SECTION EM

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Parts Requiring Angular Tightening

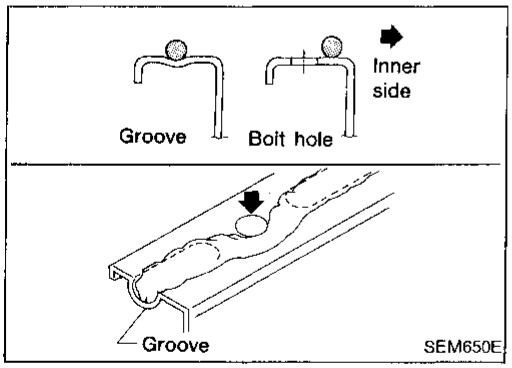
- Some engine parts are tightened with angular-tightening method rather than torque setting method.
- If these parts are tightened with torque setting method, dispersal of the tightening force (axial bolt force) would be two or three times wider than that of the correct angular-tightening method.
- Although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

Supplemental Restraint System "AIR BAG" and "SEAT BELT PRE-TENSIONER"

The Supplemental Restraint System "Air Bag" and "Seat Belt Pre-tensioner" help to reduce the risk or severity of injury to the driver and front passenger in a frontal collision. The Supplemental Restraint System consists of air bags (located in the center of the steering wheel and on the instrument panel on the passenger side), seat belt pre-tensioners, sensors, a diagnosis unit, warning lamp, wiring harness and spiral cable. Information necessary to service the system safely is included in the **BF section** of this Service Manual.

WARNING:

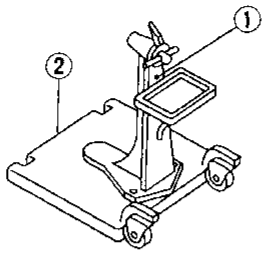
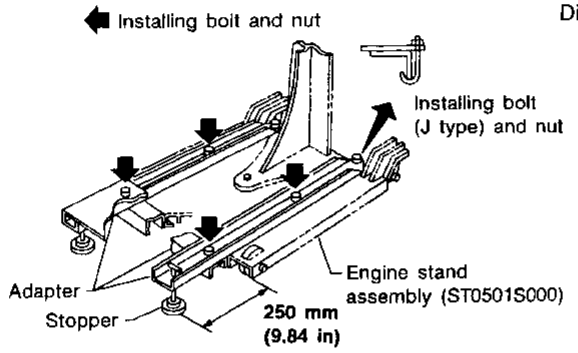
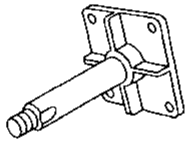
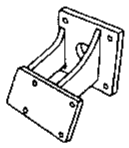
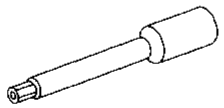
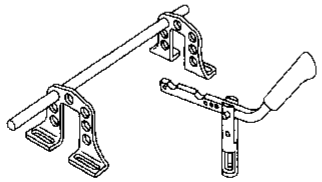
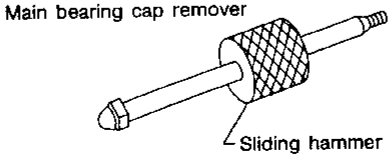
- **To avoid rendering the SRS inoperative, which could lead to personal injury or death in the event of a severe frontal collision, all maintenance must be performed by an authorized INFINITI dealer.**
- **Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal 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.**



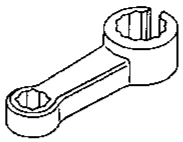
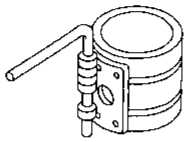
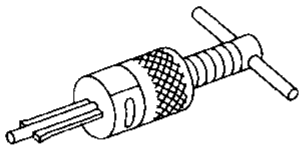
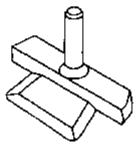
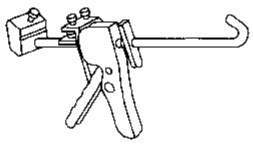
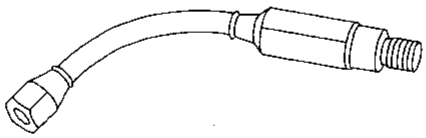
Liquid Gasket Application Procedure

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

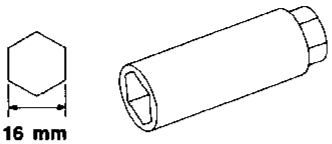
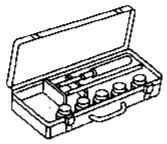
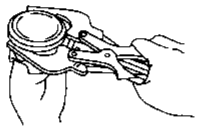
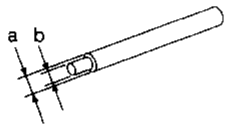
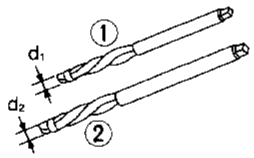
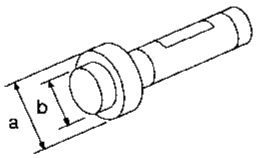
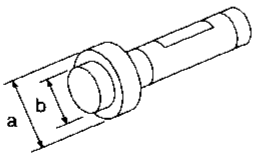
Special Service Tools

Tool number (Kent-Moore No.) Tool name	Description
ST0501S000 (—) Engine stand assembly ① ST05011000 (—) Engine stand ② ST05012000 (—) Base	Disassembling and assembling  NT042
KV10114900 (—) Engine stand support arm	Disassembling and assembling  NT043
KV10106500 (—) Engine stand shaft	 NT028
KV10114600 (—) Engine sub-attachment	 NT018
ST10120000 (J24239-01) Cylinder head bolt wrench	Loosening and tightening cylinder head bolt  NT019
(J39773) Valve spring compressor	Disassembling and assembling valve components  NT103
KV10114700 (—) Main bearing cap remover	Removing main bearing cap  NT023

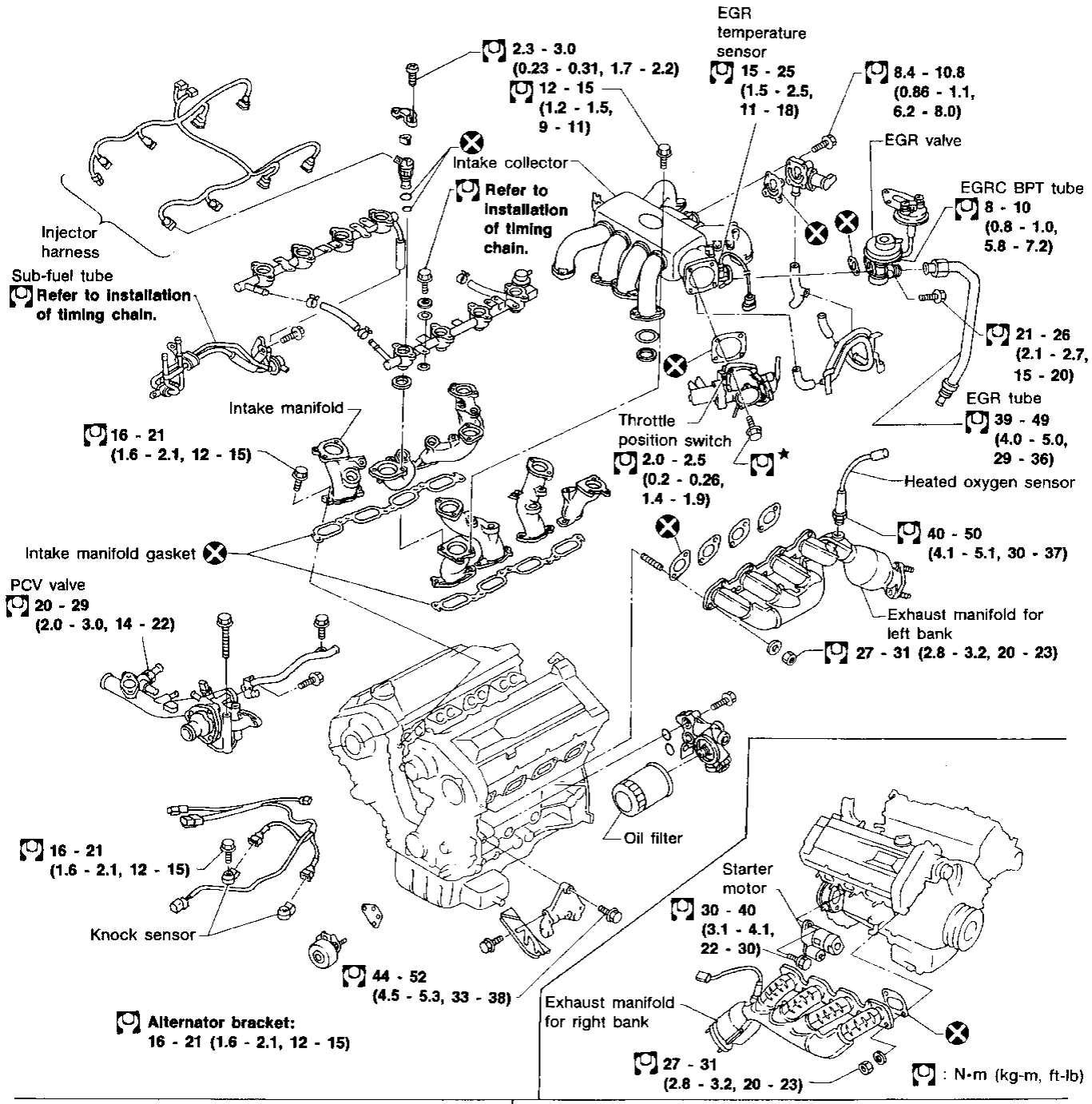
Special Service Tools (Cont'd)

Tool number (Kent-Moore No.) Tool name	Description	
(J-38365) Heated oxygen sensor wrench	 NT055	Loosening or tightening heated oxygen sensor
EM03470000 (J8037) Piston ring compressor	 NT044	Installing piston assembly into cylinder bore
ST16610001 (J23907) Pilot bushing puller	 NT045	Removing crankshaft pilot bushing
KV10111100 (J37228) Seal cutter	 NT046	Removing oil pan
WS39930000 (—) Tube presser	 NT052	Pressing the tube of liquid gasket
(J22794) Compression gauge adapter	 NT007	

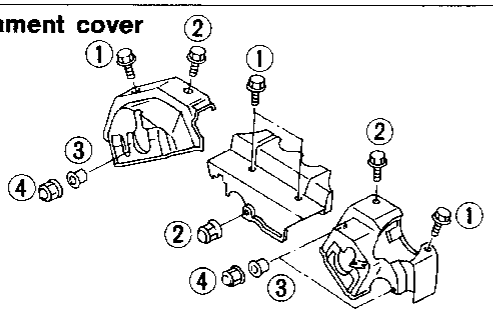
Commercial Service Tools

Tool name	Description	
Spark plug wrench	 NT047	Removing and installing spark plug
Valve seat cutter set	 NT048	Finishing valve seat dimensions
Piston ring expander	 NT030	Removing and installing piston ring
Valve guide drift	 NT015	Removing and installing valve guide **Intake:** **a = 11.5 mm (0.453 in) dia.** **b = 6.5 mm (0.256 in) dia.** **Exhaust:** **a = 12.5 mm (0.492 in) dia.** **b = 7.5 mm (0.295 in) dia.**
Valve guide reamer	 NT016	Reaming valve guide ① or hole for oversize valve guide ② **Intake:** **d_1 = 7.000 mm (0.2756 in) dia.** **Exhaust:** **d_1 = 8.000 mm (0.3150 in) dia.** **Intake:** **d_2 = 11.175 mm (0.4400 in) dia.** **Exhaust:** **d_2 = 12.175 mm (0.4793 in) dia.**
Front oil seal drift	 NT049	Installing front oil seal **a = 75 mm (2.95 in) dia.** **b = 45 mm (1.77 in) dia.**
Rear oil seal drift	 NT049	Installing rear oil seal **a = 110 mm (4.33 in) dia.** **b = 80 mm (3.15 in) dia.**

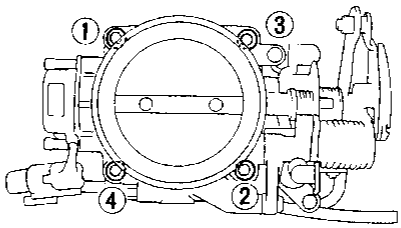
OUTER COMPONENT PARTS



Front ornament cover



Tighten in numerical order.
6.3 - 8.3 (0.64 - 0.85, 4.6 - 6.1)



Tighten in numerical order.

★ Throttle body bolts

Tightening procedure

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

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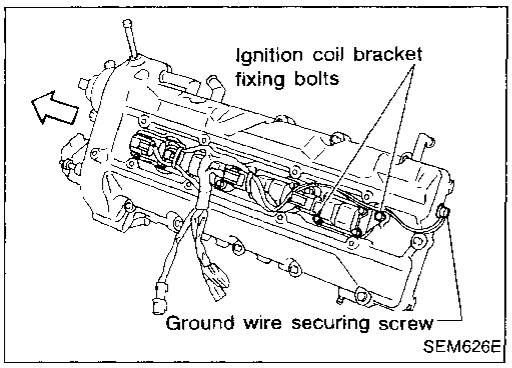
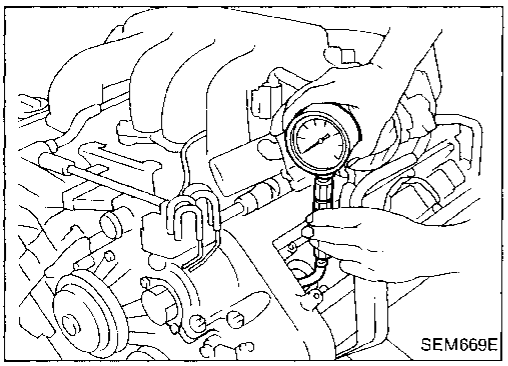


Measurement of Compression Pressure

1. Warm up engine.
2. Turn ignition switch off.
3. Release fuel pressure.
   Refer to "Releasing Fuel Pressure" in EF & EC section.
4. Remove air duct (only left bank).
5. Disconnect power transistor connectors.
6. Remove harness connector bracket (only left bank).
7. Remove ornamental rocker covers.
8. Disconnect harness connector between ignition coil and power transistor.
9. Remove ignition coil bracket fixing bolts and ground wire securing screw, and pull out this bracket with ignition coils.
10. Remove all spark plugs.



11. Attach a compression tester to No. 1 cylinder.
12. Depress gas pedal fully to keep throttle valve wide open.
13. Crank engine and record highest gauge indication.
14. Repeat the measurement on each cylinder.

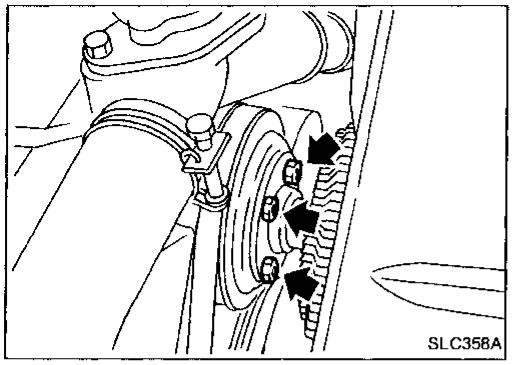
- **Use a fully-charged battery to get specified engine speed.**

Compression pressure: kPa (kg/cm^2, psi)/rpm

Standard
1,275 (13.0, 185)/300
Minimum
981 (10.0, 142)/300
Difference limit between cylinders
98 (1.0, 14)/300

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

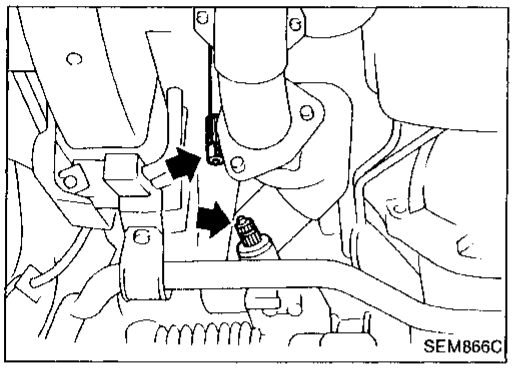
- **If adding oil improves cylinder compression, piston rings may be worn or damaged. Replace piston rings after checking piston.**
- **If pressure stays low, a valve may be sticking or seating improperly. Inspect valve and valve seat. Refer to SDS (EM-45)**
- **If compression in any two adjacent cylinders is low and if adding oil does not improve compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.**



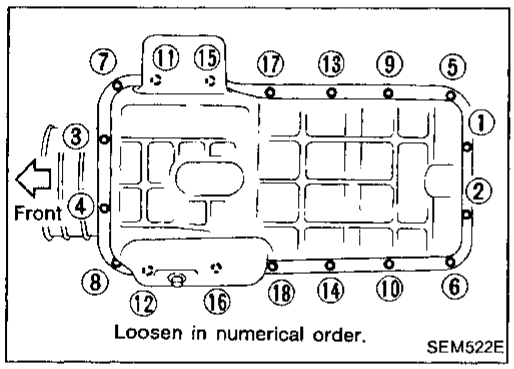
Removal

1. Remove engine under cover.
2. Drain engine oil.
3. Remove fan coupling with fan.
4. Remove the following parts.

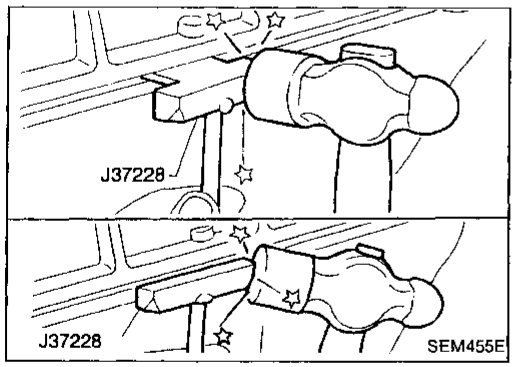
- All drive belts
- Alternator
- A/C compressor
- Engine gusset



5. Remove steering lower joint.
6. Set a suitable transmission jack under the transmission. Hoist engine with engine slinger.
7. Remove suspension member assembly.



8. Remove oil pan.

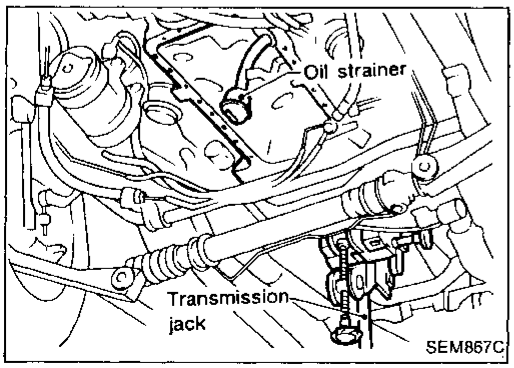


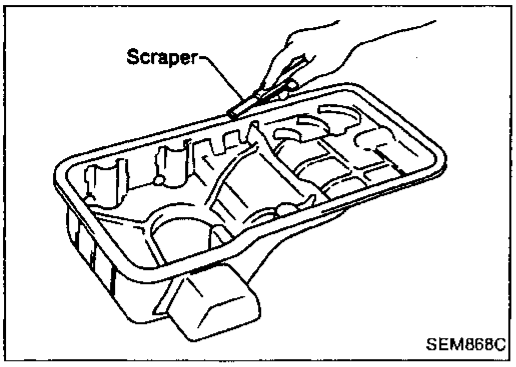
9. Remove oil pan.

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

- **Do not drive seal cutter into oil pump or rear oil seal retainer portion, or aluminum mating face will be damaged.**
- **Do not insert screwdriver, or oil pan flange will be deformed.**

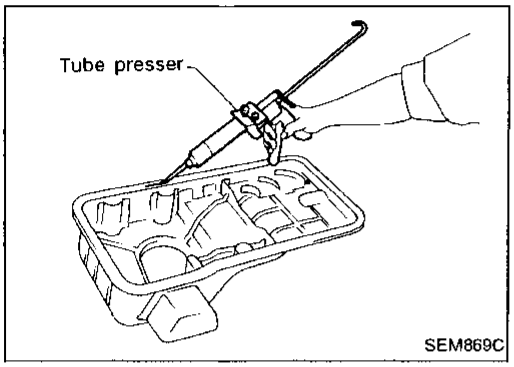
(2) Slide Tool by tapping its side with a hammer, and remove oil pan.



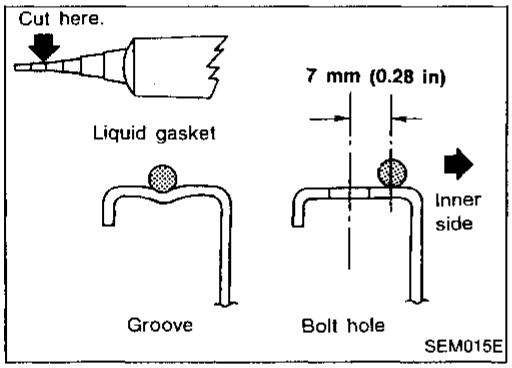


Installation

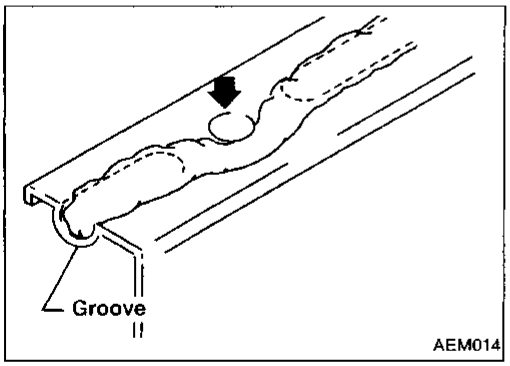
1. Before installing oil pan, remove all traces of liquid gasket from mating surface using a scraper.
- Also remove traces of liquid gasket from mating surface of cylinder block.

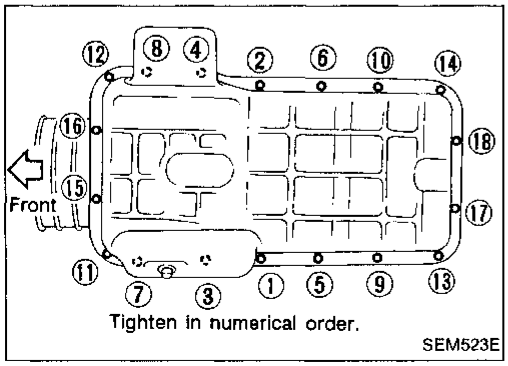


2. Apply a continuous bead of liquid gasket to mating surface of oil pan.
- **Use Genuine Liquid Gasket or equivalent.**

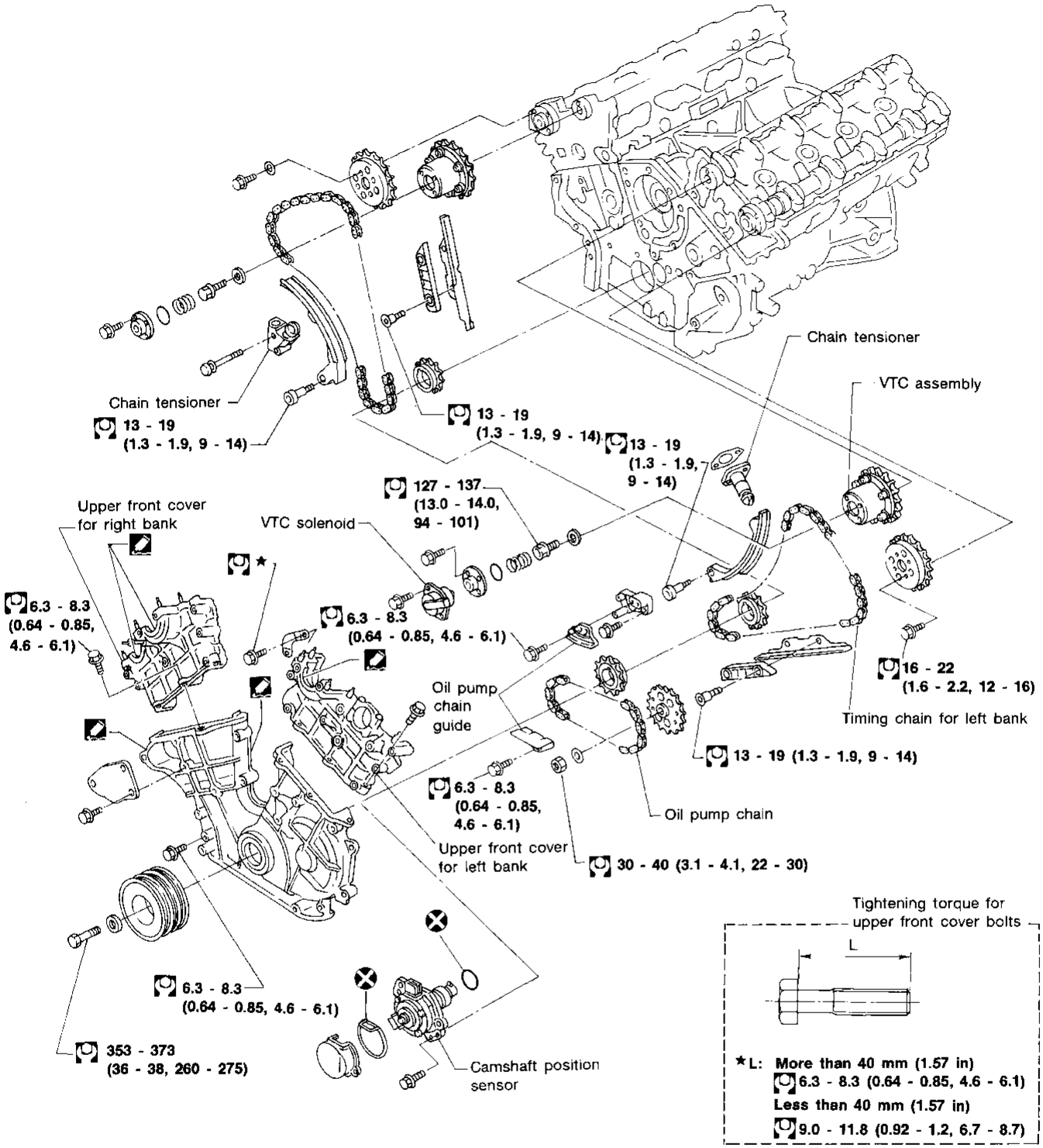


- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.
3. Apply liquid gasket to inner sealing surface as shown in figure.
- Attaching should be done within 5 minutes after coating.





4. Install oil pan.
- Install bolts/nuts in the reverse order of removal.
- Wait at least 30 minutes before refilling engine oil.



: N•m (kg-m, ft-lb)
: Liquid gasket

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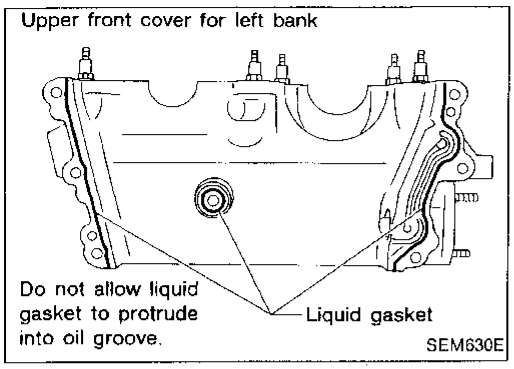
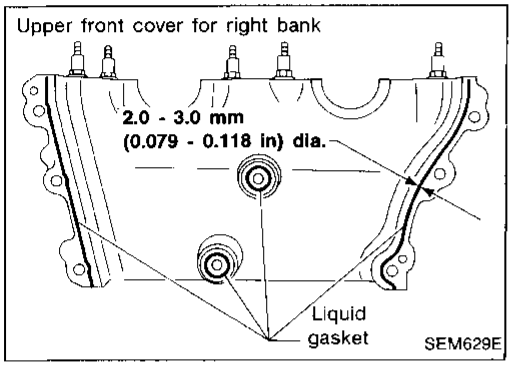
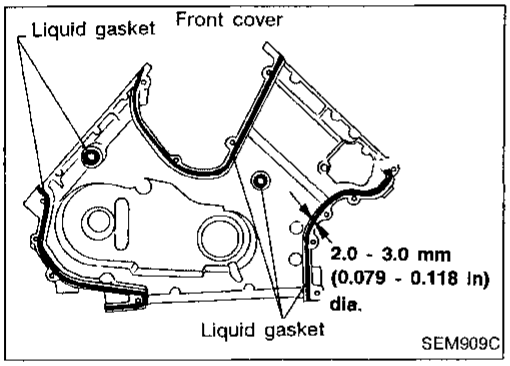
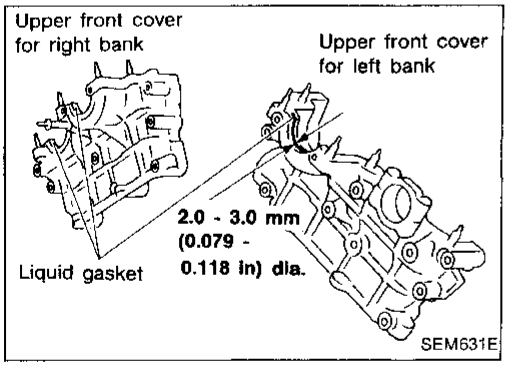
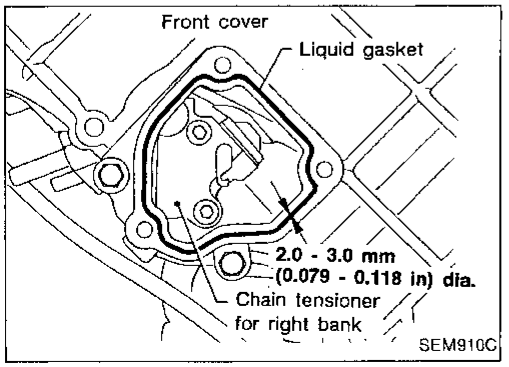








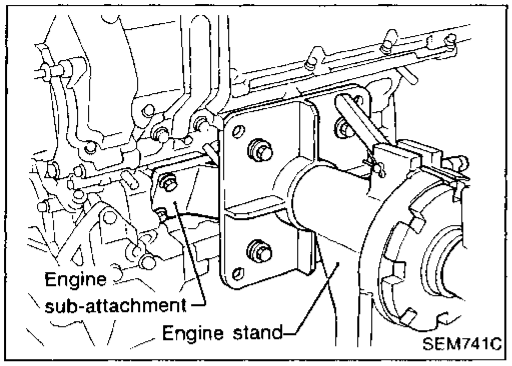


POSITION FOR APPLYING LIQUID GASKET

Refer to "Installation" in "OIL PAN" for installing oil pan.

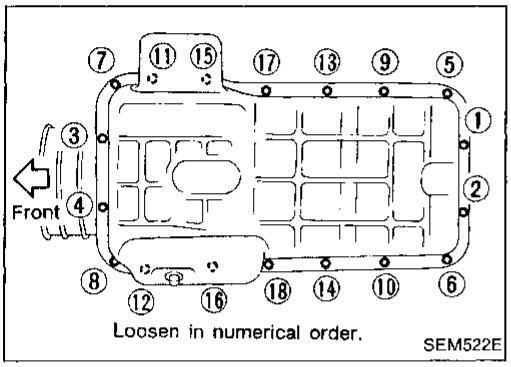
CAUTION:

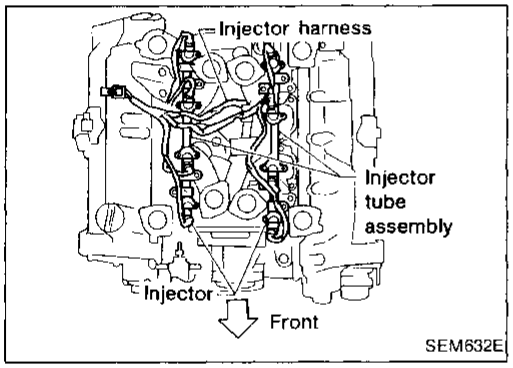
- **After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.**



Removal

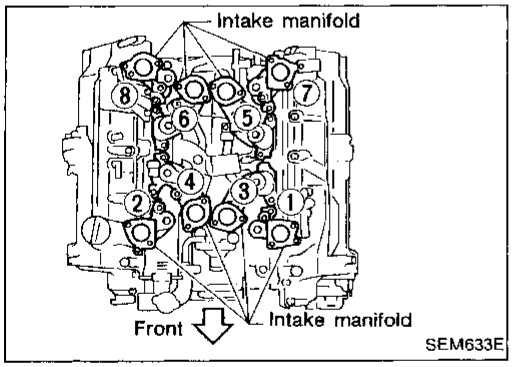
1. Remove engine with transmission. Refer to "ENGINE REMOVAL".
2. Remove the following parts
- Suspension member
- Engine mounts
- A/C compressor bracket
- Exhaust manifold
- Cooling fan with coupling
- Engine gusset
- Transmission
3. Place engine on a work stand.
4. Remove oil pan.
5. Remove intake collector.



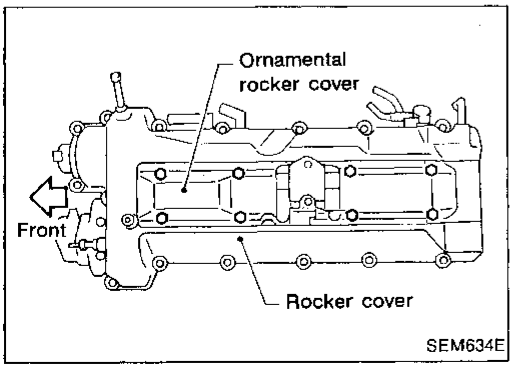


6. Disconnect injector harness connector and remove injector tube assembly with injector.

Be careful not to let rubber washer fall into intake manifold.

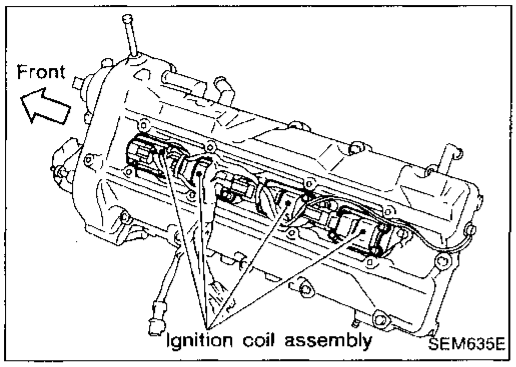


7. Remove intake manifold.

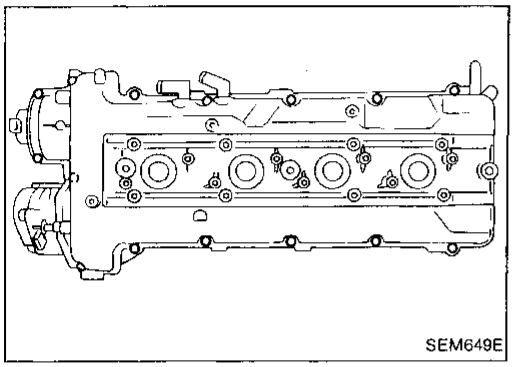


8. Remove ornamental rocker cover.

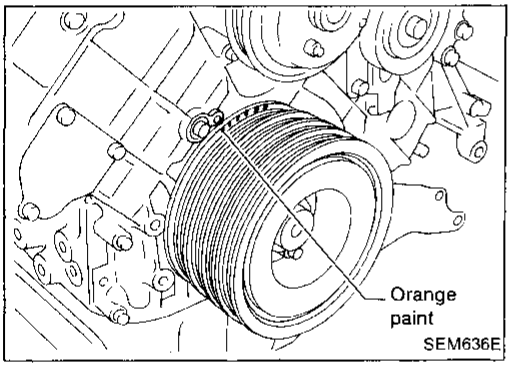
Removal (Cont'd)



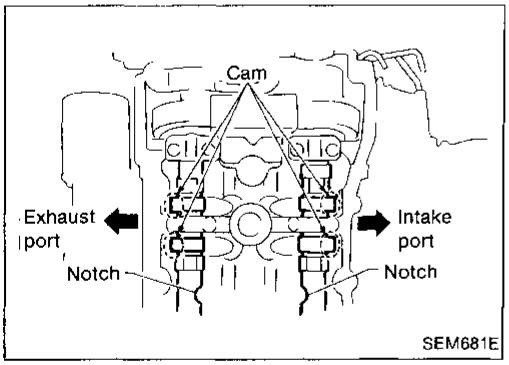
9. Remove all ignition coils and spark plugs.



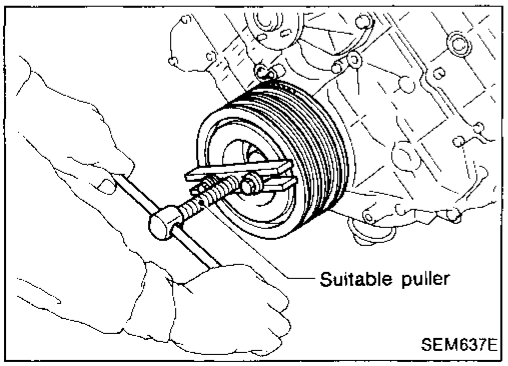
10. Remove rocker covers.



11. Set No. 1 piston at TDC on its compression stroke.
    Align the timing mark (orange paint) on crank pulley with timing indicator on front cover.

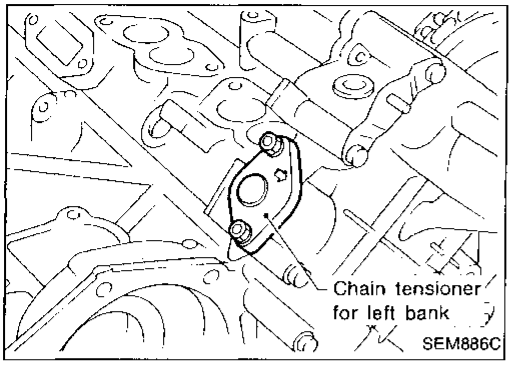


Make sure the intake camshaft lobe for the No. 1 cylinder faces the intake port and the exhaust lobe faces the exhaust port.
Reference:
It is also possible to confirm the camshaft positions by checking the position of the notches on the camshaft when the No. 1 piston is at TDC of the compression stroke because the cylinder head bolts can be removed at that position.

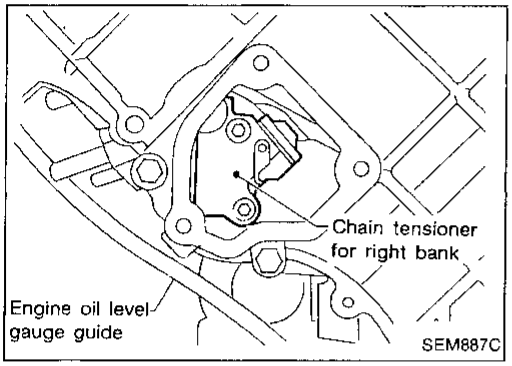


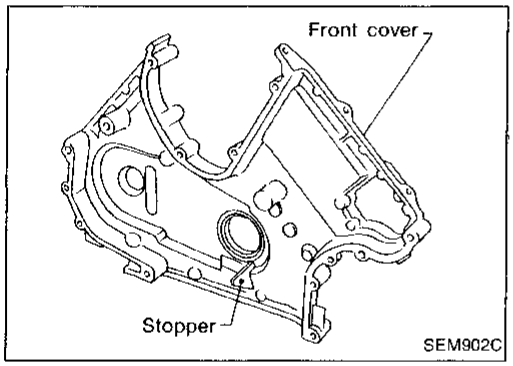
12. Remove crankshaft pulley.
13. Remove camshaft position sensor and VTC solenoid.

Removal (Cont'd)



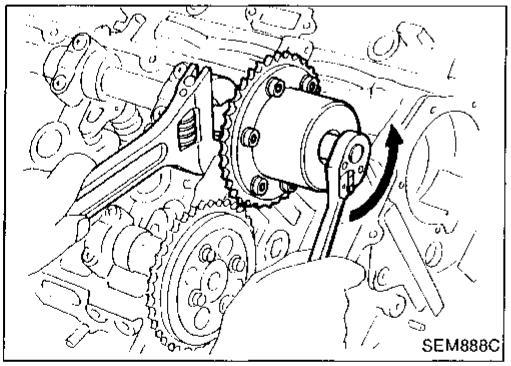
14. Remove chain tensioners.
15. Remove upper front covers.



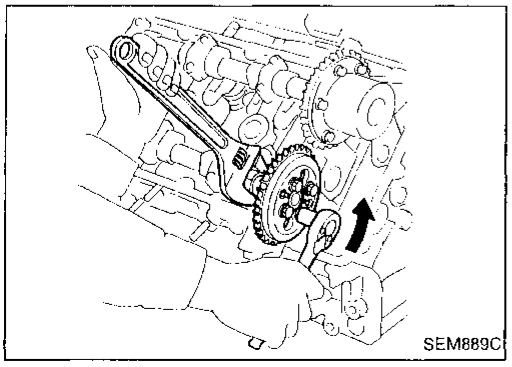


16. Remove front cover.
- Timing chain will not be disengaged or dislocated from crankshaft sprocket unless front cover is removed. For this reason, stopper need not be used.

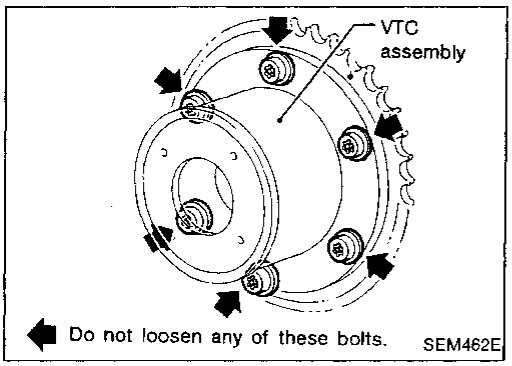
Cast portion of front cover is located on lower side of crankshaft sprocket so timing chain is not disengaged from sprocket.



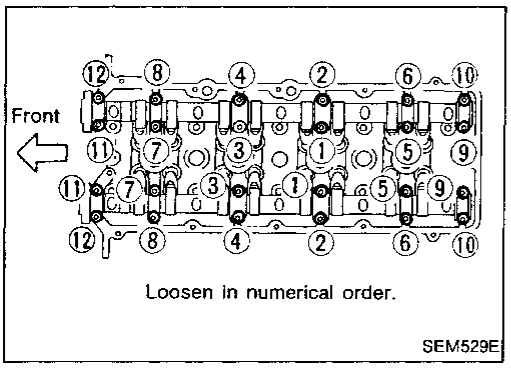
17. Remove VTC assembly and camshaft sprocket.
18. Remove oil pump chain and timing chains.



Removal (Cont'd)

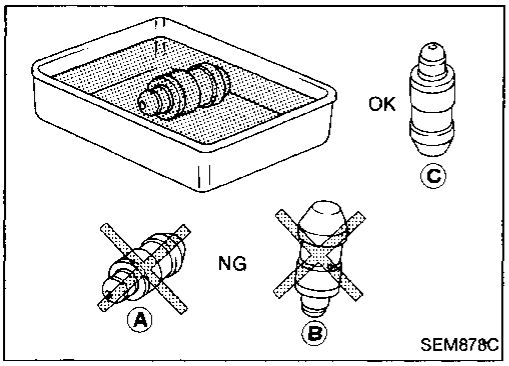


CAUTION:
Valve timing control (VTC) assembly
Do not attempt to disassemble VTC assembly since it is difficult to reassemble accurately in the field. If they should be disassembled, VTC assembly must be replaced with a new one.

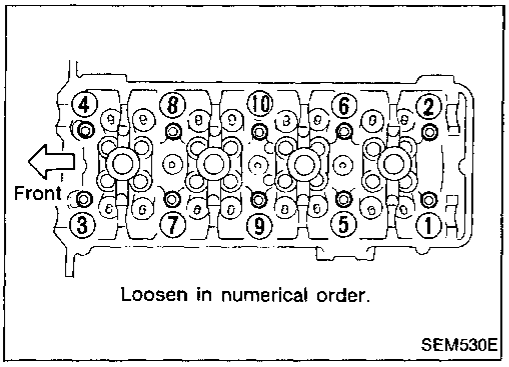


19. Remove camshaft bracket and camshaft.
- These parts should be reassembled in their original positions.

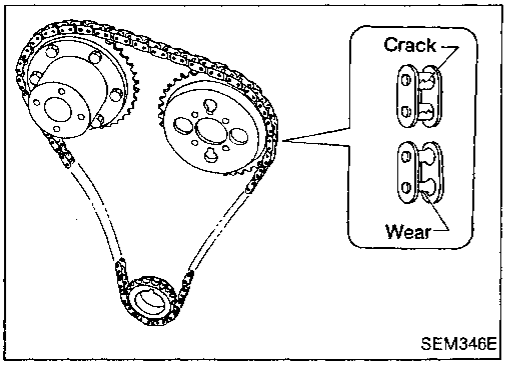
20. Remove rocker arm and hydraulic lash adjuster.
- Be sure to tie each hydraulic lash adjuster with string so that it can be reassembled in its original position during reassembly.



- **If hydraulic lash adjuster is kept on its side, there is a risk of air entering it. After removal, always set hydraulic lash adjuster straight up, or when laying it on its side, have it soak in new engine oil.**
- **Do not disassemble hydraulic lash adjuster.**
- **Attach tags to valve lifters so as not to mix them up.**

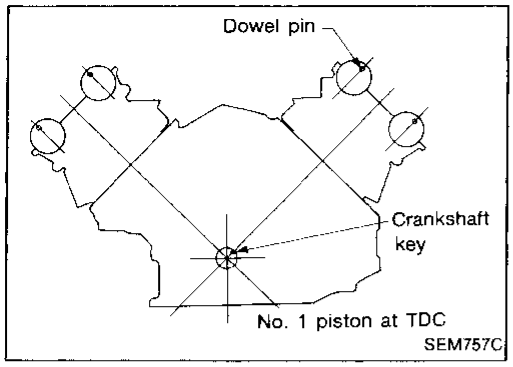


21. Remove cylinder head assembly and cylinder head gasket.
- Head warpage or cracking could result from removing in incorrect order.
- Cylinder head bolts should be loosened in two or three steps.



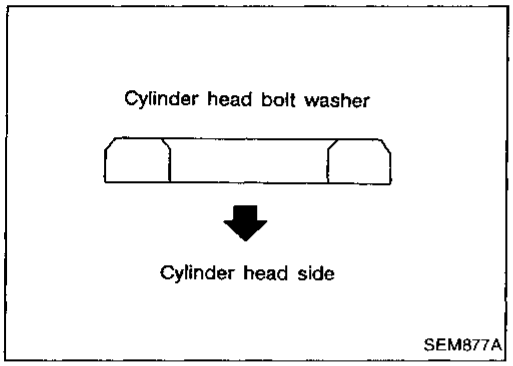
Inspection

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

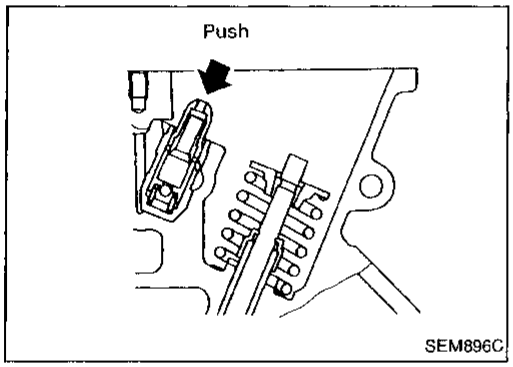


Installation

1. Position crankshaft so that No. 1 piston is set at TDC on compression stroke.
2. Turn crankshaft until No. 1 piston is set at approximately 45° before TDC on compression stroke. (At this point, No. 3 piston will be at the same height as No. 1 piston to prevent interference of valves and pistons.)

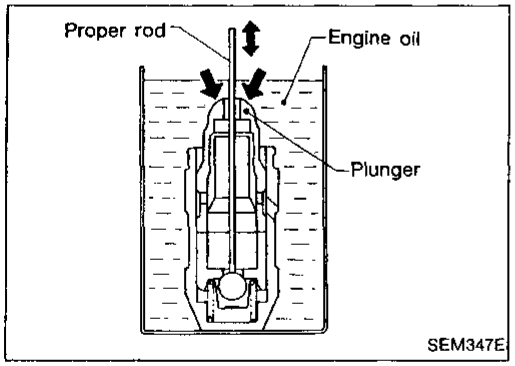


3. Install cylinder heads with new gaskets and temporarily tighten cylinder head bolts for both right and left bank cylinder heads when installing front cover.
- Temporarily tighten cylinder head bolts. This is necessary to avoid damaging cylinder head gaskets.
- Be sure to install washers between bolts and cylinder head.
- Do not rotate crankshaft and camshaft separately, or valves will hit piston heads.



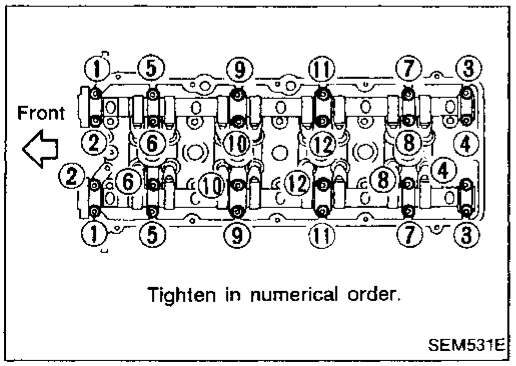
4. Install hydraulic lash adjusters and check them.

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



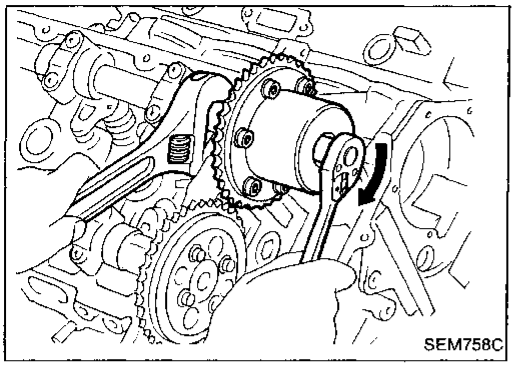
2) Remove hydraulic lash adjuster and dip in a container filled with engine oil. While pushing plunger as shown in figure, lightly push check ball using proper rod. Air is completely bled when plunger no longer moves.

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

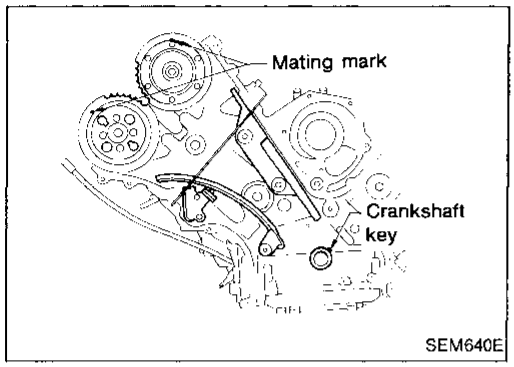


5. Install rocker arm, camshaft and camshaft bracket for right bank.

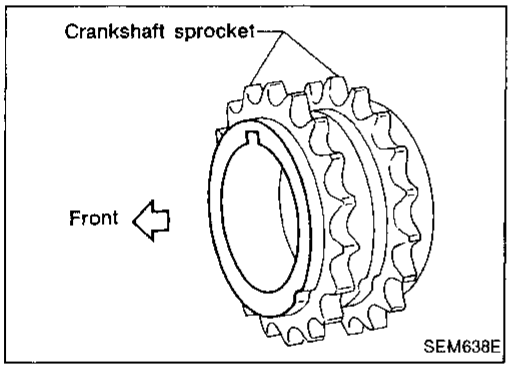
Installation (Cont'd)



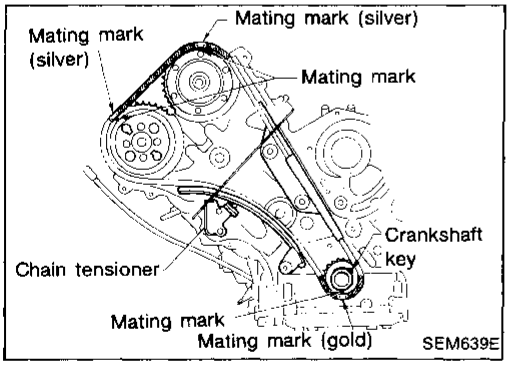
6. Install VTC assembly and exhaust cam sprocket on right bank.



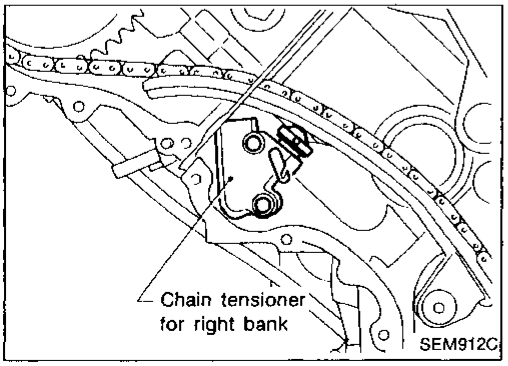
7. After making sure that camshafts are still correctly positioned turn crankshaft clockwise to set No. 1 piston at TDC on compression stroke.



8. Install two sprockets on crankshaft.

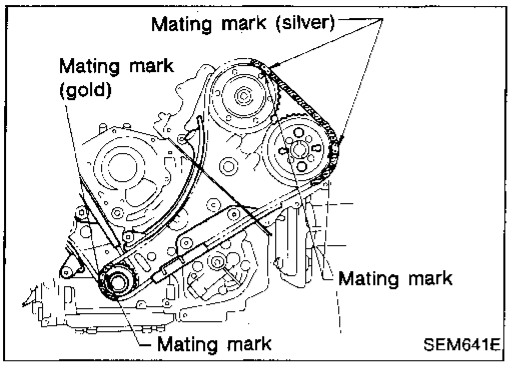


9. While aligning mating marks on crankshaft sprocket and camshaft sprockets (on both intake and exhaust sides) with those on chain, install chain on right bank.
   - Be careful not to damage cylinder head gasket when installing chain.

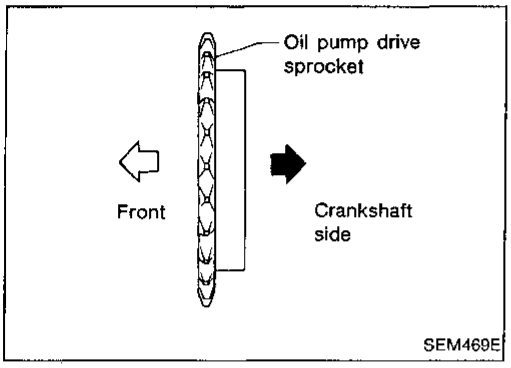


10. Install chain tensioner on right bank.

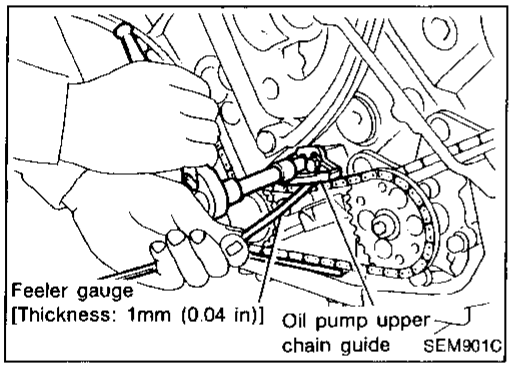
Installation (Cont'd)



11. Turn crankshaft approximately 120° clockwise from the point where No. 1 piston is at TDC on compression stroke. (At this point, valves in left bank still remain unlifted.)
12. Correctly position camshafts for left cylinder head.
13. Install VTC assembly and exhaust cam sprocket on left bank.
14. While aligning mating marks on crankshaft sprocket and camshaft sprockets (on both intake and exhaust sides) with those on chain, install chain on left bank.

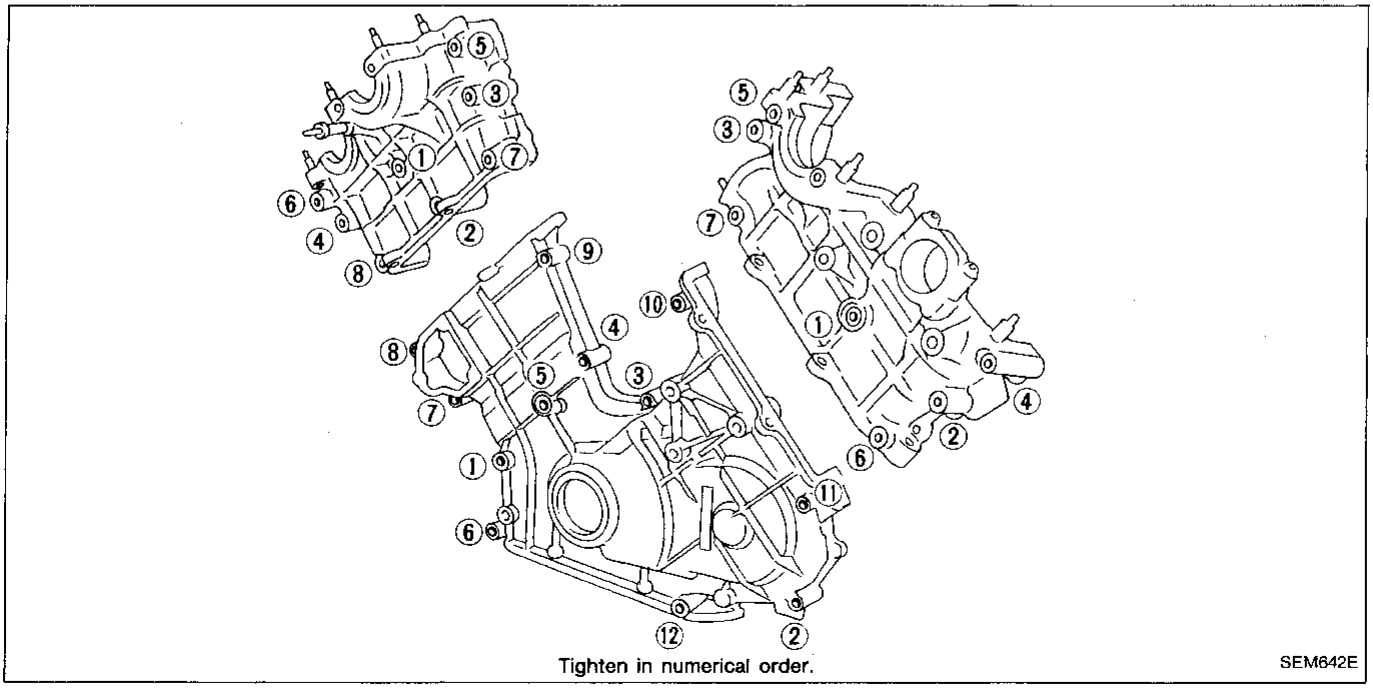


15. Install oil pump chain and sprockets.

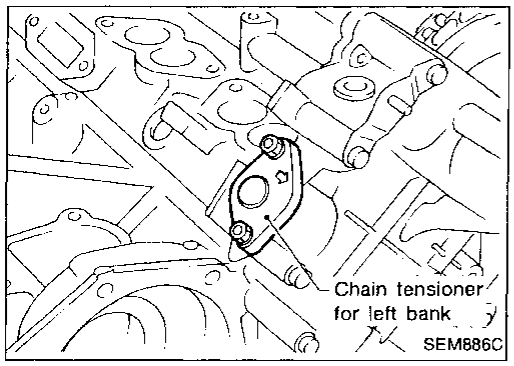


16. Install oil pump chain guides.
- Place a 1 mm (0.04 in) feeler gauge between the upper chain guide and chain before assembling chain guides. Force applied to chain is equivalent to upper chain guide weight.

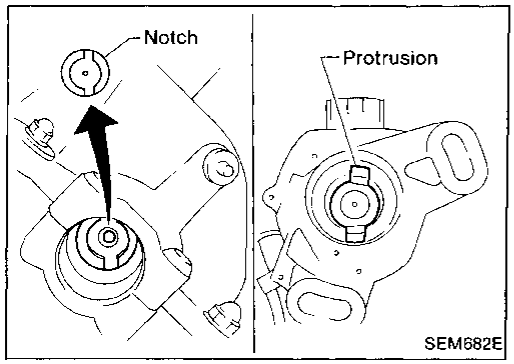
17. Install front covers.
- Be careful not to damage cylinder head gasket when installing front cover.



Installation (Cont'd)



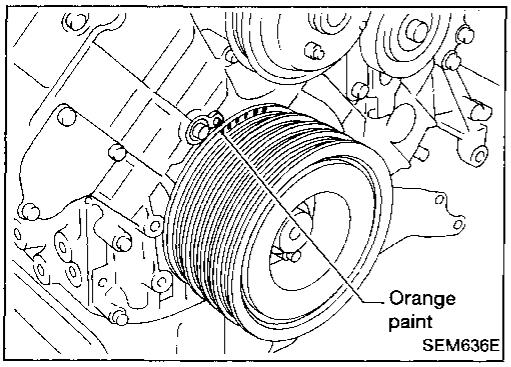
18. Install chain tensioner for left bank.



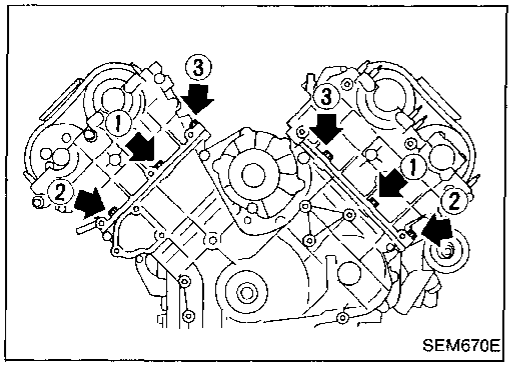
19. Install the following parts.
- Camshaft position sensor
- VTC solenoid

Note:
Notch on exhaust camshaft on left bank is off-centered so that camshaft position sensor can be installed properly.

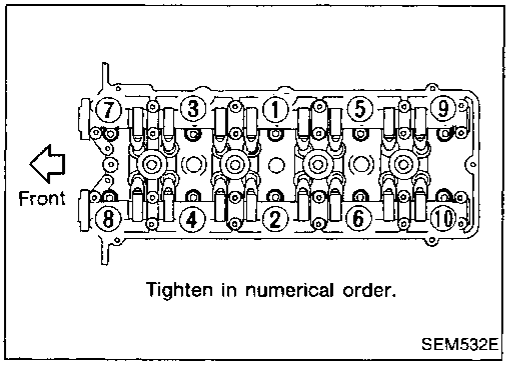
20. Install crank pulley.



21. Set No. 1 piston at TDC on its compression stroke.
Align the timing mark (orange paint) on crank pulley with timing indicator on front cover.



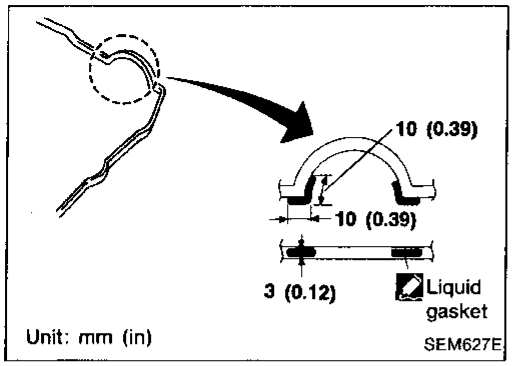
22. Tighten front cover bolts.



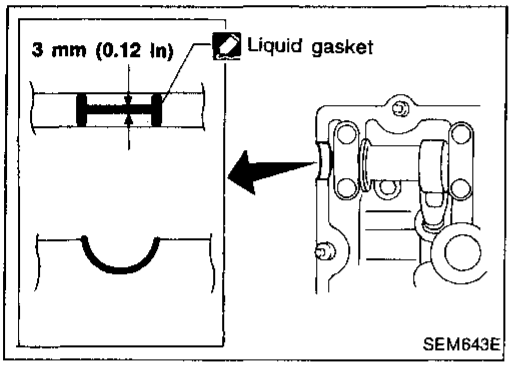
23. Tighten cylinder head bolts.
- **Tightening procedure**

ⓐ Tighten bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
ⓑ Tighten bolts to 93 N·m (9.5 kg-m, 69 ft-lb).
ⓒ Loosen bolts completely.
ⓓ Tighten bolts to 25 to 34 N·m (2.5 to 3.5 kg-m, 18 to 25 ft-lb).
ⓔ Turn bolts 90 to 95 degrees clockwise or if angle wrench is not available, tighten bolts to 93 to 98 N·m (9.5 to 10.0 kg-m, 69 to 72 ft-lb).

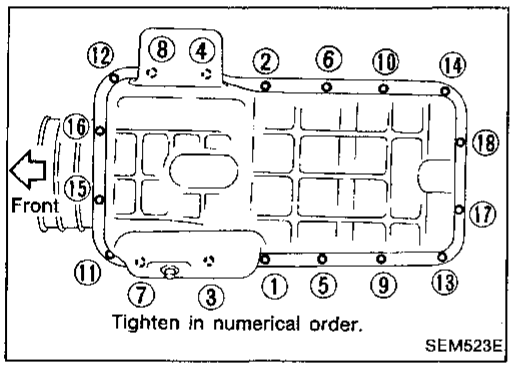
Installation (Cont'd)



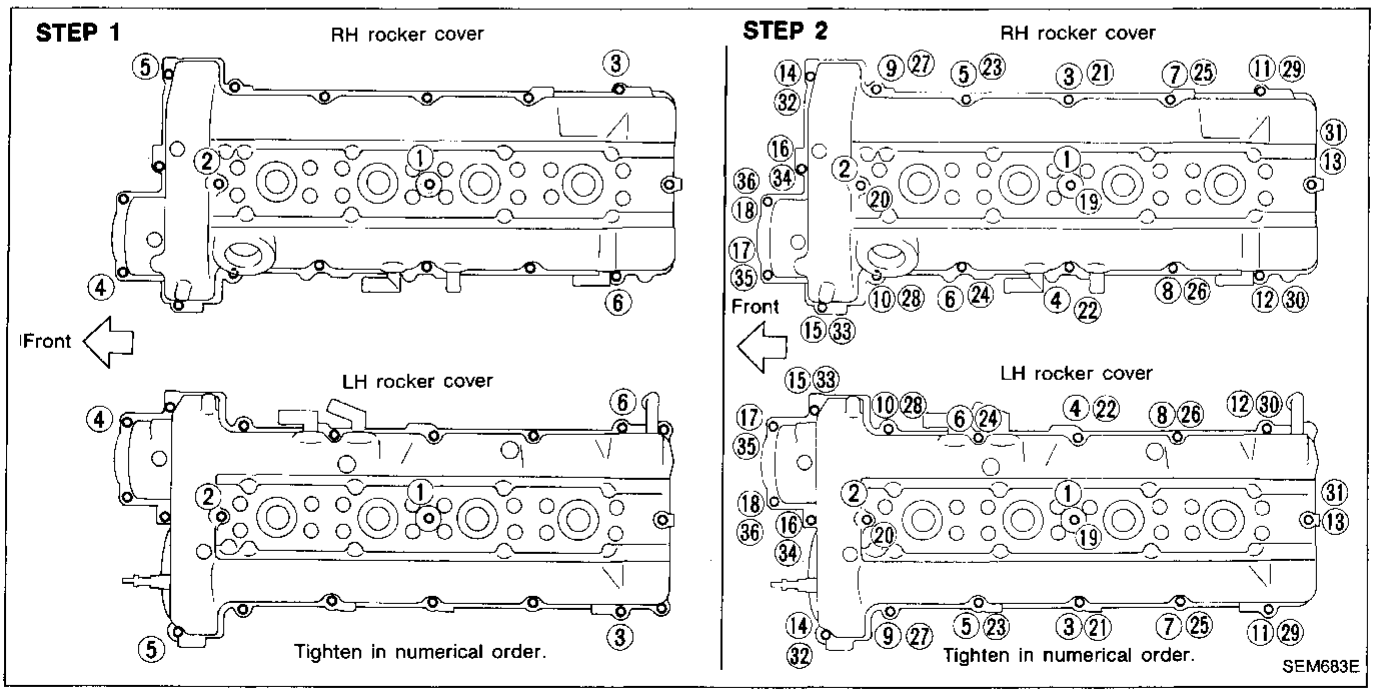
24. Before installing rocker cover, remove all traces of liquid gasket from mating surface of rocker cover gasket to cylinder head.
25. Apply a continuous bead of liquid gasket to mating surface of rocker cover gasket and cylinder head.
- **Use Genuine Liquid Gasket or equivalent.**



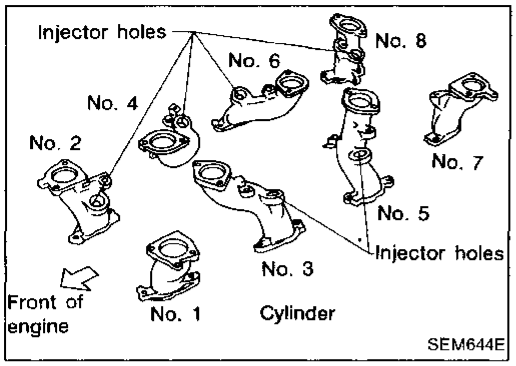
26. Install rocker cover.



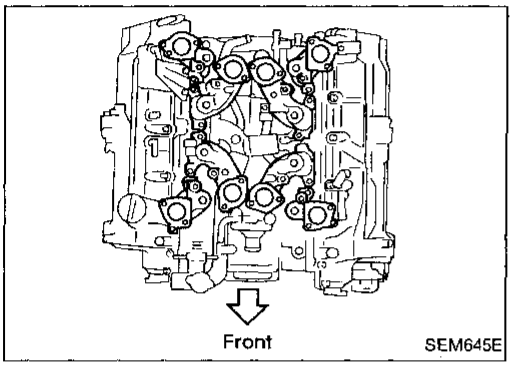
27. Install oil pan. (Refer to "Installation" in "OIL PAN".)
28. Tighten rocker cover nuts.
- Tightening procedure
  STEP1
  Tighten nuts to 4 N·m (0.4 kg-m, 2.9 ft-lb).
  STEP2
  Tighten nuts to 10 - 12 N·m (1.0 - 1.2 kg-m, 7 - 9 ft-lb).



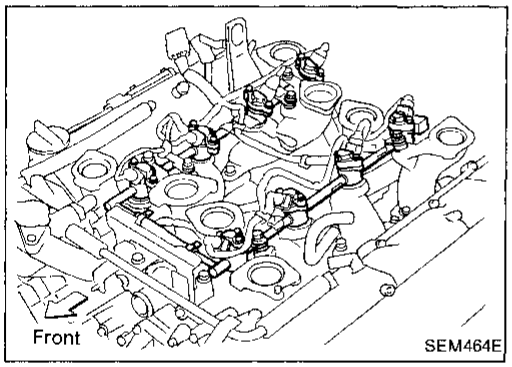
Installation (Cont'd)



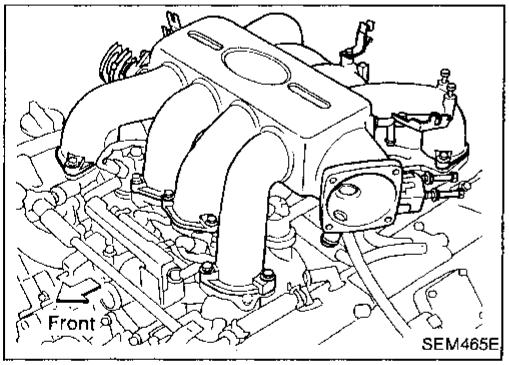
29. Install intake manifolds, fuel tube assemblies (including fuel injectors) and intake collector.
- Follow procedures 1) - 9) in order to make installation of the fuel tube assemblies and collectors less difficult. These procedures are necessary for proper alignment of intake manifolds, fuel tube and intake collector.



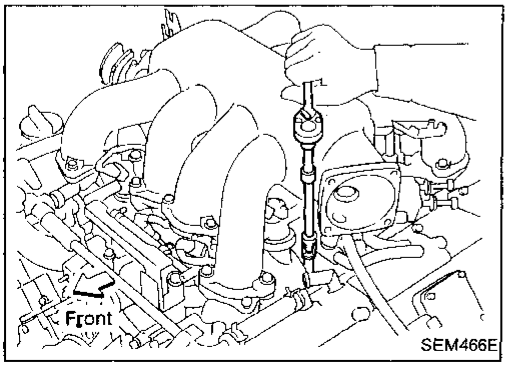
1) Install the eight intake manifolds in their proper positions on cylinder head, and lightly tighten mounting bolts.



2) Connect injector tube assemblies (including fuel injectors) to intake manifolds, and lightly tighten mounting bolts.
- **Be careful not to let rubber washer fall into intake manifold.**

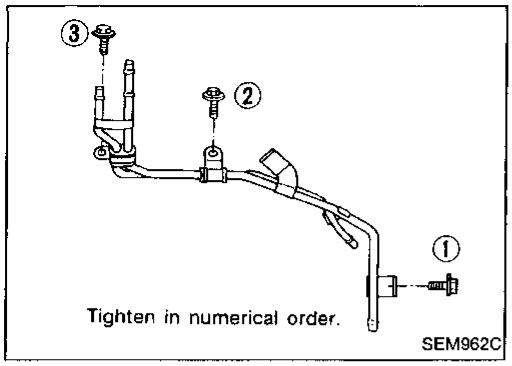


3) Install intake collector and lightly tighten mounting bolts.



4) Tighten intake manifolds mounting bolts at cylinder head.
5) Remove intake collectors.
6) Tighten intake manifolds to the specified torque.

Installation (Cont'd)

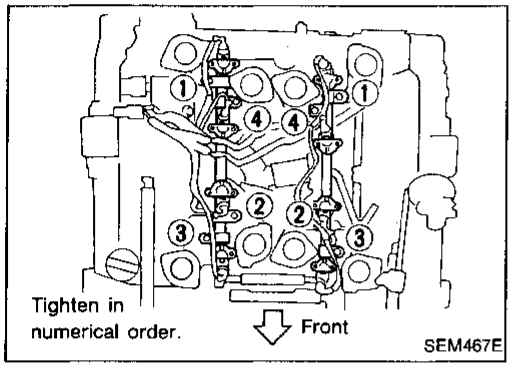


7) Tighten sub-fuel tubes in numerical order.

- **Tightening procedure**

(1) Tighten all bolts to 4.2 to 5.9 N·m (0.43 to 0.60 kg-m, 3.1 to 4.3 ft-lb).

(2) Tighten all bolts to 8.4 to 10.8 N·m (0.86 to 1.1 kg-m, 6.2 to 8.0 ft-lb).

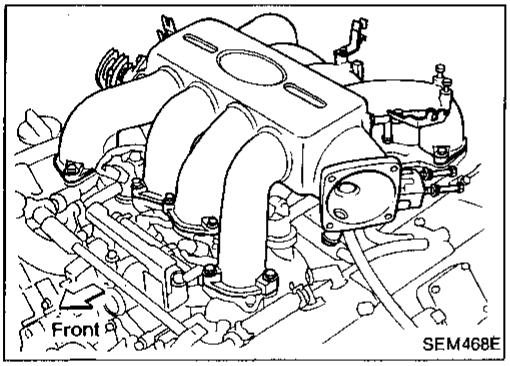


8) Tighten injector tube assemblies in numerical order.

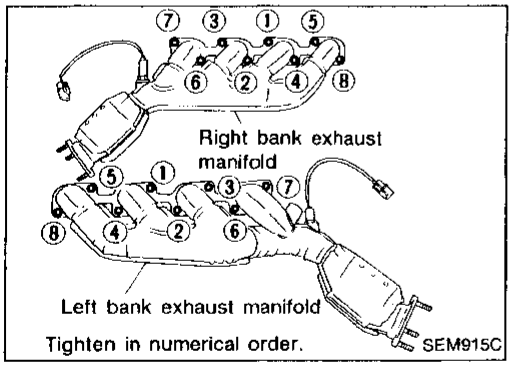
- **Tightening procedure**

(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).



9) Install intake collectors and tighten to the specified torque.

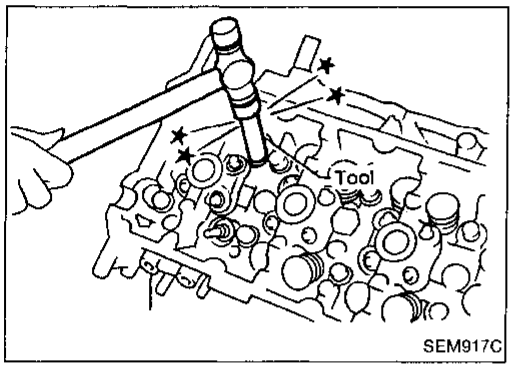


30. Install exhaust manifolds.

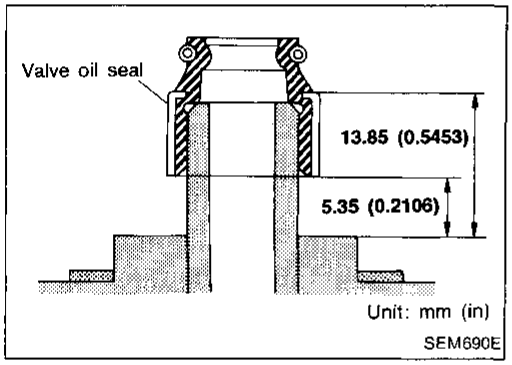
VALVE OIL SEAL

1. Remove engine with transmission from vehicle.
2. Remove rocker cover.
3. Remove camshaft.
4. Remove rocker arm.
5. Remove valve spring and valve oil seal with suitable tool.

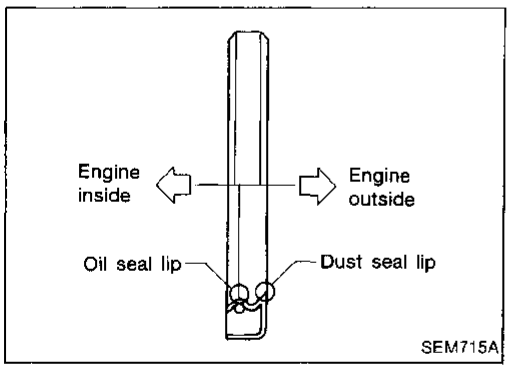
Piston concerned should be set at TDC to prevent valves from falling.



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



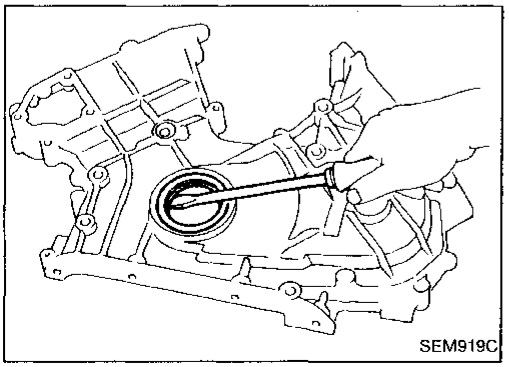
OIL SEAL INSTALLING DIRECTION

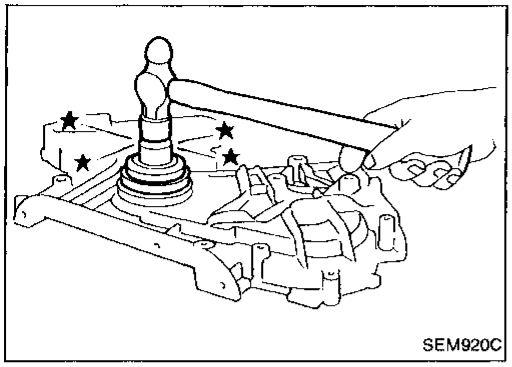


FRONT OIL SEAL

1. Remove the following parts.
- Engine under cover
- Cooling fan
- Engine gusset
- Lower rear plate (Removal of crankshaft pulley bolt requires removal of this part.)
- Crankshaft pulley

2. Remove front oil seal.

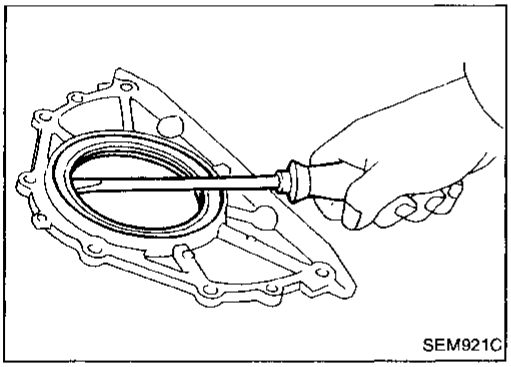



SEM920C

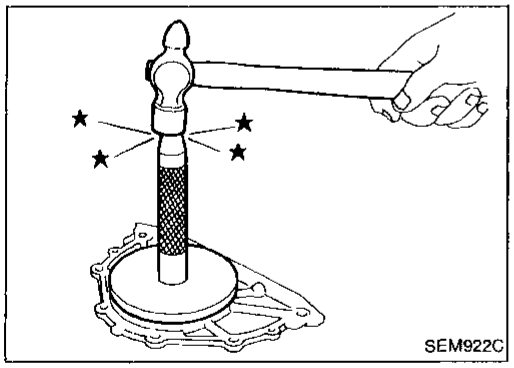
3. Apply engine oil to new oil seal and install it using suitable tool.

REAR OIL SEAL

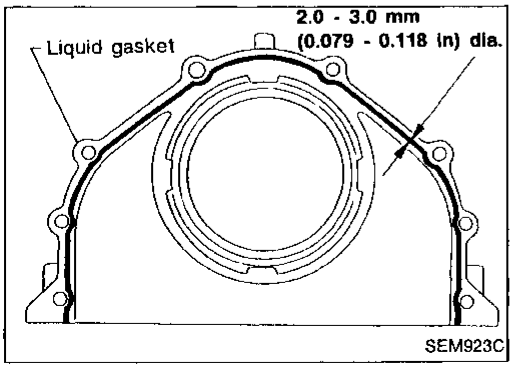
1. Remove drive plate.
2. Remove rear oil seal retainer.
3. Remove traces of liquid gasket using scraper.


SEM921C

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

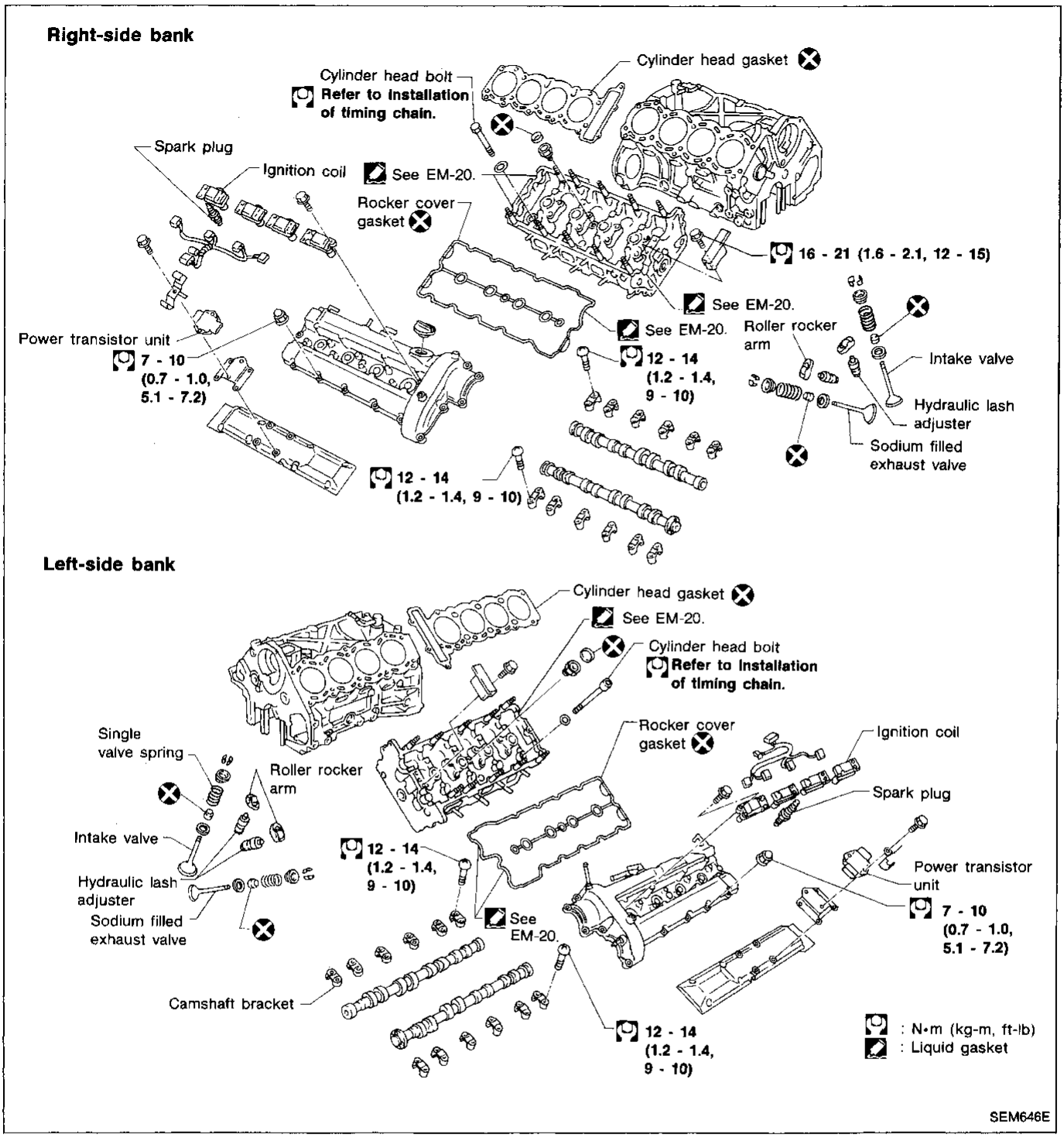

SEM922C

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



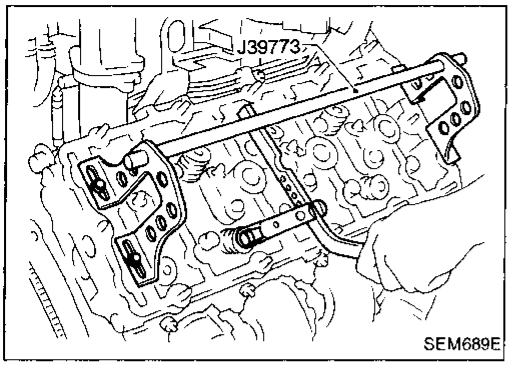
SEM923C

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



CAUTION:

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

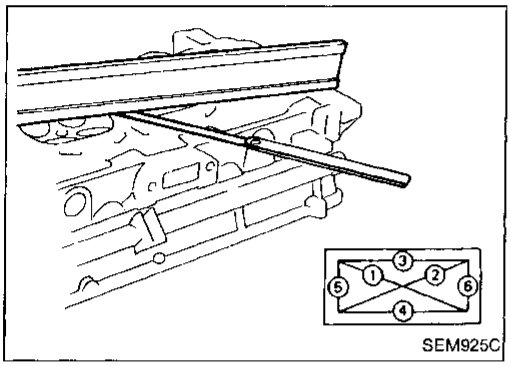


Removal

- This removal is the same procedure as those for timing chain. Refer to "Removal" in "TIMING CHAIN" (EM-15).

Disassembly

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



Inspection

CYLINDER HEAD DISTORTION

Head surface flatness:

Standard

Less than 0.03 mm (0.0012 in)

Limit

0.1 mm (0.004 in)

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

Resurfacing limit:

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

Amount of cylinder head resurfacing is "A".

Amount of cylinder block resurfacing is "B".

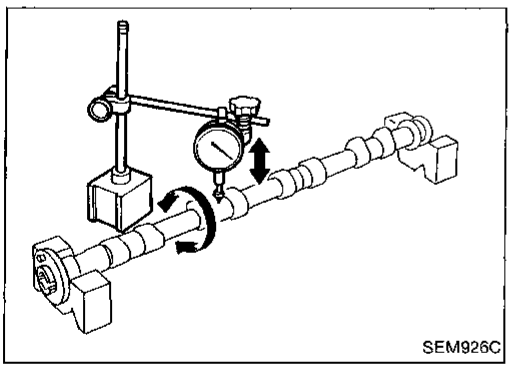
The maximum limit is as follows:

A + B = 0.2 mm (0.008 in)

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

Nominal cylinder head height:

130.7 - 130.9 mm (5.146 - 5.154 in)



CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.

CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.

Runout (Total indicator reading):

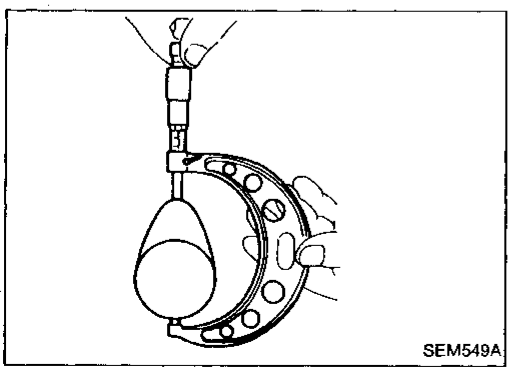
Standard

Less than 0.02 mm (0.0008 in)

Limit

0.05 mm (0.0020 in)

2. If it exceeds the limit, replace camshaft.



CAMSHAFT CAM HEIGHT

1. Measure camshaft cam height.

Standard cam height:

Intake

37.919 - 38.109 mm (1.4929 - 1.5004 in)

Exhaust

35.279 - 35.469 mm (1.3889 - 1.3964 in)

Cam wear limit:

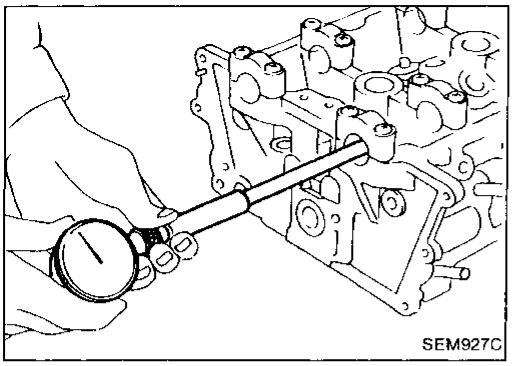
Intake & Exhaust

0.05 mm (0.0020 in)

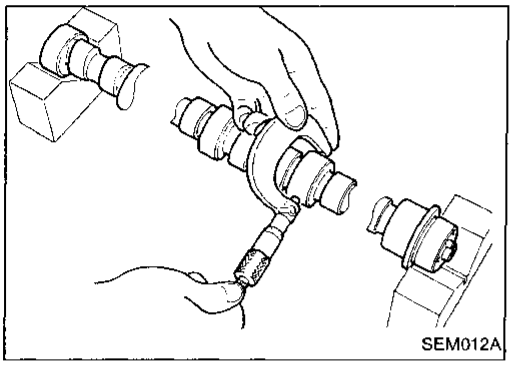
2. If wear is beyond the limit, replace camshaft.

Inspection (Cont'd)

CAMSHAFT JOURNAL CLEARANCE

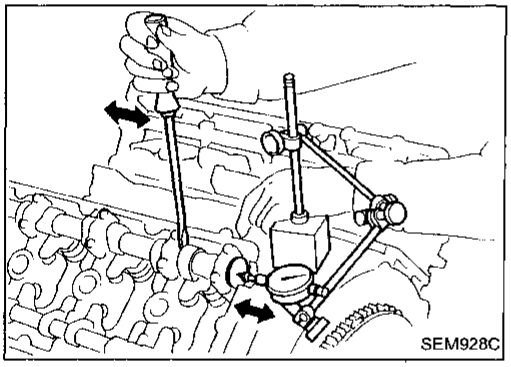

SEM927C

1. Install camshaft bracket and tighten bolts to the specified torque.
2. Measure inner diameter of camshaft bearing.
   Standard inner diameter:
   26.000 - 26.021 mm (1.0236 - 1.0244 in)


SEM012A

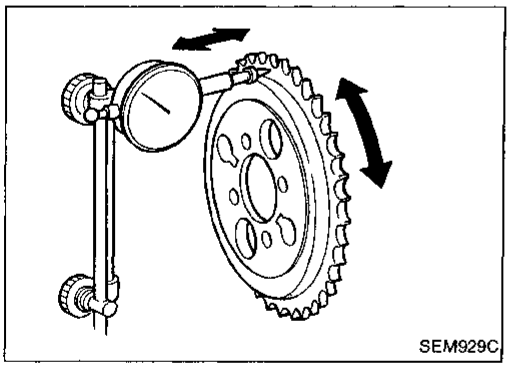
3. Measure outer diameter of camshaft journal.
   Standard outer diameter:
   25.935 - 25.955 mm (1.0211 - 1.0218 in)
4. If clearance exceeds the limit, replace camshaft and/or cylinder head.
   Camshaft journal clearance:
   Standard
   0.045 - 0.086 mm (0.0018 - 0.0034 in)
   Limit
   0.15 mm (0.0059 in)

CAMSHAFT END PLAY


SEM928C

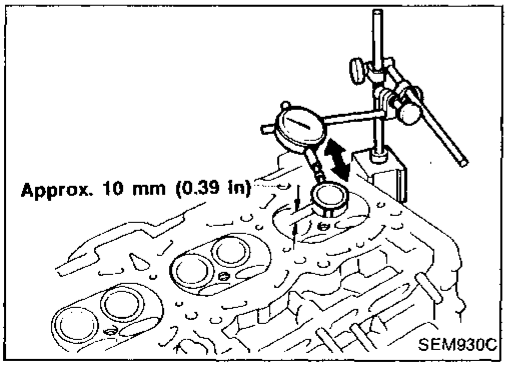
1. Install camshaft and thermostat housing in cylinder head.
2. Measure camshaft end play.
   Camshaft end play:
   Standard
   0.070 - 0.148 mm (0.0028 - 0.0058 in)
   Limit
   0.20 mm (0.0079 in)

CAMSHAFT SPROCKET RUNOUT


SEM929C

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.

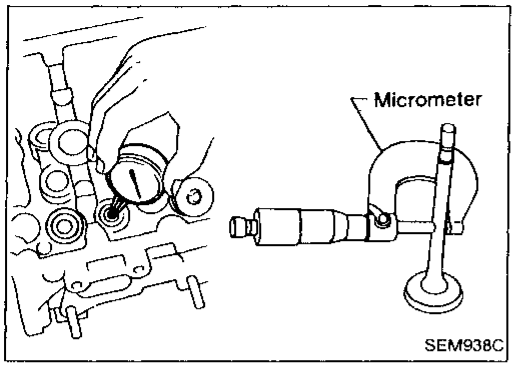
VALVE GUIDE CLEARANCE



SEM930C

1. Measure valve deflection in a parallel direction with rocker arm. (Valve and valve guide mostly wear in this direction.)
   Valve deflection limit (Dial gauge reading):
   Intake & Exhaust
   0.15 mm (0.0059 in)

Inspection (Cont'd)

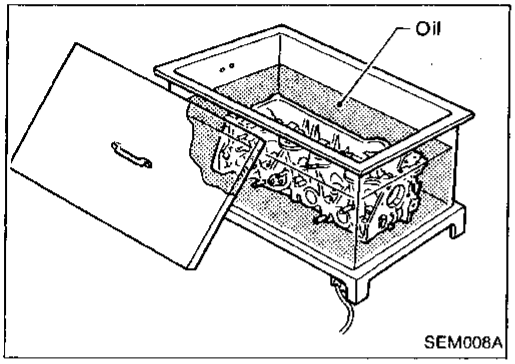


2. If it exceeds the limit, check valve to valve guide clearance.
a. Measure valve stem diameter and valve guide inner diameter.
b. Check that clearance is within specification.

Valve to valve guide clearance:

Unit: mm (in)

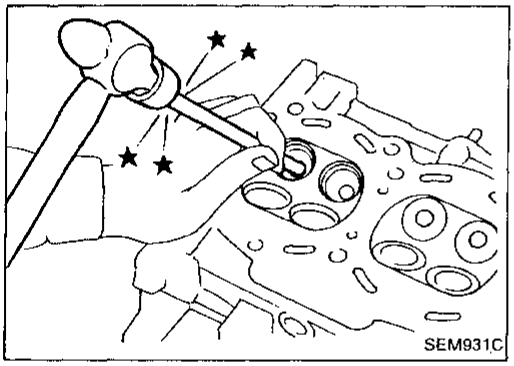
	Standard	Limit
Intake	0.029 - 0.052 (0.0011 - 0.0020)	0.080 (0.0031)
Exhaust	0.035 - 0.051 (0.0014 - 0.0020)	0.080 (0.0031)



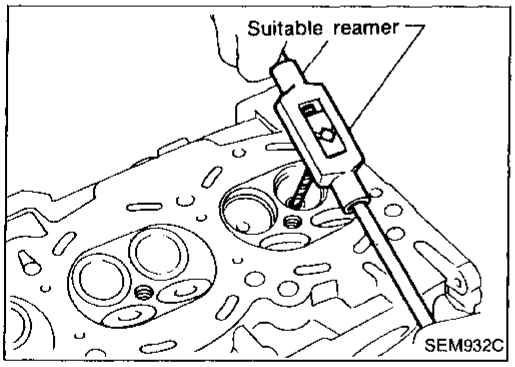
c. If it exceeds the limit, replace valve or valve guide.

VALVE GUIDE REPLACEMENT

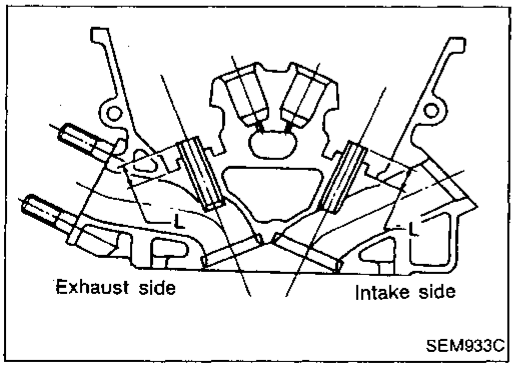
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F).



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

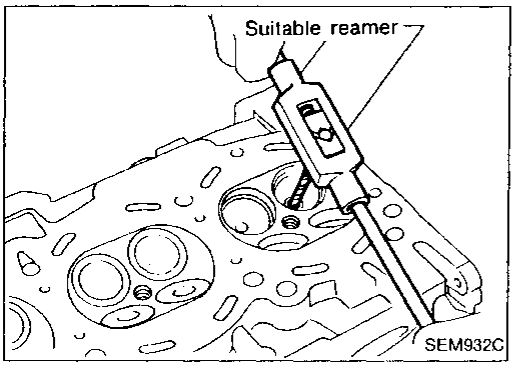


3. Ream cylinder head valve guide hole.
Valve guide hole diameter (for service parts):
Intake
11.175 - 11.196 mm (0.4400 - 0.4408 in)
Exhaust
12.175 - 12.196 mm (0.4793 - 0.4802 in)

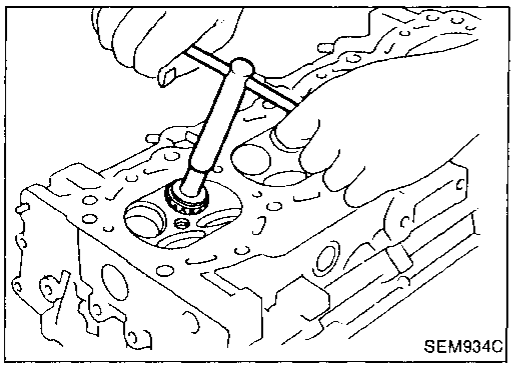


4. Heat cylinder head to 110 to 130°C (230 to 266°F) and press service valve guide onto cylinder head.
Projection "L":
13.15 - 13.35 mm (0.5177 - 0.5256 in)

Inspection (Cont'd)



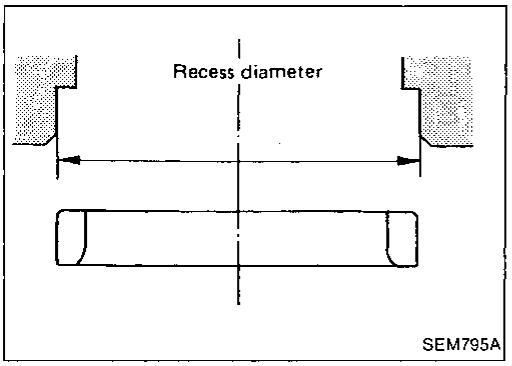
5. Ream valve guide.
   Finished size:
   Intake
   7.000 - 7.018 mm (0.2756 - 0.2763 in)
   Exhaust
   8.000 - 8.011 mm (0.3150 - 0.3154 in)



VALVE SEATS

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

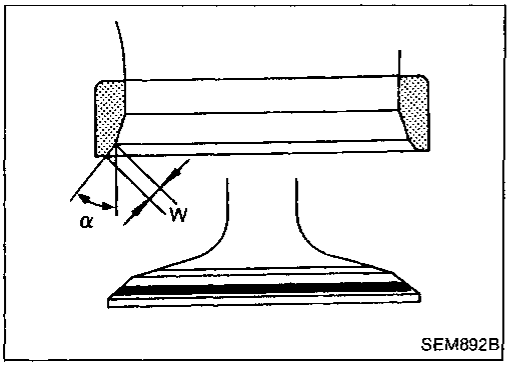
- **Before repairing valve seats, check valve and valve guide for wear. If they have worn, replace them. Then correct valve seat.**
- **Cut with both hands to uniform the cutting surface.**



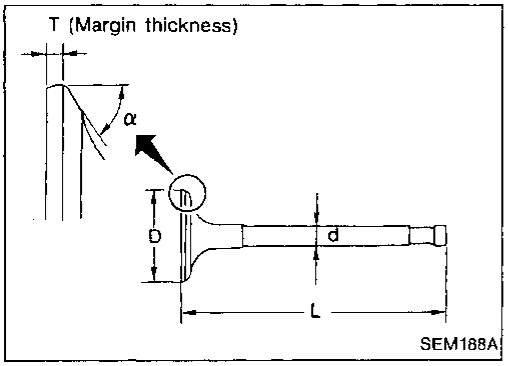
REPLACING VALVE SEAT FOR SERVICE PARTS

1. Bore out old seat until it collapses. The machine depth stop should be set so that boring cannot continue beyond the bottom face of the seat recess in cylinder head.
2. Ream cylinder head recess.
   Reaming bore for service valve seat
   Oversize [0.5 mm (0.020 in)]:
   Intake 39.500 - 39.516 mm (1.5551 - 1.5557 in)
   Exhaust 34.500 - 34.516 mm (1.3583 - 1.3589 in)

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



3. Heat cylinder head to 110 to 130°C (230 to 266°F).
4. Press fit valve seat until it seats on the bottom.
5. Cut or grind valve seat using suitable tool at the specified dimensions as shown in SDS (EM-44).
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.
   Seat face angle "α": 44°53′ - 45°07′ deg.
   Contacting width "W":
   Intake 1.49 - 1.62 mm (0.0587 - 0.0638 in)
   Exhaust 1.77 - 1.90 mm (0.0697 - 0.0748 in)



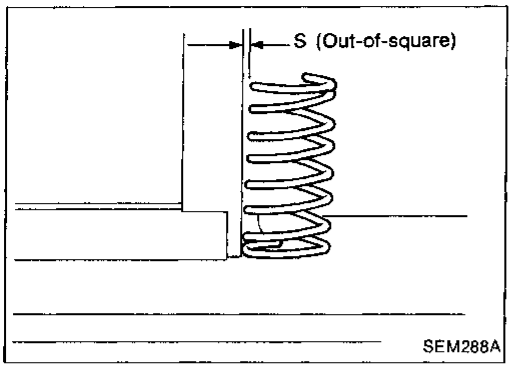
VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to SDS (EM-44).

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.

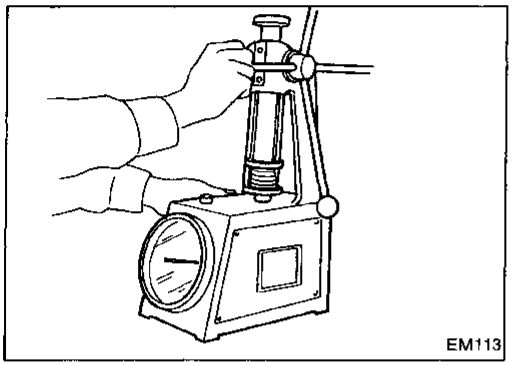
Inspection (Cont'd)



VALVE SPRING

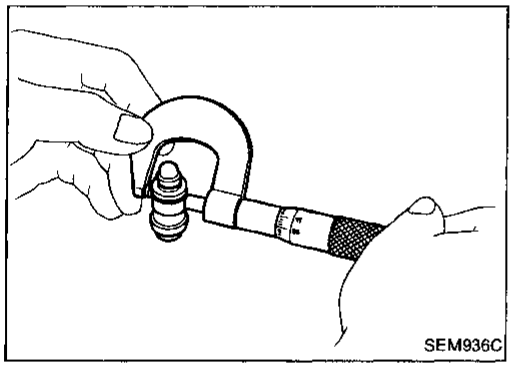
Squareness

1. Measure "S" dimension.
   Out-of-square:
   Less than 2.06 mm (0.0811 in)
2. If it exceeds the limit, replace spring.



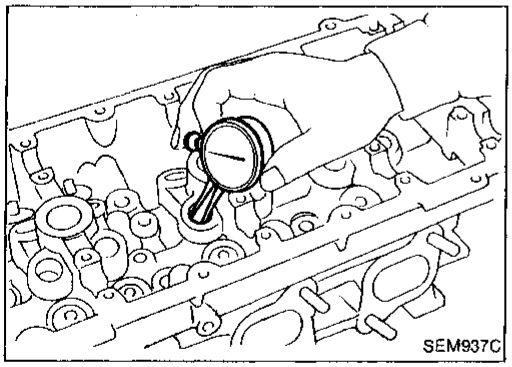
Pressure

Check valve spring pressure.
Pressure: N (kg, lb) at height mm (in)
Standard
535.5 (54.6, 120.4) at 26.8 (1.055)
Limit
More than 477.6 (48.7, 107.4) at 26.8 (1.055)
If it exceeds the limit, replace spring.

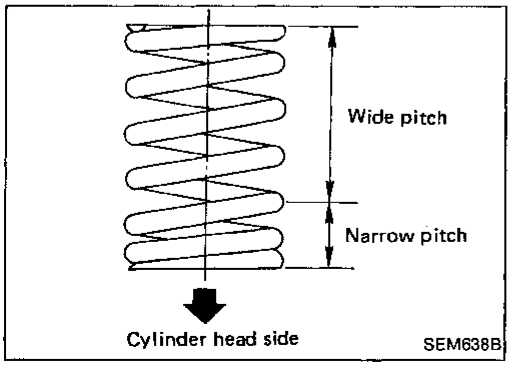


HYDRAULIC LASH ADJUSTER

1. Check contact and sliding surfaces for wear or scratches.
2. Check diameter of lash adjuster.
   Outer diameter:
   16.980 - 16.993 mm (0.6685 - 0.6690 in)



3. Check lash adjuster guide inner diameter.
   Inner diameter:
   17.000 - 17.020 mm (0.6693 - 0.6701 in)
   Standard clearance between lash adjuster and adjuster guide:
   0.007 - 0.040 mm (0.0003 - 0.0016 in)



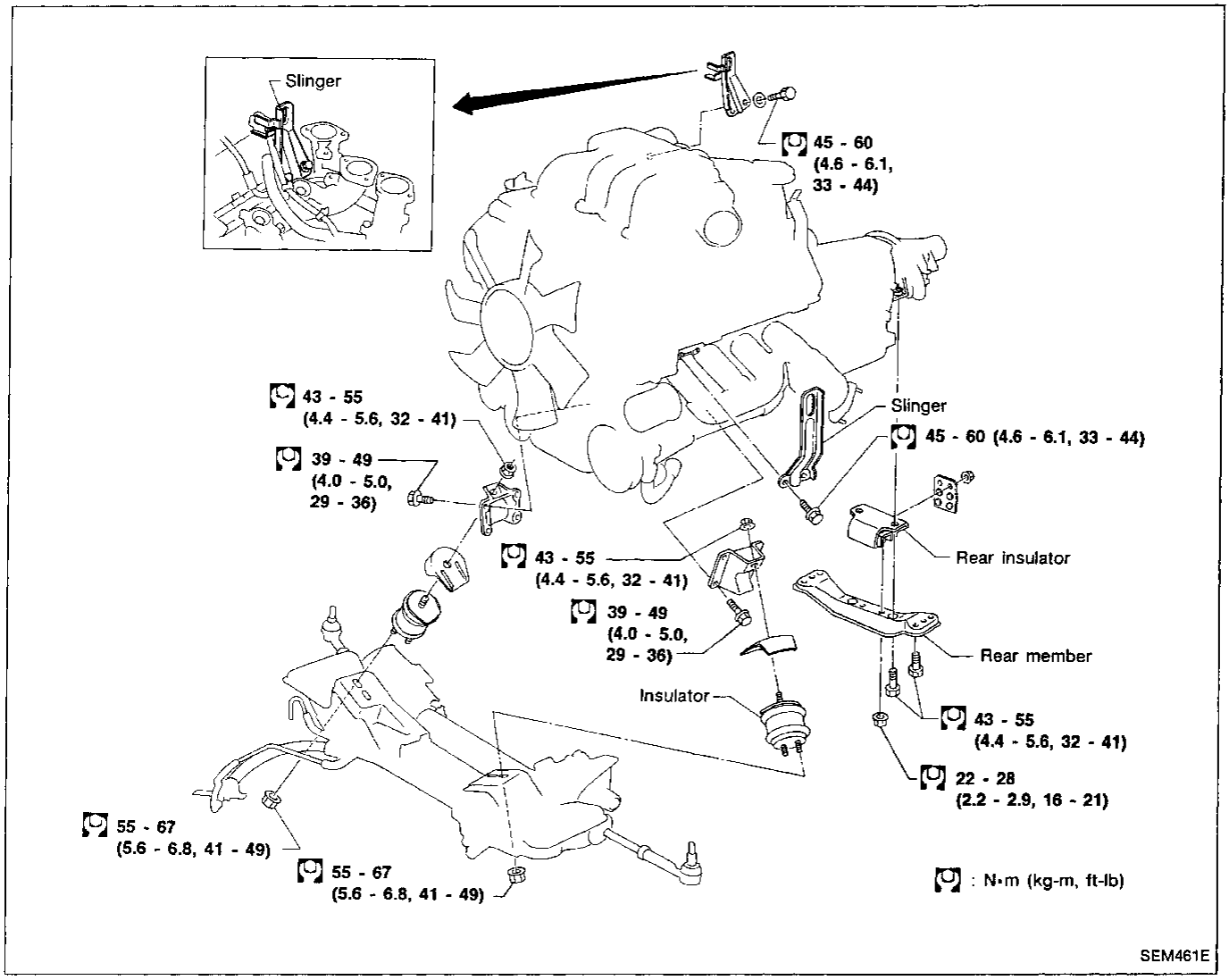
Assembly

1. Install valve component parts.

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

Installation

- This installation is the same procedure as those for timing chain. Refer to "Installation" in "TIMING CHAIN" (EM-16).



WARNING:

a. Locate vehicle on a flat and solid surface and place chocks at front and back of rear wheels.

b. Do not remove engine until exhaust system has completely cooled off.
Otherwise, you may burn yourself and/or fire may break out in fuel line.

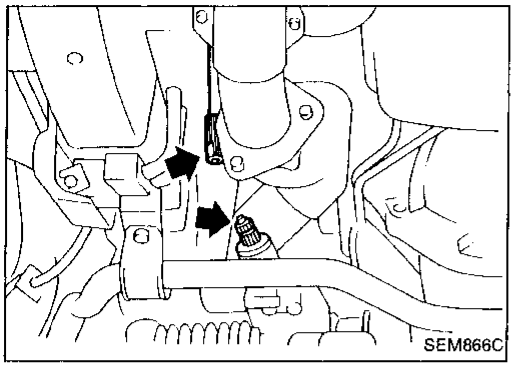
c. Be sure to hoist engine and transmission in a safe manner.
For safety during subsequent steps, the tension of wires should be slackened against the engine.

d. Before disconnecting fuel hose, release fuel pressure. Refer to "Releasing Fuel Pressure" in EF & EC section.

e. For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

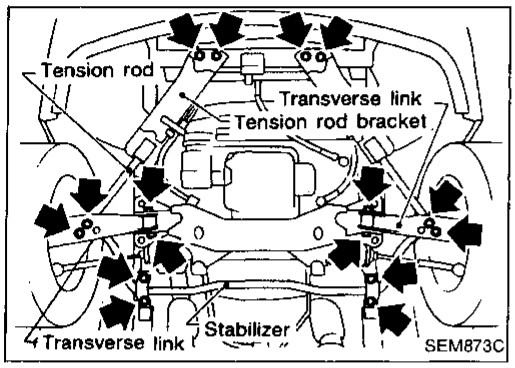
CAUTION:

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

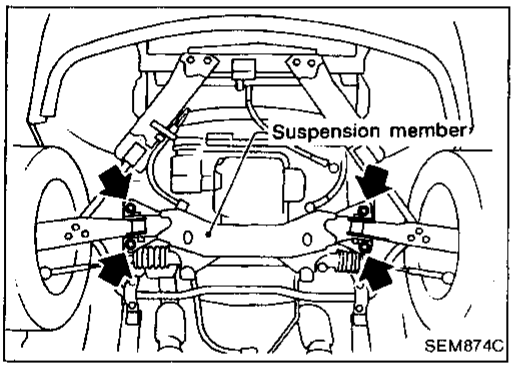

SEM866C

Removal

1. Remove engine under cover and hood.
2. Drain coolant from both cylinder block drain plugs and radiator drain cock.
3. Drain engine oil from drain plug of oil pan.
4. Remove vacuum hoses, fuel tubes, wires, harness and connectors and so on.
5. Remove exhaust tubes and propeller shaft.
6. Remove radiator and shroud.
7. Remove drive belts.
8. Remove alternator, A/C compressor and power steering tube from engine.
9. Remove steering lower joint.
10. Remove stabilizer, transverse link and tension rod with bracket.
11. Set a suitable transmission jack under transmission. Hoist engine with engine slinger.

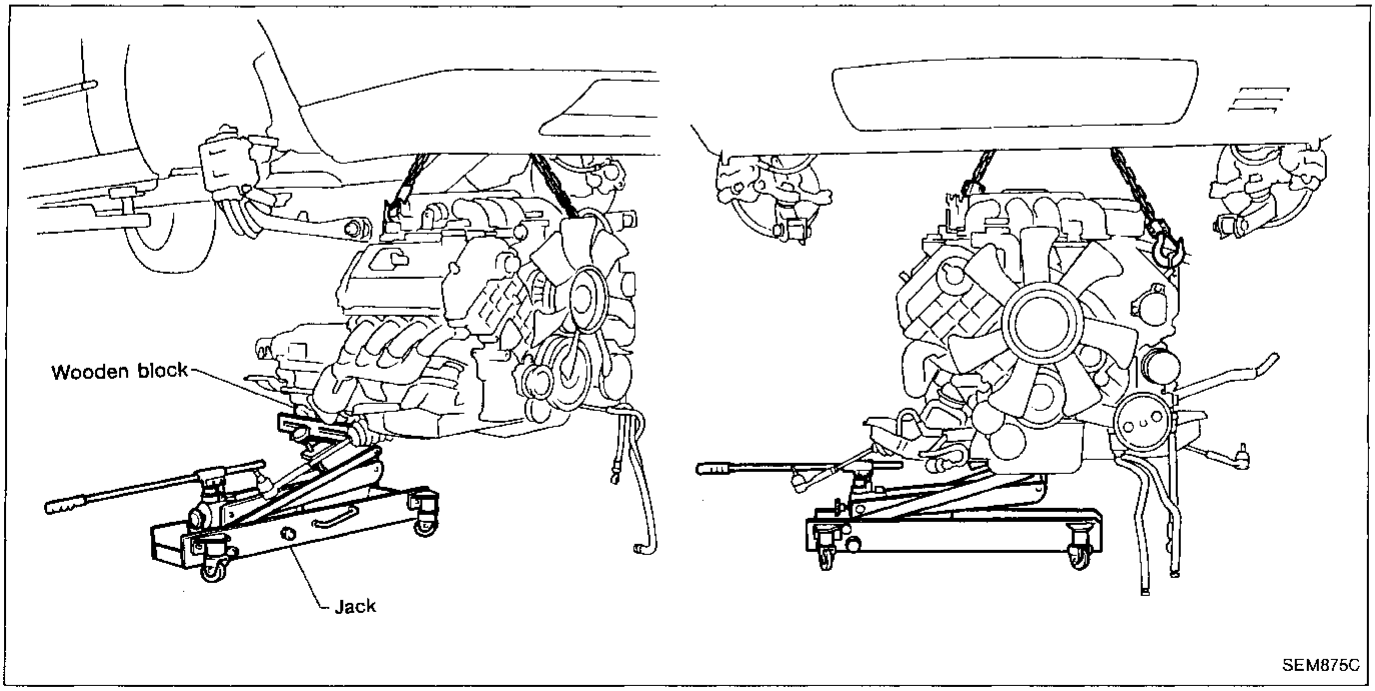


SEM873C

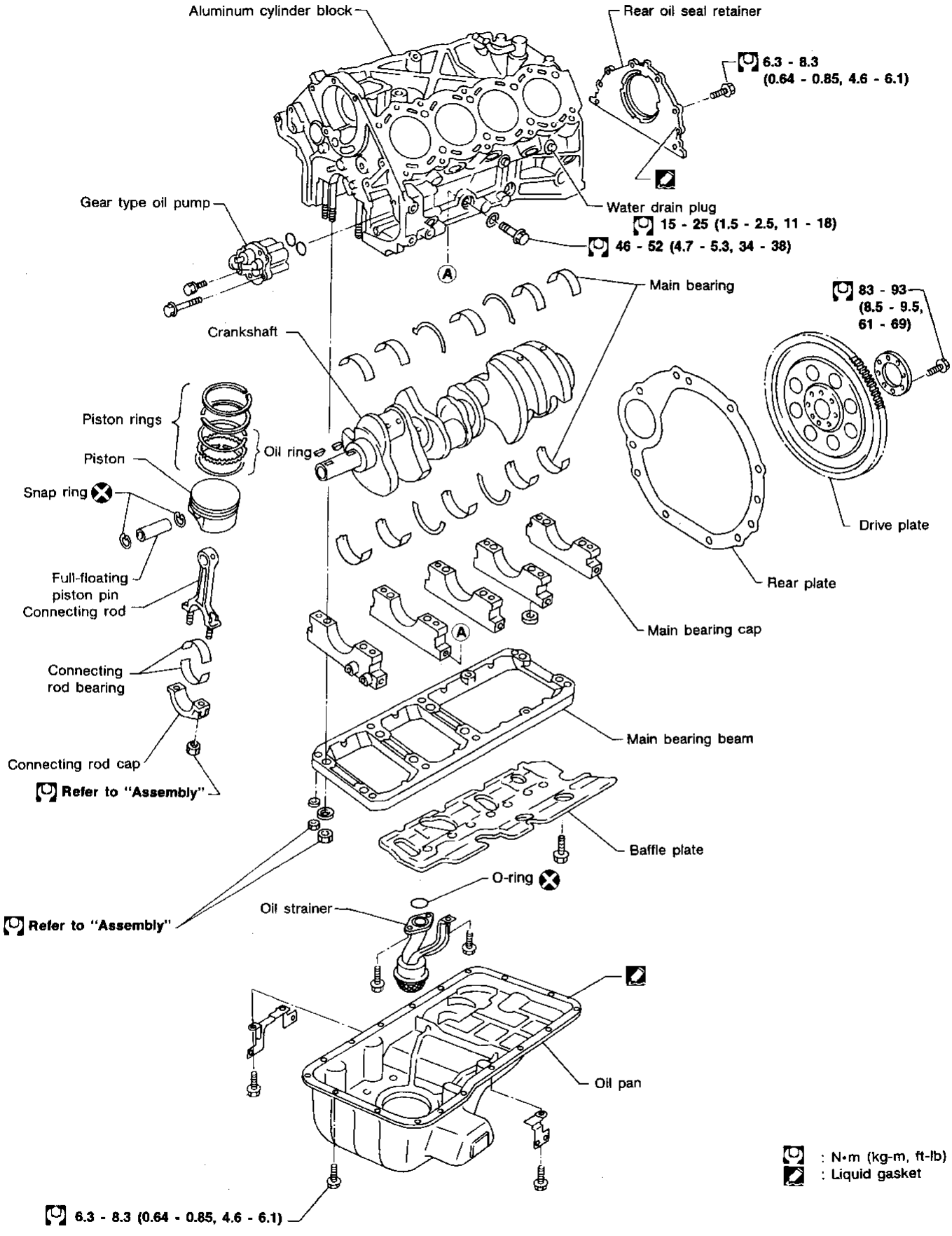


SEM874C

12. Remove suspension member fixing bolts.
13. Remove engine mounting bolts from both sides and then slowly lower transmission jack.
14. Remove engine with transmission as shown in following figure.



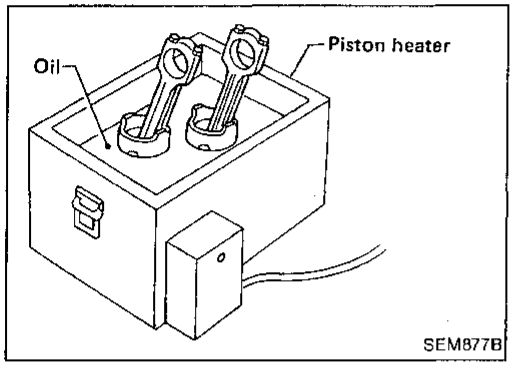
SEM875C


Aluminum cylinder block
Rear oil seal retainer
6.3 - 8.3 (0.64 - 0.85, 4.6 - 6.1)
Gear type oil pump
Water drain plug
15 - 25 (1.5 - 2.5, 11 - 18)
46 - 52 (4.7 - 5.3, 34 - 38)
Main bearing
83 - 93 (8.5 - 9.5, 61 - 69)
Crankshaft
Piston rings
Oil ring
Piston
Snap ring
Drive plate
Rear plate
Full-floating piston pin
Connecting rod
Main bearing cap
Connecting rod bearing
Main bearing beam
Connecting rod cap
Refer to "Assembly"
Baffle plate
O-ring
Refer to "Assembly"
Oil strainer
Oil pan
6.3 - 8.3 (0.64 - 0.85, 4.6 - 6.1)
: N•m (kg-m, ft-lb)
: Liquid gasket

SEM674E

CAUTION:

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

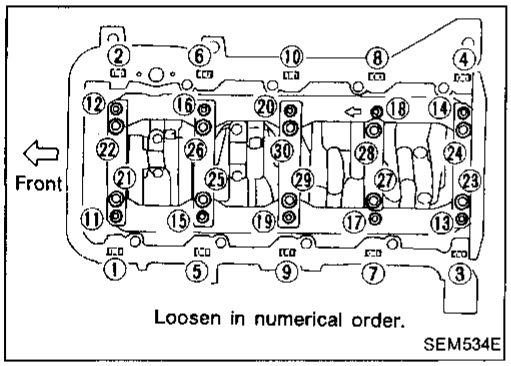


Disassembly

PISTON AND CRANKSHAFT

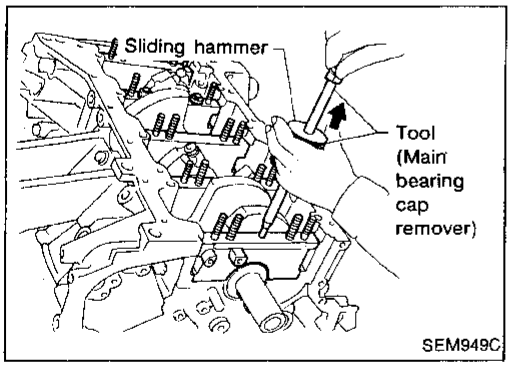
1. Remove timing chain.
   Refer to "Removal" in "TIMING CHAIN".
2. Remove baffle plate.
3. Remove pistons with connecting rods.

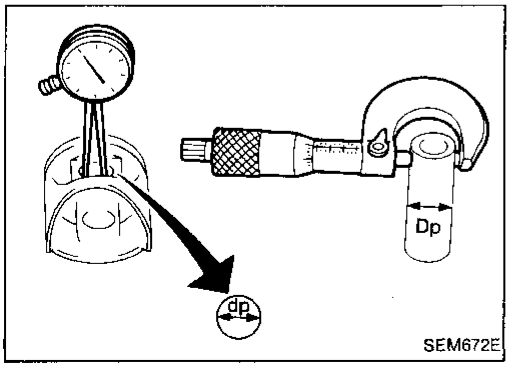
- When disassembling piston and connecting rod, remove snap ring first, then heat piston to 60 to 70°C (140 to 158°F) or use piston pin press stand at room temperature.



4. Remove bearing beam, bearing cap and crankshaft.

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





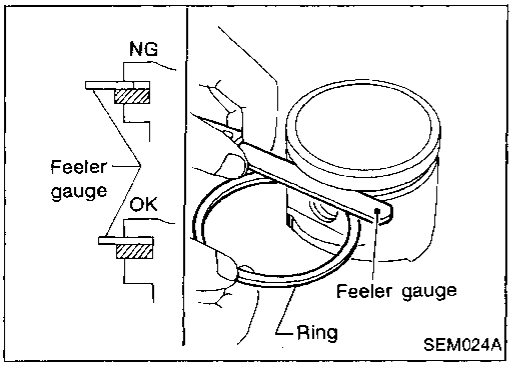
Inspection

PISTON AND PISTON PIN CLEARANCE

1. Measure inner diameter of piston pin hole "dp".
   Standard diameter "dp":
   21.987 - 21.999 mm (0.8656 - 0.8661 in)
2. Measure outer diameter of piston pin "Dp".
   Standard diameter "Dp":
   21.989 - 22.001 mm (0.8657 - 0.8662 in)
3. Calculate piston pin clearance.
   dp – Dp = –0.004 to 0 mm (–0.0002 to 0 in)

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

Inspection (Cont'd)



PISTON RING SIDE CLEARANCE

Side clearance:

Top ring

0.040 - 0.080 mm (0.0016 - 0.0031 in)

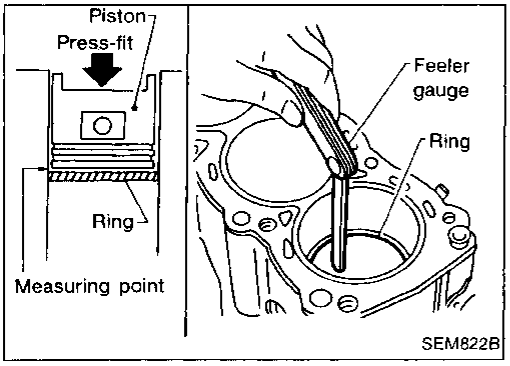
2nd ring

0.030 - 0.070 mm (0.0012 - 0.0028 in)

Max. limit of side clearance:

0.1 mm (0.004 in)

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



PISTON RING END GAP

End gap:

Top ring 0.27 - 0.46 mm (0.0106 - 0.0181 in)

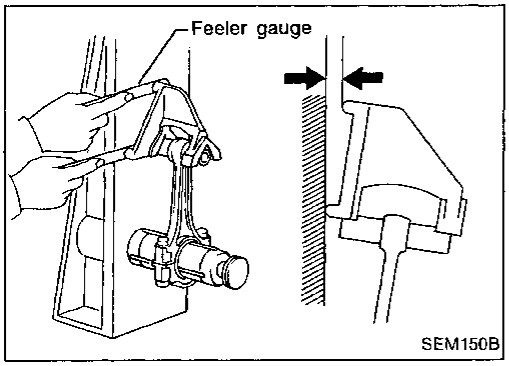
2nd ring 0.39 - 0.63 mm (0.0154 - 0.0248 in)

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

Max. limit of ring gap: 1.0 mm (0.039 in)

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

Refer to SDS.

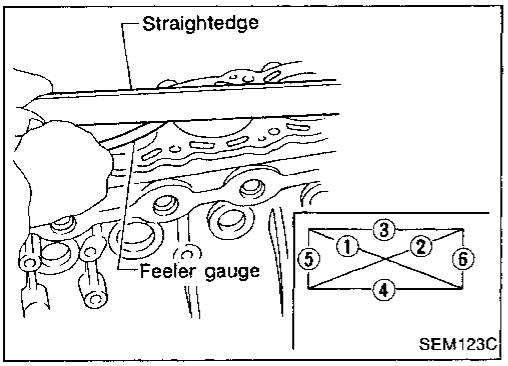


CONNECTING ROD BEND AND TORSION

Bend: Limit 0.15 mm (0.0059 in)
per 100 mm (3.94 in) length

Torsion: Limit 0.30 mm (0.0118 in)
per 100 mm (3.94 in) length

If it exceeds the limit, replace connecting rod assembly.

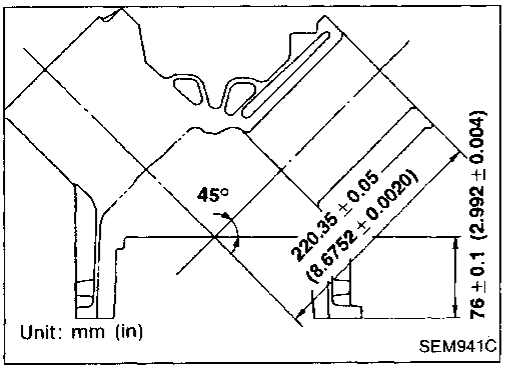


CYLINDER BLOCK DISTORTION AND WEAR

1. Clean upper face of cylinder block and measure the distortion.
   Standard: Less than 0.03 mm (0.0012 in)
   Limit: 0.10 mm (0.0039 in)
2. If out of specification, resurface it.
   The resurfacing limit is determined by the relationship with the amount of cylinder head resurfacing.

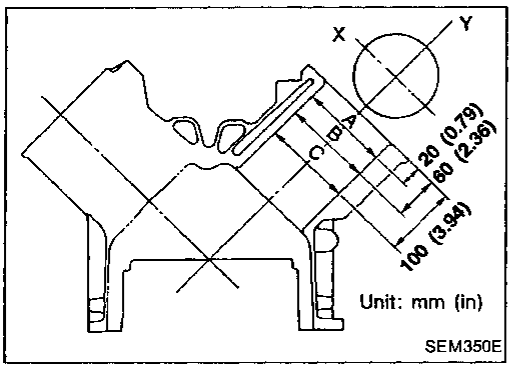
Amount of cylinder head resurfacing is "A".
Amount of cylinder block resurfacing is "B".
The maximum limit is as follows:
A + B = 0.2 mm (0.008 in)
Nominal cylinder block height from crankshaft center:
220.3 - 220.4 mm (8.673 - 8.677 in)

3. If necessary, replace cylinder block.



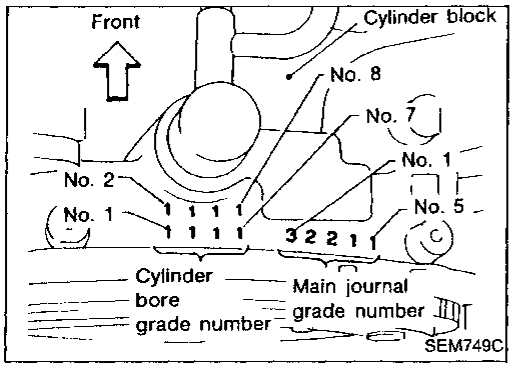
Inspection (Cont'd)

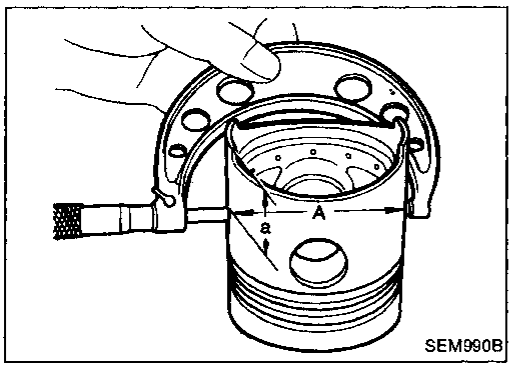
PISTON-TO-BORE CLEARANCE AND BORING



1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper.
   Standard inner diameter:
   93.000 - 93.030 mm (3.6614 - 3.6626 in)
   Wear limit: 0.20 mm (0.0079 in)
   Out-of-round (X – Y) limit: 0.015 mm (0.0006 in)
   Taper (A – B – C) limit: 0.010 mm (0.0004 in)
   If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.
2. Check for scratches and seizure. If necessary, hone it.

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





3. Measure piston skirt diameter.
   Piston diameter "A":
   Refer to SDS.
   Measuring point "a" (Distance from the bottom):
   11.5 mm (0.453 in)
4. Check that piston-to-bore clearance is within specification.
   Piston-to-bore clearance:
   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-48).

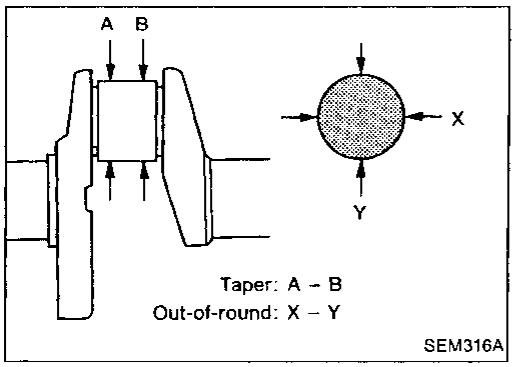
6. Cylinder bore size is determined by adding piston-to-bore clearance to piston diameter "A".
   Rebored size calculation: D = A + B – C
   where, D: Bored diameter
   A: Piston diameter as measured
   B: Piston-to-bore clearance
   C: Honing allowance 0.02 mm (0.0008 in)
7. Install main bearing caps, and tighten to the specified torque to prevent distortion of cylinder bores in final assembly.
8. Cut cylinder bores.

- **When any cylinder needs boring, all other cylinders must also be bored.**
- **Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.**

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

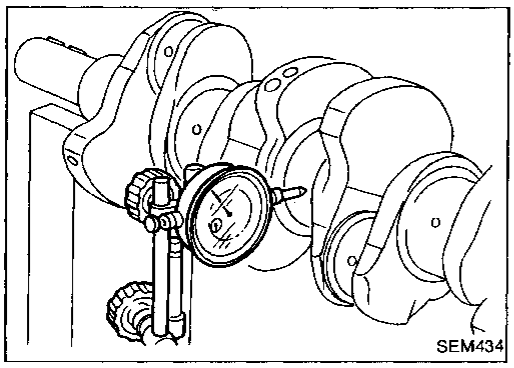
- **Measurement should be done after cylinder bore cools down.**

Inspection (Cont'd)

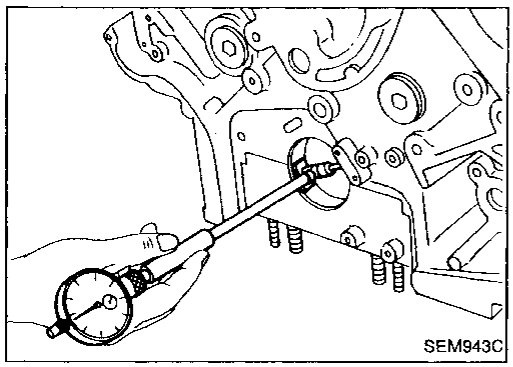


CRANKSHAFT

1. Check crankshaft main and pin journals for score, wear or cracks.
2. With a micrometer, measure journals for taper and out-of-round.
   Out-of-round (X – Y):
   Less than 0.005 mm (0.0002 in)
   Taper (A – B):
   Less than 0.005 mm (0.0002 in)



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



BEARING CLEARANCE

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

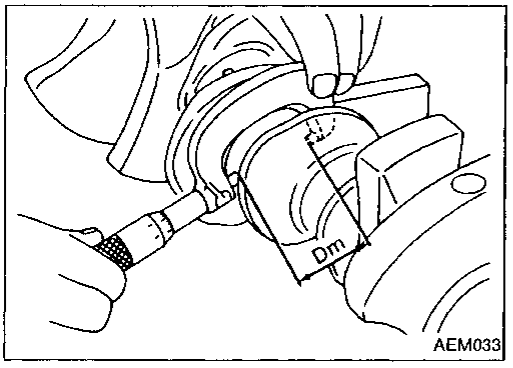
Method A (Using bore gauge & micrometer)

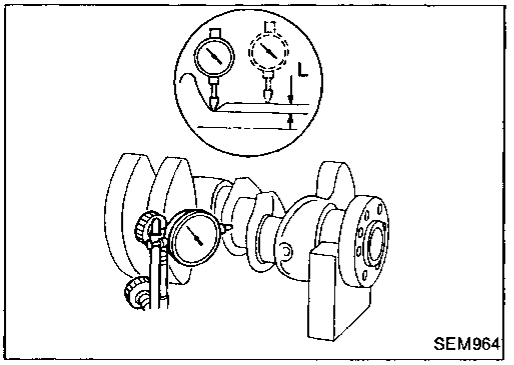
Main bearing

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

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

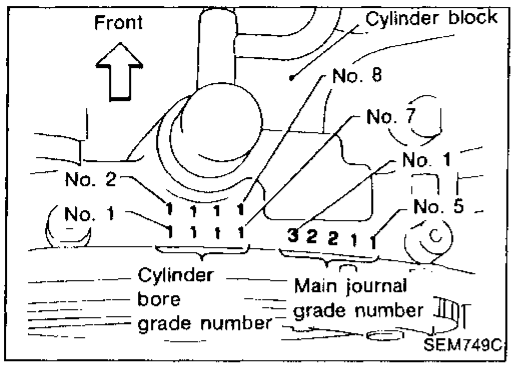
3. Measure inner diameter "A" of each main bearing.
4. Measure outer diameter "Dm" of each crankshaft main journal.
5. Calculate main bearing clearance.
   Main bearing clearance = A – Dm
   Standard: 0.012 - 0.030 mm (0.0005 - 0.0012 in)
   Limit: 0.050 mm (0.0020 in)
6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard, grind crankshaft journal and use undersized bearing.





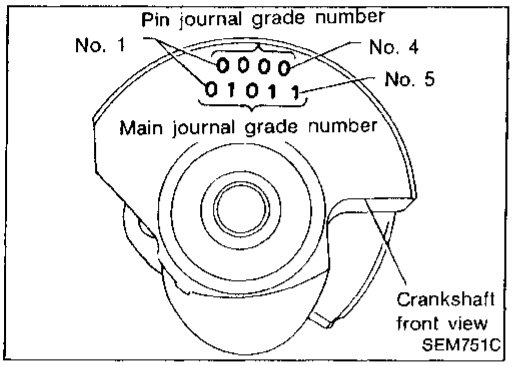
a. When grinding crankshaft journal, confirm that "L" dimension in fillet roll is more than the specified limit.
   "L": 0.1 mm (0.004 in)
b. Refer to SDS (EM-49) for grinding crankshaft and available service parts.

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, it is necessary to select thickness of main bearings as follows:

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



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

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

How to select main bearings

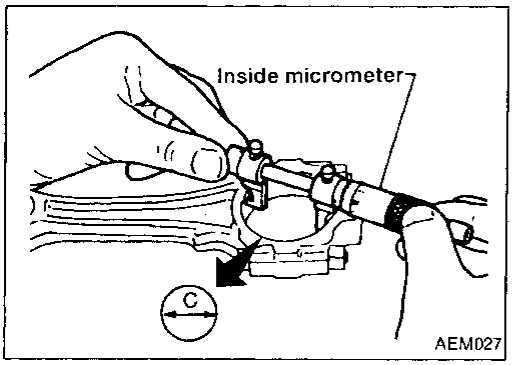
Main Bearing		Cylinder block journal grade number			
		0	1 (I)	2 (II)	3 (III)
Crankshaft journal grade number	0	0	1	2	3
	1 (I)	1	2	3	4
	2 (II)	2	3	4	5
	3 (III)	3	4	5	6

Identification mark and color

0	1	2	3	4	5	6
A, Black	B, Brown	C, Green	D, Yellow	E, Blue	F, Pink	G, No color

For example:
Cylinder block journal grade number: 1
Crankshaft journal grade number: 2
Main bearing grade number = 1 + 2
= 3
= D, Yellow

Inspection (Cont'd)

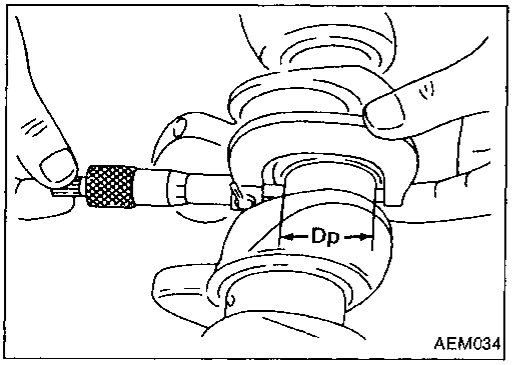


Connecting rod bearing (Big end)

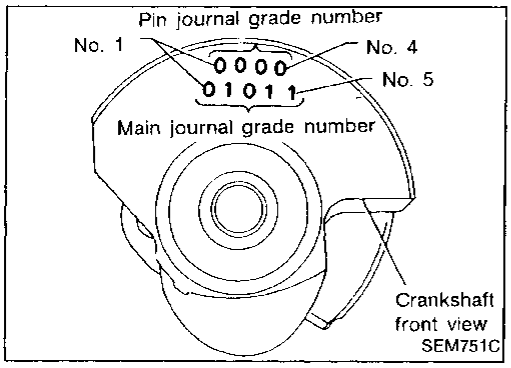
1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.

Tighten bolts to the specified torque.

3. Measure inner diameter "C" of each bearing.
4. Measure outer diameter "Dp" of each crankshaft pin journal.



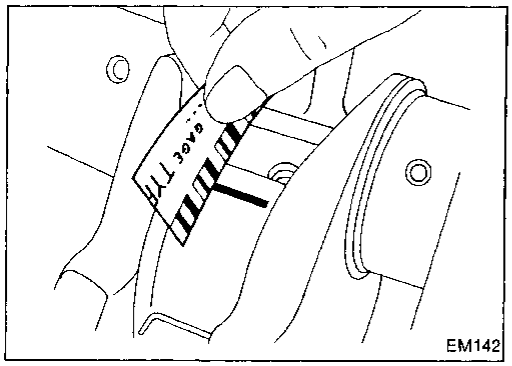
5. Calculate connecting rod bearing clearance.
   Connecting rod bearing clearance = C – Dp
   Standard: 0.020 - 0.045 mm (0.0008 - 0.0018 in)
   Limit: 0.065 mm (0.0026 in)
6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.
   Refer to step 7 of "BEARING CLEARANCE — Main bearing" (EM-37).



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

Connecting rod bearing grade number:

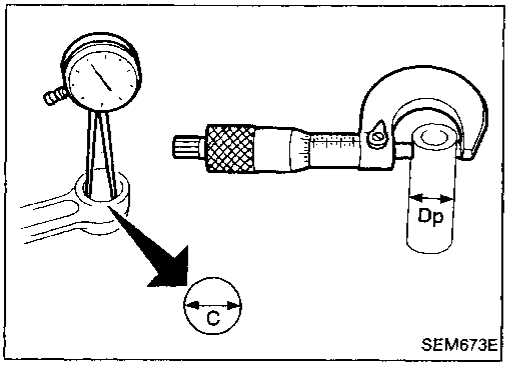
Crank pin grade number	Connecting rod bearing grade number	Identification color
0	0	No color
1 (I)	1 (I)	Brown
2 (II)	2 (II)	Green



Method B (Using plastigage)

CAUTION:

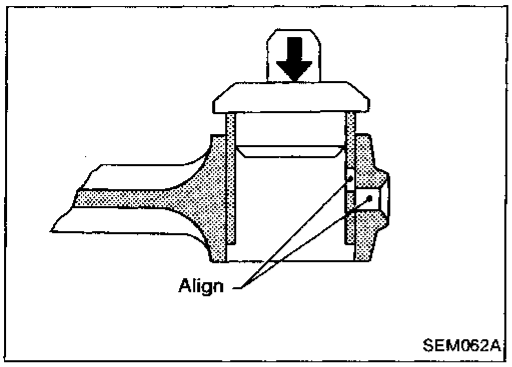
- **Do not turn crankshaft or connecting rod while plastigage is being inserted.**
- **When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. Then if excessive bearing clearance exists, use a thicker main bearing or undersized bearing so that the specified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



CONNECTING ROD BUSHING CLEARANCE (Small end)

1. Measure inner diameter "C" of bushing.
2. Measure outer diameter "Dp" of piston pin.
3. Calculate connecting rod bushing clearance.
   Connecting rod bushing clearance = C – Dp
   Standard:
   0.005 - 0.017 mm (0.0002 - 0.0007 in)
   Limit:
   0.023 mm (0.0009 in)
   If it exceeds the limit, replace connecting rod assembly or connecting rod bushing and/or piston set with pin.

Inspection (Cont'd)



REPLACEMENT OF CONNECTING ROD BUSHING (Small end)

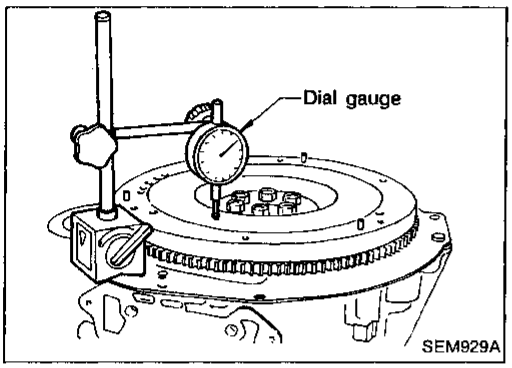
1. Drive in small end bushing until it is flush with end surface of rod.

Be sure to align oil holes.

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

Clearance:

0.005 - 0.017 mm (0.0002 - 0.0007 in)

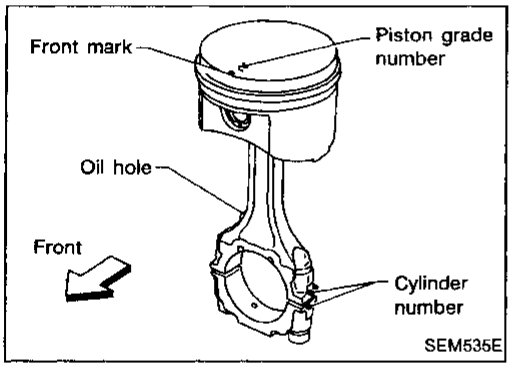


DRIVE PLATE RUNOUT

Drive plate runout (Total indicator reading):

Less than 0.20 mm (0.0079 in)

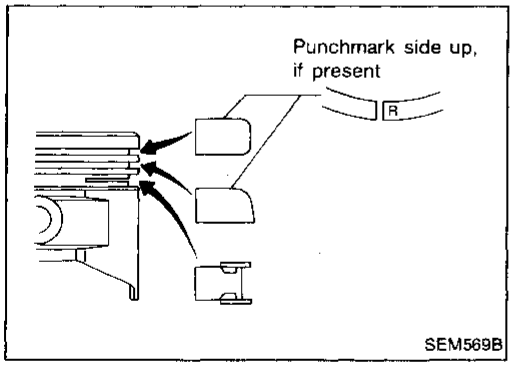
Assembly



PISTON

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

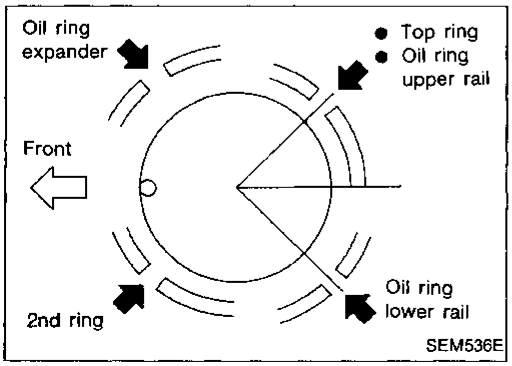
- **Align the direction of piston and connecting rod.**
- **Numbers stamped on connecting rod and cap correspond to each cylinder.**
- **After assembly, make sure connecting rod swings smoothly.**



3. Set piston rings as shown.

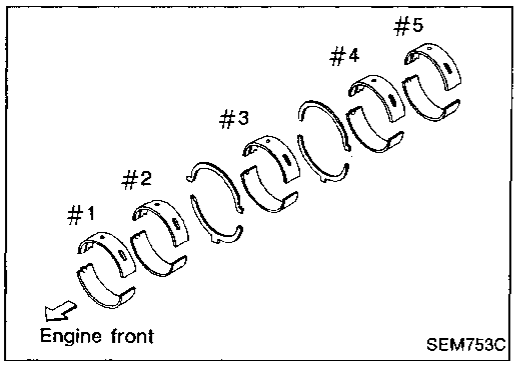
CAUTION:

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



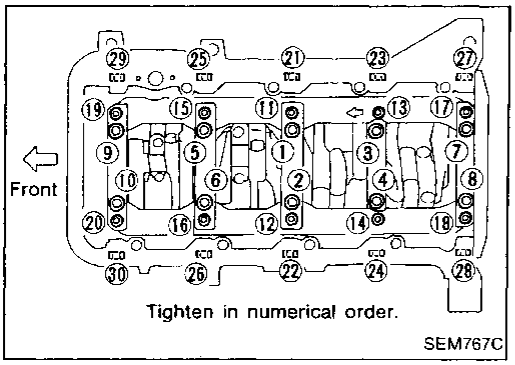
Assembly (Cont'd)

CRANKSHAFT



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

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



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

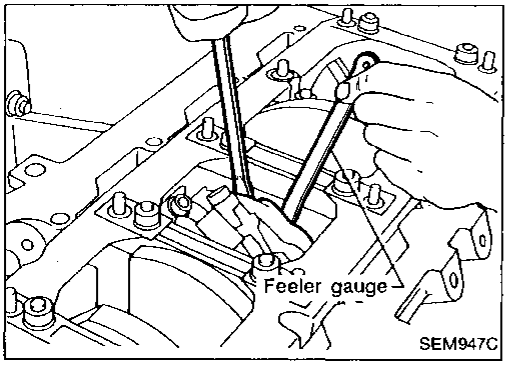
- **Prior to tightening bearing cap bolts, place bearing cap in its proper position by shifting crankshaft in the axial direction.**
- **Tightening procedure**

1) Tighten nuts (① - ⑳) to ⓐ.
2) Turn nuts (① - ⑳) ⓑ degrees clockwise or if angle wrench is not available, tighten all nuts to ⓒ.
3) Tighten all bolts (㉑ - ㉚) to ⓓ.

Unit: N·m (kg-m, ft-lb)

	Nuts (① ② ⑤ - ⑩)	Nuts (③ ④)	Nuts (⑪ - ⑳)	Bolts (㉑ - ㉚)
ⓐ	46 ± 3 (4.7 ± 0.3, 34.0 ± 2.2)	43 ± 3 (4.4 ± 0.3, 31.8 ± 2.2)	22 ± 3 (2.2 ± 0.3, 15.9 ± 2.2)	—
ⓑ	50^{+5}_{-0} degrees	40^{+5}_{-0} degrees	50^{+5}_{-0} degrees	—
ⓒ	113 ± 3 (11.5 ± 0.3, 83.2 ± 2.2)	111 ± 3 (11.3 ± 0.3, 81.7 ± 2.2)	43 ± 3 (4.4 ± 0.3, 31.8 ± 2.2)	—
ⓓ	—	—	—	49 ± 3 (5.0 ± 0.3, 36.2 ± 2.2)

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

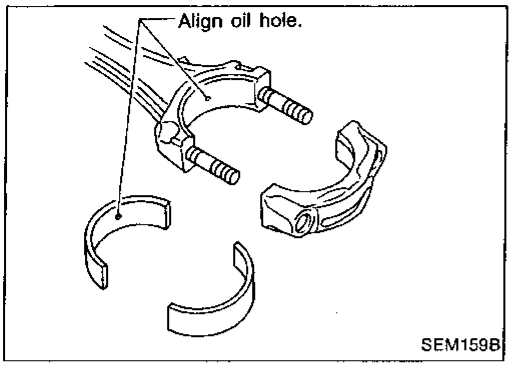


3. Measure crankshaft end play.

Crankshaft end play:
Standard
0.10 - 0.26 mm (0.0039 - 0.0102 in)
Limit
0.30 mm (0.0118 in)

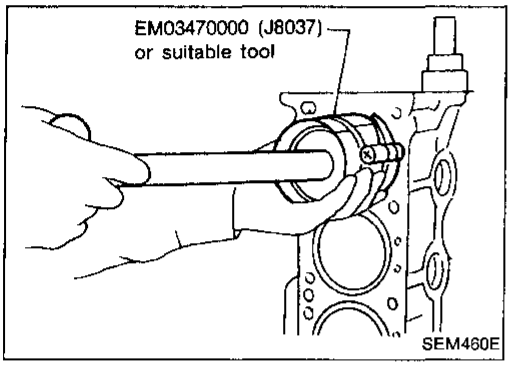
If above the limit, replace bearing with a new one.

Assembly (Cont'd)



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

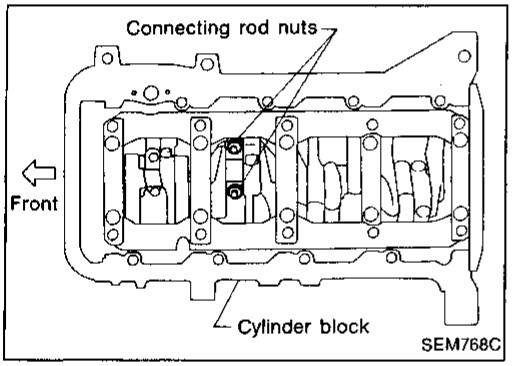
- **Confirm that correct bearings are used. Refer to "Inspection".**
- **Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.**



5. Install pistons with connecting rods.

a. Install them into corresponding cylinders with Tool.

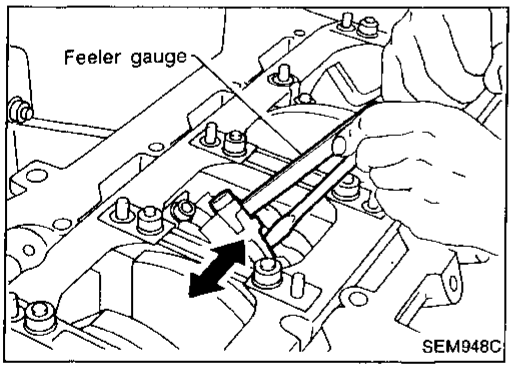
- **Be careful not to scratch cylinder wall by connecting rod.**
- **Arrange so that front mark on piston head faces toward front of engine.**



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

Tightening procedure:

1) **Tighten nuts to 14 to 16 N·m (1.4 to 1.6 kg-m, 10 to 12 ft-lb).**
2) **Turn nuts 60 to 65 degrees clockwise or if angle wrench is not available, tighten nuts to 38 to 44 N·m (3.9 to 4.5 kg-m, 28 to 33 ft-lb).**



6. Measure connecting rod side clearance.

Connecting rod side clearance:

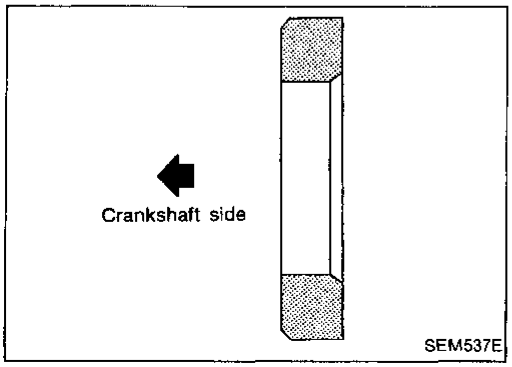
Standard

0.20 - 0.35 mm (0.0079 - 0.0138 in)

Limit

0.40 mm (0.0157 in)

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



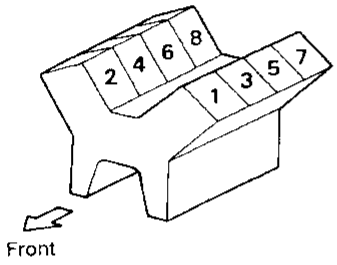
REPLACING PILOT CONVERTER

1. Remove pilot converter.
2. Install pilot converter.

General Specifications

Cylinder arrangement		V-8
Displacement	cm^3 (cu in)	4,494 (274.22)
Bore and stroke	mm (in)	93 x 82.7 (3.66 x 3.256)
Valve arrangement		DOHC
Firing order		1-8-7-3-6-5-4-2
Number of piston rings		
Compression		2
Oil		1
Number of main bearings		5
Compression ratio		10.2

Cylinder number



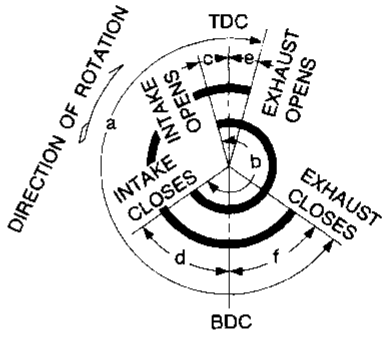
SEM957C

COMPRESSION PRESSURE

Unit: kPa (kg/cm², psi)/300 rpm

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

Valve timing



EM120

Unit: degree

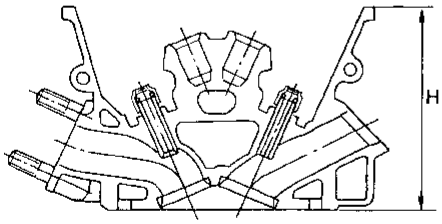
a	b	c	d	e	f
248	248	0	68	8	60

Inspection and Adjustment

CYLINDER HEAD

Unit: mm (in)

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



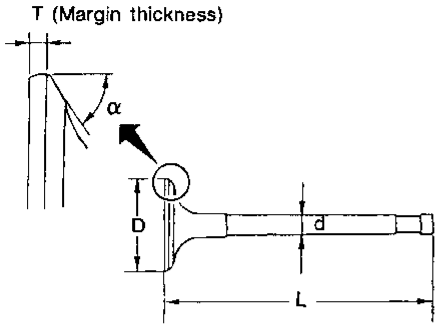
Normal cylinder head height:
H = 130.7 - 130.9 mm (5.146 - 5.154 in)

SEM956C

Inspection and Adjustment (Cont'd)

VALVE

Unit: mm (in)



SEM188

Valve head diameter "D"	
Intake	38.0 - 38.2 (1.496 - 1.504)
Exhaust	33.0 - 33.2 (1.299 - 1.307)
Valve length "L"	
Intake	101.70 - 102.30 (4.0039 - 4.0276)
Exhaust	102.12 - 102.72 (4.0205 - 4.0441)
Valve stem diameter "d"	
Intake	6.966 - 6.971 (0.2743 - 0.2744)
Exhaust	7.960 - 7.965 (0.3134 - 0.3136)
Valve seat angle "α"	
Intake Exhaust	45°15′ - 45°45′
Valve margin "T"	
Intake	1.15 - 1.45 (0.0453 - 0.0571)
Exhaust	1.45 - 1.75 (0.0571 - 0.0689)
Valve margin "T" limit	More than 0.5 (0.020)
Valve stem end surface grinding limit	Less than 0.2 (0.008)
Valve clearance	
Intake	0 (0)
Exhaust	0 (0)

Valve spring

Free height	mm (in)	47.31 (1.8626)
Pressure N (kg, lb) at height mm (in)		
Standard		535.5 (54.6, 120.4) at 26.8 (1.055)
Limit		477.6 (48.7, 107.4) at 26.8 (1.055)
Out-of-square	mm (in)	Less than 2.06 (0.0811)

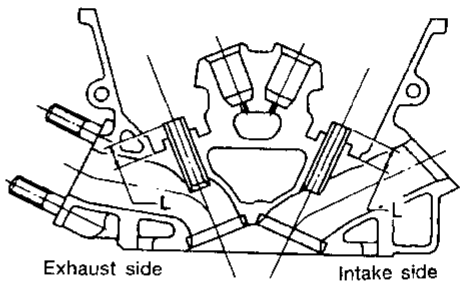
Hydraulic lash adjuster (HLA)

Unit: mm (in)

HLA outer diameter	16.980 - 16.993 (0.6685 - 0.6690)
HLA guide inner diameter	17.000 - 17.020 (0.6693 - 0.6701)
Clearance between HLA and HLA guide	0.007 - 0.040 (0.0003 - 0.0016)

Valve guide

Unit: mm (in)



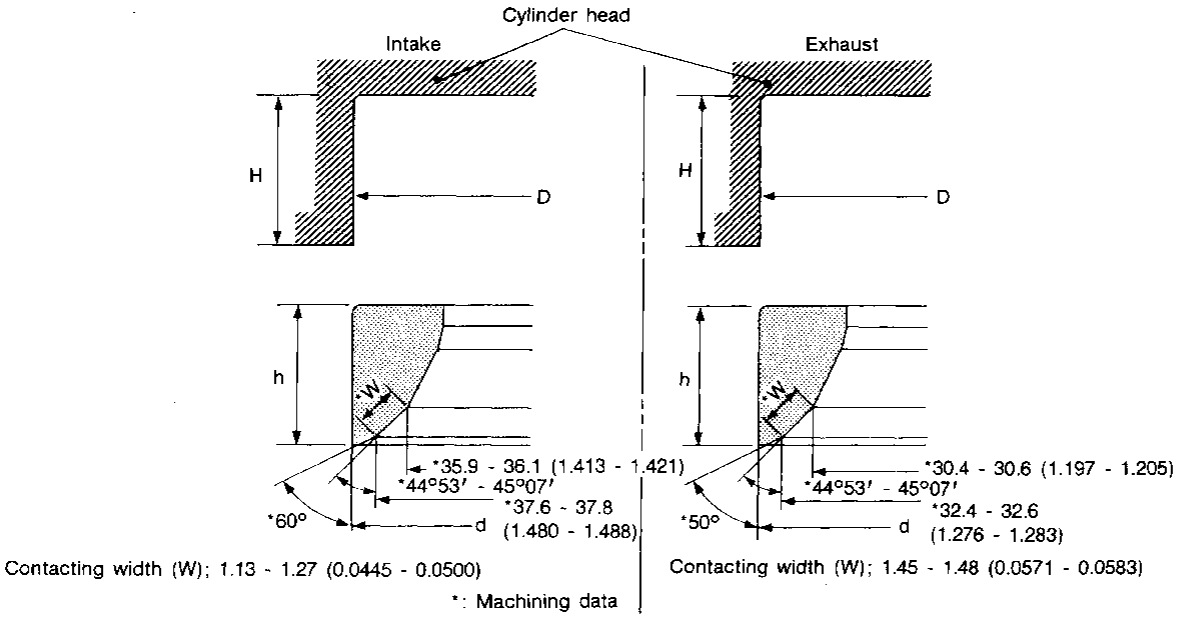
SEM933C

		Standard	Service
Valve guide Outer diameter	Intake	11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
	Exhaust	12.023 - 12.034 (0.4733 - 0.4738)	12.223 - 12.234 (0.4812 - 0.4817)
Valve guide Inner diameter (Finished size)	Intake	7.000 - 7.018 (0.2756 - 0.2763)	
	Exhaust	8.000 - 8.011 (0.3150 - 0.3154)	
Cylinder head valve guide hole diameter	Intake	10.975 - 10.996 (0.4321 - 0.4329)	11.175 - 11.196 (0.4400 - 0.4408)
	Exhaust	11.975 - 11.996 (0.4715 - 0.4723)	12.175 - 12.196 (0.4793 - 0.4802)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	Limit
Stem to guide clearance	Intake	0.029 - 0.052 (0.0011 - 0.0020)	0.080 (0.0031)
	Exhaust	0.035 - 0.051 (0.0014 - 0.0020)	0.080 (0.0031)
Valve deflection limit		—	0.15 (0.0059)
Projection length "L"		17.15 - 17.35 (0.6752 - 0.6831)	

Inspection and Adjustment (Cont'd)

VALVE SEAT

Unit: mm (in)



SEM687E

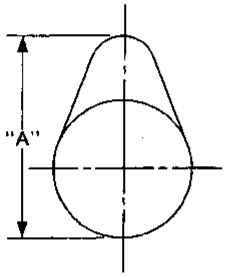
		Standard	Service
Cylinder head seat recess diameter (D)	In.	39.000 - 39.016 (1.5354 - 1.5361)	39.500 - 39.516 (1.5551 - 1.5557)
	Ex.	34.000 - 34.016 (1.3386 - 1.3392)	34.500 - 34.516 (1.3583 - 1.3589)
Valve seat interference fit	In.	0.081 - 0.113 (0.0032 - 0.0044)	
	Ex.	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	In.	39.097 - 39.113 (1.5392 - 1.5399)	39.597 - 39.613 (1.5589 - 1.5596)
	Ex.	34.080 - 34.096 (1.3417 - 1.3424)	34.580 - 34.596 (1.3614 - 1.3620)
Depth (H)	In.	6.32 - 6.52 (0.2488 - 0.2567)	
	Ex.	6.15 - 6.35 (0.2421 - 0.2500)	
Height (h)		6.2 - 6.3 (0.244 - 0.248)	

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	26.000 - 26.021 (1.0236 - 1.0244)	—
Outer diameter of camshaft journal	25.935 - 25.955 (1.0211 - 1.0218)	—
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	0.070- 0.148 (0.0028 - 0.0058)	0.20 (0.0079)



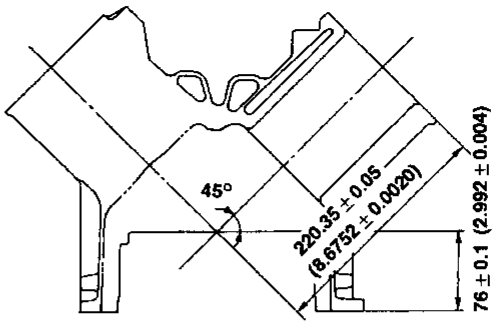
EM671

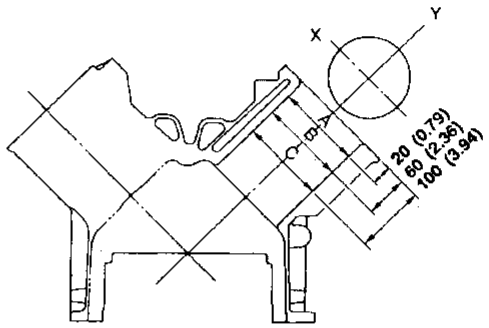
Cam height "A"	
Intake	37.919 - 38.109 (1.4929 - 1.5004)
Exhaust	35.279 - 35.469 (1.3889 - 1.3964)
Wear limit of cam height	0.05 (0.0020)

*Total indicator reading

CYLINDER BLOCK

Unit: mm (in)





SEM955C

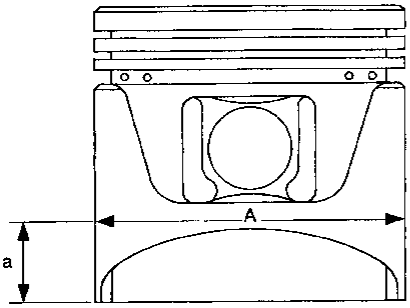
Surface flatness	
Standard	Less than 0.03 (0.0012)
Limit	0.10 (0.0039)
Cylinder bore	
Inner diameter	
Standard	
Grade No. 1	93.000 - 93.010 (3.6614 - 3.6618)
Grade No. 2	93.010 - 93.020 (3.6618 - 3.6622)
Grade No. 3	93.020 - 93.030 (3.6622 - 3.6626)
Wear limit	0.20 (0.0079)
Out-of-round (X – Y)	Less than 0.015 (0.0006)
Taper (A – B – C)	Less than 0.010 (0.0004)
Difference in inner diameter between cylinders	
Limit	Less than 0.03 (0.0012)
Main journal inner diameter	
Grade No. 0	68.944 - 68.950 (2.7143 - 2.7146)
Grade No. 1	68.950 - 68.956 (2.7146 - 2.7148)
Grade No. 2	68.956 - 68.962 (2.7148 - 2.7150)
Grade No. 3	68.962 - 68.968 (2.7150 - 2.7153)

Inspection and Adjustment (Cont'd)

PISTON, PISTON RING AND PISTON PIN

Available piston

Unit: mm (in)



SEM750C

Piston skirt diameter "A"	
Standard	
Grade No. 1	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	11.5 (0.453)
Piston clearance to cylinder block	0.010 - 0.030 (0.0004 - 0.0012)
Piston pin hole diameter	21.987 - 21.999 (0.8656 - 0.8661)

Piston ring

Unit: mm (in)

	Standard	Limit
Side clearance		
Top	0.040 - 0.080 (0.0016 - 0.0031)	0.1 (0.004)
2nd	0.030 - 0.070 (0.0012 - 0.0028)	
End gap		
Top	0.27 - 0.46 (0.0106 - 0.0181)	1.0 (0.039)
2nd	0.39 - 0.63 (0.0154 - 0.0248)	
Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)	

Piston pin

Unit: mm (in)

Piston pin outer diameter	21.989 - 22.001 (0.8657 - 0.8662)
Interference fit of piston pin to piston	0 - 0.004 (0 - 0.0002)
Piston pin to connecting rod bushing clearance	
Standard	0.005 - 0.017 (0.0002 - 0.0007)
Limit	0.023 (0.0009)

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

CONNECTING ROD

Unit: mm (in)

Center distance	146.95 - 147.05 (5.7854 - 5.7894)
Bend, torsion [per 100 (3.94)]	
Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	
Limit	0.3 (0.0012)
Connecting rod small end inner diameter	24.980 - 25.000 (0.9835 - 0.9843)
Piston pin bushing inner diameter*	22.000 - 22.012 (0.8661 - 0.8666)
Connecting rod big end inner diameter	55.000 - 55.013 (2.1654 - 2.1659)
Side clearance	
Standard	0.20 - 0.35 (0.0079 - 0.0138)
Limit	0.40 (0.0157)

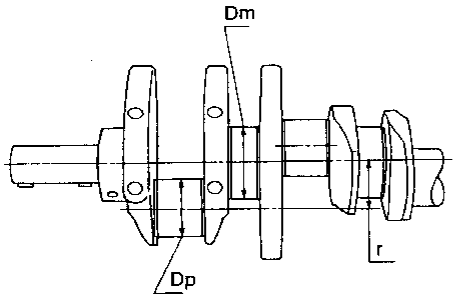
*After installing in connecting rod

Inspection and Adjustment (Cont'd)

CRANKSHAFT

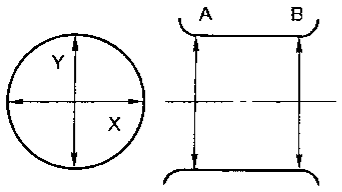
Unit: mm (in)

Main journal dia. "Dm"	
Grade No. 0	63.958 - 63.964 (2.5180 - 2.5183)
Grade No. 1	63.952 - 63.958 (2.5178 - 2.5180)
Grade No. 2	63.946 - 63.952 (2.5176 - 2.5178)
Grade No. 3	63.940 - 63.946 (2.5173 - 2.5176)
Pin journal dia. "Dp"	
Grade No. 0	51.968 - 51.974 (2.0460 - 2.0462)
Grade No. 1	51.962 - 51.968 (2.0457 - 2.0460)
Grade No. 2	51.956 - 51.962 (2.0455 - 2.0457)
Center distance "r"	41.31 - 41.39 (1.6264 - 1.6295)
Out-of-round (X – Y)	
Standard	Less than 0.005 (0.0002)
Taper (A – B)	
Standard	Less than 0.005 (0.0002)
Runout [TIR]	
Standard	Less than 0.025 (0.0010)
Limit	Less than 0.05 (0.0020)
Free end play	
Standard	0.10 - 0.26 (0.0039 - 0.0102)
Limit	0.30 (0.0118)



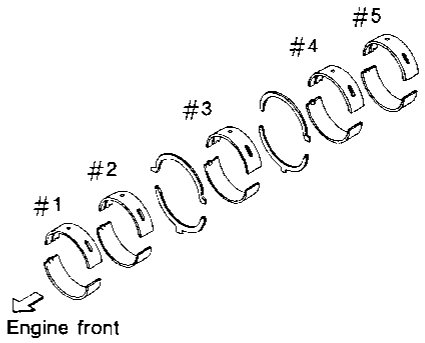
SEM954C

Out-of-round X – Y
Taper A – B



EM715

AVAILABLE MAIN BEARING



SEM753C

No. 1 and 5 main bearing

Standard size

Unit: mm (in)

Grade number	Thickness "T"	Width "W"	Identification color (mark)
0	2.481 - 2.484 (0.0977 - 0.0978)	20.0 (0.787)	Black (A)
1	2.484 - 2.487 (0.0978 - 0.0979)		Brown (B)
2	2.487 - 2.490 (0.0979 - 0.0980)		Green (C)
3	2.490 - 2.493 (0.0980 - 0.0981)		Yellow (D)
4	2.493 - 2.496 (0.0981 - 0.0983)		Blue (E)
5	2.496 - 2.499 (0.0983 - 0.0984)		Pink (F)
6	2.499 - 2.502 (0.0984 - 0.0985)		No color (G)

Inspection and Adjustment (Cont'd)

No. 2 and 4 main bearing

Standard size

Unit: mm (in)

Grade number	Thickness "T"	Width "W"	Identification color (mark)
0	2.481 - 2.484 (0.0977 - 0.0978)	22.3 (0.878)	Black (A)
1	2.484 - 2.487 (0.0978 - 0.0979)		Brown (B)
2	2.487 - 2.490 (0.0979 - 0.0980)		Green (C)
3	2.490 - 2.493 (0.0980 - 0.0981)		Yellow (D)
4	2.493 - 2.496 (0.0981 - 0.0983)		Blue (E)
5	2.496 - 2.499 (0.0983 - 0.0984)		Pink (F)
6	2.499 - 2.502 (0.0984 - 0.0985)		No color (G)

No. 3 main bearing

Standard size

Unit: mm (in)

Grade number	Thickness "T"	Width "W"	Identification color (mark)
0	2.481 - 2.484 (0.0977 - 0.0978)	21.3 (0.839)	Black (A)
1	2.484 - 2.487 (0.0978 - 0.0979)		Brown (B)
2	2.487 - 2.490 (0.0979 - 0.0980)		Green (C)
3	2.490 - 2.493 (0.0980 - 0.0981)		Yellow (D)
4	2.493 - 2.496 (0.0981 - 0.0983)		Blue (E)
5	2.496 - 2.499 (0.0983 - 0.0984)		Pink (F)
6	2.499 - 2.502 (0.0984 - 0.0985)		No color (G)

Undersize

Unit: mm (in)

	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	2.613 - 2.621 (0.1029 - 0.1032)	Grind so that bearing clearance is the specified value.

AVAILABLE CONNECTING ROD BEARING

Connecting rod bearing

Standard size

Unit: mm (in)

Grade number	Thickness "T"	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	No color (A)
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown (B)
2	1.506 - 1.509 (0.0593 - 0.0594)	Green (C)

Undersize

Unit: mm (in)

	Thickness	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.541 - 1.549 (0.0607 - 0.0610)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.561 - 1.569 (0.0615 - 0.0618)	
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	

Bearing clearance

Unit: mm (in)

Main bearing clearance	
Standard	0.012 - 0.030 (0.0005 - 0.0012)
Limit	0.050 (0.0020)
Connecting rod bearing clearance	
Standard	0.020 - 0.045 (0.0008 - 0.0018)
Limit	0.065 (0.0026)

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Drive plate	
Runout [TIR]*	Less than 0.20 (0.0079)

*Total indicator reading