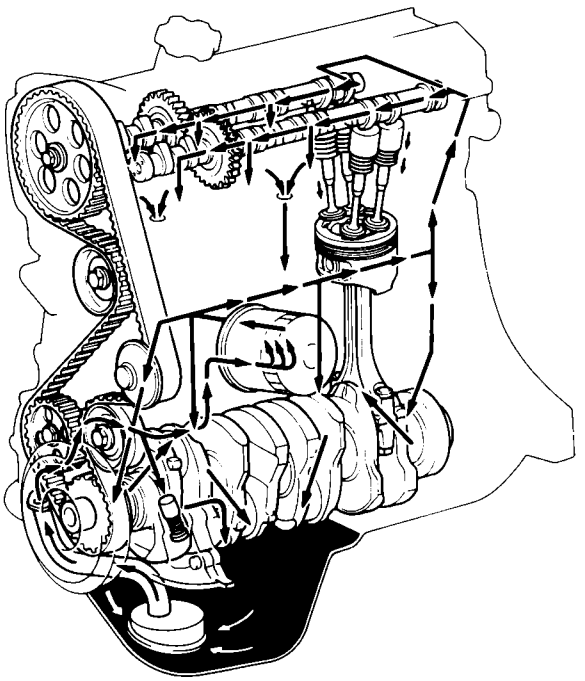
LUBRICATION SYSTEM

LU

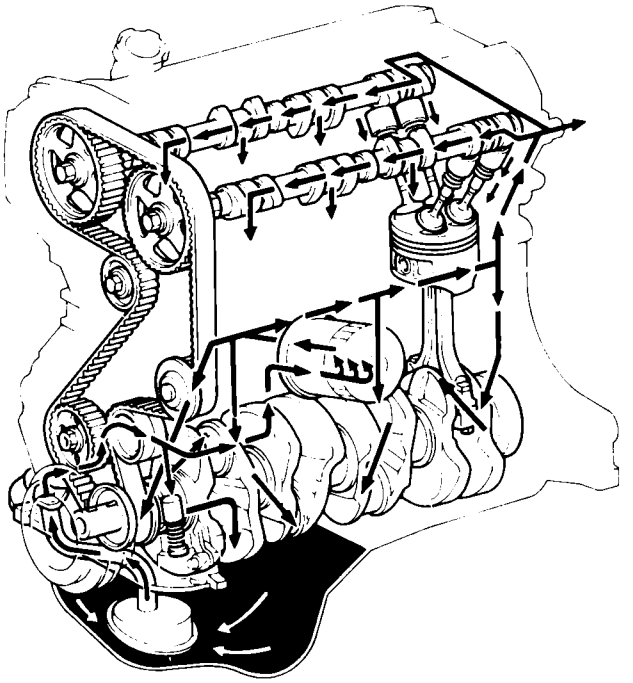
DESCRIPTION

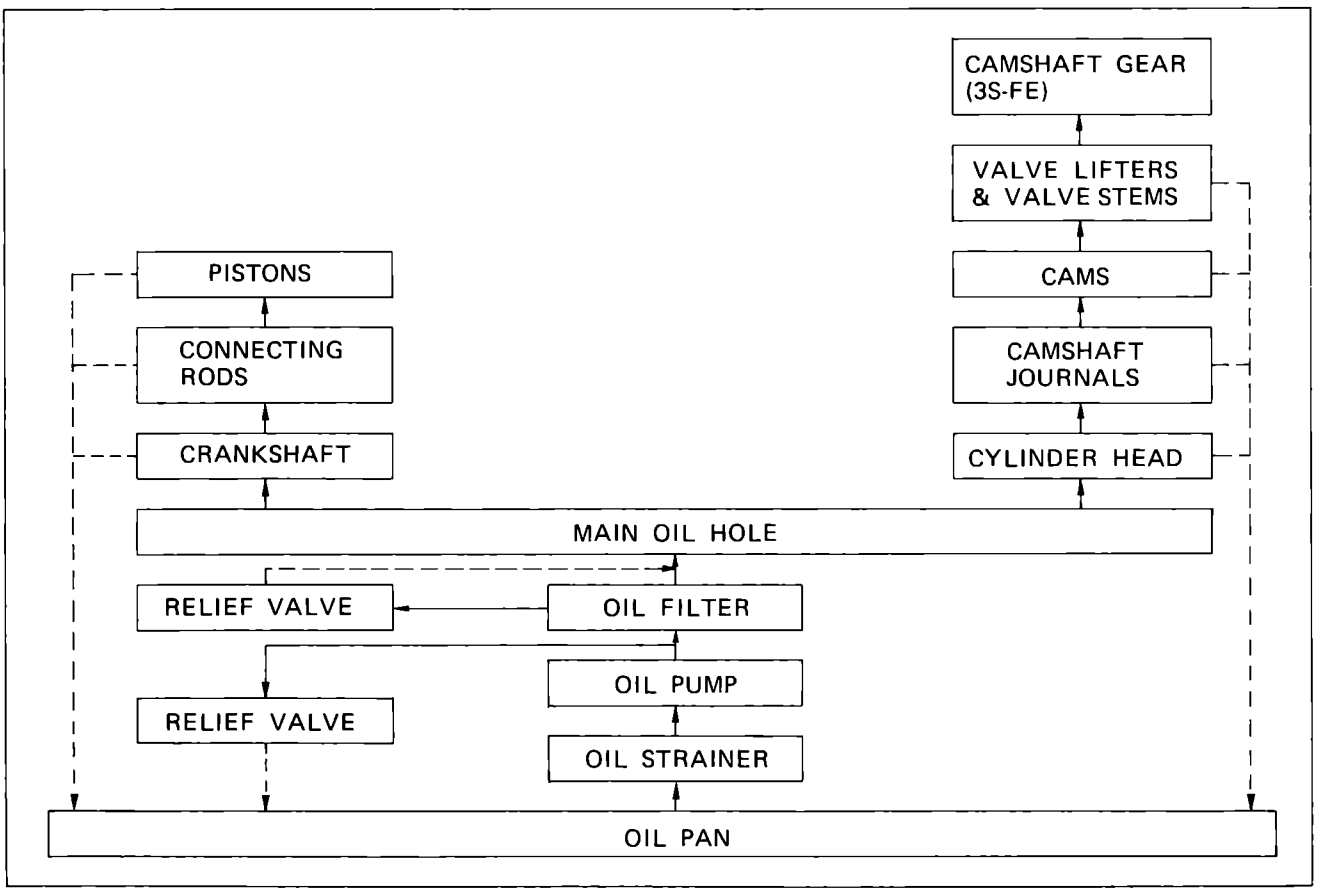
A fully pressurized, fully filitered lubrication system has been adopted for these engines.

3S-FE



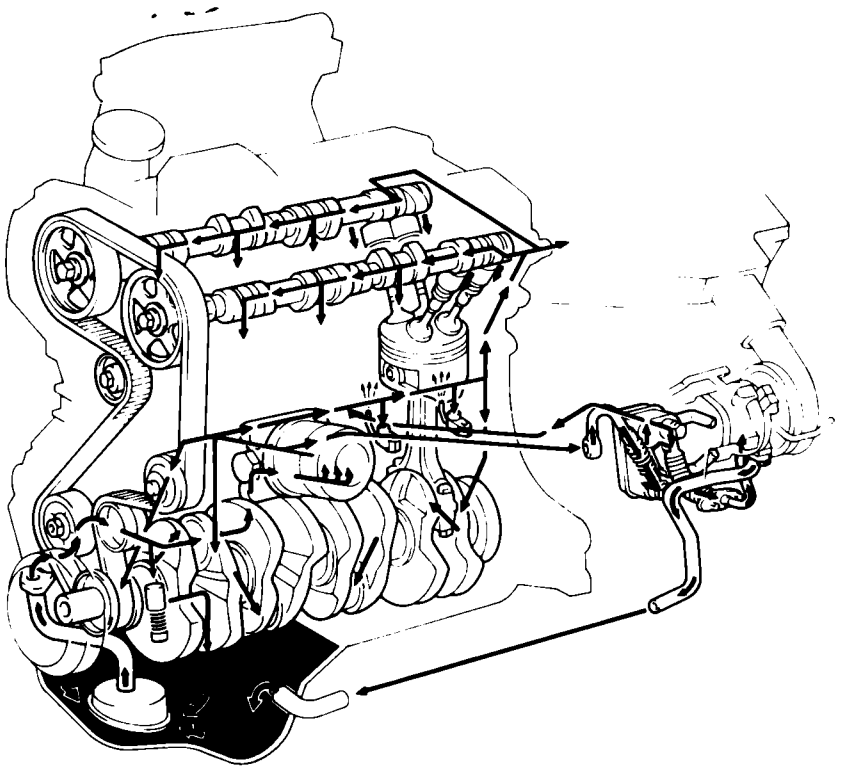
3S-GE

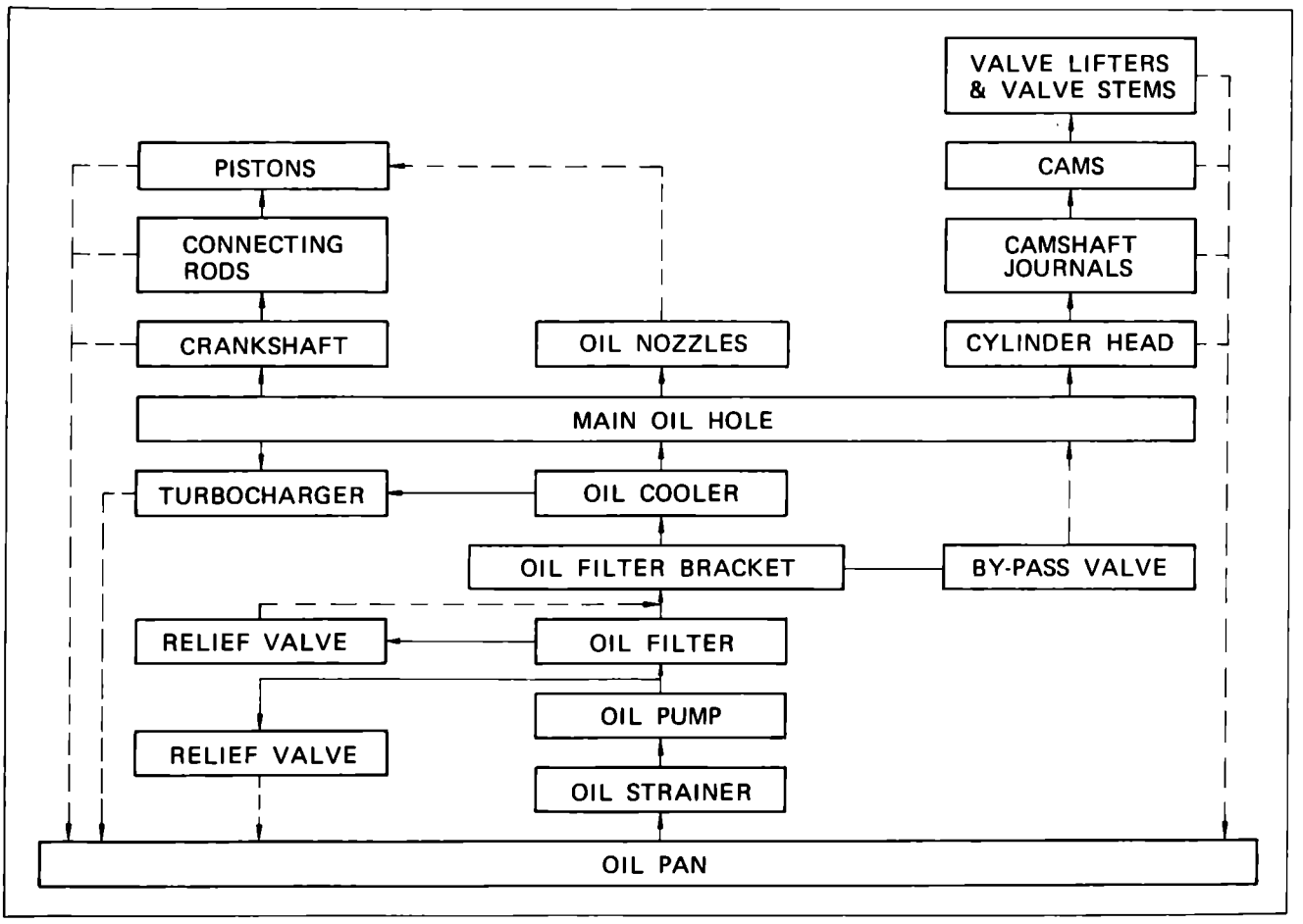




LU0564 LU0565

3S-GTE





LU0578

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 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 in narrow.

OIL PRESSURE REGULATOR (RELIEF VALVE)

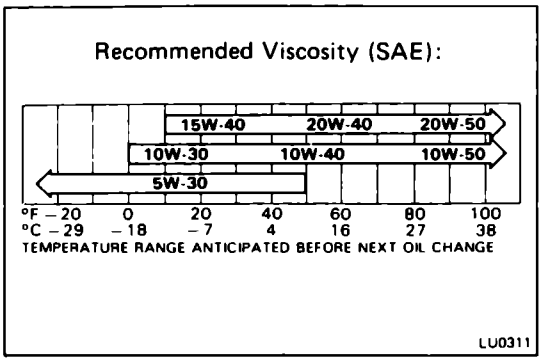
At high engine speeds, the engine oil supplied by the oil pump exceeds the capacity of the engine to utilize it. For that reason, the oil pressure regulator works to prevent an oversupply of oil. During normal oil supply, a coil spring and valve keep the bypass closed, but when too much oil is being fed, the pressure become 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, airborn 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 bypasses 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	
	Oil seal faulty	Replace oil seal	EM-142 LU-13
	Gasket faulty	Replace gasket	
Low oil pressure	Oil leakage	Repair as necessary	
	Relief valve faulty	Repair relief valve	LU-9
	Oil pump faulty	Repair oil pump	LU-9
	Engine oil poor quality	Replace engine oil	LU-7
	Crankshaft bearing faulty	Replace bearing	EM-122
	Connecting rod bearing faulty	Replace bearing	EM-122
	Oil filler clogged	Replace oil filter	LU-7
High oil pressure	Relief valve faulty	Repair relief valve	LU-9



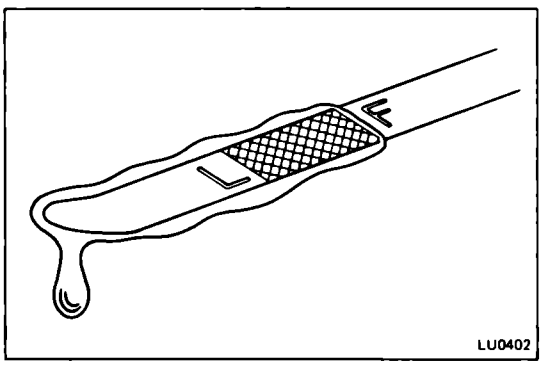
OIL PRESSURE CHECK

1. CHECK ENGINE OIL QUALITY

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

If the quality is poor, replace the oil.

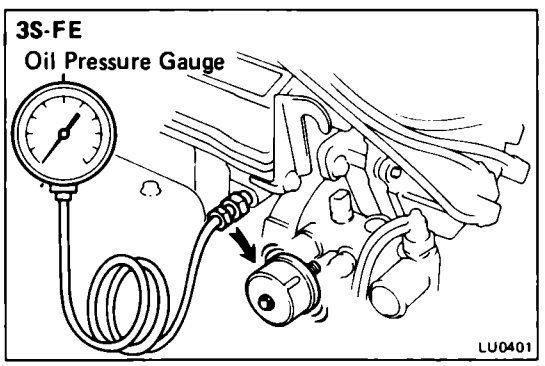
Use API grade SF or SF/CC, multigrade, fuel- efficient and recommended viscosity oil.



2. CHECK ENGINE OIL LEVEL

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

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



3. REMOVE OIL PRESSURE SENDER GAUGE

4. INSTALL OIL PRESSURE GAUGE

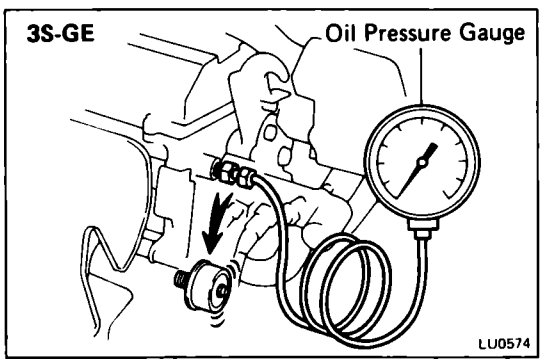
5. WARM UP ENGINE

Allow the engine to reach normal operating temperature.

6. CHECK OIL PRESSURE

Oil pressure:

At idling	**0.3 kg/cm² (4.3 psi, 29 kPa) or more**
At 3,000 rpm	**2.5 — 5.0 kg/cm² (36 — 71 psi, 245 — 490 kPa)**

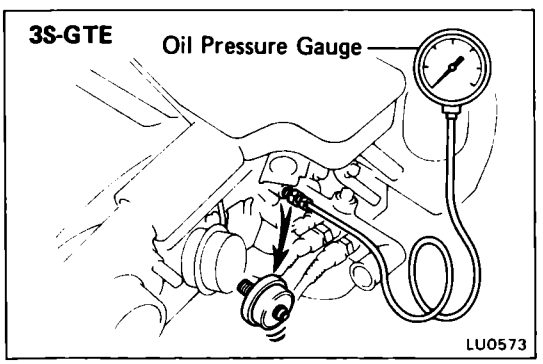


7. REINSTALL OIL PRESSURE SENDER GAUGE

Apply adhesive to two or three threads.

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

8. START ENGINE AND CHECK FOR LEAKS



REPLACEMENT OF ENGINE OIL AND OIL FILTER

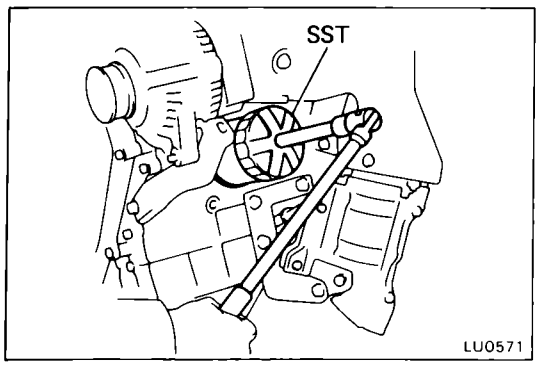
CAUTION:

- **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 potertially harmful contaminants which may cause skin cancer.**
- **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 enviroment, used oil must be disposed of only at designated disposal sites.**

1. DRAIN ENGINE OIL

(a) Remove the oil filter cap.

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

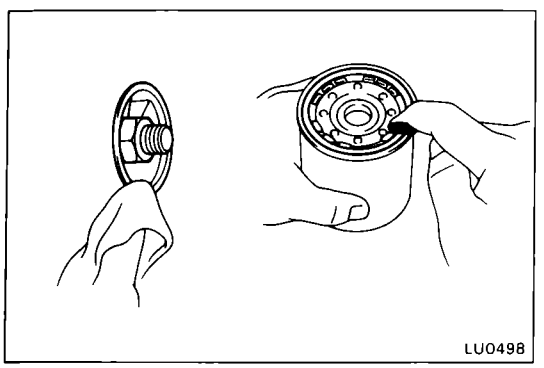


2. REPLACE OIL FILTER

(a) (3S-GTE)
Remove the alternator air duct.

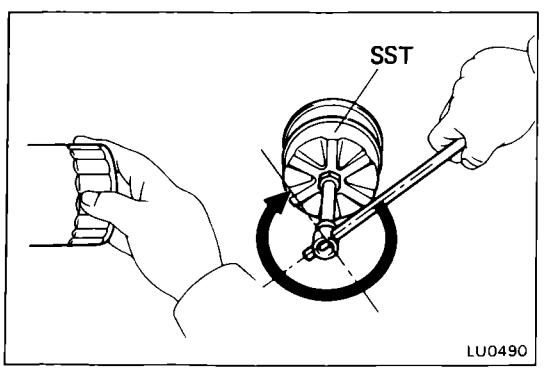
(b) Using SST, remove the oil filter.

SST 09228-06500 (3S-FE and 3S-GE)
09228-07500 (3S-GTE)



(c) Clean and check the oil filter installation surface.

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



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

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

SST 09228-06500 (3S-FE and 3S-GE)
09228-07500 (3S-GTE)

(g) (3S-GTE)
Reinstall the alternator air duct.

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 SF or SF/CC, multigrade, fuel-efficient and recommended viscosity oil).

Capacity (3S-FE):
Drain and refill
w/ Oil filter change
3.9 liters (4.1 US qts, 3.4 Imp. qts)
w/o Oil filter change
3.7 liters (3.9 US qts, 3.3 Imp. qts)
Dry fill 4.3 liters (4.5 US qts, 3.8 Imp. qts)

Capacity (3S-GE):
Drain and refill
w/ Oil filter change
3.9 liters (4.1 US qts, 3.4 Imp. qts)
w/o Oil filter change
3.6 liters (3.8 US qts, 3.2 Imp. qts)
Dry fill 4.3 liters (4.5 US qts, 3.8 Imp. qts)

Capacity (3S-GTE):
Drain and refill
w/ Oil filter change
3.6 liters (3.8 US qts, 3.2 Imp. qts)
w/o Oil filter change
3.3 liters (3.6 US qts, 2.9 Imp. qts)
Dry fill 4.6 liters (4.9 US qts, 4.0 Imp. qts)

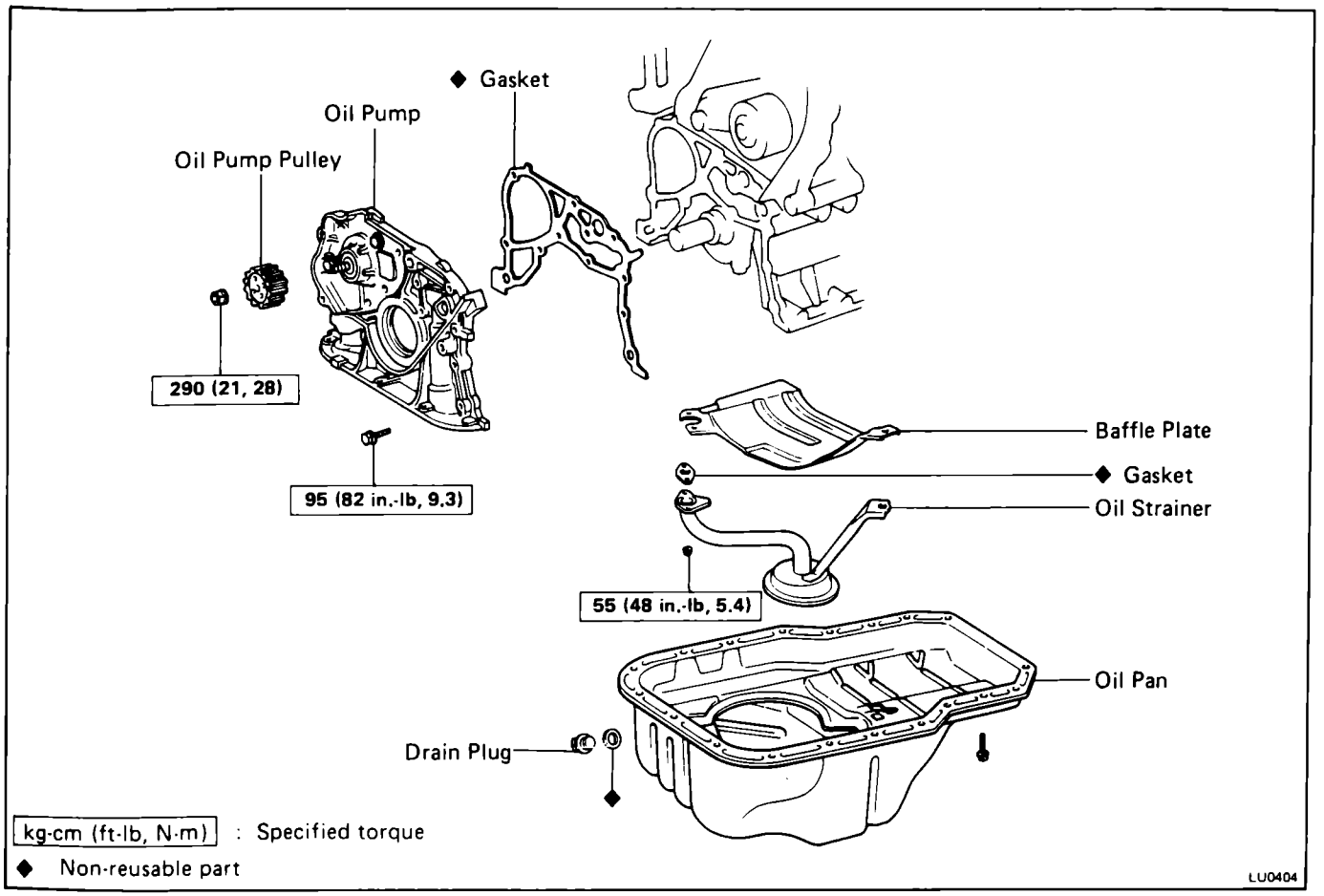
4. **START ENGINE AND CHECK FOR LEAKS**

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

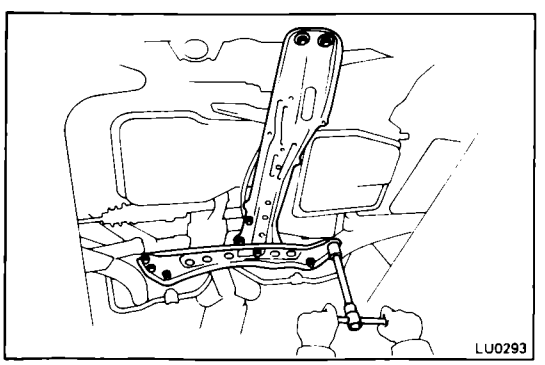
OIL PUMP

REMOVAL OF OIL PUMP

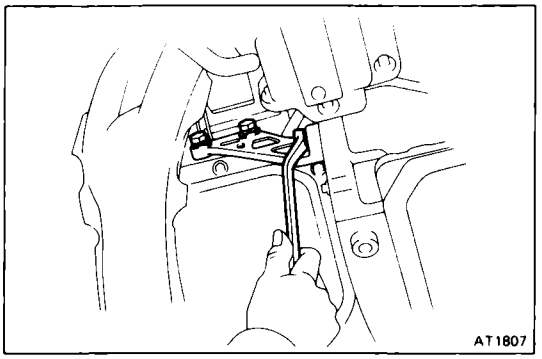
NOTE: When repairing the oil pump, the oil pan and strainer should be removed and cleaned.



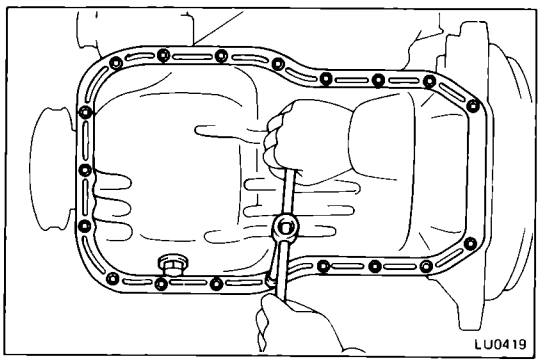
1. **REMOVE HOOD**
2. **RAISE VEHICLE**
   CAUTION: Be sure the vehicle is securely supported.
3. **REMOVE ENGINE UNDER COVERS**
4. **DRAIN ENGINE OIL (See page LU-7)**
5. **REMOVE EXHAUST FRONT PIPE**
   (See step 31 on page EM-125)



6. **REMOVE SUSPENSION LOWER CROSSMEMBER**
7. **REMOVE ENGINE MOUNTING CENTER MEMBER**



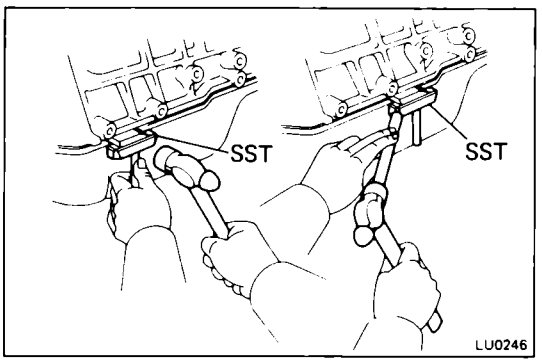
8. **REMOVE STIFFENER PLATE**



9. **REMOVE OIL PAN**

(a) Remove the dipstick.

(b) Remove the seventeen bolts and two nuts.

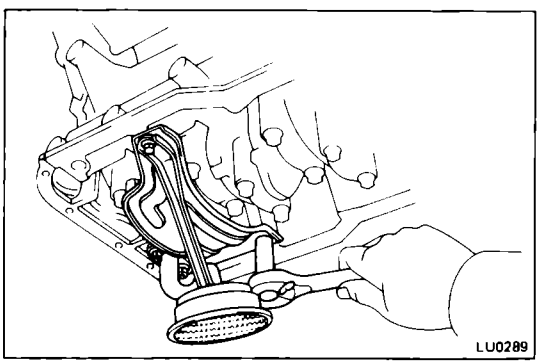


(c) Insert the blade of SST between the cylinder block and oil pan, cut off applied sealer and remove the oil pan.

SST 09032-00100

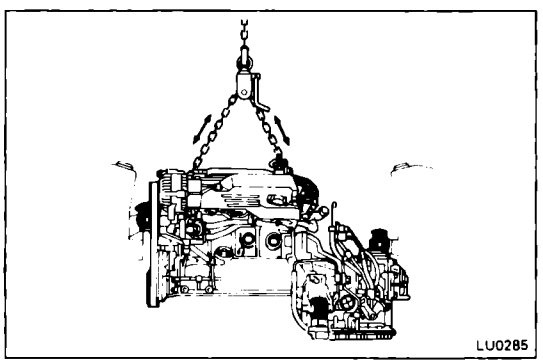
CAUTION:

- **Do not use SST for the oil pump body side and rear oil seal retainer.**
- **Be careful not to damage the oil pan flange.**



10. **REMOVE OIL STRAINER**

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

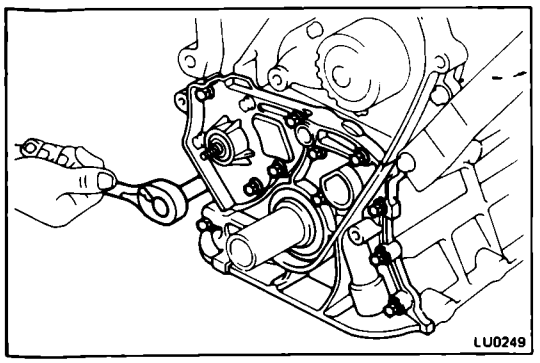


11. **SUSPEND ENGINE WITH ENGINE HOIST CHAIN**

12. **REMOVE TIMING BELT AND PULLEYS**

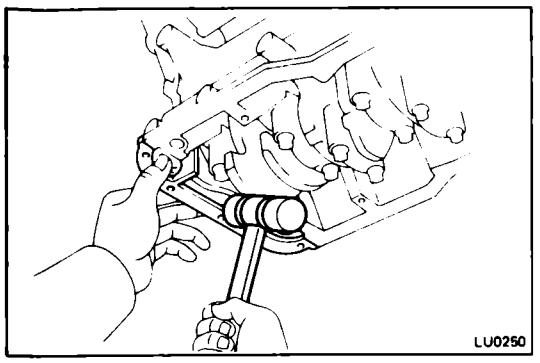
3S-FE **(See pages EM-27 to 30)**

3S-GE and 3S-GTE **(See pages EM-38 to 41)**



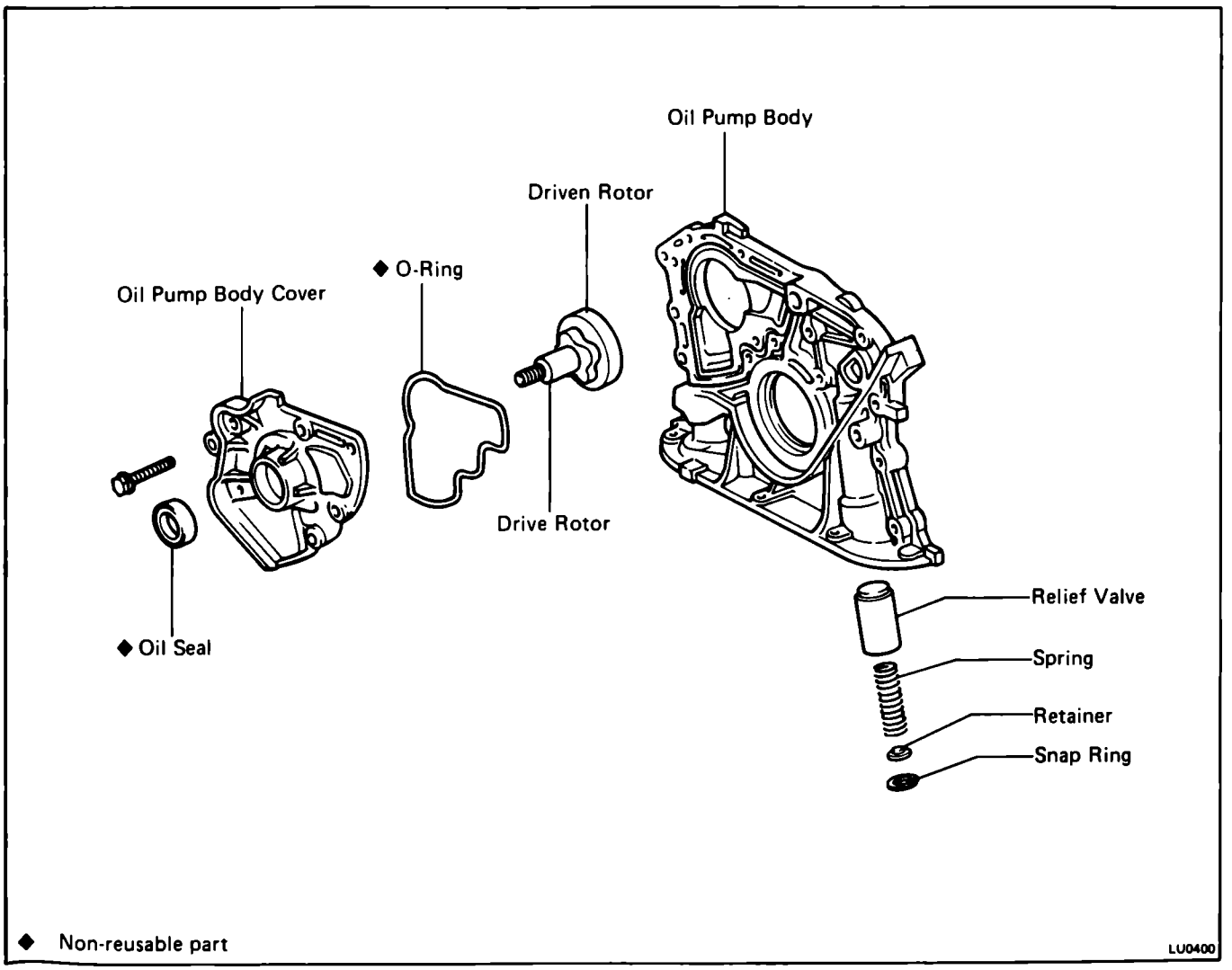
13. REMOVE OIL PUMP

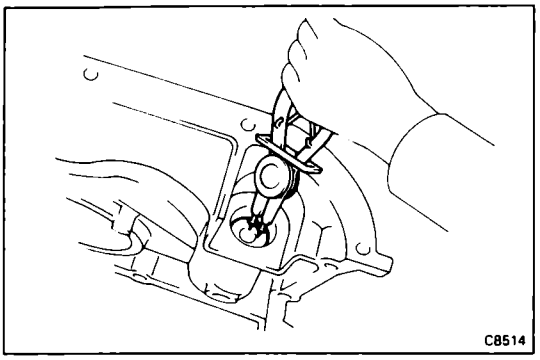
(a) Remove the twelve bolts.



(b) Using a plastic-faced hammer, careful tap out the oil pump.

COMPONENTS





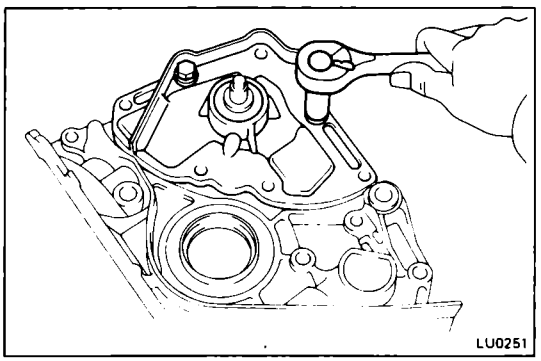
DISASSEMBLY OF OIL PUMP

(See page LU-11)

1. REMOVE RELIEF VALVE

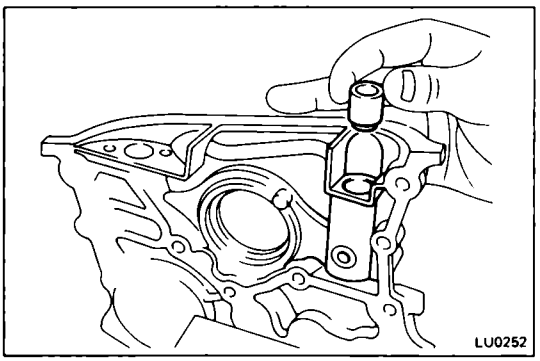
(a) Using snap ring pliers, remove the snap ring.

(b) Remove the retainer, spring and relief valve.



2. REMOVE DRIVE AND DRIVEN ROTORS

Remove the two bolts, pump body cover, O-ring, the drive and driven rotors.

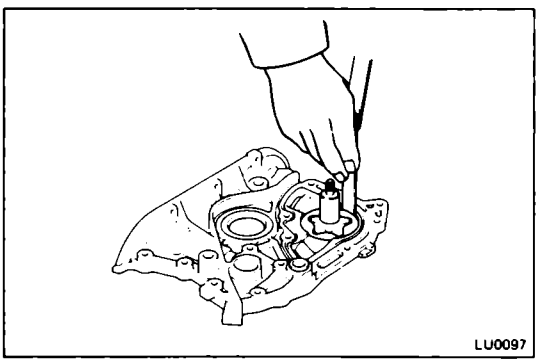


INSPECTION OF OIL PUMP

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



2. INSPECT DRIVE AND DRIVEN ROTORS

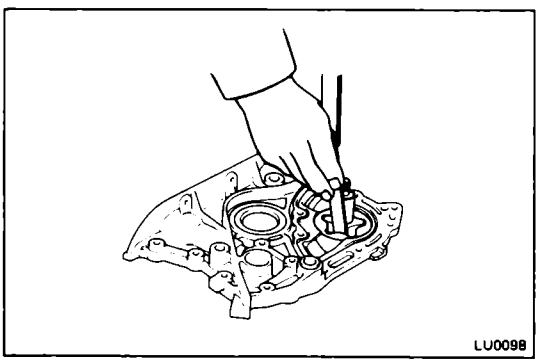
A. Inspect rotor body clearance

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

Standard body clearance: **0.10 – 0.16 mm (0.0039 – 0.0063 in.)**

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

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



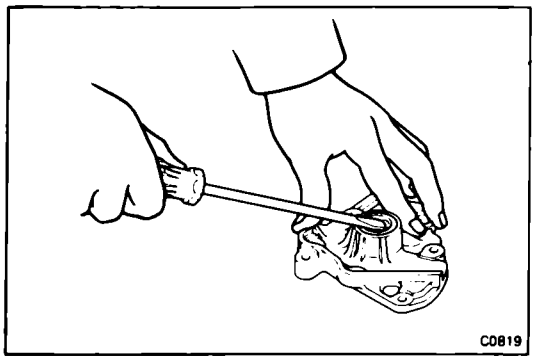
B. Inspect rotor tip clearance

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

Standard tip clearance: **0.04 – 0.16 mm (0.0016 – 0.0063 in.)**

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

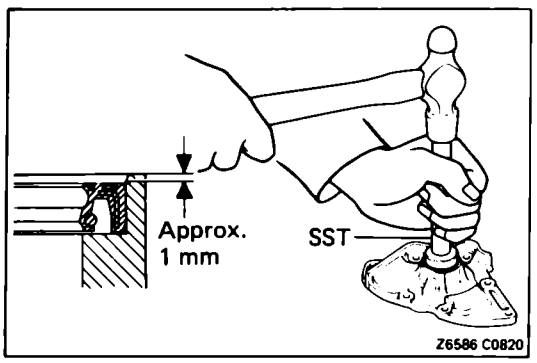
If the tip clearance is greater than maximum, replace the rotors as a set. If necessary, replace the oil pump assembly.



REPLACEMENT OF OIL SEAL

1. REMOVE OIL SEAL

Using a screwdriver, pry out the oil seal.



2. INSTALL OIL SEAL

(a) Using SST and a hammer, tap in a new oil seal to a depth of approx. 1 mm (0.04 in.) from the oil pump cover edge.

SST 09620-30010 (09627-30010, 09631-00020)

(b) Apply MP grease to the oil seal lip.

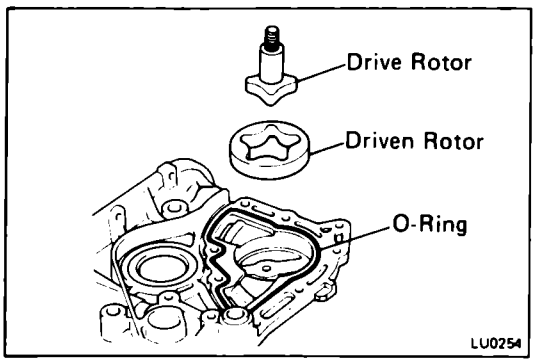
ASSEMBLY OF OIL PUMP

(See page LU-11)

1. INSTALL DRIVE AND DRIVEN ROTORS

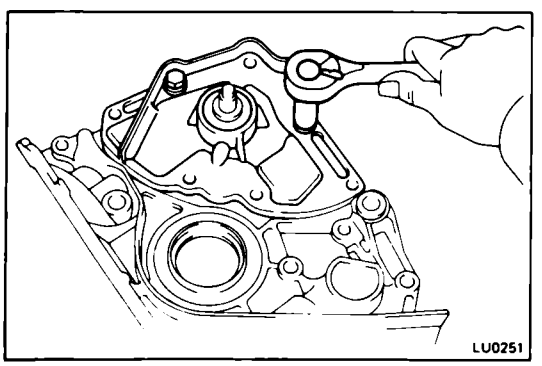
(a) Place a new O-ring into the pump body groove.

(b) Place the drive and driven rotors into pump body.



(c) Install the pump body cover with the two bolts.

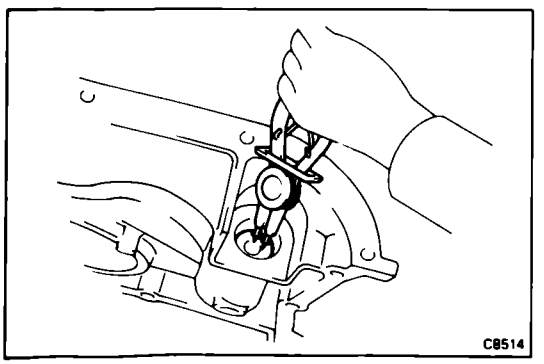
Torque: 90 kg-cm (78 in.-lb, 8.8 N·m)

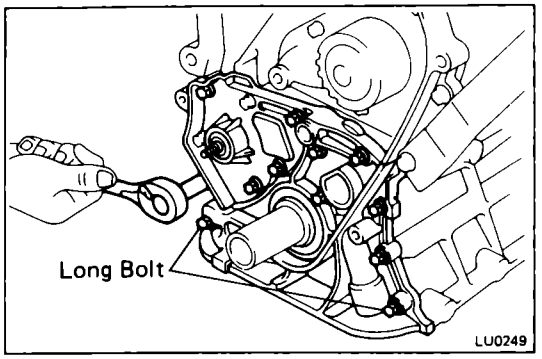


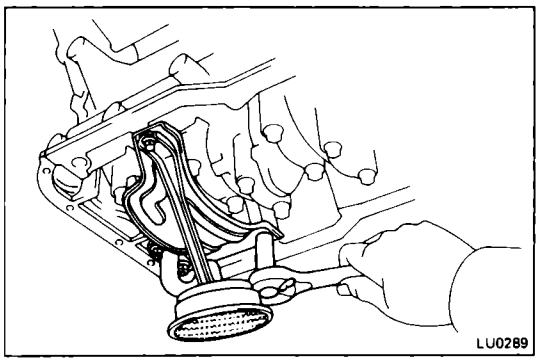
2. INSTALL RELIEF VALVE

(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**

   Install a new gasket and the oil pump with the twelve bolts.

   Torque: 95 kg-cm (82 in.-lb, 9.3 N·m)

2. **INSTALL PULLEYS AND TIMING BELT**

   3S-FE **(See pages EM-33 to 37)**
   3S-GE and 3S-GTE **(See pages EM-44 to 53)**

3. **REMOVE ENGINE HOIST CHAIN FROM ENGINE**

4. **INSTALL OIL STRAINER**

   Install a new gasket, the baffle plate and oil pan with the two bolts and two nuts.

   Torque: 55 kg-cm (48 in.-lb, 5.4 N·m)

5. **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.

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

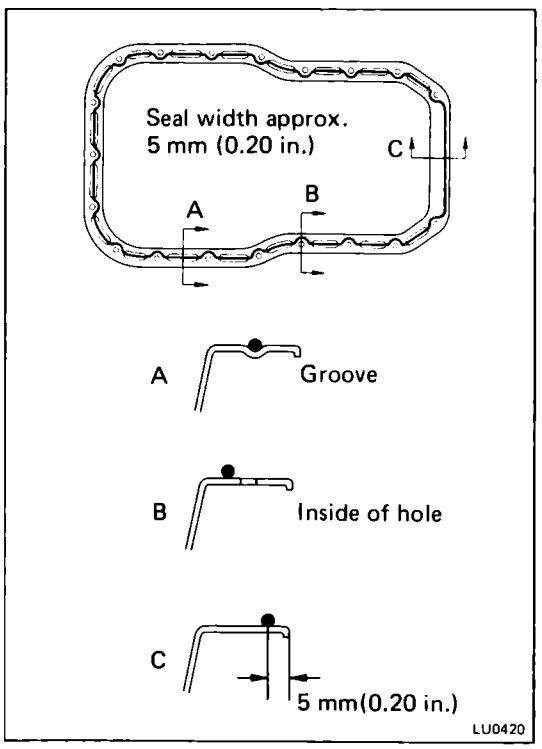
   (b) Apply seal packing to the oil pan as shown in the figure.

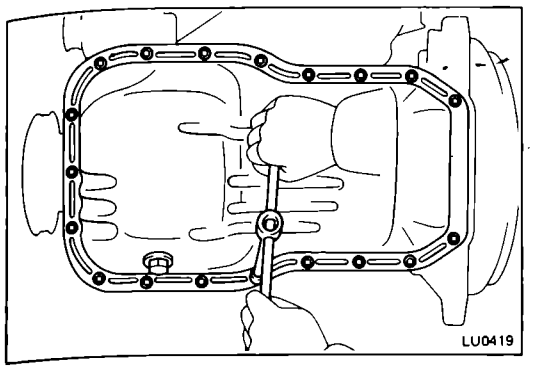
   Seal packing: Part No.08826-00080 or equivalent

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

   NOTE: Avoid applying an excessive amount 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 nozzle from the tube and and reinstall cap.

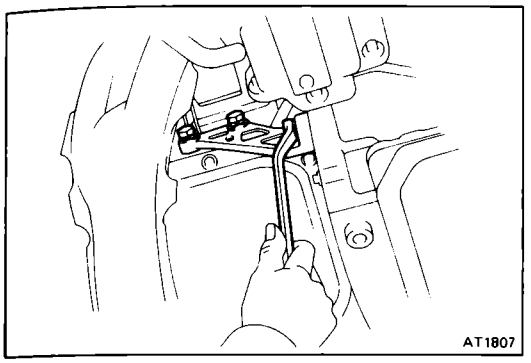




(c) Install the oil pan with the two nuts and seventeen bolts.

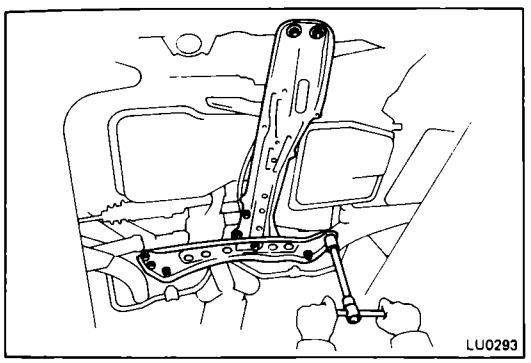
Torque: 55 kg-cm (48 in.-lb, 5.4 N·m)

(d) Install the dipstick.



6. **INSTALL STIFFENER PLATE**

Torque: 380 kg-cm (27 ft-lb, 37 N·m)



7. **INSTALL ENGINE MOUNTING CENTER MEMBER (See step 8 on page EM-152)**

8. **INSTALL SUSPENSION LOWER MEMBER (See step 15 on page EM-153)**

9. **INSTALL EXHAUST FRONT PIPE (See step 10 on page EM-152)**

10. **INSTALL ENGINE UNDER COVERS**

11. **LOWER VEHICLE**

12. **FILL WITH ENGINE OIL (See page LU-8)**

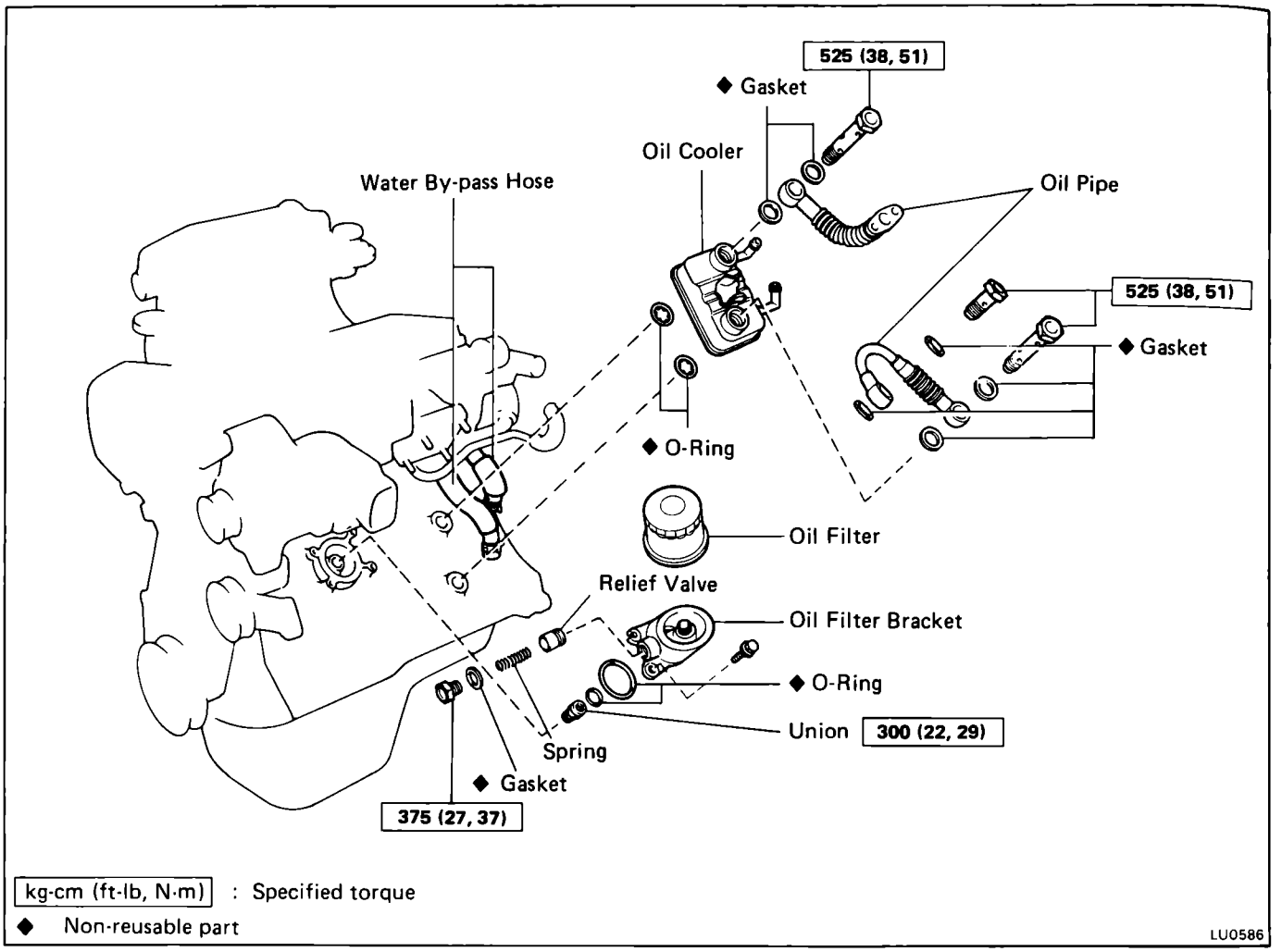
13. **START ENGINE AND CHECK FOR LEAKS**

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

15. **INSTAL HOOD**

16. **CHECK TOE-IN**

OIL COOLER AND RELIEF VALVE (3S-GTE)

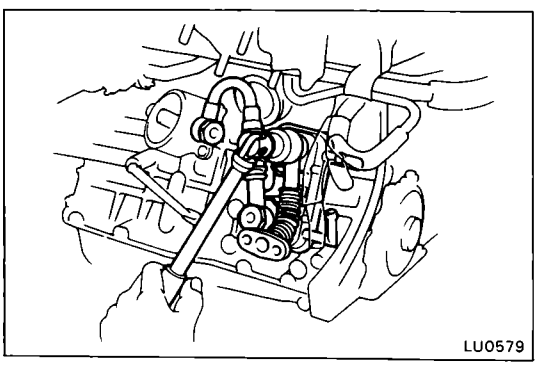


REMOVAL OF OIL COOLER AND RELIEF VALVE

1. **REMOVE TURBOCHARGER**
   (See steps 1 to 14 on pages TC-9 to 11)

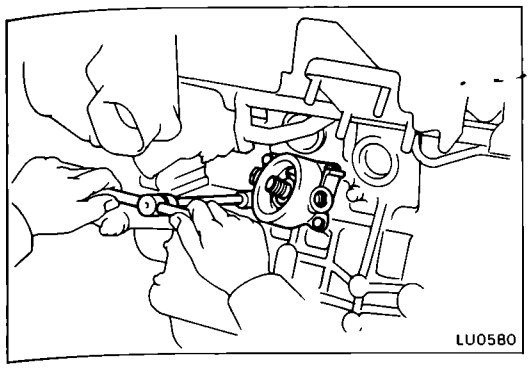
2. **REMOVE OIL FILTER (See page LU-7)**

3. **DISCONNECT WATER BY-PASS HOSES FROM OIL COOLER**



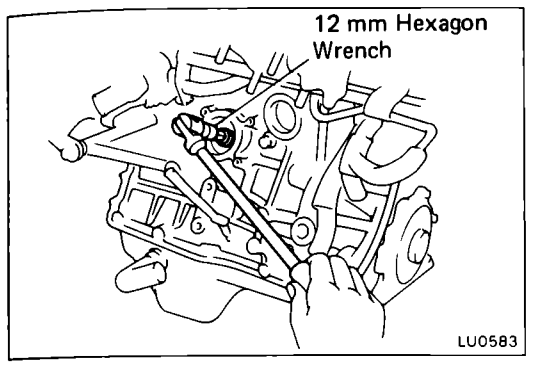
4. **REMOVE OIL COOLER**

   Remove the three union bolts, six gaskets, oil cooler and two O-rings.

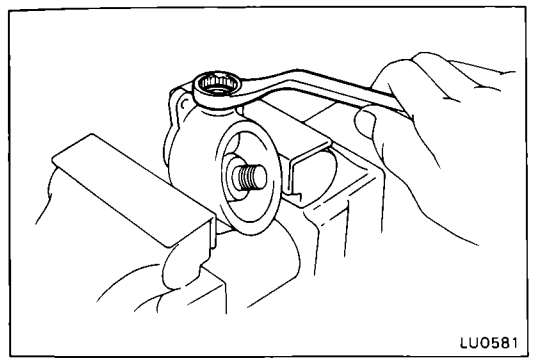


5. **REMOVE OIL FILTER BRACKET**

(a) Remove the four bolts, filter bracket and O-ring.



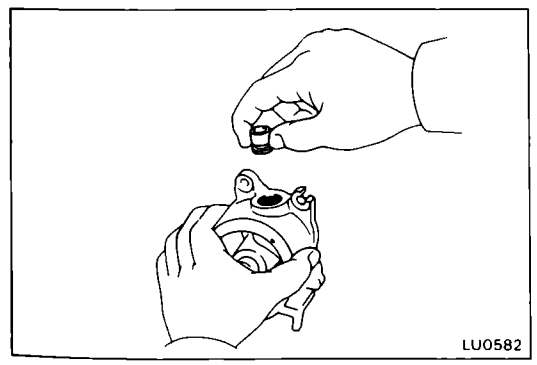
(b) Using a 12 mm hexagon wrench, remove the union and O-ring.



6. **REMOVE RELIEF VALVE FROM OIL FILTER BRACKET**

(a) Mount the filter bracket in a soft jaw vise.

(b) Remove the plug, gasket, spring and relief valve.



INSPECTION OF OIL COOLER AND RELIEF VALVE

1. **INSPECT RELIEF VALVE**

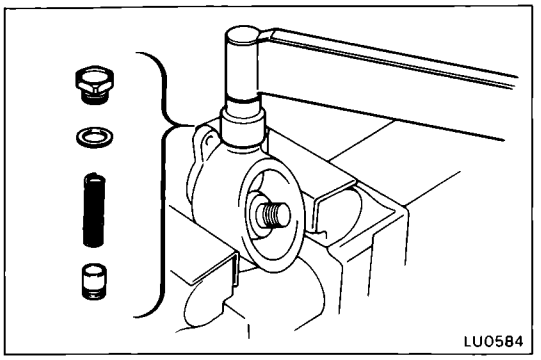
Coat the valve with engine oil and check that it falls smoothly into the valve hole by its own weight.

If not, replace the relief valve. If necessary, replace the oil filter bracket and relief valve as a set.

2. **INSPECT OIL COOLER**

Check the oil cooler for clogging.

If abnormal, replace the oil cooler.

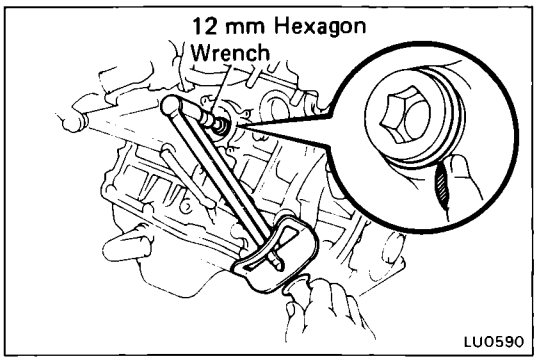


INSTALLATION OF OIL COOLER AND RELIEF VALVE

(See page LU-16)

1. **INSTALL RELIEF VALVE TO OIL FILTER BRACKET**
   (a) Mount the oil filter bracket in a soft jaw vise.
   (b) Install the relief valve and spring with a new gasket and the plug. Torque the plug.

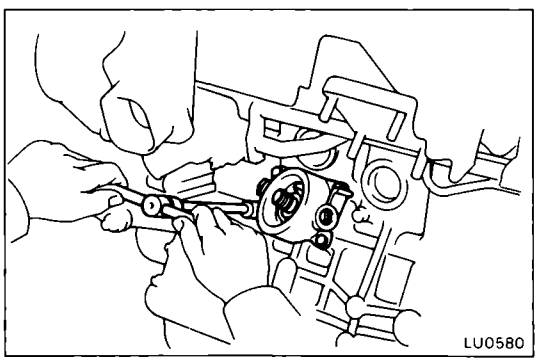
   Torque: 375 kg-cm (27 ft-lb, 37 N·m)



2. **INSTALL OIL FILTER BRACKET**
   (a) Using a 12 mm hexagon wrench, install and torque the union.

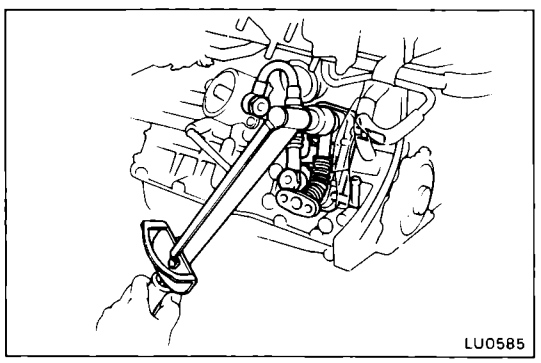
   Torque: 300 kg-cm (22 ft-lb, 29 N·m)

   (b) Install a new O-ring to the union, and apply small amount of engine oil to the O-ring.



   (c) Install a new O-ring and the oil filter bracket with the four bolts.

   Torque: 80 kg-cm (69 in.-lb, 7.8 N·m)

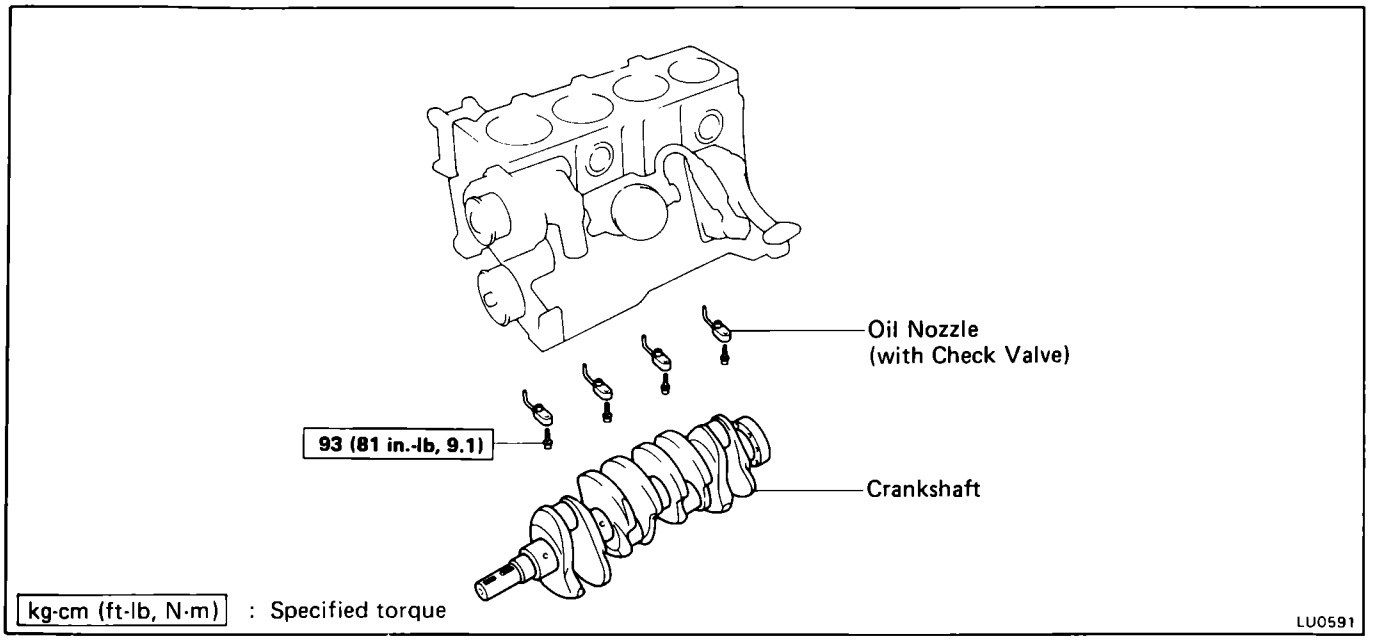


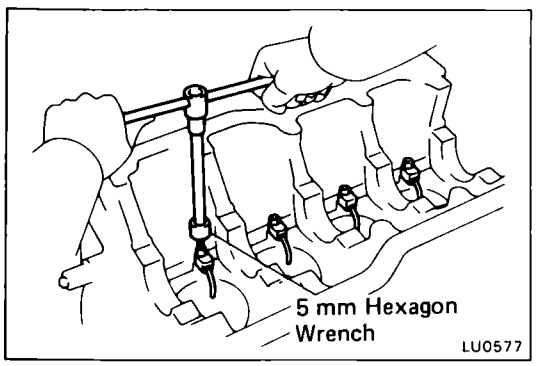
3. **INSTALL OIL COOLER**
   (a) Install new two O-rings to the oil cooler.
   (b) Install the oil cooler and two oil pipes with new six gaskets and three union bolts. Torque the union bolts.

   Torque: 525 kg-cm (38 ft-lb, 51 N·m)

4. **CONNECT WATER BY-PASS HOSES**
5. **INSTALL OIL FILTER (See page LU-7)**
6. **INSTALL TURBOCHARGER**
   (See step 4 to 19 pages TC-13 and 14)
7. **CHECK ENGINE OIL LEVEL (See page LU-6)**

OIL NOZZLES AND CHECK VALVES (3S-GTE)



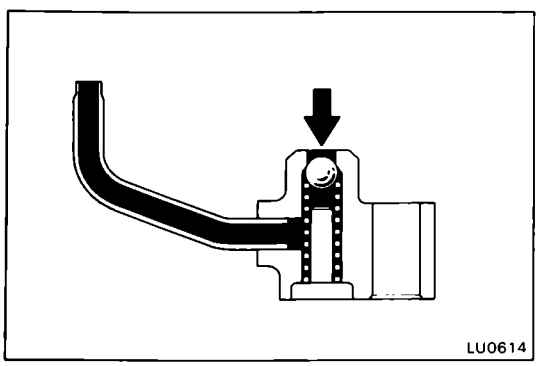


REMOVAL OF OIL NOZZLES AND CHECK VALVES

1. **REMOVE CRANKSHAFT (See pages EM-122 to 133)**

2. **REMOVE OIL NOZZLES (WITH CHECK VALVES)**

   Using 5 mm hexagon wrench, remove the four bolts and oil nozzles.



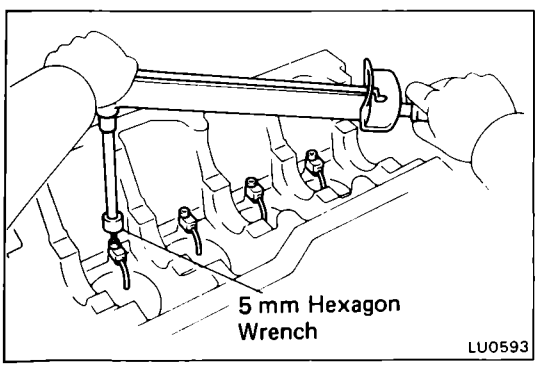
INSPECTION OF OIL NOZZLES AND CHECK VALVES

INSPECT OIL NOZZLES (WITH CHECK VALVES)

(a) Check the oil nozzles for clogging.

(b) Push the steel ball with a wooden stick to check if it is struck.

If abnormal, replace the oil nozzles.



INSTALLATION OF OIL NOZZLES AND CHECK VALVES

1. **INSTALL OIL NOZZLES (WITH CHECK VALVES)**

   Using 5 mm hexagon wrench, install the nozzle with the bolt. Install the four oil nozzles. Torque the bolts.

   Torque: 93 kg-cm (81 in.-lb, 9.1 N·m)

2. **INSTALL CRANKSHAFT (See pages EM-146 to 157)**