ENGINE MECHANICAL

SECTION EM

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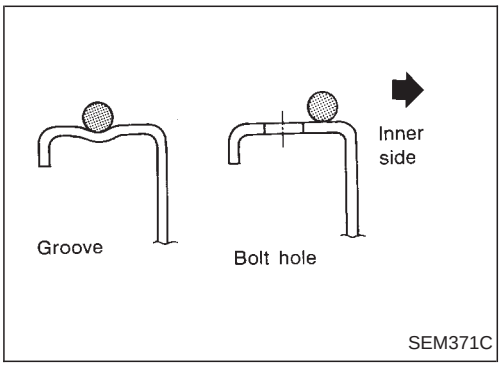
Parts Requiring Angular Tightening

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



Liquid Gasket Application Procedure

a. Before applying liquid gasket, use a scraper to remove all traces of old liquid gasket from mating surface.

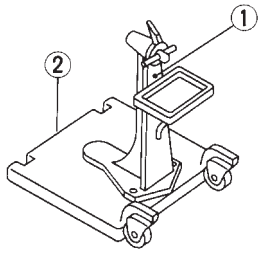
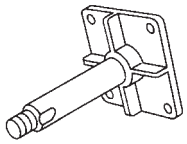
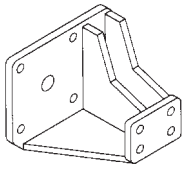
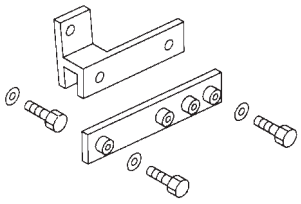
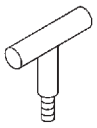
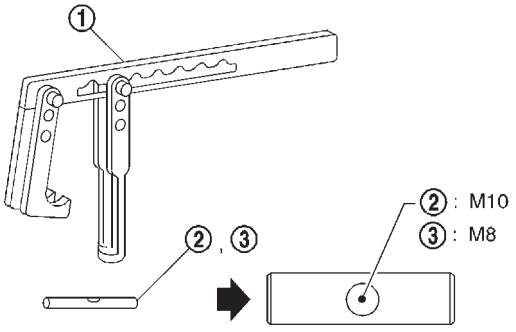
b. Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)
- **Be sure liquid gasket is specified width (for oil pan) 3.5 to 4.5 mm (0.138 to 0.177 in) for gasoline engine.**
- **Be sure liquid gasket is 2.0 to 3.0 mm (0.079 to 0.118 in) wide in areas except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

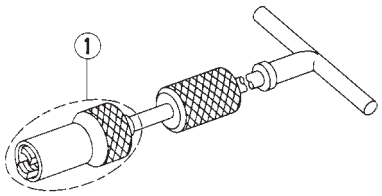
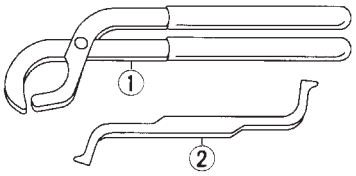
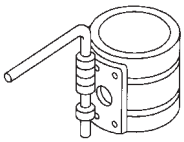
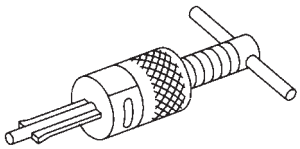
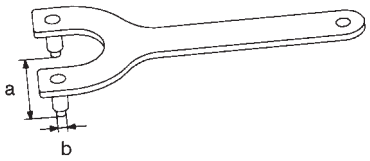
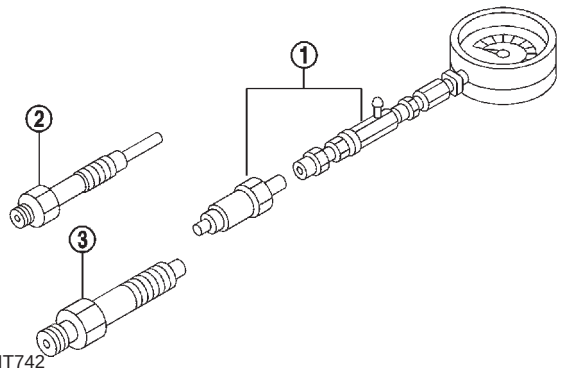
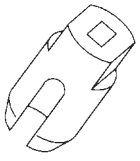
c. Apply liquid gasket to inner surface around hole perimeter area.
(Assembly should be done within 5 minutes after coating.)

d. Wait at least 30 minutes before refilling engine oil and engine coolant.

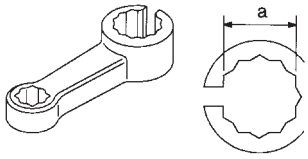
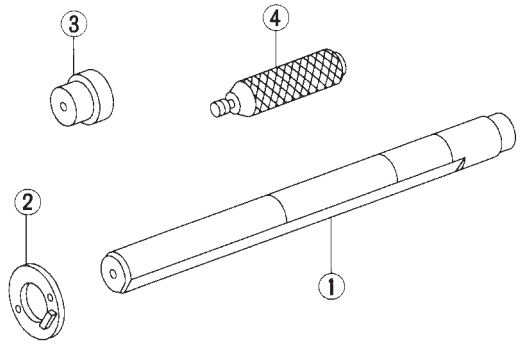
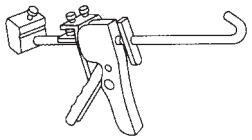
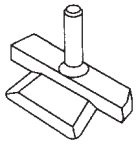
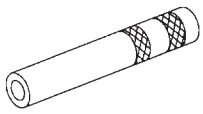
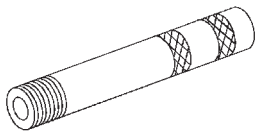
SPECIAL SERVICE TOOLS

* Special tool or commercial equivalent

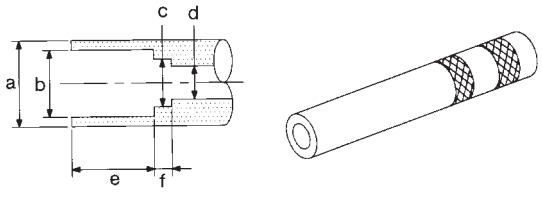
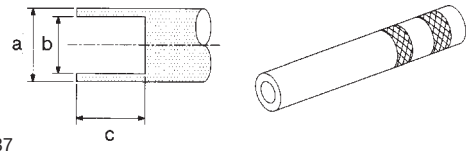
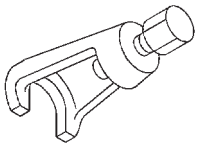
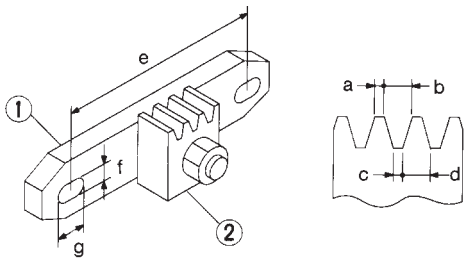
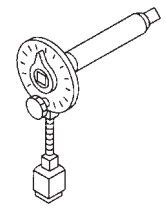
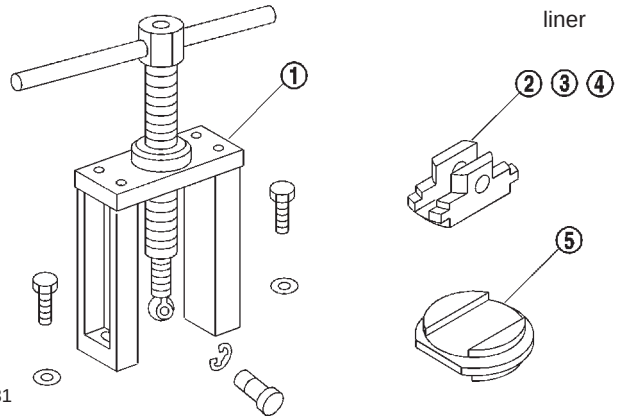
Tool number Tool name	Description		Engine application		
			TB	RD	TD
ST0501S000* Engine stand assembly ① ST05011000 Engine stand ② ST05012000 Base	 NT042	Disassembling and assembling	X	X	X
KV10106500* Engine stand shaft	 NT028		X	X	X
KV11104800* Engine sub-attachment	 NT577		X	—	X
KV1011070 Engine sub-attachment	 NT582		—	X	—
KV10111200* Adapter	 NT687	Disassembling and assembling valve components	X	—	X
KV101092S0 Valve spring compressor ① KV10109210 Compressor ② KV10109220 Adapter	 NT718	Disassembling and assembling valve components	X	X	X

Tool number Tool name	Description		Engine application		
			TB	RD	TD
KV10107902 Valve oil seal puller ① KV10116100 Valve oil seal puller adapter	 NT605		—	X	X
KV101151S0 Lifter stopper set ① KV10115110 Camshaft pliers ② KV10115120 Lifter stopper	 NT041	Changing shims	—	X	—
EM03470000* Piston ring compressor	 NT044	Installing piston assembly into cylinder bore	X	X	X
ST16610001* Pilot bushing puller	 NT045	Removing crankshaft pilot bushing	X	X	X
KV10109300 Puller holder	 NT628	**a = 68 mm (2.68 in)** **b = 8 mm (0.31 in) dia.**	—	X	X
① ED19601000 Compression gauge ② ED19600600 Compression gauge adapter (for glow plug hole) ③ ED19600700 Compression gauge adapter (for injector hole)	 NT742	Checking compression pressure	—	X	X
KV11100300 Nozzle holder socket	 NT563		—	X	—

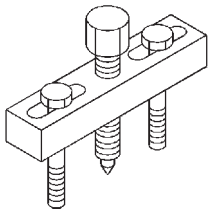
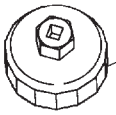
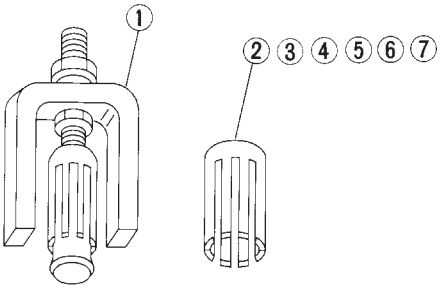
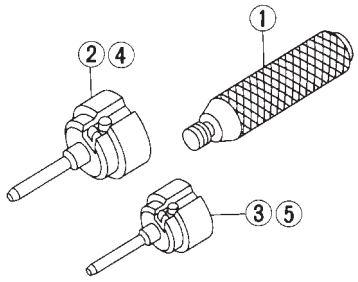
* Special tool or commercial equivalent

Tool number Tool name	Description		Engine application		
			TB	RD	TD
KV10114400 Heated oxygen sensor wrench	 NT636	Loosening or tightening heated oxygen sensor **a = 22 mm (0.87 in)**	X	—	—
KV111045S0 Cam bushing replacer set ① KV11104510 Replacer bar ② KV11104520 Guide plate ③ KV11104530 Adapter (1st bushing) ④ ST15243000 Drift	 NT258	Removing and installing cam bushing	X	—	X
WS39930000* Tube presser	 NT052	Pressing the tube of liquid gasket	X	X	X
KV10111100 Seal cutter	 NT046	Removing oil pan	X	—	X
KV10113000 Valve oil seal drift	 NT027	Installing valve oil seal	X	—	—
KV10107501 Valve oil seal drift	 NT741		—	X	—

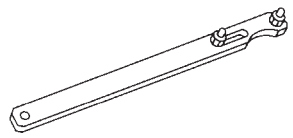
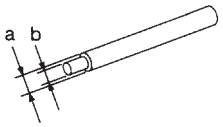
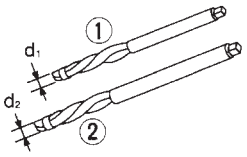
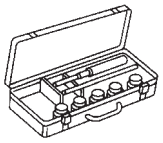
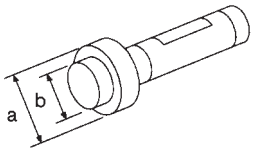
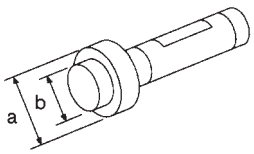
* Special tool or commercial equivalent

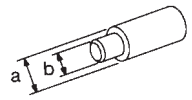
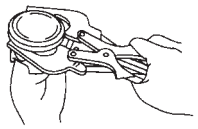
Tool number Tool name	Description		Engine application		
			TB	RD	TD
KV11105300 Valve oil seal drift	 NT602	Installing valve oil seal **a: 20 (0.79) dia.** **b: 14.6 (0.575) dia.** **c: 13.3 (0.524) dia.** **d: 8.5 (0.335) dia.** **e: 17.5 (0.689)** **f: 4.5 (0.177)** Unit: mm (in)	—	—	X
KV11105400* Valve guide drift	 NT637	Installing valve guide **a: 20 (0.79) dia.** **b: 12.2 (0.480) dia.** **c: 16 (0.63)** Unit: mm (in)	—	—	X
ST29020001 Steering gear arm puller	 NT725	Removing pitman arm	X	—	—
KV111033S0 Engine stopper ① KV10105610 Stopper plate ② KV10105630 Stopper gear	 NT616	Preventing crankshaft from rotating **a: 3 (0.12)** **b: 6.4 (0.252)** **c: 2.8 (0.110)** **d: 6.6 (0.260)** **e: 119 (4.69)** **f: 12 (0.47)** **g: 18 (0.71)** Unit: mm (in)	X	X	X
KV10112100 Angle wrench	 NT014	Tightening bolts for bearing cap, cylinder head, etc.	—	—	X
① KV11104010 Cylinder liner tool ② KV11104020 Adapter for removing ③ KV11104700 Adapter for removing ④ KV11104110 Adapter for removing ⑤ KV11104030 Adapter for installing	 NT681	Removing and installing cylinder liner	— — — — —	— — — — —	X — — X X

* Special tool or commercial equivalent

Tool number Tool name	Description	Engine application		
		TB	RD	TD
KV11103000* Injection pump drive gear puller	Removing drive gear  NT676	—	—	X
KV10106001* Oil filter wrench	Removing oil filter  15 faces, inner span: 92.5 mm (3.642 in) (Face to opposite corner) NT690	—	—	X
① KV11101110 Valve seat remover ② KV11103510 Adapter (Intake) ③ KV11103520 Adapter (Exhaust) ④ KV11104910 Adapter (Intake) ⑤ KV11104920 Adapter (Exhaust) ⑥ KV11103610 Adapter (Intake) ⑦ KV11103620 Adapter (Exhaust)	Removing valve seat  NT251	— — — — — — —	— — — — — — —	X — — — — X X
① ST15243000 Valve seat drift ② KV11103710 Adapter (Intake) ③ KV11103720 Adapter (Exhaust) ④ KV11103810 Adapter (Intake) ⑤ KV11103820 Adapter (Exhaust)	Installing valve seat  NT252	— — — — —	— — — — —	X — — — —

COMMERCIAL SERVICE TOOLS

Tool name	Description		Engine application		
			TB	RD	TD
Pulley holder	 NT035	Holding camshaft pulley while tightening or loosening camshaft bolt	X	—	—
Valve guide drift	 NT015	Removing and installing valve guide **Intake & Exhaust** **TB and TD engines** **a = 11.5 mm (0.453 in) dia.** **b = 7.6 mm (0.299 in) dia.** **RD engine** **a = 11.5 mm (0.453 in) dia.** **b = 6.5 mm (0.256 in) dia.**	X	X	X
Valve guide reamer	 NT016	Reaming valve guide ① or hole for oversize valve guide ② **Intake & Exhaust** **TB engine** **d_1 = 8.0 mm (0.315 in) dia.** **d_2 = 12.2 mm (0.480 in) dia.** **RD engine** **d_1 = 7.000 mm (0.2756 in) dia.** **d_2 = 11.19 mm (0.4406 in) dia.** **TD engine** **d_1 = 8.0 mm (0.315 in) dia.**	X	X	X
Valve seat cutter set	 NT048	Finishing valve seat dimensions	X	X	X
Front oil seal drift	 NT049	Installing front oil seal **TB engine** **a = 80 mm (3.15 in) dia.** **b = 58 mm (2.28 in) dia.** **RD engine** **a = 52 mm (2.05 in) dia.** **b = 41 mm (1.61 in) dia.**	X	X	—
Rear oil seal drift	 NT049	Installing rear oil seal **a = 100 mm (3.94 in) dia.** **b = 78 mm (3.07 in) dia.**	—	X	—

Tool name	Description		Engine application		
			TB	RD	TD
Piston pin drift	 NT074	Removing and installing piston pin **a = 22.5 mm (0.886 in) dia.** **b = 12.5 mm (0.492 in) dia.**	X	X	—
Piston ring expander	 NT030	Removing and installing piston ring	X	X	X

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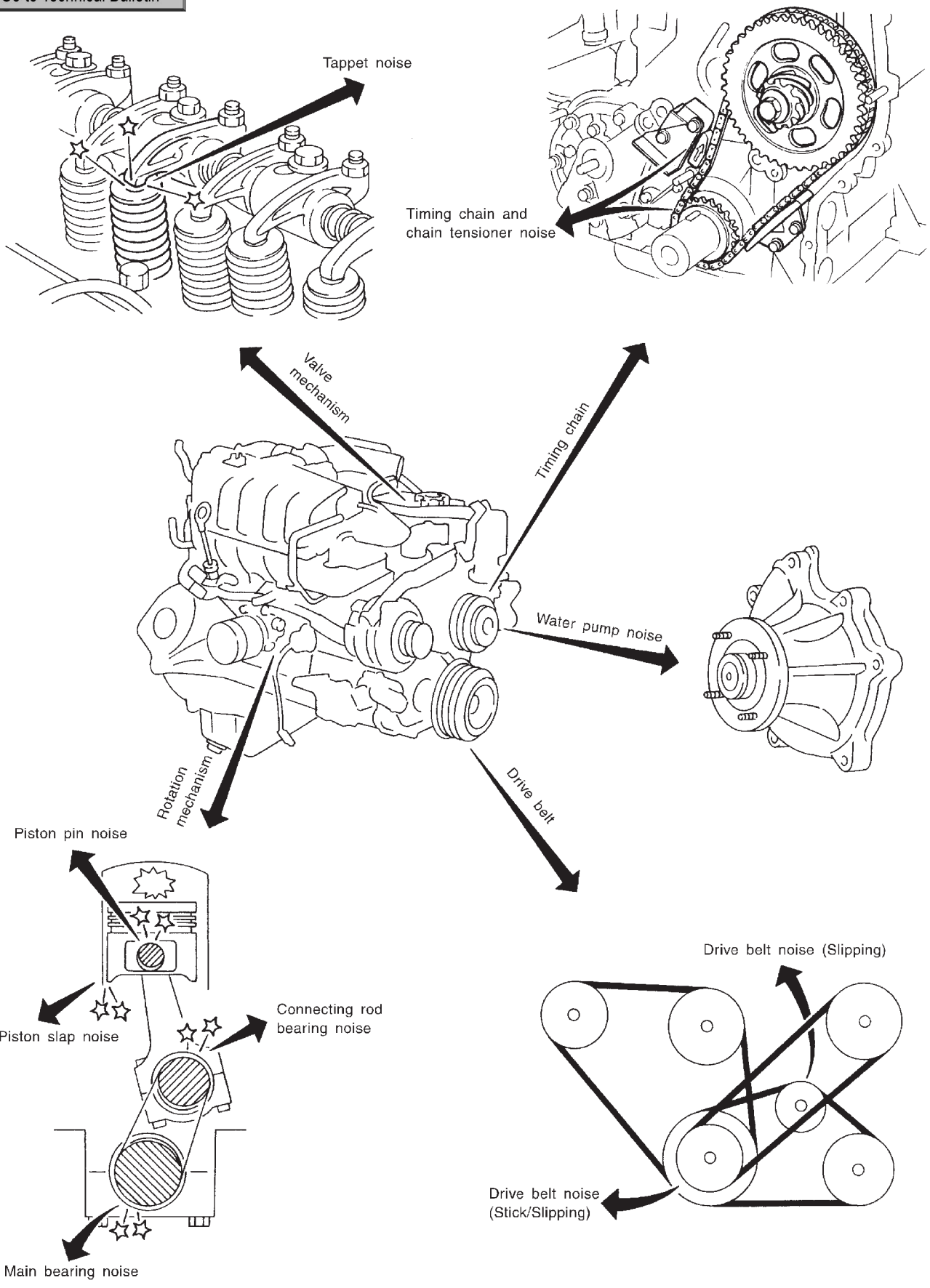


SEM735F

NVH Troubleshooting Chart — Engine Noise

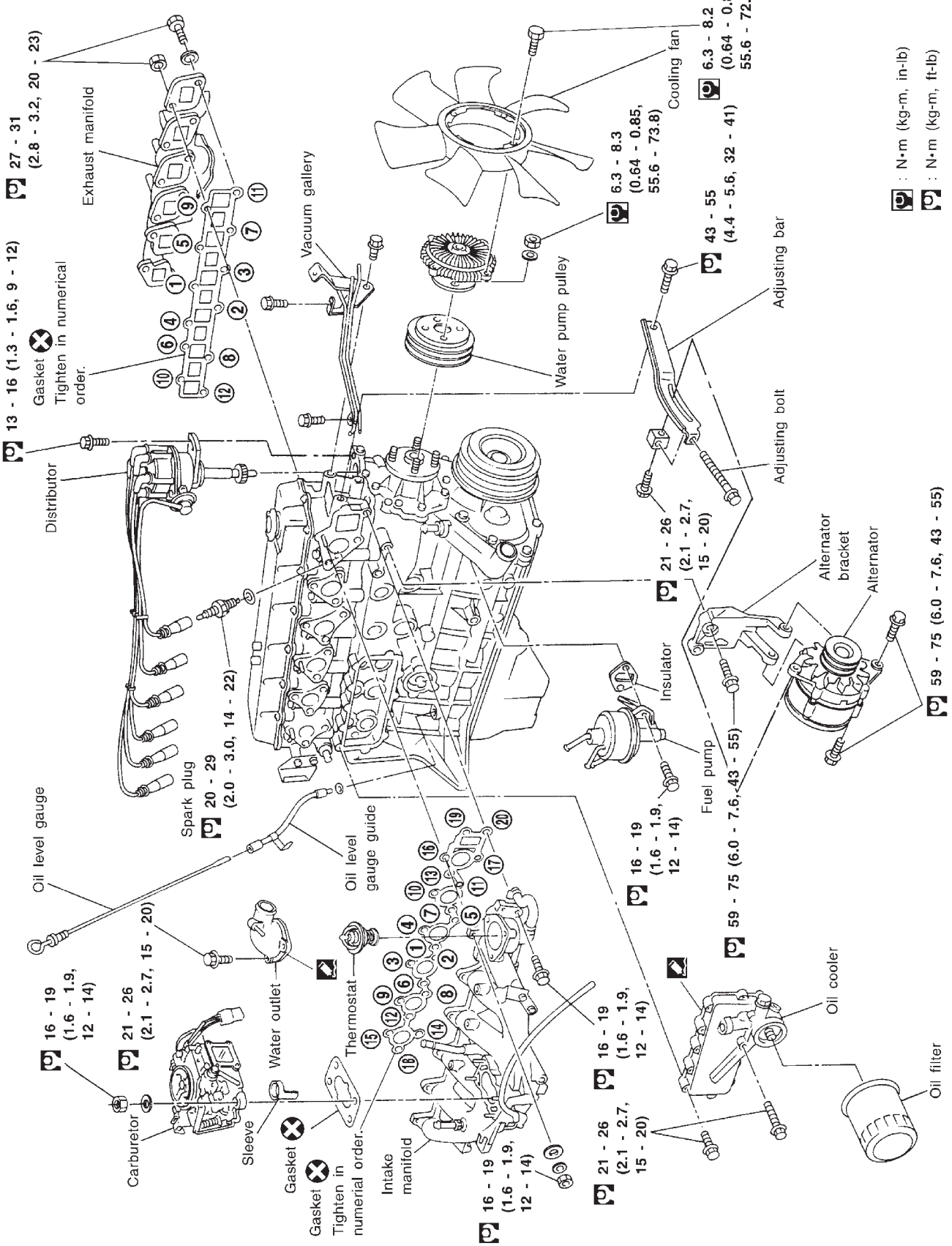
Use the chart below to help you find the cause of the symptom.
1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-47
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-60, 61
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-54, 59
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-55, 54
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-59, 58
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-57
Front of engine Timing chain cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-25, 28, 31, 34
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Other drive belts (Sticking or slipping)	Drive belts deflection	MA section (“Checking Drive Belts”, “ENGINE MAINTENANCE”)
	Creaking	A	B	A	B	A	B	Other drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	LC section (“Water Pump Inspection”, “ENGINE COOLING SYSTEM”)

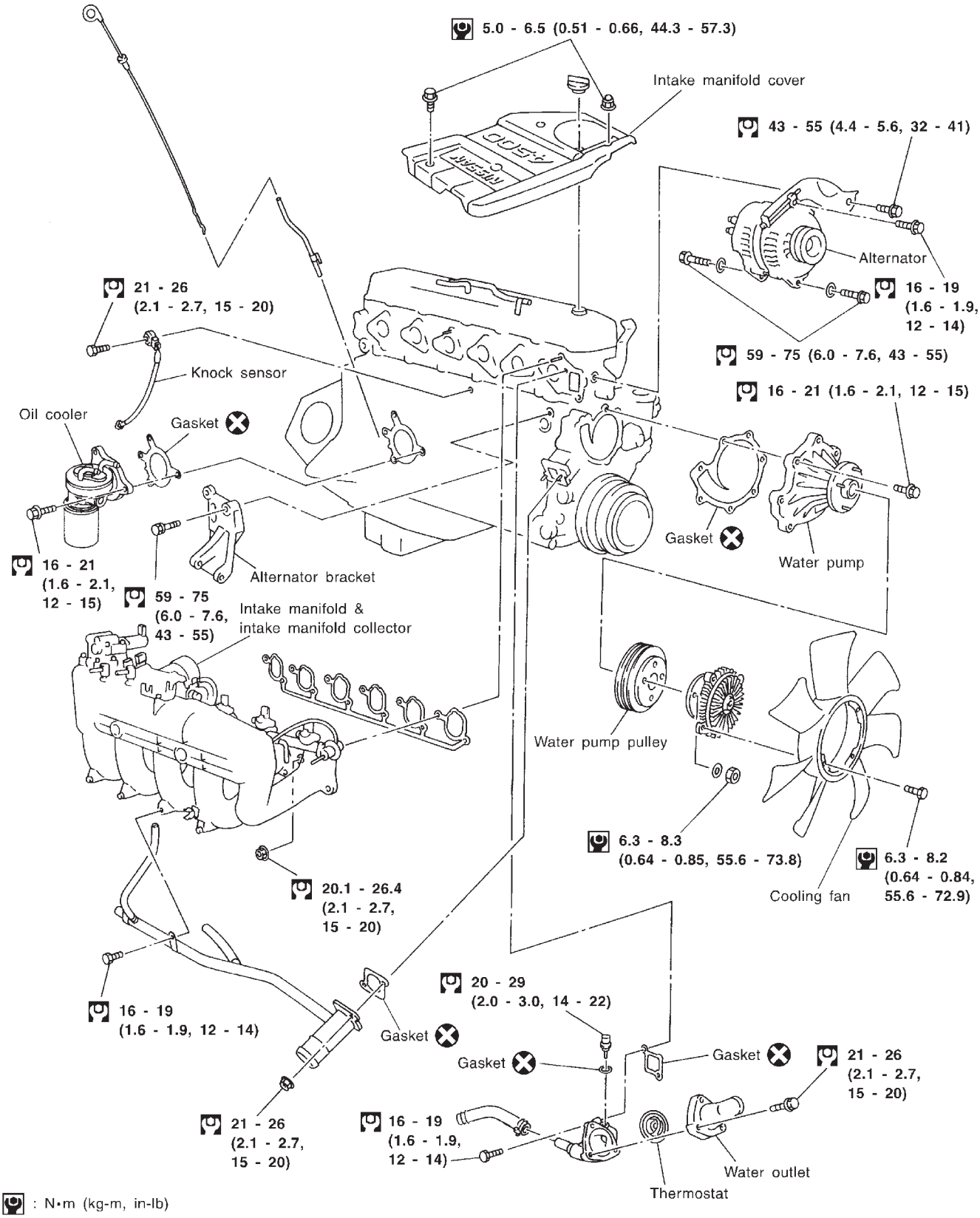
A: Closely related B: Related C: Sometimes related —: Not related

SEC. 110•140•150•160•170•210•213•220•221•230



SEM776F

SEC. 210•211•230•226•140

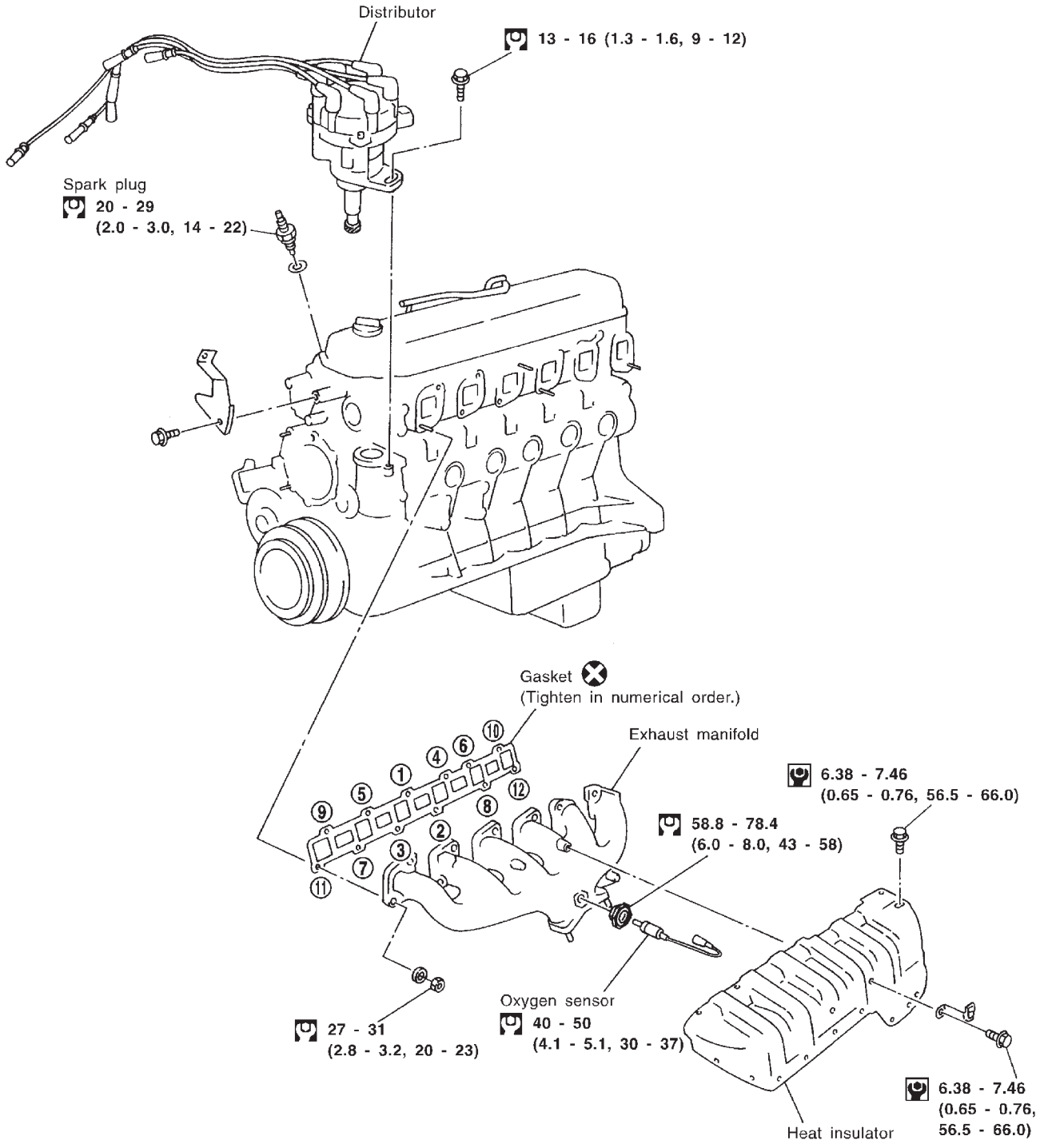


: N•m (kg-m, in-lb)

: N•m (kg-m, ft-lb)

SEM736F

SEC. 140•210•220•221

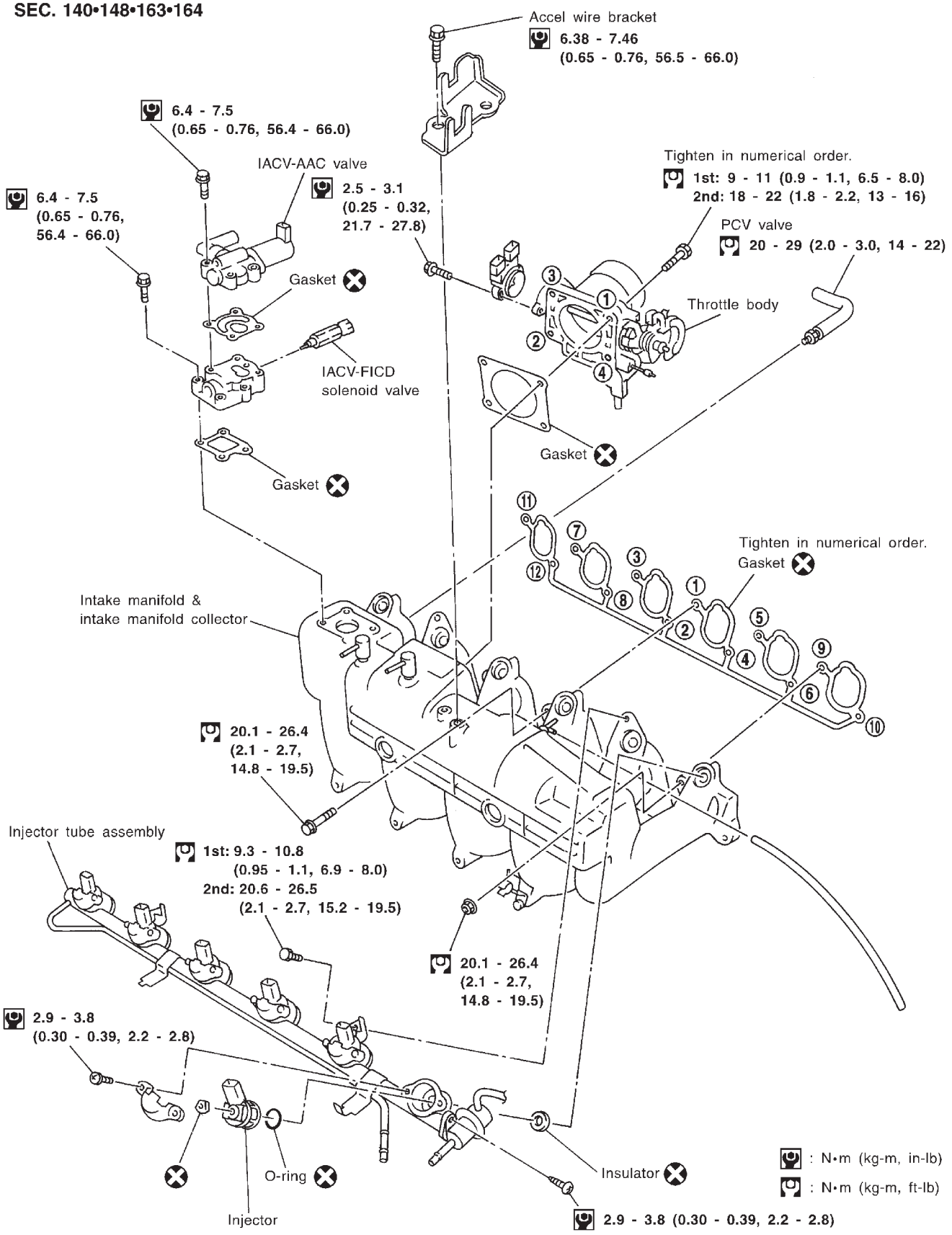


: N•m (kg-m, in-lb)

: N•m (kg-m, ft-lb)

SEM737F

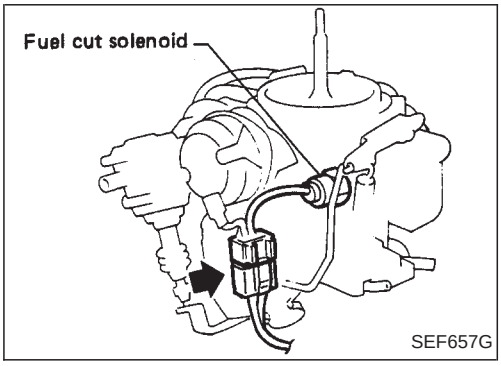
SEC. 140•148•163•164



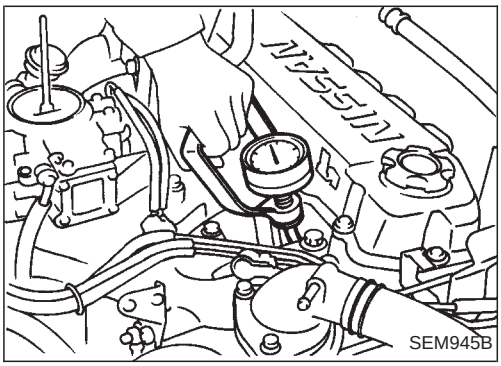
SEM738F

Measurement of Compression Pressure

1. Warm up engine.
2. Turn ignition switch OFF.
3. Remove air cleaner and all spark plugs.
4. Disconnect distributor center cable.



5. Disconnect fuel cut solenoid valve connector.



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

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

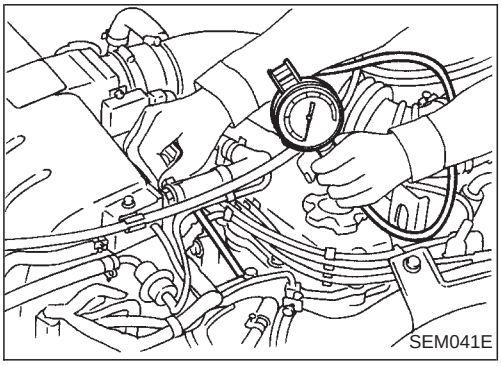
Compression pressure: kPa (bar, kg/cm^2, psi)/rpm
Standard
1,177 (11.77, 12.0, 171)/200
Minimum
883 (8.83, 9.0, 128)/200
Difference limit between cylinders:
98 (0.98, 1.0, 14)/200

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

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

Measurement of Compression Pressure

1. Warm up engine.
2. Turn ignition switch OFF.
3. Release fuel pressure.
   Refer to “Releasing Fuel Pressure” in EC section.
4. Remove air cleaner and all spark plugs.
5. Disconnect distributor center cable.



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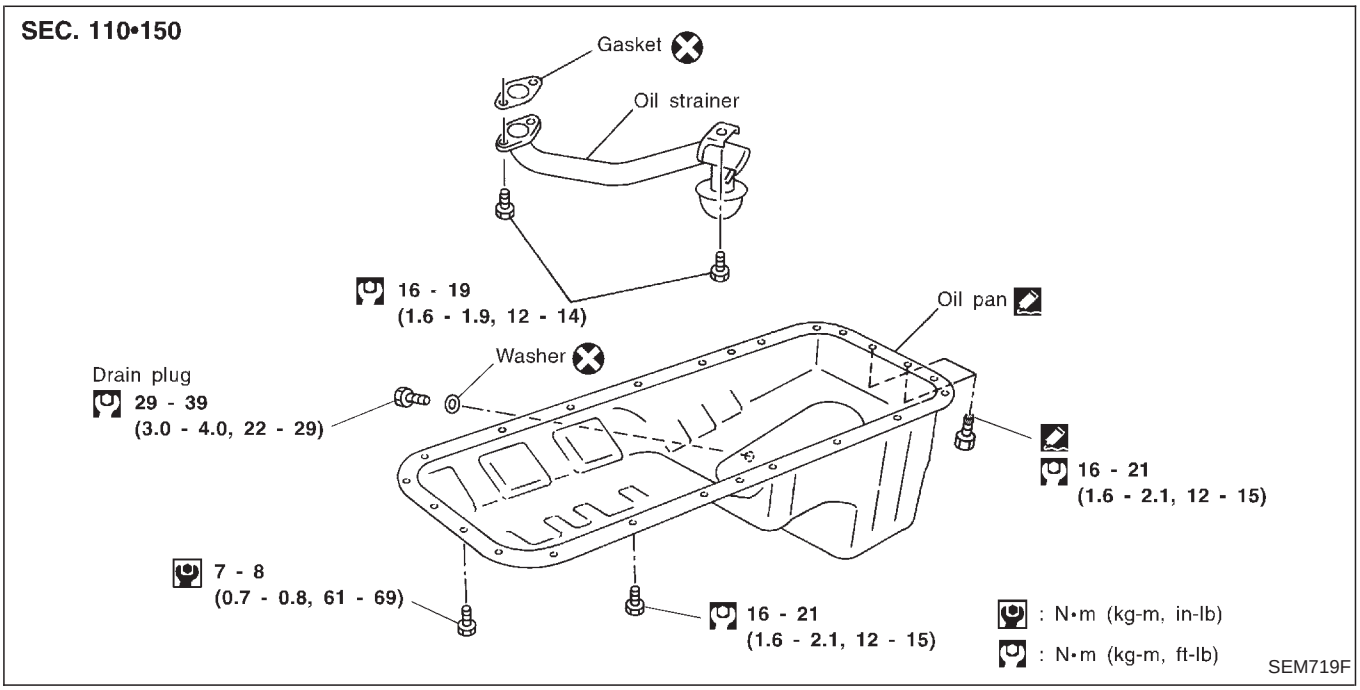
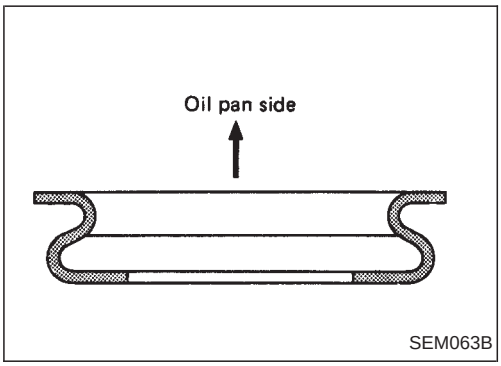
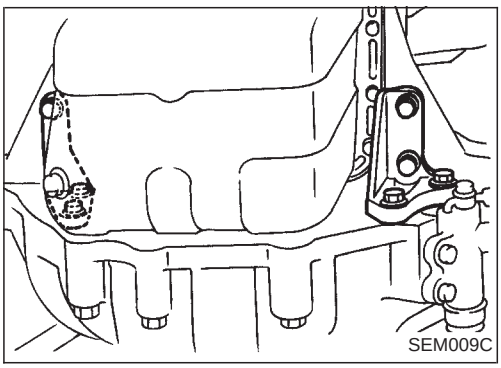


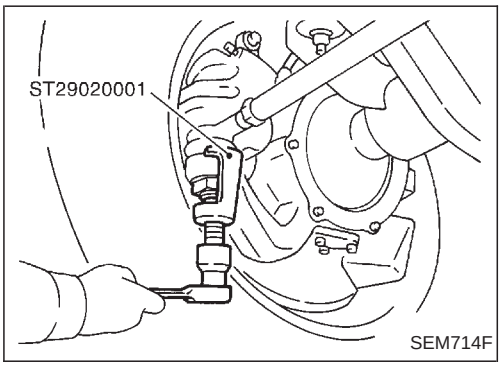


Removal

1. Drain engine oil.
- When installing drain plug washer, make sure it faces correct direction.

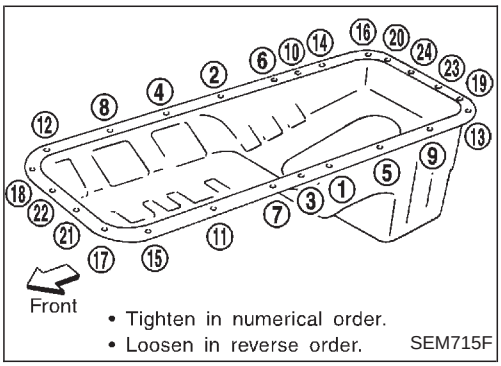


2. Remove engine gussets.

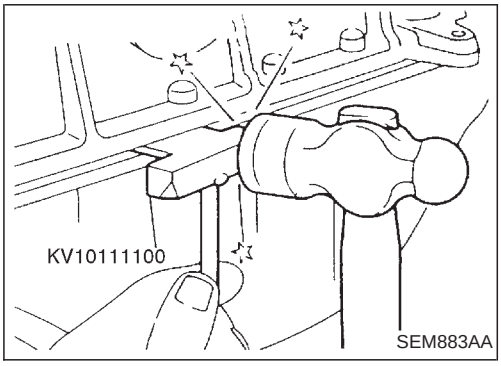


3. Remove left side of the tie rod end.

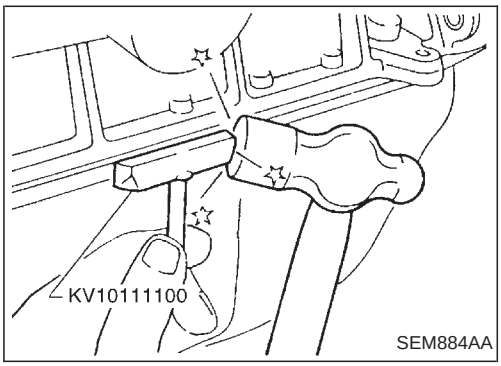
Removal (Cont'd)



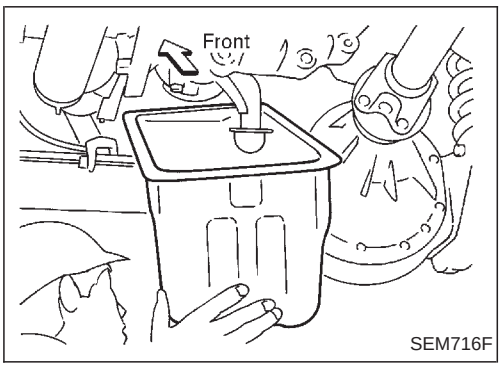
4. Remove oil pan bolts in numerical order.



5. Insert Tool between cylinder block and oil pan.
- **Do not insert screwdriver, or oil pan flange will be deformed.**
- **Do not insert Tool into rear oil seal retainer portion; otherwise, it will be damaged.**

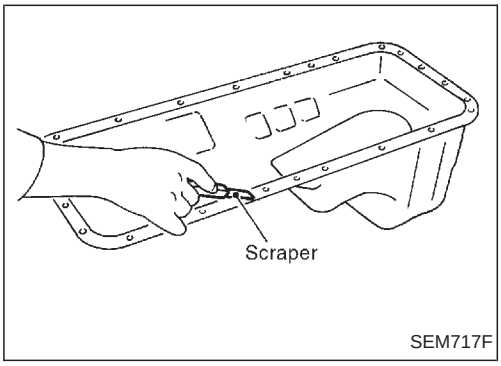


6. Slide Tool by tapping its side with a hammer.



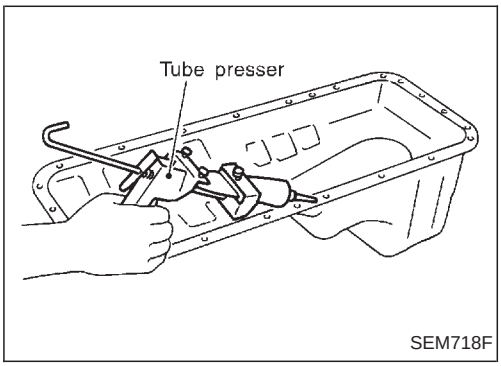
7. Remove oil pan.

Installation



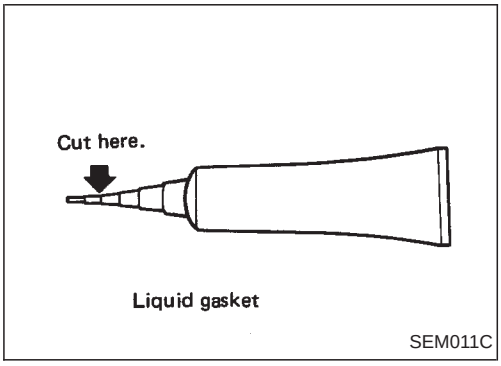
1. Before installing oil pan, remove all traces of liquid gasket from mating surface using a scraper.
- **Also remove traces of liquid gasket from mating surface of cylinder block.**

Installation (Cont'd)



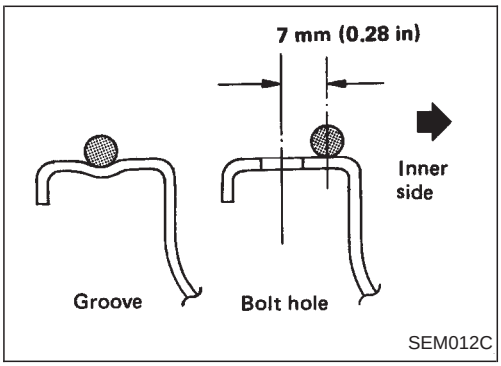
SEM718F

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



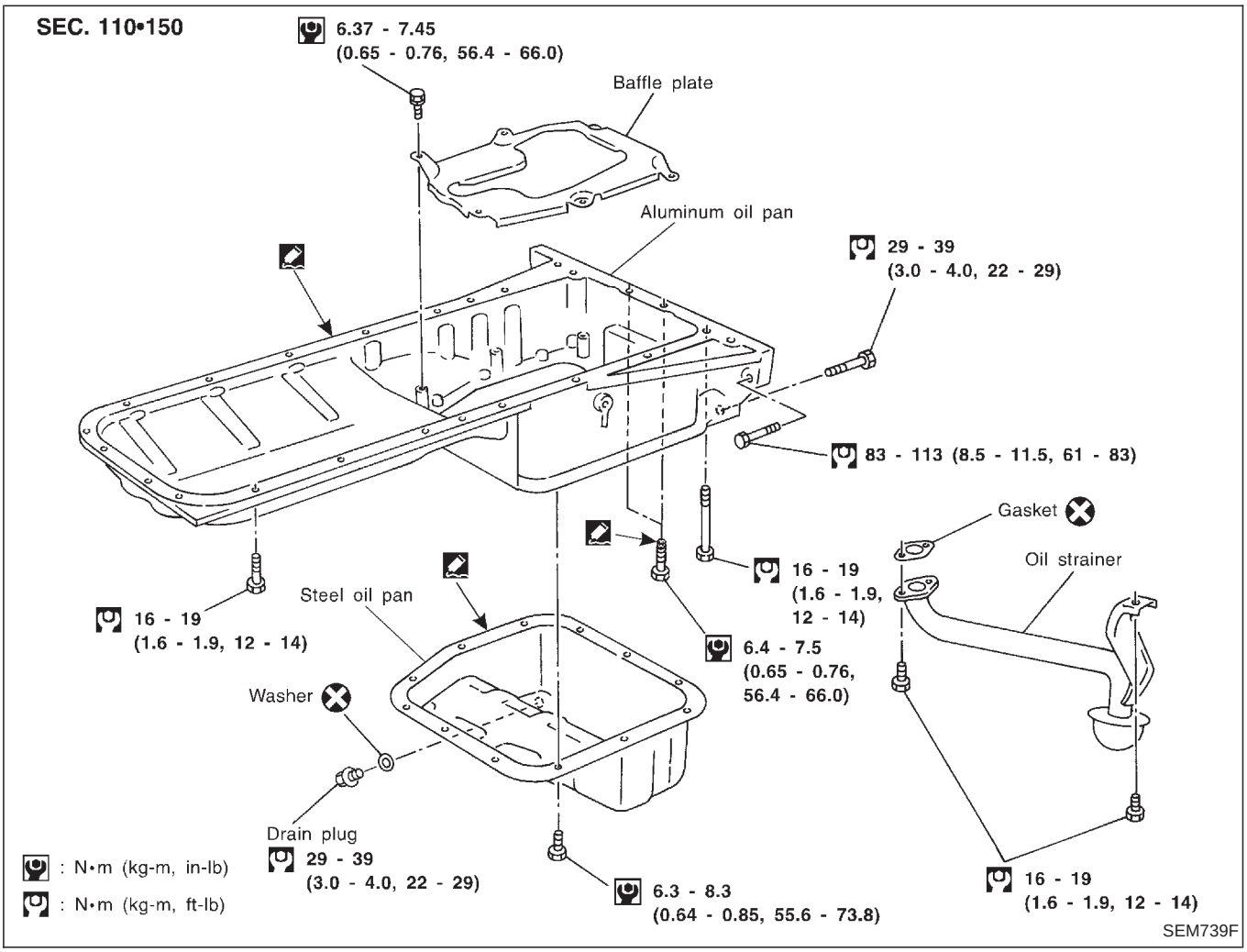
SEM011C

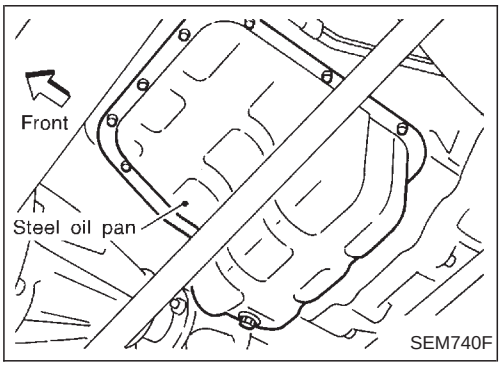
- **Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.**



SEM012C

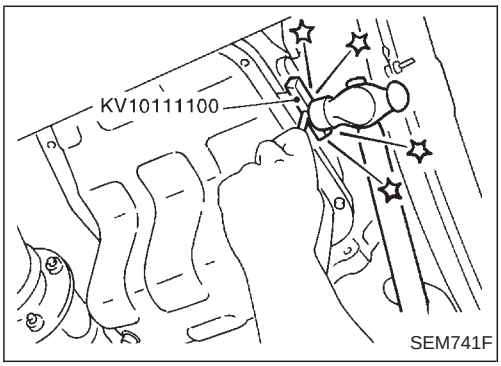
3. Apply liquid gasket to inner sealing surface instead of surface where there is no groove at bolt hole.
- **Attaching should be done within 5 minutes after coating.**
4. Install oil pan.
- Install parts in reverse order of removal.
- **Wait at least 30 minutes before refilling engine oil.**





Removal

1. Remove engine undercover.
2. Drain engine oil.
3. Remove steel oil pan bolts.

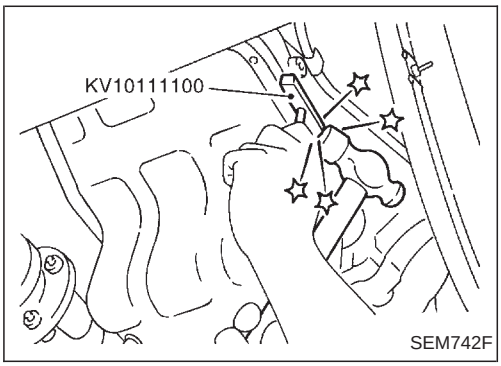


4. Remove steel oil pan.

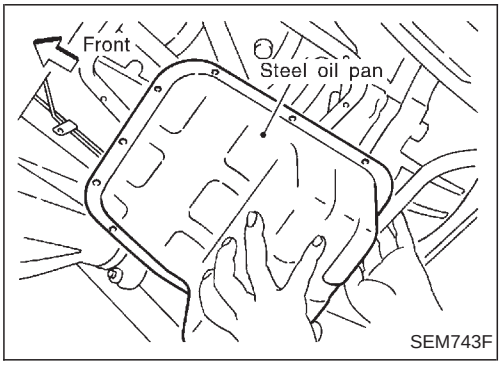
a. Insert Tool between aluminum oil pan and steel oil pan.

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

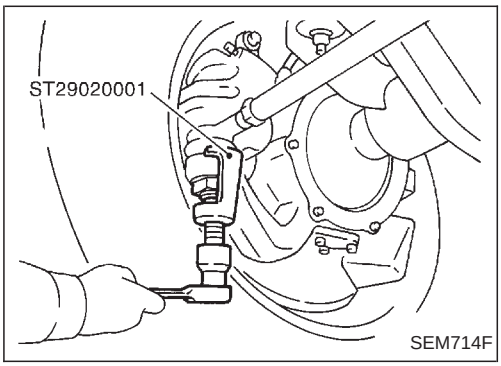
Removal (Cont'd)



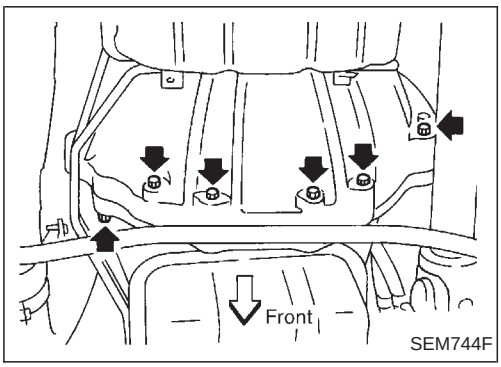
b. Slide Tool by tapping on the side of the Tool with a hammer.



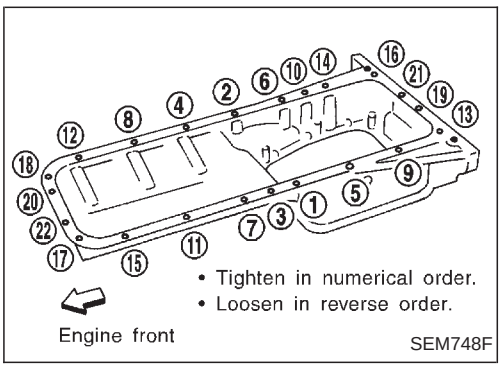
5. Remove steel oil pan.



6. Remove left side of the tie rod end.

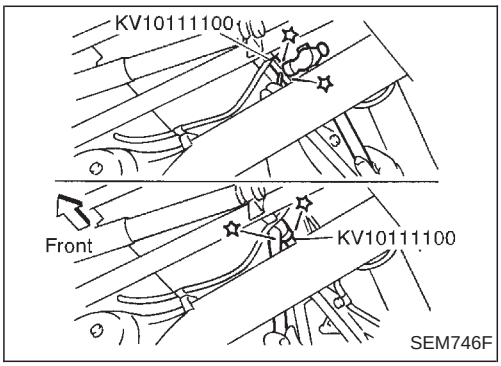


7. Remove transmission bolts.



8. Remove aluminum oil pan bolts.

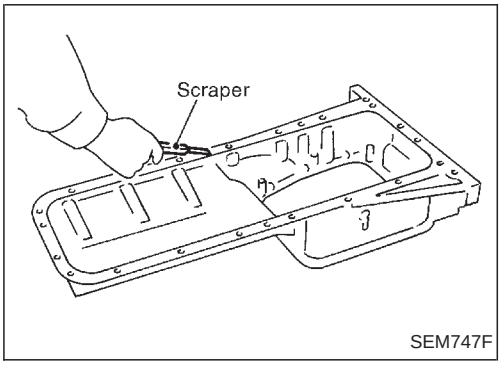
Removal (Cont'd)



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

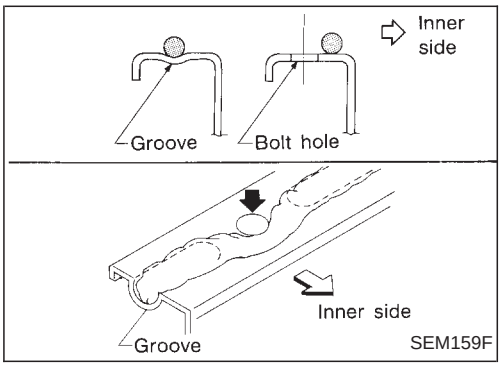
10. Remove oil strainer.

Installation

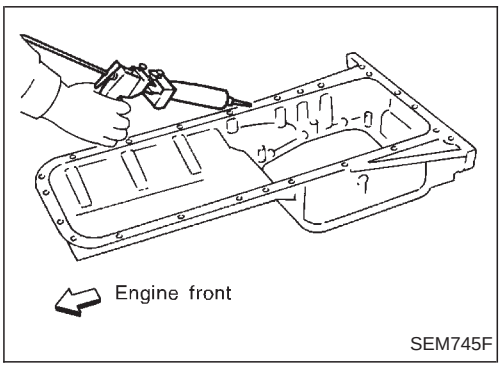


1. Install aluminum oil pan.

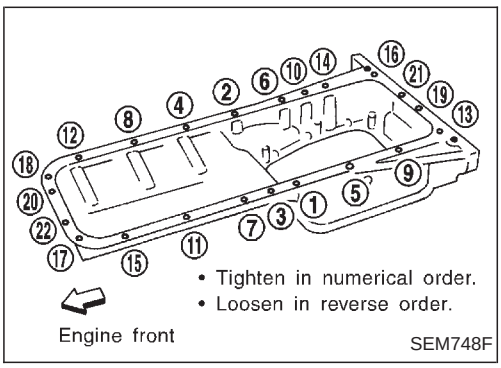
a. Use a scraper to remove all traces of liquid gasket from mating surfaces.
- Also remove traces of liquid gasket from mating surface of cylinder block, front cover and steel oil pan.
- **Remove old liquid gasket from the bolt hole and thread.**



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

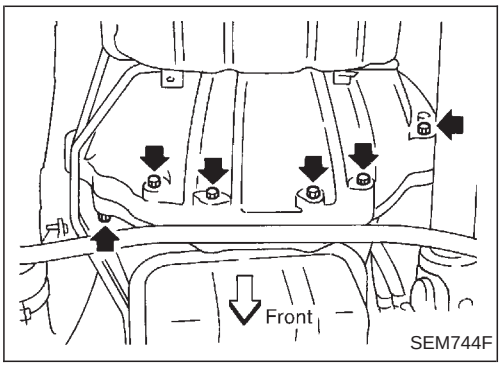


c. Apply liquid gasket to inner sealing surface as shown in figure.
- **Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in).**
- **Attaching should be done within 5 minutes after coating.**



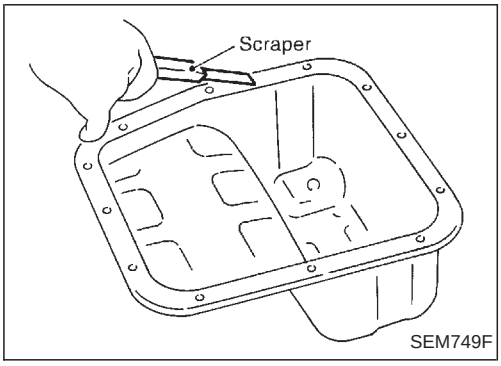
d. Install oil strainer.
e. Install aluminum oil pan.
- Tighten bolts in numerical order.
- **Wait at least 30 minutes before refilling engine oil.**

Installation (Cont'd)



SEM744F

2. Install the transmission bolts.

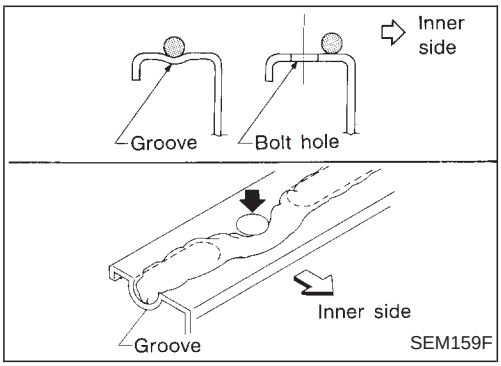


SEM749F

3. Install steel oil pan.

a. Use a scraper to remove all traces of liquid gasket from mating surfaces.

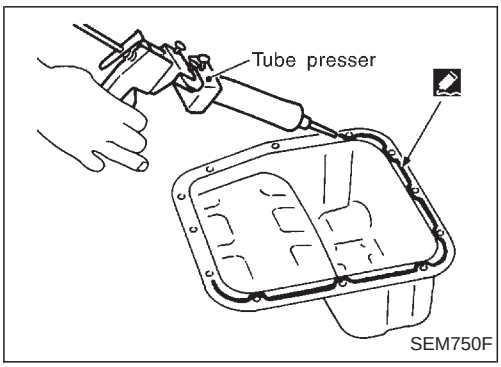
- Also remove traces of liquid gasket from mating surface of aluminum oil pan.



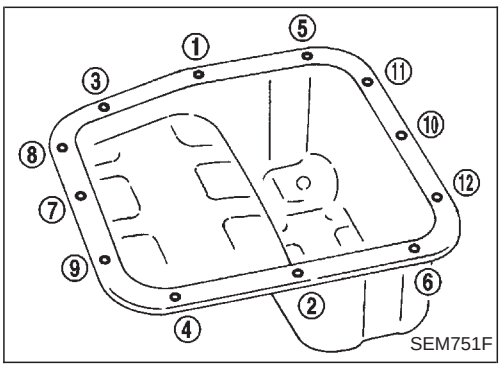
SEM159F

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

- **Use Genuine Liquid Gasket or equivalent.**
- **Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.**
- **Attaching should be done within 5 minutes after coating.**



SEM750F



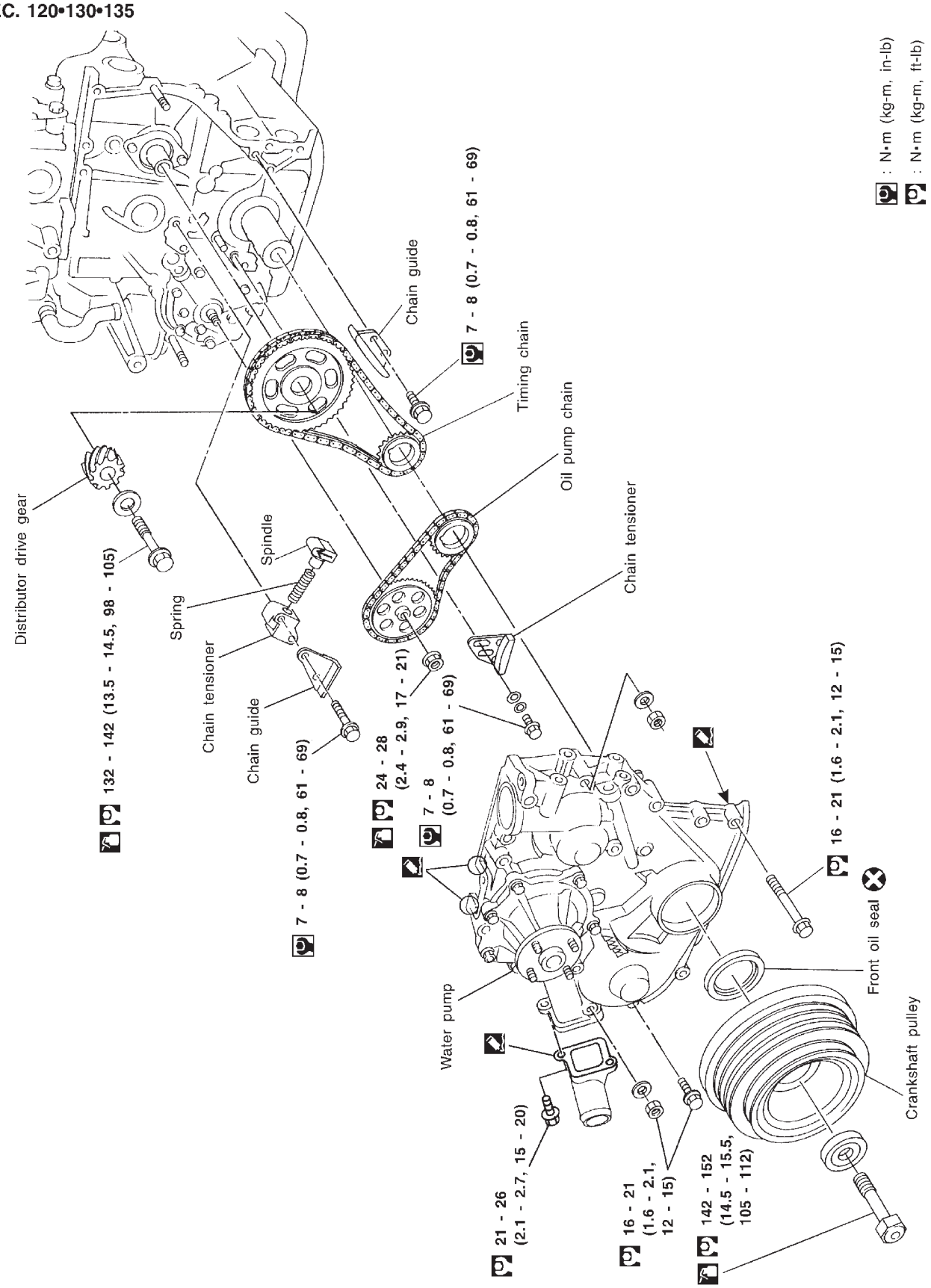
SEM751F

c. Install steel oil pan.

- **Tighten in numerical order as shown in the figure.**
- **Wait at least 30 minutes before refilling engine oil.**

4. Install left side of the tie rod end.

SEC. 120•130•135



SEM720F

CAUTION:

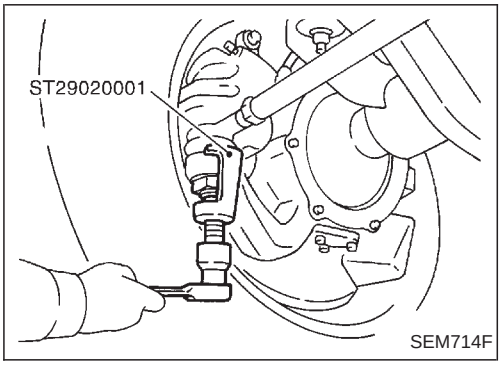
- **After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.**
- **When tightening camshaft bolt, oil pump sprocket nuts and crankshaft pulley bolt, apply new engine oil to the threaded portions and seat surfaces of bolts or nuts.**

Removal

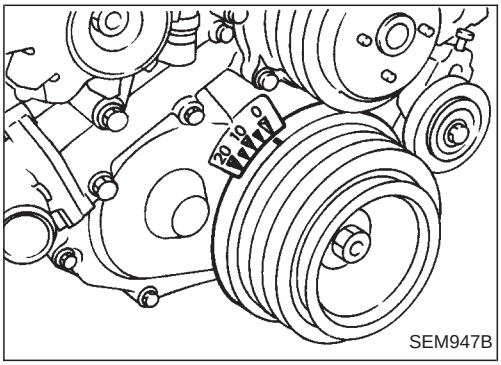
1. Disconnect battery terminal.
2. Drain engine oil.
3. Drain coolant from radiator and cylinder block.
   Refer to MA section (“Changing Engine Coolant”, “ENGINE MAINTENANCE”).

Be careful not to spill coolant on drive belts.

4. Remove the following belts.
   - Power steering drive belt
   - Alternator drive belts
   - Compressor drive belt
5. Remove radiator and radiator shroud.
6. Remove fan coupling with fan.
7. Remove power steering pump and power steering bracket.
8. Remove A/C compressor idler pulley.
9. Remove alternator and alternator bracket.

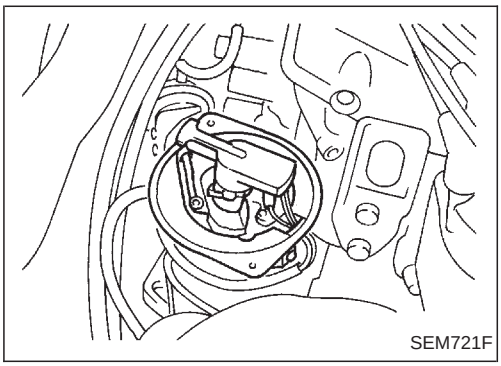


10. Remove left side of the tie rod end.
11. Remove oil pan. (Refer to “Removal” of OIL PAN, EM-18.)

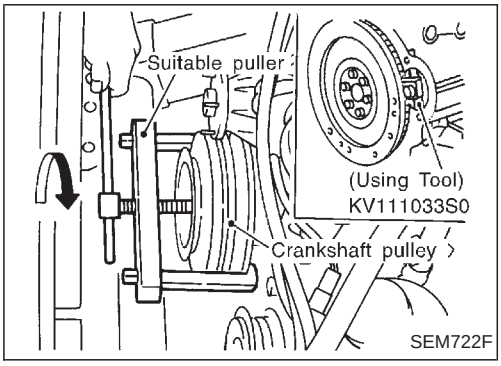


12. Set No. 1 piston at TDC on its compression stroke.

Removal (Cont'd)

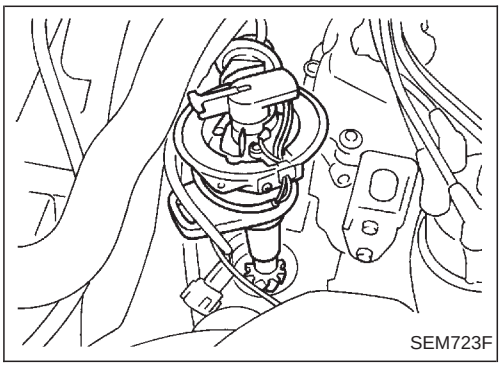

SEM721F

13. Remove crankshaft pulley bolt.
14. Remove crankshaft pulley with a suitable puller.

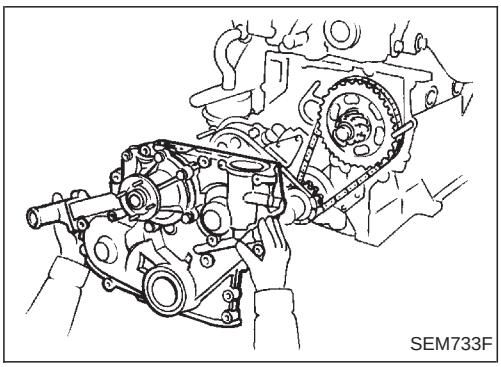


SEM722F

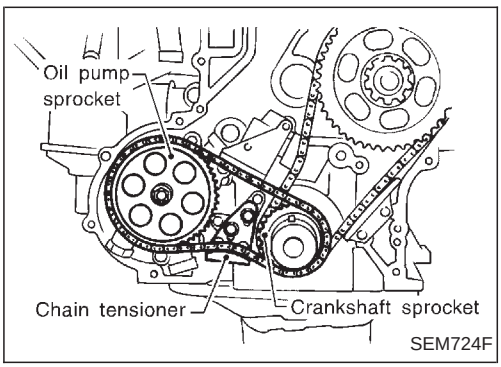
15. Remove distributor.


SEM723F

16. Remove front cover assembly.

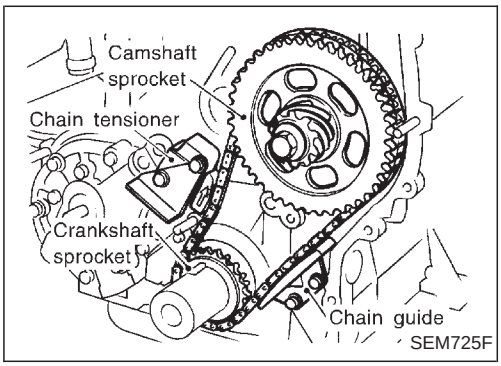

SEM733F

17. Remove the following parts.
- Chain tensioner
- Oil pump chain and sprocket



SEM724F

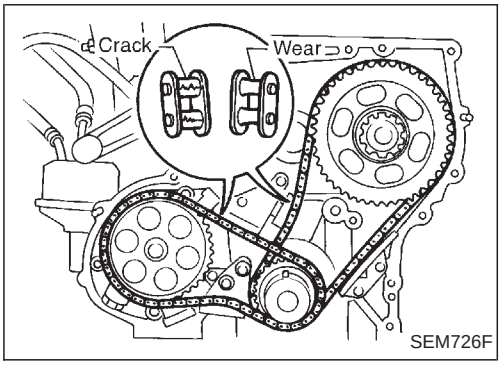
Removal (Cont'd)



18. Remove the following parts.
- Chain tensioner
- Chain guides
- Timing chain and sprocket

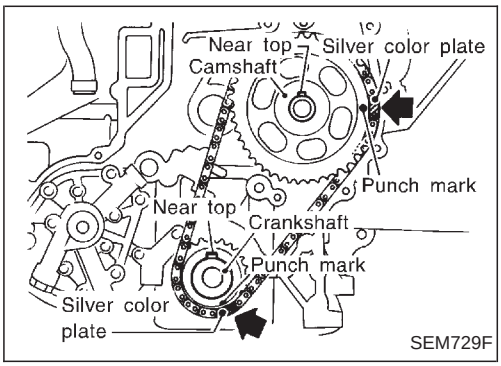
Carefully remove chain tensioner. Otherwise, spring may fall.

Inspection

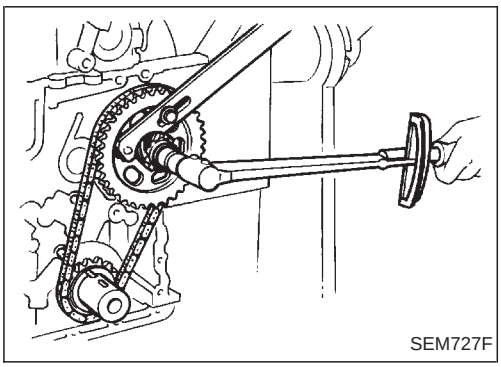


Check for cracks and excessive wear at roller links. Replace if necessary.

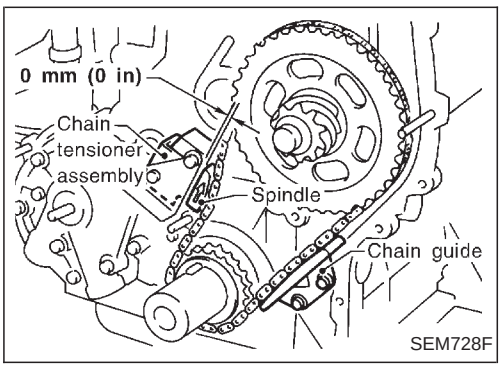
Installation



1. Install camshaft sprocket and timing chain.
- Confirm that No. 1 cylinder is set at TDC on its compression stroke.
- **Set timing chain by aligning its mating marks with those of crankshaft sprocket and camshaft sprocket.**

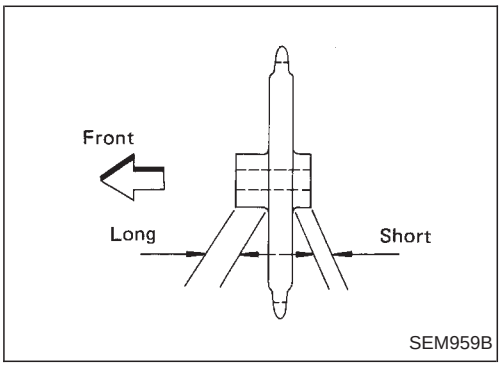


2. Tighten camshaft sprocket bolt.



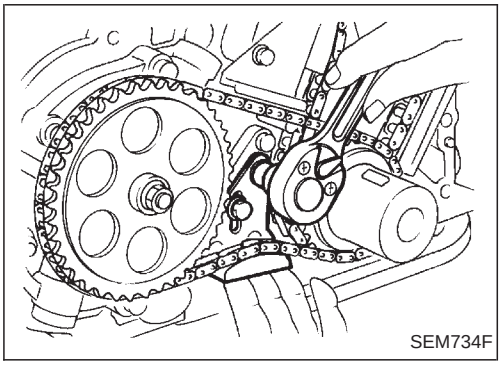
3. Install chain tensioner and chain guides.
- **Adjust protrusion of timing chain tensioner spindle to 0 mm (0 in) with slack chain guide.**

Installation (Cont'd)

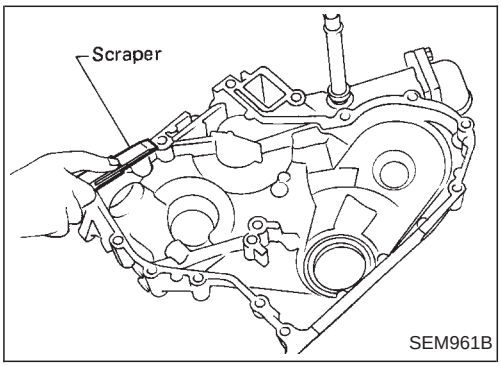


SEM959B

4. Install oil pump sprocket and oil pump chain.

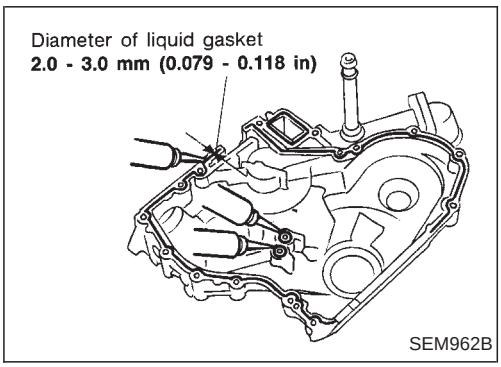

SEM734F

5. Install oil pump chain tensioner.
   Tighten bolts while applying pressure to oil pump chain with one hand.



SEM961B

6. Before installing front cover, remove all traces of liquid gasket from mating surface using a scraper.



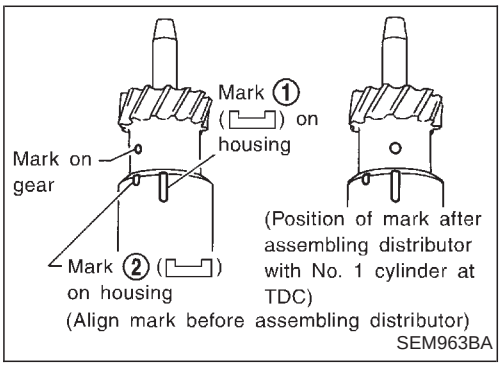
SEM962B

7. Apply a continuous bead of liquid gasket to front cover.
   - **Use Genuine Liquid Gasket or equivalent.**

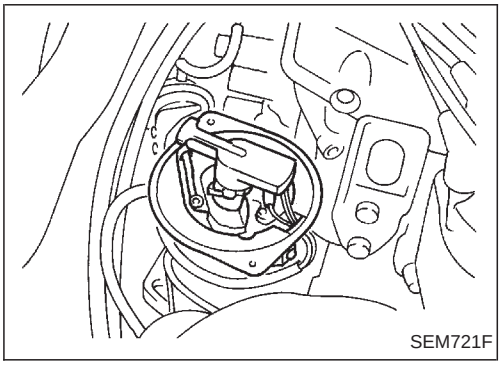
   a. Coat of liquid gasket should be maintained within 2.0 to 3.0 mm (0.079 to 0.118 in) dia. range.
   b. Attach front cover to cylinder block within 5 minutes after coating.
   c. Wait at least 30 minutes before refilling engine oil or starting engine.

8. Install front cover.
   Be careful not to damage cylinder head gasket.
9. Install oil pan.
   Refer to Installation of OIL PAN.
10. Install crankshaft pulley.

Installation (Cont'd)

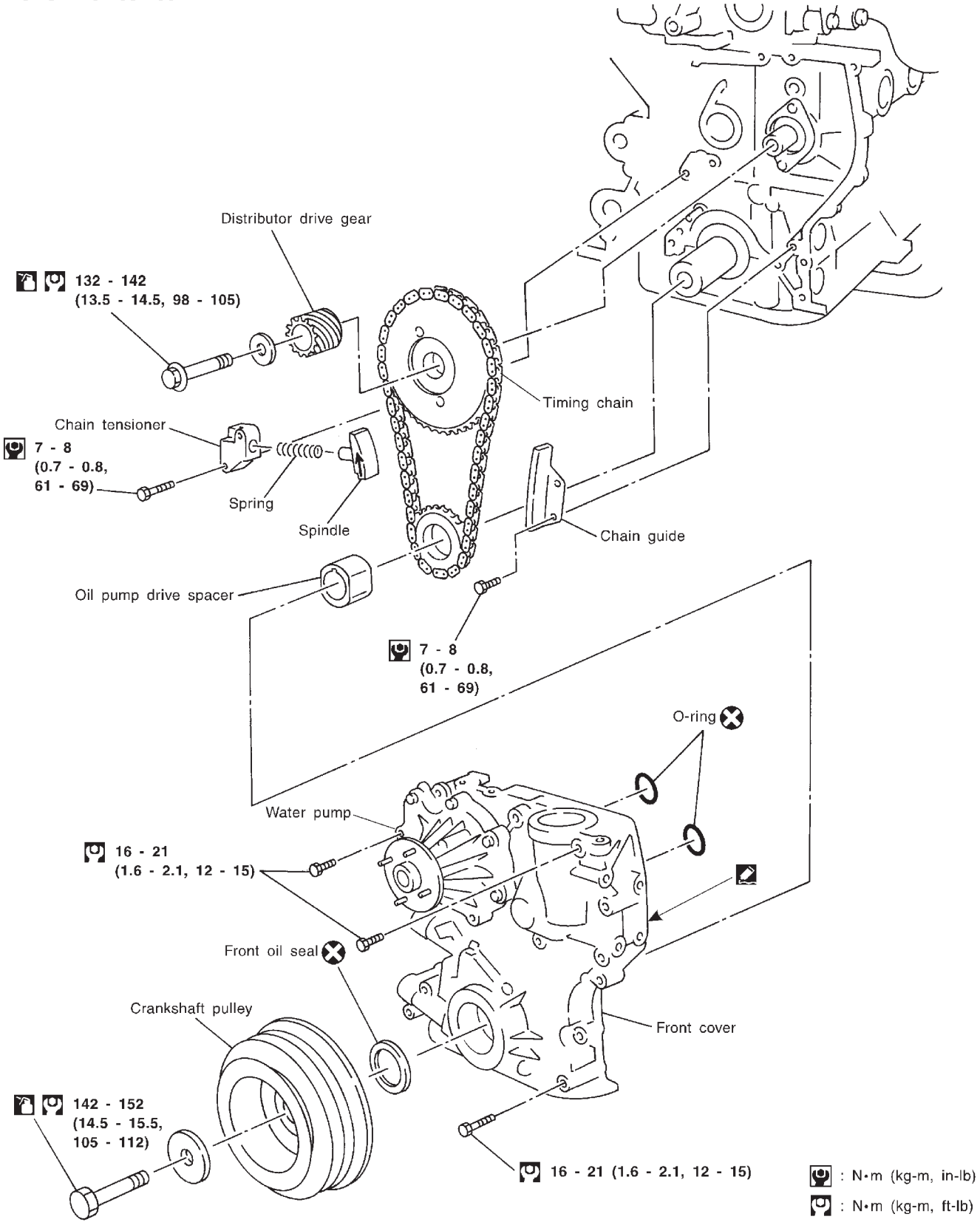


11. Install distributor.
    Set the distributor gear position.
    [Be sure mark ② (⌐¬) on housing is aligned with mark on gear.]



12. Make sure that No. 1 cylinder is set at TDC and that distributor rotor is set at No. 1 cylinder spark position.

SEC. 120•130•135



SEM752F

CAUTION:

- **After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.**
- **When tightening camshaft bolt and crankshaft pulley bolt, apply new engine oil to the threaded portions and seat surfaces of bolts or nuts.**

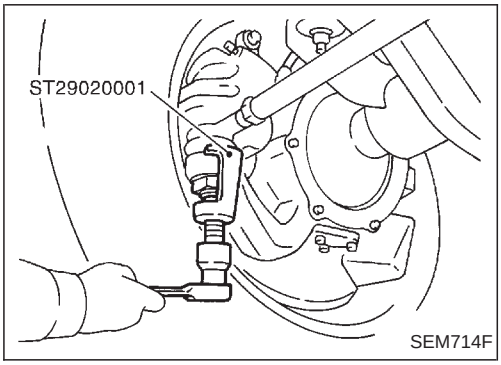
Removal

1. Disconnect battery terminal.
2. Drain engine oil.
3. Drain coolant from radiator and cylinder block.
   Refer to MA section (“Changing Engine Coolant”, “ENGINE MAINTENANCE”).

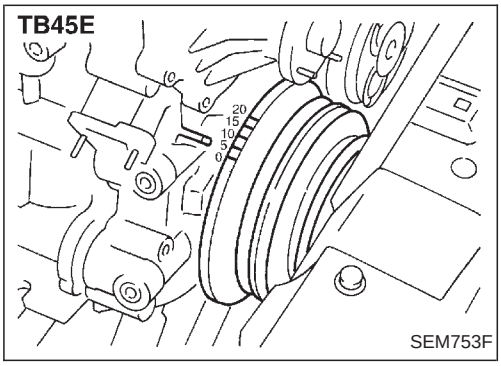
Be careful not to spill coolant on drive belts.

4. Remove the following belts.
- Power steering drive belt
- Alternator drive belts
- Compressor drive belt

5. Remove radiator and radiator shroud.
6. Remove fan coupling with fan.
7. Remove power steering pump and power steering bracket.
8. Remove A/C compressor idler pulley.
9. Remove alternator and alternator bracket.

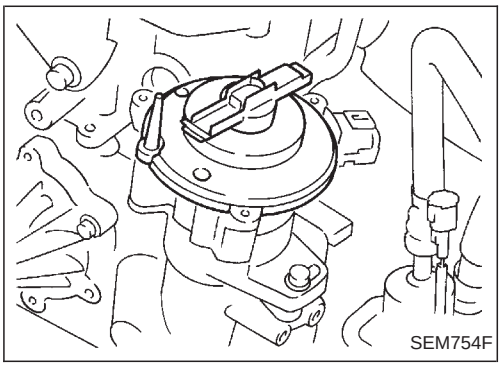


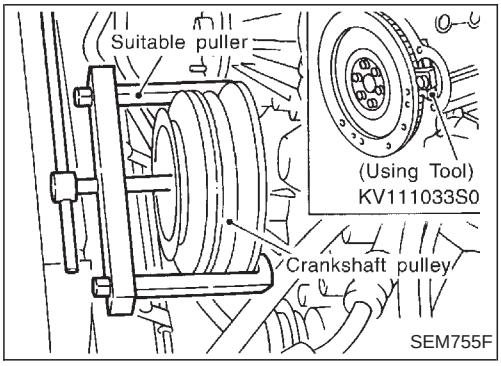
10. Remove left side of the tie rod end.
11. Remove oil pans. Refer to “Removal” of OIL PAN.



12. Set No. 1 piston at TDC on its compression stroke.

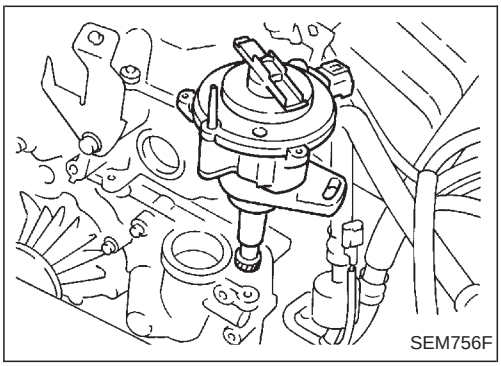
Removal (Cont'd)


SEM754F

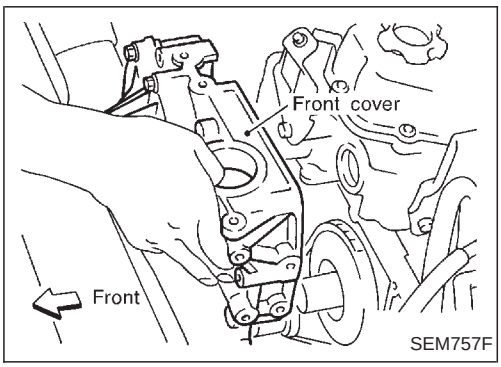


SEM755F

13. Remove crankshaft pulley bolt.
14. Remove crankshaft pulley with a suitable puller.

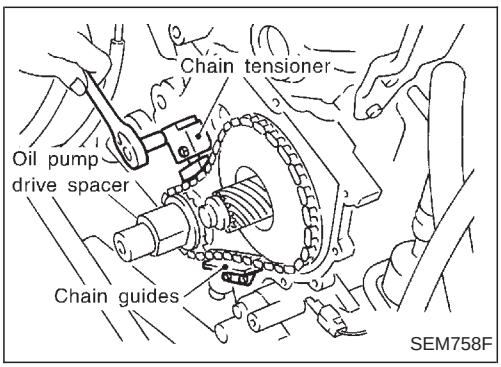

SEM756F

15. Remove distributor.



SEM757F

16. Remove front cover assembly.

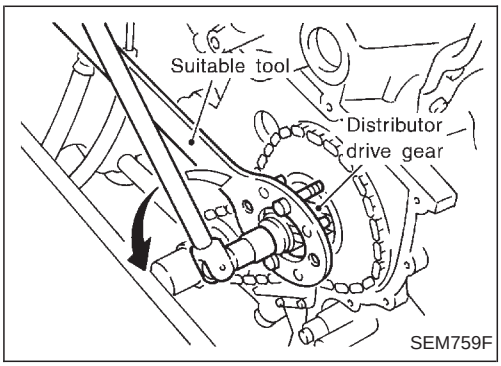


SEM758F

17. Remove the following parts.
- Chain tensioner
- Chain guides
- Oil pump drive spacer

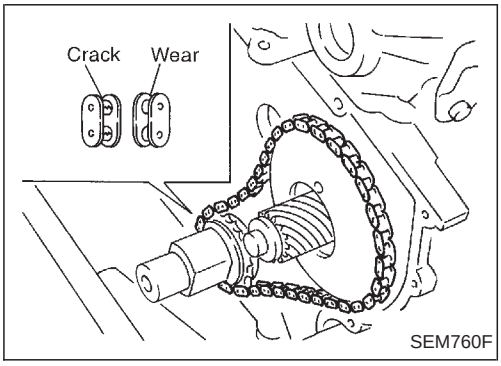
Carefully remove chain tensioner. Otherwise, spring may fall.

Removal (Cont'd)



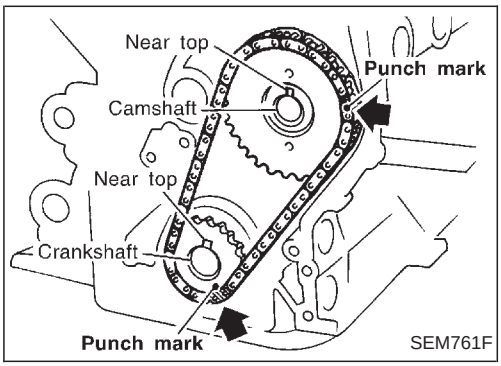
18. Remove oil pump drive spacer.
19. Remove camshaft sprocket bolt and distributor drive gear.
20. Remove crankshaft sprocket, camshaft sprocket and timing chain.
21. Remove O-rings from front cover.

Inspection

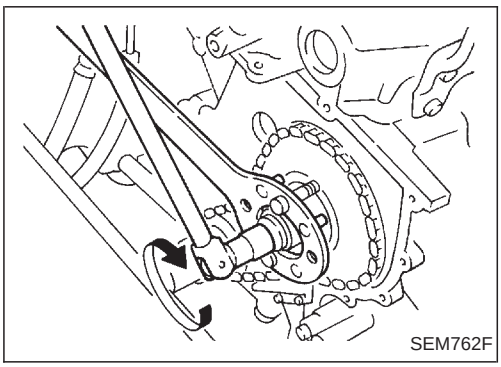


Check for cracks and excessive wear at roller links. Replace if necessary.

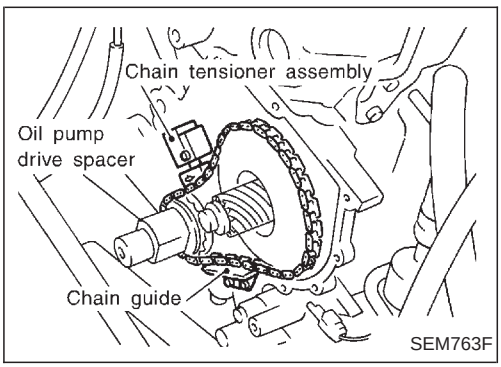
Installation



1. Install crankshaft sprocket, camshaft sprocket and timing chain.
- Confirm that No. 1 cylinder is set at TDC on its compression stroke.
- **Set timing chain by aligning its mating marks with those of crankshaft sprocket and camshaft sprocket.**

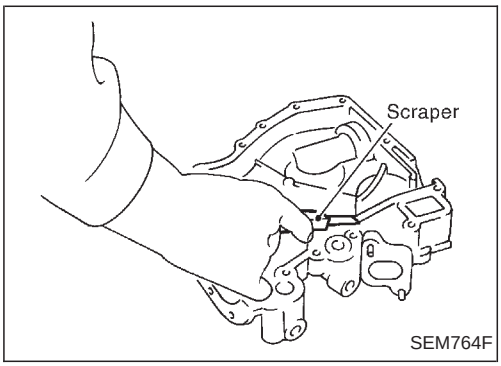


2. Install distributor drive gear.
3. Tighten camshaft sprocket bolt.

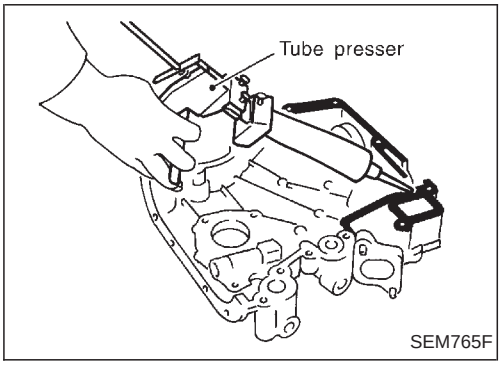


4. Install chain tensioner and chain guides.
5. Install oil pump drive spacer.

Installation (Cont'd)

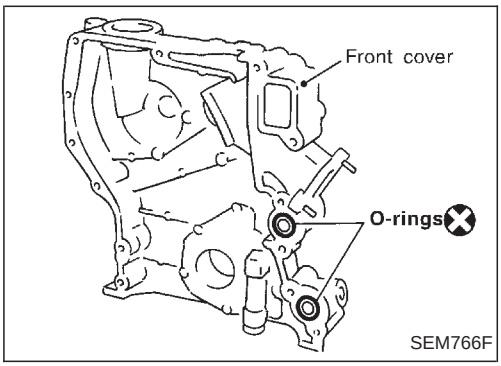


6. Before installing front cover, remove all traces of liquid gasket from mating surface using a scraper.



7. Apply a continuous bead of liquid gasket to front cover.
- **Use Genuine Liquid Gasket or equivalent.**

a. Coat of liquid gasket should be maintained within 2.0 to 3.0 mm (0.079 to 0.118 in) dia. range.
b. Attach front cover to cylinder block within 5 minutes after coating.
c. Wait at least 30 minutes before refilling engine oil or starting engine.



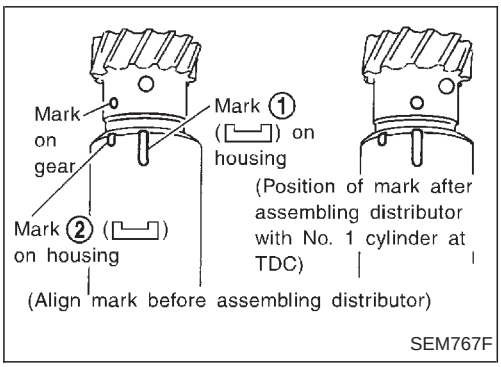
8. Install O-rings on front cover.
9. Install front cover.

Be careful not to damage cylinder head gasket.

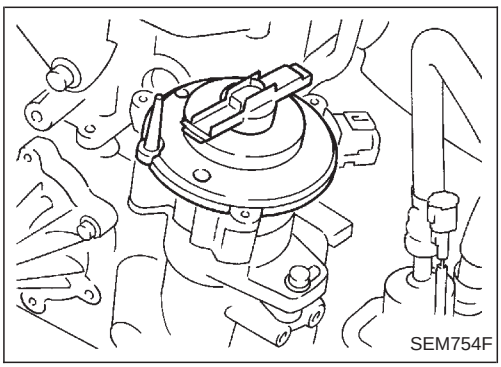
10. Install oil pan.

Refer to Installation of OIL PAN.

11. Install crankshaft pulley.



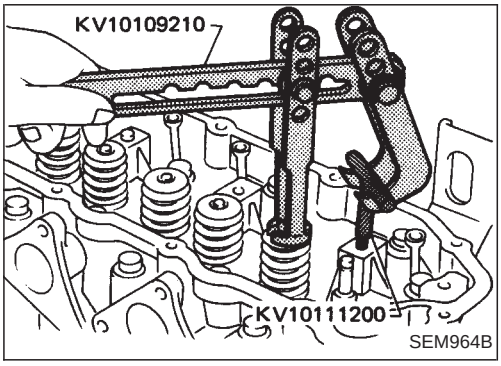
12. Install distributor.
Set the distributor gear position.
[Be sure mark ② (⌴) on housing is aligned with mark on gear.]



13. Make sure that No. 1 cylinder is set at TDC and that distributor rotor is set at No. 1 cylinder spark position.

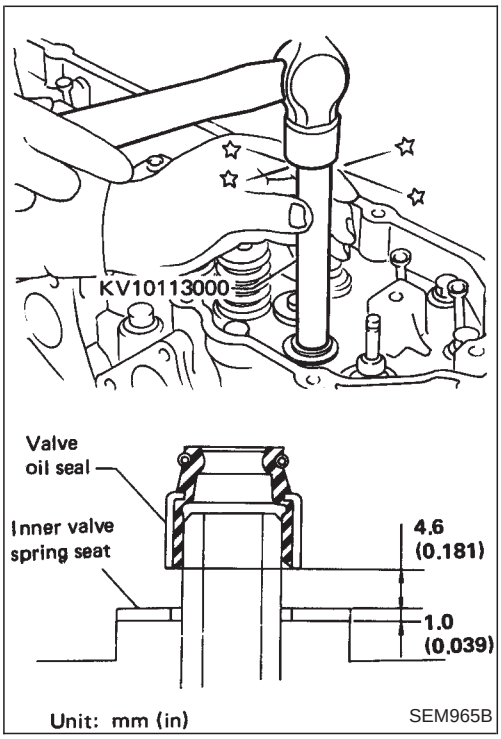
VALVE OIL SEAL

1. Remove air cleaner and air duct.
2. Remove rocker cover.
3. Remove rocker shaft assembly.



4. Remove valve springs and valve oil seals with Tool.

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

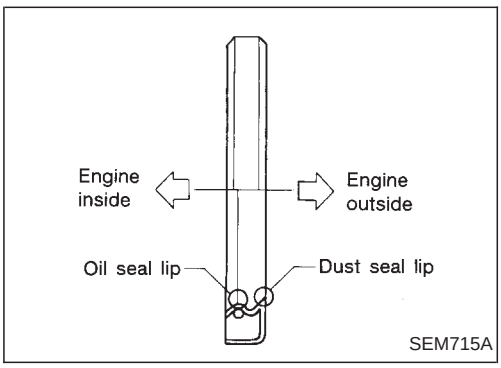


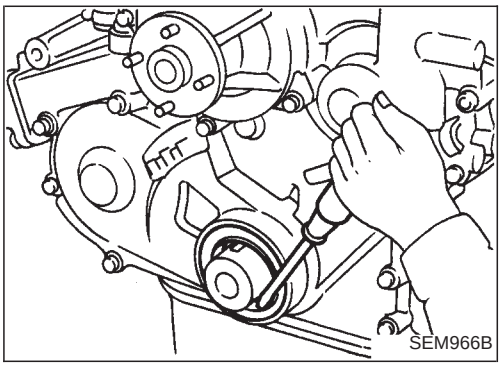
5. Apply engine oil to new valve oil seal and install it with Tool.

- **Before installing valve oil seal, install inner valve spring seat.**

OIL SEAL INSTALLING DIRECTION

- When installing a new front seal, make sure its mounting direction is correct.



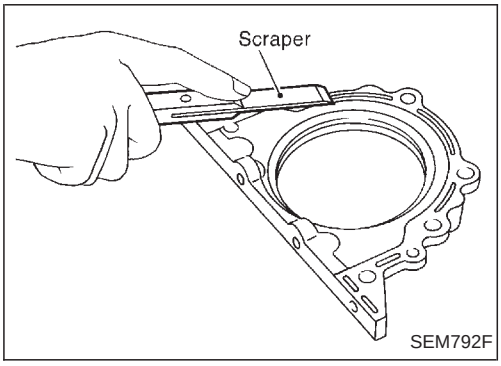

SEM966B

CRANKSHAFT FRONT OIL SEAL

1. Remove radiator and radiator shroud.
2. Remove drive belts.
3. Remove cooling fan.
4. Remove crankshaft pulley.
5. Remove crankshaft oil seal.

- **Be careful not to damage sealing surfaces of crankshaft.**

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

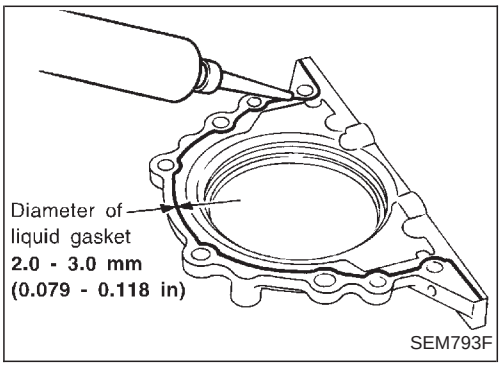


SEM792F

REAR OIL SEAL

1. Remove clutch cover assembly. Refer to CL section.
2. Remove flywheel or drive plate.
3. Remove rear oil seal retainer assembly.
4. Remove traces of liquid gasket using scraper.

- **Replace oil seal and retainer assembly as a single unit.**



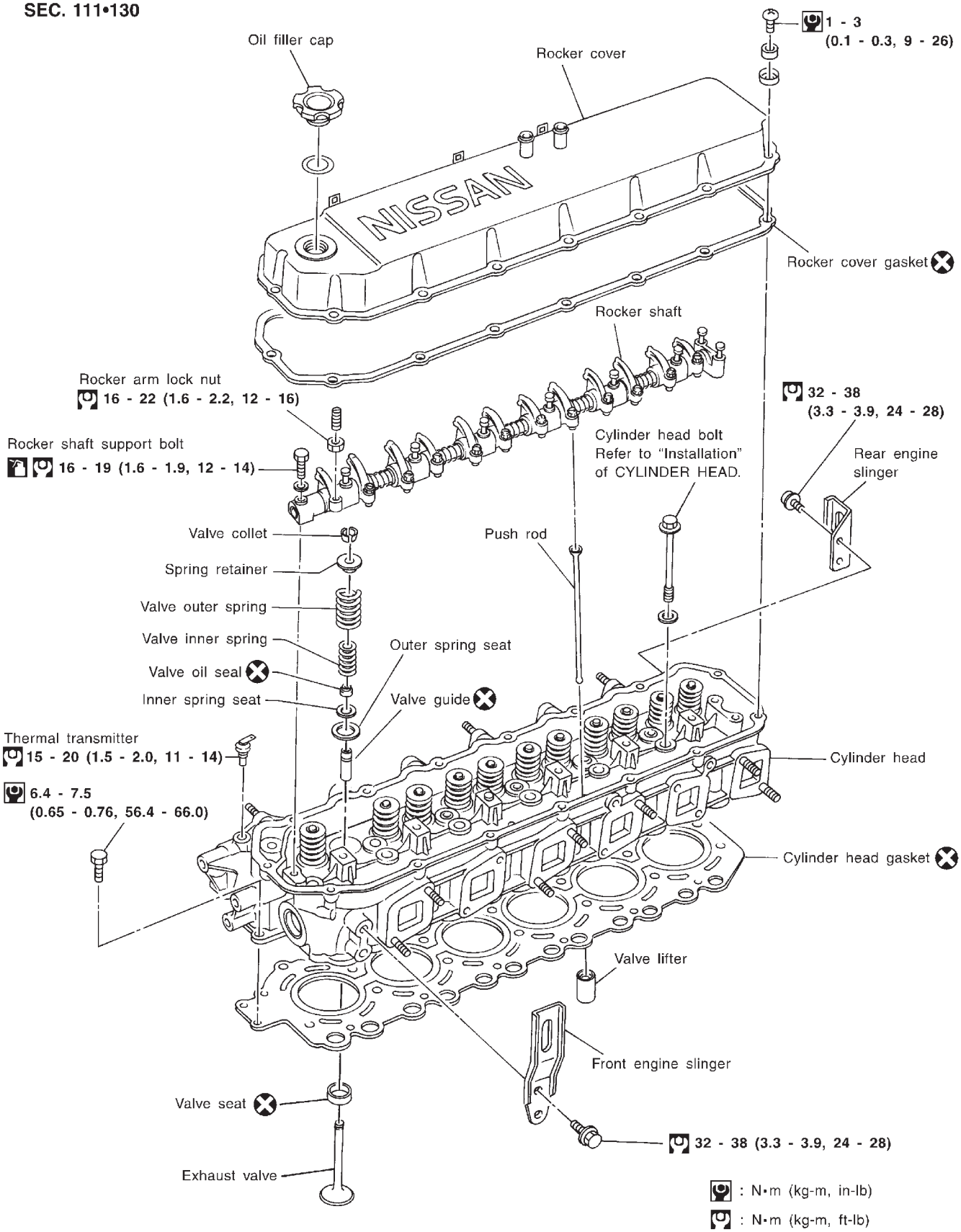
SEM793F

5. Apply a continuous bead of liquid gasket to mating surface of rear oil seal retainer.

- **Use Genuine Liquid Gasket or equivalent.**

a. Coat of liquid gasket should be maintained within 2.0 to 3.0 mm (0.079 to 0.118 in) dia. range.
b. Attach oil seal retainer to cylinder block within 5 minutes after coating.
c. Wait at least 30 minutes before refilling engine oil or starting engine.

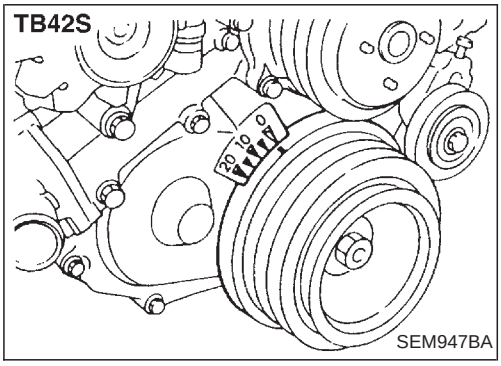
SEC. 111•130

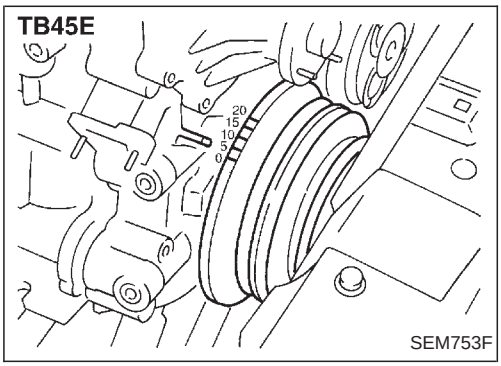


SEM774F

CAUTION:

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





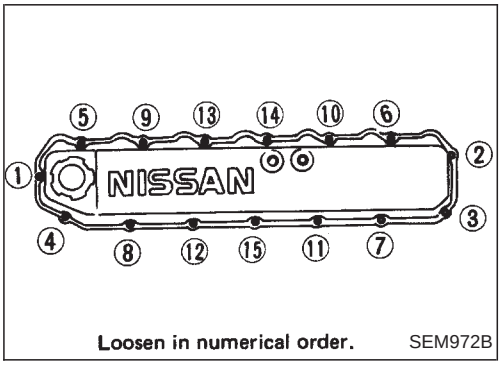
Removal

1. Release fuel pressure. Refer to “Releasing Fuel Pressure” in EC section, TB45E engine.
2. Drain coolant from radiator and cylinder block. Refer to MA section (“Changing Engine Coolant”, “ENGINE MAINTENANCE”).

Be careful not to spill coolant on drive belts.

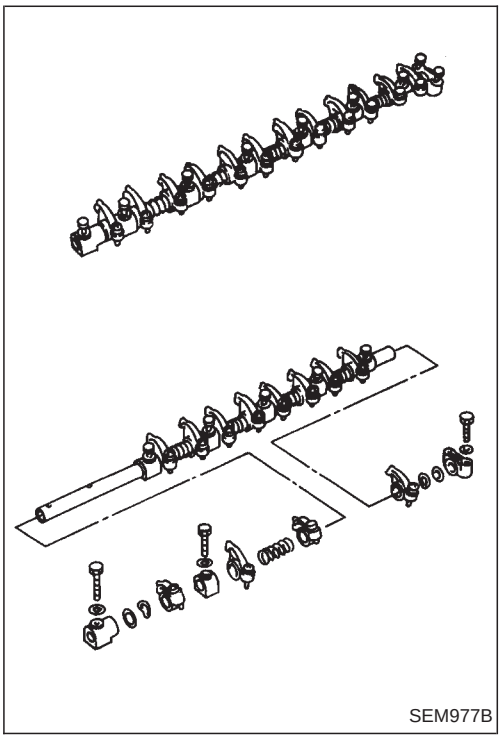
3. Remove the following parts.
- Air cleaner and duct
- Disconnect vacuum hoses, harness, water hoses and fuel hose
- Disconnect high tension wires from spark plugs
- Disconnect accelerator wire
- Alternator adjusting bar

4. Disconnect front exhaust tube from exhaust manifold.
5. Set No. 1 piston at TDC on its compression stroke.



6. Remove rocker cover.
- Loosen rocker cover bolts in numerical order.

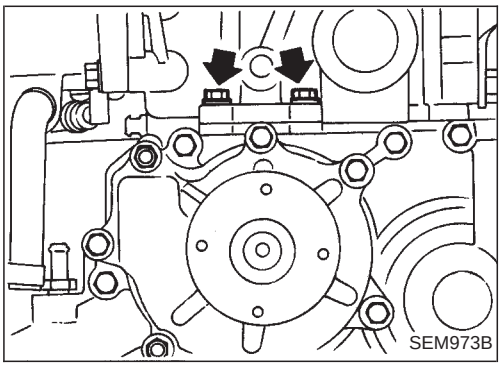
Removal (Cont'd)


SEM977B

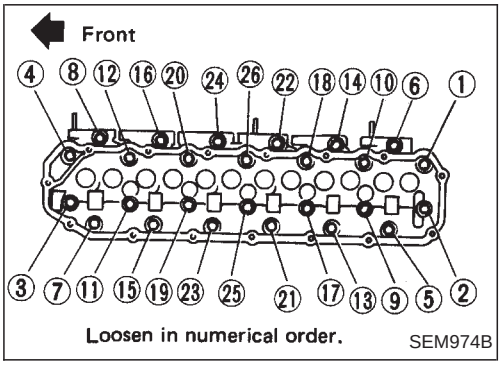
7. Remove rocker shaft with rocker arms.

Before removal, fully loosen valve clearance adjusting screws. The bolts should be loosened in two or three steps.

8. Remove push rods.


SEM973B

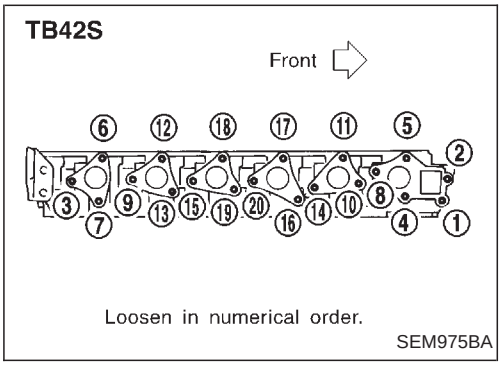
9. Remove front cover tightening bolts to cylinder head.



SEM974B

10. Remove cylinder head with manifolds.

- **Head warpage or cracking could result from removing in incorrect order.**
- **Cylinder head bolts should be loosened in two or three steps.**



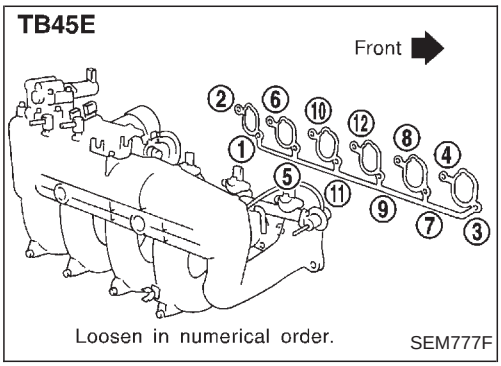
SEM975BA

Disassembly

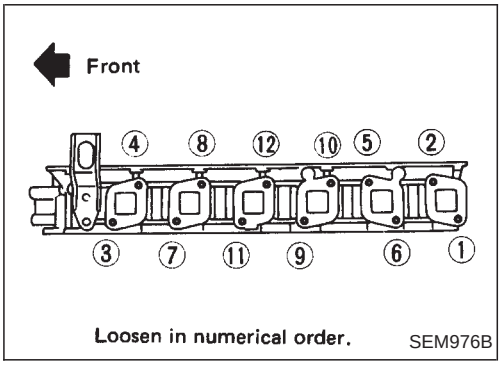
1. Remove intake manifold.

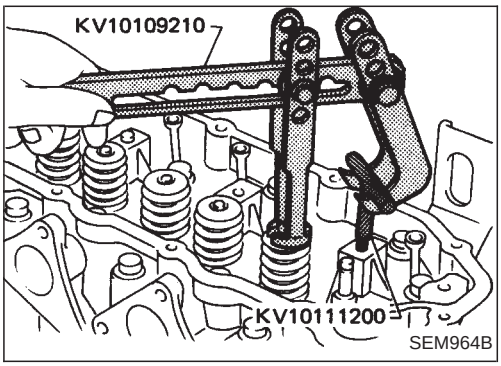
- Loosen intake manifold bolts in numerical order.

Disassembly (Cont'd)



2. Remove exhaust manifold.
- Loosen exhaust manifold bolts in numerical order.





3. Remove valve springs and valve oil seals with Tool.

Inspection

CYLINDER HEAD DISTORTION

Head surface flatness:

Less than 0.07 mm (0.0028 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".

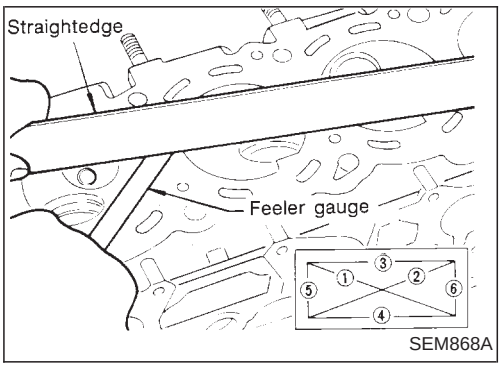
Amount of cylinder block resurfacing is "B".

The maximum limit is as follows:

A + B = 0.2 mm (0.008 in)

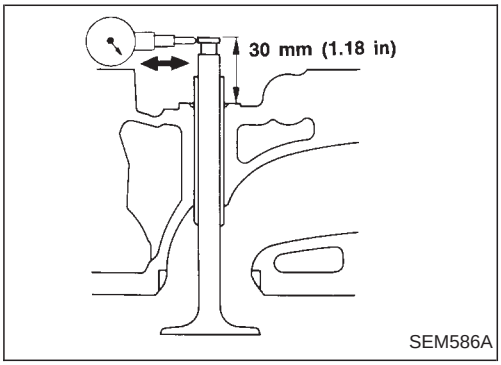
Nominal cylinder head height:

116.57 - 116.97 mm (4.5894 - 4.6051 in)

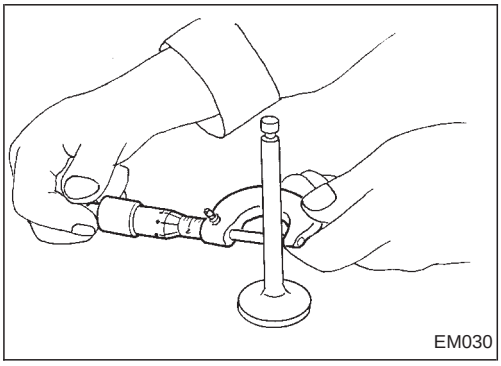


Inspection (Cont'd)

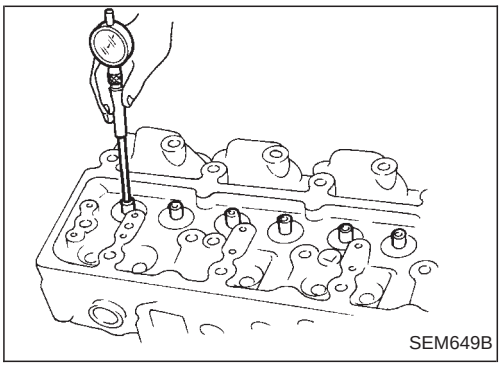
VALVE GUIDE CLEARANCE



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

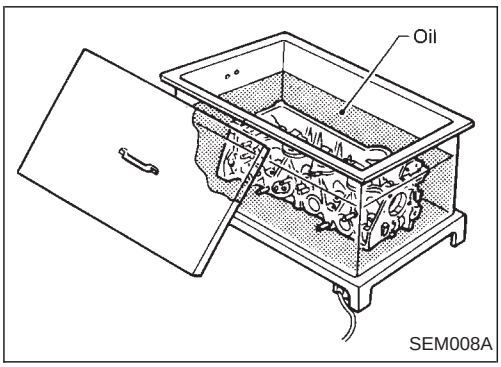


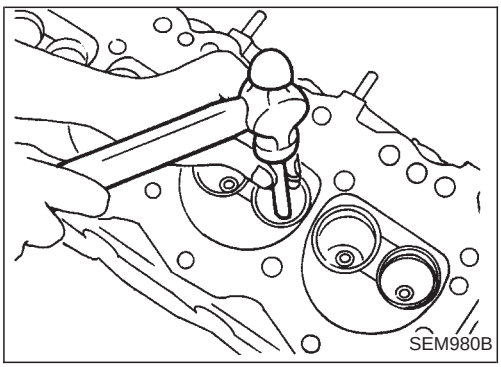
2. If it exceeds the limit, check valve to valve guide clearance.
(1) Measure valve stem diameter "d" and valve guide inner diameter.
(2) Check that clearance is within the specification.
   Valve to valve guide clearance limit:
   0.1 mm (0.004 in)
(3) If it exceeds the limit, replace valve or valve guide.



VALVE GUIDE REPLACEMENT

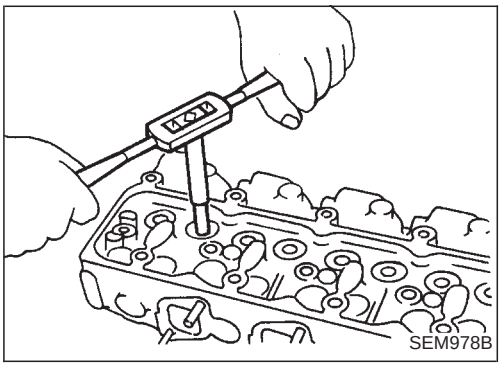
1. To remove valve guide, heat cylinder head to 150 to 160°C (302 to 320°F).



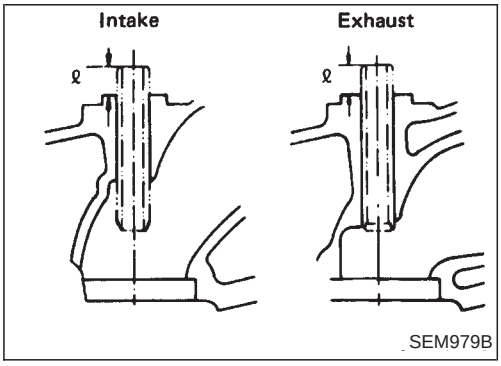


2. Drive out valve guide with a press [under a 20 kN (2 t, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and suitable tool.

Inspection (Cont'd)

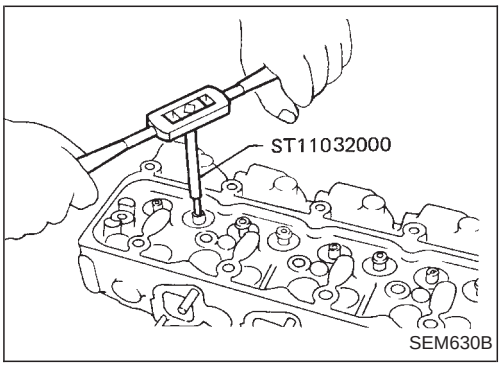

SEM978B

3. Ream cylinder head valve guide hole.
   Valve guide hole diameter (for service parts):
   Intake and exhaust
   12.233 - 12.244 mm (0.4816 - 0.4820 in)



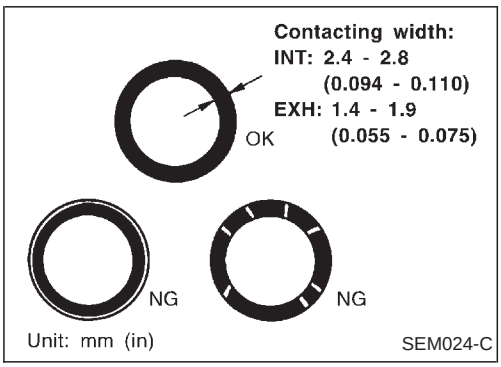
SEM979B

4. Heat cylinder head to 150 to 160°C (302 to 320°F) and press service valve guide onto cylinder head.
   Projection "ℓ":
   11.7 - 12.3 mm (0.461 - 0.484 in)



SEM630B

5. Ream valve guide.
   Finished size:
   Intake and exhaust
   8.000 - 8.018 mm (0.3150 - 0.3157 in)



SEM024-C

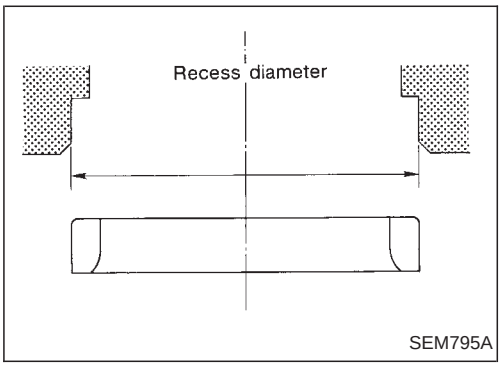
VALVE SEATS

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

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

Inspection (Cont'd)

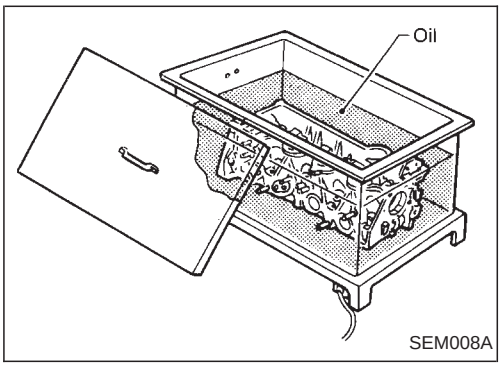
REPLACING VALVE SEAT FOR SERVICE PARTS



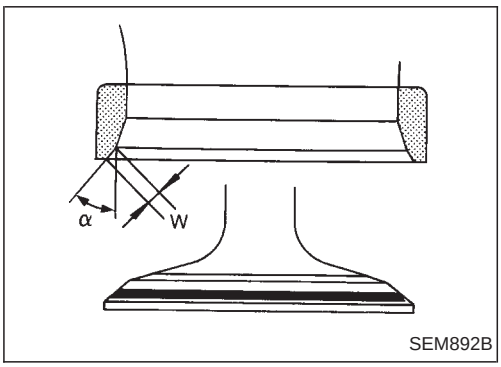
1. Bore out old seat until it collapses. The machine depth stop should be set so that boring cannot continue beyond the bottom face of the seat recess in cylinder head.
2. Ream cylinder head recess.

Reaming bore for service valve seat
Oversize [0.5 mm (0.020 in)]:
Intake
48.500 - 48.516 mm (1.9094 - 1.9101 in)
Exhaust
40.500 - 40.516 mm (1.5945 - 1.5951 in)

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

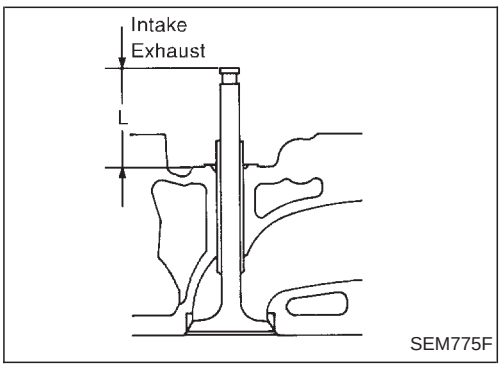


3. Heat cylinder head to 150 to 160°C (302 to 320°F).
4. Press fit valve seat until it seats on the bottom.



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

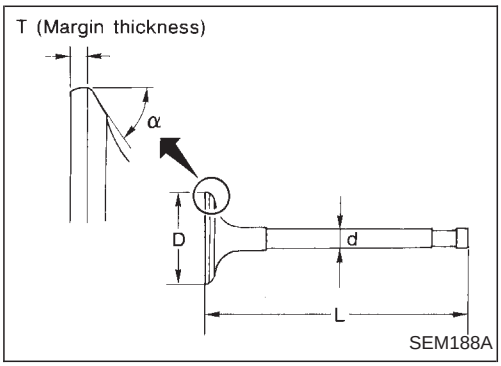
Seat face angle "α": 45 deg.
Contacting width "W":
Intake
1.08 - 1.51 mm (0.0425 - 0.0594 in)
Exhaust
1.41 - 1.89 mm (0.0555 - 0.0744 in)



8. Use a depth gauge to measure the distance between the mounting surface of the cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 above to adjust it. If it is longer, replace the valve seat with a new one.

Valve seat resurface limit "L":
Intake
46.14 mm (1.8165 in)
Exhaust
46.30 mm (1.8228 in)

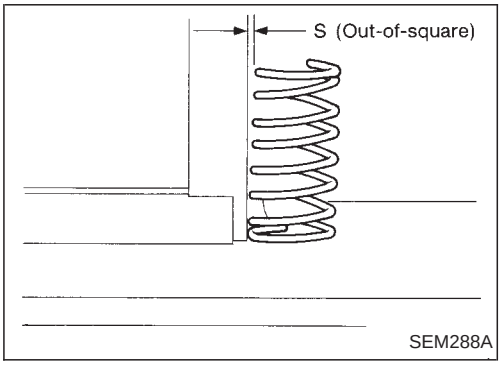
Inspection (Cont'd)



VALVE DIMENSIONS

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

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

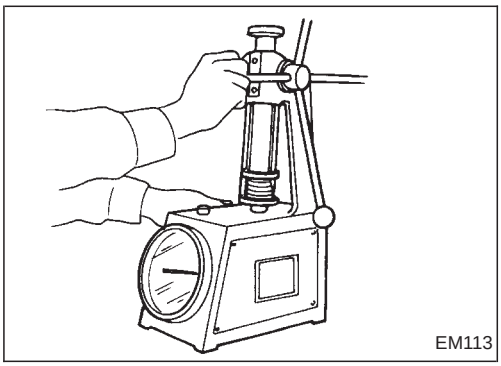


VALVE SPRING SQUARENESS

1. Measure "S" dimension.

Out-of-square:
Outer
TB42S
Less than 2.2 mm (0.087 in)
TB45E
Less than 2.1 mm (0.083 in)
Inner
TB42S, TB45E
Less than 1.9 mm (0.075 in)

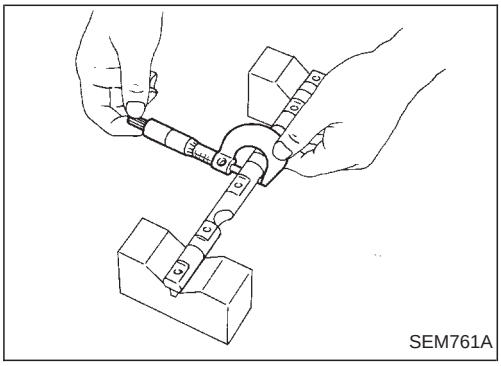
2. If it exceeds the limit, replace spring.



VALVE SPRING PRESSURE HEIGHT

Check valve spring pressure height.

Pressure height: mm/N (mm/kg, in/lb)
Outer
TB42S
30.0/512.9 (30.0/52.3, 1.181/115.3)
TB45E
27.7/611.0 (27.7/62.3, 1.091/137.4)
Inner
TB42S
25.0/255.0 (25.0/26.0, 0.984/57.3)
TB45E
24.7/305.5 (24.7/31.15, 0.972/68.7)

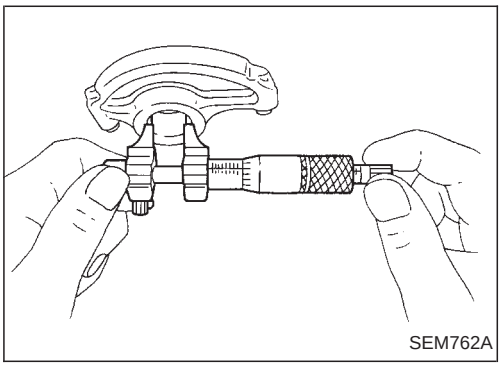


ROCKER SHAFT AND ROCKER ARM

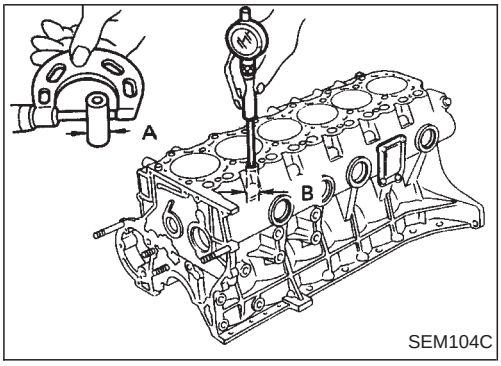
1. Check rocker shaft for scratches, seizure and wear.
2. Check outer diameter of rocker shaft.

Diameter:
19.988 - 20.000 mm (0.7869 - 0.7874 in)

Inspection (Cont'd)


SEM762A

3. Check inner diameter of rocker arm.
   Diameter:
   20.020 - 20.038 mm (0.7882 - 0.7889 in)
   Rocker arm to shaft clearance:
   0.020 - 0.050 mm (0.0008 - 0.0020 in)



SEM104C

VALVE LIFTER AND PUSH ROD

Valve lifter

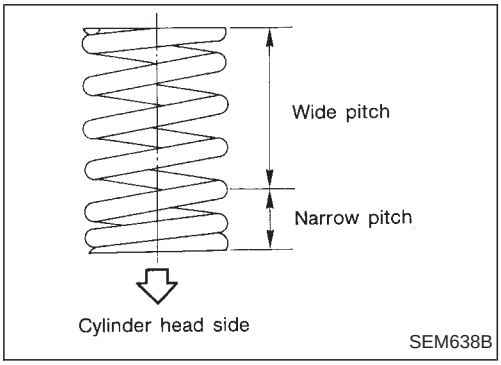
1. Check valve lifters for excessive wear on the face.
2. Replace with new ones if worn beyond repair.

a. Valve lifter end should be smooth.

b. Valve lifter to lifter hole clearance:
   Standard
   0.030 - 0.073 mm (0.0012 - 0.0029 in)
   Limit
   Less than 0.20 mm (0.0079 in)
   Valve lifter outer diameter "A":
   Standard
   24.960 - 24.970 mm (0.9827 - 0.9831 in)
   Cylinder block valve lifter hole diameter "B":
   Standard
   25.000 - 25.033 mm (0.9843 - 0.9855 in)

Push rod

1. Inspect push rod for excessive wear on the face.
2. Replace if worn or damaged beyond repair.
3. Check push rod for bend using a dial gauge.
   Maximum allowable bend
   (Total indicator reading):
   Less than 0.5 mm (0.020 in)

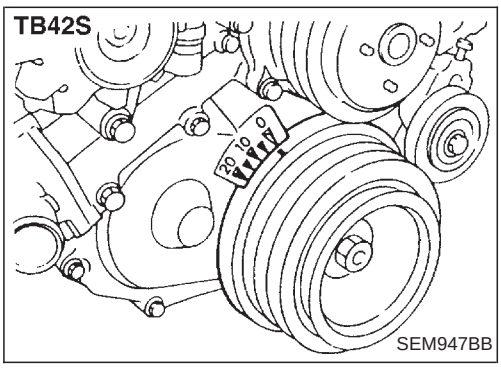


SEM638B

Assembly

1. Install valve component parts.

- **Always use new valve oil seal. Refer to OIL SEAL REPLACEMENT.**
- **Before installing valve oil seal, install inner spring seat.**
- **Install outer valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side.**



SEM947BB

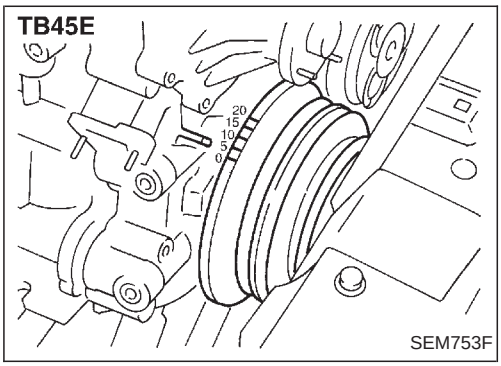
2. Install intake and exhaust manifolds.
   Tighten manifold bolts and nuts in two or three steps in reverse order of removal.

Refer to "Removal".

Installation

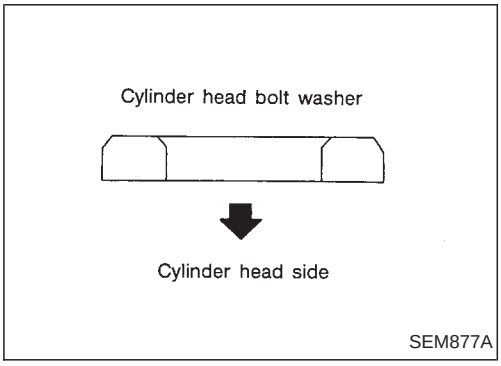
1. Set No. 1 piston at TDC on its compression stroke.

Installation (Cont'd)



SEM753F

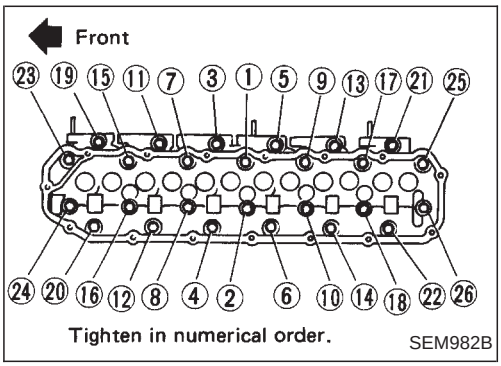
2. Install cylinder head with new gasket.
- **Be sure to install washers between bolts and cylinder head.**
- **Do not rotate crankshaft and camshaft separately, or valves will hit piston heads.**



SEM877A

3. Tighten cylinder head bolts in numerical order.
- **Tightening procedure**

(1) Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb).
(2) Tighten all bolts from 57 to 67 N·m (5.8 to 6.8 kg-m, 42 to 49 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 69 to 74 degrees clockwise or if angle wrench is not available, tighten all bolts from 64 to 74 N·m (6.5 to 7.5 kg-m, 47 to 54 ft-lb).



SEM982B

4. Install push rods and rocker shaft with rocker arms.
5. Adjust valve clearance.

Valve clearance:

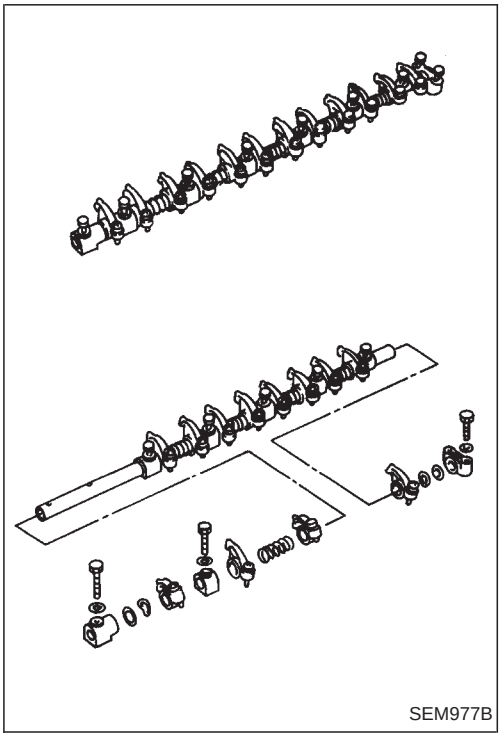
Unit: mm (in)

	TB42S, TB45E	TB42S	TB45E
	*Cold	Hot	
Intake	0.20 (0.008)	0.38 (0.015)	0.35 (0.014)
Exhaust	0.20 (0.008)	0.38 (0.015)	0.35 (0.014)

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

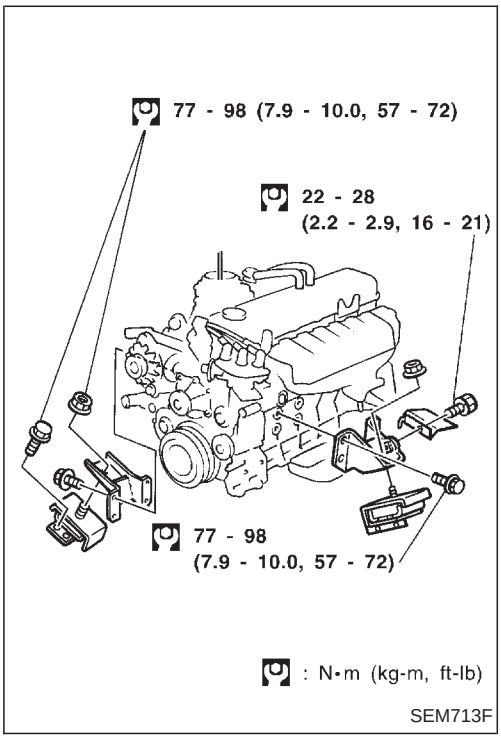
Whenever valve clearances are adjusted to cold specifications, check that the clearances satisfy hot specifications and adjust again if necessary.

Refer to MA section.


SEM977B

Installation (Cont'd)

6. Install rocker cover.
   Tighten rocker cover bolts in reverse order of removal.
Refer to "Removal".



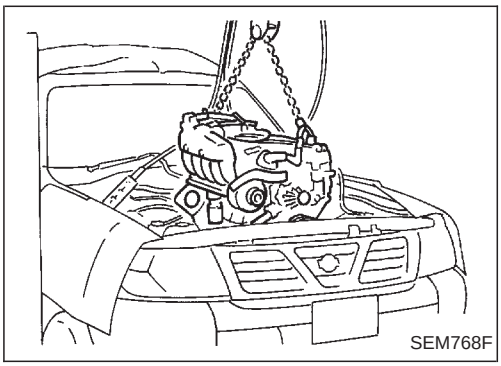
SEM713F

WARNING:

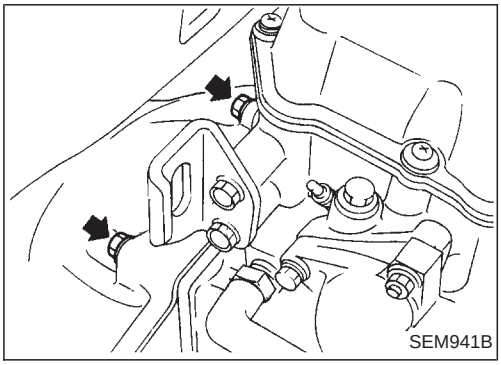
- **Situate vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **Do not remove engine until exhaust system has completely cooled off.**
  Otherwise, you may burn yourself and/or fire may break out in the fuel line.
- **For safety during subsequent steps, the tension of wires should be slackened against the engine.**
- **Before disconnecting fuel hose, release fuel pressure from fuel line.**
  Refer to "Releasing Fuel Pressure" in EC section.
- **Be sure to hoist engine in a safe manner.**

CAUTION:

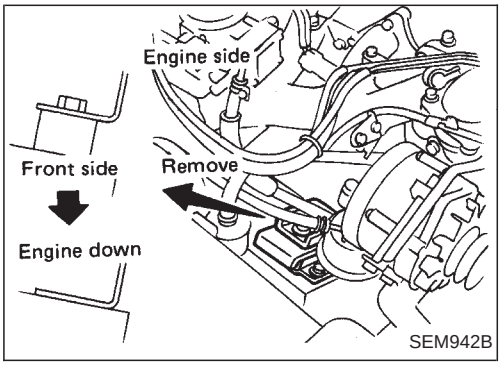
- **When lifting engine, be careful not to strike adjacent parts, especially accelerator wire casing, brake lines, and brake master cylinder.**
- **In hoisting the engine, always use engine slingers in a safe manner.**
- **For engines not equipped with engine slingers, attach proper slingers and bolts described in the PARTS CATALOG.**


SEM768F

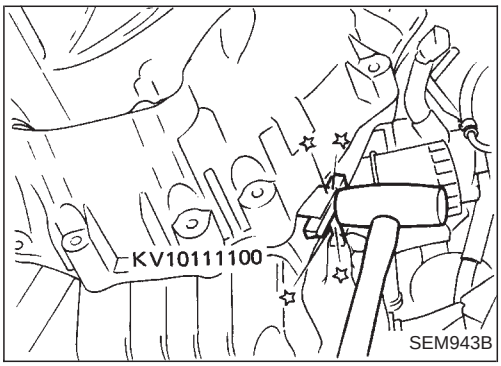
- Remove engine after disconnecting from transmission.


SEM941B

(1) Before removing two mounting bolts from upper side of transmission, remove front engine mounts and lower engine to the level of the front mount.

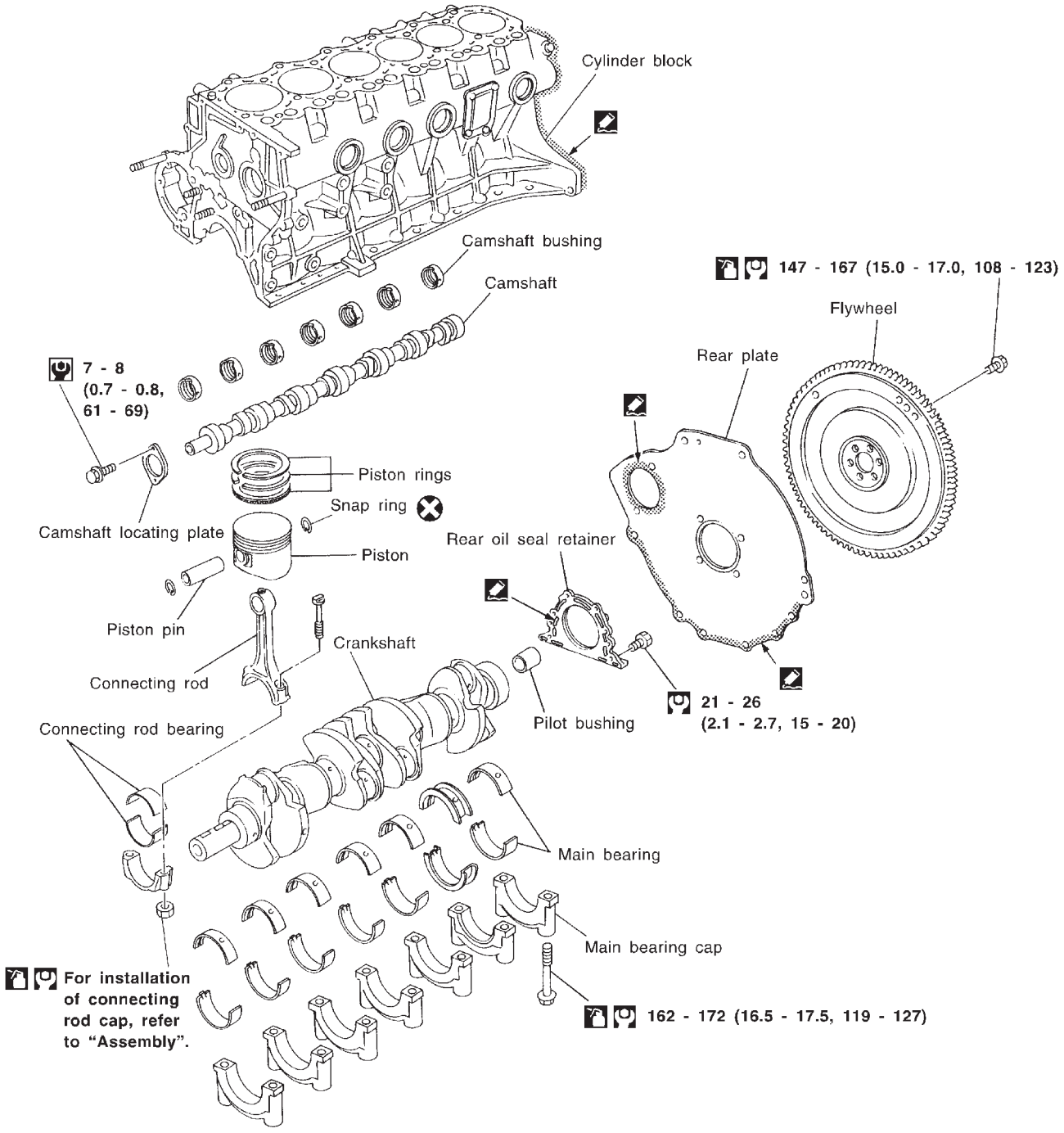


SEM942B



(2) Before separating transmission and rear plate, remove transmission mounting bolts. Position Tool into mating surface of transmission and rear plate, and slide it along mating surface.

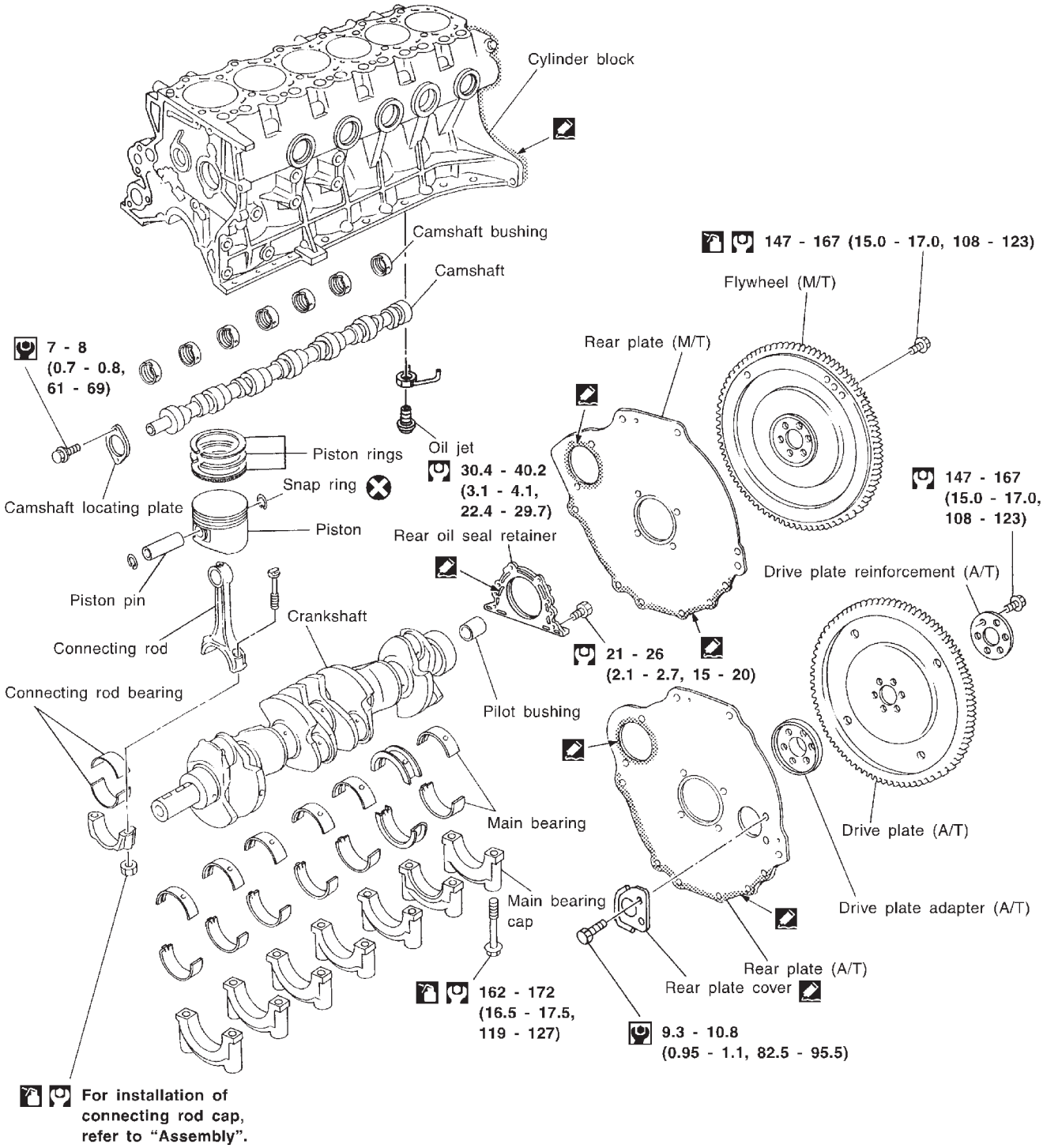
SEC. 110•120•130



: N•m (kg-m, in-lb)
: N•m (kg-m, ft-lb)

SEM730F

SEC. 110•120•130



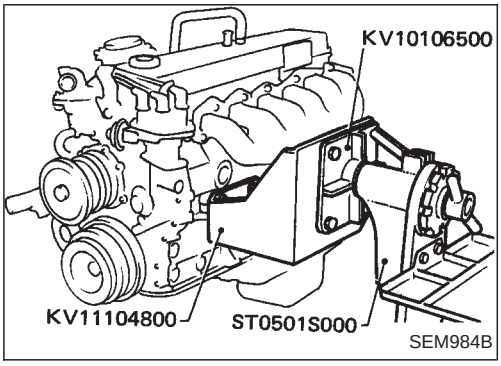
: N•m (kg-m, in-lb)

: N•m (kg-m, ft-lb)

SEM771F

CAUTION:

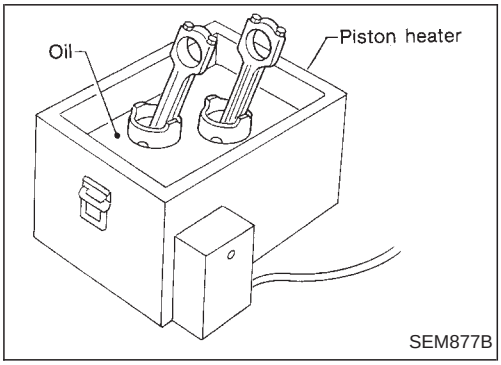
- **When installing sliding parts such as bearings and pistons, be sure to apply engine oil on the sliding surfaces.**
- **Place the removed parts such as bearings and bearing caps in their proper order and direction.**
- **When tightening connecting rod bolts, main bearing cap bolts and flywheel bolts,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



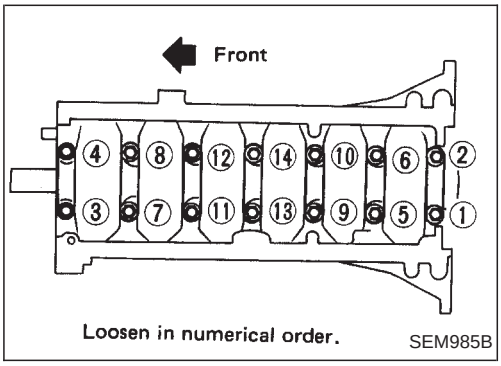
Disassembly

PISTON AND CRANKSHAFT

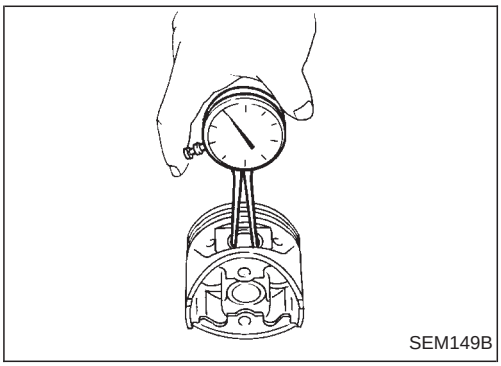
1. Place engine on work stand.
2. Drain coolant and remove water pump.
3. Drain oil.
4. Remove oil pan and oil strainer.
5. Remove distributor.
6. Remove front cover.
7. Remove oil pump chain. (TB42S only)
8. Remove timing chain.
9. Remove rocker cover.
10. Remove rocker shaft with rocker arms and push rods.
11. Remove cylinder head.
12. Remove valve lifters and camshaft.

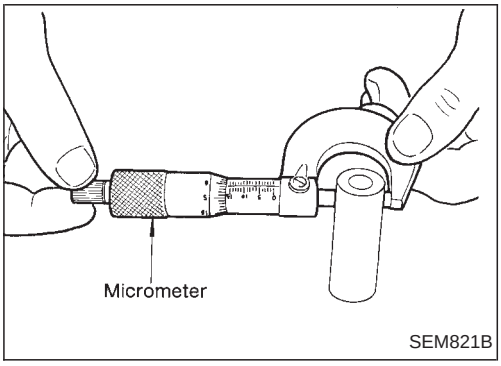


13. Remove pistons.
- When disassembling piston and connecting rod, remove snap rings first, then heat piston to 60 to 70°C (140 to 158°F) or use piston pin press stand at room temperature.

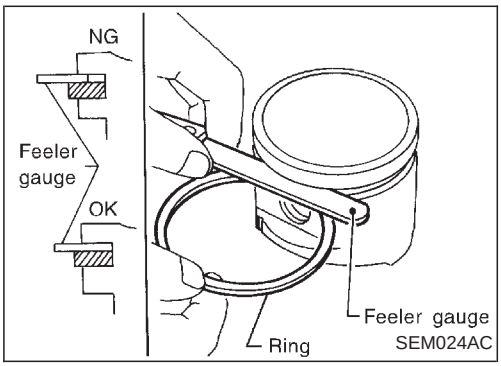


14. Remove bearing cap and crankshaft.
- **Before removing bearing cap, measure crankshaft end play.**

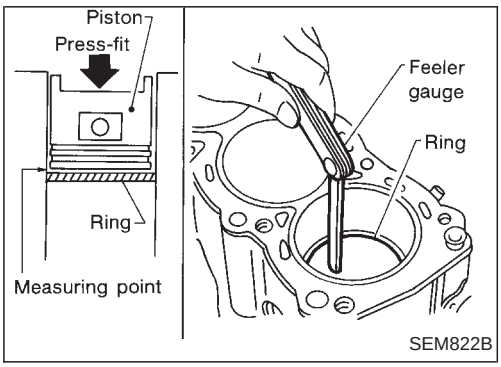

SEM149B



SEM821B



SEM024AC



SEM822B

Inspection

PISTON AND PISTON PIN CLEARANCE

1. Measure inner diameter of piston pin hole “dp”.
   Standard diameter “dp”:
   TB42S
   22.987 - 22.999 mm (0.9050 - 0.9055 in)
   TB45E
   22.993 - 23.005 mm (0.9052 - 0.9057 in)
2. Measure outer diameter of piston pin “Dp”.
   Standard diameter “Dp”:
   22.989 - 23.001 mm (0.9051 - 0.9055 in)
3. Calculate piston pin clearance.
   TB42S
   −0.007 to 0.003 mm (−0.0003 to 0.0001 in)
   TB45E
   −0.001 to 0.009 mm (−0.0000 to 0.0004 in)

If it exceeds the limit, 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)
Oil ring
0.065 - 0.135 mm (0.0026 - 0.0053 in)
Max. limit of side clearance (Top and 2nd rings):
0.1 mm (0.004 in)

If out of specification, replace piston and piston pin assembly.

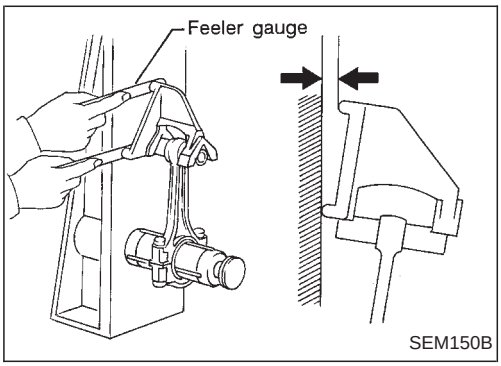
PISTON RING GAP

Standard ring gap:
Top ring
0.30 - 0.45 mm (0.0118 - 0.0177 in)
2nd ring
0.30 - 0.45 mm (0.0118 - 0.0177 in)
Oil ring
0.20 - 0.60 mm (0.0079 - 0.0236 in)
Max. limit of ring gap:
1.5 mm (0.059 in)

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

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

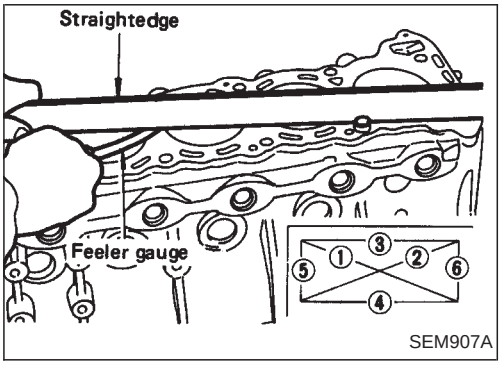
Inspection (Cont'd)



CONNECTING ROD BEND AND TORSION

Bend:
Limit 0.15 mm (0.0059 in)
per 100 mm (3.94 in) length
Torsion:
Limit 0.3 mm (0.012 in)
per 100 mm (3.94 in) length

If it exceeds the limit, replace connecting rod assembly.

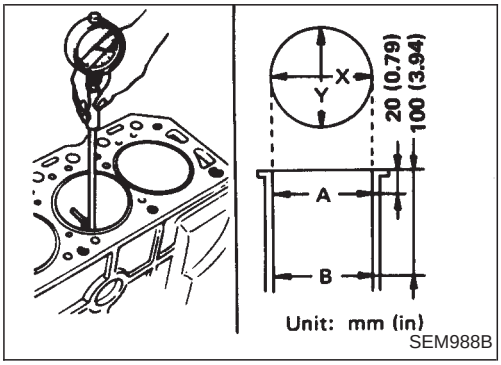


CYLINDER BLOCK DISTORTION AND WEAR

1. Clean upper face of cylinder block and measure the distortion.
   Limit: 0.10 mm (0.0039 in)
2. If out of specification, resurface it.
   The resurfacing limit is determined by the 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:
254.95 - 255.05 mm (10.0374 - 10.0413 in)

3. If necessary, replace cylinder block.



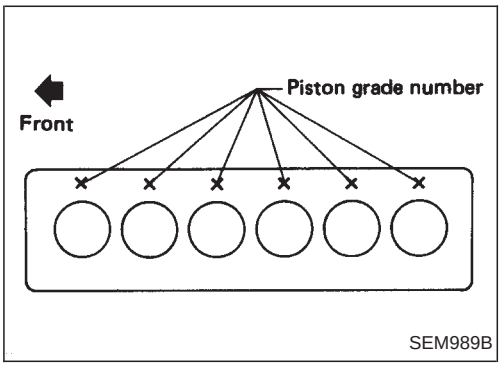
PISTON-TO-BORE CLEARANCE

Method A (Using bore gauge and micrometer)

1. Using a bore gauge, measure cylinder bore for wear, out-of-round or taper.
   Standard inner diameter:
   TB42S
   96.000 - 96.050 mm (3.7795 - 3.7815 in)
   TB45E
   99.500 - 99.550 mm (3.9173 - 3.9193 in)
   Wear limit:
   0.20 mm (0.0079 in)
   Out-of-round (X − Y) standard:
   0.015 mm (0.0006 in)
   Taper (A − B) standard:
   0.010 mm (0.0004 in)

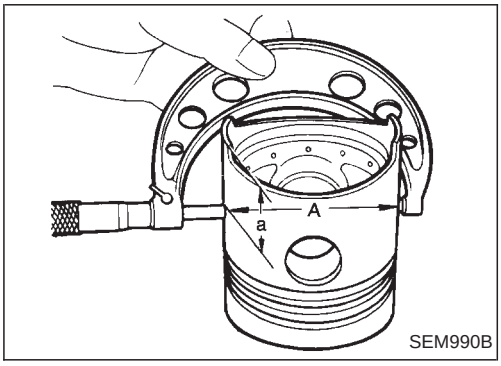
   If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.
2. Check for scratches or seizure. If seizure is found, hone it.

Inspection (Cont'd)



SEM989B

- **If cylinder block or piston is replaced with a new one, select piston of the same grade number punched on cylinder block upper surface.**



SEM990B

3. Measure piston skirt diameter.
   Piston diameter "A":
   Refer to SDS.
   Measuring point "a" (Distance from the bottom):
   20 mm (0.79 in)
4. Check that piston-to-bore clearance is within the specification.
   Piston-to-bore clearance "B":
   TB42S
   0.015 - 0.035 mm (0.0006 - 0.0014 in)
   TB45E
   0.030 - 0.050 mm (0.0012 - 0.0020 in)
5. Determine piston oversize according to amount of cylinder wear.

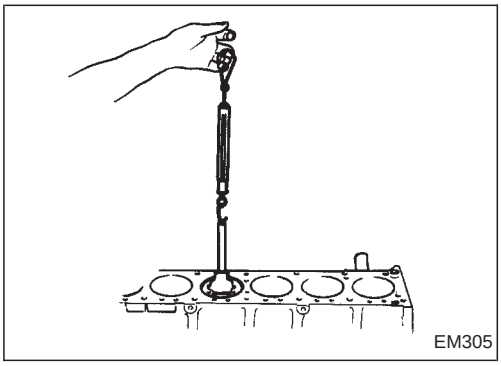
Oversize pistons are available for service. Refer to SDS.

6. Cylinder 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 the cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.**

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

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

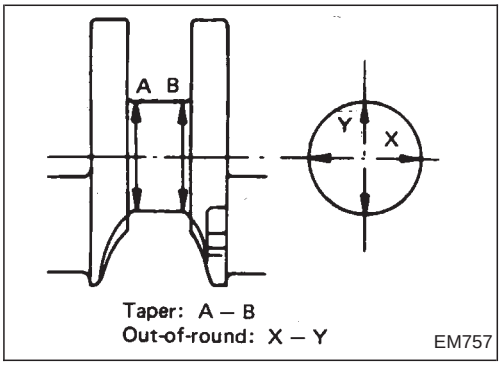

EM305

Method B (Using feeler gauge)

Measure the extracting force by pulling feeler gauge straight upward.

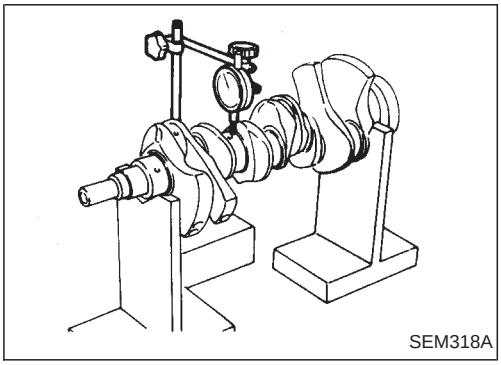
Feeler gauge thickness:
0.04 mm (0.0016 in)
Extracting force:
2.0 - 14.7 N (0.2 - 1.5 kg, 0.4 - 3.3 lb)

Inspection (Cont'd)

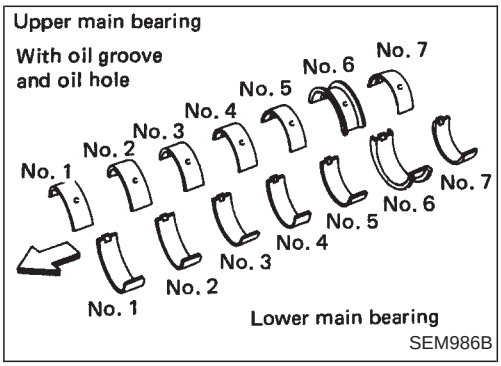


CRANKSHAFT

1. Check crankshaft main and pin journals for score, bias, wear or cracks.
2. With a micrometer, measure journals for taper and out-of-round.
   Out-of-round (X − Y):
   Less than 0.0025 mm (0.0001 in)
   Taper (A − B):
   Less than 0.0025 mm (0.0001 in)



3. Measure crankshaft runout.
   Runout (Total indicator reading):
   Less than 0.20 mm (0.0079 in)

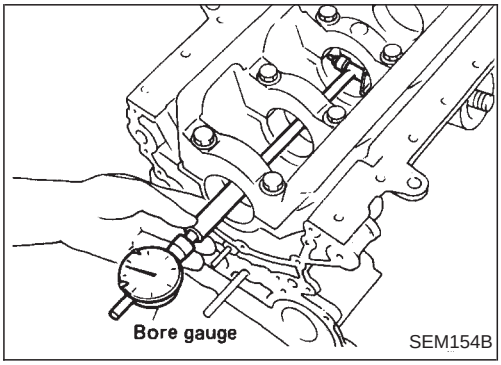


BEARING CLEARANCE

Method A (Using bore gauge and micrometer)

Main bearing clearance

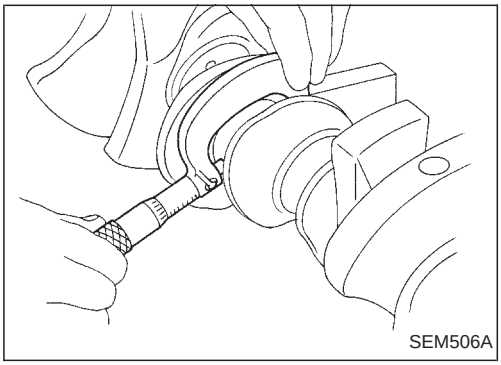
1. Set main bearings in their proper positions on cylinder block and main bearing cap.



2. Install main bearing cap to cylinder block.

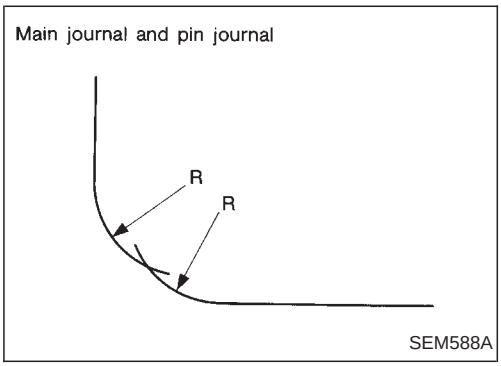
Tighten all bolts in correct order in two or three stages.

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



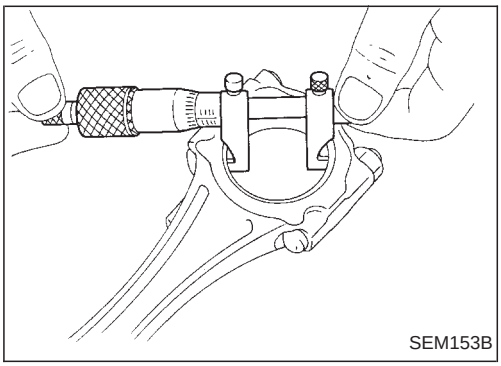
4. Measure outer diameter "Dm" of crankshaft main journal.
5. Calculate main bearing clearance.
   Main bearing clearance = A − Dm
   Standard: 0.030 - 0.087 mm (0.0012 - 0.0034 in)
   Limit: 0.09 mm (0.0035 in)
6. If it exceeds the limit, replace bearing.
7. If the clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.

Inspection (Cont'd)



a. When grinding crank pin and crank journal, fillets should be finished as shown in the figure.
   R: Main journal
   2.5 - 2.6 mm (0.098 - 0.102 in)
   Pin journal
   3.0 - 3.1 mm (0.118 - 0.122 in)
b. Refer to SDS for grinding crankshaft and available service parts.

8. If crankshaft, cylinder block and main bearings are replaced with new ones, check that the clearance of main bearing is within specifications.

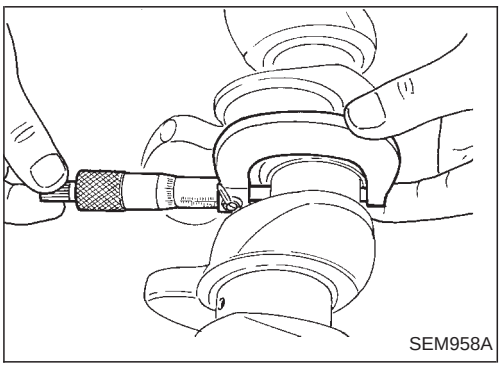


CONNECTING ROD BEARING CLEARANCE (Big end)

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

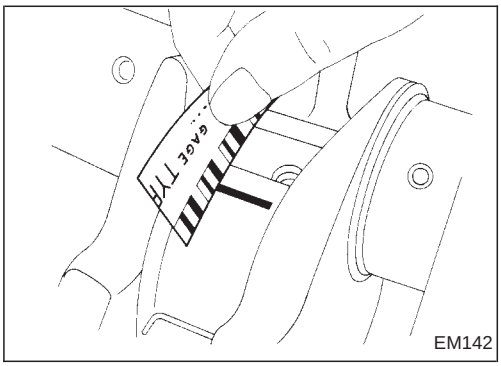
Tighten bolts to the specified torque.

3. Measure inner diameter "C" of bearing.



4. Measure outer diameter "Dp" of crankshaft pin journal.
5. Calculate connecting rod bearing clearance.
   Connecting rod bearing clearance = C − Dp
   Standard: 0.027 - 0.061 mm (0.0011 - 0.0024 in)
   Limit: 0.09 mm (0.0035 in)
6. If it exceeds the limit, replace bearing.
7. If the clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing. Refer to step 7 of "MAIN BEARING CLEARANCE".

Inspection (Cont'd)



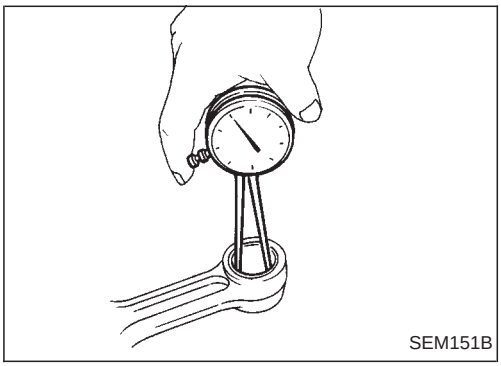
EM142

Method B (Using plastigage)

CAUTION:

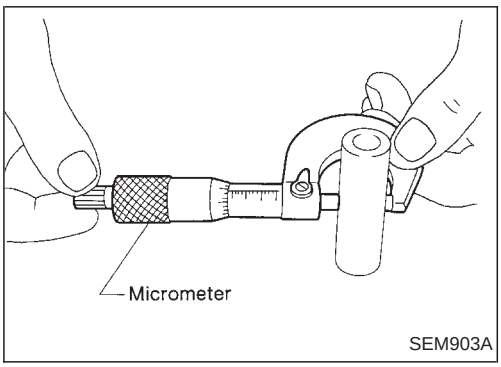
- **Do not turn crankshaft or connecting rod while the plastigage is being inserted.**
- **When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. Then if excessive bearing clearance exists, use thicker main bearing or undersized bearing so that the specified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

Main bearing clearance:
Standard
0.051 - 0.097 mm (0.0020 - 0.0038 in)
Limit
0.1 mm (0.004 in)
Connecting rod bearing clearance:
Standard
0.040 - 0.074 mm (0.0016 - 0.0029 in)
Limit
0.1 mm (0.004 in)


SEM151B

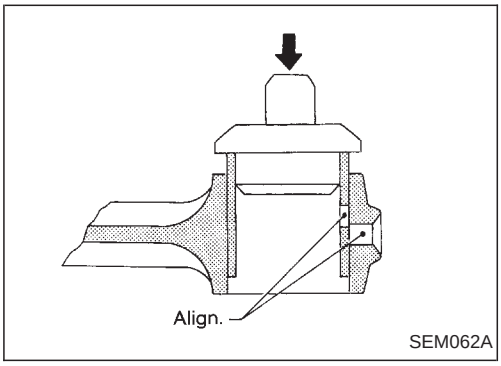
CONNECTING ROD BUSHING CLEARANCE (Small end)

1. Measure inner diameter "C" of bushing.



SEM903A

2. Measure outer diameter "Dp" of piston pin.
3. Calculate connecting rod bearing clearance.
   C − Dp = 0.005 - 0.017 mm (0.0002 - 0.0007 in)
   If it exceeds the limit, replace connecting rod bushing and/or piston set with pin.



SEM062A

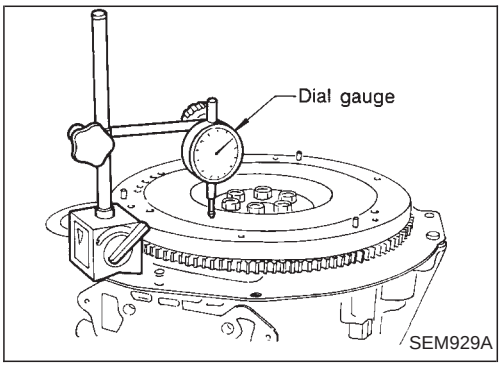
REPLACEMENT OF CONNECTING ROD SMALL END BUSHING

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

Be sure to align the oil holes.

2. After driving in the small end bushing, ream the bushing.
   Small end bushing inside diameter:
   Finished size
   23.000 - 23.012 mm (0.9055 - 0.9060 in)

Inspection (Cont'd)



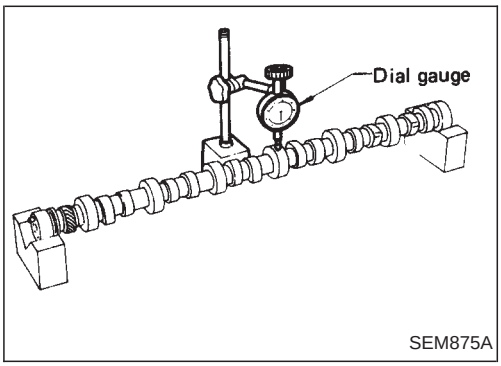
FLYWHEEL OR DRIVE PLATE RUNOUT

Runout (Total indicator reading):
Flywheel (M/T model)
0.1 mm (0.004 in) or less
Drive plate (A/T model)
0.1 mm (0.004 in) or less

If runout exceeds the limit, replace flywheel or drive plate.

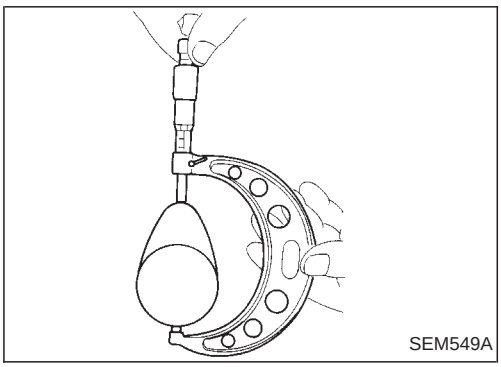
CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.



CAMSHAFT RUNOUT

1. Measure camshaft runout at the center journal.
   Runout (Total indicator reading):
   Limit 0.06 mm (0.0024 in)
2. If it exceeds the limit, replace camshaft.

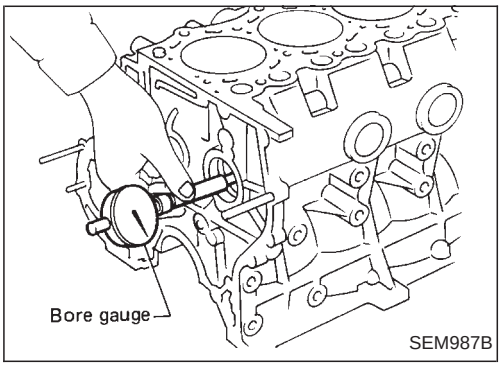


CAMSHAFT CAM HEIGHT

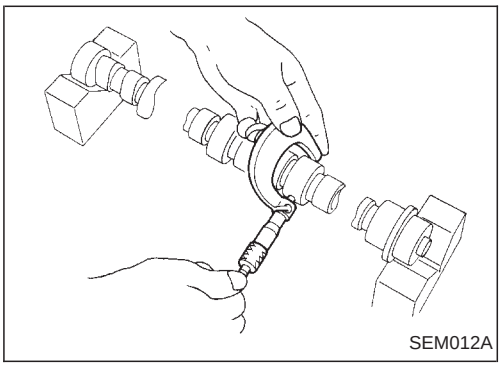
1. Measure camshaft cam height.
   Standard cam height:
   TB42S
   42.311 - 42.561 mm (1.6658 - 1.6756 in)
   TB45E
   42.126 - 42.376 mm (1.6585 - 1.6683 in)
   Cam wear limit:
   0.15 mm (0.0059 in)
2. If wear is beyond the limit, replace camshaft.

Inspection (Cont'd)

CAMSHAFT JOURNAL CLEARANCE

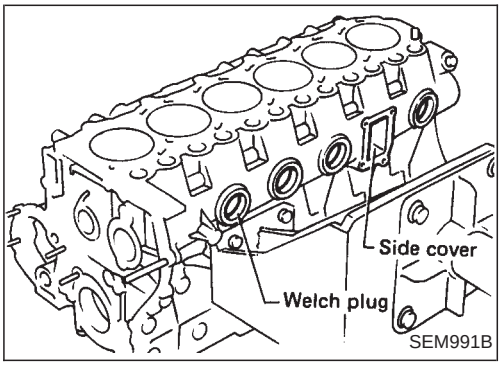


1. Measure the inner diameter of camshaft bushings.
   Standard inner diameter:
   Front
   50.76 - 50.83 mm (1.9984 - 2.0012 in)
   2nd
   50.56 - 50.63 mm (1.9905 - 1.9933 in)
   3rd
   50.36 - 50.43 mm (1.9827 - 1.9854 in)
   4th
   50.16 - 50.23 mm (1.9748 - 1.9776 in)
   5th
   49.96 - 50.03 mm (1.9669 - 1.9697 in)
   6th
   49.76 - 49.83 mm (1.9591 - 1.9618 in)
   Rear
   49.56 - 49.63 mm (1.9512 - 1.9539 in)



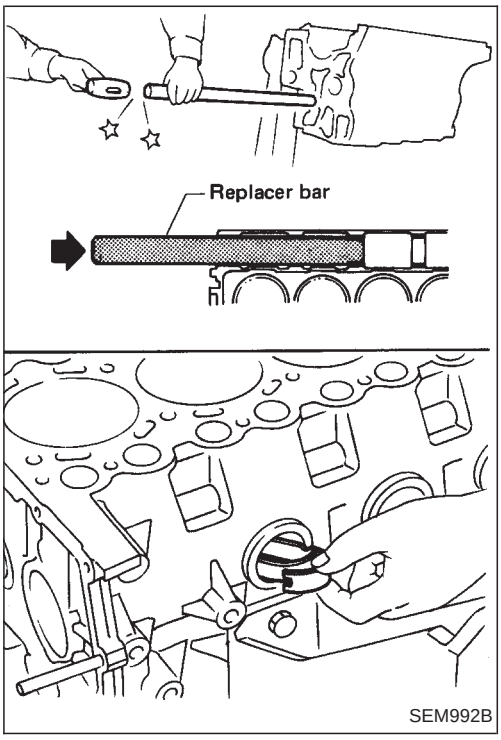
2. Measure the outer diameter of camshaft journal.
   Standard outer diameter:
   Front
   50.721 - 50.740 mm (1.9969 - 1.9976 in)
   2nd
   50.521 - 50.540 mm (1.9890 - 1.9898 in)
   3rd
   50.321 - 50.340 mm (1.9811 - 1.9819 in)
   4th
   50.121 - 50.140 mm (1.9733 - 1.9740 in)
   5th
   49.921 - 49.940 mm (1.9654 - 1.9661 in)
   6th
   49.721 - 49.740 mm (1.9575 - 1.9583 in)
   Rear
   49.521 - 49.540 mm (1.9496 - 1.9504 in)
3. If the clearance exceeds the limit, replace camshaft and/or camshaft bushings.
   Camshaft journal clearance limit:
   0.15 mm (0.0059 in)

REPLACING CAMSHAFT BUSHING

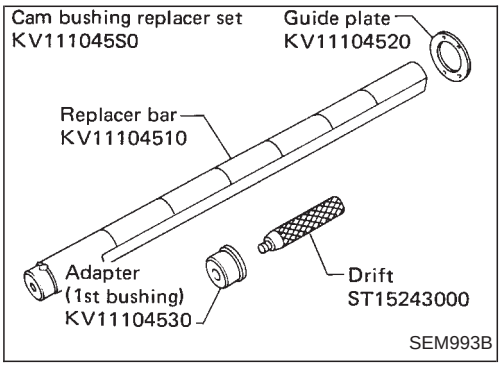


1. Remove welch plugs and side cover.

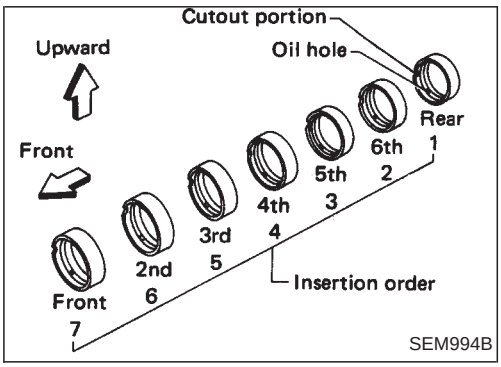
Inspection (Cont'd)



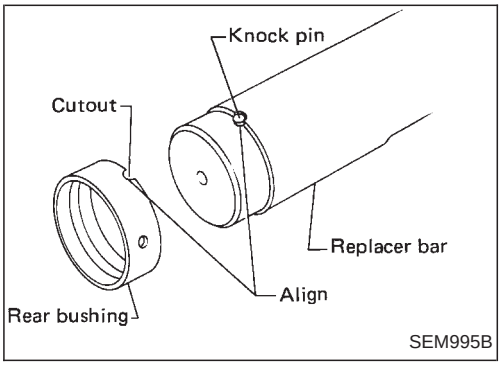
2. Using Tool, remove camshaft bushings from engine. Some bushings must be broken in order to remove.



3. Using Tool, install camshaft bushings as follows:

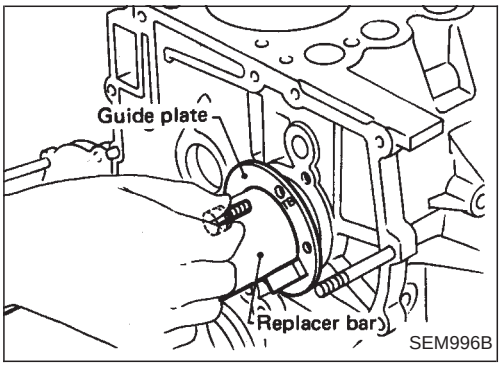


(1) Install camshaft bushings in the order of "rear", "6th", "5th", "4th", "3rd", "2nd" and "front". All bushings must be installed from the front.
(2) Face the cutout rightward and toward the front of engine during installation.



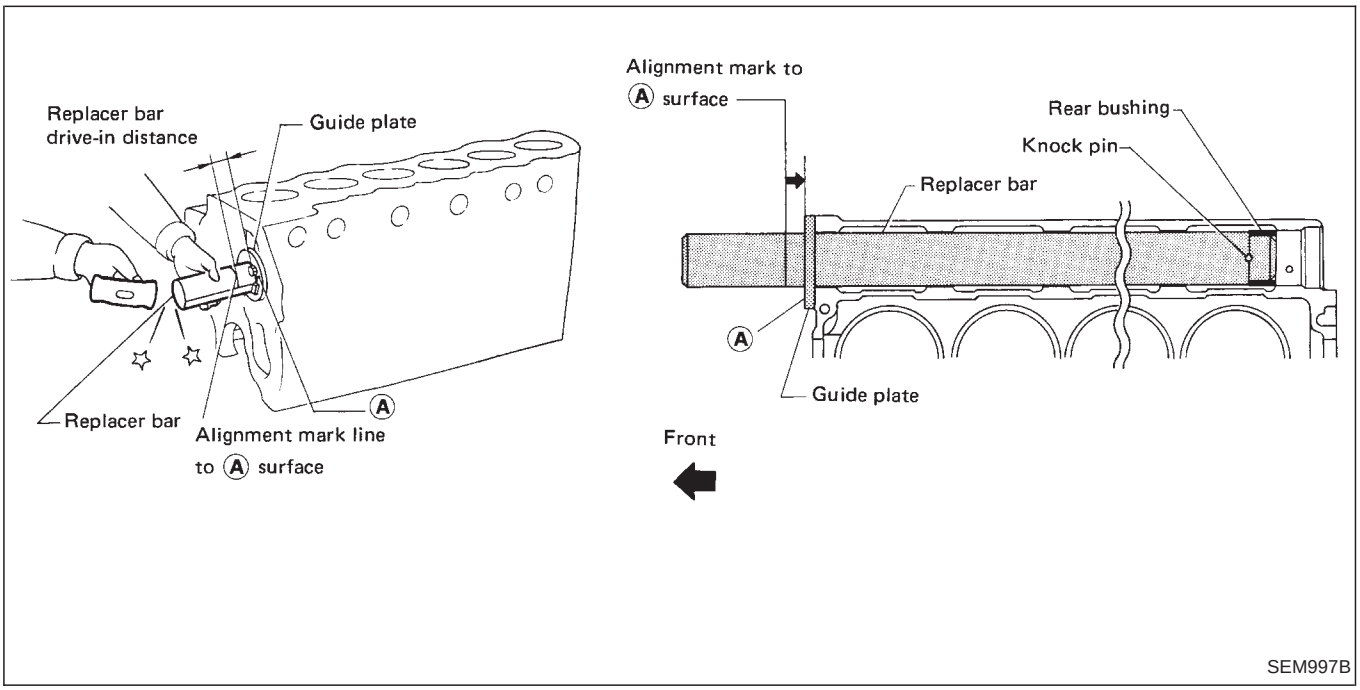
(3) Rear camshaft bushing
Align the cutout of rear bushing with knock pin of replacer bar before installation.

Inspection (Cont'd)



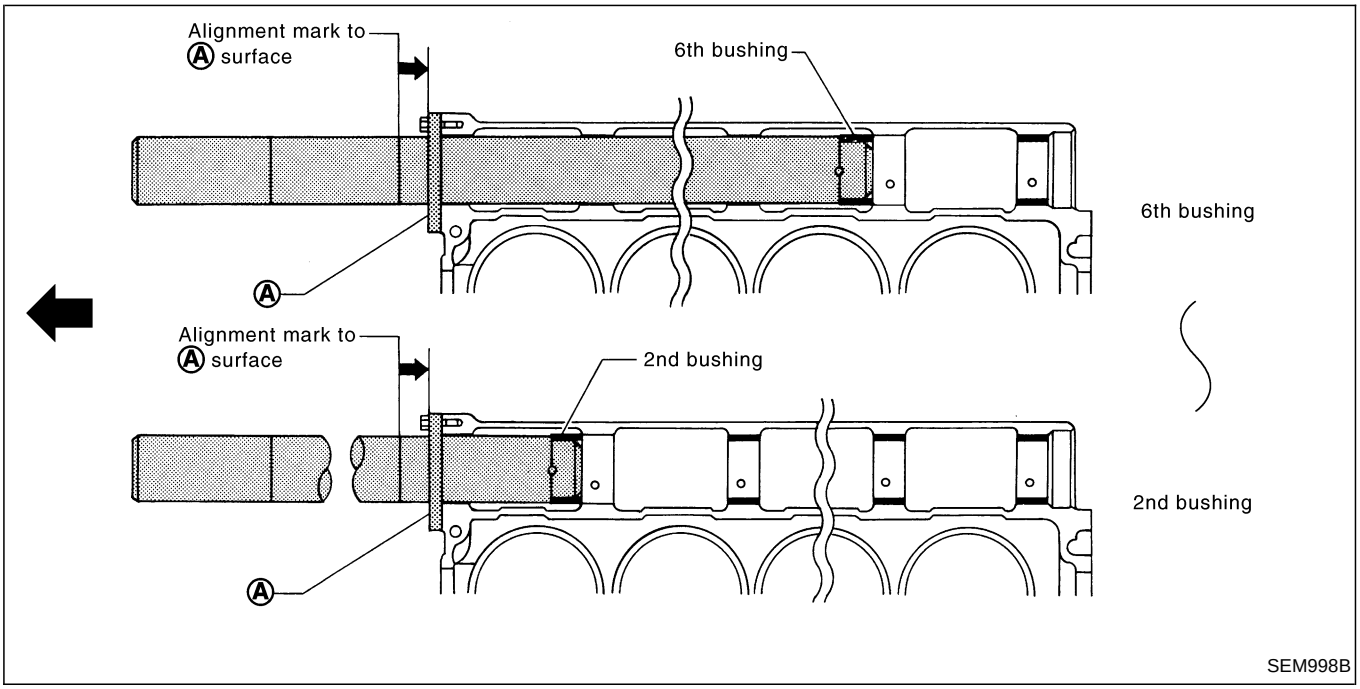
Insert rear bushing with replacer bar into cylinder block.
Install guide plate with bolt holes (on the "TB" mark side) facing upper side of cylinder block. Tighten bolts.

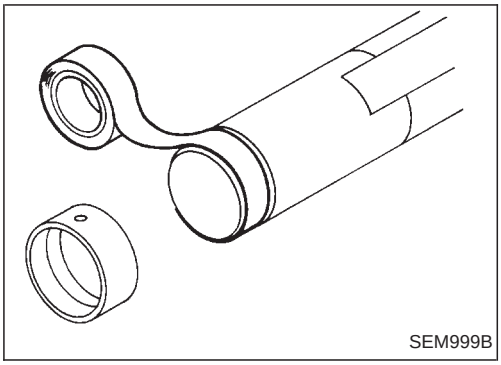
Drive replacer bar until the alignment mark on replacer bar is aligned with the end of guide plate.
Remove replacer set.
After installation, check that oil holes 4.3 mm (0.169 in) dia. in camshaft bushings are aligned with oil holes 6 mm (0.24 in) dia. in the cylinder block.



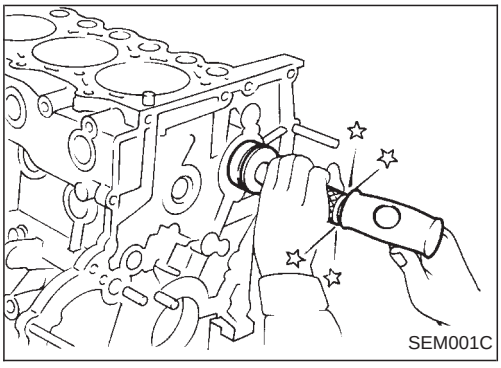
Inspection (Cont'd)

(4) 6th, 5th, 4th, 3rd and 2nd camshaft bushings
Install in the same manner as rear camshaft bushing.



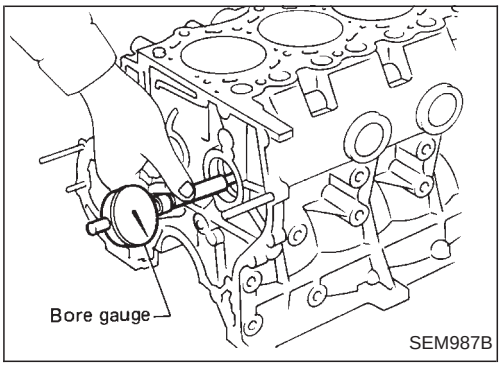


When setting 6th through 2nd bushings on replacer bar, tape the bar to prevent movement.

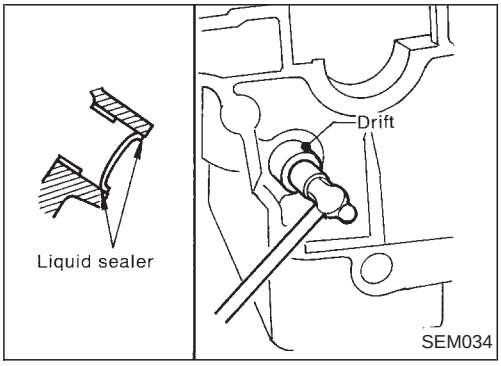


(5) Front camshaft bushing
Using 1st bushing adapter, position front camshaft bushing so that oil hole in cylinder block is aligned with oil hole in bushing.

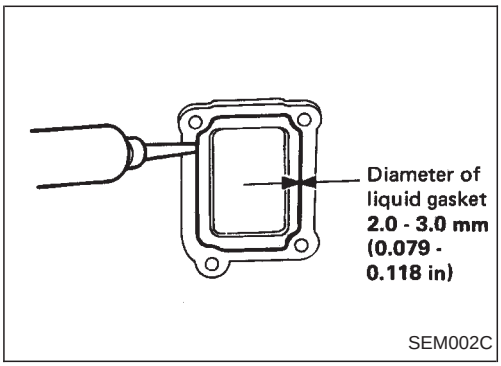
Inspection (Cont'd)



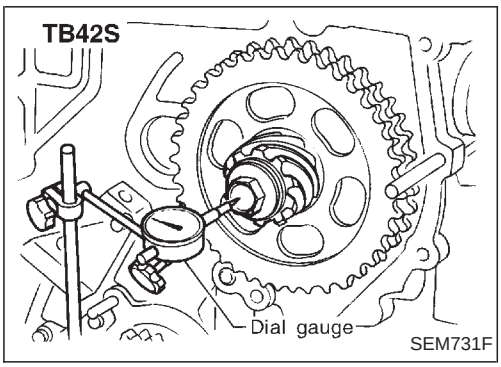
4. Check camshaft bushing inner diameter.



5. Install new welch plugs with a drift.
Apply liquid sealer.

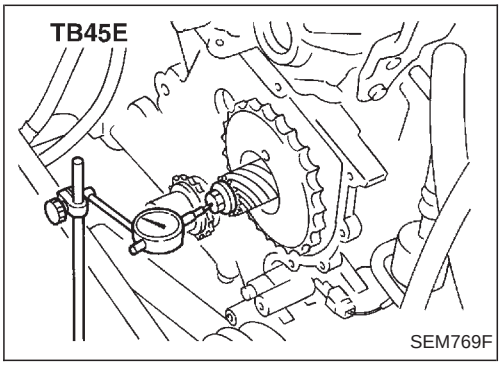


6. Install side cover. (TB42S only)
Apply liquid gasket.
- **Use Genuine Liquid Gasket or equivalent.**



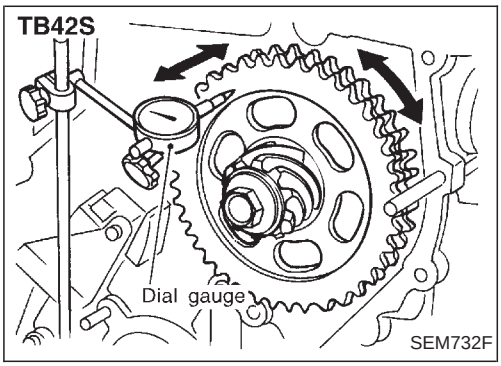
CAMSHAFT END PLAY

1. Install camshaft in cylinder block.
2. Measure camshaft end play.
   Camshaft end play:
   Standard
   0.08 - 0.28 mm (0.0031 - 0.0110 in)
   Limit
   0.05 mm (0.0020 in)
3. If end play exceeds the limit, replace locating plate.

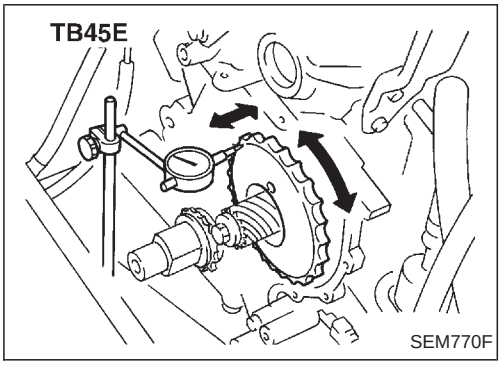


Inspection (Cont'd)

CAMSHAFT SPROCKET RUNOUT

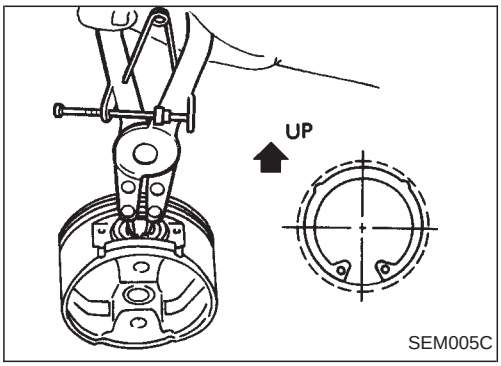


1. Install sprocket on camshaft.
2. Measure camshaft sprocket runout.
   Runout (Total indicator reading):
   Limit
   0.02 mm (0.0008 in)
3. If it exceeds the limit, replace camshaft sprocket.



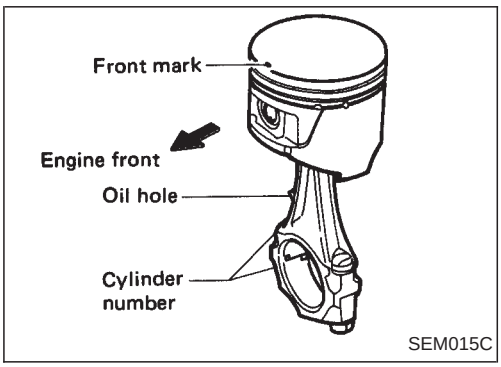
Assembly

PISTON



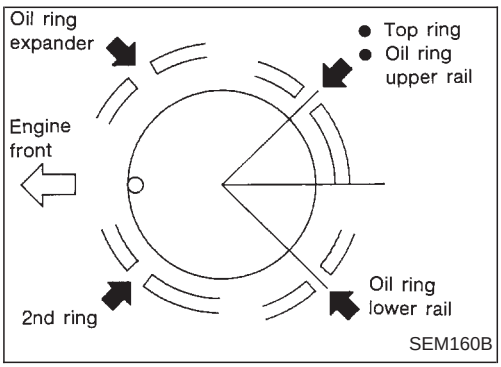
1. Install a new snap ring on one side of the piston pin hole.

Ensure that ends of snap ring face down and fit properly into groove.



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.**

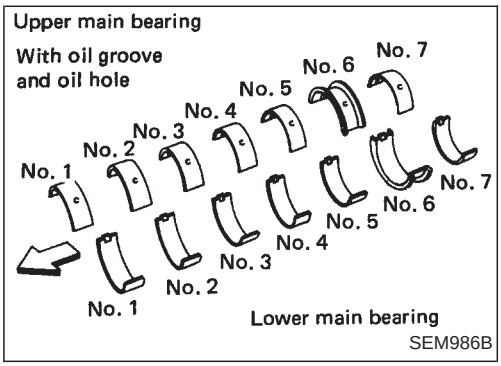


- **After assembly, make sure piston swings smoothly.**

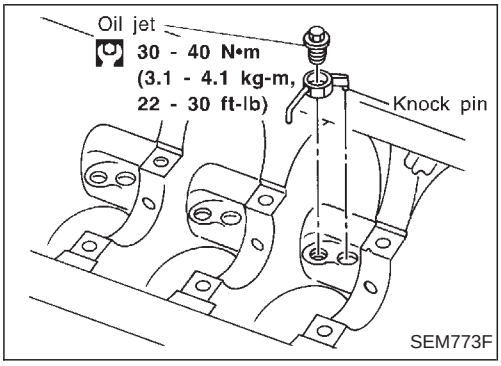
3. Set piston rings as shown.

Assembly (Cont'd)

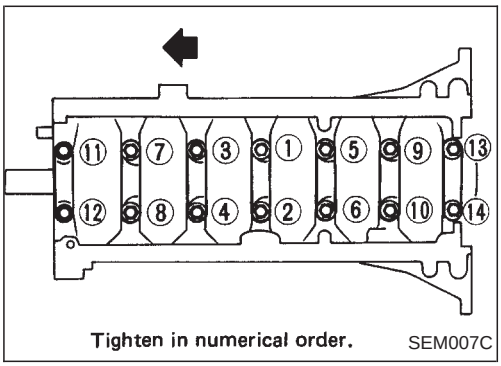
CRANKSHAFT



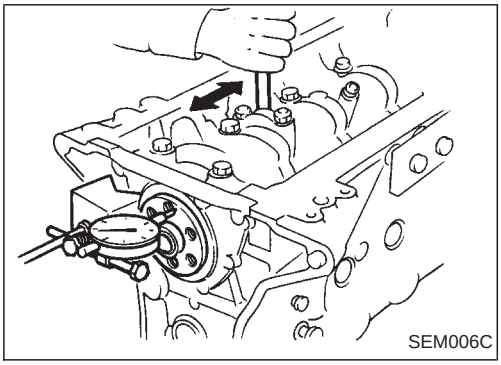
1. Set main bearings in their proper positions on cylinder block and main bearing cap.
- **Do not confuse upper and lower sides of main bearings.**



2. Install the oil jet. (TB45E engine only)
- **Insert the oil jet knock pin into the knock pin hole on the cylinder block, and tighten fixing bolt.**



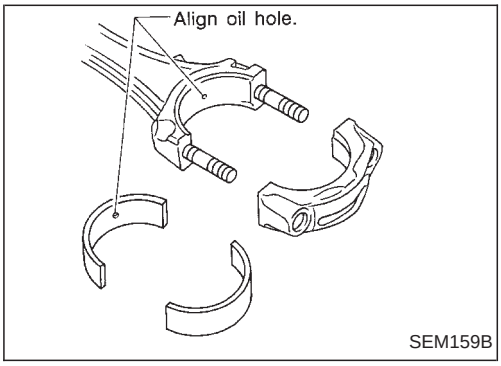
3. Install crankshaft and main bearing caps and tighten bolts to the specified torque.
- **Prior to tightening bearing cap bolts, place bearing cap in its proper position by shifting crankshaft in the axial direction.**
- **Tighten bearing cap bolts gradually in two or three stages start with the center bearing and move outward sequentially.**
- **After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.**



4. Measure crankshaft end play.

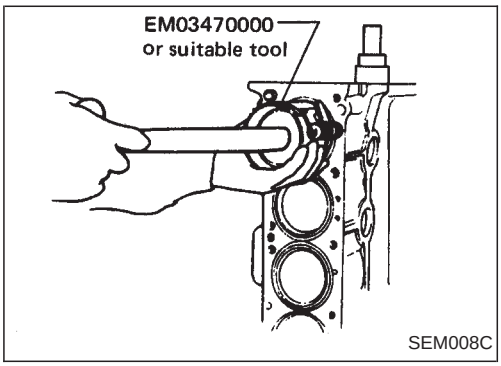
Crankshaft end play:
Standard
0.05 - 0.17 mm (0.0020 - 0.0067 in)
Limit
0.3 mm (0.012 in)

If end play exceeds the limit, replace No. 6 bearing.

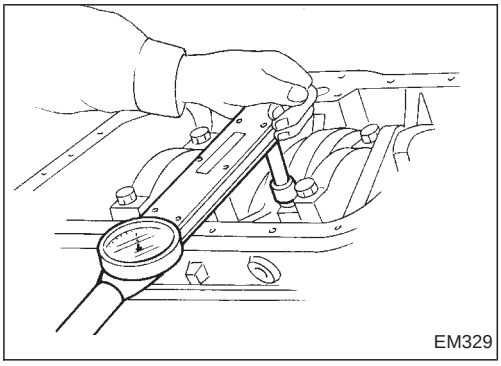


5. Install connecting rod bearings in connecting rods and connecting rod caps.
- Confirm that correct bearings are used. **Refer to "Inspection".**
- Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.

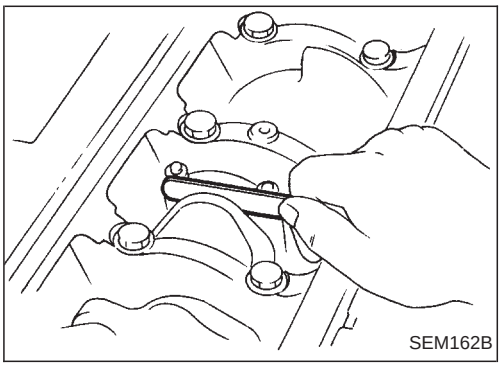
Assembly (Cont'd)



6. Install pistons with connecting rods.
(1) 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.**

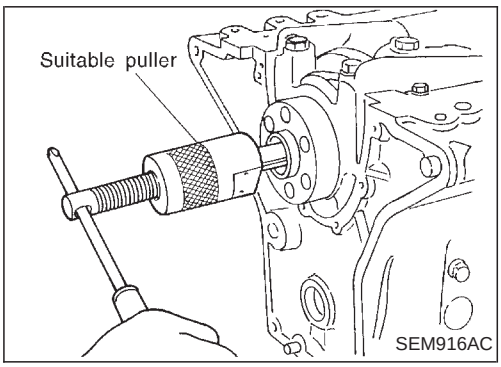


(2) Install connecting rod bearing caps.
Tighten connecting rod bearing cap nuts to the specified torque.
: Connecting rod bearing nut
(1) Tighten to 38 to 40 N·m
(3.9 to 4.1 kg-m, 28 to 30 ft-lb)
(2) Tighten to 67 to 71 N·m
(6.8 to 7.2 kg-m, 49 to 52 ft-lb)
or if you have an angle wrench, tighten bolts 40 to 45 degrees clockwise.

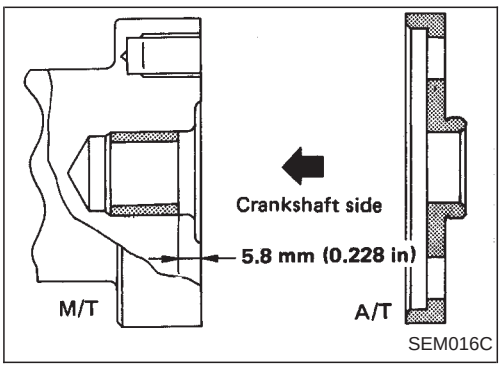


7. Measure connecting rod side clearance.
Connecting rod side clearance:
Standard
0.20 - 0.30 mm (0.0079 - 0.0118 in)
Limit
0.40 mm (0.0157 in)
If clearance exceeds the limit, replace connecting rod and/or crankshaft.

REPLACING PILOT BUSHING



1. Remove pilot bushing (M/T) or pilot converter (A/T).



2. Install pilot bushing (M/T) or pilot converter (A/T).

General Specifications

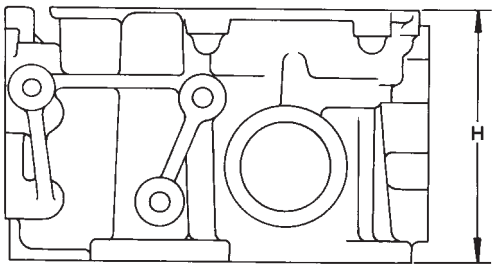
		TB42S	TB45E
Cylinder arrangement		6, in-line	
Displacement	cm^3 (cu in)	4,169 (254.39)	4,479 (273.31)
Bore and stroke	mm (in)	96 x 96 (3.78 x 3.78)	99.5 x 96.0 (3.917 x 3.780)
Valve arrangement		OHV	
Firing order		1-5-3-6-2-4	
Number of piston rings			
Compression		2	
Oil		1	
Number of main bearings		7	
Compression ratio		8.3	

Unit: kPa (bar, kg/cm^2, psi)/rpm

Compression pressure	
Standard	1,177 (11.77, 12.0, 171)/200
Minimum	883 (8.83, 9.0, 128)/200
Differential limit between cylinders	98 (0.98, 1.0, 14)/200

Inspection and Adjustment

CYLINDER HEAD



SEM013C

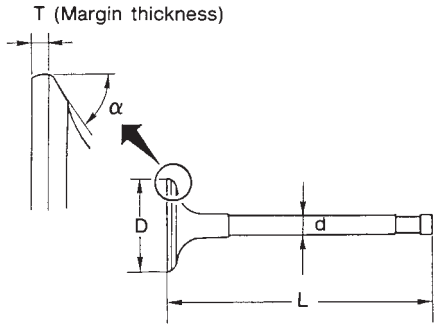
Unit: mm (in)

	Standard	Limit
Height (H)	116.57 - 116.97 (4.5894 - 4.6051)	0.2 (0.008)*
Surface distortion	Less than 0.07 (0.0028)	0.2 (0.008)

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

VALVE

Unit: mm (in)



SEM188

Valve head diameter "D"	
Intake	47.0 - 47.2 (1.850 - 1.858)
Exhaust	38.0 - 38.2 (1.496 - 1.504)
Valve length "L"	
Intake	116.7 - 117.0 (4.594 - 4.606)
Exhaust	117.15 - 117.45 (4.6122 - 4.6240)
Valve stem diameter "d"	
Intake	7.965 - 7.980 (0.3136 - 0.3142)
Exhaust	7.945 - 7.960 (0.3128 - 0.3134)
Valve seat angle "α"	
Intake Exhaust	45°30′
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

Unit: mm (in)

	TB42S, TB45E	TB42S	TB45E
	*Cold	Hot	
Intake	0.20 (0.008)	0.38 (0.015)	0.35 (0.014)
Exhaust	0.20 (0.008)	0.38 (0.015)	0.35 (0.014)

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

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

Valve spring

	TB42S	TB45E
Free height mm (in)		
Outer	49.77 (1.9594)	48.02 (1.8905)
Inner	44.10 (1.7362)	42.72 (1.6819)
Pressure height mm/N (mm/kg, in/lb)		
Outer	30.0/512.9 (30.0/52.3, 1.181/115.3)	27.7/611.0 (27.7/62.3, 1.091/137.4)
Inner	25.0/255.0 (25.0/26.0, 0.984/57.3)	24.7/305.5 (24.7/31.15, 0.972/68.7)
Assembled height mm/N (mm/kg, in/lb)		
Outer	40.0/225.6 (40.0/23.0, 1.575/50.7)	
Inner	35.0/107.9 (35.0/11.0, 1.378/24.3)	
Out-of-square mm (in)		
Outer	2.2 (0.087)	2.1 (0.083)
Inner	1.9 (0.075)	1.9 (0.075)

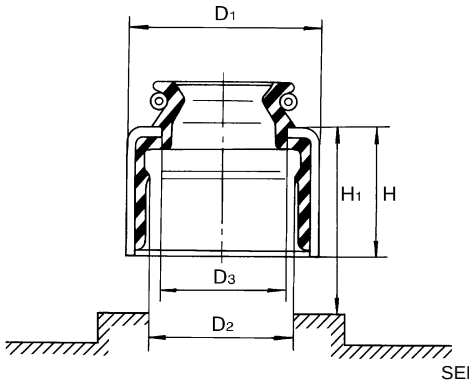
Valve lifter and push rod

Unit: mm (in)

	Standard	Limit
Valve lifter outer diameter	24.960 - 24.970 (0.9827 - 0.9831)	—
Cylinder block valve lifter hole diameter	25.000 - 25.033 (0.9843 - 0.9855)	—
Valve lifter to lifter hole clearance	0.030 - 0.073 (0.0012 - 0.0029)	0.1 (0.004)
Push rod bend (TIR)*	Less than 0.2 (0.008)	0.5 (0.020)

*: Total indicator reading

Valve oil seal



SEM736EA

	D_1 (dia.)	D_2 (dia.)	D_3 (dia.)	H	H_1
Intake side Exhaust side mm (in)	15.0 (0.591)	11.68 - 11.78 (0.4598 - 0.4638)	10.2 (0.402)	8.5 (0.335)	14.8 - 15.4 (0.583 - 0.606)

Valve guide

Unit: mm (in)

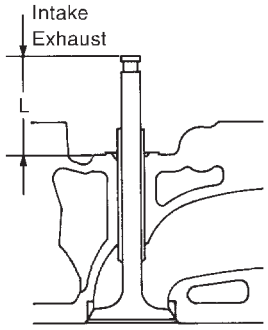
	Standard	Oversize
Valve guide		
Outer diameter		
Intake	12.015 - 12.029 (0.4730 - 0.4736)	12.233 - 12.244 (0.4816 - 0.4820)
Exhaust		
Valve guide		
Inner diameter [Finished size]		
Intake	8.000 - 8.018 (0.3150 - 0.3157)	
Exhaust		
Cylinder head valve guide hole diameter		
Intake	11.970 - 11.988 (0.4713 - 0.4720)	12.185 - 12.206 (0.4797 - 0.4806)
Exhaust		
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)	0.1 (0.004)
Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	
Valve deflection limit	—	0.2 (0.008)

Rocker shaft and rocker arm

Unit: mm (in)

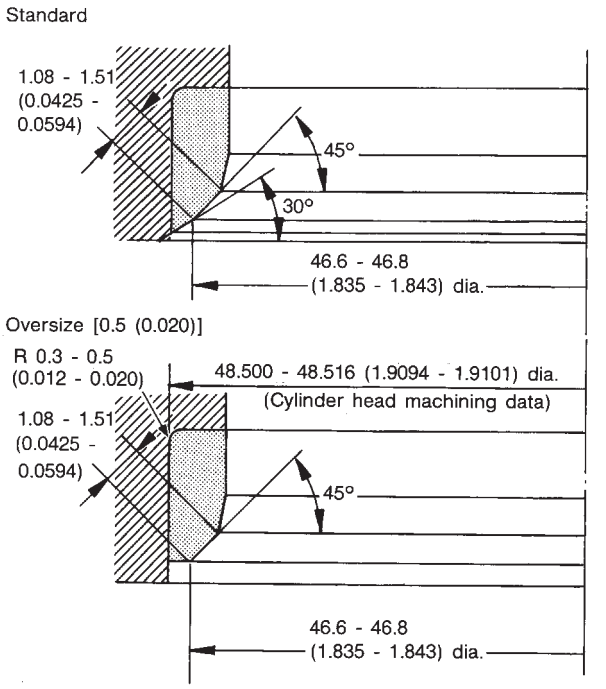
Rocker shaft	
Outer diameter	19.988 - 20.000 (0.7869 - 0.7874)
Rocker arm	
Inner diameter	20.020 - 20.038 (0.7882 - 0.7889)
Clearance between rocker arm and rocker shaft	0.020 - 0.050 (0.0008 - 0.0020)



SEM775F

Depth (L)	
Intake	46.14 (1.8165)
Exhaust	46.30 (1.8228)

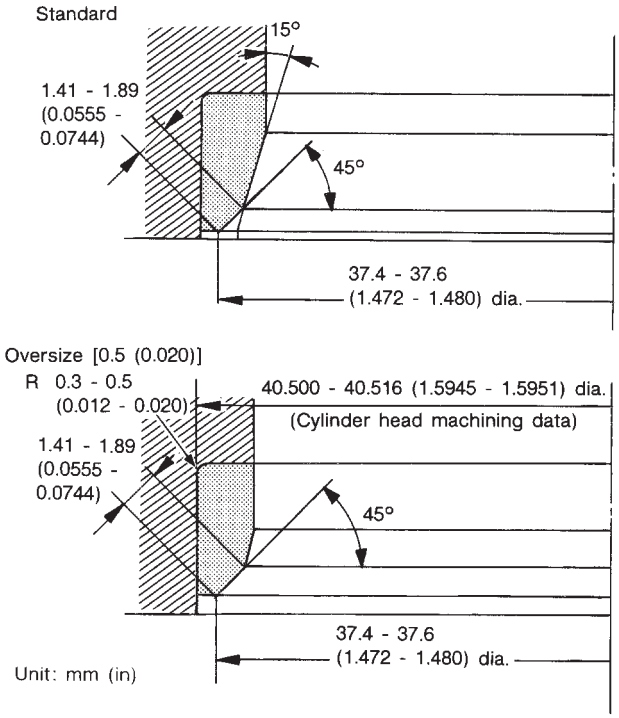
Intake valve seat



SEM755AD

Unit: mm (in)

Exhaust valve seat

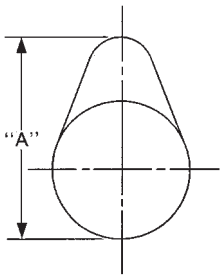


SEM108CA

CAMSHAFT AND CAMSHAFT BUSHING

Unit: mm (in)

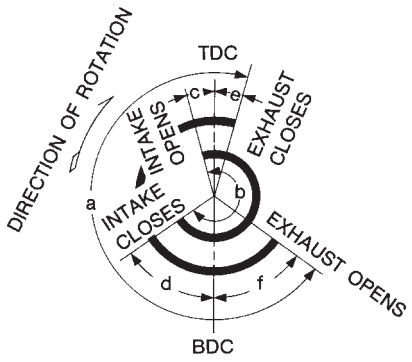
	Standard	Limit
Camshaft journal to bushing clearance [Oil clearance]	0.020 - 0.109 (0.0008 - 0.0043)	0.15 (0.0059)
Inner diameter of camshaft bushing		
Front	50.76 - 50.83 (1.9984 - 2.0012)	—
2nd	50.56 - 50.63 (1.9905 - 1.9933)	—
3rd	50.36 - 50.43 (1.9827 - 1.9854)	—
4th	50.16 - 50.23 (1.9748 - 1.9776)	—
5th	49.96 - 50.03 (1.9669 - 1.9697)	—
6th	49.76 - 49.83 (1.9591 - 1.9618)	—
Rear	49.56 - 49.63 (1.9512 - 1.9539)	—
Outer diameter of camshaft journal		
Front	50.721 - 50.740 (1.9969 - 1.9976)	—
2nd	50.521 - 50.540 (1.9890 - 1.9898)	—
3rd	50.321 - 50.340 (1.9811 - 1.9819)	—
4th	50.121 - 50.140 (1.9733 - 1.9740)	—
5th	49.921 - 49.940 (1.9654 - 1.9661)	—
6th	49.721 - 49.740 (1.9575 - 1.9583)	—
Rear	49.521 - 49.540 (1.9496 - 1.9504)	—
Camshaft bend (Total indicator reading)	Less than 0.02 (0.0008)	0.06 (0.0024)
Camshaft end play	0.08 - 0.28 (0.0031 - 0.0110)	0.5 (0.020)



EM671

	TB42S	TB45E
Cam height "A"		
Intake	42.311 - 42.561 (1.6658 - 1.6756)	42.126 - 42.376 (1.6585 - 1.6683)
Exhaust		
Wear limit of cam height	0.15 (0.0059)	

Valve timing



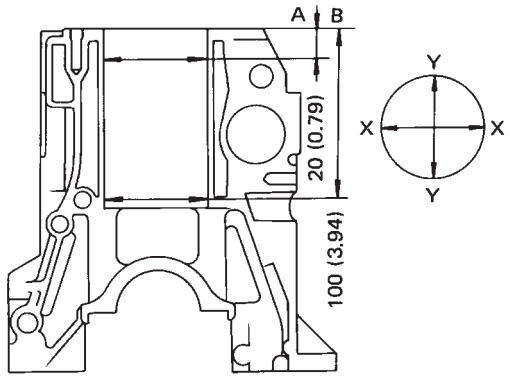
EM120

Unit: degree

	a	b	c	d	e	f
TB42S	248	248	16	52	6	62
TB45E	240	240	0	60	8	52

CYLINDER BLOCK

Unit: mm (in)



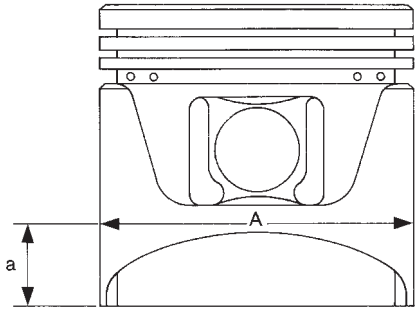
SEM014C

	TB42S	TB45E
Surface flatness		
Standard	Less than 0.03 (0.0012)	
Limit	0.10 (0.0039)	
Cylinder bore		
Inner diameter		
Standard		
Grade No. 1	96.000 - 96.010 (3.7795 - 3.7799)	99.500 - 99.510 (3.9173 - 3.9177)
Grade No. 2	96.010 - 96.020 (3.7799 - 3.7803)	99.510 - 99.520 (3.9177 - 3.9181)
Grade No. 3	96.020 - 96.030 (3.7803 - 3.7807)	99.520 - 99.530 (3.9181 - 3.9185)
Grade No. 4	96.030 - 96.040 (3.7807 - 3.7811)	99.530 - 99.540 (3.9185 - 3.9189)
Grade No. 5	96.040 - 96.050 (3.7811 - 3.7815)	99.540 - 99.550 (3.9189 - 3.9193)
Wear limit	0.20 (0.0079)	
Out-of-round (X − Y)	Less than 0.015 (0.0006)	
Taper (A − B)	Less than 0.010 (0.0004)	
Difference in inner diameter between cylinders		
Standard	Less than 0.05 (0.0020)	
Wear limit	0.20 (0.0079)	

PISTON, PISTON RING AND PISTON PIN

Available piston

Unit: mm (in)



SEM891B

	TB42S	TB45E
Piston skirt diameter "A"		
Standard		
Grade No. 1	95.975 - 95.985 (3.7785 - 3.7789)	99.460 - 99.470 (3.9157 - 3.9161)
Grade No. 2	95.985 - 95.995 (3.7789 - 3.7793)	99.470 - 99.480 (3.9161 - 3.9165)
Grade No. 3	95.995 - 96.005 (3.7793 - 3.7797)	99.480 - 99.490 (3.9165 - 3.9169)
Grade No. 4	96.005 - 96.015 (3.7797 - 3.7801)	99.490 - 99.500 (3.9169 - 3.9173)
Grade No. 5	96.015 - 96.025 (3.7801 - 3.7805)	99.500 - 99.510 (3.9173 - 3.9177)
Oversize		
0.50 (0.0197)		
(mark: "50")	96.475 - 96.525 (3.7982 - 3.8002)	99.960 - 100.010 (3.9354 - 3.9374)
1.00 (0.0394)		
(mark: "100")	96.975 - 97.025 (3.8179 - 3.8199)	100.460 - 100.510 (3.9551 - 3.9571)
"a" dimension	20 (0.79)	
Piston pin hole diameter	22.987 - 22.999 (0.9050 - 0.9055)	22.993 - 23.005 (0.9052 - 0.9057)
Piston clearance to cylinder block	0.015 - 0.035 (0.0006 - 0.0014)	0.030 - 0.050 (0.0012 - 0.0020)

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

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	0.065 - 0.135 (0.0026 - 0.0053)	
Ring gap [at master bore D = 96.000 (3.7795)]		
Top	0.30 - 0.45 (0.0118 - 0.0177)	1.5 (0.059)
2nd	0.30 - 0.45 (0.0118 - 0.0177)	
Oil	0.20 - 0.60 (0.0079 - 0.0236)	

Piston pin

Unit: mm (in)

	TB42S	TB45E
Piston pin outer diameter	22.989 - 23.001 (0.9051 - 0.9055)	
Interference fit of piston pin to piston	−0.007 to 0.003 (−0.0003 to 0.0001)	−0.001 to 0.009 (−0.0000 to 0.0004)
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

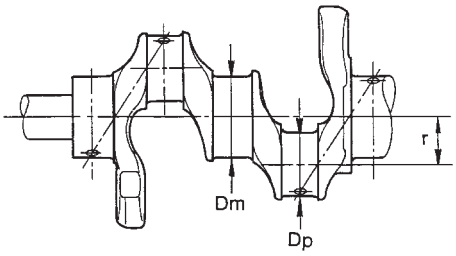
Unit: mm (in)

Center distance	166.45 - 166.55 (6.5531 - 6.5571)
Bend, torsion [per 100 (3.94)]	
Limit	Bend 0.15 (0.0059) Torsion 0.3 (0.012)
Piston pin bushing inner diameter	23.000 - 23.012 (0.9055 - 0.9060)
Connecting rod big end inner diameter	59.987 - 60.000 (2.3617 - 2.3622)
Side clearance	
Standard	0.20 - 0.30 (0.0079 - 0.0118)
Limit	0.40 (0.0157)

CRANKSHAFT

Unit: mm (in)

Main journal dia. "Dm"	70.897 - 70.921 (2.7912 - 2.7922)
Pin journal dia. "Dp"	56.913 - 56.926 (2.2407 - 2.2412)
Center distance "r"	48 (1.89)
Out-of-round (X − Y)	
Standard	Less than 0.0025 (0.0001)
Taper (A − B)	
Standard	Less than 0.0025 (0.0001)
Runout [TIR]	
Standard	Less than 0.20 (0.0079)
Free end play	
Standard	0.05 - 0.17 (0.0020 - 0.0067)
Limit	0.30 (0.0118)



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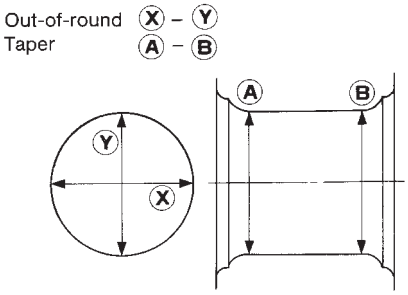

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AVAILABLE MAIN BEARING

Unit: mm (in)

	Thickness "T"	Main journal diameter "Dm"
Standard	2.008 - 2.012 (0.0791 - 0.0792)	—
Undersize		
0.25 (0.0098)	2.133 - 2.137 (0.0840 - 0.0841)	Grind so that bearing clearance is the specified value.
0.50 (0.0197)	2.258 - 2.262 (0.0889 - 0.0891)	
0.75 (0.0295)	2.383 - 2.387 (0.0938 - 0.0940)	
1.00 (0.0394)	2.508 - 2.512 (0.0987 - 0.0989)	

AVAILABLE CONNECTING ROD BEARING

Unit: mm (in)

	Thickness "T"	Crank pin journal diameter "Dp"
Standard	1.513 - 1.517 (0.0596 - 0.0597)	—
Undersize		
0.25 (0.0098)	1.638 - 1.642 (0.0645 - 0.0646)	Grind so that bearing clearance is the specified value.
0.50 (0.0197)	1.763 - 1.767 (0.0694 - 0.0696)	
0.75 (0.0295)	1.888 - 1.892 (0.0743 - 0.0745)	
1.00 (0.0394)	2.013 - 2.017 (0.0793 - 0.0794)	

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Flywheel & drive plate	
Runout [TIR]	Less than 0.1 (0.004)

Bearing clearance

Unit: mm (in)

Main bearing clearance	
Standard	0.030 - 0.087 (0.0012 - 0.0034)
Limit	0.09 (0.0035)
Connecting rod bearing clearance	
Standard	0.027 - 0.061 (0.0011 - 0.0024)
Limit	0.09 (0.0035)