

SERVICE BRAKES

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SPECIFICATIONS**GENERAL SPECIFICATIONS**

E35CA--

Items	2400, 3000, 3500	2500D, 2800D
Master cylinder Type I.D. mm (in.)	Tandem Type (with level sensor) 23.8 (15/16)	Tandem type (with level sensor) 23.8 (15/16)
Brake booster Type Effective dia. of power cylinder mm (in.)	Vacuum Type, tandem 205 + 230 (8 + 9)	Vacuum Type, tandem 180 + 205 (7 + 8)
Boosting ratio	6.0	6.0
Proportioning valve type	Load sensing proportioning type	Load sensing proportioning type
Front brakes Type Disc effective dia. x thickness mm (in.)	Floating caliper, double pistons, ventilated disc (M-R57W) 228 x 24 (8.98 x 0.94) <2400, 3000> 228 x 27 (8.98 x 1.06) <3500>	Floating caliper, double pistons, ventilated disc (M-R57W) 228 x 24 (8.98 x 0.94)
Wheel cylinder I.D. mm (in.)	42.8 (1 11/16) x 2	42.8 (1 11/16) x 2
Lining thickness mm (in.)	10 (0.39)	10 (0.39)
Clearance adjustment	Automatic	Automatic
Rear brakes Type Disc effective dia. x thickness mm (in.)	Floating caliper, single piston, solid disc (M-R59S) 272 x 18 (10.71 x 0.71)	Floating caliper, single piston, solid disc (M-R59S) 272 x 18 (10.71 x 0.71)
Wheel cylinder I.D. mm (in.)	42.8 (1 11/16)	42.8 (1 11/16)
Lining thickness mm (in.)	9 (0.354)	9 (0.354)
Clearance adjustment	Automatic	Automatic
ABS Rotor teeth <Vehicles built up to May, 1994> front rear <Vehicles built from June, 1994> front rear Speed sensor type	110 110 47 47 Magnet coil type	110 110 47 47 Magnet coil type

SERVICE SPECIFICATIONS

E35CB--

Items	Specifications
Standard value	
Brake pedal height	mm (in.)
Brake pedal to toeboard clearance	mm (in.)
Brake pedal free play	mm (in.)
Load sensing spring length	mm (in.)
Load sensing proportioning valve output pressure	MPa (kg/cm ² , psi)
2-door models	
When load sensing spring length is 227.5 mm (9.0 in.)	
Input pressure	MPa (kg/cm ² , psi)
at 10 (100, 1422)	5.37-6.27 (53.7-62.7, 763.8-891.8)
at 18 (180, 2560)	7.17-8.47 (71.7-84.7, 1019.8-1204.7)
When load sensing spring length is 255.6 mm (10.1 in.)	
Input pressure	MPa (kg/cm ² , psi)
at 18 (180, 2560)	10.4-12.4 (104-124, 1479.2-1763.7)
4-door models	
When load sensing spring length is 226.7 mm (8.9 in.)	
Input pressure	MPa (kg/cm ² , psi)
at 10 (100, 1422)	6.14-7.04 (61.4-70.4, 873.3-1001.3)
at 18 (180, 2560)	7.94-9.24 (79.4-92.4, 1129.3-1314.2)
When load sensing spring length is 257.7 mm (10.1 in.)	
Input pressure	MPa (kg/cm ² , psi)
at 18 (180, 2560)	13.1-15.1 (131-151, 1863.3-2147.7)
Booster push rod to master cylinder piston clearance	mm (in.)
7 + 8 inch tandem brake booster	0.85-1.10 (0.033-0.043)
8 + 9 inch tandem brake booster	0.65-0.90 (0.026-0.035)
Brake dragging force	N (kg, lbs.)
[Brake dragging torque]	Nm (kgm, ft.lbs.)
Pad thickness	mm (in.)
Front	10.0 (0.39)
Rear	9.0 (0.35)
Disc thickness	mm (in.)
Front	24 (0.94) <Except 3500> 27 (1.06) <3500>
Rear	18 (0.71)
Lining thickness	mm (in.)
Brake drum inside diameter	mm (in.)
	6.5 (0.256)
	197 (7.76)

Items	Specifications	
Limit		
Pad thickness	mm (in.)	2.0 (0.079)
Disc thickness	mm (in.)	
Front		22.4 (0.882) <Except 3500>
Rear		25.4 (1.0) <3500>
Brake disc runout	mm (in.)	16.4 (0.646)
Front		0.1 (0.0039)
Rear		0.08 (0.0031)
Hub axial play	mm (in.)	0.25 (0.0098)
Lining thickness	mm (in.)	4.5 (0.177)
Brake drum inside diameter	mm (in.)	198 (7.8)

LUBRICANTS

E35CD--

Items	Specified lubricant	Quantity
Brake fluid	DOT3 or DOT4	As required
Brake piston boot inner surfaces		
Lock pin boot inner surfaces	Repair kit grease	As required
Guide pin boot inner surfaces		

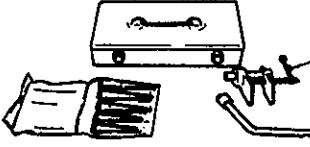
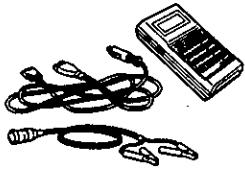
SEALANTS

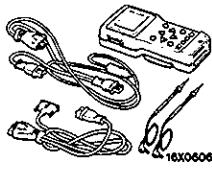
E35CE--

Items	Specified sealants	Remarks
Thread part of vacuum switch	3M ATD Part No. 8659 or equivalent	Non-drying sealant
Thread part of fitting	3M ATD Part No. 8663, 8661 or equivalent	Semi-drying sealant

SPECIAL TOOLS

E35DA--

Tool	Number	Name	Use
	MB990964 MB990520	Brake tool set	Pushing-in of the front disc brake piston MB990520
	MB991341	Multi-use tester assembly	Vehicles built up to October, 1993 For checking of A.B.S.
	MB991419	ROM pack	

Tool	Number	Name	Use
 16X0606	MB991502	MUT-II sub assembly	All models For checking of A.B.S.
 16X0607		ROM pack	
	MB991529	Diagnosis code check harness	For checking of ABS with a voltmeter

NOTES

ABS TROUBLESHOOTING

<Vehicles built up to May, 1994>

E35EC-

PARTICULAR PHENOMENA OF THE ANTI-LOCK BRAKE SYSTEM

Models equipped with the anti-lock brake system (A.B.S.) may exhibit one or more of the following phenomena from time to time, but none of these are abnormal.

- (1) A pulsing feeling in the brake pedal, or vibration of the body or the steering wheel, when the anti-lock brake system is activated by sudden braking or by braking on a slippery road surface. Actually, this phenomenon is an indication that the A.B.S. is functioning normally.
- (2) When the vehicle speed reaches approximately 8 km/h (5 mph) after the engine is started and the vehicle starts off (for the first time), a whining motor noise may be heard from the engine compartment if the vehicle is traveling in a quiet place, but this noise is simply the result of a self-check being made of the A.B.S. operation.

TROUBLESHOOTING METHODS

Problems related to the A.B.S. can be classified into two general categories: problems in the electrical system and those in the hydraulic system.

For problems in the electrical system the selfdiagnosis function is built into the electronic control unit (E.C.U.), causing the A.B.S. warning lamp to illuminate as a warning to the driver. In this instance, checks can be made by using the multi-use tester and oscilloscope.

Problems in the hydraulic system (poor braking, etc.) can be located in the same way as for ordinary brakes. There is, however, the necessity to check to determine whether the problem is related to ordinary brake components or to the components related to the A.B.S. To make this check, use the multi-use tester.

HOW TO USE THE TROUBLESHOOTING FLOW CHART

- (1) Following the flow chart, first refer to the illumination pattern of the ABS warning lamp, and next note the diagnosis code and inspect the brake operation.
- (2) Follow the inspection charts listed in the "Remedy" column to carry out an inspection. In each inspection chart, [Comment] and [Hint] are listed for troubleshooting reference.

NOTE

ECU: Electronic control unit

35-6 SERVICE BRAKES – ABS Troubleshooting <Vehicles built up to May, 1994>

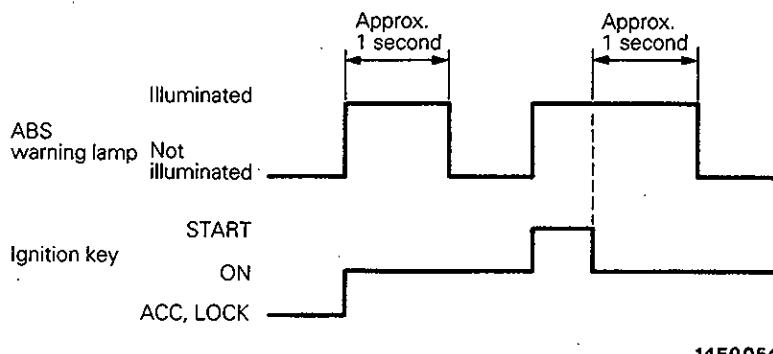
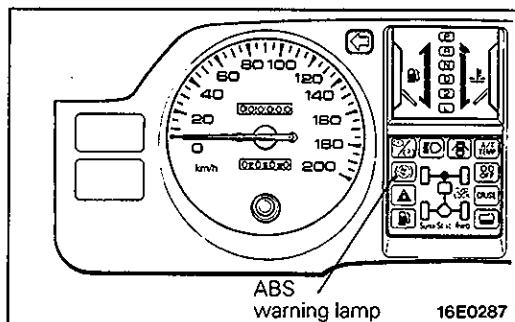
Check the trouble symptoms by the following procedure, and inspect according to the instructions.

Before the engine starts, does the ABS warning lamp illuminate?

- (1) With the ignition key in the "ON" position, the ABS-ECU causes the ABS warning lamp to illuminate for approximately 1 second (during this time, the initial check is carried out), and then the lamp switches off.
- (2) With the ignition key in the "START" position, power to the ABS-ECU is cut, and be-

cause the valve relay turns OFF, the ABS warning lamp remains illuminated.

- (3) When the ignition key is turned from the "START" position back to the "ON" position, the ABS warning lamp illuminates for approximately 1 second (during this time, the initial check is carried out once more), and then the lamp switches off.



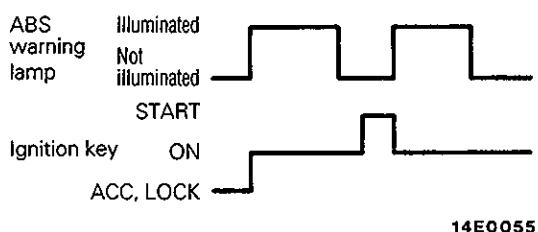
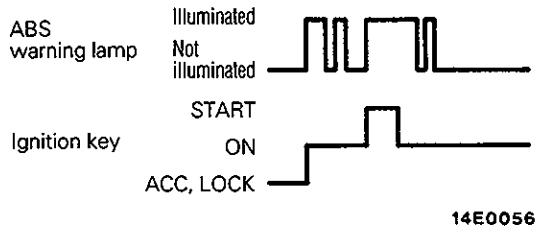
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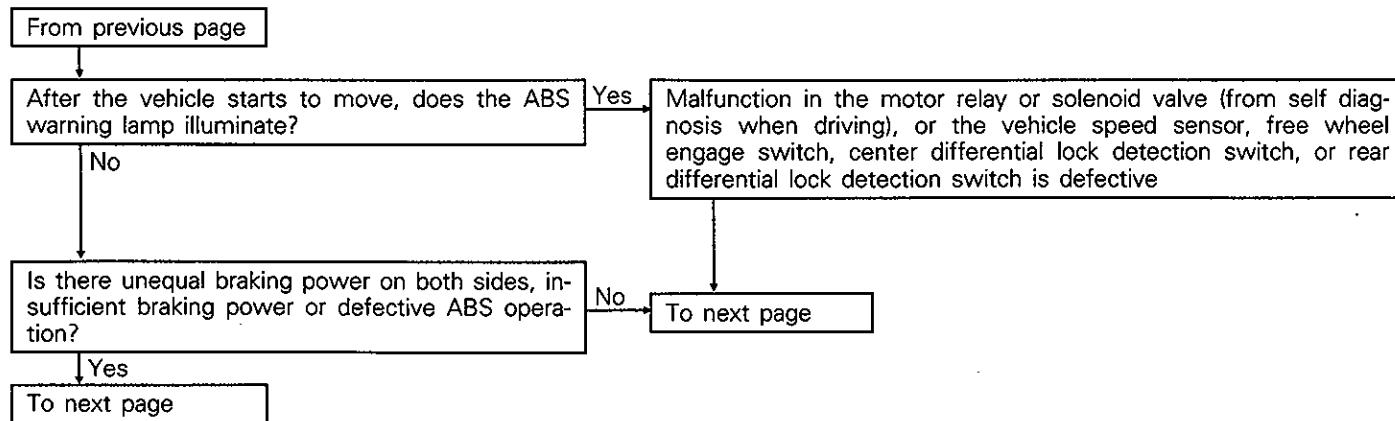
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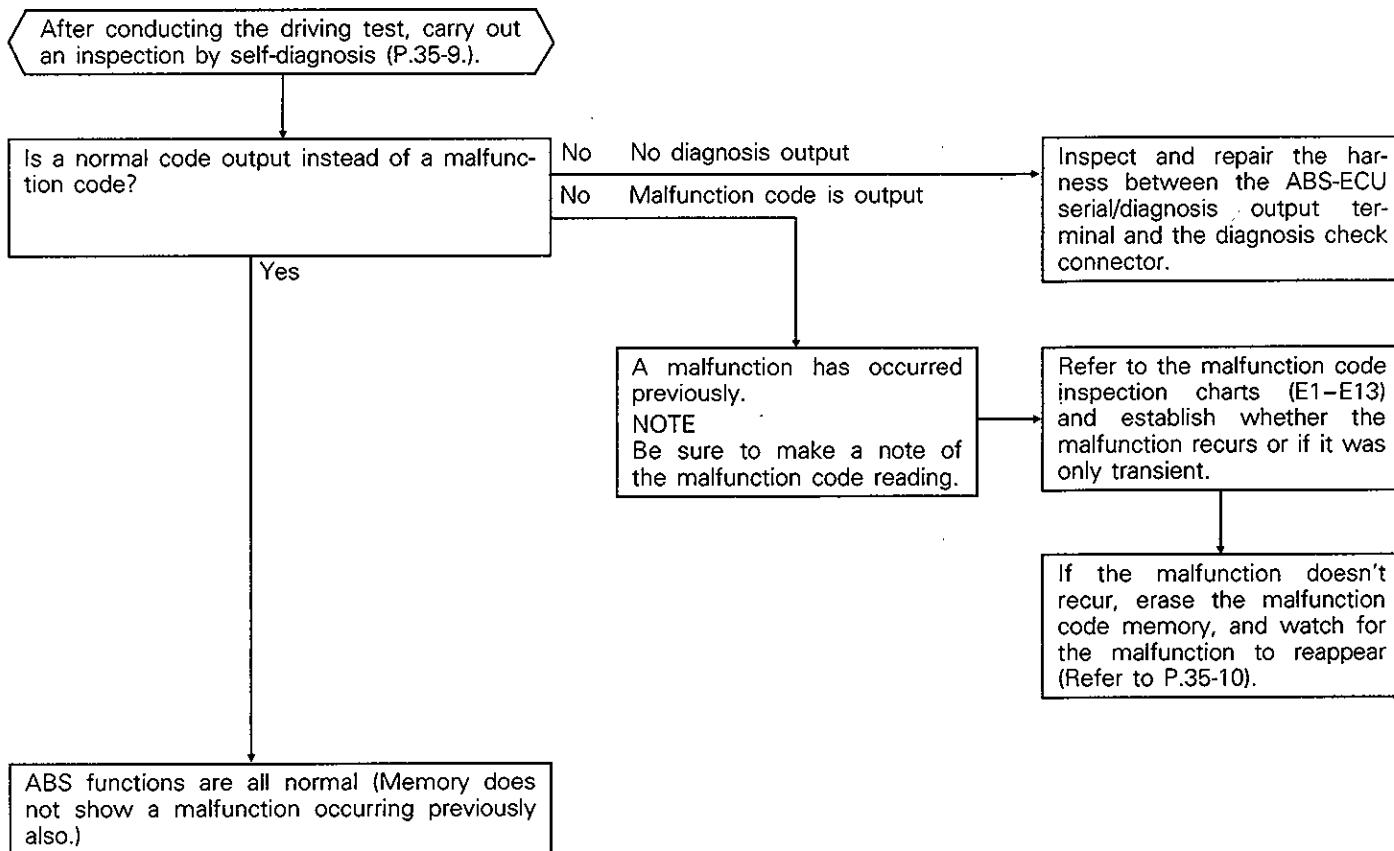
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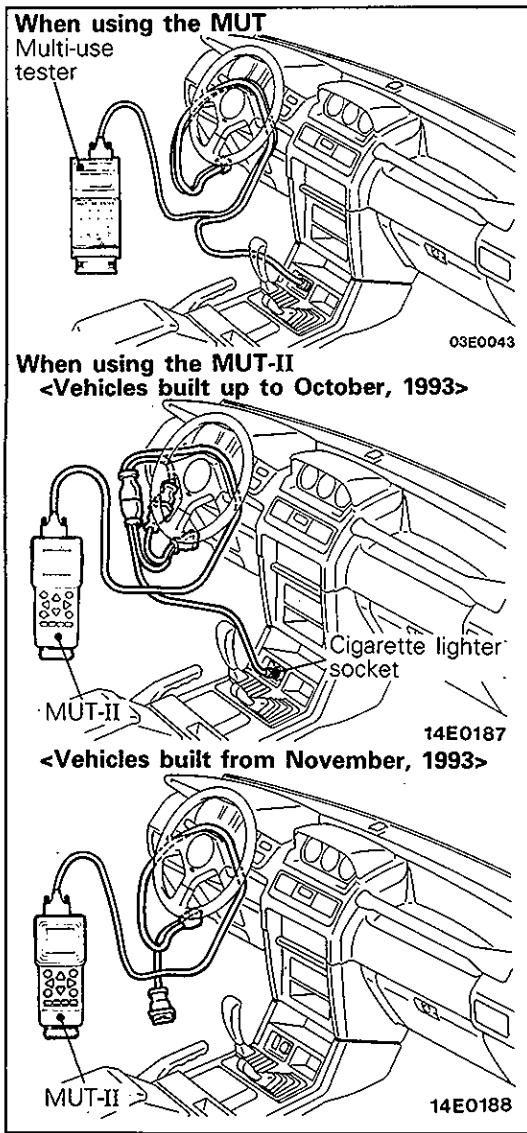
No.	Trouble symptom	Main cause	Remedy
1	<p>The ABS warning lamp does not illuminate at all.</p> <p>ABS warning lamp Illuminated Not illuminated</p> <p>Ignition key START ON ACC, LOCK</p> <p>14A0590</p>	<ul style="list-style-type: none"> • ABS warning lamp bulb failure. • Broken wire in the ABS warning lamp power circuit (including blown fuse). 	Inspect according to Flow Chart A (Refer to P.35-13).
2	<p>When the ignition key is turned to "ON", the ABS warning lamp remains illuminated.</p> <p>ABS warning lamp Illuminated Not illuminated</p> <p>Ignition key START ON ACC, LOCK</p> <p>14A0591</p>	<ul style="list-style-type: none"> • Fail safe function is operated by the ABS-ECU self-diagnosis. • Short in the ABS-ECU warning lamp drive circuit • ABS-ECU is defective 	Inspect according to Flow Chart B (Refer to P.35-16).

No.	Trouble symptom	Main cause	Remedy
3	When the ignition key is turned to "START", the ABS warning lamp does not illuminate.  14E0055	<ul style="list-style-type: none"> • Valve relay is defective • Broken harness wire between the ABS warning lamp and the hydraulic unit • Broken harness wire between the hydraulic unit and the earth 	Inspect according to Flow Chart C (Refer to P.35-18).
4	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. (The blinking when the key is turned to "ON" occurs simultaneously with the operation noise from the valve relay)  14E0056	<ul style="list-style-type: none"> • Broken harness wire in the ABS-ECU warning lamp drive circuit • ABS-ECU is defective 	Inspect according to Flow Chart D (Refer to P.35-19).



From previous page		
Trouble symptom	Main cause	Remedy
Unequal braking power Insufficient braking power	<ul style="list-style-type: none"> Blocked pressure circuit inside the hydraulic unit. Mechanical lock in the hydraulic unit solenoid valve. 	Follow the hydraulic unit operation inspection (refer to P.35-50) and replace the hydraulic unit if necessary. If the hydraulic unit is normal, inspect the components of the normal brake.
Decline in ABS function	<ul style="list-style-type: none"> Blocked pressure circuit inside the hydraulic unit. Operation of the hydraulic unit solenoid valve is defective. 	
	<ul style="list-style-type: none"> Operation of the idle-up system during ABS operation when vehicle speed is approx. 24 km/h (15 mph) or more is defective <2500D-M/T> 	Inspect the operation of the idle-up system (Refer to GROUP 13 – Service Adjustment Procedures <4D56>)
ABS operates even when not carrying out sudden braking (ABS operating vibration starts to be felt).	<ul style="list-style-type: none"> Insufficient wheel speed sensor output voltage (sensor is defective, excessive clearance between the sensor and rotor, or rotor is chipped). ABS-ECU is defective 	Inspect the wheel speed sensor (refer to P.35-48), and replace the sensor or adjust the sensor clearance if necessary. If the problem occurs frequently even though the sensor is normal, then replace the ABS-ECU.





INSPECTION BY SELF-DIAGNOSIS

1. Turn the ignition key to ACC and connect the multi-use tester or MUT-II as shown in the illustration.

Caution

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

2. Start the engine, and select the ABS system.
3. Read and make a note of the diagnosis output codes. If the ABS-ECU and multi-use tester cannot communicate, inspect the harness between diagnosis connector and the ABS-ECU power circuit or the ABS-ECU.
4. Momentarily erase the diagnosis code memory. (Refer to P.35-10.) If the memory cannot be erased, the function is being stopped by a malfunction that is currently displaying a malfunction code. If the memory can be erased, then the malfunction was only temporary, or it is a malfunction that can only be detected while driving.
5. If the malfunction code is not erased, or if the ABS function is stopped by a repeated driving test and a malfunction code is output, inspect according to the malfunction code inspection charts (E-1–E-13).

NOTE

The codes below are output as diagnosis codes according to the vehicle's condition, even when the ABS system is normal. These codes are output only for a current malfunction, and if the vehicle's condition returns to normal, malfunction code will be erased automatically.

METHOD OF ERASING THE DIAGNOSIS CODE MEMORY

Caution

When repairs are completed, the diagnosis code memory should be erased. When the ABS-ECU function is stopped, the malfunction code memory cannot be erased, so the function should be continuing while inspection and repair is being carried out.

1. Erase the memory with the multi-use tester or MUT-II.

NOTE

After erasing the memory, a command cannot be received from the multi-use tester or MUT-II. When checking diagnosis codes, momentarily stop and restart the engine, and then reactivate the multi-use tester or MUT-II.

2. Check the diagnosis codes to check that the memory has been erased.

DIAGNOSIS CODE REFERENCE TABLE

Diagnosis code no.	Name of inspection chart or remedy	Reference page	Diagnosis code no.	Name of inspection chart or remedy	Reference page
11	E-1	P.35-20	27	E-7	P.35-28
12			31	E-8	P.35-29
13			32	E-9	P.35-30
14			33	E-10	P.35-33
15	E-2	P.35-21	41	E-11	P.35-34
16	E-4	P.35-24	43		
21	E-3	P.35-22	45	E-12	P.35-35
22			51		
23			53	E-13	P.35-36
24			63	Replace the ABS-ECU	—
25	E-5	P.35-25	64		
26	E-6	P.35-26			

DIAGNOSIS CODE DISPLAY METHOD

All problem codes that are in memory are displayed.

NOTE

- (1) Diagnosis code no. 16 (abnormally low or abnormally high voltage) is only displayed when there is a current problem. (Past occurrences are not recorded in memory.)
- (2) Even if identical codes are output continuously, the code is only displayed one time.

SERVICE DATA INSPECTION TABLE

The following items can be read by the multi-use tester or MUT-II from the ABC-ECU input data.

Service data item		Display units
No.	Item	
11	Front right wheel speed	km/H
12	Front left wheel speed	km/H
13	Rear right wheel speed	km/H
14	Rear left wheel speed	km/H
16	ABS-ECU power voltage	V
25	ON/OFF condition of free wheel engage switch	ON/OFF
26	ON/OFF condition of centre differential lock detection switch	ON/OFF
27	ON/OFF condition of rear differential lock detection switch	ON/OFF
32	G sensor output voltage	V
33	ON/OFF condition of stop lamp switch	ON/OFF

ACTUATOR TEST FUNCTION

By using the multi-use tester or MUT-II, the following force-activation of the actuator can be performed.

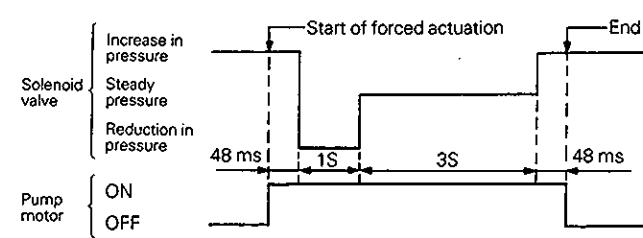
By using this function, function checking of the hydraulic unit can be done without the need for special devices such as a hydraulic unit checker (MB991131).

NOTE

- (1) When the ABS-ECU function is stopped, actuator testing cannot be carried out.
- (2) Actuator testing can be carried out only when the vehicle is stopped.
- (3) During actuator testing, if the maximum vehicle wheel speed reaches 10 km/h (6 mph), the test will be cancelled.
- (4) During actuator testing, the ABS warning lamp illuminates, and ABS control is interrupted.

ACTUATOR TEST SPECIFICATIONS

No.	Driving objective	Driving pattern
01	Solenoid valves and pump motors for each corresponding channel in the hydraulic unit	Solenoid valve for front left wheel
02		Solenoid valve for front right wheel
03		Solenoid valve for rear wheels

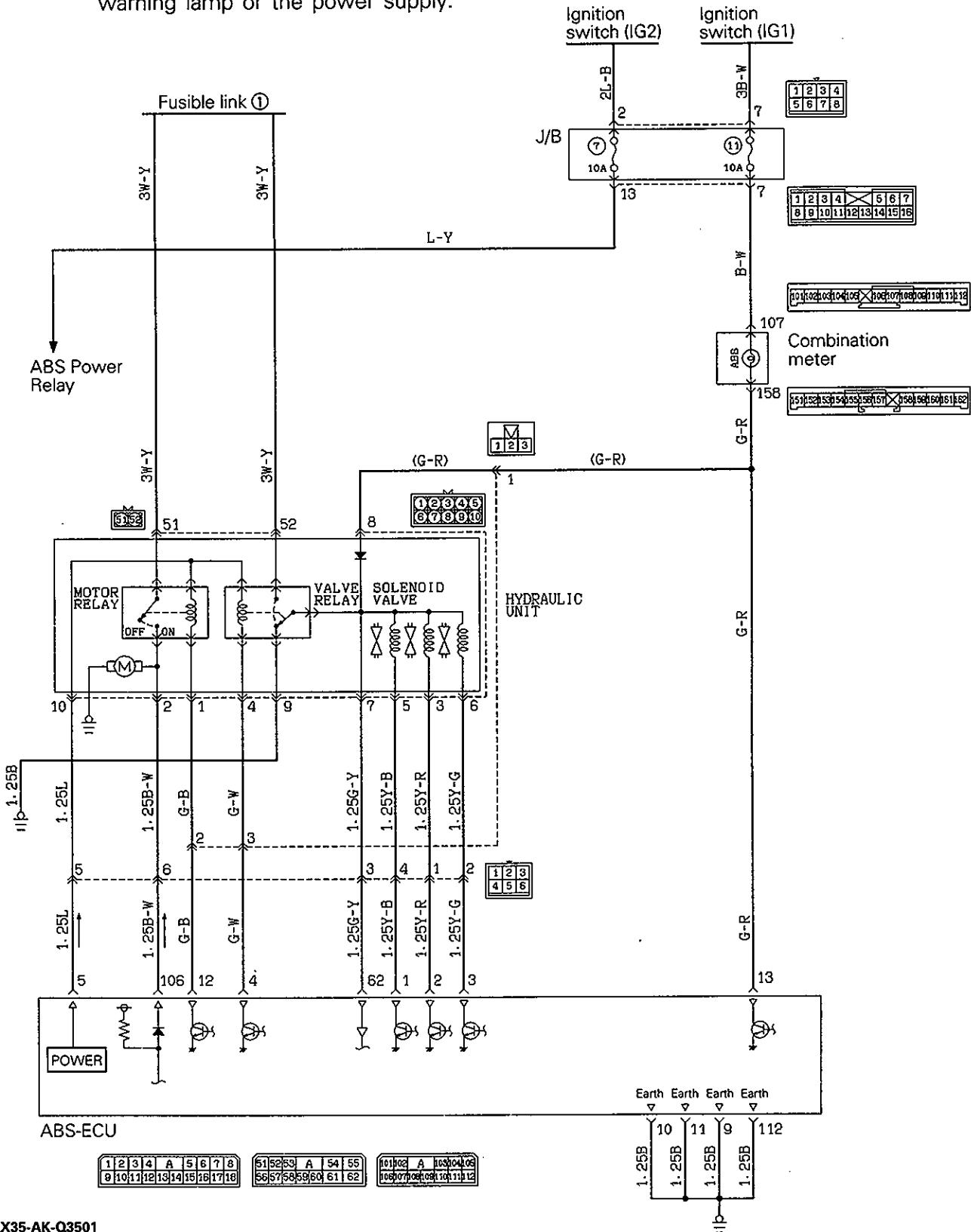


A ABS warning lamp does not illuminate at all

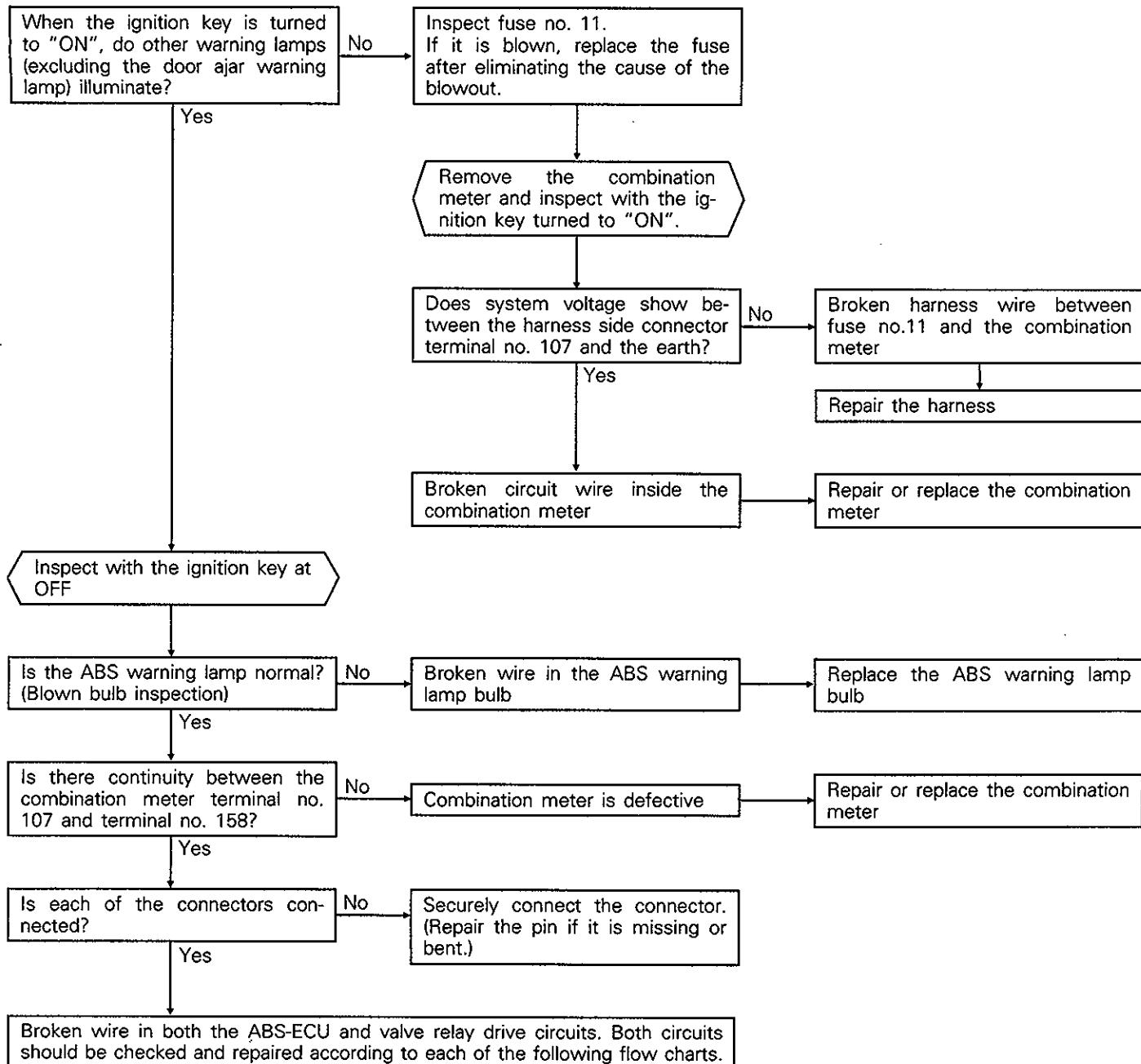
<Vehicles built up to October, 1993>

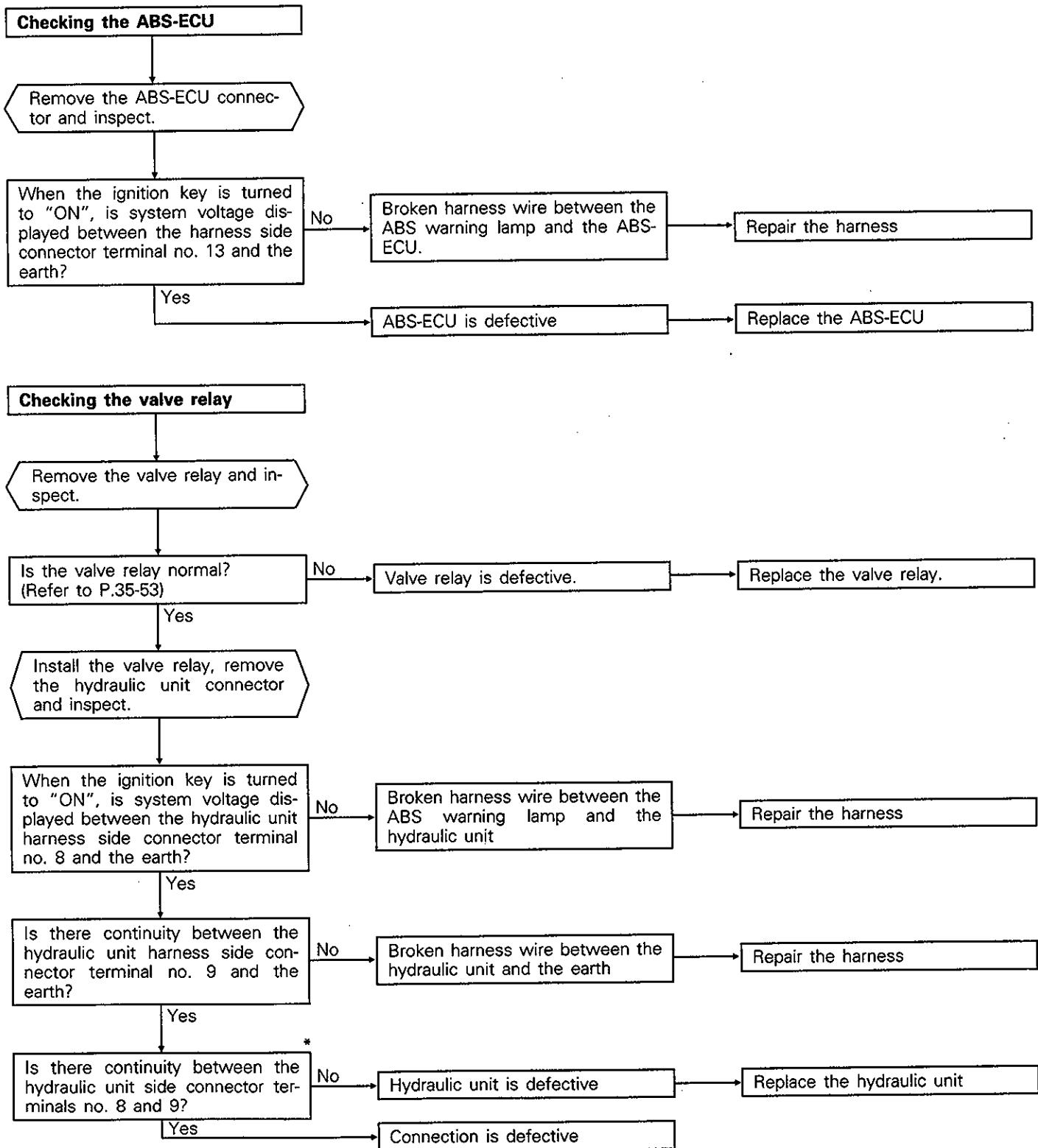
[Comment] When the lamp does not illuminate at all, there is a strong possibility that there is a malfunction of the ABS warning lamp or the power supply.

(Hint) If other warning lamps also do not illuminate, it is probably a blown fuse.



35-14 SERVICE BRAKES – ABS Troubleshooting <Vehicles built up to May, 1994>





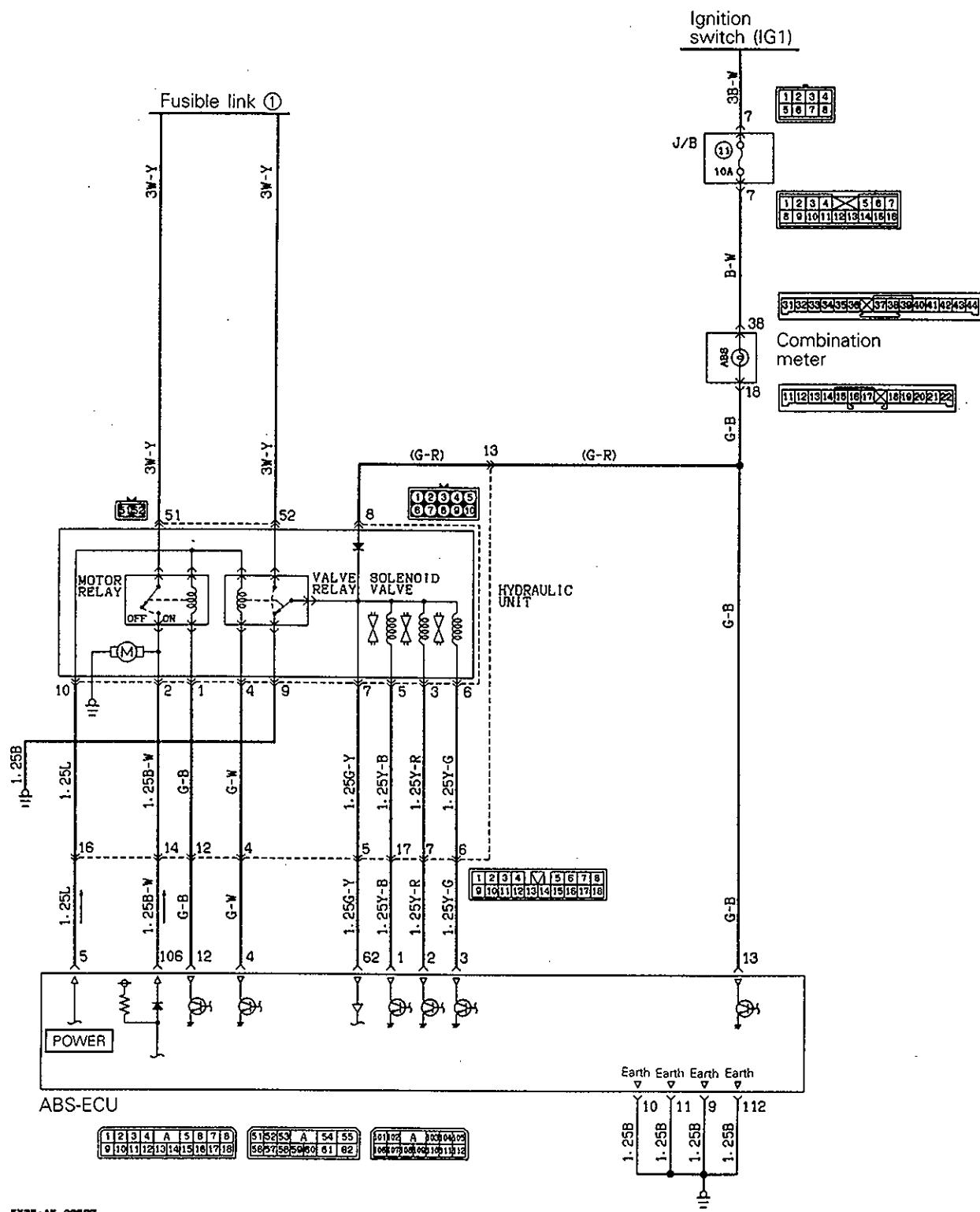
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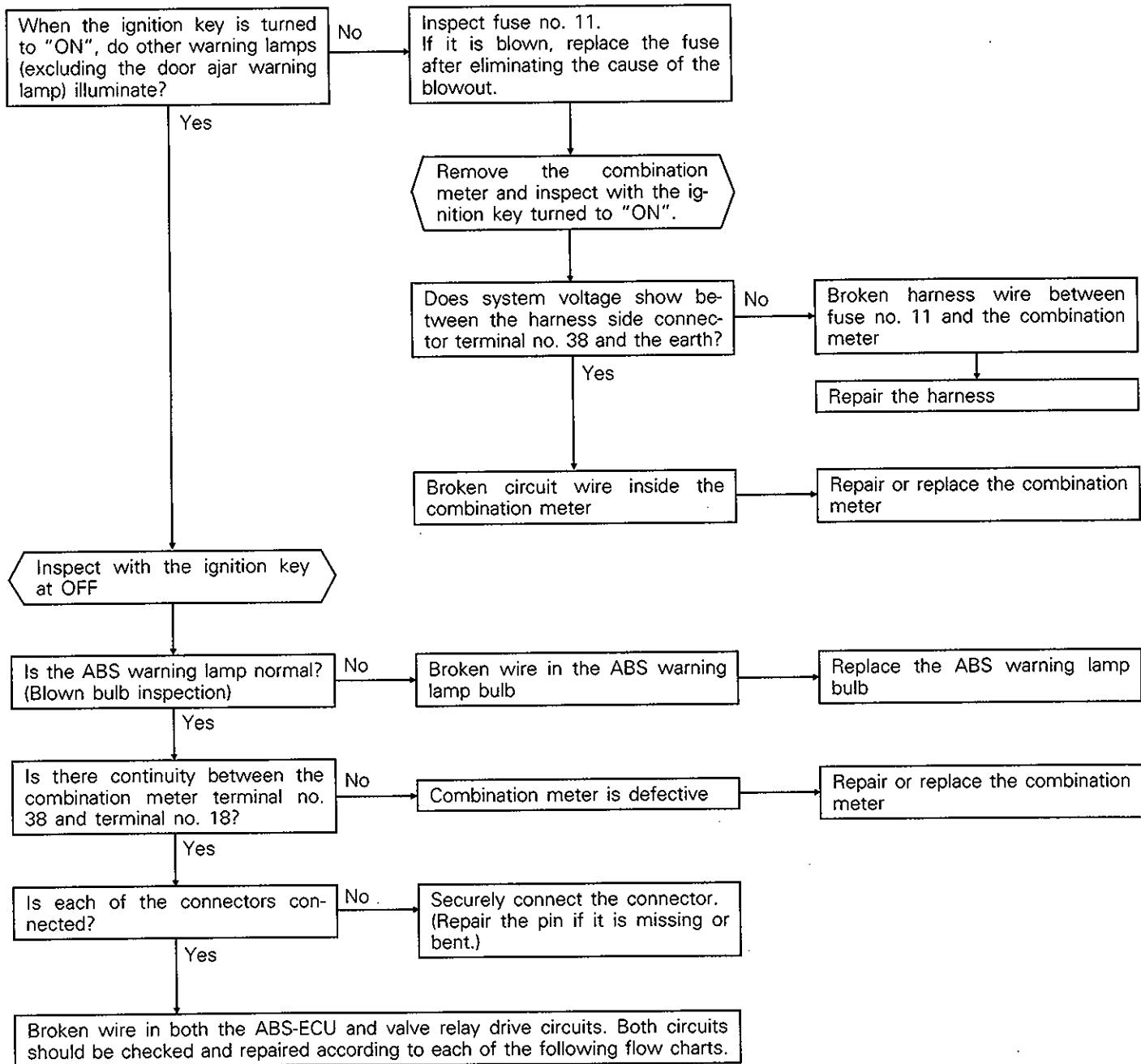
For inspection sections marked by *, pay attention to the polarity of the diodes. (Refer to the circuit diagram on P.35-13.)

<Vehicles built from November, 1993>

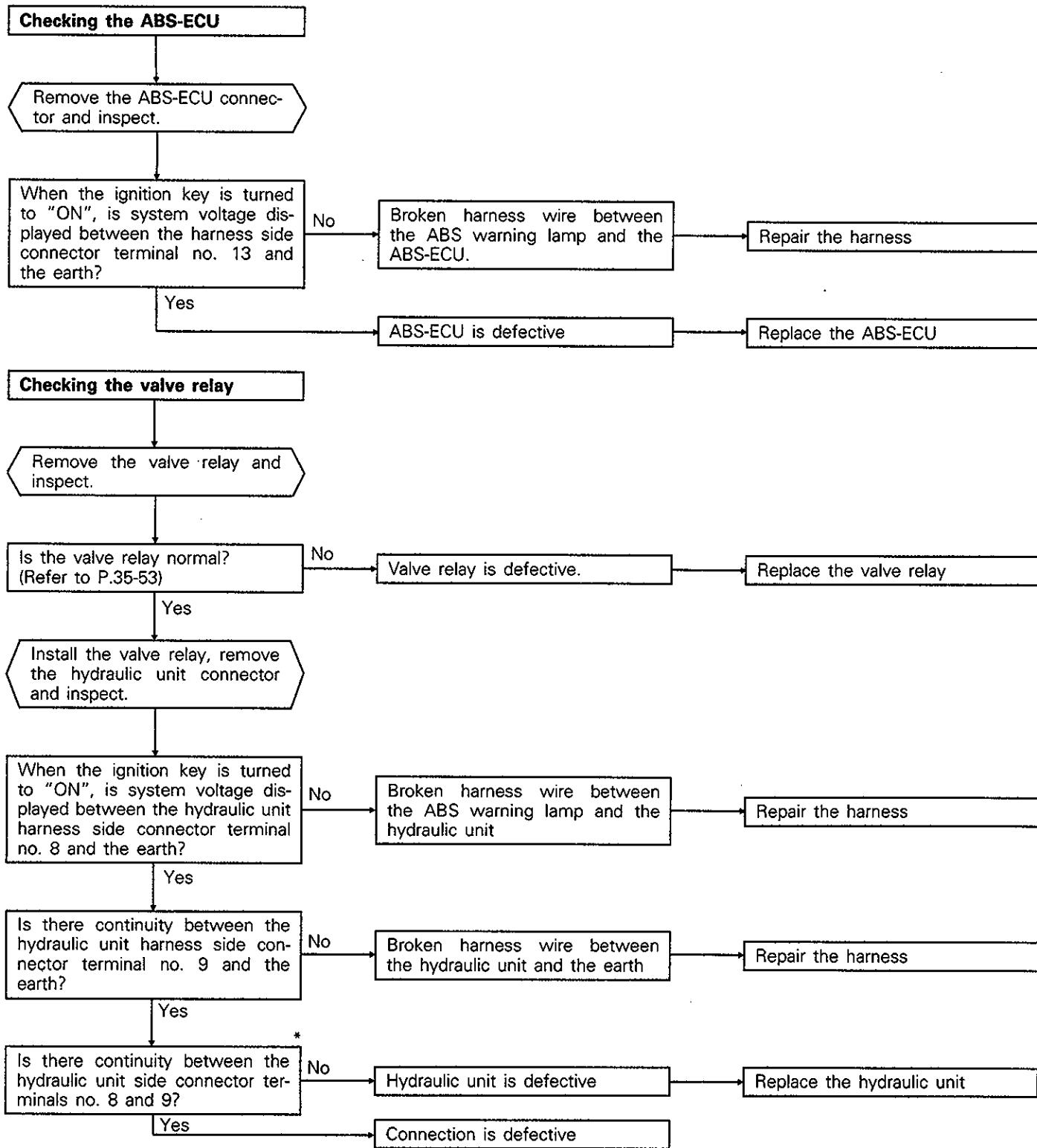
[Comment] When the lamp does not illuminate at all, there is a strong possibility that there is a malfunction of the ABS warning lamp or the power supply.

(Hint) If other warning lamps also do not illuminate, it is probably a blown fuse.





35-15-3 SERVICE BRAKES – ABS Troubleshooting <Vehicles built up to May, 1994>



NOTE

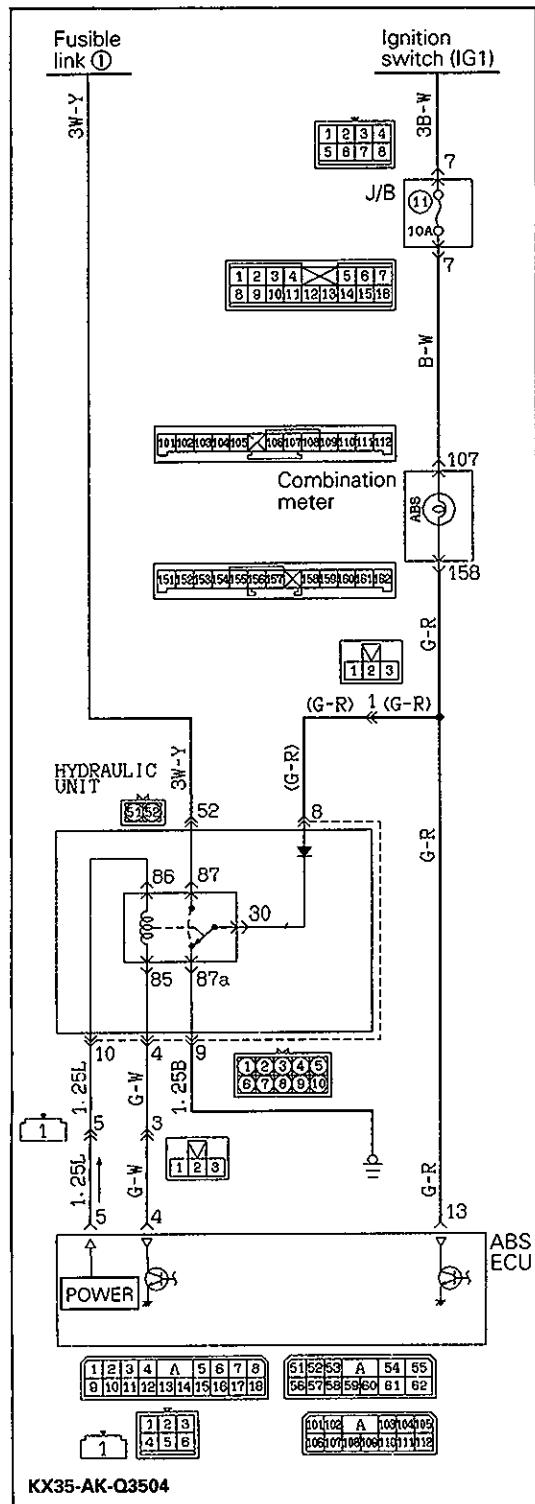
For inspection sections marked by *, pay attention to the polarity of the diodes. (Refer to the circuit diagram on P.35-13.)

NOTES

B When the ignition switch is turned to "ON", the ABS warning lamp remains illuminated

<Vehicles built up to October, 1993>

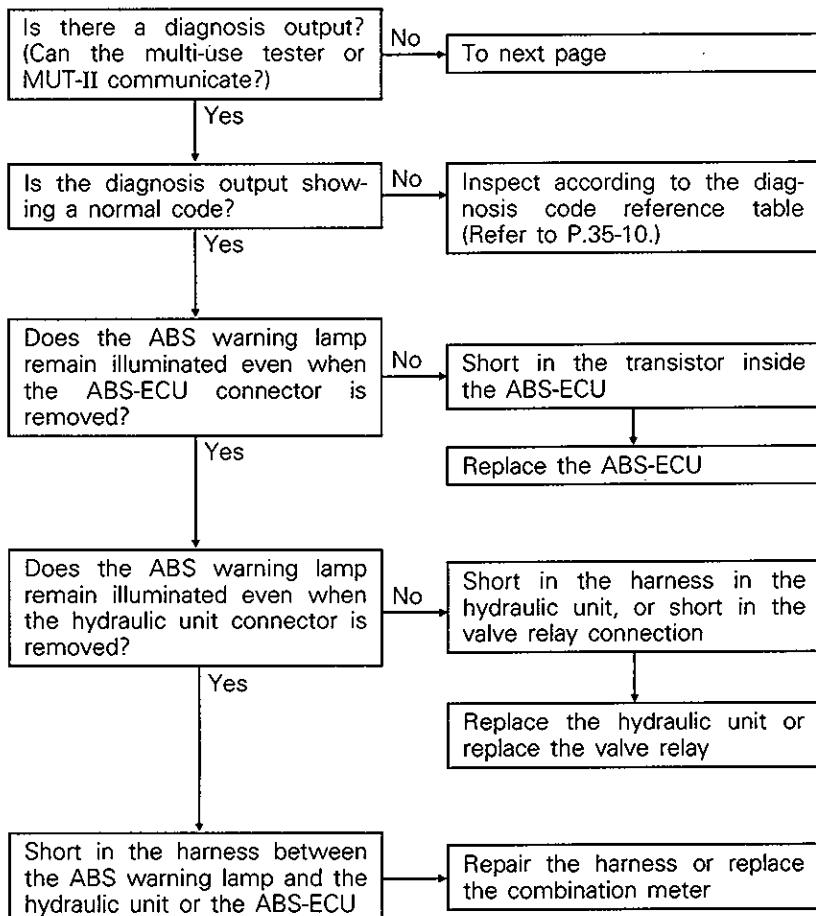
[Comment] This symptom occurs when the ABS-ECU is not functioning due to a broken wire, etc., in the ABS-ECU power circuit, when the fail-safe function is operating to isolate the system, or when there is a short in the warning lamp drive circuit.

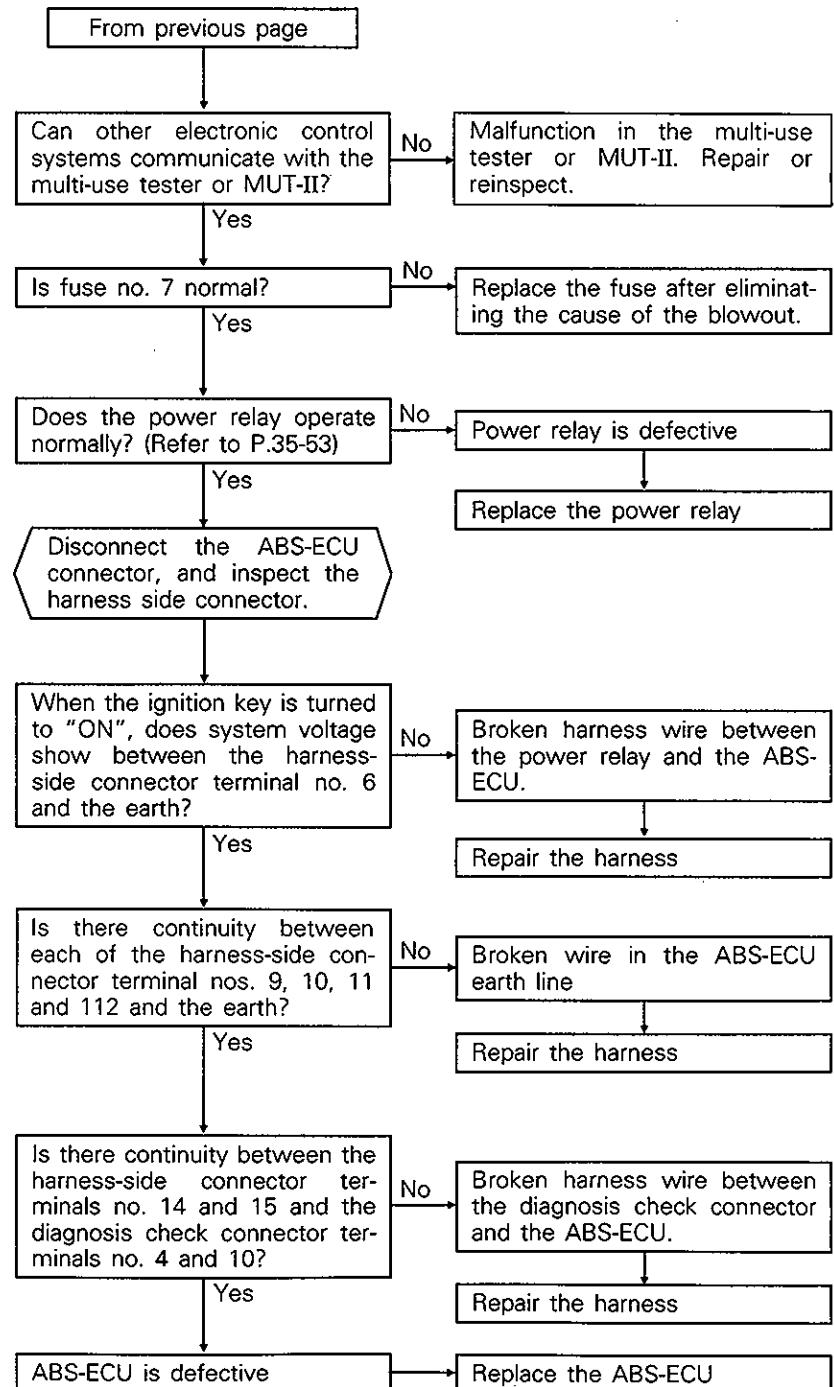
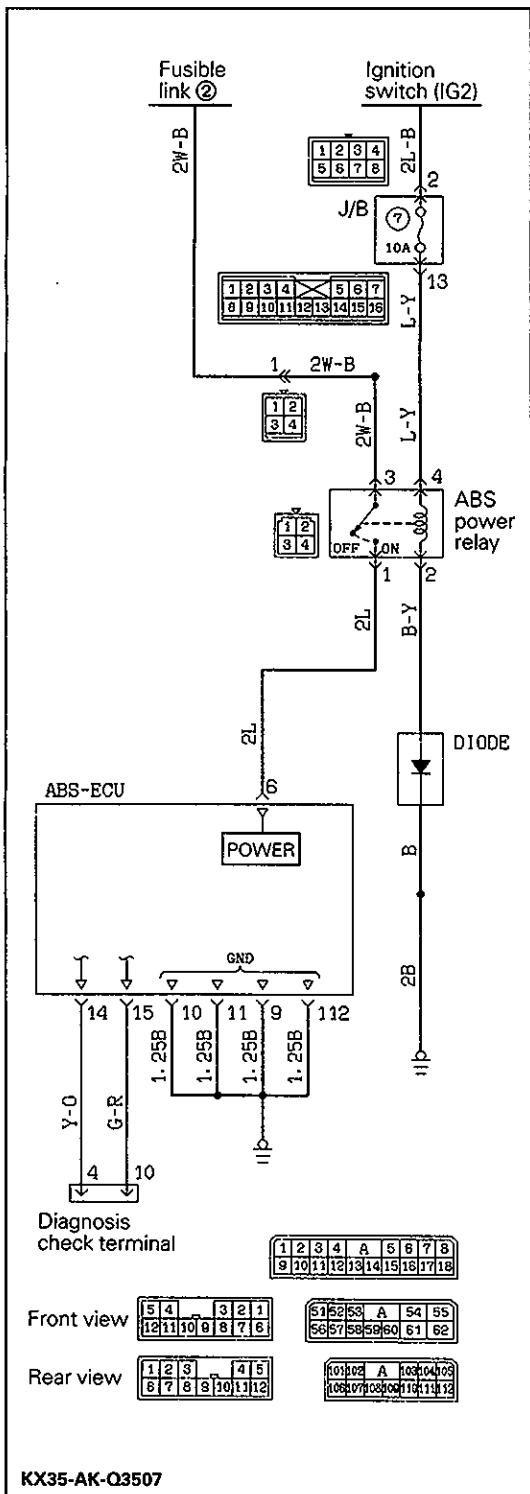


(Hint) Check the diagnosis output, and if there is no output voltage, or the multi-use tester and the ABS-ECU cannot communicate, then there is a high possibility that power is not being supplied to the ABS-ECU.

Caution

- If no malfunction code is output, there is a high possibility that the fail-safe function is operating. In this case, to check if there is a current problem, the memory should be temporarily erased, and a test run should be carried out.





KX35-AK-Q3507

35-17-1 SERVICE BRAKES – ABS Troubleshooting <Vehicles built up to May, 1994>

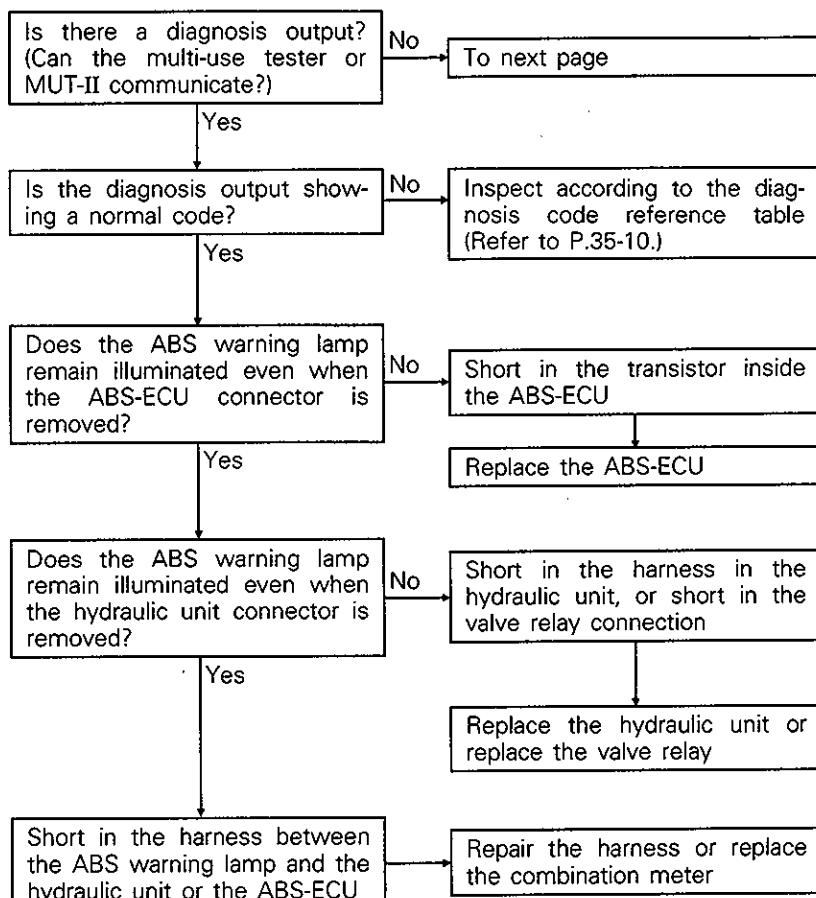
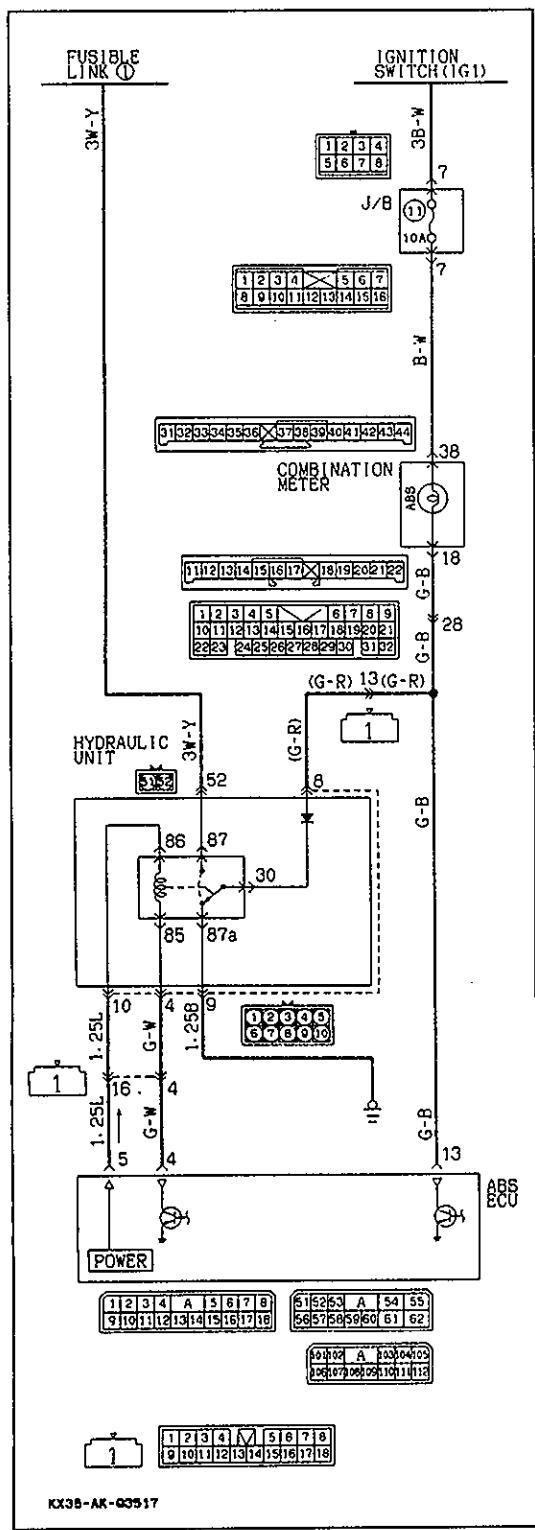
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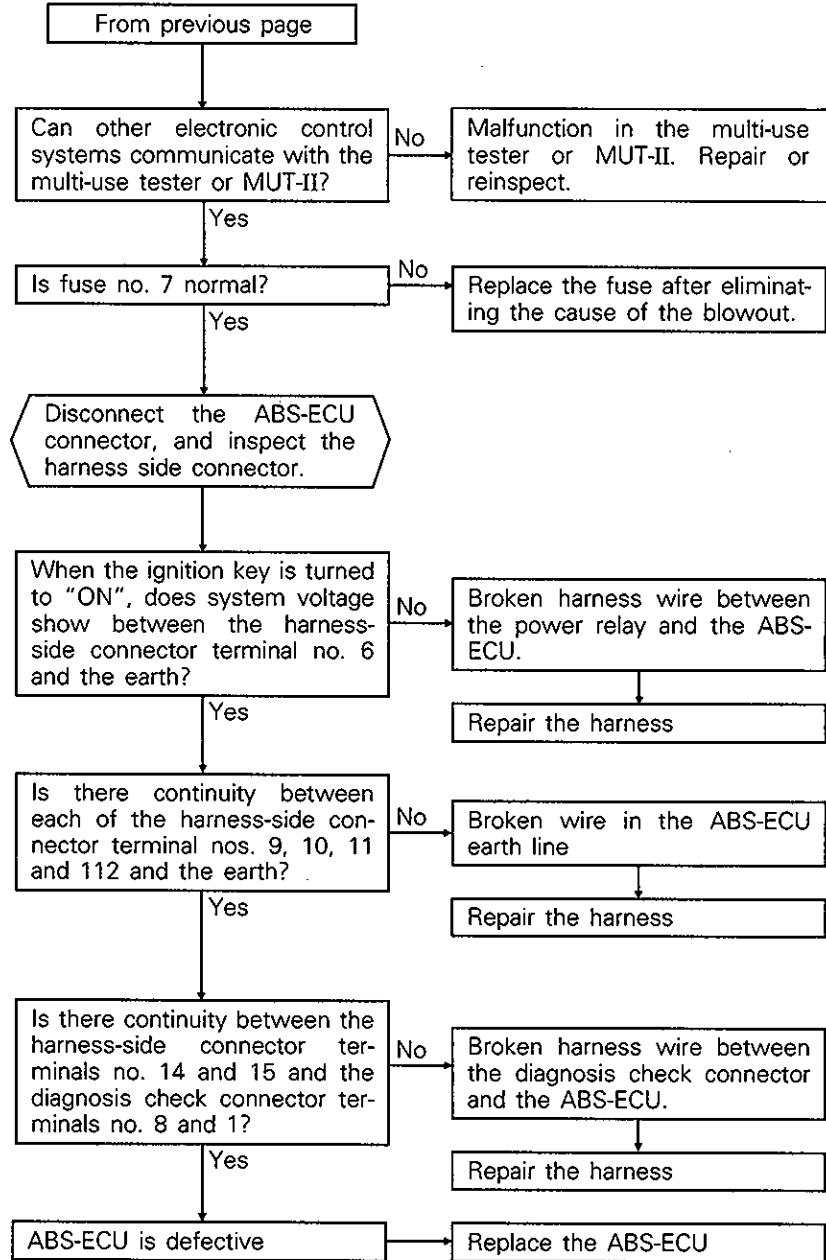
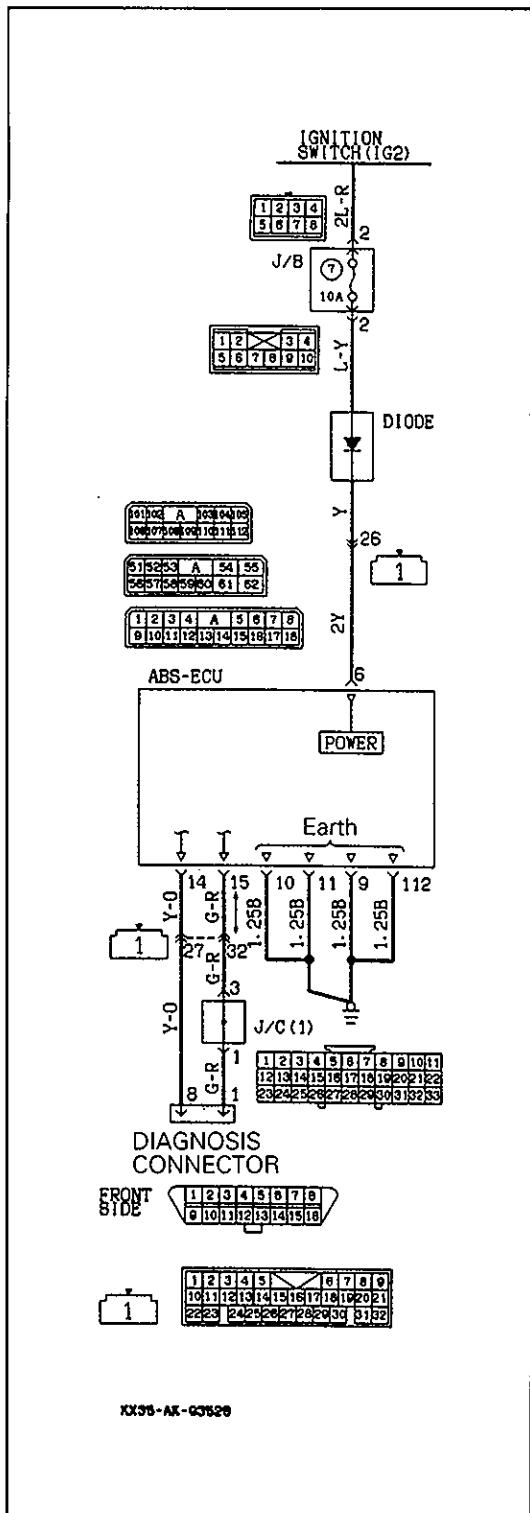
[Comment] This symptom occurs when the ABS-ECU is not functioning due to a broken wire, etc., in the ABS-ECU power circuit, when the fail-safe function is operating to isolate the system, or when there is a short in the warning lamp drive circuit.

(Hint) Check the diagnosis output, and if there is no output voltage, or the multi-use tester and the ABS-ECU cannot communicate, then there is a high possibility that power is not being supplied to the ABS-ECU.

Caution

- If no malfunction code is output, there is a high possibility that the fail-safe function is operating. In this case, to check if there is a current problem, the memory should be temporarily erased, and a test run should be carried out.



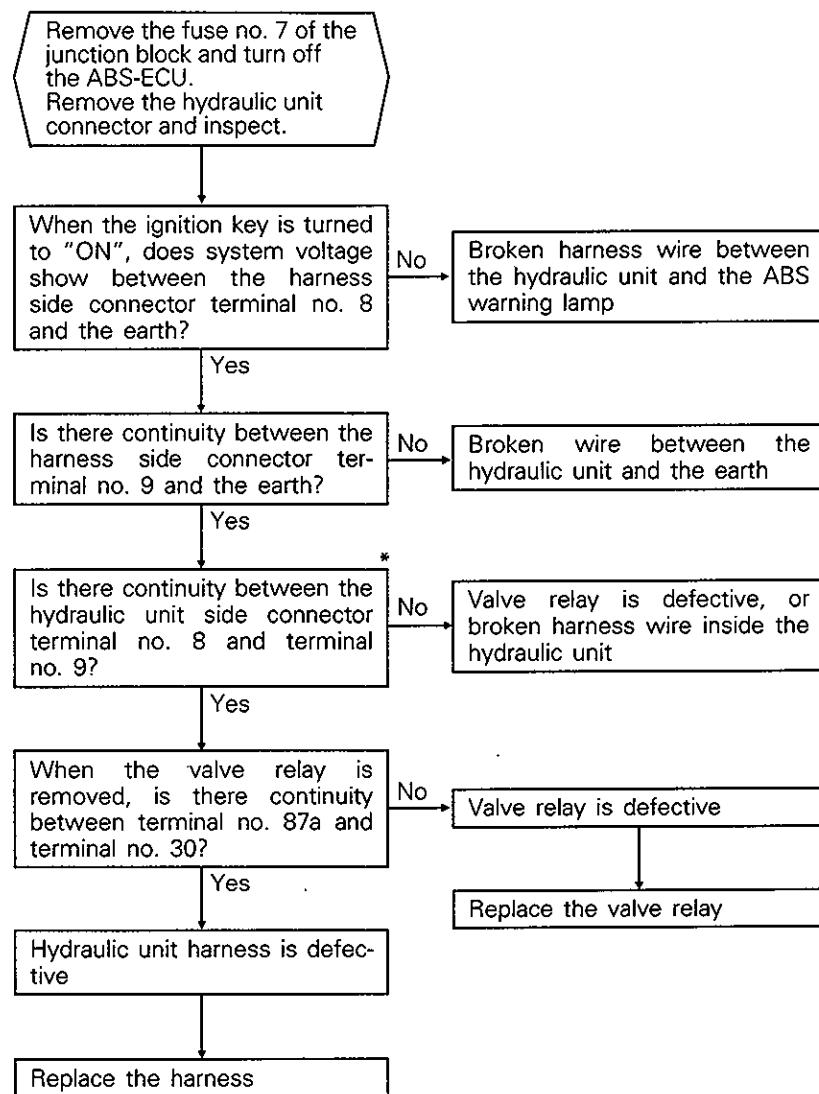
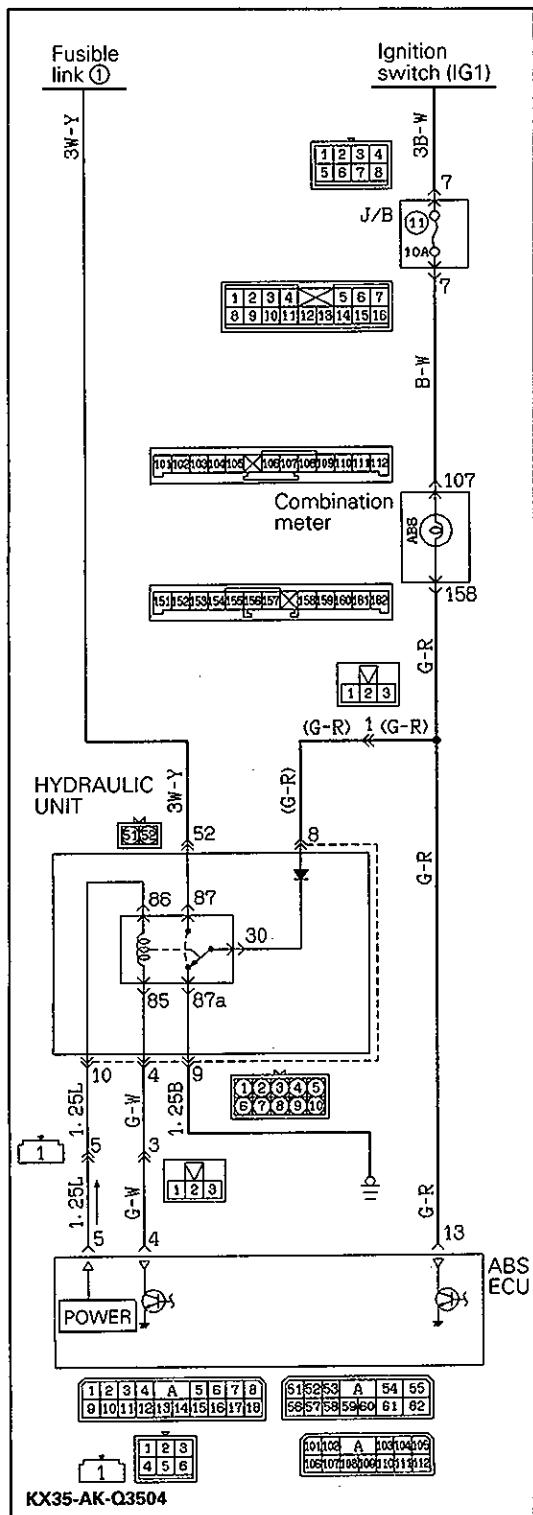


C When ignition key is turned to "START", ABS warning lamp switches off

<Vehicles built up to October, 1993>

[Comment] The ABS-ECU uses the power to the IG2 which is cut when the ignition switch is turned to "START". The ABS warning lamp uses IG1 power which is not cut even when the ignition switch is turned to "START". Accordingly, because the power to the

ABS-ECU is stopped in "START" position, the valve relay turns OFF. At this time, if the warning lamp does not illuminate, the cause is a problem in the lamp illumination circuit in the valve relay.



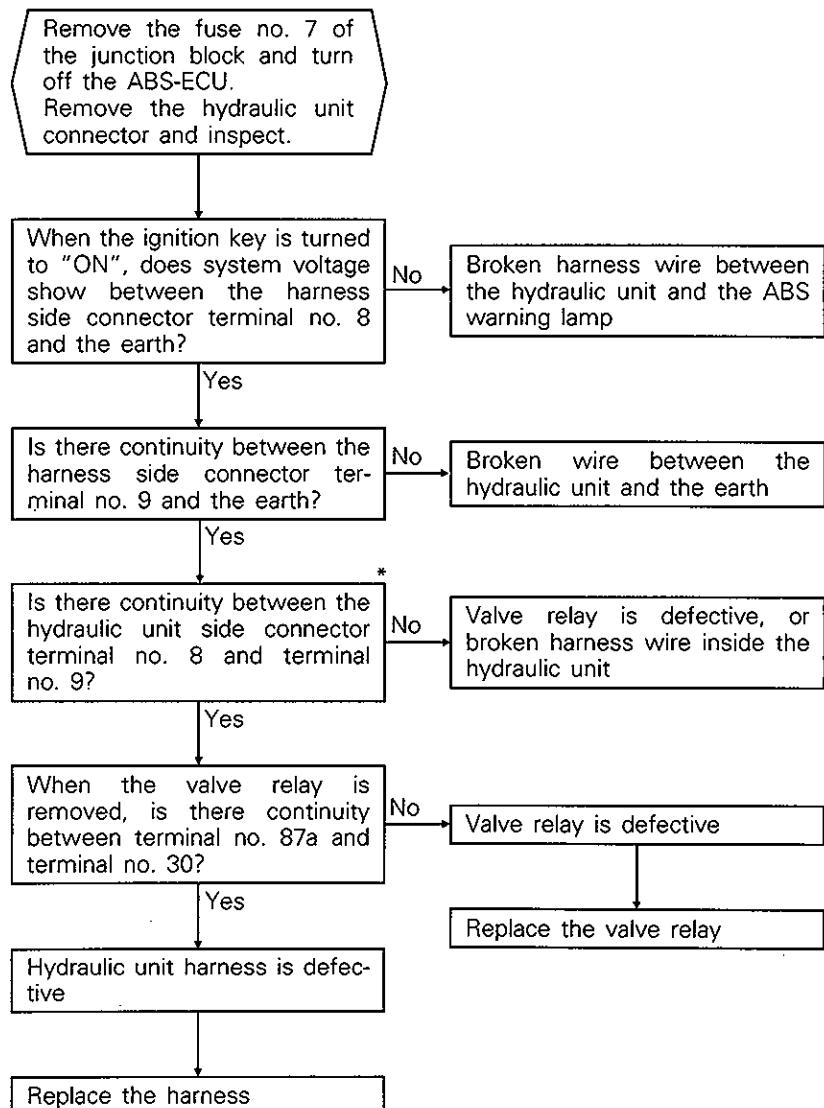
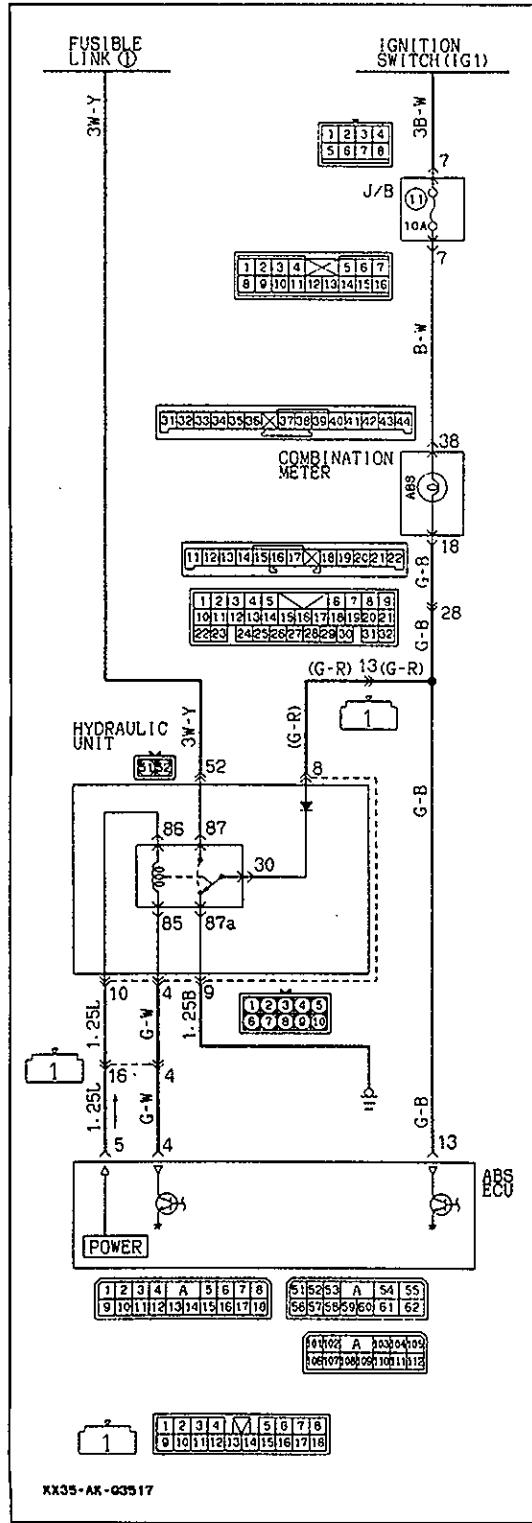
NOTE

For inspection sections marked by *, pay attention to the polarity of the diodes. (Refer to the circuit diagram)

<Vehicles built from November, 1993>

[Comment] The ABS-ECU uses the power to the IG2 which is cut when the ignition switch is turned to "START". The ABS warning lamp uses IG1 power which is not cut even when the ignition switch is turned to "START". Accordingly, because the power to

the ABS-ECU is stopped in "START" position, the valve relay turns OFF. At this time, if the warning lamp does not illuminate, the cause is a problem in the lamp illumination circuit in the valve relay.



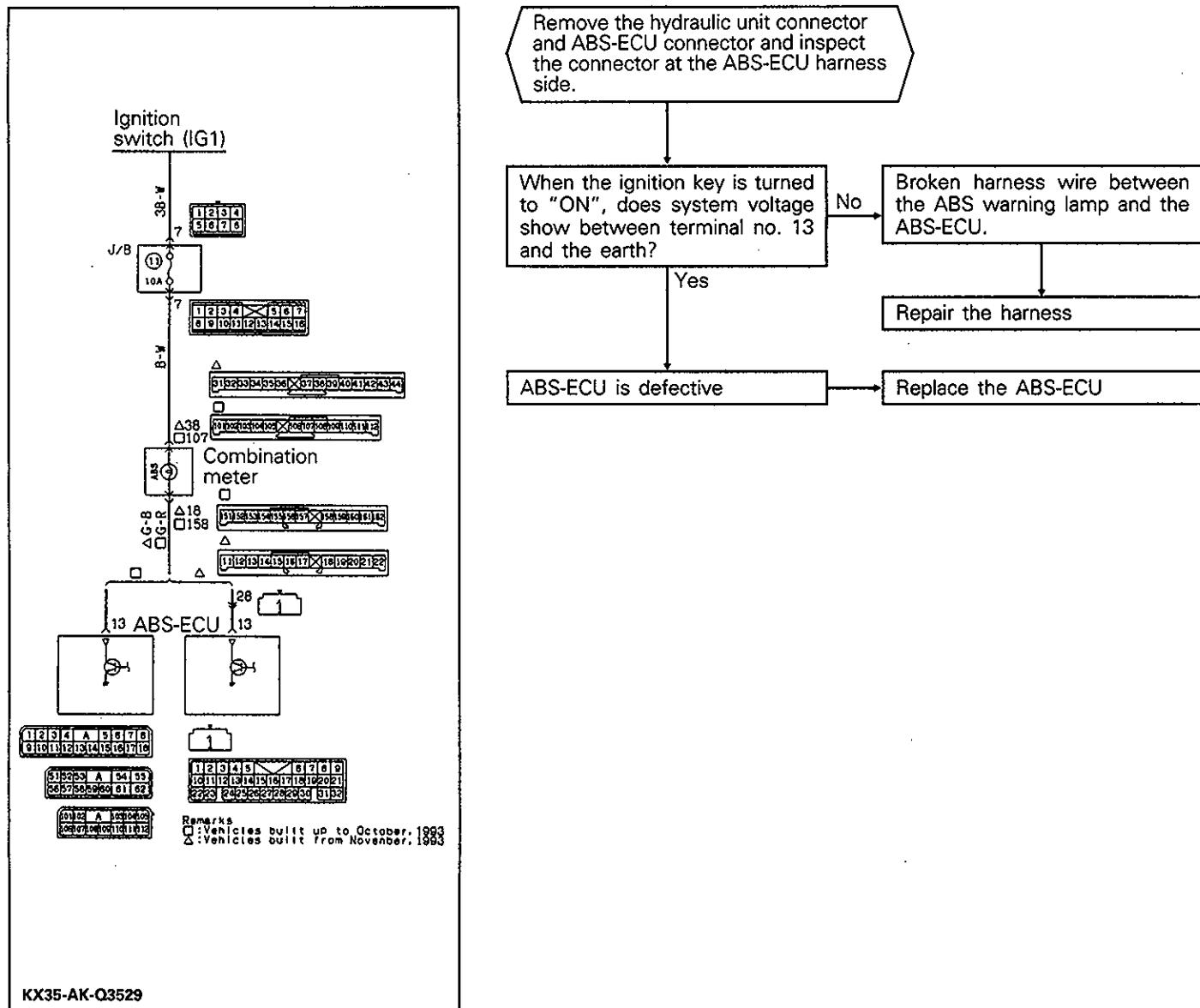
NOTE

For inspection sections marked by *, pay attention to the polarity of the diodes. (Refer to the circuit diagram)

D The ABS warning lamp flashes twice after the ignition key is turned to "ON". The lamp illuminates when the ignition key is turned to "START", and when the key is returned to "ON", it flashes once.

[Comment] The ABS-ECU causes the ABS warning lamp to illuminate during the initial check (approx. 1 second). During the initial check, the valve relay changes from OFF to ON→OFF→ON, and

if there is a broken harness wire between the ABS-ECU and the ABS warning lamp, the lamp will illuminate only when the valve relay is OFF because of a valve relay test, etc.



E-1 When diagnosis code nos. 11, 12, 13, or 14 are displayed

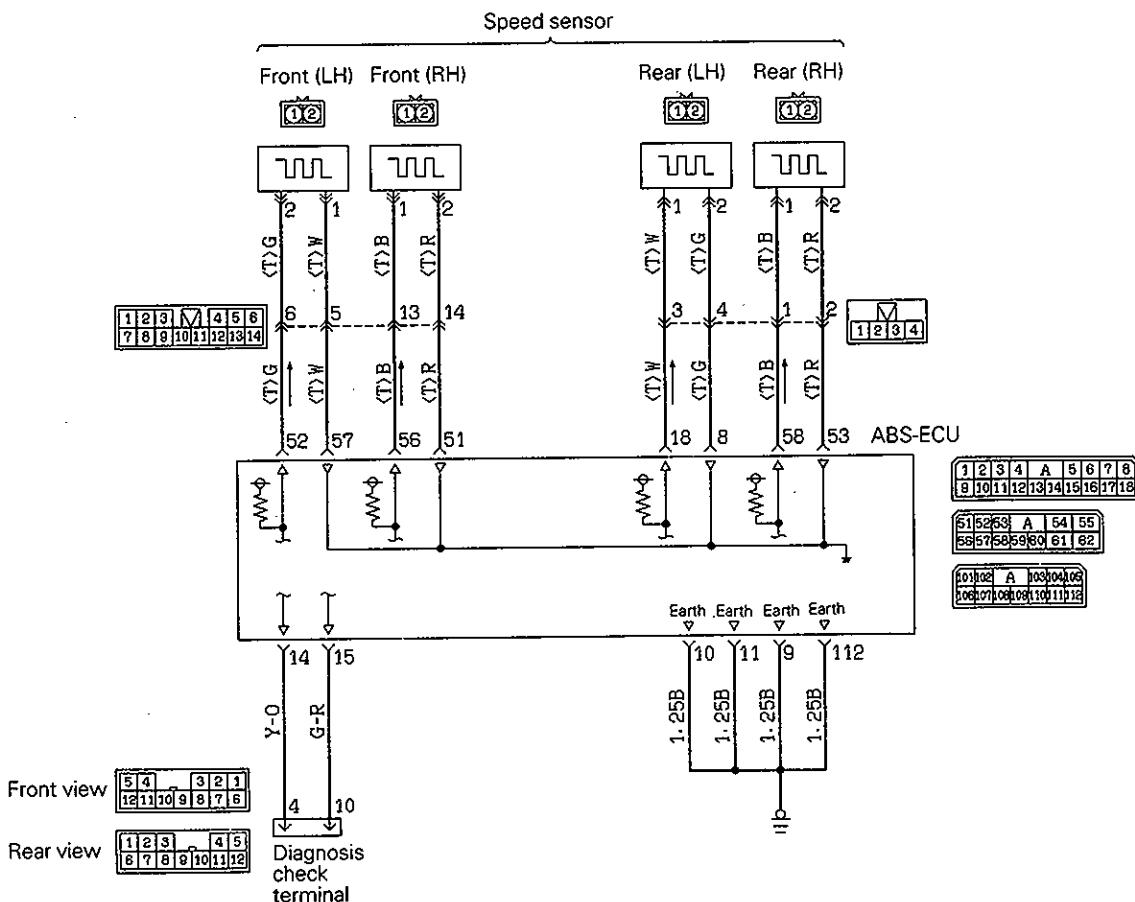
[Comment] These codes are displayed when there is a broken (+) wire or (-) wire in one of the vehicle speed sensors detected by the ABS-ECU hardware circuit.

(Hint) Apart from a broken wire in a vehicle speed sensor, the cause could also be an intermittent break in a sensor harness or a defective harness connection, so check these also.

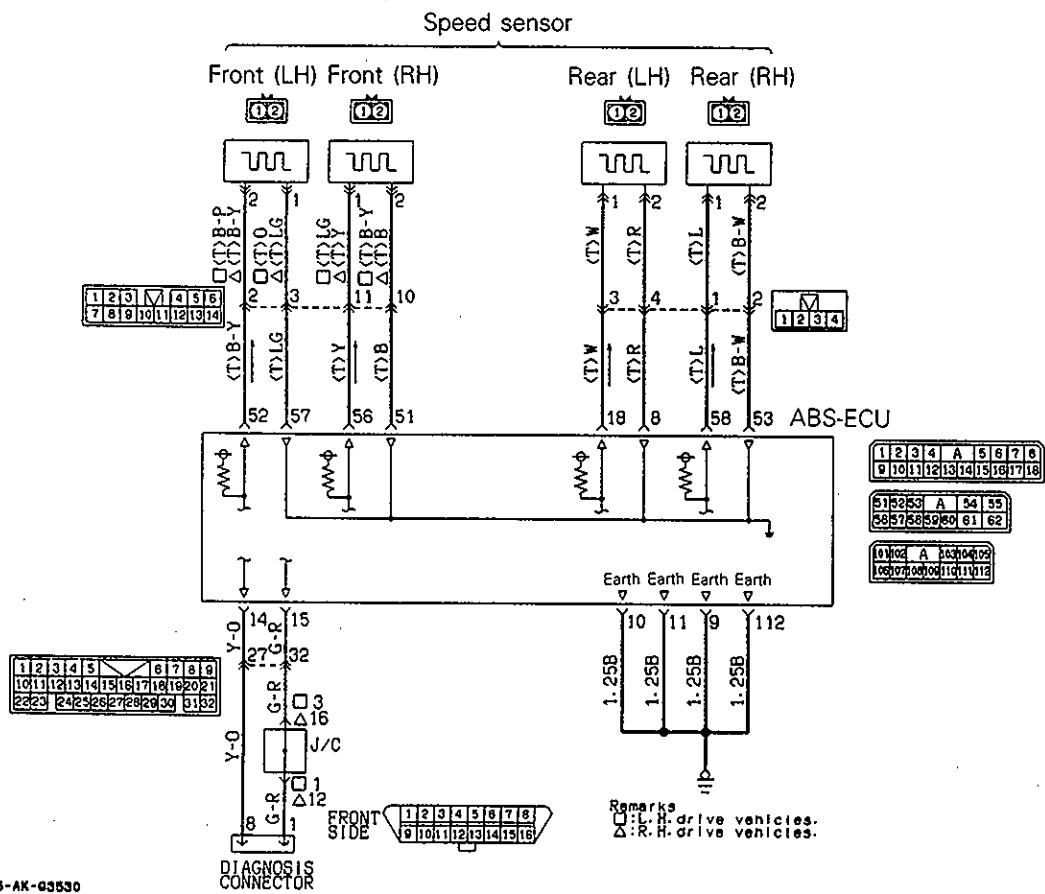
NOTE

1. When there is a defective contact, inspect the sensor cable by lightly flexing and stretching it.
2. If there is no current problem, a normal value will result even if a problem is detected, so when the malfunction in the sensor circuit indicated cannot be discovered, momentarily turn the ignition switch to OFF, and carry out another driving test. At this time, replace the ABS-ECU only if the same problem code is output. After this, if the code does not reappear, there is a problem with the ABS-ECU interface. (For a problem that is difficult to reproduce, there is a possibility that the code will recur even when the ABS-ECU is replaced.)

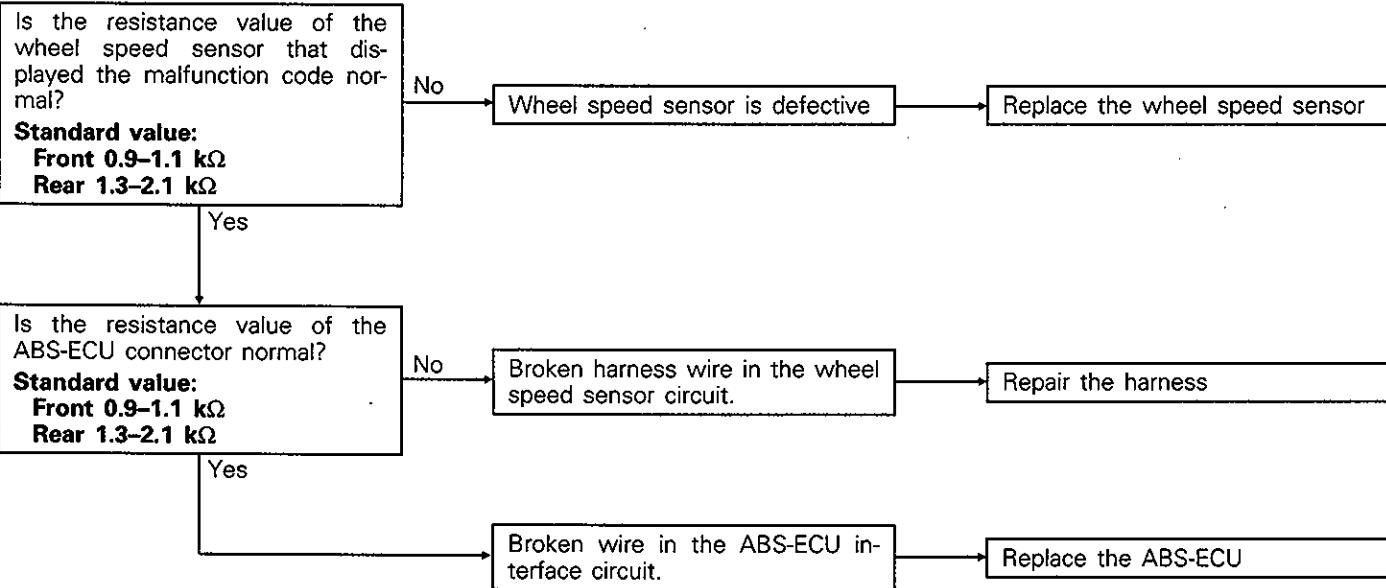
<Vehicles built up to October, 1993>



<Vehicles built from November, 1993>



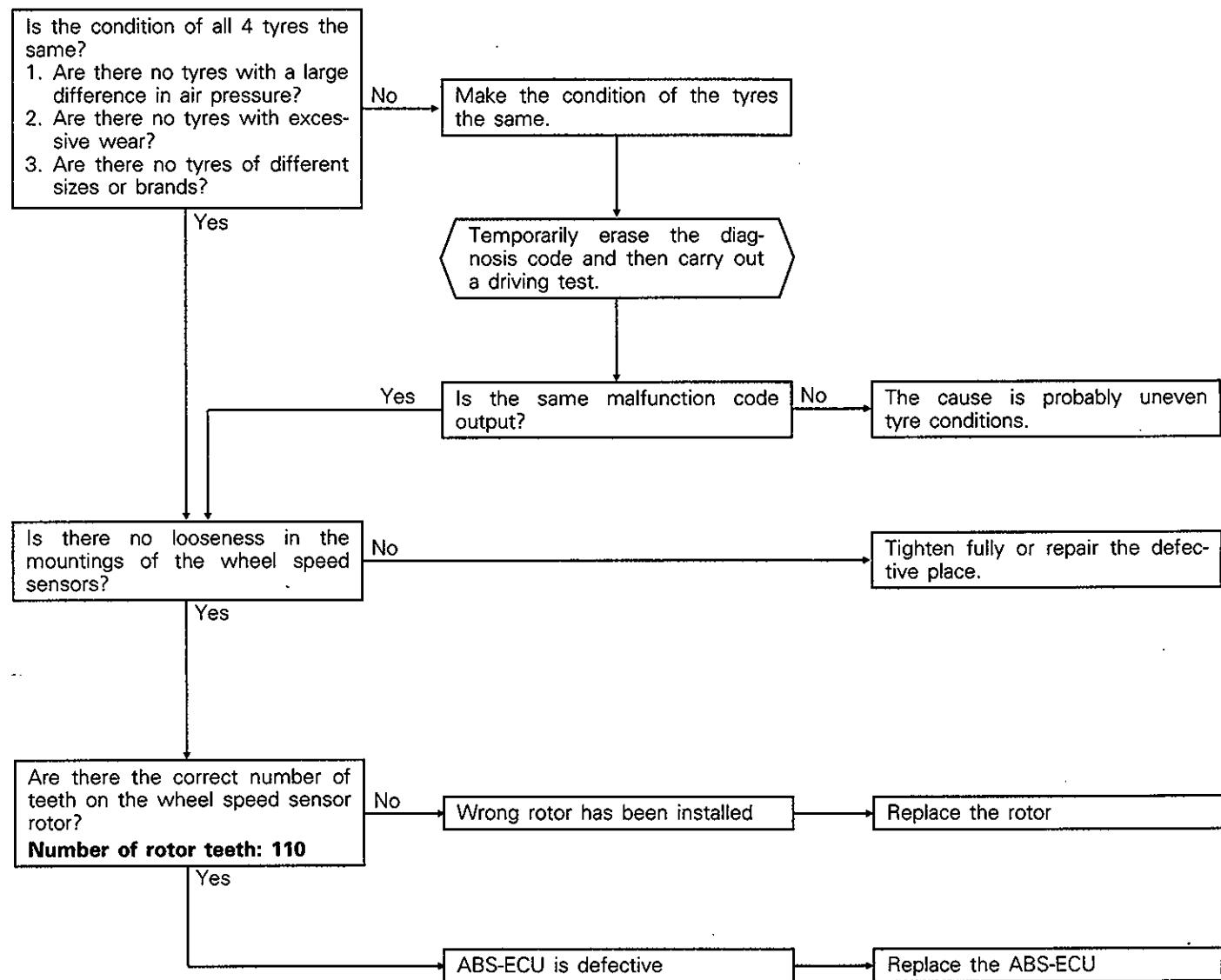
KX35-AK-03530



E-2 When diagnosis code no. 15 is displayed

[Comment] This malfunction code is output when any one of the wheel speed sensor output signals during driving is abnormal.

(Hint) The cause of the abnormal wheel speed sensor output could be noise in the sensor signal from a loose wheel speed sensor.



NOTES

E-3 When diagnosis code no. 21, 22, 23 or 24 is displayed

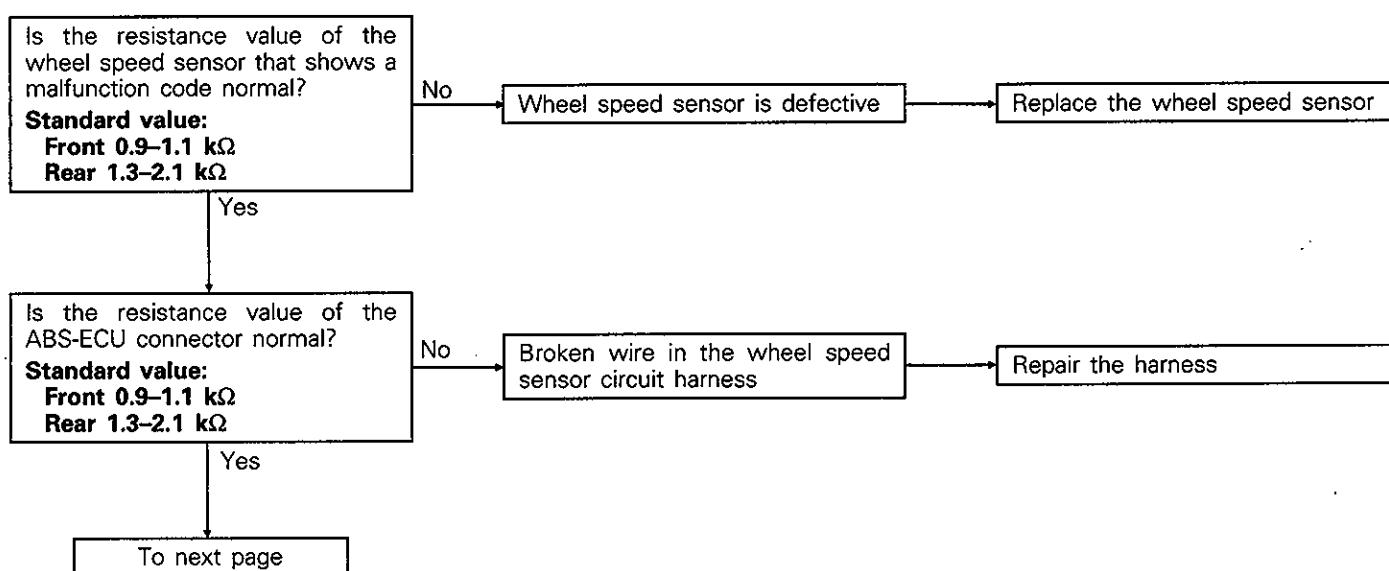
[Comment] These malfunction codes are displayed when a broken wire cannot be verified, and when the vehicle speed reaches 8 km/h (5 mph) or more, no pulses are input.

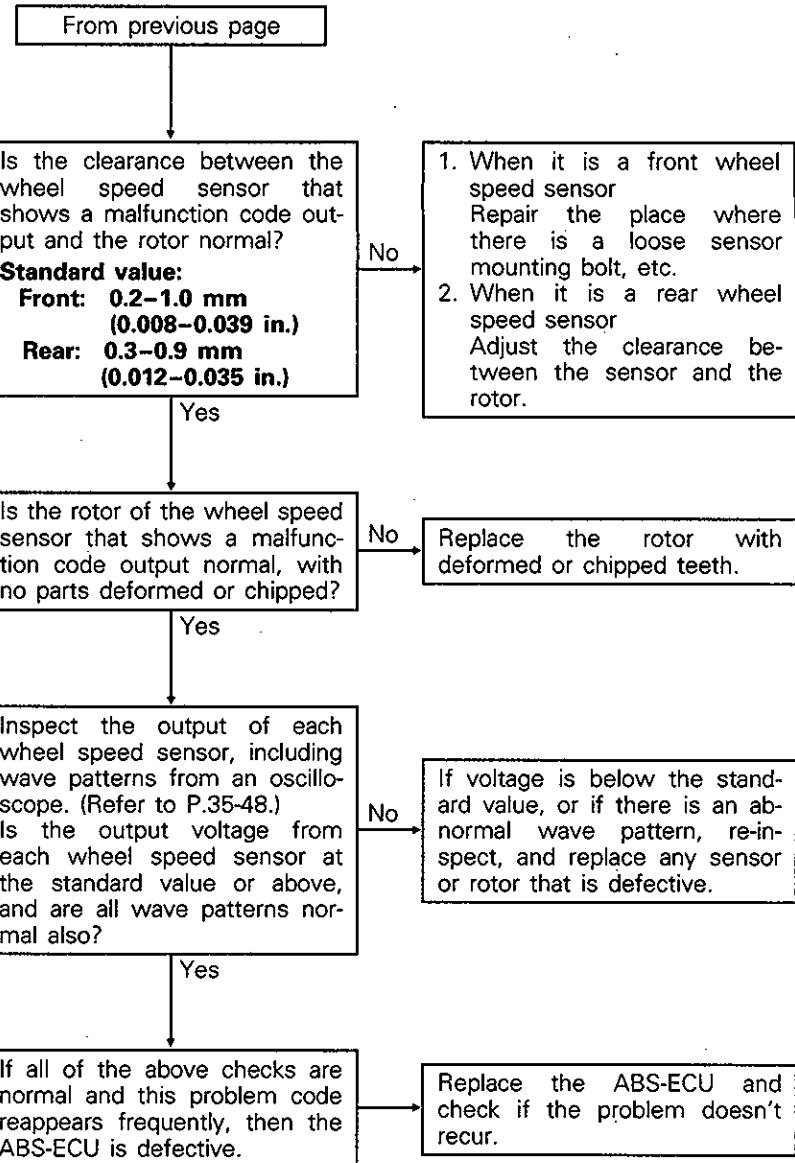
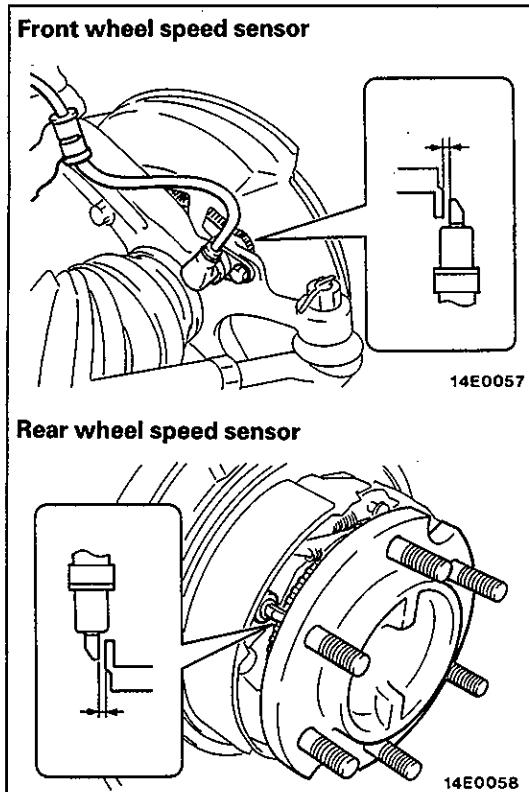
(Hint) The cause is likely to be either a short between the sensor harnesses, a short between the sensor (+) wire and the body, or an excessive sensor gap.

NOTE

(1) When there is a defective contact, inspect the sensor cable by lightly flexing and stretching it.

(2) If there is no current problem, a normal value will result even if a problem is detected, so when the malfunction in the sensor circuit indicated cannot be discovered, momentarily erase the diagnosis code and turn the ignition switch to OFF, and carry out another driving test. At this time, replace the ABS-ECU only if the same malfunction code is output. After this, if the code does not reappear, there is a problem with the ABS-ECU interface. (For a problem that is difficult to reproduce, there is a possibility that the code will recur even when the ABS-ECU is replaced.)





E-4 When diagnosis code no. 16 is displayed

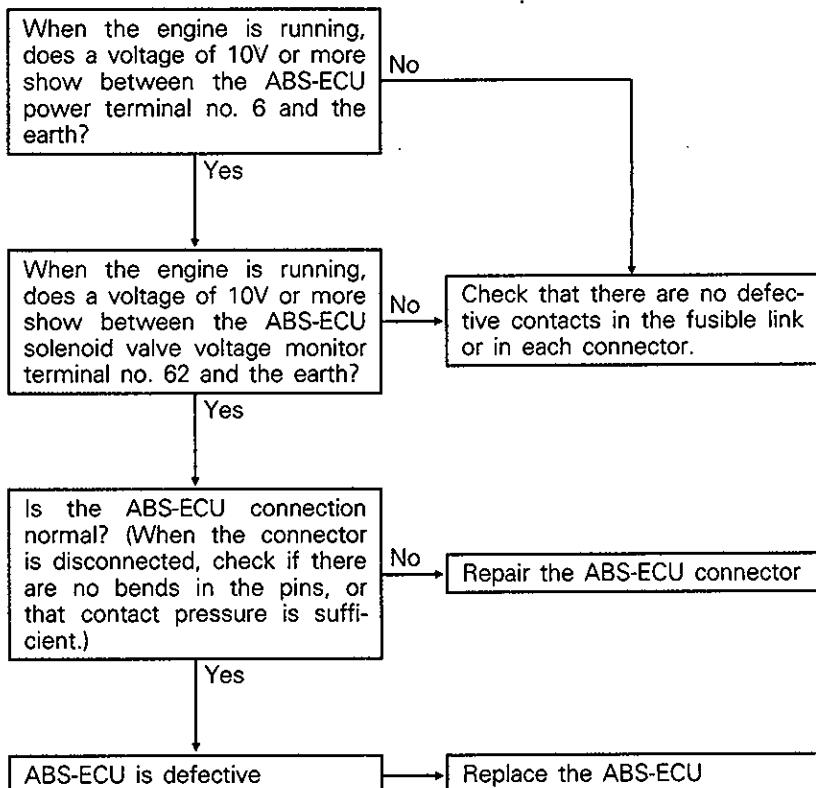
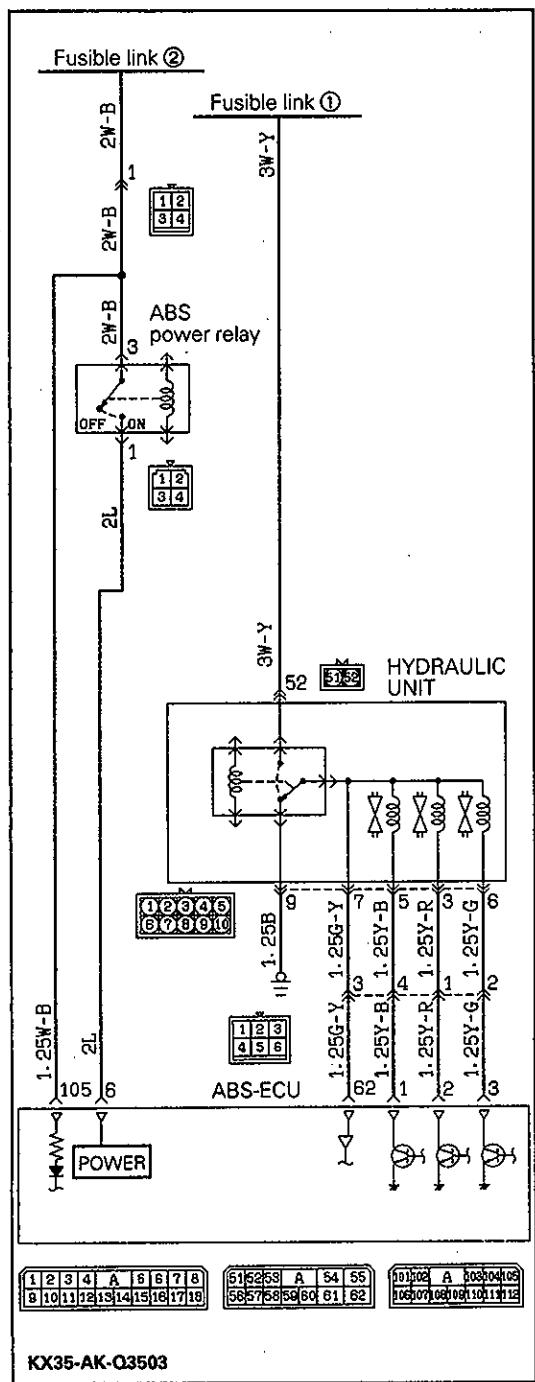
<Vehicles built up to October, 1993>

[Comment] This indicates that the ABS-ECU power voltage or the solenoid valve power voltage is lower than the standard value.

If the voltage returns to standard voltage or above, this malfunction code will not be output.

Caution

If the system voltage drops during inspection, this code will be output as a current problem, and correct diagnosis of the problem cannot be made. Before carrying out the following inspection, check the battery, and charge it if necessary.



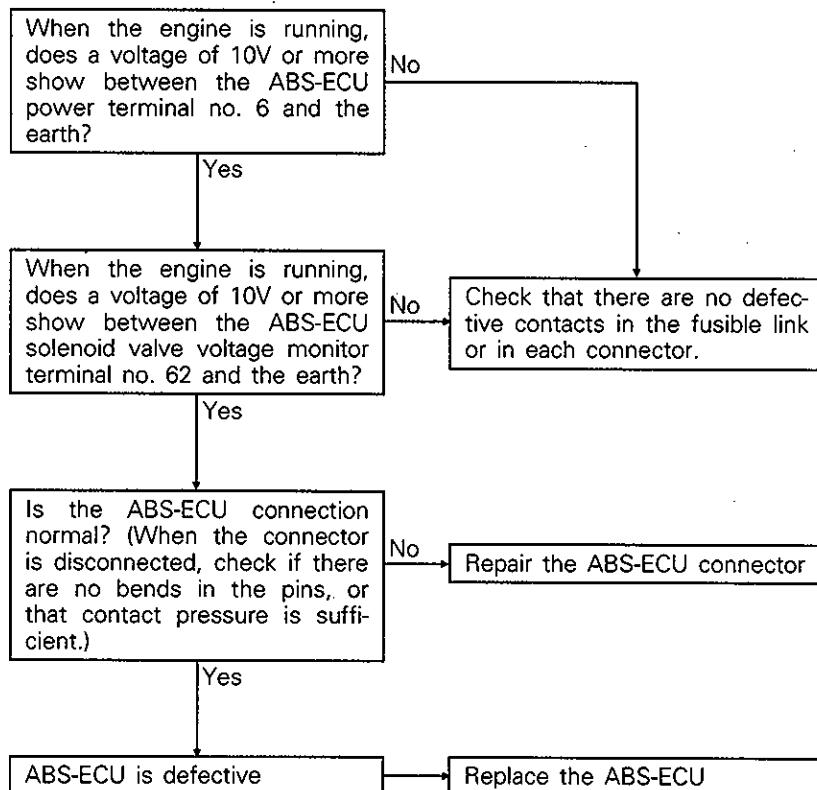
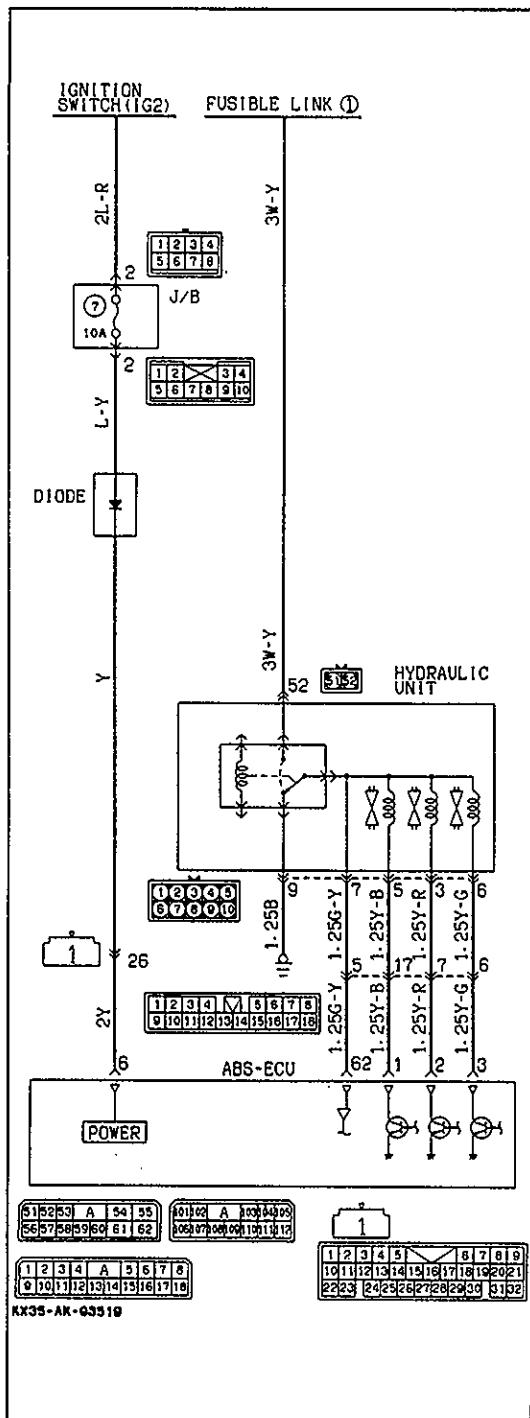
<Vehicles built from November, 1993>

[Comment] This indicates that the ABS-ECU power voltage or the solenoid valve power voltage is lower than the standard value.

If the voltage returns to standard voltage or above, this malfunction code will not be output.

Caution

If the system voltage drops during inspection, this code will be output as a current problem, and correct diagnosis of the problem cannot be made. Before carrying out the following inspection, check the battery, and charge it if necessary.

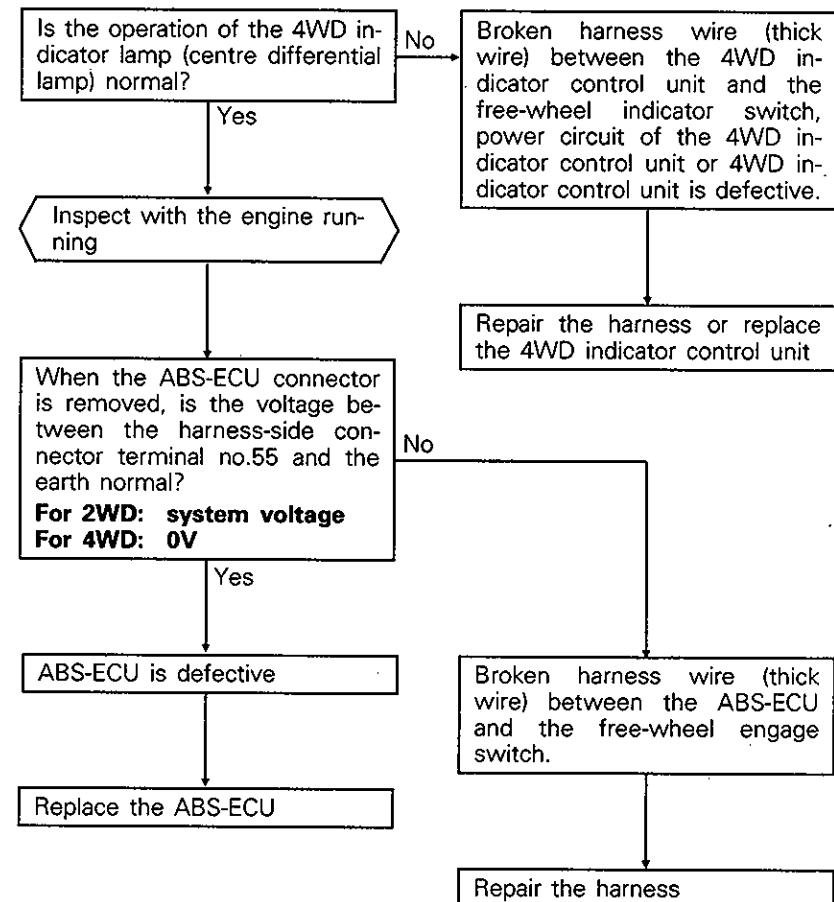
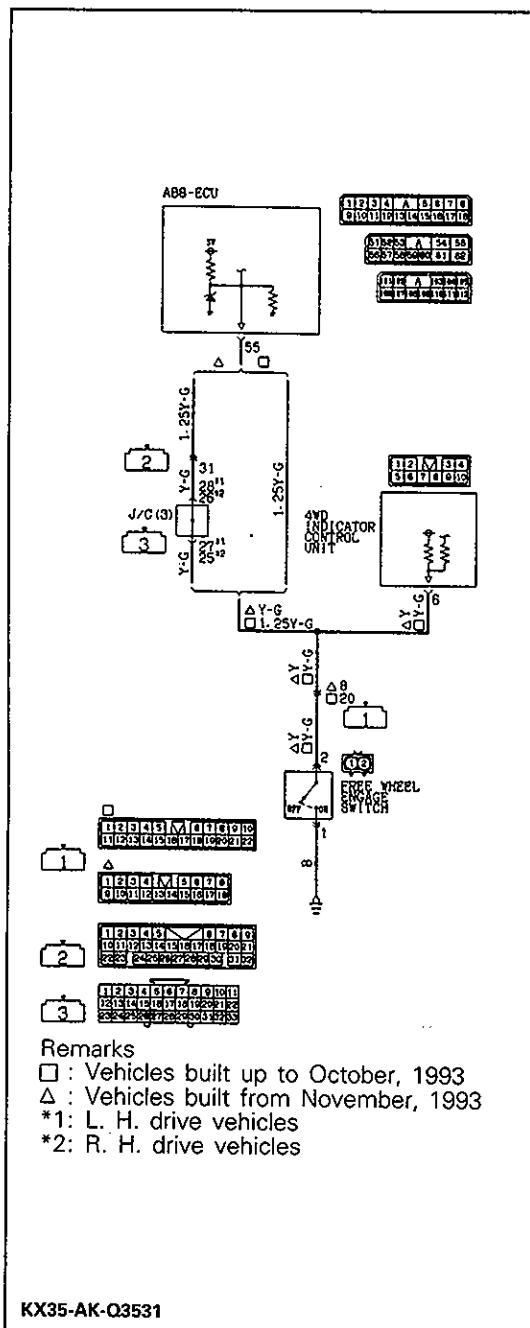


NOTES

E-5 When diagnosis code no. 25 is displayed

[Comment] This malfunction code is output by the ABS-ECU when there is a broken harness wire or defective 4WD indicator circuit in the free-wheel engage switch (thick wire in centre of circuit diagram).

(Hint) When this malfunction code is output, and also none of the 4WD indicator lamps (excluding the rear differential lamp) are illuminated, the cause is likely to be the power circuit in the 4WD indicator control unit.



E-6 When diagnosis code no. 26 is displayed

[Comment] This malfunction code is output by the ABS-ECU in the following cases:

- Broken harness wire (thick wire) in the center differential lock detection switch system
- At a vehicle speed of 15 km (9 mph) or higher, the free-wheel engage switch is OFF and the center differential lock switch is ON for a continuous period of 5 seconds or more (Combination switch signal abnormality)
- When the 4WD indicator circuit is defective

(Hint) 1. • A combination switch signal abnormality occurs at the following times:
Broken harness wire (thick wire)

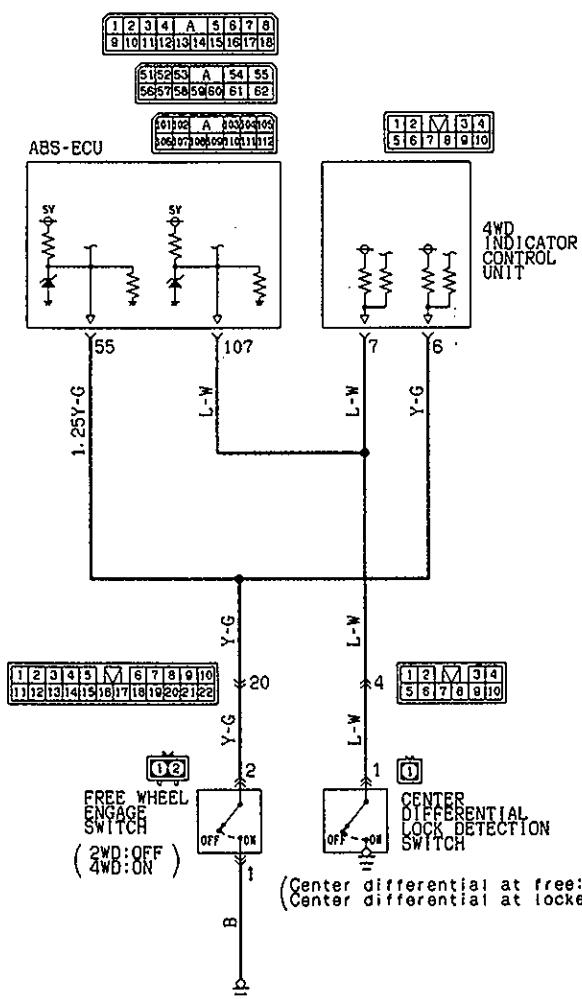
in the free-wheel engage switch system or defective switch (stays OFF)

- (Short in harness wire (thick wire) in the center differential lock switch system or defective switch (stays ON)

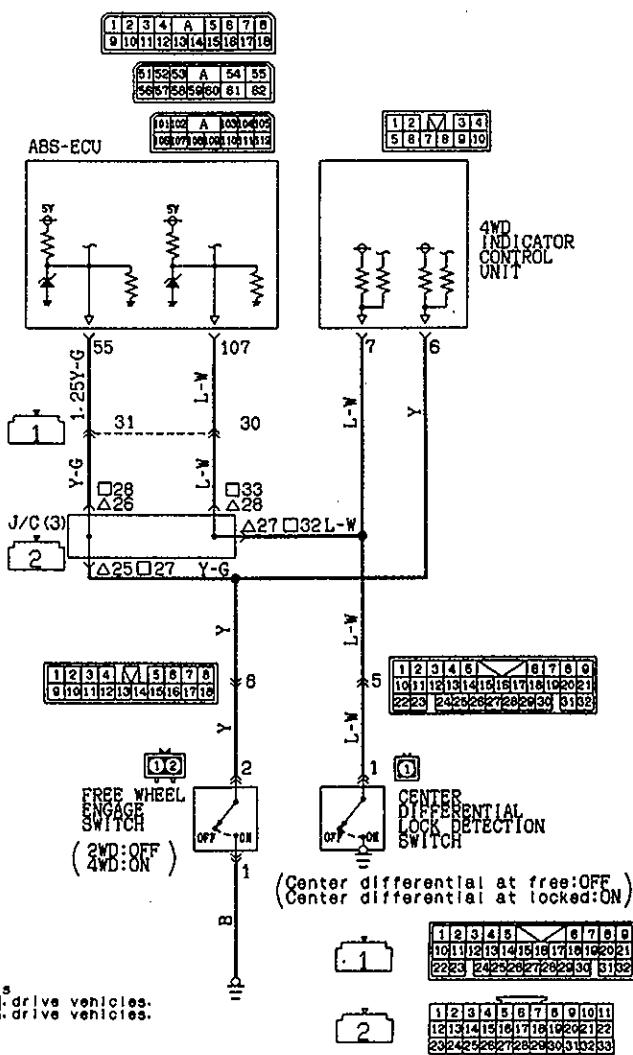
The above malfunctions are also affected by the 4WD indicator, so it might be the case that the malfunction is caused by a trouble symptom in the 4WD indicator.

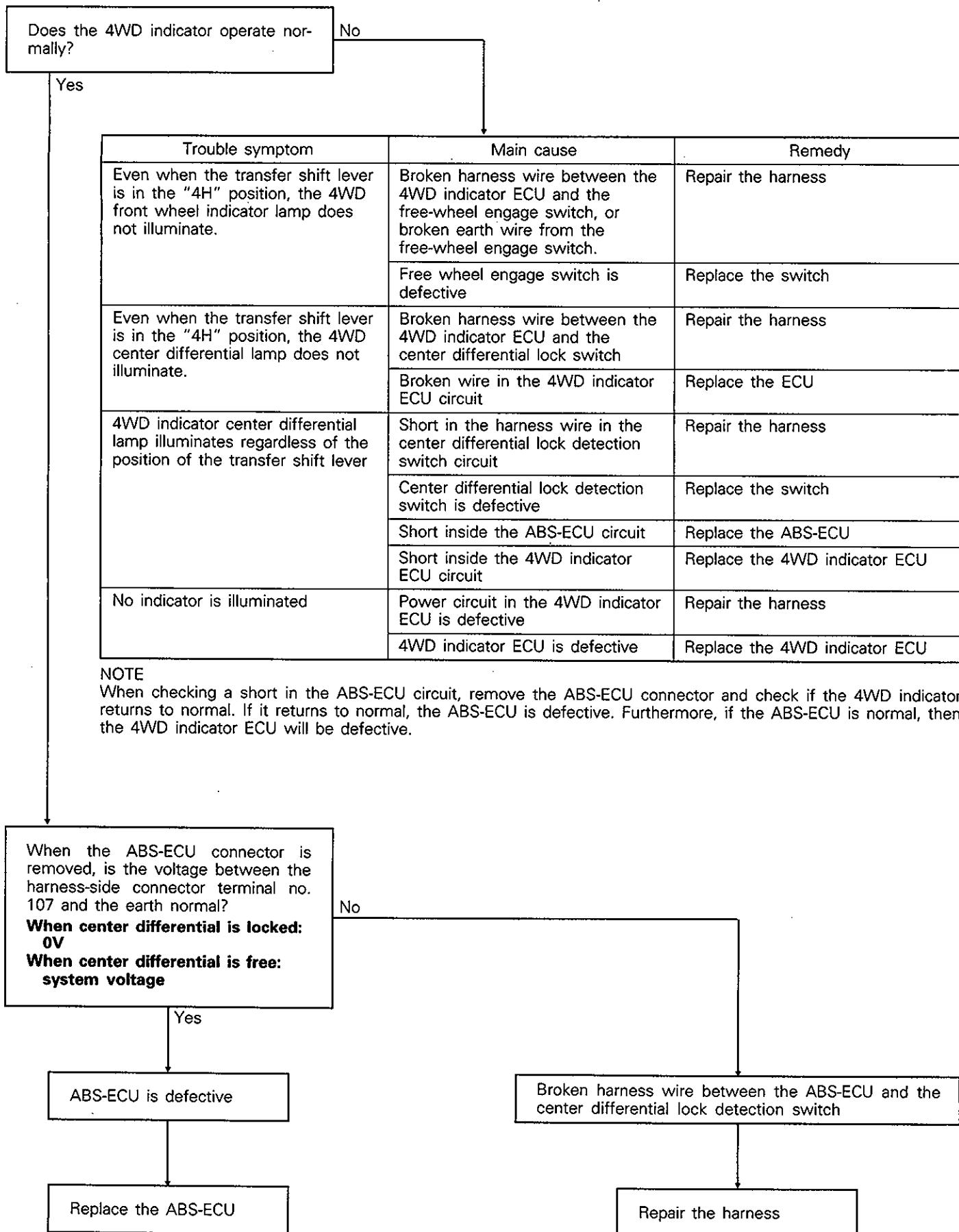
2. When this malfunction code is output, and also none of the 4WD indicator lamps (excluding the rear differential lamp) are illuminated, the cause is likely to be the power circuit in the 4WD indicator control unit.

<Vehicles built up to October, 1993>



<Vehicles built from November, 1993>



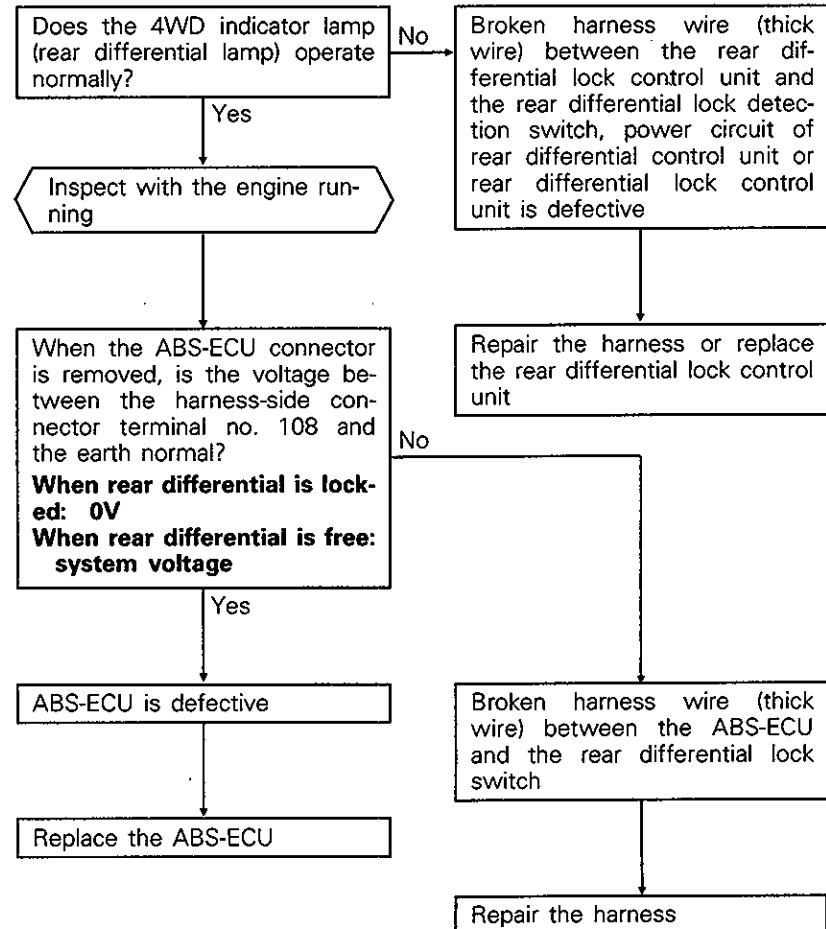
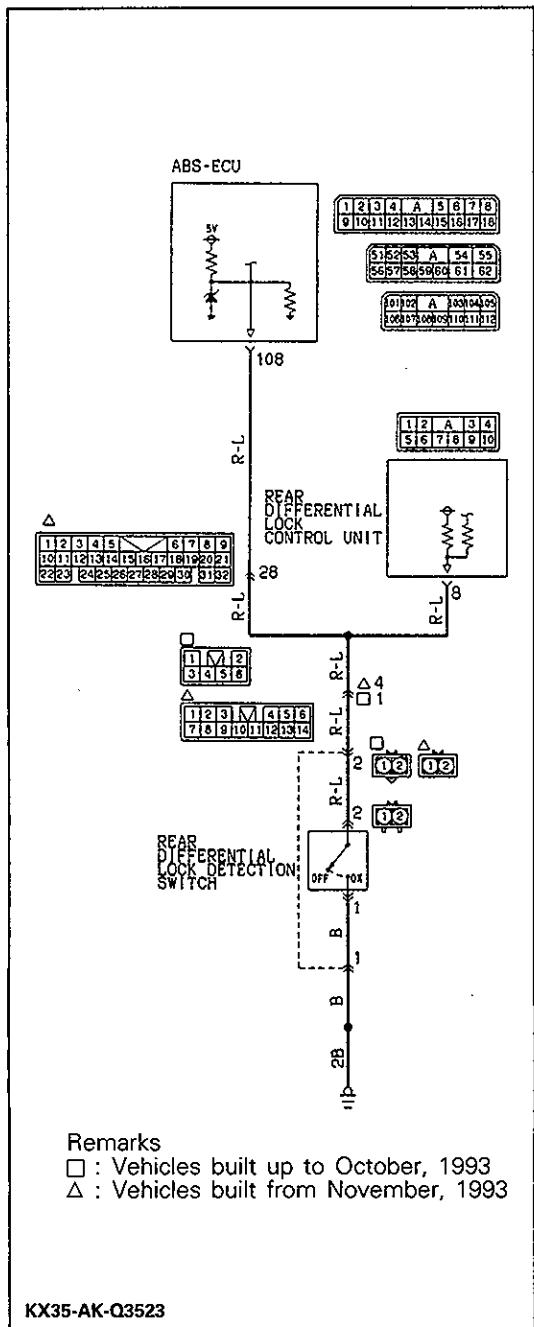


E-7 When diagnosis code no. 27 is displayed

<Vehicles with rear differential lock>

[Comment] This malfunction code is output by the ABS-ECU when there is a broken harness wire or a defective rear differential lock circuit (thick wire in circuit diagram) in the rear differential lock detection switch system.

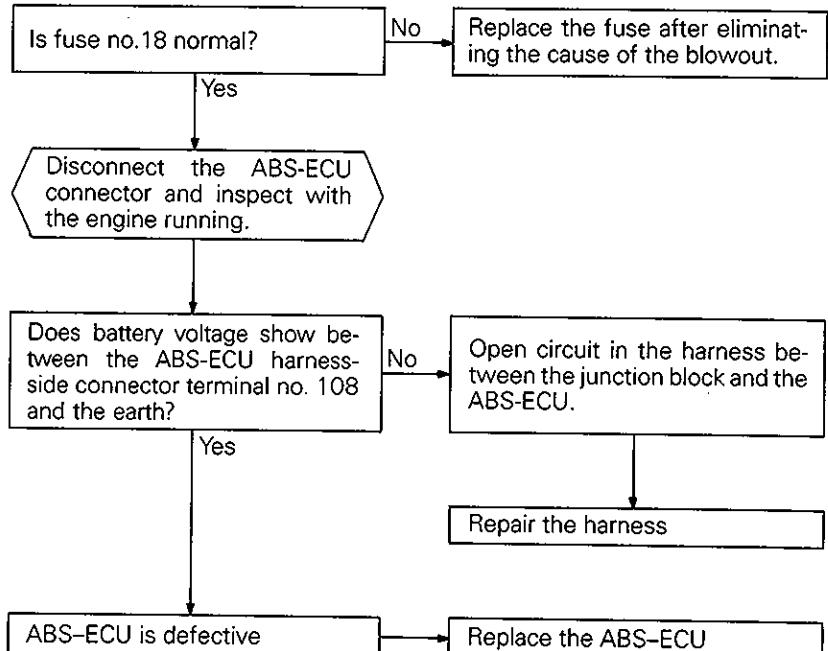
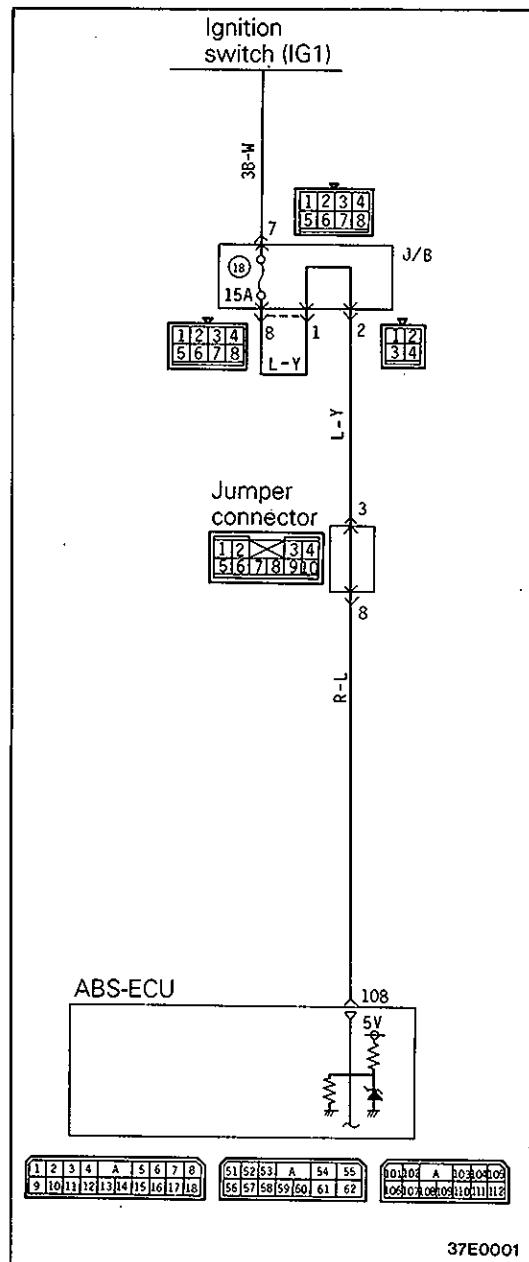
[Hint] When this malfunction code is output, and also none of the 4WD indicator lamps (rear differential lamp) are illuminated, the cause is likely to be the power circuit in the 4WD indicator control unit.



<Vehicles without rear differential lock>

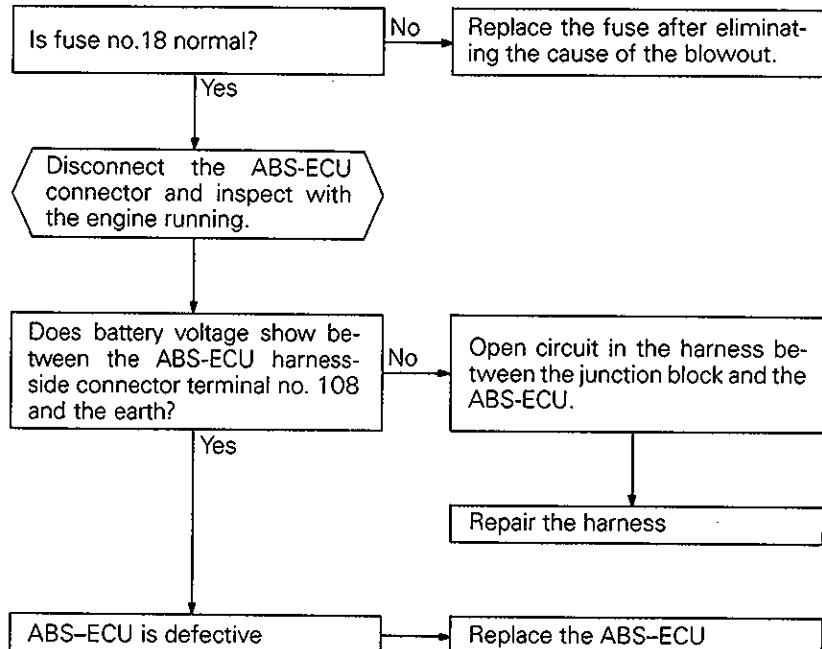
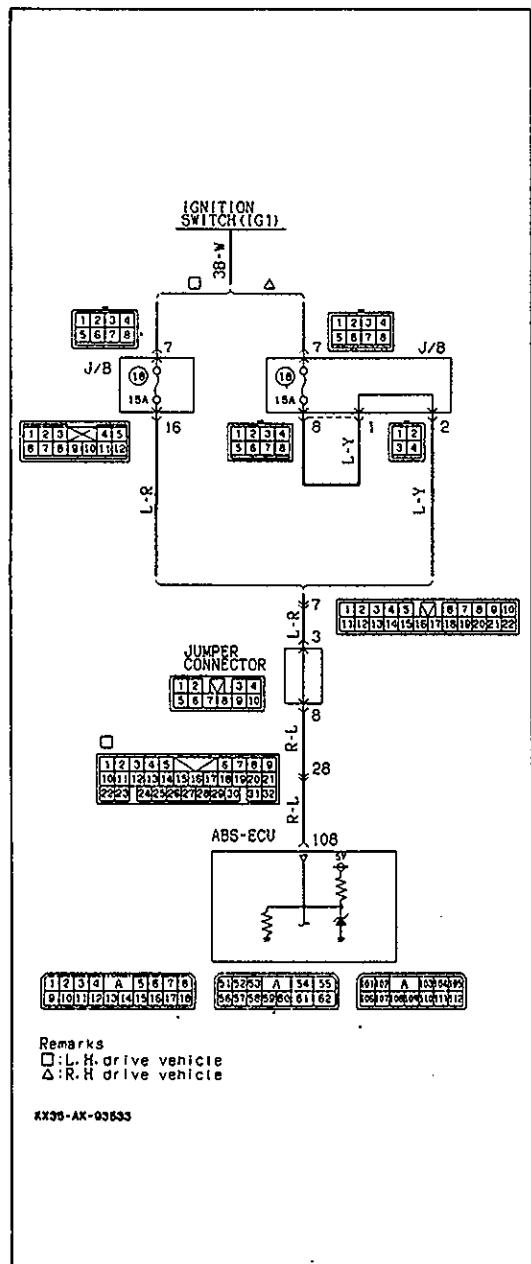
(Vehicles built up to October, 1993)

[Comment] For vehicles without rear differential lock, battery voltage is applied to the ABS-ECU terminal no. 108. This malfunction code is output when this line is interrupted.



(Vehicles built from November, 1993)

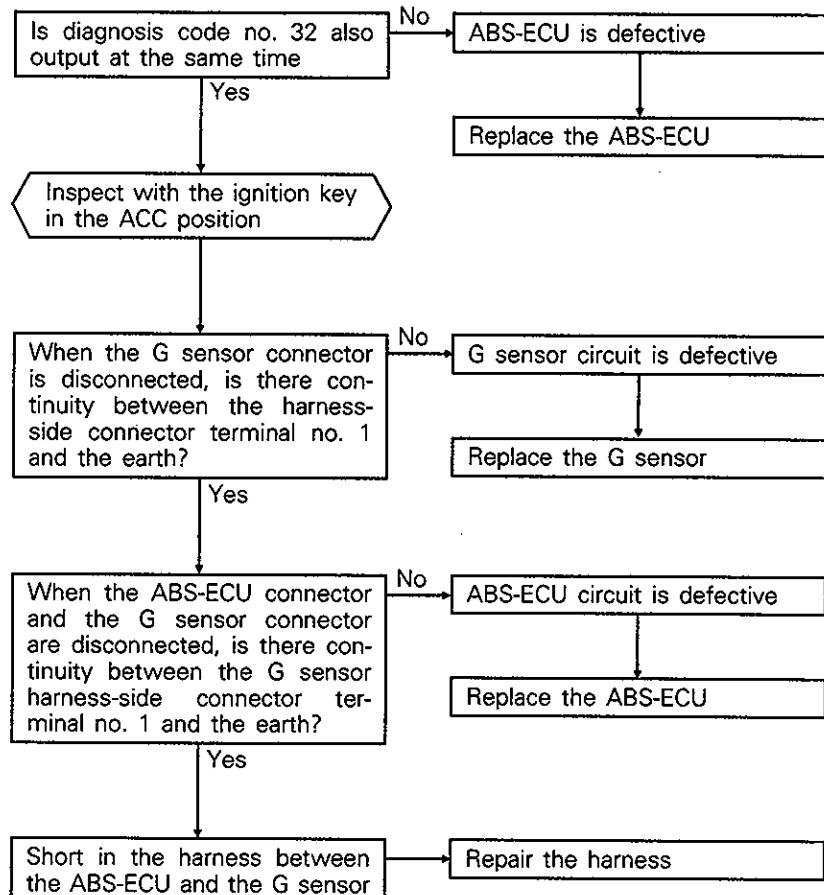
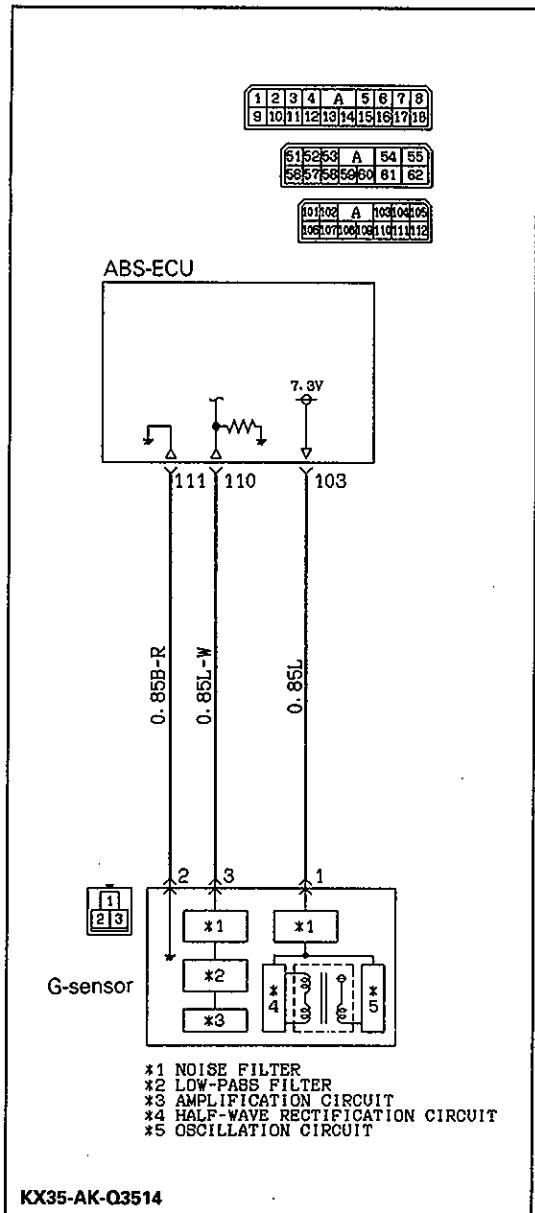
[Comment] For vehicles without rear differential lock, battery voltage is applied to the ABS-ECU terminal no. 108. This malfunction code is output when this line is interrupted.



E-8 When diagnosis code no. 31 is displayed

[Comment] This code is displayed when there is an abnormality in the G sensor power voltage (including a short in the G sensor power harness).

(Hint) If there is a short in the G sensor power harness, code no. 32 will be output at the same time as this code.



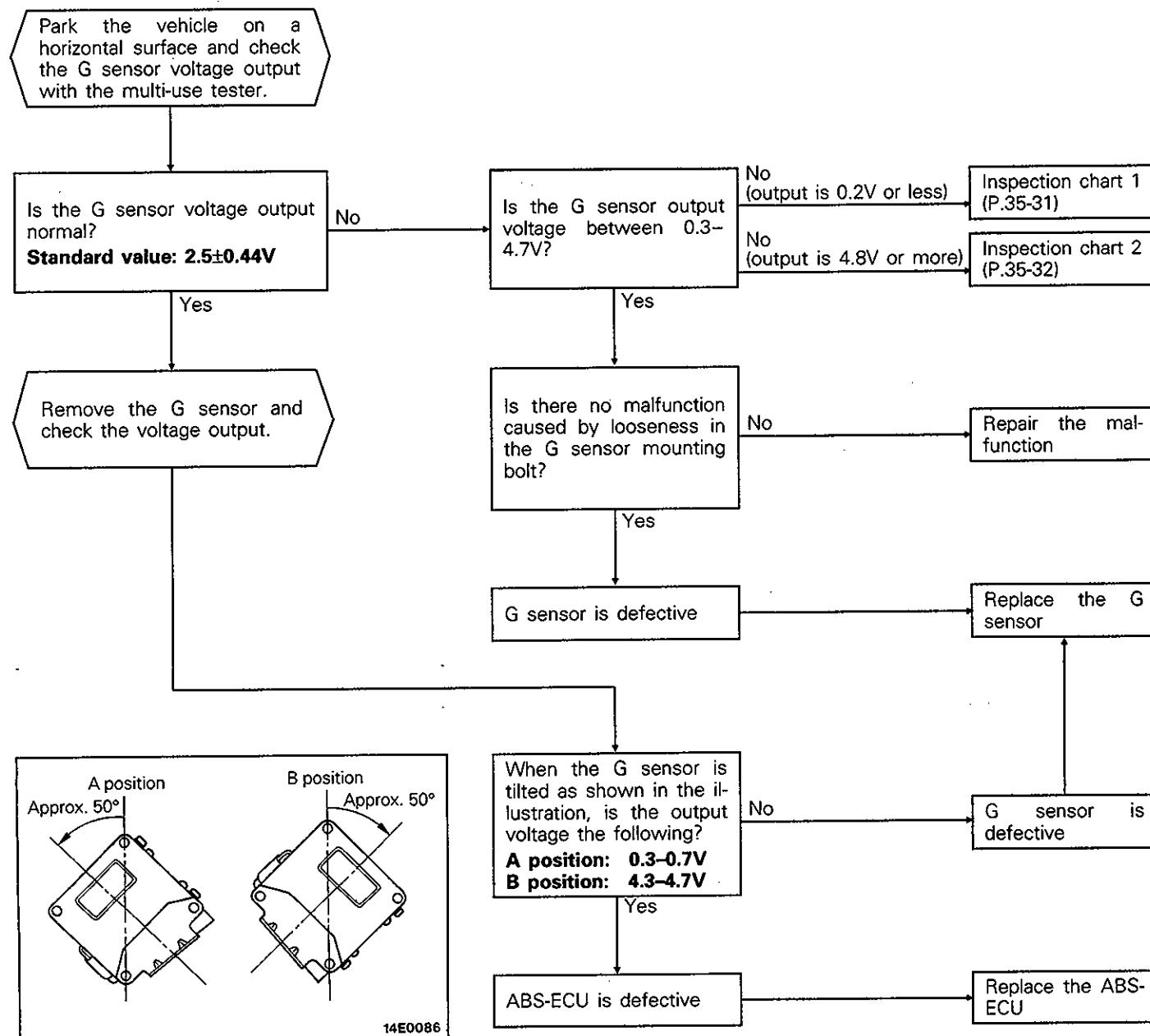
E-9 When diagnosis code no. 32 is displayed

<Vehicles built up to October, 1993>

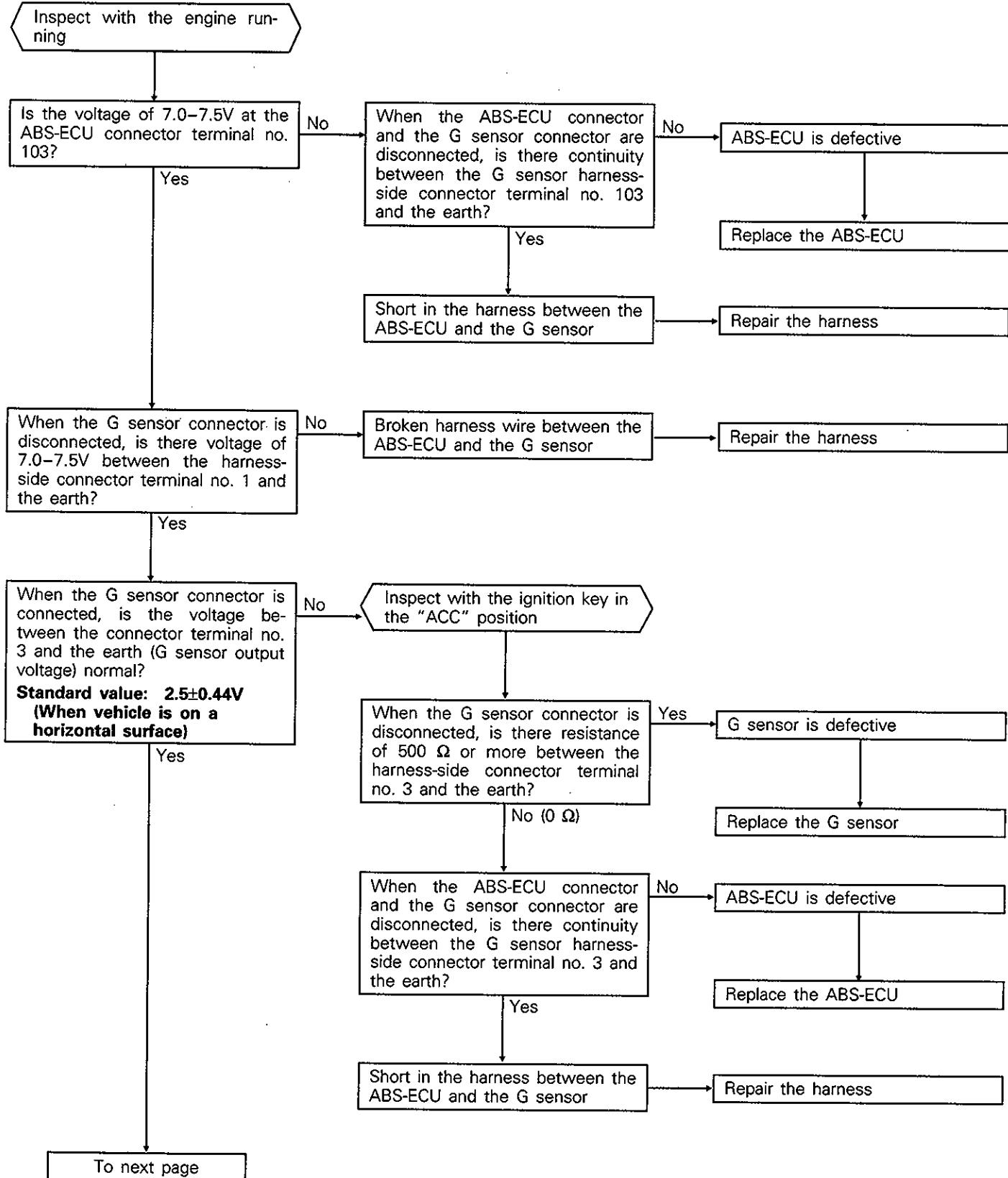
[Comment] This malfunction code is output when there is an abnormality in the G sensor voltage output. This code is also output when there is a broken wire or short in the G sensor power or signal harness or a broken earth wire.

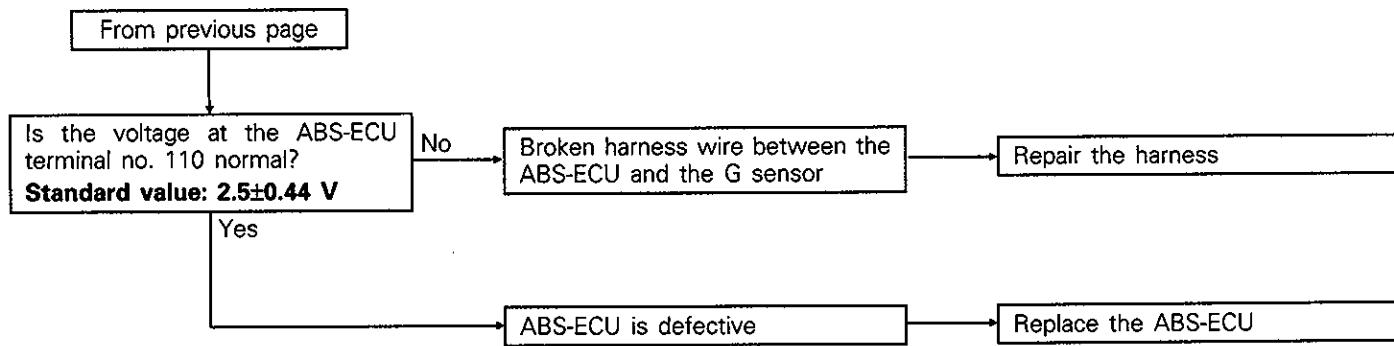
(Hint) Malfunctions can be distinguished by the G sensor output voltage read by the multi-use tester or MUT-II service data.

G sensor output voltage (when vehicle is on a horizontal surface)	Main problem location
2.5±0.44V	Normal
0.2V or less	Broken wire or short in the power harness or signal harness
4.8V or more	Broken earth wire
Other than the above	G sensor is defective (including defective installation)

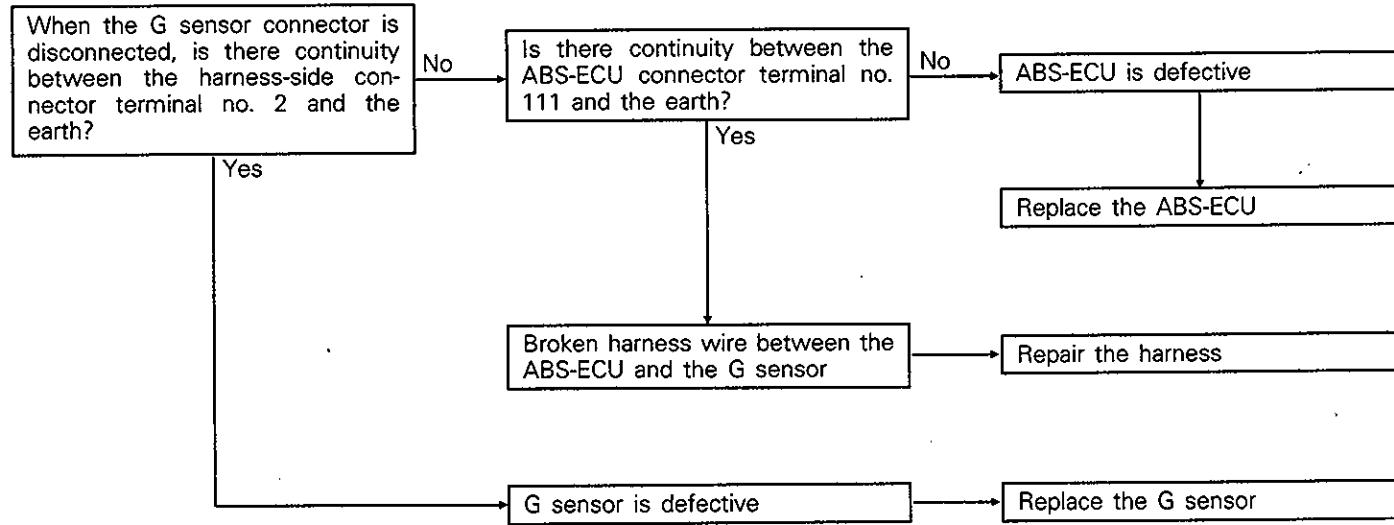


Inspection Chart 1





Inspection Chart 2

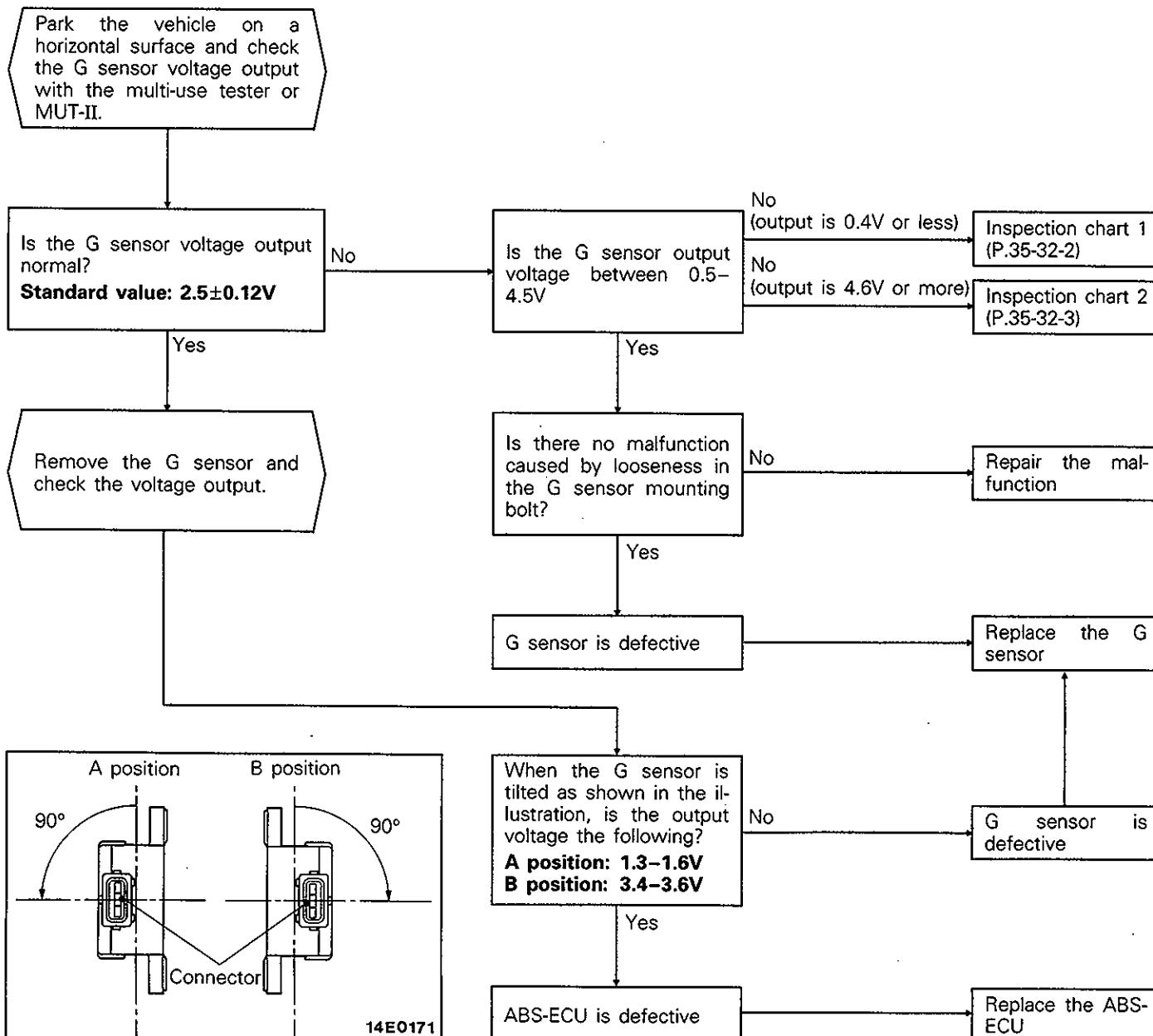


<Vehicles built from November, 1993>

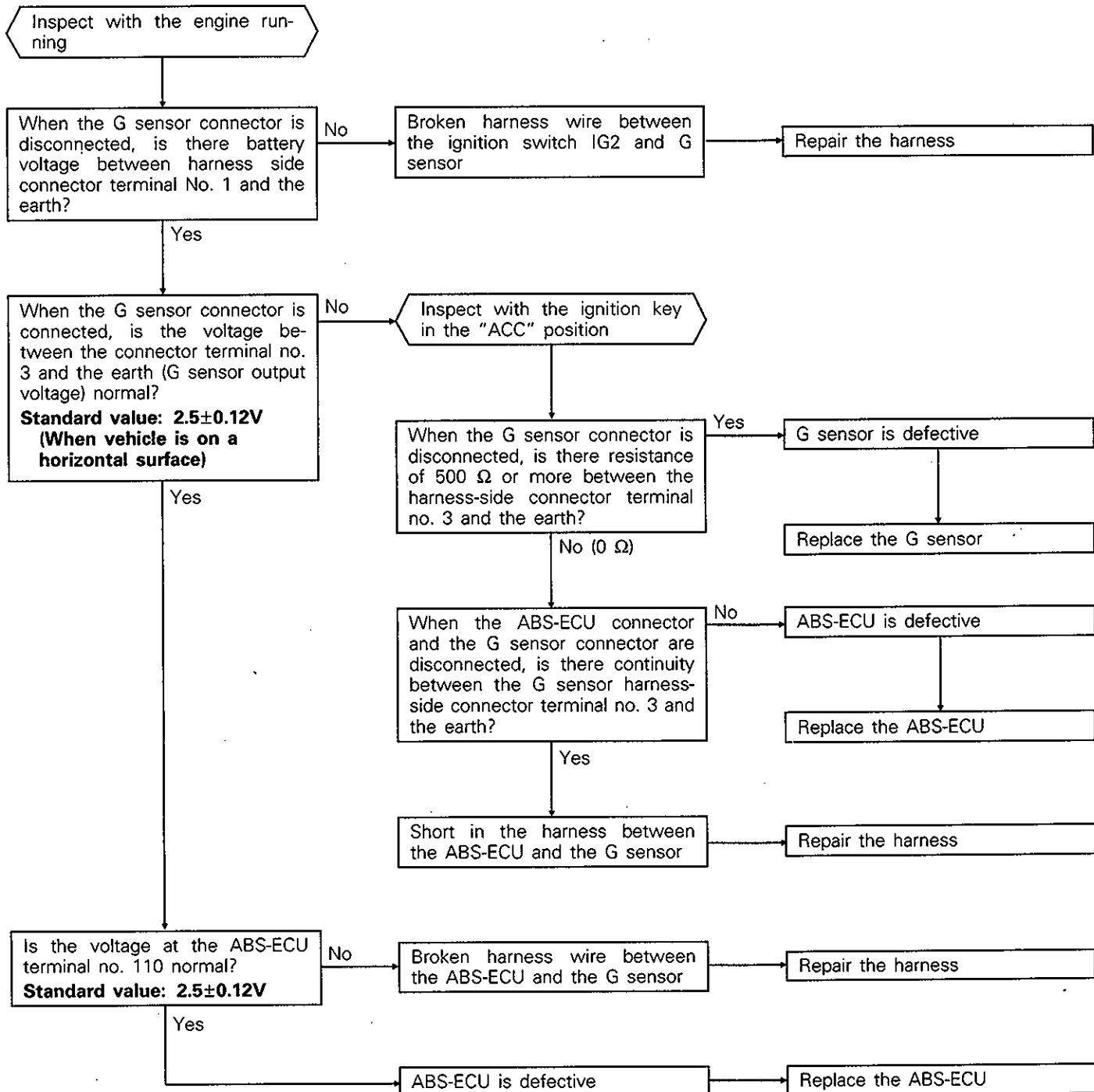
[Comment] This malfunction code is output when there is an abnormality in the G sensor voltage output. This code is also output when there is a broken wire or short in the G sensor power or signal harness or a broken earth wire.

(Hint) Malfunctions can be distinguished by the G sensor output voltage read by the multi-use tester or MUT-II service data.

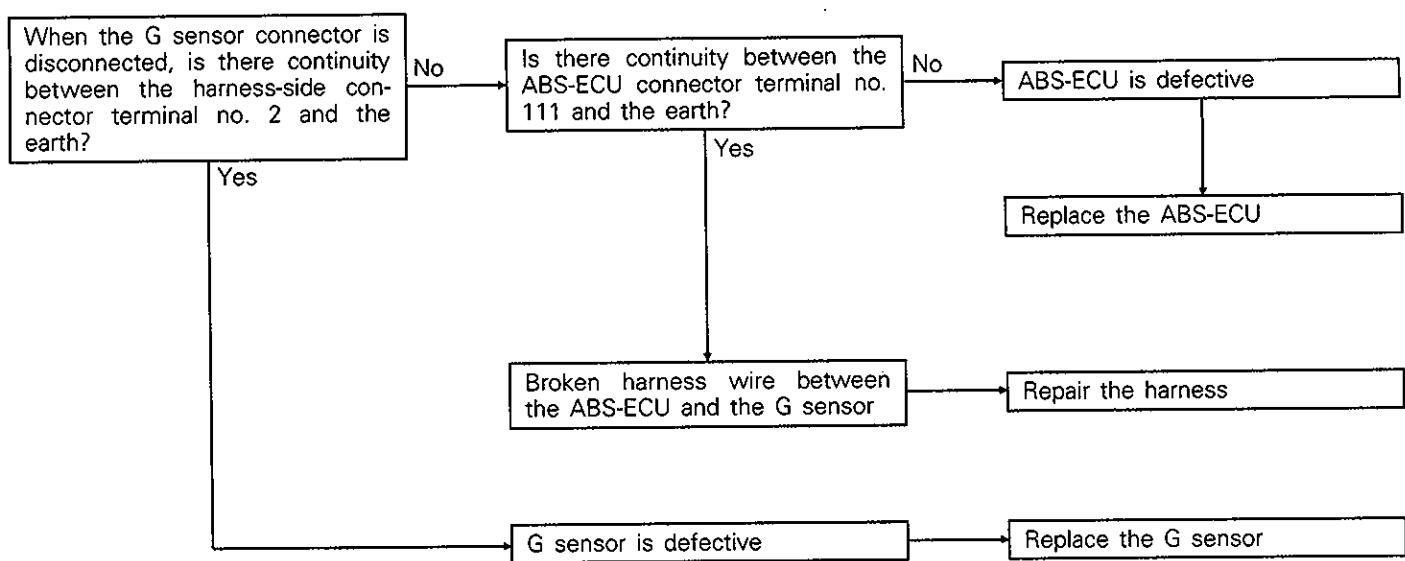
G sensor output voltage (when vehicle is on a horizontal surface)	Main problem location
$2.5 \pm 0.12V$	Normal
0.4V or less	Broken wire or short in the power harness or signal harness
4.6V or more	Broken earth wire
Other than the above	G sensor is defective (including defective installation)



Inspection Chart 1



Inspection Chart 2



NOTES

E-10 When diagnosis code no. 33 is displayed

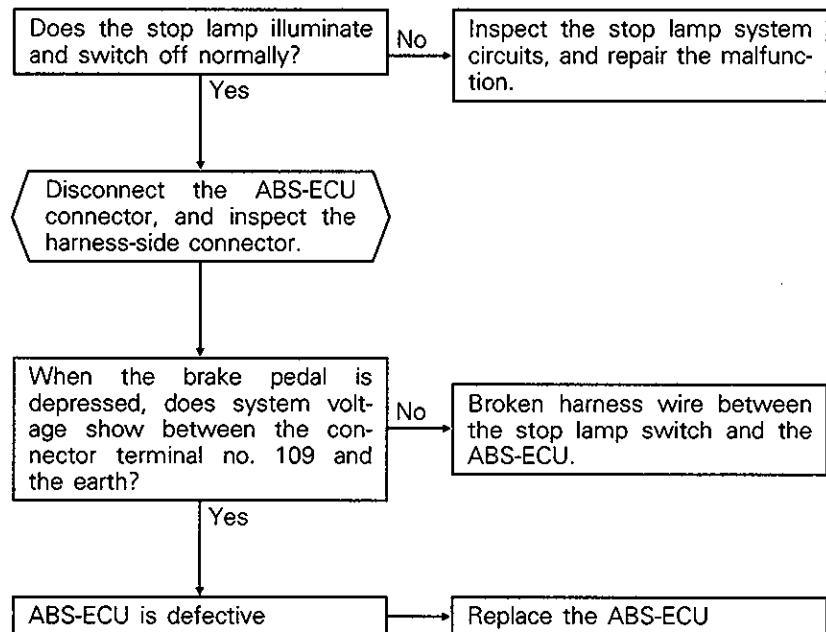
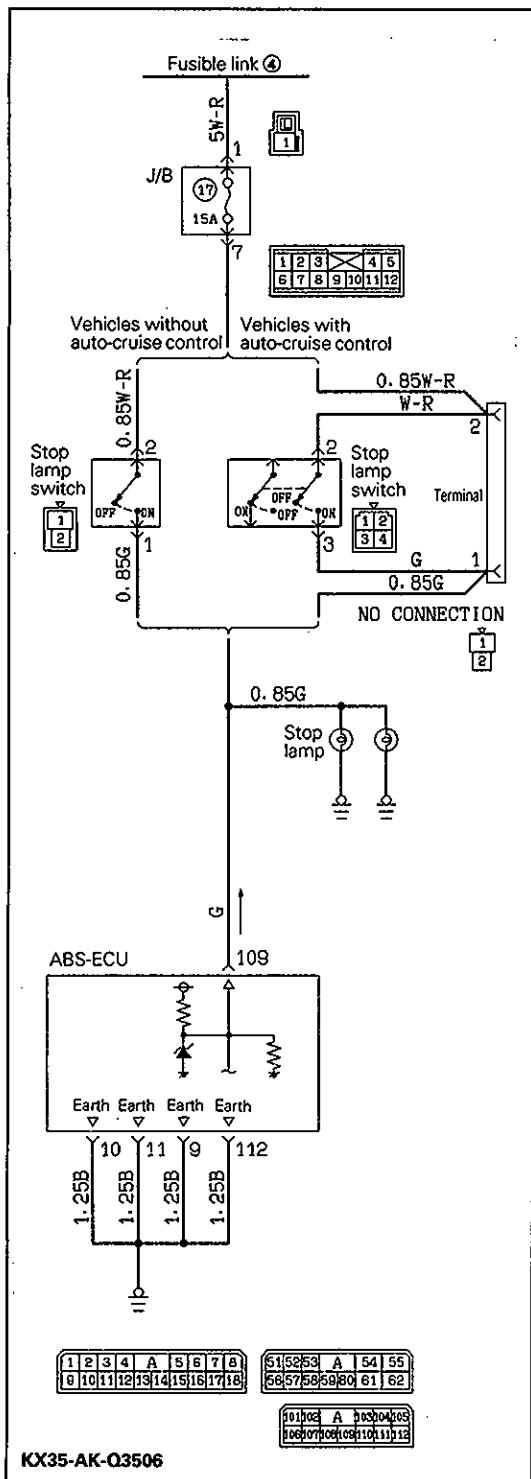
<Vehicles built up to October, 1993>

[Comment] This malfunction code is output by the ABS-ECU in the following cases:

- Problem with the stop lamp switch being ON (even though the ABS is not operating, the stop lamp is continuously diagnosed as being ON for a continuous period of 15 minutes or more.)

- Broken harness wire in the stop lamp switch system.

(Hint) If the stop lamp illuminates and switches off normally, then there is a broken harness wire in the stop lamp switch input circuit, or the ABS-ECU circuit is defective.



35-33-1 SERVICE BRAKES – ABS Troubleshooting <Vehicles built up to May, 1994>

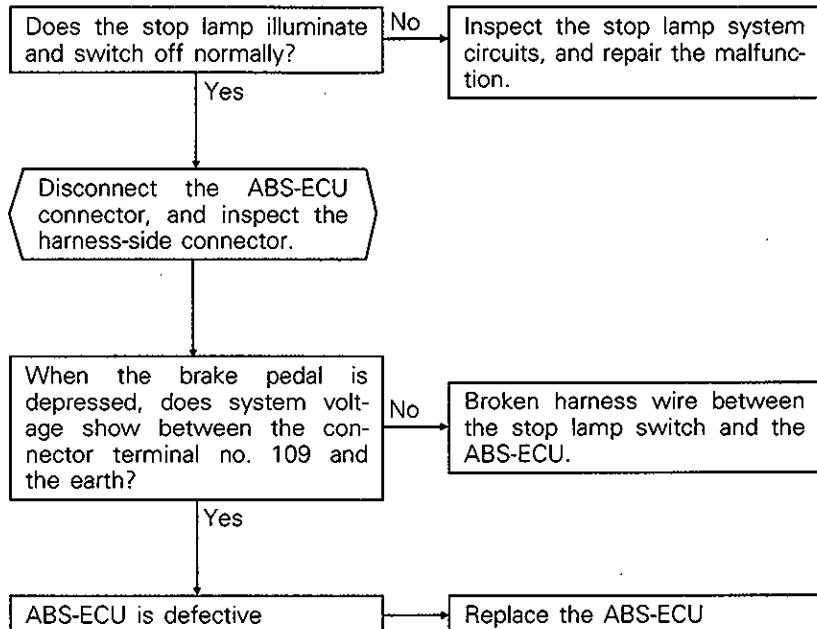
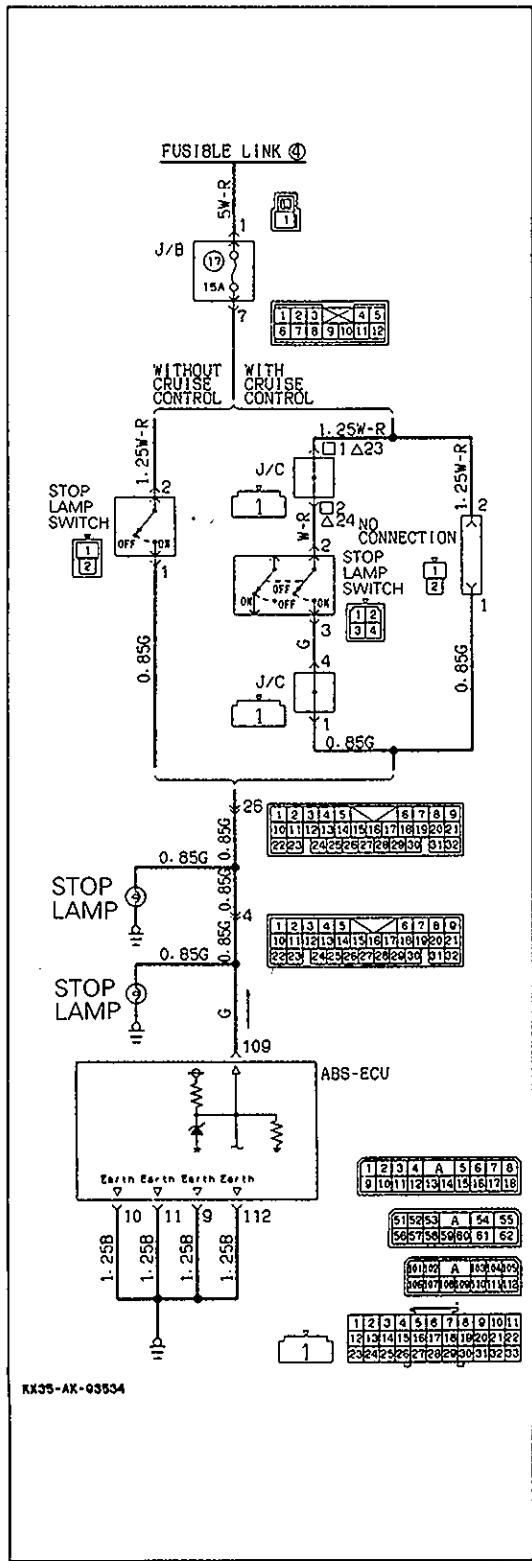
<Vehicles built from November, 1993>

[Comment] This malfunction code is output by the ABS-ECU in the following cases:

- Problem with the stop lamp switch being ON (even though the ABS is not operating, the stop lamp is continuously diagnosed as being ON for a continuous period of 15 minutes or more.)

- Broken harness wire in the stop lamp switch system.

(Hint) If the stop lamp illuminates and switches off normally, then there is a broken harness wire in the stop lamp switch input circuit, or the ABS-ECU circuit is defective.



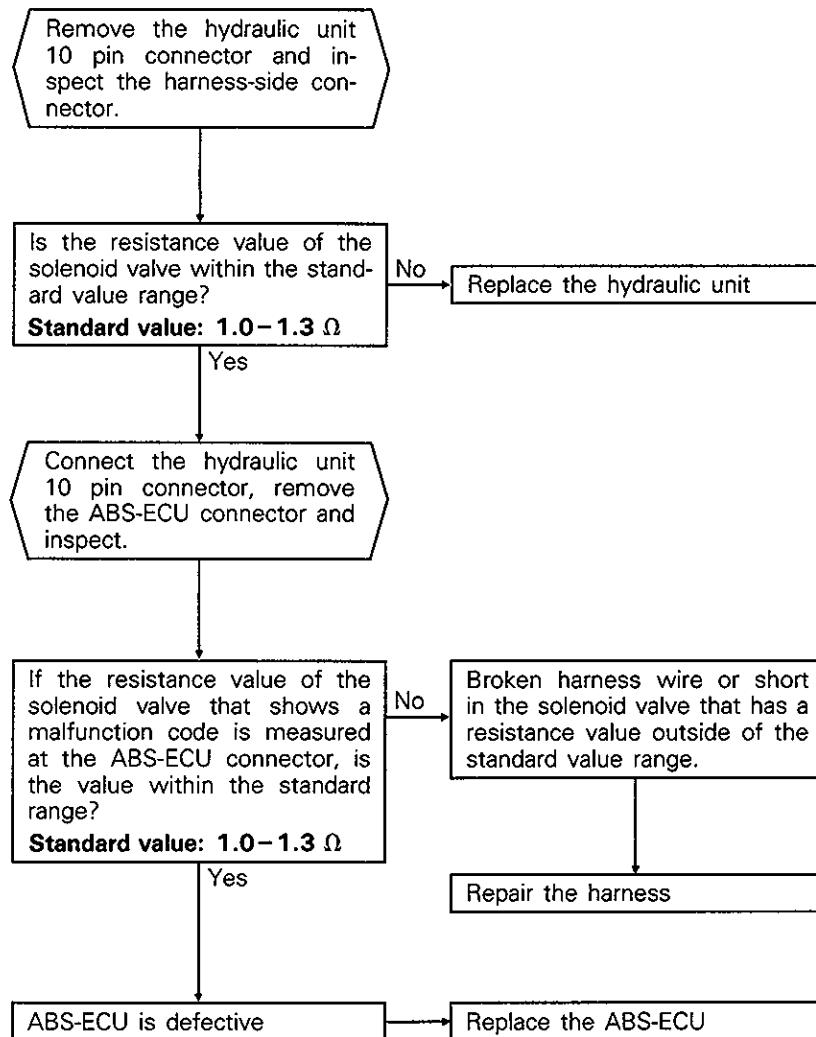
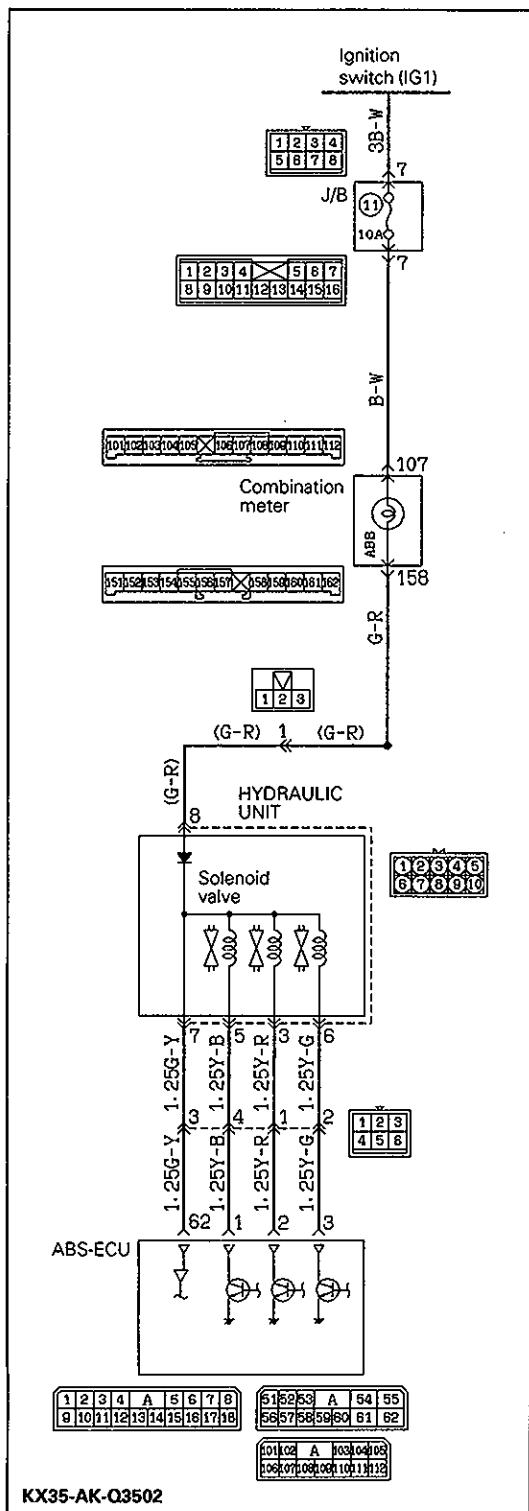
NOTES

E-11 When diagnosis code nos. 41, 43 or 45 are displayed

<Vehicles built up to October, 1993>

[Comment] The ABS-ECU normally monitors the solenoid valve drive circuit. If there is no current flowing to the solenoid even when the solenoid is ON, or the current continues to flow to the solenoid even when

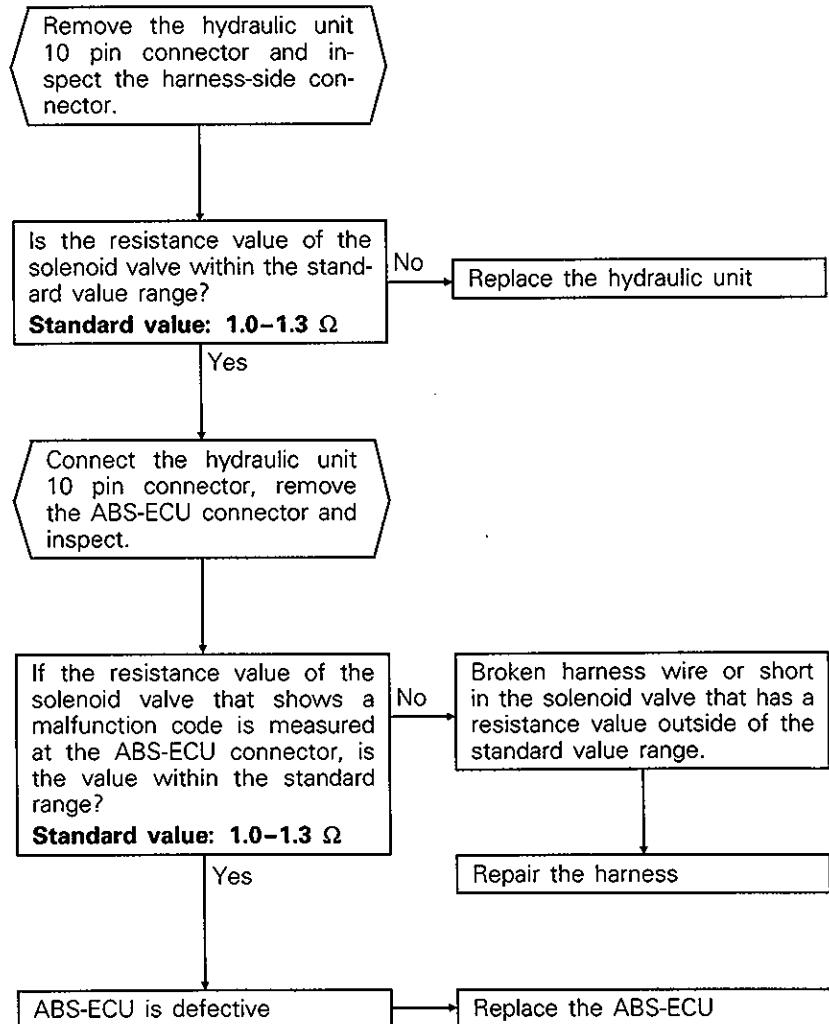
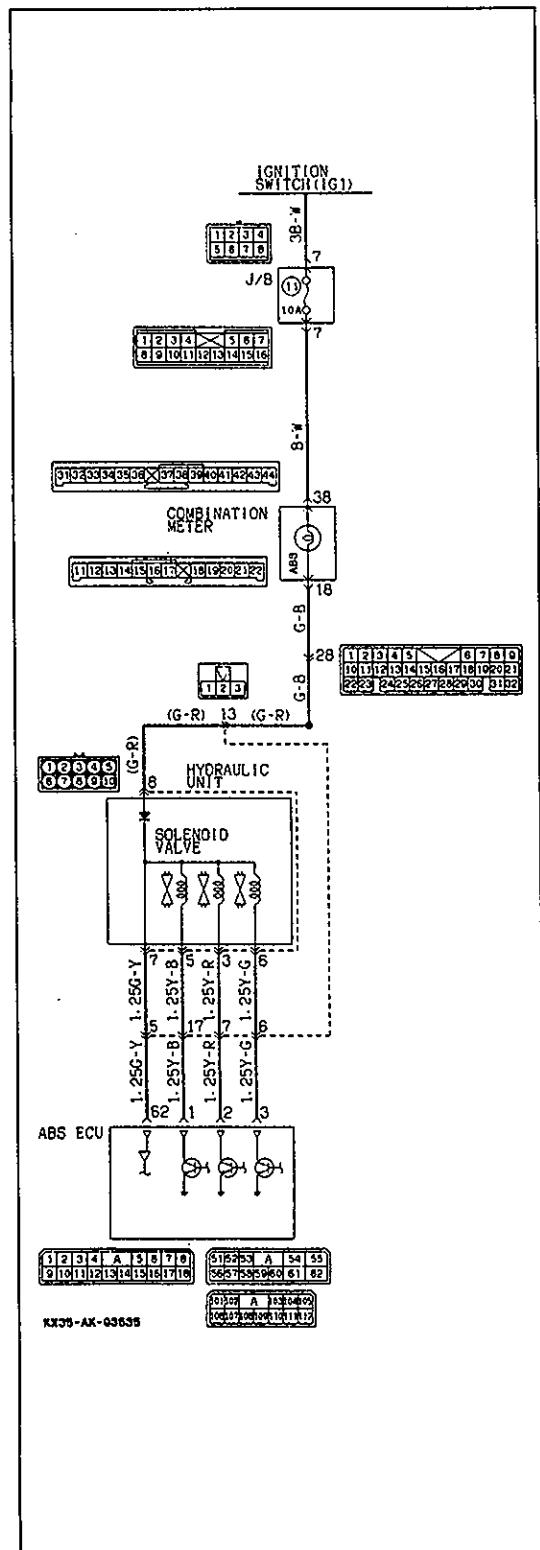
the solenoid is OFF, the ABS-ECU diagnoses a broken wire or short in the solenoid coil or a broken wire or short in the harness, and this malfunction code is output.



<Vehicles built from November, 1993>

[Comment] The ABS-ECU normally monitors the solenoid valve drive circuit. If there is no current flowing to the solenoid even when the solenoid is ON, or the current continues to flow to the solenoid even when the solenoid is

OFF, the ABS-ECU diagnoses a broken wire or short in the solenoid coil or a broken wire or short in the harness, and this malfunction code is output.



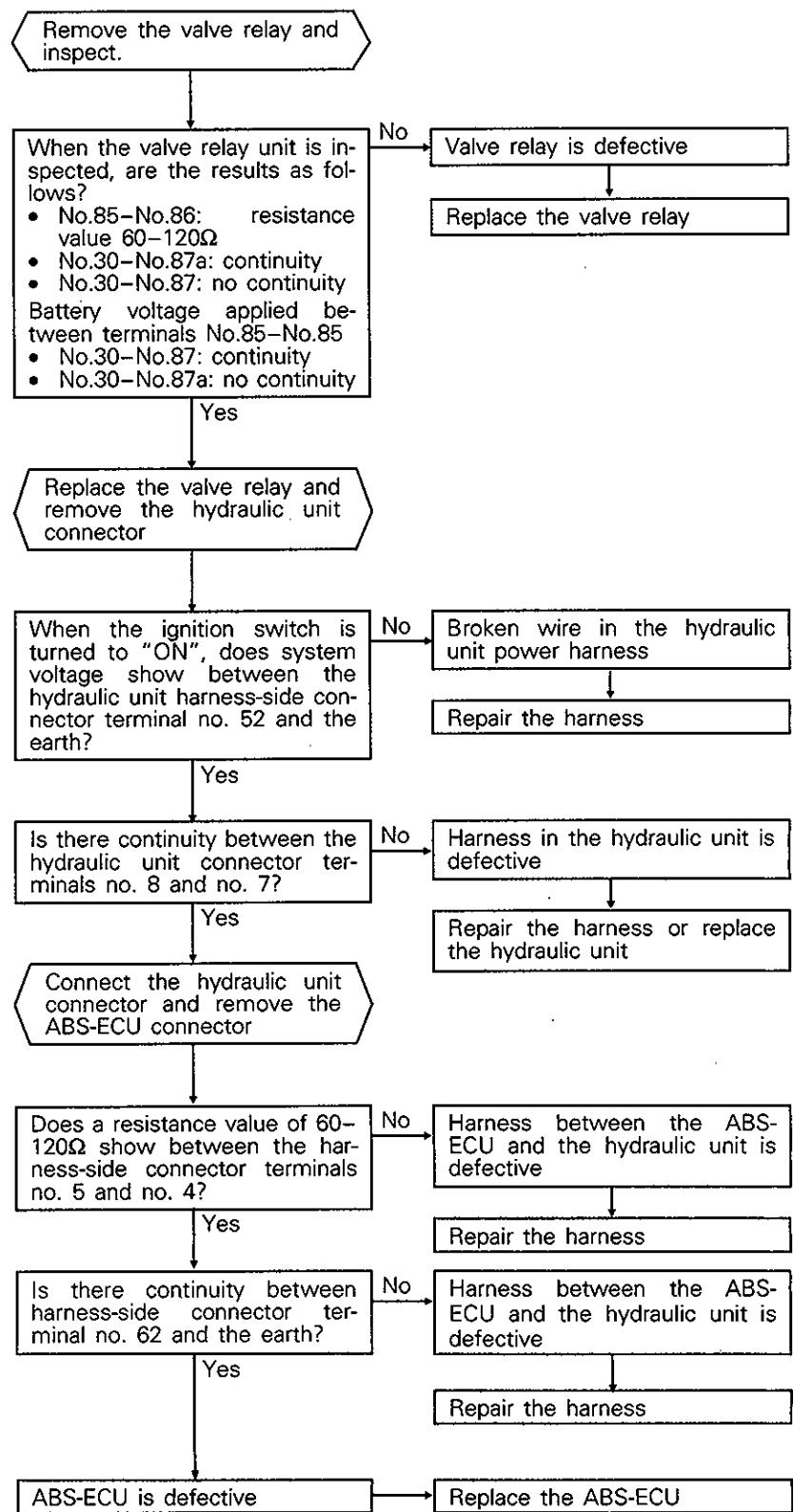
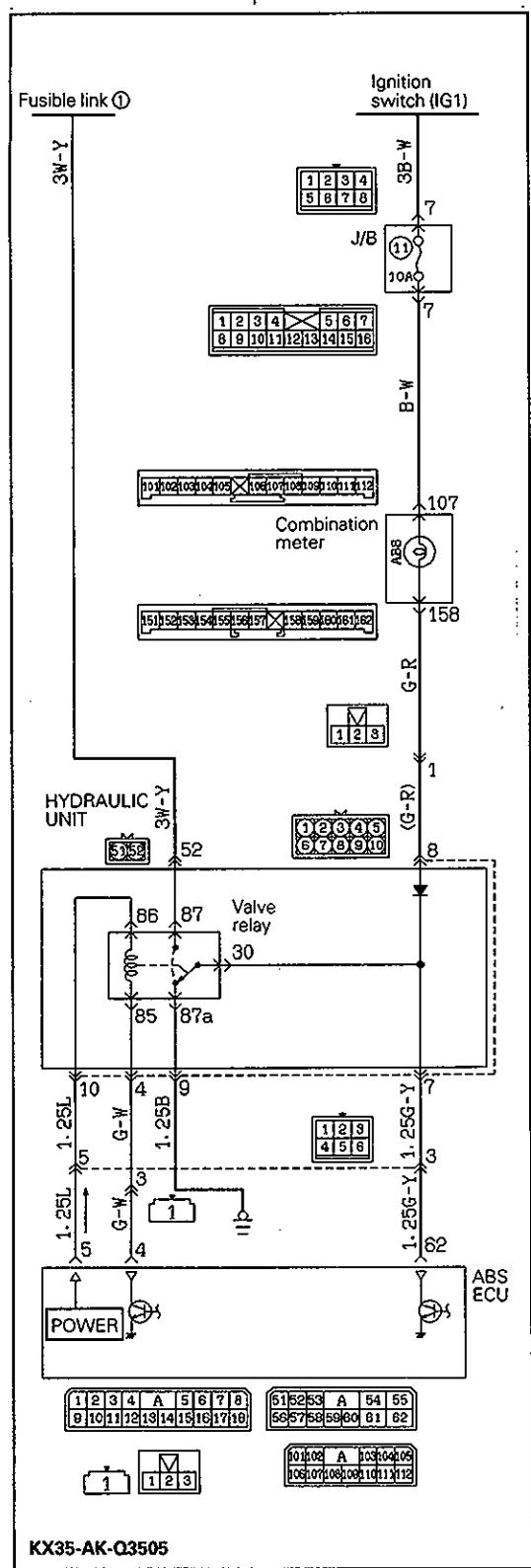
NOTES

E-12 When diagnosis code no. 51 is displayed

<Vehicles built up to October, 1993>

[Comment] When the ignition switch is turned to ON, the valve relay is switched ON and OFF during the initial check, and the ABS-ECU compares the signal to the valve relay and the voltage in the valve power monitor line to check if

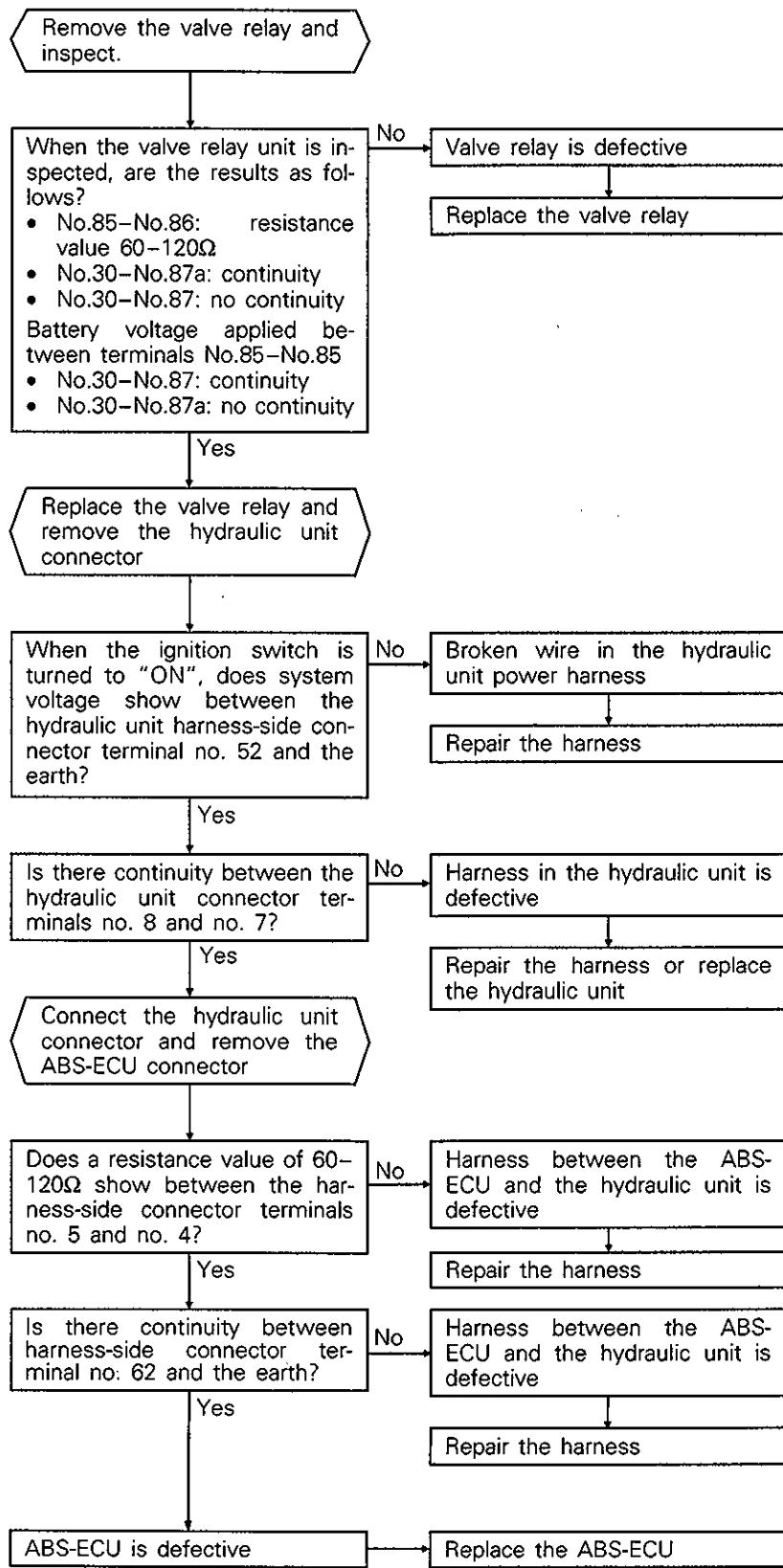
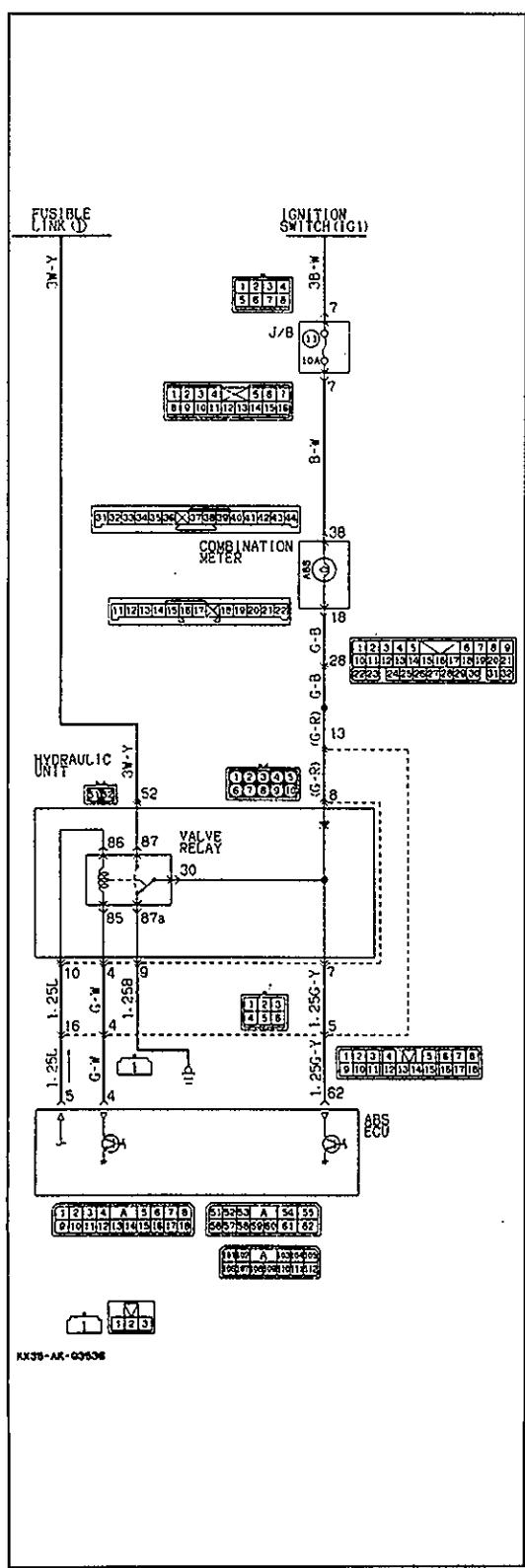
the valve relay is operating normally. Normally, the valve relay is ON, so if power is not being supplied to the valve power monitor line, this malfunction code is output.



<Vehicles built from November, 1993>

[Comment] When the ignition switch is turned to ON, the valve relay is switched ON and OFF during the initial check, and the ABS-ECU compares the signal to the valve relay and the voltage in the valve power monitor line to check if

the valve relay is operating normally. Normally, the valve relay is ON, so if power is not being supplied to the valve power monitor line, this malfunction code is output.



NOTES

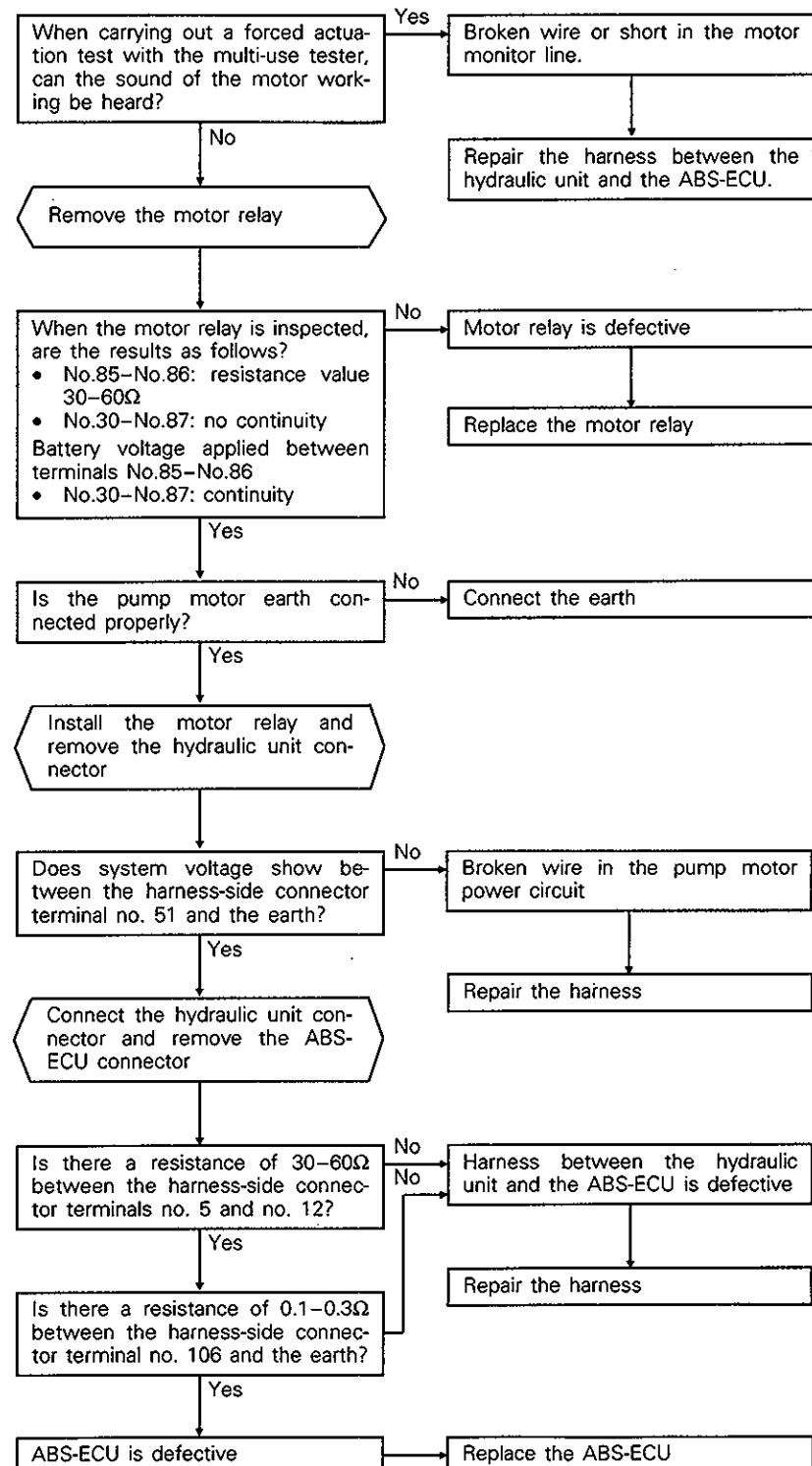
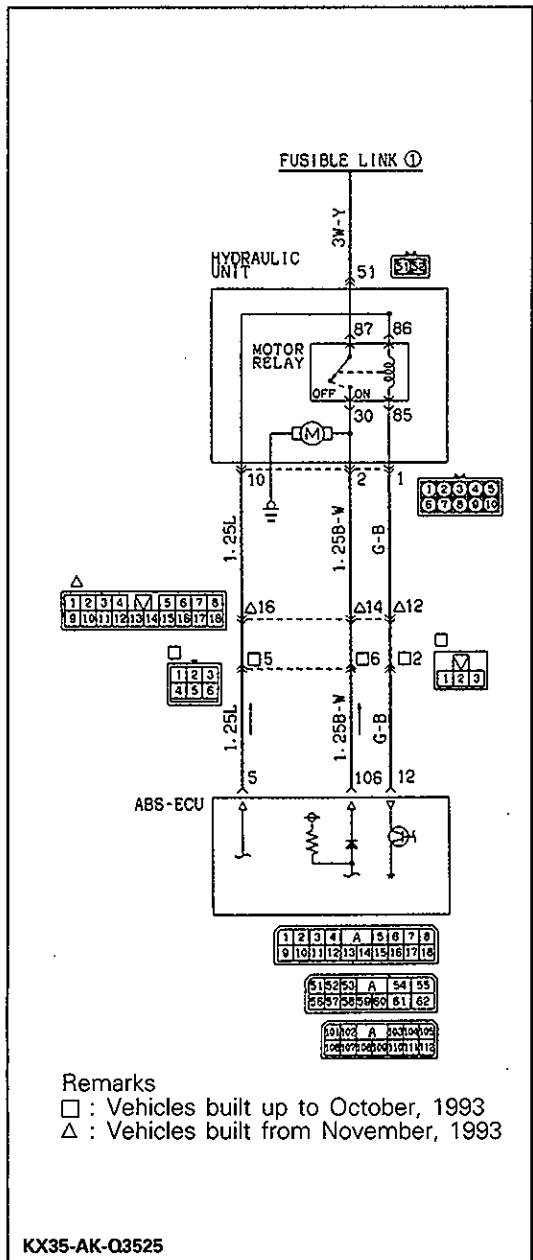
E-13 When diagnosis code no. 53 is displayed

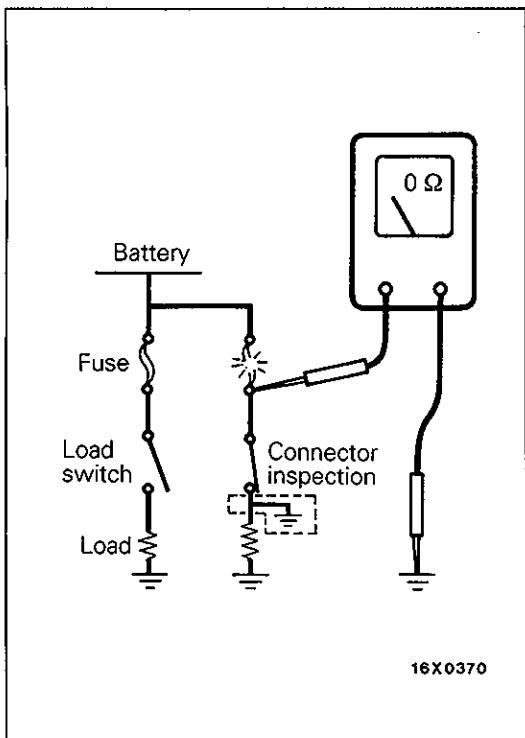
[Comment] This code is output by the ABS-ECU when the motor relay or motor is as follows:

- Motor relay does not operate
- Motor will not work due to some problem
- Motor will not work because the earth is insufficient

- Motor will not stop

(Hint) Temporarily turn the ignition switch to OFF and after releasing the fail-safe mechanism, carry out an actuator test with the multi-use tester. If the sound of the motor working is heard during the multi-use tester actuator test, there is a broken wire or short in the motor monitor line.





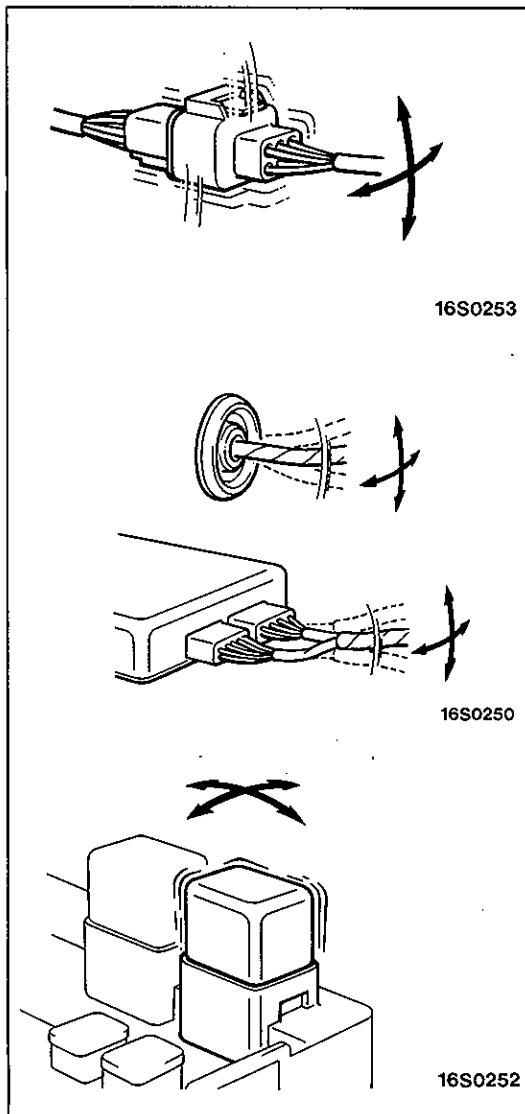
ABS TROUBLESHOOTING <Vehicles built from June, 1994>

INSPECTION SERVICE POINTS FOR A BLOWN FUSE

Remove the fuse and measure the resistance between the load side of the fuse and the earth. Set the switches of all circuits which are connected to this fuse to a condition of continuity. If the resistance is almost $0\ \Omega$ at this time, there is a short circuit somewhere between these switches and the load. If the resistance is not $0\ \Omega$, there is no short circuit at the present time, but a momentary short circuit has probably caused the fuse to blow.

The main causes of a short circuit are the following.

- Harness being clamped by the vehicle body
- Damage to the outer, casing of the harness due to wear or heat
- Water getting into the connector or circuitry
- Human error (mistakenly shorting a circuit, etc.)



POINTS TO NOTE FOR INTERMITTENT MALFUNCTIONS.

Intermittent malfunctions often occur under certain conditions, and if these conditions can be ascertained, determining the cause becomes simple. In order to ascertain the conditions under which an intermittent malfunction occurs, first ask the customer for details about the driving conditions, weather conditions, frequency of occurrence and trouble symptoms, and then try to recreate the trouble symptoms. Next, ascertain whether the reason why the trouble symptom occurred under these conditions is due to vibration, temperature or some other factors. If vibration is thought to be the cause, carry out the following checks with the connectors and components to confirm whether the trouble symptom occurs.

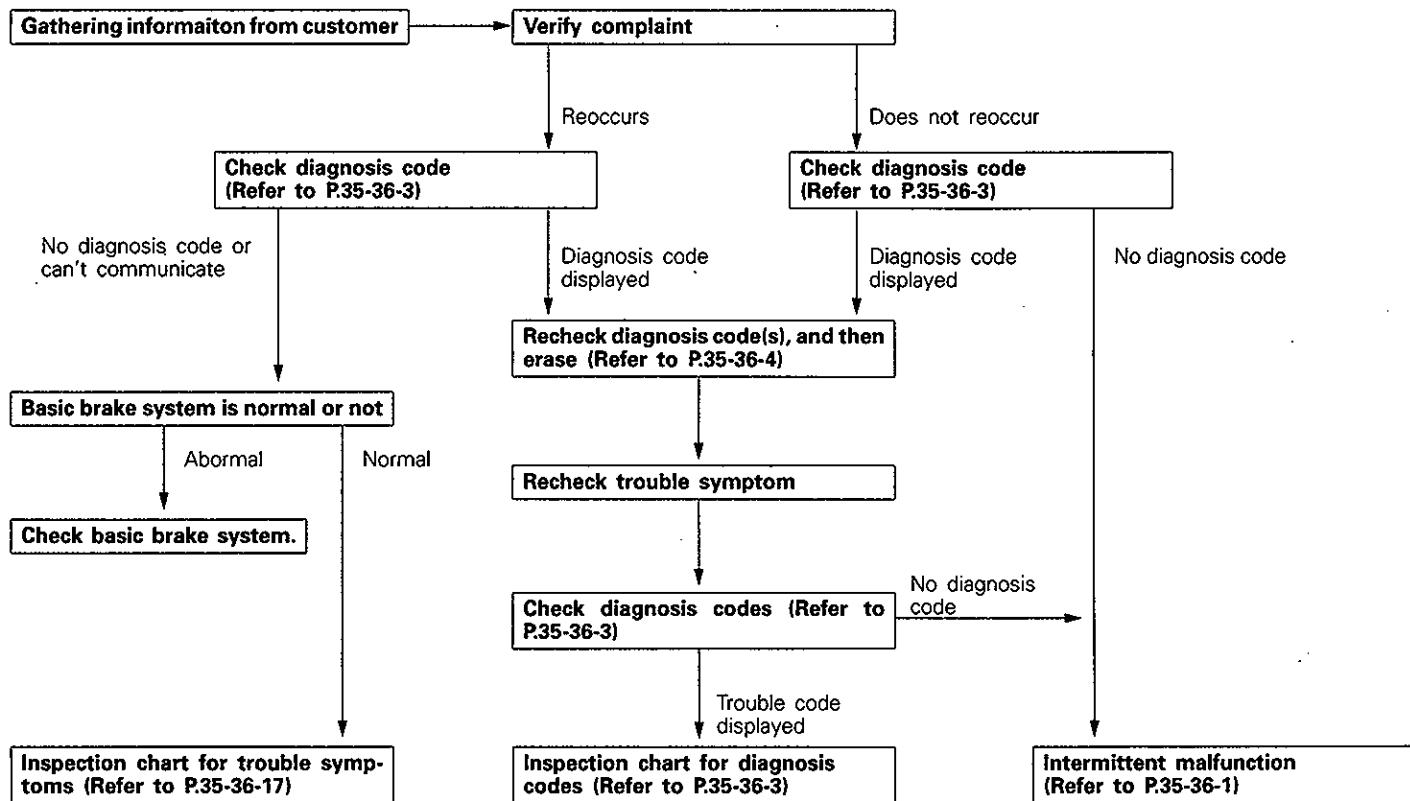
The objects to be checked are connectors and components which are indicated by inspection procedures or given as probable causes (which generate diagnosis codes or trouble symptoms).

- Gently shake the connector up, down and to the left and right.
- Gently shake the wiring harness up, down and to the left and right.
- Gently rock each sensor and relay, etc. by hand.
- Gently shake the wiring harness at suspensions and other moving parts.

NOTE

If determining the cause is difficult, the flight recorder function of the MUT-II can also be used.

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

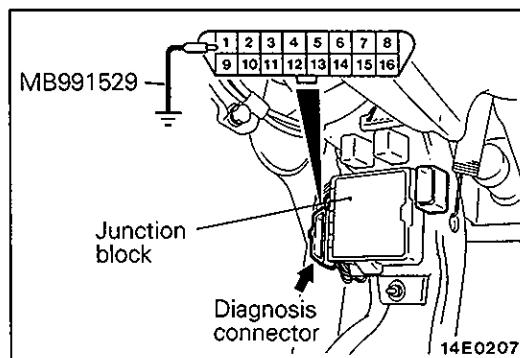
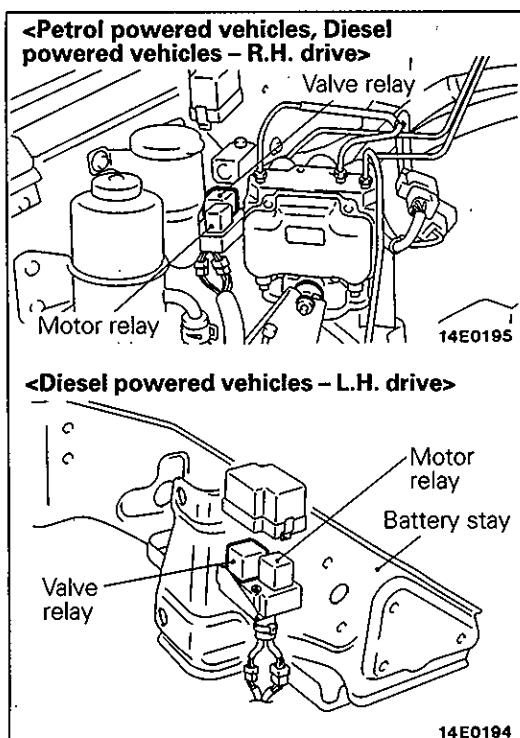
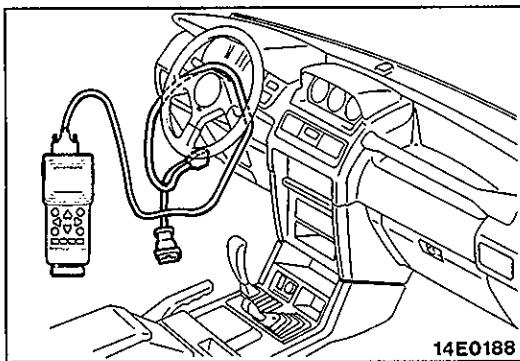


NOTES WITH REGARD TO DIAGNOSIS

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. However, the sound doesn't mean any malfunction, but indicates that the system operation check is working.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operating. (whine) 2. Sound is generated along with vibration of the brake pedal. (scraping) 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release. (Thump: suspension: squeak: tyres)
ABS operation (Long braking distance)	For road surfaces such as snow-covered roads and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed and not being too overconfident.

Diagnosis detection condition depends on a diagnosis code. So, when rechecking a trouble symptom, be sure to satisfy the condition in the listed in the "Comments" column of the inspection procedure for diagnosis codes.



DIAGNOSTIC FUNCTION

DIAGNOSIS CODES CHECK

With the MUT-II

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

Caution

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

Without the MUT-II

1. Turn the ignition switch off and then disconnect the valve relay connector.
2. Use the special tool to earth diagnosis connector terminal No. 1.

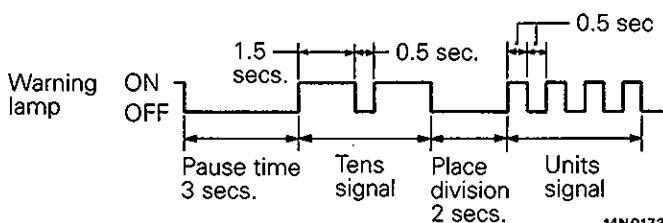
2. Use the special tool to earth diagnosis connector terminal No. 1.
3. Turn the ignition switch to ON and then take a reading of the diagnosis codes from the flashing of the ABS warning lamp.

NOTE

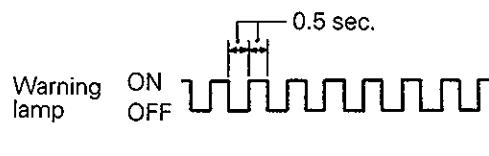
Diagnosis code No. 51 (indicating an open or short circuit in the valve relay) will be always output, because the valve relay connector is disconnected.

All diagnosis code numbers are the same as those when using the MUT-II.

When diagnosis code No. 24 is output



When no diagnosis code is output



4. Remedy the malfunctions indicated by the diagnosis codes, disconnect the diagnosis code check harness, and then install the valve relay. Then turn the ignition switch to ON again to check the ABS warning lamp. (Refer to P.35-36-16.) If the lamp indicates a malfunction, the valve relay system may be defective. (Refer to P.35-36-14.)

ERASING DIAGNOSIS CODES

With the MUT-II

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

Without the MUT-II

Remove the battery cable from the battery (–) terminal for 10 seconds or more, and then reconnect the cable.

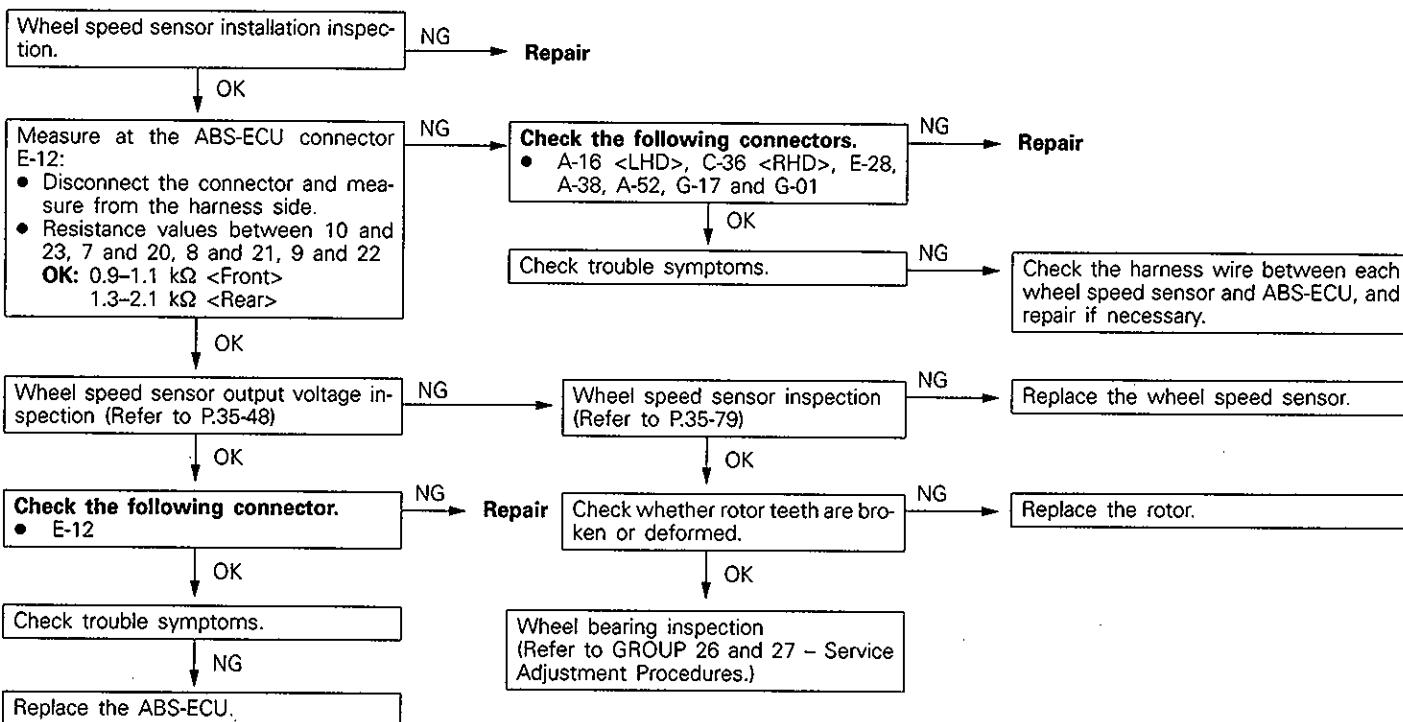
INSPECTION CHART FOR DIAGNOSIS CODES

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

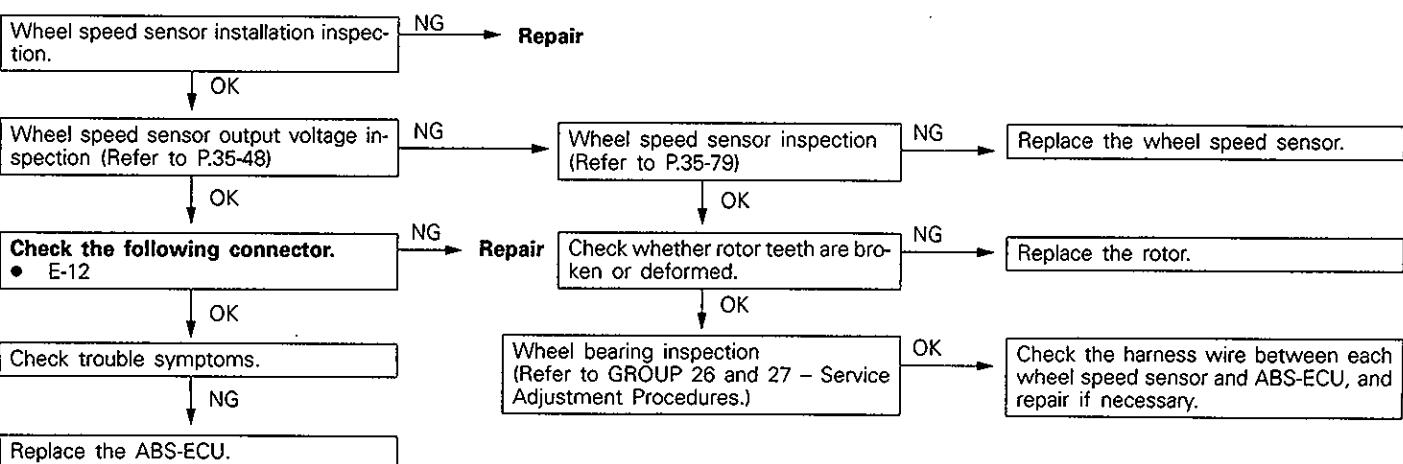
Diagnosis code no.	Inspection item	Diagnosis content	Reference page
11	Front right wheel speed sensor	Open circuit	P.35-36-6
12	Front left wheel speed sensor		
13	Rear right wheel speed sensor		
14	Rear left wheel speed sensor		
15	Wheel speed sensor	Abnormal output signal	P.35-36-6
16	Power supply system		P.35-36-7
21	Front right wheel speed sensor	Short circuit	P.35-36-7
22	Front left wheel speed sensor		
23	Rear right wheel speed sensor		
24	Rear left wheel speed sensor		
25	Free-wheeling engage switch		P.35-36-8
26	Center differential lock detection switch		P.35-36-9
27	Rear differential lock detection switch		P.35-36-10
32	G-sensor system		P.35-36-11
33	Stop lamp switch system		P.35-36-12
41	Front right solenoid valve	P.35-36-13	P.35-36-13
42	Front left solenoid valve		
43	Rear solenoid valve		
51	Valve relay		P.35-36-14
53	Motor relay, motor		P.35-36-15
63	Replace the ABS-ECU	—	—
64			

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

Code No. 11, 12, 13, 14 Wheel speed sensor open circuit	Probable cause
<p>[Comment] The ABS-ECU determines that an open circuit occurs in more than one line of wheel speed sensors.</p>	<ul style="list-style-type: none"> Malfunction of wheel speed sensor Malfunction of wiring harness or connector Malfunction of ABS-ECU



Code No. 15 Wheel speed sensor (Abnormal output signal)	Probable cause
<p>[Comment] A wheel speed sensor outputs an abnormal signal (other than an open or short-circuit).</p>	<ul style="list-style-type: none"> Improper installation of wheel speed sensor Malfunction of wheel speed sensor Malfunction of rotor Malfunction of wheel bearing Malfunction of wiring harness or connector Malfunction of ABS-ECU

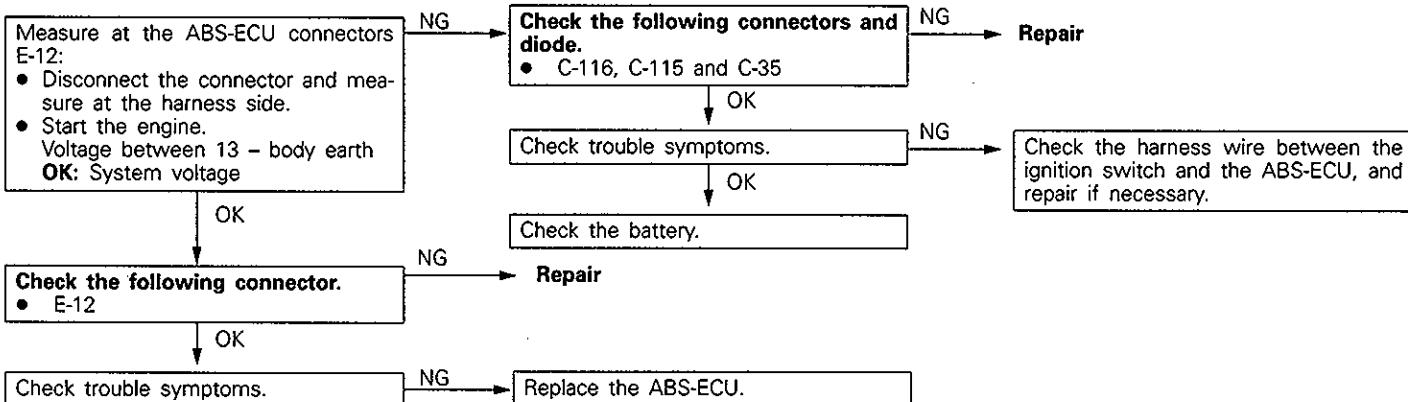


Code No. 16 Power supply system	Probable cause
<p>[Comment] The voltage of the ABS-ECU power supply drops lower or rises higher than the specified value. If the voltage returns to the specified value, this code is no longer output.</p>	<ul style="list-style-type: none"> Malfunction of wiring harness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

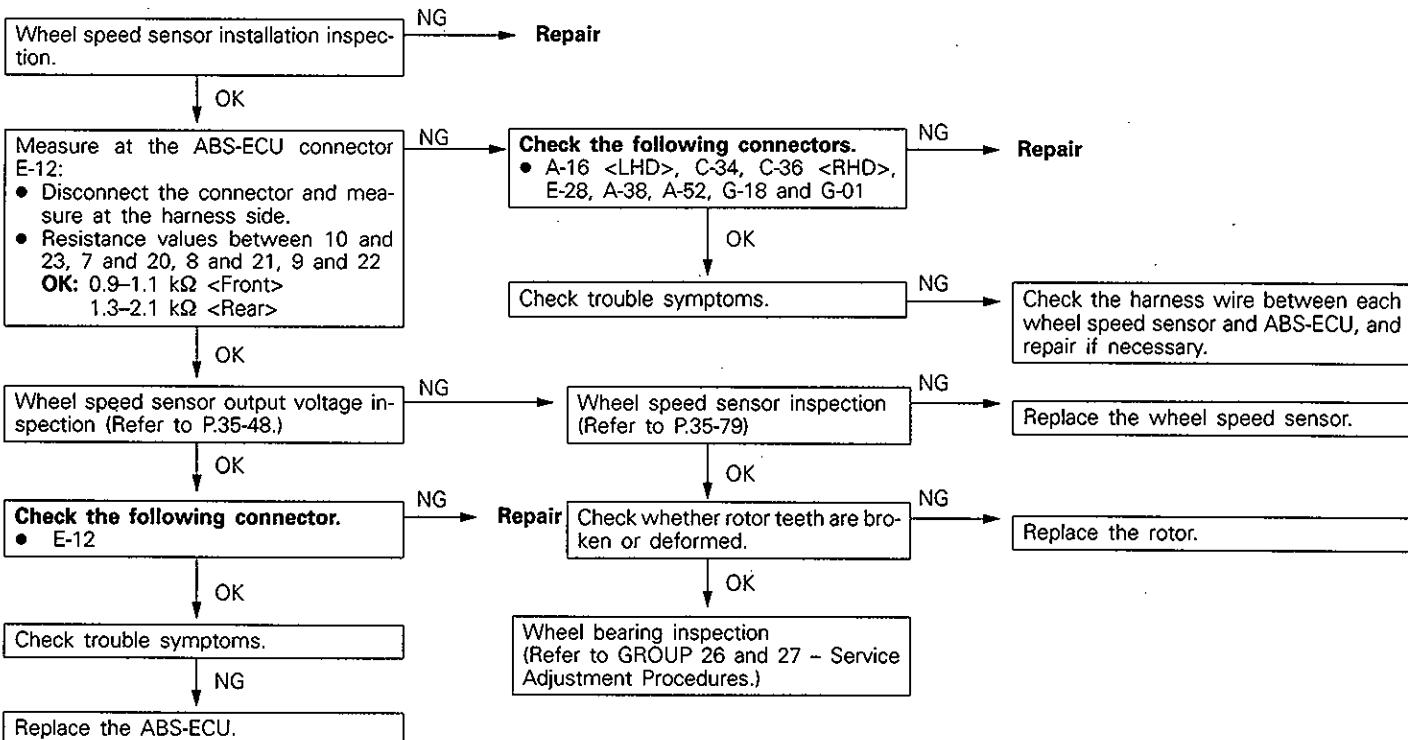
Caution

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

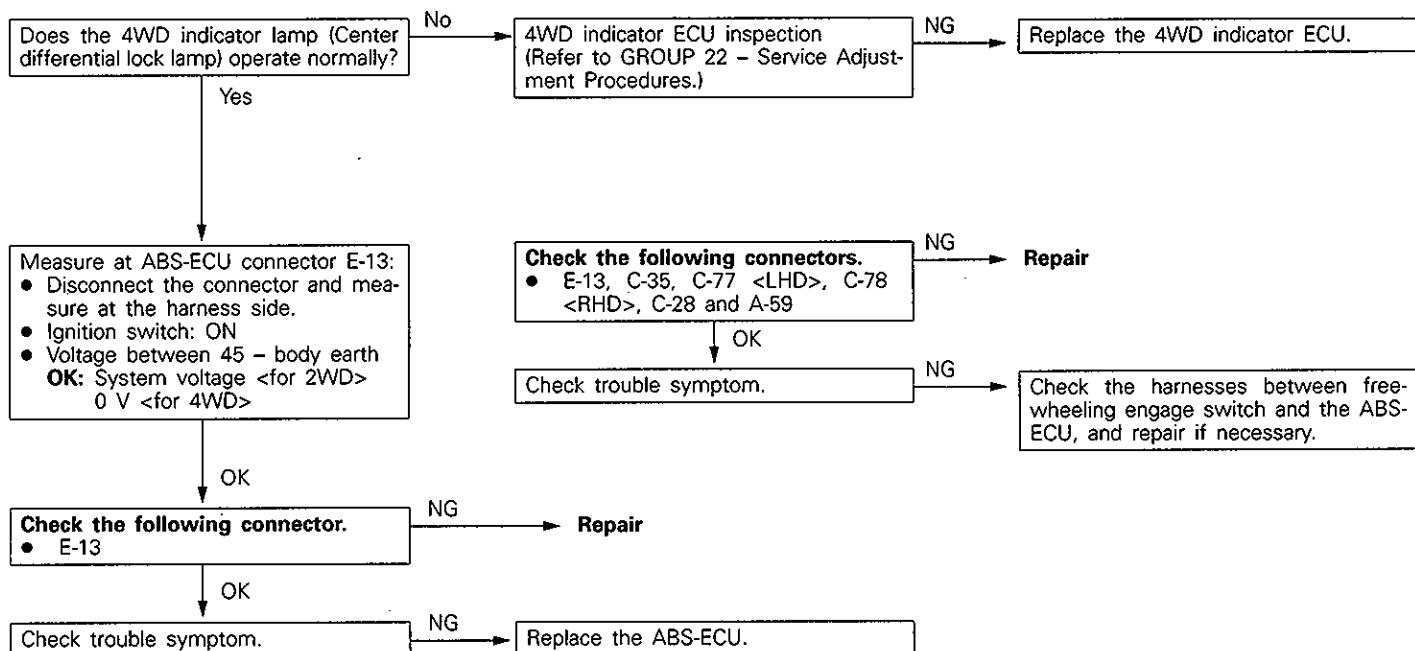
Before carrying out the following inspection, check the battery level, and refill it if necessary.



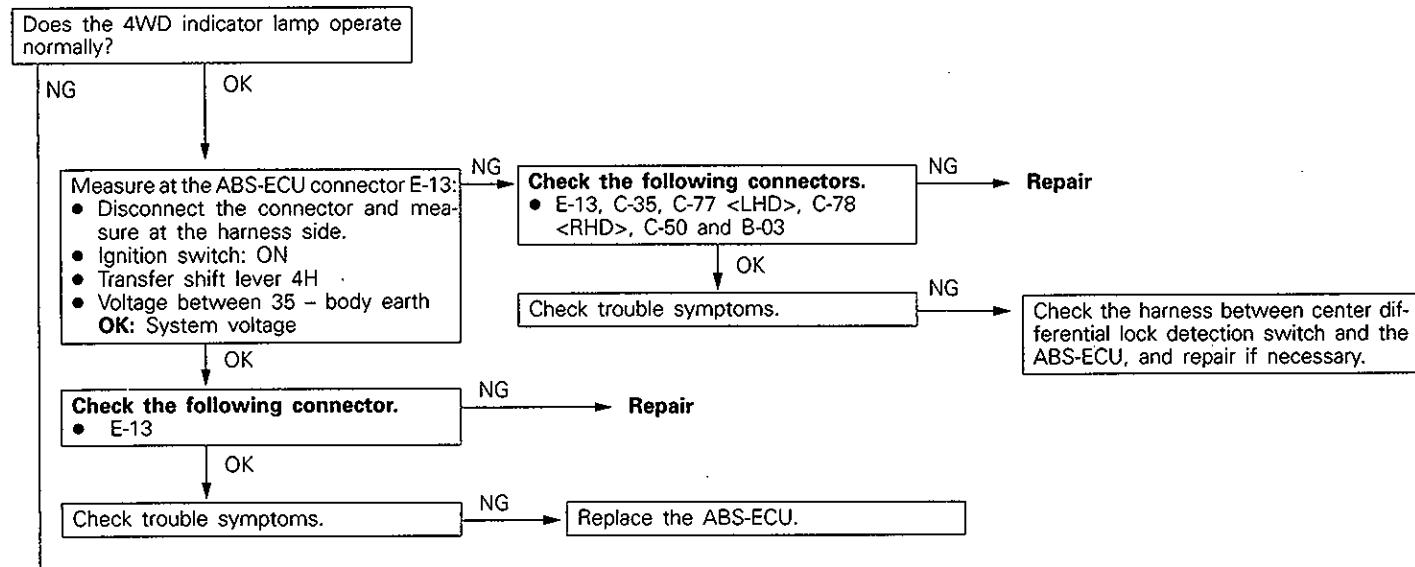
Code No. 21, 22, 23, 24 Wheel speed sensor short circuit	Probable cause
<p>[Comment] These codes are output at the following times:</p> <ul style="list-style-type: none"> When an open circuit cannot be found, but more than one wheel speed sensor does not output any signal during driving at 8 km/h or higher. When a chipped or plugged-up rotor tooth, etc. is detected. When the sensor output drops and anti-lock control is continuously carried out due to a defective sensor or a warped rotor. 	<ul style="list-style-type: none"> Malfunction of wheel speed sensor Malfunction of rotor Malfunction of wheel bearing Malfunction of wiring harness or connector Malfunction of ABS-ECU



Code No. 25 Free-wheeling engage switch	Probable cause
<p>[Comment] ABS-ECU determines that an open circuit exists in the free-wheeling engage switch system.</p>	<ul style="list-style-type: none"> Malfunction of wiring harness or connector Malfunction of 4WD indicator ECU Malfunction of ABS-ECU



Code No. 26 4WD position detection switch	Probable cause
<p>[Comment] This code is output at the following times:</p> <ul style="list-style-type: none"> ABS-ECU determines that an open circuit exists in the 4WD detection switch system. The free-wheeling engage switch is off and the 4WD detection switch is on at a vehicle speed of 15 km/h or more for 5 seconds or more. 	<ul style="list-style-type: none"> Malfunction of wiring harness or connector Malfunction of free-wheeling engage switch Malfunction of 4WD indicator ECU Malfunction of 4WD position detection switch Malfunction of ABS-ECU



Continued on next page

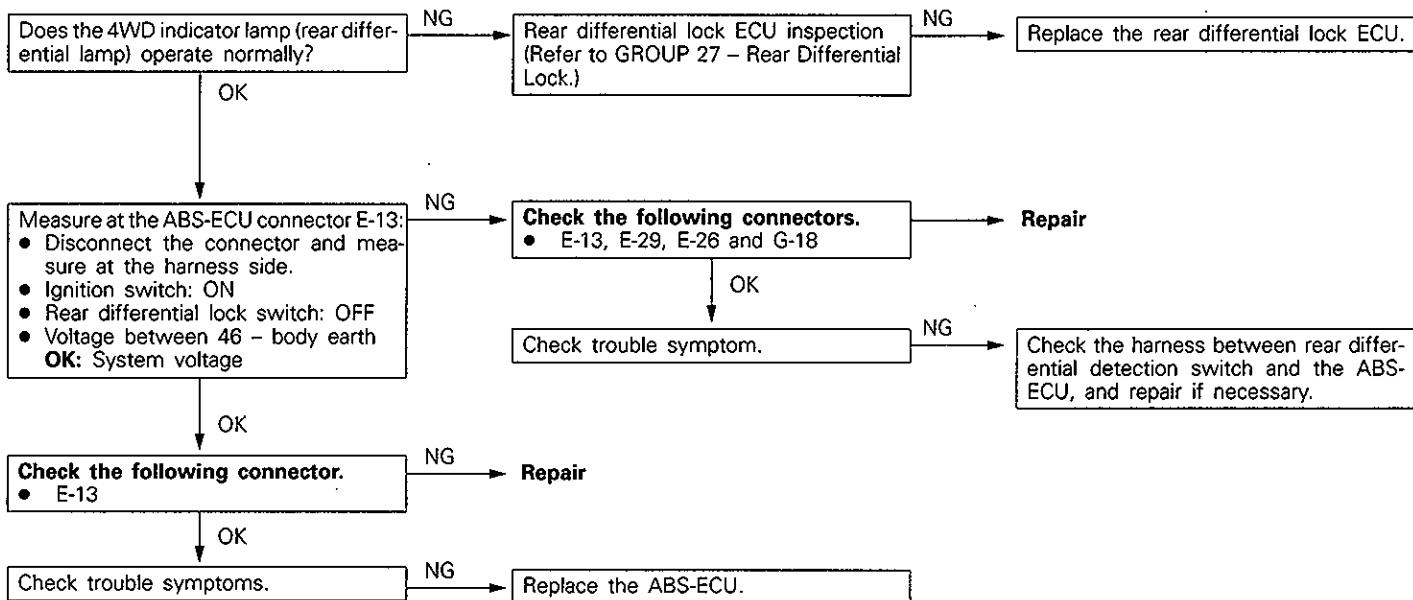
Continued from previous page

Trouble symptom	Main causes	Remedy
Even when the transfer shift lever is in the "4H" position, the 4WD front wheel indicator lamp does not illuminate.	Broken harness wire between the 4WD indicator ECU and the free-wheel engage switch, or broken earth wire from the free-wheel engage switch.	Repair the harness
	Free-wheeling engage switch is defective	Replace the switch
Even when the transfer shift lever is in the "4H" position, the 4WD center differential lamp does not illuminate.	Broken harness wire between the 4WD indicator ECU and the center differential lock switch	Repair the harness
	Broken wire in the 4WD indicator ECU circuit	4WD indicator ECU inspection (Refer to GROUP 22 – Service Adjustment Procedures.)
4WD indicator center differential lamp illuminates regardless of the position of the transfer shift lever	Short in the harness wire in the center differential lock detection switch circuit	Repair the harness
	Center differential lock detection switch is defective	Replace the switch
	Short inside the ABS-ECU circuit	Replace the ABS-ECU
	Short inside the 4WD indicator ECU circuit	4WD indicator ECU inspection (Refer to GROUP 22 – Service Adjustment Procedures.)
No indicator is illuminated	Power circuit in the 4WD indicator ECU is defective	Repair the harness
	4WD indicator ECU is defective	4WD indicator ECU inspection (Refer to GROUP 22 – Service Adjustment Procedures.)

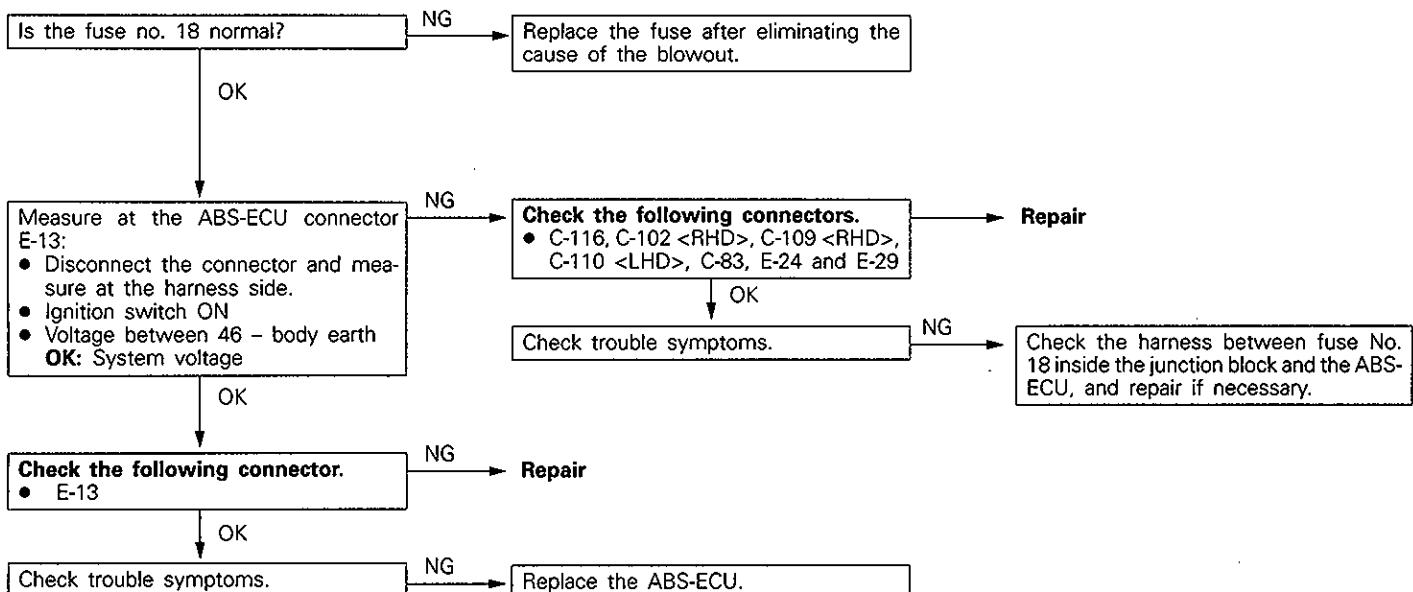
NOTE

When checking a short in the ABS-ECU circuit, remove the ABS-ECU connector and check if the 4WD indicator returns to normal. If it returns to normal, the ABS-ECU is defective. Furthermore, if the ABS-ECU is normal, then the 4WD indicator ECU will be defective.

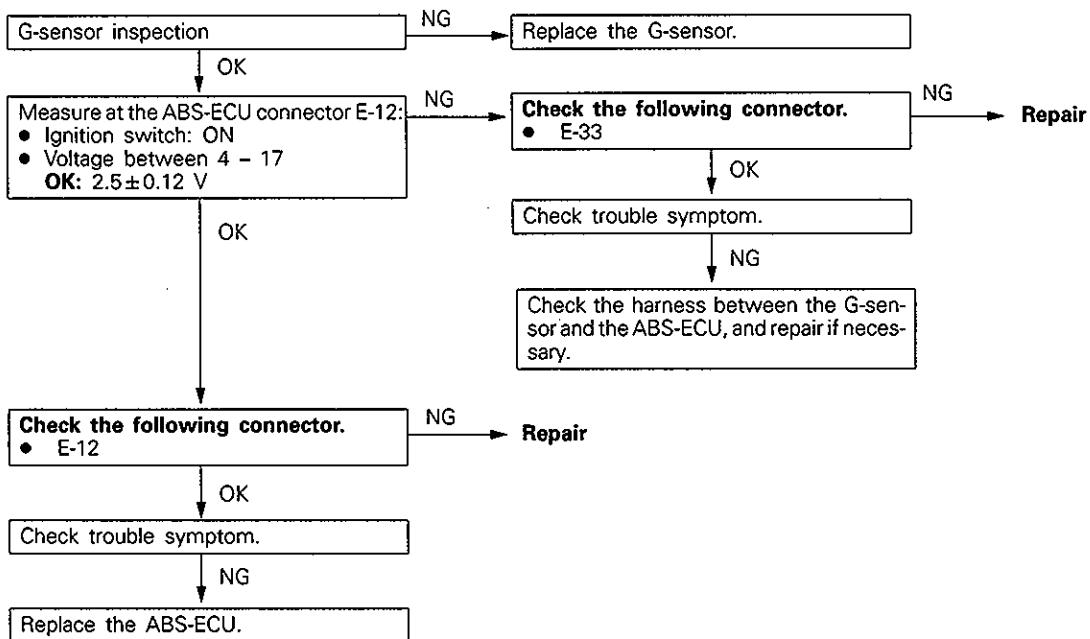
Code No. 27 Rear differential lock detection switch <Vehicles with rear differential lock>	Probable cause
<p>[Comment] The ABS-ECU determines that an open circuit occurs in rear differential detection switch system.</p>	<ul style="list-style-type: none"> • Malfunction of wiring harness or connector • Malfunction of rear differential lock ECU • Malfunction of ABS-ECU



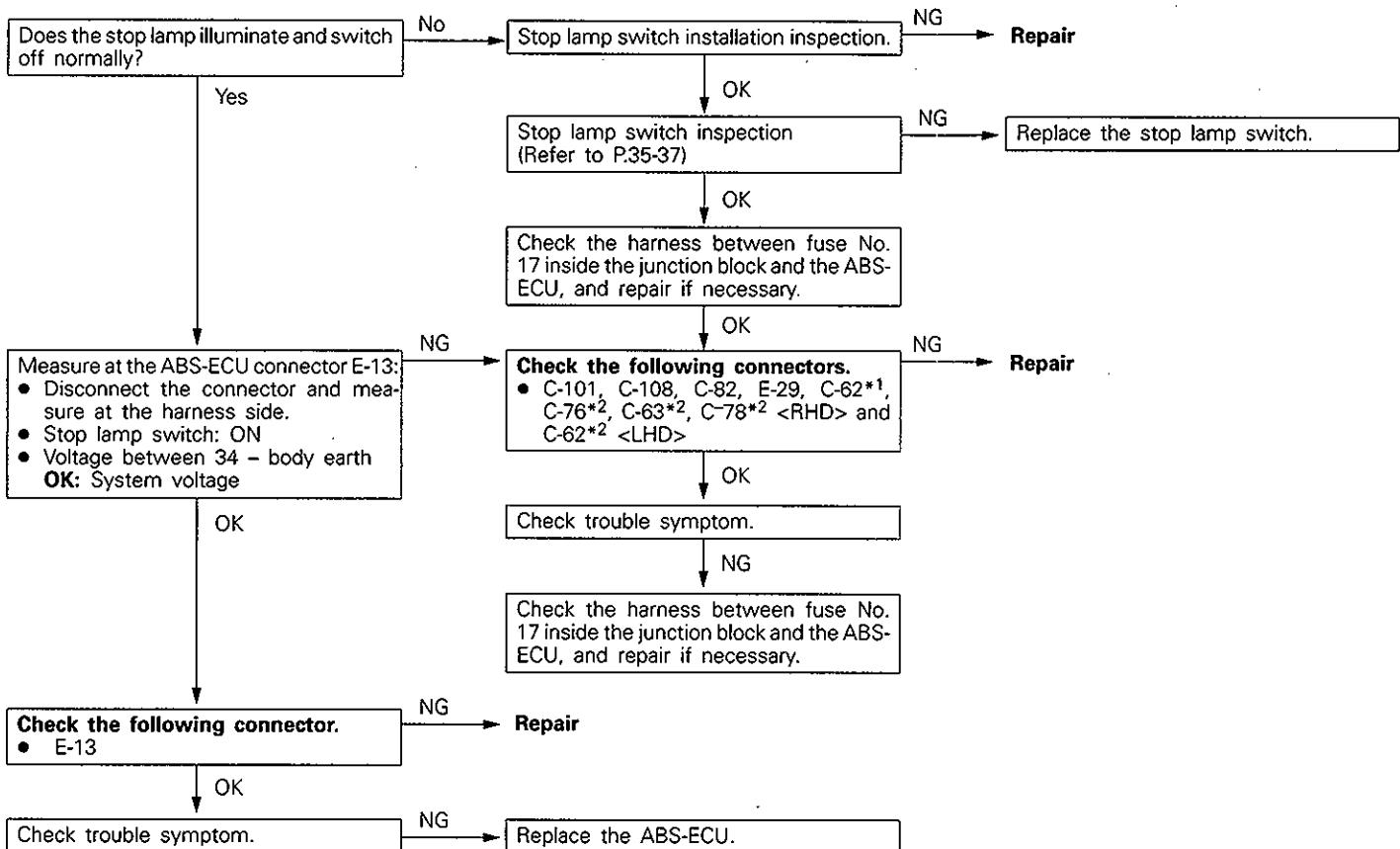
Code No. 27 Rear differential lock detection switch <Vehicles without rear differential lock>	Probable cause
<p>[Comment] For vehicles without rear differential lock, battery voltage is applied to the ABS-ECU terminal no. 46. This code is output when this line is interrupted.</p>	<ul style="list-style-type: none"> • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



Code No. 32 G-sensor system	Probable cause
<p>[Comment] This code is output at the following times:</p> <ul style="list-style-type: none"> • The G-sensor output is less than 0.5 V or more than 4.5 V. • An open or short circuit is present in the G-sensor system. 	<ul style="list-style-type: none"> • Malfunction of G-sensor • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



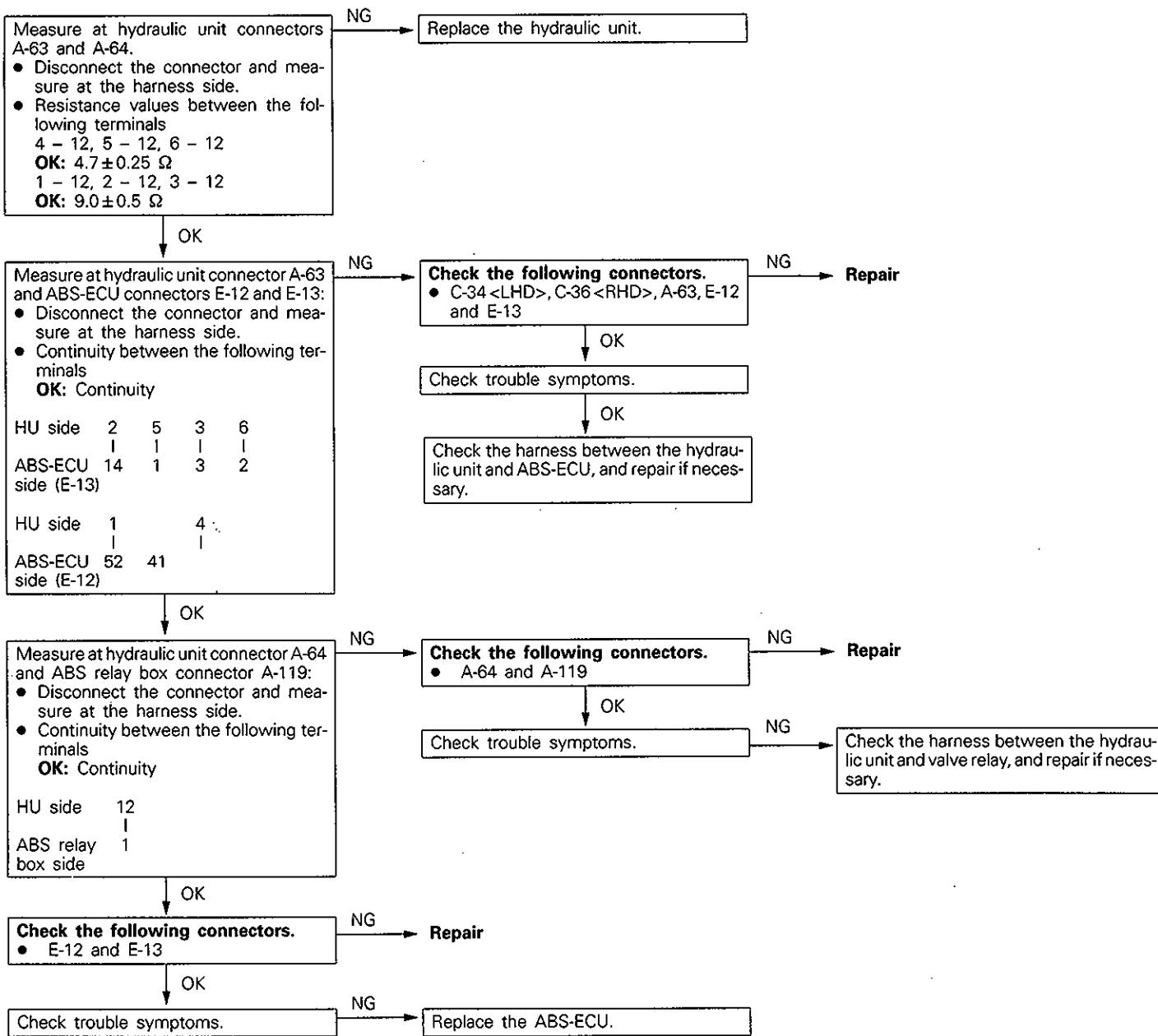
Code No. 33 Stop lamp switch system	Probable cause
<p>[Comment] These codes are output at the following times:</p> <ul style="list-style-type: none"> • When the stop lamp switch is not be turned off (when the stop lamp switch stays on for 15 minutes or more although the ABS is not operating) • When the ABS-ECU determines that there is an open circuit in harness of the stop lamp switch system. 	<ul style="list-style-type: none"> • Malfunction of stop lamp switch • Malfunction of harness or connector • Malfunction of ABS-ECU



NOTE

- (1) *1 indicates vehicles without auto-cruise control system.
- (2) *2 indicates vehicles with auto-cruise control system.

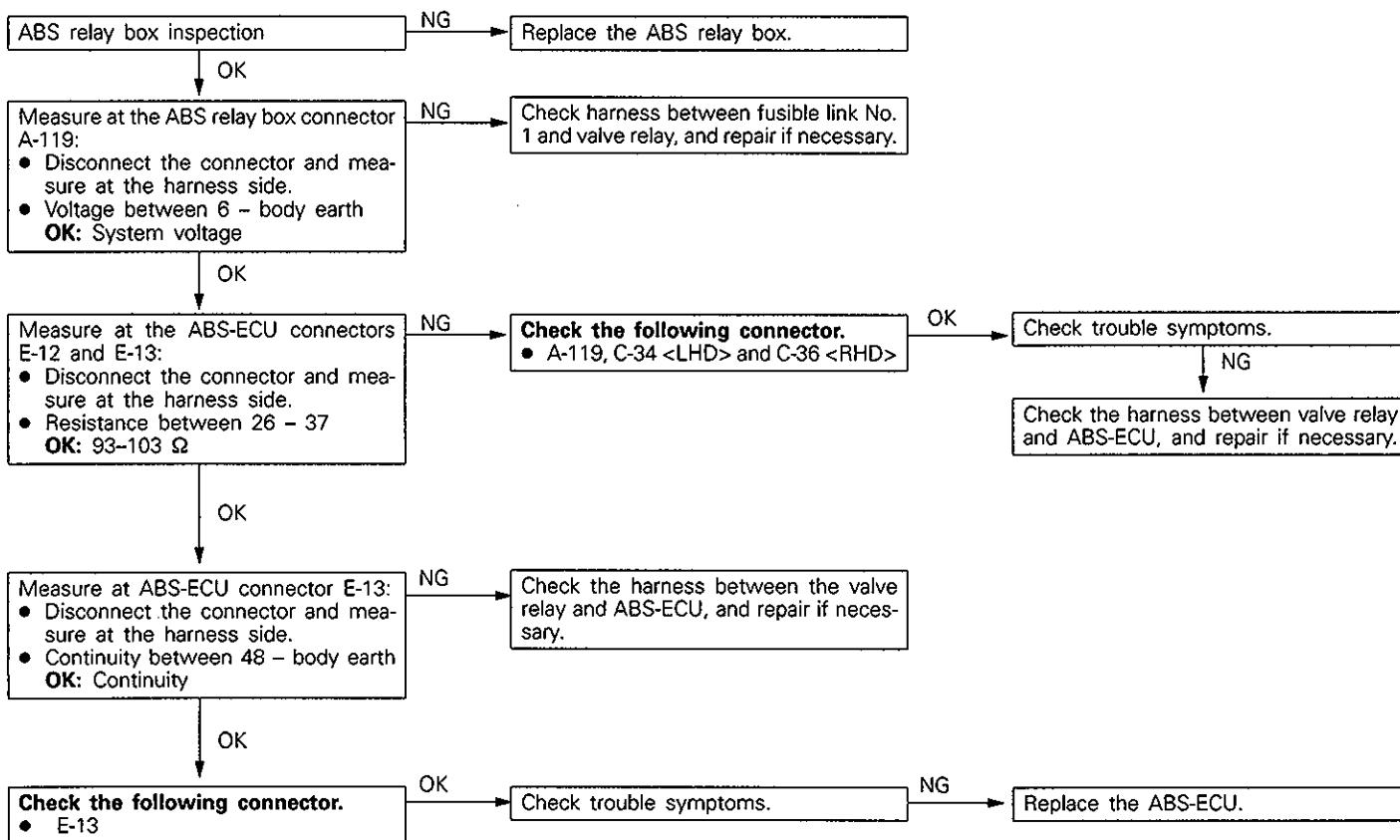
Code No. 41, 42, 43 Solenoid valve	Probable cause
<p>[Comment] The ABS-ECU always monitors the solenoid valve drive circuit. It determines that there is an open or short-circuit in the solenoid coil or in a harness:</p> <ul style="list-style-type: none"> When no current flows in the solenoid even though the ABS-ECU turns on it, and vice versa. 	<ul style="list-style-type: none"> Malfunction of wiring harness Malfunction of hydraulic unit Malfunction of ABS-ECU



Code No. 51 Valve relay	Probable cause
<p>[Comment] When the ignition switch is turned to ON, the ABS-ECU switches the valve relay off and on during the initial check. In that way, the ABS-ECU compares the signals sent to the valve relay with the voltage in the valve power monitor line. That is how to check if the valve relay is operating normally. The ABS-ECU always checks if current flows in the valve power monitor line, too. It determines that there is an open circuit when no current flows. If no current flows in the valve power monitor line, this diagnosis code is output.</p>	<ul style="list-style-type: none"> Malfunction of valve relay Malfunction of wiring harness or connector Malfunction of ABS-ECU Malfunction of hydraulic unit

NOTE

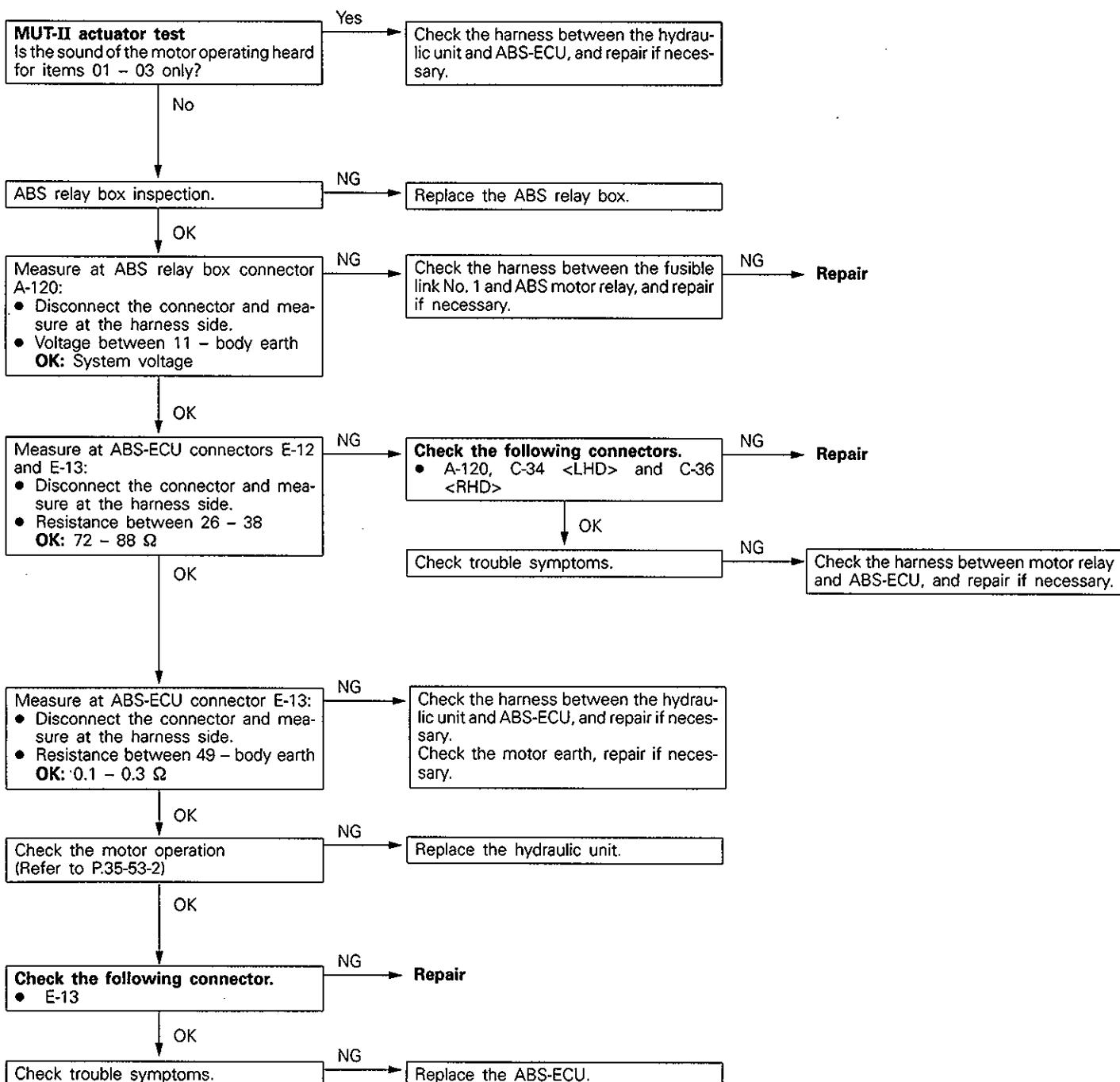
Whenever reading the diagnosis codes using the ABS warning lamp (P.35-36-16), this diagnosis code will be output. That is not a malfunction but because the valve relay connector is disconnected. After repairing all other malfunctions, connect the valve relay connector again to check the valve relay. Then check that the ABS warning lamp does not illuminate. If it illuminates, the valve relay may be defective. So carry out the following procedure.

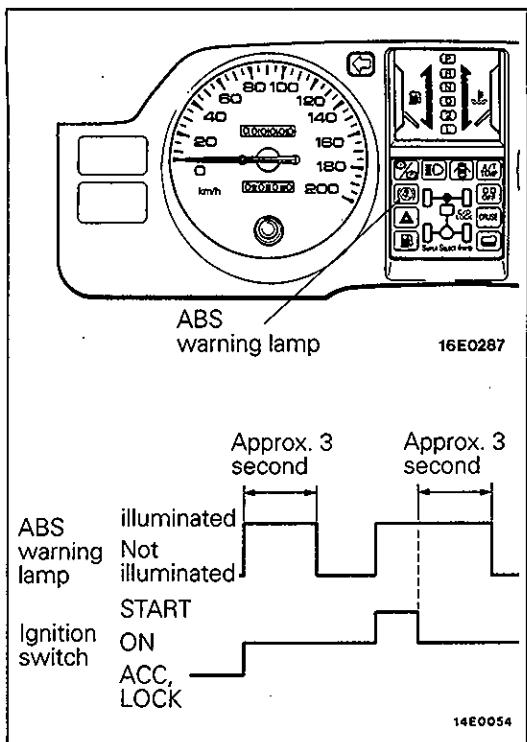


Code No. 53 Motor relay, motor	Probable cause
<p>[Comment] These codes are output at the following times:</p> <ul style="list-style-type: none"> • When the motor relay is on but no signal is input to the motor monitor line (motor is not operating, etc.) • When the motor relay is off but a signal is input to the motor monitor line for 5 seconds or more (motor continues operating, etc.) <p>When the motor relay does not operate</p>	<ul style="list-style-type: none"> • Malfunction of motor relay • Malfunction of wiring harness or connector • Malfunction of hydraulic unit • Malfunction of ABS-ECU

Caution

Because force-driving of the motor by means of the actuator test will drain the battery, the engine should be started and left to run for a while after testing is completed.





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 stays switched off.
4. If the illumination is other than the above, check the diagnosis codes.

INSPECTION CHART FOR TROUBLE SYMPTOMS

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

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is not possible.	No communication with any system is possible.	1	P.35-36-18
	Communication is not possible with ABS only.	2	P.35-36-18
When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate.		3	P.35-36-19
After the engine starts, the lamp remains illuminated.		4	P.35-36-19
When the ignition key is turned to "START", the ABS warning lamp does not illuminate.		5	P.35-36-20
After the ignition key is turned on "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.		6	P.35-36-20
Faulty ABS operation	Unequal braking power on both sides	7	P.35-36-21
	Insufficient braking power		
	ABS operates under normal braking conditions		
	ABS operates before vehicle stops under normal braking conditions		
	Large brake pedal vibration (Caution 2.)	–	–

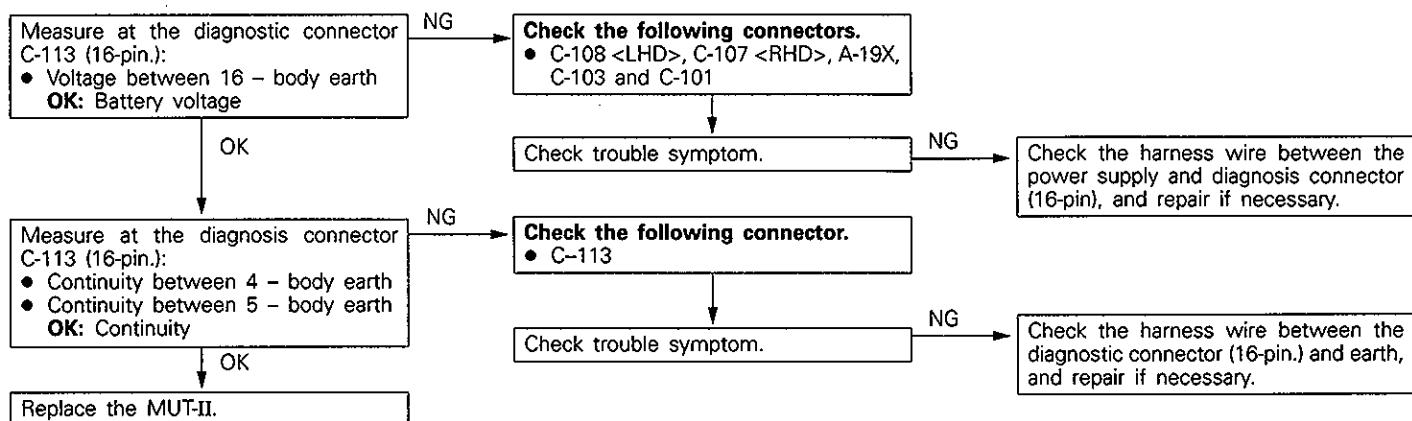
Caution

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

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

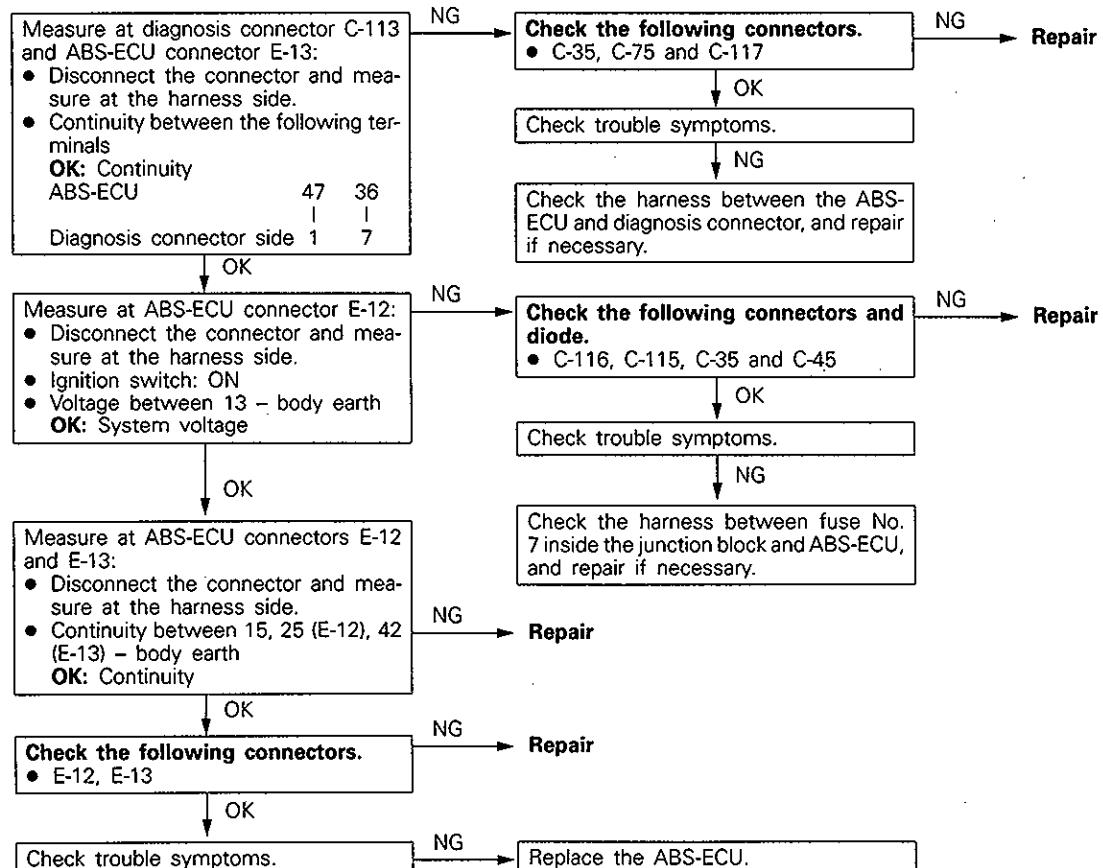
Inspection Procedure 1

Communication with MUT-II is not possible. (No communication with any system is possible.)	Probable cause
<p>[Comment] The reason is probably a defect in the power supply system (including earth) for the diagnosis line.</p>	<ul style="list-style-type: none"> • Malfunction of connector • Malfunction of harness



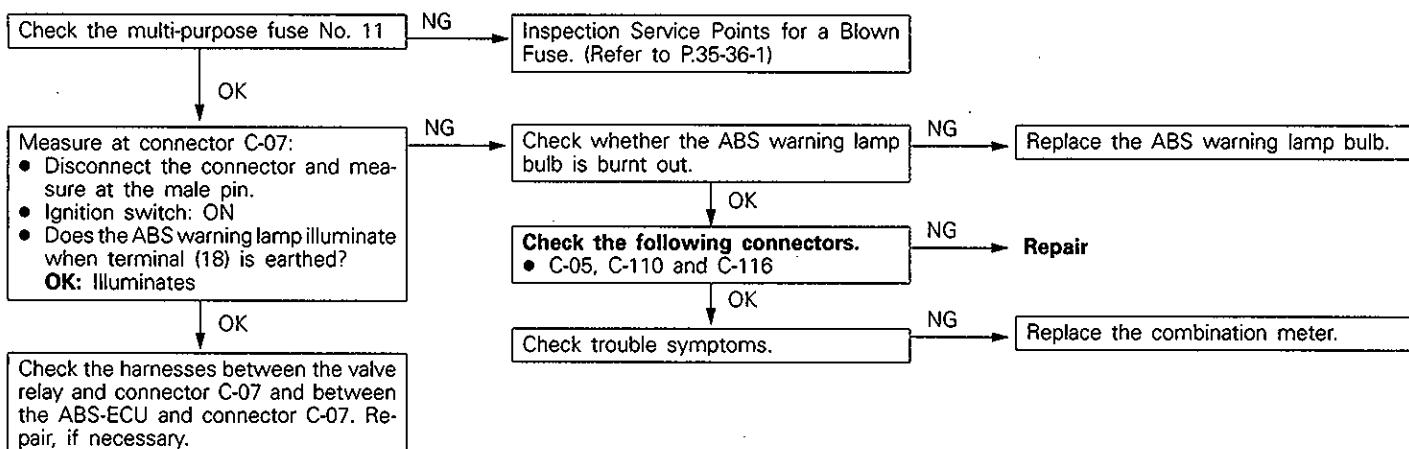
Inspection Procedure 2

Communication with MUT-II is not possible. (Communication is not possible with ABS only.)	Probable cause
<p>[Comment] When communication with the MUT-II is not possible, the cause is probably an open circuit in the ABS-ECU power circuit or an open circuit in the diagnosis output circuit.</p>	<ul style="list-style-type: none"> • Blown fuse • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



Inspection Procedure 3

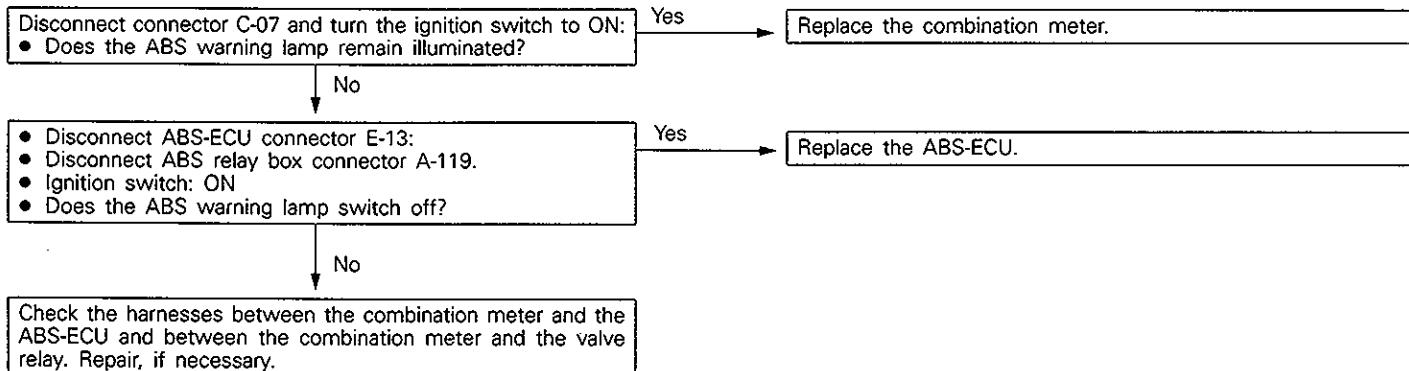
When ignition key is turned to "ON" (engine stopped), ABS warning lamp does not illuminate.	Probable cause
<p>[Comment] When current flows in the ABS-ECU, the valve relay turns from off to on, off and back to on again as the initial check. So the ABS warning lamp will illuminate twice when the valve relay is off even if there is a problem with the circuit between the ABS warning lamp and the ABS-ECU. Therefore, if the lamp does not illuminate, the cause may be: an open circuit in the lamp power supply circuit, a blow lamp bulb, an open circuit in both the circuit between the ABS warning lamp and the ABS-ECU and in the circuit between the ABS warning lamp and the valve relay</p>	<ul style="list-style-type: none"> Blow fuse Burnt out ABS warning lamp bulb Malfunction of wiring harness or connector

**Inspection Procedure 4**

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

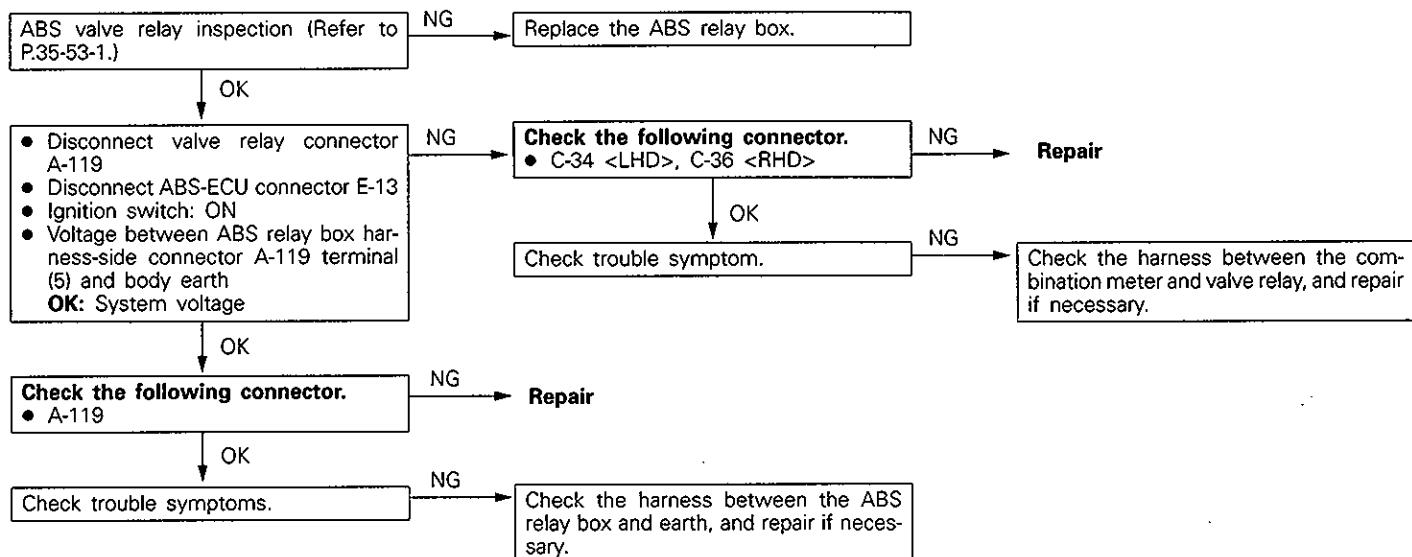
NOTE

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



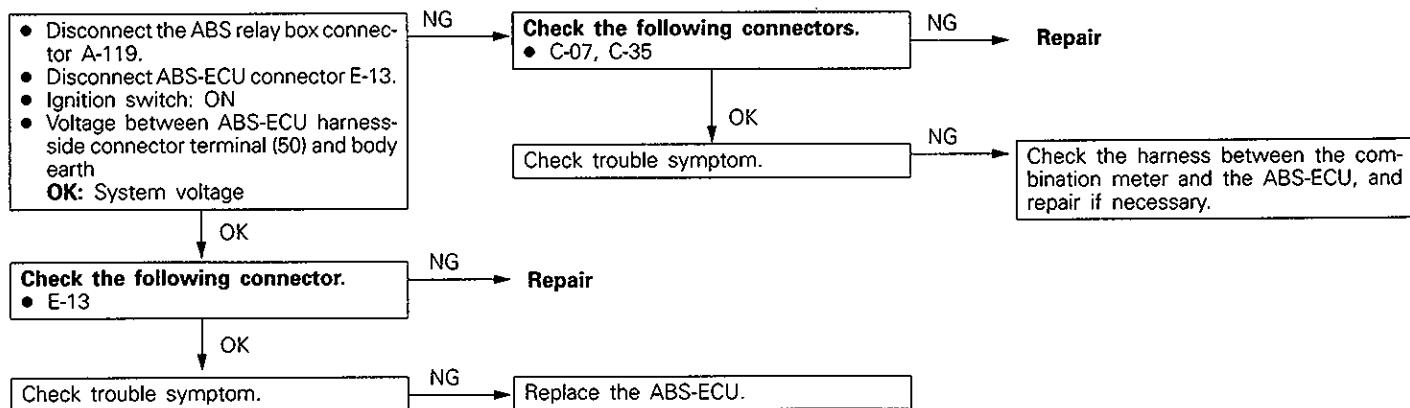
Inspection Procedure 5

When ignition key is turned to "START", ABS warning lamp does not illuminate.	Probable cause
<p>[Comment] Current does not flow in the ABS-ECU when the ignition switch is turned to START. Current flows in the ABS warning lamp even when the ignition switch is turned to START. Therefore, the valve relay, which current is supplied through the ABS-ECU, turns off when the ignition switch is at START. However, the warning lamp circuit of the valve relay must turn on in turn. So the cause must be a defective circuit on valve relay side.</p>	<ul style="list-style-type: none"> • Malfunction of wiring harness or connector • Malfunction of ABS-ECU.



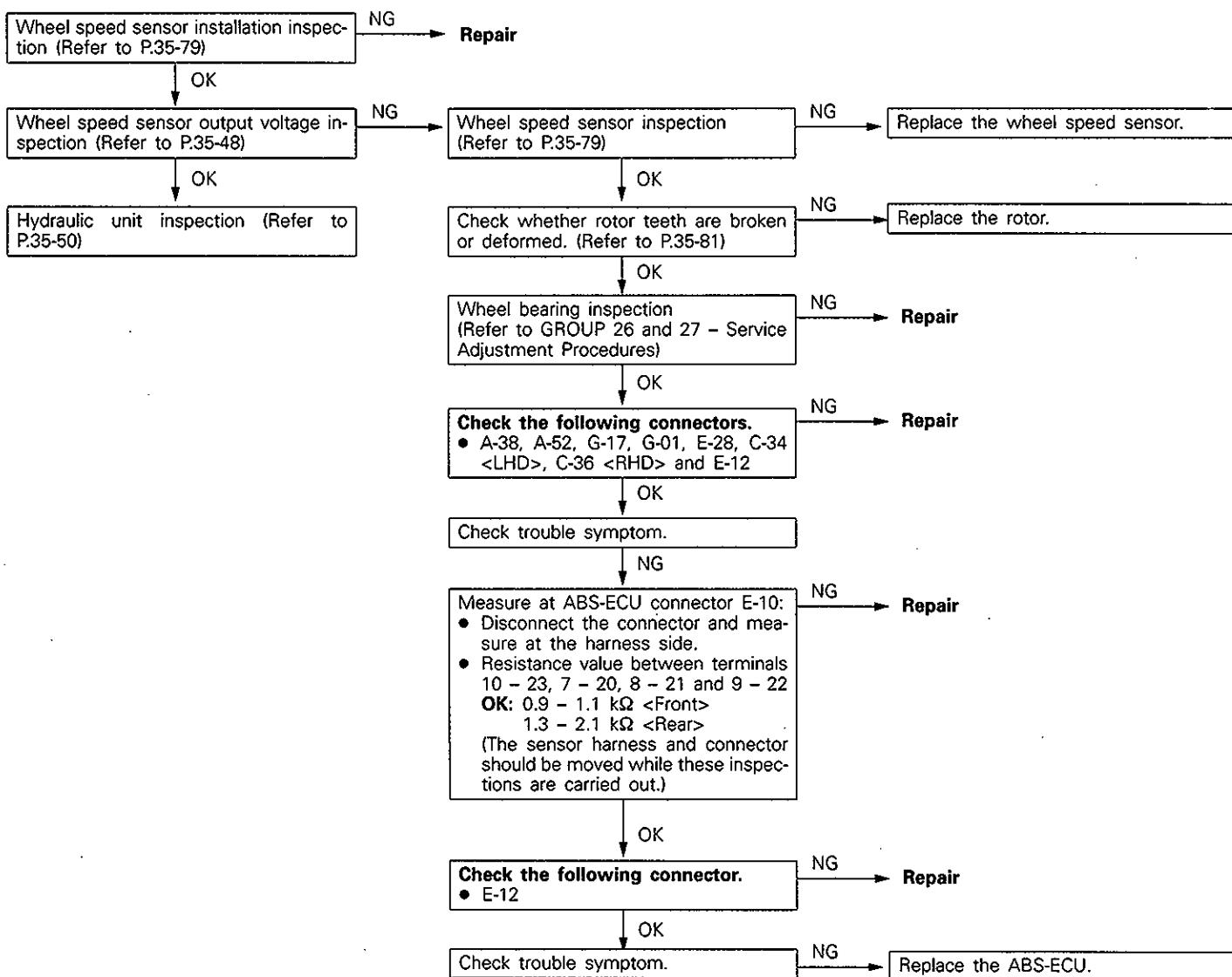
Inspection Procedure 6

The ABS warning lamp flashes twice after the ignition key is turned to "ON". The lamp illuminates when the ignition key is turned to "START", and when the key is returned to "ON", it flashes once.	Probable cause
<p>[Comment] The ABS-ECU causes the ABS warning lamp to illuminate during the initial check (approx. 3 seconds). 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 7

Brake operation is abnormal	Probable cause
<p>[Comment] This depends on the driving conditions and the road surface conditions, so problem diagnosis is difficult. However, if a normal diagnosis code is displayed, carry out the following inspection.</p>	<ul style="list-style-type: none"> Improper installation of wheel speed sensor Incorrect sensor harness contact Foreign material adhering to wheel speed sensor Malfunction of wheel speed sensor Malfunction of rotor 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

Item No.	Check item	Checking Requirements	Normal Value
11	Front-right wheel speed sensor	Do a test run.	Vehicle speeds displayed on the speedometer and MUT-II are identical.
12	Front-left wheel speed sensor		
13	Rear-right wheel speed sensor		
14	Rear-left wheel speed sensor		
16	ABS-ECU power supply voltage	IG power supply voltage and valve monitor voltage	9–16V
25	Free-wheeling engage switch	Engage 4WD.	ON
		Engage 2WD.	OFF
26	Center differential lock detection switch	Place the transfer lever at 4HLC.	ON
		Place the transfer lever at 4H.	OFF
27	Rear differential lock detection switch	Turn on the switch.	ON
		Turn off the switch.	OFF
32	G-sensor output voltage	Stop the vehicle.	2.5 ± 0.12V
		Do a test turn.	Display value fluctuates with a mean value of 2.5 V.
33	Stop lamp switch	Depress the brake pedal.	ON
		Release the brake pedal.	OFF

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

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

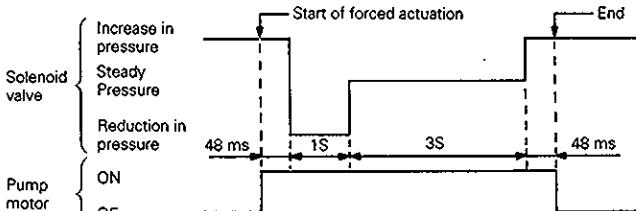
ACTUATOR TEST REFERENCE TABLE

The MUT-II activates the following actuators for testing.

NOTE

1. If the ABS-ECU runs down, actuator testing cannot be carried out.
2. Actuator testing is only possible when the vehicle is stationary. If the vehicle speed during actuator testing exceeds 10 km/h, forced actuation will cancel.

ACTUATOR TEST SPECIFICATIONS

No.	Driving objective		Driving pattern
01	Solenoid valves and pump motors for each corresponding channel in the hydraulic unit	Solenoid valve for front left wheel	
02		Solenoid valve for front right wheel	
03		Solenoid valve for rear wheels	

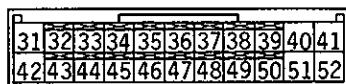
14E0048

CHECK AT ABS-ECU

120000123

TERMINAL VOLTAGE CHECK CHART

1. Measure the voltages between terminals (15), (25) and (42) (earth terminals) and each respective terminal.
2. The terminal layouts are shown in the illustrations below.



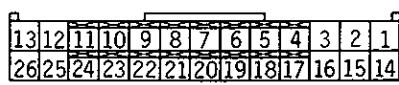
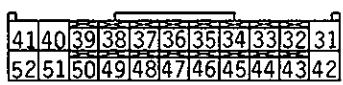
14W0043

Item No.	Signal	Checking Requirements	Normal Condition
1	Output to front-left hydraulic unit solenoid valve (OUT side)		
2	Output to rear hydraulic unit solenoid valve (OUT side)	Ignition switch: ON (When solenoid valve is off approximately 1 second after engine is started)	System voltage
3	Output to rear hydraulic unit solenoid valve (IN side)		
4	G-sensor signal	Ignition switch: ON	$2.5 \pm 0.12V$ (Horizontal condition)
13	ABS-ECU power supply	Ignition switch: ON	System voltage
		Ignition switch: START	0 V

Connector Terminal No.	Signal	Checking Requirements		Normal Condition		
14	Output to front-left hydraulic unit solenoid valve (IN side)	Ignition switch: ON (When solenoid valve is off approximately 1 second after engine is started)		System voltage		
17	G-sensor earth	Always		0 V		
26	Output to relay power supply	Ignition switch: ON		System voltage		
32	Memory power supply	Always		System voltage		
34	Input from stop lamp switch	Ignition switch: ON	Stop lamp switch ON			
			Stop lamp switch OFF			
35	Input from center differential lock detection switch	Ignition switch: ON	Transfer lever position: 4H			
			Transfer lever position: 4Lc			
36	MUT-II	Connect the MUT-II.				
		Do not connect the MUT-II.				
37	Output to valve relay	Ignition switch: ON	Approximately 1 second after engine is started. The relay is on.			
			The system runs down. The relay is off.			
38	Output to motor relay	Ignition switch: ON (Approximately 1 second after engine is started)	Motor is on			
			Motor is off			
39	Idle-up solenoid valve (-)	Ignition switch: ON (When motor is on approximately 1 second after engine is started)				
41	Output to front-right hydraulic unit solenoid valve (OUT side)	Ignition switch: ON (When solenoid valve is off approximately 1 second after engine is started)				
43	Idle-up solenoid valve (+)	Ignition switch: ON (When motor is on approximately 1 second after engine is started)				

RESISTANCE AND CONTINUITY BETWEEN HARNESS-SIDE CONNECTOR TERMINALS

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



14W0042

Connector Terminal No.	Signal	Checking Requirements		Normal Condition
45	Input from free-wheeling engage switch	Ignition switch: ON	Engage 2WD.	System voltage
			Engage 4WD.	1 V or less
46* ¹	Ignition switch	Ignition switch: ON		System voltage
		Ignition switch: START		0 V
46* ²	Input from rear differential lock detection switch	Ignition switch: ON	Rear differential lock switch: ON	0 V
			Rear differential lock switch: OFF	System voltage
47	Input from diagnosis indication selection	Connect the MUT-II.		0 V
		Do not connect the MUT-II.		Approx. 12 V
48	Input from valve relay monitor	Ignition switch: ON		System voltage
49	Motor monitor	Ignition switch: ON (Approximately 1 second after engine is started)	Motor is on	System voltage
			Motor is off	0.5 V or less
50	Output to ABS warning lamp	Ignition switch: ON	The lamp is switched off	System voltage
			The lamp illuminates	0–2 V
52	Output to front-right hydraulic unit solenoid valve (IN side)	Ignition switch: ON (When solenoid valve is off approximately 1 second after engine is started)		System voltage

NOTE

(1) *¹: Vehicles without rear differential lock
 (2) *²: Vehicles with rear differential lock

RESISTANCE AND CONTINUITY BETWEEN HARNESS-SIDE CONNECTOR TERMINALS

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

Connector Terminal No.	Signal	Normal Condition
1 – Body earth	Front-left solenoid valve (OUT side)	$4.7 \pm 0.25 \Omega$
2 – Body earth	Rear solenoid valve (OUT side)	$4.7 \pm 0.25 \Omega$
3 – Body earth	Rear solenoid valve (IN side)	$9.0 \pm 0.5 \Omega$
7–20	Front-left wheel speed sensor (+ wire)	$0.9 \pm 1.1 \Omega$
8–21	Rear-right wheel speed sensor (+ wire)	$1.3 \pm 2.1 \Omega$
9–22	Rear-left wheel speed sensor (+ wire)	$1.3 \pm 2.1 \Omega$
10–23	Front-right wheel speed sensor (+ wire)	$0.9 \pm 1.1 \Omega$
14 – Body earth	Front-left solenoid valve (IN side)	$9.0 \pm 0.5 \Omega$
15 – Body earth	ABS-ECU earth	Continuity
25 – Body earth		
39–43	Idle-up solenoid valve	$36 - 44 \Omega$
41 – Body earth	Front-right solenoid valve (OUT side)	$4.7 \pm 0.25 \Omega$
42 – Body earth	ABS-ECU earth	Continuity
48 – Body earth	Valve relay monitor input	Continuity
49 – Body earth	Motor monitor	Continuity
52 – Body earth	Front-right solenoid valve (IN side)	$9.0 \pm 0.5 \Omega$

SERVICE ADJUSTMENT PROCEDURES

E35FAAH

BRAKE PEDAL INSPECTION AND ADJUSTMENT

1. Measure the brake pedal height (A) as illustrated.

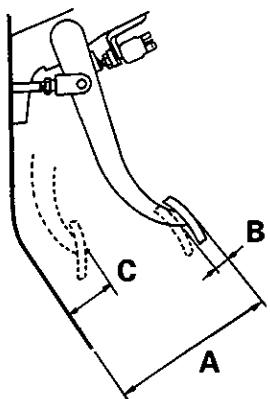
Standard value (A): 186–191 mm (7.3–7.5 in.)

2. Start the engine, depress the brake pedal with approximately 500N (50 kg, 110 lbs.) of force, and measure the clearance between the brake pedal and the floorboard.

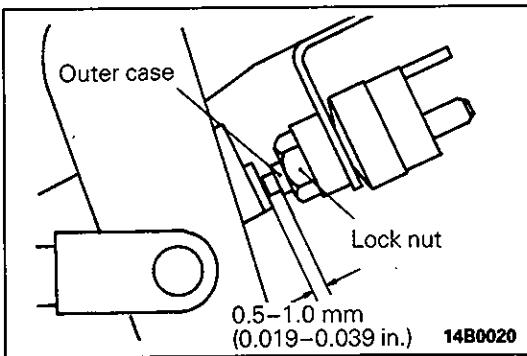
Standard value (C): 100 mm (3.94 in.) or more

3. While the engine is stopped, depress the brake pedal two or three times. After thus eliminating the vacuum in the brake booster, press the pedal down by hand, and confirm that the free play (B) is within the standard value range.

Standard value (B): 3–8 mm (0.12–0.31 in.)



14F519



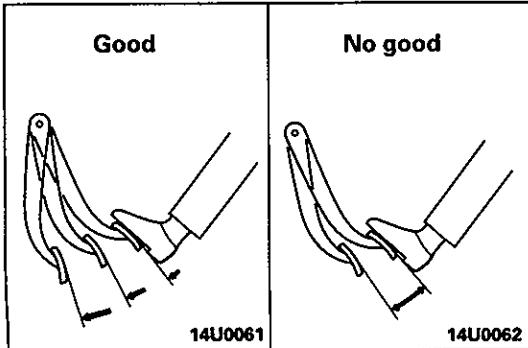
14B0020

4. Adjust the brake pedal height.

- (1) Sufficiently loosen the stop lamp switch by loosening lock nut.
- (2) Adjust the brake pedal height by turning the operating rod with pliers (with lock nut loosened).
- (3) After turning the stop lamp switch until it contacts the pedal stop (until immediately before the brake pedal begins to move), turn the stop lamp switch back 1/2 to 1 revolution and secure with a lock nut.

Caution

Check that the stop lamp is not illuminated when the brake pedal is not depressed.

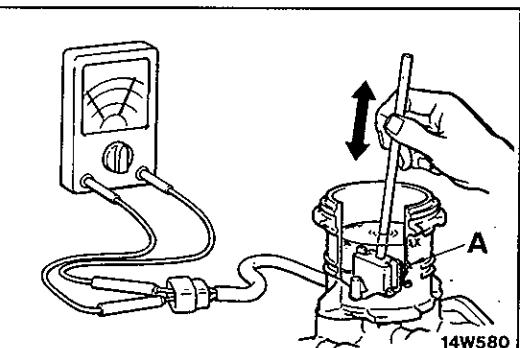
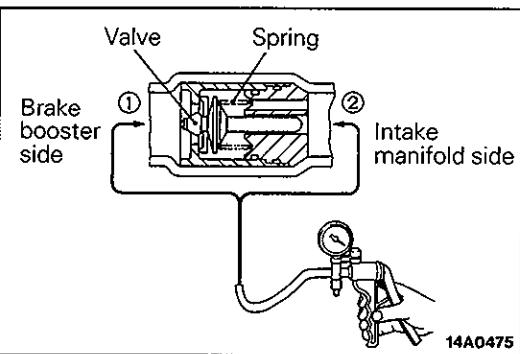
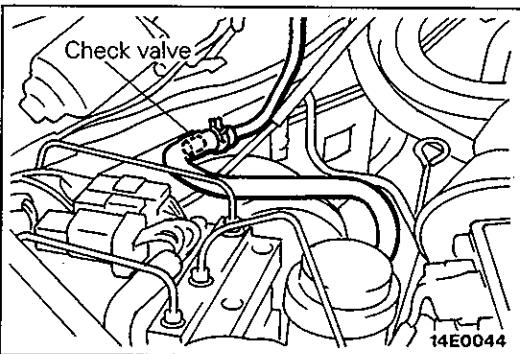
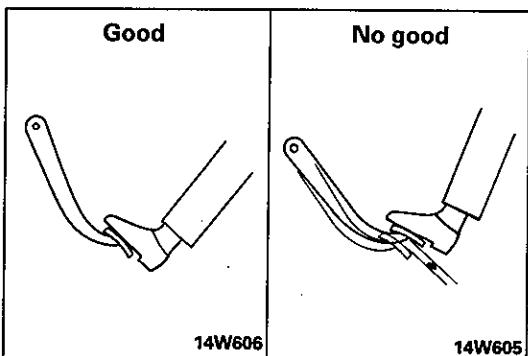
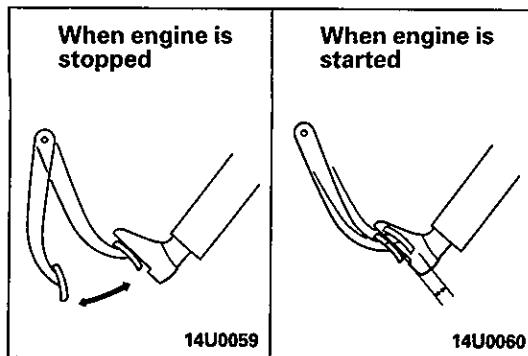


BRAKE BOOSTER OPERATING TEST

E35FCAAa

For simple checking of the brake booster operation, carry out the following tests:

1. Run the engine for one or two minutes, and then stop it. If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly. If the pedal height remains unchanged, the booster is defective.



2. With the engine stopped, step on the brake pedal several times.

Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is defective.

3. With the engine running, step on the brake pedal and then stop the engine.

Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is defective.

If the above three tests are okay, the booster performance can be determined as good.

If one of the above three tests is not okay at last, the check valve, vacuum hose, or booster will be defective.

CHECK VALVE OPERATION CHECK

E35FEAI

When checking the check valve, keep the check valve fit in the vacuum hose.

1. Remove the vacuum hose.

NOTE

The check valve is press-fit inside the vacuum hose.

2. Check the operation of the check valve by using a vacuum pump.

Vacuum pump connection	Accept/reject criteria
Connection at the brake booster side ①	A negative pressure (vacuum) is created and held.
Connection at the engine side ②	A negative pressure (vacuum) is not created.

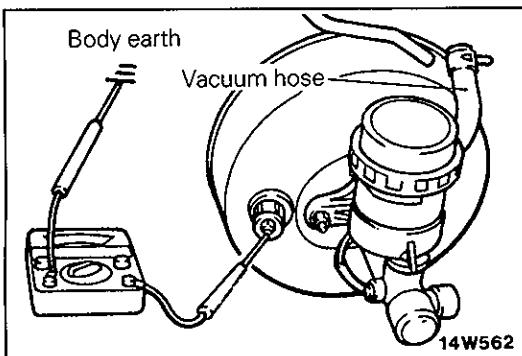
Caution

If the check valve is defective, replace it as an assembly unit together with the vacuum hose.

BRAKE FLUID LEVEL SENSOR CHECK

E35FBAE

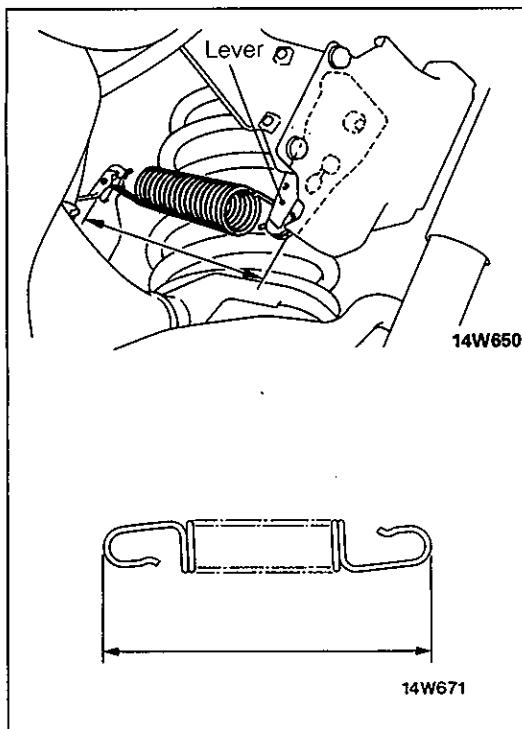
The brake fluid level sensor is in good condition if there is no continuity when the float surface is above "A", and if there is continuity when the float surface is below "A".



BRAKE BOOSTER VACUUM SWITCH CHECK <2500D>

E35FDAAb

1. Connect an ohmmeter to the connector of the vacuum switch.
2. Start the engine and check for continuity when the vacuum hose is connected and when it is disconnected. The vacuum switch is in good condition if there is no continuity when the vacuum hose is connected, and if there is continuity when it is not connected.



LOAD SENSING SPRING LENGTH CHECK AND ADJUSTMENT

E35FHAK

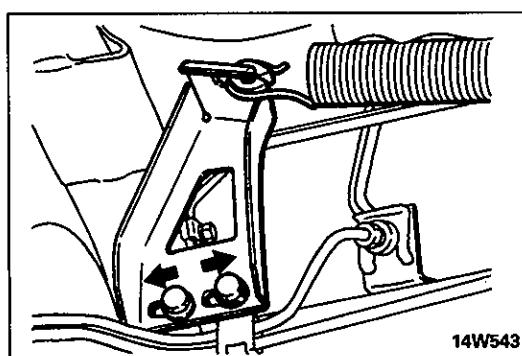
1. Park the vehicle on a level ground. The vehicle should be unloaded and supported only by wheels.

Caution

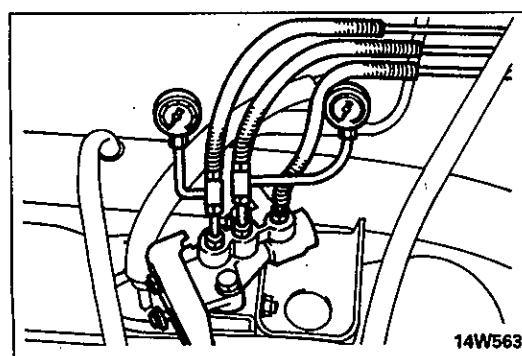
Never support the vehicle with jacks or other similar means.

2. With the lever pressed all the way to the load-sensing proportioning valve side, check whether or not the length (shown in the figure) of the spring (the length between its ends) is the standard value.

Standard value: 224–228 mm (8.8–9.0 in.)



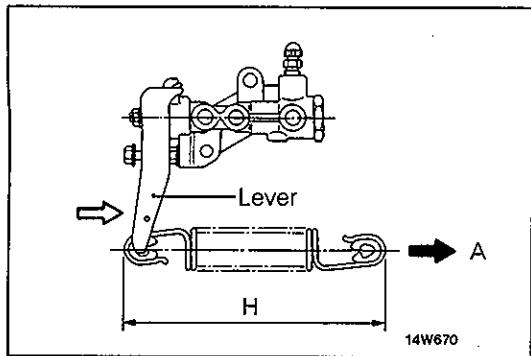
3. If the spring length is not within the standard value, loosen the bolt attaching the support and adjust the distance by moving the support.



LOAD SENSING PROPORTIONING VALVE FUNCTION TEST

E35FKAK

1. Connect pressure gauges to the input and output ports of the load sensing proportioning valve. Bleed the system.



2. Disconnect the spring at the support side.
3. Place the spring so that it is in parallel with the load-sensing proportioning valve, and then pull in the direction indicated by arrow A so that its length H shown in the figure (the length between its ends) is as noted below.

NOTE

At this time the lever is pressed all the way to the load-sensing proportioning valve side.

Check at this time whether or not the output fluid's pressure, relative to the load-sensing proportioning valve's input fluid pressure, is within the standard value.

Standard value:

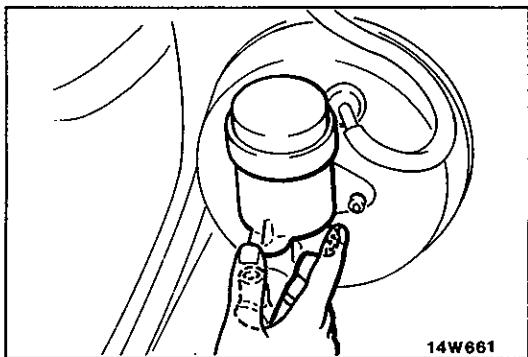
Items	Spring length H mm (in.)	Input fluid pressure MPa (kg/cm ² , psi)	Output fluid pressure MPa (kg/cm ² , psi)
2-door models	227.5 (9.0)	10 (100, 1422)	5.37–6.27 (53.7–62.7, 763.8–891.8)
		18 (180, 2560)	7.17–8.47 (71.7–84.7, 1019.8–1204.7)
4-door models	226.7 (8.9)	10 (100, 1422)	6.14–7.04 (61.4–70.4, 873.3–1001.3)
		18 (180, 2560)	7.94–9.24 (79.4–92.4, 1129.3–1314.2)

4. In the same manner as in step 3., check whether or not the output fluid's pressure, relative to the load-sensing proportioning valve's input fluid pressure, is within the standard value when the spring's length H is the dimension noted below.

Standard value:

Items	Spring length H mm (in.)	Input fluid pressure MPa (kg/cm ² , psi)	Output fluid pressure MPa (kg/cm ² , psi)
2-door models	255.6 (10.1)	18 (180, 2560)	13.1–15.1 (131–151, 1863.3–2147.7)
4-door models	257.7 (10.1)	18 (180, 2560)	10.4–12.4 (104–124, 1479.2–1763.7)

5. After making the check, install the spring. Disconnect the pressure gauges from the load-sensing proportioning valve and bleed the air.



BLEEDING

E35FYAJ

Caution

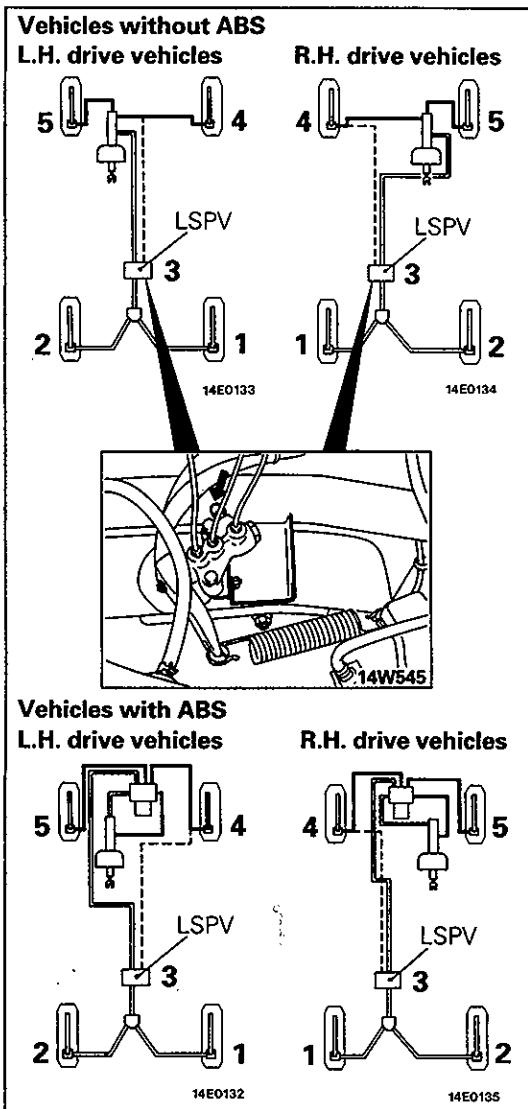
Use the specified brake fluid. Avoid using a mixture of the specified brake fluid and other fluid.

Specified brake fluid: DOT3 or DOT4

AIR BLEEDING OF THE MASTER CYLINDER

If there is no brake fluid in the master cylinder, bleed air from the master cylinder by following the steps below.

- (1) Supply brake fluid to the reservoir tank.
- (2) Depress and hold the brake pedal.
- (3) Another person should then plug the outlet of the master cylinder with a finger.
- (4) In the (3) condition, return the brake pedal.
- (5) Repeat steps (2) to (4) three or four times so as to supply brake fluid inside the master cylinder.



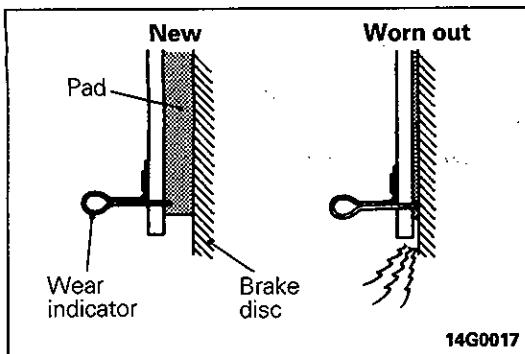
AIR BLEEDING OF THE BRAKE PIPE LINE

Bleed the brake system in the sequence shown in the illustration.

Furthermore, for vehicles with ABS, start the engine before bleeding the air.

Caution

When supplying brake fluid for vehicles with ABS, the filter should be installed to the master cylinder reserve tank.



DISC BRAKE PAD CHECK

E35FQAG

Check brake pad thickness through caliper body check port.

Standard valve:

10.0 mm (0.39 in.)

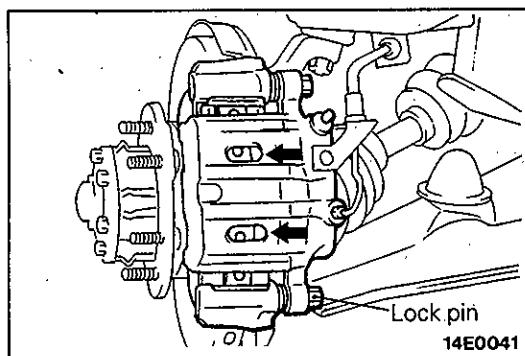
Limit:

2.0 mm (0.079 in.)

Replace brake pads on both sides when wear exceeds limit value. Replace both left and right brake pads at a time.

NOTE

The brake pads have been equipped with wear indicator, so that when the brake pad thickness reaches 2 mm (0.08 in.), the wear indicator touches the brake disc and produces a warning squeaking sound.



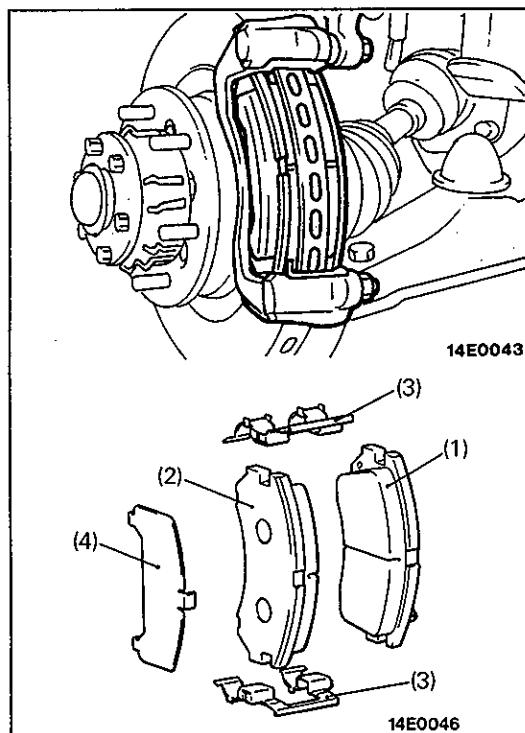
FRONT DISC BRAKE PAD REPLACEMENT AND BRAKE DRAG CHECK

E35FQBA

1. Remove lock pin. Lift caliper assembly and retain with wires.

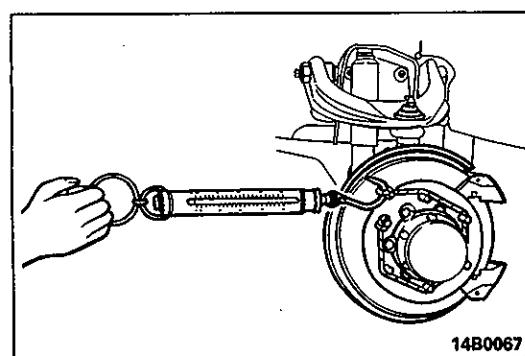
Caution

Do not wipe off the special grease that is on the lock pin or allow it to contaminate the lock pin.



2. Remove the following parts from caliper support.

- (1) Pad and wear indicator assembly
- (2) Pad assembly
- (3) Clip
- (4) Outer shim

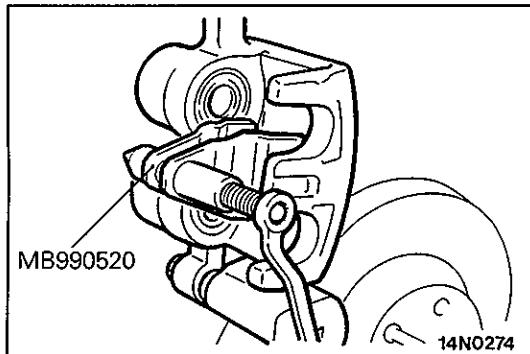


3. In order to measure the dragging force of the disc brakes after installation of the brake pads, use a spring balance to measure the rotational sliding resistance of the hub in the forward direction with the pads removed.

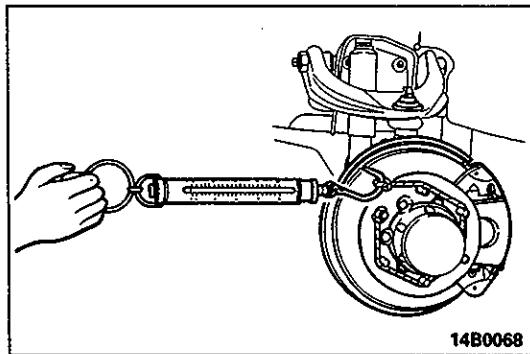
4. Securely attach the pad clip to the caliper support.

Caution

Do not deposit grease or other dirt on pad or brake disc friction surfaces.



5. Clean piston and insert into cylinder with special tool. Be careful that the piston boot does not become caught, when lowering the caliper assembly and install the lock pin.



6. Start the engine and, after strongly depressing the brake pedal 2-3 times, stop the engine.
7. Turn brake disc forward 10 times.
8. Use a spring balance to measure the rotational sliding resistance of the hub in the forward direction.
9. Calculate the dragging force of the disc brakes (the difference between the values measured in steps 8 and 3).

Standard value: 57N (5.7 kg. 13 lbs.) or less

10. If the dragging force of the disc brakes exceeds the standard value, disassemble piston and clean the piston. Check for corrosion or worn piston seal, and check the sliding condition of the lock pin sleeve and guide pin sleeve.

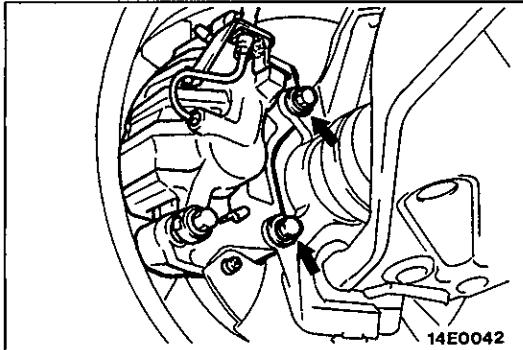
FRONT DISC BRAKE ROTOR INSPECTION

CAUTION

When servicing disc brakes, it is necessary to exercise caution to keep the disc brakes within the allowable service values in order to maintain normal brake operation.

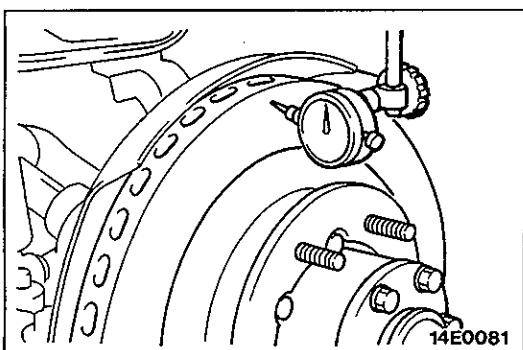
Before re-finishing or re-processing the brake disc surface, the following conditions should be checked.

Inspection items	Remarks
Scratches, rust, saturated lining materials and wear	<ul style="list-style-type: none"> • If the vehicle is not driven for a certain period, the sections of the discs that are not in contact with lining will become rusty, causing noise and shuddering. • If grooves resulting from excessive disc wear and scratches are not removed prior to installing a new pad assembly, there will momentarily be inappropriate contact between the disc and the lining (pad).
Run-out or drift	Excessive run-out or drift of the discs will increase the pedal depression resistance due to piston knock-back.
Change in thickness (parallelism)	If the thickness of the disc changes, this will cause pedal pulsation, shuddering and surging.
Inset or warping (flatness)	Overheating and improper handling while servicing will cause inset or warping.



FRONT BRAKE DISC RUN-OUT CHECK

1. Remove the caliper support; then raise the caliper assembly upward and secure by using wire.



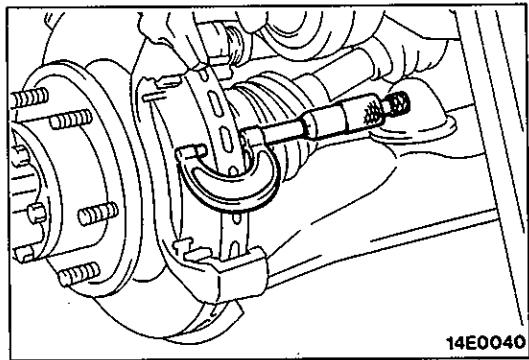
2. Place a dial gauge approximately 5 mm (.2 in.) from the outer circumference of the brake disc, and measure the run-out of the disc.

Limit: 0.1 mm (0.0039 in.)

If the measurement exceeds the limit, change the relative position of the hub and brake disc, and measure the run-out again. If the result still does not fall within the limit, check the run-out of the hub, and replace either the hub or disc, whichever is appropriate.

FRONT BRAKE DISC RUN-OUT CORRECTION

1. If the run-out of the brake disc is equivalent to or exceeds the limit specification, change the phase of the disc and hub, and then measure the run-out again. (Refer to P. 35-44)
2. If the run-out cannot be corrected by changing the phase of the brake disc, replace the disc or turn rotor with on the car type brake lathe ("MAD, DL-8700PF" or equivalent).

**FRONT BRAKE DISC THICKNESS CHECK**

E35FRAB

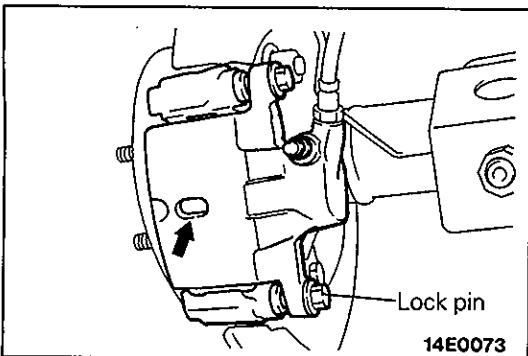
1. Inspect the disc surface for grooves, cracks, and rust. Clean the disc thoroughly and remove all rust.
2. Using a micrometer, measure disc thickness at eight positions, approximately 45° apart and 10 mm (0.39 in.) in from the outer edge of the disc.

Standard value: **24 mm (0.94 in.) <Except 3500>**
 27 mm (1.01 in.) <3500>

Limit: **22.4 mm (0.882 in.) <Except 3500>**
 25.4 mm (1.0 in.) <3500>

The difference between any thickness measurements should not be more than 0.015 mm (0.0006 in.)

3. Replace the discs and pad assembly for both sides left and right of the vehicle if they are beyond the limits for thickness.
4. If thickness variation exceeds the specification, replace the disc or turn rotor with on the car type brake lathe ("MAD, DL-8700PF" or equivalent).



REAR DISC BRAKE PAD CHECK AND REPLACEMENT

E35FUAC

1. Check brake pad thickness through caliper body check port.

Standard value: **9.0 mm (0.35 in.)**
Limit: **2.0 mm (0.079 in.)**

Caution

1. When the limit is exceeded, replace the pads at both sides, and also the brake pads for the wheels on the opposite side at the same time.
2. If there is a significant difference in the thicknesses of the pads on the left and right sides, check the sliding condition of the piston, lock pin sleeve and guide pin sleeve.

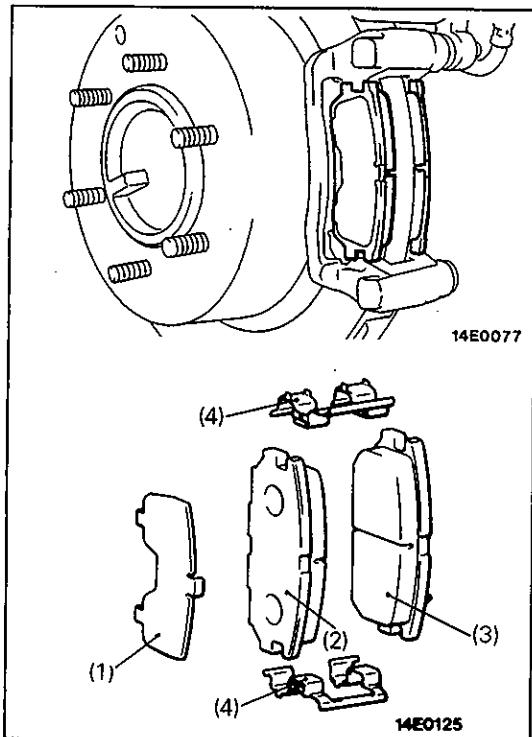
2. Remove lock pin. Lift caliper assembly and retain with wires.

Caution

Do not wipe off the special grease that is on the lock pin or allow it to contaminate the lock pin.

3. Remove the following parts from caliper support.

- (1) Outer shim
- (2) Pad assembly
- (3) Pad and wear indicator assembly
- (4) Clip



4. In order to measure the dragging force of the disc brakes after installation of the brake pads, use a spring balance to measure the rotational sliding resistance of the hub in the forward direction with the pads removed

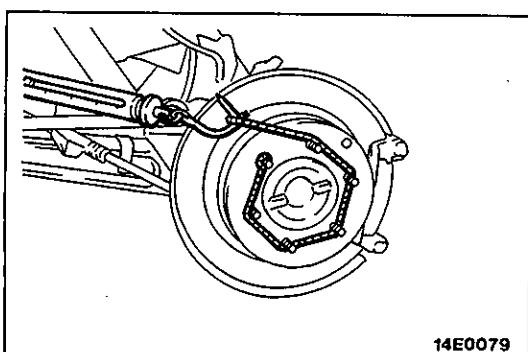
NOTE

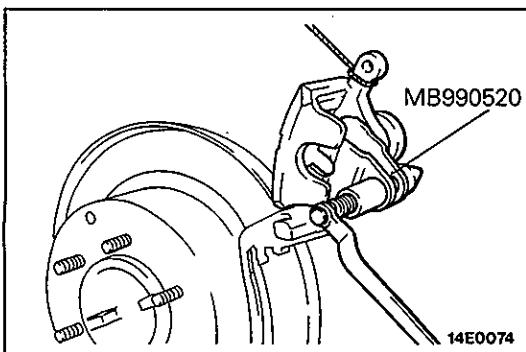
To secure the disc to the hub, tighten the nuts.

5. Securely attach the pad clip to the caliper support.

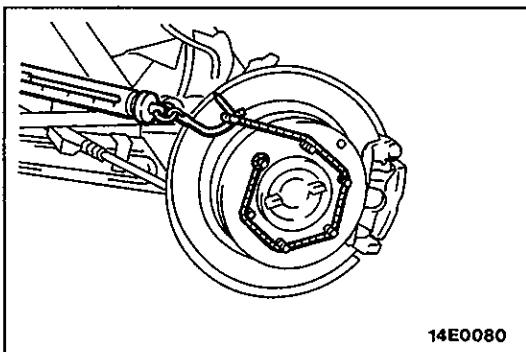
Caution

Do not deposit grease or other dirt on pad or brake disc friction surfaces.





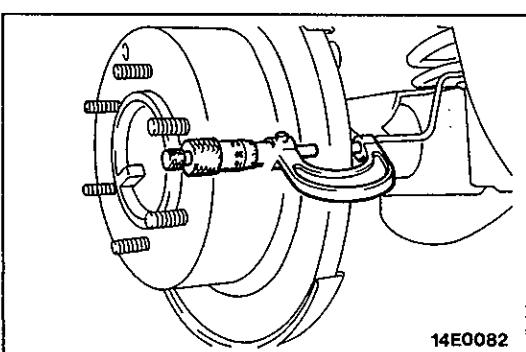
6. Clean piston and insert into cylinder with special tool. Be careful that the piston boot does not become caught, when lowering the caliper assembly and install the lock pin.



7. Start the engine and, after strongly depressing the brake pedal 2-3 times, stop the engine.
8. Turn brake disc forward 10 times.
9. Use a spring balance to measure the rotational sliding resistance of the hub in the forward direction.
10. Calculate the dragging force of the disc brakes (the difference between the values measured in steps 9 and 4).

Standard value: 57N (5.7 kg. 13 lbs.) or less

11. If the dragging force of the disc brakes exceeds the standard value, disassemble piston and clean the piston. Check for corrosion or worn piston seal, and check the sliding condition of the lock pin sleeve and guide pin sleeve.



REAR BRAKE DISC THICKNESS CHECK

E35FVAB

1. Remove dirt and rust from brake disc surface.
2. Measure disc thickness at 4 locations or more.

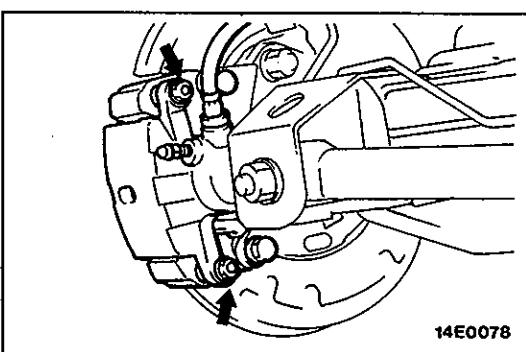
Standard value:

18.0 mm (0.71 in.)

Limit:

16.4 mm (0.646 in.)

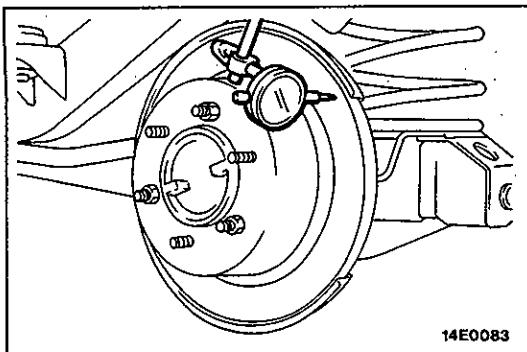
Replace the discs and pad assembly for both sides left and right of the vehicle if they are worn beyond the specified limit.



REAR BRAKE DISC RUN-OUT CHECK

E35PWAB

1. Remove the caliper support, raise the caliper assembly, and secure it by using a wire, etc.



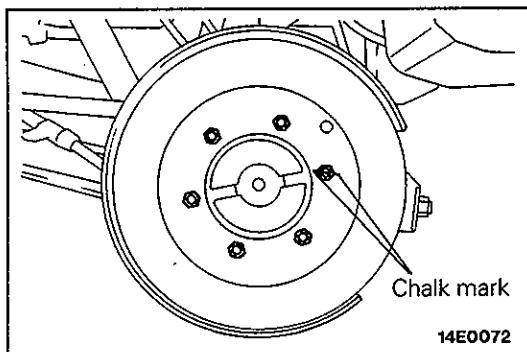
14E0083

2. Place a dial gauge approximately 5 mm (0.2 in.) from the outer circumference of the brake disc, and measure the run-out of the disc.

Limit: 0.08 mm (0.0031 in.)

NOTE

To secure the disc to the hub, tighten the nuts.



14E0072

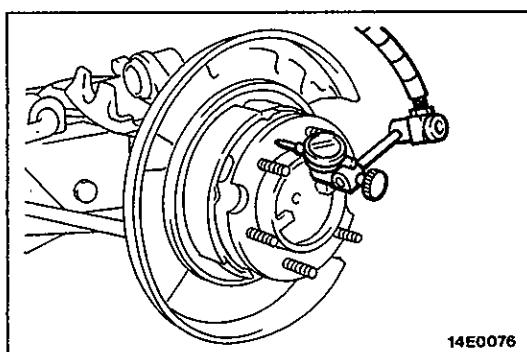
REAR BRAKE DISC RUN-OUT CORRECTION

E35FTAAa

1. If the run-out of the brake disc is equivalent to or exceeds the limit specification, change the phase of the disc and axle shaft and then measure the run-out again.
(1) Before removing the brake disc, chalk both sides of the wheel stud on the side at which run-out is greatest.

- (2) Remove the brake disc, and then place a dial gauge, then move the hub in the axial direction and measure the play.

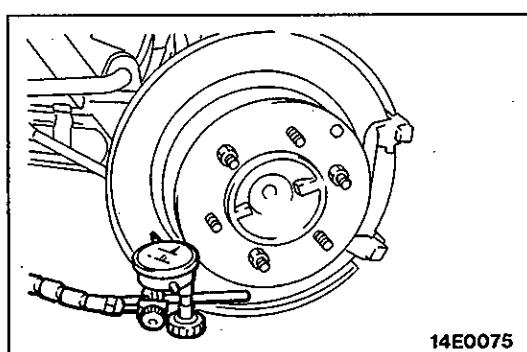
Limit: 0.25 mm (0.0098 in.) or less



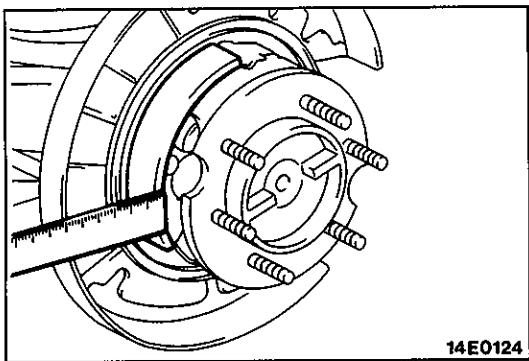
14E0076

- (3) If the play does not exceed the limit specification, install the brake disc at a different phase, and then check the run-out of the brake disc once again.

2. If the runout cannot be corrected by changing the phase of the brake disc, replace the disc.



14E0075

**BRAKE LINING THICKNESS CHECK**

E35FFAA

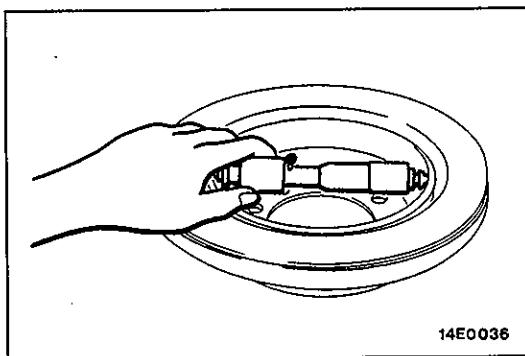
1. Remove the rear brake assembly and secure it with wire.
2. Remove the brake drum.
3. Measure the wear of the brake lining at the place worn the most.

Standard value:**6.5 mm (0.256 in.)****Limit:****4.5 mm (0.177 in.)**

Replace the shoe and lining assembly if brake lining thickness is less than the limit if it is not worn evenly. For information concerning the procedures for installation of the shoe and lining assembly, refer to GROUP 36 - Parking Brake Drum.

Caution

1. Whenever the shoe and lining assembly is replaced, replace both RH and LH assemblies as a set to prevent car from pulling to one side when braking.
2. If there is a significant difference in the thicknesses of the shoe and lining assemblies on the left and right sides, check the sliding condition of the piston.

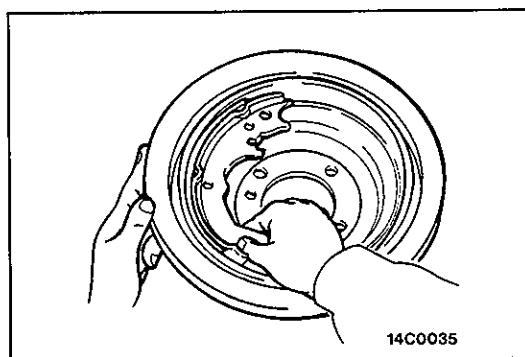
**BRAKE DRUM INSIDE DIAMETER CHECK**

E35FGAA

1. Remove the rear brake assembly and secure it with wire.
2. Remove the brake drum.
3. Measure the inside diameter of the brake drum at two or more locations.

Standard value:**197 mm (7.76 in.)****Limit:****198 mm (7.8 in.)**

4. Replace brake drums and shoe and lining assembly when wear exceeds the limit value or is badly imbalanced.

**BRAKE LINING AND BRAKE DRUM CONNECTION CHECK**

E35FIAA

1. Remove the rear brake assembly and secure it with wire.
2. Remove the brake drum.
3. Remove the shoe and lining assembly, refer to GROUP 36 - Parking Brake Drum.
4. Chalk inner surface of brake drum and rub with shoe and lining assembly.
5. Replace shoe and lining assembly or brake drums if very irregular contact area.
6. For information concerning the procedures for installation of the shoe and lining assembly, refer to GROUP 36 - Parking Brake Drum.

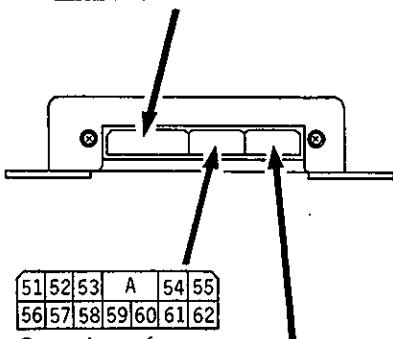
NOTE

Wipe off chalk after check.

<Vehicles built up to May, 1994>

Rear view of harness-side connector

1	2	3	4	A	5	6	7	8
9	10	11	12	13	14	15	16	17



Rear view of harness-side connector

101	102	A	103	104	105
106	107	108	109	110	111

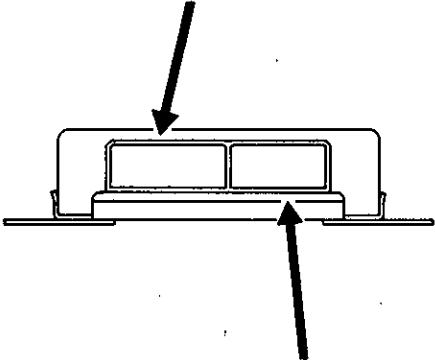
Rear view of harness-side connector

14E0085

<Vehicles built from June, 1994>

Rear view of harness-side connector

1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	26



Rear view of harness-side connector

14E0204

WHEEL SPEED SENSOR OUTPUT VOLTAGE MEASUREMENT <A.B.S.>

E35FPAR

1. Check that the clearance between the wheel speed sensor and the rotor are within the standard values.
2. Raise up the wheels and release the parking brake.
3. Remove the ABS-ECU harness connector and measure from the harness-side connector.

Caution

Be sure to remove the connector double lock and insert the probe into the harness side. Inserting it into the terminal side will result in a bad connection.

4. Rotate the wheel by hand to be measured at approximately 1/2 – 1 rotations per second and check the output voltage using a voltmeter (AC mV range) or an oscilloscope.

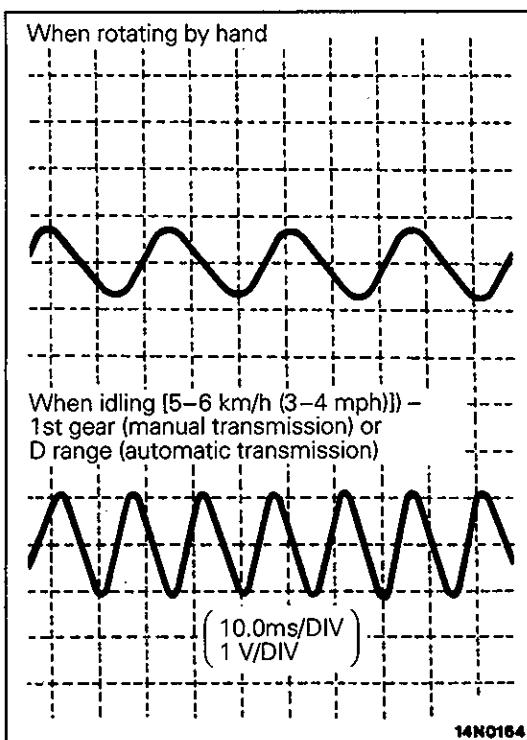
<Terminal no. >**[Vehicles built up to May, 1994]**

Polarity	Front LH	Front RH	Rear LH	Rear RH
+	52	51	8	53
-	57	56	18	58

[Vehicles built from June, 1994]

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

Output voltage:**When measuring with a voltmeter:****70mV or more****When measuring with an oscilloscope:****200mVp-p or more**



- If the output voltage is lower than the above values, the reason could be as follows:
 - Excessive clearance between the wheel speed sensor pole piece and the rotor
 - Wheel speed sensor is defective
 If necessary, adjust the wheel speed sensor or replace it.
- Next, to observe the output of the wheel speed sensors, move the transfer shift lever to "4H", and the transmission control lever to "1" (M/T vehicles) or "D" range (A/T vehicles), and rotate the wheels.

NOTE

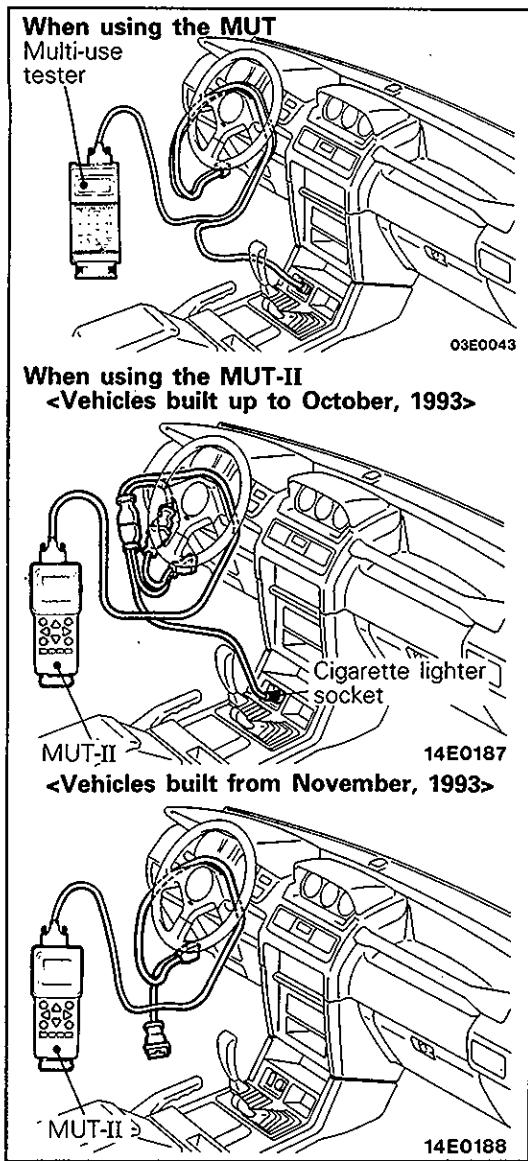
- Check the connection of the sensor harness and connector before using the oscilloscope
- The wave form measurements can also be taken while the vehicle is actually moving.
- The output voltage will be small when the wheel speed is low, and similarly it will be large when the wheel speed is high.

WAVE OBSERVATION POINTS

Symptom	Cause	Suggested remedy
Wave amplitude is too small, or doesn't appear at all	Wheel speed sensor is defective	Replace the sensor
	Wrong clearance between the pole piece and rotor	Adjust the clearance
Excessive variation in the wave amplitude (However, if the lowest amplitude occurs at 200mV-p-p, there is no problem)	Excessive runout or eccentricity in the axle hub	Replace the hub
Noise or interference in the wave pattern	Broken sensor wire	Replace the sensor
	Broken harness wire	Repair the harness
	Defective wheel speed sensor attachment	Repair the sensor attachment
	Eccentric rotor or broken rotor teeth	Replace the rotor

NOTE

As the wheel speed sensor harness move in conjunction with the movement of the front and rear suspension, the wires might break while driving on rough roads, but may have continuity while driving on normal roads. Accordingly, when measuring the wave pattern of the wheel speed sensor output voltage, take a measurement while shaking the sensor harness to simulate the special conditions of a rough road.



HYDRAULIC UNIT CHECK <ABS>

E35FPAS

1. Jack up the vehicle and support it on axle stands.
2. Release the parking brake and feel the drag force (drag torque) on each wheel brake.
3. Turn the ignition key to the ACC position and set the multi-use tester or MUT-II as shown in the illustration.
4. After checking that the selector lever is in neutral, start the engine.

Caution
At this time, check that the ABS warning lamp illuminates for a brief period before turning off. If it doesn't turn off, refer to the "Troubleshooting" section (P.35-6).

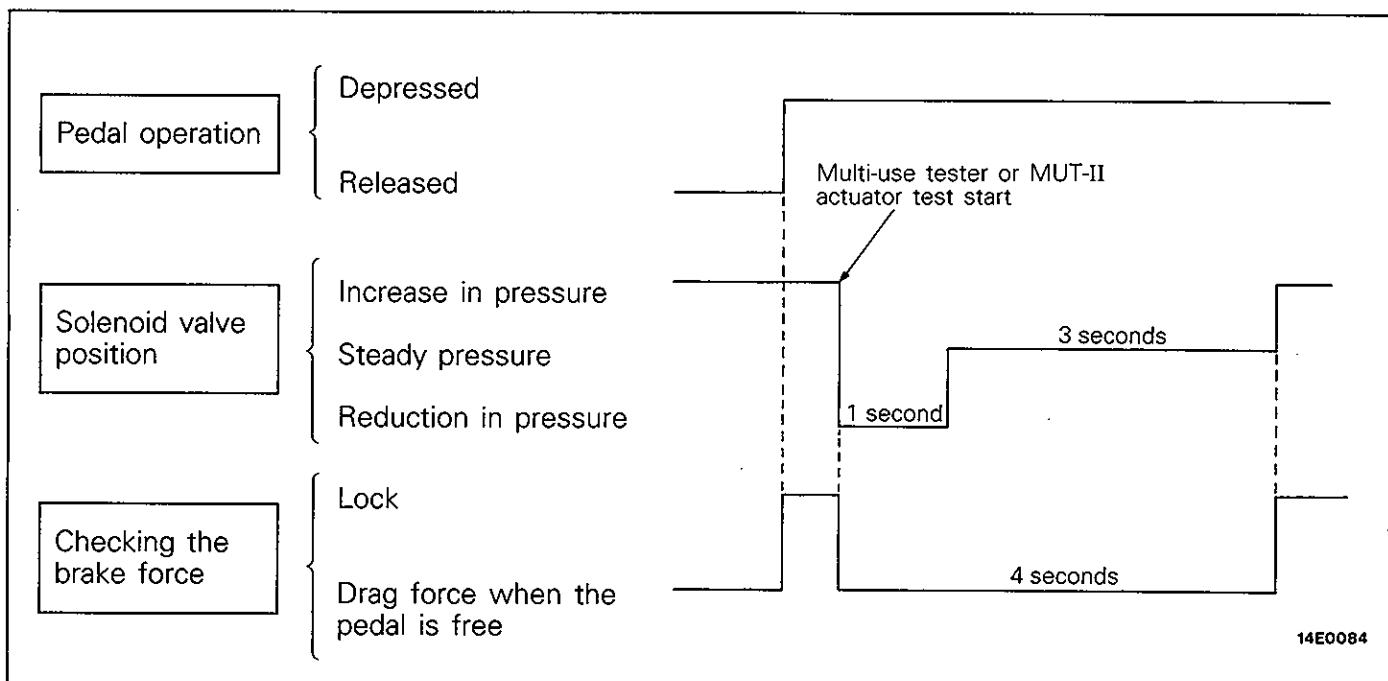
5. Depress the brake pedal to lock the wheels.
6. Select the item number on the multi-use tester actuator test for the wheel to be inspected.

Item no.	Drive object	
01	Front left wheel	Solenoid valve and pump monitor in the hydraulic unit corresponding to each wheel at left
02	Front right wheel	
03	Rear wheels	

7. Use the multi-use tester or MUT-II to force-drive the actuator, and turn the wheel by hand to check the change in braking force when the brake pedal is depressed. The result should be as shown in the following illustration.

NOTE

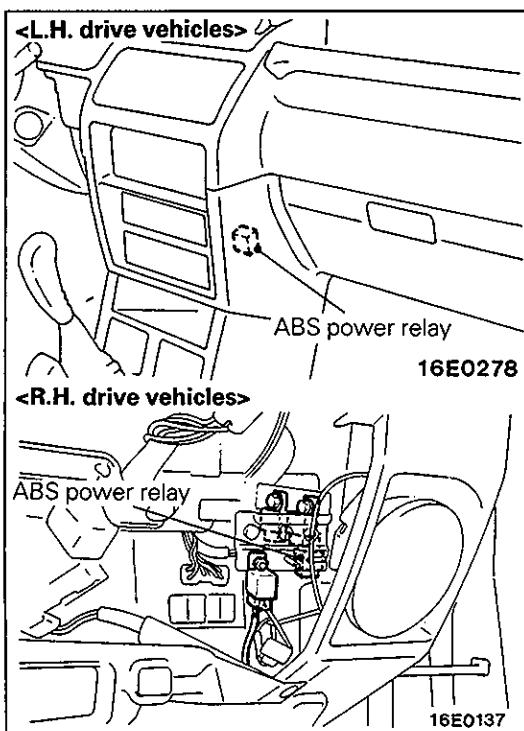
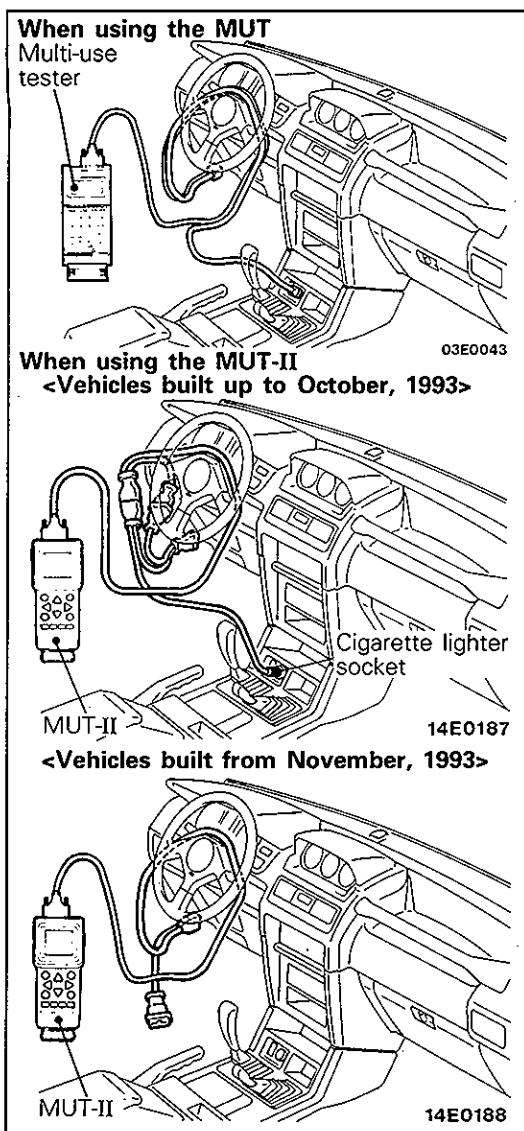
1. When the multi-use tester or MUT-II is used and the ABS system is selected, the ABS system will switch to multi-use tester mode and the ABS warning lamp will illuminate.
2. When the ABS function has been interrupted by the fail-safe, the multi-use tester or MUT-II actuator testing cannot be used.



8. If a different result is obtained when checking, correct it by following the procedure in the "Diagnosis Table for Simple Inspection" below.

Diagnosis Table for Simple Inspection

Diagnosis		Cause	Suggested remedy
Normal	Problem		
After locking for a 4 second period, the braking force will release.	The wheel will not lock even when the pedal is depressed.	Blockage in the brake line outside the hydraulic unit	Inspect the brake line and clean
		Blockage in the oil pressure circuit in the hydraulic unit	Replace the hydraulic unit
	Braking force does not release.	Hydraulic unit brake pipes are incorrectly connected	Connect correctly
		Hydraulic unit solenoid valve is defective	Replace the hydraulic unit



G-SENSOR OUTPUT VOLTAGE CHECK <A.B.S. >

E35FPAT

1. Unload the vehicle and move it to a horizontal surface.
2. Turn the ignition key to the ACC position and connect the multi-use tester or MUT-II as shown in the illustration.

Caution

Make certain that the ignition switch is OFF when the multi-use tester or MUT-II is connected or disconnected.

3. Start the engine.

Caution

At this time, check that the ABS warning lamp momentarily illuminates before turning off. If it does not turn off, refer to "Troubleshooting" (P.35-6).

4. Check whether the G-sensor output voltage is within the standard value range.

Standard value: 2.5 ± 0.44 V

<Vehicles built up to October, 1993>

2.5 ± 0.12 V

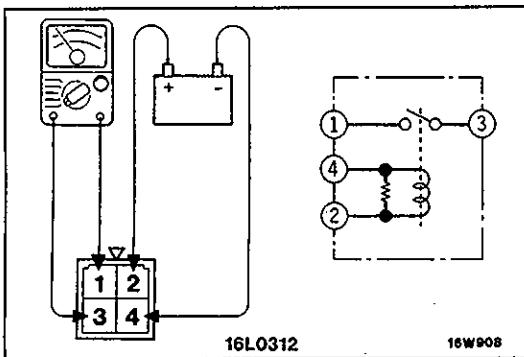
<Vehicles built from November, 1993>

5. If the G-sensor output voltage is not within the standard value range, check the installation condition of the G sensor; if there is bolt loose, deformation of the G-sensor bracket, etc., repair it. If the problem is not repairable, replace the G sensor.

A.B.S. POWER RELAY CHECK <A.B.S. >

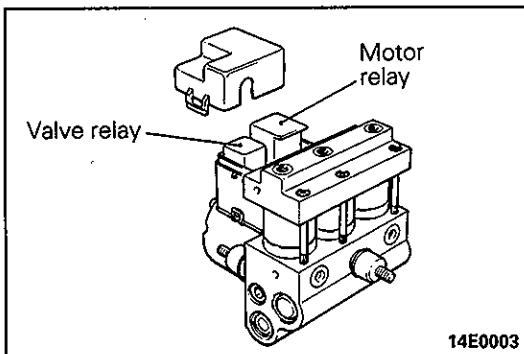
E35FPAAe

1. Remove the A.B.S. power relay.



2. Connect battery to terminal 2 and check continuity between terminals with terminal 4 earthed.

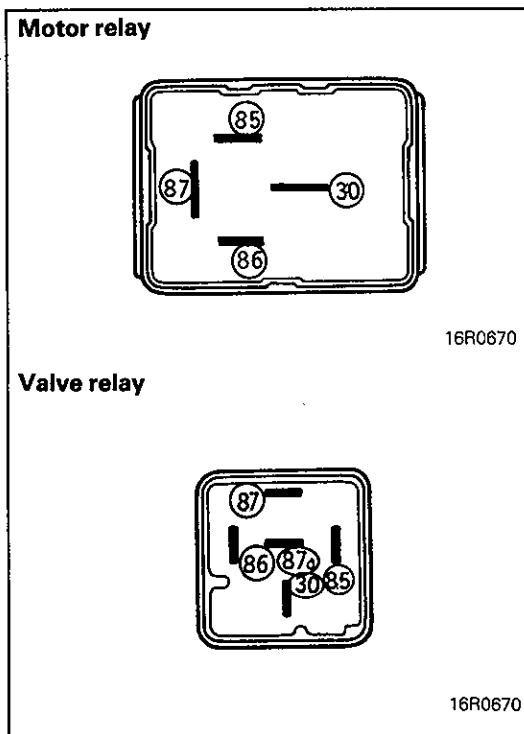
Power is supplied	1–3 terminals	Continuity
Power is not supplied	1–3 terminals	No continuity
	2–4 terminals	Continuity



VALVE RELAY AND MOTOR RELAY CHECK <ABS> [Vehicles built up to May, 1994]

E35FPAU

1. Remove the motor relay and valve relay from the hydraulic unit.



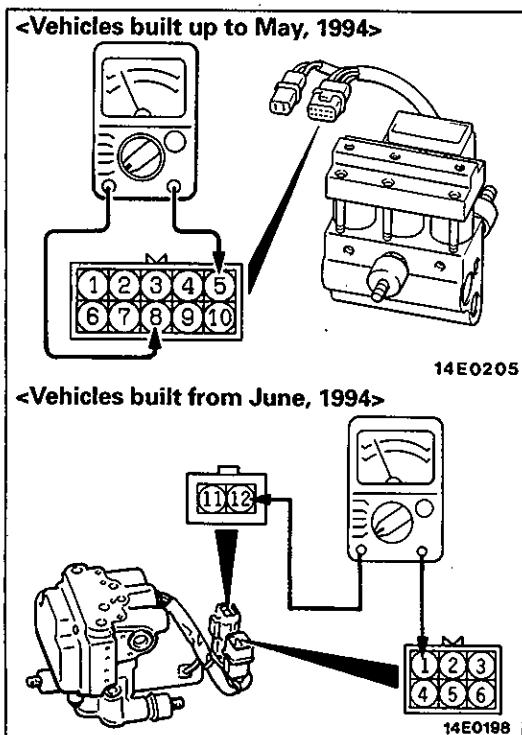
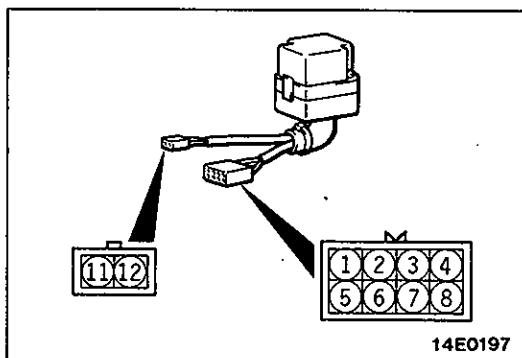
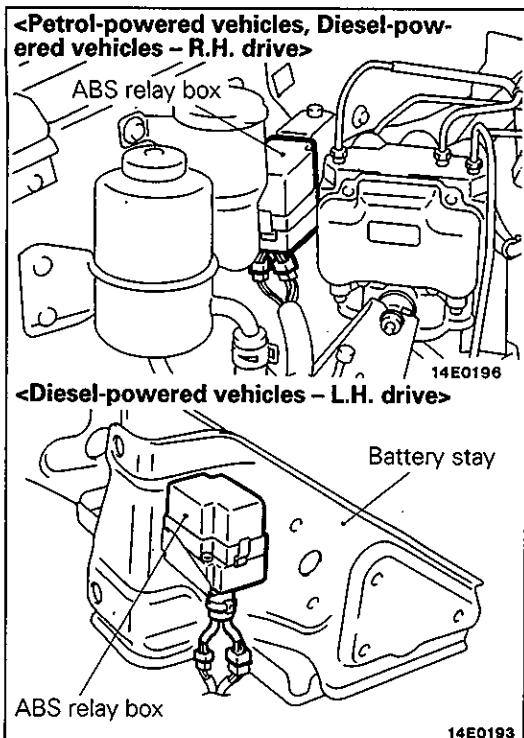
2. Check whether there is continuity between terminals when there is no current flow at each relay and when there is current flow.

MOTOR RELAY

When no current flows	Between terminals 85–86	30–60 Ω
	Between terminals 30–87	No continuity ($\infty \Omega$)
When current flows between terminal 85–86	Between terminals 30–87	Continuity (approx. 0 Ω)

VALVE RELAY

When no current flows	Between terminals 85–86	60–120 Ω
	Between terminals 30–87a	Continuity (approx. 0 Ω)
	Between terminals 30–87	No continuity ($\infty \Omega$)
When current flows between terminal 85–86	Between terminals 30–87a	No continuity ($\infty \Omega$)
	Between terminals 30–87	Continuity (approx. 0 Ω)



ABS RELAY BOX CHECK <ABS> [Vehicles built from June, 1994]

Disconnect the ABS relay box connector and check for continuity at the connector side.

When no current flows	Between terminals (7) – (4)	72 – 88 Ω
	Between terminals (7) – (8)	93 – 113 Ω
	Between terminals (11) – (12)	No continuity ($\infty \Omega$)
	Between terminals (6) – (2)	No continuity ($\infty \Omega$)
	Between terminals (5) – (2)	No continuity (approx. 0 Ω)
When current flows between terminals (7) – (4)	Between terminals (11) – (12)	Continuity (approx. 0 Ω)
When current flows between terminals (7) – (8)	Between terminals (5) – (2)	No continuity ($\infty \Omega$)
	Between terminals (6) – (2)	Continuity (approx. 0 Ω)

SOLENOID VALVE CHECK <ABS>

Measure the resistance between terminals.

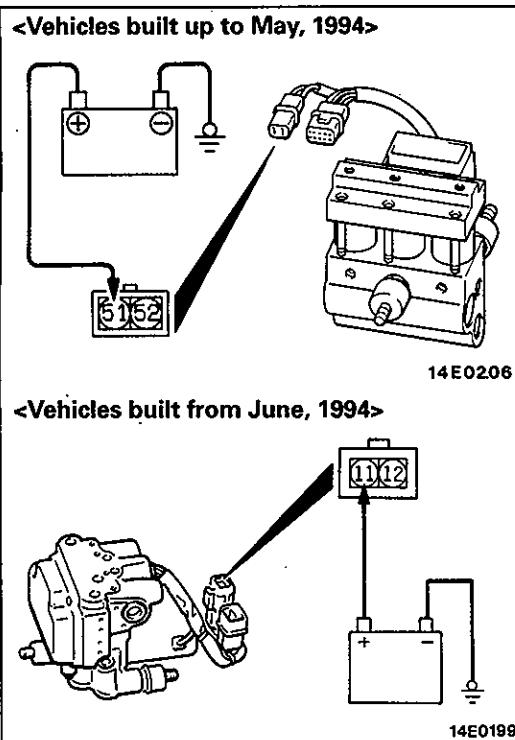
Standard value:

<Vehicles built up to May, 1994>

Solenoid valve	Measurement terminal	Resistance between terminals
Front (right)	8 – 5	
Front (left)	8 – 3	1.0 – 1.3 Ω
Rear	8 – 6	

<Vehicles built from June, 1994>

Solenoid valve	Measurement terminal	Resistance between terminals
Front OUT (right)	12 – 4	3.8 Ω
Front OUT (left)	12 – 5	
Rear OUT	12 – 6	
Front IN (right)	12 – 1	8.2 Ω
Front IN (left)	12 – 2	
Rear IN	12 – 3	

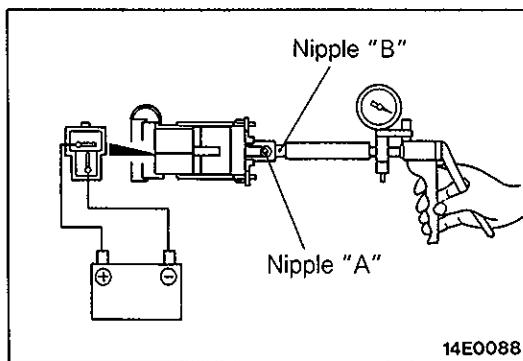
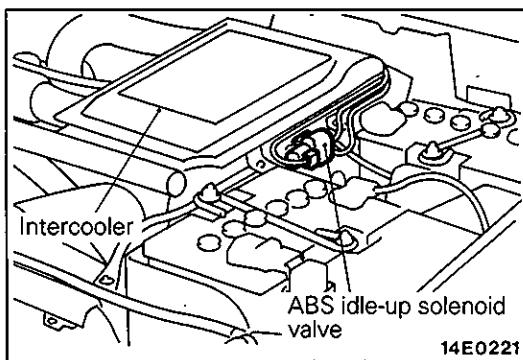


MOTOR OPERATION CHECK <ABS>

Connect the battery and check to be sure that the sound of the hydraulic unit motor operating can be heard.

Caution

The battery power should not be applied for more than 1 second.



ABS IDLE-UP SOLENOID VALVE CHECK < DIESEL-POWERED VEHICLES – M/T > [Vehicles built from June, 1994]

NOTE

When disconnecting the vacuum hose, always make a mark so that the hose can be reconnected at original position.

1. Remove the idle-up solenoid valve from the intercooler.
2. Connect a hand vacuum pump to the nipple "A".
3. Check airtightness by applying a vacuum with voltage applied directly from the battery to the solenoid valve terminal and without applying voltage.

Battery voltage	Solenoid valve nipple "B"	Normal condition
Applied	Open	Vacuum leaks
	Blocked with finger	Vacuum maintained
Not applied	Open	Vacuum maintained

ABS IDLE-UP SOLENOID VALVE CHECK < DIESEL-POWERED VEHICLES – M/T > [Vehicles built up to May, 1994]
NOTE

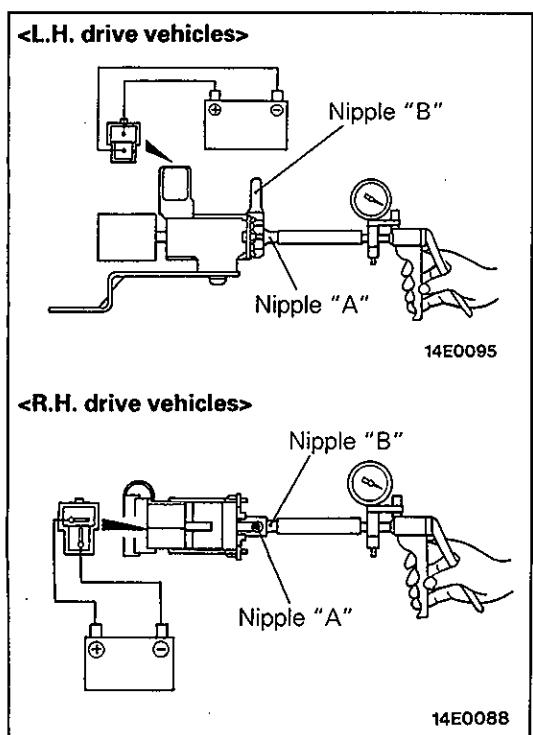
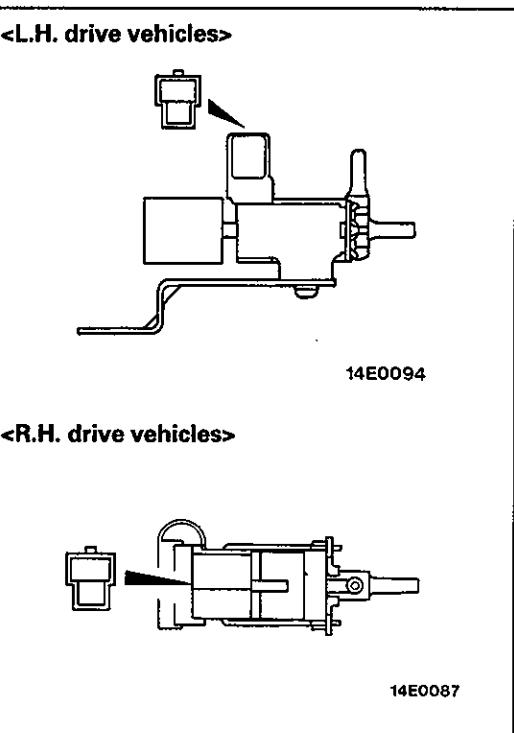
When disconnecting the vacuum hose, always make a mark so that the hose can be reconnected at original position.

1. Remove the idle-up solenoid valve from the hydraulic unit.

2. Measure the resistance between the solenoid valve terminals.

Standard value:

<L.H. drive vehicles>	38–44 Ω
<R.H. drive vehicles>	33–39 Ω

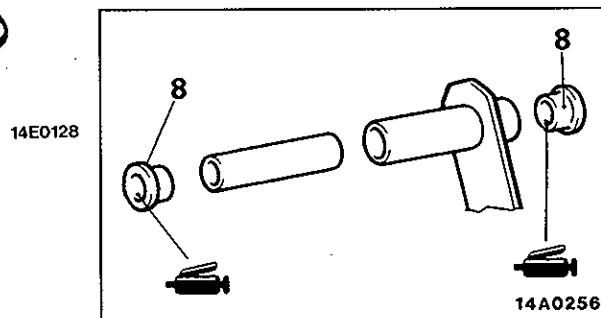
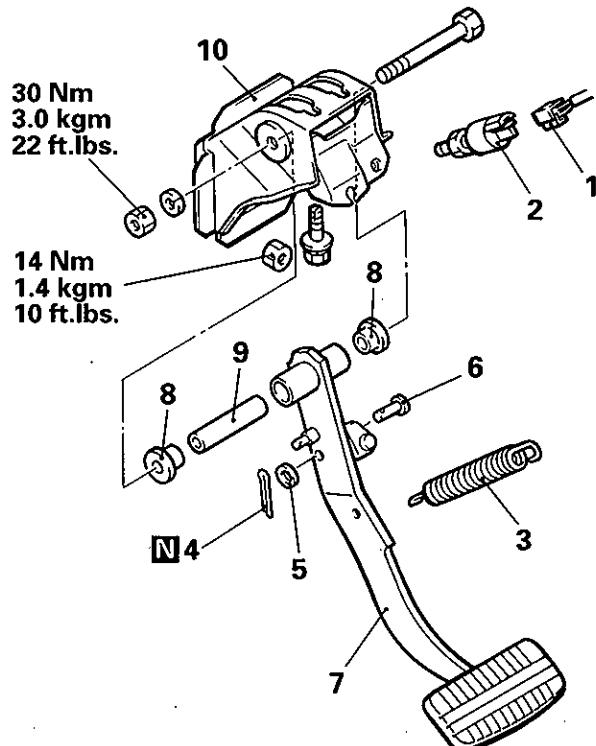


3. Connect a hand vacuum pump to the nipple "A".
4. Check airtightness by applying a vacuum with voltage applied directly from the battery to the solenoid valve terminal and without applying voltage.

Battery voltage	Solenoid valve nipple "B"	Normal condition
Applied	Open	Vacuum leaks
	Blocked with finger	Vacuum maintained
Not applied	Open	Vacuum maintained

BRAKE PEDAL**REMOVAL AND INSTALLATION****Post-installation Operation**

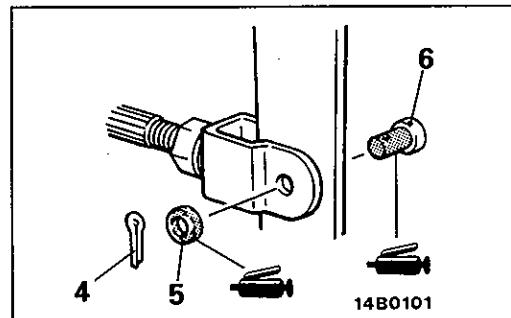
- Adjustment of Brake Pedal
(Refer to P.35-37.)

**Removal steps of stop lamp switch**

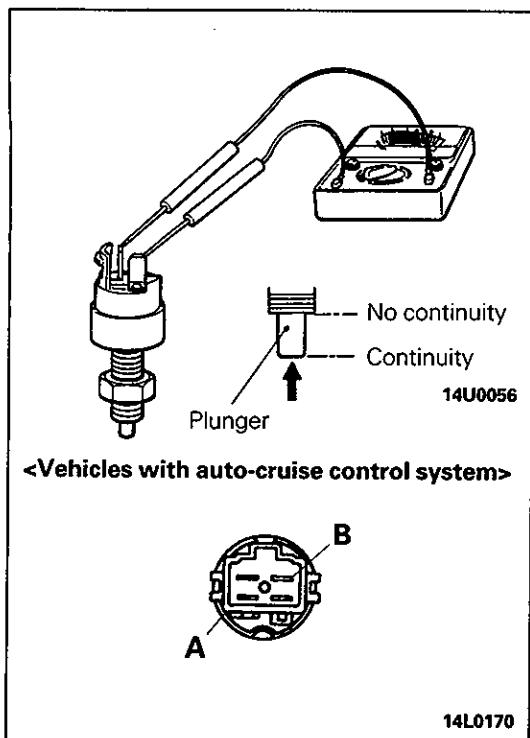
1. Stop lamp switch connector
2. Stop lamp switch

Removal steps of brake pedal

3. Return spring
4. Split pin
5. Washer
6. Clevis pin
7. Brake pedal
8. Bushing
9. Spacer
10. Pedal support member

**Removal steps of pedal support member**

2. Stop lamp switch
7. Brake pedal
10. Pedal support member

**INSPECTION**

E35GCAE

STOP LAMP SWITCH

The stop lamp switch is in good condition if there is no continuity when the plunger is pressed in, and if there is continuity when the plunger is released outward.

For models equipped with auto-cruise control system, check for continuity at stop lamp switch connectors A and B.

MASTER CYLINDER AND BRAKE BOOSTER

REMOVAL AND INSTALLATION

E35JA--

Pre-removal Operation

- Draining of Brake Fluid

Post-installation Operation

- (1) Draining of Brake Fluid and Bleeding of Air (Refer to P.35-41.)
- (2) Adjustment of Brake Pedal (Refer to P.35-37.)

Brake pipe flare nut

.15 Nm
1.5 kgm
11 ft.lbs.

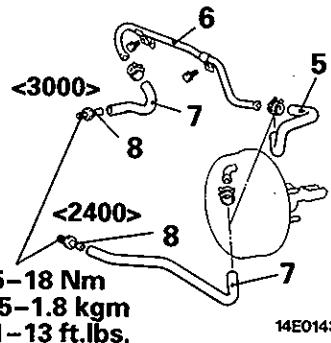


Removal steps of master cylinder

1. Brake fluid level sensor connector
2. Brake pipe
3. Connector <Vehicles without ABS>
4. Master cylinder

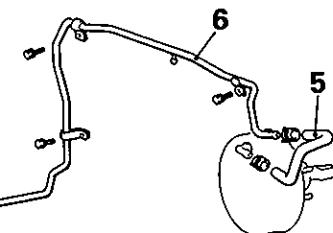
➡➡ • Clearance check and adjustment between primary piston and push rod

<Petrol-powered vehicles>



<Diesel-powered vehicles>

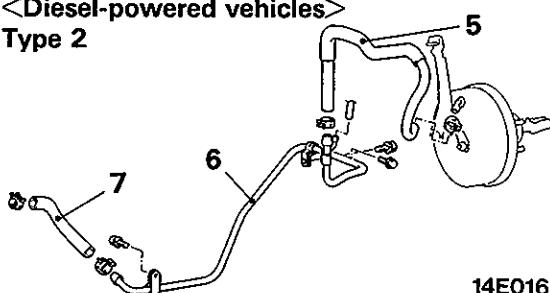
Type 1



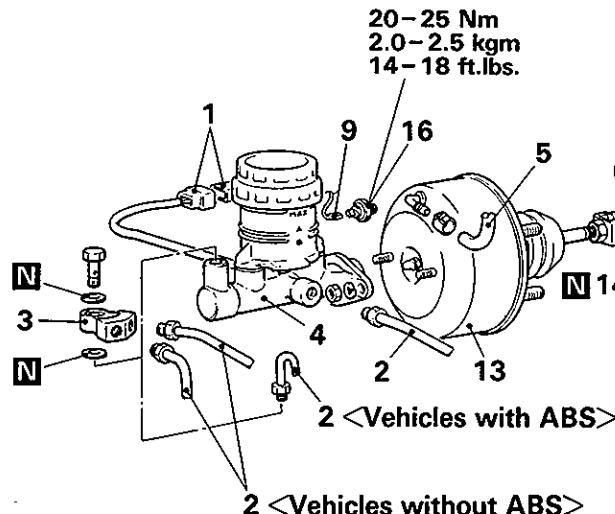
14E0144

<Diesel-powered vehicles>

Type 2



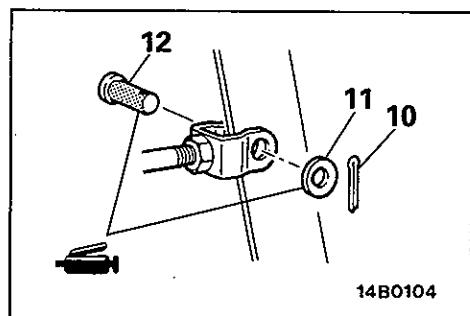
14E0168



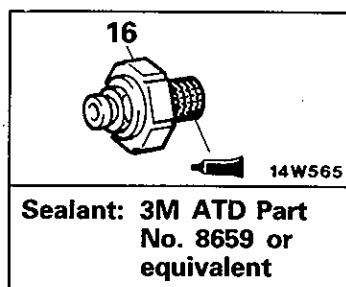
14E0130

Removal steps of brake booster

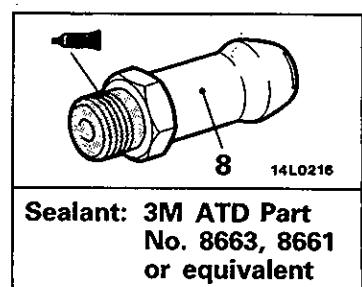
➡➡ 4. Master cylinder
5. Vacuum hose (with built-in check valve)
➡➡ 6. Vacuum pipe
➡➡ 7. Vacuum hose
8. Fitting
9. Vacuum switch connector
10. Split pin
11. Washer
12. Clevis pin
13. Brake booster
14. Sealer
15. Spacer
16. Vacuum switch



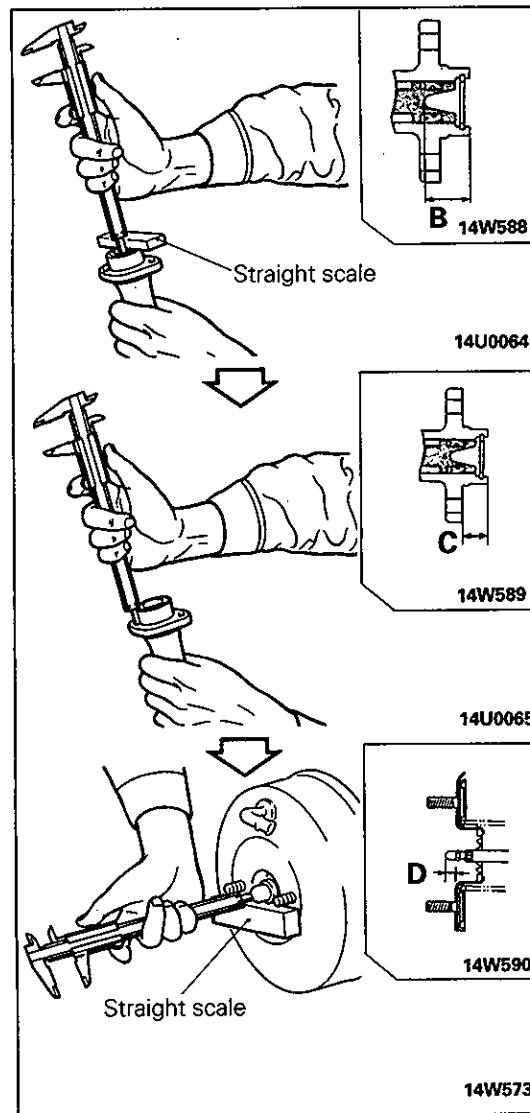
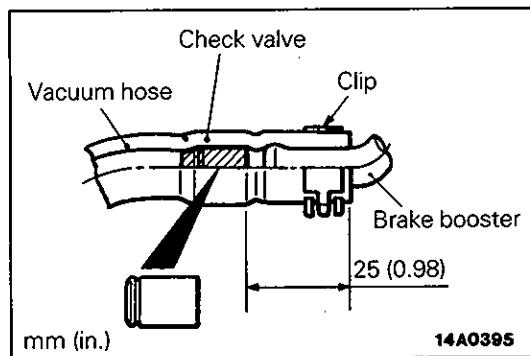
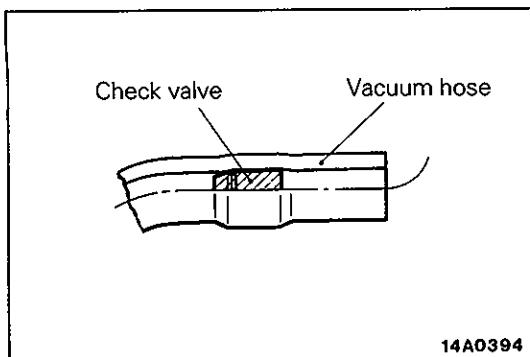
14B0104



Sealant: 3M ATD Part No. 8659 or equivalent



Sealant: 3M ATD Part No. 8663, 8661 or equivalent



SERVICE POINTS OF REMOVAL

E35JBAK

5. REMOVAL OF VACUUM HOSES WITH CHECK VALVE

NOTE

Since the check valve is fit to the vacuum hose, replace the check valve as an assembly unit together with the vacuum hose if the check valve is defective.

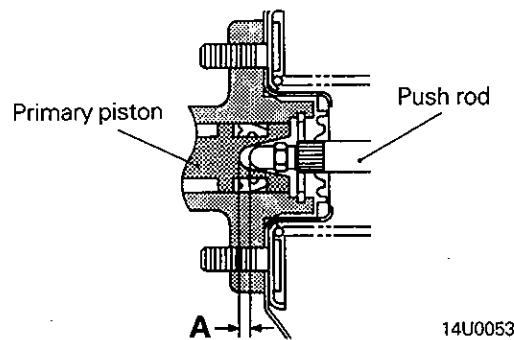
SERVICE POINTS OF INSTALLATION

7. INSTALLATION OF VACUUM HOSE/6. VACUUM PIPE/5. VACUUM HOSE WITH CHECK VALVE

- (1) The vacuum hose at the engine should be securely connected until it contacts the hexagonal edge of the fitting, and then should be secured by the hose clip.
- (2) Attach the vacuum hose so that it may be inserted to a dimension illustrated.

• ADJUSTMENT OF CLEARANCE BETWEEN BRAKE BOOSTER PUSH ROD AND PRIMARY PISTON

Adjust the clearance (A) between the brake booster push rod and primary piston as follows:



Calculate clearance A from the B, C and D measurements.

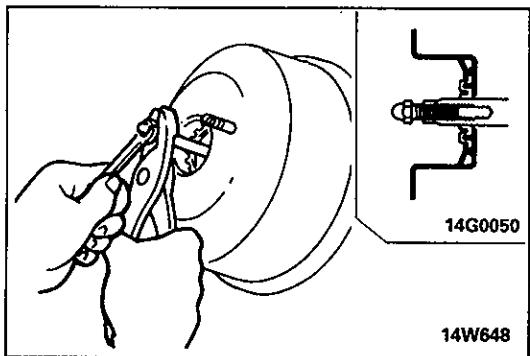
$$A = B - C - D$$

Standard value:

Brake booster size	Clearance A standard value mm (in.)
7 + 8 inch tandem brake booster	0.85–1.10 (0.033–0.043)
8 + 9 inch tandem brake booster	0.65–0.90 (0.026–0.035)

NOTE

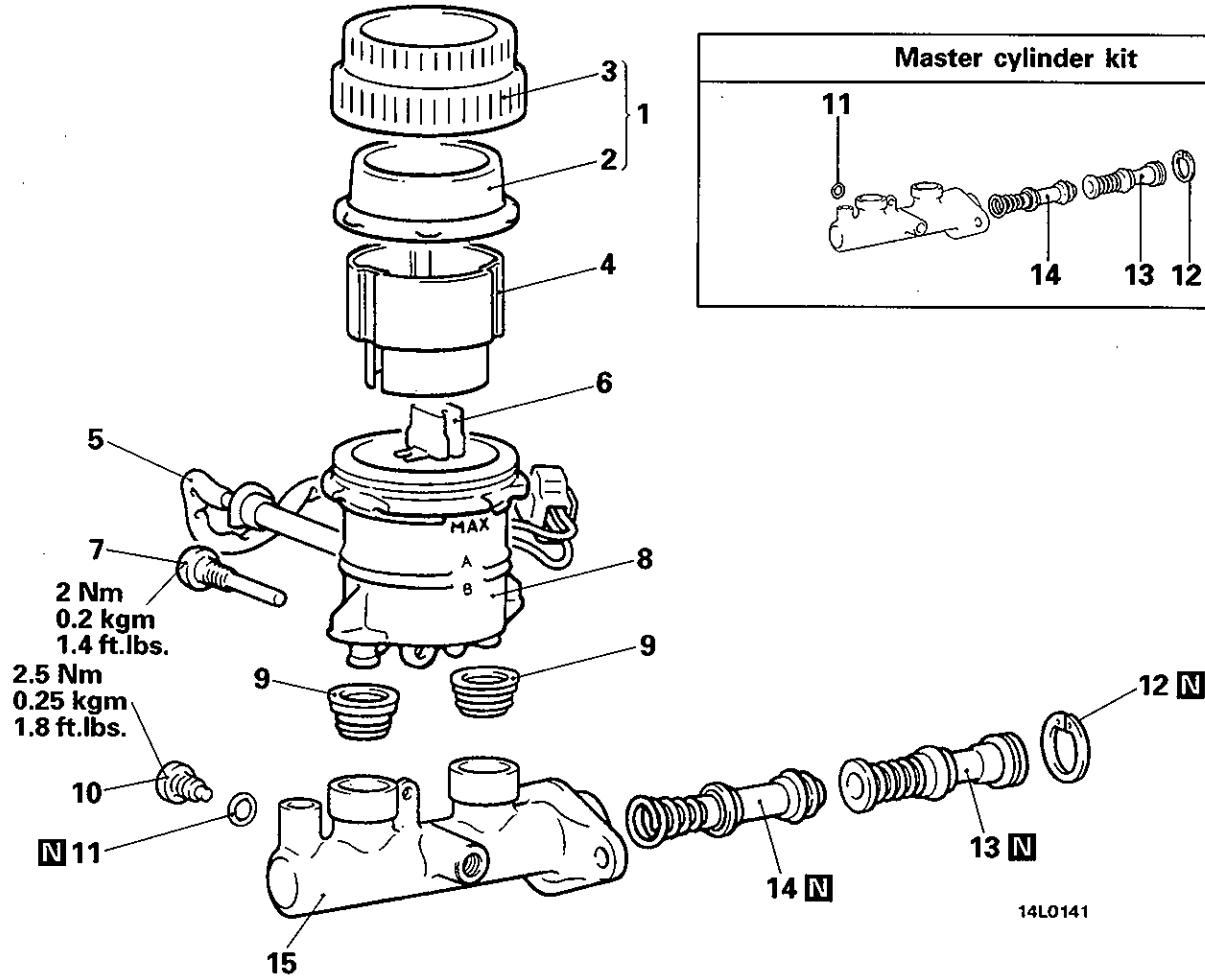
When brake booster negative pressure (diesel powered vehicles: -66.7 kPa [500 mmHg, 20.4 in.Hg], petrol powered vehicles: -93.3 kPa [700 mmHg, 27.6 in.Hg]) is applied, clearance value will become 0.05–0.30 mm (0.0020–0.012 in.).



If the clearance is not within the standard value range, adjust by changing the push rod length by turning the screw of the push rod.

DISASSEMBLY AND REASSEMBLY

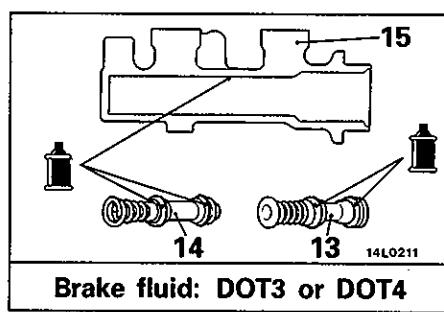
E35IE--



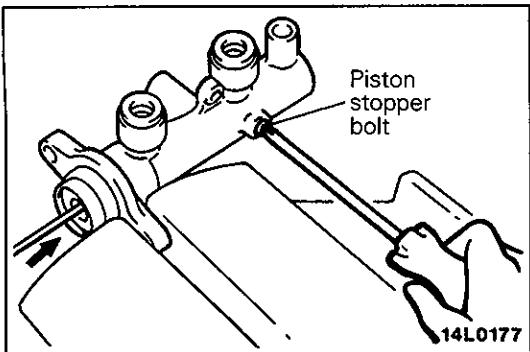
Disassembly steps

1. Reservoir cap assembly
2. Diaphragm
3. Reservoir cap
4. Filter <Vehicles with ABS>
5. Brake fluid level sensor
6. Float
7. Reservoir stopper bolt
8. Reservoir tank
9. Reservoir seal
10. Piston stopper bolt
11. Gasket
12. Stopper ring
13. Primary piston assembly
14. Secondary piston assembly
15. Master cylinder body

Caution
Do not disassemble the secondary and primary piston assembly.



Brake fluid: DOT3 or DOT4

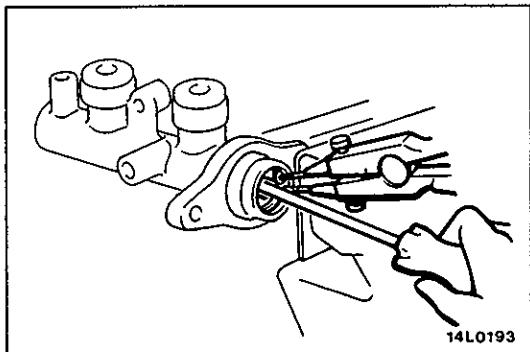


SERVICE POINTS OF DISASSEMBLY

E35IFAD

10. REMOVAL OF PISTON STOPPER BOLT

Remove the piston stopper bolt, while depressing the piston.



12. REMOVAL OF STOPPER RING

Remove the piston stopper ring, while depressing the piston.

BRAKE LINE**REMOVAL AND INSTALLATION**

E35KA--

L.H. drive vehicles**<Vehicles without ABS>****Pre-removal Operation**

- Draining of Brake Fluid

Post-installation Operation

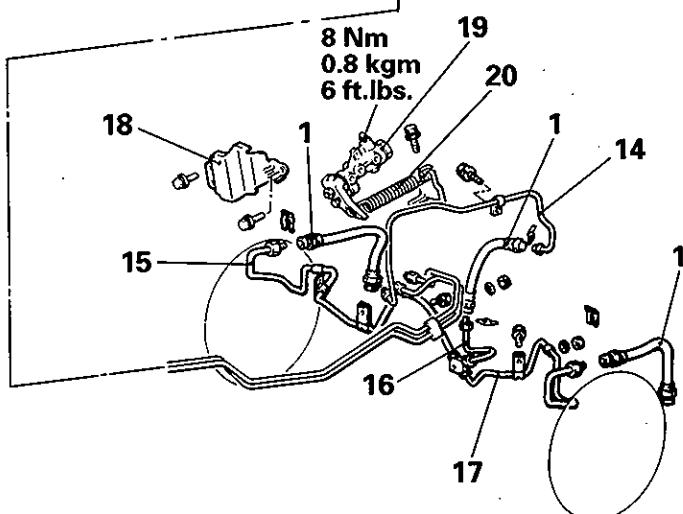
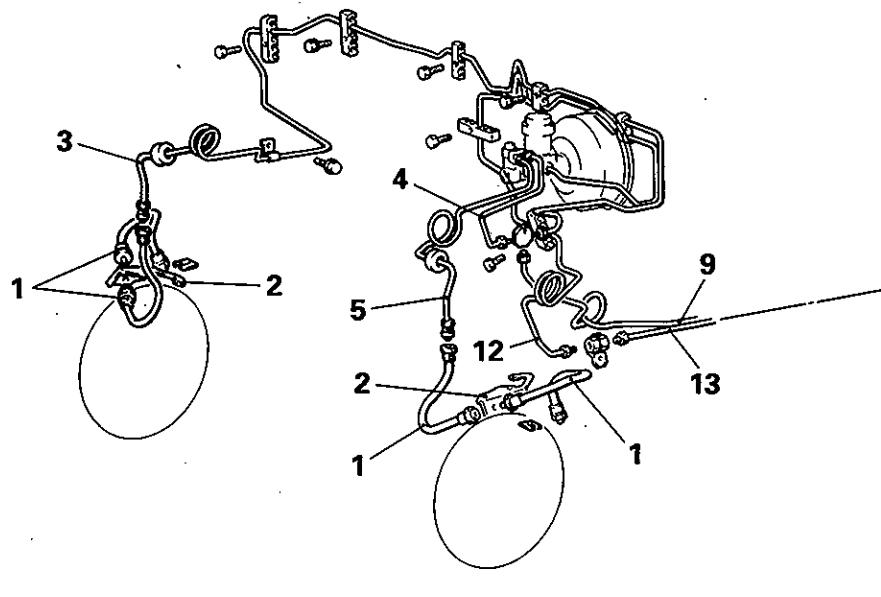
- Supplying of Brake Fluid
- Bleeding (Refer to P.35-41.)

Flare nut

15 Nm
1.5 kgm
11 ft.lbs.



14F038



14E0150

1. Brake hose
2. Brake hose support
3. Brake pipe (front, R.H.)
4. Brake pipe (front, R.H. 1)
5. Brake pipe (front, L.H.)
9. Brake pipe (floor)
12. Brake pipe (main 1)
13. Brake pipe (main 2)
14. Brake pipe (main 3)
15. Brake pipe (rear, R.H.)
16. Brake pipe (rear, center)
17. Brake pipe (rear, L.H.)
18. Protector
19. Load sensing proportioning valve
20. Load sensing spring

Caution

Do not disassemble the load sensing proportioning valve because its performance depends on the load of the spring.

<Vehicles with ABS>

2500D

Pre-removal Operation

- Draining of Brake Fluid

Post-installation Operation

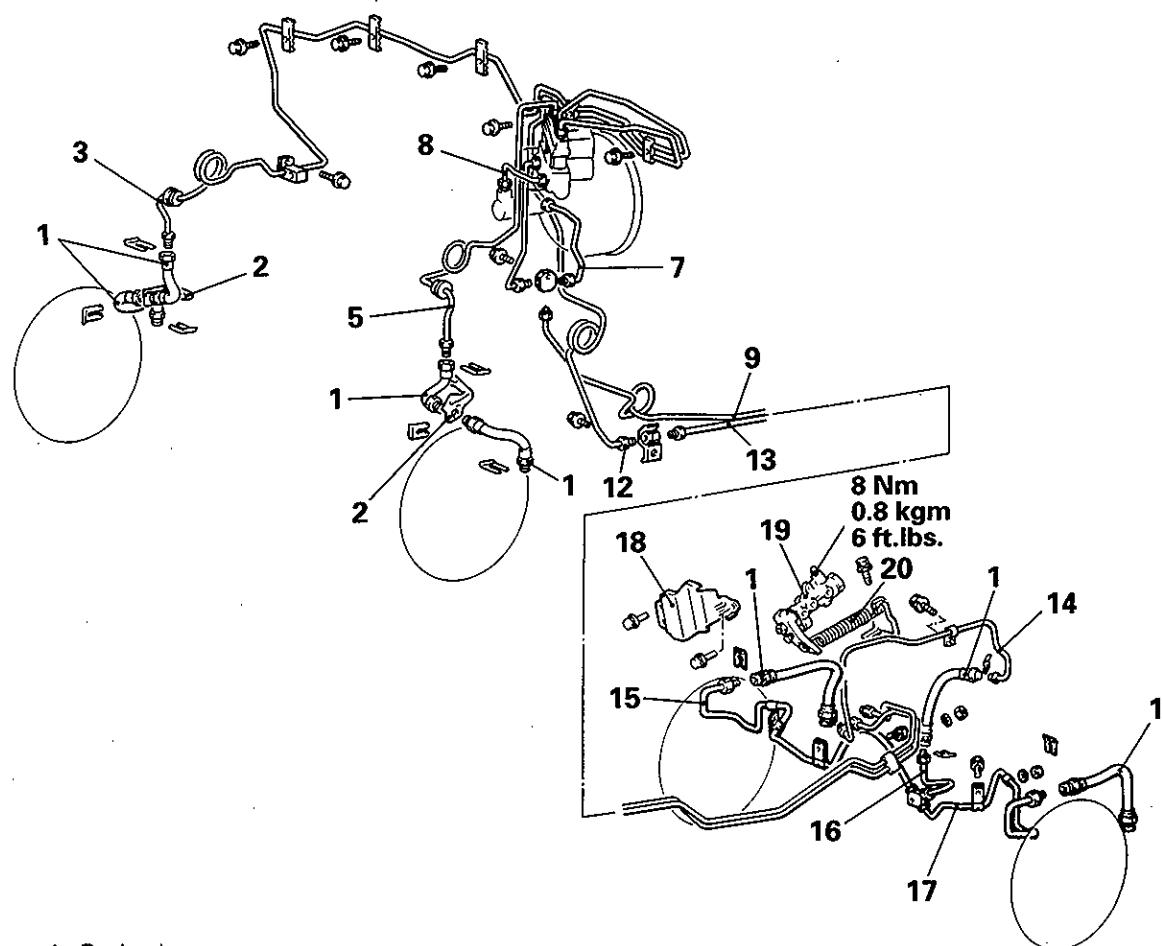
- Supplying of Brake Fluid
- Bleeding (Refer to P.35-41.)

Flare nut

15 Nm
1.5 kgm
11 ft.lbs.



14F038



14E0154

1. Brake hose
2. Brake hose support
3. Brake pipe (front, R.H.)
4. Brake pipe (front, R.H. 1)
5. Brake pipe (front, L.H.)
7. Brake pipe (A)
8. Brake pipe (B)
9. Brake pipe (floor)
12. Brake pipe (main 1)
13. Brake pipe (main 2)
14. Brake pipe (main 3)
15. Brake pipe (rear, R.H.)
16. Brake pipe (rear, center)
17. Brake pipe (rear, L.H.)
18. Protector
19. Load sensing proportioning valve
20. Load sensing spring

Caution

Do not disassemble the load sensing proportioning valve because its performance depends on the set load of the spring.

3000

Pre-removal Operation

- Draining of Brake Fluid

Post-installation Operation

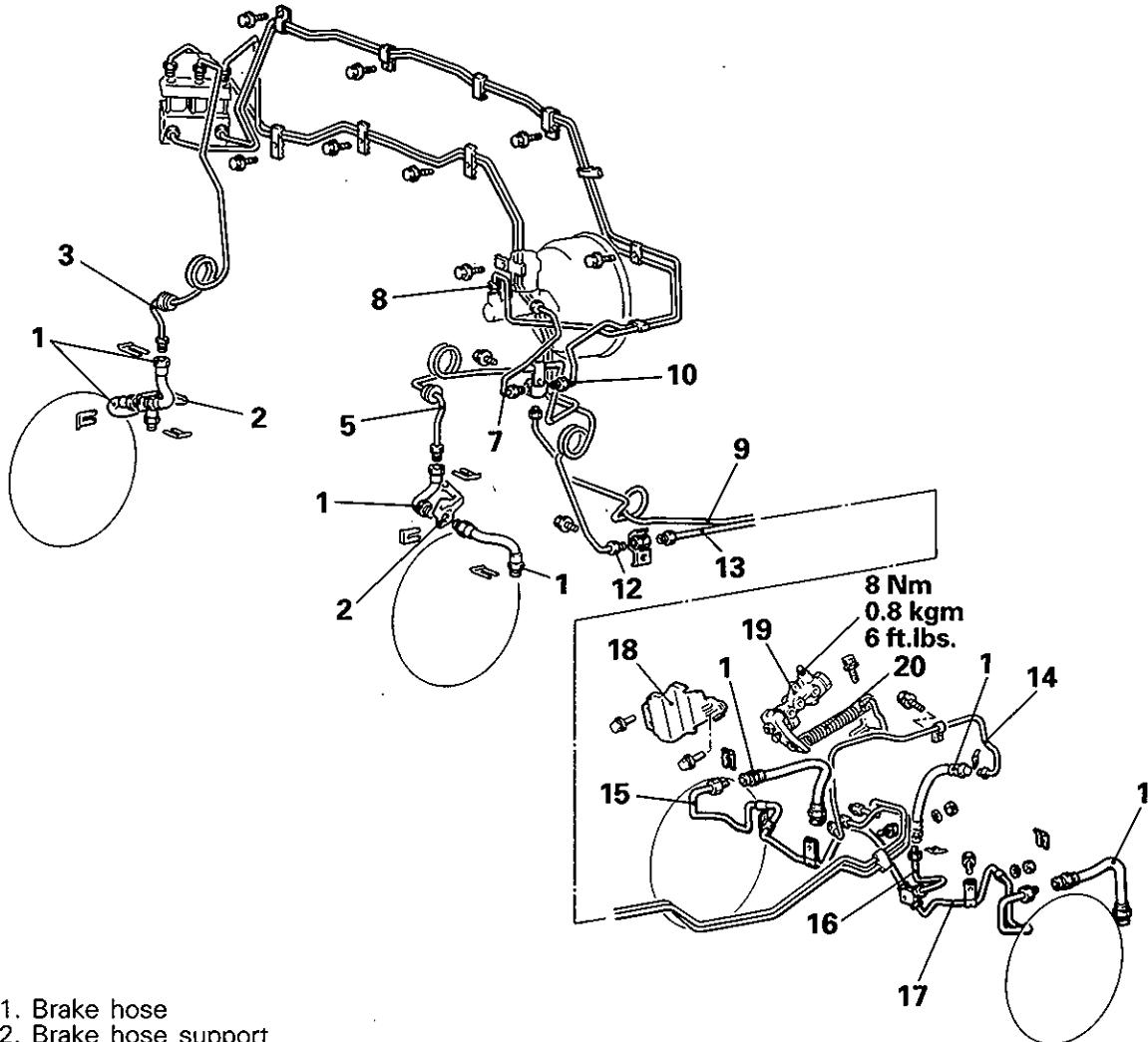
- Supplying of Brake Fluid
- Bleeding (Refer to P.35-41.)

Flare nut

15 Nm
1.5 kgm
11 ft.lbs.



14F038



14E0152

1. Brake hose
2. Brake hose support
3. Brake pipe (front, R.H.)
5. Brake pipe (front, L.H.)
7. Brake pipe (A)
8. Brake pipe (B)
9. Brake pipe (floor)
10. Brake pipe (floor 1)
12. Brake pipe (main 1)
13. Brake pipe (main 2)
14. Brake pipe (main 3)
15. Brake pipe (rear, R.H.)
16. Brake pipe (rear, center)
17. Brake pipe (rear, L.H.)
18. Protector
19. Load sensing proportioning valve
20. Load sensing spring

Caution

Do not disassemble the load sensing proportioning valve because its performance depends on the set load of the spring.

R.H. drive vehicles

<Vehicles without ABS>

Pre-removal Operation

- Draining of Brake Fluid

Post-installation Operation

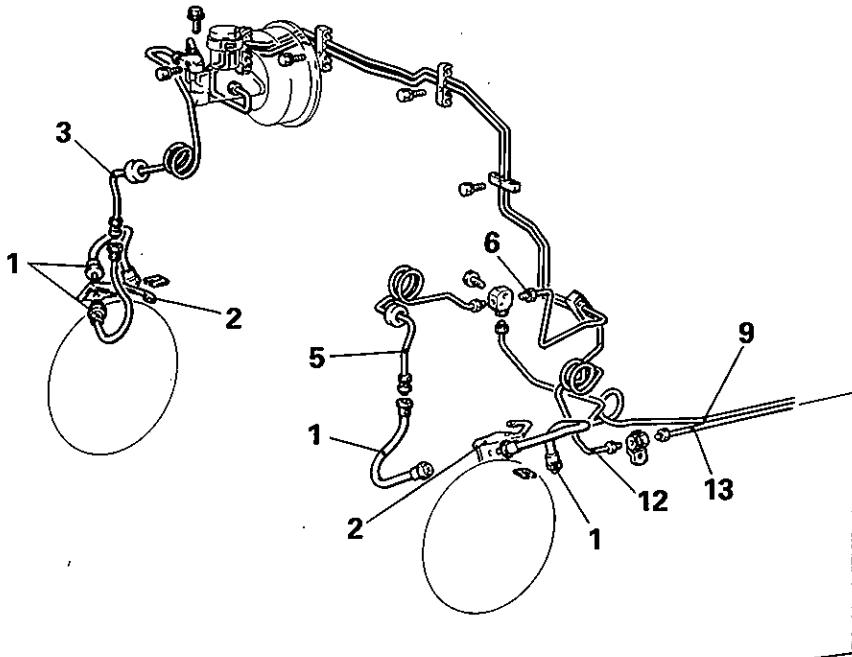
- Supplying of Brake Fluid
- Bleeding (Refer to P.35-41.)

Flare nut

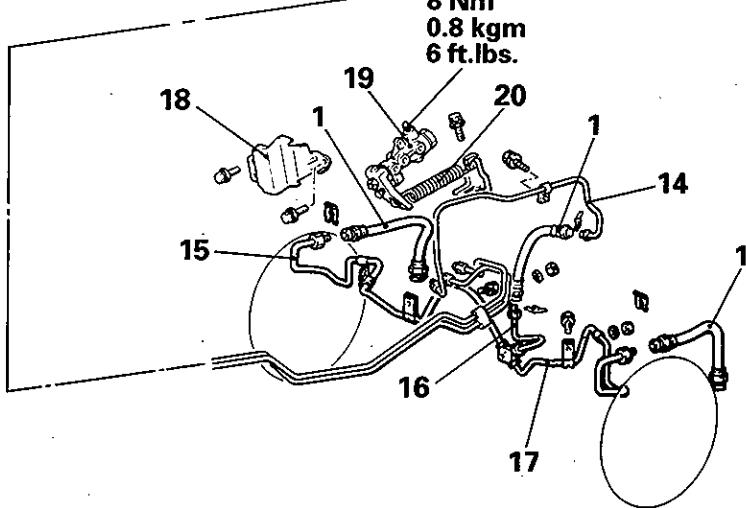
15 Nm
1.5 kgm
11 ft.lbs.



14F038



8 Nm
0.8 kgm
6 ft.lbs.



14E0147

1. Brake hose
2. Brake hose support
3. Brake pipe (front, R.H.)
5. Brake pipe (front, L.H.)
6. Brake pipe (front, L.H. 1)
9. Brake pipe (floor)
12. Brake pipe (main 1)
13. Brake pipe (main 2)
14. Brake pipe (main 3)
15. Brake pipe (rear, R.H.)
16. Brake pipe (rear, center)
17. Brake pipe (rear, L.H.)
18. Protector
19. Load sensing proportioning valve
20. Load sensing spring

Caution

Do not disassemble the load sensing proportioning valve because its performance depends on the set load of the spring.

<Vehicles with ABS>

Pre-removal Operation

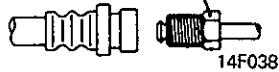
- Draining of Brake Fluid

Post-installation Operation

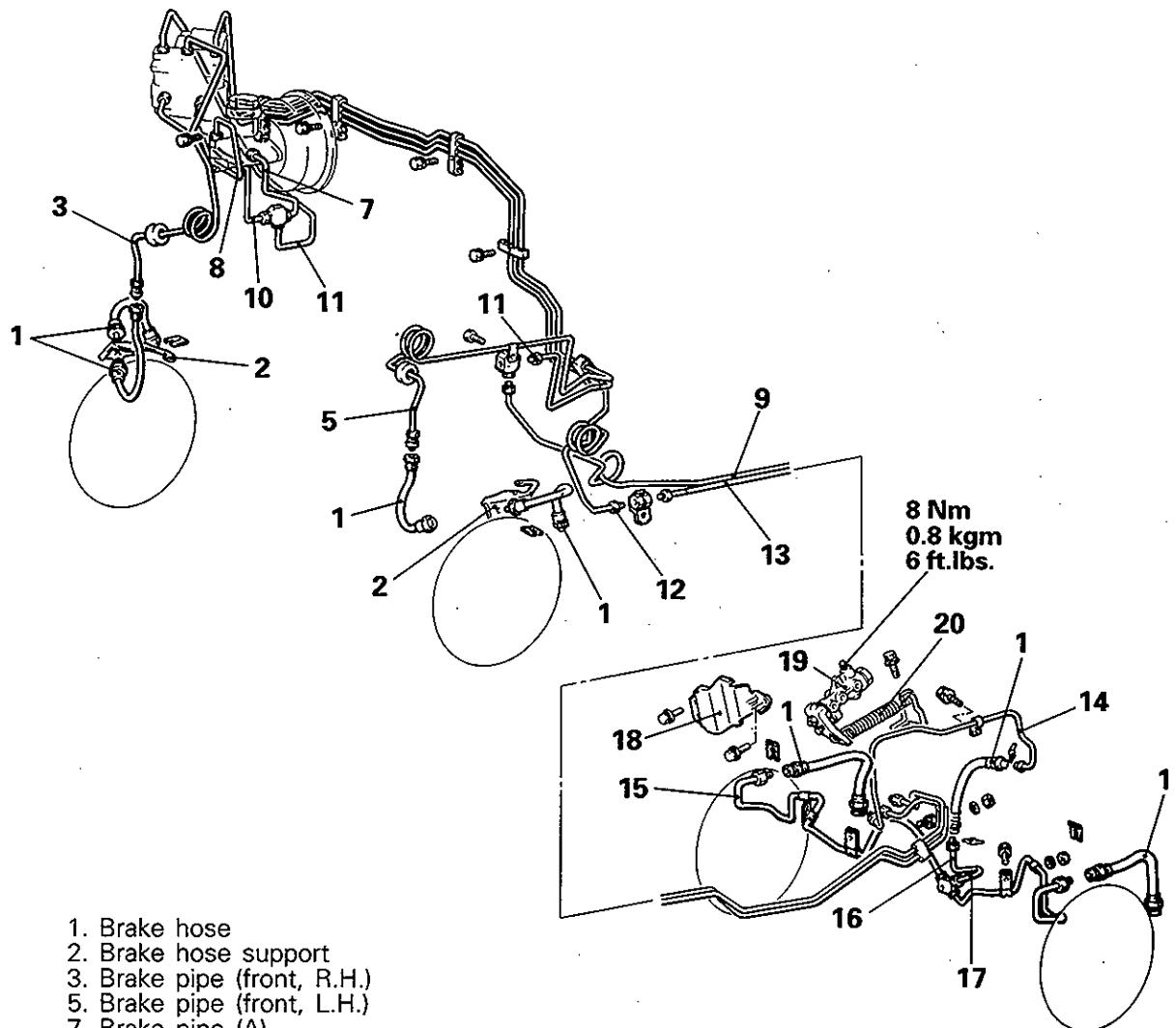
- Supplying of Brake Fluid
- Bleeding (Refer to P.35-41.)

Flare nut

15 Nm
1.5 kgm
11 ft.lbs.



14F038

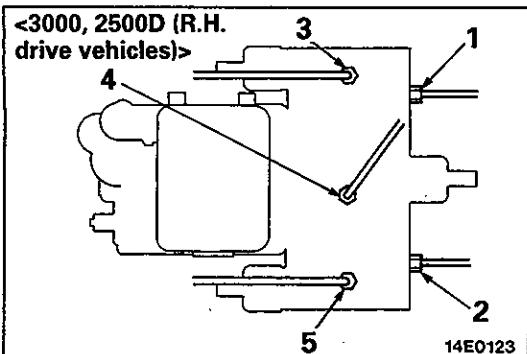


14E0148

1. Brake hose
2. Brake hose support
3. Brake pipe (front, R.H.)
5. Brake pipe (front, L.H.)
7. Brake pipe (A)
8. Brake pipe (B)
9. Brake pipe (floor)
10. Brake pipe (floor 1)
11. Brake pipe (floor 2)
12. Brake pipe (main 1)
13. Brake pipe (main 2)
14. Brake pipe (main 3)
15. Brake pipe (rear, R.H.)
16. Brake pipe (rear, center)
17. Brake pipe (rear, L.H.)
18. Protector
19. Load sensing proportioning valve
20. Load sensing spring

Caution

Do not disassemble the load sensing proportioning valve because its performance depends on the set load of the spring.



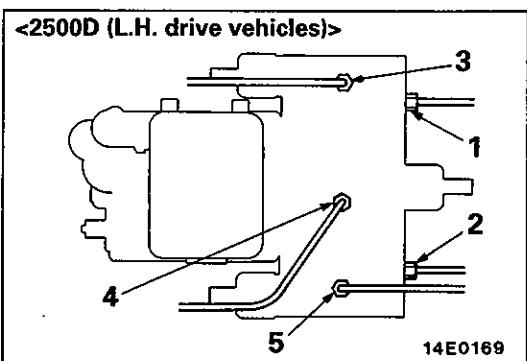
SERVICE POINTS OF INSTALLATION

E35KDAL

INSTALLATION OF BRAKE PIPES TO HYDRAULIC UNIT

Install the brake pipes as shown in the illustration.

1. From master cylinder to hydraulic unit (to rear brake)
2. From master cylinder to hydraulic unit (to front brake)
3. From hydraulic unit to rear brake
4. From hydraulic unit to front brake (RH)
5. From hydraulic unit to front brake (LH)



FRONT DISC BRAKE

REMOVAL AND INSTALLATION

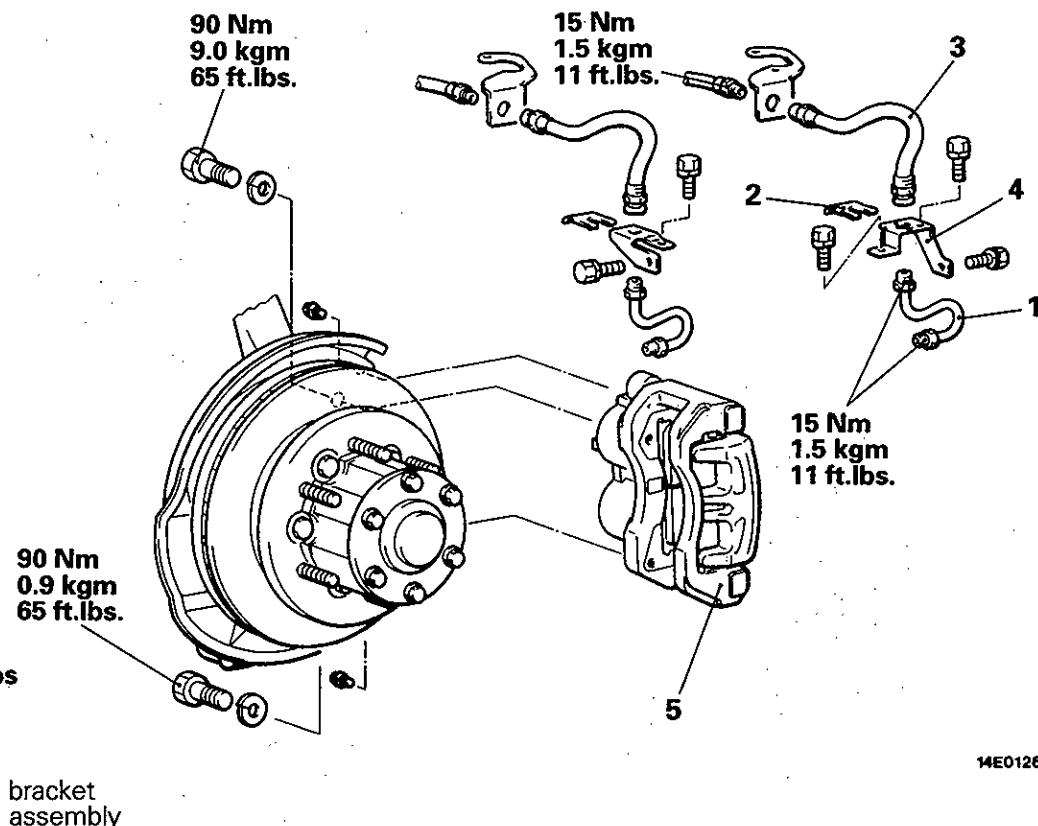
E35LA--

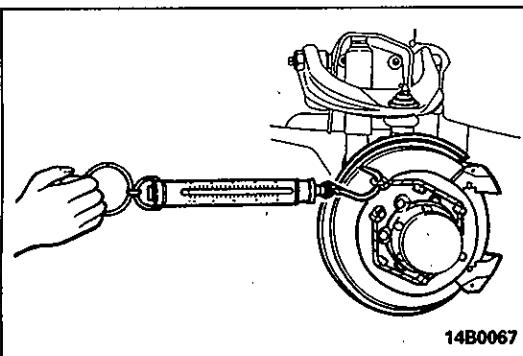
Pre-Removal Operation

- Draining of Brake Fluid

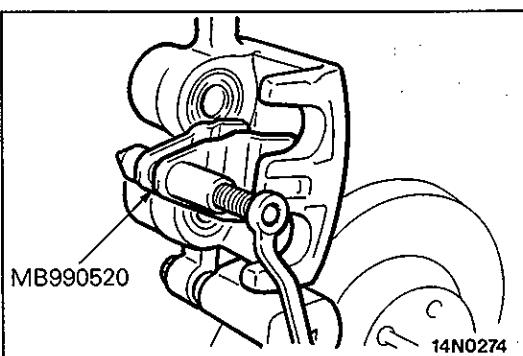
Post-installation Operation

- Supplying of Brake fluid and Bleeding of Air (Refer to P.35-41.)



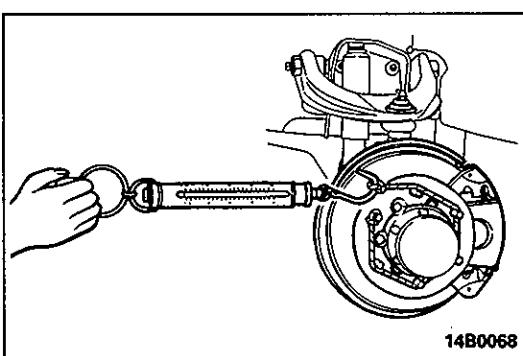


14B0067



MB990520

14N0274



14B0068

SERVICE POINTS OF INSTALLATION

E35LBAG

5. INSTALLATION OF FRONT BRAKE ASSEMBLY

After installation of the brake assembly, measure the dragging force of the disc brakes by the following procedure.

(1) With the brake assembly removed, use a spring balance to measure the rotational sliding resistance of the hub in the forward direction.

(2) After installing the caliper support to the knuckle, use the special tool to expand the piston, and then install the caliper body.

(3) Start the engine and, after strongly depressing the brake pedal 2-3 times, stop the engine.

(4) Turn brake disc forward 10 times.

(5) Use a spring balance to measure the rotational sliding resistance of the hub in the forward direction.

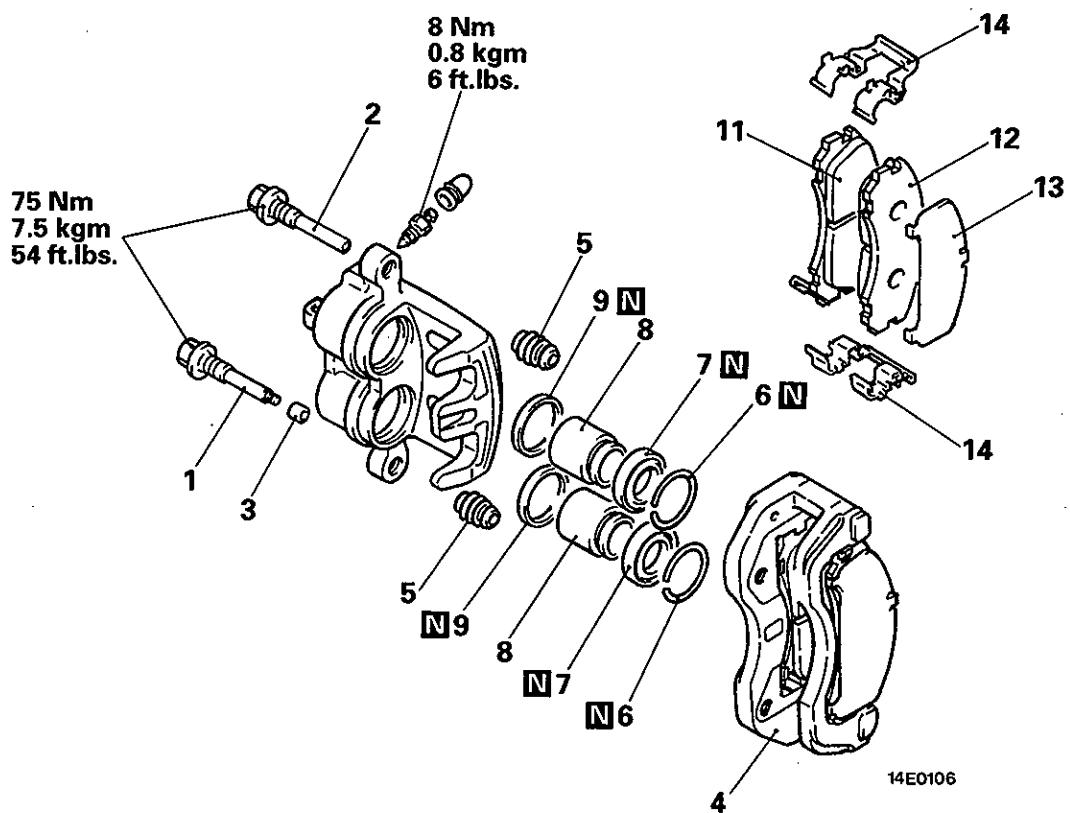
(6) Calculate the dragging force of the disc brakes (the difference between the values measured in steps 5 and 1).

Standard value: 57N (5.7 kg, 13 lbs.) or less

(7) If the dragging force of the disc brakes exceeds the standard value, disassemble piston and clean the piston. Check for corrosion or worn piston seal.

DISASSEMBLY AND REASSEMBLY

E35LF--



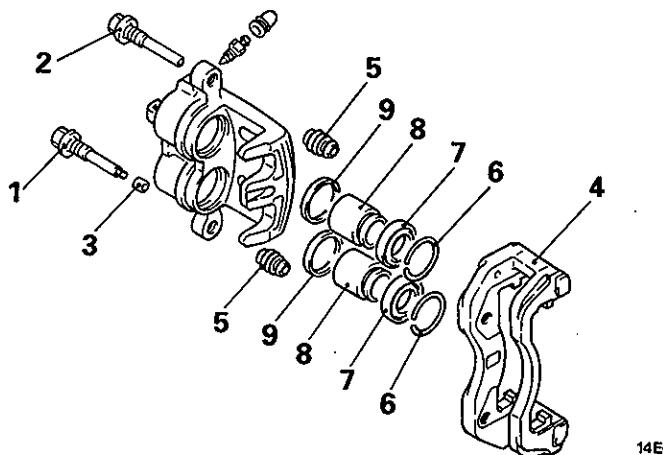
Disassembly steps of caliper assembly

- ➡➡ 1. Lock pin
- ➡➡ 2. Guide pin
- 3. Bushing
- 4. Caliper support
(Pad, clip and shim)
- 5. Pin boot
- 6. Boot ring
- 7. Piston boot
- 8. Piston
- 9. Piston seal
- 10. Caliper body

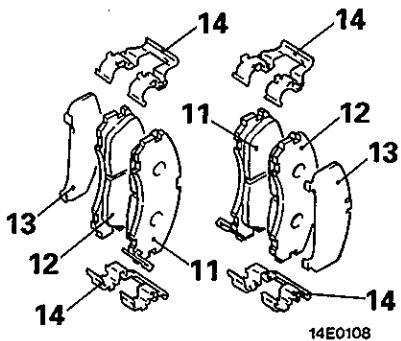
Disassembly steps of pad assembly

- ➡➡ 1. Lock pin
- ➡➡ 2. Guide pin
- 3. Bushing
- 4. Caliper support
(Pad, clip and shim)
- 11. Pad and wear indicator assembly
- 12. Pad assembly
- 13. Outer shim
- 14. Clip

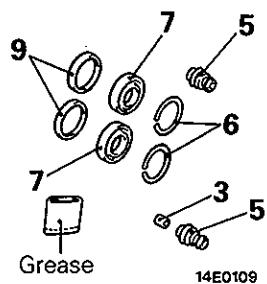
Brake caliper kit



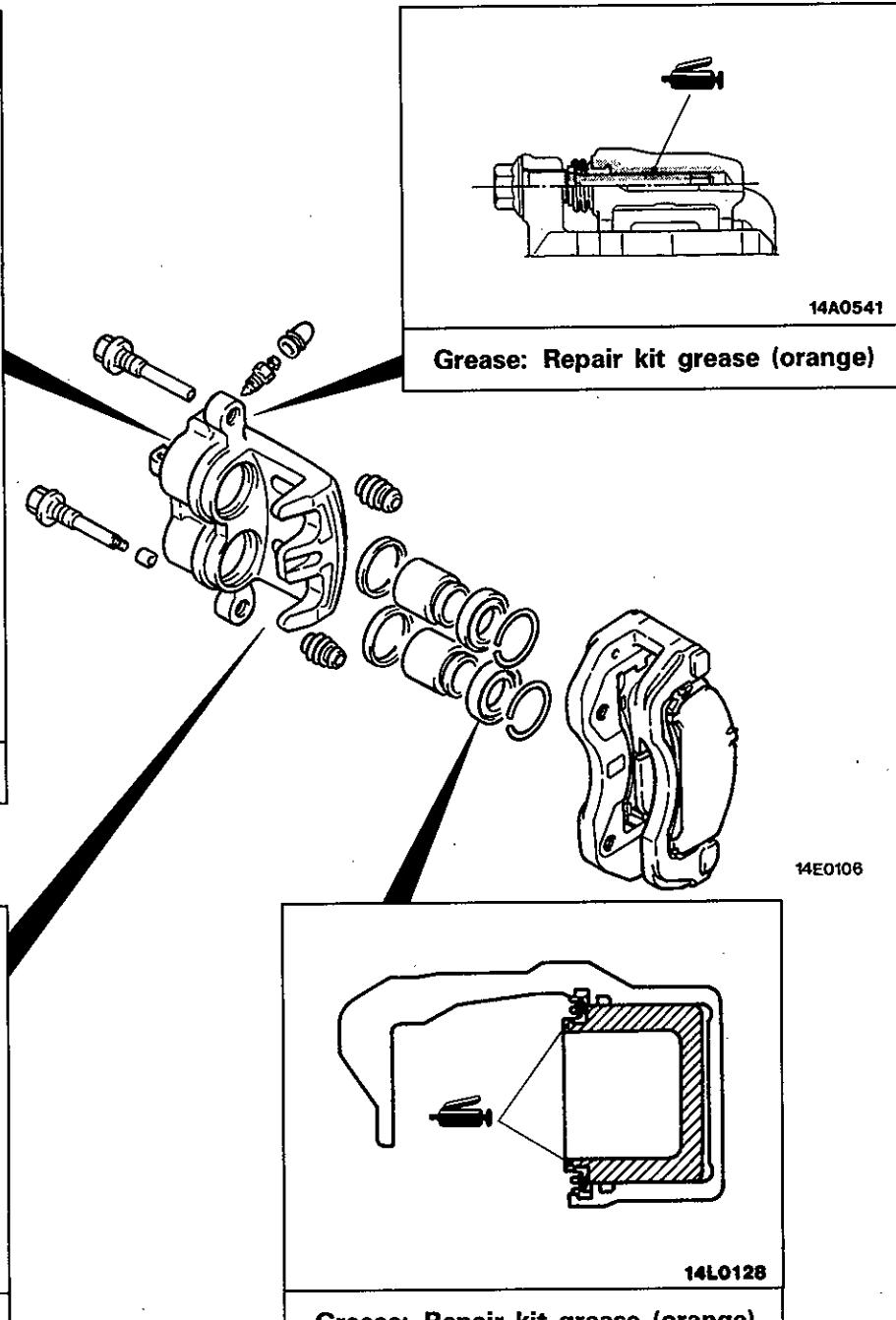
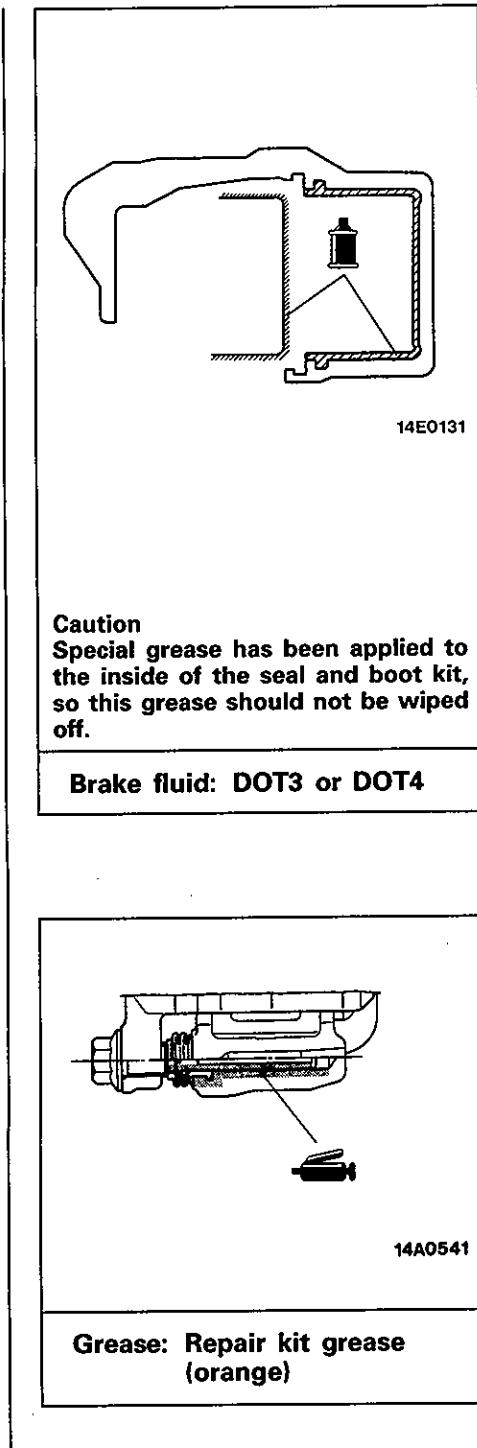
Pad kit

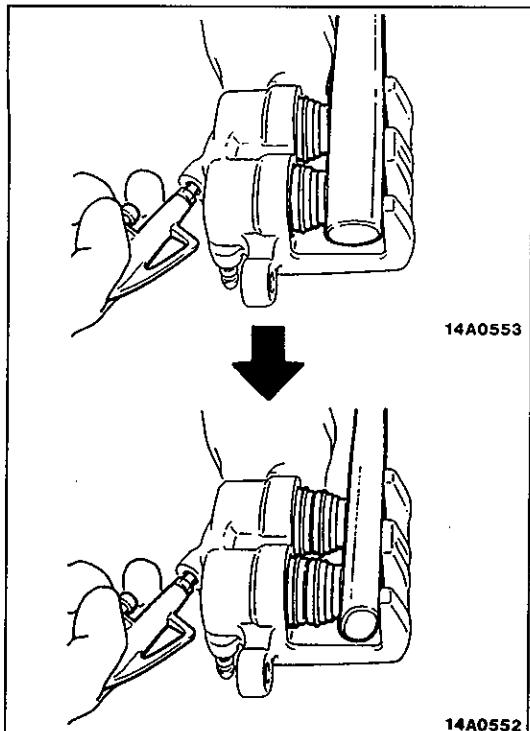


Seal and boot kit



LUBRICATION POINTS





SERVICE POINTS OF DISASSEMBLY

E35LGAD

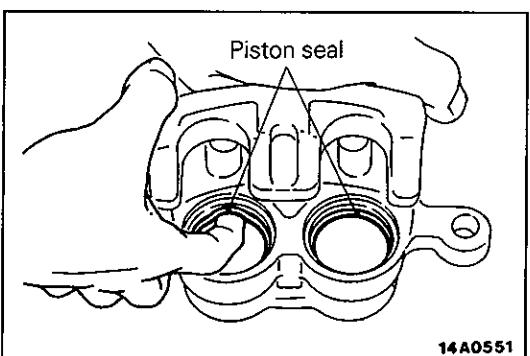
7. REMOVAL OF PISTON BOOT/8. PISTON

Pump in compressed air through the brake hose installation hole and remove the pistons and piston boot.

Caution

When removing the pistons, be sure to use the handle of a plastic hammer and adjust the height of the two pistons while pumping in air slowly in so that the pistons protrude evenly.

Do not remove one piston completely before trying to remove the other piston because it will become impossible to remove the second piston.



9. REMOVAL OF PISTON SEAL

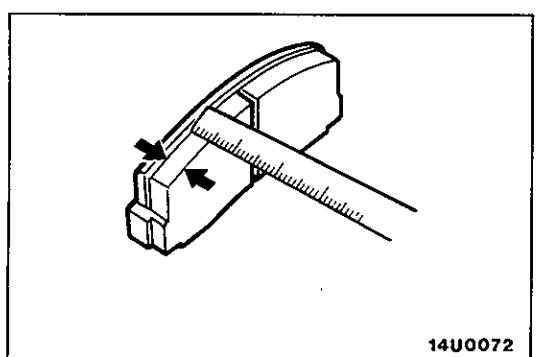
- (1) Remove piston seal with finger tip.

Caution

Do not use a screwdriver or other tool to prevent damage to inner cylinder.

- (2) Clean piston surface and inner cylinder with trichloroethylene alcohol or specified brake fluid.

Specified brake fluid: DOT3 or DOT4



INSPECTION

E35RIAD

PAD WEAR

Measure thickness at the thinnest and worn area of the pad. Replace pad assembly when pad thickness is less than the limit value.

Standard value:

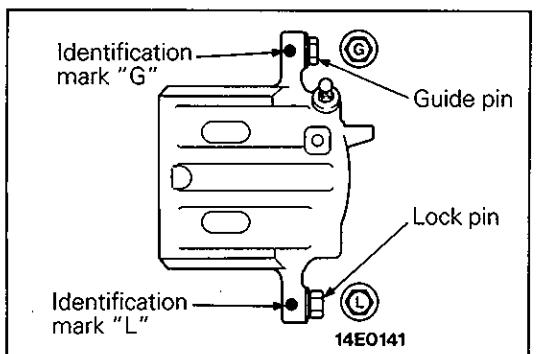
10.0 mm (0.39 in.)

Limit value:

2.0 mm (0.079 in.)

Caution

1. When the limit is exceeded, replace the pads at both sides, and also the brake pads for the wheels on the opposite side at the same time.
2. If there is a significant difference in the thicknesses of the pads on the left and right sides, check the sliding parts.



SERVICE POINTS OF INSTALLATION

2. INSTALLATION OF GUIDE PIN/1. LOCK PIN

Install the guide pin and lock pin as illustrated so that each head mark of the guide pin and the lock pin matches the indication mark ("G" or "L") located on the caliper body.

REAR DISC BRAKE**REMOVAL AND INSTALLATION**

E35RA--

Pre-removal Operation

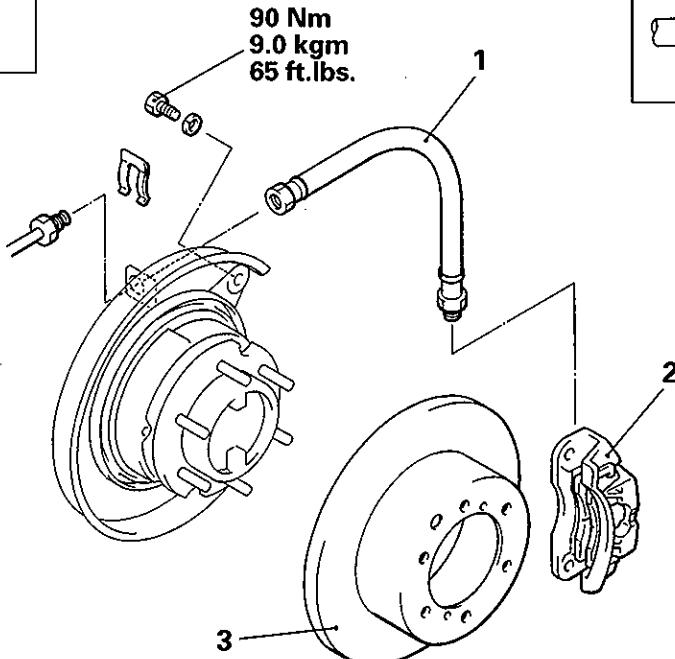
- Draining of Brake Fluid

Post-installation Operation

- Supplying of Brake Fluid
- Bleeding
(Refer to P.35-41.)

Flare nut

15 Nm
1.5 kgm
11 ft.lbs.

**Removal steps**

➡➡

1. Brake hose connection
2. Rear brake assembly
3. Brake disc

INSPECTION

E35RCAB

BRAKE DISC

- Check disc for wear. (Refer to P.35-45.)
- Check disc for runout. (Refer to P.35-45.)
- Check disc for damage.

SERVICE POINTS OF INSTALLATION

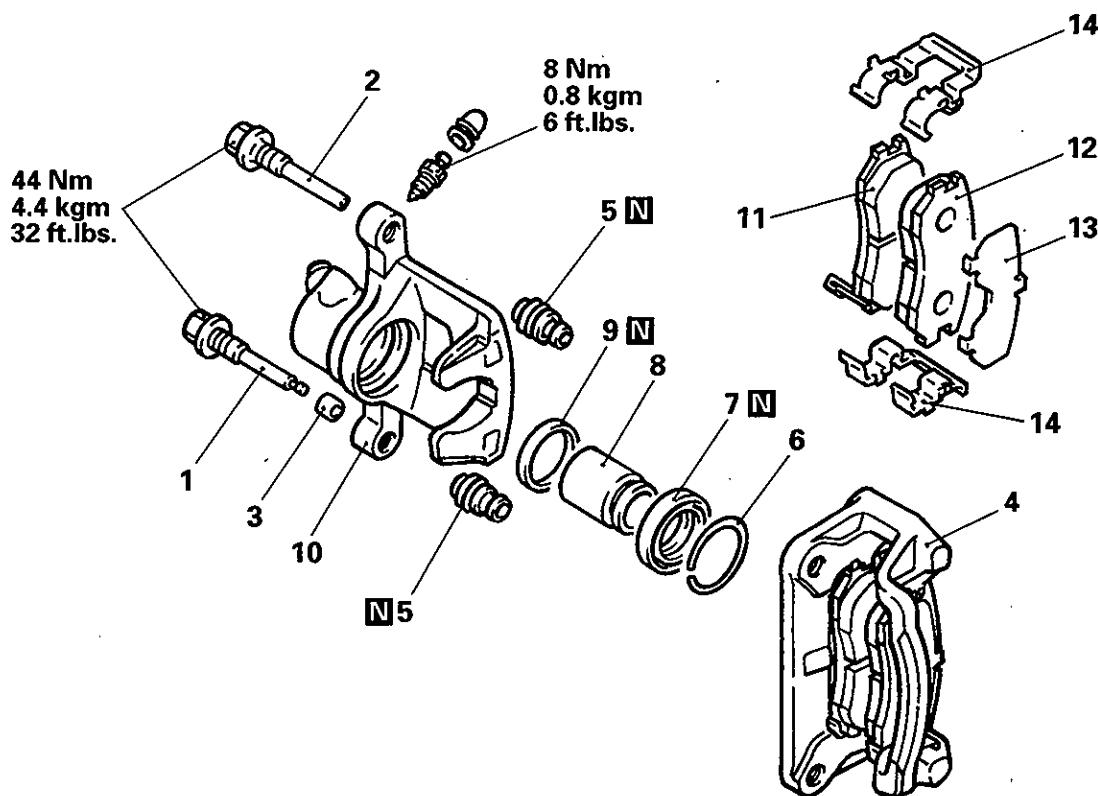
E35RDAG

2. INSTALLATION OF THE REAR BRAKE ASSEMBLY

Install the rear brake assembly using the same procedure as that for the front brake assembly. (Refer to P.35-67.)

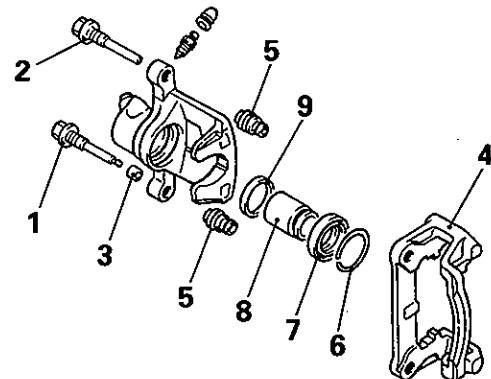
DISASSEMBLY AND REASSEMBLY

E35RF--



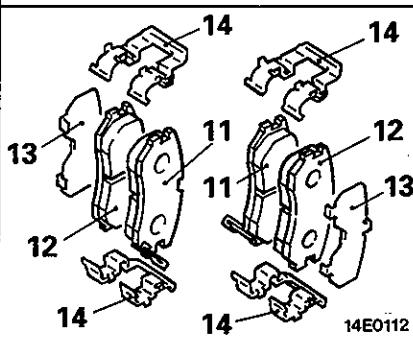
14E0110

Brake caliper kit

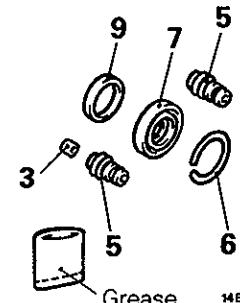


14E0111

Pad kit



Seal and boot repair kit



14E0113

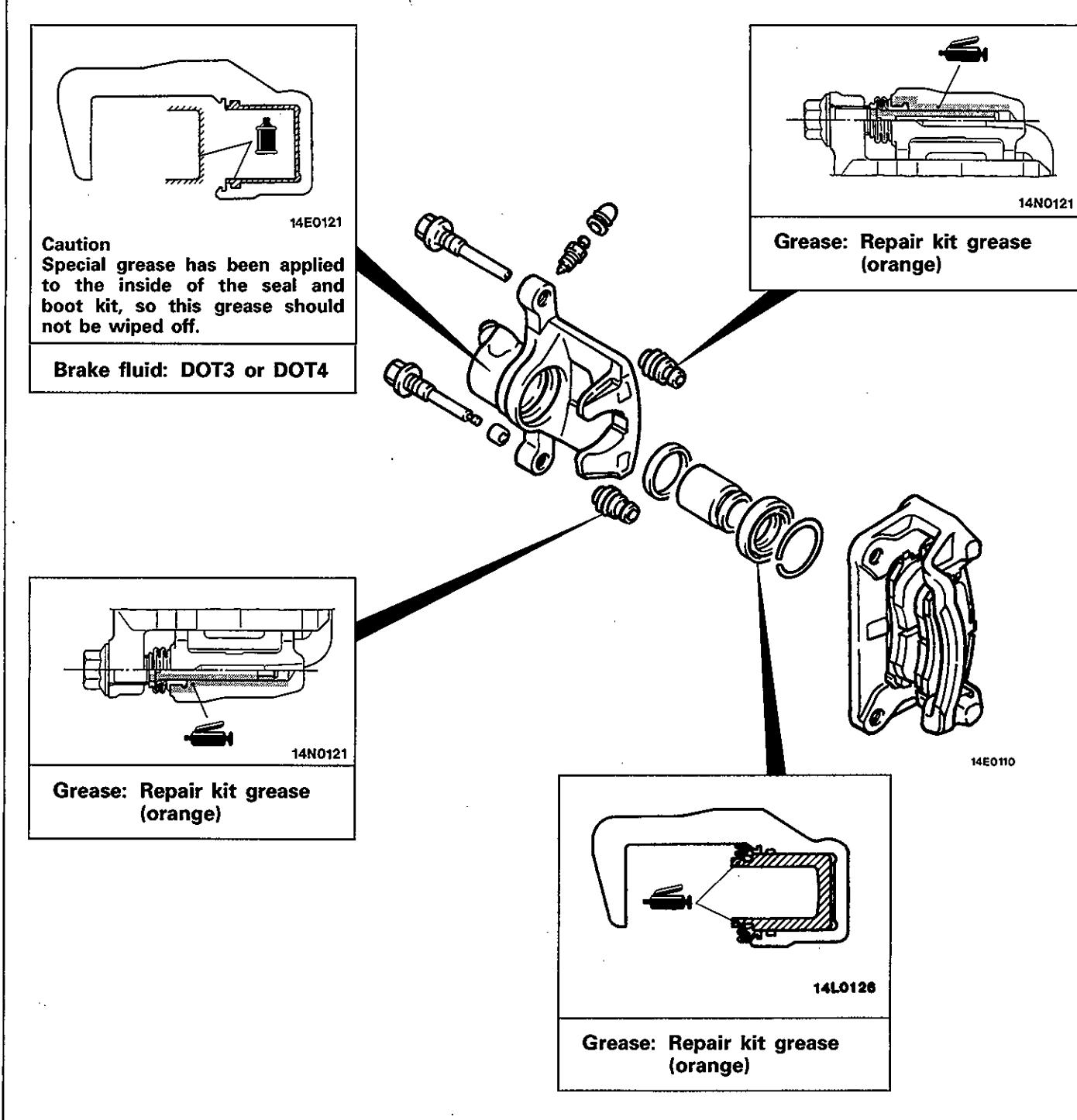
Disassembly steps of caliper assembly

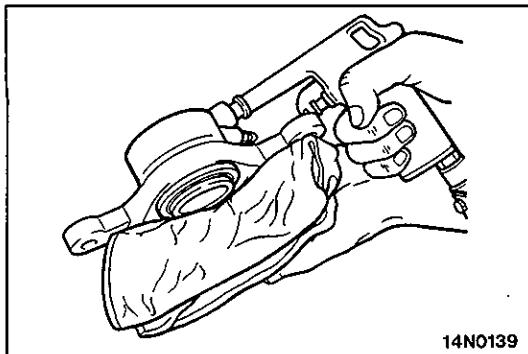
- ➡ 1. Lock pin
- ➡ 2. Guide pin
- 3. Bushing
- 4. Caliper support (Pad, clip and shim)
- 5. Pin boot
- 6. Boot ring
- 7. Piston boot
- 8. Piston
- 9. Piston seal
- 10. Caliper body

Disassembly steps of pad assembly

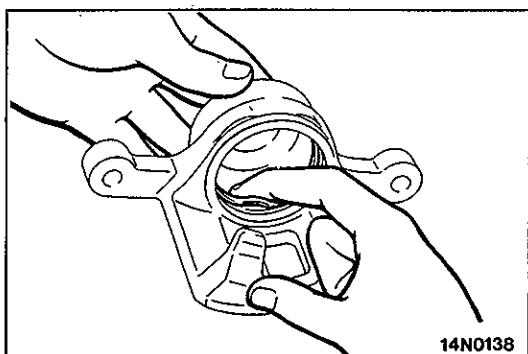
- ➡ 1. Lock pin
- ➡ 2. Guide pin
- 3. Bushing
- 4. Caliper support (Pad, clip and shim)
- 11. Pad and wear indicator assembly
- 12. Pad assembly
- 13. Outer shim
- 14. Clip

LUBRICATION POINTS

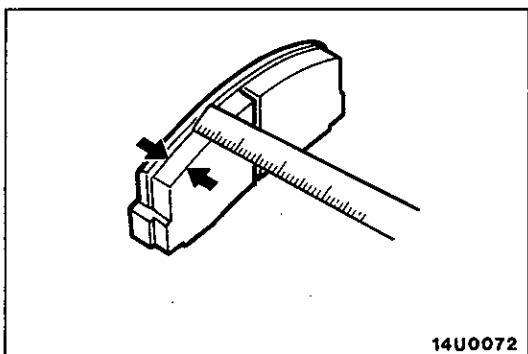




14N0139



14N0138



14U0072

SERVICE POINTS OF DISASSEMBLY

E35RGAE

7. REMOVAL OF PISTON BOOT/8. PISTON

Protect caliper body with cloth. Blow compressed air through brake hose to remove piston boot and piston.

Caution

Blow compressed air gently.

9. REMOVAL OF PISTON SEAL

(1) Remove piston seal with finger tip.

Caution

Do not use (—) screwdriver or other tool to prevent damage to inner cylinder.

(2) Clean piston surface and inner cylinder with trichloroethylene, alcohol or specified brake fluid.

Specified brake fluid: DOT3 or DOT4

INSPECTION

E35RHAC

PAD WEAR

Measure thickness at the thinnest and worn area of the pad. Replace pad assembly when pad thickness is less than the limit value.

Standard value:

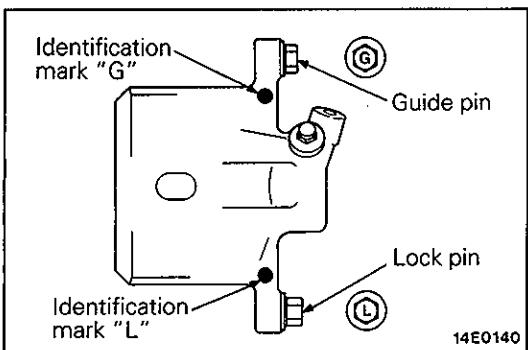
9.0 mm (0.35 in.)

Limit:

2.0 mm (0.079 in.)

Caution

1. When the limit is exceeded, replace the pads at both sides, and also the brake pads for the wheels on the opposite side at the same time.
2. If there is a significant difference in the thicknesses of the pads on the left and right sides, check the sliding parts.



14E0140

SERVICE POINTS OF REASSEMBLY

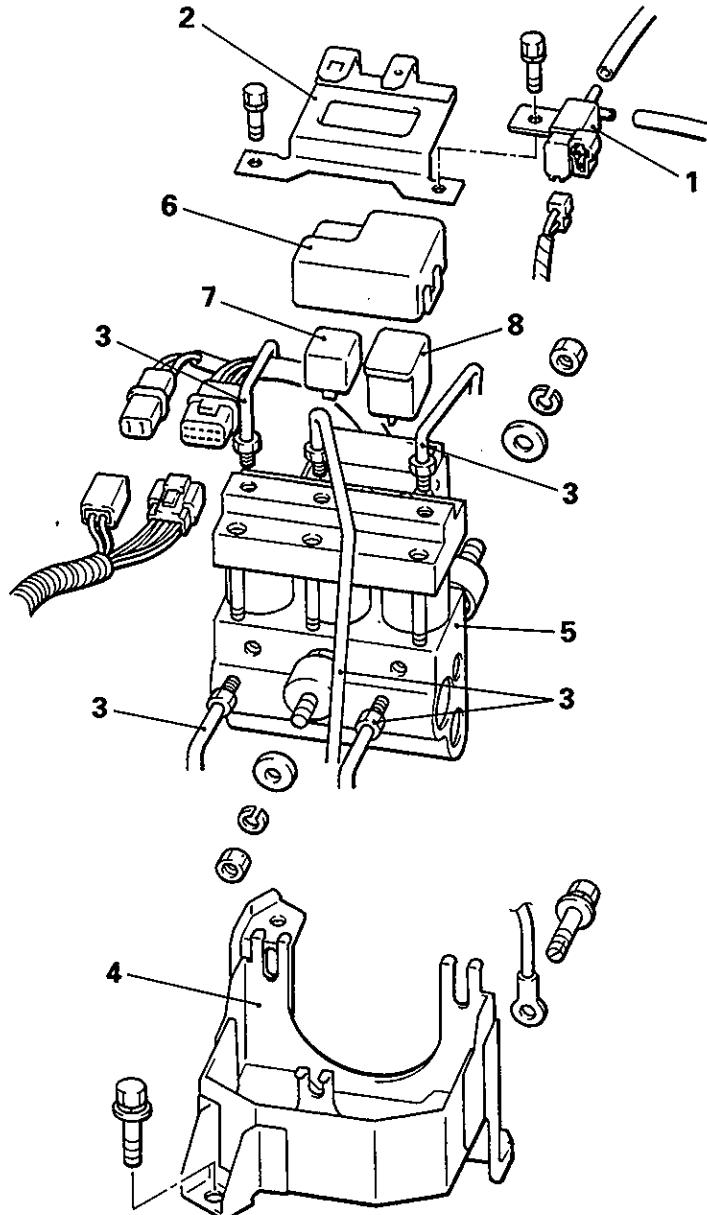
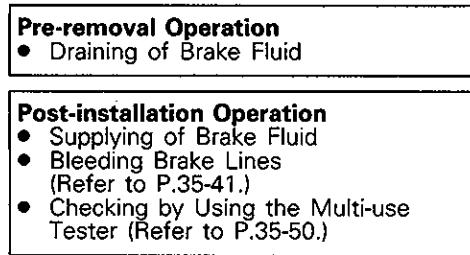
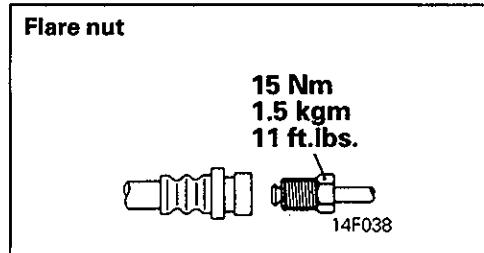
E35RIAD

2. INSTALLATION OF GUIDE PIN/1. LOCK PIN

Install the guide pin and lock pin as illustrated so that each head mark of the guide pin and the lock pin matches the indication mark ("G" or "L") located on the caliper body.

HYDRAULIC UNIT <A.B.S.>

E35WA--

REMOVAL AND INSTALLATION**[Vehicles built up to May, 1994]****<Petrol-powered vehicles, Diesel-powered vehicles – R.H. drive>**

14E0068

Removal steps of relay

◆ ◆

1. Idle-up solenoid valve (for ABS)
<Diesel-powered vehicles – M/T>
2. Connector bracket
6. Relay box cover
7. Valve relay
8. Motor relay

Removal steps of hydraulic unit

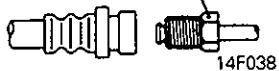
◆ ◆

1. Idle-up solenoid valve (for ABS)
<Diesel-powered vehicles – M/T>
2. Connector bracket
3. Brake pipe
4. Hydraulic unit bracket
5. Hydraulic unit
6. Relay box cover
7. Valve relay
8. Motor relay

<Diesel-powered vehicles – L.H. drive>

Flare nut

15 Nm
1.5 kgm
11 ft.lbs.



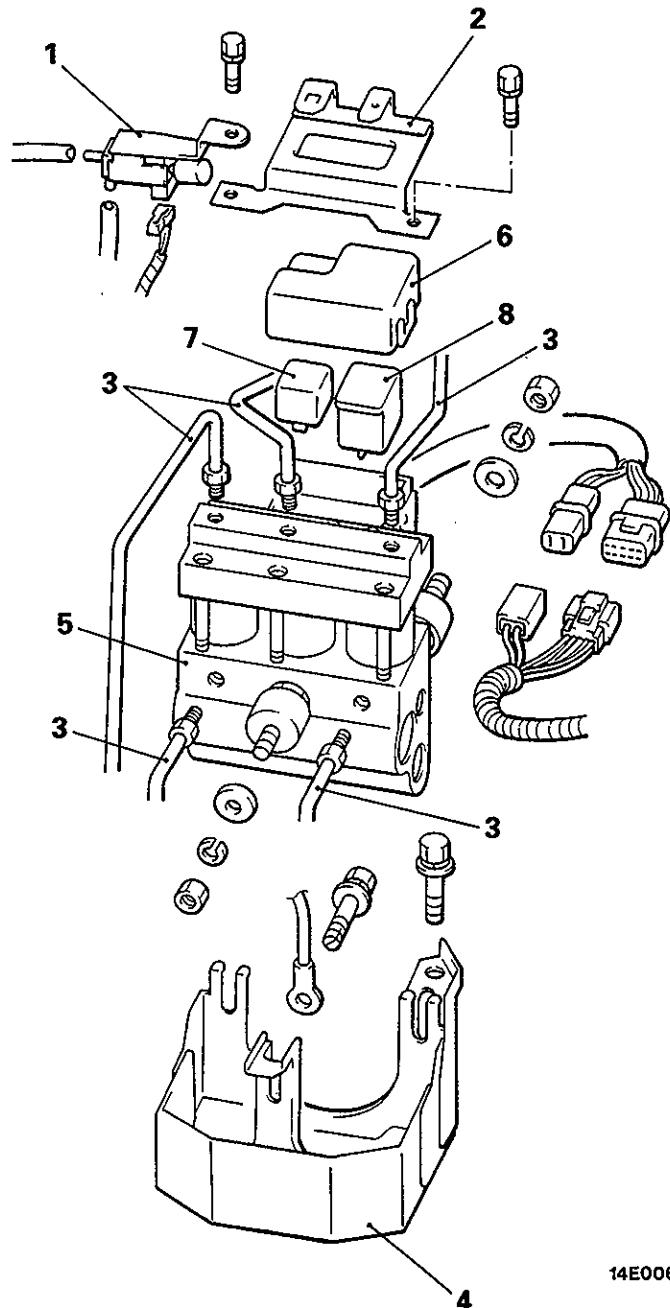
14F038

Pre-removal Operation

- Draining of Brake Fluid

Post-installation Operation

- Supplying of Brake Fluid
- Bleeding Brake Lines
(Refer to P.35-41.)
- Checking by Using the Multi-use Tester (Refer to P.35-50.)



14E0069

Removal steps of relay

◆◆ 1. Idle-up solenoid valve (for ABS) <M/T>
2. Connector bracket
6. Relay box cover
7. Valve relay
8. Motor relay

Removal steps of hydraulic unit

◆◆ 1. Idle-up solenoid valve (for ABS) <M/T>
2. Connector bracket
3. Brake pipe
4. Hydraulic unit bracket
5. Hydraulic unit
6. Relay box cover
7. Valve relay
8. Motor relay

SERVICE POINTS OF REMOVAL

E35WBAF

5. REMOVAL OF THE HYDRAULIC UNIT

Caution

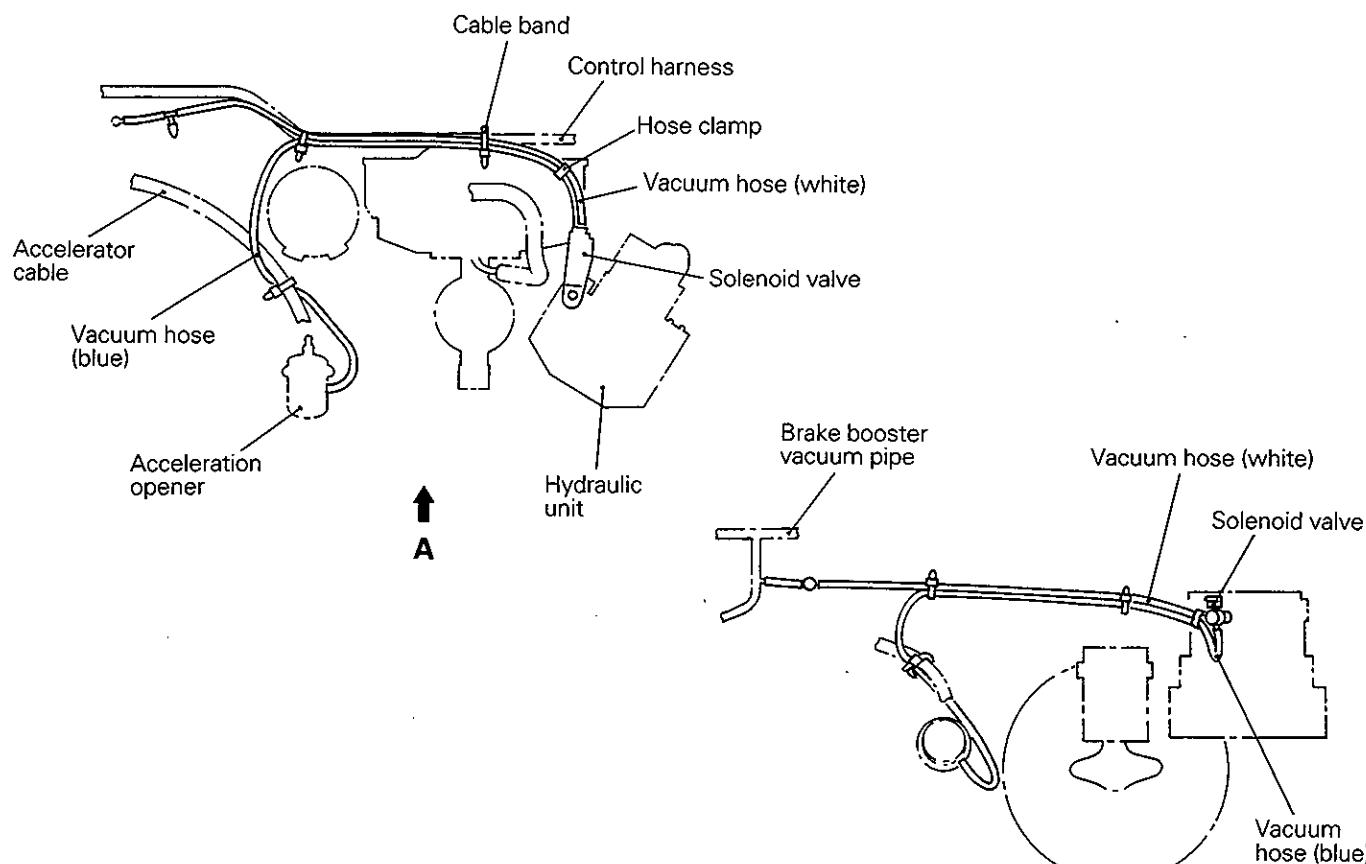
1. The hydraulic unit is heavy, and so care should be taken when removing it.
2. The hydraulic unit is not to be disassembled; its nuts and bolts should absolutely not be loosened.
3. The hydraulic unit must not be dropped or otherwise subjected to impact shocks.
4. The hydraulic unit must not be turned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

SERVICE POINTS OF INSTALLATION

1. INSTALLATION OF IDLE-UP SOLENOID VALVE (FOR ABS) <2500D-M/T>

Install the solenoid valve and vacuum hose as shown in the illustration.

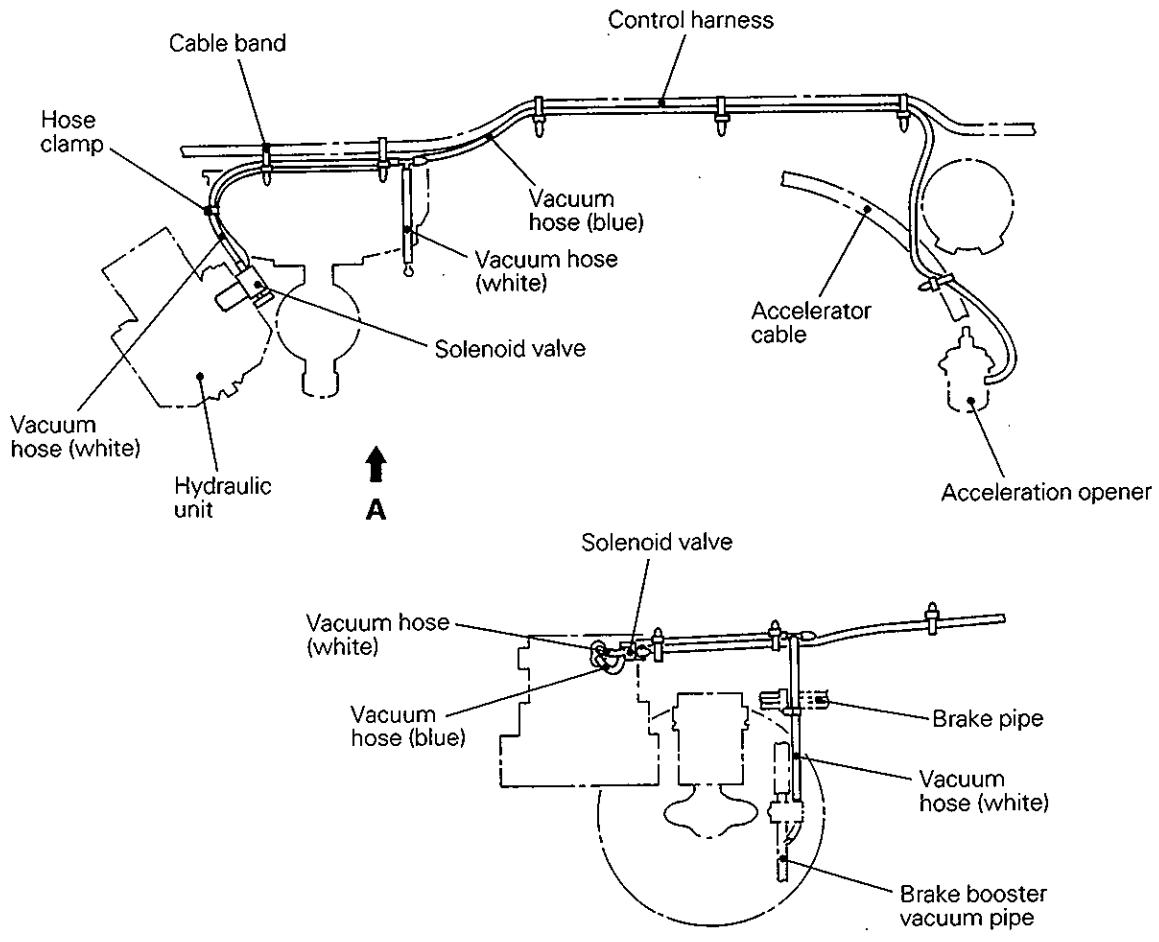
<L.H. drive vehicles>



View A

14E0059

<R.H. drive vehicles>



14E0060

[Vehicles built from June, 1994]

Pre-removal Operation

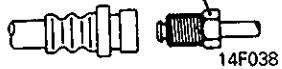
- Draining of Brake Fluid

Post-installation Operation

- Supplying of Brake Fluid
- Bleeding Brake Lines (Refer to P.35-41.)
- Checking by Using the MUT-II (Refer to P.35-50.)

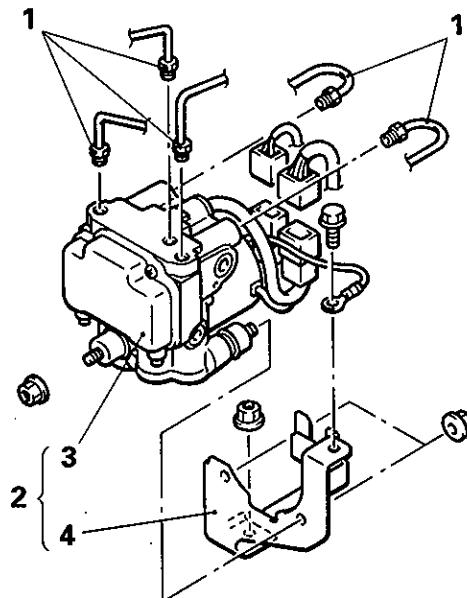
Flare nut

15 Nm
1.5 kgm
11 ft.lbs.



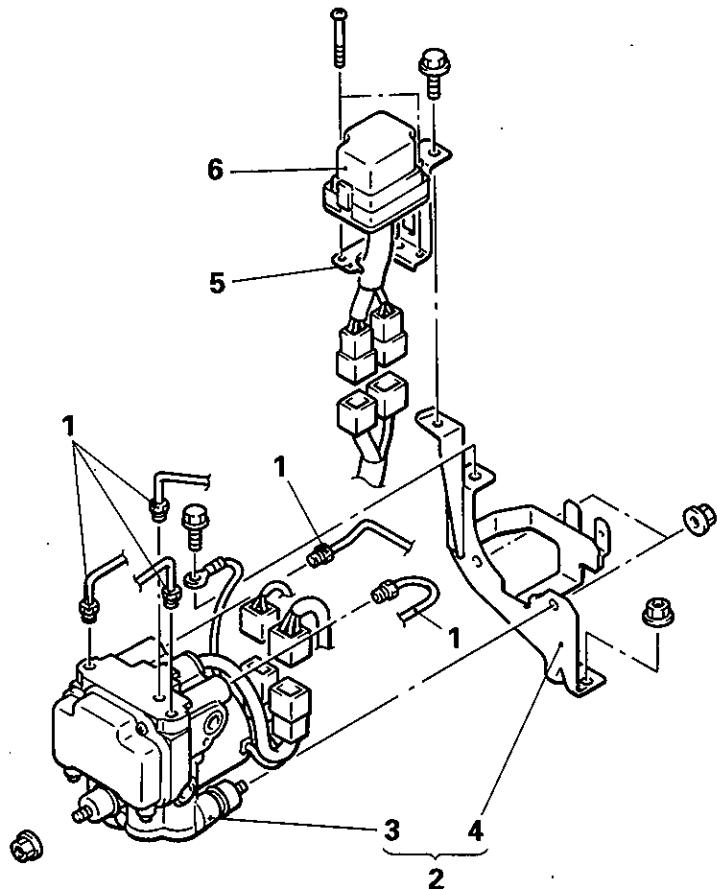
14F038

<Diesel-powered vehicles – L.H. drive>



14E0202

<Petrol-powered vehicles, Diesel powered vehicles – R.H. drive>



14E0203

Removal steps

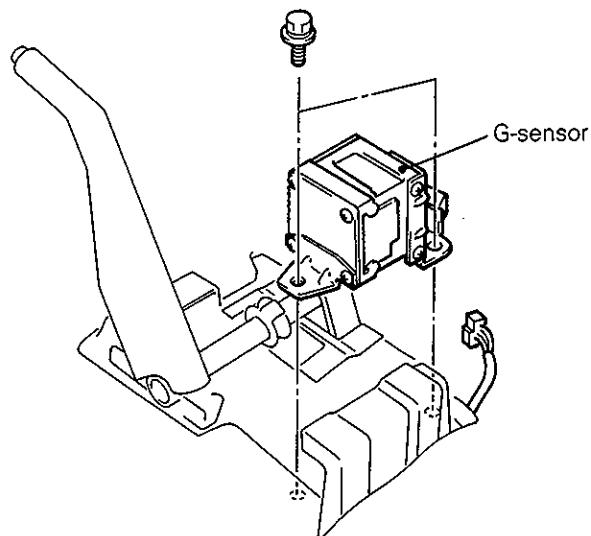
- 1. Brake tube connection
- 2. Hydraulic unit assembly
- 3. Hydraulic unit
- 4. Hydraulic unit bracket
- 5. Relay box bracket
- 6. Relay box assembly

G-SENSOR <A.B.S.>**REMOVAL AND INSTALLATION****Pre-removal and Post-installation
Operation**

- Removal and Installation of Floor Console
(Refer to GROUP 52 – Floor Console.)

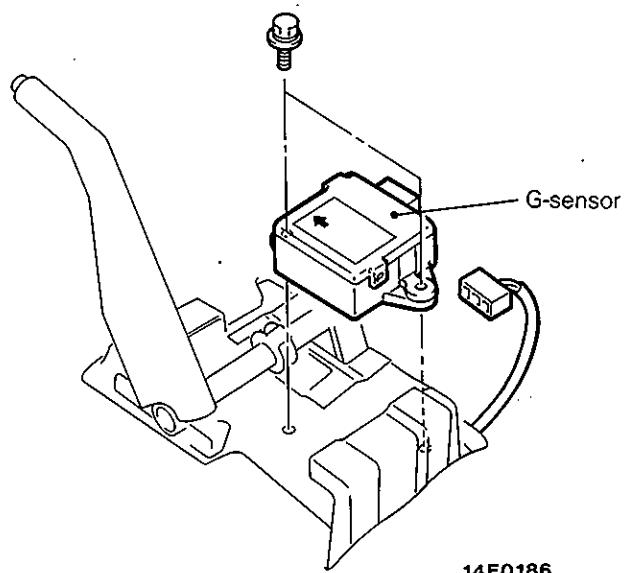
E35NA--

<Vehicles built up to October, 1993>



14E0062

<Vehicles built from November, 1993>



14E0186

Caution

When removing the G sensor, take care not to drop it or subject it to severe impact.

WHEEL SPEED SENSOR <A.B.S.>

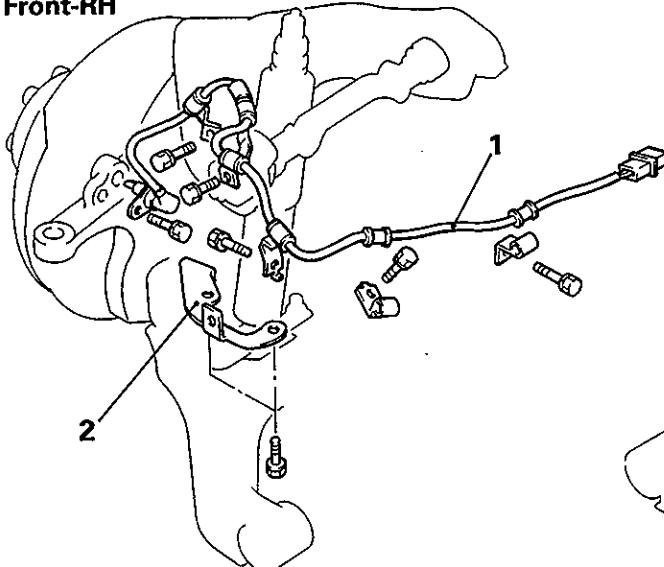
E35YA-

REMOVAL AND INSTALLATION

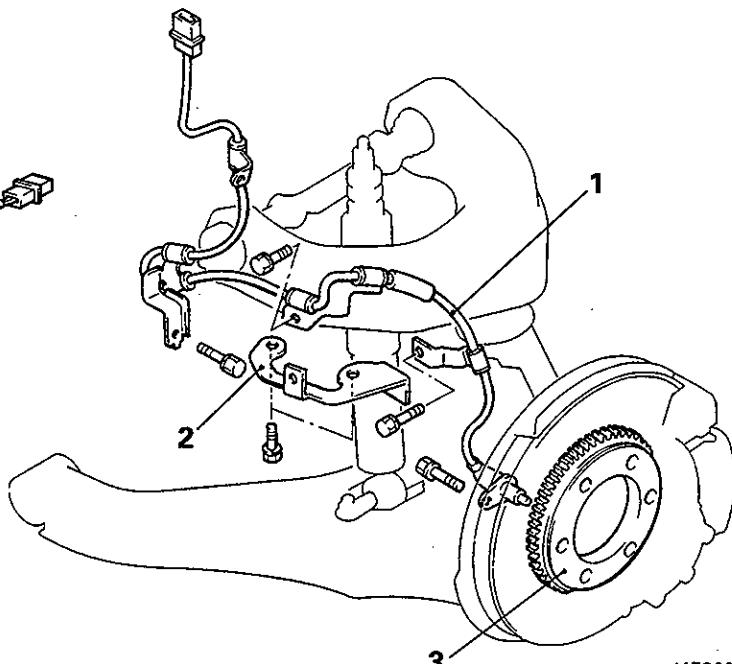
Post-installation Operation

- Checking of the Anti-lock Brake System (Refer to P.35-48.)

Front-RH



Front-LH



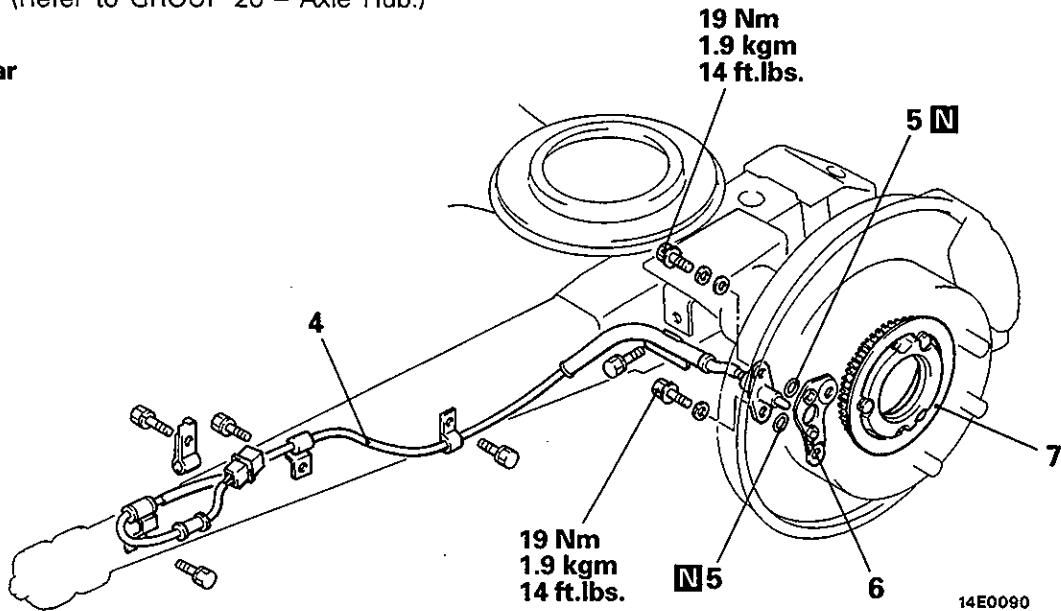
14E0092

Front speed sensor removal steps

➡➡➡

1. Front speed sensor
2. Harness bracket
3. Front rotor
(Refer to GROUP 26 – Axle Hub.)

Rear



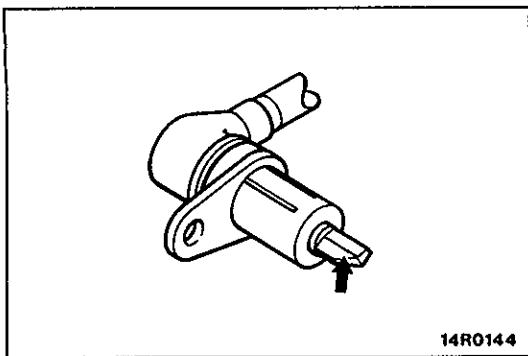
14E0090

Rear speed sensor removal steps

➡➡➡

4. Rear speed sensor
5. Sealant
6. Sensor bracket
7. Rear rotor

} (Refer to GROUP 27 – Axle shaft.)



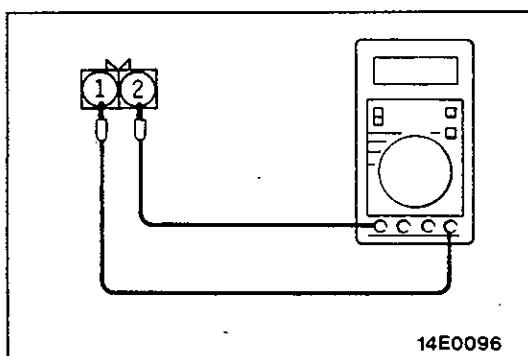
SERVICE POINTS OF REMOVAL

E35YBAE

1. REMOVAL OF THE FRONT SPEED SENSOR/4. REAR SPEED SENSOR

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

E35YCAAa

SPEED SENSOR

(1) Check whether any metallic foreign material has adhered to the pole piece at the speed sensor tip, and, if so, remove it.

Also check whether the pole piece is damaged, and, if so, replace it with a new one.

NOTE

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

(2) Measure the resistance between the speed sensor terminals.

Standard value:

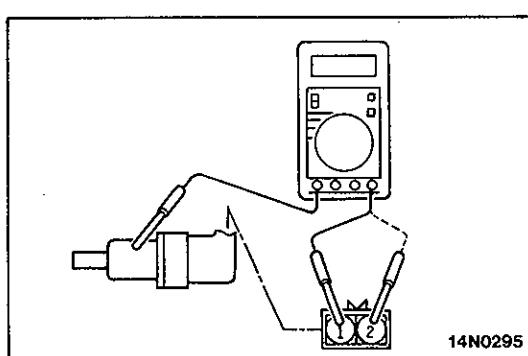
Front:	0.9–1.1 kΩ
Rear:	1.3–2.1 kΩ

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

(3) 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: 100kΩ or more

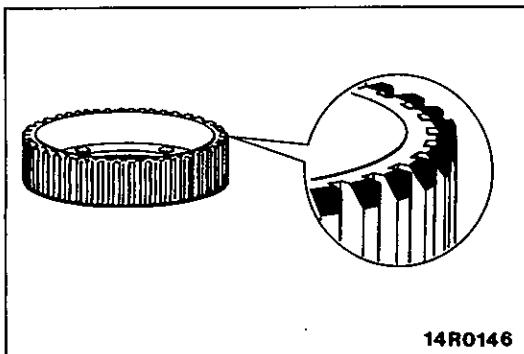
If the speed sensor insulation resistance is outside the standard value range, replace with a new speed sensor.



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

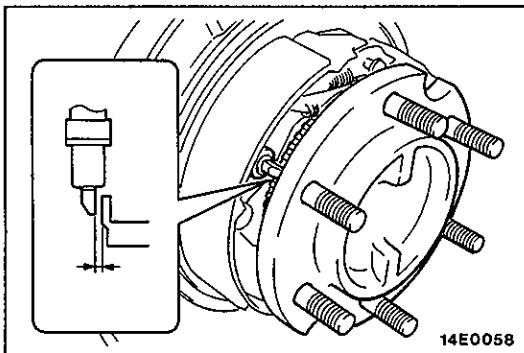
NOTE

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.



TOOTCHED ROTOR

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



SERVICE POINTS OF INSTALLATION

E35YDAE

4. INSTALLATION OF REAR SPEED SENSOR

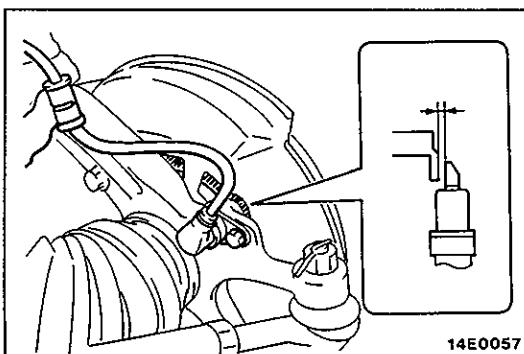
Insert a thickness gauge into the space between the speed sensor's pole piece and the rotor's toothed surface and then tighten the speed sensors at the position where the clearance is the standard value.

Standard value: 0.3–0.9 mm (0.012–0.035 in.)

NOTE

Check to be sure that there is no contact of the speed sensor's pole piece and the rotor's toothed surface when the rear hub assembly is slowly rotated one time.

If there is contact, it is probable that the rotor or the rear hub is installed incorrectly, recheck installation.



1. INSTALLATION OF FRONT SPEED SENSOR

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

Standard value: 0.2–1.0 mm (0.008–0.039 in.)

NOTE

If the clearance between the speed sensor's pole piece and the rotor's toothed surface is not within the standard value range, it is probable that the rotor is incorrectly installed, recheck installation.

ELECTRONIC CONTROL UNIT <A.B.S.>

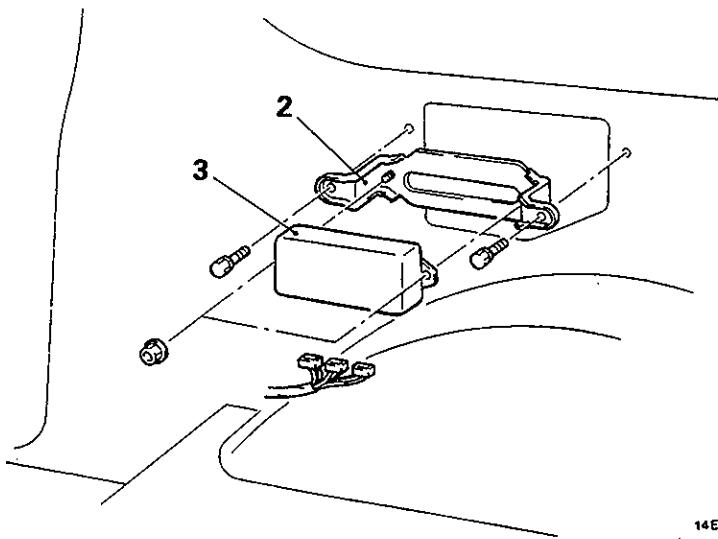
E35ZA--

REMOVAL AND INSTALLATION

<2-door models>

Removal steps

- Quarter trim, lower
(Refer to GROUP 52 – Trim.)
- 2. Bracket
- 3. Electronic control unit

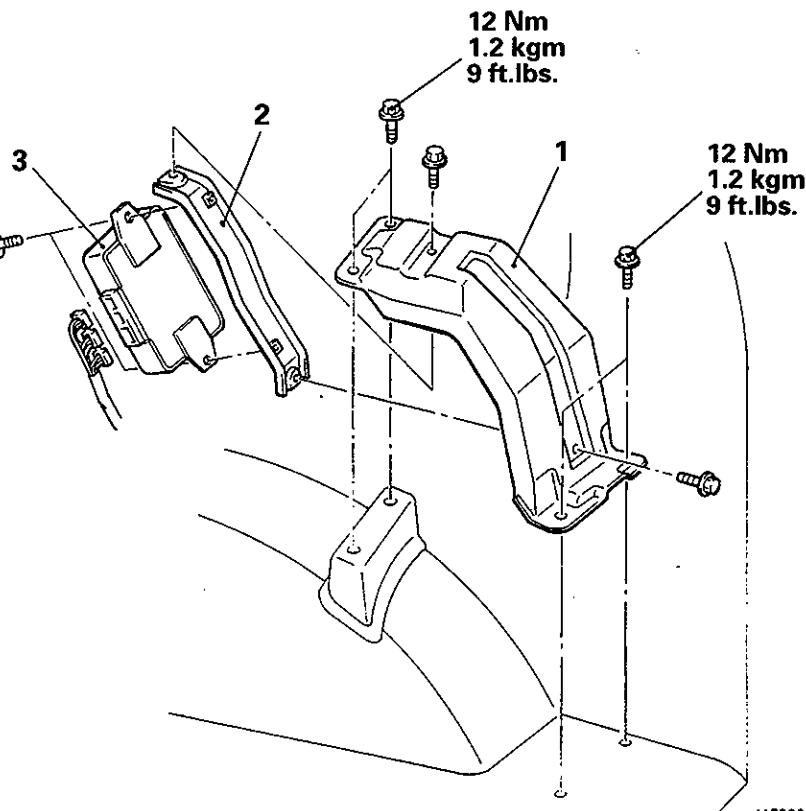


14E0097

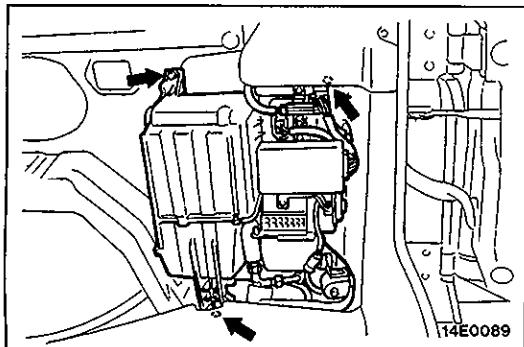
<4-door models>

Removal steps

- Quarter trim, lower
(Refer to GROUP 52 – Trim.)
- 1. Third seat bracket (A)
<vehicles with rear air conditioning>
- 2. Bracket
- 3. Electronic control unit



14E0098



SERVICE POINTS OF REMOVAL

E35ZBAC

1. REMOVAL OF THIRD SEAT BRACKET (A) <VEHICLES WITH REAR AIR CONDITIONING>

- (1) Remove the rear air conditioning unit mounting bolt.
- (2) Remove the third seat bracket (A) mounting bolt, and pull the third seat bracket (A) forward.