

EG1-268

5S-FE ENGINE - LUBRICATION SYSTEM

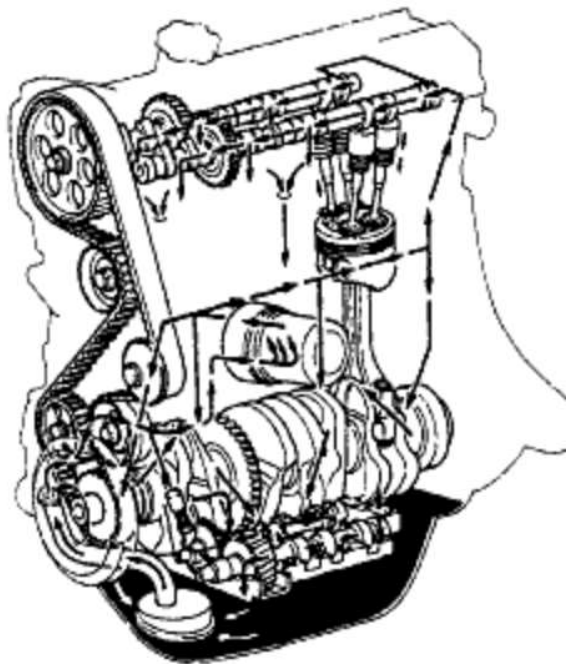
LUBRICATION SYSTEM

DESCRIPTION

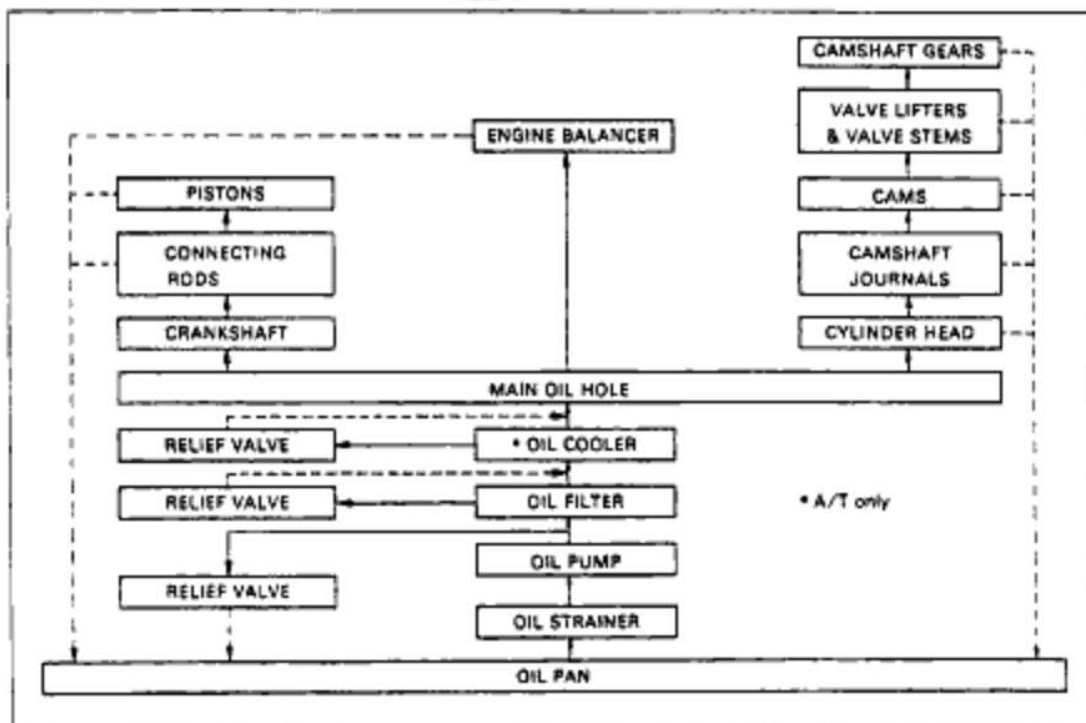
A fully pressurized, fully filtered lubrication system has been adopted for this engine.

05A12-91

OPERATION



P01101



210118

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 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 feeds 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, 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 drive rotor shaft is different from the center of the driven rotor, the space between the two rotors changes as they rotate. 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 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 relief valve built into the 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 seizing 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.








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5S-FE ENGINE - LUBRICATION SYSTEM

PREPARATION




SST (SPECIAL SERVICE TOOLS)

SSTP-01

	09032-00100 Oil Pan Seat Cutter	
	09226-10010 Crankshaft Front & Rear Bearing Replacer	Crankshaft front oil seal
	09228-06500 Oil Filter wrench	
	09616-30011 Steering Worm Bearing Adjusting Screw Wrench	Oil pump pulley
	09620-30010 Steering Gear Box Replacer Set	
	(09627-30010) Steering Sector Shaft Bushing Replacer	Oil pump oil seal
	(09631-00020) Handle	Oil pump oil seal

SSTP-01

RECOMMENDED TOOLS

	09090-04000 Engine Sling Device	For suspending engine
	09200-00010 Engine Adjust Kit	
	09905-00013 Snap Ring Pliers	

SSTP-01

EQUIPMENT

Oil pressure gauge	
Precision straight edge	Oil pump
Torque wrench	

5S-FE ENGINE - LUBRICATION SYSTEM

LUBRICANT

88878-08

Item	Capacity	Classification
Engine oil (M/T)		API grade SG or SH, Energy-Conserving II multigrade engine oil or ILSAC multigrade engine oil and recommended viscosity oil
Dry fill	4.2 liters (4.4 US qts, 3.7 Imp. qts)	
Drain and refill		
w/ Oil filter change	3.6 liters (3.8 US qts, 3.2 Imp. qts)	
w/o Oil filter change	3.4 liters (3.6 US qts, 3.0 Imp. qts)	
Engine oil (A/T)		
Dry fill	4.3 liters (4.5 US qts, 3.8 imp. qts)	
Drain and refill		
w/ Oil filter change	3.6 liters (3.8 US qts, 3.2 Imp. qts)	
w/o Oil filter change	3.4 liters (3.6 US qts, 3.0 Imp. qts)	

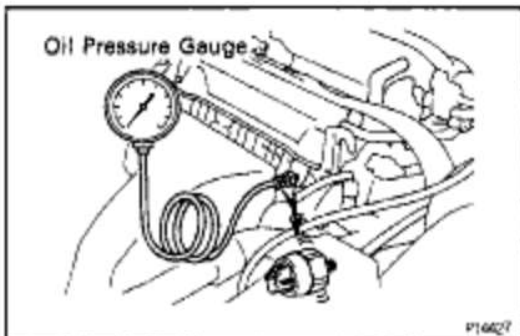
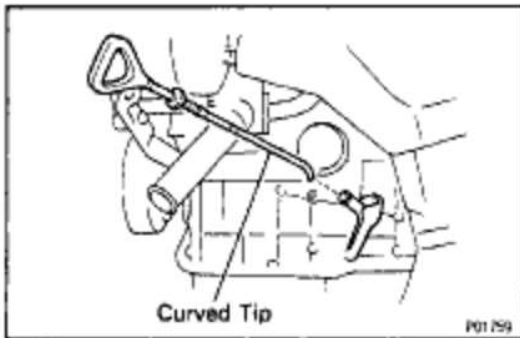
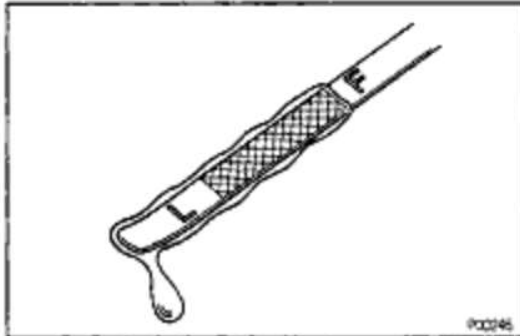
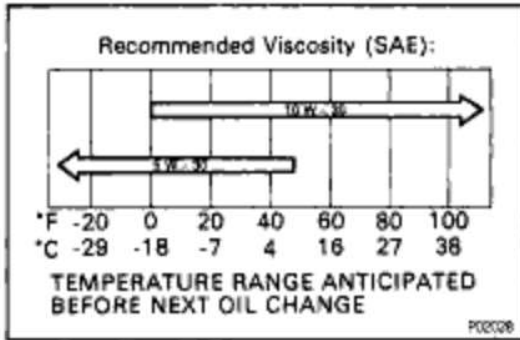
SSM (SPECIAL SERVICE MATERIALS)

88871-01

08826-00080 Seal packing or equivalent	Oil pan
08833-00080 Adhesive 1344, THREE BOND 1344, LOCTITE 242 or equivalent	Oil pressure switch

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5S-FE ENGINE - LUBRICATION SYSTEM



OIL PRESSURE CHECK

1. CHECK ENGINE OIL QUALITY

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

If the quality is visibly poor, replace the oil.

Oil grade:

API grade SG or SH, Energy Conserving II multi-grade engine oil or ILSAC multigrade engine oil.

Recommended viscosity is as shown in the illustration.

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:

- When inserting the oil dipstick, insert the curved tip of the dipstick facing the same direction as the curve of the guide.
- If the dipstick gets caught while inserting it, do not force it in. Reconfirm the direction of the dipstick.

3. REMOVE OIL PRESSURE SWITCH, AND INSTALL OIL PRESSURE GAUGE

4. WARM UP ENGINE

Allow the engine to warm up to normal operating temperature.

5. CHECK OIL PRESSURE

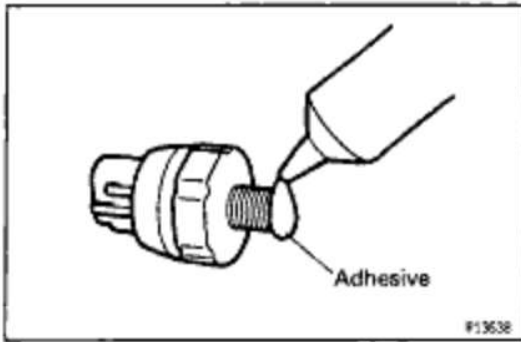
Oil pressure:

At idle

29 kPa (0.3 kgf/cm², 4.3 psi) or more

At 3,000 rpm

245 – 490 kPa (2.5 – 5.0 kg f/cm², 36 – 71 psi)

**6. REMOVE OIL PRESSURE GAUGE AND REINSTALL OIL PRESSURE SWITCH**

- (a) Remove the oil pressure gauge.
- (b) Apply adhesive to 2 or 3 threads of the oil pressure switch.

Adhesive:

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

- (c) Reinstall the oil pressure switch.

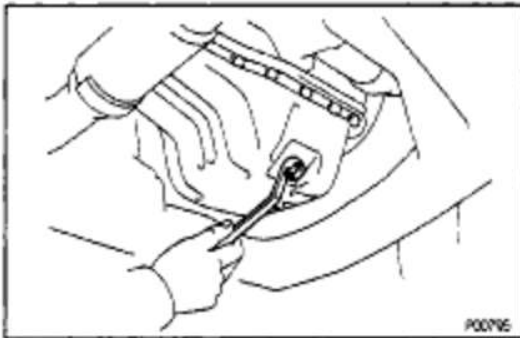
7. START ENGINE AND CHECK FOR LEAKS

OIL AND FILTER REPLACEMENT

CAUTION:

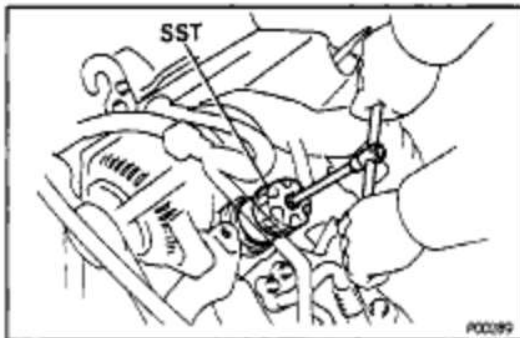
8847V-14

- 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.
- 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 water-less 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 filter must be disposed of only at designated disposal sites.



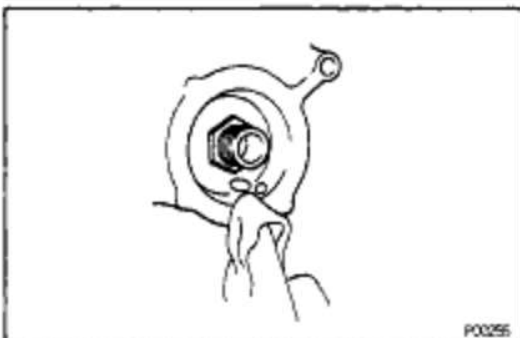
1. DRAIN ENGINE OIL

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

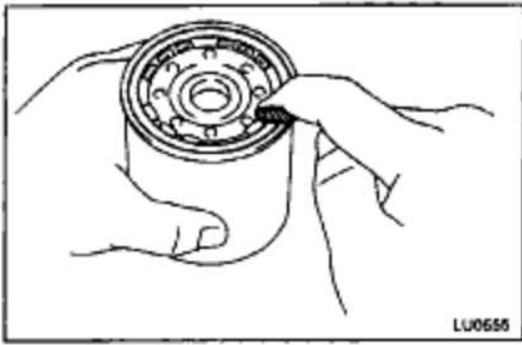


2. REPLACE OIL FILTER

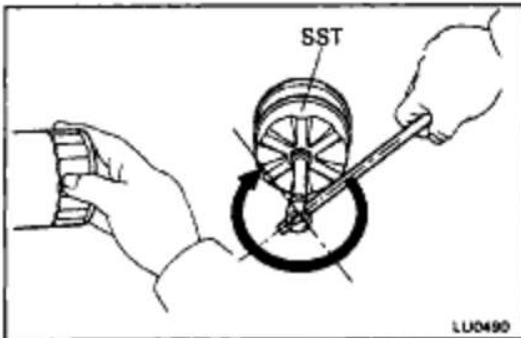
- Using SST, remove the oil filter.
SST 09228-06500



- Check and clean 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 an additional 3/4 turn.
SST 09228-06500

3. FILL WITH ENGINE OIL

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

Torque: 39 N-m (400 kgf-cm, 29 ft-lbf)

(b) Fill with new engine oil.

Oil grade: (See step 1 on page EG1-272)

Capacity (M/T):

Drain and refill

w/ Oil filter change

3.6 liters (3.8 US qts, 3.2 Imp. qts)

w/o Oil filter change

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

Dry fill

4.2 liters (4.4 US qts, 3.7 Imp. qts)

Capacity (A/T):

Drain and refill

w/ Oil filter change

3.6 liters (3.8 US qts, 3.2 Imp. qts)

w/o Oil filter change

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

Dry fill

4.3 liters (4.5 US qts, 3.8 Imp. qts)

(c) Reinstall the oil filler cap.

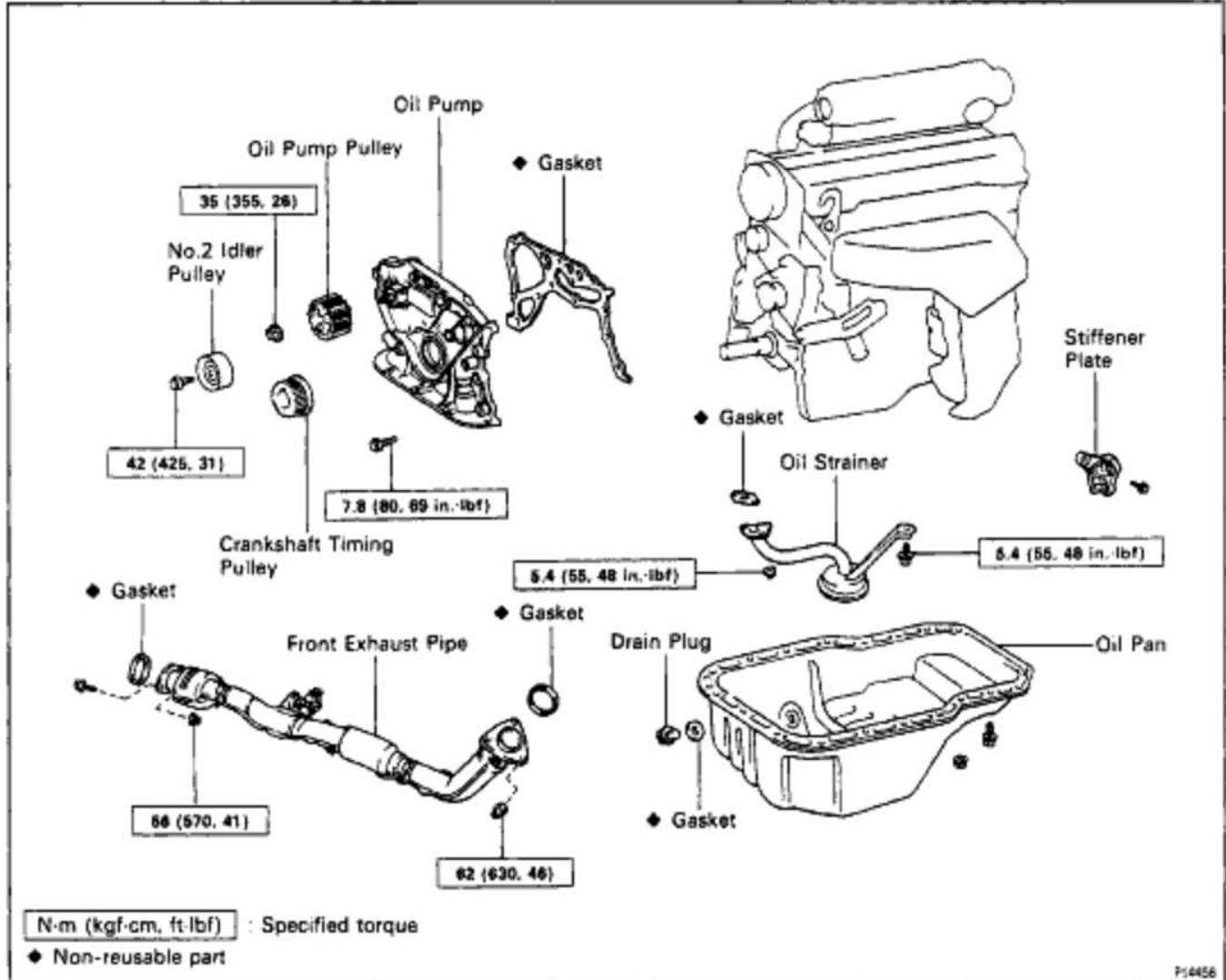
4. START ENGINE AND CHECK FOR LEAKS

5. RECHECK ENGINE OIL LEVEL

(See page EG1-272)

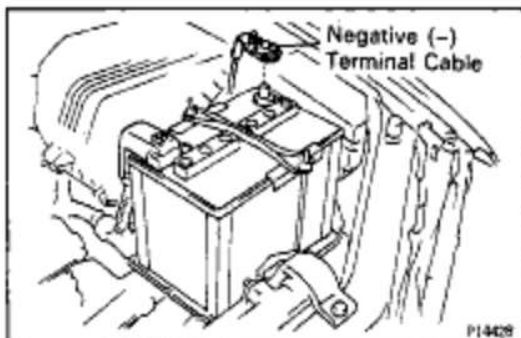
OIL PUMP

COMPONENTS FOR REMOVAL AND INSTALLATION



OIL PUMP REMOVAL

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

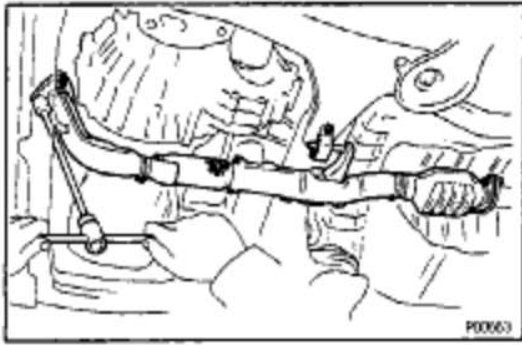


1. DISCONNECT NEGATIVE (-) TERMINAL CABLE FROM BATTERY

CAUTION: Work must be started after 90 seconds from the time the ignition switch is turned to the "LOCK" position and the negative (-) terminal cable is disconnected from the battery.

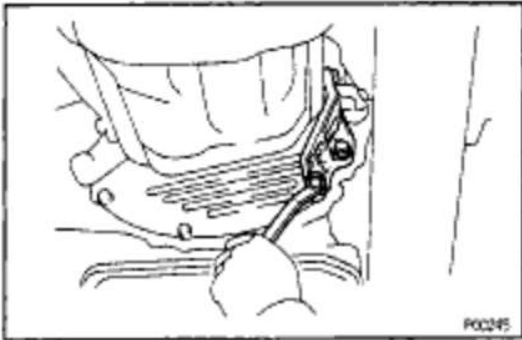
2. REMOVE HOOD

3. DRAIN ENGINE OIL (See page [EG1-274](#))



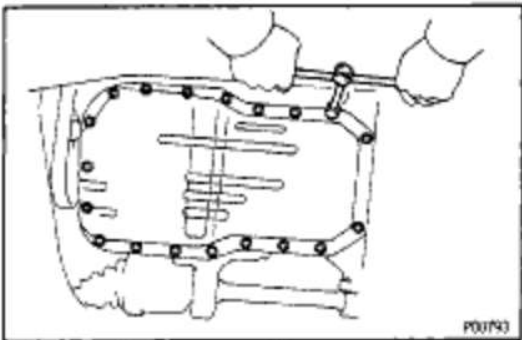
4. REMOVE FRONT EXHAUST PIPE

- (a) Loosen the 2 bolts, and disconnect the bracket.
- (b) Remove the 2 bolts and nuts holding the front exhaust pipe to the center exhaust pipe.
- (c) Using a 14 mm deep socket wrench, remove the 3 nuts holding the front exhaust pipe to the WU-TWC.
- (d) Remove the front exhaust pipe and gaskets.



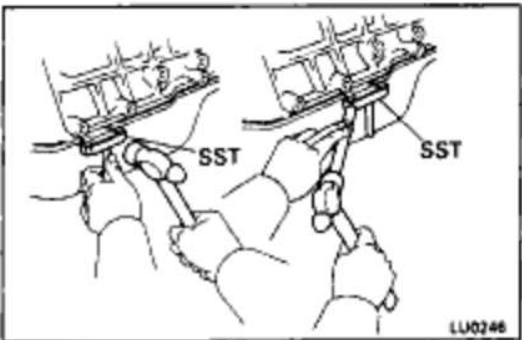
5. REMOVE STIFFENER PLATE

Remove the 3 bolts and stiffener plate.



6. REMOVE OIL PAN

- (a) Remove the dipstick.
- (b) Remove the 17 bolts and 2 nuts.

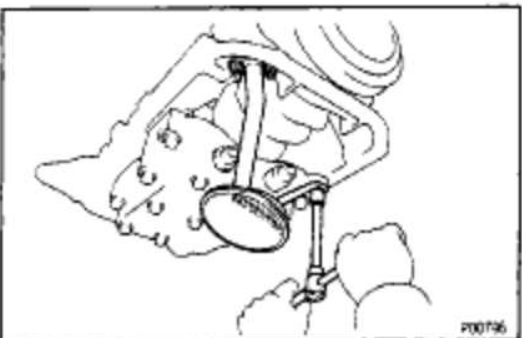


- (c) Insert the blade of SST between the cylinder block and oil pan, and cut off applied sealer and remove the oil pan.

SST 09032 - 00100

NOTICE:

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

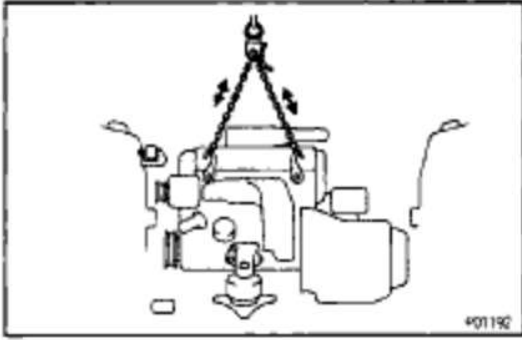


7. REMOVE OIL STRAINER

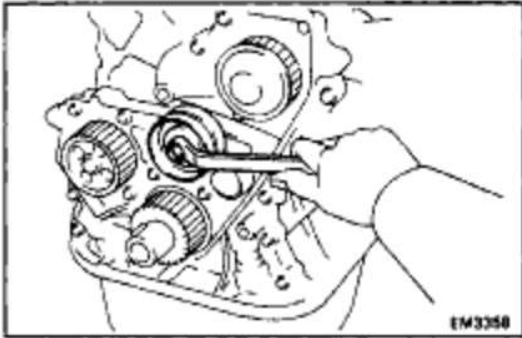
Remove the bolt, nuts, oil strainer and gasket.

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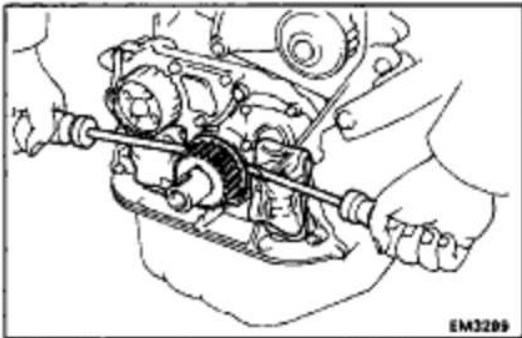


8. SUSPEND ENGINE WITH ENGINE SLING DEVICE
9. REMOVE TIMING BELT (See page EG1-26)



10. REMOVE NO.2 IDLER PULLEY

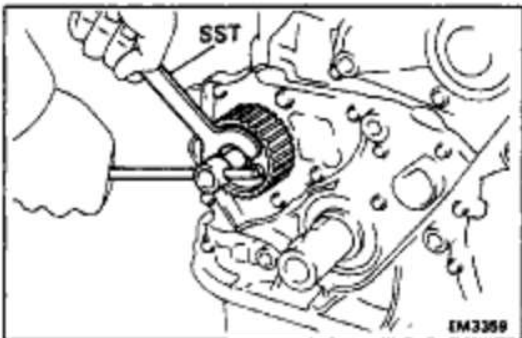
Remove the bolt and pulley.



11. REMOVE CRANKSHAFT TIMING PULLEY

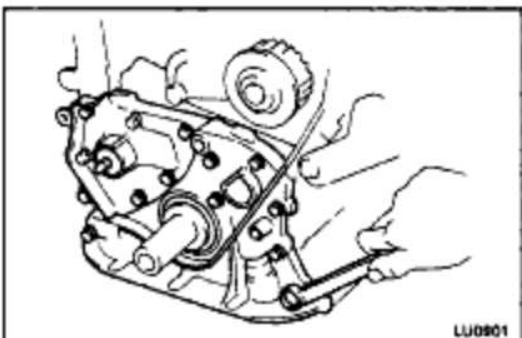
If the pulley cannot be removed by hand, use 2 screwdrivers.

HINT: Position shop rags as shown to prevent damage.



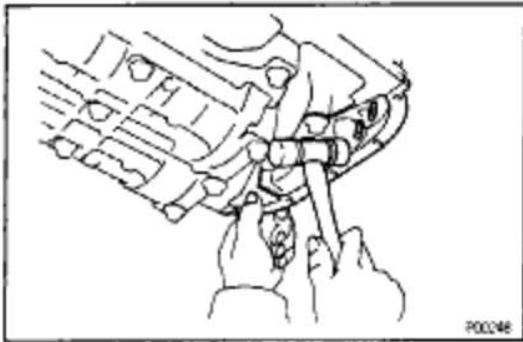
12. REMOVE OIL PUMP PULLEY

Using SST, remove the nut and pulley.
SST 09616 - 30011



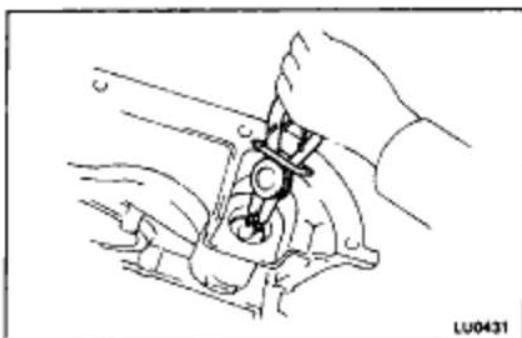
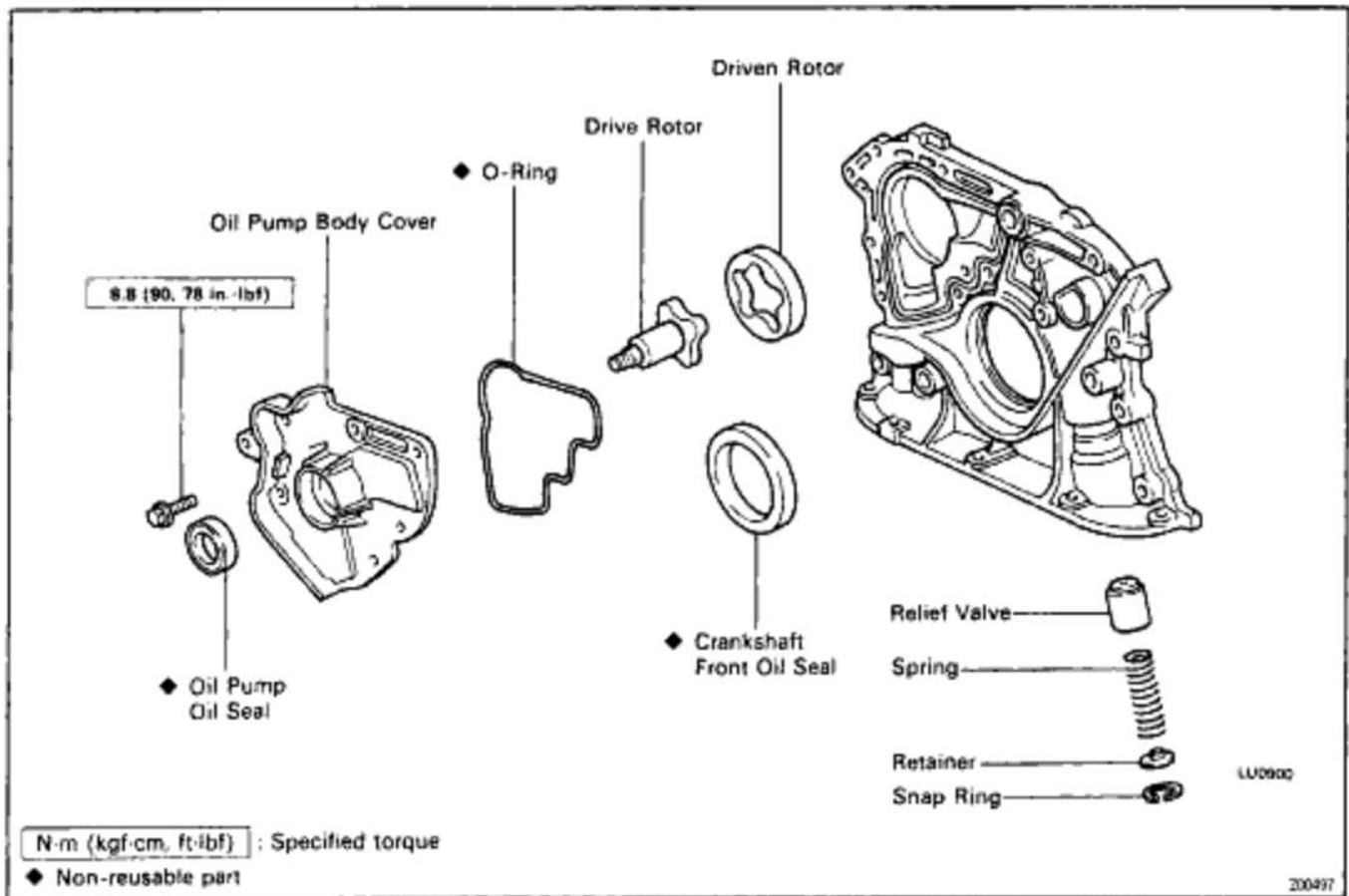
13. REMOVE OIL PUMP

(a) Remove the 12 bolts.



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

COMPONENTS FOR DISASSEMBLY AND ASSEMBLY



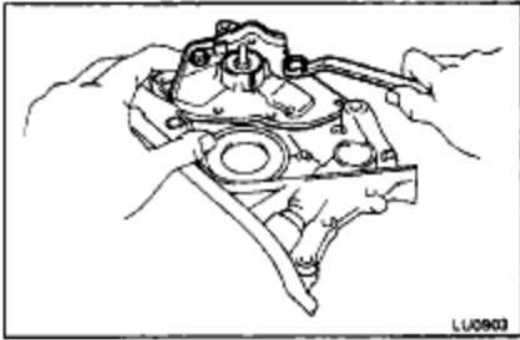
OIL PUMP DISASSEMBLY

1. REMOVE RELIEF VALVE

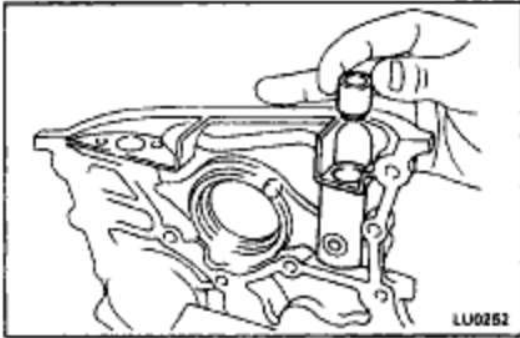
- (a) Using snap ring pliers, remove the snap ring.
 (b) Remove the retainer, spring and relief valve.

EG1-280

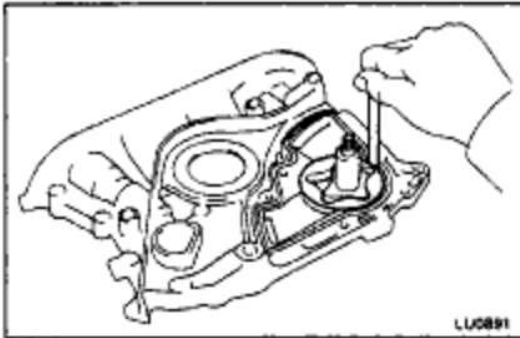
5S-FE ENGINE - LUBRICATION SYSTEM

**2. REMOVE DRIVE AND DRIVEN ROTORS**

Remove the 2 bolts, pump body cover, O-ring, the drive and driven rotors.

**OIL PUMP INSPECTION****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.

**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 – 0.16 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 rotors as a set. If necessary, replace the oil pump assembly.

B. Inspect rotor tip clearance

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

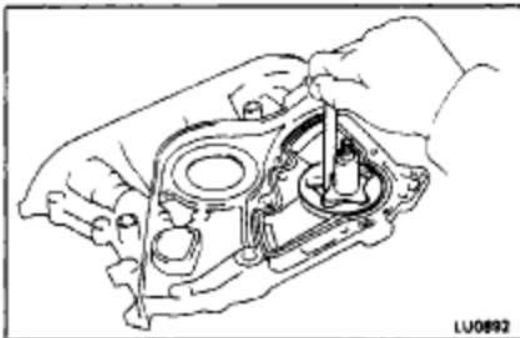
Standard tip clearance:

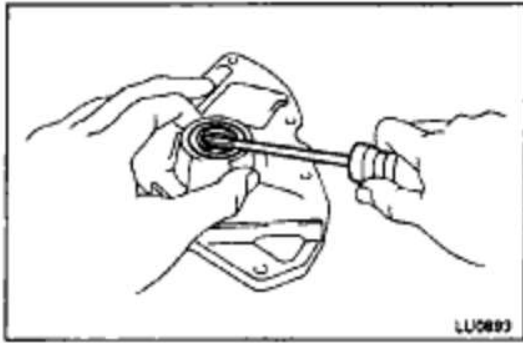
0.04 – 0.16 mm (0.0016 – 0.0063 in.)

Maximum tip clearance:

0.20 mm (0.0079 in.)

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

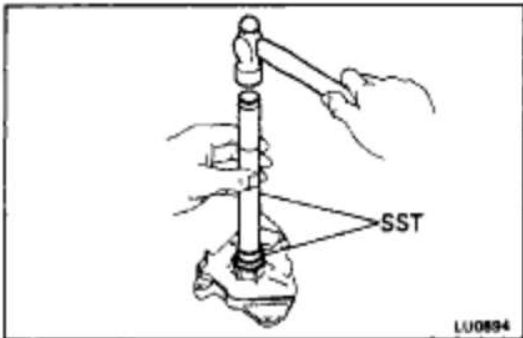




OIL PUMP OIL SEAL REPLACEMENT

1. REMOVE OIL SEAL

Using a screwdriver, pry out the oil seal.



2. INSTALL OIL SEAL

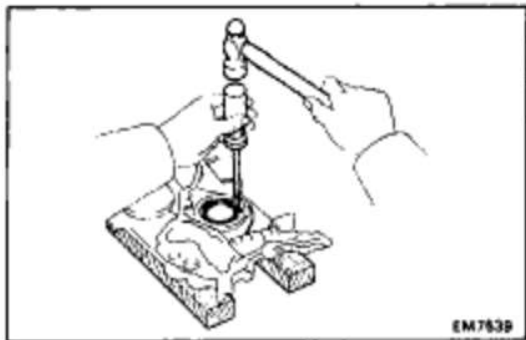
(a) Using SST and a hammer, tap in a new oil seal until its surface is flush with the oil pump cover edge.

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

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

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

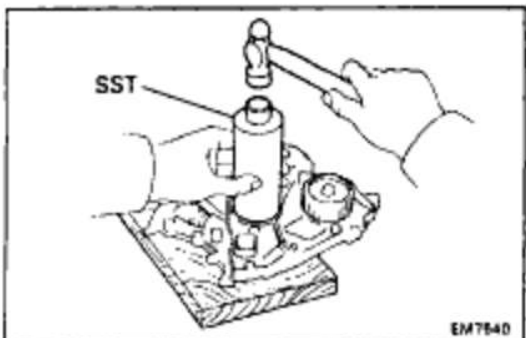
HINT: There are 2 methods (A and B) to replace the oil seal which are as follows:



REPLACE CRANKSHAFT FRONT OIL SEAL

A. If oil pump is removed from cylinder block:

(a) Using screwdriver and hammer, tap out the oil seal.



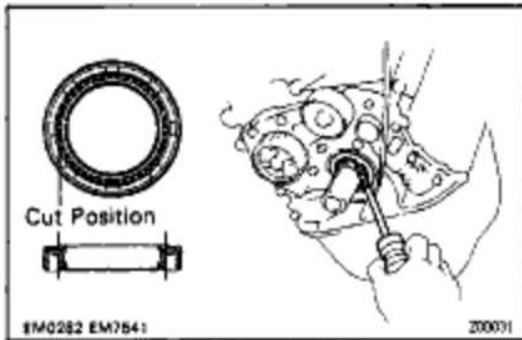
(b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the oil pump case edge.

SST 09226-10010

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

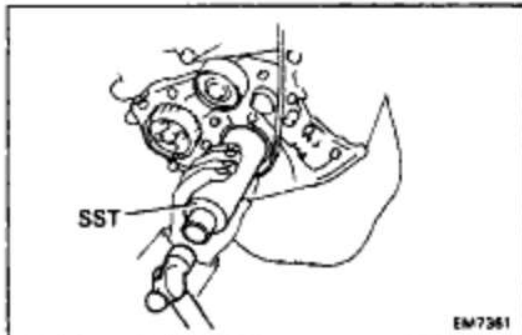
EG1-282

5S-FE ENGINE - LUBRICATION SYSTEM

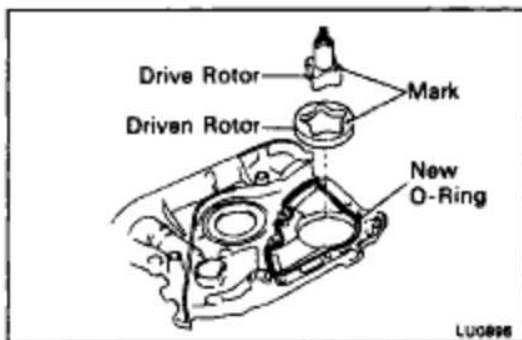
**B. If oil pump is installed to the cylinder block:**

- (a) Using a knife, cut off the oil seal lip.
- (b) Using a screwdriver, pry out the oil seal.

NOTICE: Be careful not to damage the crankshaft. Tape the screwdriver tip.



- (c) Apply MP grease to a new oil seal lip.
- (d) Using SST and a hammer, tap in the oil seal until its surface is flush with the oil pump case edge.
SST 09226 -10010

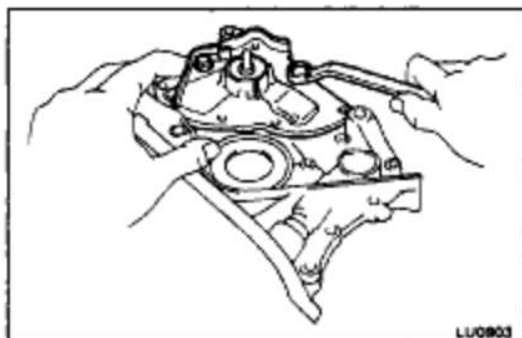
**OIL PUMP ASSEMBLY**

FORM-01

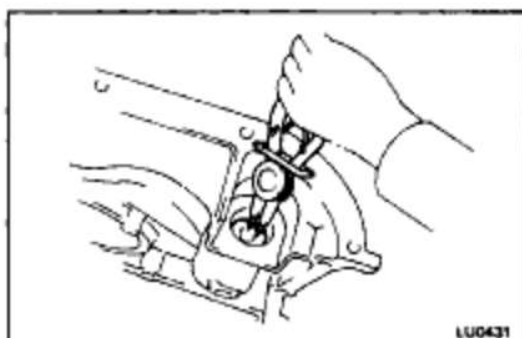
(See Components for Disassembly and Assembly)

1. INSTALL DRIVE AND DRIVEN ROTORS

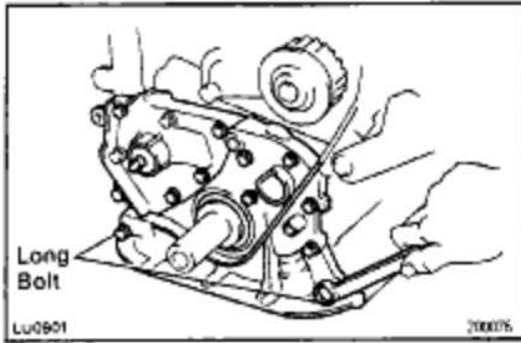
- (a) Place the drive and driven rotors into pump body with the marks facing the pump body cover side.



- (b) Install the pump body cover with the 2 bolts.
Torque: 8.8 N-m (90 kgf-cm. 78 in.-lbf)

**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.



OIL PUMP INSTALLATION

(See Components for Removal and Installation)

1. INSTALL OIL PUMP

Install a new gasket and the oil pump with the 12 bolts.

Torque: 9.3 N-m (95 kgf-cm, 82 in.-lbf)

HINT: Long bolts are indicated in the illustration.

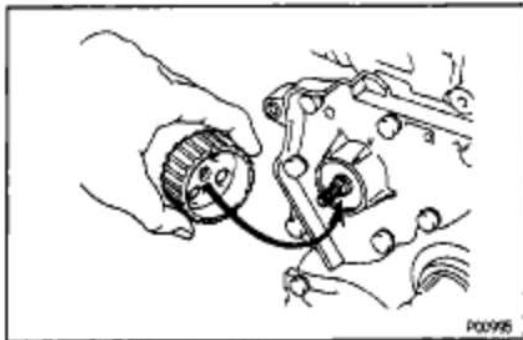
Bolt length:

Long bolt

35 mm (1.38 in.)

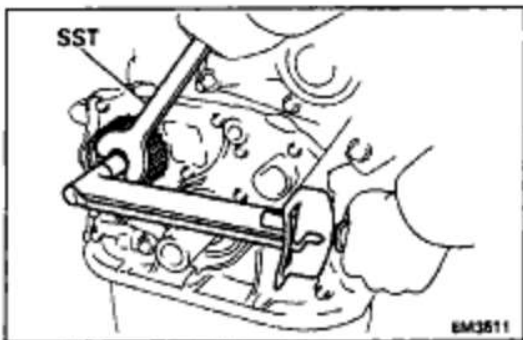
Others

25 mm (0.98 in.)



2. INSTALL OIL PUMP PULLEY

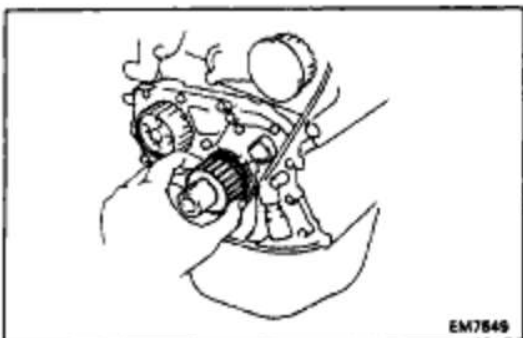
(a) Align the cutouts of the pulley and shaft, and slide on the pulley.



(b) Using SST, install the nut.

SST 09616-30011

Torque: 28 N-m (290 kgf-cm, 21 ft-lbf)



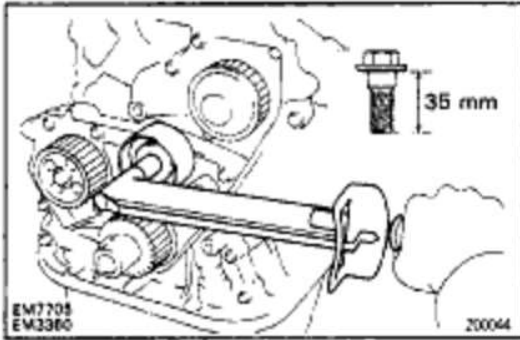
3. INSTALL CRANKSHAFT TIMING PULLEY

(a) Align the timing pulley set key with the key groove of the pulley.

(b) Slide on the timing pulley, facing the flange side inward.

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5S-FE ENGINE - LUBRICATION SYSTEM

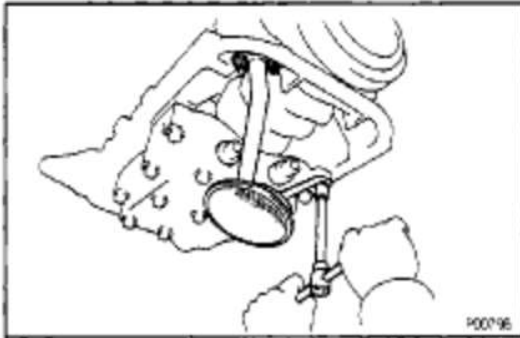
**4. INSTALL NO.2 IDLER PULLEY**

(a) Install the pulley with the bolt.

Torque: 42 N-m (425 kgf-cm, 31 ft-lbf)

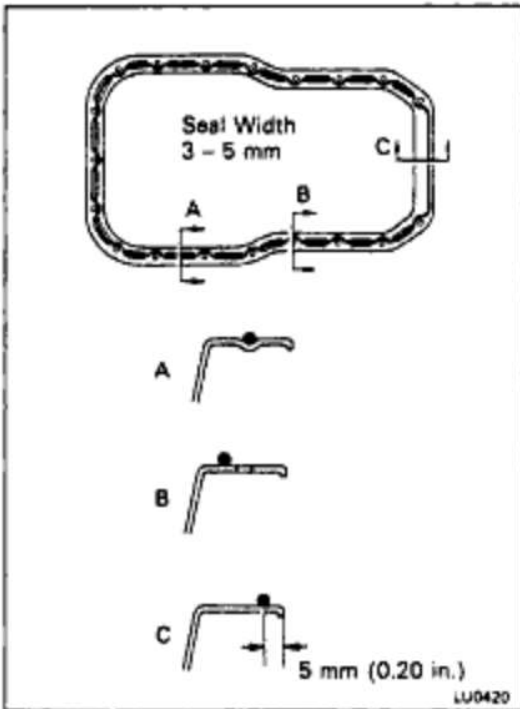
HINT: Use a bolt 35 mm (1.38 in.) in length.

(b) Check that the idler pulley moves smoothly.

5. INSTALL TIMING BELT (See page EG1-33)**6. REMOVE ENGINE SLING DEVICE****7. INSTALL OIL STRAINER**

Install a new gasket and the oil strainer with bolt and nuts.

Torque: 5.4 N-m (55 kgf-cm, 48 in.-lbf)

**8. 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.

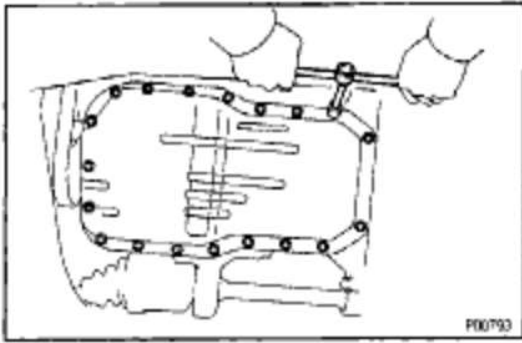
NOTICE: Do not use a solvent which will affect the painted surfaces.

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

Seal packing:

Part No.08826 - 00080 or equivalent

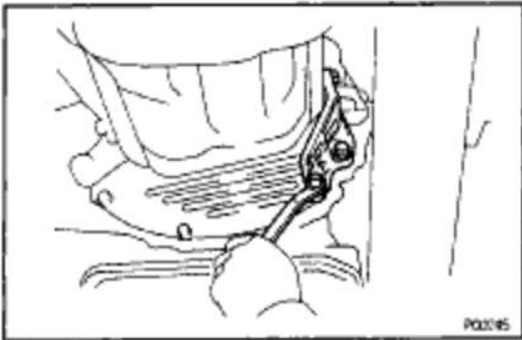
- Install a nozzle that has been cut to a 3-5 mm (0.12-0.20 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.



(c) Install the oil pan with 17 bolts and 4 nuts.

Torque: 5.4 N-m (55 kgf-cm, 48 in.-lbf)

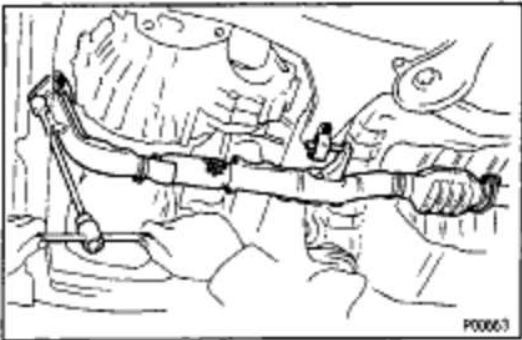
(d) Install the dipstick.



9. INSTALL STIFFENER PLATE

Install the stiffener plate with the 3 bolts.

Torque: 37 N-m (380 kgf-cm, 27 ft-lbf)



10. INSTALL FRONT EXHAUST PIPE

(a) Place 2 new gaskets on the front and rear of the front exhaust pipe.

(b) Temporarily install the 2 bolts and 2 new nuts holding front exhaust pipe to the center exhaust pipe.

(c) Using a 14 mm deep socket wrench, install the 3 new nuts holding the front exhaust pipe to the WU-TWC.

Torque: 62 N-m (630 kgf-cm, 46 ft-lbf)

(d) Tighten the 2 bolts and 2 nuts holding front exhaust pipe to the center exhaust pipe.

Torque: 56 N-m (570 kgf-cm, 41 ft-lbf)

(e) Install the bracket with the 2 bolts.

11. CONNECT NEGATIVE (-) TERMINAL CABLE TO BATTERY

12. FILL WITH ENGINE OIL (See page [EG1-275](#))

13. START ENGINE AND CHECK FOR LEAKS

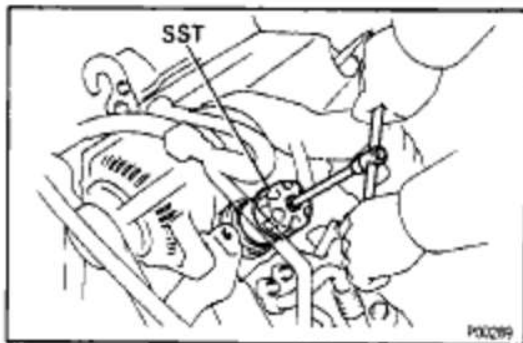
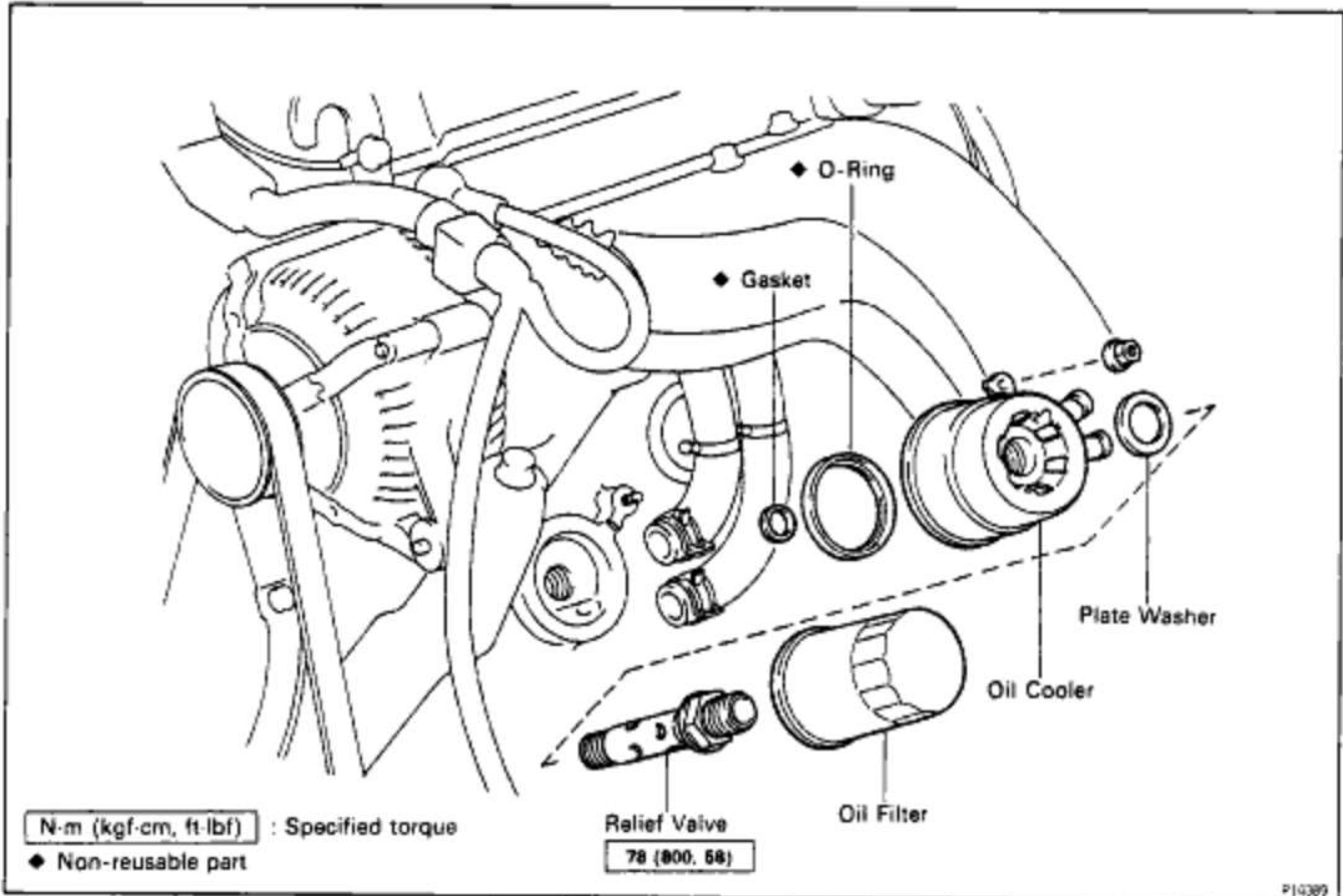
14. RECHECK ENGINE OIL LEVEL

15. INSTALL HOOD

EG1-286

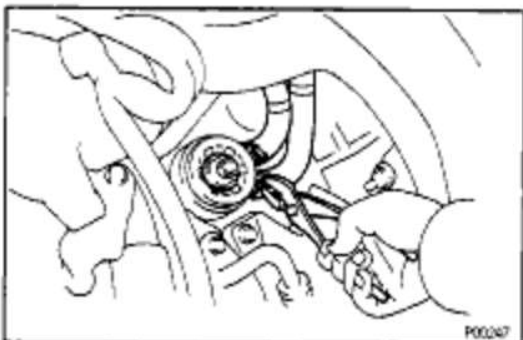
5S-FE ENGINE - LUBRICATION SYSTEM

OIL COOLER COMPONENTS FOR REMOVAL AND INSTALLATION



OIL COOLER REMOVAL

1. DRAIN ENGINE COOLANT
 2. REMOVE OIL FILTER
- Using SST, remove the oil filter.
SST 09228-06500

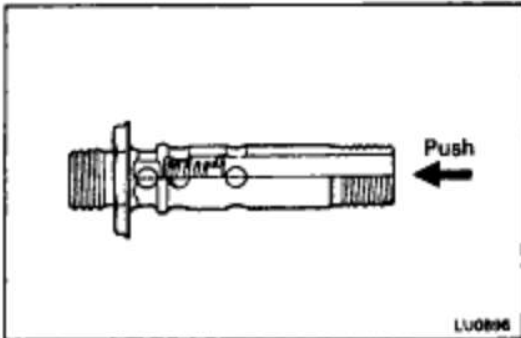


3. DISCONNECT WATER BYPASS HOSES FROM OIL COOLER
- Disconnect the 2 water bypass hoses.



4. REMOVE OIL COOLER

- (a) Remove the relief valve and plate washer.
- (b) Remove the nut and oil cooler.
- (c) Remove the O-ring and gasket from the oil cooler.

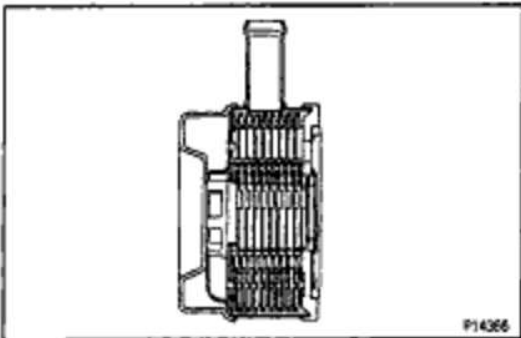


OIL COOLER INSPECTION

1. INSPECT RELIEF VALVE

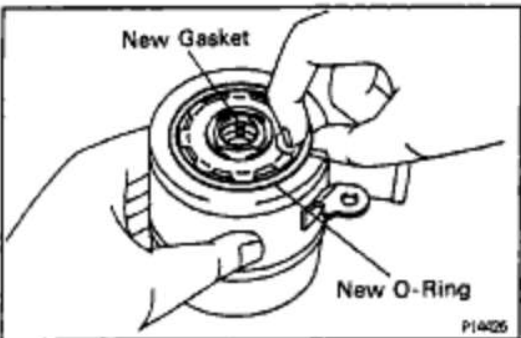
Push the valve with a wooden stick to check if it is stuck.

If stuck, replace the relief valve.



2. INSPECT OIL COOLER

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



OIL COOLER INSTALLATION

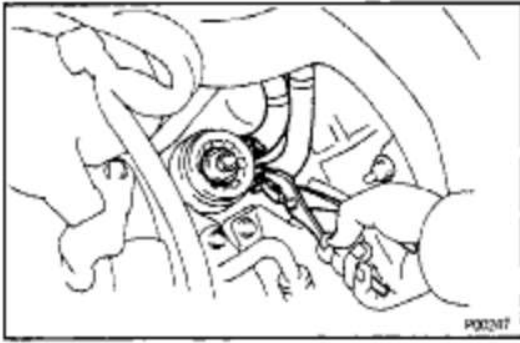
(See Components for Removal and Installation)

1. INSTALL OIL COOLER

- (a) Install new O-ring and gasket to the oil cooler.



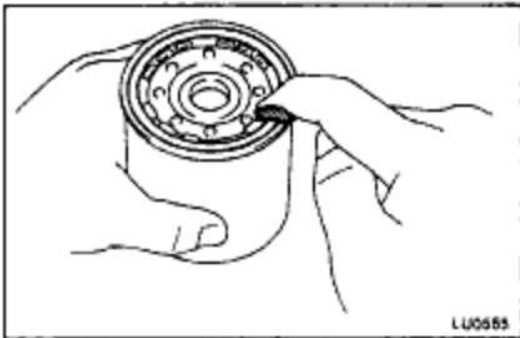
- (b) Apply a light coat of engine oil on the threads and under the head of the relief valve.
- (c) Temporarily install the oil cooler with the nut.
- (d) Install the plate washer and relief valve.
Torque: 78 N-m (800 kgf-cm, 58 ft-lbf)
- (e) Tighten the nut.
Torque: 7.8 N-m (80 kgf-cm, 69 In.-lbf)

EG1-288**5S-FE ENGINE - LUBRICATION SYSTEM****2. CONNECT WATER BYPASS HOSES**

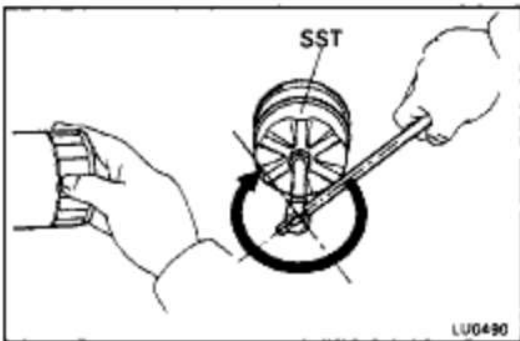
Connect the 2 water bypass hoses.

**3. INSTALL OIL FILTER**

(a) Clean the oil filter contact surface on the filter mounting.



(b) Lubricate the filter rubber gasket with engine oil.



(c) Tighten the oil filter by hand until the rubber gasket contacts the seat of the filler mounting. Then using SST, give it an additional 3/4 turn to seat the oil filter.
SST 09228-06500

4. FILL WITH ENGINE COOLANT

(See page [EG1-241](#))

5. START ENGINE AND CHECK FOR LEAKS**6. CHECK ENGINE OIL LEVEL**

SERVICE SPECIFICATIONS

SERVICE DATA

82088-01

Oil pressure		at idle speed at 3,000 rpm	29 kPa (0.3 kgf/cm ² , 43 psi) or more 245 - 480 kPa (2.5 - 5.0 kgf/cm ² , 36 - 71 psi)
Oil pump	Body clearance	STD	0.10 - 0.16 mm (0.0039 - 0.0063 in.)
		Limit	0.20 mm (0.0079 in.)
	Tip clearance	STD	0.04 - 0.16 mm (0.0016 - 0.0063 in.)
		Limit	0.20 mm (0.0079 in.)

TORQUE SPECIFICATIONS

82088-07

Part tightened	N·m	kgf·cm	ft·lbf
Oil pan x Drain plug	39	400	29
Oil pump body cover x Oil pump body	8.8	90	78 in.-lbf
Oil pump x Cylinder block	9.3	95	82 in.-lbf
Oil pump pulley x Oil pump drive shaft	26	290	21
No.2 idler pulley x Cylinder block	42	425	31
Oil strainer x Cylinder block	5.4	55	48 in.-lbf
Oil strainer x Oil pump	5.4	55	48 in.-lbf
Oil pan x Cylinder block	5.4	55	48 in.-lbf
Oil pan x Oil pump	5.4	55	48 in.-lbf
Stiffener plate x Cylinder block	37	380	27
Stiffener plate x Transaxle case	37	380	27
Front exhaust pipe x WU-TWC	62	630	46
Front exhaust pipe x Center exhaust pipe	56	570	41
Oil cooler x Cylinder block (Relief valve)	78	800	58
Oil cooler x Cylinder block (Nut)	7.8	80	69 in.-lbf

5S-FE ENGINE –

-Memo