

ENGINE SECTION 3

This service manual has been prepared to provide SUBARU service personnel with the necessary information and data for the correct maintenance and repair of SUBARU vehicles.

This manual includes the procedures for maintenance, disassembling, reassembling, inspection and adjustment of components and diagnostics for guidance of experienced mechanics.

Please peruse and utilize this manual fully to ensure complete repair work for satisfying our customers by keeping their vehicle in optimum condition. When replacement of parts during repair work is needed, be sure to use SUBARU genuine parts.

All information, illustration and specifications contained in this manual are based on the latest product information available at the time of publication approval.

FUEL INJECTION (FUEL SYSTEMS) FU(H4DOSTC)

**EMISSION CONTROL
(AUX. EMISSION CONTROL DEVICES) EC(H4DOSTC)**

INTAKE (INDUCTION) IN(H4DOSTC)

MECHANICAL ME(H4DOSTC)

EXHAUST EX(H4DOSTC)

COOLING CO(H4DOSTC)

LUBRICATION LU(H4DOSTC)

SPEED CONTROL SYSTEMS SP(H4DOSTC)

IGNITION IG(H4DOSTC)

STARTING/CHARGING SYSTEMS SC(H4DOSTC)

ENGINE (DIAGNOSTICS) EN(H4DOSTC)

LUBRICATION

LU(H4DOSTC)

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GENERAL DESCRIPTION

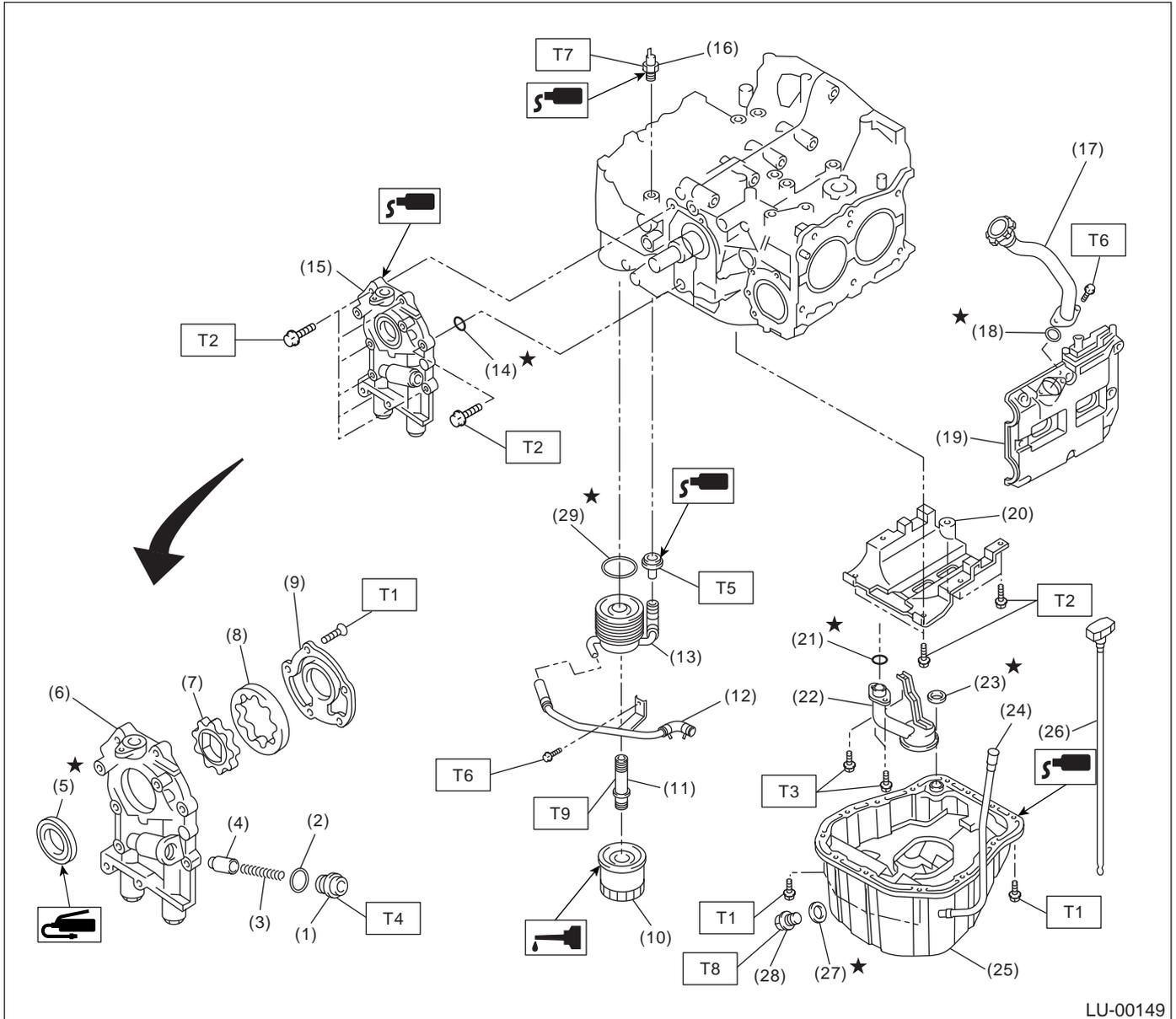
LUBRICATION

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			4.6 ℓ (4.9 US qt, 4.0 Imp qt)/min.
5,000 rpm		- Discharge pressure	294 kPa (3.0 kg/cm ² , 43 psi)
		- Discharge quantity	47.0 ℓ (12.42 US gal, 10.34 Imp gal)/min.
Relief valve operation pressure			588 kPa (6.0 kg/cm ² , 85 psi)
Oil filter	Type		Full-flow filter type
	Filtration area		760 cm ² (118 sq in)
	By-pass valve opening pressure		157 kPa (1.6 kg/cm ² , 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 ² , 2.1 psi)
	Proof pressure		More than 981 kPa (10 kg/cm ² , 142 psi)
Oil capacity (when replacing oil)			Approx. 4.5 ℓ (4.8 US qt, 4.0 Imp qt)

B: COMPONENT



LU-00149

- | | |
|-------------------------------|----------------------------|
| (1) Plug | (16) Oil pressure switch |
| (2) Gasket | (17) Oil filler duct |
| (3) Relief valve spring | (18) O-ring |
| (4) Relief valve | (19) Rocker cover |
| (5) Oil seal | (20) Baffle plate |
| (6) Oil pump case | (21) O-ring |
| (7) Inner rotor | (22) Oil strainer |
| (8) Outer rotor | (23) Gasket |
| (9) Oil pump cover | (24) Oil level gauge guide |
| (10) Oil filter | (25) Oil pan |
| (11) Connector (MT model) | (26) Oil level gauge |
| (12) Water by-pass (MT model) | (27) Metal gasket |
| (13) Oil cooler (MT model) | (28) Drain plug |
| (14) O-ring | (29) O-ring |
| (15) Oil pump ASSY | |

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: 44 (4.5, 33)
T5: 69 (7.0, 51)
T6: 6.4 (0.65, 4.7)
T7: 25 (2.5, 18.1)
T8: 44 (4.5, 33)
T9: 54 (5.5, 40)

GENERAL DESCRIPTION

LUBRICATION

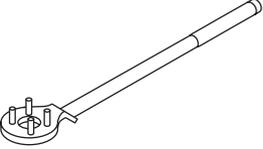
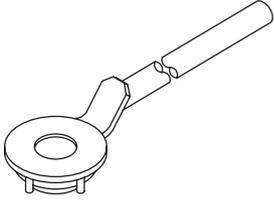
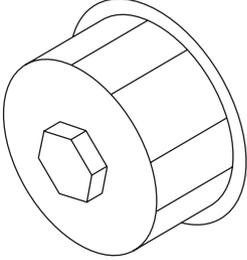
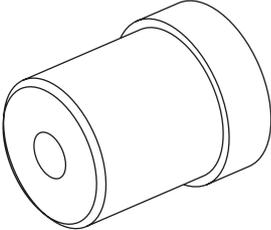
C: CAUTION

- 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.

GENERAL DESCRIPTION

LUBRICATION

D: PREPARATION TOOL

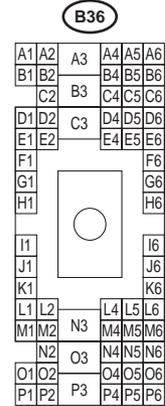
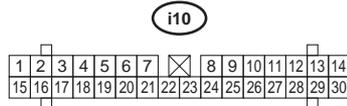
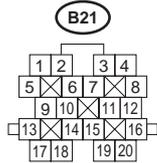
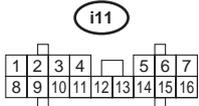
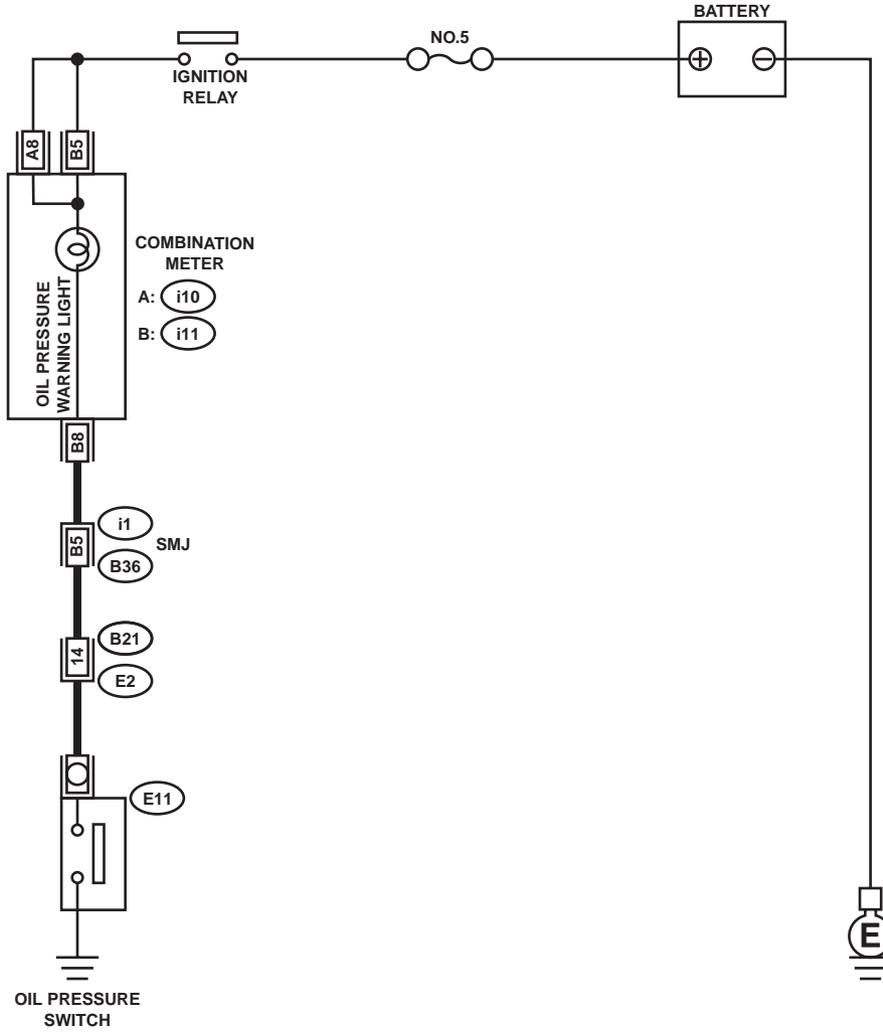
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p style="text-align: center;">ST-499977100</p>	<p style="text-align: center;">499977100 (MT model)</p>	<p>CRANKSHAFT PULLEY WRENCH</p>	<p>Used for stopping rotation of crankshaft pulley when loosening and tightening crankshaft pulley bolt.</p>
 <p style="text-align: center;">ST-499977400</p>	<p style="text-align: center;">499977400 (AT model)</p>	<p>CRANKSHAFT PULLEY WRENCH</p>	<p>Used for stopping rotation of crankshaft pulley when loosening and tightening crankshaft pulley bolt.</p>
 <p style="text-align: center;">ST-498547000</p>	<p style="text-align: center;">498547000</p>	<p>OIL FILTER WRENCH</p>	<p>Used for removing and installing oil filter.</p>
 <p style="text-align: center;">ST-499587100</p>	<p style="text-align: center;">499587100</p>	<p>OIL SEAL INSTALLER</p>	<p>Used for installing oil pump oil seal.</p>

OIL PRESSURE SYSTEM

LUBRICATION

2. Oil Pressure System

A: SCHEMATIC



LU-00150

B: INSPECTION

Step	Value	Yes	No
1 CHECK COMBINATION METER. 1) Turn ignition switch to ON. (engine OFF) 2) Check other warning lights. Does the warning lights go on?	Warning light goes on.	Go to step 2.	Repair or replace the combination meter. <Ref. to IDI-4, INSPECTION, Combination Meter System.>
2 CHECK HARNESS CONNECTOR BETWEEN COMBINATION METER AND OIL PRESSURE SWITCH. 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. Connector & terminal (E11) No. 1 — Chassis ground: Does the measured value exceed the specified value?	10 V	Replace oil pressure switch.	Go to step 3.
3 CHECK COMBINATION METER. 1) Turn ignition switch to OFF. 2) Remove the combination meter. 3) Measure the resistance of the combination meter. Terminal No. A8 — No. B8: No. B5 — No. B8: Is the measured value less than the specified value?	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.

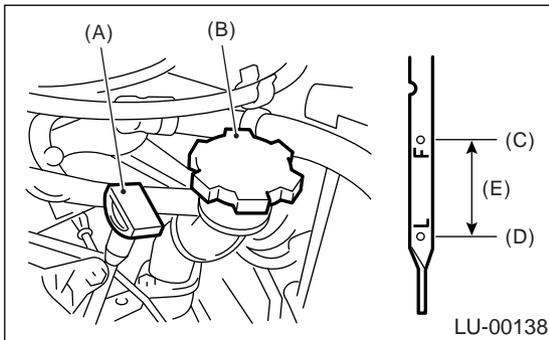
ENGINE OIL

LUBRICATION

3. Engine Oil

A: INSPECTION

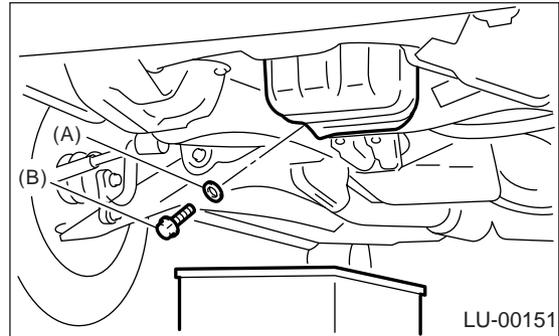
- 1) Park vehicle on a level surface.
- 2) Remove oil level gauge and wipe it clean.
- 3) Reinsert the level gauge all the way. Be sure that the level gauge is correctly inserted and in the proper orientation.
- 4) Remove it again and note the reading. If the engine oil level is below the "L" line, add 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. (1.1 US qt, 0.9 Imp qt)

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.

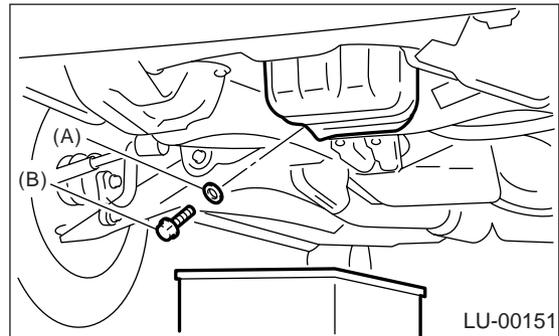


- (A) Gasket
- (B) Drain plug

- 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)



- (A) Gasket
- (B) Drain plug

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

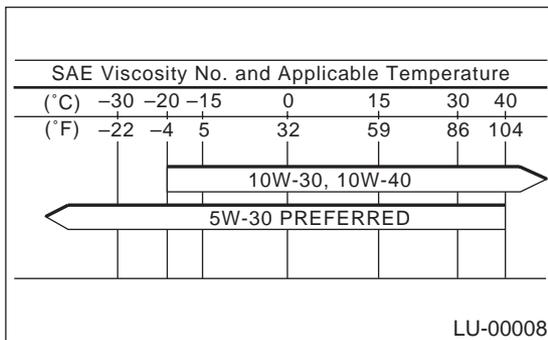
ILSAC GF-3, which can be identified with the new API certification mark (Star burst mark)

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. 4.5 ℓ (4.8 US qt, 4.0 Imp qt)



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.

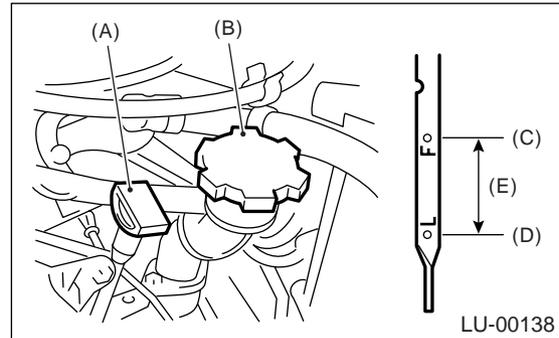
NOTE:

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. (1.1 US qt, 0.9 Imp qt)

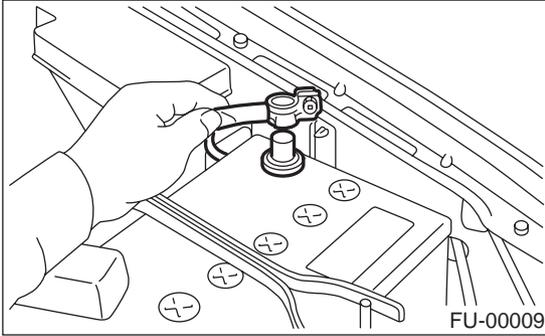
OIL PUMP

LUBRICATION

4. Oil Pump

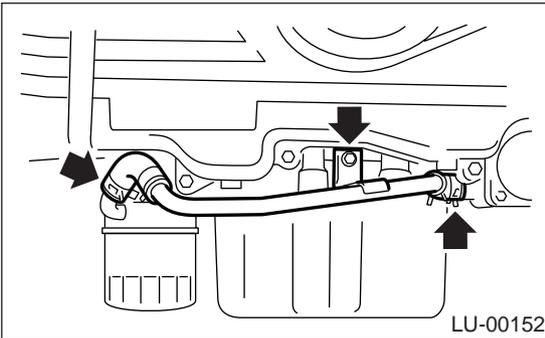
A: REMOVAL

1) Disconnect battery ground cable.



2) Lift-up the vehicle.

3) Remove under cover.



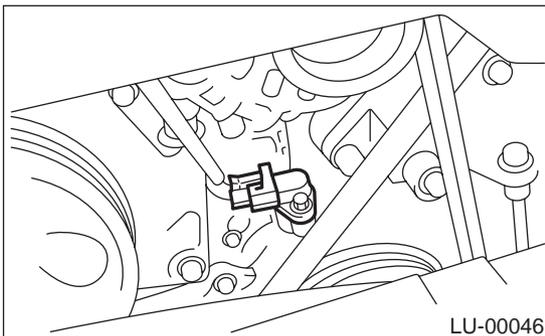
4) Remove bolts which install water pipe of oil cooler onto oil pump. (MT model)

5) Remove water pipe and hose between water pipe and oil cooler. (MT model)

6) Lower the vehicle.

7) Remove radiator. <Ref. to CO(H4DOSTC)-23, REMOVAL, Radiator.>

8) Remove crankshaft position sensor.



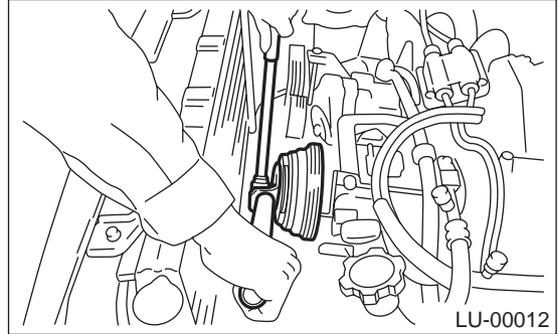
9) Remove V-belts. <Ref. to ME(H4DOSTC)-42, REMOVAL, V-belt.>

10) Remove rear side V-belt tensioner.

11) Remove crankshaft pulley by using ST.

ST 499977100 CRANKSHAFT PULLEY WRENCH (MT model)

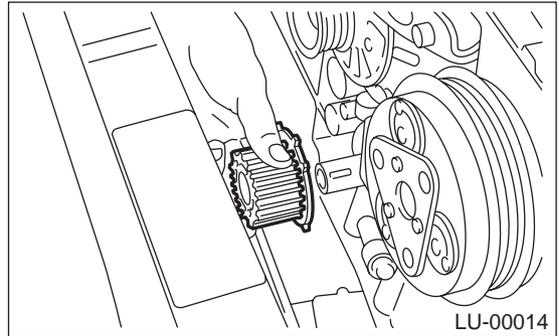
ST 499977400 CRANKSHAFT PULLEY WRENCH (AT model)



12) Remove water pump. <Ref. to CO(H4DOSTC)-17, REMOVAL, Water Pump.>

13) Remove timing belt guide. (MT model)

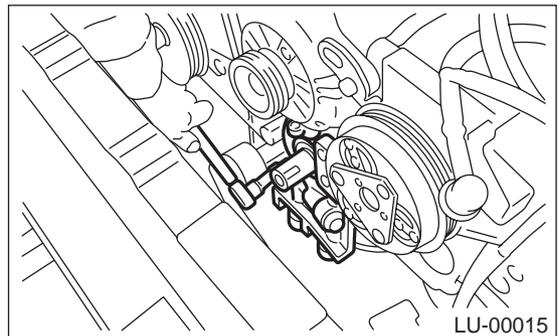
14) Remove crankshaft sprocket.



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

NOTE:

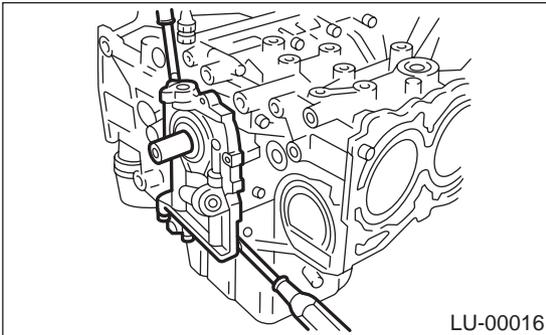
To disassemble and check oil pump, loosen relief valve plug before removing the pump.



16) Remove oil pump by using flat bladed screwdriver.

CAUTION:

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



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

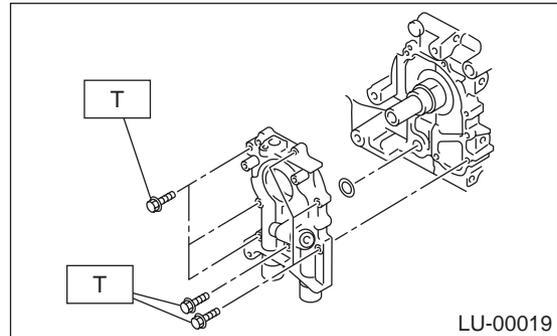
CAUTION:

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)



B: INSTALLATION

Install in the reverse order of removal.

Do the following:

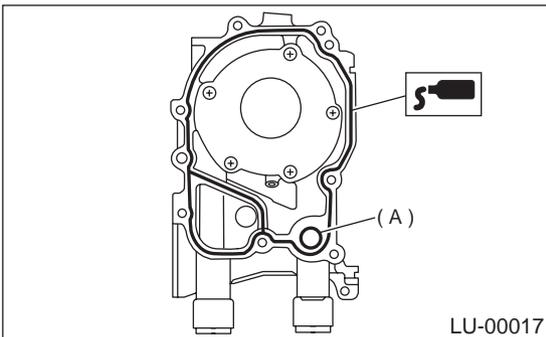
1) Apply fluid gasket to matching surfaces of oil pump.

Fluid gasket:

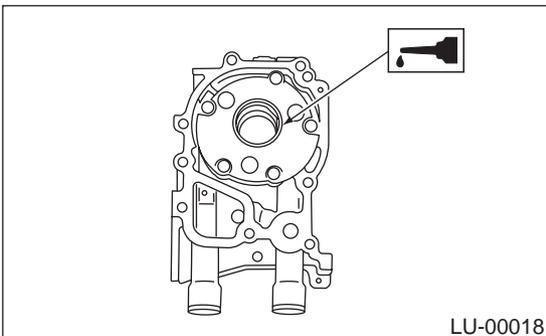
Part No. 004403007

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.



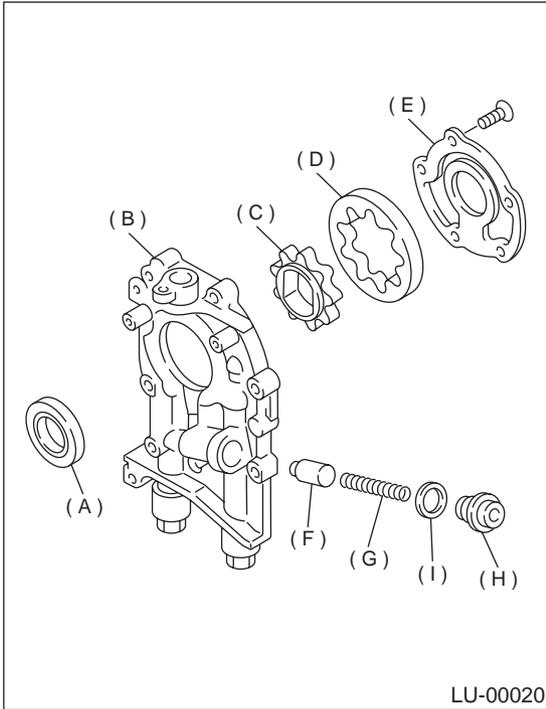
4) Be careful not to scratch oil seal when installing oil pump on cylinder block.

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.

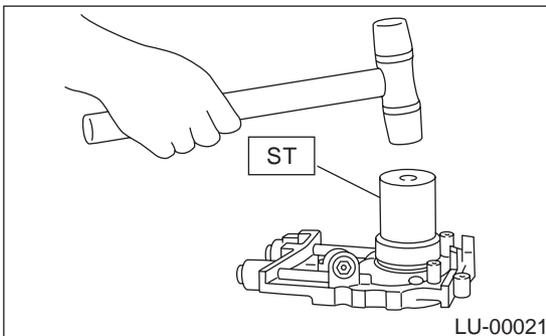


- (A) Oil seal
- (B) Pump case
- (C) Inner rotor
- (D) Outer rotor
- (E) Pump cover
- (F) Relief valve
- (G) Relief valve spring
- (H) Plug
- (I) Gasket

D: ASSEMBLY

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

NOTE:
Use a new oil seal.

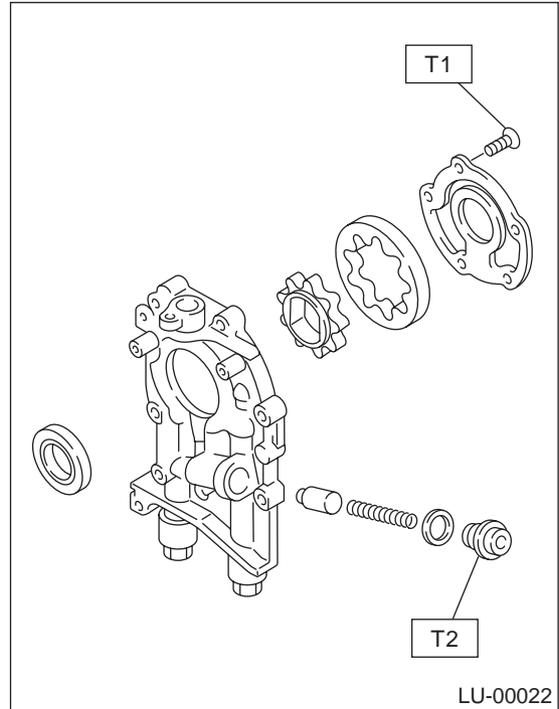


- 2) Apply engine oil to inner and outer rotors.
- 3) Install inner and outer rotors in their original positions.
- 4) Install oil relief valve and relief valve spring.
- 5) Install oil pump cover.

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.

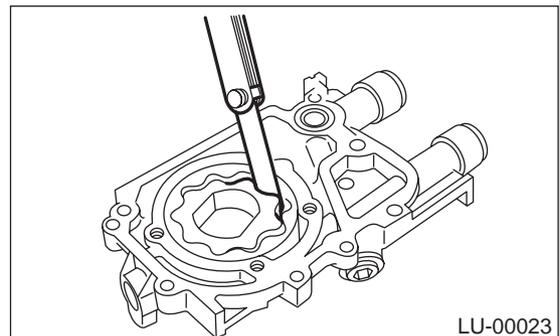
Tip clearance:

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 oil pump rotor housing. If the clearance exceeds the limit, replace the rotor.

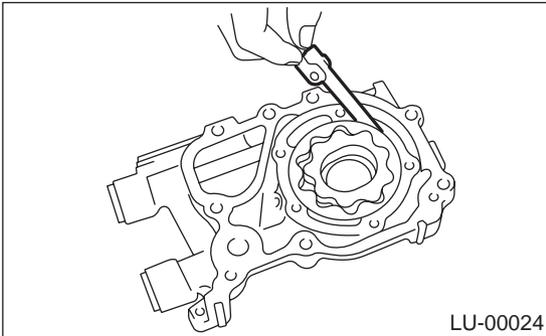
Case clearance:

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.

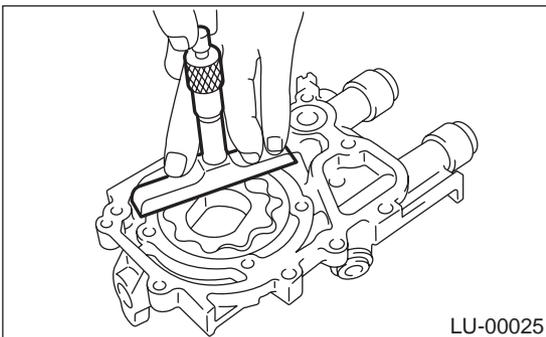
Side clearance:

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

73.7 mm (2.902 in)

Installed length

54.7 mm (2.154 in)

Load when installed

93.1 N (9.49 kgf, 20.93 lb)

5. OIL PUMP CASE

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

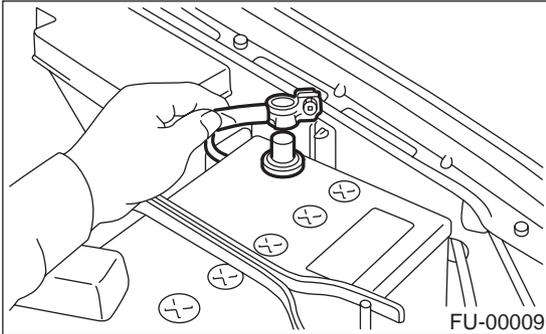
6. OIL SEAL

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

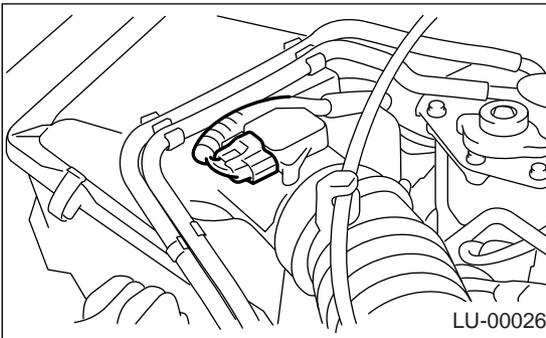
5. Oil Pan and Strainer

A: REMOVAL

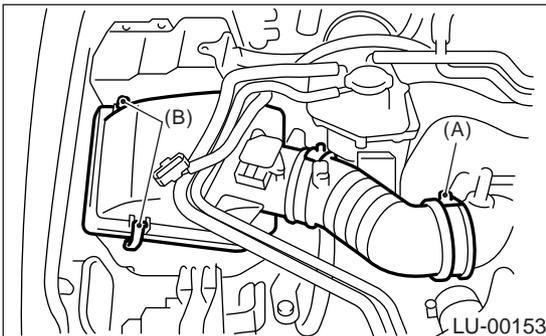
- 1) Set the vehicle on lift arms.
- 2) Remove front wheels.
- 3) Disconnect battery ground cable.



- 4) Disconnect the connector from mass air flow sensor.

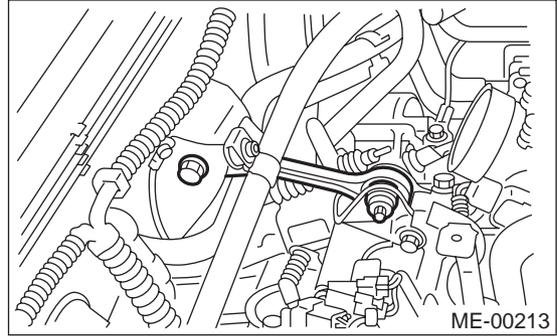


- 5) Loosen the clamp (A) which connects air intake boot to intake duct.
- 6) Remove the two clips (B) from air cleaner upper cover.
- 7) Remove the air intake boot and air cleaner upper cover.

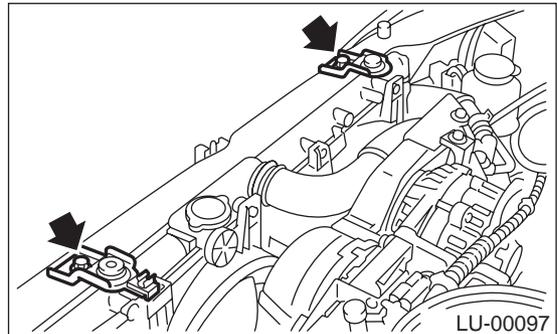


- 8) Remove the intercooler. <Ref. to IN(H4DOSTC)-13, REMOVAL, Intercooler.>

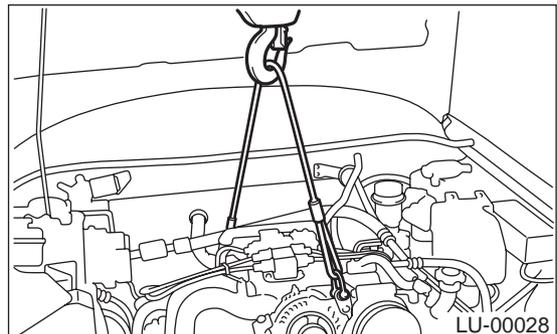
- 9) Remove pitching stopper.



- 10) Remove radiator upper brackets.



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

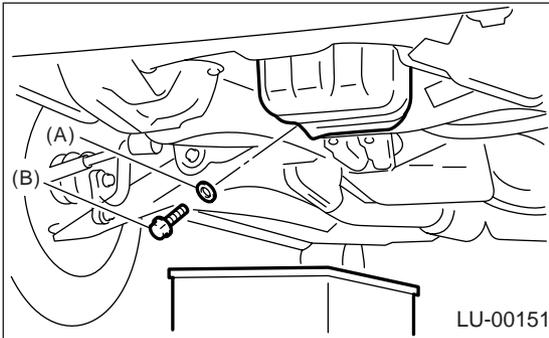


- 12) Lift-up the vehicle.

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

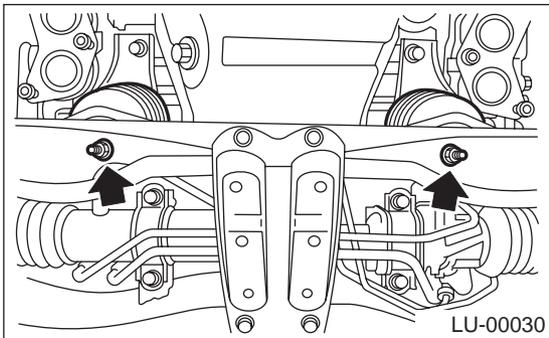
- 13) Remove under cover.

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



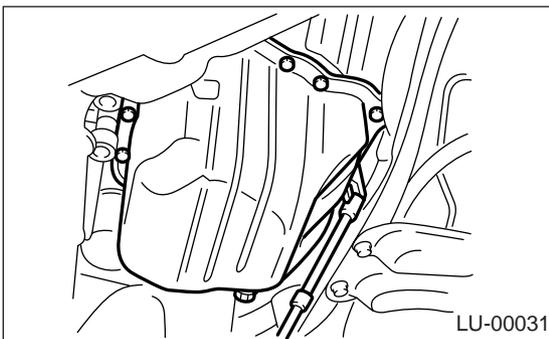
- (A) Gasket
- (B) Drain plug

- 15) Remove nuts which secure front cushion rubber onto front crossmember.

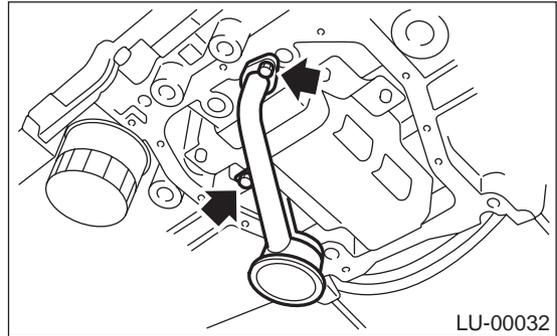


- 16) Remove bolts which secure oil pan on cylinder block while raising up engine.
17) Insert oil pan cutter blade between cylinder block-to-oil pan clearance.

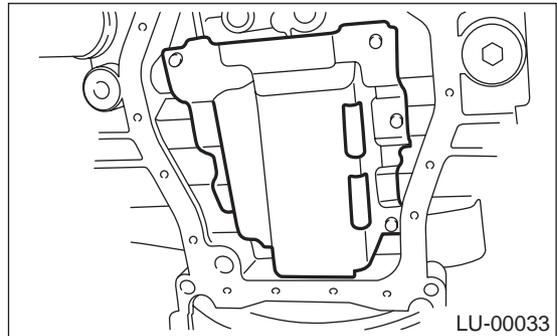
CAUTION:
Do not use a screwdriver or similar tool in place of oil pan cutter.



- 18) Remove oil strainer.



- 19) Remove baffle plate.



B: INSTALLATION

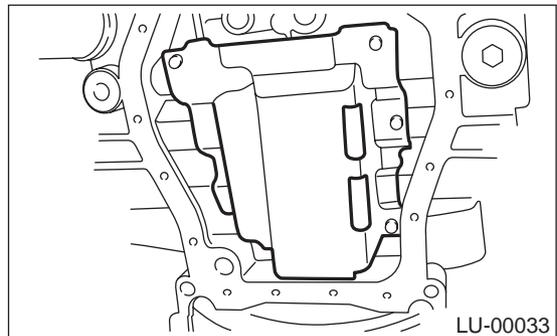
NOTE:

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

- 1) Install baffle plate.

Tightening torque:

6.4 N·m (0.65 kgf-m, 4.7 ft-lb)



OIL PAN AND STRAINER

LUBRICATION

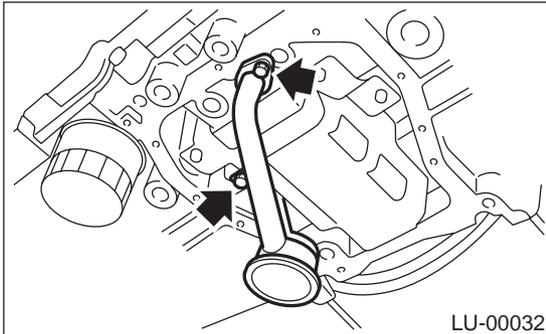
2) Install oil strainer onto baffle plate.

CAUTION:

Replace O-ring with a new one.

Tightening torque:

10 N·m (1.0 kgf·m, 7 ft·lb)

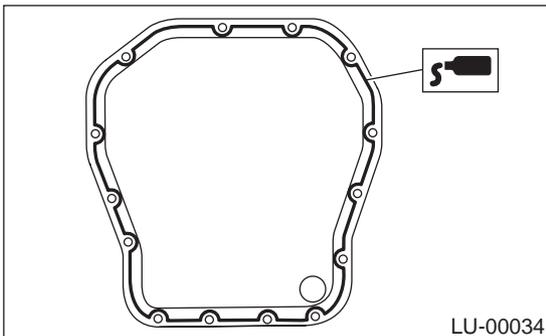


3) Apply fluid gasket to mating surfaces and install oil pan.

Fluid gasket:

Part No. 004403007

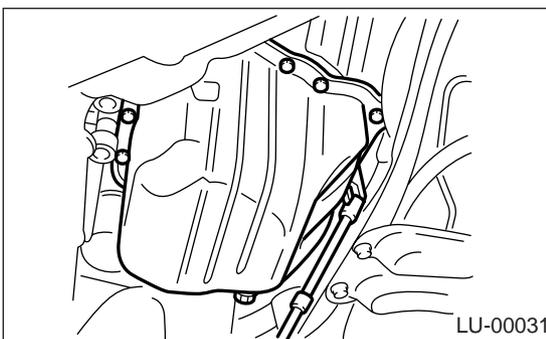
THREE BOND 1215 or equivalent



4) Mount oil pan on engine block.

Tightening torque:

5 N·m (0.5 kgf·m, 3.6 ft·lb)

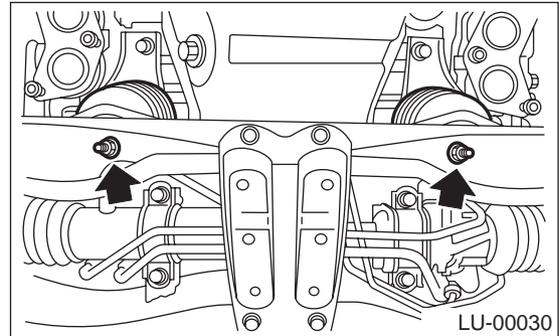


5) Lower engine onto front crossmember.

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

Tightening torque:

69 N·m (7.0 kgf·m, 51 ft·lb)



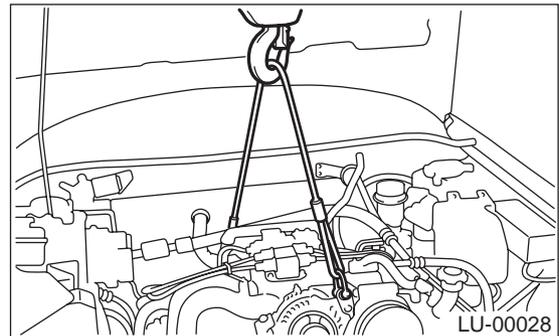
7) Install under cover.

8) Lower the vehicle.

CAUTION:

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

9) Remove lifting device and steel cables.

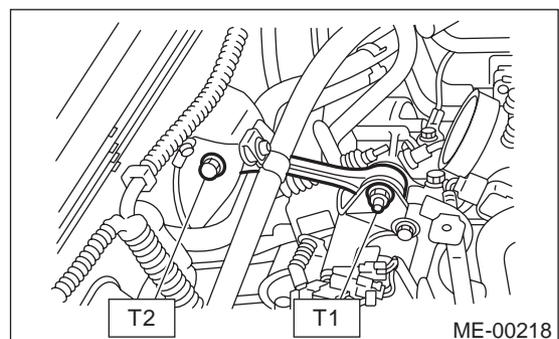


10) Install pitching stopper.

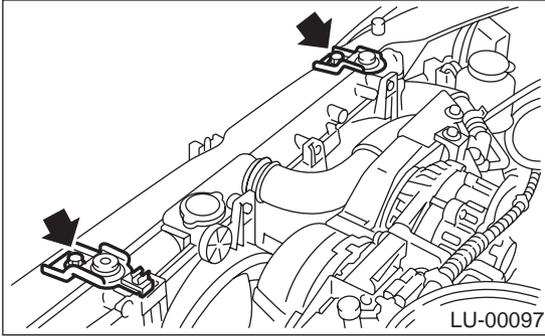
Tightening torque:

T1: 50 N·m (5.1 kgf·m, 37 ft·lb)

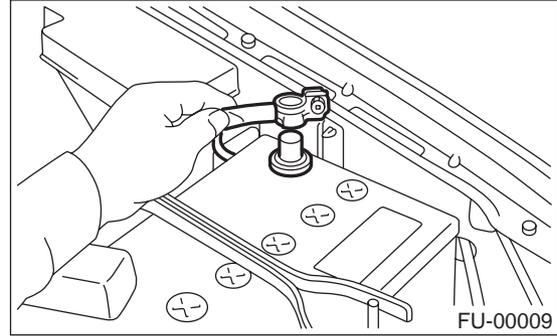
T2: 58 N·m (5.9 kgf·m, 43 ft·lb)



11) Install radiator upper brackets.



18) Connect battery ground cable.

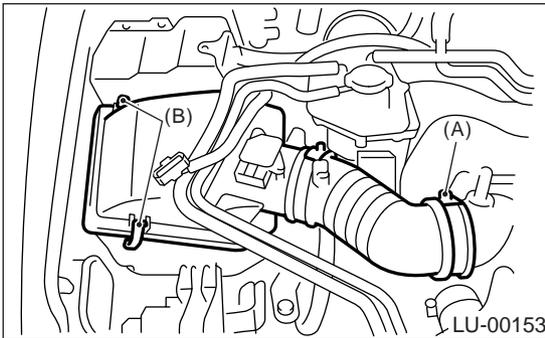


12) Install the intercooler. <Ref. to IN(H4DOSTC)-14, INSTALLATION, Intercooler.>

13) Install the air intake boot and air cleaner upper cover.

14) Tighten the clamp (A) which connects air intake boot to intake duct.

15) Lock the two clips (B) to air cleaner upper cover.

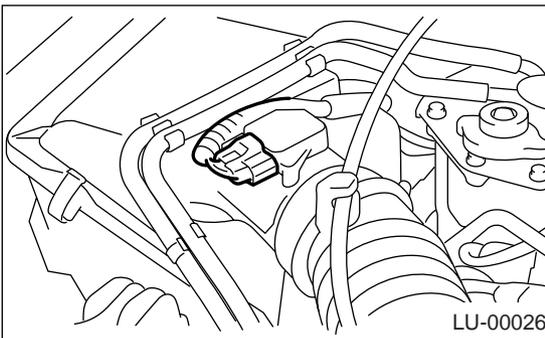


19) Fill engine oil. <Ref. to LU(H4DOSTC)-8, INSPECTION, Engine Oil.>

C: INSPECTION

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

16) Connect the connector to mass air flow sensor.



17) Install front wheels.

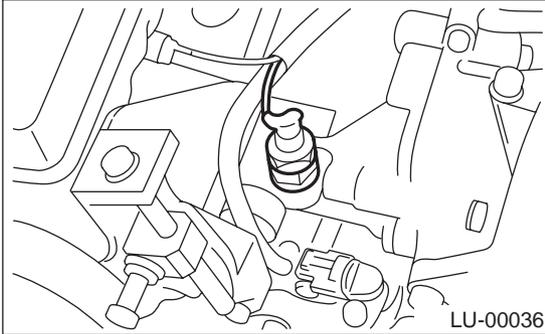
OIL PRESSURE SWITCH

LUBRICATION

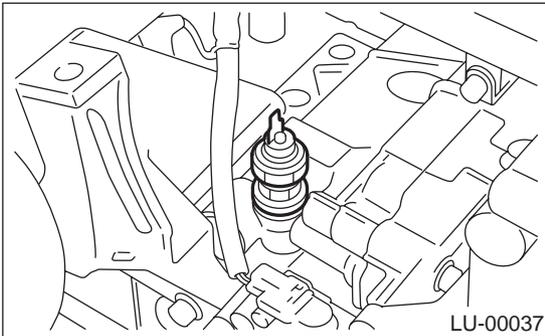
6. Oil Pressure Switch

A: REMOVAL

- 1) Remove generator from bracket. <Ref. to SC(H4DOSTC)-14, REMOVAL, Generator.>
- 2) Disconnect terminal from oil pressure switch.



- 3) Remove oil pressure switch.



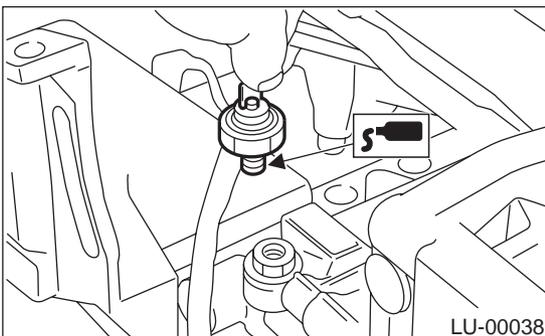
B: INSTALLATION

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

Fluid gasket:

Part No. 004403042

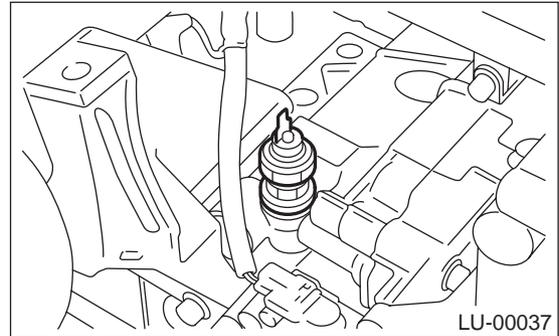
THREE BOND 1324 or equivalent



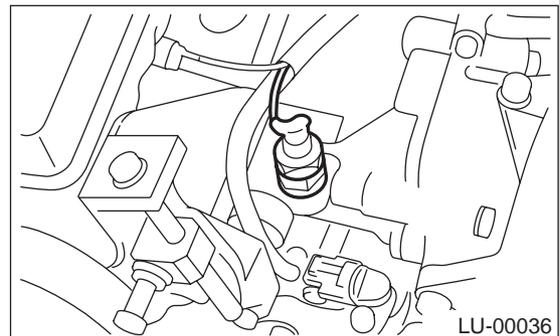
- 2) Install oil pressure switch onto engine block.

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(H4DOSTC)-14, INSTALLATION, Generator.>

C: INSPECTION

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

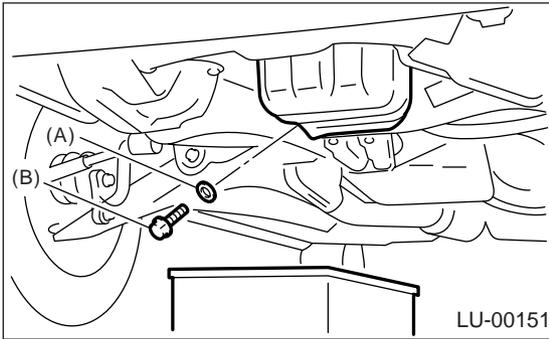
7. Engine Oil Cooler

A: REMOVAL

NOTE:

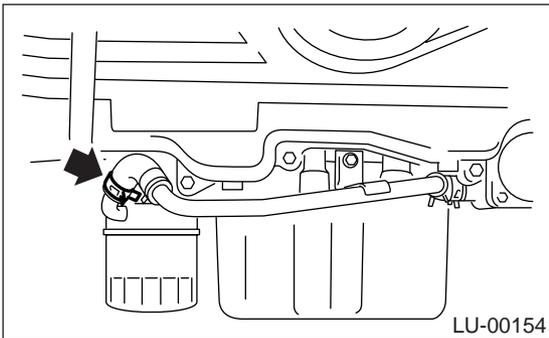
Equipped only for MT model.

- 1) Lift-up the vehicle.
- 2) Remove the under cover.
- 3) Drain the engine oil.
Set a container under the vehicle, and remove the drain plug from oil pan.



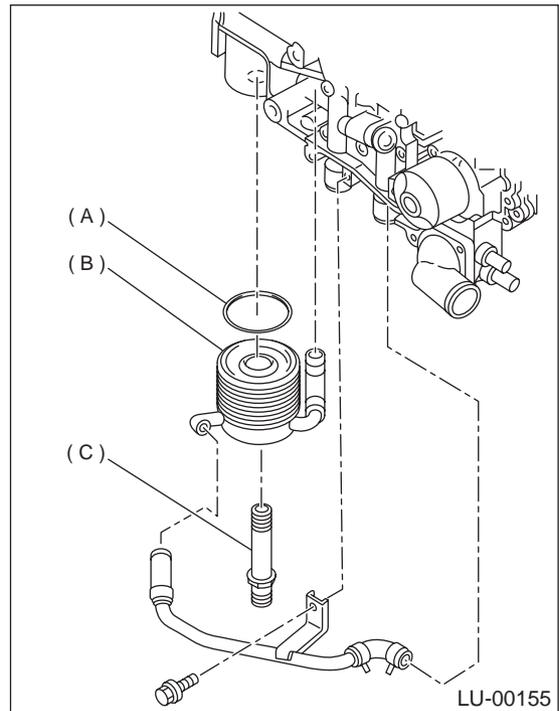
- (A) Metal gasket
- (B) Drain plug

- 4) Drain the coolant.
- 5) Remove the water by-pass pipe between oil cooler and water pump.



- 6) Remove the engine oil filter. <Ref. to LU(H4DOSTC)-21, REMOVAL, Engine Oil Filter.>

- 7) Remove the connector, and then remove the oil cooler.



- (A) O-ring
- (B) Oil cooler
- (C) Connector

ENGINE OIL COOLER

LUBRICATION

B: INSTALLATION

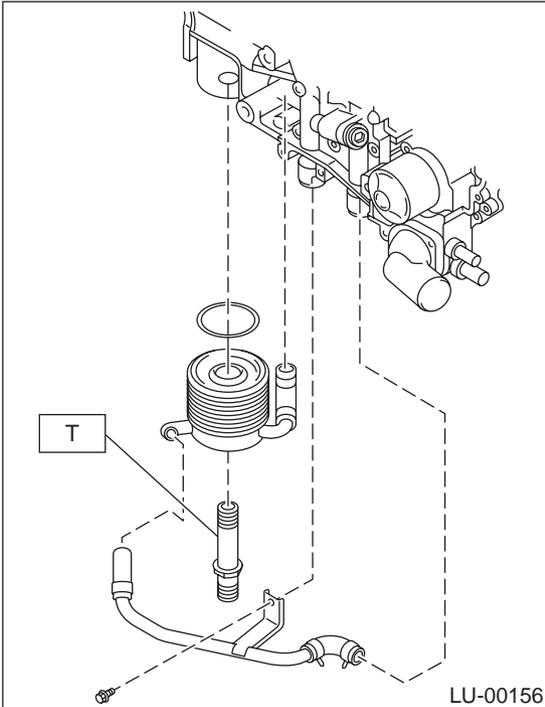
1) Install in the reverse order of removal.

Tightening torque:

T: 54 N·m (5.5 kgf-m, 40 ft-lb)

CAUTION:

Always use a new O-ring.



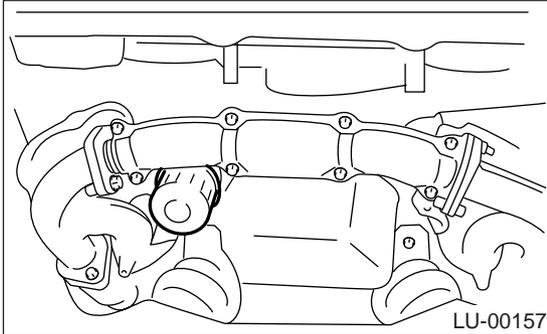
C: INSPECTION

- 1) Check that the coolant passages are not clogged using an air blow method.
- 2) Check the mating surfaces of cylinder block, O-ring groove and oil filter for damage.

8. Engine Oil Filter

A: REMOVAL

- 1) Remove under cover.
 - 2) Remove oil filter with ST.
- ST 498547000 OIL FILTER WRENCH



B: INSTALLATION

- 1) Get a new oil filter and thinly apply engine oil to the seal rubber.
- 2) Install oil filter by turning it by hand, being careful not to damage seal rubber.
- 3) Tighten more (approximately 2/3 to 3/4 turn) after the seal rubber contacts the oil pump case. 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 are integrated therefore, interior cleaning is not necessary.

- 2) Check the engine oil level. <Ref. to LU(H4DOSTC)-8, INSPECTION, Engine Oil.>z

ENGINE LUBRICATION SYSTEM TROUBLE IN GENERAL

LUBRICATION

9. 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).