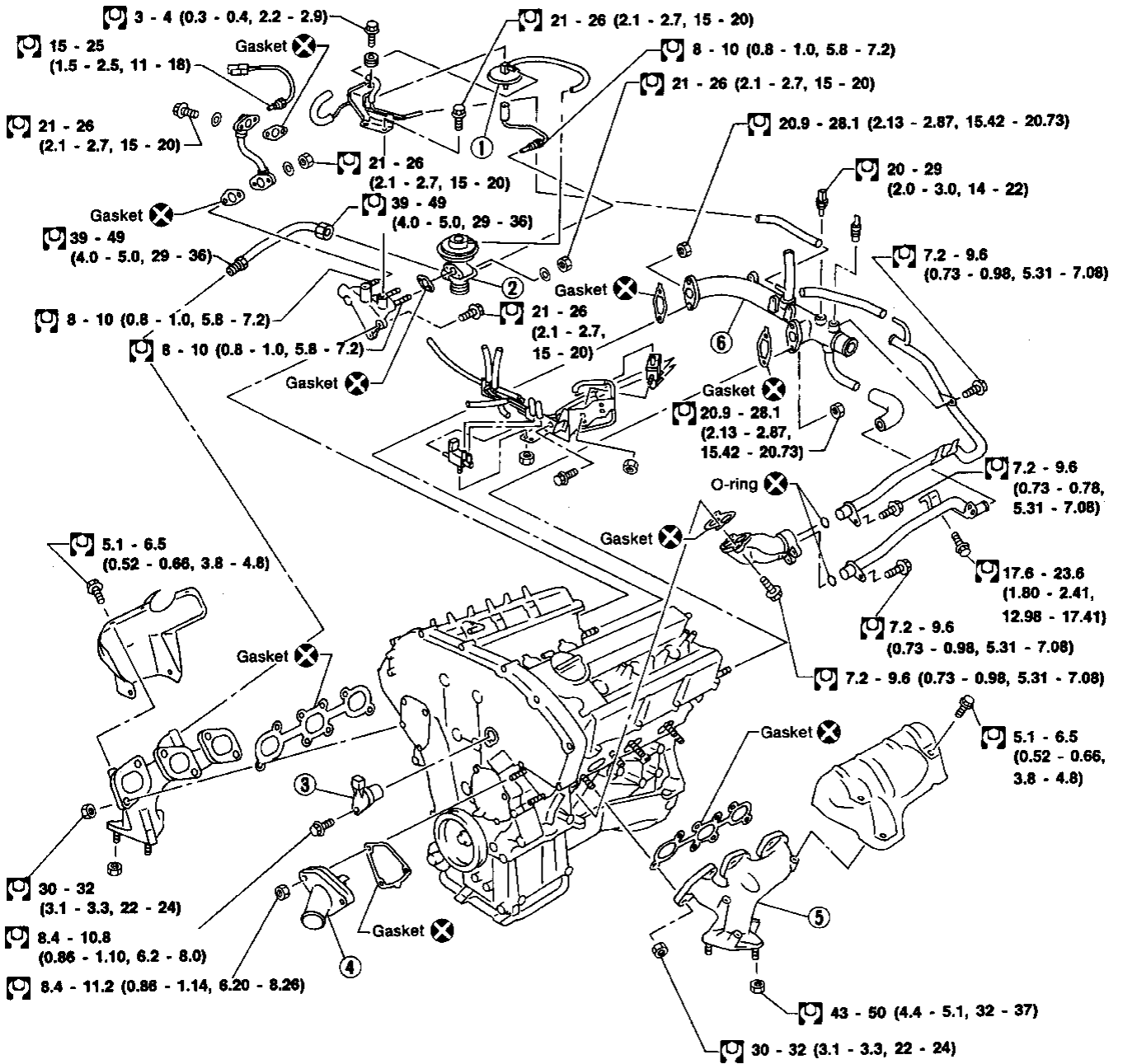
☐ : N·m (kg-m, ft-lb)

SEM906E

- |                                     |                                       |                                |
|-------------------------------------|---------------------------------------|--------------------------------|
| ① Intake manifold collector support | ⑤ Fuel tube assembly                  | ⑨ Intake manifold              |
| ② Intake manifold collector         | ⑥ Fuel pressure regulator             | ⑩ Throttle body                |
| ③ Sub-fuel tube                     | ⑦ Ignition coil with power transistor | ⑪ IACV-AAC valve               |
| ④ Injector                          | ⑧ Ornament cover                      | ⑫ Canister purge cut valve     |
|                                     |                                       | ⑬ Canister purge control valve |

# OUTER COMPONENT PARTS

SEC. 140-147-210-211-221



- ① EGRC-BPT valve
- ② EGR valve

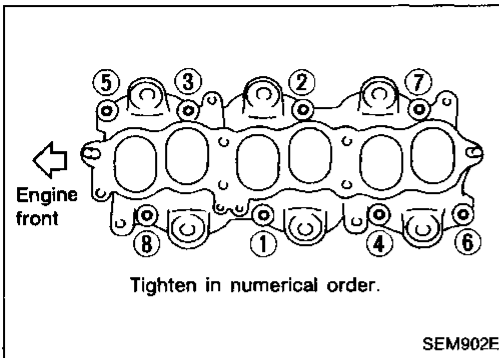
- ③ Camshaft position sensor (PHASE)
- ④ Thermostat with water inlet

- ⑤ Exhaust manifold
- ⑥ Water outlet

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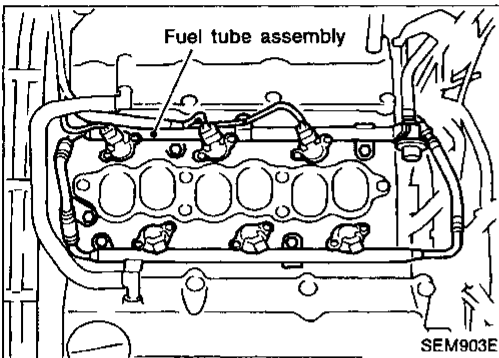
## OUTER COMPONENT PARTS



### TIGHTENING PROCEDURES

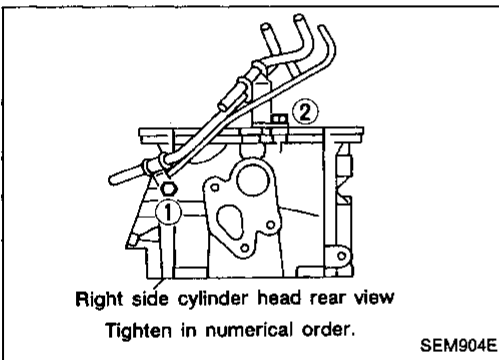
#### Intake manifold

1. Tighten all bolts and nuts to 5 to 10 N·m (0.5 to 1.0 kg-m, 3.6 to 7.2 ft-lb).
2. Tighten all bolts and nuts to 26 to 31 N·m (2.7 to 3.2 kg-m, 20 to 23 ft-lb).



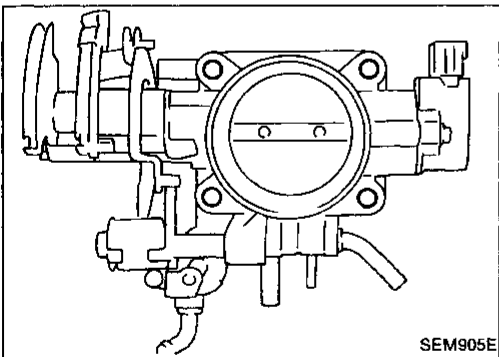
#### Fuel tube

1. Tighten all bolts to 9.3 to 10.8 N·m (0.95 to 1.1 kg-m, 6.9 to 8.0 ft-lb).
2. Tighten all bolts to 21 to 26 N·m (2.1 to 2.7 kg-m, 15 to 20 ft-lb).



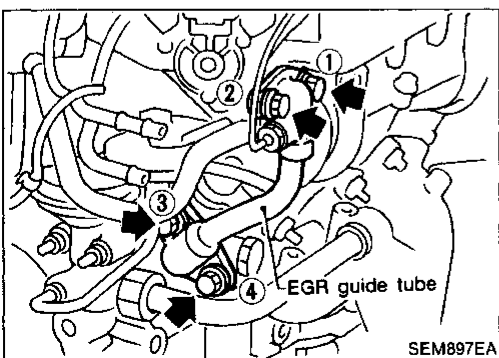
#### Sub-fuel tube

1. Tighten all bolts to 4.21 to 5.88 N·m (0.429 to 0.600 kg-m, 3.105 to 4.337 ft-lb).
2. Tighten all bolts to 8.43 to 10.78 N·m (0.860 to 1.100 kg-m, 6.218 to 7.951 ft-lb).



#### Throttle body

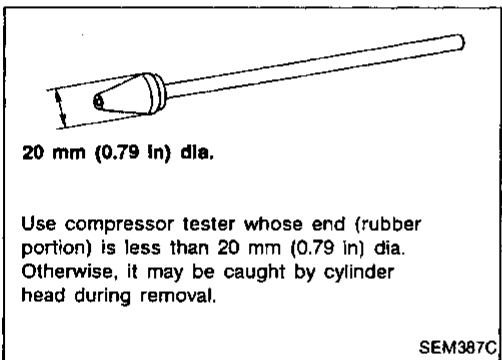
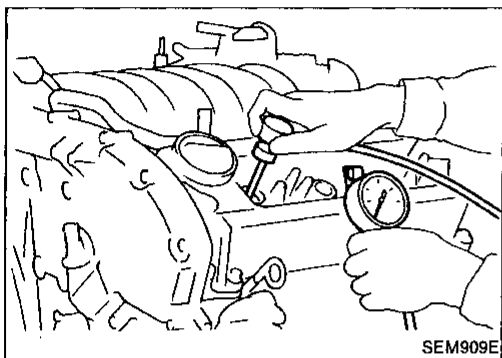
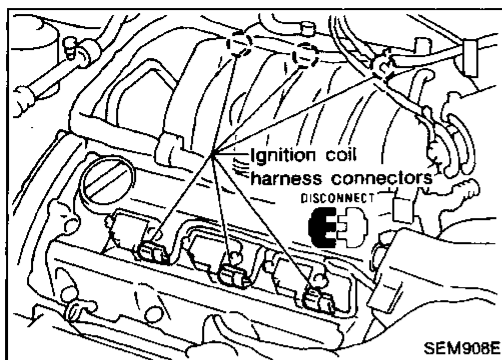
1. Tighten all bolts to 9 to 11 N·m (0.9 to 1.1 kg-m, 6.5 to 8.0 ft-lb).
2. Tighten all bolts to 18 to 22 N·m (1.8 to 2.2 kg-m, 13 to 16 ft-lb).



#### EGR guide tube

1. Tighten all bolts to 9 to 10 N·m (0.9 to 1.0 kg-m, 6.5 to 7.2 ft-lb).
2. Tighten all bolts to 21 to 26 N·m (2.1 to 2.7 kg-m, 15 to 20 ft-lb).





## Measurement of Compression Pressure

1. Warm up engine.
2. Turn ignition switch off.
3. Release fuel pressure.  
Refer to "Releasing Fuel Pressure" in EC section.
4. Disconnect ignition coil (and power transistor) harness connector.
5. Remove all spark plugs.
6. Disconnect all injector harness connectors.

7. Attach a compression tester to No. 1 cylinder.
8. Depress accelerator pedal fully to keep throttle valve wide open.
9. Crank engine and record highest gauge indication.
10. Repeat the measurement on each cylinder as shown above.

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

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

**Standard**

1,275 (13.0, 185)/300

**Minimum**

981 (10.0, 142)/300

**Difference limit between cylinders:**

98 (1.0, 14)/300

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

- **If adding oil helps compression, piston rings may be worn or damaged. If so, replace piston rings after checking piston.**
- **If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. (Refer to SDS.) If valve or valve seat is damaged excessively, replace them.**
- **There is leakage past the gasket surface if the following is observed. Compression in two adjacent cylinders is low and adding oil does not improve compression. If so, replace cylinder head gasket.**

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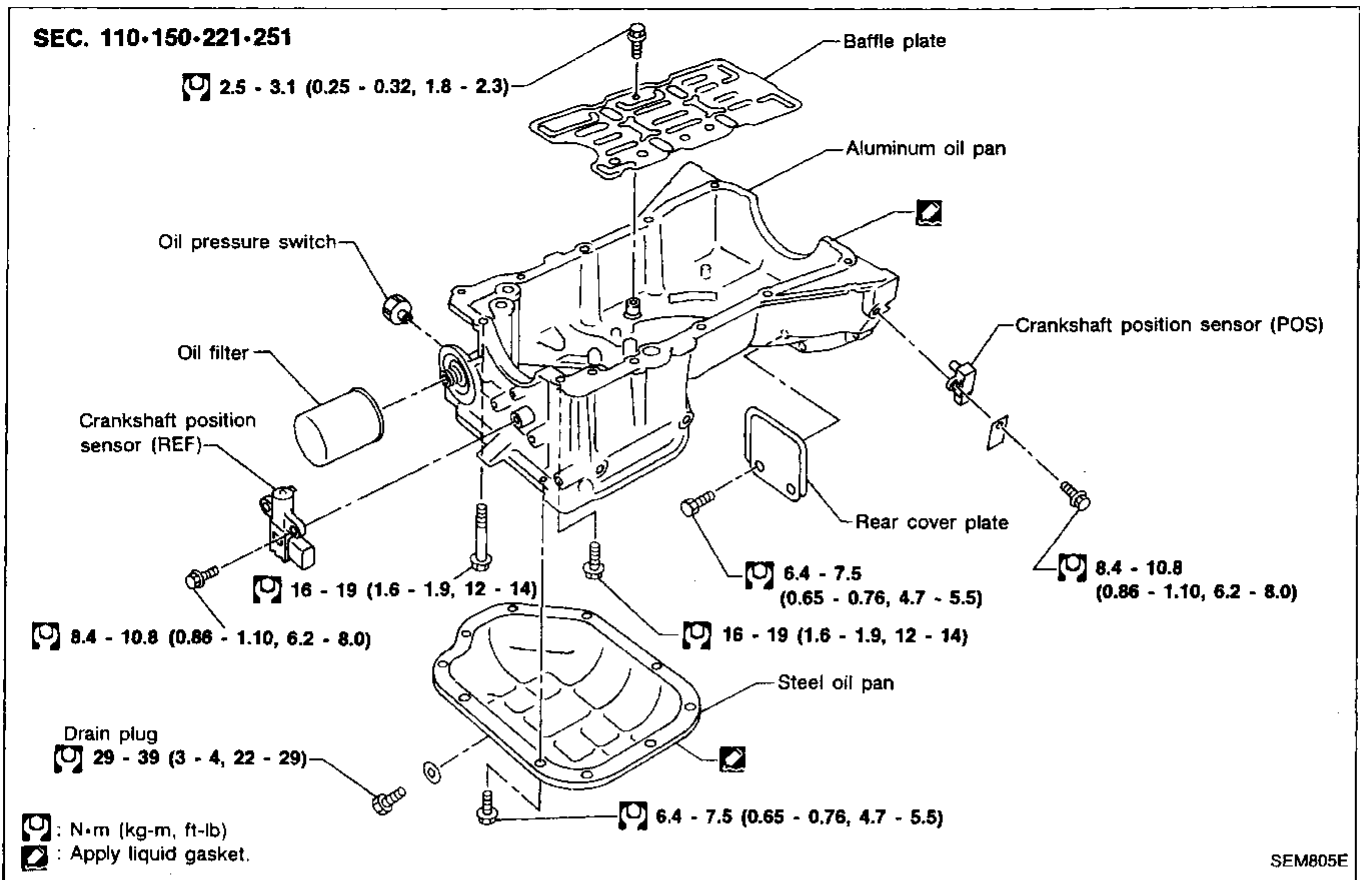
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# OIL PAN



## Removal

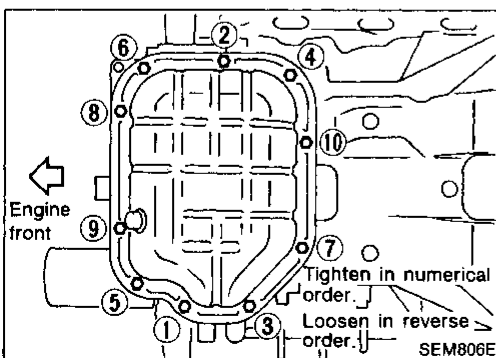
### CAUTION:

When removing the aluminum oil pan from engine, first remove the crankshaft position sensors (POS and REF) from the assembly.

Be careful not to damage sensor edges and ring gear teeth.

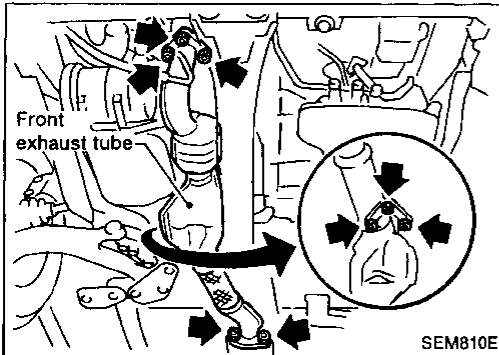
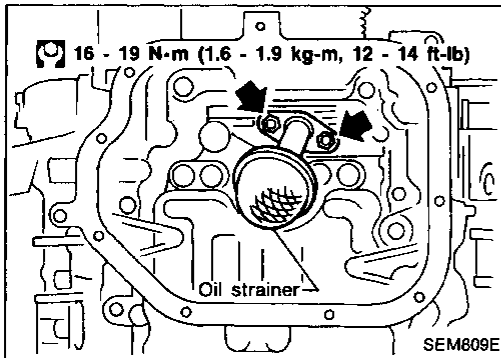
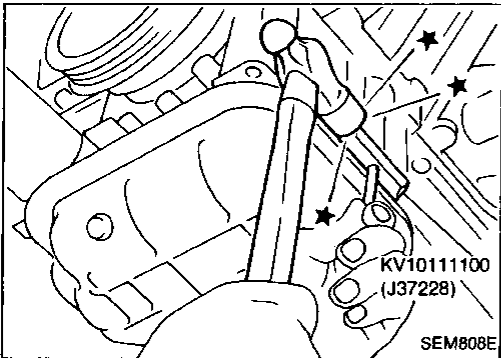
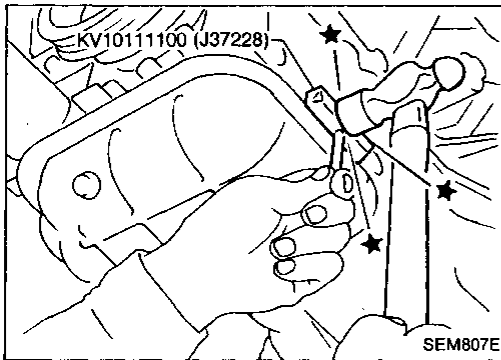
1. Remove engine undercover.
2. Drain engine oil.

3. Remove steel oil pan bolts.



## OIL PAN

### Removal (Cont'd)



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

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

5. Remove oil strainer.

6. Remove front exhaust tube and its support.

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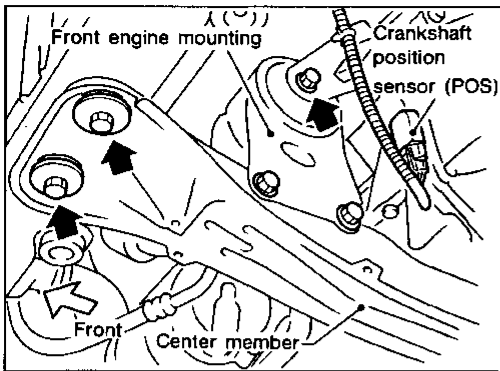
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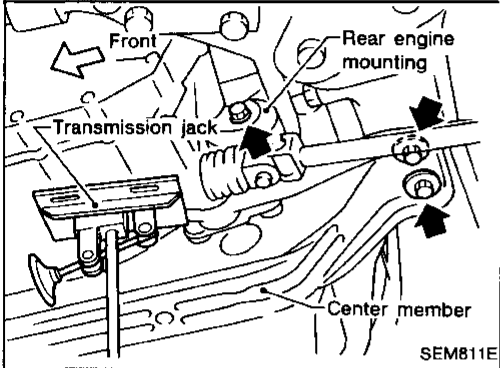
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# OIL PAN

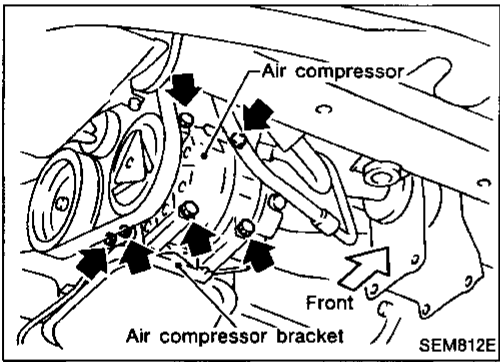
## Removal (Cont'd)



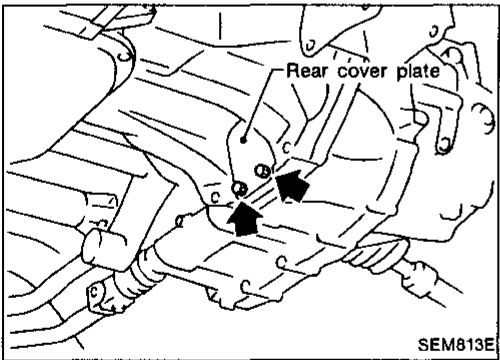
7. Set a suitable transmission jack under transaxle and hoist engine with engine slinger.
8. Remove crankshaft position sensors (POS and REF) from oil pan.
9. Remove front and rear engine mounting nuts and bolts.
10. Remove center member.



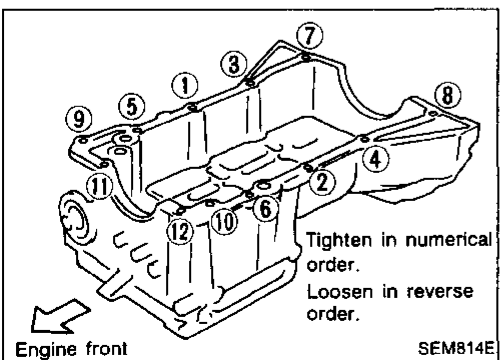
11. Remove drive belts.
12. Remove air compressor and bracket.



13. Remove rear cover plate.



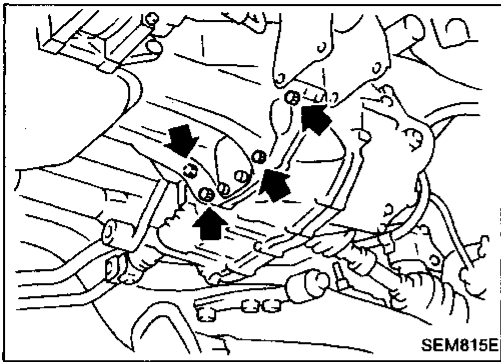
14. Remove aluminum oil pan bolts.



# OIL PAN

## Removal (Cont'd)

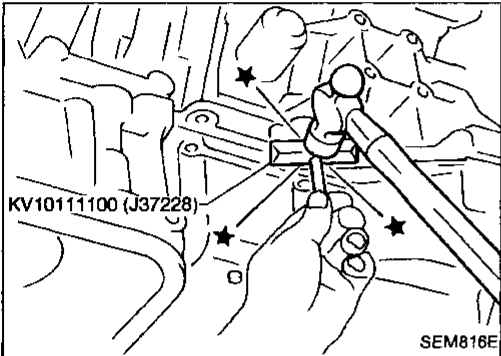
15. Remove transaxle bolts.



16. Remove aluminum oil pan.

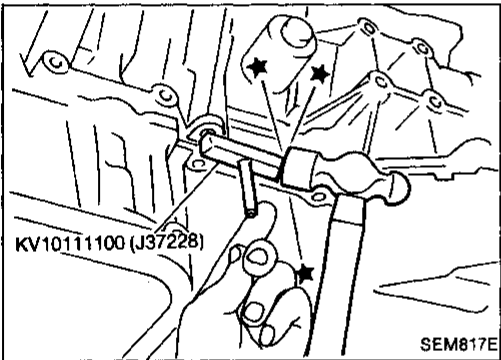
(1) Insert Tool between cylinder block and aluminum oil pan.

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

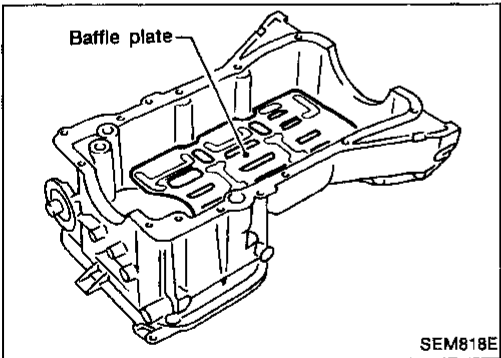


(2) Slide Tool by tapping on the side of the Tool with a hammer.

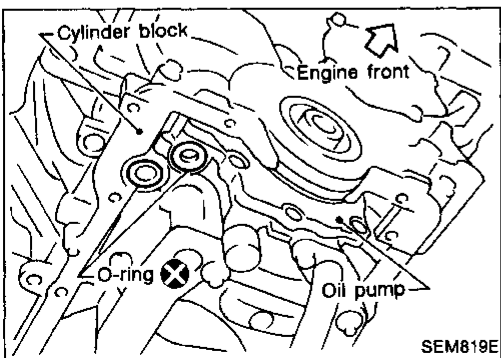
(3) Remove aluminum oil pan.



17. Remove baffle plate.



18. Remove O-rings from cylinder block and oil pump body.



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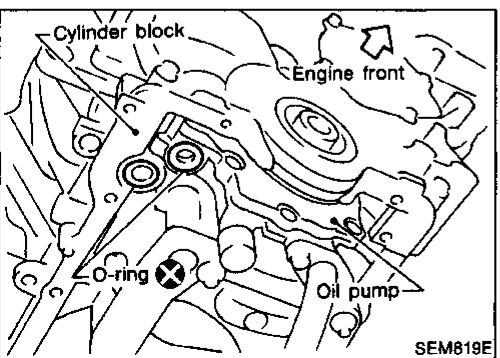
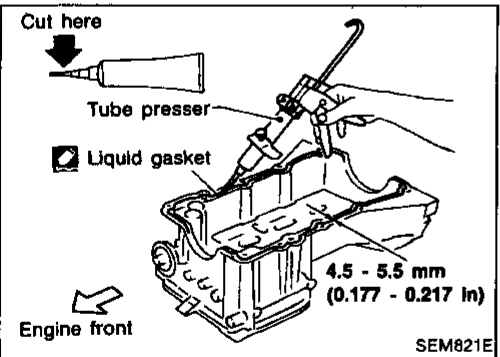
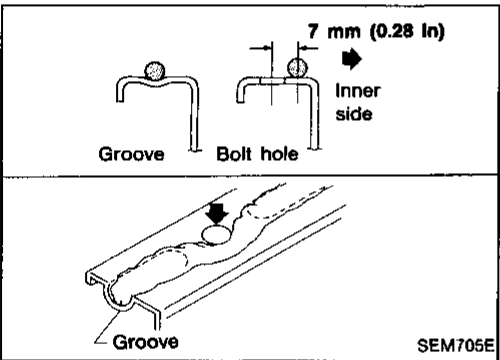
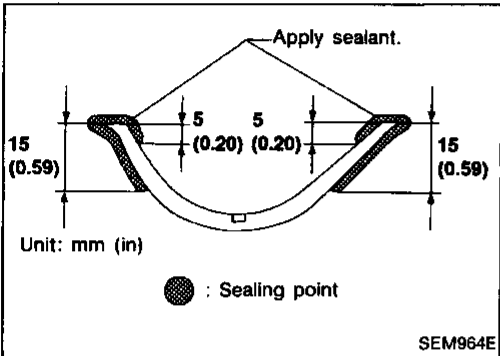
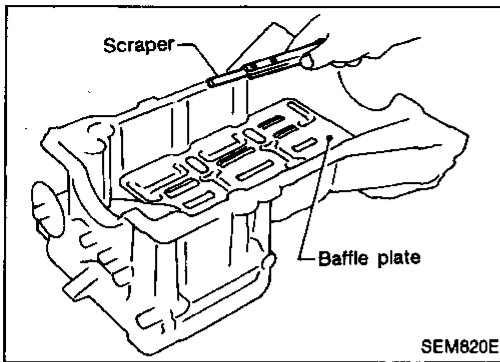
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# OIL PAN

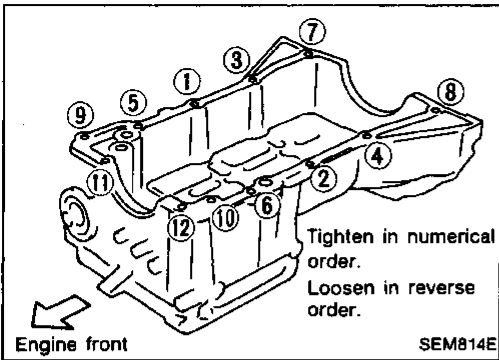


## Installation

1. Install aluminum oil pan.
  - (1) Before installing aluminum oil pan, remove all traces of liquid gasket from mating surfaces using a scraper.
    - Also remove traces of liquid gasket from mating surface of cylinder block, front cover and steel oil pan.
  - (2) Install baffle plate.
  - (3) Apply sealant to front cover gasket and rear oil seal retainer gasket.
  - (4) Apply a continuous bead of liquid gasket to mating surface of aluminum oil pan.
    - **Use Genuine Liquid Gasket or equivalent.**
  - (5) Apply liquid gasket to inner sealing surface as shown in figure.
    - **Be sure liquid gasket is 4.5 to 5.5 mm (0.177 to 0.217 in) wide.**
    - **Attaching should be done within 5 minutes after coating.**
  - (6) Install O-rings, cylinder block and oil pump body.

# OIL PAN

## Installation (Cont'd)



- (7) Install aluminum oil pan.
- Install bolts in the reverse order of removal.
  - **Wait at least 30 minutes before refilling engine oil.**

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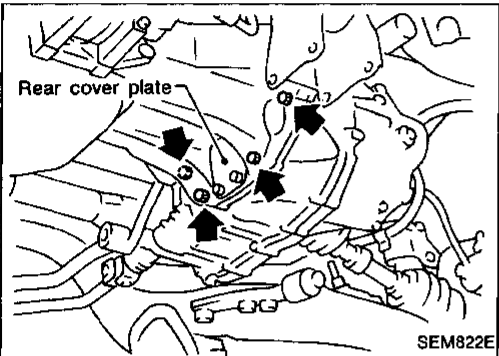
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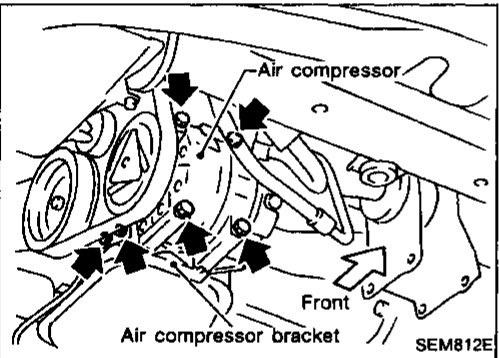
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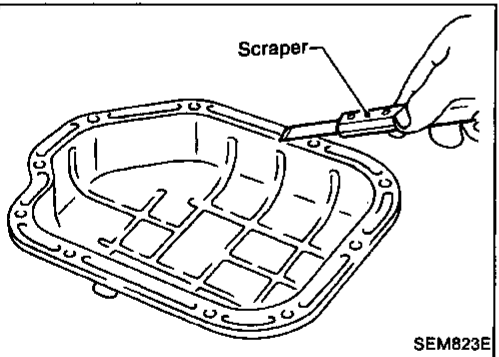
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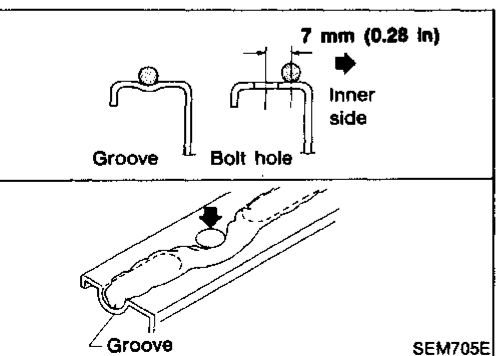
2. Install the transaxle bolts.  
3. Install rear cover plate.



4. Install air compressor and bracket.  
5. Install drive belts.  
6. Install center member.  
7. Install front and rear engine mounting insulator nuts and bolts.  
8. Install crankshaft position sensors (POS and REF).  
9. Install front exhaust tube and its support.  
10. Install oil strainer.



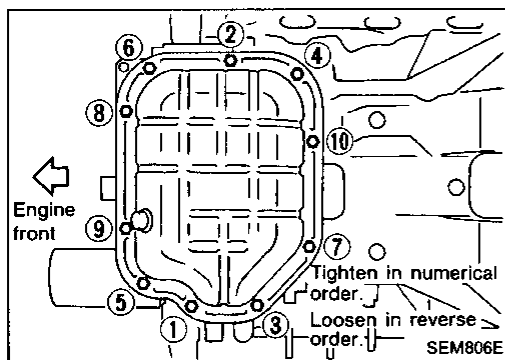
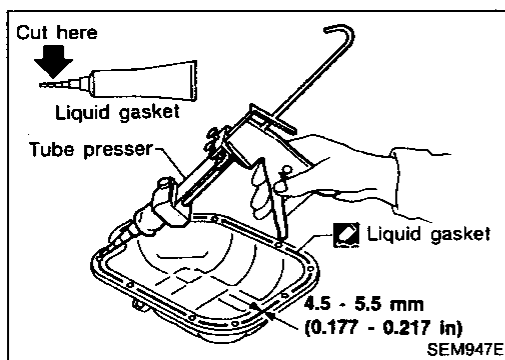
11. Install steel oil pan.  
(1) Before installing steel oil pan, remove all traces of liquid gasket from mating surfaces using a scraper.
- Also remove traces of liquid gasket from mating surface of aluminum oil pan.



- (2) Apply a continuous bead of liquid gasket to mating surface of steel oil pan.
- **Use Genuine Liquid Gasket or equivalent.**
  - **Be sure liquid gasket is 4.5 to 5.5 mm (0.177 to 0.217 in) wide.**
  - **Attaching should be done within 5 minutes after coating.**

# OIL PAN

## Installation (Cont'd)



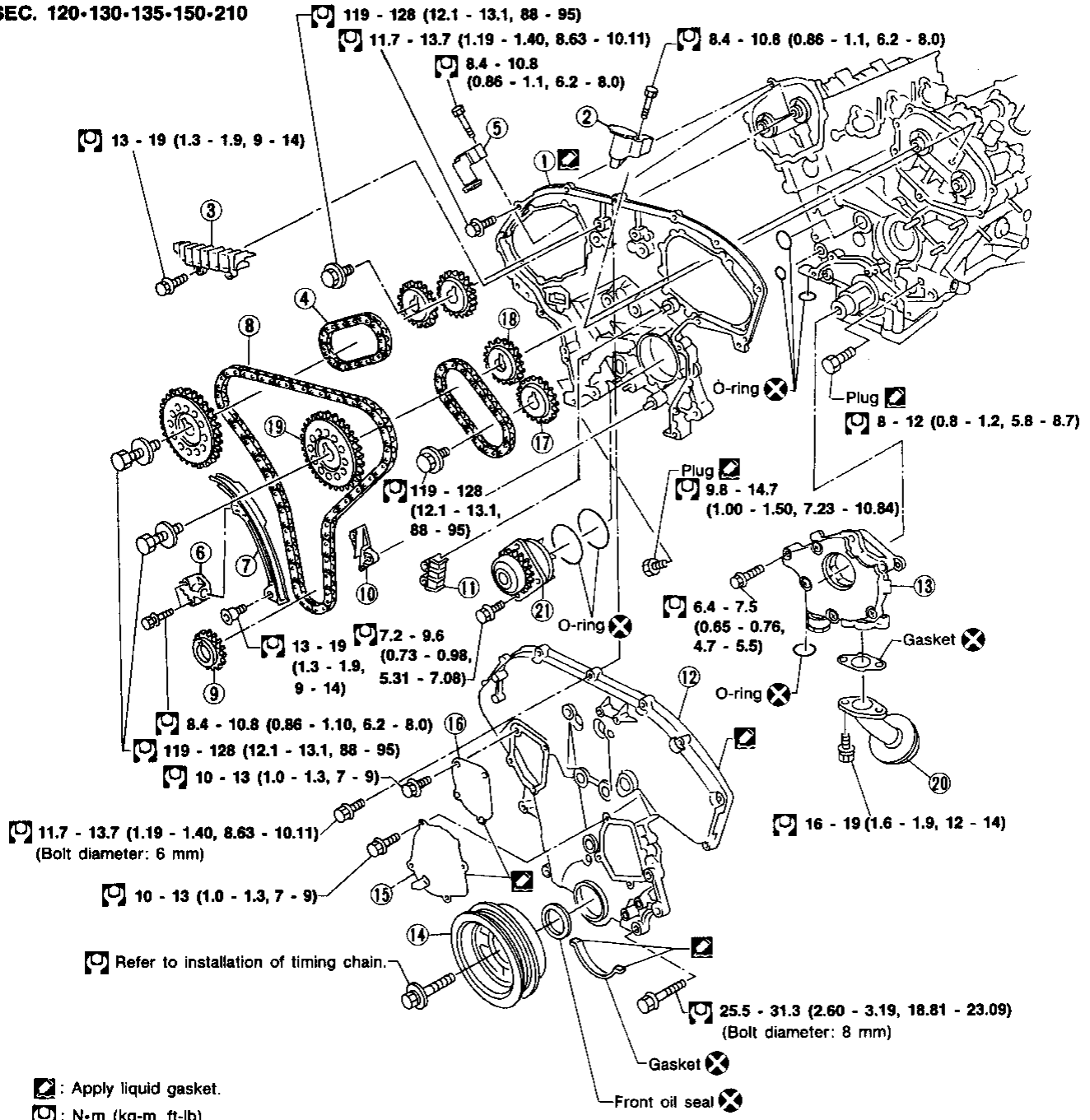
(3) Install steel oil pan.

- Install bolts in the reverse order of removal.
- **Wait at least 30 minutes before refilling engine oil.**



# TIMING CHAIN

SEC. 120-130-135-150-210



- |                            |                           |                                 |
|----------------------------|---------------------------|---------------------------------|
| ① Rear timing chain case   | ⑧ Timing chain            | ⑮ Water pump cover              |
| ② Left camshaft tensioner  | ⑨ Crankshaft sprocket     | ⑯ Chain tensioner cover         |
| ③ Internal chain guide     | ⑩ Lower chain guide       | ⑰ Exhaust camshaft sprocket 2ND |
| ④ Camshaft chain           | ⑪ Upper chain guide       | ⑱ Intake camshaft sprocket 2ND  |
| ⑤ Right camshaft tensioner | ⑫ Front timing chain case | ⑲ Camshaft sprocket 1ST         |
| ⑥ Timing chain tensioner   | ⑬ Oil pump assembly       | ⑳ Oil strainer                  |
| ⑦ Slack side chain guide   | ⑭ Crankshaft pulley       | ㉑ Water pump                    |

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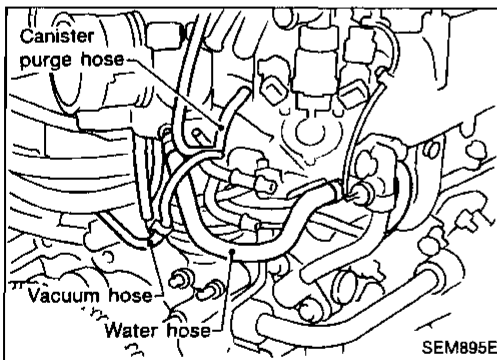
## TIMING CHAIN

### CAUTION:

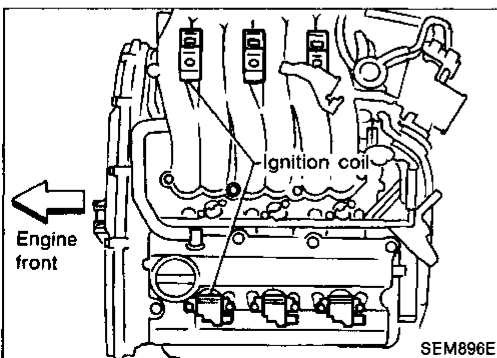
- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- Apply new engine oil to the sliding surfaces when installing sliding parts. Sliding parts include rocker arms, camshafts, chain tensioner, oil seal, etc.
- Apply new engine oil to bolt thread and seat surfaces when tightening the following: Cylinder head bolts, camshaft sprocket bolts, crankshaft pulley bolt and camshaft bracket bolts.
- When removing the oil pans, oil pump assembly and timing chain from engine, first remove the camshaft position sensor (PHASE) and the crankshaft position sensors (REF)/(POS) from the assembly.  
Be careful not to damage sensor edges.

### Removal

1. Drain engine oil.
2. Release fuel pressure.  
Refer to "Releasing Fuel Pressure" in EC section.
3. Drain coolant by removing cylinder block drain plugs and radiator drain cock.
4. Remove left side rocker cover ornament.
5. Remove air duct to intake manifold, collector, blow-by hose, vacuum hoses, fuel hoses, wires, harness, connectors and so on.



6. Remove the following hoses.
  - Vacuum hoses
  - Water hoses
  - Canister purge hose
  - Blow-by hose

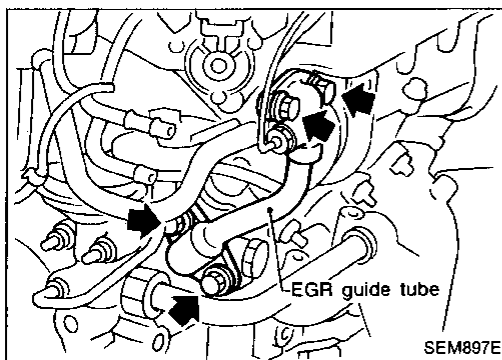


7. Remove RH and LH ignition coils.

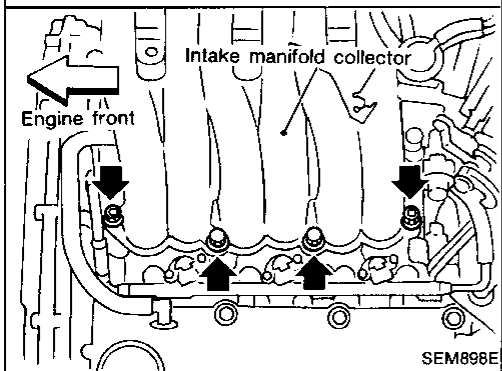
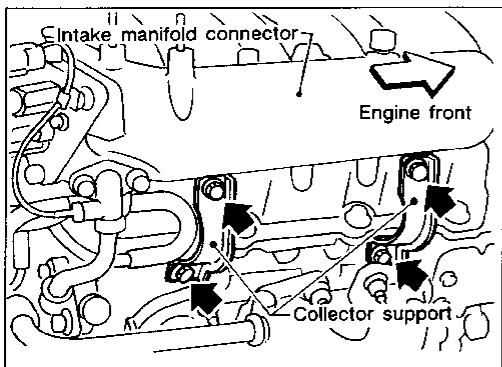
## TIMING CHAIN

### Removal (Cont'd)

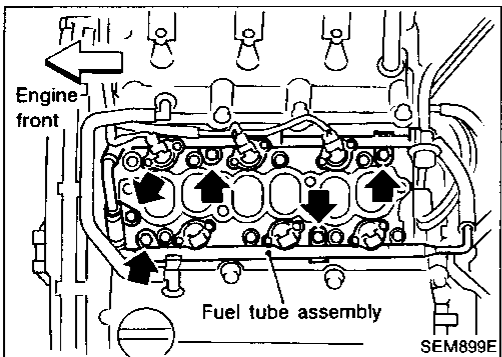
8. Remove EGR guide tube.



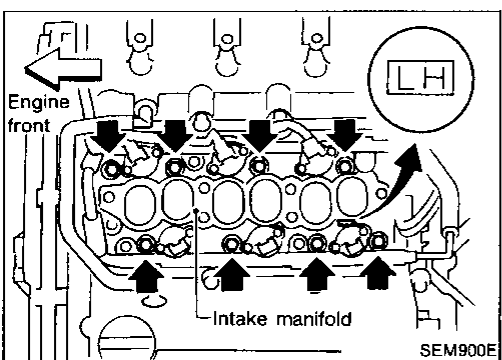
9. Remove intake manifold collector supports and intake manifold collector (RH cylinder head only).



10. Remove fuel tube assembly. Refer to "TIGHTENING PROCEDURES" in "OUTER COMPONENT PARTS", (EM-8).



11. Remove intake manifold in reverse order of installation. Refer to "TIGHTENING PROCEDURES" in "OUTER COMPONENT PARTS", (EM-8).



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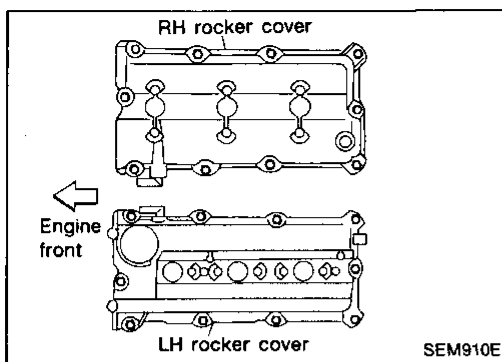
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## TIMING CHAIN

### Removal (Cont'd)

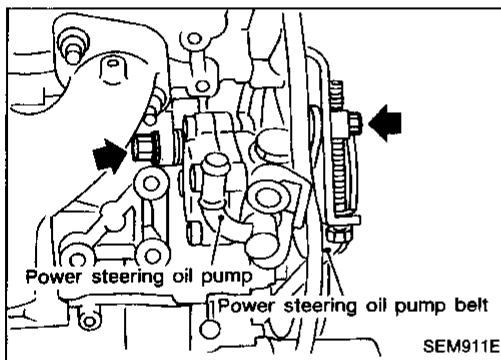
12. Remove RH and LH rocker covers from cylinder head.



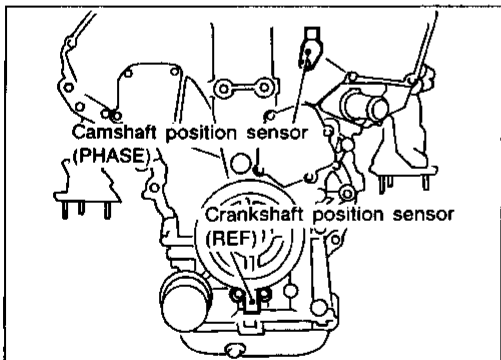
13. Remove engine undercover.

14. Remove front RH wheel and engine side cover.

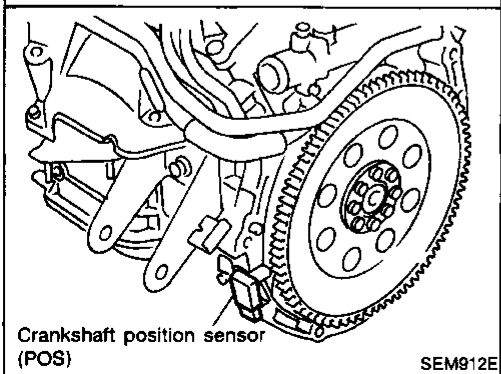
15. Remove drive belts and idler pulley bracket.



16. Remove power steering oil pump belt and power steering oil pump assembly.

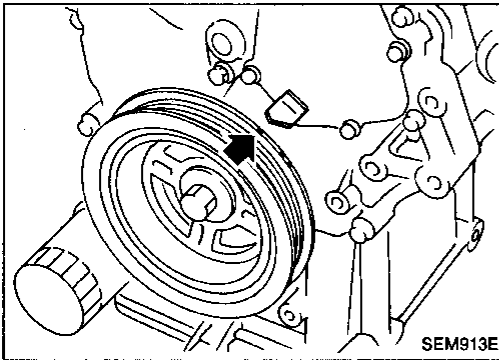


17. Remove camshaft position sensor (PHASE) and crankshaft position sensors (REF)/(POS).

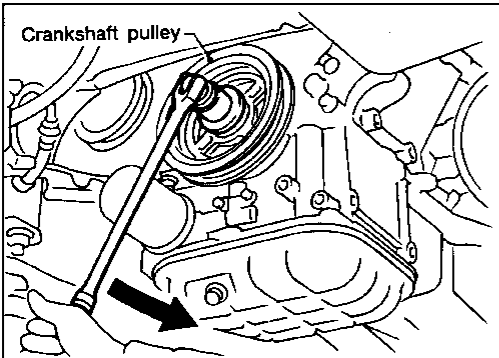


## TIMING CHAIN

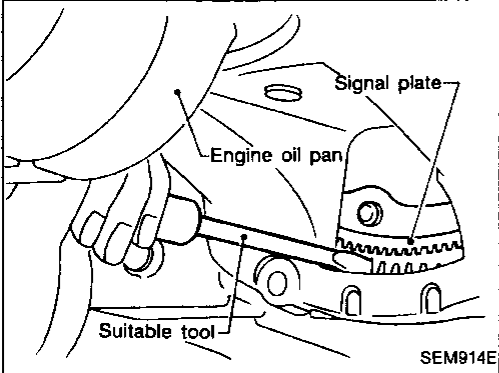
### Removal (Cont'd)



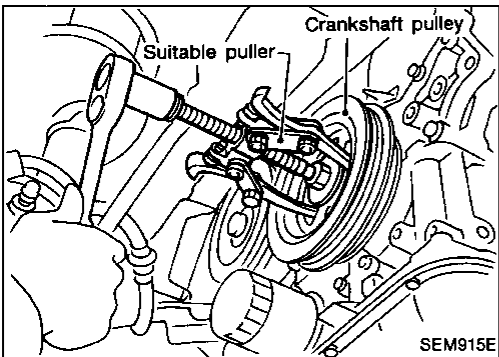
18. Set No. 1 piston at TDC on the compression stroke by rotating crankshaft.



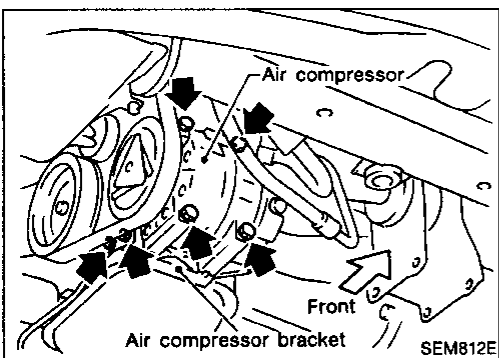
19. Loosen crankshaft pulley bolt. (At this time remove oil pan rear cover plate and set a suitable tool to ring gear so that crankshaft cannot rotate.)



- Be careful not to damage the signal plate teeth.



20. Remove crankshaft pulley with a suitable puller.



21. Remove air compressor and bracket.
22. Remove front exhaust tube and its support.
23. Hang engine at right and left side engine slingers with a suitable hoist.
24. Remove right side engine mounting, mounting bracket and nuts.
25. Remove center member assembly.
26. Remove upper and lower oil pans. (Refer to "Removal" in "OIL PAN".)

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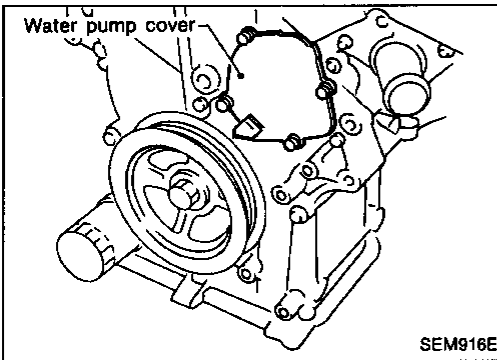
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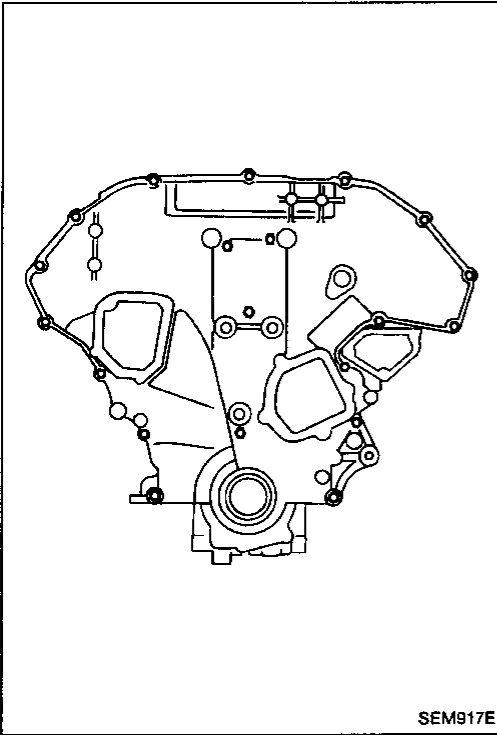
## TIMING CHAIN

### Removal (Cont'd)

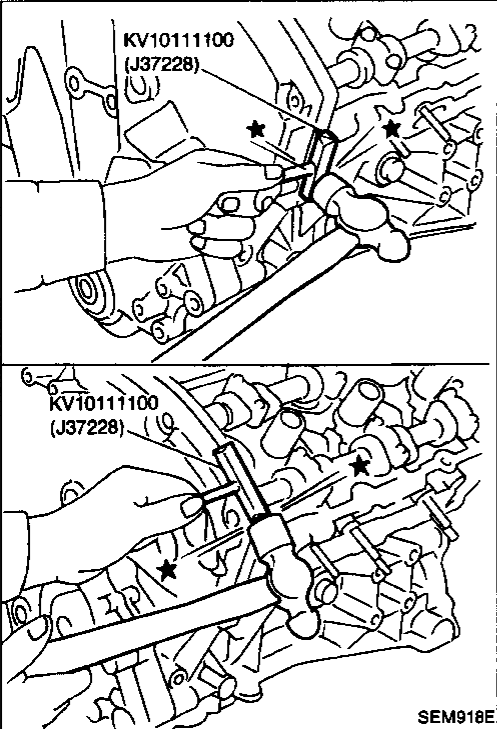
27. Remove water pump cover.



28. Remove front timing chain case bolts.

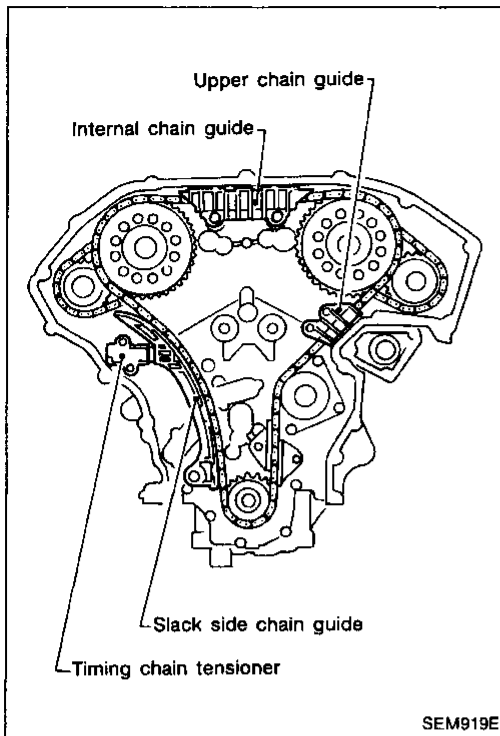


29. Remove front timing chain case.

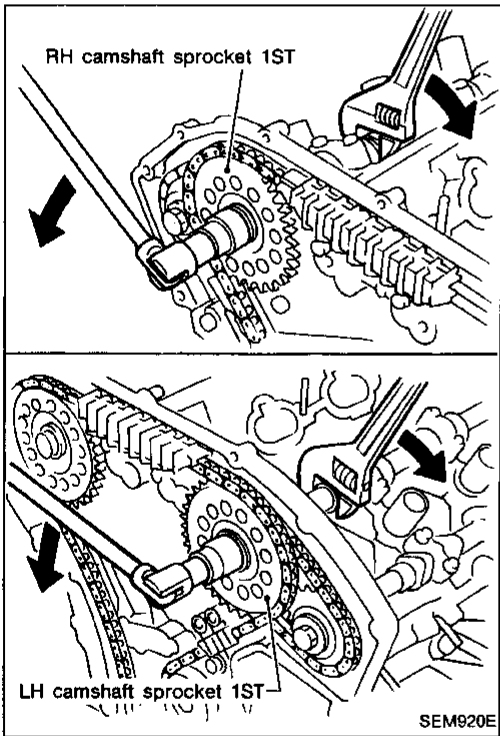


## TIMING CHAIN

### Removal (Cont'd)



30. Remove internal timing chain guide.
31. Remove upper chain guide.
32. Remove timing chain tensioner and slack side chain guide.



33. Remove RH & LH camshaft sprocket bolts 1ST.

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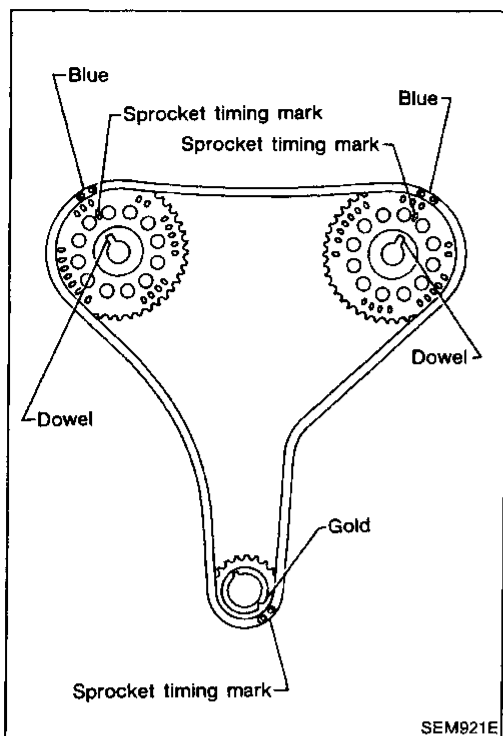
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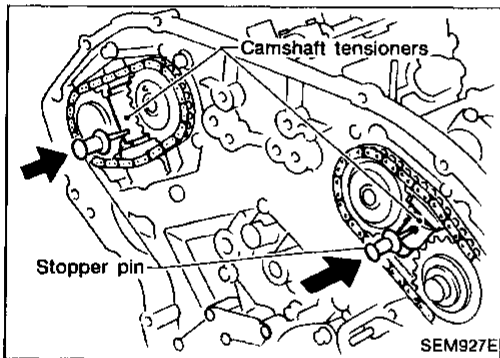
## TIMING CHAIN

### Removal (Cont'd)

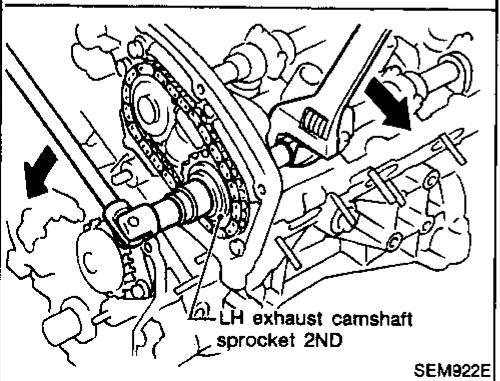
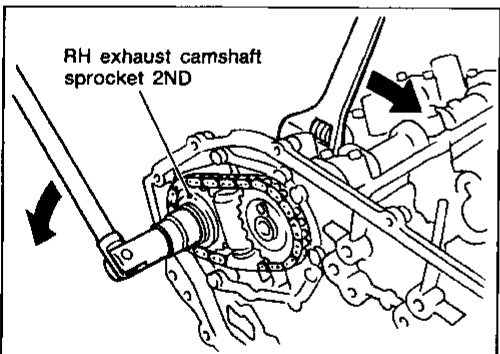
34. Remove camshaft sprockets 1ST on both sides, crankshaft sprocket and timing chain.



35. Attach a suitable stopper pin to RH and LH camshaft tensioners.



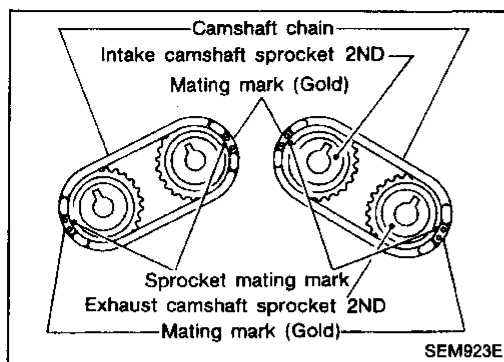
36. Remove exhaust camshaft sprocket 2ND bolts on both sides.



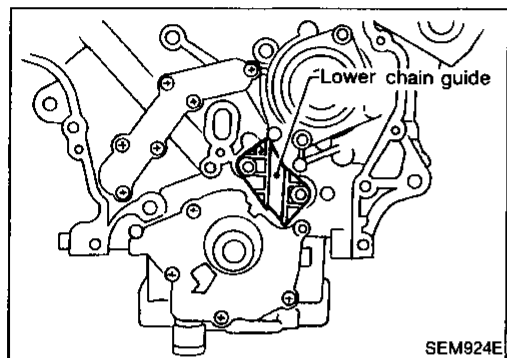


## TIMING CHAIN

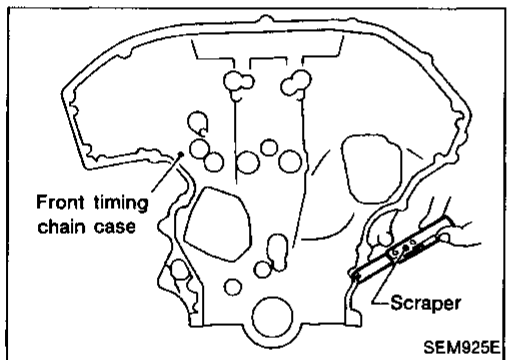
### Removal (Cont'd)



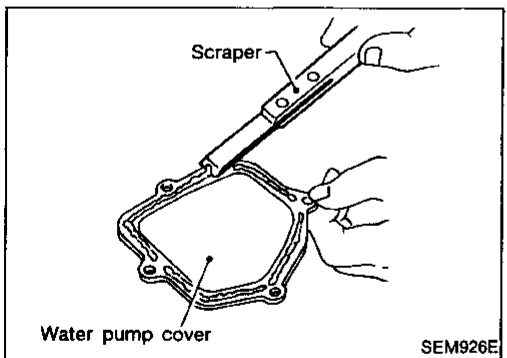
37. Remove exhaust camshaft sprockets 2ND, intake camshaft sprockets 2ND and camshaft chains on both sides.



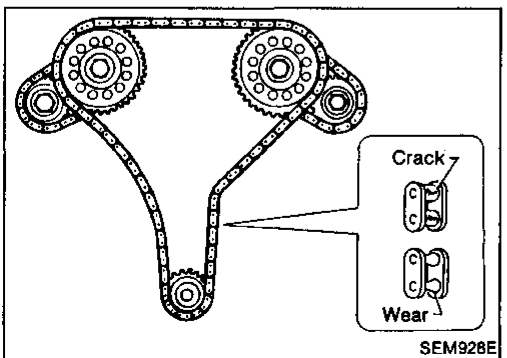
38. Remove lower chain guide.



39. Use a scraper to remove all traces of liquid gasket from front timing chain case.



40. Use a scraper to remove all traces of liquid gasket from water pump cover.



### Inspection

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

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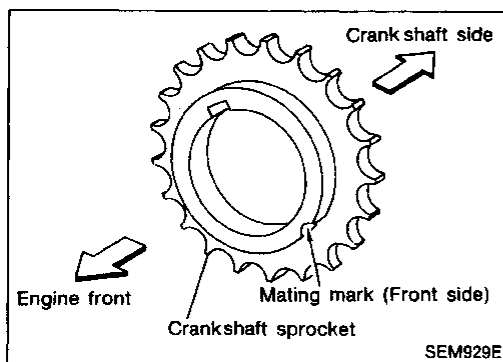
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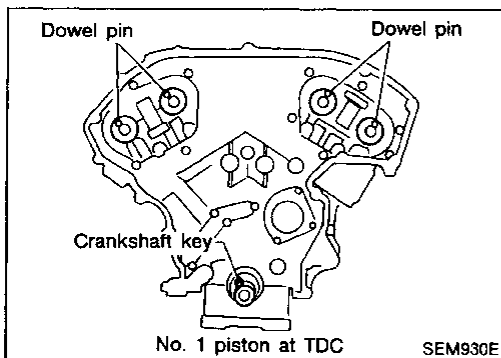
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# TIMING CHAIN

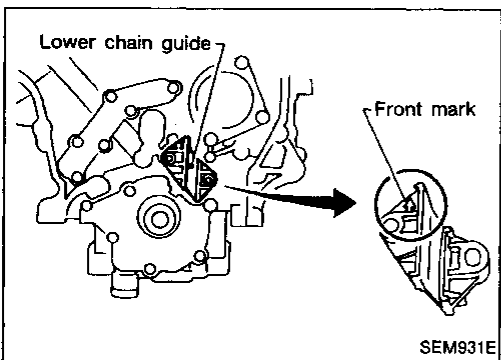


## Installation

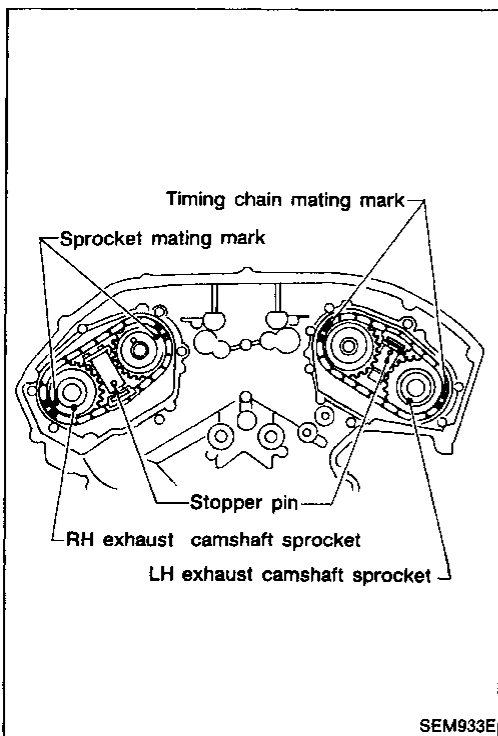
1. Install crankshaft sprocket on crankshaft.



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



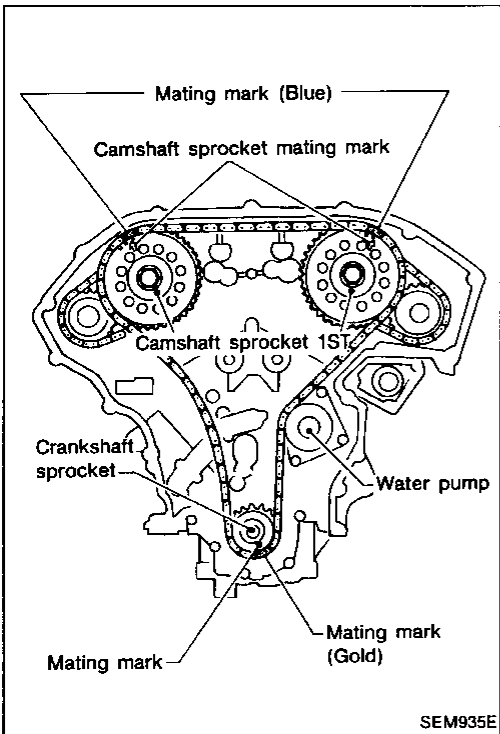
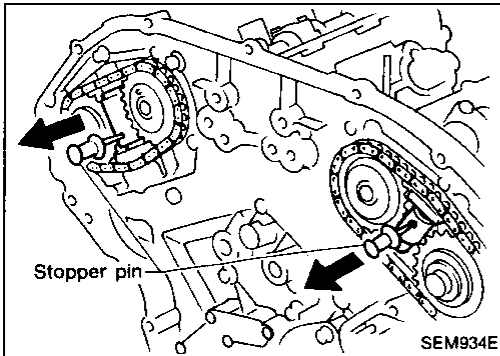
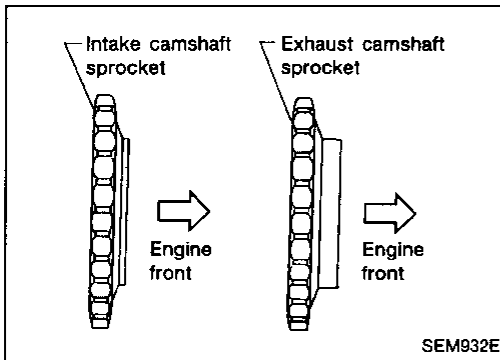
3. Install lower chain guide on dowel pin, with front mark on the guide facing upside.



4. Align the marks on RH and LH intake camshaft sprockets (2ND), exhaust camshaft sprockets 2ND and camshaft chain, as shown.
  5. Put LH camshaft dowel pin into camshaft sprocket dowel groove and install these on camshaft. Tighten LH exhaust camshaft sprocket 2ND bolt.
  6. Put RH camshaft dowel pin in camshaft sprocket hole and install sprocket on camshaft.
  7. Tighten RH exhaust camshaft sprocket 2ND bolt.
- **Make sure that the timing marks on RH and LH intake camshaft sprockets (2ND) are aligned with the camshaft chain mark.**

## TIMING CHAIN

### Installation (Cont'd)



8. Install intake and exhaust camshaft sprockets, being careful not to confuse the two (their thicknesses are different).
9. Remove RH and LH camshaft tensioner stopper pins.
10. Align mating mark on crankshaft sprocket with matchmark (gold) on chain as shown.
11. Attach lower timing chain on the water pump sprocket.
12. Install RH and LH camshaft sprockets (1ST) onto timing chain by matching sprocket dowel grooves with camshaft.
13. Tighten RH and LH camshaft sprocket 1ST bolts.
14. Install timing chain. Make sure that mating marks on crankshaft sprocket and RH and LH camshaft sprockets are aligned with matchmarks on timing chain.

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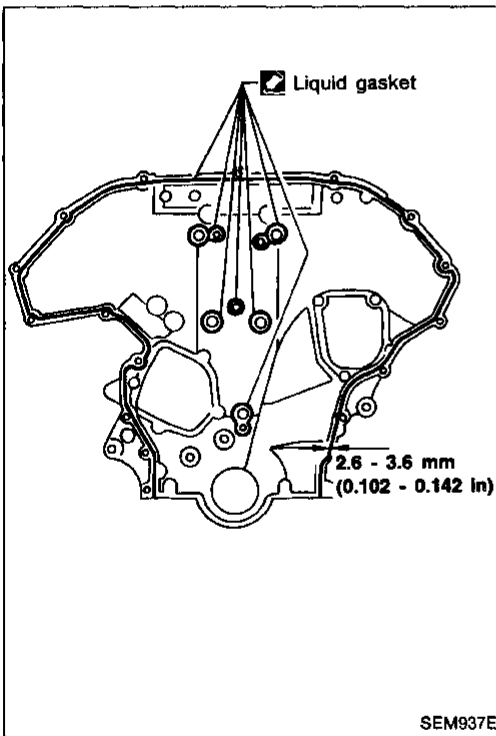
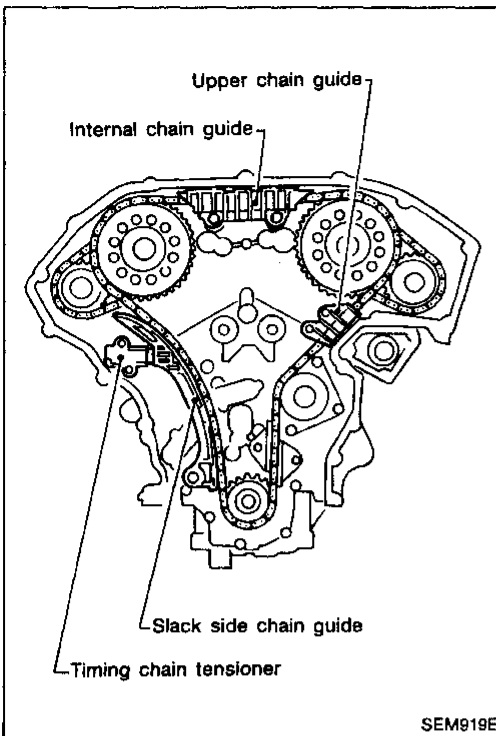
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## TIMING CHAIN

### Installation (Cont'd)

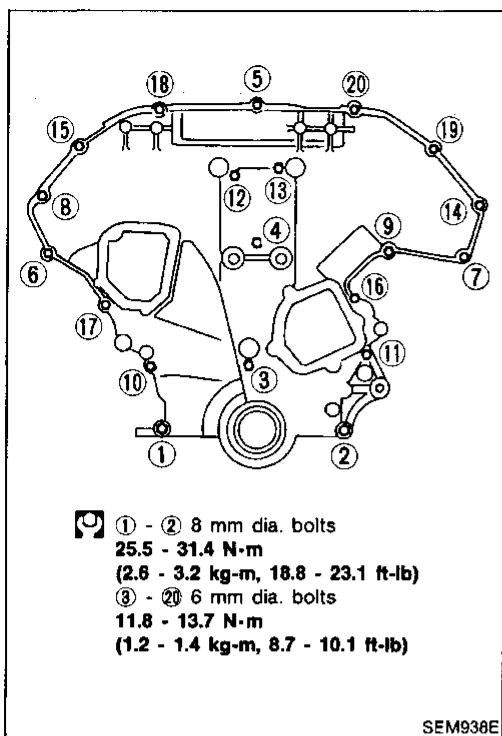
15. Install internal chain guide.
16. Install upper chain guide.
17. Install timing chain tensioner and slack side chain guide.



18. Apply liquid gasket to front timing chain case.

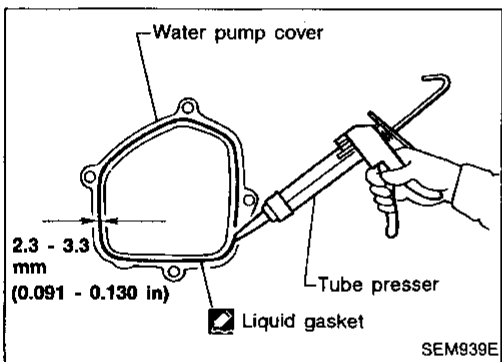
# TIMING CHAIN

## Installation (Cont'd)

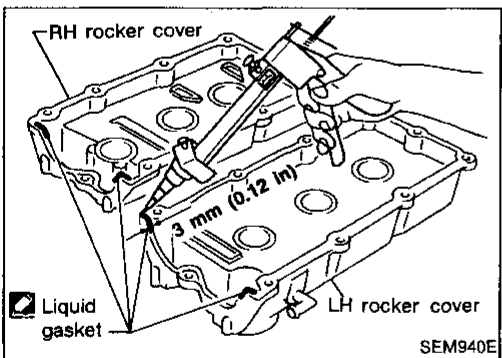


19. Install rear case pin into dowel pin hole on front timing chain case.
20. Tighten bolts to the specified torque in order shown in the figure.

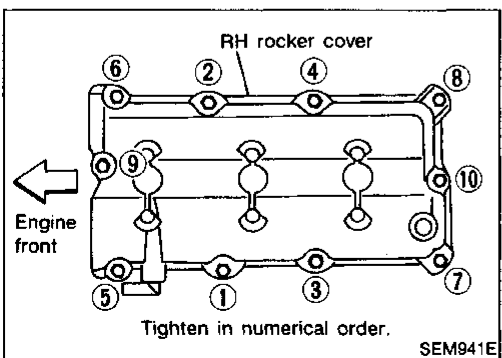
- **Leave the bolts unattended for 30 minutes or more after tightening.**



21. Apply liquid gasket to water pump cover.
22. Install water pump cover.



23. Apply liquid gasket to RH and LH rocker covers.
- **Use genuine liquid gasket or equivalent.**



24. Install RH and LH rocker covers.

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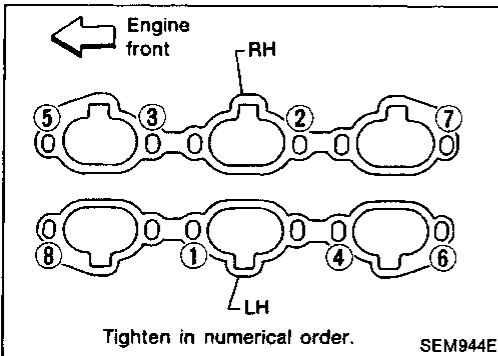
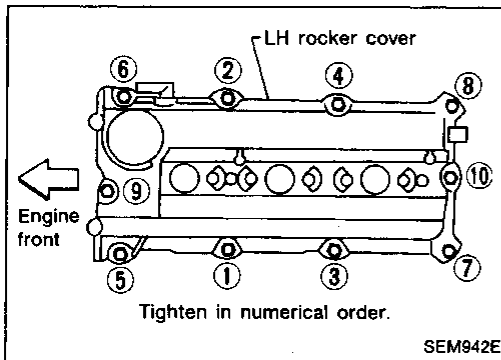
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## TIMING CHAIN

### Installation (Cont'd)

#### Rocker cover tightening procedure:

- (1) Tighten bolts ① to ⑩ in that order to 1 to 3 N·m (0.1 to 0.3 kg-m, 0.7 to 2.2 ft-lb).
- (2) Tighten bolts ① to ⑩ as indicated in figure to 6 to 8 N·m (0.6 to 0.8 kg-m, 4.3 to 5.8 ft-lb).



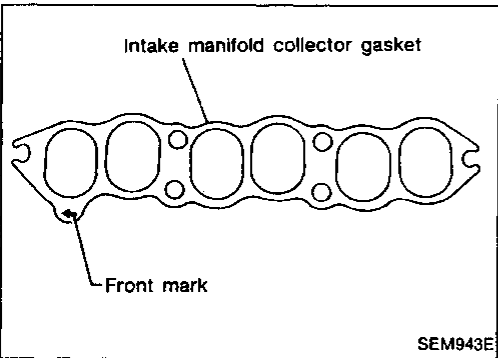
25. Install intake manifold. Tighten intake manifold nuts and bolts in two stages as follows:

#### Tightening torque

Unit: N·m (kg-m, ft-lb)

	Nuts	Bolts
1st	5 - 10 (0.5 - 1.0, 3.6 - 7.2)	5 - 10 (0.5 - 1.0, 3.6 - 7.2)
2nd	22 - 26 (2.2 - 2.7, 16 - 20)	20 - 25 (2.0 - 2.5, 14 - 18)

26. Install fuel tube assembly.



27. Install intake manifold collector gasket, with its front mark facing forwards.

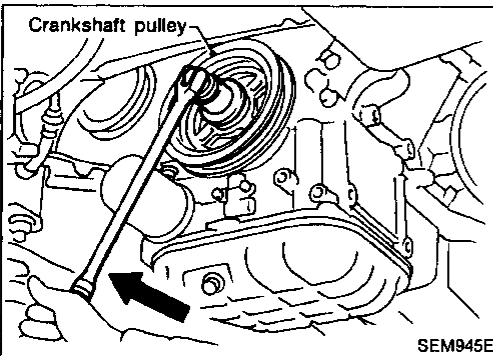
28. Install intake manifold collector, supports and intake manifold collector bolt.

29. Install EGR guide tube.

Refer to "TIGHTENING PROCEDURES" in "OUTER COMPONENT PARTS", (EM-8).

30. Install RH and LH ignition coils.

31. Install rocker cover ornament on left side.

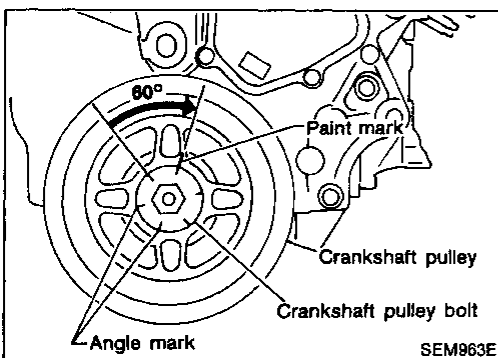


32. Install crankshaft pulley to crankshaft.

- 1) Tighten to 20 to 29 N·m (2.0 to 3.0 kg-m, 14 to 22 ft-lb).

- 2) Put a paint mark on the crankshaft pulley.

- 3) Again tighten by turning 60° to 66°, about the angle from one hexagon bolt head corner to another.



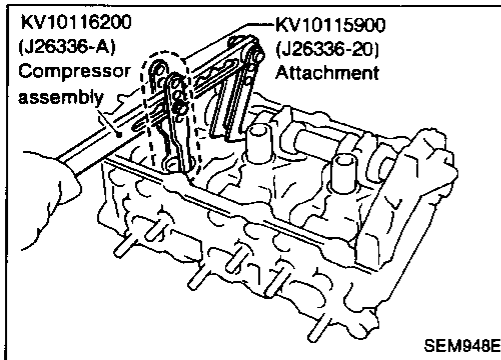
33. Install camshaft position sensor (PHASE) and crankshaft position sensors (REF)/(POS).

34. Reinstall removed parts in reverse order of removal.

- When installing fuel tube assembly, refer to "Injector Removal and Installation" in EC section.

- After installing the tensioner, race the engine at about 3,000 rpm under no load to purge air from the high-pressure chamber. The engine may produce a rattling noise. This indicates that air still remains in the chamber and is not a matter of concern.

# OIL SEAL REPLACEMENT



## VALVE OIL SEAL

### CAUTION:

When removing the oil pans, oil pump assembly and timing chain from engine, first remove the camshaft position sensor (PHASE) and the crankshaft position sensors (REF)/(POS) from the assembly.

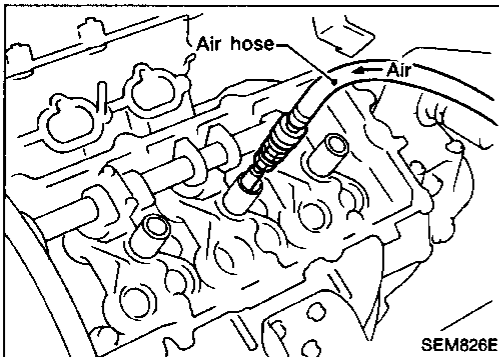
Be careful not to damage sensor edges.

1. Remove LH rocker cover ornament.
2. Remove RH and LH ignition coils.
3. Remove EGR guide tube.
4. Remove intake manifold collector supports and intake manifold collector (RH cylinder head only).
5. Remove RH and LH rocker covers from cylinder head.
6. Remove camshaft position sensor (PHASE) and crankshaft position sensors (REF)/(POS).
7. Remove oil pan. (Refer to "Removal" in "OIL PAN".)
8. Remove timing chain. (Refer to "Removal in "TIMING CHAIN".)
9. Remove camshaft brackets and camshaft. (Refer to "Removal" in "CYLINDER HEAD".)
10. Remove valve lifters and shims.
11. Remove valve spring with Tool.
12. Reinstall any parts removed in reverse order of removal.

Before removing valve spring, fix valve as follows.

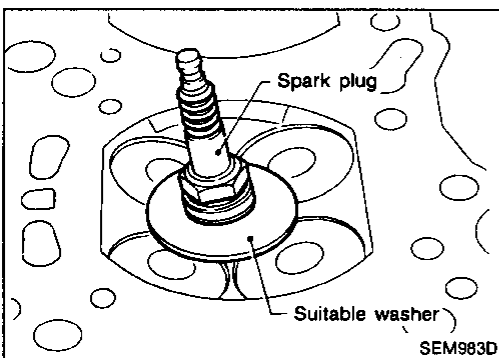
#### Method A:

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



#### Method B:

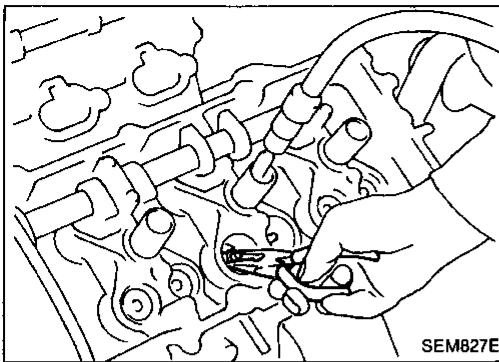
Remove spark plug, then install air hose adapter into spark plug hole and apply air pressure to hold valves in place. Apply a pressure of 490 kPa (5 kg/cm<sup>2</sup>, 71 psi).



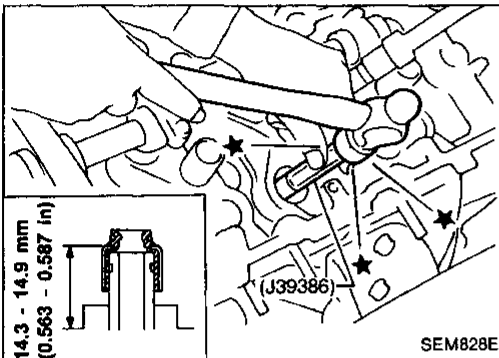
#### Method C:

Install spark plug with suitable washer into spark plug hole from combustion chamber side.

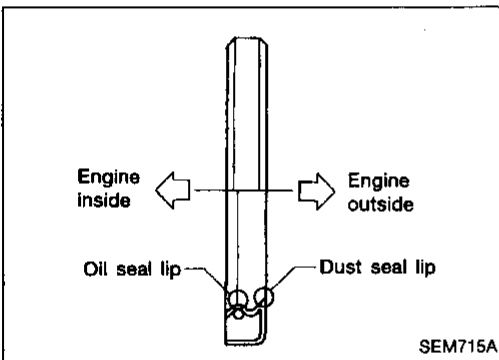
# OIL SEAL REPLACEMENT



13. Remove valve oil seal.



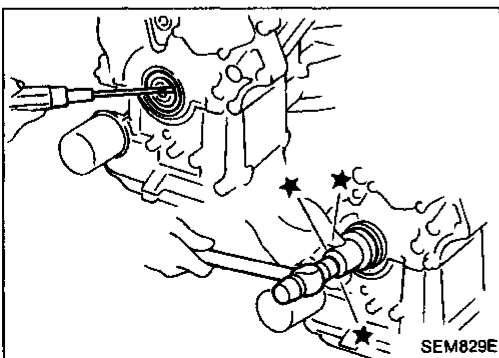
14. Apply engine oil to new valve oil seal and install it with Tool.



## OIL SEAL INSTALLATION DIRECTION

### FRONT OIL SEAL

1. Remove the following parts:
  - Engine undercover
  - Front RH wheel and engine side cover
  - Drive belts
  - Crankshaft position sensor (REF)
  - Crankshaft pulley



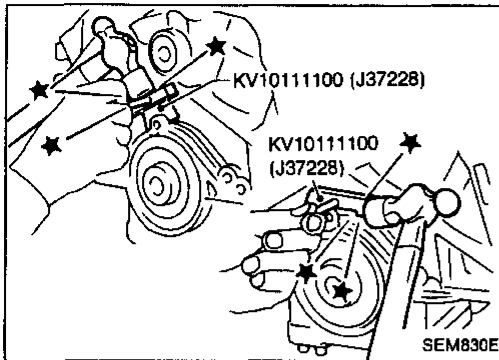
2. Remove front oil seal using a suitable tool.

**Be careful not to scratch front cover.**

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



# OIL SEAL REPLACEMENT



## REAR OIL SEAL

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

GI

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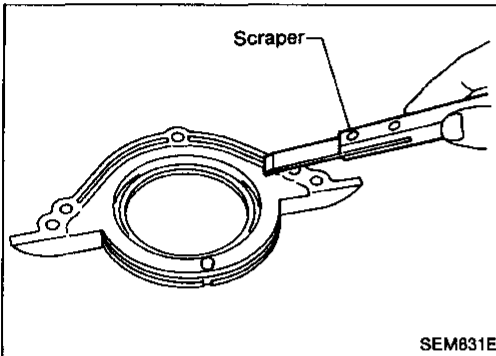
ST

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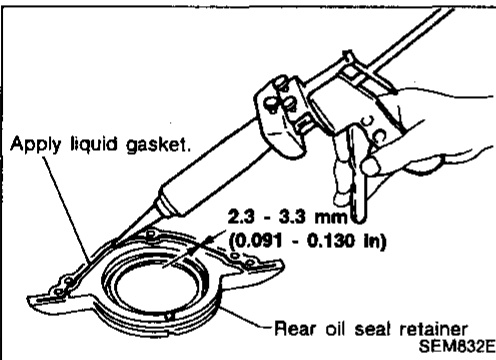
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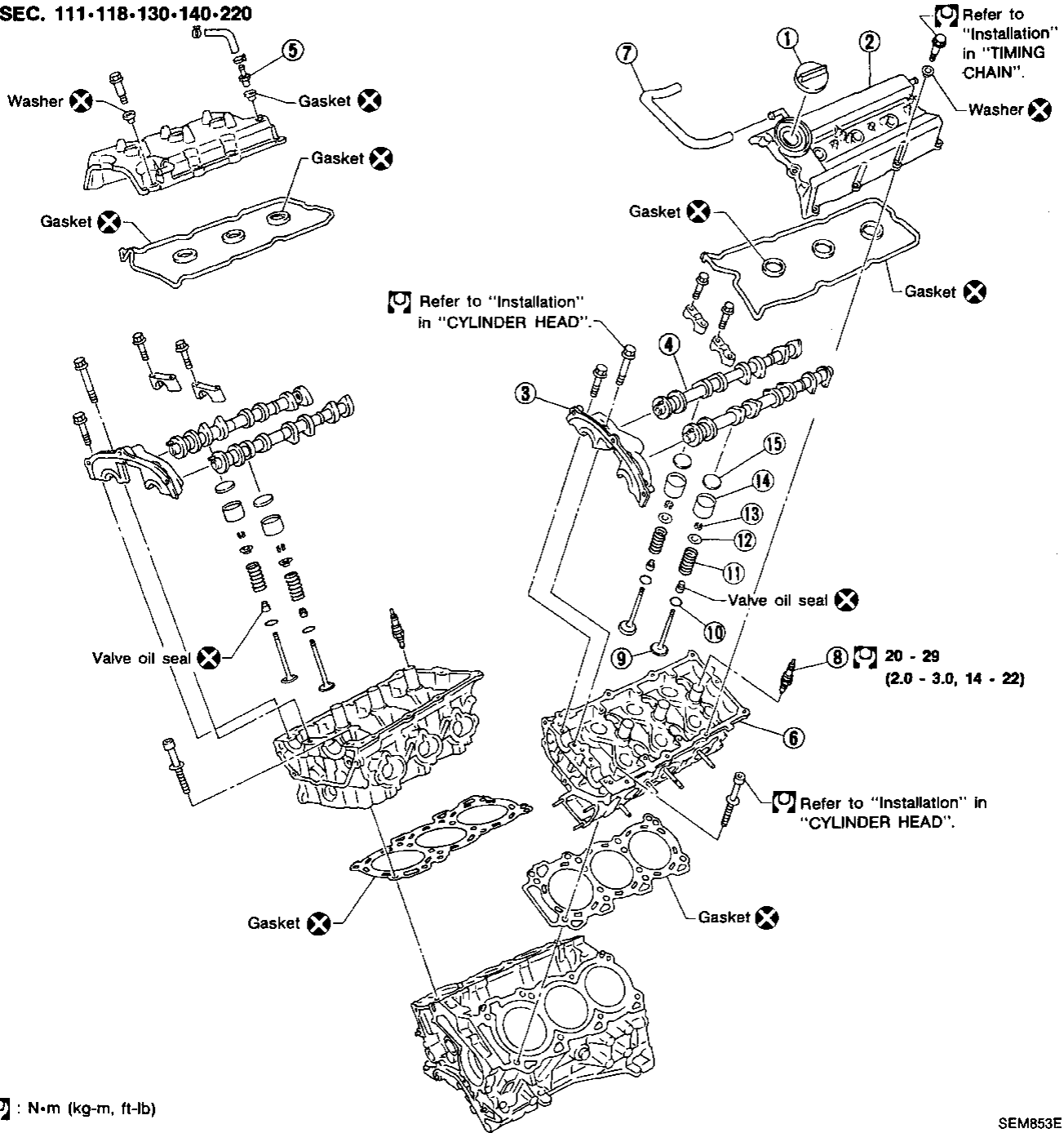
5. Remove traces of liquid gasket using scraper.



6. Apply liquid gasket to rear oil seal retainer.

# CYLINDER HEAD

SEC. 111-118-130-140-220



SEM853E

- |                    |                     |                         |
|--------------------|---------------------|-------------------------|
| ① Oil filler cap   | ⑥ Cylinder head     | ⑪ Valve spring          |
| ② Rocker cover     | ⑦ Blow by hose      | ⑫ Valve spring retainer |
| ③ Camshaft bracket | ⑧ Spark plug        | ⑬ Valve collet          |
| ④ Camshaft         | ⑨ Valve             | ⑭ Valve lifter          |
| ⑤ PCV valve        | ⑩ Valve spring seat | ⑮ Shim                  |

# CYLINDER HEAD

## CAUTION:

- Apply new engine oil to the sliding surfaces when installing sliding parts. Sliding parts include rocker arms, camshafts, oil seal, etc.
- Apply new engine oil to bolt thread and seat surfaces when tightening the following: Cylinder head bolts, camshaft sprocket bolts and camshaft bracket bolts.
- Attach tags to valve lifters for clear identification.

GI

MA

## Removal

This removal is the same procedure as that for timing chain. Refer to "Removal" in "TIMING CHAIN" (EM-18).

EM

## Disassembly

1. Remove rear timing chain case bolts.

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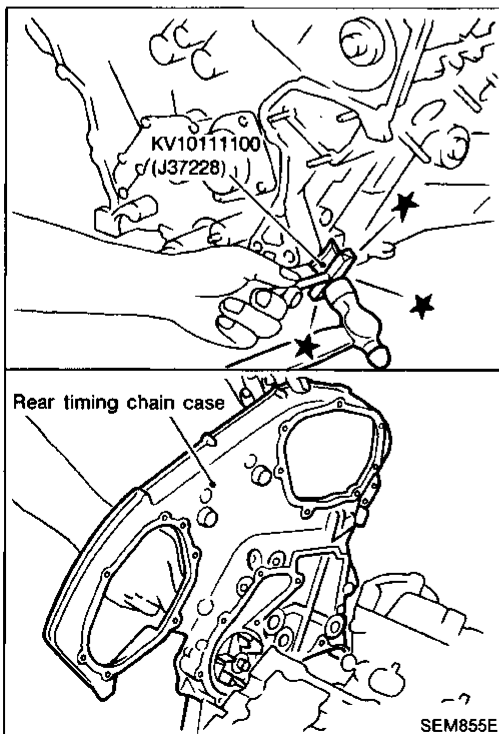
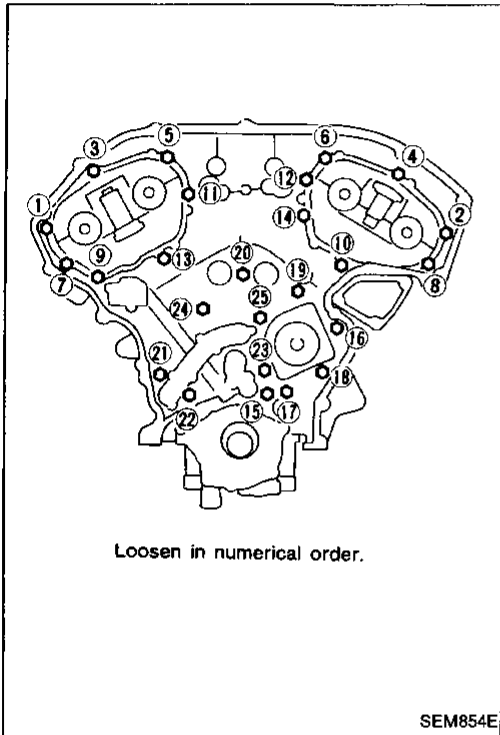
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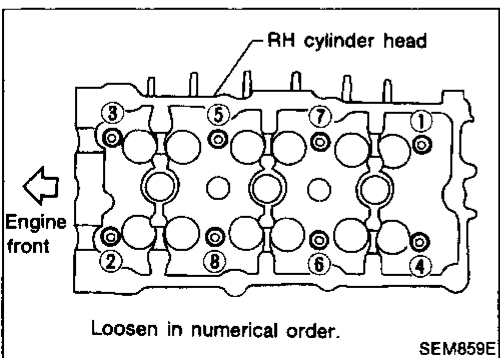
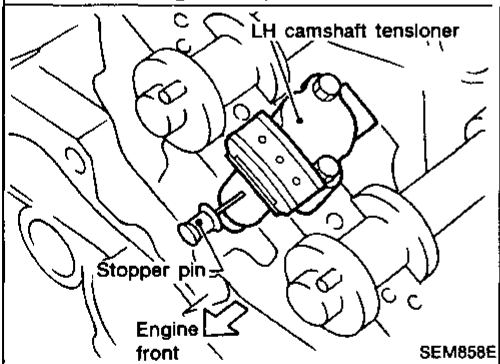
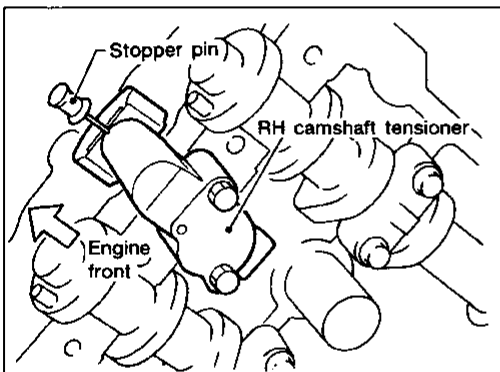
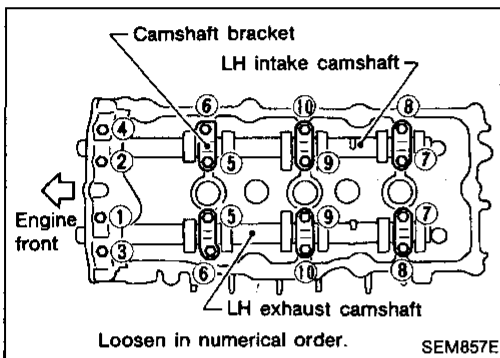
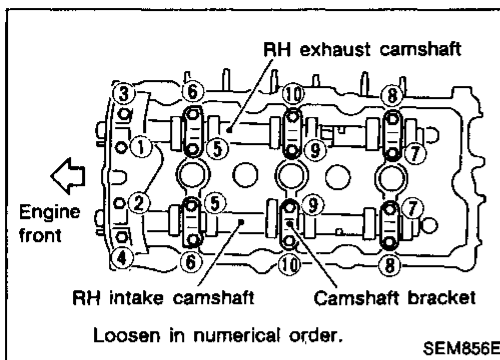
IDX



2. Remove rear timing chain case.

## CYLINDER HEAD

### Disassembly (Cont'd)



3. Remove intake and exhaust camshafts and camshaft brackets.

- Equally loosen camshaft bracket bolts in several steps in the numerical order shown in the figure.

**For reinstallation, be sure to put marks on camshaft bracket before removal.**

4. Remove valve component parts.

Refer to "VALVE OIL SEAL" in "OIL SEAL REPLACEMENT" (EM-31).

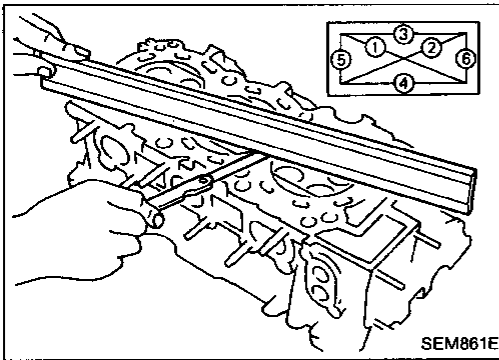
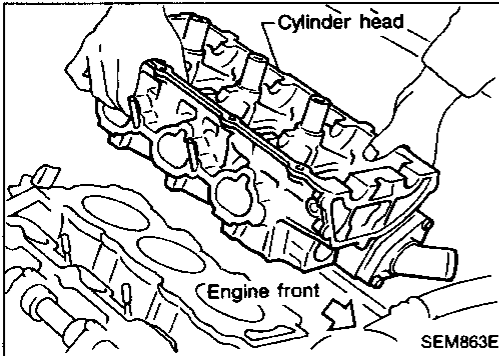
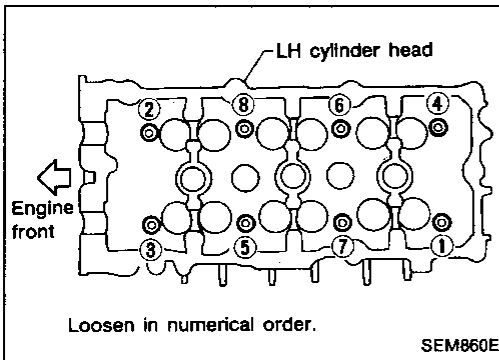
5. Remove RH and LH camshaft tensioners from cylinder head.

6. Remove cylinder head bolts.

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

# CYLINDER HEAD

## Disassembly (Cont'd)



7. Remove cylinder head.

### Inspection

#### CYLINDER HEAD DISTORTION

**Head surface flatness: Limit 0.1 mm (0.004 in)**  
If beyond the specified limit, replace it or resurface it.

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

#### Resurfacing limit:

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

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

**The maximum limit :  $A + B = 0.2 \text{ mm (0.008 in)}$**

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

#### Nominal cylinder head height:

**126.3 - 126.5 mm (4.972 - 4.980 in)**

#### CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.

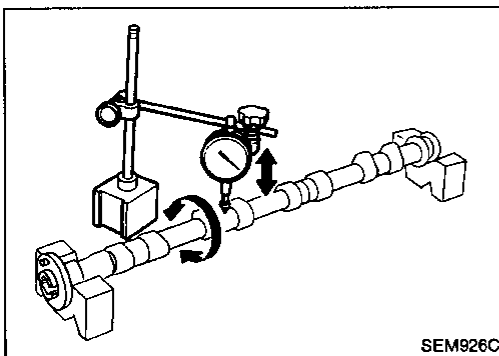
#### CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.

**Runout (Total indicator reading):**

**Limit 0.05 mm (0.0020 in)**

2. If it exceeds the limit, replace camshaft.



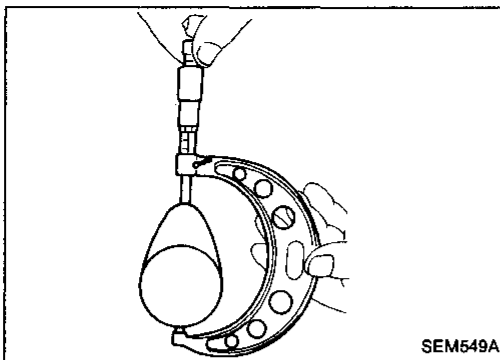
GI  
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## CYLINDER HEAD

### Inspection (Cont'd)

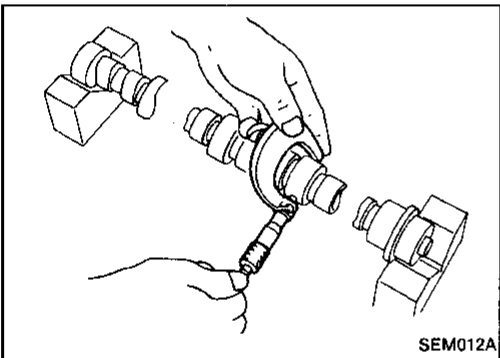
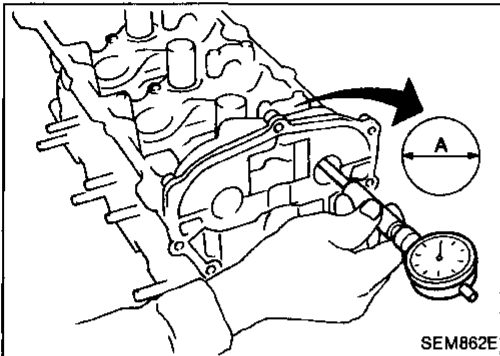
#### CAMSHAFT CAM HEIGHT

1. Measure camshaft cam height.  
**Standard cam height:**  
43.955 - 44.145 mm (1.7305 - 1.7380 in)  
**Cam wear limit:**  
0.2 mm (0.008 in)
2. If wear is beyond the limit, replace camshaft.



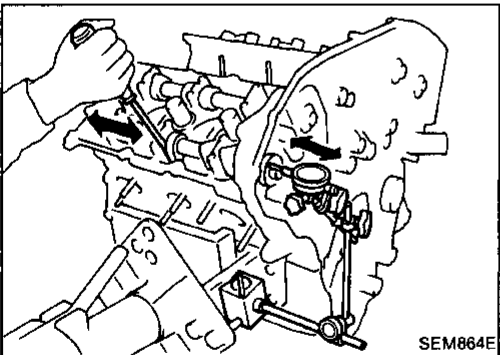
#### CAMSHAFT JOURNAL CLEARANCE

1. Install camshaft bracket and tighten bolts to the specified torque.
2. Measure inner diameter "A" of camshaft bearing.  
**Standard inner diameter:**  
23.500 - 23.521 mm (0.9252 - 0.9260 in)
3. Measure outer diameter of camshaft journal.  
**Standard outer diameter:**  
23.435 - 23.455 mm (0.9226 - 0.9234 in)
4. If clearance exceeds the limit, replace camshaft and/or cylinder head.  
**Camshaft journal clearance:**  
**Standard**  
0.045 - 0.086 mm (0.0018 - 0.0034 in)  
**Limit**  
0.15 mm (0.0059 in)



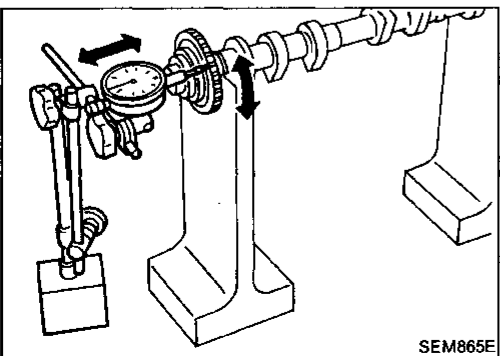
#### CAMSHAFT END PLAY

1. Install camshaft in cylinder head.
2. Measure camshaft end play.  
**Camshaft end play:**  
**Standard**  
0.115 - 0.188 mm (0.0045 - 0.0074 in)  
**Limit**  
0.24 mm (0.0094 in)



#### CAMSHAFT SPROCKET RUNOUT

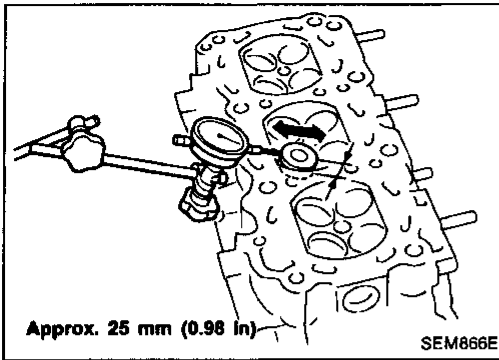
1. Install sprocket on camshaft.
2. Measure camshaft sprocket runout.  
**Runout (Total indicator reading):**  
**Limit 0.15 mm (0.0059 in)**
3. If it exceeds the limit, replace camshaft sprocket.



# CYLINDER HEAD

## Inspection (Cont'd)

### VALVE GUIDE CLEARANCE



1. Measure valve deflection at right-angles direction to camshaft. (Valve and valve guide mostly wear in this direction.)  
**Valve deflection limit (Dial gauge reading):**  
Intake 0.24 mm (0.0094 in)  
Exhaust 0.28 mm (0.0110 in)

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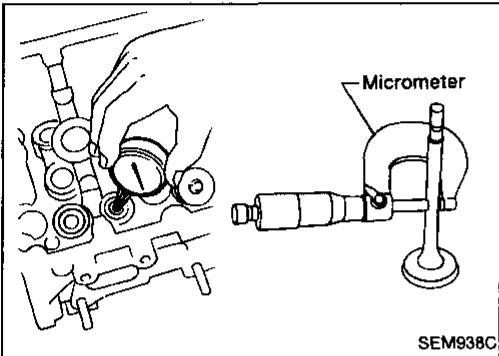
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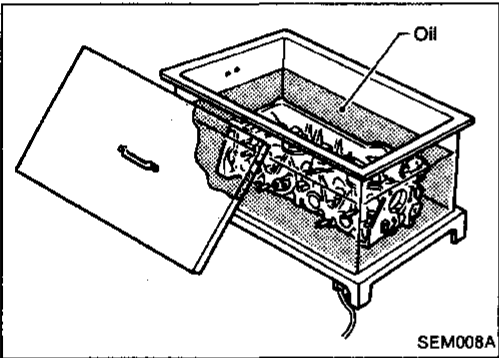
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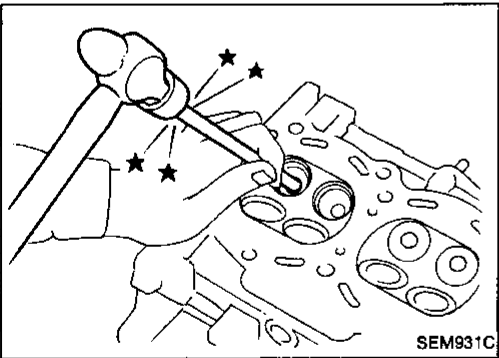


2. If it exceeds the limit, check valve to valve guide clearance.
  - a. Measure valve stem diameter and valve guide inner diameter.
  - b. Check that clearance is within specification.  
**Valve to valve guide clearance limit:**  
Intake 0.08 mm (0.0031 in)  
Exhaust 0.1 mm (0.004 in)
  - c. If it exceeds the limit, replace valve or valve guide.

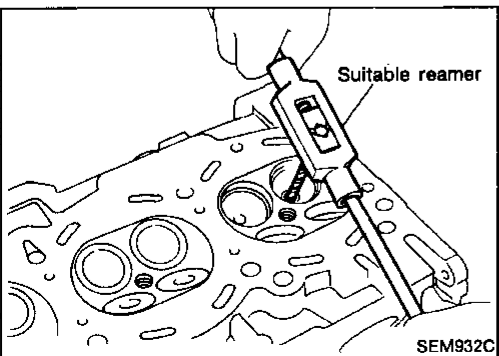
### VALVE GUIDE REPLACEMENT



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



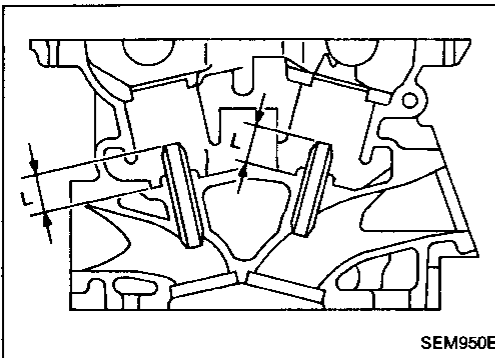
2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and suitable tool.



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

## CYLINDER HEAD

### Inspection (Cont'd)



- Heat cylinder head to 110 to 130°C (230 to 266°F) and press service valve guide onto cylinder head.

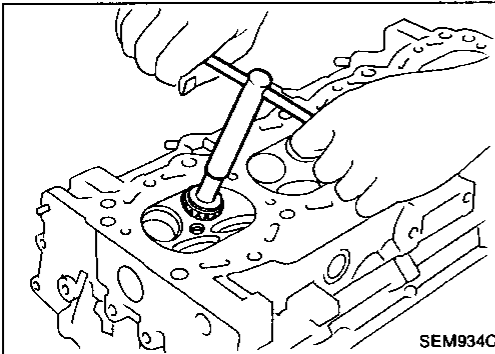
**Projection "L":**

12.6 - 12.8 mm (0.496 - 0.504 in)

- Ream valve guide.

**Finished size:**

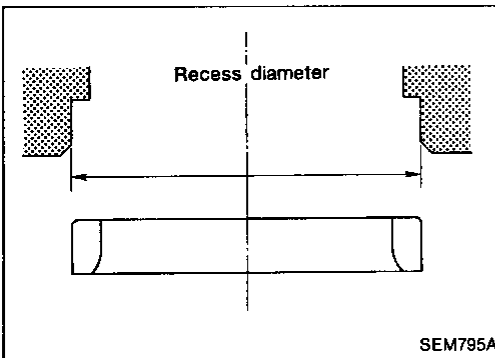
6.000 - 6.018 mm (0.2362 - 0.2369 in)



### VALVE SEATS

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

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



### REPLACING VALVE SEAT FOR SERVICE PARTS

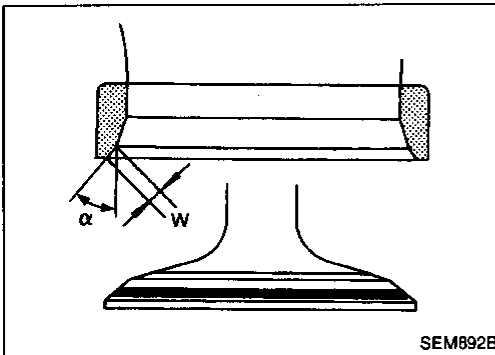
- Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
- Ream cylinder head recess for service valve seat.

**Over-size [0.5 mm (0.020 in)]:**

Intake 37.500 - 37.516 mm (1.4764 - 1.4770 in)

Exhaust 32.700 - 32.716 mm (1.2874 - 1.2880 in)

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



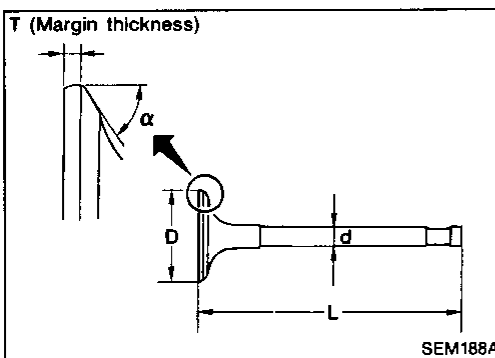
- Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.
- Press fit valve seat until it seats on the bottom.
- Cut or grind valve seat using suitable tool at the specified dimensions as shown in SDS (EM-68.)
- After cutting, lap valve seat with abrasive compound.
- Check valve seating condition.

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

**Contacting width "W":**

Intake: 1.09 - 1.31 mm (0.0429 - 0.0516 in)

Exhaust: 1.29 - 1.51 mm (0.0508 - 0.0594 in)



### VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to SDS (EM-65).

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

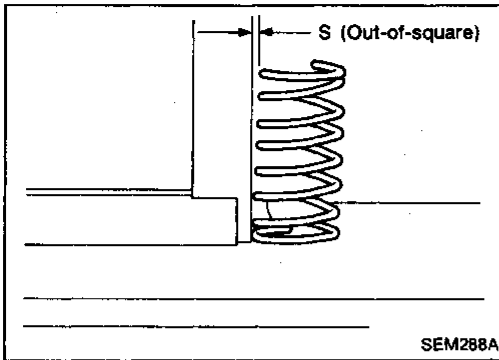
**Grinding allowance for valve stem tip is 0.2 mm (0.008 in) or less.**



# CYLINDER HEAD

## Inspection (Cont'd)

### VALVE SPRING



#### Squareness

1. Measure "S" dimension.  
**Out-of-square:**  
**Less than 2.0 mm (0.079 in)**
2. If it exceeds the limit, replace spring.

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#### Pressure

Check valve spring pressure.

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

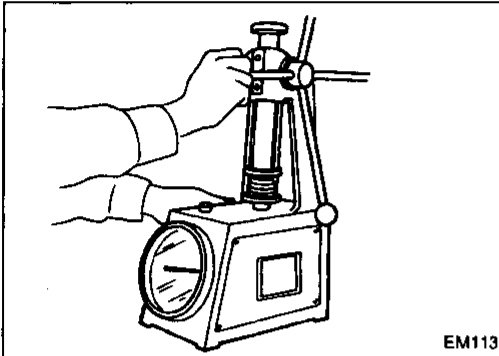
**Standard**

**454 (46.3, 102.1) at 27.55 (1.0846)**

**Limit**

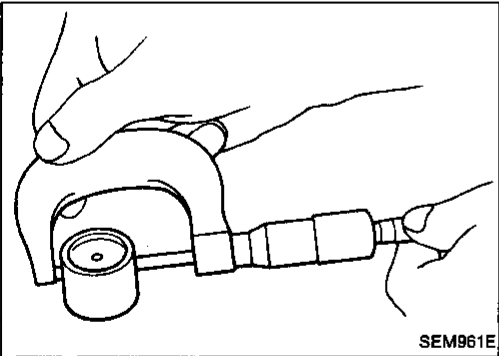
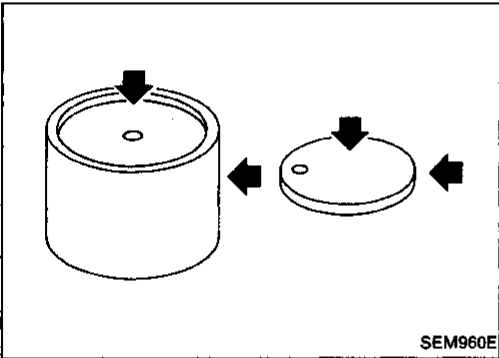
**More than 428 (43.7, 96.2) at 27.55 (1.0846)**

If it exceeds the limit, replace spring.



### VALVE LIFTER

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



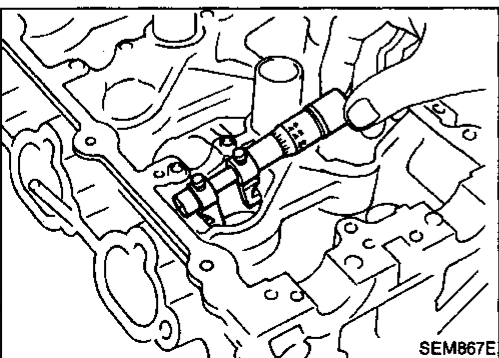
2. Check diameter of valve lifter and valve lifter guide bore.

**Valve lifter diameter:**

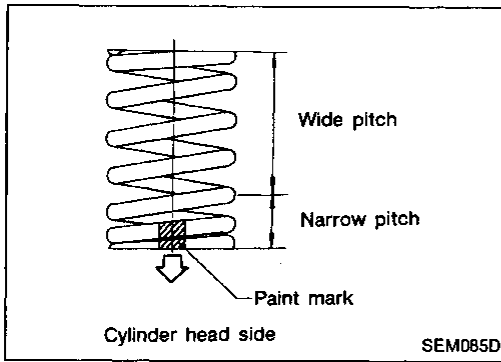
**34.960 - 34.975 mm (1.3764 - 1.3770 in)**

**Lifter guide bore diameter:**

**35.000 - 35.021 mm (1.3780 - 1.3788 in)**



## CYLINDER HEAD

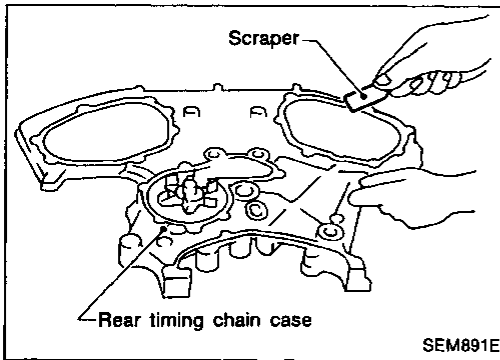


### Assembly

1. Install valve component parts.
  - Always use new valve oil seal. Refer to OIL SEAL REPLACEMENT (EM-31).
  - Before installing valve oil seal, install valve spring seat.
  - Install valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side (paint mark).

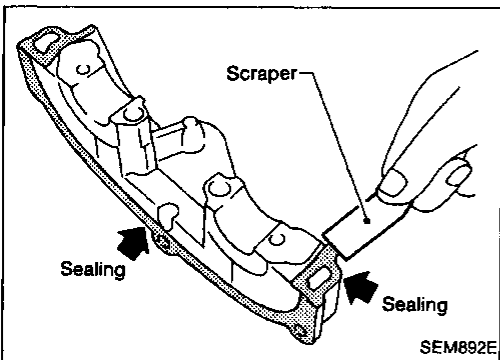
	Intake valve spring	Exhaust valve spring
Paint mark	Yellow	Yellow

- After installing valve component parts, tap valve stem tip with plastic hammer to assure a proper fit.

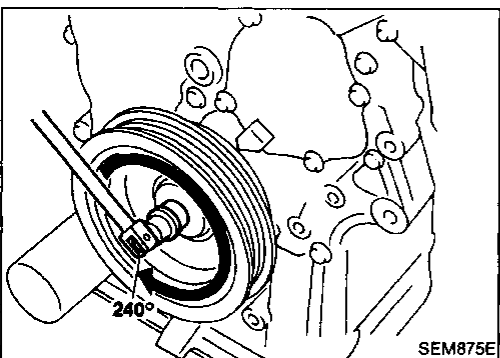


### Installation

1. Before installing rear timing chain case, remove all traces of liquid gasket from mating surface using a scraper.
  - Also remove traces of liquid gasket from mating surface of cylinder block.



2. Before installing cam bracket, remove all traces of liquid gasket from mating surface using a scraper.
3. Remove O-rings from cylinder block.

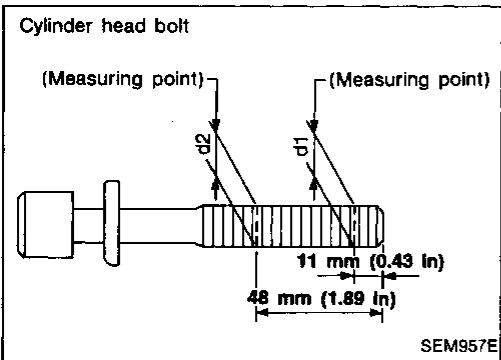
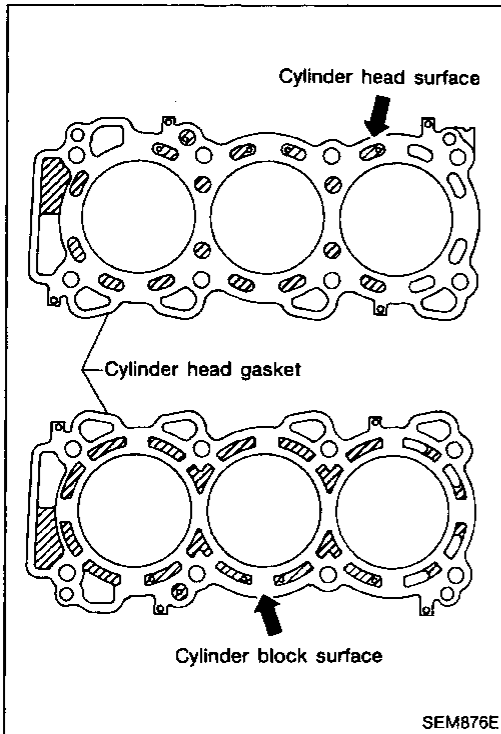


4. Turn crankshaft until No. 1 piston is set at approximately 240° before TDC on compression stroke to prevent interference of valves and pistons.

# CYLINDER HEAD

## Installation (Cont'd)

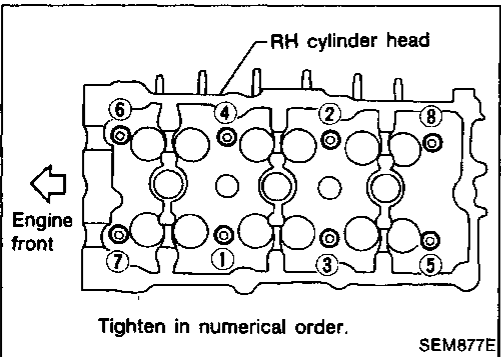
5. Install cylinder heads with new gaskets.
  - Do not rotate crankshaft and camshaft separately, or valves will strike piston heads.



### CAUTION:

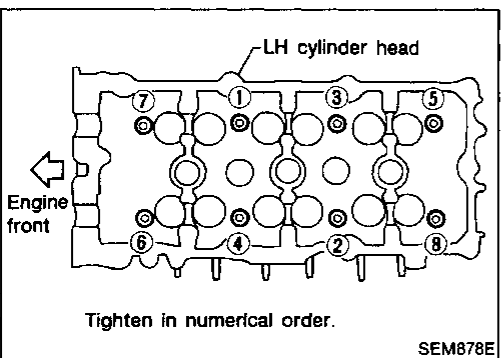
Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between d1 and d2 exceeds the limit, replace them with new ones.

Limit (d1 - d2):  
0.11 mm (0.0043 in)



### ● Tightening procedure:

- ① Tighten all bolts to 98 N·m (10 kg-m, 72 ft-lb).
- ② Completely loosen all bolts.
- ③ Tighten all bolts to 34 to 44 N·m (3.5 to 4.5 kg-m, 25 to 33 ft-lb).
- ④ Turn all bolts 90 to 95 degrees clockwise.
- ⑤ Turn all bolts 90 to 95 degrees clockwise.



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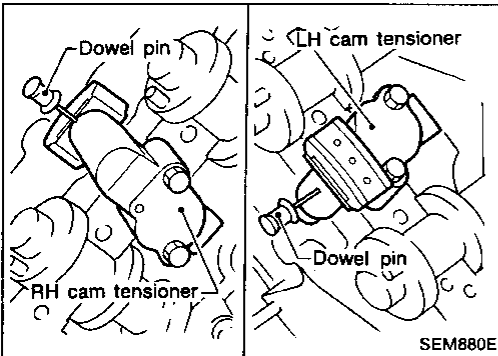
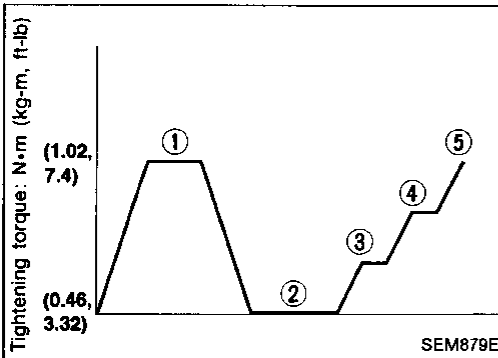
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## CYLINDER HEAD

### Installation (Cont'd)

6. Install cylinder head outside bolts.

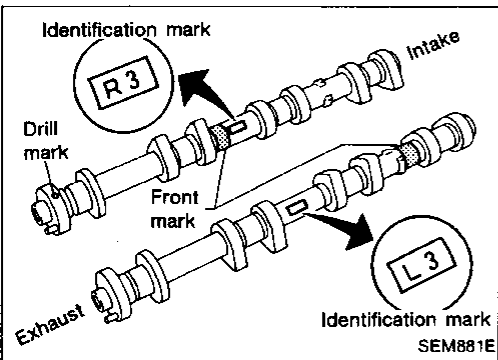


7. Install cam tensioners on both sides of cylinder head.

8. Install exhaust and intake camshafts and camshaft brackets.

● Identification marks are present on camshafts.

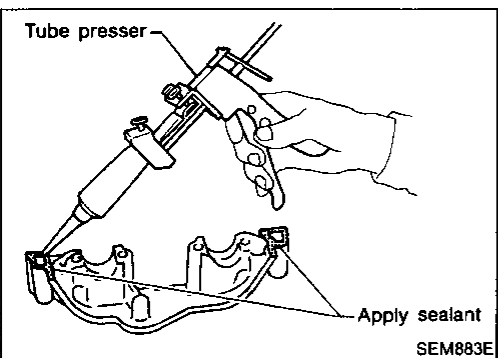
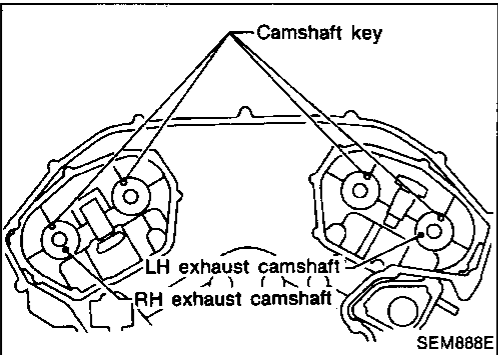
	Paint mark
RH exhaust camshaft	White
RH intake camshaft	White
	Paint mark
LH exhaust camshaft	Yellow
LH intake camshaft	Yellow



● Position camshaft

RH exhaust camshaft key at about 10 o'clock

LH exhaust camshaft key at about 12 o'clock

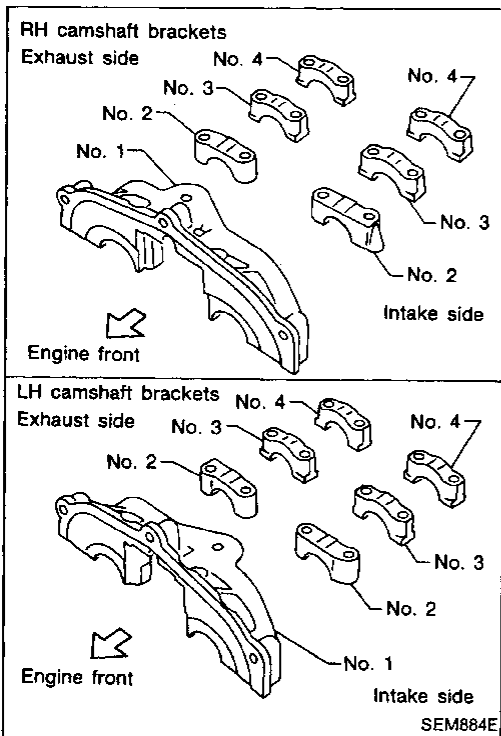


9. Before installing camshaft brackets, apply sealant to mating surface of No. 1 journal head.

● Use Genuine Liquid Gasket or equivalent.

# CYLINDER HEAD

## Installation (Cont'd)



- Install camshaft brackets in their original positions.
- Tighten camshaft bracket bolts gradually in two or three stages.
- If any part of valve assembly or camshaft is replaced, check valve clearance according to reference data. After completing assembly check valve clearance. Refer to "Checking" and "Adjusting" in "VALVE CLEARANCE" (EM-47).

Reference data valve clearance (Cold):

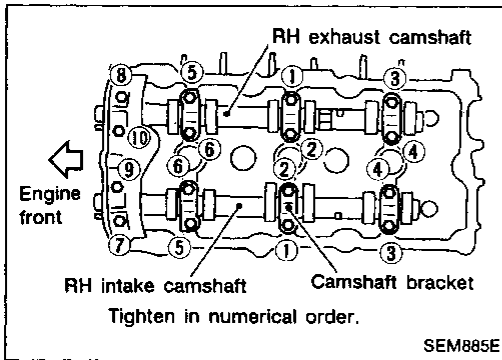
Intake

0.26 - 0.34 mm (0.010 - 0.013 in)

Exhaust

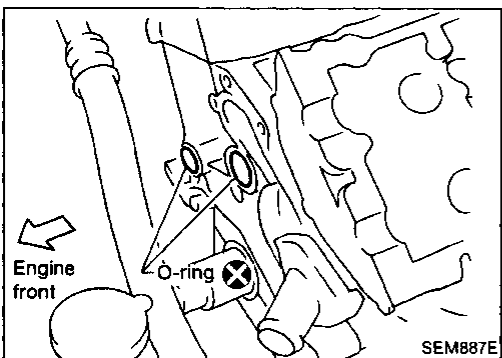
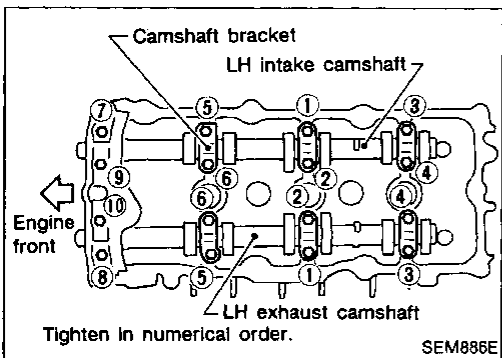
0.29 - 0.37 mm (0.011 - 0.015 in)

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### Tightening procedure

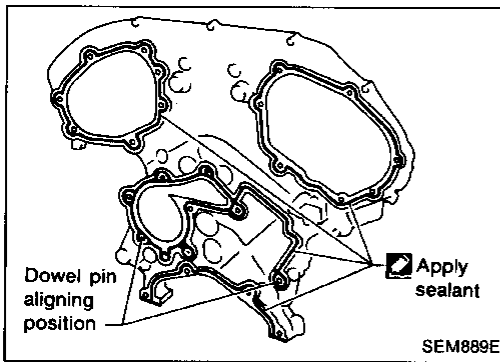
Step	Tightening torque	Tightening order
1	2 N·m (0.2 kg-m, 1.4 ft-lb)	Tighten in the order of ⑦ to ⑩, then tighten ① to ⑥.
2	6 N·m (0.6 kg-m, 4.3 ft-lb)	Tighten in the numerical order.
3	9.0 - 11.8 N·m (0.92 - 1.20 kg-m, 6.7 - 8.7 ft-lb)	Tighten in the numerical order.



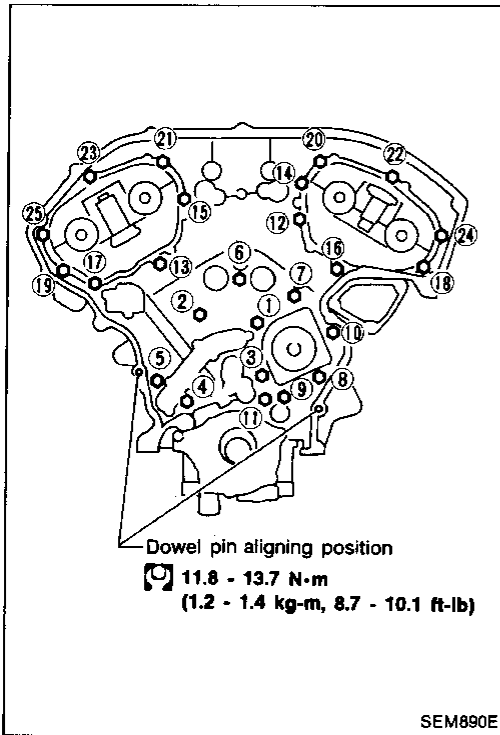
10. Install O-rings to cylinder block.

## CYLINDER HEAD

### Installation (Cont'd)

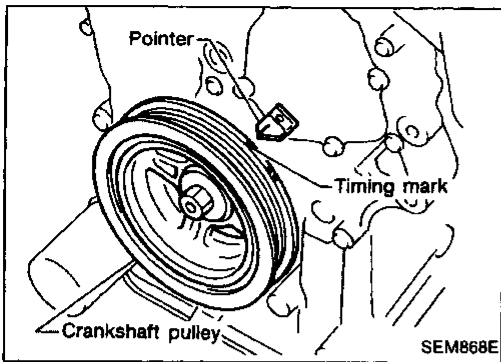


11. Apply sealant to the hatched portion of rear timing chain case.



12. Align rear timing chain case with dowel pins, then install on cylinder head and block.
  13. Tighten bolts in the numerical order shown in the figure.
- This installation is the same procedure as that for timing chain. Refer to "Installation" in "TIMING CHAIN" (EM-26).

# VALVE CLEARANCE

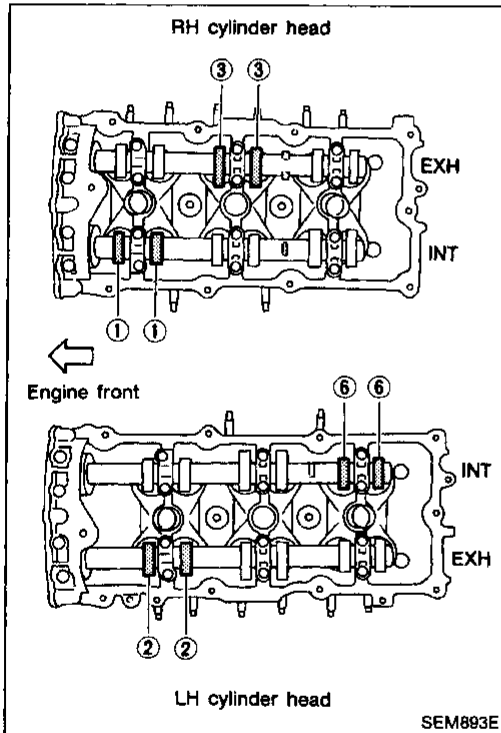


## Checking

Check valve clearance while engine is cold and not running.

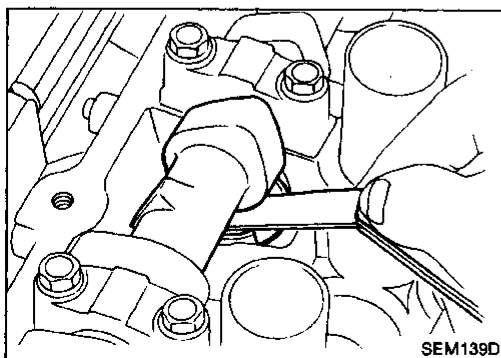
1. Remove intake manifold collector.
2. Remove rocker cover ornaments.
3. Remove RH and LH rocker covers.
4. Remove all spark plugs.
5. Set No. 1 cylinder at TDC on its compression stroke.
  - Align pointer with TDC mark on crankshaft pulley.
  - Check that valve lifters on No. 1 cylinder are loose and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

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



6. Check only those valves shown in the figure.

Valve Crank position	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 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 (Cold):**

**Intake**

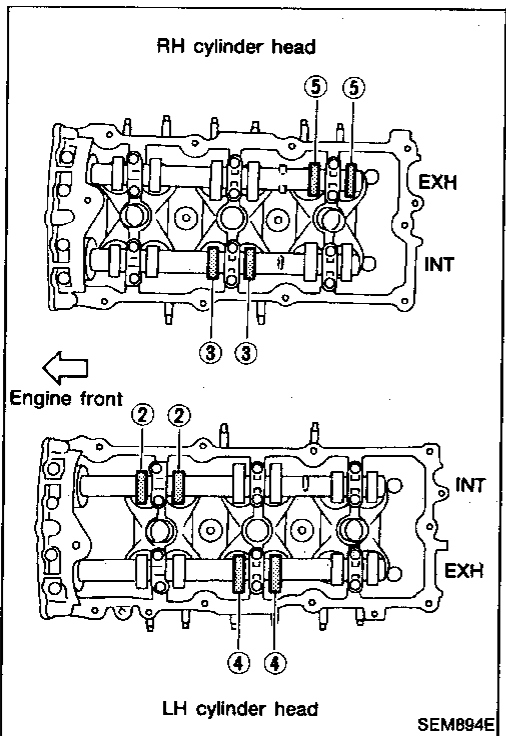
0.26 - 0.34 mm (0.010 - 0.013 in)

**Exhaust**

0.29 - 0.37 mm (0.011 - 0.015 in)

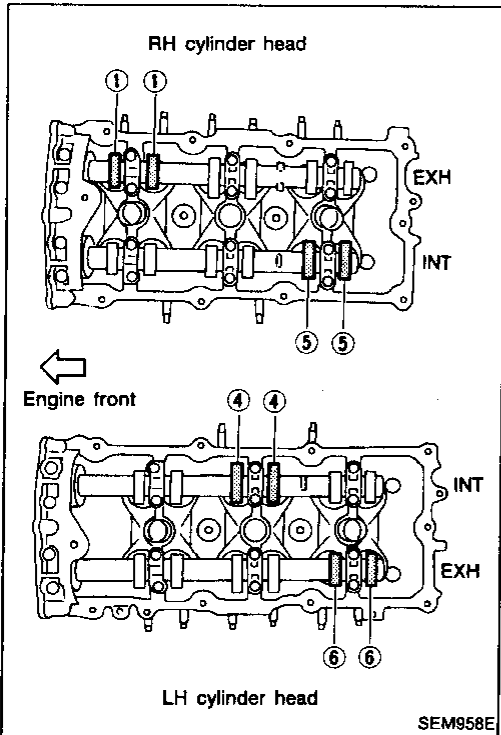
# VALVE CLEARANCE

## Checking (Cont'd)



7. Turn crankshaft 240° and align as above.
8. Set No. 3 cylinder at TDC on its compression stroke.
9. Check only those valves shown in the figure.

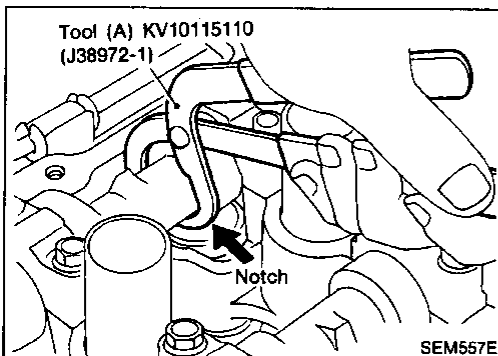
Valve Crank position	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH
No. 3 TDC			○		○			○		○		



10. Turn crankshaft 240° and align as above.
11. Set No. 5 cylinder at TDC on its compression stroke.
12. Check only those valves shown in the figure.

Valve Crank position	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. 5 TDC		○					○		○			○

13. If all valve clearances are within specification, install the following parts.
  - Intake manifold collector
  - RH and LH rocker covers
  - All spark plugs
  - Rocker cover ornament



## Adjusting

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

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

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

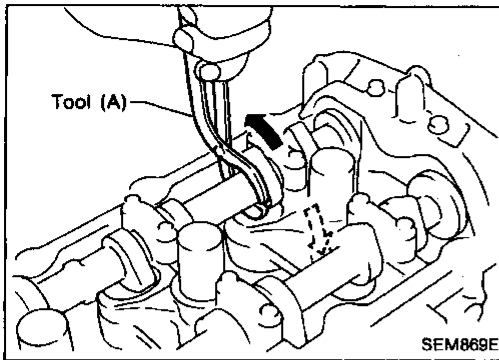
### CAUTION:

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

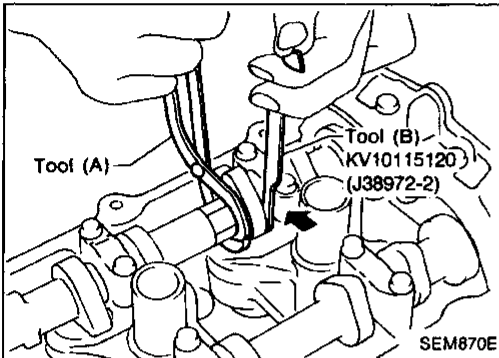


# VALVE CLEARANCE

## Adjusting (Cont'd)



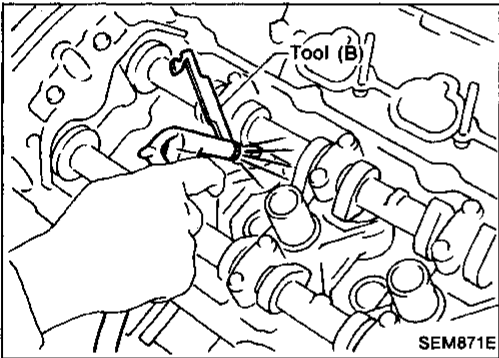
3. Rotate Tool (A) (See figure.) so that valve lifter is pushed down.



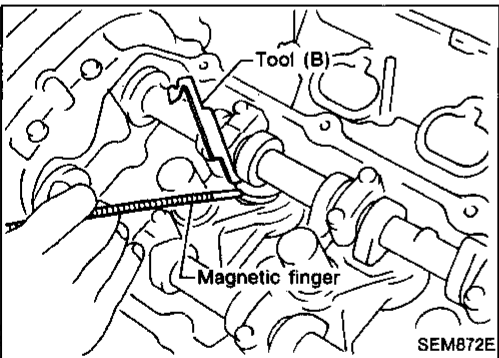
4. Place Tool (B) between camshaft and the edge of the valve lifter to retain valve lifter.

### CAUTION:

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



6. Blow air into the hole to separate adjusting shim from valve lifter.



7. Remove adjusting shim using a small screwdriver and a magnetic finger.

8. Determine replacement adjusting shim size following formula.

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

R = Thickness of removed shim

N = Thickness of new shim

M = Measured valve clearance

### Intake:

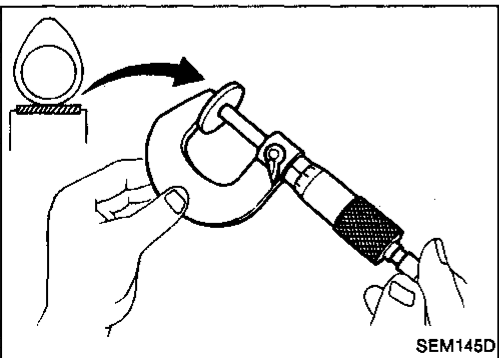
$$N = R + [M - 0.30 \text{ mm (0.0118 in)}]$$

### Exhaust:

$$N = R + [M - 0.33 \text{ mm (0.0130 in)}]$$

Shims are available in 64 sizes from 2.32 mm (0.0913 in) to 2.95 mm (0.1161 in), in steps of 0.01 mm (0.0004 in).

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



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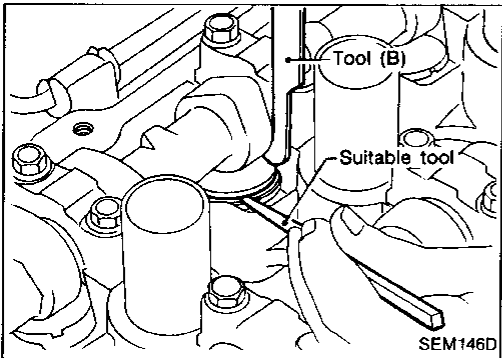
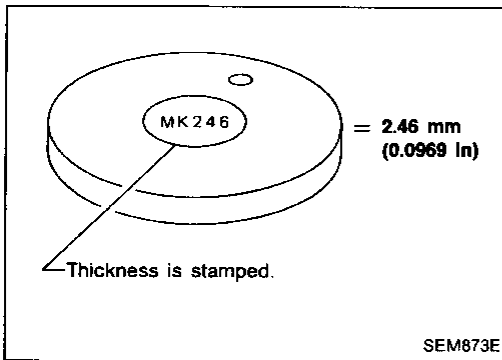
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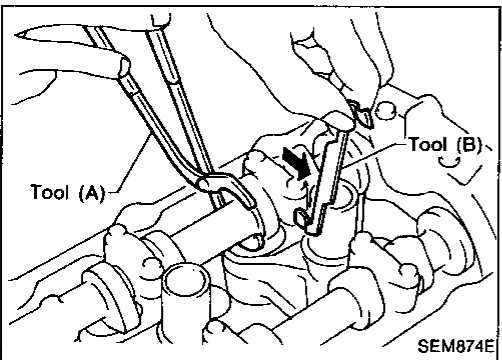
# VALVE CLEARANCE

## Adjusting (Cont'd)



9. Install new shim using a suitable tool.

- Install with the surface on which the thickness is stamped facing down.



10. Place Tool (A) as mentioned in steps 2 and 3.

11. Remove Tool (B).

12. Remove Tool (A).

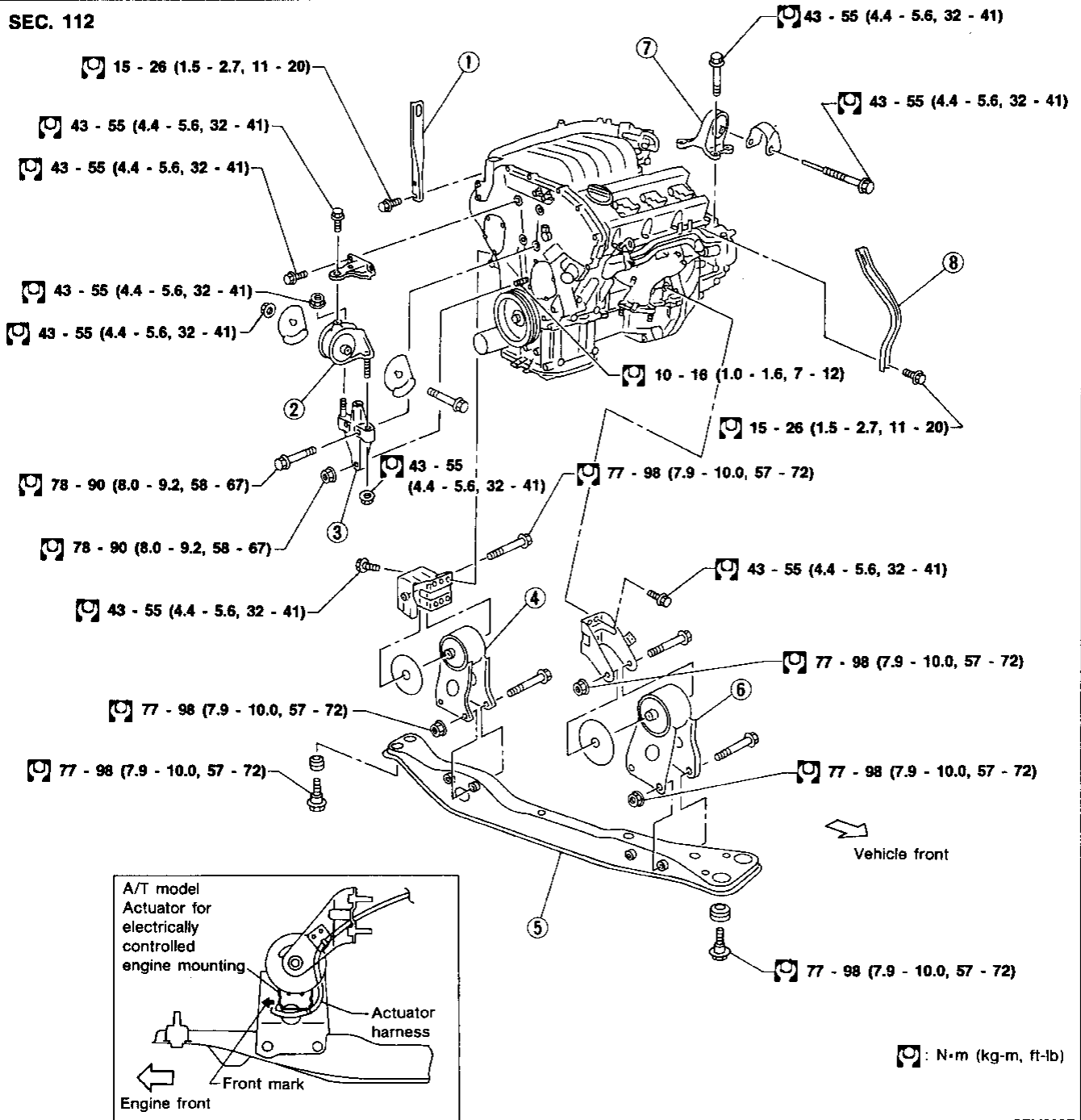
13. Recheck valve clearance.

### Valve clearance:

	Unit: mm (in)	
	Cold	Hot
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

# ENGINE REMOVAL

SEC. 112



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

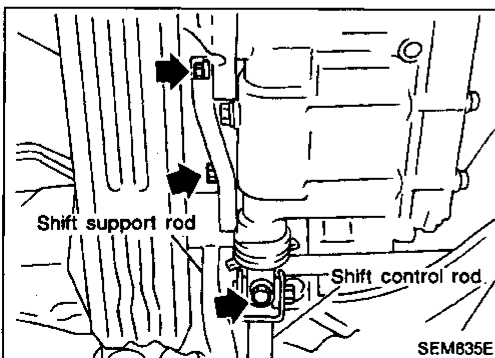
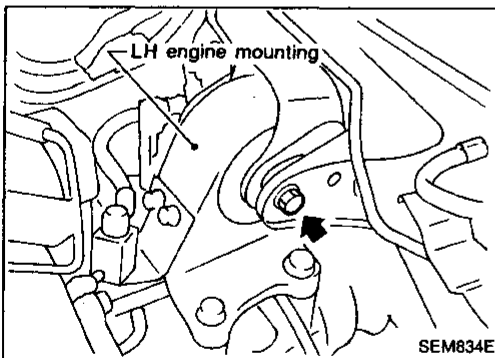
# ENGINE REMOVAL

## WARNING:

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

## CAUTION:

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

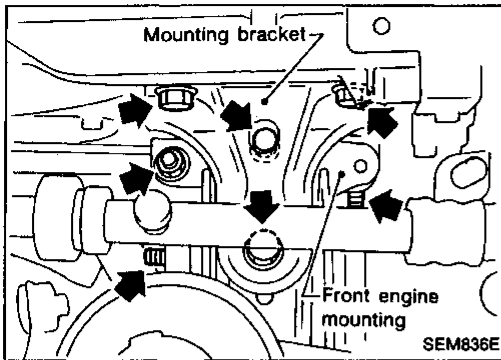


## Removal

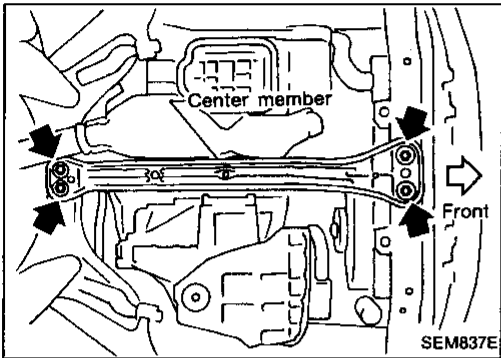
1. Remove engine undercover and hood.
2. Drain coolant from both cylinder block and radiator.
3. Remove vacuum hoses, fuel hoses, wires, harnesses, connectors and so on.
4. Remove front exhaust tubes, ball joints and drive shafts.
5. Remove radiator and fans.
6. Remove drive belts.
7. Remove alternator, compressor and power steering oil pump from engine.
8. Set a suitable transmission jack under transaxle. Hoist engine with engine slinger.
9. Remove rear engine mounting.
10. Disconnect control rod and support rod from transaxle (M/T model).
11. Disconnect control cable from transaxle (A/T model).

# ENGINE REMOVAL

## Removal (Cont'd)

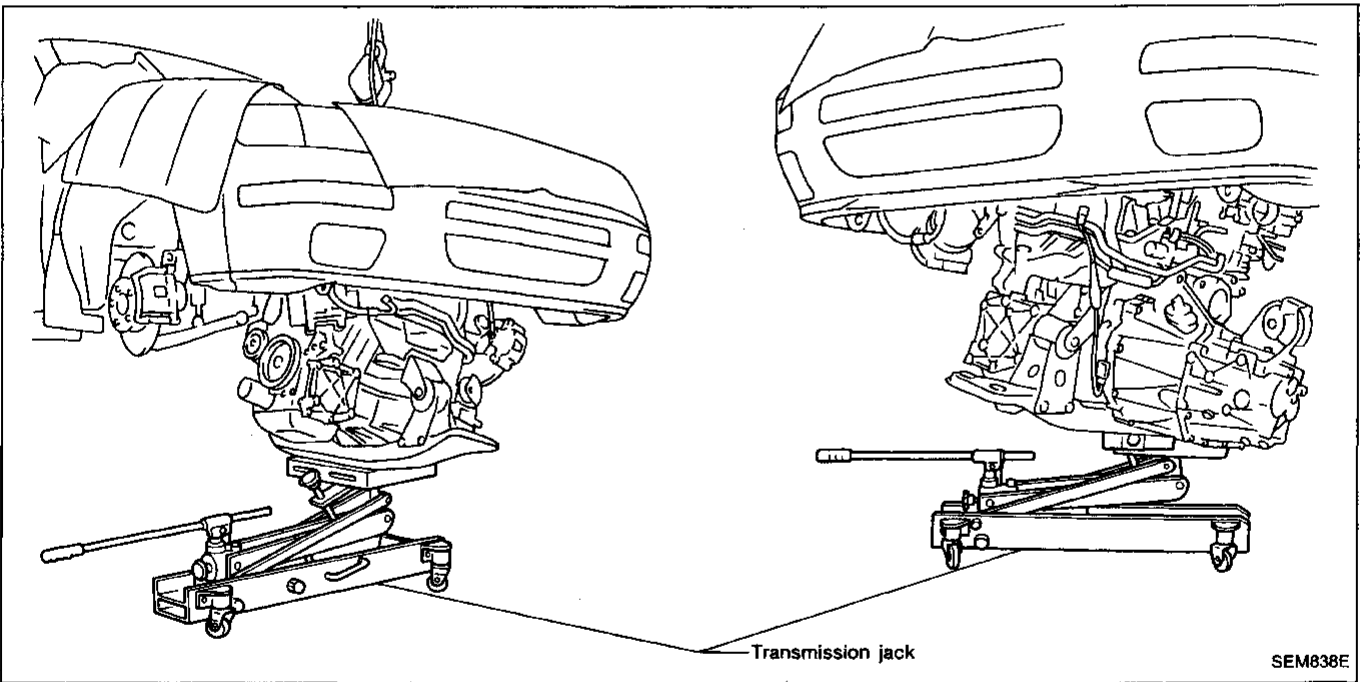


12. Remove front engine mounting.



13. Remove center member and then slowly lower transmission jack.

14. Remove engine with transaxle as shown.



## Installation

1. Installation is in the reverse order of removal.

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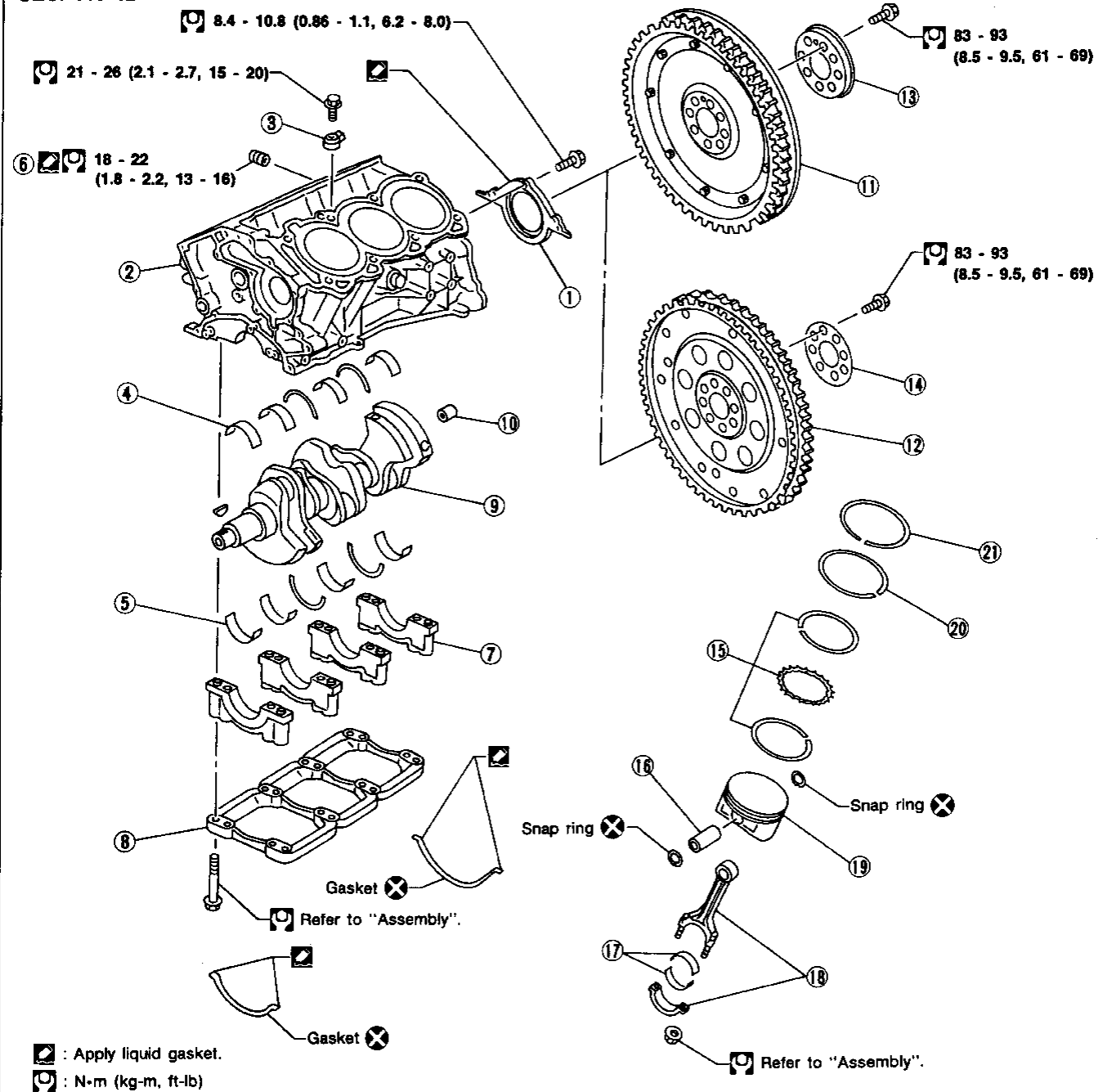
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# CYLINDER BLOCK

SEC. 110-120-226



SEM840E

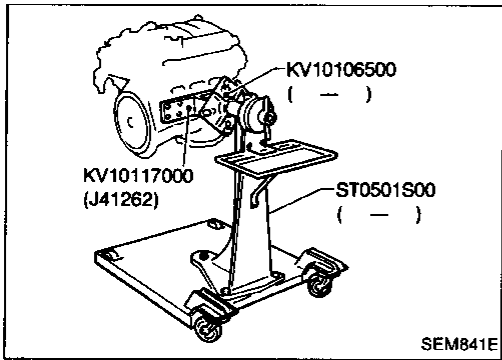
- |                          |                                    |                          |
|--------------------------|------------------------------------|--------------------------|
| ① Rear oil seal retainer | ⑧ Main bearing beam                | ⑮ Oil ring               |
| ② Cylinder block         | ⑨ Crankshaft                       | ⑯ Piston pin             |
| ③ Knock sensor           | ⑩ Pilot bushing or pilot converter | ⑰ Connecting rod bearing |
| ④ Upper main bearing     | ⑪ Flywheel (M/T models)            | ⑱ Connecting rod         |
| ⑤ Lower main bearing     | ⑫ Drive plate (A/T model)          | ⑲ Piston                 |
| ⑥ Drain plug             | ⑬ Flywheel reinforcement           | ⑳ 2nd ring               |
| ⑦ Main bearing cap       | ⑭ Drive plate reinforcement        | ㉑ Top ring               |

# CYLINDER BLOCK

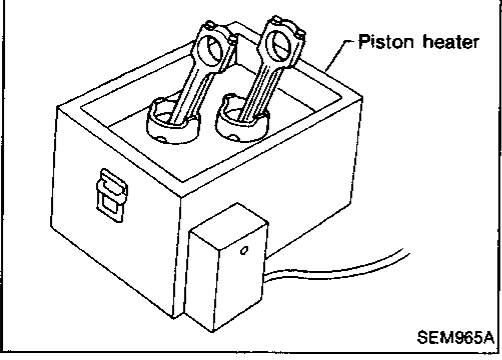
## CAUTION:

- When installing sliding parts (bearings, pistons, etc.), apply new engine oil to the sliding surfaces.
- Place removed parts such as bearings and bearing caps in their proper order and direction.
- Apply new engine oil to bolt thread and seat surfaces when tightening the following: Connecting rod bolts and main bearing cap bolts.
- Do not allow any magnetic materials to contact the ring gear teeth of flywheel/drive plate.

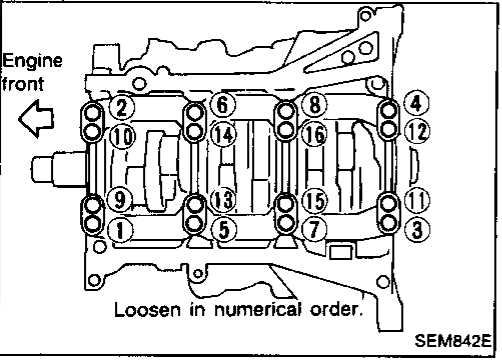
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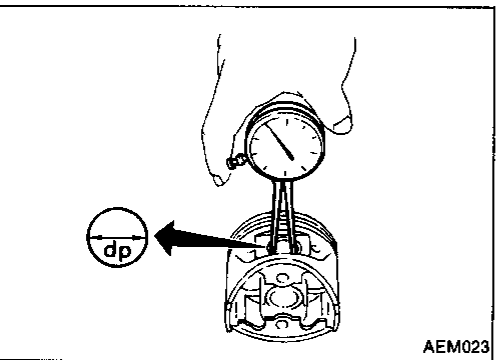
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SEM965A



SEM842E



AEM023

## Disassembly

### PISTON AND CRANKSHAFT

1. Remove engine. Refer to "ENGINE REMOVAL".
2. Place engine on a work stand.
3. Drain coolant and oil.
4. Remove cylinder head. Refer to "Removal" in "TIMING CHAIN".
5. Remove oil pan. Refer to "Removal" in "OIL PAN".
6. Remove timing chain. Refer to "Removal" in "TIMING CHAIN" (EM-18).
7. Remove pistons with connecting rods.
  - When disassembling piston and connecting rod, remove snap ring first, then heat piston to 60 to 70°C (140 to 158°F) or use piston pin press stand at room temperature.
8. Remove rear oil seal retainer.
9. Remove main bearing beam, cap and crankshaft.
  - Before removing bearing beam and bearing cap, measure crankshaft end play.
  - Bolts should be loosened in two or three steps.

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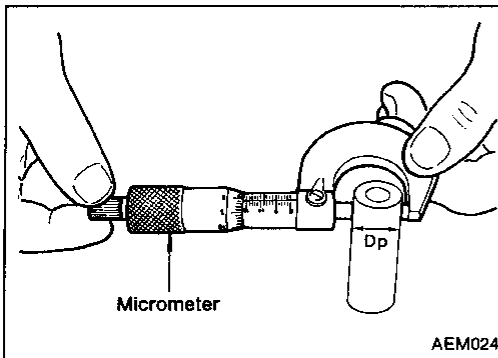
## Inspection

### PISTON AND PISTON PIN CLEARANCE

1. Measure inner diameter of piston pin hole "dp".
  - Standard diameter "dp":  
21.993 - 22.005 mm (0.8659 - 0.8663 in)

## CYLINDER BLOCK

### Inspection (Cont'd)



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

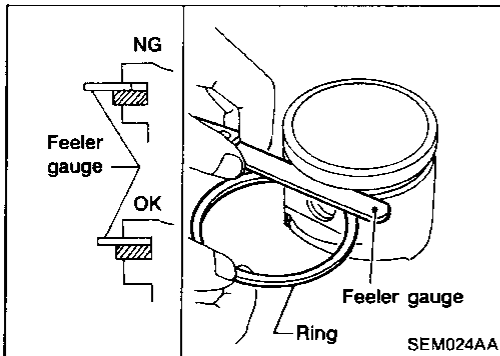
**Standard diameter "Dp":**

**21.989 - 22.001 mm (0.8657 - 0.8662 in)**

3. Calculate piston pin clearance.

**dp - Dp = 0.002 - 0.006 mm (0.0001 - 0.0002 in)**

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



### PISTON RING SIDE CLEARANCE

**Side clearance:**

**Top ring**

**0.040 - 0.080 mm (0.0016 - 0.0031 in)**

**2nd ring**

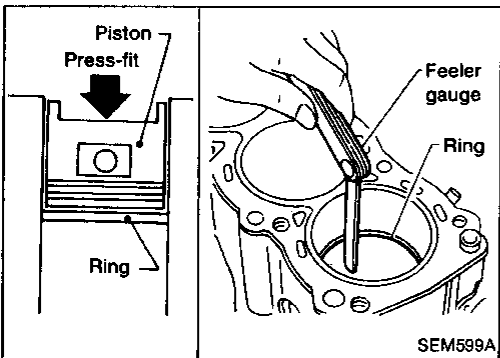
**0.030 - 0.070 mm (0.0012 - 0.0028 in)**

**Max. limit of side clearance:**

**2nd ring 0.1 mm (0.004 in)**

**Top ring 0.11 mm (0.0043 in)**

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



### PISTON RING END GAP

**End gap:**

**Top ring 0.22 - 0.41 mm (0.0087 - 0.0161 in)**

**2nd ring 0.50 - 0.74 mm (0.0197 - 0.0291 in)**

**Oil ring 0.20 - 0.69 mm (0.0079 - 0.0272 in)**

**Max. limit of ring gap:**

**Top ring 0.55 mm (0.0217 in)**

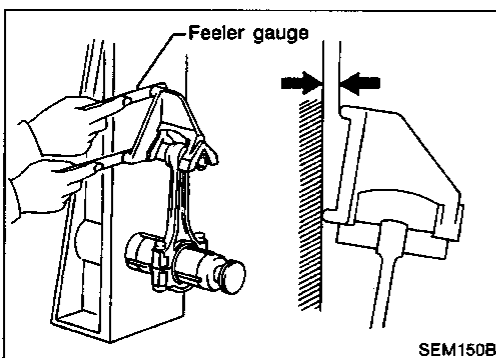
**2nd ring 0.85 mm (0.0335 in)**

**Oil ring 0.95 mm (0.0374 in)**

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

**Refer to SDS (EM-70).**

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



### CONNECTING ROD BEND AND TORSION

**Bend:**

**Limit 0.15 mm (0.0059 in)**

**per 100 mm (3.94 in) length**

**Torsion:**

**Limit 0.30 mm (0.0118 in)**

**per 100 mm (3.94 in) length**

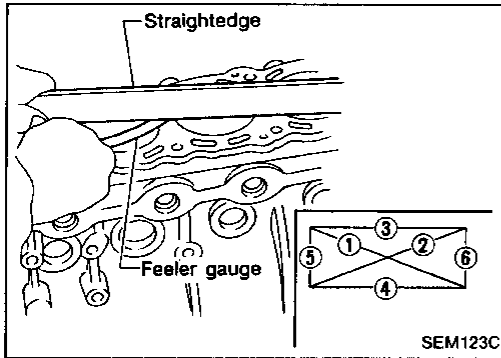
If it exceeds the limit, replace connecting rod assembly.



# CYLINDER BLOCK

## Inspection (Cont'd)

### CYLINDER BLOCK DISTORTION AND WEAR



1. Clean upper face of cylinder block and measure the distortion.  
**Limit: 0.10 mm (0.0039 in)**
2. If out of specification, resurface it. The resurfacing limit is determined by cylinder head resurfacing in engine.

### Resurfacing limit:

Amount of cylinder head resurfacing is "A".

Amount of cylinder block resurfacing is "B".

The maximum limit is as follows:

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

Nominal cylinder block height from crankshaft center:

$$214.95 - 215.05 \text{ mm (8.4626 - 8.4665 in)}$$

3. If necessary, replace cylinder block.

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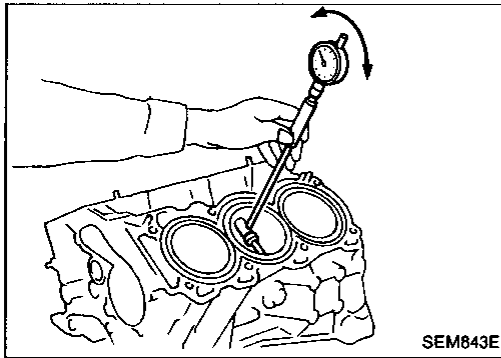
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### PISTON-TO-BORE CLEARANCE

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

**Standard inner diameter:**

$$93.000 - 93.030 \text{ mm (3.6614 - 3.6626 in)}$$

**Wear limit:**

$$0.20 \text{ mm (0.0079 in)}$$

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

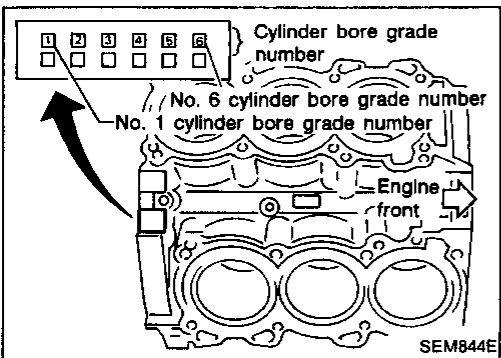
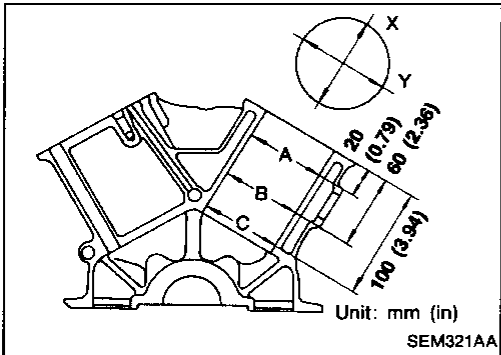
**Out-of-round (X - Y):**

$$\text{Limit } 0.015 \text{ mm (0.0006 in)}$$

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

$$\text{Limit } 0.010 \text{ mm (0.0004 in)}$$

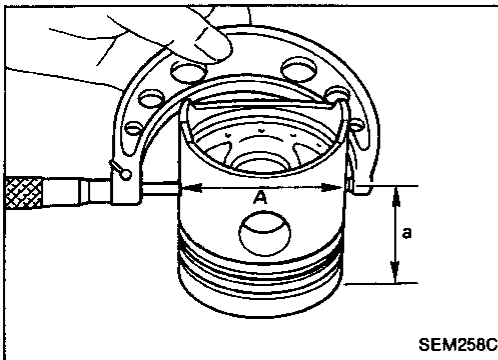
2. Check for scratches and seizure. If seizure is found, hone it.



- If both cylinder block and piston are replaced with new ones, select piston of the same grade number punched on cylinder block rear position. These numbers are punched in either Arabic or Roman numerals.

## CYLINDER BLOCK

### Inspection (Cont'd)



3. Measure piston skirt diameter.  
**Piston diameter "A":**  
Refer to SDS (EM-70).  
**Measuring point "a" (Distance from the top):**  
45.4 mm (1.787 in)
4. Check that piston-to-bore clearance is within specification.  
**Piston-to-bore clearance "B":**  
0.010 - 0.030 mm (0.0004 - 0.0012 in)
5. Determine piston oversize according to amount of cylinder wear.

**Oversize pistons are available for service. Refer to SDS (EM-70).**

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

$$\text{Rebored size calculation: } D = A + B - C$$

where,

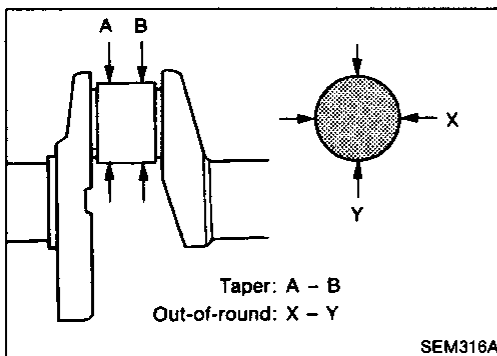
**D: Bored diameter**

**A: Piston diameter as measured**

**B: Piston-to-bore clearance**

**C: Honing allowance 0.02 mm (0.0008 in)**

7. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
8. Cut cylinder bores.
  - **When any cylinder needs boring, all other cylinders must also be bored.**
  - **Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.**
- 9.hone cylinders to obtain specified piston-to-bore clearance.
10. Measure finished cylinder bore for out-of-round and taper.
  - **Measurement should be done after cylinder bore cools down.**



### CRANKSHAFT

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

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

**Standard**

0.002 mm (0.0001 in)

**Taper (A - B):**

**Standard**

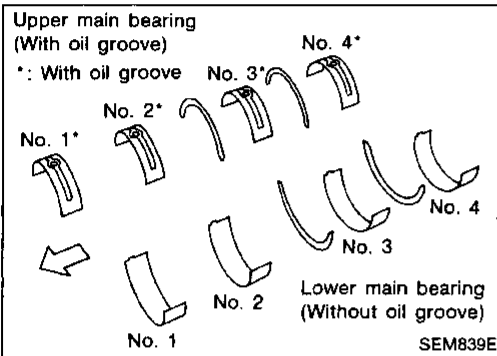
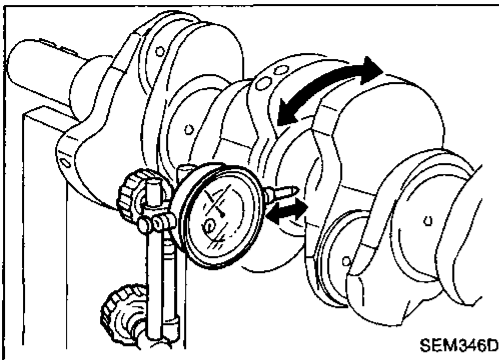
0.002 mm (0.0001 in)

# CYLINDER BLOCK

## Inspection (Cont'd)

3. Measure crankshaft runout.

**Runout (Total indicator reading):**  
**Limit: 0.10 mm (0.0039 in)**



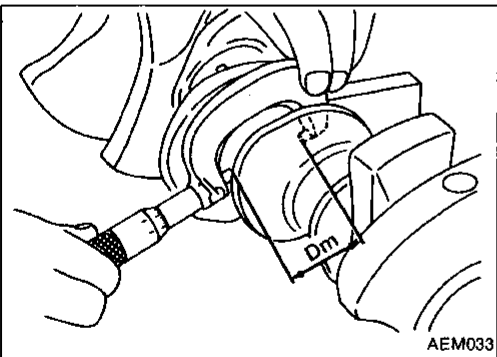
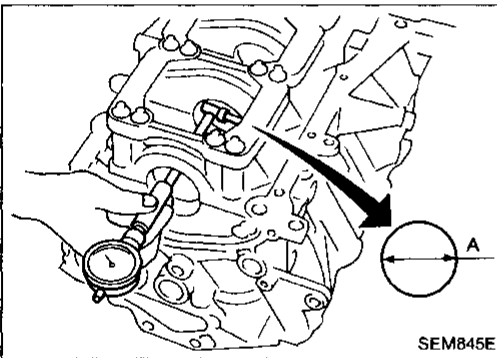
## BEARING CLEARANCE

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

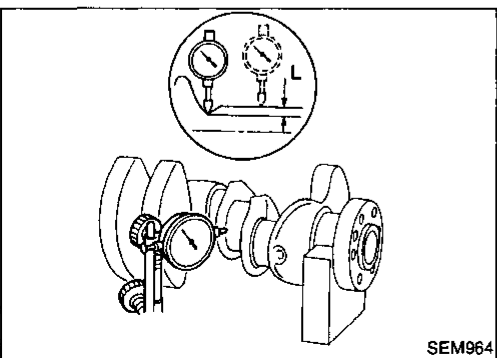
### Method A (Using bore gauge & micrometer)

#### Main bearing

1. Set main bearings in their proper positions on cylinder block and main bearing cap.
2. Install main bearing cap and bearing beam to cylinder block.
3. Measure inner diameters "A" of each main bearing.



4. Measure outer diameters "Dm" of each crankshaft main journal.
5. Calculate main bearing clearance.  
**Main bearing clearance = A - Dm**  
**Standard: 0.035 - 0.053 mm (0.0014 - 0.0021 in)**  
**Limit: 0.065 mm (0.0026 in)**
6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted using any standard bearing grade, grind crankshaft journal and use undersized bearing.



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

GI

MA

EM

LC

EC

FE

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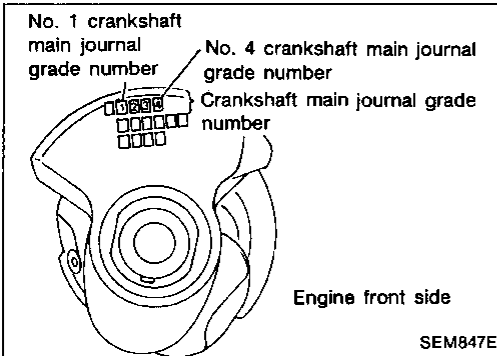
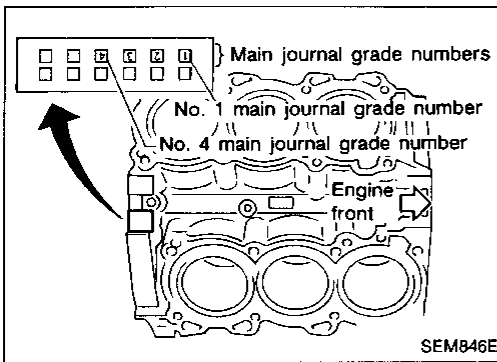
HA

EL

IDX

# CYLINDER BLOCK

## Inspection (Cont'd)



8. If crankshaft is reused, measure main bearing clearances and select thickness of main bearings. If crankshaft is replaced with a new one, select thickness of main bearings as follows:
- 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.

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

Example of calculation:

Main journal grade number: 1

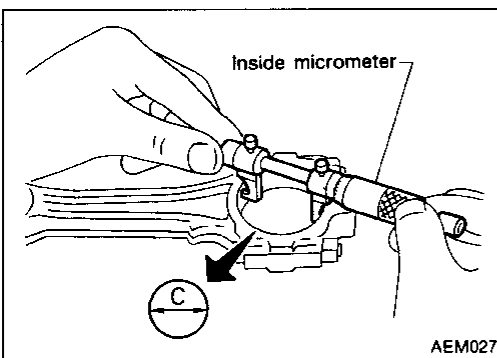
Crankshaft journal grade number: 2

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

### Main bearing grade number (Identification color):

These numbers are punched in either Arabic or Roman numerals.

		Main journal grade number			
		"0"	"1"	"2"	"3"
Crankshaft journal grade number	"0"	0 (Black)	1 (Brown)	2 (Green)	3 (Yellow)
	"1"	1 (Brown)	2 (Green)	3 (Yellow)	4 (Blue)
	"2"	2 (Green)	3 (Yellow)	4 (Blue)	5 (pink)
	"3"	3 (Yellow)	4 (Blue)	5 (Pink)	6 (Purple)



### Connecting rod bearing (Big end)

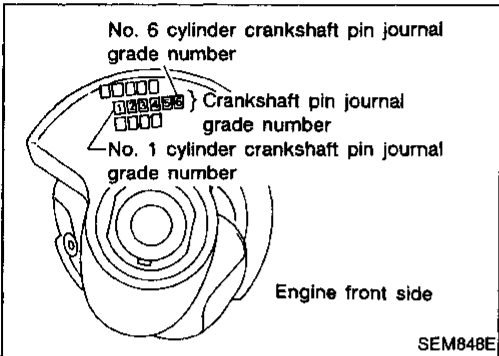
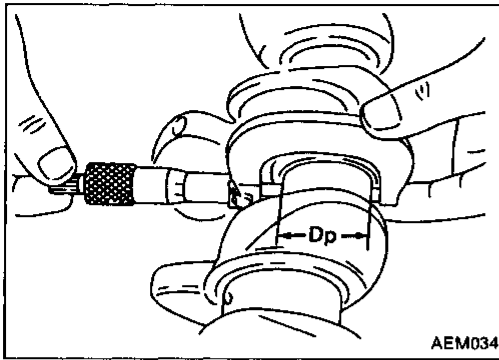
- Install connecting rod bearing to connecting rod and cap.
- Install connecting rod cap to connecting rod.

**Tighten bolts to the specified torque.**

- Measure inner diameter "C" of connecting rod.

# 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: 0.034 - 0.059 mm (0.0013 - 0.0023 in)**  
**Limit: 0.070 mm (0.0028 in)**
6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing. Refer to step 7 of "BEARING CLEARANCE — Main bearing" (EM-59).

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

### Connecting rod bearing grade number (Identification color):

These numbers are punched in either Arabic or Roman numerals.

Crankshaft pin grade number	Connecting rod bearing grade number
0	0 (Black)
1	1 (Brown)
2	2 (Green)

GI

MA

EM

LC

EC

FE

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MT

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FA

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BR

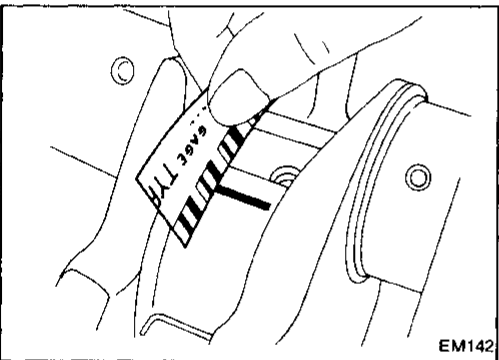
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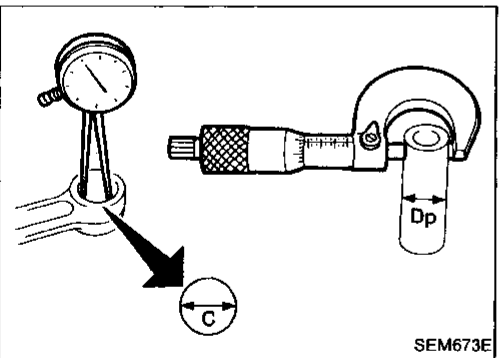
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## Method B (Using plastigage)

### CAUTION:

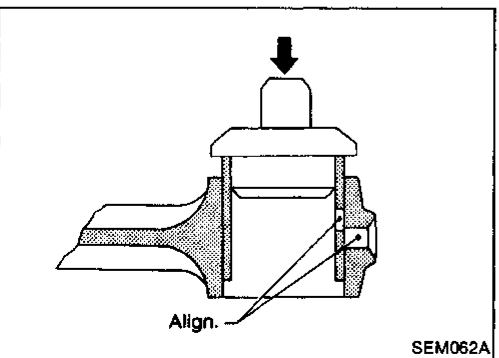
- Do not turn crankshaft or connecting rod while plastigage is being inserted.
- When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. If incorrect bearing clearance exists, use a thicker or undersized main bearing to ensure specified clearance.



## CONNECTING ROD BUSHING CLEARANCE (Small end)

1. Measure inner diameter "C" of bushing.
2. Measure outer diameter "Dp" of piston pin.
3. Calculate connecting rod bushing clearance.  
Connecting rod bushing clearance = C - Dp  
**Standard: 0.005 - 0.017 mm (0.0002 - 0.0007 in)**  
**Limit: 0.030 mm (0.0012 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. After driving in small end bushing, ream the bushing. This is to ensure the clearance between connecting rod bushing and piston pin is the specified value.

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

## CYLINDER BLOCK

### Inspection (Cont'd)

#### FLYWHEEL/DRIVE PLATE RUNOUT

Runout (Total indicator reading):

Flywheel (M/T model)

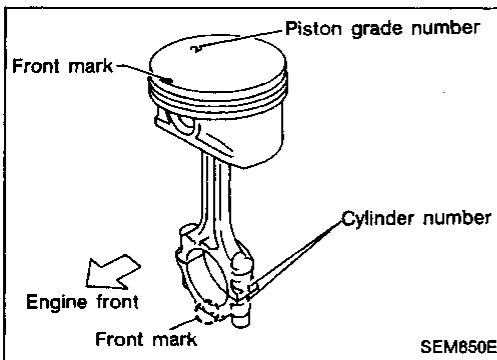
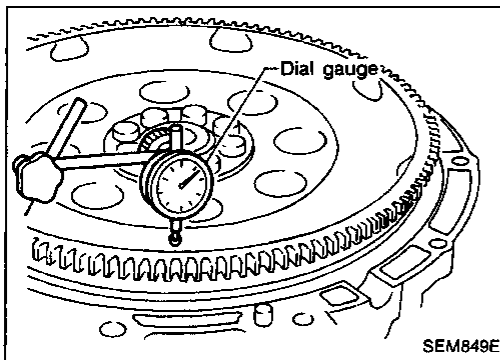
Less than 0.15 mm (0.0059 in)

Drive plate (A/T model)

Less than 0.15 mm (0.0059 in)

#### CAUTION:

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



### Assembly

#### PISTON

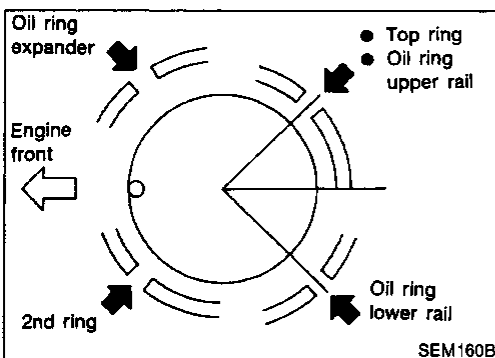
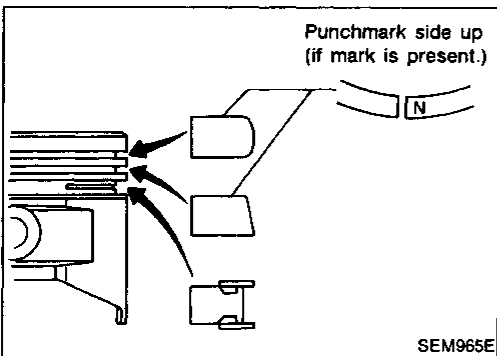
1. Install new snap ring on one side of piston pin hole.
2. Heat piston to 60 to 70°C (140 to 158°F) and assemble piston, piston pin, connecting rod and new snap ring.

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

3. Set piston rings as shown.

#### CAUTION:

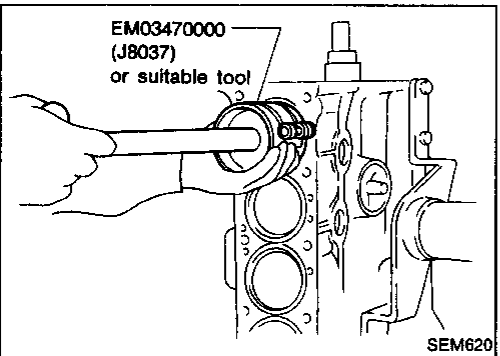
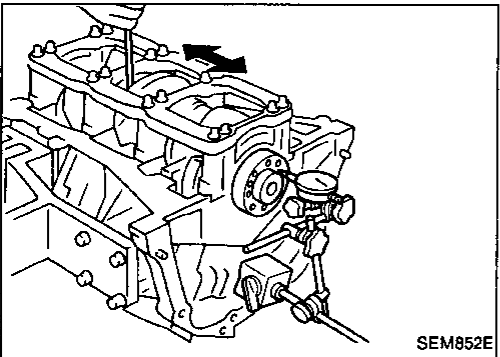
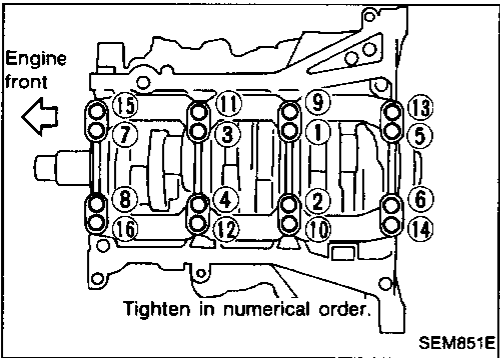
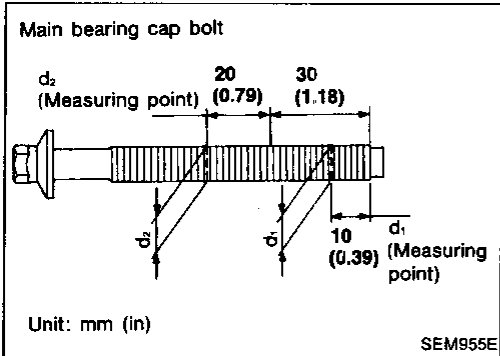
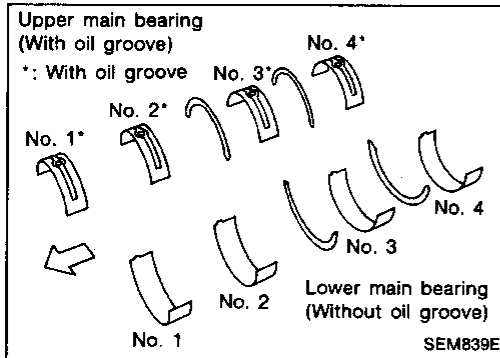
- When piston rings are not replaced, make sure that piston rings are mounted in their original positions.
- When replacing piston rings, these without punchmarks, present, piston rings can be mounted with either side up.



# CYLINDER BLOCK

## Assembly (Cont'd)

### CRANKSHAFT



1. Set main bearings in their proper positions on cylinder block and main bearing beam.
  - Confirm that correct main bearings are used. Refer to "Inspection" of this section.

2. Instructions for re-use of main bearing cap bolts.
  - A plastic zone tightening method is used for tightening main bearing cap bolts. If the difference between d1 and d2 shown in the figure exceeds the limit, replace the bolts with new ones.

Limit (d1 - d2): 0.11 mm (0.0043 in)

3. After installing crankshaft, main bearing cap, main bearing beam and bearing cap bolts, tighten bearing cap bolts in numerical order.

- Tightening procedure
- (1) Tighten all bolts to 32 to 38 N·m (3.3 to 3.9 kg·m, 24 to 28 ft·lb).
- (2) Turn all bolts 90 to 95 degrees clockwise with angle wrench.

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

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

4. Measure crankshaft end play.

Crankshaft end play:

Standard

0.10 - 0.25 mm (0.0039 - 0.0098 in)

Limit

0.30 mm (0.0118 in)

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

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

- Confirm that correct bearings are used.

- Tightening procedure

- (1) Tighten all bolts to 32 to 38 N·m (3.3 to 3.9 kg·m, 24 to 28 ft·lb).
- (2) Turn all bolts 90 to 95 degrees clockwise with angle wrench.

6. Install pistons with connecting rods.

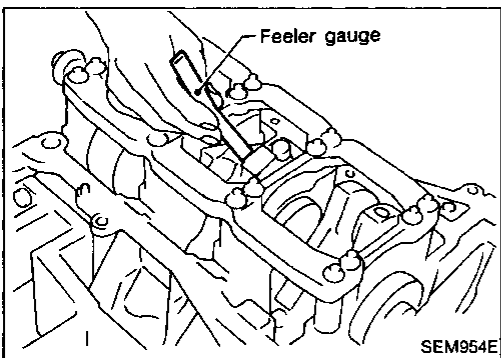
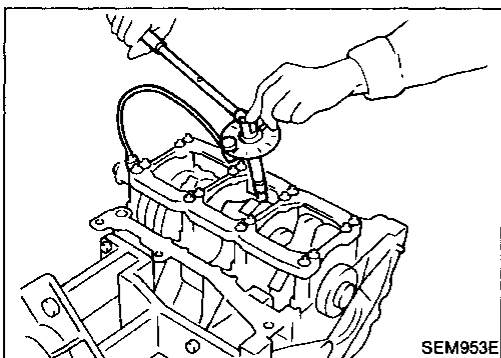
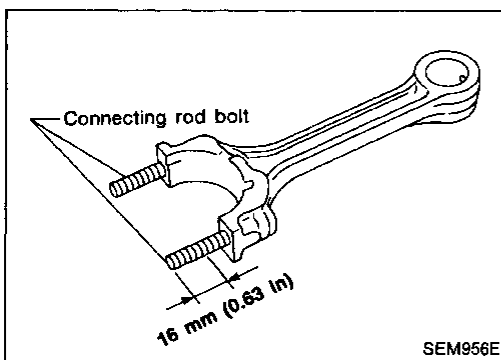
- a. Install them into corresponding cylinders with Tool.

- Be careful not to scratch cylinder wall with the connecting rod.

- Arrange so that front mark on piston head faces toward front of engine.

## CYLINDER BLOCK

### Assembly (Cont'd)



b. A plastic zone tightening method is used for tightening connecting rod bolts and nuts. Check the old bolts for deformation before re-using them.

- Ensure that the connecting rod nut can be screwed smoothly as far as the bolt thread end.
- If this is not possible, use slide calipers to measure the outside diameter of the narrowest thread part of the bolt at 16 mm (0.63 in) from the thread end. Replace the connecting rod bolt and nut, if under the limit.

**Standard: 7.90 - 8.00 mm (0.3110 - 0.3150 in)**

**Limit: 7.75 mm (0.3051 in)**

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

**Connecting rod bearing nut:**

- (1) Tighten nuts to 19 to 21 N·m  
(1.9 to 2.1 kg-m, 14 to 15 ft-lb).
- (2) Turn nuts 90 to 95 degrees clockwise with angle wrench

7. Measure connecting rod side clearance.

**Connecting rod side clearance:**

**Standard**

**0.20 - 0.35 mm (0.0079 - 0.0138 in)**

**Limit**

**0.40 mm (0.0157 in)**

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

8. Install rear oil seal retainer.



# SERVICE DATA AND SPECIFICATIONS (SDS)

## General Specifications

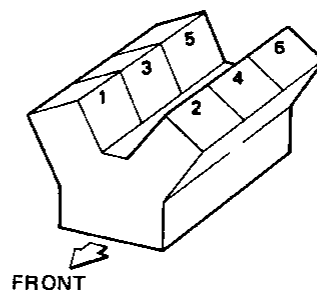
Cylinder arrangement	V-6	
Displacement	cm <sup>3</sup> (cu in)	2,988 (182.33)
Bore and stroke	mm (in)	93 x 73.3 (3.66 x 2.886)
Valve arrangement	DOHC	
Firing order	1-2-3-4-5-6	
Number of piston rings		
Compression	2	
Oil	1	
Number of main bearings	4	
Compression ratio	10.0	

## COMPRESSION PRESSURE

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

Compression pressure		
Standard	1,275 (13.0, 185)	
Minimum	981 (10.0, 142)	
Differential limit between cylinders	98 (1.0, 14)	

Cylinder number



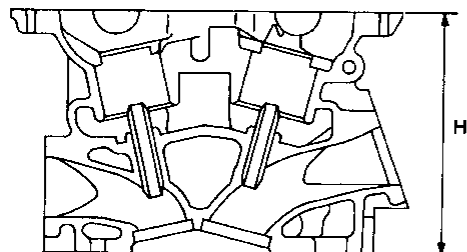
SEM713A

## Inspection and Adjustment

### CYLINDER HEAD

Unit: mm (in)

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

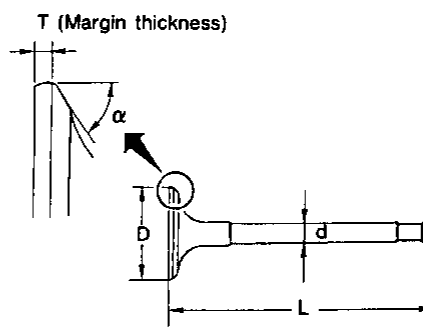


Nominal cylinder head height:  
H = 126.3 - 126.5 mm (4.972 - 4.980 in)

SEM949E

### VALVE

Unit: mm (in)



SEM188

Valve head diameter "D"		
Intake	36.0 - 36.3 (1.417 - 1.429)	
Exhaust	31.2 - 31.5 (1.228 - 1.240)	
Valve length "L"		
Intake	97.32 - 97.82 (3.8315 - 3.8512)	
Exhaust	94.85 - 95.35 (3.7342 - 3.7539)	
Valve stem diameter "d"		
Intake	5.965 - 5.980 (0.2348 - 0.2354)	
Exhaust	5.945 - 5.960 (0.2341 - 0.2346)	
Valve seat angle "α"		
Intake	45°15' - 45°45'	
Exhaust		
Valve margin "T"		
Intake	0.95 - 1.25 (0.0374 - 0.0492)	
Exhaust	1.15 - 1.45 (0.0453 - 0.0571)	
Valve margin "T" limit		
More than 0.5 (0.020)		
Valve stem end surface grinding limit		
Less than 0.2 (0.008)		
Valve clearance (Cold)		
Intake	0.26 - 0.34 (0.0102 - 0.0134)	
Exhaust	0.29 - 0.37 (0.0114 - 0.0146)	

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

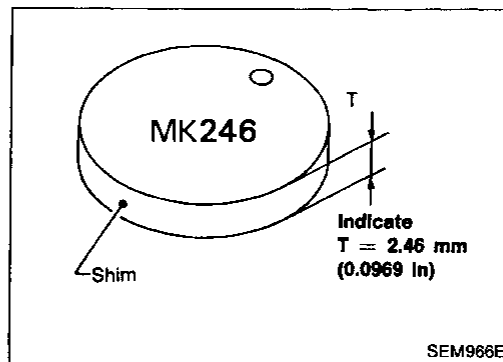
### Valve clearance

	Unit: mm (in)	
	Cold	Hot [at 80°C (176°F)]
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

### Available shims

Thickness mm (in)	Identification mark
2.32 (0.0913)	232
2.33 (0.0917)	233
2.34 (0.0921)	234
2.35 (0.0925)	235
2.36 (0.0929)	236
2.37 (0.0933)	237
2.38 (0.0937)	238
2.39 (0.0941)	239
2.40 (0.0945)	240
2.41 (0.0949)	241
2.42 (0.0953)	242
2.43 (0.0957)	243
2.44 (0.0961)	244
2.45 (0.0965)	245
2.46 (0.0969)	246
2.47 (0.0972)	247
2.48 (0.0976)	248
2.49 (0.0980)	249
2.50 (0.0984)	250
2.51 (0.0988)	251
2.52 (0.0992)	252
2.53 (0.0996)	253
2.54 (0.1000)	254
2.55 (0.1004)	255
2.56 (0.1008)	256
2.57 (0.1012)	257
2.58 (0.1016)	258
2.59 (0.1020)	259
2.60 (0.1024)	260
2.61 (0.1028)	261
2.62 (0.1031)	262
2.63 (0.1035)	263
2.64 (0.1039)	264

Thickness mm (in)	Identification mark
2.65 (0.1043)	265
2.66 (0.1047)	266
2.67 (0.1051)	267
2.68 (0.1055)	268
2.69 (0.1059)	269
2.70 (0.1063)	270
2.71 (0.1067)	271
2.72 (0.1071)	272
2.73 (0.1075)	273
2.74 (0.1079)	274
2.75 (0.1083)	275
2.76 (0.1087)	276
2.77 (0.1091)	277
2.78 (0.1094)	278
2.79 (0.1098)	279
2.80 (0.1102)	280
2.81 (0.1106)	281
2.82 (0.1110)	282
2.83 (0.1114)	283
2.84 (0.1118)	284
2.85 (0.1122)	285
2.86 (0.1126)	286
2.87 (0.1130)	287
2.88 (0.1134)	288
2.89 (0.1138)	289
2.90 (0.1142)	290
2.91 (0.1146)	291
2.92 (0.1150)	292
2.93 (0.1154)	293
2.94 (0.1157)	294
2.95 (0.1161)	295



# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### Valve spring

Free height	mm (in)	46.93 (1.8476)
Pressure N (kg, lb) at height mm (in)		454 (46.3, 102.1) at 27.55 (1.0846)
		Standard
		Limit
Out-of-square	mm (in)	Less than 2.0 (0.079)

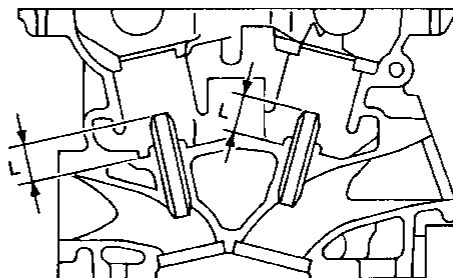
### Valve lifter

Unit: mm (in)

Valve lifter outer diameter	34.960 - 34.975 (1.3764 - 1.3770)
Lifter guide inner diameter	35.000 - 35.021 (1.3780 - 1.3788)
Clearance between lifter and filter guide	0.025 - 0.061 (0.0010 - 0.0024)

### Valve guide

Unit: mm (in)



SEM950E

	Standard	Service
Valve guide		
Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
Valve guide		
Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter	9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide	0.027 - 0.059 (0.0011 - 0.0023)	
	Standard	Max. tolerance
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)
Valve deflec- tion limit	Intake	—
	Exhaust	0.24 (0.0094)
Projection length "L"	12.6 - 12.8 (0.496 - 0.504)	

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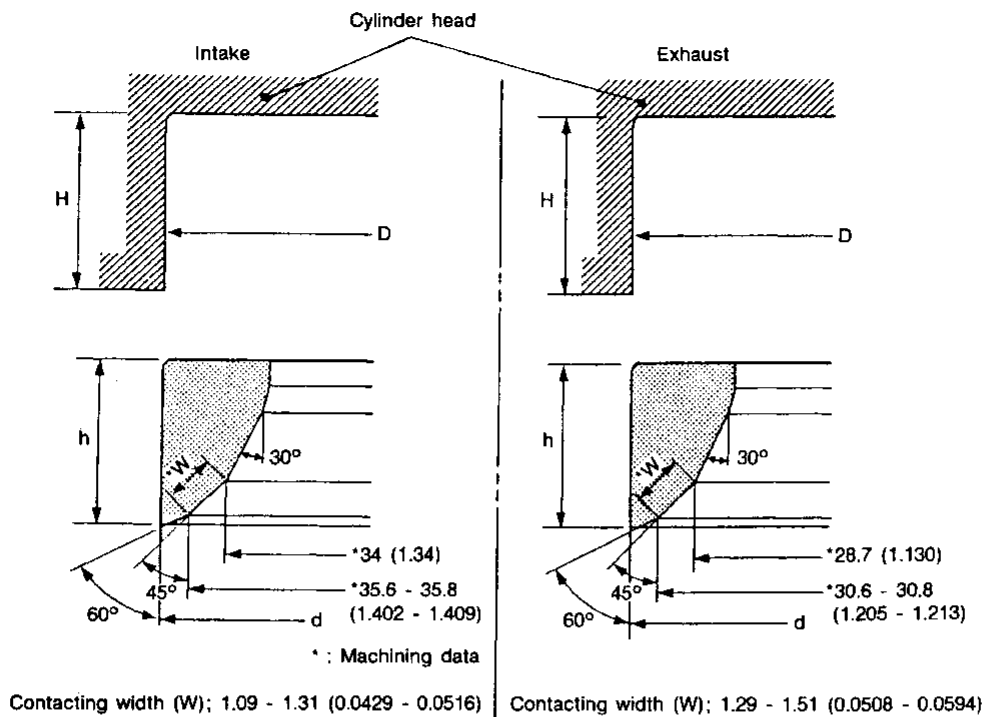
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# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### VALVE SEAT



SEM021EA

Unit: mm (in)

		Standard	Service
Cylinder head seat recess diameter (D)	In.	37.000 - 37.016 (1.4567 - 1.4573)	37.500 - 37.516 (1.4764 - 1.4770)
	Ex.	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat interference fit	In.	0.081 - 0.113 (0.0032 - 0.0044)	
	Ex.	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	In.	37.097 - 37.113 (1.4605 - 1.4611)	37.597 - 37.613 (1.4802 - 1.4808)
	Ex.	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Height (h)	In.	5.9 - 6.0 (0.232 - 0.236)	5.05 - 5.15 (0.1988 - 0.2028)
	Ex.	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth (H)		5.9 - 6.1 (0.232 - 0.240)	

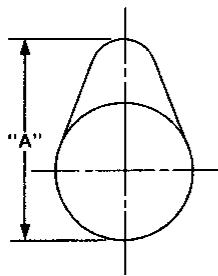
# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard	Limit
Camshaft journal to bearing clearance	0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
Inner diameter of camshaft bearing	23.500 - 23.521 (0.9252 - 0.9260)	—
Outer diameter of camshaft journal	23.435 - 23.455 (0.9226 - 0.9234)	—
Camshaft runout [TIR*]	Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]	Less than 0.15 (0.0059)	—
Camshaft end play	0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)



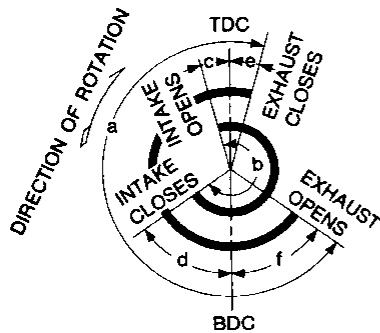
EM671

#### Cam height "A"

Intake	43.955 - 44.145 (1.7305 - 1.7380)
Exhaust	43.955 - 44.145 (1.7305 - 1.7380)
Wear limit of cam height	0.2 (0.008)

\*Total indicator reading

#### Valve timing

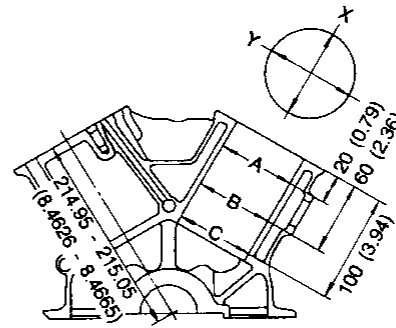


EM120  
Unit: degree

a	b	c	d	e	f
232	232	3	49	3	49

### CYLINDER BLOCK

Unit: mm (in)



SEM022EA

#### Surface flatness

Standard	Less than 0.03 (0.0012)
Limit	0.10 (0.0039)

#### Cylinder bore

Inner diameter	
Standard	
Grade No. 1	93.000 - 93.010 (3.6614 - 3.6618)
Grade No. 2	93.011 - 93.020 (3.6618 - 3.6622)
Grade No. 3	93.021 - 93.030 (3.6622 - 3.6626)
Wear limit	0.20 (0.0079)

Out-of-round (X - Y)	Less than 0.015 (0.0006)
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Taper (A - B - C)	Less than 0.010 (0.0004)
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#### Main journal inner diameter

Grade No. 0	63.993 - 63.999 (2.5194 - 2.5196)
Grade No. 1	64.000 - 64.005 (2.5197 - 2.5199)
Grade No. 2	64.006 - 64.011 (2.5199 - 2.5201)
Grade No. 3	64.012 - 64.017 (2.5202 - 2.5203)

#### Difference in inner diameter between cylinders

Standard	Less than 0.03 (0.0012)
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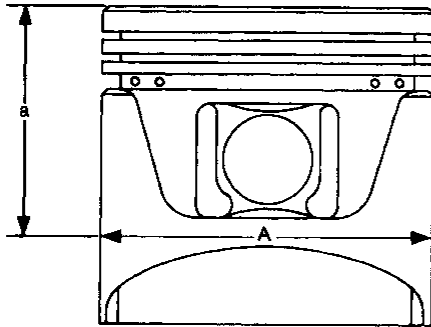
# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### PISTON, PISTON RING AND PISTON PIN

#### Available piston

Unit: mm (in)



SEM882E

#### Piston skirt diameter "A"

##### Standard

Grade No. 1	92.980 - 92.990 (3.6606 - 3.6610)
Grade No. 2	92.990 - 93.000 (3.6610 - 3.6614)
Grade No. 3	93.000 - 93.010 (3.6614 - 3.6618)
0.20 (0.0079) oversize (Service)	93.180 - 93.210 (3.6685 - 3.6697)
"a" dimension	45.4 (1.787)
Piston pin hole diameter	21.993 - 22.005 (0.8659 - 0.8663)
Piston clearance to cylinder block	0.010 - 0.030 (0.0004 - 0.0012)

#### Piston ring

Unit: mm (in)

	Standard	Limit
Side clearance		
Top	0.040 - 0.080 (0.0016 - 0.0031)	0.11 (0.0043)
2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
End gap		
Top	0.22 - 0.41 (0.0087 - 0.0161)	0.55 (0.0217)
2nd	0.50 - 0.74 (0.0197 - 0.0291)	0.85 (0.0335)
Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)	0.95 (0.0374)

#### Piston pin

Unit: mm (in)

Piston pin outer diameter	21.989 - 22.001 (0.8657 - 0.8662)
Interference fit of piston pin to piston	0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing clearance	0.005 - 0.017 (0.0002 - 0.0007)

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

### CONNECTING ROD

Unit: mm (in)

Center distance	147.60 - 147.70 (5.8110 - 5.8149)
Bend [per 100 (3.94)]	
Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	
Limit	0.30 (0.0118)
Connecting rod small end inner diameter	23.980 - 24.000 (0.9441 - 0.9449)
Piston pin bushing inner diameter*	22.000 - 22.012 (0.8661 - 0.8666)
Connecting rod big end inner diameter	48.000 - 48.013 (1.8898 - 1.8903)
Side clearance	
Standard	0.20 - 0.35 (0.0079 - 0.0138)
Limit	0.40 (0.0157)

\*After installing in connecting rod

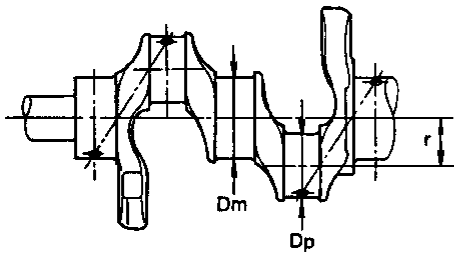
# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### CRANKSHAFT

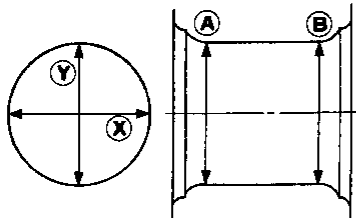
Unit: mm (in)

Main journal dia. "Dm"	
Grade No. 0	59.969 - 59.975 (2.3610 - 2.3612)
Grade No. 1	59.963 - 59.969 (2.3607 - 2.3610)
Grade No. 2	59.957 - 59.963 (2.3605 - 2.3607)
Grade No. 3	59.951 - 59.957 (2.3603 - 2.3605)
Pin journal dia. "Dp"	
Grade No. 0	44.968 - 44.974 (1.7704 - 1.7706)
Grade No. 1	44.962 - 44.968 (1.7702 - 1.7704)
Grade No. 2	44.956 - 44.962 (1.7699 - 1.7702)
Center distance "r"	
	36.61 - 36.69 (1.4413 - 1.4445)
Out-of-round (X - Y)	
Standard	Less than 0.002 (0.0001)
Taper (A - B)	
Standard	Less than 0.002 (0.0001)
Runout [TIR]	
Limit	Less than 0.10 (0.0039)
Free end play	
Standard	0.10 - 0.25 (0.0039 - 0.0098)
Limit	0.30 (0.0118)



SEM645

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

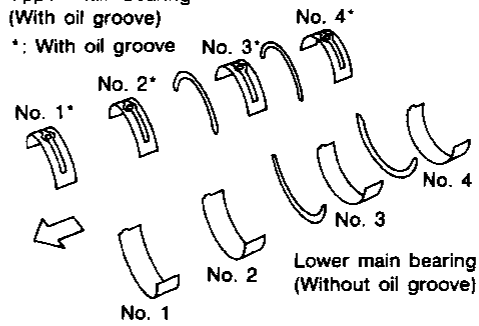


EM715

### AVAILABLE MAIN BEARING

Upper main bearing  
(With oil groove)

\*: With oil groove



SEM839E

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color
0	2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black
1	2.003 - 2.006 (0.0789 - 0.0790)		Brown
2	2.006 - 2.009 (0.0790 - 0.0791)		Green
3	2.009 - 2.012 (0.0791 - 0.0792)		Yellow
4	2.012 - 2.015 (0.0792 - 0.0793)		Blue
5	2.015 - 2.018 (0.0793 - 0.0794)		Pink
6	2.018 - 2.021 (0.0794 - 0.0796)		Purple

### Undersize

Unit: mm (in)

	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	Grind so that bearing clearance is the specified value.

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Inspection and Adjustment (Cont'd)

### AVAILABLE CONNECTING ROD BEARING

#### Connecting rod bearing

Grade number	Thickness "T" mm (in)	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

#### Undersize

Unit: mm (in)

	Thickness	Crank pin journal diameter "Dp"
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

### MISCELLANEOUS COMPONENTS

Unit: mm (in)

Flywheel runout [TIR]*	Less than 0.15 (0.0059)
Drive plate runout [TIR]*	Less than 0.15 (0.0059)

\*Total indicator reading

#### Bearing clearance

Unit: mm (in)

Main bearing clearance	
Standard	0.035 - 0.053 (0.0014 - 0.0021)
Limit	0.065 (0.0026)

Connecting rod bearing clearance	
Standard	0.034 - 0.059 (0.0013 - 0.0023)
Limit	0.070 (0.0028)