

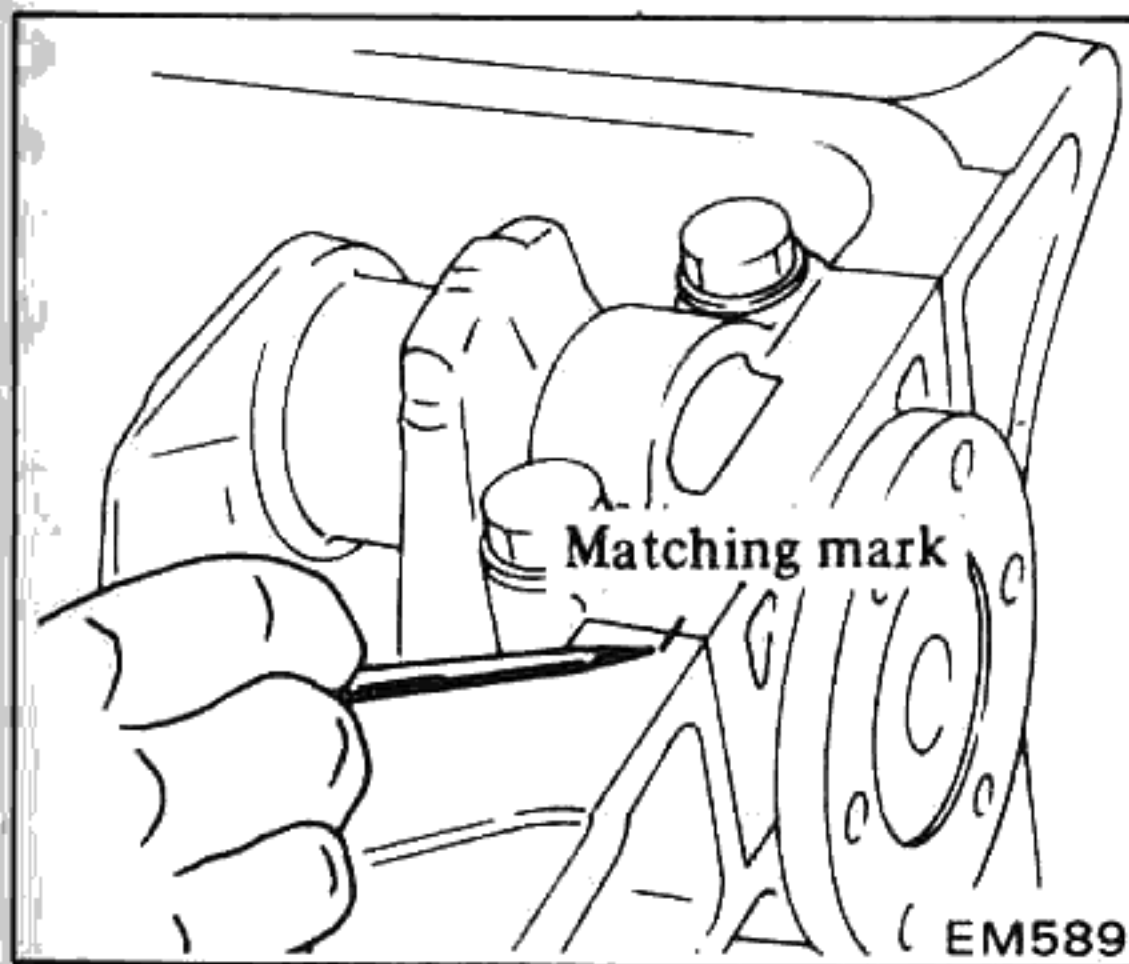
# NISSAN

MODEL **SD** SERIES  
DIESEL ENGINE  
SD22, SD23, SD25 & SD33

SERVICE MANUAL  
**2nd Revision**

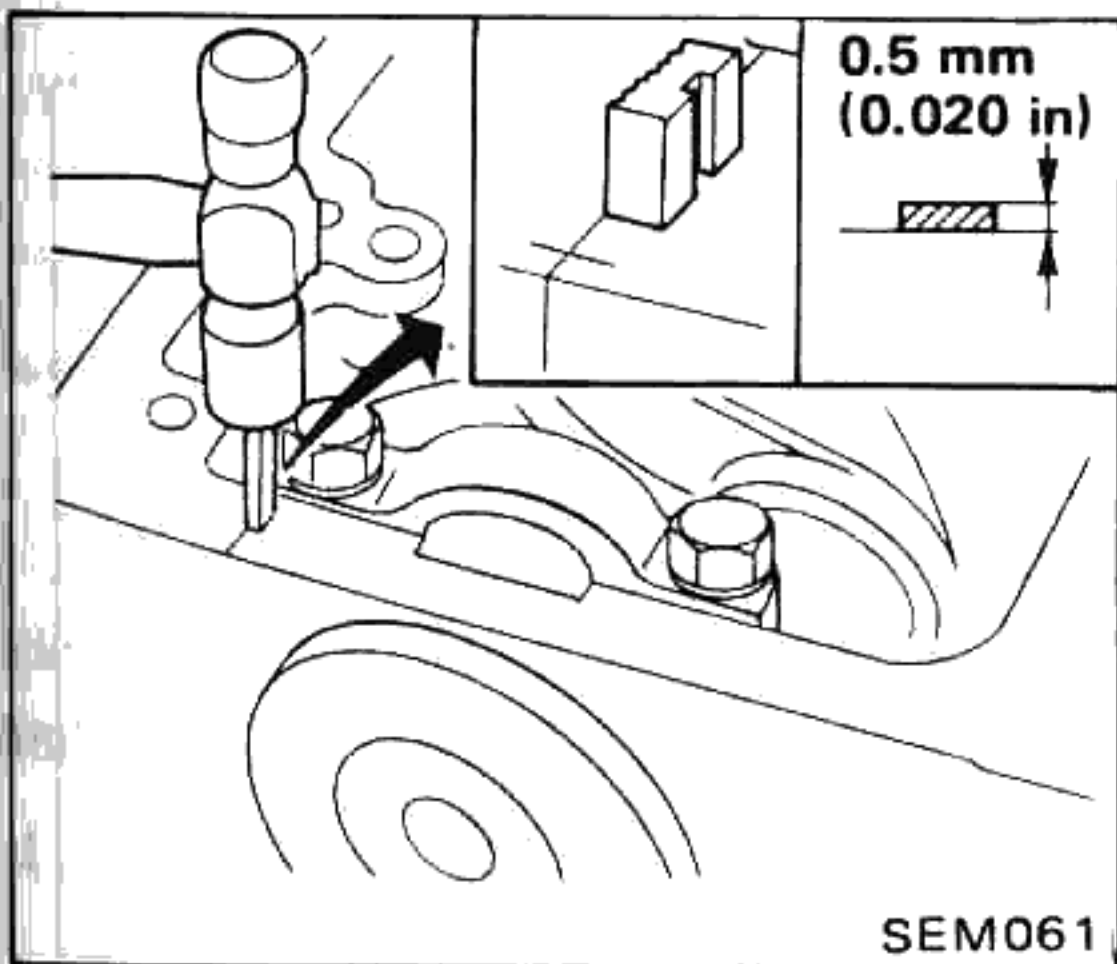


- d) Install rear main bearing cap by aligning marks on cylinder block and cap.



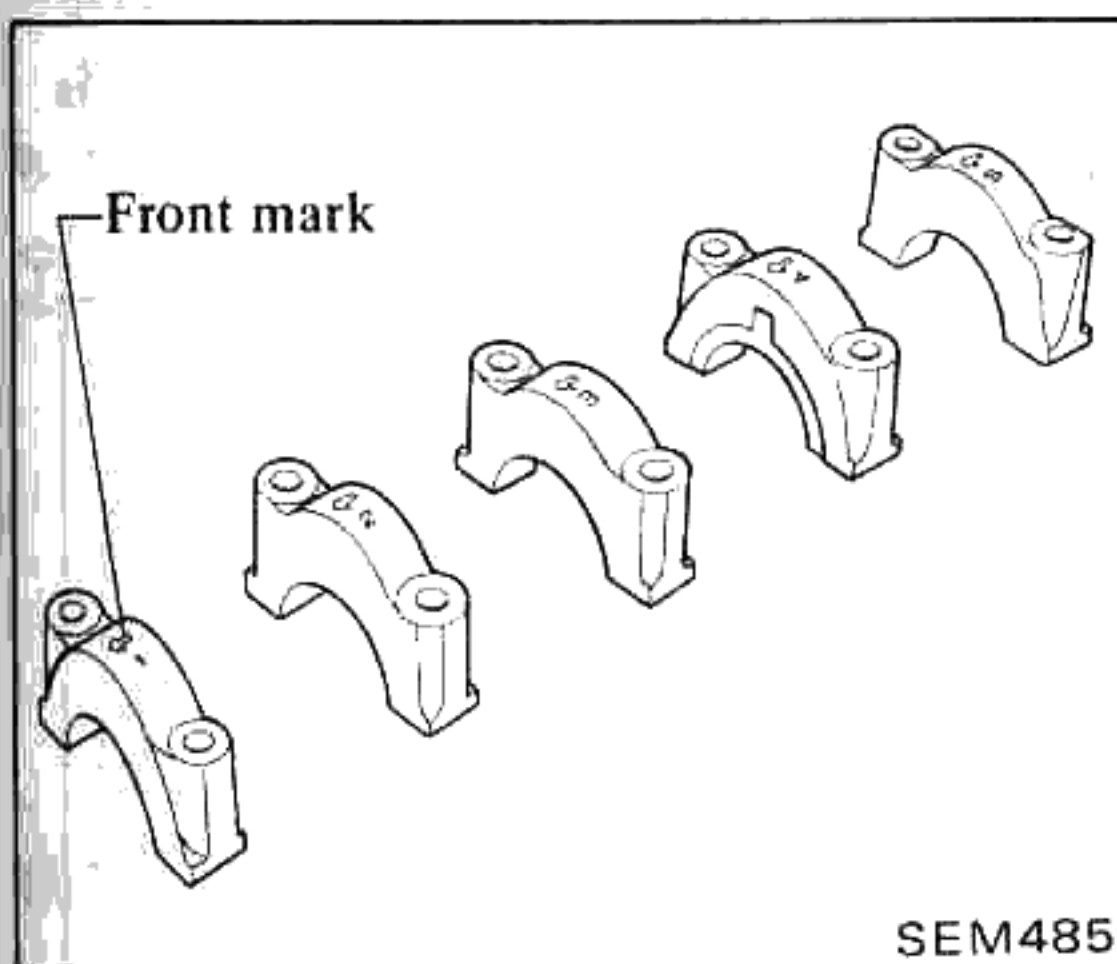
- e) Install new rear main bearing cap side seal with liquid sealant.

- Face groove of side oil seal toward cap and block.
- Make sure that side oil seal end protrudes by 0.5 mm (0.020 in) from cylinder block.



## 5 bearings (SD 4-cylinder)

- Install main bearing cap so that "F" mark is at front side of vehicle.

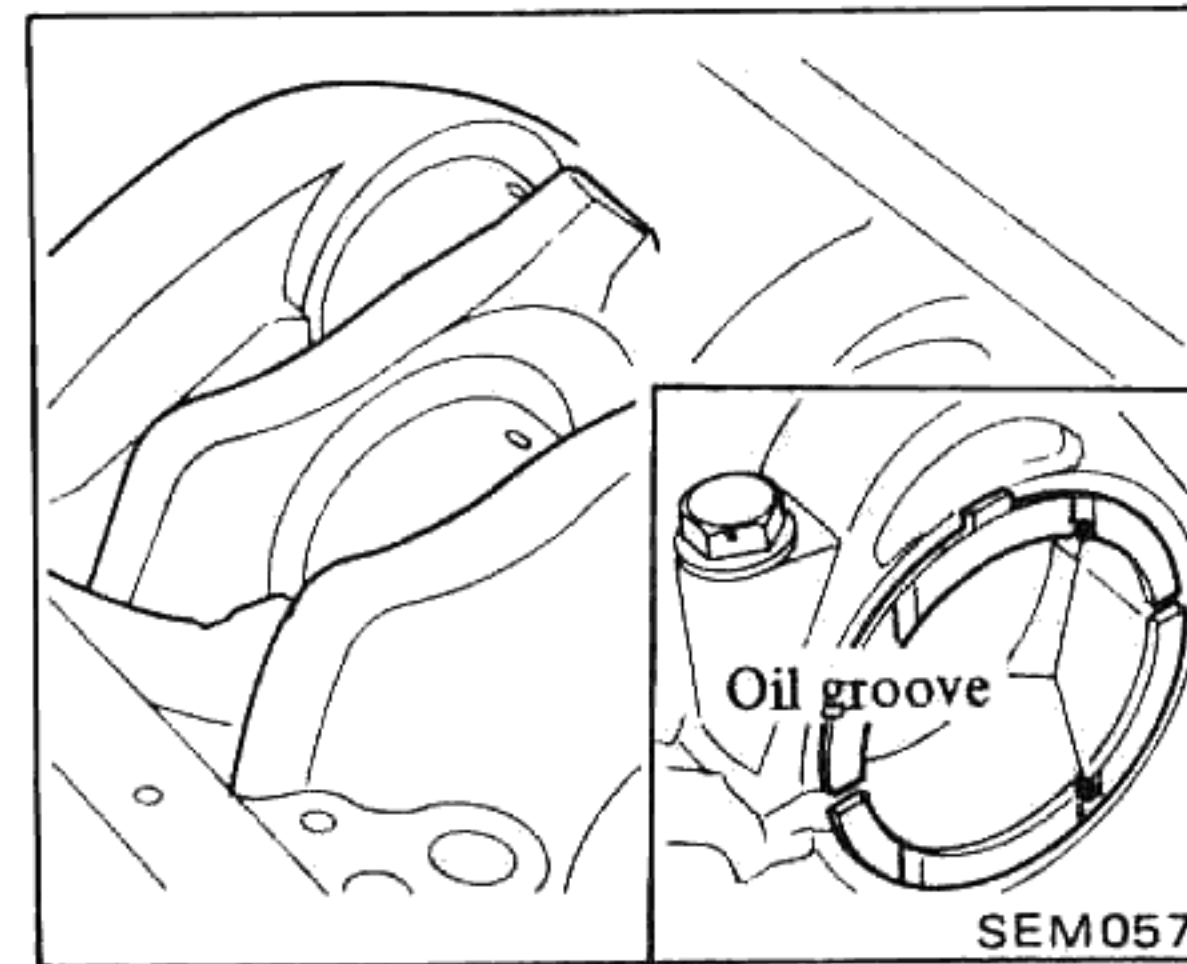


- Apply engine oil to main bearing cap and cylinder block contact surfaces.

- Install oil seal assembly. Apply grease to contact surface of rear end oil seal and crankshaft.

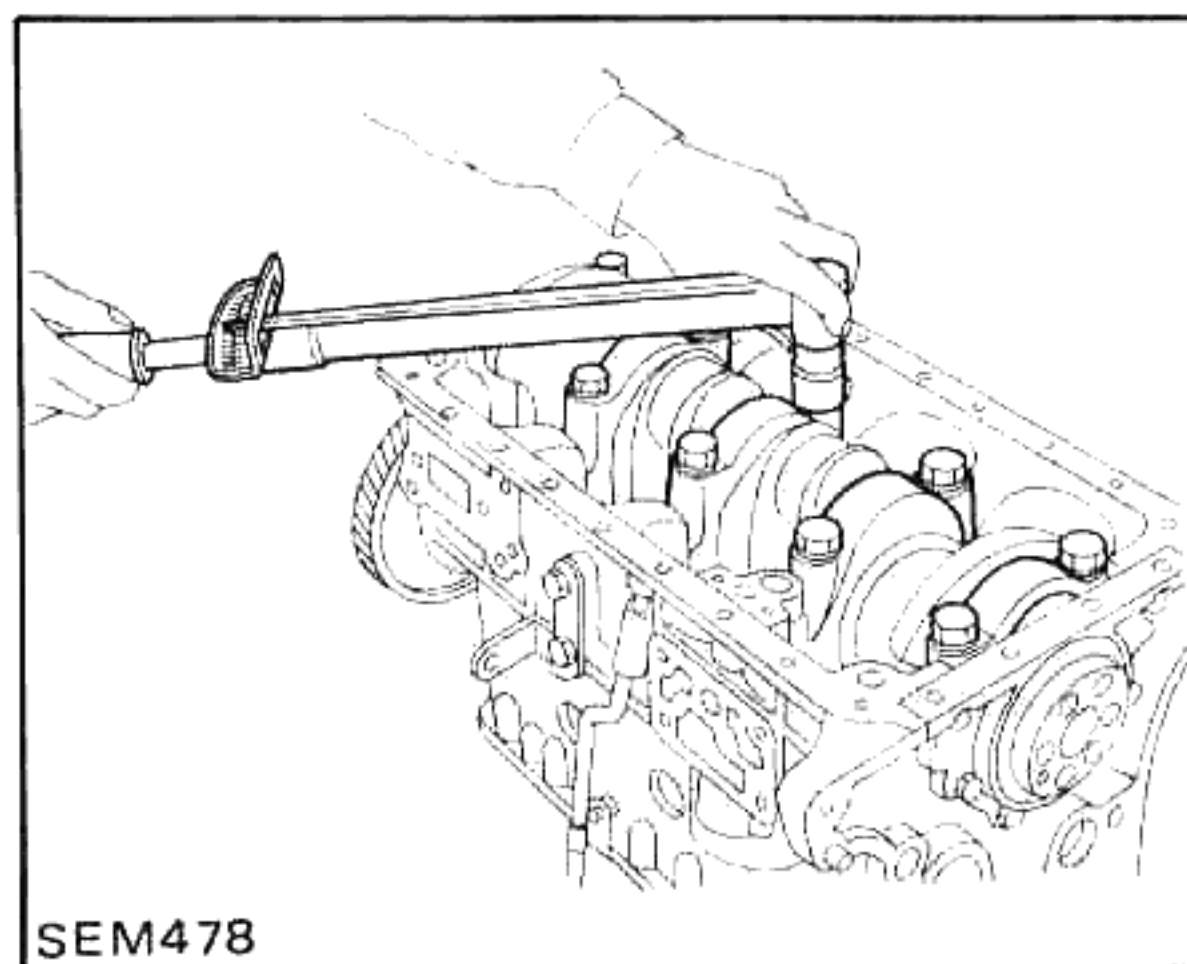
- (4) Install crankshaft thrust washer at the 4th journal from front.

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.

**T : Main bearing cap bolt:**  
 167 - 172 N·m  
 (17.0 - 17.5 kg-m,  
 123 - 127 ft-lb)



- (6) Measure crankshaft end play.

If not within specification, replace with proper thrust washer.

## Crankshaft end play:

### Standard

0.06 - 0.14 mm

(0.0024 - 0.0055 in)

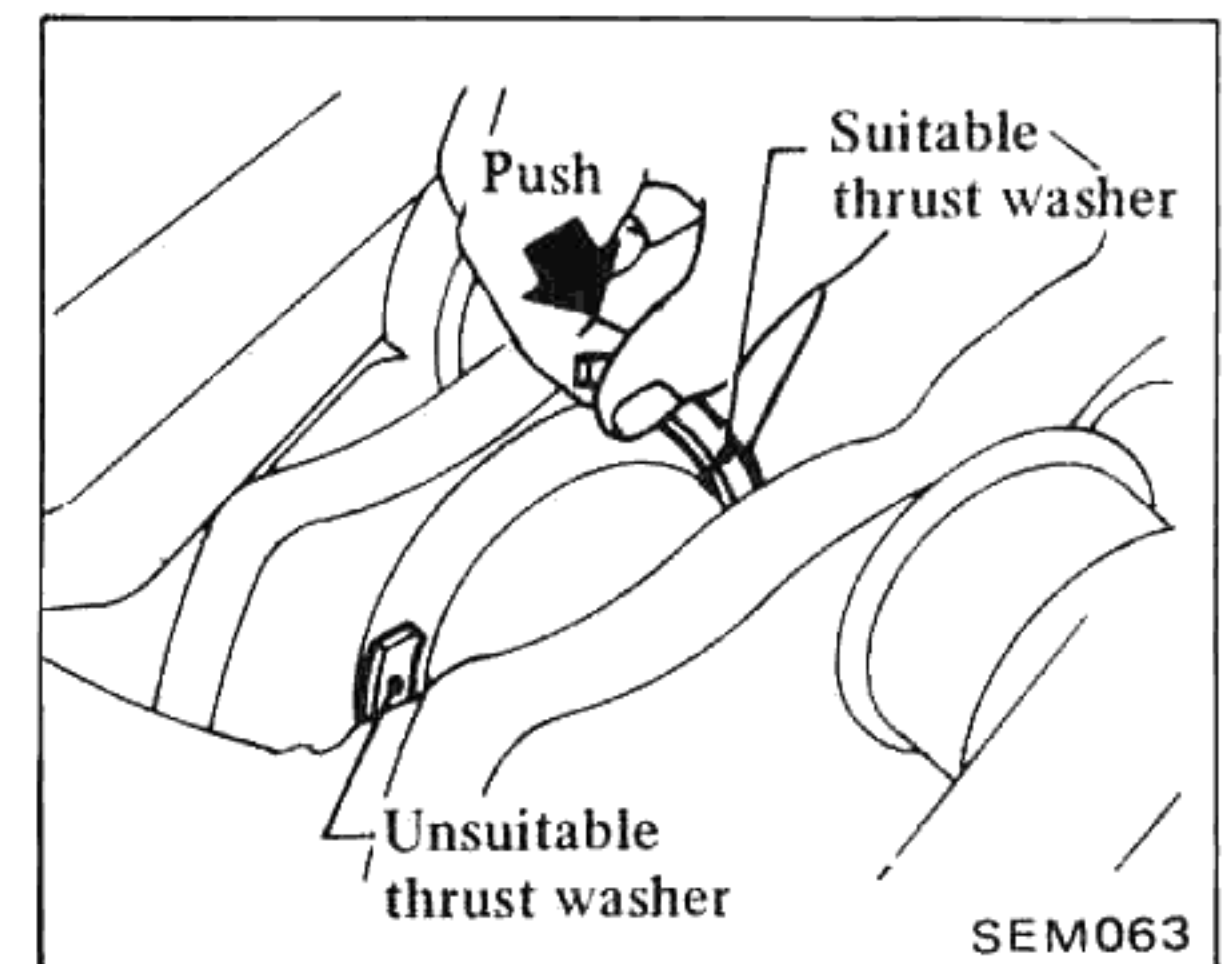
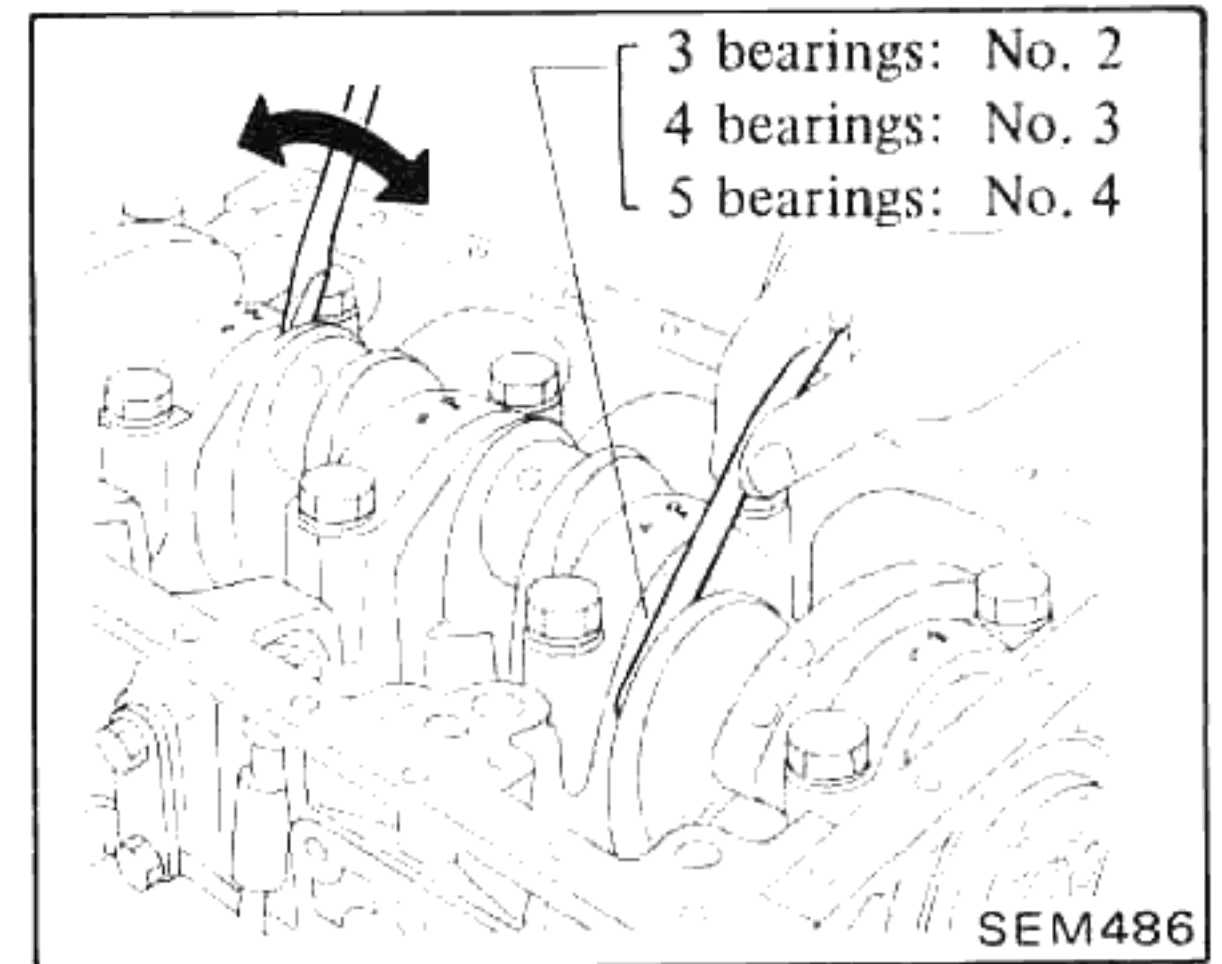
### Limit

Less than 0.4 mm (0.016 in)

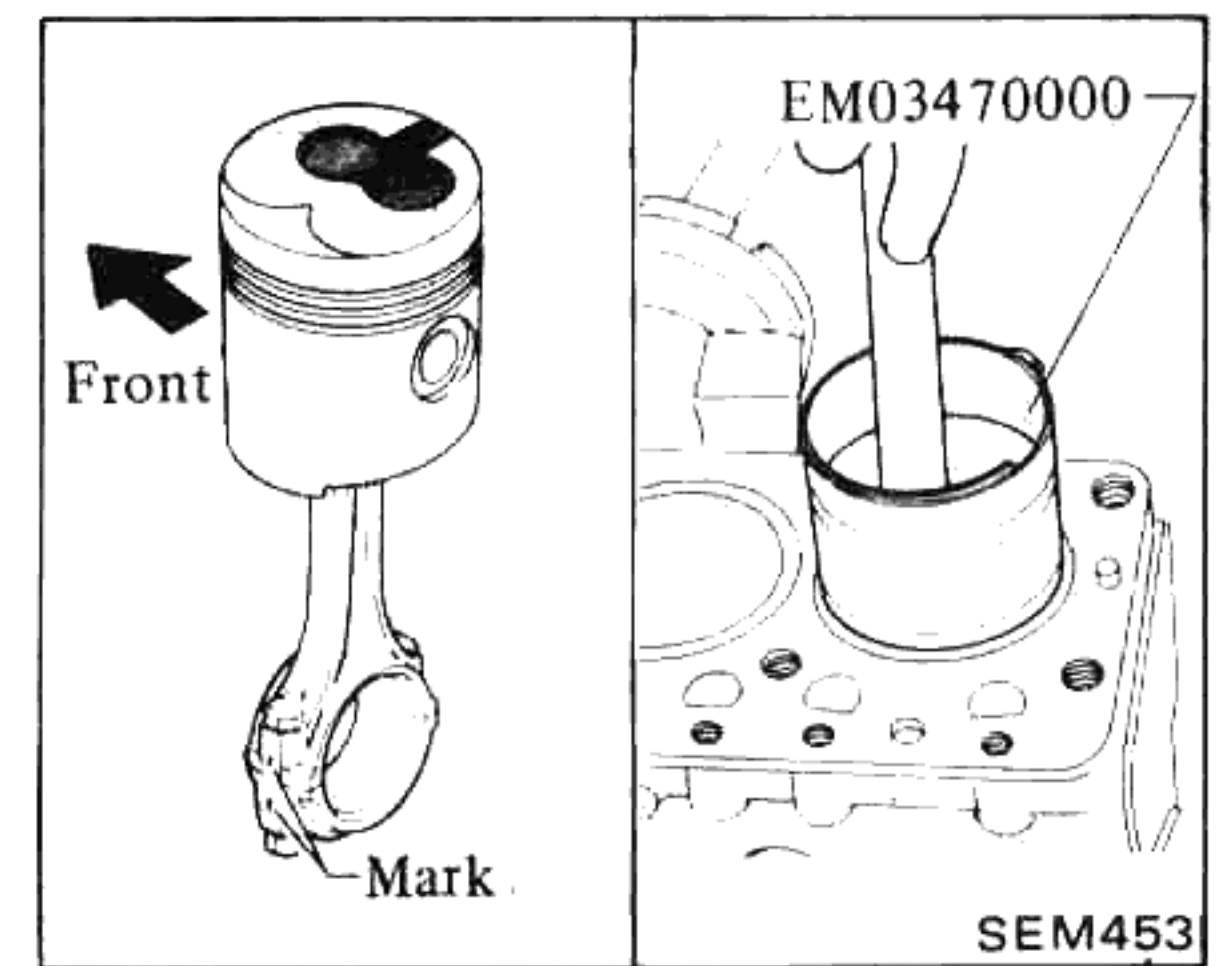
## Thrust washer oversize:

0.2 mm (0.008 in) and

0.4 mm (0.016 in) oversize



5. Install piston assembly with Tool.  
 (1) Install piston assembly by aligning matching mark on connecting rod big end.





(2) Tighten connecting rod bearing cap nut.

Ⓣ : Connecting rod bearing cap:

SD22 and SD33

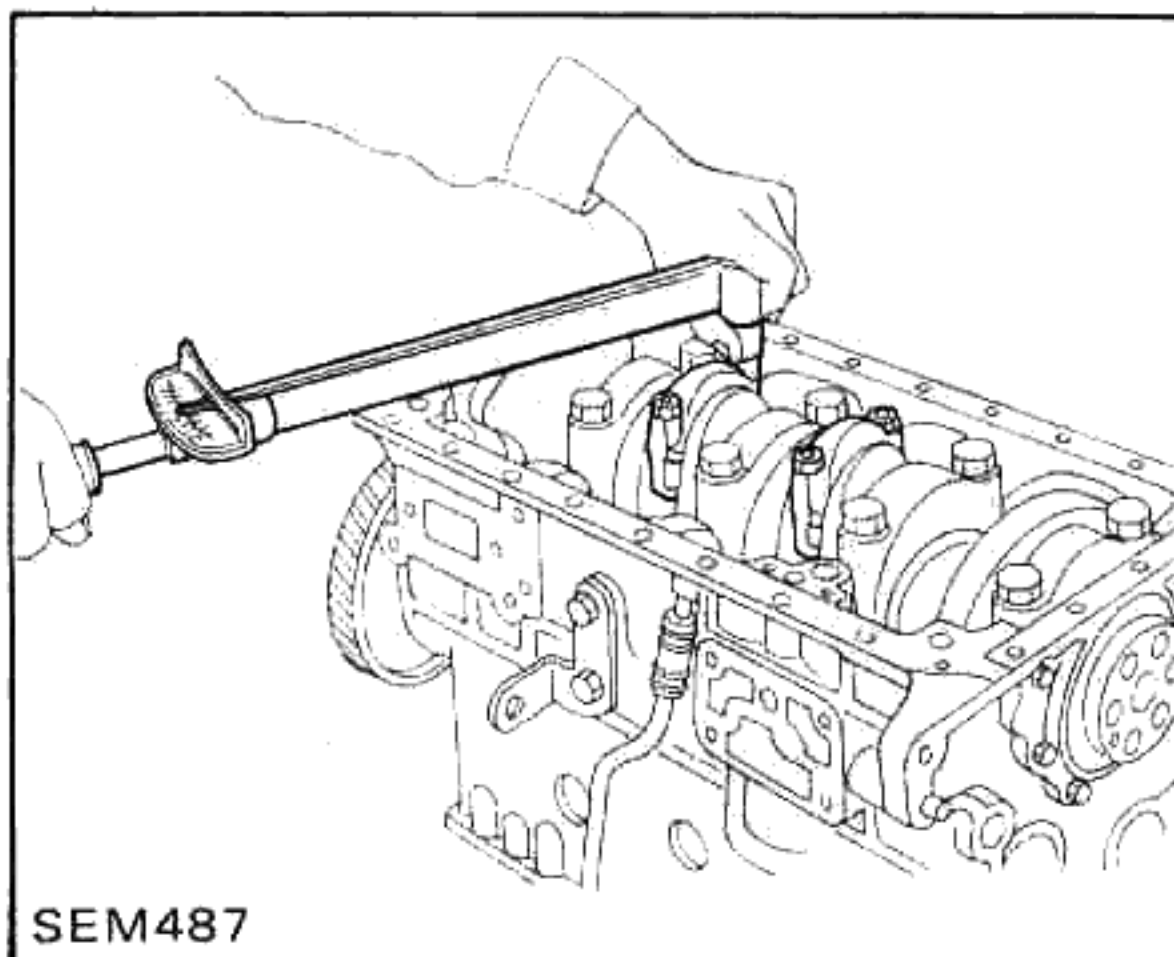
51 - 56 N·m

(5.2 - 5.7 kg-m,  
38 - 41 ft-lb)

SD23 and SD25

67 - 71 N·m

(6.8 - 7.2 kg-m,  
49 - 52 ft-lb)



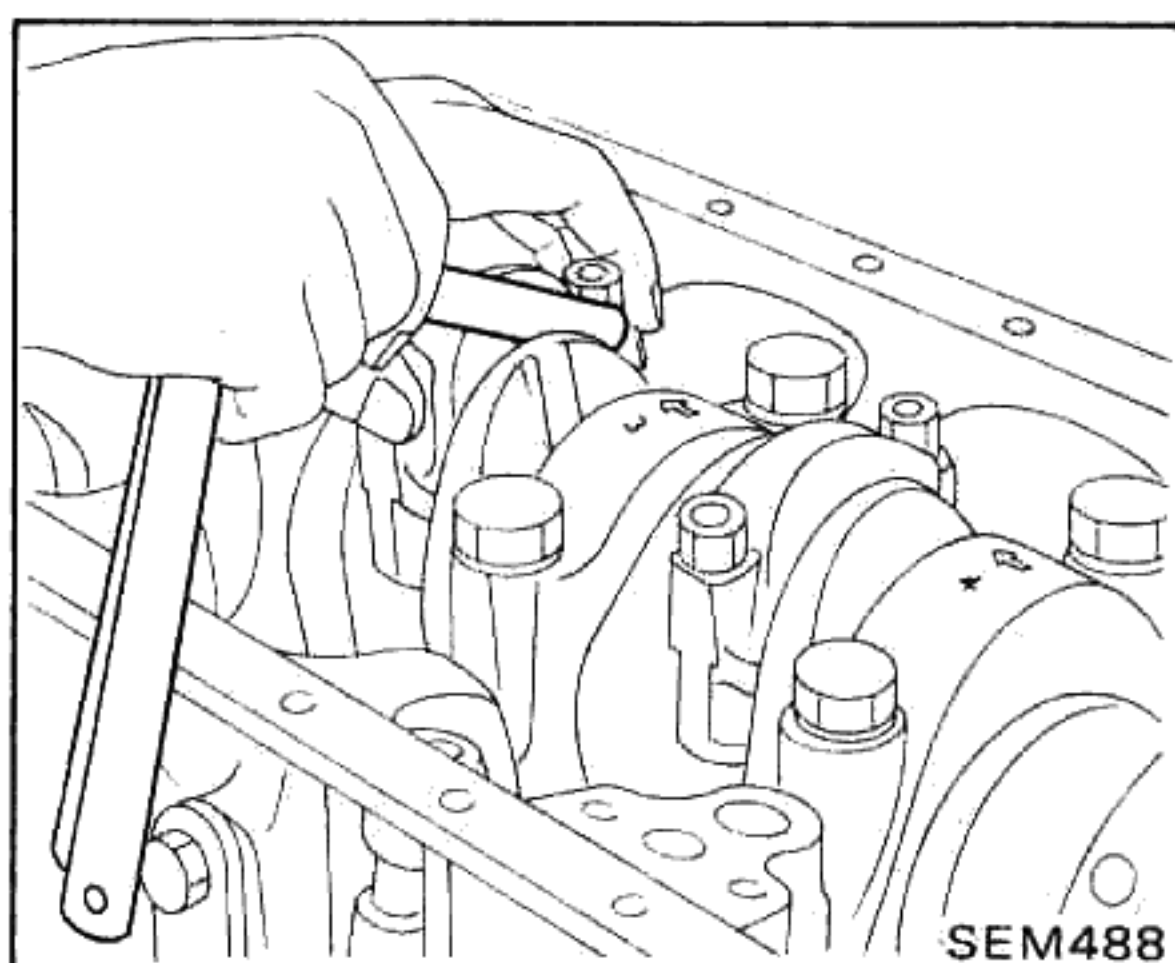
(3) Measure clearance between connecting rod big end and web of crankshaft.

If beyond the specified value, replace connecting rod.

**Connecting rod thrust clearance:**

0.1 - 0.2 mm

(0.004 - 0.008 in)



6. Install oil pump assembly.

7. Measure piston top clearance.

(1) Set piston to T.D.C.

(2) Measure clearance between top of piston and cylinder block with dial gauge. Measure clearance at front and rear of each piston.

**Piston top clearance:**

**Standard**

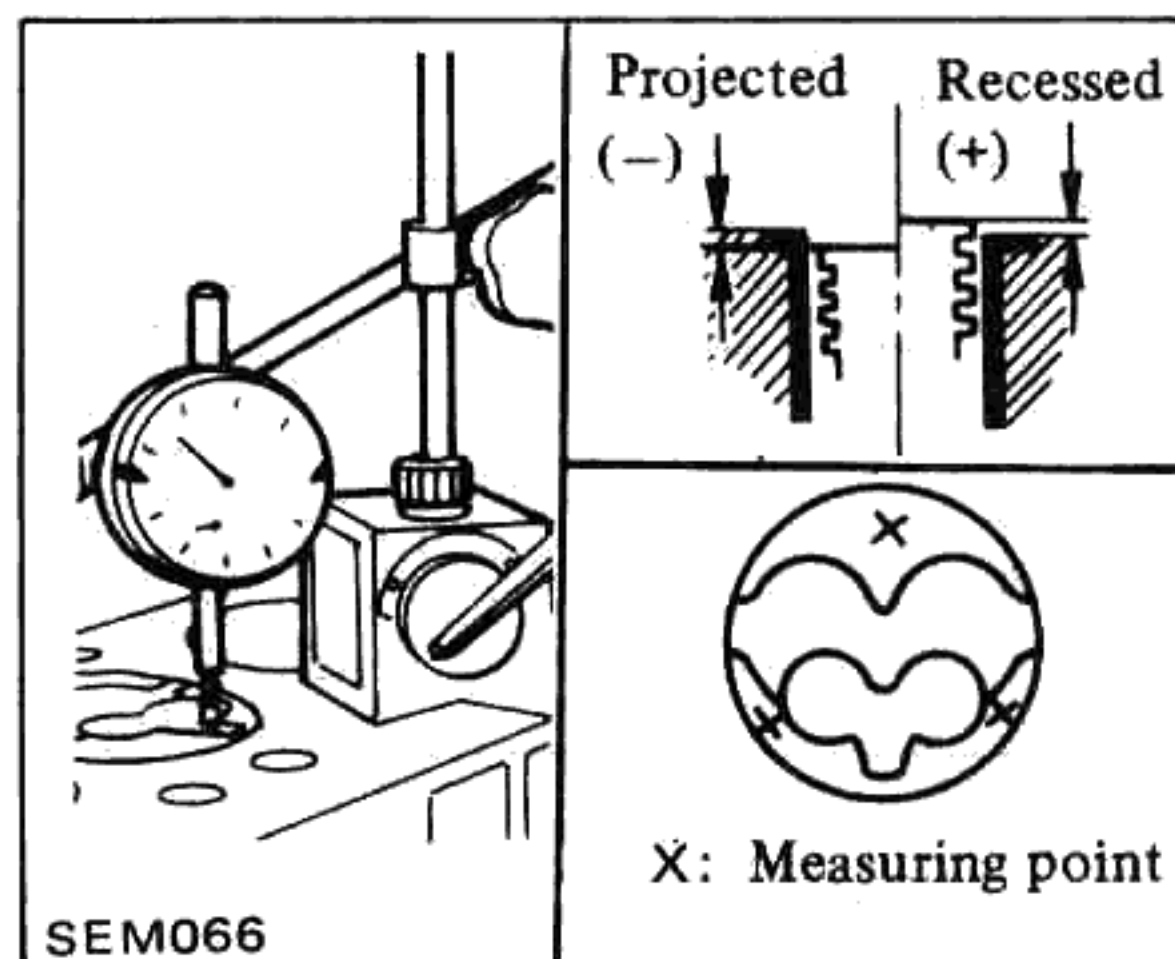
-0.27 - +0.08 mm

(-0.0106 - +0.0031 in)

**Limit**

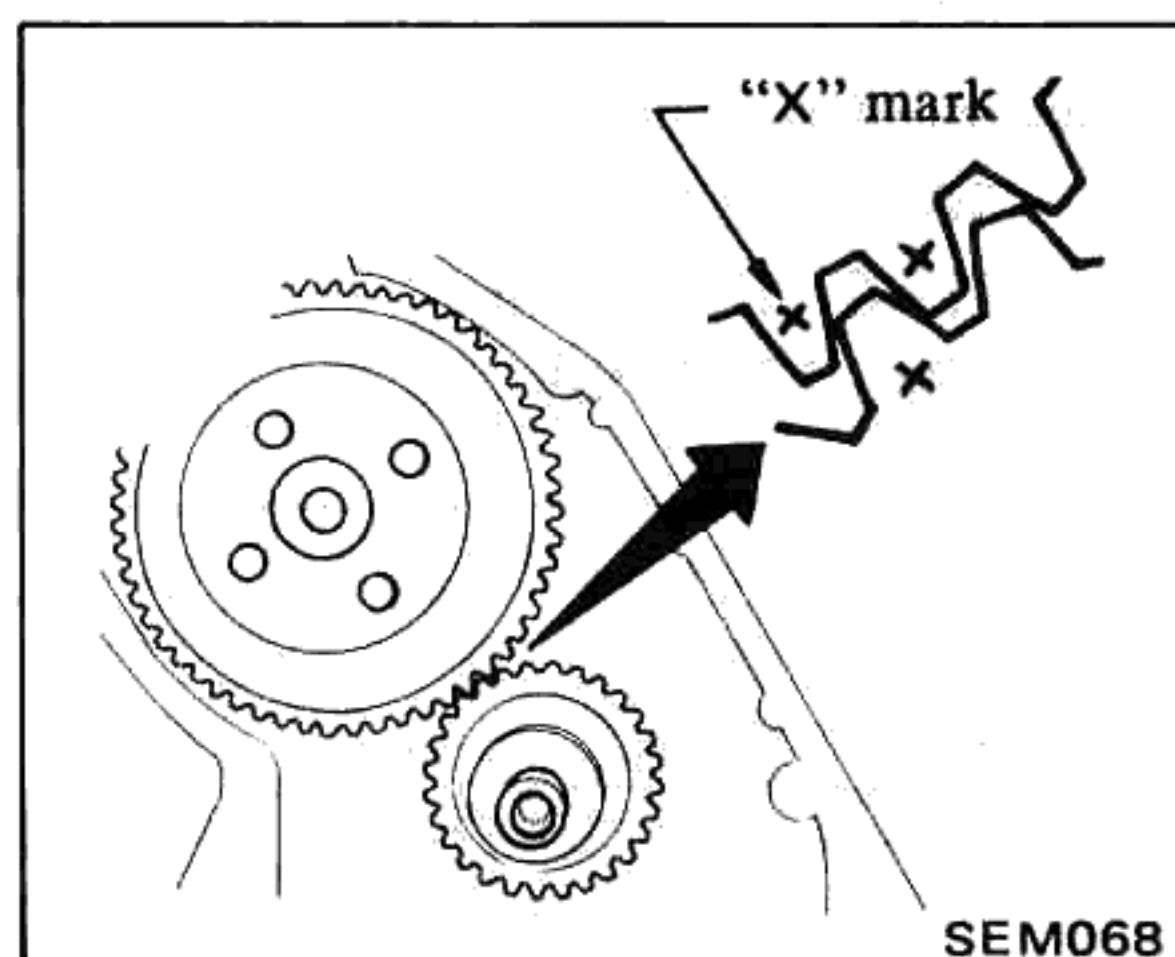
-0.4 - +0.3 mm

(-0.016 - +0.012 in)



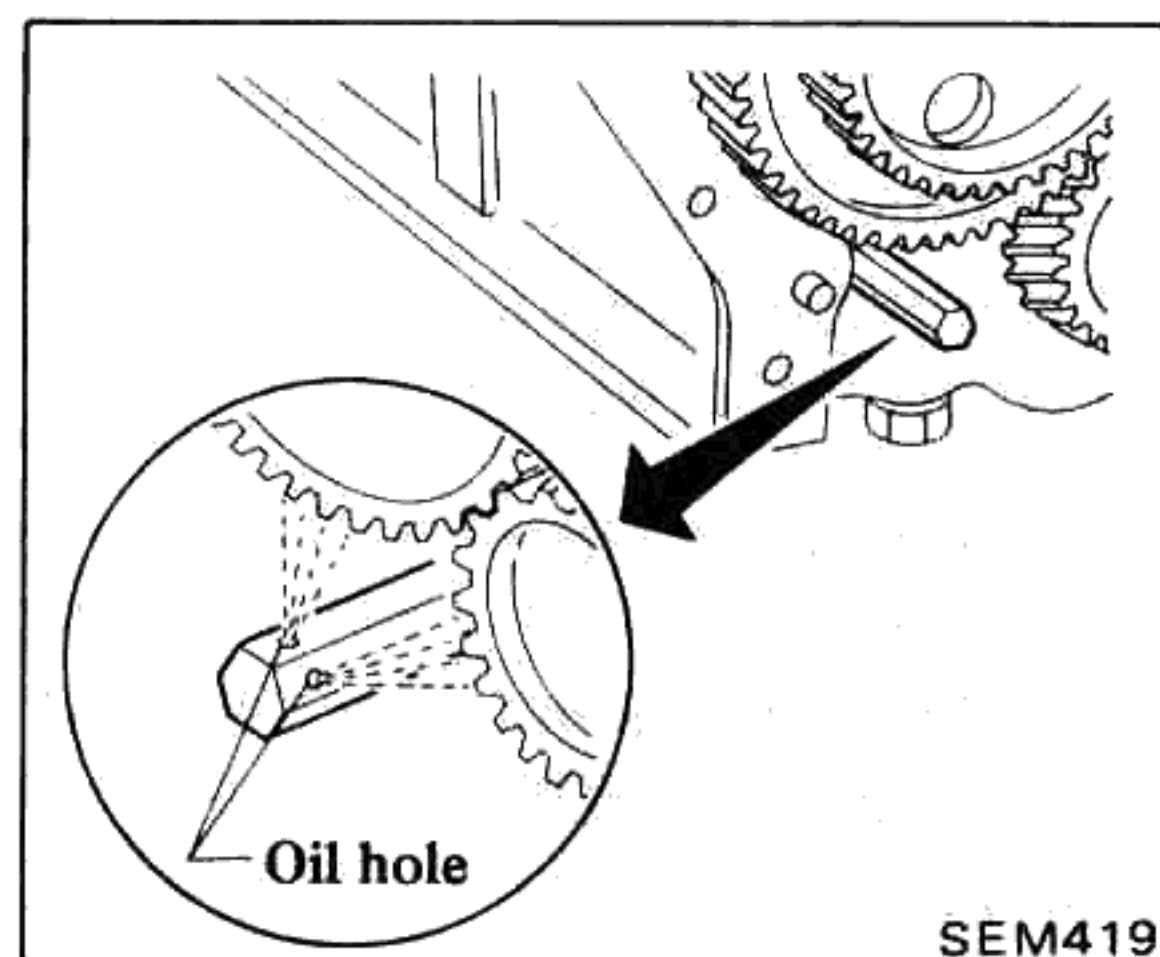
8. Install crankshaft gear.

(1) Install crankshaft gear through key by aligning crank gear and camshaft gear matching marks.



(2) Measure gear backlash. Refer to Inspection and Repair.

9. Install oil jet so that it can face each gear.



10. Install rear engine plate (SD 4-cylinder)/flywheel housing (SD33)

and flywheel and then bend lock plate (if equipped).

Ⓣ : Flywheel bolt

3 bearings & 4 bearings

44 - 49 N·m

(4.5 - 5.0 kg-m,  
33 - 36 ft-lb)

5 bearings

88 - 98 N·m

(9.0 - 10.0 kg-m,  
65 - 72 ft-lb)

Washer based bolt

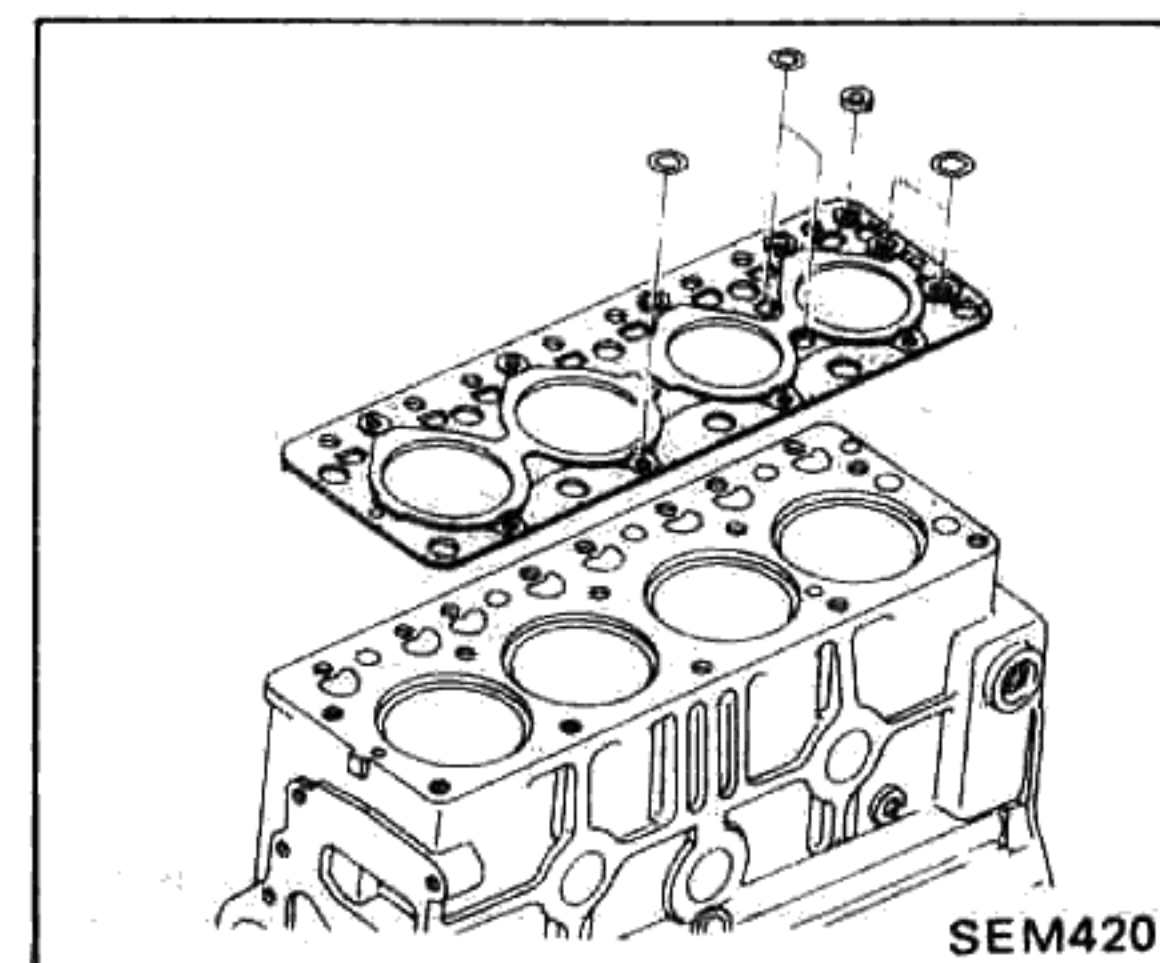
127 - 147 N·m

(13.0 - 15.0 kg-m,  
94 - 108 ft-lb)

## INSTALLING CYLINDER HEAD

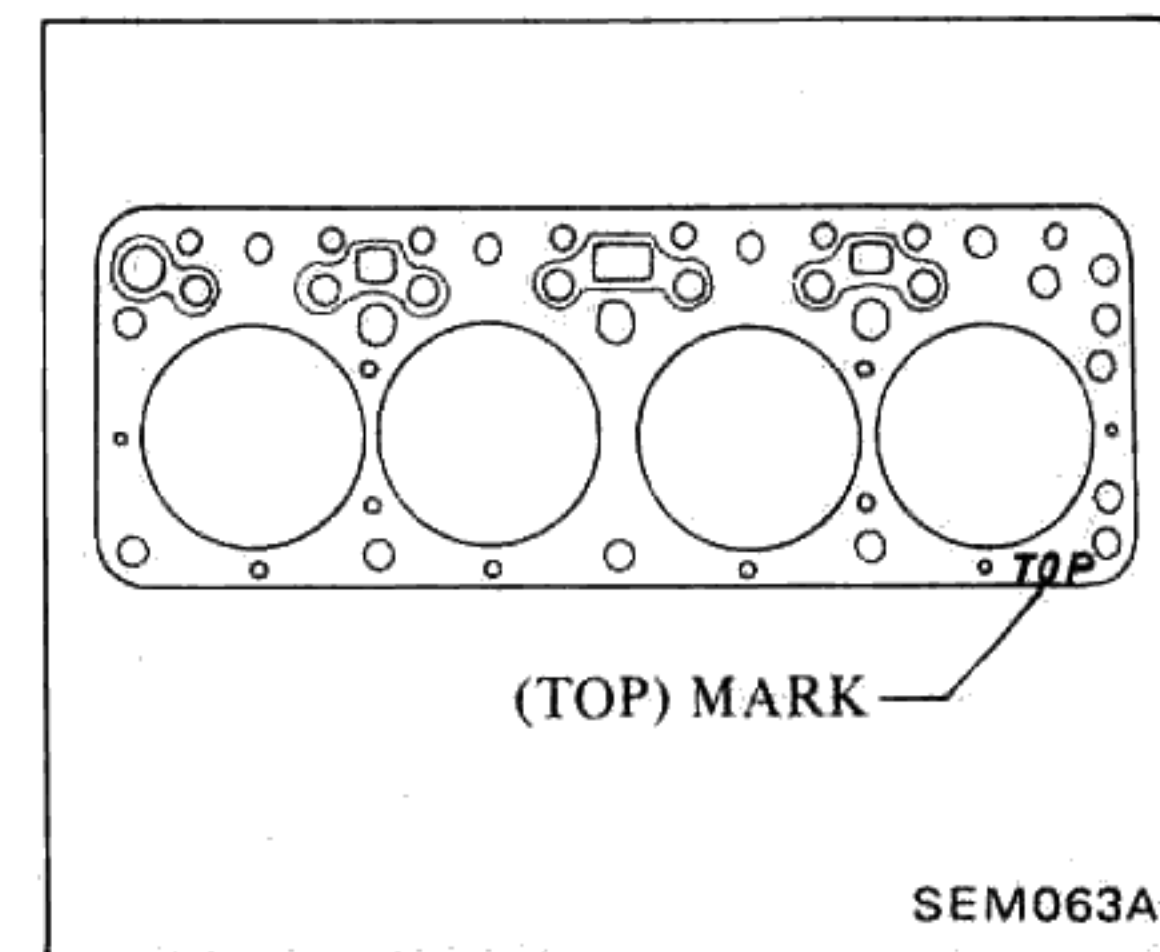
1. Install new cylinder head gasket.

Securely install rubber rings into water and oil holes.



2. Install cylinder head by accommodating knock pin of cylinder block.

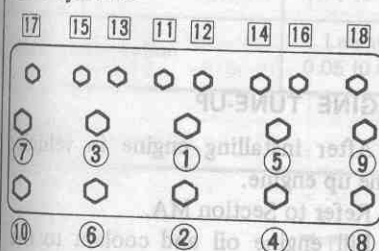
Be sure to install gasket with TOP mark facing upward if that mark is stamped.



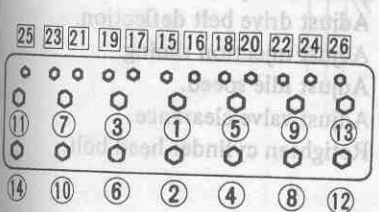
3. Tighten cylinder head bolts in the sequence shown below. Install cylinder head.

- (1) Tighten main bolts to 59 - 78 N·m (6 - 8 kg-m, 43 - 58 ft-lb).
- (2) Tighten sub bolts to 20 - 29 N·m (2 - 3 kg-m, 14 - 22 ft-lb).
- (3) Tighten main bolts to 118 - 127 N·m (12 - 13 kg-m, 87 - 94 ft-lb).
- (4) Tighten sub bolts to 44 - 54 N·m (4.5 - 5.5 kg-m, 33 - 40 ft-lb).

## SD 4-cylinder



## SD33



SEM008

After installing engine in the vehicle, warm up engine and retighten cylinder head bolts.

## 4. Install push rod.

Turn push rod and make sure that it is within spherical area of valve lifter.

## 5. Install rocker shaft assembly.

a. Tighten in two or three stages outwardly from center bracket.

b. Fully loosen rocker arm screws.

- Ⓣ : Rocker shaft bolt  
20 - 25 N·m  
(2.0 - 2.5 kg-m,  
14 - 18 ft-lb)

## INSTALLING FRONT PARTS

1. Install front cover with new gasket and new front oil seal.

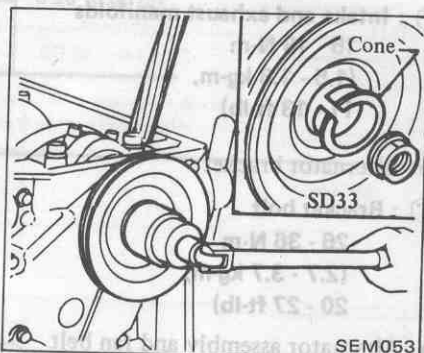
- Ⓣ : Front cover fixing bolt  
M6  
4 - 6 N·m  
(0.4 - 0.6 kg-m,  
2.9 - 4.3 ft-lb)

## M8

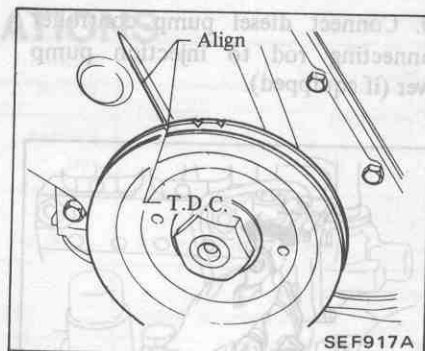
10 - 13 N·m  
(1.0 - 1.3 kg-m,  
7 - 9 ft-lb)

## 2. Install crank pulley.

- Ⓣ : Crank pulley  
294 - 324 N·m  
(30 - 33 kg-m,  
217 - 239 ft-lb)



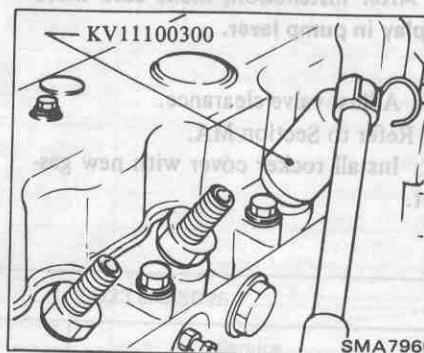
3. Install oil pan with new gasket coated with liquid sealant.
4. Install water pump with new gasket.
5. Install thermostat housing with new gasket.



5. Install injection pump assembly. Refer to Section EF.

6. Injection nozzle and tube.

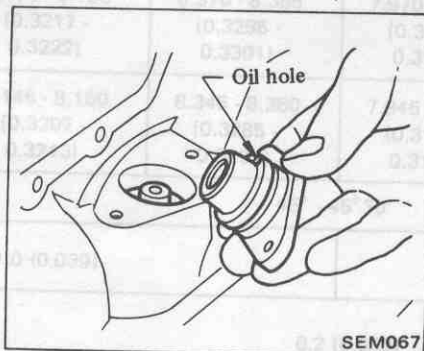
(1) Install new washer and injection nozzle.



## INSTALLING SIDE PARTS

1. Install oil pump spindle by aligning grooves of camshaft, oil pump, drive gear and oil pump drive shaft.

Face oil hole in support toward cylinder block side and install support with new O-ring (SD 4-cylinder)/gasket (SD33).



2. Connect oil cooler hose to cylinder head.
3. Install glow plug harness.
4. Align front cover and crank pulley mark for setting No. 1 piston at T.D.C.

(2) Install spill tube.

- Ⓣ : Spill tube fixing nut  
39 - 49 N·m  
(4 - 5 kg-m,  
29 - 36 ft-lb)

(3) Install injection tube.

- Ⓣ : Injection tube flare nut  
29 - 34 N·m  
(3.0 - 3.5 kg-m,  
22 - 25 ft-lb)

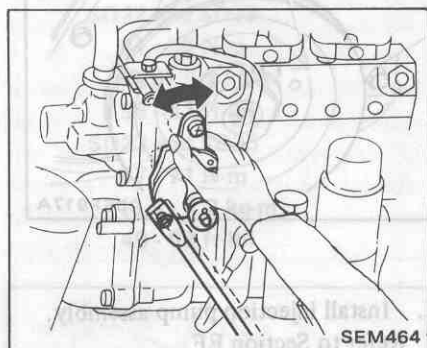
7. Temporarily install oil cooler, oil filter bracket and oil pipe, and then gradually tighten them.

8. Vacuum tube assembly.

9. Install diesel pump controller.



10. Connect diesel pump controller connecting rod to injection pump lever (if equipped).



After installation, make sure there is play in pump lever.

11. Adjust valve clearance.  
Refer to Section MA.
12. Install rocker cover with new gasket.

- ⊕ : **Rocker cover bolt**  
10 - 13 N·m  
(1.0 - 1.3 kg·m,  
7 - 9 ft·lb)

13. Dismount engine from work stand and remove engine attachment.

14. Install rear and left side parts.

- Breather assembly
- Intake and Exhaust manifold

- ⊕ : **Intake and exhaust manifolds**  
15 - 18 N·m  
(1.5 - 1.8 kg·m,  
11 - 13 ft·lb)

- Alternator bracket

- ⊕ : **Bracket bolt**  
26 - 36 N·m  
(2.7 - 3.7 kg·m,  
20 - 27 ft·lb)

- Alternator assembly and fan belt

- ⊕ : **11 - 14 N·m**  
(1.1 - 1.4 kg·m,  
8 - 10 ft·lb)

- Engine mountings
- Starter motor
- Clutch cover assembly  
Refer to Section CL.
- Transmission assembly  
Refer to Section MT.

## ENGINE TUNE-UP

After installing engine in vehicle, tune up engine.

Refer to Section MA.

- Fill engine oil and coolant to the specified levels.
- Bleed fuel system.
- Adjust drive belt deflection.
- Adjust injection timing.
- Adjust idle speed.
- Adjust valve clearance.
- Retighten cylinder head bolt.

## SERVICE DATA AND SPECIFICATIONS

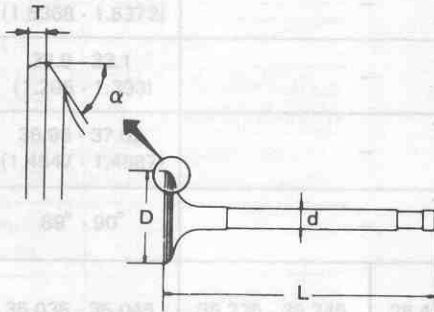
INSPECTION AND ADJUSTMENT  
CYLINDER HEAD

Unit: mm (in)

|                        | Standard                   | Limit         |
|------------------------|----------------------------|---------------|
| Longitudinal direction | Less than<br>0.10 (0.0039) | 0.20 (0.0079) |
| Transverse direction   | Less than<br>0.05 (0.0020) |               |

## VALVE

Unit: mm (in)



SEM188

|                                       | SD22 and SD33                      |                                    |                                    | SD23 and SD25                      |         |
|---------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|---------|
|                                       | Standard                           | Service                            |                                    | Standard                           | Service |
| Valve head diameter "D"               |                                    |                                    |                                    |                                    |         |
| Intake                                | 38.0 (1.496)                       |                                    |                                    | 40.0 (1.575)                       |         |
| Exhaust                               | 32.0 (1.260)                       |                                    |                                    | 34.0 (1.339)                       |         |
| Valve length "L"                      |                                    |                                    |                                    |                                    |         |
| Intake                                | 117 (4.61)                         |                                    |                                    |                                    |         |
| Exhaust                               |                                    |                                    |                                    |                                    |         |
| Valve stem diameter "d"               |                                    |                                    |                                    |                                    |         |
| Intake                                | 7.970 - 7.985<br>(0.3138 - 0.3144) | 8.170 - 8.185<br>(0.3217 - 0.3222) | 8.370 - 8.385<br>(0.3295 - 0.3301) | 7.970 - 7.985<br>(0.3138 - 0.3144) | —       |
| Exhaust                               | 7.945 - 7.960<br>(0.3128 - 0.3134) | 8.145 - 8.160<br>(0.3207 - 0.3213) | 8.345 - 8.360<br>(0.3285 - 0.3291) | 7.945 - 7.960<br>(0.3128 - 0.3134) | —       |
| Valve seat angle "α"                  | 45° - 45°30'                       |                                    |                                    |                                    |         |
| Valve margin "T" limit                | 1.0 (0.039)                        |                                    |                                    | 1.5 (0.059)                        |         |
| Valve stem and surface grinding limit | 0.2 (0.008)                        |                                    |                                    |                                    |         |
| Valve clearance (Hot)                 | 0.35 (0.014)                       |                                    |                                    |                                    |         |
| Intake                                |                                    |                                    |                                    |                                    |         |
| Exhaust                               |                                    |                                    |                                    |                                    |         |



# SERVICE DATA AND SPECIFICATIONS

## Valve spring

|                  |                     |                                        |               |
|------------------|---------------------|----------------------------------------|---------------|
| Free length      | mm (in)             | Painted yellow                         | 50.20 (1.976) |
|                  |                     | Painted red                            | 50.35 (1.982) |
| Pressure height  | mm/N (mm/kg, in/lb) | 30.4/599.2<br>(30.4/61.1, 1.197/134.7) |               |
| Assembled height | mm/N (mm/kg, in/lb) | 39/294<br>(39/30, 1.54/66)             |               |
| Out of square    | mm (in)             | 1.3 (0.051)                            |               |

## Valve guide (SD23 and SD25)

Unit: mm (in)

|                                               | Standard                             | Service        |
|-----------------------------------------------|--------------------------------------|----------------|
| Valve guide outside diameter                  | 12.033 - 12.044<br>(0.4737 - 0.4742) | —              |
| Valve guide inner diameter<br>(Finished size) | 8.00 - 8.015<br>(0.3150 - 0.3156)    |                |
| Cylinder head valve guide<br>hole diameter    | 12.00 - 12.011<br>(0.4724 - 0.4729)  | —              |
| Interference fit of valve guide               | 0.022 - 0.044<br>(0.0009 - 0.0017)   |                |
|                                               | Standard                             | Max. tolerance |
| Stem to guide clearance<br>Intake             | 0.015 - 0.045<br>(0.0006 - 0.0018)   | 0.15 (0.0059)  |
| Exhaust                                       | 0.04 - 0.07<br>(0.0016 - 0.0028)     | 0.20 (0.0079)  |
| Valve deflection limit                        | 0.15 (0.0059)                        |                |

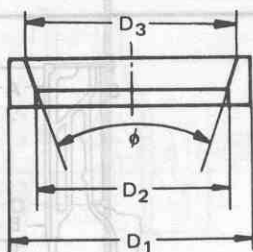
## Valve stem hole (Cylinder head) (SD22 and SD33)

Unit: mm (in)

| Valve stem hole inner<br>diameter     | 8.000 - 8.015<br>(0.3150 - 0.3156) |                |
|---------------------------------------|------------------------------------|----------------|
|                                       | Standard                           | Max. tolerance |
| Stem to stem hole clearance<br>Intake | 0.015 - 0.045<br>(0.0006 - 0.0018) | 0.15 (0.0059)  |
| Exhaust                               | 0.04 - 0.07<br>(0.0016 - 0.0028)   | 0.20 (0.0079)  |
| Valve deflection limit                | 0.15 (0.0059)                      |                |

# SERVICE DATA AND SPECIFICATIONS

## Valve seat



EM733

Unit mm (in)

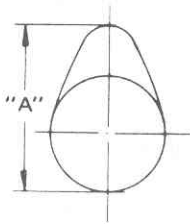
|                                   | SD22 and SD33                        |                                      |                                      | SD23 and SD25                        |                                      |                                      |
|-----------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
|                                   | Standard                             | Service                              |                                      | Standard                             | Service                              |                                      |
| <b>Intake</b>                     |                                      |                                      |                                      |                                      |                                      |                                      |
| Outer diameter "D1"               | 39.035 - 39.045<br>(1.5368 - 1.5372) | —                                    |                                      | 41.035 - 41.045<br>(1.6155 - 1.6159) | —                                    |                                      |
| Inner diameter "D2"               | 32.9 - 33.1<br>(1.295 - 1.303)       | —                                    |                                      | 34.9 - 35.1<br>(1.374 - 1.382)       | —                                    |                                      |
| Diameter of seat "D3"             | 36.95 - 37.05<br>(1.4547 - 1.4587)   | —                                    |                                      | 38.95 - 39.05<br>(1.5335 - 1.5374)   | —                                    |                                      |
| Valve seat face angle "φ"         | 89° - 90°                            | —                                    |                                      | 89° - 90°                            | —                                    |                                      |
| <b>Exhaust</b>                    |                                      |                                      |                                      |                                      |                                      |                                      |
| Outer diameter "D1"               | 35.035 - 35.045<br>(1.3793 - 1.3797) | 35.235 - 35.245<br>(1.3872 - 1.3876) | 35.435 - 35.445<br>(1.3951 - 1.3955) | 37.035 - 37.045<br>(1.4581 - 1.4585) | 37.235 - 37.245<br>(1.4659 - 1.4663) | 37.435 - 37.445<br>(1.4738 - 1.4742) |
| Inner diameter "D2"               | 28.4 - 28.6<br>(1.118 - 1.126)       | 28.4 - 28.6<br>(1.118 - 1.126)       | 28.4 - 28.6<br>(1.118 - 1.126)       | 30.4 - 30.6<br>(1.197 - 1.205)       |                                      |                                      |
| Diameter of seat "D3"             | 30.95 - 31.05<br>(1.2185 - 1.2224)   | 30.95 - 31.05<br>(1.2185 - 1.2224)   | 30.95 - 31.05<br>(1.2185 - 1.2224)   | 32.950 - 33.050<br>(1.2972 - 1.3012) |                                      |                                      |
| Cylinder head valve seat diameter | 34.995 - 35.01<br>(1.3778 - 1.3783)  | 35.195 - 35.21<br>(1.3856 - 1.3862)  | 35.395 - 35.41<br>(1.3935 - 1.3941)  | 36.995 - 37.010<br>(1.4565 - 1.4571) | —                                    | —                                    |
| Valve seat face angle "φ"         | 89° - 90°                            | —                                    |                                      | 89° - 90°                            |                                      |                                      |

# SERVICE DATA AND SPECIFICATIONS

## CAMSHAFT AND CAMSHAFT BUSHING

Unit: mm (in)

|                                                          | Standard                             | Limit         |
|----------------------------------------------------------|--------------------------------------|---------------|
| Camshaft journal to bushing clearance<br>[Oil clearance] |                                      |               |
| Front                                                    | 0.024 - 0.102<br>(0.0009 - 0.0040)   | 0.15 (0.0059) |
| Center                                                   | 0.037 - 0.115<br>(0.0015 - 0.0045)   |               |
| Rear                                                     | 0.024 - 0.102<br>(0.0009 - 0.0040)   |               |
| Camshaft journal diameter                                |                                      |               |
| Front                                                    | 45.434 - 45.447<br>(1.7887 - 1.7892) | —             |
| Center                                                   | 43.897 - 43.910<br>(1.7282 - 1.7287) | —             |
| Rear                                                     | 41.218 - 41.231<br>(1.6228 - 1.6233) | —             |
| Camshaft bend (Total indicator reading)                  | Less than 0.03<br>(0.0012)           | 0.06 (0.0024) |
| Camshaft end play                                        | 0.08 - 0.28<br>(0.0031 - 0.0110)     | 0.50 (0.0197) |

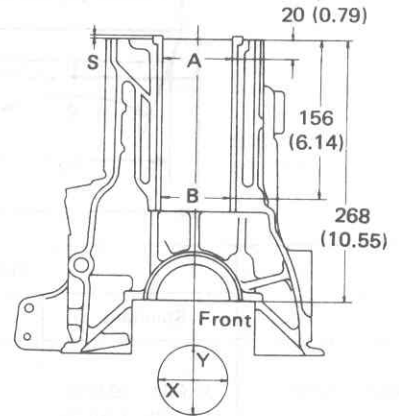


EM671

|                  |                                    |
|------------------|------------------------------------|
| Cam height "A"   | 37.28 - 37.32<br>(1.4677 - 1.4693) |
| Cam height limit | 36.8 (1.449)                       |

## CYLINDER BLOCK AND CYLINDER LINER

Unit: mm (in)

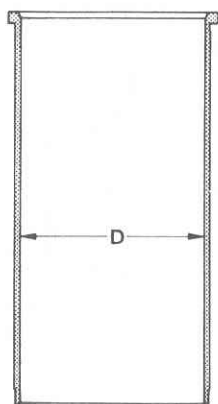


SEM251

|                                                          | Standard                                                                                                 | Wear limit  |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------|
| Surface flatness<br>(Without cylinder liner)             | Less than 0.10<br>(0.0039)<br>(Shaft direction)<br>Less than 0.02<br>(0.0008)<br>(Right angle direction) | 0.3 (0.012) |
| Cylinder bore<br>(With cylinder liner)<br>Inner diameter |                                                                                                          |             |
| SD22 and SD33                                            | 82.985 - 83.020<br>(3.2671 - 3.2685)                                                                     | 0.3 (0.012) |
| SD23 and SD25                                            | 89.000 - 89.030<br>(3.5039 - 3.5051)                                                                     |             |
| Out-of-round (X-Y)                                       | Less than 0.02<br>(0.0008)                                                                               | —           |
| Taper (A-B)                                              | Less than 0.02<br>(0.0008)                                                                               | —           |
| Projection "S"                                           | 0.02 - 0.09<br>(0.0008 - 0.0035)                                                                         | —           |
| Division of each cylinder "S"                            | Less than 0.05<br>(0.0020)                                                                               | —           |
| Piston to cylinder liner clearance                       |                                                                                                          |             |
| SD22 and SD33                                            | 0.04 - 0.11 (0.0016 - 0.0043)                                                                            |             |
| SD23 and SD25                                            | 0.09 - 0.115 (0.0035 - 0.0045)                                                                           |             |
| Interference fit cylinder liner to block                 |                                                                                                          |             |
| SD22 and SD33                                            | 0.01 - 0.03 (0.0004 - 0.0012)                                                                            |             |
| SD23 and SD25                                            | 0.02 - 0.09 (0.0008 - 0.0035)                                                                            |             |



Unit: mm (in)



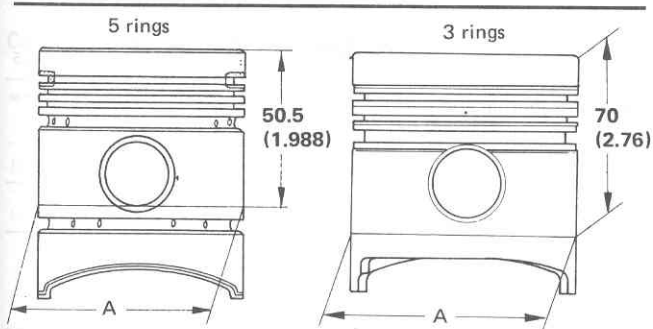
SEM427

|                                   | Standard                             | Service                              |
|-----------------------------------|--------------------------------------|--------------------------------------|
| Cylinder liner inner diameter "D" |                                      |                                      |
| SD22 and SD33                     | 82.995 - 83.025<br>(3.2675 - 3.2687) | 83.03 - 83.05<br>(3.2689 - 3.2697)   |
| SD23 and SD25                     | 89.000 - 89.035<br>(3.5039 - 3.5053) | 89.050 - 89.070<br>(3.5059 - 3.5067) |

## PISTON, PISTON RING AND PISTON PIN

### Piston

Unit: mm (in)



SEM105A

SEM778A

|                           | SD22 and SD33                        | SD23 and SD25                        |
|---------------------------|--------------------------------------|--------------------------------------|
| Piston skirt diameter "A" |                                      |                                      |
| 3 rings                   | 82.905 - 82.945<br>(3.2640 - 3.2655) | 88.895 - 88.935<br>(3.4998 - 3.5014) |
| 5 rings                   | 82.845 - 82.885<br>(3.2616 - 3.2632) | —                                    |
| Piston pin hole diameter  | 25.99 - 26.00 (1.0232 - 1.0236)      |                                      |

### Piston ring

Unit: mm (in)

|                | Standard                         |                                  | Limit            |                  |
|----------------|----------------------------------|----------------------------------|------------------|------------------|
|                | 5 rings                          | 3 rings                          | 5 rings          | 3 rings          |
| Side clearance |                                  |                                  |                  |                  |
| No. 1          | 0.06 - 0.10<br>(0.0024 - 0.0039) |                                  | 0.5 (0.020)      |                  |
| No. 2          | 0.04 - 0.08<br>(0.0016 - 0.0031) |                                  | 0.3 (0.012)      |                  |
| No. 3          | 0.04 - 0.08<br>(0.0016 - 0.0031) | 0.02 - 0.06<br>(0.0008 - 0.0024) | 0.3<br>(0.012)   | 0.15<br>(0.0059) |
| No. 4          | 0.02 - 0.06<br>(0.0008 - 0.0024) | —                                | 0.15<br>(0.0059) | —                |
| No. 5          |                                  |                                  | 0.15<br>(0.0059) | —                |
| Ring gap       |                                  |                                  |                  |                  |
| No. 1          | 0.30 - 0.45<br>(0.0118 - 0.0177) |                                  | 1.5 (0.059)      |                  |
| No. 2          | 0.20 - 0.35<br>(0.0079 - 0.0138) |                                  |                  |                  |
| No. 3          | 0.20 - 0.35<br>(0.0079 - 0.0138) | 0.15 - 0.30<br>(0.0059 - 0.0118) |                  |                  |
| No. 4 & No. 5  | 0.15 - 0.30<br>(0.0059 - 0.0118) | —                                |                  |                  |

### Piston pin

Unit: mm (in)

|                                          | SD22 and SD33                        | SD23 and SD25                        |
|------------------------------------------|--------------------------------------|--------------------------------------|
| Piston pin outer diameter                | 25.993 - 26.000<br>(1.0233 - 1.0236) |                                      |
| Interference fit of piston pin to piston | 0 - 0.003<br>(0 - 0.0001)            | −0.007 - 0.010<br>(−0.0003 - 0.0004) |
| Piston pin to connecting rod clearance   | 0.025 - 0.045<br>(0.0010 - 0.0018)   |                                      |

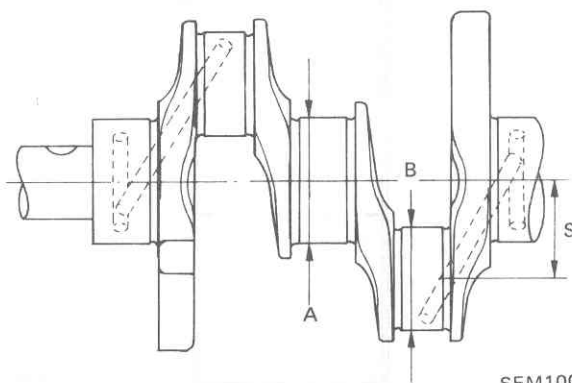
## CONNECTING ROD

Unit: mm (in)

|                                                                 |                                      |
|-----------------------------------------------------------------|--------------------------------------|
| Center distance<br>SD22, SD25 and SD33                          | 170.0 (6.69)                         |
| SD23                                                            | 174.2 (6.86)                         |
| Connecting rod bend or torsion<br>[Per 100 mm (3.94 in) length] |                                      |
| Standard                                                        | 0 - 0.05 (0 - 0.0020)                |
| Limit                                                           | 0.05 (0.0020)                        |
| Piston pin bore diameter                                        | 26.025 - 26.038<br>(1.0246 - 1.0251) |
| Big end play                                                    |                                      |
| Standard                                                        | 0.1 - 0.2 (0.004 - 0.008)            |
| Limit                                                           | 0.2 (0.008)                          |

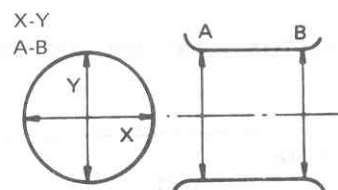
## CRANKSHAFT

Unit: mm (in)



|                      |                                      |
|----------------------|--------------------------------------|
| Journal diameter "A" | 70.907 - 70.920<br>(2.7916 - 2.7921) |
| Pin diameter "B"     | 52.913 - 52.926<br>(2.0832 - 2.0837) |
| "S"                  |                                      |
| SD22, SD25 and SD33  | 50.00 (1.9685)                       |
| SD23                 | 46.00 (1.8110)                       |

Out-of-round  
Taper



|                                          |                               |
|------------------------------------------|-------------------------------|
| Taper of journal and pin<br>"A-B"        |                               |
| Standard                                 | 0.01 (0.0004)                 |
| Limit                                    | 0.02 (0.0008)                 |
| Out-of-round of journal and<br>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                                 | 0.06 - 0.14 (0.0024 - 0.0055) |
| Limit                                    | 0.40 (0.0157)                 |

## SERVICE DATA AND SPECIFICATIONS

### BEARING

#### Bearing clearance

Unit: mm (in)

|                                  | Standard                           | Limit         |
|----------------------------------|------------------------------------|---------------|
| Main bearing clearance           | 0.035 - 0.093<br>(0.0014 - 0.0037) | 0.15 (0.0059) |
| 3 or 4 bearings                  |                                    |               |
| 5 bearings                       | 0.035 - 0.087<br>(0.0014 - 0.0034) |               |
| Connecting rod bearing clearance | 0.035 - 0.081<br>(0.0014 - 0.0032) | 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) |

#### Connecting rod bearing undersize

Unit: mm (in)

|               | Crank pin diameter                |
|---------------|-----------------------------------|
| Standard      | 52.913 - 52.926 (2.0832 - 2.0837) |
| Undersize     |                                   |
| 0.25 (0.0098) | 52.663 - 52.676 (2.0733 - 2.0739) |
| 0.50 (0.0197) | 52.413 - 52.426 (2.0635 - 2.0640) |
| 0.75 (0.0295) | 52.163 - 52.176 (2.0537 - 2.0542) |
| 1.00 (0.0394) | 51.913 - 51.926 (2.0438 - 2.0443) |

### MISCELLANEOUS COMPONENTS

Unit: mm (in)

|                                  |                   |
|----------------------------------|-------------------|
| Gear train                       | 0.07 - 0.20       |
| Backlash of each gear            | (0.0028 - 0.0079) |
| Flywheel                         | Less than         |
| Runout (Total indicator reading) | 0.15 (0.0059)     |

### TIGHTENING TORQUE

#### Engine outer parts

|                                           | N·m     | kg·m      | ft·lb     |
|-------------------------------------------|---------|-----------|-----------|
| Water outlet bolt                         | 10 - 13 | 1.0 - 1.3 | 7 - 9     |
| Water pump bolt                           |         |           |           |
| M8                                        | 10 - 13 | 1.0 - 1.3 | 7 - 9     |
| M10                                       | 20 - 25 | 2.0 - 2.5 | 14 - 18   |
| Manifold bolt and nut                     | 15 - 18 | 1.5 - 1.8 | 11 - 13   |
| Injection pump nut (In-line)              | 20 - 25 | 2.0 - 2.5 | 14 - 18   |
| Injection pump (VE type) nut              | 20 - 25 | 2.0 - 2.5 | 14 - 18   |
| bolt                                      | 16 - 22 | 1.6 - 2.2 | 12 - 16   |
| Injection pump (C.A.V.-D.P.A.)            | 15 - 20 | 1.5 - 2.0 | 11 - 14   |
| Injection nozzle to cylinder head         | *1      | 59 - 69   | 6.0 - 7.0 |
|                                           | *2      | 69 - 78   | 7.0 - 8.0 |
| Oil cooler bolt                           | 10 - 13 | 1.0 - 1.3 | 7 - 9     |
| Oil cooler pipe nut                       | 10 - 13 | 1.0 - 1.3 | 7 - 9     |
| Timing gear cover bolt                    | 10 - 13 | 1.0 - 1.3 | 7 - 9     |
| Injection pump timer nut                  | 59 - 69 | 6 - 7     | 43 - 51   |
| Injection pump drive gear nut (VE type)   | 59 - 69 | 6.0 - 7.0 | 43 - 51   |
| Injection pump drive gear (C.A.V.-D.P.A.) | 15 - 20 | 1.5 - 2.0 | 11 - 14   |
| Feed pump gear (C.A.V.-D.P.A.)            | 15 - 20 | 1.5 - 2.0 | 11 - 14   |
| Injection tube flare nut                  | 29 - 34 | 3.0 - 3.5 | 22 - 25   |
| Spill tube with cap nut                   | 39 - 49 | 4 - 5     | 29 - 36   |
| Oil filter bracket bolt                   | 26 - 36 | 2.7 - 3.7 | 20 - 27   |
| Alternator bracket bolt                   | 26 - 36 | 2.7 - 3.7 | 20 - 27   |
| Alternator to adjusting bar bolt          | 11 - 14 | 1.1 - 1.4 | 8 - 10    |
| Diesel pump controller bolt               | 10 - 13 | 1.0 - 1.3 | 7 - 9     |
| Diesel pump controller bracket bolt       | 45 - 61 | 4.6 - 6.2 | 33 - 45   |
| Thermostat housing                        | 10 - 13 | 1.0 - 1.3 | 7 - 9     |

\*1: Part No. of injection nozzle  
16600-90060, 16600-36W00, 16600-T9000

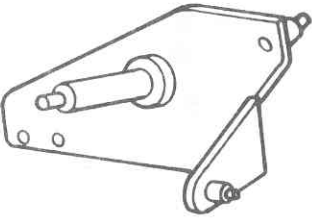
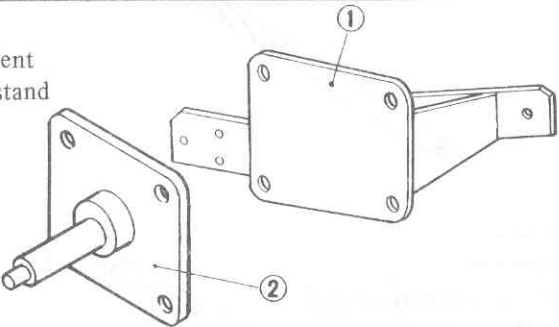
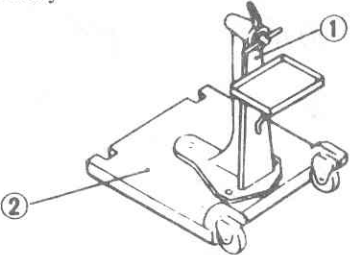
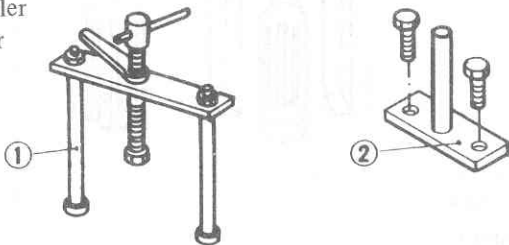
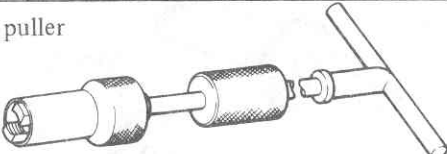
\*2: Part No. of injection nozzle  
16600-37502, 16600-90012, 16600-90019, 16600-J5571,  
16600-T3401, 16600-T3470, 16600-T6200, 16600-T6201,  
16600-Y8400, 16600-Y8401.



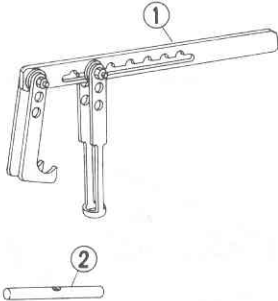
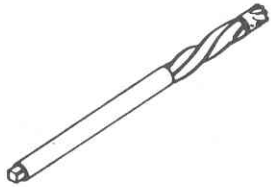
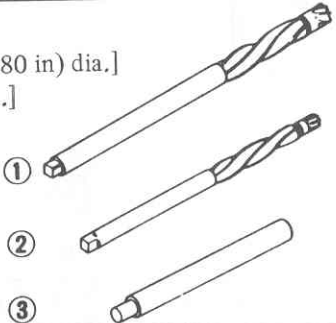
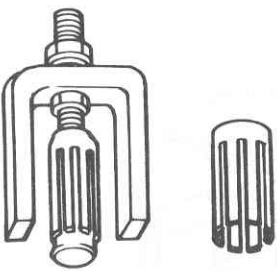
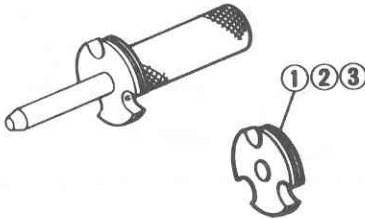
Engine internal parts

|                            |  | N·m       | kg·m        | ft·lb     |
|----------------------------|--|-----------|-------------|-----------|
| Main bearing cap bolt      |  | 167 - 172 | 17.0 - 17.5 | 123 - 127 |
| Crank pulley nut           |  | 294 - 324 | 30 - 33     | 217 - 239 |
| Flywheel bolt              |  |           |             |           |
| 3 bearings & 4 bearings    |  | 44 - 49   | 4.5 - 5.0   | 33 - 36   |
| 5 bearings                 |  | 88 - 98   | 9.0 - 10.0  | 65 - 72   |
| Bolt w/washer              |  | 127 - 147 | 13 - 15     | 94 - 108  |
| Front cover bolt           |  |           |             |           |
| M6                         |  | 4 - 6     | 0.4 - 0.6   | 2.9 - 4.3 |
| M8                         |  | 10 - 13   | 1.0 - 1.3   | 7 - 9     |
| Front end plate bolt       |  | 10 - 13   | 1.0 - 1.3   | 7 - 9     |
| Camshaft gear bolt         |  | 44 - 49   | 4.5 - 5.0   | 33 - 36   |
| Oil pump bolt              |  | 13 - 19   | 1.3 - 1.9   | 9 - 14    |
| Oil pan bolt               |  | 7 - 10    | 0.7 - 1.0   | 5.1 - 7.2 |
| Cylinder head bolt         |  |           |             |           |
| Sub                        |  | 44 - 54   | 4.5 - 5.5   | 33 - 40   |
| Main                       |  | 118 - 127 | 12 - 13     | 87 - 94   |
| Rocker arm shaft bolt      |  | 20 - 25   | 2.0 - 2.5   | 14 - 18   |
| Rocker arm lock nut        |  | 20 - 25   | 2.0 - 2.5   | 14 - 18   |
| Camshaft thrust plate bolt |  | 4 - 6     | 0.4 - 0.6   | 2.9 - 4.3 |
| Connecting rod big end nut |  |           |             |           |
| SD22 and SD33              |  | 51 - 56   | 5.2 - 5.7   | 38 - 41   |
| SD23 and SD25              |  | 67 - 71   | 6.8 - 7.2   | 49 - 52   |
| Rocker cover bolt          |  | 10 - 13   | 1.0 - 1.3   | 7 - 9     |
| Oil jet (for piston)       |  | 29 - 39   | 3 - 4       | 22 - 29   |

## SPECIAL SERVICE TOOLS

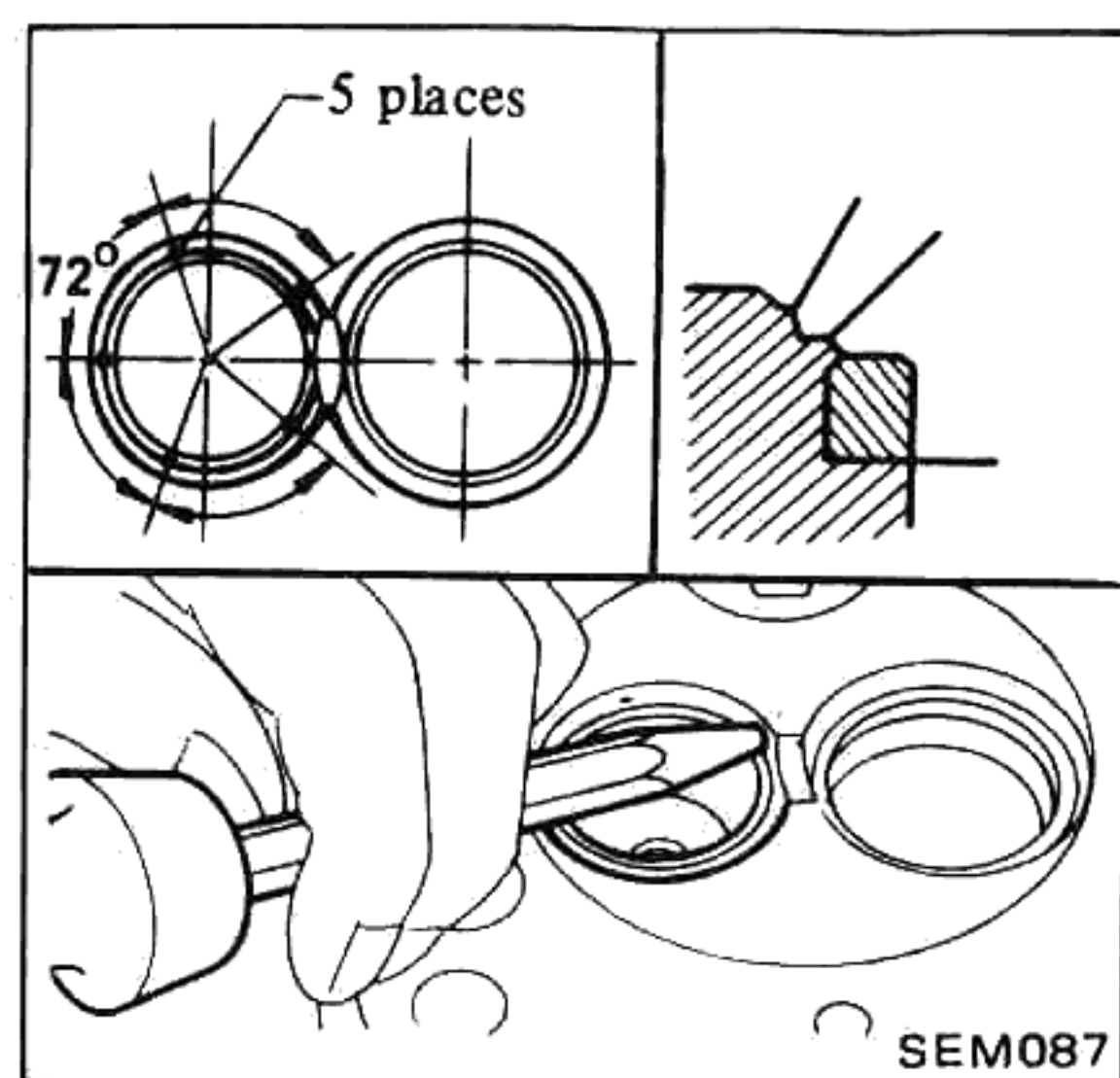
| Tool number                                | Tool name                                                                                                                               | Engine application |      |      |      |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|------|------|
|                                            |                                                                                                                                         | SD22               | SD23 | SD25 | SD33 |
| ST05300000                                 | Engine attachment<br>                                  | X                  | X    | X    | —    |
| ① KV11101800<br>② KV10106500               | Engine attachment<br>Engine stand shaft<br>            | —                  | —    | —    | X    |
| ST0501S000<br>① ST05011000<br>② ST05012000 | Engine stand assembly<br>Engine stand<br>Base<br>    | X                  | X    | X    | X    |
| KV111021S0<br>① ST16660000<br>② KV11101300 | Crankshaft main bearing<br>Cap puller<br>Adapter<br> | X                  | —    | —    | X    |
| KV10107900                                 | Valve lip seal puller<br>                            | X                  | X    | X    | X    |

# SPECIAL SERVICE TOOLS

| Tool number                                                | Tool name                                                                                                                                                                                         | Engine application |      |      |      |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|------|------|
|                                                            |                                                                                                                                                                                                   | SD22               | SD23 | SD25 | SD33 |
| KV101092S0<br>① KV10109210<br>② KV10109220                 | Valve spring compressor<br>Compressor<br>Adapter<br>                                                             | X                  | X    | X    | X    |
| ST1101S000                                                 | Valve guide reamer<br>                                                                                           | X                  | —    | —    | X    |
| KV101039S0<br>① ST11081000<br>② ST11032000<br>③ ST11033000 | Valve guide reamer set<br>Reamer [12.2 mm (0.480 in) dia.]<br>[8.0 mm (0.315 in) dia.]<br>Valve guide drift<br> | —                  | X    | X    | —    |
| KV111011S0<br>① KV11101120<br>② KV11101130                 | Valve seat remover<br>Adapter (Exhaust)<br>Adapter (Intake)<br>                                                | X                  | —    | —    | X    |
| KV111012S0<br>① KV11101220<br>② KV11101230<br>③ KV11101240 | Valve seat insert tool<br>Adapter (Intake)<br>Adapter (Exhaust)<br>Adapter (Exhaust)<br>                       | X                  | —    | —    | X    |

(4) Stake exhaust valve seat at five places with punch.

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



## 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)

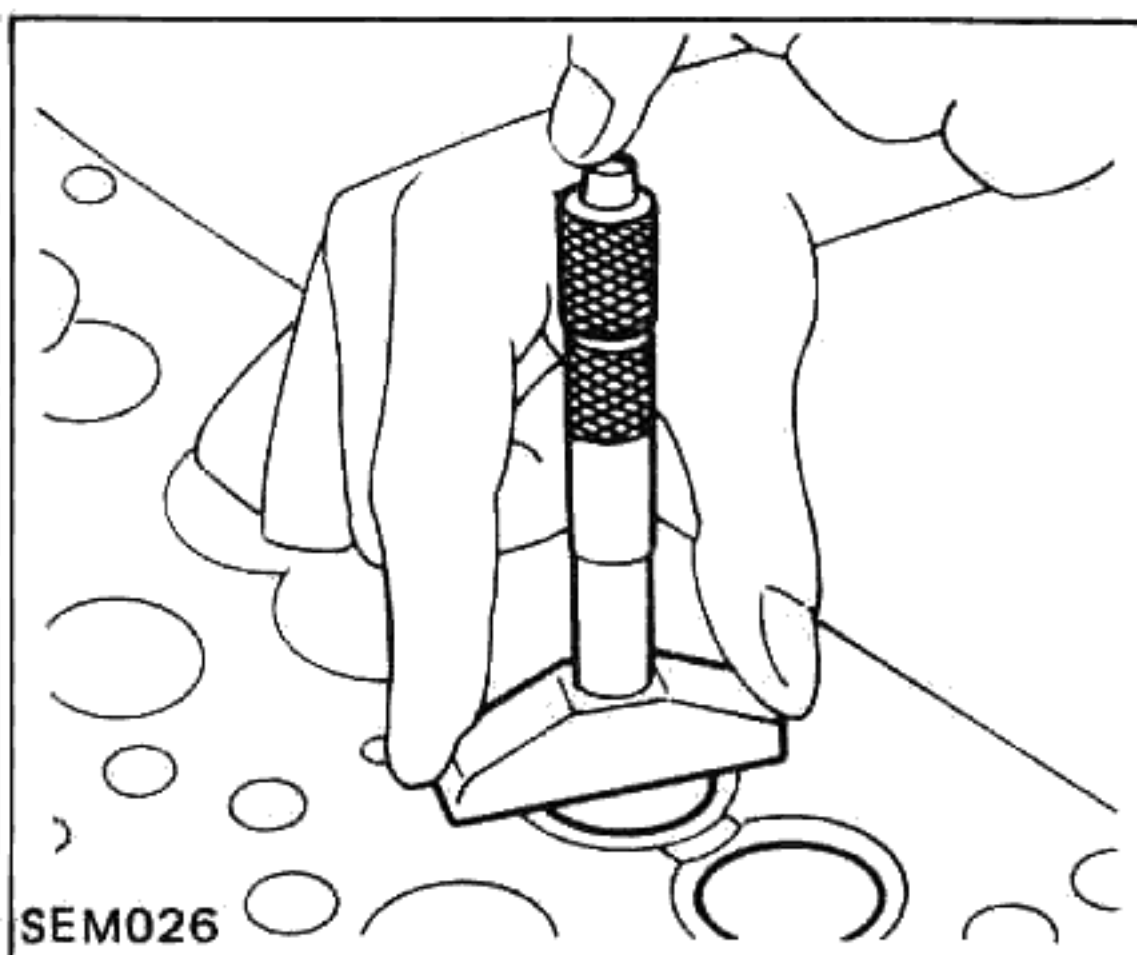
**Exhaust**

0.305 - 0.695 mm  
(0.0120 - 0.0274 in)

**Limit**

**Less than**

1.25 mm (0.0492 in)  
for intake and exhaust valves



## CAMSHAFT AND CAMSHAFT BUSHING

### CAMSHAFT BUSHING CLEARANCE

Measure inside diameter of camshaft bushing with an inside dial gauge and outside diameter of camshaft journal with a micrometer.

**Clearance between camshaft and bushing (A-B):**

**Standard**

**Front**

0.024 - 0.102 mm  
(0.0009 - 0.0040 in)

**Center (SD 4-cylinder),  
Nos. 2 and 3 (SD33)**

0.037 - 0.115 mm  
(0.0015 - 0.0045 in)

**Rear**

0.024 - 0.102 mm  
(0.0009 - 0.0040 in)

**Limit**

**Less than**

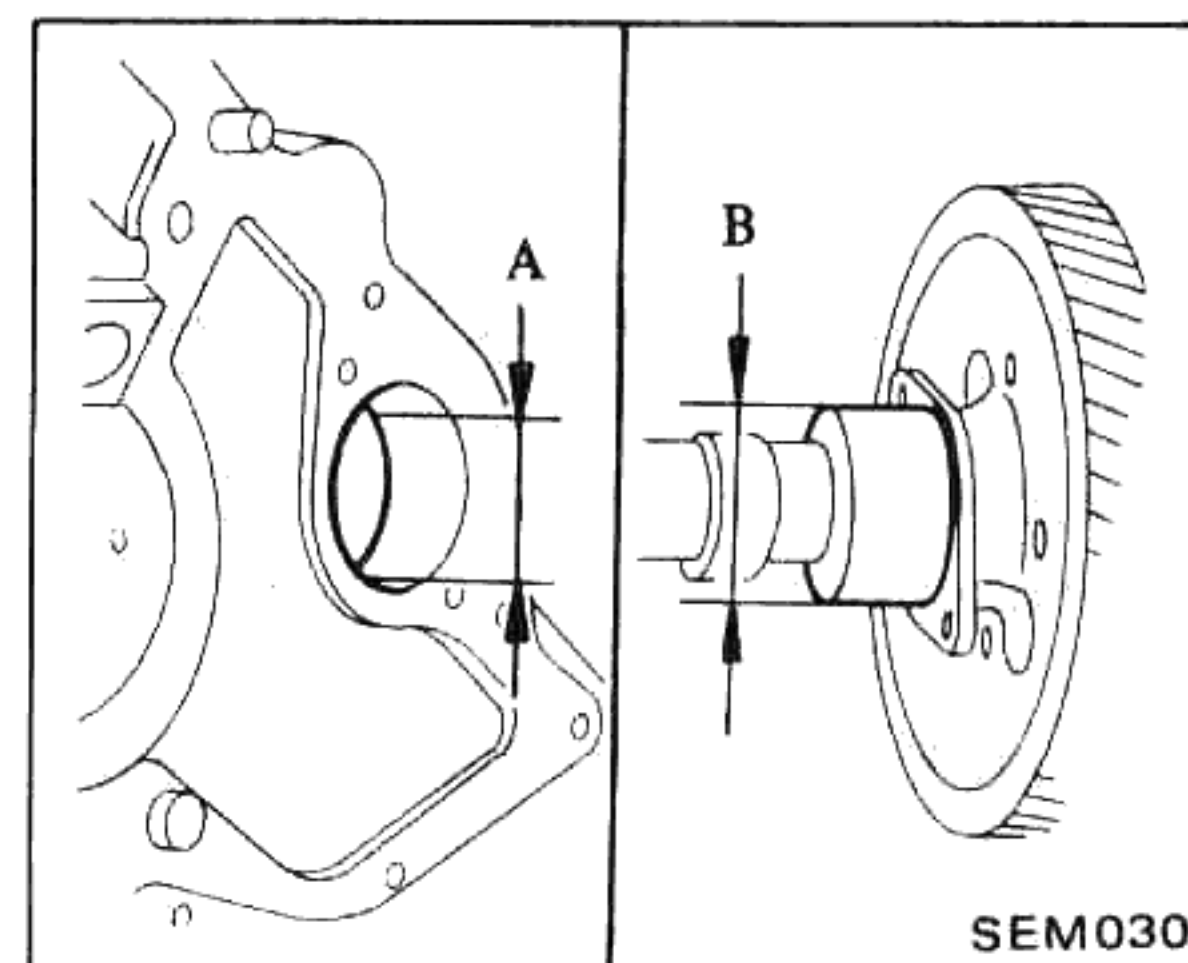
0.15 mm (0.0059 in)

**Camshaft bushing undersize:**

0.25 mm (0.0098 in),

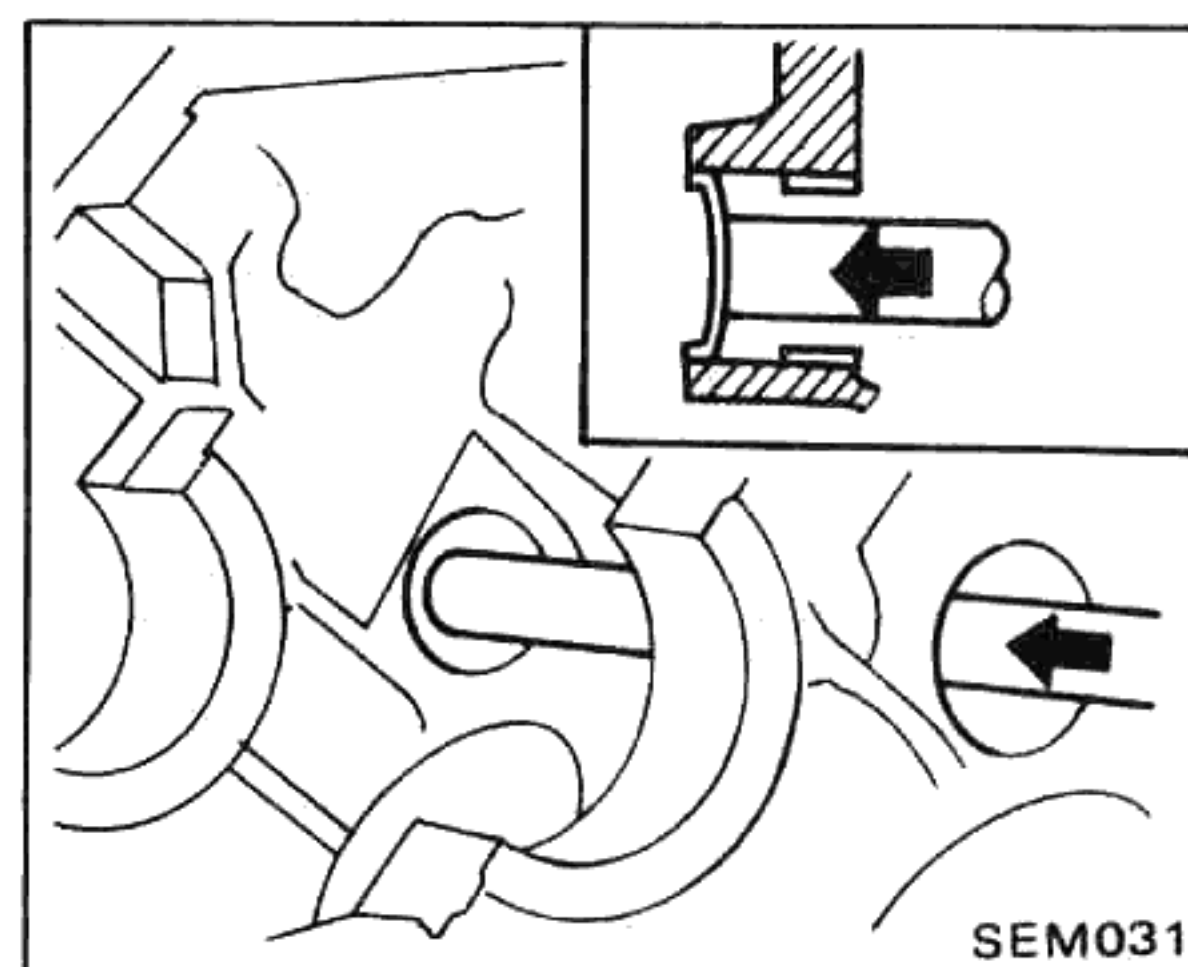
0.50 mm (0.0197 in),

0.75 mm (0.0295 in)



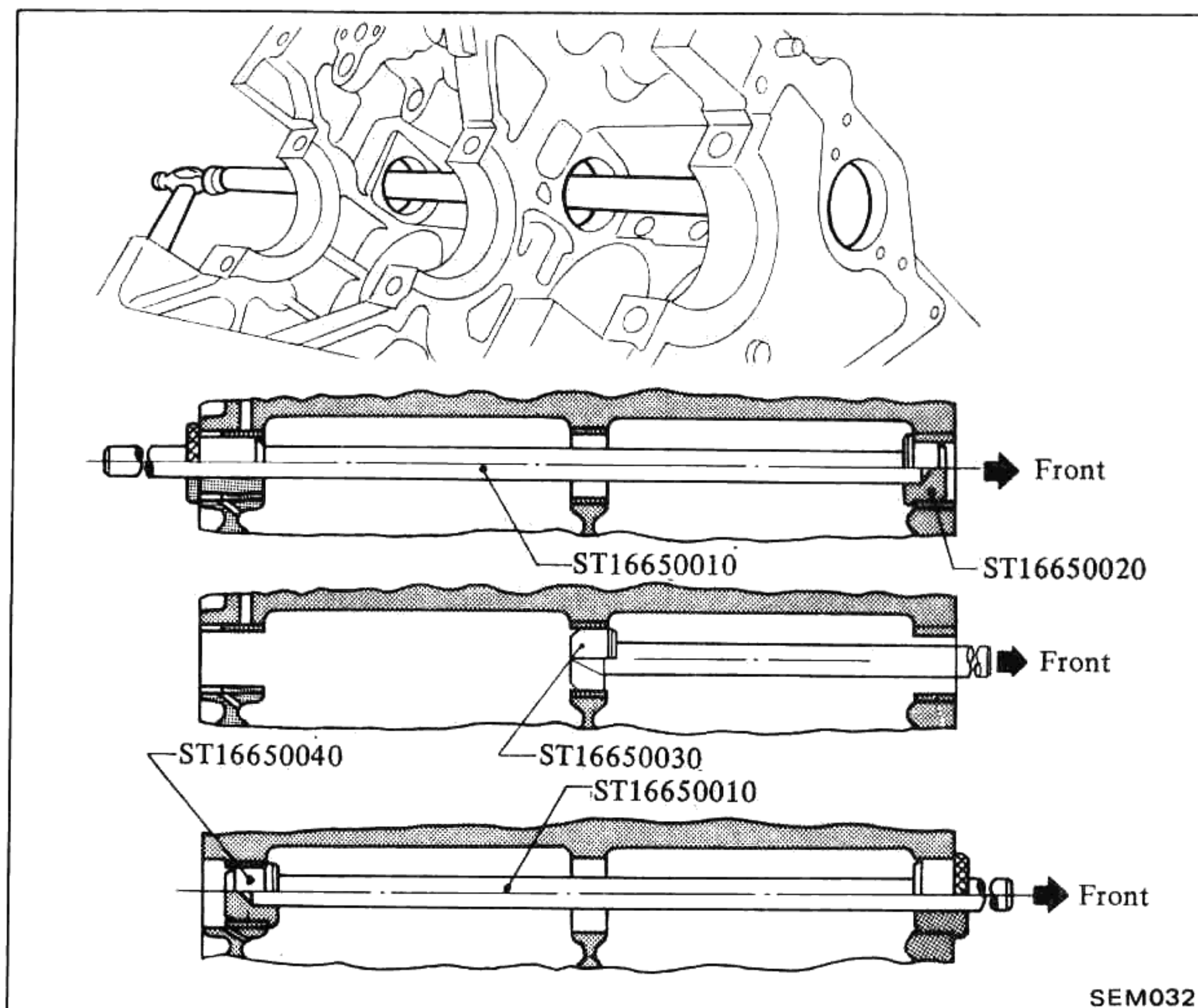
## REPLACING CAMSHAFT BUSHING

1. Remove rear plug.



2. Remove camshaft bushing with Tool.

**Remove bushing from front side of engine.**





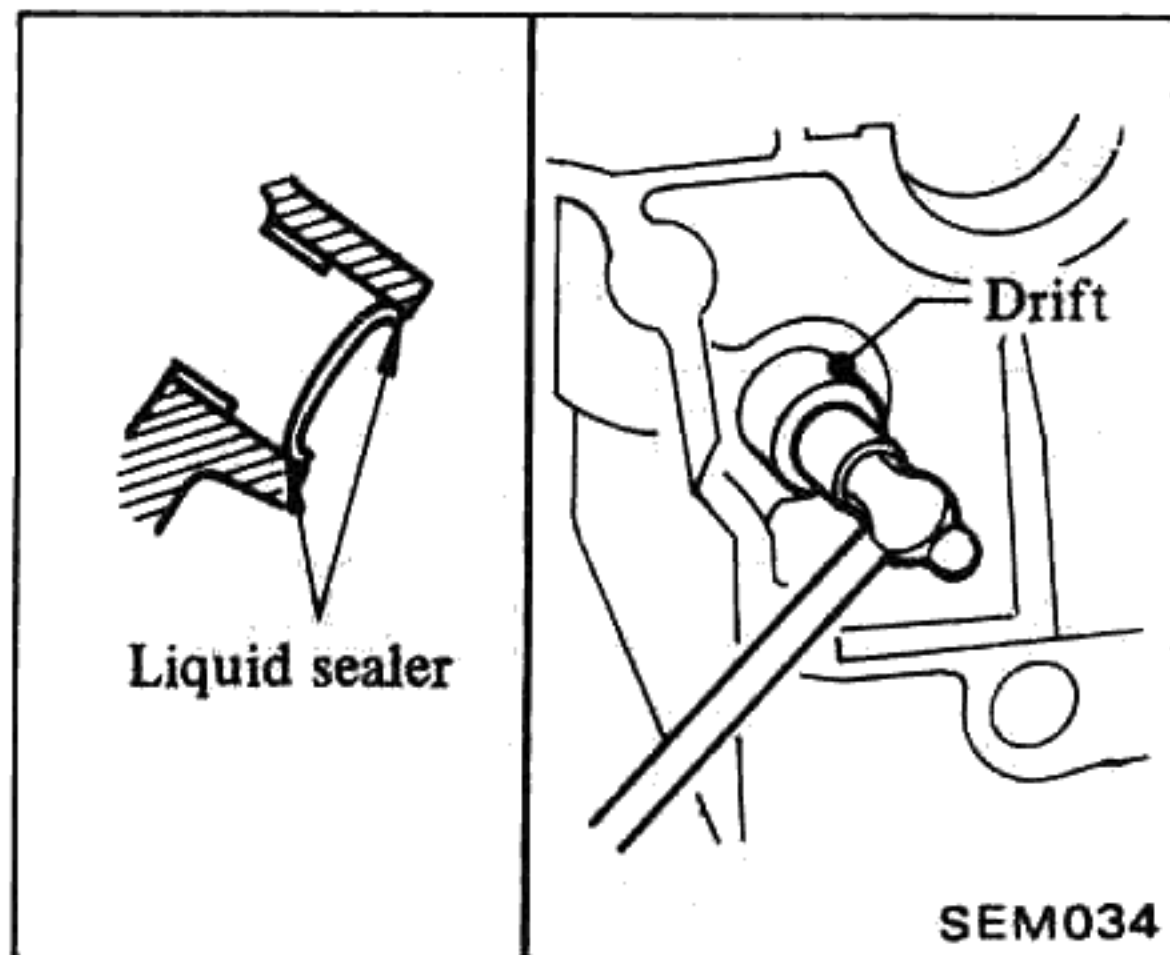
3. Install new bushing with Tool, following in the reverse order of removal.

- Align cylinder block oil passage hole and bushing oil hole.
- Install bushing with beveled end facing front.

4. Check camshaft bushing clearance.

5. Install new rear plug with a drift.

**Apply liquid sealer.**



## 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**

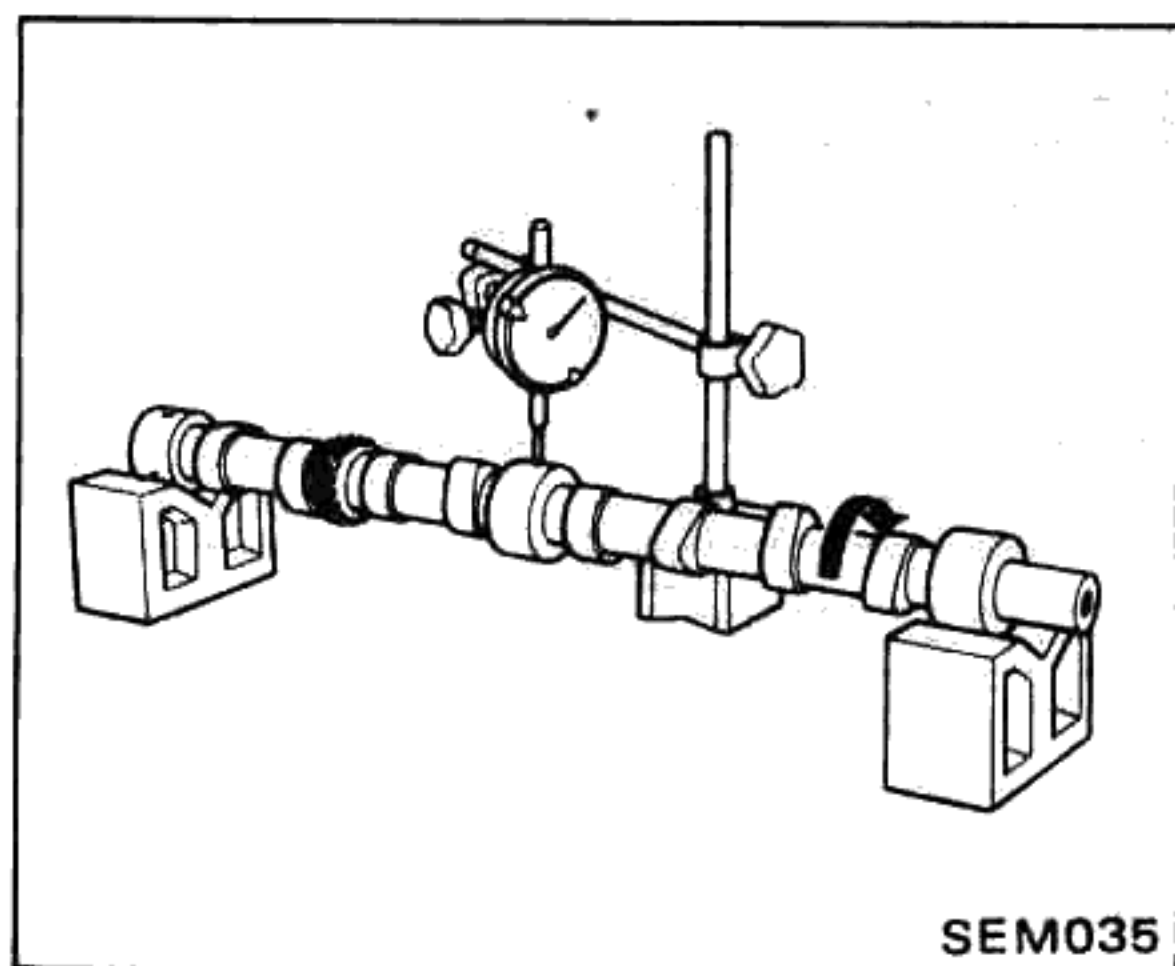
(Total indicator reading):

**Standard**

0 - 0.03 mm (0 - 0.0012 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.

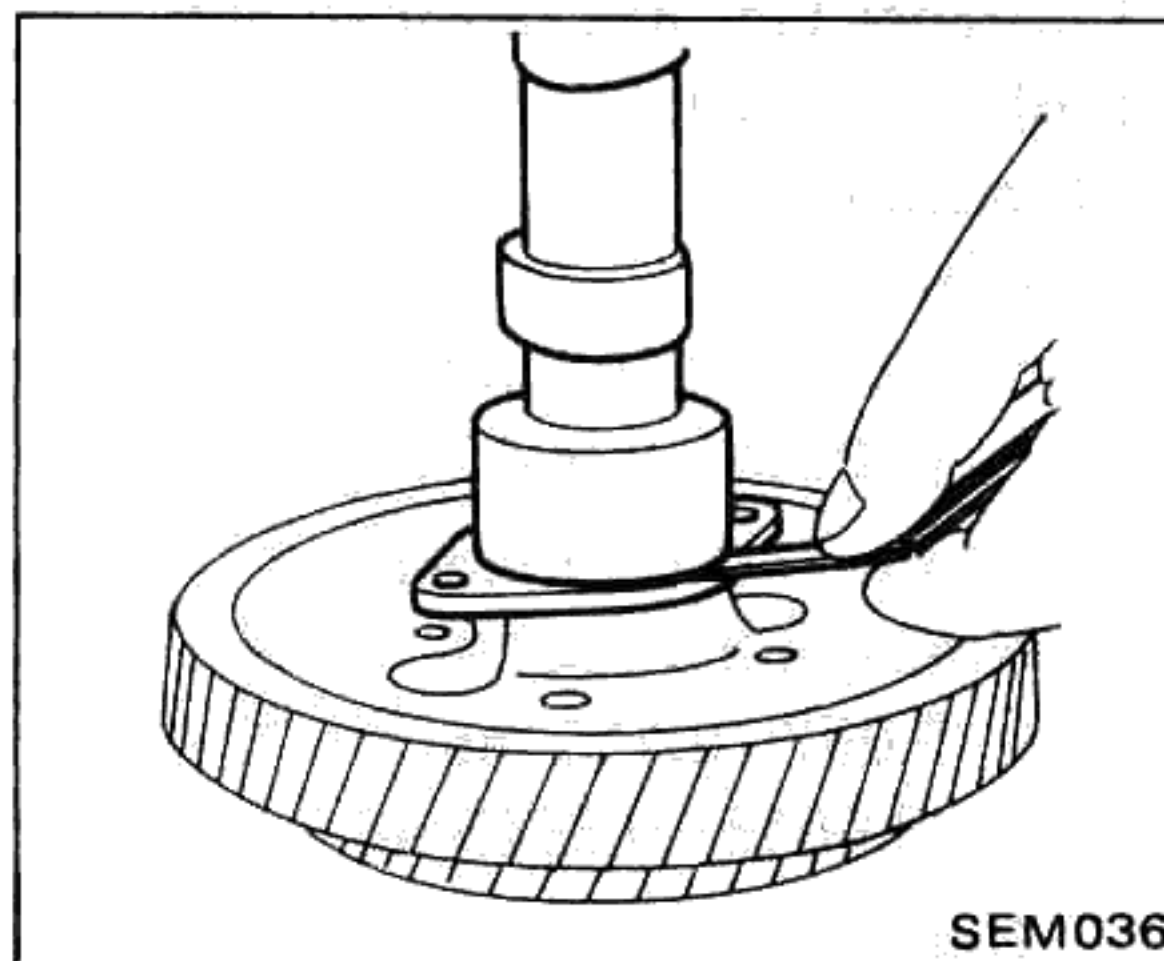
**Camshaft end play:**

**Standard**

0.08 - 0.28 mm  
(0.0031 - 0.0110 in)

**Limit**

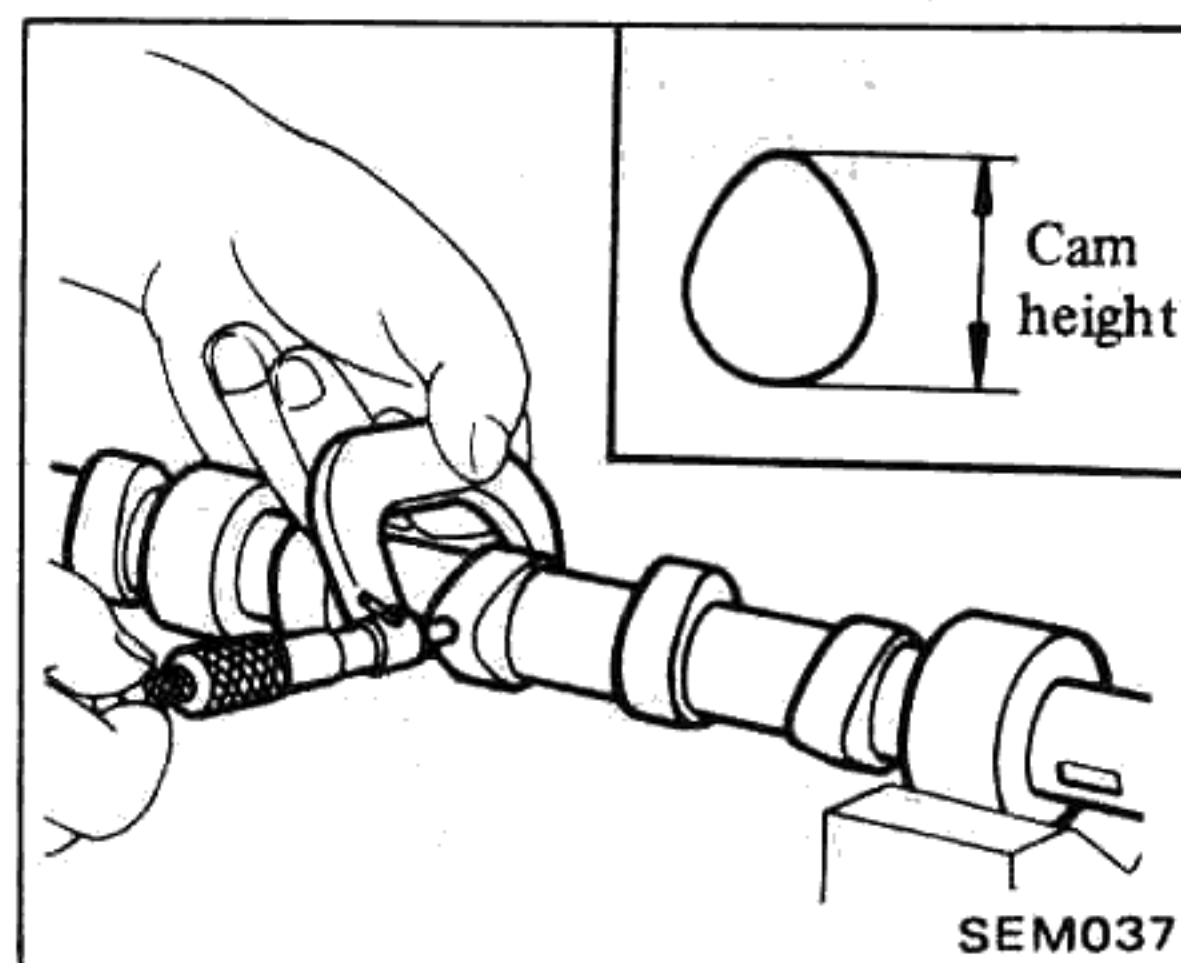
Less than 0.5 mm (0.020 in)



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

**Cam height limit:**

36.8 mm (1.449 in)



## CYLINDER BLOCK

1. Check cylinder block for cracks or flaws.

2. Check cylinder block warpage with cylinder liner removed. If beyond the limit, correct with a surface grinder.

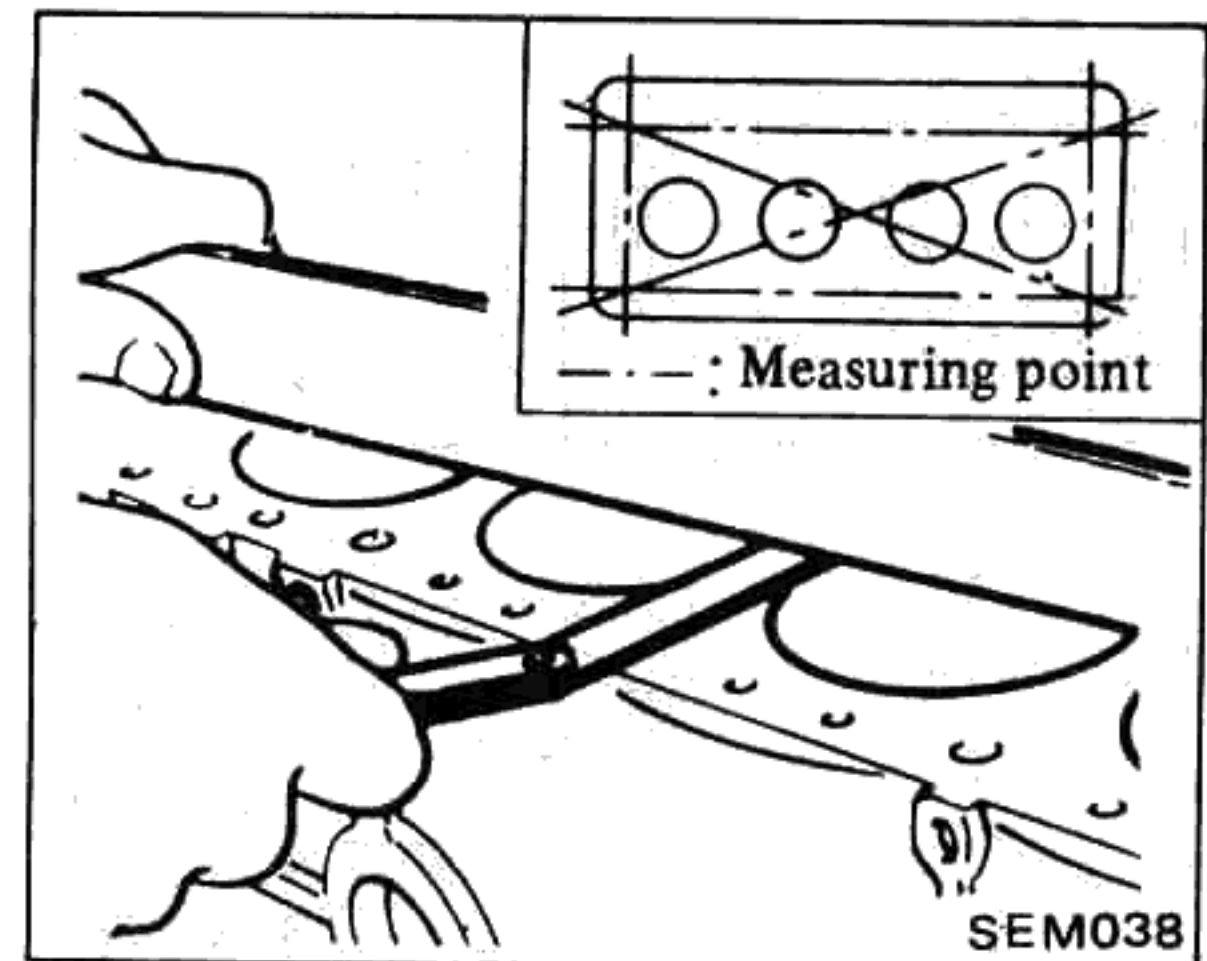
**Warpage of cylinder block surface (Without cylinder liner):**

**Longitudinal**

Less than 0.10 mm (0.0039 in)

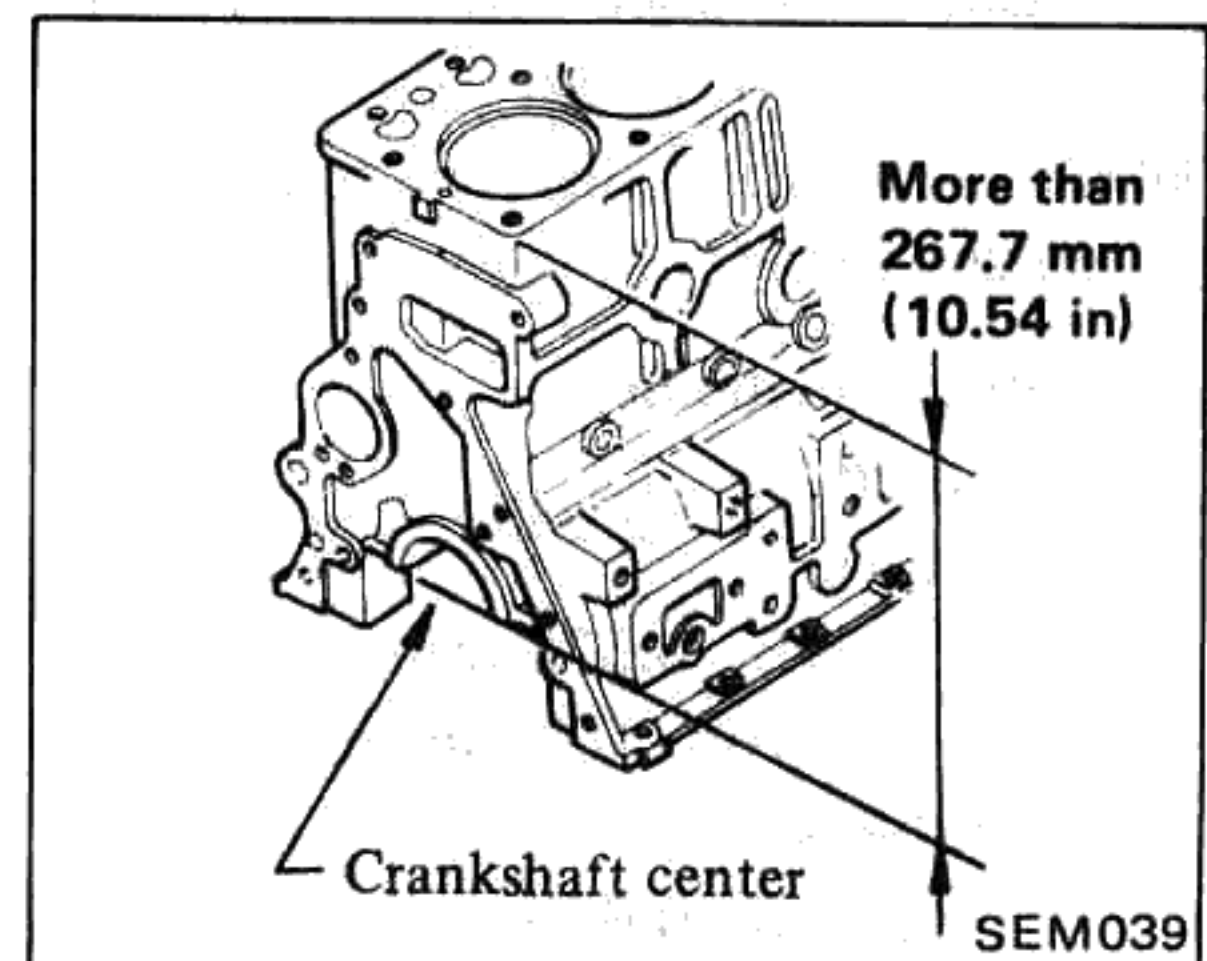
**Transverse direction**

Less than 0.02 mm (0.0008 in)



**Surface grinding limit:**

Height from upper face of cylinder block to crankshaft center-line should be greater than specified limit.



## CYLINDER LINER

1. Check cylinder liner wear by means of bore diameter.

**Cylinder liner bore wear limit:**

Less than 0.3 mm (0.012 in)

**Bore standard:**

**SD22 and SD33**

82.995 - 83.025 mm  
(3.2675 - 3.2687 in)

**SD23 and SD25**

89.000 - 89.035 mm  
(3.5039 - 3.5053 in)

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



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

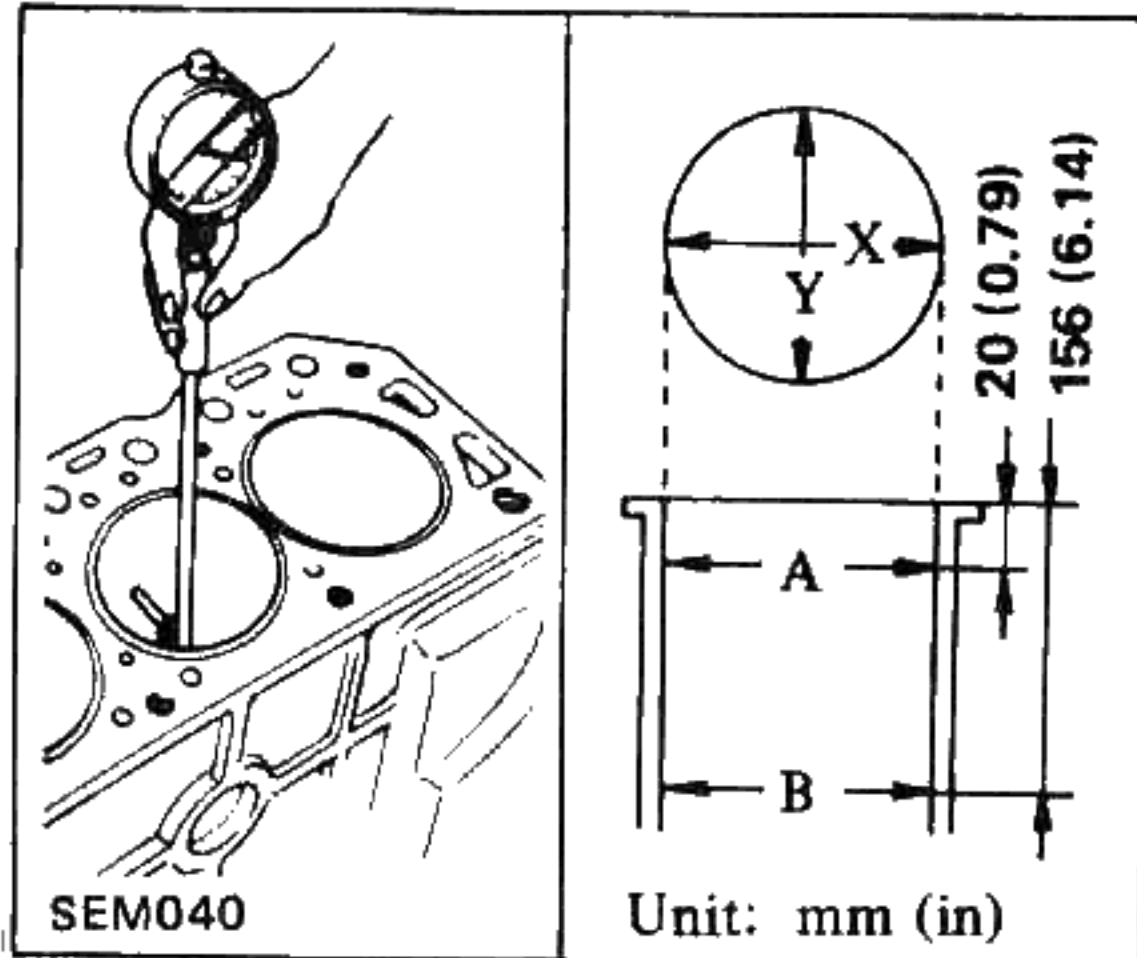
### Standard

0.02 mm (0.0008 in)

## Taper (A-B):

### Standard

0.02 mm (0.0008 in)



## 3. Check amount of projection of cylinder liner.

### Cylinder liner projection:

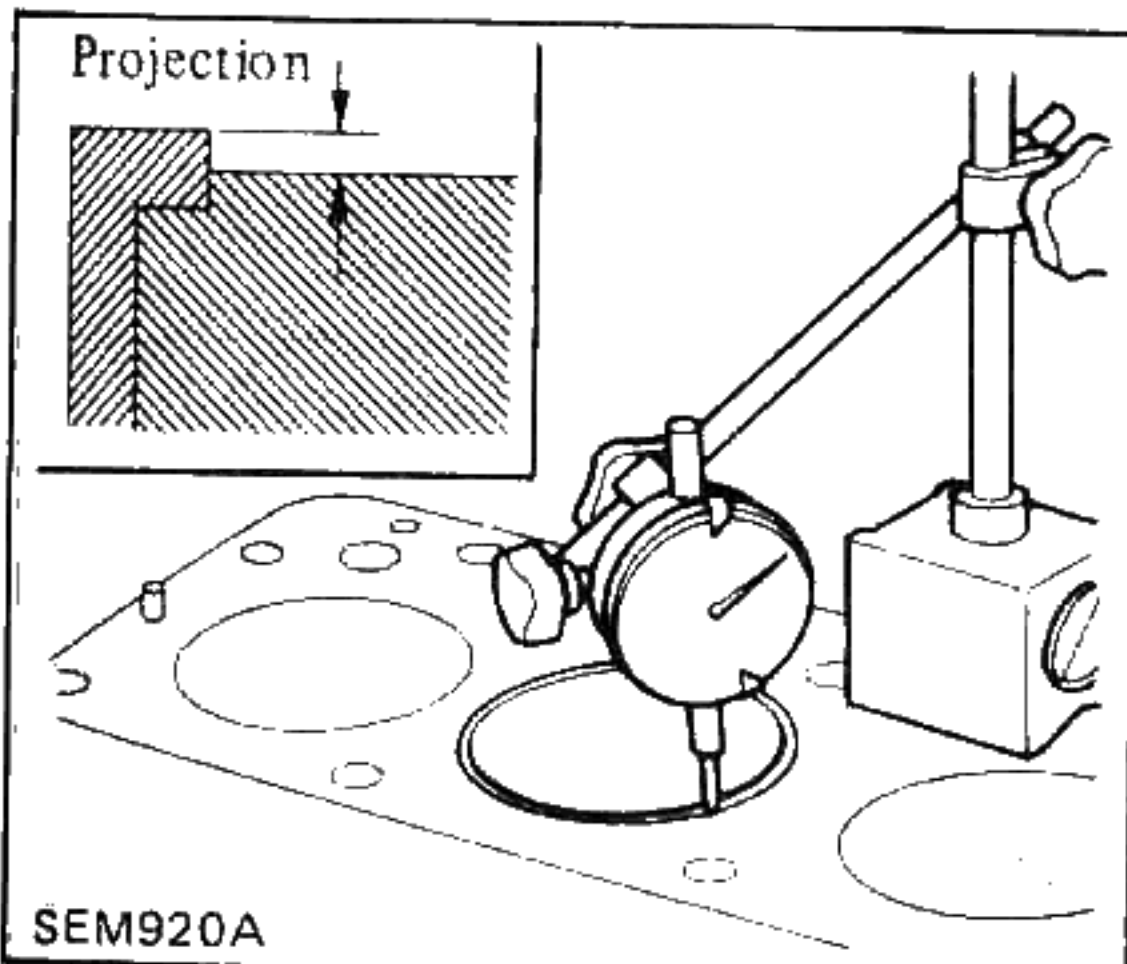
#### Standard

0.02 - 0.09 mm

(0.0008 - 0.0035 in)

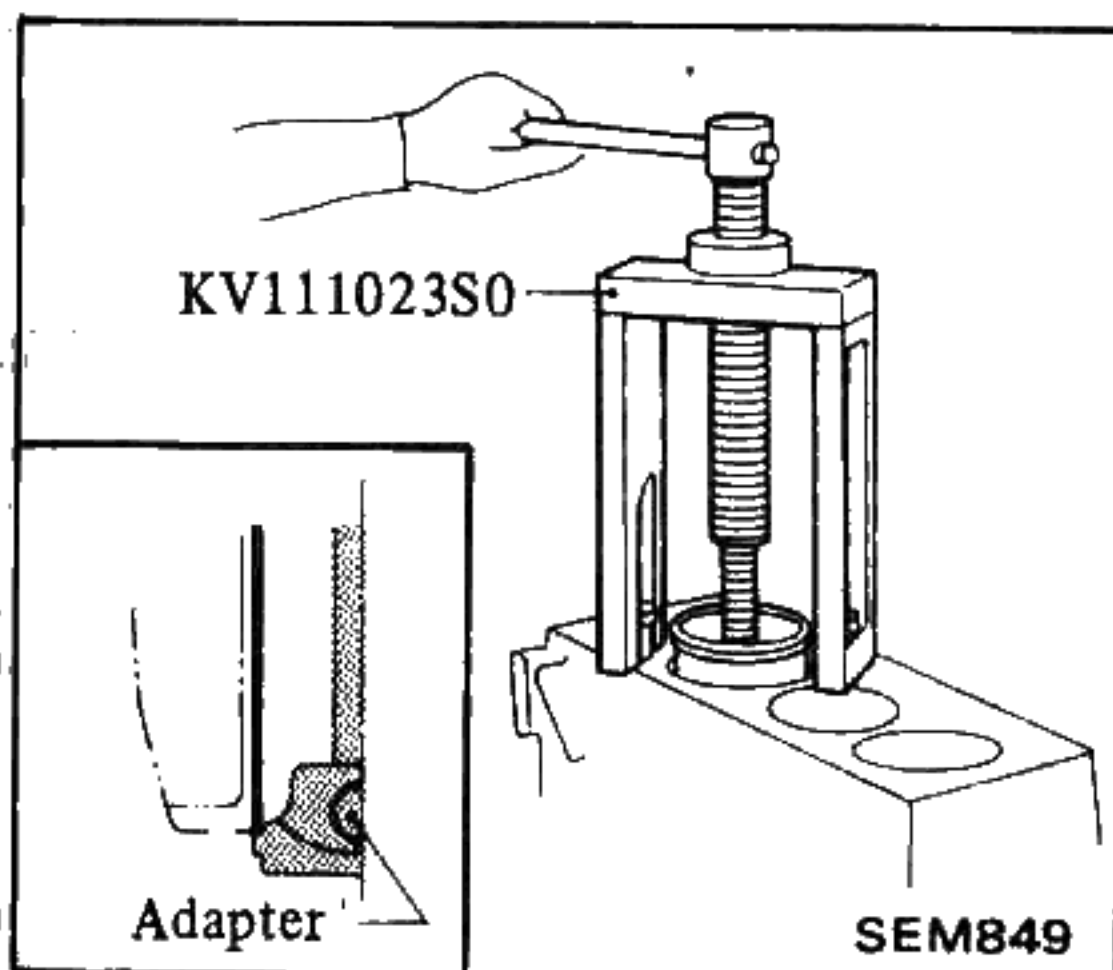
#### Deviation of each cylinder

Less than 0.05 mm (0.0020 in)

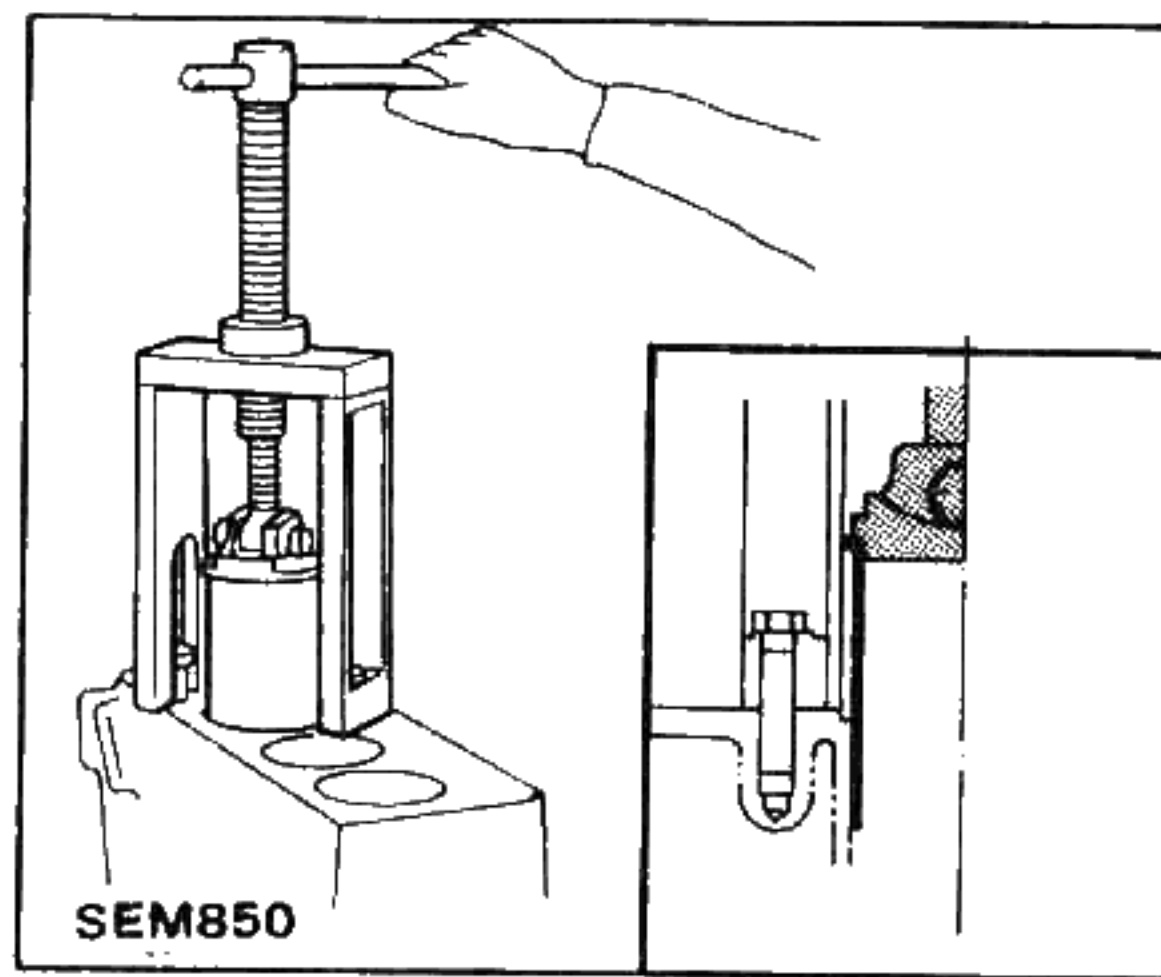


## CYLINDER LINER REPLACEMENT

### 1. Remove cylinder liner with Tool.



### 2. Install cylinder liner with Tool or press stand.



## 3. Check amount of projection of cylinder liner.

## PISTON, PISTON PIN AND PISTON RINGS

### 1. Check for damage, scratches and wear. Replace if such a fault is detected.

### 2. Check piston outside diameter.

#### • 5-ring piston

Measure piston outside diameter at 50.5 mm (1.988 in) from piston head.

If beyond the limit, replace piston.

#### Piston wear limit:

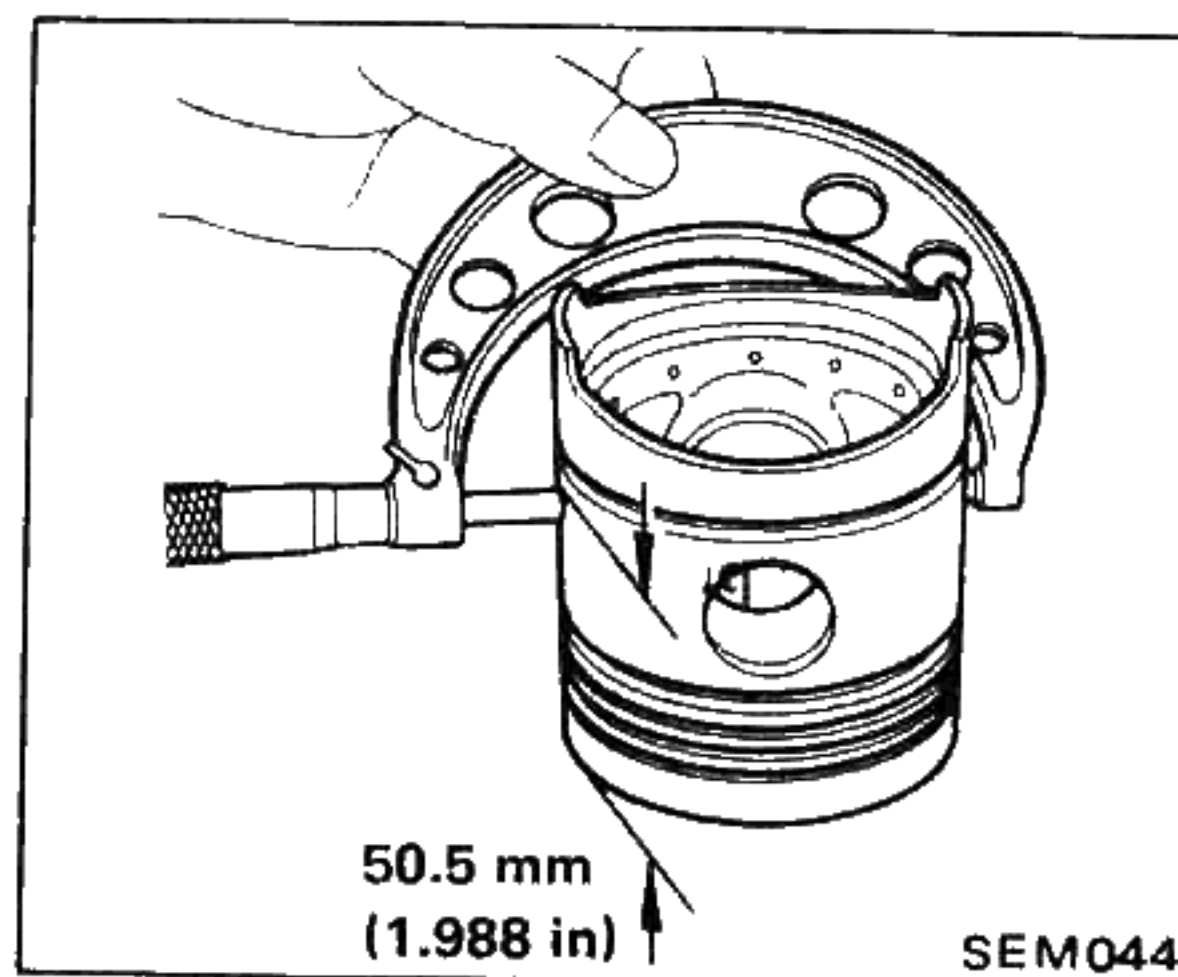
Less than 0.15 mm (0.0059 in)

#### Piston outside diameter:

##### Standard

82.845 - 82.885 mm

(3.2616 - 3.2632 in)



#### • 3-ring piston

Measure piston outside diameter at 70.0 mm (2.756 in) from piston head.

If beyond the limit, replace piston.

#### Piston wear limit:

Less than 0.15 mm (0.0059 in)

#### Piston outside diameter:

##### Standard

SD22 and SD33

##### 3 rings

82.905 - 82.945 mm

(3.4998 - 3.5014 in)

EM-13

#### 5 rings

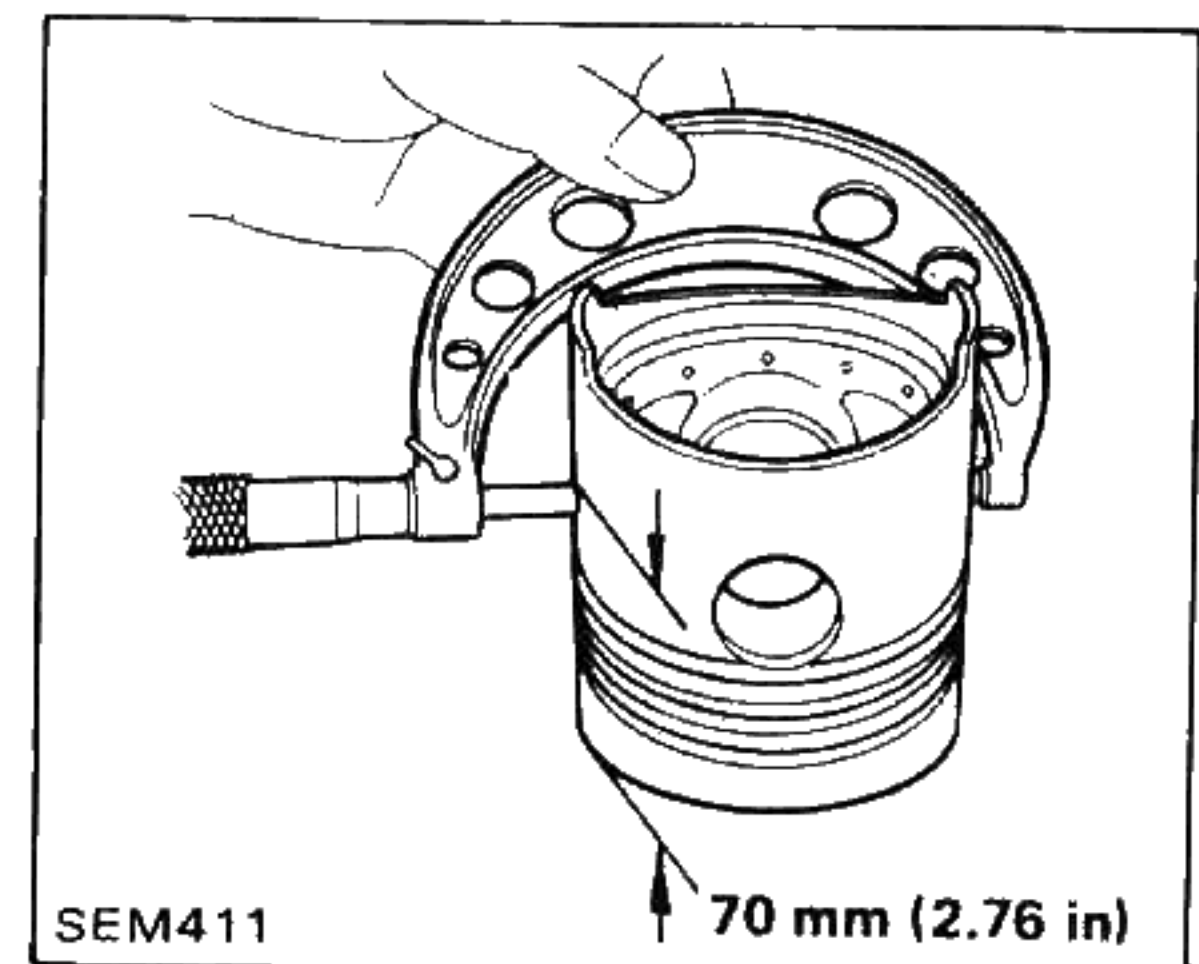
82.845 - 82.885 mm

(3.2616 - 3.2632 in)

#### SD23 and SD25

88.895 - 88.935 mm

(3.4998 - 3.5014 in)



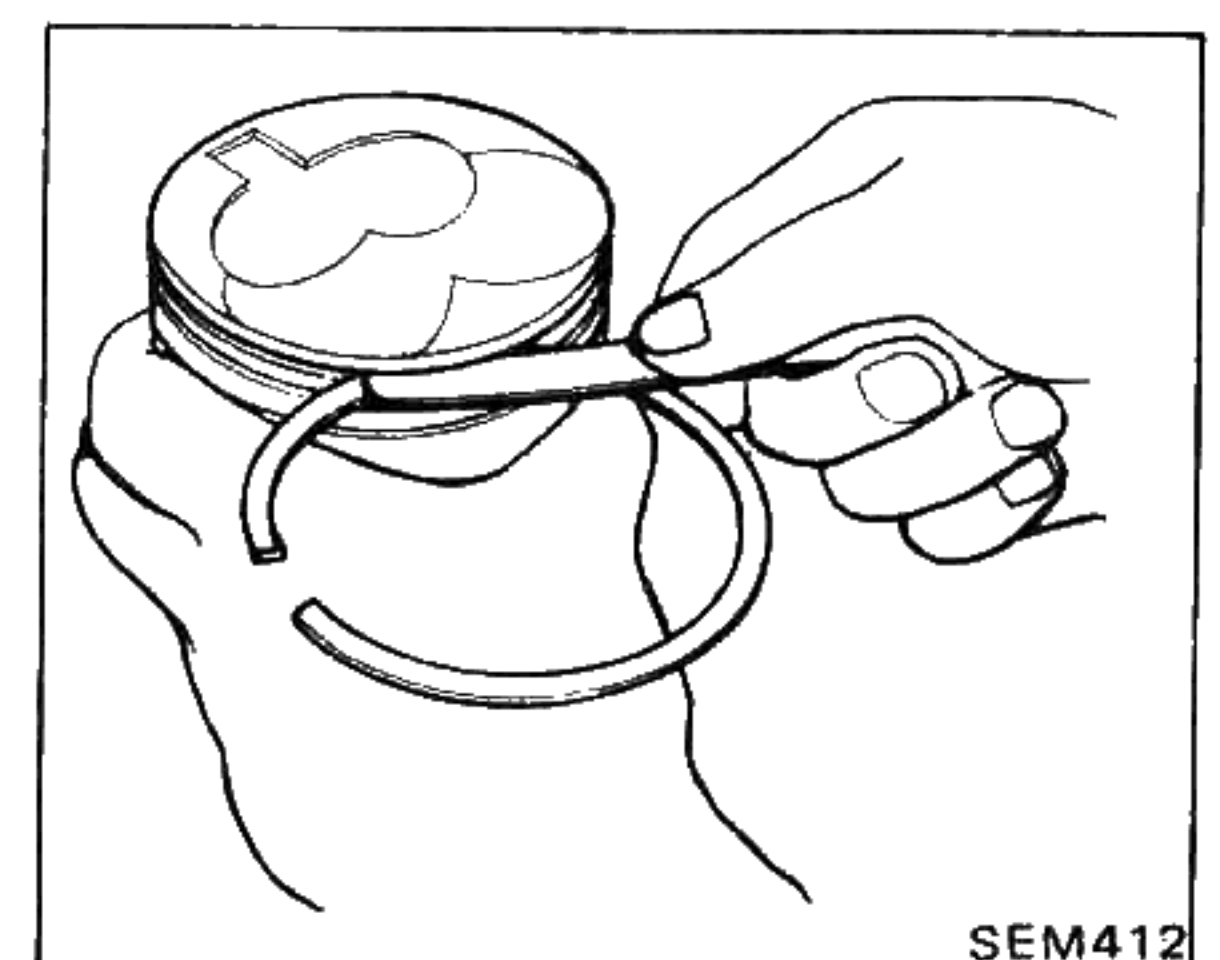
### 3. Measure Piston ring to ring groove clearance. If beyond the limit, replace piston rings or piston.

#### Piston ring to groove clearance (side clearance):

##### Limit

Unit: mm (in)

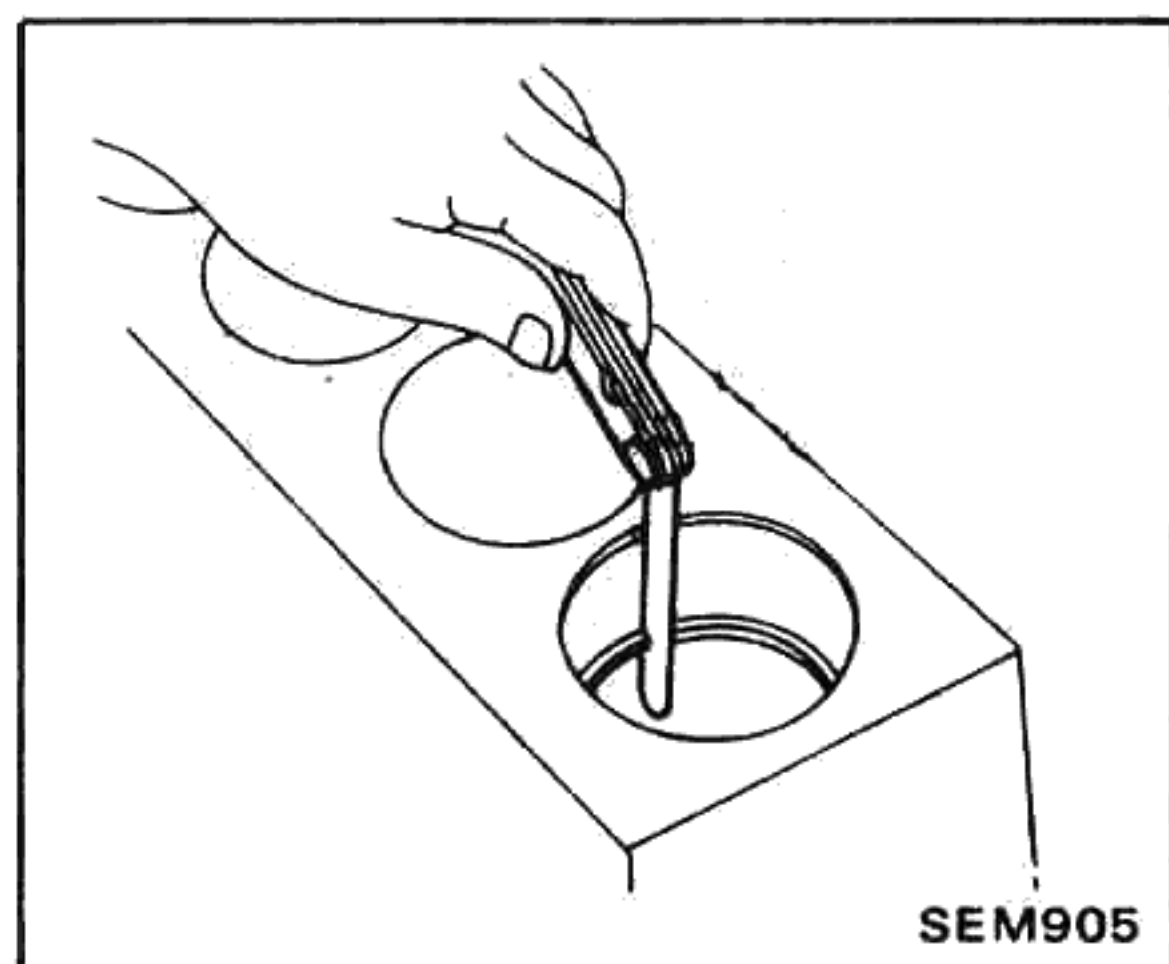
| Ring No. | 5 rings                 | 3 rings                 |
|----------|-------------------------|-------------------------|
| 1        | Less than 0.5 (0.020)   | Less than 0.5 (0.020)   |
| 2        | Less than 0.3 (0.012)   | Less than 0.3 (0.012)   |
| 3        |                         | Less than 0.15 (0.0059) |
| 4        | Less than 0.15 (0.0059) | —                       |
| 5        |                         |                         |





4. Measure piston ring end gap by securely placing piston ring in cylinder liner at position where cylinder bore wear is least. If beyond the maximum limit, replace piston ring.

**Maximum ring gap:**  
**1.5 mm (0.059 in)**

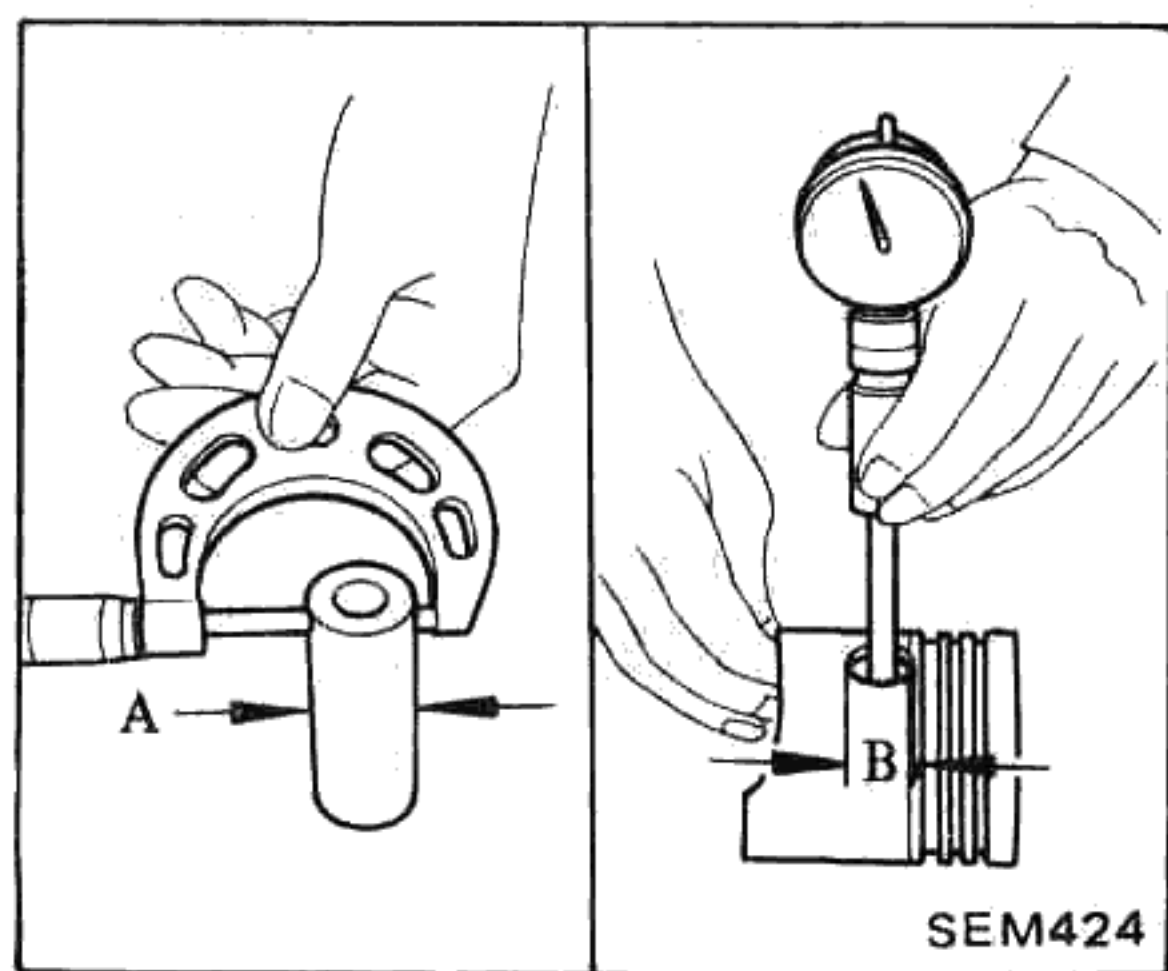


5. Measure piston pin to piston clearance. If beyond the limit, replace piston pin and piston.

**Piston pin to piston clearance (A-B):**  
**Limit**

**Unit: mm (in)**

|                                 |
|---------------------------------|
| <b>5 rings &amp; 3 rings</b>    |
| <b>Less than 0.003 (0.0001)</b> |

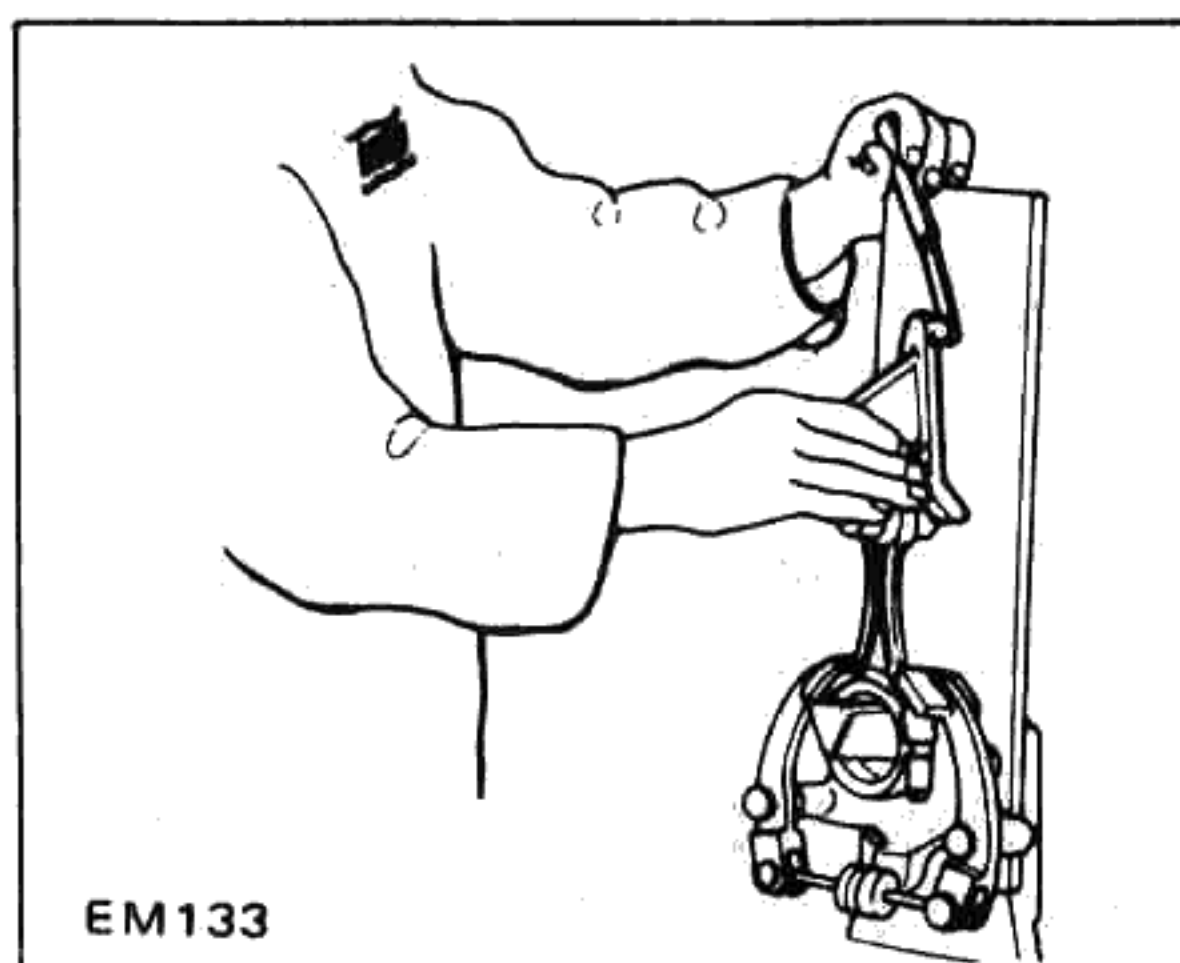


## CONNECTING ROD

1. If a connecting rod has any flaw on both sides of the thrust face and the large end, correct or replace it.
2. Check connecting rod for bend or torsion using a connecting rod aligner. If bend or torsion exceeds the limit, correct or replace.

**Bend and torsion**  
**[per 100 mm (3.94 in) length]:**  
**Standard**

**Bend**  
**Less than 0.05 mm**  
**(0.0020 in)**  
**Torsion**  
**Less than 0.05 mm**  
**(0.0020 in)**



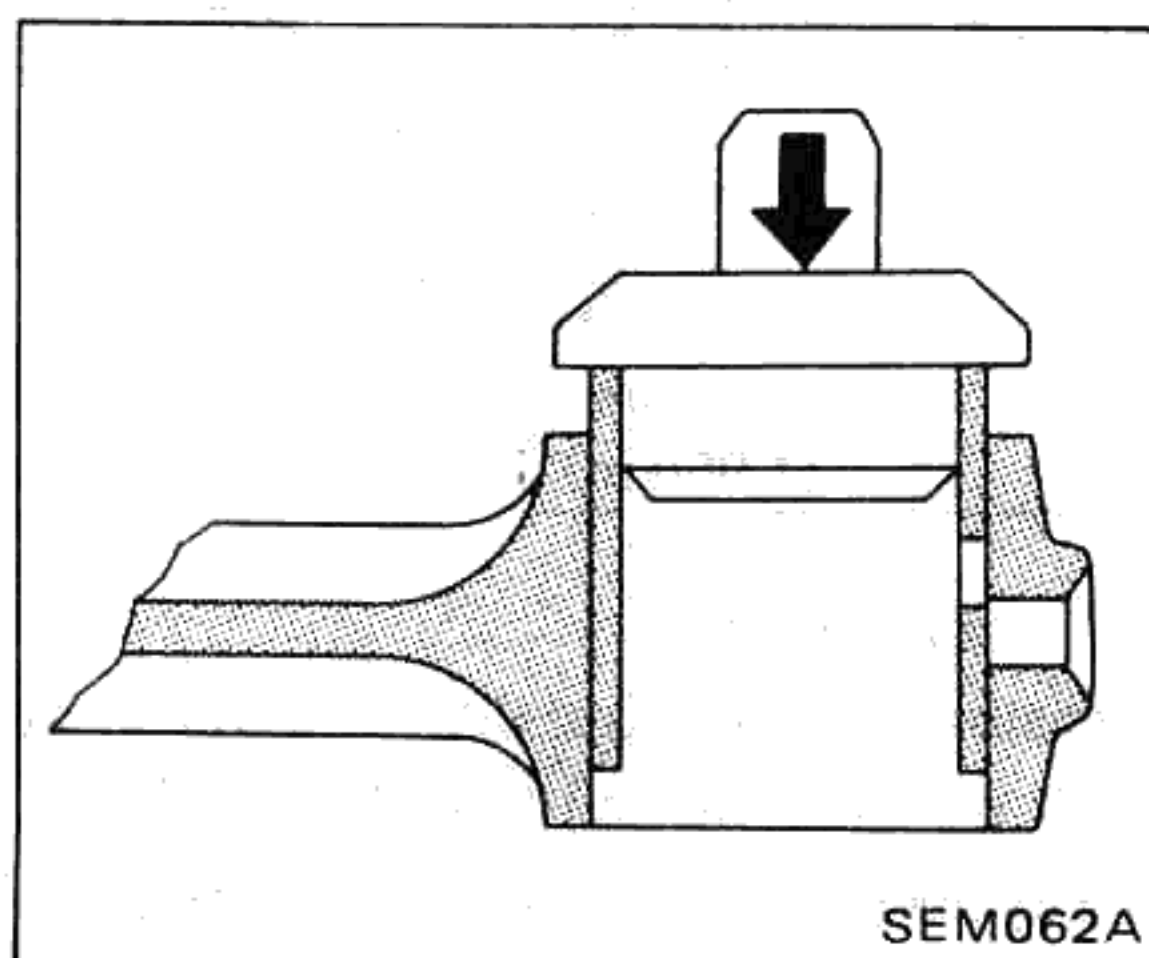
## REPLACEMENT OF CONNECTING ROD SMALL END BUSHING

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, finish the bushing to the inside diameter specified by maintenance standard.

**Small end bushing inside diameter**  
**Maintenance standard:**  
**26.025 - 26.038 mm**  
**(1.0246 - 1.0251 in)**



## CRANKSHAFT

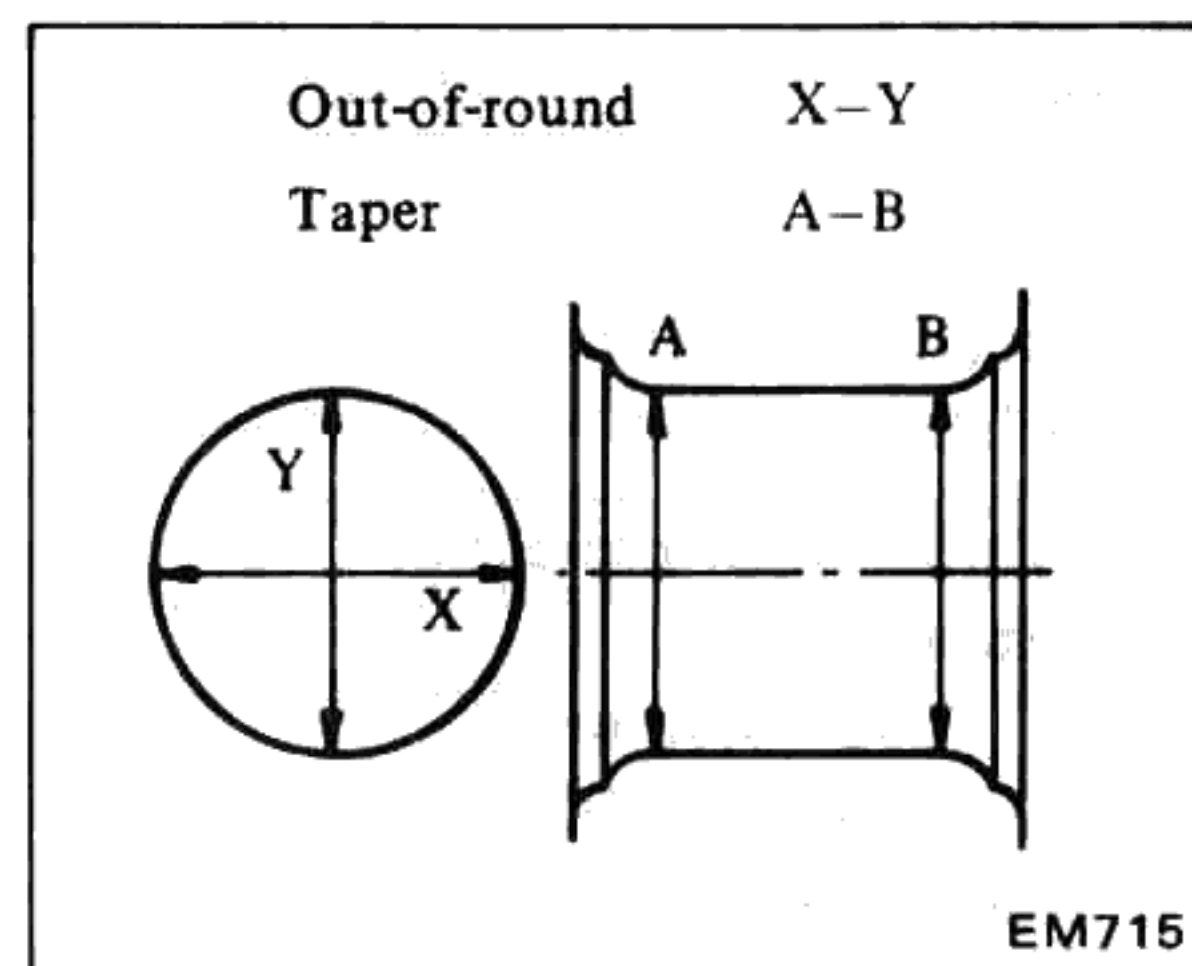
1. Check journal and crank pin for flaws or clogged oil passage. If necessary, replace crankshaft.

2. Check journal and crank pin for out-of-round and taper with a micrometer.

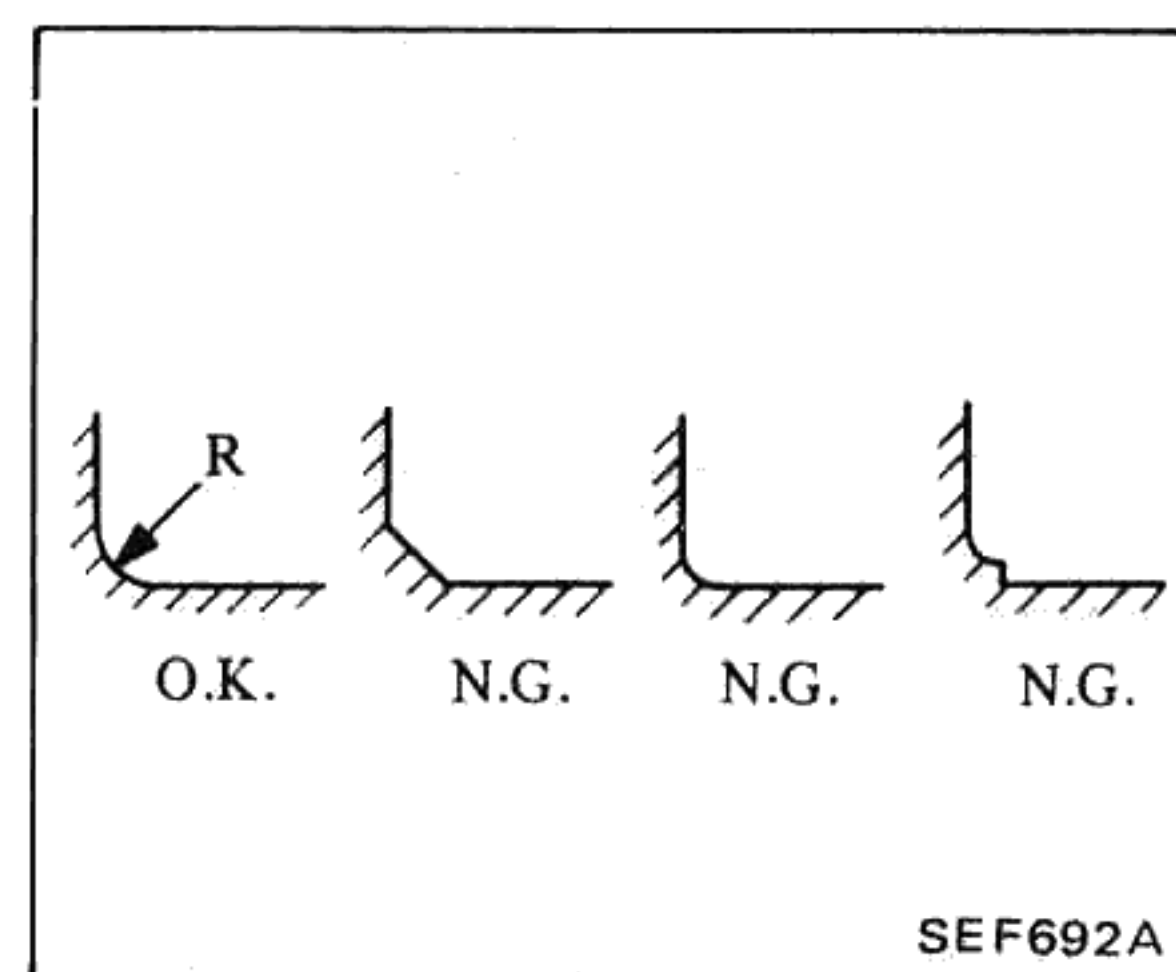
If beyond the specified value, replace or regrind crankshaft.

After regrinding crankshaft, use suitable undersize main bearing.

**Out-of-round (X-Y):**  
**Less than**  
**0.02 mm (0.0008 in)**  
**Taper (A-B):**  
**Less than**  
**0.02 mm (0.0008 in)**



When regrinding crankshaft, finish fillets as follows:



**R Crank journal: 3.0 mm (0.118 in)**  
**Crank pin: 3.5 mm (0.138 in)**

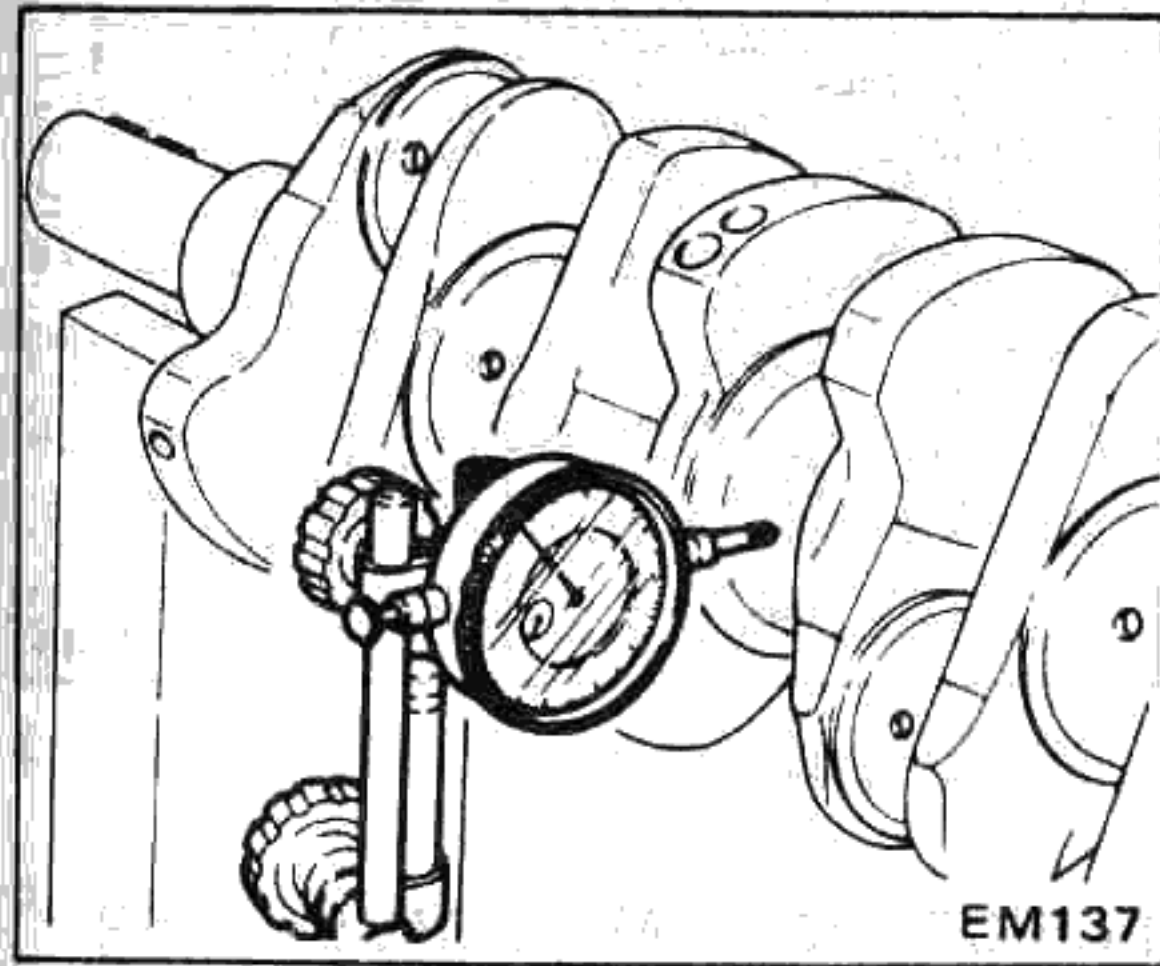
Do not attempt to cut counterweight of crankshaft.

3. Check crankshaft bend on center journal. If beyond the specified value, replace or repair.

**Crankshaft bend**  
**(Total indicator reading):**  
**Standard**  
**0 - 0.06 mm**  
**(0 - 0.0024 in)**



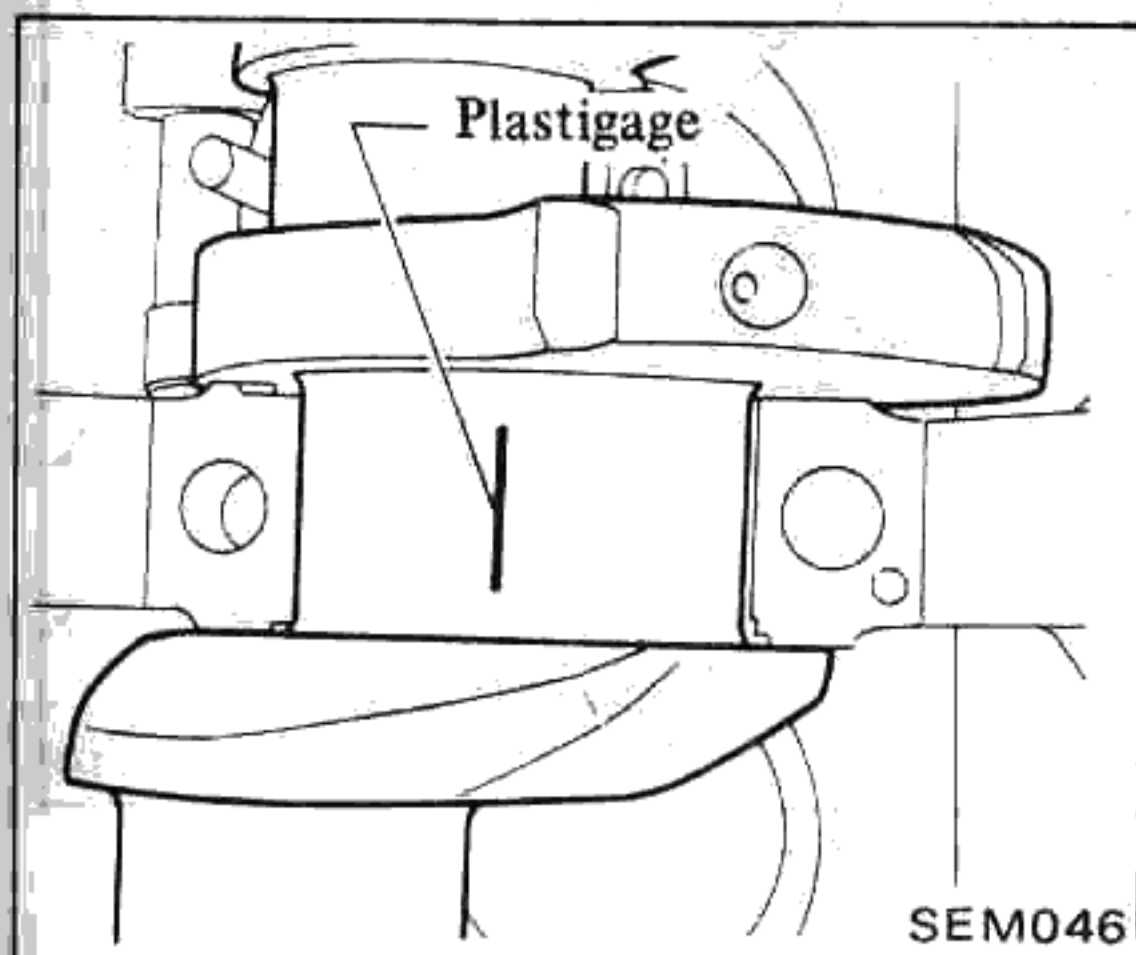
**Limit**  
**Less than**  
**0.2 mm (0.008 in)**



## BEARINGS

### MAIN BEARING OIL CLEARANCE

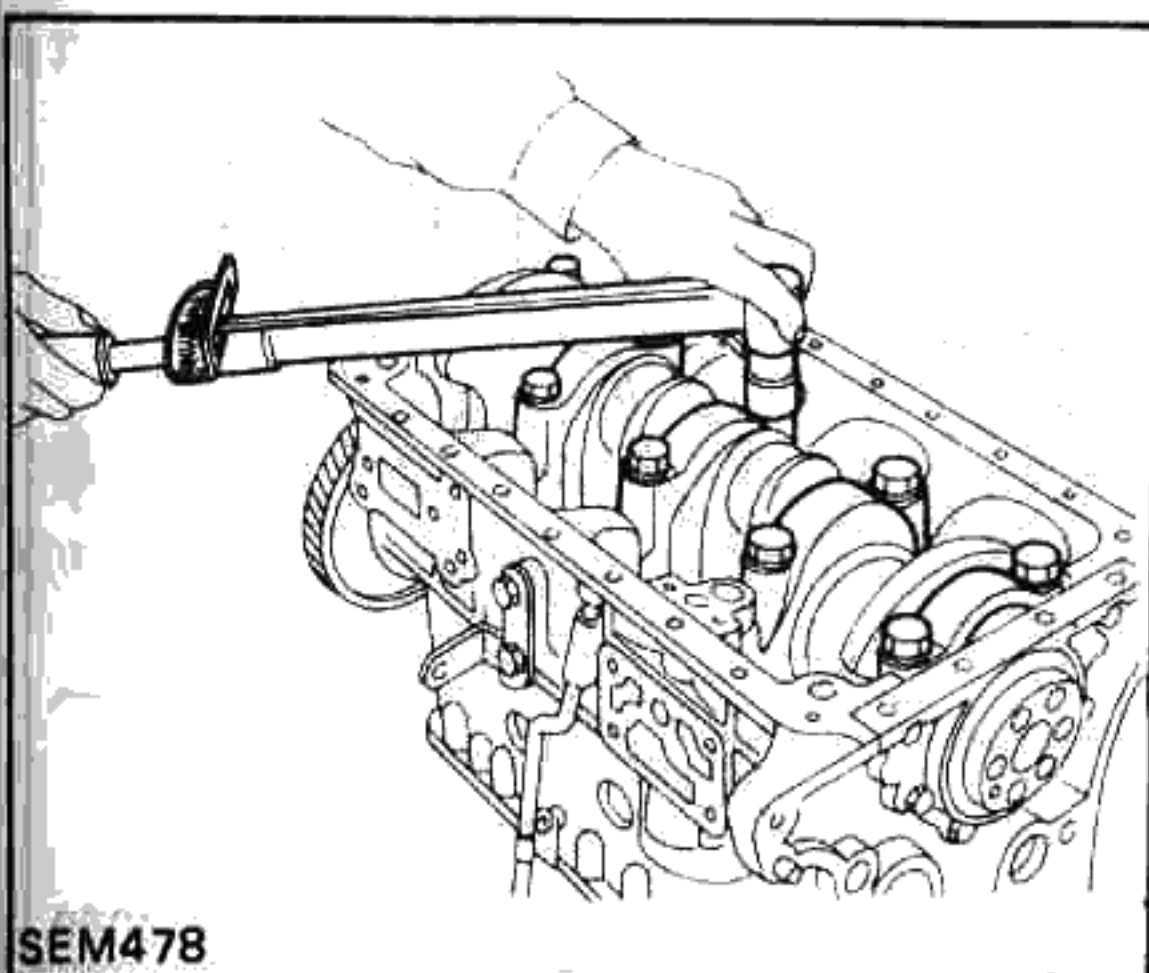
1. Thoroughly clean all bearings, journal and caps, and check for scratches, melt, scores or wear. Replace bearings, if any fault is detected.
2. Set main bearings on cylinder block and install crankshaft.
3. Set plastigage at each journal.



4. Install main bearing caps with main bearings and tighten.

**Do not turn crankshaft.**

Ⓣ : Main bearing cap bolt:  
 167 - 172 N·m  
 (17.0 - 17.5 kg-m,  
 123 - 127 ft-lb)

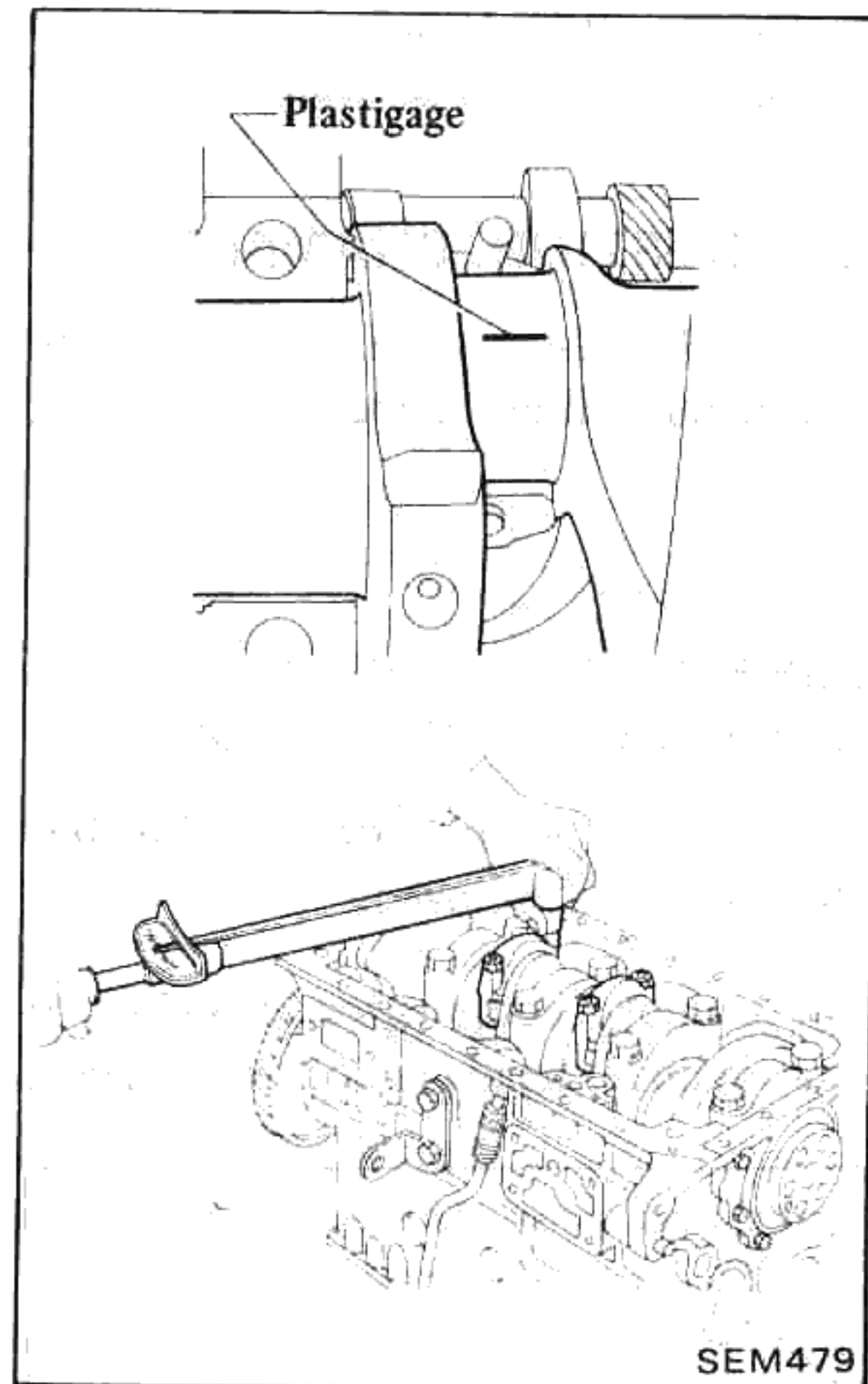
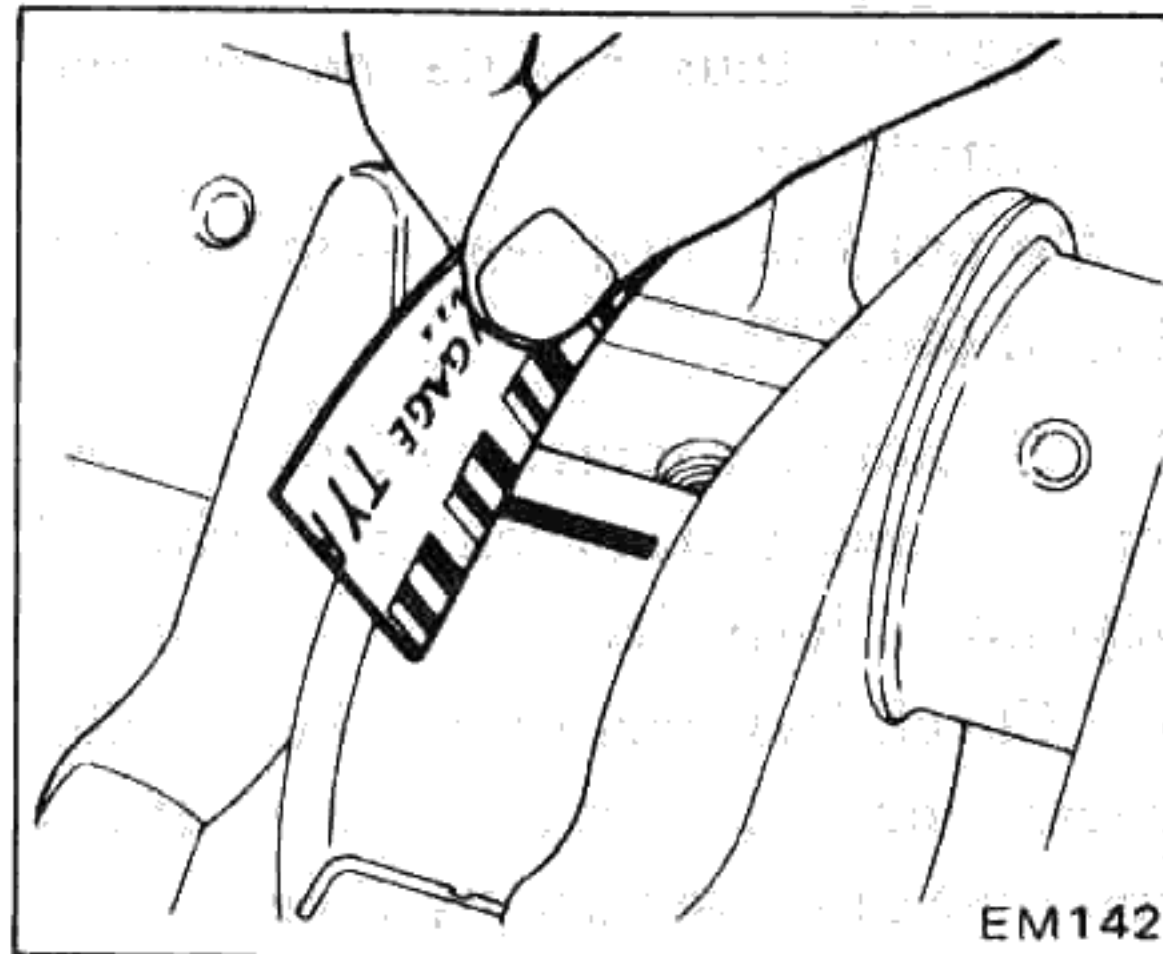


5. Remove cap and measure main bearing oil clearance with plastigage. If clearance is not within specification, replace bearings.

**Main bearing oil clearance:**

**Standard**  
 0.035 - 0.093 mm  
 (0.0014 - 0.0037 in)

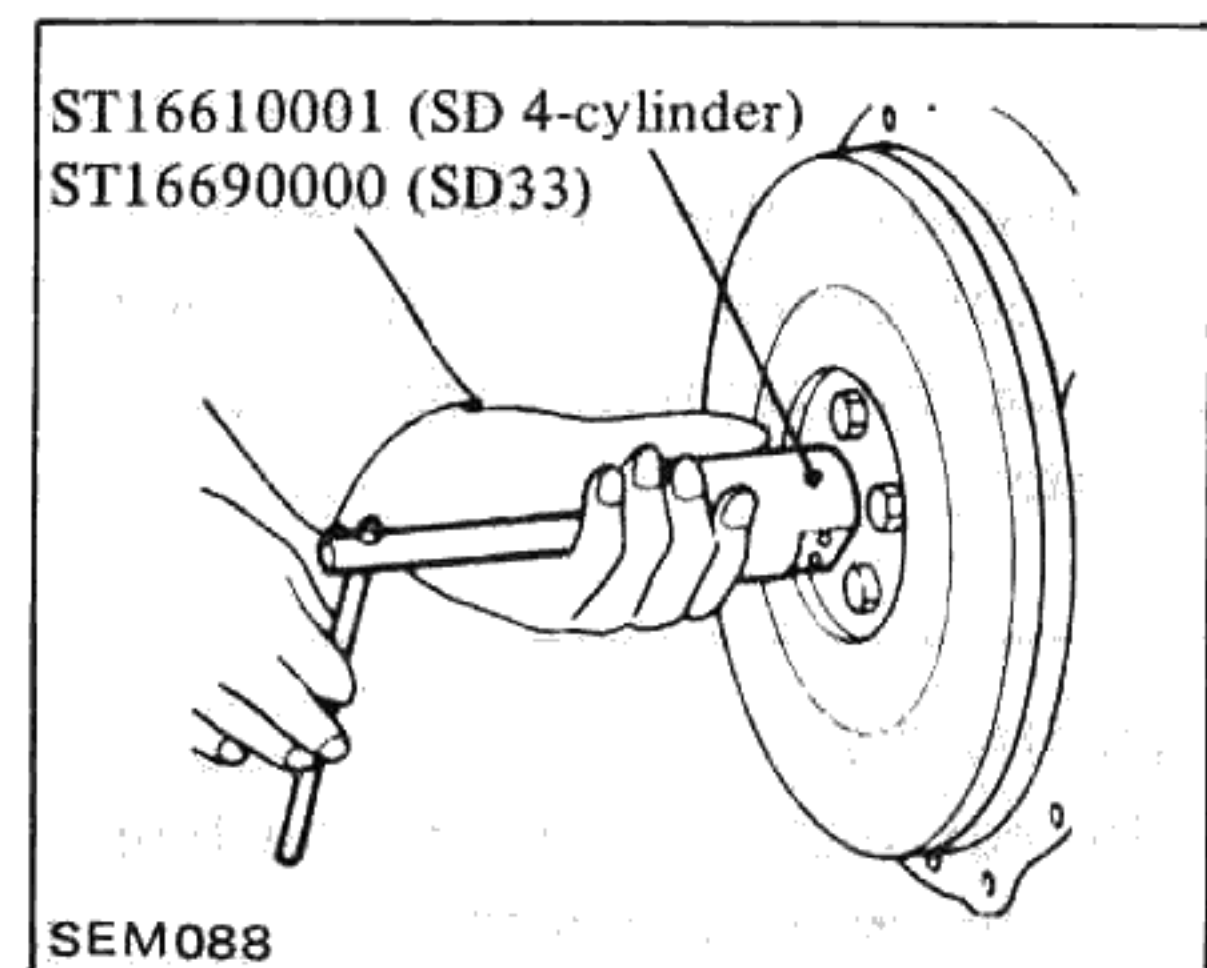
**Limit**  
**Less than**  
**0.15 mm (0.0059 in)**



## CRANKSHAFT PILOT BUSHING

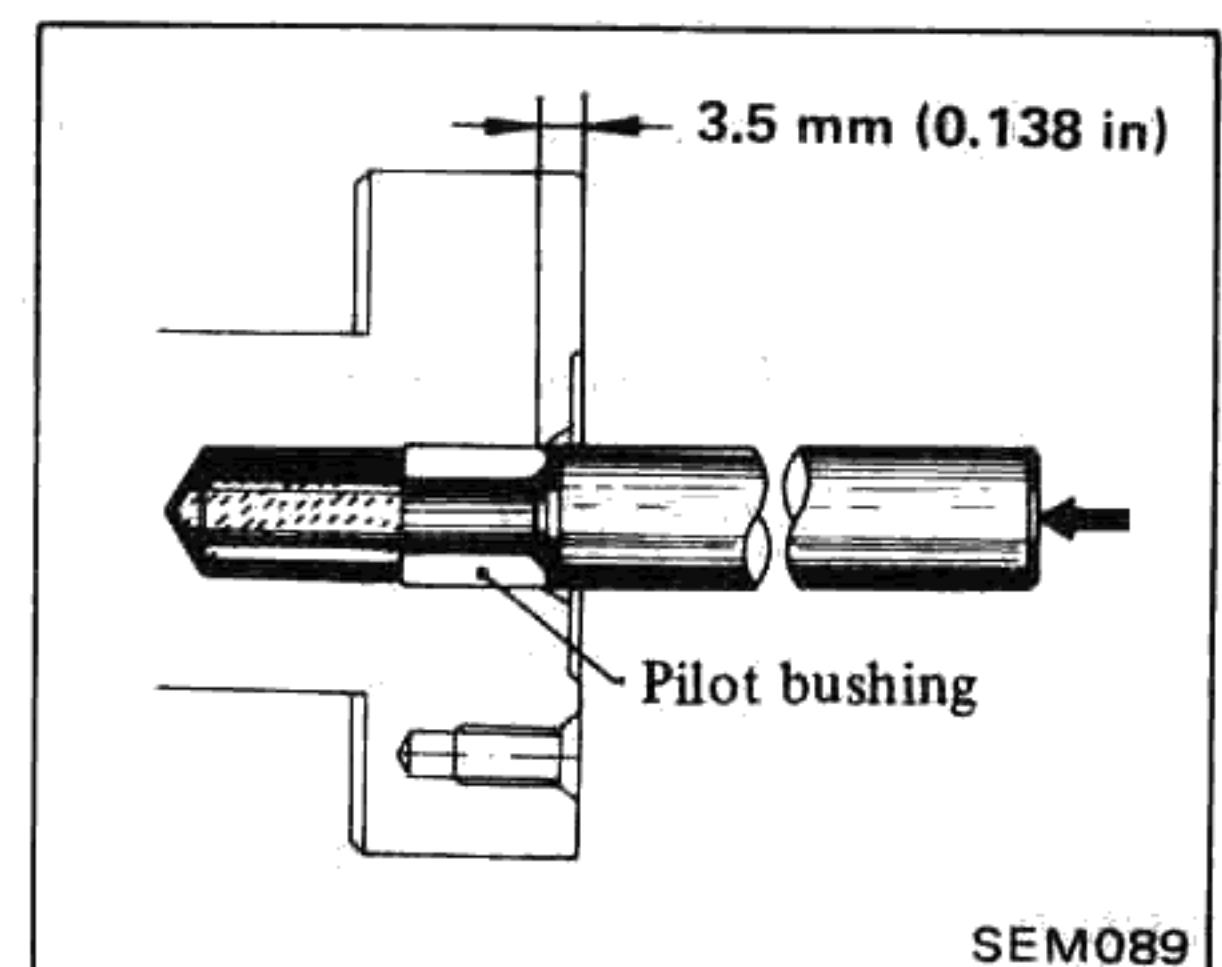
### CRANKSHAFT PILOT BUSHING REPLACEMENT

1. Pull out bushing with Tool.



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

**Distance "A":**  
 Approx. 3.5 mm (0.138 in)



## CONNECTING ROD BEARING OIL CLEARANCE

Measure connecting rod bearing oil clearance in same manner as main bearing oil clearance.

If clearance is not within specification, replace bearings.

**Do not turn connecting rod or crankshaft.**

Ⓣ : Connecting rod cap:

SD22 and SD33  
 51 - 56 N·m  
 (5.2 - 5.7 kg-m,  
 38 - 41 ft-lb)

SD23 and SD25  
 67 - 71 N·m  
 (6.8 - 7.2 kg-m,  
 49 - 52 ft-lb)

**Connecting rod bearing oil clearance:**

**Standard**  
 0.035 - 0.087 mm  
 (0.0014 - 0.0034 in)

**Limit**  
**Less than**  
**0.15 mm (0.0059 in)**



- a. Do not oil bushing.
- b. Do not insert excessively.

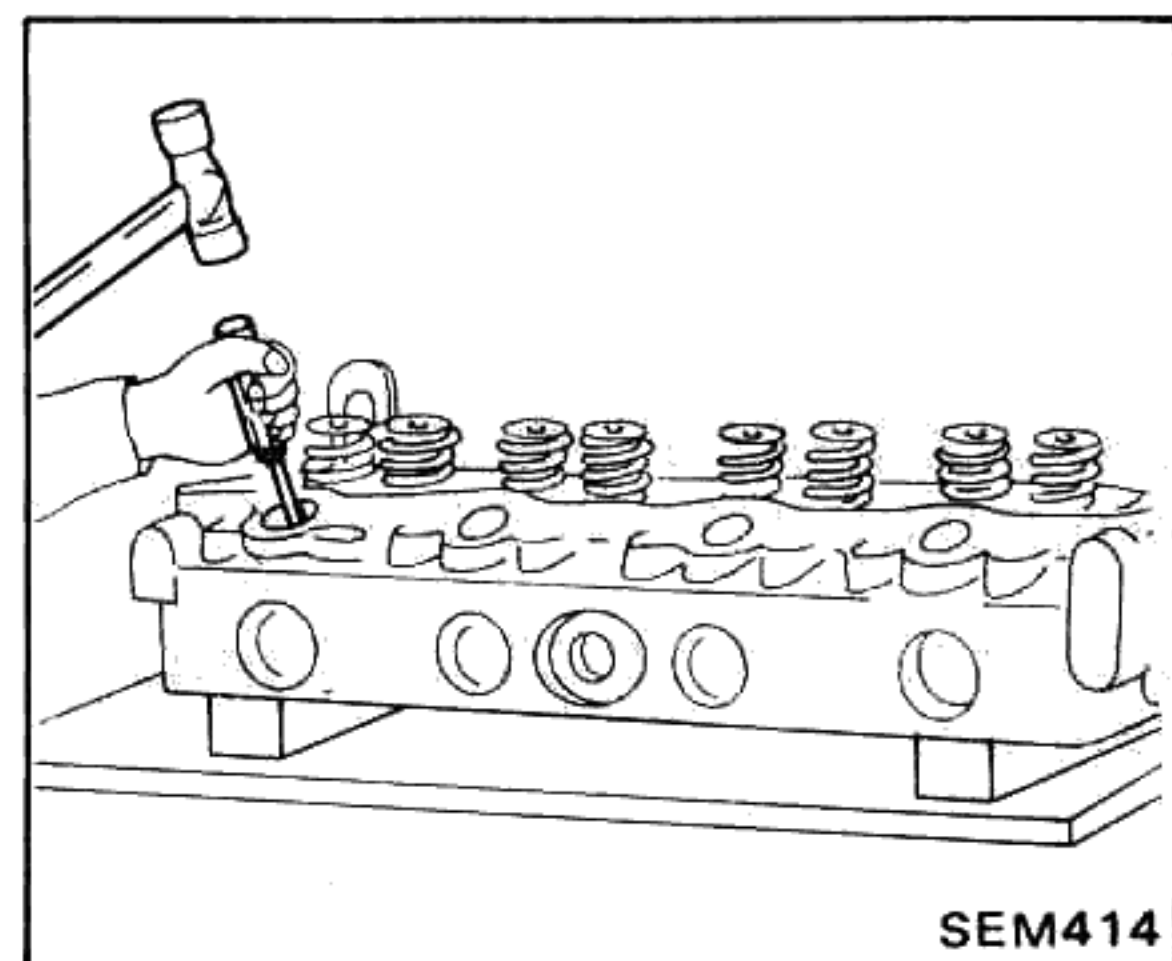
## COMBUSTION CHAMBER

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

## COMBUSTION CHAMBER REPLACEMENT

Usually combustion chamber should not be removed.

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

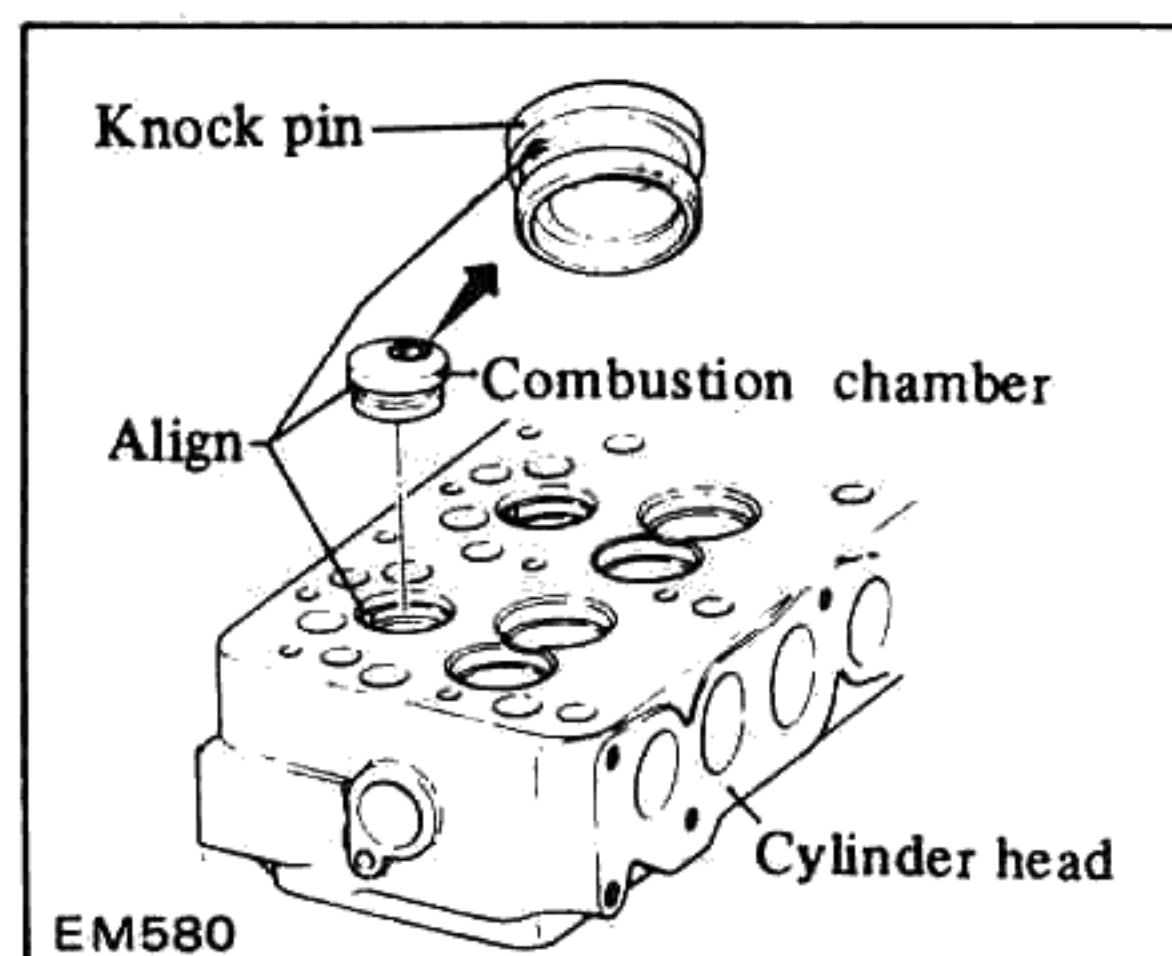


2. Install combustion chamber.
  - (1) Cool combustion chamber with dry ice for approximately 5 to 10 minutes.

### WARNING:

Do not touch cooled combustion chamber with bare hand.

- (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.

## FLYWHEEL

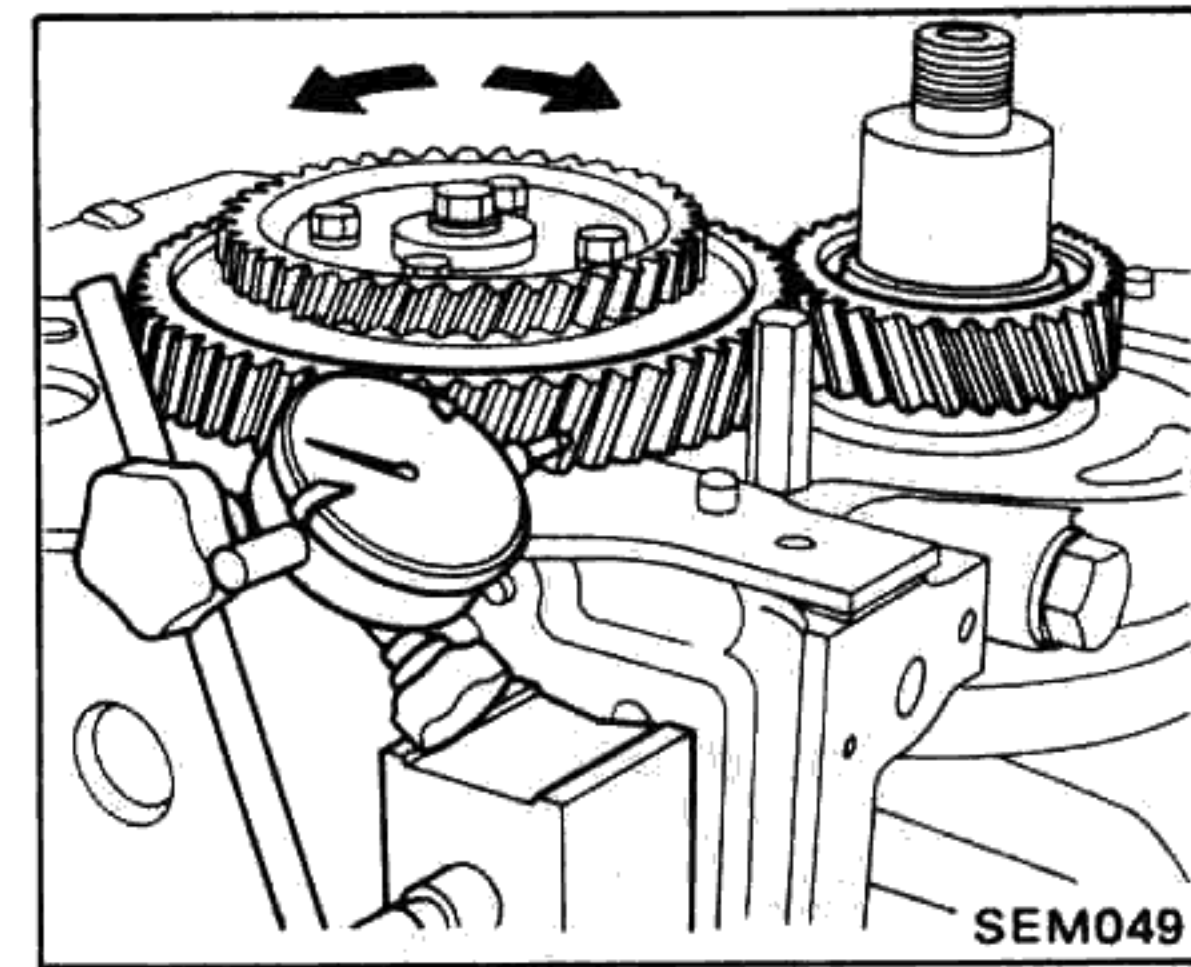
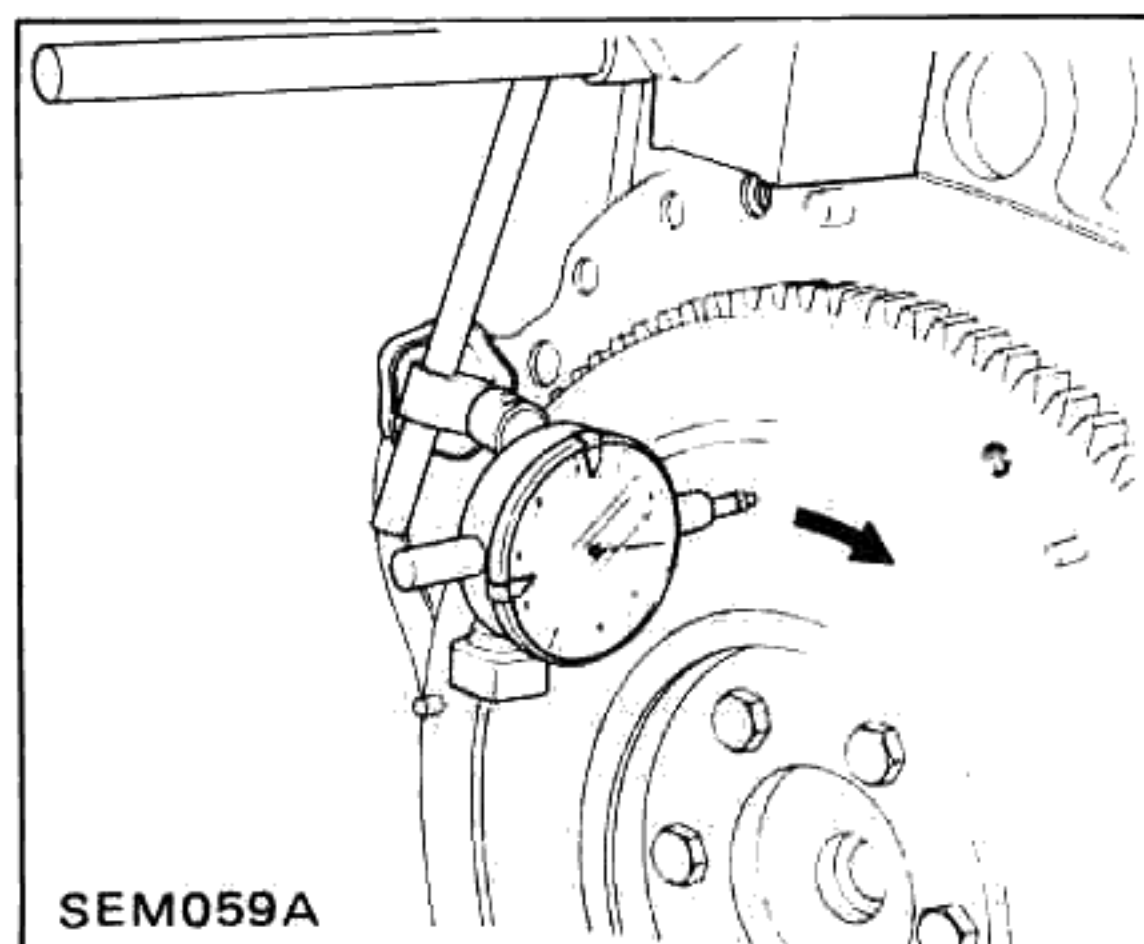
1. Check ring gear for wear or damage. If worn or damaged excessively, replace.

Removal and installation of ring gear requires use of hydraulic press. Heat ring gear to 180 to 200°C (356 to 392°F), thus facilitating removal and installation.

Do not heat ring gear to more than 250°C (482°F).

2. If clutch contact surface of flywheel is worn, damaged or roughened beyond limit, replace.
3. Check flywheel runout before disassembling and after assembling. If beyond the limit, replace flywheel.

Runout (Total indicator reading):  
Less than 0.15 mm (0.0059 in)



## INJECTION PUMP DRIVE GEAR

Check gear backlash before disassembling and after assembling. If beyond the limit, replace idler gear or injection pump drive gear.

Gear backlash:

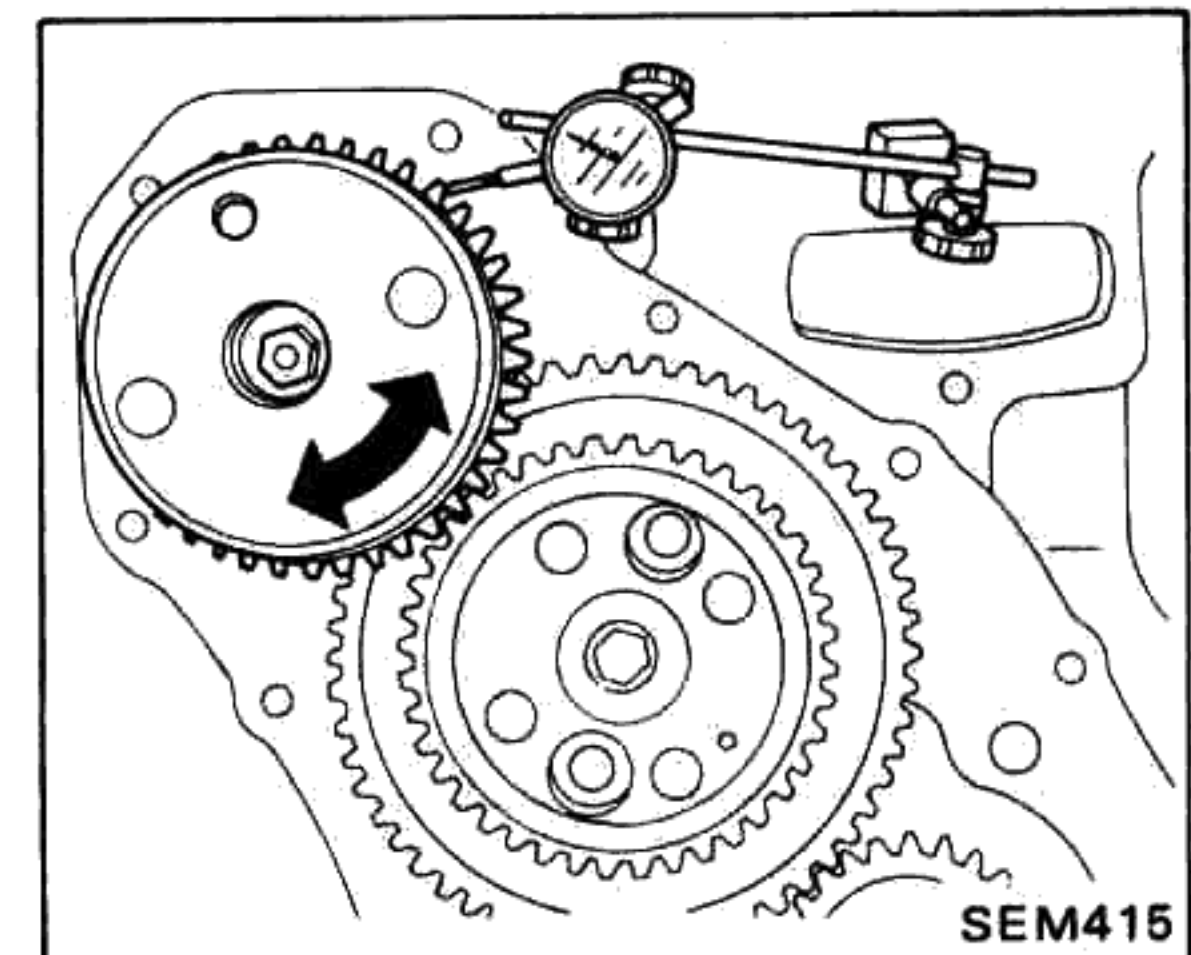
Standard

0.07 - 0.20 mm

(0.0028 - 0.0079 in)

Limit

0.30 mm (0.0118 in)

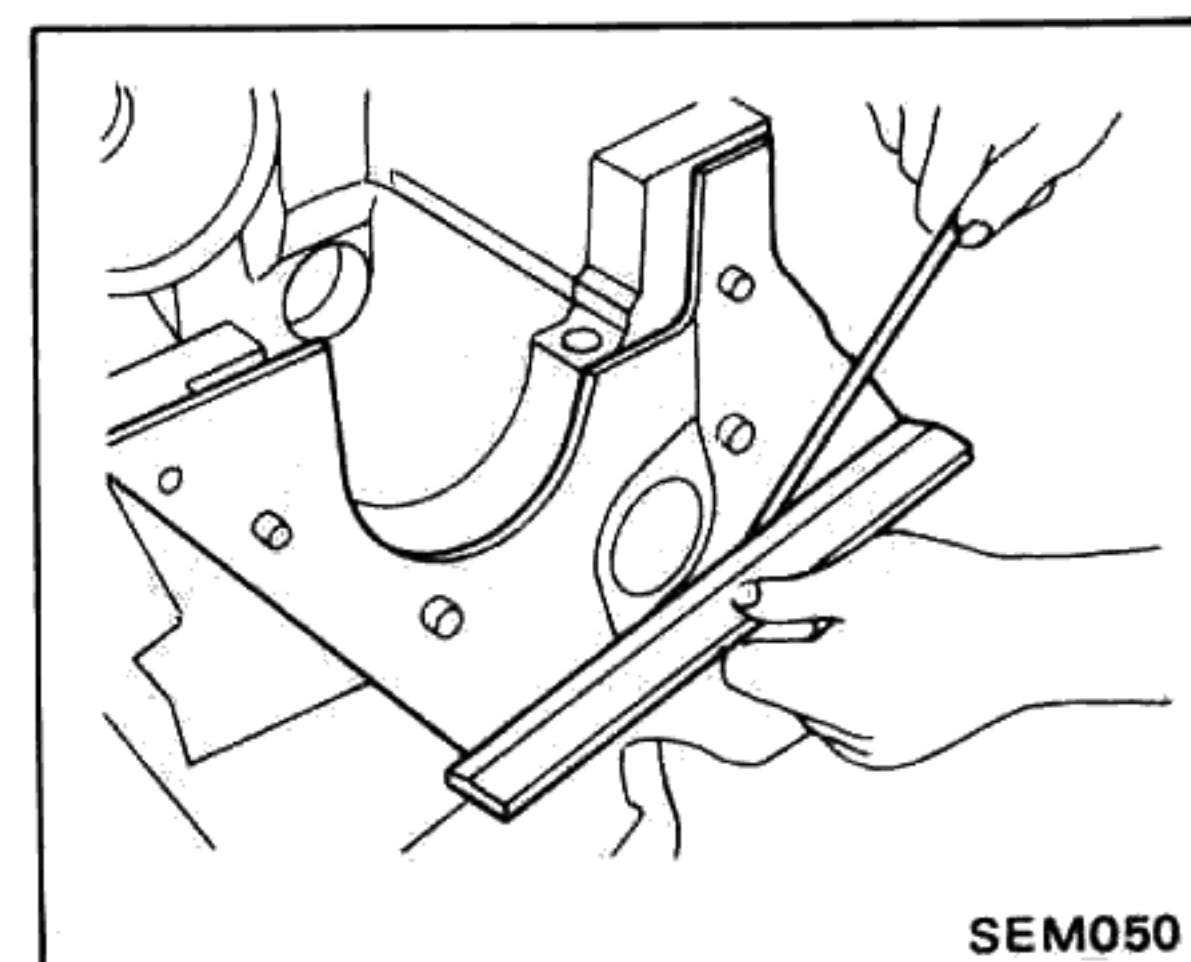


## FRONT PLATE

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

Warpage limit:

0.2 mm (0.008 in)



## GEAR TRAIN

### CAMSHAFT DRIVE 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. If beyond the limit, replace gear.

Backlash:

Standard

0.07 - 0.20 mm

(0.0028 - 0.0079 in)

Limit

0.30 mm (0.0118 in)



# ENGINE ASSEMBLY

## PRECAUTIONS

1. When installing sliding parts such as bearings, be sure to apply engine oil on the sliding surfaces.
2. Use new packing and oil seals.
3. Be sure to follow the specified order and tightening torque.

4 bearings (SD33) & 3 bearings (SD22)

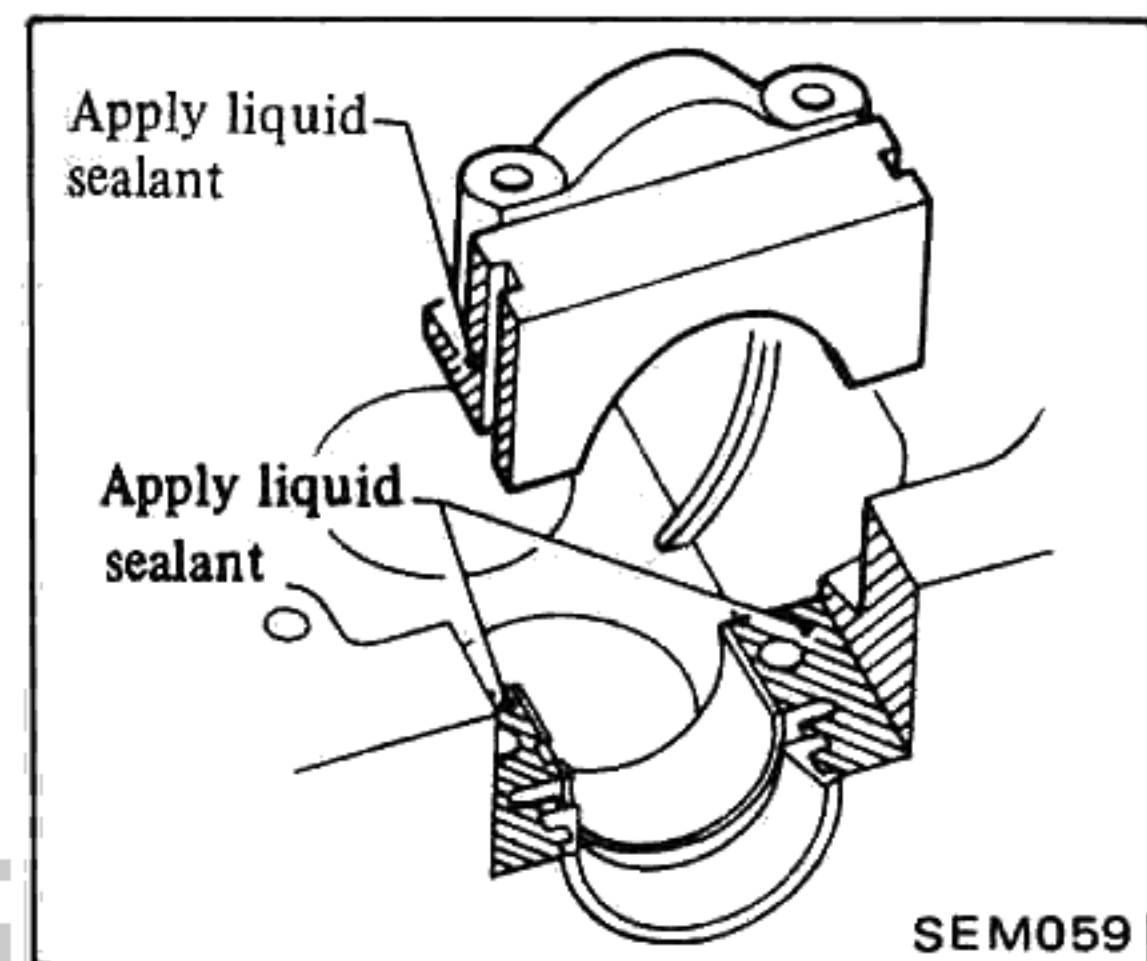
### 4. Applying sealant

Use sealant to eliminate water and oil leaks.

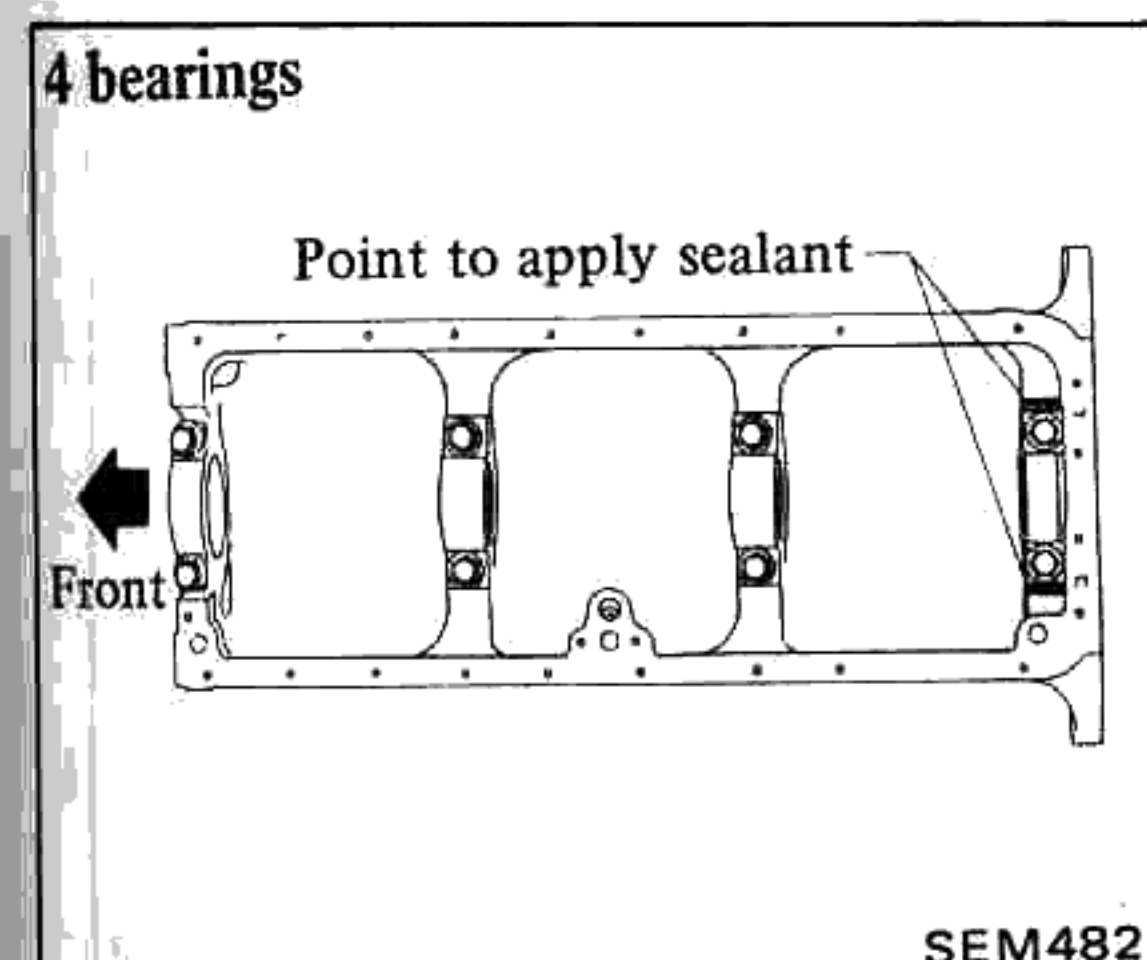
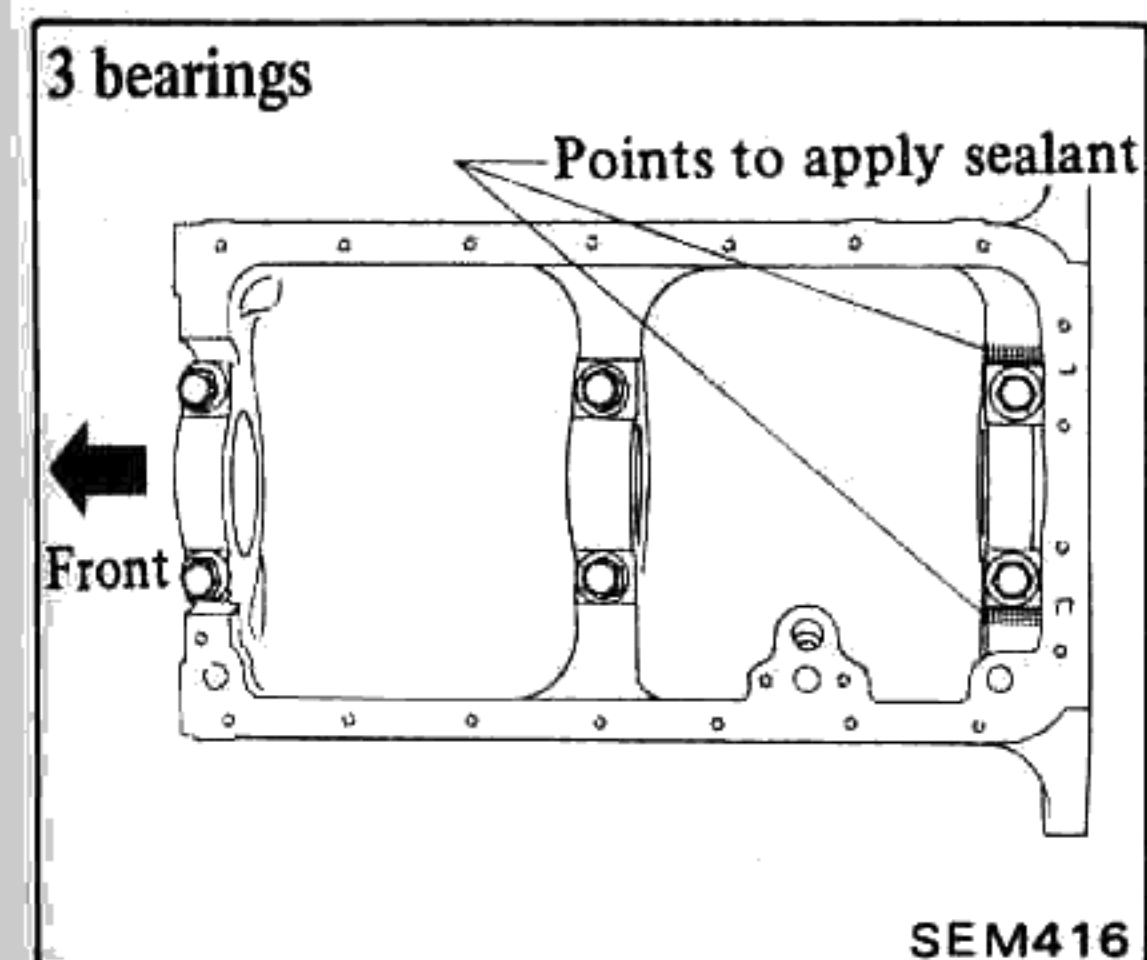
**Do not apply too much sealant.**

**Parts requiring sealant are:**

- (1) Main bearing cap and cylinder block



- (2) Cylinder block



After inserting rear bearing cap side seals, apply sealant to rear main bearing cap.

## ASSEMBLING CYLINDER HEAD

1. Install glow plugs.

⊕ : Glow plug

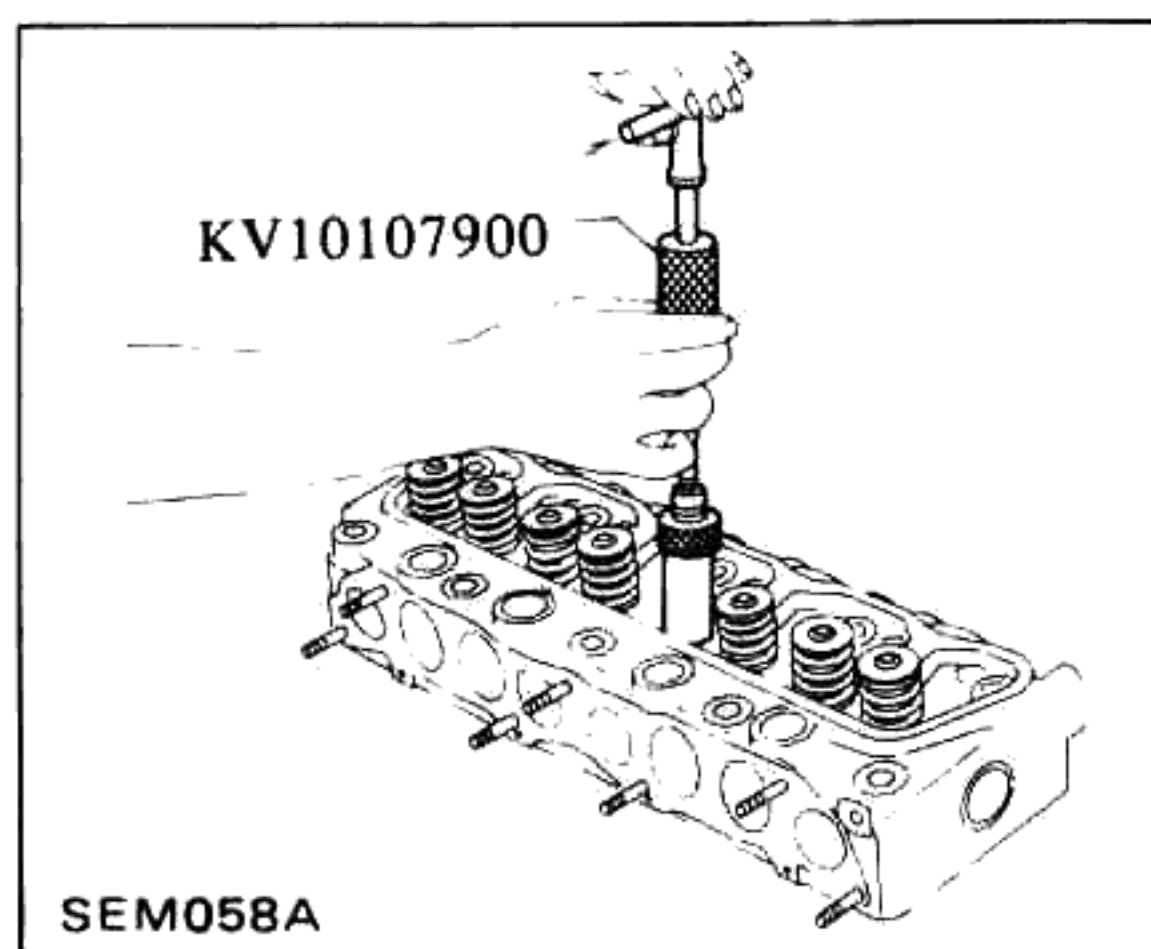
15 - 20 N·m

(1.5 - 2.0 kg·m,

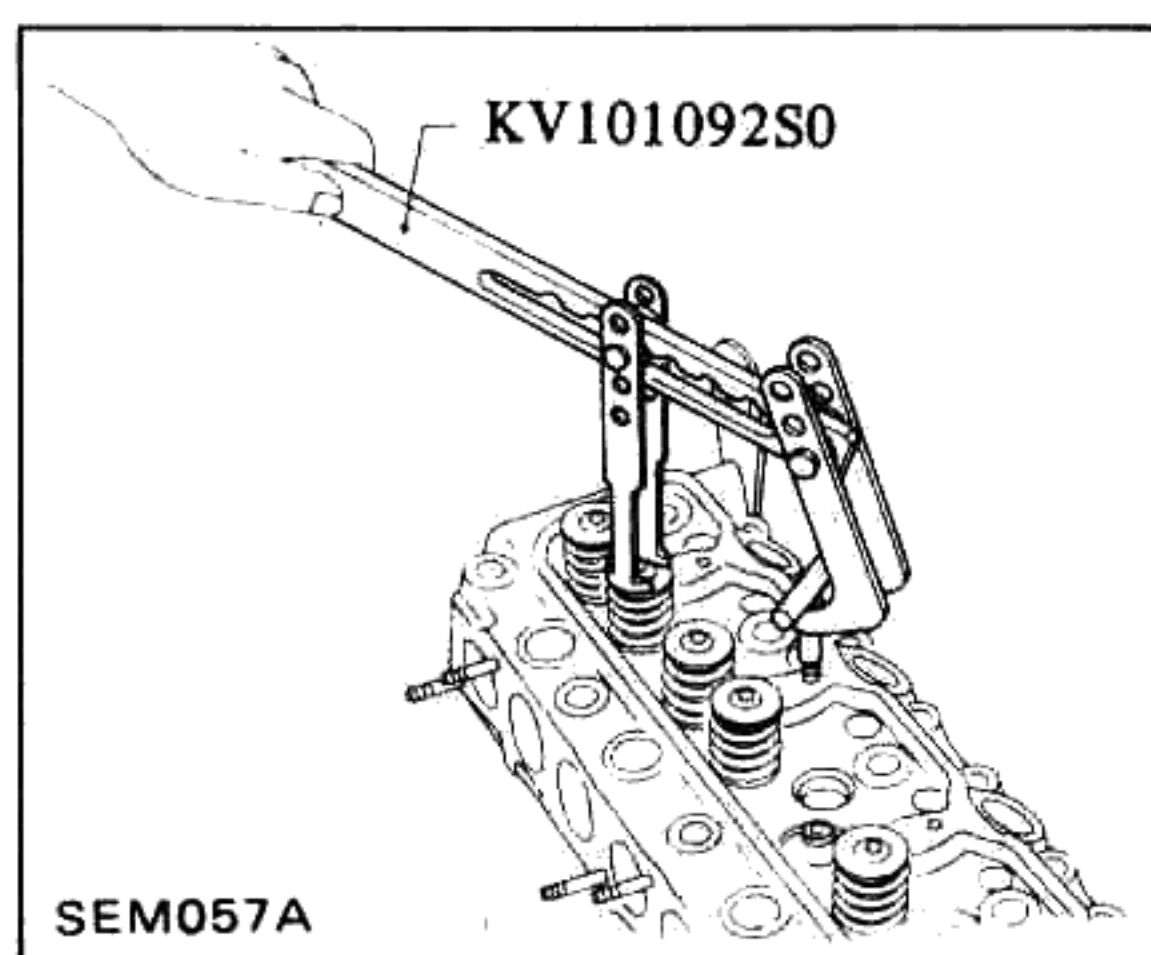
11 - 14 ft·lb)

2. Install valve and valve spring.

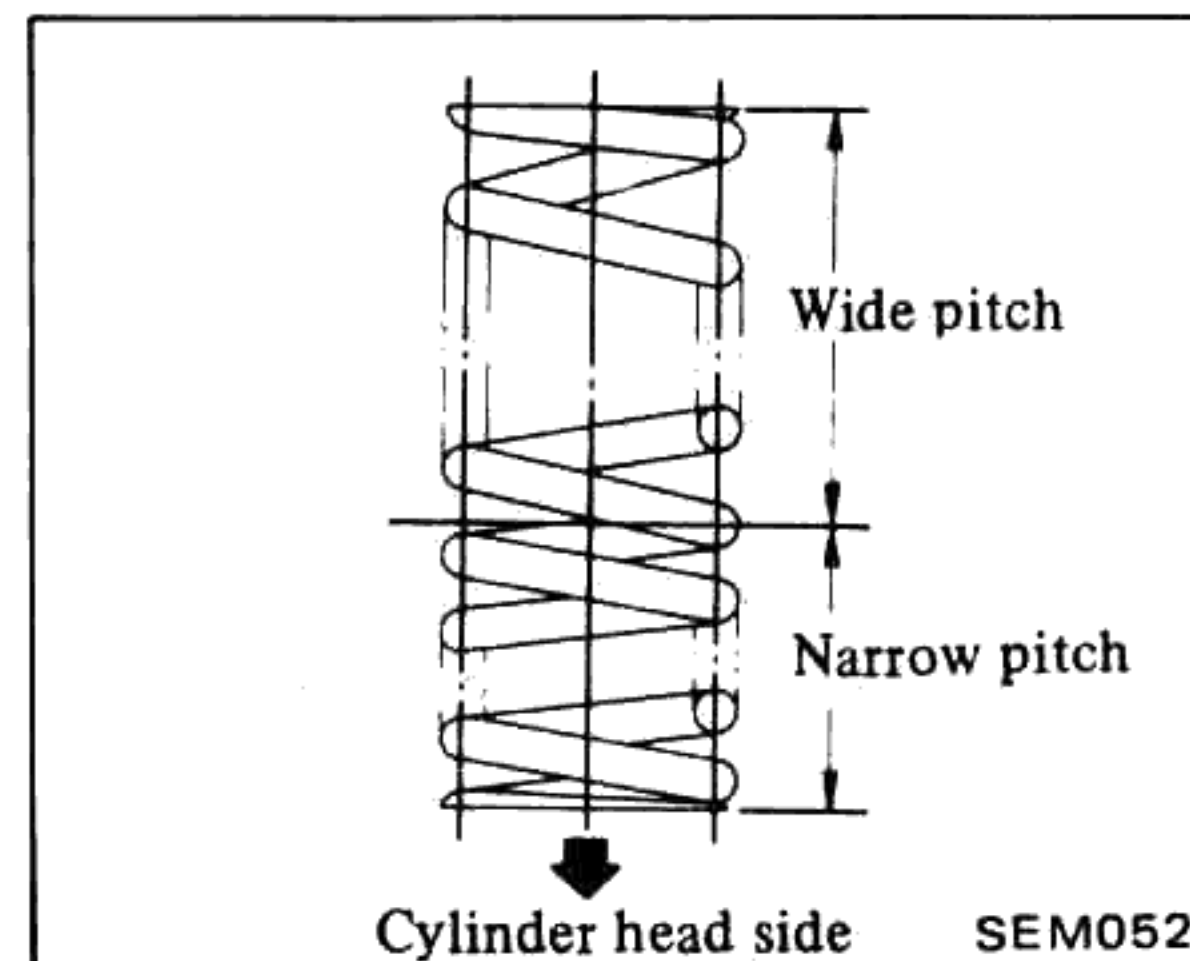
(1) Install new valve stem seal with Tool.



- (2) Install valve, valve spring, valve spring retainer and valve spring collet by using Tool.



- a. Install valve spring (uneven pitch type) with its narrow pitch side (yellow or red painted) at cylinder head side.

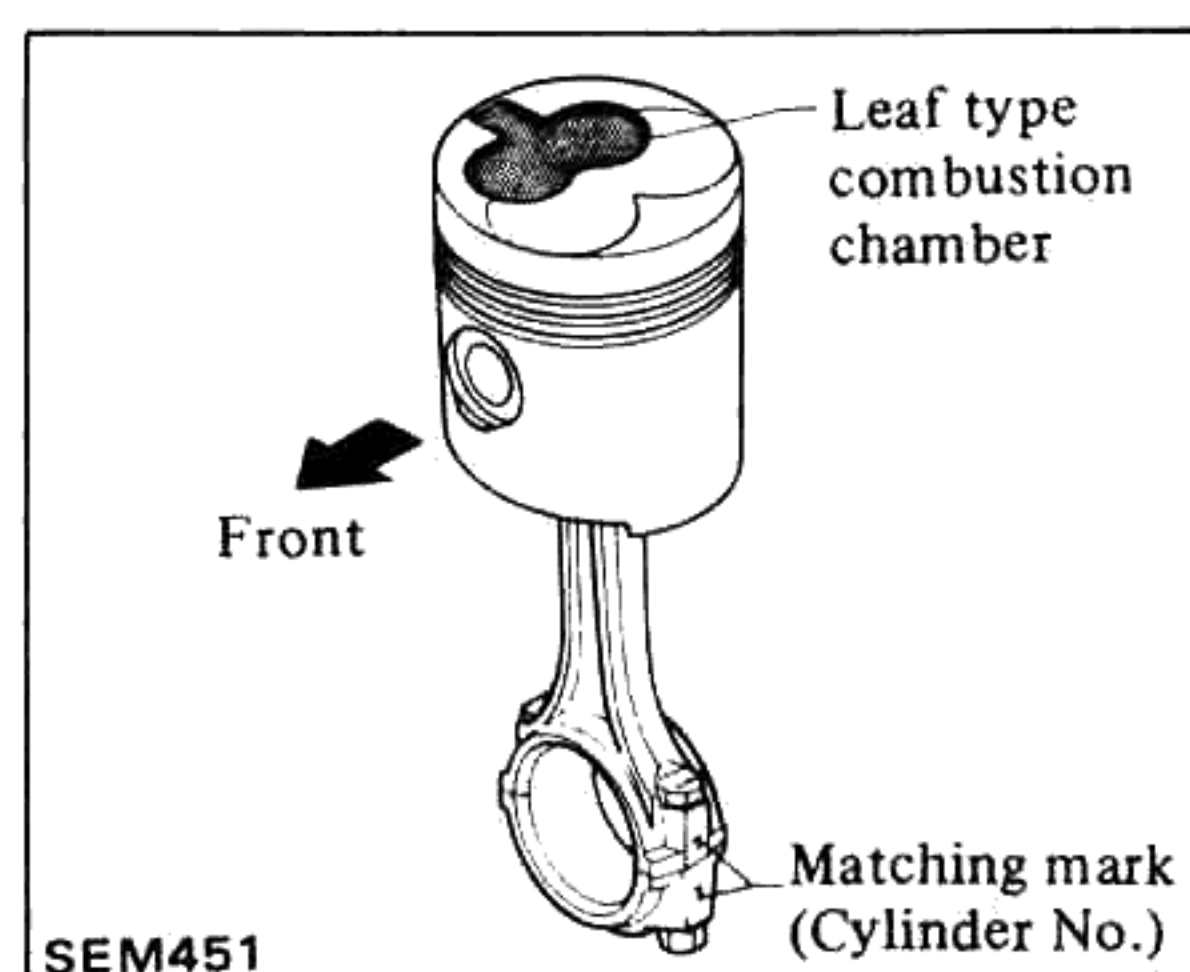


- b. When installing valve, apply engine oil on the valve stem and lip of valve stem oil seal.
- c. Check whether the valve face is free of foreign matter.

## ASSEMBLING PISTON AND CONNECTING ROD

Assemble pistons, piston pins and connecting rods of the designated cylinders.

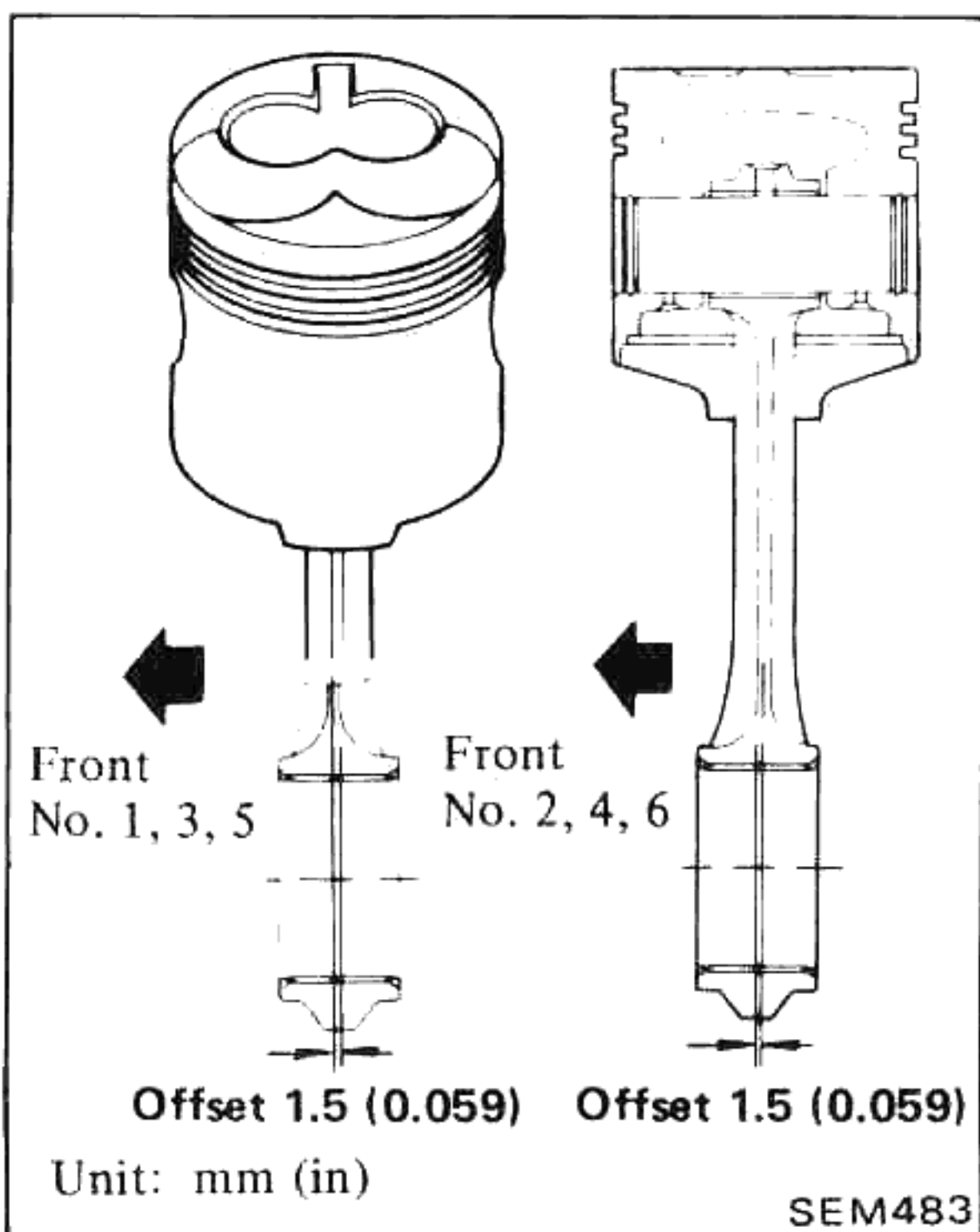
- a. Immerse piston in oil of 80°C (176°F), and push in piston pin. Install snap ring.
- b. Install connecting rod and piston so that leaf type combustion chamber on piston head is opposite the matching marks on connecting rod and cap.





## SD22-3 bearing & SD33

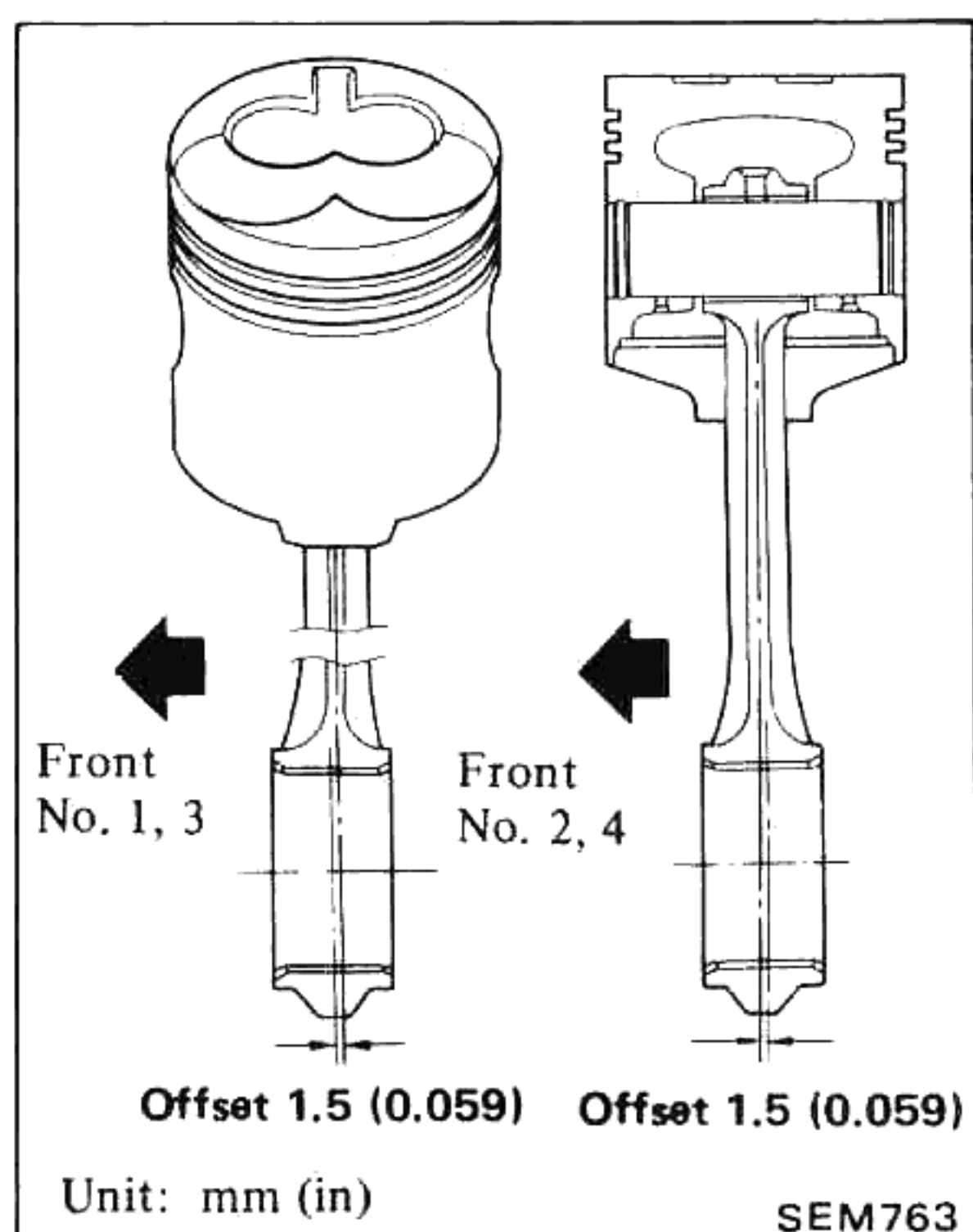
No matching marks are stamped on service parts of connecting rod. Install so that connecting rod big end is offset with respect to piston, so that on No. 1, No. 3 and No. 5 cylinders this offset is rearward with respect to engine and on No. 2, No. 4 and No. 6 cylinders this offset is forward with respect to engine and so that leaf type combustion chamber on piston head is at right side of engine.



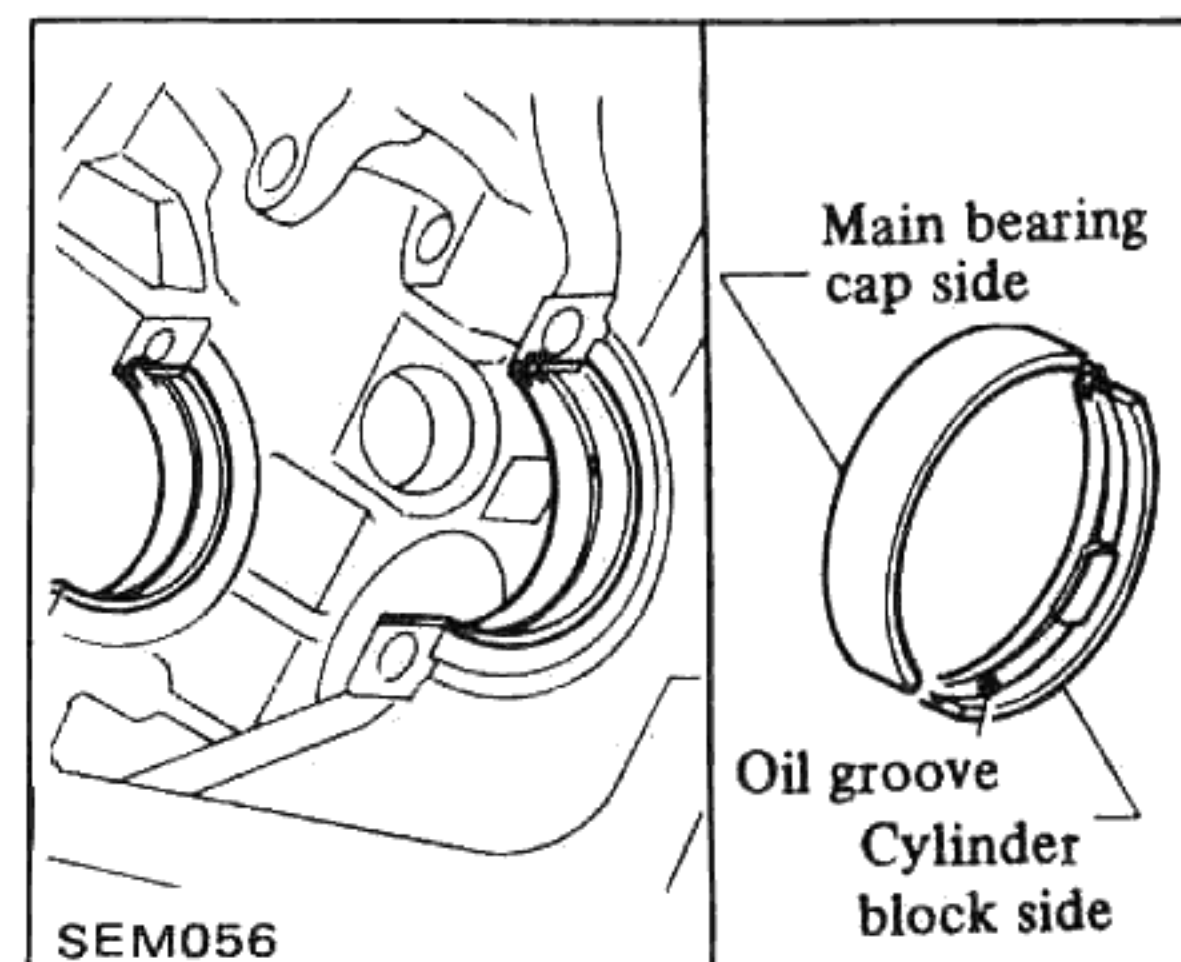
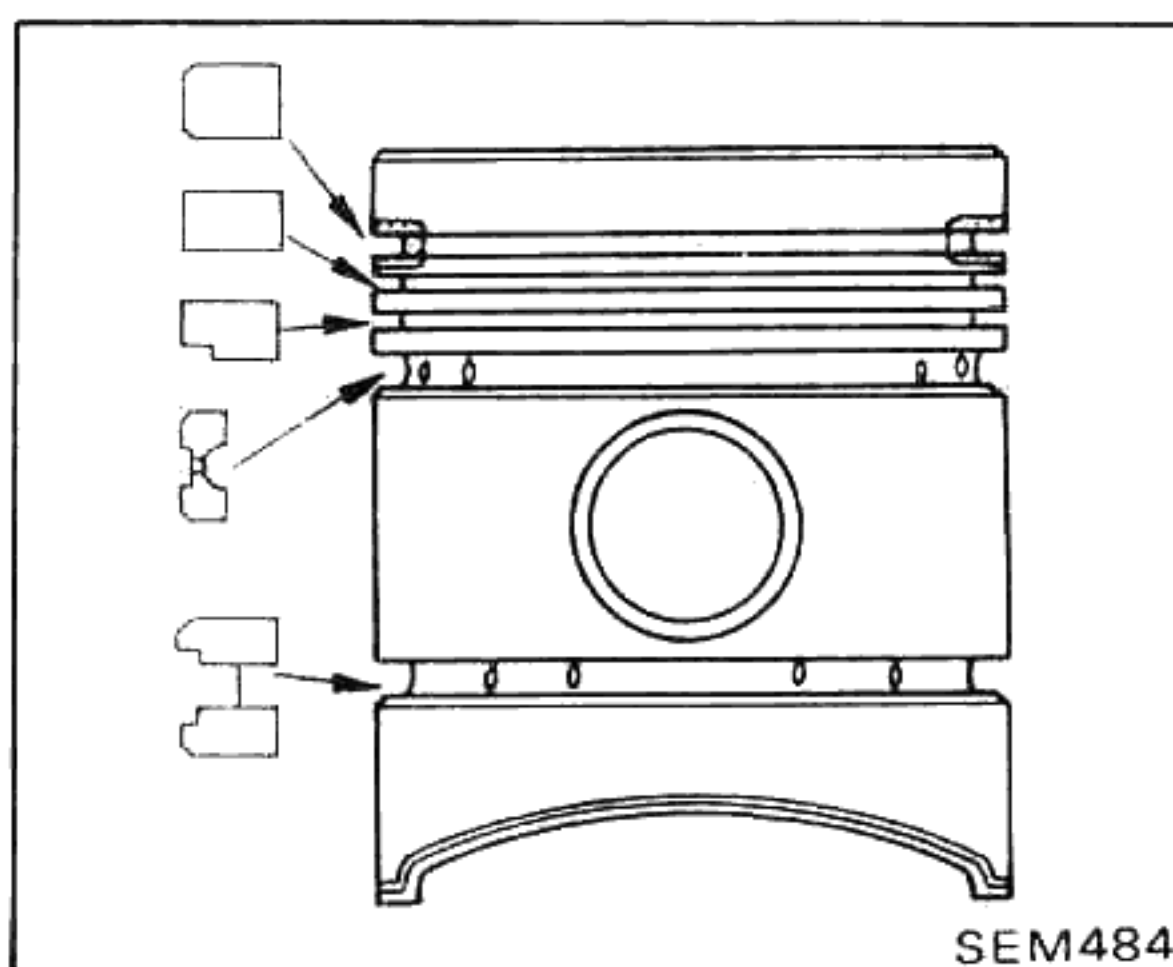
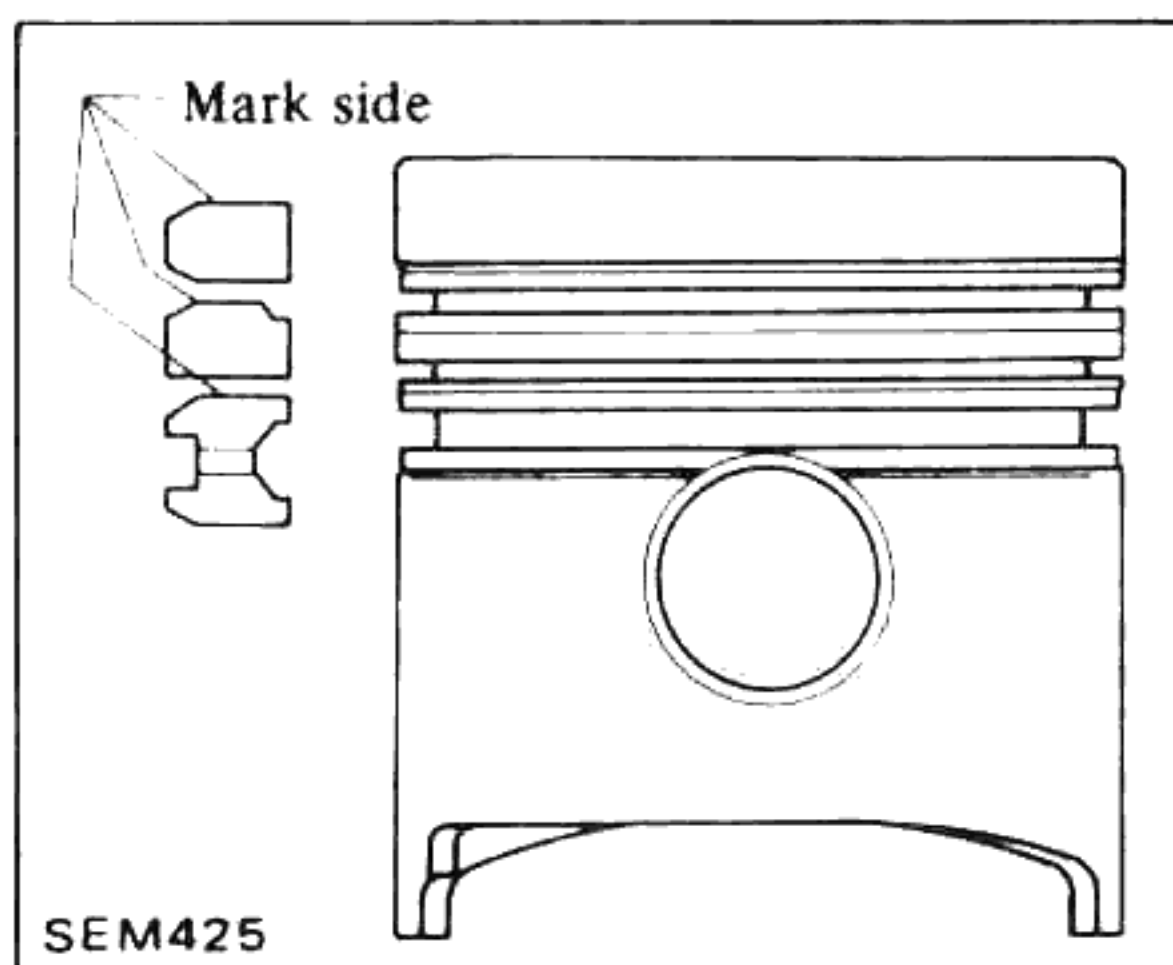
## SD series 5-bearing engine

Install so that connecting rod big end is offset with respect to piston, and that this offset is forward on No. 1 and No. 3 cylinders with respect to engine and rearward on No. 2 and No. 4 cylinders.

Additionally, the leaf type combustion chamber on piston head must be at right side of engine.



Install piston ring so that mark stamped on ring faces upward.



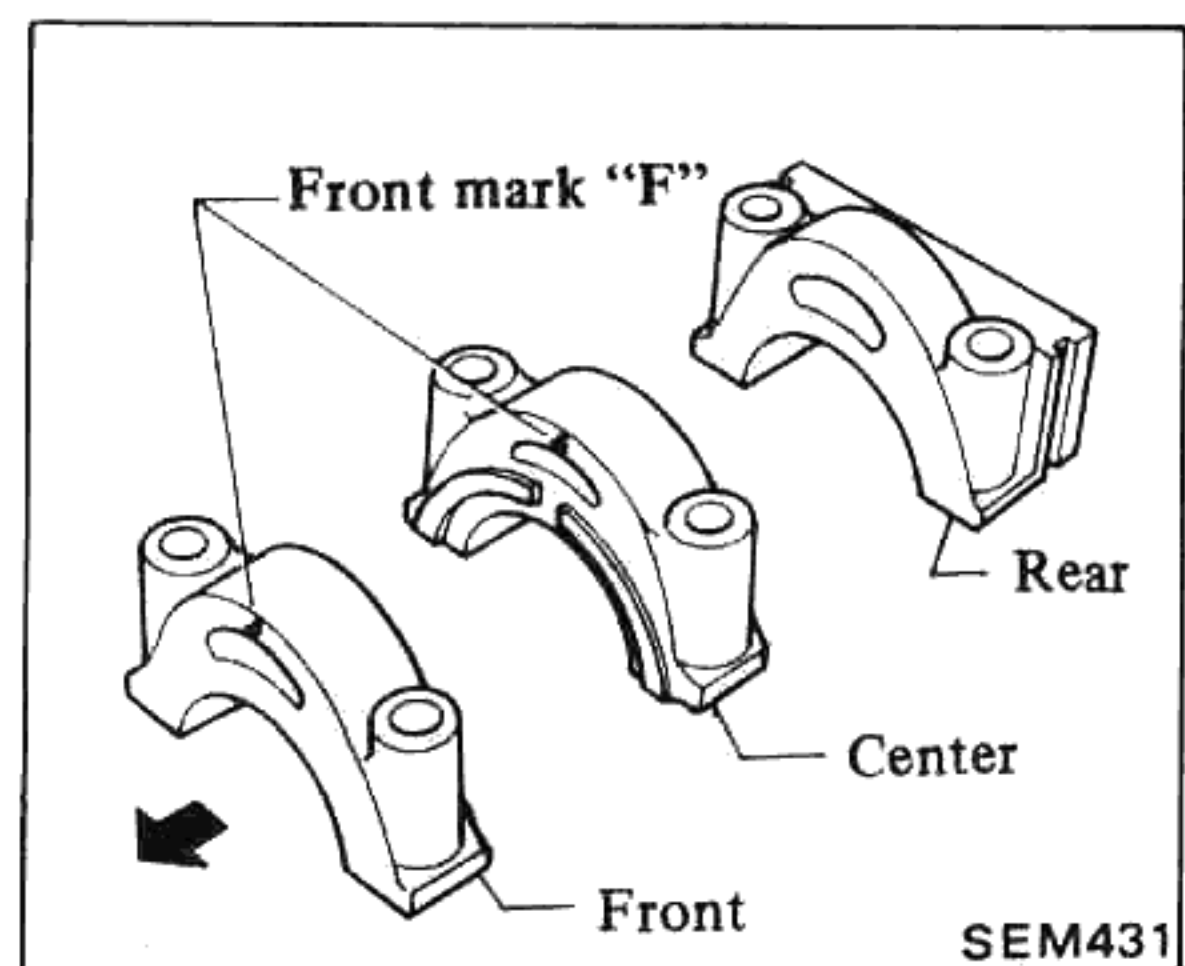
b. Only apply engine oil to inside of bearing.

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

(3) Install main bearing caps.

3 bearings (SD22) & 4 bearings (SD33)

a) Install main bearing cap so that embossed "F" mark is at front side of vehicle.

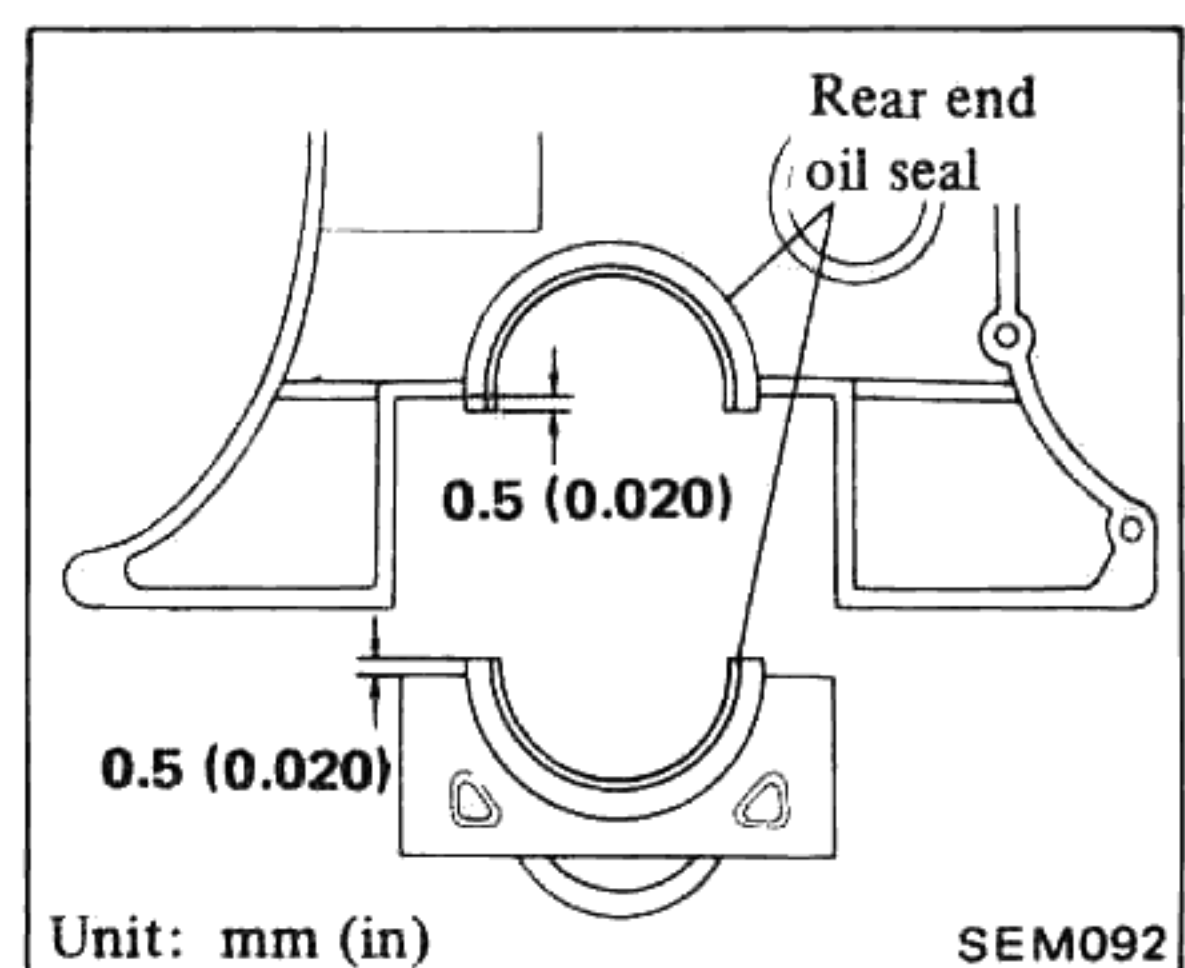


b) Apply engine oil to main bearing cap and cylinder block contact surfaces.

c) Install rear end oil seals to main bearing cap and cylinder block by hand so that they are protruded by 0.5 mm (0.020 in) from end surface.

Apply grease to contact surface of rear end oil seal and crankshaft.

**Do not depress oil seal at middle portion.**



## ASSEMBLING ENGINE OVERALL

### INSTALLING INTERNAL PARTS

First, mount cylinder block on work stand (refer to Engine Disassembly).

Then install following parts:

1. Install front plate, and measure front plate warpage.
2. Install valve lifter with engine oil coated.
3. Install camshaft assembly with engine oil applied to bushing.
4. Crankshaft

(1) Set upper main bearings at the proper position on cylinder block.

a. Install bearing so that side with oil groove is on cylinder block side and side without oil groove is on cap side.



# INSPECTION AND REPAIR

Clean all removed parts in cleaning oil, eliminating obstacles or dust/dirt from passages or holes. Also check these parts to make sure they are free from cracks or flaws.

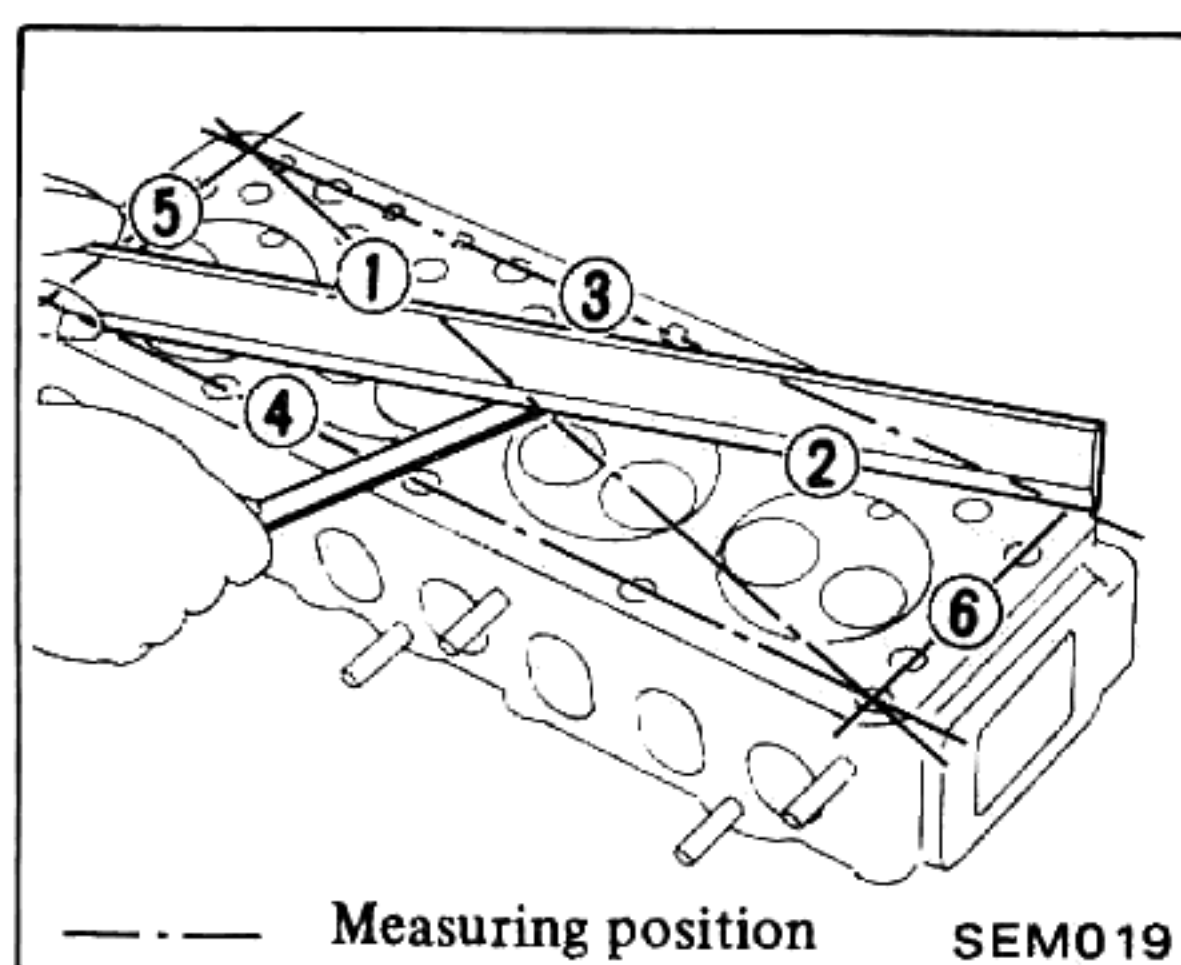
## CYLINDER HEAD AND VALVE

### CHECKING CYLINDER HEAD MATING FACE

Measure the surface of cylinder head (on cylinder block side) for warpage.

**Warpage of surface:**

**Less than**  
**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.

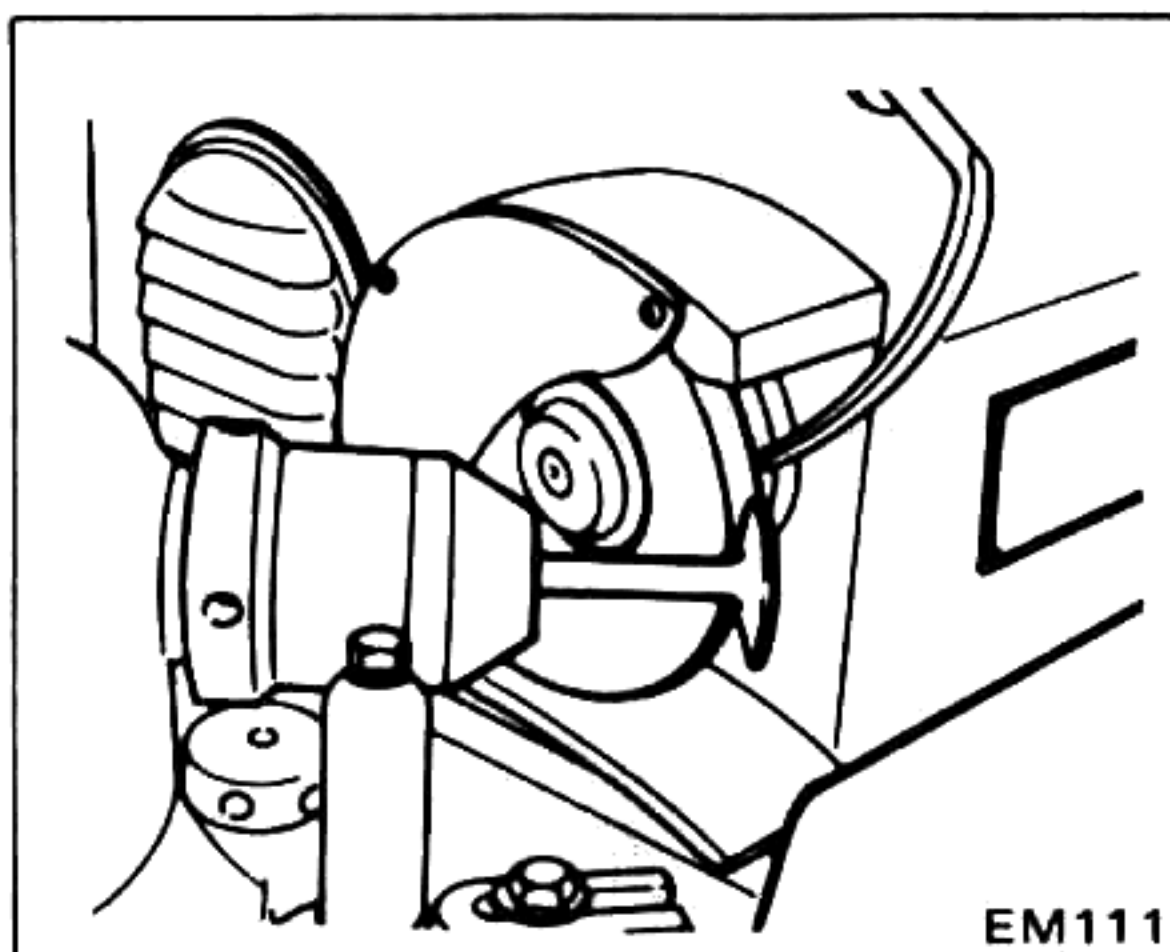
### VALVE

1. Check each of the intake and exhaust valve for worn, damaged or deformed valve stems. Correct or replace the valve that is faulty.

For standard size of valve, refer to S.D.S.

2. Valve face or valve stem end surface should be refaced by using a valve grinder.

**Valve face angle:**  
**45° - 45°30'**



### 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.

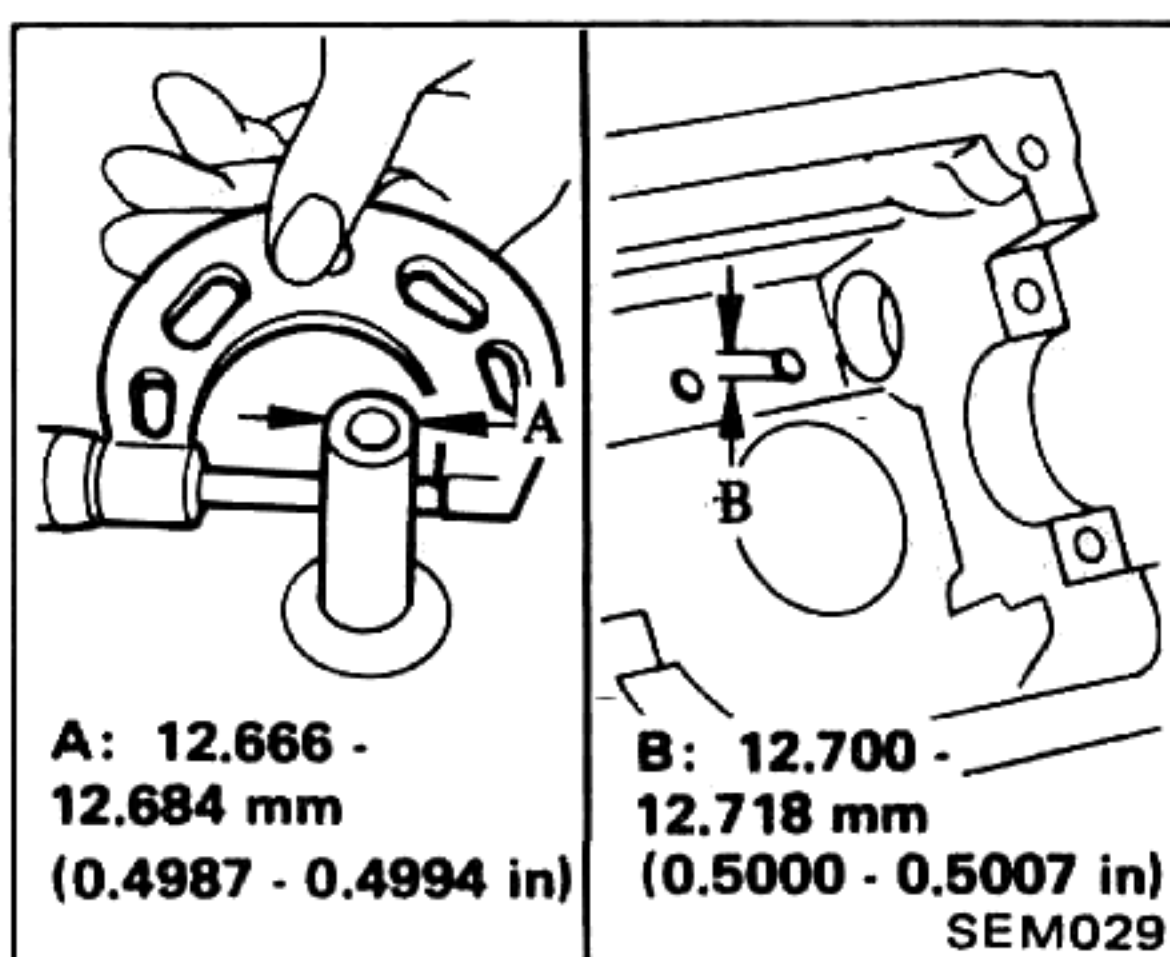
- a. Valve lifter end should be smooth.
- b. Valve lifter to lifter hole clearance:

**Standard**

**0.016 - 0.052 mm**  
**(0.0006 - 0.0020 in)**

**Limit**

**Less than**  
**0.10 mm (0.0039 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:**

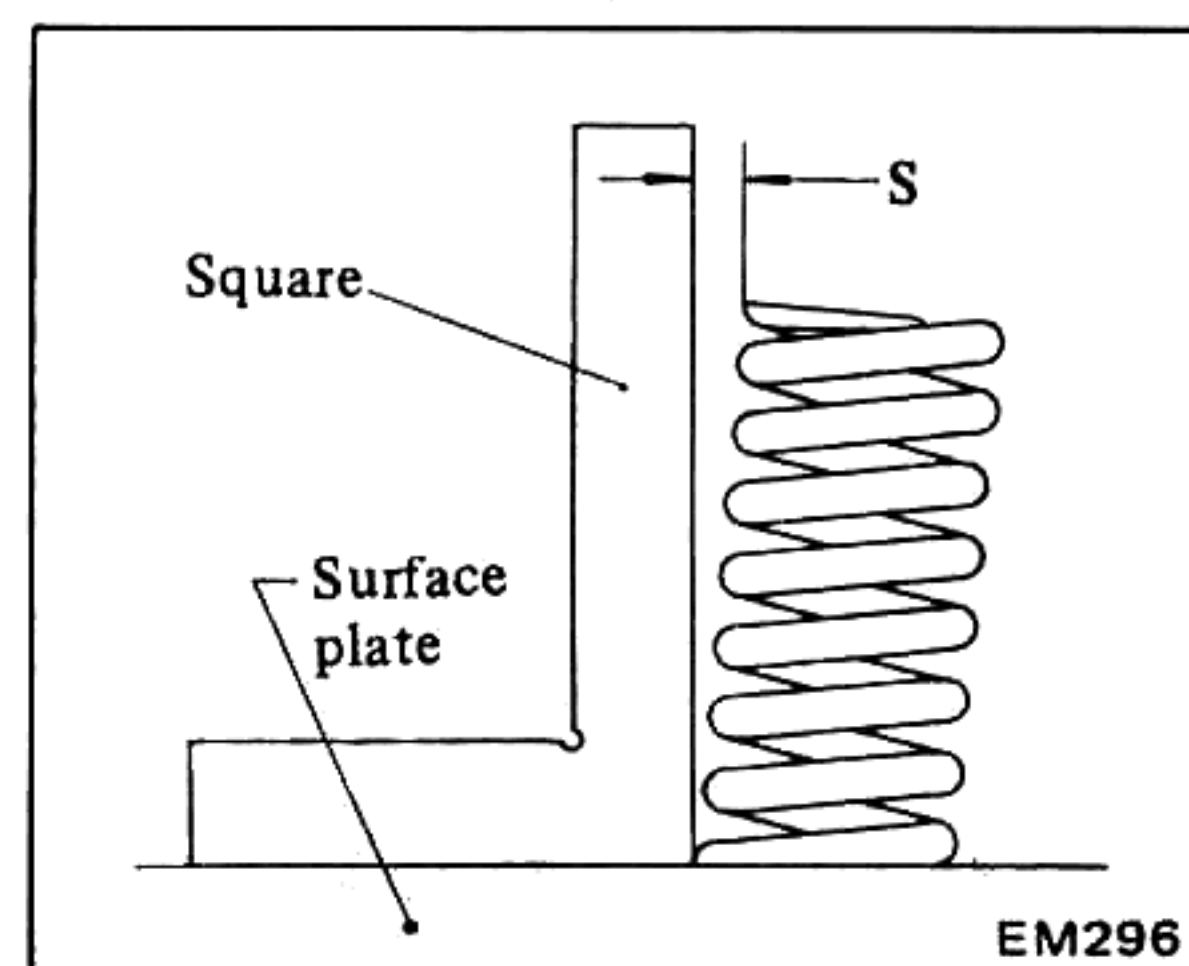
**Less than**  
**0.5 mm**  
**(0.020 in)**

### VALVE SPRING

1. Check valve spring for squareness using a steel square and surface plate. If spring is out of square "S" more than specified limit, replace with new ones.

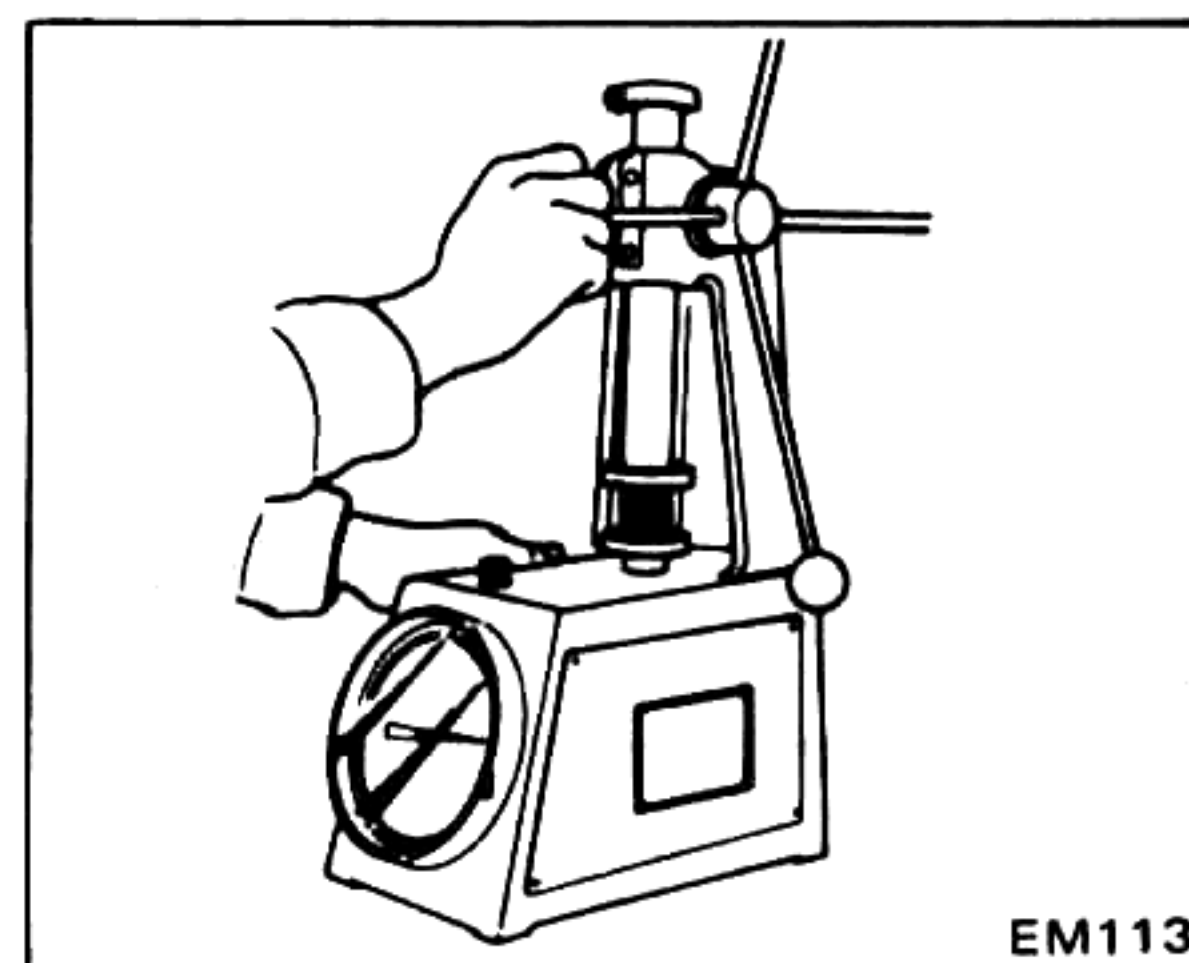
**Out of square ("S"):**

**Less than**  
**1.3 mm (0.051 in)**



2. Measure free length and tension of spring. If measured value exceeds specified limit, replace spring.

Refer to S.D.S.



### VALVE ROCKER ASSEMBLY

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



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

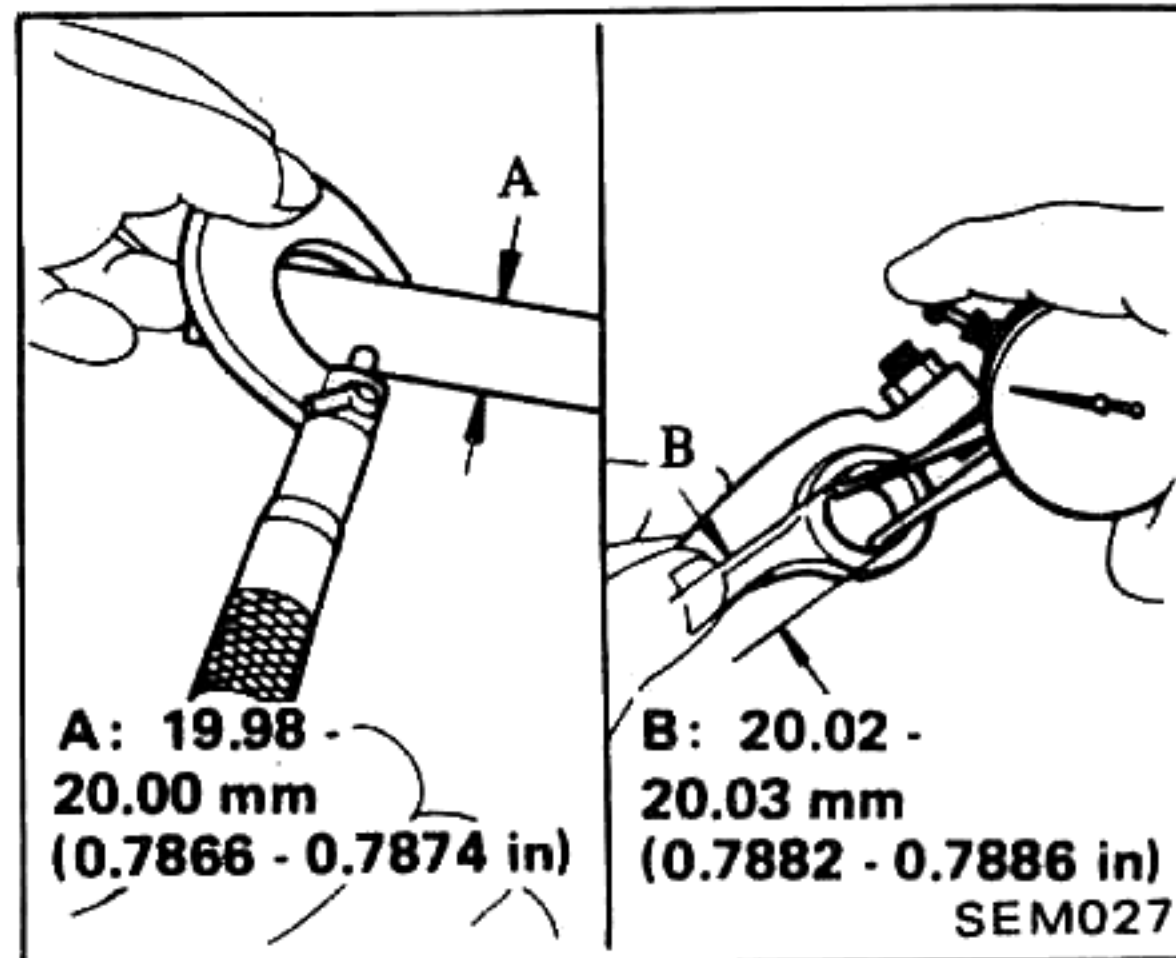
**Specified clearance:**

**Standard**

**0.02 - 0.05 mm  
(0.0008 - 0.0020 in)**

**Limit**

**Less than  
0.15 mm (0.0059 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**

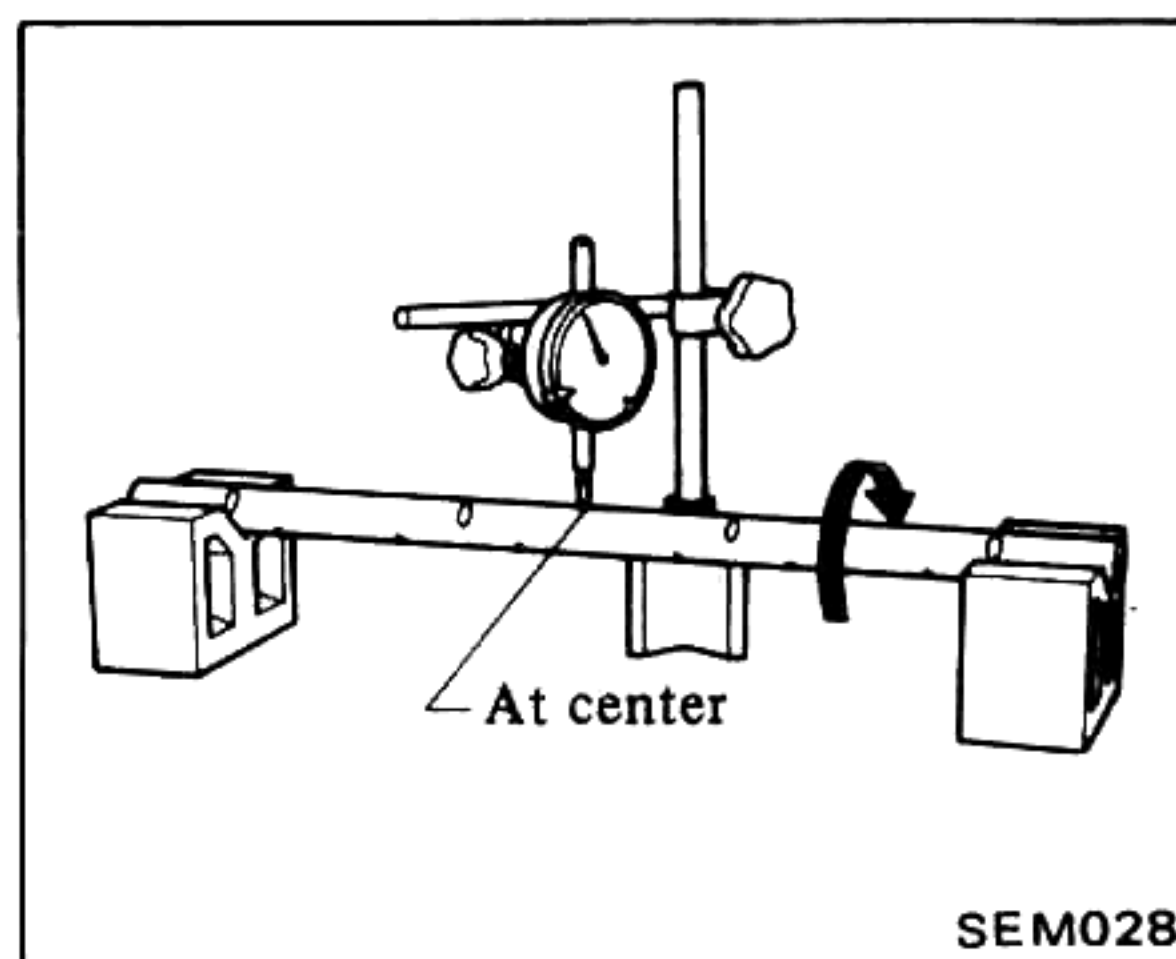
**(Total indicator reading):**

**Standard**

**0 - 0.1 mm (0 - 0.004 in)**

**Limit**

**Less than  
0.3 mm (0.012 in)**



**VALVE GUIDE (SD23 and SD25)**

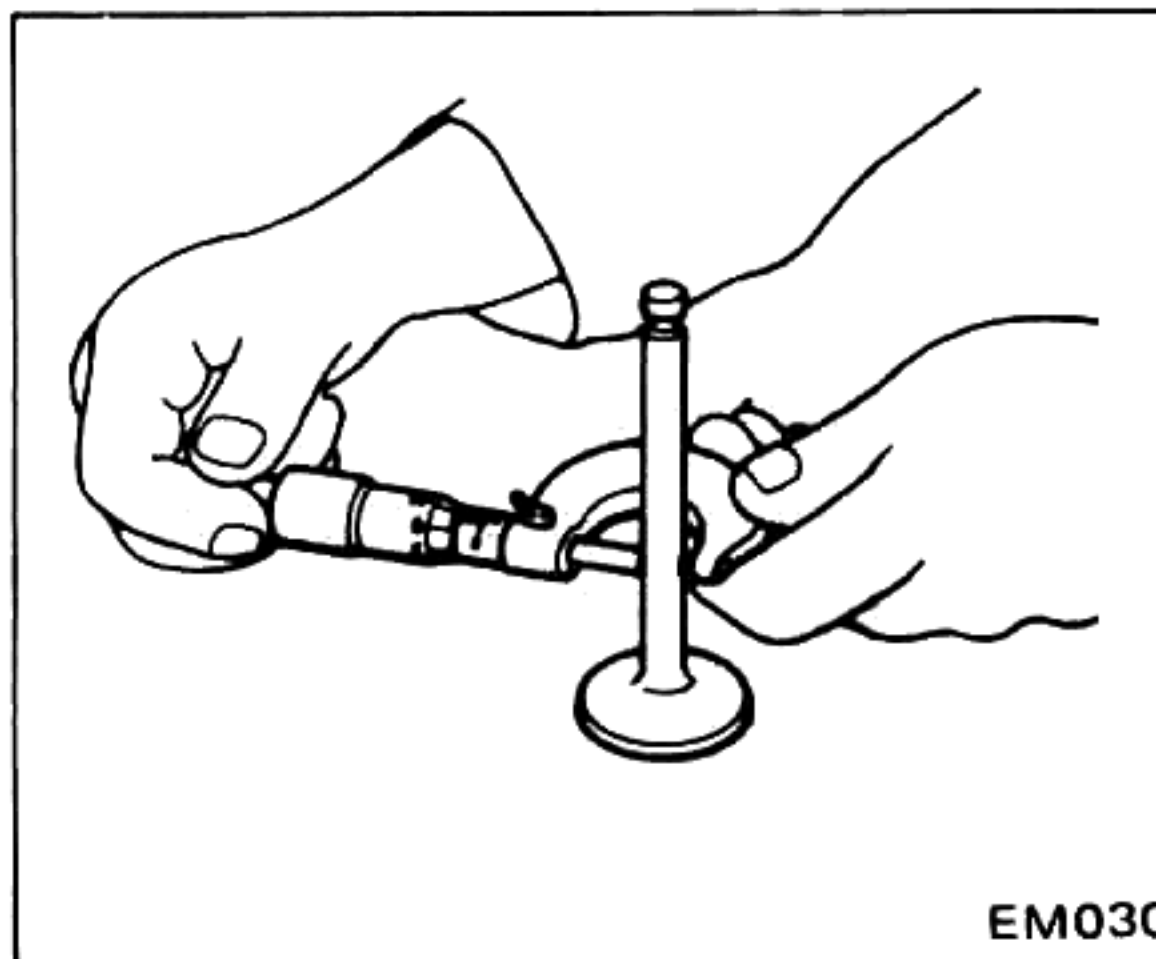
Measure the clearance between valve guide and valve stem. If the clearance exceeds the specified limit, replace the worn parts or both valve and valve guide. In this case, it is

essential to determine if such a clearance has been caused by a worn or bent valve stem or by a worn valve guide.

**Determining clearance**

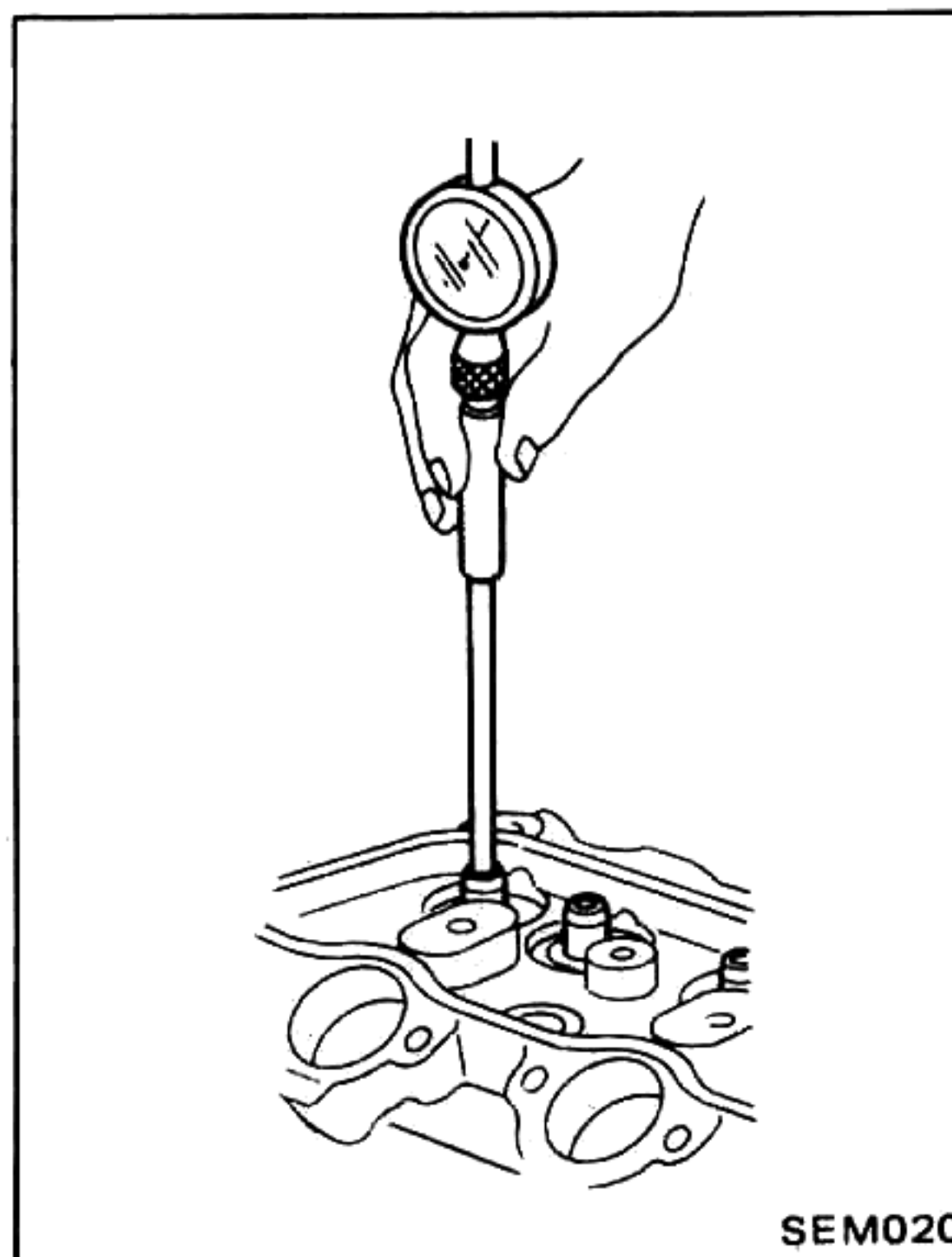
1. Precise method

(1) Measure diameter of valve stem in three places: top, center, and bottom. Refer to S.D.S.



(2) Measure valve guide bore at center using telescope hole gauge.

(3) Subtract the highest reading of valve stem diameter from valve guide bore to obtain the stem to guide clearance.



**Stem to guide clearance:**

**Standard**

**Intake**

**0.015 - 0.045 mm  
(0.0006 - 0.0018 in)**

**Exhaust**

**0.04 - 0.07 mm  
(0.0016 - 0.0028 in)**

**Max. tolerance**

**Intake**

**Less than  
0.15 mm (0.0059 in)**

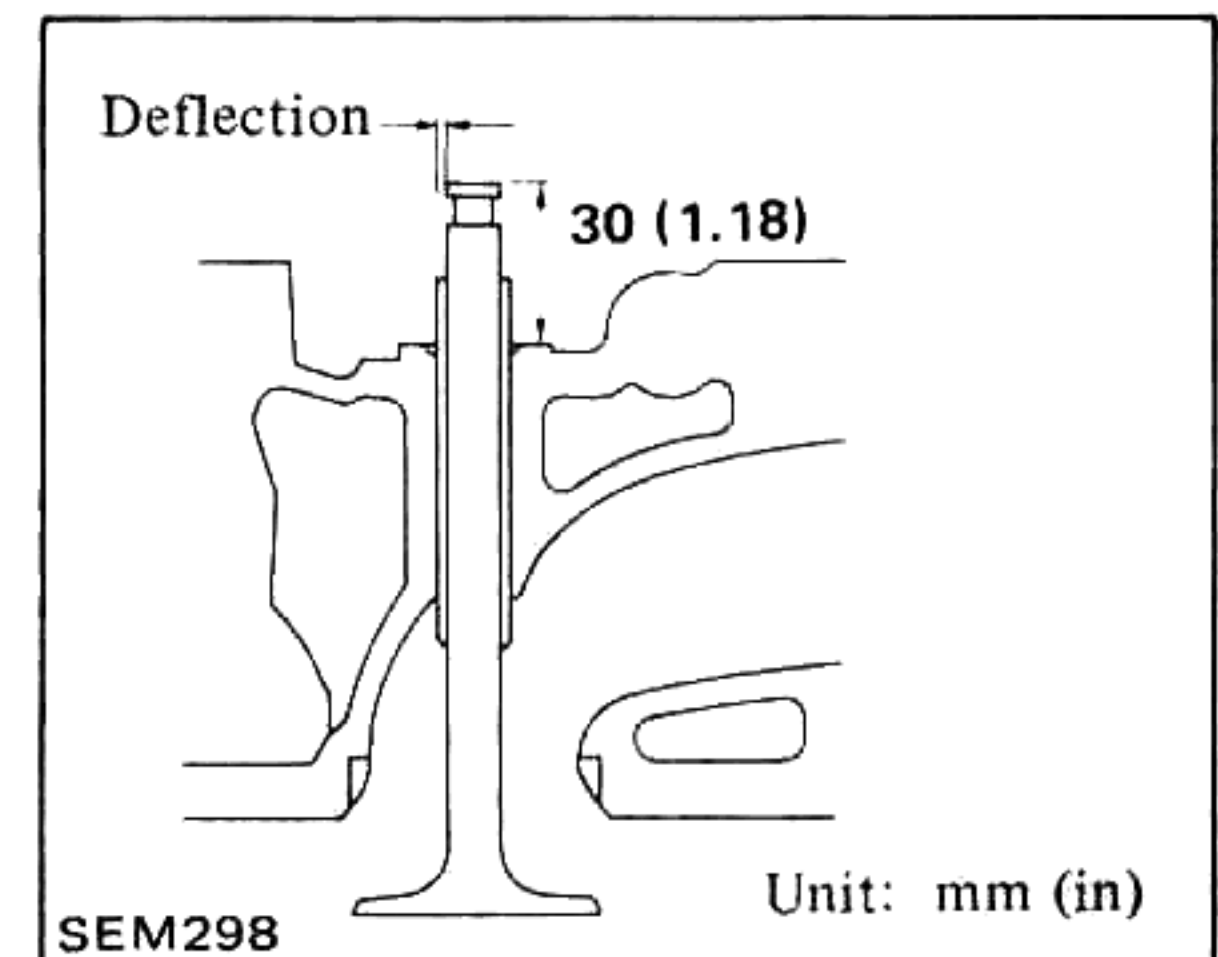
**Exhaust**

**Less than  
0.20 mm (0.0079 in)**

2. Expedient method

Pry the valve in a lateral direction, and measure the deflection at stem tip with dial gauge.

**Stem to guide clearance is 1/2 of measured value.**



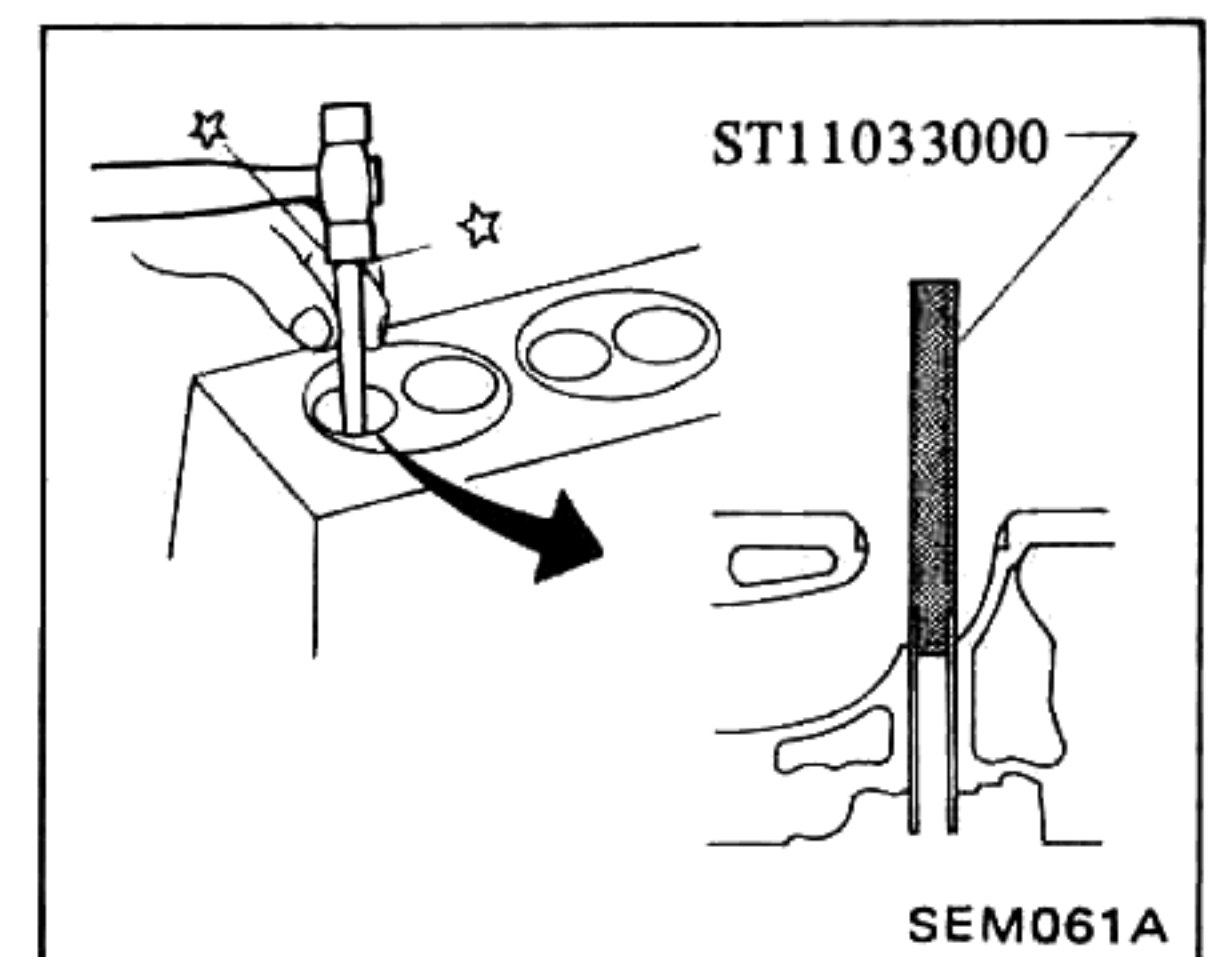
**Valve should be moved in parallel with rocker arm. (Generally, a large amount of wear occurs in this direction.)**

**Replacement of valve guide**

To remove old guides, use a press (under a 2-ton pressure) or a hammer, and Tool.

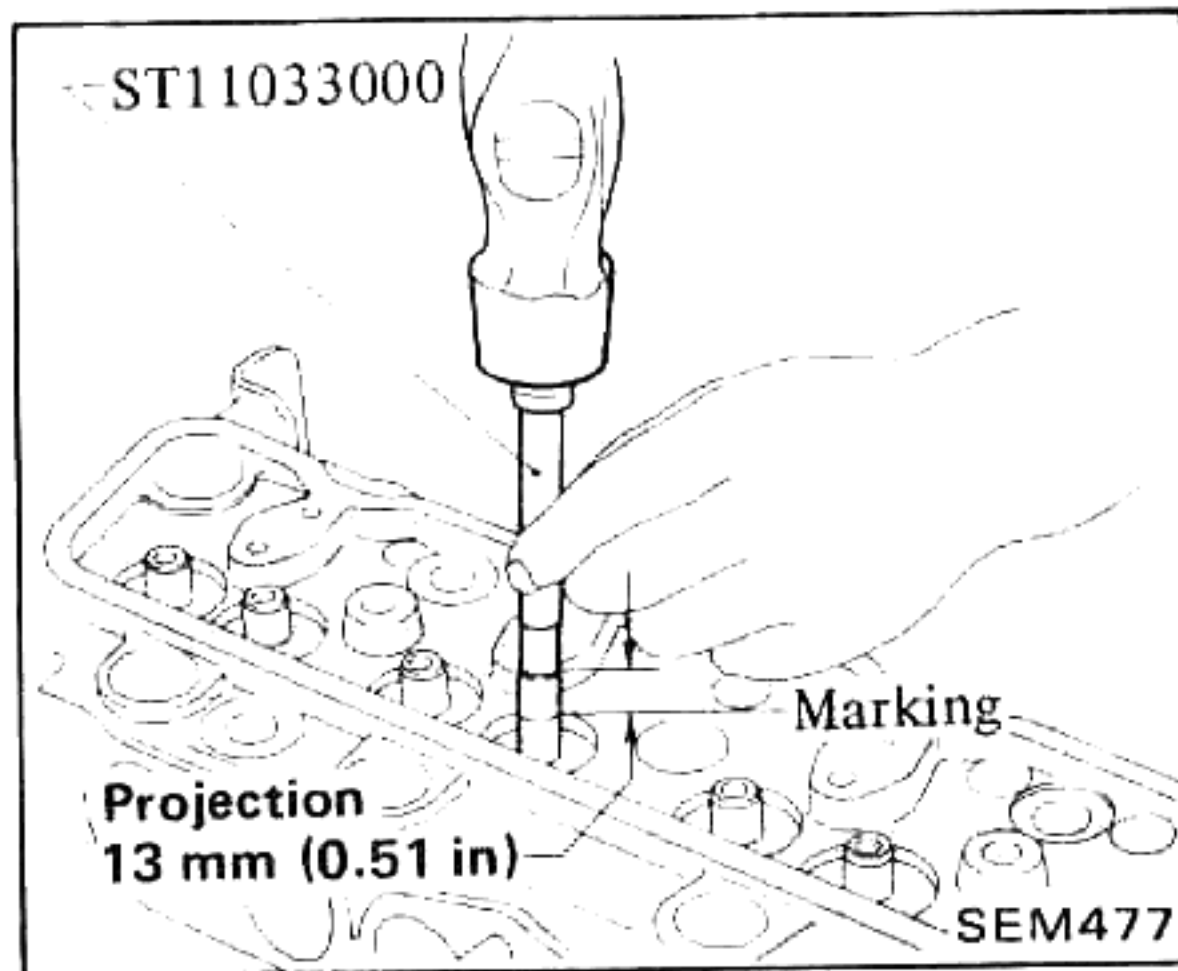
1. Drive them out toward rocker cover side using Tool.

Heating the cylinder head will facilitate the operation.





2. Install new guide onto cylinder head until the guide projects out 13 mm (0.51 in).



3. Ream the bore using Tool ST11032000.

Reaming bore:  
8.000 - 8.015 mm  
(0.3150 - 0.3156 in)

## VALVE STEM HOLE (SD22 and SD33) (Cylinder head)

Measure clearance between valve stem hole (cylinder head) and valve stem. If clearance exceeds specified limit, replace worn parts.

### Determining clearance

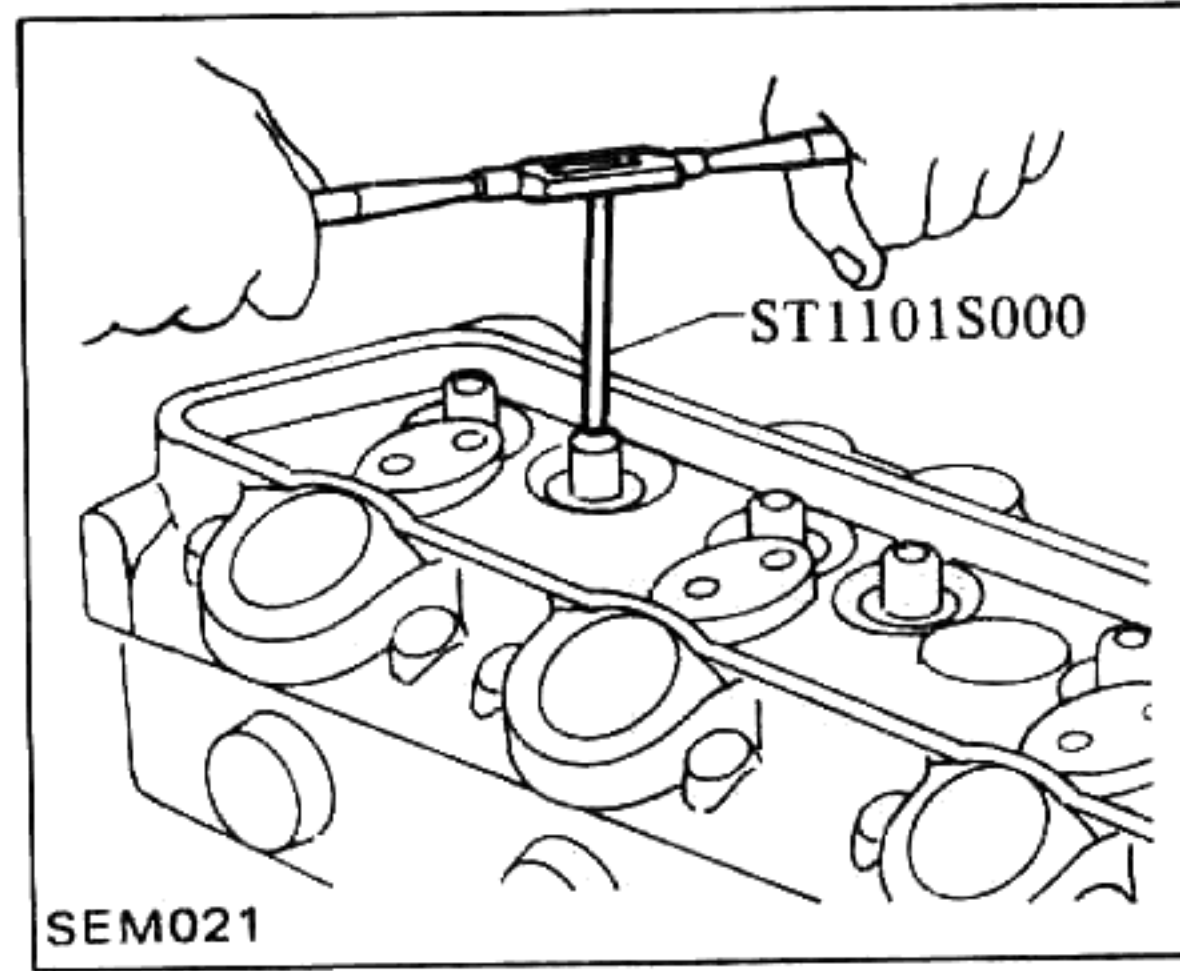
Refer to Valve Guide for determining clearance check method.

1. If valve stem clearance exceeds limit, grind valve stem hole and use oversize intake and exhaust valves.

Select oversize valve stem so that clearance between valve stem hole and stem is less than 0.15 mm (0.0059 in) at intake side and less than 0.20 mm (0.0079 in) at exhaust side.

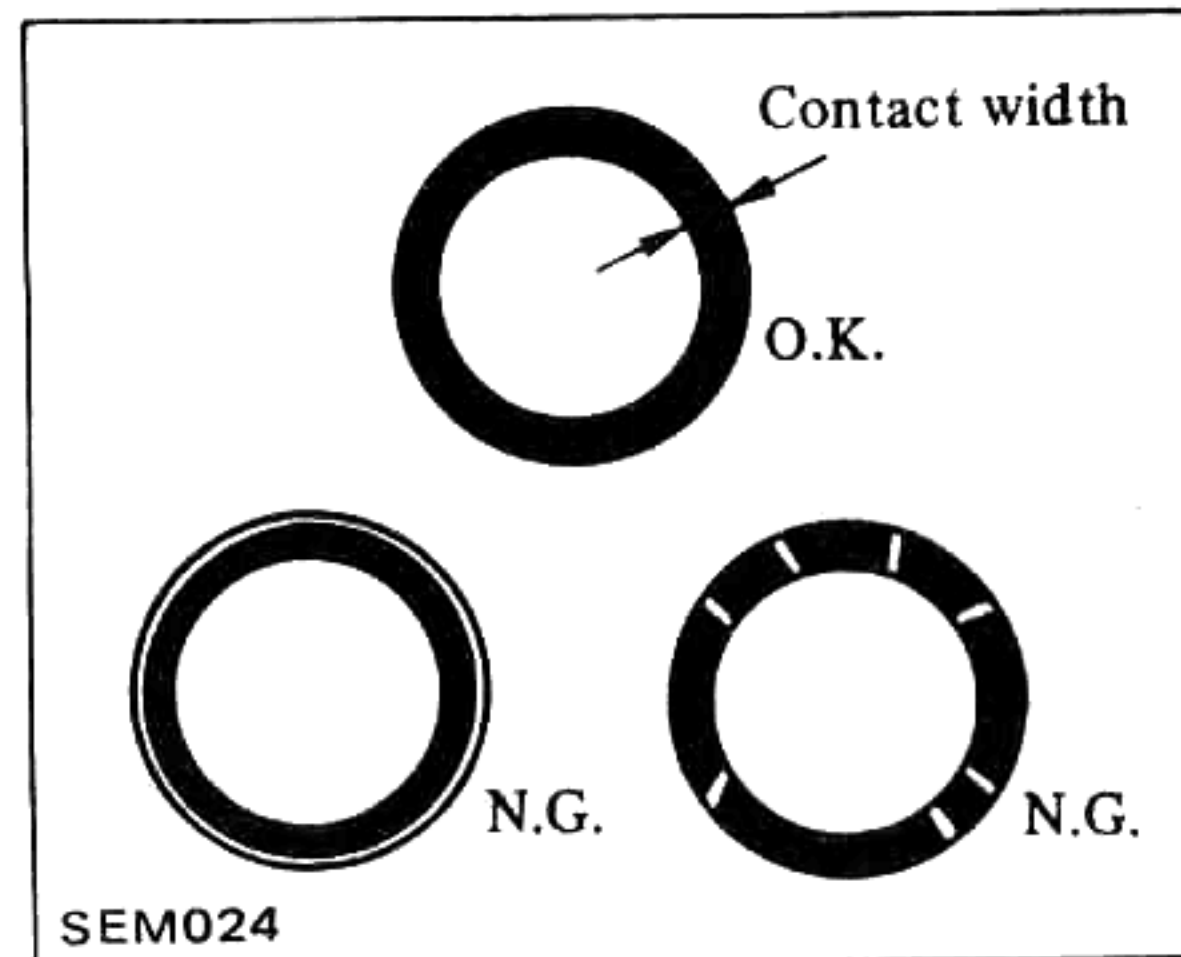
Unit: mm (in)

| Grinding valve stem hole diameter  | Diameter of oversize valve stem to be used |
|------------------------------------|--------------------------------------------|
| 8.200 - 8.215<br>(0.3228 - 0.3234) | 8.2 (0.323)                                |
| 8.400 - 8.415<br>(0.3307 - 0.3313) | 8.4 (0.331)                                |



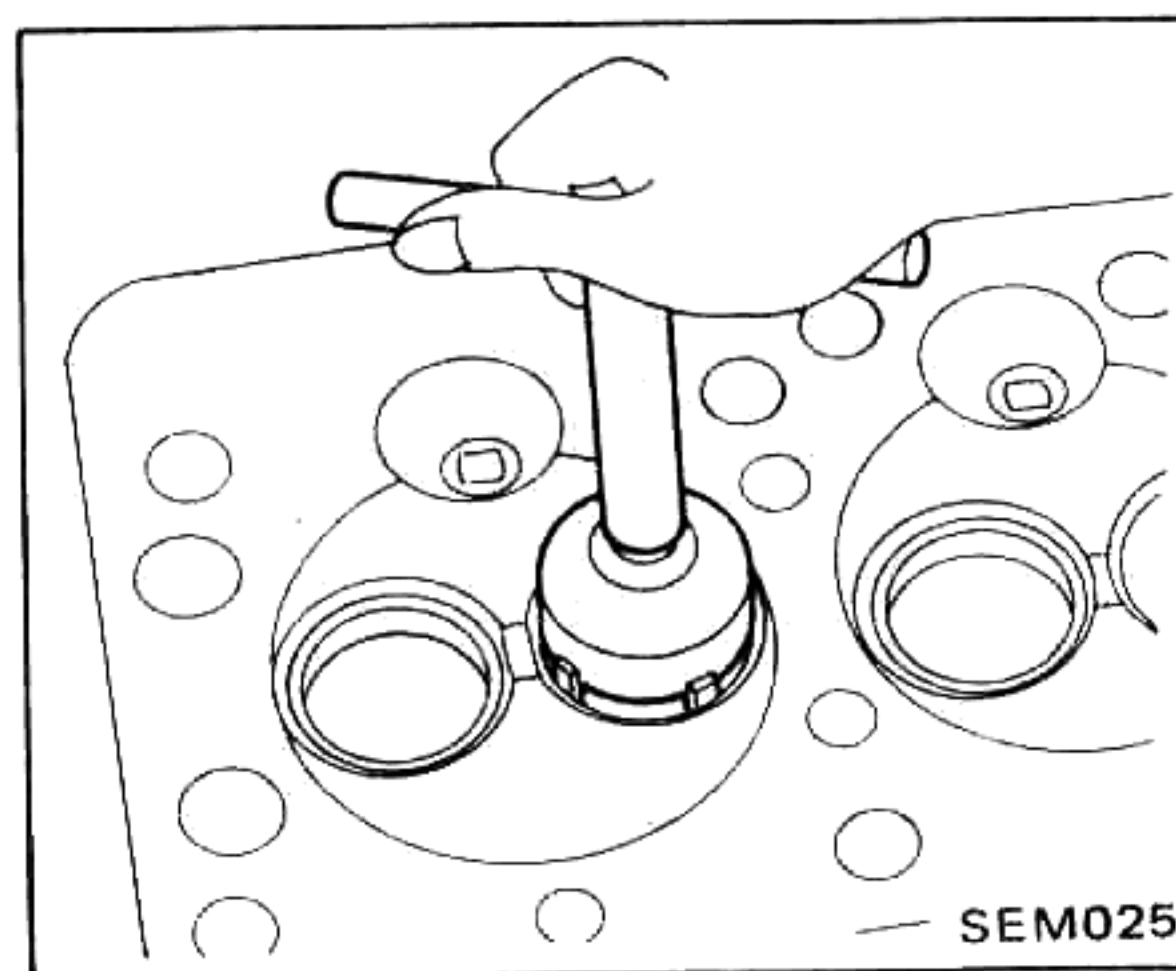
## VALVE SEAT INSERTS

1. Check contact width and state of contact between valve and valve seat.



2. Reface valve seat with valve seat cutter.

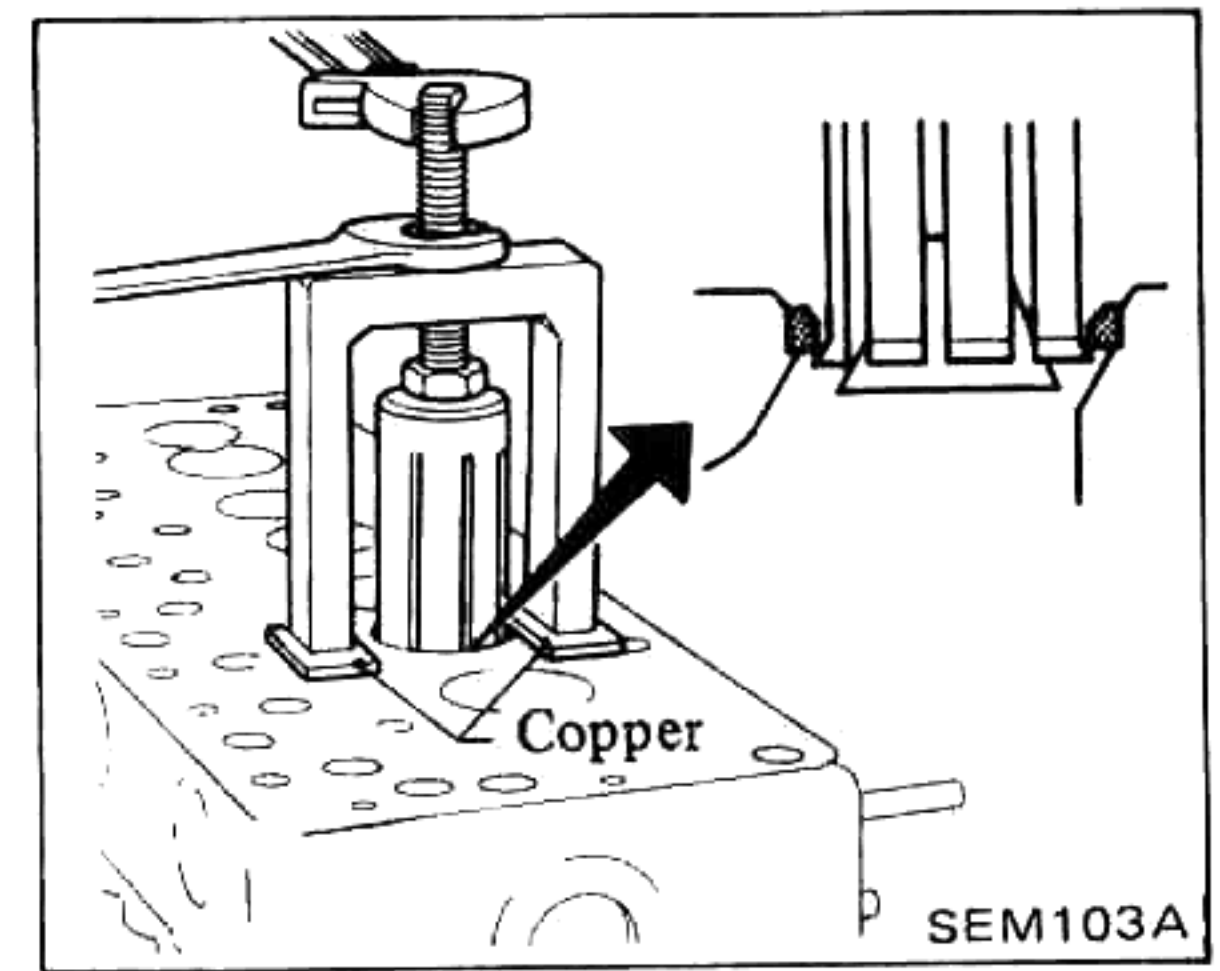
Valve seat surface:  
Refer to S.D.S.



## Valve seat insert replacement

1. Remove valve seats with Tool.

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



2. Install new valve seats.

- a. Eliminate the old staked lugs (Exhaust side).
- b. Oversize exhaust valve seats are available as 0.2 and 0.4 mm (0.008 and 0.016 in).

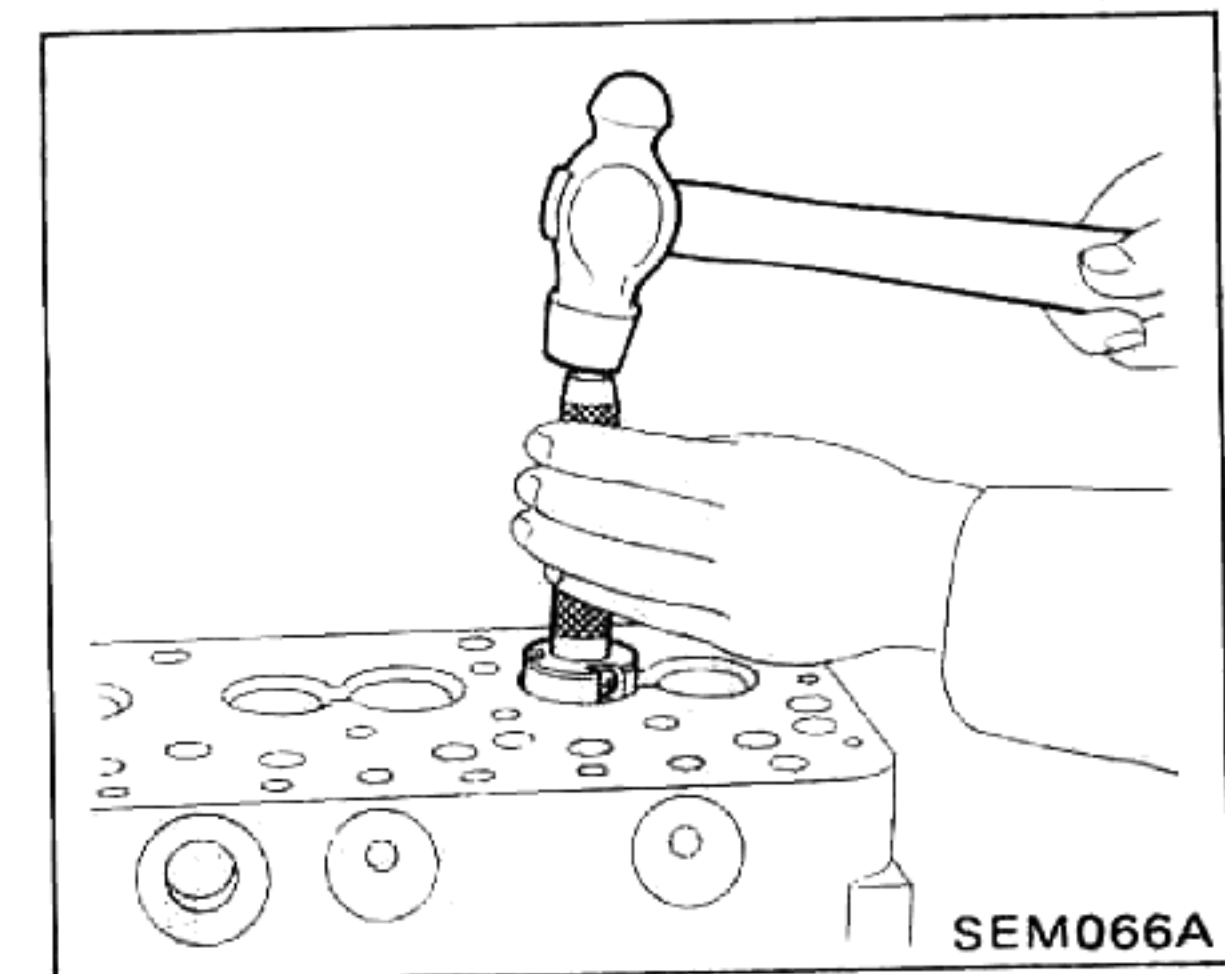
- (1) Place new valve seats dry ice and allow it to cool for five minutes.

### WARNING:

Do not touch cooled valve seats with bare hand.

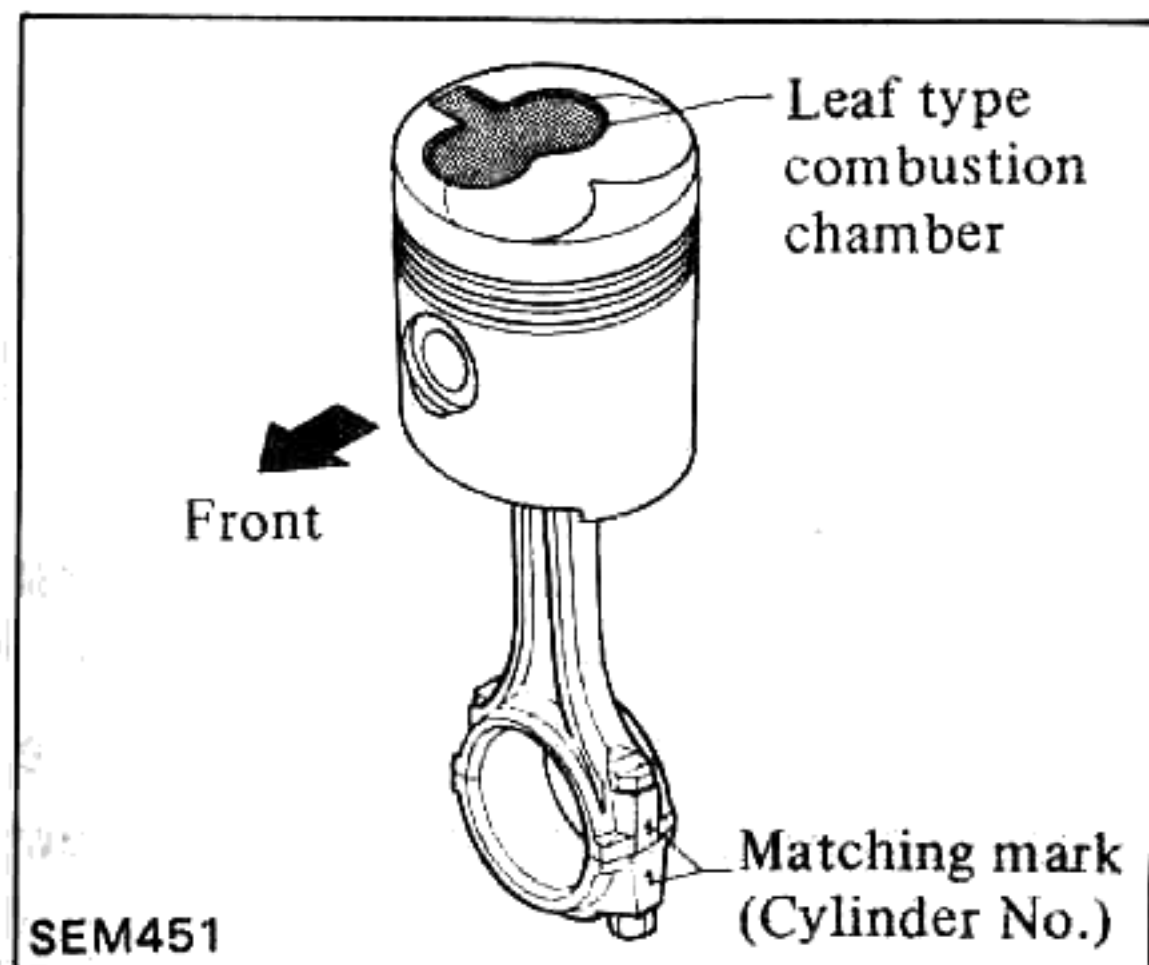
- (2) Heat cylinder head to 80°C (176°F).

- (3) Install cooled valve seats on cylinder head with Tool.





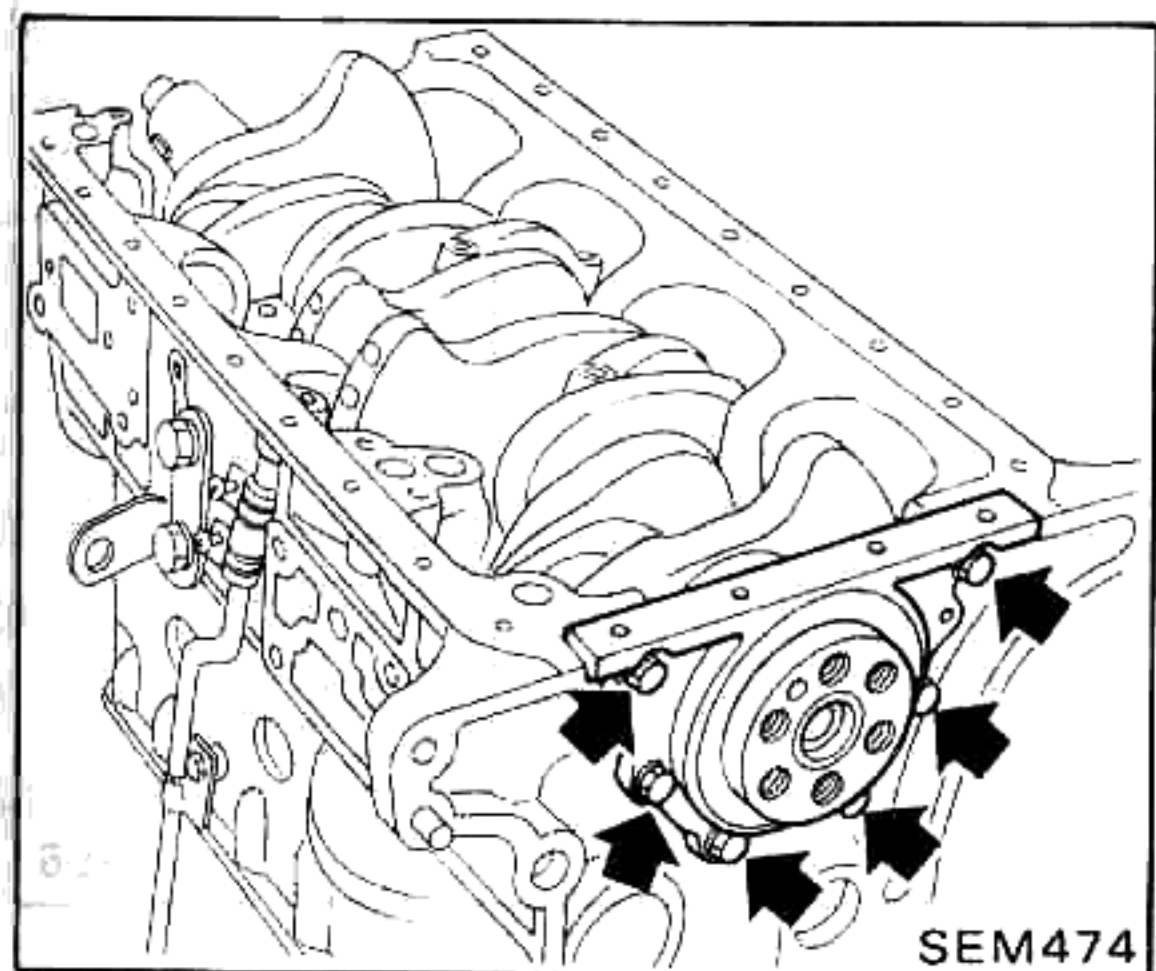
- b. Numbers are stamped on connecting rod and cap corresponding to each cylinder. Care should be taken to avoid a wrong combination including bearing.



## 16. Crankshaft

- (1) 5 bearings (SD 4-cylinder)

- a) Remove rear oil seal assembly.



- b) Remove main bearing cap with bearing.

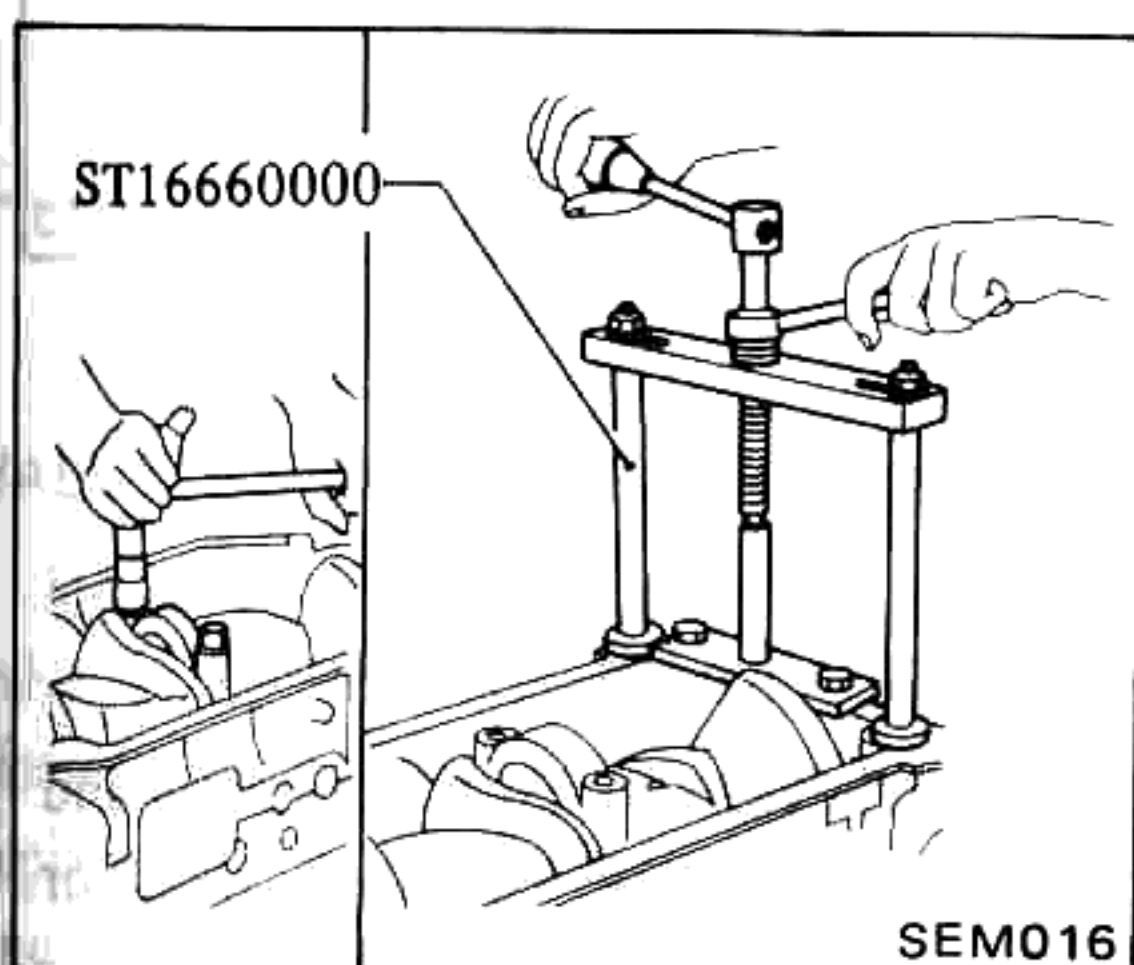
- c) Remove crankshaft and main bearings.

Keep main bearing in correct order.

- (2) 3 bearings (SD22) & 4 bearings (SD33).

- a) Remove main bearing cap with bearing.

Remove rear main bearing cap with Tool.



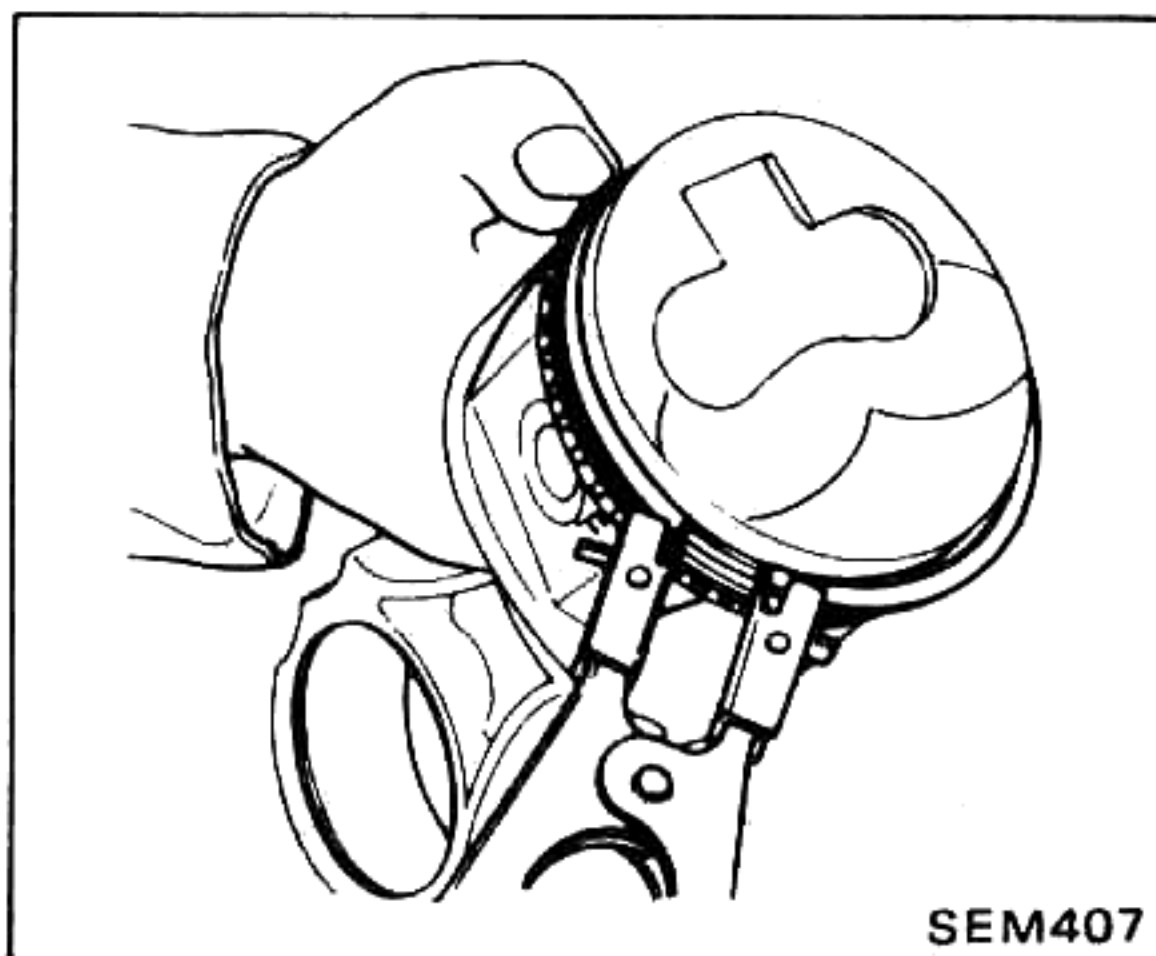
- b) Remove crankshaft and main bearings.

Keep main bearing in correct order.

- c) Remove oil seal from crankshaft and rear main cap.

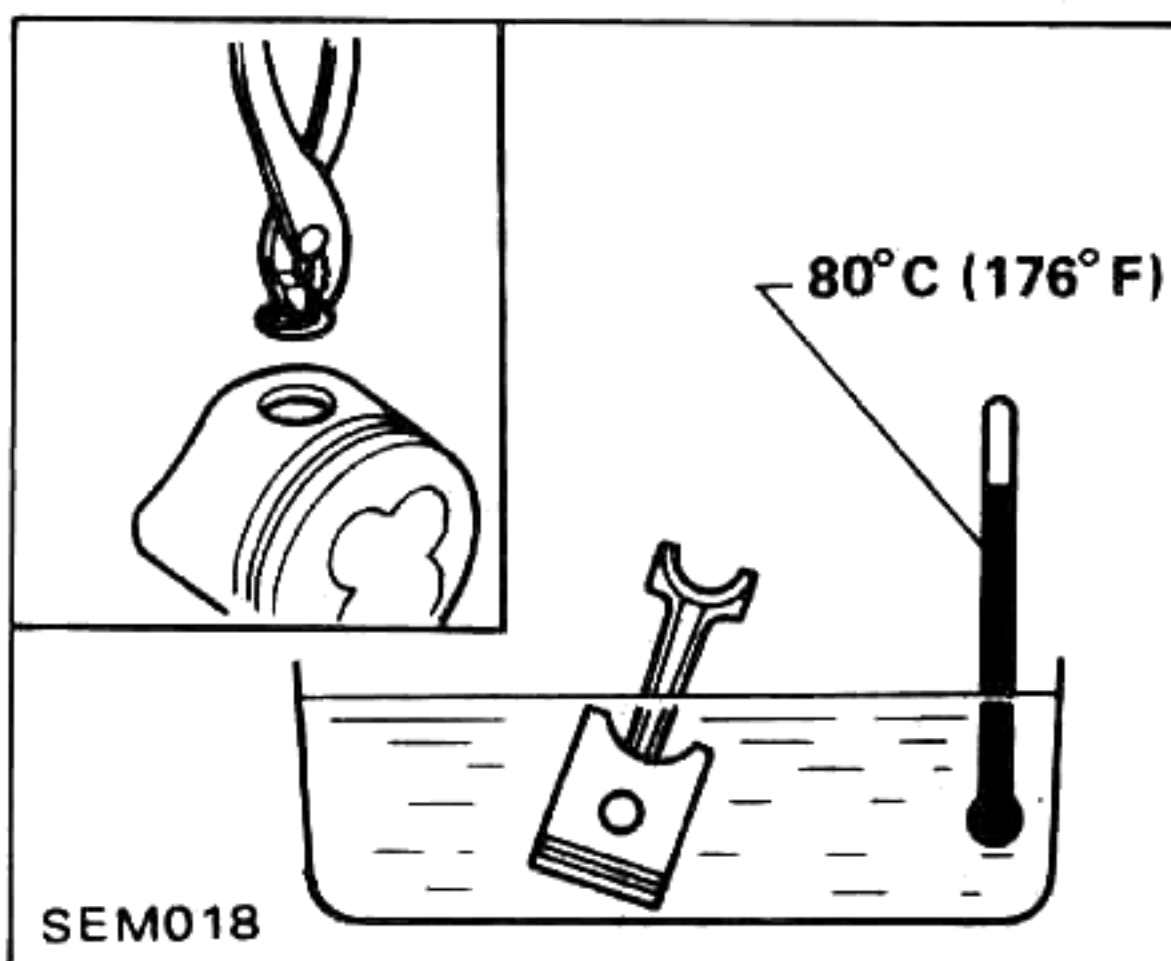
## DISASSEMBLING PISTON AND CONNECTING ROD

1. Remove piston ring with a ring remover.



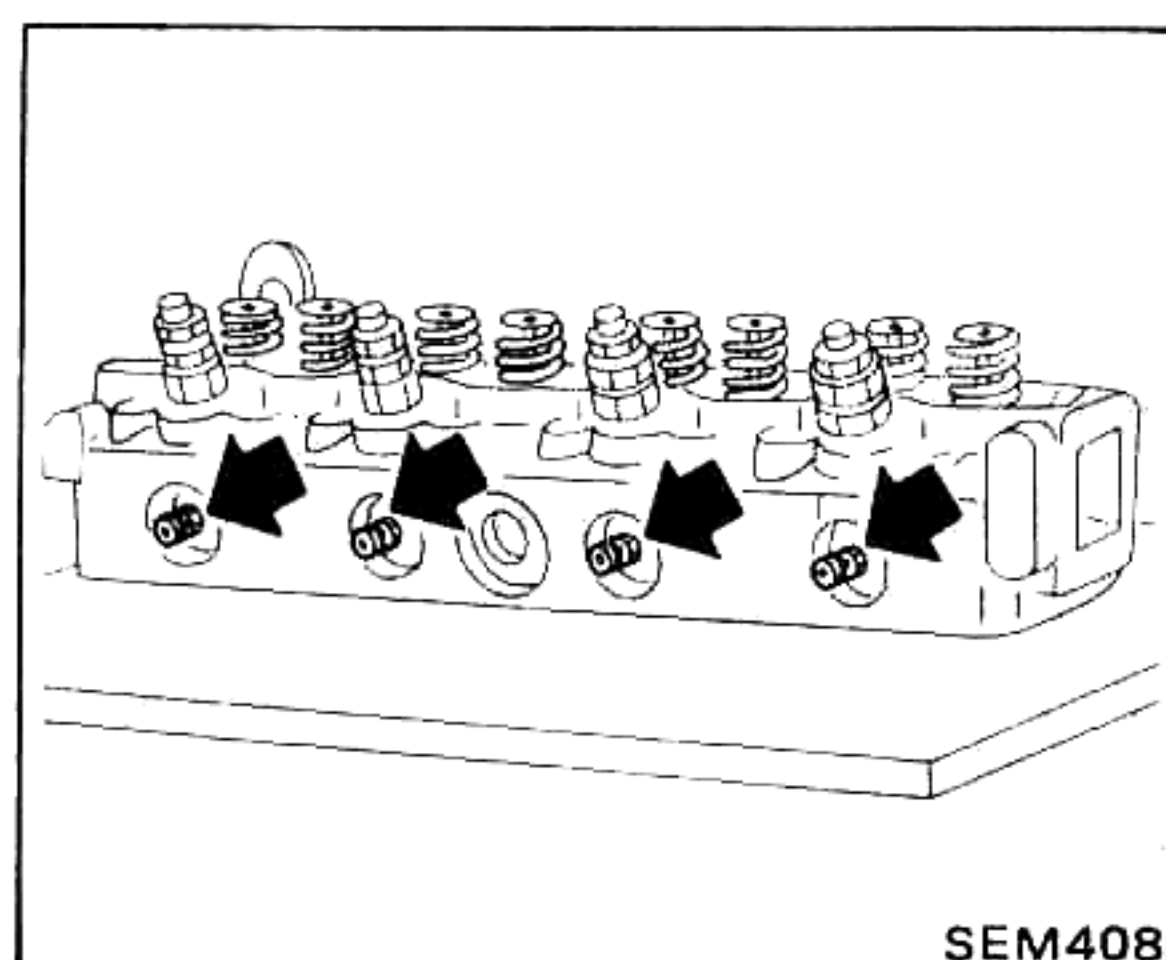
When removing piston rings, be careful not to scratch piston.

2. Remove piston snap rings, and immerse piston in oil of 80°C (176°F), and push out piston pin.

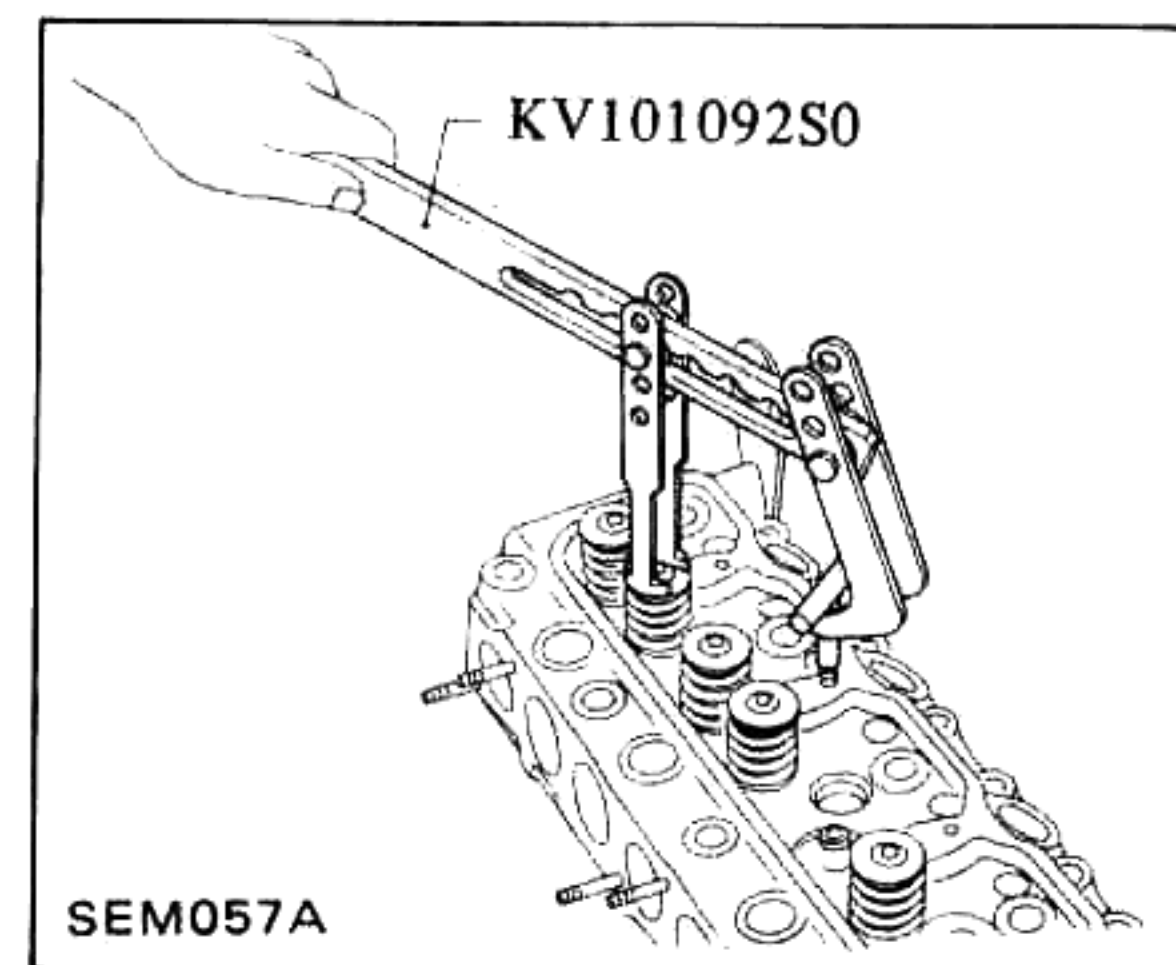


## DISASSEMBLING CYLINDER HEAD

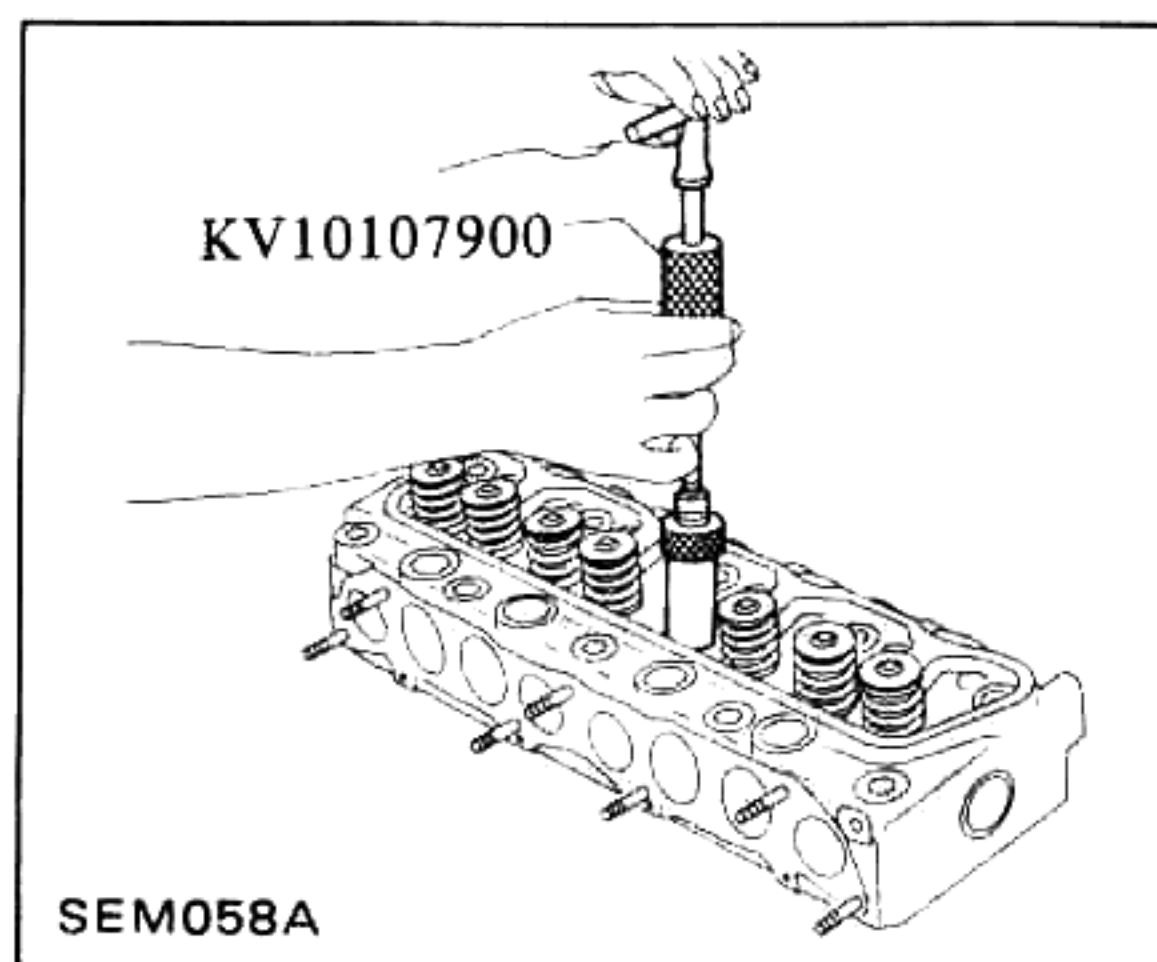
1. Remove glow plugs.



2. Remove valves, valve springs and relating parts using Tool.



3. Remove valve stem seals.



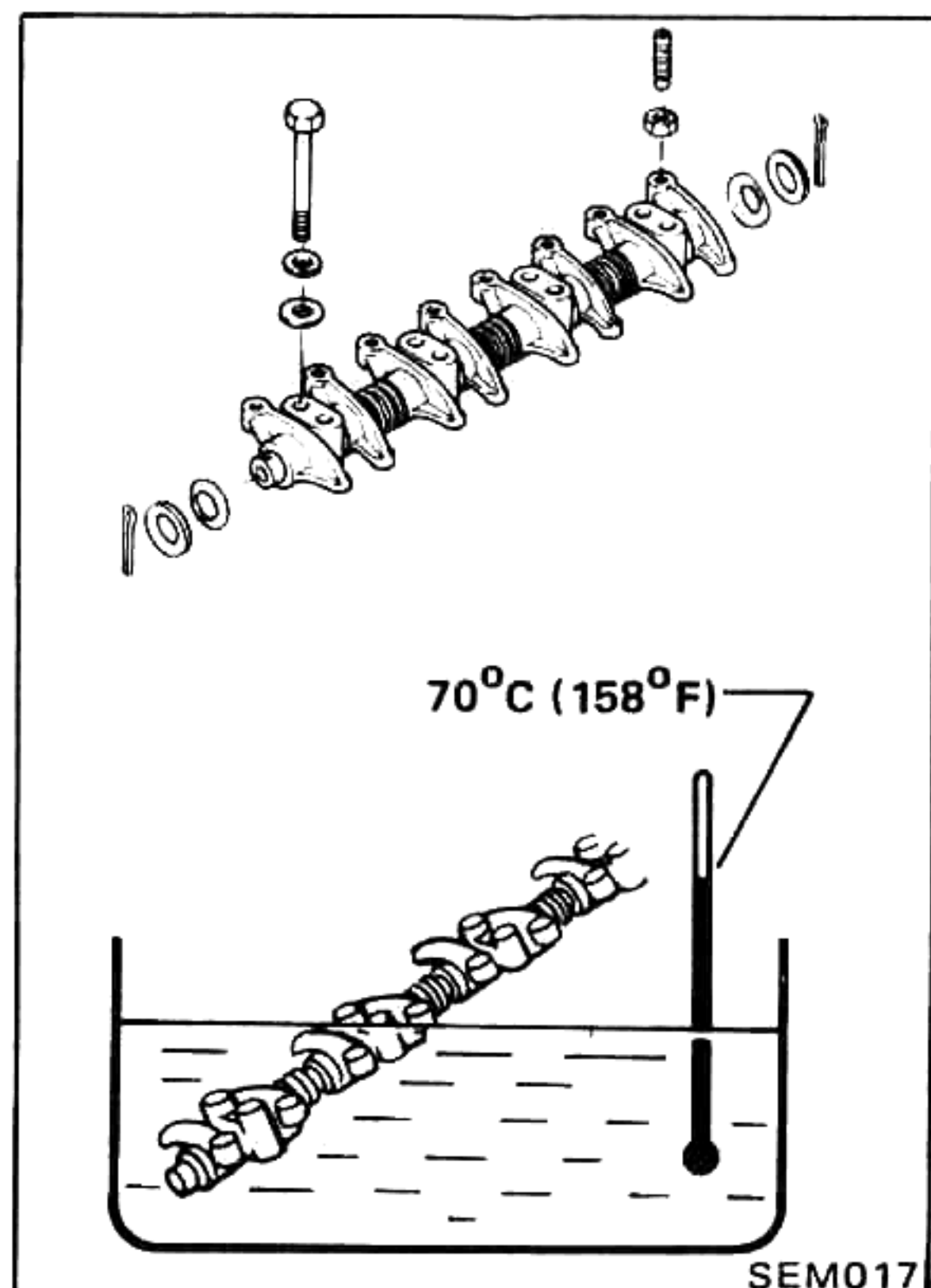
Keep valve spring and valves in correct order.

## DISASSEMBLING ROCKER SHAFT

1. Remove cotter pin, washer and outer spring.

2. Remove valve rocker and rocker shaft bracket.

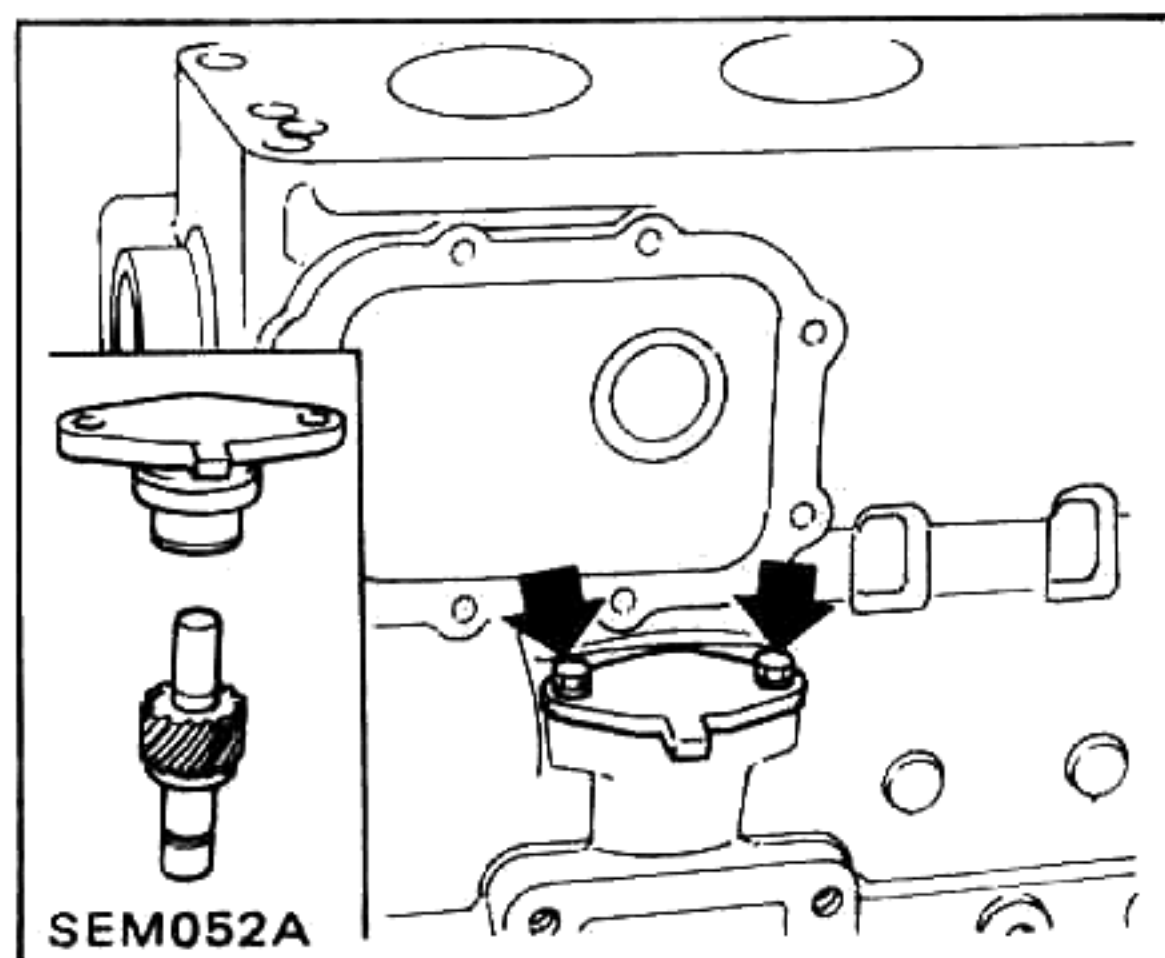
If it is difficult to remove rocker shaft bracket, immerse rocker shaft assembly in oil of 70°C (158°F) for a few minutes and then remove bracket.



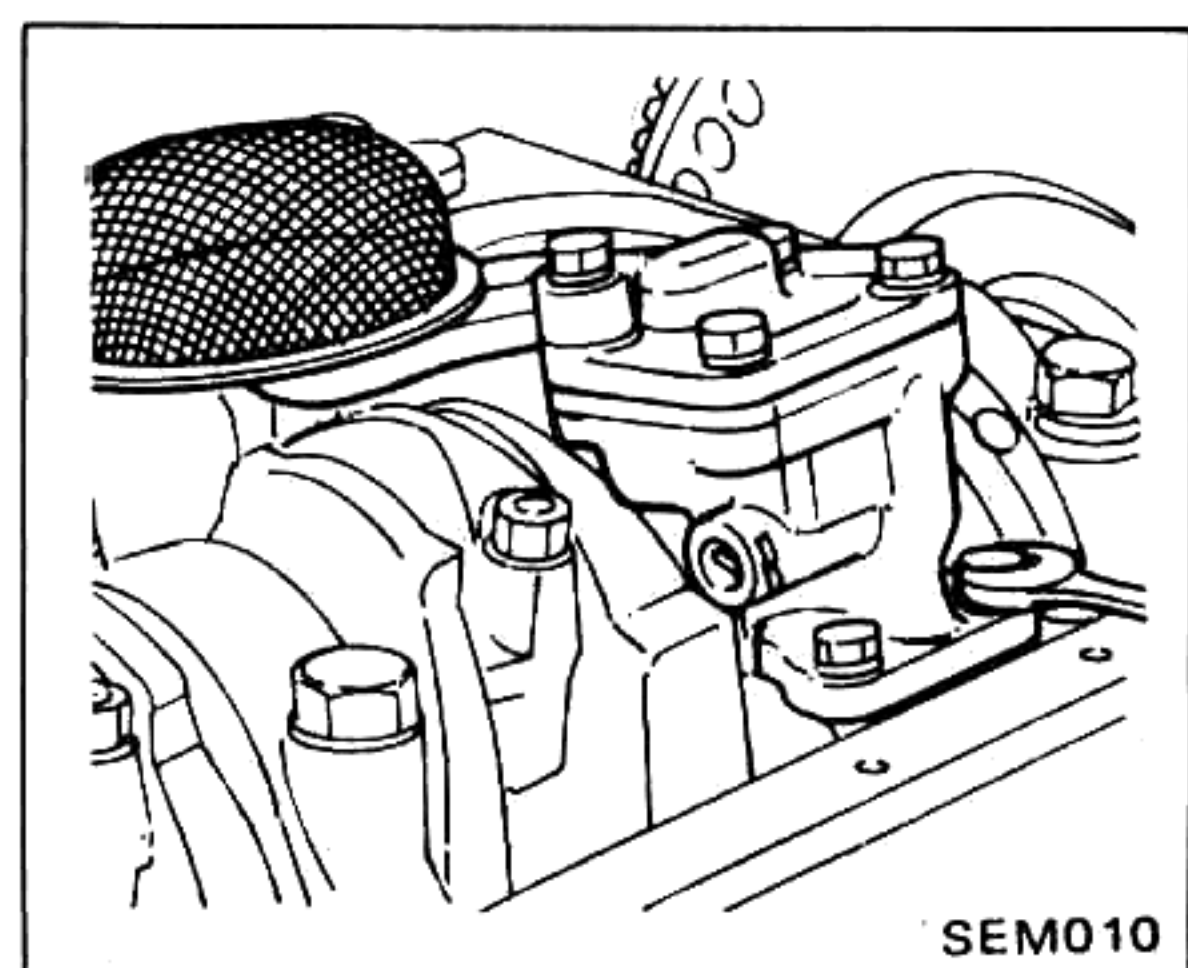


## 5. Remove oil pump.

- (1) Remove spindle support and drive spindle.

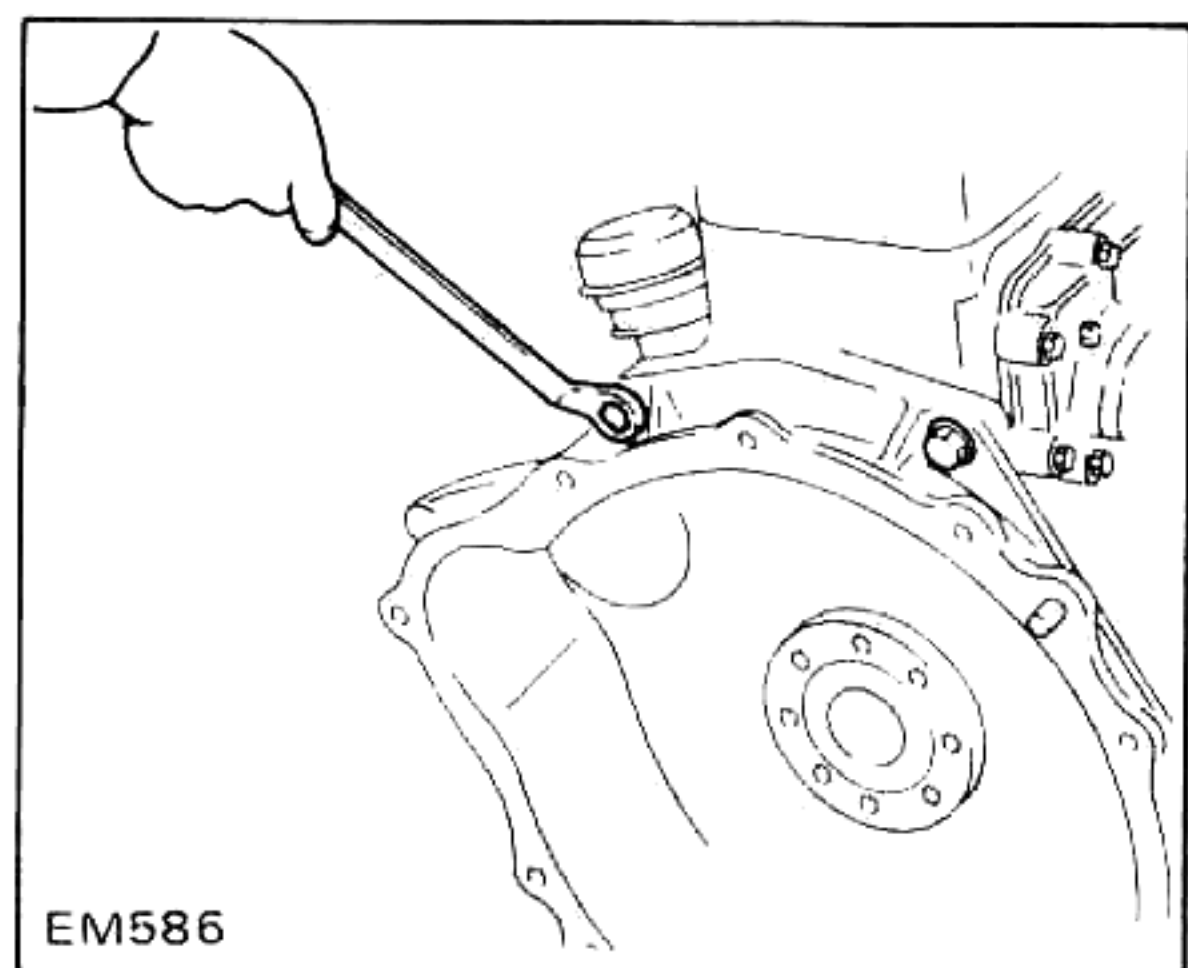


- (2) Remove oil pan.
- (3) Remove oil pump assembly.



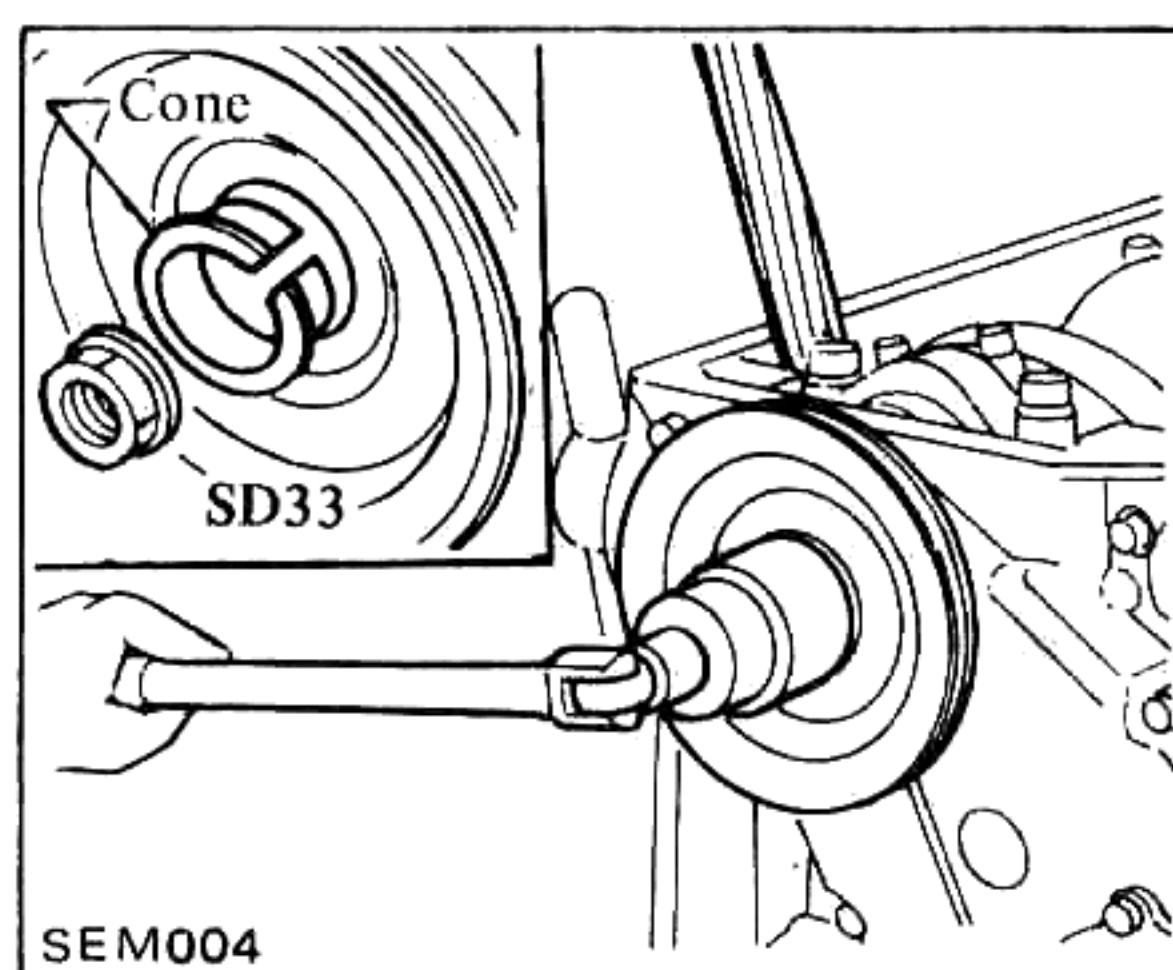
## 6. Remove flywheel.

- (1) Straighten lock plates (if equipped).
- (2) Place a wooden block between cylinder block and flywheel to prevent crankshaft from turning (SD33).
- (3) Remove flywheel.
- (4) Remove flywheel housing (SD33).



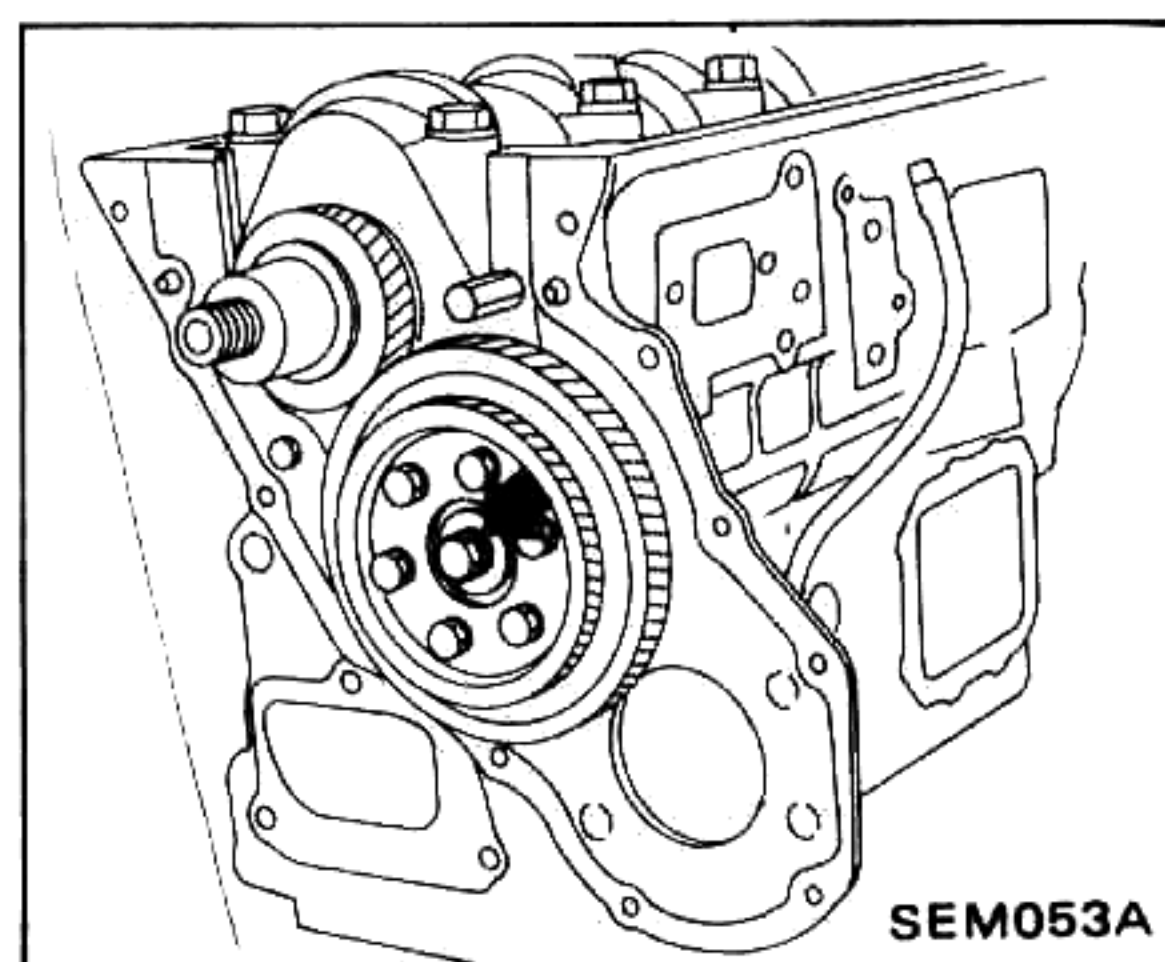
**WARNING:**  
When removing flywheel, be careful not to drop it.

## 7. Crank pulley



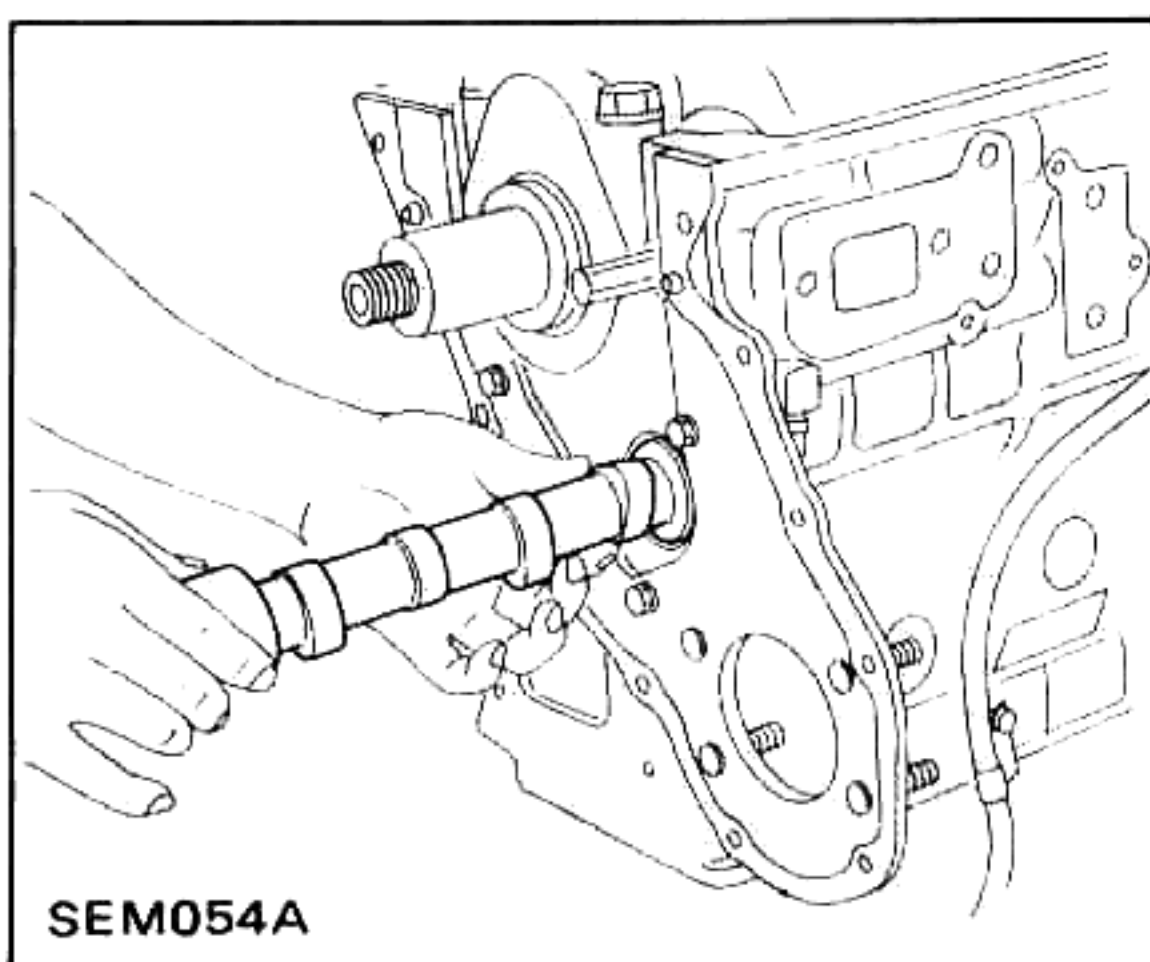
If it is difficult to remove cone, tap evenly around the periphery of the crankshaft pulley (with a brass rod and hammer), causing the cone to protrude beyond the pulley (SD33).

8. Remove front cover.
9. Remove camshaft gear.



## 10. Remove camshaft.

- (1) Remove camshaft locating plate.
- (2) Bring crankshaft to upper side as shown below and remove camshaft.

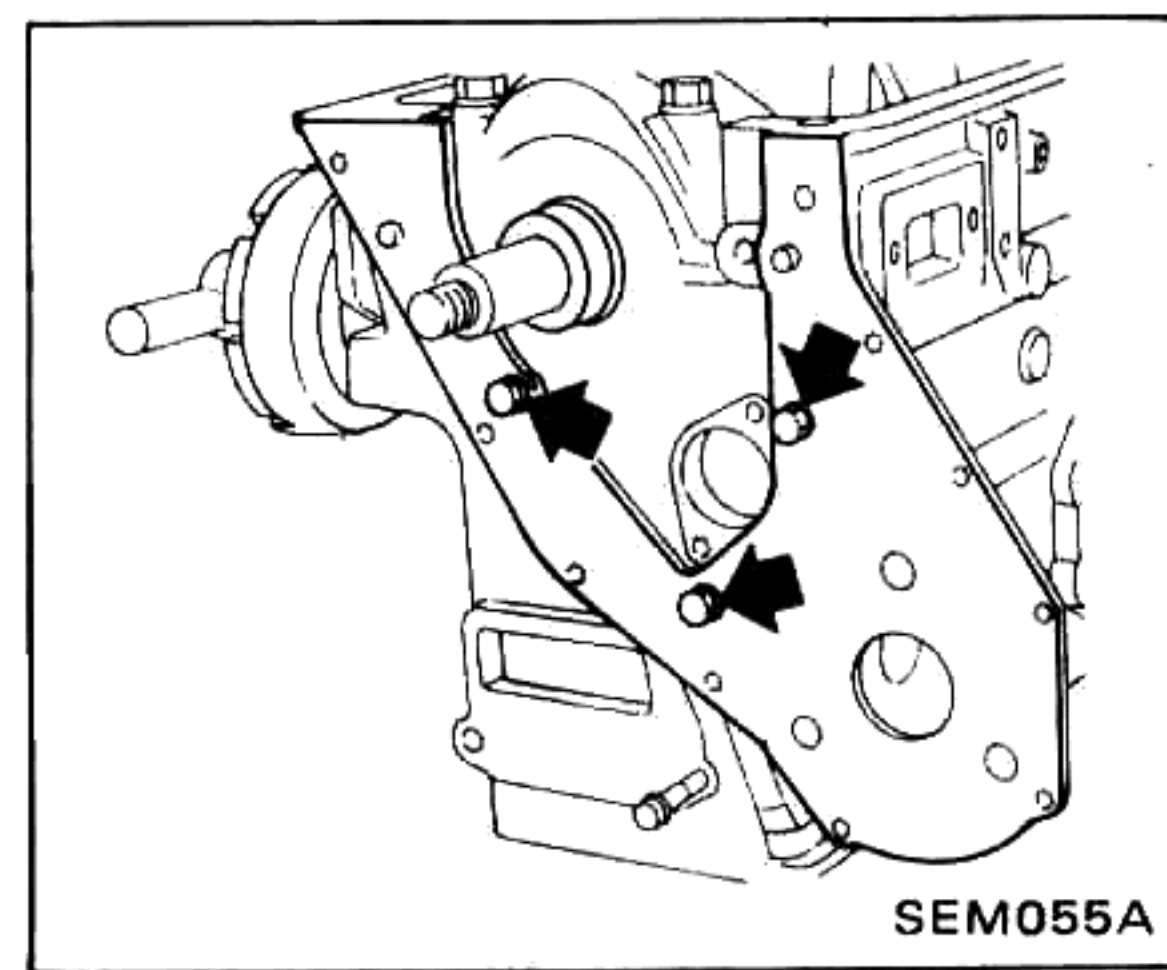


## 11. Remove valve lifters and keep them in correct order.

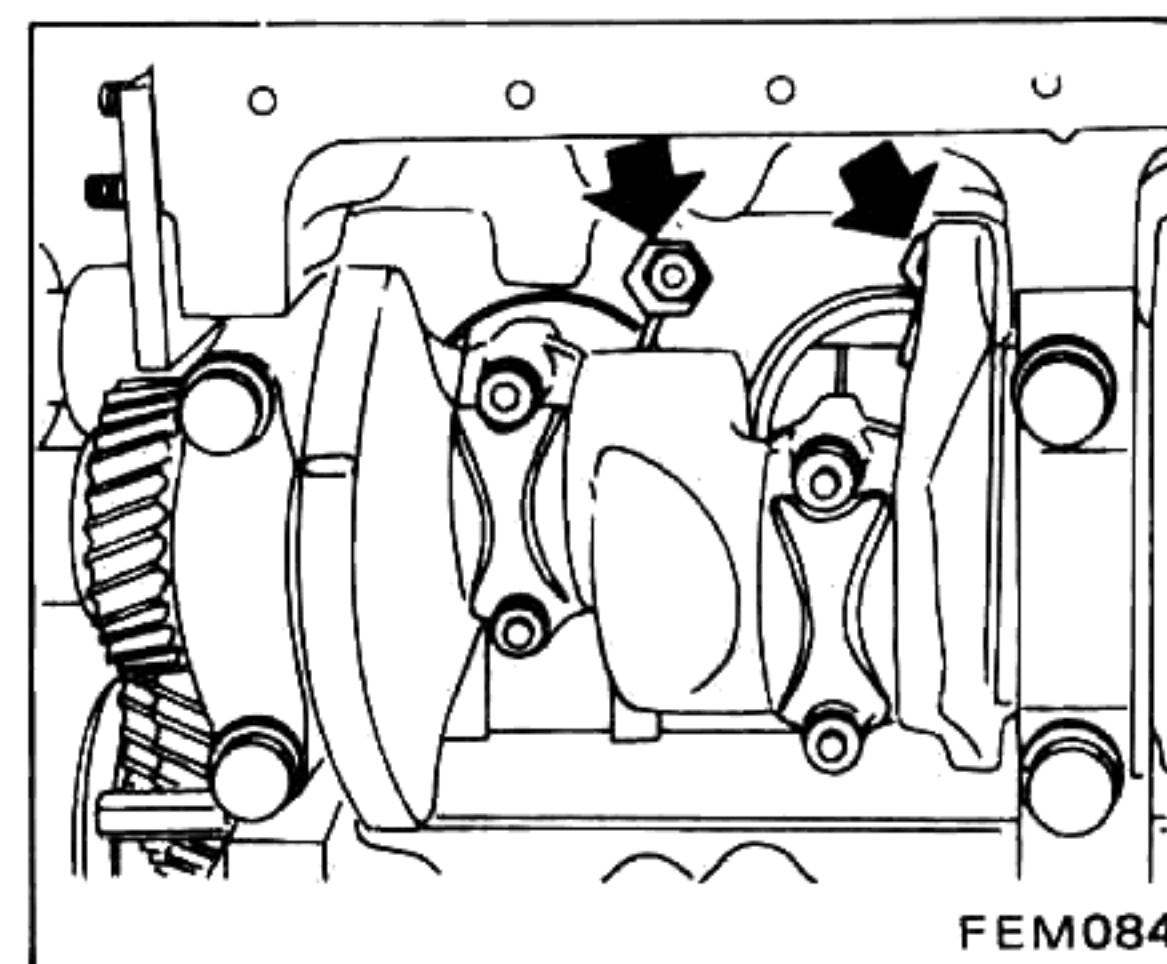
## 12. Remove crankshaft gear.

If it is difficult to extract crankshaft gear, use a suitable puller.

## 13. Remove front plate.

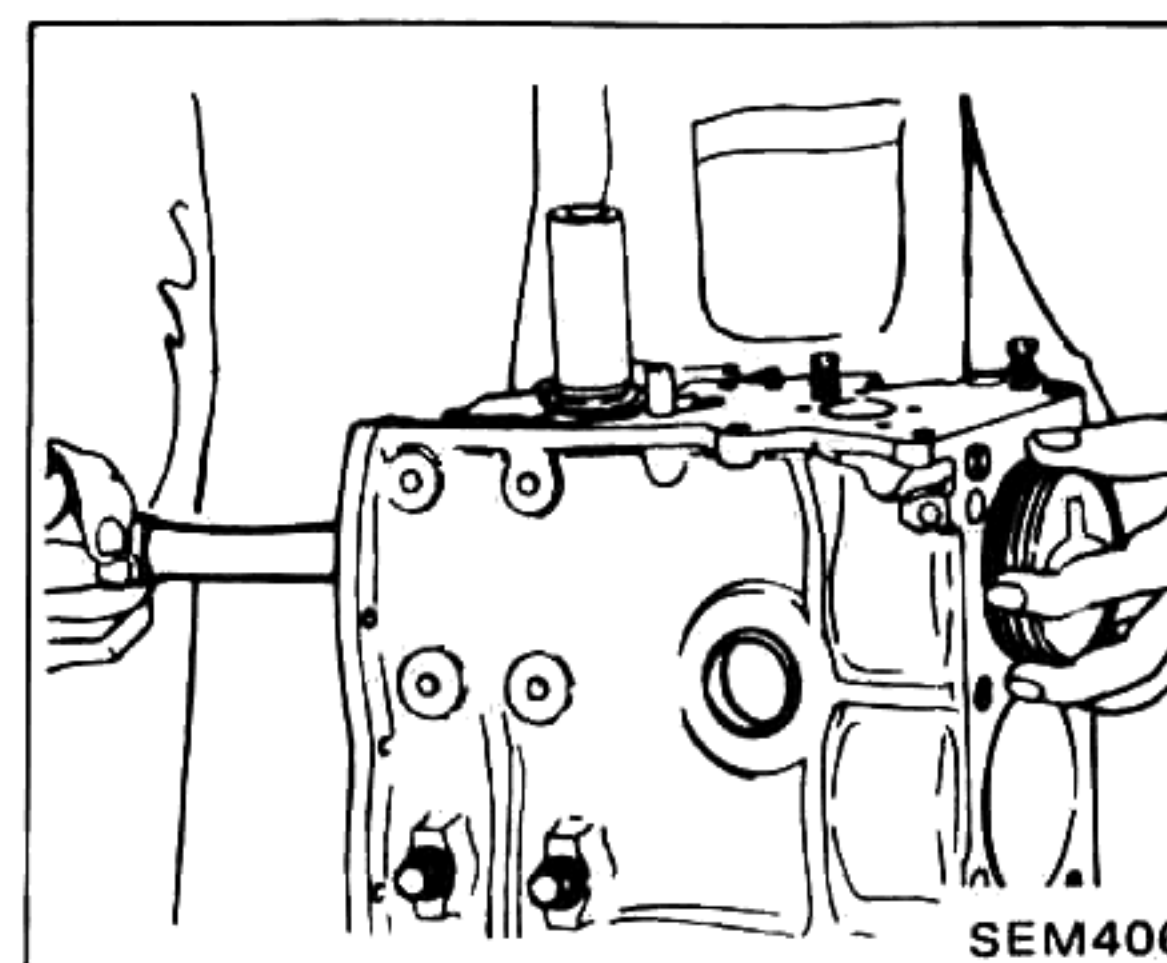


## 14. Remove oil jet bolts and then remove oil jet.



## 15. Pistons and connecting rod assembly

- (1) Remove connecting rod caps and connecting rod bearings.
- (2) Take pistons and connecting rods out of cylinder head side.



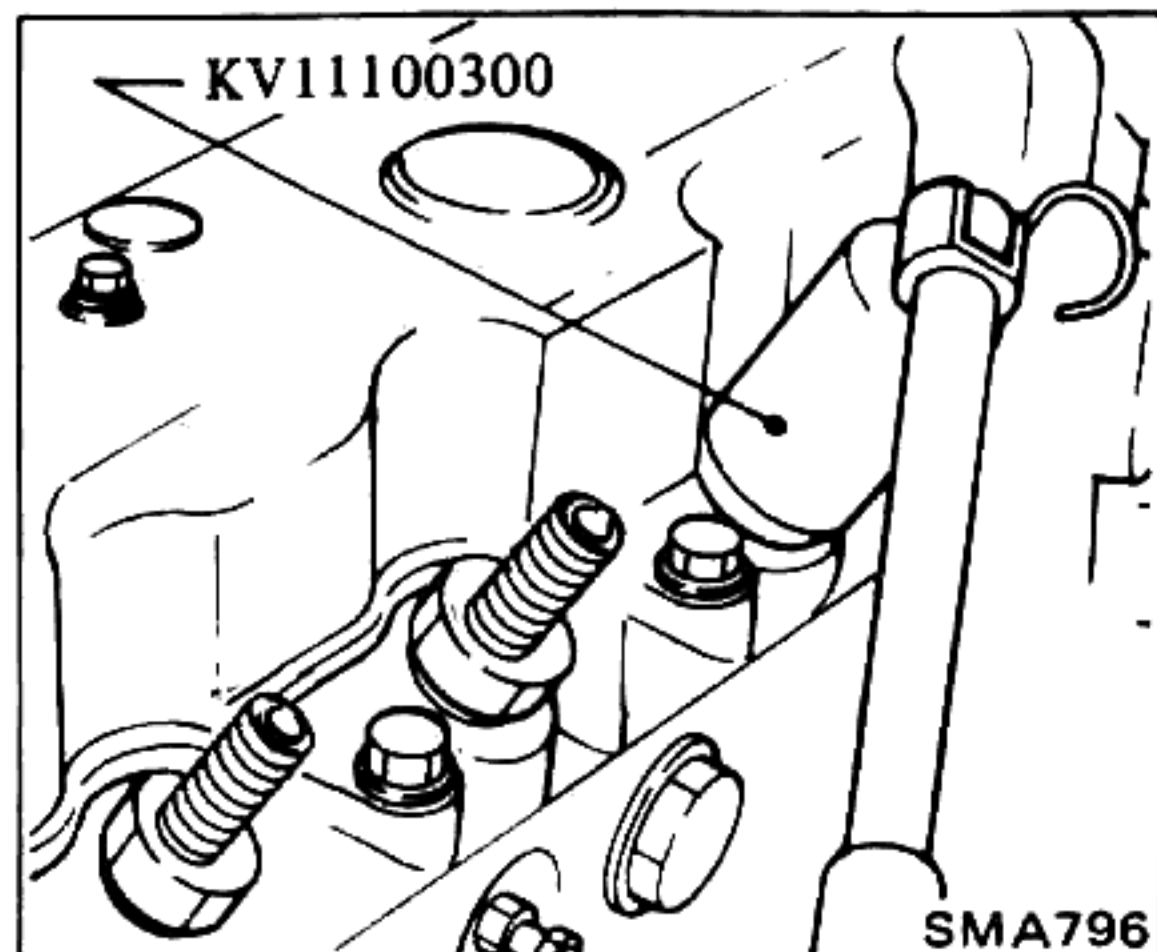
a. Piston can be easily removed by scraping carbon off top face of cylinder with a scraper.



# ENGINE DISASSEMBLY

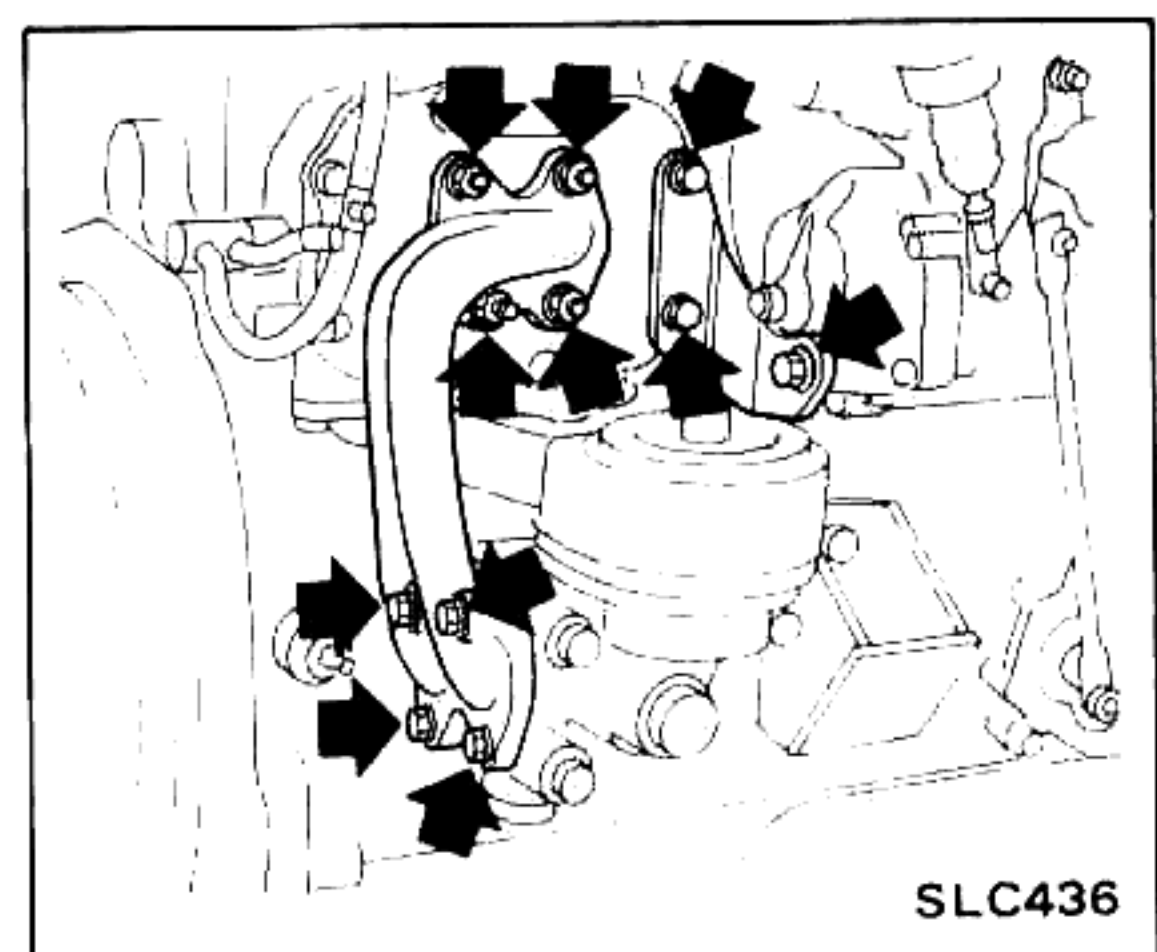
- (2) Spill tube
- (3) Injection nozzles
- (4) Nozzle washers

Plug nozzle holes to prevent entry of dust and dirt.

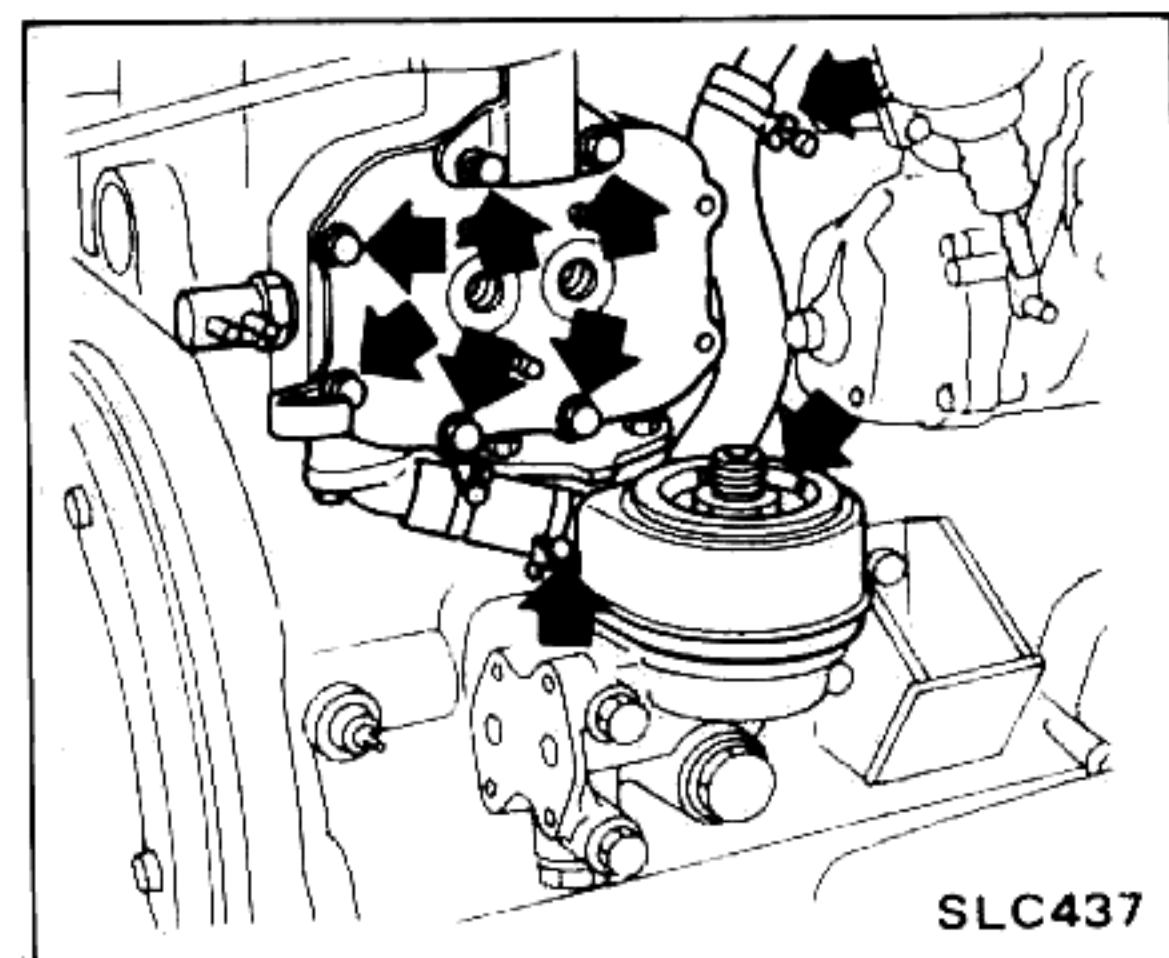


- (5) Oil cooler
- (a) SD 4-cylinder

- Oil filter using Tool.
- Remove injection pump rear bracket (if equipped) and oil pipe.



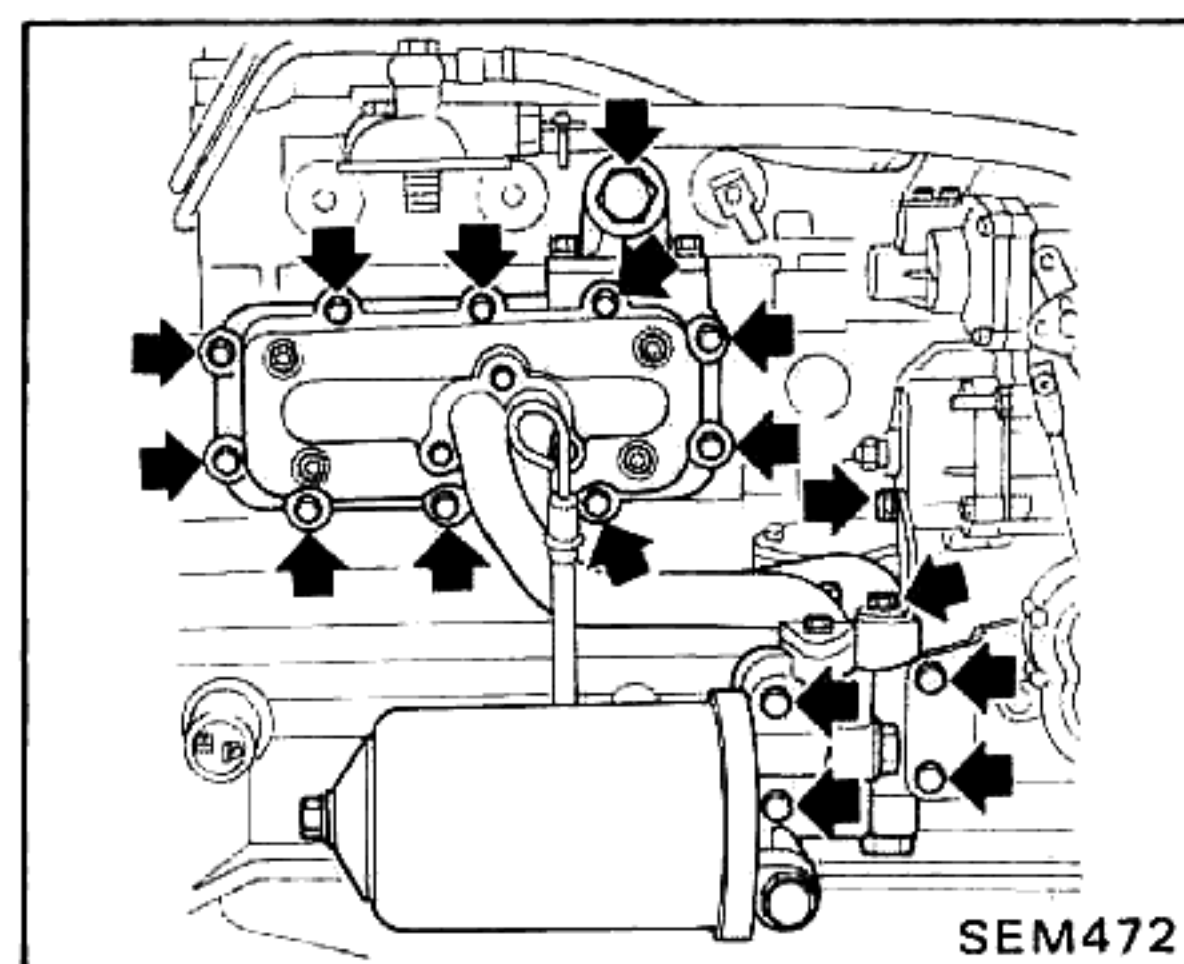
- Remove main and sub oil cooler (if equipped) assembly.



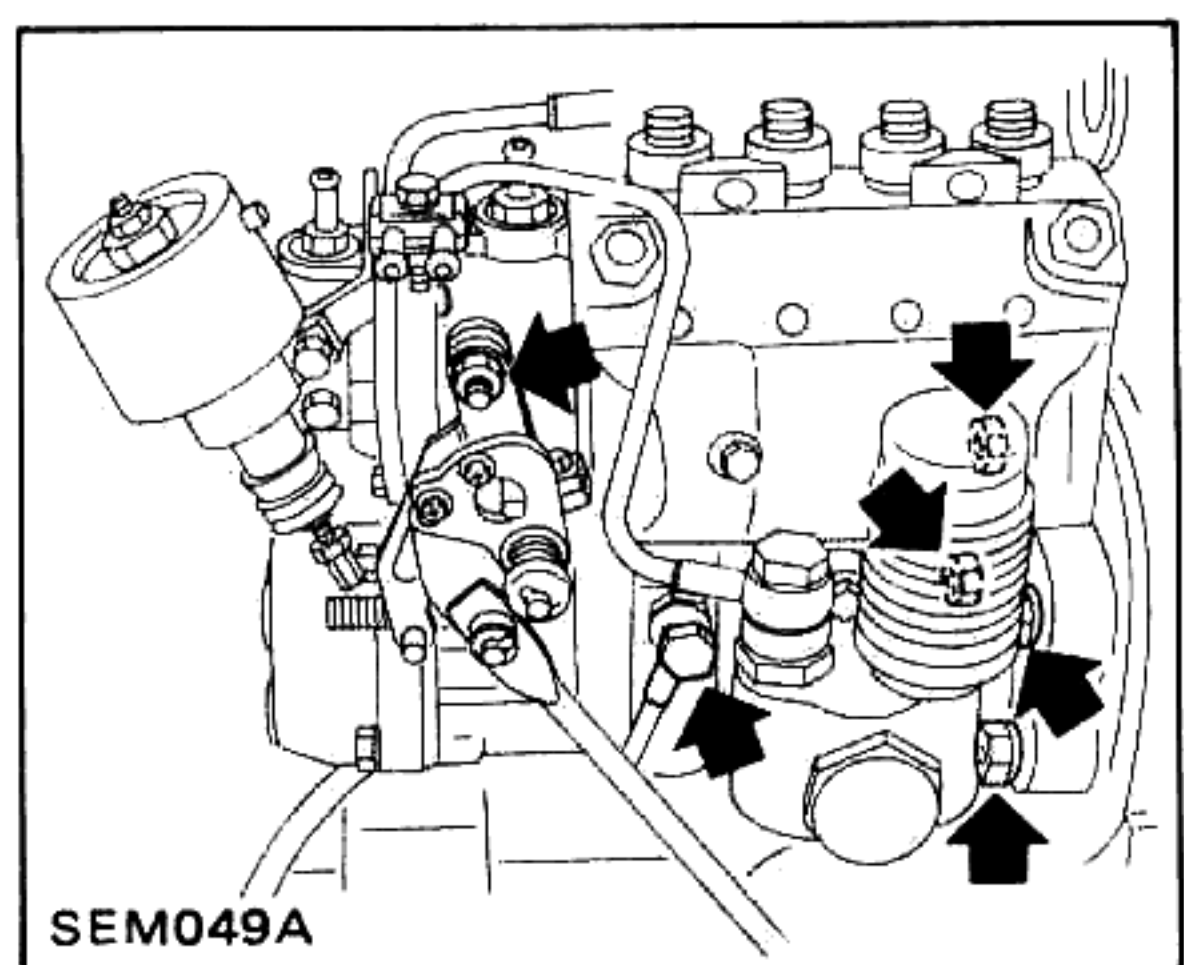
- Remove oil filter bracket.

- (b) SD33

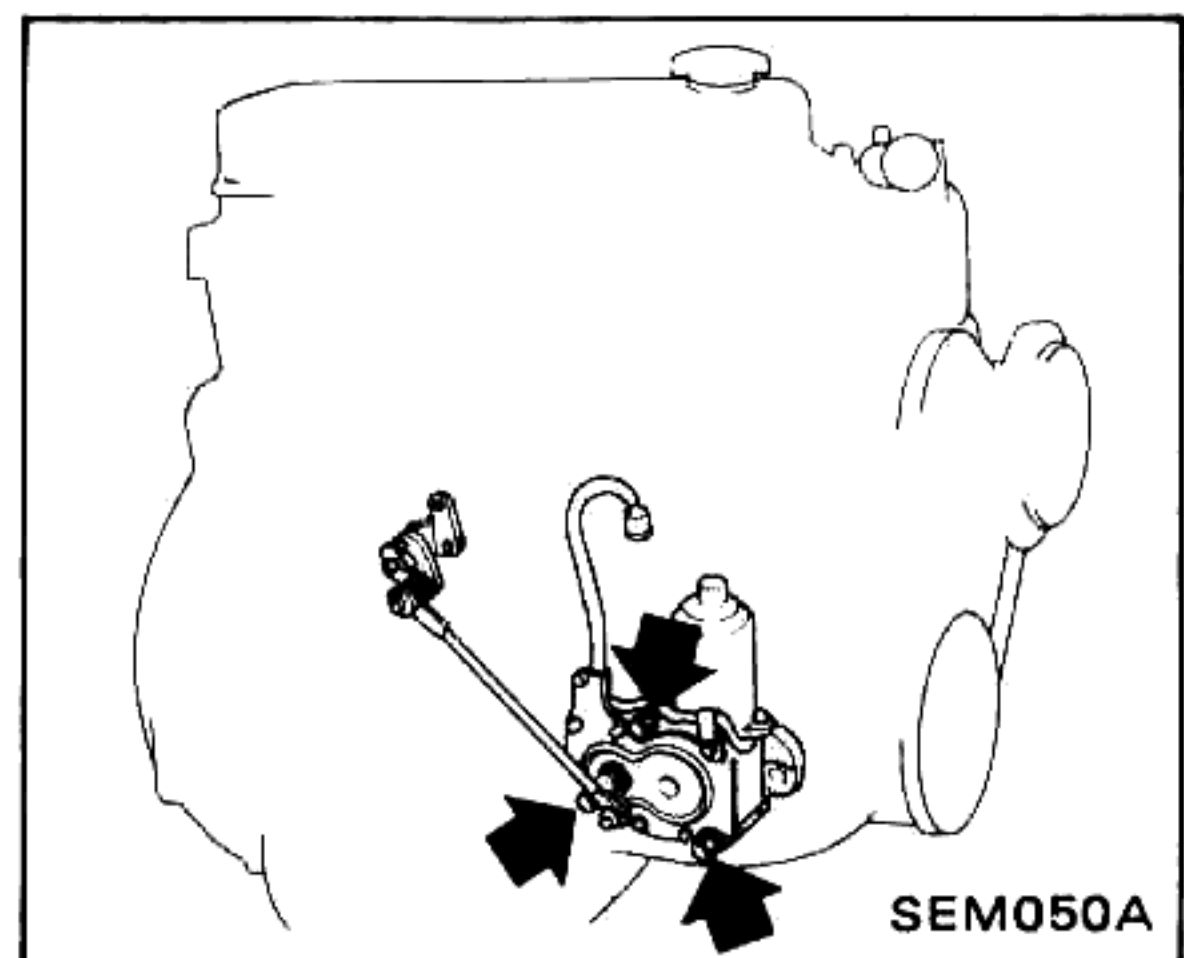
- Fuel filter using Tool
- Oil cooler and oil filter bracket with oil filter



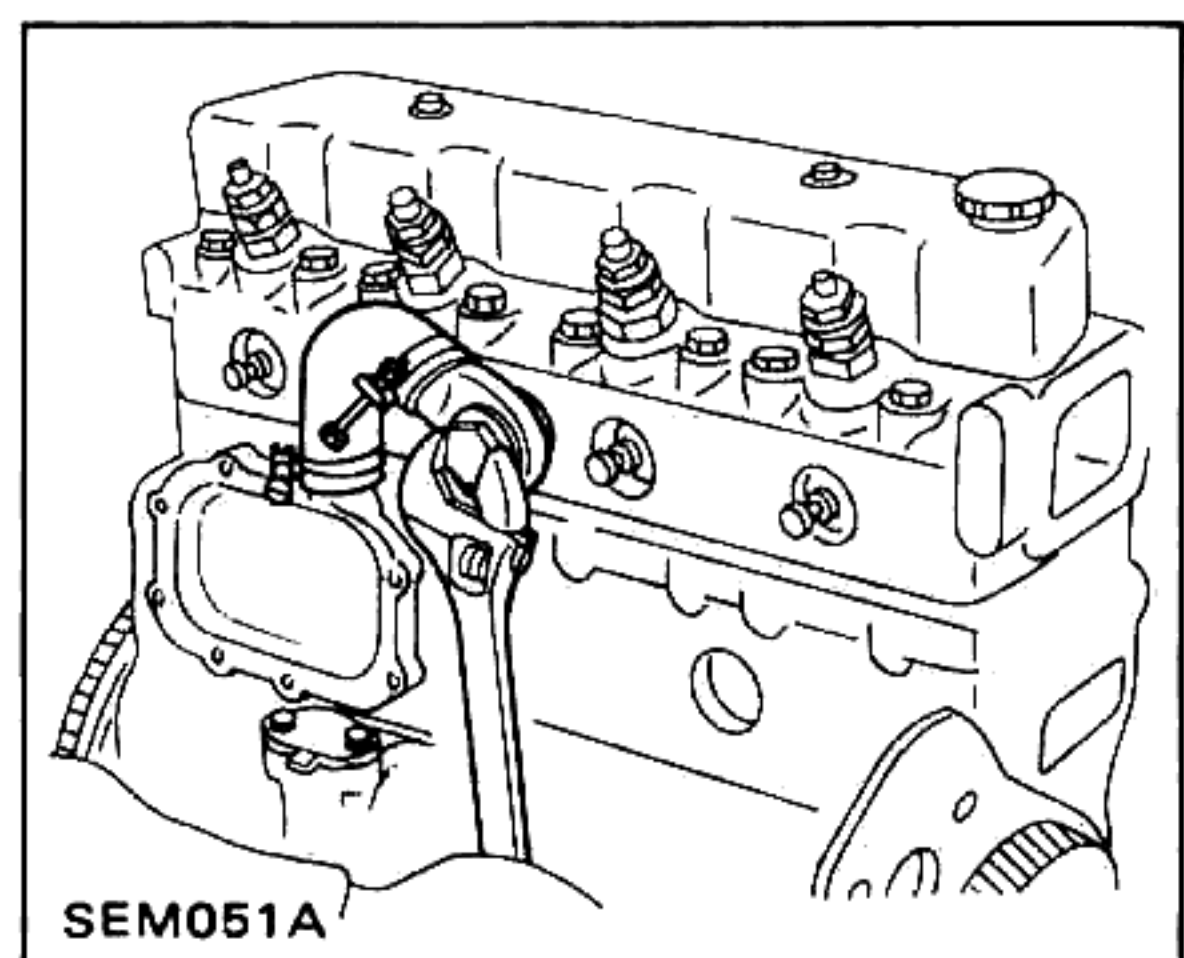
- (6) Injection pump assembly



- (7) Diesel pump controller assembly (In-line type only)

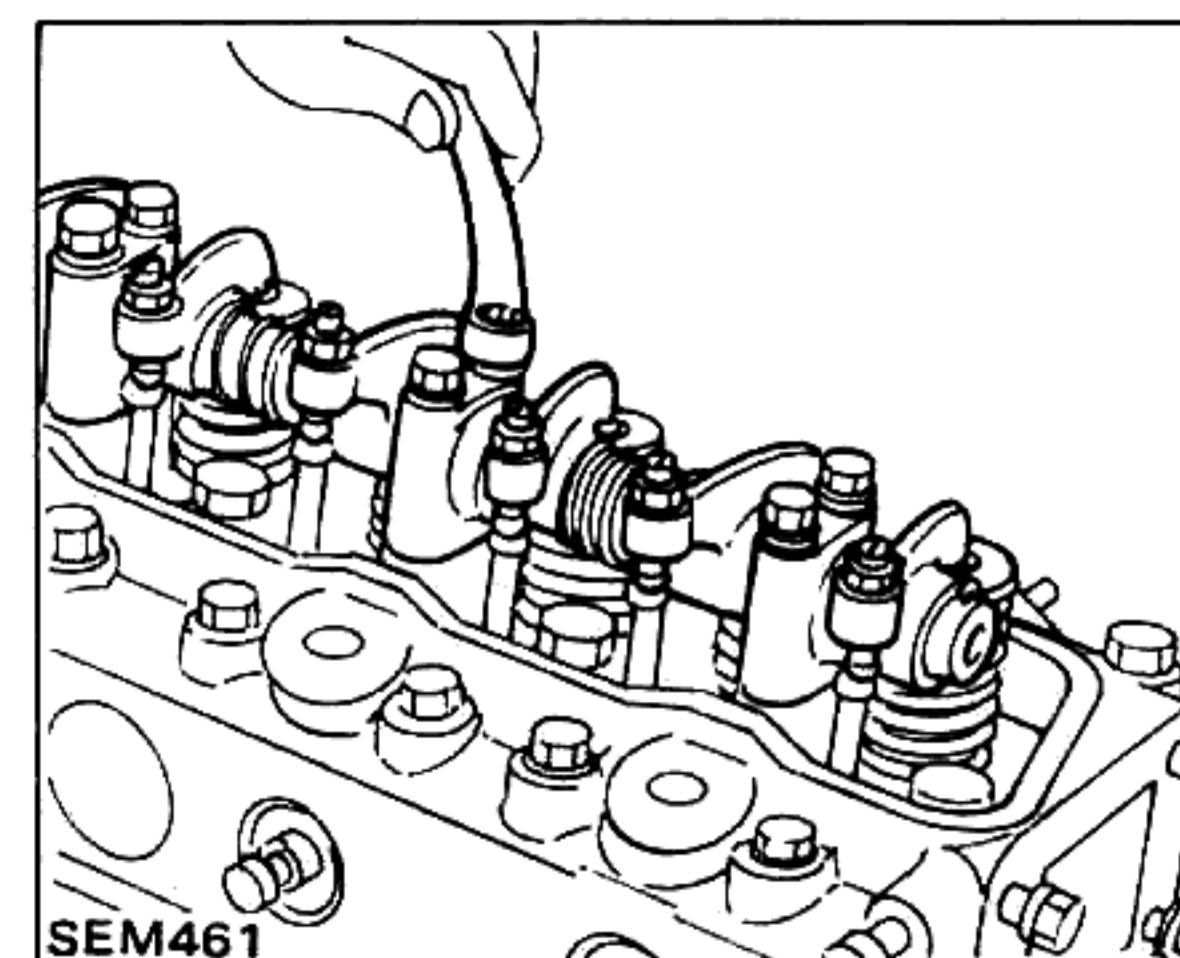


- (8) Glow plug harness and oil cooler hose.

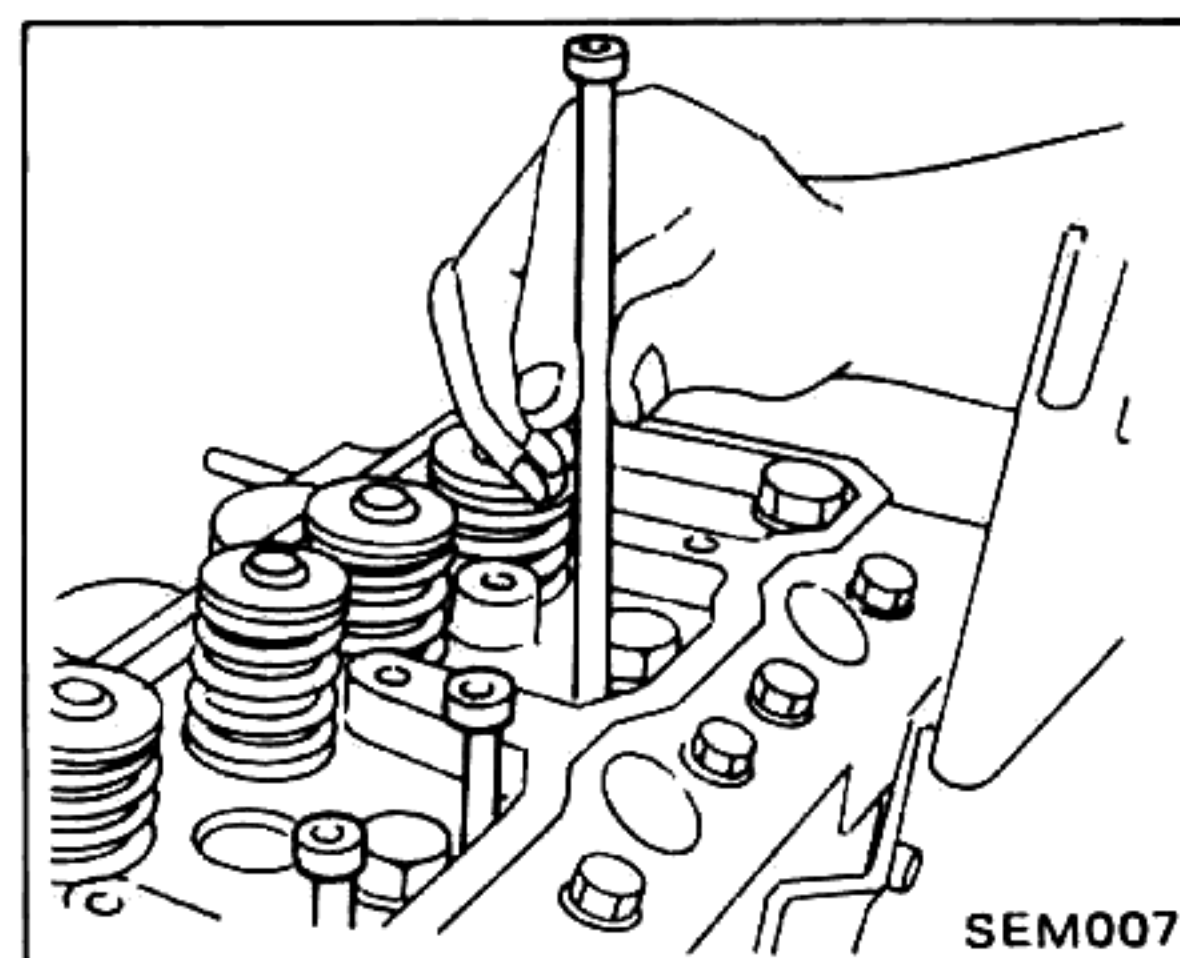


## REMOVING INTERNAL PARTS

1. Remove rocker cover.
2. Remove rocker shaft assembly.



3. Remove push rods and keep them in correct order.



4. Remove cylinder head bolts in the sequence shown below and then remove cylinder head assembly and cylinder head gasket assembly.

### SD 4-cylinder

|    |    |    |    |    |   |   |   |
|----|----|----|----|----|---|---|---|
| 2  | 4  | 6  | 8  | 7  | 5 | 3 | 1 |
| ○  | ○  | ○  | ○  | ○  | ○ | ○ | ○ |
| ○  | ○  | ○  | ○  | ○  | ○ | ○ | ○ |
| 12 | 16 | 18 | 14 | 10 |   |   |   |
| ○  | ○  | ○  | ○  | ○  | ○ | ○ | ○ |
| 9  | 13 | 17 | 15 | 11 |   |   |   |

### SD33

|    |    |    |    |    |    |    |   |   |   |   |   |
|----|----|----|----|----|----|----|---|---|---|---|---|
| 2  | 4  | 6  | 8  | 10 | 12 | 11 | 9 | 7 | 5 | 3 | 1 |
| ○  | ○  | ○  | ○  | ○  | ○  | ○  | ○ | ○ | ○ | ○ | ○ |
| ○  | ○  | ○  | ○  | ○  | ○  | ○  | ○ | ○ | ○ | ○ | ○ |
| 16 | 20 | 24 | 26 | 22 | 18 | 14 |   |   |   |   |   |
| ○  | ○  | ○  | ○  | ○  | ○  | ○  | ○ | ○ | ○ | ○ | ○ |
| 13 | 17 | 21 | 25 | 23 | 19 | 15 |   |   |   |   |   |

SEM511



# ENGINE DISASSEMBLY

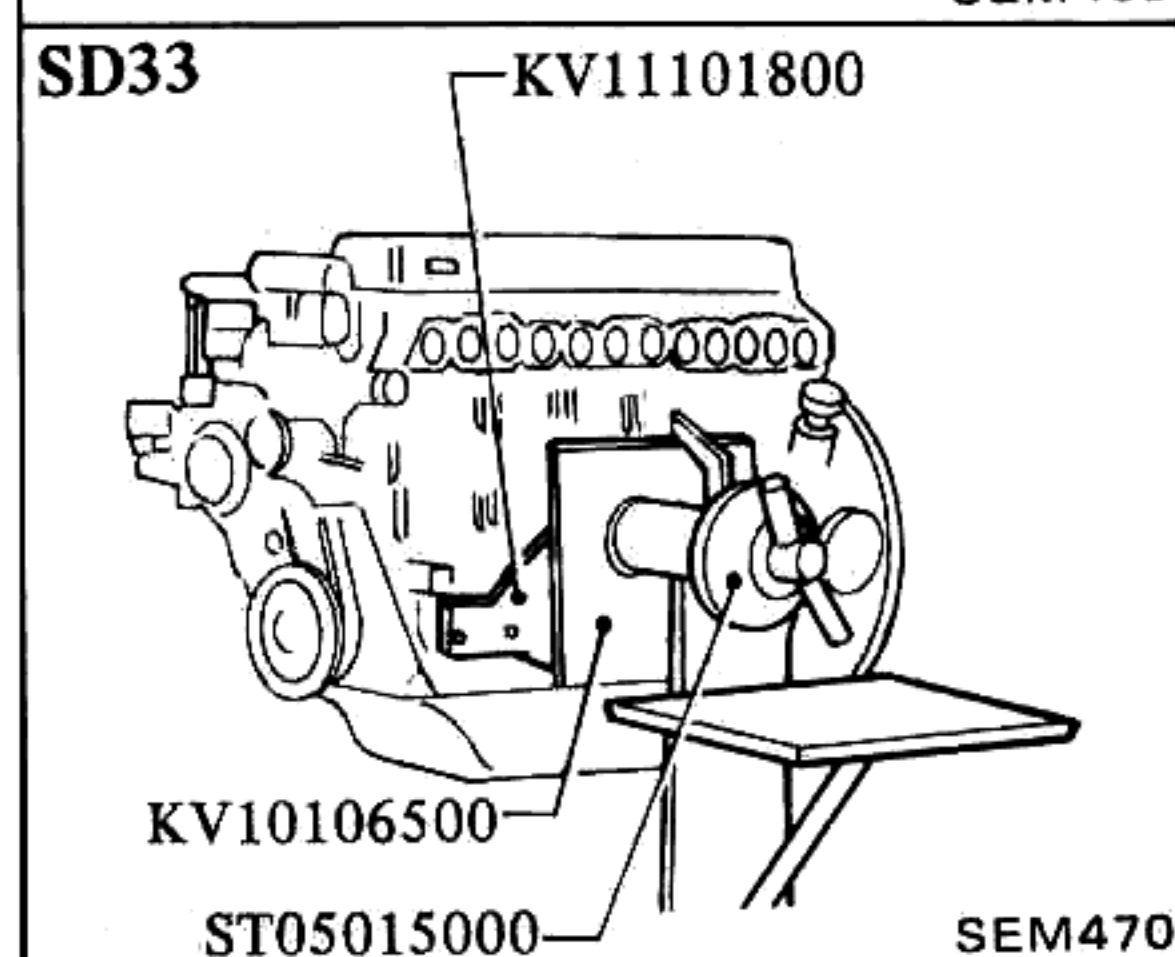
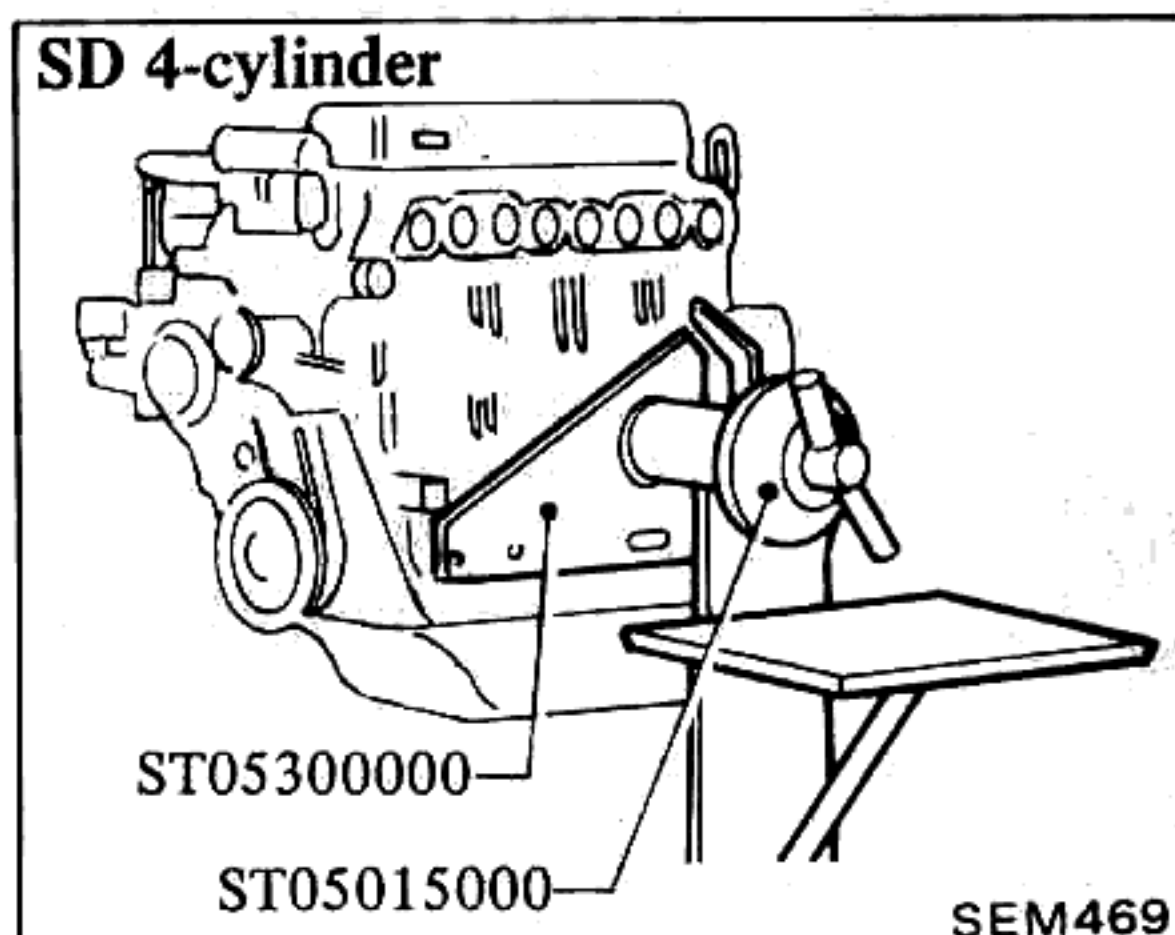
## PRECAUTIONS

Arrange the disassembled parts on the parts stand in accordance with their assembled locations, sequence, etc., so that the parts will be reassembled in their original locations. Place mating marks on the parts if necessary.

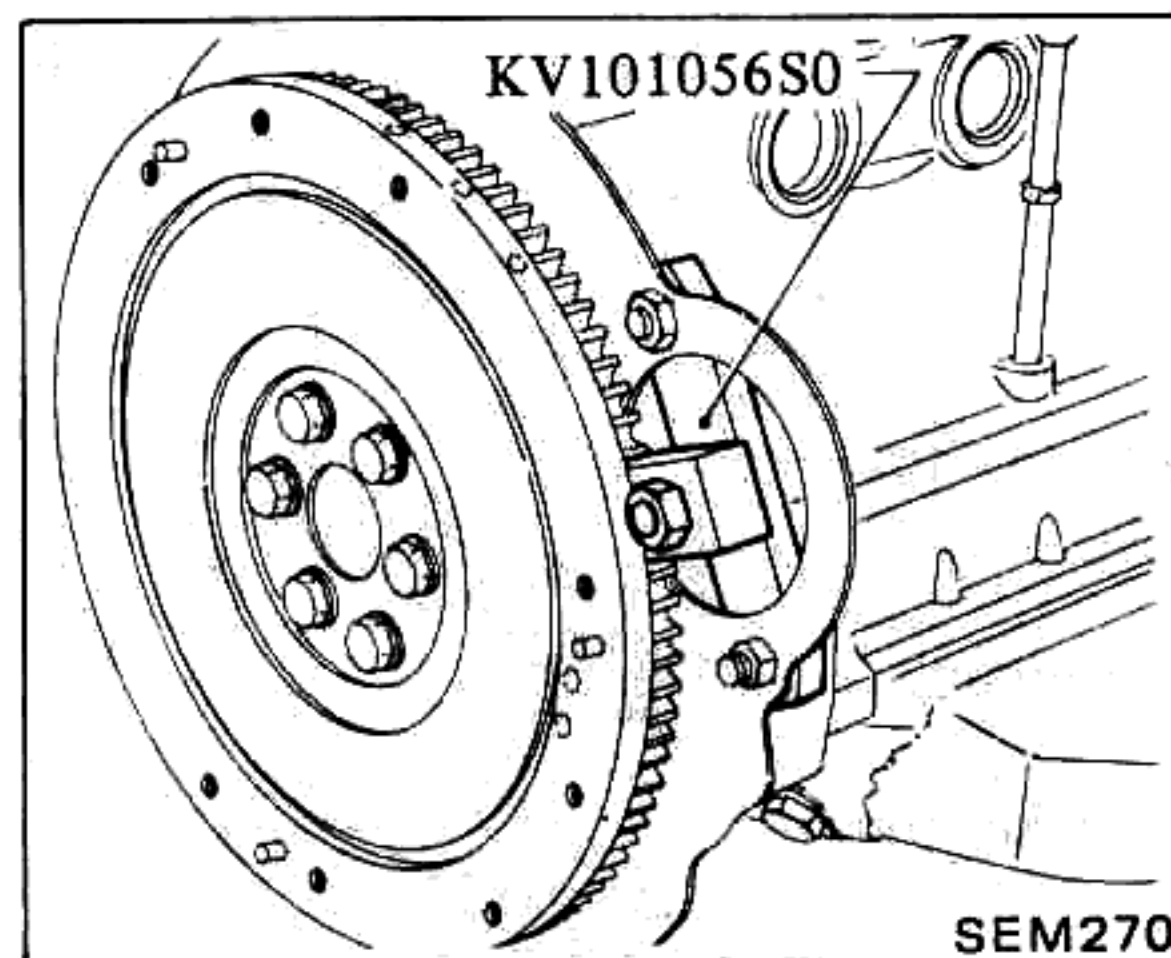
## DISASSEMBLY

### MOUNTING ENGINE ON WORK STAND

1. Remove rear and left side parts.
  - Transmission assembly
  - Clutch cover assembly
  - Starter motor
  - Engine mounting bracket
  - Alternator assembly and fan belt
  - Alternator bracket
  - Intake manifold with venturi
  - Exhaust manifold & engine slinger
  - Breather assembly (SD 4-cylinder)
2. Install engine attachment on engine, using engine mounting bracket holes, air breather mounting hole and starter motor mounting holes (SD 4-cylinder). Install engine attachment on engine, using mounting bracket holes and cylinder block water drain cock hole (SD33).
3. Place both engine and attachment on engine stand.



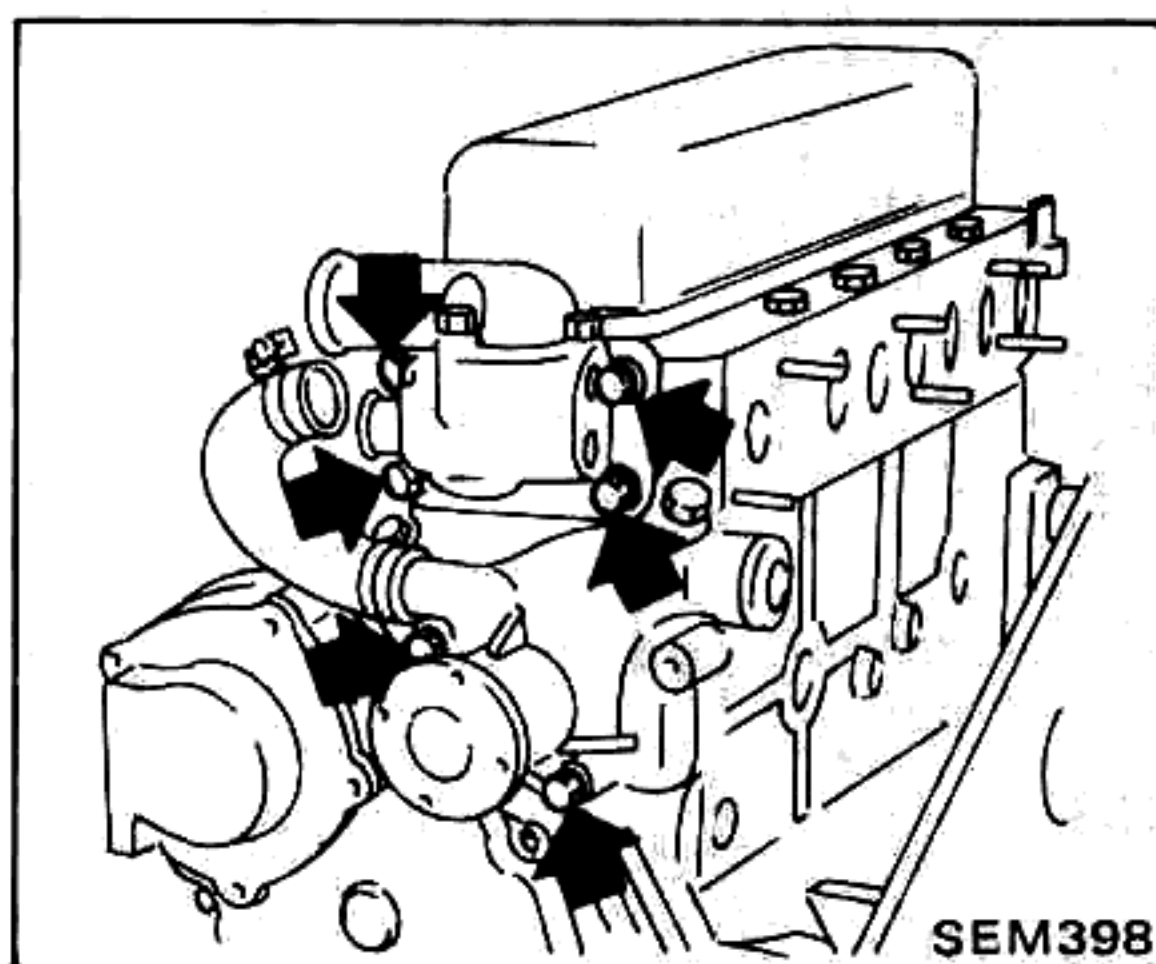
4. Install Tool to prevent crankshaft rotation (SD 4-cylinder).



5. Drain engine oil and coolant.

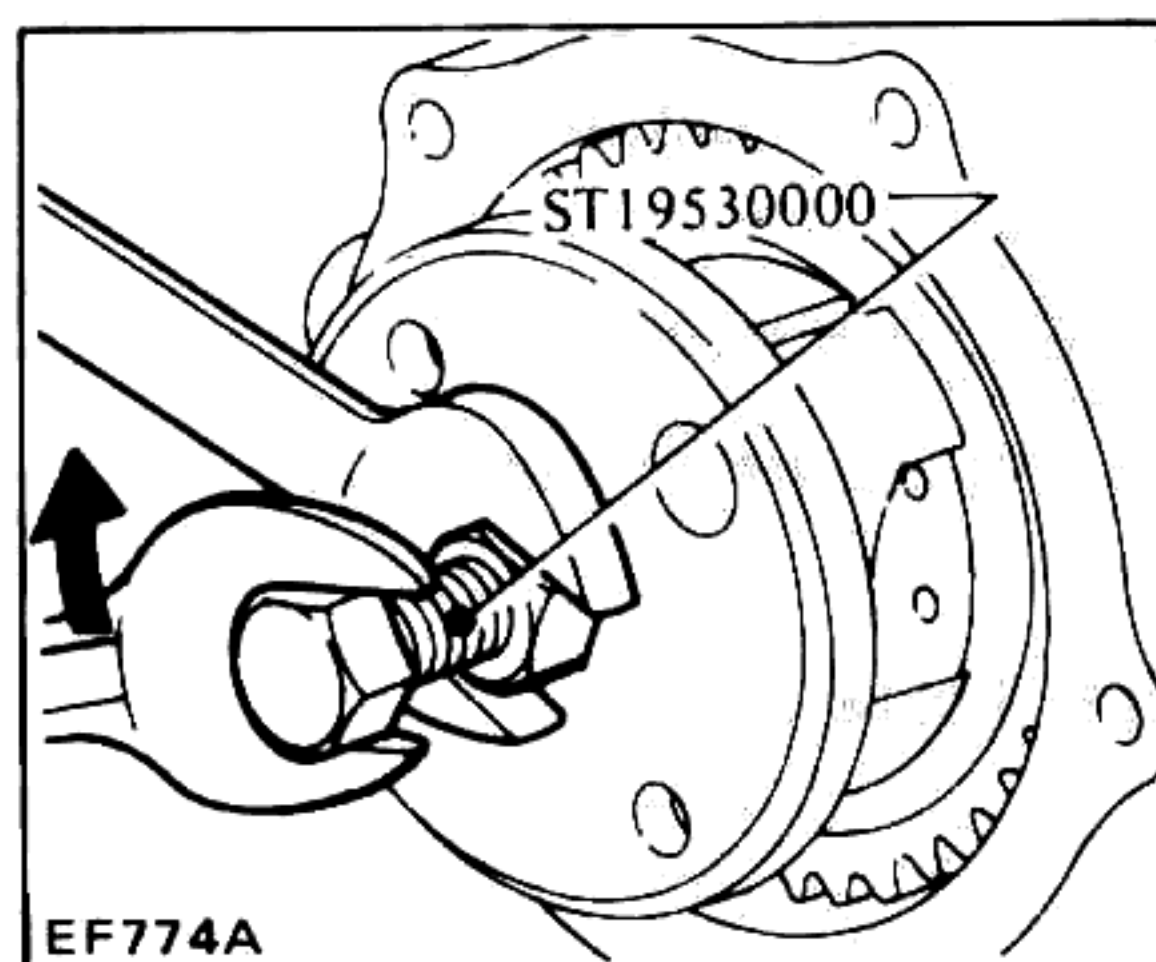
### REMOVING OUTER PARTS

1. Remove front side engine parts.
  - Fan, Tem-coupling and fan pulley
  - Alternator adjusting bar
  - Thermostat housing
  - Water pump



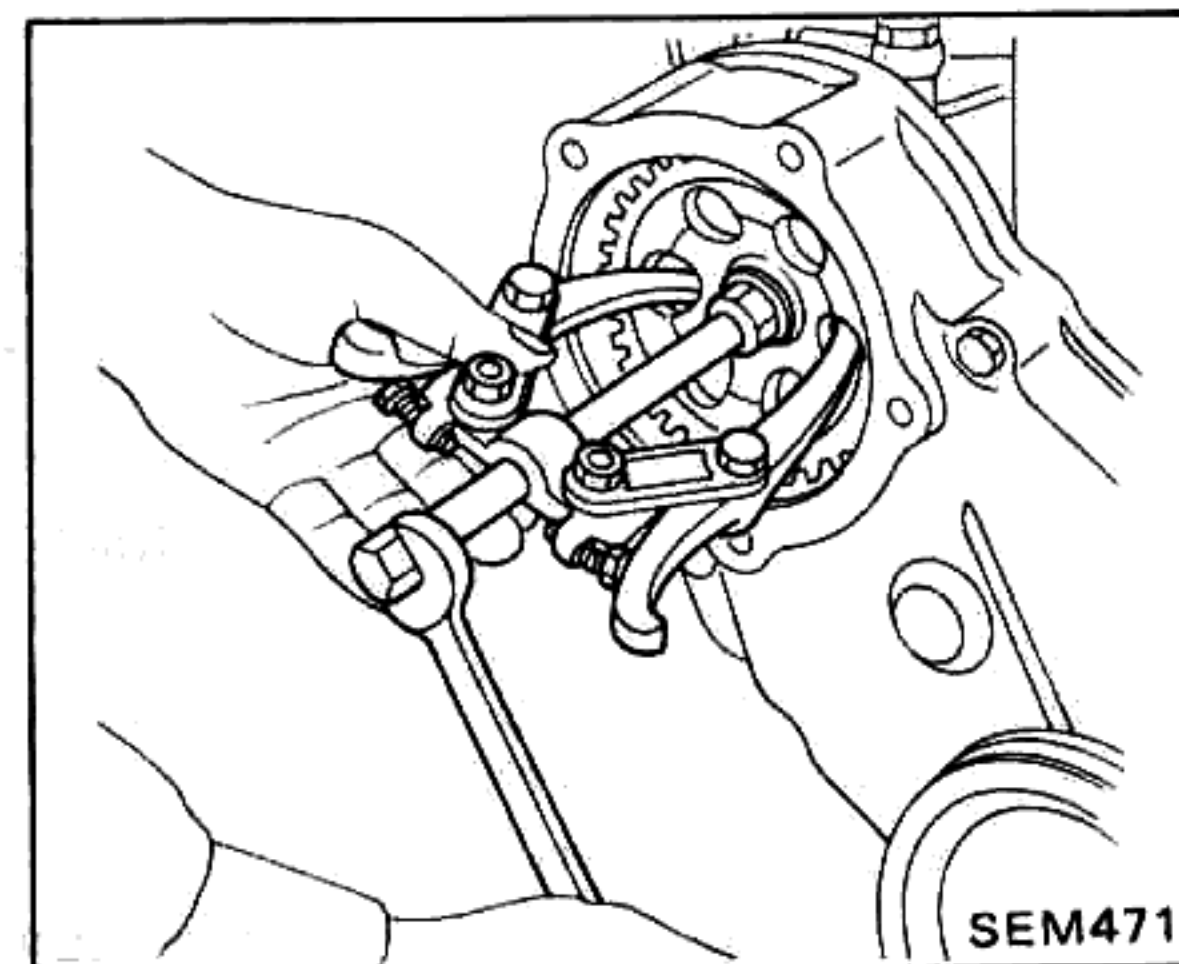
### In-line pump

- (1) Timer cover
- (2) Timer



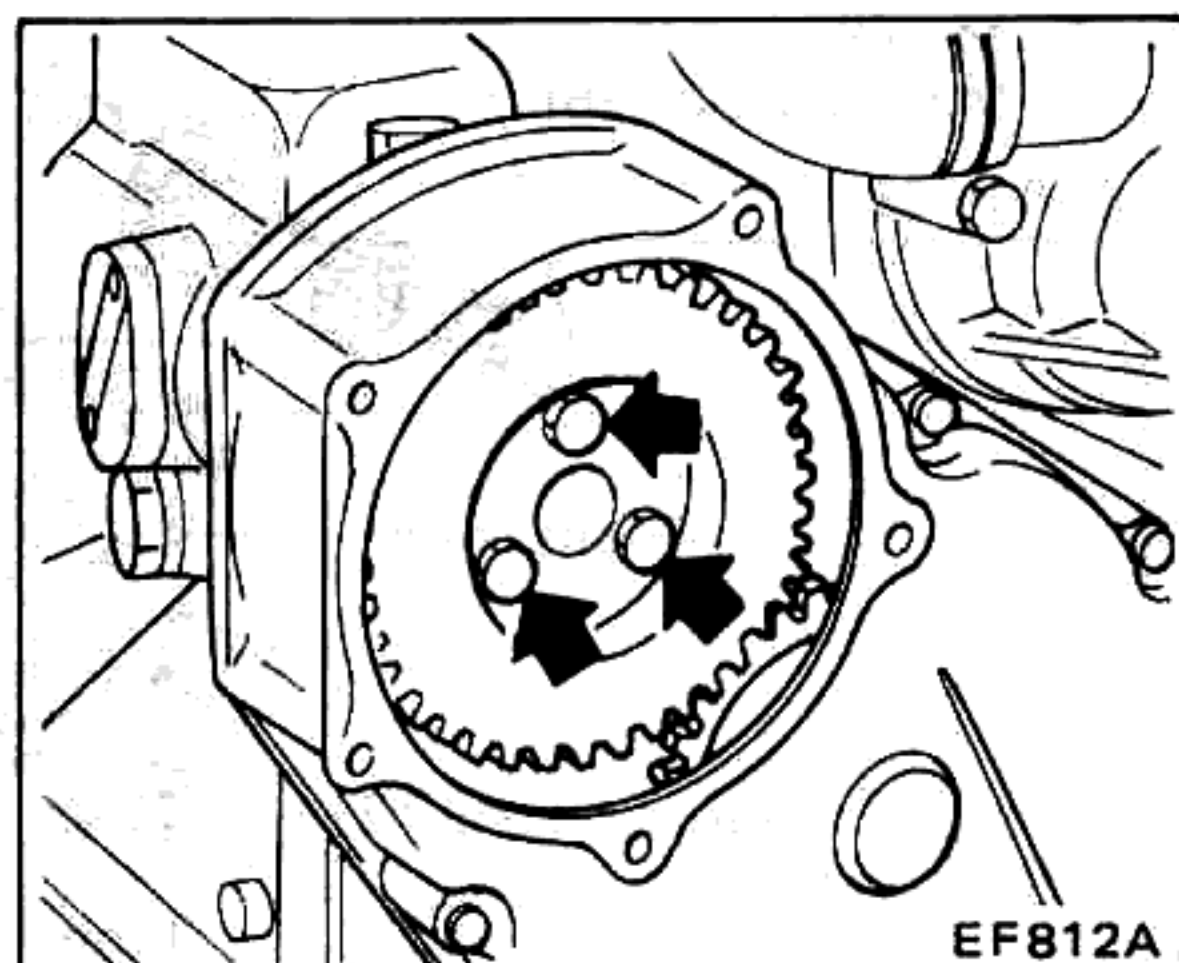
### VE pump

- (1) Drive gear cover
- (2) Drive gear



### C.A.V.-D.P.A. pump

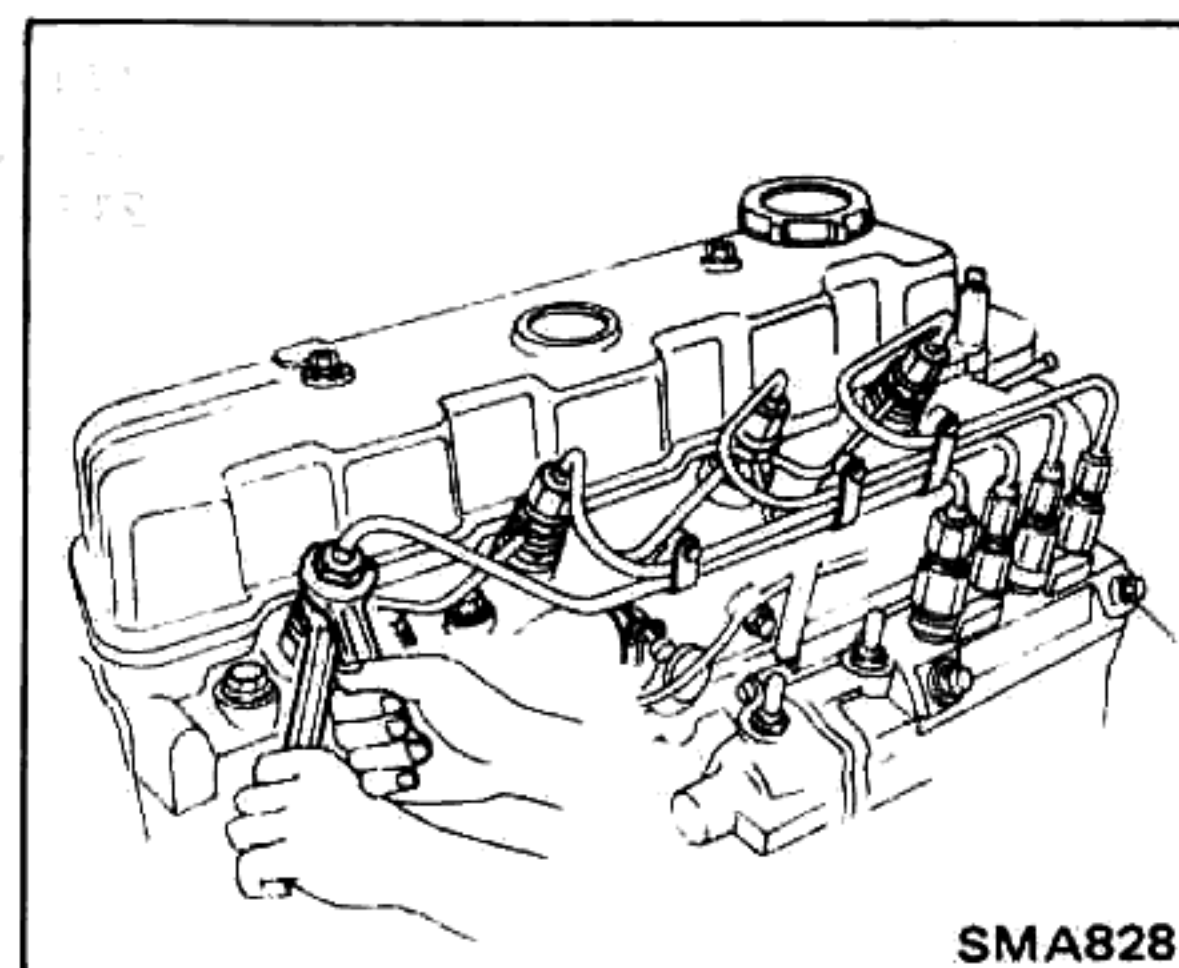
- (1) Timing gear cover
- (2) Feed pump camshaft
- (3) Drive gear



- Vacuum tube assembly

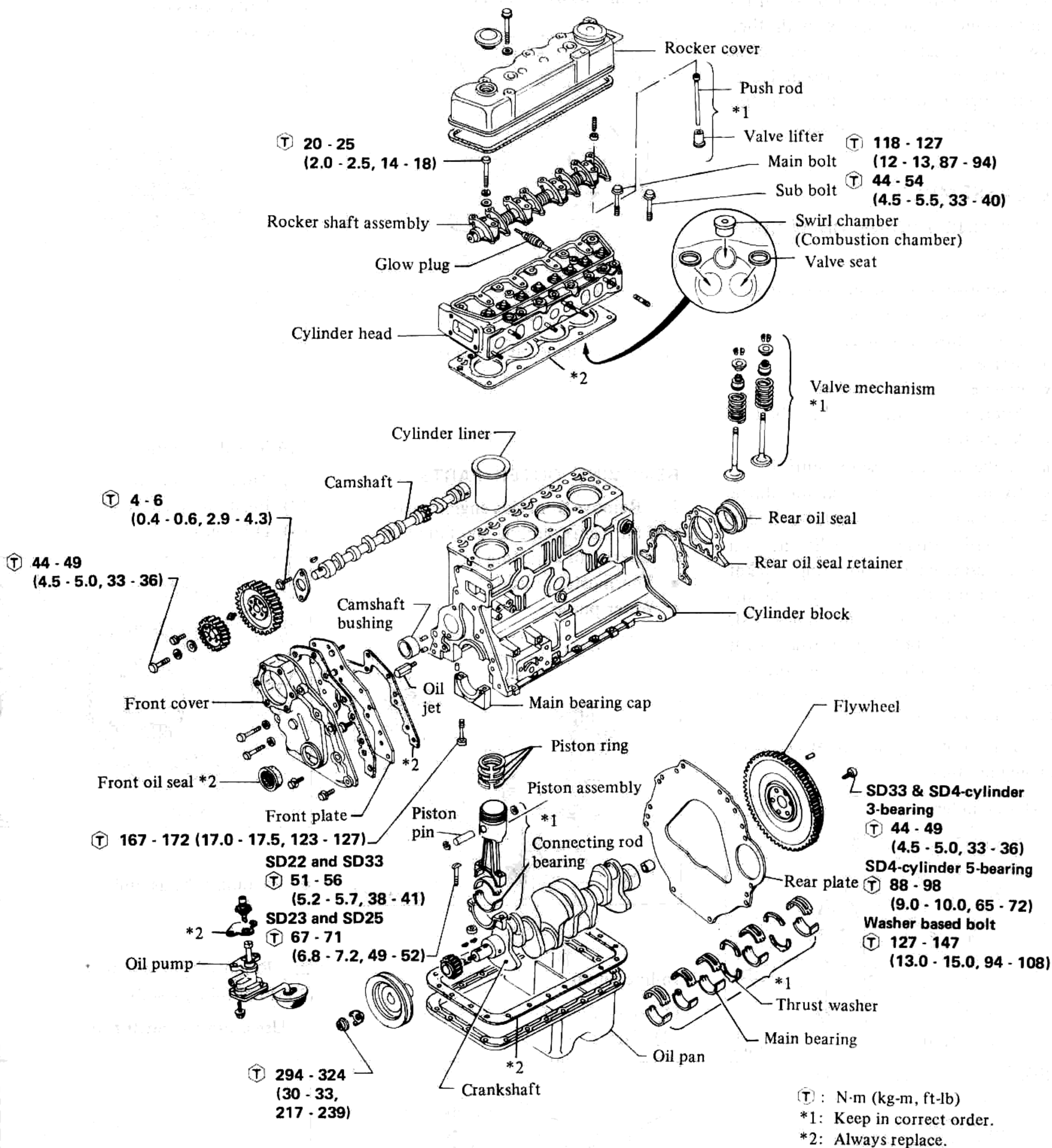
2. Remove right side parts.
  - (1) Fuel tube assembly

**Use double wrench action.**



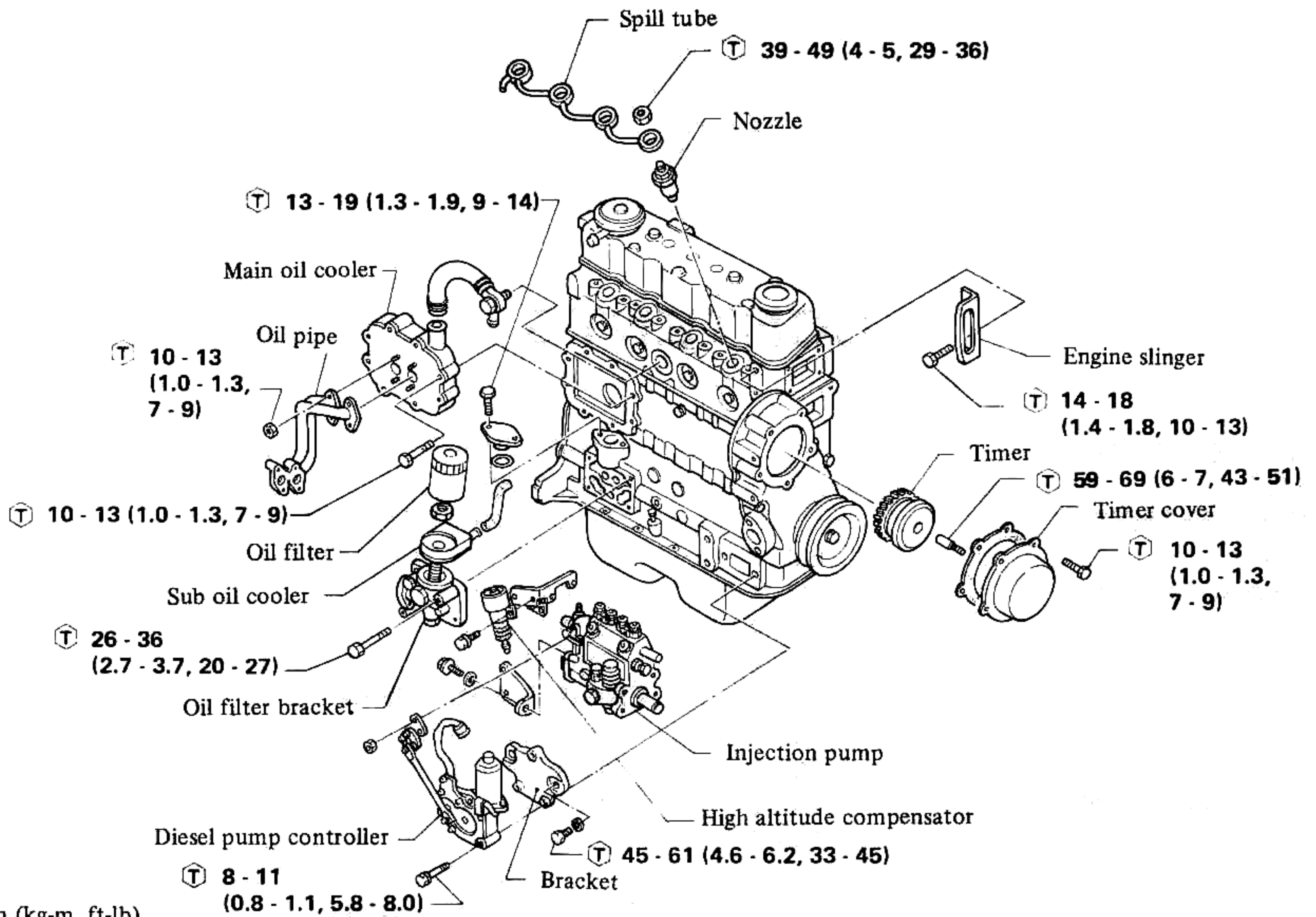


## ENGINE COMPONENTS (Internal parts)

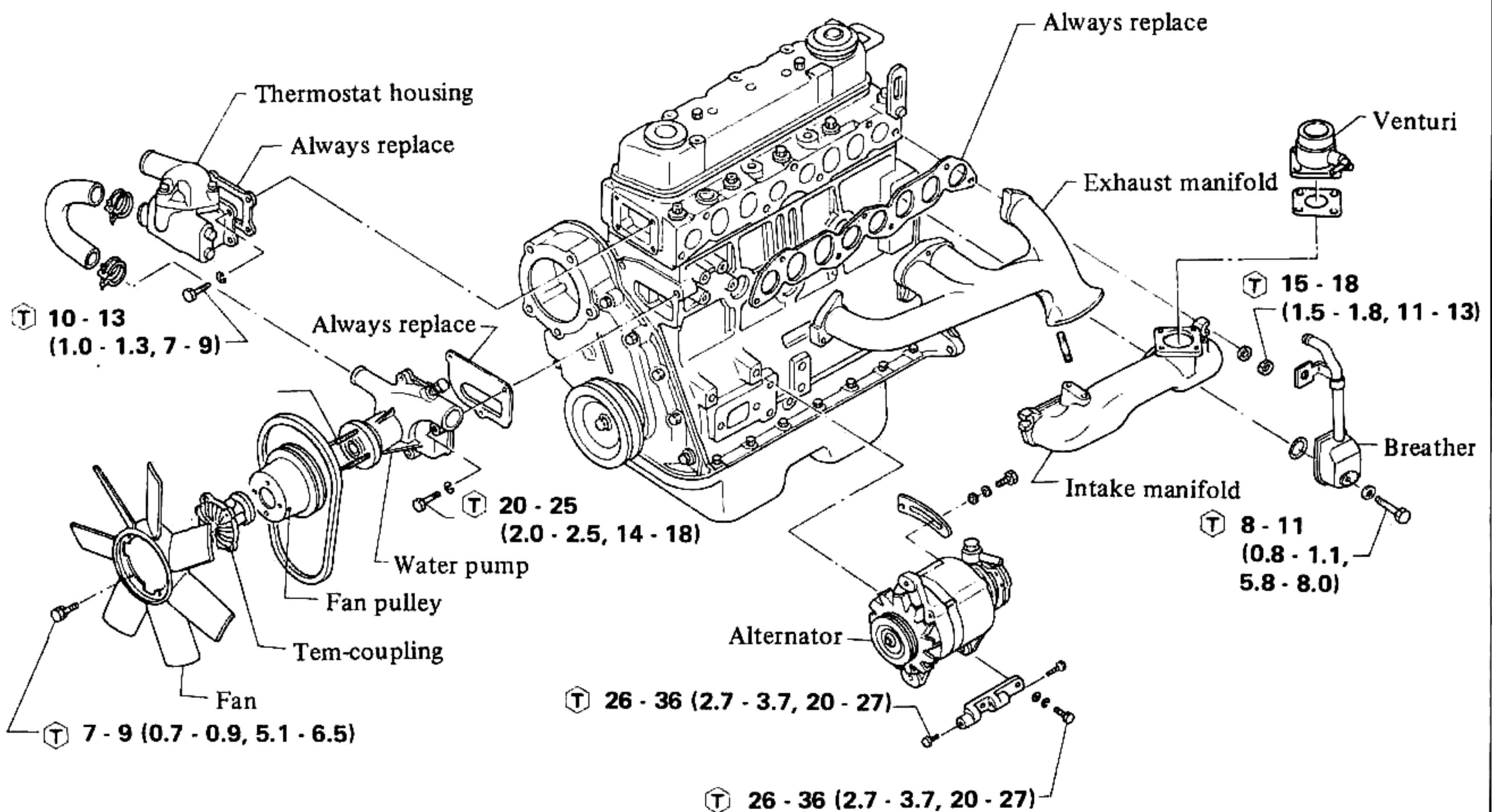




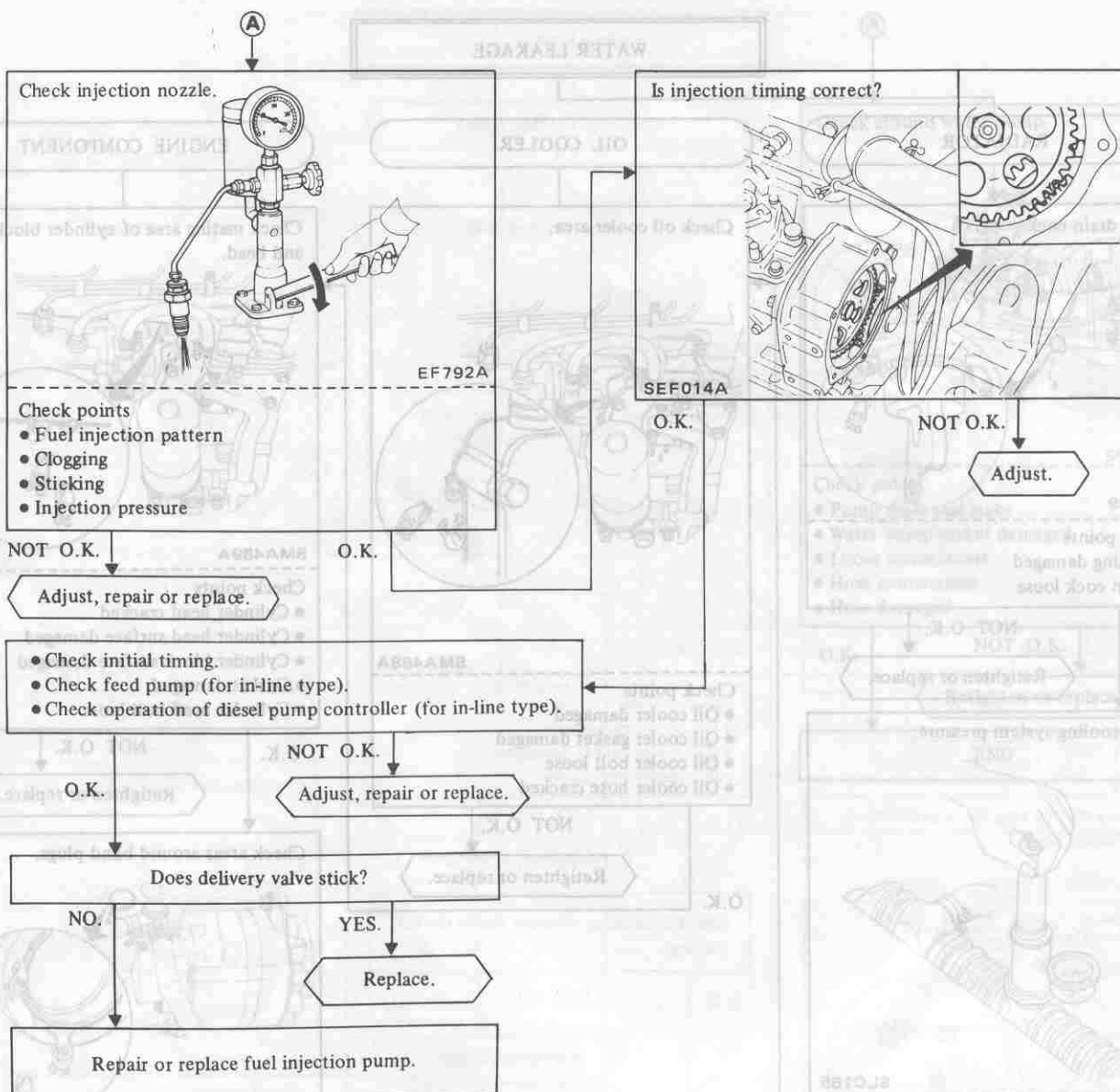
## ENGINE COMPONENTS (Outer parts)



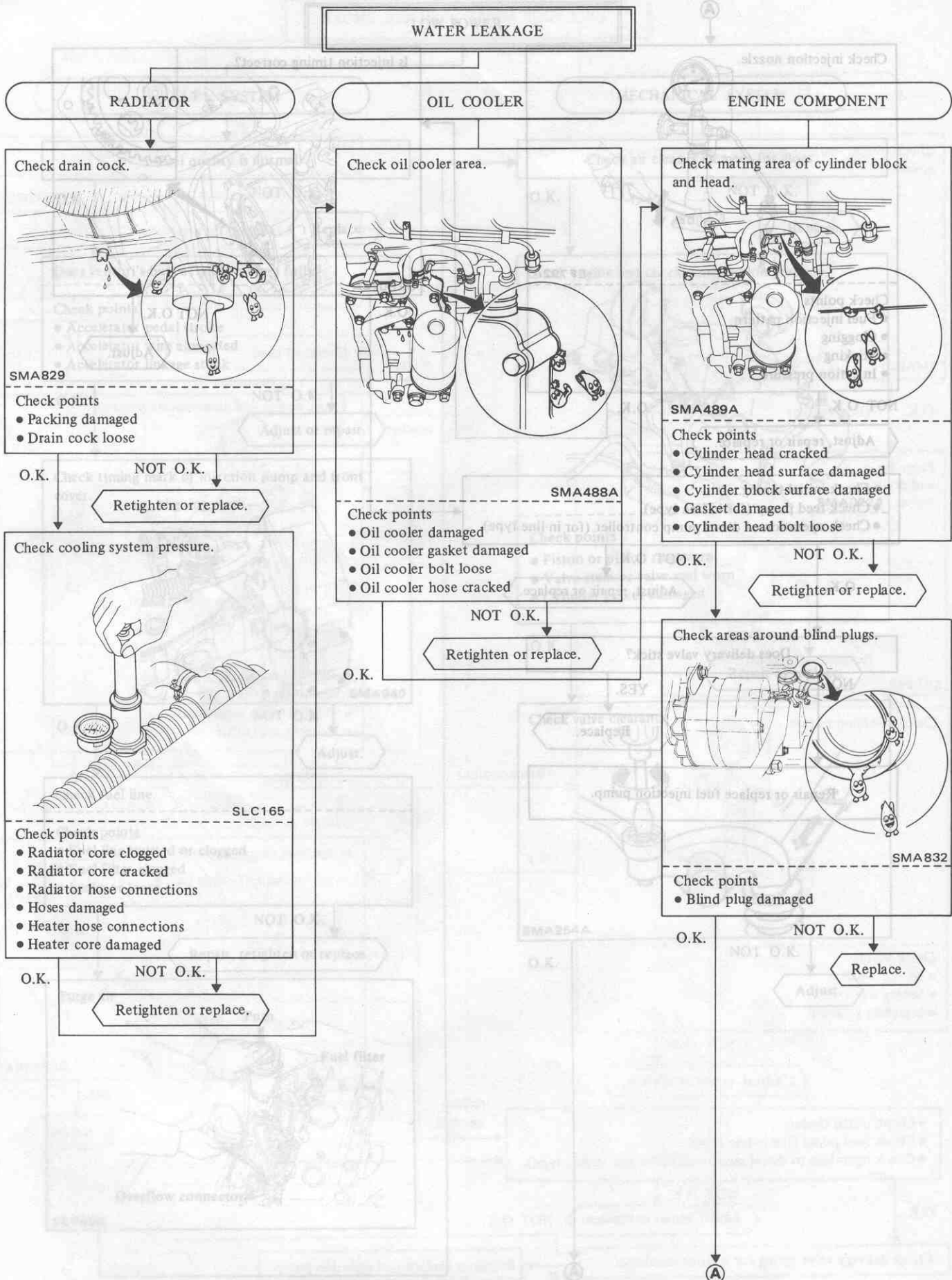
SEM064A



SEM065A





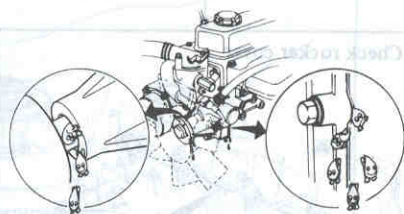


## COOLANT LEAKAGE

### ENGINE COMPONENT

A

Check around water pump.



SMA833

Check points

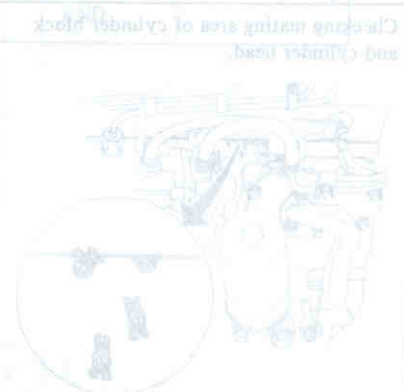
- Pump shaft seal leaks
- Water pump gasket damaged
- Loose connections
- Hose connections
- Hose damaged

O.K.

NOT O.K.

Retighten or replace.

END



SMA834

Check points

- Cylinder head surface damaged
- Cylinder block surface damaged
- Gasket damaged
- Cylinder head bolt loose

NOT O.K.

Retighten or replace.



SMA831

- Oil cooler mounting area
- Oil cooler gasket damaged
- Oil cooler bolt loose

NOT O.K.

Retighten or replace.

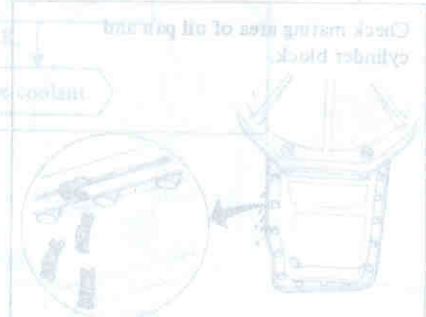


SMA832

- Oil pan gasket damaged
- Oil pan bolt loose
- Oil pan surface damaged

NOT O.K.

Retighten or replace.

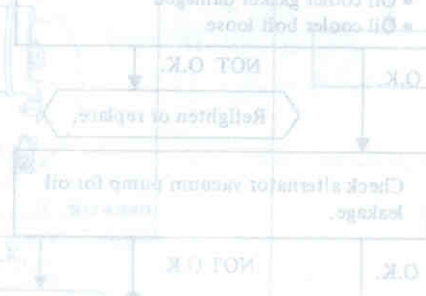


SMA830

- Cylinder block surface damaged
- Cylinder head bolt loose
- Cylinder head surface damaged

NOT O.K.

Retighten or replace.

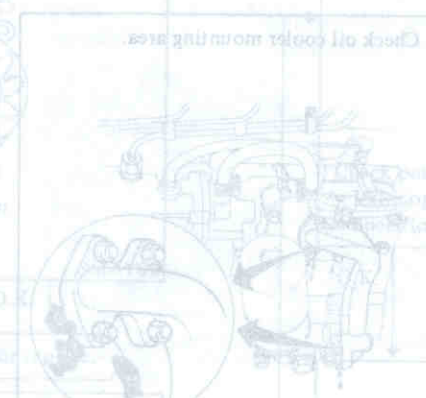


SMA835

- Engine front and rear side
- Engine side
- Engine front

NOT O.K.

Retighten or replace.



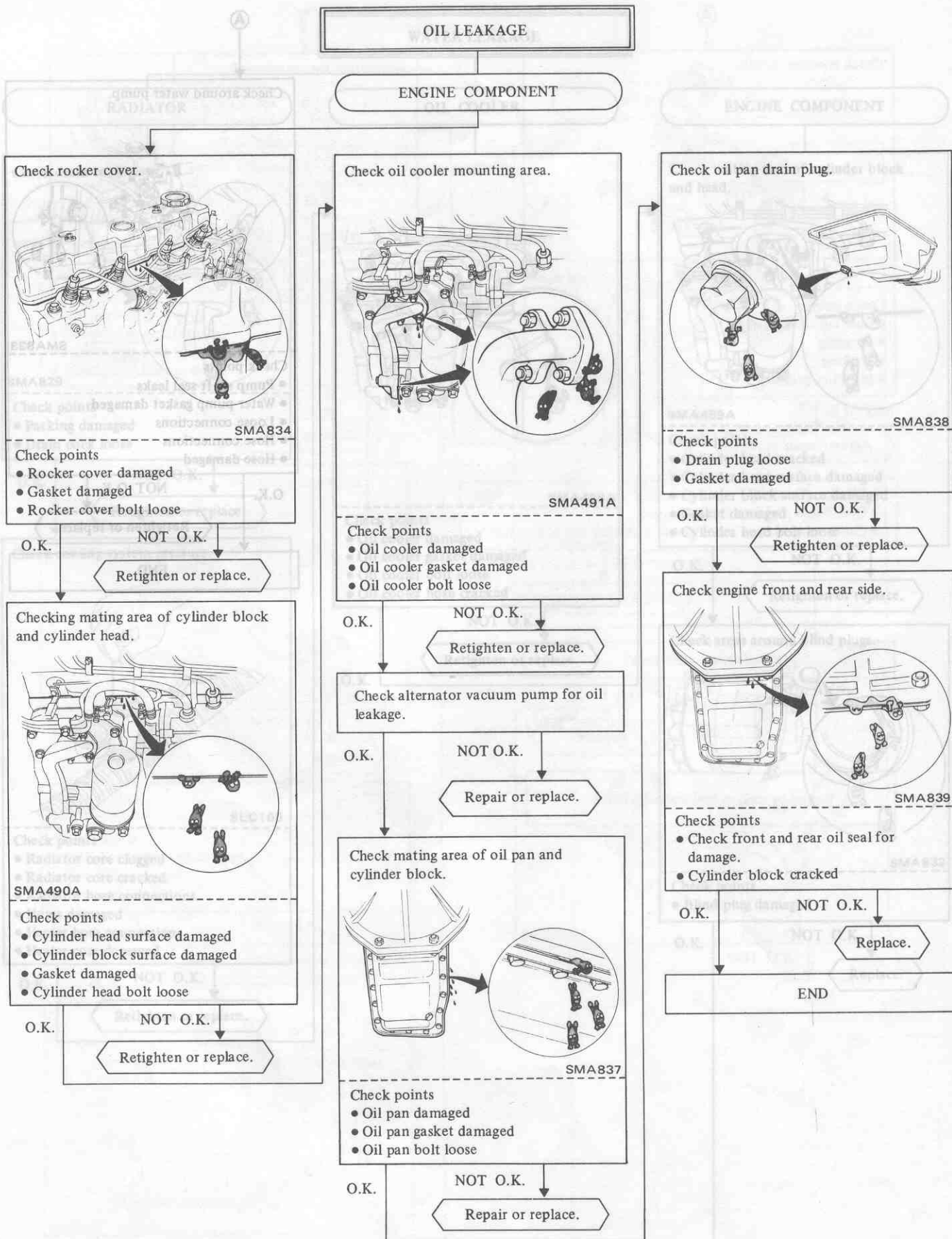
SMA836

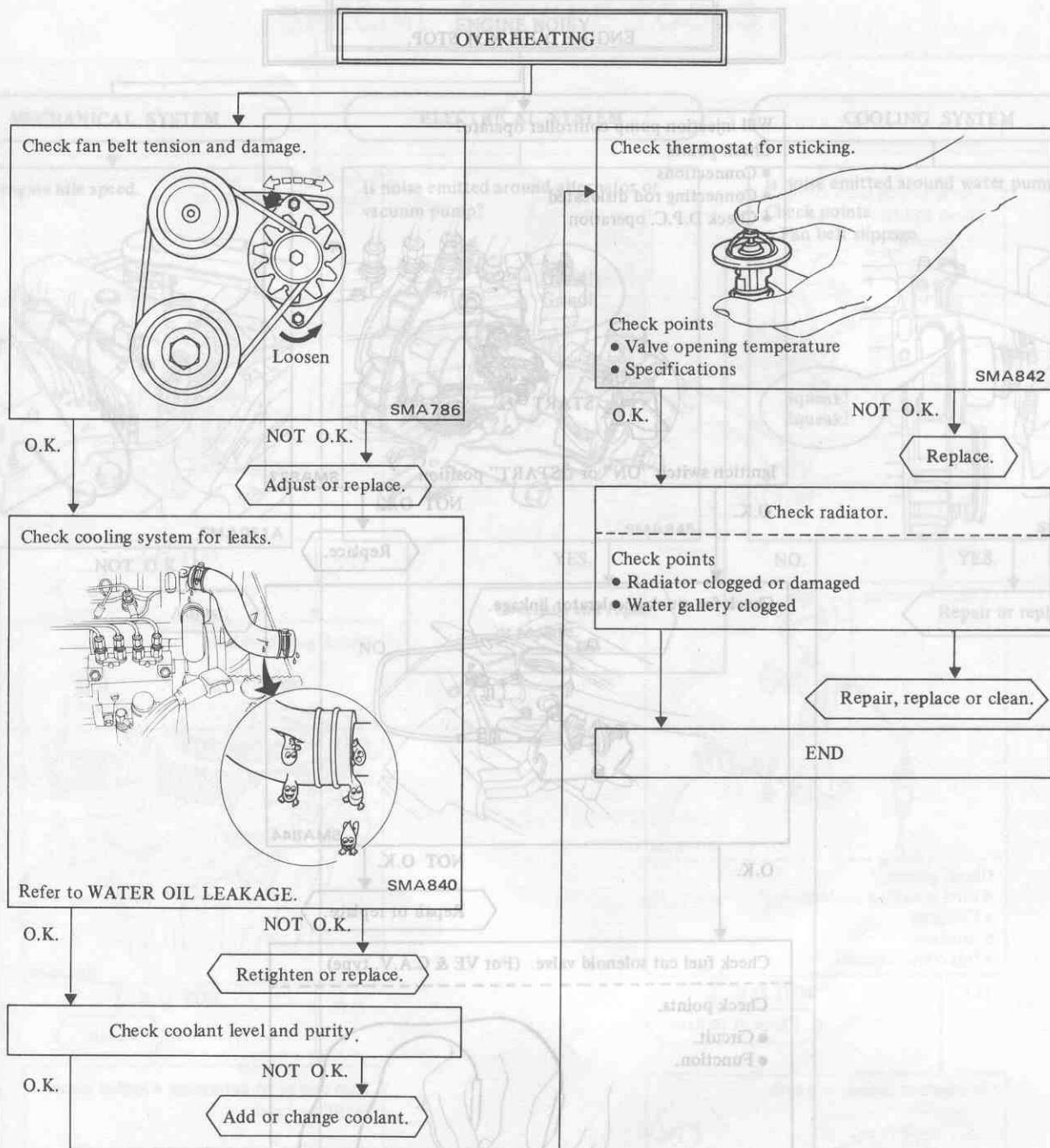
- Oil pan drain plug
- Oil pan gasket
- Oil pan bolt

NOT O.K.

Retighten or replace.







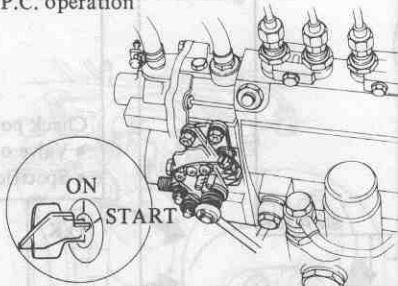


ENGINE DOES NOT STOP.

Will injection pump controller operate?

Check points

- Connections
- Connecting rod dislocated
- Check D.P.C. operation



Ignition switch "ON" or "START" position

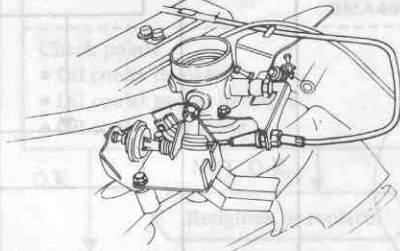
SMA827

O.K.

NOT O.K.

Replace.

Check for stuck accelerator linkage.



SMA844

O.K.

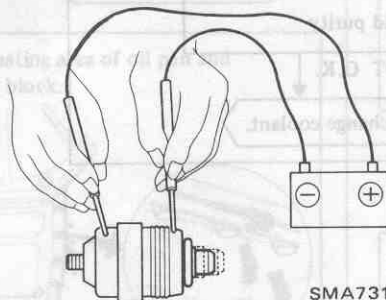
NOT O.K.

Repair or replace.

Check fuel cut solenoid valve. (For VE &amp; C.A.V. type)

Check points.

- Circuit.
- Function.



SMA731

O.K.

NOT O.K.

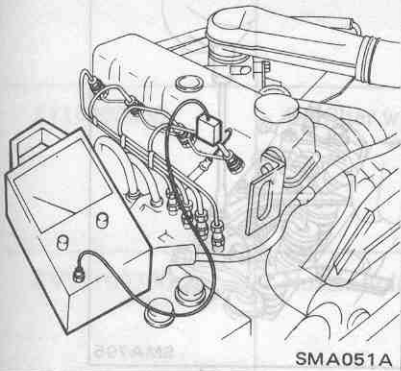
Replace.

Repair or replace fuel injection pump.

## ENGINE NOISY

### MECHANICAL SYSTEM

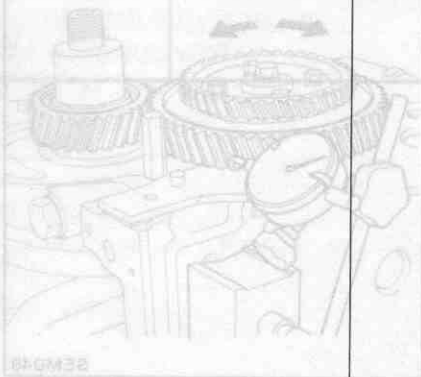
Check engine idle speed.



O.K.

NOT O.K.

Adjust.



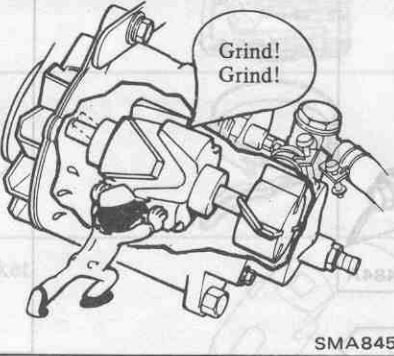
Repair.



END

### ELECTRICAL SYSTEM

Is noise emitted around alternator or vacuum pump?



YES.

Overhaul and repair or replace.

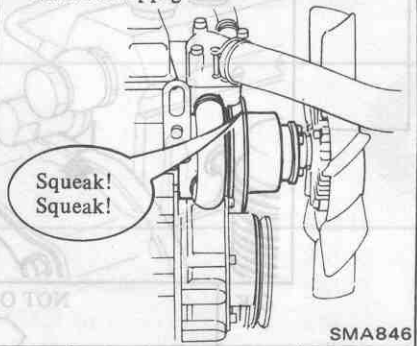
NO.

### COOLING SYSTEM

Is noise emitted around water pump?

Check points

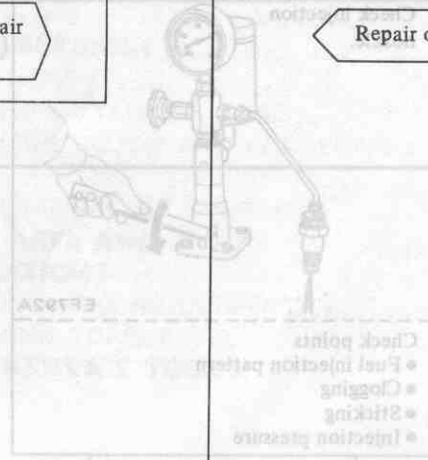
- Fan belt slippage



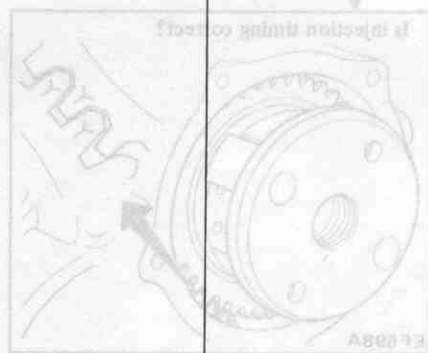
NO.

YES.

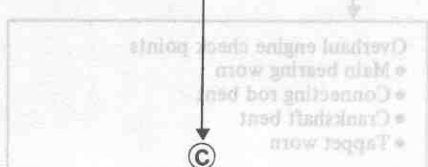
Repair or replace.



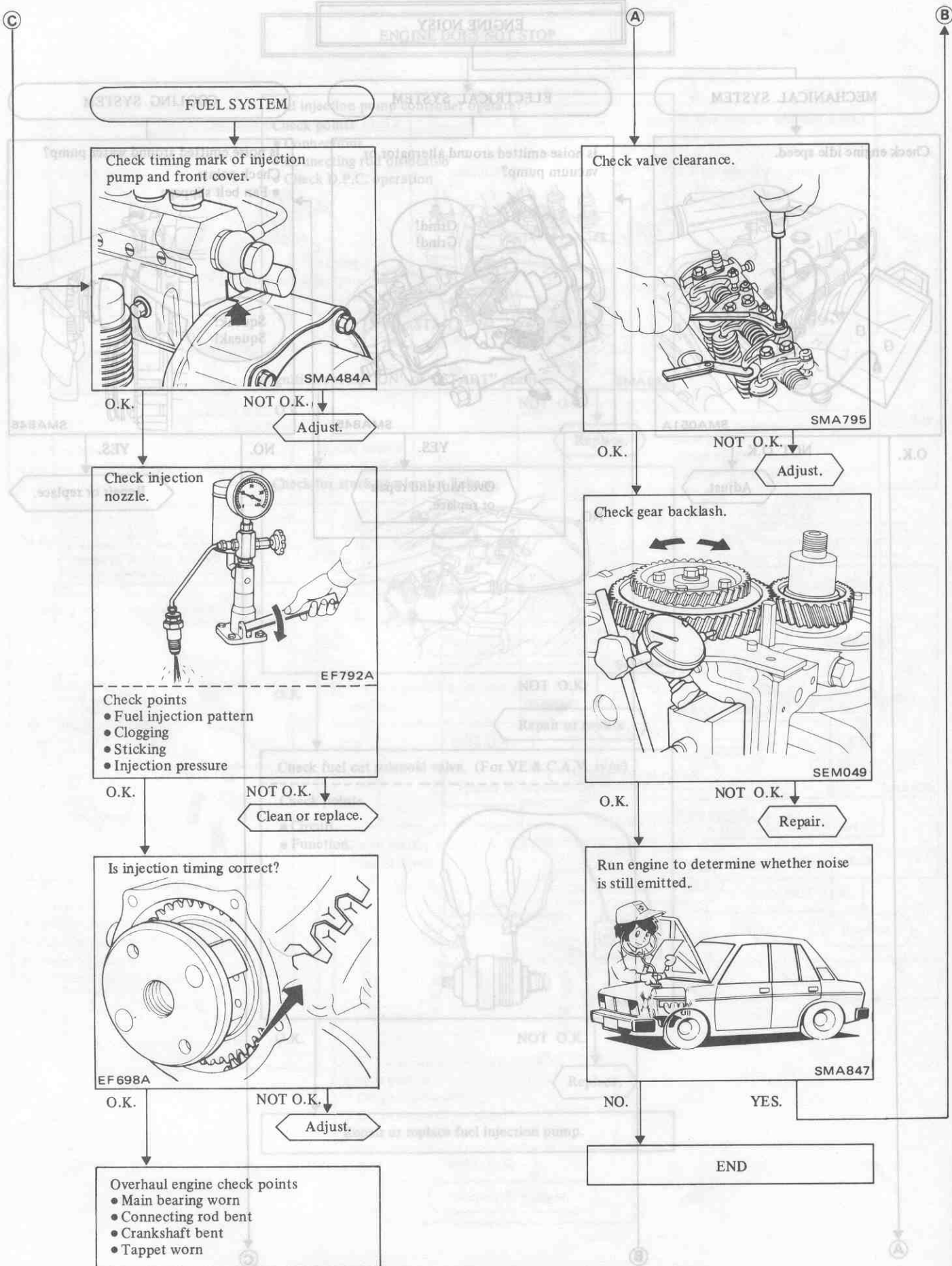
Clean or replace.



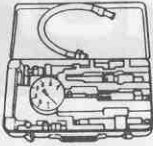
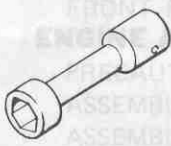
Adjust.





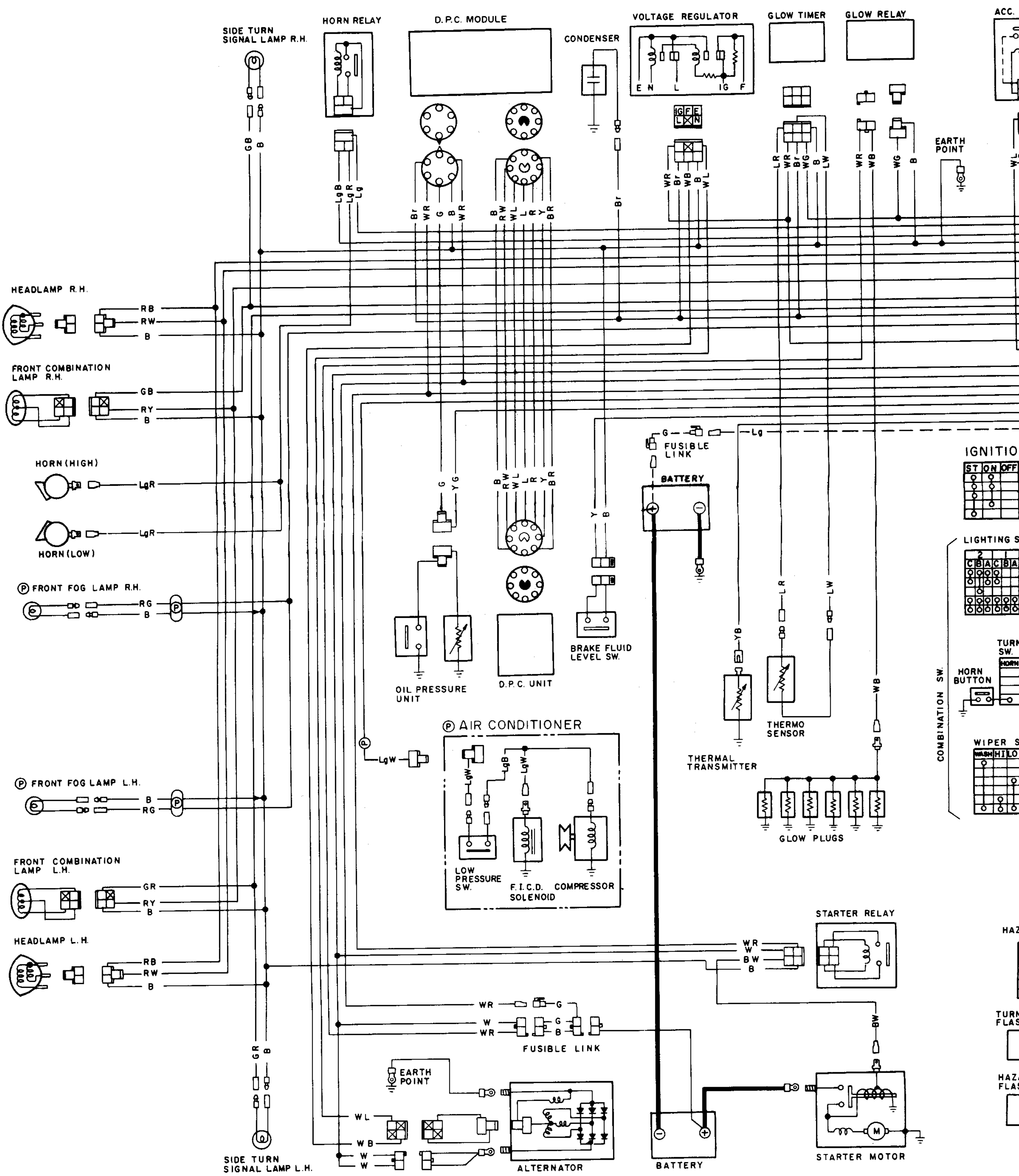


## SPECIAL SERVICE TOOLS

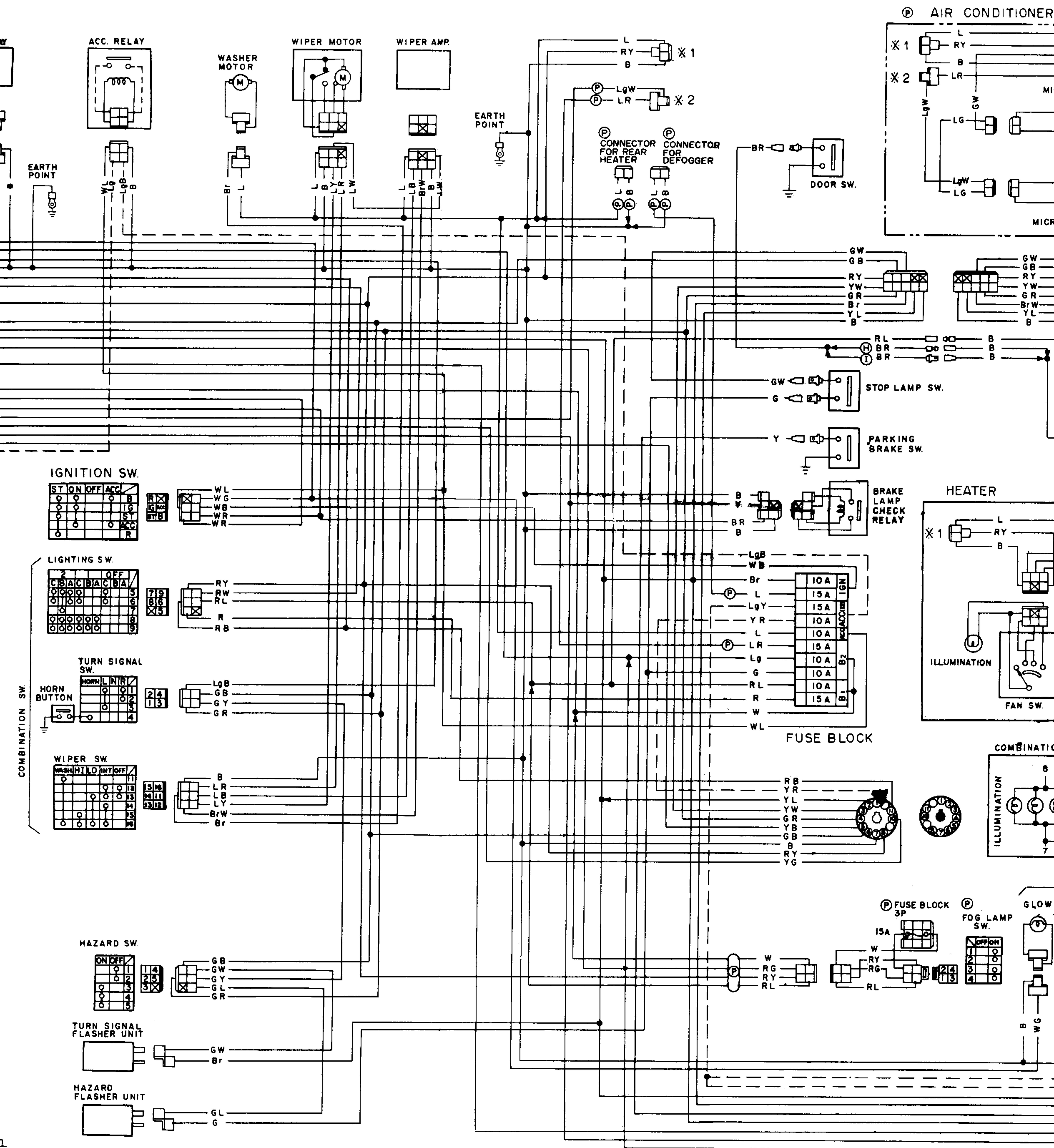
| Tool number | Tool name             |                                                                                   |
|-------------|-----------------------|-----------------------------------------------------------------------------------|
| ED19600000  | Compression gauge set |  |
| ST19320000  | Oil filter wrench     |  |
| KV11100300  | Nozzle holder socket  |  |
| KV11100400  | Socket                |  |



MODEL 160 SERIES (Equipped with SD33 engine)





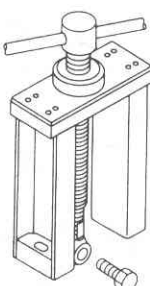
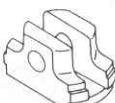
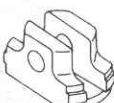
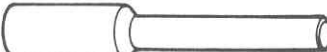




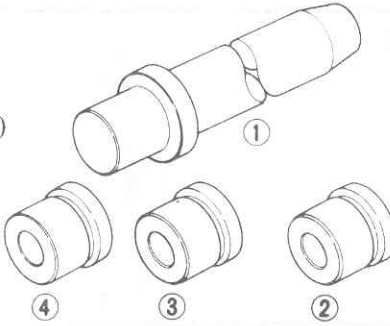
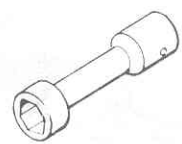




# SPECIAL SERVICE TOOLS

| Tool number | Tool name                                                                                                        | Engine application |      |      |      |
|-------------|------------------------------------------------------------------------------------------------------------------|--------------------|------|------|------|
|             |                                                                                                                  | SD22               | SD23 | SD25 | SD33 |
| KV111023S0  | Cylinder liner tool<br>         | X                  | X    | X    | X    |
| KV11102320  | Cylinder liner tool adapter<br> | —                  | X    | X    | —    |
| KV11102500  | Cylinder liner tool adapter<br> | X                  | —    | —    | X    |
| ST16610001  | Pilot bushing puller<br>       | X                  | X    | X    | —    |
| ST16690000  | Pilot bushing puller<br>      | —                  | —    | —    | X    |
| KV11101000  | Valve oil seal drift<br>      | X                  | X    | X    | X    |
| EM03470000  | Piston ring compressor<br>    | X                  | X    | X    | X    |
| KV11100300  | Nozzle holder socket<br>      | X                  | X    | X    | X    |

# SPECIAL SERVICE TOOLS

| Tool number                                                                | Tool name                                                                                                                                                           | Engine application |      |      |      |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|------|------|
|                                                                            |                                                                                                                                                                     | SD22               | SD23 | SD25 | SD33 |
| ST16650000<br>① ST16650010<br>② ST16650020<br>③ ST16650030<br>④ ST16650040 | Cam bush replacer<br>Bar<br>Adapter (Front)<br>Adapter (Center)<br>Adapter (Rear)  | X                  | X    | X    | X    |
| ST19530000                                                                 | Injection pump timer puller                                                        | X                  | X    | X    | X    |
| ST19320000                                                                 | Oil filter wrench                                                                  | X                  | X    | X    | X    |
| KV11100400                                                                 | Socket wrench                                                                     | X                  | X    | X    | X    |



# GENERAL INFORMATION

GI

## SECTION GI

### CONTENTS

|                                               |      |                                          |      |
|-----------------------------------------------|------|------------------------------------------|------|
| SPECIFICATIONS .....                          | GI-2 | TIGHTENING TORQUE OF STANDARD BOLT ..... | GI-4 |
| Table of model and corresponding engine ..... | GI-2 |                                          |      |
| ENGINE SERIAL NUMBER LOCATION .....           | GI-3 |                                          |      |

### ENGINE SERIAL NUMBER LOCATION

| Model | Engine   | Injection pump type       | Remarks                             |
|-------|----------|---------------------------|-------------------------------------|
| 430   | SD23     | DIESEL KIKI-BOSCH in-line | no pictures in technical manual and |
| 180   | SD33 & T | DIESEL KIKI-BOSCH in-line |                                     |
| H40   | SD25     | DIESEL KIKI-BOSCH in-line | XXXXXX XXXX                         |
| W40   | SD25     | DIESEL KIKI-BOSCH VE      | Only for Hong Kong                  |
| 140   | SD23     | DIESEL KIKI-BOSCH in-line |                                     |
| F23   | SD23     | DIESEL KIKI-BOSCH in-line | Only for Taiwan                     |
| E23   | SD23     | DIESEL KIKI-BOSCH VE      | Only for Europe and Australia       |
| 720   | SD25     | DIESEL KIKI-BOSCH in-line | Only for Europe and Australia       |
|       | SD23     | DIESEL KIKI-BOSCH VE      | Only for Europe and Australia       |
|       | SD23     | DIESEL KIKI-BOSCH in-line | Only for Europe and Australia       |

\*2: There are a few different kinds of SD23 engines with respect to the number of piston rings and main bearings. When you are not sure of the number of piston rings or main bearings of a particular SD23 engine, refer to the table below.

# SPECIFICATIONS

## SPECIFICATIONS

| Engine model                 |                         | SD22                   | SD23                  | SD25                   | SD33                   |
|------------------------------|-------------------------|------------------------|-----------------------|------------------------|------------------------|
| Cylinder arrangement         |                         | In-line                |                       |                        |                        |
| Number of cylinders          |                         | 4                      |                       |                        | 6                      |
| Valve arrangement            |                         | O.H.V.                 |                       |                        |                        |
| Bore x Stroke                | mm (in)                 | 83 x 100 (3.27 x 3.94) | 89 x 92 (3.50 x 3.62) | 89 x 100 (3.50 x 3.94) | 83 x 100 (3.27 x 3.94) |
| Displacement                 | cm <sup>3</sup> (cu in) | 2,164 (132.05)         | 2,289 (139.67)        | 2,488 (151.82)         | 3,246 (198.07)         |
| Firing order                 |                         | 1-3-4-2                |                       |                        | 1-4-2-6-3-5            |
| Number of piston rings       | Compression             | 3                      | 2                     | 3                      |                        |
|                              | Oil                     | 2                      | 1                     | 2                      |                        |
| Number of main bearings      |                         | 3                      | 5                     | 4                      |                        |
| Compression ratio            |                         | 20.8                   | 20.5                  | 20.7                   | 21.4 *1                |
| Cetane number of diesel fuel |                         | More than 45           |                       |                        |                        |

\*1: Only for 720 model

### TABLE OF MODEL AND CORRESPONDING ENGINE

| Model | Engine   | Injection pump type       | Remarks                       |
|-------|----------|---------------------------|-------------------------------|
| 430   | SD22     | DIESEL KIKI-BOSCH in-line | *2                            |
| 160   | SD33 & T | DIESEL KIKI-BOSCH in-line |                               |
| H40   | SD25     | DIESEL KIKI-BOSCH in-line |                               |
|       |          | DIESEL KIKI-BOSCH VE      |                               |
| W40   | SD25     | DIESEL KIKI-BOSCH in-line | Only for Hong Kong            |
|       |          | DIESEL KIKI-BOSCH VE      |                               |
| 140   | SD22     | DIESEL KIKI-BOSCH in-line | *2                            |
| F22   | SD22     | C.A.V.-D.P.A.             | Only for Taiwan               |
|       | SD25     | DIESEL KIKI-BOSCH in-line |                               |
|       |          | DIESEL KIKI-BOSCH VE      | Only for Europe and Australia |
|       | SD23     | DIESEL KIKI-BOSCH in-line |                               |
| E23   | SD22     | DIESEL KIKI-BOSCH VE      | *2                            |
|       | SD23     | DIESEL KIKI-BOSCH VE      |                               |
| 720   | SD22     | DIESEL KIKI-BOSCH in-line | *2                            |
|       | SD23     | DIESEL KIKI-BOSCH in-line |                               |
|       |          | DIESEL KIKI-BOSCH VE      | Only for Europe and Australia |
|       | SD25     | DIESEL KIKI-BOSCH in-line |                               |
|       |          | DIESEL KIKI-BOSCH VE      | Only for Europe and Australia |

\*2: There are a few different kinds of SD22 engines with respect to the number of piston rings and main bearings. When you are not sure of the number of piston rings or main bearings of a particular SD22 engine, refer to the table below.

# ENGINE SERIAL NUMBER LOCATION

|           |               | Applied SD22 engine number |               |               |                       |
|-----------|---------------|----------------------------|---------------|---------------|-----------------------|
| Number of |               |                            |               |               |                       |
| 430       | Piston rings  | 5 rings                    | 3 rings       | SD22-743434 ~ | (only for Hong Kong)  |
|           |               |                            |               | SD22-754092 ~ | (for other countries) |
|           | Main bearings | 3 bearings                 | SD22-618766 ~ | 5 bearings    |                       |
| 140       | Piston rings  | 5 rings                    |               |               |                       |
|           | Main bearings | 3 bearings                 |               |               |                       |
| E23       | Piston rings  | 5 rings                    | SD22-557447 ~ |               | 3 rings               |
|           | Main bearings | 3 bearings                 |               |               |                       |
| 720       | Piston rings  | 5 rings                    | SD22-703539 ~ |               | 3 rings               |
|           | Main bearing  | 3 bearings                 |               |               | 5 bearings            |

## ENGINE SERIAL NUMBER LOCATION

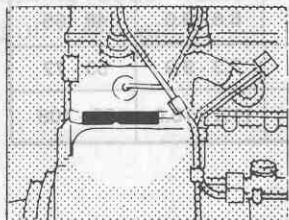
The engine number is stamped on the right side of the cylinder block.

SDXX      XXXXXX

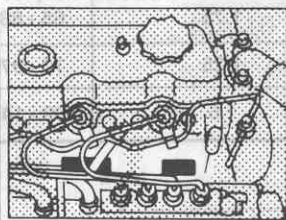
Serial No.

Engine model

SD 4-cylinder



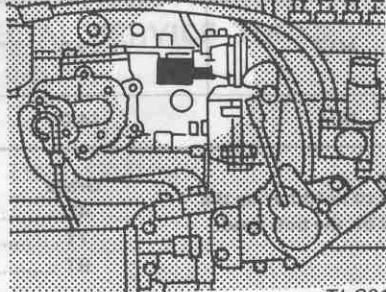
Up to  
Apr., 1980



From  
May, 1980

SGI016

SD33



TLC019



## TIGHTENING TORQUE OF STANDARD BOLT

| Grade | Nominal size | Diameter mm | Pitch mm  | Tightening torque |            |           |
|-------|--------------|-------------|-----------|-------------------|------------|-----------|
|       |              |             |           | N·m               | kg·m       | ft·lb     |
| 4T    | M6           | 6.0         | 1.0       | 3 - 4             | 0.3 - 0.4  | 2.2 - 2.9 |
|       | M8           | 8.0         | 1.25      | 8 - 11            | 0.8 - 1.1  | 5.8 - 8.0 |
|       |              |             | 1.0       | 8 - 11            | 0.8 - 1.1  | 5.8 - 8.0 |
|       | M10          | 10.0        | 1.5       | 16 - 22           | 1.6 - 2.2  | 12 - 16   |
|       |              |             | 1.25      | 16 - 22           | 1.6 - 2.2  | 12 - 16   |
|       | M12          | 12.0        | 1.75      | 26 - 36           | 2.7 - 3.7  | 20 - 27   |
|       |              |             | 1.25      | 30 - 40           | 3.1 - 4.1  | 22 - 30   |
|       | M14          | 14.0        | 1.5       | 46 - 62           | 4.7 - 6.3  | 34 - 46   |
| 7T    | M6           | 6.0         | 1.0       | 6 - 7             | 0.6 - 0.7  | 4.3 - 5.1 |
|       | M8           | 8.0         | 1.25      | 14 - 18           | 1.4 - 1.8  | 10 - 13   |
|       |              |             | 1.0       | 14 - 18           | 1.4 - 1.8  | 10 - 13   |
|       | M10          | 10.0        | 1.5       | 25 - 35           | 2.6 - 3.6  | 19 - 26   |
|       |              |             | 1.25      | 26 - 36           | 2.7 - 3.7  | 20 - 27   |
|       | M12          | 12.0        | 1.75      | 45 - 61           | 4.6 - 6.2  | 33 - 45   |
|       |              |             | 1.25      | 50 - 68           | 5.1 - 6.9  | 37 - 50   |
|       | M14          | 14.0        | 1.5       | 76 - 103          | 7.7 - 10.5 | 56 - 76   |
| 9T    | M6           | 6.0         | 1.0       | 8 - 11            | 0.8 - 1.1  | 5.8 - 8.0 |
|       | M8           | 8.0         | 1.25      | 19 - 25           | 1.9 - 2.5  | 14 - 18   |
|       |              |             | 1.0       | 20 - 27           | 2.0 - 2.8  | 14 - 20   |
|       | M10          | 10.0        | 1.5       | 36 - 50           | 3.7 - 5.1  | 27 - 37   |
|       |              |             | 1.25      | 39 - 51           | 4.0 - 5.2  | 29 - 38   |
|       | M12          | 12.0        | 1.75      | 65 - 88           | 6.6 - 9.0  | 48 - 65   |
|       |              |             | 1.25      | 72 - 97           | 7.3 - 9.9  | 53 - 72   |
| M14   | 14.0         | 1.5         | 109 - 147 | 11.1 - 15.0       | 80 - 108   |           |

1. Special parts are excluded.

2. This standard is applicable to bolts having the following marks embossed on the bolt head.

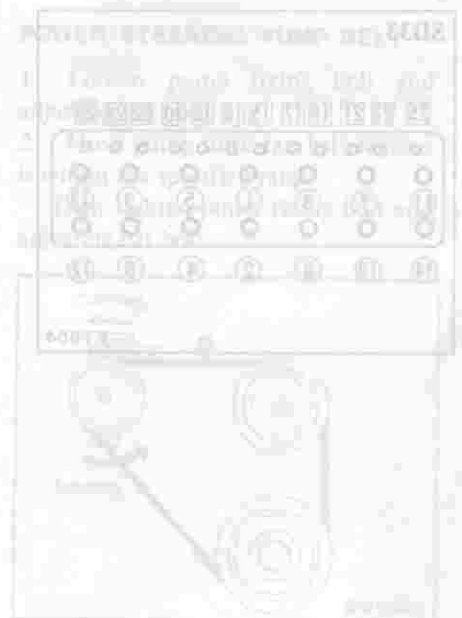
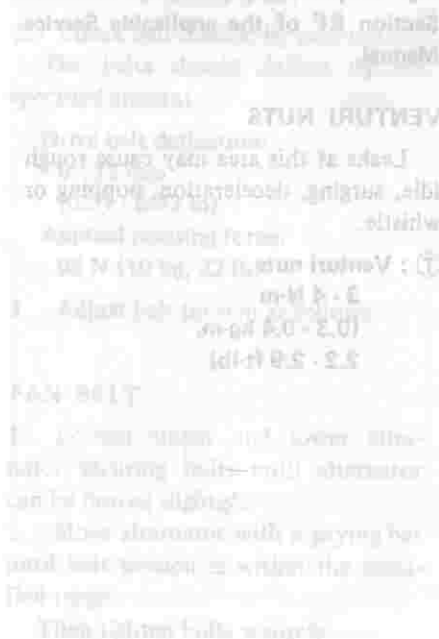
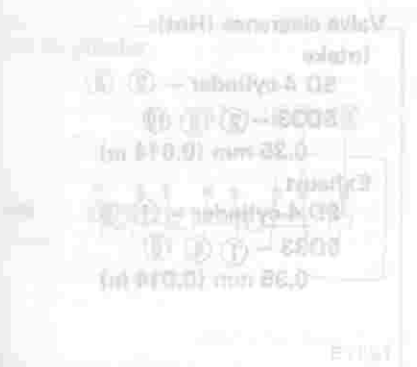
| Grade    | Mark |
|----------|------|
| 4T ..... | 4    |
| 7T ..... | 7    |
| 9T ..... | 9    |

## SECTION V

MA

### CONTENTS

|                                                                            |       |                                                                            |       |
|----------------------------------------------------------------------------|-------|----------------------------------------------------------------------------|-------|
| <b>BASIC MECHANICAL SYSTEM</b> . . . . .                                   | MA- 2 | <b>COOLING AND LUBRICATION SYSTEM</b> . . . . .                            | MA-11 |
| Retightening cylinder head bolts, manifold nuts and venturi nuts . . . . . | MA- 2 | Changing engine coolant . . . . .                                          | MA-11 |
| Adjusting intake and exhaust valve clearance . . . . .                     | MA- 2 | Checking cooling system hoses and connections for leaks . . . . .          | MA-11 |
| Checking and adjusting drive belt . . . . .                                | MA- 3 | Changing engine oil and oil filter . . . . .                               | MA-11 |
| Checking engine compression pressure . . . . .                             | MA- 4 | Checking engine oil for leaks . . . . .                                    | MA-12 |
| <b>INJECTION AND FUEL SYSTEM</b> . . . . .                                 | MA- 5 | Checking and changing injection pump oil (Lubrication type only) . . . . . | MA-12 |
| Checking and adjusting injection timing . . . . .                          | MA- 5 | Lubricating injection pump governor diaphragm . . . . .                    | MA-13 |
| Idle and maximum speed adjustment . . . . .                                | MA- 5 | <b>ELECTRICAL SYSTEM</b> . . . . .                                         | MA-13 |
| Injection nozzle . . . . .                                                 | MA- 8 | Checking glow plugs . . . . .                                              | MA-13 |
| Cleaning and replacing air cleaner filter . . . . .                        | MA- 8 | <b>SERVICE DATA AND SPECIFICATIONS</b> . . . . .                           | MA-14 |
| Checking fuel filter, draining water and replacing filter . . . . .        | MA- 9 | Inspection and adjustment . . . . .                                        | MA-14 |
| Checking fuel lines (Hoses, piping, connectors, etc.) . . . . .            | MA-10 | Tightening torque . . . . .                                                | MA-14 |
| Checking rubber hoses (Water, air vacuum and oil hoses, etc.) . . . . .    | MA-10 | <b>TROUBLE DIAGNOSES AND CORRECTIONS</b> . . . . .                         | MA-15 |
|                                                                            |       | <b>SPECIAL SERVICE TOOLS</b> . . . . .                                     | MA-29 |



## BASIC MECHANICAL SYSTEM

## RETIGHTENING CYLINDER HEAD BOLTS, MANIFOLD NUTS AND VENTURI NUTS

## CYLINDER HEAD BOLTS

1. Run engine until coolant temperature indicator points to the middle of gauge, then stop engine.
2. Remove valve rocker cover.
3. Tighten cylinder head bolts according to the order shown in the figure, starting with the center and moving toward the ends.

Ⓘ : Cylinder head bolts

Main bolts (○):

118 - 127 N·m

(12 - 13 kg-m,

87 - 94 ft-lb)

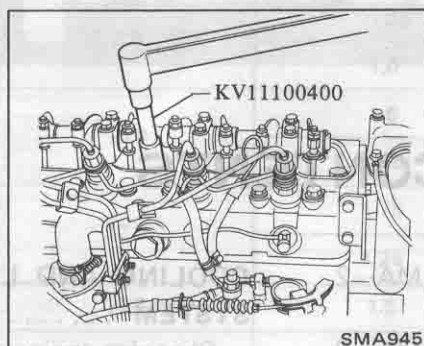
Sub bolts (□):

44 - 54 N·m

(4.5 - 5.5 kg-m,

33 - 40 ft-lb)

When tightening main bolts (near the rocker shaft side), be sure to use Tool.



4. Install valve rocker cover.

## MANIFOLD AND EXHAUST TUBE NUTS

## WARNING:

Do not check the exhaust system until it has cooled off. Otherwise, you may burn yourself.

Ⓘ : Intake & Exhaust manifold nuts

15 - 18 N·m

(1.5 - 1.8 kg-m,

11 - 13 ft-lb)

For the exhaust tube nuts' tightening torque specifications, refer to Section EF of the applicable Service Manual.

## VENTURI NUTS

Leaks at this area may cause rough idle, surging, deceleration, popping or whistle.

Ⓘ : Venturi nuts

3 - 4 N·m

(0.3 - 0.4 kg-m,

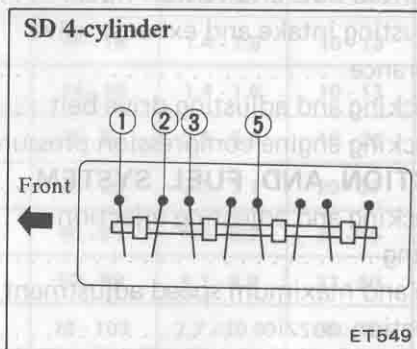
2.2 - 2.9 ft-lb)

## ADJUSTING INTAKE AND EXHAUST VALVE CLEARANCE

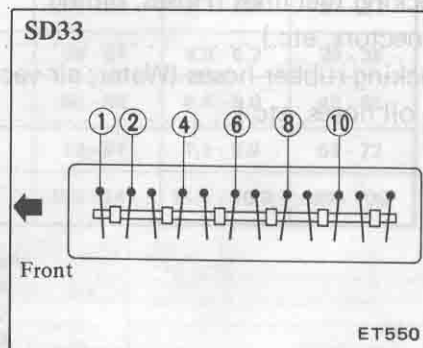
- a. Adjustment should be made while engine is hot.
- b. Adjustment cannot be made while engine is in operation.

To adjust, proceed as follows:

1. Remove valve rocker cover.
2. Set No. 1 piston to Top Dead Center on compression stroke.
3. Adjust clearances of ①, ②, ③ and ⑤ valves.



Adjust clearances of valves ①, ②, ④, ⑥, ⑧ and ⑩.



## Valve clearance (Hot):

## Intake

SD 4-cylinder - ② ③

SD33 - ② ⑥ ⑩

0.35 mm (0.014 in)

## Exhaust

SD 4-cylinder - ① ⑤

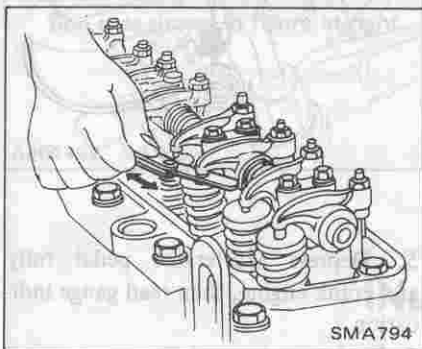
SD33 - ① ④ ⑧

0.35 mm (0.014 in)



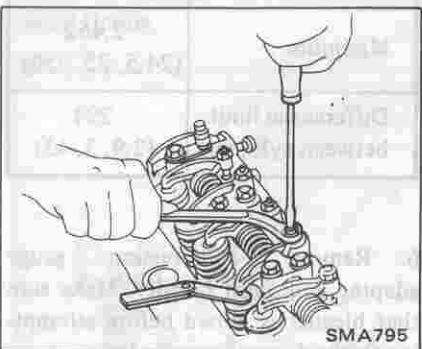
(1) Using feeler gauge, measure clearance between rocker arm and valve head.

Feeler gauge should move with a very slight drag.



(2) If clearance is not the specified value, loosen rocker arm nut and turn rocker arm screw to provide proper clearance.

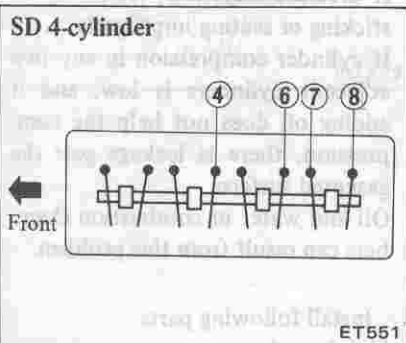
(3) Hold rocker arm screw and tighten rocker arm nut.



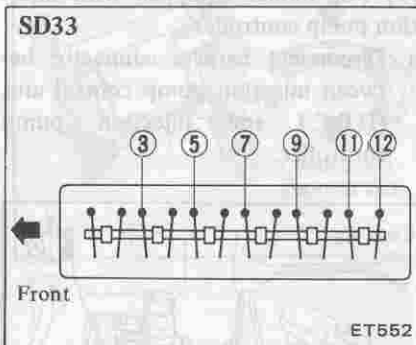
(4) Recheck clearance.

4. Bring No. 4 piston (SD 4-cylinder) or No. 6 piston (SD33) to Top Dead Center on compression stroke.

5. Adjust clearances of ④, ⑥, ⑦ and ⑧ valves.



Adjust clearances of valves ③, ⑤, ⑦, ⑨, ⑪ and ⑫.



#### Valve clearance (Hot):

##### Intake

SD 4-cylinder — ⑥ ⑦

SD33 — ③ ⑦ ⑪

0.35 mm (0.014 in)

##### Exhaust

SD 4-cylinder — ④ ⑧

SD33 — ⑤ ⑨ ⑫

0.35 mm (0.014 in)

6. Install valve rocker cover.

### CHECKING AND ADJUSTING DRIVE BELT

1. Visually inspect for cracks or damage.

The belts should not touch the bottom of the pulley groove.

2. Check belt tension by pushing.

The belts should deflect by the specified amount.

#### Drive belt deflection:

8 - 12 mm

(0.31 - 0.47 in)

#### Applied pressing force:

98 N (10 kg, 22 lb)

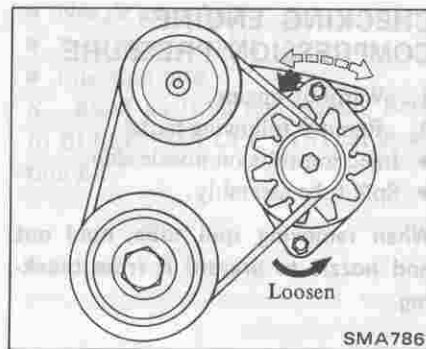
3. Adjust belt tension as follows:

### FAN BELT

1. Loosen upper and lower alternator securing bolts until alternator can be moved slightly.

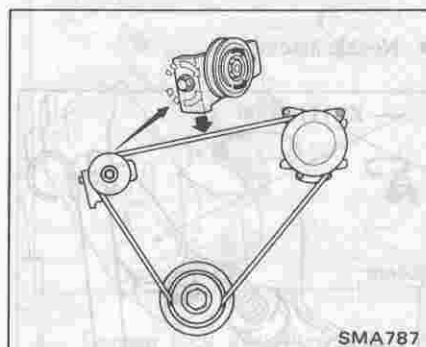
2. Move alternator with a prying bar until belt tension is within the specified range.

Then tighten bolts securely.



### AIR CONDITIONER COMPRESSOR BELT

1. Loosen idler pulley lock nut.
2. Turn idler pulley adjusting bolt in either direction until air conditioner compressor belts' tension is within the specified range.

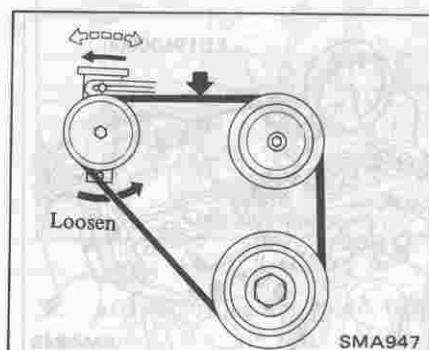


3. Tighten idler pulley lock nut.

### POWER STEERING PUMP BELT

1. Loosen pump fixing bolt and adjusting bar bolt.
2. Move pump until fan belt tension is within the specified range.

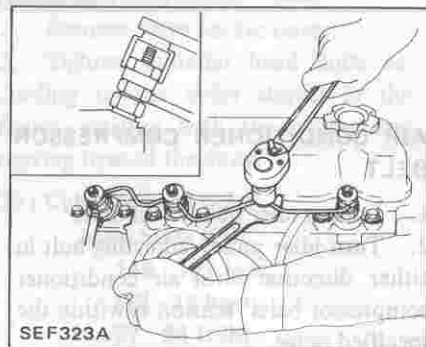
Then tighten pump fixing bolt and adjusting bar bolt.



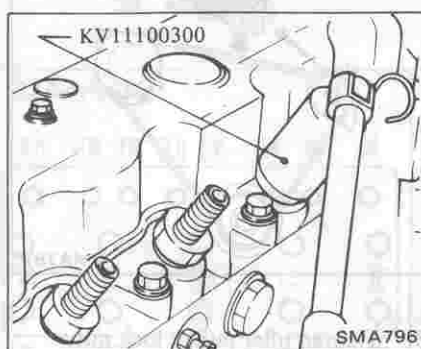
## CHECKING ENGINE COMPRESSION PRESSURE

1. Warm up engine.
2. Remove following parts:
  - Injection tube on nozzle side
  - Spill tube assembly.

When removing spill tube, hold nut and nozzle to prevent it from breaking.



- Nozzle assemblies

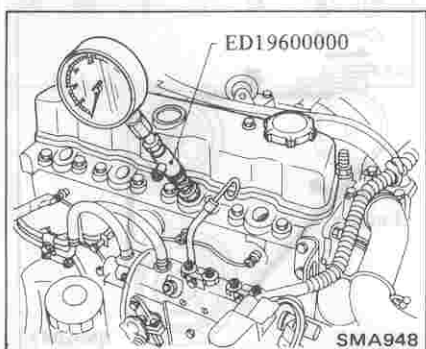


- Nozzle gaskets

3. Fit compression gauge adapter to cylinder head. Make sure bleeder of gauge is closed.

① : Compression gauge adapter

76 - 78 N·m  
(7.7 - 8.0 kg-m,  
56 - 58 ft-lb)

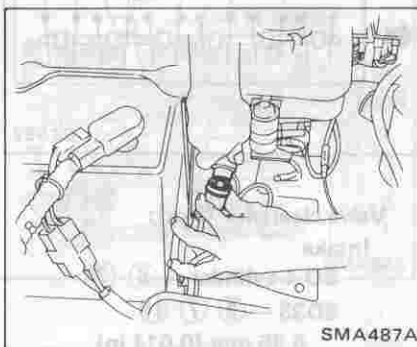


4. Set no fuel injected condition.

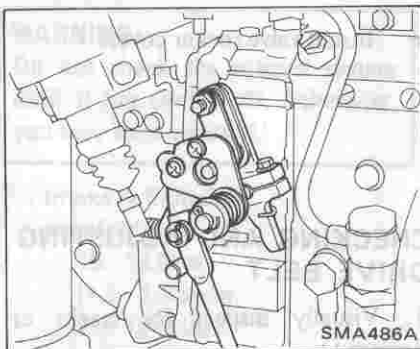
- In-line type

(1) For model equipped with injection pump controller

- a. Disconnect harness connector between injection pump control unit (D.P.C.) and injection pump controller.

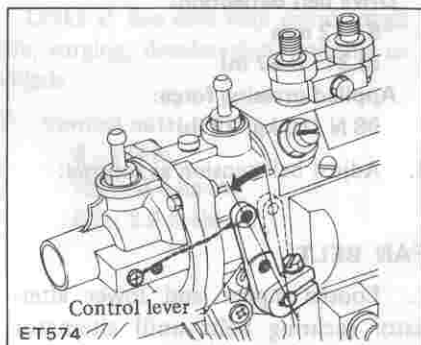


- b. Confirm that injection pump control lever stays in the stop position.



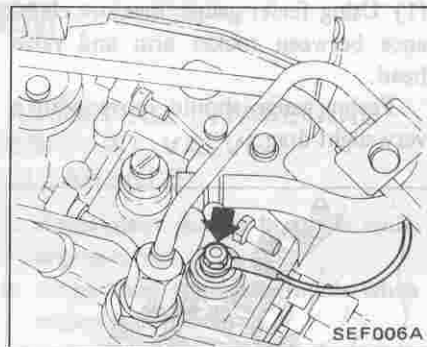
(2) For model not equipped with injection pump controller

Set control lever of injection pump at zero injection.



- VE and C.A.V.-D.P.A. type

Disconnect or remove fuel cut solenoid wire.



5. Depress accelerator pedal fully and crank engine, then read gauge indication.

- Engine compression measurement should be made as quickly as possible.

**Compression pressure:**

Unit: kPa (bar, kg/cm<sup>2</sup>, psi)/200 rpm

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

6. Remove compression gauge adapter and push bleeder. Make sure that bleeder is closed before attempting to check another cylinder.

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

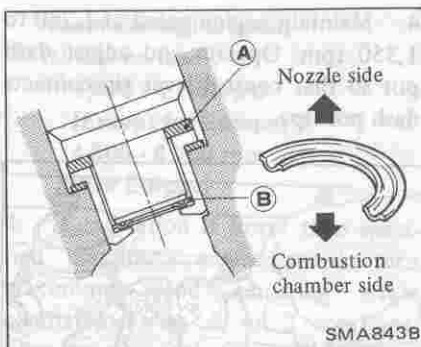
- If adding oil helps the compression pressure, chances are that piston rings are worn or damaged.
- If pressure stays low, valve may be sticking or seating improperly.
- If cylinder compression in any two adjacent cylinders is low, and if adding oil does not help the compression, there is leakage past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

7. Install following parts:

- Nozzle gaskets

When installing injection nozzle, observe the following cautions.

- Always use new injection nozzle gaskets (A and B).
- When installing the small nozzle gasket (B), the installation direction is as shown in figure at right.



- Nozzle assemblies
- Spill tube assembly
- Injection tube

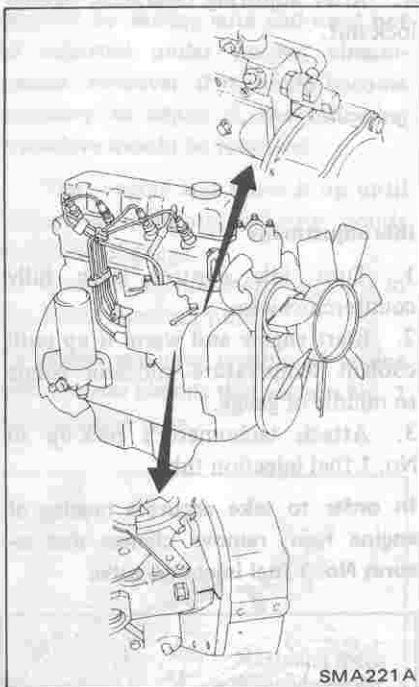
8. Bleed air from fuel system. Refer to BLEEDING FUEL SYSTEM in section EF.

## INJECTION AND FUEL SYSTEM

### CHECKING AND ADJUSTING INJECTION TIMING

#### CHECKING

Check alignment marks on pump and engine front plate. Align these if necessary or check initial injection timing. Refer to section EF for adjusting initial timing.



### IDLE AND MAXIMUM SPEED ADJUSTMENT

#### IN-LINE TYPE

##### CAUTION:

- Do not remove sealing wires unless absolutely necessary.
- Maximum speed adjusting screw is retained by sealing wire and need not be adjusted under normal circumstances. However, if it should become necessary, adjust it with the screw. After adjustment, always wind up with sealing wire.

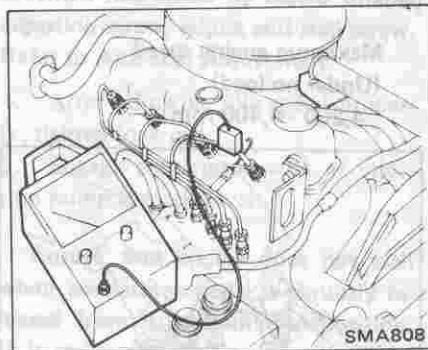
#### Throttle control wire adjustment

- Turn idle control knob fully counterclockwise.
  - Push idle control knob in.
- Make sure that free play is 1 mm (0.04 in) at venturi's throttle lever.
- If not within the specified range, adjust with wire adjusting nut.
- After adjusting free play properly, tighten lock nut.

#### Idle adjustment

- Turn idle control knob fully counterclockwise.
  - Push idle control knob in.
- Run engine until coolant temperature indicator points to the middle of gauge.
- Attach tachometer's pick-up to No.1 fuel injection tube.

In order to obtain a more accurate reading of engine speed, remove the clamps on No. 1 injection tube.



- Loosen lock nut, then adjust engine to the specified idle speed with idle speed screw.

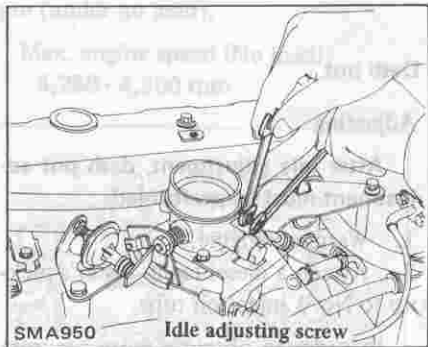
#### Idle speed:

550 - 650 rpm

(without power steering/  
Air conditioner)

650 - 750 rpm

(with power steering/  
Air conditioner)



- After adjusting idle speed, tighten lock nut.



## Maximum speed adjustment

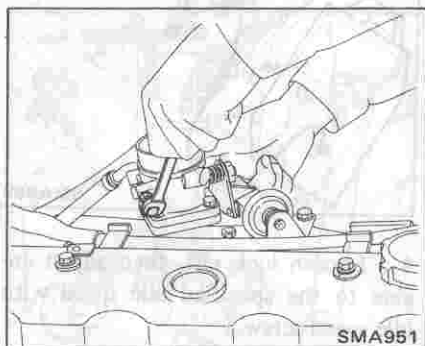
Maximum speed adjusting screw is retained by sealing wire and need not be adjusted under normal circumstances. However, if it should become necessary to adjust it, the following procedures should be followed:

1. Start engine and warm it up until coolant temperature indicator points to middle of gauge.
2. Connect tachometer's pick-up to No. 1 fuel injection tube.

To obtain accurate reading of engine rpm, loosen clamp that secures No. 1 fuel injection tubes.

3. To obtain maximum speed, turn the adjusting screw either direction while fully depressing accelerator pedal.

**Maximum engine speed  
(Under no load):**  
4,200 - 4,400 rpm



4. After adjustment, tighten lock nut securely.
5. Wind up with a sealing wire.

## Dash pot

### Adjusting

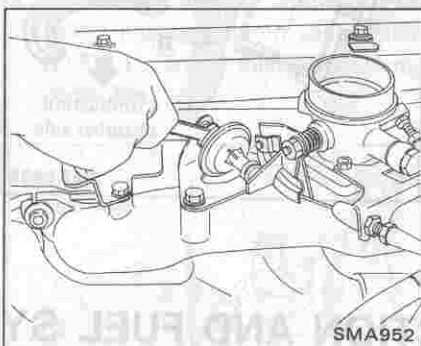
After idle adjustment, dash pot adjustment must be performed.

1. Warm up engine.
2. Attach a diesel tacho tester's pick-up to No. 1 injection tube.

In order to obtain a more accurate reading of engine speed, remove the clamp on No. 1 injection tube.

3. Loosen dash pot lock nut.

4. Maintain engine speed at 1,280 to 1,350 rpm. Operate and adjust dash pot so that control lever tip contacts dash pot tip.

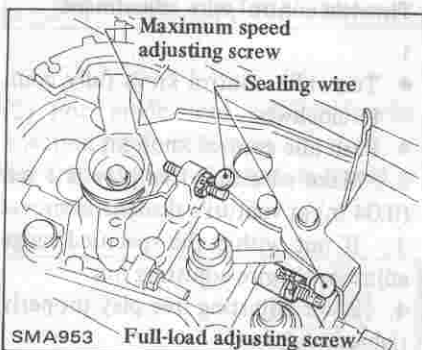


5. Tighten dash pot lock nut.

## VE-TYPE

### CAUTION:

- a. Do not remove sealing wires unless absolutely necessary.



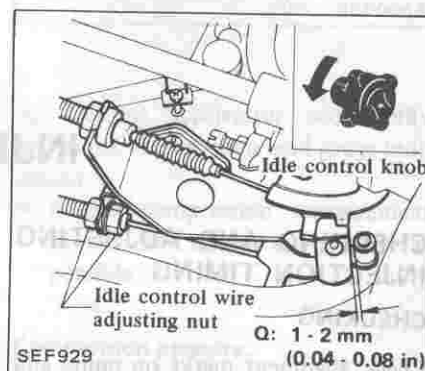
- b. Disturbing full-load adjusting screw adjustment will change fuel flow characteristics, resulting in an improperly adjusted engine. Readjustment of fuel injection pump should be done using a pump tester.
- c. If maximum speed adjusting screw is turned in direction that increases control lever angle, engine damage may result.

## Throttle control wire adjustment

1. Turn idle control knob fully counterclockwise.
2. Make sure that clearance between idle control lever pin and fuel injection pump control lever is within the specified range.

### Clearance:

1 - 2 mm (0.04 - 0.08 in)

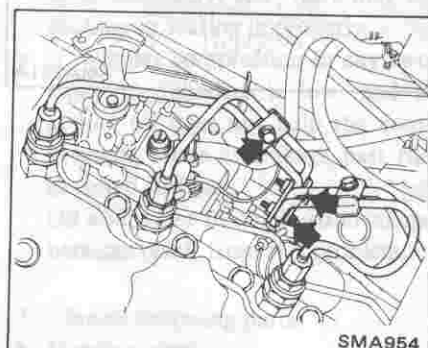


3. If not within the specified range, adjust with idle control wire adjusting nut.
4. After adjusting clearance, tighten lock nut.

## Idle adjustment

1. Turn idle control knob fully counterclockwise.
2. Start engine and warm it up until coolant temperature indicator points to middle of gauge.
3. Attach tachometer's pick-up to No. 1 fuel injection tube.

In order to take accurate reading of engine rpm, remove clamps that secures No. 1 fuel injection tube.



4. Adjust engine to specified idle speed with idle speed adjusting screw.

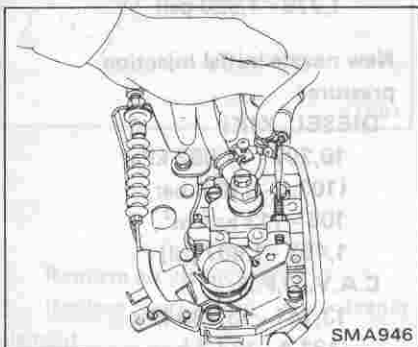
## Idle speed:

550 - 650 rpm

(without power steering/  
Air conditioner)

650 - 750 rpm

(with power steering/  
Air conditioner)



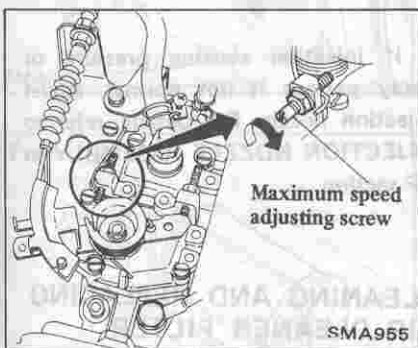
5. After adjusting idle speed properly, tighten lock nut.

## Maximum speed adjustment

Maximum speed adjusting screw is retained by sealing wire and need not be adjusted under normal circumstances. However, if it should become necessary to adjust it, the following procedure should be followed:

1. Start engine and warm it up until coolant temperature indicator points to middle of gauge.
2. Connect tachometer's pick-up to No. 1 fuel injection tube.

To obtain accurate reading of engine rpm, remove clamps that secures No. 1 fuel injection tube.



3. Depress accelerator pedal fully under no load and, at this point, read the tachometer indication.

## Maximum engine speed (Under no load):

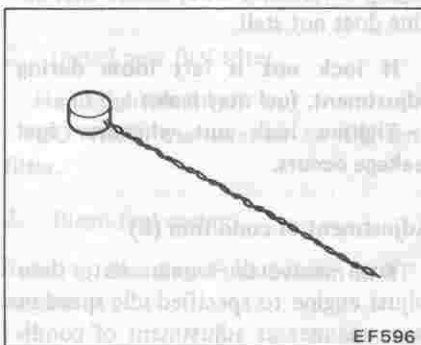
4,450 - 4,750 rpm

(Except for Europe)

4,500 - 4,700 rpm

(For Europe)

4. If indication is lower than specified maximum engine speed, turn maximum speed adjusting screw counterclockwise 1 or 2 rotations. Then depress accelerator pedal to floor under no load and, at this point, read indication.
5. If indication is still lower than specified speed, repeat step 4 above until specified engine speed is reached.
6. After adjustment, tighten lock nut securely.
7. Wind up with a sealing wire.



## C.A.V.-D.P.A. TYPE

### CAUTION:

- a. Do not remove sealing wires unless absolutely necessary.
- b. Always adjust the engine's maximum speed so that it can not overrun. Overrunning can damage engine.

## Throttle control wire adjustment

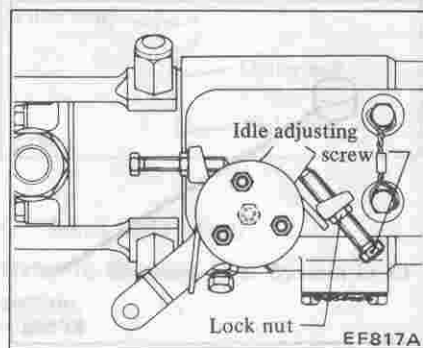
1. Turn idle control knob fully counterclockwise.
2. Make sure that free play is 1 mm (0.04 in) at pump control lever.
3. If not within the specified range, adjust with wire adjusting nuts.
4. After adjusting free play properly, tighten lock nut.

## Idle adjustment

1. Run engine until coolant temperature indicator points to middle of gauge.

2. Disengage accelerator wire at injection pump throttle lever.
3. Adjust engine to the specified idle speed with idle adjusting screw.

Idle speed: 650 rpm



If engine speed does not drop to specified idle speed by means of idle adjusting screw, adjust anti-stall screw. Refer to Anti-stall Adjustment.

4. After adjusting idle speed properly, tighten lock nut.
5. Engage accelerator wire at injection pump throttle lever.

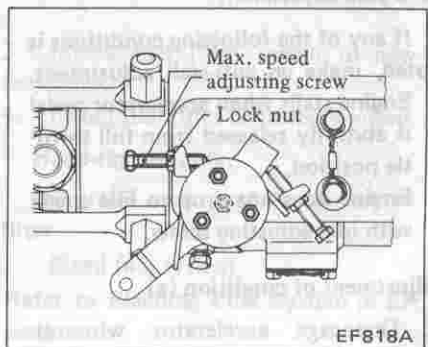
Ensure that engine does not stall when accelerator pedal is abruptly released from fully depressed position. If it stalls, make "an anti-stall adjustment".

## Maximum speed adjustment

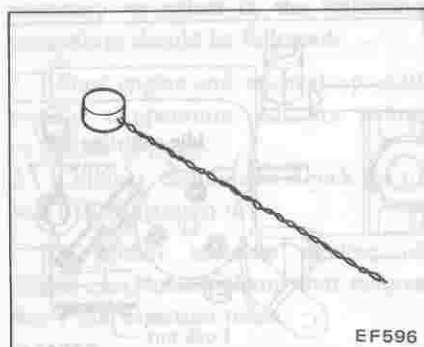
1. Disengage accelerator wire at the injection pump throttle lever.
2. Run engine under no load, and move throttle lever to fully open position. Adjust engine to specified max. rpm (under no load).

Max. engine speed (No load):

4,250 - 4,300 rpm



3. After adjustment, tighten lock nut securely.
4. Slide a sealing sleeve over max. speed adjusting screw, and wind up with a wire.

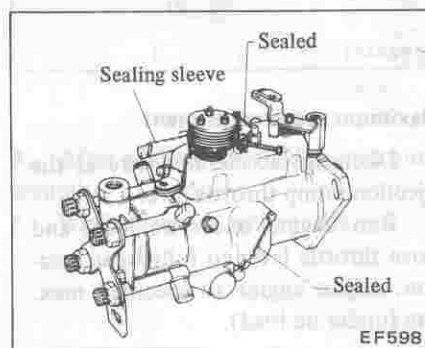


5. Engage accelerator wire at injection pump throttle lever.

Seal up at the following three places.

- (1) Max. speed adjusting screw (Nissan)
- (2) Control cover mounting bolt (Pump manufacturer)
- (3) Cover plate mounting bolt on pump housing side (Pump manufacturer)

If injection pump is renewed, have new pump adjusted for max. engine speed and sealed up by distributor.



## Anti-stall adjustment

If any of the following conditions is noted, make an anti-stall adjustment.

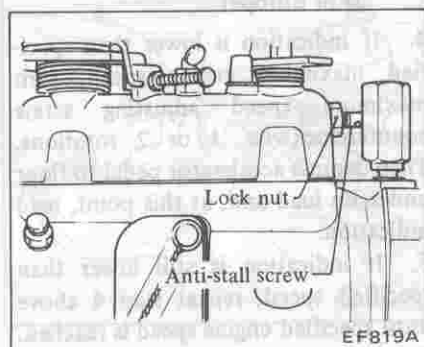
- a. Engine stalls when accelerator pedal is abruptly released from full throttle position.
- b. Engine does not drop to idle speed with idle adjusting screw.

## Adjustment of condition (a)

1. Disengage accelerator wire at

injection pump throttle lever.

2. Turn anti-stall screw in until engine speed starts to increase. From that position, turn screw out one-half rotation.



3. After adjusting idle speed and engaging accelerator wire, ensure that engine does not stall.

If lock nut is left loose during adjustment, fuel may leak.

Tighten lock nut whenever fuel leakage occurs.

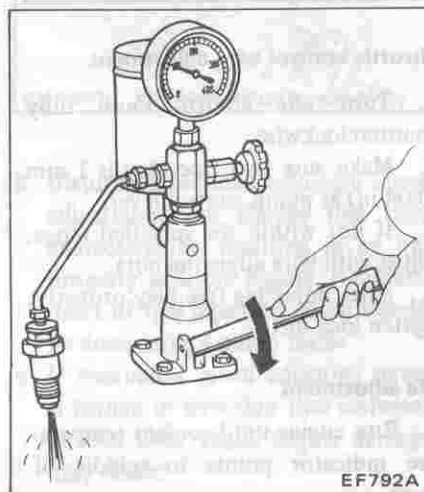
## Adjustment of condition (b)

Turn anti-stall screw out, then adjust engine to specified idle speed in same manner as adjustment of condition (a).

## INJECTION NOZZLE INSPECTION

Check valve for nozzle tester should be closed to prevent damage to gauge.

- a. Check initial injection pressure by pumping tester handle one time per second.



## Initial injection pressure:

### DIESEL KIKI

9,807 - 10,297 kPa  
(98.1 - 103.0 bar,  
100 - 105 kg/cm<sup>2</sup>,  
1,422 - 1,493 psi)

### C.A.V.-D.P.A.

12,259 - 13,239 kPa  
(122.6 - 132.4 bar,  
125 - 135 kg/cm<sup>2</sup>,  
1,778 - 1,920 psi)

## New nozzle initial injection pressure:

### DIESEL KIKI

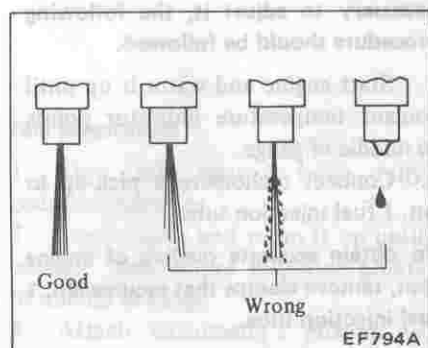
10,297 - 11,082 kPa  
(103.0 - 110.8 bar,  
105 - 113 kg/cm<sup>2</sup>,  
1,493 - 1,607 psi)

### C.A.V.-D.P.A.

13,141 - 13,730 kPa  
(131.4 - 137.3 bar,  
134 - 140 kg/cm<sup>2</sup>,  
1,905 - 1,991 psi)

The new nozzle requires that the initial injection pressure always be checked.

- b. Check spray pattern by pumping tester handle 4 to 6 times per second or more.



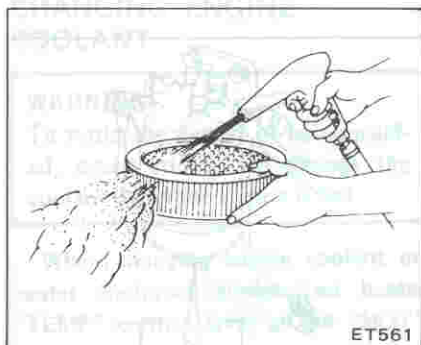
If injection starting pressure or spray pattern is not normal, adjust injection nozzle. For details, refer to INJECTION NOZZLE ASSEMBLY in EF section.

## CLEANING AND REPLACING AIR CLEANER FILTER

- a. Replace viscous type filter element at the specified maintenance intervals. It does not have to be cleaned between replacement periods.

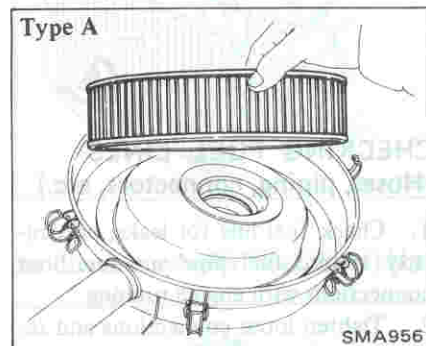


- b. Clean dry type filter element at the specified maintenance intervals. If necessary, replace it.

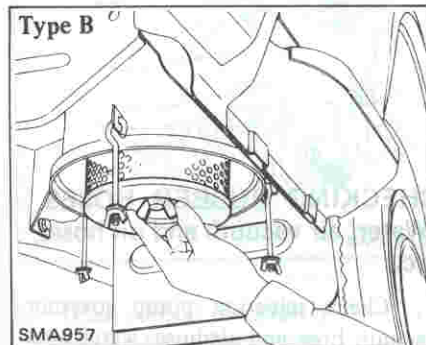


1. Remove air cleaner cover.
2. Replace or clean air cleaner element.

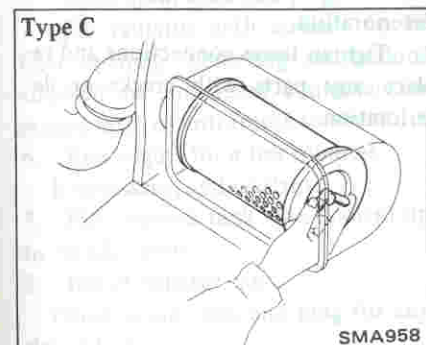
Type A



Type B



Type C



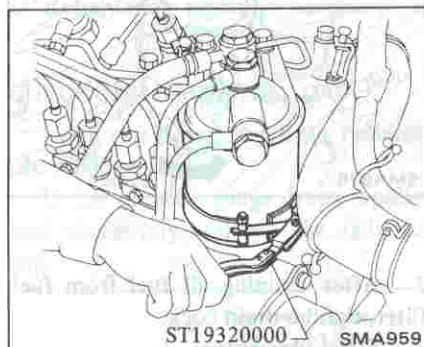
## CHECKING FUEL FILTER, DRAINING WATER AND REPLACING FILTER

### REPLACING FUEL FILTER

#### In-line type

#### Cartridge

1. Remove fuel filter, using Tool.



2. Install new fuel filter.

**Hand-tighten only.**

**DO NOT use wrench to tighten filter.**

3. Bleed fuel system.

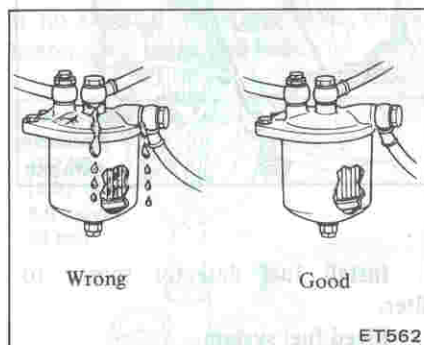
**Refer to Bleeding Fuel System in EF section.**

#### Except cartridge

1. Check fuel filter.

Check for contamination, leak or cracks.

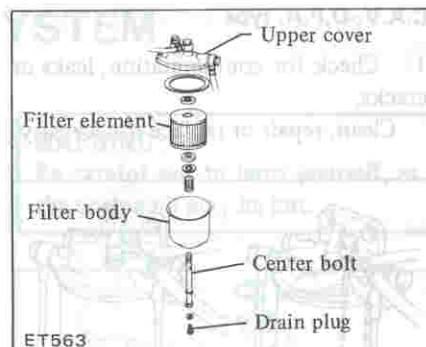
Clean, repair or replace if necessary.



2. Drain fuel by loosening drain plug.

3. Loosen center bolt and remove bolt, filter body, element, lower cover, etc.
4. Clean component parts.

5. Install new element and assemble fuel filter.

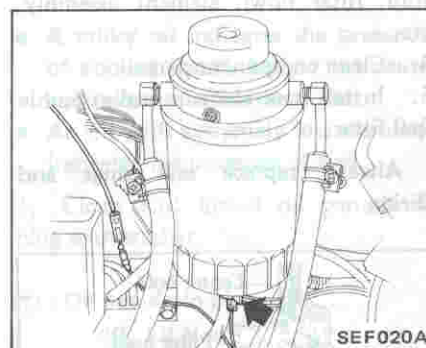


6. Bleed fuel system.

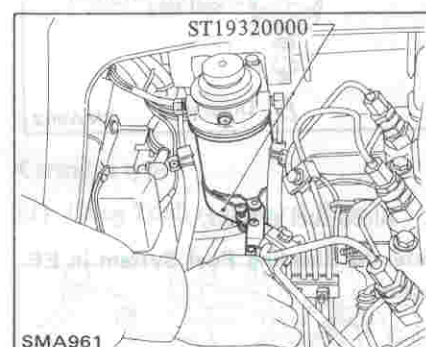
**Refer to Bleeding Fuel System in EF section.**

#### VE-type

1. Remove fuel filter sensor and drain fuel.



2. Remove fuel filter, using Tool.



3. Install fuel filter sensor to new fuel filter.

4. Install fuel filter to priming pump.

**Hand-tighten only.**

**DO NOT use wrench to tighten filter.**

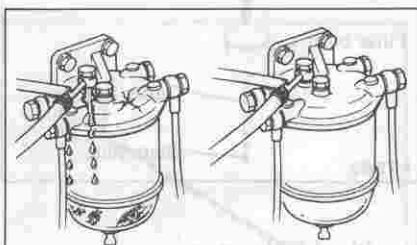
5. Bleed fuel system.

**Refer to Bleeding Fuel System in EF section.**

## C.A.V.-D.P.A. type

1. Check for contamination, leaks or cracks.

Clean, repair or replace if necessary.



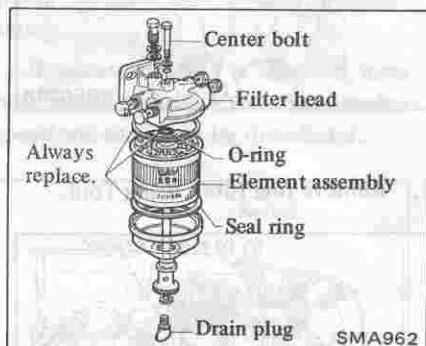
Wrong

Good

ET564

2. Drain fuel in filter.
3. Loosen center bolt and remove stud, filter bowl, element assembly, etc.
4. Clean component parts.
5. Install new element and assemble fuel filter.

Always replace seal rings and O-ring.



SMA962

6. Bleed fuel system.

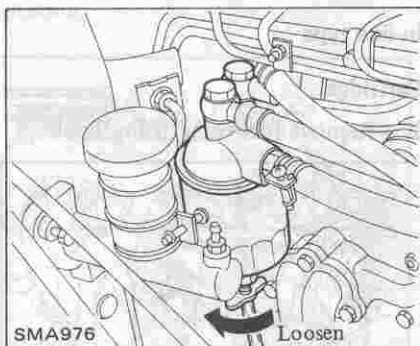
Refer to Bleeding Fuel System in EF section.

## DRAINING WATER

- a. Drain water from fuel filter in accordance with maintenance schedule. Also do this when warning light comes on (for VE-type.)
- b. Bleed air from fuel system.
- c. Be sure to place a container beneath fuel filter.

## In-line type

1. Loosen drain cock and drain water.



SMA976

Loosen

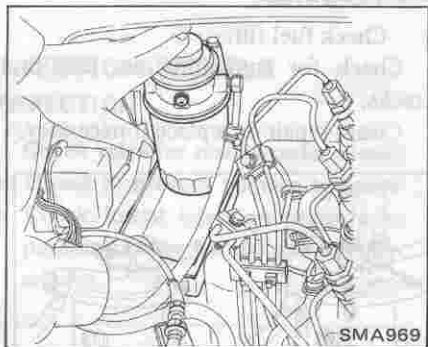
2. After draining all fuel from fuel filter, tighten drain cock.
3. Bleed fuel system.

Refer to Bleeding Fuel System in EF section.

## VE-type

1. Set a container under fuel filter.
2. Remove fuel detector sensor and drain water.

Pumping priming pump will quickly drain water.



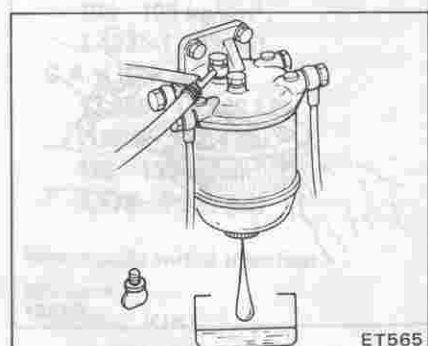
SMA969

3. Install fuel detector sensor to filter.
4. Bleed fuel system.

Refer to Bleeding Fuel System in EF section.

## C.A.V.-D.P.A. type

1. Remove drain plug and drain water.



ET565

2. Install drain plug to filter.
3. Bleed fuel system.

Refer to Bleeding Fuel System in EF section.

## CHECKING FUEL LINES (Hoses, piping, connectors, etc.)

1. Check fuel line for leaks, particularly around fuel pipe and fuel hose connections with engine running.
2. Tighten loose connections and replace any damaged or deformed parts.

## CHECKING RUBBER HOSES (Water, air vacuum and oil hoses, etc.)

1. Check injection pump governor vacuum hose and air hose, water hose and oil hose for damage, cracks or deterioration.
2. Tighten loose connections and replace any parts with cracks or deterioration.

## COOLING AND LUBRICATION SYSTEM

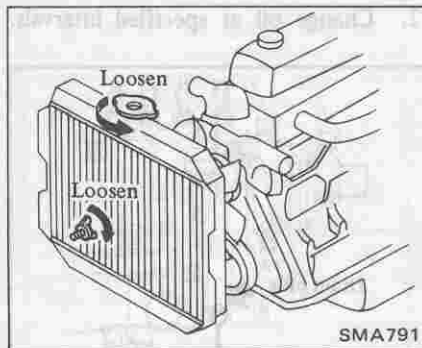
## CHANGING ENGINE COOLANT

**WARNING:**

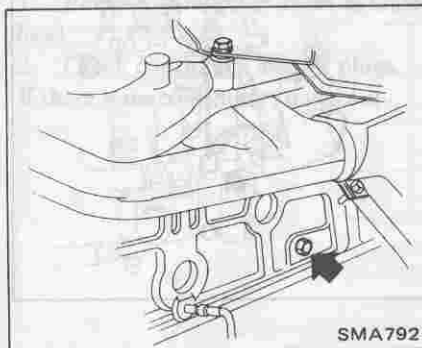
To avoid the danger of being scalded, never attempt to change the coolant when the engine is hot.

When changing engine coolant on heater equipped models, set heater "TEMP" control lever at full "HOT" position.

1. Open drain cock at bottom of radiator, and remove radiator cap.



2. Remove cylinder block drain plug.



3. Drain coolant completely. Then flush cooling system.
  4. Close drain cock and plug.
  5. Fill radiator with coolant up to filler opening, observing instructions attached to anti-freeze container for mixing ratio of anti-freeze to water.
  6. Run engine for a few minutes. If necessary, add coolant.
  7. Fill reservoir tank with coolant up to "MAX" level.
  8. Install radiator cap.
- Check drain cock and plug for any sign of leakage.

## CHECKING COOLING SYSTEM HOSES AND CONNECTIONS FOR LEAKS

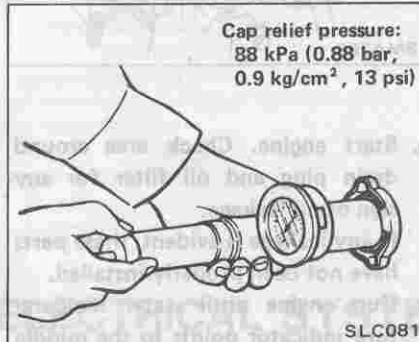
Check hoses and fittings for loose connections or deterioration.

Retighten or replace if necessary.

## CHECKING RADIATOR CAP

Using cap tester, check the radiator cap relief pressure.

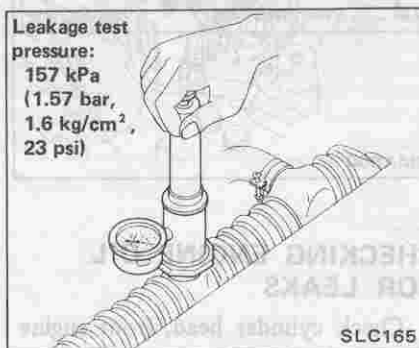
If the pressure gauge drops rapidly and excessively, replace the radiator cap.



## CHECKING COOLING SYSTEM FOR LEAKS

Attach pressure tester and pump tester, and apply specified pressure. Check for drop in pressure.

If pressure drops, check for leaks from hoses, radiator, or water pump. If no external leaks are found, check heater core, block and head.

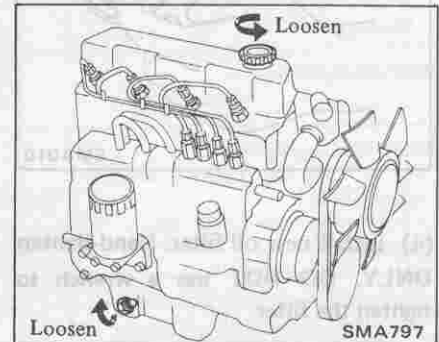


## CHANGING ENGINE OIL AND OIL FILTER

1. Warm up engine.
2. Remove oil pan drain plug and oil filler cap, and allow oil to drain.

**WARNING:**

Be careful not to burn yourself, as the engine oil may be hot.



- A milky oil indicates the presence of cooling water. Isolate the cause and take corrective measures.
- An oil with extremely low viscosity indicates the presence of fuel.

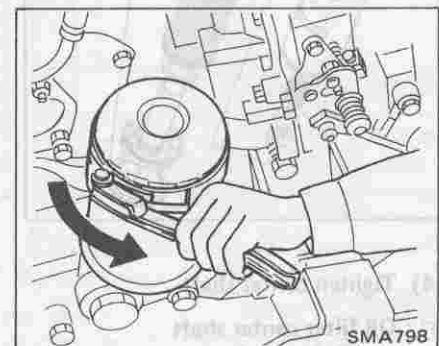
3. Clean and install oil pan drain plug with washer.

Ⓓ : Oil pan drain plug  
49 - 59 N·m  
(5 - 6 kg·m,  
36 - 43 ft·lb)

4. Remove oil filter.

## Cartridge type

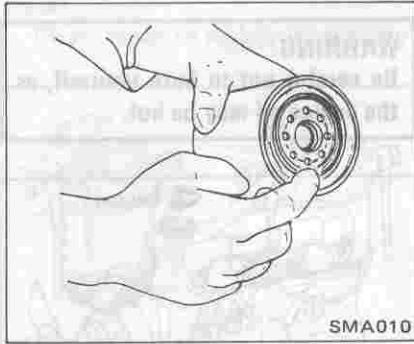
- (1) Using Tool, remove oil filter.



- (2) Wipe oil filter mounting surface with a clean rag.



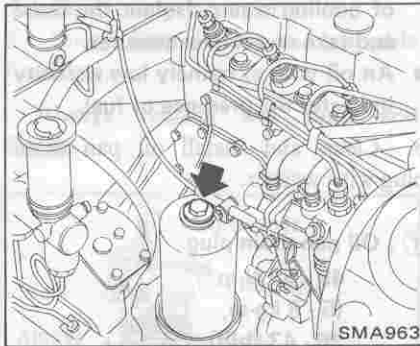
- (3) Smear a little engine oil on rubber lip of new oil filter.



- (4) Install new oil filter. **Hand-tighten ONLY. DO NOT** use a wrench to tighten the filter.

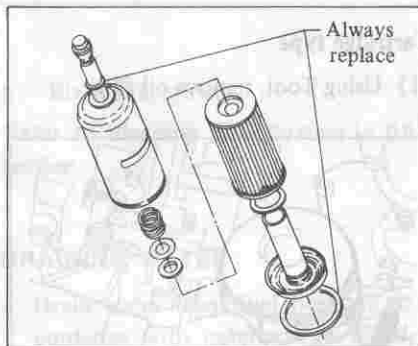
#### Center shaft type

- (1) Remove center shaft.



- (2) Take out filter element.  
(3) Install new element

Always use new gaskets.



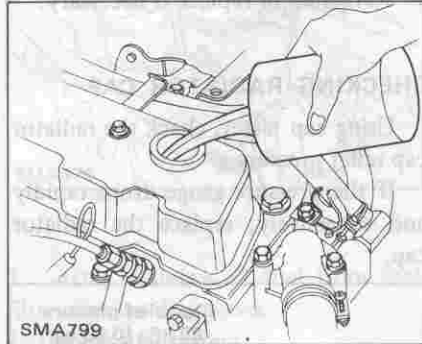
- (4) Tighten center shaft.

- ⊕ : Oil filter center shaft  
SD 4-cylinder  
25 - 29 N·m  
(2.5 - 3.0 kg·m,  
18 - 22 ft·lb)

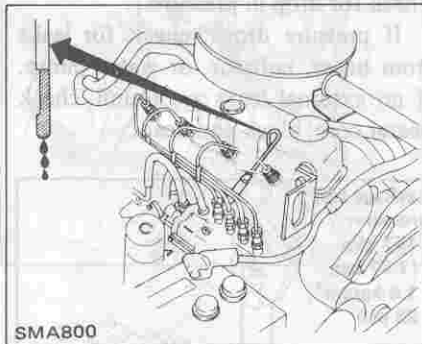
#### SD33

20 - 25 N·m  
(2.0 - 2.5 kg·m,  
14 - 18 ft·lb)

5. Refill engine with new engine oil, referring to Recommended Lubricants in Owner's Manual loaded on vehicle.



- Start engine. Check area around drain plug and oil filter for any sign of oil leakage. If any leakage is evident, these parts have not been properly installed.
- Run engine until water temperature indicator points to the middle of gauge. Then stop engine and check oil level with dipstick. If necessary, add engine oil.
- When checking oil level, park the car on a level surface.

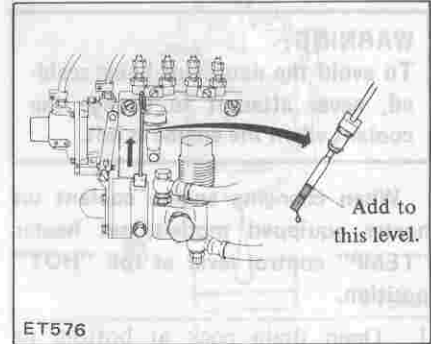


#### CHECKING ENGINE OIL FOR LEAKS

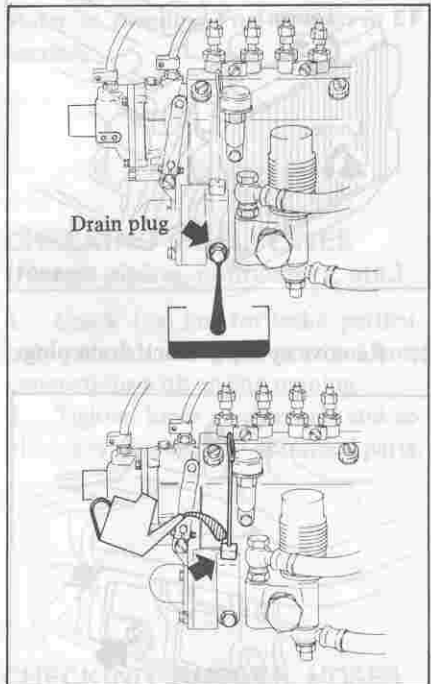
Check cylinder head, front engine cover, oil pan, oil pump, oil filter gasket, etc. or other parts for sign of leaks past their gasketed surfaces. If necessary, replace gaskets or faulty parts. After maintenance has been done, check replaced parts to see if any leaks occur.

#### CHECKING AND CHANGING INJECTION PUMP OIL (Lubrication type only)

1. Check oil level.



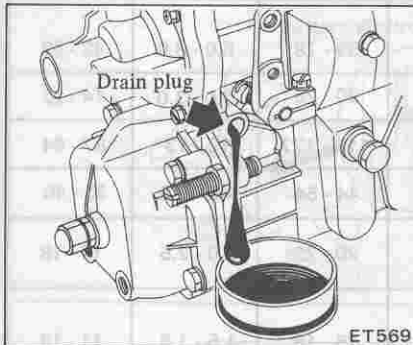
2. Change oil at specified intervals.



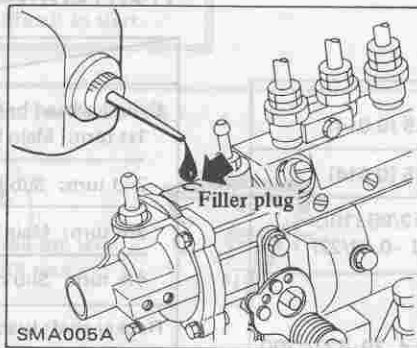
3. Check for leaks.

## LUBRICATING INJECTION PUMP GOVERNOR DIAPHRAGM

1. Drain fuel from governor chamber.



2. Lubricate governor diaphragm.  
Fill with three to four droplets of diaphragm oil.

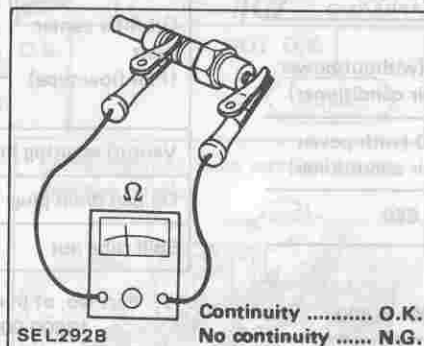


Diaphragm oil  
OL36V1 or cod liver oil

## ELECTRICAL SYSTEM

### CHECKING GLOW PLUGS

1. Remove glow plugs from cylinder head.
2. Check continuity in glow plugs.  
If there is no continuity, replace it.



## SERVICE DATA AND SPECIFICATIONS

## INSPECTION AND ADJUSTMENT

## BASIC MECHANICAL SYSTEM

|                                                     |                                         |                                     |
|-----------------------------------------------------|-----------------------------------------|-------------------------------------|
| Valve clearance (Hot)                               | mm (in)                                 | 0.35 (0.014)                        |
| Intake                                              |                                         |                                     |
| Exhaust                                             |                                         | 0.35 (0.014)                        |
| Fan belt deflection                                 | mm/N (kg), (in/lb)                      | 8 - 12/98 (10),<br>(0.31 - 0.47/22) |
| Compression pressure                                | kPa (bar, kg/cm <sup>2</sup> , psi)/rpm |                                     |
| Standard                                            |                                         | 2,942 (29.4, 30, 427)/200           |
| Minimum                                             |                                         | 2,452 (24.5, 25, 356)/200           |
| Compression differential limit<br>between cylinders |                                         | 294 (2.9, 3, 43)/200                |

## INJECTION SYSTEM

|                                    |                                                |                                                       |
|------------------------------------|------------------------------------------------|-------------------------------------------------------|
| Injection timing                   | B.T.D.C./rpm<br>DIESEL KIKI-Bosch in-line type | 18°/600<br>(Only for 720 model<br>with SD23 or SD25)  |
|                                    |                                                | 20°/600 (For the others)                              |
| VE type                            |                                                | 8°/600                                                |
| C.A.V.-D.P.A. type                 |                                                | 14.5°/600                                             |
| Idling                             | rpm<br>In-line & VE type                       | 550 - 650 (without power<br>steering/air conditioner) |
|                                    |                                                | 650 - 750 (with power<br>steering/air conditioner)    |
| C.A.V.-D.P.A. type                 |                                                | 650                                                   |
| Max. engine speed under<br>no load | rpm                                            |                                                       |
|                                    |                                                | In-line type                                          |
|                                    |                                                | 4,200 - 4,400                                         |
| VE type                            |                                                | 4,450 - 4,750<br>(Except for Europe)                  |
|                                    |                                                | 4,500 - 4,700<br>(For Europe)                         |
| C.A.V.-D.P.A. type                 |                                                | 4,250 - 4,300                                         |
| Dash pot                           |                                                |                                                       |
| Touch speed                        | rpm                                            | 1,280 - 1,350                                         |

## TIGHTENING TORQUE

|                                                |                   | N·m       | kg·m      | ft·lb     |
|------------------------------------------------|-------------------|-----------|-----------|-----------|
| Cylinder head bolt                             |                   |           |           |           |
| 1st turn: Main bolt                            |                   | 59 - 78   | 6.0 - 8.0 | 43 - 58   |
| 2nd turn: Sub bolt                             |                   | 20 - 29   | 2.0 - 3.0 | 14 - 22   |
| 3rd turn: Main bolt                            |                   | 118 - 127 | 12 - 13   | 87 - 94   |
| 4th turn: Sub bolt                             |                   | 44 - 54   | 4.5 - 5.5 | 33 - 40   |
| Rocker shaft bracket<br>bolt                   |                   | 20 - 25   | 2.0 - 2.5 | 14 - 18   |
| Manifold nut                                   |                   |           |           |           |
| Intake & exhaust                               |                   | 15 - 18   | 1.5 - 1.8 | 11 - 13   |
| Injection nozzle<br>assembly                   | *1                | 59 - 69   | 6.0 - 7.0 | 43 - 51   |
| (to cylinder head)                             | *2                | 69 - 78   | 7.0 - 8.0 | 51 - 58   |
| Injection pump securing<br>nut                 |                   |           |           |           |
| DIESEL KIKI-Bosch<br>in-line type              |                   | 20 - 25   | 2.0 - 2.5 | 14 - 18   |
| VE-type                                        | nut               | 20 - 25   | 2.0 - 2.5 | 14 - 18   |
|                                                | bolt              | 16 - 22   | 1.6 - 2.2 | 12 - 16   |
| C.A.V.-D.P.A. type                             |                   | 15 - 20   | 1.5 - 2.0 | 11 - 14   |
| Oil filter center<br>shaft<br>(Full-flow type) | SD 4-<br>cylinder | 25 - 29   | 2.5 - 3.0 | 18 - 22   |
|                                                | SD33              | 20 - 25   | 2.0 - 2.5 | 14 - 18   |
| Venturi securing nut                           |                   | 3 - 4     | 0.3 - 0.4 | 2.2 - 2.9 |
| Oil pan drain plug                             |                   | 49 - 59   | 5.0 - 6.0 | 36 - 43   |
| Spill tube nut                                 |                   | 39 - 49   | 4.0 - 5.0 | 29 - 36   |

\*1 Part No. of injection nozzle  
16600-90060, 16600-36W00, 16600-T9000

\*2 Part No. of injection nozzle  
16600-37502, 16600-90012, 16600-90019,  
16600-J5571, 16600-T3401, 16600-T3470,  
16600-T6200, 16600-T6201, 16600-Y8400,  
16600-Y8401

## COOLING SYSTEM

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

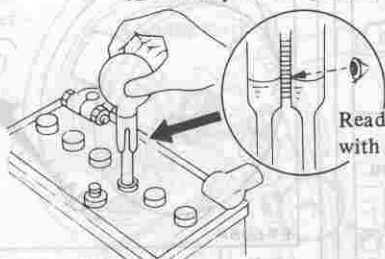
|                                            |                     |
|--------------------------------------------|---------------------|
| Radiator cap relief pressure               | 88 (0.88, 0.9, 13)  |
| Cooling system leakage testing<br>pressure | 157 (1.57, 1.6, 23) |



# TROUBLE DIAGNOSES AND CORRECTIONS

Engine fails or is difficult to start.

Are battery electrolyte and fuel levels O.K.?



SMA826

- : Condition
- : Check points
- : Action
- : Probable cause system

## ELECTRICAL SYSTEM

Will starter motor rotate?

- Check points
- Connections
  - Ignition switch
  - Starting circuit
  - Starter motor

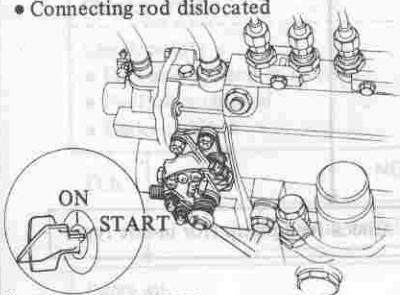
O.K.

NOT O.K.

Repair or replace.

Will injection pump controller operate?

- Check points
- Connections
  - Check D.P.C. operations (including D.P.C. module)
- Refer to Section EL.
- Connecting rod dislocated



Ignition switch "ON" or "START" position

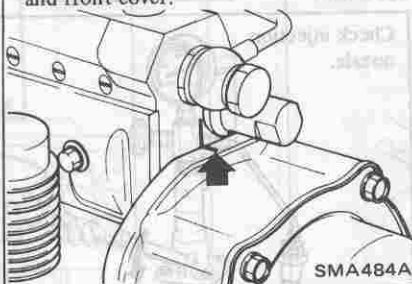
SMA827

NOT O.K.

Repair or replace.

## FUEL SYSTEM

Check timing mark of injection pump and front cover.



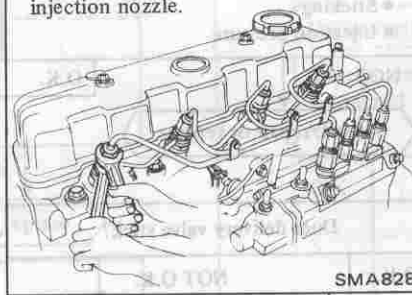
SMA484A

O.K.

NOT O.K.

Adjust.

Crank engine to make sure fuel reaches injection nozzle.



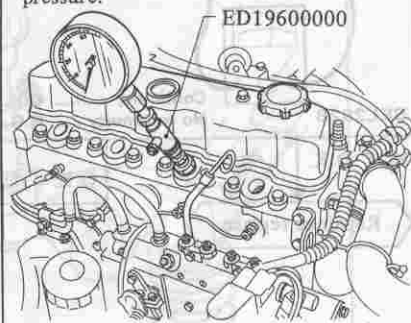
SMA828

NOT O.K.

O.K.

## MECHANICAL SYSTEM

Crank engine and check compression pressure.



ED19600000

SMA948

Check points

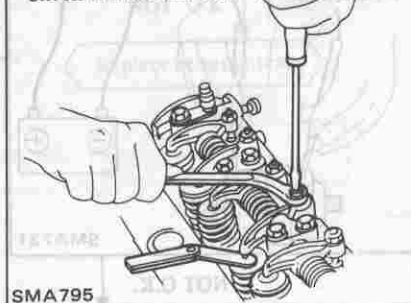
- Piston or piston ring worn
- Valve or valve seat worn
- Cylinder head gasket damaged

O.K.

NOT O.K.

Repair or replace.

Check valve clearance.



SMA795

O.K.

NOT O.K.

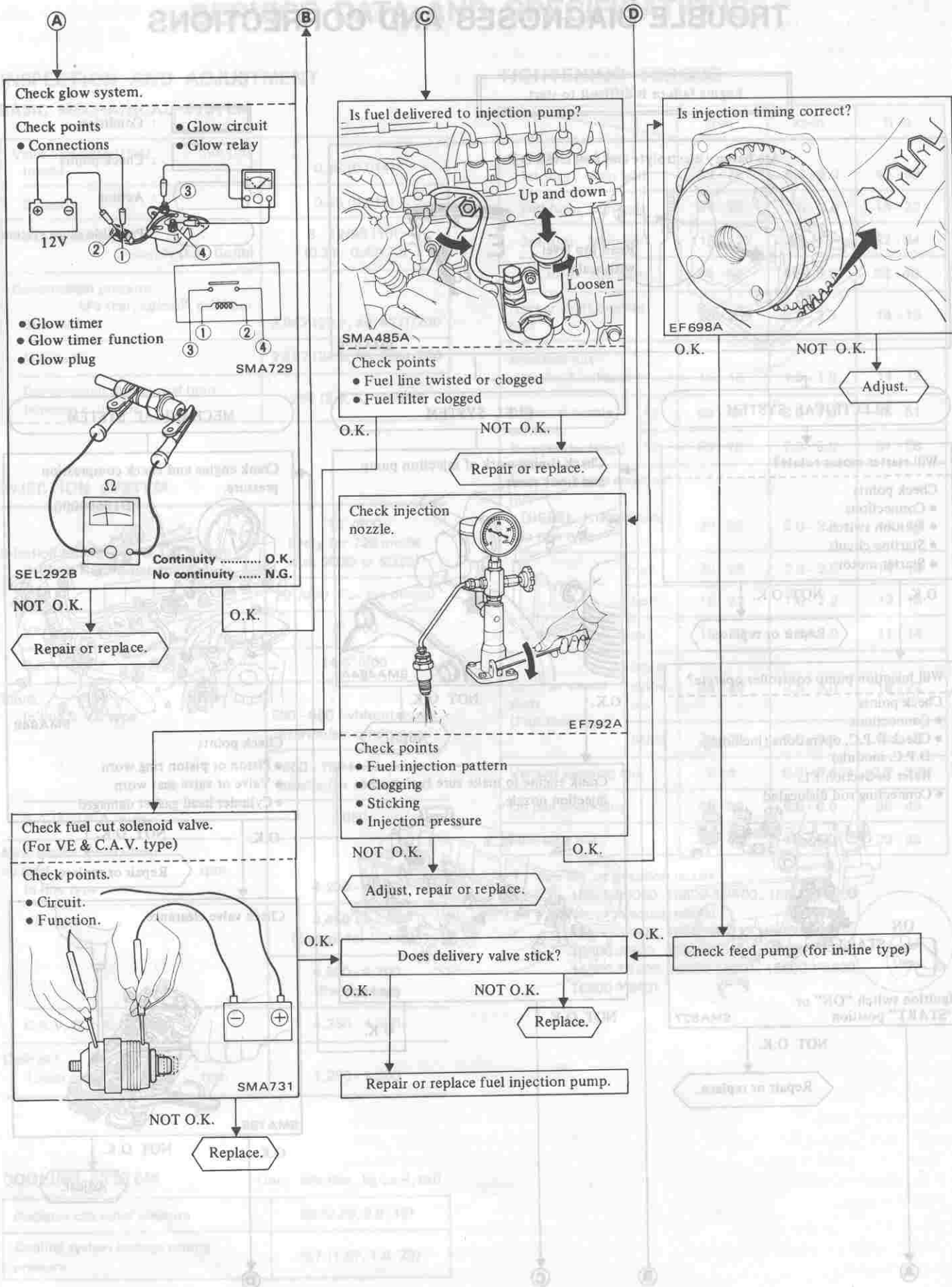
Adjust.

A

B

C

D

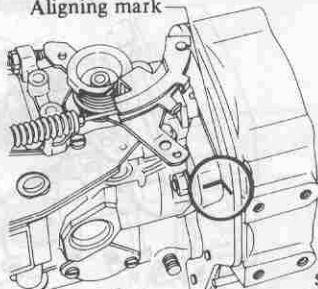


## UNSTABLE IDLING SPEED

### FUEL SYSTEM

Check timing mark of injection pump and front cover.

Aligning mark



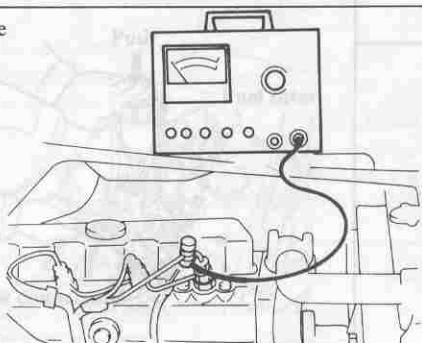
SMA949

O.K.

NOT O.K.

Adjust.

Check idle speed.



SMA021A

O.K.

NOT O.K.

Adjust.

Check fuel line.

Check points

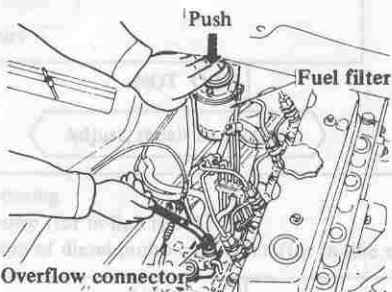
- Fuel line twisted or clogged
- Fuel filter clogged
- Leaks or loose

O.K.

NOT O.K.

Repair, retighten or replace.

Purge air



SEF958

### MECHANICAL SYSTEM

Is injection timing correct?

SEF014A

O.K.

NOT O.K.

Adjust.

Check valve clearance.

SMA254A

O.K.

NOT O.K.

Adjust.

Check engine mounting.

Check points

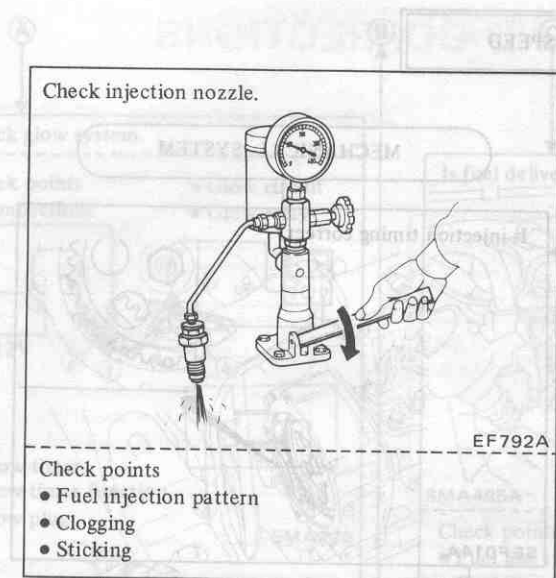
- Cracked
- Loose

O.K.

NOT O.K.

Replace or retighten.

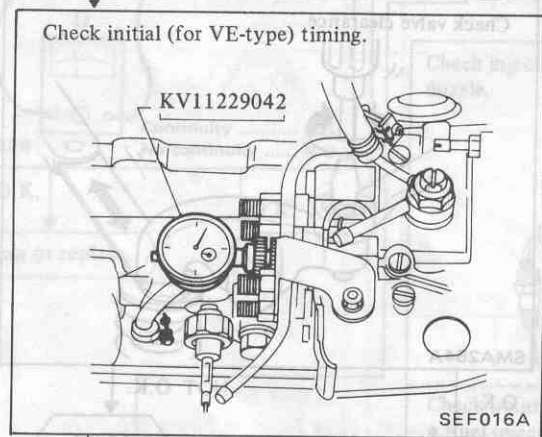




O.K.

NOT O.K.

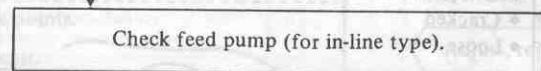
Adjust, repair or replace.



O.K.

NOT O.K.

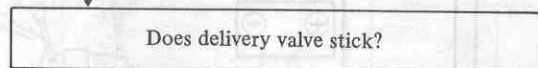
Adjust or replace.



O.K.

NOT O.K.

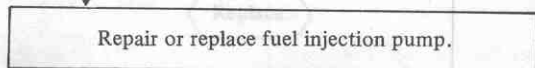
Repair or replace.



NO.

YES.

Replace.



## EXCESSIVE WHITE or BLACK SMOKE

### FUEL SYSTEM

Check timing mark of injection pump and front cover.

Aligning mark



SMA949

O.K. (White smoke)

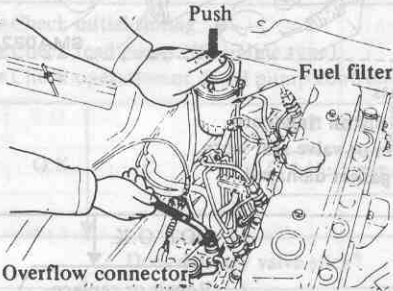
NOT O.K.

Adjust.

Purge air and drain water.

Push

Fuel filter



Overflow connector

SEF958

Check injection nozzle.



EF792A

Check points

- Nozzle worn
- Spring worn
- Injection pressure

NOT O.K.

Adjust, repair or replace.

- Check initial timing.
- Check feed pump (for in-line type).
- Check operation of diesel pump controller (for in-line type).

O.K.

NOT O.K.

Adjust, repair or replace.

NOT O.K.

Check delivery valve spring for wear or breakage.

O.K.

Repair or replace fuel injection pump.

Replace.

### MECHANICAL SYSTEM

Black smoke or white smoke?

(Black smoke)

(White smoke)

NO.

Is air cleaner element clogged?

NO.

Check for oil or similar material in or on tail pipe.

YES.

Replace.

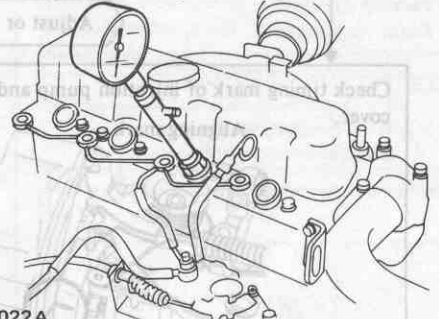
Normal

Check oil level.

YES.

Decreases

Crank engine and compression pressure.



SMA022A

Check points

- Cylinder head gasket damaged
- Piston or piston ring worn
- Valve stem or valve seat worn
- Valve lip seal worn

O.K.

NOT O.K.

Repair or replace.

(Black smoke)

O.K.

Is injection timing correct?

YES.

NO.

Adjust.

(White smoke)

## LOW POWER

### FUEL SYSTEM

Fuel quality is normal.

O.K.

NOT O.K.

Replace.

Does venturi's butterfly valve open fully?

Check points

- Accelerator pedal stroke
- Accelerator wire elongated
- Accelerator linkage stuck

O.K.

NOT O.K.

Adjust or repair.

Check timing mark of injection pump and front cover.

Aligning mark



SMA949

O.K.

NOT O.K.

Adjust.

Check fuel line.

Check points

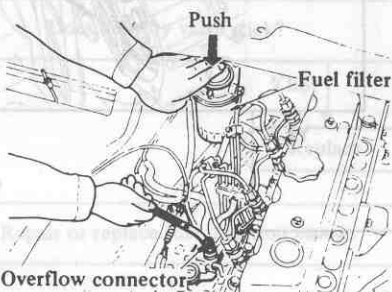
- Fuel line twisted or clogged
- Fuel filter clogged
- Leaks or loose

O.K.

NOT O.K.

Repair, retighten or replace.

Purge air



SEF958

### MECHANICAL SYSTEM

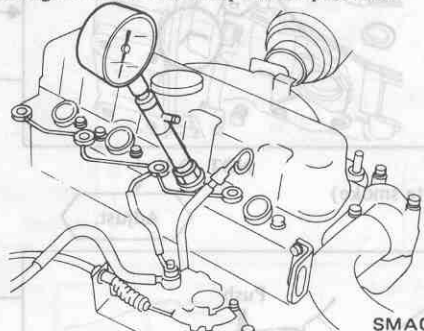
Check air cleaner element for clogs.

O.K.

NOT O.K.

Replace.

Crank engine and check compression pressure.



SMA022A

Check points

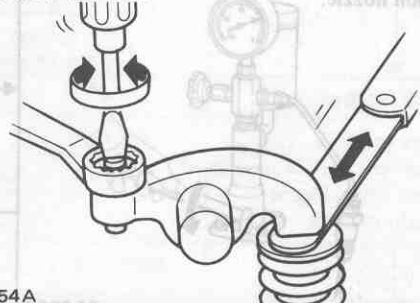
- Piston or piston ring worn
- Valve stem or valve seal worn
- Cylinder gasket damaged

O.K.

NOT O.K.

Repair or replace.

Check valve clearance



SMA254A

O.K.

NOT O.K.

Adjust.