

LUBRICATION SYSTEM

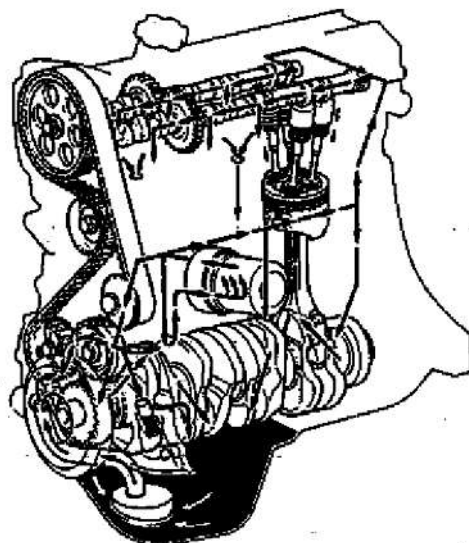
DESCRIPTION

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

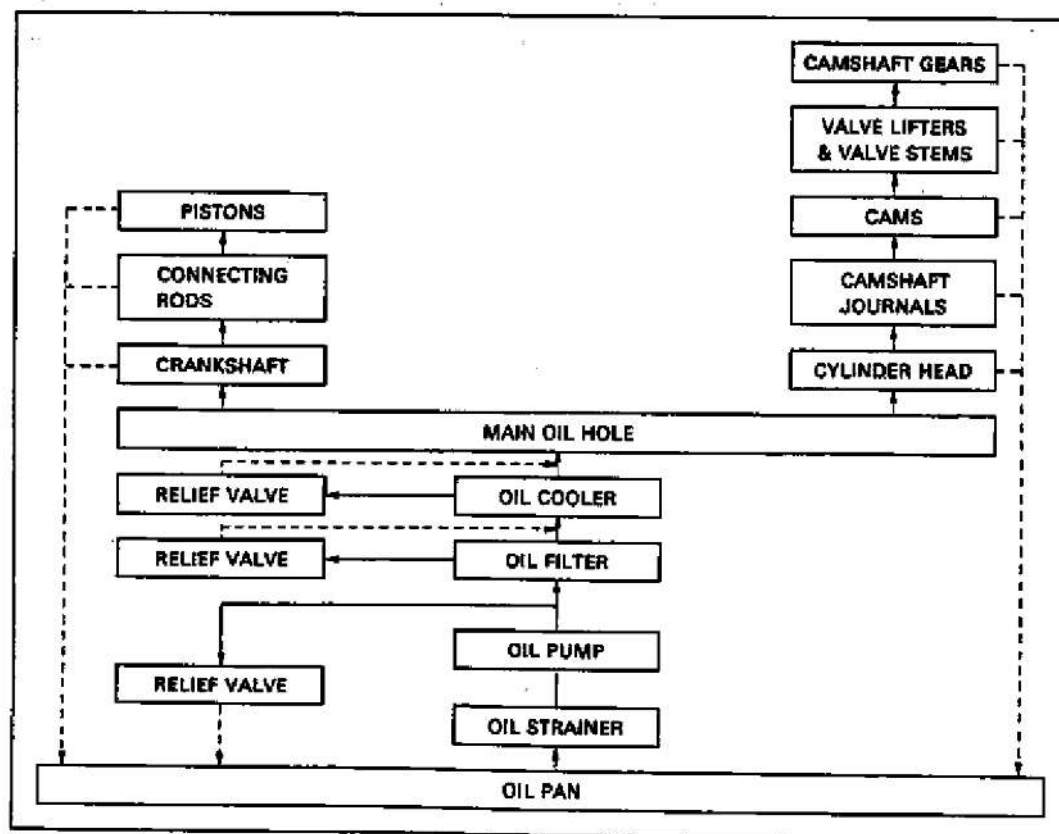
60140-04

OPERATION

EG



LU0910



Z02904

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 on 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.

EG

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 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 bypass the oil filter and flows directly into the main oil hole in the engine.

PREPARATION

SST (SPECIAL SERVICE TOOLS)

8844-0A

	09032-00100 Oil Pan Seal Cutter	
	09226-10010 Crankshaft Front & Rear Bearing Replacer	Crankshaft front oil seal
	09228-08500 Oil Filter Wrench	
	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
	09960-10010 Variable Pin Wrench Set	
	(09962-01000) Variable Pin Wrench Arm Assy	Oil pump pulley
	(09963-00500) Pin 5	Oil pump pulley

8844-07

RECOMMENDED TOOLS

	09200-00010 Engine Adjust Kit	
	09905-00013 Snap Ring Pliers	

EQUIPMENT

B014W-0A

Oil pressure gauge	
Torque wrench	

LUBRICANT

B014X-0J

Item	Capacity	Classification
Engine oil		API grade SG, SH or ILSAC multigrade engine oil and recommended viscosity oil
Dry fill		
w/ Oil cooler	4.4 liters (4.7 US qts, 3.9 Imp. qts)	
w/o Oil cooler	4.3 liters (4.5 US qts, 3.8 Imp. qts)	
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)	

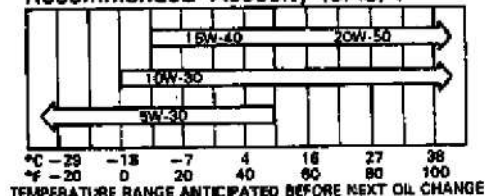
SSM (SPECIAL SERVICE MATERIALS)

B014Y-0A

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

EG

Recommended Viscosity (SAE) :



P02645

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:

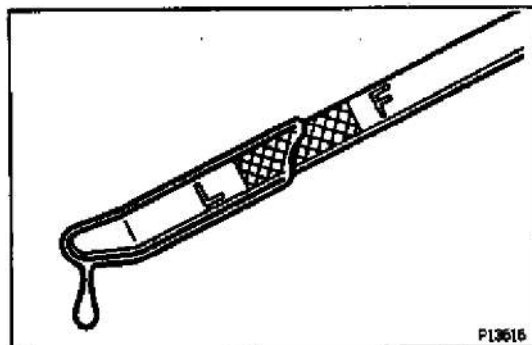
API grade SG, SH or ILSAC multigrade engine oil.

Recommended viscosity is as shown in the illustration.

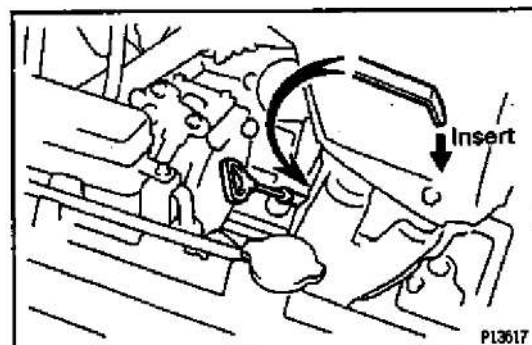
2. CHECK ENGINE OIL LEVEL

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.



P13616



P13617

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 kgf/cm², 36 – 71 psi)

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

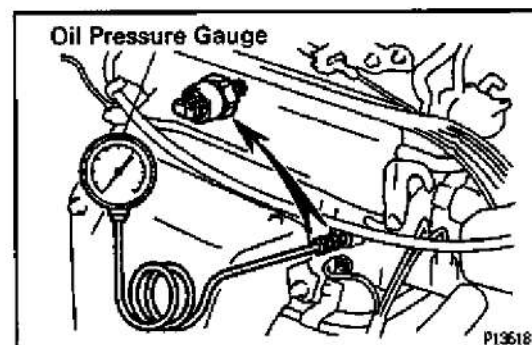
- Remove the oil pressure gauge.
- Apply adhesive to 2 or 3 threads of the oil pressure switch.

Adhesive:

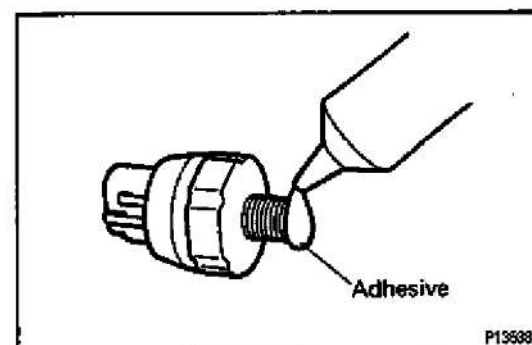
Part No. 08833-00080, THREE BOND 1344, LOCTITE 242 or equivalent

- Reinstall the oil pressure switch.

7. START ENGINE, AND CHECK FOR OIL LEAKS



P13618



P13638

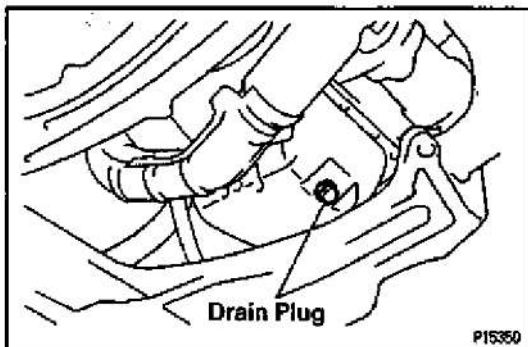
OIL AND FILTER REPLACEMENT

CAUTION:

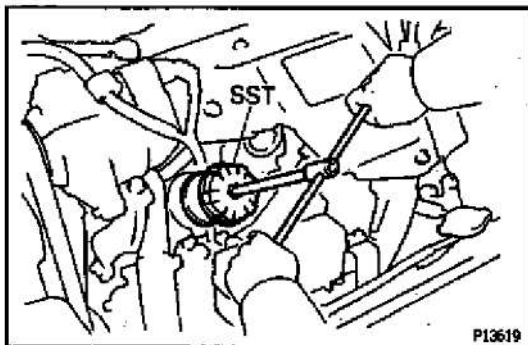
B9700-04

- 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.

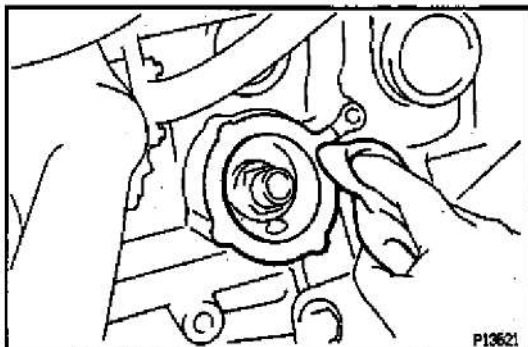
EG

**1. DRAIN ENGINE OIL**

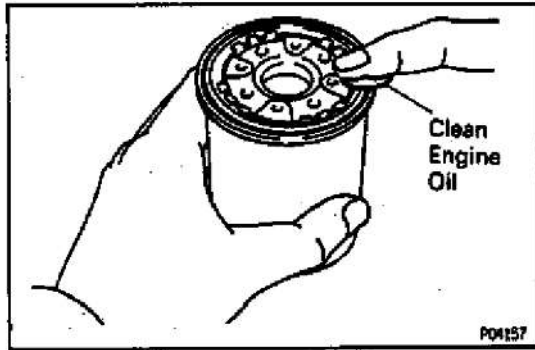
- (a) Remove the oil filler cap.
- (b) Remove the oil drain plug, and drain the oil into a container.

**2. REPLACE OIL FILTER**

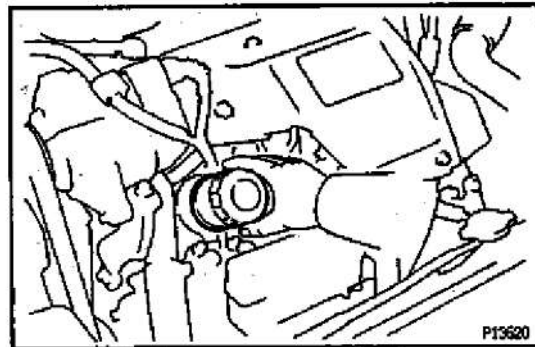
- (a) Using SST, remove the oil filter.
SST 09228-06500



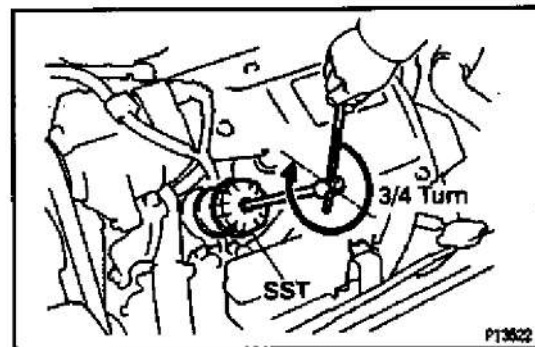
- (b) Clean the oil filter contact surface on the oil filter mounting.



- (c) Lubricate the filter rubber gasket with clean engine oil.

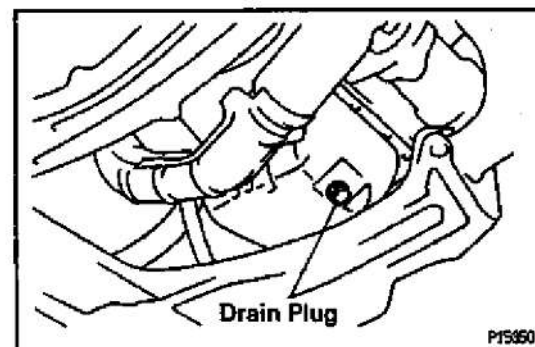


- (d) Tighten the oil filter by hand until the rubber gasket contacts the seat of the filter mounting.



- (e) Using SST, give it an additional 3/4 turn to seat the filter.

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 EG-340

Capacity:

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

w/ Oil cooler

4.4 liters (4.7 US qts, 3.9 Imp. qts)

w/o Oil cooler

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

- (c) Reinstall the oil filler cap.

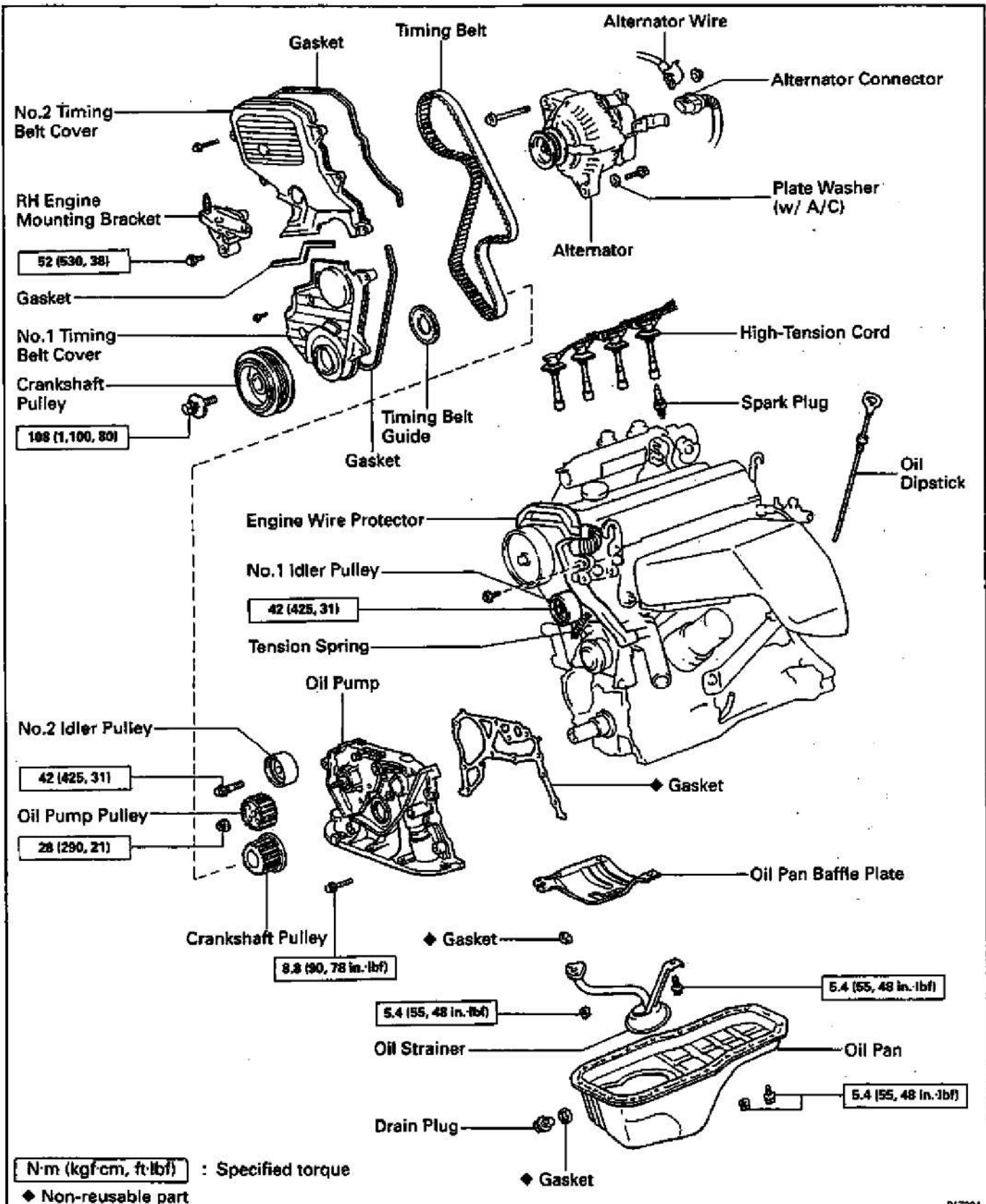
4. START ENGINE AND CHECK FOR OIL LEAKS

5. RECHECK ENGINE OIL LEVEL

OIL PUMP COMPONENTS FOR REMOVAL AND INSTALLATION

EG-343-01

EG

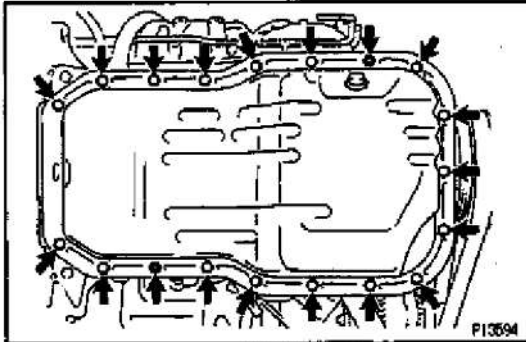


OIL PUMP REMOVAL**(See Components for Removal and Installation)**

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

1. DRAIN ENGINE OIL**2. REMOVE OIL PAN**

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

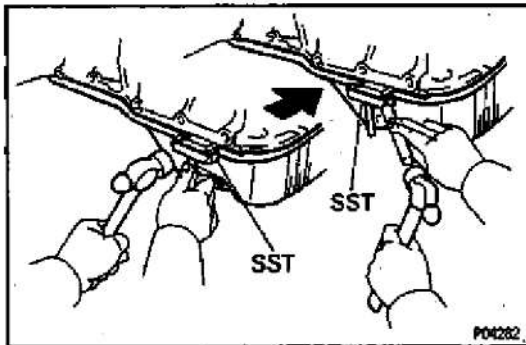


- (c) Insert the blade of SST between the cylinder block and oil pan, and cut off applied sealer and remove the oil pan.

SST 09032-00100

NOTICE:

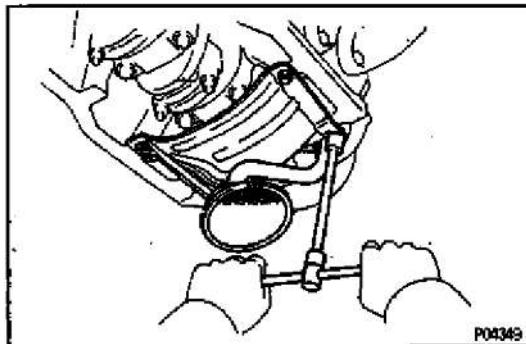
- Do not use SST for the oil pump body side and rear oil seal retainer.
- Be careful not to damage the oil pan flange.

**3. REMOVE OIL STRAINER AND OIL PAN BAFFLE PLATE**

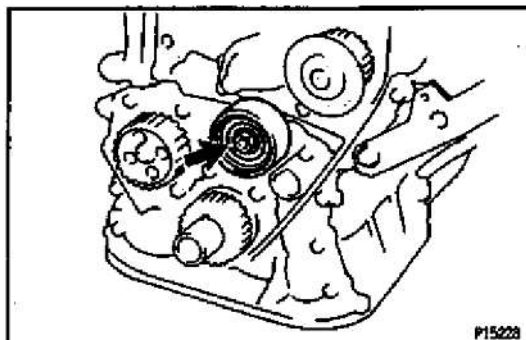
Remove the 2 bolts, 2 nuts, oil strainer, baffle plate and gasket.

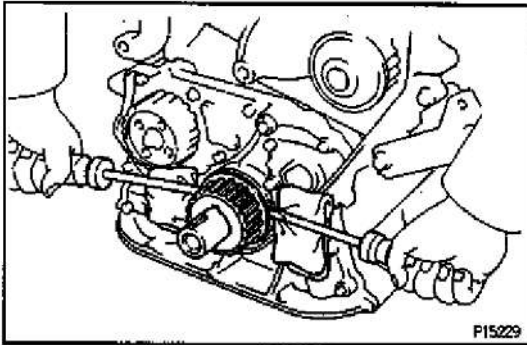
4. REMOVE TIMING BELT

(See steps 1 to 6 and 8 to 12 on pages EG-35 to 40)

**5. REMOVE NO.2 IDLER PULLEY**

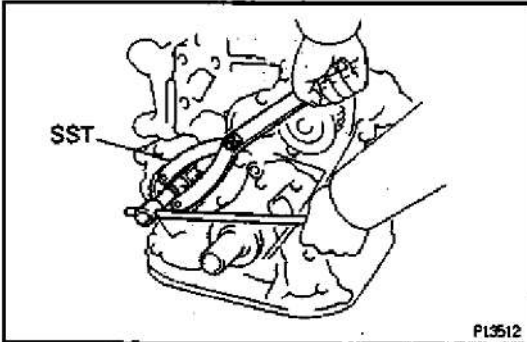
Remove the bolt and pulley.



**6. REMOVE CRANKSHAFT TIMING PULLEY**

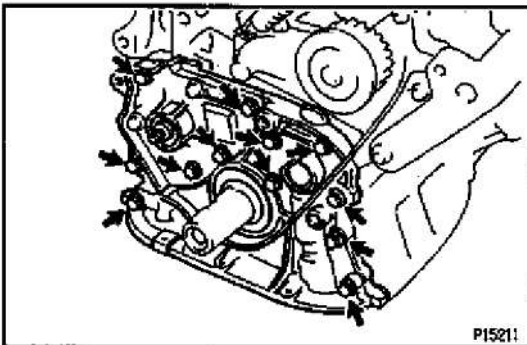
If the pulley cannot be removed by hand, use 2 screwdrivers.

HINT: Position shop rags as shown to prevent damage.

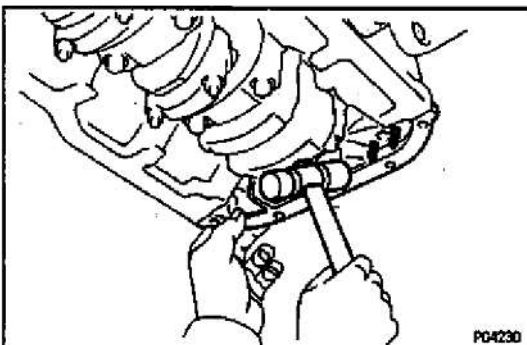
**7. REMOVE OIL PUMP PULLEY**

Using SST, remove the nut and pulley.

SST 09960-10010 (09962-01000, 09963-00500)

**8. REMOVE OIL PUMP**

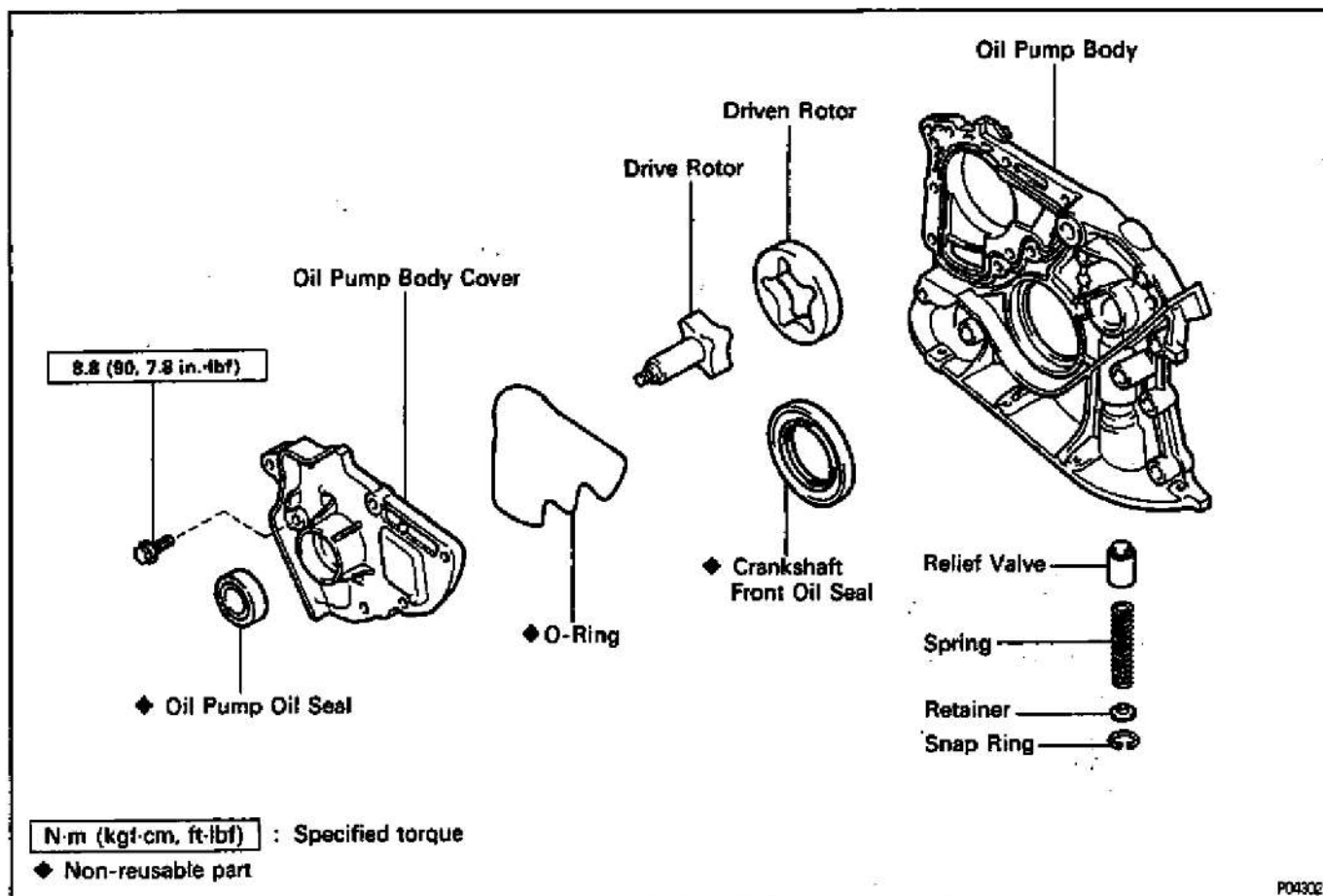
(a) Remove the 12 bolts.



(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



P04302

B0158-00

OIL PUMP DISASSEMBLY

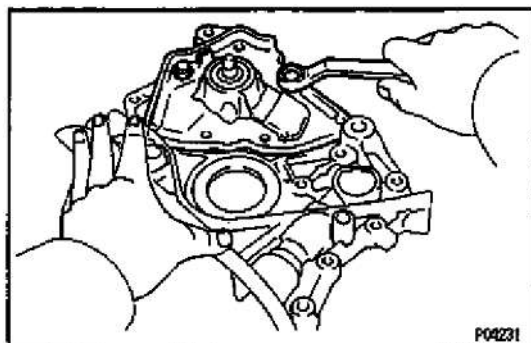
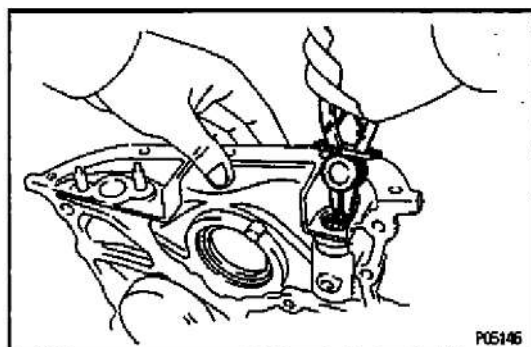
(See Components for Disassembly and Assembly)

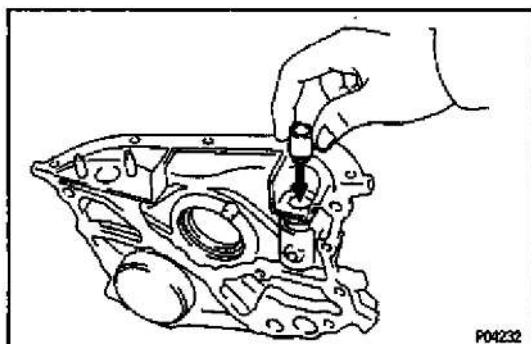
1. REMOVE RELIEF VALVE

- Using snap ring pliers, remove the snap ring.
- Remove the retainer, spring and relief valve.

2. REMOVE DRIVE AND DRIVEN ROTORS

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





P04232

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.

EG

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 rotors 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 rotor tips.

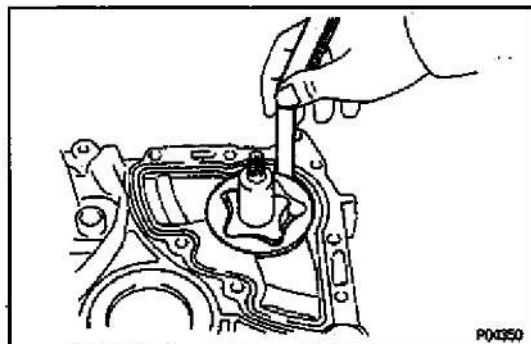
Standard tip clearance:

0.04 – 0.16 mm (0.0016 – 0.0063 in.)

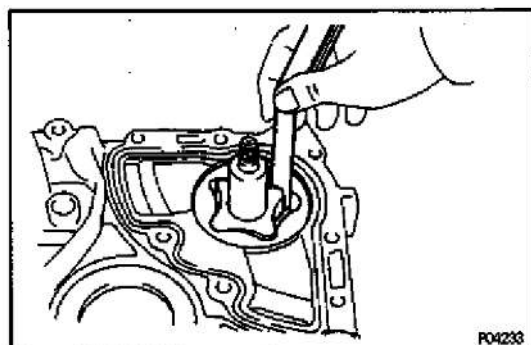
Maximum tip clearance:

0.20 mm (0.0079 in.)

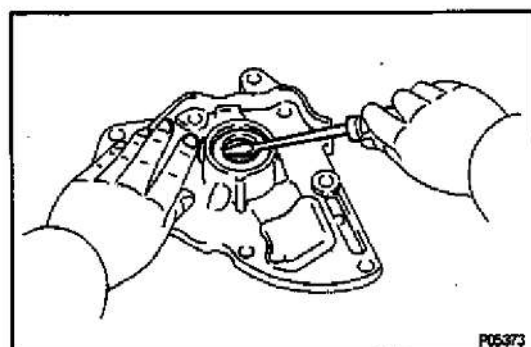
If the tip clearance is greater than maximum, replace the rotors as a set.



P04350



P04233



P05373

OIL PUMP OIL SEAL REPLACEMENT

1. REMOVE OIL SEAL

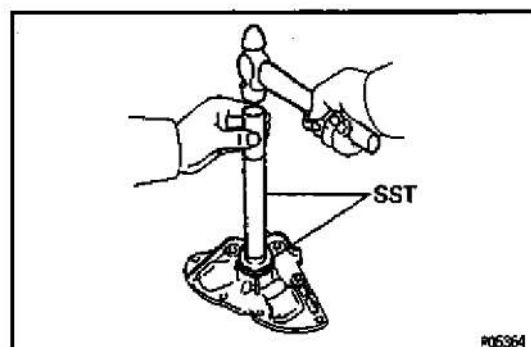
Using a screwdriver, pry out the oil seal.

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)

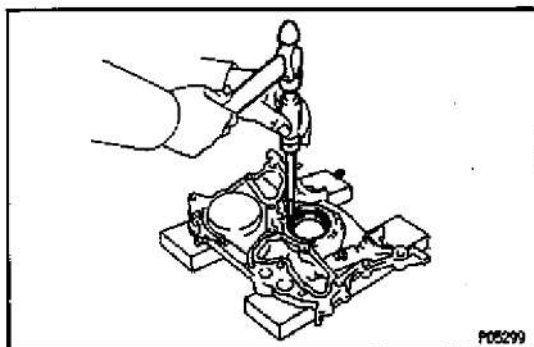
(b) Apply MP grease to the oil seal lip.



P05364

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

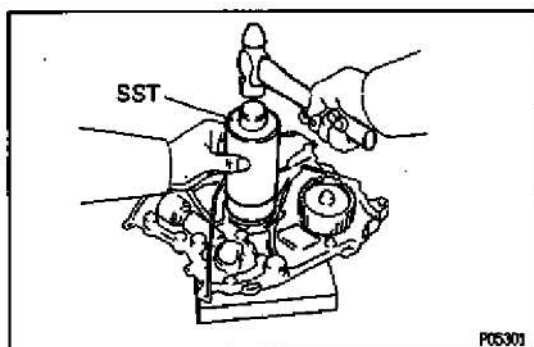
HINT: There are 2 methods (A and B) to replace the oil seal which are as follows:



REPLACE CRANKSHAFT FRONT OIL SEAL

A. If oil pump is removed from cylinder block:

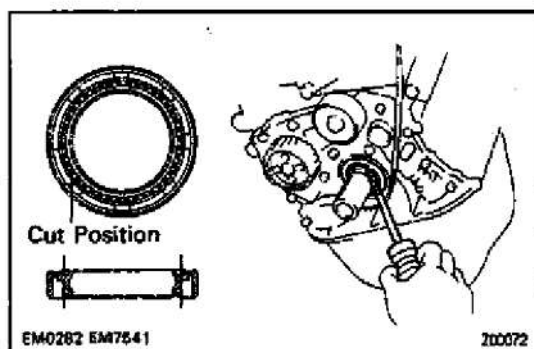
- (a) Using a screwdriver and hammer, tap out the oil seal.



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

SST 09226-10010

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

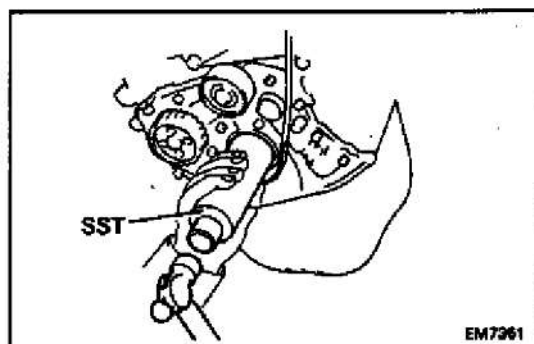


B. If oil pump is installed to the cylinder block:

- (a) Using a knife, cut off the oil seal lip.

- (b) Using a screwdriver, pry out the oil seal.

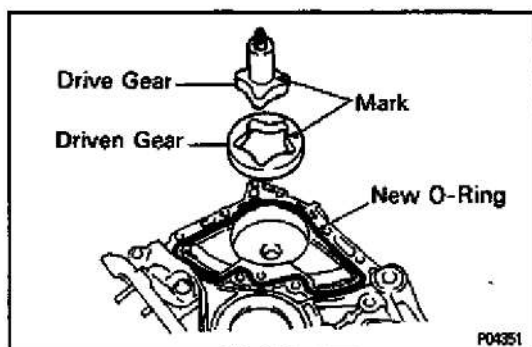
NOTICE: Be careful not to damage the crankshaft. Tape the screwdriver tip.



- (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 body edge.

SST 09226-10010



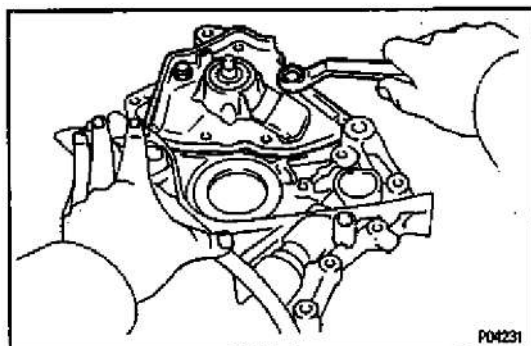
OIL PUMP ASSEMBLY

(See Components for Disassembly and Assembly)

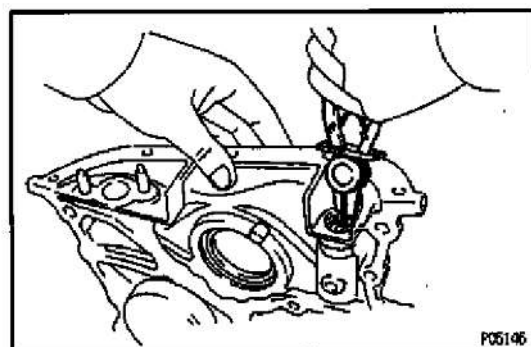
1. INSTALL DRIVE AND DRIVEN ROTORS

- (a) Place the drive and driven rotors into pump body with the marks facing the pump body cover side.
- (b) Install a new O-ring to the oil pump body.

EG

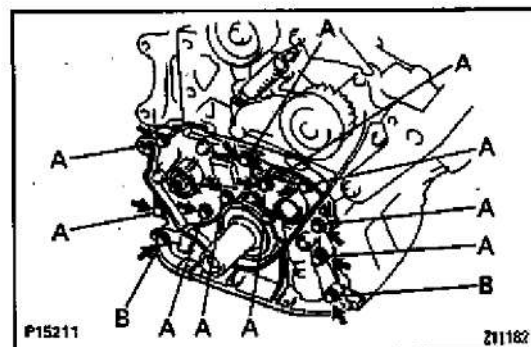


- (c) Install the oil pump body cover with the 2 bolts.
Torque: 8.8 N-m (90 kgf-cm, 78 in.-lbf)



2. INSTALL RELIEF VALVE

- (a) Insert the relief valve, spring and retainer into the oil 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. Uniformly tighten the bolts in several passes.

Torque: 8.8 N-m (90 kgf-cm, 78 in.-lbf)

HINT: Each bolt length is indicated in the illustration.

Bolt length:

A: 25 mm (0.98 in.)

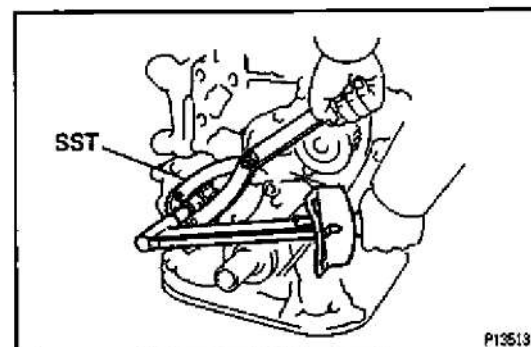
B: 35 mm (1.38 in.)

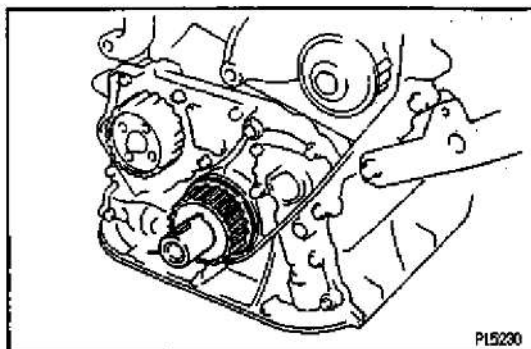
2. INSTALL OIL PUMP PULLEY

- (a) Align the cutouts of the pulley and shaft, and slide on the pulley.
- (b) Using SST, install the pulley nut.

SST 09960-10010 (09962-01000, 09963-00500)

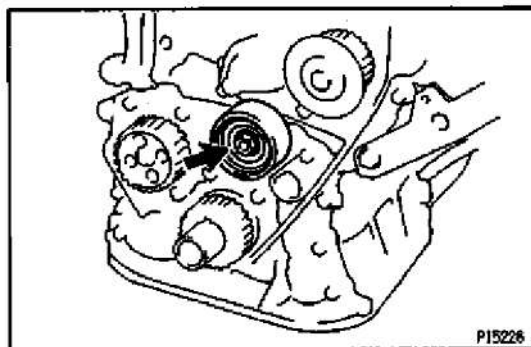
Torque: 28 N-m (290 kgf-cm, 21 ft.-lbf)





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.

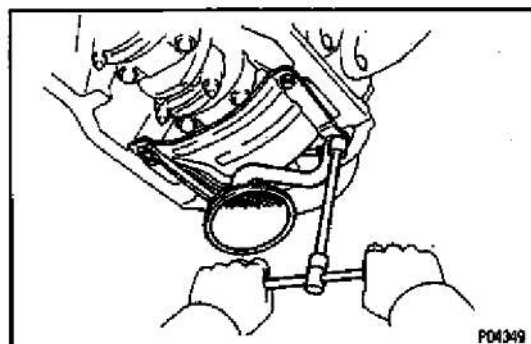


4. INSTALL NO.2 IDLER PULLEY

- (a) Install the pulley with the bolt.
Torque: 42 N·m (425 kgf·cm, 31 ft·lbf)
- (b) Check that the idler pulley moves smoothly.

5. INSTALL TIMING BELT

(See steps 5 to 8 and 10 to 16 on pages EG-44 to 49)



6. INSTALL OIL PAN BAFFLE PLATE AND OIL STRAINER

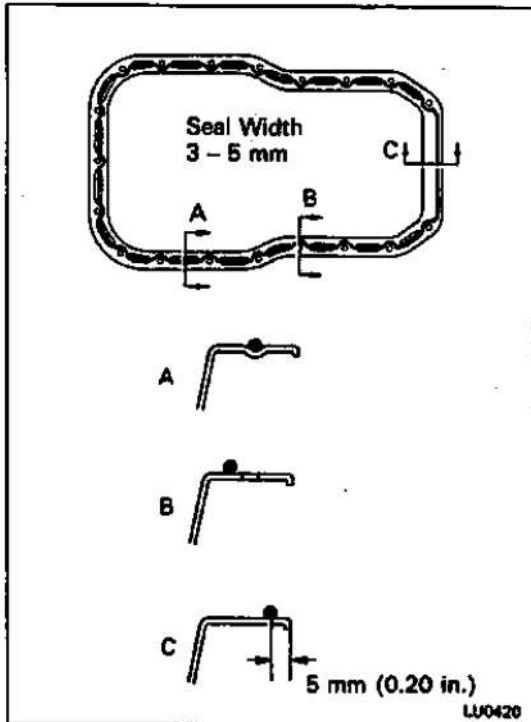
Install a new gasket, the oil strainer and baffle plate with the 2 bolts and 2 nuts.

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

7. 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.



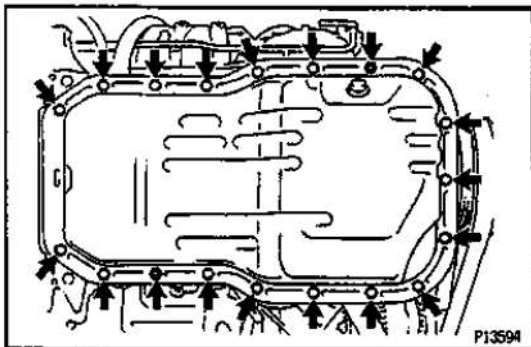
- (b) Apply seal packing to the oil pan as shown in the illustration.

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.

EG

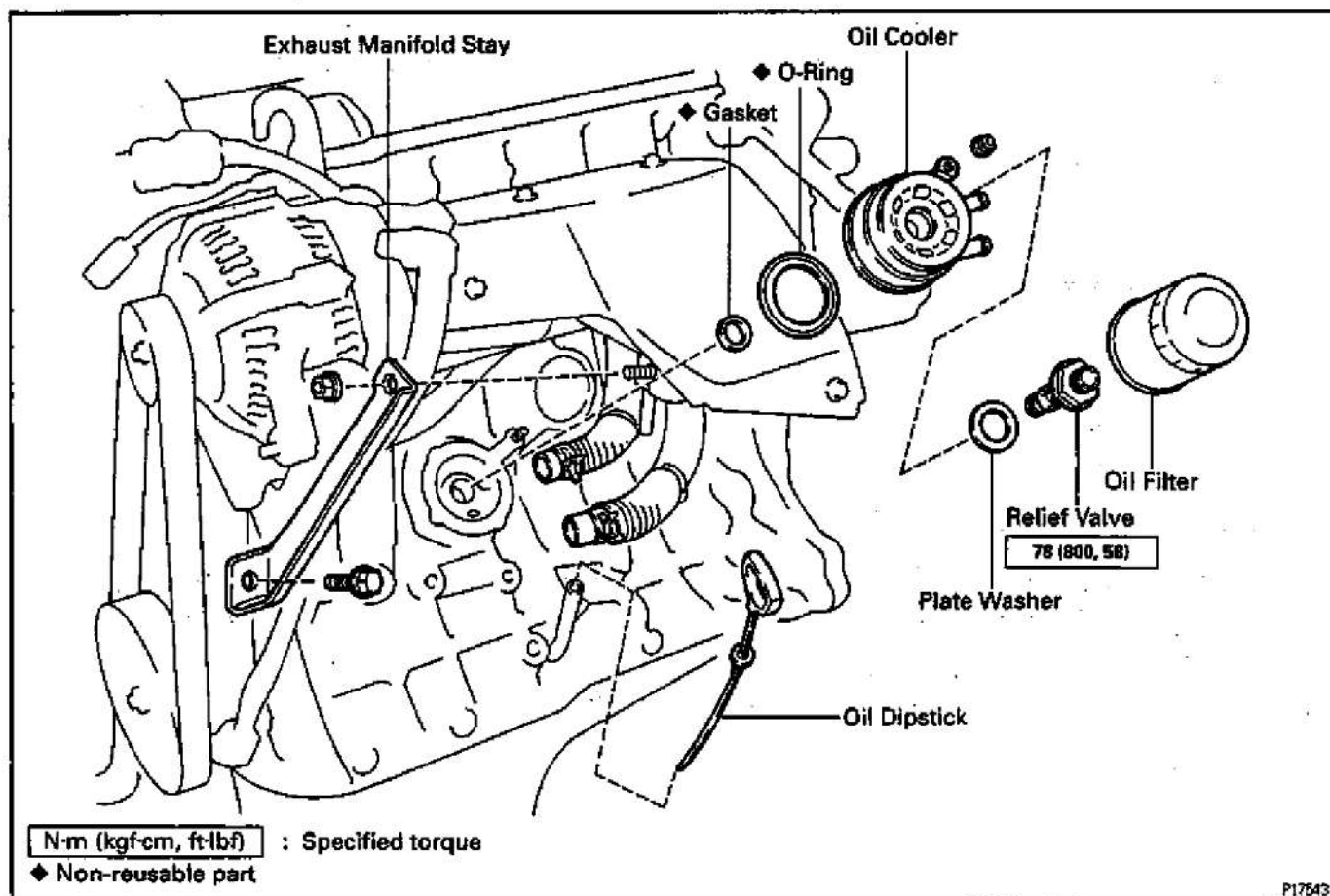


- (c) Install the oil pan with the 17 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.
Torque: 5.4 N·m (55 kgf·cm, 48 in·lbf)
- (d) Install the dipstick.

- 8. FILL WITH ENGINE OIL**
- 9. START ENGINE AND CHECK FOR OIL LEAKS**
- 10. RECHECK ENGINE OIL LEVEL**

OIL COOLER COMPONENTS FOR REMOVAL AND INSTALLATION

90301-01

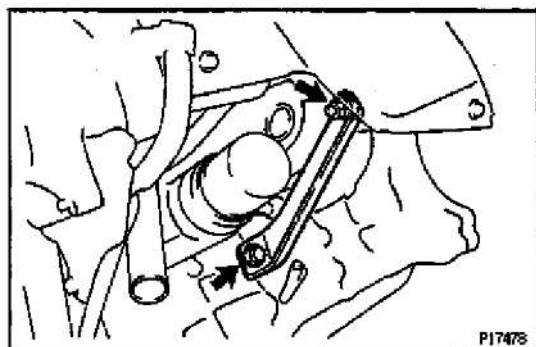


90301-01

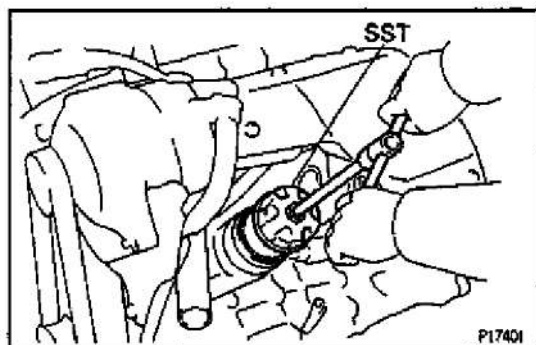
OIL COOLER REMOVAL

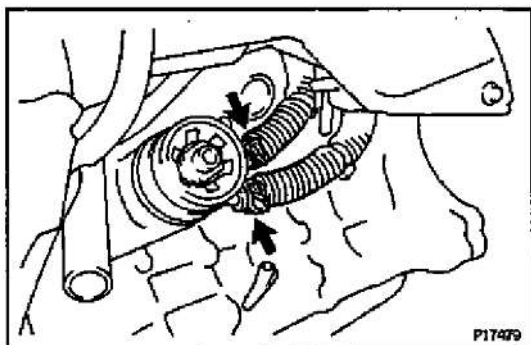
(See Components for Removal and Installation)

1. **DRAIN ENGINE COOLANT**
2. **REMOVE OIL DIPSTICK**
3. **REMOVE EXHAUST MANIFOLD STAY**
Remove the bolt, nut and manifold stay.

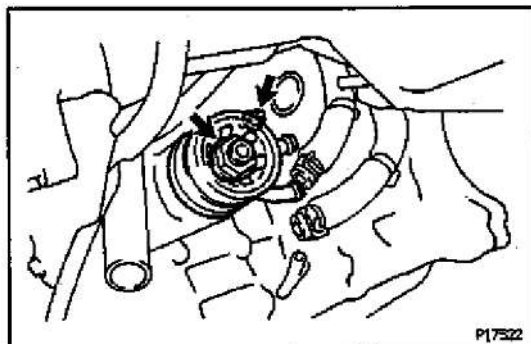


4. **REMOVE OIL FILTER**
Using SST, remove the oil filter.
SST 09228-06500

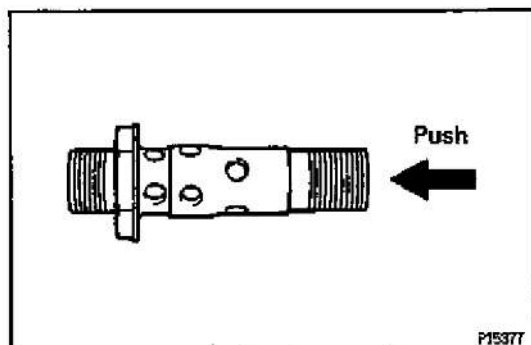


**5. REMOVE OIL COOLER**

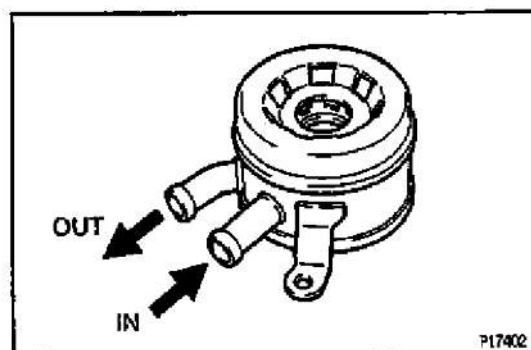
- (a) Disconnect the 2 water bypass hoses from the oil cooler.



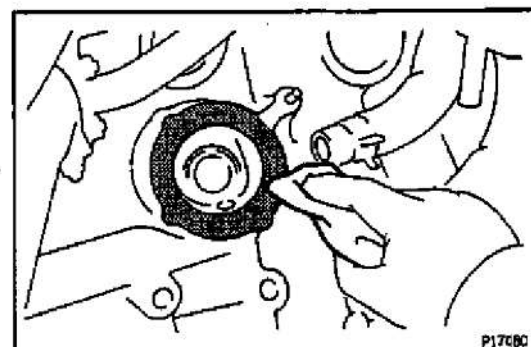
- (b) Remove the relief valve and plate washer.
 (c) Remove the nut and oil cooler.
 (d) Remove the O-ring and gasket from the oil cooler.

**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**

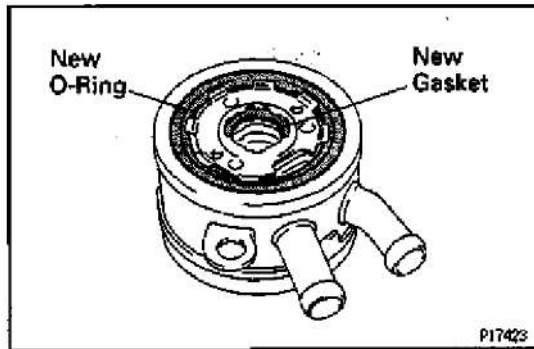
Check the oil cooler for damage or clogging.
 If necessary, replace the oil cooler.

**OIL COOLER INSTALLATION**

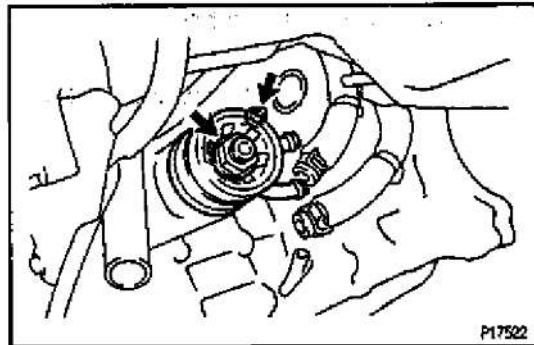
(See Components for Removal and Installation)

1. INSTALL OIL COOLER

- (a) Clean the oil cooler contact surface on the oil cooler mounting.



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



(c) Temporarily install the oil cooler with the nut.

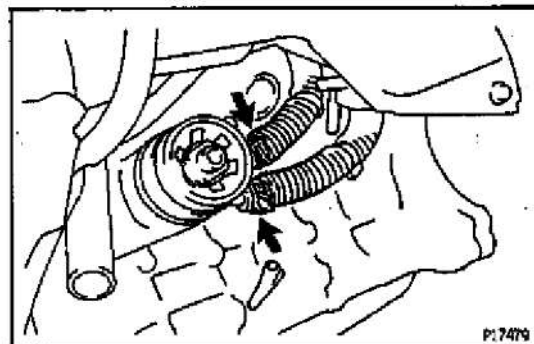
(d) Apply a light coat of engine oil on the threads and under the head of the relief valve.

(e) Install the plate washer and relief valve.

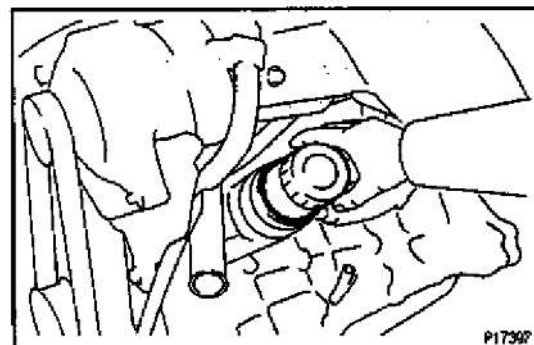
Torque: 78 N·m (800 kgf·cm, 58 ft·lbf)

(f) Tighten the nut.

Torque: 7.8 N·m (80 kgf·cm, 69 in·lbf)

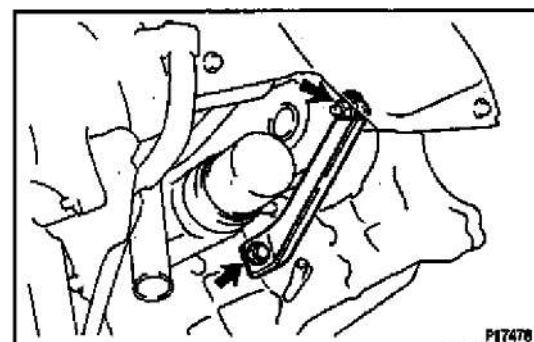


(g) Connect the 2 water bypass hoses to the oil cooler.



2. INSTALL OIL FILTER

(See page EG-341)



3. INSTALL EXHAUST MANIFOLD STAY

Install the manifold stay with the bolt and nut.

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

4. FILL RADIATOR WITH ENGINE COOLANT

5. START ENGINE AND CHECK FOR LEAKS

6. CHECK ENGINE OIL LEVEL

SERVICE SPECIFICATIONS

SERVICE DATA

B016A-6A

Oil pressure		at idle speed at 3,000 rpm	29 kPa (0.3 kgf/cm ² , 43 psi) or more 245 — 490 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.)

EG

TORQUE SPECIFICATIONS

B016D-0E

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	8.8	90	78 in.-lbf
Oil pump pulley x Oil pump drive rotor	28	290	21
No.2 idler pulley x Oil pump	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
Oil cooler x Cylinder block	Relief valve	78	800
	Nut	7.8	80
Exhaust manifold stay x Exhaust manifold	42	425	31
Exhaust manifold stay x Cylinder block	42	425	31

—MEMO—

EG