

GROUP 35B

ANTI-SKID BRAKING SYSTEM (ABS) <2WD>

GENERAL

OUTLINE OF CHANGES

- With the change in the hydraulic unit, the following service procedure have also been changed.
 1. Troubleshooting
 2. ABS operation check
 3. Removal and installation of hydraulic unit

GENERAL INFORMATION

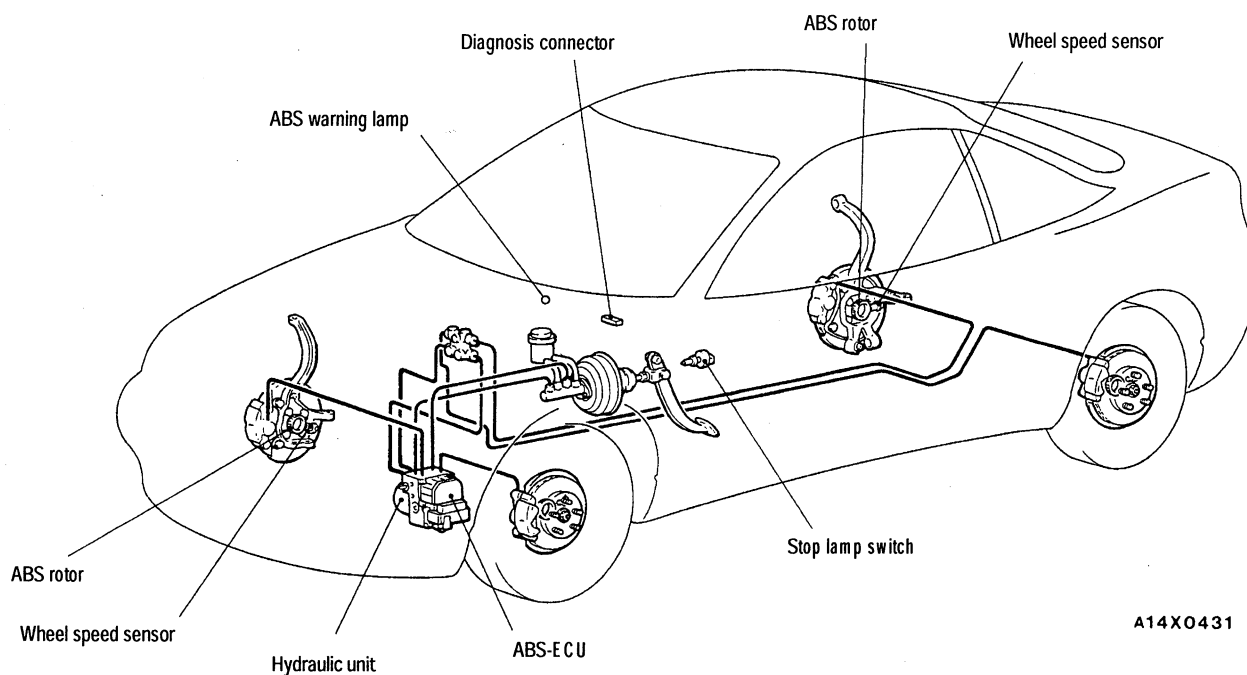
The ABS consists of wheel speed sensors, stop lamp switch, hydraulic unit and the ABS-ECU. If a problem occurs in the system, the malfunctioning system can be identified by means of the diagnostic function.

The diagnosis code will not be erased even if the ignition switch is turned to OFF.

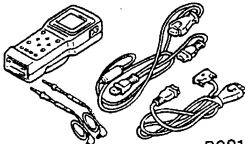
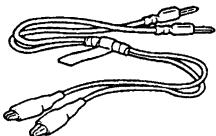
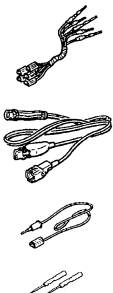
In addition, reading of diagnosis codes, service data and actuator testing are possible using the MUT-II.

Items	Specifications
Wheel speed sensor	Magnet coil type
Front toothed ABS rotor	43 teeth
Rear toothed ABS rotor	43 teeth

CONSTRUCTION DIAGRAM



SPECIAL TOOLS

Tool	Number	Name	Application
 B991502	MB991502	MUT-II sub assembly	• Reading diagnosis codes • Erasing diagnosis codes • ABS system inspection
 B991529	MB991529	Diagnosis code check harness	ABS inspection with ABS warning lamp
A  C991223	MB991223 A: MB991219	Harness set	ABS-ECU terminal voltage measurement

TROUBLESHOOTING

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

Refer to Basic Manual.

DIAGNOSTIC FUNCTION

Refer to Basic Manual.

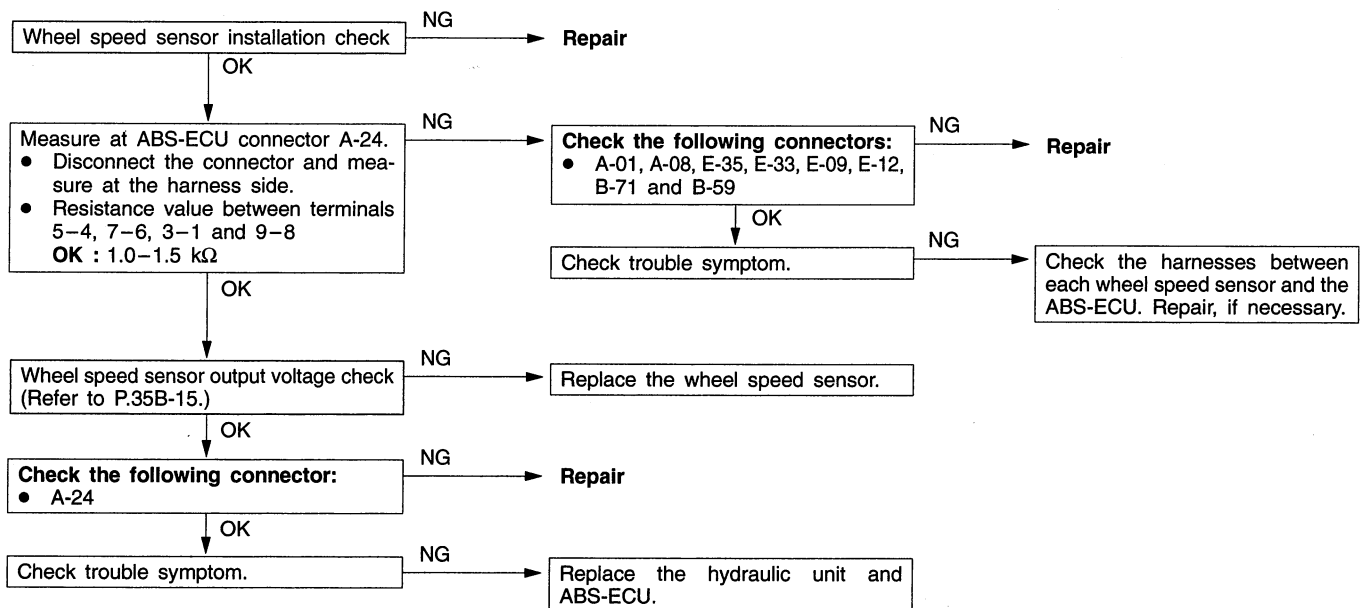
INSPECTION CHART FOR DIAGNOSIS CODES

Check according to the inspection chart that is appropriate for the diagnosis code.

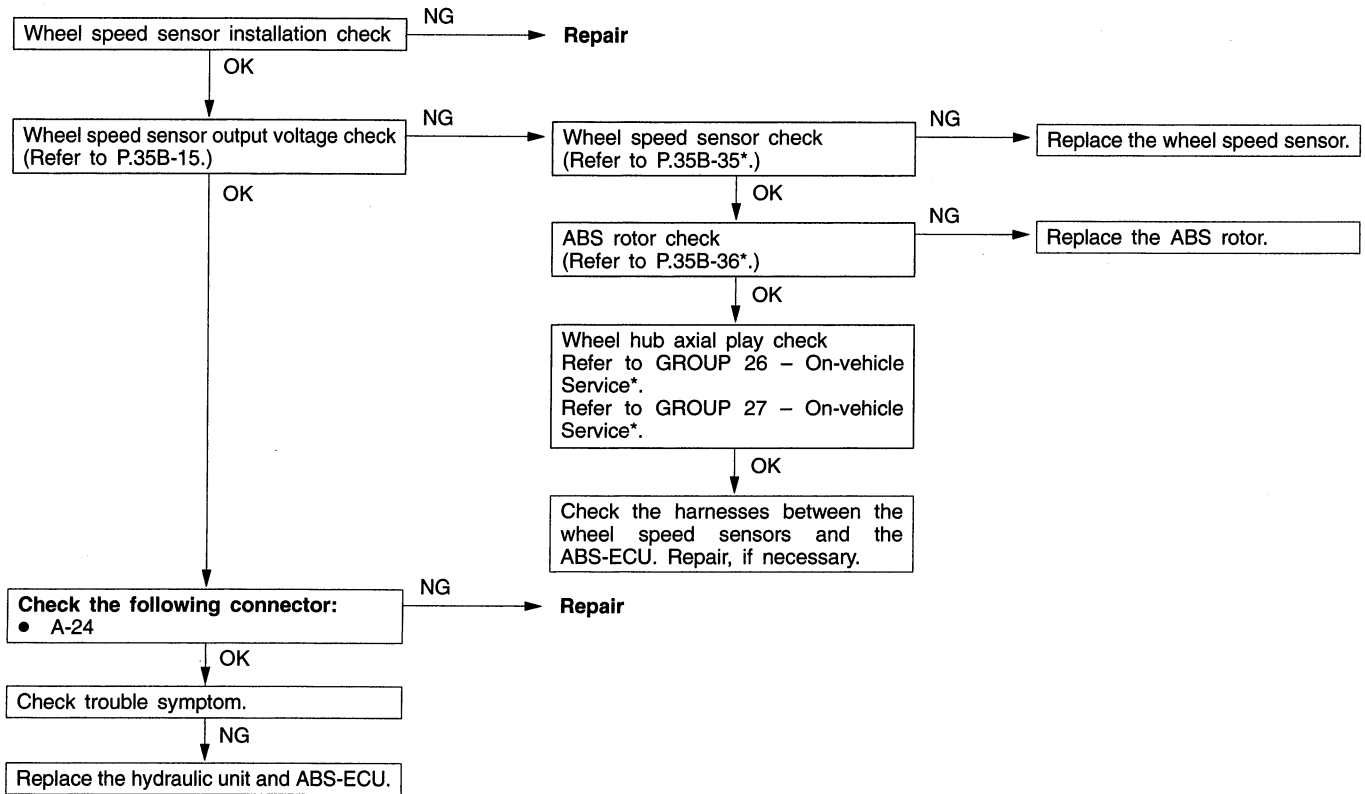
Diagnosis code No.	Inspection item	Diagnosis content	Reference page
11	Front right wheel speed sensor	Open circuit	35B-4
12	Front left wheel speed sensor		
13	Rear right wheel speed sensor		
14	Rear left wheel speed sensor		
15	Wheel speed sensor	Abnormal output signal	35B-5
16	Power supply system		35B-6
21	Front right wheel speed sensor	Short circuit	35B-6
22	Front left wheel speed sensor		
23	Rear right wheel speed sensor		
24	Rear left wheel speed sensor		
38	Stop lamp switch system		35B-7
41	Front right inlet solenoid valve		35B-19 (Replace the hydraulic unit assembly)
42	Front left inlet solenoid valve		
43	Rear right inlet solenoid valve		
44	Rear left inlet solenoid valve		
45	Front right outlet solenoid valve		35B-19 (Replace the hydraulic unit assembly)
46	Front left outlet solenoid valve		
47	Rear right outlet solenoid valve		
48	Rear left outlet solenoid valve		
51	Valve power supply		35B-8
53	Pump motor		35B-8
63	ABS-ECU		35B-19 (Replace the hydraulic unit assembly)

INSPECTION PROCEDURE CLASSIFIED BY DIAGNOSTIC TROUBLE

Code No. 11, 12, 13, 14 Wheel speed sensor open circuit	Probable cause
The ABS-ECU detects breaks in the wheel speed sensor wire.	• Malfunction of wheel speed sensor • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



Code No. 15 Wheel speed sensor system	Probable cause
This diagnosis code is output when there is a malfunction (other than broken wire or short circuit) in any of the wheel speed sensor output signals while driving. The following can be considered as the cause of the wheel speed sensor output malfunction. • Distortion of rotor, teeth missing • Low frequency noise interference when sensor harness wire is broken • Noise interference in sensor signal • Sensor output signal is below the standard value or amplitude modulation is over the standard value. Using an oscilloscope to measure the wave shape of the wheel speed sensor output signal is very effective. • Broken sensor harness • Poor connection of connector	• Malfunction of wheel speed sensor • Malfunction of wiring harness • Malfunction of ABS rotor • Malfunction of wheel bearing • Malfunction of ABS-ECU

**NOTE**

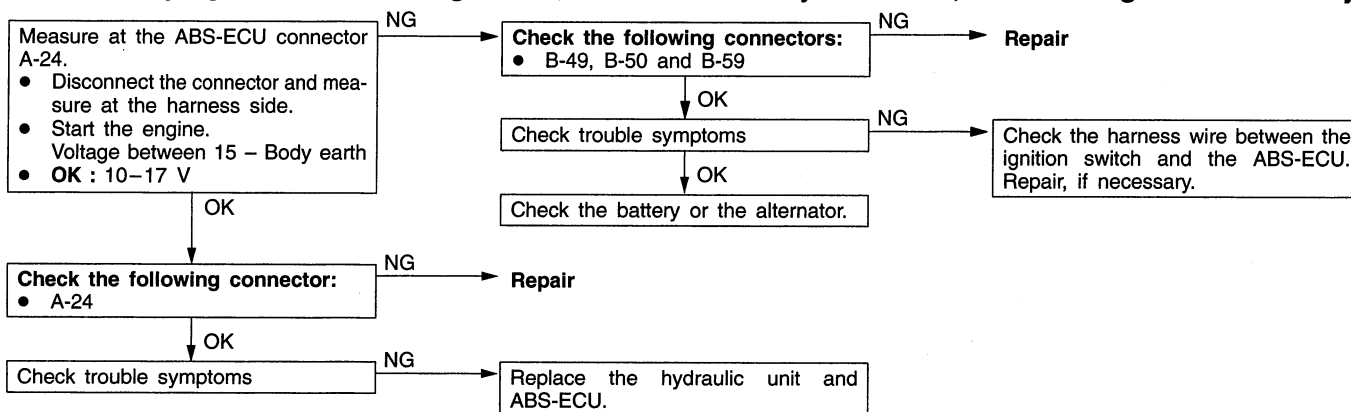
*: Refer to Basic Manual.

Code No. 16 Power supply system	Probable cause
This diagnosis code is output when the ABS-ECU power voltage is outside the standard value. Furthermore, if the voltage returns to normal, this diagnosis code will not be output.	• Malfunction of wiring harness or connector. • Malfunction of battery or generator • Malfunction of ABS-ECU

Caution

If the battery voltage drops during check, this code will be output as a current problem, and correct diagnostic of the problem cannot be made.

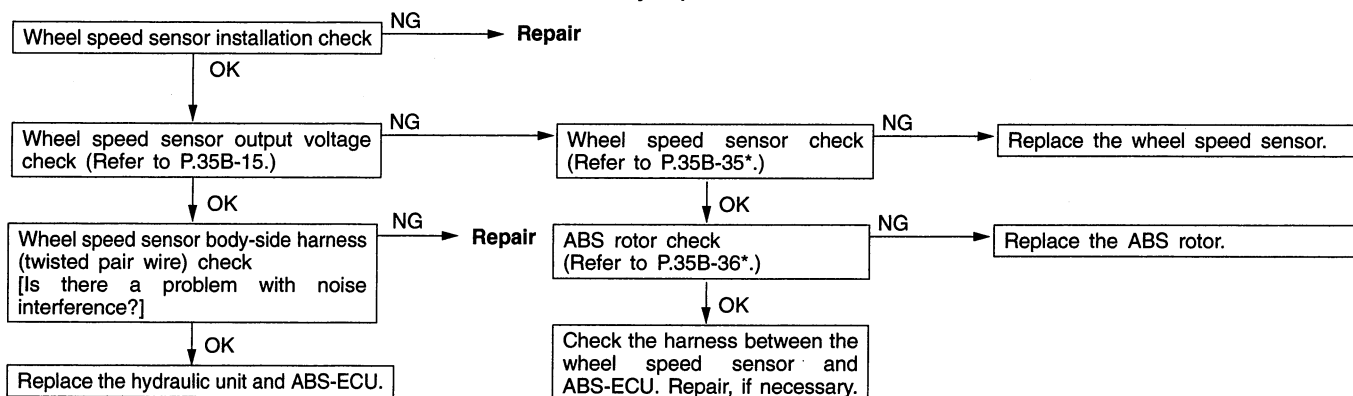
Before carrying out the following check, check the battery condition, and recharge it if necessary.



Code No. 21, 22, 23, 24 Wheel speed sensor excessive gap or short circuit	Probable cause
These diagnosis codes are output when the detection speed of the wheel speed sensors is below the standard value.	• Improper installation of wheel speed sensor • Malfunction of wheel speed sensor (intermittent open circuit or short circuit) • Malfunction of ABS rotor (chipped tooth or rotor not installed) • Noise interference in wheel speed sensor • Malfunction of ABS-ECU

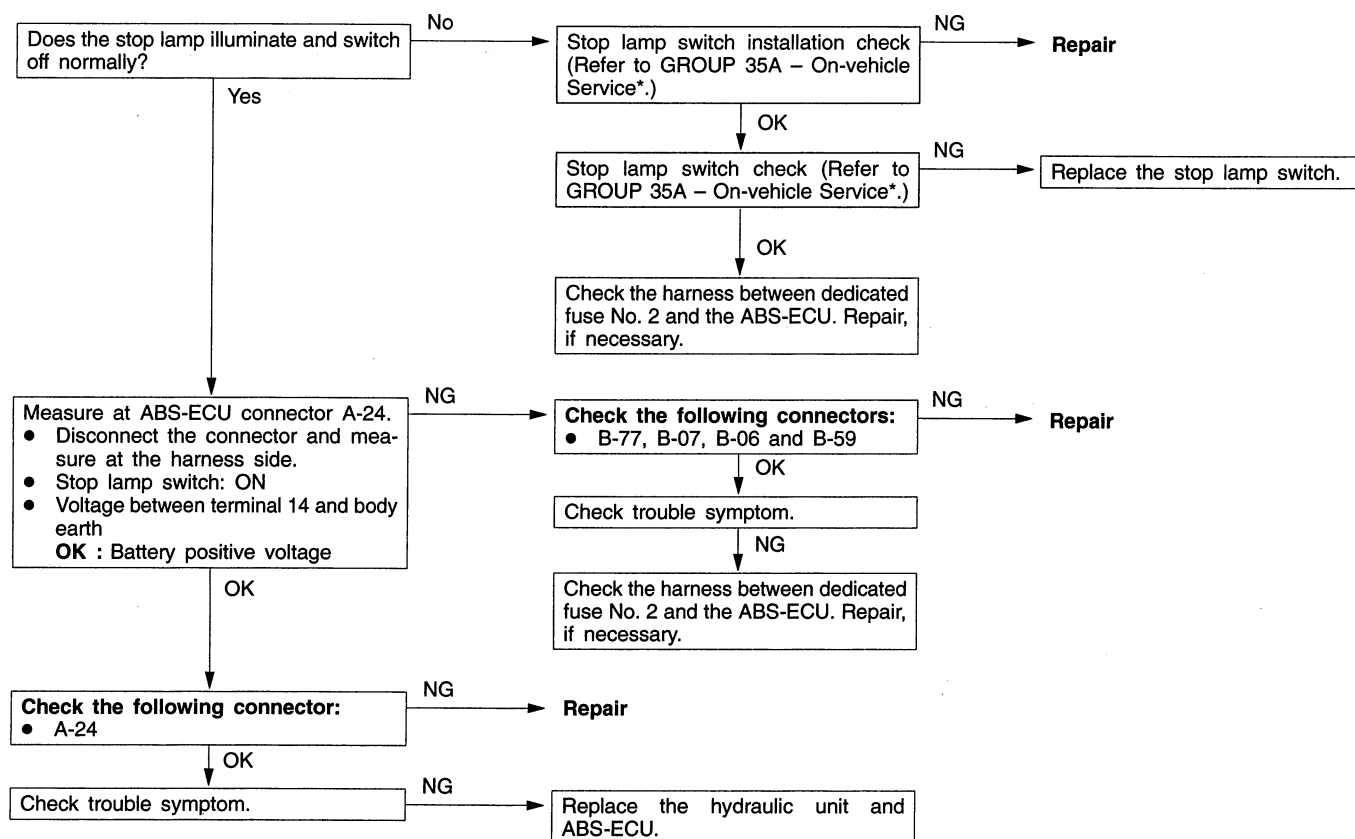
NOTE

1. Momentary interruptions within approximately 100 ms are not detected.
2. To inspect the twisted pair wires in the wheel speed sensor, check if there is any damage to the cables, and flex the cables to check for any open circuits.

**NOTE**

*: Refer to Basic Manual.

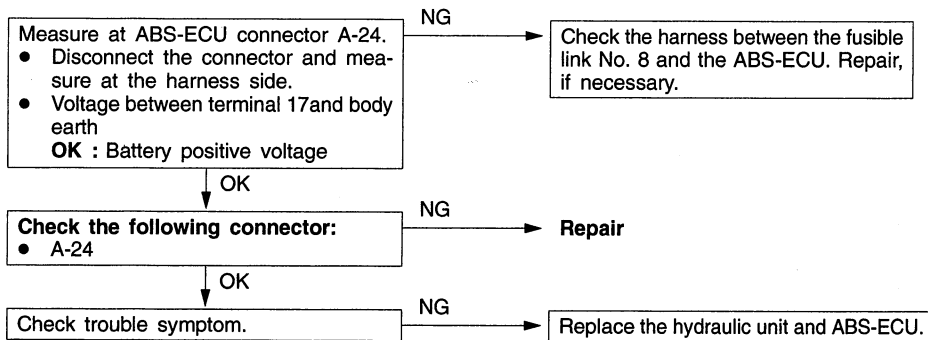
Code No. 38 Stop lamp switch system	Probable cause
The ABS-ECU outputs this diagnosis code in the following cases. - Stop lamp switch remains on for more than 15 minutes while the ABS is not functioning. - The harness wire for the stop lamp switch may be open-circuited. If the stop lamp operates normally, there is an open circuit in the harness for the stop lamp switch input circuit or there is a malfunction in the ABS-ECU.	- Malfunction of stop lamp switch - Malfunction of harness or connector - Malfunction of ABS-ECU



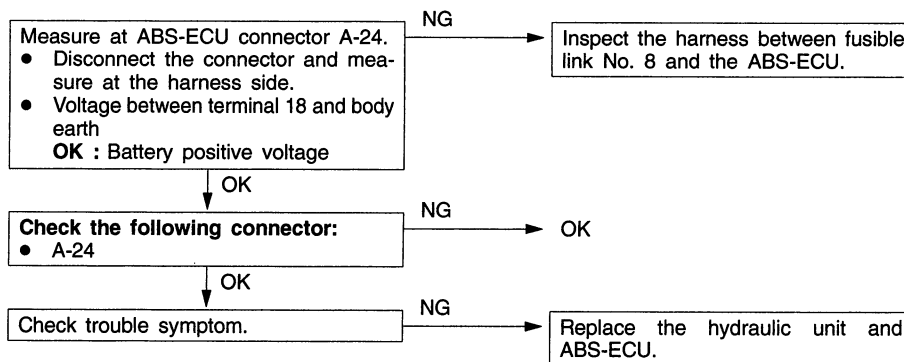
NOTE

*: Refer to Basic Manual.

Code No. 51 Valve power supply	Probable cause
This code is output when there is an abnormality in the solenoid valve power supply system.	• Malfunction of wiring harness or connector • Malfunction of ABS-ECU • Blown fuse



Code No. 53 Pump motor	Probable cause
This code is output when there is an abnormality in the pump motor system.	• Malfunction of wiring harness or connector • Malfunction of hydraulic unit • Malfunction of ABS-ECU



ABS WARNING LAMP CHECK

Refer to Basic Manual.

INSPECTION CHART FOR TROUBLE SYMPTOMS

Get an understanding of the trouble symptoms and check according to the inspection procedure chart.

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is not possible.	Communication with all systems is not possible.	1	35B-10
	Communication with ABS only is not possible.	2	35B-10
When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate.		3	35B-11
After the engine starts, the ABS warning lamp remains illuminated.		4	35B-11
Faulty ABS operation	Unequal braking power on both sides	5	35B-12
	Insufficient braking power		
	ABS operates under normal braking conditions		
	ABS operates before vehicle stops under normal braking conditions		
	Large brake pedal vibration (Caution 2.)	—	—

Caution

1. If steering movements are made when driving at high speed, or when driving on road surfaces with low frictional resistance, or when passing over bumps, the ABS may operate even though sudden braking is not being applied. Because of this, when getting information from the customer, check if the problem occurred while driving under such conditions as these.
2. During ABS operation, changes in the feeling of the brake pedal (vibration may occur). Such changes are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking, and is considered normal.

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

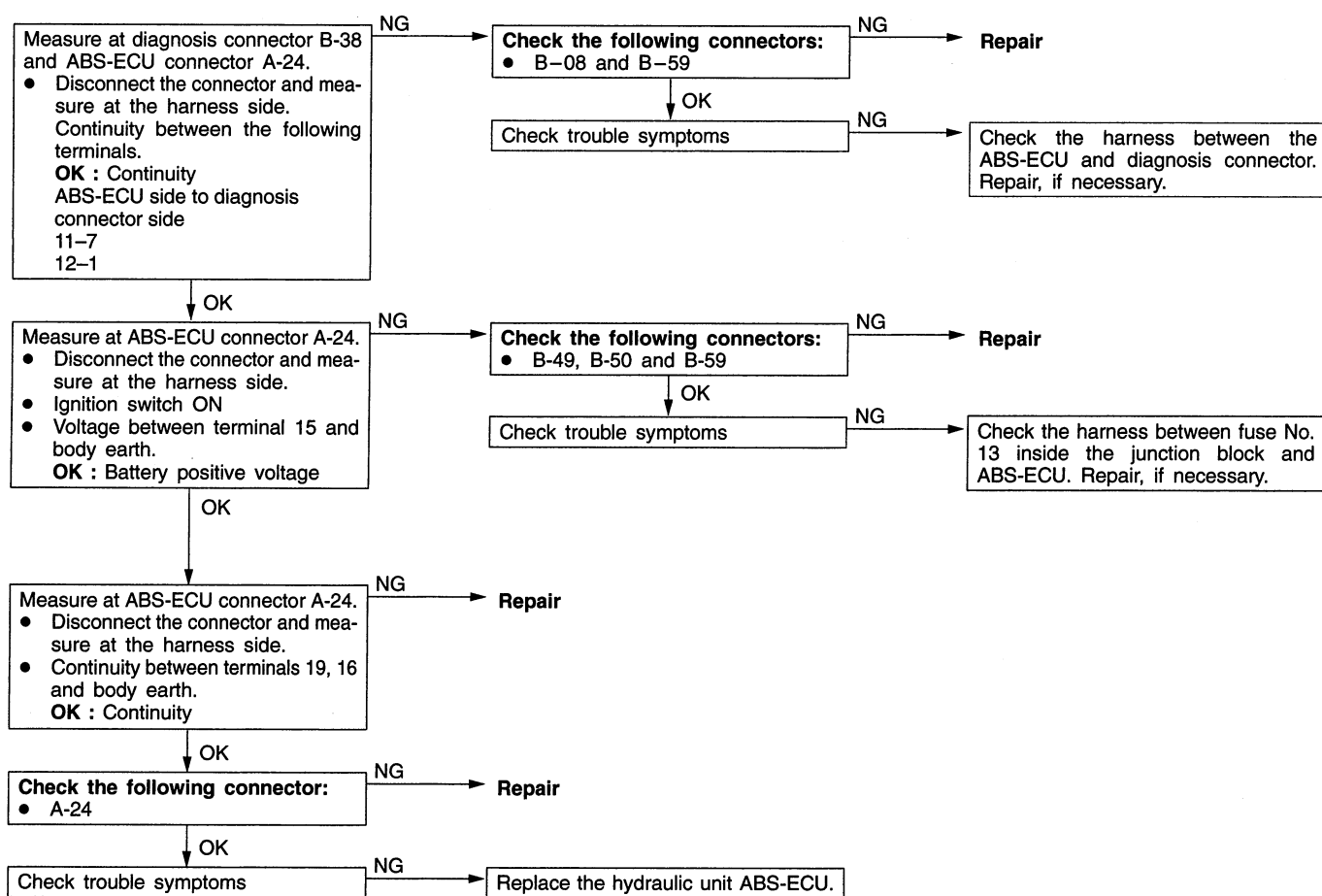
INSPECTION PROCEDURE 1

Communication with MUT-II is not possible. (Communication with all systems is not possible.)	Probable cause
The reason is probably a defect in the power supply system (including earth) for the diagnosis line.	• Malfunction of connector • Malfunction of harness

Refer to GROUP 13A – Troubleshooting. (Refer to Basic Manual.)

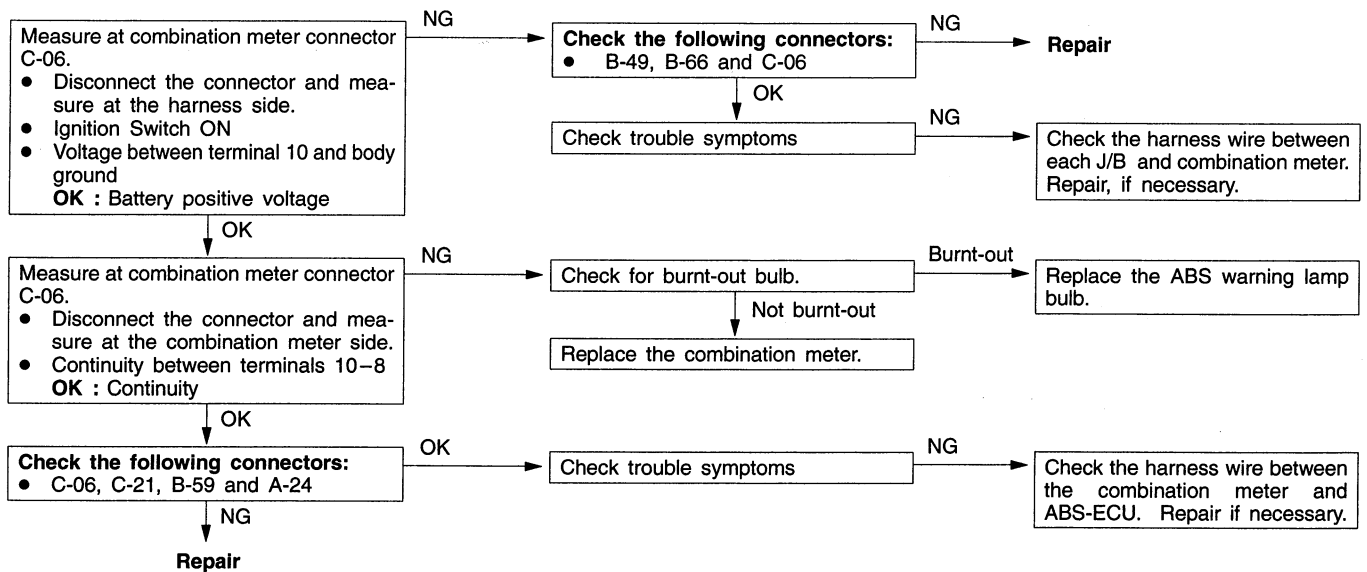
INSPECTION PROCEDURE 2

Communication with MUT-II is not possible. (Communication with ABS only is not possible.)	Probable cause
When communication with the MUT-II is not possible, the cause is probably an open circuit in the ABS-ECU power circuit or an open circuit in the diagnosis output circuit.	• Blown fuse • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



INSPECTION PROCEDURE 3

When ignition key is turned to "ON" (engine stopped), ABS warning light does not illuminate	Probable cause
The cause may be: an open circuit in the lamp power supply circuit, a blown lamp bulb, an open circuit in both the circuit between the ABS warning lamp and the ABS-ECU.	• Blown fuse • Burnt out ABS warning lamp bulb • Malfunction of wiring harness or connector

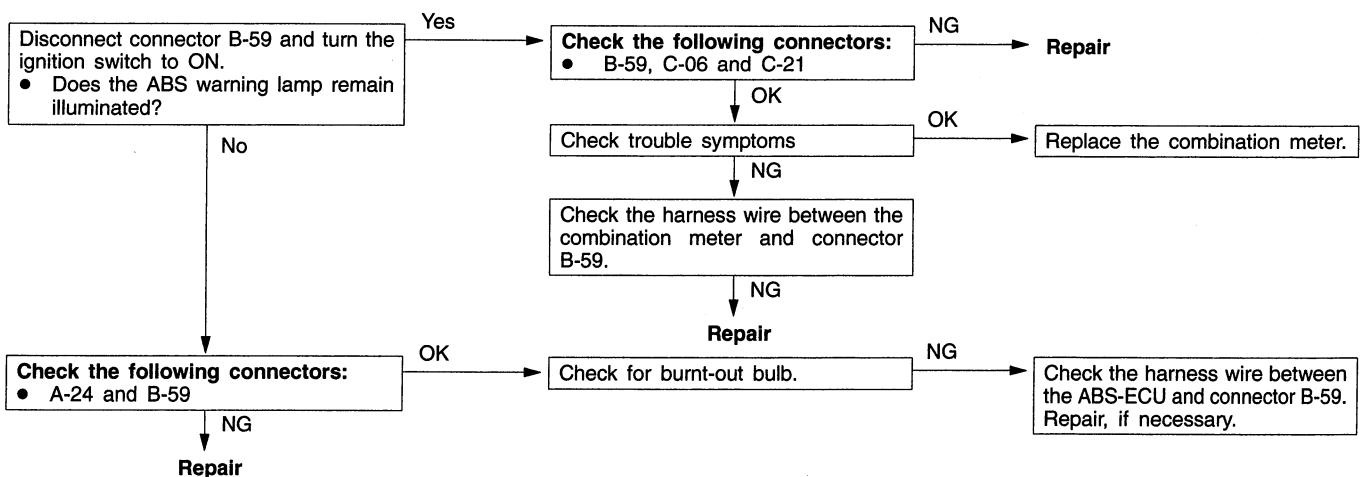


INSPECTION PROCEDURE 4

Even after the engine is started, the ABS warning lamp remains illuminated.	Probable cause
There is probably a short in the ABS warning lamp illumination circuit.	• Malfunction of combination meter • Malfunction of wiring harness

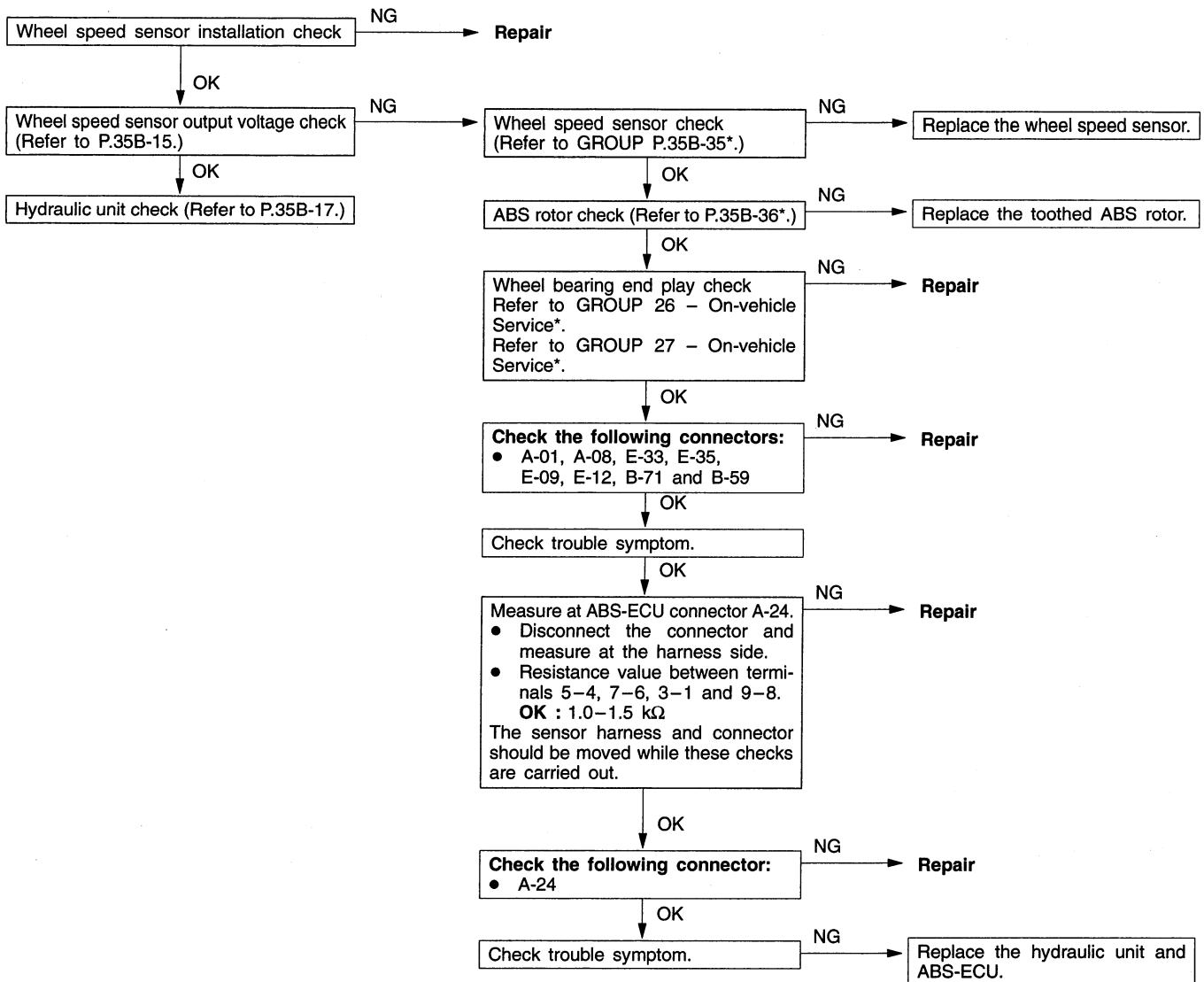
NOTE

This trouble symptom is limited to cases where communication with the MUT-II is possible (ABS-ECU power supply is normal) and the diagnosis code is a normal diagnosis code.



INSPECTION PROCEDURE 5

Break operation is irregular	Probable cause
This varies depending on the driving conditions and the road surface conditions, so problem diagnosis is difficult. However, if a normal diagnosis code is displayed, carry out the following inspection.	• Improper installation of wheel speed sensor • Incorrect sensor harness contact • Foreign material adhering to wheel speed sensor • Malfunction of wheel speed sensor • Malfunction of ABS rotor • Malfunction of wheel bearing • Malfunction of hydraulic unit • Malfunction of ABS-ECU



NOTE

*: Refer to Basic Manual.

DATA LIST REFERENCE TABLE

The following items can be read by the MUT-II from the ABS-ECU input data.

1. When the system is normal

Item No.	Check item	Checking requirements	Normal value
11	Front-right wheel speed sensor	Perform a test run	Vehicle speeds displayed on the speedometer and MUT-II are identical.
12	Front-left wheel speed sensor		
13	Rear-right wheel speed sensor		
14	Rear-left wheel speed sensor		
16	ABS-ECU power supply voltage	Ignition switch power supply voltage and valve monitor voltage	9 – 16 V
38	Stop lamp switch	Depress the brake pedal.	ON
		Release the brake pedal.	OFF

2. When the ABS-ECU shut off ABS operation.

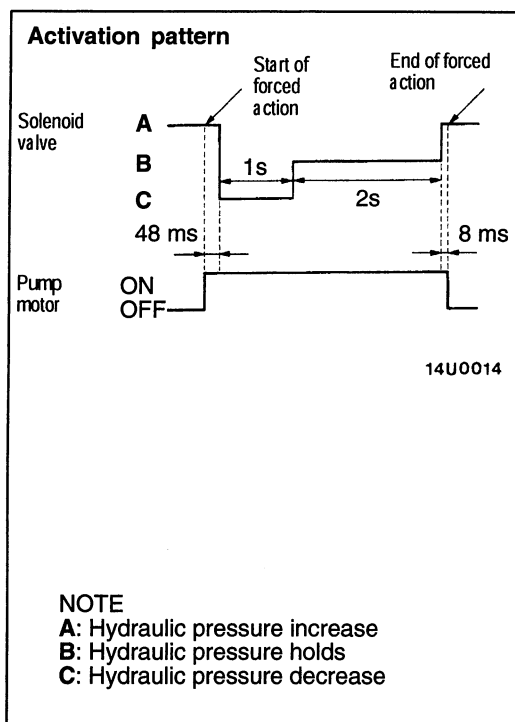
When the diagnosis system stops the ABS-ECU, the MUT-II display data will be unreliable.

ACTUATOR TEST REFERENCE TABLE

The MUT-II activates the following actuators for testing.

NOTE

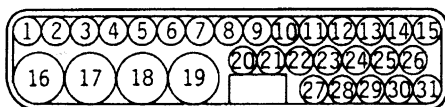
1. If the battery runs down, actuator testing cannot be carried out.
2. Actuator testing is only possible when the vehicle is stationary. If the vehicle speed during actuator testing exceeds 10 km/h, forced actuation will be canceled.
3. During the actuator test, the ABS warning lamp will illuminate and the anti-lock control will be disabled.

**ACTUATOR TEST SPECIFICATIONS**

No.	Item	
01	Solenoid valve for front-left wheel	Solenoid valves and pump motors in the hydraulic unit (simple inspection mode)
02	Solenoid valve for front-right wheel	
03	Solenoid valve for rear-left wheel	
04	Solenoid valve for rear-right wheel	

CHECK AT ABS-ECU**TERMINAL VOLTAGE CHECK CHART**

1. Measure the voltages between terminals (16) and (19) (earth terminals) and each respective terminal.
2. The terminal layouts are shown in the illustrations below.

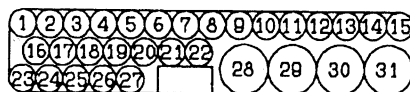


14U0122

Connector terminal No.	Signal	Checking requirements		Normal condition
11	MUT-II	Connect the MUT-II.		Serial communication with the MUT-II
		Do not connect the MUT-II.		1 V or less
12	Input from diagnosis indication selection	Connect the MUT-II.		0 V
		Do not connect the MUT-II.		Approx. 12 V
14	Input from stop lamp switch	Ignition switch: ON	Stop lamp switch: ON	System voltage
			Stop lamp switch: OFF	1 V or less
15	ABS-ECU power supply	Ignition switch: ON		System voltage
		Ignition switch: START		0 V
17	Pump motor power supply	Always		System voltage
18	Solenoid valve power supply	Always		System voltage
21	Output to ABS warning lamp	Ignition switch: ON	The lamp is switched off.	System voltage
			The lamp is illuminated.	0 – 2 V

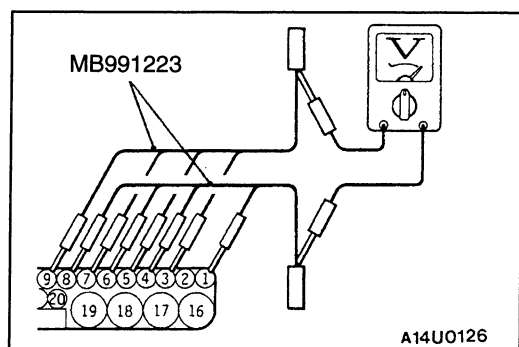
RESISTANCE AND CONTINUITY BETWEEN HARNESS-SIDE CONNECTOR TERMINALS

1. Turn the ignition switch off and disconnect the ABS-ECU connectors before checking resistance and continuity.
2. Check them between the terminals indicated in the table below.
3. The terminal layouts are shown in the illustrations below.



V0108AA

Connector terminal No.	Signal	Normal condition
1 – 3	Rear-right wheel speed sensor	1.0–1.5 kΩ
4 – 5	Front-right wheel speed sensor	1.0–1.5 kΩ
6 – 7	Front-left wheel speed sensor	1.0–1.5 kΩ
8 – 9	Rear-left wheel speed sensor	1.0–1.5 kΩ
16 – Body earth	ABS-ECU earth	Continuity
19 – Body earth		

**ON-VEHICLE SERVICE****ABS OPERATION CHECK****WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK**

1. Lift up the vehicle and release the parking brake.
2. Disconnect the ABS-ECU connector, and then use the special tool MB991219 to measure the output voltage at the harness-side connector.
3. Rotate the wheel to be measured at approximately 1/2 - 1 rotation per second, and check the output voltage using a voltmeter or an oscilloscope.

Wheels	Front left	Front right	Rear left	Rear right
Terminal No.	6	4	8	1
	7	5	9	3

Output voltage

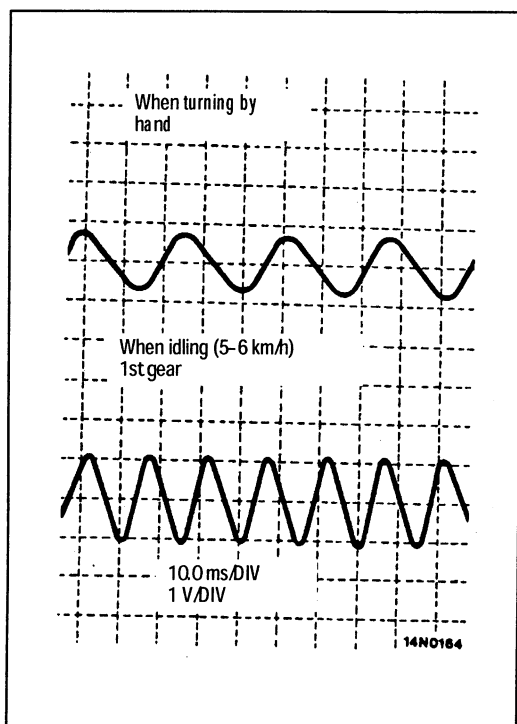
When measuring with a voltmeter:

70 mV or more

When measuring with an oscilloscope:

200 mV p-p or more

4. If the output voltage is lower than the above values, the reason could be as follows:
 - Faulty wheel speed sensor.
 So replace the wheel speed sensor.



Inspecting Wave Forms With An Oscilloscope

Use the following method to observe the output voltage wave form from each wheel sensor with an oscilloscope

- Start the engine, and rotate the front wheels by engaging 1st gear. Turn the rear wheels manually so that they rotate at a constant speed.

NOTE

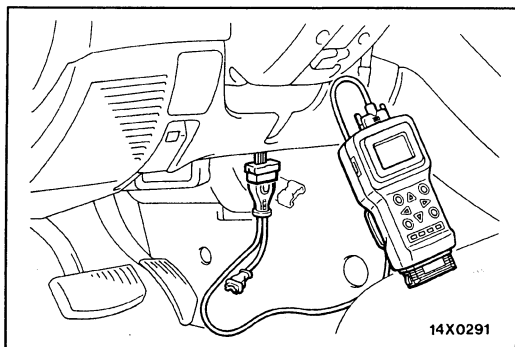
1. Check the connection of the sensor harness and connector before using the oscilloscope.
2. The wave form measurements can also be taken while the vehicle is actually moving.
3. The output voltage will be low when the wheel speed is low, and similarly it will be higher as the wheel speed increases.

Points In Waveform Measurement

Symptom	Probable causes	Remedy
Too small or zero waveform amplitude	Faulty wheel speed sensor	Replace sensor
Waveform amplitude fluctuates excessively (this is no problem if the minimum amplitude is 100 mV or more)	Axle hub eccentric or with large runout	Replace hub
Noisy or disturbed waveform	Open circuit in sensor	Replace sensor
	Open circuit in harness	Correct harness
	Incorrectly mounted wheel speed sensor	Mount correctly
	ABS rotor with missing or damaged teeth	Replace ABS rotor

NOTE

The wheel speed sensor cable moves following motion of the front or rear suspension. Therefore, it is likely that it has an open circuit only when driving on rough roads and it functions normally on ordinary roads. It is, therefore, recommended to observe sensor output voltage waveform also under special conditions, such as rough road driving.



HYDRAULIC UNIT CHECK

Caution

Always connect and disconnect the MUT-II with the ignition switch in the OFF position.

1. Jack up the vehicle and support the vehicle with rigid racks placed at the specified jack-up points or place the wheels which are checked on the rollers of the braking force tester.

Caution

1. The roller of the braking force tester and the tyre should be dry during testing.
2. When testing the front brakes, apply the parking brake. When testing the rear brakes, stop the front wheels by chocking them.

2. Release the parking brake, and feel the drag force (drag torque) on each road wheel.
When using the braking force tester, take a reading of the brake drag force.
3. Turn the ignition key to the OFF position and set the MUT-II as shown in the diagram.
4. After checking that the shift lever is in neutral, start the engine.

NOTE

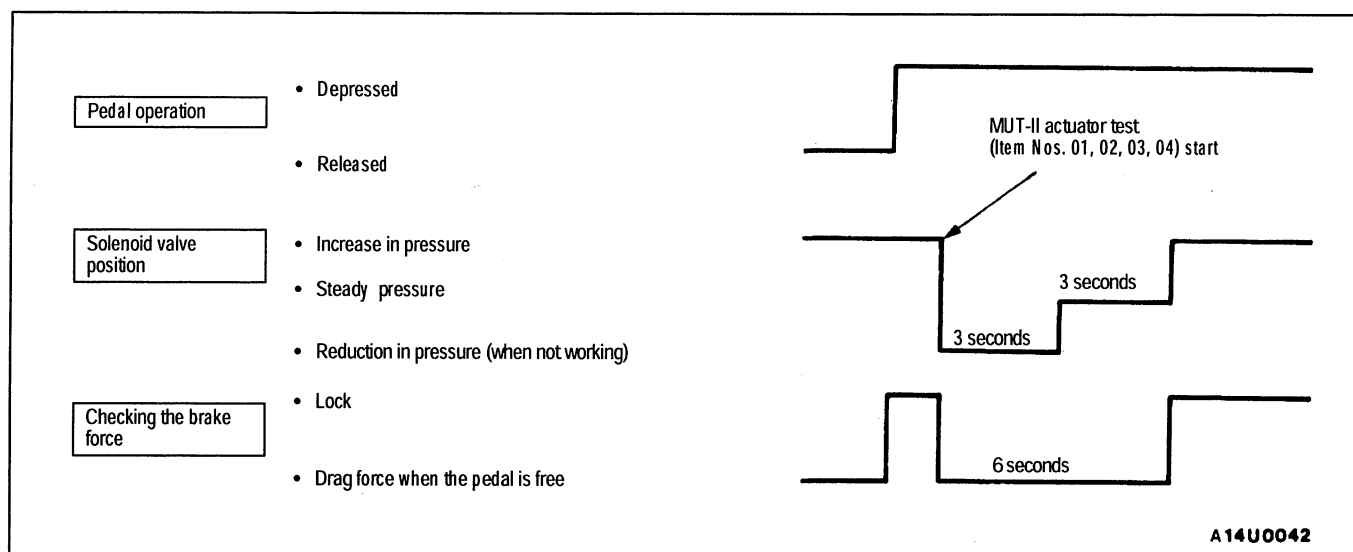
1. At this time, the ABS system will switch to the MUT-II mode and the ABS warning lamp will illuminate.
2. When the ABS has been interrupted by the fail-safe function, the MUT-II actuator testing cannot be used.
5. Use the MUT-II to force-drive the actuator.
6. Turn the wheel by hand and check the change in braking force when the brake pedal is depressed.
When using the braking force tester, depress the brake pedal until the braking force is at the following values, and check to be sure that the braking force changes to the brake drag force inspected in step 2 when the actuator is force-driven.

N

Front wheel	785–981
Rear wheel	588–785

The result should be as shown in the following diagram.

7. If the result of inspection is abnormal, correct according to the Diagnosis Table below.



Diagnosis Table

No.	Operation	Judgement – Normal	Judgement – Abnormal	Probable cause	Remedy
01	(1) Depress brake pedal to lock wheel.	Brake force released for 6 seconds after locking.	Wheel does not lock when brake pedal is depressed.	Clogged brake line other than hydraulic unit	Check and clean brake line
02	(2) Using the MUT-II, select the wheel to be checked and force the actuator to operate.			Clogged hydraulic circuit in hydraulic unit	Replace hydraulic unit assembly
03	(3) Turn the selected wheel manually to check the change of brake force.		Brake force is not released	Incorrect hydraulic unit brake tube connection	Connect correctly
04				hydraulic unit solenoid valve not functioning correctly	Replace hydraulic unit assembly

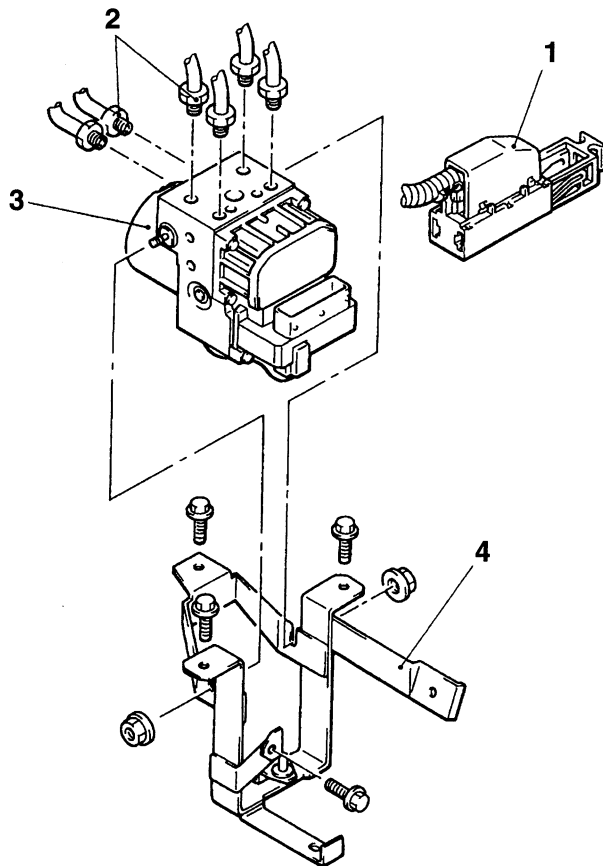
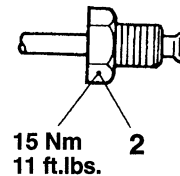
8. After inspection, disconnect the MUT-II immediately after turning the ignition switch to OFF.

HYDRAULIC UNIT**REMOVAL AND INSTALLATION****Pre-removal Operation**

- (1) Brake Fluid Draining
- (2) Splash Shield (L.H.) Removal
- (3) Headlamp Assembly (L.H.) Removal
- (4) Power Steering Oil Reservoir Mounting Bolts Removal
- (5) Power Steering Pressure Pipe and Return Pipe Clamp Mounting Bolts Removal

Post-installation Operation

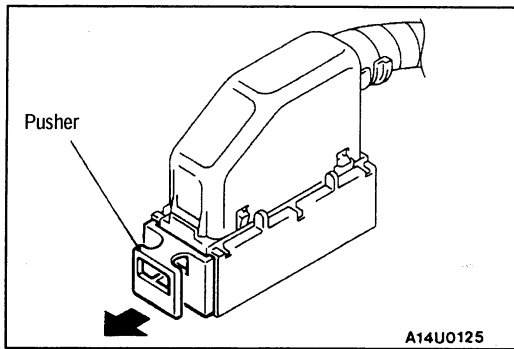
- (1) Power Steering Pressure Pipe and Return Pipe Clamp Mounting Bolts Installation
- (3) Power Steering Oil Reservoir Mounting Bolts Installation
- (3) Headlamp Assembly (L.H.) Installation
- (4) Splash Shield (L.H.) Installation
- (5) Brake Fluid Supplying
- (6) Brake Lines Bleeding
- (7) Hydraulic Unit Check (Refer to P.35B-17)

**Flared brake line nuts**

14X0343

14X0429
00006892**Removal steps**

- ◀A▶ ▶A◀
- ◀B▶
1. Harness connector
 2. Brake pipe connection
 3. Hydraulic unit and ABS-ECU
 4. Hydraulic unit bracket assembly



REMOVAL SERVICE POINTS

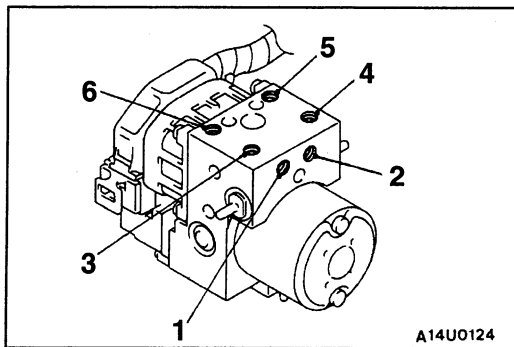
◀A▶ HARNESS CONNECTOR REMOVAL

Pull the pusher in the direction of the arrow to remove the connector.

◀B▶ HYDRAULIC UNIT AND ABS-ECU REMOVAL

Caution

1. The hydraulic unit and ABS-ECU is heavy, and so care should be taken when removing it.
2. The hydraulic unit and ABS-ECU is not to be disassembled; its nuts and bolts must not be loosened.
3. The hydraulic unit and ABS-ECU must not be dropped or otherwise subjected to impact shocks.
4. The hydraulic unit and ABS-ECU must not be turned upside down or laid on its side.



INSTALLATION SERVICE POINT

▶A▶ BRAKE PIPE CONNECTION

Connect the pipes to the hydraulic unit and ABS-ECU as shown in the illustration.

1. To the proportioning valve (R.H.)
2. To the proportioning valve (L.H.)
3. From the master cylinder (Primary)
4. From the master cylinder (Secondary)
5. To the front brake (R.H.)
6. To the front brake (L.H.)