

LUBRICATION SYSTEM

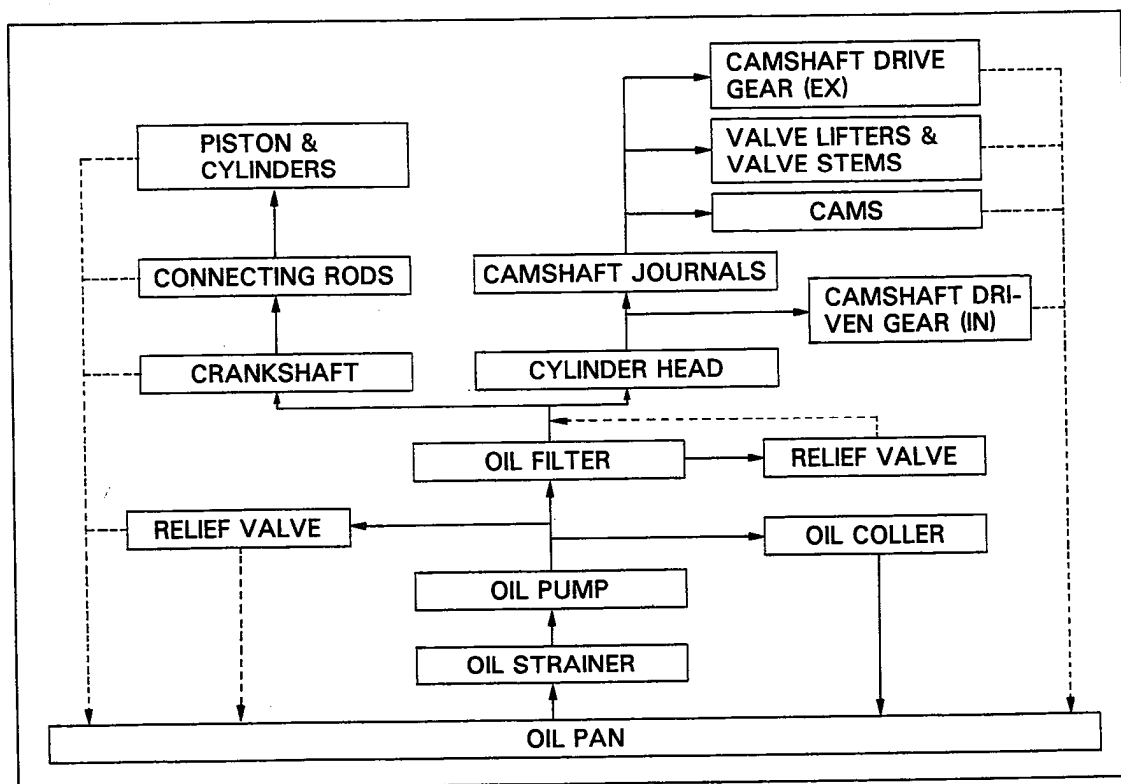
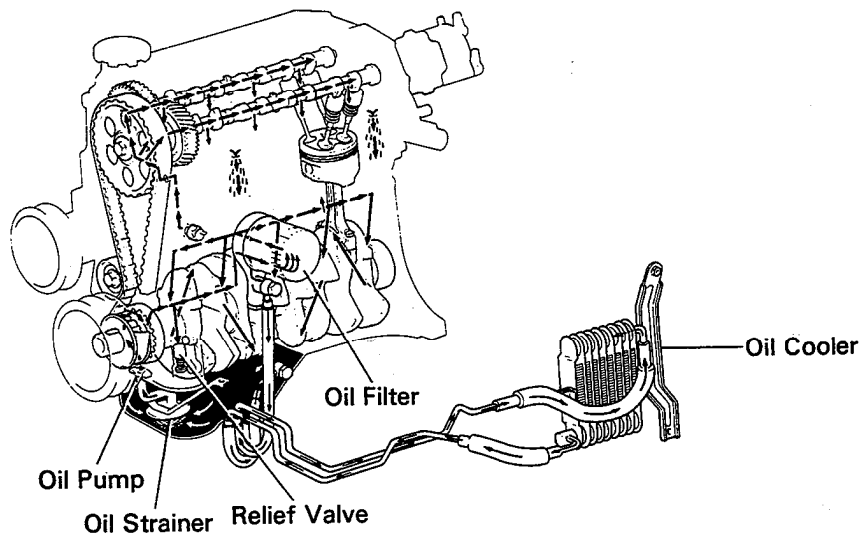
	Page
DESCRIPTION	LU-2
TROUBLESHOOTING	LU-5
OIL PRESSURE CHECK	LU-6
REPLACEMENT OF ENGINE OIL AND OIL FILTER ..	LU-7
OIL PUMP	LU-9
OIL COOLER AND PRESSURE REGULATOR	LU-17

LU

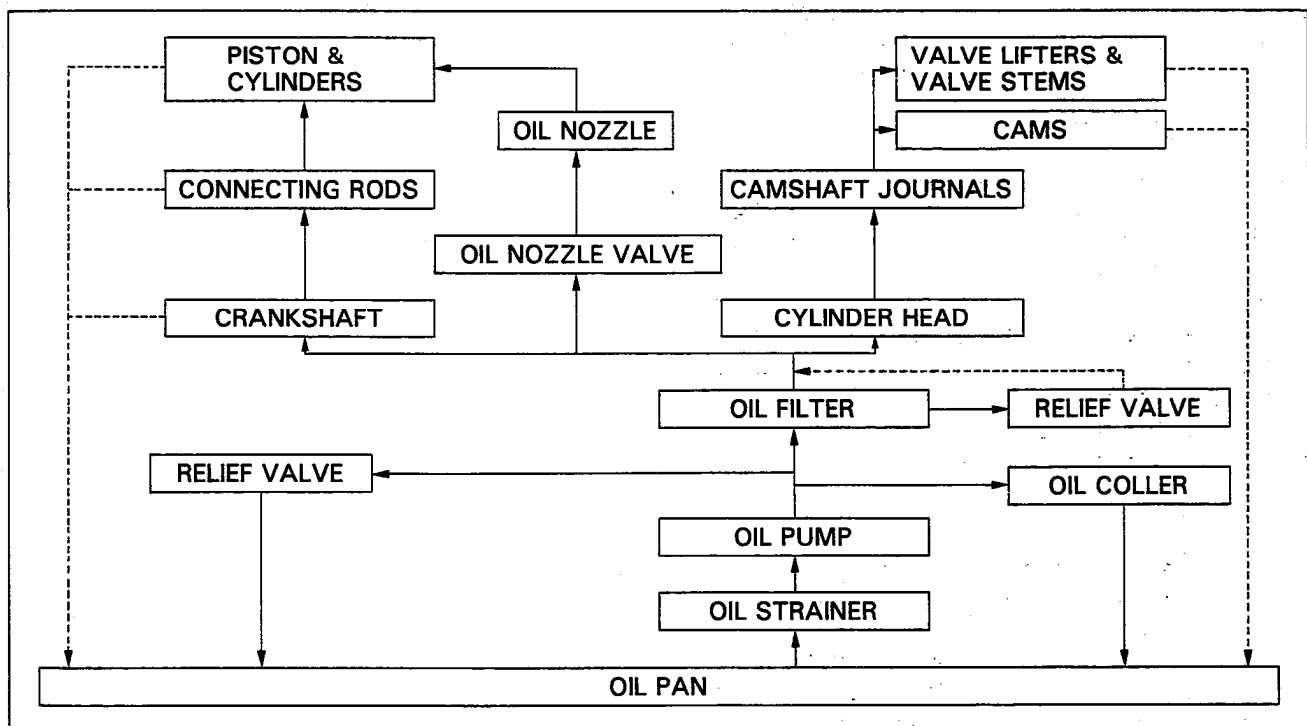
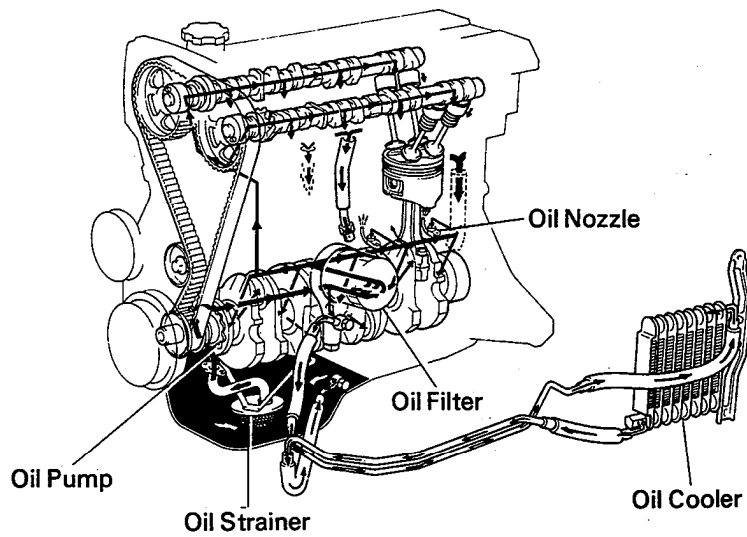
DESCRIPTION

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

4A-FE



4A-GE



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 side of the oil pump body 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. The oil pump itself is a trochoid type pump, inside of which there is a drive rotor and a driven rotor. When the drive rotor rotates, the driven rotor rotates in the same direction, and since the axis of the driven rotor shaft is different from the center of the driven rotor, the space between the two rotors is changed as they rotate. Oil is drawn in when the space is wide and is discharged when the space is narrow.

OIL PRESSURE REGULATOR

At high engine speeds, the engine oil supplied by the oil pump exceeds the capacity of the engine to utilize it. For that reason, the oil pressure regulator works to prevent an oversupply of oil. During normal oil supply, a coil spring and valve keep the bypass closed, but when too much oil is being fed, 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 oil pan.

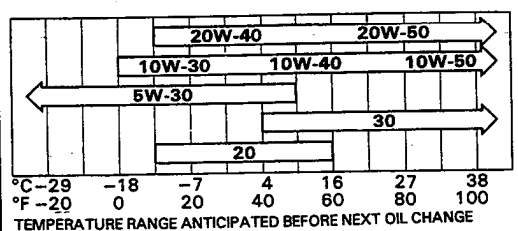
OIL FILTER

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 into the oil during use and could cause accelerated wear or sizing 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 that 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.

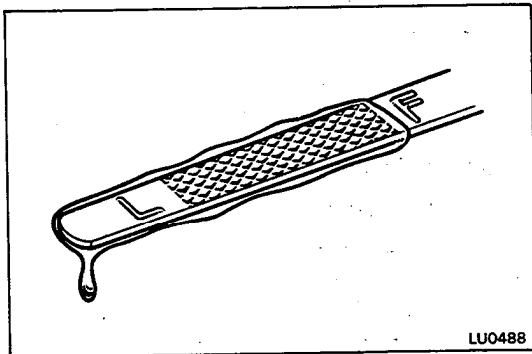
TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Oil leakage	Cylinder head, cylinder block or oil pump body damaged or cracked	Repair as necessary	EM-135 LU-13
	Oil seal faulty	Replace oil seal	
	Gasket faulty	Replace gasket	
Low oil pressure	Oil leakage	Repair as necessary	LU-12,13
	Relief valve faulty	Repair relief valve	
	Oil pump faulty	Repair oil pump	LU-9
	Poor quality engine oil	Replace engine oil	LU-6
	Crankshaft bearing faulty	Replace bearing	EM-122
	Connecting rod bearing faulty	Replace bearing	EM-119
	Oil filter clogged	Replace oil filter	LU-7
High oil pressure	Relief valve faulty	Repair relief valve	LU-12,13

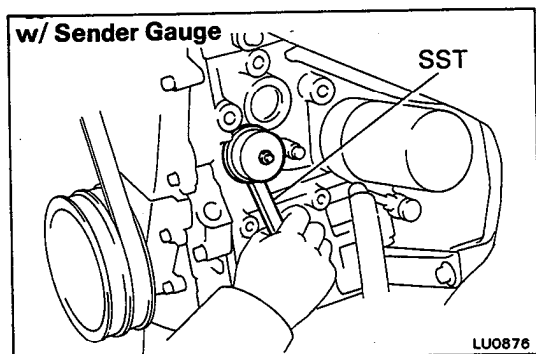
Recommended Viscosity (SAE):



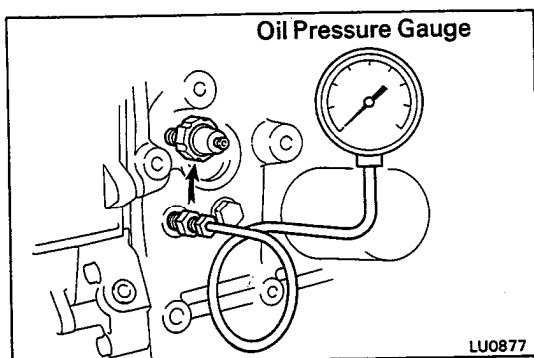
LU0310



LU0488



LU0876



LU0877

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.

(4A-FE for Europe & Australia and 4A-GE)

Use API grade SE, SF, SG or better and recommended viscosity oil.

(4A-FE for Others)

Use API grade SD, SE, SF, SG or better and recommended viscosity oil.

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 the "F" mark.

3. REMOVE OIL PRESSURE SWITCH OR SENDER GAUGE AND INSTALL OIL PRESSURE GAUGE

(a) (4A-FE)

Remove the alternator and bracket.

(b) Remove the oil pressure switch (4A-FE) or oil pressure sender gauge (4A-GE).

HINT: (w/ Sender gauge): Use SST.

SST 09027-12140

(c) Install an oil pressure gauge.

(d) (4A-FE)

Reinstall the bracket and alternator.

4. WARM UP ENGINE

Allow the engine to warm up to reach normal operating temperature.

5. CHECK OIL PRESSURE

Oil pressure:

At idling 0.3 kg/cm² (4.3 psi, 29 kPa) or more

At 3,000 rpm 2.5 – 5.0 kg/cm² (36 – 71 psi, 245 – 490 kPa)

6. REMOVE OIL PRESSURE GAUGE

(a) (4A-FE)

Remove the alternator and bracket.

(b) Remove an oil pressure gauge.

(c) Apply adhesive to two or three threads of the oil pressure switch (4A-FE) or oil pressure sender gauge (4A-GE).

Adhesive: Part No.08833-00080, THREE BOND 1344, LOCTITE 242 or equivalent.

(d) Reinstall the oil pressure switch.

(e) (4A-FE)

Reinstall the bracket and alternator.

7. START ENGINE AND CHECK FOR LEAKS

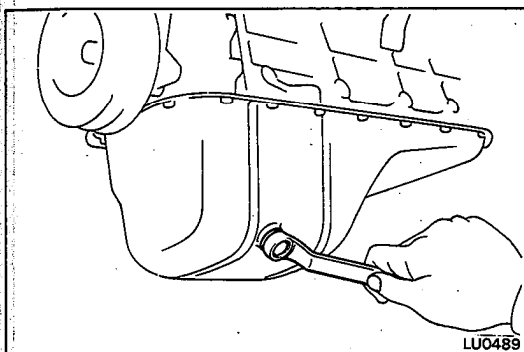
REPLACEMENT OF ENGINE OIL AND OIL FILTER

CAUTION:

- 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 must be disposed of only at designated disposal sites.

1. DRAIN ENGINE OIL

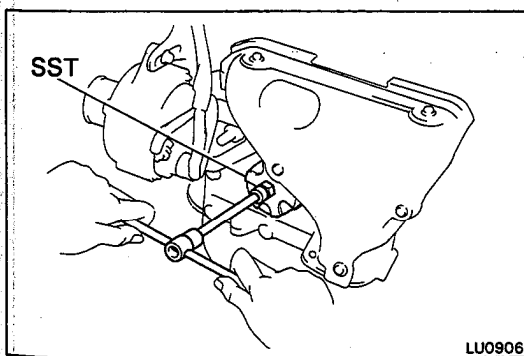
- (a) Remove the oil filler cap.
- (b) Remove the oil drain plug and drain the oil into a container.



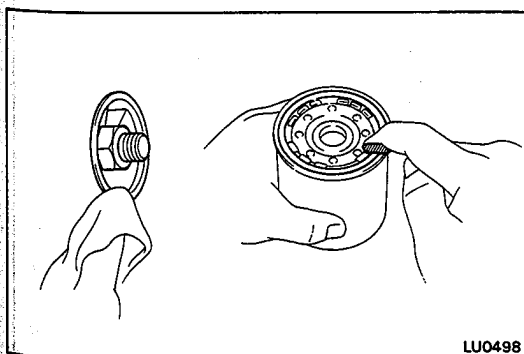
2. REPLACE OIL FILTER

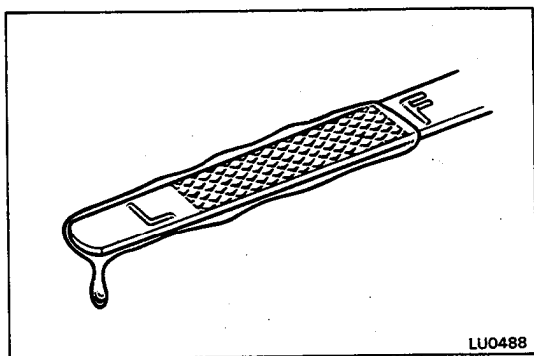
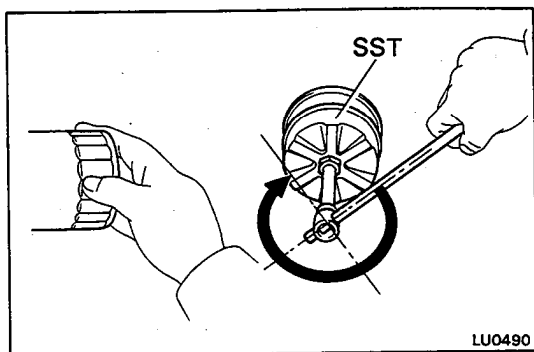
- (a) Using SST, remove the oil filter (located on left side of the engine block).

SST 09228-06500



- (b) Inspect and clean the oil filter installation surface.
- (c) Apply clean engine oil to the gasket of a new oil filter.





- (d) Lightly screw in the filter to where you feel resistance.
- (e) Then, using SST, tighten the oil filter an extra 3/4 turn.

SST 09228-06500

3. REFILL WITH ENGINE OIL

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

Torque: 350 kg-cm (25 ft-lb, 34 N·m)

- (b) Fill the engine with new oil, API grade SD, SE, SF, SG or better.

Capacity:

4A-FE

Drain and refill

Without oil filter change

3.0 liters (3.1 US qts, 2.6 Imp.qts)

With oil filter change

3.2 liters (3.3 US qts, 2.8 Imp.qts)

Dry fill (w/ Oil cooler)

4.1 liters (4.3 US qts, 3.6 Imp.qts)

Dry fill (w/o Oil cooler)

3.7 liters (3.9 US qts, 3.3 Imp.qts)

4A-GE

Drain and refill

Without oil filter change

3.4 liters (3.6 US qts, 3.0 Imp.qts)

With oil filter change

3.7 liters (3.9 US qts, 3.3 Imp.qts)

Dry fill

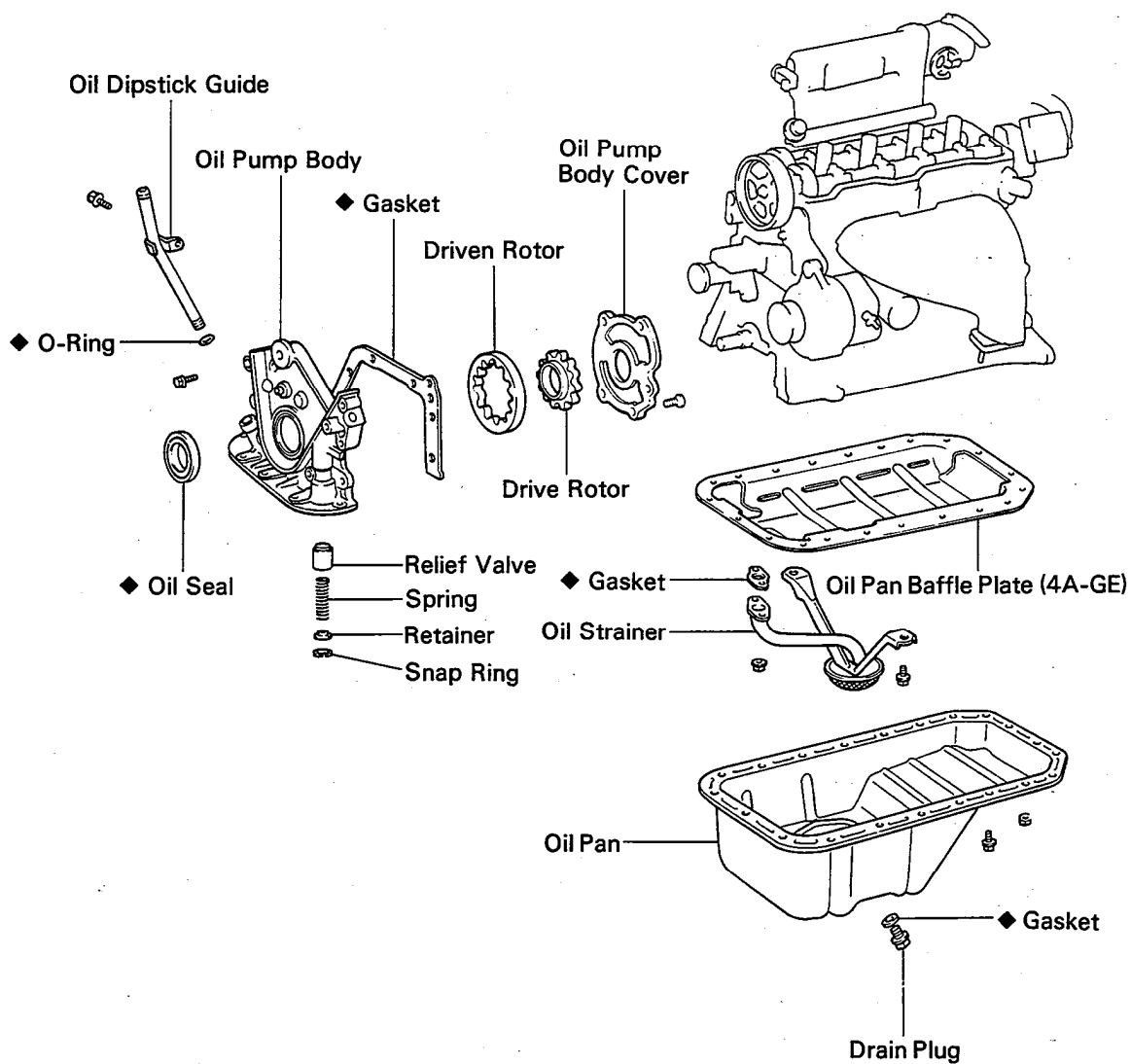
4.1 liters (4.3 US qts, 3.6 Imp.qts)

- (c) Reinstall the oil filler cap with the gasket.

4. START ENGINE AND CHECK FOR LEAKS

5. RECHECK ENGINE OIL LEVEL (See page LU-6)

OIL PUMP COMPONENTS



◆ Non-reusable part

REMOVAL OF OIL PUMP

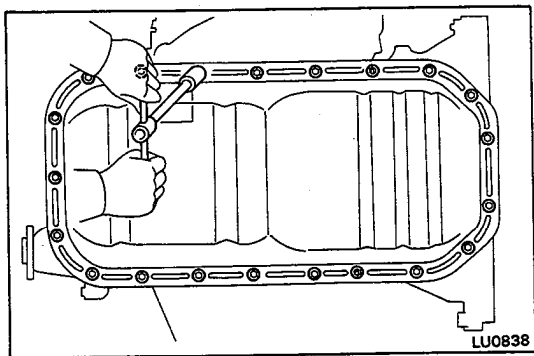
(See page LU-9)

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

1. **DRAIN ENGINE OIL** (See page LU-7)
2. **REMOVE TIMING BELT, IDLER PULLEY AND CRANKSHAFT TIMING PULLEY**

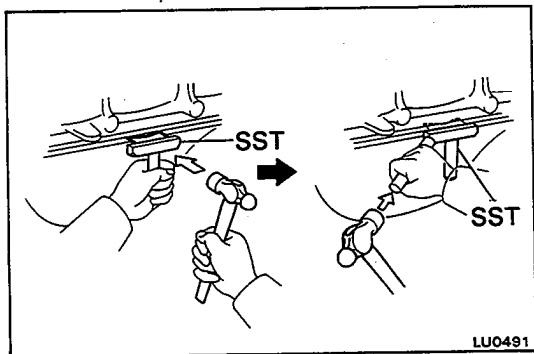
4A-FE (See page EM-39)

4A-GE (See page EM-47)



3. **REMOVE OIL PAN**

- (a) Remove the oil cooler hose and union from the oil pan.
- (b) Remove the two nuts and nineteen bolts.



- (c) (4A-FE)

Insert the blade of SST between the oil pan and cylinder block, cut off applied sealer and then remove the oil pan.

SST 09032-00100

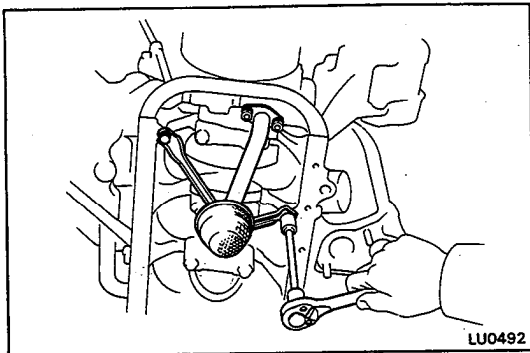
- (d) (4A-GE)

Insert the blade of SST between the oil pan and baffle plate, cut off applied sealer and then remove the oil pan.

SST 09032-00100

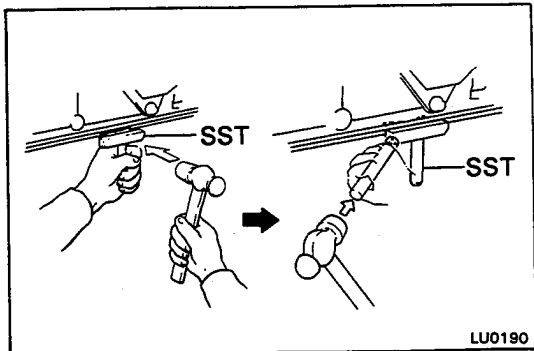
NOTICE:

- Do not use SST for the oil pump body side. If necessary, use a screwdriver.
- When removing the oil pan, be careful not to damage the oil pan flange.



4. **REMOVE OIL STRAINER**

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



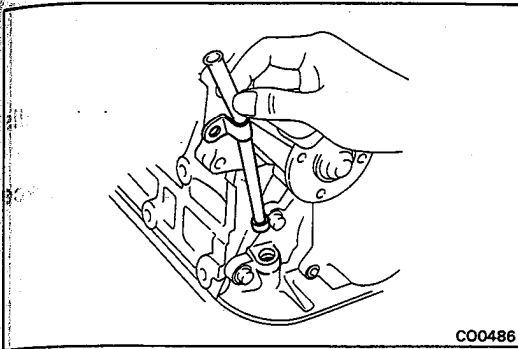
5. (4A-GE)
REMOVE OIL PAN BAFFLE PLATE

Insert the blade of SST between the cylinder block and baffle plate, cut off applied sealer and remove the baffle plate.

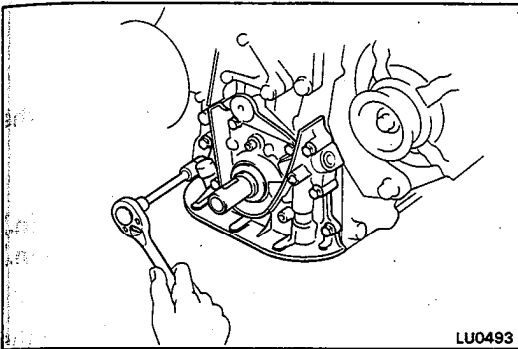
SST 09032-00100

NOTICE:

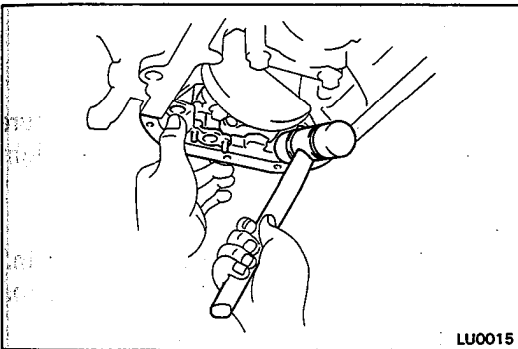
- Do not use SST for the oil pump body side. If necessary, use a screwdriver.
- When removing the haffle plate, be careful not to damage the baffle plate flange.

**6. REMOVE OIL DIPSTICK GUIDE AND DIPSTICK**

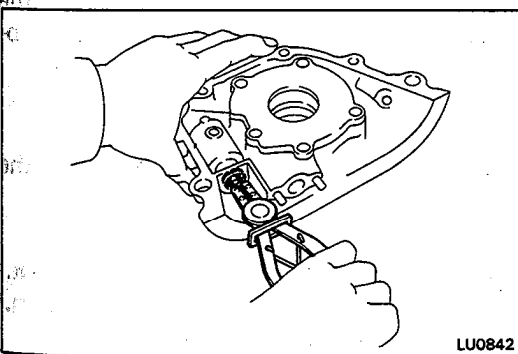
- (a) Remove the dipstick.
- (b) Remove the bolt, and pull out the dipstick guide.
- (c) Remove the O-ring from the dipstick guide.

**7. REMOVE OIL PUMP**

- (a) Remove the seven bolts.



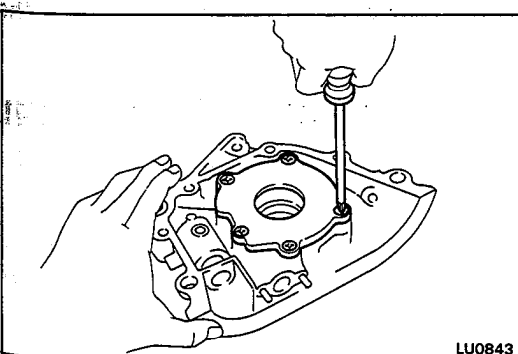
- (b) Using a plastic-faced hammer, remove the oil pump by carefully tapping the oil pump body.

**DISASSEMBLY OF OIL PUMP**

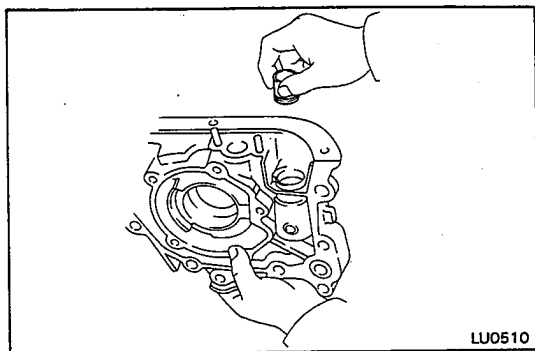
(See page LU-9)

1. REMOVE RELIEF VALVE

- (a) Using snap ring pliers, remove the snap ring.
- (b) Remove the retainer, spring and relief valve.

**2. REMOVE DRIVE AND DRIVEN ROTORS**

Remove the five screws, pump body cover, drive and driven rotors.



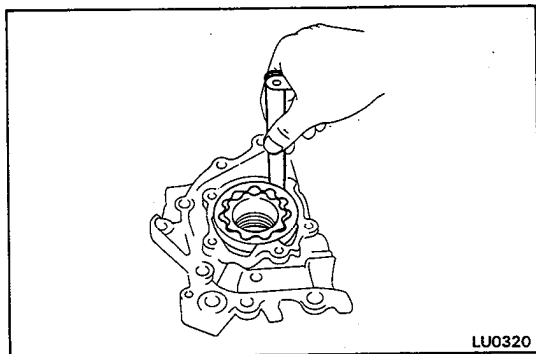
LU0510

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 doesn't, replace the relief valve. If necessary, replace the oil pump assembly.



LU0320

2. INSPECT DRIVE AND DRIVEN ROTORS

A. Inspect rotor body clearance

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

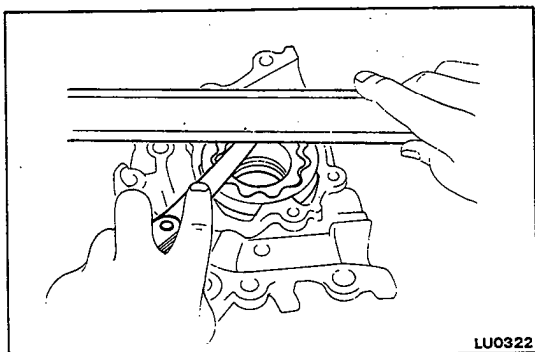
Standard body clearance:

4A-FE 0.080 – 0.180 mm (0.0031 – 0.0071 in.)

4A-GE 0.100 – 0.191 mm (0.0039 – 0.0075 in.)

Maximum body clearance: 0.20 mm (0.0079 in.)

If the body clearance is greater than maximum, replace the rotors as a set. If necessary, replace the oil pump assembly.



LU0322

B. Inspect rotor side clearance

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

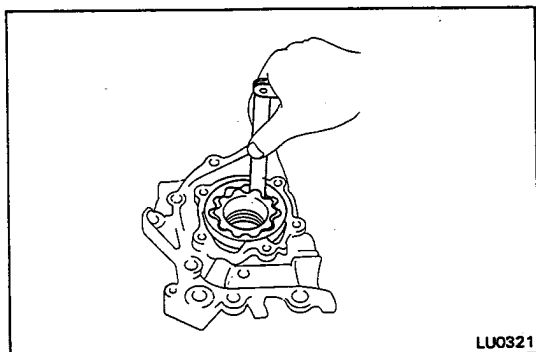
Standard side clearance:

4A-FE 0.025 – 0.085 mm (0.0010 – 0.0033 in.)

4A-GE 0.025 – 0.075 mm (0.0010 – 0.0030 in.)

Maximum side clearance: 0.10 mm (0.0039 in.)

If the side clearance is greater than maximum, replace the rotors as a set. If necessary, replace the oil pump assembly.



LU0321

C. Inspect rotor tip clearance

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

Standard tip clearance:

4A-FE 0.025 – 0.085 mm (0.0010 – 0.0033 in.)

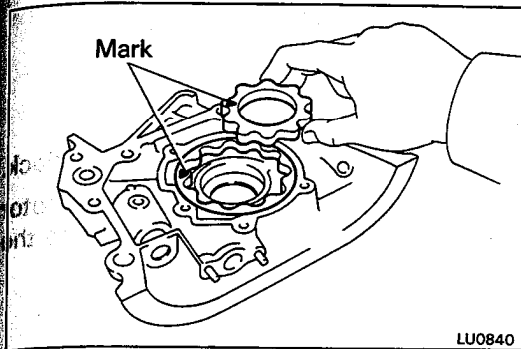
4A-GE 0.060 – 0.180 mm (0.0024 – 0.0071 in.)

Maximum tip clearance: 0.35 mm (0.0138 in.)

If the tip clearance is greater than maximum, replace the rotors as a set.

REPLACEMENT OF CRANKSHAFT FRONT OIL SEAL

(See page EM-135)

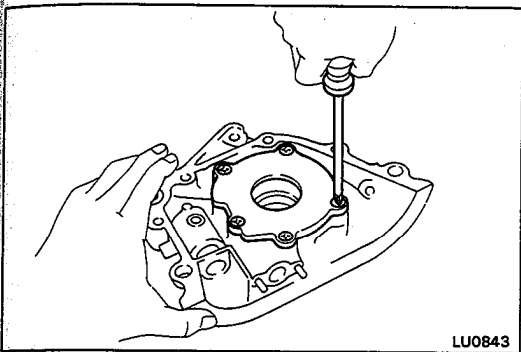


ASSEMBLY OF OIL PUMP

(See page LU-9)

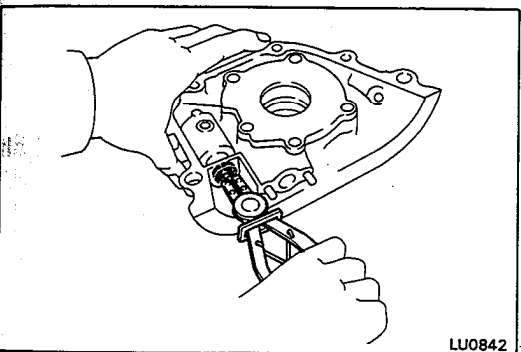
1. INSTALL DRIVE AND DRIVEN ROTORS

- (a) Place the drive and driven rotors into pump body with the marks facing the pump body cover side.



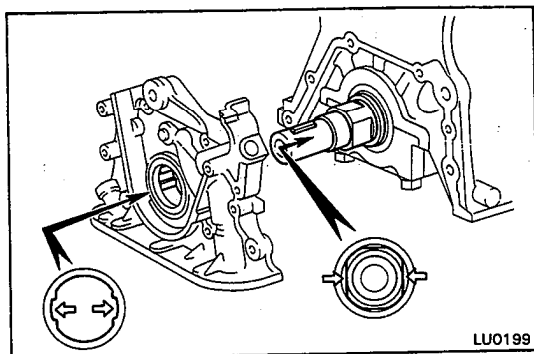
- (b) Install the pump body cover with the five screws.

Torque: 105 kg-cm (8 ft-lb, 10 N·m)



2. INSTALL RELIEF VALVE

- (a) Insert the relief valve, spring and retainer into the pump body hole.
- (b) Using snap ring pliers, install the snap ring.



INSTALLATION OF OIL PUMP

(See page LU-9)

1. INSTALL OIL PUMP

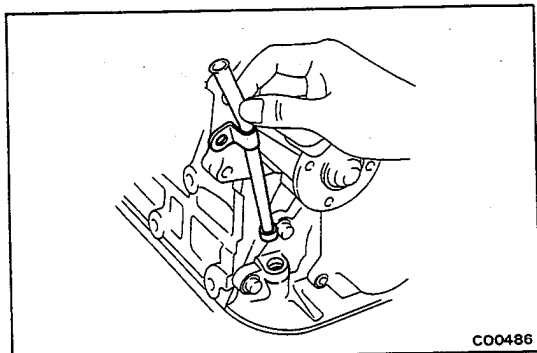
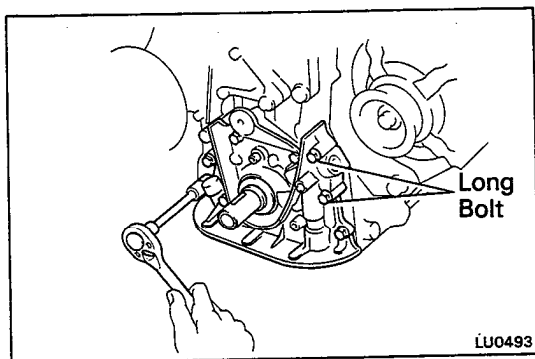
- Place a new gasket in position on the cylinder block.
- Engage the spline teeth of the oil pump drive rotor with the large teeth of the crankshaft, and slide the oil pump.

- Install the oil pump with the seven bolts.

Torque: 220 kg-cm (16 ft-lb, 21 N·m)

HINT: Each bolt length is indicated in the figure.

Bolt length: Long bolt 35 mm (1.38 in.)
Others 25 mm (0.98 in.)



2. INSTALL OIL DIPSTICK GUIDE AND DIPSTICK

- Install a new O-ring to the dipstick guide.
- Apply soapy water to the O-ring.
- Push in the dipstick guide, and install it with the bolt.

Torque: 95 kg-cm (82 in.-lb, 9.3 N·m)

- Install the dipstick.

3. (4A-GE)

INSTALL OIL PAN BAFFLE PLATE

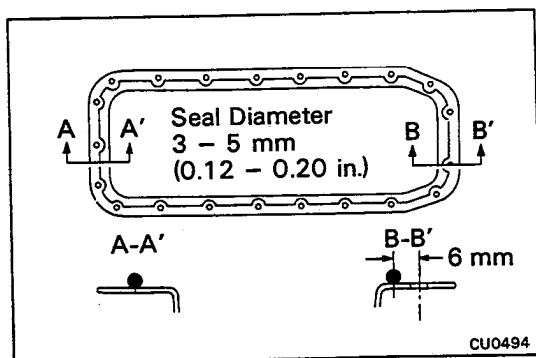
- Remove any old packing (FIPG) material and be careful not to drop any oil on the contacting surfaces of the baffle plate and cylinder block.
 - Using a razor blade and gasket scraper, remove all the packing (FIPG) material from the gasket surfaces.
 - Thoroughly clean all components to remove all the loose material.
 - Clean both sealing surfaces with a non-residue solvent.

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

- Apply seal packing to the baffle plate as shown in the figure.

Seal packing: Part No.08826-00080 or equivalent

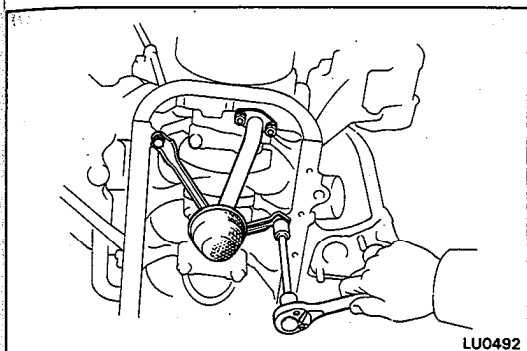
- Install a nozzle that has been cut to a 3 – 5 mm (0.12 – 0.20 in.) opening.



HINT: Avoid applying an excess amount of seal to the surface. Be particularly careful near oil passages.

- Parts must be assembled within 3 minutes of application. Otherwise, the material must be removed and reapplied.
- Immediately remove the nozzle from the tube and reinstall cap.

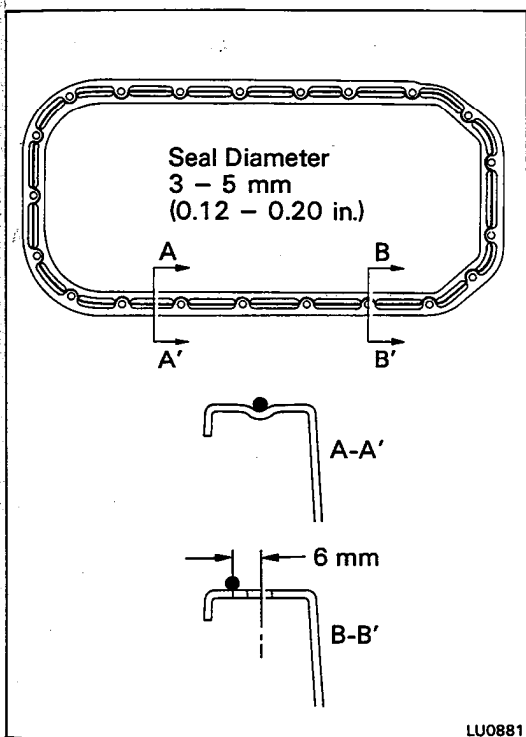
(c) Install the baffle plate.



4. INSTALL OIL STRAINER

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

Torque: 95 kg-cm (82 in.-lb, 9.3 N·m)



5. INSTALL OIL PAN

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contacting surfaces of the oil pan and cylinder block (4A-FE) or baffle plate (4A-GE).

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

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

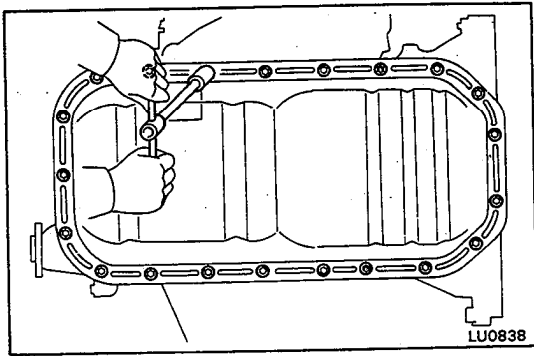
(b) Apply seal packing to the oil pan as shown in the figure.

Seal packing: Part No.08826-00080 or equivalent

- Install a nozzle that has been cut to a 3 – 5 mm (0.12 – 0.20 in.) opening.

HINT: Avoid applying an excess amount of seal to the surface. Be particularly careful near oil passages.

- Parts must be assembled within 3 minutes of application. Otherwise, the material must be removed and reapplied.
- Immediately remove the nozzle from the tube and reinstall cap.



- (c) Install the oil pan over the studs on the block with the nineteen bolts and two nuts.

Torque: 50 kg-cm (43 in.-lb, 4.9 N·m)

- (d) Install the cooler pipe, two new gaskets and union bolt. Torque the union bolt.

Torque: 250 kg-cm (18 ft-lb, 25 N·m)

6. INSTALL CRANKSHAFT TIMING PULLEY, IDLER PULLEY AND TIMING BELT

4A-FE (See page EM-44)

4A-GE (See page EM-52)

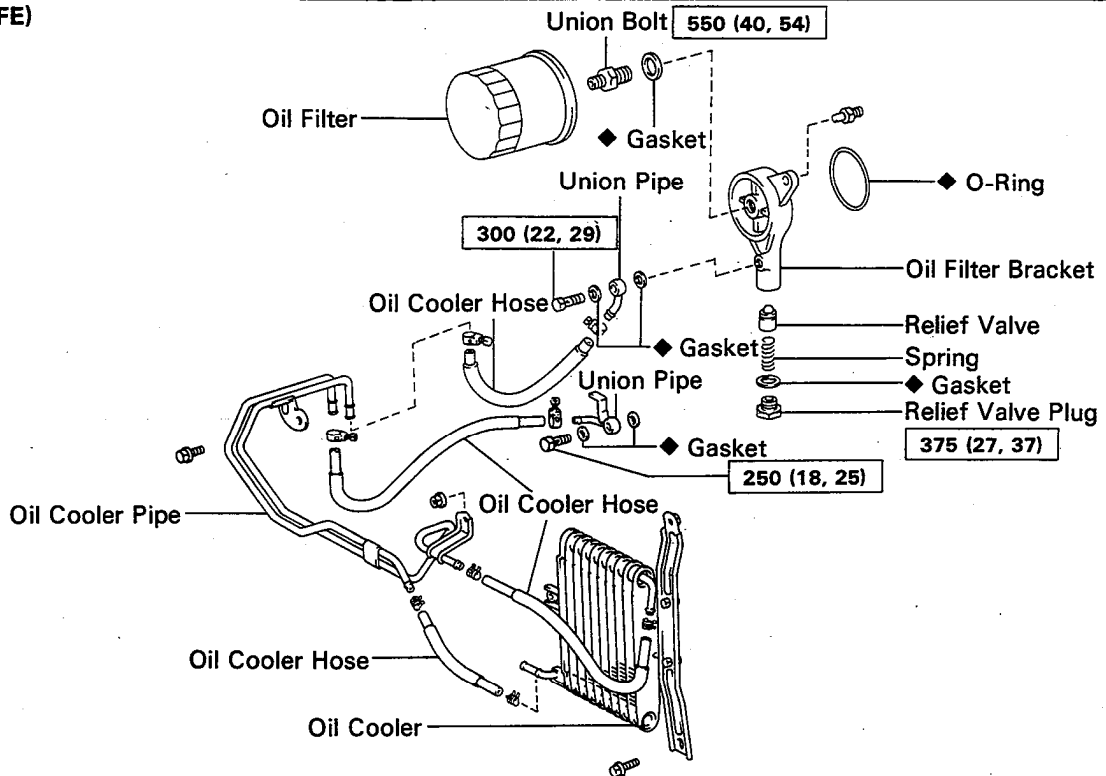
7. REFILL WITH ENGINE OIL (See page LU-8)

8. START ENGINE AND CHECK FOR LEAKS

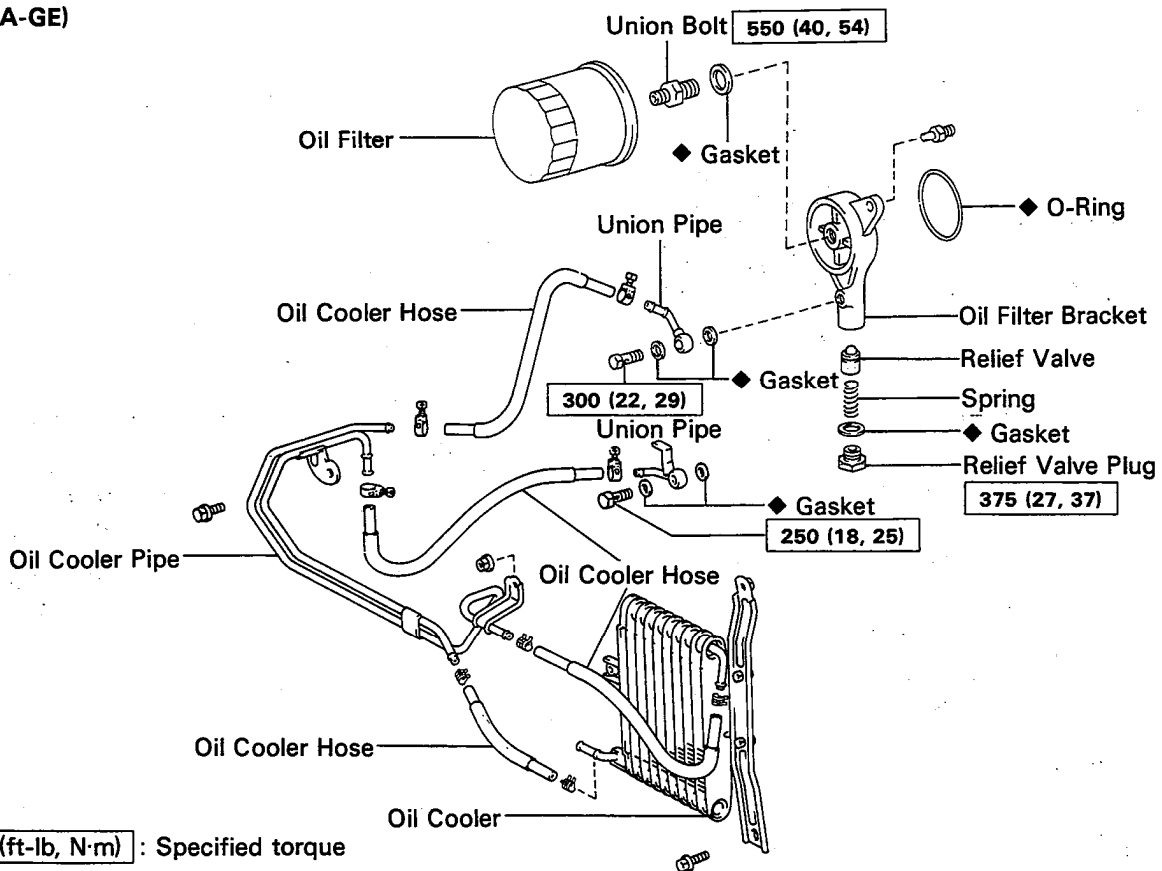
9. RECHECK OIL LEVEL (See page LU-6)

OIL COOLER AND PRESSURE REGULATOR COMPONENTS

AE92, 95 (4A-FE)



AE92 (4A-GE)

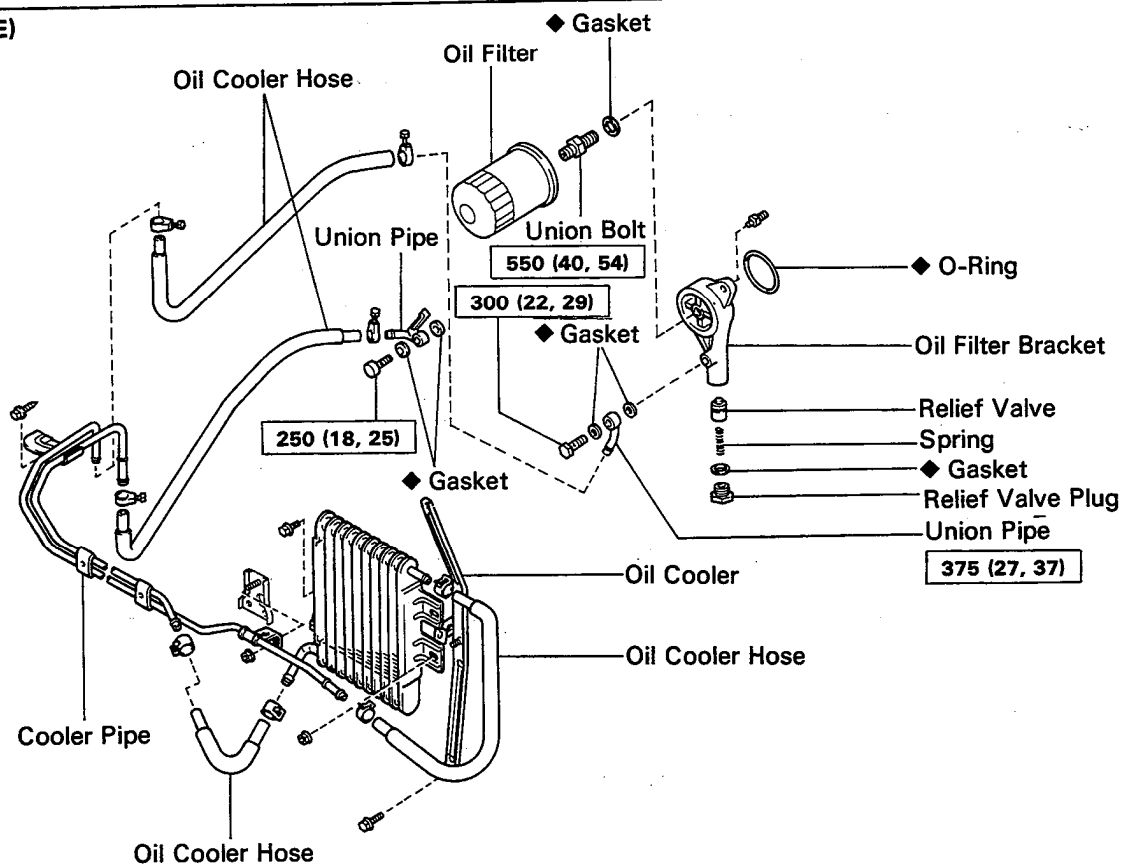


kg-cm (ft-lb, N·m) : Specified torque

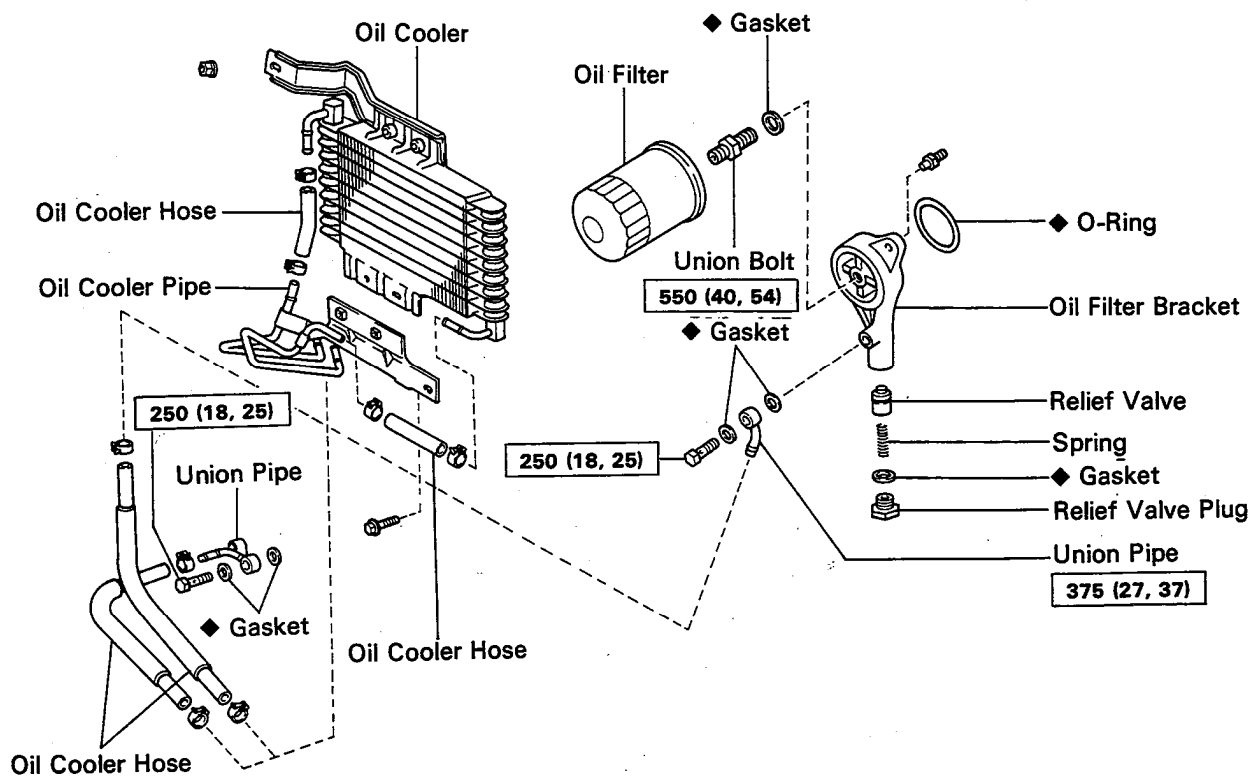
◆ Non-reusable part

COMPONENTS (Cont'd)

AT171 (4A-FE)



AT180 (4A-FE)



kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part