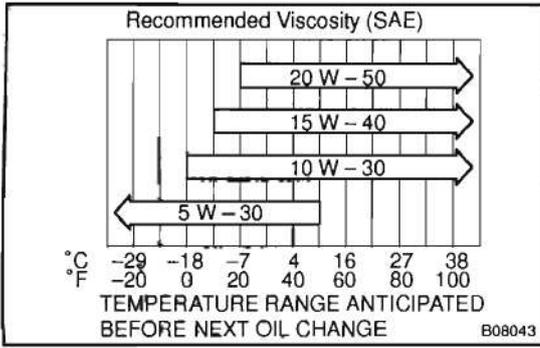

LUBRICATION

OIL AND FILTER	LU-1
OIL PUMP	LU-4
OIL COOLER	LU-15
OIL NOZZLE	LU-21



OIL AND FILTER INSPECTION

LU0BW-07

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 CF-4 or CF (You may also use API CE or CD)

If you use SAE 10W-30 or higher viscosity oil in extremely low temperatures, the engine may become difficult to start, so SAE 5W-30 engine oil is recommended.

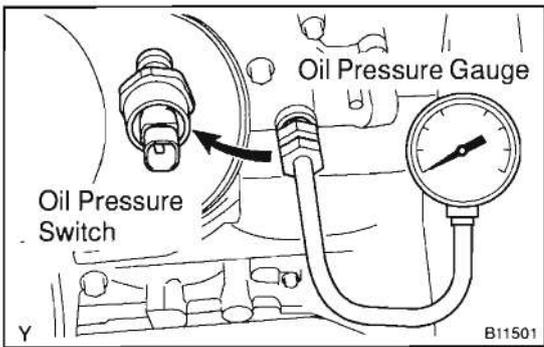
2. CHECK ENGINE OIL LEVEL

After warming up the engine and then 5 minutes after the engine stops, oil level should be between the "L" and "F" marks of the dipstick.

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

NOTICE:

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



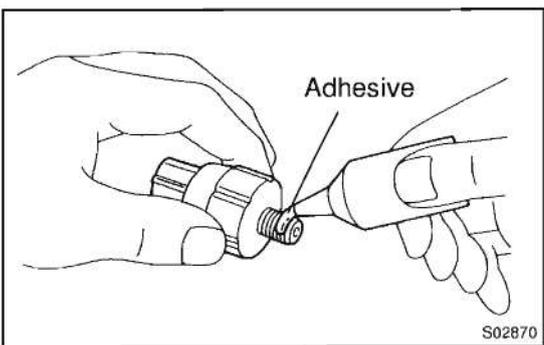
3. CHECK OIL PRESSURE

- Using a 24 mm deep socket wrench, remove the oil pressure switch.
- Install an oil pressure gauge.
- Allow the engine to warm up to normal operating temperature.
- Check the oil pressure.

Oil pressure:

At idle	29 kPa (0.3 kgf/cm ² , 4.3 psi) or more
At 3,000 rpm	245 kPa (2.5 kgf/cm ² , 33 psi) or more

- 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.
- Start the engine and check for oil leak.

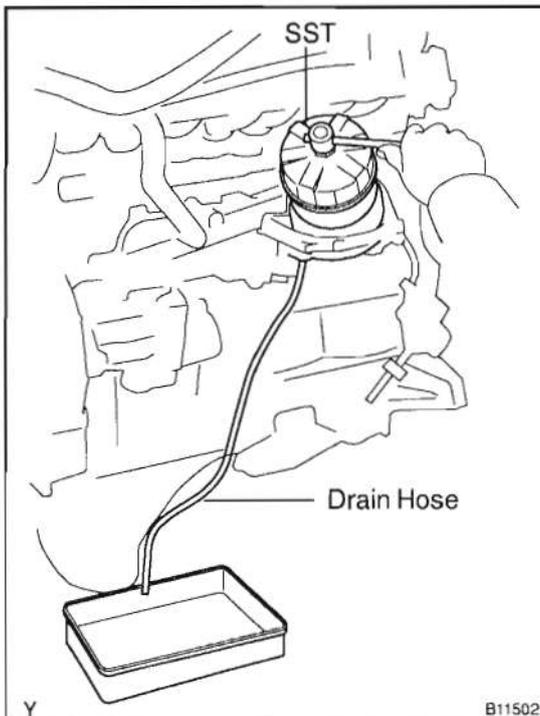
REPLACEMENT

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



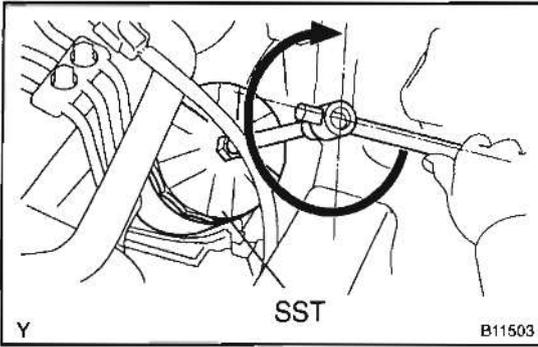
2. REPLACE OIL FILTER

- Using SST, remove the oil filter.
SST 09228-10002

HINT:

As the oil in the filter flows out through the drain hose, place the drain oil container under the drain hose.

- Clean the oil filter contact surface on the oil filter mounting.
- Lubricate the filter rubber gasket with clean engine oil.
- 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 09228-10002

3. FILL WITH ENGINE OIL

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

Torque: 34 N·m (350 kgf·cm, 25 ft·lbf)

- (b) Fill with fresh engine oil.

Capacity:

Drain and refill	w/ Oil filter change	7.5 liters (7.9 US qts, 6.6 Imp. qts)
	w/o Oil filter change	6.8 liters (7.2 US qts, 6.0 Imp. qts)
Dry fill		8.0 liters (8.5 US qts, 7.0 Imp. qts)

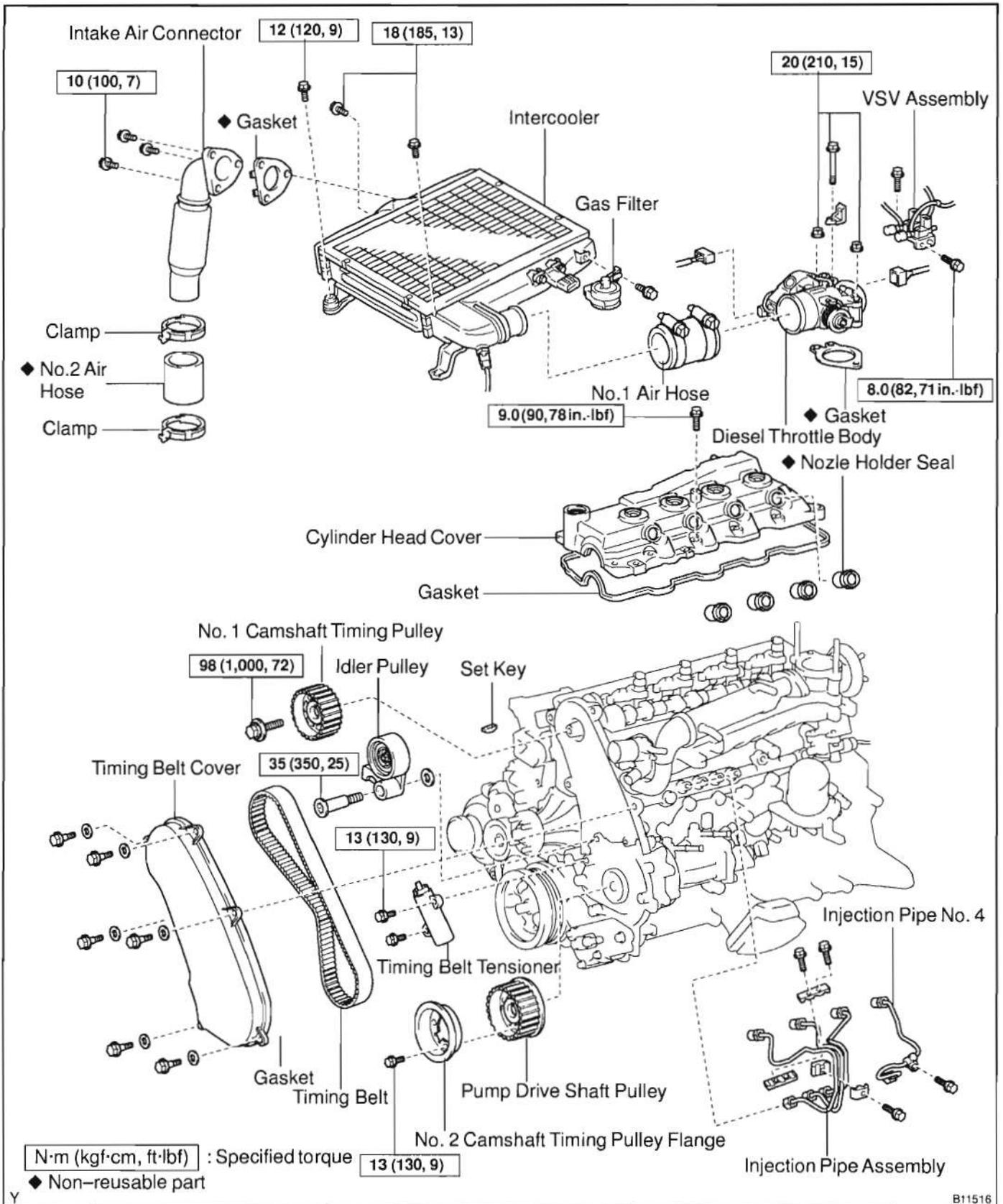
- (c) Reinstall the oil filter cap.

4. START ENGINE AND CHECK FOR OIL LEAKS

5. RECHECK ENGINE OIL LEVEL

OIL PUMP COMPONENTS

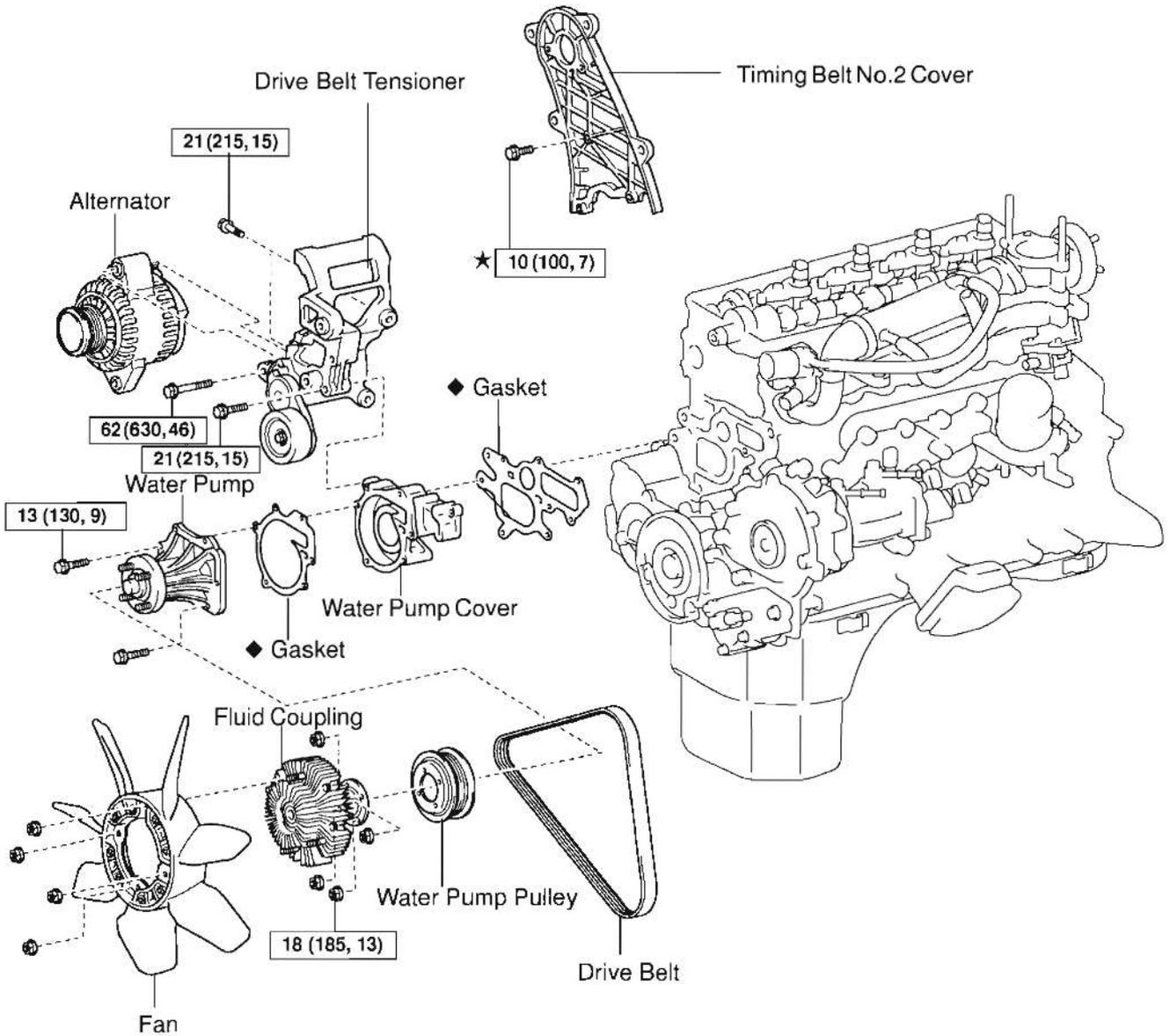
LU04K-03



LU

Y

B11516



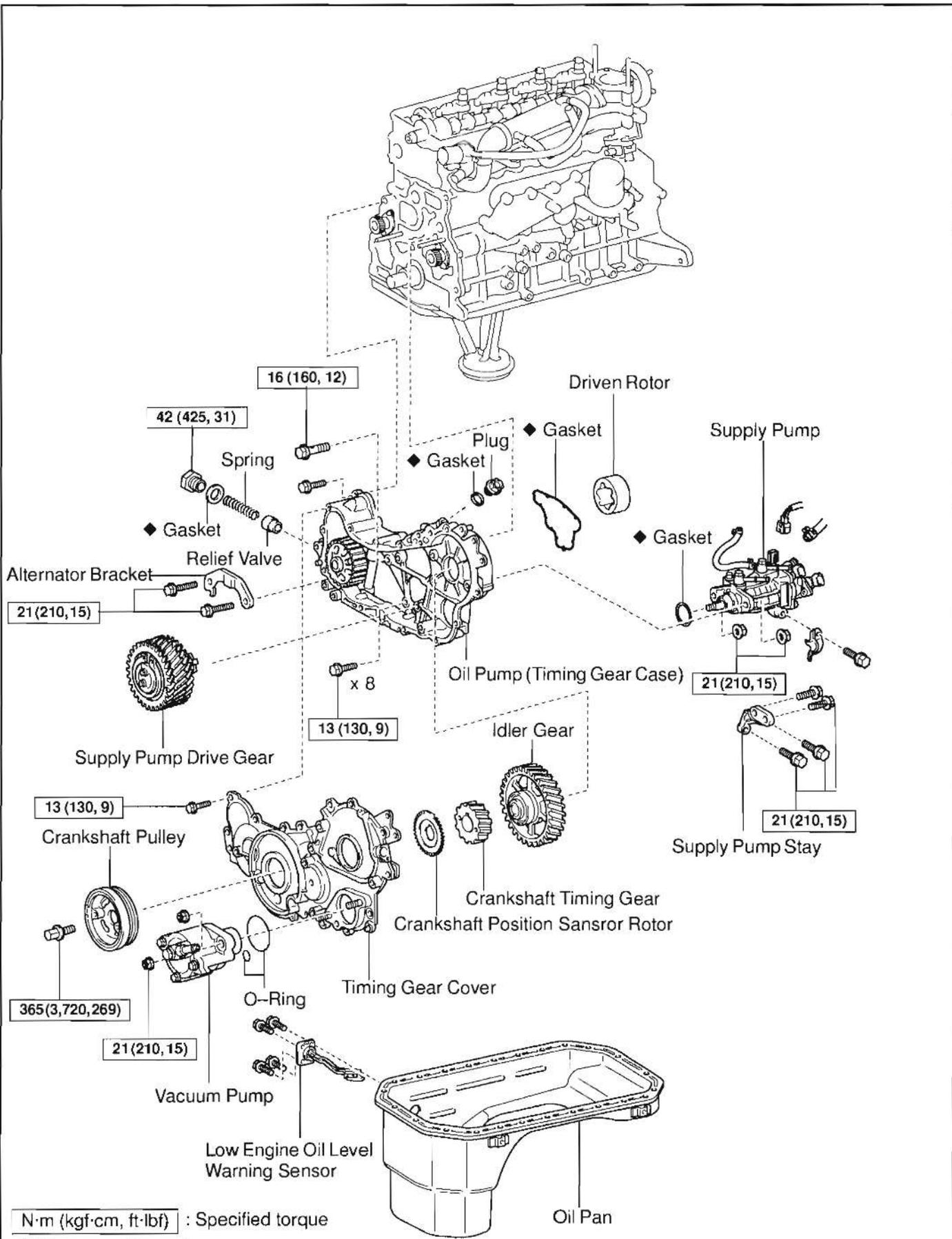
LU

\square N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

★ Precoated part

LU



Y

REMOVAL

HINT:

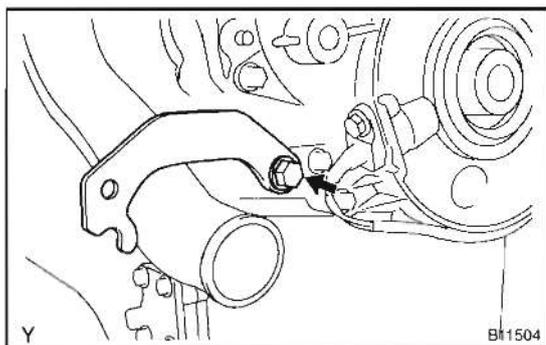
When repairing the oil pump, oil pan and strainer should be removed and cleaned.

1. **DRAIN ENGINE COOLANT**
2. **DRAIN ENGINE OIL**
3. **REMOVE DRIVE BELT, FAN AND WATER PUMP PULLEY (See page CO-5)**
4. **REMOVE TIMING BELT (See page EM-11)**
5. **REMOVE TIMING GEARS (See page EM-21)**
6. **REMOVE ALTERNATOR AND DRIVE BELT TENSIONER (See page CO-5)**

7. REMOVE ALTERNATOR ALTERNATOR BRACKET

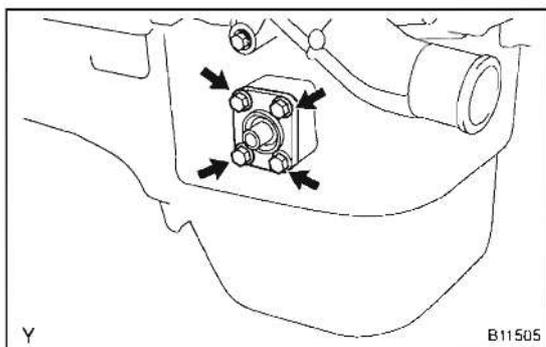
Remove the bolt and alternator bracket.

8. REMOVE WATER PUMP (See page CO-5)



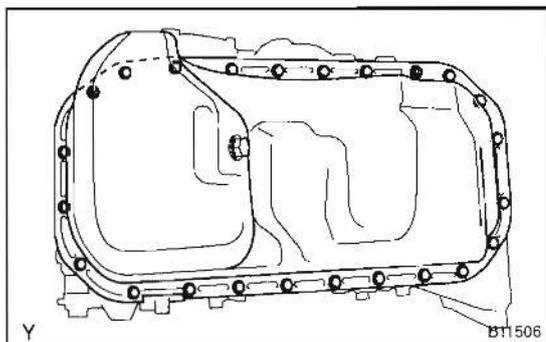
9. REMOVE OIL LEVEL SENSOR

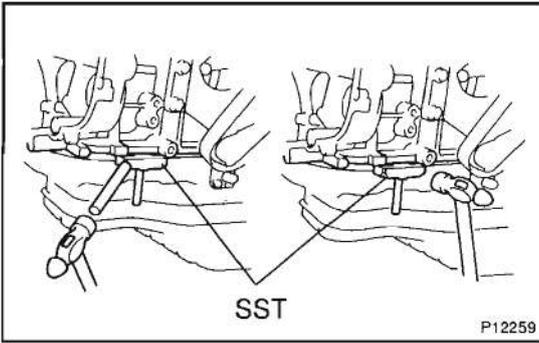
- (a) Disconnect the oil level sensor connector.
- (b) Remove the 4 bolts and oil level sensor.



10. REMOVE OIL PAN

- (a) Remove the 22 bolts and 2 nuts.





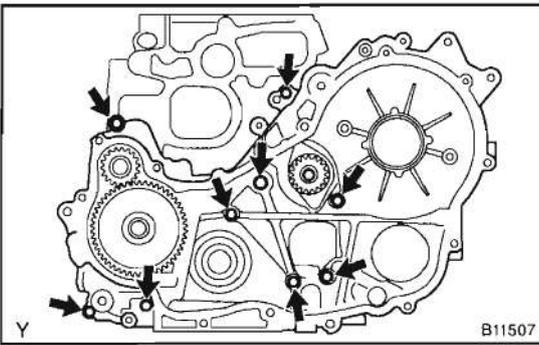
- (b) Insert the blade of SST between the cylinder block and oil pan, and cut off applied sealer and remove the oil pan.
SST 09032-00100

NOTICE:

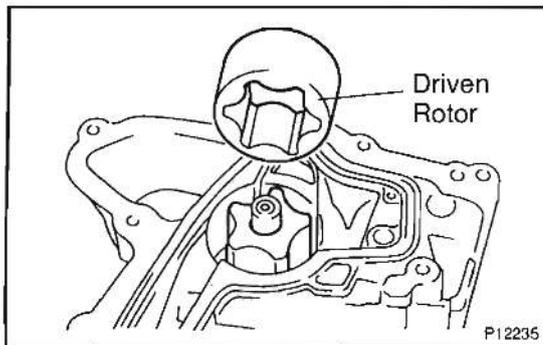
- Do not use SST for the oil pump body side and rear oil seal retainer.
- Be careful not to damage the oil pan flange.

11. REMOVE SUPPLY PUMP

12. REMOVE OIL PUMP (TIMING GEAR CASE)



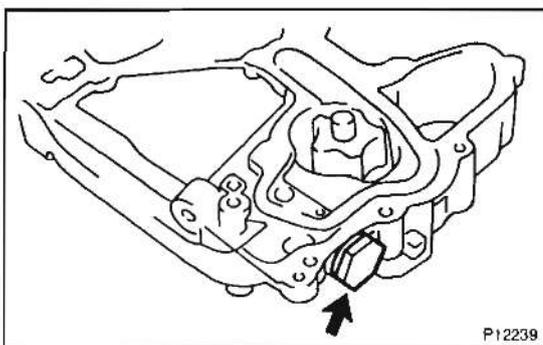
- (a) Remove the 8 bolts and union bolt.
(b) Using a plastic-faced hammer, lightly tap out the timing gear case.
(c) Remove the 3 O-rings.



DISASSEMBLY

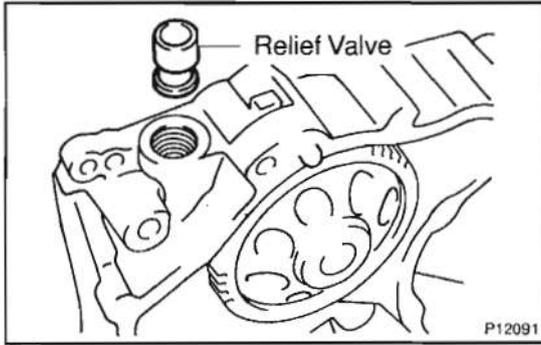
1. REMOVE DRIVE ROTOR

Pull out the driven rotor.



2. REMOVE RELIEF VALVE

Remove the plug, gasket, spring and relief valve.



INSPECTION

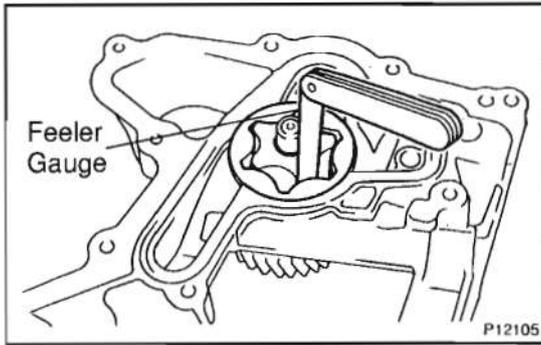
1. INSPECT RELIEF VALVE

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) Place the driven rotor into the oil pump body.



(b) Inspect the rotor tip clearance.

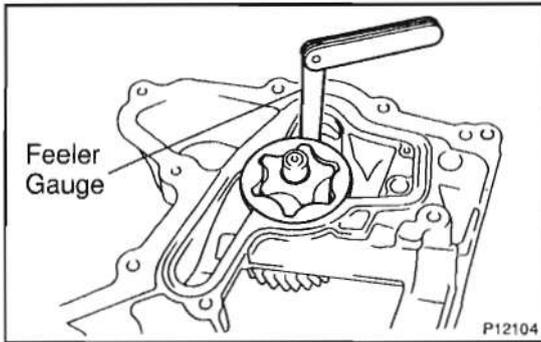
Using a feeler gauge, measure the clearance between the drive and driven rotor tips.

Standard tip clearance:

0.060 – 0.160 mm (0.0024 – 0.0063 in.)

Maximum tip clearance: 0.21 mm (0.0083 in.)

If the tip clearance is greater than maximum, replace the timing gear case.



(c) Inspect the rotor body clearance.

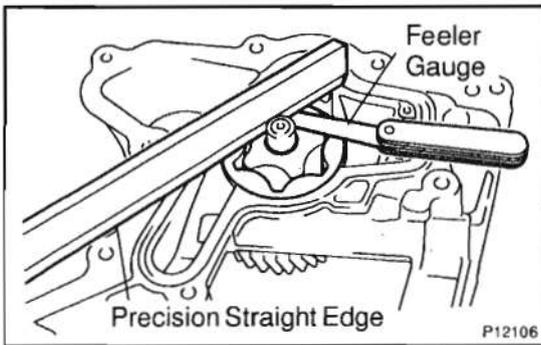
Using a feeler gauge, measure the clearance between the driven rotor and body.

Standard body clearance:

0.100 – 0.170 mm (0.0039 – 0.0067 in.)

Maximum body clearance: 0.20 mm (0.0079 in.)

If the body clearance is greater than maximum, replace the timing gear case.



(d) Inspect the rotor side clearance.

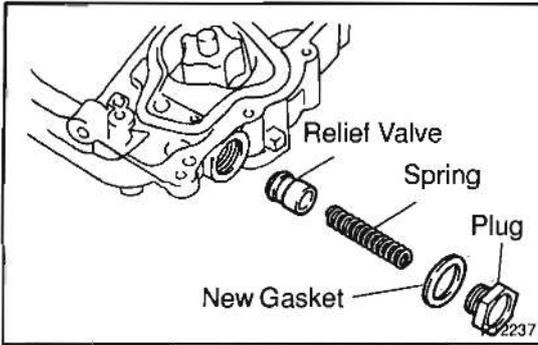
Using a feeler gauge and precision straight edge, measure the clearance between the rotors and precision straight edge.

Standard side clearance:

0.030 – 0.090 mm (0.0012 – 0.0035 in.)

Maximum side clearance: 0.15 mm (0.0059 in.)

If the side clearance is greater than maximum, replace the timing gear case.

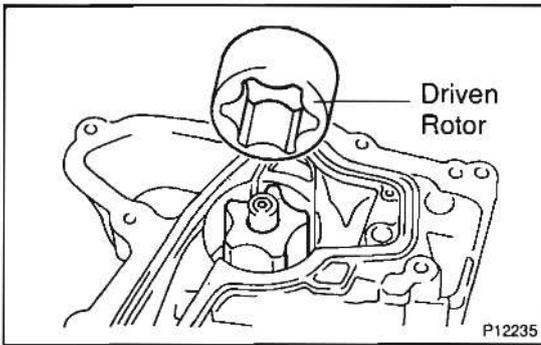


REASSEMBLY

1. INSTALL RELIEF VALVE

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

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



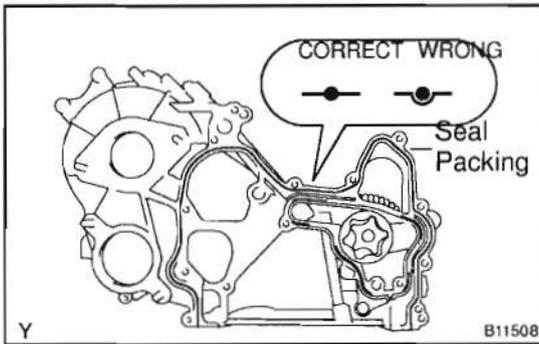
2. INSTALL DRIVE AND DRIVEN ROTORS

Install the driven rotor into the pump.

INSTALLATION

1. INSTALL OIL PUMP (TIMING GEAR CASE)

- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the timing gear case and cylinder block.
- Using a razor blade and gasket scraper, remove 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.



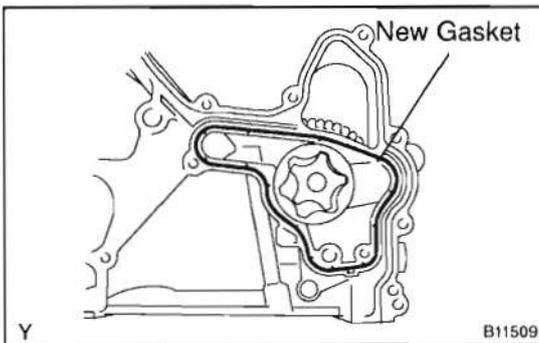
- (b) Apply seal packing to the timing gear case as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent

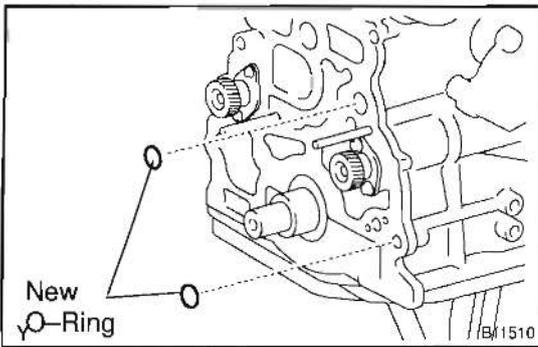
NOTICE:

Avoid applying an excessive amount to the surface.

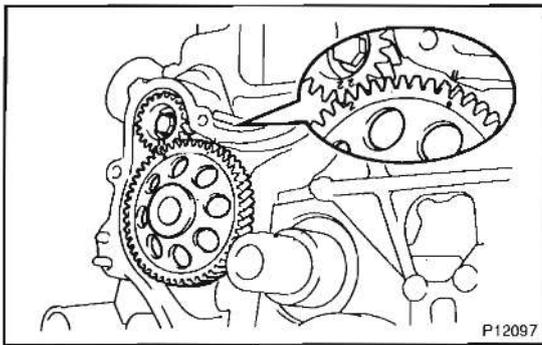
- Install a nozzle that has been cut to a 3–5 mm (0.12 – 0.20 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and re-install cap.



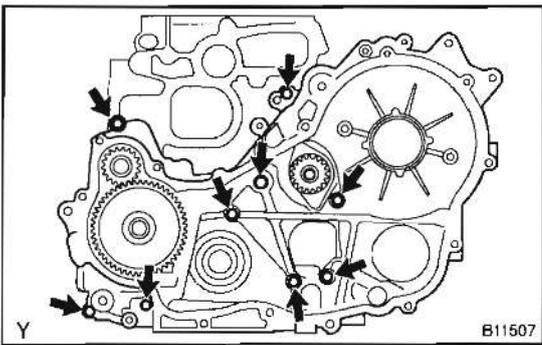
- (c) Place a new gasket into the groove of the timing gear case as shown in the illustration.



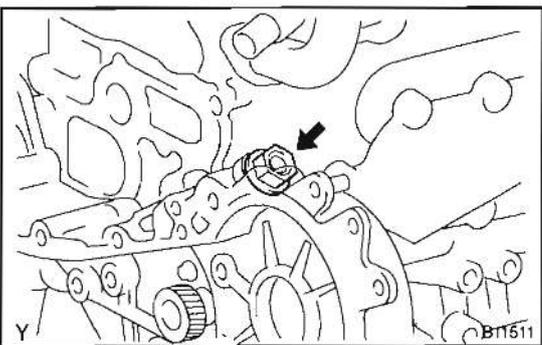
- (d) Install 2 new O-rings to the cylinder block.
- (e) Install the timing gear case.



- (f) The matchmark on the No.1 balance shaft driven gear should be aligned with the "2" mark.
- (g) Align the mark on the oil pump drive gear with the mark on the timing gear case.



- (h) Install the 8 bolts and union bolt.
Torque:
13 N·m (130 kgf·cm, 9 ft·lbf) for Bolt
16 N·m (160 kgf·cm, 12 ft·lbf) for Union bolt
- 2. INSTALL SUPPLY PUMP**



3. POUR ENGINE OIL INTO OIL PUMP

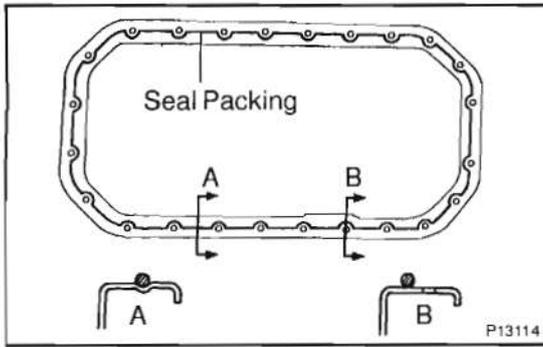
- (a) Remove the plug and gasket.
- (b) Pour in approx. 20 cc (0.12 cu in.) of engine oil into the oil pump.
- (c) Install the plug with a new gasket.

4. INSTALL OIL PAN

- (a) Remove any old packing (FIG) 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 (FIG) 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:

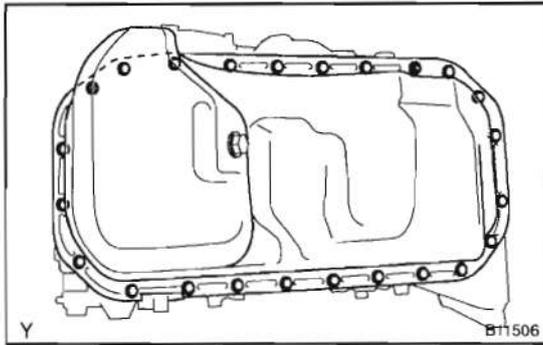
Do not use a solvent which will affect the painted surfaces.



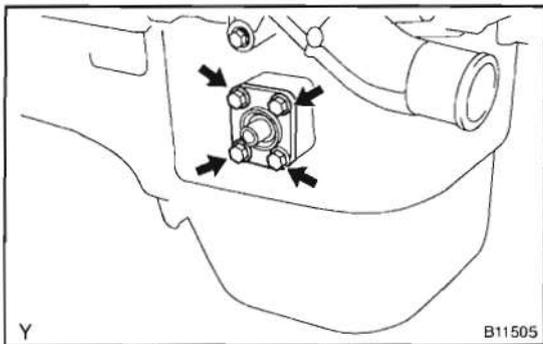
- (b) Apply seal packing to the oil pan as shown in the illustration.

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 re-install cap.



- (c) Install the oil pan with the 22 bolts and 2 nuts.
Torque: 16 N·m (165 kgf·cm, 12 ft·lbf)

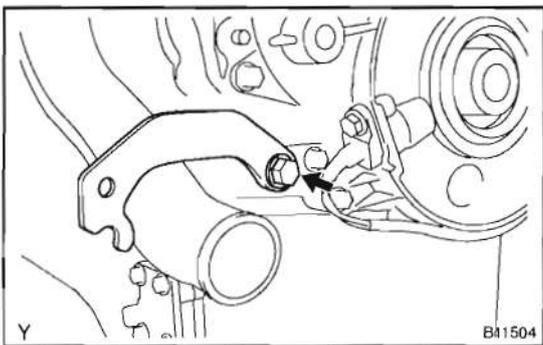


5. INSTALL OIL LEVEL SENSOR

- (a) Install the oil level sensor with the 4 bolts.
(b) Connect the oil level sensor connector.

6. INSTALL WATER PUMP (See page CO-8)

7. INSTALL ALTERNATOR AND DRIVE BELT TENSIONER (See page CO-8)



8. INSTALL ALTERNATOR BRACKET

Install the bracket with the bolt.

Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)

9. INSTALL TIMING GEARS (See page EM-31)

10. INSTALL TIMING BELT (See page EM-16)

11. INSTALL WATER PUMP PULLEY, FAN AND DRIVE BELT (See page CO-8)

12. FILL WITH ENGINE OIL

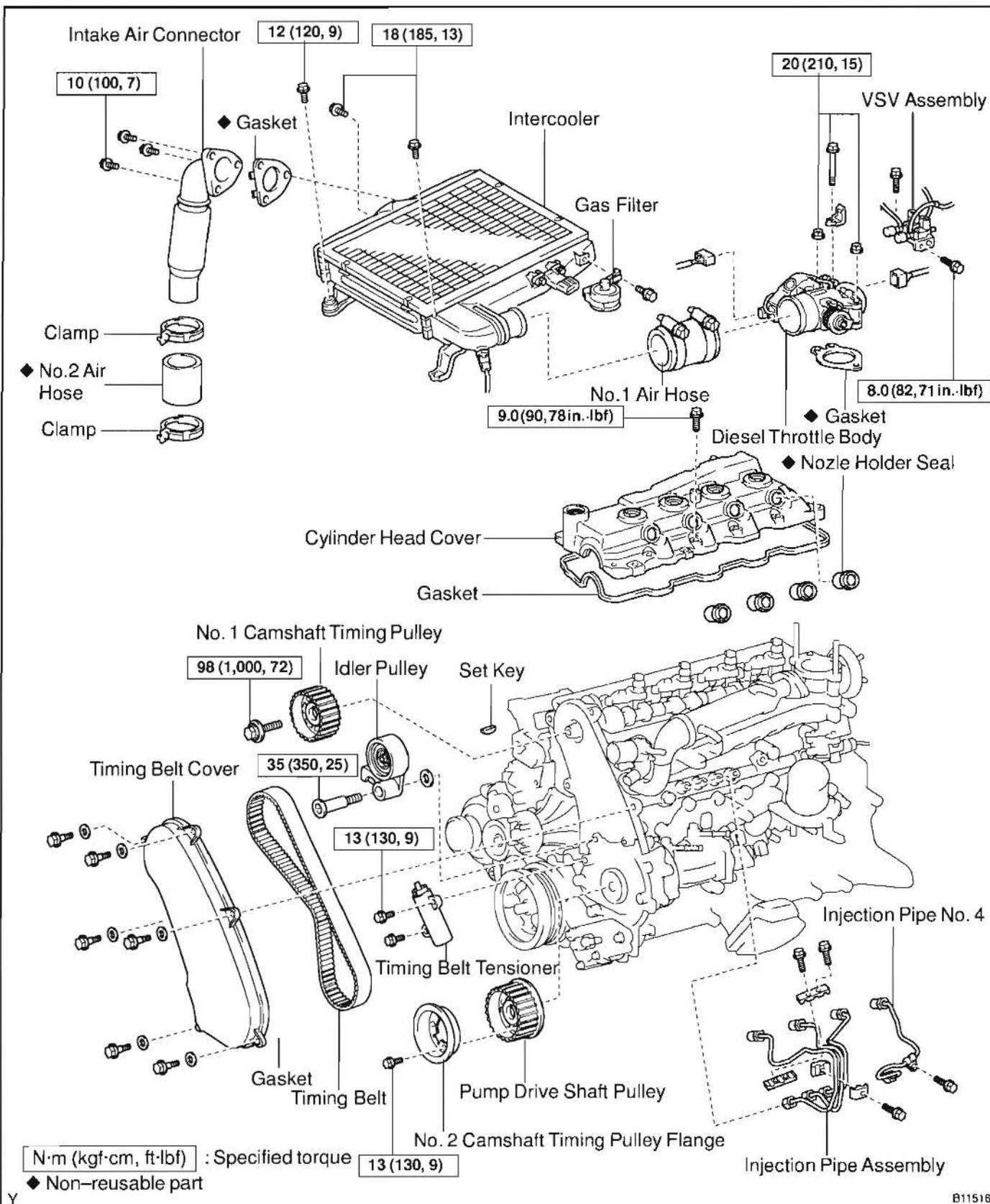
13. FILL WITH ENGINE COOLANT

14. START ENGINE AND CHECK FOR OIL LEAKS

15. RECHECK ENGINE OIL LEVEL

OIL COOLER COMPONENTS

LU013-02

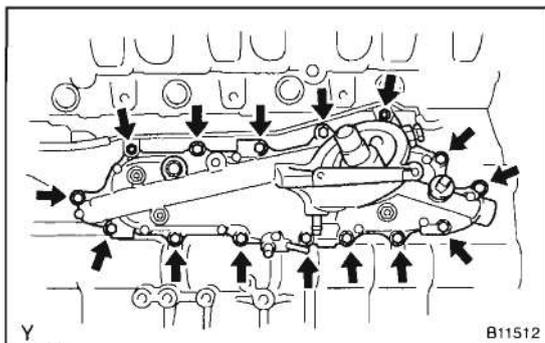


REMOVAL

1. DRAIN ENGINE COOLANT
2. REMOVE TIMING BELT (See page EM-11)
3. REMOVE SUPPLY PUMP (See page FU-16)
4. REMOVE OIL FILTER (See page LU-2)
5. REMOVE COMMON RAIL(See page FU-21)

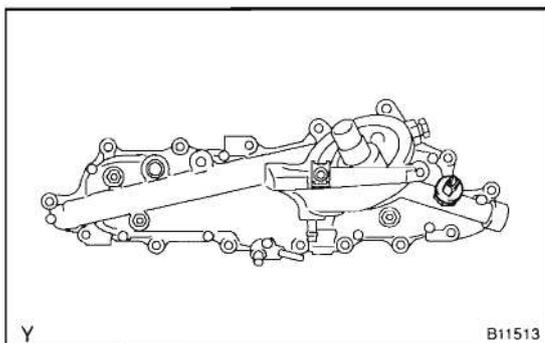
6. REMOVE OIL COOLER AND OIL COOLER COVER ASSEMBLY

- (a) Remove the 2 nuts and disconnect the vacuum pipe.
- (b) Remove the 13 bolts, oil cooler, oil cooler cover assembly and gasket.



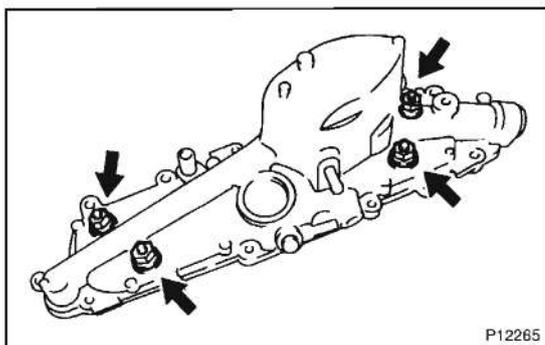
7. REMOVE OIL PRESSURE SWITCH

Remove the oil pressure switch from the oil cooler cover.



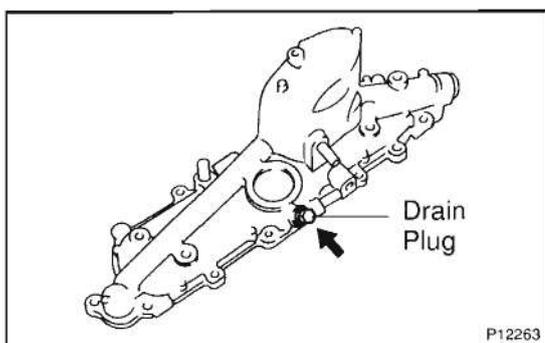
8. SEPARATE OIL COOLER AND OIL COOLER COVER

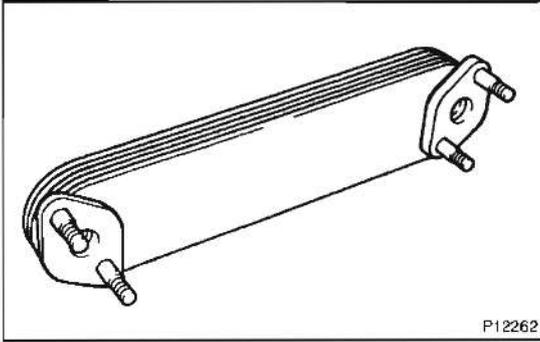
Remove the 4 nuts, oil cooler and 2 gaskets from the oil cooler cover.



9. REMOVE DRAIN PLUG

Remove the drain plug from the oil cooler cover.

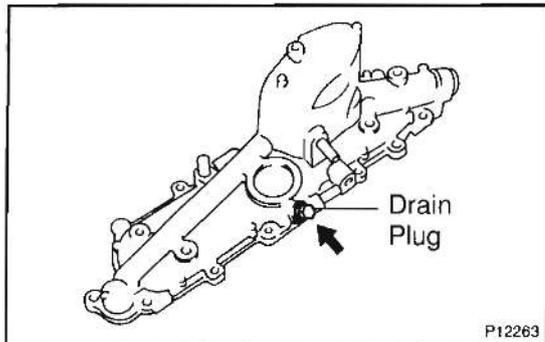




INSPECTION

INSPECT OIL COOLER

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

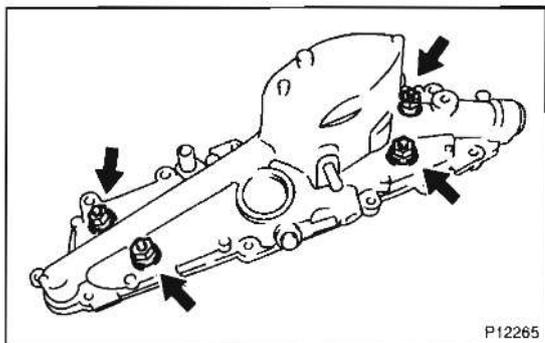


INSTALLATION

1. INSTALL ENGINE DRAIN PLUG

Install the engine drain plug to the oil cooler cover.

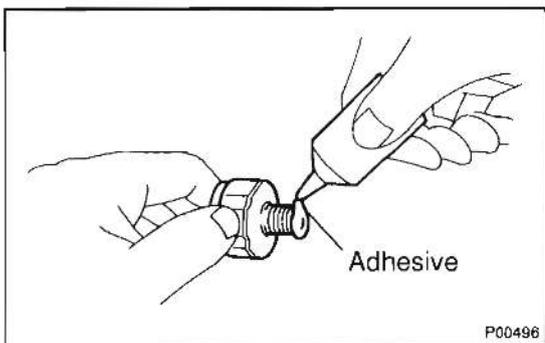
Torque: 8 N·m (80 kgf·cm, 69 in.-lbf)



2. ASSEMBLY OIL COOLER AND OIL COOLER COVER

Install 2 new gaskets and the oil cooler to the oil cooler cover with the 4 nuts.

Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)

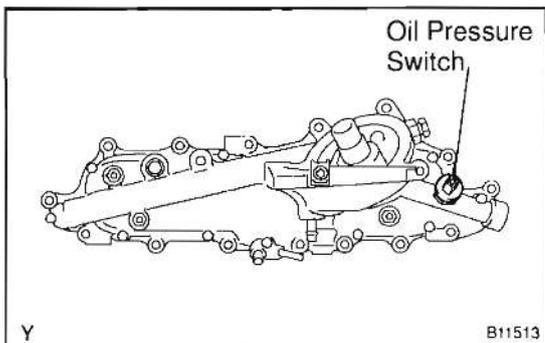


3. INSTALL OIL PRESSURE SWITCH

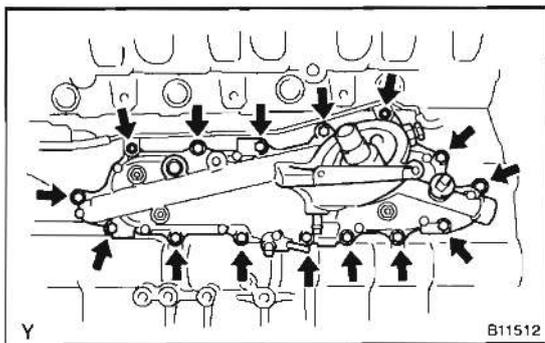
(a) Apply adhesive to 2 or 3 threads of the oil pressure switch.

Adhesive:

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



(b) Install the oil pressure switch.



4. INSTALL OIL COOLER AND OIL COOLER COVER ASSEMBLY

Install a new gasket, the oil cooler and oil cooler cover assembly with the 13 bolts.

Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)

5. **INSTALL COMMON RAIL** (See page FU-22)

6. **INSTALL OIL FILTER** (See page LU-2)

7. **INSTALL SUPPLY PUMP** (See page FU-18)

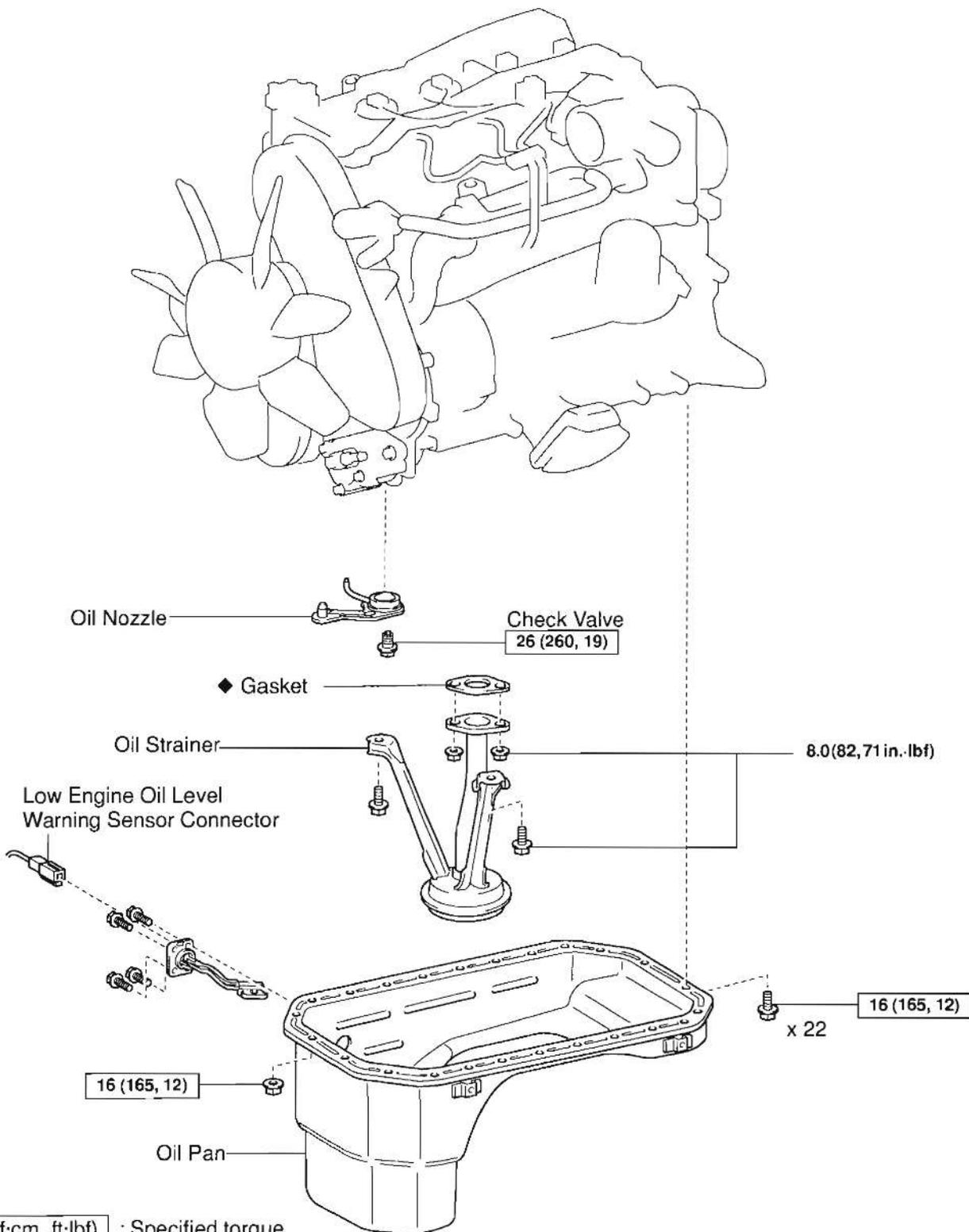
8. **INSTALL TIMING BELT** (See page EM-16)

9. **FILL WITH ENGINE COOLANT**

10. START ENGINE AND CHECK FOR LEAKS
11. CHECK ENGINE OIL LEVEL

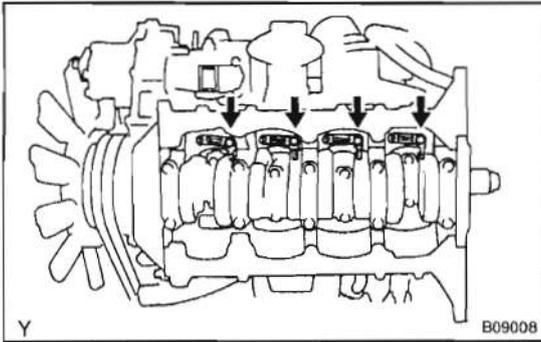
OIL NOZZLE COMPONENTS

LU9C0-03



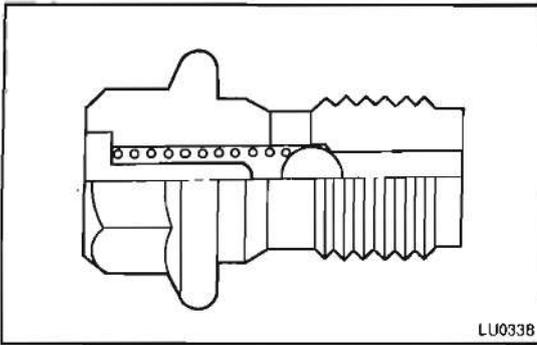
N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part



REMOVAL

1. **DRAIN ENGINE OIL**
2. **REMOVE OIL PAN** (See page LU-7)
3. **REMOVE OIL STRAINER**
Remove the 2 bolts, 2 nuts, gasket and oil strainer.
4. **REMOVE CHECK VALVE AND OIL NOZZLES**
Remove the 4 check valves and oil nozzles.



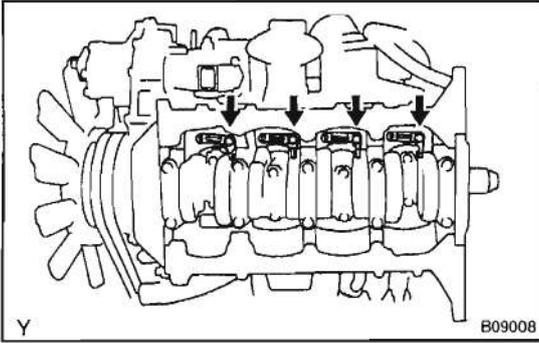
INSPECTION

1. INSPECT CHECK VALVES

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

2. INSPECT OIL NOZZLES

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



INSTALLATION

1. INSTALL OIL NOZZLES AND CHECK VALVES

- (a) Align the pin of the oil nozzle with the pin hole of the cylinder block.
- (b) Install the oil nozzle with the check valve. Install the 4 oil nozzles and check valves.

Torque: 26 N·m (260 kgf·cm, 19 ft·lbf)

2. INSTALL OIL STRAINER

Install the oil strainer and new gasket with the 2 bolts and 2 nuts.

Torque: 8.0 N·m (80 kgf·cm, 71 in.-lbf)

3. INSTALL OIL PAN (See page LU-12)

4. FILL WITH ENGINE OIL

5. START ENGINE AND CHECK FOR LEAKS

