

# TIGHTENING TORQUE OF STANDARD BOLT

## 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
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
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.

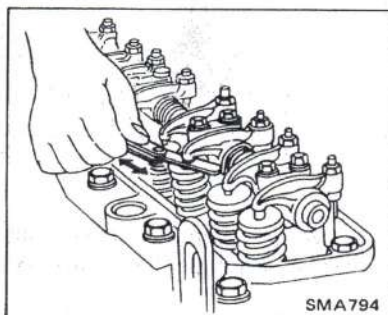
2. This standard is applicable to bolts having the following marks embossed on the bolt head.

Grade	Mark
4T .....	4
7T .....	7
9T .....	9

## BASIC MECHANICAL SYSTEM

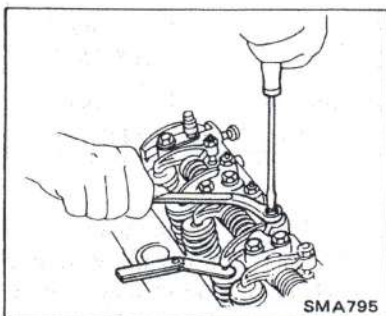
(1) Using feeler gauge, measure clearance between rocker arm and valve head.

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.

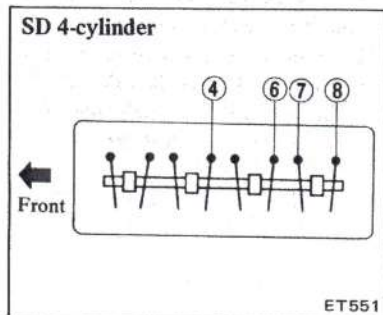
(3) Hold rocker arm screw and tighten rocker arm nut.



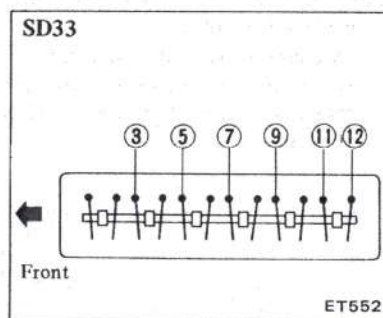
(4) Recheck clearance.

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)

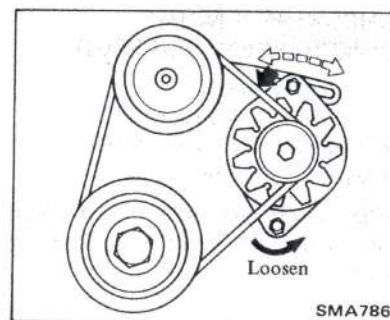
3. Adjust belt tension as follows:

### 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.

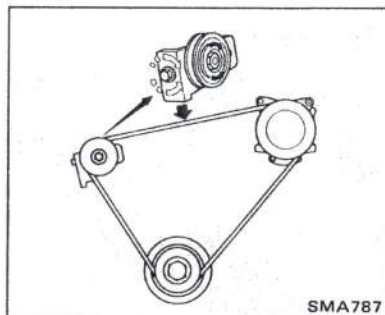
Then tighten bolts securely.



### 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.



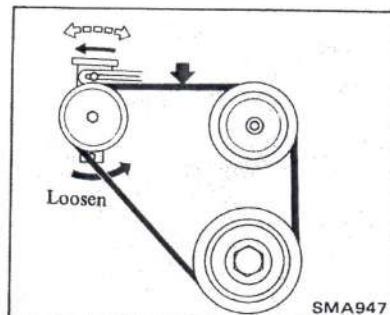
3. Tighten idler pulley lock nut.

### 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.

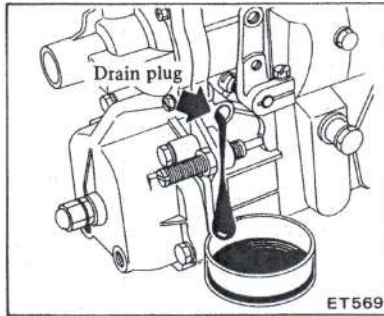
Then tighten pump fixing bolt and adjusting bar bolt.



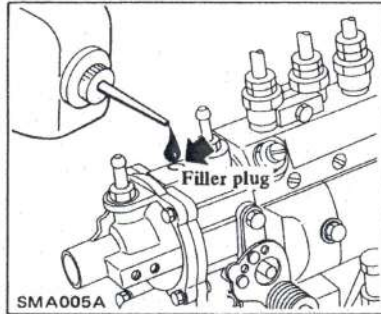
## ELECTRICAL SYSTEM

### LUBRICATING INJECTION PUMP GOVERNOR DIAPHRAGM

1. Drain fuel from governor chamber.



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

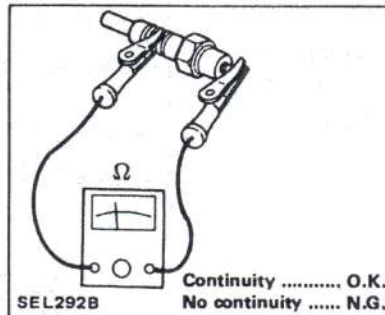


Diaphragm oil  
OL36V1 or cod liver oil

## ELECTRICAL SYSTEM

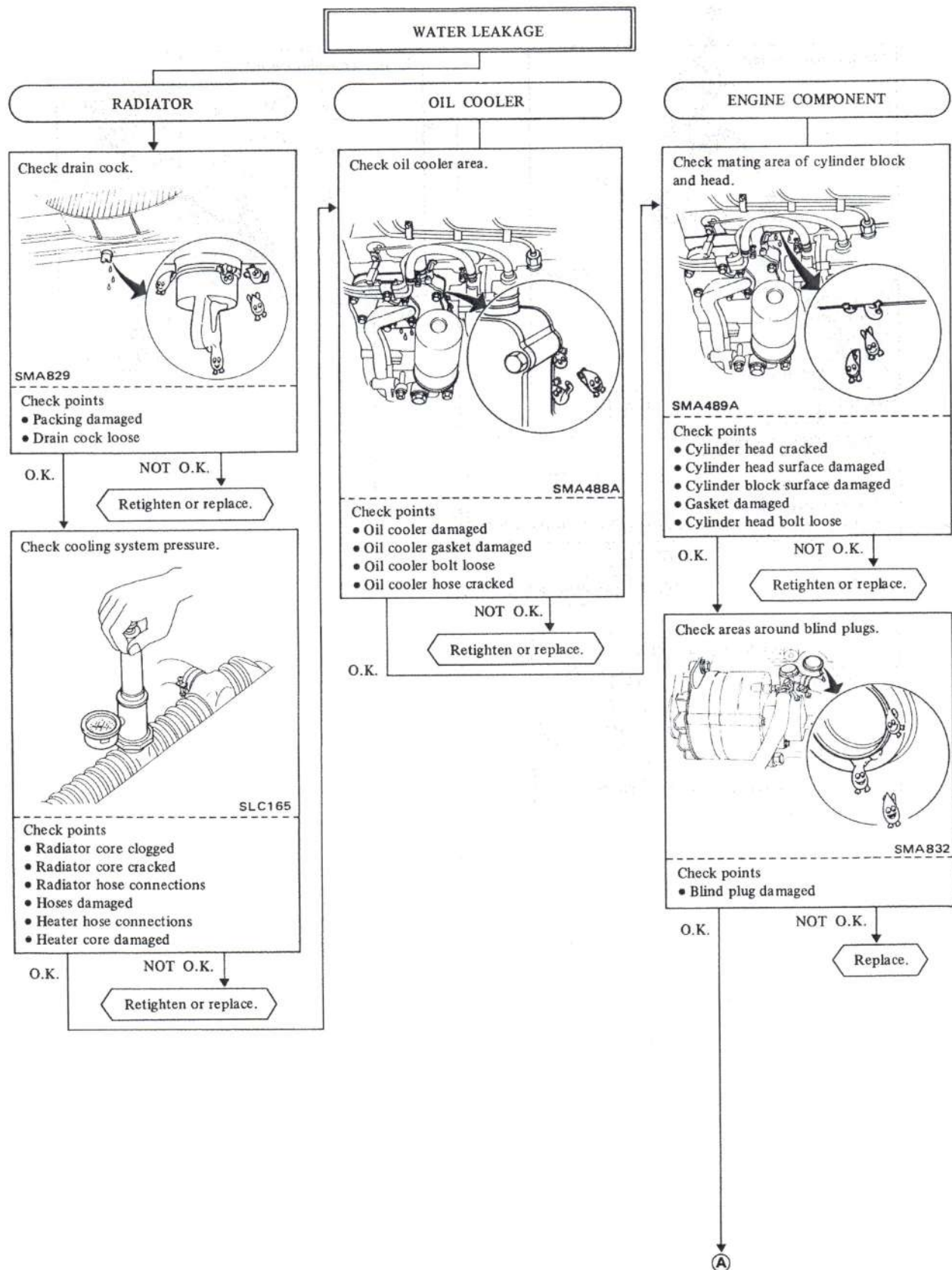
### CHECKING GLOW PLUGS

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

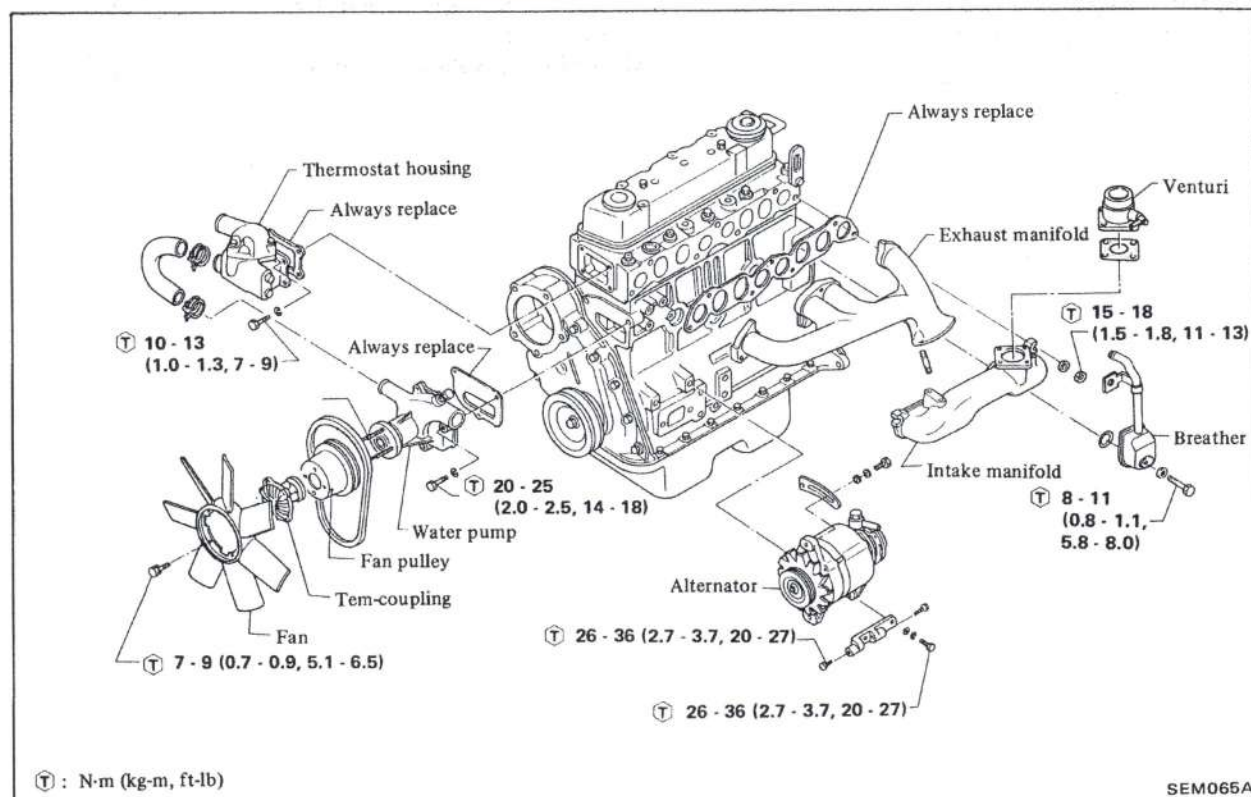
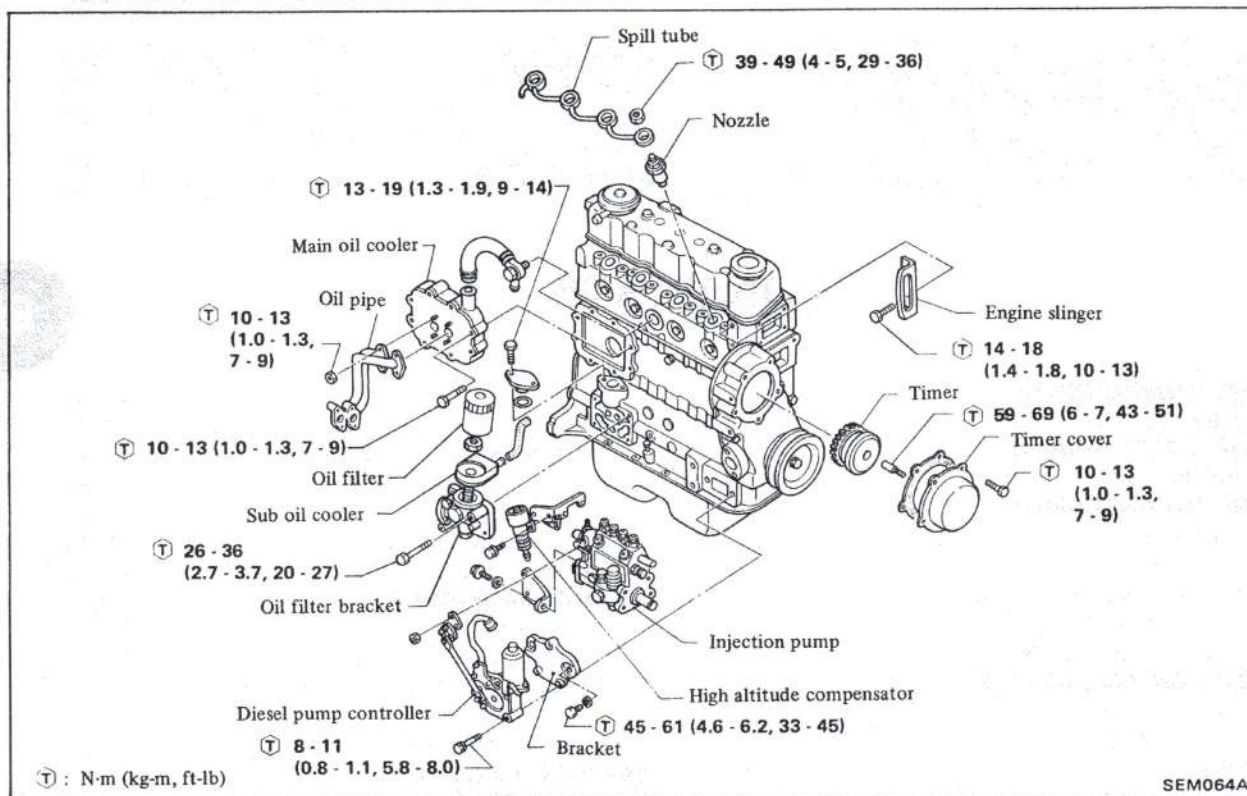




## TROUBLE DIAGNOSES AND CORRECTIONS



## ENGINE COMPONENTS (Outer parts)

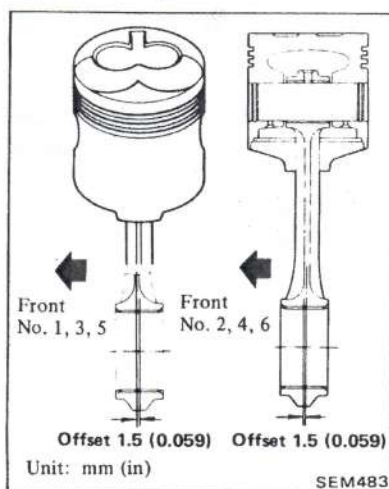




## ENGINE ASSEMBLY

### SD22-3 bearing & SD33

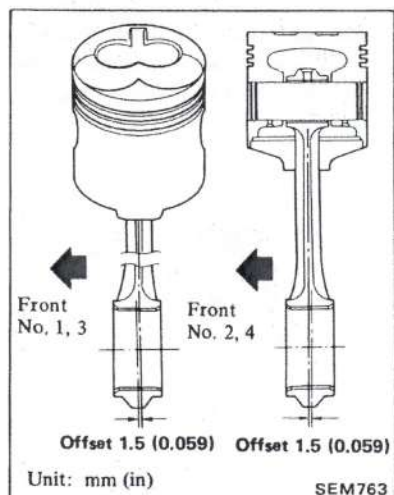
No matching marks are stamped on service parts of connecting rod. Install so that connecting rod big end is offset with respect to piston, so that on No. 1, No. 3 and No. 5 cylinders this offset is rearward with respect to engine and on No. 2, No. 4 and No. 6 cylinders this offset is forward with respect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



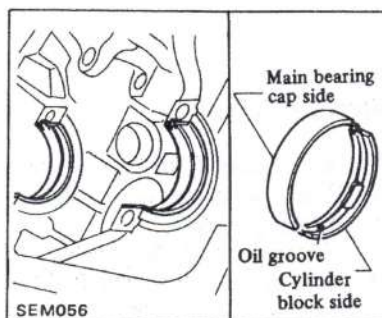
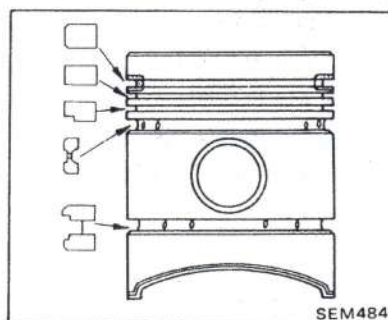
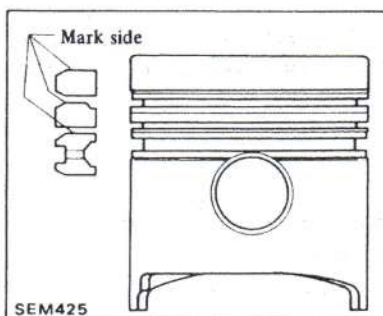
### SD series 5-bearing engine

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.

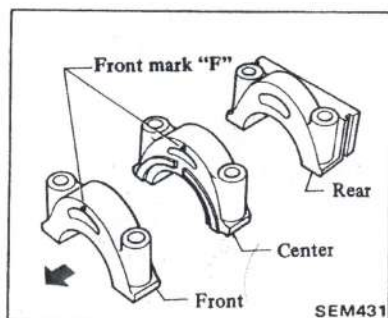


b. Only apply engine oil to inside of bearing.

- (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.

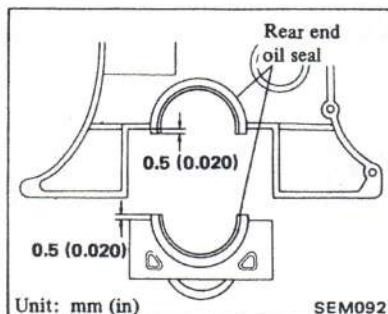


- b) Apply engine oil to main bearing cap and cylinder block contact surfaces.

- 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

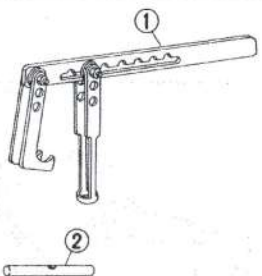

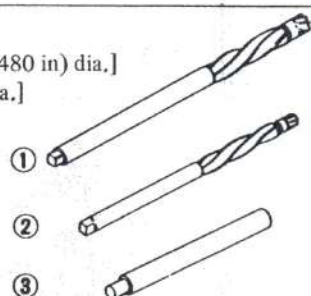
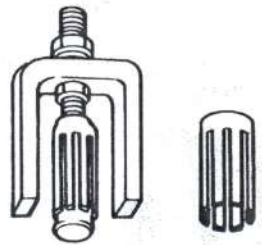
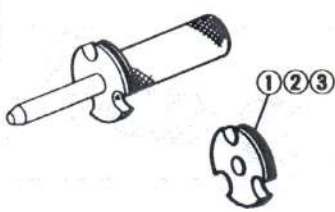
First, mount cylinder block on work stand (refer to Engine Disassembly).

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.

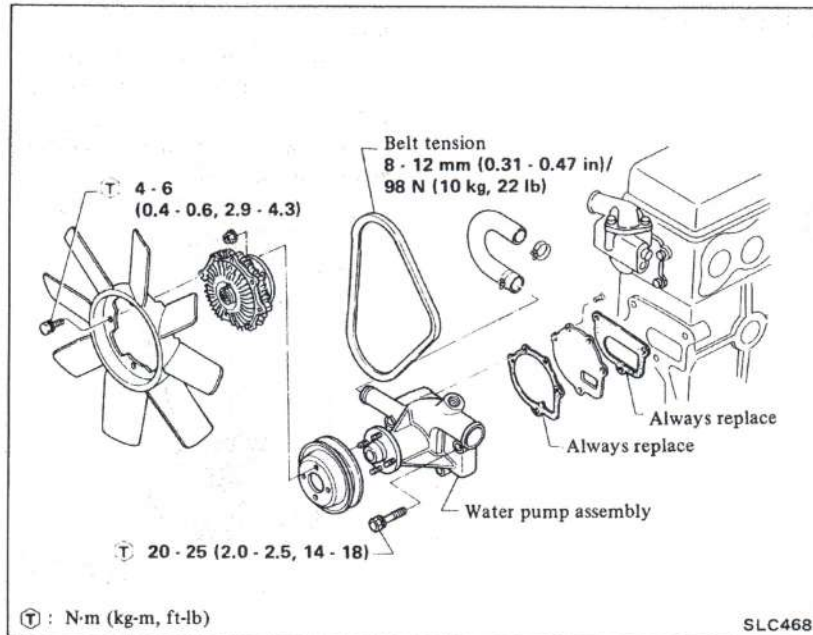
# SPECIAL SERVICE TOOLS

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



## COOLING SYSTEM

### WATER PUMP



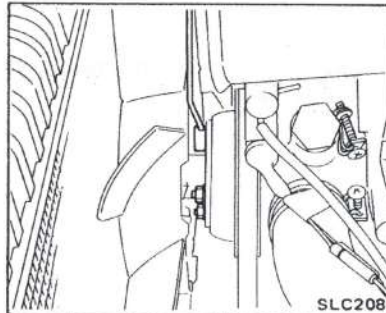
### REMOVAL

1. Remove radiator drain cock and radiator cap, and drain coolant.

#### WARNING:

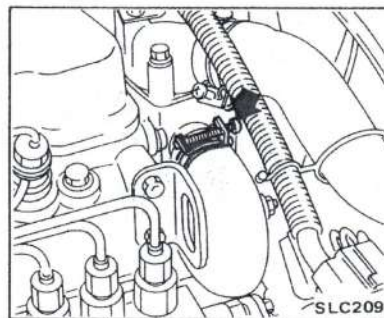
To avoid the danger of being scalded, never attempt to drain the coolant when engine is hot.

2. Remove radiator shroud.
3. Loosen fan pulley nuts.

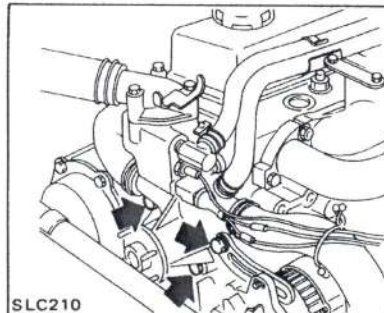


4. Loosen fan belt.  
(1) Loosen alternator upper and lower securing bolts.

- (2) Move the alternator toward the engine.
5. Remove fan pulley with Tem-coupling and fan.
6. Disconnect coolant hose on thermostat housing side.



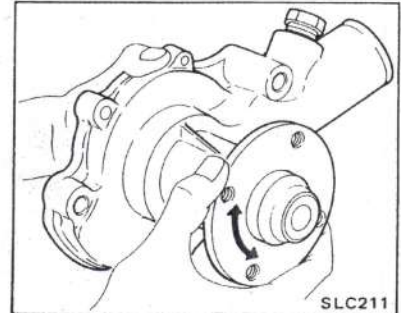
7. Remove water pump.



### INSPECTION

The water pump and Tem-coupling cannot be disassembled and should be replaced as a unit.

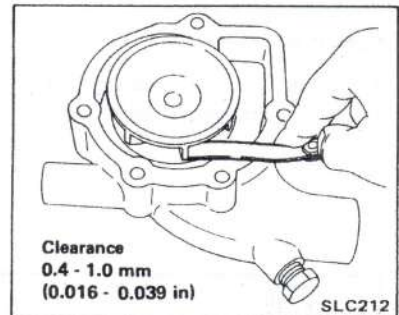
1. Inspect water pump body and vane for rust or corrosion.
  2. Inspect water pump bearing.
- Check for excessive end play or rough operation.



If excessive mechanical seal squeak occurs when engine is running, use suitable water pump seal lubricant to prevent squeak.

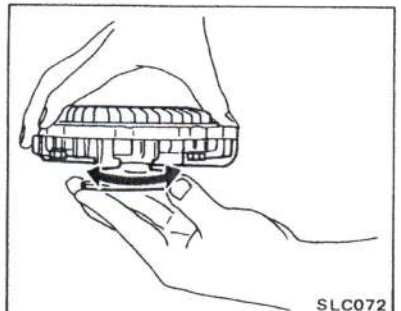
3. Check clearance between housing and vane.

If necessary, replace as a unit.



4. Inspect Tem-coupling.

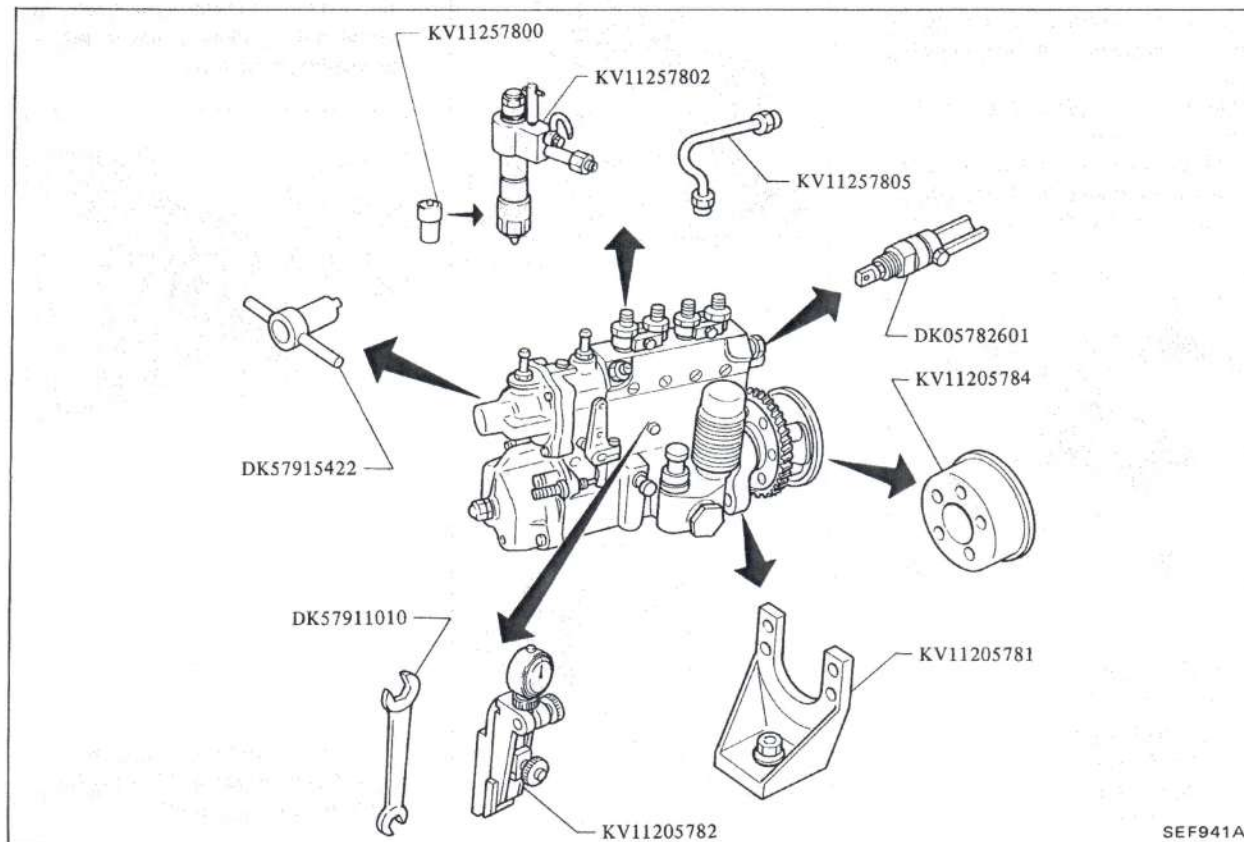
Check coupling for oil leakage or bent bimetal.



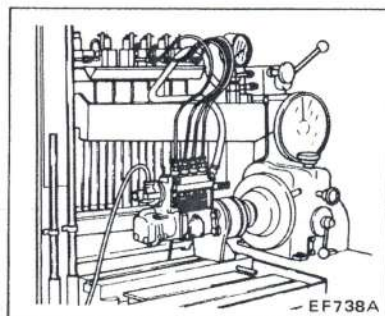
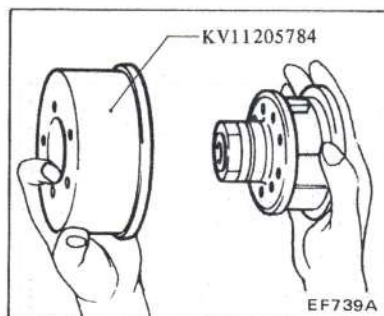


## INJECTION PUMP ASSEMBLY (Diesel Kiki-Bosch in-line type)

1. Prepare necessary service tools.



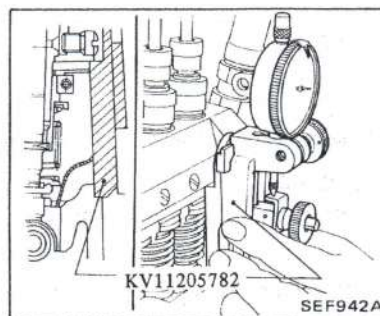
2. Remove fuel feed pump and cover plate.
3. Remove timer drive gear and attach coupling.



### ADJUSTMENT

#### Adjusting injection timing

1. Adjust No. 1 injection timing.
  - (1) Set a Tool to No. 1 cylinder tappet.



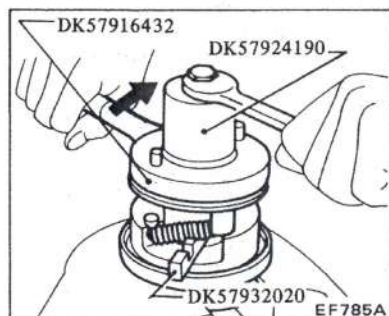
4. Install fuel injection pump on the bed of tester with Tool KV11205781. Then attach pump to timer.
5. Connect coupling to tester drive shaft with coupling disc.
6. Connect flexible hose from tester to nozzle tube on pump.

7. Remove cap and apply tester dial to camshaft for measurement of rotating angle.
8. Bleed air from injection pump.

- (2) Set No. 1 tappet to bottom dead center (B.D.C.) position and set dial gauge at "0".

## INJECTION PUMP ASSEMBLY (Diesel Kiki-Bosch in-line type)

6.  
(1) Turn Tool DK57916432 in direction to compress timer spring, thread in Tool DK57924190, and then remove Tool DK57932020.



- (2) Using a lever, insert timer spring into flange hole, thread in Tool DK57924190 all the way and install flange in its proper position.

**Make sure that spring is fully seated in holes in flange and flyweight holder.**

7. Adjust flyweight holder and flange clearance.

- (1) Install thrust washer, lock plate and adjusting shims, and completely tighten them with nut.

Ⓙ : Nut

98 - 177 N·m

(10 - 18 kg·m,

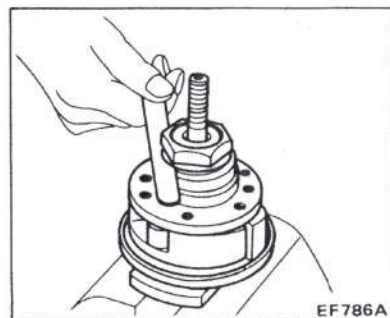
72 - 130 ft-lb)

**Lock plate and thrust washer clearance:**

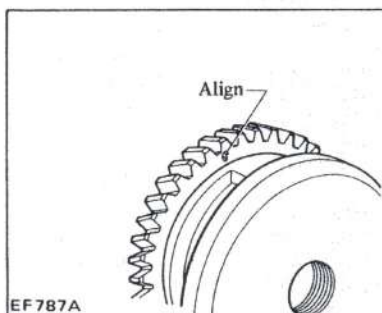
0.02 - 0.10 mm

(0.0008 - 0.0039 in)

- (2) Measure lock plate and thrust washer clearance. If the clearance is not within specifications, adjust with adjusting shim.



8. Align "O" mark on drive gear with notch in timer flange, and install drive gear.



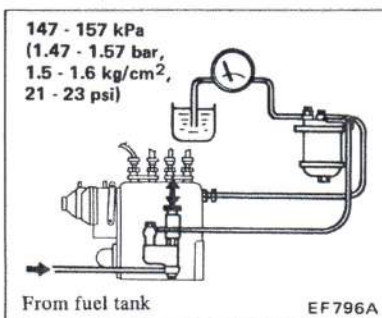
## FUEL FILTER

**Bleed air from fuel system after installing fuel filter.**

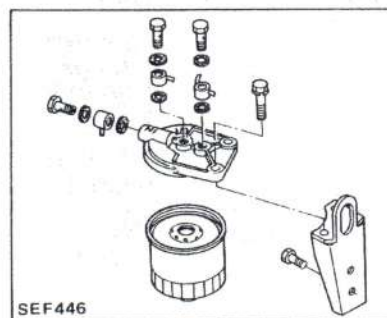
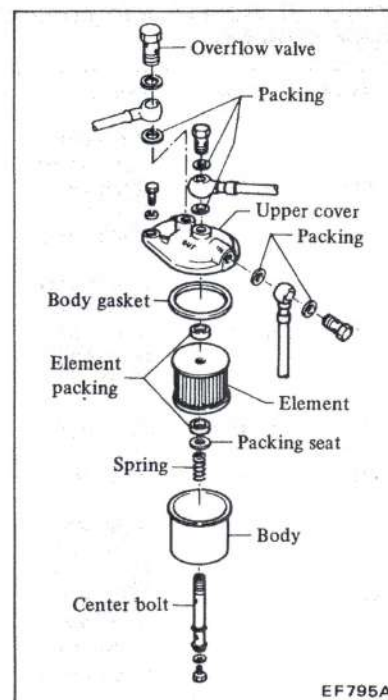
## TEST

### Overflow valve

Attach a pressure gauge to fuel filter discharge port, and check valve opening pressure by operating priming pump. If pressure is not within range of 147 to 157 kPa (1.47 to 1.57 bar, 1.5 to 1.6 kg/cm<sup>2</sup>, 21 to 23 psi), replace overflow valve.



## INSPECTION



### Element

Check element for clogging, damage, or peeling. If faulty, replace with a new filter element.

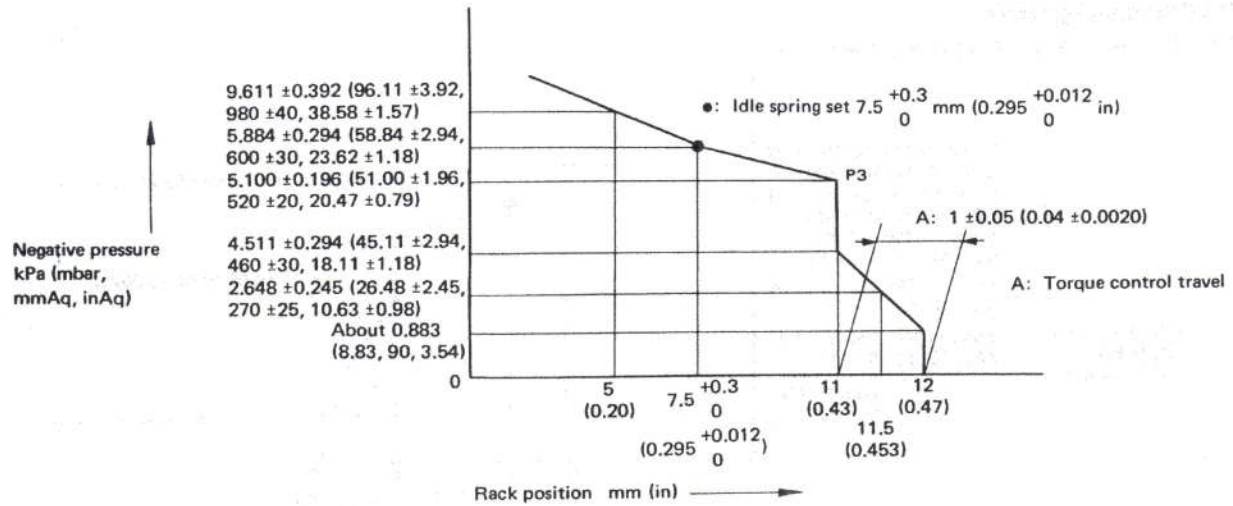
### Body and upper covers

Inspect body for cracks or damage and examine covers for splits or damage. Replace faulty components with new ones.

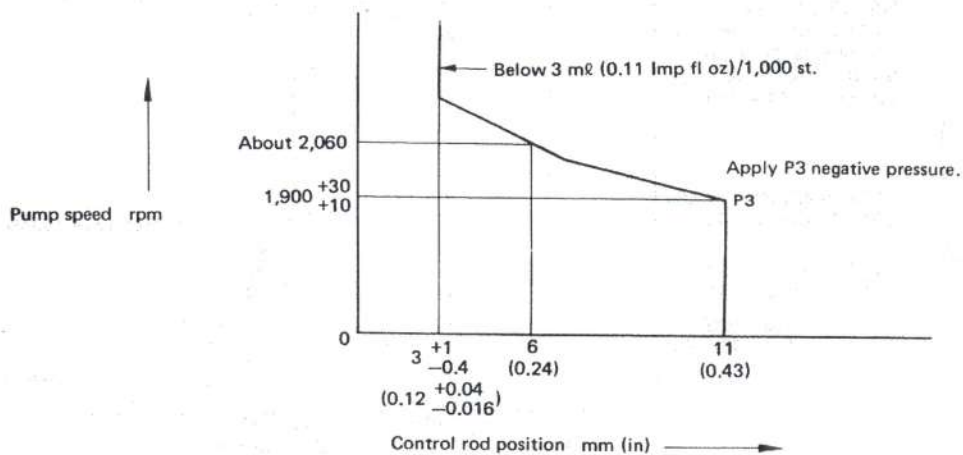
# INJECTION PUMP ASSEMBLY (Diesel Kiki-Bosch in-line type)

Pump Nos. 101431-9770, 101431-9980

Pneumatic



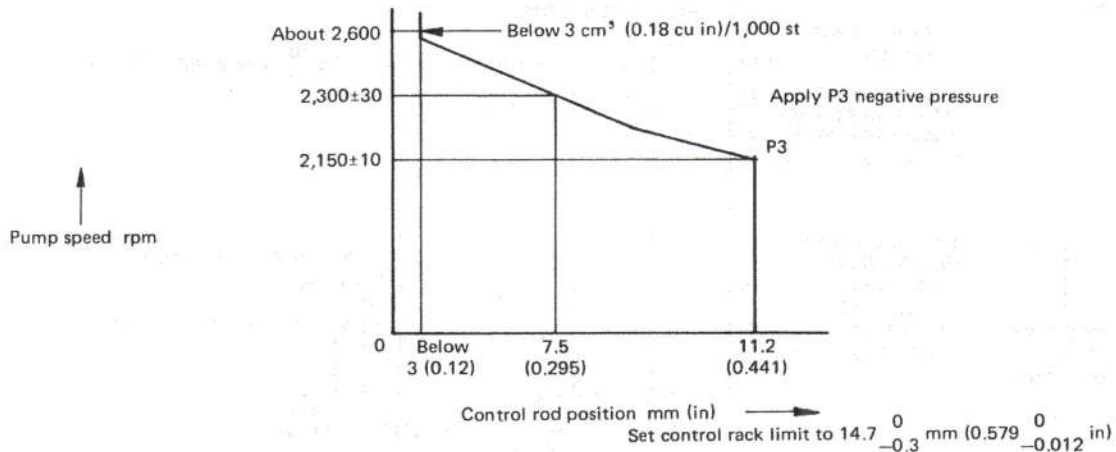
Mechanical





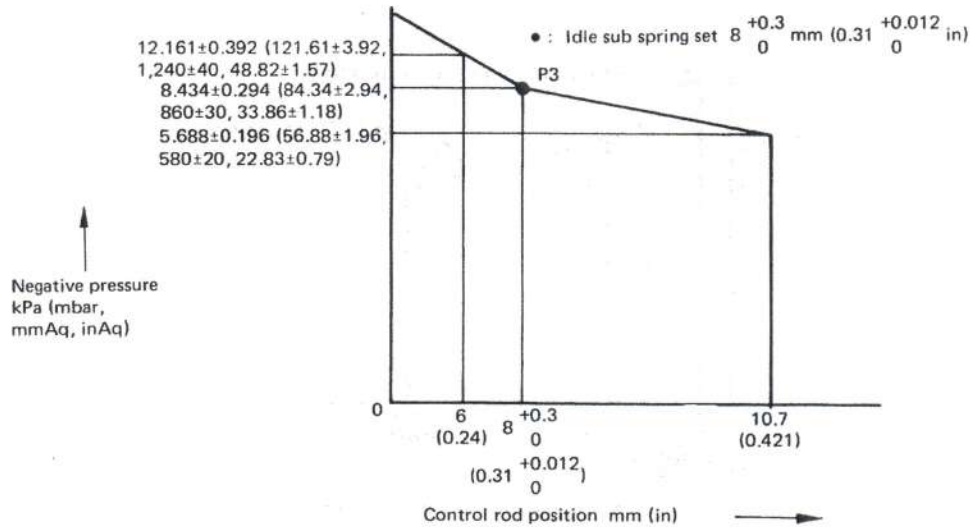
# INJECTION PUMP ASSEMBLY (Diesel Kiki-Bosch in-line type)

Mechanical

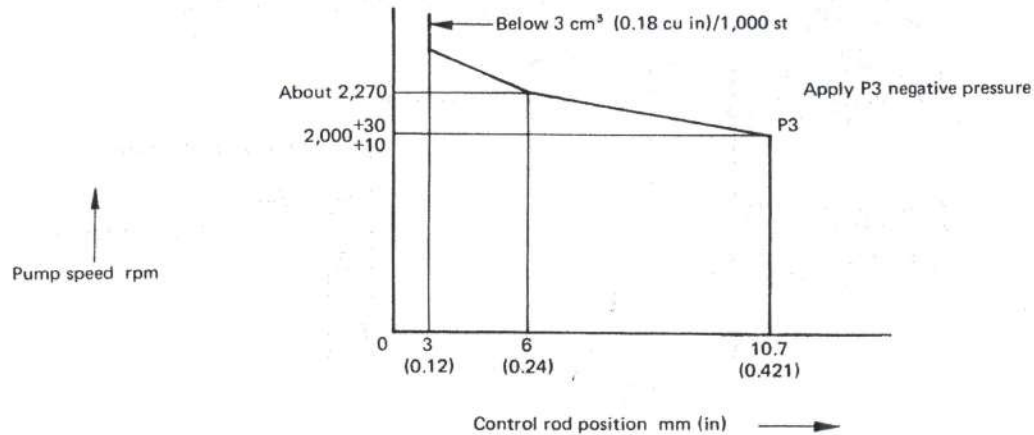


Pump No. 101631-9562

Pneumatic



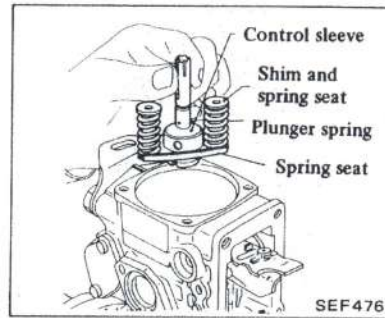
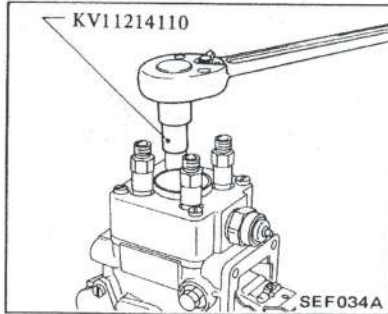
Mechanical



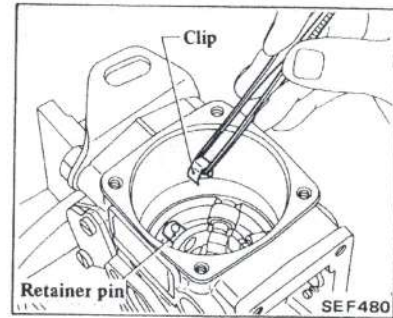
## INJECTION PUMP ASSEMBLY (Diesel Kiki-Bosch VE-type)

7. Remove delivery holder, spring, delivery valve and gasket.

Distributor head has letters (A, B, C, D) stamped on it. Remove lettered parts in alphabetical order and arrange neatly.

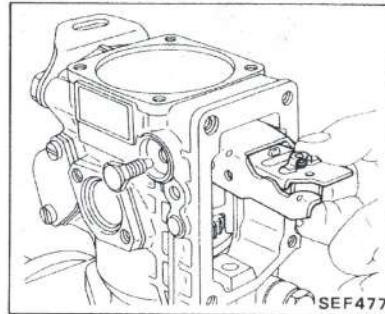


13. Remove clips and pins.

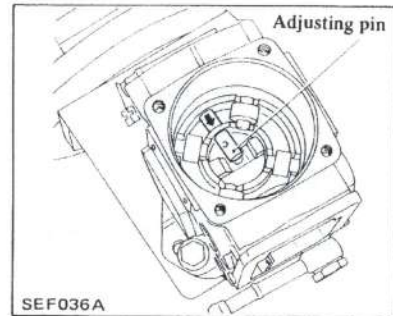


11. Remove governor lever assembly.

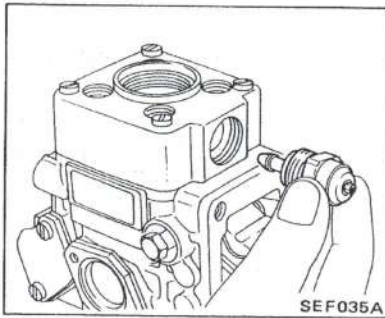
Avoid pulling on start spring and start idle spring.



14. Move adjusting pin to center of roller holder, as shown.

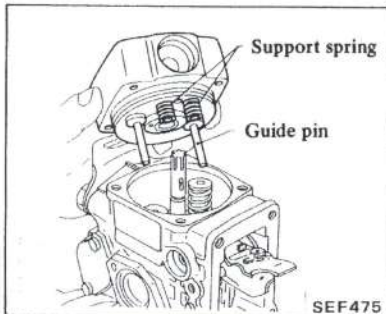


8. Remove fuel-cut solenoid valve.

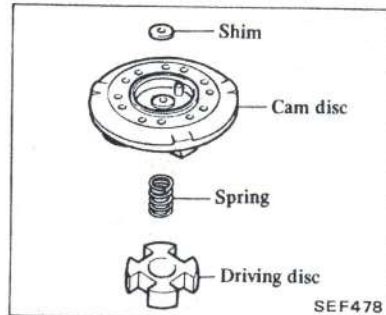


9. Remove distributor head.

Be careful not to drop the two support springs and guide pins.

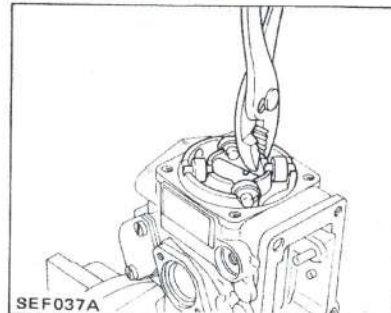


12. Remove shim, cam disc, spring and driving disc.



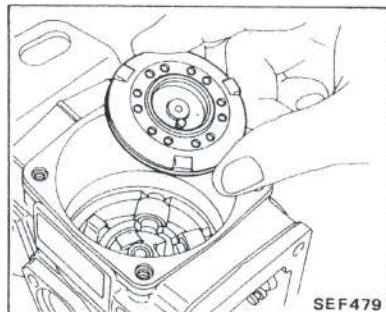
15. Lift out roller holder with rollers without tilting.

Be careful not to drop rollers.



10. Remove plunger assembly.

Lift plunger, along with control sleeve, shim, spring seat and plunger spring.



## INJECTION PUMP ASSEMBLY (Diesel Kiki-Bosch VE-type)

### 3. Measure fuel injection volume.

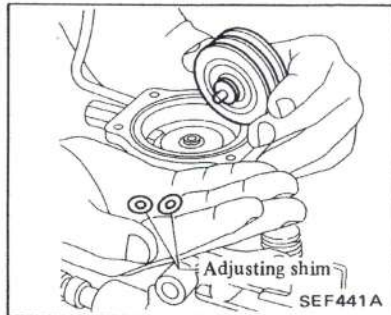
#### 1) Below 2,000 m (6,562 ft)

Altitude m (ft)	0 (0)	250 (820)	500 (1,641)	750 (2,461)	1,000 (3,281)	1,250 (4,101)	1,500 (4,922)	1,750 (5,742)	2,000 (6,562)
Item									
Applied vacuum kPa (bar, mmHg, inHg)	21.2 - 22.5 (212 - 225, 159 - 169, 6.26 - 6.65)	18.3 - 19.6 (183 - 196, 137 - 147, 5.39 - 5.79)	15.3 - 16.7 (153 - 167, 115 - 125, 4.53 - 4.92)	12.4 - 13.7 (124 - 137, 93 - 103, 3.66 - 4.06)	9.5 - 10.8 (95 - 108, 71 - 81, 2.80 - 3.19)	6.9 - 8.3 (69 - 83, 52 - 62, 2.05 - 2.44)	4.4 - 5.7 (44 - 57, 33 - 43, 1.30 - 1.69)	1.9 - 3.2 (19 - 32, 14 - 24, 0.55 - 0.94)	0 (0, 0, 0)
Fuel injection pump rpm	1,000								
Standard fuel injection mL (Imp fl oz)/ 1,000 stroke	29.4 - 33.4 (1.03 - 1.18)								

#### 2) Above 2,000 m (6,562 ft)

Altitude m (ft)	2,250 (7,382)	2,500 (8,203)	2,750 (9,023)	3,000 (9,843)	3,250 (10,663)	3,500 (11,484)	3,750 (12,304)	4,000 (13,124)
Item								
Fuel injection pump rpm	1,000							
Standard fuel injection mL (Imp fl oz)/1,000 stroke	28.4 -32.5 (1.00 - 1.14)	27.4 -31.5 (0.96 - 1.11)	26.5 -30.5 (0.93 - 1.07)	25.5 -29.6 (0.90 - 1.04)	24.5 -28.6 (0.86 - 1.01)	23.6 -27.6 (0.83 - 0.97)	22.7 -26.7 (0.80 - 0.94)	21.7 -25.7 (0.76 - 0.90)

4. If fuel injection is not within the standard range, increase or decrease the adjusting shims.

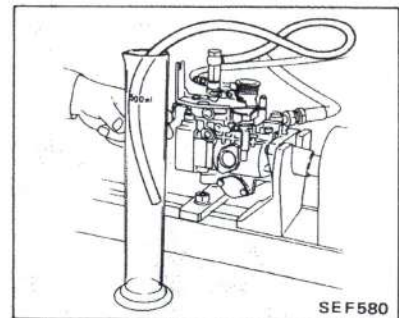


#### Shims (Service parts)

Part number	Thickness mm (in)
19275-W3300	0.2 (0.008)
19275-W3301	0.3 (0.012)
19275-W3302	0.4 (0.016)
19275-W3303	0.6 (0.024)
19275-W3304	0.7 (0.028)

3. Measure fuel overflow at specified fuel injection rpm.

**Fuel overflow:**  
**Refer to S.D.S.**



#### Measurement of overflow amount

- Set control lever at "full load" by pulling spring.
- Furnish specified voltage of 12 volts to activate fuel-cut solenoid valve.

#### Operation check of fuel-cut solenoid valve

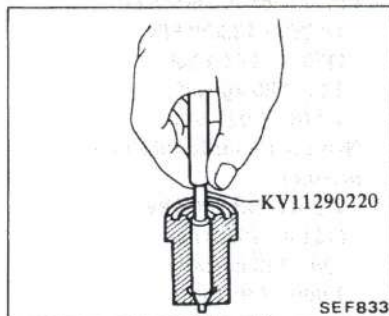
When engine is idling and fuel-cut solenoid valve current is OFF, be sure there is no injection. This check has to be done for approx. 5 seconds.



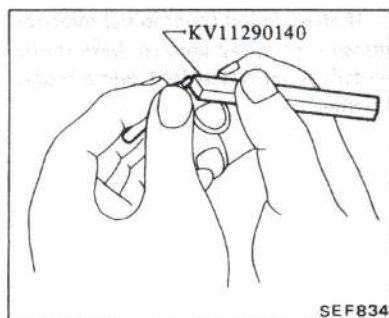
## INJECTION NOZZLE ASSEMBLY

6. Clean spray hole of nozzle body by using Tool.

To prevent spray hole from canting, always clean it by starting with inner side and working towards outside.

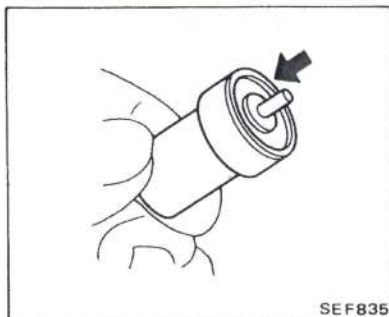


7. Decarbon nozzle needle tip by using Tool.



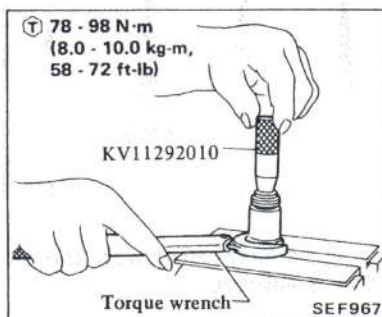
8. Check needle for proper position.  
(1) Pull needle about halfway out from body and then release it.  
(2) Needle should sink into body very smoothly from just its own weight.  
(3) Repeat this test and rotate needle slightly each time.

If needle fails to sink smoothly from any position, replace both needle and body as a unit.



### ASSEMBLY

1. Assemble in the reverse order of disassembly, observing the following.



If nozzle body is not installed properly, tool cannot be removed and nozzle body may be damaged.

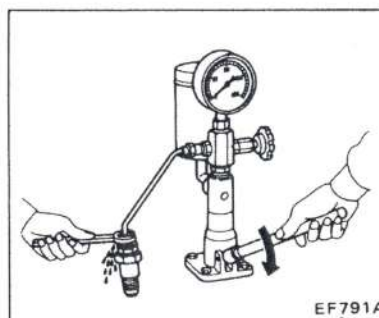
### TEST AND ADJUSTMENT

#### WARNING

When using nozzle tester, be careful not to allow fuel sprayed from nozzle to come into contact with your hand or body, and make sure that your eyes are properly protected with goggles.

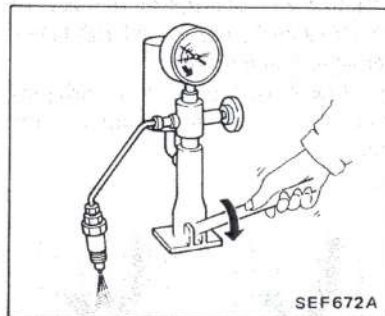
#### Injection pressure test

1. Install nozzle to injection nozzle tester and bleed air from flare nut.



2. Pump the tester handle slowly (one time per second) and watch the pressure gauge.

3. Read the pressure gauge when the injection pressure just starts to drop.



#### Initial injection pressure:

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

#### New nozzle initial injection pressure:

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

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

4. To adjust injection pressure, change adjusting shims.

a. Increasing the thickness of adjusting shims increases injection starting pressure. Decreasing shim thickness reduces initial injection pressure.

b. A shim thickness of 0.04 mm (0.0016 in) corresponds approximately to a difference of 471 kPa (4.71 bar, 4.8 kg/cm<sup>2</sup>, 68 psi) in initial injection pressure.

