

# LUBRICATION

# *LU(H4SO)*

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# GENERAL DESCRIPTION

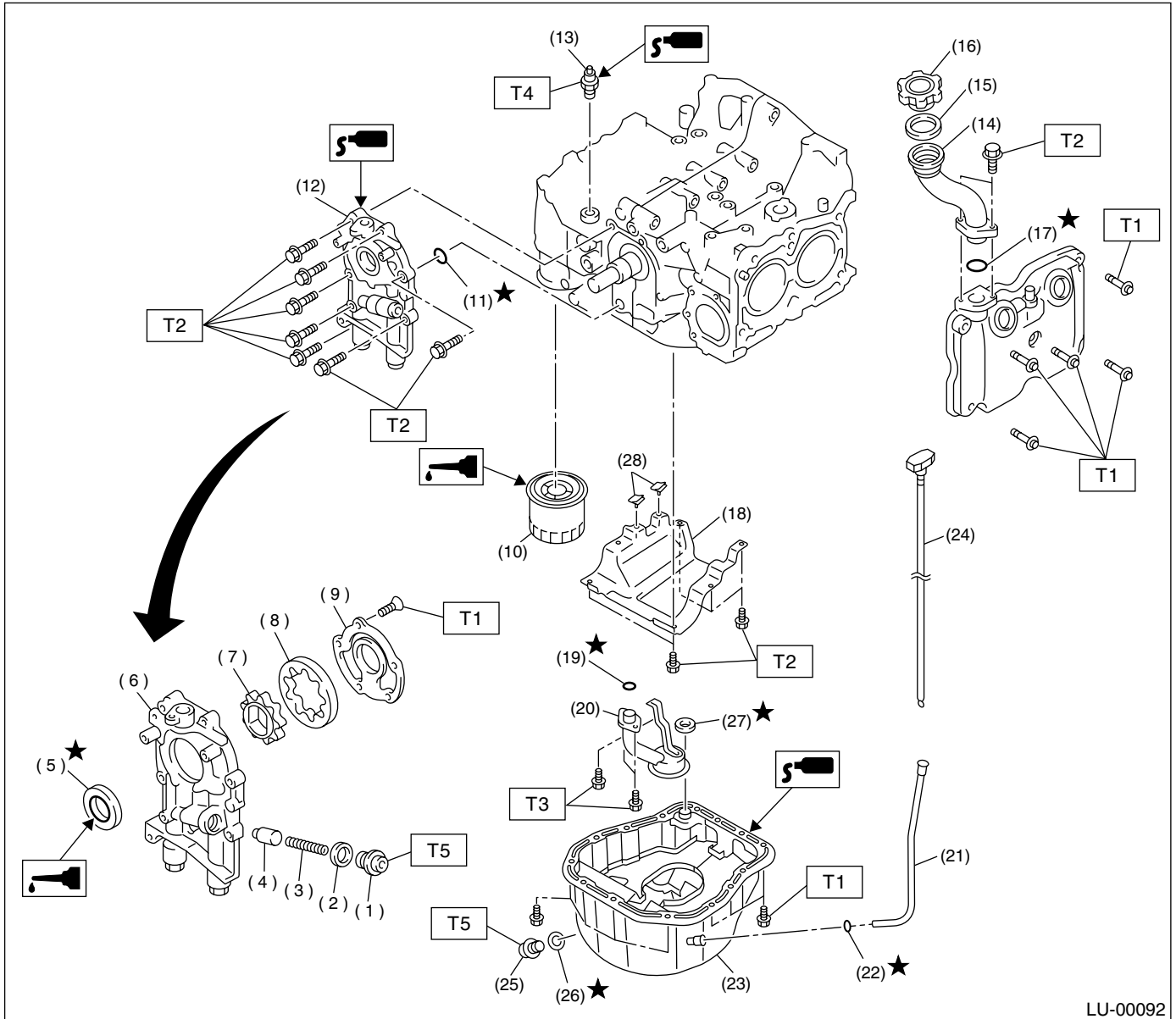
## LUBRICATION

### 1. General Description

#### A: SPECIFICATIONS

Lubrication method			Forced lubrication
Oil pump	Pump type		Trochoid type
	Number of teeth	Inner rotor	9
		Outer rotor	10
	Outer rotor diameter × thickness		78 × 7 mm (3.07 × 0.28 in)
	Tip clearance between inner and outer rotor	STANDARD	0.04 — 0.14 mm (0.0016 — 0.0055 in)
		LIMIT	0.18 mm (0.0071 in)
	Side clearance between inner rotor and pump case	STANDARD	0.02 — 0.07 mm (0.0008 — 0.0028 in)
		LIMIT	0.12 mm (0.0047 in)
	Case clearance between outer rotor and pump case	STANDARD	0.10 — 0.175 mm (0.0039 — 0.0069 in)
		LIMIT	0.20 mm (0.0079 in)
	Capacity at 80°C (176°F)	600 rpm	- Discharge pressure
- Discharge quantity			3.2 ℓ (3.4 US qt, 2.8 Imp qt)/min.
5,000 rpm		- Discharge pressure	294 kPa (3.0 kg/cm <sup>2</sup> , 43 psi)
		- Discharge quantity	32.6 ℓ (8.61 US gal, 7.17 Imp gal)/min.
Relief valve operation pressure			490 kPa (5.0 kg/cm <sup>2</sup> , 71 psi)
Oil filter	Type		Full-flow filter type
	Filtration area		910 cm <sup>2</sup> (141 sq in)
	By-pass valve opening pressure		157 kPa (1.6 kg/cm <sup>2</sup> , 23 psi)
	Outer diameter × width		80 × 75 mm (3.15 × 2.95 in)
	Installation screw type		M 20 × 1.5
Oil pressure switch	Type		Immersed contact point type
	Working voltage — wattage		12 V — 3.4 W or less
	Warning light activation pressure		14.7 kPa (0.15 kg/cm <sup>2</sup> , 2.1 psi)
	Proof pressure		More than 981 kPa (10 kg/cm <sup>2</sup> , 142 psi)
Oil capacity (when replacing oil)			Approx. 4.0 ℓ (4.2 US qt, 3.5 Imp qt)

## B: COMPONENT



LU-00092

- |                         |                            |                   |
|-------------------------|----------------------------|-------------------|
| (1) Plug                | (13) Oil pressure switch   | (25) Drain plug   |
| (2) Gasket              | (14) Oil filler duct       | (26) Metal gasket |
| (3) Relief valve spring | (15) O-ring                | (27) Gasket       |
| (4) Relief valve        | (16) Oil filler cap        | (28) Seal         |
| (5) Oil seal            | (17) O-ring                |                   |
| (6) Oil pump case       | (18) Baffle plate          |                   |
| (7) Inner rotor         | (19) O-ring                |                   |
| (8) Outer rotor         | (20) Oil strainer          |                   |
| (9) Oil pump cover      | (21) Oil level gauge guide |                   |
| (10) Oil filter         | (22) O-ring                |                   |
| (11) O-ring             | (23) Oil pan               |                   |
| (12) Oil pump ASSY      | (24) Oil level gauge       |                   |

**Tightening torque: N·m (kgf·m, ft·lb)**

**T1: 5 (0.5, 3.6)**

**T2: 6.4 (0.65, 4.7)**

**T3: 10 (1.0, 7.2)**

**T4: 25 (2.5, 18.1)**

**T5: 44 (4.5, 33)**

## GENERAL DESCRIPTION

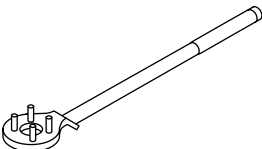
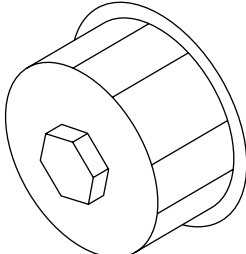
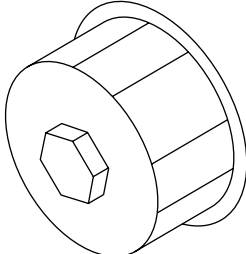
### LUBRICATION

#### C: CAUTION

- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust or dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.

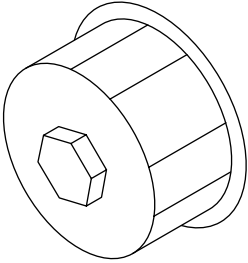
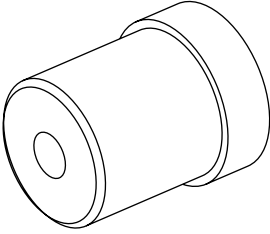
- Be careful not to burn your hands, because each part in the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or safety stands at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect ground cable from battery.

#### D: PREPARATION TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499977100	499977100	CRANKSHAFT PULLEY WRENCH	Used for stopping rotation of crankshaft pulley when loosening and tightening crankshaft pulley bolt.
 ST-498547000	498547000 [Outer diameter 80 mm (3.15 in) for oil filter]	OIL FILTER WRENCH	Used for removing and installing oil filter.
 ST18332AA000	18332AA000 [Outer diameter 68 mm (2.68 in) for oil filter]	OIL FILTER WRENCH	Used for removing and installing oil filter.

# GENERAL DESCRIPTION

LUBRICATION

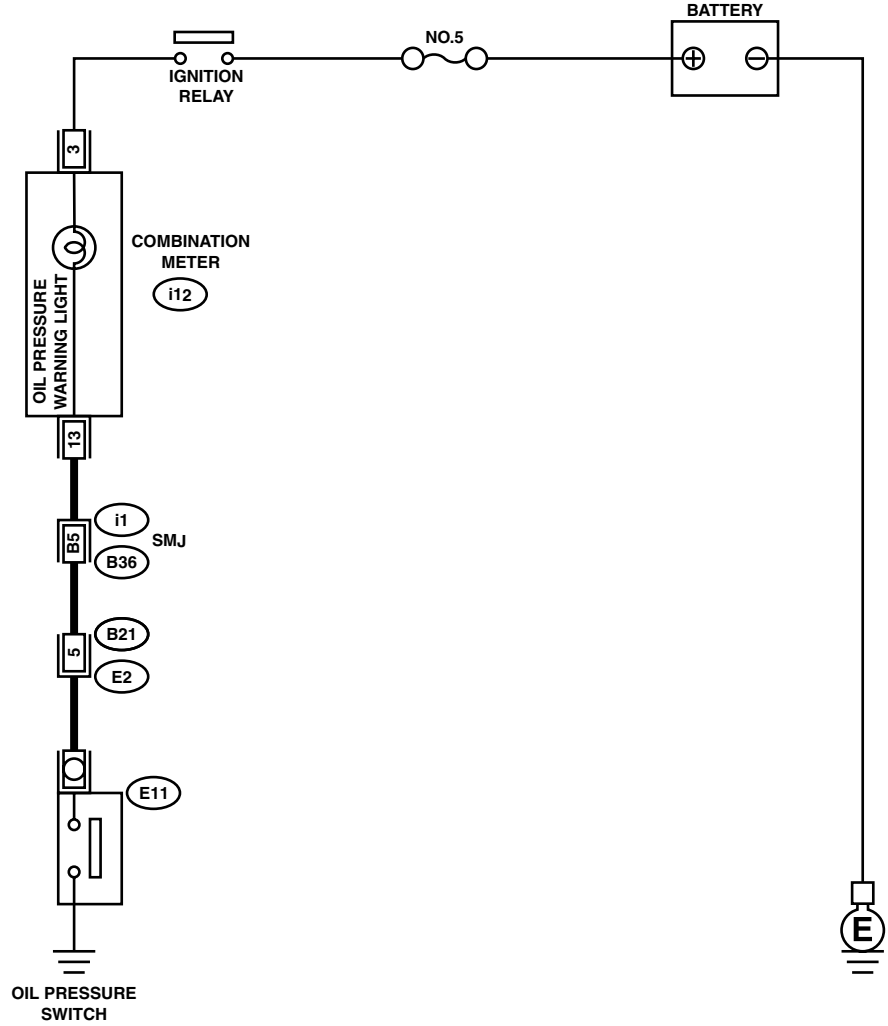
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p>ST18332AA010</p>	18332AA010 [Outer diameter 65 mm (2.56 in) for oil filter]	OIL FILTER WRENCH	Used for removing and installing oil filter.
 <p>ST-499587100</p>	499587100	OIL SEAL INSTALLER	Used for installing oil pump oil seal.

# OIL PRESSURE SYSTEM

LUBRICATION

## 2. Oil Pressure System

### A: SCHEMATIC



i12 (GREEN)

1	2	3	4	5	6
7	8	9	10	11	12
13	14				

B21 (GRAY)

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20

B36

A1	A2	A3	A4	A5	A6
B1	B2	B3	B4	B5	B6
C1	C2	C3	C4	C5	C6
D1	D2	D3	D4	D5	D6
E1	E2	E3	E4	E5	E6
F1	F2	F3	F4	F5	F6
G1	G2	G3	G4	G5	G6
H1	H2	H3	H4	H5	H6
I1	I2	I3	I4	I5	I6
J1	J2	J3	J4	J5	J6
K1	K2	K3	K4	K5	K6
L1	L2	L3	L4	L5	L6
M1	M2	M3	M4	M5	M6
N1	N2	N3	N4	N5	N6
O1	O2	O3	O4	O5	O6
P1	P2	P3	P4	P5	P6

LU-00093

## B: INSPECTION

Step	Check	Yes	No
<b>1</b> <b>CHECK COMBINATION METER.</b> 1) Turn ignition switch to ON. (engine OFF) 2) Check other warning lights.	Does the warning lights go on?	Go to step 2.	Repair or replace the combination meter. <Ref. to IDI-4, INSPECTION, Combination Meter System.>
<b>2</b> <b>CHECK HARNESS CONNECTOR BETWEEN COMBINATION METER AND OIL PRESSURE SWITCH.</b> 1) Turn ignition switch to OFF. 2) Disconnect connector from the oil pressure switch. 3) Turn ignition switch ON. 4) Measure the voltage of harness between the combination meter connector and chassis ground. <b>Connector &amp; terminal</b> <b>(E11) No. 1 — Chassis ground:</b>	Is the measured value more than 10 V?	Replace oil pressure switch.	Go to step 3.
<b>3</b> <b>CHECK COMBINATION METER.</b> 1) Turn ignition switch to OFF. 2) Remove the combination meter. 3) Measure the resistance of the combination meter. <b>Terminal</b> <b>No. C13 — No. C3:</b>	Is the measured value less than 10 Ω?	Replace the harness connector between combination meter and oil pressure switch.	Repair or replace the combination meter and the oil pressure switch warning light bulb.

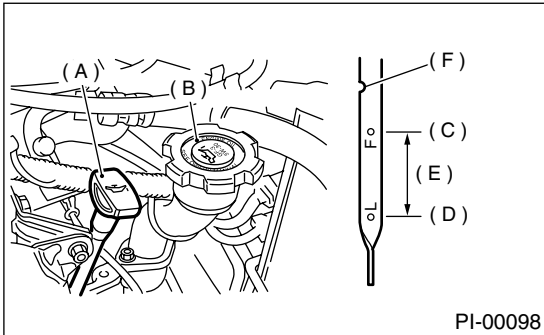
# ENGINE OIL

## LUBRICATION

### 3. Engine Oil

#### A: INSPECTION

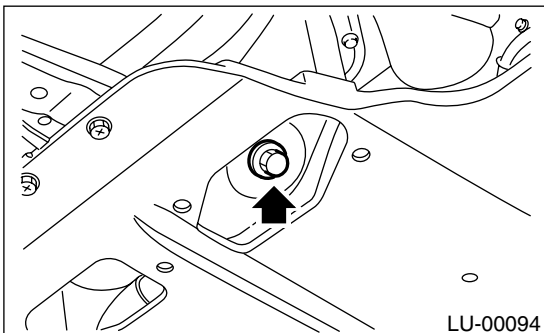
- 1) Park vehicle on a level surface.
- 2) Remove oil level gauge and wipe it clean.
- 3) Reinsert oil level gauge. Be sure that the level gauge is correctly inserted and in the proper orientation.
- 4) Remove it again and note the reading. If the engine oil level is below the "L" line, add oil to bring the level up to the "F" line.
- 5) After turning off the engine, wait a few minutes for the oil to drain back into the oil pan before checking the level.
- 6) Just after driving or while the engine is warm, engine oil level may show in the range between the "F" line and the notch mark. This is caused by thermal expansion of the engine oil.
- 7) To prevent overfilling the engine oil, do not add oil above the "F" line when the engine is cold.



- (A) Oil level gauge
- (B) Engine oil filler cap
- (C) Upper level
- (D) Lower level
- (E) Approx. 1.0 ℓ (1.1 US qt, 0.9 Imp qt)
- (F) Notch mark

#### B: REPLACEMENT

- 1) Open engine oil filler cap for quick draining of the engine oil.
- 2) Drain engine oil by loosening engine oil drain plug.

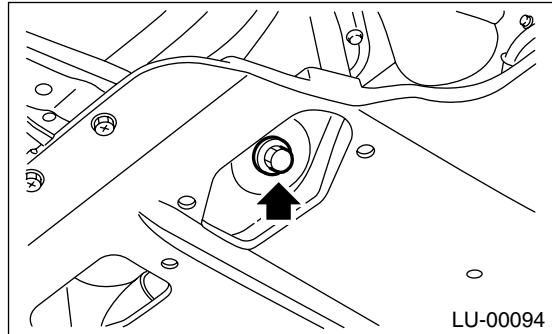


- 3) Replace drain plug gasket.

- 4) Tighten engine oil drain plug after draining engine oil.

#### Tightening torque:

**44 N·m (4.5 kgf·m, 33 ft·lb)**



- 5) Fill engine oil through filler pipe up to upper point on level gauge. Make sure that vehicle is placed level when checking oil level. Use engine oil of proper quality and viscosity, selected in accordance with the table in figure.

#### Recommended oil

**ILSAC GF-3, which can be identified with the new API certification mark (Star burst mark)**

**API classification SL with the words "ENERGY CONSERVING" (if you cannot obtain the oil with SL grade, you may use SJ grade "ENERGY CONSERVING" oil)**  
**ACEA specification A1, A2 or A3**

#### Oil amount for preparation (when replacing engine oil):

**Approx. 4.0 ℓ (4.2 US qt, 3.5 Imp qt)**

SAE Viscosity No. and Applicable Temperature						
(°C)	-30	-20	-15	0	15	30 40
(°F)	-22	-4	5	32	59	86 104
				10W-30, 10W-40		
				5W-30 PREFERRED		

The proper viscosity helps vehicle get good cold and hot starting by reducing viscous friction and thus increasing cranking speed.

#### CAUTION:

**When replenishing oil, it does not matter if the oil to be added is a different brand from that in the engine; however, use oil having the ILSAC or API classification and SAE viscosity No. designated by SUBARU.**

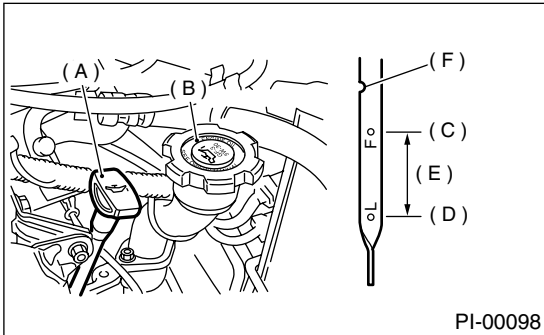


**NOTE:**

If vehicle is used in desert areas with very high temperatures or for other heavy duty applications, the following viscosity oils may be used: ILSAC classification: GF-3 or API classification: SL

SAE Viscosity No.: 30, 40, 10W-50, 20W-40, 20W-50.

- 6) Close engine oil filler cap.
- 7) Start engine and warm it up for a time.
- 8) After engine stops, recheck the oil level. If necessary, add engine oil up to upper level on level gauge.



- (A) Oil level gauge
- (B) Engine oil filler cap
- (C) Upper level
- (D) Lower level
- (E) Approx. 1.0 ℓ (1.1 US qt, 0.9 Imp qt)
- (F) Notch mark

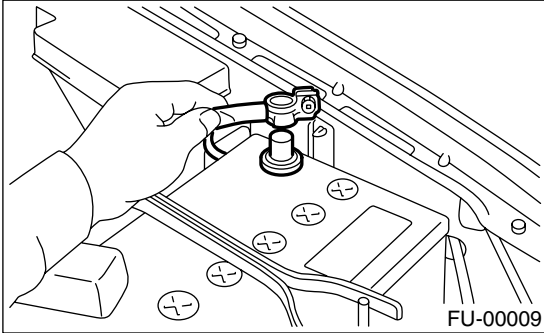
# OIL PUMP

## LUBRICATION

### 4. Oil Pump

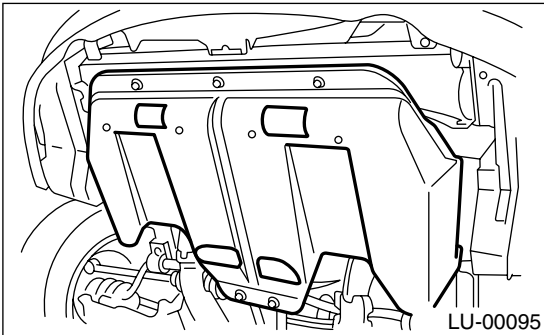
#### A: REMOVAL

1) Disconnect ground cable from battery.



2) Lift-up the vehicle.

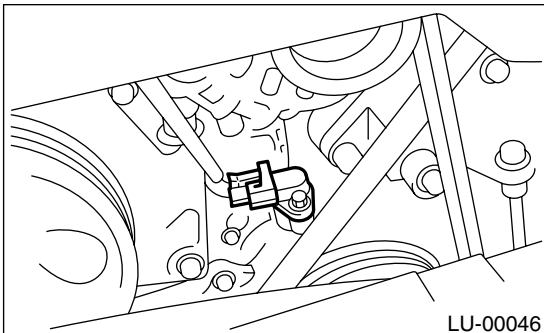
3) Remove undercover.



4) Lower the vehicle.

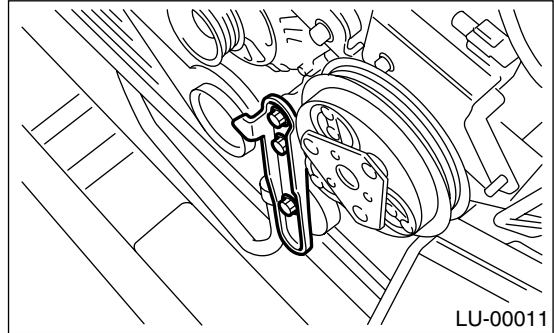
5) Remove radiator. <Ref. to CO(H4SO)-20, REMOVAL, Radiator.>

6) Remove crankshaft position sensor.

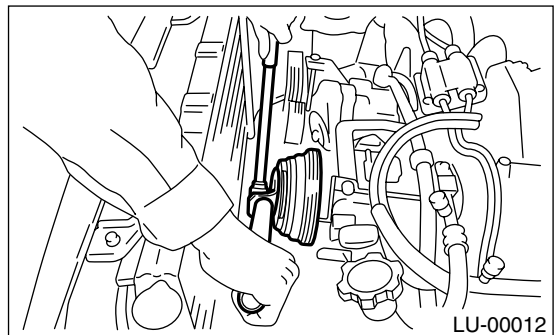


7) Remove V-belts. <Ref. to ME(H4SO)-43, REMOVAL, V-belt.>

8) Remove rear side V-belt tensioner.



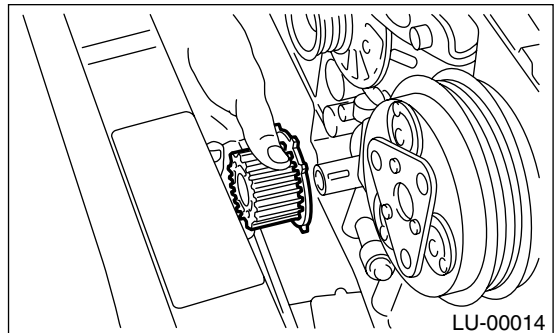
9) Remove crankshaft pulley by using ST.  
ST 499977100 CRANKSHAFT PULLEY  
WRENCH



10) Remove water pump. <Ref. to CO(H4SO)-14, REMOVAL, Water Pump.>

11) Remove timing belt guide. (MT vehicle)

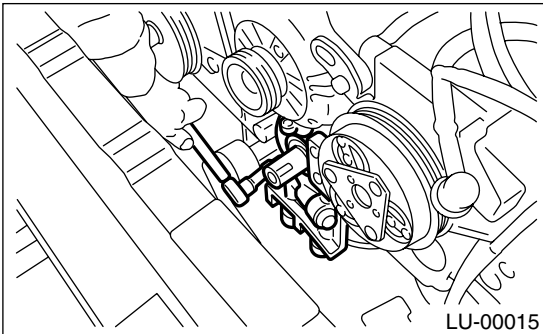
12) Remove crankshaft sprocket.



13) Remove bolts which install oil pump onto cylinder block.

**NOTE:**

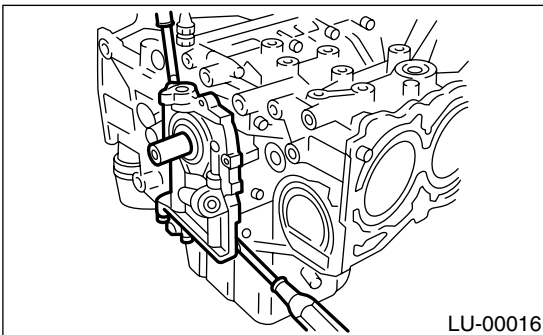
To disassemble and check oil pump, loosen relief valve plug before removing the pump.



14) Remove oil pump by using flat bladed screwdriver.

**CAUTION:**

Be careful not to scratch mating surfaces of cylinder block and oil pump.



## B: INSTALLATION

Install in the reverse order of removal.

Do the following:

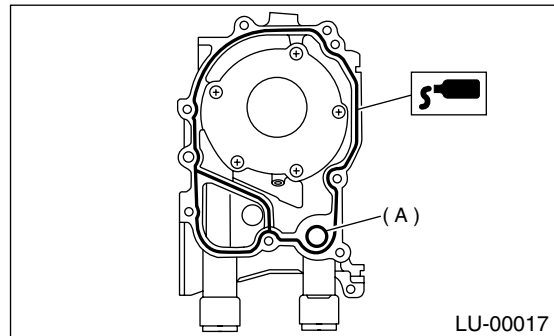
1) Apply fluid gasket to matching surfaces of oil pump.

**Fluid gasket:**

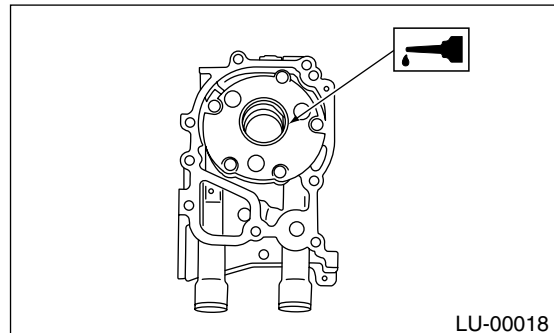
**Part No. 004403007**

**THREE BOND 1215 or equivalent**

2) Replace O-ring (A) with a new one.



3) Apply engine oil to the inside of the oil seal.



4) Be careful not to scratch oil seal when installing oil pump on cylinder block.

5) Position the oil pump, aligning the notched area with the crankshaft, and push the oil pump straight.

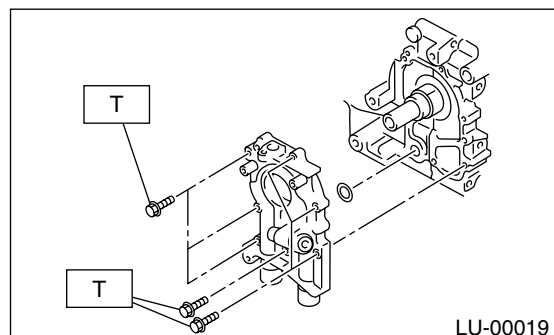
**CAUTION:**

Make sure the oil seal lip is not folded.

6) Install oil pump.

**Tightening torque:**

**6.4 N·m (0.65 kgf-m, 4.7 ft-lb)**

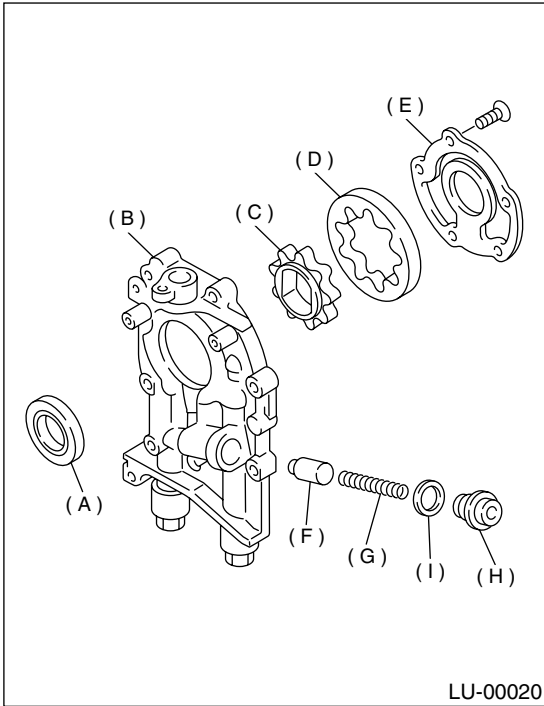


# OIL PUMP

## LUBRICATION

### C: DISASSEMBLY

Remove screws which secure oil pump cover and disassemble oil pump. Inscribe alignment marks on inner and outer rotors so that they can be replaced in their original positions during reassembly.

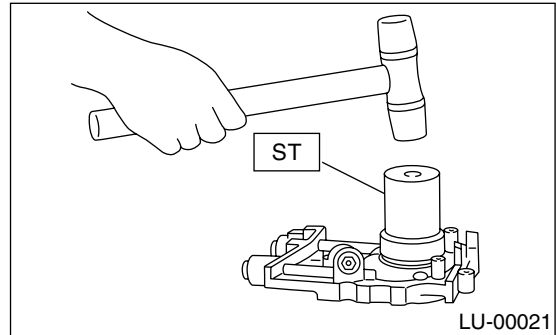


- (A) Oil seal
- (B) Pump case
- (C) Inner rotor
- (D) Outer rotor
- (E) Pump cover
- (F) Relief valve
- (G) Relief valve spring
- (H) Plug
- (I) Gasket

### D: ASSEMBLY

- 1) Install front oil seal by using ST.  
ST 499587100 OIL SEAL INSTALLER

NOTE:  
Use a new oil seal.

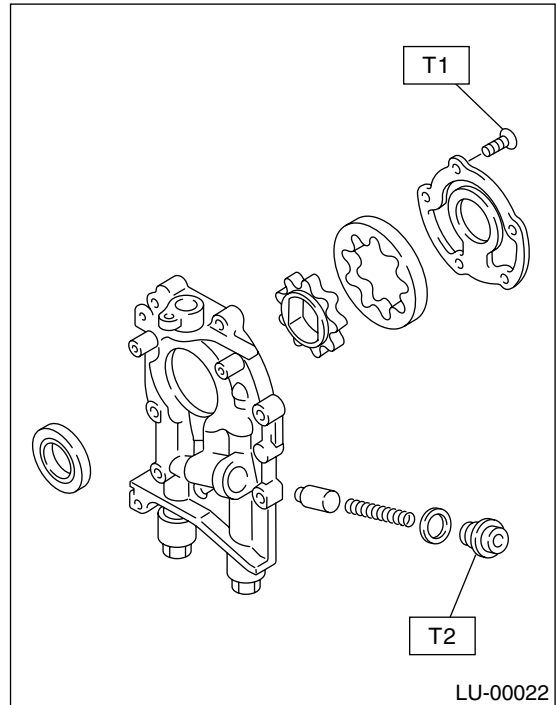


- 2) Apply engine oil to inner and outer rotors.
- 3) Install inner and outer rotors in their original positions.
- 4) Install oil relief valve and relief valve spring.
- 5) Install oil pump cover.

#### Tightening torque:

**T1: 5 N·m (0.5 kgf·m, 3.6 ft·lb)**

**T2: 44 N·m (4.5 kgf·m, 33 ft·lb)**



**E: INSPECTION****1. TIP CLEARANCE**

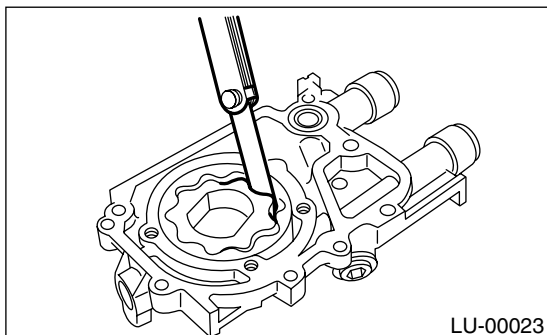
Measure the tip clearance of rotors. If the clearance exceeds the limit, replace rotors as a set.

**Tip clearance:****Standard**

**0.04 — 0.14 mm (0.0016 — 0.0055 in)**

**Limit**

**0.18 mm (0.0071 in)**

**2. CASE CLEARANCE**

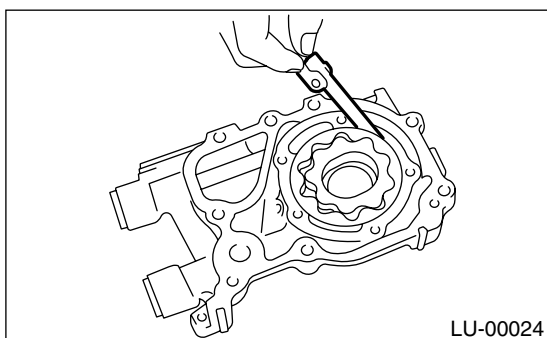
Measure the clearance between the outer rotor and the cylinder block rotor housing. If the clearance exceeds the limit, replace the rotor.

**Case clearance:****Standard**

**0.10 — 0.175 mm (0.0039 — 0.0069 in)**

**Limit**

**0.20 mm (0.0079 in)**

**3. SIDE CLEARANCE**

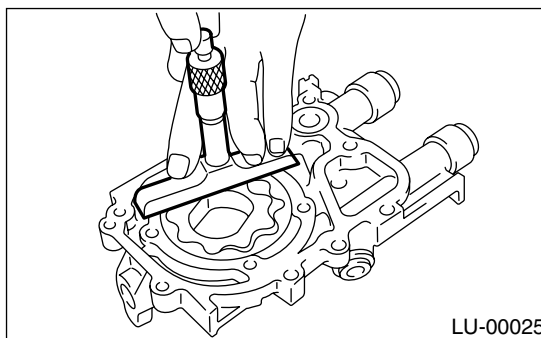
Measure clearance between oil pump inner rotor and pump cover. If the clearance exceeds the limit, replace rotor or pump body.

**Side clearance:****Standard**

**0.02 — 0.07 mm (0.0008 — 0.0028 in)**

**Limit**

**0.12 mm (0.0047 in)**

**4. OIL RELIEF VALVE**

Check the valve for fitting condition and damage, and the relief valve spring for damage and deterioration. Replace the parts if defective.

**Relief valve spring:****Free length**

**72.8 mm (2.866 in)**

**Installed length**

**54.7 mm (2.154 in)**

**Load when installed**

**81.3 N (8.29 kgf, 18.28 lb)**

**5. OIL PUMP CASE**

Check the oil pump case for worn shaft hole, clogged oil passage, worn rotor chamber, cracks, and other faults.

**6. OIL SEAL**

Check the oil seal lips for deformation, hardening, wear, etc. and replace if defective.

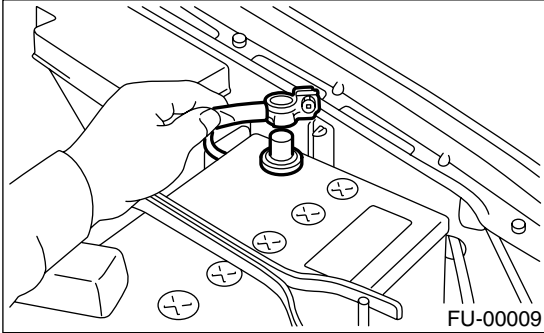
# OIL PAN AND STRAINER

## LUBRICATION

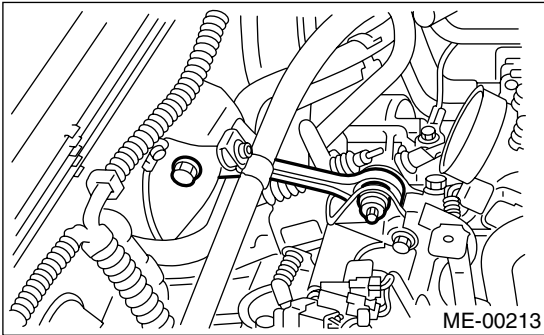
### 5. Oil Pan and Strainer

#### A: REMOVAL

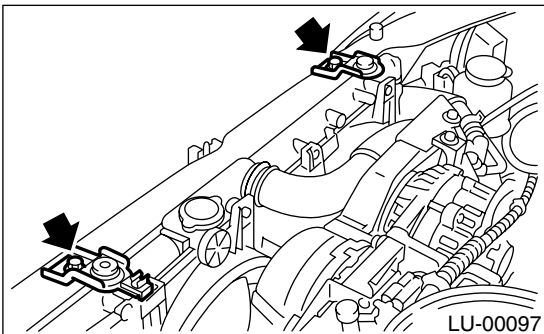
- 1) Set the vehicle on lift arms.
- 2) Remove front wheels.
- 3) Disconnect ground cable from battery.



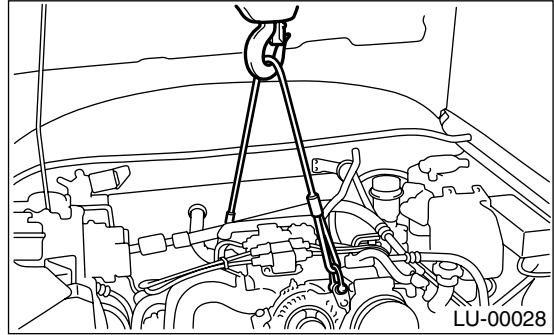
- 4) Remove air intake duct and air cleaner case.  
<Ref. to IN(H4SO)-6, REMOVAL, Air Intake Duct.>  
and <Ref. to IN(H4SO)-5, REMOVAL, Air Cleaner Case.>
- 5) Remove pitching stopper.



- 6) Remove radiator upper brackets.



- 7) Support engine with a lifting device and wire ropes.

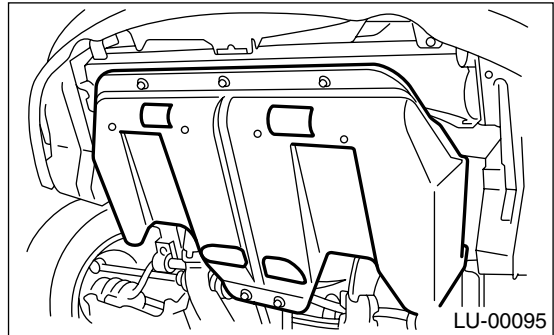


- 8) Lift-up the vehicle.

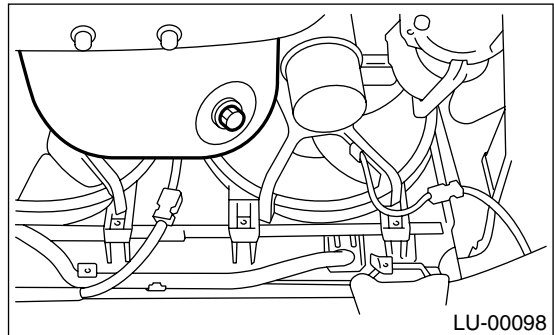
#### CAUTION:

**When lifting up the vehicle, wire rope must be raised at the same time.**

- 9) Remove under cover.

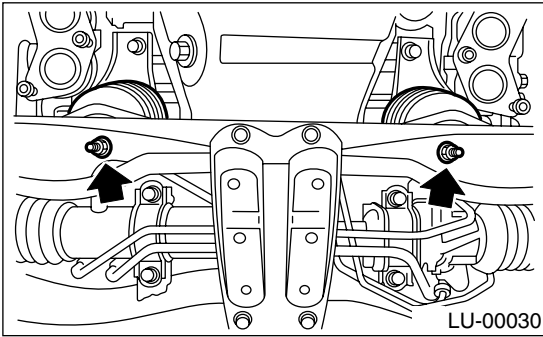


- 10) Drain engine oil.  
Set container under the vehicle, and remove drain plug from oil pan.



- 11) Remove front and center exhaust pipes. <Ref. to EX(H4SO)-5, REMOVAL, Front Exhaust Pipe.>

12) Remove nuts which secure front cushion rubber onto front crossmember.

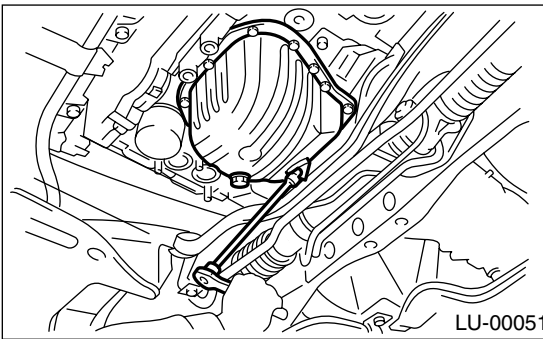


13) Remove bolts which secure oil pan on cylinder block while raising up engine.

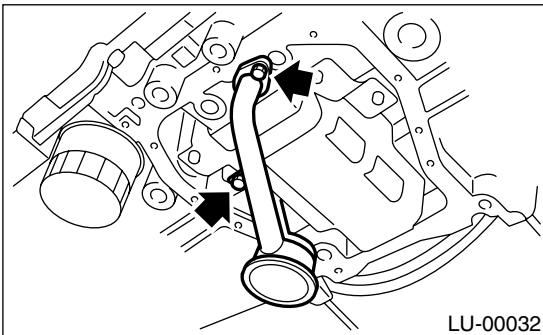
14) Insert oil pan cutter blade between cylinder block-to-oil pan clearance.

**CAUTION:**

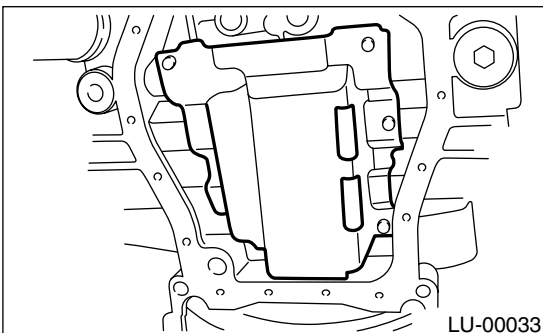
**Do not use a screwdriver or similar tool in place of oil pan cutter.**



15) Remove oil strainer.



16) Remove baffle plate.

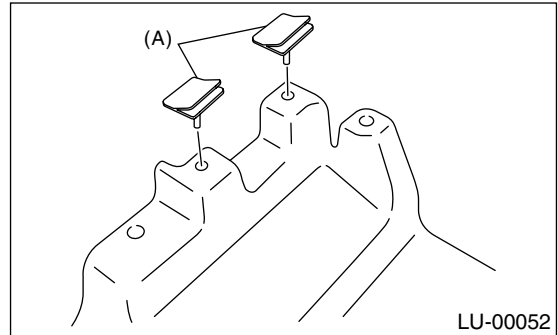


## B: INSTALLATION

**CAUTION:**

**Before installing oil pan, clean sealant from oil pan and engine block.**

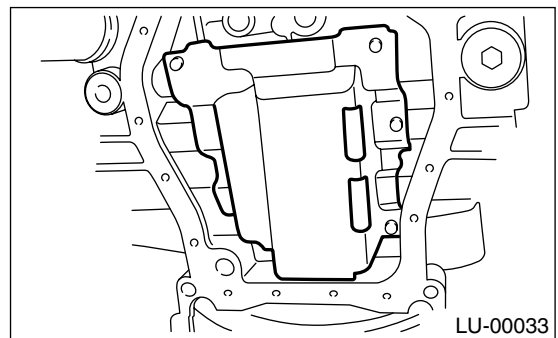
1) Make sure seal (A) is facing to the direction shown in the figure below and installed on baffle plate securely.



2) Install baffle plate.

**Tightening torque:**

**6.4 N·m (0.65 kgf·m, 4.7 ft·lb)**



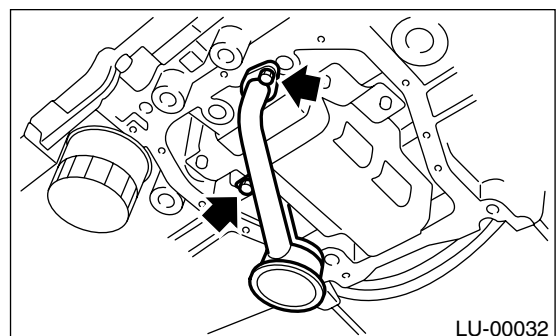
3) Install oil strainer onto baffle plate.

**CAUTION:**

**Replace O-ring with a new one.**

**Tightening torque:**

**10 N·m (1.0 kgf·m, 7 ft·lb)**



# OIL PAN AND STRAINER

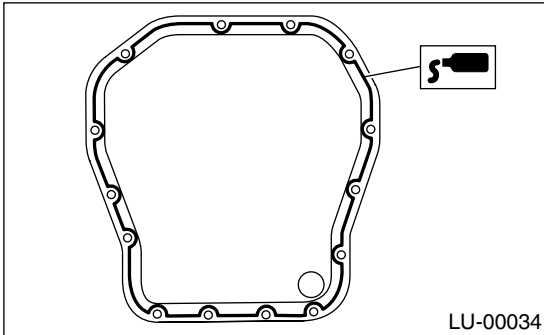
## LUBRICATION

4) Apply fluid gasket to mating surfaces and install oil pan.

**Fluid gasket:**

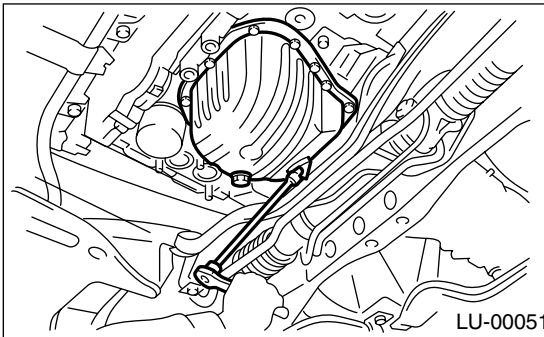
**Part No. 004403007**

**THREE BOND 1215 or equivalent**



**Tightening torque:**

**5 N·m (0.5 kgf-m, 3.6 ft-lb)**

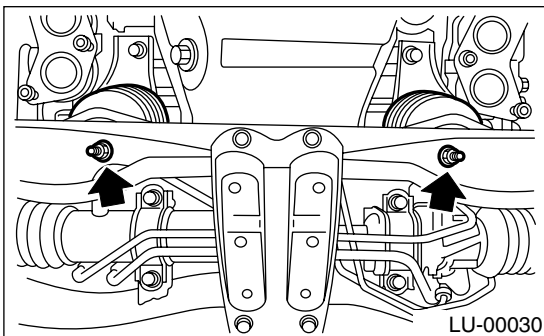


5) Lower engine onto front crossmember.

6) Tighten nuts which secure front cushion rubber onto front crossmember.

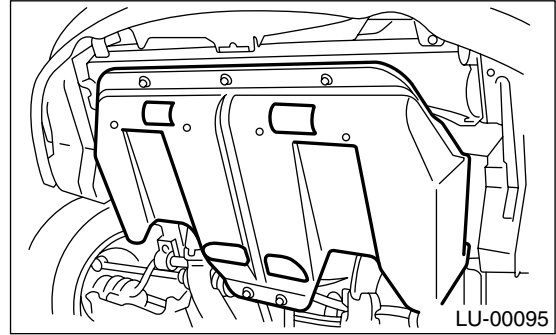
**Tightening torque:**

**69 N·m (7.0 kgf-m, 51 ft-lb)**



7) Install front and center exhaust pipes.  
<Ref. to EX(H4SO)-6, INSTALLATION, Front Exhaust Pipe.>

8) Install under cover.

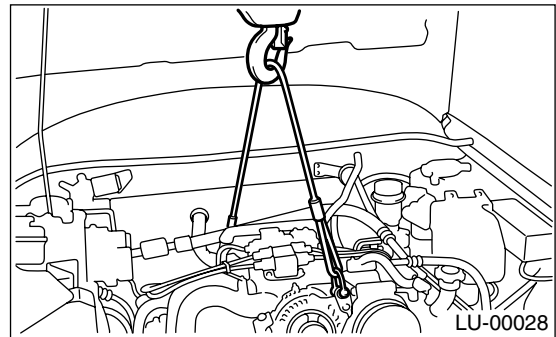


9) Lower the vehicle.

**CAUTION:**

**When lowering vehicle, wire rope must be released at the same time.**

10) Remove lifting device and steel cables.

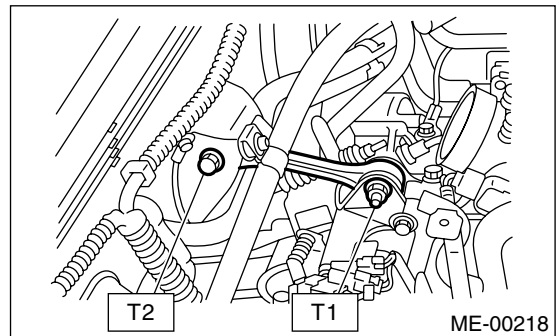


11) Install pitching stopper.

**Tightening torque:**

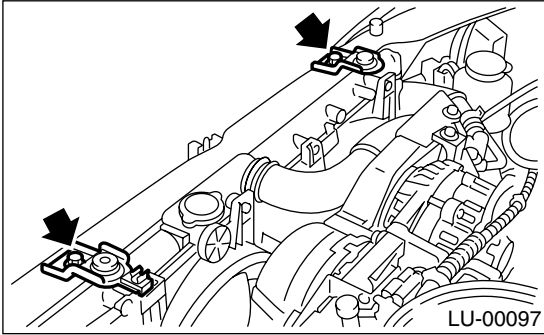
**T1: 50 N·m (5.1 kgf-m, 37 ft-lb)**

**T2: 58 N·m (5.9 kgf-m, 43 ft-lb)**





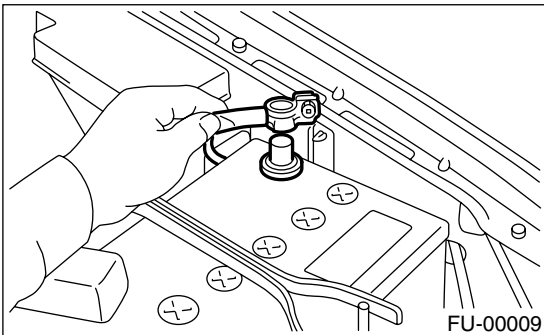
12) Install radiator upper brackets.



13) Install air intake duct and air cleaner case.  
<Ref. to IN(H4SO)-6, INSTALLATION, Air Intake Duct.> and <Ref. to IN(H4SO)-5, INSTALLATION, Air Cleaner Case.>

14) Install front wheels.

15) Connect battery ground cable.



16) Fill engine oil. <Ref. to LU(H4SO)-8, INSPECTION, Engine Oil.>

## **C: INSPECTION**

By visual check make sure oil pan, oil strainer, oil strainer stay and baffle plate are not damaged.

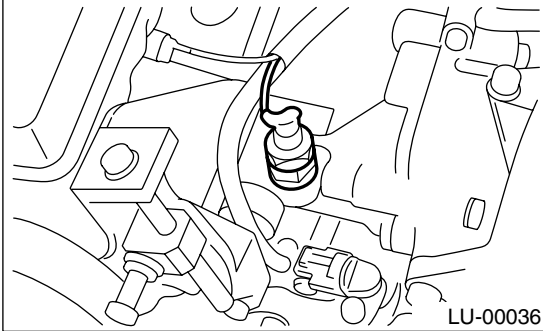
# OIL PRESSURE SWITCH

## LUBRICATION

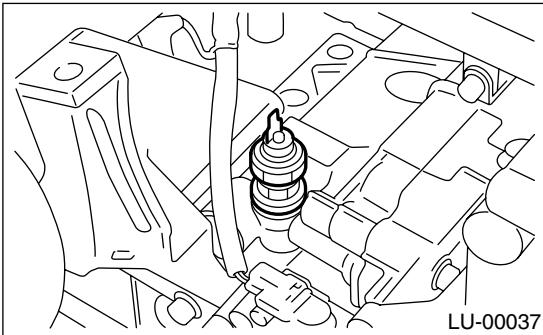
### 6. Oil Pressure Switch

#### A: REMOVAL

- 1) Remove generator from bracket. <Ref. to SC(H4SO)-15, REMOVAL, Generator.>
- 2) Disconnect terminal from oil pressure switch.



- 3) Remove oil pressure switch.



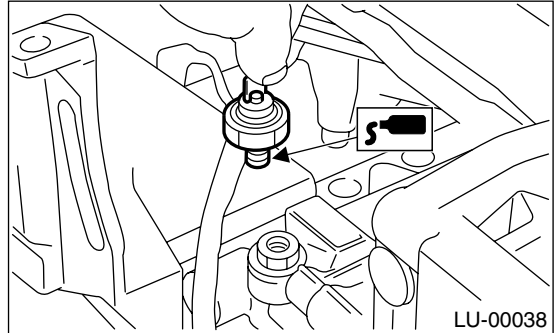
#### B: INSTALLATION

- 1) Apply fluid gasket to oil pressure switch threads.

**Fluid gasket:**

**Part No. 004403042**

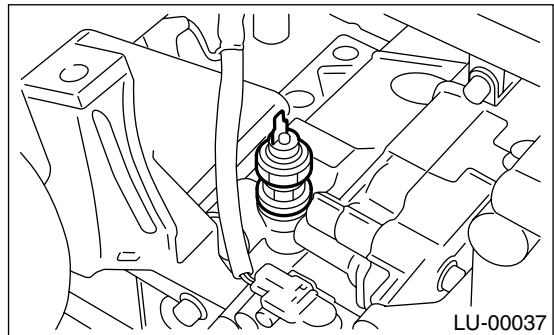
**THREE BOND 1324 or equivalent**



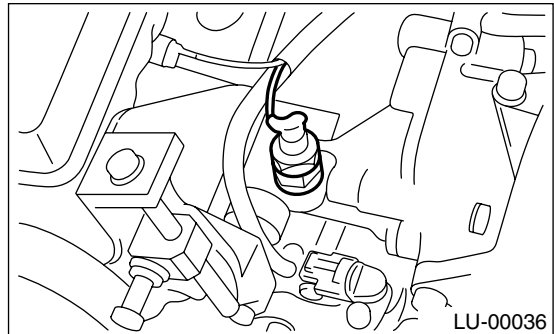
- 2) Install oil pressure switch onto engine block.

**Tightening torque:**

**25 N·m (2.5 kgf-m, 18.1 ft-lb)**



- 3) Connect terminal of oil pressure switch.



- 4) Install generator on bracket. <Ref. to SC(H4SO)-15, INSTALLATION, Generator.>

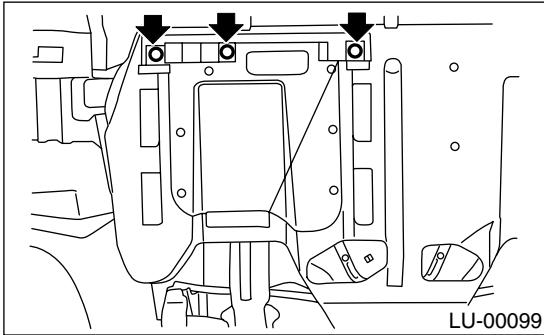
#### C: INSPECTION

Make sure oil does not leak or seep from where the oil pressure switch is installed.

## 7. Engine Oil Filter

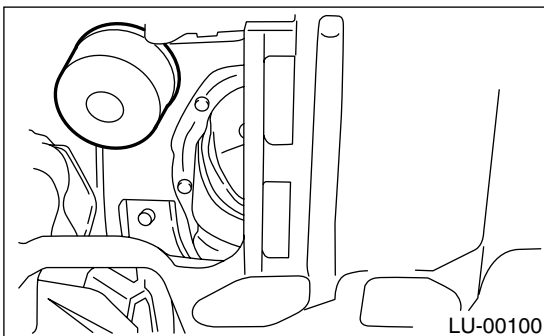
### A: REMOVAL

1) Remove access lid.



2) Remove oil filter with ST.

- |               |   |
|---------------|---|
| ST 498547000  | OIL FILTER WRENCH [Outer diameter 80 mm (3.15 in) for oil filter] |
| ST 18332AA000 | OIL FILTER WRENCH [Outer diameter 68 mm (2.68 in) for oil filter] |
| ST 18332AA010 | OIL FILTER WRENCH [Outer diameter 65 mm (2.56 in) for oil filter] |



### B: INSTALLATION

- 1) Clean oil filter mounting surface of cylinder block or oil cooler.
- 2) Thinly apply engine oil to the seal rubber of new oil filter.
- 3) Be careful not to damage seal rubber when oil filter is turned by hand and installed.
  - Oil filters with 80 mm (3.15 in) and 65 mm (2.56 in) outer diameter are further tightened (about 2/3 to 3/4 rotation) after seal rubber contacts a cylinder block.
  - Oil filter with 68 mm (2.68 in) outer diameter is further tightened (about 1 rotation) after seal rubber contacts a cylinder block.

#### CAUTION:

**Do not tighten excessively, or oil may leak.**

### C: INSPECTION

- 1) After installing oil filter, run engine and make sure that no oil is leaking around seal rubber.

#### NOTE:

The filter element and filter case cannot be disassembled therefore, interior cleaning is not impossible.

- 2) Check the engine oil level. <Ref. to LU(H4SO)-8, INSPECTION, Engine Oil.>

# ENGINE LUBRICATION SYSTEM TROUBLE IN GENERAL

## LUBRICATION

### 8. Engine Lubrication System Trouble in General

#### A: INSPECTION

Before performing diagnostics, make sure that the engine oil level is correct and no oil leakage exists.

Trouble	Possible cause		Corrective action
1. Warning light remains on.	1) Oil pressure switch failure	Cracked diaphragm or oil leakage within switch	Replace.
		Broken spring or seized contacts	Replace.
	2) Low oil pressure	Clogged oil filter	Replace.
		Malfunction of oil by-pass valve of oil filter	Clean or replace.
		Malfunction of oil relief valve of oil pump	Clean or replace.
		Clogged oil passage	Clean.
		Excessive tip clearance and side clearance of oil pump rotor and gear	Replace.
		Clogged oil strainer or broken pipe	Clean or replace.
	3) No oil pressure	Insufficient engine oil	Replenish.
		Broken pipe of oil strainer	Replace.
Stuck oil pump rotor		Replace.	
2. Warning light does not go on.	1) Burn-out bulb		Replace.
	2) Poor contact of switch contact points		Replace.
	3) Disconnection of wiring		Repair.
3. Warning light flickers momentarily.	1) Poor contact at terminals		Repair.
	2) Defective wiring harness		Repair.
	3) Low oil pressure		Check for the same possible causes as listed in 1.—2).