

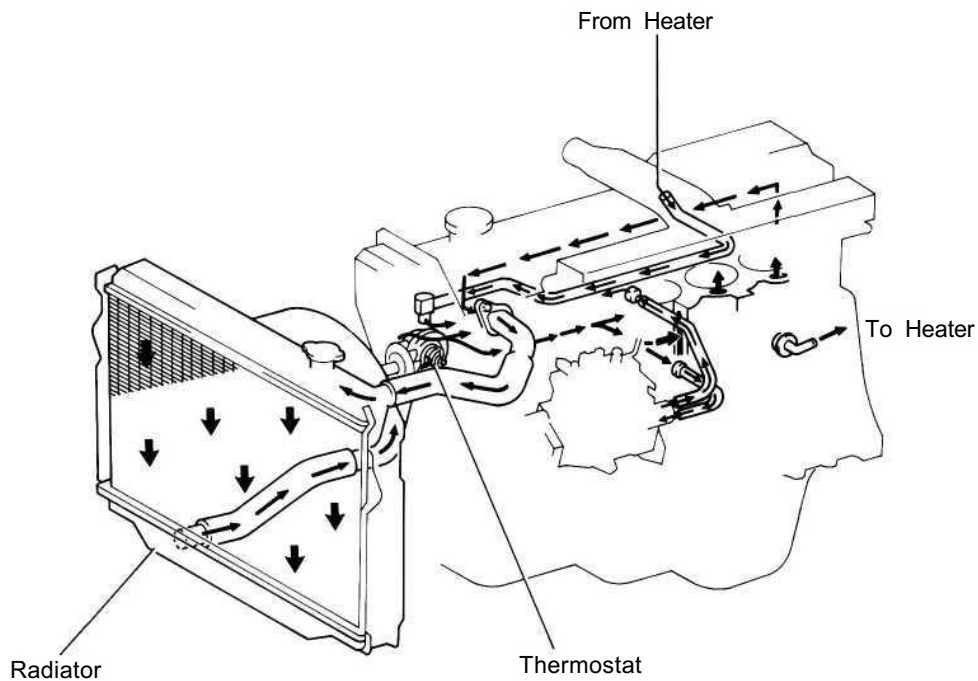
# COOLING SYSTEM

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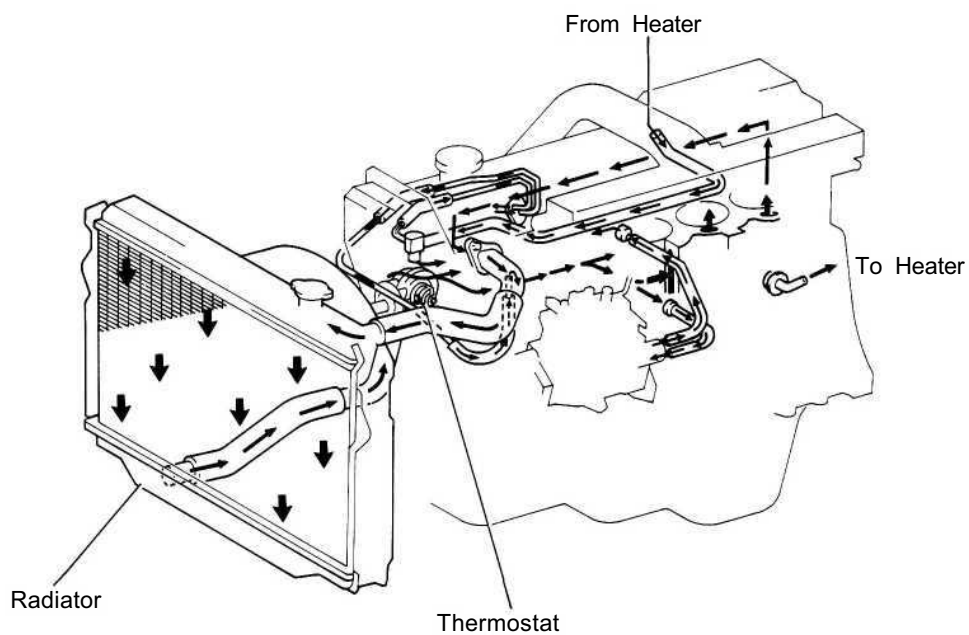
## DESCRIPTION

This engine utilizes a pressurized water forced circulation cooling system which includes a thermostat equipped with a by-pass valve mounted on the inlet side.

### IPZand1HZ



### 1HD-T



The cooling system is composed of the water jacket (inside the cylinder block and cylinder head), radiator, water pump, thermostat, cooling fan, hoses and other components. Coolant which is heated in the water jacket is pumped to the radiator, where it is cooled by the cooling fan and the vehicle windstream. Coolant which has been cooled is then sent back to the engine by the water pump, where it cools the engine. The water jacket is a network of channels in the shell of the cylinder block and cylinder head through which coolant passes. It is designed to provide adequate cooling of the cylinders and combustion chambers which become the hottest during engine operation.

### **RADIATOR**

The radiator performs the function of cooling the coolant which has passed through the water jacket and become hot, and it is mounted in the front of the vehicle. The radiator consists of an upper tank and lower tank, and a core which connects the two tanks. The upper tank contains an inlet for coolant from the water jacket and a filler inlet. It also has a hose through which excess coolant or steam can flow. The lower tank has an outlet and drain cock for the coolant. The core contains many tubes and cooling fins through which coolant flows from the upper tank to the lower tank so that coolant has been heated up as it passes through the water jacket is cooled here by the air sucked through the radiator by the cooling fan, as well as by the wind generated by the vehicle's travel. Models with an automatic transmission include an automatic transmission fluid cooler built into the lower tank of the radiator.

### **RADIATOR CAP**

The radiator cap is a pressure type cap which seals the radiator, resulting in pressurization of the radiator as the coolant expands. The pressurization prevents the coolant from boiling even when the coolant temperature exceeds 100°C (212°F). A relief valve (pressurization valve) and a vacuum valve (negative pressure valve) are built into the radiator cap. When the pressure generated inside the cooling system exceeds the limit (coolant temperature: 110-120°C, 230 - 248°F, pressure: 0.3-1.0 kg/cm<sup>2</sup>, 4.3-14.2 psi, 29.4-98.1 kPa) the relief valve is opened by the pressure and lets steam escape through the overflow pipe. The vacuum valve opens to allow atmospheric air to enter to alleviate the vacuum which develops in the cooling system after the engine is stopped and the coolant temperature drops. The valve's opening allows the pressure in the cooling system to return to the reservoir tank.

### **RESERVOIR TANK**

The reservoir tank is used to catch coolant which overflows the cooling system as a result of volumetric expansion when the coolant is heated. When the coolant temperature drops the coolant in the reservoir tank returns to the radiator, thus keeping the radiator full at all times and avoiding needless coolant loss. To find out if the coolant needs to be replenished, check the reservoir tank level.

### **WATER PUMP**

The water pump is used for forced circulation of coolant through the cooling system. It is mounted on the front of the cylinder block and driven by a drive belt.

### **THERMOSTAT**

The thermostat has a wax type by-pass valve and is mounted in the cylinder block. The thermostat includes a type of automatic valve operated by fluctuations in the coolant temperature. This valve closes when the coolant temperature drops, preventing the circulation of coolant through the radiator and thus permitting the engine to warm up rapidly. The valve opens when the coolant temperature has risen, allowing the circulation of coolant. Wax inside the thermostat expands when heated and contracts when cooled. Heating the wax thus generates pressure which overpowers the force of the spring which keeps the valve closed, thus opening the valve. When the wax cools, its contraction causes the force of the spring to take effect once more, closing the valve. The thermostat in this engine operates at a temperature of 76°C (169°F).

## TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine overheats	Fan belt loose or missing	Adjust or replace belts	CH-5
	Dirt, leaves or insects on radiator or condenser	Clean radiator or condenser	CO-12
	Hoses, water pump, thermostat housing, radiator, heater, core plugs or head gasket leakage	Repair as necessary	
	Thermostat faulty	Check thermostat	CO-10
	Injection timing retarded	Adjust timing	EM-24
	Fluid coupling faulty	Replace fluid coupling	CO-7
	Radiator hose plugged or rotted	Replace hose	
	Water pump faulty	Replace water pump	CO-7
	Radiator plugged or cap faulty	Check radiator	CO-12
	Cylinder head or block cracked or plugged	Repair as necessary	

**HINT:** Removal of the thermostat would have an adverse effect, causing a lowering of cooling efficiency. Do not remove the thermostat, even if the engine tends to overheat.

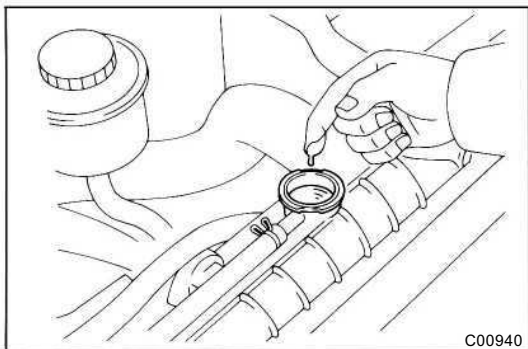


## CHECK AND REPLACEMENT OF ENGINE COOLANT

### 1. CHECK ENGINE COOLANT LEVEL AT RESERVOIR TANK

The coolant level should be between the "LOW" and "FULL" lines.

If low, check for leaks and add coolant up to the "FULL" line.



### 2. CHECK ENGINE COOLANT QUALITY

There should not be any excessive deposits of rust or scales around the radiator cap or radiator filler hole, and the coolant should be free from oil.

If excessively dirty, replace the coolant.

### 3. REPLACE ENGINE COOLANT

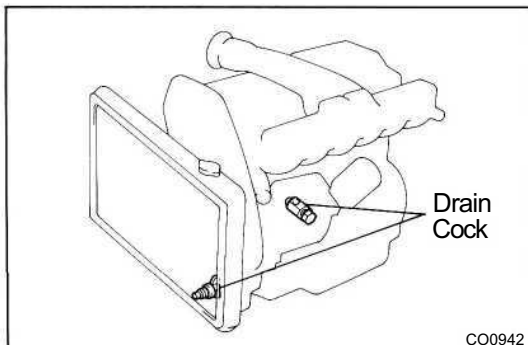
- (a) Remove the radiator cap.

**CAUTION:** To avoid the danger of being burned, do not remove it while the engine and radiator are still hot, as fluid and steam can be blown out under pressure.

- (b) Drain the coolant from the radiator and engine drain cocks.

- (c) Close the drain cocks.

**Torque (Engine drain cock):**  
**250 kg-cm (18 ft-lb, 25 N-m)**



- (d) Fill the system with coolant.

Use a good brand of ethylene-glycol or TOYOTA radiator conditioner or equivalent anticorrosive, mixed according to the manufacturer's directions.

Ethylene-glycol type: This type has an antifreeze and anticorrosive effect.

TOYOTA radiator conditioner: This has only an anticorrosive effect.

**NOTICE:**

- Do not use alcohol type coolant.
- The coolant should be mixed with demineralized water or distilled water.

**Capacity (w/o Heater):**

PZJ70, 73, 75

9.6 liters (10.1 US qts, 8.4 Imp. qts)

HZJ70, 73, 75

M/T 9.9 liters (10.5 US qts, 8.7 Imp. qts)

A/T 9.7 liters (10.3 US qts, 8.5 Imp. qts)

HZJ80 and HDJ80

M/T 10.4 liters (11.0 US qts, 9.2 Imp. qts)

A/T 10.2 liters (10.8 US qts, 9.0 Imp. qts)

HZB30 and HDB30

10.2 liters (10.8 US qts, 9.0 Imp. qts)

**Capacity (w/ Heater):**

PZJ70, 73, 75

10.3 liters (10.9 US qts, 9.1 Imp. qts)

HZJ70, 73, 75

M/T 10.6 liters (11.2 US qts, 9.3 Imp. qts)

A/T 10.4 liters (11.0 US qts, 9.2 Imp. qts)

HZJ80 and HDJ80

M/T 11.1 liters (11.6 US qts, 9.8 Imp. qts)

A/T 10.9 liters (11.5 US qts, 9.6 Imp. qts)

HZB30 and HDB30

14.6 liters (15.4 US qts, 12.8 Imp. qts)

**Capacity (w/ Front and rear heaters):**

PZJ70, 73, 75

11.3 liters (11.9 US qts, 9.9 Imp. qts)

HZJ70, 73, 75

11.6 liters (12.2 US qts, 10.2 Imp. qts)

HZJ80 and HDJ80

M/T (Europe)

12.0 liters (12.7 US qts, 10.6 Imp. qts)

A/T (Europe)

11.8 liters (12.5 US qts, 10.4 Imp. qts)

M/T (Others)

11.9 liters (12.6 US qts, 10.5 Imp. qts)

A/T (Others)

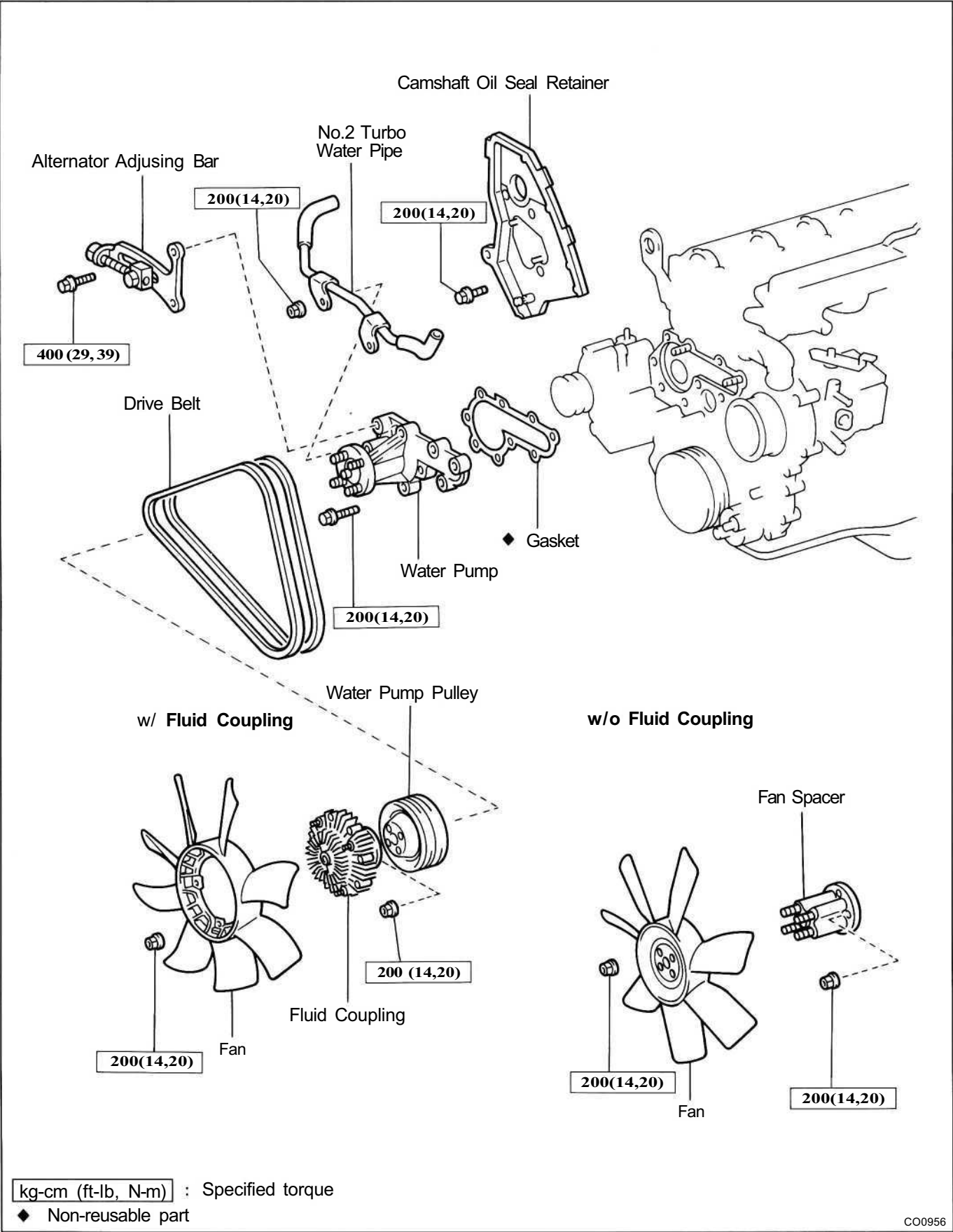
11.7 liters (12.4 US qts, 10.3 Imp. qts)

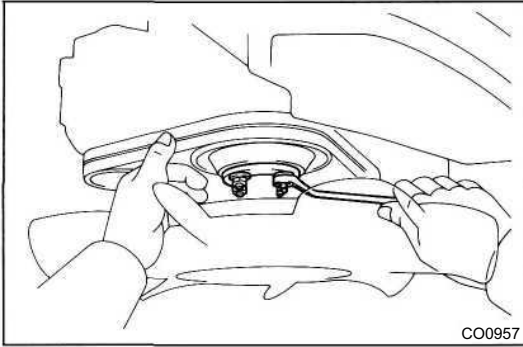
- (e) Reinstall the radiator cap.

- (f) Warm up the engine and check for leaks.

- (g) Recheck the coolant level and refill as necessary.

WATER PUMP  
COMPONENTS

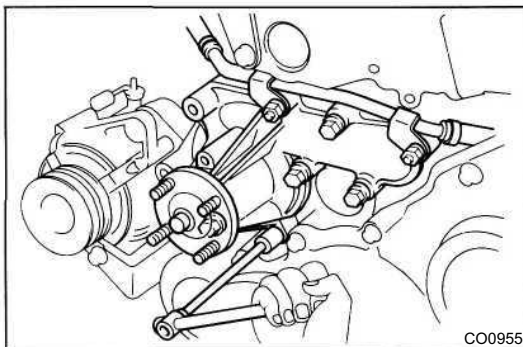
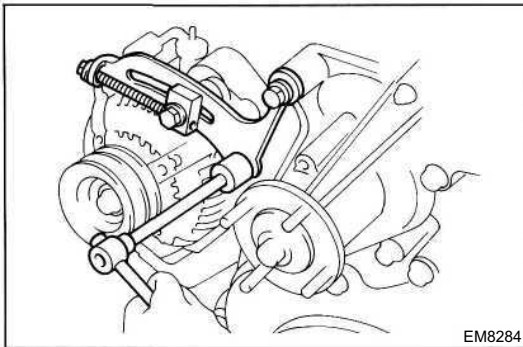


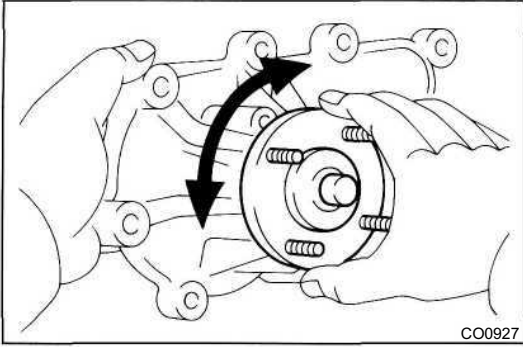


## REMOVAL OF WATER PUMP

(See page CO-6)

1. **DRAIN ENGINE COOLANT** (See page CO-5)
2. **REMOVE DRIVE BELT, FAN AND WATER PUMP PULLEY**
  - (a) Stretch the belt tight and loosen the four pump pulley set nuts.
  - (b) Loosen the pivot bolt, lock bolt and adjusting bolt, and remove the drive belt.
  - (c) Remove the four nuts, fan and fluid coupling (fan spacer) assembly and pulley.
3. **REMOVE TIMING BELT AND IDLER PULLEY**  
(See steps 1 to 4 on pages EM-33 to 34)
4. **REMOVE NO.1 CAMSHAFT TIMING PULLEY**  
(See steps 6 to 8 on pages EM-34 to 35)
5. **REMOVE CAMSHAFT OIL SEAL RETAINER**  
(See step 14 on page EM-55)
6. **REMOVE WATER PUMP**
  - (a) (1HD-T)  
Disconnect the turbo water by-pass hoses.
  - (b) Remove the three bolts and alternator adjusting bar.
  - (c) Remove the five bolts, two nuts, No.2 turbo water pipe (1 HD-T), water pump and gasket.



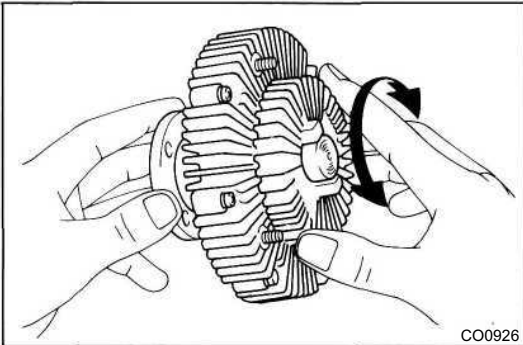


## INSPECTION OF WATER PUMP

### 1. INSPECT WATER PUMP

Turn the pulley and check that the water pump bearing moves smoothly and quietly.

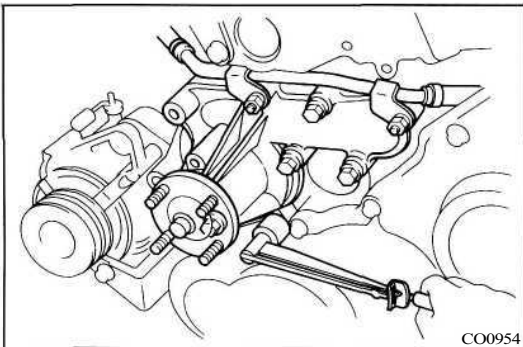
If necessary, replace the water pump.



### 2. INSPECT FLUID COUPLING

Check the fluid coupling for damage and silicon oil leakage.

If necessary, replace the fluid coupling.



## INSTALLATION OF WATER PUMP

(See page CO-6)

### 1. INSTALL WATER PUMP

- (a) Install a new gasket, the water pump and No.2 turbo water pipe (1 HD-T) with the five bolts and two nuts.

**Torque: 200 kg-cm (14 ft-lb, 20 N-m)**

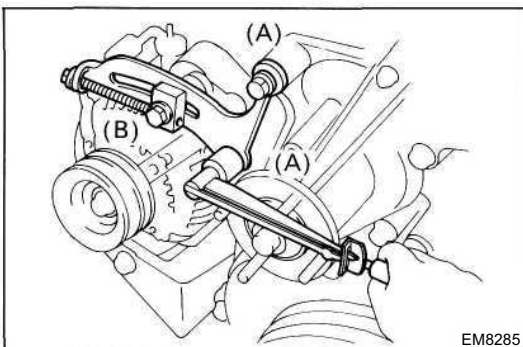
- (b) Install the alternator adjusting bar with the two bolts (A).

**Torque: 400 kg-cm (29 ft-lb, 39 N-m)**

- (c) Temporarily install the lock bolt (B).

- (d) (1HD-T)

Connect the water by-pass hoses.

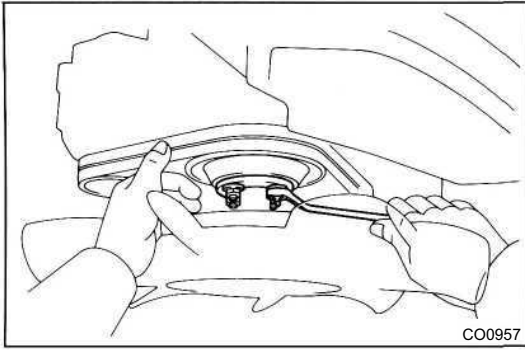


### 2. INSTALL CAMSHAFT OIL SEAL RETAINER (See step 6 on page EM-79)

### 3. INSTALL NO.1 CAMSHAFT TIMING PULLEY (See steps 1 to 3 on page EM-38)

### 4. INSTALL IDLER PULLEY TIMING BELT (See steps 5 to 11 on pages EM-39 to 41)



**5. INSTALL WATER PUMP PULLEY, FAN AND DRIVE BELT**

- (a) Install the pump pulley, the fluid fan and coupling (fan spacer) assembly with the four nuts.
- (b) Place the drive belt on each pulley.
- (c) Stretch the belt tight and torque the four nuts.

**Torque: 200 kg-cm (14 ft-lb, 20 N-m)**

- (d) Adjust the drive belt deflection.  
(See step 3 on page CH-5)

**6. FILL WITH ENGINE COOLANT (See page CO-5)****7. START ENGINE AND CHECK FOR LEAKS**

# THERMOSTAT

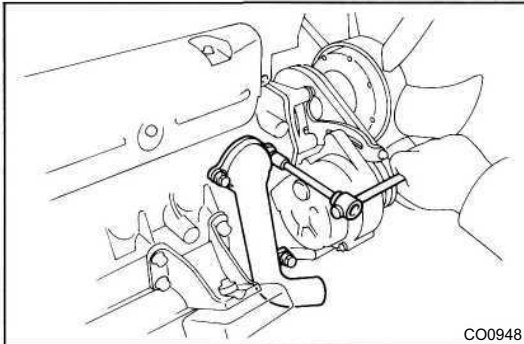
## REMOVAL OF THERMOSTAT

### 1. DRAIN ENGINE COOLANT (See page CO-5)

### 2. REMOVE WATER INLET

Remove the three bolts and water inlet from the water inlet housing.

### 3. REMOVE THERMOSTAT

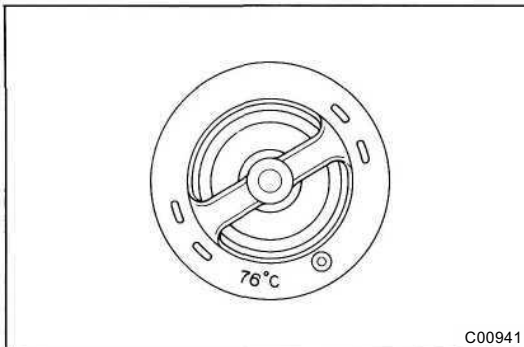


CO0948

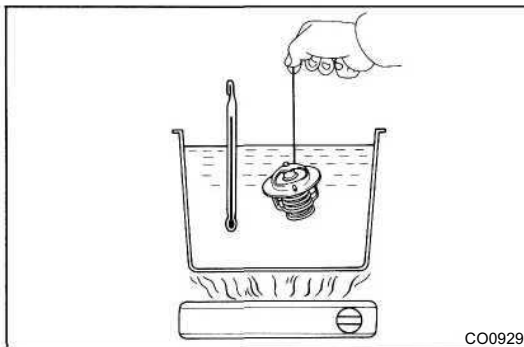
## INSPECTION OF THERMOSTAT

### INSPECT THERMOSTAT

HINT: The thermostat is numbered with the valve opening temperature.



CO0941



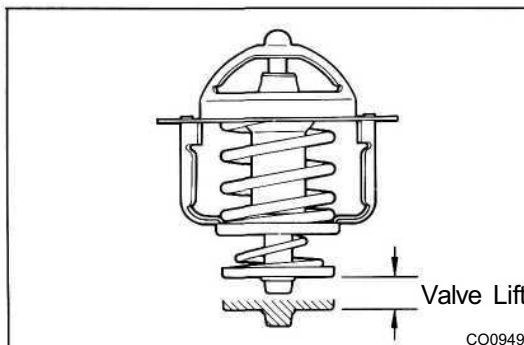
CO0929

(a) Immerse the thermostat in water and gradually heat the water.

(b) Check the valve opening temperature.

**Valve opening temperature: 74-78X (165-172°F)**

If the valve opening temperature is not as specified, replace the thermostat.



CO0949

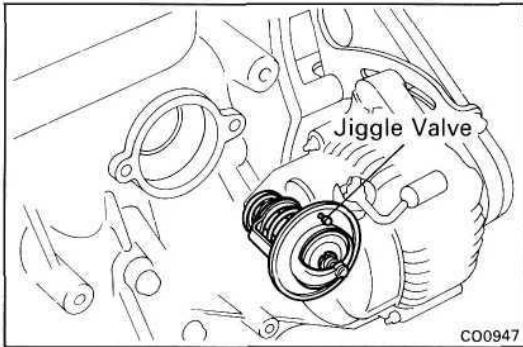
(c) Check the valve lift.

**Valve lift: 10 mm (0.39 in.) or more at 90°C (194°F)**

If the valve lift is not as specified, replace the thermostat.

(d) Check that the valve spring is tight when the thermostat is fully closed.

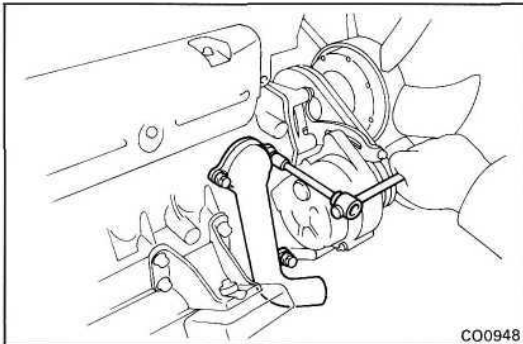
If necessary, replace the thermostat.



## INSTALLATION OF THERMOSTAT

### 1. PLACE THERMOSTAT IN CYLINDER BLOCK

- (a) Install a new gasket to the thermostat.
- (b) Install the thermostat with the jiggle valve upward.



### 2. INSTALL WATER INLET TO CYLINDER BLOCK

Install the water inlet with the three bolts.

**Torque:** 200 kg-cm (14 ft-lb, 20 N-m)

**NOTICE:** Torque the two upper bolts first.

### 3. FILL WITH ENGINE COOLANT (See page CO-5)

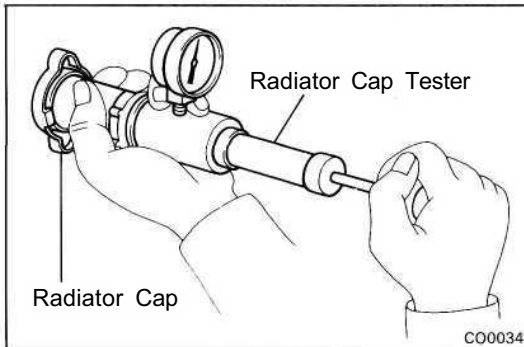
### 4. START ENGINE AND CHECK FOR LEAKS

## RADIATOR

### CLEANING OF RADIATOR

Using water or a steam cleaner, remove any mud and dirt from the radiator core.

**NOTICE:** If using a high pressure type cleaner, be careful not to deform the fins of the radiator core. If the cleaner nozzle pressure is 30-35 kg/cm<sup>2</sup> (427-498 psi, 2,942-3,432 kPa), keep a distance of at least 40-50 cm (15.75-19.69 in.) between the radiator core and cleaner nozzle.



### INSPECTION OF RADIATOR

#### 1. INSPECT RADIATOR CAP

Using a radiator cap tester, pump the tester and measure the relief valve opening pressure.

**Standard opening pressure:**

0.75-1.05 kg/cm<sup>2</sup> (10.7-14.9 psi, 74-103 kPa)

**Minimum opening pressure:**

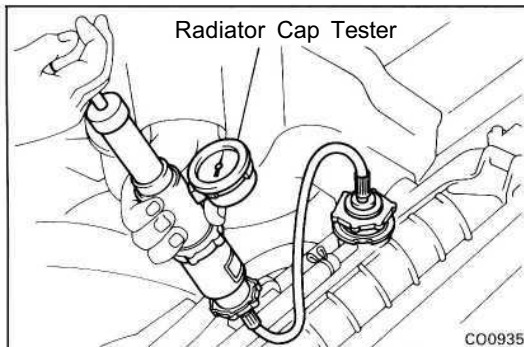
0.6 kg/cm<sup>2</sup> (8.5 psi, 59 kPa)

If the opening pressure is less than minimum, replace the radiator cap.

#### 2. INSPECT COOLING SYSTEM FOR LEAKS

- Fill the radiator with coolant and attach a radiator cap tester.
- Warm up the engine.
- Pump it to 1.2 kg/cm<sup>2</sup> (17.1 psi, 118 kPa), check that pressure does not drop.

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



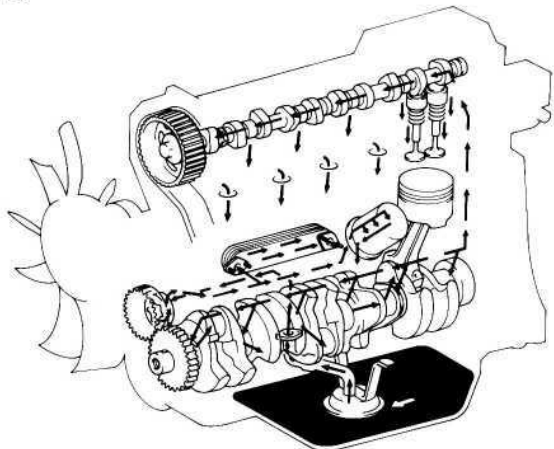
# LUBRICATION SYSTEM

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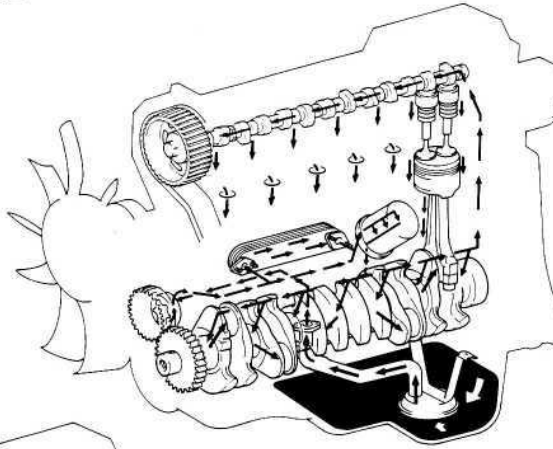
## DESCRIPTION

A fully pressurized, fully filtered lubrication system has been adopted for this engine.

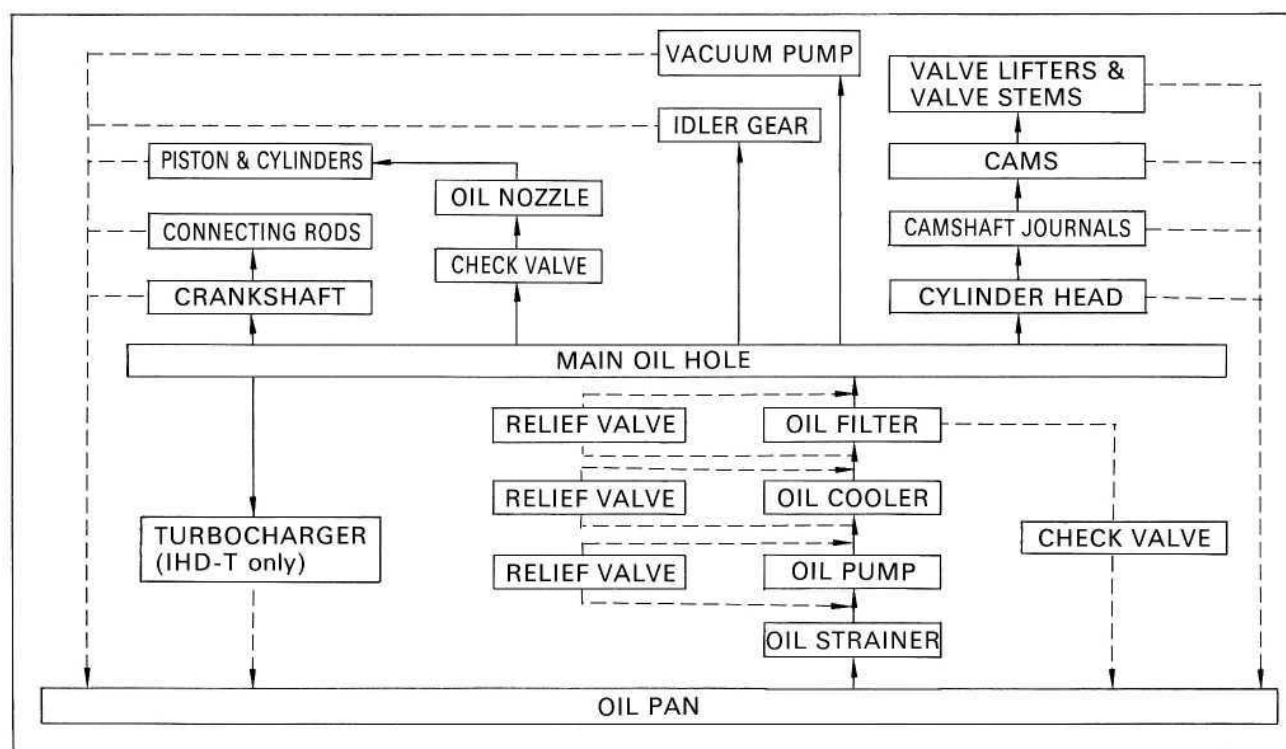
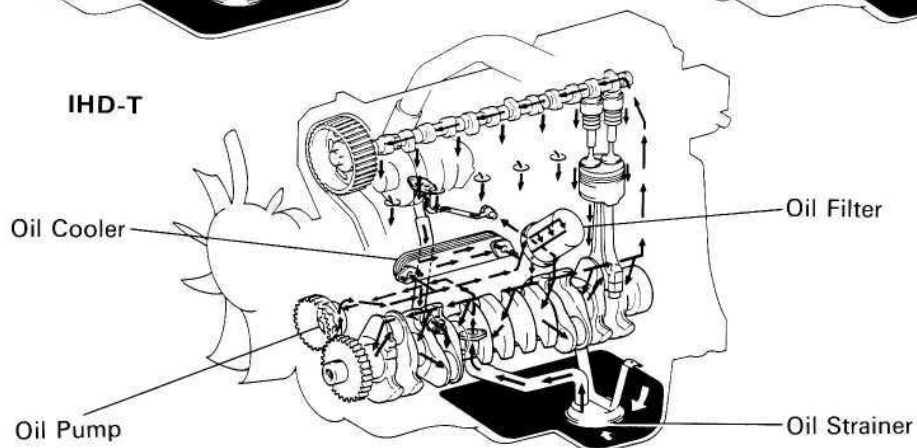
IPZ



IHZ



IHD-T



A pressure feeding lubrication system has been adopted to supply oil to the moving parts of this engine. The lubrication system consists of an oil pan, oil pump, oil filter and other external parts which supply oil to the moving parts in the engine block. The oil circuit is shown in the illustration at the top of the previous page. Oil from the oil pan is pumped up by the oil pump. After it passes through the oil filter, it is fed through the various oil holes in the crankshaft and cylinder block. After passing through the cylinder block and performing its lubricating function, the oil is returned by gravity to the oil pan. A dipstick on the center left side of the cylinder block is provided to check the oil level.

### **OIL PUMP**

The oil pump pumps up oil from the oil pan and sends it under pressure to the various parts of the engine. An oil strainer is mounted in front of the inlet to the oil pump to remove impurities. The oil pump itself is a trochoid type pump, which uses a drive rotor and driven rotor inside the pump body. When the drive rotor rotates, the driven rotor rotates in the same direction. The axis of the driven rotor shaft is different from the center of the driven rotor, so when both rotors rotate, the space between the two rotors changes. Oil is drawn in when the space widens and is discharged when the space becomes narrow.

### **OIL PRESSURE REGULATOR (RELIEF VALVE)**

At high engine speeds, the oil pump supplies more oil to each part that is necessary. For this reason, an oil pressure regulator which works to prevent oversupply of oil is installed on the oil pump. During normal oil supply, a coil spring and valve keep the by-pass closed, but when too much oil is being supplied, the pressure becomes extremely high, overpowering the force of the spring and opening the valves. This allows the excess oil to flow through the valve and return to the inlet of the oil pump.

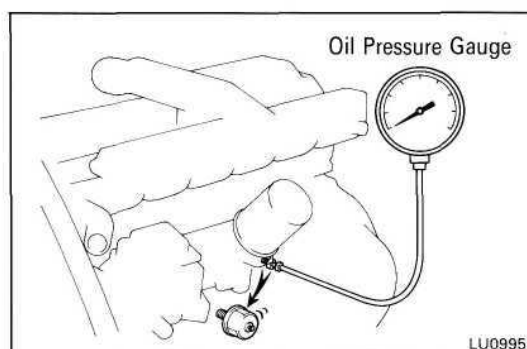
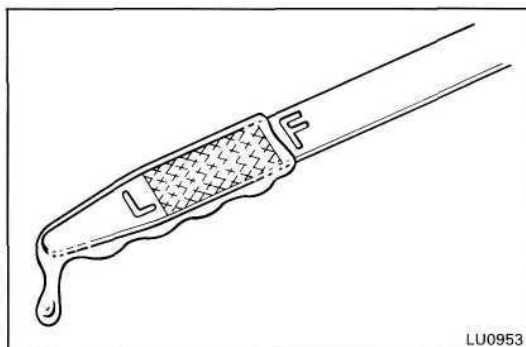
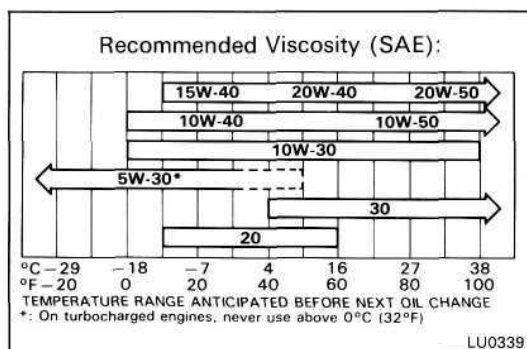
### **OIL FILTER**

The oil filter is a full flow type filter with a built-in paper filter element. Particles of metal from wear, airborne dirt, carbon and other impurities can get in the oil during use and could cause accelerated wear or siezing if allowed to circulate through the engine. The oil filter, integrated into the oil line, removes these impurities as the oil passes through it. The filter is mounted outside the engine to simplify replacement of the filter element. A relief valve is also included ahead of the filter element to relieve the high oil pressure in case the filter element becomes clogged with impurities. The relief valve opens when the oil pressure overpowers the force of the spring. Oil passing through the relief valve by-passes the oil filter and flows directly into the main oil hole in the engine.

## TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Oil leakage	Cylinder head, cylinder block or oil pump body damaged or cracked	Repair as necessary	EM-48, 49, 72, 105
	Oil seal faulty	Replace oil seal	
	Gasket faulty	Replace gasket	
Low oil pressure	Oil leakage	Repair as necessary	LU-8
	Relief valve faulty	Repair relief valve	LU-9
	Oil pump faulty	Repair oil pump	LU-6
	Engine oil poor quality	Replace engine oil	EM-84
	Crankshaft bearing faulty	Replace bearing	EM-84
	Connecting rod bearing faulty	Replace bearing	LU-6
	Oil filter clogged	Replace oil filter	LU-8
High oil pressure	Relief valve faulty	Repair relief valve	LU-8





## OIL PRESSURE CHECK

### 1. CHECK ENGINE OIL QUALITY

Check the oil for deterioration, entry of water, discoloring or thinning.

If the quality is poor, replace the oil.

Use API grade CD or better and recommended viscosity oil. (Europe)

Use API grade CC, CD or better and recommended viscosity oil. (Others)

### 2. CHECK ENGINE OIL LEVEL

The oil level should be between the "L" and "F" marks on the dipstick.

If low, check for leakage and add oil up to "F" mark.

**NOTICE:** Do not fill with engine oil above the "F" mark.

### 3. REMOVE OIL PRESSURE SENDER GAUGE

### 4. INSTALL OIL PRESSURE GAUGE

### 5. WARM UP ENGINE

Allow the engine to reach normal operating temperature.

### 6. CHECK OIL PRESSURE

Oil pressure:

At idling 0.3 kg/cm<sup>2</sup> (4.3 psi, 29 kPa)  
or more

At 3,000 rpm 2.5 kg/cm<sup>2</sup> (36 psi, 245 kPa)  
or more

### 7. REMOVE OIL PRESSURE GAUGE

### 8. REINSTALL OIL PRESSURE SENDER GAUGE

### 9. START ENGINE AND CHECK FOR LEAKS

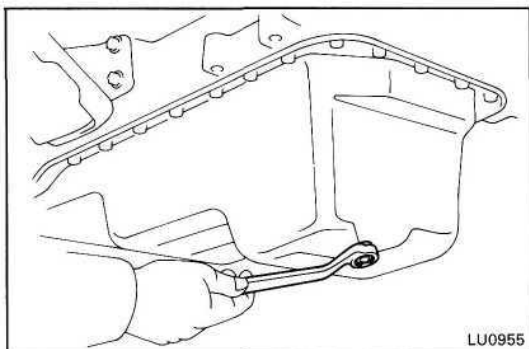
## REPLACEMENT OF ENGINE OIL AND OIL FILTER

### NOTICE:

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer. Adequate means of skin protection and washing facilities should be provided.
- Care should be taken, therefore, when changing engine oil, to minimize the frequency and length of time your skin is exposed to used engine oil. Protective clothing and gloves, that cannot be penetrated by oil, should be worn. The skin should be thoroughly washed with soap and water, or use waterless hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- In order to preserve the environment, used oil and used oil filters must be disposed of only at designated disposal sites.

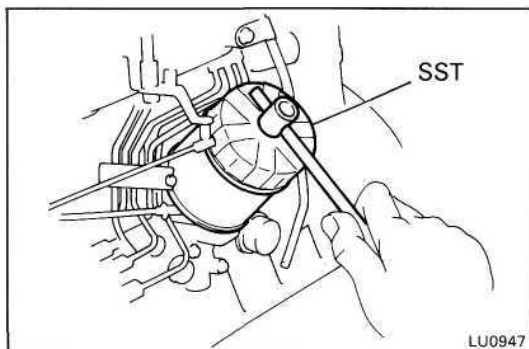
### 1. DRAIN ENGINE OIL

- (a) Remove the oil filler cap.
- (b) Remove the oil drain plug, and drain the oil into a container.

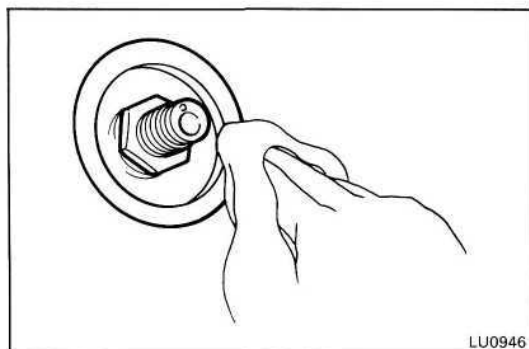


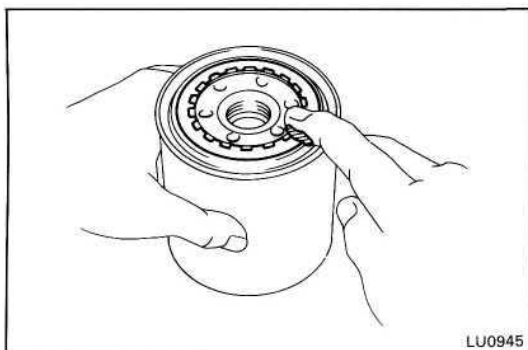
### 2. REPLACE OIL FILTER

- (a) Using SST, remove the oil filter.  
SST 09228-10001

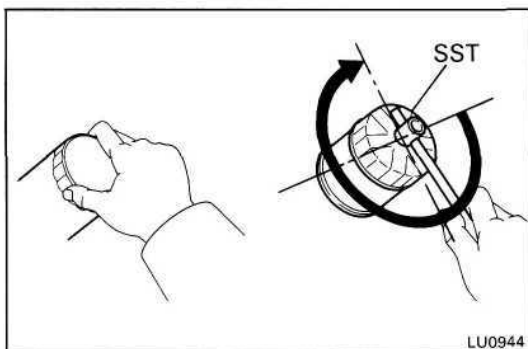


- (b) Clean and check the oil filter installation surface.





(c) Apply clean engine oil to the gasket of a new oil filter.



(d) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.

(e) Using SST, tighten it additional 3/4 turn.

SST 09228-10001

### 3. FILL WITH ENGINE OIL

(a) Clean and install the oil drain plug with a new gasket.

**Torque: 250 kg-cm (18 ft-lb, 25 N-m)**

(b) Fill with new engine oil (API grade CC (ex. Europe), CD or better and recommended viscosity oil).

**Capacity (PZJ70, 73, 75):**

**Drain and refill**

**w/ Oil filter change**

**9.0 liters (9.5 US qts, 7.9 Imp. qts)**

**w/o Oil filter change**

**7.7 liters (8.1 US qts, 6.8 Imp. qts)**

**Dry fill 9.3 liters (9.8 US qts, 8.2 Imp. qts)**

**Capacity (HZJ70, 73, 75):**

**Drain and refill**

**w/ Oil filter change**

**9.5 liters (10.0 US qts, 8.4 Imp. qts)**

**w/o Oil filter change**

**8.2 liters (8.7 US qts, 7.2 Imp. qts)**

**Dry fill 9.8 liters (10.4 US qts, 8.6 Imp. qts)**

**Capacity (HZJ80 and HDJ80):**

**Drain and refill**

**w/ Oil filter change**

**9.3 liters (9.8 US qts, 8.1 Imp. qts)**

**w/o Oil filter change**

**8.0 liters (8.5 US qts, 7.0 Imp. qts)**

**Dry fill 9.6 liters (10.1 US qts, 8.4 Imp. qts)**

**Capacity (HJB30 and HDB30):**

**Drain and refill**

**w/ Oil filter change**

**9.8 liters (10.4 US qts, 8.6 Imp. qts)**

**w/o Oil filter change**

**8.5 liters (9.0 US qts, 7.5 Imp. qts)**

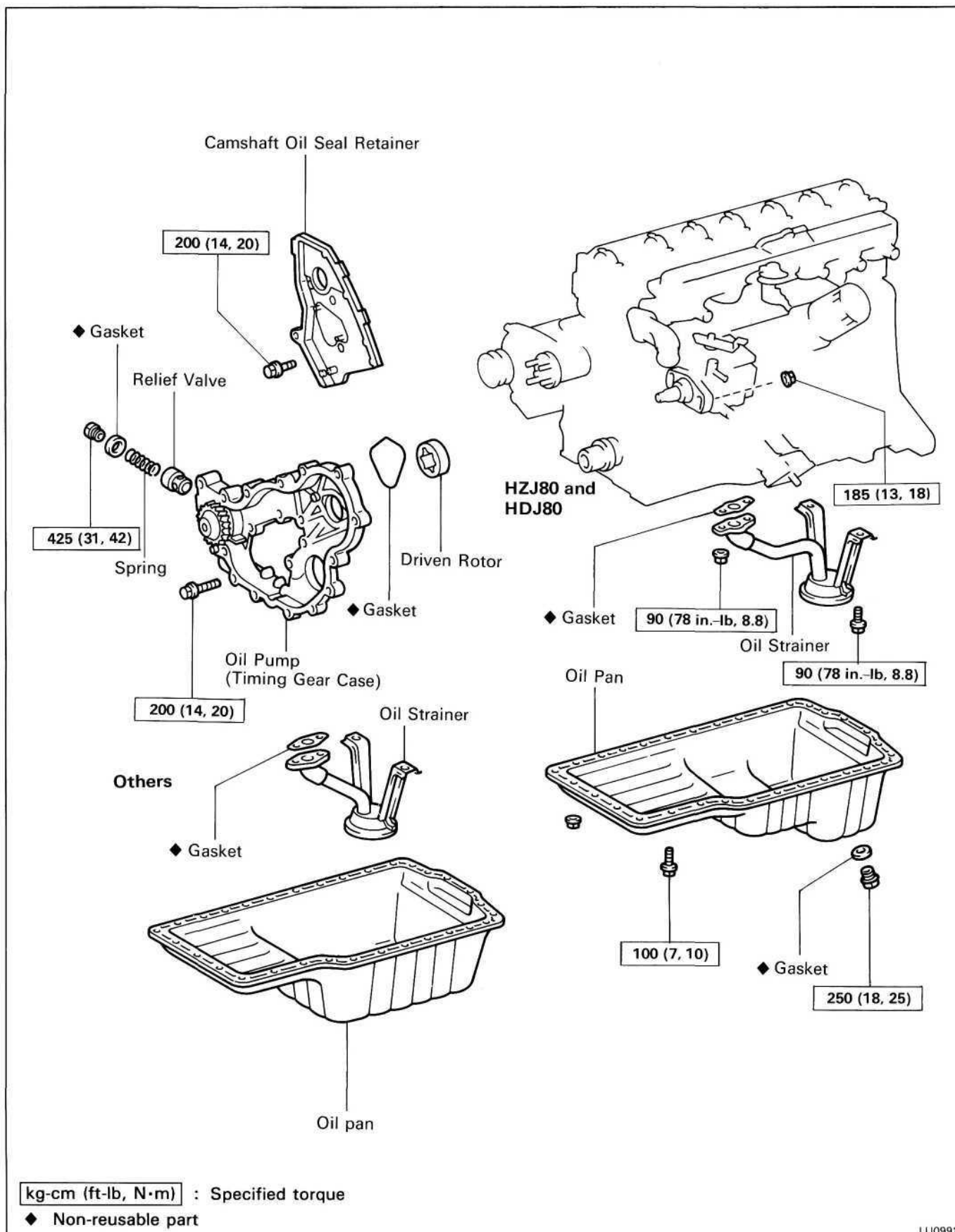
**Dry fill 10.1 liters (10.7 US qts, 8.9 Imp. qts)**

(c) Reinstall the oil filler cap.

### 4. START ENGINE AND CHECK FOR LEAKS

### 5. RECHECK ENGINE OIL LEVEL (See page LU-5)

# OIL PUMP COMPONENT



## REMOVAL OF OIL PUMP

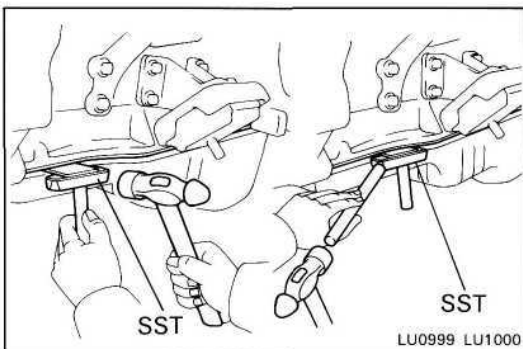
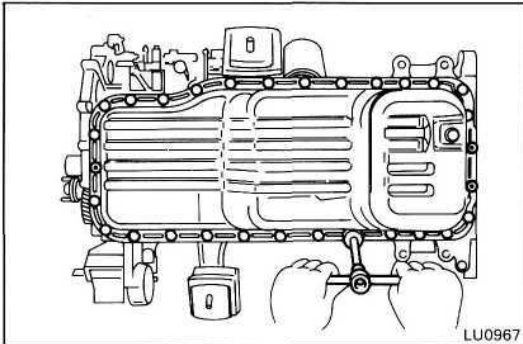
(See page LU-8)

HINT: When repairing the oil pump, the oil pan and strainer should be removed and cleaned.

1. DRAIN ENGINE COOLANT (See page CO-4)
2. DRAIN ENGINE OIL (See page LU-6)
3. REMOVE TIMING GEARS  
(See steps 1 to 12 on pages EM-43 to 45)

### 4. REMOVE OIL PAN

- (a) Remove the twenty-three bolts (1PZ) or twenty-seven bolts (1 HZ and IHD-T) and three nuts.



- (b) Insert the blade of SST between the cylinder block and oil pan, cut off applied sealer and remove the oil pan.

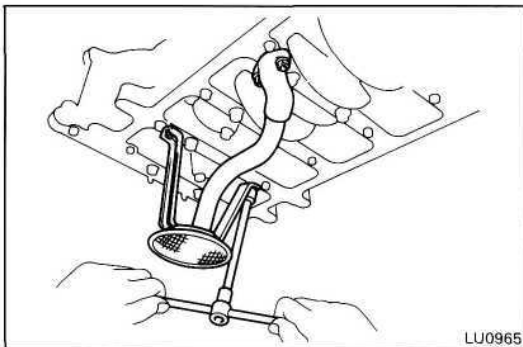
SST 09032-001 00

#### NOTICE:

- Do not use SST for the timing gear case side and rear oil seal retainer.
- Be careful not to damage the oil pan flange.

### 5. REMOVE OIL STRAINER

Remove the two bolts, two nuts, oil strainer and gasket.

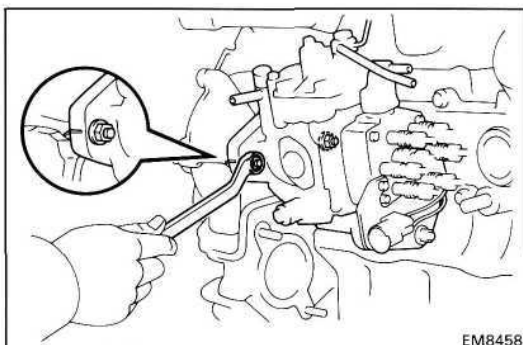


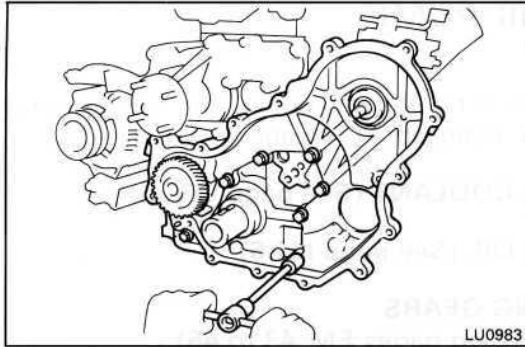
### 6. REMOVE OIL PUMP (TIMING GEAR CASE)

- (a) Before removing the two nuts holding the timing gear case to the injection pump, check if the injection pump period lines are aligned.

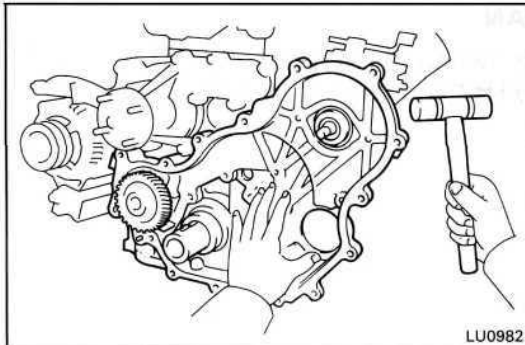
If not, place new matchmarks for reinstallation.

- (b) Remove the two nuts.



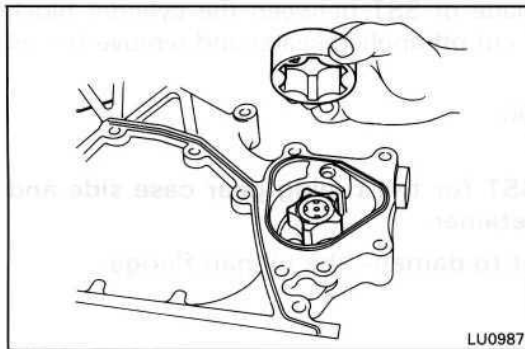


(c) Remove the seven bolts, timing gear case and gasket.



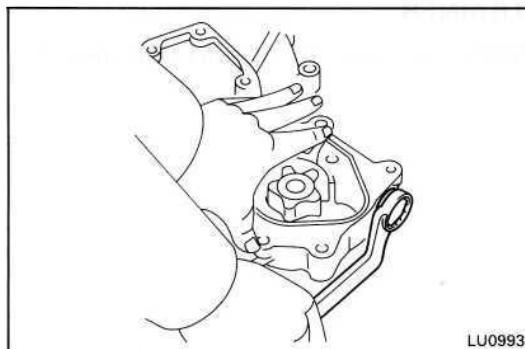
(d) Using a plastic-faced hammer, lightly tap out the timing gear case.

(e) Remove the gasket.



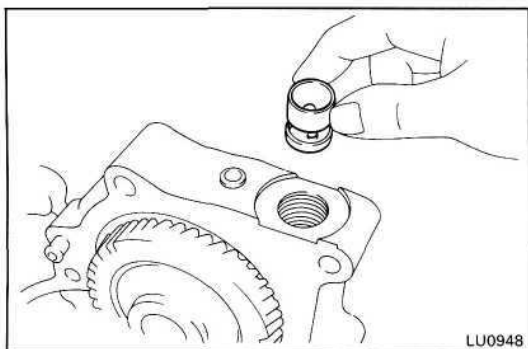
## DISASSEMBLY OF OIL PUMP

### 1. REMOVE DRIVEN ROTOR



### 2. REMOVE RELIEF VALVE

Remove the plug, gasket, spring and relief valve.

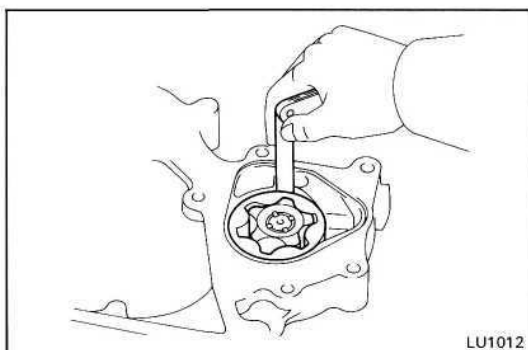


## INSPECTION OF OIL PUMP

### 1. INSPECT RELIEF VALVE

Coat the valve with engine oil and check that it falls smoothly into the valve hole by its own weight.

If it does not, replace the relief valve. If necessary, replace the oil pump assembly.



### 2. INSPECT DRIVE AND DRIVEN ROTORS

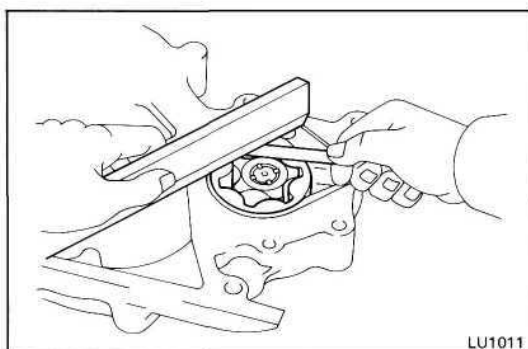
#### A. Inspect rotor body clearance

Using a thickness gauge, measure the clearance between the driven rotor and body.

**Standard body clearance:** 0.10-0.17 mm  
(0.039-0.0067 in.)

**Maximum body clearance:** 0.20 mm (0.0079 in.)

If the body clearance is greater than maximum, replace the oil pump assembly.



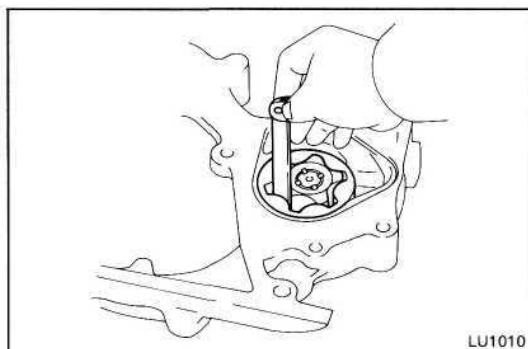
#### B. Inspect rotor side clearance

Using a thickness gauge and precision straight edge, measure the clearance between the rotors and precision straight edge.

**Standard side clearance:** 0.03-0.09 mm  
(0.0012-0.0035 in.)

**Maximum side clearance:** 0.15 mm (0.0059 in.)

If the side clearance is greater than maximum, replace the oil pump assembly.



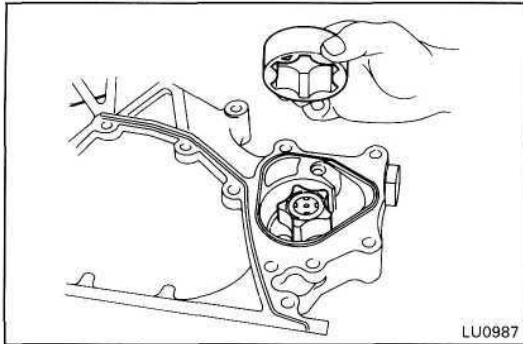
#### C. Inspect rotor tip clearance

Using a thickness gauge, measure the clearance between the drive and driven rotors.

**Standard tip clearance:** 0.08 — 0.16 mm  
(0.0031 - 0.0063 in.)

**Maximum tip clearance:** 0.21 mm (0.0083 in.)

If the tip clearance is greater than maximum, replace the oil pump assembly.



## ASSEMBLY OF OIL PUMP

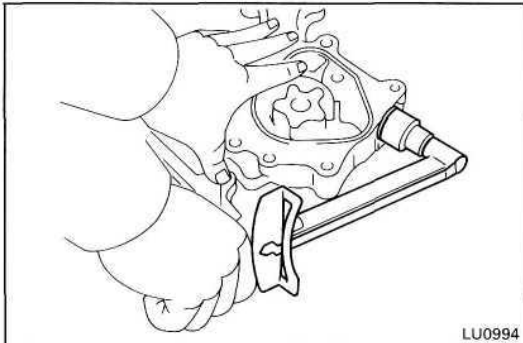
(See page LU-8)

### 1. INSTALL DRIVEN ROTOR

### 2. INSTALL RELIEF VALVE

- (a) Insert the relief valve and spring into the installation hole of the timing gear case.
- (b) Install a new gasket and the plug.

**Torque: 425 kg-cm (31 ft-lb, 42 N-m)**



## INSTALLATION OF OIL PUMP

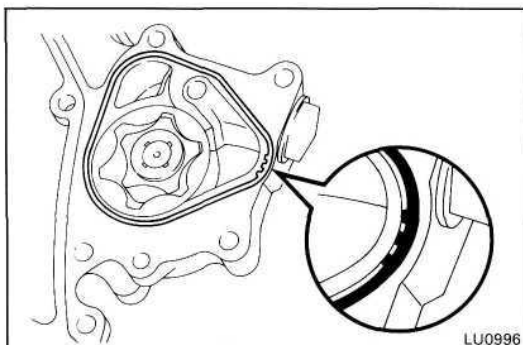
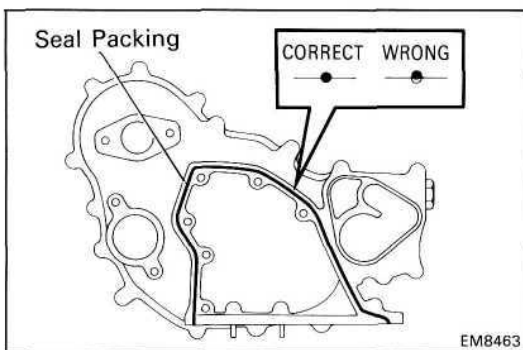
(See page LU-8)

### 1. INSTALL OIL PUMP (TIMING GEAR CASE)

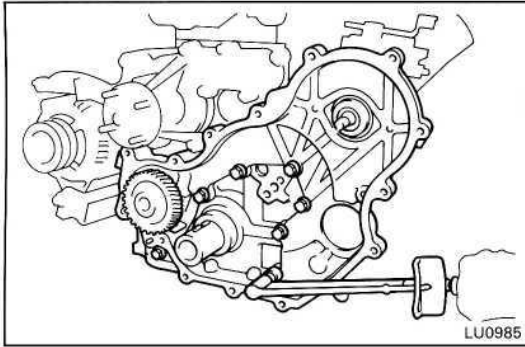
- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the timing gear case and cylinder block.
  - Using a razor blade and gasket scraper, remove the old packing (FIPG) material from the gasket surfaces and sealing groove.
  - Thoroughly clean all components to remove all the loose material.
  - Using a non-residue solvent, clean both sealing surfaces.
- (b) Apply seal packing to the timing gear case as shown in the illustration.

**Seal packing: Part No.08826-00080 or equivalent**

- Install a nozzle that has been cut to a 2 - 3 mm (0.08-0.12 in.) opening.
  - Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
  - Immediately remove nozzle from the tube and reinstall cap.
- (c) Place a new gasket into the groove of the timing gear case as shown in the illustration.

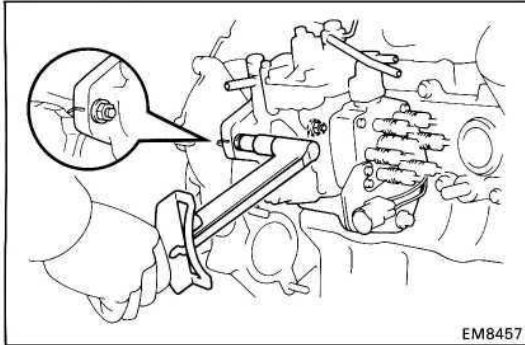






(d) Install the timing gear case with the seven bolts.

**Torque: 200 kg-cm (14 ft-lb, 20 N-m)**

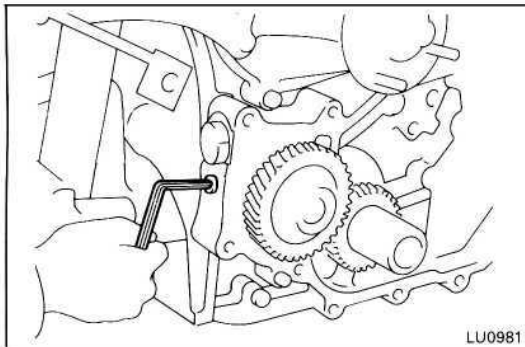


(e) Install the two nuts holding the injection pump to the timing gear case.

**Torque: 185 kg-cm (13 ft-lb, 18 N-m)**

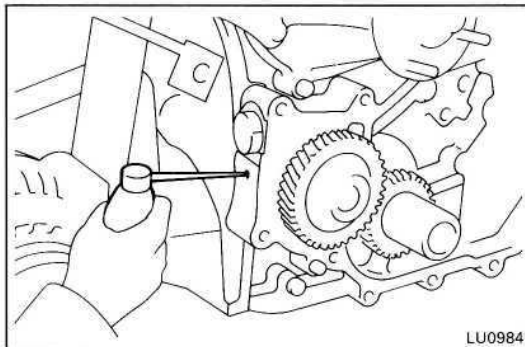
(f) Check that the injection pump period lines (or matchmarks) are aligned.

If not correct, align the period lines (or matchmarks) by tilting the injection pump.

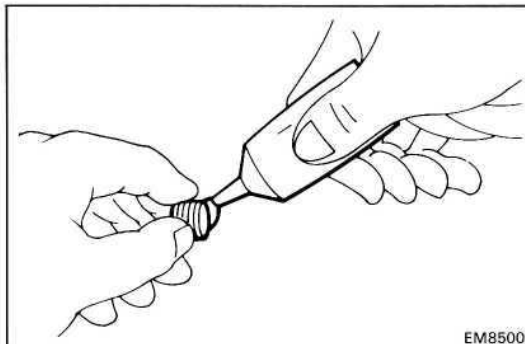


## 2. POUR ENGINE OIL INTO OIL PUMP

(a) Using a 5 mm hexagon wrench, remove the taper screw plug.



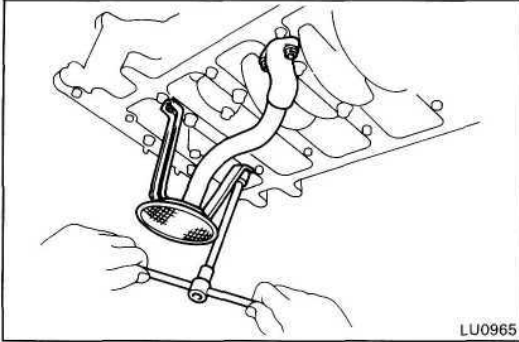
(b) Pour in approx. 10 cc (0.061 cu in.) of engine oil into the oil pump.



(c) Apply adhesive to two or three threads of the taper screw.

**Adhesive: Part No. 08833-00070, THREE BOND 1324 or equivalent**

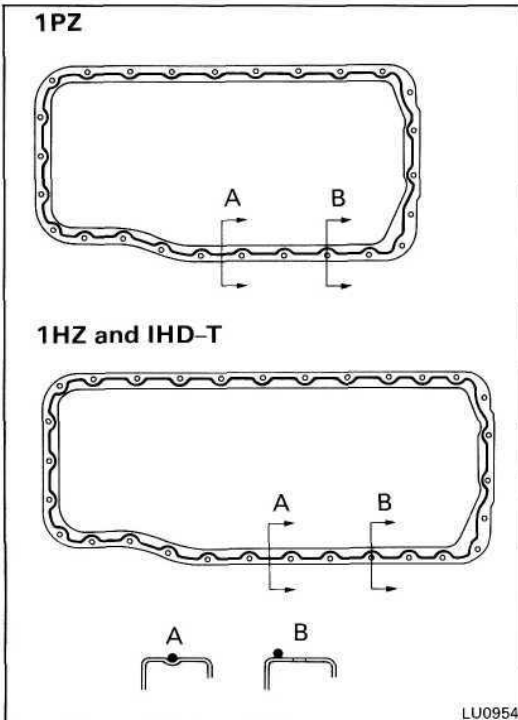
(d) Using a 5 mm hexagon wrench, install the taper screw.



### 3. INSTALL OIL STRAINER

Install a new gasket and the oil strainer with the two bolts and two nuts.

**Torque: 90 kg-cm (78 in.-lb, 8.8 Nm)**



### 4. INSTALL OIL PAN

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the oil pan and cylinder block.

- Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing groove.
- Thoroughly clean all components to remove all the loose material.
- Using a non-residue solvent, clean both sealing surfaces.

**NOTICE: Do not use a solvent which will affect the painted surfaces.**

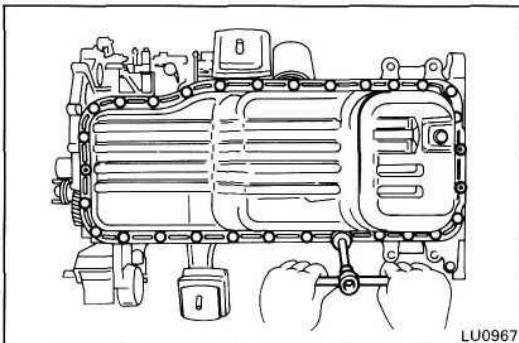
(b) Apply seal packing to the oil pan as shown in the illustration.

**Seal packing: Part No.08826-00080 or equivalent**

- Install a nozzle that has been cut to a 5 mm (0.20 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied. \*
- Immediately remove nozzle from the tube and re-install cap.

(c) Install the oil pan with the twenty-three bolts (1 PZ) or twenty-seven bolts (1 HZ and 1 HD-T) and three nuts.

**Torque: 100 kg-cm (7 ft-lb, 10 Nm)**



### 5. INSTALL TIMING GEARS

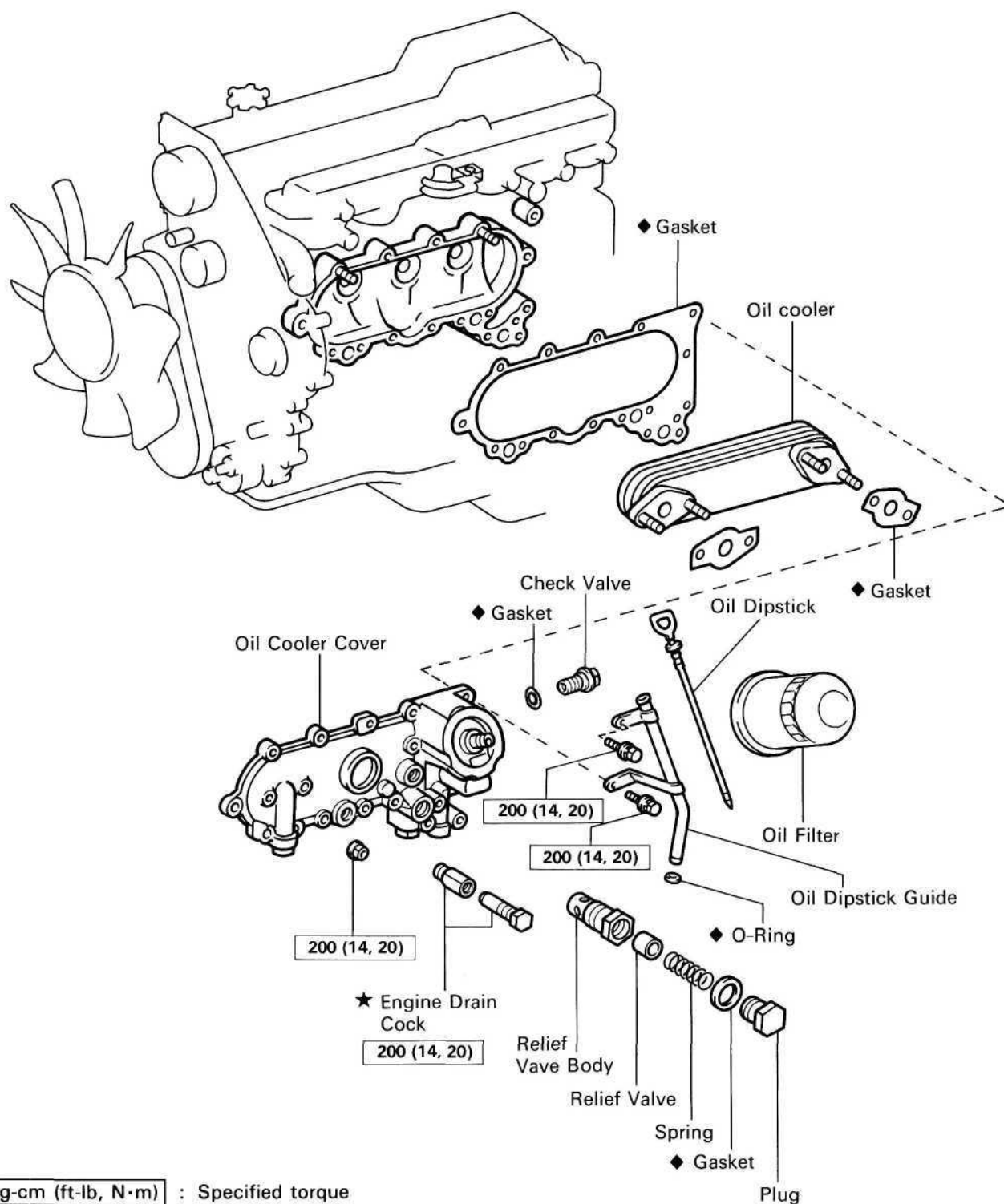
(See steps 2 to 12 on pages EM-50 to 53)

### 6. FILL WITH ENGINE OIL (See page LU-7)

### 7. FILL WITH ENGINE COOLANT (See page CO-5)

### 8. START ENGINE AND CHECK FOR LEAKS

# OIL COOLER, RELIEF VALVE AND CHECK VALVE COMPONENTS



kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

★ Precoated part

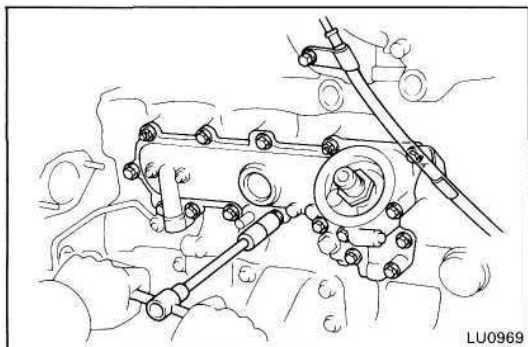
## REMOVAL OF OIL COOLER, RELIEF VALVE AND CHECK VALVE

(See page LU-15)

1. **DRAIN ENGINE COOLANT** (See page CO-4)
2. **REMOVE OIL FILTER** (See page LU-6)
3. **REMOVE INJECTION PUMP**  
(See page FU-27)

### 4. REMOVE OIL DIPSTICK AND GUIDE

- (a) Remove the two bolts, oil dipstick and guide.
- (b) Remove the oil ring from the oil dipstick guide.

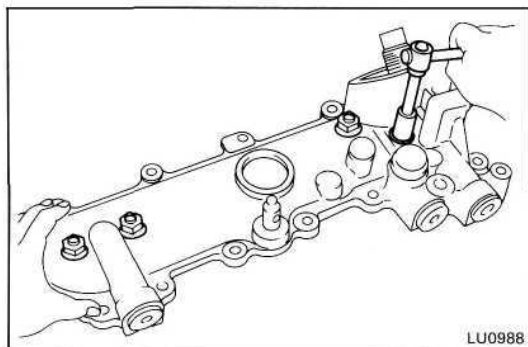


### 5. REMOVE OIL COOLER AND OIL COOLER COVER ASSEMBLY

Remove the thirteen bolts, two nuts, oil cooler and oil cooler assembly and gasket.

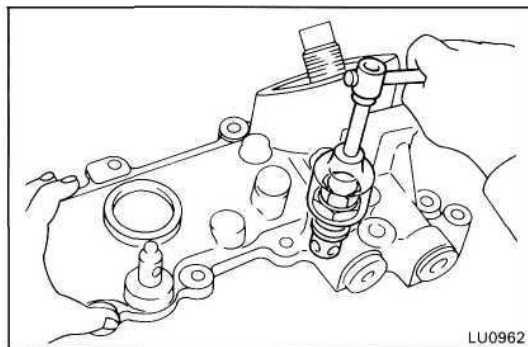
### 6. SEPARATE OIL COOLER AND OIL COOLER COVER

Remove the four nuts, oil cooler and two gaskets from the oil cooler cover.



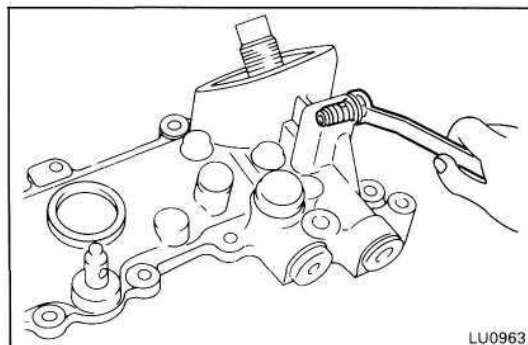
### 7. REMOVE RELIEF VALVE

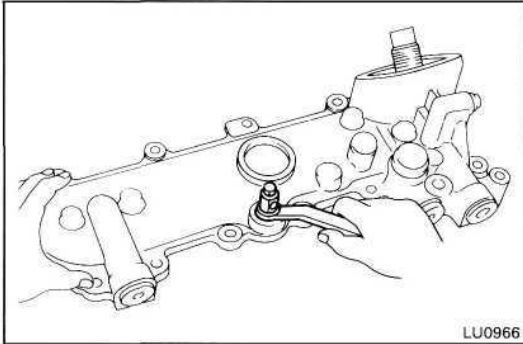
Remove the relief valve and gasket.



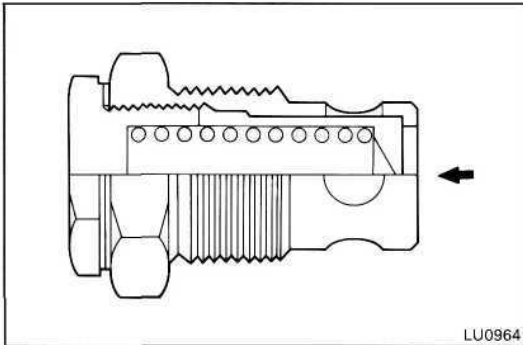
### 8. REMOVE CHECK VALVE

Remove the check valve and gasket.





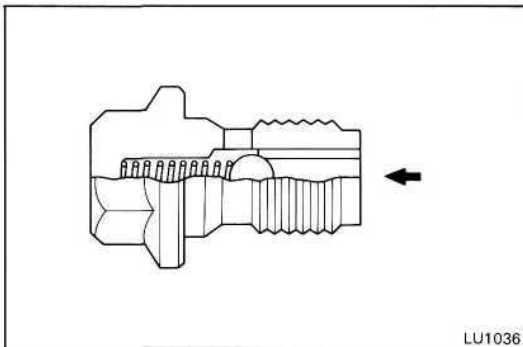
## 9. REMOVE ENGINE DRAIN COCK



## INSPECTION OF OIL COOLER, RELIEF VALVE AND CHECK VALVE

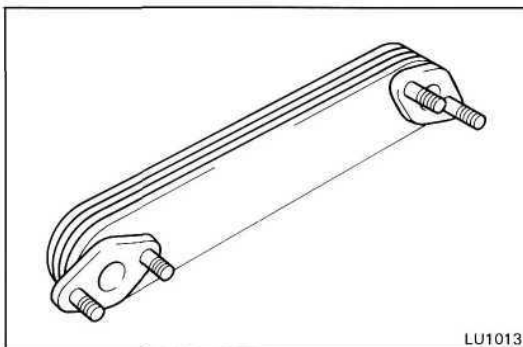
### 1. INSPECT RELIEF VALVE

Push the valve with a wooden stick to check if it is stuck. If stuck, replace the relief valve.



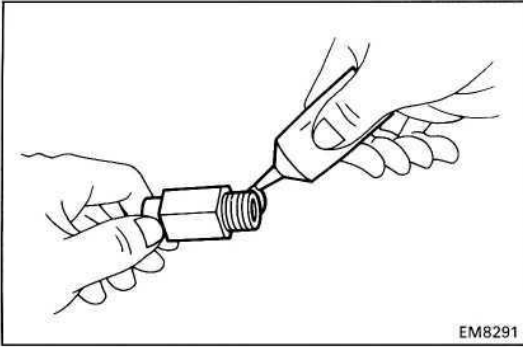
### 2. INSPECT CHECK VALVE

Push the valve with a wooden stick to check if it is stuck. If stuck, replace the check valve.



### 3. INSPECT OIL COOLER

Check the oil cooler for damage or clogging. If necessary, replace the oil cooler.



## INSTALLATION OF OIL COOLER, RELIEF VALVE AND CHECK VALVE

(See page LU-15)

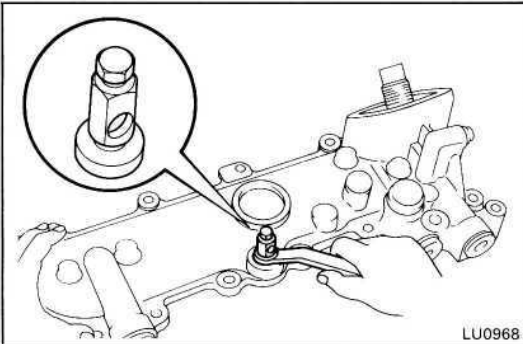
### 1. INSTALL ENGINE DRAIN COCK

- (a) Apply adhesive to two or three threads of the drain cock.

**Adhesive:** Part No. 08833-00070, THREE BOND 1324 or equivalent

- (b) Install and torque the drain cock as shown.

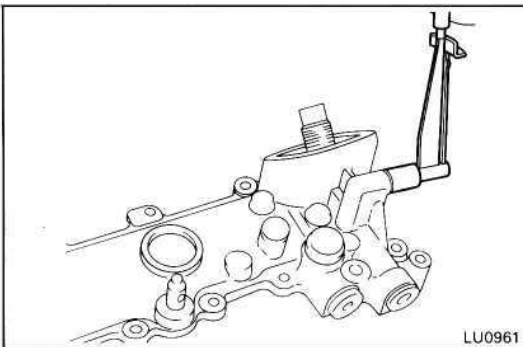
**Torque:** 200 kg-cm (14 ft-lb, 20 N-m)



### 2. INSTALL CHECK VALVE

Install the check valve with a new gasket.

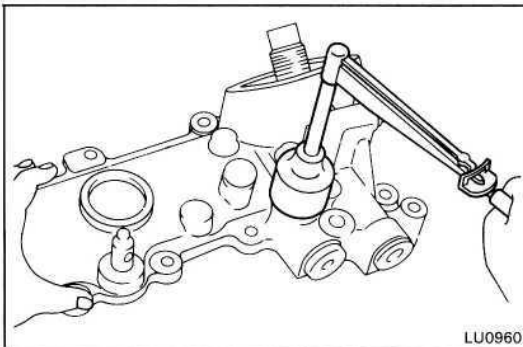
**Torque:** 275 kg-cm (20 ft-lb, 27 N-m)



### 3. INSTALL RELIEF VALVE

Install the relief valve with a new gasket.

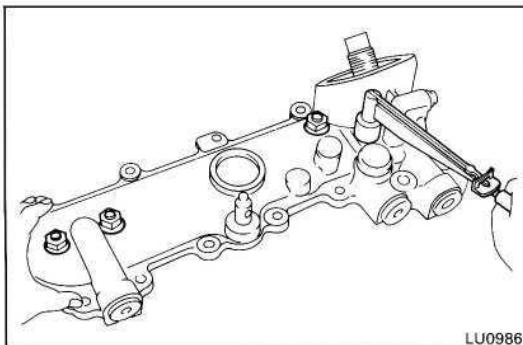
**Torque:** 400 kg-cm (29 ft-lb, 39 N-m)

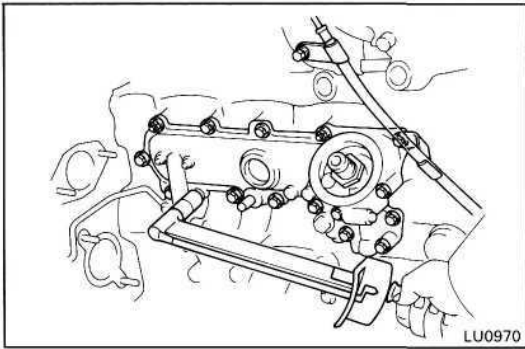


### 4. ASSEMBLE OIL COOLER AND OIL COOLER COVER

Install two new gaskets and the oil cooler to the oil cooler cover with the four nuts.

**Torque:** 200 kg-cm (14 ft-lb, 20 N-m)





**5. INSTALL OIL COOLER AND OIL COOLER COVER ASSEMBLY**

Install a new gasket, the oil cooler and oil cooler cover assembly with the thirteen bolts and two nuts.

**Torque: 200 kg-cm (14 ft-lb, 20 N-m)**

**6. INSTALL OIL DIPSTICK GUIDE AND DIPSTICK**

- (a) Install a new O-ring to the oil dipstick guide.
- (b) Apply engine oil to the new O-ring.
- (c) Install the oil dipstick and guide with the two bolts.

**Torque:**

Intake manifold side

**200 kg-cm (14 ft-lb, 20 N-m)**

Oil cooler cover side

**200 kg-cm (14 ft-lb, 20 N-m)**

**7. INSTALL INJECTION PUMP**

(See page FU-93)

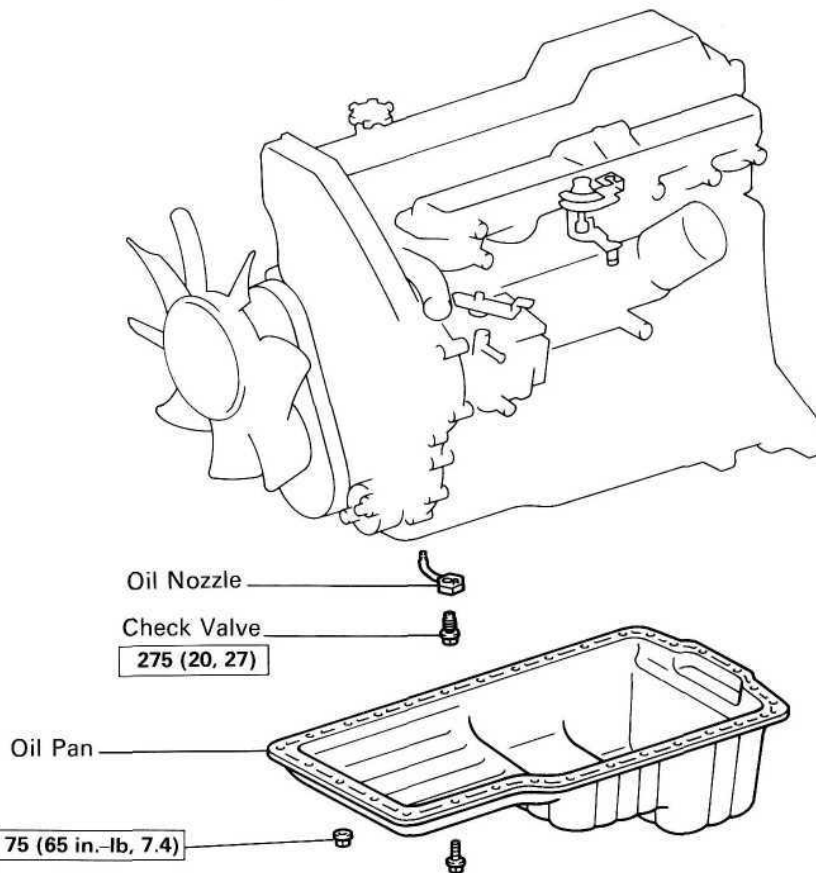
**8. INSTALL OIL FILTER (See page LU-6)**

**9. FILL WITH ENGINE COOLANT (See page CO-5)**

**10. START ENGINE AND CHECK FOR LEAKS**

**11. CHECK ENGINE OIL (See page LU-5)**

## OIL NOZZLES AND CHECK VALVES COMPONENTS



kg-cm (ft-lb, N·m) : Specified torque

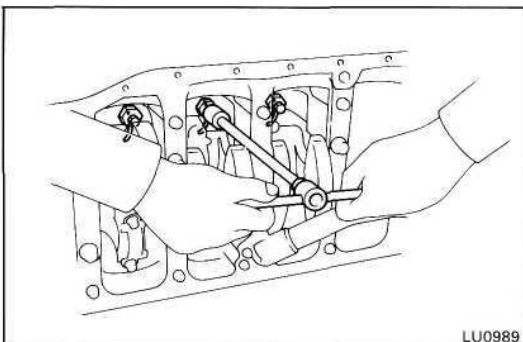
LU0992

### REMOVAL OF OIL NOZZLES AND CHECK VALVES

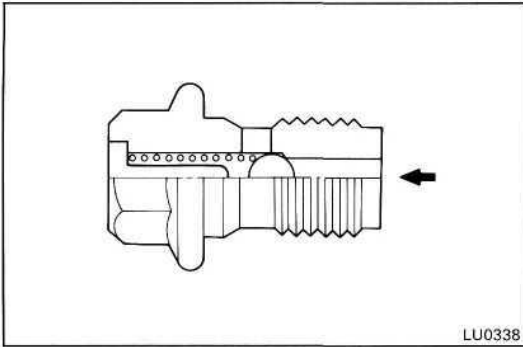
1. DRAIN ENGINE OIL (See page LU-6)
2. REMOVE OIL PAN  
(See step 4 on page LU-9)

#### 3. REMOVE CHECK VALVE AND OIL NOZZLES

Remove the five (1 PZ) or six (1 HZ and 1HD-T) check valves and oil nozzles.



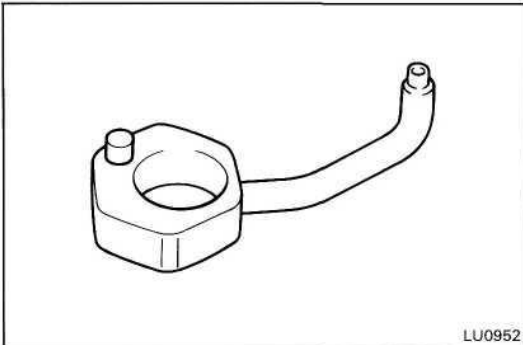




## INSPECTION OF OIL NOZZLES AND CHECK VALVES

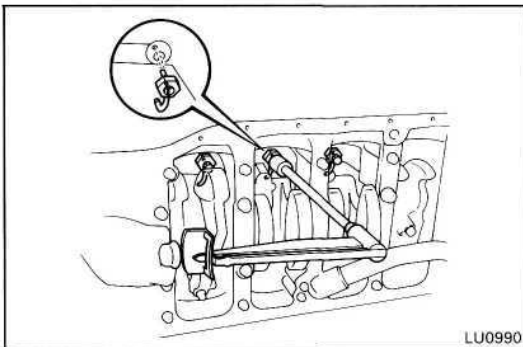
### 1. INSPECT CHECK VALVES

Push the valve with a wooden stick to check if it is stuck. If stuck, replace the check valve.



### 2. INSPECT OIL NOZZLES

Check the oil nozzles for damage or clogging. If necessary, replace the oil nozzle.



## INSTALLATION OF OIL NOZZLES AND CHECK VALVES

(See page LU-20)

### 1. INSTALL OIL NOZZLES AND CHECK VALVES

- Align the pin of the oil nozzle with the pin hole of the cylinder block.
- Install the oil nozzle with the check valve. Install the five (1PZ) or six (1HZ and 1HD-T) oil nozzles and check valves.

**Torque: 275 kg-cm (20 ft-lb, 27 N·m)**

### 2. INSTALL OIL PAN

(See step 4 on page LU-14)

### 3. FILL WITH ENGINE OIL (See page LU-7)

### 4. START ENGINE AND CHECK FOR LEAKS