

SECTION **EM**

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PRECAUTIONS

Precautions for Supplemental Restraint System Supplemental "AIR BAG"

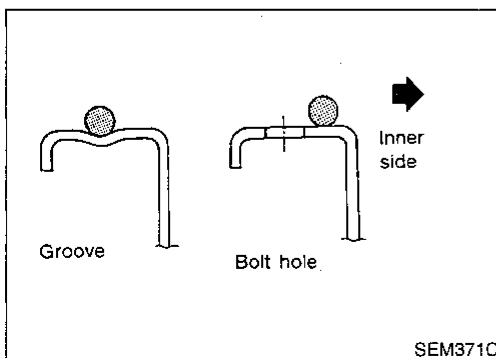
The Supplemental Restraint System Supplemental "Air Bag", used along with seat belts, helps to reduce the risk or severity of injury to the driver in a frontal collision. The Supplemental Restraint System consists of a supplemental air bag module (located in the center of the steering wheel), sensors,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

WARNING:

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

Parts Requiring Angular Tightening

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

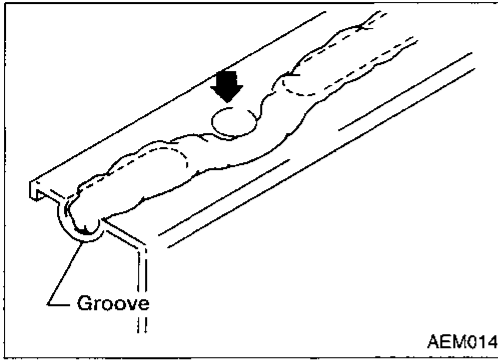


Liquid Gasket Application Procedure

- a. Before applying liquid gasket, use a scraper to remove all traces of old liquid gasket from mating surfaces and grooves, and then completely clean any oil stains from these portions.
- 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).

PRECAUTIONS

Liquid Gasket Application Procedure (Cont'd)



- c. Apply liquid gasket to inner surface around hole perimeter area.
(Assembly should be done within 5 minutes after coating.)
- d. Wait at least 30 minutes before refilling engine oil and engine coolant.

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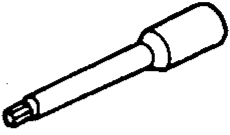
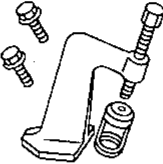
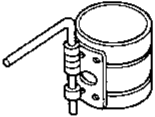
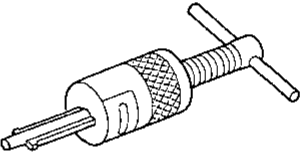
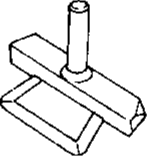
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PREPARATION

Special Service Tools

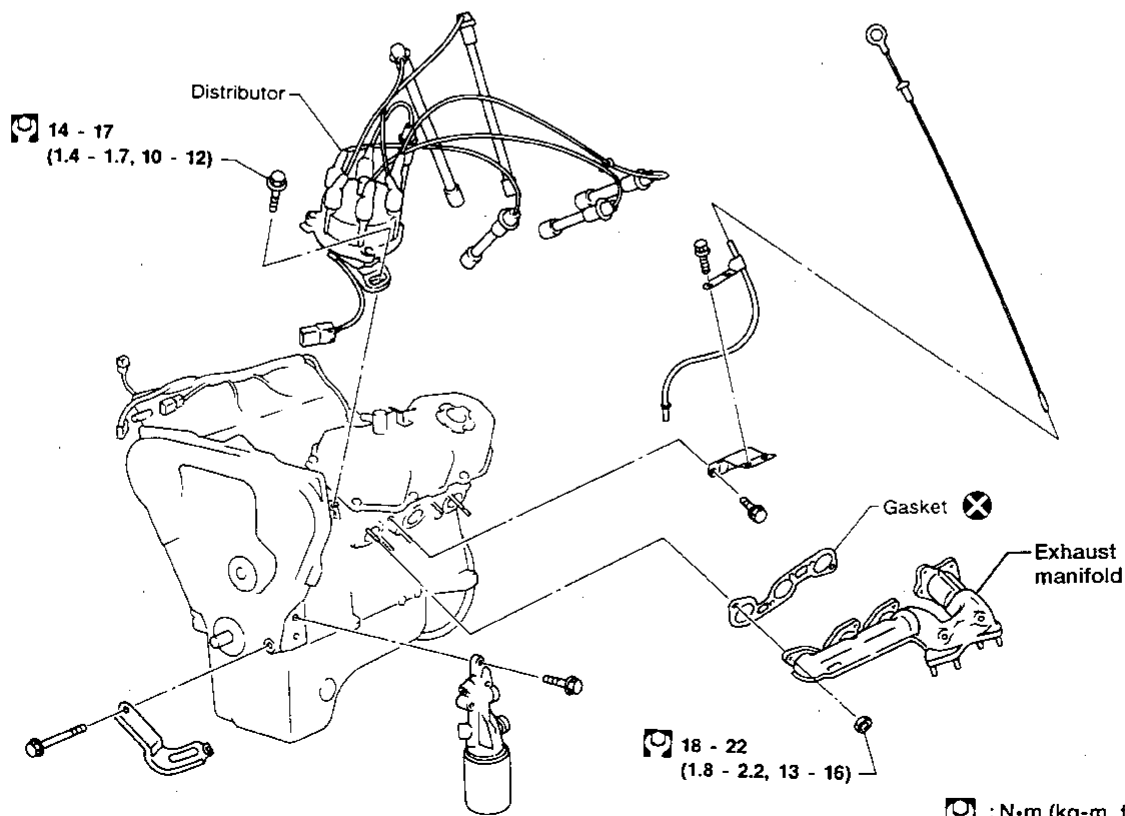
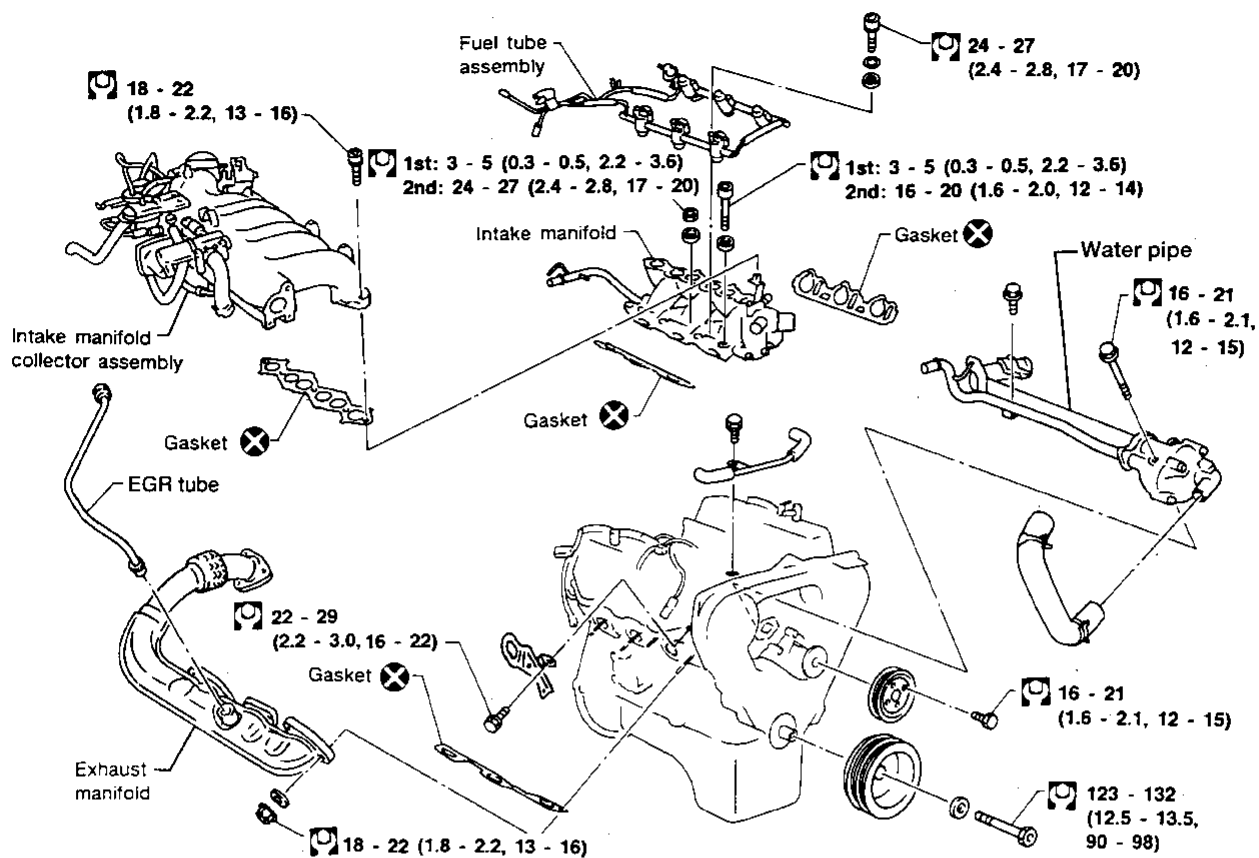
Tool number (Kent-Moore No.) Tool name	Description
ST10120000 (J24239-01) Cylinder head bolt wrench	Loosening and tightening cylinder head bolt 
KV10110600 (J33986) Valve spring compressor	Disassembling and assembling valve components 
EM03470000 (J8037) Piston ring compressor	Installing piston assembly into cylinder bore 
ST16610001 (J23907) Pilot bushing puller	Removing crankshaft pilot bushing 
KV10111100 (J37228) Seal cutter	Removing oil pan 

PREPARATION

Commercial Service Tools

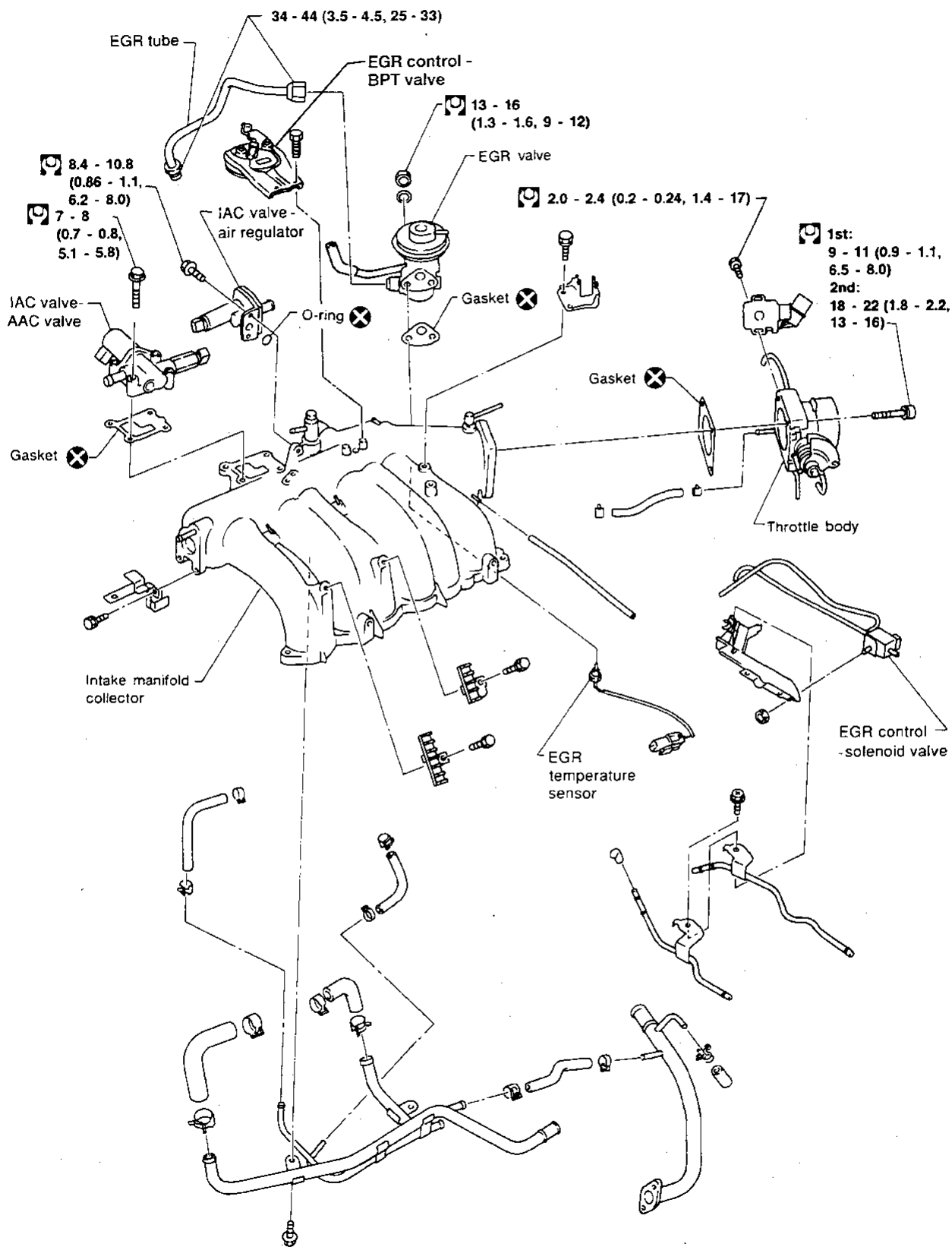
Tool name	Description			
Spark plug wrench	Removing and installing spark plug			GI MA
Pulley holder	Holding camshaft pulley while tightening or loosening camshaft bolt			EM LC
Valve seat cutter set	Finishing valve seat dimensions			EF & EC FE
Piston ring expander	Removing and installing piston ring			AT FA
Valve guide drift	Removing and installing valve guide Intake & Exhaust: A = 10.5 mm (0.413 in) dia. B = 6.6 mm (0.260 in) dia.			RA BR
Valve guide reamer	Reaming valve guide ① or hole for oversize valve guide ② Intake: D₁ = 7.0 mm (0.276 in) dia. D₂ = 11.2 mm (0.441 in) dia. Exhaust: D₁ = 8.0 mm (0.315 in) dia. D₂ = 12.2 mm (0.480 in) dia.			ST BF HA EL
Valve oil seal drift	Installing valve oil seal			IDX

OUTER COMPONENT PARTS



: N·m (kg-m, ft-lb)

OUTER COMPONENT PARTS



: N·m (kg·m, ft·lb)

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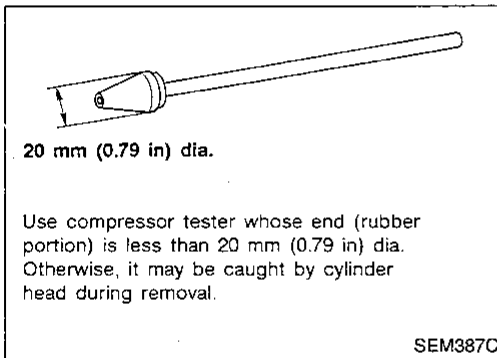
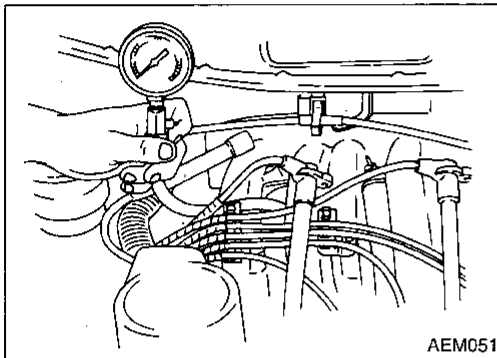
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COMPRESSION PRESSURE

Measurement of Compression Pressure

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



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

Compression pressure: kPa (kg/cm², psi)/300 rpm

Standard

1,196 (12.2, 173)

Minimum

883 (9.0, 128)

Difference limit between cylinders

98 (1.0, 14)

10. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through spark plug holes and retest compression.
- **If adding oil improves cylinder compression, piston rings may be worn or damaged. If so, replace piston rings after checking piston.**
 - **If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. Refer to EM-52 and EM-53. If valve or valve seat is damaged excessively, replace them.**
 - **If compression in any two adjacent cylinders is low and if adding oil does not improve compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.**

OIL PAN

Removal

1. Drain engine oil.
2. Remove engine lower covers.

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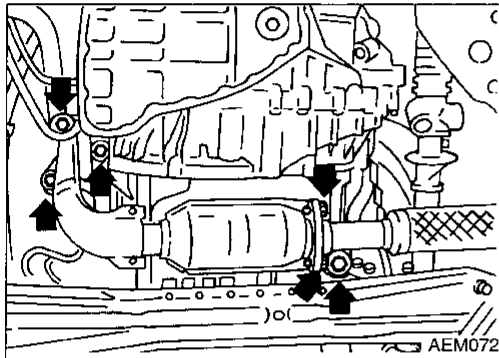
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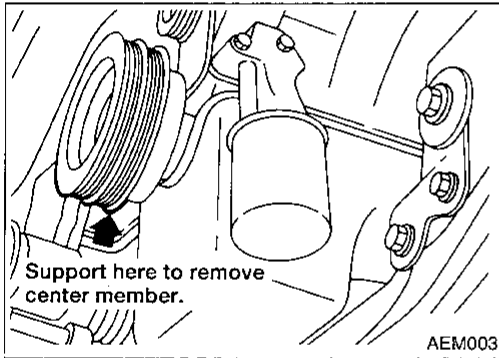
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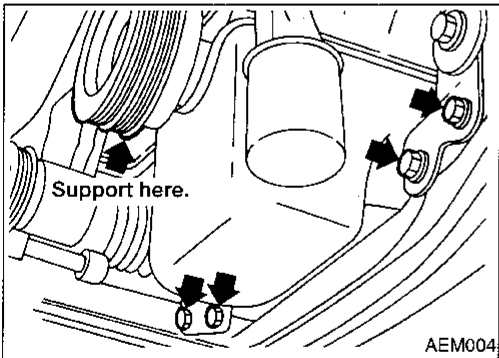
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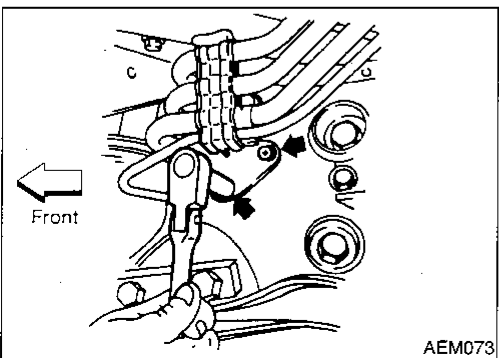
3. Remove exhaust tube fixing nuts and exhaust tube.



4. Support engine at crank pulley with a suitable jack and block or from above with a suitable support bar or hoist.



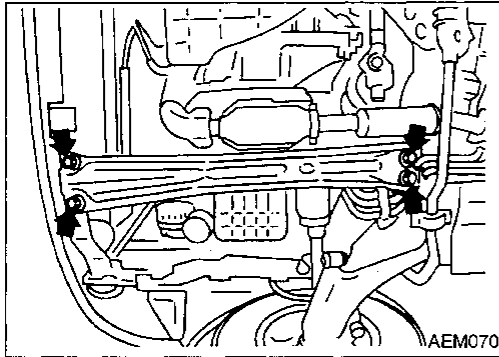
5. Remove engine mounting insulator bolts and nuts.



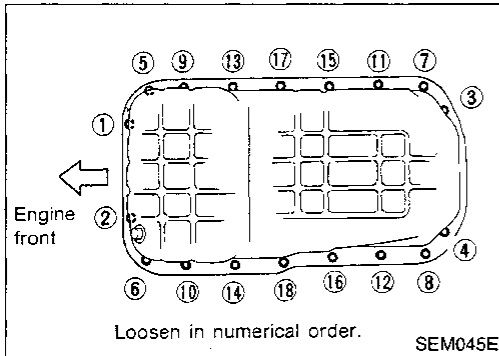
6. If equipped, remove the rear A/C refrigerant lines support bracket bolts.

OIL PAN

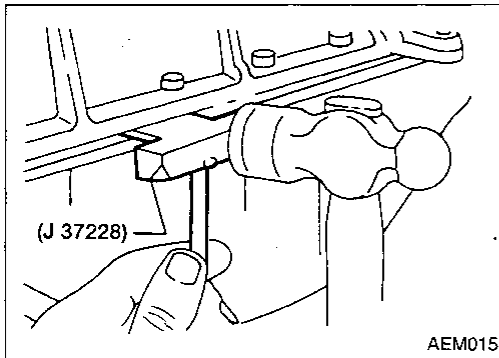
Removal (Cont'd)



7. Remove center member assembly.



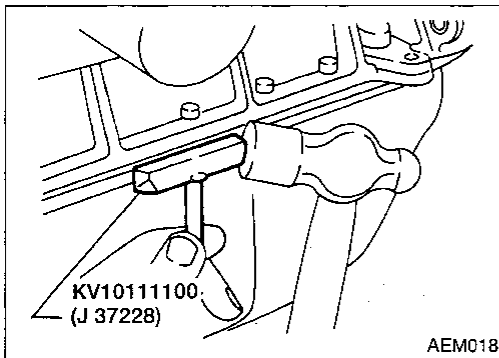
8. Remove oil pan bolts.



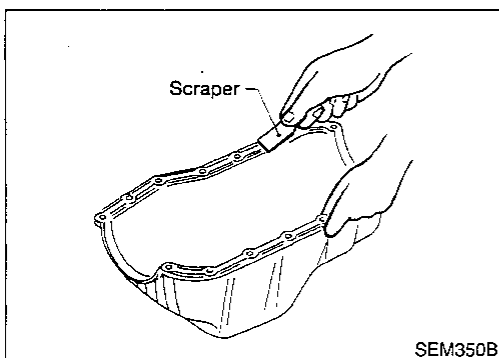
9. Remove oil pan.

(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 surfaces 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.



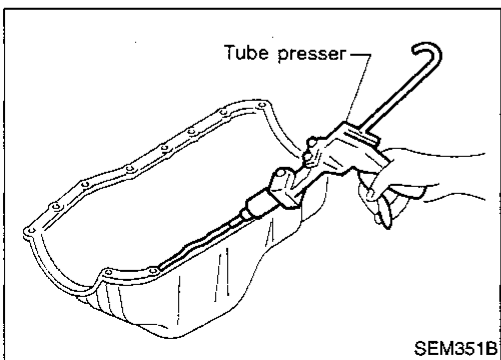
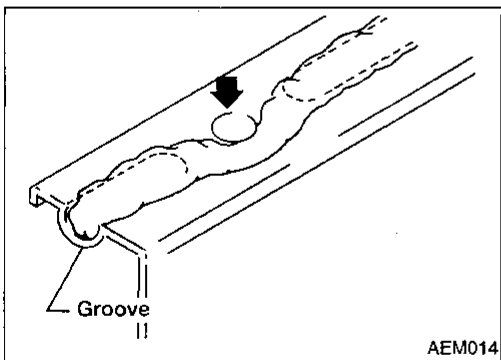
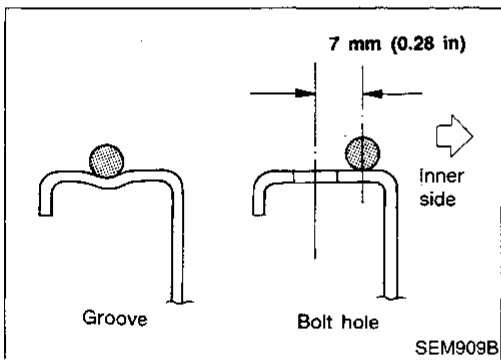
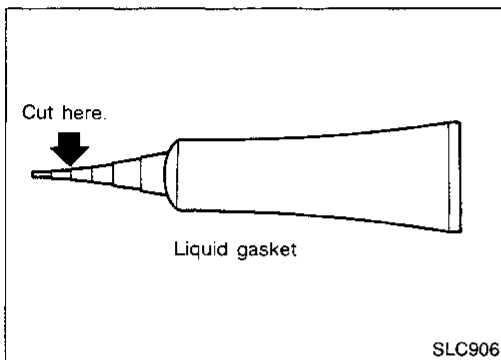
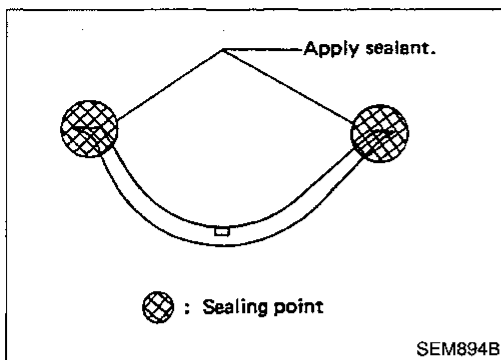
Installation

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

- Also remove traces of liquid gasket from cylinder block mating surface.

OIL PAN

Installation (Cont'd)



2. Apply sealant to oil pump gasket and rear oil seal retainer gasket.

- 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. Apply a continuous bead of liquid gasket to mating surface of oil pan.

- Use Genuine Liquid Gasket or equivalent.

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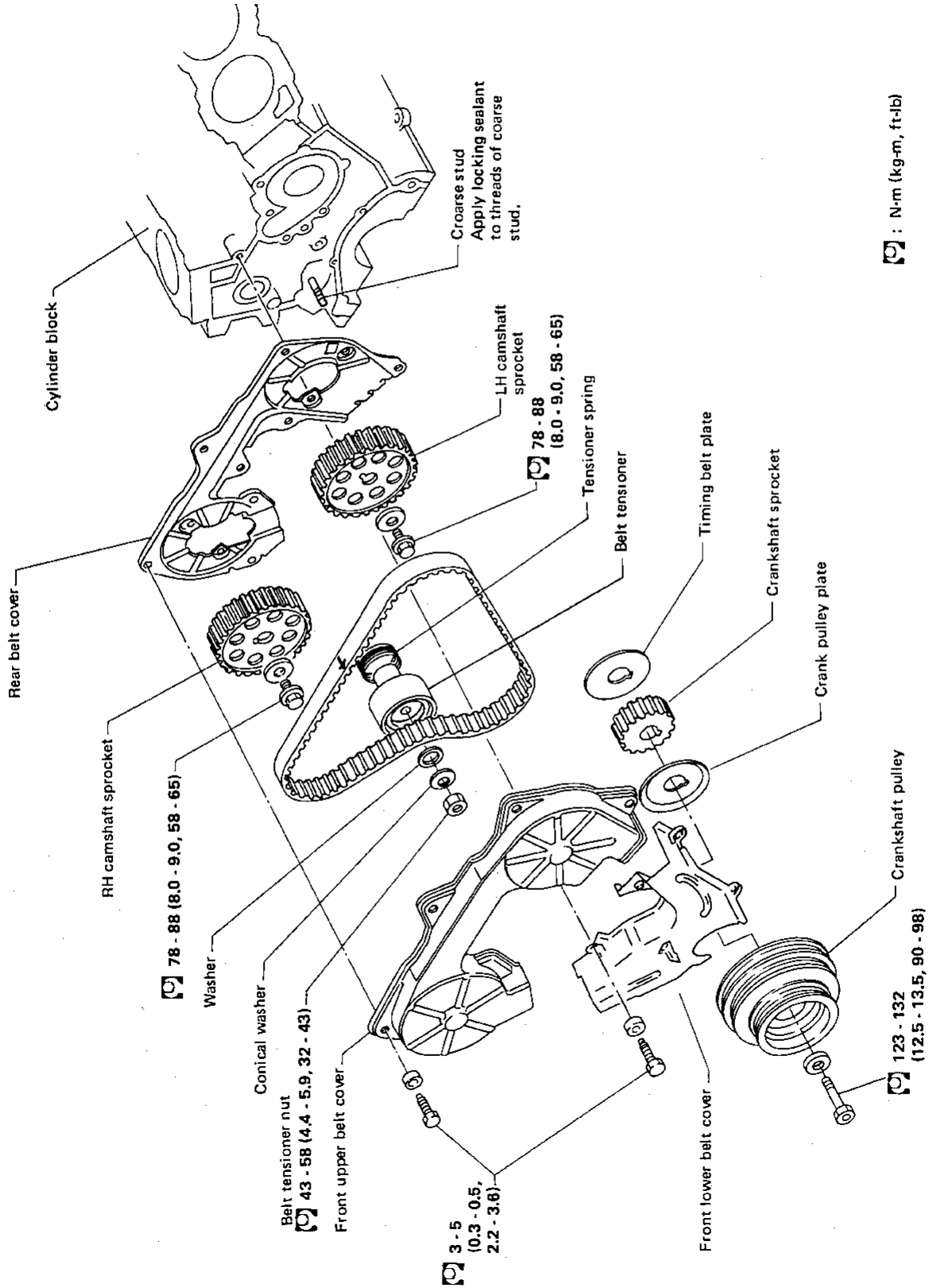
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TIMING BELT

CAUTION:

- Do not bend or twist timing belt.
- Make sure that timing belt, camshaft sprocket, crankshaft sprocket and belt tensioner are clean and free from oil and water.
- Installation should be carried out when engine is cold.



TIMING BELT

Removal

1. Jack up the vehicle front and support with safety stand.
2. Remove engine under covers and drain engine coolant from radiator.
3. Remove front RH wheel and engine side cover.
4. Remove the following belts:
 - Generator drive belt
 - Power steering drive belt
 - Compressor drive belt

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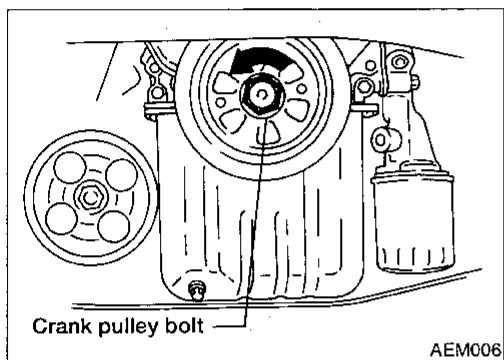
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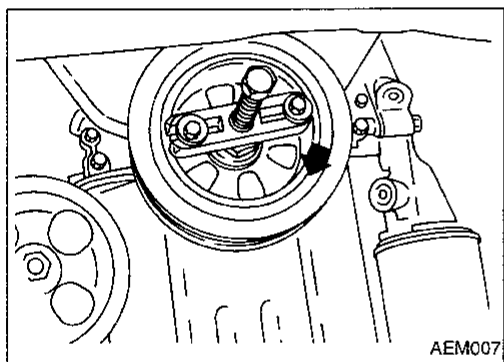
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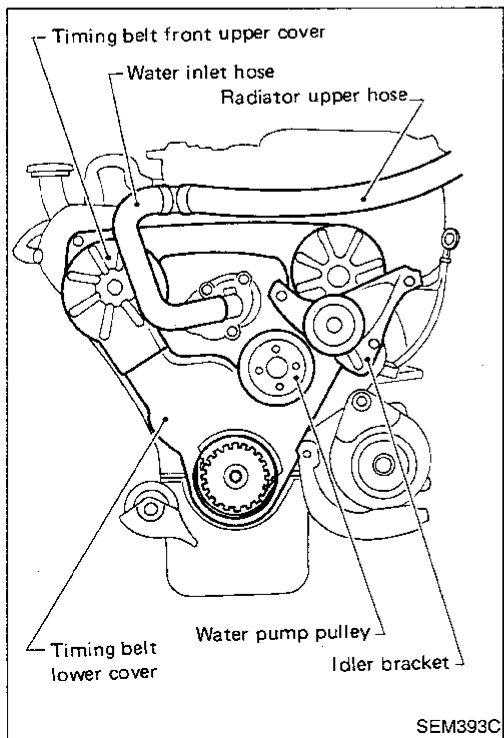
5. Loosen crankshaft pulley bolt.



6. Remove crank pulley with a suitable puller.

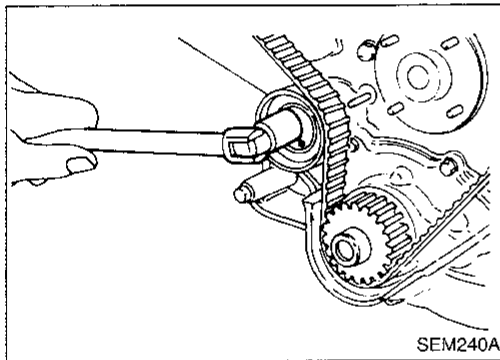
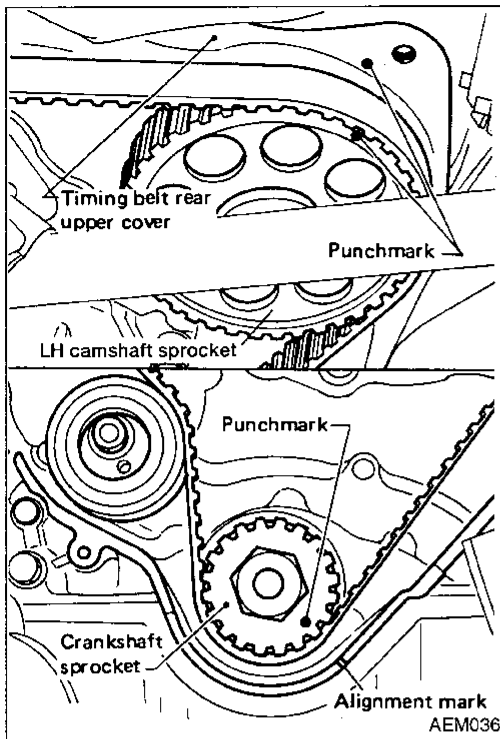


7. Remove radiator upper hose and water inlet hose.
8. Remove compressor drive belt idler bracket.
9. Remove water pump pulley.
10. Remove front upper and lower belt covers.



TIMING BELT

Removal (Cont'd)



11. Set No. 1 piston at TDC on its compression stroke by rotating crankshaft.

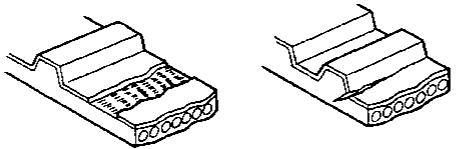
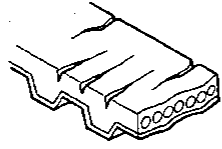
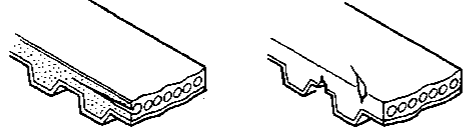
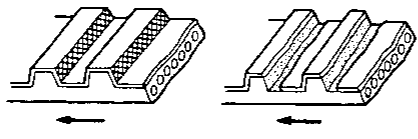
- Align punchmark on LH camshaft sprocket with punchmark on timing belt upper rear cover.
- Align punchmark on crankshaft sprocket with notch on oil pump housing.
- Temporarily install crank pulley bolt on crankshaft so that crankshaft can be rotated.

12. Loosen timing belt tensioner nut, turn tensioner, then remove timing belt.

TIMING BELT

Inspection

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

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

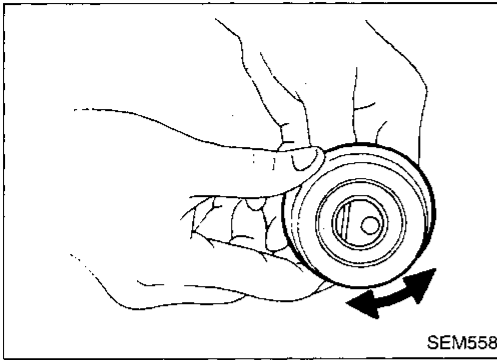
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TIMING BELT

Inspection (Cont'd)

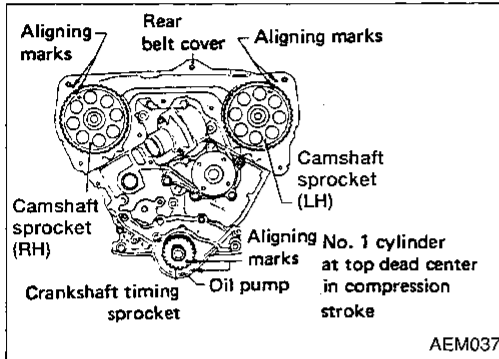
BELT TENSIONER AND TENSIONER SPRING

1. Check belt tensioner for smooth turning.
2. Check condition of tensioner spring.



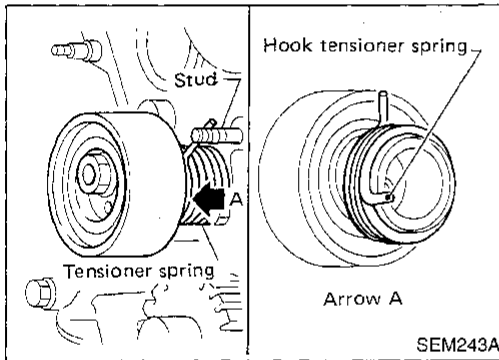
Installation

1. Confirm that No. 1 piston is set at TDC on its compression stroke.

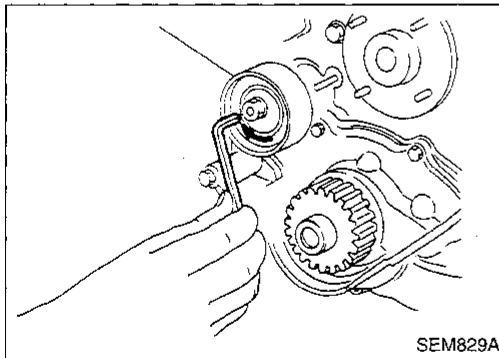


2. Install tensioner and tensioner spring.

If stud is once removed, apply locking sealant to threads before installing.



3. Turn tensioner fully outward with hexagon wrench, and temporarily tighten lock nut.

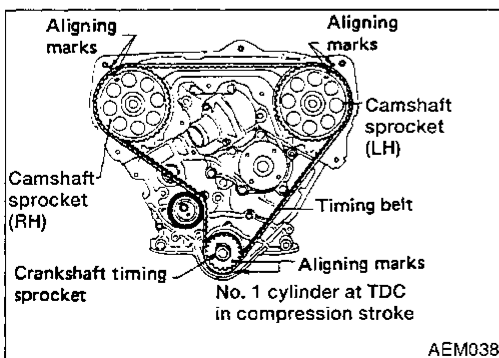


4. Set timing belt.

- (1) Align white lines on timing belt with punchmarks on camshaft sprockets and crankshaft sprocket.
- (2) Point arrow on timing belt toward front belt cover.

Number of teeth (reference):

Number of timing belt teeth	133	
Number of teeth between timing sprockets	Between LH and RH camshaft sprockets	40
	Between LH camshaft sprocket and crankshaft timing sprocket	43



TIMING BELT

Installation (Cont'd)

- Loosen tensioner lock nut, keeping tensioner steady with hexagon wrench.

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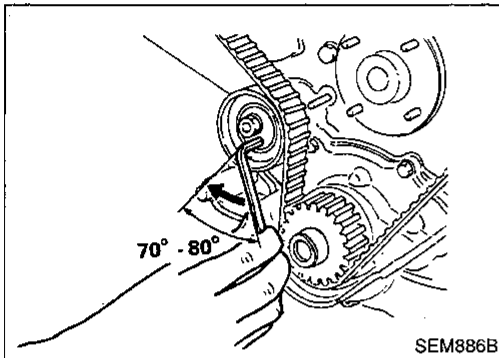
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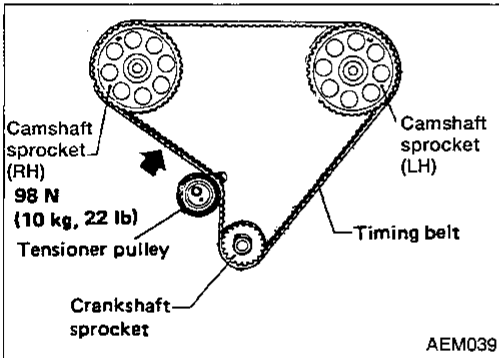
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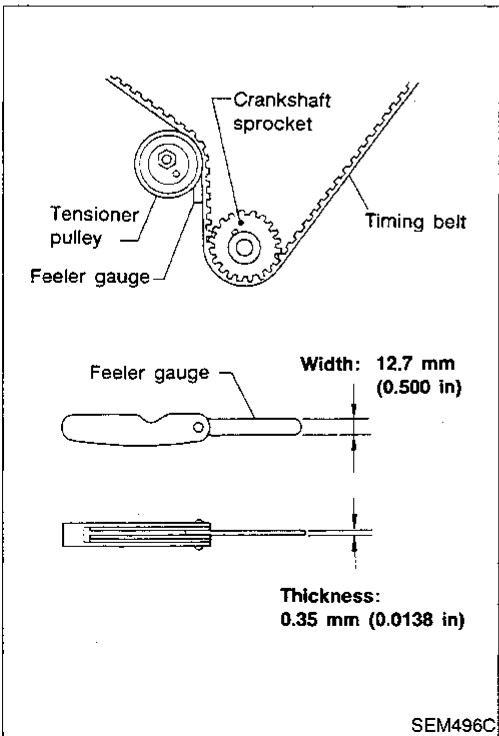
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- Turn tensioner 70 to 80 degrees clockwise with hexagon wrench, and temporarily tighten lock nut.
- Turn crankshaft clockwise at least 2 times, then slowly set No. 1 piston at TDC on its compression stroke.



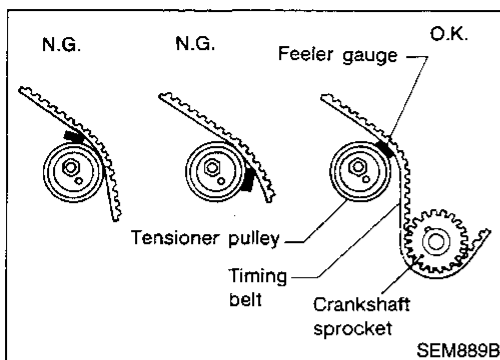
- Push middle of timing belt between RH camshaft sprocket and tensioner pulley with force of 98 N (10 kg, 22 lb).
- Loosen tensioner lock nut, keeping tensioner steady with hexagon wrench.



- Set feeler gauge as shown in figure which is 0.35 mm (0.0138 in) thick and 12.7 mm (0.500 in) wide.

TIMING BELT

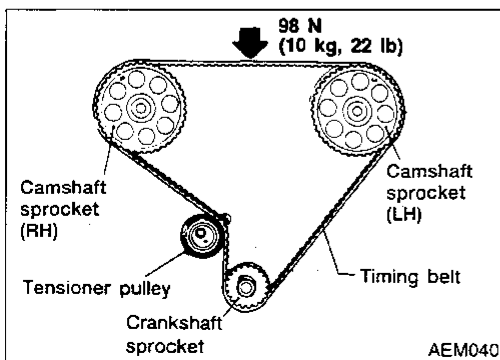
Installation (Cont'd)



11. Turn crankshaft clockwise, and set feeler gauge as shown in figure.
 - Timing belt will move about 2.5 teeth.
12. Tighten tensioner lock nut, keeping tensioner steady with hexagon wrench.
13. Turn crankshaft clockwise or counterclockwise, and remove feeler gauge.
14. Turn crankshaft clockwise at least 2 times, then slowly set No. 1 piston at TDC on its compression stroke.
15. Install lower and upper belt covers.

Tightened parts	Section	Parts tightened with bolts
Bolt A (6 pcs.) Rubber washer Belt cover front (lower)	①, ②, ③ ④, ⑤, ⑩	①, ②, ③, ④: Cylinder block ⑤, ⑩: Compressor bracket
Bolt B (1 pc.) Rubber washer Belt cover front (lower) Water pump mounting bolts	⑥	Water pump mounting bolt
Bolt C (4 pcs.) Belt cover (rear)	⑦, ⑧, ⑨ ⑩	Cylinder head
Bolt A (7 pcs.) Rubber washer Belt cover front (upper) Belt cover (rear) Welded nut (4 pcs.)	⑮, ⑯, ⑰ ⑱, ⑲, ⑲, ⑲ ⑳	⑮, ⑯, ⑰, ⑱: Welded nuts ⑲, ⑲: Cylinder head ⑳: Water outlet

Belt cover front (upper) ⑮ ⑧ ⑰
Belt cover (rear) ⑱
Belt cover front (lower) ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ⑰ ⑱
SEM248A



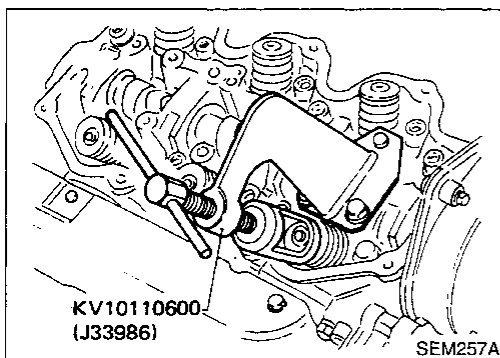
BELT TENSION CHECK

1. Set No. 1 piston at TDC on its compression stroke.
2. Measure deflection of timing belt midway between camshaft sprockets when pushing with 10 kg force.

Belt deflection (Reference value):

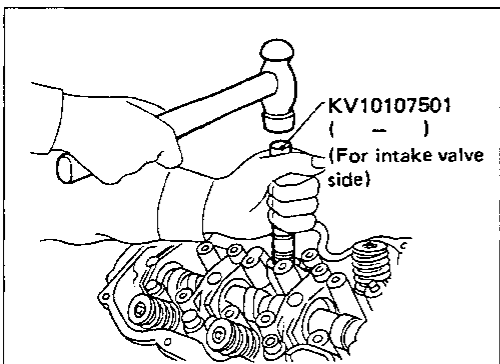
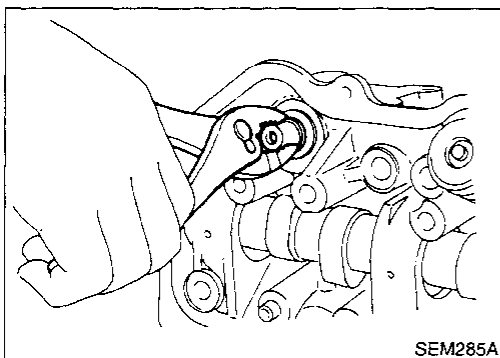
13 - 15 mm (0.51 - 0.59 in)/98 N (10 kg, 22 lb)

OIL SEAL REPLACEMENT

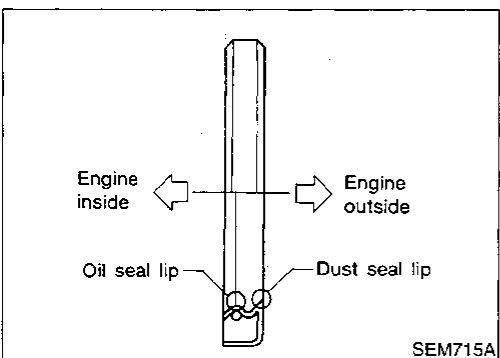
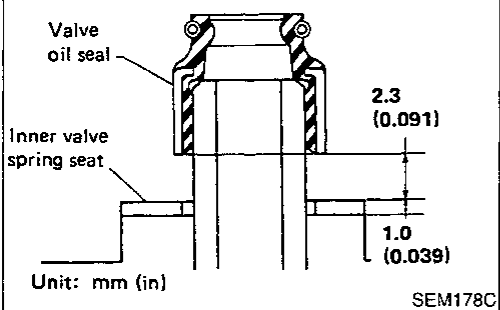


VALVE OIL SEAL

1. Remove rocker cover.
2. Remove rocker shaft assembly and valve lifters with valve lifter guide.
3. Remove valve springs and valve oil seal.
 - Piston concerned should be set at TDC to prevent valve from falling.
 - When removing intake side valve oil seal, use Tool or suitable tool.
- When removing exhaust side valve oil seal, pull it out with suitable tool.

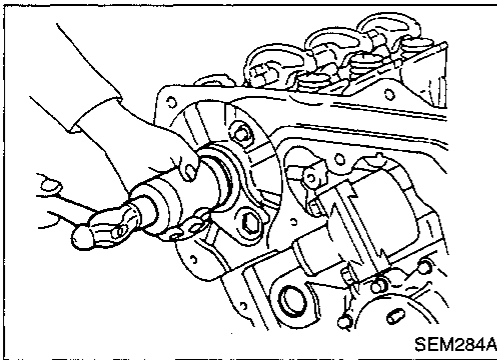


4. Apply engine oil to new valve oil seal and install.
 - Before installing valve oil seal, install inner valve spring seat.
 - When installing intake side valve oil seal, use Tool.
 - When installing exhaust side valve oil seal, set it by hand.



OIL SEAL INSTALLING DIRECTION

OIL SEAL REPLACEMENT

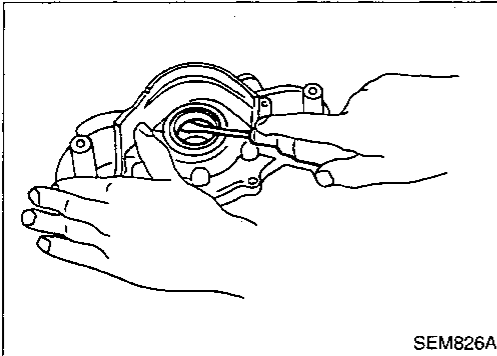


CAMSHAFT OIL SEAL

1. Remove timing belt.
2. Remove camshaft sprocket.
3. Remove camshaft oil seal.

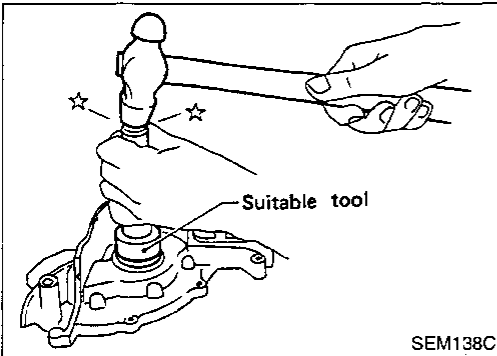
Be careful not to scratch camshaft.

4. Apply engine oil to new camshaft oil seal.

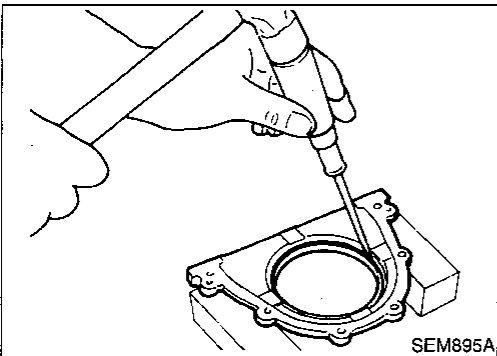


FRONT OIL SEAL

1. Remove timing belt and crankshaft sprocket.
2. Remove oil pump assembly.
3. Remove front oil seal from oil pump body.

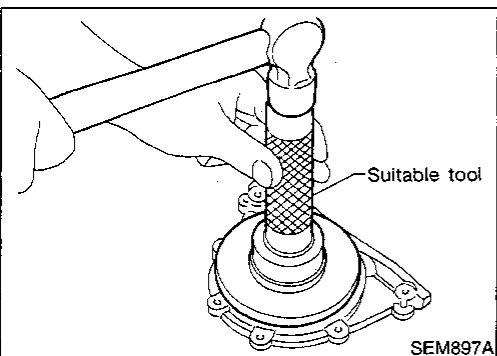


4. Apply engine oil to new oil seal and install it using suitable tool.



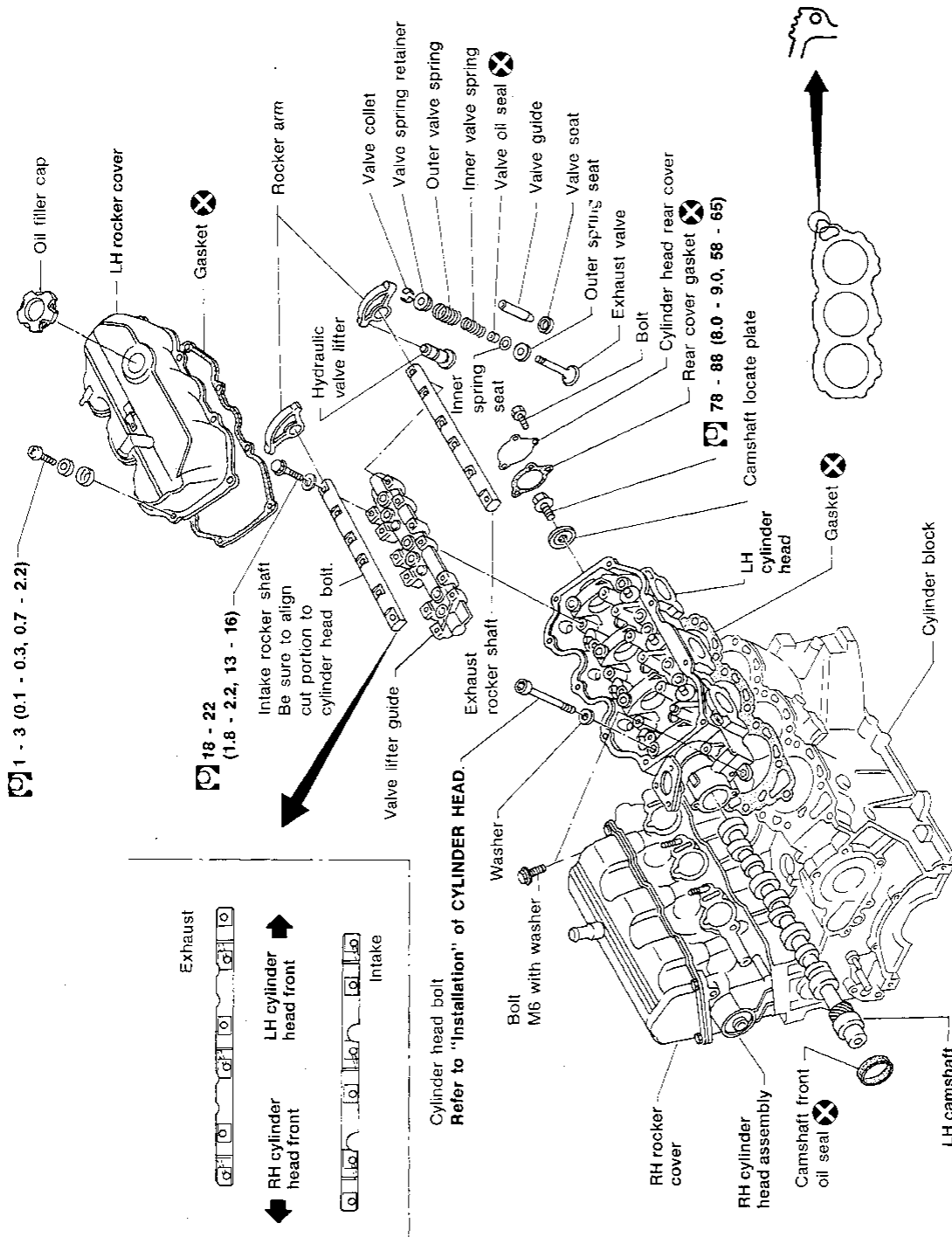
REAR OIL SEAL

1. Remove flywheel or drive plate.
2. Remove rear oil seal retainer.
3. Remove rear oil seal from retainer.



4. Apply engine oil to new oil seal and install it using suitable tool.
5. Install rear oil seal retainer with a new gasket to cylinder block.

CYLINDER HEAD



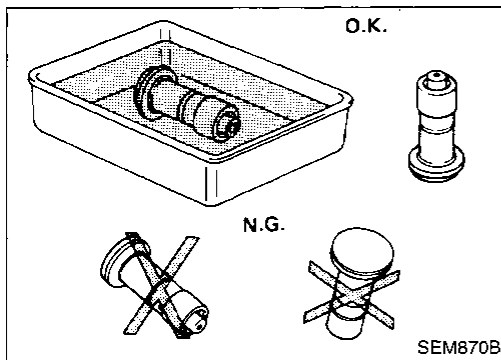
N•m (kg-m, ft-lb)

- GI
- NA
- EM**
- LC
- EE & EC
- FE
- AT
- FA
- PA
- BR
- ST
- BF
- HA
- EL
- IDX

CYLINDER HEAD

CAUTION:

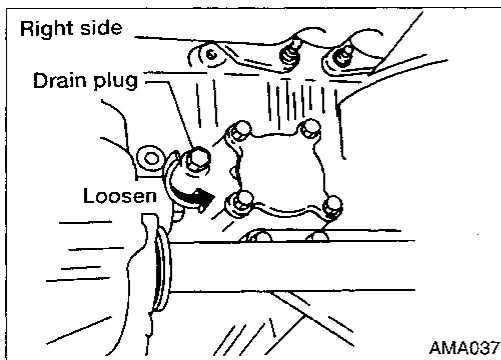
- When installing sliding parts such as rocker arms, camshaft and oil seal, be sure to apply new engine oil on their sliding surfaces.
- When tightening cylinder head bolts and rocker shaft bolts, apply new engine oil to thread portions and seat surfaces of bolts.



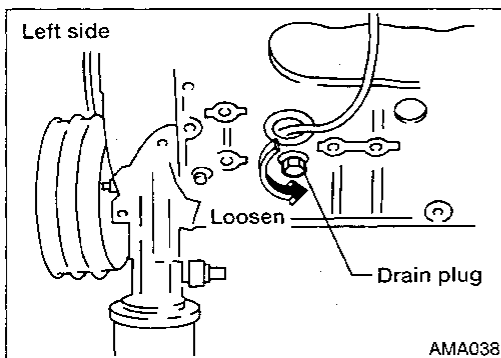
- If hydraulic valve lifter is kept on its side, there is a risk of air entering it. After removal, always set hydraulic valve lifter straight up, or when laying it on its side, have it soak in new engine oil.
- Do not disassemble hydraulic valve lifter.
- Attach tags to valve lifters so as not to mix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

Removal

1. Release fuel pressure.
Refer to EF & EC section ("Releasing Fuel Pressure", "MULTIPOINT FUEL INJECTION (MFI) CONTROL SYSTEM INSPECTION").
2. Remove timing belt.
Refer to EM-13.



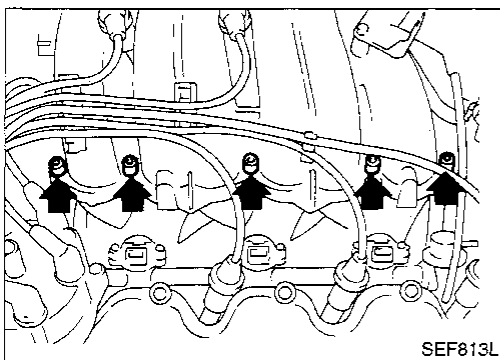
3. Drain coolant by removing drain plugs from both sides of cylinder block.



CYLINDER HEAD

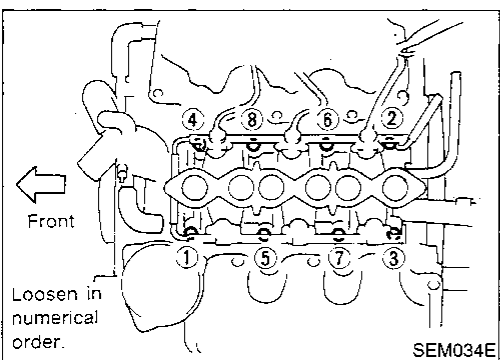
Removal (Cont'd)

4. Separate ASCD and accelerator control wire from intake manifold collector.



5. Remove intake manifold collector from engine. The following parts should be disconnected or removed:

- (1) Harness connectors for:
 - IAC valve-AAC valve
 - IAC valve-FICD solenoid valve
 - Closed throttle position switch
 - Throttle position sensor
 - IAC valve-air regulator
 - EGR control-solenoid valve
 - EGR temperature sensor
 - Main harness connectors and brackets
- (2) Spark plug wires
- (3) Distributor dust cover
- (4) Distributor cap
- (5) PCV hoses
- (6) Vacuum hoses for
 - Master brake cylinder
 - Fuel pressure regulator
 - Carbon canister
 - Rear heater valve (if equipped)
- (7) Air hoses from
 - Air duct
- (8) Water hoses for
 - Throttle body
 - Water tube
- (9) Carbon canister purge hose
- (10) BPT tube (to EGR valve)
- (11) EGR tube



6. Remove intake manifold. The following parts should be disconnected or removed:
 - Fuel feed and return hoses
 - All fuel injector harness connectors
 - Fuel tube assembly
 - Upper radiator hose and bracket
 - Bypass hose
 - Engine coolant temperature sensor harness connector
 - Thermal transmitter

GI

NA

EM

LC

EF &
EC

FE

AT

FA

RA

BR

ST

BF

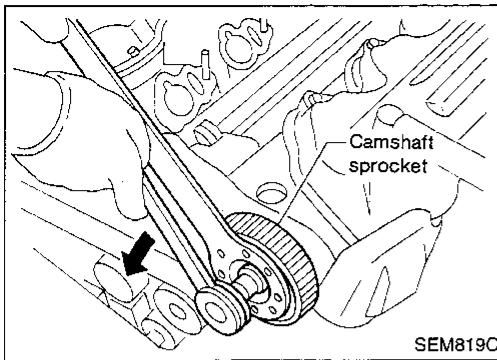
HA

EL

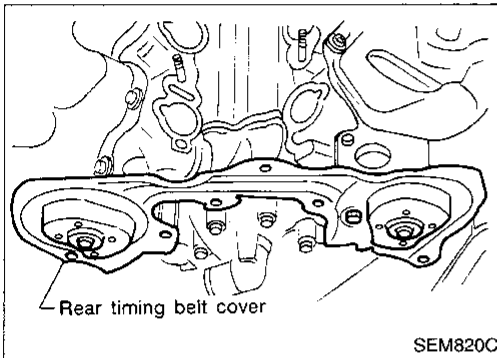
IDX

CYLINDER HEAD

Removal (Cont'd)

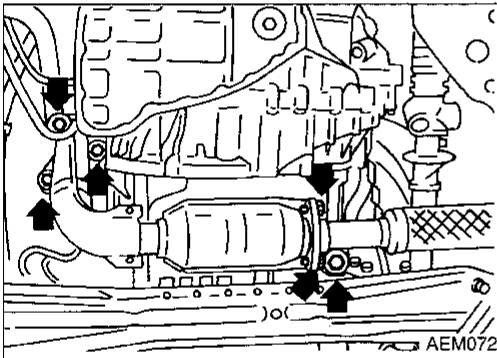


7. Remove both camshaft sprockets.

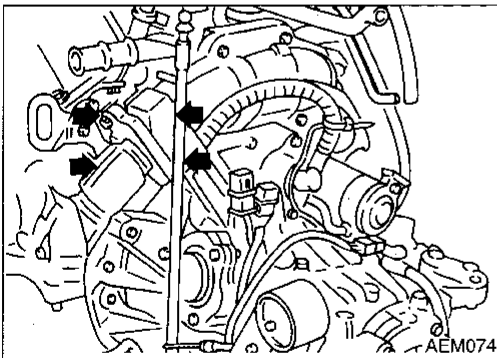


8. Remove rear timing belt cover.
9. Remove distributor and ignition wires.

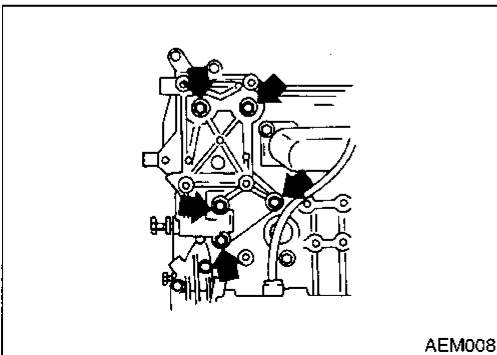
After pulling out distributor from cylinder head, do not rotate distributor rotor.



10. Remove exhaust tube from LH exhaust manifold.



11. Remove the nuts and bolt and separate the LH exhaust manifold from the RH exhaust manifold.
12. Remove the LH exhaust manifold-to-support bracket bolt.

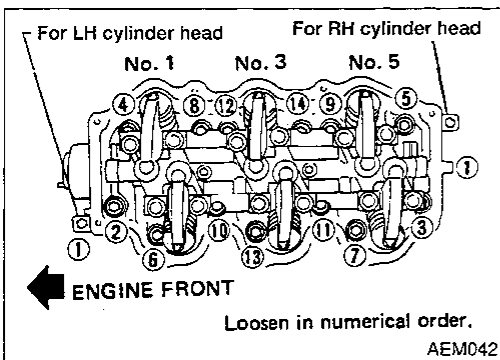
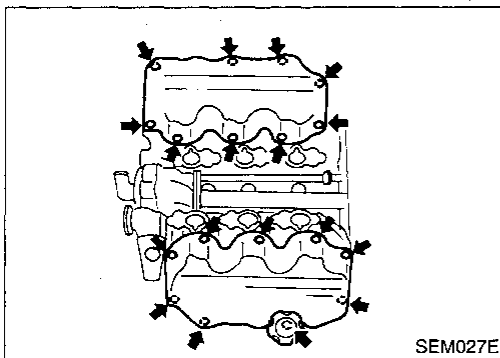


13. Remove compressor from bracket.
14. Remove compressor bracket.
15. Disconnect high pressure switch and magnetic clutch connectors.

CYLINDER HEAD

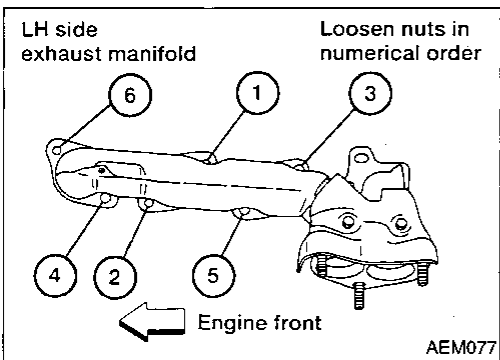
Removal (Cont'd)

16. Remove both rocker covers.



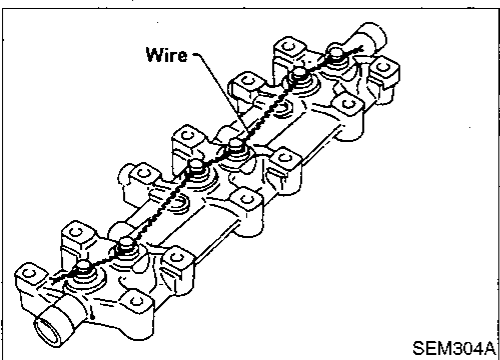
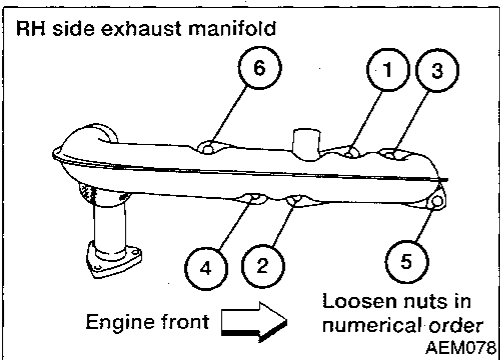
17. Remove cylinder head with exhaust manifold.

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



Disassembly

1. Remove exhaust manifolds from cylinder head.



2. Remove rocker shafts with rocker arms.

Bolts should be loosened in two or three steps.

3. Remove hydraulic valve lifters and lifter guide.

- Hold hydraulic valve lifters with wire so that they will not drop from lifter guide.

GI

MA

EM

LC

EF &

EC

FE

AT

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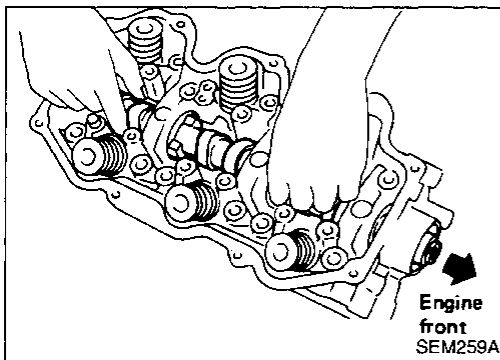
HA

EL

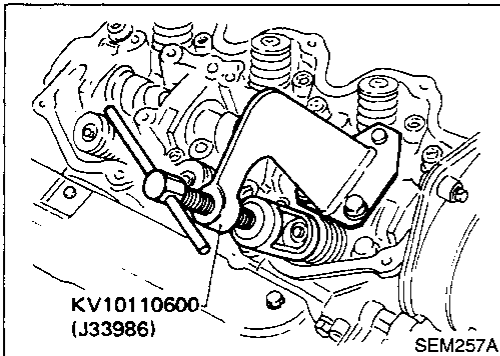
IDX

CYLINDER HEAD

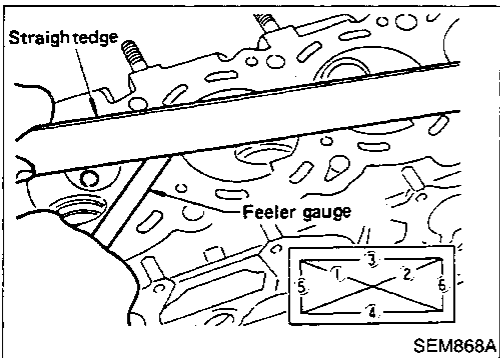
Disassembly (Cont'd)



4. Remove oil seal and camshaft.
 - Before removing camshaft, measure camshaft end play.



5. Remove valve components with Tool.
6. Remove valve oil seals with Tool or suitable tool.



Inspection

CYLINDER HEAD DISTORTION

Head surface flatness:

Less than 0.1 mm (0.004 in)

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

Resurfacing limit:

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

Amount of cylinder head resurfacing is "A".

Amount of cylinder block resurfacing is "B".

The maximum limit is as follows:

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

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

Nominal cylinder head height:

106.8 - 107.2 mm (4.205 - 4.220 in)

CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.

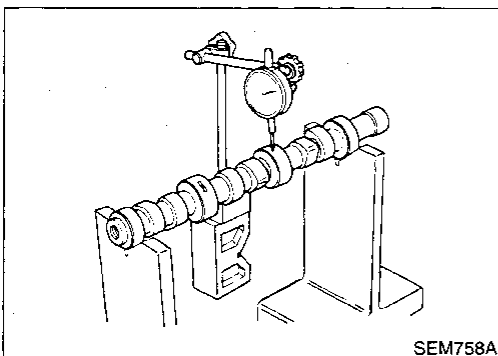
CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.

Runout (Total indicator reading):

Limit 0.1 mm (0.004 in)

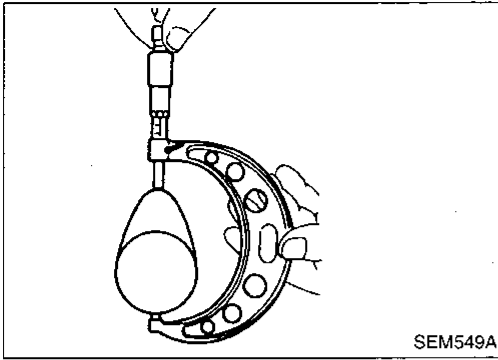
2. If it exceeds the limit, replace camshaft.



CYLINDER HEAD

Inspection (Cont'd)

CAMSHAFT CAM HEIGHT



1. Measure camshaft cam height.

Standard cam height:

38.942 - 39.132 mm (1.5331 - 1.5406 in)

Cam wear limit:

0.15 mm (0.0059 in)

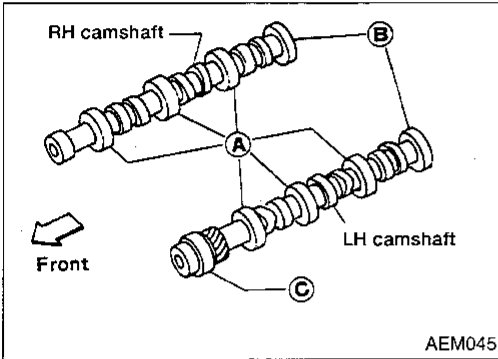
2. If wear is beyond the limit, replace camshaft.

GI

MA

EM

CAMSHAFT JOURNAL CLEARANCE



LC

EF &

EC

FE

AT

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BF

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EL

IDX

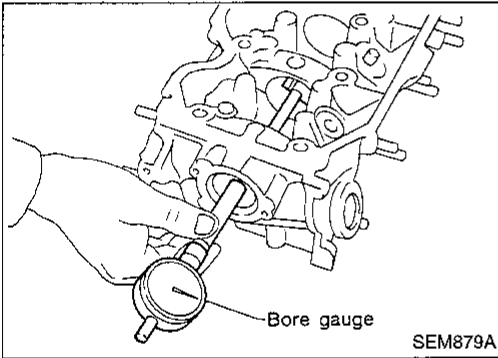
1. Measure inner diameter of camshaft bearing.

Standard inner diameter:

A 47.000 - 47.025 mm (1.8504 - 1.8514 in)

B 42.500 - 42.525 mm (1.6732 - 1.6742 in)

C 48.000 - 48.025 mm (1.8898 - 1.8907 in)



2. Measure outer diameter of camshaft journal.

Standard outer diameter:

A 46.920 - 46.940 mm (1.8472 - 1.8480 in)

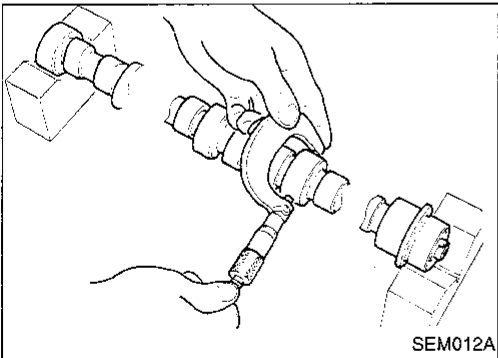
B 42.420 - 42.440 mm (1.6701 - 1.6709 in)

C 47.920 - 47.940 mm (1.8866 - 1.8874 in)

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

Camshaft journal clearance limit:

0.15 mm (0.0059 in)



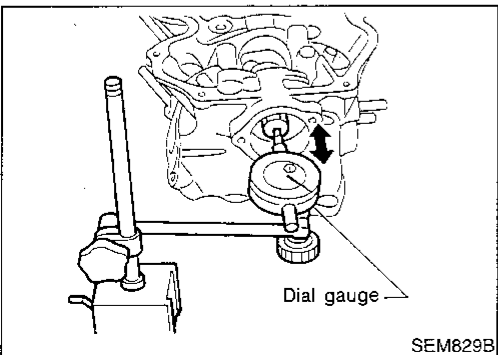
CAMSHAFT END PLAY

1. Install camshaft and locate plate in cylinder head.

2. Measure camshaft end play.

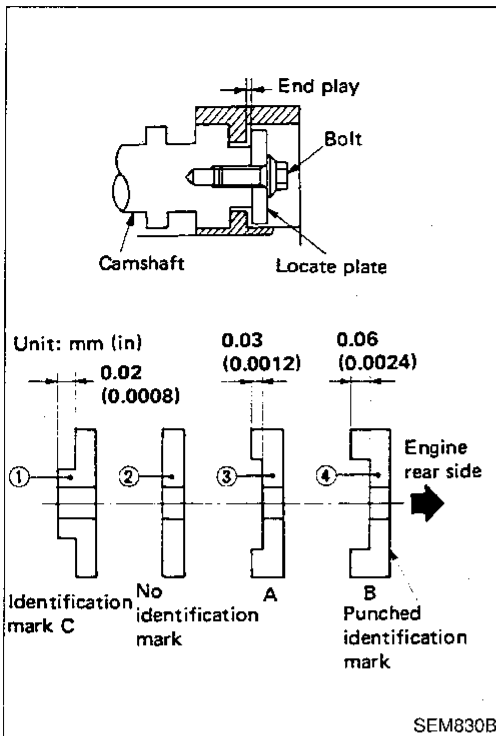
Camshaft end play:

Standard 0.03 - 0.06 mm (0.0012 - 0.0024 in)



CYLINDER HEAD

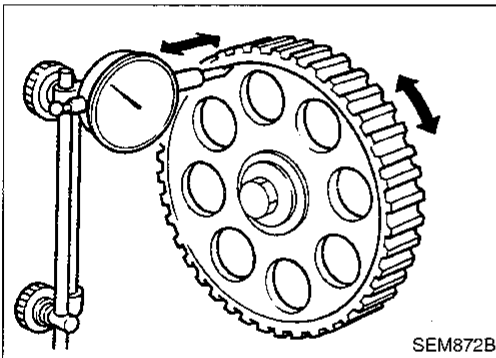
Inspection (Cont'd)



3. If it is out of the specified range, select thickness of camshaft locate plate to obtain standard specified end play.

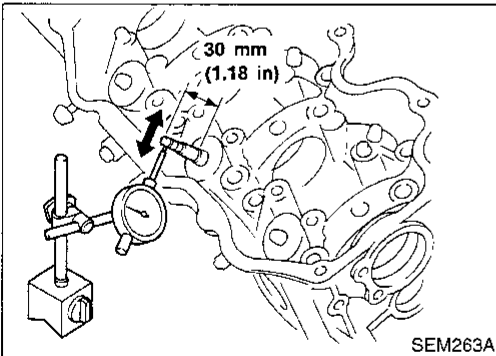
Example:

When camshaft end play is 0.08 mm (0.0031 in) with camshaft locating plate ②, replace camshaft locating plate ② with camshaft locating plate ③ to set the end play at 0.05 mm (0.0020 in).



CAMSHAFT SPROCKET RUNOUT

1. Install sprocket on camshaft.
2. Measure camshaft sprocket runout.
Runout (Total indicator reading):
Limit 0.1 mm (0.004 in)
3. If it exceeds the limit, replace camshaft sprocket.



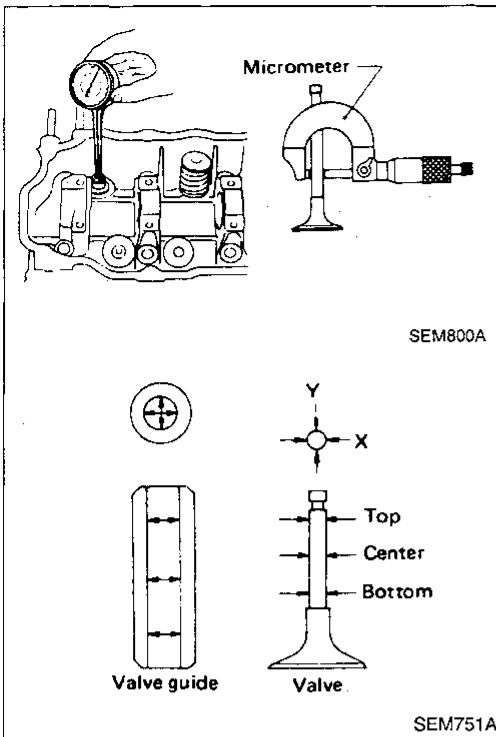
VALVE GUIDE CLEARANCE

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

Valve deflection limit (Dial gauge reading):
0.20 mm (0.0079 in)

CYLINDER HEAD

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:

Intake

0.020 - 0.053 mm (0.0008 - 0.0021 in)

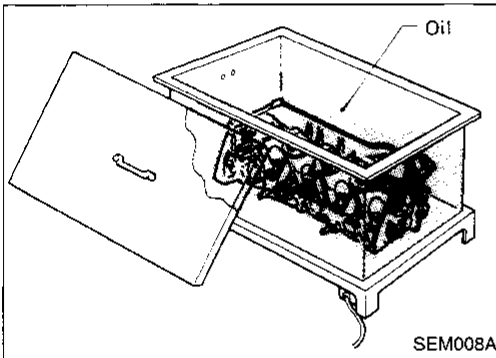
Exhaust

0.040 - 0.073 mm (0.0016 - 0.0029 in)

Limit

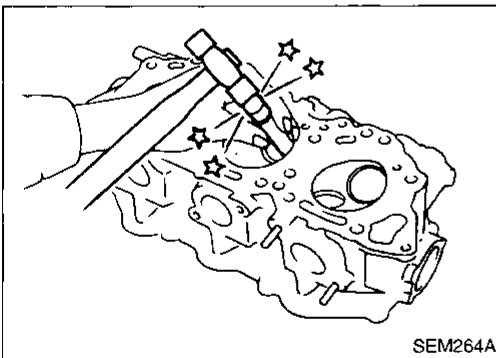
0.10 mm (0.0039 in)

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

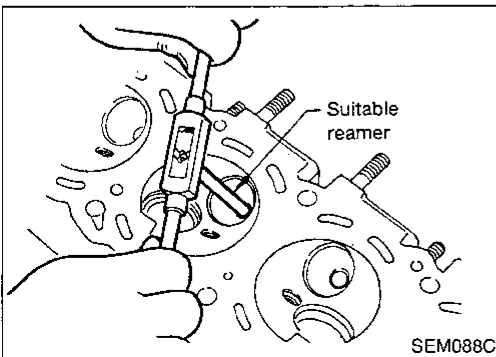


VALVE GUIDE REPLACEMENT

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



2. Drive out valve guide with a press [under a 20 kN (2 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

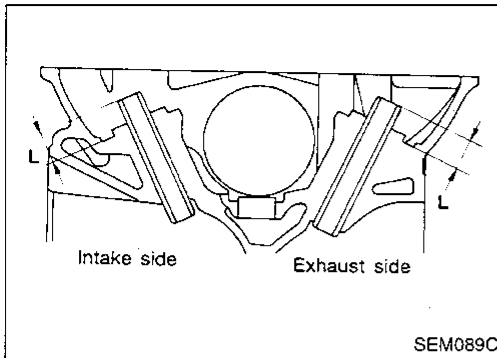
11.175 - 11.196 mm (0.4400 - 0.4408 in)

Exhaust

12.175 - 12.196 mm (0.4793 - 0.4802 in)

CYLINDER HEAD

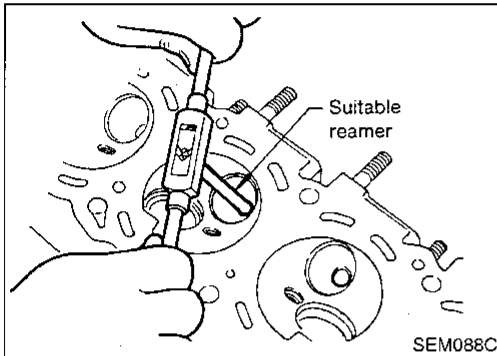
Inspection (Cont'd)



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

Projection "L":

13.2 - 13.4 mm (0.520 - 0.528 in)



5. Ream valve guide.

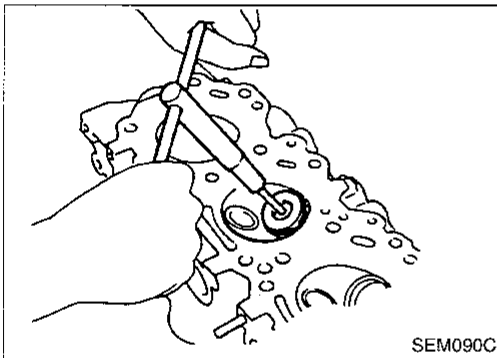
Finished size:

Intake

7.000 - 7.018 mm (0.2756 - 0.2763 in)

Exhaust

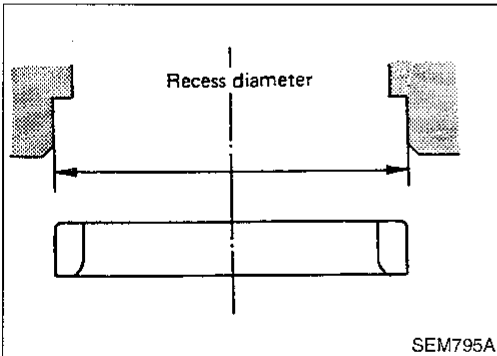
8.000 - 8.018 mm (0.3150 - 0.3157 in)



VALVE SEATS

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

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

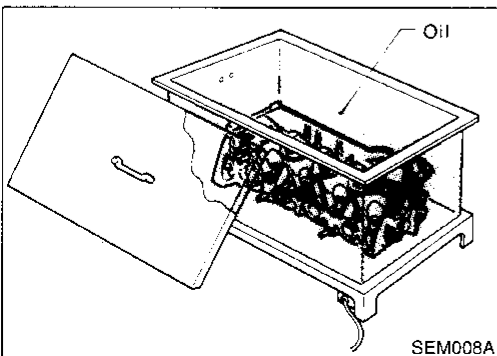
Reaming bore for service valve seat

Overize [0.5 mm (0.020 in)]:

Intake 44.500 - 44.516 mm (1.7520 - 1.7526 in)

Exhaust 37.500 - 37.516 mm (1.4764 - 1.4770 in)

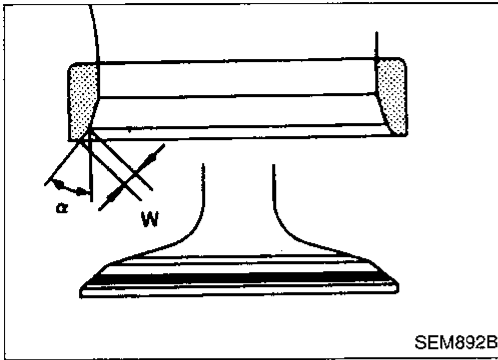
Reaming should be done in circles concentric to the valve guide center so that valve seat will have the correct fit.



3. Heat cylinder head to 150 to 160°C (302 to 320°F).
4. Press fit valve seat until it seats on the bottom.

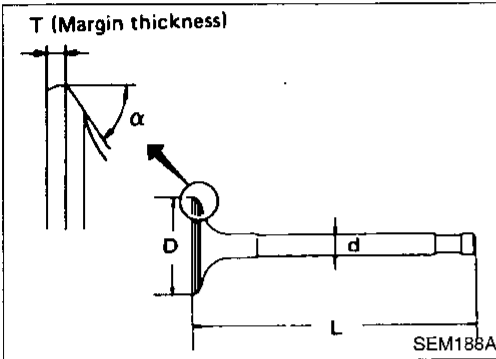
CYLINDER HEAD

Inspection (Cont'd)



5. Cut or grind valve seat using suitable tool at the specified dimensions as shown on EM-53.
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.

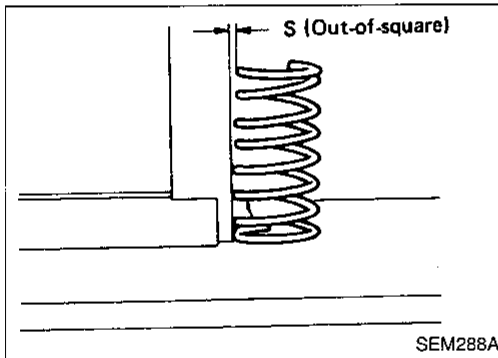
		Intake	Exhaust
Seat face angle "α"	degree	45	45
Contacting width "W"	mm (in)	1.75 (0.0689)	1.7 (0.067)



VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to EM-52. When valve head has been worn down to 0.5 mm (0.020 in) in margin thickness, replace valve.

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



VALVE SPRING

Squareness

1. Measure "S" dimension.

Out-of-square:

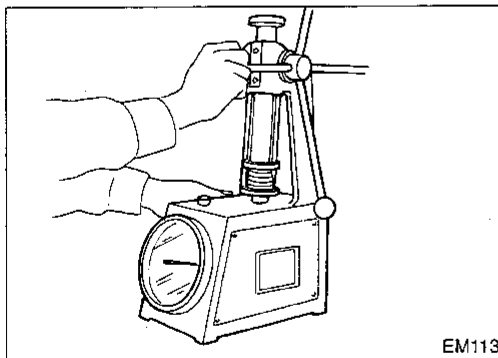
Outer

Less than 2.2 mm (0.087 in)

Inner

Less than 1.9 mm (0.075 in)

2. If it exceeds the limit, replace spring.



Pressure

Check valve spring pressure.

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

Standard

Outer 523.7 (53.4, 117.7) at 30.0 (1.181)

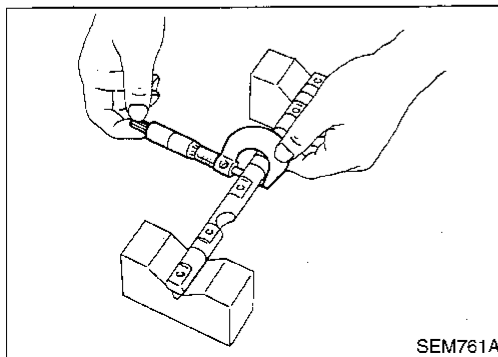
Inner 255.0 (26.0, 57.3) at 25.0 (0.984)

Limit

Outer More than 228.5 (23.3, 51.4) at 25.0 (0.984)

Inner More than 225.6 (23.0, 50.7) at 25.0 (0.984)

If it exceeds the limit, replace spring.



ROCKER SHAFT AND ROCKER ARM

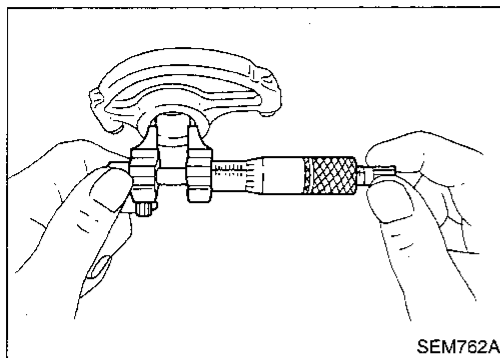
1. Check rocker shafts for scratches, seizure and wear.
2. Check outer diameter of rocker shaft.

Diameter:

17.979 - 18.000 mm (0.7078 - 0.7087 in)

CYLINDER HEAD

Inspection (Cont'd)



3. Check inner diameter of rocker arm.

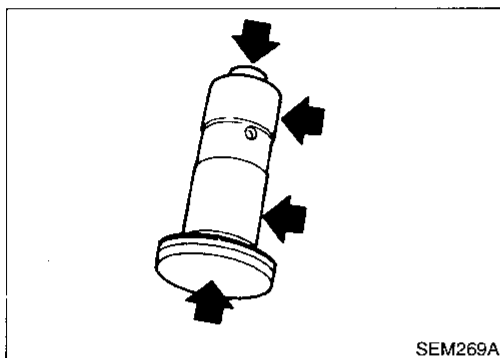
Diameter:

18.007 - 18.028 mm (0.7089 - 0.7098 in)

Rocker arm to shaft clearance:

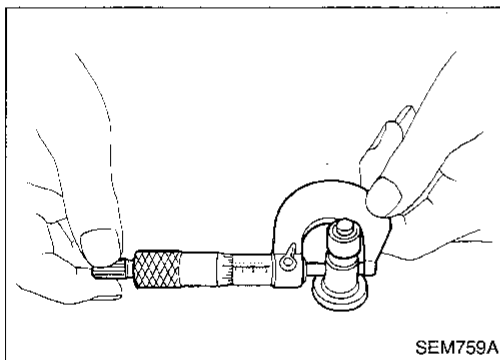
0.007 - 0.049 mm (0.0003 - 0.0019 in)

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



HYDRAULIC VALVE LIFTER

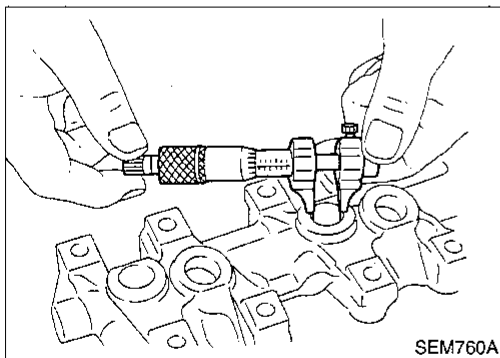
1. Check contact and sliding surfaces for wear or scratches.



2. Check diameter of valve lifter.

Outer diameter:

15.947 - 15.957 mm (0.6278 - 0.6282 in)



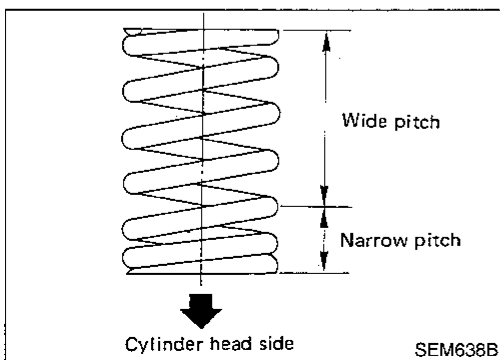
3. Check valve lifter guide inner diameter.

Inner diameter:

16.000 - 16.013 mm (0.6299 - 0.6304 in)

Standard clearance between valve lifter and lifter guide:

0.043 - 0.066 mm (0.0017 - 0.0026 in)



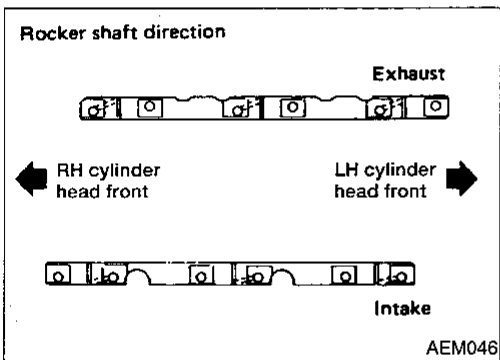
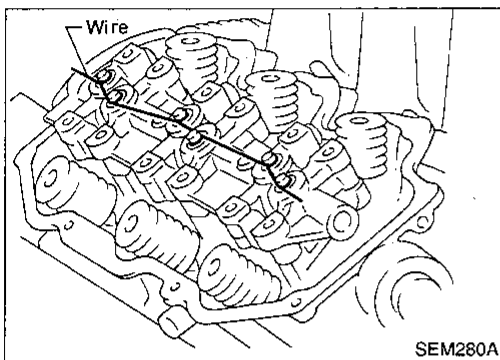
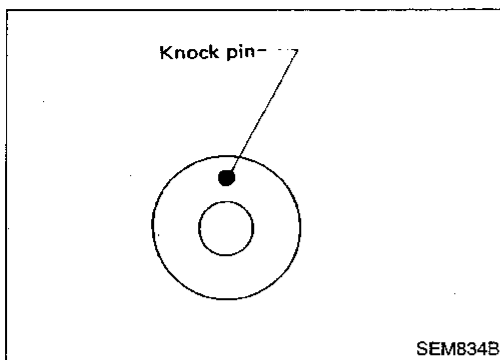
Assembly

1. Install valve component parts.

- Always use new valve oil seal. Refer to EM-19.
- Before installing valve oil seal, install inner valve spring seat.
- Install outer valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side.
- After installing valve component parts, use plastic hammer to lightly tap valve stem tip to assure a proper fit.

CYLINDER HEAD

Assembly (Cont'd)



2. Install camshafts, locate plates and cylinder head rear covers.

- Set knock pin of camshaft at the top.

3. Install valve lifters into valve lifter guide.

- Assemble valve lifters to their original position and hold all valve lifters with wire to prevent lifters from falling off.
- After installing, remove the wire.

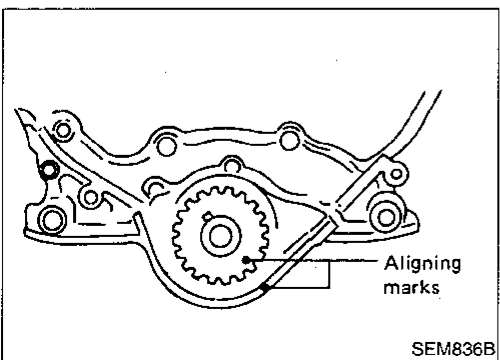
4. Install rocker shafts with rocker arms.

- Tighten bolts gradually in two or three stages.
- Before tightening, be sure to set camshaft the lobe at the position where lobe is not lifted.

a. Set No. 1 piston at TDC on its compression stroke and tighten rocker shaft bolts for No. 2, No. 4 and No. 6 cylinders.

b. Set No. 4 piston at TDC on its compression stroke and tighten rocker shaft bolts for No. 1, No. 3 and No. 5 cylinders.

5. Install exhaust manifold to cylinder head in reverse order of removal.



Installation

1. Set No. 1 piston at TDC on its compression stroke as follows:

- a. Align crankshaft sprocket aligning mark with mark on oil pump body.
- b. Confirm that knock pin on camshaft is set at the top.

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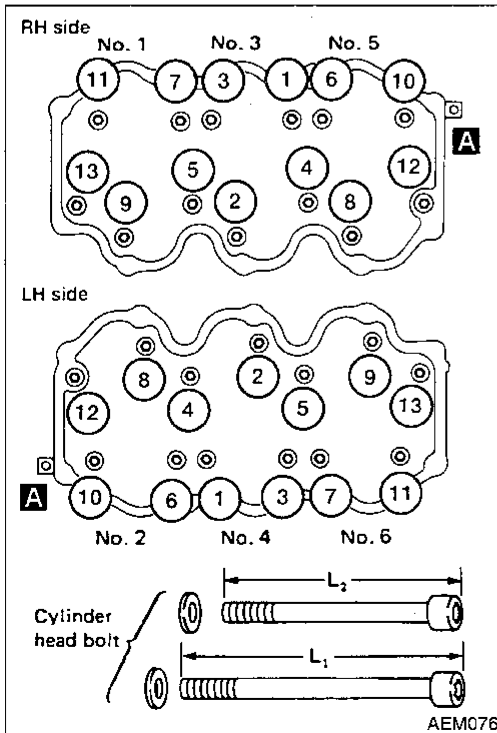
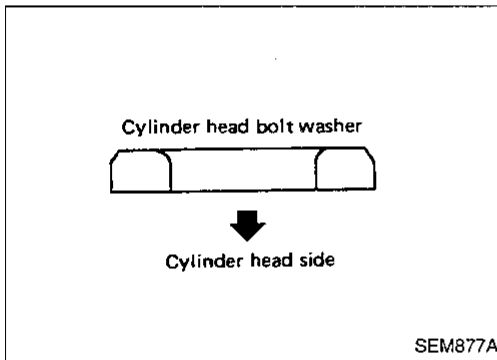
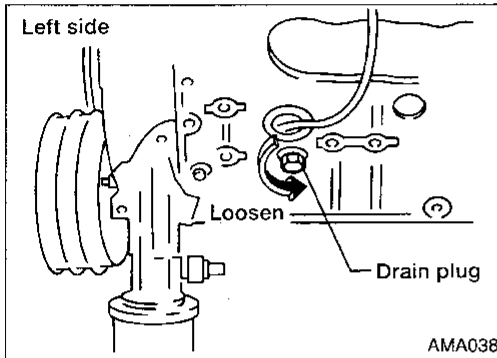
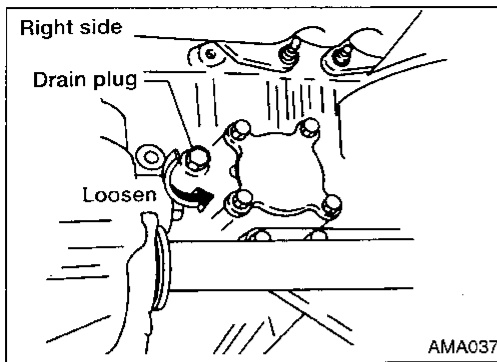
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CYLINDER HEAD

Installation (Cont'd)



2. Install both drain plugs.
 - Apply sealant to drain plug threads.
3. Install exhaust manifolds to cylinder head in reverse order of removal.

4. Install cylinder head with new gasket.
 - Be sure to install washers between bolts and cylinder head.

5. Tighten cylinder head bolts in numerical order using ST10120000 (J24239-01).

• **Tightening procedure:**

- (1) Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
- (2) Tighten all bolts to 59 N·m (6.0 kg-m, 43 ft-lb).
- (3) Loosen all bolts completely.
- (4) Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
- (5) Turn all bolts 60 to 65 degrees clockwise.

If an angle wrench is not available, tighten all bolts to 54 to 64 N·m (5.5 to 6.5 kg-m, 40 to 47 ft-lb).

- Bolts for ④, ⑤, ⑫ and ⑬ are longer than the others.

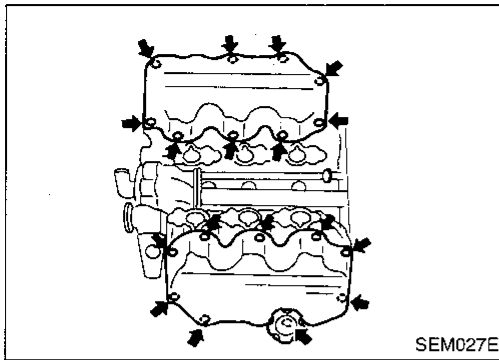
L₁: 127 mm (5.00 in) for ④, ⑤, ⑫ and ⑬

L₂: 106 mm (4.17 in) for others

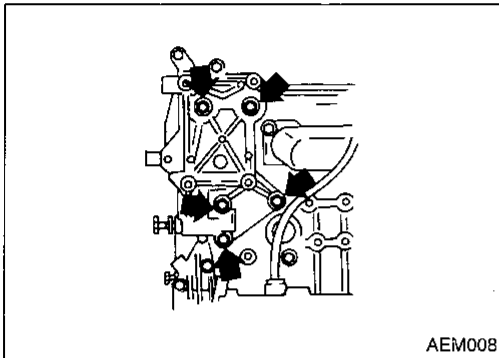
6. Tighten cylinder head bolt "A" to 8 N·m (0.8 kg-m, 5.9 ft-lb) using ST10120000 (J24239-01).

CYLINDER HEAD

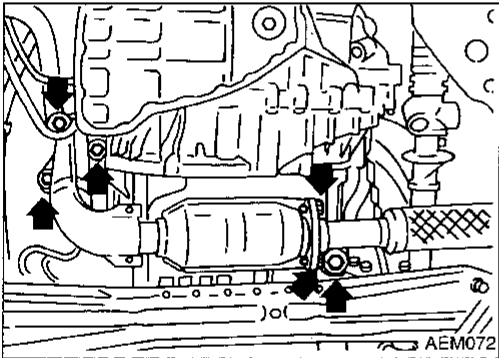
Installation (Cont'd)



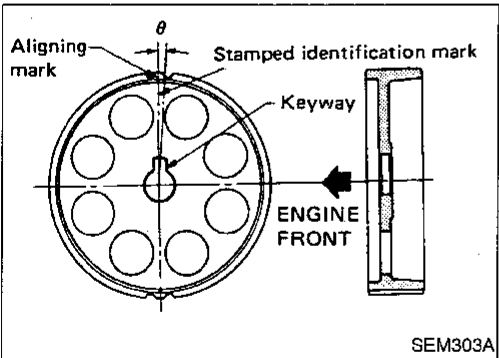
7. Install both rocker covers.



8. Install compressor bracket and compressor.



9. Install front exhaust tube to exhaust manifold.



10. Install rear belt cover and camshaft sprocket.

- **RH camshaft sprocket and LH camshaft sprocket are different parts. Be sure to install them in the correct location.**

	Identification mark	θ
RH camshaft sprocket	R3	0°53'
LH camshaft sprocket	L3	-3°27'

11. Install timing belt and adjust belt tension.
Refer to EM-16.

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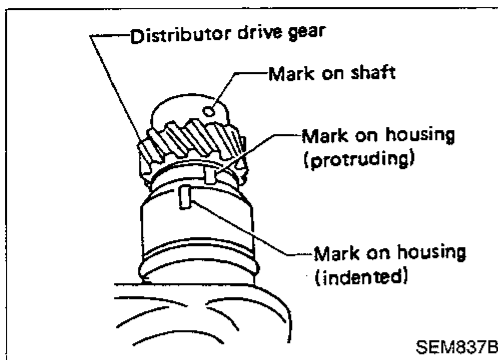
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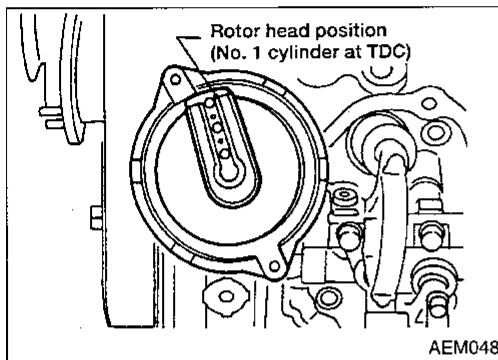
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CYLINDER HEAD

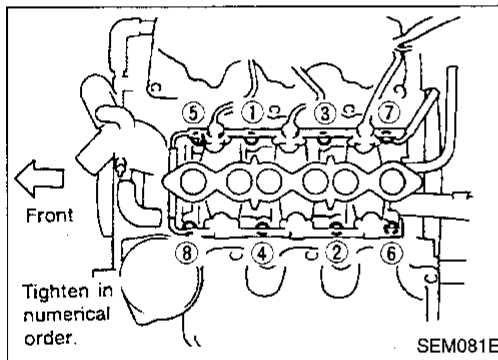
Installation (Cont'd)



12. Install distributor.
(1) Align mark on shaft with protruding mark on housing.



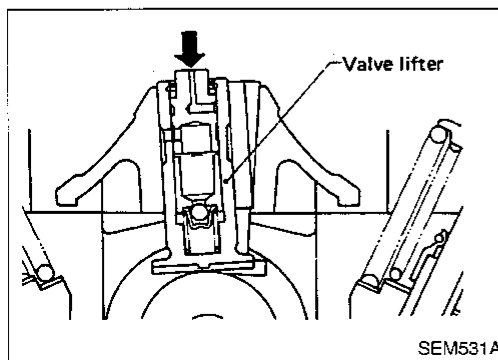
- (2) After installing, confirm that distributor rotor head is set as shown in figure.



13. Install intake manifold.
- **Tightening procedure**
STEP 1: Tighten bolts and nuts ① - ⑧ in that order
⌘: 3 - 5 N·m (0.3 - 0.5 kg-m, 2.2 - 3.6 ft-lb)
STEP 2: Tighten bolts and nuts in the specified order
⌘: bolts 16 - 20 N·m (1.6 - 2.0 kg-m, 12 - 14 ft-lb)
nuts 24 - 27 N·m (2.4 - 2.8 kg-m, 17 - 20 ft-lb)
STEP 3: Retighten bolts and nuts in the specified order
⌘: Same as those of step 2.

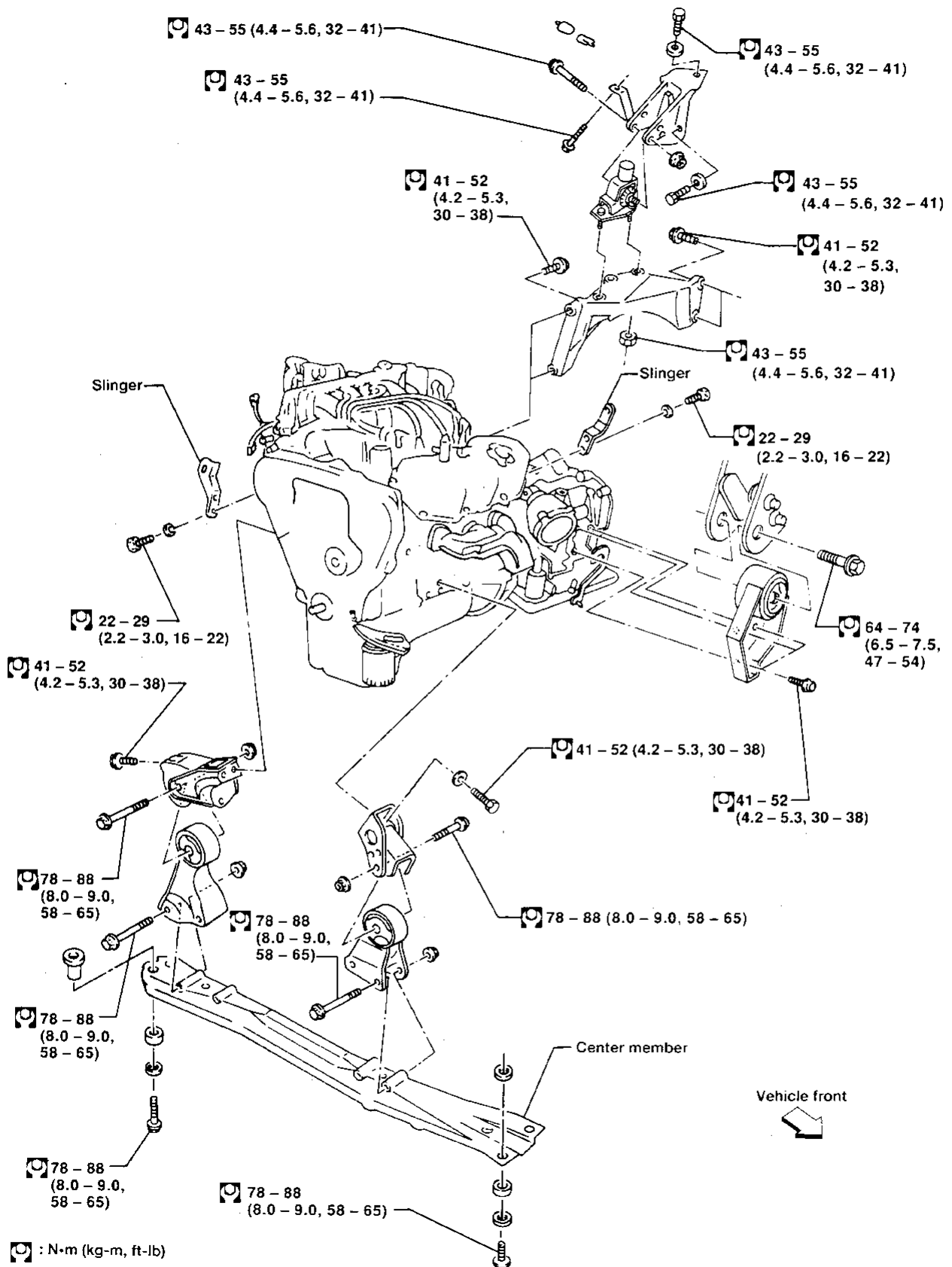
Install all parts which were removed in step 6 on EM-23.

14. Install intake manifold collector.
Install all parts which were removed in step 5 on EM-23.
15. Install ASCD and accelerator control wire.



16. Check hydraulic valve lifter.
- Push plunger forcefully with your finger.
- **Be sure to check it with rocker arm in its free position (not on the lobe).**
 - If valve lifter moves more than 1 mm (0.04 in), air may be inside it.
 - Bleed air off by running engine at 1,000 rpm under no load for about 10 minutes.
 - If hydraulic valve lifters are still noisy, replace them and bleed air off again in the same manner as in step 16 (c).

ENGINE REMOVAL



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ENGINE REMOVAL

WARNING:

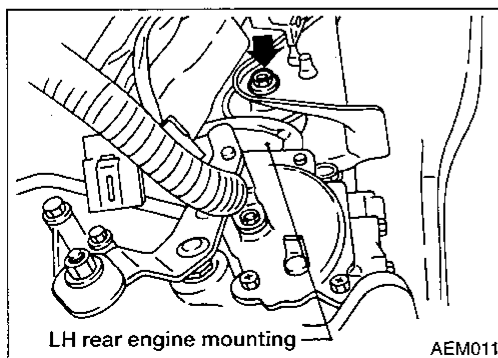
- a. Position vehicle on a flat and solid surface.
- b. Place chocks at front and back of rear wheels.
- c. Do not remove engine until exhaust system has completely cooled off.
Otherwise, you may burn yourself and/or fire may break out in fuel line.
- d. For safety during subsequent steps, the tension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

CAUTION:

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

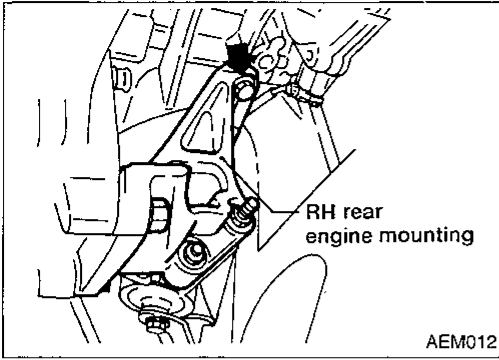
Removal

1. Remove front wheels, engine under covers and side cover.
2. Drain coolant from both cylinder block, and radiator.
3. Remove vacuum hoses, fuel hoses, wires, harnesses and connectors and so on.
4. Remove exhaust tube, ball joints and drive shafts.
5. Remove drive belts.
6. Remove generator, compressor and power steering oil pump from engine.
7. Set a powertrain lift under engine and transaxle.
8. Remove LH rear engine mounting bolts.

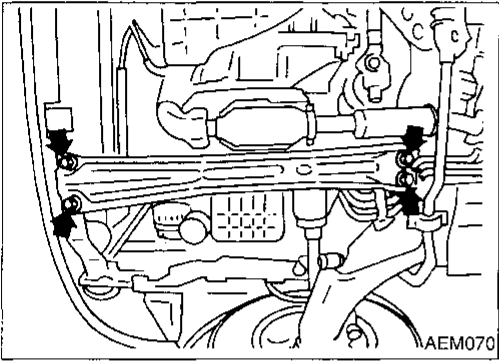


ENGINE REMOVAL

Removal (Cont'd)

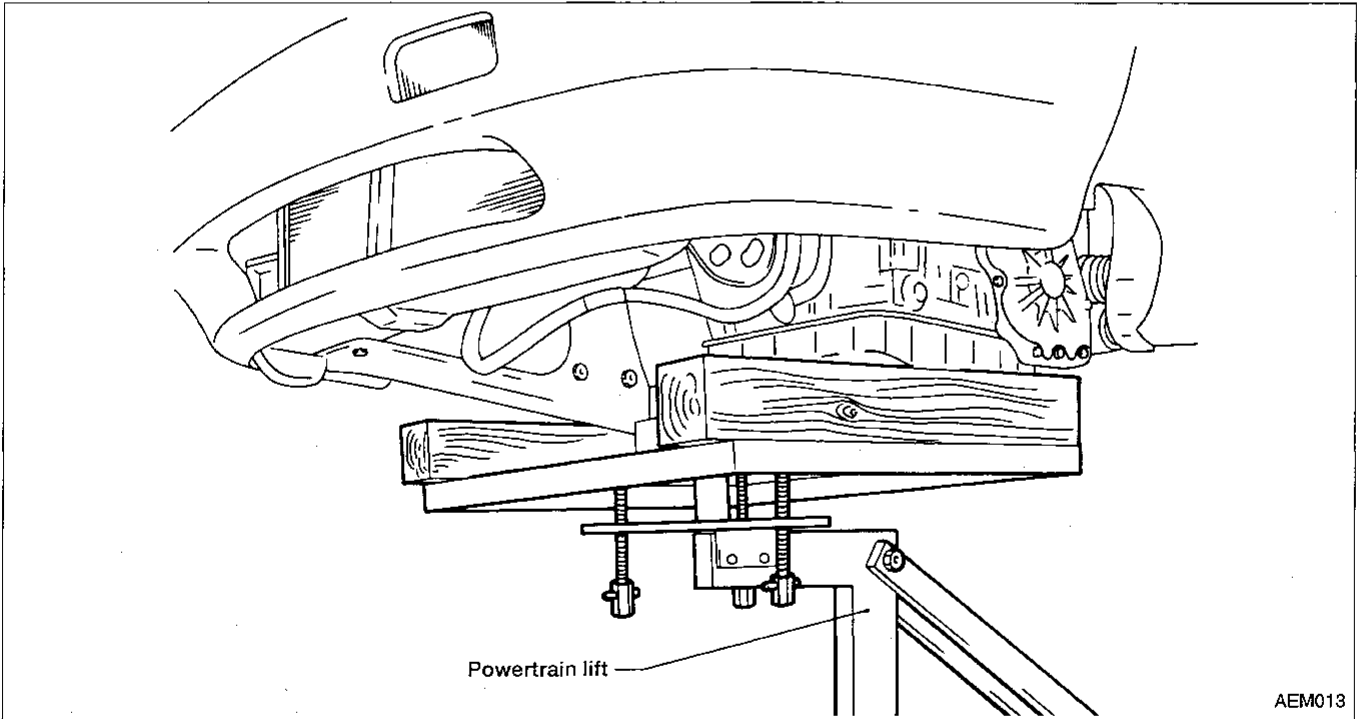


9. Remove RH rear engine mounting.
10. If equipped, remove the rear A/C refrigerant lines support bracket bolts.



11. Remove center member bolts and slowly lower powertrain lift.

12. Remove engine with transaxle as shown.



Installation

1. Installation is in the reverse order of removal.

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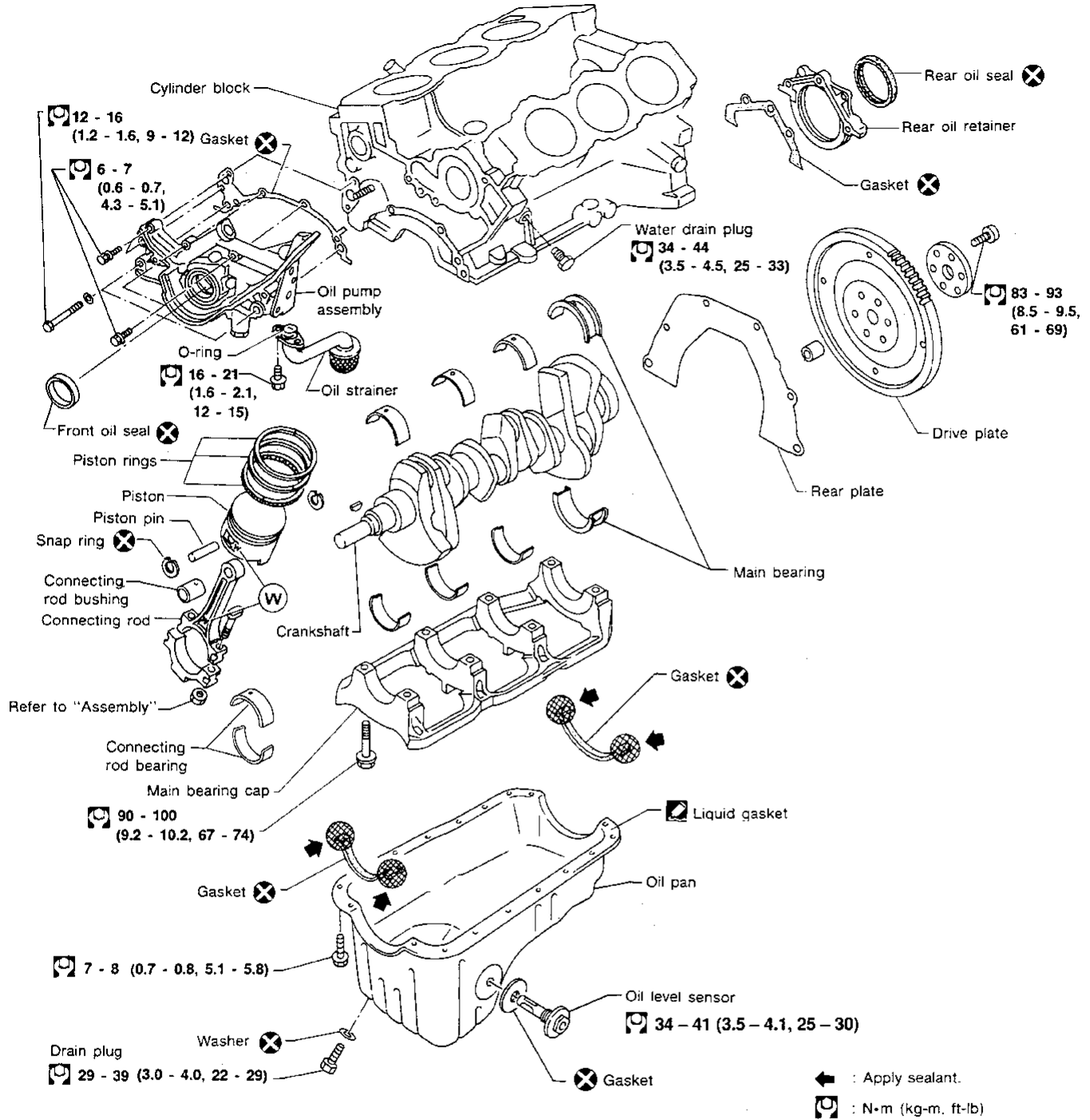
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CYLINDER BLOCK



CYLINDER BLOCK

CAUTION:

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

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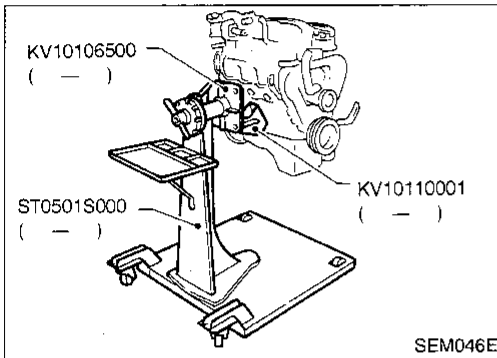
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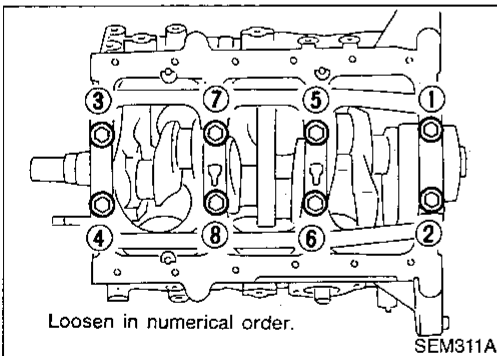
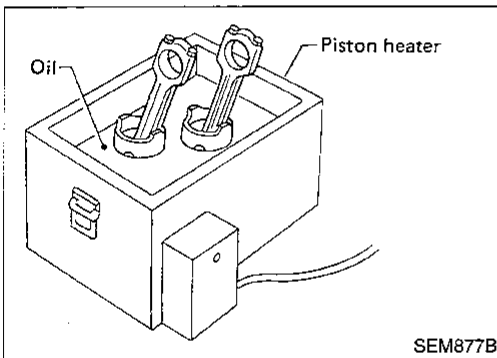
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Disassembly

PISTON AND CRANKSHAFT

1. Place engine on a work stand.
 2. Drain coolant and oil.
 3. Remove oil pan and oil pump.
 4. Remove timing belt.
 5. Remove water pump.
 6. Remove cylinder head.
 7. Remove pistons with connecting rods.
- When disassembling piston and connecting rod, remove snap ring first, then heat piston to 60 to 70°C (140 to 158°F) or use piston pin press stand at room temperature.

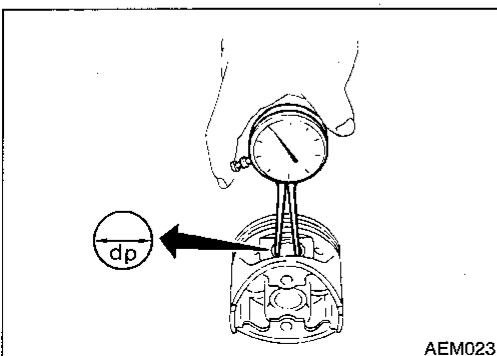


8. Remove bearing cap and crankshaft.
- Before removing bearing cap, measure crankshaft end play.
 - Bolts should be loosened in two or three steps.

Inspection

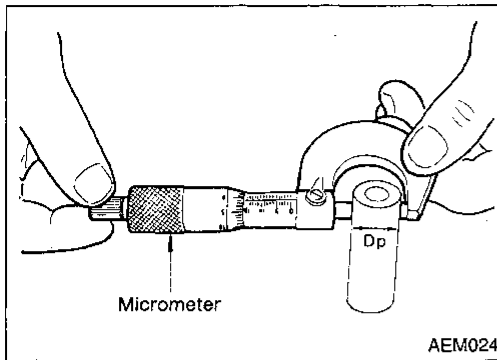
PISTON AND PISTON PIN CLEARANCE

1. Measure inner diameter of piston pin hole "dp".
Standard diameter "dp":
20.969 - 20.981 mm (0.8255 - 0.8260 in)



CYLINDER BLOCK

Inspection (Cont'd)



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

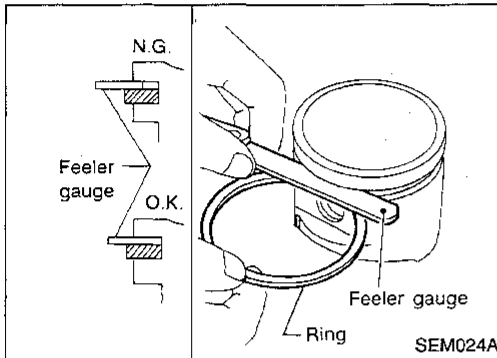
Standard diameter "Dp":

20.971 - 20.983 mm (0.8256 - 0.8261 in)

3. Calculate piston pin clearance.

$dp - Dp = 0 \text{ to } -0.004 \text{ mm (0 to } -0.0002 \text{ in)}$

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



PISTON RING SIDE CLEARANCE

Side clearance:

Top ring

0.040 - 0.073 mm (0.0016 - 0.0029 in)

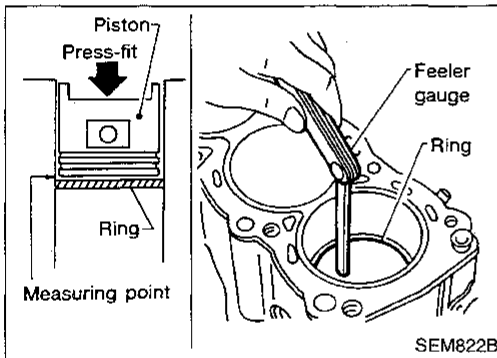
2nd ring

0.030 - 0.063 mm (0.0012 - 0.0025 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

0.21 - 0.44 mm (0.0083 - 0.0173 in)

2nd ring

0.18 - 0.44 mm (0.0071 - 0.0173 in)

Oil ring

0.20 - 0.76 mm (0.0079 - 0.0299 in)

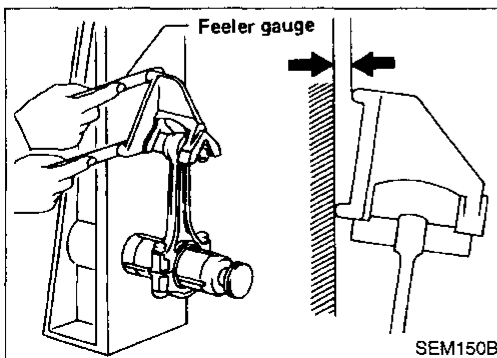
Max. limit of ring gap:

1.0 mm (0.039 in)

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

Refer to EM-55.

- When replacing a piston, inspect cylinder block surface for scratches or seizure. If scratches or seizure is found, hone or replace cylinder block.



CONNECTING ROD BEND AND TORSION

Bend:

Limit 0.10 mm (0.0039 in)

per 100 mm (3.94 in) length

Torsion:

Limit 0.10 mm (0.0039 in)

per 100 mm (3.94 in) length

If it exceeds the limit, replace connecting rod assembly.

CYLINDER BLOCK

Inspection (Cont'd)

CYLINDER BLOCK DISTORTION AND WEAR

1. Clean upper face of cylinder block and measure the distortion.

Limit:

0.10 mm (0.0039 in)

2. If out of specification, resurface it.

The resurfacing limit is determined by cylinder head resurfacing in engine.

Amount of cylinder head resurfacing is "A".

Amount of cylinder block resurfacing is "B".

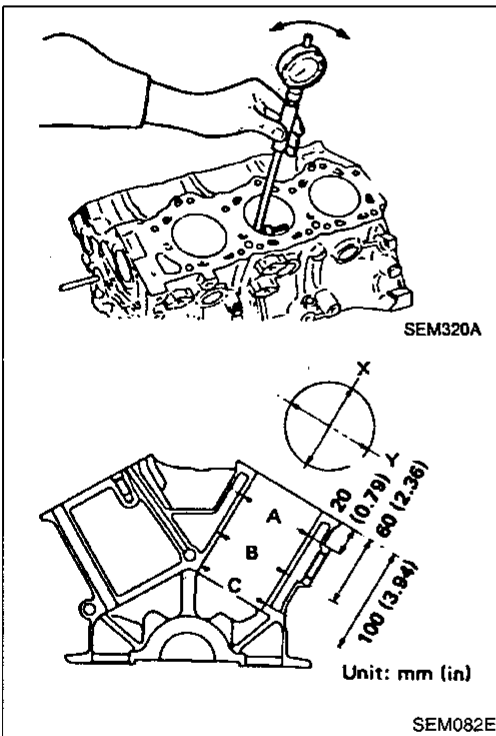
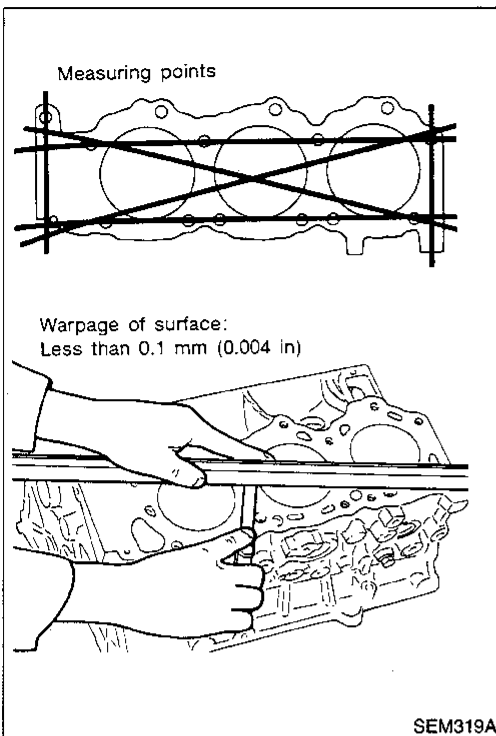
The maximum limit is as follows:

A + B = 0.2 mm (0.008 in)

Nominal cylinder block height from crankshaft center:

227.60 - 227.70 mm (8.9606 - 8.9645 in)

3. If necessary, replace cylinder block.



PISTON-TO-BORE CLEARANCE

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

Standard inner diameter:

87.000 - 87.030 mm (3.4252 - 3.4264 in)

Wear limit:

0.20 mm (0.0079 in)

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

0.015 mm (0.0006 in)

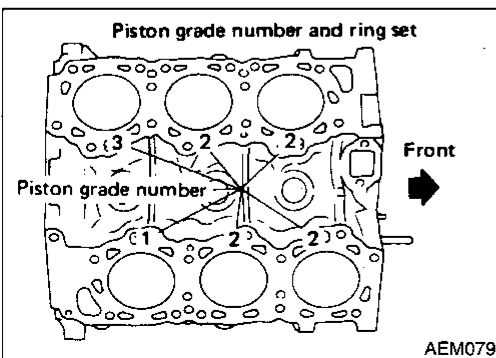
Taper (A - B) limit:

0.015 mm (0.0006 in)

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

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

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



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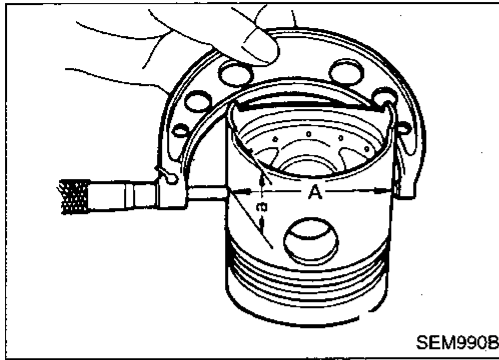
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CYLINDER BLOCK

Inspection (Cont'd)



3. Measure piston skirt diameter.
Piston diameter "A":
Refer to EM-55.
Measuring point "a" (Distance from the bottom):
18 mm (0.71 in)
4. Check that piston-to-bore clearance is within specification.
Piston-to-bore clearance "B":
0.025 - 0.045 mm (0.0010 - 0.0018 in)

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

Oversize pistons are available for service. Refer to EM-55.

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

Rebored size calculation:

$$D = A + B - C$$

where,

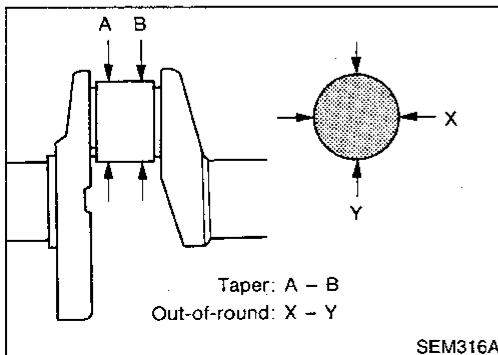
D: Bored diameter

A: Piston diameter as measured

B: Piston-to-bore clearance

C: Honing allowance 0.02 mm (0.0008 in)

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



CRANKSHAFT

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

Out-of-round (X - Y):

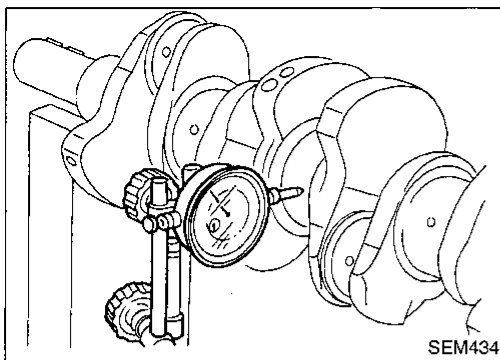
Less than 0.005 mm (0.0002 in)

Taper (A - B):

Less than 0.005 mm (0.0002 in)

CYLINDER BLOCK

Inspection (Cont'd)

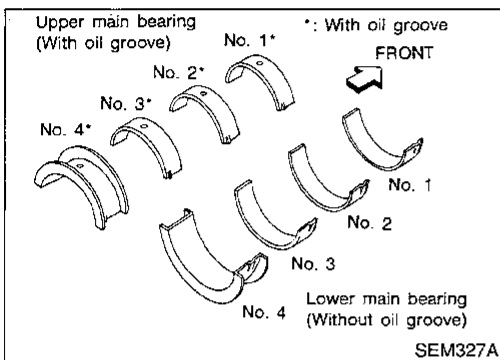


3. Measure crankshaft runout.

Runout (Total indicator reading):

Standard Less than 0.025 mm (0.0010 in)

Limit Less than 0.10 mm (0.0039 in)



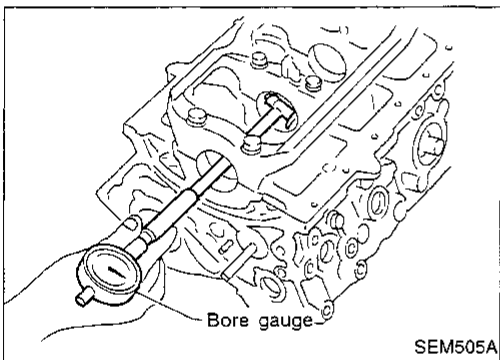
BEARING CLEARANCE

- 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

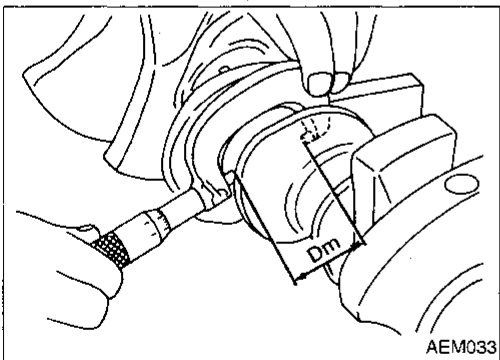
1. Set main bearings in their proper positions on cylinder block and main bearing cap.



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.

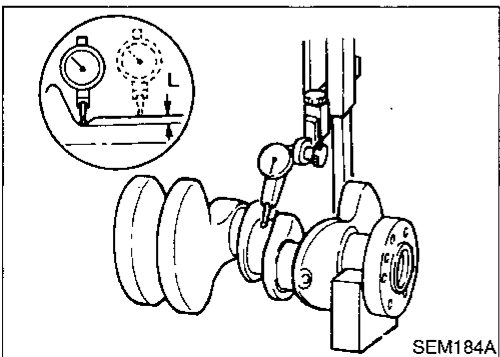
Main bearing clearance (A - Dm):

Standard 0.028 - 0.055 mm (0.0011 - 0.0022 in)

Limit 0.090 mm (0.0035 in)

6. If it exceeds the limit, replace bearing.

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



a. When grinding crankshaft journal, confirm that "L" dimension in fillet roll is more than the specified limit.

"L": 0.1 mm (0.004 in)

b. Refer to EM-56 for grinding crankshaft and available service parts.

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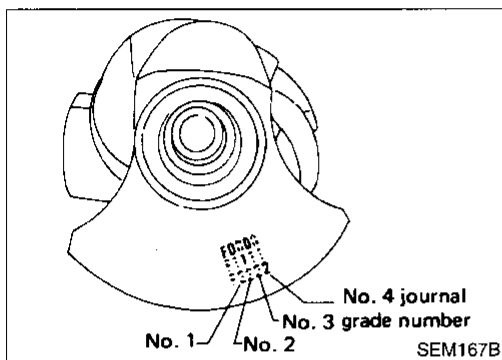
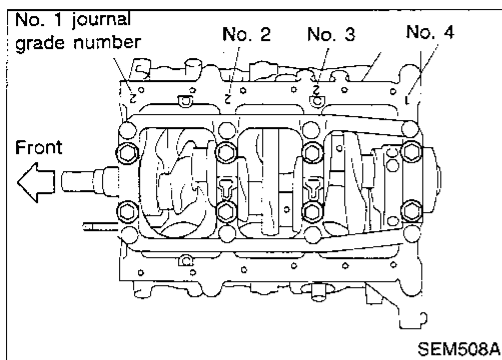
HA

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CYLINDER BLOCK

Inspection (Cont'd)



8. If crankshaft is reused, measure main bearing clearances and select thickness of main bearings.
If crankshaft is replaced with a new one, it is necessary to select thickness of main bearings as follows:
 - a. Grade number of each cylinder block main journal is punched on the respective cylinder block. These numbers are punched in either Arabic or Roman numerals.
 - b. Grade number of each crankshaft main journal is punched on the respective crankshaft. These numbers are punched in either Arabic or Roman numerals.
 - c. Select main bearing with suitable thickness according to the following table.

Main bearing grade number:

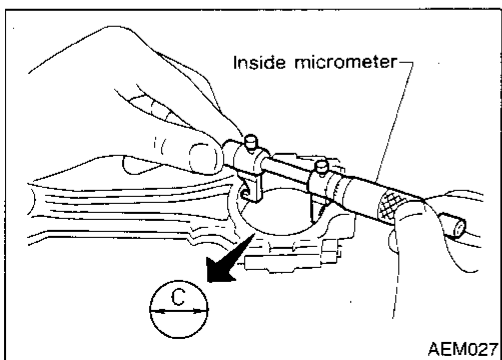
Main journal grade number		0	1	2
Crankshaft journal grade number	0	0	1	2
	1	1	2	3
	2	2	3	4

For example:

Main journal grade number: 1

Crankshaft journal grade number: 2

Main bearing grade number = 1 + 2
= 3

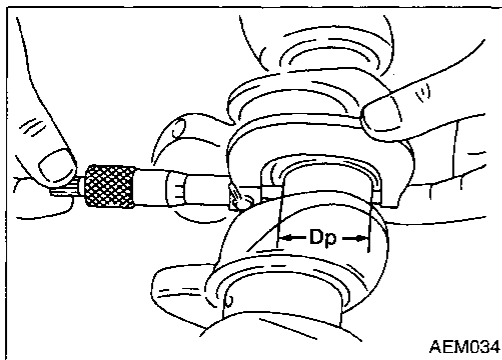


Connecting rod bearing (Big end)

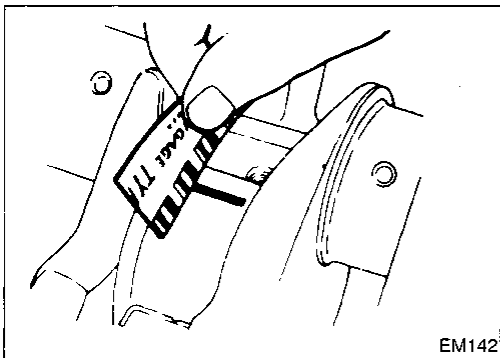
1. Install connecting rod bearing to connecting rod and cap.
 2. Install connecting rod cap to connecting rod.
- Tighten bolts to the specified torque.**
3. Measure inner diameter "C" of each bearing.

CYLINDER BLOCK

Inspection (Cont'd)



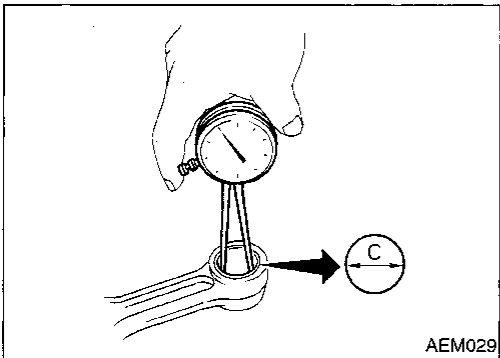
4. Measure outer diameter "Dp" of each crankshaft pin journal.
5. Calculate connecting rod bearing clearance.
Connecting rod bearing clearance (C - Dp):
Standard
 0.014 - 0.054 mm (0.0006 - 0.0021 in)
Limit
 0.090 mm (0.0035 in)
6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.
 Refer to step 7 on EM-45.



Method B (Using plastigage)

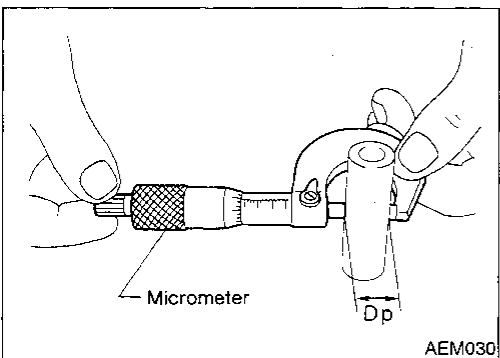
CAUTION:

- 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.

CYLINDER BLOCK

Inspection (Cont'd)

REPLACEMENT OF CONNECTING ROD BUSHING (Small end)

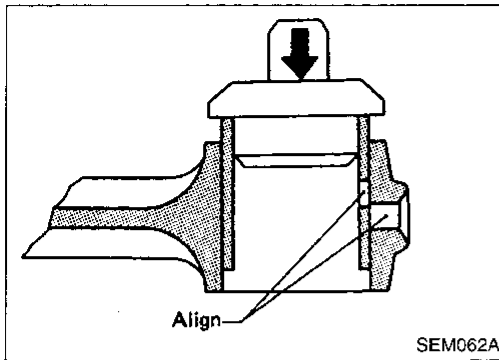
1. Drive in small end bushing until it is flush with end surface of rod.

Be sure to align the oil holes.

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

Clearance between connecting rod bushing and piston pin:

0.005 - 0.017 mm (0.0002 - 0.0007 in)



DRIVE PLATE RUNOUT

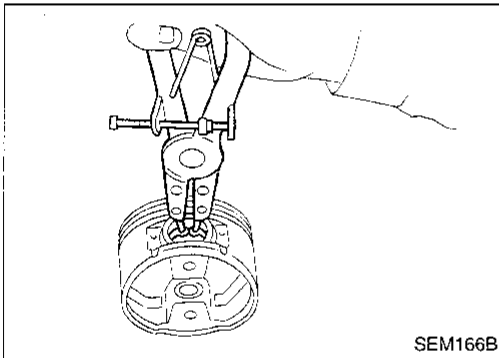
Runout (Total indicator reading):

Less than 0.15 mm (0.0059 in)

Assembly

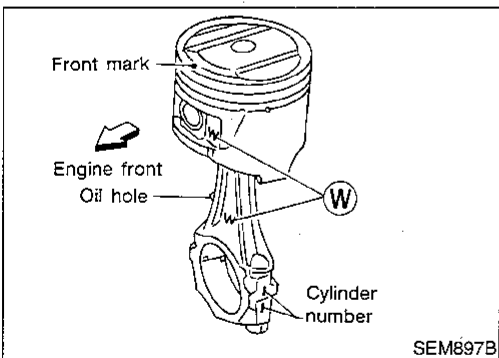
PISTON

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



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

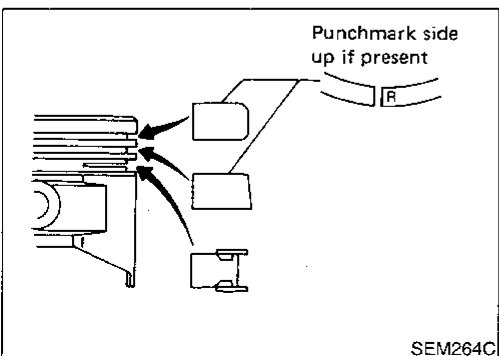
- **Align the direction of piston and connecting rod.**
- **Numbers stamped on connecting rod and cap correspond to each cylinder.**
- **After assembly, make sure connecting rod swings smoothly.**



3. Set piston rings as shown.

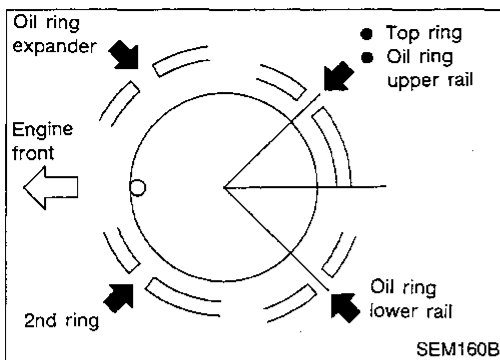
CAUTION:

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

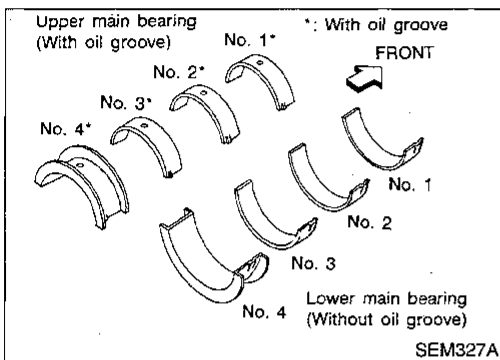


CYLINDER BLOCK

Assembly (Cont'd)



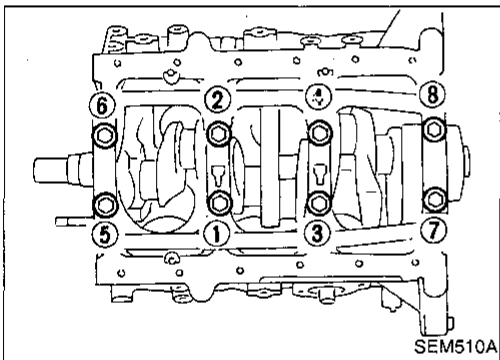
4. Set piston rings as shown.



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 EM-45.**

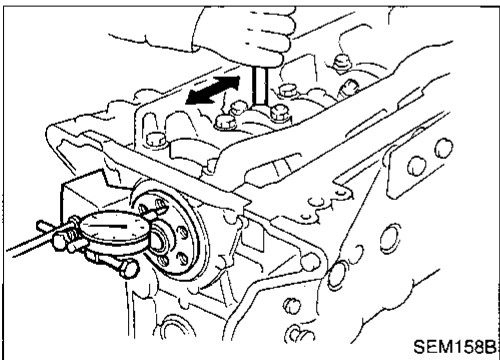


2. Install crankshaft and main bearing caps and tighten bolts to the specified torque.

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

● **Tighten bearing cap bolts gradually in two or three stages. Start with center bearing and move outward sequentially.**

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



3. Measure crankshaft end play.

Crankshaft end play:

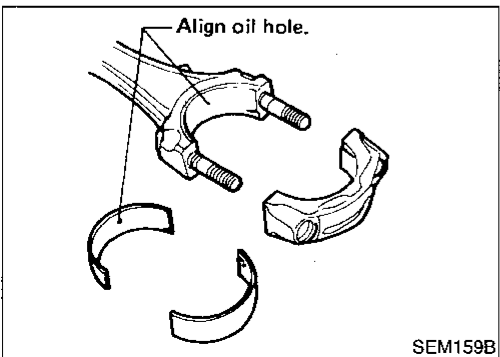
Standard

0.050 - 0.170 mm (0.0020 - 0.0067 in)

Limit

0.30 mm (0.0118 in)

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



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

● **Confirm that correct bearings are used.**

Refer to EM-46.

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

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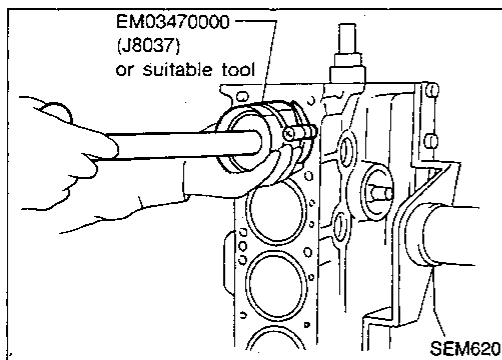
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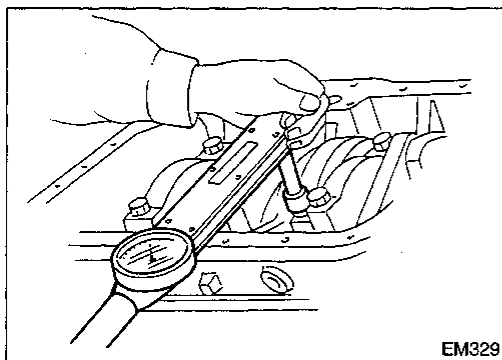
IDX

CYLINDER BLOCK

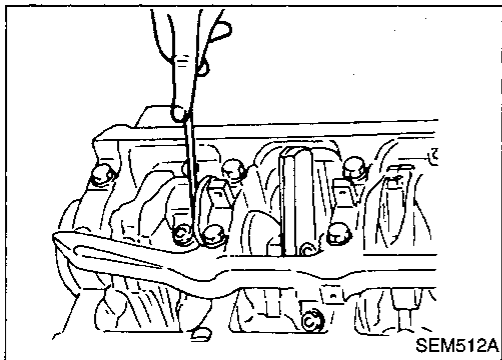
Assembly (Cont'd)



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



- b. Install connecting rod bearing caps. Tighten connecting rod bearing cap nuts to the specified torque.
 - ☑: **Connecting rod bearing nut**
 - (1) Tighten to 14 to 16 N·m (1.4 to 1.6 kg-m, 10 to 12 ft-lb).
 - (2) Turn nuts 60 to 65 degrees clockwise.
If an 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.

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specifications

Cylinder arrangement	V-6	
Displacement	cm ³ (cu in)	2,960 (180.62)
Bore and stroke	mm (in)	87 × 83 (3.43 × 3.27)
Valve arrangement	OHC	
Firing order	1-2-3-4-5-6	
Number of piston rings		
Compression	2	
Oil	1	
Number of main bearings	4	
Compression ratio	9.0	

COMPRESSION PRESSURE

Unit: kPa (kg/cm², psi)/300 rpm

Compression pressure		
Standard	1,196 (12.2, 173)	
Minimum	883 (9.0, 128)	
Differential limit between cylinders	98 (1.0, 14)	

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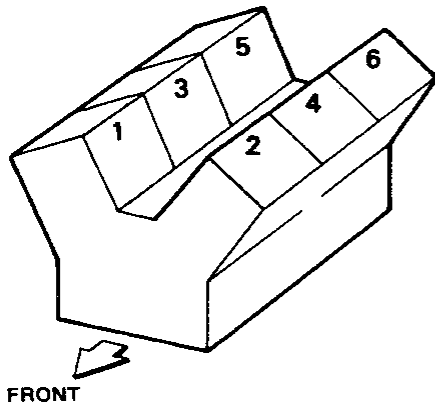
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Cylinder number



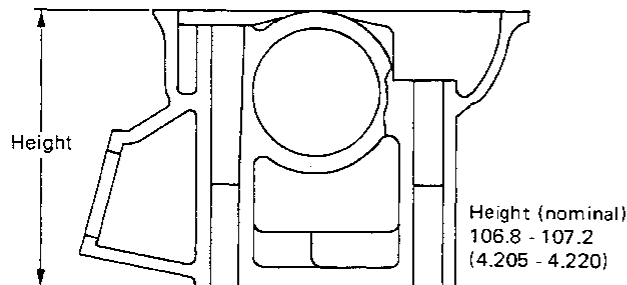
SEM713A

Inspection and Adjustment

CYLINDER HEAD

Unit: mm (in)

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



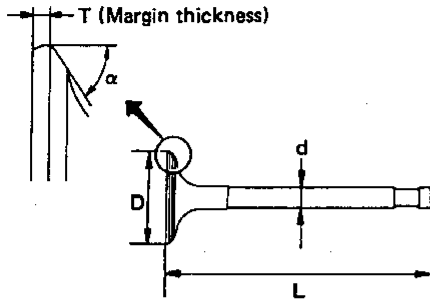
SEM082B

SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

VALVE

Unit: mm (in)



SEM188

Valve head diameter "D"	
Intake	42.0 - 42.2 (1.654 - 1.661)
Exhaust	35.0 - 35.2 (1.378 - 1.386)
Valve length "L"	
Intake	125.3 - 125.9 (4.933 - 4.957)
Exhaust	124.2 - 124.8 (4.890 - 4.913)
Valve stem diameter "d"	
Intake	6.965 - 6.980 (0.2742 - 0.2748)
Exhaust	7.965 - 7.970 (0.3136 - 0.3138)
Valve seat angle "α"	
Intake	45°15' - 45°45'
Exhaust	
Valve margin "T"	
Intake	1.15 - 1.45 (0.0453 - 0.0571)
Exhaust	1.35 - 1.65 (0.0531 - 0.0650)
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)	Outer	51.2 (2.016)
		Inner	44.1 (1.736)
Pressure N (kg, lb) at height mm (in)		Outer	523.7 (53.4, 117.7) at 30.0 (1.181)
		Inner	255.0 (26.0, 57.3) at 25.0 (0.984)
Out-of-square	mm (in)	Outer	2.2 (0.087)
		Inner	1.9 (0.075)

Hydraulic valve lifter

Unit: mm (in)

Lifter outside diameter	15.947 - 15.957 (0.6278 - 0.6282)
Lifter guide inside diameter	16.000 - 16.013 (0.6299 - 0.6304)
Clearance between lifter and lifter guide	0.043 - 0.066 (0.0017 - 0.0026)

Valve guide

Unit: mm (in)

		Standard	Service
Valve guide	Outer diameter	Intake	11.023 - 11.034 (0.4340 - 0.4344)
		Exhaust	12.023 - 12.034 (0.4733 - 0.4738)
Valve guide	Inner diameter (Finished size)	Intake	7.000 - 7.018 (0.2756 - 0.2763)
		Exhaust	8.000 - 8.018 (0.3150 - 0.3157)
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	Intake	0.027 - 0.059 (0.0011 - 0.0023)	
	Exhaust		
		Standard	Max. tolerance
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.10 (0.0039)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	
Valve deflection limit		—	0.20 (0.0079)

Rocker shaft and rocker arm

Unit: mm (in)

Rocker shaft	
Outer diameter	17.979 - 18.000 (0.7078 - 0.7087)
Rocker arm	
Inner diameter	18.007 - 18.028 (0.7089 - 0.7098)
Clearance between rocker arm and rocker shaft	0.007 - 0.049 (0.0003 - 0.0019)

SERVICE DATA AND SPECIFICATIONS (SDS)

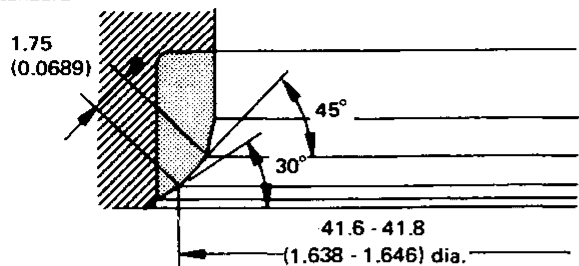
Inspection and Adjustment (Cont'd)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

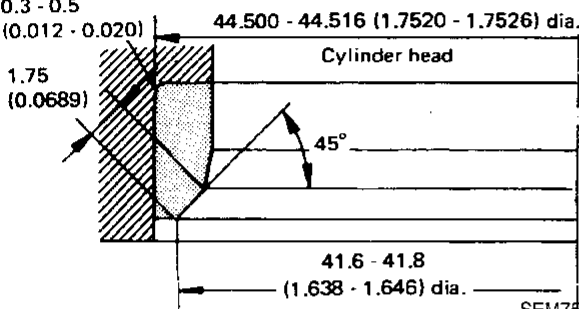
Intake valve seat

Standard



Oversize [0.5 (0.020)]

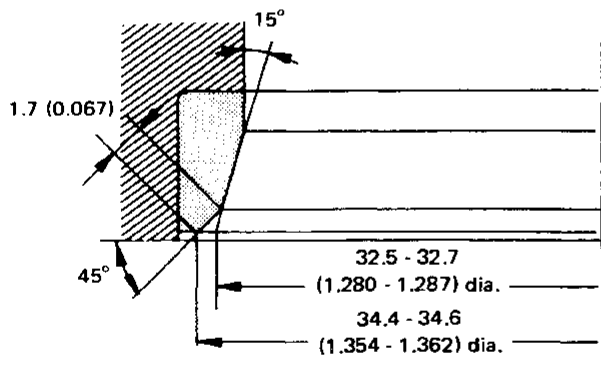
R0.3 - 0.5
(0.012 - 0.020)



Unit: mm (in)

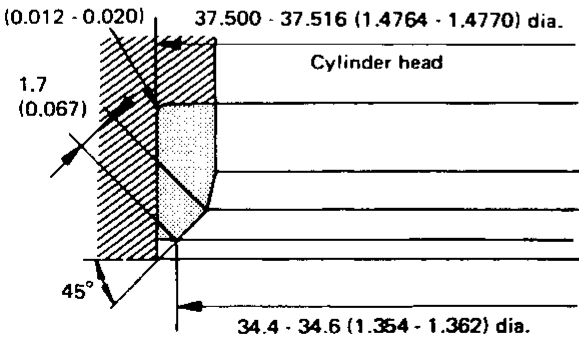
Exhaust valve seat

Standard

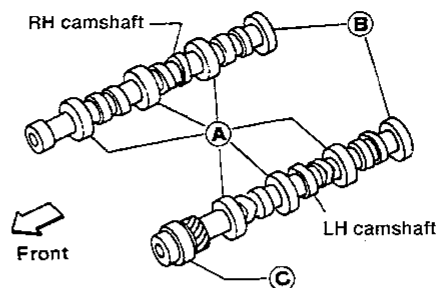


Oversize [0.5 (0.020)]

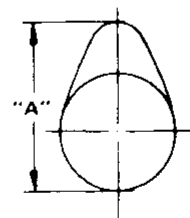
R0.3 - 0.5
(0.012 - 0.020)



Unit: mm (in)



	Standard	Max. tolerance
Camshaft journal to bearing clearance	0.045 - 0.090 (0.0018 - 0.0035)	0.15 (0.0059)
Inner diameter of camshaft bearing		
A :	47.000 - 47.025 (1.8504 - 1.8514)	—
B :	42.500 - 42.525 (1.6732 - 1.6742)	—
C :	48.000 - 48.025 (1.8898 - 1.8907)	—
Outer diameter of camshaft journal		
A :	46.920 - 46.940 (1.8472 - 1.8480)	—
B :	42.420 - 42.440 (1.6701 - 1.6709)	—
C :	47.920 - 47.940 (1.8866 - 1.8874)	—
Camshaft runout [TIR*]	Less than 0.04 (0.0016)	0.1 (0.004)
Camshaft end play	0.03 - 0.06 (0.0012 - 0.0024)	—



	Standard
Cam height "A"	
Intake	38.942 - 39.132 (1.5331 - 1.5406)
Exhaust	
Wear limit of cam height	0.15 (0.0059)

*Total indicator reading

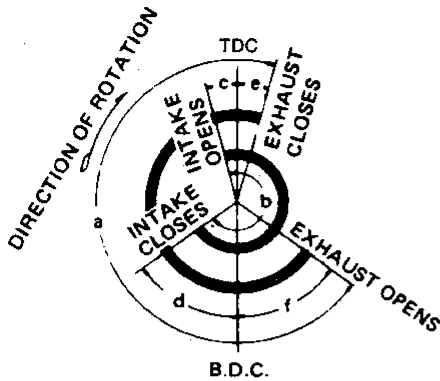
SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

CYLINDER BLOCK

Valve timing

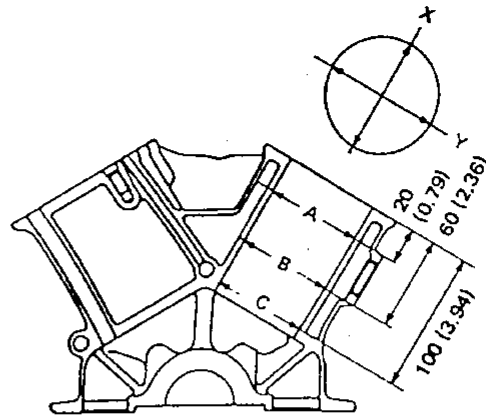
Unit: mm (In)



AEM050

Unit: degree

a	b	c	d	e	f
248	248	10	58	10	58



SEM321A

Surface flatness

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

Cylinder bore

Inner diameter

Standard

Grade No. 1	87.000 - 87.010 (3.4252 - 3.4256)
Grade No. 2	87.010 - 87.020 (3.4256 - 3.4260)
Grade No. 3	87.020 - 87.030 (3.4260 - 3.4264)

Wear limit

0.20 (0.0079)

Out-of-round (X - Y)
standard

Less than 0.015 (0.0006)

Taper (A - B - C)
standard

Less than 0.015 (0.0006)

Main journal inner diameter

Grade No. 0	66.645 - 66.654 (2.6238 - 2.6242)
Grade No. 1	66.654 - 66.663 (2.6242 - 2.6245)
Grade No. 2	66.663 - 66.672 (2.6245 - 2.6249)

Difference in inner
diameter between
cylinders

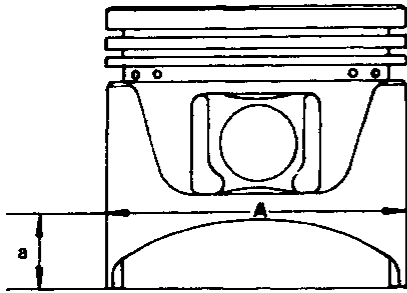
Standard	Less than 0.05 (0.0020)
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SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

PISTON, PISTON RING AND PISTON PIN Available piston

Unit: mm (in)



SEM891B

Piston skirt diameter "A"

Standard

Grade No. 1	86.965 - 86.975 (3.4238 - 3.4242)
Grade No. 2	86.975 - 86.985 (3.4242 - 3.4246)
Grade No. 3	86.985 - 86.995 (3.4246 - 3.4250)
0.25 (0.0098) oversize (Service)	87.215 - 87.265 (3.4337 - 3.4356)
0.50 (0.0197) oversize (Service)	87.465 - 87.515 (3.4435 - 3.4455)

"a" dimension 18 (0.71)

Piston pin hole diameter 20.969 - 20.981 (0.8255 - 0.8260)

Piston clearance to cylinder block 0.025 - 0.045 (0.0010 - 0.0018)

Piston ring

Unit: mm (in)

	Standard	Limit
Side clearance		
Top	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
2nd	0.030 - 0.063 (0.0012 - 0.0025)	
Oil	0.015 - 0.19 (0.0006 - 0.0075)	—
Ring gap		
Top	0.21 - 0.44 (0.0083 - 0.0173)	1.0 (0.039)
2nd	0.18 - 0.44 (0.0071 - 0.0173)	
Oil (rail ring)	0.20 - 0.76 (0.0079 - 0.0299)	

Piston pin

Unit: mm (in)

Piston pin outer diameter	20.971 - 20.983 (0.8256 - 0.8261)
Interference fit of piston pin to piston	0 - 0.004 (0 - 0.0002)
Piston pin to connecting rod bushing clearance	0.005 - 0.017 (0.0002 - 0.0007)

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

CONNECTING ROD

Unit: mm (in)

Center distance	154.1 - 154.2 (6.067 - 6.071)
Bend, torsion [per 100 (3.94)]	
Limit	0.10 (0.0039)
Piston pin bushing inner diameter*	20.982 - 20.994 (0.8261 - 0.8265)
Connecting rod big end inner diameter	53.000 - 53.013 (2.0866 - 2.0871)
Side clearance	
Standard	0.20 - 0.35 (0.0079 - 0.0138)
Limit	0.40 (0.0157)

*After installing in connecting rod

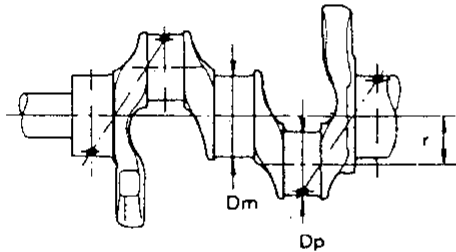
SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

CRANKSHAFT

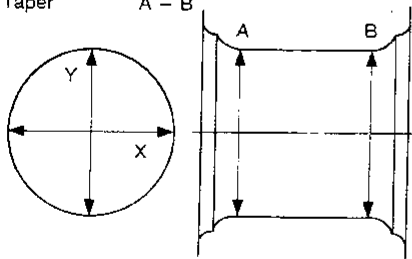
Unit: mm (in)

Main journal dia. "Dm"	
Grade No. 0	62.967 - 62.975 (2.4790 - 2.4793)
Grade No. 1	62.959 - 62.967 (2.4787 - 2.4790)
Grade No. 2	62.951 - 62.959 (2.4784 - 2.4787)
Pin journal dia. "Dp"	
49.955 - 49.974 (1.9667 - 1.9675)	
Center distance "r"	
41.5 (1.634)	
Out-of-round (X - Y)	
Standard	Less than 0.005 (0.0002)
Taper (A - B)	
Standard	Less than 0.005 (0.0002)
Runout [T.I.R.]	
Standard	Less than 0.025 (0.0010)
Limit	Less than 0.10 (0.0039)
Free end play	
Standard	0.050 - 0.170 (0.0020 - 0.0067)
Limit	0.30 (0.0118)



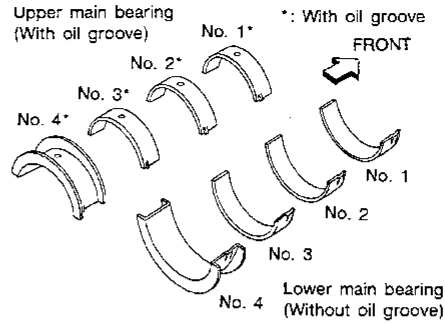
SEM645

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



EM715

AVAILABLE MAIN BEARING



SEM327A

No. 1 main bearing

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color
0	1.817 - 1.821 (0.0715 - 0.0717)		Black
1	1.821 - 1.825 (0.0717 - 0.0719)		Brown
2	1.825 - 1.829 (0.0719 - 0.0720)	22.4 - 22.6 (0.882 - 0.890)	Green
3	1.829 - 1.833 (0.0720 - 0.0722)		Yellow
4	1.833 - 1.837 (0.0722 - 0.0723)		Blue

No. 2 and 3 main bearing

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color
0	1.817 - 1.821 (0.0715 - 0.0717)		Black
1	1.821 - 1.825 (0.0717 - 0.0719)		Brown
2	1.825 - 1.829 (0.0719 - 0.0720)	18.9 - 19.1 (0.744 - 0.752)	Green
3	1.829 - 1.833 (0.0720 - 0.0722)		Yellow
4	1.833 - 1.837 (0.0722 - 0.0723)		Blue

SERVICE DATA AND SPECIFICATIONS (SDS)

Inspection and Adjustment (Cont'd)

No. 4 main bearing

Grade number	Thickness "T" mm (in)	Identification color
0	1.817 - 1.821 (0.0715 - 0.0717)	Black
1	1.821 - 1.825 (0.0717 - 0.0719)	Brown
2	1.825 - 1.829 (0.0719 - 0.0720)	Green
3	1.829 - 1.833 (0.0720 - 0.0722)	Yellow
4	1.833 - 1.837 (0.0722 - 0.0723)	Blue

Main bearing 0.25 mm (0.0098 in) undersize

Unit: mm (in)

Thickness "T"	1.948 - 1.956 (0.0767 - 0.0770)
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AVAILABLE CONNECTING ROD BEARING

Connecting rod bearing undersize

Unit: mm (in)

	Thickness	Crank pin journal diameter "Dp"
Standard	1.502 - 1.506 (0.0591 - 0.0593)	49.955 - 49.974 (1.9667 - 1.9675)
Undersize		
0.08 (0.0031)	1.542 - 1.546 (0.0607 - 0.0609)	49.875 - 49.894 (1.9636 - 1.9643)
0.12 (0.0047)	1.562 - 1.566 (0.0615 - 0.0617)	49.835 - 49.854 (1.9620 - 1.9628)
0.25 (0.0098)	1.627 - 1.631 (0.0641 - 0.0642)	49.705 - 49.724 (1.9569 - 1.9576)

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Drive plate	
Runout [T.I.R.]	Less than 0.15 (0.0059)

Bearing clearance

Unit: mm (in)

Main bearing clearance	
Standard	0.028 - 0.055 (0.0011 - 0.0022)
Limit	0.090 (0.0035)

Connecting rod bearing clearance	
Standard	0.014 - 0.054 (0.0006 - 0.0021)
Limit	0.090 (0.0035)

GI

MA

EM

LC

EF &
EC

FE

AT

FA

RA

BR

ST

BF

HA

EL

IDX