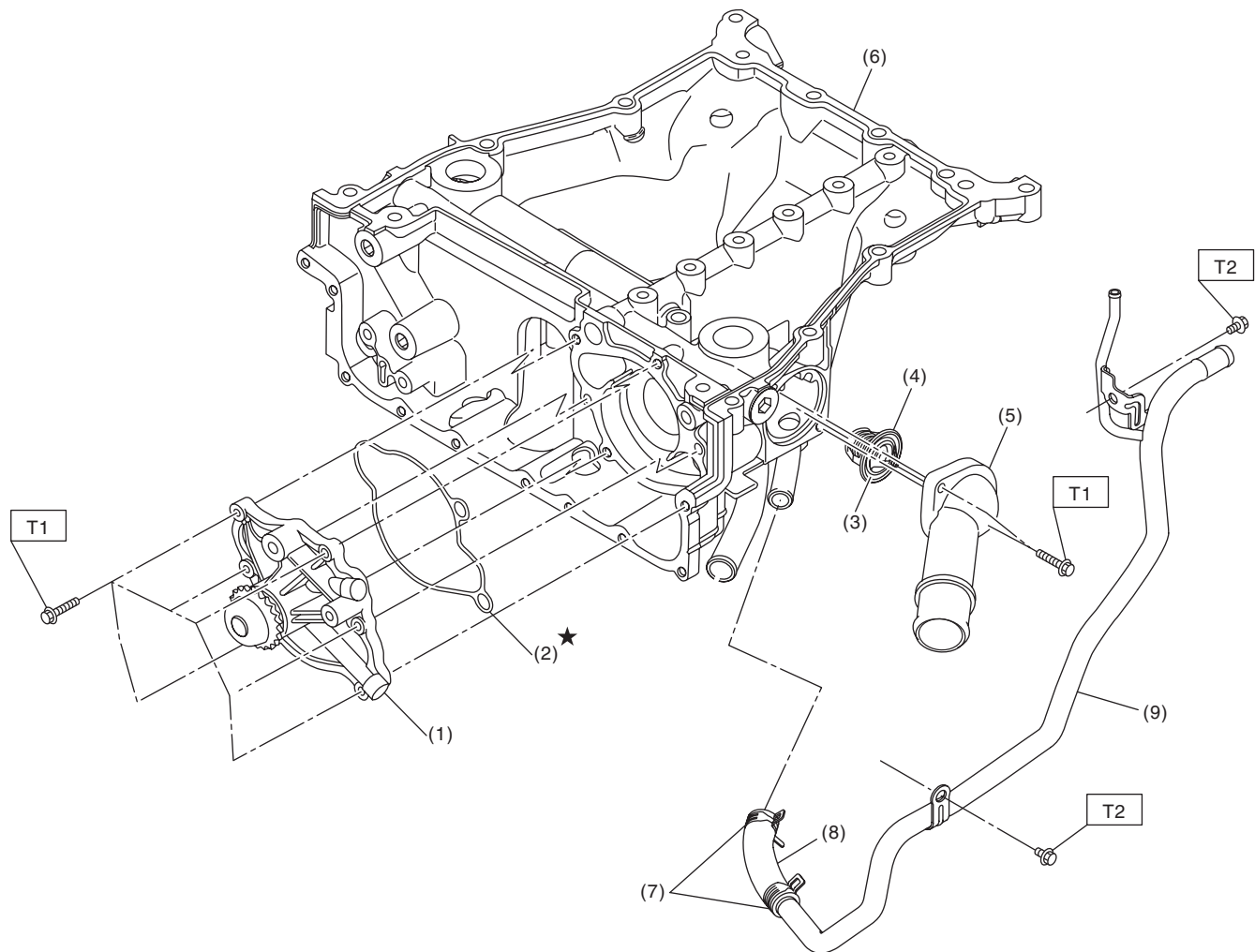


General Description

COOLING

B: COMPONENT

1. WATER PUMP & WATER PIPE



CO-02339

- | | |
|----------------------|-----------------------|
| (1) Water pump ASSY | (6) Oil pan upper |
| (2) O-ring | (7) Clamp |
| (3) Thermostat | (8) Hose |
| (4) Gasket | (9) Water return pipe |
| (5) Thermostat cover | |

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.65, 4.7)

T2: 16 (1.6, 11.8)

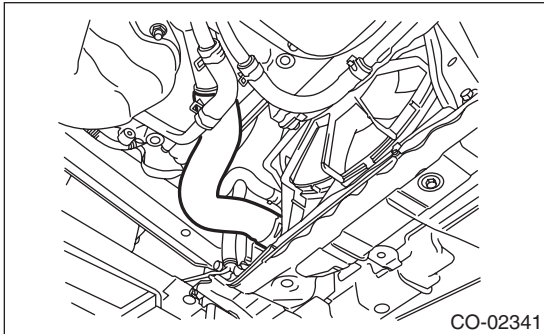
6. Radiator

A: REMOVAL

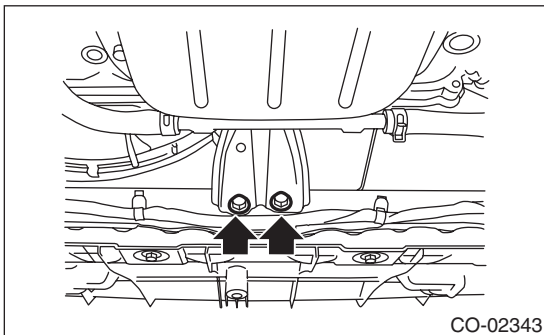
WARNING:

The radiator is pressurized. Wait until engine cools down before working on the radiator.

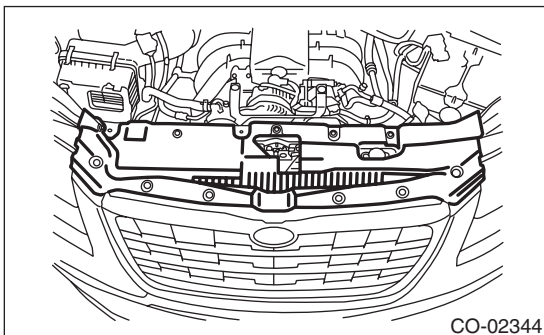
- 1) Set the vehicle on a lift.
- 2) Remove the collector cover.
- 3) Disconnect the ground cable from the battery.
- 4) Lift up the vehicle.
- 5) Remove the under cover.
- 6) Drain engine coolant completely. <Ref. to CO(H6DO)-11, DRAINING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>
- 7) Disconnect the radiator outlet hose from radiator.



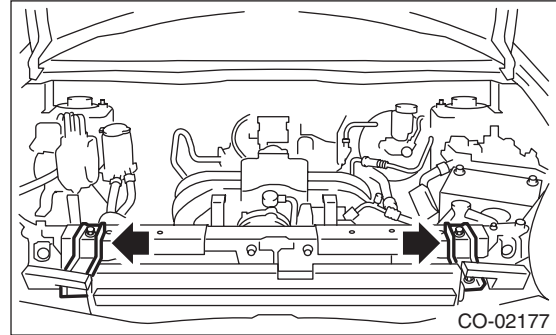
- 8) Remove the bolts on the underside of the radiator stay.



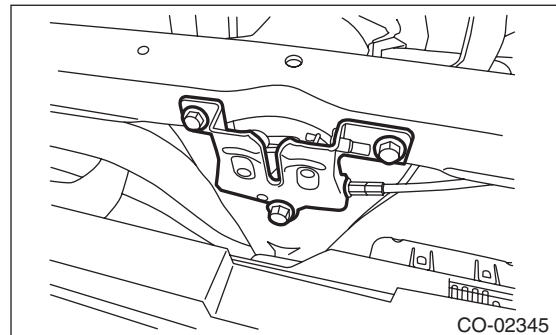
- 9) Lower the vehicle.
- 10) Remove the air intake duct. <Ref. to IN(H6DO)-7, REMOVAL, Air Intake Duct.>
- 11) Remove the front upper cover.



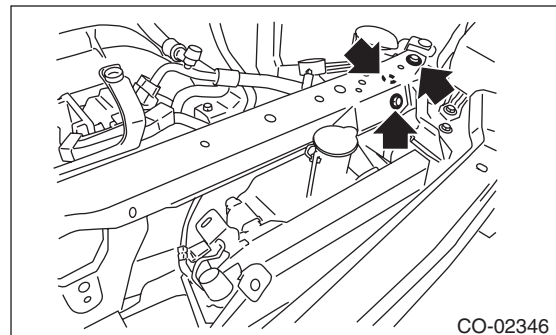
- 12) Remove the radiator upper brackets.



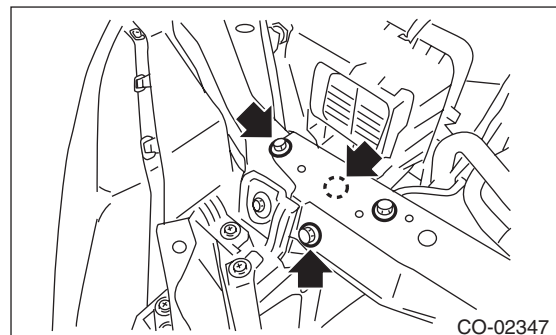
- 13) Remove the radiator stay.
 - (1) Remove the latch.



- (2) Remove the radiator hose bracket.
- (3) Remove the clip holding the harness.
- (4) Remove the bolts on the left side of the radiator stay.



- (5) Remove the bolts on the right side of the radiator stay.



6. READ FREEZE FRAME DATA FOR ENGINE (OBD MODE)

- 1) On the «Main Menu» display screen, select the {Each System Check}.
 - 2) On the «System Selection Menu» display screen, select the {Engine Control System}.
 - 3) Click the [OK] button after the information of engine type has been displayed.
 - 4) On the «Engine Diagnosis» display screen, select the {OBD System}.
 - 5) On the «OBD Menu» display screen, select the {Freeze Frame Data Display}.
- A list of the support data is shown in the following table.

Description	Display	Unit of measure
DTC of freeze frame data	Freeze frame data	DTC
Air fuel ratio control system for bank 1	Fuel system for Bank1	—
Air fuel ratio control system for bank 2	Fuel system for Bank2	—
Engine load data	Calculated load valve	%
Engine coolant temperature signal	Coolant Temp.	°C or °F
Short term fuel trim by front oxygen (A/F) sensor (Bank 1)	Short term fuel trim B1	%
Long term fuel trim by front oxygen (A/F) sensor (Bank 1)	Long term fuel trim B1	%
Short term fuel trim by front oxygen (A/F) sensor (Bank 2)	Short term fuel trim B2	%
Long term fuel trim by front oxygen (A/F) sensor (Bank 2)	Long term fuel trim B2	%
Intake manifold absolute pressure signal	Mani.Absolute Pressure	mmHg, kPa, inHg or psig
Engine speed signal	Engine Speed	rpm
Vehicle speed signal	Vehicle Speed	km/h or MPH
Ignition timing adv. #1	Ignition timing adv. #1	°
Intake air temperature	Intake Air Temp.	°C or °F
Amount of intake air	Mass Air Flow	g/s
Throttle opening angle	Throttle Opening Angle	%
Oxygen sensor #12	Oxygen sensor #12	V
A/F correction value #12	Short term fuel trim #12	%
Oxygen sensor #22	Oxygen sensor #22	V
A/F correction value #22	Short term fuel trim #22	%
On-board diagnostic system	On-board diagnostic system	OBD/OBD2
Oxygen sensor #11	Oxygen sensor #11	Support
Oxygen sensor #12	Oxygen sensor #12	Support
Oxygen sensor #21	Oxygen sensor #21	Support
Oxygen sensor #22	Oxygen sensor #22	Support
Elapsed time after engine start	Elapsed time after starting the engine	sec
Target EGR	Target EGR	%
EGR deviation	EGR Error	%
Evaporative purge	Evaporative purge	%
Fuel level signal	Fuel level	%
Fuel tank pressure signal	Tank pressure	mmHg, kPa, inHg or psig
Atmospheric pressure	Atmospheric pressure	mmHg, kPa, inHg or psig
ECM power voltage	ECM power voltage	V
Absolute load	Absolute load	%
A/F target lambda	A/F target lambda value	—
Relative throttle opening angle	Relative throttle opening angle	%
Ambient temperature	Ambient temperature	°C or °F
Absolute throttle opening angle 2	Absolute throttle opening angle 2	%
Absolute accelerator opening angle 1	Absolute accelerator opening angle 1	%
Absolute accelerator opening angle 2	Absolute accelerator opening angle 2	%
Target throttle opening angle	Target throttle opening angle	%

NOTE:

For detailed operation procedure, refer to the “PC application help for Subaru Select Monitor”.

ENGINE (DIAGNOSTICS)

MAIN RELAY

BATTERY

SBF-5

8

B22 E3

B47

FRONT OXYGEN (A/F) SENSOR LH

E24

FRONT OXYGEN (A/F) SENSOR RH

E47

E3 B22

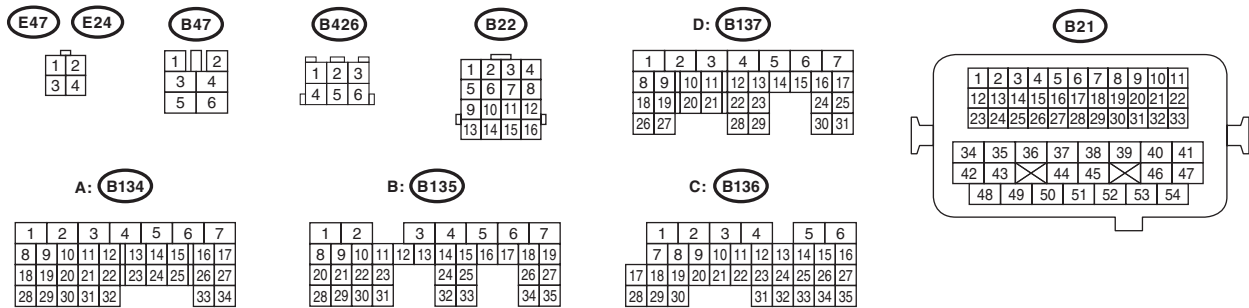
B426

A: B134 B: B135 C: B136 D: B137 ECM

B21 E2

E

* : TERMINAL No. OPTIONAL ARRANGEMENT



EN(H6DO)(diag)-165

BG:DTC P0197 ENGINE OIL TEMPERATURE SENSOR LOW

DTC DETECTING CONDITION:

- Immediately at fault recognition
- GENERAL DESCRIPTION <Ref. to GD(H6DO)-99, DTC P0197 ENGINE OIL TEMPERATURE SENSOR LOW, Diagnostic Trouble Code (DTC) Detecting Criteria.>

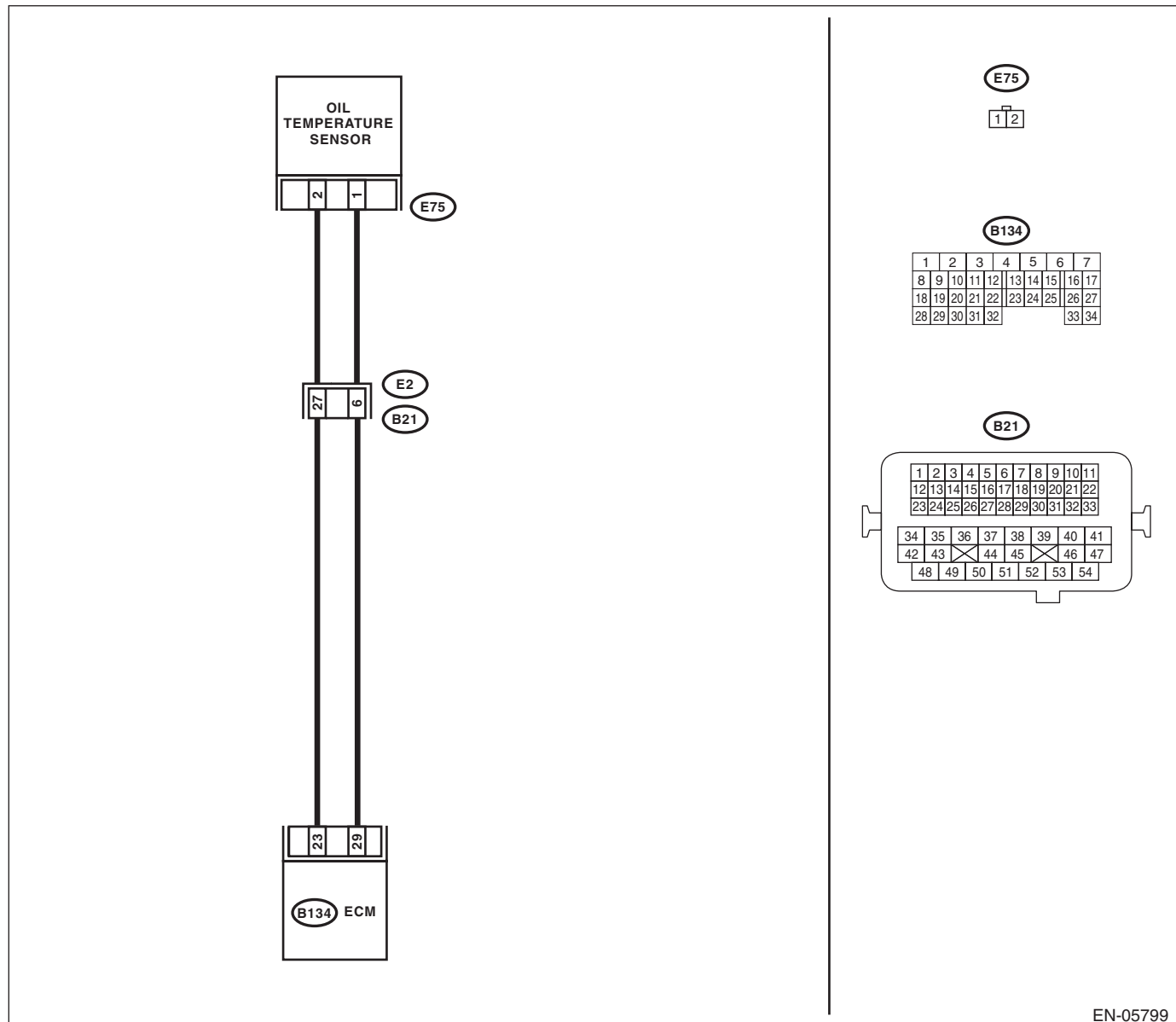
TROUBLE SYMPTOM:

- Hard to start
- Improper idling
- Poor driving performance

CAUTION:

After repair or replacement of faulty parts, perform Clear Memory Mode <Ref. to EN(H6DO)(diag)-56, OPERATION, Clear Memory Mode.> and Inspection Mode <Ref. to EN(H6DO)(diag)-44, PROCEDURE, Inspection Mode.>.

WIRING DIAGRAM:



EN-05799

Diagnostic Procedure with Diagnostic Trouble Code (DTC)

ENGINE (DIAGNOSTICS)

Step	Check	Yes	No
1 CHECK OUTPUT SIGNAL OF ECM. 1) Turn the ignition switch to ON. 2) Measure the voltage between ECM and chassis ground. Connector & terminal (B136) No. 17 (+) — Chassis ground (-):	Is the voltage 10 V or more?	Repair poor contact in ECM connector.	Go to step 2.
2 CHECK HARNESS BETWEEN ECM AND DRAIN VALVE. 1) Turn the ignition switch to OFF. 2) Disconnect the connectors from the ECM and drain valve. 3) Measure the resistance between the drain valve connector and chassis ground. Connector & terminal (R143) No. 1 — Chassis ground:	Is the resistance 1 M Ω or more?	Go to step 3.	Repair the ground short circuit of harness between ECM and drain valve connector.
3 CHECK HARNESS BETWEEN ECM AND DRAIN VALVE. Measure the resistance of harness between ECM and drain valve connector. Connector & terminal (B136) No. 17 — (R143) No. 1:	Is the resistance less than 1 Ω ?	Go to step 4.	Repair the harness and connector. NOTE: In this case, repair the following item: • Open circuit of harness between ECM and drain valve connector • Poor contact of coupling connector
4 CHECK DRAIN VALVE. Measure the resistance between drain valve terminals. Terminals No. 1 — No. 2:	Is the resistance between 10 — 100 Ω ?	Go to step 5.	Replace the drain valve. <Ref. to EC(H6DO)-12, Drain Valve.>
5 CHECK POWER SUPPLY TO DRAIN VALVE. 1) Turn the ignition switch to ON. 2) Measure the voltage between drain valve and chassis ground. Connector & terminal (R143) No. 2 (+) — Chassis ground (-):	Is the voltage 10 V or more?	Repair poor contact of the drain valve connector.	Repair the harness and connector. NOTE: In this case, repair the following item: • Open circuit of harness between main relay and drain valve • Poor contact of coupling connector • Poor contact of main relay connector

Diagnostic Procedure with Diagnostic Trouble Code (DTC)

ENGINE (DIAGNOSTICS)

Step	Check	Yes	No
1 CHECK FRONT OXYGEN (A/F) SENSOR CONNECTOR AND COUPLING CONNECTOR.	Has water entered the connector?	Completely remove any water inside.	Go to step 2.
2 CHECK HARNESS BETWEEN ECM AND FRONT OXYGEN (A/F) SENSOR CONNECTOR. 1) Turn the ignition switch to OFF. 2) Disconnect the connectors from the ECM. 3) Measure the resistance between ECM and chassis ground. Connector & terminal (B135) No. 11 — Chassis ground: (B135) No. 10 — Chassis ground:	Is the resistance 1 MΩ or more?	Go to step 3.	Repair the ground short circuit of harness between ECM and front oxygen (A/F) sensor connector.
3 CHECK OUTPUT SIGNAL FOR ECM. 1) Connect the ECM. 2) Turn the ignition switch to ON. 3) Measure the voltage between ECM and chassis ground. Connector & terminal (B135) No. 11 (+) — Chassis ground (-):	Is the voltage 4.5 V or more?	Go to step 5.	Go to step 4.
4 CHECK OUTPUT SIGNAL FOR ECM. Measure the voltage between ECM and chassis ground. Connector & terminal (B135) No. 10 (+) — Chassis ground (-):	Is the voltage 4.95 V or more?	Go to step 5.	Replace the front oxygen (A/F) sensor. <Ref. to FU(H6DO)-33, Front Oxygen (A/F) Sensor.>
5 CHECK OUTPUT SIGNAL FOR ECM. Measure the voltage between ECM and chassis ground. Connector & terminal (B135) No. 11 (+) — Chassis ground (-): (B135) No. 10 (+) — Chassis ground (-):	Is the voltage 8 V or more?	Repair the short circuit to power in the harness between the ECM and front oxygen (A/F) sensor connector. After repair, replace the ECM. <Ref. to FU(H6DO)-37, Engine Control Module (ECM).>	Repair poor contact of the ECM connector.

DF:DTC P1160 RETURN SPRING FAILURE

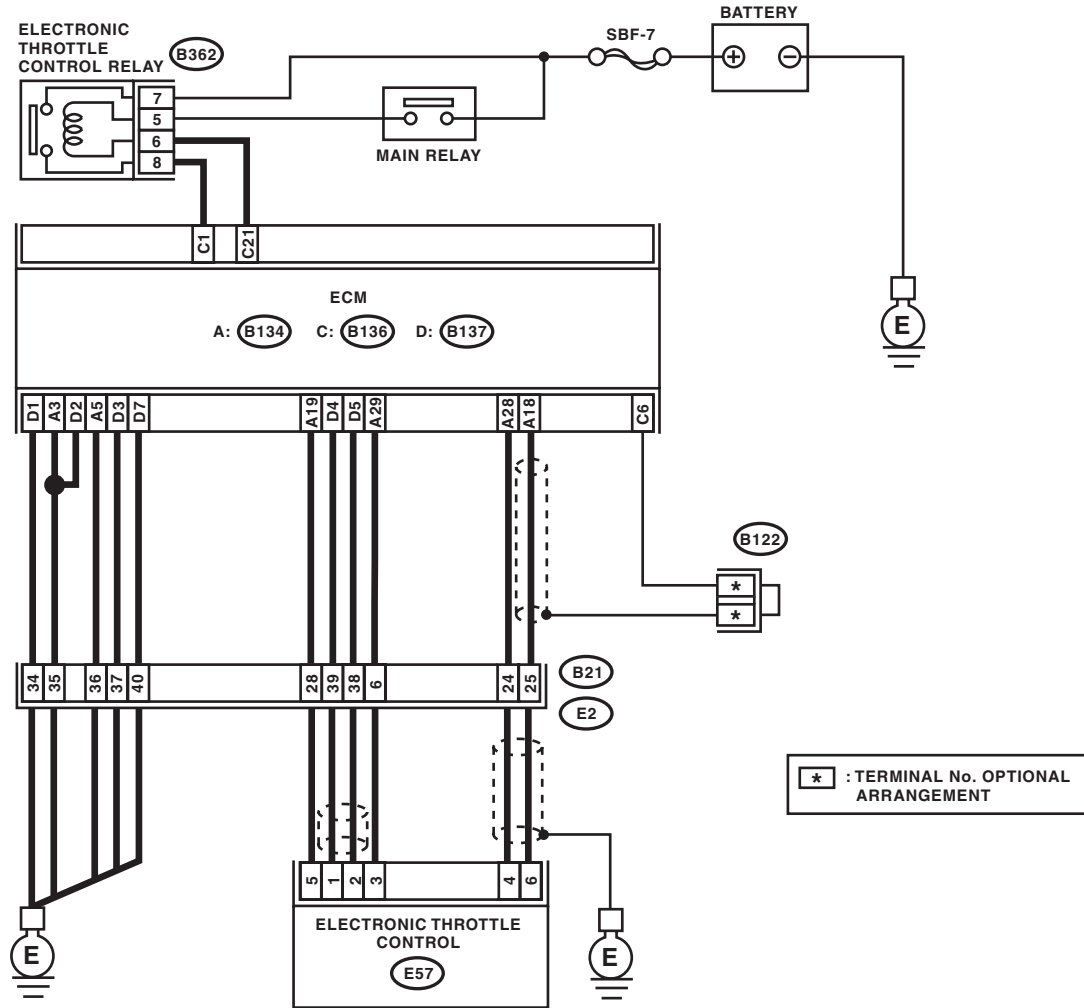
NOTE:

For the diagnostic procedure, refer to DTC P2101. <Ref. to EN(H6DO)(diag)-365, DTC P2101 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT RANGE/PERFORMANCE, Diagnostic Procedure with Diagnostic Trouble Code (DTC).>

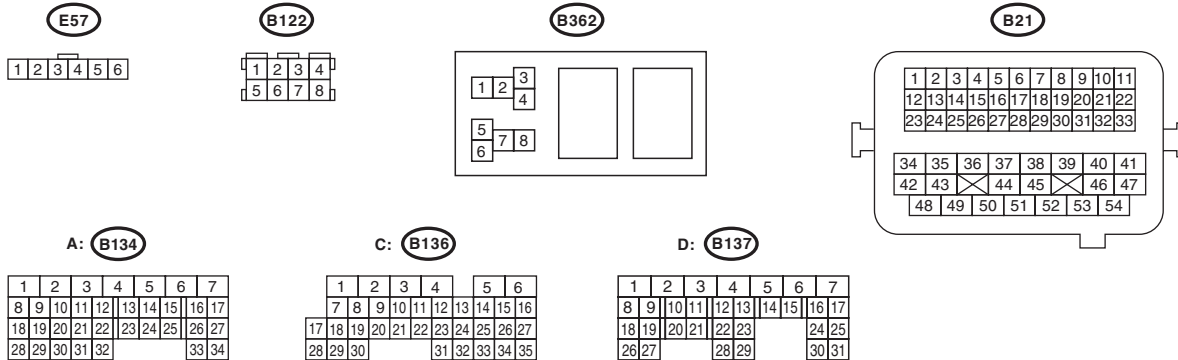
Diagnostic Procedure with Diagnostic Trouble Code (DTC)

ENGINE (DIAGNOSTICS)

WIRING DIAGRAM:



* : TERMINAL No. OPTIONAL ARRANGEMENT



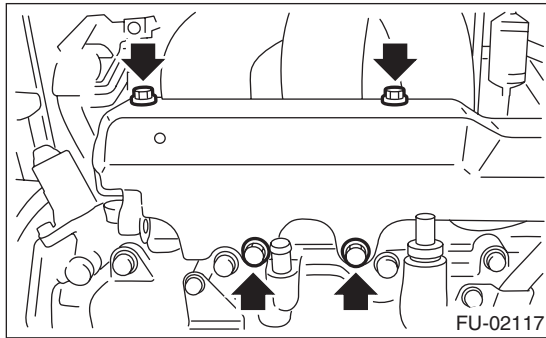
EN-05797

6. Camshaft Position Sensor

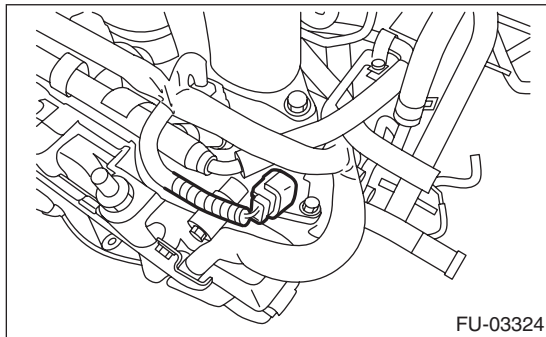
A: REMOVAL

1. INTAKE SIDE

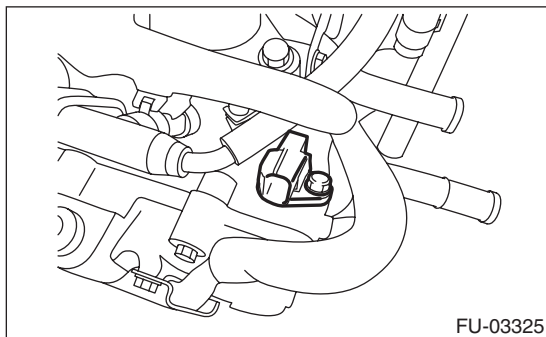
- 1) Remove the collector cover.
- 2) Disconnect the ground cable from battery.
- 3) Remove the generator harness from the fuel protector LH.
- 4) Remove the fuel protector LH.



- 5) Disconnect the connector from intake camshaft position sensor LH.



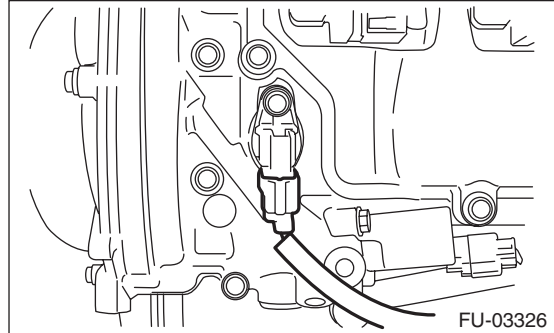
- 6) Remove the intake camshaft position sensor LH.



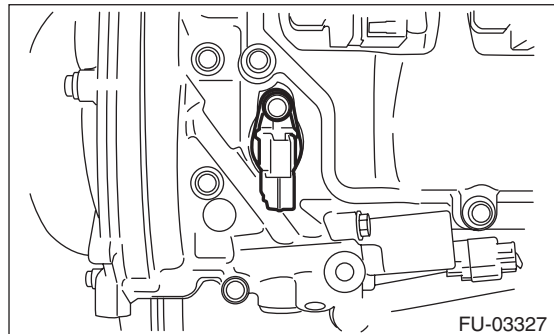
- 7) Remove the intake camshaft position sensor RH in the same procedure as LH.

2. EXHAUST SIDE

- 1) Disconnect the ground cable from battery.
- 2) Lift up the vehicle.
- 3) Remove the under cover.
- 4) Disconnect the connector from exhaust camshaft position sensor LH.



- 5) Remove the exhaust camshaft position sensor LH.



- 6) Remove the exhaust camshaft position sensor RH in the same procedure as LH.

B: INSTALLATION

1. INTAKE SIDE

Install in the reverse order of removal.

Tightening torque:

Intake camshaft position sensor

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

Fuel pipe protector

19 N·m (1.9 kgf-m, 14.0 ft-lb)

2. EXHAUST SIDE

Tightening torque:

Exhaust camshaft position sensor

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

Diagnostic Trouble Code (DTC) Detecting Criteria

GENERAL DESCRIPTION

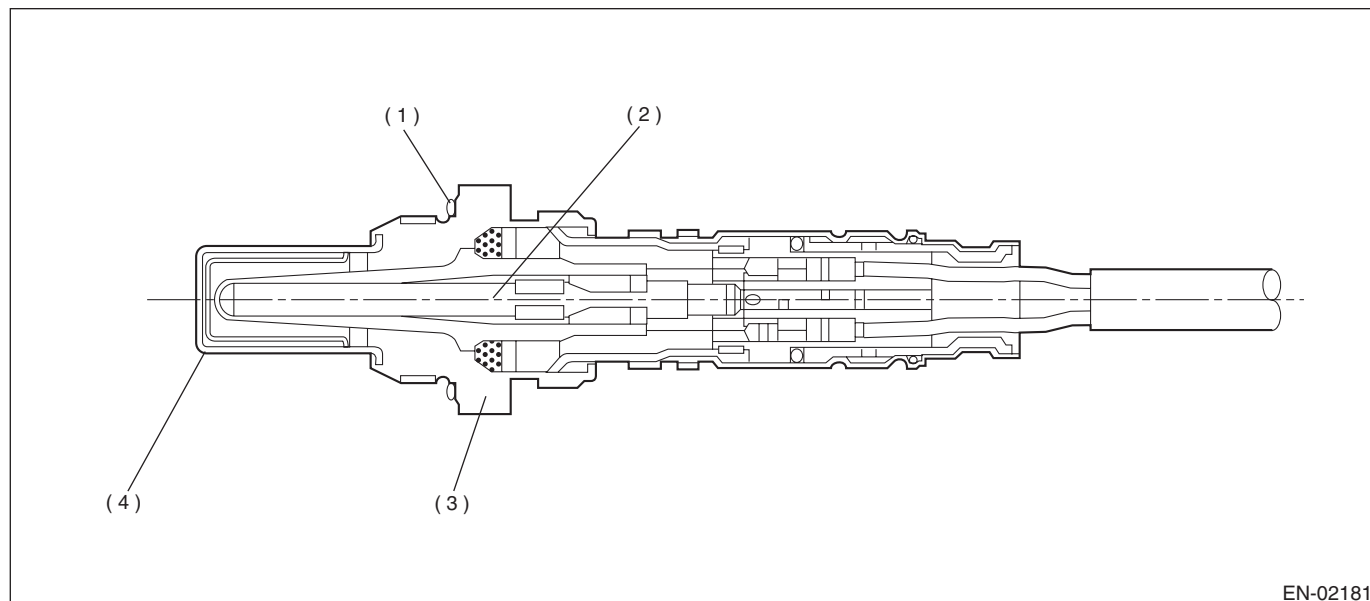
I: DTC P0030 HO2S HEATER CONTROL CIRCUIT (BANK 1 SENSOR 1)

1. OUTLINE OF DIAGNOSIS

Detect functional errors of the front oxygen (A/F) sensor heater.

Judge as NG when it is determined that the front oxygen (A/F) sensor impedance is large when looking at engine status such as deceleration fuel cut.

2. COMPONENT DESCRIPTION



EN-02181

(1) Gasket

(3) Sensor housing

(4) Protection tube

(2) Ceramic heater

3. ENABLE CONDITION

Secondary Parameters	Enable Conditions
Condition established time	≥ 30000 ms
Battery voltage	≥ 10.9 V
Heater current	Permitted
Control duty ≥ 35 %	Experienced
After fuel cut	≥ 20000 ms

4. GENERAL DRIVING CYCLE

Perform the diagnosis continuously after 30000 ms seconds or more have passed since the engine started.

Diagnostic Trouble Code (DTC) Detecting Criteria

GENERAL DESCRIPTION

5. DIAGNOSTIC METHOD

• Abnormality Judgment

If the duration of time while the following conditions are met is longer than the time indicated, judge as NG.

Judgment Value

Malfunction Criteria	Threshold Value
Minimum output voltage or Maximum output voltage	> 0.15 V < 0.55 V

Time Needed for Diagnosis:200000 ms

Malfunction Indicator Light Illumination: Illuminates when malfunction occurs in 2 continuous driving cycles.

• Normality Judgment

Judge as OK and clear the NG if the following conditions are established.

Judgment Value

Malfunction Criteria	Threshold Value
Diagnosis of the rear oxygen sensor voltage low side	Incomplete
Minimum output voltage	≤ 0.15 V
Maximum output voltage	≥ 0.55 V

Time Needed for Diagnosis: Less than 1 second

6. DTC CLEAR CONDITION

- When the OK idling cycle is completed 40 times in a row
- When "Clear Memory" is performed

7. MALFUNCTION INDICATOR LIGHT CLEAR CONDITIONS

- When the OK driving cycle is completed 3 times in a row
- When "Clear Memory" is performed

8. FAIL SAFE

Sub feedback control: Not allowed

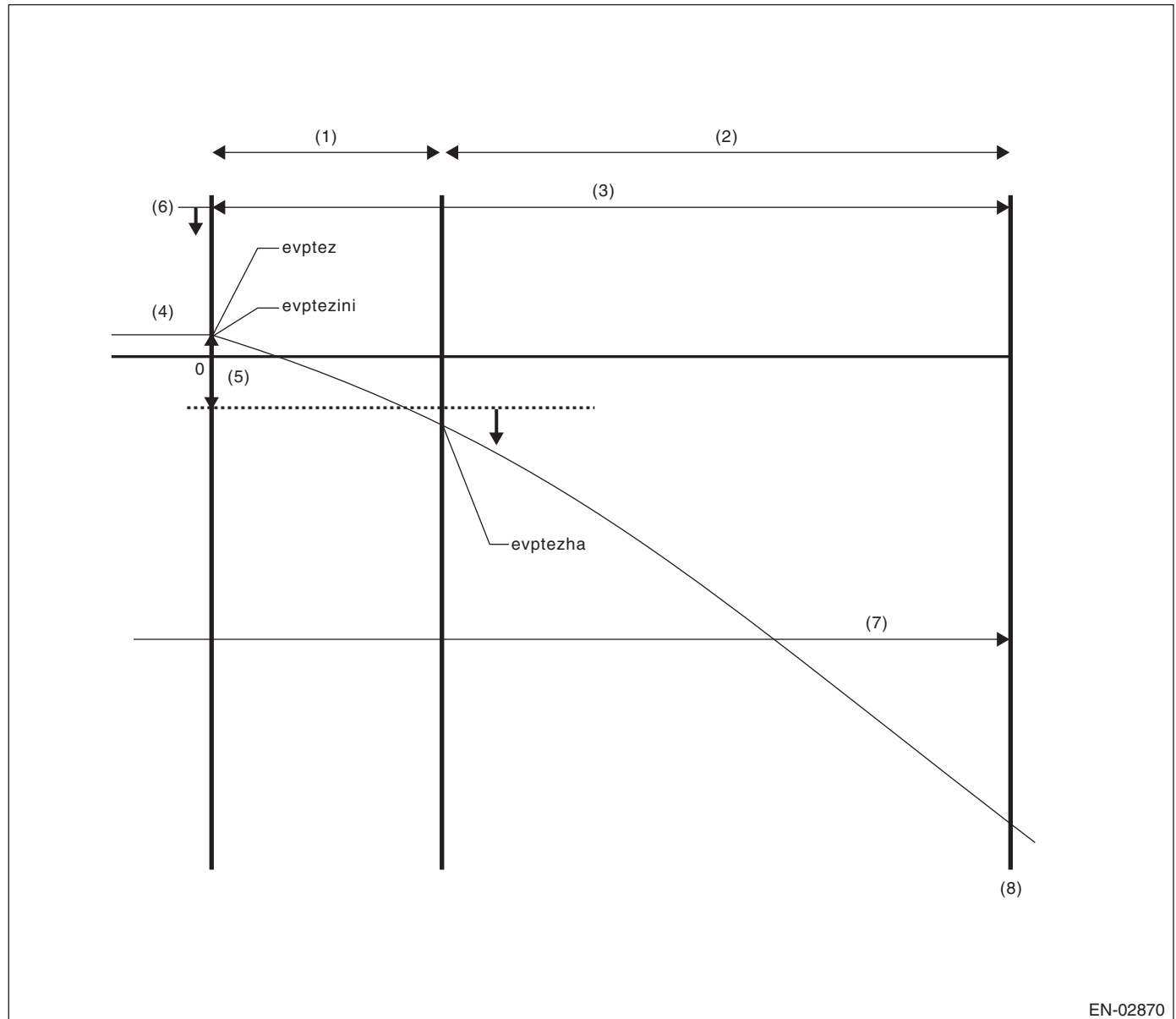
9. ECM OPERATION AT DTC SETTING

- Memorize the freeze frame data. (For test mode \$02)
- Memorize the diagnostic value and trouble standard value. (For test mode \$06)

Diagnostic Trouble Code (DTC) Detecting Criteria

GENERAL DESCRIPTION

Purge control solenoid valve Open Fixation



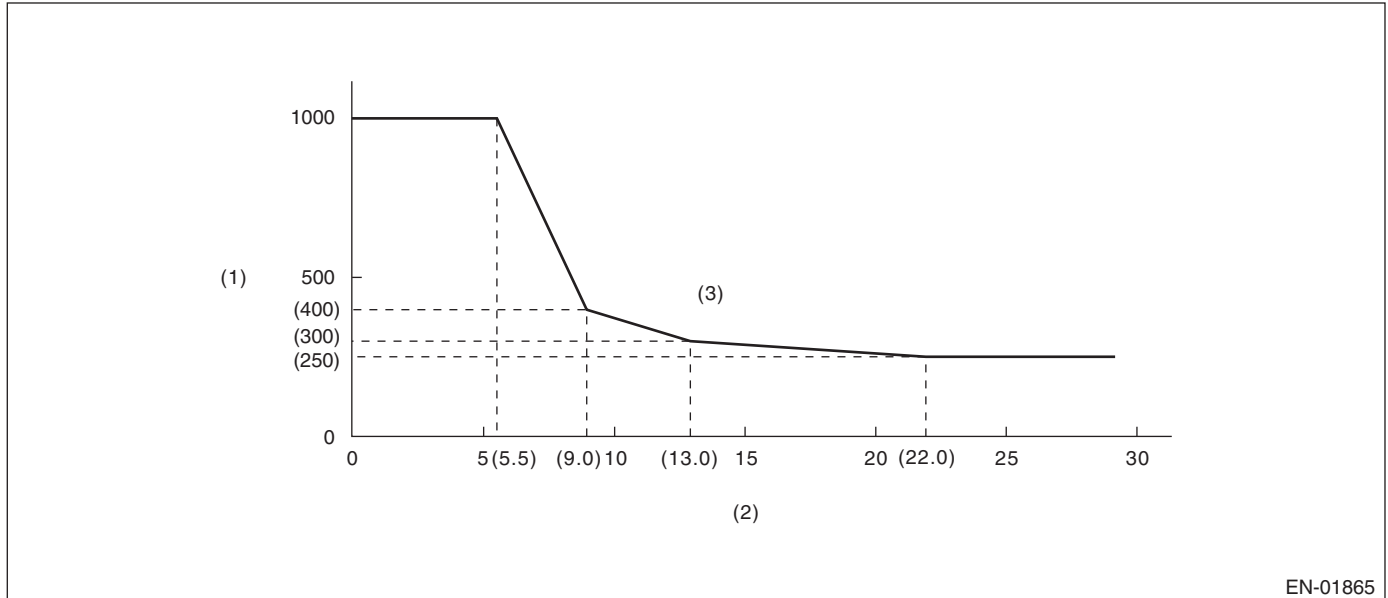
- | | | |
|------------------------|----------------------------------|-------------------------------|
| (1) Mode Z | (4) Fuel tank pressure | (7) 40000 ms no fuel sloshing |
| (2) Extended mode Z | (5) 0.6 kPa (4.5 mmHg, 0.2 inHg) | (8) NG judgment |
| (3) 3000 ms + 13000 ms | (6) 0.4 kPa (2.9 mmHg, 0.1 inHg) | |

- $evptezini \leq 0.4 \text{ kPa (2.9 mmHg, 0.1 inHg)}$
 - $evptez - evptezha > 0.6 \text{ kPa (4.5 mmHg, 0.2 inHg)}$
 - No fuel sloshing of over 2 \varnothing (0.53 US gal, 0.44 Imp gal) lasts for more than 40000 ms.
- Judge as abnormal when all are established.

Diagnostic Trouble Code (DTC) Detecting Criteria

GENERAL DESCRIPTION

Details of Judgment time (The actual opening angle \leq target opening angle is always 1000 milliseconds)



EN-01865

(1) Judgment time (milliseconds)

(2) Throttle position sensor 1 opening angle

(3) NG area

Malfunction Indicator Light Illumination: Illuminates as soon as a malfunction occurs.

6. DTC CLEAR CONDITION

- When the OK idling cycle is completed 40 times in a row
- When "Clear Memory" is performed (Only with engine stopped)

7. MALFUNCTION INDICATOR LIGHT CLEAR CONDITIONS

- When the OK driving cycle is completed 3 times in a row
- When "Clear Memory" is performed (Only with engine stopped)

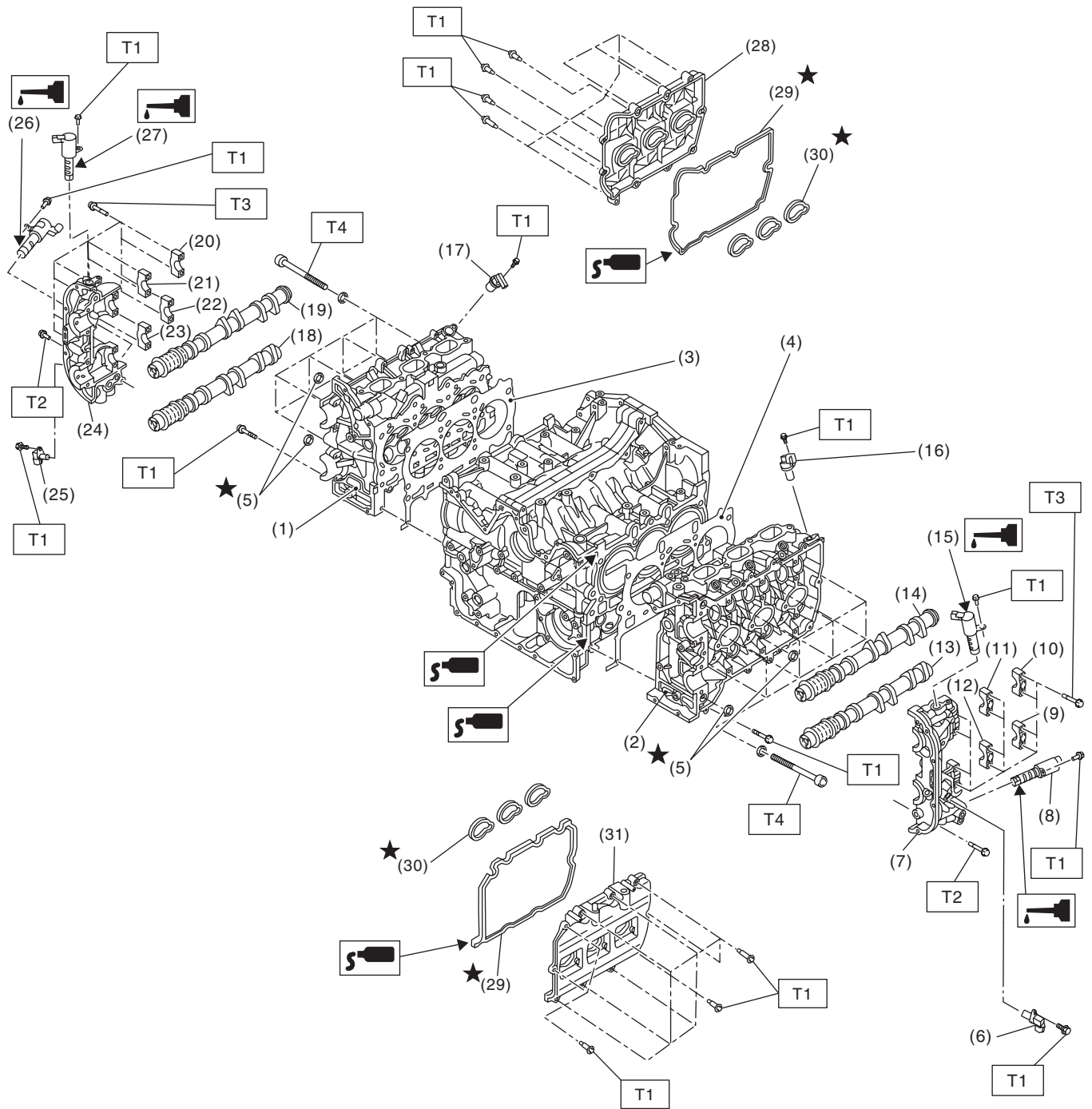
8. FAIL SAFE

Stop the continuity to the electronic throttle control motor. (Throttle opening is fixed to 6.375°.)

9. ECM OPERATION AT DTC SETTING

Memorize the freeze frame data. (For test mode \$02)

4. CYLINDER HEAD AND CAMSHAFT



ME-03338

Starter

STARTING/CHARGING SYSTEMS

4) Assemble the shock absorber as follows:

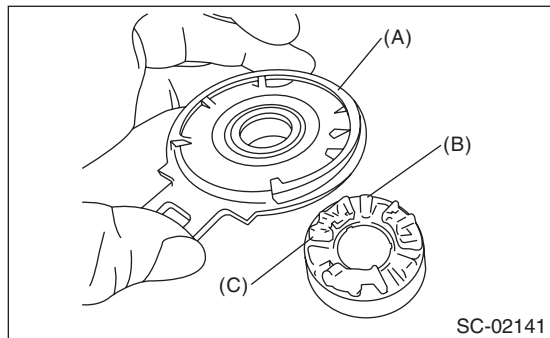
- (1) Apply grease to the shock absorber (C), and install the internal gear (B) to the shock absorber bearing (A).

NOTE:

Align with the claw position of internal gear to install shock absorber bearing.

Grease:

DENSO HL50



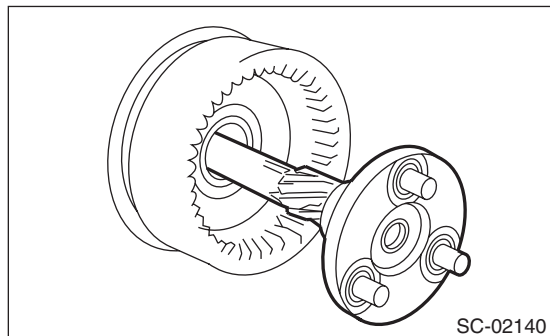
- (2) Install the shaft to the internal gear.

NOTE:

Apply grease to the sliding part for the shaft inside the internal gear.

Grease:

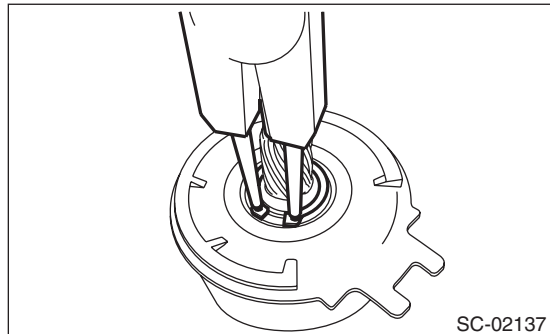
DENSO HL50



- (3) Install the snap ring to shaft.

NOTE:

Use new snap rings.



5) Install the planetary gear to the internal gear.

- (1) Apply grease to the installation part of the planetary gear.

Grease:

DENSO HL50

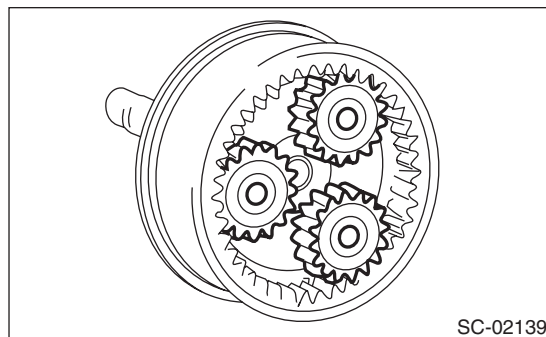
- (2) Install the planetary gear to pin.
- (3) Apply grease to the planetary gear, internal gear and upper part of the pin.

NOTE:

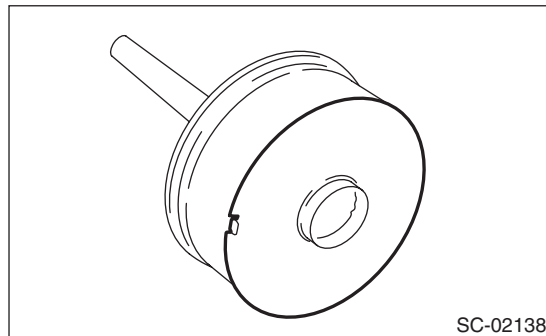
- Apply grease so that it contacts each gear.
- Be careful not to allow dirt to get in.

Grease:

DENSO HL50



- (4) Install the starter plate.



6) Assemble the overrunning clutch as follows:

- (1) Apply grease to the spline portion of the shaft.

Grease:

DENSO HL50

- (2) Install the overrunning clutch to shaft.

