# **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.

FRONT SUSPENSION	FS
REAR SUSPENSION	RS
WHEEL AND TIRE SYSTEM	WT
DIFFERENTIALS	DI
TRANSFER CASE	тс
DRIVE SHAFT SYSTEM	DS
ABS	ABS
ABS (DIAGNOSTICS)	ABS
BRAKE	BR
PARKING BRAKE	PB
POWER ASSISTED SYSTEM (POWER STEERING)	PS

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

FUJI HEAVY INDUSTRIES LTD.

# ABS

# ABS

1	General Description	Page
2	ABS Control Module and Hydraulic Control Unit (ABSCM&H/U)	2
3.	ABS Sequence Control	
4.	Front ABS Sensor	14
5.	Rear ABS Sensor	17
6.	Front Tone Wheel	20
7.	Rear Tone Wheel	21
8.	G Sensor	22

# 1. General Description

# A: SPECIFICATIONS

Item			Standard or remarks	
	ABS concer gen		Front	0.3 — 0.8 mm (0.012 — 0.031 in)
	ABS sensor yap	S sensor gap		0.7 — 1.2 mm (0.028 — 0.047 in)
	APS concer registered		Front	1.25±0.25 kΩ
ABS consor	ADS SEIISUI TESISIAITUE	ISOF TESISTANCE		1.0±0.2 kΩ
ADS SEIISUI		Front	RH	White
	Marks of the harness		LH	Yellow
		Rear	RH	Light blue
			LH	Brown
G sensor	G sensor voltage			2.3±0.2 V
	FWD model		AT	CA
ABS control module and			MT	СВ
(ABSCM&H/U) marks	AWD model		AT	CC
(120011011/0)			MT	CD

# **B: COMPONENT**

# 1. SENSOR



- (1) G sensor
- (2) Rear ABS sensor RH
- (3) ABD 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: 7.4 (0.75, 5.4) T2: 32 (3.3, 24)

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



(1) Stud bolt

(2)

(3)

- (6) Front-RH outlet
- (7) Primary inlet
- ABS control module and hydraulic (8) control unit (9)
- (4) Front-LH outlet

Damper

(5) Secondary 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:	29 (3.0, 21.7)		
Т3:	32 (3.3, 24)		

ABS-4

# **C: CAUTION**

• Wear working clothing, including a cap, protective goggles, and protective shoes during operation.

• Remove contamination including 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 negative terminal from battery.

# **D: PREPARATION TOOL**

# 1. SPECIAL TOOLS

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	24082AA150	CARTRIDGE	Troubleshooting for electrical systems.
B2M3876			
	22771AA030	SELECT MONITOR KIT	Troubleshooting for electrical systems. • English: 22771AA030 (Without printer) • German: 22771AA070 (Without printer) • French: 22771AA080 (Without printer) • Spanish: 22771AA090 (Without printer)
B2M3877			

# 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 (AB-SCM&H/U)

# A: REMOVAL

1) Disconnect ground cable from battery.

2) Remove 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 AB-SCM&H/U.

## CAUTION:

# The contact will be insufficient if the terminal gets wet.

4) Pull off the lock of the ABSCM&H/U connector to remove it.



5) Disconnect connector from ABSCM&H/U.

#### CAUTION:

Be careful not to let water or other foreign matter contact the ABSCM&H/U terminal.

6) Unlock cable clip.

7) Disconnect brake pipes from ABSCM&H/U.

#### CAUTION:

Wrap brake pipes with vinyl bag to avoid spilling brake fluid on vehicle body.

8) Remove 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 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.

• Apply a coat of rust-preventive wax (Nippeco LT or GB) to bracket attaching bolt after tightening. • Do not pull harness when disconnecting connector.



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

# **B: INSTALLATION**

1) Install ABSCM&H/U bracket.

#### Tightening torque:

32 N⋅m (3.3 kgf-m, 24 ft-lb)

Install ABSCM&H/U.

#### CAUTION:

Confirm that the specifications of the AB-SCM&H/U conforms to the vehicle specifications.

#### Tightening torque:





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

# Tightening torque:

#### 15 N·m (1.5 kgf-m, 10.8 ft-lb)

4) Using cable clip, secure ABSCM&H/U harness to bracket.

5) Connect connector to ABSCM&H/U.

#### CAUTION:

• Be sure to remove all foreign matter from inside the connector before connecting.

• Ensure that the ABSCM&H/U connector is securely locked.

- 6) Install air intake duct.
- 7) Bleed air from the brake system.

# **C: INSPECTION**

1) Check connected and fixed condition of connector.

2) Check specifications of the mark with AB-SCM&H/U.

Mark Model		
CA AT (FWD)		
СВ	MT (FWD)	
CC AT (AWD)		
CD	MT (AWD)	



(1) Mark

#### 1. CHECKING THE HYDRAULIC UNIT ABS OPERATION BY PRESSURE GAUGE

1) Lift-up vehicle and remove 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 ABS sequence control.

<Ref. to ABS-11, ABS Sequence Control.> 6) When the hydraulic unit begins to work, and first the EL side performs decompression holding, and

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	
	3,432 kPa	3,432 kPa	
Initial value	(35 kgf/cm <sup>2</sup> , 498	(35 kgf/cm <sup>2</sup> , 498	
	psi)	psi)	
When	490 kPa	490 kPa	
decom-	(5 kgf/cm <sup>2</sup> , 71 psi)	(5 kgf/cm <sup>2</sup> , 71 psi)	
pressed	or less	or less	
	3,432 kPa	3,432 kPa	
When	(35 kgf/cm <sup>2</sup> , 498	(35 kgf/cm <sup>2</sup> , 498	
compressed	psi)	psi)	
	or more	or more	

8) Remove pressure gauges from FL and FR caliper bodies.

9) Remove 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 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 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) FWD connector

2) Prepare for operating 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 "neutral".





(1) Brake tester

4) Operate the brake tester.

5) Perform 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.

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

(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	981 N (100 kgf. 221 lb)	981 N (100 kgf, 221 lb)
When decompressed	490 N (50 kgf, 110 lb) or less	490 N (50 kgf, 110 lb) or less
When compressed	981 N (100 kgf, 221 lb) or more	981 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 select monitor.

#### 1. ABS SEQUENCE CONTROL WITH DIAG-NOSIS CONNECTOR

1) Connect diagnosis terminals to terminals No. 3 and No. 6 of the diagnosis connector beside driver's seat heater unit.



2) Set the speed of all wheels at 4 km/h (2 MPH) or less.

3) Turn ignition switch OFF.

4) Within 0.5 seconds after the ABS warning light goes out, depress the brake pedal and hold it immediately after ignition switch is turned to ON.

#### CAUTION:

#### Do not depress the clutch pedal.

NOTE:

• When the ignition switch is set to on, the brake pedal must not be depressed.

• Engine must not operate.

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

#### 2. ABS SEQUENCE CONTROL WITH SE-LECT 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 select monitor to data link connector under driver's seat instrument panel lower cover.

2) Turn ignition switch ON.

3) Turn select monitor switch ON.

4) Put select monitor to "BRAKE CONTROL" mode.

5) When "Function check sequence" is selected, 'ABS sequence control' will start.

6) The message 'Press Brake Pedal Firmly' is displayed as follows:

(1) When using the brake tester, depress brake pedal with braking force of 981 N (100 kgf, 221 lb).

(2) When using the pressure gauge, depress brake pedal so as to make the pressure gauge indicate 3,432 kPa (35 kg/cm<sup>2</sup>, 498 psi).

#### CAUTION:

#### Do not depress the clutch pedal.

7) When the message "Press YES" is displayed, press YES key.

8) Operation points will be displayed on select monitor.

# **ABS SEQUENCE CONTROL**

#### 3. CONDITIONS FOR ABS SEQUENCE CONTROL



#### NOTE:

• When 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.

HIGH means high voltage.

• LOW means low voltage.

# **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 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 brake pedal is depressed after ignition key is turned to ON, and before ABS warning light goes out. (When select monitor is not used.)

5) When brake pedal is not depressed after ignition key is turned to ON, and within 0.5 seconds after ABS warning light goes out. (When select monitor is not used.)

6) After completion of the sequence control.

7) When malfunction is detected. (When select monitor is used.)

# 4. Front ABS Sensor

# A: REMOVAL

1) Disconnect battery ground cable.

2) Disconnect front ABS sensor connector located next to front strut mounting house in engine compartment.

3) Remove bolts which secure sensor harness to strut.



4) Remove bolts which secure sensor harness to body.



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

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

#### CAUTION:

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

• Do not pull sensor harness during removal.



# **B: INSTALLATION**

1) Temporarily install front ABS sensor on housing.

#### CAUTION:

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



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

#### Tightening torque: 32 N⋅m (3.3 kgf-m, 24 ft-lb)



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

3) Place a thickness gauge between ABS sensor's and tone wheel's tooth face. After standard clearance is obtained over the entire perimeter, tighten ABS sensor on housing to specified torque.

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

Tightening torque:



#### CAUTION:

Check the marks on the harness to make sure that no distortion exists.

#### RH: White

LH: Yellow

#### NOTE:

If the clearance is outside specifications, readjust.

4) After confirmation of the ABS sensor clearance, connect connector to ABS sensor.

5) Connect connector to battery ground cable.

# **C: INSPECTION**

#### 1. ABS SENSOR

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

#### 2) Measure ABS sensor resistance.



#### CAUTION:

# If resistance is outside the standard value, replace ABS sensor with new one.

#### NOTE:

Check 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 valves 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 specifications, readjust.

#### 3. OUTPUT VOLTAGE

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

#### NOTE:

Regarding terminal No., please refer to item 1. ABS SENSOR.



# **D: ADJUSTMENT**

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

# 5. Rear ABS Sensor

# A: REMOVAL

- 1) Disconnect battery ground cable.
- 2) Lift-up the vehicle.

3) Remove rear seat and disconnect rear ABS sensor connector.

4) Remove rear sensor harness bracket from rear trailing link and bracket.

5) Remove rear ABS sensor from back plate.



6) Remove rear tone wheel while removing hub from housing and hub assembly.<Ref. to DS-24, REMOVAL, Rear Axle.>

#### CAUTION:

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

• Do not pull sensor harness during removal.

# **B: INSTALLATION**

 Install rear tone wheel on hub, then rear housing on hub.<Ref. to DS-30, ASSEMBLY, Rear Axle.>
 Temporarily install rear ABS sensor on back plate.

#### CAUTION:

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



3) Install rear drive shaft to rear housing and rear differential spindle.<Ref. to DS-27, INSTALLA-TION, Rear Axle.>

4) Install rear sensor harness on rear trailing link.

#### Tightening torque: 32 N·m (3.3 kgf-m, 24 ft-lb)



**ABS-17** 

5) Place a thickness gauge between ABS sensor's and tone wheel's tooth face. After standard clearance is obtained over the entire perimeter, tighten ABS sensor on rear arm to specified torque.

#### ABS sensor standard clearance:

0.7 — 1.2 mm (0.028 — 0.047 in)

#### Tightening torque:

32 N·m (3.3 kgf-m, 24 ft-lb)

#### CAUTION:

Check the marks on the harness to make sure that no distortion exists. (RH: white, LH: yellow)

If the clearance is outside specifications, readjust.

6) After confirmation of the ABS sensor clearance, connect connector to ABS sensor.

7) Connect connector to battery ground cable.

## **C: INSPECTION**

#### 1. ABS SENSOR

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

2) Measure ABS sensor resistance.



#### **CAUTION:**

• If resistance is outside the standard value, replace ABS sensor with new one.

• Check the marks on the harness to make sure that no distortion exists.

**RH: Light blue** 

LH: Brown

NOTE:

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

#### 2. SENSOR GAP

Clearances (sensor gaps) should be measured one by one to ensure tone wheel and speed sensor are installed correctly.

NOTE:

• If clearance is narrow, adjust by using spacer (Part No. 26755AA000).

• If clearance is wide, check the outputted voltage then replace ABS sensor or tone wheel if the outputted voltage is outside the specification.

#### ABS sensor clearance:





#### 3. OUTPUT VOLTAGE

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

#### NOTE:

Regarding terminal No., please refer to item 1. ABS SENSOR.



#### 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-32, 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 tone wheels teeth (44 pieces) for cracks or dents. If necessary, replace tone wheel with a new one.

#### NOTE:

Replace BJ assembly with 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 Drive Shaft, because rear tone wheel is integrated with hub. <Ref. to DS-37, REMOVAL, Rear Drive Shaft.>

# **B: INSTALLATION**

Refer to Rear Drive Shaft, because rear tone wheel is integrated with hub.

<Ref. to DS-37, INSTALLATION, Rear Drive Shaft.>

# **C: INSPECTION**

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

# 8. G Sensor

# A: REMOVAL

1) Disconnect battery ground terminal.



- 2) Remove console cover.
- <Ref. to EI-24, Console Box.>
- 3) Disconnect connector from G sensor.
- 4) Remove G sensor from body.

#### CAUTION:

#### Do not drop or bump G sensor.



# **B: INSTALLATION**

1) Install in the reverse order of removal.

CAUTION:

Do not drop or bump G sensor.

# **C: INSPECTION**

	Step	Check	Yes	No
1	CHECK SUBARU SELECT MONITOR.	Do you have SUBARU SELECT MONITOR?	Go to step 5.	Go to step 2.
2	CHECK G SENSOR. 1)Turn ignition switch to OFF. 2)Remove G sensor from vehicle. 3)Connect connector to G sensor. 4)Turn ignition switch to ON. 5)Measure voltage between G sensor connec- tor terminals. Connector & terminal: (R70) No. 2 (+) — No. 3 (-)	Is the voltage 2.3±0.2 V when G sensor is horizontal?	Go to step 3.	Replace G sensor.
3	CHECK G SENSOR. Measure voltage between G sensor connector terminals. <i>Connector &amp; terminal:</i> <i>(R70) No. 2 (+) — No. 3 (–)</i>	Is the voltage 3.9±0.2 V when G sensor is inclined forwards to 90°?	Go to step 4.	Replace G sensor.
4	CHECK G SENSOR. Measure voltage between G sensor connector terminals. Connector & terminal: (R70) No. 2 (+) — No. 3 (–)	Is the voltage 0.7±0.2 V when G sensor is inclined backwards to 90°?	G sensor is nor- mal.	Replace G sensor.
5	CHECK G SENSOR. 1)Turn ignition switch to OFF. 2)Connect select monitor connector to data link connector. 3)Turn 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 2.3±0.2 V when the vehicle is in horizontal position?	Go to step <b>6</b> .	Replace G sensor.
6	CHECK G SENSOR. 1)Remove console box. 2)Remove G sensor from vehicle. (Do not dis- connect connector.) 3)Read the select monitor display.	Is the indicated reading 3.9±0.2 V when G sensor is inclined forwards to 90°?	Go to step 7.	Replace G sensor.
7	CHECK G SENSOR. Read the select monitor display.	Is the indicated reading 0.7±0.2 V when G sensor is inclined backwards to 90°?	G sensor is nor- mal.	Replace G sensor.