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# ANTI-LOCK BRAKING SYSTEM (ABS)

## CONTENTS

<b>TROUBLESHOOTING</b> .....	<b>2</b>	<b>ON-VEHICLE SERVICE</b> .....	<b>17</b>
1. Inspection Chart for Diagnosis Codes ...	2	Wheel Speed Sensor Output Voltage	
2. Inspection Procedure for Diagnostic		Measurement <EVOLUTION-V> .....	17
Trouble Codes .....	3	<b>LATERAL ACCELERATION SENSOR</b> ...	<b>17</b>
3. Inspection Chart for Trouble Symptoms	11	<b>WHEEL SPEED SENSOR</b> .....	<b>18</b>
4. Inspection Procedure for Trouble			
Symptoms .....	12		
5. Check at ABS-ECU Terminals .....	15		



The EVOLUTION-V is provided with a lateral acceleration sensor in addition to the longitudinal acceleration sensor, and the ABS-ECU connector is changed in terminal arrangement. When servicing EVOLUTION-V, therefore, use the following service procedures.

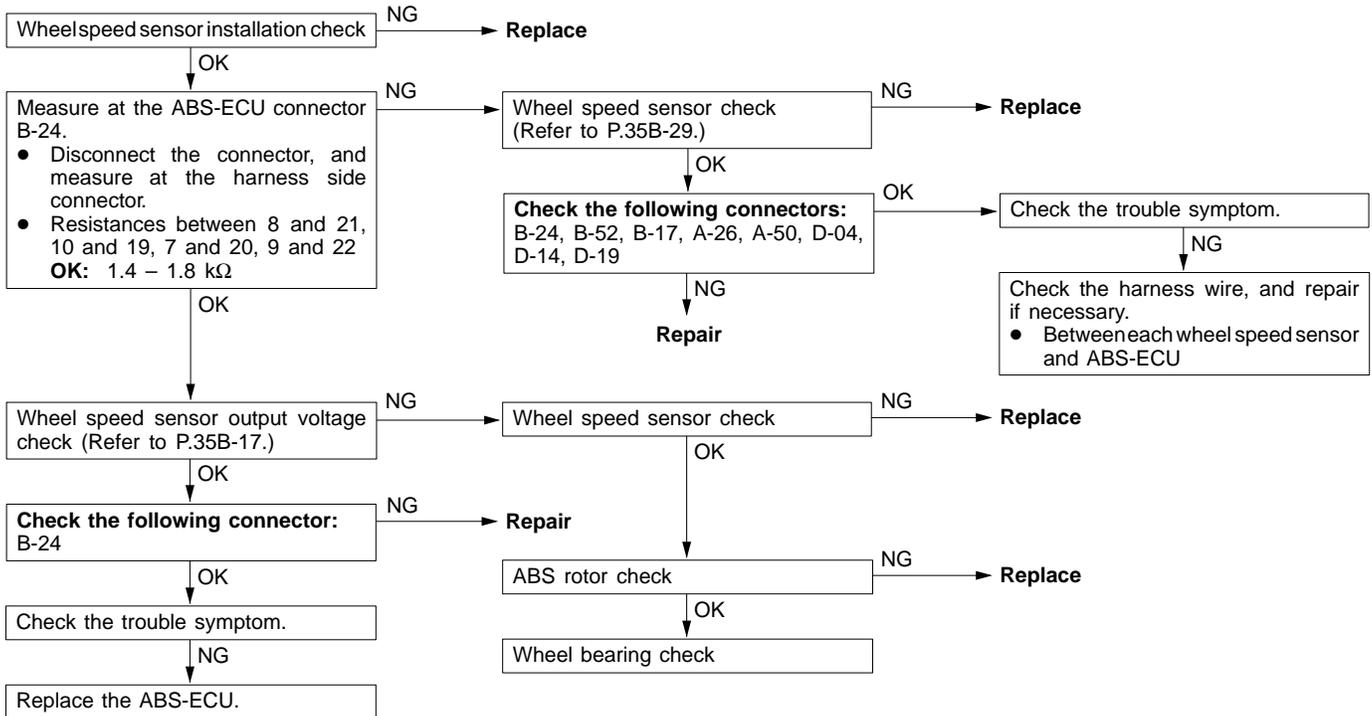
## TROUBLESHOOTING

### 1. INSPECTION CHART FOR DIAGNOSIS CODES

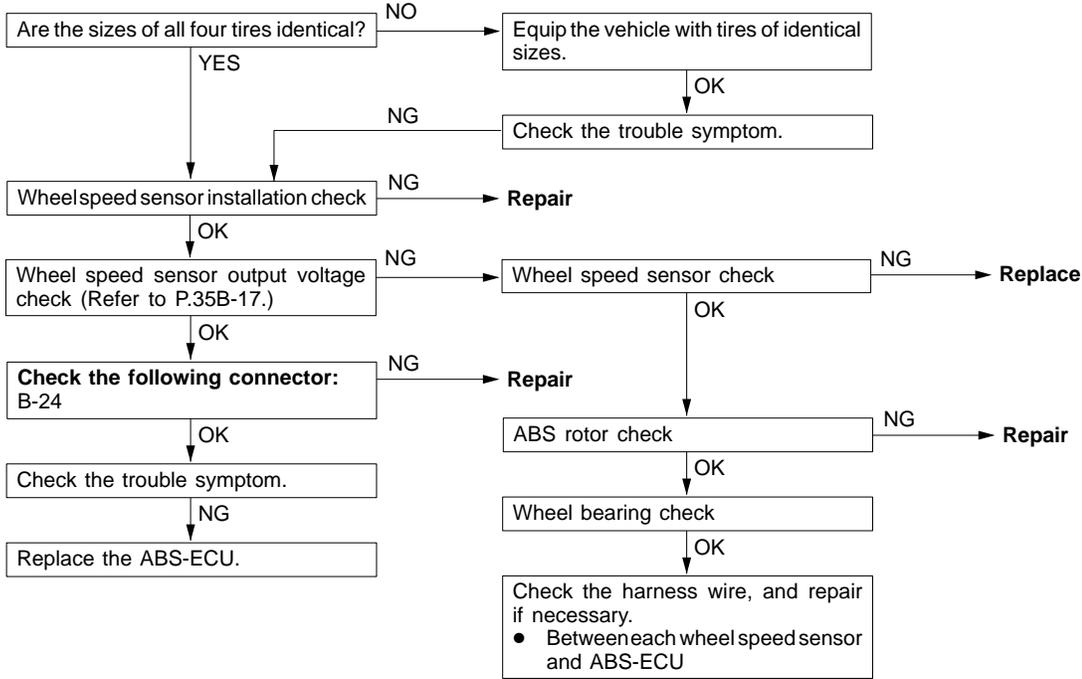
Diagnosis code No.	Diagnosis items	Reference Page
11	Wheel speed sensor (FR) system (open- or short-circuit)	35B-3
12	Wheel speed sensor (FL) system (open- or short-circuit)	35B-3
13	Wheel speed sensor (RR) system (open- or short-circuit)	35B-3
14	Wheel speed sensor (RL) system (open- or short-circuit)	35B-3
15	Wheel speed sensor system (abnormal output signal)	35B-4
16	ABS-ECU power supply voltage system (abnormal voltage drop or rise)	35B-5
21	Wheel speed sensor (FR) system	35B-2
22	Wheel speed sensor (FL) system	35B-2
23	Wheel speed sensor (RR) system	35B-2
24	Wheel speed sensor (RL) system	35B-2
27	AYC monitor system (detective AYC)	35B-6
32	Longitudinal acceleration sensor circuit system	35B-6
33	Stop lamp switch system	35B-7
41	Solenoid valve (FR) system	35B-7
42	Solenoid valve (FL) system	35B-7
43	Solenoid valve (RR) system	35B-7
44	Solenoid valve (RL) system	35B-7
51	Valve relay system	35B-8
53	Motor relay system	35B-9
63	ABS-ECU failure	Replace ABS-ECU.
71	Lateral acceleration sensor system	35B-10

**2. INSPECTION PROCEDURE FOR DIAGNOSTIC TROUBLE CODES**

<p><b>Code Nos.11, 12, 13 and 14: Wheel speed sensor (open circuit or short circuit)</b></p>	<p><b>Probable cause</b></p>
<p><b>Code Nos.21, 22, 23 and 24: Wheel speed sensor</b></p>	
<p>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.</p>	<ul style="list-style-type: none"> <li>● Malfunction of wheel speed sensor</li> <li>● Malfunction of wiring harness or connector</li> <li>● Malfunction of ABS-ECU</li> </ul>
<p>Code Nos.21, 22, 23 and 24 are output in the following cases.</p> <ul style="list-style-type: none"> <li>● 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.</li> <li>● 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.</li> </ul>	<ul style="list-style-type: none"> <li>● Malfunction of wheel speed sensor</li> <li>● Malfunction of wiring harness or connector</li> <li>● Too much gap between the sensor and the rotor</li> <li>● Malfunction of ABS-ECU</li> <li>● Malfunction of wheel bearing</li> </ul>



Code No.15: Wheel speed sensor (abnormal output signal)	Probable cause
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).	<ul style="list-style-type: none"> <li>● The four vehicle tires are of different sizes</li> <li>● Malfunction of wheel speed sensor</li> <li>● Malfunction of wiring harness or connector</li> <li>● Malfunction of ABS-ECU</li> <li>● Malfunction of wheel bearing</li> </ul>

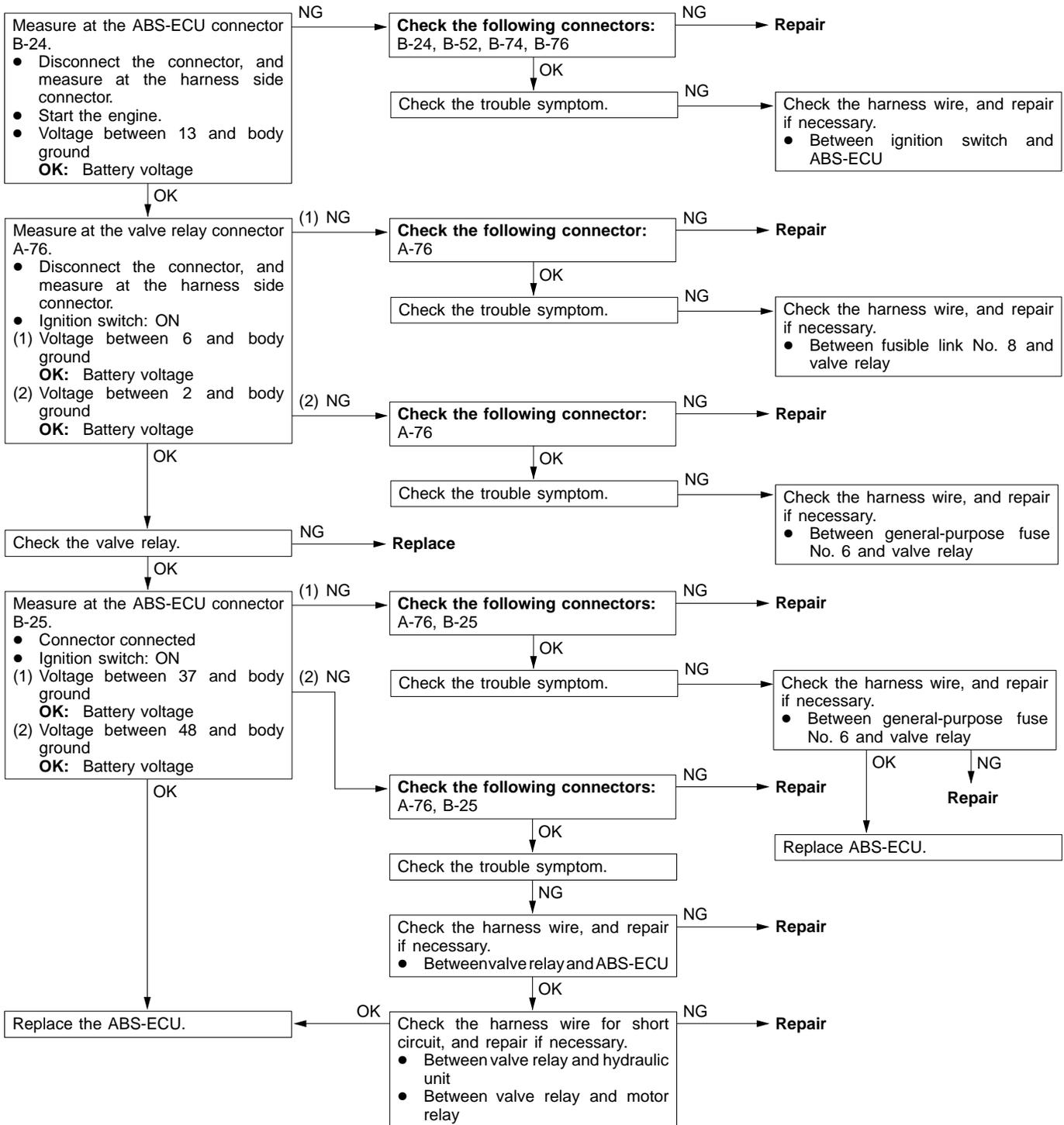


Code No.16: ABS-ECU power supply system (abnormal voltage drop or rise)	Probable cause
This code is output if the ABS-ECU or valve relay power supply voltage drops below or rises above the rated values. The valve relay power supply voltage is detected based on the voltage in the valve relay monitor line.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

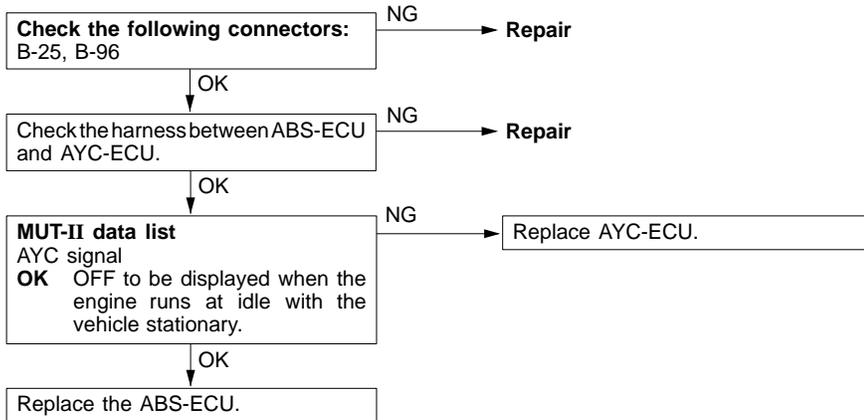
**Caution**

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

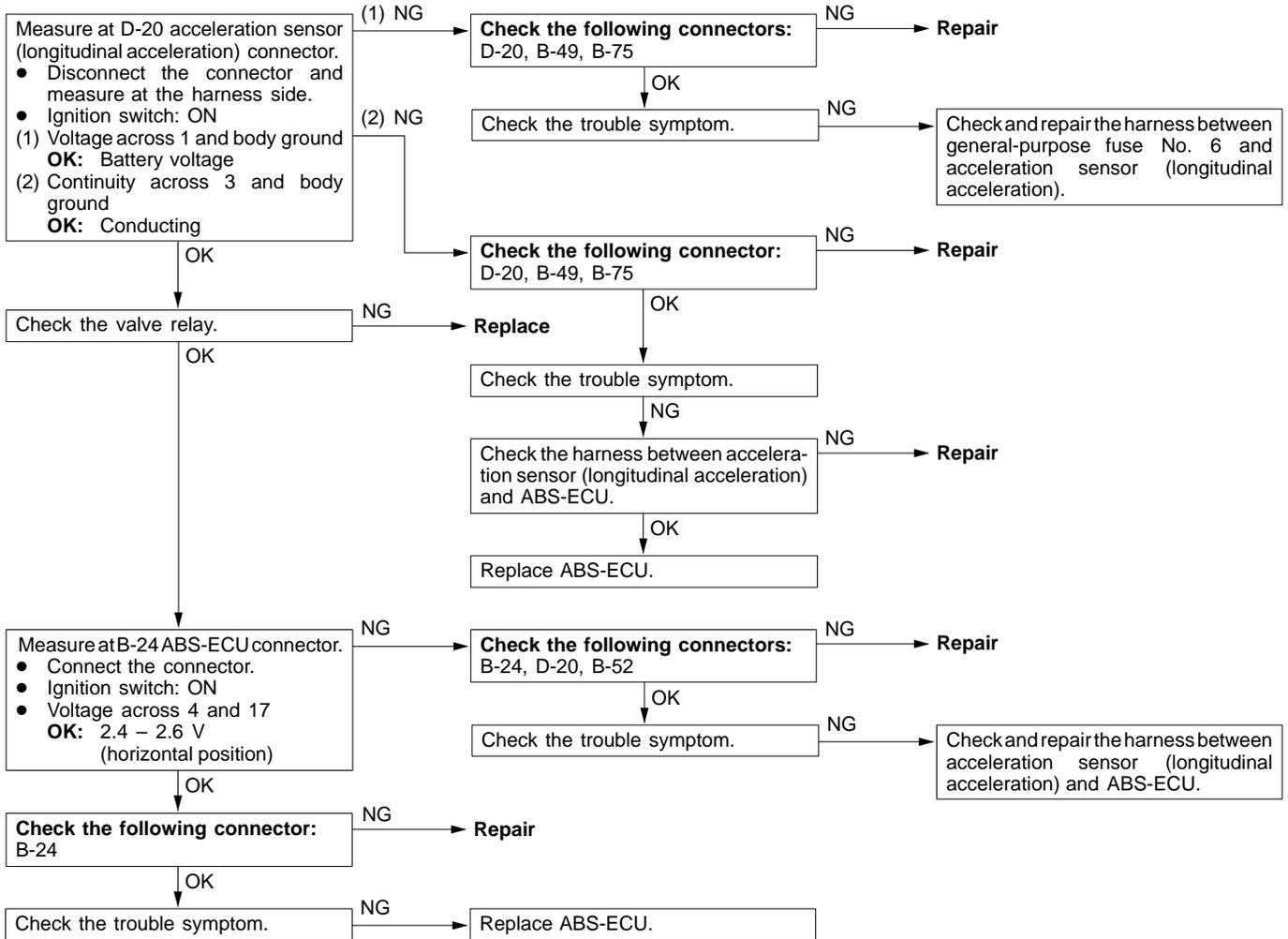
Before carrying out the following inspection, check the battery level, and refill it if necessary.



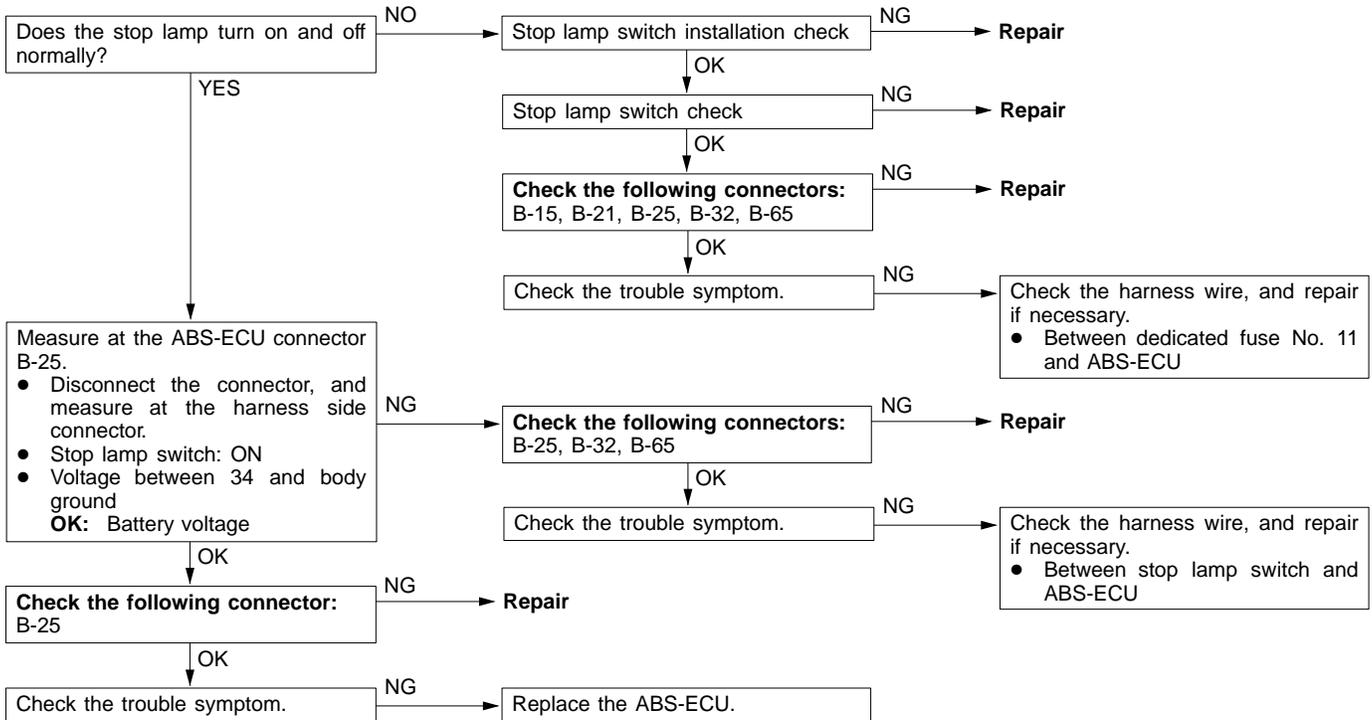
Code No. 27: AYC monitor system (defective AYC)	Probable cause
This code is output when the AYC monitor signal becomes faulty.	<ul style="list-style-type: none"> <li>• Defective AYC-ECU</li> <li>• Defective ABS-ECU</li> <li>• Defective harness or connector</li> </ul>



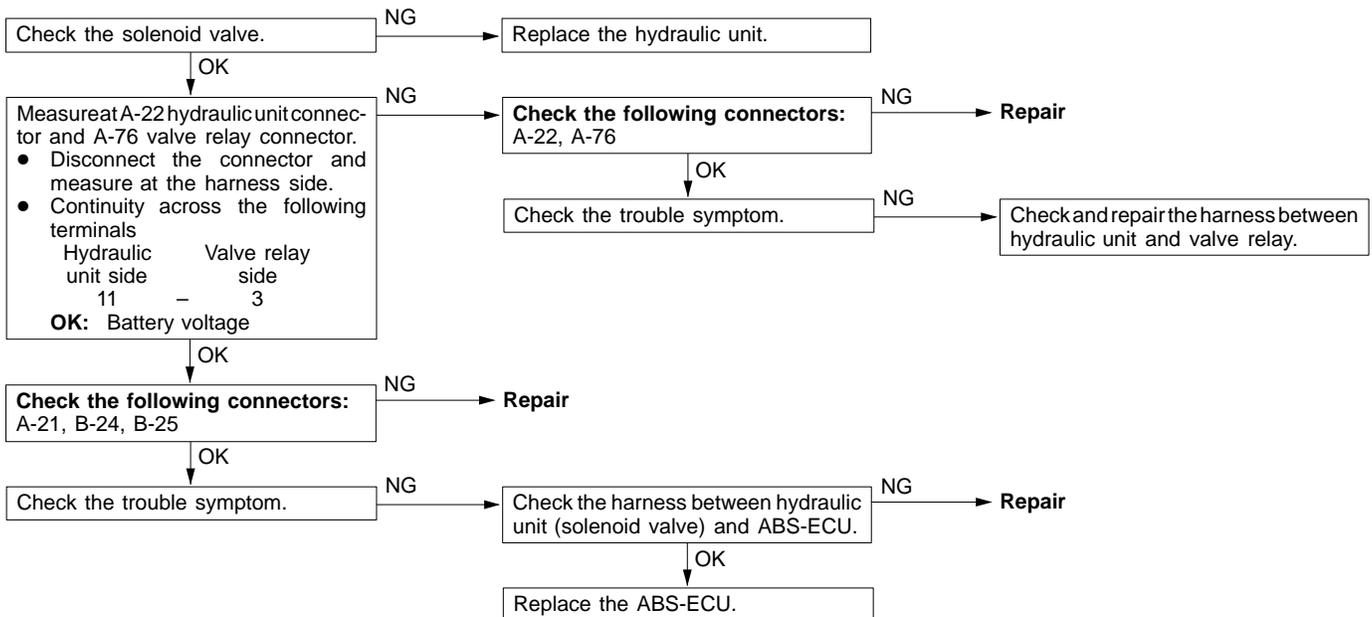
Code No. 32: Acceleration sensor (longitudinal acceleration) circuit system	Probable cause
This code is output under either of the following conditions: <ul style="list-style-type: none"> <li>• The output from the acceleration sensor (longitudinal acceleration) becomes 0.5 V or less, or 4.5 V or more.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



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"> <li>● Malfunction of stop lamp switch</li> <li>● Malfunction of wiring harness or connector</li> <li>● Malfunction of ABS-ECU</li> </ul>



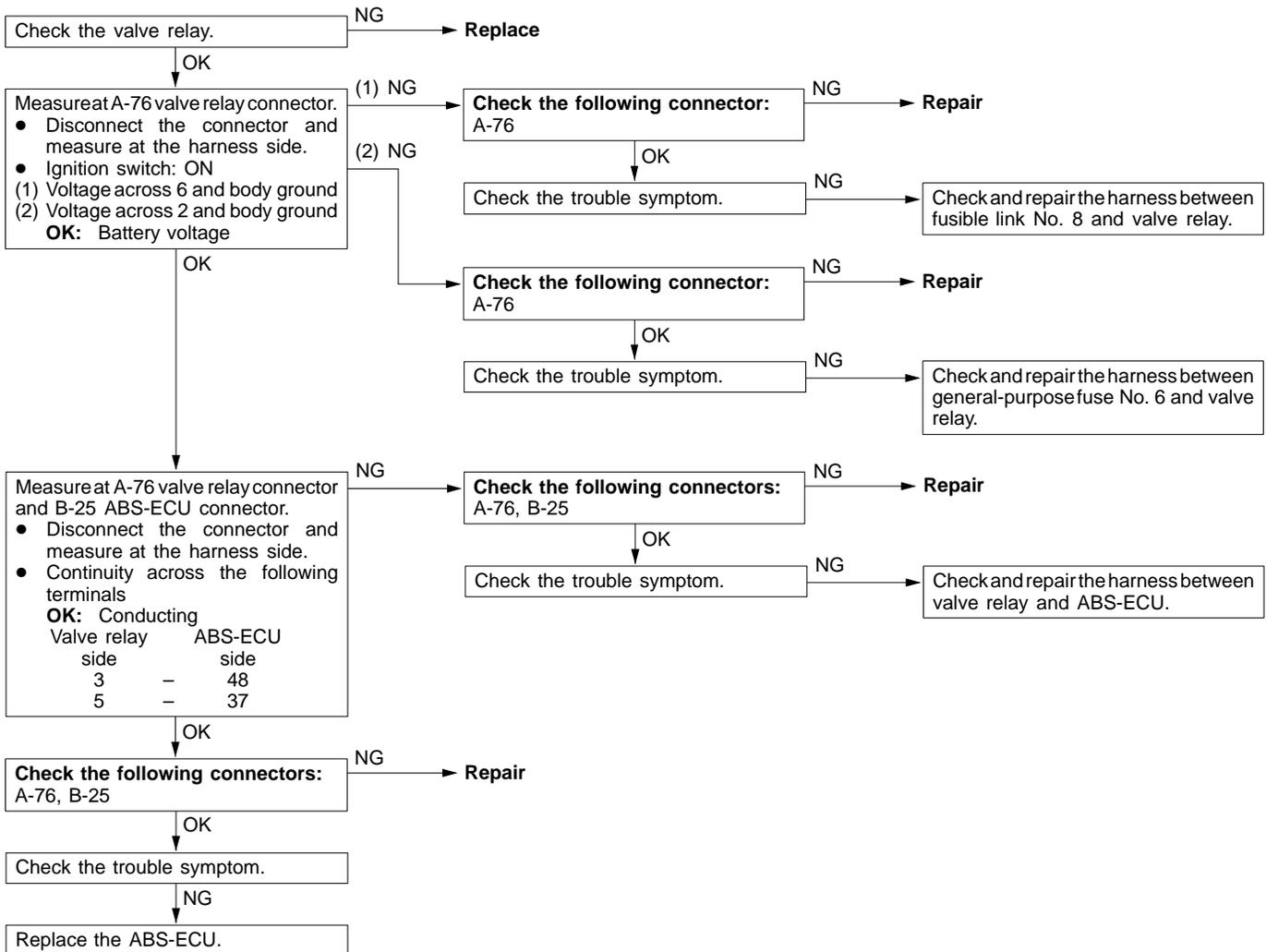
Code No. 41, 42, 43, 44: Solenoid valve system	Probable cause
ABS-ECU monitors the solenoid valve energization circuit at all times. This code is output when no current flows through the solenoid even when ABS-ECU energizes it or when current continues flowing through the solenoid even when ABS-ECU deenergizes 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"> <li>● Defective hydraulic unit</li> <li>● Defective harness or connector</li> <li>● Defective ABS-ECU</li> </ul>



Code No. 51: Valve relay system	Probable cause
This code is output under any of the following conditions: <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• The solenoid valve power is not supplied while the valve relay remains ON under normal conditions.</li> </ul>	<ul style="list-style-type: none"> <li>• Defective ABS valve relay</li> <li>• Defective harness or connector</li> <li>• Defective ABS-ECU</li> </ul>

**NOTE**

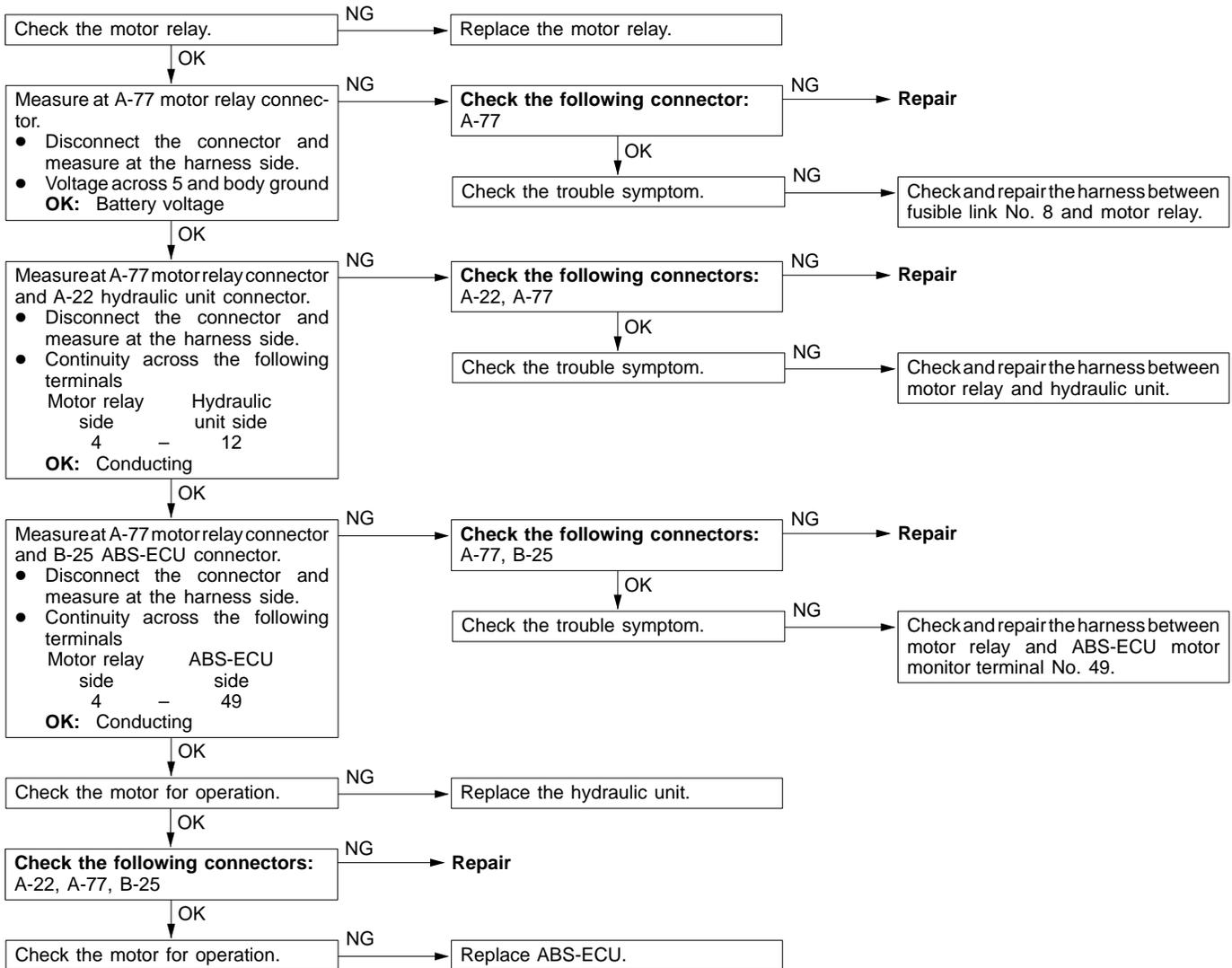
In the diagnosis code reading by means of the ABS warning lamp, this code is output in addition to the actual diagnosis code since the valve relay connector is disconnected. If the ABS warning lamp turns ON even when the spot represented by the diagnosis code output in addition to this code has been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



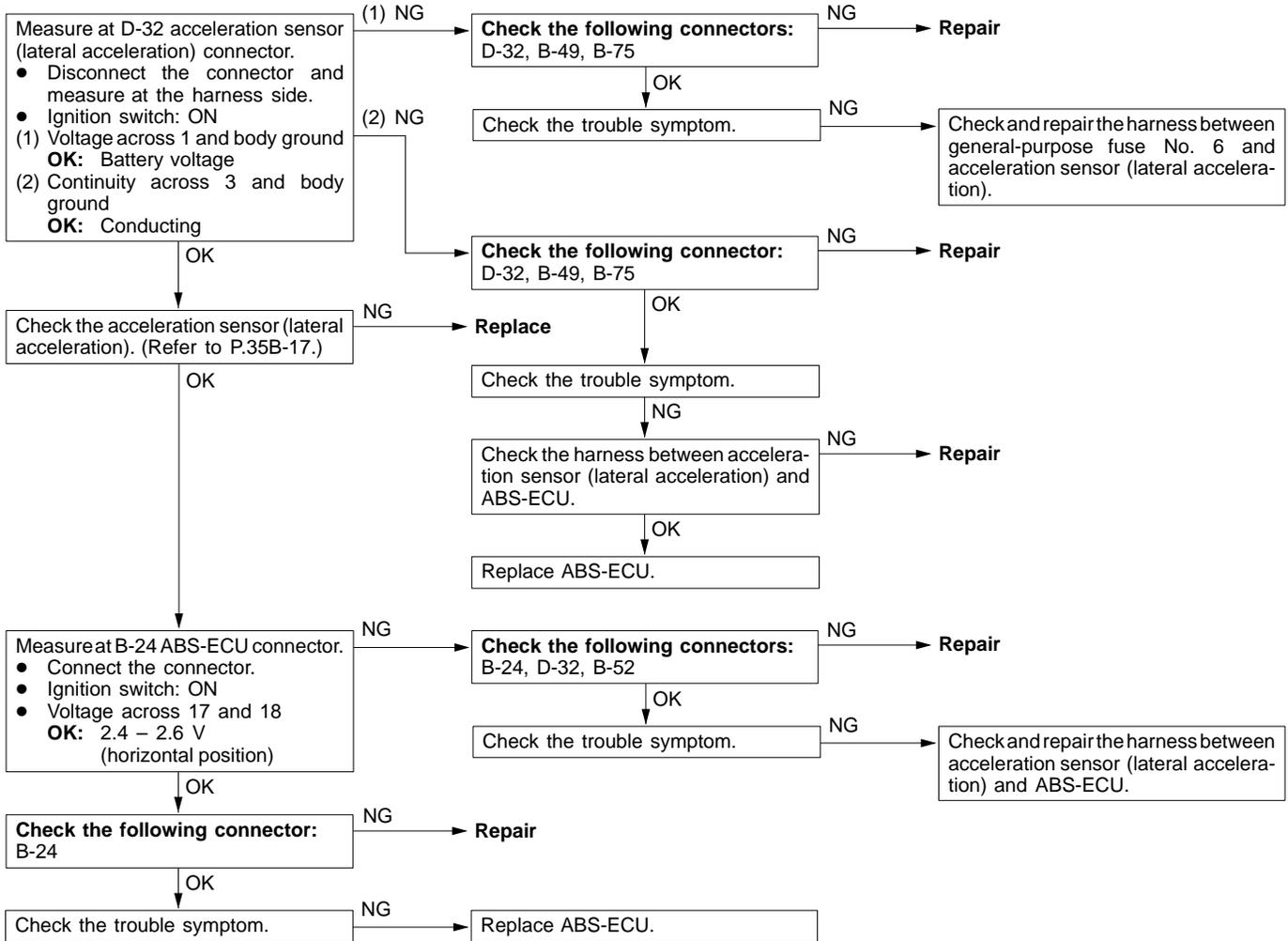
Code No. 53: Motor relay system	Probable cause
<p>This code is output under any of the following conditions:</p> <ul style="list-style-type: none"> <li>• No signals are input to the motor monitor when the motor relay is ON (motor does not run, etc.).</li> <li>• A signal is being input to the motor monitor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

**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 connector or A-77 motor relay connector of the hydraulic unit. 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.**



Code No. 71: Acceleration sensor (lateral acceleration) system	Probable cause
<p>This code is output under either of the following conditions:</p> <ul style="list-style-type: none"> <li>• The output from the acceleration sensor (lateral acceleration) becomes 0.5 V or less, or 4.5 V or more.</li> <li>• The acceleration sensor (lateral acceleration) harness is open- or short-circuited.</li> </ul>	<ul style="list-style-type: none"> <li>• Defective acceleration sensor (lateral acceleration)</li> <li>• Defective harness or connector</li> <li>• Defective ABS-ECU</li> </ul>



### 3. 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
When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate.	1	35B-12
Even after the engine is started, the ABS warning lamp remains illuminated.	2	35B-13
After the ignition key is turned to "ON", the ABS warning lamp blinks twice, and when turned to "START", it illuminates. When returned to "ON", the lamp flashes once, and then switches off.	3	35B-13
When the ignition key is turned to "START", the ABS warning lamp does not illuminate.	4	35B-14
Brake operation is abnormal	5	35B-14

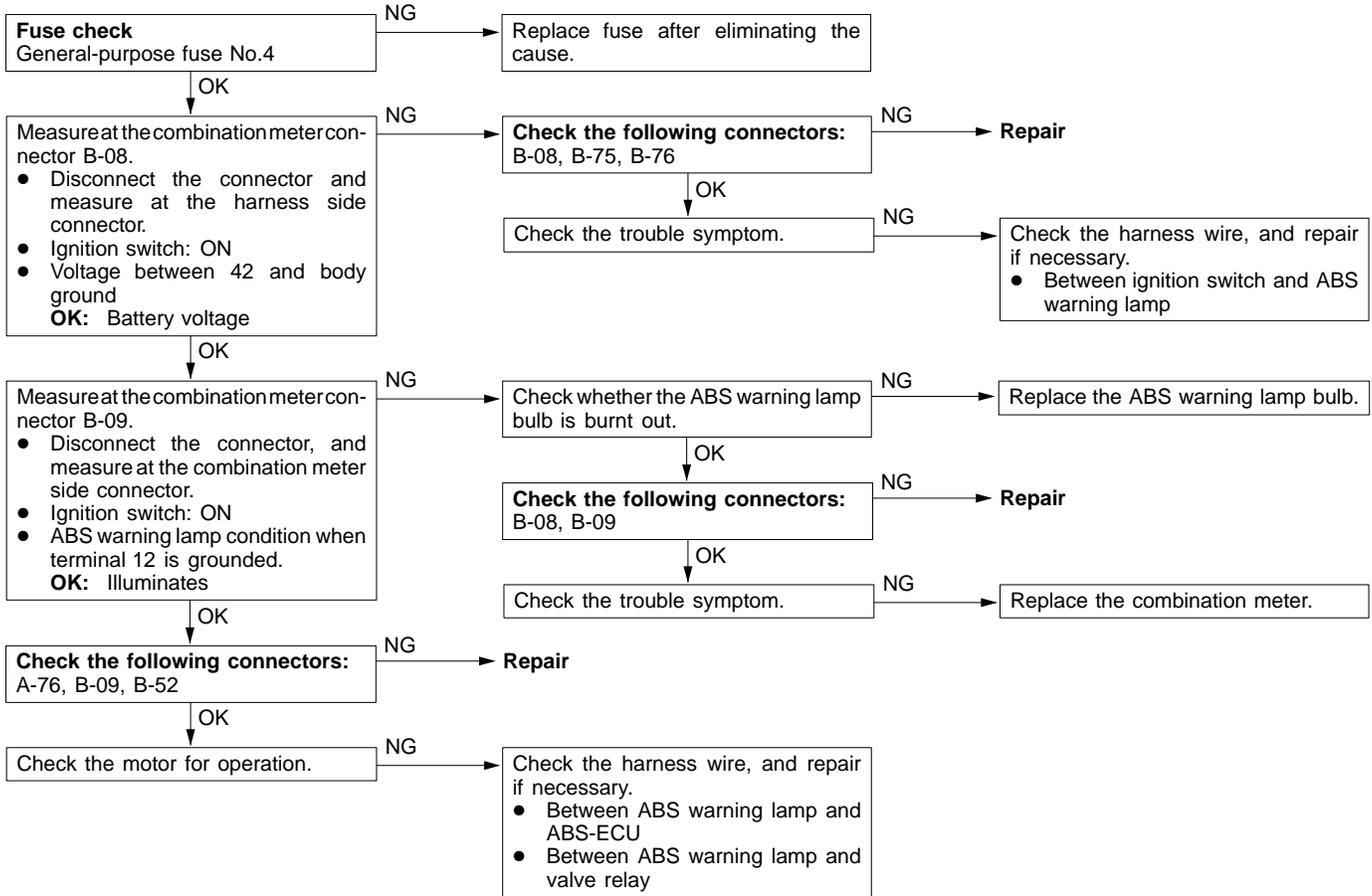
#### Caution

- (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.

4. INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

INSPECTION PROCEDURE 1

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"> <li>● Blown fuse</li> <li>● Burn out ABS warning lamp bulb</li> <li>● Malfunction of wiring harness or connector</li> </ul>

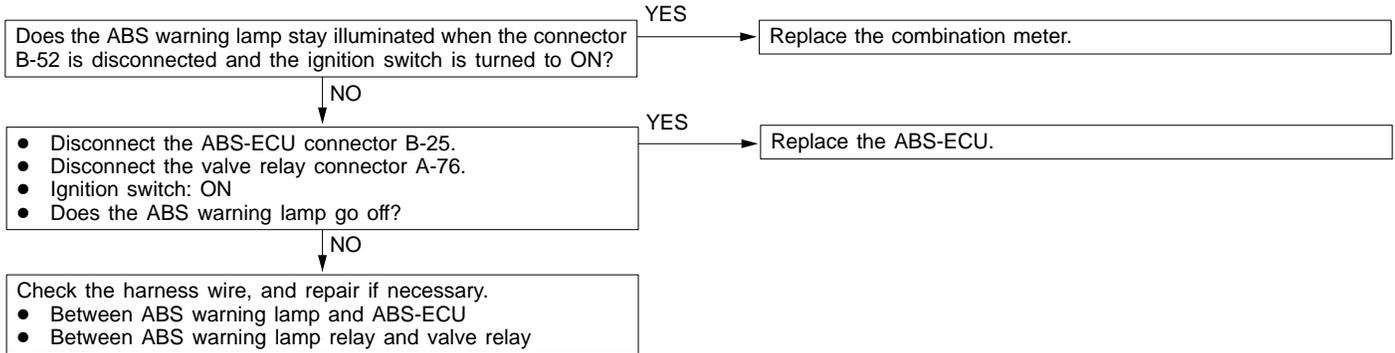


**INSPECTION PROCEDURE 2**

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"> <li>● Malfunction of combination meter</li> <li>● Malfunction of ABS-ECU</li> <li>● Malfunction of wiring harness (short circuit)</li> </ul>

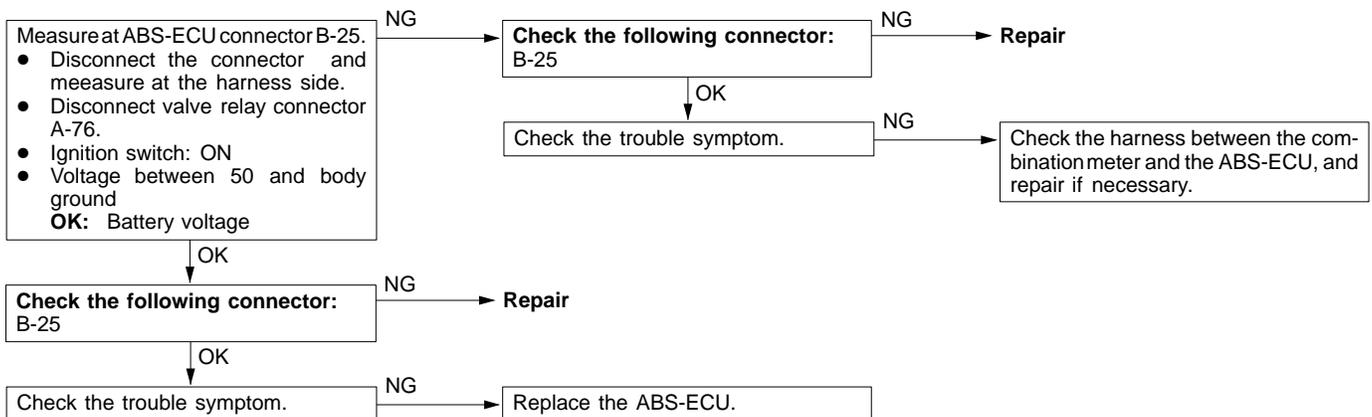
**NOTE**

This trouble symptom is limited to cases where ABS-ECU power supply is normal and the diagnosis code is a normal diagnosis code.



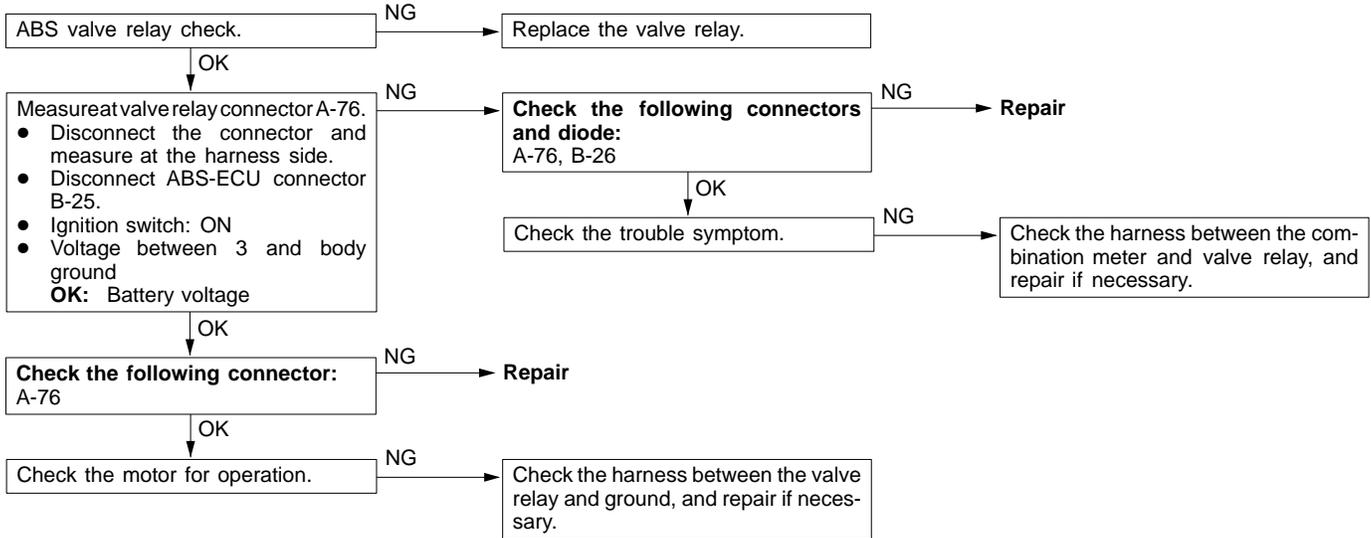
**INSPECTION PROCEDURE 3**

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.	Probable cause
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.	<ul style="list-style-type: none"> <li>● Malfunction of wiring harness or connector</li> <li>● Malfunction of ABS-ECU</li> </ul>



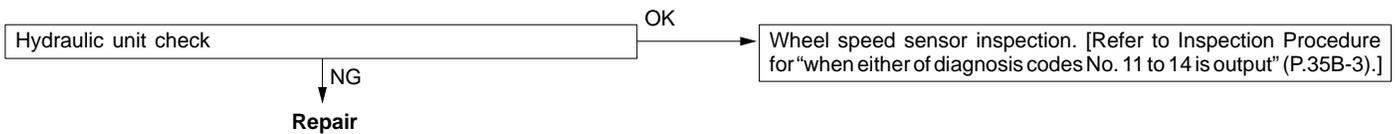
**INSPECTION PROCEDURE 4**

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"> <li>● Malfunction of wiring harness or connector</li> <li>● Malfunction of valve relay</li> </ul>



**INSPECTION PROCEDURE 5**

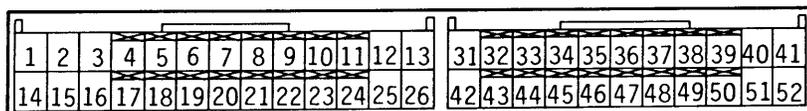
Brake operation is abnormal	Probable cause
The varies depending on the driving conditions and the road surface conditions, so problem diagnosis is difficult. However, if a normal diagnosis code is displayed, carry out the following inspection.	<ul style="list-style-type: none"> <li>● Improper installation of wheel speed sensor</li> <li>● Incorrect sensor harness contact</li> <li>● Foreign material adhering to wheel speed sensor</li> <li>● Malfunction of wheel speed sensor</li> <li>● Malfunction of wheel bearing</li> <li>● Malfunction of hydraulic unit</li> <li>● Malfunction of ABS-ECU</li> </ul>



## 5. CHECK AT ABS-ECU TERMINALS

### 5-1 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.



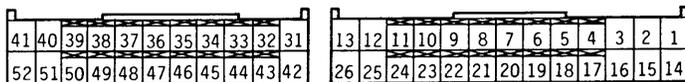
14M0128

Terminal No.	Check item	Check requirement	Normally	
1	Solenoid valve OUT (FL) output	Ignition switch: ON (after initial check)	Battery voltage	
2	Solenoid valve OUT (RR) output	Ignition switch: ON (after initial check)	Battery voltage	
3	Solenoid valve IN (RR) output	Ignition switch: ON (after initial check)	Battery 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	Battery voltage	
14	Solenoid valve IN (FL) output	Ignition switch: ON (after initial check)	Battery 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	Battery 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	Battery voltage	
		Stop lamp switch: OFF	0 V	
37	Valve relay output	Ignition switch: ON	When relay is ON	0 V
			When relay is OFF	Battery voltage
38	Motor relay output	Ignition switch: ON	When motor is energized	0 V
			When motor is deenergized	Battery voltage
40	Solenoid valve OUT (RL) output	Ignition switch: ON (after initial check)	Battery voltage	
41	Solenoid valve OUT (FR) output	Ignition switch: ON (after initial check)	Battery 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	
48	Valve relay monitor input	Ignition switch: ON (after initial check)	Battery voltage	
49	Motor relay monitor output	Ignition switch: ON	When motor is energized	0 V
			When motor is deenergized	Battery voltage
50	ABS warning lamp output	Ignition switch: ON	When lamp is off	Battery voltage
			When lamp is on	0 V
51	Solenoid valve IN (RL) output	Ignition switch: ON (after initial check)	Battery voltage	
52	Solenoid valve IN (FR) output	Ignition switch: ON (after initial check)	Battery voltage	

## 5-2 LISTING OF RESISTANCE AND CONTINUITY ACROSS CONNECTOR TERMINALS ON HARNESS SIDE

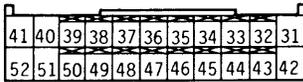
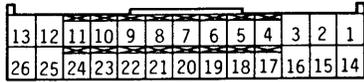
- (1) Measure the resistance and check for continuity with the ignition switch in the "OFF" position and ABS-ECU connector disconnected.
- (2) Measure the resistance and check for continuity across terminals listed below.
- (3) Fig. below shows the arrangement of terminals.



14M0127

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

ABS-ECU connector harness side



14M0127

**ON-VEHICLE SERVICE**

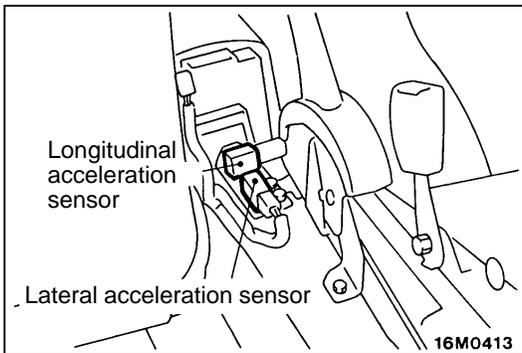
**WHEEL SPEED SENSOR OUTPUT VOLTAGE MEASUREMENT <EVOLUTION-V>**

The EVOLUTION-V has the ABS-ECU connector terminal arranged as shown at left. Accordingly, the terminals to measure the output voltage of the wheel speed sensors are different from EVOLUTION-V.

Follow the conventional procedures except these pick-out terminals.

**Measurement terminals:**

Front LH	Front RH	Rear LH	Rear RH
7	10	9	8
20	23	22	21



**LATERAL ACCELERATION SENSOR**

**INSPECTION**

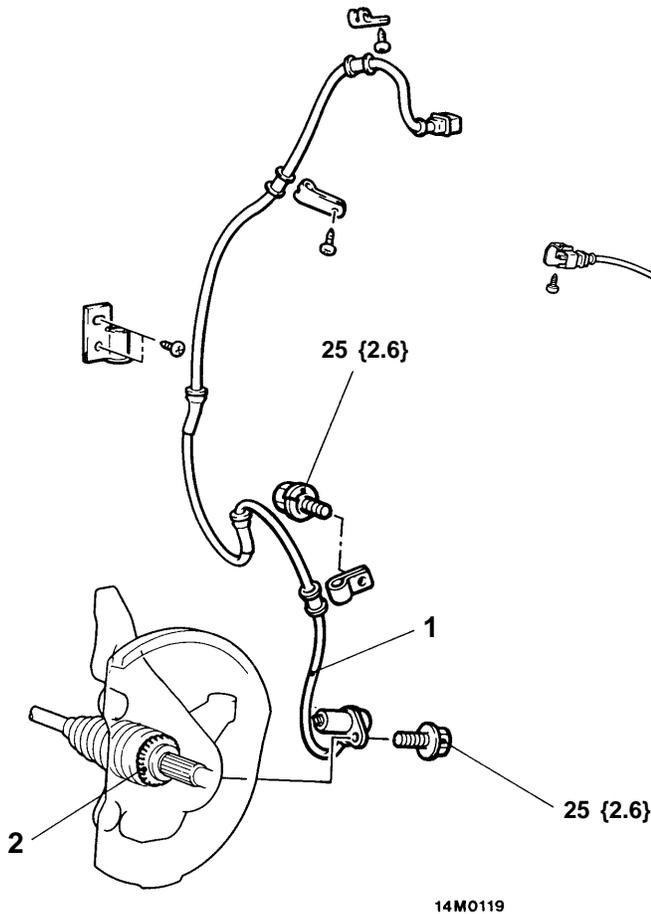
Use the same procedures as those for the conventional longitudinal acceleration sensor.

# WHEEL SPEED SENSOR

## REMOVAL AND INSTALLATION

### Post-installation Operation

- Wheel Speed Sensor Output Voltage Measurement

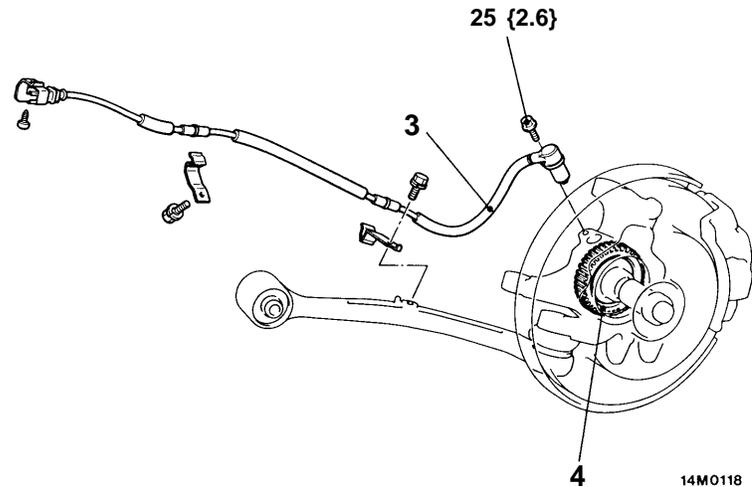


### Front speed sensor removal steps

- Splash shield
- 1. Front speed sensor
- 2. Front rotor (Refer to GROUP 26 DRIVE SHAFT.)

### Rear speed sensor removal steps

- 3. Rear speed sensor
- 4. Rear rotor (Refer to GROUP 27 REAR AXLE HUB.)



Unit: Nm {kgf·m}

### NOTE

The front rotor and rear rotor are integrated with the drive shaft and thus nonmaintainable.

### Caution

When removing and installing the speed sensor and rotor, use care not to allow the surfaces of the ball piece and rotor at the end of the speed sensor to be hit against a metal or other object, damaging it.