

ANTI-SKID BRAKING SYSTEM (ABS)

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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 (*).

GENERAL


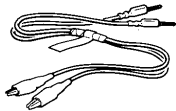
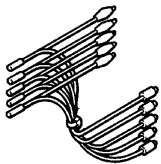
OUTLINE OF CHANGE

- The description of the service procedures including the troubleshooting using an MUT-II tester has been incorporated.

SERVICE SPECIFICATIONS

Items		Standard value
Resistance between hydraulic unit solenoid valve terminals Ω	IN	8.04 – 9.04
	OUT	4.04 – 4.54
Wheel speed sensor-to-rotor clearance mm		0.3 – 0.9
Wheel speed sensor's internal resistance k Ω		1.4 – 1.8
Wheel speed sensor insulation resistance k Ω		100
Acceleration sensor output voltage V	On stationary vehicle	2.4 – 2.6
	With front mark downward	3.4 – 3.6

SPECIAL TOOLS

Tool	Number	Name	Use
	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)
 B991348	MB991348	Test harness set	For checking of acceleration sensor

TROUBLESHOOTING

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

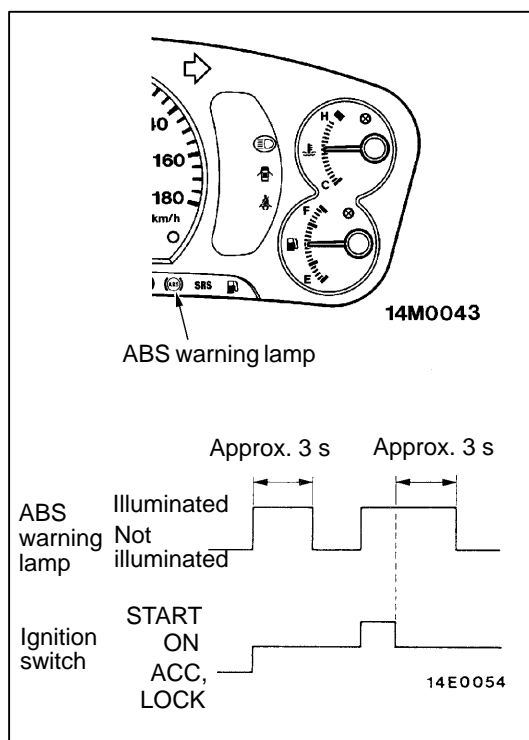
Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

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)

- 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.



ABS WARNING LAMP INSPECTION

Check that the ABS warning lamp illuminates as follows.

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

DIAGNOSIS FUNCTION**DIAGNOSIS CODES CHECK**

Read a diagnosis code by the MUT-II or ABS warning lamp.
(Refer to GROUP 00 – How to Use Troubleshooting/Inspection
Service Points.)

NOTE

Connect the MUT-II to the 16-pin diagnosis connector.

ERASING DIAGNOSIS CODES

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

INSPECTION CHART FOR DIAGNOSIS CODES**<EVOLUTION-IV>**

Diagnosis code No.	Diagnosis items	Reference Page
11	Wheel speed sensor (FR) system (open- or short-circuit)	35B-7
12	Wheel speed sensor (FL) system (open- or short-circuit)	35B-7
13	Wheel speed sensor (RR) system (open- or short-circuit)	35B-7
14	Wheel speed sensor (RL) system (open- or short-circuit)	35B-7
15	Wheel speed sensor system (abnormal output signal)	35B-9
16	ABS-ECU power supply system (abnormal voltage drop or rise)	35B-10
21	Wheel speed sensor (FR) system	35B-7
22	Wheel speed sensor (FL) system	35B-7
23	Wheel speed sensor (RR) system	35B-7
24	Wheel speed sensor (RL) system	35B-7
27	AYC monitor system (defective AYC)	35B-12
32	Acceleration sensor circuit system	35B-12
33	Stop lamp switch system (open circuit or stop lamp stays ON)	35B-14
41	Solenoid valve (FR) system	35B-15
42	Solenoid valve (FL) system	35B-15
43	Solenoid valve (RR) system	35B-15
44	Solenoid valve (RL) system	35B-15
51	Valve relay system	35B-16
53	Motor relay system	35B-18
63	ABS-ECU failure	Replace ABS-ECU.

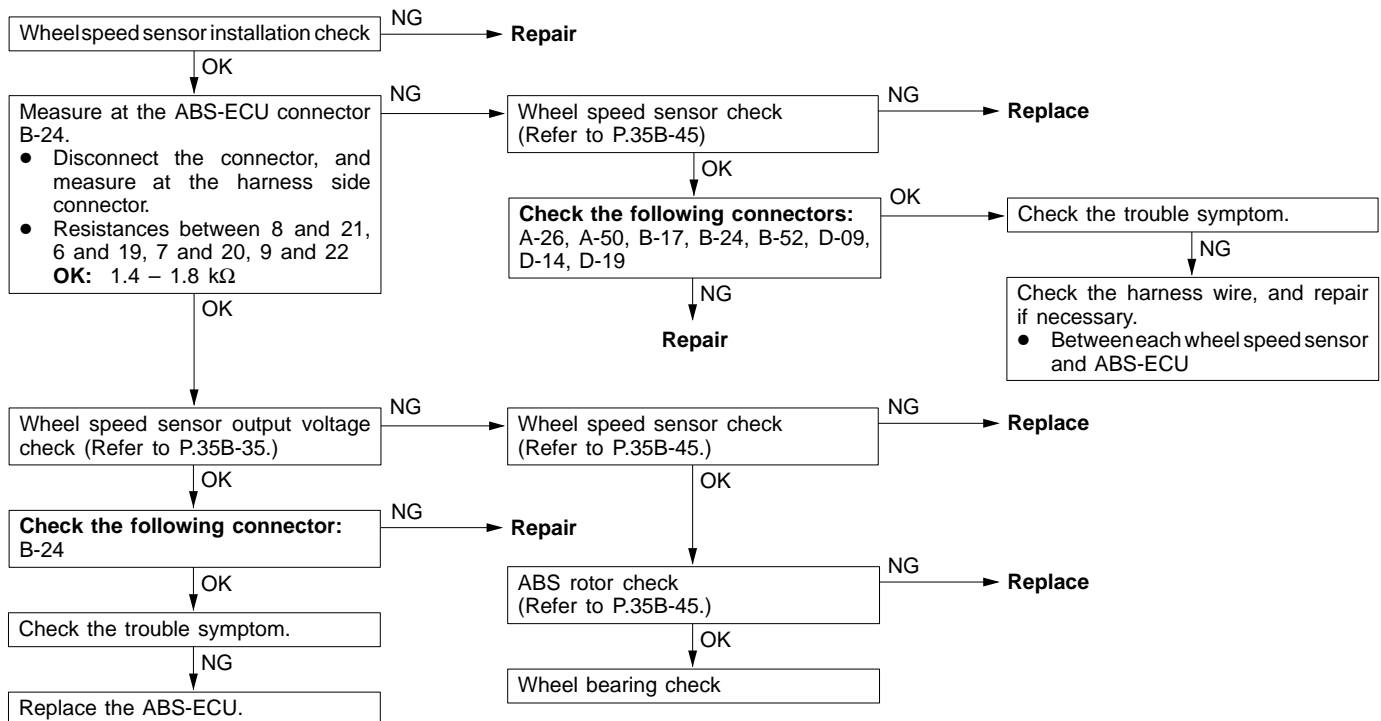
<EVOLUTION-V, VI>

Diagnosis code No.	Diagnosis items	Reference Page
11	Wheel speed sensor (FR) system (open- or short-circuit)	35B-8
12	Wheel speed sensor (FL) system (open- or short-circuit)	35B-8
13	Wheel speed sensor (RR) system (open- or short-circuit)	35B-8
14	Wheel speed sensor (RL) system (open- or short-circuit)	35B-8
15	Wheel speed sensor system (abnormal output signal)	35B-9
16	ABS-ECU power supply system (abnormal voltage drop or rise)	35B-11
21	Wheel speed sensor (FR) system	35B-8
22	Wheel speed sensor (FL) system	35B-8
23	Wheel speed sensor (RR) system	35B-8
24	Wheel speed sensor (RL) system	35B-8
32	Acceleration sensor (longitudinal acceleration) circuit system	35B-13
33	Stop lamp switch system (open circuit or stop lamp stays ON)	35B-15
41	Solenoid valve (FR) system	35B-15
42	Solenoid valve (FL) system	35B-15
43	Solenoid valve (RR) system	35B-15
44	Solenoid valve (RL) system	35B-15
51	Valve relay system	35B-17
53	Motor relay system	35B-19
63	ABS-ECU failure	Replace ABS-ECU.
71	Acceleration sensor (lateral acceleration) system	35B-20

INSPECTION PROCEDURE FOR DIAGNOSTIC TROUBLE CODES

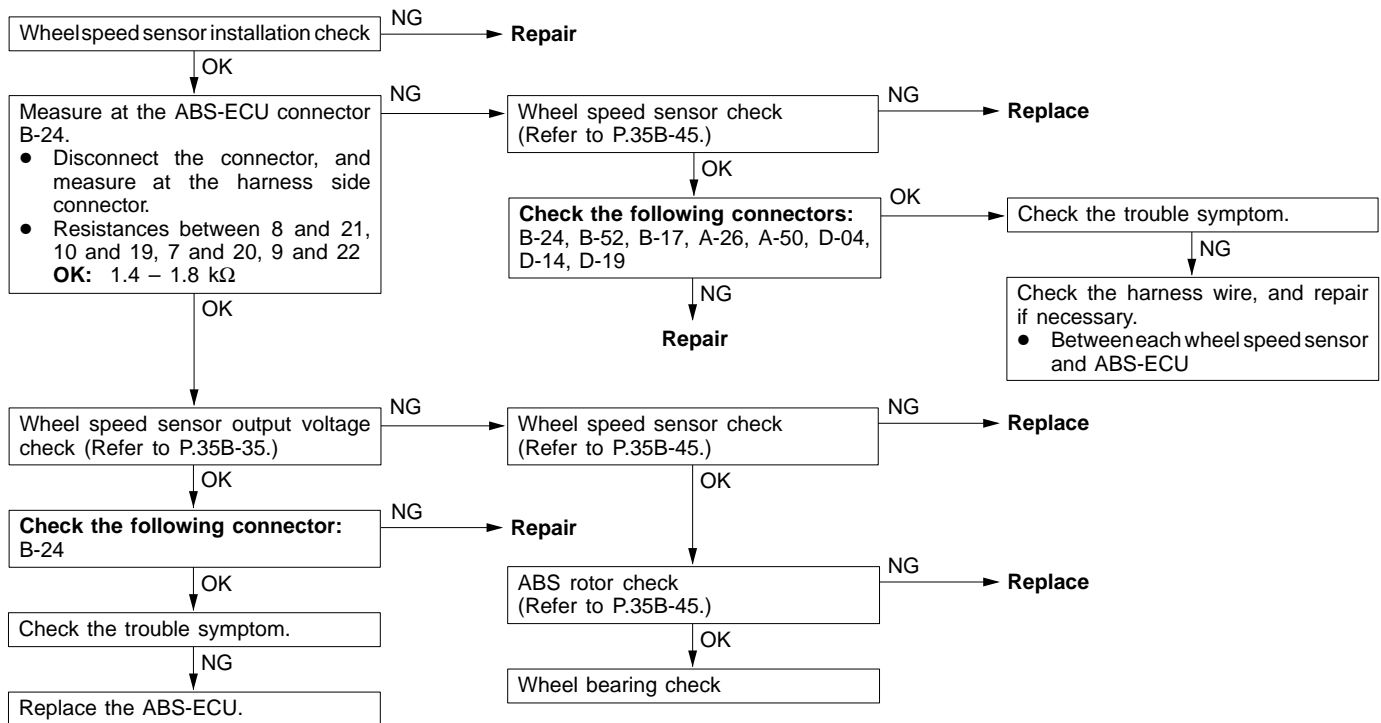
<EVOLUTION-IV>

Code Nos.11, 12, 13 and 14 Wheel speed sensor system (open- or short-circuit)	Probable cause
Code Nos.21, 22, 23 and 24 Wheel speed sensor system	
Code Nos 11, 12, 13 and 14 are output if the ABS-ECU detects an open circuit or short-circuit in the (+) wire or (–) wire 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 travelling at 8 km/h or more, even though open circuit can not be verified. • When a chipped or blocked-up ABS rotor is detected and if the anti-lock system operates continuously because a malfunctioning sensor or a warped ABS rotor is causing sensor output to drop. 	<ul style="list-style-type: none"> • Malfunction of wheel speed sensor • Malfunction of wiring harness or connector • Malfunction of ABS rotor • Too much gap between the sensor and the ABS rotor • Malfunction of ABS-ECU • Malfunction of wheel bearing

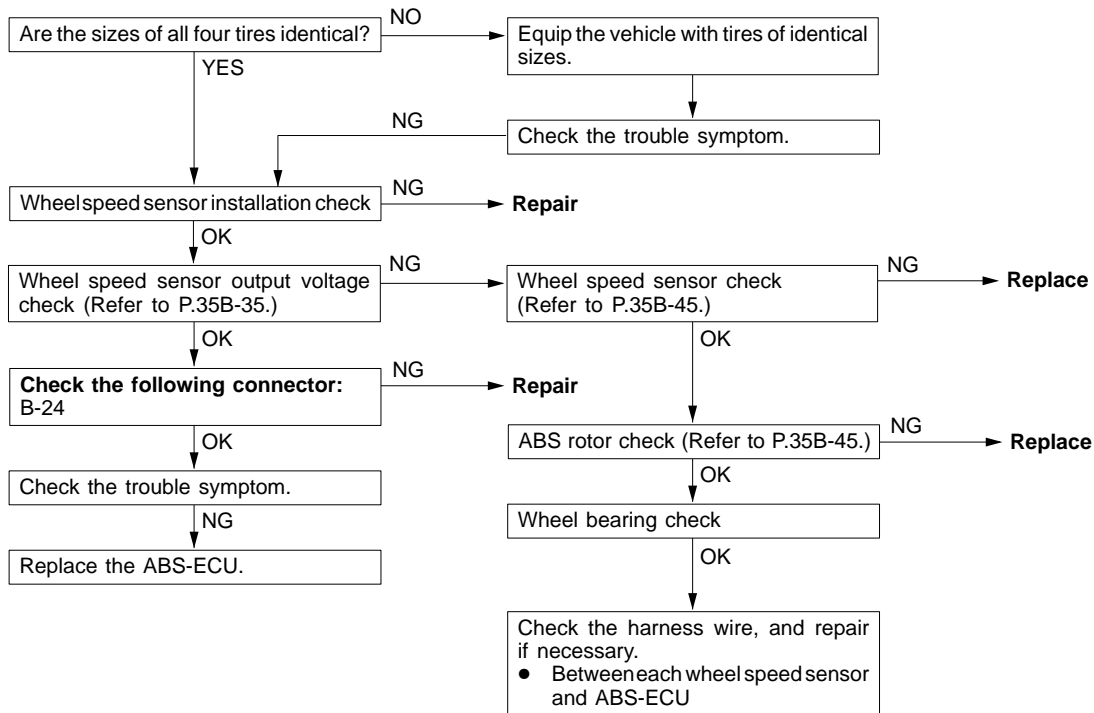


<EVOLUTION-V, VI>

Code Nos.11, 12, 13 and 14 Wheel speed sensor system (open- or short-circuit)	Probable cause
Code Nos.21, 22, 23 and 24 Wheel speed sensor system	
Code Nos 11, 12, 13 and 14 are output if the ABS-ECU detects an open circuit or short-circuit in the (+) wire or (–) wire 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 travelling at 8 km/h or more, even though open circuit can not be verified. • When a chipped or blocked-up ABS rotor is detected and if the sensor output is lowered due to faulty wheel speed sensor. 	<ul style="list-style-type: none"> • Malfunction of wheel speed sensor • Malfunction of wiring harness or connector • Too much gap between the sensor and the ABS rotor • Malfunction of ABS-ECU • Malfunction of wheel bearing



Code No.15 Wheel speed sensor system (abnormal output signal)	Probable cause
<p>This code is output when there is an abnormality in the output signal from any one of the four wheel speed sensors while driving (except for an open circuit or short circuit).</p>	<ul style="list-style-type: none"> • The four vehicle tires are of different sizes • Improperly installed wheel speed sensor • Malfunction of wheel speed sensor • Malfunction of wiring harness or connector • Malfunction of ABS rotor • Malfunction of wheel bearing • Malfunction of ABS-ECU



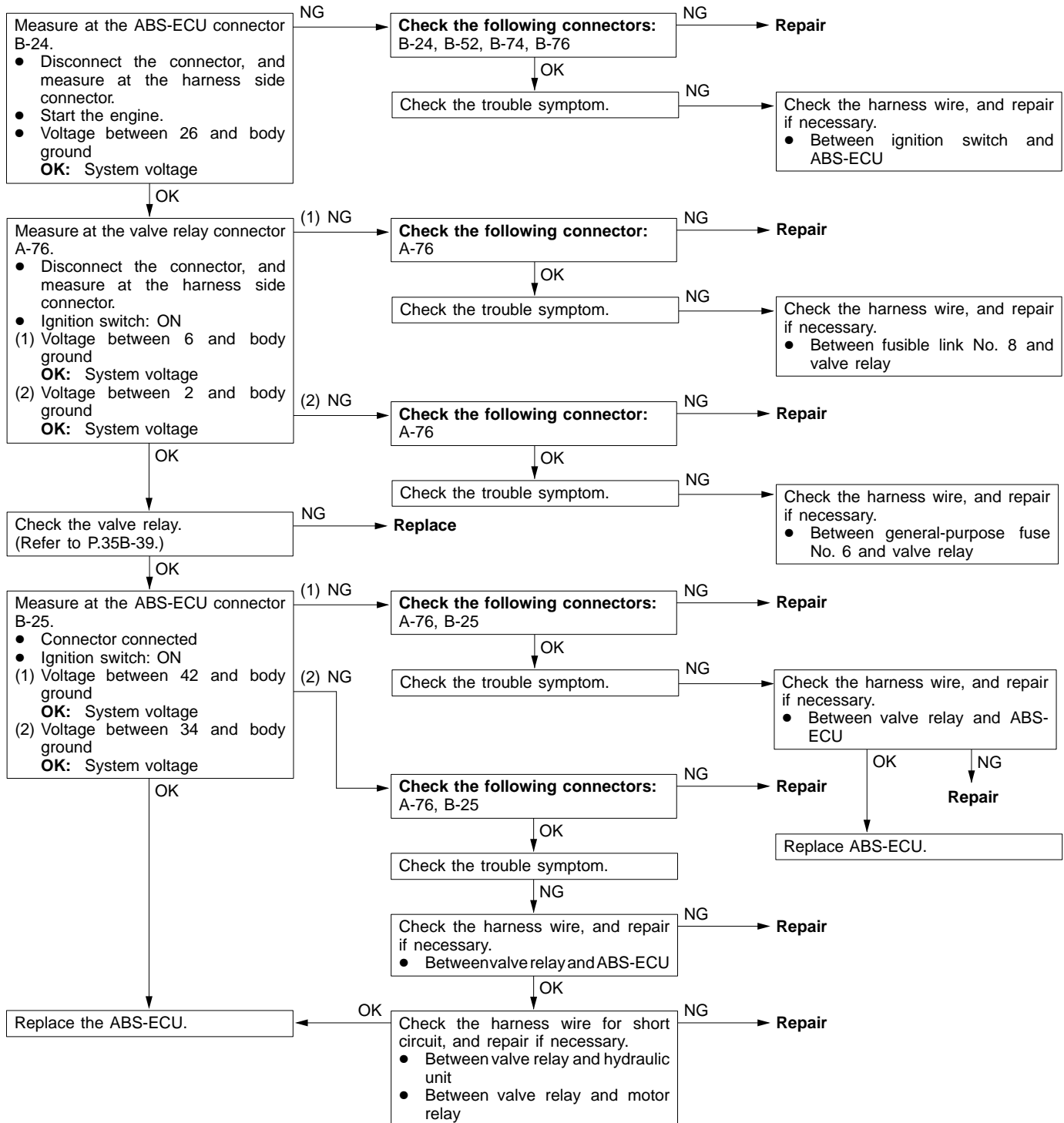
<EVOLUTION-IV>

Code No.16 ABS-ECU power supply system (abnormal voltage drop or rise)	Probable cause
<p>This code is output if the ABS-ECU or valve relay power supply voltage drops below or rises above the rated values.</p> <p>The valve relay power supply voltage is detected based on the voltage in the valve relay monitor line.</p>	<ul style="list-style-type: none"> • Malfunction of battery • Malfunction of wiring harness or connector • Malfunction of valve relay • Malfunction of ABS-ECU

Caution

If system voltage drops or rises during inspection, this code will be output as well, making it impossible to obtain correct diagnostic results.

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



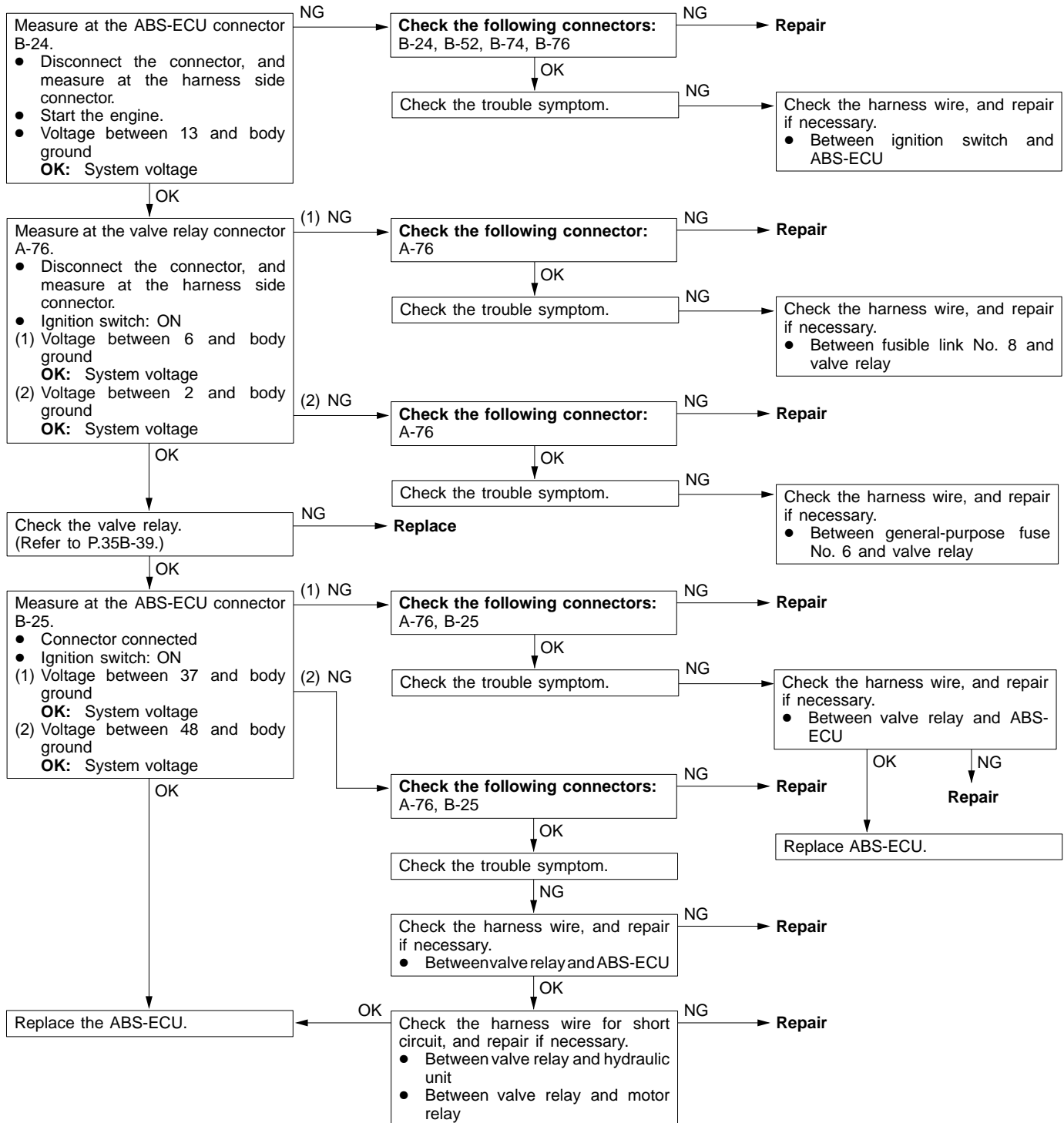
<EVOLUTION-V, VI>

Code No.16 ABS-ECU power supply system (abnormal voltage drop or rise)	Probable cause
<p>This code is output if the ABS-ECU or valve relay power supply voltage drops below or rises above the rated values.</p> <p>The valve relay power supply voltage is detected based on the voltage in the valve relay monitor line.</p>	<ul style="list-style-type: none"> • Malfunction of battery • Malfunction of wiring harness or connector • Malfunction of valve relay • Malfunction of ABS-ECU

Caution

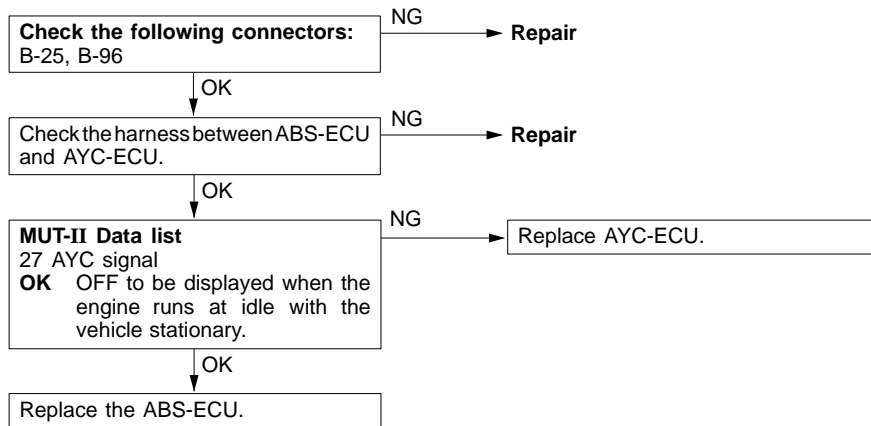
If system voltage drops or rises during inspection, this code will be output as well, making it impossible to obtain correct diagnostic results.

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



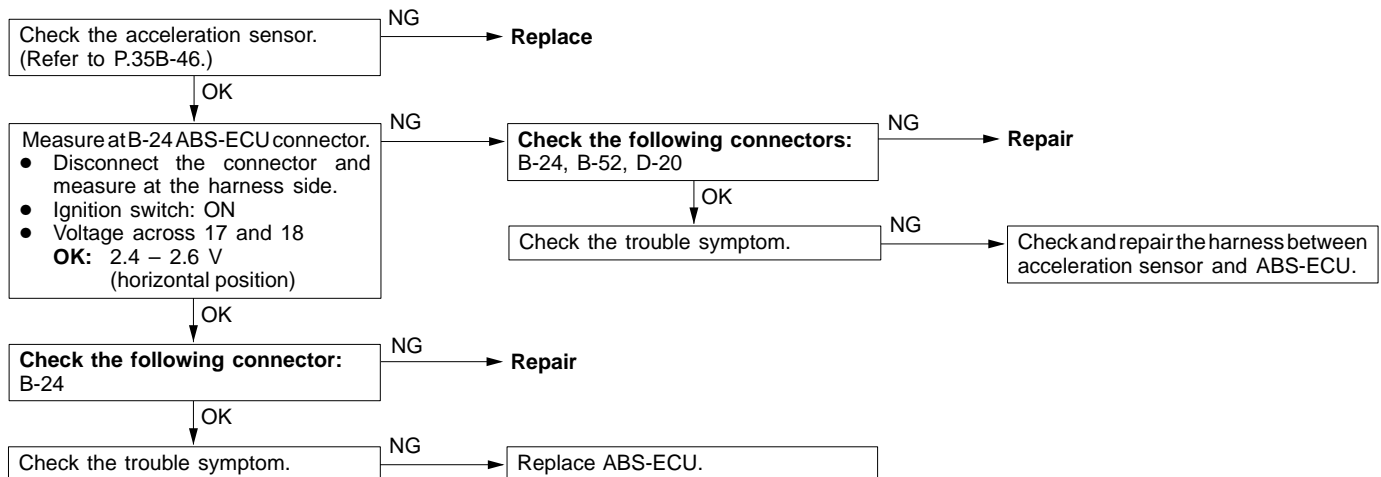
<EVOLUTION-IV>

Code No.27 AYC monitor system (defective AYC)	Probable cause
This code is output when the AYC monitor signal becomes faulty.	<ul style="list-style-type: none"> Defective AYC-ECU Defective ABS-ECU Defective harness or connector



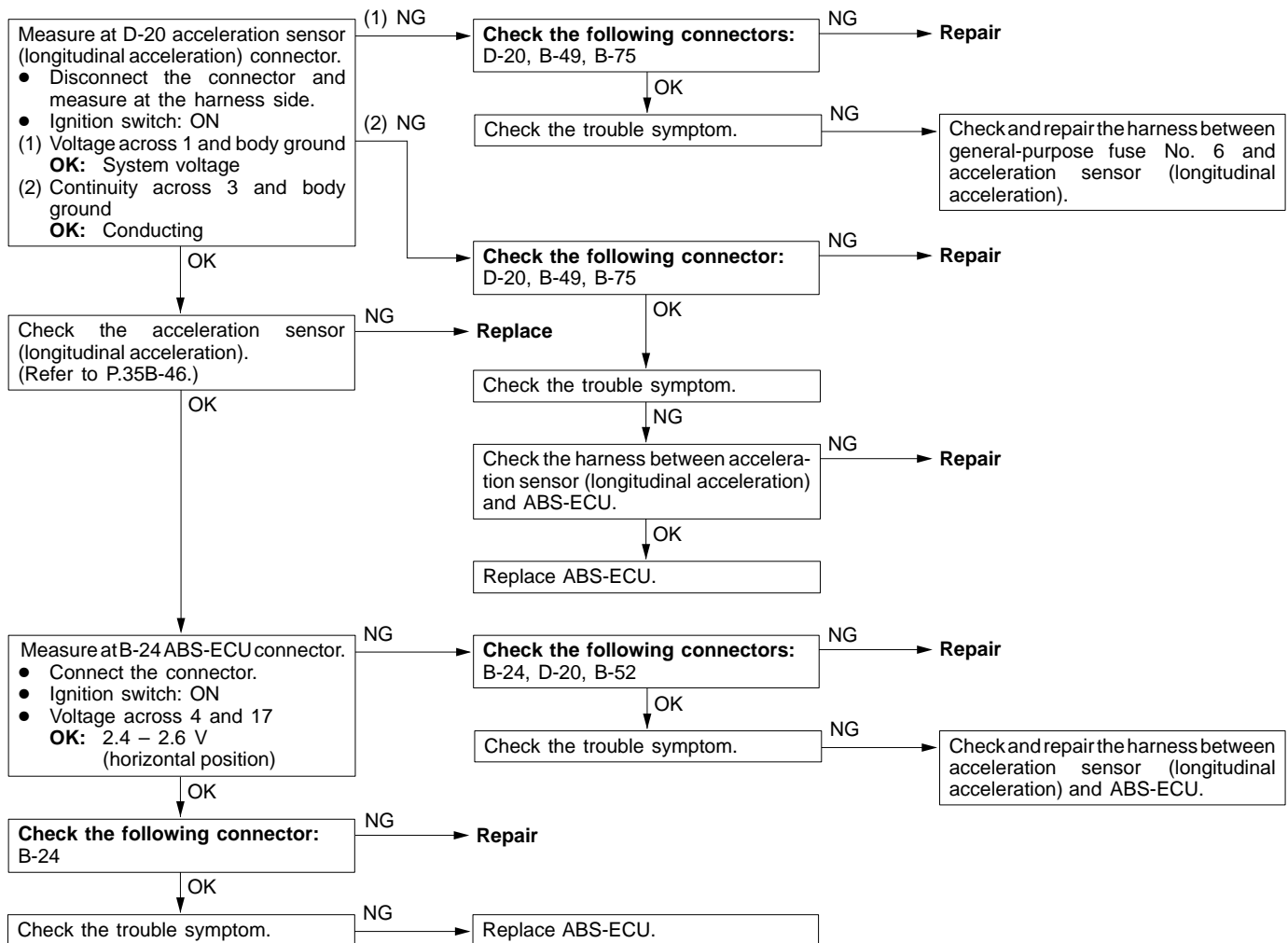
<EVOLUTION-IV>

Code No.32 Acceleration sensor circuit system	Probable cause
This code is output under either of the following conditions: <ul style="list-style-type: none"> The output from the acceleration sensor becomes 0.5 V or less, or 4.5 V or more. The acceleration sensor harness is open- or short-circuited. 	<ul style="list-style-type: none"> Defective acceleration sensor Defective harness or connector Defective ABS-ECU



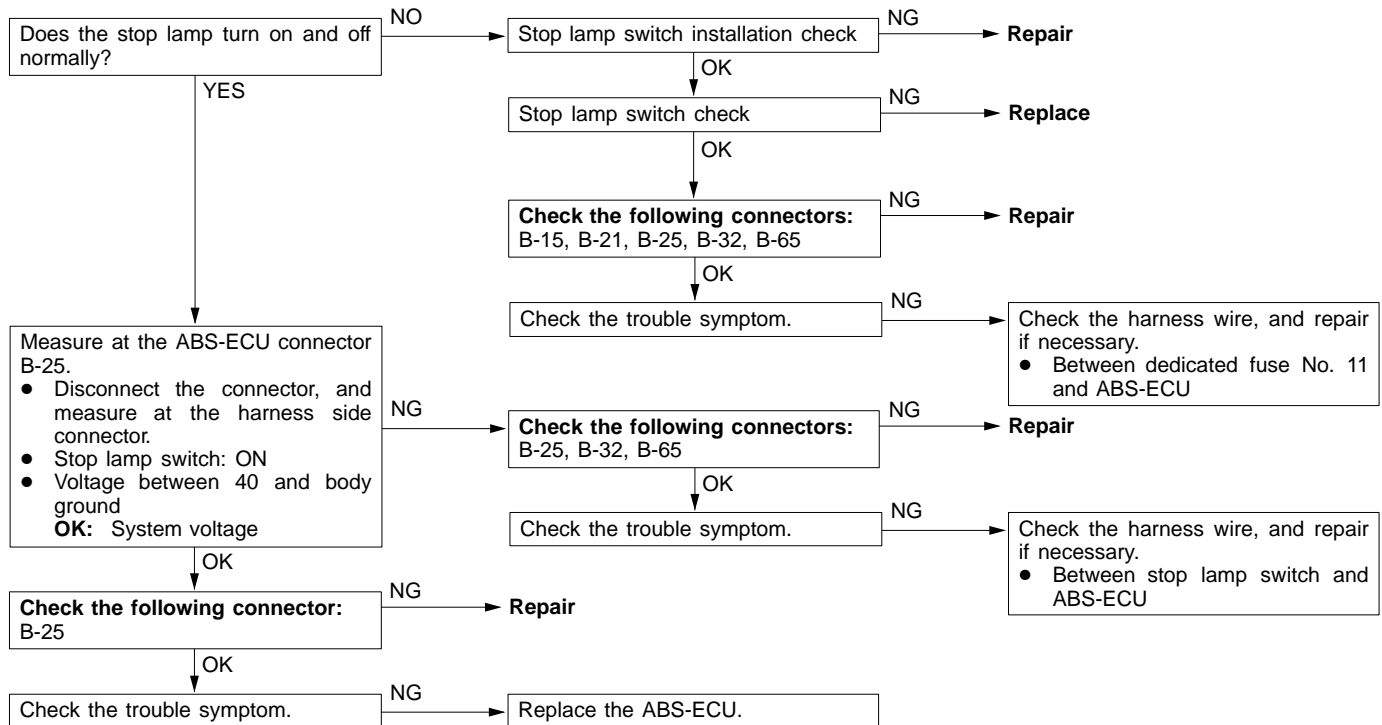
<EVOLUTION-V, VI>

Code No.32 Acceleration sensor (longitudinal acceleration) circuit system	Probable cause
<p>This code is output under either of the following conditions:</p> <ul style="list-style-type: none"> The output from the acceleration sensor (longitudinal acceleration) becomes 0.5 V or less, or 4.5 V or more. The acceleration sensor (longitudinal acceleration) harness is open- or short-circuited. 	<ul style="list-style-type: none"> Defective acceleration sensor (longitudinal acceleration) Defective harness or connector Defective ABS-ECU



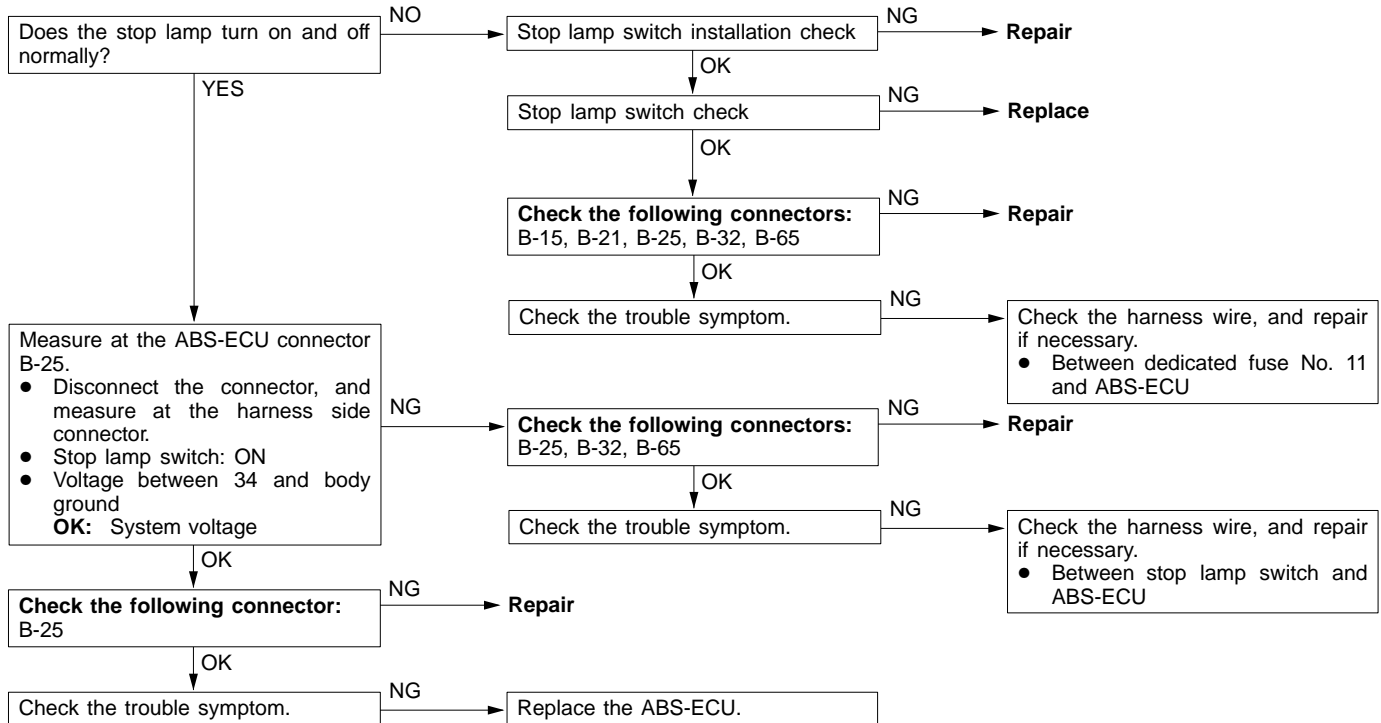
<EVOLUTION-IV>

Code No.33 Stop lamp switch system (open circuit or stop lamp stays ON)	Probable cause
This code is output, if the stop lamp switch is continuously on for 15 minutes or more.	<ul style="list-style-type: none"> • Malfunction of stop lamp switch • Malfunction of wiring harness or connector • Malfunction of ABS-ECU

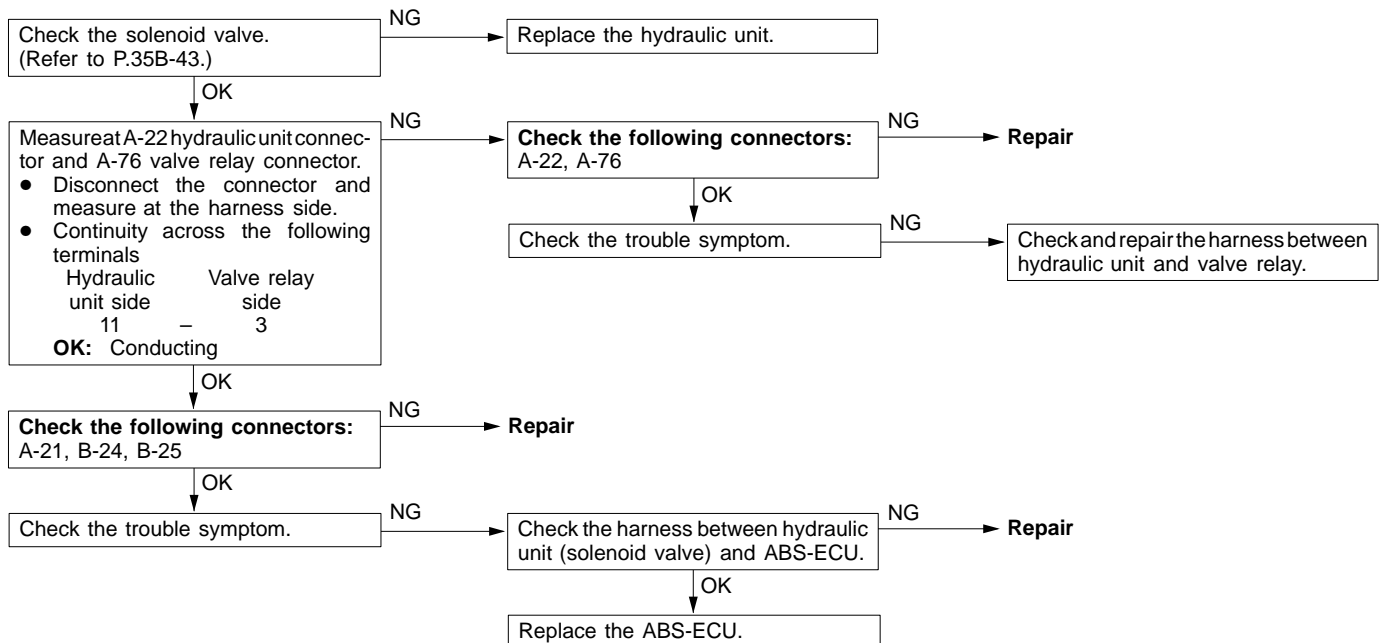


<EVOLUTION-V, VI>

Code No.33 Stop lamp switch system (open circuit or stop lamp stays ON)	Probable cause
This code is output, if the stop lamp switch is continuously on for 15 minutes or more.	<ul style="list-style-type: none"> • Malfunction of stop lamp switch • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



Code No. 41, 42, 43, 44: Solenoid valve system	Probable cause
ABS-ECU monitors the solenoid valve energization circuit at all times. This code is output when no current flows through the solenoid even when ABS-ECU energizes it or when current continues flowing through the solenoid even when ABS-ECU deenergizes it, which is considered to be attributable to an open- or short-circuited solenoid coil or open- or short-circuited harness.	<ul style="list-style-type: none"> • Defective hydraulic unit • Defective harness or connector • Defective ABS-ECU



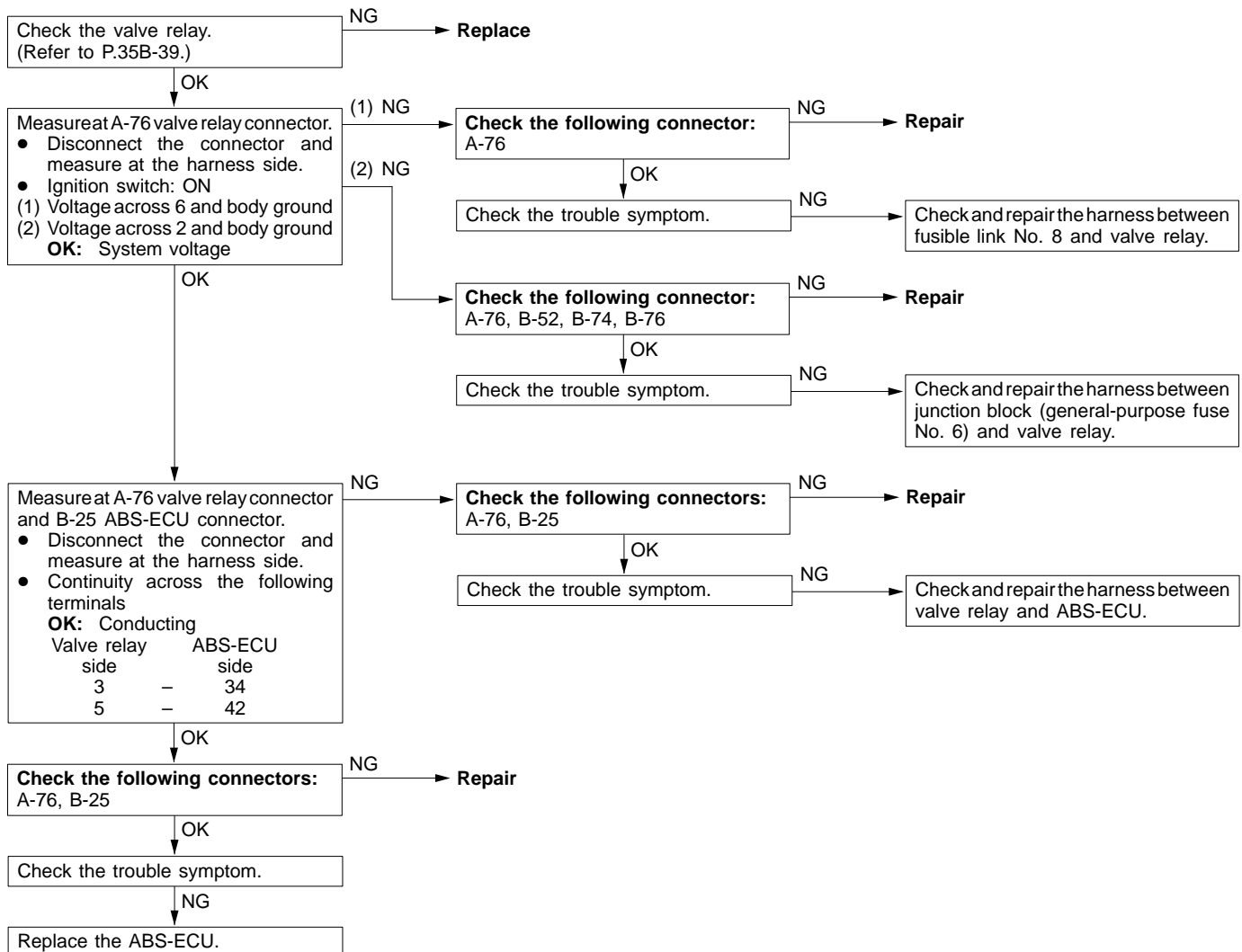
<EVOLUTION-IV>

Code No.51 Valve relay system	Probable cause
This code is output under any of the following conditions: <ul style="list-style-type: none"> • The solenoid valve power is not supplied when ABS-ECU attempts to turn ON the valve relay as part of the initial check when the ignition switch is turned ON. • The solenoid valve power remains supplied when ABS-ECU attempts to turn OFF the valve relay as part of the initial check when the ignition switch is turned ON. • The solenoid valve power is not supplied while the valve relay remains ON under normal conditions. 	<ul style="list-style-type: none"> • Defective ABS valve relay • Defective harness or connector • Defective ABS-ECU

NOTE

In the diagnosis code reading by means of the ABS warning lamp (refer to P.35B-4), this code is output in addition to the actual diagnosis code since the valve relay connector is disconnected.

If the ABS warning lamp turns ON even when the spot represented by the diagnosis code output in addition to this code has been repaired, and if no diagnosis code other than No. 51 is output, then the valve relay system is probably defective. Make the following checks.



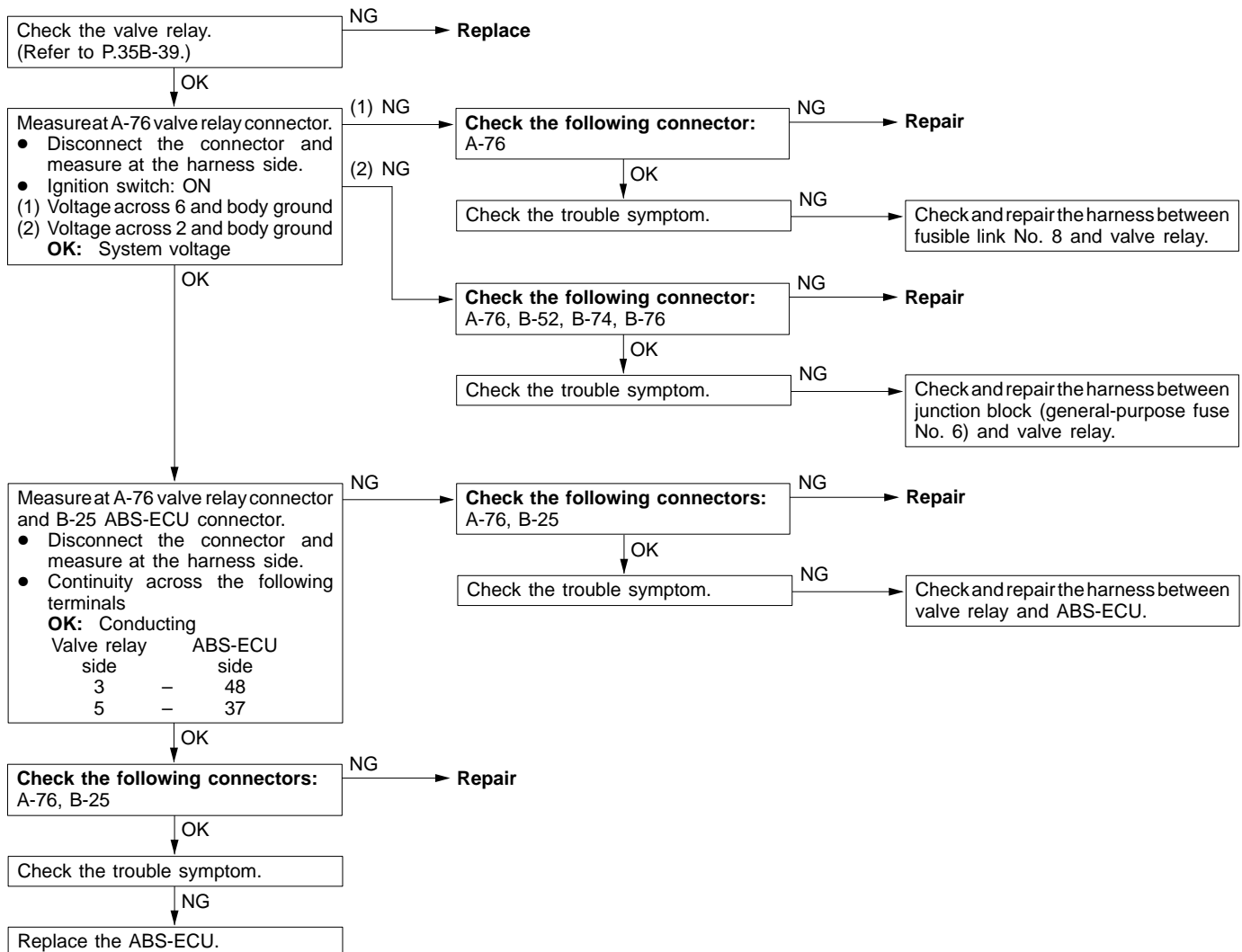
<EVOLUTION-V, VI>

Code No.51 Valve relay system	Probable cause
<p>This code is output under any of the following conditions:</p> <ul style="list-style-type: none"> The solenoid valve power is not supplied when ABS-ECU attempts to turn ON the valve relay as part of the initial check when the ignition switch is turned ON. The solenoid valve power remains supplied when ABS-ECU attempts to turn OFF the valve relay as part of the initial check when the ignition switch is turned ON. The solenoid valve power is not supplied while the valve relay remains ON under normal conditions. 	<ul style="list-style-type: none"> Defective ABS valve relay Defective harness or connector Defective ABS-ECU

NOTE

In the diagnosis code reading by means of the ABS warning lamp (refer to P.35B-4), this code is output in addition to the actual diagnosis code since the valve relay connector is disconnected.

If the ABS warning lamp turns ON even when the spot represented by the diagnosis code output in addition to this code has been repaired, and if no diagnosis code other than No. 51 is output, then the valve relay system is probably defective. Make the following checks.

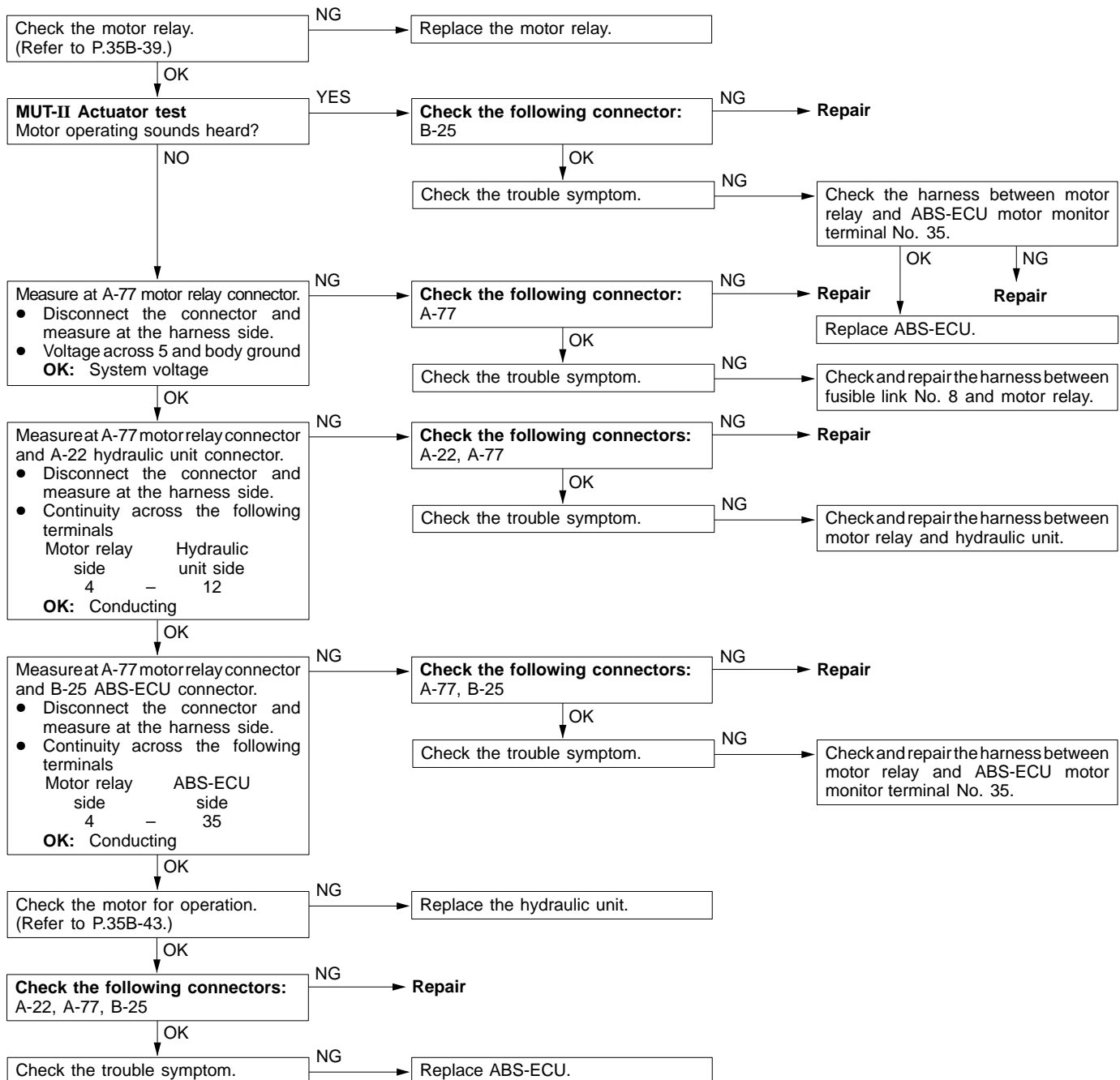


<EVOLUTION-IV>

Code No.53 Motor relay system	Probable cause
This code is output under any of the following conditions: <ul style="list-style-type: none"> • No signals are input to the motor monitor when the motor relay is ON (motor does not run, etc.). • A signal is being input to the motor monitor for 3 sec. or more when the motor relay is OFF (motor continues running, etc.). • The motor relay is inoperative. 	<ul style="list-style-type: none"> • Defective motor relay • Defective harness or connector • Defective hydraulic unit • Defective ABS-ECU

Caution

- (1) If the motor relay contacts fuse, the motor continues running even when the ignition switch is turned OFF. In this case, immediately remove fusible link No. 8 (60 A) or disconnect the A-22 hydraulic unit connector or A-77 motor relay connector. Overloading the motor results in a rundown battery.
- (2) Driving the motor through actuator test runs down the battery. After the test, run the engine for some while.

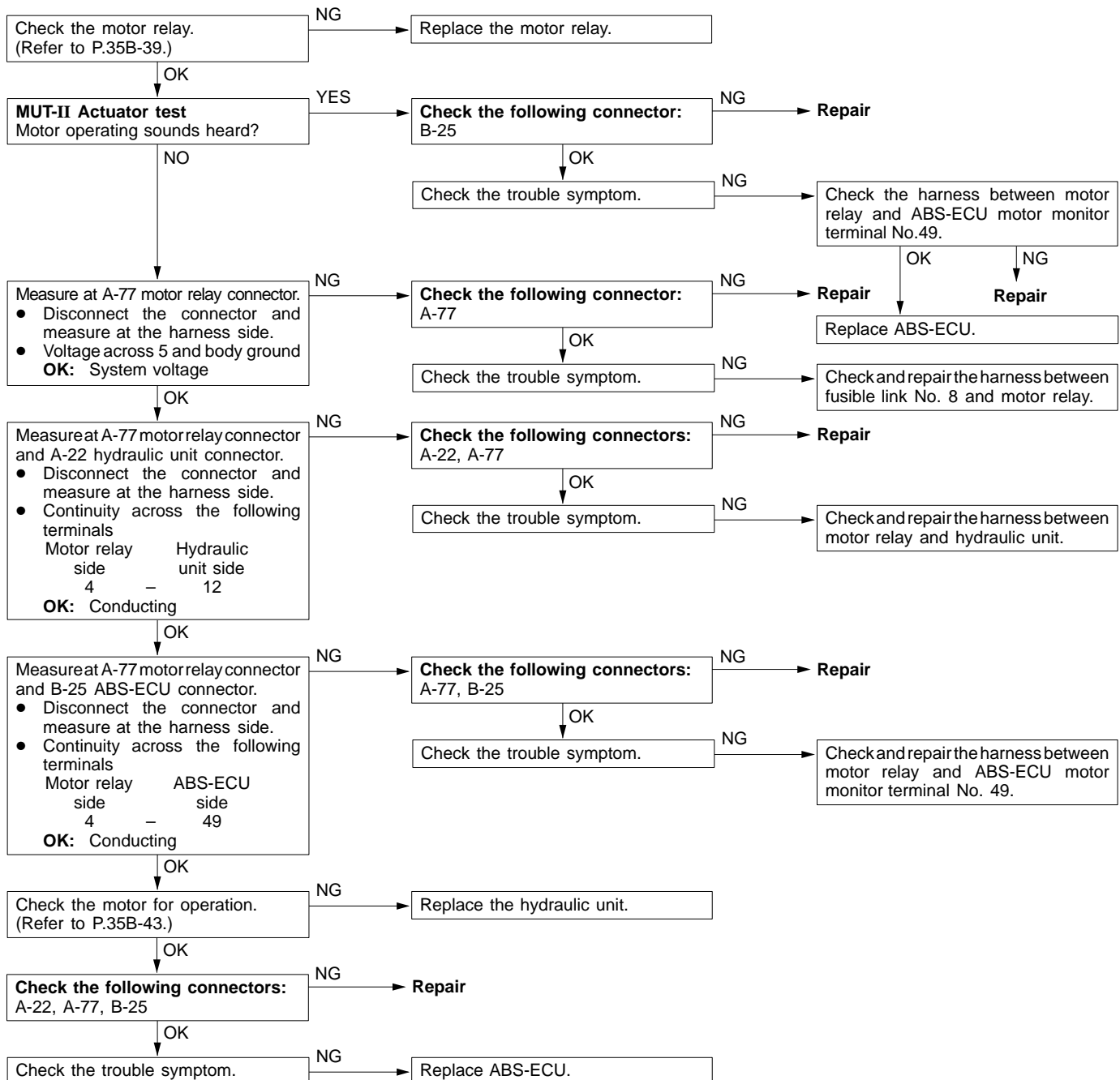


<EVOLUTION-V, VI>

Code No.53 Motor relay system	Probable cause
This code is output under any of the following conditions: <ul style="list-style-type: none"> • No signals are input to the motor monitor when the motor relay is ON (motor does not run, etc.). • A signal is being input to the motor monitor for 3 sec. or more when the motor relay is OFF (motor continues running, etc.). • The motor relay is inoperative. 	<ul style="list-style-type: none"> • Defective motor relay • Defective harness or connector • Defective hydraulic unit • Defective ABS-ECU

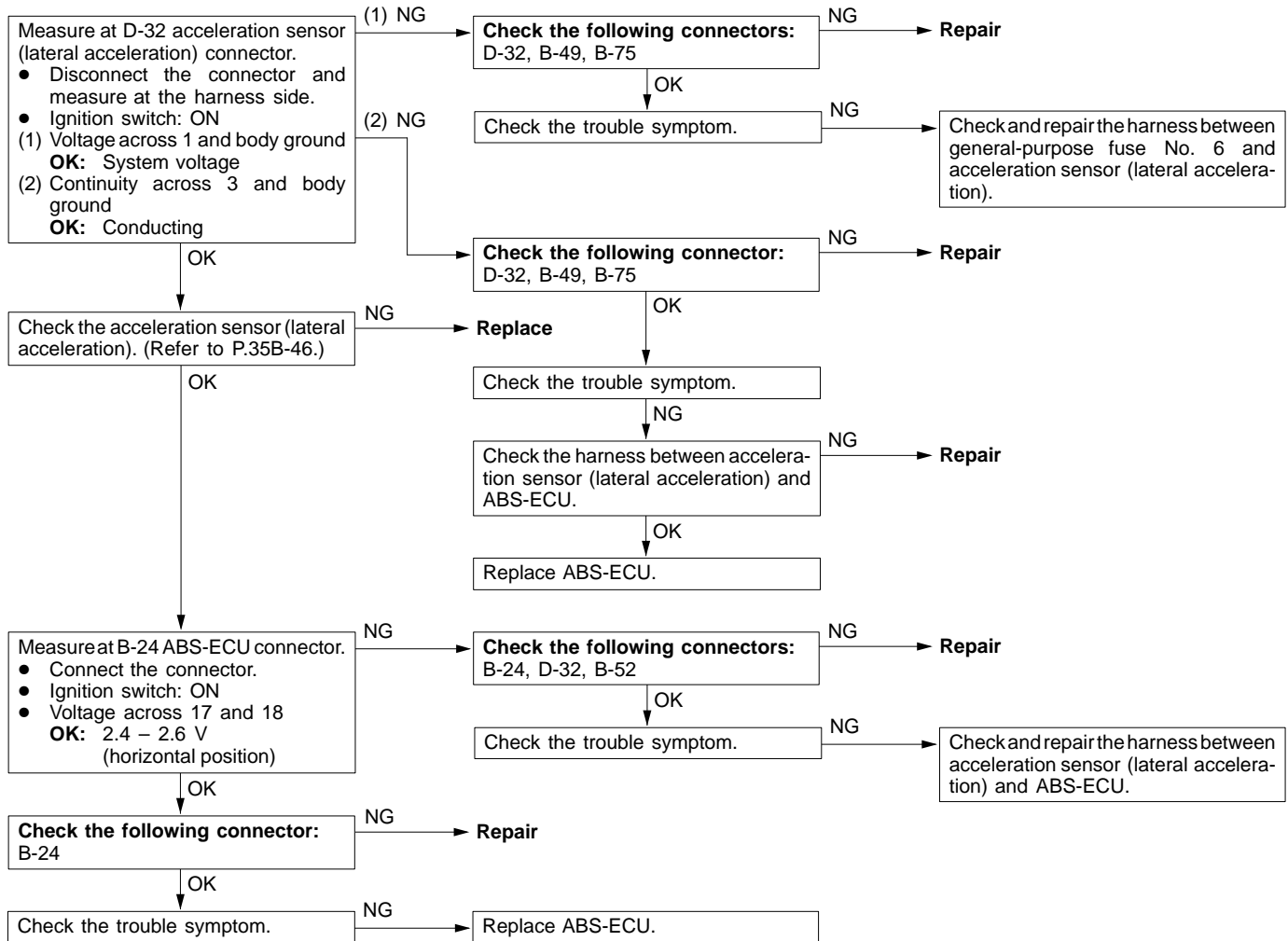
Caution

- (1) If the motor relay contacts fuse, the motor continues running even when the ignition switch is turned OFF. In this case, immediately remove fusible link No. 8 (60 A) or disconnect the A-22 hydraulic unit connector or A-77 motor relay connector. Overloading the motor results in a rundown battery.
- (2) Driving the motor through actuator test runs down the battery. After the test, run the engine for some while.



<EVOLUTION-V, VI>

Code No.71 Acceleration sensor (lateral acceleration) system	Probable cause
This code is output under either of the following conditions: <ul style="list-style-type: none"> • The output from the acceleration sensor (lateral acceleration) becomes 0.5 V or less, or 4.5 V or more. • The acceleration sensor (lateral acceleration) harness is open- or short-circuited. 	<ul style="list-style-type: none"> • Defective acceleration sensor (lateral acceleration) • Defective harness or connector • Defective 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 between the MUT-II and the whole system is not possible.	1	35B-22
Communication between the MUT-II and the ABS-ECU is not possible.	2	35B-23, 24
When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate.	3	35B-25
Even after the engine is started, the ABS warning lamp remains illuminated.	4	35B-26
After the ignition key is turned to "ON", the ABS warning lamp blinks once, and when turned to "START", it illuminates. When returned to "ON", the lamp flashes once, and then switches off.	5	35B-27
When the ignition key is turned to "START", the ABS warning lamp does not illuminate.	6	35B-28
Brake operation is abnormal.	7	35B-28

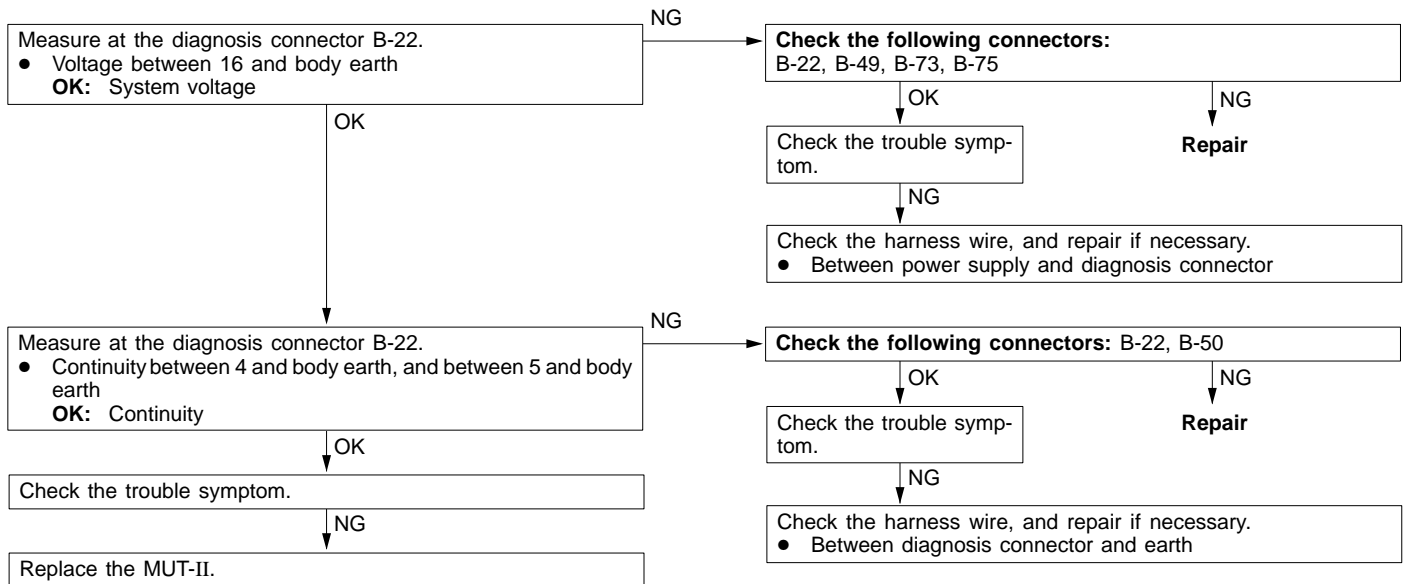
Caution

- (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

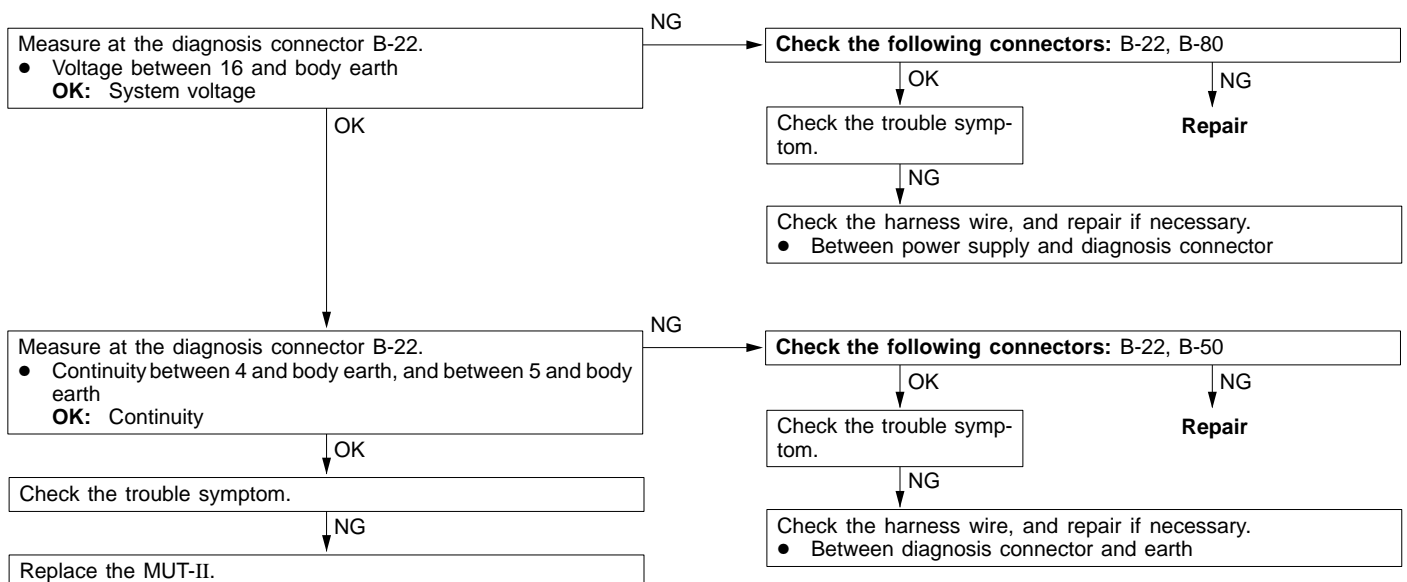
Inspection Procedure 1 <EVOLUTION-IV>

Communication between the MUT-II and the whole system is not possible.	Probable cause
The cause may be a malfunction of the power supply circuit or the earth circuit of the diagnosis connector.	<ul style="list-style-type: none"> Malfunction of diagnosis connector Malfunction of wiring harness or connector



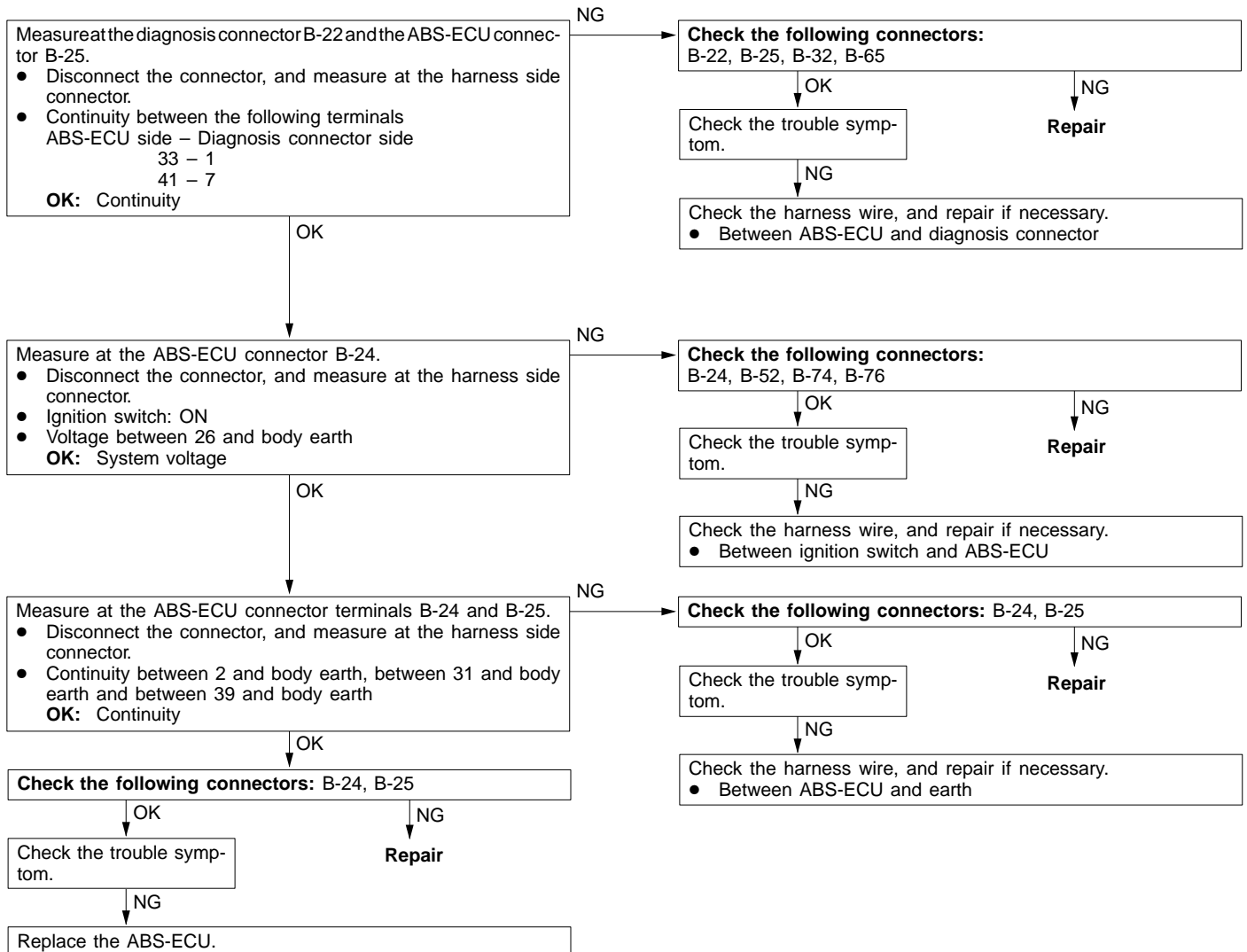
Inspection Procedure 1 <EVOLUTION-V, VI>

Communication between the MUT-II and the whole system is not possible.	Probable cause
The cause may be a malfunction of the power supply circuit or the earth circuit of the diagnosis connector.	<ul style="list-style-type: none"> Malfunction of diagnosis connector Malfunction of wiring harness or connector



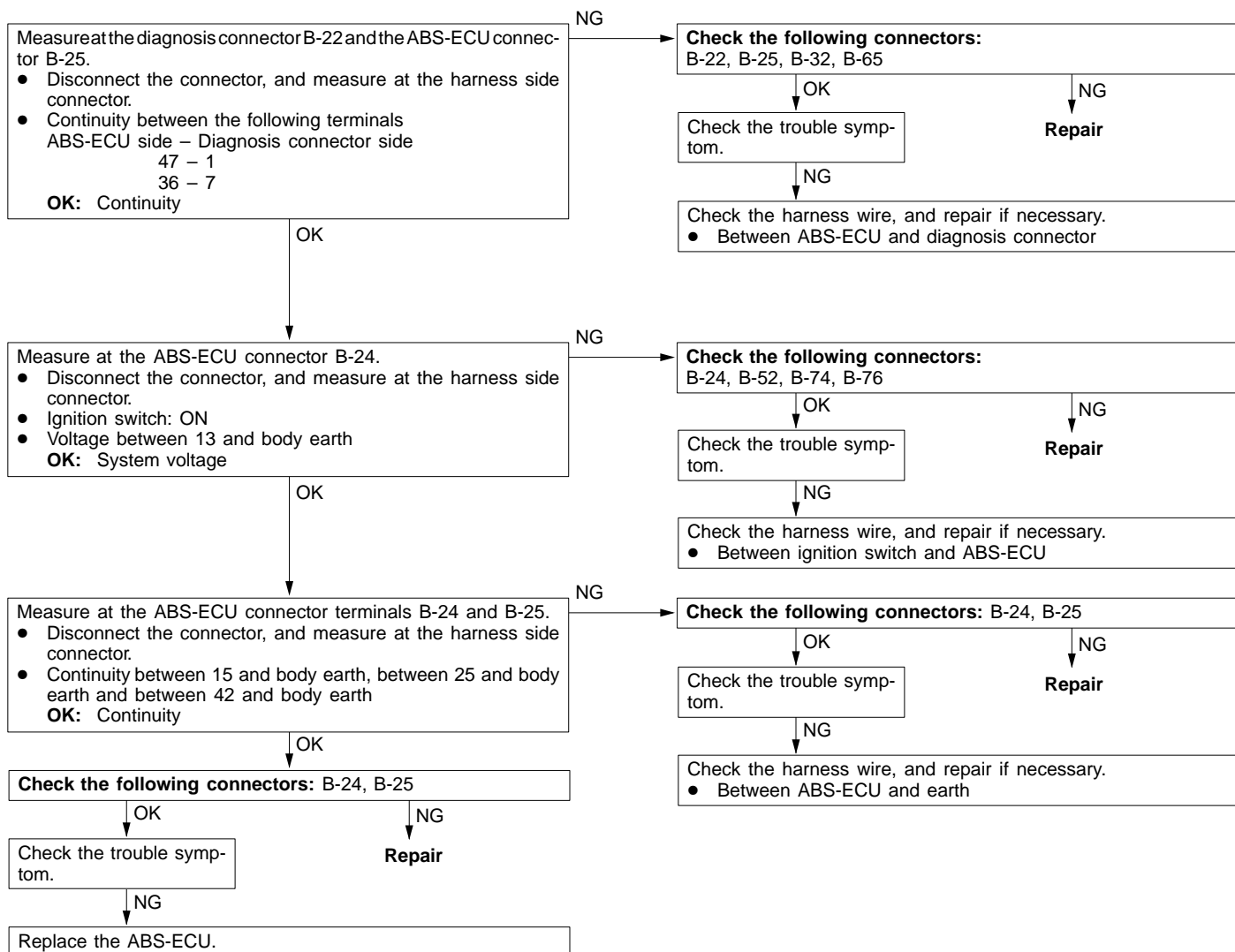
Inspection Procedure 2 <EVOLUTION-IV>

Communication between MUT-II and the ABS-ECU is not possible.	Probable cause
The cause may be an open circuit in the ABS-ECU power supply 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



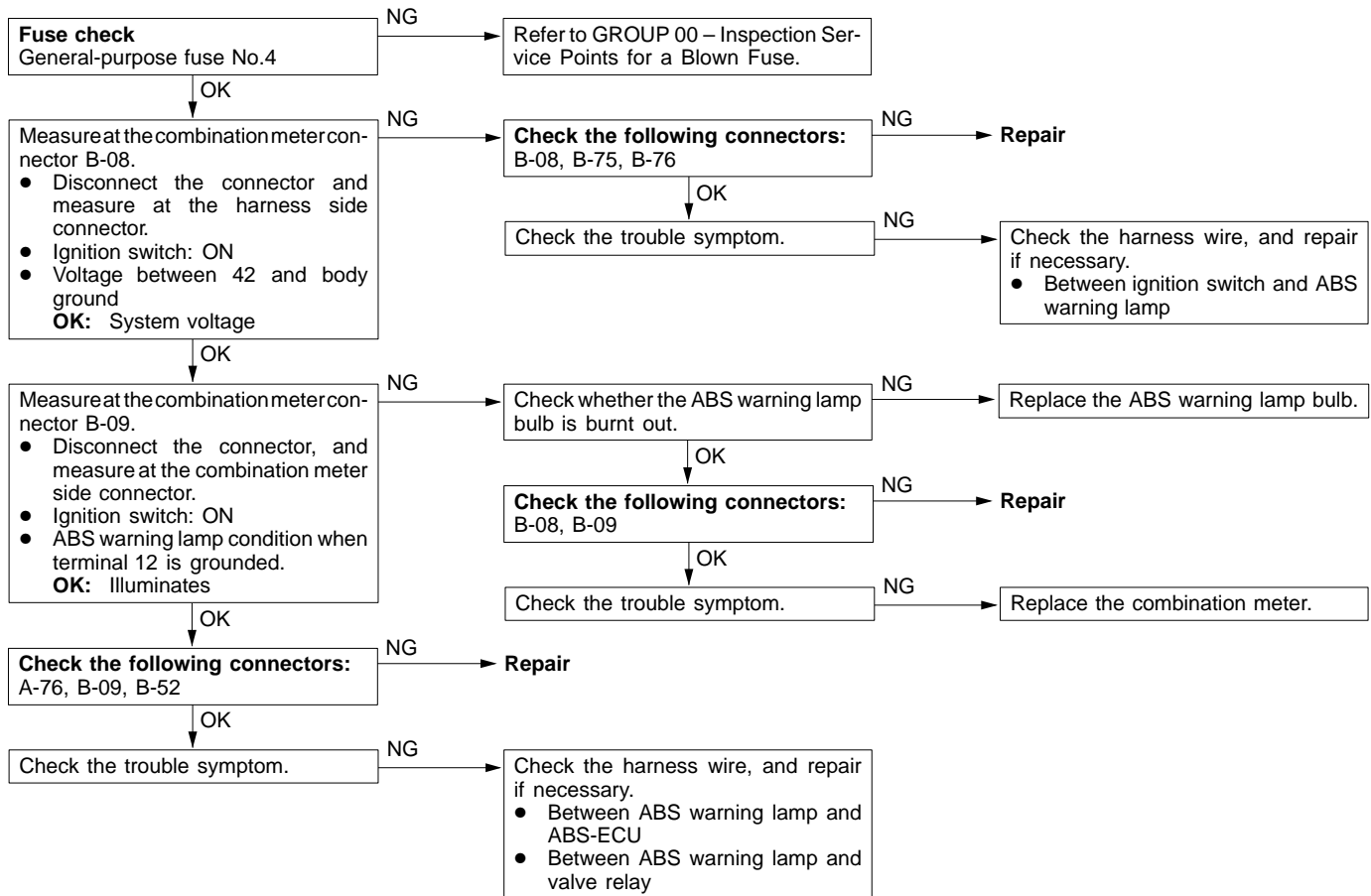
Inspection Procedure 2 <EVOLUTION-V, VI>

Communication between MUT-II and the ABS-ECU is not possible.	Probable cause
The cause may be an open circuit in the ABS-ECU power supply 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 3

When the ignition key is turned to “ON” (engine stopped), the ABS warning lamp does not illuminate.	Probable cause
<p>The ABS-ECU turns the valve relay ON → OFF → ON for initial checking when it is powered ON. Accordingly, the ABS warning lamp illuminates twice even if the circuit between the ABS warning lamp and ABS-ECU is faulty.</p> <p>The cause may be an open circuit in the lamp power supply circuit, a blown lamp, an open circuit between the ABS warning lamp and ABS-ECU or between the ABS warning lamp and the valve relay.</p>	<ul style="list-style-type: none"> • Blown fuse • Burn out ABS warning lamp bulb • Malfunction of wiring harness or connector

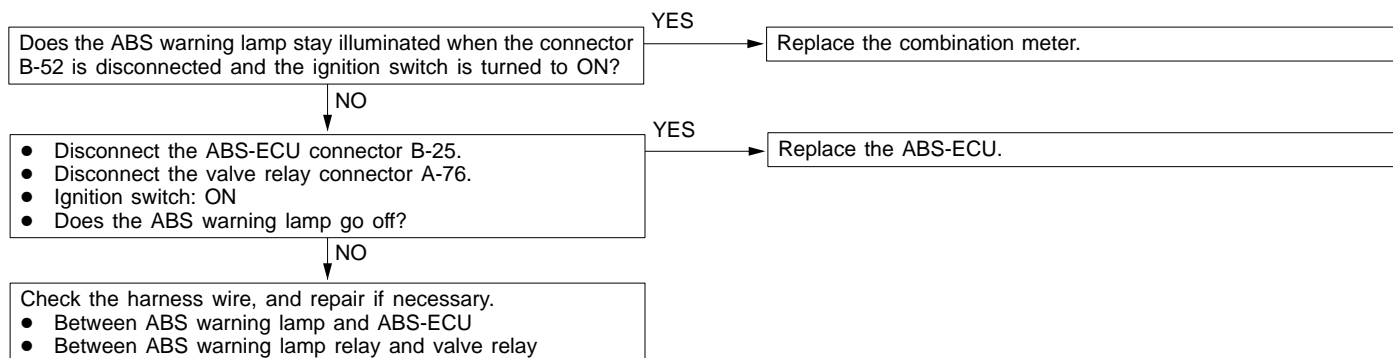


Inspection Procedure 4

Even after the engine is started, the ABS warning lamp remains illuminated.	Probable cause
The cause is probably a short-circuit in the ABS warning lamp illumination circuit.	<ul style="list-style-type: none"> • Malfunction of combination meter • Malfunction of ABS-ECU • Malfunction of wiring harness (short circuit)

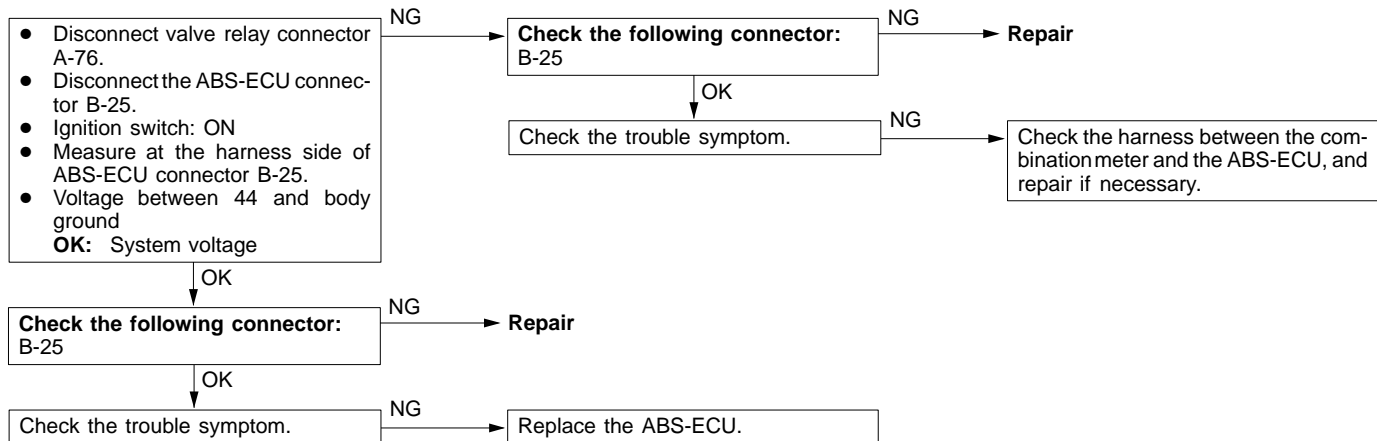
NOTE

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



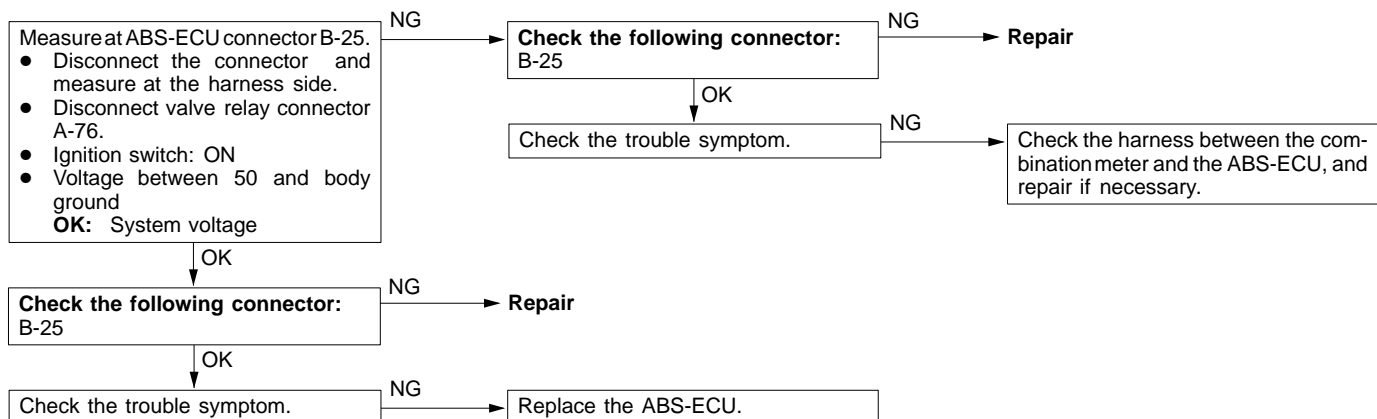
Inspection Procedure 5 <EVOLUTION-IV>

<p>After the ignition key is turned to “ON”, the ABS warning lamp blinks once, and when turned to “START”, it illuminates. When returned to “ON”, the lamp flashes once, and then switches off.</p>	<p>Probable cause</p>
<p>The ABS-ECU causes the ABS warning lamp to illuminate during the initial check. During the initial check, the valve relay turns from off to on, off and back to on again. If there is an open circuit in the harness between the ABS-ECU and the ABS warning lamp, the lamp will illuminate only when the valve relay is OFF during valve relay test, etc.</p>	<ul style="list-style-type: none"> • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



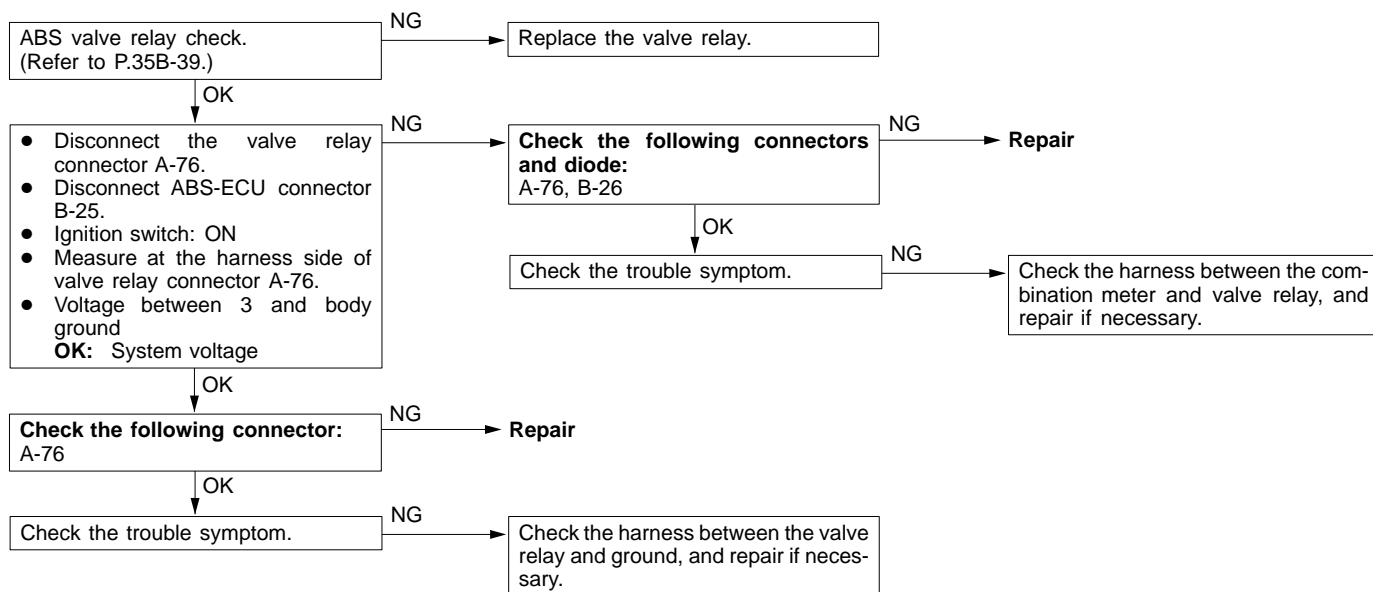
Inspection Procedure 5 <EVOLUTION-V, VI>

<p>After the ignition key is turned to “ON”, the ABS warning lamp blinks once, and when turned to “START”, it illuminates. When returned to “ON”, the lamp flashes once, and then switches off.</p>	<p>Probable cause</p>
<p>The ABS-ECU causes the ABS warning lamp to illuminate during the initial check. During the initial check, the valve relay turns from off to on, off and back to on again. If there is an open circuit in the harness between the ABS-ECU and the ABS warning lamp, the lamp will illuminate only when the valve relay is OFF during valve relay test, etc.</p>	<ul style="list-style-type: none"> • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



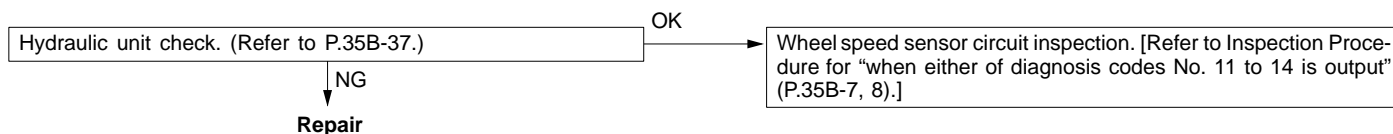
Inspection Procedure 6

When the ignition key is turned to “START”, the ABS warning lamp does not illuminate.	Probable cause
The ABS-ECU is powered through IG2 which is turned off when the ignition key is in START position. The ABS warning lamp is powered through IG1 which is not turned off even when the ignition key is in START position. So the cause must be a defective circuit on valve relay side.	<ul style="list-style-type: none"> • Malfunction of valve relay • Malfunction of wiring harness or connector



Inspection Procedure 7

Brake operation is abnormal.	Probable cause
This symptom varies depending on the driving conditions and the road surface conditions, so problem diagnosis is difficult. However, if no diagnosis code is displayed, carry out the following inspection.	<ul style="list-style-type: none"> • Improper installation of wheel speed sensor • Malfunction of wiring harness or connector • Malfunction of wheel speed sensor • Malfunction of ABS rotor • Foreign material adhering to wheel speed sensor • Malfunction of wheel bearing • Malfunction of hydraulic unit • Malfunction of ABS-ECU



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**<EVOLUTION-IV>**

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	System voltage	Ignition switch: ON	9 – 16 V
27	AYC monitor signal	Perform a test run.	Turns on and off alternately.
32	Acceleration sensor	Keep the vehicle stationary.	2.4 – 2.6 V
		Drive the vehicle.	0.5 – 4.5 V
33	Stop lamp switch	Depress the brake pedal.	ON
		Release the brake pedal.	OFF

<EVOLUTION-V, VI>

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	System voltage	Ignition switch: ON	9 – 16 V
32	Acceleration sensor (longitudinal)	Keep the vehicle stationary on level ground.	2.4 – 2.6 V
		Drive the vehicle.	0.5 – 4.5 V
33	Stop lamp switch	Depress the brake pedal.	ON
		Release the brake pedal.	OFF
71	Acceleration sensor (lateral)	Keep the vehicle stationary on level ground.	2.4 – 2.6 V
		Drive the vehicle.	0.5 – 4.5 V

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

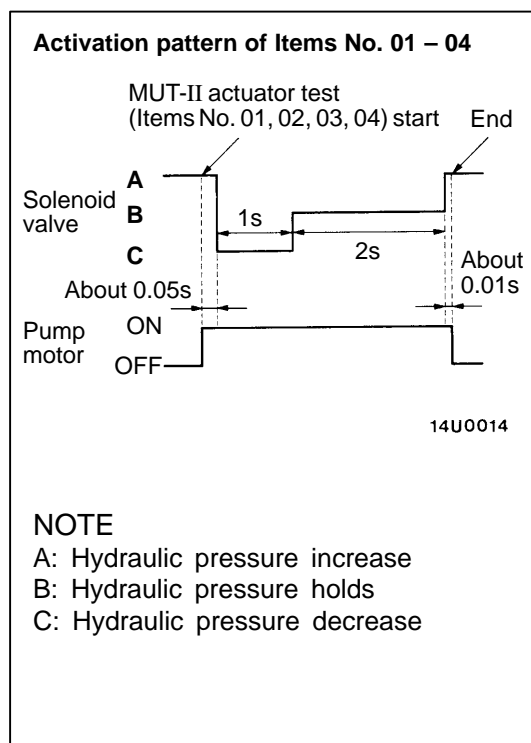
When the diagnosis system stops the ABS-ECU, the MUT-II display data will be unreliable.

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.



ACTUATOR TEST SPECIFICATIONS

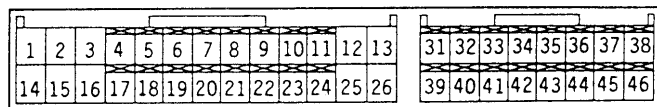
Item No.	Checking item	Activation
01	Solenoid valve for front-right wheel	Solenoid valves and pump motors in the hydraulic unit (simple inspection mode)
02	Solenoid valve for front-left wheel	
03	Solenoid valve for rear-right wheel	
04	Solenoid valve for rear-left wheel	

CHECK AT ABS-ECU TERMINALS

TERMINAL VOLTAGE LISTING

1. The voltage is to be measured across each terminal and ground terminal.
2. Fig. below shows the arrangement of the terminals.

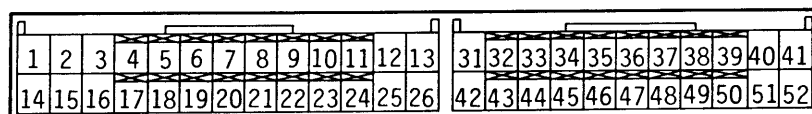
<EVOLUTION-IV>



Terminal No.	Check item	Check requirement	Normally
1	Solenoid valve IN (RR) output	Ignition switch: ON (after initial check)	System voltage
2	Ground	At all times	0 V
14	Solenoid valve OUT (FL) output	Ignition switch: ON (after initial check)	System voltage
15	Solenoid valve OUT (RR) output	Ignition switch: ON (after initial check)	System voltage
16	Solenoid valve IN (FL) output	Ignition switch: ON (after initial check)	System voltage

Terminal No.	Check item	Check requirement		Normally
17	Acceleration sensor input	Ignition switch: ON		2.4 – 2.6 V (horizontal position)
18	Acceleration sensor ground	At all times		0 V
25	ABS-ECU backup power supply	At all times		System voltage
26	ABS-ECU power supply	Ignition switch: ON		System voltage
		Ignition switch: START		0 V
31	Ground	At all times		0 V
33	Diagnosis changeover input	When the MUT-II is connected		0 V
		When the MUT-II is not connected		System voltage
34	Valve relay monitor input	Ignition switch: ON (after initial check)		System voltage
35	Motor monitor input	Ignition switch: ON (after initial check)	When motor is ON	System voltage
			When motor is OFF	0 V
37	Solenoid valve OUT (RL) output	Ignition switch: ON (after initial check)		System voltage
38	Solenoid valve IN (FR) output	Ignition switch: ON (after initial check)		System voltage
39	Ground	At all times		0 V
40	Stop lamp switch input	Ignition switch: ON	Stop lamp switch: ON	System voltage
			Stop lamp switch: OFF	0 V
41	Diagnosis data input/output	When the MUT-II is connected		Serial communication with MUT-II possible
		When the MUT-II is not connected		–
42	Valve relay output	Ignition switch: ON	When relay is ON (after initial check)	0 V
			When relay is OFF	System voltage
43	Motor relay output	Ignition switch: ON	When motor is energized	0 V
			When motor is deenergized	System voltage
44	ABS warning lamp output	Ignition switch: ON	When lamp is off	System voltage
			When lamp is on	0 V
45	Solenoid valve IN (RL) output	Ignition switch: ON		System voltage
46	Solenoid valve OUT (FR) output	Ignition switch: ON		System voltage

<EVOLUTION-V, VI>



14M0128

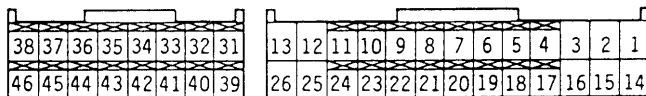
Terminal No.	Check item	Check requirement		Normally
1	Solenoid valve OUT (FL) output	Ignition switch: ON (after initial check)		System voltage
2	Solenoid valve OUT (RR) output	Ignition switch: ON (after initial check)		System voltage
3	Solenoid valve IN (RR) output	Ignition switch: ON (after initial check)		System voltage
4	Acceleration sensor (longitudinal acceleration) input	Ignition switch: ON		2.4 – 2.6 V (horizontal position)
11	Wheel speed (FL) output	Vehicle stationary		1 V or less
		Moving forward slowly		0 – 5 V
13	ABS-ECU power supply	Ignition switch: ON		System voltage
14	Solenoid valve IN (FL) output	Ignition switch: ON (after initial check)		System voltage
15	Ground	At all times		0 V
17	Acceleration sensor ground	At all times		0 V
18	Acceleration sensor (lateral acceleration) input	Ignition switch: ON		2.4 – 2.6 V (horizontal position)
24	Wheel speed (RL) output	Vehicle stationary		1 V or less
		Moving forward slowly		0 – 5 V
25	Ground	At all times		0 V
32	ABS-ECU backup power supply	At all times		System voltage
33	Wheel speed (FR) output	Vehicle stationary		1 V or less
		Moving forward slowly		0 – 5 V
34	Stop lamp switch input	Stop lamp switch: ON		System voltage
		Stop lamp switch: OFF		0 V
36	Diagnosis data input/output	When the MUT-II is connected		Serial communication with MUT-II possible
		When the MUT-II is not connected		–
37	Valve relay output	Ignition switch: ON	When relay is ON	0 V
			When relay is OFF	System voltage
38	Motor relay output	Ignition switch: ON	When motor is energized	0 V
			When motor is deenergized	System voltage
40	Solenoid valve OUT (RL) output	Ignition switch: ON (after initial check)		System voltage
41	Solenoid valve OUT (FR) output	Ignition switch: ON (after initial check)		System voltage
42	Ground	At all times		0 V

Terminal No.	Check item	Check requirement		Normally
44	Wheel speed (RR) output	Vehicle stationary		1 V or less
		Moving forward slowly		0 – 5 V
47	Diagnosis changeover input	When the MUT-II is connected		0 V
		When the MUT-II is not connected		System voltage
48	Valve relay monitor input	Ignition switch: ON (after initial check)		System voltage
49	Motor relay monitor input	Ignition switch: ON	When motor is energized	0 V
			When motor is deenergized	System voltage
50	ABS warning lamp output	Ignition switch: ON	When lamp is off	System voltage
			When lamp is on	0 V
51	Solenoid valve IN (RL) output	Ignition switch: ON (after initial check)		System voltage
52	Solenoid valve IN (FR) output	Ignition switch: ON (after initial check)		System voltage

LISTING OF RESISTANCE AND CONTINUITY ACROSS CONNECTOR TERMINALS ON HARNESS SIDE

1. Measure the resistance and check for continuity with the ignition switch in the “OFF” position and ABS-ECU connector disconnected.
2. Measure the resistance and check for continuity across terminals listed below.
3. Fig. below shows the arrangement of terminals.

<EVOLUTION-IV>

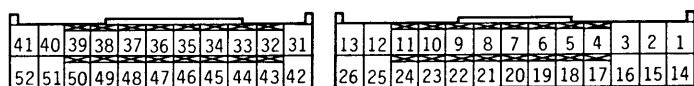


14Y0077

Terminal No.	Signal name	Normally
1 – body ground	Solenoid valve IN (RR)	8.04 – 9.04 Ω
2 – body ground	ECU ground	Conducting
6 – 19	Wheel speed sensor (FL)	1.4 – 1.8 k Ω
7 – 20	Wheel speed sensor (RR)	1.4 – 1.8 k Ω
8 – 21	Wheel speed sensor (FR)	1.4 – 1.8 k Ω
9 – 22	Wheel speed sensor (RL)	1.4 – 1.8 k Ω
14 – body ground	Solenoid valve OUT (FL)	4.04 – 4.54 Ω
15 – body ground	Solenoid valve OUT (RR)	4.04 – 4.54 Ω
16 – body ground	Solenoid valve IN (FL)	8.04 – 9.04 Ω
18 – body ground	Acceleration sensor ground	Conducting
31 – body ground	ECU ground	Conducting
34 – body ground	Valve relay monitor	Conducting
35 – body ground	Motor monitor	Conducting
37 – body ground	Solenoid valve OUT (RL)	4.04 – 4.54 Ω

Terminal No.	Signal name	Normally
38 – body ground	Solenoid valve IN (FR)	8.04 – 9.04 Ω
39 – body ground	ECU ground	Conducting
45 – body ground	Solenoid valve IN (RL)	8.04 – 9.04 Ω
46 – body ground	Solenoid valve OUT (FR)	4.04 – 4.54 Ω

<EVOLUTION-V, VI>



14M0127

Terminal No.	Signal name	Normally
1 – body ground	Solenoid valve OUT (FL) output	4.04 – 4.54 Ω
2 – body ground	Solenoid valve OUT (RR) output	4.04 – 4.54 Ω
3 – body ground	Solenoid valve IN (RR) output	8.04 – 9.04 Ω
7 – 20	Wheel speed sensor (FL) input	1.4 – 1.8 k Ω
8 – 21	Wheel speed sensor (RR) input	1.4 – 1.8 k Ω
9 – 22	Wheel speed sensor (RL) input	1.4 – 1.8 k Ω
10 – 23	Wheel speed sensor (FR) input	1.4 – 1.8 k Ω
14 – body ground	Solenoid valve IN (FL) output	8.04 – 9.04 Ω
15 – body ground	Ground	Conducting
25 – body ground	Ground	Conducting
40 – body ground	Solenoid valve OUT (RL) output	4.04 – 4.54 Ω
41 – body ground	Solenoid valve OUT (FR) output	4.04 – 4.54 Ω
42 – body ground	Ground	Conducting
48 – body ground	Valve relay monitor input	Conducting
49 – body ground	Motor relay monitor input	Conducting
51 – body ground	Solenoid valve IN (RL) output	8.04 – 9.04 Ω
52 – body ground	Solenoid valve IN (FR) output	8.04 – 9.04 Ω

ON-VEHICLE SERVICE

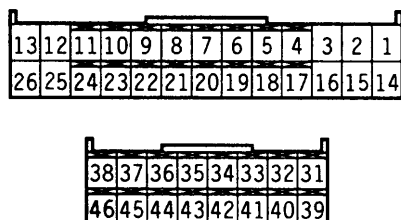
WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK

1. Lift up the vehicle and release the parking brake.
2. Disconnect the ABS-ECU connector, and then measure the output voltage at the harness-side connector.

Caution

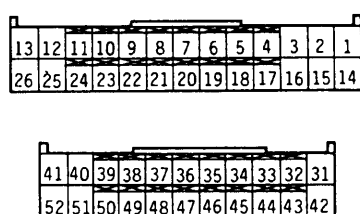
Insert the probe in the connector from the harness side after releasing the double lock. Inserting it from the terminal side could cause poor contacts.

ABS-ECU connector (harness side)
<EVOLUTION-IV>



14P0040

ABS-ECU connector (harness side)
<EVOLUTION-V, VI>



A14M0127

3. Rotate the wheel to be measured at approximately 1/2–1 rotation per second, and check the output voltage using a circuit tester (ACmV range) or an oscilloscope.

Terminal numbers

<EVOLUTION-IV>

Front left	Front right	Rear left	Rear right
6	8	9	7
19	21	22	20

<EVOLUTION-V, VI>

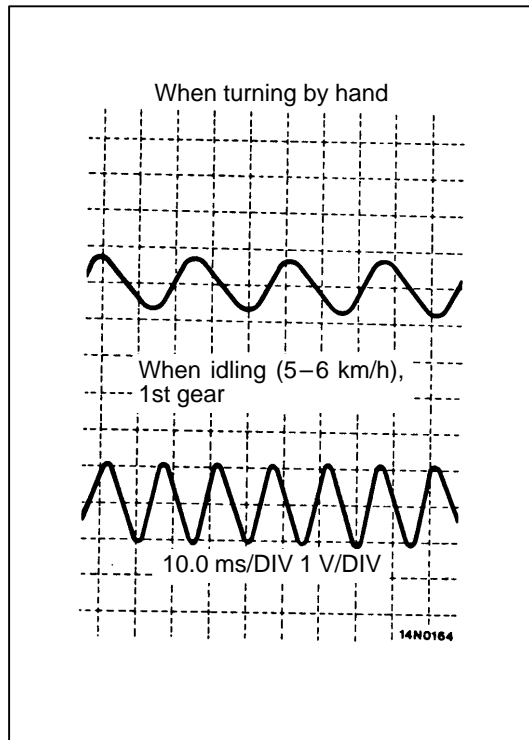
Front left	Front right	Rear left	Rear right
7	10	9	8
20	23	22	21

Output voltage

When measuring with a circuit tester:
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 following causes are suspected. Check the wheel speed sensors and replace if necessary.
 - Too large gap between wheel speed sensor pole piece and ABS rotor
 - Faulty 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. Check the connection of the sensor harness and connector before using the oscilloscope.

Start the engine, and rotate the wheels by engaging 1st gear.

NOTE

- (1) The waveform measurements can also be taken while the vehicle is actually moving.
- (2) 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
	Faulty ABS-ECU ground	Repair
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 rotor

Caution

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.

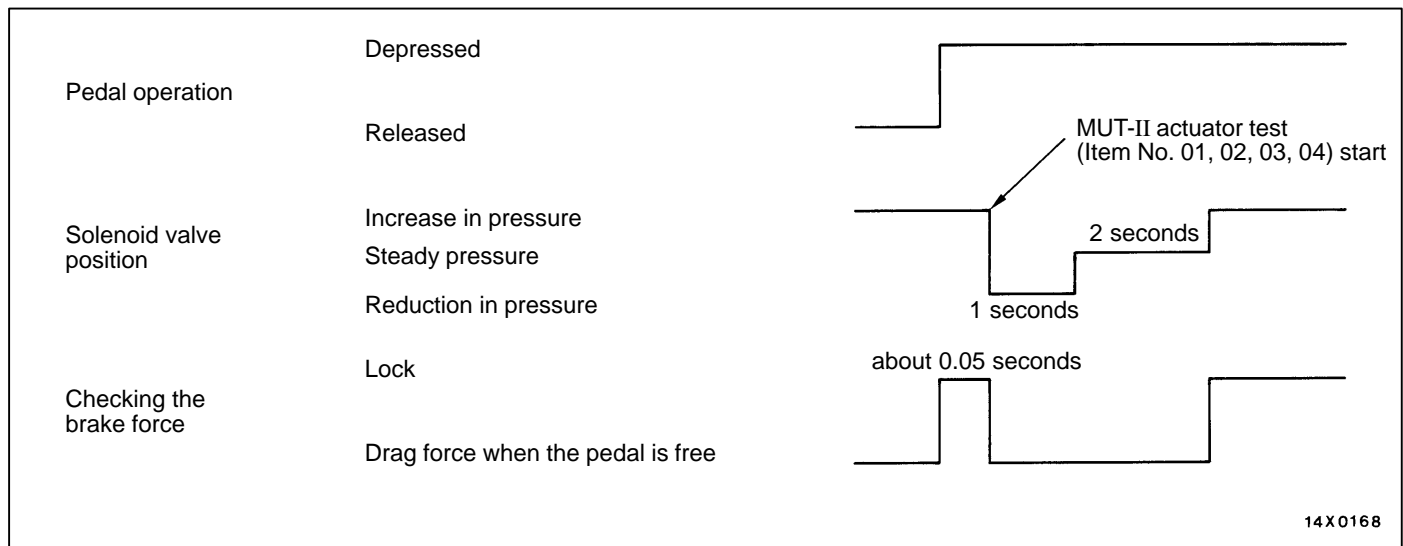
2. Turn the ignition key to the OFF position and set the MUT-II.
3. After checking that the shift lever is in neutral, start the engine.

NOTE

- (1) During the actuator test, the ABS warning lamp will illuminate and the anti-skid control will be cancelled.
 - (2) When the ABS has been interrupted by the fail-safe function, the MUT-II actuator testing cannot be used.
4. Use the MUT-II to force-drive the actuator.
 5. 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 decreases 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.

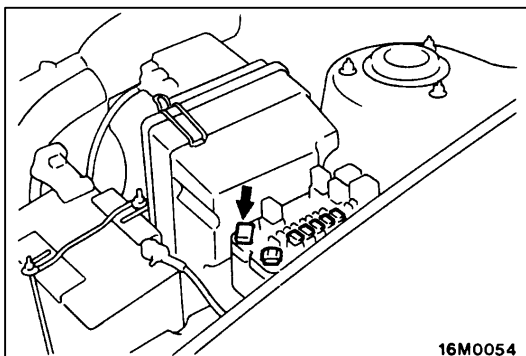


6. If the result of inspection is abnormal, correct according to the “Diagnosis Table”.

Diagnosis Table

No.	MUT-II display	Operation	Judgement – Normal	Judgement – Abnormal	Probable cause	Remedy
01	FR valve	(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 using brake force tester or manually to check the change of brake force.	Brake force released for 3 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	FL valve				Clogged hydraulic circuit in hydraulic unit	Replace hydraulic unit assembly
03	RR valve			Brake force is not released	Incorrect hydraulic unit brake tube connection	Connect correctly
04	RL valve				Hydraulic unit solenoid valve not functioning correctly	Replace hydraulic unit assembly

7. After inspection, turn the ignition switch off and remove the MUT-II.

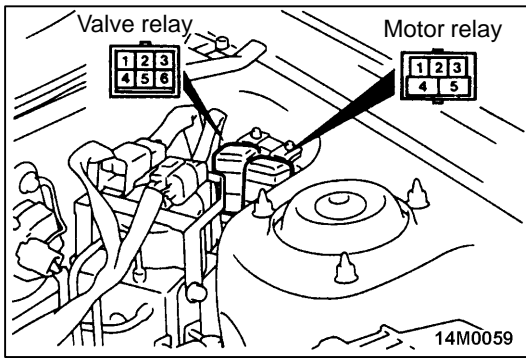


REMEDY FOR A FLAT BATTERY

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.

**ABS MOTOR RELAY CONTINUITY CHECK**

Checking condition	Terminal No.				
	1	2	3	4	5
Power is not supplied	○		○		
Power is supplied	⊕		⊖	○	○

ABS VALVE RELAY CONTINUITY CHECK

Checking condition	Terminal No.					
	1	2	3	4	5	6
Power is not supplied		○			○	
Power is supplied	○		○			○
		⊕			⊖	

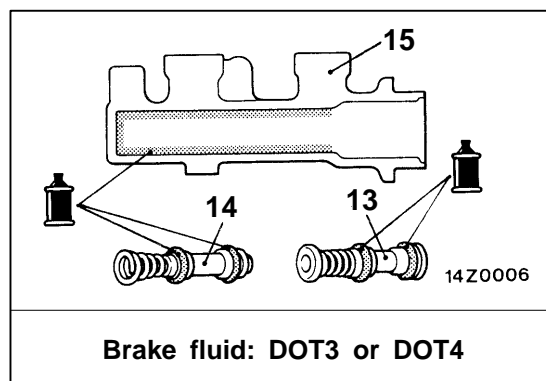
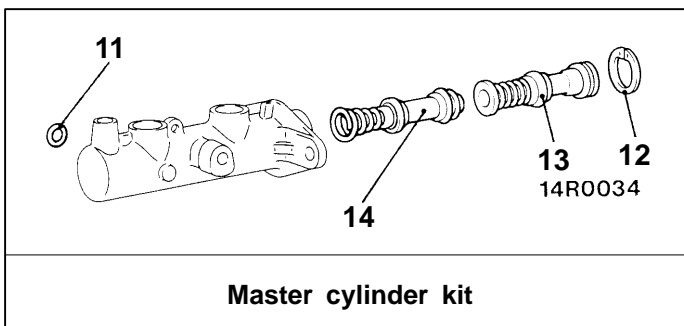
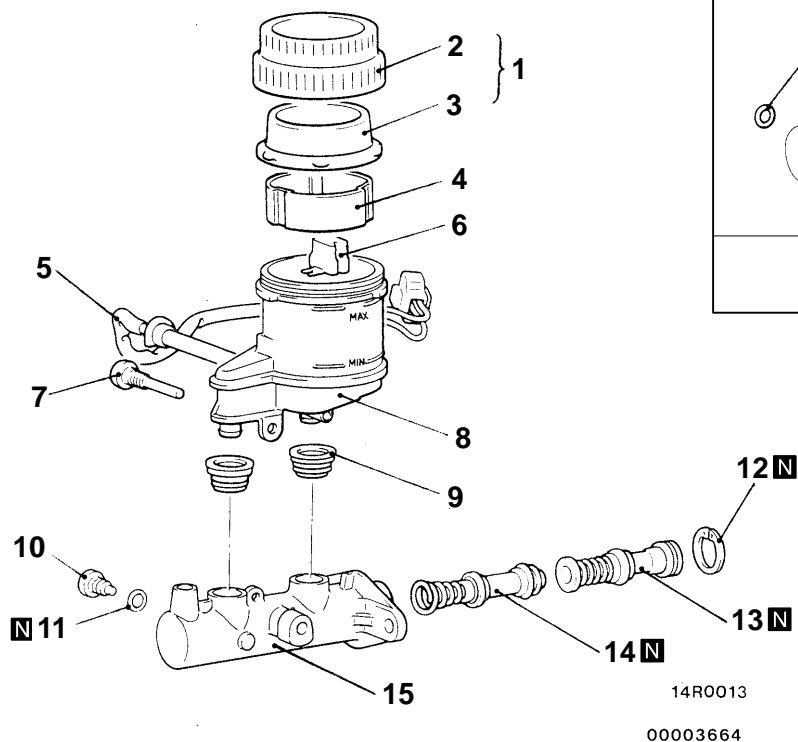
MASTER CYLINDER AND BRAKE BOOSTER

REMOVAL AND INSTALLATION

Refer to GROUP 35A.

MASTER CYLINDER

DISASSEMBLY AND REASSEMBLY

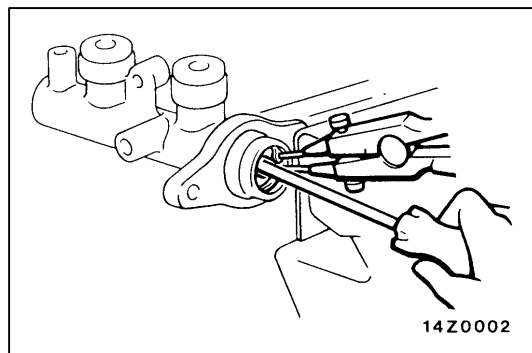


Disassembly steps

1. Reservoir cap assembly
2. Reservoir cap
3. Diaphragm
4. Filter
5. Brake fluid level sensor
6. Float
7. Reservoir stopper bolt



8. Reservoir tank
9. Reservoir seal
10. Piston stopper bolt
11. Gasket
12. Piston stopper ring
13. Primary piston assembly
14. Secondary piston assembly
15. Master cylinder body



DISASSEMBLY SERVICE POINTS

◀A▶ PISTON STOPPER BOLT / STOPPER RING REMOVAL

Remove the piston stopper bolt and stopper ring, while depressing the primary piston assembly.

NOTE

Shown at left is the stopper ring removal manner.

HYDRAULIC UNIT

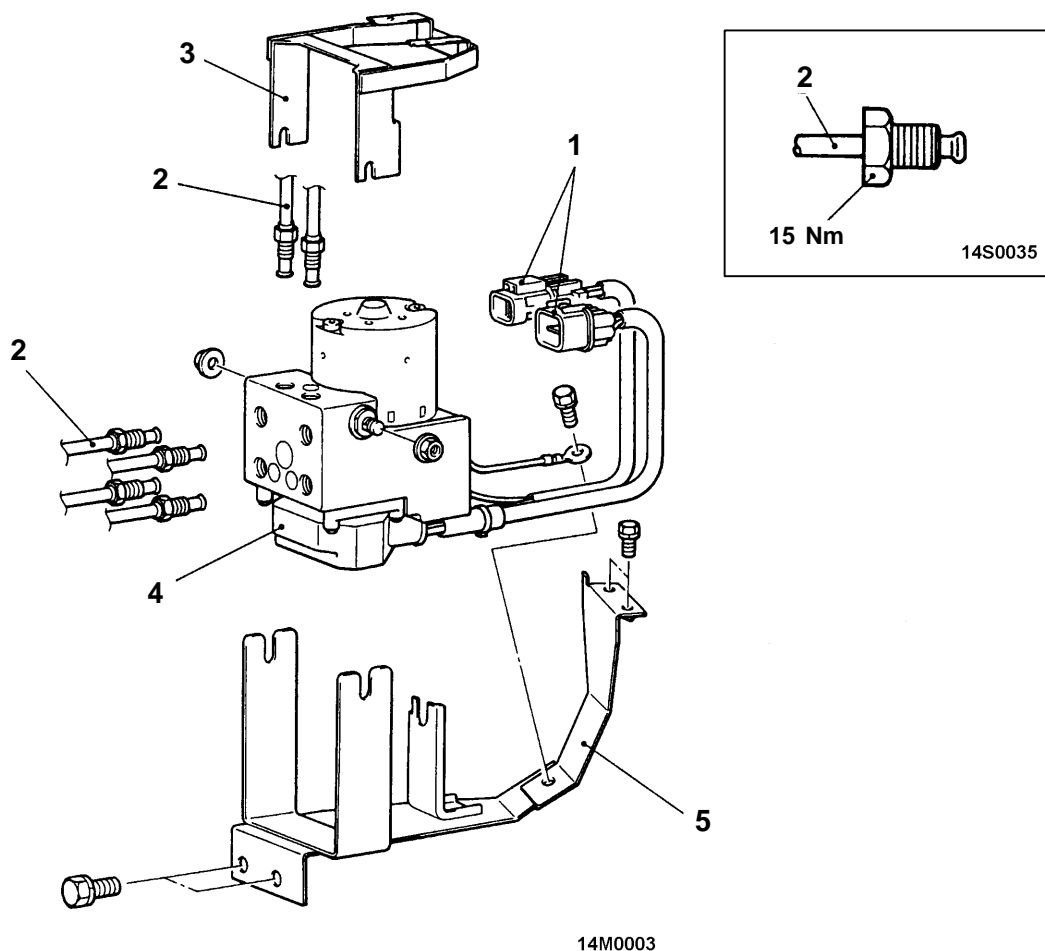
REMOVAL AND INSTALLATION

Pre-removal Operation

- Brake Fluid Draining

Post-installation Operation

- Brake Fluid Supplying and Air Bleeding
- Hydraulic Unit Checking (Refer to P.35B-37.)



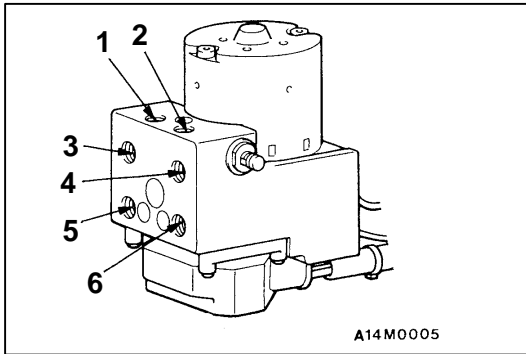
Removal steps

1. Harness connector
2. Brake pipe connection
3. Connector bracket
4. Hydraulic unit assembly
5. Hydraulic unit bracket



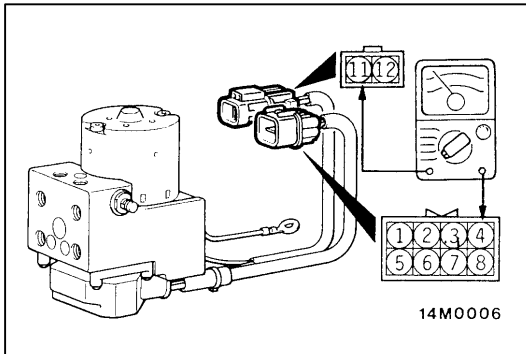
REMOVAL SERVICE POINT**◀A▶ HYDRAULIC UNIT ASSEMBLY REMOVAL****Caution**

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



INSPECTION

SOLENOID VALVE CHECK

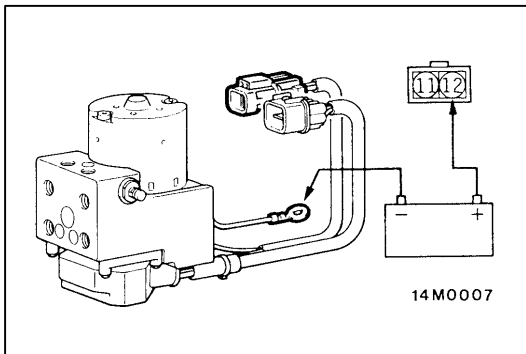
Measure the resistance between the terminals of the following solenoid valves.

Standard value:

Solenoid valve IN 8.04 – 9.04 Ω

Solenoid valve OUT 4.04 – 4.54 Ω

Solenoid valve IN	Measurement terminal	Solenoid valve OUT	Measurement terminal
Front (right)	1 – 11	Front (right)	5 – 11
Front (left)	4 – 11	Front (left)	8 – 11
Rear (right)	3 – 11	Rear (right)	7 – 11
Rear (left)	2 – 11	Rear (left)	6 – 11



MOTOR OPERATION CHECK

Connect the battery to the motor and check if the operating sound is heard.

Caution

Never apply the battery power for more than 1 second.

WHEEL SPEED SENSOR

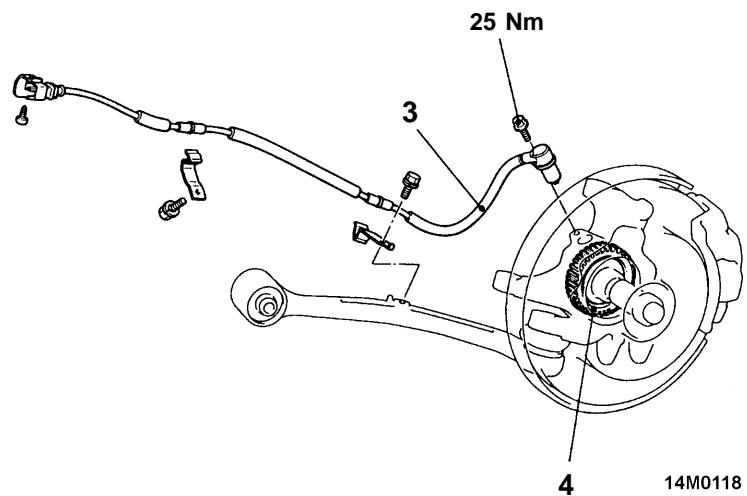
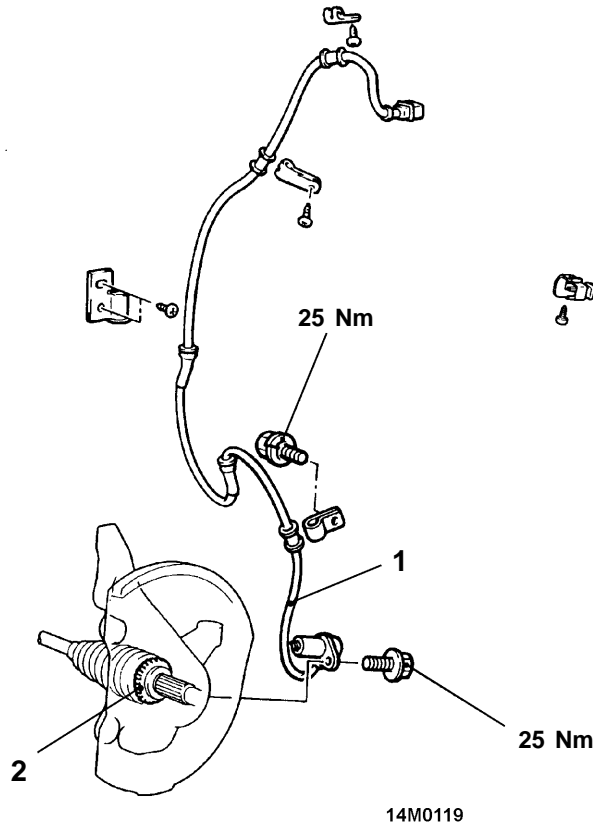
REMOVAL AND INSTALLATION

Post-installation Operation

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

<Front>

<Rear>



Front speed sensor removal steps



- Splash shield
- 1. Front speed sensor
- 2. Front ABS rotor

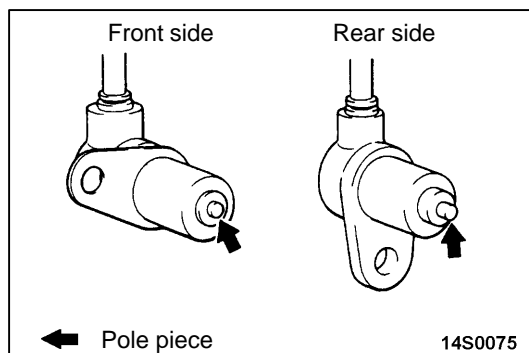
NOTE

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

Rear speed sensor removal steps



- 3. Rear speed sensor
- 4. Rear ABS rotor



REMOVAL SERVICE POINT

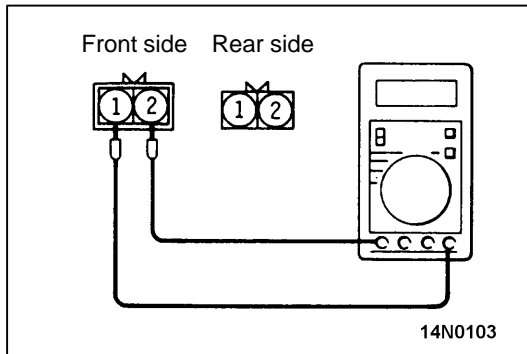
◀A▶ FRONT SPEED SENSOR / REAR SPEED SENSOR REMOVAL

Caution

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

INSPECTION**RESISTANCE CHECK BETWEEN SPEED SENSOR TERMINALS****NOTE**

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



1. Measure the resistance between the speed sensor terminals.

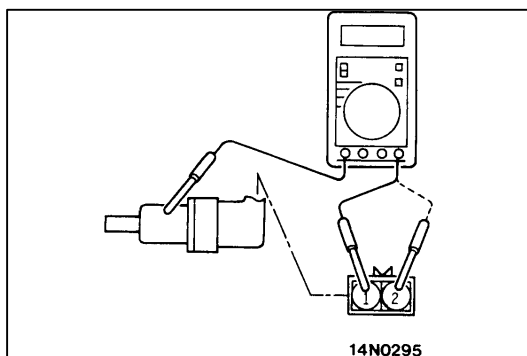
Standard value: 1.4 – 1.8 k Ω

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

2. 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. Check also that the connector is free from poor contact, loose terminal, etc.

**SPEED SENSOR INSULATION CHECK**

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

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

ABS ROTOR CHECK

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

ACCELERATION SENSOR

REMOVAL AND INSTALLATION

CAUTION: SRS

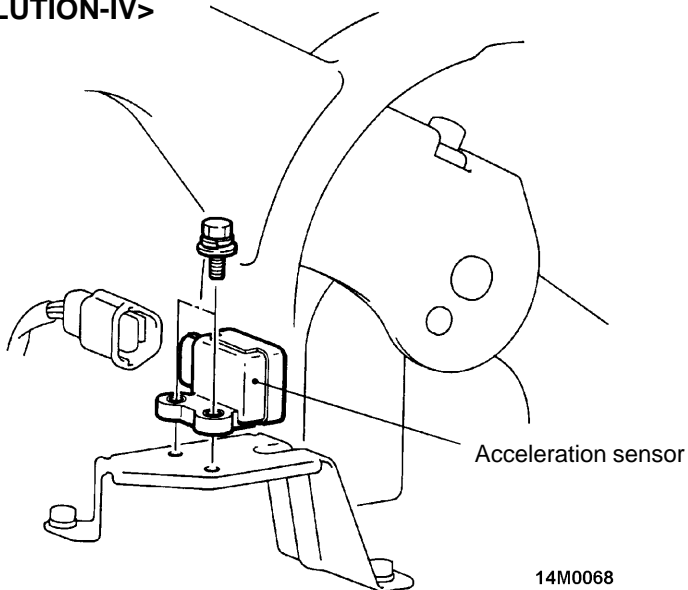
When removing and installing the ABS-ECU from vehicles equipped with SRS, do not let it bump against the SRS-ECU or other components.

Caution

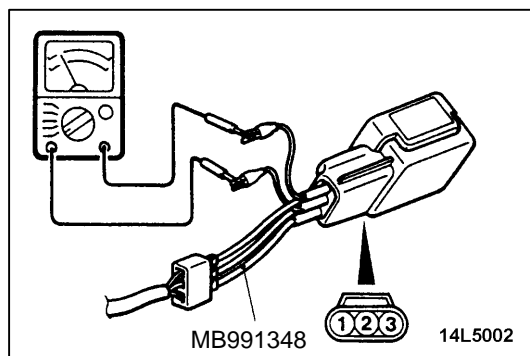
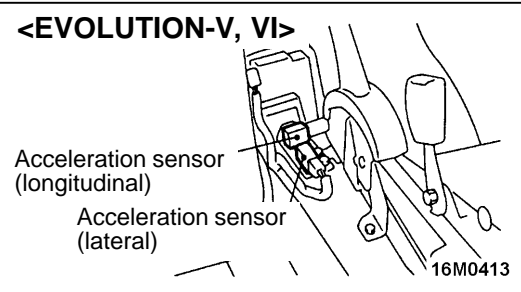
Use utmost care not to drop the sensors nor expose them to any other type of shock.

Pre-removal and Post-installation Operation
 • Floor Console Removal and Installation

<EVOLUTION-IV>



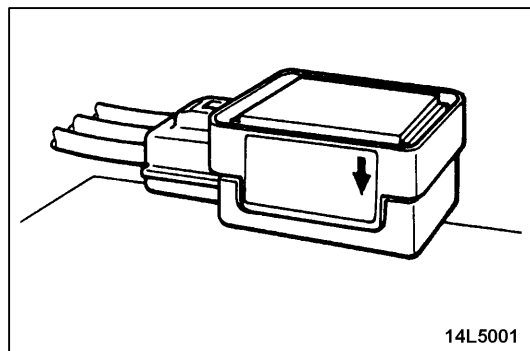
<EVOLUTION-V, VI>



INSPECTION

1. Disconnect the acceleration sensor connector and connect the special tool to the terminals of the disconnected connector.
2. Turn on the ignition switch. Measure the output voltage across the terminals No. 2 and No. 3.

Standard value: 2.4 – 2.6 V



3. With the special tool connected, hold the sensor in such a way that the front mark on the mounting surface is directed downward. Then, read the output voltage between the terminals No. 2 and No. 3.

Standard value: 3.4 – 3.6 V

4. If the reading does not conform to the standard value, check the power supply and grounding lines for abnormality. If they are in order, replace the acceleration sensor.

ABS-ECU

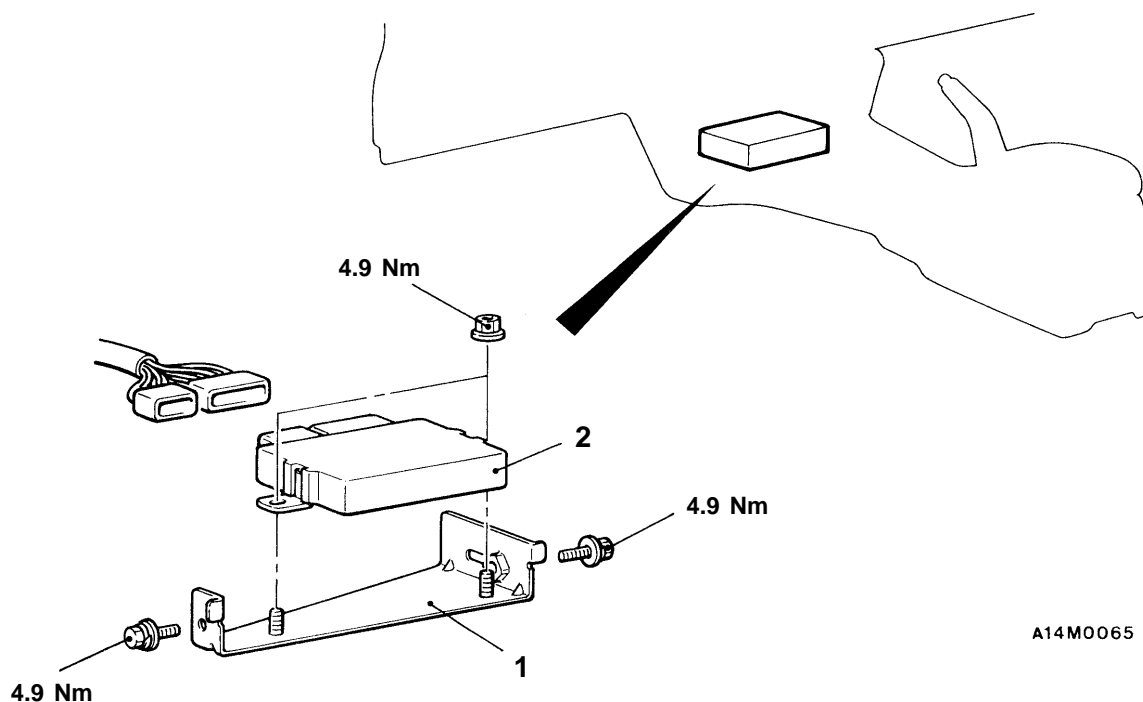
REMOVAL AND INSTALLATION

CAUTION: SRS

When removing and installing the ABS-ECU from vehicles equipped with SRS, do not let it bump against the SRS-ECU or other components.

Pre-removal and Post-installation Operation

- Floor Console Removal and Installation



A14M0065

Removal steps

1. ABS-ECU bracket
2. ABS-ECU

INSPECTION

Refer to P.35B-30.

NOTES