ABS

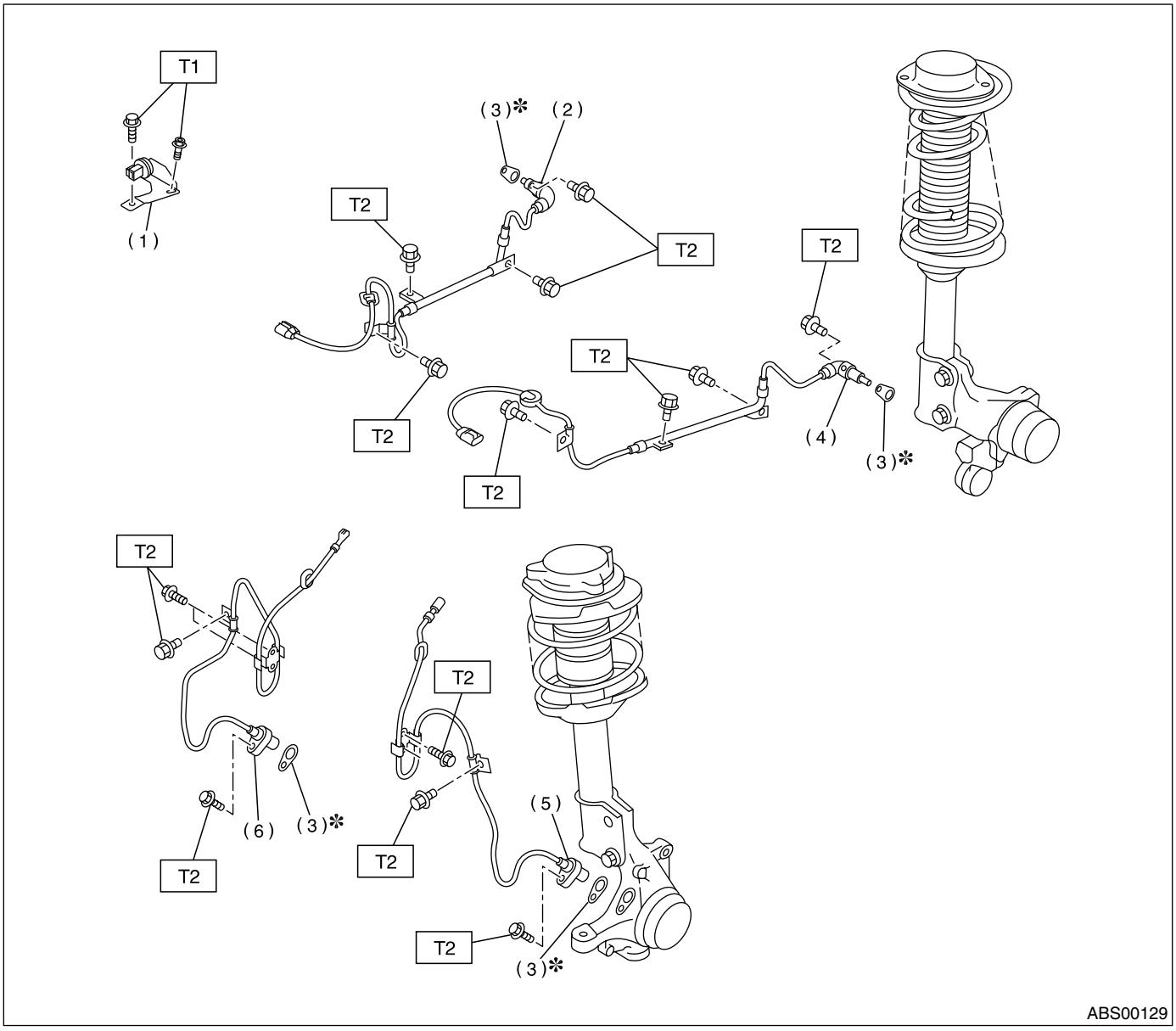
1. General Description

A: SPECIFICATIONS

Item				Standard or remarks
ABS sensor	ABS sensor gap		Front	0.3 — 0.8 mm (0.012 — 0.031 in)
			Rear	0.7 — 1.2 mm (0.028 — 0.047 in)
	ABS sensor resistance		Front	1.25±0.25 kΩ
			Rear	1.15±0.115 kΩ
	Marks of the harness	Front	RH	Light blue
			LH	Brown
		Rear	RH	White
			LH	Yellow
G sensor	G sensor voltage			2.3±0.2 V
ABS control module and hydraulic control unit (ABSCM&H/U) marks			AT vehicles	CO
			MT vehicles	CP

B: COMPONENT

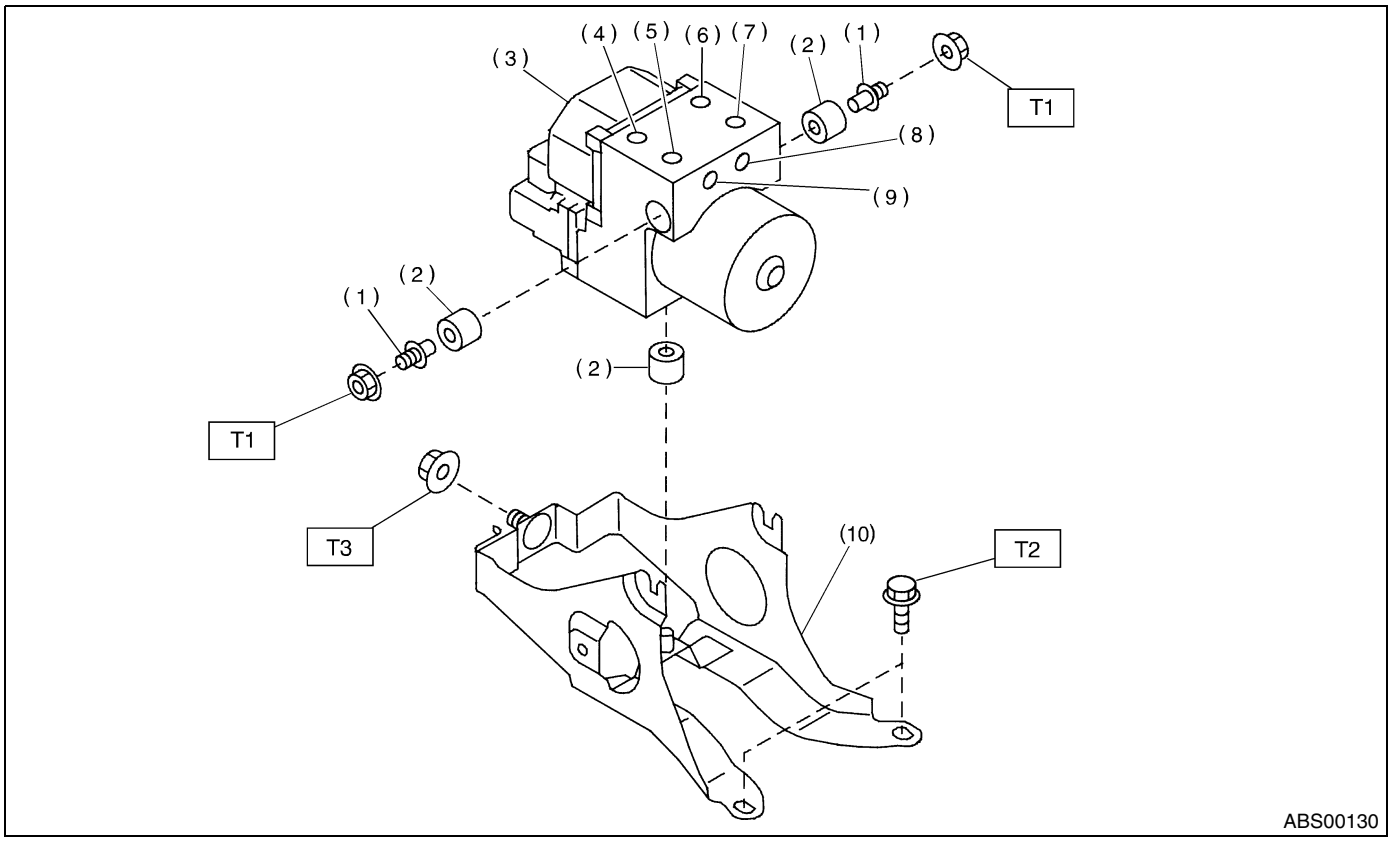
1. SENSOR



(1) G sensor
(2) Rear ABS sensor RH
(3) ABS spacer
(4) Rear ABS sensor LH
(5) Front ABS sensor LH
(6) Front ABS sensor RH

Tightening torque: N·m (kgf-m, ft-lb)
T1: 18 (1.8, 13.0)
T2: 33 (3.4, 24.6)

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



(1) Stud bolt
(2) Damper
(3) ABS control module and hydraulic control unit
(4) Front-LH outlet
(5) Secondary inlet
(6) Front-RH outlet
(7) Primary inlet
(8) Rear-LH outlet
(9) Rear-RH outlet
(10) Bracket

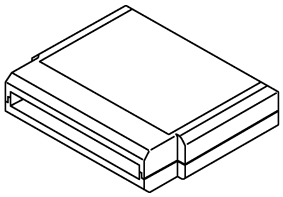
Tightening torque: N·m (kgf-m, ft-lb)
T1: 18 (1.8, 13.0)
T2: 33 (3.4, 24.6)
T3: 38 (3.8, 27.5)

C: CAUTION

- Before disconnecting electrical connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- 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.

D: PREPARATION TOOL

1. SPECIAL TOOLS

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST24082AA210	24082AA210	CARTRIDGE	Troubleshooting for electrical systems.
 ST22771AA030	22771AA030	SUBARU SELECT MONITOR KIT	Troubleshooting for electrical systems. • English: 22771AA030 (Without printer) • German: 22771AA070 (Without printer) • French: 22771AA080 (Without printer) • Spanish: 22771AA090 (Without printer)

2. GENERAL PURPOSE TOOLS

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

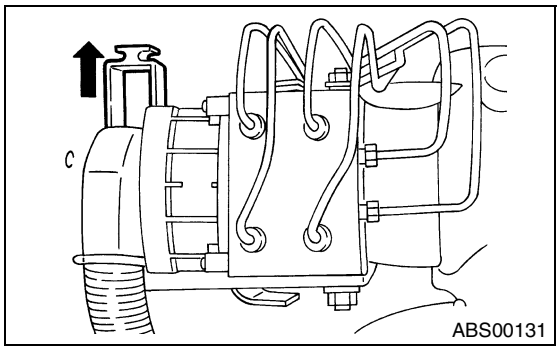
2. ABS Control Module and Hydraulic Control Unit (ABSCM&H/U)

A: REMOVAL

1) Disconnect the ground cable from battery.
2) Remove the air intake duct from engine compartment to facilitate removal of ABSCM&H/U.
3) Use an air gun to get rid of water around the ABSCM&H/U.

NOTE:
Contact will be insufficient if the terminal gets wet.

4) Remove the ground cable from ABSCM&H/U.
5) Pull off the lock of ABSCM&H/U connector to remove it.



6) Disconnect the connector from ABSCM&H/U.

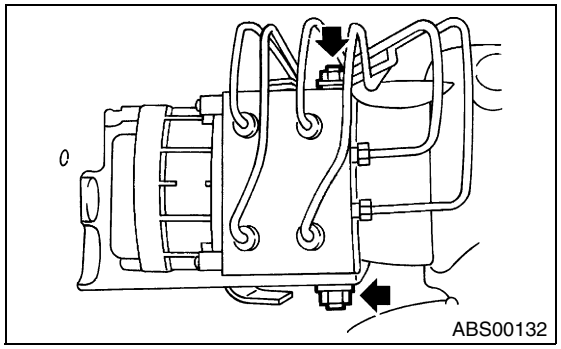
CAUTION:
Do not pull the harness when disconnecting the connector.

7) Unlock the cable clip.
8) Disconnect the brake pipes from ABSCM&H/U.
9) Wrap the brake pipes with vinyl bag to avoid spilling brake fluid on vehicle body.

CAUTION:
• Brake fluid spilt on the vehicle body will harm the painted surface; wash away quickly with water if spilt.

10) Remove the ABSCM&H/U from engine compartment.

CAUTION:
• ABSCM&H/U cannot be disassembled. Do not attempt to loosen bolts and nuts.
• Do not drop or bump the ABSCM&H/U.
• Do not turn the ABSCM&H/U upside down or place it on its side.
• Be careful to prevent foreign particles from getting into ABSCM&H/U.
• Do not let water get into the connector.



B: INSTALLATION

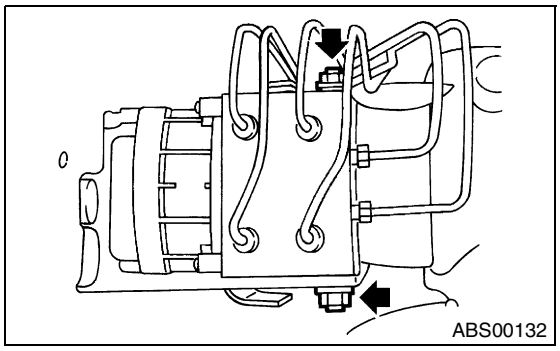
1) Install the ABSCM&H/U bracket.

Tightening torque:
33 N·m (3.4 kgf-m, 24.6 ft-lb)

2) Apply a coat of grease (Nippeco LT or GB) to the bracket attaching bolt.
3) Align the width across flat portion of ABSCM&H/U side stud bolt with the bolt hole groove on bracket, and then install the ABSCM&H/U.

NOTE:
Confirm the specification mark of ABSCM&H/U.

Tightening torque:
18 N·m (1.8 kgf-m, 13.0 ft-lb)



4) Connect the brake pipes to their correct ABSCM&H/U connections.

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

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

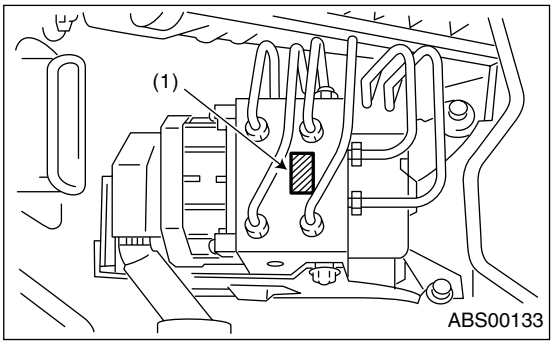
NOTE:
• Be sure to remove all foreign matter from inside of the connector before connecting.
• Ensure that the ABSCM&H/U connector is securely locked.

7) Connect the ground cable to ABSCM&H/U, and then apply grease.
8) Install the air intake duct.
9) Bleed air from the brake system.

C: INSPECTION

1) Check the connected and fixed condition of connector.
2) Check specifications of the mark with ABSCM&H/U.

Mark	Model
CO	AT vehicles
CP	MT vehicles



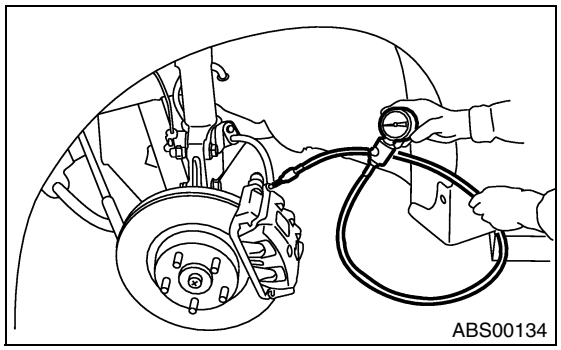
(1) Mark

1. CHECKING THE HYDRAULIC UNIT ABS OPERATION BY PRESSURE GAUGE

1) Lift-up the vehicle and 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 employ pressure gauge previously used for transmission since the piston seal is expanded which may lead to malfunction of the brake.

NOTE:
Wrap sealing tape around the pressure gauge.



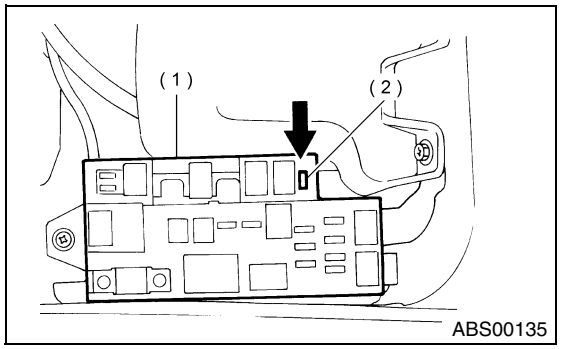
4) Bleed air from the pressure gauges.
5) Perform the ABS sequence control.
<Ref. to ABS-11, ABS Sequence Control.>
6) When the hydraulic unit begins to work, and first the FL side performs decompression, holding, and compression, and then the FR side performs decompression, holding, and compression.
7) Read values indicated on the pressure gauge and check if the fluctuation of the values between decompression and compression meets the standard values. Also check if any irregular brake pedal tightness is felt.

	Front wheel	Rear wheel
Initial value	3,500 kPa (35 kgf/cm^2, 498 psi)	3,500 kPa (35 kgf/cm^2, 498 psi)
Decompressed	500 kPa (5 kgf/cm^2, 71 psi) or less	500 kPa (5 kgf/cm^2, 71 psi) or less
Compressed	3,500 kPa (35 kgf/cm^2, 498 psi) or more	3,500 kPa (35 kgf/cm^2, 498 psi) or more

8) Remove the pressure gauges from FL and FR caliper bodies.
9) Remove the air bleeder screws from the RL and RR caliper bodies.
10) Connect the air bleeder screws to the FL and FR caliper bodies.
11) Connect two pressure gauges to the RL and RR caliper bodies.
12) Bleed air from the pressure gauges and the FL and FR caliper bodies.
13) Perform the ABS sequence control. <Ref. to ABS-11, ABS Sequence Control.>
14) When the hydraulic unit begins to work, at first the RR side performs decompression, holding, and compression, and then the RL side performs decompression, holding, and compression.
15) Read values indicated on the pressure gauges and check if they meet the standard value.
16) After checking, remove the pressure gauges from caliper bodies.
17) Connect the air bleeder screws to RL and RR caliper bodies.
18) Bleed air from the brake line.

2. CHECKING THE HYDRAULIC UNIT ABS OPERATION WITH BRAKE TESTER

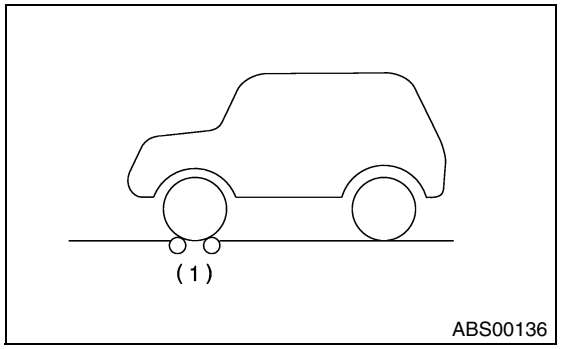
1) In the case of AWD AT vehicles, install a spare fuse with the FWD connector in the main fuse box to simulate FWD vehicles.

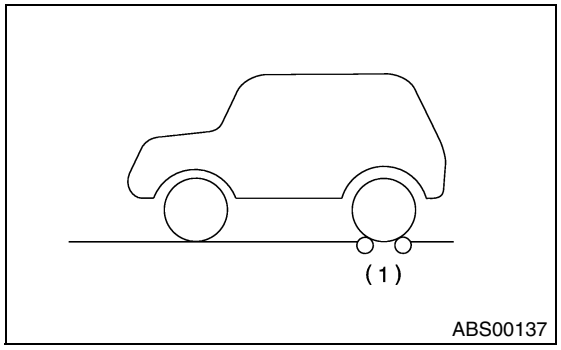


(1) Main fuse box
(2) FWD connector

NOTE:
AWD circuit of MT vehicles can not be disabled because viscous coupling is used inside center differential.

2) Prepare for operating the ABS sequence control.
<Ref. to ABS-11, ABS Sequence Control.>
3) Set the front wheels or rear wheels on the brake tester and set the select lever's position at "N" range.





(1) Brake tester

4) Operate the brake tester.
5) Perform the ABS sequence control.

<Ref. to ABS-11, ABS Sequence Control.>

6) Hydraulic unit begins to work; and 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.

7) Read values indicated on the brake tester and check if the fluctuation of values, when decompressed and compressed, meet the standard values.

	Front wheel	Rear wheel
Initial value	1,000 N (100 kgf, 221 lb)	1,000 N (100 kgf, 221 lb)
Decompressed	500 N (50 kgf, 110 lb) or less	500 N (50 kgf, 110 lb) or less
Compressed	1,000 N (100 kgf, 221 lb) or more	1,000 N (100 kgf, 221 lb) or more

8) After checking, also check if any irregular brake pedal tightness is felt.

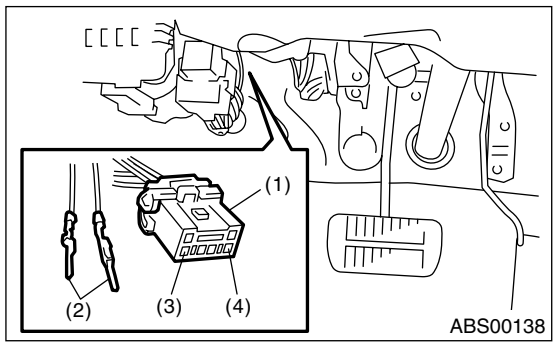
3. ABS Sequence Control

A: OPERATION

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

1. ABS SEQUENCE CONTROL WITH DIAGNOSIS CONNECTOR

1) Turn the ignition switch to OFF.
2) Connect the diagnosis terminal to terminal No. 6 of the diagnosis connector beside driver's seat.



(1) Diagnosis connector
(2) Diagnosis terminals
(3) Terminal No. 3
(4) Terminal No. 6

3) Turn the ignition switch to ON.
4) Confirm that start code (code 11) is only displayed.
5) Turn the ignition switch to OFF.
6) Connect the diagnosis terminals to terminals No. 6 and No. 3 of the diagnosis connector.
7) Set the speed of all wheels at 4 km/h (2 MPH) or less.
8) Turn the ignition switch to ON.
9) Within 0.5 seconds after the ABS warning light goes out, depress the brake pedal and hold it depressed.

NOTE:
• Engine must not operate.

CAUTION:
Do not depress the clutch pedal in case of vehicle with hill holder.

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

2. ABS SEQUENCE CONTROL WITH SUBARU SELECT MONITOR

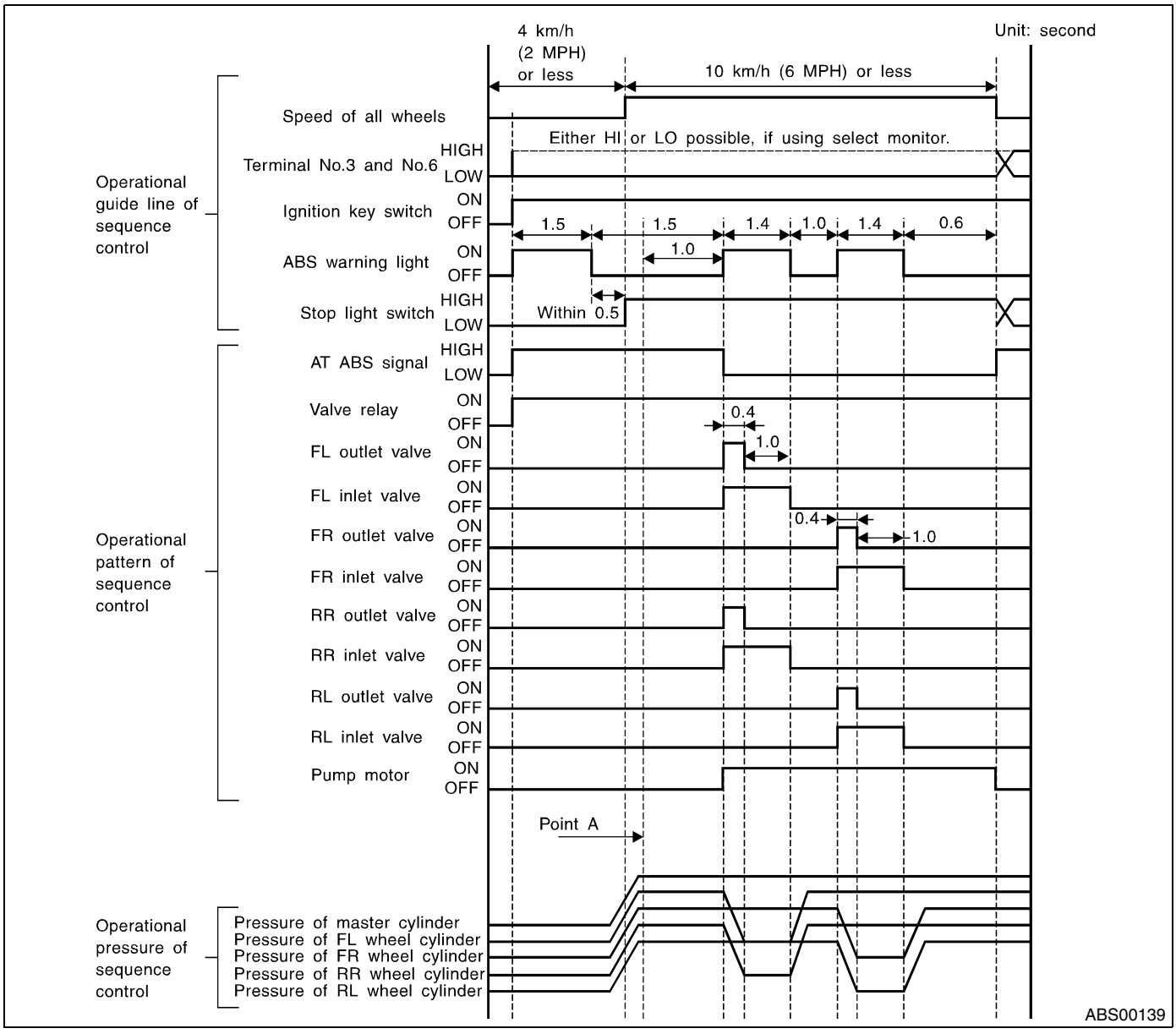
NOTE:
• In the event of any trouble, the sequence control may not be operative. In such a case, activate the sequence control, referring to “ABS SEQUENCE CONTROL WITH DIAGNOSIS CONNECTOR”.
<Ref. to ABS-11, ABS SEQUENCE CONTROL WITH DIAGNOSIS CONNECTOR, ABS Sequence Control.>
• When the diagnosis terminal is connected to the diagnosis connector, the sequence control will not operate.

1) Connect the Subaru Select Monitor to data link connector under driver’s seat instrument panel lower cover.
2) Turn the ignition switch to ON.
3) Turn the Subaru Select Monitor switch to ON.
4) Put the Subaru Select Monitor to “BRAKE CONTROL” mode.
5) When “Function check sequence” is selected, ‘ABS sequence control’ will start.
6) When the message “Press Brake Pedal Firmly” is displayed, perform the followings.
(1) When using the brake tester, depress the brake pedal with braking force of 1,000 N (100 kgf, 221 lb).
(2) When using the pressure gauge, depress the brake pedal so as to make the pressure gauge indicate 3,500 kPa (35 kg/cm^2, 498 psi).

CAUTION:
Do not depress the clutch pedal in case of vehicle with hill holder.

7) When the message “Press YES” is displayed, press the YES key.
8) The braking system in operation is displayed on Subaru Select Monitor.

3. CONDITIONS FOR ABS SEQUENCE CONTROL



NOTE:
When the Subaru Select Monitor is used, control operation starts at point A. The patterns from IGN key ON to the point A show that operation is started by diagnosis connector. (However, the brake light switch must be ON before point A.)

B: SPECIFICATION

1. CONDITIONS FOR COMPLETION OF ABS SEQUENCE CONTROL

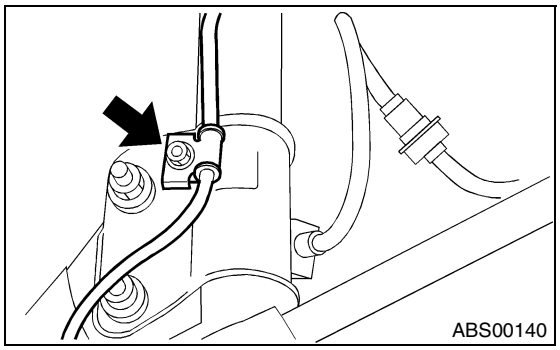
When the following conditions develop, the ABS sequence control stops and ABS operation is returned to the normal control mode.

1) When the speed of at least one wheel reaches 10 km/h (6 MPH).
2) When terminal No. 3 or No. 6 are separated from diagnosis terminals. (When the Subaru Select Monitor is not used.)
3) When the brake pedal is released during sequence control and the braking lamp switch is set to off.
4) When the brake pedal is depressed after ignition key is turned to ON, and before ABS warning light goes out. (When the Subaru Select Monitor is not used.)
5) When the brake pedal is not depressed after ignition key is turned to ON, and within 0.5 seconds after ABS warning light goes out. (When the Subaru Select Monitor is not used.)
6) After completion of the sequence control.
7) When malfunction is detected. (When the Subaru Select Monitor is used.)

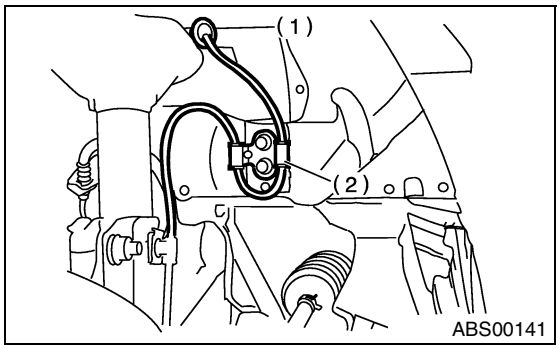
4. Front ABS Sensor

A: REMOVAL

1) Disconnect the ground cable from battery.
2) Disconnect the front ABS sensor connector located next to the front strut mounting house in engine compartment. Pull the connector out from grommet hole to tire side.
3) Remove the bolts which secure sensor harness to strut.



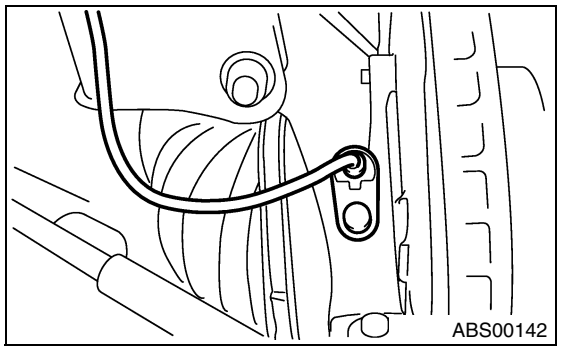
4) Remove the bolts which secure sensor harness to body.



(1) To front ABS sensor connector
(2) Bracket

5) Remove the bolts which secure front ABS sensor to housing, and remove the front ABS sensor.

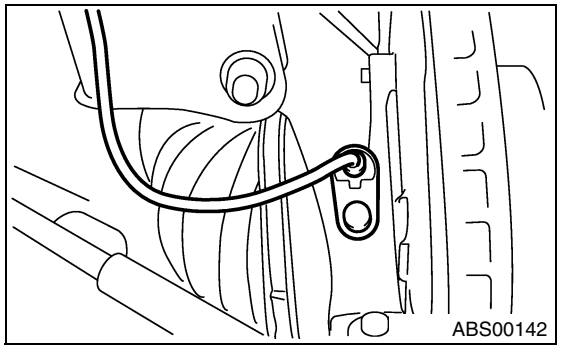
CAUTION:
• Be careful not to damage the pole piece located at tip of the sensor and teeth faces during removal.
• Do not pull the sensor harness during removal.



B: INSTALLATION

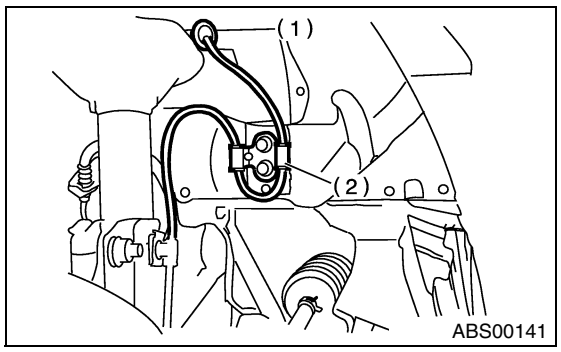
1) Temporarily install the front ABS sensor on housing.

CAUTION:
Be careful not to strike the ABS sensor's pole piece against tone wheel and adjacent metal parts during installation.



2) Install the front ABS sensor on strut and wheel apron bracket.

Tightening torque:
33 N·m (3.4 kgf-m, 24.6 ft-lb)

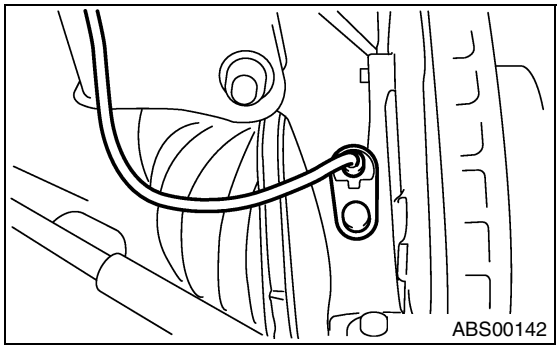


(1) To front ABS sensor connector
(2) Bracket

3) Check the ABS sensor gap. <Ref. to ABS-15, SENSOR GAP, INSPECTION, Front ABS Sensor.> After standard clearance is obtained, tighten the ABS sensor on housing to specified torque.
If the clearance is outside specification, readjust using spacer (Part No. 26755AA000).

ABS sensor standard clearance:
0.3 — 0.8 mm (0.012 — 0.031 in)

Tightening torque:
33 N·m (3.4 kgf-m, 24.6 ft-lb)



NOTE:
• Check the marks on the harness and make sure that no kink exists.
• Make sure that the harness is not pulled and does not contact to suspension or body when steering wheel is turned.

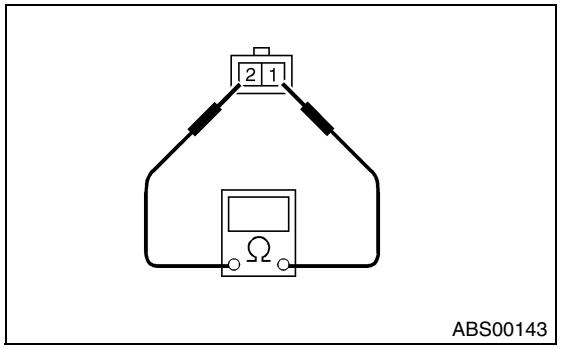
RH: Light blue
LH: Brown

4) After confirmation of the ABS sensor clearance, connect the connector to ABS sensor.
5) Connect the battery ground cable to battery.

C: INSPECTION

1. ABS SENSOR

1) Check the pole piece of ABS sensor for foreign particles or damage. If necessary, clean the pole piece or replace ABS sensor.
2) Measure the ABS sensor resistance.
If the resistance is outside standard value, replace the ABS sensor with a new one.

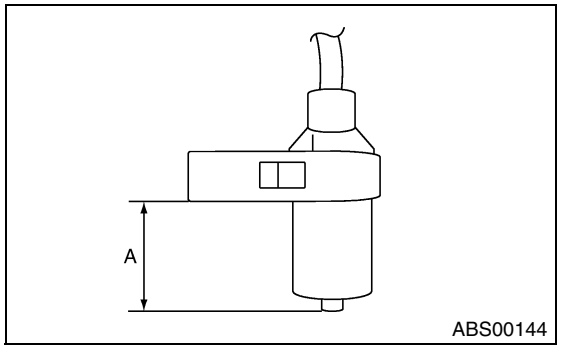


Terminal No.	Standard
1 and 2	1.25±0.25 kΩ

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

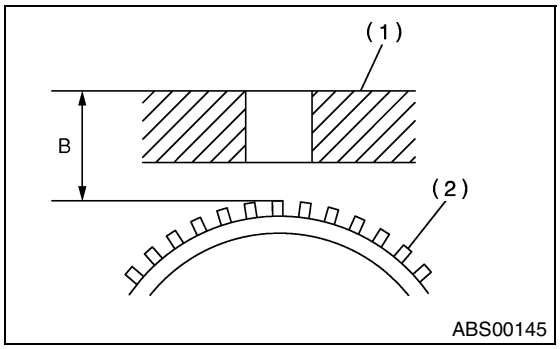
2. SENSOR GAP

1) Measure the distance “A” between ABS sensor surface and sensor pole face.



2) Measure the distance “B” between surface where the front axle housing meets the ABS sensor, and the tone wheel.

NOTE:
Measure so that the gauge touches the tone wheel teeth top.



(1) Axle housing
(2) Tone wheel

3) Find the gap between the ABS sensor pole face and the surface of the tone wheel teeth by putting the measured values in the formula below and calculating.

ABS sensor clearance = B – A

ABS sensor standard clearance:
0.3 — 0.8 mm (0.012 — 0.031 in)

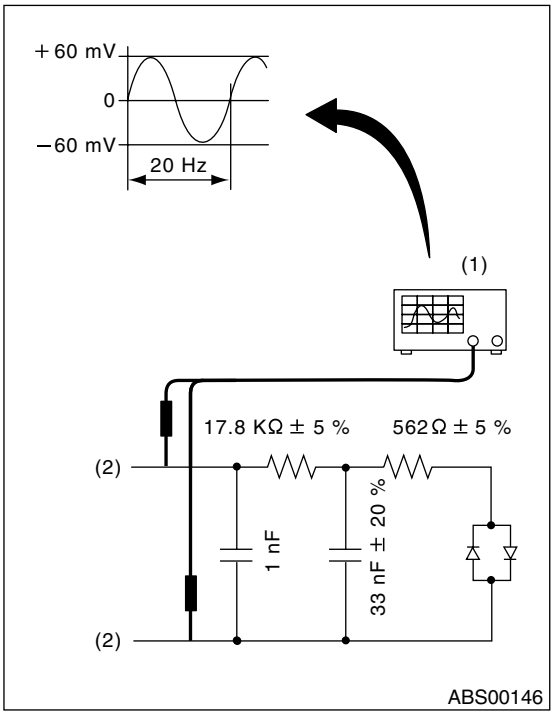
NOTE:
If the clearance is outside specification, readjust using spacer (Part No. 26755AA000).

3. OUTPUT VOLTAGE

Output voltage can be checked by the following method. Install the resistor and condenser, then rotate the wheel about 2.75 km/h (2 MPH) or equivalent.

Output voltage specification:
0.12 to 1 V (at 20 Hz)

NOTE:
Regarding terminal No., please refer to item 1. ABS SENSOR.<Ref. to ABS-15, ABS SENSOR, INSPECTION, Front ABS Sensor.>



(1) Oscilloscope
(2) Terminal

D: ADJUSTMENT

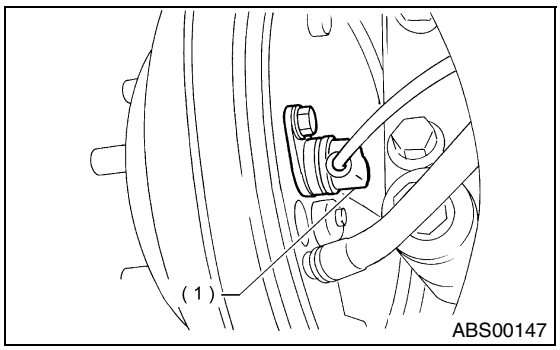
Adjust the gap using spacer (Part No. 26755A000).

5. Rear ABS Sensor

A: REMOVAL

1) Disconnect the ground cable from battery.
2) Lift-up the vehicle.
3) Remove the rear seat and disconnect the rear ABS sensor connector. Pull the connector out from grommet hole to under floor.
4) Remove the rear sensor harness bracket from the rear trailing link and bracket.
5) Remove the rear ABS sensor from back plate.

CAUTION:
• Be careful not to damage the pole piece located at tip of the sensor and teeth faces during removal.
• Do not pull the sensor harness during removal.



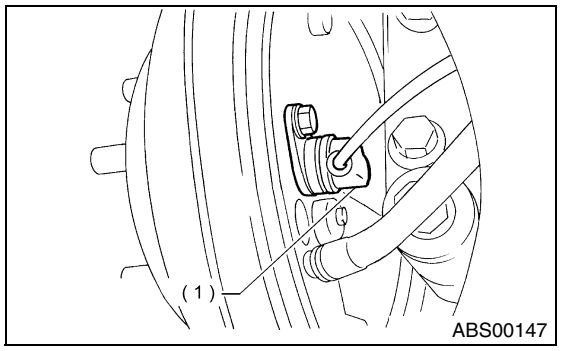
(1) Rear ABS sensor

6) Remove the rear tone wheel while removing the hub from housing and hub assembly. <Ref. to DS-23, REMOVAL, Rear Axle.>

B: INSTALLATION

1) Install the rear tone wheel on hub, then rear housing on hub. <Ref. to DS-29, ASSEMBLY, Rear Axle.>
2) Temporarily install the rear ABS sensor on back plate.

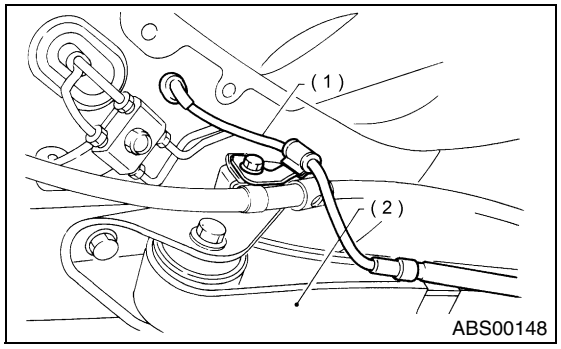
CAUTION:
Be careful not to strike the ABS sensor's pole piece against tone wheel and adjacent metal parts during installation.



(1) Rear ABS sensor

3) Install the rear drive shaft to rear housing and rear differential spindle. <Ref. to DS-26, INSTALLATION, Rear Axle.>
4) Install the rear sensor harness on rear trailing link.

Tightening torque:
33 N·m (3.4 kgf-m, 24.6 ft-lb)



(1) Rear sensor harness
(2) Trailing link

5) Check the ABS sensor gap. <Ref. to ABS-18, SENSOR GAP, INSPECTION, Rear ABS Sensor.> After standard clearance is obtained, tighten the ABS sensor on back plate to specified torque.
If the clearance is outside specification, readjust using spacer (Part No. 26755AA000).

ABS sensor standard clearance:
0.7 — 1.2 mm (0.028 — 0.047 in)

Tightening torque:
33 N·m (3.4 kgf-m, 24.6 ft-lb)

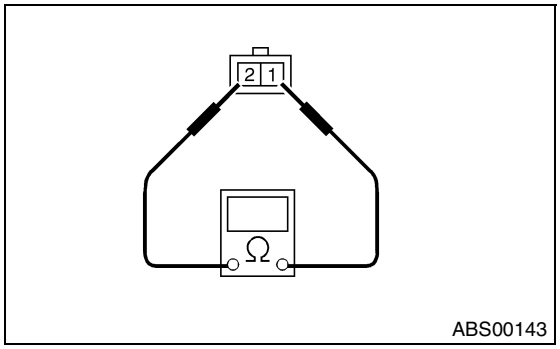
NOTE:
Check the marks on the harness and make sure that no kink exists. (RH: white, LH: yellow)

6) After confirmation of the ABS sensor clearance, connect the connector to ABS sensor.
7) Connect the battery ground cable to battery.

C: INSPECTION

1. ABS SENSOR

1) Check the pole piece of ABS sensor for foreign particles or damage. If necessary, clean the pole piece or replace ABS sensor.
2) Measure the ABS sensor resistance.
If resistance is outside the standard value, replace the ABS sensor with a new one.



Terminal No.	Standard
1 and 2	1.15±0.115 kΩ

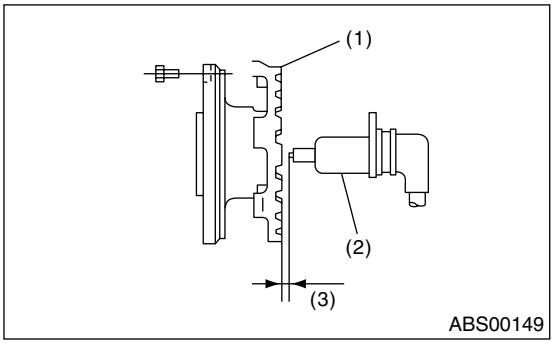
NOTE:
Check the ABS sensor cable for discontinuity. If necessary, replace with a new one.

2. SENSOR GAP

Measure clearance between tone wheel and ABS sensor at whole periphery.

NOTE:
• If clearance is narrow, adjust by using spacer (Part No. 26755AA000).
• If clearance is wide, check the outputted voltage then replace the ABS sensor or tone wheel if the outputted voltage is outside specification.

ABS sensor clearance:
0.7 — 1.2 mm (0.028 — 0.047 in)



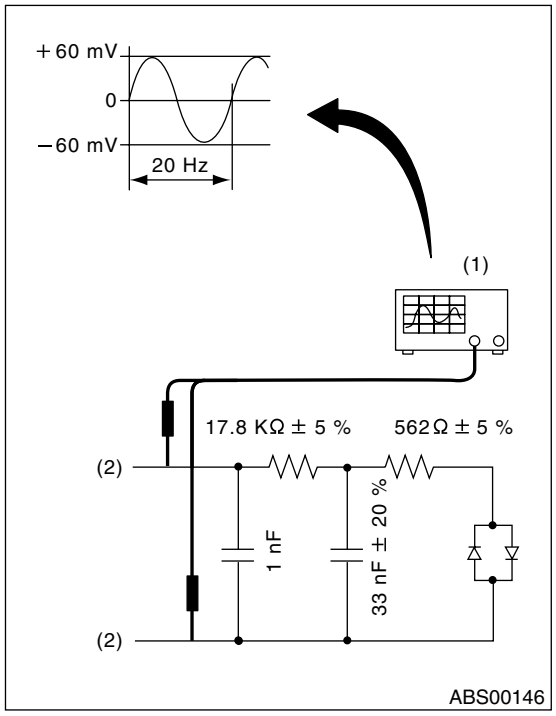
(1) Tone wheel
(2) ABS sensor
(3) Sensor gap

3. OUTPUT VOLTAGE

Output voltage can be checked by the following method. Install the resistor and condenser, then rotate the wheel about 2.75 km/h (2 MPH) or equivalent.

Output voltage specification:
0.12 — 1 V (at 20 Hz)

NOTE:
Regarding terminal No., please refer to item 1. ABS SENSOR. <Ref. to ABS-18, ABS SENSOR, INSPECTION, Rear ABS Sensor.>



(1) Oscilloscope
(2) Terminal

D: ADJUSTMENT

Adjust the gap using spacer (Part No. 26755AA000).

6. Front Tone Wheel

A: REMOVAL

Refer to Front Drive Shaft, because front tone wheel is integrated with front drive shaft. <Ref. to DS-31, REMOVAL, Front Drive Shaft.>

B: INSTALLATION

Refer to Front Drive Shaft, because front tone wheel is integrated with front drive shaft. <Ref. to DS-32, INSTALLATION, Front Drive Shaft.>

C: INSPECTION

Visually check the tone wheel's teeth (44 pieces) for cracks or dents. If necessary, replace the tone wheel with a new one.

NOTE:
Replace the BJ assembly with a new one as a single unit if there are any defects found on tone wheel is unitized with BJ assembly of drive shaft.

7. Rear Tone Wheel

A: REMOVAL

Refer to Rear Axle, because the rear tone wheel is installed to rear hub. <Ref. to DS-23, REMOVAL, Rear Axle.>

B: INSTALLATION

Refer to Rear Axle, because the rear tone wheel is installed to rear hub. <Ref. to DS-26, INSTALLATION, Rear Axle.>

C: INSPECTION

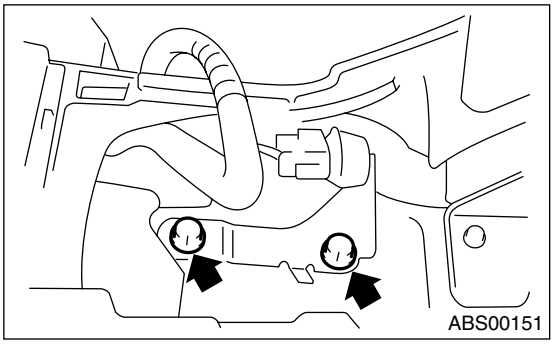
Visually check the tone wheel's teeth (44 pieces) for cracks or dents. If necessary, replace the tone wheel with a new one.

8. G Sensor

A: REMOVAL

1) Disconnect the ground cable from battery.
2) Remove the console cover.
<Ref. to EI-39, 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.**
- **G sensor and the bracket are integrated into one unit. Therefore, do not disassemble it.**



B: INSTALLATION

1) Install in the reverse order of removal.

CAUTION:
Do not drop or bump the G sensor.

Tightening torque:
18 N·m (1.8 kgf-m, 13.0 ft-lb)

C: INSPECTION

	Step	Value	Yes	No
1	**DO YOU HAVE SUBARU SELECT MONITOR?**	—	Go to step **5.**	Go to step **2.**
2	**CHECK G SENSOR.** 1)Turn the ignition switch to OFF. 2)Remove the G sensor from vehicle. 3)Connect the connector to G sensor. 4)Turn the ignition switch to ON. 5)Measure the voltage between G sensor connector terminals. ***Connector & terminal:*** ***(B292) No. 2 (+) — No. 3 (–)*** Is the voltage as specified when G sensor is horizontal?	2.1 — 2.5 V	Go to step **3.**	Replace the G sensor.
3	**CHECK G SENSOR.** Measure the voltage between G sensor connector terminals. ***Connector & terminal:*** ***(B292) No. 2 (+) — No. 3 (–)*** Is the voltage as specified when G sensor is inclined forwards to 90°?	3.7 — 4.1 V	Go to step **4.**	Replace the G sensor.
4	**CHECK G SENSOR.** Measure the voltage between G sensor connector terminals. ***Connector & terminal:*** ***(B292) No. 2 (+) — No. 3 (–)*** Is the voltage as specified when G sensor is inclined backwards to 90°?	0.5 — 0.9 V	G sensor is normal.	Replace the G sensor.
5	**CHECK G SENSOR.** 1)Turn the ignition switch to OFF. 2)Connect the Subaru Select Monitor connector to data link connector. 3)Turn the Subaru Select Monitor into {BRAKE CONTROL} mode. 4)Set the display in the {Current Data Display & Save} mode. 5)Read the G sensor output voltage. Is the indicated reading as specified when the vehicle is in horizontal position?	2.1 — 2.5 V	Go to step **6.**	Replace the G sensor.
6	**CHECK G SENSOR.** 1)Remove the console box. 2)Remove the G sensor from vehicle. (Do not disconnect the connector.) 3)Read the Subaru Select Monitor display. Is the voltage as specified when G sensor is inclined forwards to 90°?	3.7 — 4.1 V	Go to step **7.**	Replace the G sensor.
7	**CHECK G SENSOR.** Read the Subaru Select Monitor display. Is the voltage as specified when G sensor is inclined backwards to 90°?	0.5 — 0.9 V	G sensor is normal.	Replace the G sensor.