

ENGINE MECHANICAL

SECTION **EM**

EM

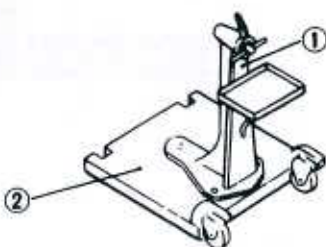
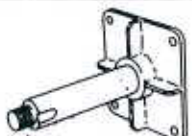
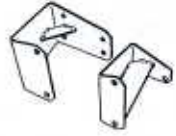
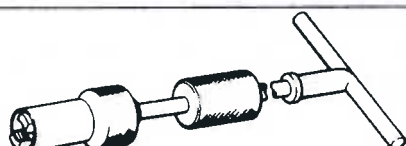
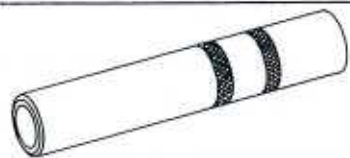
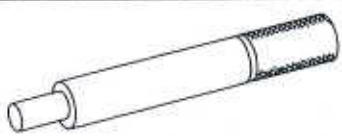
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PREPARATION

SPECIAL SERVICE TOOLS

*: Special tool or commercial equivalent

Tool number Tool name	Description	Engine application		
		TD23	TD25	TD27 and TD27T
ST0501S000* Engine stand assembly ① ST05011000 Engine stand ② ST05012000 Base	Disassembling and assembling 	X	X	X
KV10106500* Engine attachment		X	X	X
KV11103200* Engine sub-attachment		X	X	X
① KV10109210* Valve spring compressor ② KV10111200* Adapter	Disassembling and assembling valve components 	X	X	X
KV10107900* Valve oil seal puller	Disassembling valve oil seal 	X	X	X
KV11103400 Valve oil seal drift	Installing valve oil seal 	X	X	X
ST11033000* Valve guide drift	Removing valve guide 	X	X	X

Tool nu
Tool na

KV1110
Valve g

ST1103
Valve g
8.0 mm

① KV1
Valv

② KV1
Ada

③ KV1
Ada

④ KV1
Ada

⑤ KV1
Ada

⑥ KV1
Ada

⑦ KV1
Ada

① ST11
Valv

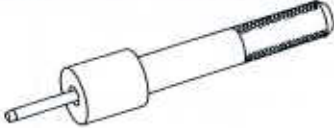
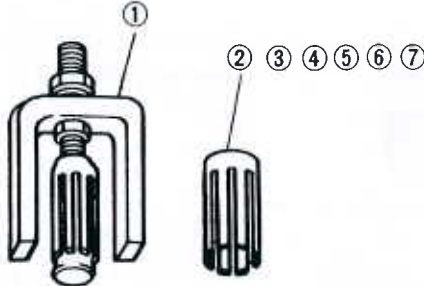
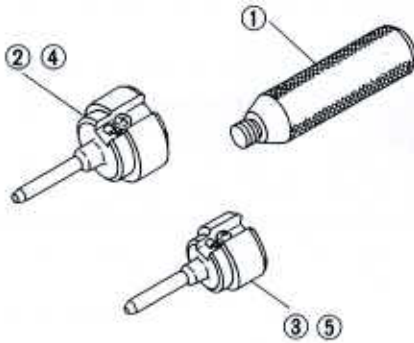
② KV1
Ada

③ KV1
Ada

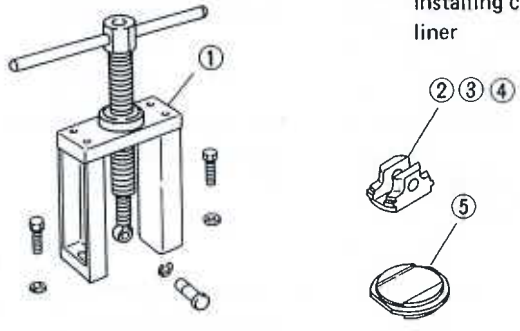
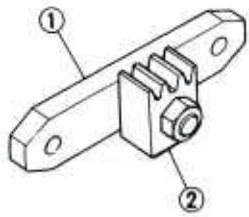
④ KV1
Ada

⑤ KV1
Ada

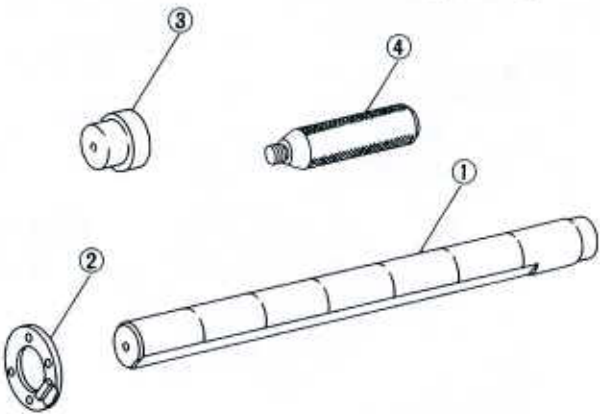
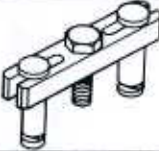
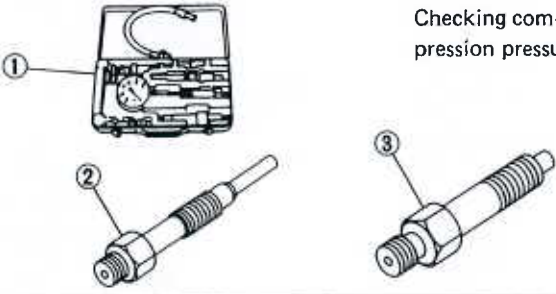
PREPARATION

Tool number. Tool name	Description	Engine application		
		TD23	TD25	TD27 and TD27T
KV11103900* Valve guide drift	Installing valve guide 	X	X	X
ST11032000* Valve guide reamer 8.0 mm (0.315 in) dia.	Reaming valve guide 	X	X	X
① KV11101110 Valve seat remover	Removing valve seat 	X	X	X
② KV11103510 Adapter (Intake)		X	—	—
③ KV11103520 Adapter (Exhaust)		X	—	—
④ KV11104910 Adapter (Intake)		—	X	—
⑤ KV11104920 Adapter (Exhaust)		—	X	—
⑥ KV11103610 Adapter (Intake)		—	—	X
⑦ KV11103620 Adapter (Exhaust)		—	—	X
① ST15243000 Valve seat drift	Installing valve seat 	X	X	X
② KV11103710 Adapter (Intake)		X	X	—
③ KV11103720 Adapter (Exhaust)		X	X	—
④ KV11103810 Adapter (Intake)		—	—	X
⑤ KV11103820 Adapter (Exhaust)		—	—	X

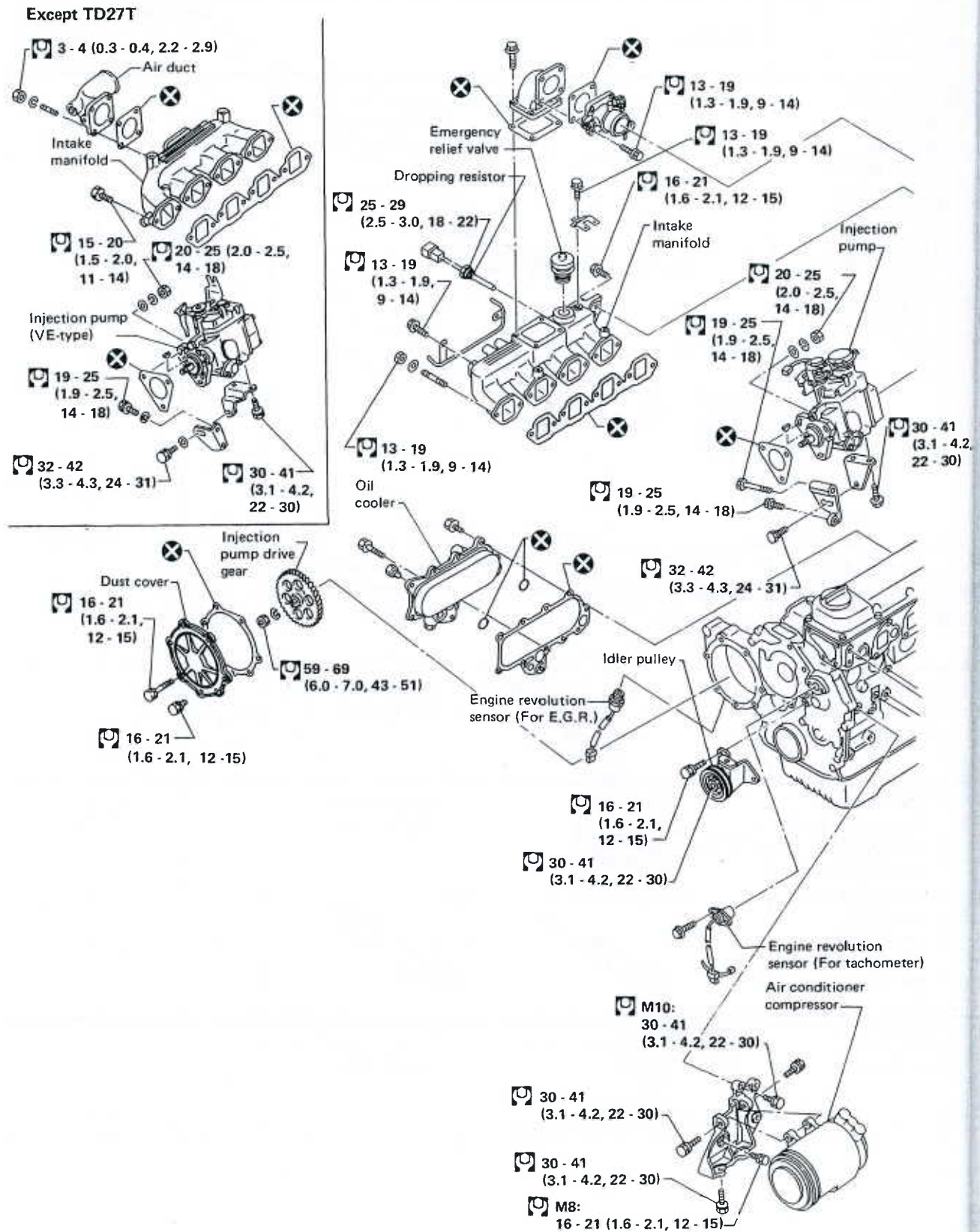
PREPARATION

Tool number Tool name	Description	Engine application		
		TD23	TD25	TD27 and TD27T
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	 Removing and installing cylinder liner	X X - - X	X - X - X	X - - X X
EM03470000* Piston ring compressor	 Installing piston into cylinder	X	X	X
KV111033S0 Engine stopper ① KV11103310 Stopper plate ② KV10105630 Stopper gear	 Preventing crank- shaft from rotating	X	X	X
ST16610001* Pilot bushing puller	 Removing pilot bushing	X	X	X

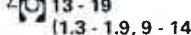
PREPARATION

n D27 and TD27T	Tool number Tool name	Description	Engine application		
			TD23	TD25	TD27 and TD27T
X - - X X	KV111045S0 Cam bushing replacer set ① KV11104510 Replacer bar ② KV11104520 Guide plate ③ KV11104530 Adapter (1st bushing) ④ ST15243000 Drift	Removing cam bushing or installing cam bushing 	X	X	X
X	KV10109300* Injection pump drive gear holder	Preventing drive gear from rotating (VE-type) 	X	X	X
X	KV11103000* Injection pump drive gear puller	Removing drive gear (VE-type) 	X	X	X
X	① ED19601000 Compression gauge ② ED19600600 Compression gauge adapter (for glow plug hole) ③ ED19600700 Compression gauge adapter (for injector hole)	Checking com- pression pressure 	X	X	X
	WS39930000* Tube presser	Pressing the tube of liquid gasket 	X	X	X

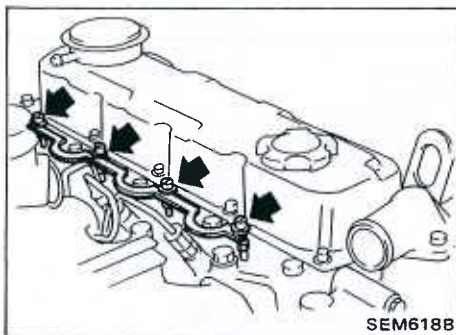
ENGINE COMPONENTS —Outer Parts



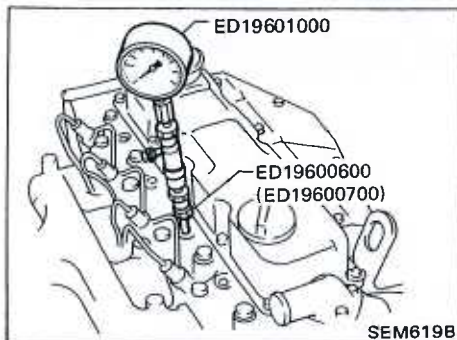
ENGINE COMPONENTS —Outer Parts

 : N·m (kg-m, ft-lb)

CHECKING COMPRESSION PRESSURE (On-Vehicle Service)

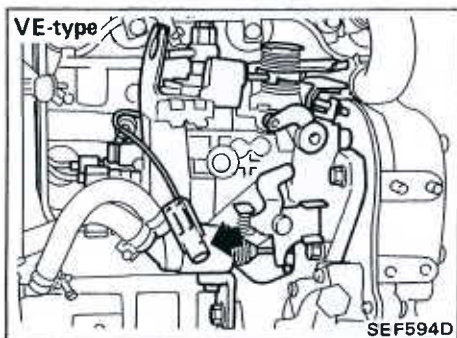


1. Warm up engine.
2. Remove glow plate and glow plugs.



3. Fit compression gauge adapter to cylinder head.

 : Compression gauge adapter
15 - 20 N·m
(1.5 - 2.0 kg-m, 11 - 14 ft-lb)

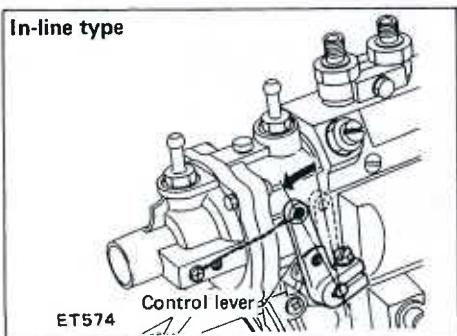


4. Set no fuel injected condition.

- VE-type
Disconnect fuel cut solenoid wire.
- In-line type
Set control lever of injection pump at zero injection.

5. Crank engine, then read gauge indication.

- In case of engine equipped with In-line type, depress accelerator pedal fully and crank engine.
- Engine compression measurement should be made as quickly as possible.



Compression pressure:

Unit: kPa (bar, kg/cm², psi)/200 rpm

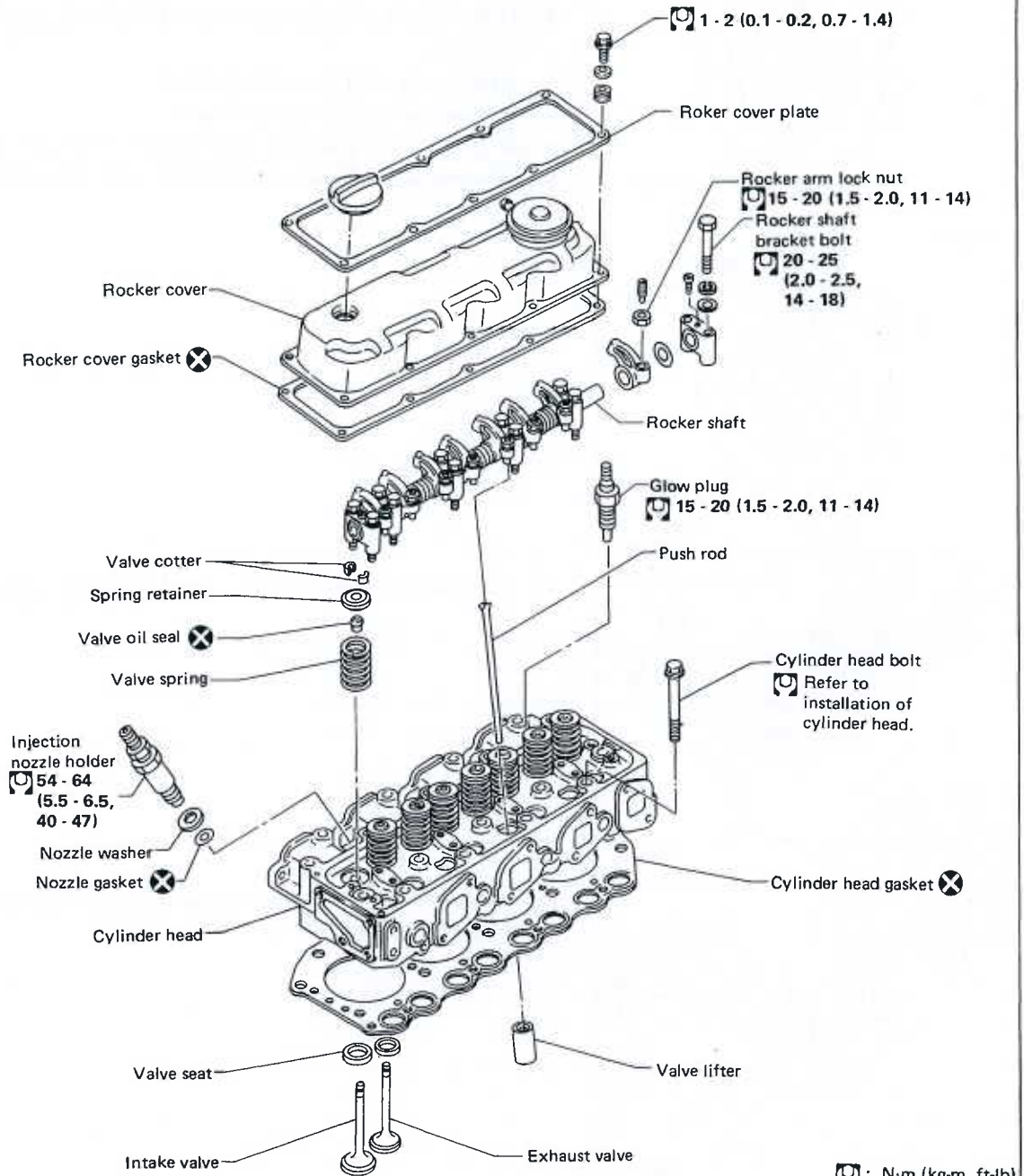
Standard	2,942 (29.4, 30, 427)
Minimum	2,452 (24.5, 25, 356)
Differential limit between cylinders	294 (2.9, 3, 43)

6. If cylinder compression in one or more cylinders is low, pour a small quantity of engine oil into cylinders through the glow holes and retest compression.

- If adding oil helps the compression pressure, chances are that piston rings are worn or damaged.
- If pressure stays low, valve may be sticking or seating improperly.
- If cylinder compression in any two adjacent cylinders is low, and if adding oil does not help the compression, there is leakage past the gasketed surface.

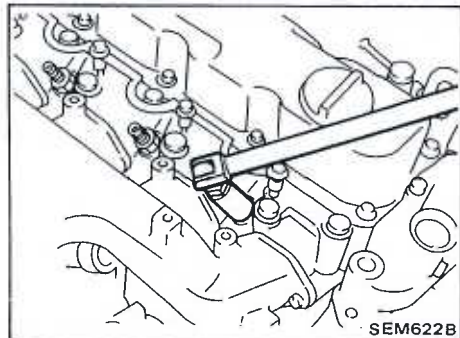
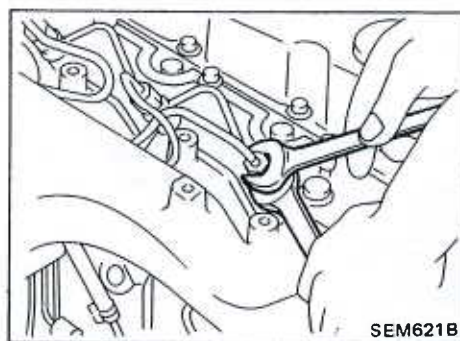
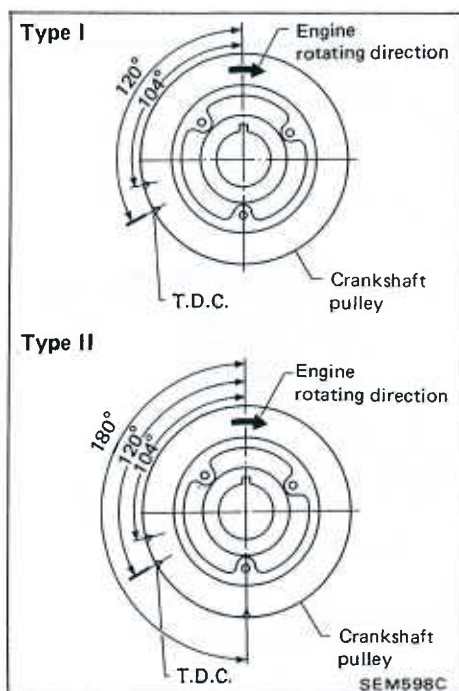
Oil and water in combustion chambers can result from this problem.

CYLINDER HEAD



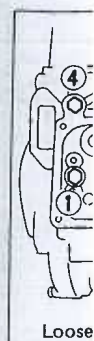
⌘ : N·m (kg-m, ft-lb)
SEM6208

CYLINDER HEAD — Removal (On-Vehicle Service)



Removal

1. Set No. 1 cylinder at T.D.C. on its compression stroke.
2. Drain engine coolant from drain plugs on cylinder block and radiator.
3. Remove air cleaner and/or air duct.
4. Remove alternator adjusting bolt.
5. Disconnect exhaust manifold from front exhaust tube.
6. Disconnect radiator outlet hose and thermostat housing water inlet hose.
7. Remove fuel injection tube assembly and spill tube.
8. Remove injection nozzle holder and top nozzle gasket using deep socket wrench.
9. Remove rocker cover.
10. Remove rocker shaft with rocker arms.
11. Remove push rods.

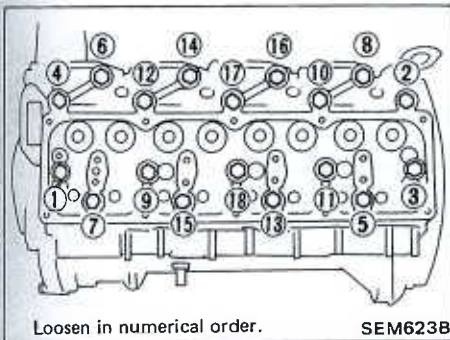


CYLINDER HEAD — Removal (On-Vehicle Service)

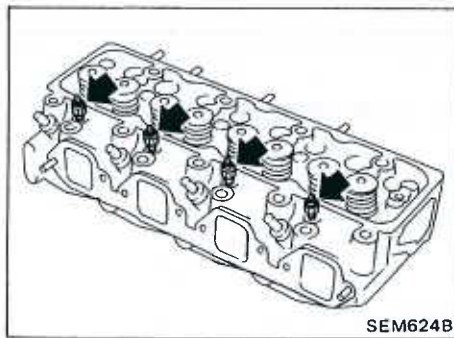
Removal (Cont'd)

12. Remove cylinder head bolts in numerical order and remove cylinder head.

Head warpage or cracking could result from removing in incorrect order.

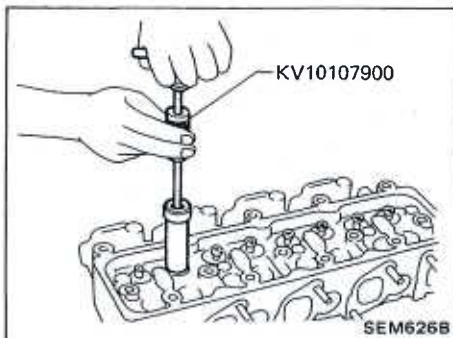
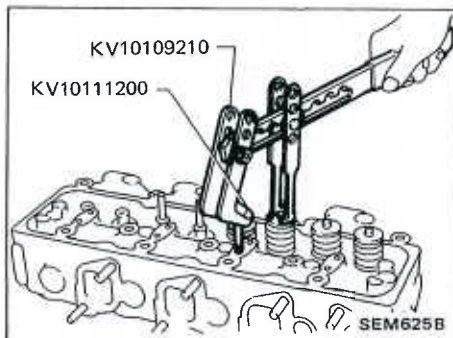


CYLINDER HEAD — Disassembly

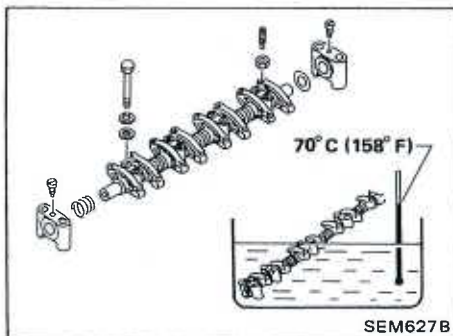


Disassembly

1. Remove following parts:
 - Intake manifold
 - Exhaust manifold
 - Thermostat housing
 - Alternator adjusting bar & engine slinger
 - Glow plate and glow plugs
2. Remove valve component parts with Tool.



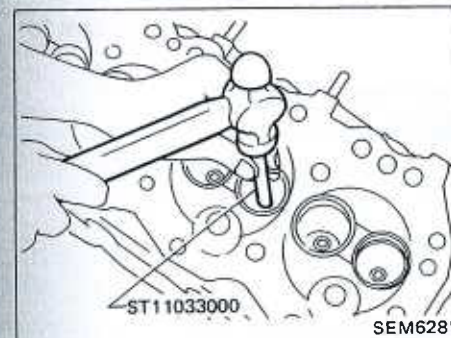
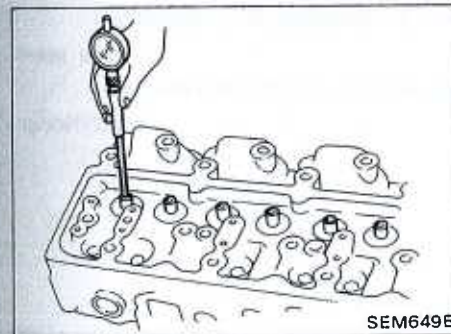
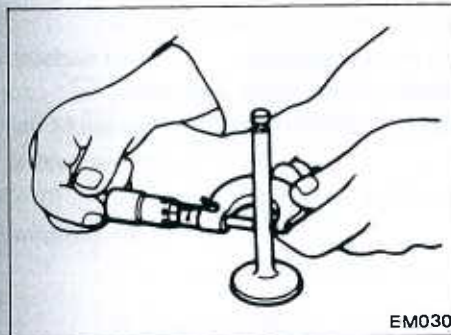
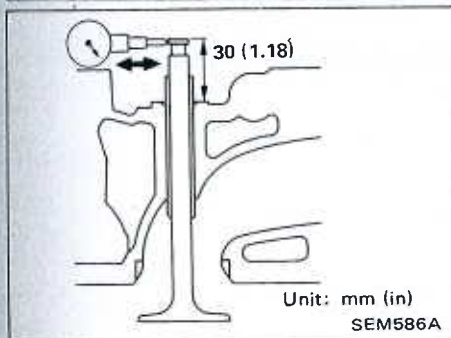
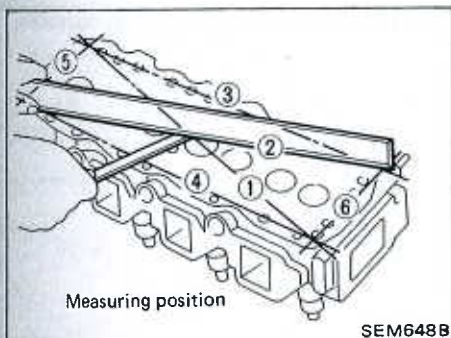
3. Remove valve oil seals with Tool.



4. Disassemble rocker shaft assembly.
 - a. Remove rocker shaft lock bolt.
 - b. Remove valve rocker and rocker shaft bracket.

If it is difficult to remove rocker shaft bracket, immerse rocker shaft assembly in oil of 70°C (158°F) for a few minutes and then remove bracket.

CYLINDER HEAD — Inspection



CYLINDER HEAD DISTORTION

Cylinder head distortion:

Standard

Less than 0.07 mm (0.0028 in)

Limit

0.2 mm (0.008 in)

If beyond the specified limit, correct with a surface grinder. Cylinder head height should be greater than 89.7 mm (3.531 in) after surface has been ground.

VALVE GUIDE CLEARANCE

- Valve guide clearance should be measured parallel with rocker arm. (Generally, a large amount of wear occurs in this direction.)

Stem to guide clearance:

Limit

Intake 0.15 mm (0.0059 in)

Exhaust 0.20 mm (0.0079 in)

Maximum allowable deflection

(Dial indicator reading)

Intake 0.30 mm (0.0118 in)

Exhaust 0.40 mm (0.0157 in)

- To determine the correct replacement part, measure valve stem diameter and valve guide inner diameter.

Valve stem diameter:

Standard

Intake

7.962 - 7.977 mm (0.3135 - 0.3141 in)

Exhaust

7.945 - 7.960 mm (0.3128 - 0.3134 in)

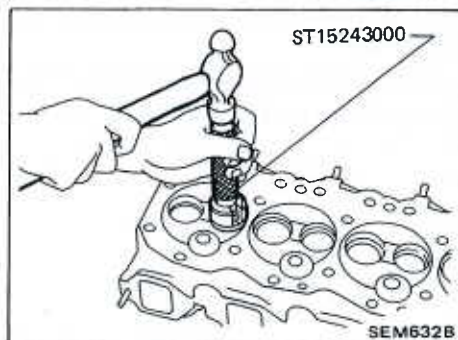
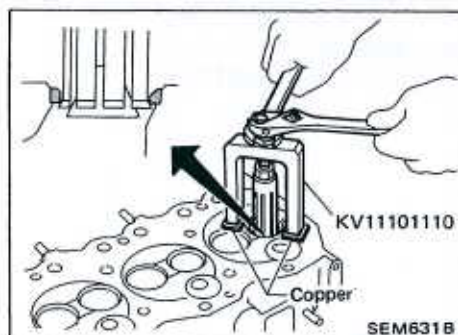
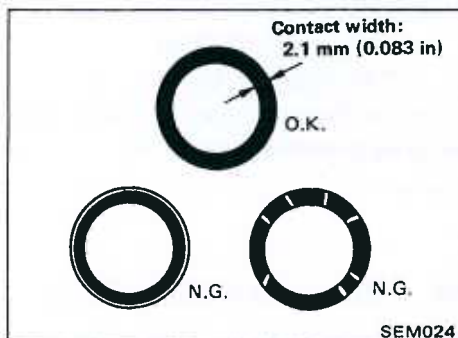
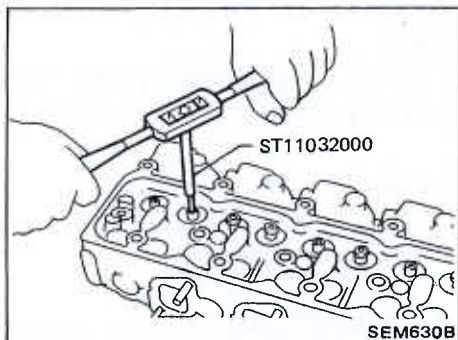
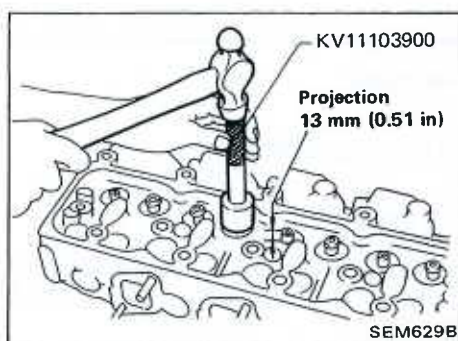
Valve guide inner diameter:

8.00 - 8.015 mm (0.3150 - 0.3156 in)

VALVE GUIDE REPLACEMENT

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

CYLINDER HEAD — Inspection



- Press service valve guide onto cylinder head using suitable tool until the guide projects out 13 mm (0.51 in).

- Ream valve guide.

Finished size:

8.000 - 8.015 mm (0.3150 - 0.3156 in)

VALVE SEATS

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

- When repairing valve seats, check valve and valve guide for wear beforehand. If worn, replace them. Then correct valve seat.
- The cutting should be done with both hands for uniform cutting.

REPLACING VALVE SEAT FOR SERVICE PARTS

- Bore out old seat until it collapses or remove valve seats with Tool.

Place a copper seat between contact surface of Tool and cylinder head.

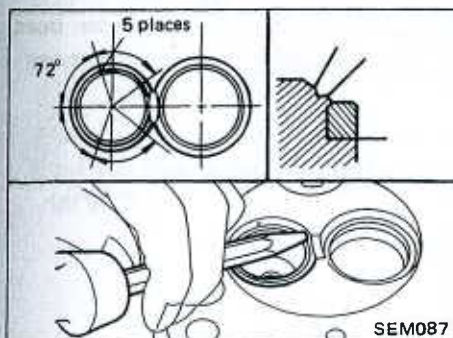
- Place new valve seats on dry ice and allow them to cool for five minutes.

WARNING:

Do not touch cooled valve seats with bare hand.

- Heat cylinder head to 80°C (176°F).
- Install cooled valve seats on cylinder head with Tool.

CYLINDER HEAD — Inspection



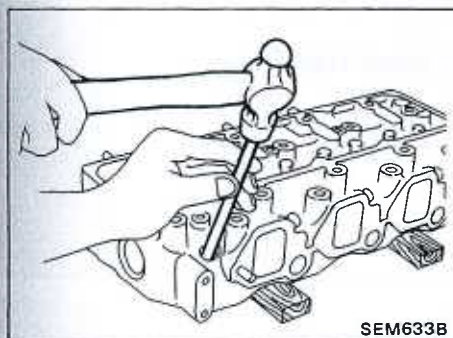
5. Stake exhaust valve seat at five places with punch.

When staking valve seat, select different places than those staked before.

6. Cut or grind valve seat using suitable tool at the specified dimensions as shown in S.D.S.

7. After cutting, lap valve seat with a lapping compound.

8. Check contact condition of valve seat.



COMBUSTION CHAMBER

Check combustion chamber for cracks and other damage. If necessary, replace.

REPLACING COMBUSTION CHAMBER

Usually combustion chamber should not be removed.

1. Remove combustion chamber so that cylinder head cannot be damaged.

2. Install combustion chamber.

• Identification of combustion chambers

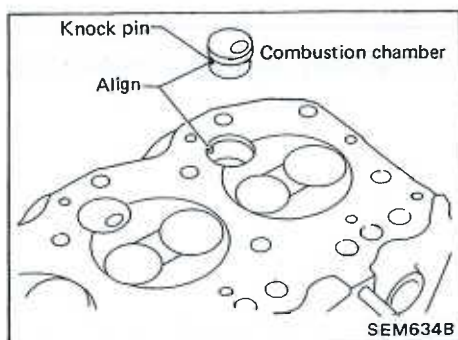
Identification mark (on combustion chamber)	Outer diameter "D" mm (in)	Engine
—	34 (1.34)	TD23
2	37 (1.46)	TD25
—		TD27
3		TD27T

(1) Cool combustion chamber with dry ice for approximately 5 to 10 minutes.

WARNING:

Do not touch cooled combustion chamber with bare hand.

CYLINDER HEAD — Inspection

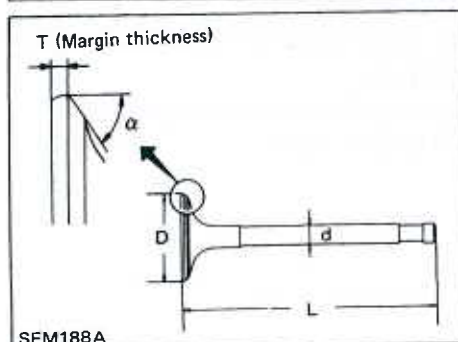


- (2) Align combustion chamber knock pin with cylinder head notch, and drive in combustion chamber with a soft hammer.
3. Check amount of protrusion of combustion chamber.

Protrusion:

Standard

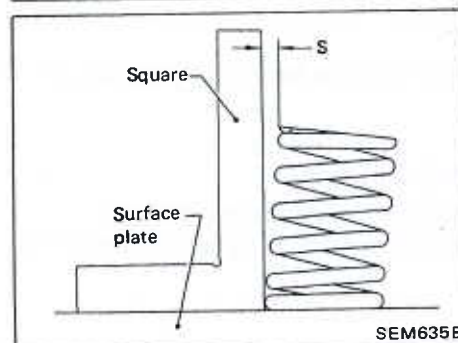
−0.05 to 0.10 mm (−0.0020 to 0.0039 in)



VALVE DIMENSIONS

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

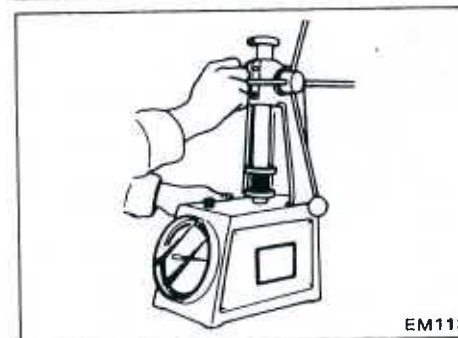
Grinding allowance for valve stem tip is 0.2 mm (0.008 in) or less.



VALVE SPRING SQUARENESS

Out-of-square "S":

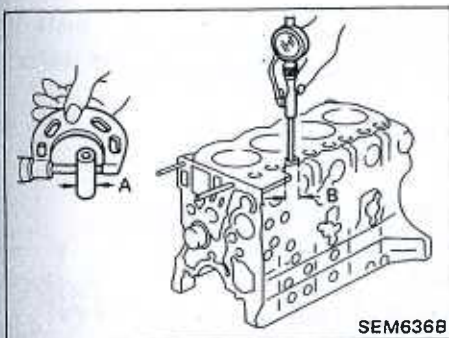
Less than 2.0 mm (0.079 in)



VALVE SPRING PRESSURE LOAD

Refer to S.D.S.

CYLINDER HEAD — Inspection



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

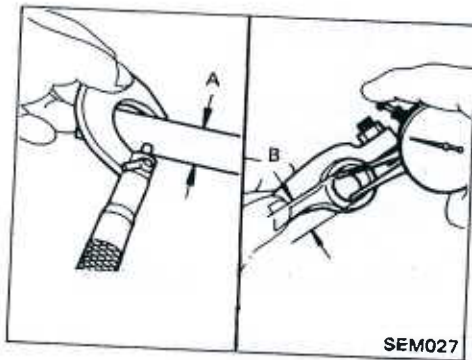
(Total indicator reading):

Less than 0.5 mm (0.020 in)

ROCKER SHAFT AND ROCKER ARM

1. Check valve rockers, brackets and rocker shafts for scoring, wear or distortion. Replace if necessary.

CYLINDER HEAD — Inspection



2. Check clearance between valve rockers and rocker shaft. If specified clearance is exceeded, replace affected valve rockers or shafts.

Specified clearance:

Limit

Less than 0.15 mm (0.0059 in)

Rocker shaft outer diameter "A":

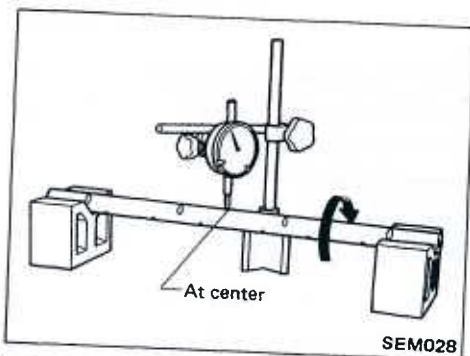
Standard

19.979 - 20.000 mm (0.7866 - 0.7874 in)

Rocker arm inner diameter "B":

Standard

20.014 - 20.035 mm (0.7880 - 0.7888 in)



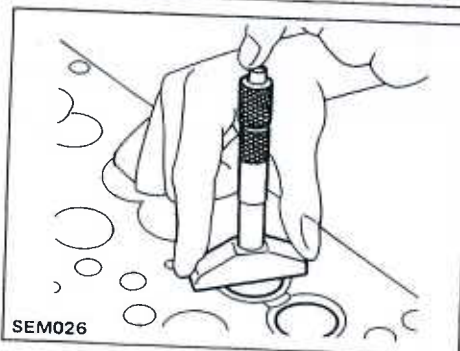
3. Check rocker shaft bend at its center. If bend is within specified limit, straighten it; and if it is greater than specified limit, replace rocker shaft.

Rocker shaft bend

(Total indicator reading):

Limit

Less than 0.3 mm (0.012 in)



MEASURING CYLINDER HEAD TO VALVE DISTANCE

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

Specified distance:

Standard

Intake

0.275 - 0.675 mm
(0.0108 - 0.0266 in)

Exhaust

0.305 - 0.695 mm
(0.0120 - 0.0274 in)

Limit

Less than

1.25 mm (0.0492 in)
for intake and exhaust valves

CYLINDER HEAD — Assembly

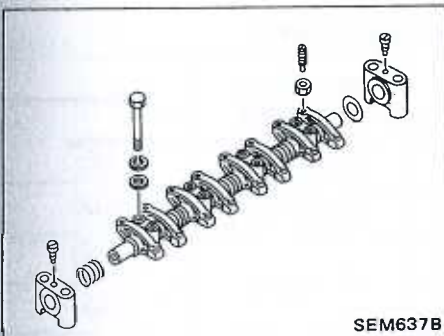
er shaft. If
lve rockers

74 in)

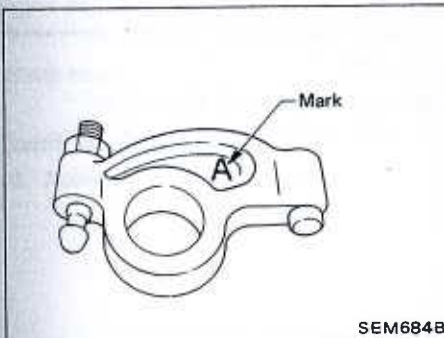
38 in)

is within
specified

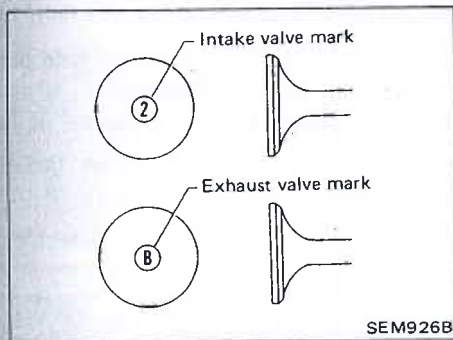
ANCE
ntake and
ce valve(s)



SEM637B



SEM684B



SEM926B

1. Assemble rocker shaft component parts.

• Identification of rocker arms

Identification mark (on rocker arm)	Engine	For use with
A	TD23	Intake and exhaust
B	TD25, TD27 and TD27T	Intake
C		Exhaust

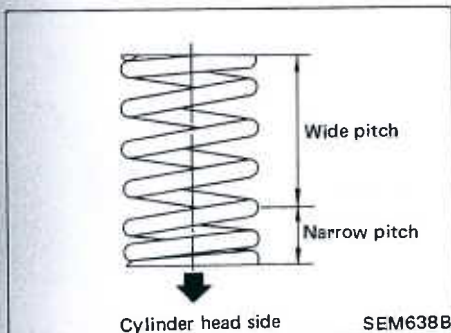
2. Install valve component parts.

• Identification of valves

Identification mark (on intake and exhaust valve)		Engine
Intake valve	Exhaust valve	
1	A	TD23
2	B	TD25
3	C	TD27
	D	TD27T

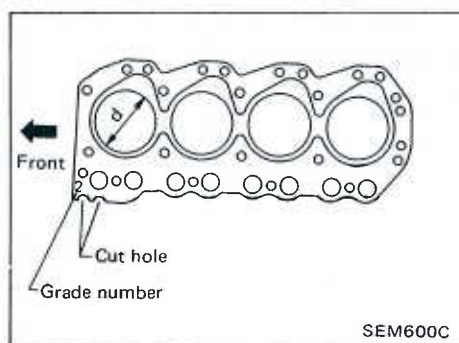
- Always use new valve oil seal. (Refer to OIL SEAL REPLACEMENT.)

- Install valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side.



SEM638B

CYLINDER HEAD — Installation (On-Vehicle Service)

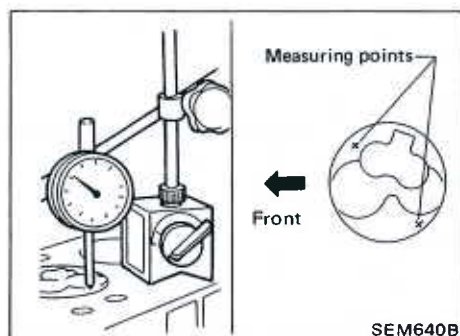


1. Install cylinder head gasket.

• Identification of cylinder head gaskets

Identification cut hole (on cylinder head gasket)	Inner diameter "d" mm (in)	Engine
—	90.5 (3.563)	TD23
2	94.4 (3.717)	TD25
1	97.5 (3.839)	TD27
—		TD27T

- When replacing only cylinder head gasket, install same grade gasket as the one formerly used.
- When replacing or repairing cylinder block, cylinder head, piston, connecting rod and crankshaft, select gasket as follows:



(1) Measure piston projection.

- Set each piston at its Top Dead Center. With piston held in that position, measure its projections at two points.
- Calculate the average value of the two measurements.
- Determine the amount of projection of the other three pistons.

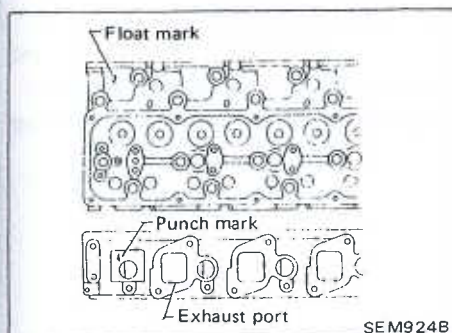
(2) Select suitable cylinder head gasket which conforms to the largest amount of projection of the four pistons.

Unit: mm (in)

Average values piston projections	Gasket thickness	Gasket grade number
Less than 0.118 (0.0046)	1.30 (0.0512)	1
0.118 - 0.168 (0.0046 - 0.0066)	1.35 (0.0531)	2
More than 0.168 (0.0066)	1.40 (0.0551)	3

Make sure that No. 1 piston is at T.D.C. on its compression stroke.

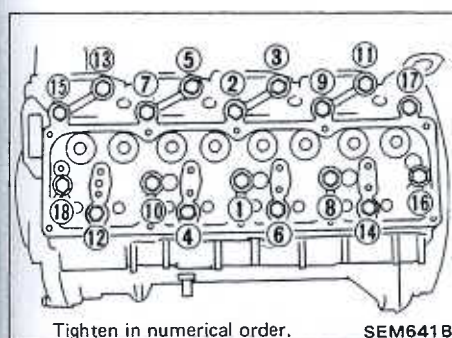
CYLINDER HEAD — Installation (On-Vehicle Service)



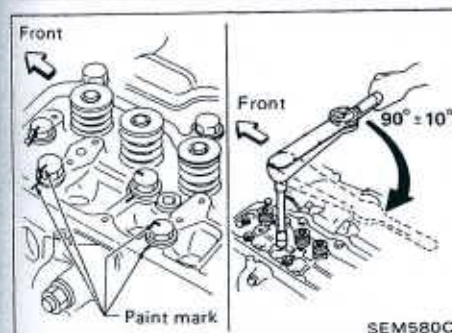
2. Install cylinder head.

• Cylinder head identification mark

Identification number (on cylinder head)		Engine
Float mark	Punch mark	
1	—	TD23
2	4	TD25
2	—	TD27
2T	—	TD27T



Tighten in numerical order.



3. Apply oil to the thread portion and seat surface of bolts and tighten cylinder head bolts using Tool.

CAUTION:

• Tightening procedure

1st: Tighten bolts to 39 - 44 N·m
(4.0 - 4.5 kg-m, 29 - 33 ft-lb)

2nd: Tighten bolts to 54 - 59 N·m
(5.5 - 6.0 kg-m, 40 - 43 ft-lb)

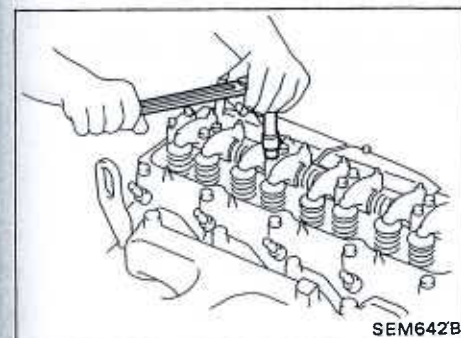
3rd:

- (1) Mark exhaust side of cylinder head and cylinder head bolts with paint as shown.
- (2) Turn all bolts 90 ± 10 degrees clockwise.
- (3) Check that the paint mark of each bolt is facing the front of the vehicle.

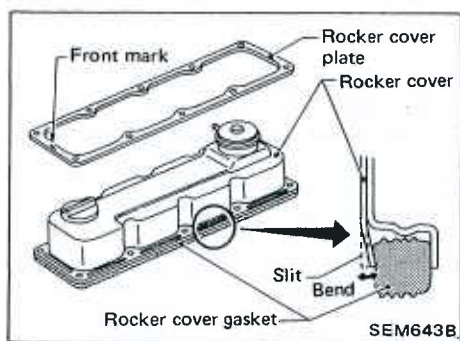
4. Apply engine oil and install push rods.

5. Install rocker shaft assembly.

Adjusting intake and exhaust valve clearance tentatively.
Refer to section MA.

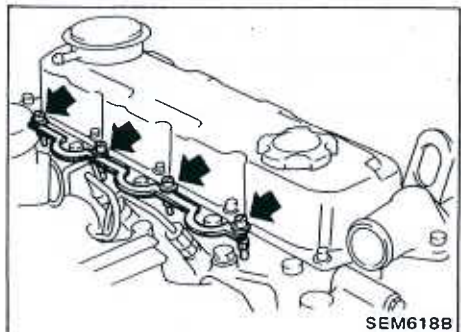


CYLINDER HEAD — Installation (On-Vehicle Service)

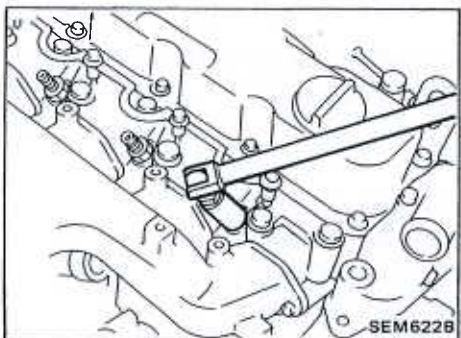


6. Install rocker cover with rocker cover plate.

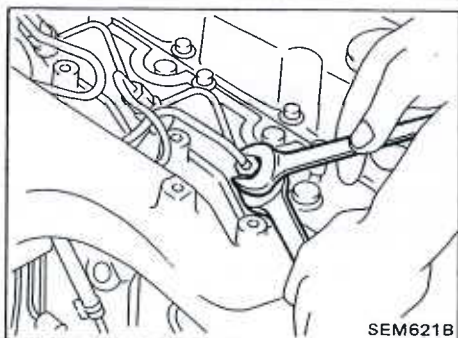
- Be sure the "F" mark on rocker cover plate faces upward and is at the front end.
- When replacing rocker cover gasket, bend slit of rocker cover baffle plate a little to hold the gasket. Do not twist gasket.



7. Install glow plugs and glow plate.



8. Install new top nozzle gasket and injection nozzle.



9. Install spill tube and injection tube.

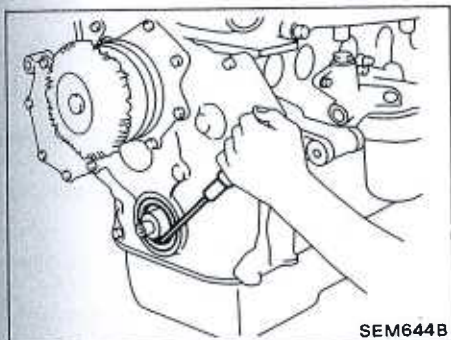
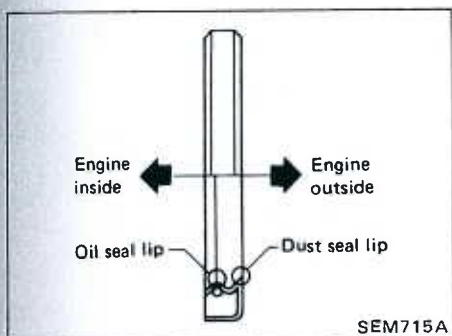
10. Connect thermostat housing water inlet hose and radiator hose.

11. After assembling all disassembled parts, fill radiator and engine with new coolant up to filler opening.

OIL SEAL REPLACEMENT (On-Vehicle Service)

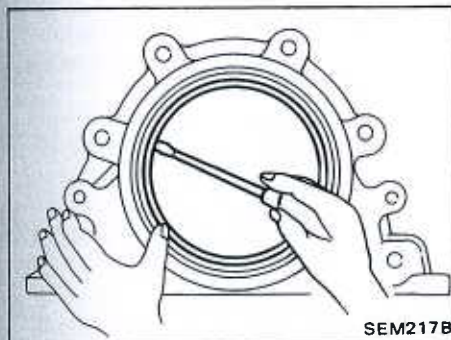
OIL SEAL INSTALLING DIRECTION

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



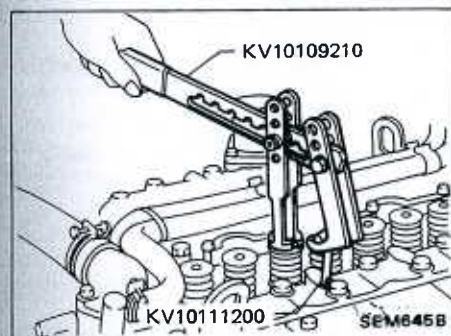
CRANKSHAFT FRONT OIL SEAL

1. Remove radiator shroud.
 2. Remove cooling fan.
 3. Remove drive belts.
 4. Remove crank pulley.
 5. Remove crankshaft oil seal.
- Be careful not to damage sealing surfaces of crankshaft.
6. Coat new oil seal with engine oil and install it in place.



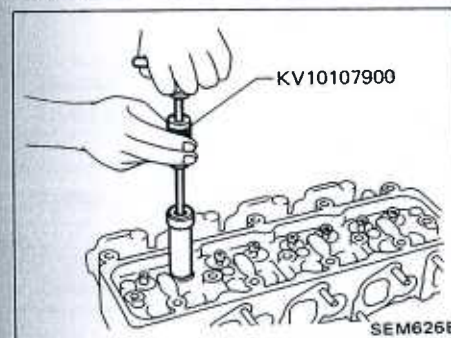
CRANKSHAFT REAR OIL SEAL

1. Dismount transmission.
 2. Remove clutch cover assembly.
 3. Remove flywheel and rear plate.
 4. Remove engine gusset and oil pan.
 5. Remove oil seal retainer assembly, then remove oil seal.
- Be careful not to damage sealing surfaces of crankshaft.
6. Coat new oil seal with engine oil and install it in place.



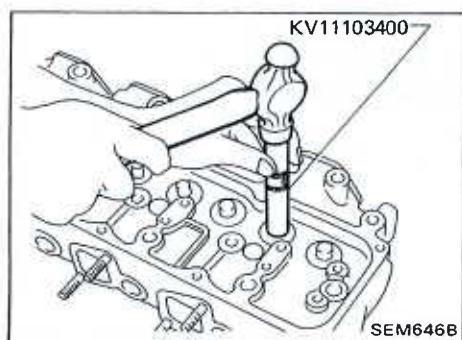
VALVE STEM OIL SEAL

1. Remove rocker cover.
2. Remove rocker shaft assembly.
3. Remove valve spring.

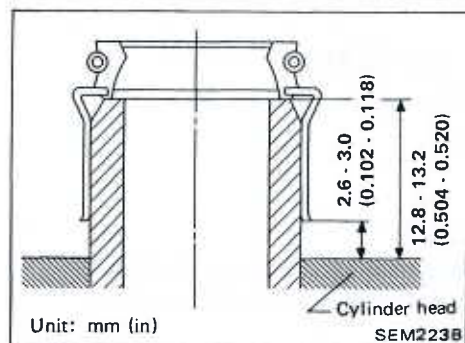


4. Remove valve oil seals.

OIL SEAL REPLACEMENT (On-Vehicle Service)



5. Apply engine oil to valve oil seal and install it in place.



TURBOCHARGER

Removal and Installation

Turbocharger should not be disassembled.

1. Drain engine coolant.
2. Remove the following:
 - Air duct and hoses
 - Air intake pipe
 - Heat shield plates
 - Exhaust front tube
 - Oil tube
 - Water tubes
3. Remove turbocharger from exhaust manifold.

Inspection

Condition 1: Low engine power

Probable cause	Corrective action
Air leak at the connection of compressor housing and suction hose/inlet tube, or inlet tube and intake manifold.	Correct the connection.
Exhaust gas leak at the connection of turbine housing and exhaust manifold, connecting tube or exhaust outlet	Correct the connection or replace gasket.
By-pass valve is stuck open.	Replace turbocharger assembly.
Stuck or worn journal or bearing	
Broken shaft	
Sludge on back of turbine wheel	
Broken turbine wheel	

Condition 2: Excessively high engine power

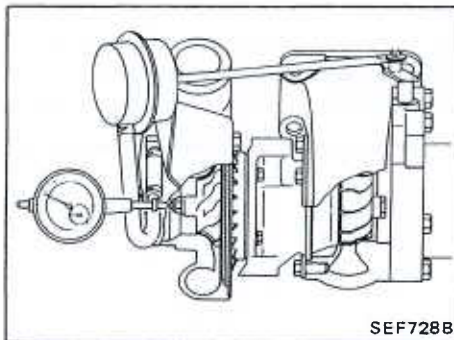
Probable cause	Corrective action
Disconnected or cracked rubber hose of by-pass valve controller	Correct or replace rubber hose.
By-pass valve is stuck closed.	Replace turbocharger assembly.
Controller diaphragm is broken.	

TURBOCHARGER

Inspection (Cont'd)

Condition 3: Excessively high oil consumption or exhaust shows pale blue smoke

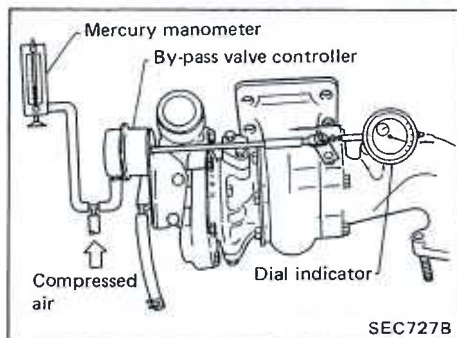
Probable cause	Corrective action
Oil leak at the connection of lubricating oil passage	Correct the connection.
Oil leak at oil seal of turbine	Replace turbocharger assembly.
Oil leak at oil seal of compressor	
Worn journal or bearing	



1. Inspect turbine and compressor wheel as follows:
 - Visually check for cracks, clogging, deformity or other damage.
 - Revolve wheels to make sure that they turn freely without any abnormal noise or friction.
 - Measure play in axial direction.

Play (axial direction):

0.002 - 0.006 mm (0.0001 - 0.0002 in)



2. Check operation of by-pass valve controller.
 - Move by-pass valve to make sure that it is not sticking or scratched.
 - Measure rod end play of the by-pass valve controller.

Do not apply more than 93.3 kPa (933 mbar, 770 mmHg, 27.56 inHg) pressure to controller diaphragm.

By-pass valve controller stroke/pressure:

1.5 mm (0.059 in)/84.0 - 89.3 kPa

(840 - 893 mbar, 630 - 670 mmHg,

24.80 - 26.38 inHg)

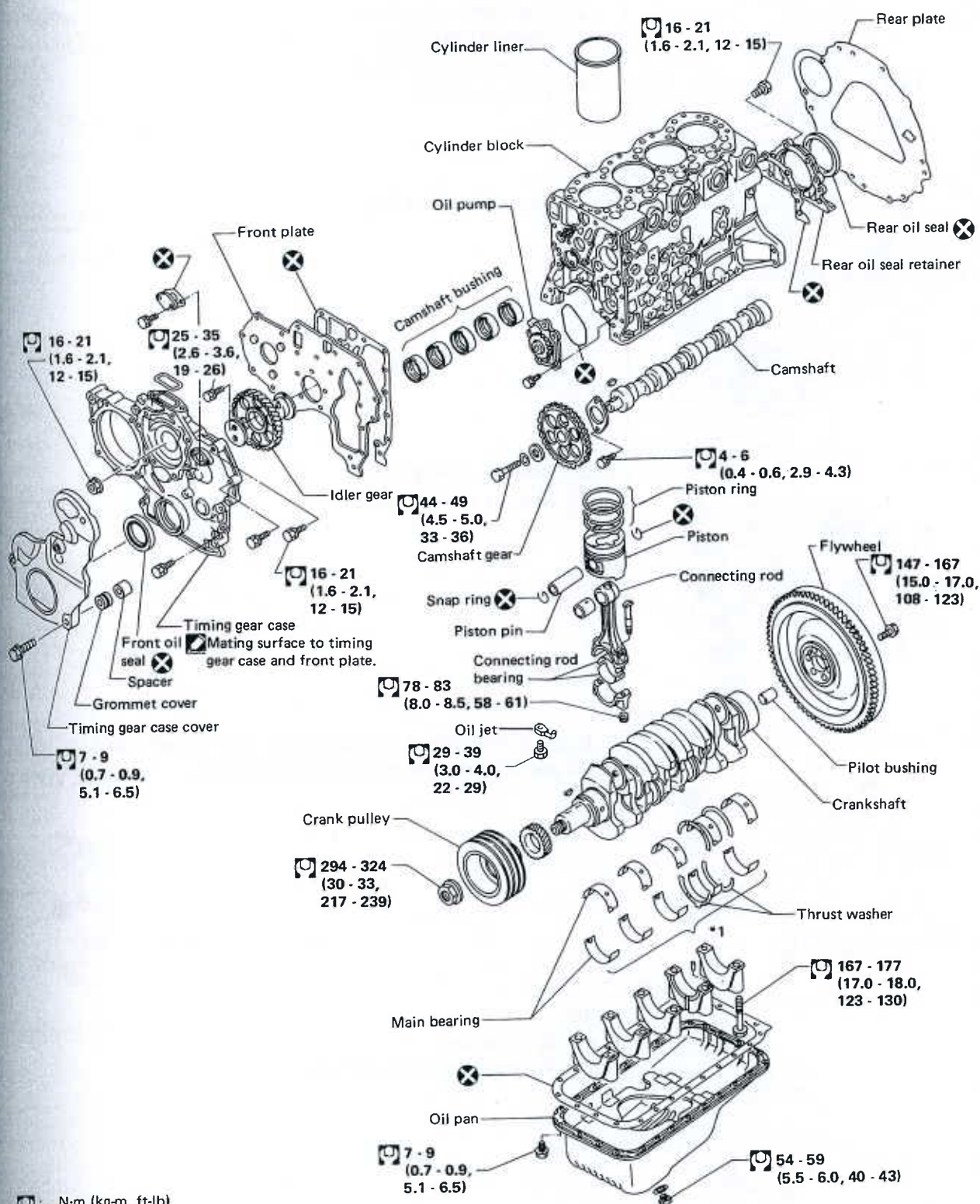
16 - 21
(1.6 - 2.1)
12 - 15



□ : N·m ()
□ : Apply (Nissa or eq)

*1 : Keep

ENGINE OVERHAUL



N-m (kg-m, ft-lb)

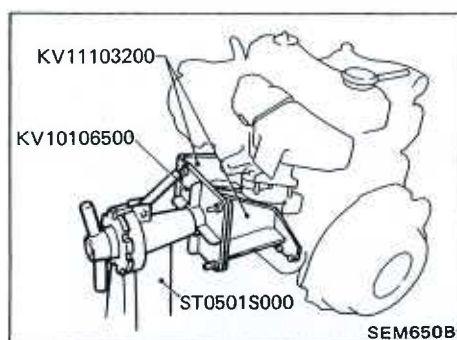


Apply recommended sealant
(Nissan genuine part: KP610-00250)
or equivalent.

*1: Keep in correct order.

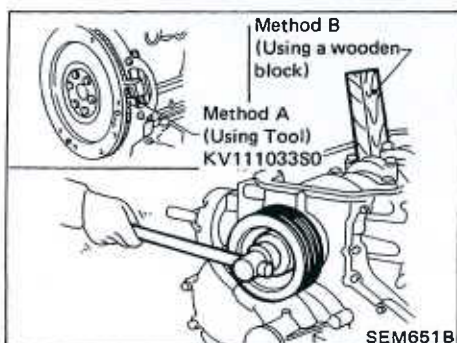
SEM727C

ENGINE OVERHAUL — Disassembly

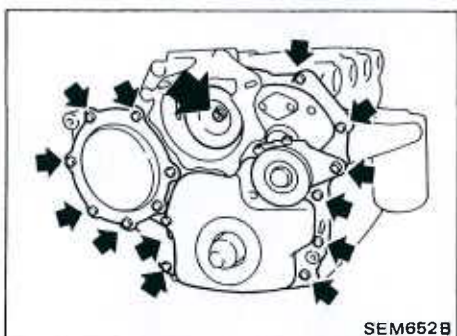


PISTON AND CRANKSHAFT

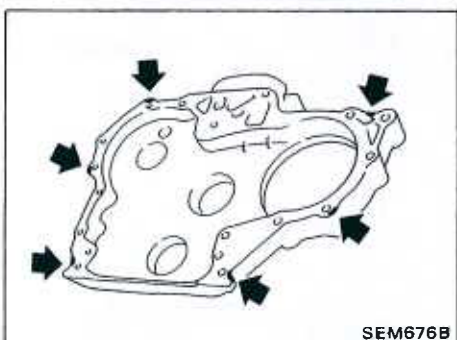
1. Remove oil filter.
2. Place engine on work stand.
3. Drain coolant and oil.
4. Remove drive belts.
5. Remove cylinder head.
6. Remove oil pan.



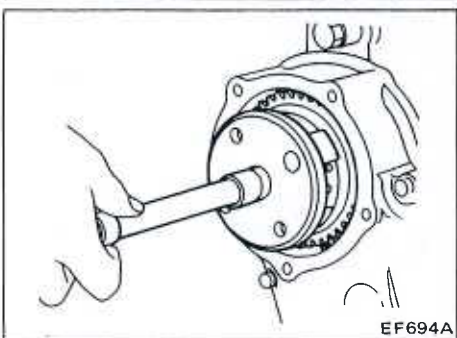
7. Remove crank pulley.



8. Remove water pump.
9. Remove timing gear case.

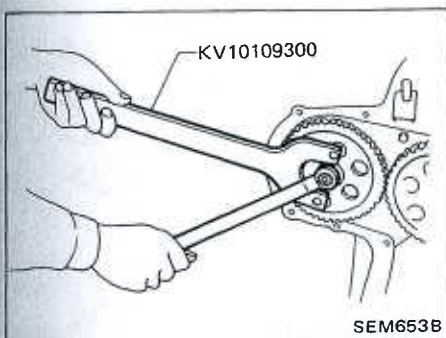


If the timing case is hard to remove due to liquid gasket, pry it off with a suitable tool at the cutout section.

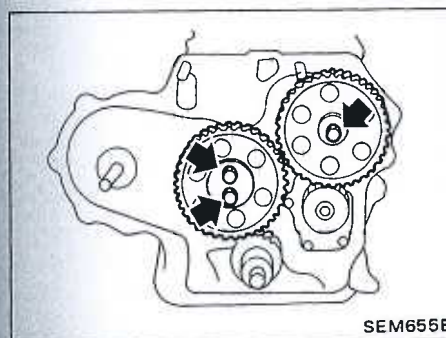
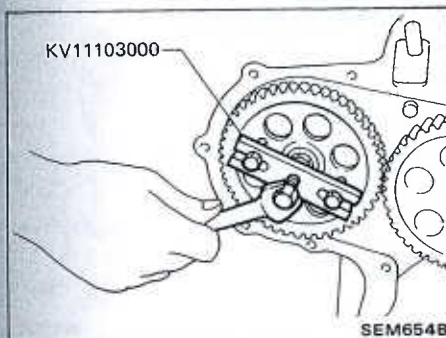


10.
 - In-line pump
 - Remove timer cover and timer.

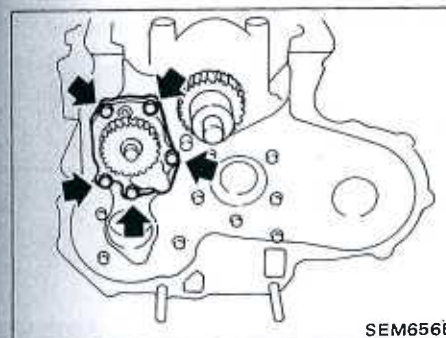
ENGINE OVERHAUL — Disassembly



- VE-pump
Remove injection pump gear.



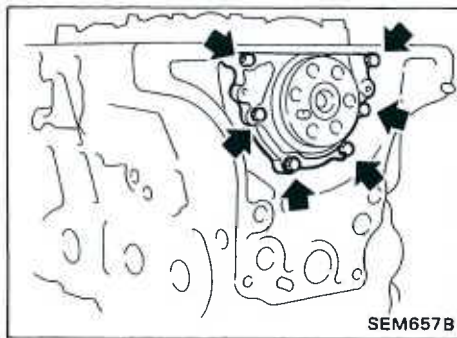
11. Remove idler gear and idler gear shaft.
12. Remove camshaft gear, camshaft and valve lifters.



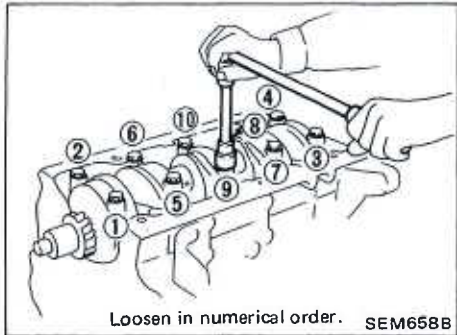
13. Remove oil pump assembly.

14. Remove crankshaft gear.
15. Remove flywheel and rear plate.
16. Remove connecting rod caps.
17. Remove pistons.

ENGINE OVERHAUL — Disassembly



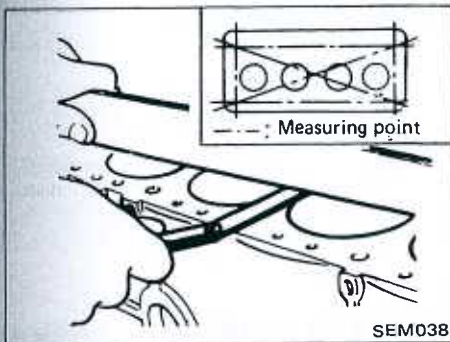
18. Remove rear oil seal retainer.



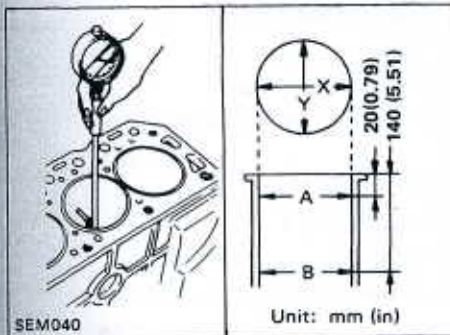
Loosen in numerical order.

19. Remove bearing cap and crankshaft.
Place the bearings and caps in their proper order.

ENGINE OVERHAUL — Inspection and Replacement



SEM038



SEM040

Unit: mm (in)

CYLINDER BLOCK DISTORTION

If beyond the specified limit, replace it.

Cylinder block distortion:

Standard

Less than 0.05 mm (0.0020 in)

Limit

0.2 mm (0.008 in)

CYLINDER LINER WEAR

1. Measure cylinder liner bore for out-of-round and taper with a bore gauge. If beyond the limit, replace cylinder liner.

Standard inside diameter:

TD23

89.000 - 89.030 mm (3.5039 - 3.5051 in)

TD25

92.900 - 92.930 mm (3.6575 - 3.6587 in)

TD27 and TD27T

96.000 - 96.030 mm (3.7795 - 3.7807 in)

Refer to S.D.S.

Wear limit:

0.20 mm (0.0079 in)

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

0.020 mm (0.0008 in)

Taper (A-B) limit:

0.20 mm (0.0079 in)

2. Check for scratches or seizure. If seizure is found, replace cylinder liner.

3. Check amount of projection of cylinder liner.

Cylinder liner projection:

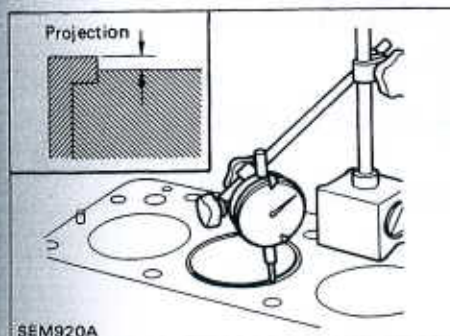
Standard

0.02 - 0.09 mm

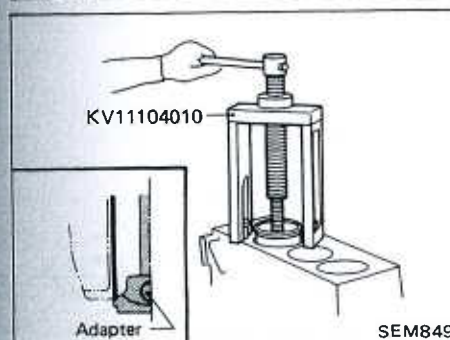
(0.0008 - 0.0035 in)

Deviation of each cylinder:

Less than 0.05 mm (0.0020 in)



SEM920A



KV11104010

Adapter

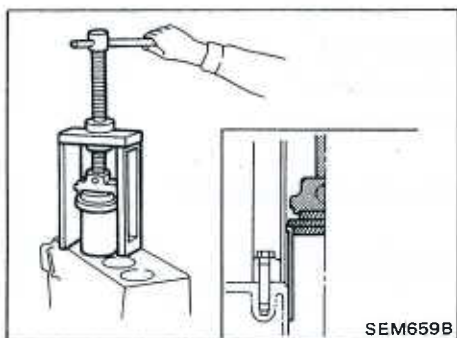
SEM849

CYLINDER LINER

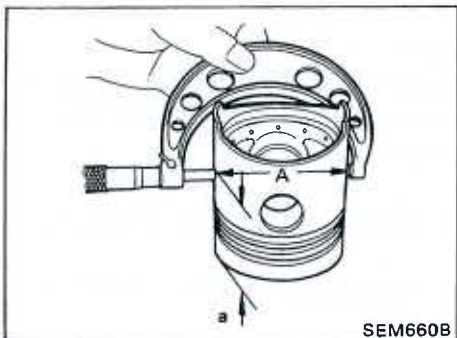
Replacement

1. Remove cylinder liner with Tool.

ENGINE OVERHAUL — Inspection and Replacement



2. Install cylinder liner with Tool.
3. Check amount of projection of cylinder liner.



PISTON TO CYLINDER WALL CLEARANCE

1. Measure piston and cylinder bore diameter.

Piston diameter "A":

Refer to S.D.S.

Measuring point "a" (Distance from the top):

TD23

67 mm (2.64 in)

TD25, TD27 and TD27T

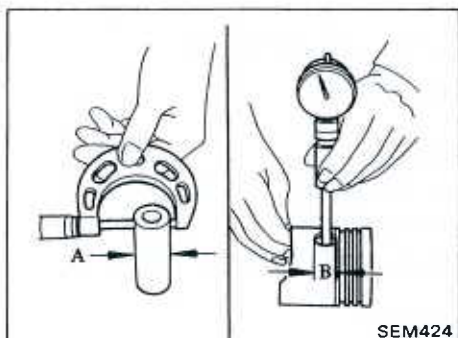
70 mm (2.76 in)

2. Check that piston clearance is within the specification.

Piston clearance:

0.05 - 0.07 mm

(0.0020 - 0.0028 in)



PISTON AND PISTON PIN CLEARANCE

Check clearance between pistons and piston pins.

Clearance (A-B):

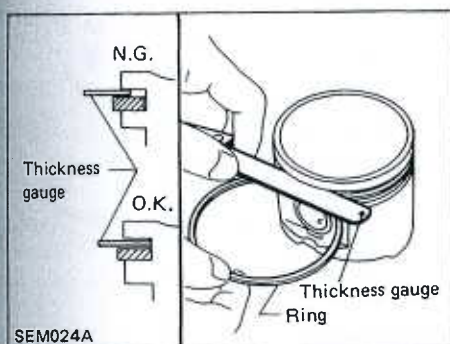
Standard

-0.008 to 0.007 mm (-0.0003 to 0.0003 in)

Limit

Less than 0.1 mm (0.004 in)

ENGINE OVERHAUL — Inspection and Replacement



PISTON RING SIDE CLEARANCE

Side clearance:

Top ring

0.06 - 0.10 mm (0.0024 - 0.0039 in)

2nd ring

0.04 - 0.08 mm (0.0016 - 0.0031 in)

Oil ring

0.02 - 0.06 mm (0.0008 - 0.0024 in)

Max. limit of side clearance:

Top

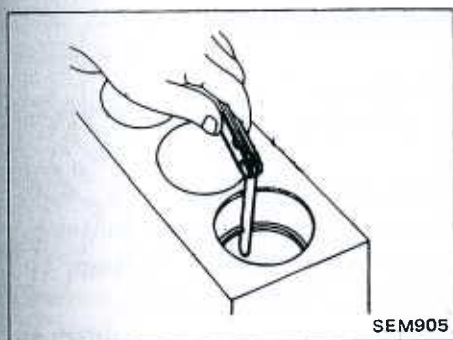
0.5 mm (0.020 in)

2nd

0.3 mm (0.012 in)

Oil

0.15 mm (0.0059 in)



PISTON RING GAP

Standard ring gap:

Top ring

0.30 - 0.45 mm (0.0118 - 0.0177 in)

2nd ring

TD23 and TD25

0.20 - 0.35 mm (0.0079 - 0.0138 in)

TD27 and TD27T

0.50 - 0.65 mm (0.0197 - 0.0256 in)

Oil ring

0.30 - 0.50 mm (0.0118 - 0.0197 in)

Max. limit of ring gap:

1.5 mm (0.059 in)

MAIN BEARING CLEARANCE

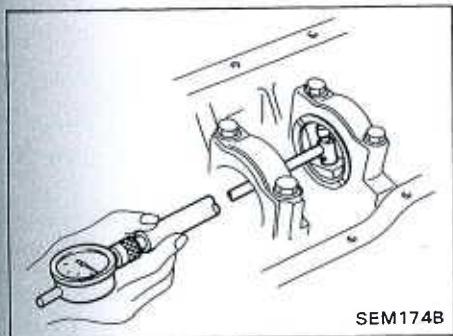
Main bearing clearance:

Standard

0.035 - 0.087 mm (0.0014 - 0.0034 in)

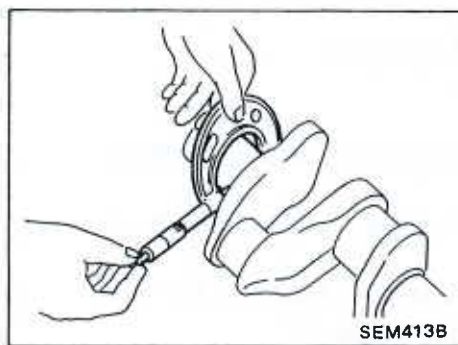
Limit

Less than 0.15 mm (0.0059 in)



1. Install main bearings to cylinder block and main bearing cap.
 2. Install main bearing cap to cylinder block.
- Tighten all bolts in correct order and in two or three stages.
3. Measure inside diameter "A" of main bearing.

ENGINE OVERHAUL — Inspection and Replacement



4. Measure outside diameter "Dm" of main journal in crankshaft.

5. Calculate main bearing clearance.
Main bearing clearance = $A - Dm$

CONNECTING ROD BEARING CLEARANCE

Connecting rod bearing clearance:

Standard

0.035 - 0.081 mm

(0.0014 - 0.0032 in)

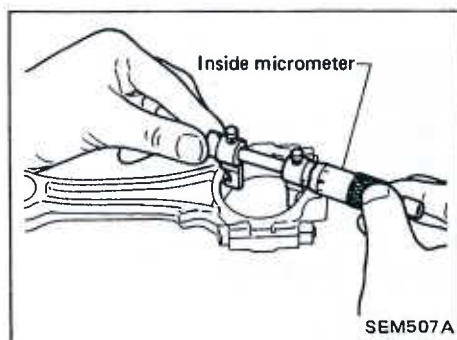
Limit

Less than 0.15 mm (0.0059 in)

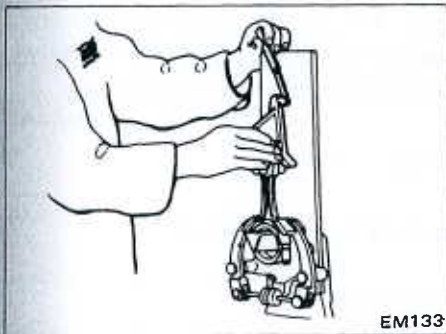
1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.

Apply oil to the thread portion of bolts and seating surface of nuts.

3. Measure inside diameter "A" of bearing.
4. Measure outside diameter "Dp" of pin journal in crankshaft.
5. Calculate connecting rod bearing clearance.
Connecting rod bearing clearance = $A - Dp$



ENGINE OVERHAUL — Inspection and Replacement



EM133

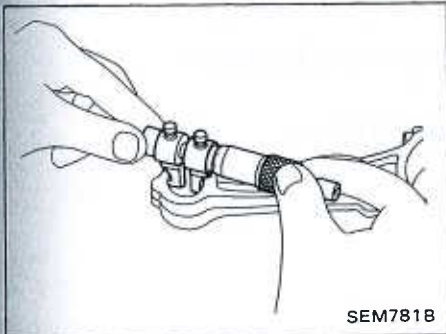
CONNECTING ROD BEND AND TORSION

Bend and torsion:

Limit

0.05 mm (0.0020 in)

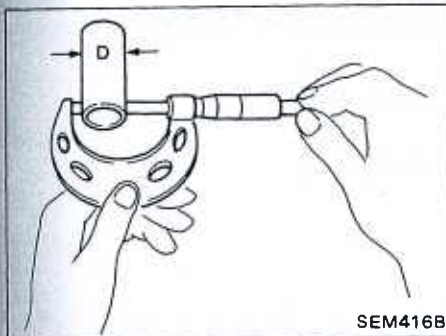
per 100 mm (3.94 in) length



SEM781B

CONNECTING ROD SMALL END BUSHING CLEARANCE

1. Measure inside diameter "A" of connecting rod small end bushings.



SEM416B

2. Measure outside diameter "D" of piston pin.
3. Calculate connecting rod small end bushing clearance.
Connecting rod small end bushing clearance = A - D

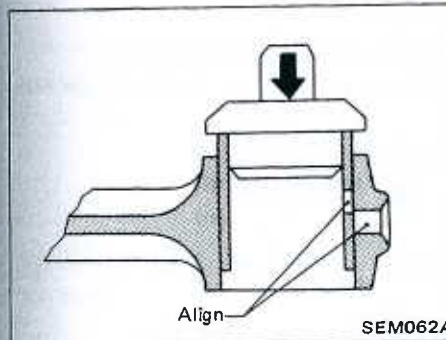
Bushing clearance:

Standard

0.025 - 0.045 mm (0.0010 - 0.0018 in)

Limit

0.15 mm (0.0059 in)



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:

TD23

26.025 - 26.038 mm (1.0246 - 1.0251 in)

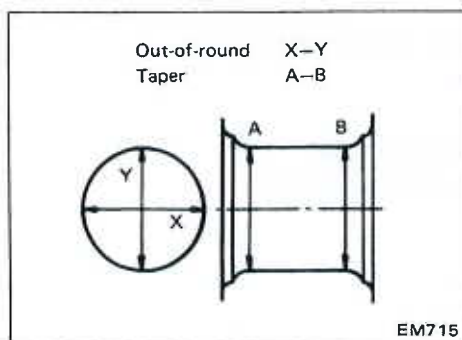
TD25 and TD27

28.025 - 28.038 mm (1.1033 - 1.1039 in)

TD27T

30.025 - 30.038 mm (1.1821 - 1.1826 in)

ENGINE OVERHAUL — Inspection and Replacement



CRANKSHAFT

1. Check crankshaft journals and pins for score, bias, wear or cracks. If faults are minor, correct with fine crocus cloth.
2. Check journals and pins with a micrometer for taper and out-of-round.

Out-of-round (X-Y):

Standard

Less than 0.01 mm (0.0004 in)

Limit

0.02 mm (0.0008 in)

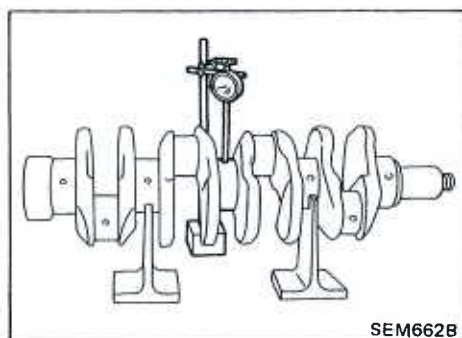
Taper (A-B):

Standard

Less than 0.01 mm (0.0004 in)

Limit

0.02 mm (0.0008 in)



3. Check crankshaft runout.

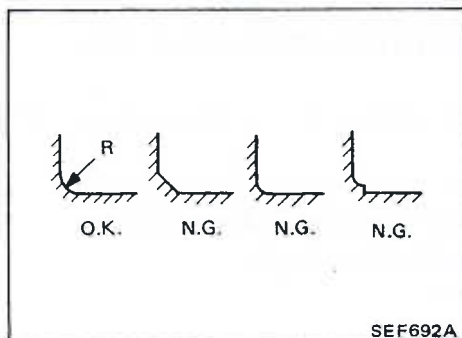
Runout [T.I.R. (Total Indicator Reading)]

Standard

0 - 0.03 mm (0 - 0.0012 in)

Limit

0.10 mm (0.0039 in)



RESURFACING OF CRANKSHAFT JOURNAL AND CRANK PIN

When using undersize main bearings and connecting rod bearings, the crankshaft journals or crank pins must be finished to match the bearings.

R: Crank journal: 3.0 mm (0.118 in)

Crank pin: 3.5 mm (0.138 in)

CAUTION:

- At the same time make sure that the surface width does not increase.
- Do not attempt to cut counterweight of crankshaft.

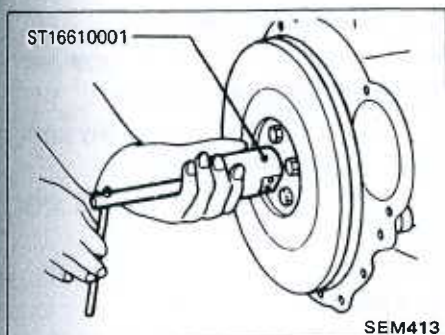
ST1661000



SEM059A



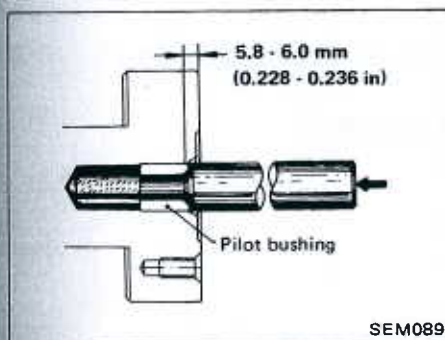
ENGINE OVERHAUL — Inspection and Replacement



CRANKSHAFT PILOT BUSHING

Crankshaft pilot bushing replacement

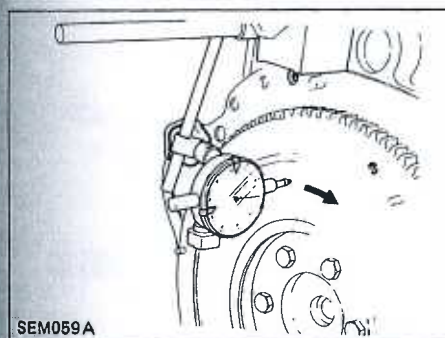
1. Pull out bushing with Tool.



2. Insert pilot bushing until distance between flange end and bushing is specified value.

Distance:

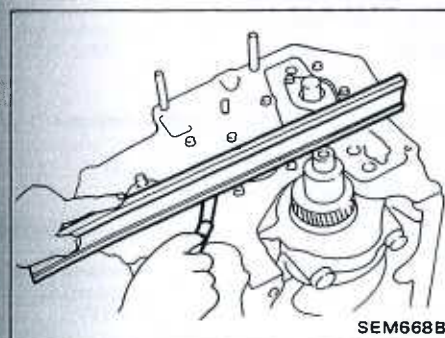
Approx. 5.8 - 6.0 mm (0.228 - 0.236 in)



FLYWHEEL RUNOUT

Runout (Total indicator reading):

Less than 0.15 mm (0.0059 in)



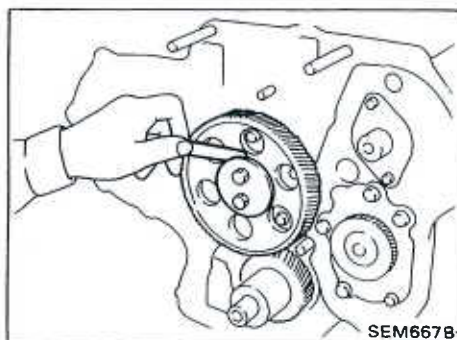
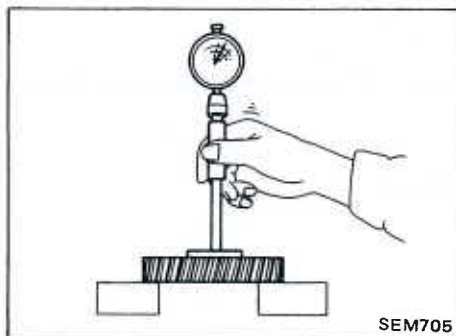
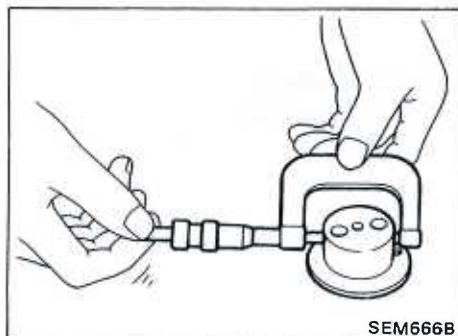
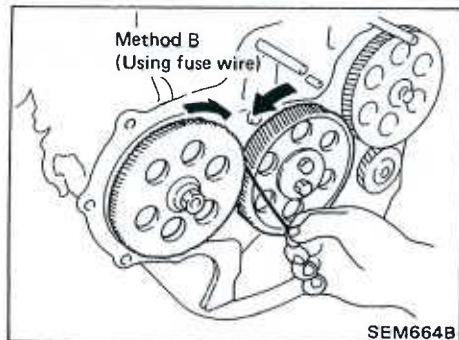
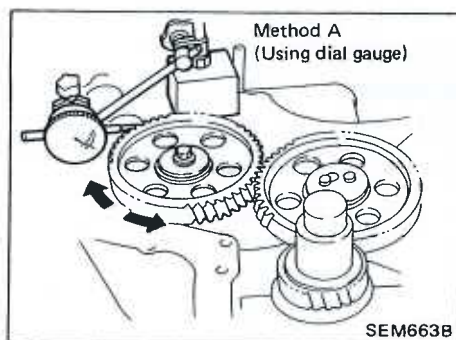
FRONT PLATE

Check front plate for warpage. If not within the limit, make flat or replace front plate.

Warpage limit:

0.2 mm (0.008 in)

ENGINE OVERHAUL — Inspection and Replacement



GEAR TRAIN

Camshaft drive gear, injection pump drive gear, oil pump gear, idler gear and crankshaft gear

1. If gear tooth and key have scratches or are excessively worn, replace gear and key.
2. Check gear train backlash before disassembling and after assembling.

Method A (Using dial gauge)

Method B (Using fuse wire)

If beyond the limit, replace gear.

Backlash:

Standard

0.07 - 0.11 mm (0.0028 - 0.0043 in)

Limit

0.20 mm (0.0079 in)

IDLER GEAR BUSHING CLEARANCE

1. Measure idler gear shaft outer diameter.

2. Measure idler gear bushing inner diameter.

3. Calculate idler gear bushing clearance.

Bushing oil clearance:

Standard

0.025 - 0.061 mm (0.0010 - 0.0024 in)

Limit

0.20 mm (0.0079 in)

IDLER GEAR END PLAY

Measure idler gear end play between gear plate and gear.

Idler gear end play:

Standard

0.03 - 0.14 mm (0.0012 - 0.0055 in)

Limit

Less than 0.3 mm (0.012 in)



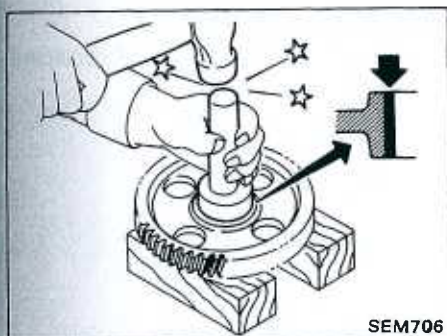
Cam bushing rep.
KV111045S0

Replacer b.
KV111045

Adapter
(1st bushing)
KV111045



ENGINE OVERHAUL — Inspection and Replacement



REPLACEMENT OF IDLER GEAR BUSHING

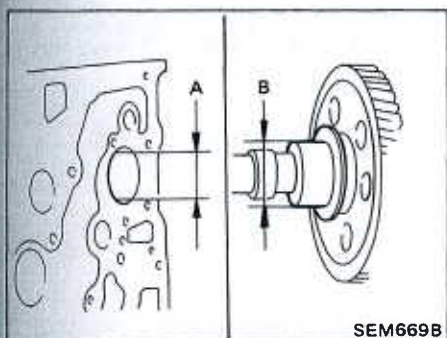
1. Use a suitable tool to replace bushing.
2. Ream idler gear bushing.

Finished size:

42.00 - 42.02 mm (1.6535 - 1.6543 in)

Idler gear shaft

Install idler gear shaft so that oil hole of shaft faces upward.



CAMSHAFT AND CAMSHAFT BUSHING

Camshaft bushing clearance

Measure inside diameter of camshaft bushing and outside diameter of camshaft journal with a suitable gauge.

Clearance between camshaft and bushing (A-B):

Standard

0.020 - 0.109 mm

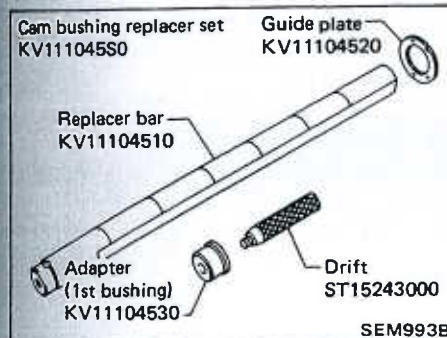
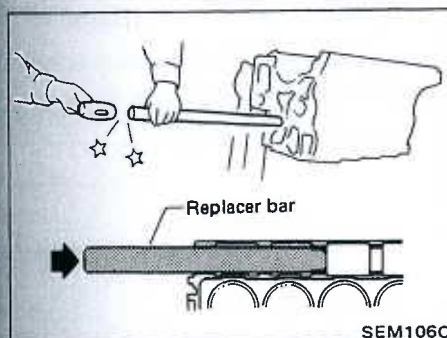
(0.0008 - 0.0043 in)

Limit

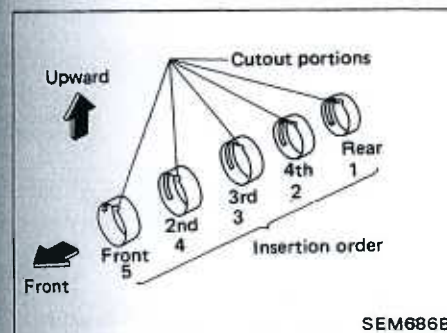
Less than 0.15 mm (0.0059 in)

REPLACING CAMSHAFT BUSHING

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

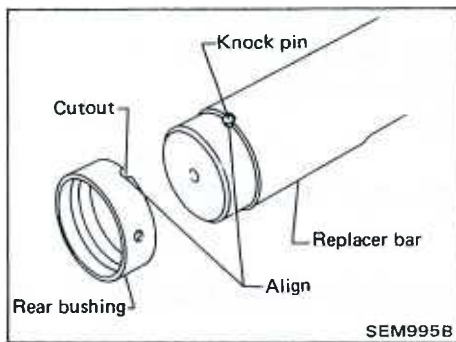


2. Using Tool, install camshaft bushings as follows:



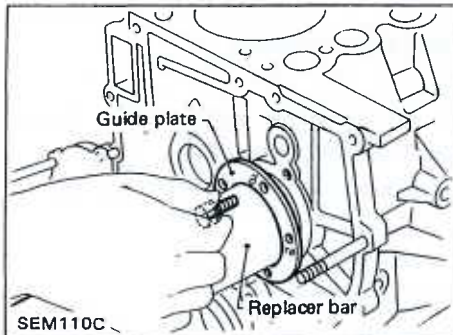
- (1) Install camshaft bushings in the order of "rear", "4th", "3rd", "2nd" and "front". All bushings must be installed from the front.
- (2) Face the cutout upward and toward the front of the engine during installation.

ENGINE OVERHAUL — Inspection and Replacement



(3) Rear camshaft bushing

Align the cutout of rear bushing with knock pin of replacer bar before installation.



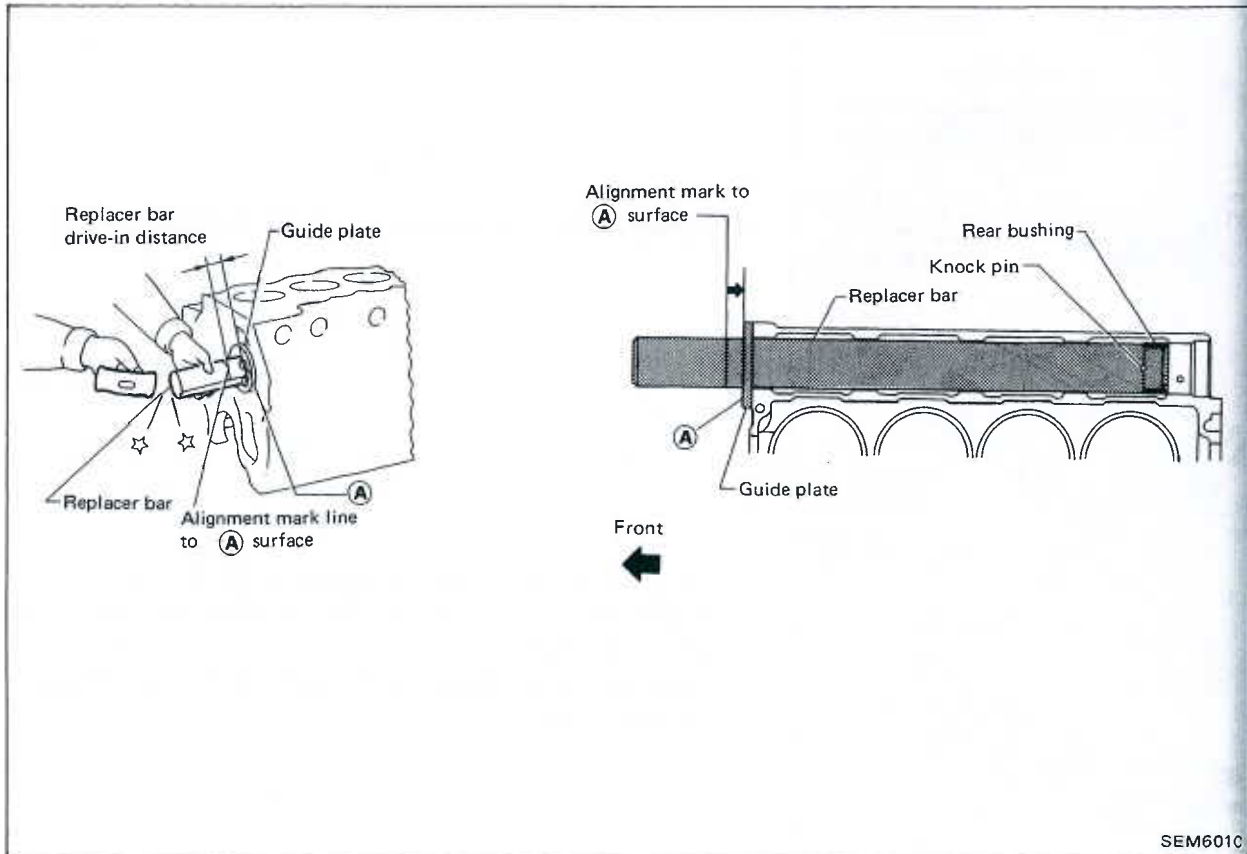
Insert rear bushing with replacer bar into the engine.

Install guide plate with bolt holes (on the "TD" 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 replacer guide.

Remove replacer set.

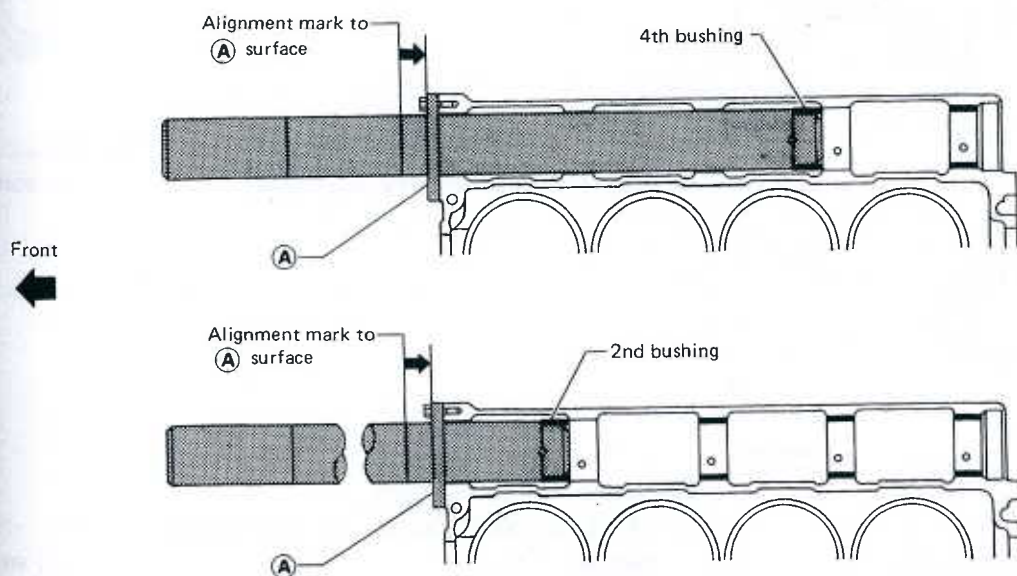
After installation, check that oil holes in camshaft bushings are aligned with oil holes in cylinder block.



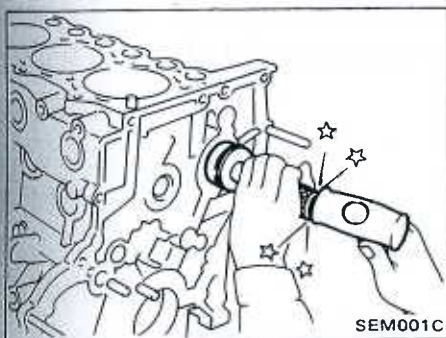
ENGINE OVERHAUL — Inspection and Replacement

(4) 4th, 3rd and 2nd camshaft bushings

Install in the same manner as rear camshaft bushing.



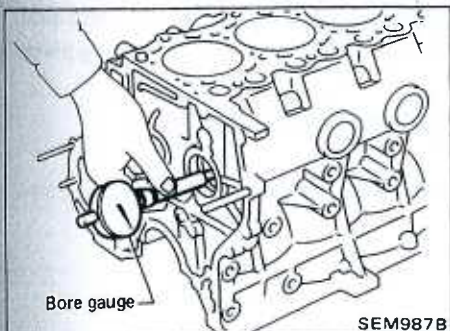
SEM602C



(5) Front camshaft bushing

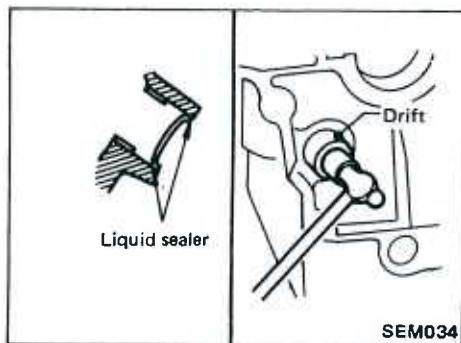
Using 1st bushing adapter, position front camshaft bushing so that oil hole in cylinder block is aligned with oil hole in bushing.

3. Check camshaft bushing clearance.

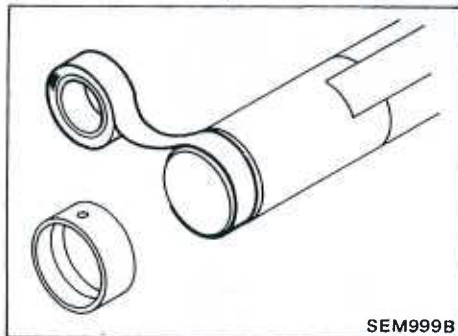


SEM601C

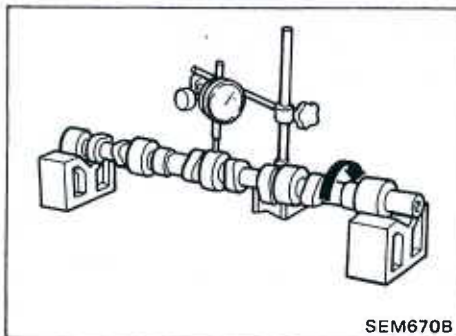
ENGINE OVERHAUL — Inspection and Replacement



4. Install new weld plug with a drift.
Apply liquid sealer.



When setting 4th through 2nd bushings on replacer bar, tape the bar to prevent movement.



CAMSHAFT ALIGNMENT

1. Check camshaft journal and cam surface for bend, wear or damage.
If fault is beyond limit, replace.
2. Check camshaft bend at center journal.
If bend is greater than specified limit, repair or replace camshaft.

Camshaft bend

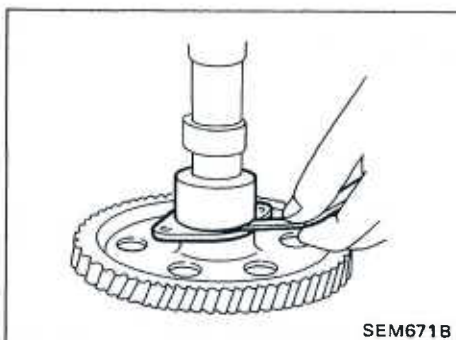
(Total indicator reading):

Standard

Less than 0.02 mm (0.0008 in)

Limit

Less than 0.06 mm (0.0024 in)



3. Measure camshaft end play between locating plate and gear.
If beyond the specified limit, replace camshaft locating plate.

Camshaft end play:

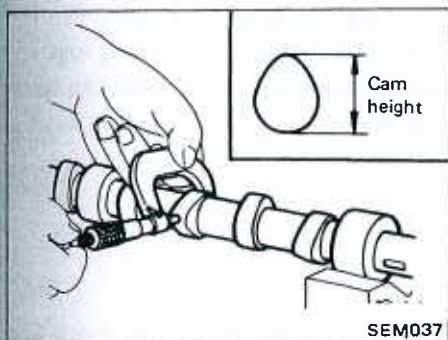
Standard

0.08 - 0.28 mm (0.0031 - 0.0110 in)

Limit

Less than 0.5 mm (0.020 in)

ENGINE OVERHAUL — Inspection and Replacement



4. Measure camshaft cam height. If beyond the specified limit, replace camshaft.

Cam height:

Standard

Intake

41.733 mm (1.6430 in)

Exhaust

41.900 mm (1.6496 in)

Limit

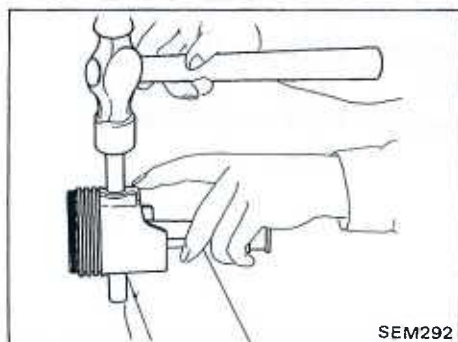
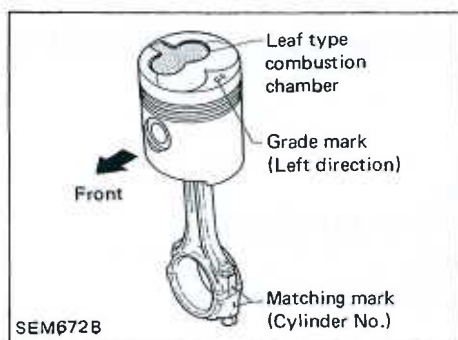
Intake

Less than 41.20 mm (1.6220 in)

Exhaust

Less than 41.40 mm (1.6299 in)

ENGINE OVERHAUL — Assembly



PISTON

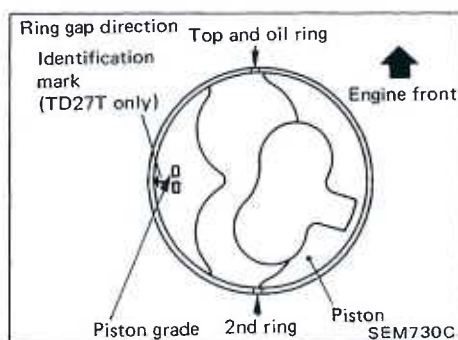
Assemble pistons, piston pins, snap rings and connecting rods.

- Numbers are stamped on the connecting rod and cap corresponding to each cylinder. Care should be taken to avoid wrong combination including bearing.
- When inserting piston pin in connecting rod, heat piston with a heater or hot water [approximately 60 to 70°C (140 to 158°F)] and apply engine oil to pin and small end of connecting rod.
- After assembling, ascertain that piston swings smoothly.

Install piston assembly.

CAUTION:

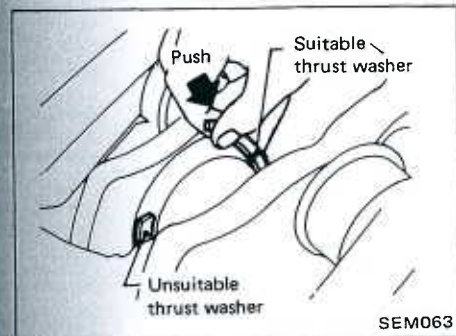
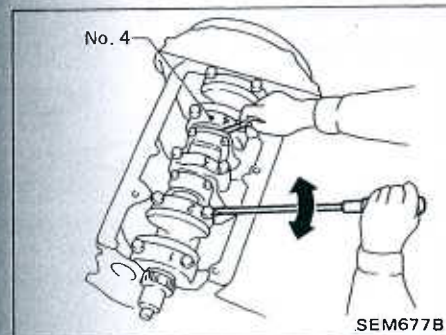
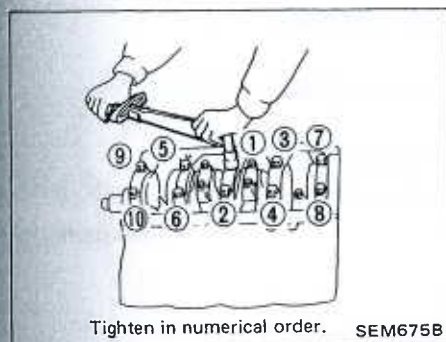
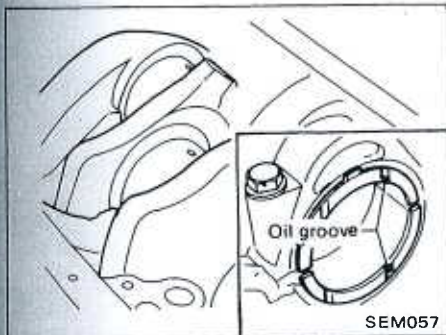
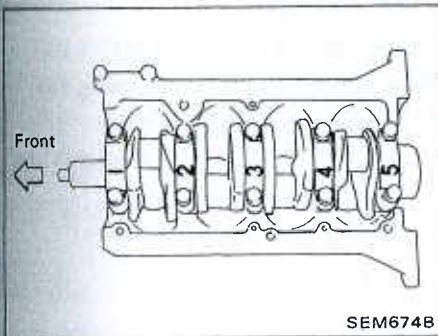
- Stretch the piston rings only enough to fit them in the piston grooves.
- Be sure the manufacturer's mark faces upward.
- Install No. 1 piston ring in such a way that its gap faces the direction of the piston pin; and then install piston rings so that their gap positioned at 180° to one another.



CRANKSHAFT

- Install crankshaft.
 - Set main bearings in the proper position on cylinder block.
 - If either crankshaft, cylinder block or main bearing is reused again, it is necessary to measure main bearing clearance.
 - Upper bearings have oil hole and oil groove, however lower bearings do not.

ENGINE OVERHAUL — Assembly



(2) Apply engine oil to crankshaft journal and pin and install crankshaft.

(3) Install main bearing caps.

a) Install main bearing cap with the number facing the front of vehicle.

b) Apply engine oil to main bearing cap and cylinder block contact surfaces.

c) Install rear oil seal assembly. Apply engine oil to contact surface of rear end oil seal and crankshaft.

(4) Install crankshaft thrust washer at the 4th journal from front.

Install thrust washer so that oil groove can face crankshaft.

(5) Tighten bearing cap bolts gradually in stages, starting from two to three separate stages, from center bearing and moving outward in sequence.

(6) Measure crankshaft free end play at No. 4 bearing.

Crankshaft free end play:

Standard

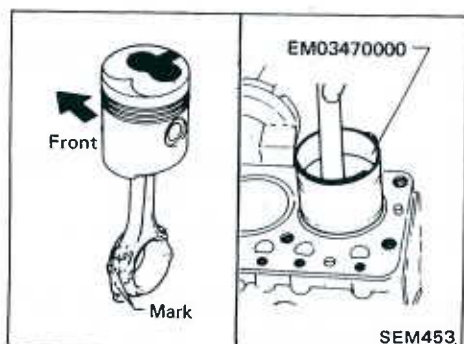
0.055 - 0.140 mm (0.0022 - 0.0055 in)

Limit

0.4 mm (0.016 in)

If beyond the limit, replace No. 4 main bearing thrust washer.
Refer to S.D.S.

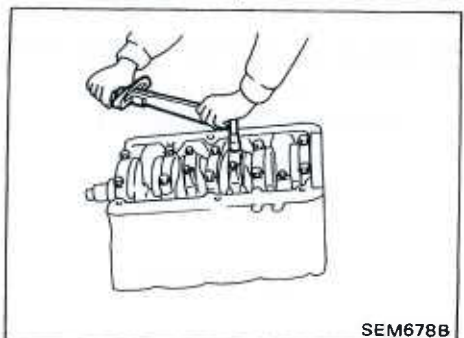
ENGINE OVERHAUL — Assembly



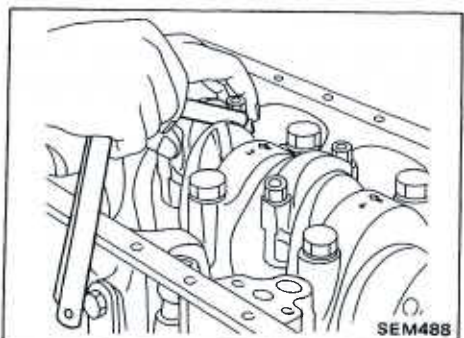
2. Install pistons with connecting rods.

(1) Install them into corresponding cylinder using Tool.

- Be careful not to scratch cylinder wall with connecting rod.
- Apply engine oil to cylinder wall, piston and bearing.
- The leaf type combustion chamber on piston head must be at right side of engine.



(2) Install connecting rod bearing caps.



3. Measure connecting rod side clearance.

Connecting rod side clearance:

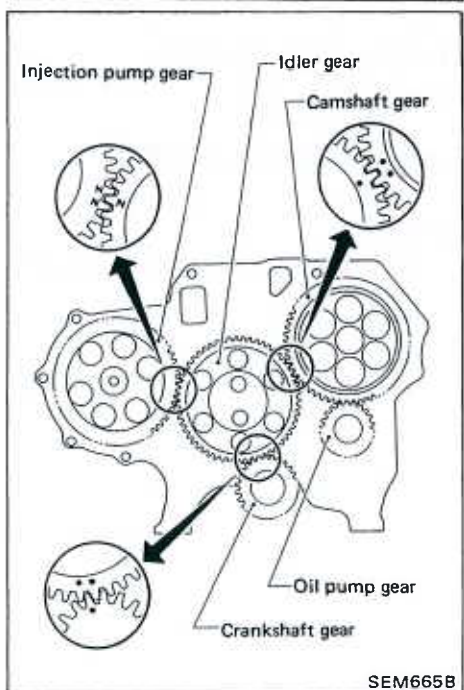
Standard

0.10 - 0.22 mm (0.0039 - 0.0087 in)

Limit

0.22 mm (0.0087 in)

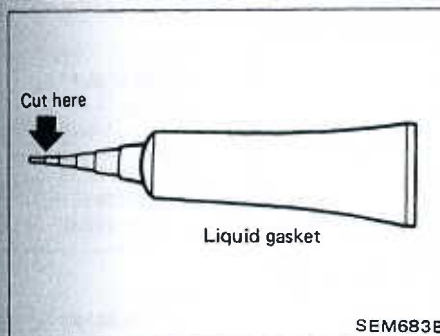
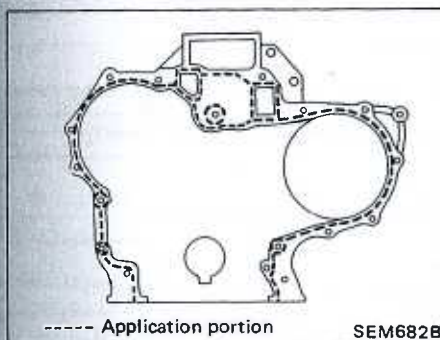
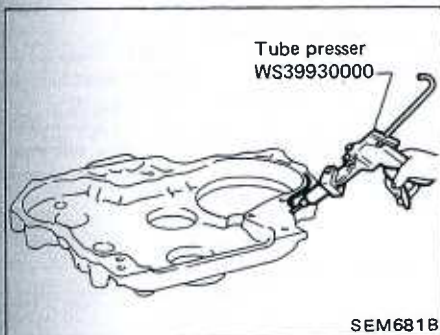
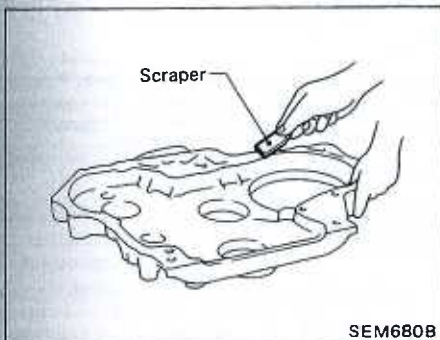
If beyond the limit, replace connecting rod and/or crankshaft.



GEAR TRAIN

1. Set No. 1 piston at its top dead center.
2. Align each gear mark and install gears.

ENGINE OVERHAUL — Assembly



TIMING GEAR CASE

Installation

1. Before installing timing gear case, remove all traces of liquid gasket from mating surface using a scraper. Also remove traces of liquid gasket from mating surface of front plate.

2. Apply a continuous bead of liquid gasket to mating surface of timing gear case.

- Be sure liquid gasket is 2.5 to 3.5 mm (0.098 to 0.138 in) wide.
- Attach timing gear case to front plate within 10 minutes after coating.
- Wait at least 30 minutes before refilling engine coolant or starting engine.
- Use Genuine Liquid Gasket or equivalent.

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment

COMPRESSION PRESSURE

Unit: kPa (bar, kg/cm², psi)/rpm

Standard	2,942 (29.4, 30, 427)/200
Minimum	2,452 (24.5, 25, 356)/200
Differential limit between cylinders	294 (2.9, 3, 43)/200

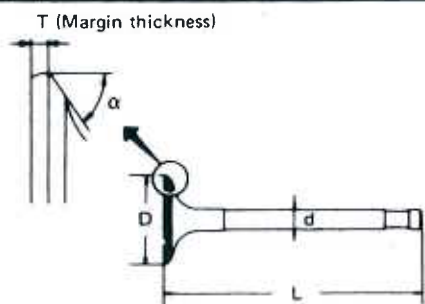
CYLINDER HEAD

Unit: mm (in)

	Standard	Limit
Head surface distortion	Less than 0.07 (0.0028)	0.2 (0.008)
Nominal cylinder head height	89.9 - 90.1 (3.539 - 3.547)	

VALVE

Unit: mm (in)



Engine	TD23	TD25	TD27 and TD27T
Item			
Valve head diameter "D"			
Intake	39.9 - 40.1 (1.571 - 1.579)	41.4 - 41.6 (1.630 - 1.638)	43.4 - 43.6 (1.709 - 1.717)
Exhaust	34.9 - 35.1 (1.374 - 1.382)	36.9 - 37.1 (1.453 - 1.461)	37.9 - 38.1 (1.492 - 1.500)
Valve length "L"			
Intake	117 (4.61)		
Exhaust			
Valve stem diameter "d"			
Intake	7.962 - 7.977 (0.3135 - 0.3141)		
Exhaust	7.945 - 7.960 (0.3128 - 0.3134)		
Valve seat angle "α"			
Intake	45° - 45°30'		
Exhaust			
Valve margin "T" limit	1.0 (0.039)		
Valve stem end surface grinding limit	0.2 (0.008)		
Valve clearance (Hot)			
Intake	0.35 (0.0138)		
Exhaust			

Valve guide

Unit: mm (in)

	Standard	Service
Valve guide outside diameter	12.033 - 12.044 (0.4737 - 0.4742)	-
Valve guide inner diameter (Finished size)	8.00 - 8.015 (0.3150 - 0.3156)	
Cylinder head valve guide hole diameter	12.00 - 12.011 (0.4724 - 0.4729)	-
Interference fit of valve guide	0.022 - 0.044 (0.0009 - 0.0017)	
Stem to guide clearance		
Intake	0.023 - 0.053 (0.0009 - 0.0021)	0.15 (0.0059)
Exhaust	0.04 - 0.07 (0.0016 - 0.0028)	0.20 (0.0079)
Valve deflection limit		
Intake	0.30 (0.0118)	
Exhaust	0.40 (0.0157)	

Valve spring

Free length	mm (in)	
Painted red	52.15 (2.0531)	
Painted yellow	53.0 (2.087)	
Pressure height	mm/N (mm/kg, in/lb)	
Painted red	32.3/672.8 - 759.1 (32.3/68.6 - 77.4, 1.272/151.3 - 170.7)	
Painted yellow	31.8/697.3 - 779.7 (31.8/71.1 - 79.5, 1.252/156.8 - 175.3)	
Assembled height	mm/N (mm/kg, in/lb)	
Standard	42.3/287.3 - 330.5 (42.3/29.3 - 33.7, 1.665/64.6 - 74.3)	
Limit	42.3/270.7 (42.3/27.6, 1.665/60.9)	
Out of square	mm (in)	2.0 (0.079)

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

VALVE LIFTER AND PUSH ROD

Unit: mm (in)

Unit: mm (in)		Standard	Limit
Service	Valve lifter outer diameter	24.960 - 24.970 (0.9827 - 0.9831)	—
15 3156)	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)	0.20 (0.0079)
044 0017)	Push rod bend (T.I.R.)*	Less than 0.3 (0.012)	0.5 (0.020)

*: Total indicator reading

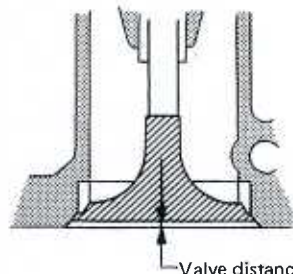
Rocker shaft and rocker arm

Unit: mm (in)

Unit: mm (in)		Standard	Limit
15 (0.0059)	Rocker shaft		
20 (0.0079)	Outer diameter	19.979 - 20.00 (0.7866 - 0.7874)	—
18)	Rocker shaft bend (T.I.R.)	0 - 0.10 (0 - 0.0039)	Less than 0.30 (0.0118)
57)	Rocker arm		
	Inner diameter	20.014 - 20.035 (0.7880 - 0.7888)	—
531)	Clearance between rocker arm and rocker shaft	0.014 - 0.056 (0.0006 - 0.0022)	0.15 (0.0059)

CYLINDER HEAD TO VALVE DISTANCE

Unit: mm (in)



SEM724C

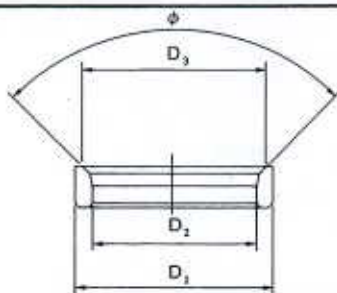
	Standard	Limit
Intake	0.275 - 0.675 (0.0108 - 0.0266)	1.25 (0.0492)
Exhaust	0.305 - 0.695 (0.0120 - 0.0274)	1.25 (0.0492)

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

Valve seat

Unit: mm (in)



SEM953C

	TD23	TD25	TD27 and TD27T	
Intake				
Outer diameter "D ₁ "	41.035 - 41.045 (1.6155 - 1.6159)	42.535 - 42.545 (1.6746 - 1.6750)	44.535 - 44.545 (1.7533 - 1.7537)	
Inner diameter "D ₂ "	34.9 - 35.1 (1.374 - 1.382)	36.4 - 36.6 (1.433 - 1.441)	38.4 - 38.6 (1.512 - 1.520)	
Diameter of seat "D ₃ "	38.9 - 39.1 (1.531 - 1.539)	40.4 - 40.6 (1.591 - 1.598)	42.4 - 42.6 (1.669 - 1.677)	
Cylinder head valve seat diameter	41.000 - 41.015 (1.6142 - 1.6148)	42.500 - 42.515 (1.6732 - 1.6738)	44.500 - 44.515 (1.7520 - 1.7526)	
Valve seat face angle "φ"	89° - 91°	89° - 91°	89° - 91°	
Exhaust				
Outer diameter "D ₁ "				
Standard	36.535 - 36.545 (1.4384 - 1.4388)	38.535 - 38.545 (1.5171 - 1.5175)	39.535 - 39.545 (1.5565 - 1.5569)	
0.2 (0.008) Oversize (Service)	36.735 - 36.745 (1.4463 - 1.4467)	38.735 - 38.745 (1.5250 - 1.5254)	39.735 - 39.745 (1.5644 - 1.5648)	
0.4 (0.016) Oversize (Service)	36.935 - 36.945 (1.4541 - 1.4545)	38.935 - 38.945 (1.5329 - 1.5333)	39.935 - 39.945 (1.5722 - 1.5726)	
Inner diameter "D ₂ "	29.4 - 30.1 (1.157 - 1.185)	31.4 - 32.1 (1.236 - 1.264)	TD27	32.4 - 33.1 (1.276 - 1.303)
			TD27T	32.9 - 33.1 (1.295 - 1.303)
Diameter of seat "D ₃ "	33.90 - 34.10 (1.3346 - 1.3425)	35.90 - 36.10 (1.4134 - 1.4213)	36.90 - 37.10 (1.4528 - 1.4606)	
Cylinder head valve seat diameter				
Standard	36.495 - 36.510 (1.4368 - 1.4374)	38.495 - 38.510 (1.5155 - 1.5161)	39.495 - 39.510 (1.5549 - 1.5555)	
0.2 (0.008) Oversize	36.695 - 36.710 (1.4447 - 1.4453)	38.695 - 38.710 (1.5234 - 1.5240)	39.695 - 39.710 (1.5628 - 1.5634)	
0.4 (0.016) Oversize	36.895 - 36.910 (1.4526 - 1.4531)	38.895 - 38.910 (1.5313 - 1.5319)	39.895 - 39.910 (1.5707 - 1.5713)	
Valve seat face angle "φ"	89° - 90°	89° - 90°	89° - 90°	

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

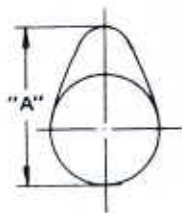
Inspection and Adjustment (Cont'd)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Unit: mm (in)

	Standard	Limit
Camshaft journal to bushing clearance (Oil clearance)	0.020 - 0.109 (0.0008 - 0.0043)	0.15 (0.0059)
Camshaft journal diameter		
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)	—
Rear	49.921 - 49.940 (1.9654 - 1.9661)	—
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)	0.50 (0.0197)



EM671

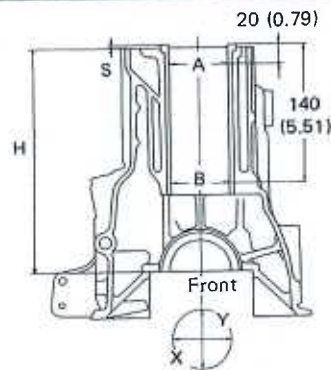
	Standard	Limit
Cam height "A"		
Intake	41.733 (1.6430)	41.20 (1.6220)
Exhaust	41.900 (1.6496)	41.40 (1.6299)

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

CYLINDER BLOCK AND CYLINDER LINER

Unit: mm (in)



SEM950C

	TD23	TD25	TD27 and TD27T
Nominal cylinder block height (From crankshaft center)	54.95 - 55.05 (2.1634 - 2.1673)		
Surface flatness (Without cylinder liner) Standard	Less than 0.05 (0.0020)		
Limit	0.2 (0.008)		
Cylinder bore Inner diameter Standard	92.000 - 92.020 (3.6220 - 3.6228)	95.900 - 95.920 (3.7756 - 3.7764)	99.000 - 99.020 (3.8976 - 3.8984)
Cylinder bore (With cylinder liner) Inner diameter Standard			
Grade No. 1	89.000 - 89.010 (3.5039 - 3.5043)	92.900 - 92.910 (3.6575 - 3.6579)	96.000 - 96.010 (3.7795 - 3.7799)
Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)	92.910 - 92.920 (3.6579 - 3.6583)	96.010 - 96.020 (3.7799 - 3.7803)
Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)	92.920 - 92.930 (3.6583 - 3.6587)	96.020 - 96.030 (3.7803 - 3.7807)
Wear limit	0.20 (0.0079)		
Out-of-round (X - Y)	Less than 0.020 (0.0008)		
Taper (A - B)	Less than 0.20 (0.0079)		
Projection "S"	0.02 - 0.09 (0.0008 - 0.0035)		
Division of each cylinder "S"	Less than 0.05 (0.0020)		
Interference fit cylinder liner to block	-0.01 to 0.03 (-0.0004 to 0.0012)		

Cylinder liner
diameter "D"

*Before insta

PISTON,

Available p

Piston skirt d
Standard

Grade

Grade

Grade

"a" dimension

Piston pin hol

Piston to cylin

* Grade No. 3

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

Unit: mm (in)

Unit: mm (in)



SEM427

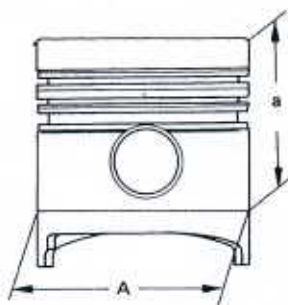
	TD23	TD25	TD27 and TD27T
Cylinder liner diameter "D" (service)*	89.050 - 89.070 (3.5059 - 3.5067)	92.950 - 92.970 (3.6594 - 3.6602)	96.050 - 96.070 (3.7815 - 3.7823)

*Before installing in cylinder block

PISTON, PISTON RING AND PISTON PIN

Available piston

Unit: mm (in)



SEM778A

	TD23	TD25	TD27	TD27T
Piston skirt diameter "A" Standard				
Grade No. 1	88.940 - 88.950 (3.5016 - 3.5020)	92.840 - 92.850 (3.6551 - 3.6555)	95.940 - 95.950 (3.7772 - 3.7776)	
Grade No. 2	88.950 - 88.960 (3.5020 - 3.5024)	92.850 - 92.860 (3.6555 - 3.6559)	95.950 - 95.960 (3.7776 - 3.7779)	
Grade No. 3*	88.960 - 88.970 (3.5024 - 3.5027)	92.860 - 92.870 (3.6559 - 3.6563)	95.960 - 95.970 (3.7779 - 3.7783)	
"a" dimension	67 (2.04)	70 (2.76)	70 (2.76)	
Piston pin hole diameter	25.992 - 26.000 (1.0233 - 1.0236)	27.992 - 28.000 (1.1020 - 1.1024)	27.992 - 28.000 (1.1020 - 1.1024)	29.992 - 30.000 (1.1808 - 1.1811)
Piston to cylinder liner clearance	0.05 - 0.07 (0.0020 - 0.0028)			

* Grade No. 3 piston is not provided as a service part.

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

Piston ring

Unit: mm (in)

	Standard	Limit
Side clearance		
Top	0.06 - 0.10 (0.0024 - 0.0039)	0.50 (0.0197)
2nd	0.04 - 0.08 (0.0016 - 0.0031)	0.30 (0.0118)
Oil	0.02 - 0.06 (0.0008 - 0.0024)	0.15 (0.0059)
Ring gap		
Top	0.30 - 0.45 (0.0118 - 0.0177)	1.5 (0.059)
TD23, TD25	0.20 - 0.35 (0.0079 - 0.0138)	
2nd TD27, TD27T	0.50 - 0.65 (0.0197 - 0.0256)	
Oil (rail ring)	0.30 - 0.50 (0.0118 - 0.0197)	

Piston pin

Unit: mm (in)

	TD23	TD25 and TD27	TD27T
Piston pin outer diameter	25.993 - 26.000 (1.0233 - 1.0236)	27.993 - 28.000 (1.1021 - 1.1024)	29.993 - 30.000 (1.1808 - 1.1811)
Piston pin to piston clearance	-0.008 to 0.007 (-0.0003 to 0.0003)		
Piston pin to connecting rod clearance			
Standard	0.025 - 0.045 (0.0010 - 0.0018)		
Limit	0.15 (0.0059)		

CONNECTING ROD

Unit: mm (in)

	TD23	TD25 and TD27	TD27T
Center distance	158.975 - 159.025 (6.2588 - 6.2608)	156.975 - 157.025 (6.1801 - 6.1821)	
Bend, torsion [per 100 (3.94)] Limit	0.05 (0.0020)		
Piston pin bore dia.	26.025 - 26.038 (1.0246 - 1.0251)	28.025 - 28.038 (1.1033 - 1.1039)	30.025 - 30.038 (1.1821 - 1.1826)
Side clearance Standard	0.10 - 0.22 (0.0039 - 0.0087)		
Limit	0.22 (0.0087)		

CRANKSHAFT

Journal dia.

Pin diameter

TD23

TD25, T

Center dist

Out-of-round
Taper A-B

Taper of jou
Standard

Limit

Out-of-round
pin "X-Y"
Standard

Limit

Crankshaft I
Standard

Limit

Crankshaft
Standard

Limit

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Inspection and Adjustment (Cont'd)

CRANKSHAFT

Unit: mm (in)

Unit: mm (in)

TD27T

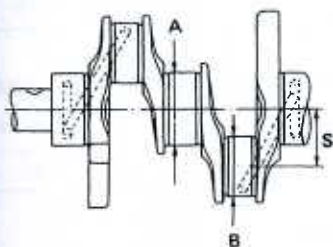
157.025
6.1821

))

30.025
30.038
(1.1821
1.1826)

0.0087)

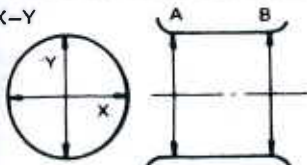
)



SEM100A

Journal diameter "A"	70.907 - 70.920 (2.7916 - 2.7921)
Pin diameter "B"	52.913 - 52.926 (2.0832 - 2.0837)
TD23	
TD25, TD27 and TD27T	56.913 - 56.962 (2.2407 - 2.2426)
Center distance "S"	46.00 (1.8110)

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



EM715

Taper of journal and pin "A-B"	
Standard	0.01 (0.0004)
Limit	0.02 (0.0008)
Out-of-round of journal and pin "X-Y"	
Standard	0.01 (0.0004)
Limit	0.02 (0.0008)
Crankshaft bend	
Standard	0 - 0.03 (0 - 0.0012)
Limit	0.10 (0.0039)
Crankshaft end play	
Standard	0.055 - 0.14 (0.0022 - 0.0055)
Limit	0.40 (0.0157)

AVAILABLE MAIN BEARING

Bearing clearance

Unit: mm (in)

Main bearing clearance	
Standard	0.035 - 0.087 (0.0014 - 0.0034)
Limit	0.15 (0.0059)
Connecting rod bearing clearance	
Standard	0.035 - 0.081 (0.0014 - 0.0032)
Limit	0.15 (0.0059)

Main bearing undersize

Unit: mm (in)

	Crank journal diameter
Standard	70.907 - 70.920 (2.7916 - 2.7921)
Undersize	
0.25 (0.0098)	70.657 - 70.670 (2.7818 - 2.7823)
0.50 (0.0197)	70.407 - 70.420 (2.7719 - 2.7724)
0.75 (0.0295)	70.157 - 70.170 (2.7621 - 2.7626)
1.00 (0.0394)	69.907 - 69.920 (2.7522 - 2.7528)

AVAILABLE CONNECTING ROD BEARING

Connecting rod bearing undersize

Unit: mm (in)

	Crank pin journal diameter	
	TD23	TD25, TD27 and TD27T
Standard	52.913 - 52.926 (2.0832 - 2.0837)	56.913 - 56.926 (2.2407 - 2.2412)
Undersize		
0.25 (0.0098)	52.663 - 52.676 (2.0733 - 2.0739)	56.663 - 56.676 (2.2308 - 2.2313)
0.50 (0.0197)	52.413 - 52.426 (2.0635 - 2.0640)	56.413 - 56.676 (2.2210 - 2.2313)
0.75 (0.0295)	52.163 - 52.176 (2.0537 - 2.0542)	56.163 - 56.176 (2.2111 - 2.2116)
1.00 (0.0394)	51.913 - 51.926 (2.0438 - 2.0443)	55.913 - 55.926 (2.2013 - 2.2018)

CO
PRE-
ENG
ENG
ENG
ENG
ENG
ENG
COO
COO
COO
COO
SERV

Thrust washer undersize

Unit: mm (in)

Gear train	
Backlash of each gear	0.07 - 0.11 (0.0028 - 0.0043)
Limit	0.20 (0.0079)
Flywheel	
Runout (Total indicator reading)	Less than 0.15 (0.0059)
Front plate	
Warpage limit	0.2 (0.008)

Engine outer parts

Unit	N-m	kg-m	ft-lb
Manifold nut			
Intake	15 - 20	1.5 - 2.0	11 - 14
Exhaust			
Without turbo-charger	25 - 29	2.5 - 3.0	18 - 22
With turbocharger	29 - 34	3.0 - 3.5	22 - 25
Turbocharger nut	17 - 23	1.7 - 2.3	12 - 17
Exhaust outlet nut (with turbocharger)	17 - 23	1.7 - 2.3	12 - 17
Injection pump nut	20 - 25	2.0 - 2.5	14 - 18
Injection pump to bracket bolt	30 - 41	3.1 - 4.2	22 - 30
Injection nozzle to cylinder head	54 - 64	5.5 - 6.5	40 - 47
Injection pump drive gear nut	59 - 69	6.0 - 7.0	43 - 51
Injection tube flare nut	20 - 25	2.0 - 2.5	14 - 18
Spill tube with cap nut	29 - 39	3.0 - 4.0	22 - 29
Alternator bracket bolt	30 - 41	3.1 - 4.2	22 - 30
Alternator to adjusting bar bolt	16 - 21	1.6 - 2.1	12 - 15
Starter motor to transmission	39 - 44	4.0 - 4.5	29 - 33
Dropping resistor (with intake manifold)	25 - 29	2.5 - 3.0	18 - 22
E.G.R. tube nut (for exhaust manifold side)	17 - 23	1.7 - 2.3	12 - 17
E.G.R. valve bolt	16 - 21	1.6 - 2.1	12 - 15

Unit	N-m	kg-m	ft-lb
Main bearing cap bolt	167 - 177	17.0 - 18.0	123 - 130
Connecting rod big end nut	78 - 83	8.0 - 8.5	58 - 61
Crank pulley nut	294 - 324	30 - 33	217 - 239
Flywheel bolt	147 - 167	15.0 - 17.0	108 - 123
Timing gear case bolt	16 - 21	1.6 - 2.1	12 - 15
Timing gear case nut	16 - 21	1.6 - 2.1	12 - 15
Front end plate bolt	10 - 13	1.0 - 1.3	7 - 9
Camshaft gear bolt	44 - 49	4.5 - 5.0	33 - 36
Camshaft locating plate bolt	4 - 6	0.4 - 0.6	2.9 - 4.3
Idle gear shaft bolt	25 - 35	2.6 - 3.6	19 - 26
Oil pan bolt	7 - 9	0.7 - 0.9	5.1 - 6.5
Oil pan drain plug	54 - 59	5.5 - 6.0	40 - 43
Cylinder head bolt	Refer to installation of cylinder head		
Glow plug	15 - 20	1.5 - 2.0	11 - 14
Rocker shaft bracket bolt	20 - 25	2.0 - 2.5	14 - 18
Rocker arm lock nut	15 - 20	1.5 - 2.0	11 - 14
Rocker cover screw	1 - 2	0.1 - 0.2	0.7 - 1.4

