CHASSIS SECTION

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.

ABS

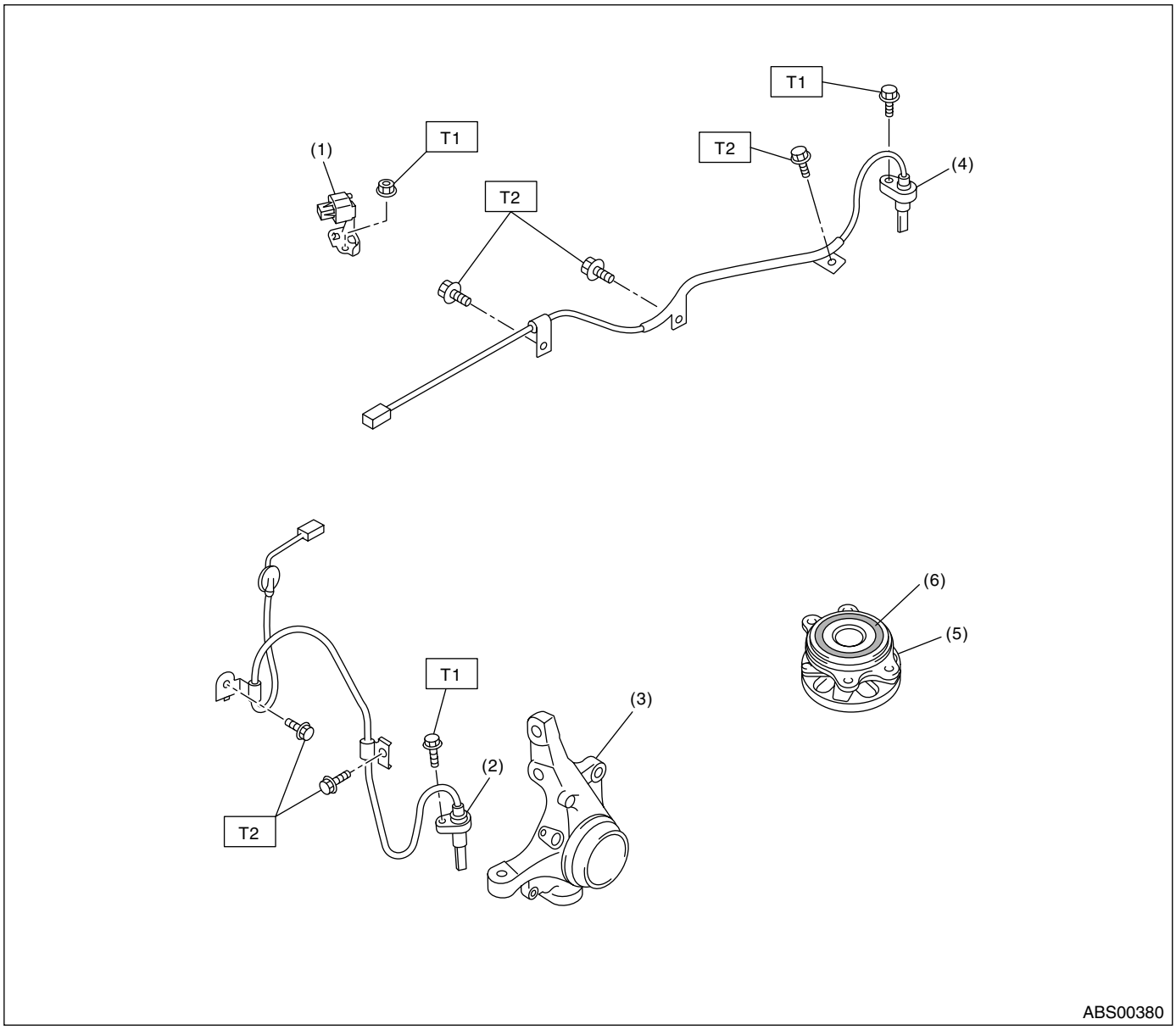
1. General Description

A: SPECIFICATION

Item				Standard value or identification
ABS wheel speed sensor	ABS wheel speed sensor gap (for reference)		Front	0.77 — 1.43 mm (0.030 — 0.056 in)
			Rear	0.64 — 1.56 mm (0.025 — 0.061 in)
	Marks of harness (Marks, Color)	Front	RH	K1 (White)
			LH	K2 (Yellow)
		Rear	RH	K5 (White)
			LH	K6 (Yellow)
G sensor	G sensor voltage			2.3±0.2 V
ABSCM&H/U identification	AT (Except for OUTBACK)			J1
	MT (Except for OUTBACK)			J2
	AT (OUTBACK)			J3
	MT (OUTBACK)			J4

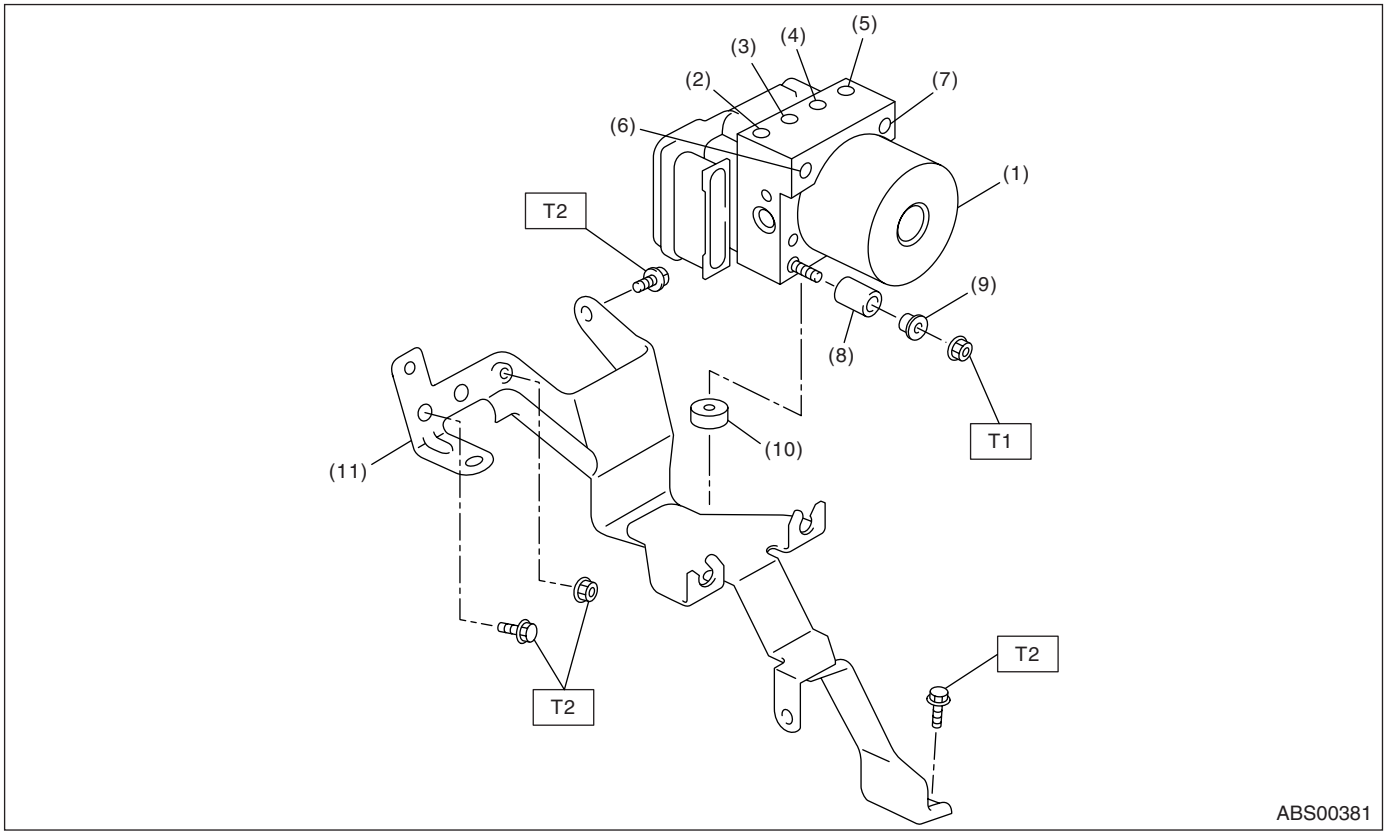
B: COMPONENT

1. ABS WHEEL SPEED SENSOR



(1)	G sensor	(4)	Rear ABS wheel speed sensor LH	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Front ABS wheel speed sensor LH	(5)	Hub unit bearing	***T1: 7.5 (0.76, 5.5)***
(3)	Front housing	(6)	Magnetic encoder	***T2: 33 (3.3, 24)***

2. ABS CONTROL MODULE AND HYDRAULIC CONTROL UNIT (ABSCM&H/U)



(1) ABS control module and hydraulic control unit (ABSCM&H/U)
(2) Front outlet RH
(3) Rear outlet LH
(4) Rear outlet RH
(5) Front outlet LH
(6) Primary inlet
(7) Secondary inlet
(8) Damper
(9) Spacer
(10) Damper
(11) Bracket

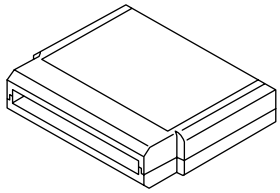
Tightening torque: N·m (kgf-m, ft-lb)
T1: 7.5 (0.76, 5.5)
T2: 33 (3.3, 24)

C: CAUTION

- Wear work clothing, including a cap, protective goggles and protective shoes during operation.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly and replacement.
- Be careful not to burn yourself, because each part on the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or rigid racks at the specified points.

D: PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST24082AA230	24082AA230	CARTRIDGE	Troubleshooting for electrical system.
 ST22771AA030	22771AA030	SUBARU SELECT MONITOR KIT	Troubleshooting for electrical system. • English: 22771AA030 (Without printer) • German: 22771AA070 (Without printer) • French: 22771AA080 (Without printer) • Spanish: 22771AA090 (Without printer)

2. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and ampere.
Pressure gauge	Used for measuring oil pressure.
Oscilloscope	Used for measuring sensor.

2. ABS Control Module and Hydraulic Control Unit (ABSCM&H/U)

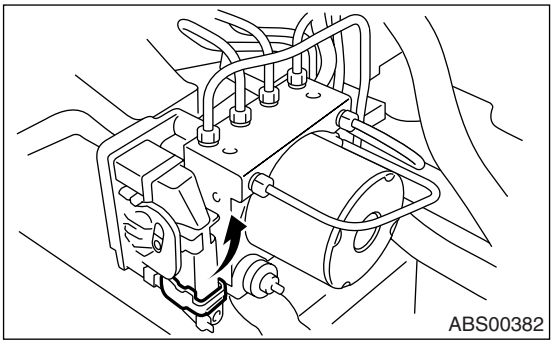
A: REMOVAL

1) Disconnect the ground cable from battery.
2) Use compressed air to get rid of water around the ABSCM&H/U.

NOTE:
When dust and dirt are attached to the terminal, they may cause poor contact.

3) Disconnect the ABSCM&H/U connector pulling up the lock lever.

CAUTION:
Do not pull the harness when disconnecting connector.

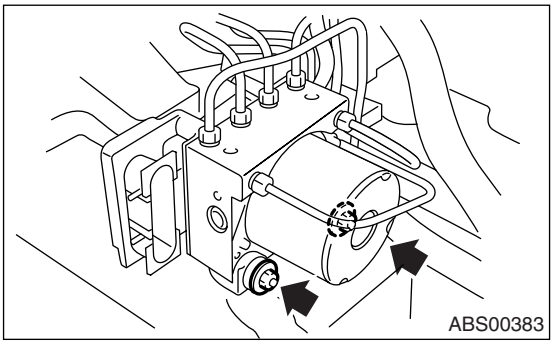


4) Remove the harness clip.
5) Disconnect the brake pipes from ABSCM&H/U.
6) Wrap the brake pipe using a vinyl bag not to spill the brake fluid on the vehicle body.

CAUTION:
When brake fluid is attached to the vehicle body, wash it off with water and wipe the water.

7) Remove the nuts and remove the ABSCM&H/U.

CAUTION:
• Do not drop or bump the ABSCM&H/U.
• Do not turn ABSCM&H/U upside down or place it sideways for storage.
• Be careful that no foreign objects are mixed in ABSCM&H/U.
• Be careful that no water enters inside the connectors.



8) Remove the ABSCM&H/U bracket.

B: INSTALLATION

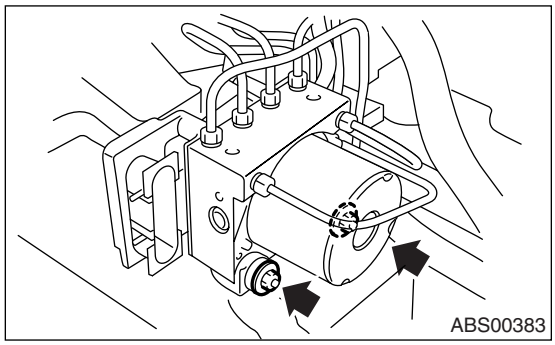
1) Install the ABSCM&H/U bracket.

Tightening torque:
33 N·m (3.3 kgf-m, 24 ft-lb)

2) Install the ABSCM&H/U aligning the groove of damper on ABSCM&H/U side with the pawl of bracket.

NOTE:
Check the identification mark of ABSCM&H/U.

Tightening torque:
7.5 N·m (0.76 kgf-m, 5.5 ft-lb)



3) Connect the brake pipes to their correct ABSCM&H/U positions.

Tightening torque:
15 N·m (1.5 kgf-m, 10.8 ft-lb)

4) Using a harness clip, secure the ABSCM&H/U harness to bracket.
5) Connect the connector to ABSCM&H/U.

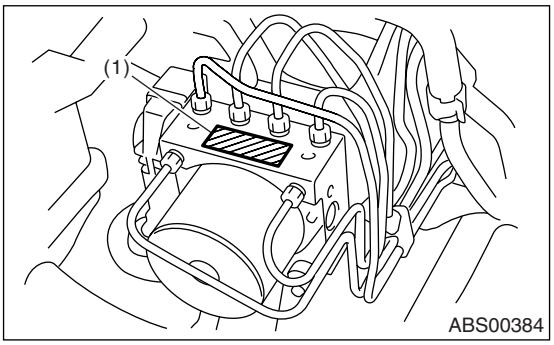
NOTE:
• Be sure to remove all foreign matters from inside the connector before connecting.
• Ensure the ABSCM&H/U connector is securely locked.

6) Bleed air from the brake system.

C: INSPECTION

1) Check the connected and fixed condition of connector.
2) Check the mark used for ABSCM&H/U identification.

Refer to “SPECIFICATION” for mark. <Ref. to ABS-2, SPECIFICATION, General Description.>



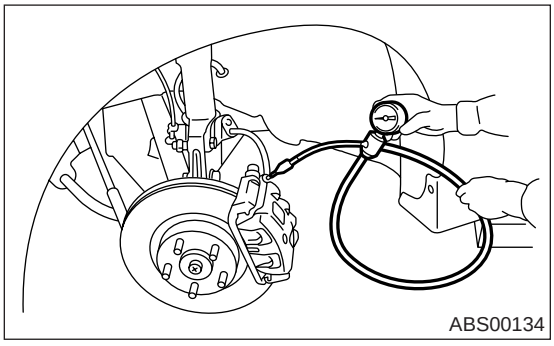
(1) Mark

1. CHECKING THE HYDRAULIC UNIT ABS OPERATION BY PRESSURE GAUGE

1) Lift-up the vehicle, and then remove the wheels.
2) Disconnect the air bleeder screws from the FL and FR caliper bodies.
3) Connect two pressure gauges to the FL and FR caliper bodies.

CAUTION:
• Pressure gauges used exclusively for brake fluid must be used.
• Do not use the pressure gauge for the measurement of transmission oil pressure since the piston seal may be expanded and deformed.

NOTE:
Wrap a sealing tape around the pressure gauge.



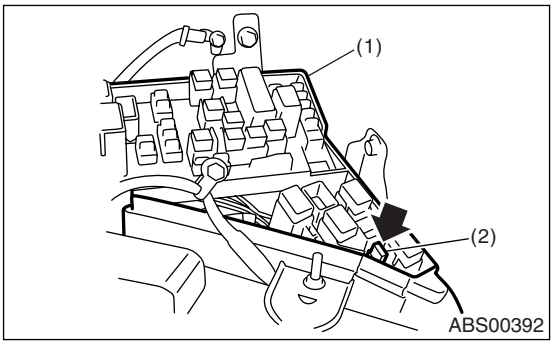
4) Bleed air from the pressure gauges and the FL and FR caliper bodies.
5) Perform ABS sequence control.
<Ref. to ABS-10, ABS Sequence Control.>
6) When the hydraulic unit begins to work, first the FL side performs decompression, holding and compression, and then the FR side performs decompression, holding and compression.
7) Read values indicated on the pressure gauge and check if the fluctuation of the values between decompression and compression meets the standard values. Depress the brake pedal and check that the kick-back is normal, and tightness is normal.

	Front wheel	Rear wheel
Initial value	3,500 kPa (36 kgf/cm^2, 511 psi)	3,500 kPa (36 kgf/cm^2, 511 psi)
When decompressed	500 kPa (5 kgf/cm^2, 73 psi) or less	500 kPa (5 kgf/cm^2, 73 psi) or less
When compressed	3,500 kPa (36 kgf/cm^2, 511 psi) or more	3,500 kPa (36 kgf/cm^2, 511 psi) or more

8) Remove the pressure gauges from the FL and FR caliper bodies.
9) Connect the air bleeder screws of the FL and FR caliper bodies.
10) Remove the air bleeder screws from the RL and RR caliper bodies.
11) Connect two pressure gauges to the RL and RR caliper bodies.
12) Bleed air from the brake system.
13) Bleed air from the pressure gauges and the RL and RR caliper bodies.
14) Perform ABS sequence control.
<Ref. to ABS-10, ABS Sequence Control.>
15) When the hydraulic unit begins to work, first the RR side performs decompression, holding and compression, and then the RL side performs decompression, holding and compression.
16) Read values indicated on the pressure gauge and check if the fluctuation of the values between decompression and compression meets the standard values. Depress the brake pedal and check that the kick-back is normal, and tightness is normal.
17) Remove the pressure gauge from the RL and RR caliper bodies.
18) Connect the air bleeder screws of the RL and RR caliper bodies.
19) Bleed air from the brake system.

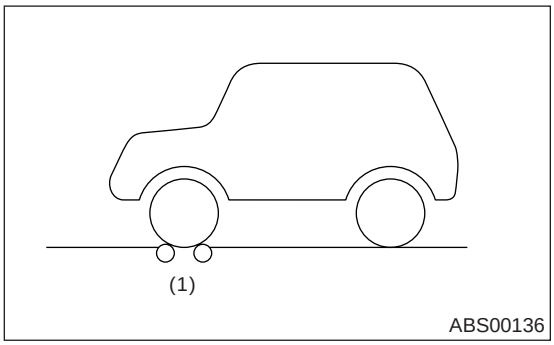
2. CHECKING THE HYDRAULIC UNIT ABS OPERATION WITH BRAKE TESTER

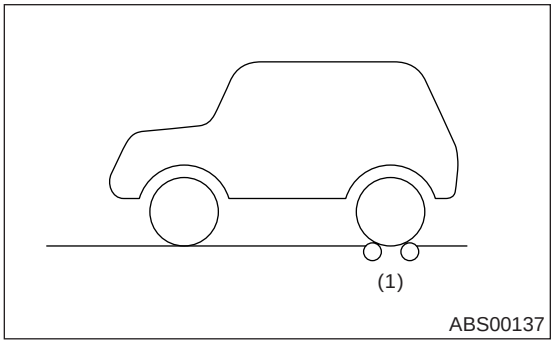
1) Install the spare fuse to the FWD connector located in the main fuse box for the model without AT VTD.



(1) Main fuse box
(2) FWD connector

2) Since the MT model and AT VTD model cannot cut off the AWD circuit forcibly, set the wheels other than measured one onto free rollers.
3) Prepare for the ABS sequence control.
<Ref. to ABS-10, ABS Sequence Control.>
4) Set the front wheels or rear wheels on the brake tester and set the select lever to “neutral”.





(1) Brake tester

5) Operate the brake tester.
6) Perform ABS sequence control.
<Ref. to ABS-10, ABS Sequence Control.>
7) When the hydraulic unit begins to work, check the following working sequence.

(1) The FL wheel performs decompression, holding and compression in sequence, and subsequently the FR wheel repeats the cycle.
(2) The RR wheel performs decompression, holding and compression in sequence, and subsequently the RL wheel repeats the cycle.

8) Read values indicated on the brake tester and check if the fluctuation of the values between decompression and compression meets the standard values.

	Front wheel	Rear wheel
Initial value	1,000 N (102 kgf, 225 lb)	1,000 N (102 kgf, 225 lb)
When decompressed	500 N (51 kgf, 112 lb) or less	500 N (51 kgf, 112 lb) or less
When compressed	1,000 N (102 kgf, 225 lb) or more	1,000 N (102 kgf, 225 lb) or more

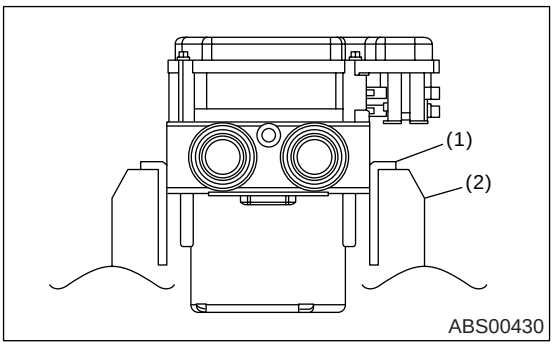
9) After the inspection, depress the brake pedal and check that it is not abnormally hard, and tightness is normal.

D: REPLACEMENT

CAUTION:
• Because the seal of ABSCM cannot be replaced, do not pull or peel it with lifting up.
• Because the screw part of H/U deteriorates in every replacement procedure, do not perform the replacement more than five times on it. When the malfunction is found though the replacement that performed is less than five times, replace the H/U body.
• Use new screws for installation of ABSCM.
• When the sealing surface of ABSCM or H/U is dirty or damaged and it cannot be removed or repaired, replace it with new one.

1) Remove the ABSCM&H/U. <Ref. to ABS-6, REMOVAL, ABS Control Module and Hydraulic Control Unit (ABSCM&H/U).>
2) To prevent entering foreign matter and brake fluid leakage, plug the oil pressure port of ABSCM&H/U using screw plug and etc.
3) Set the pump motor part of removed ABSCM&H/U faces down on a vise.

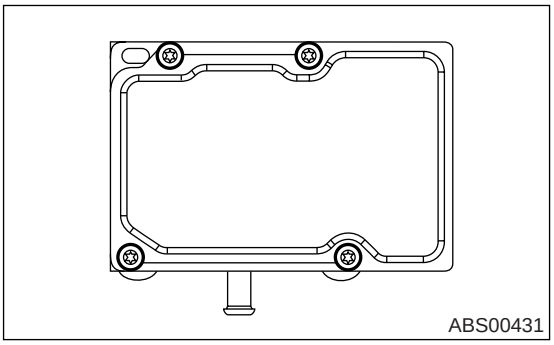
NOTE:
Before securing a part on a vice, place cushioning material such as wood blocks, aluminum plate or cloth between the part and vice.



(1) Aluminum plate or etc.
(2) Vise

4) Using TORX® bit T20, remove the four screws of ABSCM.

NOTE:
Always use new screws.



5) Slowly remove the ABSCM upward from H/U.

NOTE:
To prevent damaging of coil part, remove the ABSCM straightly from H/U.

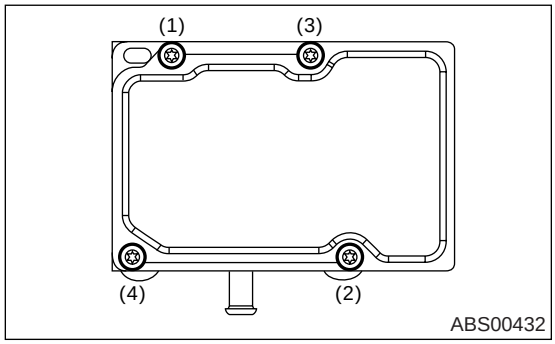
6) Ensure there are no dirt or damage on sealing surface of H/U.

CAUTION:
• Do not clean the ABSCM & H/U with applying compressed air.
• Do not repair the damages of H/U sealing surface using file or metal scraper. To remove the sealing, use resin scraper. Do not use the chemical materials (thinner and etc.).

7) Position the coil of new ABSCM to align H/U valve.
8) To prevent deforming of ABSCM housing cover, hold the corner of ABSCM and install it to the H/U without tilting.
9) Using TORX® bit T20, tighten the screws stepwise in the order of (1) through (4).

CAUTION:
Always use new screws.

Tightening torque:
1.5 N·m (0.15 kgf-m, 1.1 ft-lb)



10) Check that there is no foreign matter in aligning part between ABSCM and H/U.
11) Using TORX® bit T20, tighten the screws stepwise in the order of (1) through (4) again.

Tightening torque:
3 N·m (0.3 kgf-m, 2.2 ft-lb)

12) Check that there is no clearance in aligning part between ABSCM and H/U.
13) Install the ABSCM&H/U to vehicle.

3. ABS Sequence Control

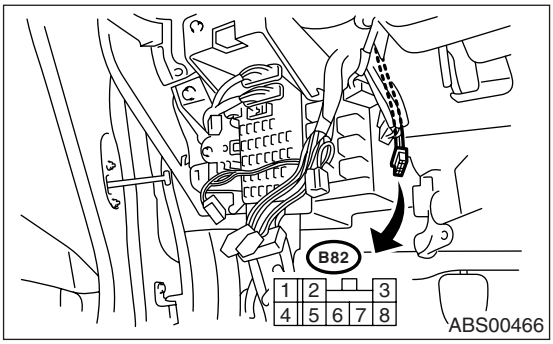
A: OPERATION

1) While the ABS sequence control is performed, the operation of the hydraulic unit can be checked using the brake tester or pressure gauge after the hydraulic unit solenoid valve operation.
2) ABS sequence control can be started by diagnosis connector or Subaru Select Monitor.

1. ABS SEQUENCE CONTROL WITH DIAGNOSIS CONNECTOR

NOTE:
In the event of any trouble, the ABS sequence control is not operated.

1) Turn the ignition switch to OFF at the vehicle stationary mode.
2) Take out the diagnosis connector from the inside of instrument panel lower cover on the driver's side, and connect one of ground terminal to connector terminal No. 8.



3) Turn the ignition switch to ON without depressing the brake pedal.
4) After the ABS warning light is turned off, perform the brake pedal operation as follows; press it within 3 seconds, → release it, → press it again, → release it again, → and then press it.

NOTE:
Engine must not start.

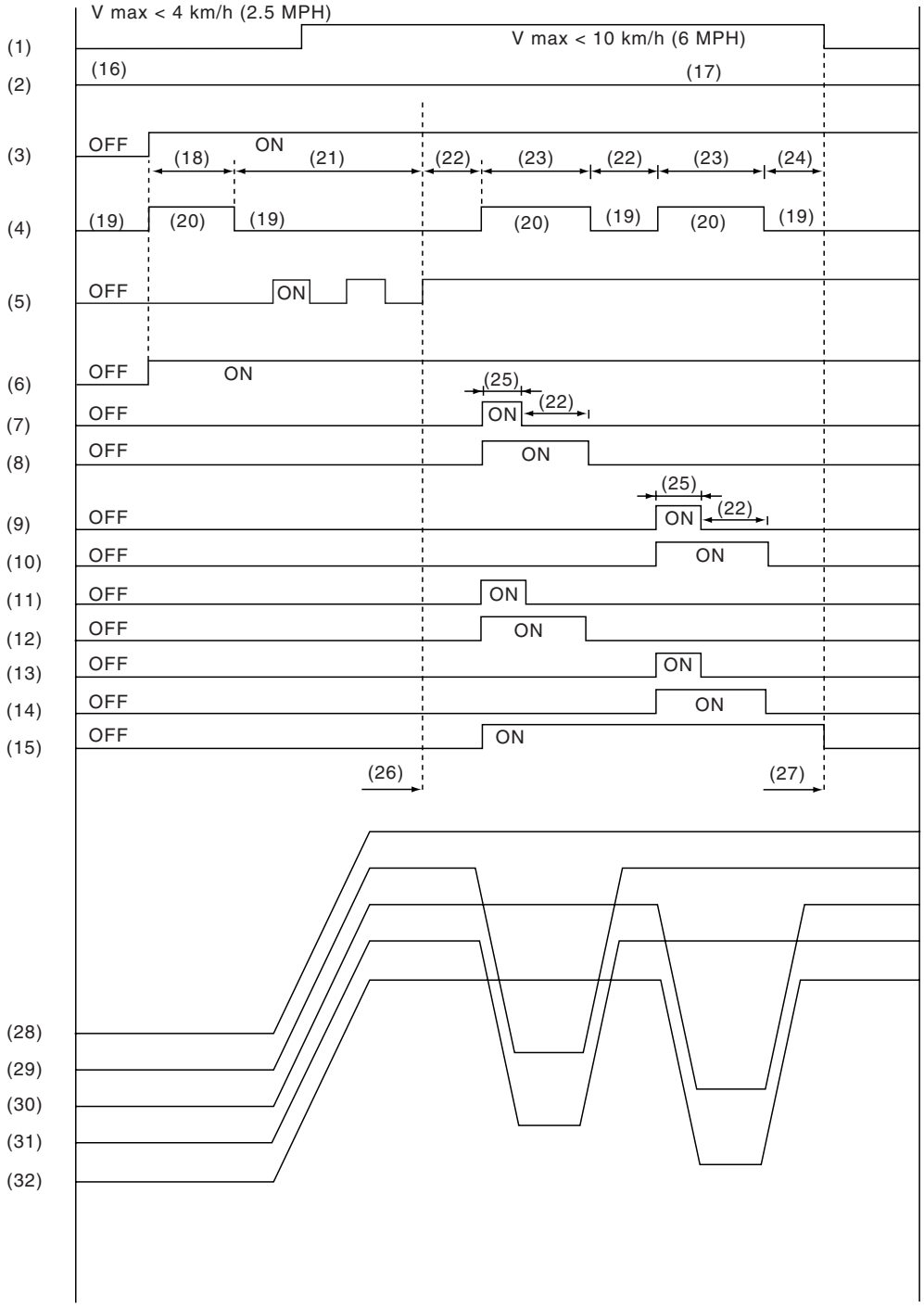
5) After completion of ABS sequence control, turn the ignition switch to OFF.

2. ABS SEQUENCE CONTROL WITH SUBARU SELECT MONITOR

NOTE:
In the event of any trouble, the ABS sequence control is not operated.

1) Connect the Subaru Select Monitor to data link connector under the driver's side instrument panel lower cover.
2) Turn the ignition switch to ON.
3) Set the Subaru Select Monitor switch to ON.
4) Set the Subaru Select Monitor to "Brake Control" mode.
5) When the "Function check sequence" is selected, the "ABS sequence control" will start.
6) Execute the following operations when the message "Press the brake pedal so that the brake pedal force is between 100 and 150 kgf" is displayed.
   (1) When the brake tester is used, press brake pedal pad with a force of 1,000 N (102 kgf, 225 lb).
   (2) When using the pressure gauge, press the brake pedal so as to make the pressure gauge indicate 3,500 kPa (36 kg/cm^2, 511 psi).
7) "Press the [YES] key" will be displayed. Press the [YES] key.
8) The brake line being operated is displayed on the Subaru Select Monitor.

3. CONDITIONS FOR ABS SEQUENCE CONTROL



ABS00385

(1) All wheel speed
(2) DL terminal
(3) Ignition key
(4) ABS warning light
(5) Stop light switch
(6) Valve relay
(7) FL decompression valve
(8) FL compression valve
(9) FR decompression valve
(10) FR compression valve
(11) RR decompression valve
(12) RR compression valve
(13) RL decompression valve
(14) RL compression valve
(15) Pump motor
(16) Diagnosis connector and connection
(17) When using the Subaru Select Monitor, both connection and non-connection of diagnosis connector are acceptable.
(18) 1.5 seconds
(19) Light OFF
(20) Light ON
(21) Within 3 seconds
(22) 1.0 second
(23) 1.4 seconds
(24) 0.6 second
(25) 0.4 second
(26) Point A
(27) Reset
(28) Master cylinder pressure
(29) FL wheel cylinder pressure
(30) FR wheel cylinder pressure
(31) RR wheel cylinder pressure
(32) RL wheel cylinder pressure

NOTE:
When using the Subaru Select Monitor, the control operation starts from point A. The patterns from ignition key ON to the point A show that operation is started by diagnosis connector. (However, it is required to turn the stop light switch to ON before point A.)

B: SPECIFICATION

1. CONDITIONS FOR COMPLETION OF ABS SEQUENCE CONTROL

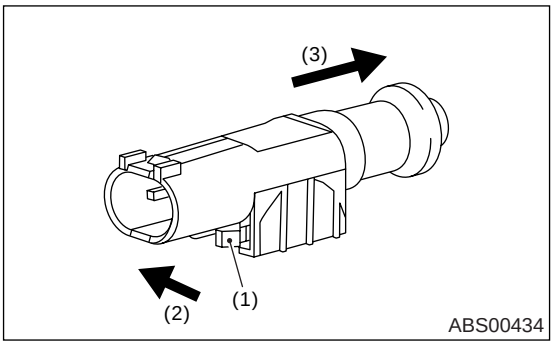
When the following conditions develop, the ABS sequence control stops and ABS operation is returned to the normal control mode.
1) When the speed of at least one wheel reaches 10 km/h (6 MPH).
2) When the diagnosis connector is disconnected. (Without Subaru Select Monitor)
3) When the brake pedal is released during ABS sequence control and the stop light switch goes OFF.
4) When the brake pedal is depressed after the ignition key is turned to ON, but before ABS warning light goes out. (Without Subaru Select Monitor)
5) When the ignition key is turned to ON, but the brake pedal is not depressed within 3 seconds after ABS warning light goes OFF. (Without Subaru Select Monitor)
6) After completion of ABS sequence control.
7) When malfunction is detected.

4. Front ABS Wheel Speed Sensor

A: REMOVAL

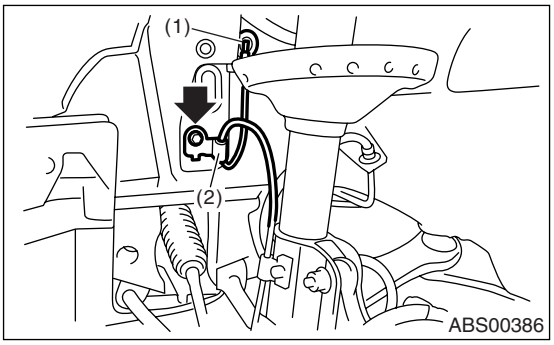
1) Disconnect the ground cable from battery.
2) Disconnect the ABS wheel speed sensor connector located next to the front strut mounting house in engine compartment.
3) Separate the sensor connector and vehicle securing clip. Apply force in the direction of (2) to unlock the pawl, and then slide the connector in the direction of (3). Pull out the connector to the tire side from grommet hole.

CAUTION:
Clip would break when removing the clip without separating sensor connector and clip.



(1) Pawl

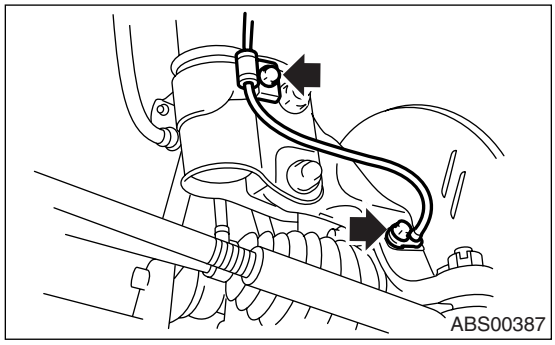
4) Remove the sensor harness bracket.



(1) To front ABS wheel speed sensor connector
(2) Sensor harness bracket

5) Remove the bolts which secure sensor harness to front strut.
6) Remove the front ABS wheel speed sensor from housing.

CAUTION:
- **Be careful not to damage the sensor portion.**
- **Do not apply excessive force to the sensor harness.**



B: INSTALLATION

Install in the reverse order of removal.

Tightening torque:
Sensor:
7.5 N·m (0.76 kgf-m, 5.5 ft-lb)
Bracket:
33 N·m (3.3 kgf-m, 24 ft-lb)

CAUTION:
Be careful not to damage the sensor portion.

NOTE:
- Check the identification (mark) on the harness to make sure that no warp exists. (RH: K1 (White), LH: K2 (Yellow))
- Check if the harness is not pulled and does not come in contact with the suspension or body during steering wheel effort.

C: INSPECTION

1. INSPECTION WITH SUBARU SELECT MONITOR

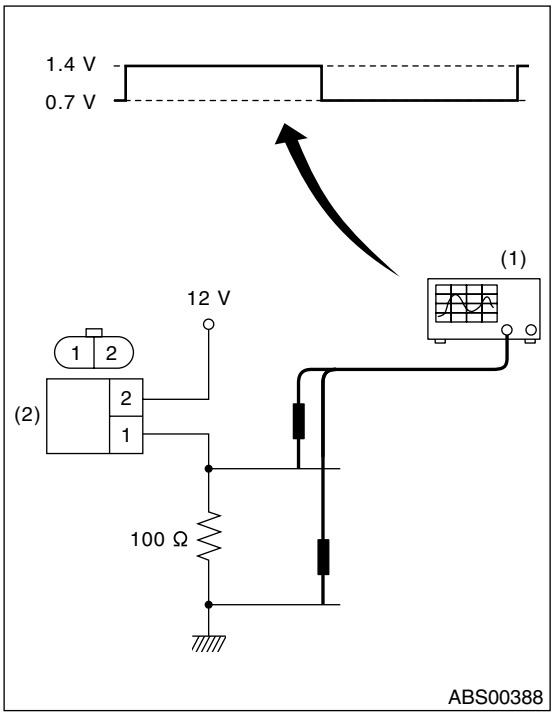
1) Connect the Subaru Select Monitor to data link connector.
2) Select {Current Data Display & Save}. Check if the speed indicated on the display change in response to the speedometer reading during acceleration/deceleration when the steering wheel is in the straight-ahead position.
3) If the speed indicated on the display does not change, check the ABS wheel speed sensor. <Ref. to ABS-13, ABS WHEEL SPEED SENSOR, INSPECTION, Front ABS Wheel Speed Sensor.>

2. ABS WHEEL SPEED SENSOR

1) Check the pole piece of the ABS wheel speed sensor for foreign particles or damage. If necessary, clean the pole piece or replace the ABS wheel speed sensor.

2) Charge a 12 V power supply to the No. 2 terminal of sensor connector as shown in the figure, and then install the resistance to No. 1 terminal. Rotate the wheel about 2.75 km/h (2 MPH) or equivalent, measure the voltage using oscilloscope.

Standard value of output voltage:
0.7 — 1.4 V



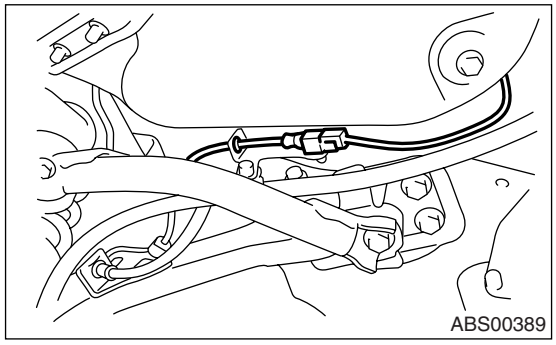
(1) Oscilloscope
(2) ABS wheel speed sensor

NOTE:
Check the ABS wheel speed sensor cable for discontinuity. If necessary, replace with a new one.

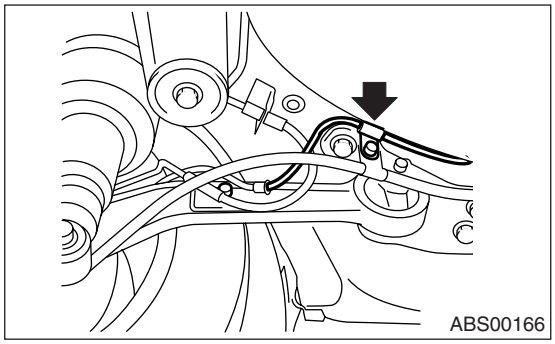
5. Rear ABS Wheel Speed Sensor

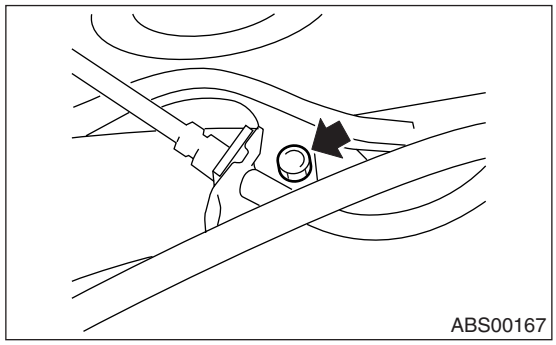
A: REMOVAL

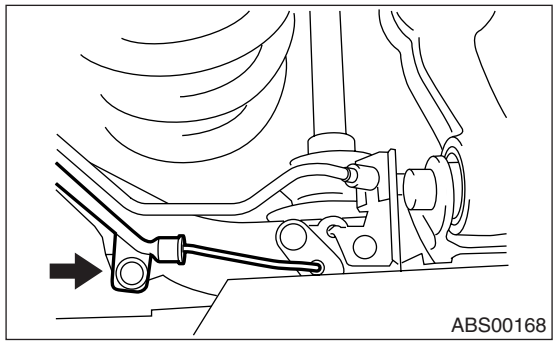
1) Disconnect the ground cable from battery.
2) Disconnect the connector from rear ABS wheel speed sensor.



3) Remove the sensor harness bracket from rear arm.

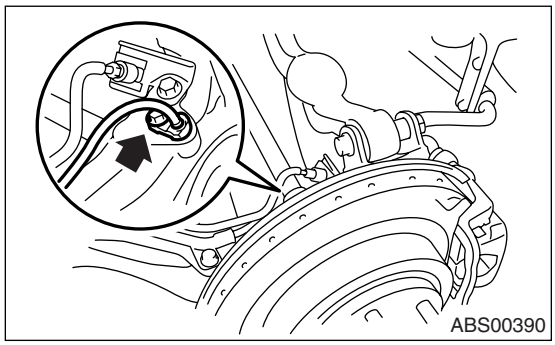






4) Remove the rear ABS wheel speed sensor from rear arm.

CAUTION:
• Be careful not to damage the sensor portion.
• Do not apply excessive force to the sensor harness.



B: INSTALLATION

Install in the reverse order of removal.

CAUTION:
Be careful not to damage the sensor portion.

Tightening torque:
Sensor:
7.5 N·m (0.76 kgf-m, 5.5 ft-lb)
Bracket:
33 N·m (3.3 kgf-m, 24 ft-lb)

NOTE:
Check the identification (mark) on the harness to make sure that no warp exists. (RH:K5(White), LH:K6(Yellow))

C: INSPECTION

1. ABS WHEEL SPEED SENSOR

<Ref. to ABS-13, ABS WHEEL SPEED SENSOR, INSPECTION, Front ABS Wheel Speed Sensor.>

6. Front Magnetic Encoder

A: REMOVAL

Refer to “Front Hub Bearing” for removal, because the front magnetic encoder is integrated with front hub bearing.
<Ref. to DS-17, REMOVAL, Front Hub Unit Bearing.>

B: INSTALLATION

Refer to “Front Hub Bearing” for installation, because the front magnetic encoder is integrated with front hub bearing.
<Ref. to DS-17, INSTALLATION, Front Hub Unit Bearing.>

C: INSPECTION

Visually check the magnetic encoder for any damage. If necessary, replace with a new hub unit bearing.

NOTE:
Replace the hub unit bearing with a new one if there is any defect found on the magnetic encoder, since the magnetic encoder is integrated with hub unit bearing assembly.

7. Rear Magnetic Encoder

A: REMOVAL

Refer to “Rear Hub Unit Bearing” for removal, because the rear magnetic encoder is integrated with rear hub unit bearing.
<Ref. to DS-19, REMOVAL, Rear Hub Unit Bearing.>

B: INSTALLATION

Refer to “Rear Hub Unit Bearing” for installation, because the rear magnetic encoder is integrated with rear hub unit bearing.
<Ref. to DS-20, INSTALLATION, Rear Hub Unit Bearing.>

C: INSPECTION

Visually check the magnetic encoder for any damage. If necessary, replace with a new hub unit bearing.

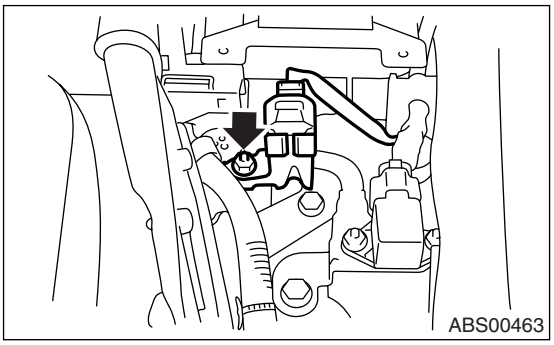
NOTE:
Replace the hub unit bearing with a new one if there is any defect found on the magnetic encoder, since the magnetic encoder is integrated with hub unit bearing assembly.

8. G Sensor

A: REMOVAL

1) Disconnect the ground cable from battery.
2) Remove the console box.
<Ref. to EI-53, REMOVAL, Console Box.>
3) Disconnect the connector from G sensor.
4) Remove the G sensor from body.

CAUTION:
- **Do not drop or bump the G sensor.**
- **Since G sensor is a unit with the bracket, do not disassemble them.**



B: INSTALLATION

Install in the reverse order of removal.

CAUTION:
Do not drop or bump the G sensor.

Tightening torque:
7.5 N·m (0.76 kgf-m, 5.5 ft-lb)

C: INSPECTION

Step		Check	Yes	No
1	**CHECK G SENSOR.** 1) Turn the ignition switch to OFF. 2) Connect the Subaru Select Monitor to data link connector. 3) Set the Subaru Select Monitor to the {Brake Control} mode. 4) Set the display in the {Current Data Display & Save} mode. 5) Read the G sensor output value.	Is the value −1.2 — 1.2 m/s^2 when the vehicle is in horizontal position?	Go to step **2.**	Repair the harness connector between G sensor and ABSCM&H/U. Or replace G sensor.
2	**CHECK G SENSOR.** 1) Remove the console box. 2) Remove the G sensor from vehicle. (Do not disconnect connector.) 3) Read the Subaru Select Monitor display.	Is the value 8.1 — 11.2 m/s^2 when G sensor is inclined forward to 90°?	Go to step **3.**	Repair the harness connector between G sensor and ABSCM&H/U. Or replace G sensor.
3	**CHECK G SENSOR.** Read the Subaru Select Monitor display.	Is the value −8.1 — −11.2 m/s^2 when G sensor is inclined backward to 90°?	G sensor is normal.	Repair the harness connector between G sensor and ABSCM&H/U. Or replace G sensor.