
SERVICE BRAKES

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

CONTENTS

GENERAL INFORMATION	3	ON-VEHICLE SERVICE	16
SERVICE SPECIFICATIONS	4	Brake Pedal Check and Adjustment Refer to GROUP 35A	
LUBRICANTS	4	Stop Lamp Switch Check Refer to GROUP 35A	
SPECIAL TOOLS	4	Brake Booster Operating Test Refer to GROUP 35A	
TROUBLESHOOTING	5		

CONTINUED ON NEXT PAGE

WARNINGS REGARDING SERVICING OF SUPPLEMENTAL RESTRAINT SYSTEM (SRS) EQUIPPED VEHICLES

WARNING!

- (1) Improper service or maintenance of any component of the SRS, or any SRS-related component, can lead to personal injury or death to service personnel (from inadvertent firing of the air bag) or to the driver and passenger (from rendering the SRS inoperative).
- (2) Service or maintenance of any SRS component or SRS-related component must be performed only at an authorized MITSUBISHI dealer.
- (3) MITSUBISHI dealer personnel must thoroughly review this manual, and especially its GROUP 52B – Supplemental Restraint System (SRS) before beginning any service or maintenance of any component of the SRS or any SRS-related component.

NOTE

The SRS includes the following components: SRS-ECU, SRS warning lamp, air bag module, clock spring and interconnecting wiring. Other SRS-related components (that may have to be removed/installed in connection with SRS service or maintenance) are indicated in the table of contents by an asterisk (*).

Proportioning Valve Function Test	
.....	Refer to GROUP 35A
Brake Fluid Level Sensor Check	
.....	Refer to GROUP 35A
Bleeding	Refer to GROUP 35A
Brake Disc Run-out Check	
.....	Refer to GROUP 35A
Brake Disc Run-out Correction	
.....	Refer to GROUP 35A
Brake Disc Thickness Check	
.....	Refer to GROUP 35A
Wheel Speed Sensor Output Voltage	
Check	16
Hydraulic Unit Check	18
Remedy for a Flat Battery	19

BRAKE PEDAL	.....	Refer to GROUP 35A
MASTER CYLINDER AND BRAKE BOOSTER	.....	Refer to GROUP 35A
FRONT DISC BRAKE	.....	Refer to GROUP 35A
REAR DRUM BRAKE	.....	20
PROPORTIONING VALVE	.....	Refer to GROUP 35A
HYDRAULIC UNIT*	.....	22
WHEEL SPEED SENSOR	.....	24

GENERAL INFORMATION

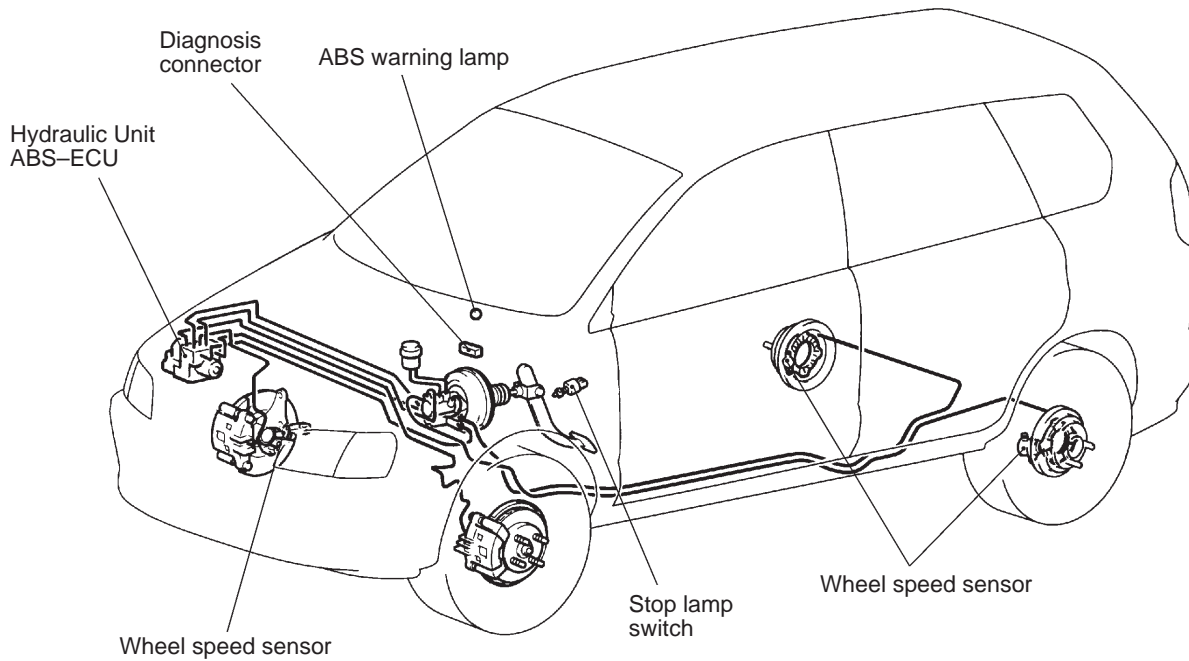
The ABS consists of components such as the wheel speed sensors, stop lamp switch, hydraulic unit assembly (integrated with the ABS-ECU) and the ABS warning lamp. If a problem occurs in the system, the malfunctioning component can be

identified and the trouble symptoms will be memorized by the diagnosis function. In addition, reading of diagnosis codes and service data and actuator testing are possible by using the MUT-II.

WHEEL SPEED SENSOR

Type	Magnet coil type
ABS rotor teeth	43

CONSTRUCTION DIAGRAM



AV0338AJ

SERVICE SPECIFICATIONS

Items	Standard value
Clearance between rear speed sensor pole piece and ABS rotor mm	0.1–1.9
Wheel speed sensor's internal resistance k Ω	1.28–1.92
Wheel speed sensor insulation resistance k Ω	100 or more

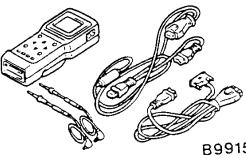
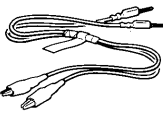
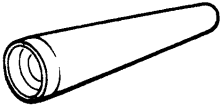
LUBRICANTS

Items	Specified lubricant
Brake fluid	DOT3 or DOT4
Piston cup	Repair kit grease
Rear brake shoe and backing plate contact surfaces	Brake grease SAE J310, NLGI No.1

SEALANT

Item	Specified sealant	Remark
Thread part fitting	3M ATD Part No. 8663 or equivalent	Semi-drying sealant

SPECIAL TOOLS

Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub assembly	For checking of ABS (Diagnosis code display when using the MUT-II)
	MB991529	Diagnosis code check harness	For checking of ABS (Diagnosis code display when using the ABS warning lamp)
 B991008	MB991008(F)	Wheel cylinder piston cup installer	Installation of drum brake wheel cylinder piston cup

TROUBLESHOOTING

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

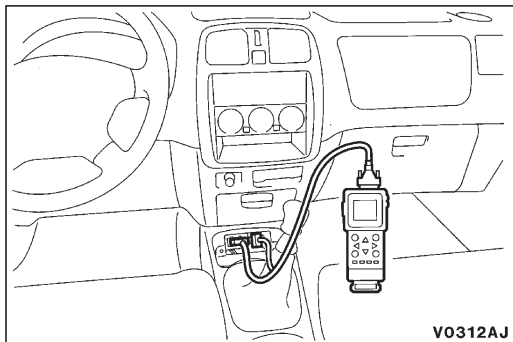
NOTES WITH REGARD TO DIAGNOSIS

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation of phenomenon
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment, but this is because the system operation check is being performed, and is not an abnormality.
ABS operation sound	<ol style="list-style-type: none"> 1. Sound of the motor inside the ABS hydraulic unit operation. (whine) 2. Sound is the generated along with vibration of the brake pedal. (scraping) 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release. (Thump: suspension; squeak: tyres)
ABS operation (Long braking distance)	For road surfaces such as snow-covered roads and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed and not being too overconfident.

Diagnosis detection condition can vary depending on the diagnosis code.

Make sure that checking requirements listed in the “Comment” are satisfied when checking the trouble symptom again.



DIAGNOSIS FUNCTION

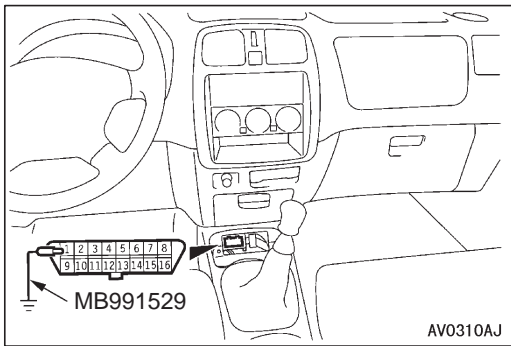
DIAGNOSIS CODES CHECK

With the MUT-II

Connect the MUT-II to the diagnosis connector (16-pin), then check diagnosis codes.

Caution

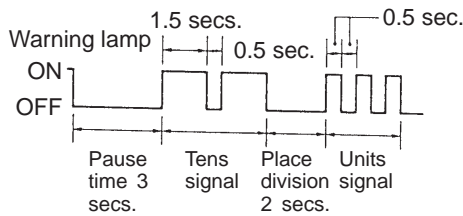
Turn the ignition switch off before connecting or disconnecting the MUT-II.



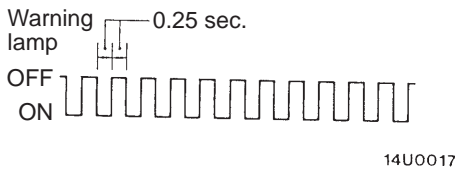
Without the MUT-II

1. Use the special tool to earth diagnosis connector terminal No. 1.
2. Turn the ignition switch to ON and then take a reading of the diagnosis codes from the flashing of the ABS warning lamp.

When diagnosis code No. 23 is output



When no diagnosis code is output



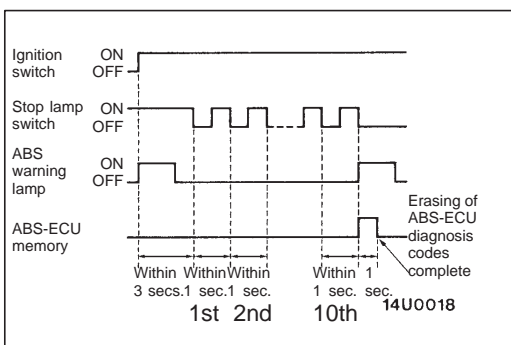
ERASING DIAGNOSIS CODES

With the MUT-II

Connect the MUT-II to the diagnosis connector (16-pin), then erase the diagnosis codes.

Without the MUT-II

The diagnosis codes can only be erased by operating the brake switch ten times according to the pattern shown in the illustration at left while the ABS is active and while driving at a speed of 10 km/h or less.



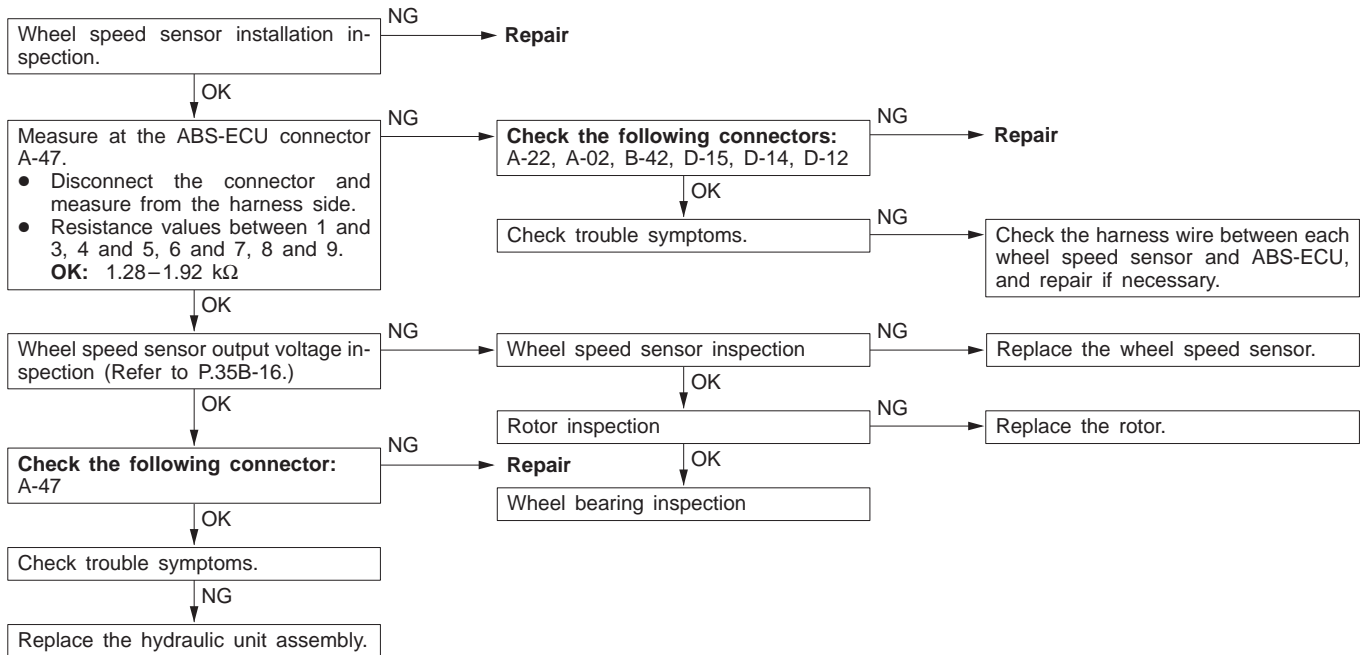
INSPECTION CHART FOR DIAGNOSIS CODES

Inspect according to the inspection chart that is appropriate for the malfunction code.

Diagnosis code No.	Inspection item	Diagnosis content	Reference page
11	Front right wheel speed sensor	Open circuit	35B-8
12	Front left wheel speed sensor		
13	Rear right wheel speed sensor		
14	Rear left wheel speed sensor		
16	Power supply system		35B-9
21	Front right wheel speed sensor	Short circuit	35B-8
22	Front left wheel speed sensor		
23	Rear right wheel speed sensor		
24	Rear left wheel speed sensor		
38	Stop lamp switch system		35B-9
41	Front right inlet solenoid valve		35B-22 (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		
46	Front left outlet solenoid valve		
47	Rear right outlet solenoid valve		
48	Rear left outlet solenoid valve		
51	Valve power supply		35B-10
53	Pump motor		35B-10
63	ABS-ECU		35B-22 (Replace the hydraulic unit assembly)

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

Code Nos.11, 12, 13 and 14 Wheel speed sensor open circuit	Probable cause
Code Nos.21, 22, 23 and 24 Wheel speed sensor short circuit	
Code Nos.11, 12, 13 and 14 are output if the ABS-ECU detects an open circuit in any one of the four wheel speed sensors.	<ul style="list-style-type: none"> ● Malfunction of wheel speed sensor ● Malfunction of wiring harness or connector ● Malfunction of ABS-ECU
Code Nos.21, 22, 23 and 24 are output in the following cases. <ul style="list-style-type: none"> ● When there is no input from any one of the four wheel speed sensors when traveling at 12 km/h or more, even though open circuit verified. ● When a chipped or blocked-up ABS rotor is detected during driving at 12 km/h or more. 	<ul style="list-style-type: none"> ● Malfunction of wheel speed sensor ● Malfunction of wiring harness or connector ● Malfunction of rotor ● Malfunction of ABS-ECU ● Malfunction of wheel bearing

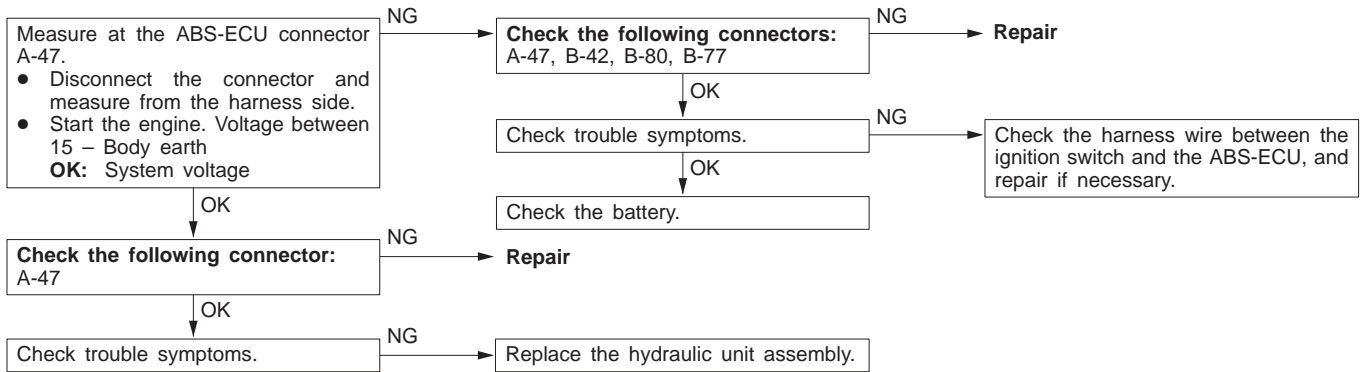


Code No. 16 Power supply system	Probable cause
The voltage of the ABS-ECU power supply drops lower or rises higher than the specified value. If the voltage returns to the specified value, this code is no longer output.	<ul style="list-style-type: none"> ● Malfunction of wiring harness or connector. ● Malfunction of ABS-ECU

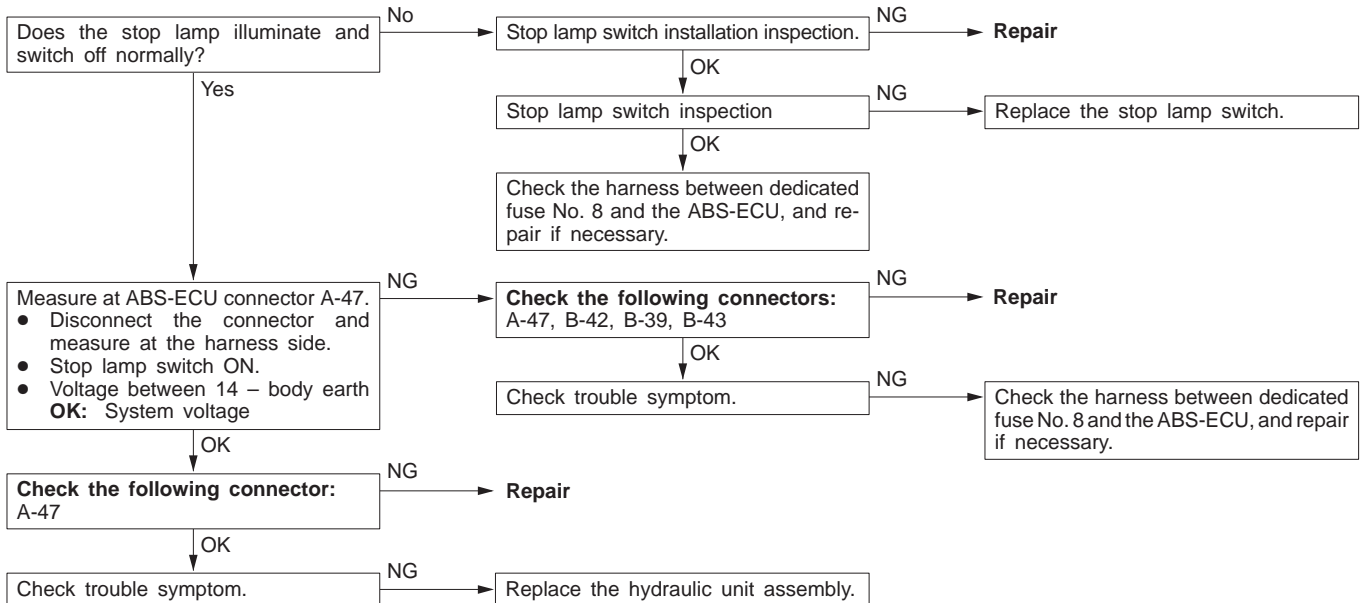
Caution

If battery voltage drops or rises during inspection, this code will be output as well. If the voltage returns to standard value, this code is no longer output.

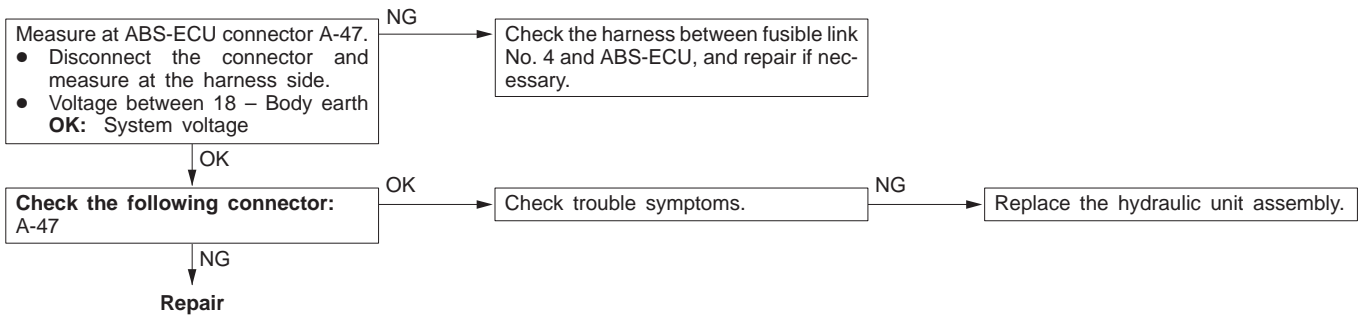
Before carrying out the following inspection, check the battery level, and refill it if necessary.



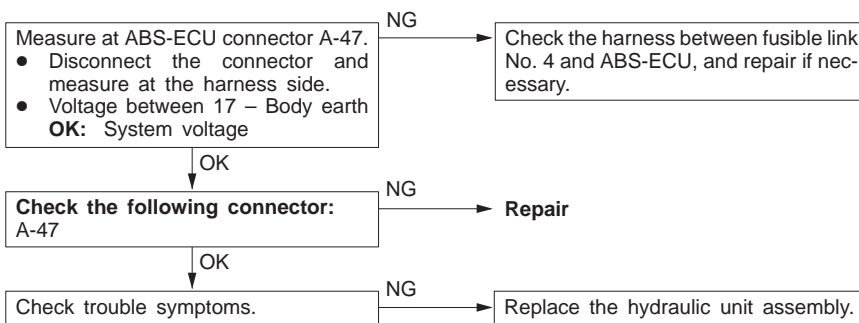
Code No. 38 Stop lamp switch system	Probable cause
These codes are output at the following times: <ul style="list-style-type: none"> ● When the stop lamp switch is not be turned off (when the stop lamp switch stays on for 15 minutes or more although the ABS is not operating). ● When the ABS-ECU determines that there is an open circuit in harness of the stop lamp switch system. 	<ul style="list-style-type: none"> ● Malfunction of stop lamp switch ● Malfunction of harness or connector ● Malfunction of ABS-ECU

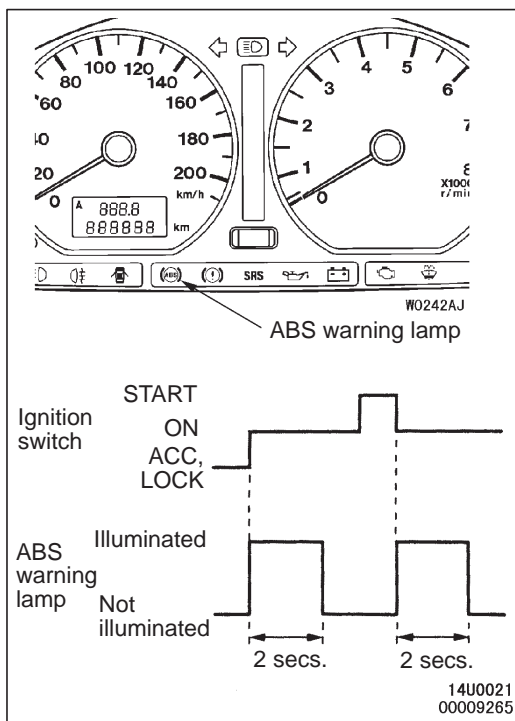


Code No. 51 Valve power supply	Probable cause
This code is output when there is an abnormality in the solenoid valve power supply system.	<ul style="list-style-type: none"> ● Malfunction of wiring harness or connector ● Malfunction of ABS-ECU



Code No. 53 Pump motor	Probable cause
This code is output when there is an abnormality in the pump motor system.	<ul style="list-style-type: none"> ● Malfunction of wiring harness or connector ● Malfunction of hydraulic unit ● Malfunction of ABS-ECU





ABS WARNING LAMP INSPECTION

Check that the ABS warning lamp illuminates as follows.

1. When the ignition switch is turned to “ON”, the ABS warning lamp illuminates for approximately 2 seconds and then switches off.
2. When the ignition switch is turned to “START”, the ABS warning lamp remains switched off.
3. When the ignition switch is turned from “START” back to “ON”, the ABS warning lamp illuminates for approximately 2 seconds and then stays switched off.
4. If the illumination is other than the above, check the diagnosis codes.

INSPECTION CHART FOR TROUBLE SYMPTOMS

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

Trouble symptoms		Inspection procedure No.	Reference page
Communication with MUT-II is not possible.	Communication with all systems is not possible.	1	35B-12
	Communication with ABS only is not possible.	2	35B-12
Faulty ABS operation	Unequal braking power on both sides	5	35B-13
	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, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

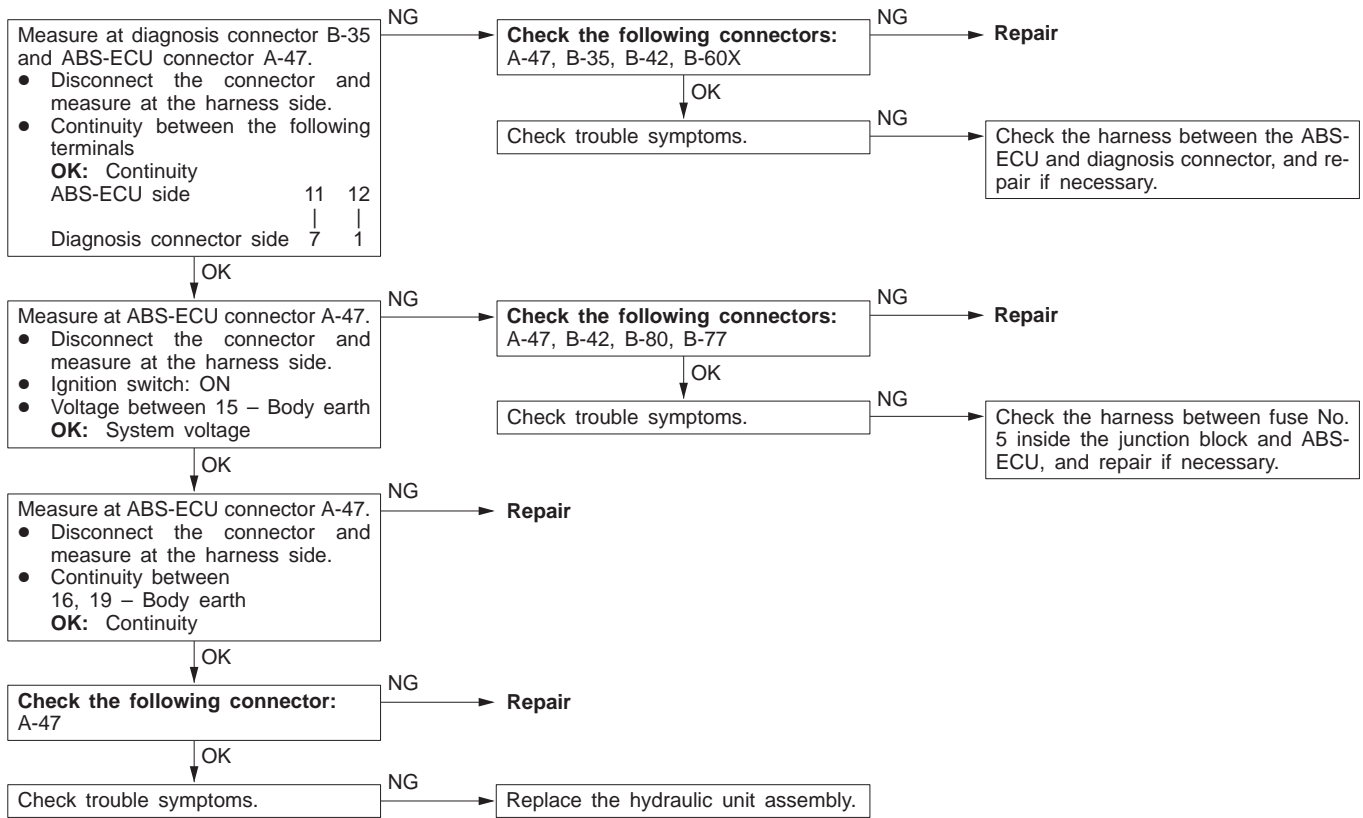
Inspection Procedure 1

Communication with MUT-II is not possible. (Communication with all systems is not possible.)	Probable cause
The reason is probably defect in the power supply system (including earth) for the diagnosis line.	<ul style="list-style-type: none"> ● Malfunction of wiring harness or connector

Refer to GROUP 13A – Troubleshooting.

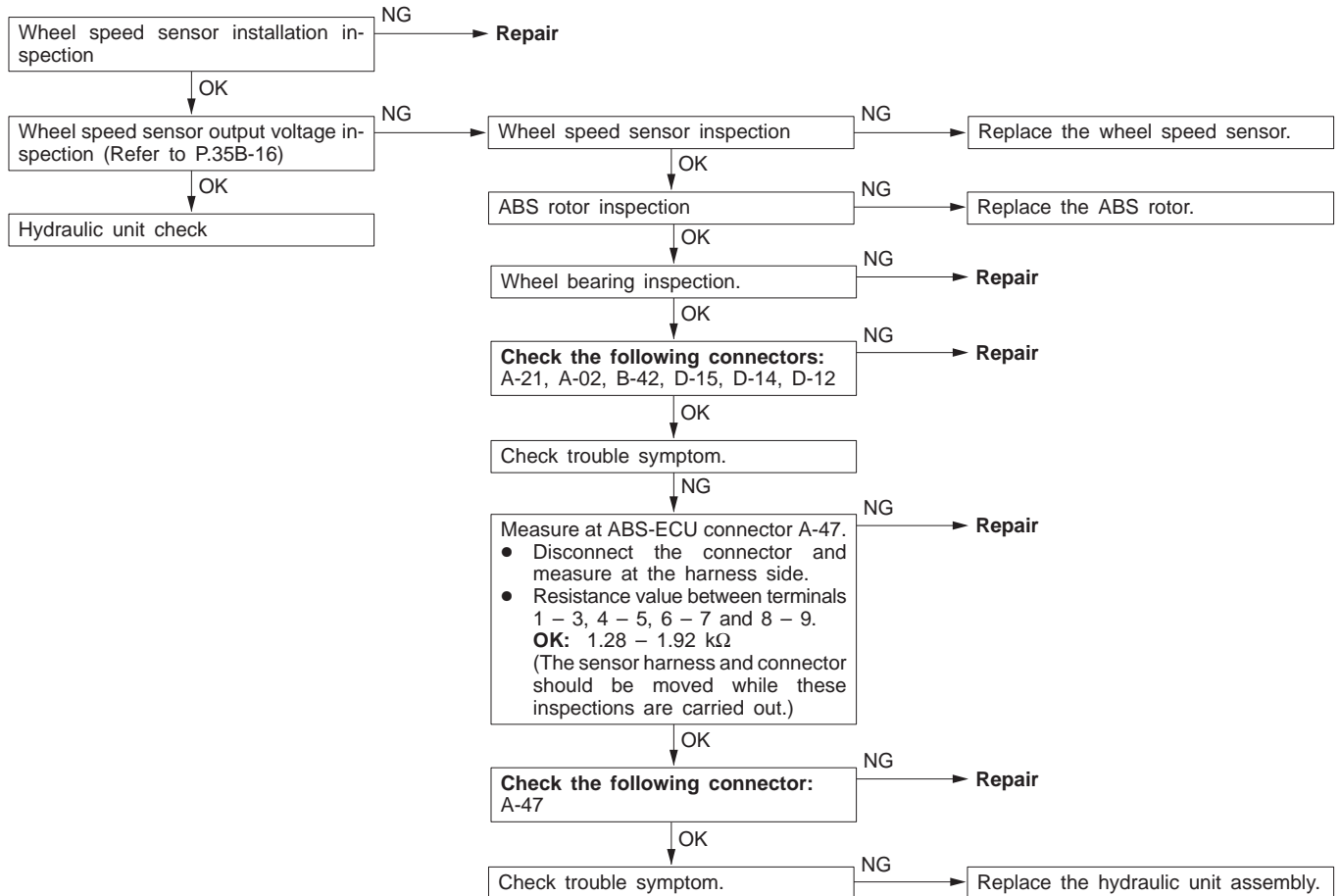
Inspection Procedure 2

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.	<ul style="list-style-type: none"> ● Blown fuse ● Malfunction of wiring harness or connector ● Malfunction of ABS-ECU



Inspection Procedure 5

Brake operation is abnormal.	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.	<ul style="list-style-type: none"> ● 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



SERVICE DATA 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.

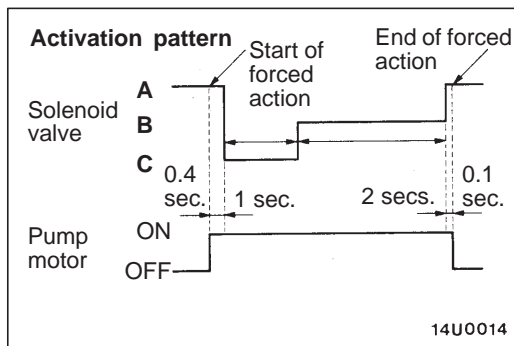
When the diagnosis system stops the ABS-ECU, the MUT-II display data will be unreliable.

ACTUATOR TEST REFERENCE TABLE

The MUT-II activates the following actuators for testing.

NOTE

1. If the ABS-ECU 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.



ACTUATOR TEST SPECIFICATIONS

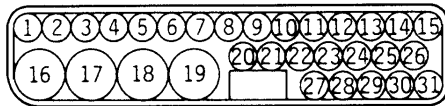
No.	Item	
01	Solenoid valve for front-left wheel	Solenoid valves and pump motors in the hydraulic unit (simple inspection mode)
02	Solenoid valve for front-right wheel	
03	Solenoid valve for rear-left wheel	
04	Solenoid valve for rear-right wheel	

NOTE

- A: Hydraulic pressure increase
- B: Hydraulic pressure holds
- C: Hydraulic pressure decrease

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.

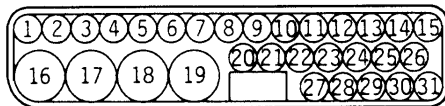


14U0122

Connector terminal No.	Signal	Checking requirements		Normal condition
11	MUT-II	Connect the MUT-II.		Serial communication with 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

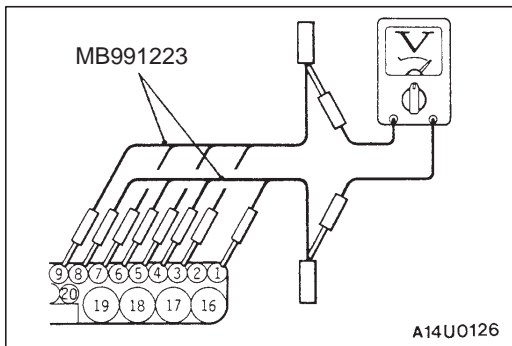
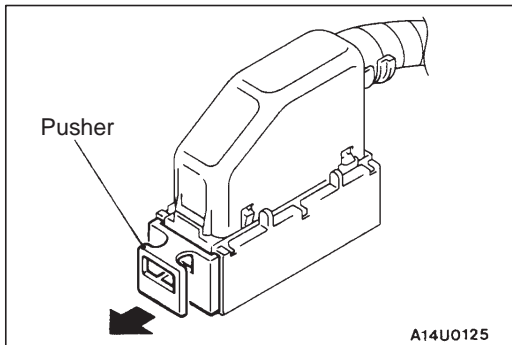
1. Turn the ignition switch off and disconnect the ABS-ECU connectors before checking resistance and continuity.
2. Check them between the terminals indicated in the table below.
3. The terminal layouts are shown in the illustrations below.



14U0122

Connector terminal No.	Signal	Normal condition
1 – 3	Rear-right wheel speed sensor (+ wire)	1.28 – 1.92 k Ω
4 – 5	Front-right wheel speed sensor (+ wire)	1.28–1.92 k Ω

Connector terminal No.	Signal	Normal condition
6 – 7	Front-left wheel speed sensor (+ wire)	1.28–1.92 kΩ
8 – 9	Rear-left wheel speed sensor (+ wire)	1.28–1.92 kΩ
16 – Body earth	ABS-ECU earth	Continuity
19 – Body earth		



ON-VEHICLE SERVICE

WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK

- Lift up the vehicle and release the parking brake.
- Pull the pusher in the direction indicated by the arrow and disconnect the connector.
- Use the special tool (inspection harness for connector pin contact pressure) to measure the output voltage at the harness-side connector.
- Rotate the wheel to be measured at approximately 1/2–1 rotation per second, and check the output voltage using a circuit tester or an oscilloscope.

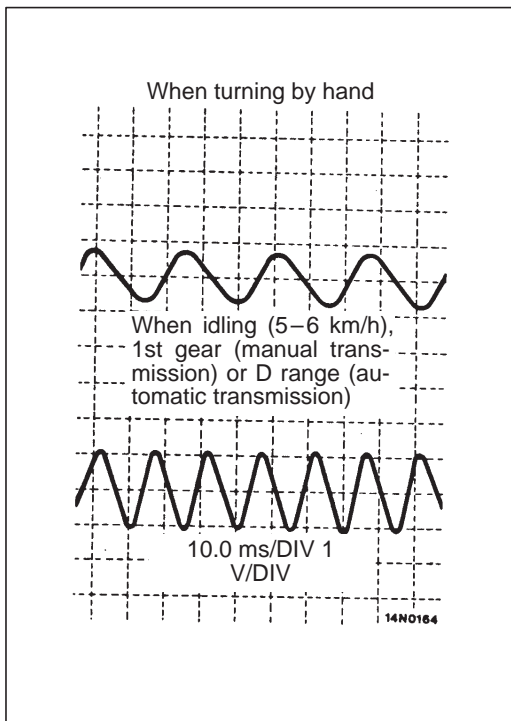
Wheel speed sensor	Front left	Front right	Rear left	Rear right
Terminal No.	6	4	8	1
	7	5	9	3

Output voltage

When measuring with a circuit tester:
50 mV or more

When measuring with an oscilloscope:
120 mV p-p or more

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



Inspecting Waveforms With An Oscilloscope

Use the following method to observe the output voltage waveform from each wheel sensor with an oscilloscope.

- Start the engine, and rotate the front wheels by engaging 1st gear (vehicles with manual transmission) or D range (vehicles with automatic transmission). 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 waveform measurements can also be taken while the vehicle is actually moving.
3. The output voltage will be small when the wheel speed is low, and similarly it will be large when the wheel speed is high.

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

Turn the ignition switch off before connecting or disconnecting the MUT-II.

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, and 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 switch to the OFF position and set the MUT-II.
4. After checking that the selector lever is in neutral, start the engine.

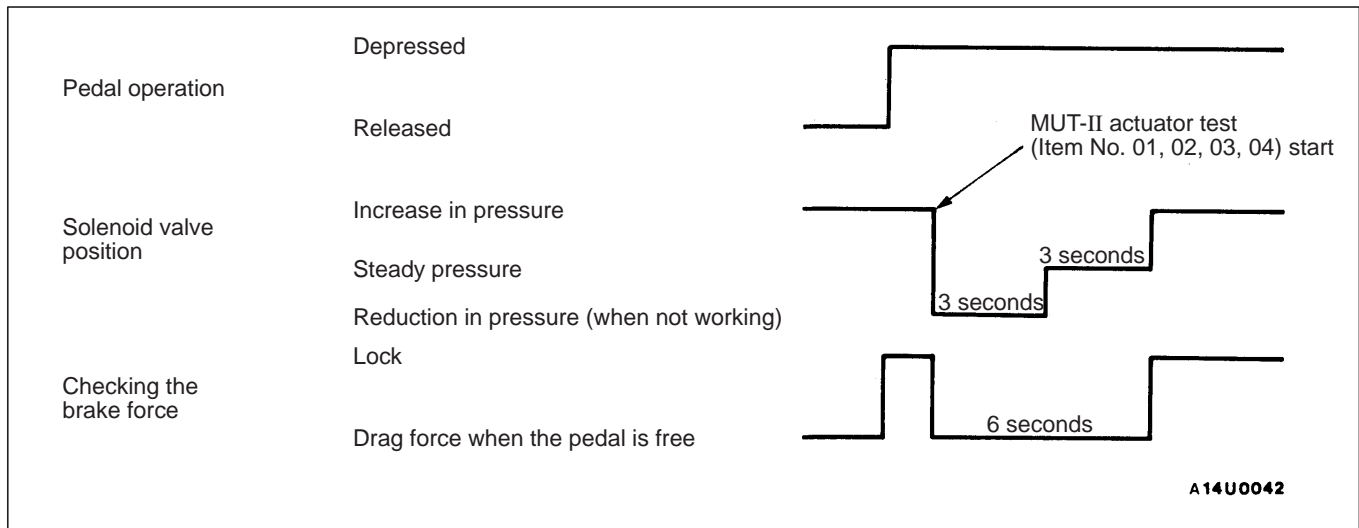
NOTE

- (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 that the braking force changes to the brake drag force inspected in step 2 when the actuator is force-driven.

Front wheel	785–981 N
Rear wheel	294–490 N

The result should be as shown in the following diagram.

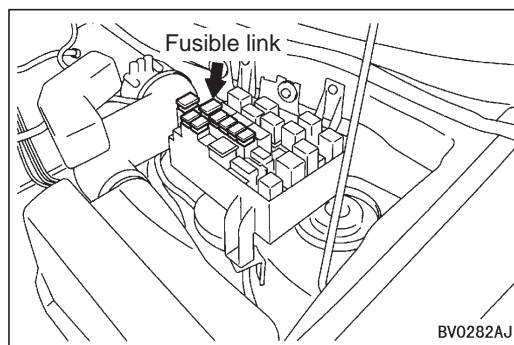
7. If the result of inspection is abnormal, correct according to the “Diagnosis Table”.



Diagnosis Table

No.	Operation	Judgement – Normal	Judgement – Abnormal	Probable cause	Remedy
01	(1) Depress brake pedal to lock wheel. (2) Using the MUT-II, select the wheel to be checked and force the actuator to operate. (3) Turn the selected wheel manually to check the change of brake force.	Brake force released for 1 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				Clogged hydraulic circuit in hydraulic unit	Replace hydraulic unit assembly
03			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.

**REMEDY FOR A FLAT BATTERY**

When booster cables are used to start the engine when the battery is completely flat and then the vehicle is immediately driven without waiting for the battery to recharge itself to some extent, the engine may misfire, and driving might not be possible.

This happens because ABS consumes a great amount of current for its self-check function; the remedy is to either allow the battery to recharge sufficiently, or to remove the fusible link for ABS circuit, thus disabling the anti-skid brake system. The ABS warning lamp will illuminate when the fusible link (for ABS) is removed.

After the battery has sufficiently recharged, install the fusible link (for ABS) and restart the engine; then check to be sure the ABS warning lamp is not illuminated.

REAR DRUM BRAKE

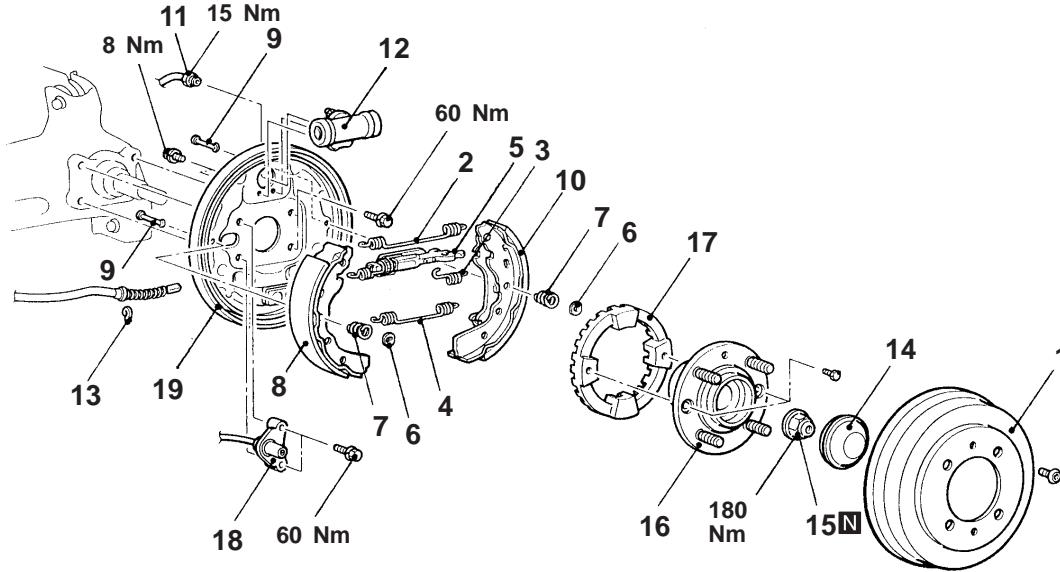
REMOVAL AND INSTALLATION

Pre-removal Operation

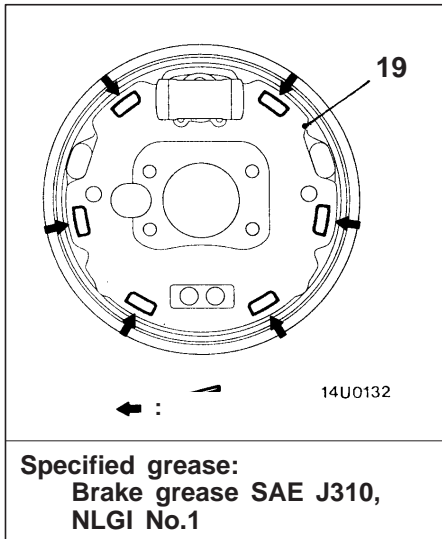
- Loosening the Parking Brake Cable Adjusting Nut. (Refer to GROUP 36 On-vehicle service)
- Brake Fluid Draining (Refer to GROUP 35A On-vehicle service)

Post-installation Operation

- Brake Line Bleeding (Refer to GROUP 35A On-vehicle service)
- Parking Brake Lever Stroke Adjustment (Refer to GROUP 36 On-vehicle service)



14U0131
00006948

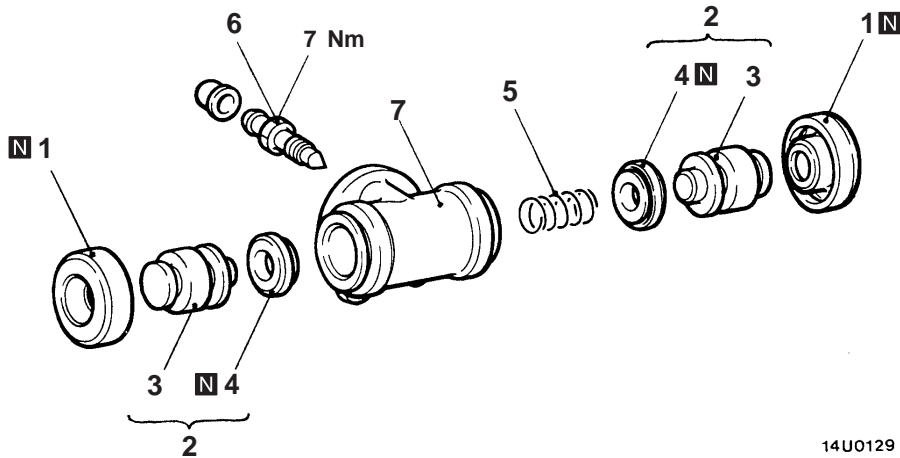


Specified grease:
Brake grease SAE J310,
NLGI No.1

Rear drum brake removal steps

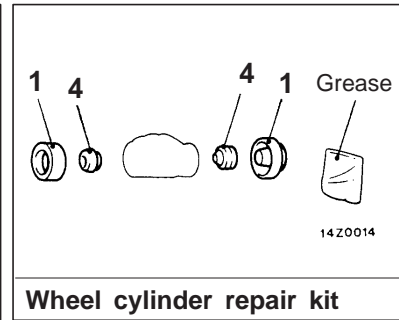
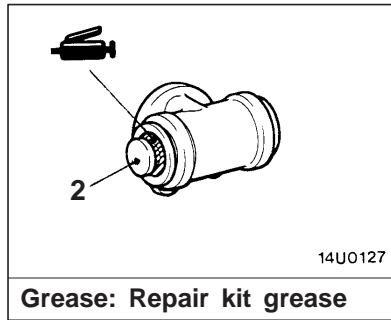
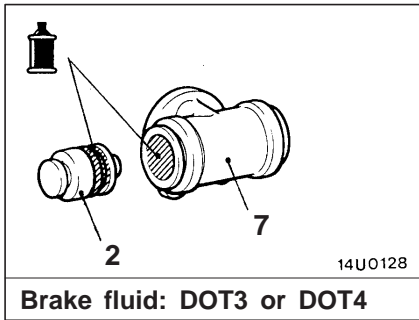
- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Brake drum 2. Return shoe spring 3. Strut retaining spring 4. Retaining shoe spring 5. Auto-adjuster assembly 6. Shoe hold-down cup 7. Shoe hold-down spring 8. Shoe and lining assembly 9. Shoe hold-down pin 10. Shoe, lining and lever assembly | <ol style="list-style-type: none"> 11. Brake pipe connection 12. Wheel cylinder assembly 13. Snap ring 14. Hub cap 15. Flange nut 16. Rear hub assembly (Refer to GROUP 27 – Rear Axle Hub.) 17. ABS rotor 18. Wheel speed sensor 19. Backing plate |
|--|--|

**WHEEL CYLINDER ASSEMBLY
DISASSEMBLY AND REASSEMBLY**



14U0129

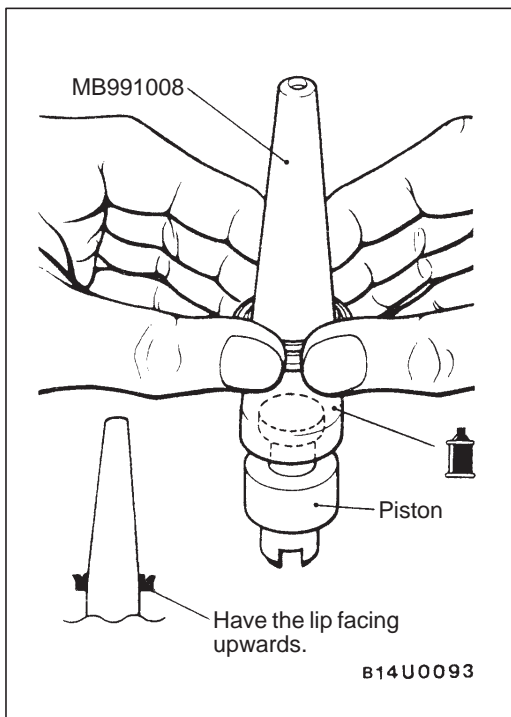
00006932



Disassembly steps

- 1. Boots
- 2. Piston assembly
- ▶◀ 3. Pistons
- ▶◀ 4. Piston cups

- 5. Spring
- 6. Bleeder
- 7. Wheel cylinder body



REASSEMBLY SERVICE POINT

▶◀ PISTON CUP/PISTON REASSEMBLY

1. Use alcohol or specified brake fluid to clean the wheel cylinder and the piston.
2. Apply the specified brake fluid to the piston cups and the special tool.

Specified brake fluid: DOT3 or DOT4

3. Set the piston cup on the special tool with the lip of the cup facing up, fit the cup onto the special tool, and then slide it down the outside of the tool into the piston groove.

Caution

In order to keep the piston cup from becoming twisted or slanted, slide the piston cup down the tool slowly and carefully, without stopping.

HYDRAULIC UNIT

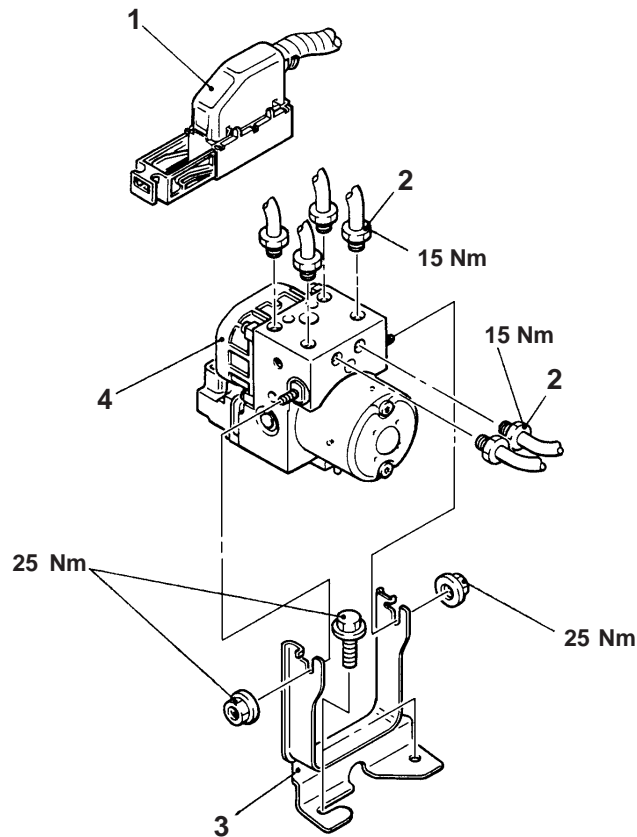
REMOVAL AND INSTALLATION

Pre-removal Operation

- Brake Fluid Draining
(Refer to GROUP 35A On-vehicle service)
- A/C Relay Box Removal

Post-installation Operation

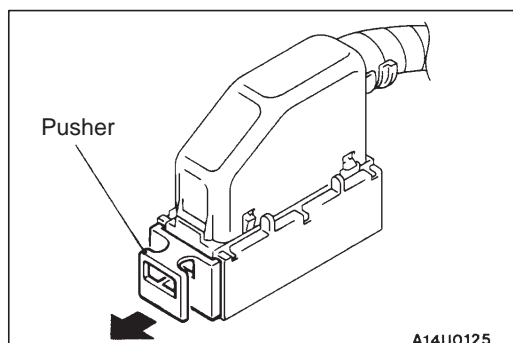
- A/C Relay Box Installation
- Brake Fluid Supplying
- Brake Line Bleeding
(Refer to GROUP 35A On-vehicle service)
- Brake Pedal Adjustment
(Refer to GROUP 36 On-vehicle service)



A14U0123

Removal steps

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



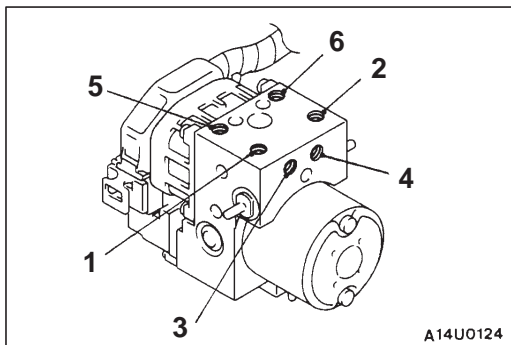
A14U0125

REMOVAL SERVICE POINTS**◀A▶ ABS-ECU CONNECTOR REMOVAL**

Pull the pusher in the direction indicated by the arrow, and then disconnect the connector.

◀B▶ HYDRAULIC UNIT ASSEMBLY REMOVAL**Caution**

1. The hydraulic unit assembly is heavy, and so care should be taken when removing it.
2. The hydraulic unit assembly is not to be disassembled; its nuts and bolts should absolutely not be loosened.
3. The hydraulic unit assembly must not be dropped or otherwise subjected to impact shocks.
4. The hydraulic unit assembly 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 assembly as shown in the illustration.

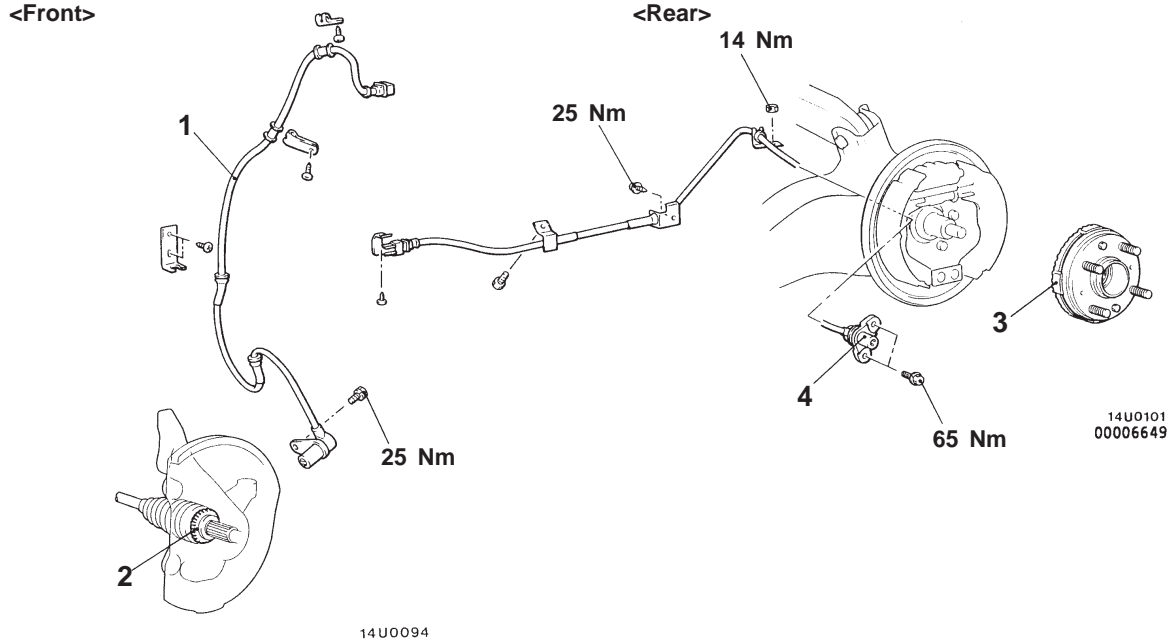
1. From the master cylinder (Primary)
2. From the master cylinder (Secondary)
3. To the proportioning valve (RH)
4. To the proportioning valve (LH)
5. To the front brake (LH)
6. To the front brake (RH)

WHEEL SPEED SENSOR

REMOVAL AND INSTALLATION

Post-installation Operation

- Wheel Speed Sensor Output Voltage Check (Refer to P.35B-16.)



Front speed sensor removal steps



1. Front speed sensor
2. Front ABS rotor
(Refer to GROUP 26 – Drive shaft.)

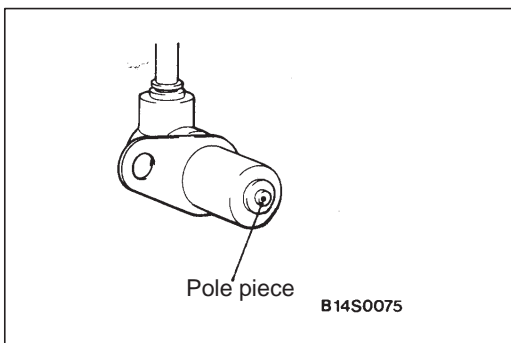
NOTE

The front ABS rotor is integrated with the drive shaft and is not disassembled.

Rear speed sensor removal steps



3. Rear ABS rotor
(Refer to GROUP 27 – Rear Axle Hub.)
4. Rear speed sensor

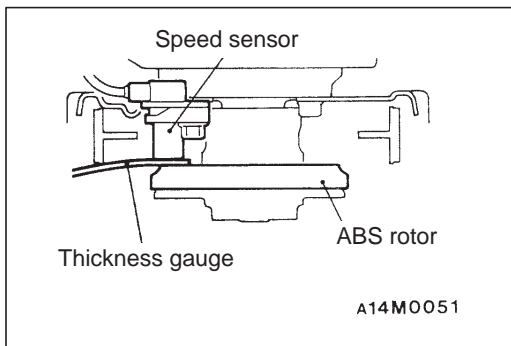


REMOVAL SERVICE POINT

◀A▶ FRONT SPEED SENSOR/REAR SPEED SENSOR REMOVAL

Caution

Be careful when handling the pole piece at the tip of the speed sensor and the toothed edge of the ABS rotor so as not to damage them by striking against other parts.



INSTALLATION SERVICE POINT

►A◄ REAR SPEED SENSOR INSTALLATION

Caution

Be careful that the pole piece at the end of the speed sensor and the ABS rotor teeth do not become damaged by striking them against the metal parts.

Insert a thickness gauge into the space between the speed sensor's pole piece and the ABS rotor's toothed surface, and check the clearance is the standard value all around.

Standard value: 0.1–0.9 mm

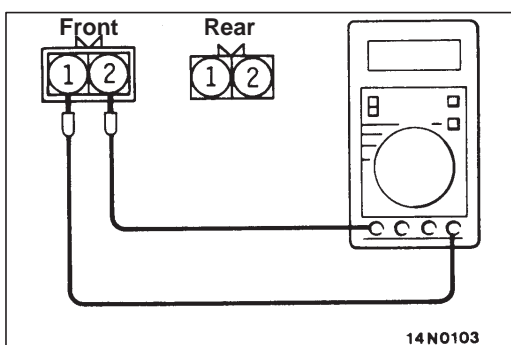
INSPECTION

SPEED SENSOR

1. Check whether any metallic foreign material has adhered to the pole piece at the speed sensor tip, and if so, remove it.
Also check whether the pole piece is damaged, and if so, replace it with a new one.

NOTE

The pole piece can become magnetized because of the magnet but into the speed sensor, with the result that metallic foreign material easily adheres to it. Moreover, the pole piece may not be able to function to correctly sense the wheel rotation speed if it is damaged.



2. Measure the resistance between the speed sensor terminals.

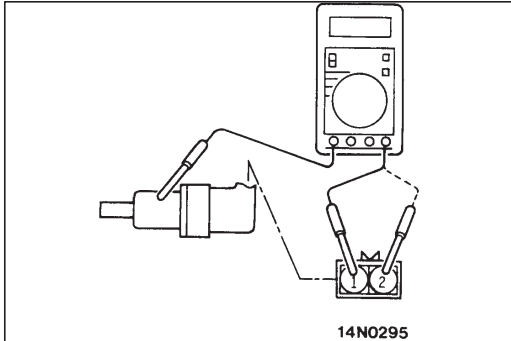
Standard value: 1.28–1.92 kΩ

If the internal resistance of the speed sensor is not within the standard value, replace with a new speed sensor.

3. Check the speed sensor cable for breakage, damage or disconnection; replace with a new one if a problem is found.

NOTE

When checking for cable damage, remove the cable clamp part from the body and then bend and pull the cable near the clamp to check whether or not temporary disconnection occurs.

**SPEED SENSOR INSULATION INSPECTION**

1. Remove all connections from the speed sensor, and then measure the resistance between terminals (1) and (2) and the body of the speed sensor.

Standard value: 100 k Ω or more

2. If the speed sensor insulation resistance is outside the standard value range, replace with a new speed sensor.


TOOTHED ABS ROTOR

Check whether ABS rotor teeth are broken or deformed, and, if so, replace the ABS rotor.

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

CONTENTS

GENERAL	2	ON-VEHICLE SERVICE	8
Outline of change	2	Wheel Speed Sensor Output Voltage Check	8
TROUBLESHOOTING	2		



GENERAL

OUTLINE OF CHANGE

Due to the adoption of the electronic brake-force distribution (EBD*) system to secure the maximum braking force regardless of laden conditions of a vehicle, the layout of the ABS-ECU terminals and ABS circuit have been changed so that the service procedures have been established.

NOTE

*EBD: Electronic Brake-force Distribution

EBD CONTROL

The vehicle with ABS can electronically control brake fluid pressure to rear brakes during applying braking force corresponding to deceleration and slip at the front/rear wheels calculated by wheel speed sensor signals using rear wheel solenoid valves. EBD

control allows braking force of the vehicle to be compatible with stability at a high level characterized by the following features:

- Since ideal braking force to rear wheels can be obtained regardless of laden conditions of the vehicle or road surface, applied force to the braking pedal on a high-friction coefficient road can be reduced especially when the vehicle is laden.
- Due to a reduction of the load on the front brakes, temperature increase in the pads during applying braking force can be suppressed. Thus, tolerance for wear is improved.
- Control valves, such as proportioning valves are unnecessary.

TROUBLESHOOTING

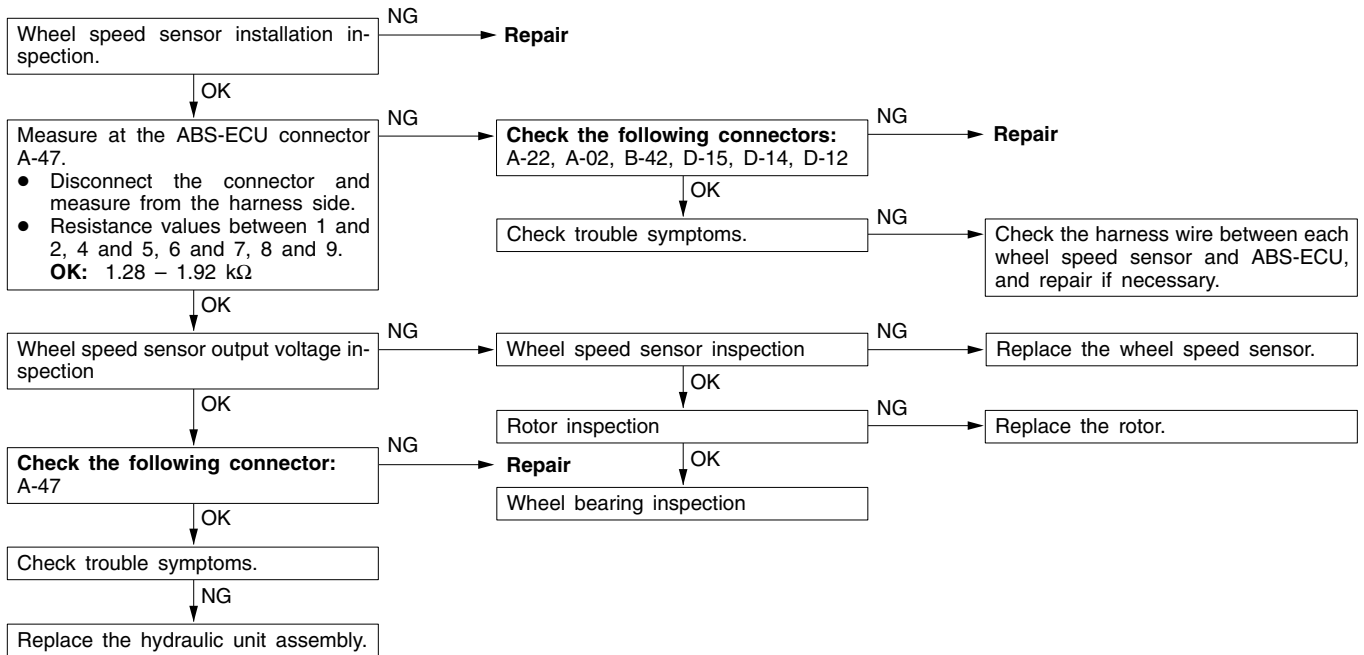
The same procedures as before are applied except for the items shown below.

INSPECTION CHART FOR DIAGNOSIS CODES

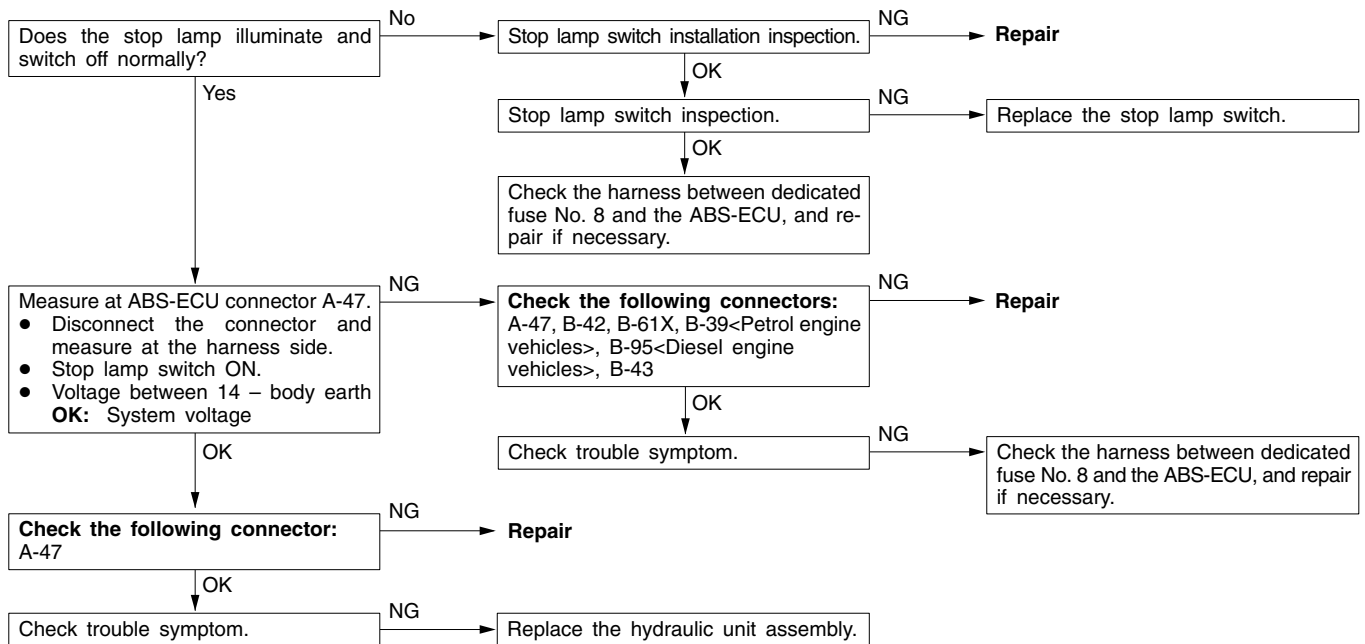
Diagnosis code No.	Inspection item	Diagnosis content	Reference page
11	Front right wheel speed sensor	Open circuit	35B-3
12	Front left wheel speed sensor		
13	Rear right wheel speed sensor		
14	Rear left wheel speed sensor		
21	Front right wheel speed sensor	Short circuit	35B-3
22	Front left wheel speed sensor		
23	Rear right wheel speed sensor		
24	Rear left wheel speed sensor		
38	Stop lamp switch system		35B-4

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

Code Nos.11, 12, 13 and 14 Wheel speed sensor open circuit	Probable cause
Code Nos.21, 22, 23 and 24 Wheel speed sensor short circuit	
Code Nos.11, 12, 13 and 14 are output if the ABS-ECU detects an open circuit in any one of the four wheel speed sensors.	<ul style="list-style-type: none"> ● Malfunction of wheel speed sensor ● Malfunction of wiring harness or connector ● Malfunction of ABS-ECU
Code Nos.21, 22, 23 and 24 are output in the following cases. <ul style="list-style-type: none"> ● When there is no input from any one of the four wheel speed sensors when traveling at 12 km/h or more, even though open circuit verified. ● When a chipped or blocked-up ABS rotor is detected during driving at 12 km/h or more. 	<ul style="list-style-type: none"> ● Malfunction of wheel speed sensor ● Malfunction of wiring harness or connector ● Malfunction of rotor ● Malfunction of ABS-ECU ● Malfunction of wheel bearing



Code No. 38 Stop lamp switch system	Probable cause
These codes are output at the following times: <ul style="list-style-type: none"> • When the stop lamp switch is not be turned off (when the stop lamp switch stays on for 15 minutes or more although the ABS is not operating). • When the ABS-ECU determines that there is an open circuit in harness of the stop lamp switch system. 	<ul style="list-style-type: none"> • Malfunction of stop lamp switch • Malfunction of harness or connector • Malfunction of ABS-ECU



INSPECTION CHART FOR TROUBLE SYMPTOMS

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

Trouble symptoms		Inspection procedure No.	Reference page
Communication with MUT-II is not possible.	Communication with ABS only is not possible.	2	35B-5
Faulty ABS operation	Unequal braking power on both sides.	5	35B-6
	Insufficient braking power.		
	ABS operates under normal braking conditions.		
	ABS operates before vehicle stops under normal braking conditions.		
	Large brake pedal vibration (Caution 2).	–	–

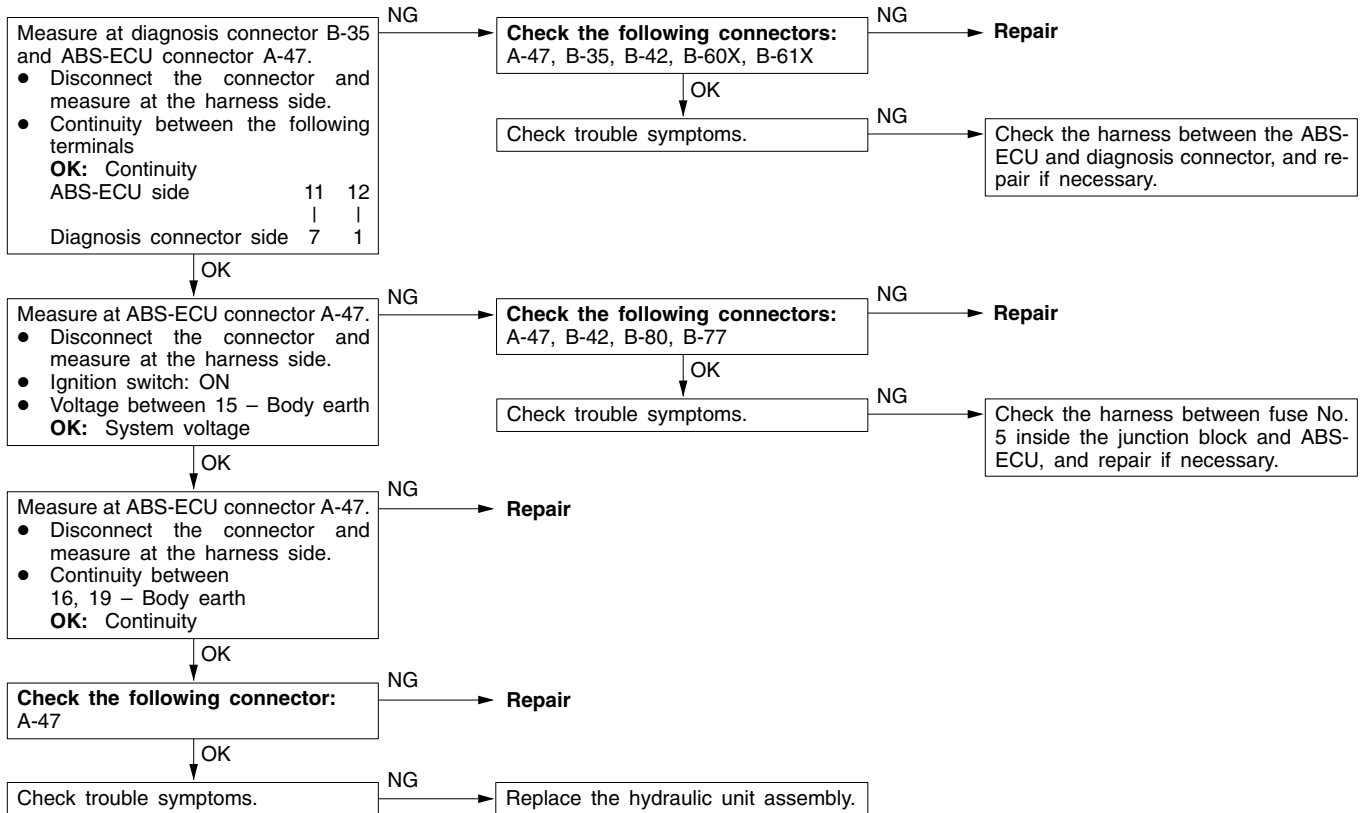
Caution

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, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

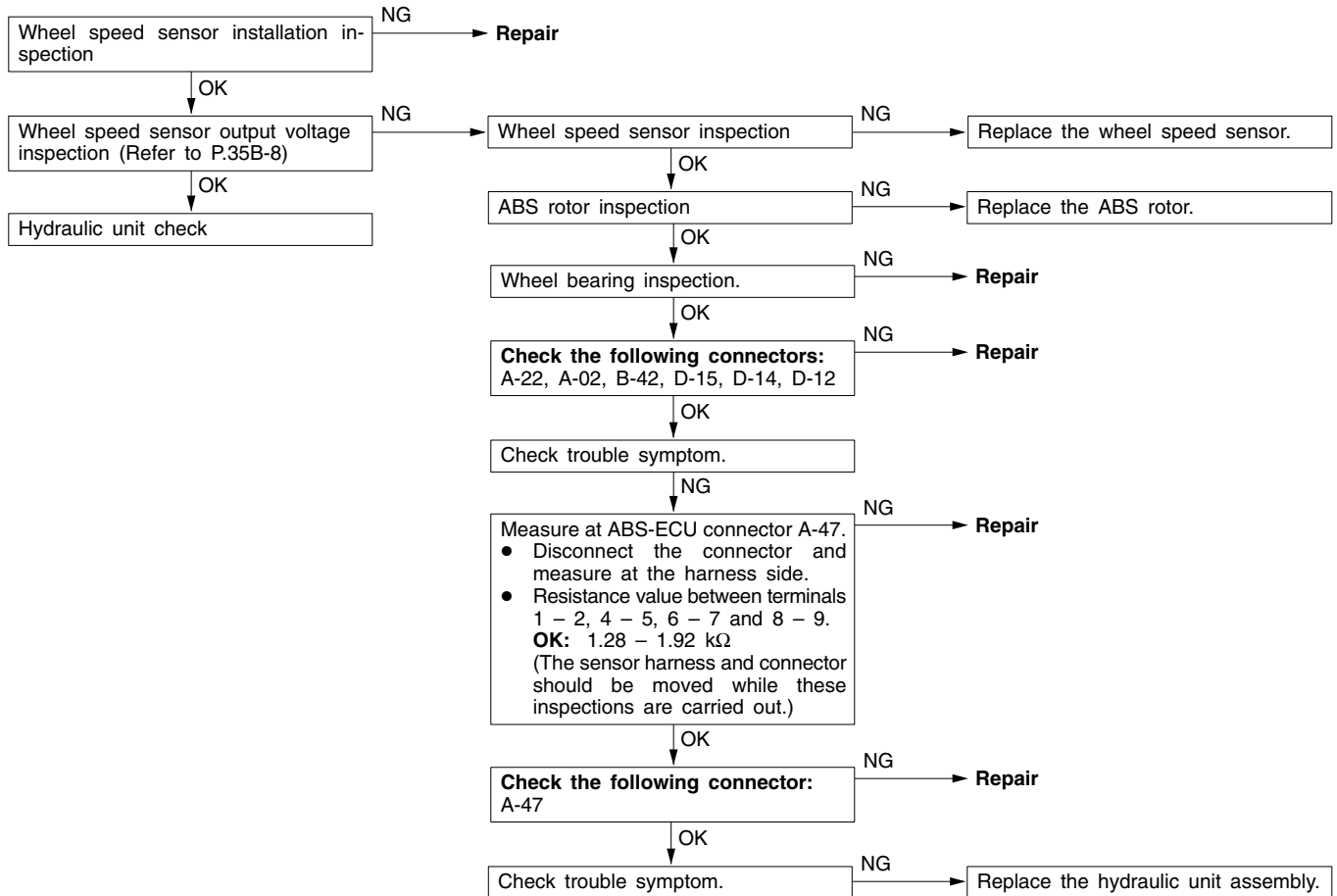
Inspection Procedure 2

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.	<ul style="list-style-type: none"> ● Blown fuse ● Malfunction of wiring harness or connector ● Malfunction of ABS-ECU



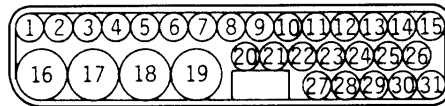
Inspection Procedure 5

Brake operation is abnormal.	Probable cause
<p>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.</p>	<ul style="list-style-type: none"> ● 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



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.

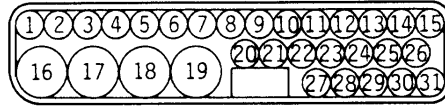


14U0122

Connector terminal No.	Signal	Checking requirements		Normal condition
11	MUT-II	Connect the MUT-II.		Serial communication with 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
20	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.



14U0122

Connector terminal No.	Signal	Normal condition
1 – 2	Rear-right wheel speed sensor (+ wire)	1.28 – 1.92 kΩ
4 – 5	Front-right wheel speed sensor (+ wire)	1.28 – 1.92 kΩ
6 – 7	Front-left wheel speed sensor (+ wire)	1.28 – 1.92 kΩ
8 – 9	Rear-left wheel speed sensor (+ wire)	1.28 – 1.92 kΩ
16 – Body earth	ABS-ECU earth	Continuity
19 – Body earth		

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

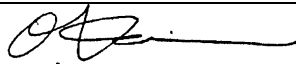
Measurement terminal No. has been changed. The same procedures as before are applied except for the items shown below.

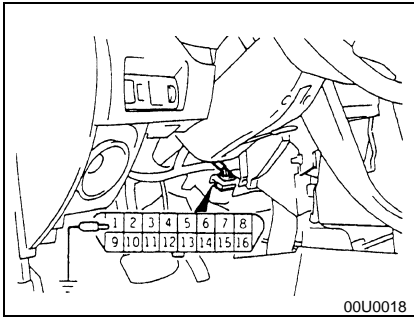
Wheel speed sensor	Front left	Front right	Rear left	Rear right
Terminal No.	6	4	8	1
	7	5	9	2



SERVICE BULLETIN

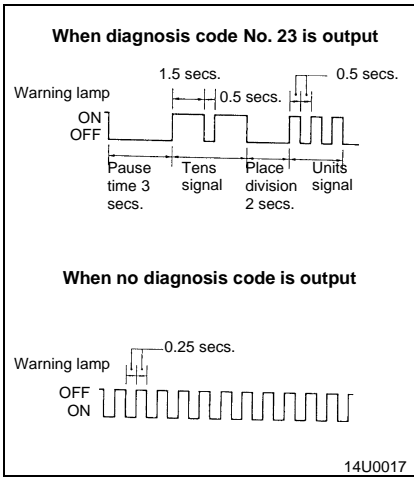
PUBLICATION GROUP, AFTER SALES SERVICE DEP.
MITSUBISHI MOTOR SALES EUROPE BV

SERVICE BULLETIN		No.: ESB-99E35-506	
		Date: 2000-04-15	<Model> <M/Y>
Subject: ADDITION OF CAUTION ON READING OF DIAGNOSTIC TROUBLE CODES		(EC) CARISMA	96-10
Group: SERVICE BRAKE		(EC) SPACE STAR	
CORRECTION		 O. Kai - E.V.P. & G.M. After Sales Service Dept.	
1. Description:			
Caution has been added on reading of the diagnostic trouble codes by use of the ABS warning light.			
2. Applicable Manuals:			
Manual	Pub. No.	Language	Page(s)
'96 CARISMA Workshop Manual Chassis	PWDE9502	(English)	35B-7
	PWDS9503	(Spanish)	
	PWDF9504	(French)	
	PWDG9505	(German)	
	PWDD9506	(Dutch)	
	PWDW9507	(Swedish)	
	PWDI96E1	(Italian)	
'99 SPACE STAR Workshop Manual Chassis	CMXE99E1	(English)	35B-6
	CMXS99E1	(Spanish)	
	CMXF99E1	(French)	
	CMXG99E1	(German)	
	CMXD99E1	(Dutch)	
	CMXW99E1	(Swedish)	
	CMXI99E1	(Italian)	
3. Details:			
'96 CARISMA Workshop Manual chassis, page 2			
'99 SPACE STAR Workshop Manual chassis, page 3			



Without the MUT-II

1. Use the special tool to earth diagnosis connector terminal No. 1.



2. Turn the ignition switch to ON and then take a reading of the diagnosis codes from the flashing of the ABS warning lamp.

<Added>

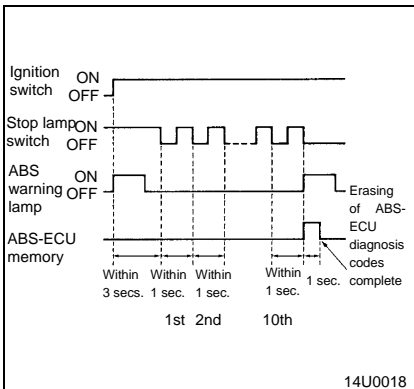
Caution:

After placing the ignition switch in the ON position, do not press the brake pedal.
When an ABS fault occurs, if the brake pedal is depressed with the ignition switch in the ON position, the ABS warning light will remain illuminated.
This makes it impossible for the diagnostic trouble codes to be read.

ERASING DIAGNOSIS CODES

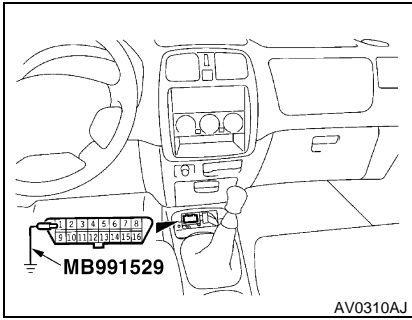
With the MUT-II

Connect the MUT-II to the diagnosis connector (16-pin), then erase the diagnosis codes.



Without the MUT-II

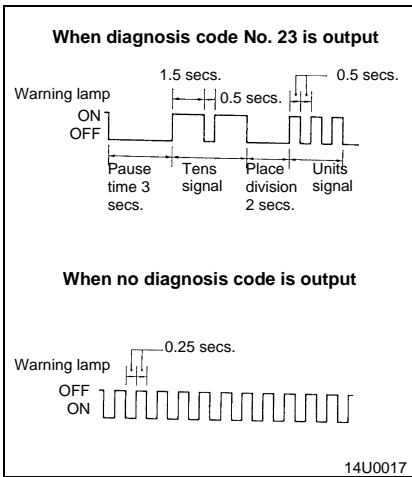
The diagnosis codes can only be erased by operating the brake switch ten times according to the pattern shown in the illustration at left while the ABS is active and while driving at a speed of 10 km/h or less.



Without the MUT-II

- I. Use the special tool to earth diagnosis connector terminal No. 1.

3. Turn the ignition switch to ON and then take a reading of the diagnosis codes from the flashing of the ABS warning lamp.



<Added>

Caution:

After placing the ignition switch in the ON position, do not press the brake pedal.

When an ABS fault occurs, if the brake pedal is depressed with the ignition switch in the ON position, the ABS warning light will remain illuminated.

This makes it impossible for the diagnostic trouble codes to be read.

ERASING DIAGNOSIS CODES

With the MUT-II

Connect the MUT-II to the diagnosis connector (16-pin), then erase the diagnosis codes.

Without the MUT-II

The diagnosis codes can only be erased by operating the brake switch ten times according to the pattern shown in the illustration at left while the ABS is active and while driving at a speed of 10 km/h or less.

