
ANTI-SKID BRAKING SYSTEM (ABS) <4WD>

CONTENTS

GENERAL	2	ON-VEHICLE SERVICE	14
Outline of Changes	2	Wheel Speed Sensor Output Voltage Check	14
GENERAL INFORMATION	2		
TROUBLESHOOTING	5	HYDRAULIC UNIT AND ABS-ECU	15

GENERAL

OUTLINE OF CHANGES

- The hydraulic unit (integrated with the ABS-ECU) has been reshaped. In addition, the troubleshooting has been changed due to the change on the ABS-ECU connector.
- The Electronic Brake-force Distribution (EBD) has been adopted. The EBD makes it possible to maintain the maximum amount of braking force for the rear wheels even when the vehicle's load is unevenly distributed

GENERAL INFORMATION

EBD CONTROL

In ABS, electronic control method is used whereby the rear wheel brake hydraulic pressure during braking is regulated by rear wheel control solenoid valves in accordance with the vehicle's rate of deceleration and the front and rear wheel slippage which are calculated from the signals received from the various wheel sensors. EBD control is a control system which provides a high level of control for both vehicle braking force and vehicle stability. The system has the following features.

- Because the system provides the optimum rear wheel braking force regardless of the vehicle

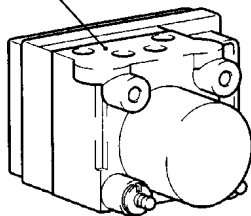
laden condition and the condition of the road surface, the system reduces the required pedal depression force, particularly when the vehicle is heavily laden or driving on road surfaces with high frictional coefficients.

- Because the duty placed on the front brakes has been reduced, the increases in pad temperature can be controlled during front brakes applying to improve the wear resistance characteristics of the pad.
- Control valves such as the proportioning valve are no longer required.

HYDRAULIC UNIT

New

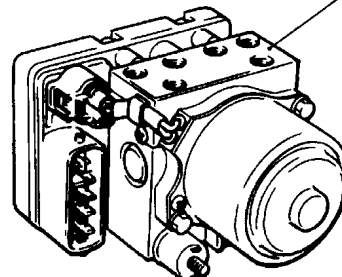
Hydraulic unit



AY0103AL

Old

Hydraulic unit

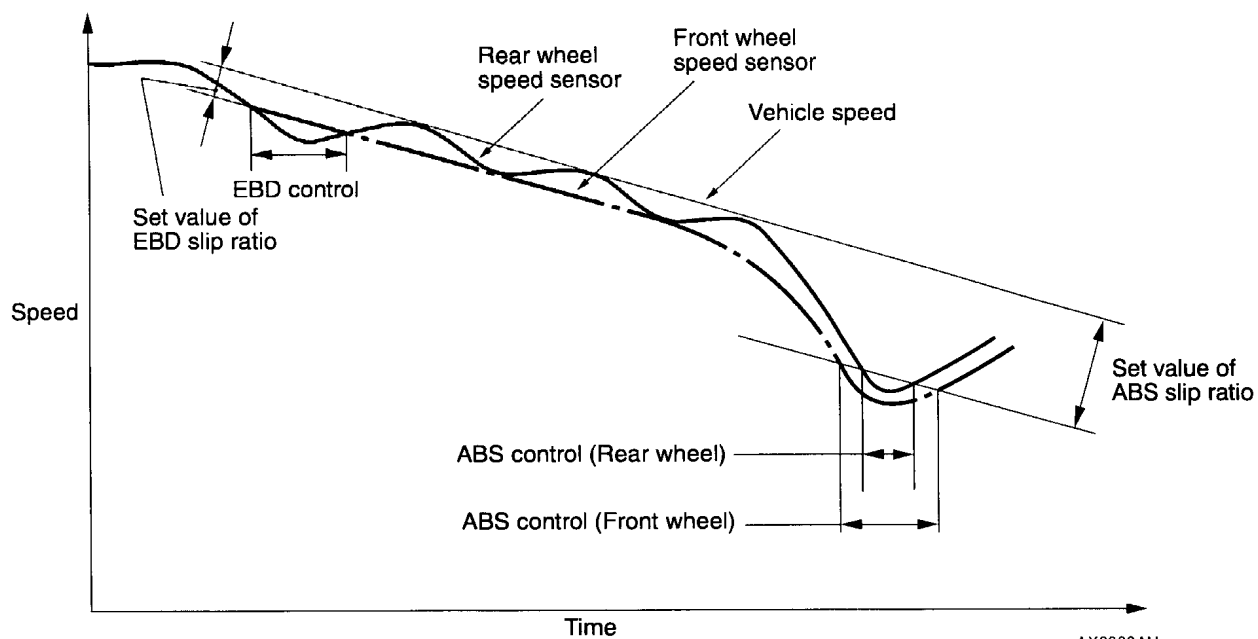


AW0134AL

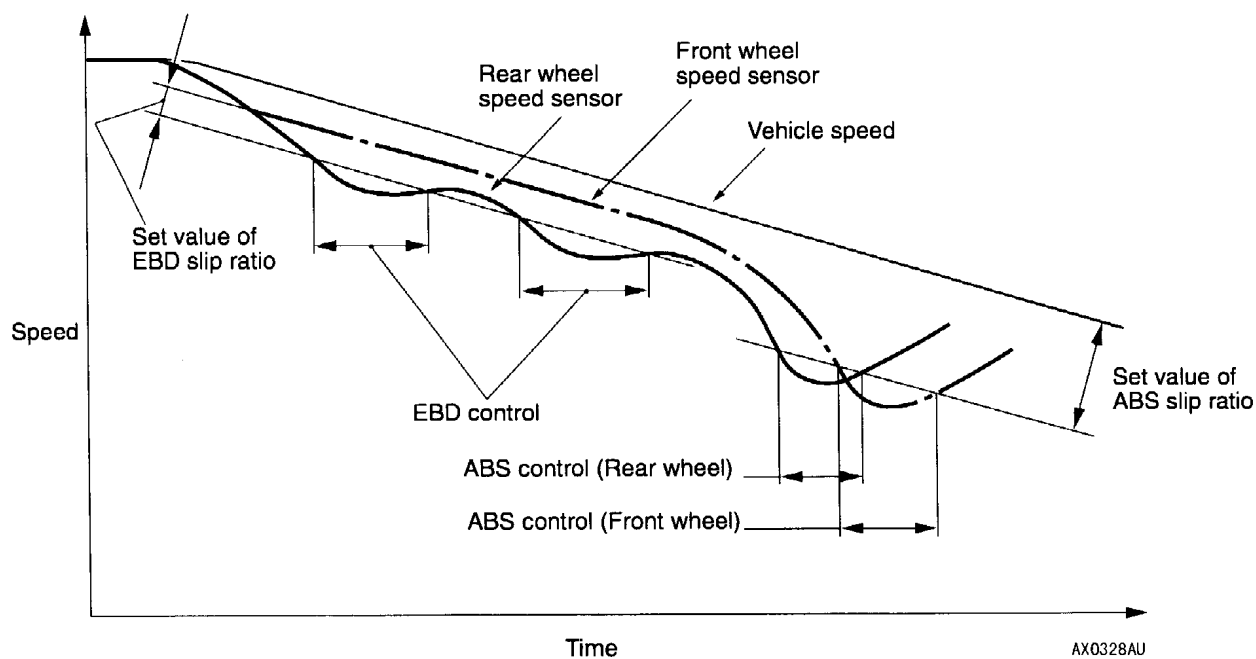
ABS-ECU**EBD HYDRAULIC PRESSURE CONTROL**

The procedures are the same as that used in PAJERO except for the items shown below.

Item	PAJERO-PININ	PAJERO
EBD control condition	When the difference between the rear wheel speed and the vehicle speed exceeds the set value.	When the difference between the rear wheel speed and the front wheel speed exceeds the set value.

<PAJERO-PININ>

AX0328AU

<PAJERO>

AX0328AU

FAIL-SAFE FUNCTION

The procedures are the same as that used in PAJERO except for the items shown below.

Item	PAJERO-PININ	PAJERO
Warning lamp during fail-safe operation	ABS warning lamp	Brake warning lamp

Diagnosis code No.	Item	Action during fail-safe operation		
		ABS control	EBD control	ABS warning lamp
11	Open circuit or short-circuit in wheel speed sensor (FR)	If faulty wheels include two rear wheels: Control stopped in all wheels Other than the above: Control stopped in faulty wheels	If faulty wheels include two rear wheels: Control stopped Other than the above: Control carried out	Illuminated
12	Open circuit or short-circuit in wheel speed sensor (FL)			
13	Open circuit or short-circuit in wheel speed sensor (RR)			
14	Open circuit or short-circuit in wheel speed sensor (RL)			
15	Problem with any one of the four wheel speed sensors			
16	Abnormal drop or rise in ABS-ECU power supply voltage	Control stopped	Control stopped	Illuminated
21	Wheel speed sensor (FR) system	If faulty wheels include two rear wheels: Control stopped in all wheels Other than the above: Control stopped in faulty wheels	If faulty wheels include two rear wheels: Control stopped Other than the above: Control carried out	Illuminated
22	Wheel speed sensor (FL) system			
23	Wheel speed sensor (RR) system			
24	Wheel speed sensor (RL) system			
32	G sensor system	Control stopped	Control carried out	Illuminated
33	Stop lamp switch system	Control stopped	Control carried out	Illuminated
41	Solenoid valve (FR) system	System interrupted	System interrupted	Illuminated
42	Solenoid valve (FL) system			
43	Solenoid valve (RR) system			
44	Solenoid valve (RL) system			
51	Valve relay ON problem	Control stopped	Control carried out	Illuminated
52	Valve relay OFF problem	System interrupted	System interrupted	Illuminated
53	Motor relay OFF problem	Control stopped	Control carried out	Illuminated
54	Motor relay ON problem	System interrupted	Control carried out	Illuminated
55	Motor system	Control stopped	Control carried out	Illuminated
63	ABS-ECU abnormality	System interrupted	System interrupted	Illuminated

NOTE

Control stopped: Control is not carried out until the ignition switch is turned to the "LOCK" (OFF) position. However, if the problem returns to normal, control is carried out again.

System interrupted: Control is not carried out until the valve relay turns off and the ignition switch is turned to the "LOCK" (OFF) position.

TROUBLESHOOTING

INSPECTION CHART FOR DIAGNOSIS CODES

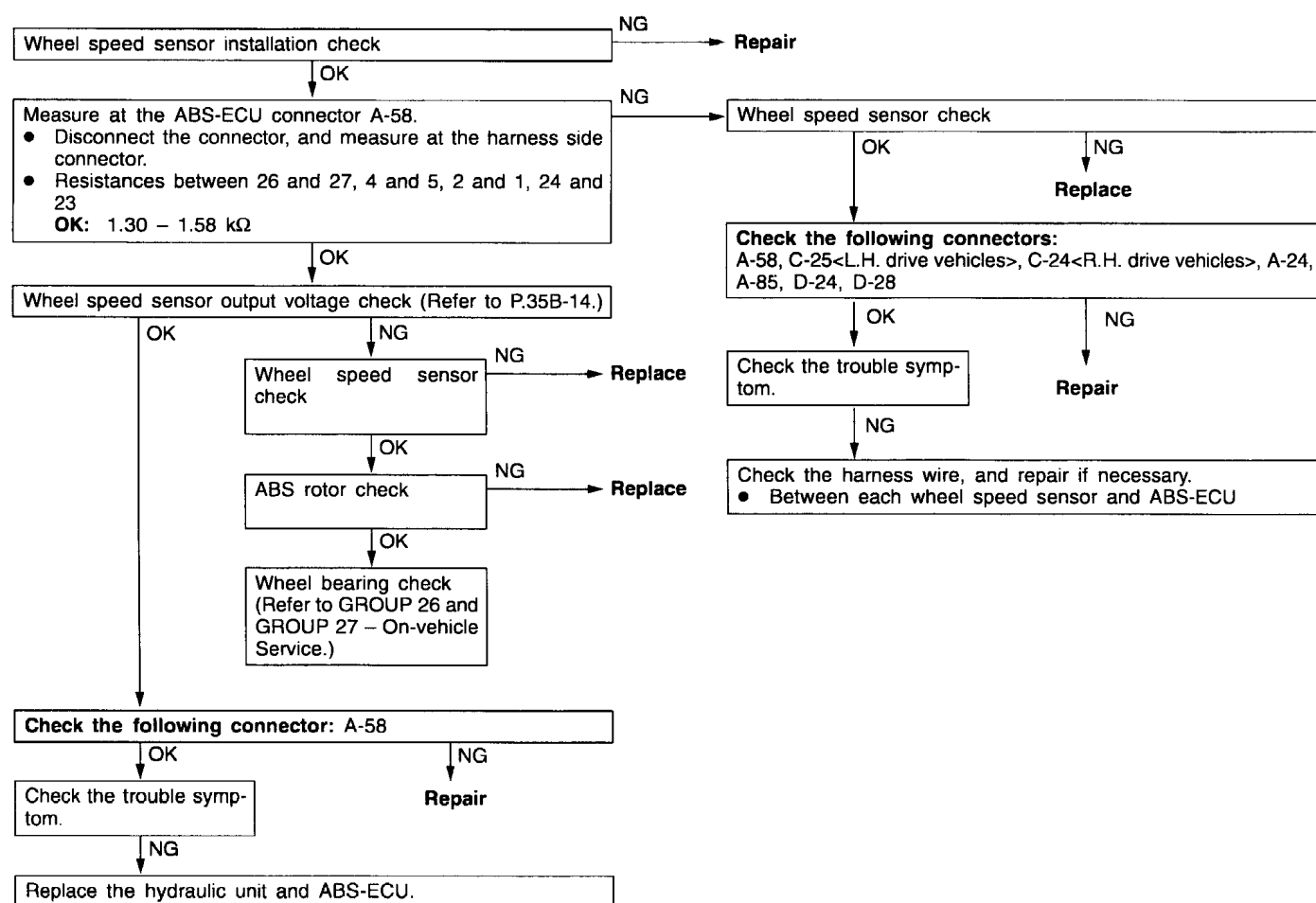
Diagnosis code No.	Inspection item		Reference page
11	Front right wheel speed sensor (Open circuit or short circuit)		35B-6
12	Front left wheel speed sensor (Open circuit or short circuit)		35B-6
13	Rear right wheel speed sensor (Open circuit or short circuit)		35B-6
14	Rear left wheel speed sensor (Open circuit or short circuit)		35B-6
15	Wheel speed sensor (Abnormal output signal)		—
16*	ABS-ECU power supply system (Abnormal voltage drop or rise)		35B-7
21	Front right wheel speed sensor		35B-6
22	Front left wheel speed sensor		35B-6
23	Rear right wheel speed sensor		35B-6
24	Rear left wheel speed sensor		35B-6
32	G sensor system		35B-7
33	Stop lamp switch system		—
41	Front right solenoid valve	The diagnosis codes are output when there is no response to the drive signals for respective solenoid valves or the ABS-ECU power supply system is defective.	35B-8
42	Front left solenoid valve		
43	Rear right solenoid valve		
44	Rear left solenoid valve		
51	Valve relay problem (stays on)		—
52	Valve relay problem (stays off) or ABS-ECU power supply system problem		35B-8
53	Motor relay problem (stays off) or ABS-ECU power supply system problem		
54	Motor relay problem (stays on)		
55	Motor system (seized pump motor) or ABS-ECU power supply system problem		35B-8
63	ABS-ECU		—

NOTE

*: Turning the ignition switch to ACC will erase the diagnosis code No.16.

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

Code Nos.11, 12, 13 and 14 Wheel speed sensor (open circuit or short circuit)	Probable cause
Code Nos.21, 22, 23 and 24 Wheel speed sensor	
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.	• Malfunction of wheel speed sensor • Malfunction of wiring harness or connector • Malfunction of hydraulic unit and ABS-ECU
Code Nos. 21, 22, 23 and 24 are output in the following cases. • When there is no input from any one of the four wheel speed sensors when travelling at several 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.	• 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 hydraulic unit and ABS-ECU • Malfunction of wheel bearing

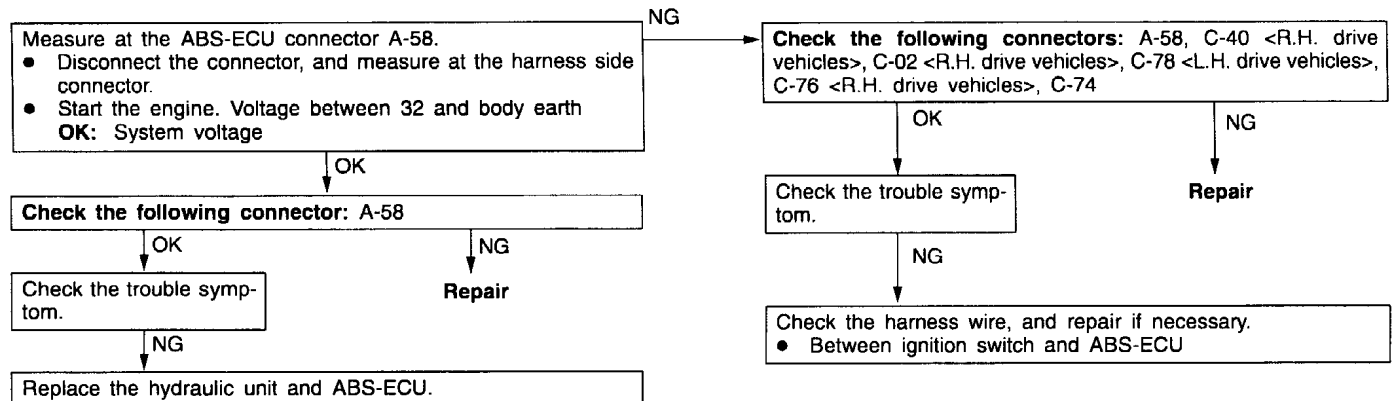


Code No.16 ABS-ECU power supply system (abnormal voltage drop or rise)	Probable cause
This code is output if the ABS-ECU power supply voltage drops below or rises above the rated values. Furthermore, turning the ignition switch to ACC will erase this code.	• Malfunction of battery • Malfunction of wiring harness or connector • Malfunction of hydraulic unit and ABS-ECU

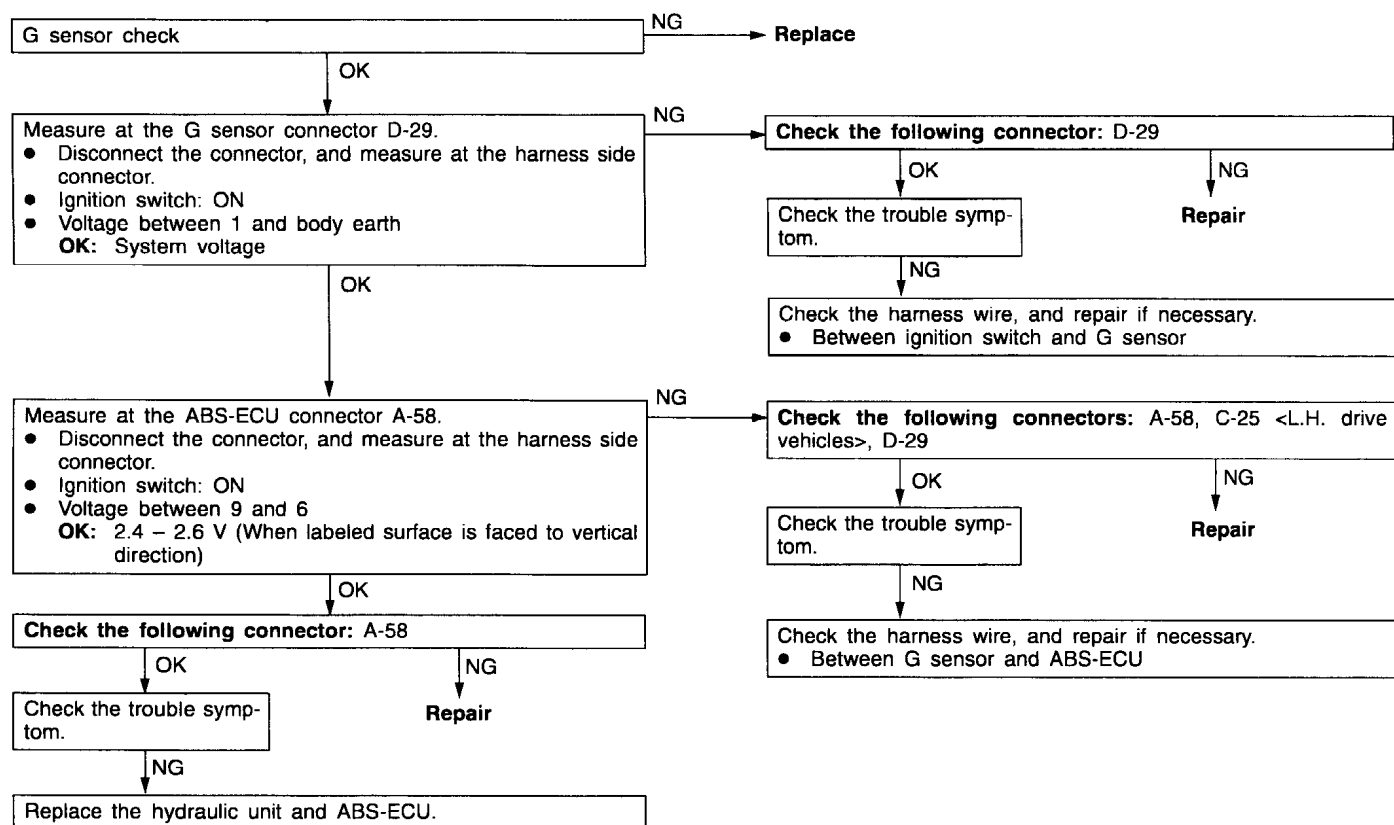
Caution

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.

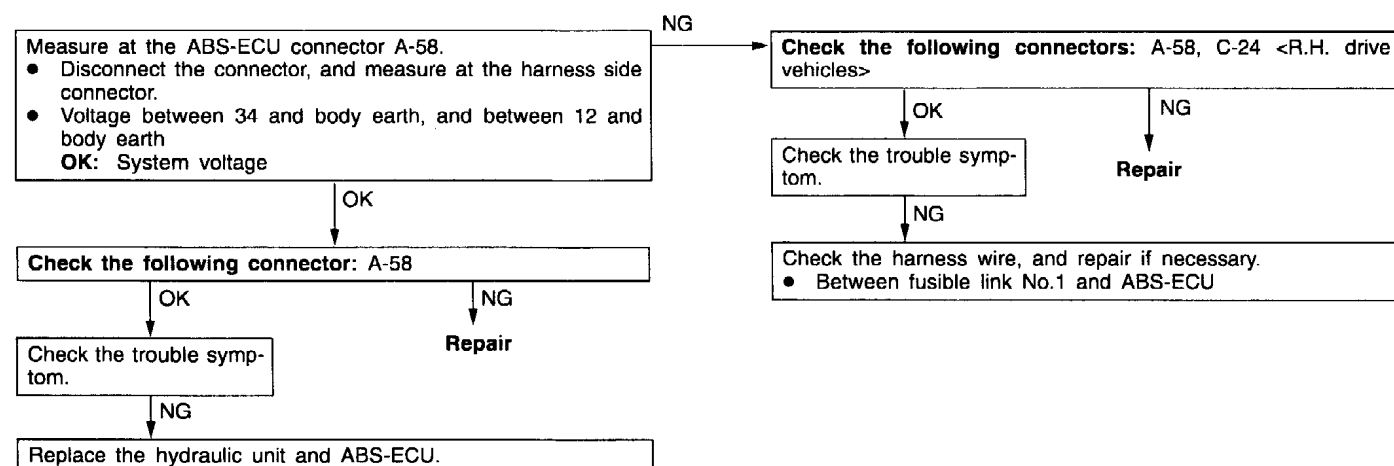
Before carrying out the following inspection, check the battery level, and refill it if necessary.



Code No.32 G sensor system	Probable cause
This code is output in the following cases. • G sensor output voltage is less than 0.5 V or more than 4.5 V. (An open or short circuit is present in the G sensor circuit.) • G sensor output voltage does not change. (G sensor output voltage is abnormal.)	• Malfunction of G sensor • Malfunction of wiring harness or connector • Malfunction of hydraulic unit and ABS-ECU



Code Nos.41, 42, 43 and 44 Solenoid valve	Probable cause
Code No.52 Valve relay problem (stays off)	
Code No.53 Motor relay problem (stays off)	
Code No.55 Motor system (seized pump motor)	
These codes are output if there is an open circuit or short-circuit in the ABS-ECU power supply circuit (power supply circuit for solenoid valve and motor), or the internal circuit in the hydraulic unit and ABS-ECU is defective.	• Malfunction of wiring harness or connector • Malfunction of hydraulic unit and ABS-ECU



INSPECTION CHART FOR TROUBLE SYMPTOMS

Trouble symptoms	Inspection procedure No.	Reference page
Communication between the MUT-II and the whole system is not possible.	1	–
Communication between the MUT-II and the ABS-ECU is not possible.	2	35B-10
When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate.	3	–
Even after the engine is started, the ABS warning lamp remains illuminated.	4	35B-11
Faulty ABS operation	5	35B-12

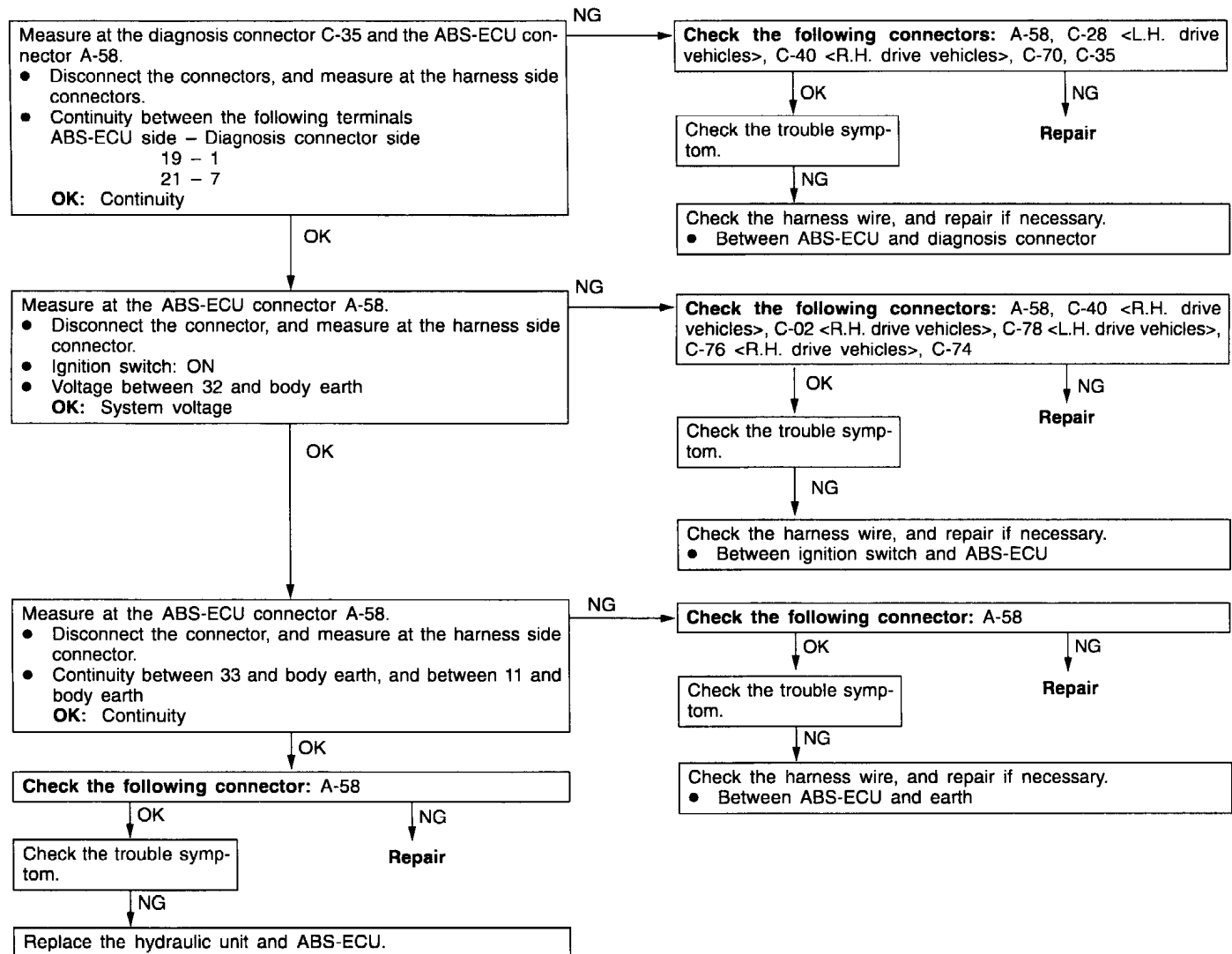
Caution

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 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.	● Blown fuse ● Malfunction of wiring harness or connector ● Malfunction of hydraulic unit and ABS-ECU

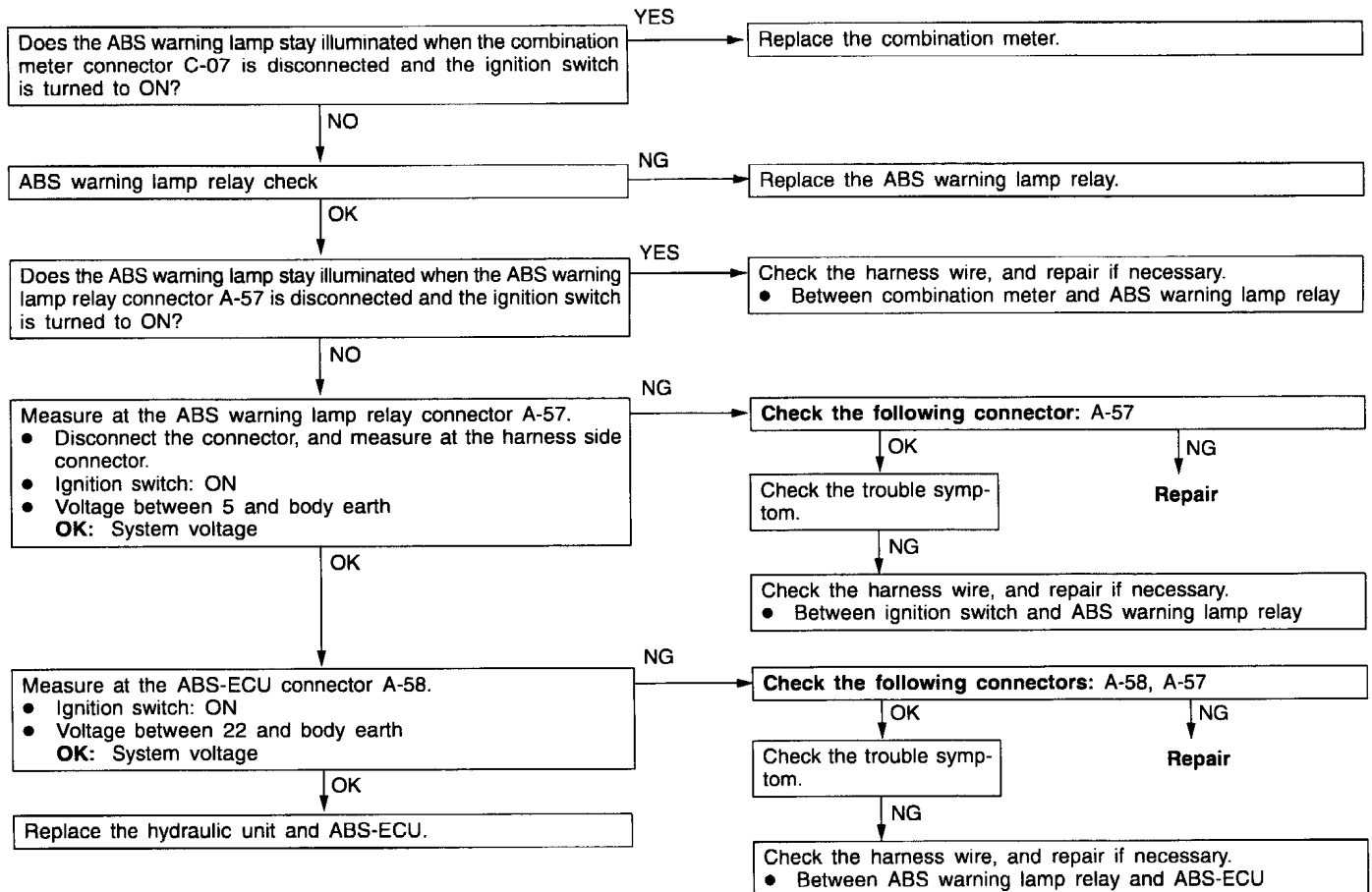


Inspection Procedure 4

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.	• Malfunction of combination meter • Malfunction of ABS warning lamp relay • Malfunction of wiring harness (short circuit) • Malfunction of hydraulic unit and ABS-ECU

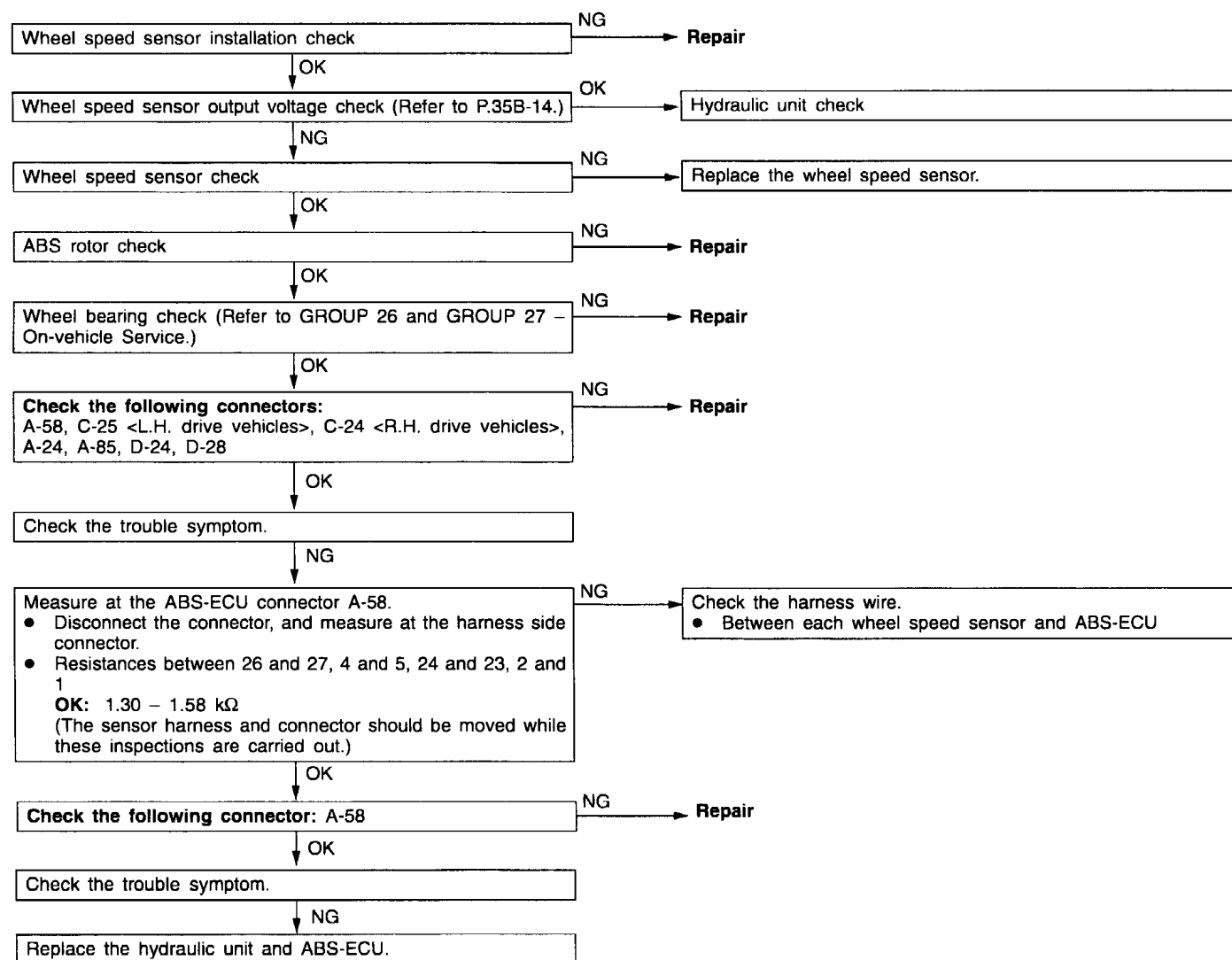
NOTE

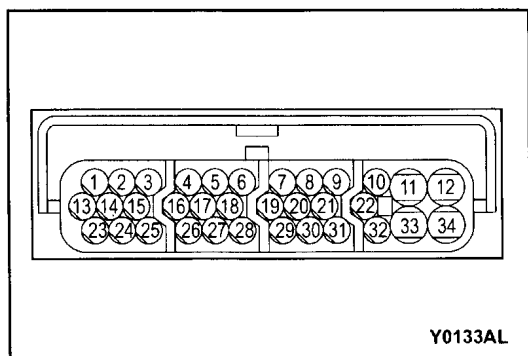
This trouble symptom is limited to cases where communication with the MUT-II is possible (ABS-ECU power supply is normal) and the diagnosis code is a normal diagnosis code.



Inspection Procedure 5

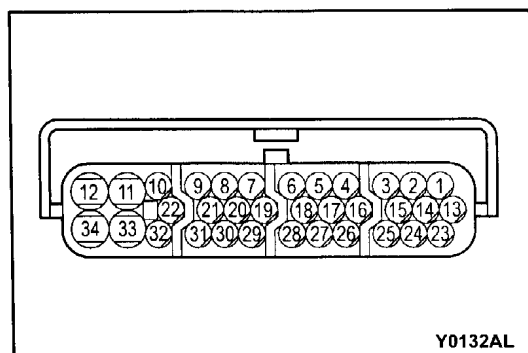
Faulty ABS operation	Probable cause
This varies depending on the driving conditions and the road surface conditions, so problem diagnosis is difficult. However, if a normal diagnosis code is displayed, carry out the following inspection.	● Improper installation of wheel speed sensor ● Malfunction of 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 and ABS-ECU



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

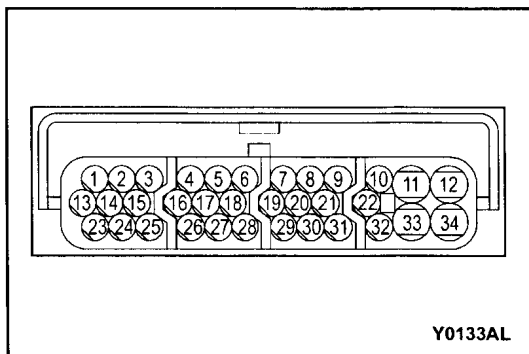
1. Measure the voltages between the respective terminal and earth.
2. The terminal layout is shown in the illustration.

Terminal No.	Check item	Checking requirements		Normal condition
3	Stop lamp switch input	Ignition switch: ON	Stop lamp switch: ON	System voltage
			Stop lamp switch: OFF	1 V or less
6	G sensor earth	Always		0 V
9	Input from G sensor	Ignition switch: ON Vehicle is horizontal		2.4 – 2.6 V
12	Solenoid valve power supply	Always		System voltage
19	Diagnosis changeover input	When the MUT-II is connected		0 V
		When the MUT-II is not connected		Approx. 12 V
21	MUT-II	When the MUT-II is connected		Serial communication with MUT-II
		When the MUT-II is not connected		1 V or less
22	ABS warning lamp relay transistor output	Ignition switch: ON	When the lamp is switched off	2 V or less
			When the lamp is illuminated	System voltage
32	ABS-ECU power supply	Ignition switch: ON		System voltage
		Ignition switch: START		0 V
34	Motor power supply	Always		System voltage

**RESISTANCE AND CONTINUITY BETWEEN HARNESS-SIDE CONNECTOR TERMINALS**

1. Turn the ignition key to the LOCK (OFF) position.
2. Disconnect the ABS-ECU connector.
3. Check the resistance and continuity between the terminals indicated in the table below.
4. The terminal layout is shown in the illustration.

ABS-ECU terminal No.	Signal	Normal condition
1 – 2	Wheel speed sensor (rear left)	1.30 – 1.58 kΩ
23 – 24	Wheel speed sensor (rear right)	
4 – 5	Wheel speed sensor (front left)	
26 – 27	Wheel speed sensor (front right)	
11 – Body earth	Earth	Continuity
33 – Body earth	Earth	



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.
3. 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.	4	26	2	24
	5	27	1	23

Output voltage

When measuring with a circuit tester:
42 mV or more

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

4. The followings are suspected if the output voltage is lower than the value described above. Check the wheel speed sensor, and replace if necessary.
 - Too large clearance between the pole piece of the wheel speed sensor and ABS rotor
 - Faulty wheel speed sensor

HYDRAULIC UNIT AND ABS-ECU

REMOVAL AND INSTALLATION

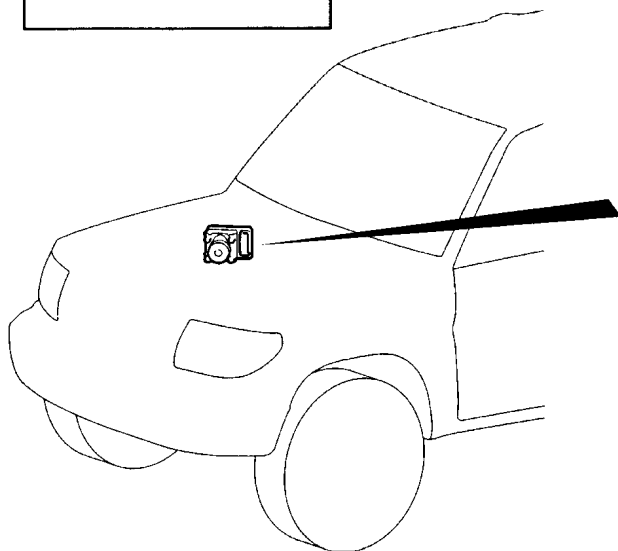
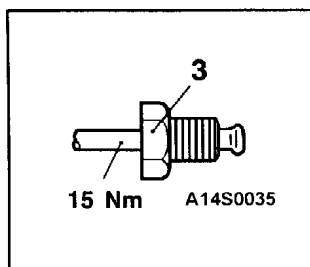
Pre-removal Operation

- Brake Fluid Draining
- Air Cleaner Removal (Refer to GROUP 15.)

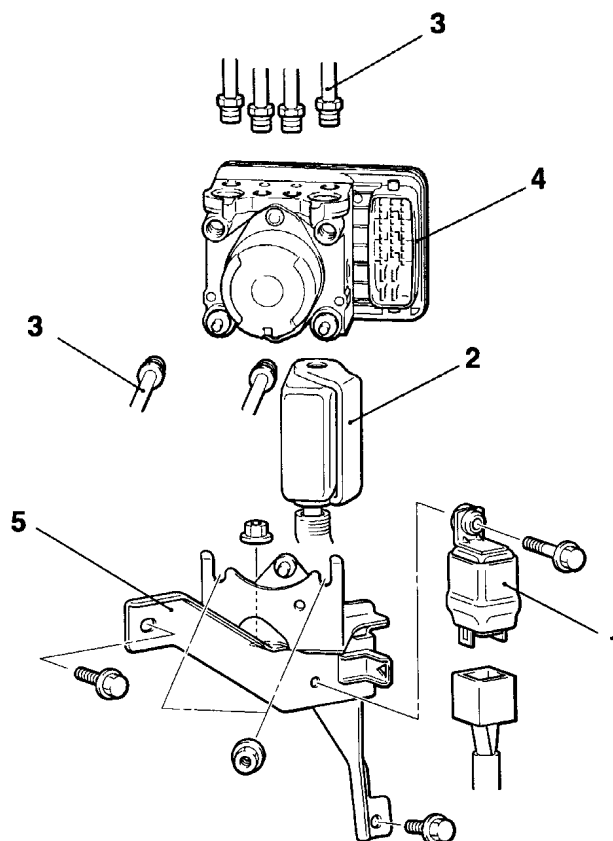
Post-installation Operation

- Brake Fluid Supplying and Brake Line Bleeding (Refer to GROUP 35A – On-vehicle Service.)
- Hydraulic Unit Inspection
- Air Cleaner Installation (Refer to GROUP 15.)

<L.H. drive vehicles>

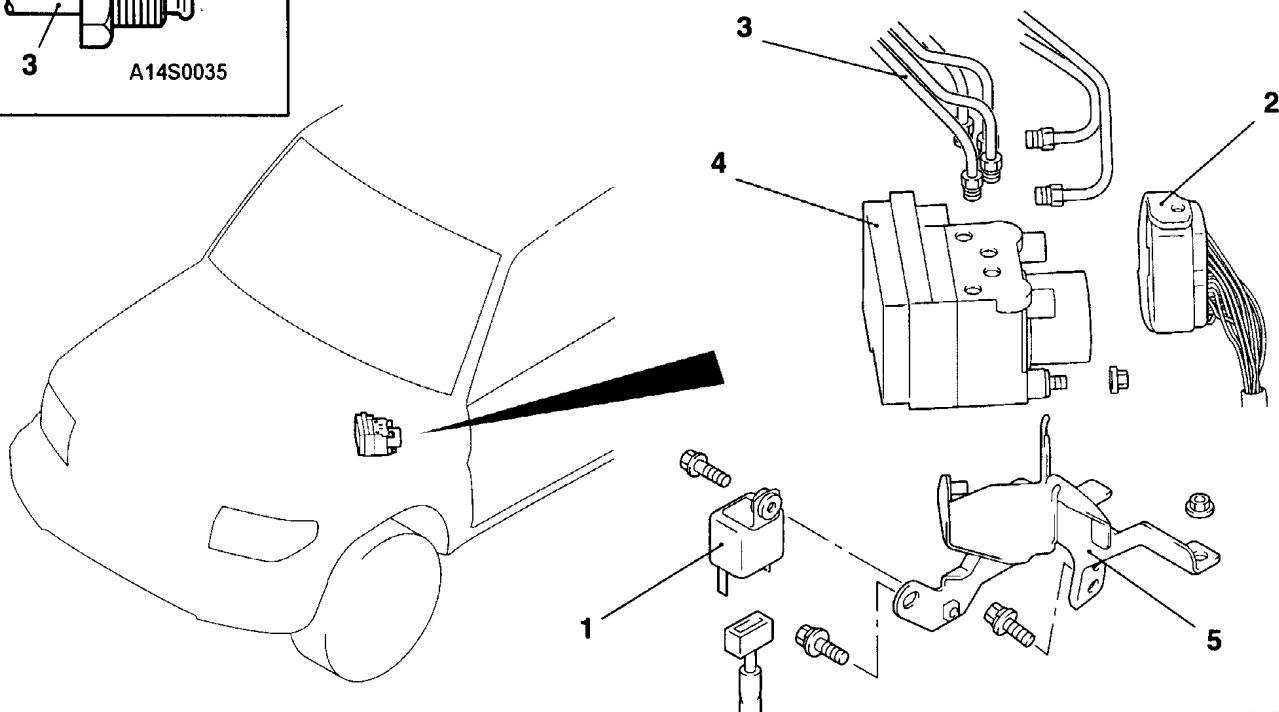
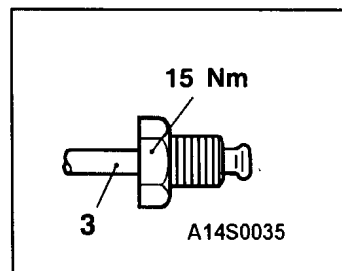


Y0226AL



AY0210AL

<R.H. drive vehicles>



AY0117AL

Removal steps

◀A▶

▶A▶

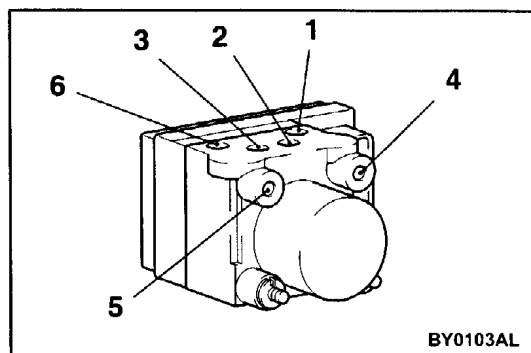
◀B▶

1. ABS warning lamp relay
2. Harness connector
3. Brake pipe connection
4. Hydraulic unit and ABS-ECU

5. Hydraulic unit bracket assembly

NOTE

The removal service points are the same as before.

**INSTALLATION SERVICE POINT****▶A◀ BRAKE PIPE CONNECTION**

Connect the pipes to the hydraulic unit assembly as shown in the illustration.

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