

# SERVICE BRAKES

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# BASIC BRAKE SYSTEM

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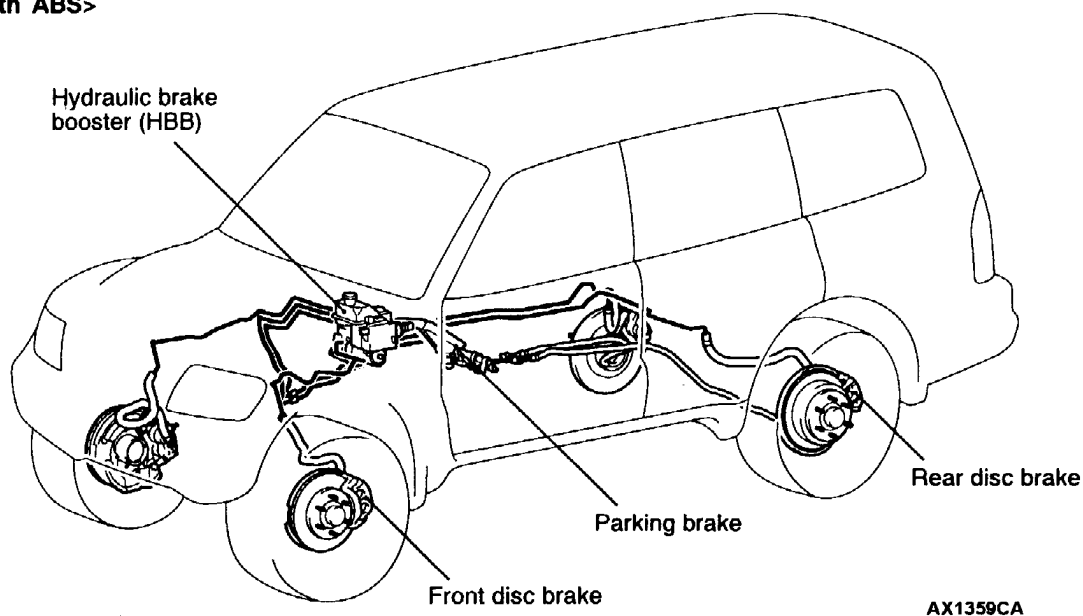
## GENERAL INFORMATION

The brake system offers high dependability and durability along with improved braking performance and brake sensitivity.

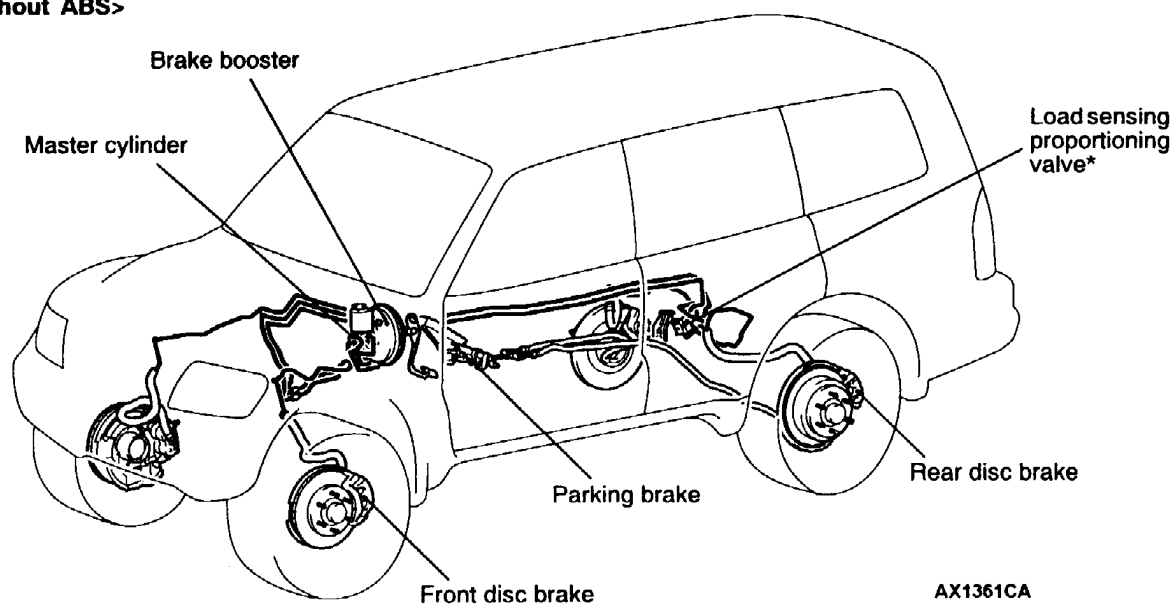
| Items                                                          |                                     | Specifications                              |
|----------------------------------------------------------------|-------------------------------------|---------------------------------------------|
| Hydraulic brake booster (HBB) <Vehicles with ABS>              | Master cylinder type                | Single type (with center valve)             |
|                                                                | Master cylinder I.D. mm             | 22.22                                       |
|                                                                | Boosting ratio                      | 5.4 <Pedal depressing force: 274 N>         |
| Master cylinder <Vehicles without ABS>                         | Type                                | Tandem type                                 |
|                                                                | I.D. mm                             | 23.81                                       |
| Brake booster <Vehicles without ABS>                           | Type                                | Vacuum type, tandem                         |
|                                                                | Effective dia. of power cylinder mm | 216 + 217                                   |
|                                                                | Boosting ratio                      | 6.5 <Pedal depressing force: 240 N>         |
| Rear wheel hydraulic pressure control type <Vehicles with ABS> |                                     | Electronic brake-force distribution (EBD)   |
| Load sensing proportioning valve<Vehicles without ABS>         | Decompression ratio                 | 0.3                                         |
| Front brakes                                                   | Type                                | Floating caliper, 2 piston, ventilated disc |
|                                                                | Disc effective dia. × thickness mm  | 241 × 26                                    |
|                                                                | Wheel cylinder I.D. mm              | 45.4                                        |
|                                                                | Pad thickness mm                    | 10.0                                        |
|                                                                | Clearance adjustment                | Automatic                                   |
| Rear brakes                                                    | Type                                | Floating caliper, 1 piston, ventilated disc |
|                                                                | Disc effective dia. × thickness mm  | 256 × 22                                    |
|                                                                | Wheel cylinder I.D. mm              | 44.5                                        |
|                                                                | Pad thickness mm                    | 10.0                                        |
|                                                                | Clearance adjustment                | Automatic                                   |
| Brake fluid                                                    |                                     | DOT3 or DOT4                                |

## CONSTRUCTION DIAGRAM

## &lt;Vehicles with ABS&gt;



## &lt;Vehicles without ABS&gt;



## NOTE

For short wheelbase, only the position indicated by the \* is symmetrical.

## SERVICE SPECIFICATIONS

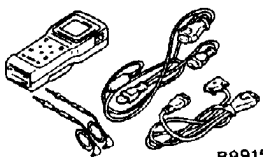
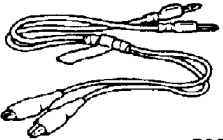
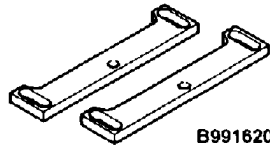
| Items                                                                                                       |                                                           |                                                              |                    | Standard value | Limit |
|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------|--------------------|----------------|-------|
| Brake pedal height<br>mm                                                                                    | L.H. drive vehicles                                       |                                                              |                    | 192 – 195      | –     |
|                                                                                                             | R.H. drive vehicles                                       |                                                              |                    | 187 – 190      | –     |
| Brake pedal play mm                                                                                         |                                                           |                                                              |                    | 3 – 8          | –     |
| Brake pedal to floorboard clearance when the brake pedal is depressed mm                                    |                                                           |                                                              |                    | 90 or more     | –     |
| Hydraulic brake booster (HBB)<br><Vehicles with ABS>                                                        | Pump motor operation time<br>second                       | When power supply system brake fluid pressure is not applied |                    | 20 – 80        | –     |
|                                                                                                             |                                                           | When power supply system brake fluid pressure is applied     |                    | 2 – 11         | –     |
|                                                                                                             | Hydraulic pressure during no vacuum operation test<br>MPa | Pedal depression force: 100 N                                | Front              | 0.6 or more    | –     |
|                                                                                                             |                                                           |                                                              | Rear               | 0              | –     |
|                                                                                                             |                                                           | Pedal depression force: 500 N                                | Front              | 4.5 or more    | –     |
|                                                                                                             |                                                           |                                                              | Rear               | 0              | –     |
|                                                                                                             | Hydraulic pressure during vacuum operation test MPa       | Pedal depression force: 100 N                                | Front              | 3.0 – 4.0      | –     |
|                                                                                                             |                                                           |                                                              | Rear               | 3.3 – 4.3      | –     |
|                                                                                                             |                                                           | Pedal depression force: 200 N                                | Front              | 8.0 – 10.0     | –     |
|                                                                                                             |                                                           |                                                              | Rear               | 8.0 – 10.0     | –     |
|                                                                                                             |                                                           | Pedal depression force: 400 N                                | Front              | 14.0 – 18.0    | –     |
|                                                                                                             |                                                           |                                                              | Rear               | 14.0 – 18.0    | –     |
|                                                                                                             |                                                           | Pedal depression force: 500 N                                | Front              | 15.0 – 19.0    | –     |
|                                                                                                             |                                                           |                                                              | Rear               | 15.0 – 19.0    | –     |
| Clearance between brake booster push rod and primary piston<br>mm <Vehicles without ABS>                    |                                                           |                                                              | 6G7                | 0.5 – 0.9      | –     |
|                                                                                                             |                                                           |                                                              | 4D5, 4M4           | 0.8 – 1.2      | –     |
| Load sensing proportioning valve output fluid pressure (Input fluid pressure) MPa<br><Vehicles without ABS> | When load sensing spring length is 133 mm (when unladen)  | Short wheelbase                                              | 4.9 – 5.9 (9.8)    | –              |       |
|                                                                                                             |                                                           | Long wheelbase                                               | 5.9 – 6.9 (9.8)    | –              |       |
|                                                                                                             | When load sensing spring length is 149 mm (when laden)    | Short wheelbase                                              | 7.5 – 8.5 (9.8)    | –              |       |
|                                                                                                             |                                                           |                                                              | 9.0 – 11.0 (16.7)  | –              |       |
|                                                                                                             |                                                           | Long wheelbase                                               | 9.3 – 10.3 (9.8)   | –              |       |
|                                                                                                             |                                                           |                                                              | 11.4 – 13.4 (16.7) | –              |       |
| Load sensing spring length <Distance between spring ends> mm<br><Vehicles without ABS>                      |                                                           |                                                              |                    | 135 – 139      | –     |

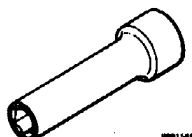
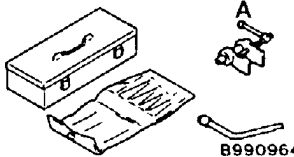
| Items                 |                   | Standard value | Limit |
|-----------------------|-------------------|----------------|-------|
| Front disc brake      | Pad thickness mm  | 10.0           | 2.0   |
|                       | Disc thickness mm | 26.0           | 24.4  |
|                       | Disc runout mm    | –              | 0.06  |
|                       | Drag force N      | 55             | –     |
| Rear disc brake       | Pad thickness mm  | 10.0           | 2.0   |
|                       | Disc thickness mm | 22.0           | 20.4  |
|                       | Disc runout mm    | –              | 0.06  |
|                       | Drag force N      | 55             | –     |
| Front hub end play mm |                   | –              | 0     |
| Rear hub end play mm  |                   | –              | 0     |

## LUBRICANTS

| Items                       | Specified Lubricant | Quantity    |
|-----------------------------|---------------------|-------------|
| Brake fluid                 | DOT3 or DOT4        | As required |
| Piston boot, piston seal    | Repair kit grease   |             |
| Guide pin, lock pin         |                     |             |
| Piston, wheel cylinder body | DOT3 or DOT4        |             |

## SPECIAL TOOLS

| Tool                                                                                        | Number   | Name                            | Use                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------|----------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  B991502 | MB991502 | MUT-II sub assembly             | <ul style="list-style-type: none"> <li>Hydraulic brake booster (HBB) check (Reading diagnosis code by using MUT-II)</li> <li>Air bleeding of hydraulic brake booster (HBB) ABS system</li> </ul> |
|  B991529 | MB991529 | Diagnosis code check harness    | <ul style="list-style-type: none"> <li>Hydraulic brake booster (HBB) check (Reading diagnosis code by using brake warning lamp)</li> <li>Erasing diagnosis code (not using MUT-II)</li> </ul>    |
|  B991620 | MB991620 | Valve spring compressor adapter | Holding hydraulic brake booster (HBB)                                                                                                                                                            |

| Tool                                                                              | Number                  | Name                                            | Use                                                        |
|-----------------------------------------------------------------------------------|-------------------------|-------------------------------------------------|------------------------------------------------------------|
|  | MB991568                | Push rod adjusting socket                       | Adjustment of the brake booster push rod protrusion amount |
|  | MB990964<br>A: MB990520 | Brake tool set<br>A: Disc brake piston expander | Pushing-in of the disc brake piston                        |

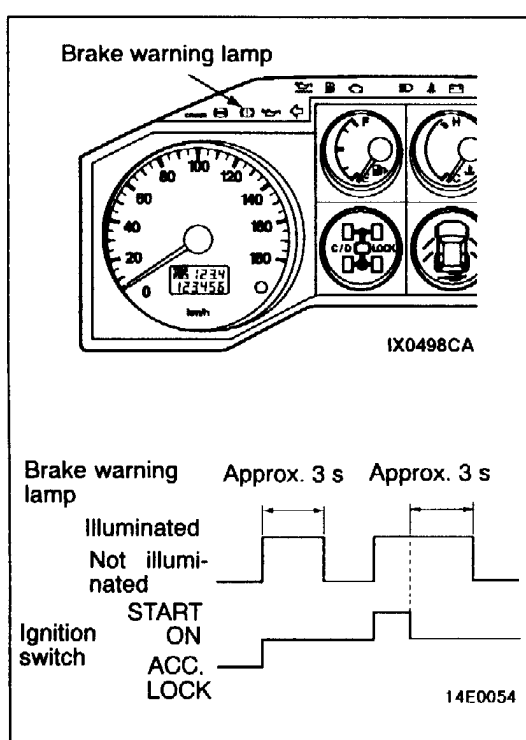
## TROUBLESHOOTING <Vehicles with ABS>

### STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

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

### NOTES WITH REGARD TO DIAGNOSIS

1. The hydraulic brake booster (HBB) accumulates a high-pressure fluid in the accumulator by operating the pump motor, thus boosting the brake. Therefore, the pump motor generates an operating sound, but it indicates that the HBB is operating correctly, and it is not a malfunction.
2. Diagnosis detection condition can vary depending on the diagnosis code.  
Make sure that checking requirements listed in the "Comment" are satisfied when checking the trouble symptom again.



### BRAKE WARNING LAMP INSPECTION

Check that the brake warning lamp illuminates as follows.

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

**DIAGNOSIS FUNCTION****READING DIAGNOSIS CODES**

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

**NOTE**

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

**ERASING DIAGNOSIS CODES****When using the MUT-II**

Connect the MUT-II to the diagnosis connector (16-pin) and erase the diagnosis code.

**Caution**

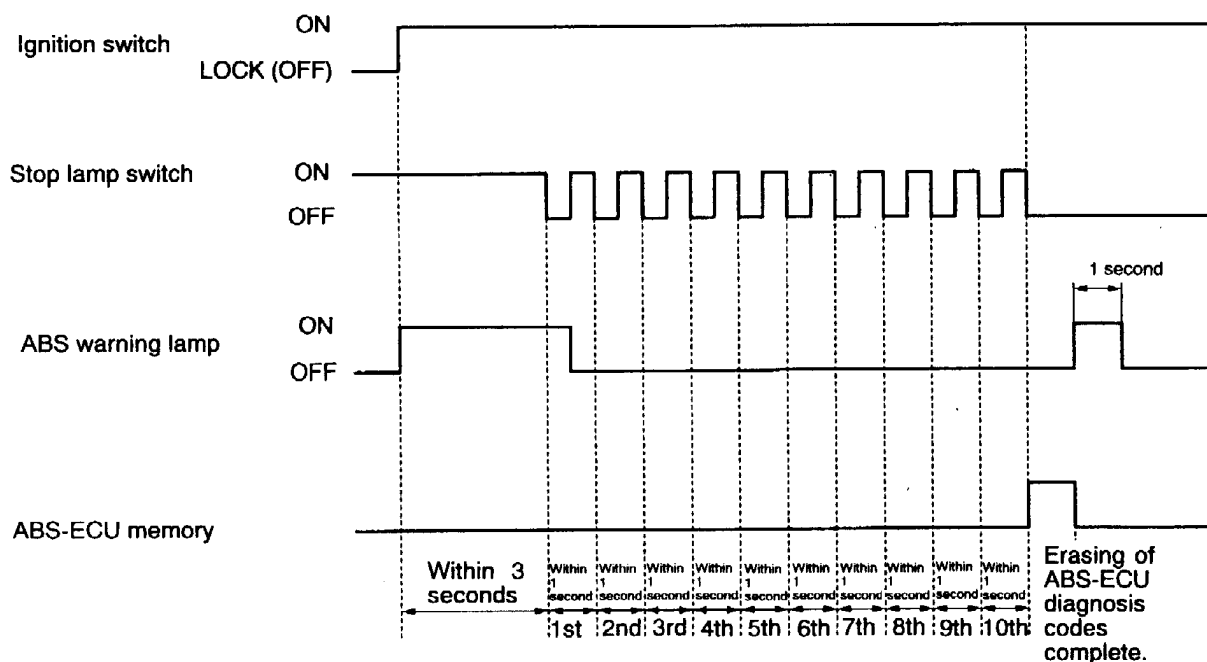
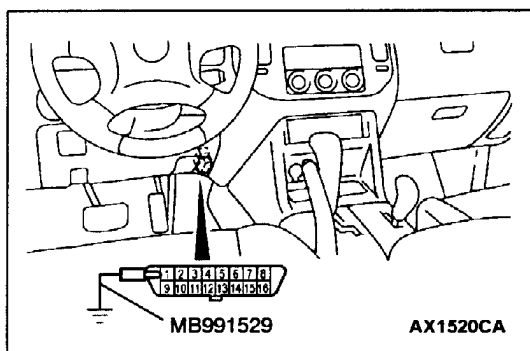
Turn the ignition key to the **LOCK (OFF)** position before connecting or disconnecting the MUT-II.

**When not using the MUT-II**

1. Stop the engine.
2. Use the special tool to earth terminal (1) (diagnosis control terminal) of the diagnosis connector.
3. Turn on the stop lamp switch. (Depress the brake pedal.)
4. After carrying out steps 1. to 3., turn the ignition switch to ON. Within 3 seconds after turning the ignition switch to ON, turn off the stop lamp switch (release the brake pedal). Then, turn the stop lamp switch on and off a total of 10 times.

**NOTE**

If the ABS-ECU function has been stopped because of fail-safe operation, it will not be possible to erase the diagnosis codes.



## INSPECTION CHART FOR DIAGNOSIS CODES

| Diagnosis code No. | Diagnosis items                                                                                             | Reference page                  |
|--------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------|
| 16*                | ABS-ECU power supply (Abnormal voltage decrease or increase)                                                | 35A-9                           |
| 17, 18             | ABS-ECU power supply (Open circuit or short circuit)                                                        |                                 |
| 53                 | Motor relay system (open circuit, short circuit or motor relay coil failure)                                | 35A-10                          |
| 55                 | Pump motor system (Pump motor seized or abnormal ABS-ECU current detection circuit)                         | 35A-11                          |
| 63                 | ABS-ECU system                                                                                              | Replace ABS-ECU (Refer to 35B.) |
| 78                 | Accumulator system (Motor has been energized abnormally for long time or abnormal low-pressure accumulator) | 35A-12                          |
| 79                 | Pressure switch system (open circuit or short circuit)                                                      | 35A-13                          |

## NOTE

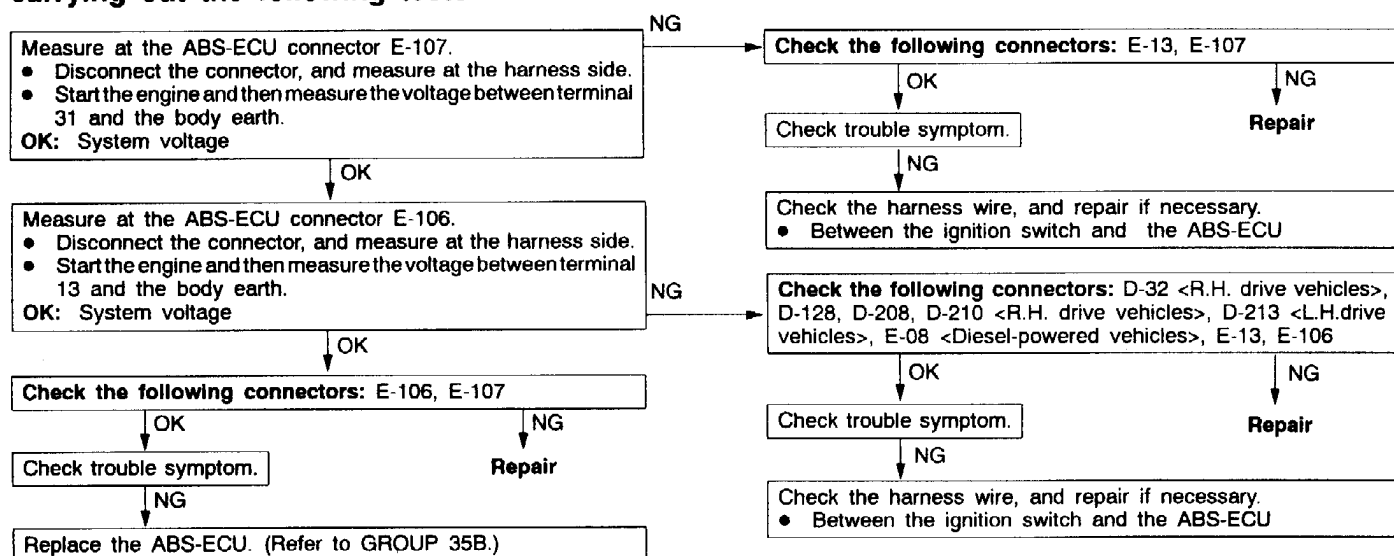
\*: Code No. 16 is erased by turning the ignition switch OFF.

## INSPECTION PROCEDURE FOR DIAGNOSIS CODES

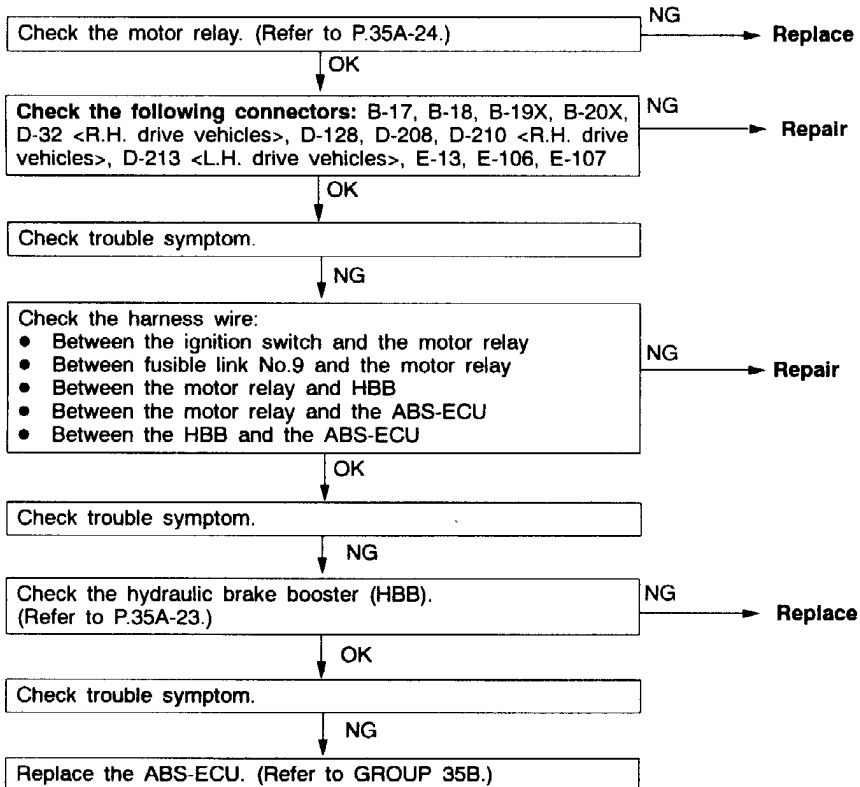
|                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Code No.16 ABB-ECU power supply system (abnormal voltage increase or decrease)</b>                                                                                                                                                                                                                            | <b>Probable cause</b>                                                                                                                                               |
| <b>Code No.17, 18 ABS-ECU power supply system (open or short circuit)</b>                                                                                                                                                                                                                                        |                                                                                                                                                                     |
| Code No.16 is output if the ABS-ECU power supply voltage is increased or decreased than the specified.<br>Code No.17, 18 is output if the ABS-ECU power supply circuit is open or short, or the ABS-ECU internal circuit is defective.<br>In addition, code No. 16 is erased by turning the ignition switch OFF. | <ul style="list-style-type: none"> <li>• Malfunction of the battery</li> <li>• Malfunction of connector or harness</li> <li>• Malfunction of the ABS-ECU</li> </ul> |

## Caution

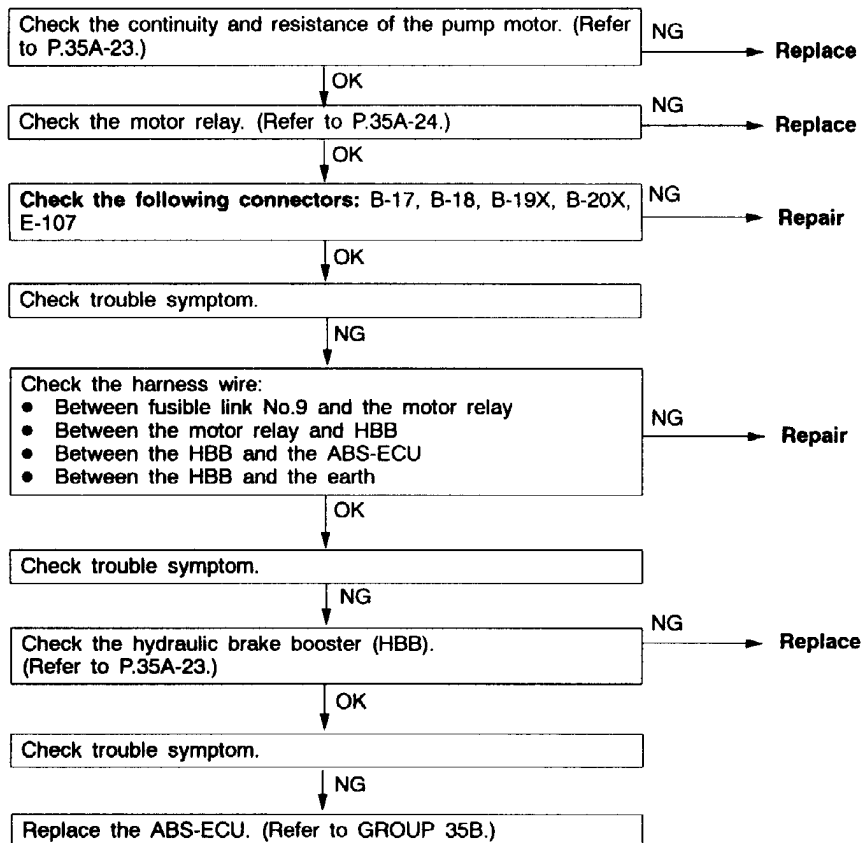
If the battery voltage is decreased or increased during the test, code No. 16 is output as a present malfunction, disabling a correct diagnosis. Check the battery and fully charge it if necessary before carrying out the following tests.



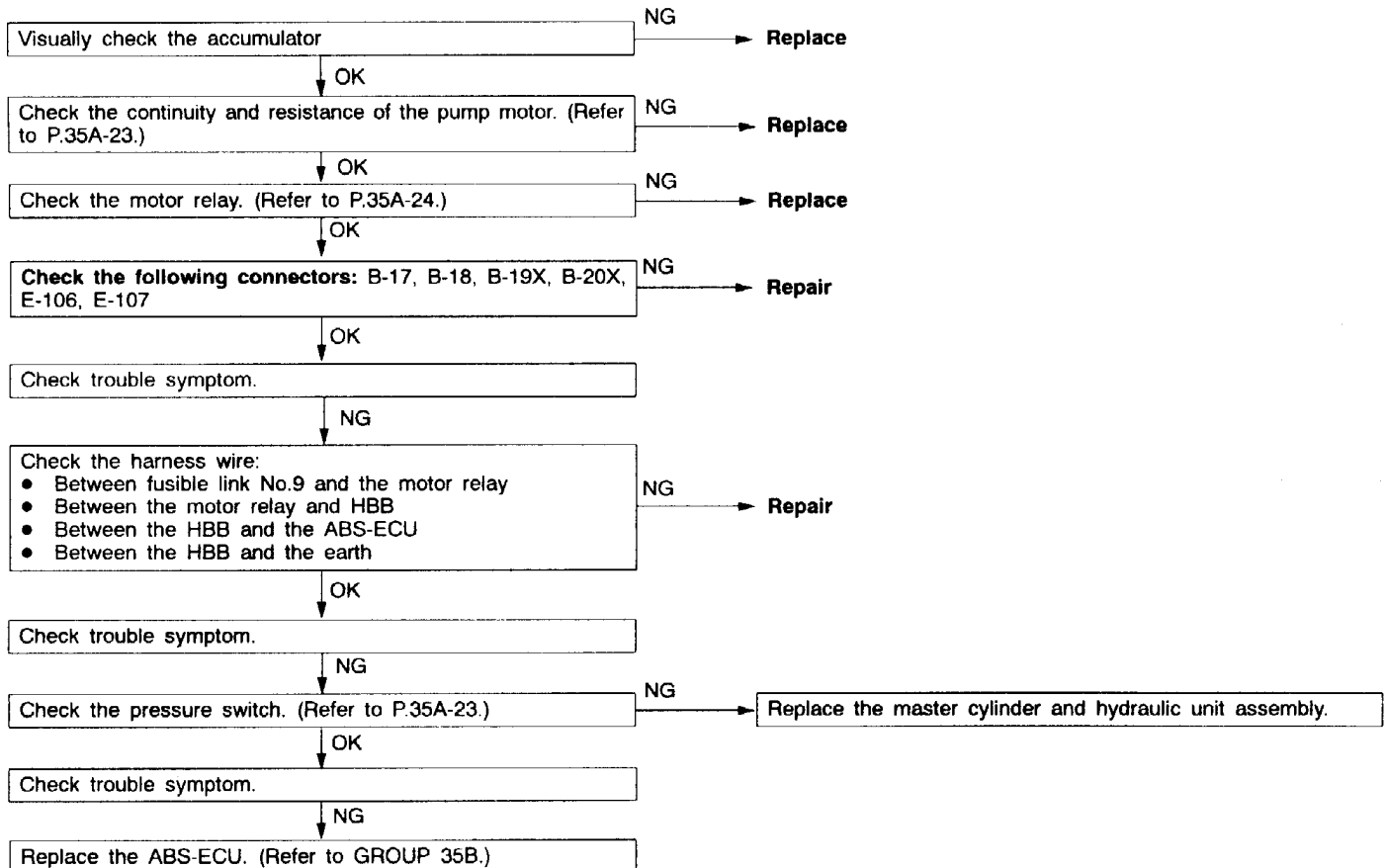
| Code No.53 Motor relay system (open circuit, short circuit or a defective motor relay coil)                                                                                                            | Probable cause                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This code is output if the motor relay circuit is short or open, ABS-ECU internal circuit is defective, or the hydraulic brake booster (HBB) master cylinder and hydraulic unit assembly is defective. | <ul style="list-style-type: none"> <li>• Malfunction of connector or harness</li> <li>• Malfunction of the motor relay</li> <li>• Malfunction of the ABS-ECU</li> <li>• Malfunction of the HBB (master cylinder and hydraulic unit assembly)</li> </ul> |



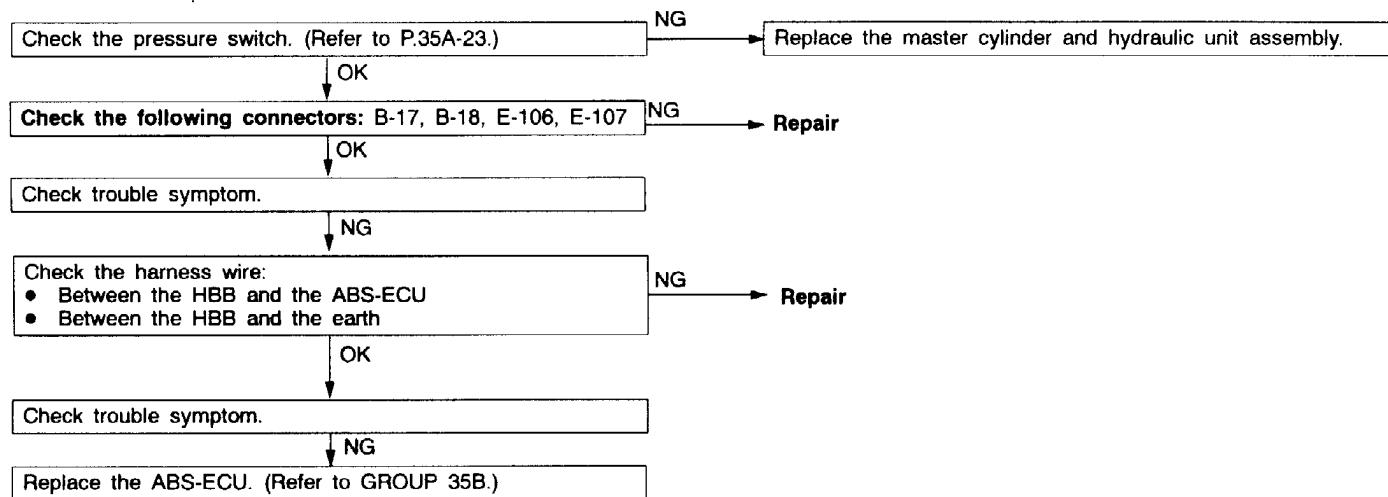
| Code No.55 Pump motor system (pump motor seized or abnormal ABS-ECU current detection circuit)                                                                                                                                                    | Probable cause                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This code is output if the motor relay drive circuit is short or open, the motor relay or the ABS-ECU internal circuit is defective, or the hydraulic brake booster (HBB) pump motor or master cylinder and hydraulic unit assembly is defective. | <ul style="list-style-type: none"> <li>• Malfunction of connector or harness</li> <li>• Malfunction of the motor relay</li> <li>• Malfunction of the ABS-ECU</li> <li>• Malfunction of the HBB (pump motor or master cylinder and hydraulic unit assembly)</li> </ul> |



| Code No. 78 Accumulator system (Motor has been energized abnormally for long time or abnormal low-pressure accumulator)                                                                                                                                                                                                                               | Probable cause                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>This code is output under the following cases:</p> <ul style="list-style-type: none"> <li>• Pump motor is operated for consecutive 300 seconds</li> <li>• Brake fluid pressure is decreased, the HBB buzzer sounds due to the operation of the pressure switch (for low pressure warning), and then the brake warning lamp illuminates.</li> </ul> | <ul style="list-style-type: none"> <li>• Brake fluid leaks inside the hydraulic brake booster (HBB)</li> <li>• Malfunction of the HB motor relay</li> <li>• Malfunction of connector or harness</li> <li>• Malfunction of the ABS-ECU</li> <li>• Malfunction of HBB (accumulator, pressure switch, pump motor or master cylinder and hydraulic unit assembly)</li> </ul> |



| Code No.79 Pressure switch system (open or short circuit)                                                                                                                                                             | Probable cause                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This code is output if the pressure switch circuit is short, ABS-ECU internal circuit is defective, or the hydraulic brake booster (HBB) pressure switch or master cylinder and hydraulic unit assembly is defective. | <ul style="list-style-type: none"> <li>• Malfunction of connector or harness</li> <li>• Malfunction of the ABS-ECU</li> <li>• Malfunction of the HBB (pressure switch or master cylinder and hydraulic unit assembly)</li> </ul> |

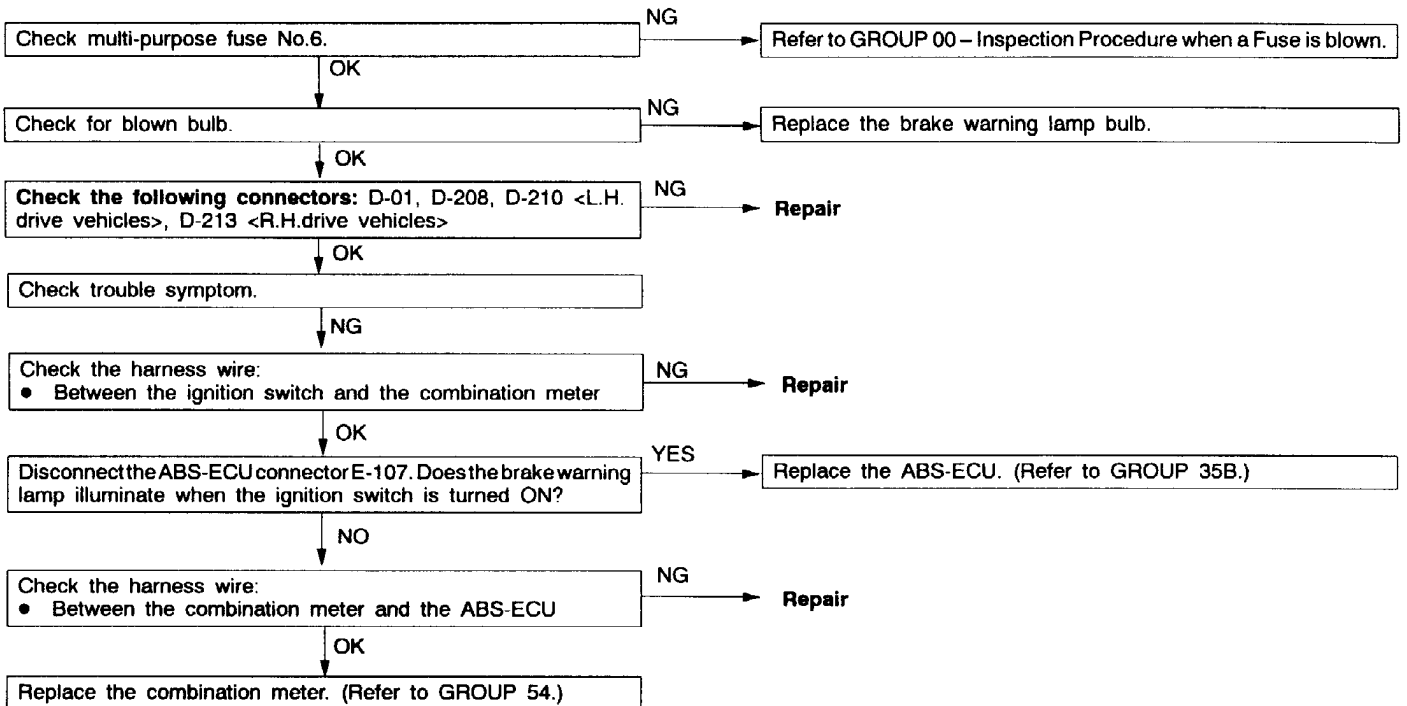


## INSPECTION CHART FOR TROUBLE SYMPTOMS

| Trouble symptom                                                                                                                      | Inspection procedure No. | Reference page |
|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------|
| The brake warning lamp does not illuminate when the ignition switch is turned ON (engine stopped).                                   | 1                        | 35A-14         |
| The brake warning lamp remains illuminated after the engine is started.                                                              | 2                        | 35A-15         |
| The HBB buzzer does not sound when the hydraulic brake booster (HBB) is defective. (However, the brake warning lamp is illuminated.) | 3                        | 35A-15         |
| The HBB buzzer does not stop sounding.                                                                                               | 4                        | 35A-16         |
| Communication with MUT-II is not possible.                                                                                           | Refer to GROUP 35B.      |                |
| Communication with MUT-II and the ABS-ECU is not possible.                                                                           |                          |                |

## Inspection procedure 1

| The brake warning lamp does not illuminate when the Ignition switch is turned ON (engine stopped).                                                                                                                                                                                     | Probable cause                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The cause may be an open circuit in the lamp power supply circuit, a blown lamp, a malfunction of the lamp drive transistor inside the ABS-ECU, an open circuit between the ignition switch and brake warning lamp or an short circuit between the brake warning lamp and the ABS-ECU. | <ul style="list-style-type: none"> <li>• Blown fuse</li> <li>• Burn out brake warning lamp bulb</li> <li>• Malfunction of combination meter</li> <li>• Malfunction of connector or harness</li> <li>• Malfunction of ABS-ECU (lamp drive transistor)</li> </ul> |

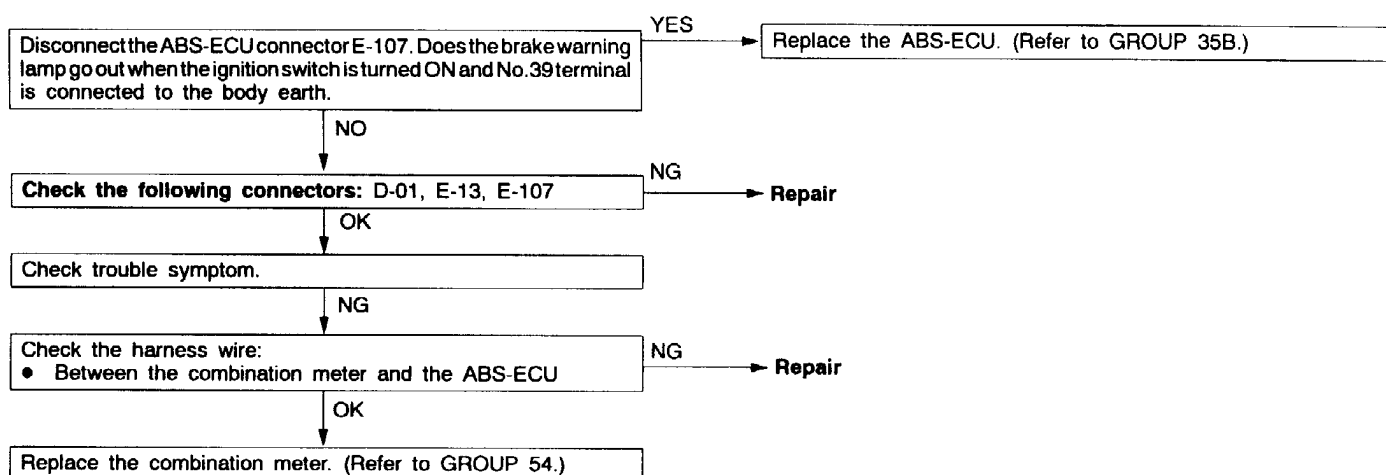


## Inspection procedure 2

| The brake warning lamp remains illuminated after the engine is started.                                                                              | Probable cause                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The cause is probably malfunction of the lamp drive transistor inside the ABS-ECU or an open circuit between the brake warning lamp and the ABS-ECU. | <ul style="list-style-type: none"> <li>• Malfunction of combination meter</li> <li>• Malfunction of connector or harness</li> <li>• Malfunction of ABS-ECU (lamp drive transistor)</li> </ul> |

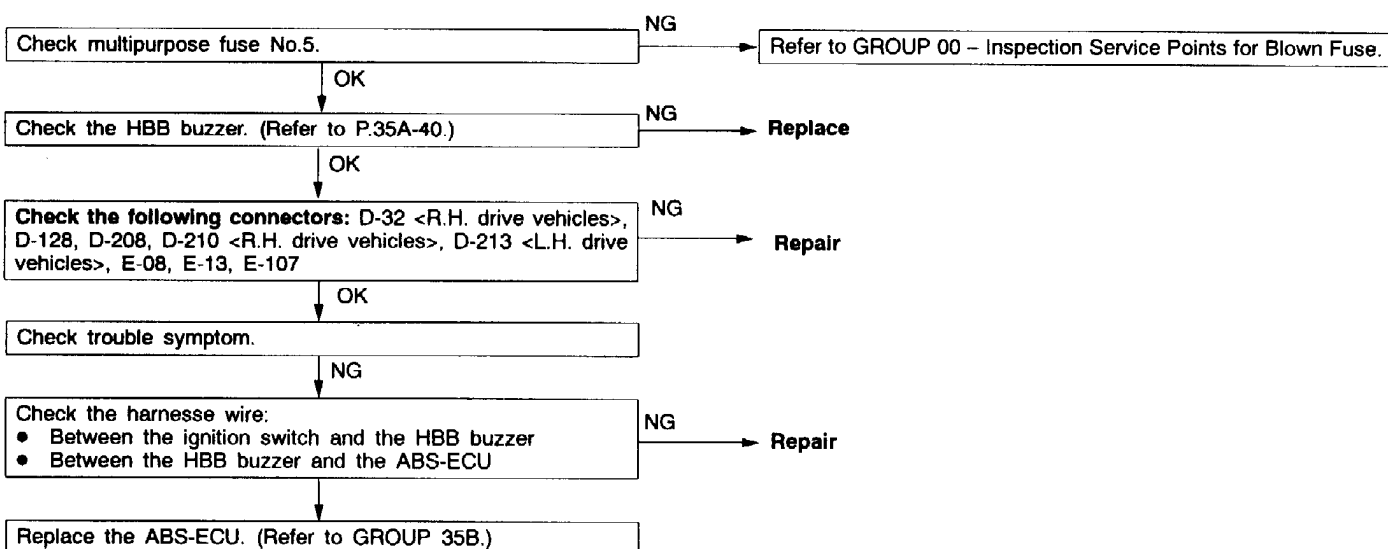
## NOTE

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 3

| The HBB buzzer does not sound when the hydraulic brake booster (HBB) is defective. (However, the brake warning lamp is illuminated.)                                                                                                             | Probable cause                                                                                                                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The cause is probably an open circuit in the buzzer power supply circuit, a defective buzzer, a malfunction of the buzzer drive transistor inside the ABS-ECU or an open circuit from the ignition switch through the HBB buzzer to the ABS-ECU. | <ul style="list-style-type: none"> <li>• Blown fuse</li> <li>• Malfunction of the HBB buzzer</li> <li>• Malfunction of connector or harness</li> <li>• Malfunction of ABS-ECU (buzzer drive transistor)</li> </ul> |

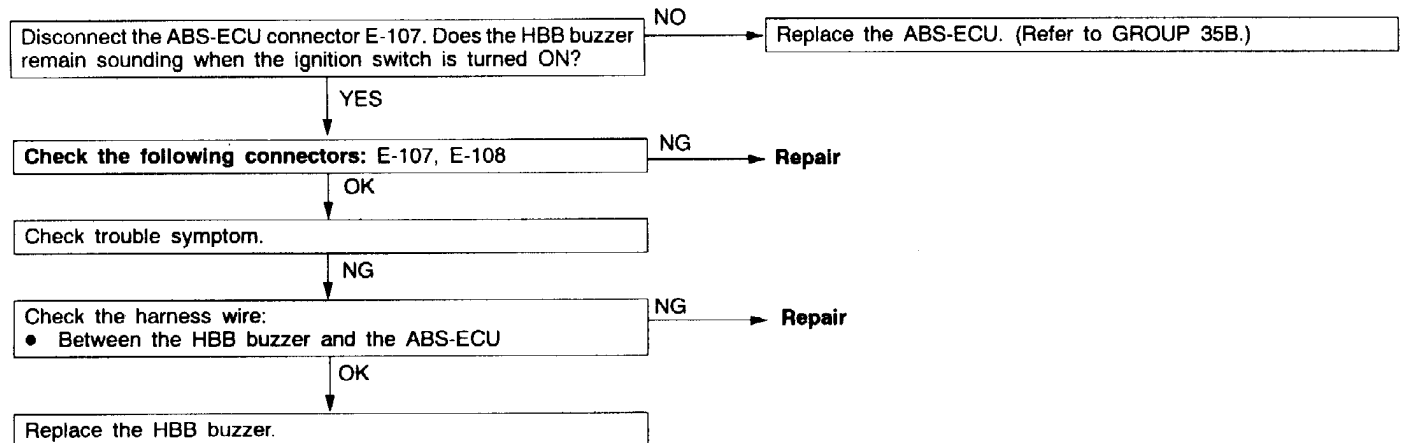


## Inspection procedure 4

| The HBB buzzer does not stop sounding. | Probable cause                                                                                                                                                                      |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The HBB buzzer circuit may be short.   | <ul style="list-style-type: none"> <li>• Malfunction of the HBB buzzer</li> <li>• Malfunction of the harness</li> <li>• Malfunction of ABS-ECU (buzzer drive transistor)</li> </ul> |

## 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.



## ACTUATOR TEST REFERENCE TABLE

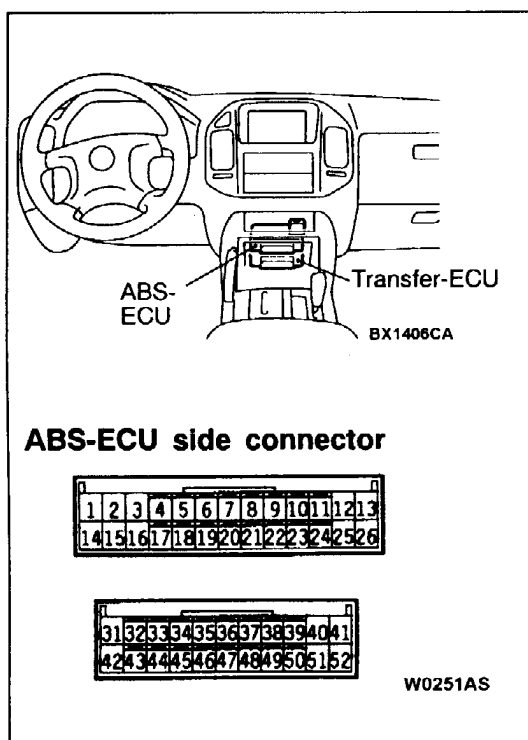
The MUT-II activates the following actuators for testing.

## NOTE

1. If the ABS-ECU runs down, actuator testing cannot be carried out.
2. Actuator testing is only possible when the vehicle is stationary.

## ACTUATOR TEST SPECIFICATIONS

| Item No. | Inspection item | Drive contents                         |
|----------|-----------------|----------------------------------------|
| 01       | HBB pump motor  | Operate the pump motor for one second. |
| 02       | HBB buzzer      | Sound the buzzer for three seconds.    |



## CHECK AT ABS-ECU

### NOTE

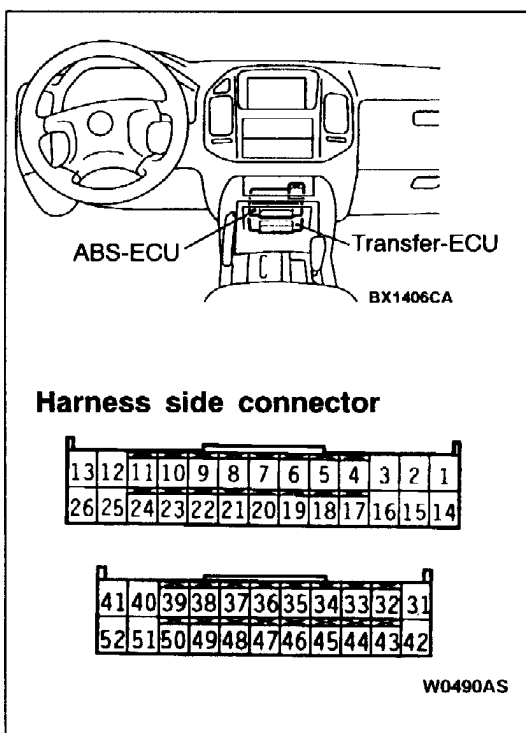
The two same ECUs are installed behind the floor console. The upper ECU is the ABS-ECU and has a blue connector. The lower ECU is the transfer-ECU and has a green connector.

### TERMINAL VOLTAGE CHECK CHART

1. Measure the voltage between each terminal and the earth.
2. The terminal layout is shown in the illustration.

| Terminal No. | Check item                                               | Check requirements               |                                                                              | Normal condition                     |
|--------------|----------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------|--------------------------------------|
| 36           | MUT-II                                                   | When the MUT-II is connected     |                                                                              | Serial communication with the MUT-II |
|              |                                                          | When the MUT-II is not connected |                                                                              | 1 V or less                          |
| 13, 31       | ABS-ECU power supply                                     | Ignition switch: ON              |                                                                              | System voltage                       |
|              |                                                          | Ignition switch: START           |                                                                              | 0 V                                  |
| 47           | Diagnosis changeover input                               | When the MUT-II is connected     |                                                                              | 1 V or less                          |
|              |                                                          | When the MUT-II is not connected |                                                                              | Approximately 12 V                   |
| 39           | Output to brake warning lamp                             | Ignition switch: ON              | When the lamp is off                                                         | 2 V or less                          |
|              |                                                          |                                  | When the lamp is on                                                          | System voltage                       |
| 44           | Output to the HBB buzzer                                 | Ignition switch: ON              | When the HBB buzzer does not sound                                           | System voltage                       |
|              |                                                          |                                  | When the HBB buzzer sounds                                                   | 2 V or less                          |
| 6, 38        | Output to the motor relay                                | Ignition switch: ON              | When the pump motor is not operating                                         | System voltage                       |
|              |                                                          |                                  | When the pump motor is operating                                             | 2 V or less                          |
| 17           | Output to the pressure switch (for low pressure warning) | Ignition switch: ON              | When the brake fluid pressure is low (When the HBB buzzer sounds)            | Approximately 9 V                    |
|              |                                                          |                                  | When the brake fluid pressure is normal (When the HBB buzzer does not sound) | Approximately 4 V                    |

| Terminal No. | Check item                                           | Check requirements  |                                                                                 | Normal condition |
|--------------|------------------------------------------------------|---------------------|---------------------------------------------------------------------------------|------------------|
| 43           | Output to pressure switch (for pump control)         | Ignition switch: ON | When the brake fluid pressure is low<br>(When the pump motor is operating)      | Approx. 6V       |
|              |                                                      |                     | When the brake fluid pressure is high<br>(When the pump motor is not operating) | 2 V or less      |
| 35           | Negative current detection input from the pump motor | Ignition switch: ON | When the pump motor is not operating                                            | 2 V or less      |
|              |                                                      |                     | When the pump motor is operating                                                | 2 V or less      |
| 49           | Voltage detection input from the pump motor          | Ignition switch: ON | When the pump motor is not operating                                            | 2 V or less      |
|              |                                                      |                     | When the pump motor is operating                                                | 2 V or less      |
| 45           | Positive current detection input from the pump motor | Ignition switch: ON | When the pump motor is not operating                                            | 2 V or less      |
|              |                                                      |                     | When the pump motor is operating                                                | System voltage   |



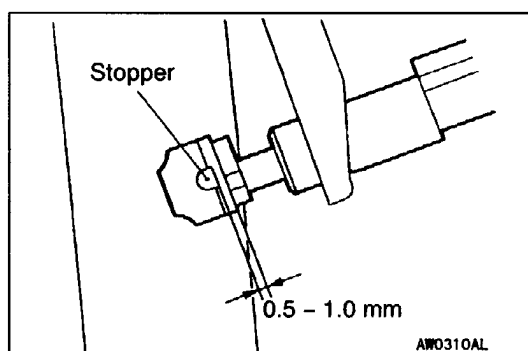
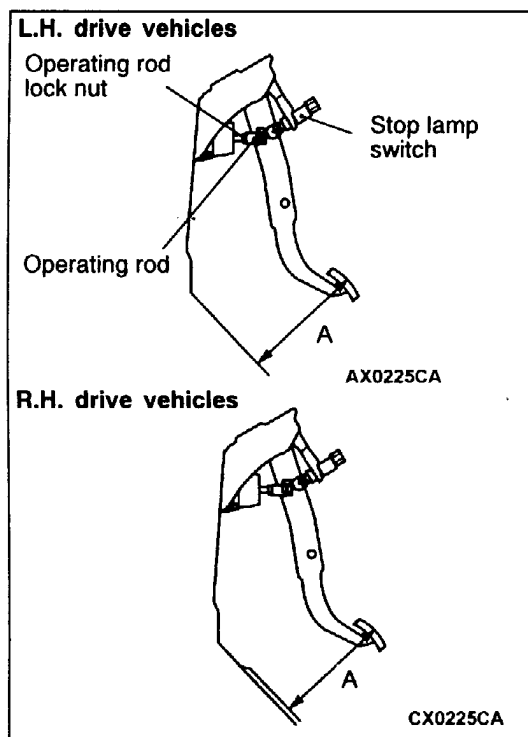
### CONTINUITY BETWEEN HARNESS-SIDE CONNECTOR TERMINALS

#### NOTE

The two same ECUs are installed behind the floor console. The upper ECU is the ABS-ECU and has a blue connector. The lower ECU is the transfer-ECU and has a green connector.

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

| Terminal No.                           | Signal name | Normal condition   |
|----------------------------------------|-------------|--------------------|
| Between terminal 12 and the body earth | Earth       | Continuity exists. |
| Between terminal 25 and the body earth | Earth       |                    |
| Between terminal 26 and the body earth | Earth       |                    |
| Between terminal 42 and the body earth | Earth       |                    |



## ON-VEHICLE SERVICE

### BRAKE PEDAL CHECK AND ADJUSTMENT

#### BRAKE PEDAL HEIGHT

1. Turn up the carpet, etc. under the brake pedal.
2. Measure the brake pedal height as illustrated.

#### Standard value (A):

<L.H. drive vehicles> 192 – 195 mm

<R.H. drive vehicles> 187 – 190 mm

3. If the brake pedal height is not within the standard value, follow the procedure below.
  - (1) Disconnect the stop lamp switch connector.
  - (2) Loosen the stop lamp switch by turning it approx. 1/4 turns anticlockwise.
  - (3) Remove the pin, and then adjust so that the brake pedal height meets the standard value by turning the clevis.

- (4) Screw in the stop lamp switch until it touches the stopper. At this time, support the brake pedal to the highest position by hand.
- (5) Lock the stop lamp switch by turning it approx. 1/4 turns clockwise, and confirm that the clearance between the switch plunger and the stopper is as shown.
- (6) Connect the connector at the stop lamp switch.

#### Caution

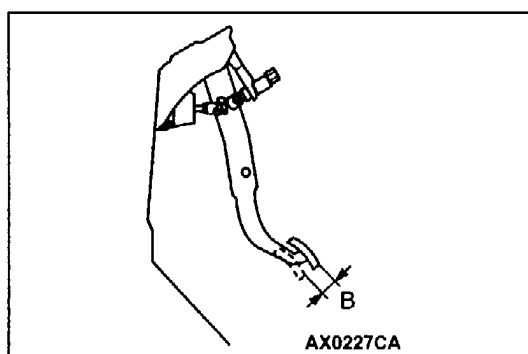
**Check that the stop lamp does not illuminate when the brake pedal is not depressed.**

4. For A/T, check the key interlock and shift lock mechanisms. (Refer to GROUP 23 – On-vehicle Service.)
5. Return the carpet, etc.

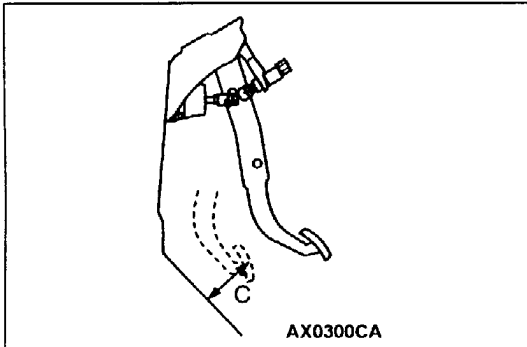
#### BRAKE PEDAL FREE PLAY

1. Turn the ignition switch to LOCK (OFF) position. Depressurise the power supply system of the hydraulic brake booster (HBB) by depressing the brake pedal at least forty times until the pedal effort becomes high. Then push the pedal with your finger to check the pedal height (free play) is within the standard value.

**Standard value (B): 3 – 8 mm**



2. If the brake pedal play is not within the standard value, check the following, and adjust or replace if necessary:
  - Excessive play between the brake pedal and the clevis pin, or between the clevis pin and the brake booster operating rod
  - Brake pedal height
  - Installation position of the stop lamp switch, etc.



#### CLEARANCE BETWEEN BRAKE PEDAL AND FLOOR BOARD

1. Turn up the carpet etc. under the brake pedal.
2. Start the engine, depress the brake pedal with approximately 490 N of force, and measure the clearance between the brake pedal and the floorboard.

**Standard value (C): 90 mm or more**

3. If the clearance is outside the standard value, check for air trapped in the brake line and thickness of the disc brake pad.  
Adjust and replace defective parts as required.
4. Return the carpet, etc.

#### HYDRAULIC BRAKE BOOSTER (HBB) OPERATION CHECK <Vehicles with ABS>

##### Caution

A diagnosis code may be stored when carrying out the checks. Always erase the diagnosis codes after the checks, and then check that any diagnosis code is output.

##### POWER SUPPLY SYSTEM FUNCTION AND OPERATION CHECK

1. Turn the ignition switch to the LOCK (OFF) position. Depressurise the power supply system of the hydraulic brake booster (HBB) by depressing the brake pedal at least forty times until the pedal effort becomes high.
2. Check that the reservoir fluid level is at the MAX position.
3. Chock the wheels and release the parking brakes.
4. Turn the ignition switch ON, and measure how much time is elapsed after the pump motor starts until it stops.

**Standard value: 20 – 80 seconds**

5. After the pump motor stopped, start the engine. The brake warning lamp should not be turned on.
6. Stop the engine, and then turn on the ignition switch again.

7. When the brake pedal is depressed four or five times, the pump motor should start and then stop.
8. Depress the brake pedal four or five times again, and then measure how much time is elapsed after the pump motor starts until it stops.

**Standard value: 2 – 11 seconds**

9. Depress the brake pedal fully consecutive 15 – 20 times for ten seconds. The brake warning lamp should illuminate and the buzzer should sound.

**Caution**

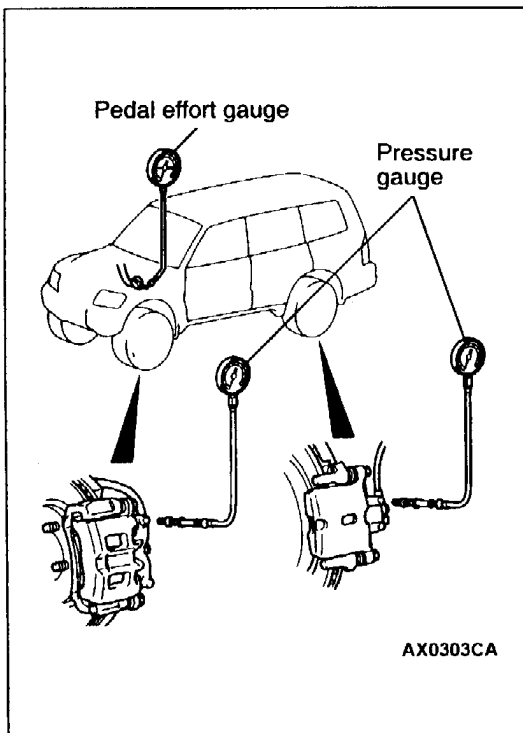
**Turn the ignition switch ON, and wait for at least 120 seconds before carrying out the checks.**

**SIMPLE INSPECTION OF HBB**

1. Turn the ignition switch to LOCK (OFF) position. Depressurise the power supply system of the hydraulic brake booster (HBB) by depressing the brake pedal at least forty times until the pedal effort becomes high.
2. Depress the brake pedal, and turn the ignition switch ON. Then check the pedal. The pedal should be lowered. If no, the pedal is defective.

**CHECK USING SIMPLE TESTER**

1. Turn the ignition switch to the LOCK (OFF) position. Depressurise the power supply system of the hydraulic brake booster (HBB) by depressing the brake pedal at least forty times until the pedal effort becomes high.
2. Connect a pressure gauge and pedal effort gauge as shown, and bleed air from the pressure gauge.
3. Carry out the operation test without vacuum assist as follows:
  - (1) Turn the ignition switch to the LOCK (OFF) position. Depressurise the power supply system of the hydraulic brake booster (HBB) by depressing the brake pedal at least forty times until the pedal effort becomes high to observe the relationship between the pedal effort and the fluid pressure.



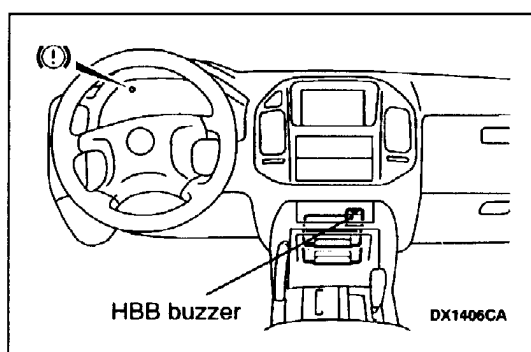
**Standard value:**

| Pedal effort N | Fluid pressure at front wheels MPa | Fluid pressure at rear wheels MPa |
|----------------|------------------------------------|-----------------------------------|
| 100            | 0.6 or more                        | 0                                 |
| 500            | 4.5 or more                        | 0                                 |

4. Carry out the operation test with power assist as follows:  
 (1) Turn the ignition switch ON. Stop the pump motor, and then check the relationship between the pedal effort and the fluid pressure.

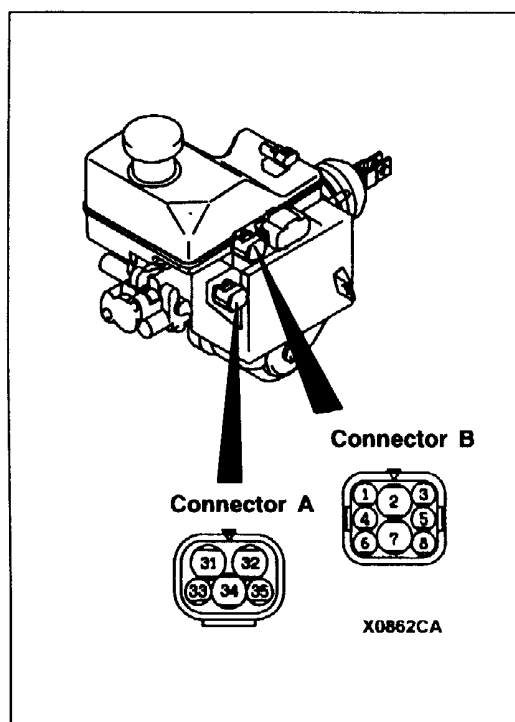
**Standard value:**

| Pedal effort N | Fluid pressure at front wheels MPa | Fluid pressure at rear wheels MPa |
|----------------|------------------------------------|-----------------------------------|
| 100            | 3.0 – 4.0                          | 3.3 – 4.3                         |
| 200            | 8.0 – 10.0                         | 8.0 – 10.0                        |
| 400            | 14.0 – 18.0                        | 14.0 – 18.0                       |
| 500            | 15.0 – 19.0                        | 15.0 – 19.0                       |

**BRAKE WARNING LAMP AND THE HBB BUZZER OPERATION CHECK****Caution**

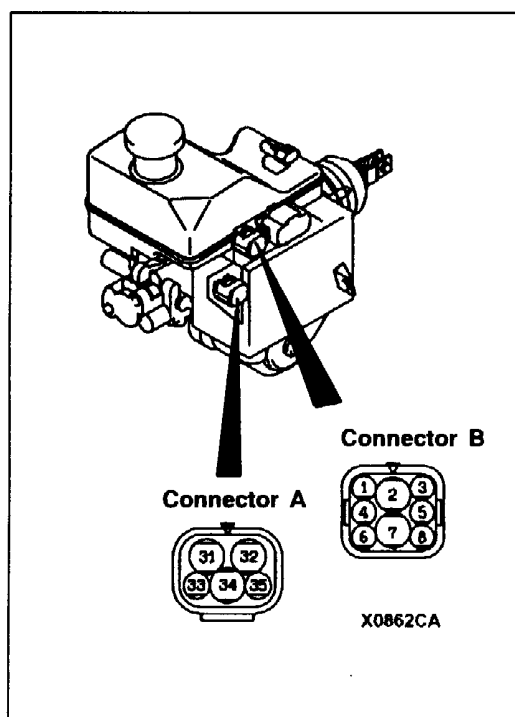
Turn the ignition switch ON, and wait for at least 120 seconds before carrying out the checks.

1. Chock the wheels and start the engine.
2. Release the parking brake lever, and depress the brake pedal fully consecutive 15 – 20 times for ten seconds. The brake warning lamp should illuminate and the buzzer should sound.

**HBB CHECK <Vehicles with ABS>****CHECKING OF THE CONTINUITY AND RESISTANCE OF THE PUMP MOTOR**

1. Disconnect the harness side connector.
2. Measure the continuity and resistance between the HBB side connector terminals.

| Terminal No.                                                                      |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     | Resistance between the terminals (reference value) |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------|
| Connector A                                                                       |                                                                                   |                                                                                   | Connector B                                                                       |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                    |
| 31                                                                                | -                                                                                 | 32                                                                                | 2                                                                                 | 4                                                                                  | -                                                                                   | 6                                                                                   | 7                                                                                   | 8                                                                                   |                                                    |
|  |  |  |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 10 Ω or less                                       |
|                                                                                   |                                                                                   |                                                                                   |  |                                                                                    |  |                                                                                     |  |                                                                                     | 10 Ω or less                                       |
|  |                                                                                   |                                                                                   |  |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 0 Ω                                                |
|                                                                                   |                                                                                   |  |                                                                                   |                                                                                    |                                                                                     |  |  |                                                                                     | 0 Ω                                                |
|                                                                                   |                                                                                   |                                                                                   |  |                                                                                    |                                                                                     |                                                                                     |                                                                                     |  | Approx. 33 Ω                                       |
|  |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |  | Approx. 33 Ω                                       |
|                                                                                   |                                                                                   |                                                                                   |                                                                                   |  |                                                                                     |  |                                                                                     |                                                                                     | Approx. 33 Ω                                       |
|                                                                                   |                                                                                   |  |  |  |                                                                                     |                                                                                     |                                                                                     |                                                                                     | Approx. 33 Ω                                       |

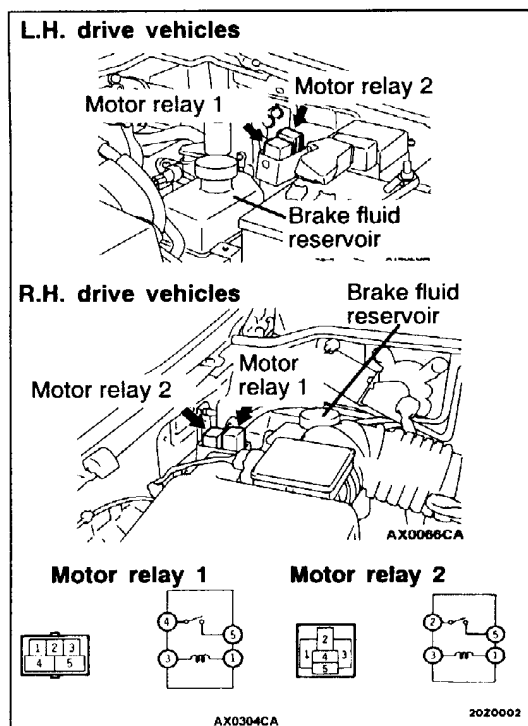
**PRESSURE SWITCH (FOR PUMP CONTROL) CHECK**

1. Turn the ignition switch to LOCK (OFF) position. Depressurise the power supply system of the hydraulic brake booster (HBB) by depressing the brake pedal at least forty times until the pedal effort becomes high.
2. Disconnect connector A of the HBB.
3. Measure the continuity between the HBB side connector A terminal No.33 and No.35. The continuity should not be present.
4. Turn on the ignition switch and operate the pump motor with connector A disconnected. Measure the continuity between the HBB side connector A terminal No.33 and No.35 while the pump motor is running. The continuity should be present.
5. Erase the diagnosis codes.(Refer to P.35A-8.)

**PRESSURE SWITCH (FOR LOW PRESSURE WARNING) CHECK**

1. Turn the ignition switch to the LOCK (OFF) position. Depressurise the power supply system of the hydraulic brake booster (HBB) by depressing the brake pedal at least forty times until the pedal effort becomes high.
2. Disconnect the HBB connector B.
3. Measure the continuity between the HBB side connector B terminals No.1 and No.5. The continuity should not be present.
4. Connect the HBB connector B to the harness side connector.
5. Then turn on the ignition switch, and operate the pump motor.
6. Wait until the pump motor stops, and then disconnect connector B of the HBB again.
7. Measure the continuity between the HBB side connector B terminals No.1 and No.5. The continuity should be present.

8. Erase the diagnosis codes. (Refer to P.35A-8.)



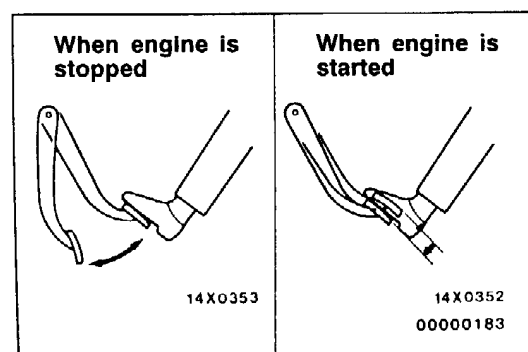
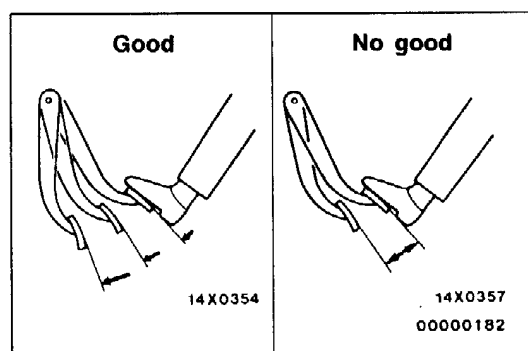
## HBB MOTOR RELAY CONTINUITY CHECK <Vehicles with ABS>

### Motor relay 1

| Battery voltage             | Terminal No. |   |   |   |
|-----------------------------|--------------|---|---|---|
|                             | 1            | 3 | 4 | 5 |
| When current is not flowing | ○            | ○ |   |   |
| When current is flowing     | ⊕            | ⊖ | ○ | ○ |

### Motor relay 2

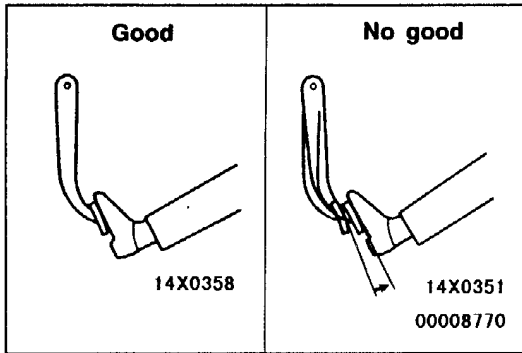
| Battery voltage             | Terminal No. |   |   |   |
|-----------------------------|--------------|---|---|---|
|                             | 1            | 2 | 3 | 5 |
| When current is not flowing | ○            |   | ○ |   |
| When current is flowing     | ⊕            | ○ | ⊖ | ○ |



## BRAKE BOOSTER OPERATING TEST <Vehicles without ABS>

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

- 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.
- With the engine stopped, step on the brake pedal several times.  
Then start the engine while the brake pedal is stepped on.  
If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is defective.



- 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 least, the check valve, vacuum hose, or booster will be defective.

### CHECK VALVE OPERATION CHECK <Vehicles without ABS>

- Remove the vacuum hose. (Refer to P.35A-41.)

#### Caution

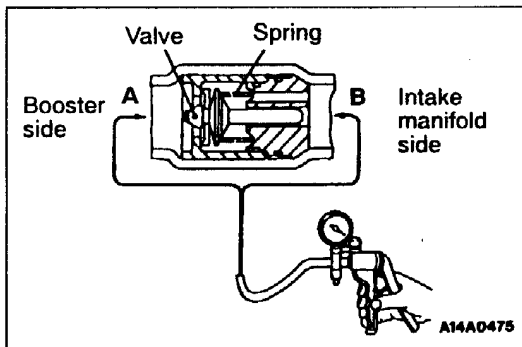
The check valve should not be disassembled from the vacuum hose as they are united as one part.

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

| Vacuum pump connection                     | Accept/reject criteria                            |
|--------------------------------------------|---------------------------------------------------|
| Connection at the brake booster side (A)   | A negative pressure (vacuum) is created and held. |
| Connection at the intake manifold side (B) | A negative pressure (vacuum) is not created.      |

#### Caution

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

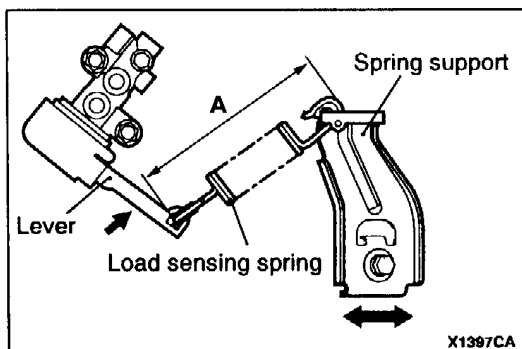


### LOAD SENSING SPRING LENGTH CHECK AND ADJUSTMENT <Vehicles without ABS>

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

#### Caution

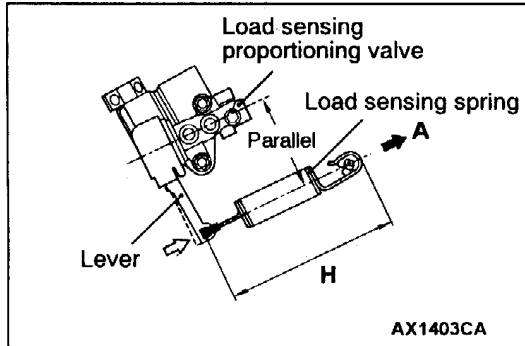
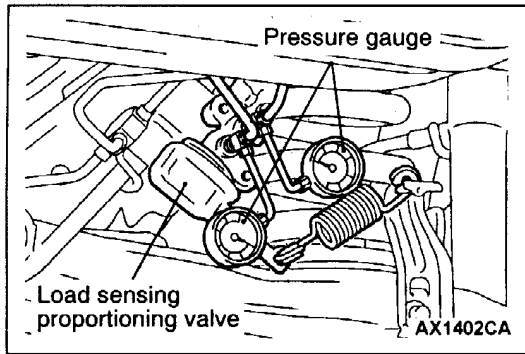
Never support the vehicle with jacks or other similar means.



- 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 (A): 135 – 139 mm**

- 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 <Vehicles without ABS>

1. Connect pressure gauges to the input and output ports of the load sensing proportioning valve.
2. Bleed the system. (Refer to P.35A-29.)
3. Disconnect the spring at the support side.

4. 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.

5. 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<br>H mm | Input fluid pressure<br>MPa | Output fluid pressure MPa |
|-----------------|-----------------------|-----------------------------|---------------------------|
| Short wheelbase | 133* <sup>1</sup>     | 9.8                         | 4.9 – 5.9                 |
|                 | 149* <sup>2</sup>     | 9.8                         | 7.5 – 8.5                 |
|                 |                       | 16.7                        | 9.0 – 11.0                |
| Long wheelbase  | 133* <sup>1</sup>     | 9.8                         | 5.9 – 6.9                 |
|                 | 149* <sup>2</sup>     | 9.8                         | 9.3 – 10.3                |
|                 |                       | 16.7                        | 11.4 – 13.4               |

#### NOTE

\*<sup>1</sup> and \*<sup>2</sup> indicate the applicable lengths for unladen and laden vehicles respectively.

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

**BLEEDING <Vehicles with ABS>****Caution**

**Specified brake fluid: DOT3 or DOT4**

1. Always use the specified brake fluid. Avoid using a mixture of the specified brake fluid and other fluid.
2. Maintain the fluid reservoir level between the MIN and MAX marks during the air bleeding.
3. Do not depress the brake pedal hard during the air bleeding (normal air bleeding) to prevent the pump motor from operating frequently.
4. After the air bleeding, check that the brake dragging does not become stronger.
5. If the pedal is depressed with the reservoir cap removed, the brake fluid may overflow. Do not depress the brake pedal while the fluid is being added.

**NORMAL AIR BLEEDING**

After the front brake or the rear brake is removed and installed, some fluid may remain in the hydraulic brake booster (HBB) reservoir. In this case, bleed air from the brake caliper.

**HBB SYSTEM AIR BLEEDING**

If all the brake fluid inside the reservoir is drained due to the removal and installation of the HBB, bleed air as follows:

**Air bleeding from front brake system**

1. Turn the ignition switch to the LOCK (OFF) position. Bleed air from the front brake calipers (right and left) by pumping the brake pedal.

**Pump motor operation**

2. Turn the ignition switch ON, and operate the pump motor. If the pump motor is running free, supply the brake fluid into the pump motor by depressing the brake pedal three or four times.

**Air bleeding from accumulator system**

3. After the pump motor stopped, depress the brake pedal three or four times with the ignition switch ON. Then observe the brake fluid in the reservoir. If the brake fluid looks whitish, wait for a few minutes until it becomes clear.
4. Repeat step 3 until the brake fluid becomes clear.

**Air bleeding from rear brake system**

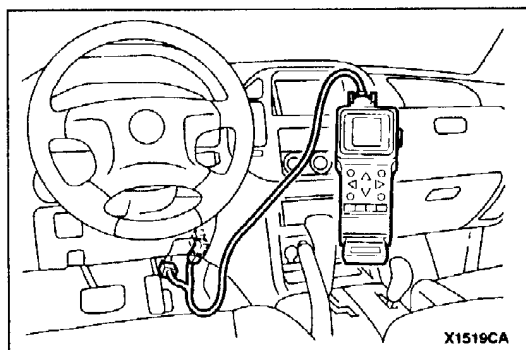
5. While the ignition switch is turned ON and the brake pedal is depressed, bleed air from the right and left rear brake calipers.

**Caution**

- (1) If too much brake fluid is drained at a time, the accumulator pressure may be dropped abnormally. So limit drain amount at a time to 100 cm<sup>3</sup> or less, and check that the pump motor stops per one air-bleeding.
- (2) If the brake fluid level in the reservoir has been dropped, air may enter the pump motor accidentally. To avoid this, always maintain the brake fluid between the MIN and MAX marks.

**Air bleeding from power supply system**

6. Turn the ignition switch to the LOCK (OFF) position. Depressurise the HBB power supply system by depressing the brake pedal several times until the braking effort becomes high.
7. Turn the ignition switch ON, and depress the brake pedal quickly twenty times. Then check that the pump motor stops.
8. Turn the ignition switch to the LOCK (OFF) position. Depressurise the power supply system of the hydraulic brake booster (HBB) by depressing the brake pedal until the pedal effort becomes high.
9. Then turn the ignition switch ON, and then operate the pump motor. The pump motor should stop within 25 seconds. If the pump motor does not stop, bleed air from the power supply system again (see steps 6 – 9).

**Air bleeding from ABS system**

10. Turn the ignition switch to the LOCK (OFF) position, and connect the MUT-II to the diagnosis connector.

**Caution**

**Turn the ignition switch to the LOCK (OFF) position when connecting and disconnecting the MUT-II.**

11. Turn the ignition switch ON, and then select the menu display on the MUT-II as follows:  
"ABS/ASC" to "ACTUATOR TEST" to "AIR BLEEDING(1)"
12. While the ignition switch is turned ON and the brake pedal is depressed, carry out the actuator test "AIR BLEEDING(1)."

**Caution**

**If you carry out the "AIR BLEEDING (1)" repeatedly, wait for at least twenty seconds before the second operation.**

13. Then select "AIR BLEEDING (2)" on the MUT-II menu display, and carry out the "AIR BLEEDING(2)" while the ignition switch is turned ON and the brake pedal is depressed.

**Air bleeding from rear brake system (final stage)**

14. Bleed air from the rear brake calipers completely while the ignition switch is turned ON and the brake pedal is depressed.

**Caution**

- (1) If too much brake fluid is drained at a time, the accumulator pressure may be dropped abnormally. So limit drain amount at a time to 100 cm<sup>3</sup> or less, and check that the pump motor stops per one air-bleeding.
- (2) If the brake fluid level in the reservoir has been dropped, air may enter the pump motor accidentally. To avoid this, always maintain the brake fluid between the MIN and MAX marks.

**Air bleeding from front brake system (final stage)**

15. Operate the pump motor while the ignition switch is turned ON. Bleed air from the front brake calipers completely by pumping the brake pedal.

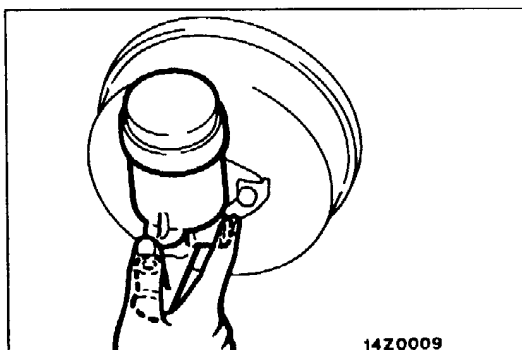
**Adding brake fluid**

16. Turn the ignition switch to the LOCK (OFF) position. Depressurise the power supply system of the hydraulic brake booster (HBB) by depressing the brake pedal at least forty times until the pedal effort becomes high.
17. Add the brake fluid up to the MAX mark on the reservoir.

**BLEEDING <Vehicles without ABS>****Caution**

**Specified brake fluid: DOT3 or DOT4**

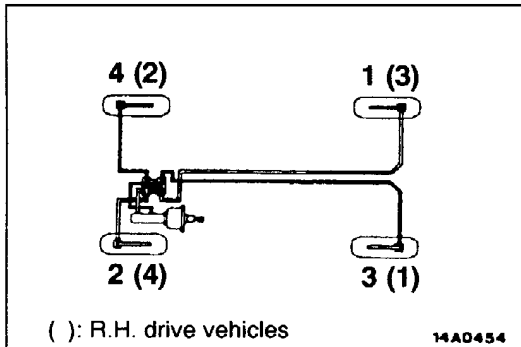
**Always use the specified brake fluid. Avoid using a mixture of the specified brake fluid and other fluid.**

**MASTER CYLINDER BLEEDING**

The master cylinder used has no check valve, so if bleeding is carried out by the following procedure, bleeding of air from the brake pipeline will become easier. (When brake fluid is not contained in the master cylinder.)

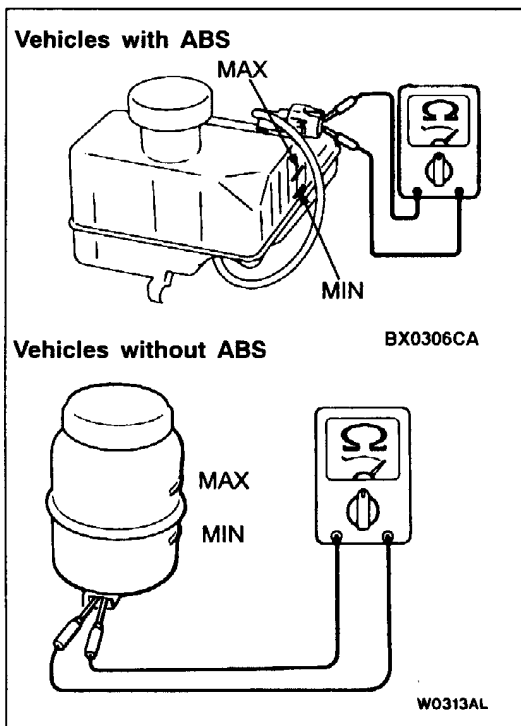
1. Fill the reserve tank with brake fluid.
2. Keep the brake pedal depressed.
3. Have another person cover the master cylinder outlet with a finger.
4. With the outlet still closed, release the brake pedal.

5. Repeat steps 2 – 4 three or four times to fill the inside of the master cylinder with brake fluid.



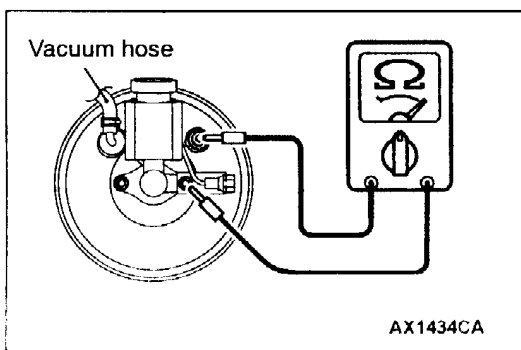
### BRAKE PIPE LINE BLEEDING

Bleed the air in the sequence shown in the figure.



### BRAKE FLUID LEVEL SENSOR CHECK

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



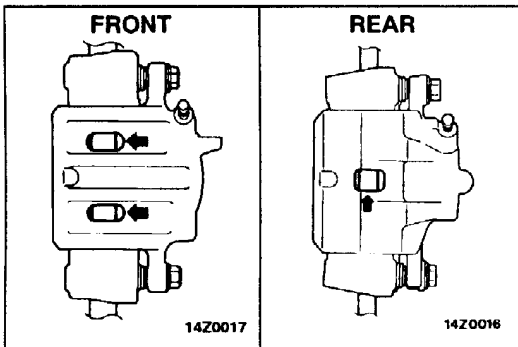
### BRAKE BOOSTER VACUUM SWITCH CHECK <Vehicles with 4D5 engine>

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.
3. Disconnect the spring at the support side.

## DISC BRAKE PAD CHECK AND REPLACEMENT

## NOTE

The brake pads have wear indicators that contact the brake disc when the brake pad thickness reaches approximately 2 mm and emit a squealing sound to warn the driver.

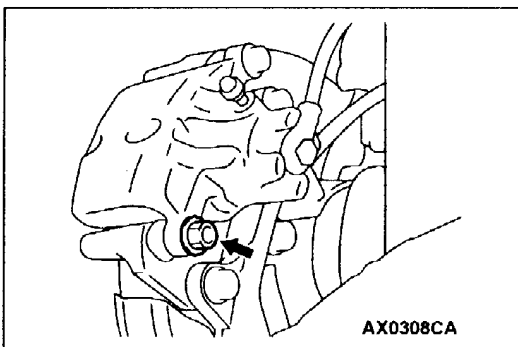


1. Check the brake pad thickness through the caliper body check port.

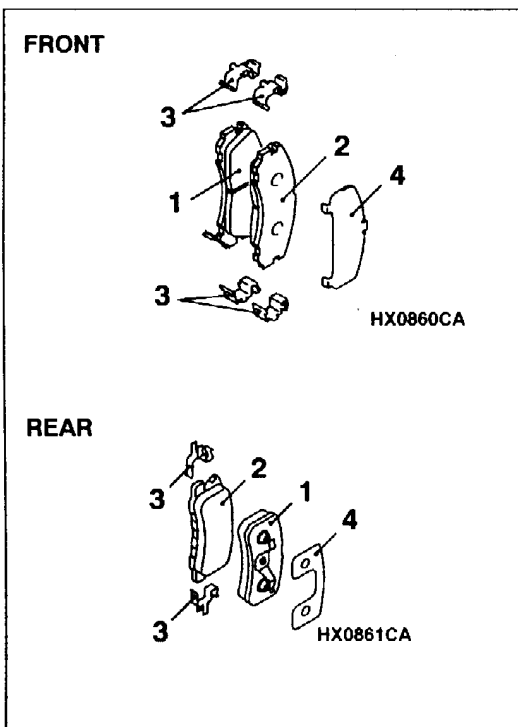
**Standard value: 10.0 mm**

**Limit: 2.0 mm**

2. When the thickness is less than the limit, always replace the pads at an axle set.



3. Remove the guide lock pin bolt. Pivot the caliper assembly and hold it with wires.



4. Remove the following parts from the caliper support.
  1. Pad and wear indicator assembly <front>  
Pad and clip assembly <rear>
  2. Pad assembly
  3. Clip
  4. Shim
5. In order to measure the brake drag force after pad installation, measure the rotary-sliding resistance of the hub with the pads removed. (Refer to P.35A-44, 49.)
6. Install the pads and caliper assembly, and then check the brake drag force. (Refer to P.35A-45, 50.)

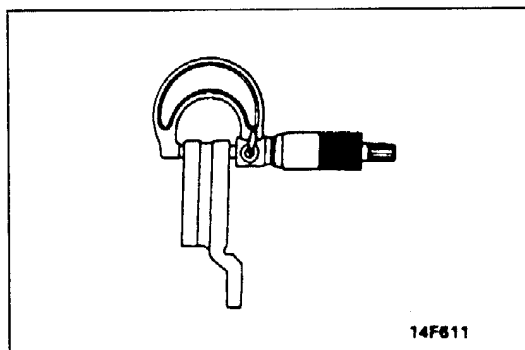
## DISC BRAKE ROTOR CHECK

### 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"> <li>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.</li> <li>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).</li> </ul> |
| 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.                                                                                                                                                                                                                                                                                                                                                          |



## BRAKE DISC THICKNESS CHECK

- Using a micrometer, measure disc thickness at eight positions, approximately 45° apart and 10 mm in from the outer edge of the disc.

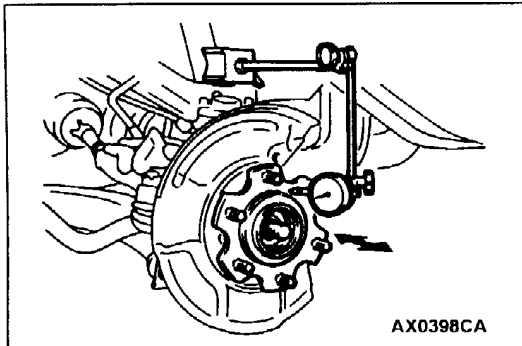
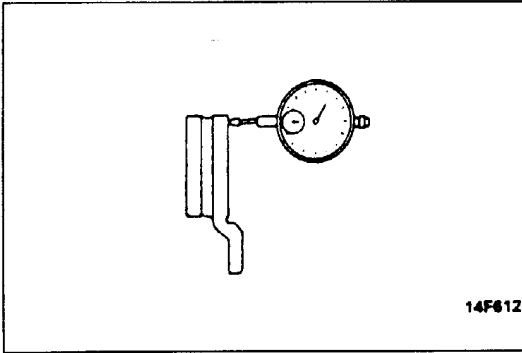
### Brake disc thickness

| Item  | Standard value | Limit |
|-------|----------------|-------|
| Front | 26.0           | 24.4  |
| Rear  | 22.0           | 20.4  |

### Thickness variation (at least 8 positions)

The difference between any thickness measurements should not be more than 0.015 mm.

- If the disc is beyond the limits for thickness, remove it and install a new one. If thickness variation exceeds the specification, replace the brake disc or grind it with on-the-car type brake lathe ("MAD, DL-8700PF" or equivalent).



### BRAKE DISC RUN-OUT CHECK AND CORRECTION

1. Remove the brake assembly, and then hold it with wire.
2. Place a dial gauge approximately 5 mm from the outer circumference of the brake disc, and measure the run-out of the disc.

**Limit: 0.06 mm or less**

3. If the brake disc run-out exceeds the limit, correct it as follows:

- (1) Chalk phase marks on the wheel stud and the brake disc, which run-out is excessive as shown.
- (2) Remove the brake disc. Then place a dial gauge as shown, and measure the end play by pushing and pulling the wheel hub.

**Limit: <Front> 0 mm, <Rear> 0 mm**

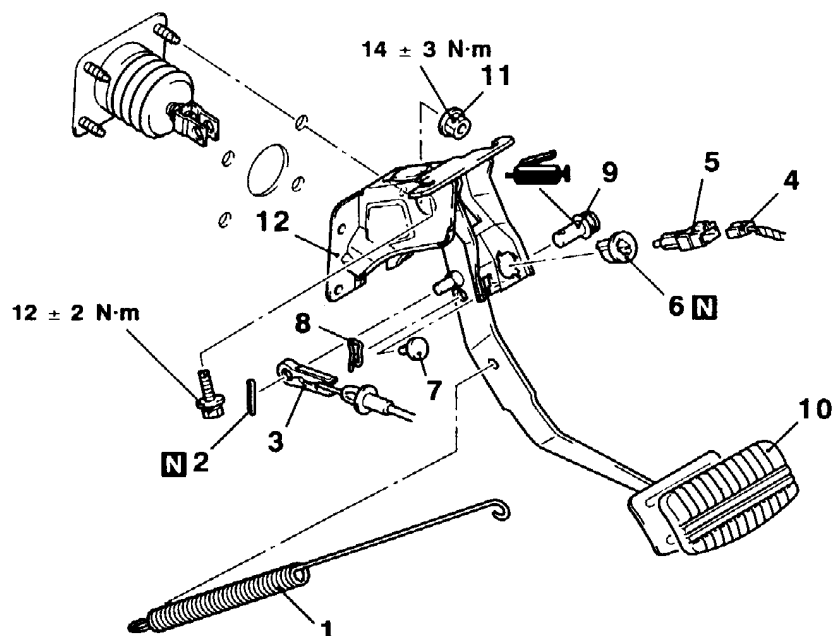
- (3) If the end play exceeds the limit, disassemble the hub and knuckle assembly to check each part.
  - (4) If the end play does not exceed the limit, dephase the brake disc and secure it. Then recheck the brake disc run-out.
4. If the run-out cannot be corrected by changing the phase of the brake disc, replace the brake disc or grind it with the on-the-car type brake lathe ( "MAD, DL-8700PF" or equivalent).

## BRAKE PEDAL

## REMOVAL AND INSTALLATION

**Post-installation Operation**

Brake Pedal Adjustment (Refer to P.35A-19.)

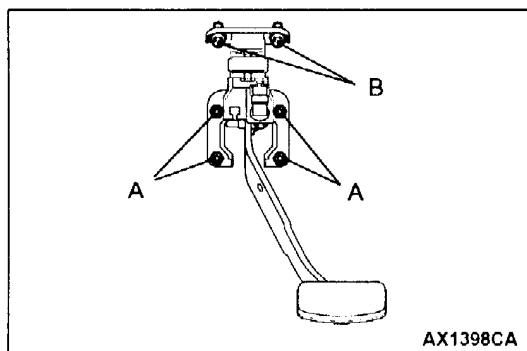


AX1405CA

**Removal steps**

- Instrument panel lower panel (Refer to GROUP 52A.)
- 1. Return spring
- 2. Split pin <A/T>
- 3. Shift lock cable connection <A/T>
- 4. Harness connector
- 5. Stop lamp switch
- 6. Adjuster

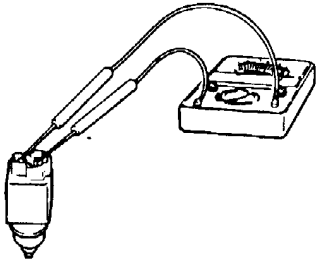
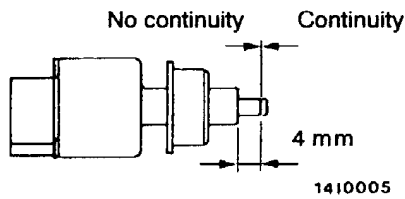
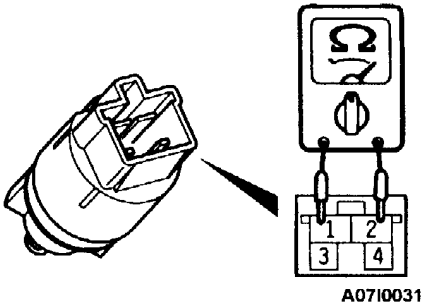
- 7. Pedal stopper
- 8. Snap pin
- 9. Pin assembly
- 10. Pedal pad
- 11. Brake booster mounting nuts
- ▶A◀ 12. Brake pedal and pedal support member

**INSTALLATION SERVICE POINT****▶A◀ BRAKE PEDAL AND PEDAL SUPPORT MEMBER INSTALLATION**

Tighten the brake booster mounting nuts (A), and then the brake pedal mounting bolts (B).

**NOTE**

The pedal support member can not be positioned correctly if the pedal mounting bolts (B) are tightened first as the their holes are oblong holes.

**Vehicles without auto-cruise control****Vehicles with auto-cruise control****INSPECTION****STOP LAMP SWITCH CHECK**

1. Connect an ohmmeter between the stop lamp switch connector terminals.
2. There should be no continuity between the terminals when the plunger is pushed in as shown. There should be continuity when it is released.

## HYDRAULIC BRAKE BOOSTER (HBB) &lt;Vehicles with ABS&gt;

## REMOVAL AND INSTALLATION

## Caution

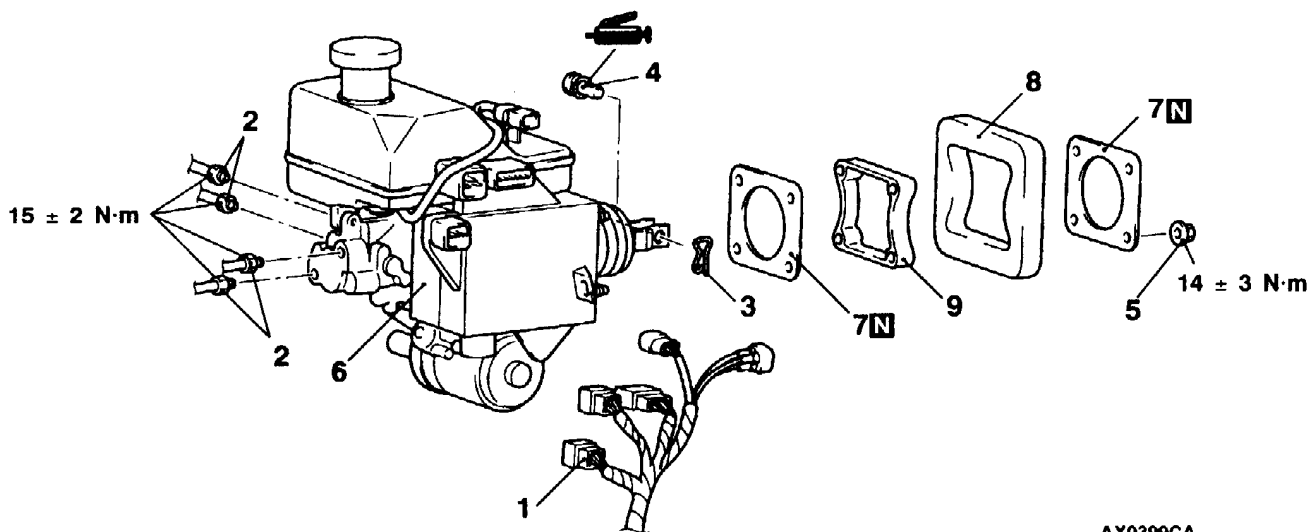
Do not turn the ignition switch ON before the brake fluid has been refilled to prevent the HBB pump motor from damage.

## Pre-removal Operation

- Depressurise the Brake Fluid in the Power Supply System  
(Depress the brake pedal at least forty times when the ignition switch is turned to "LOCK"(OFF) position)
- Brake Fluid Draining

## Post-installation Operations

- Brake Pedal Adjustment (Refer to P.35A-19.)
- Brake Fluid Supplying and Bleeding  
(Refer to P.35A-27.)
- Checking the Function and Operation of the HBB Power Supply System (Refer to P.35A-20.)



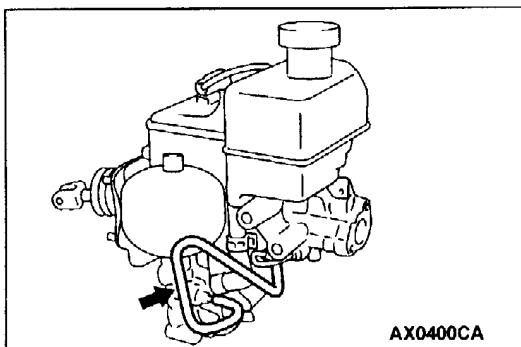
AX0399CA

## Removal steps

- Battery <L.H. drive vehicles>
- Air intake hose, and air cleaner  
<R.H. drive vehicles>  
(Refer to GROUP 15.)
- 1. Harness connector
- 2. Brake pipe connection
- 3. Snap pin



- 4. Pin assembly
- 5. HBB mounting nuts
- 6. HBB
- 7. Seal
- 8. Insulator <4M4>
- 9. Spacer



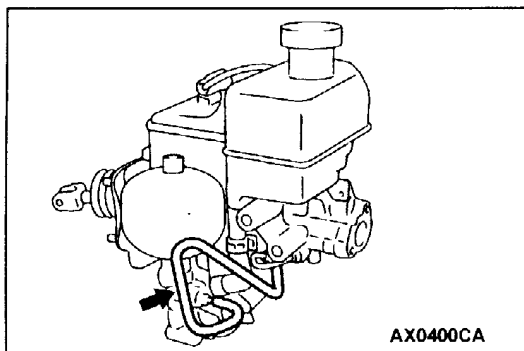
AX0400CA

## REMOVAL SERVICE POINT

## ◀A▶ HBB REMOVAL

## Caution

Never bend the shown tube as it is under high pressure.



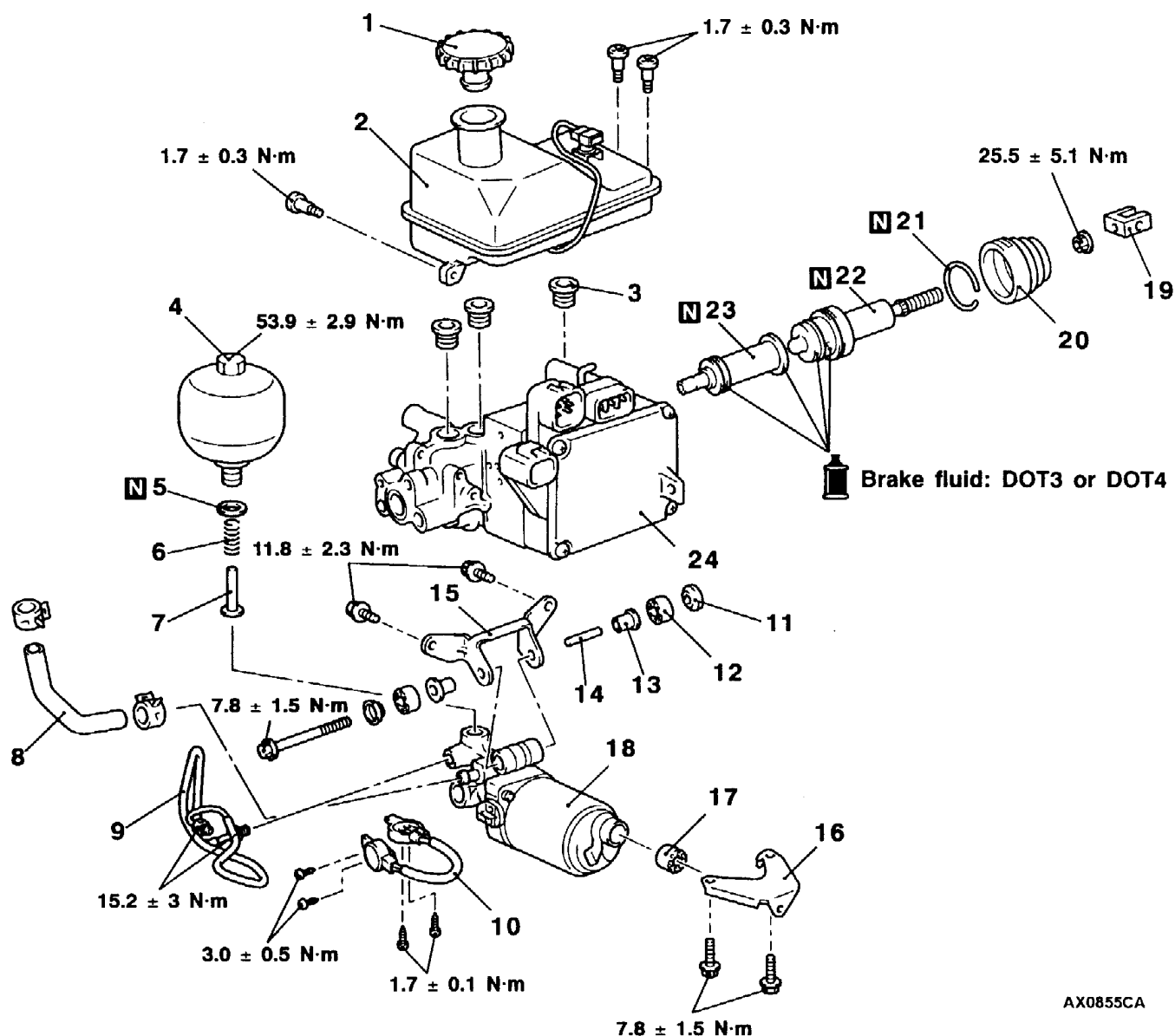
**INSTALLATION SERVICE POINT**

**▶A◀ HBB INSTALLATION**

**Caution**

**Never bend the shown tube as it is under high pressure.**

## DISASSEMBLY AND REASSEMBLY



AX0855CA

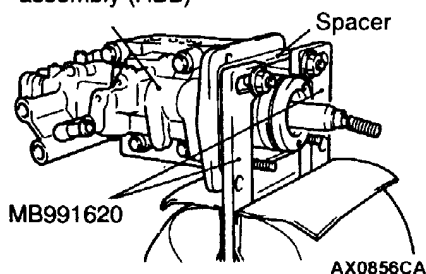
### Disassembly steps

1. Filler cap
2. Reservoir assembly
3. Grommet
4. Accumulator
5. O-ring
6. Spring
7. Silencer tube
8. Hose
9. Tube
10. Lead wire
11. Washer
12. Bushing
13. Collar



14. Pin
15. Bracket
16. Bracket
17. Bushing
18. Pump motor
19. Clevis
20. Boot
- Holding the HBB
21. Snap ring
22. Power piston assembly
23. Master cylinder piston assembly
24. Master cylinder and hydraulic unit assembly

Master cylinder and hydraulic unit assembly (HBB)

**DISASSEMBLY SERVICE POINTS****◀A▶ HOLDING THE HBB**

Use the special tools and the spacer to hold the HBB as shown.

**◀B▶ SNAP RING, POWER PISTON ASSEMBLY AND MASTER CYLINDER PISTON ASSEMBLY REMOVAL**

1. Push in the push rod of the power piston assembly, and then use a small flat-tipped screwdriver to remove the snap ring.

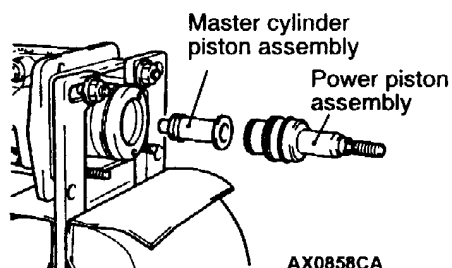
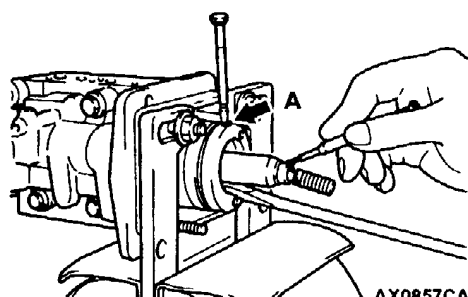
**NOTE**

If the snap ring can not be released easily, use a pin to push the snap ring out of the cylinder body hole (A).

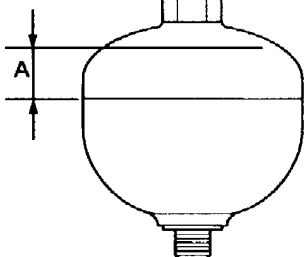
2. Withdraw the power piston assembly and the master cylinder piston assembly squarely from the cylinder body.

**Caution**

**Do not damage the cylinder wall.**



10 – 20 mm

**ACCUMULATOR DISPOSAL**

Use a saw to punch hole around (A) range of the accumulator, and discharge the gas.

**Caution**

1. **Cover the saw with a rag as metal particles may fly out.**
2. **Slowly and steadily carry out the work.**

**NOTE**

The gas is an odorless, colorless and harmless (nitrogen gas).

## HBB BUZZER <Vehicles with ABS>

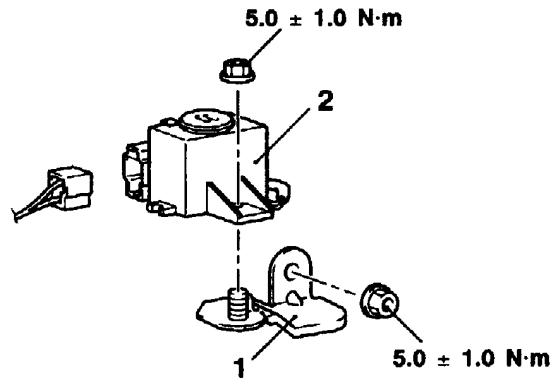
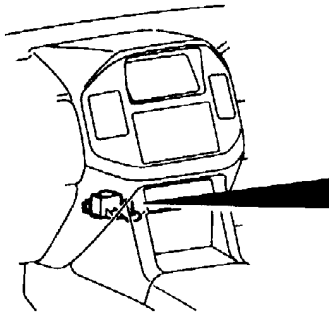
### REMOVAL AND INSTALLATION

#### Pre-removal Operation

Indicator panel and lower center panel removal  
(Refer to GROUP 52A – Floor Console.)

#### Post-installation Operations

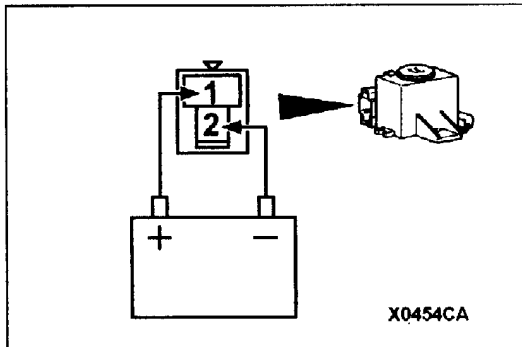
- Indicator panel and lower center panel installation (Refer to GROUP 52A – Floor Console.)
- HBB buzzer operation check (Refer to P.35A-22.)



AX0407CA

#### Removal steps

1. Bracket
2. HBB buzzer



### INSPECTION

#### HBB BUZZER CHECK

The buzzer should sound when the battery is connected as shown.

# MASTER CYLINDER AND BRAKE BOOSTER

## <Vehicles without ABS>

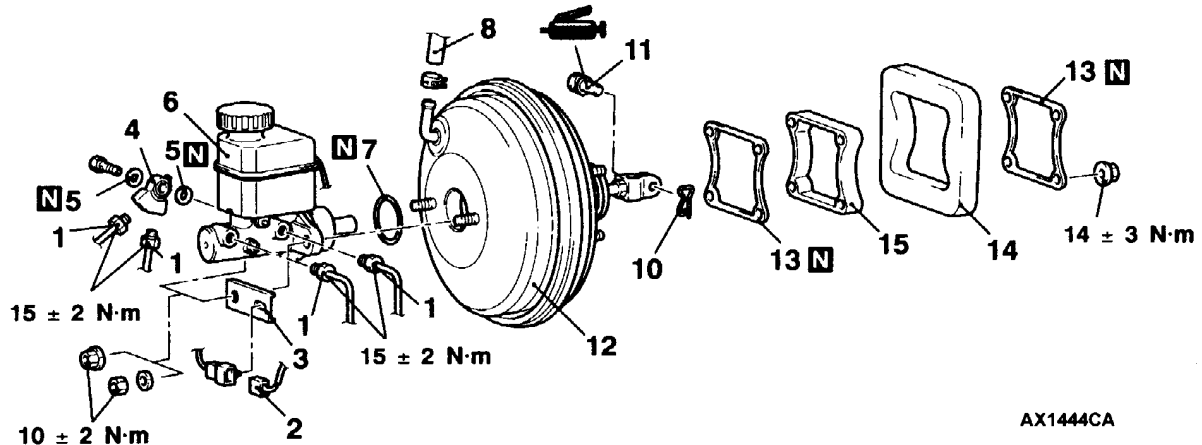
### REMOVAL AND INSTALLATION

#### Pre-removal Operation

- Battery Removal <L.H. drive vehicles>
- Air Intake Hose and Air Cleaner Removal <R.H. drive vehicles> (Refer to GROUP 15.)
- Brake Fluid Draining

#### Post-installation Operation

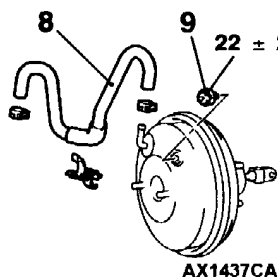
- Brake Fluid Supplying and Air Bleeding (Refer to P.35A-29.)
- Brake Pedal Adjustment (Refer to P.35A-19.)
- Battery Installation <L.H. drive vehicles>
- Air Intake Hose and Air Cleaner Installation <R.H. drive vehicles> (Refer to GROUP 15.)



AX1444CA

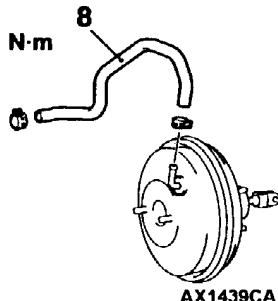
#### L.H. drive vehicles

&lt;4D5&gt;



AX1437CA

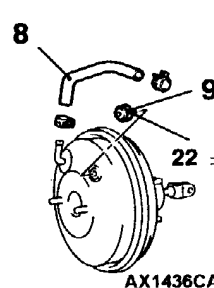
&lt;4M4&gt;



AX1439CA

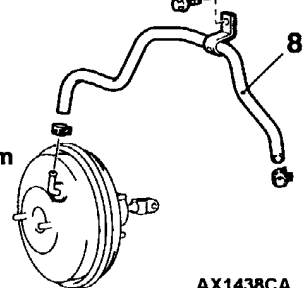
#### R.H. drive vehicles

&lt;4D5&gt;



AX1436CA

&lt;4M4&gt;



AX1438CA

#### Master cylinder removal steps

1. Brake pipe connection
2. Brake fluid level sensor connector
3. Bracket
4. Connector
5. Gasket
6. Master cylinder
7. O ring

#### Brake booster removal steps

1. Brake pipe connection
2. Brake fluid level sensor connector
3. Bracket
4. Connector
5. Gasket

6. Master cylinder
7. O ring
- B◄ • Clearance adjustment between brake booster push rod and primary piston
- A◄ 8. Vacuum hose (With built-in check valve)
9. Vacuum switch <4D5>
10. Snap pin
11. Pin assembly
12. Brake booster
13. Sealer
14. Insulator <4M4>
15. Spacer

## INSTALLATION SERVICE POINTS

### ►A◄ VACUUM HOSE CONNECTION

Insert the vacuum hose to the brake booster with its paint mark facing forward, and then secure the hose by using the hose clip.

### ►B◄ CLEARANCE ADJUSTMENT BETWEEN BRAKE BOOSTER PUSH ROD AND PRIMARY PISTON

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

$$A = B - C + D$$

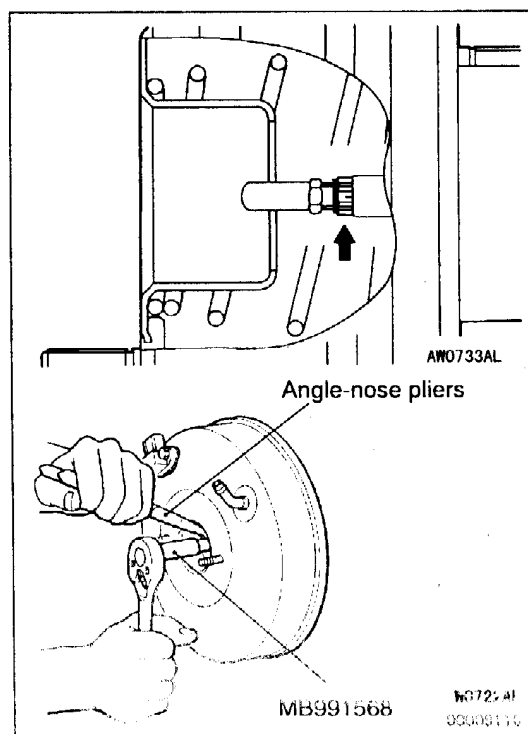
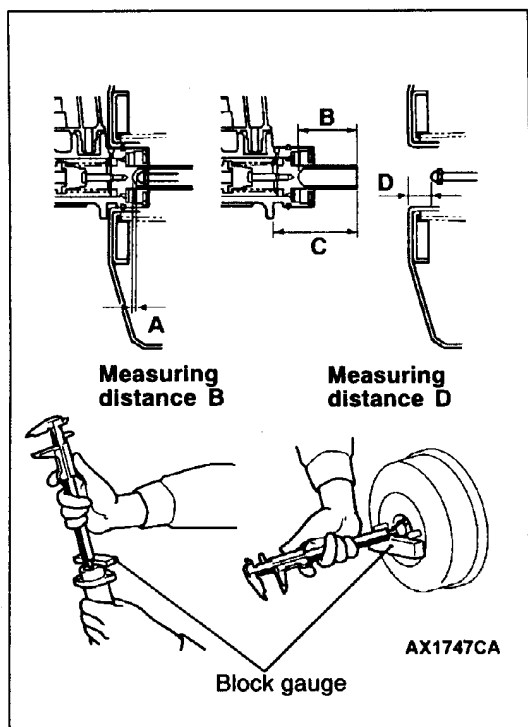
Standard value (A) :

<6G7> 0.5 – 0.9 mm

<4D5, 4M4> 0.8 – 1.2 mm

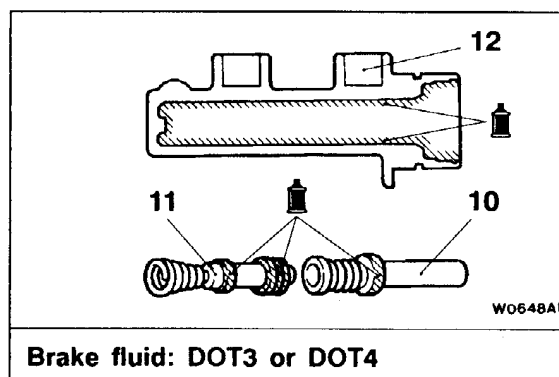
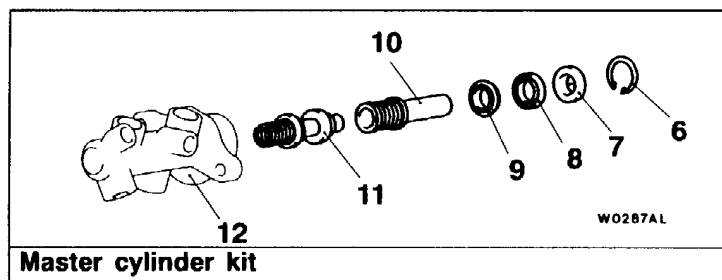
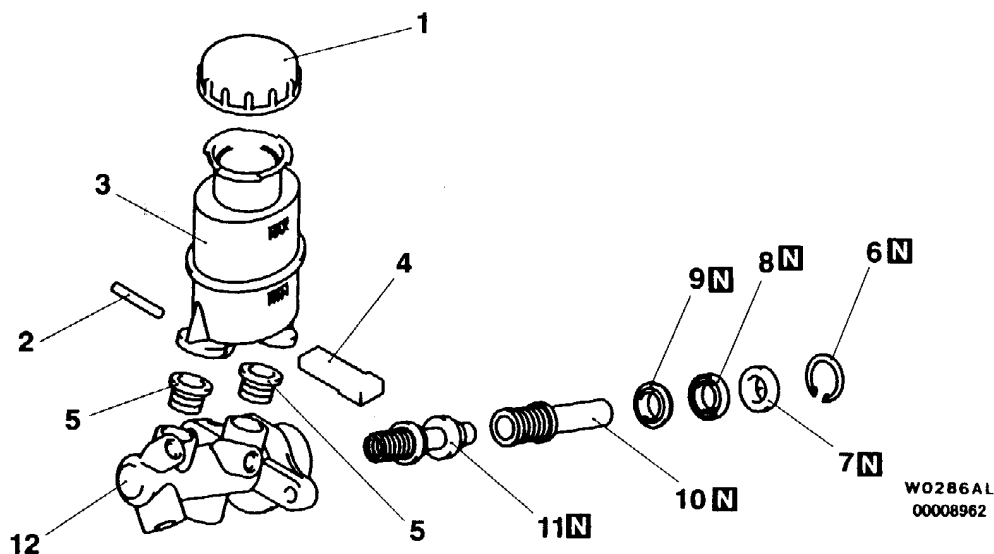
#### NOTE

- (2) When a negative pressure of 66.7 kPa is applied to the brake booster, the clearance value will become 0.10 – 0.50 mm. <6G7>
- (3) When a negative pressure of 93.3 kPa is applied to the brake booster, the clearance value will become 0.10 – 0.50 mm. <4D5, 4M4>



2. If the clearance is not within the standard value range, adjust by changing the push rod length by turning the push rod. Use the special tool to turn the push rod while holding the rod spline with angle-nose pliers.

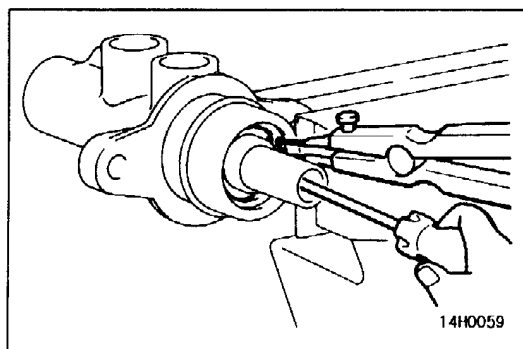
## MASTER CYLINDER DISASSEMBLY AND REASSEMBLY



### Disassembly steps

1. Reservoir cap
2. Pin
3. Reservoir tank
4. Brake fluid level sensor
5. Reservoir seal
6. Stopper ring

7. Piston guide
8. Cylinder cup
9. Plate
10. Primary piston assembly
11. Secondary piston assembly
12. Master cylinder body



### DISASSEMBLY SERVICE POINT

#### ◀▶ STOPPER RING REMOVAL

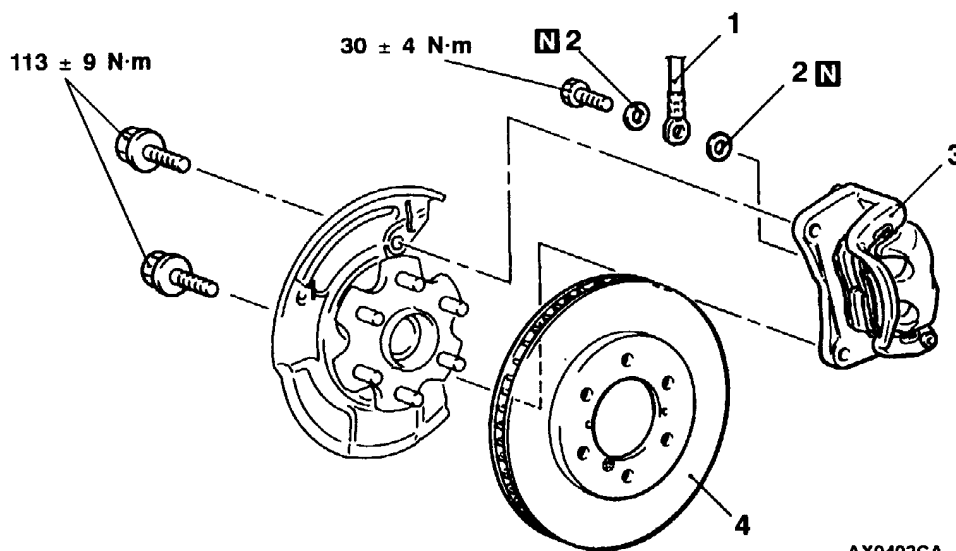
Push the primary piston assembly and remove the stopper ring.

## FRONT DISC BRAKE

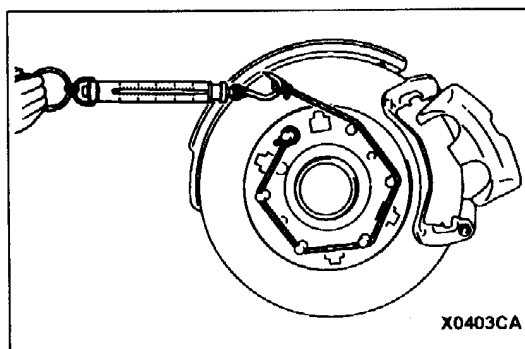
## REMOVAL AND INSTALLATION

**Pre-removal Operation**  
Brake Fluid Draining

**Post-installation Operation**  
Brake Fluid Supplying and Air Bleeding  
(Refer to P.35A-27, 29.)

**Removal steps**

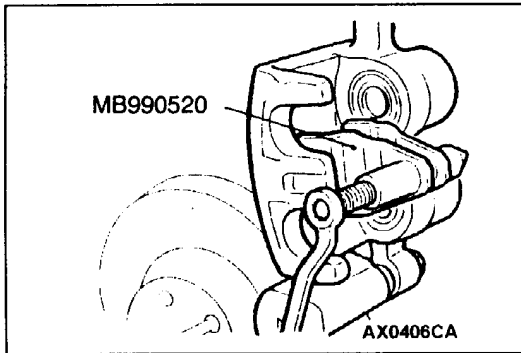
- ▶A◀
1. Brake hose connection
  2. Gasket
  3. Disc brake assembly
  4. Brake disc

**INSTALLATION SERVICE POINT****▶A◀ DISC BRAKE ASSEMBLY INSTALLATION**

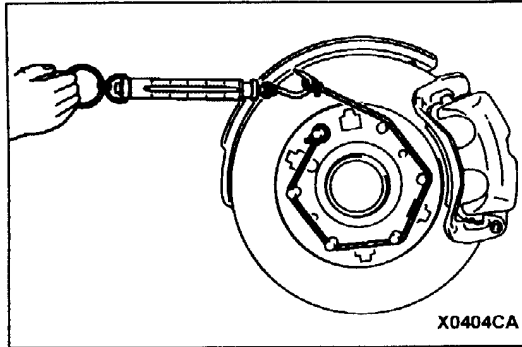
1. Use a spring balance to measure the hub rotation resistance by turning the hub to the forward direction with the pad removed in order to measure the brake dragging force.
2. Install the caliper support to the knuckle, and then assemble the pad clip and the pad to the caliper support.

**Caution**

**Do not contaminate the friction surfaces of the pads and brake discs by any oil or grease.**



3. Clean the piston and insert it into the cylinder with the special tool.
4. Be careful that the piston boot does not become caught, when lowering the caliper assembly and install the guide pin to the caliper.
5. Start the engine, and then depress the brake pedal two or three times strongly. Then stop the engine.
6. Turn the brake disc forward 10 times.

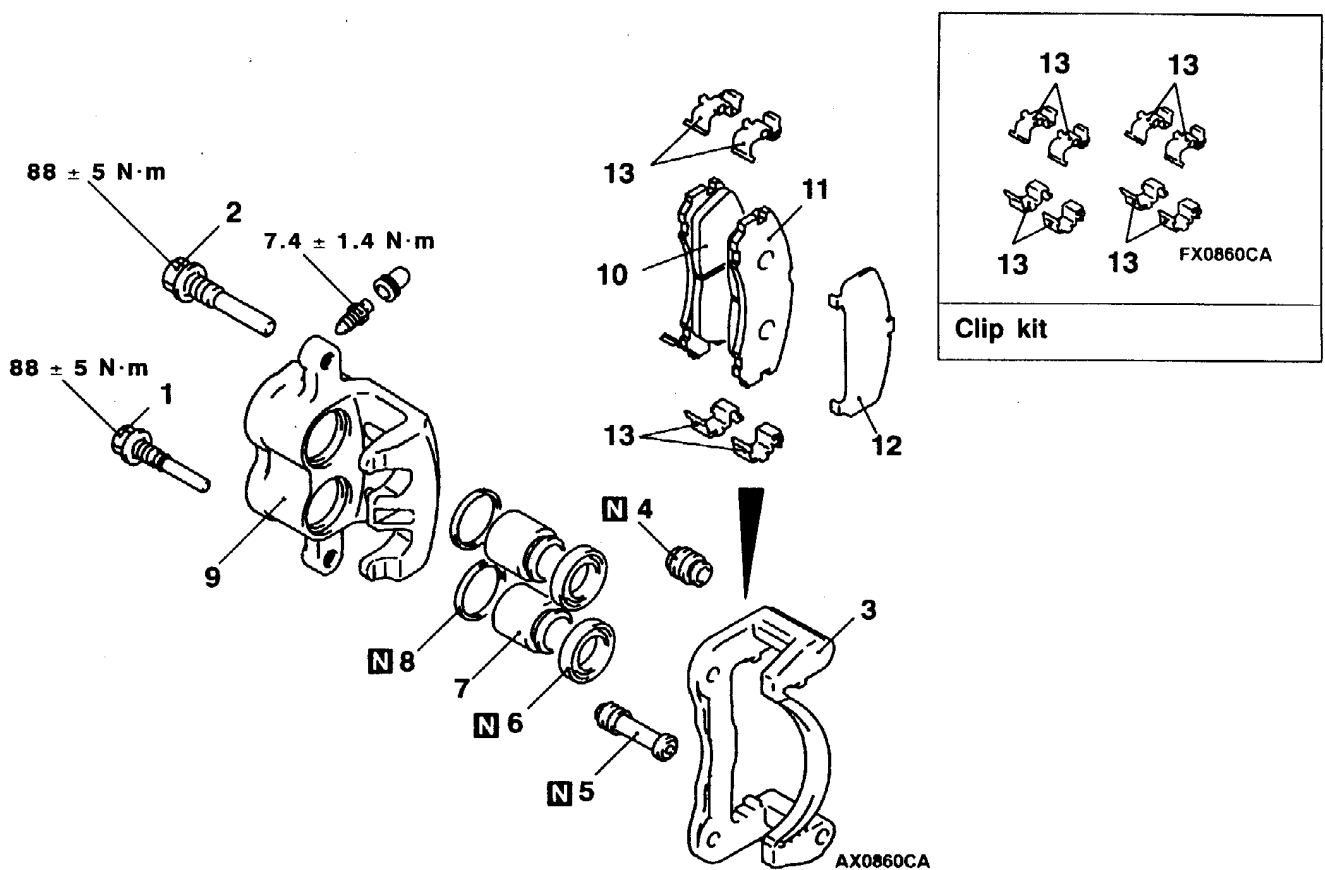


7. Use a spring balance to measure the rotary-sliding resistance of the hub.
8. Calculate the drag force of the disc brake [difference between the values measured at steps 1 and 7].

**Standard value: 55 N**

9. If that drag force exceeds the standard value, disassemble the piston assembly. Then check the piston for contamination or rust, and confirm if the piston or the piston seal is deteriorated, and if the lock pin and the guide pin slide smoothly.

## DISASSEMBLY AND REASSEMBLY



|                   |                 |                 |                   |
|-------------------|-----------------|-----------------|-------------------|
| <p>BX0860CA</p>   | <p>CX0860CA</p> | <p>DX0860CA</p> | <p>EX0860CA</p>   |
| Brake caliper kit | Pad set         | Shim kit        | Seal and boot kit |

## Disassembly steps

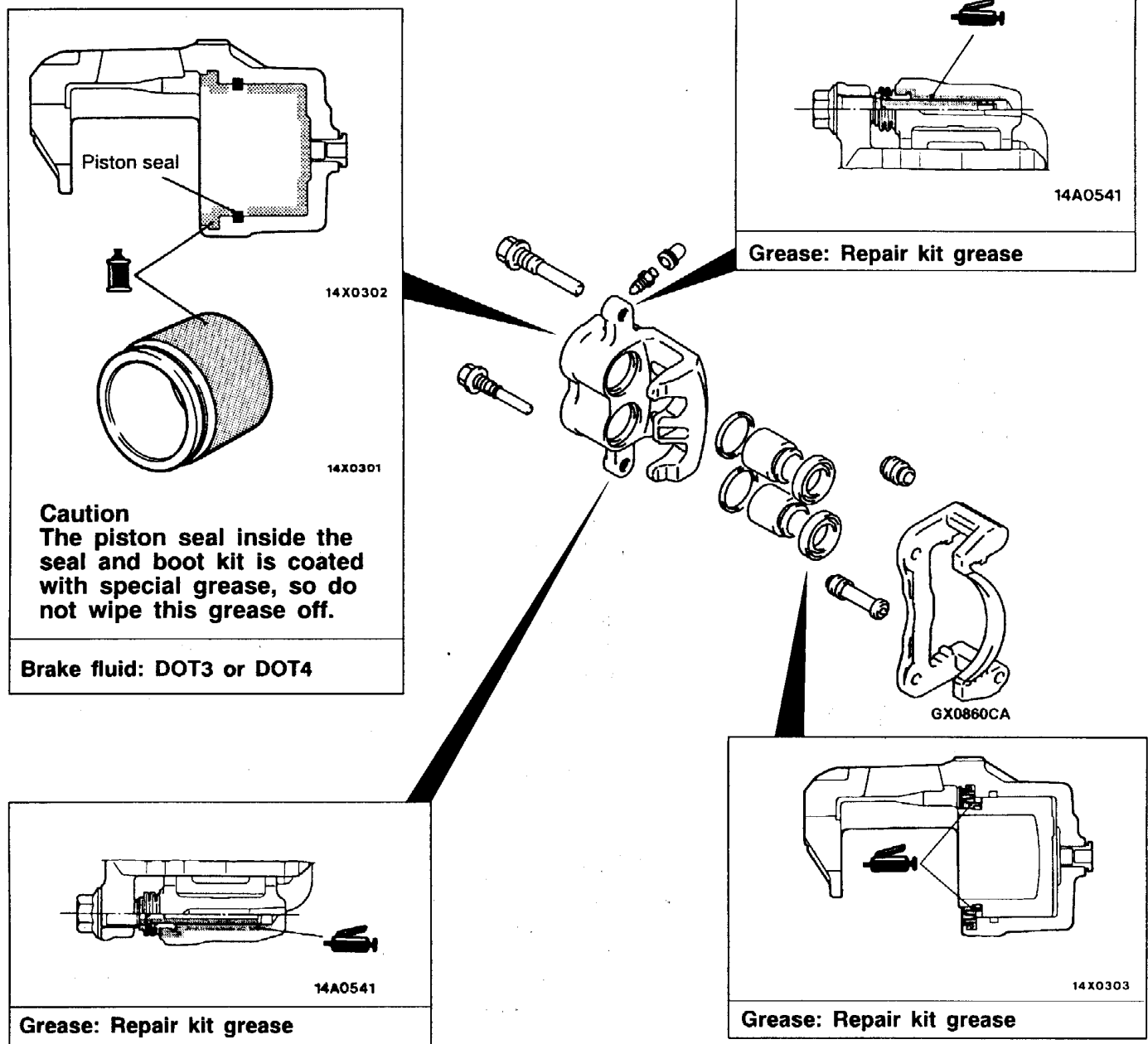
1. Guide pin lock bolt
2. Guide pin
3. Caliper support (including pad, clip and shim)
4. Boot
5. Bushing
6. Piston boot

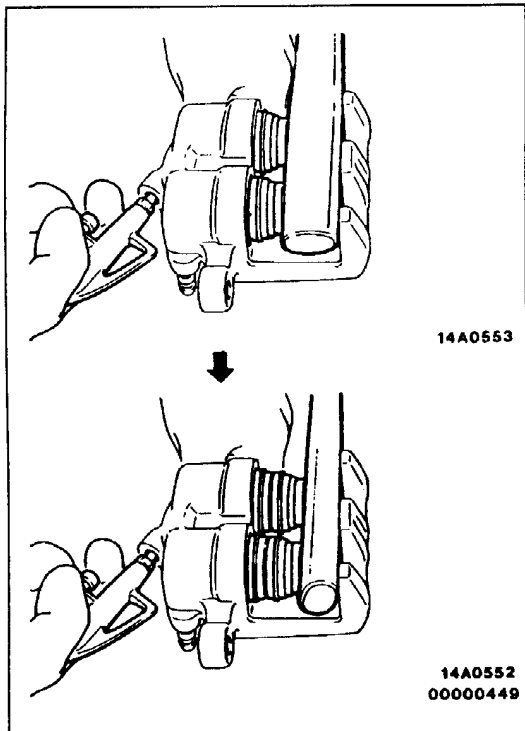


7. Piston
8. Piston seal
9. Caliper body
10. Pad and wear indicator assembly
11. Pad assembly
12. Shim
13. Clip



## LUBRICATION POINTS





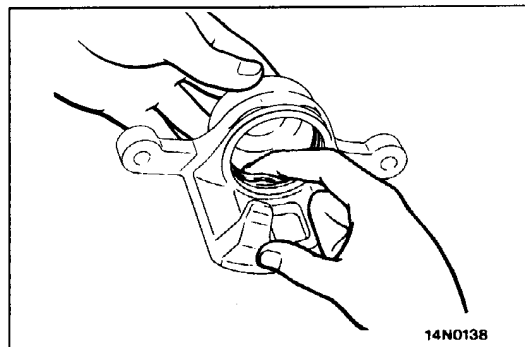
## DISASSEMBLY SERVICE POINTS

### ◀A▶ PISTON BOOT/PISTON REMOVAL

Remove the piston boot by pumping in air slowly from the brake hose connection. Be sure to use the handle of a plastic hammer and adjust the height of the two pistons while so that the pistons protrude evenly.

#### Caution

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



### ◀B▶ PISTON SEAL REMOVAL

1. Remove the piston seal with finger tip.

#### Caution

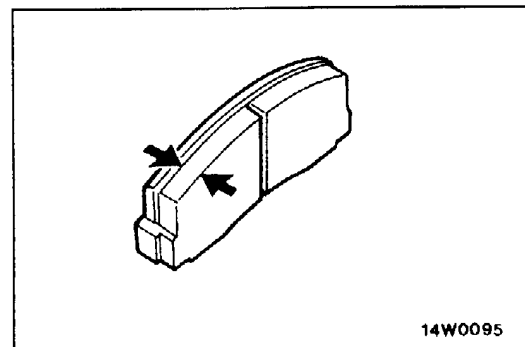
Do not use a flat-tipped screwdriver or other tool to prevent damage to inner cylinder.

2. Clean piston surface and inner bore with trichloroethylene, alcohol or the specified brake fluid.

**Specified brake fluid: DOT3 or DOT4**

## INSPECTION

- Check the cylinder for wear, damage or rust.
- Check the piston surface for wear, damage or rust.
- Check the caliper body or sleeve for wear.
- Check pad for damage or adhesion of grease, check the backing metal for damage.



### PAD WEAR CHECK

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

**Standard value: 10 mm**

**Limit: 2.0 mm**

#### Caution

1. Always replace the brake pads as an axle set.

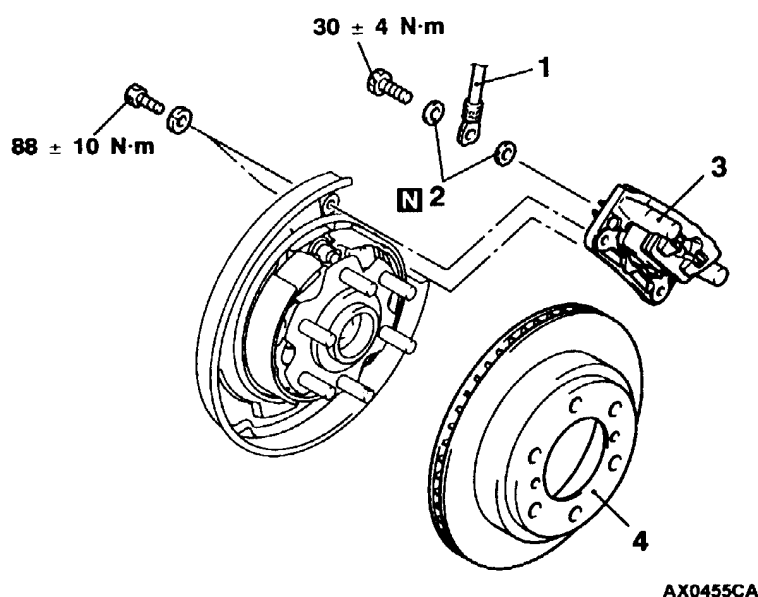
2. If an excessive difference is found in the thickness between the right and left brake pads, check moving parts.

## REAR DISC BRAKE

### REMOVAL AND INSTALLATION

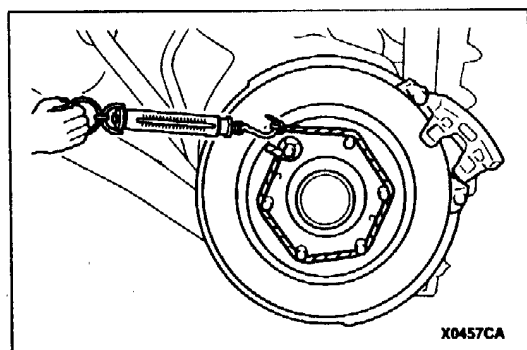
**Pre-removal Operation**  
Brake Fluid Draining

**Post-installation Operation**  
Brake Fluid Supplying and Air Bleeding  
(Refer to P.35A-27, 29.)



#### Removal steps

1. Brake hose connection
2. Gasket
3. Disc brake assembly
4. Brake disc



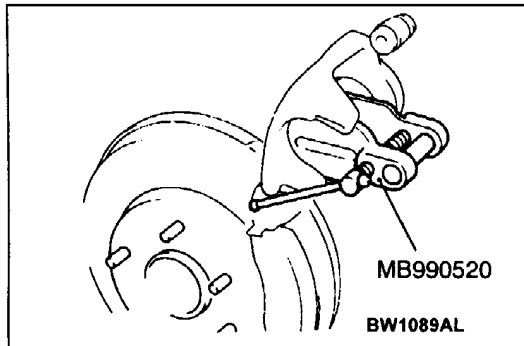
### INSTALLATION SERVICE POINT

#### ►A◄ DISC BRAKE ASSEMBLY INSTALLATION

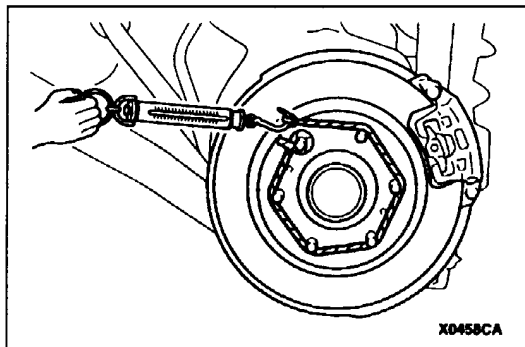
1. In order to measure the brake drag force after pad installation, use a spring balance to measure the rotary-sliding resistance of the hub with the pads removed.
2. Install the caliper support to the backing plate, and then assemble the pad clip and the pad to the caliper support.

**Caution**

Do not contaminate the friction surfaces of the pads and brake discs by any oil or grease.



3. Clean the piston and insert it into the cylinder with the special tool.
4. Be careful that the piston boot does not become caught, when lowering the caliper assembly and install the guide pin to the caliper.
5. Start the engine, and then depress the brake pedal two or three times strongly. Then stop the engine.
6. Turn the brake disc forward 10 times.

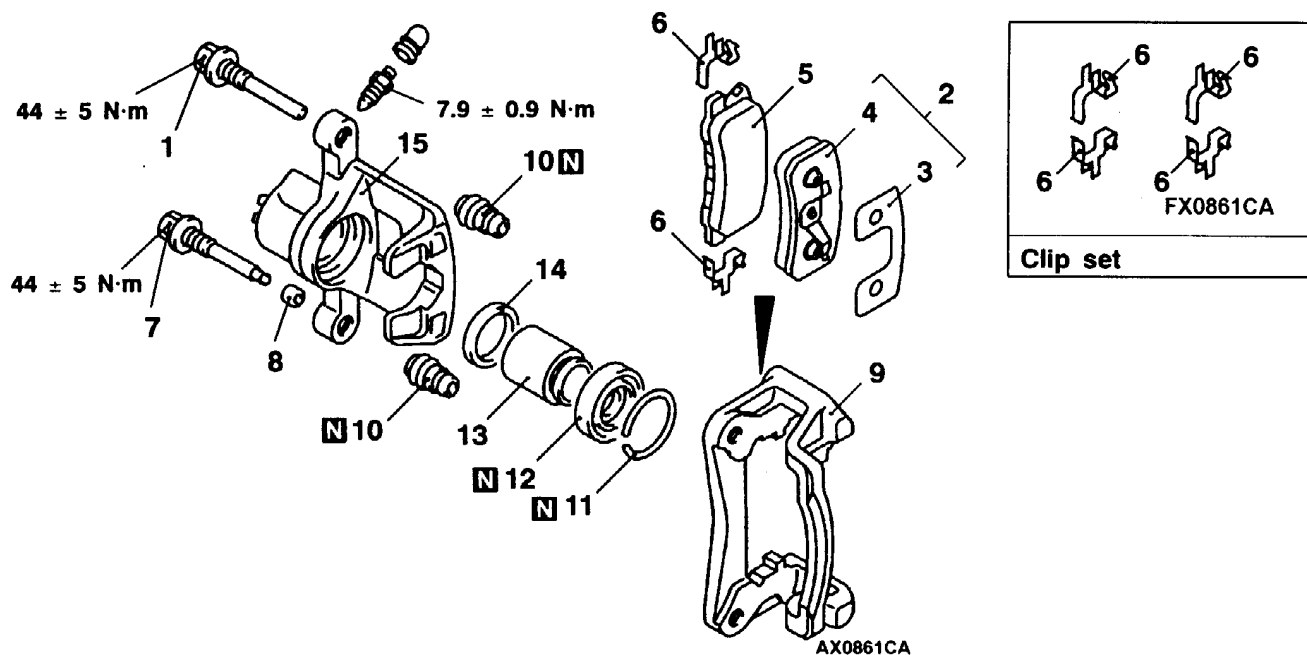


7. Use a spring balance to measure the rotary-sliding resistance of the hub.
8. Calculate the drag force of the disc brake [difference between the values measured at steps 1 and 7].

**Standard value: 55 N**

9. If that drag force exceeds the standard value, disassemble the piston assembly. Then check the piston for contamination or rust, and confirm if the piston or the piston seal is deteriorated, and if the lock pin and the guide pin slide smoothly.

## DISASSEMBLY AND REASSEMBLY



|                   |         |          |                    |
|-------------------|---------|----------|--------------------|
|                   |         |          |                    |
| Brake caliper kit | Pad set | Shim set | Seal and boots kit |

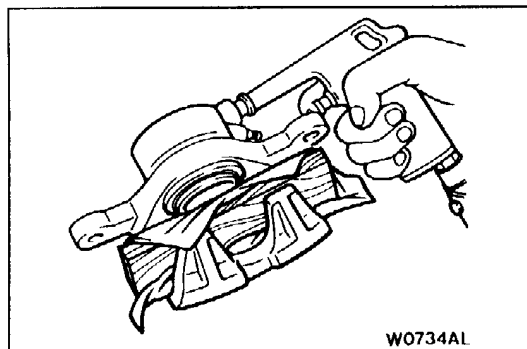
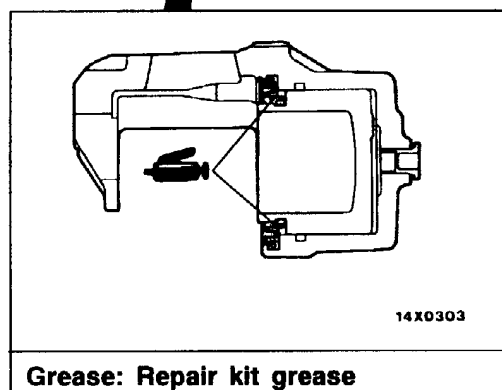
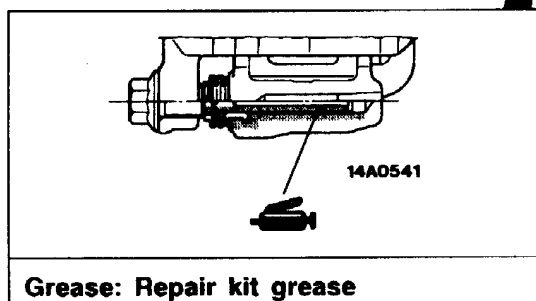
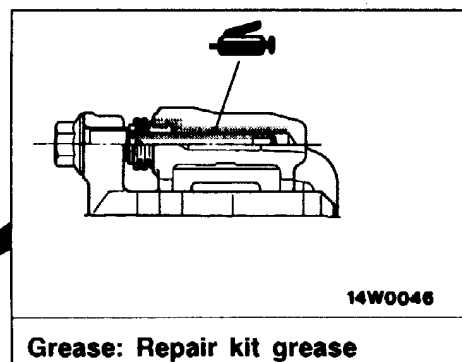
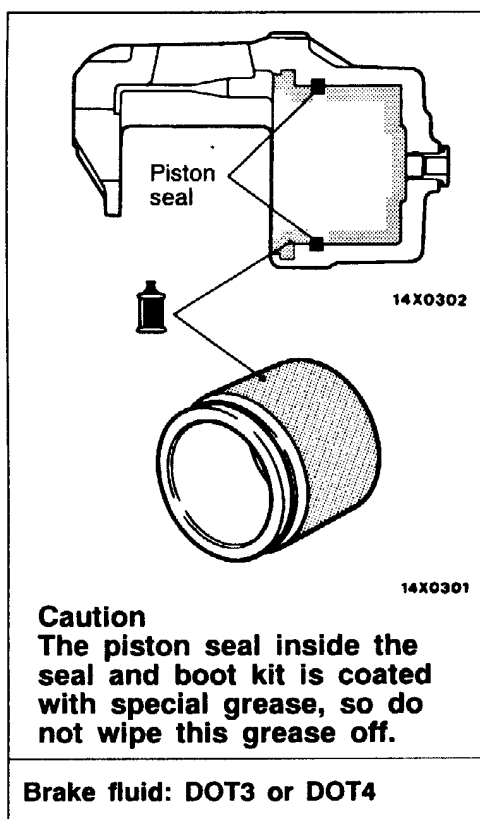
## Disassembly steps

- ▶A◀ 1. Guide pin  
 2. Pad and clip assembly, shim  
 3. Shim  
 4. Pad and clip assembly  
 5. Pad assembly  
 6. Pad clip  
 ▶A◀ 7. Lock pin  
 8. Bushing



9. Caliper support  
 10. Pin boot  
 11. Boot ring  
 12. Piston boot  
 13. Piston  
 14. Piston seal  
 15. Caliper body

## LUBRICATION POINTS



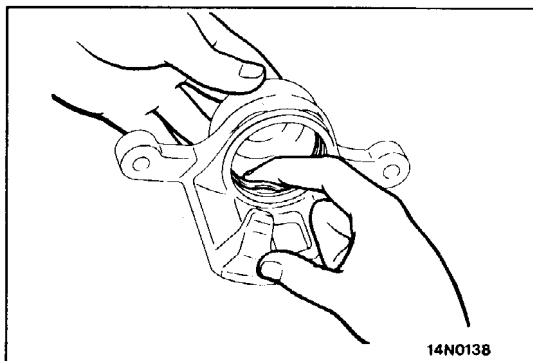
## DISASSEMBLY SERVICE POINTS

## ◀A▶ PISTON BOOT/PISTON REMOVAL

Use a piece of wood to protect the caliper body outer side, and then apply compressed air through the brake hose connection hole to withdraw the piston and piston boot.

**Caution**

If air is blown into the caliper body suddenly, the piston will pop out, causing damage to the caliper body. Be sure to apply compressed air gradually.



### ◀B▶ PISTON SEAL REMOVAL

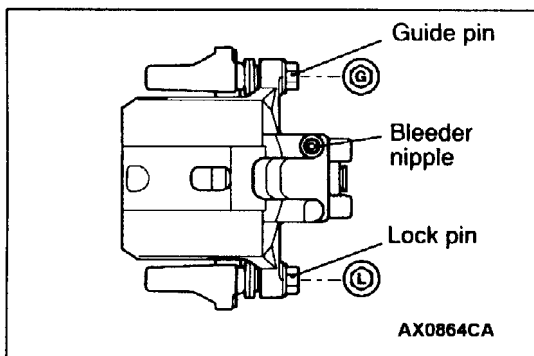
1. Remove the piston seal with finger tip.

#### Caution

**Do not use a flat-tipped screwdriver or other tool to prevent damage to inner cylinder.**

2. Clean piston surface and inner bore with trichloroethylene, alcohol or the specified brake fluid.

**Specified brake fluid: DOT3 or DOT4**



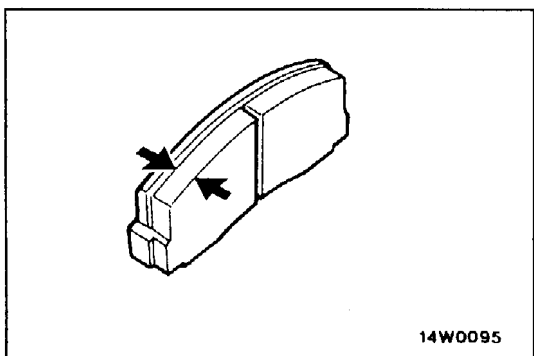
### REASSEMBLY SERVICE POINT

#### ▶A◀ LOCK PIN/GUIDE PIN INSTALLATION

Install the guide pin to the bleeder nipple side at the caliper body, the lock pin to its opposite side, respectively.

### INSPECTION

- Check the cylinder for wear, damage or rust.
- Check the piston surface for wear, damage or rust.
- Check the caliper body or sleeve for wear.
- Check pad for damage or adhesion of grease, check the backing metal for damage.



### PAD WEAR CHECK

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

**Standard value: 10 mm**

**Limit: 2.0 mm**

#### Caution

1. Always replace the brake pads as an axle set.
2. If an excessive difference is found in the thickness between the right and left brake pads, check moving parts.

## LOAD SENSING PROPORTIONING VALVE <Vehicles without ABS> REMOVAL AND INSTALLATION

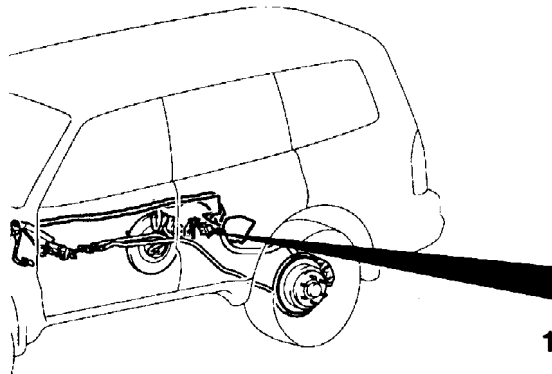
### Caution

Do not disassemble the load sensing proportioning valve.

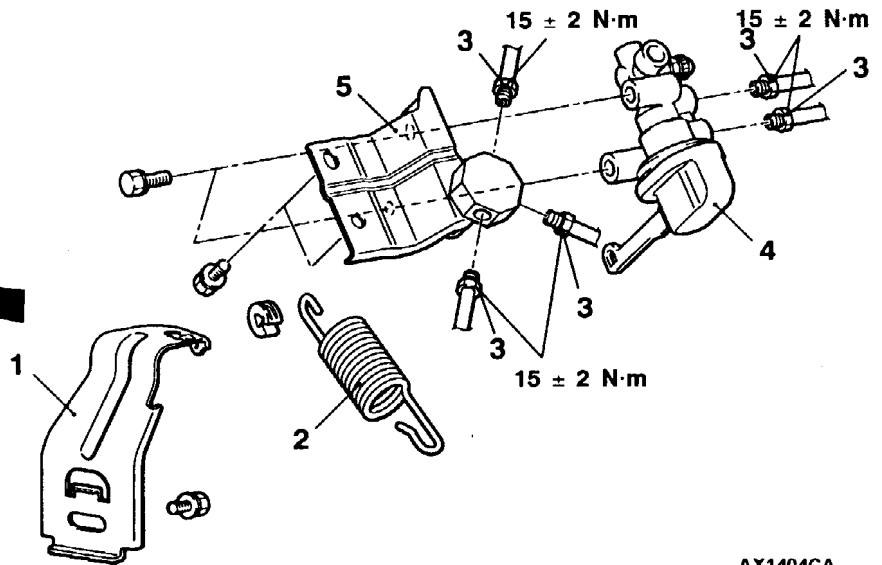
#### Pre-removal Operation Brake Fluid Draining

#### Post-installation Operation

- Brake Fluid Supplying
- Brake Line Bleeding (Refer to P.35A-29.)



BX1361CA

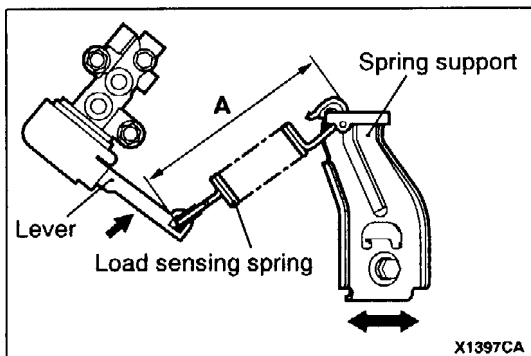


AX1404CA

### Removal steps

- A◄
1. Spring support
  2. Load sensing spring
  3. Brake pipe connection

4. Load sensing proportioning valve
5. Bracket assembly



X1397CA

## INSTALLATION SERVICE POINT

### ►A◄ SPRING SUPPORT INSTALLATION

1. Install the load sensing spring, and then tighten the spring support to the lower arm assembly temporarily.
2. Insert the lever of the load sensing proportioning valve fully into the valve side and hold it. Then adjust the spring support so that the spring length (the distance between the two ends of the spring) is at the standard value.

**Standard value (A): 135 – 139 mm**

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

## CONTENTS

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| <b>LUBRICANT .....</b>                                     | <b>Refer to GROUP 35A</b> | Brake Fluid Level Sensor Check .....         | Refer to GROUP 35A        |
| <b>SEALANTS .....</b>                                      | <b>Refer to GROUP 35A</b> | Disc Brake Pad Check and Replacement .....   | Refer to GROUP 35A        |
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| Wheel Speed Sensor Output Voltage Measurement .....        | 27                        | <b>HYDRAULIC BRAKE BOOSTER (HBB) .....</b>   | <b>Refer to GROUP 35A</b> |
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| Hydraulic Brake Booster (HBB) Operation Check .....        | Refer to GROUP 35A        | <b>G-SENSOR .....</b>                        | <b>36</b>                 |
| Hydraulic Brake Booster (HBB) Check .....                  | Refer to GROUP 35A        |                                              |                           |

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## GENERAL INFORMATION

ABS has been adopted as standard equipment in all vehicles to maintain directional stability and steering performance during sudden braking.

The ABS control method used is a 4-sensor, 4-channel method (previous models: 4-sensor, 3-channel method) which allows the brake pressures for all four wheels to be controlled independently of each other. The system has the following features.

- EBD\* (Electronic Brake force Distribution system) control has been added to provide the ideal braking force for the rear wheels.

- The hydraulic unit function has been integrated with the hydraulic brake booster (HBB).
- Select solenoid valves (two valves for FL and FR) have been adopted in order to reduce the pedal kickback and improve the operation feeling when the ABS is operating.
- Independent 4-wheel control is carried out while the vehicle is turning in order to increase the braking force.

### NOTE

\*EBD: Electronic Brake-force Distribution

### EBD CONTROL

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

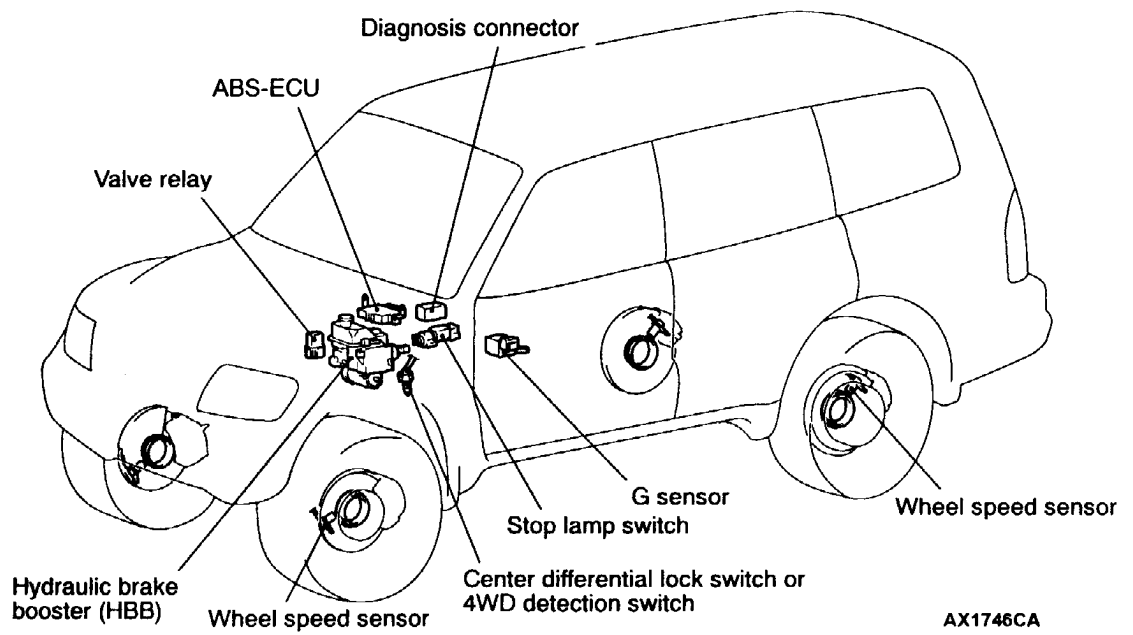
- Because the system provides the optimum rear wheel braking force regardless of the vehicle laden condition and the condition of the road surface, the system reduces the required pedal depression force, particularly when the vehicle is heavily laden or driving on road surfaces with high frictional coefficients.

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

### SPECIFICATIONS

| Item                   |                                 | Specifications            |
|------------------------|---------------------------------|---------------------------|
| ABS control method     |                                 | 4-sensor, 4-channel       |
| No. of ABS rotor teeth | Front                           | 50                        |
|                        | Rear                            | 50                        |
| ABS speed sensor       | Type                            | Magnet coil type          |
|                        | Gap between sensor and rotor mm | 0.9 (non-adjustable type) |

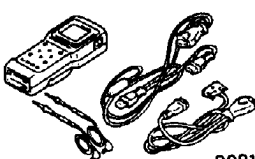
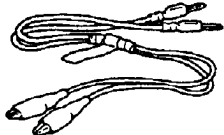
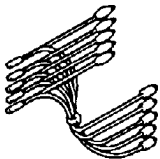
STRUCTURAL DIAGRAM



**SERVICE SPECIFICATIONS**

| Item                                               |     | Standard value |
|----------------------------------------------------|-----|----------------|
| Control solenoid valve resistance $\Omega$         | IN  | 4.75 – 5.25    |
|                                                    | OUT | 2.0 – 2.4      |
| Select solenoid valve resistance $\Omega$          |     | 3.5 – 3.9      |
| Wheel speed sensor terminal resistance $k\Omega$   |     | 1.0 – 1.5      |
| Wheel speed sensor insulation resistance $k\Omega$ |     | 100 or more    |

**SPECIAL TOOLS**

| Tools                                                                                          | No.      | Name                            | Application                                                        |
|------------------------------------------------------------------------------------------------|----------|---------------------------------|--------------------------------------------------------------------|
| <br>B991502   | MB991502 | MUT-II sub assembly             | Checking the ABS<br>(Diagnosis display using the MUT-II)           |
| <br>B991529   | MB991529 | Diagnosis code checking harness | Checking the ABS<br>(Diagnosis display using the ABS warning lamp) |
| <br>B991348 | MB991348 | Test harness set                | Checking the G sensor                                              |

**TROUBLESHOOTING****STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING**

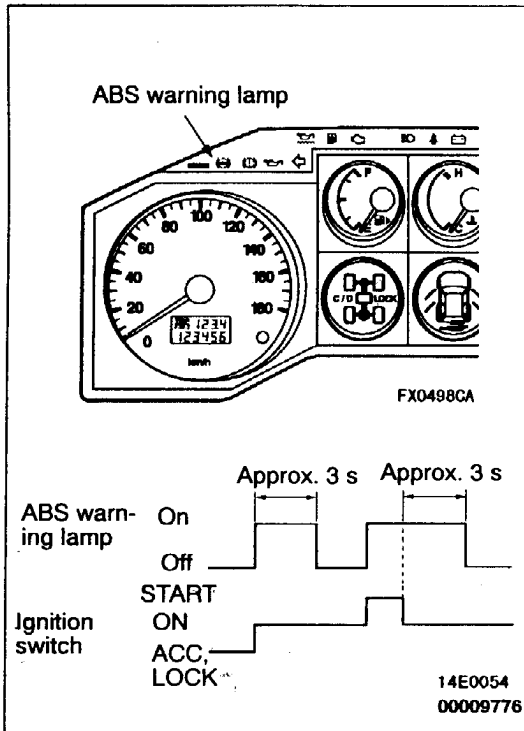
Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

**PRECAUTIONS WHEN CARRYING OUT DIAGNOSIS**

- (1) The ABS is a system which controls the brake pressure by means of the operation of the ECU. Accordingly, the following symptoms may occur at times, but these are a sign of normal ABS operation, and do not indicate a malfunction.

| Symptom                                                                                                                                                                                                                  | Explanation of symptom                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| When the engine starts, a knocking sound can be heard coming from the engine compartment.                                                                                                                                | This sound occurs as a result of system operation checking, and is not a malfunction.                                                          |
| 1. The brake pedal feeling changes and noise is generated.(Rattling)<br>2. When the ABS is operating, noise is generated by parts of the vehicle chassis as control turns on and off. (Thump: suspension; squeak: tyres) | This is the sound of normal system operation, and is not a malfunction.                                                                        |
| Shocks are felt if the brake pedal is depressed when driving at low speed.                                                                                                                                               | This is due to system operation checking (starting-of check when the vehicle speed reaches a certain number of km/h) and is not a malfunction. |

- (2) 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.
- (3) Diagnosis detection conditions vary according to the diagnosis code. When re-checking trouble symptoms, the conditions given in the "Explanation" column of the Inspection Chart Classified by Trouble Symptoms must always be satisfied.



## ABS WARNING LAMP INSPECTION

Check that the ABS warning lamp illuminates in the following way.

Even if the pressure inside the accumulator of the hydraulic brake booster (HBB) is below the specified value, the ABS warning lamp will illuminate because ABS operation has been stopped. In such cases, if the HBB pump is driven by the accumulated pressure inside the accumulator and causes the ABS warning lamp to switch off, it does not indicate a system malfunction.

- (1) When the ignition switch is turned to the ON position, the ABS warning lamp illuminates\* for approximately 3 seconds, and then switches off.
- (2) When the ignition switch is turned to the START position, the ABS warning lamp remains illuminated.
- (3) When the ignition switch returns from the START to the ON position, the ABS warning lamp illuminates\* for approximately 3 seconds, and then remains switched off.
- (4) If any of the above do not occur, check the diagnosis codes.

### NOTE

\*: The ABS warning lamp may remain illuminated after the ignition switch is turned to the ON position and the vehicle starts moving until the vehicle speed reaches a speed of several km/h. This only occurs if a diagnosis code from No. 21 to No. 24 relating to a wheel speed sensor malfunction was generated when the ignition switch was last turned to the ON position and is still stored in the ABS-ECU. The ABS-ECU will cause the ABS warning lamp to illuminate until the point where it can ascertain (during the starting-off check) that the problem associated with this diagnosis code has returned to normal.

## DIAGNOSIS FUNCTION

### READING DIAGNOSIS CODES

Use the MUT-II or the ABS warning lamp to read the diagnosis codes.

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

### NOTE

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

**ERASING DIAGNOSIS CODES****When using the MUT-II**

Connect the MUT-II to the diagnosis connector and erase the diagnosis codes.

**Caution**

**Turn the ignition switch to the LOCK (OFF) position when connecting and disconnecting the MUT-II.**

**NOTE**

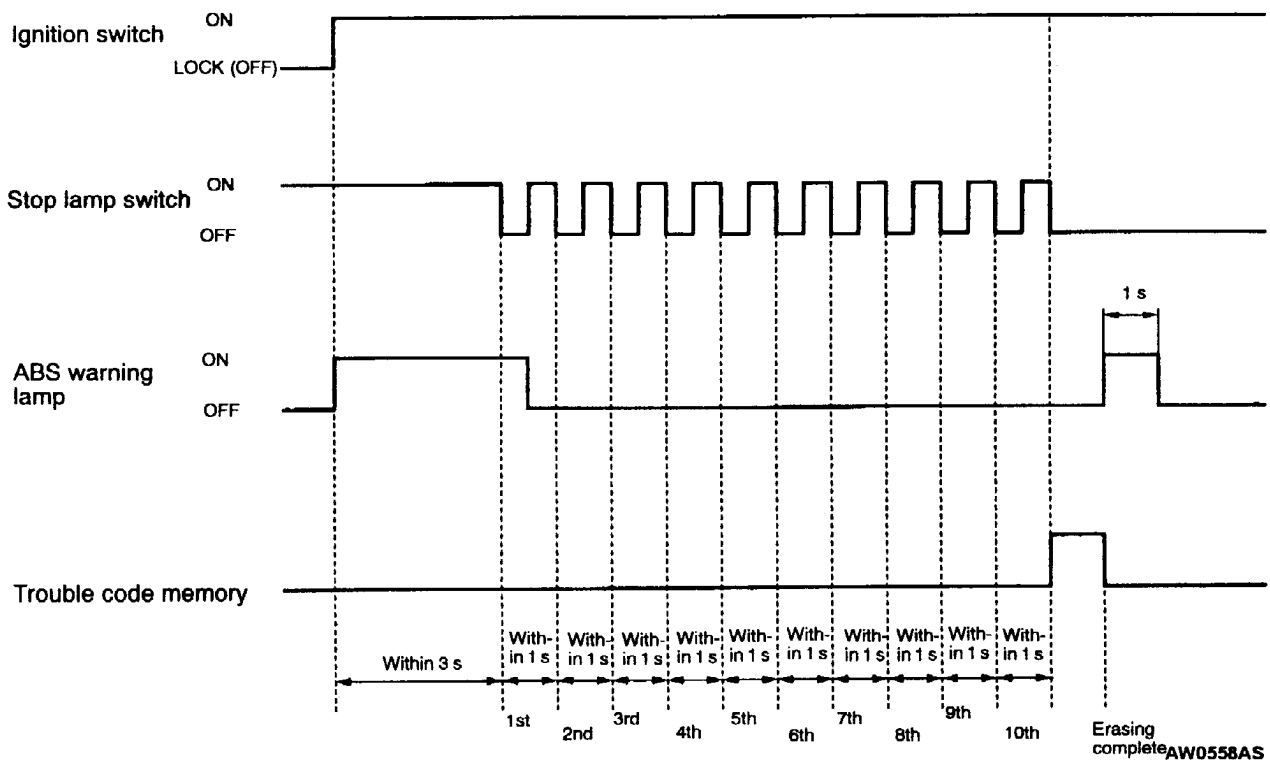
Connect the MUT-II to the 16-pin diagnosis connector.

**When not using the MUT-II**

- (1) Stop the vehicle.
- (2) Turn the stop lamp switch to ON (brake pedal depressed).
- (3) In this condition (after carrying out steps 1) to 2)), turn the ignition switch to the ON position. Then turn off the stop lamp switch (release the brake pedal) within 3 seconds, and then turn the stop lamp switch on and off again a further 10 times.

**NOTE**

If the functioning of the ABS-ECU has been stopped by the fail-safe function, the diagnosis codes cannot be erased.



## INSPECTION CHART FOR DIAGNOSIS CODES

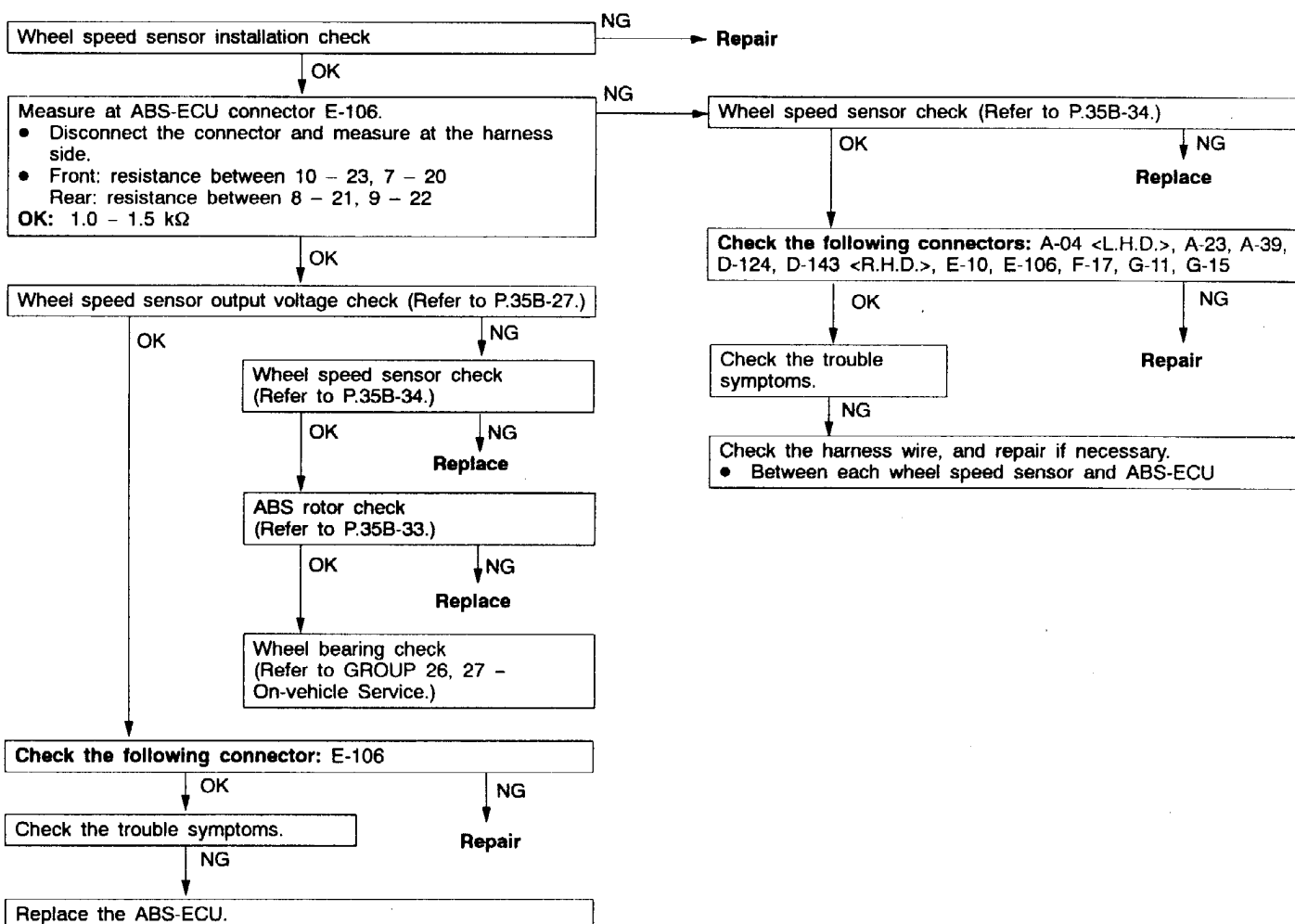
| Diagnosis code No. | Diagnosis item                                                             |                                                                                                  | Reference page                                       |
|--------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------------------|
| 11                 | Wheel speed sensor (FR) system (open circuit or short-circuit)             |                                                                                                  | 35B-8                                                |
| 12                 | Wheel speed sensor (FL) system (open circuit or short-circuit)             |                                                                                                  | 35B-8                                                |
| 13                 | Wheel speed sensor (RR) system (open circuit or short-circuit)             |                                                                                                  | 35B-8                                                |
| 14                 | Wheel speed sensor (RL) system (open circuit or short-circuit)             |                                                                                                  | 35B-8                                                |
| 15                 | Wheel speed sensor system (output signal abnormality)                      |                                                                                                  | 35B-9                                                |
| 16                 | ABS-ECU or valve relay power supply system (abnormal voltage drop or rise) |                                                                                                  | 35B-10                                               |
| 21                 | Wheel speed sensor (FR) system                                             |                                                                                                  | 35B-8                                                |
| 22                 | Wheel speed sensor (FL) system                                             |                                                                                                  | 35B-8                                                |
| 23                 | Wheel speed sensor (RR) system                                             |                                                                                                  | 35B-8                                                |
| 24                 | Wheel speed sensor (RL) system                                             |                                                                                                  | 35B-8                                                |
| 26                 | Center differential lock switch system                                     |                                                                                                  | 35B-11, 12                                           |
| 27                 | Rear differential lock switch system                                       |                                                                                                  | 35B-11, 12                                           |
| 32                 | G sensor system                                                            |                                                                                                  | 35B-13                                               |
| 33                 | Stop lamp switch system                                                    |                                                                                                  | 35B-14                                               |
| 41                 | Control solenoid valve (FR) system                                         | If there is no response to the solenoid valve drive signal corresponding to each respective item | 35B-15                                               |
| 42                 | Control solenoid valve (FL) system                                         |                                                                                                  |                                                      |
| 43                 | Control solenoid valve (RR) system                                         |                                                                                                  |                                                      |
| 44                 | Control solenoid valve (RL) system                                         |                                                                                                  |                                                      |
| 45                 | Changeover solenoid valve (FR) system                                      |                                                                                                  |                                                      |
| 46                 | Changeover solenoid valve (FL) system                                      |                                                                                                  |                                                      |
| 51                 | Valve relay system (ON problem)                                            |                                                                                                  | 35B-16                                               |
| 52                 | Valve relay system (OFF problem)                                           |                                                                                                  | 35B-17                                               |
| 55                 | HBB system                                                                 |                                                                                                  | Carry out HBB troubleshooting. (Refer to GROUP 35A.) |
| 63                 | ABS-ECU system                                                             |                                                                                                  | 35B-32 (ABS-ECU replacement)                         |

## NOTE

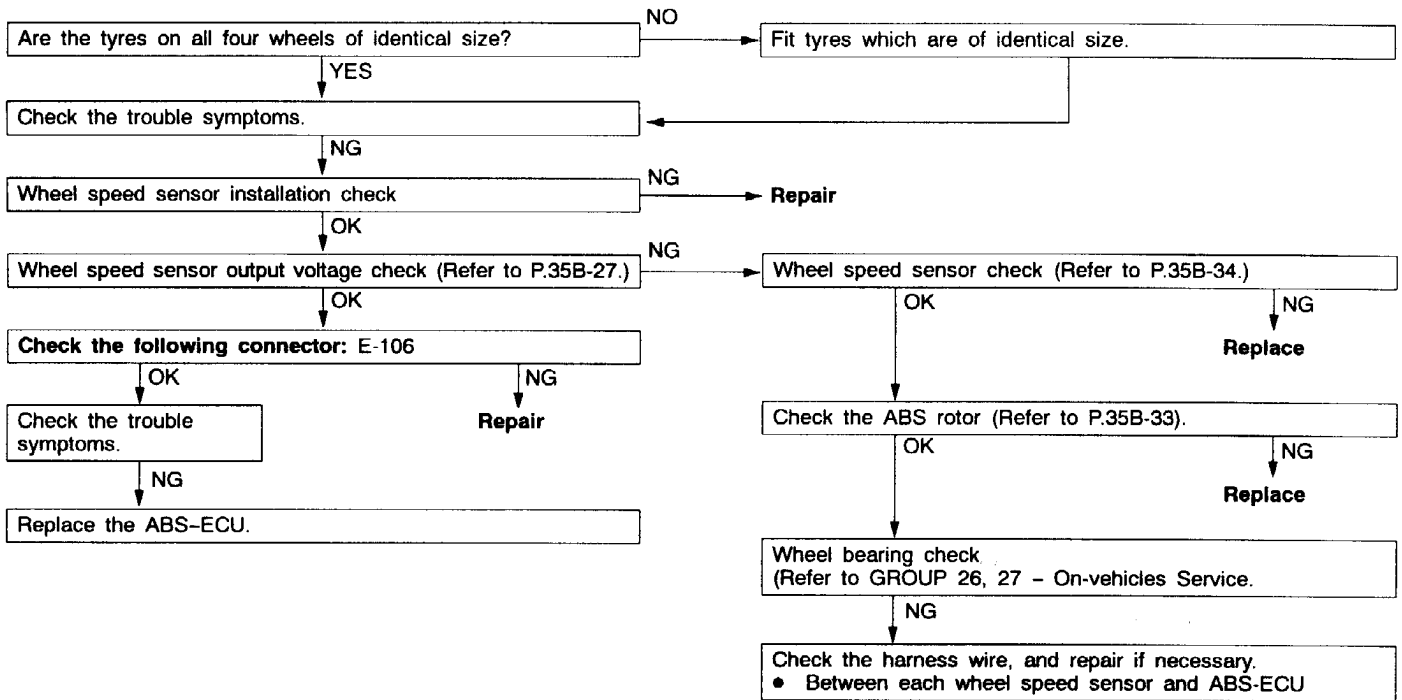
\*: Code No.16 is erased from the memory if the condition returns to normal.

## INSPECTION PROCEDURE CLASSIFIED BY DIAGNOSIS CODE

| Code No. 11, 12, 13, 14 Wheel speed sensor system (open circuit or short-circuit)                                                                                                                                                                                                                                                                                                                                                                                                                                | Probable cause                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code No. 21, 22, 23, 24 Wheel speed sensor system                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                    |
| Code Nos. 11, 12, 13, 14 are output when the open circuit or short-circuit detection carried out by the ABS-ECU hardware circuit detects that there is an open circuit or short-circuit in the (+) or (-) wire in one of the four wheel speed sensors and signals are consequently not being input.                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>• Malfunction of wheel speed sensor</li> <li>• Malfunction of harness or connector</li> <li>• Malfunction of the ABS-ECU</li> </ul>                                                                                                                                         |
| Code No. 21, 22, 23, 24 are output at the following times: <ul style="list-style-type: none"> <li>• If an open circuit cannot be verified, but one or more of the wheel speed sensors does not output any signal when the vehicle speed is a certain number of km/h or higher.</li> <li>• When a problem such as chipped or plugged-up rotor tooth is detected, or if the sensor output drops and anti-skid control is continuously carried out due to a malfunctioning sensor or a warped ABS rotor.</li> </ul> | <ul style="list-style-type: none"> <li>• Malfunction of wheel speed sensor</li> <li>• Malfunction of harness or connector</li> <li>• Malfunction of ABS rotor</li> <li>• Excessive clearance between sensor and ABS rotor</li> <li>• Malfunction of the ABS-ECU</li> <li>• Malfunction of wheel bearing</li> </ul> |



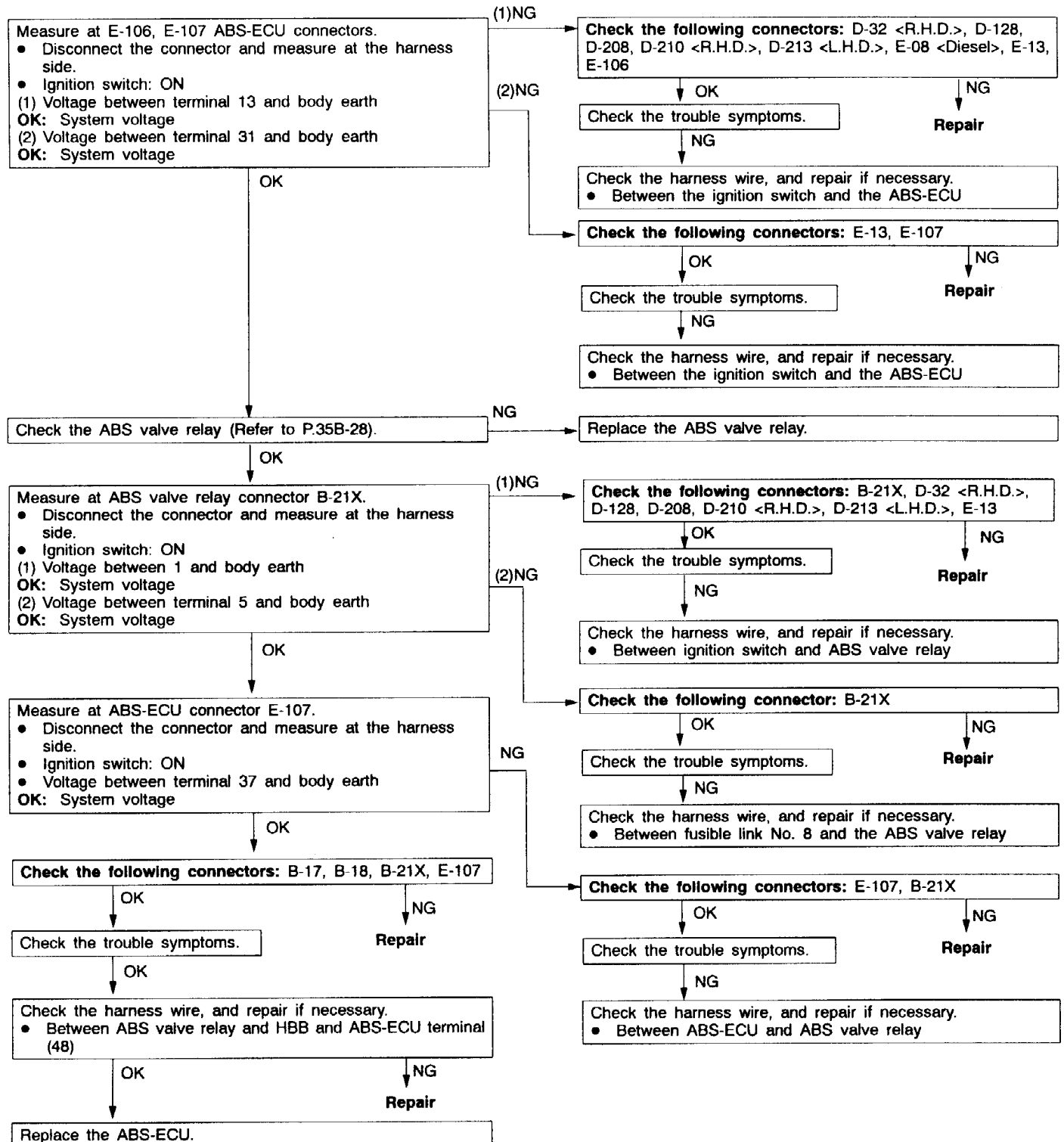
| Code No. 15 Wheel speed sensor system (output signal abnormality)                                                                                 | Probable cause                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This malfunction code is output when any one of the wheel speed sensor output signals during driving is abnormal (except open and short circuit). | <ul style="list-style-type: none"> <li>• Uneven tyre size for all four wheels</li> <li>• Incorrect wheel speed sensor installation</li> <li>• Malfunction of wheel speed sensor</li> <li>• Malfunction of harness or connector</li> <li>• Malfunction of ABS rotor</li> <li>• Malfunction of wheel bearing</li> <li>• Malfunction of the ABS-ECU</li> </ul> |



| Code No.16 ABS-ECU power supply system (abnormal voltage increase or decrease)                                                          | Probable cause                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This code is output if the ABS-ECU power supply voltage or valve relay power supply voltage drops below or rises above a certain level. | <ul style="list-style-type: none"> <li>• Malfunction of battery</li> <li>• Malfunction of harness or connector</li> <li>• Malfunction of the ABS-ECU</li> </ul> |

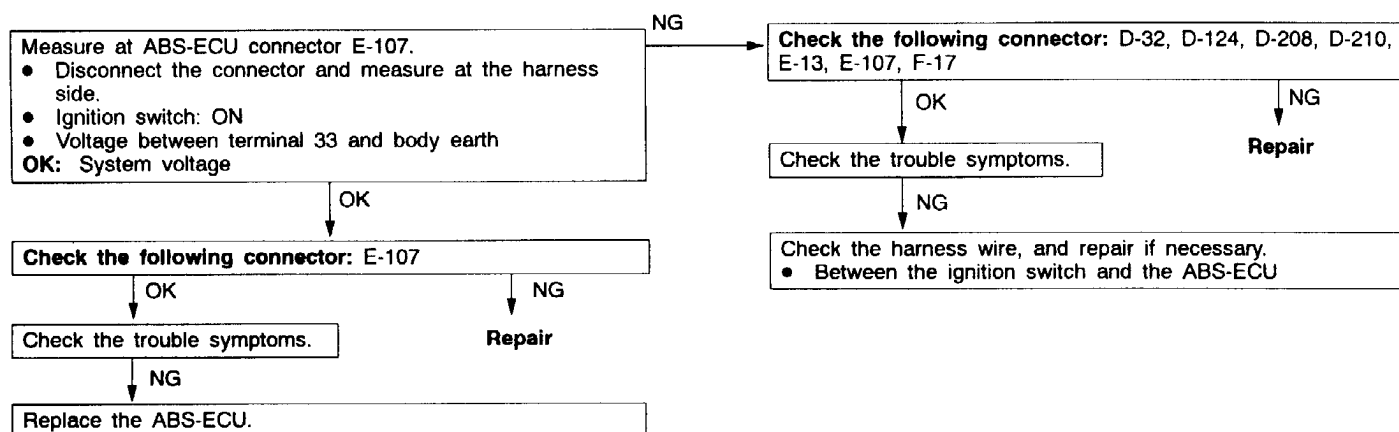
**Caution**

If the system voltage drops or rises during inspection, this code will be output to indicate a current problem. And correct problem diagnosis will not be possible. Before carrying out the following procedure, check the battery and recharge it if necessary.



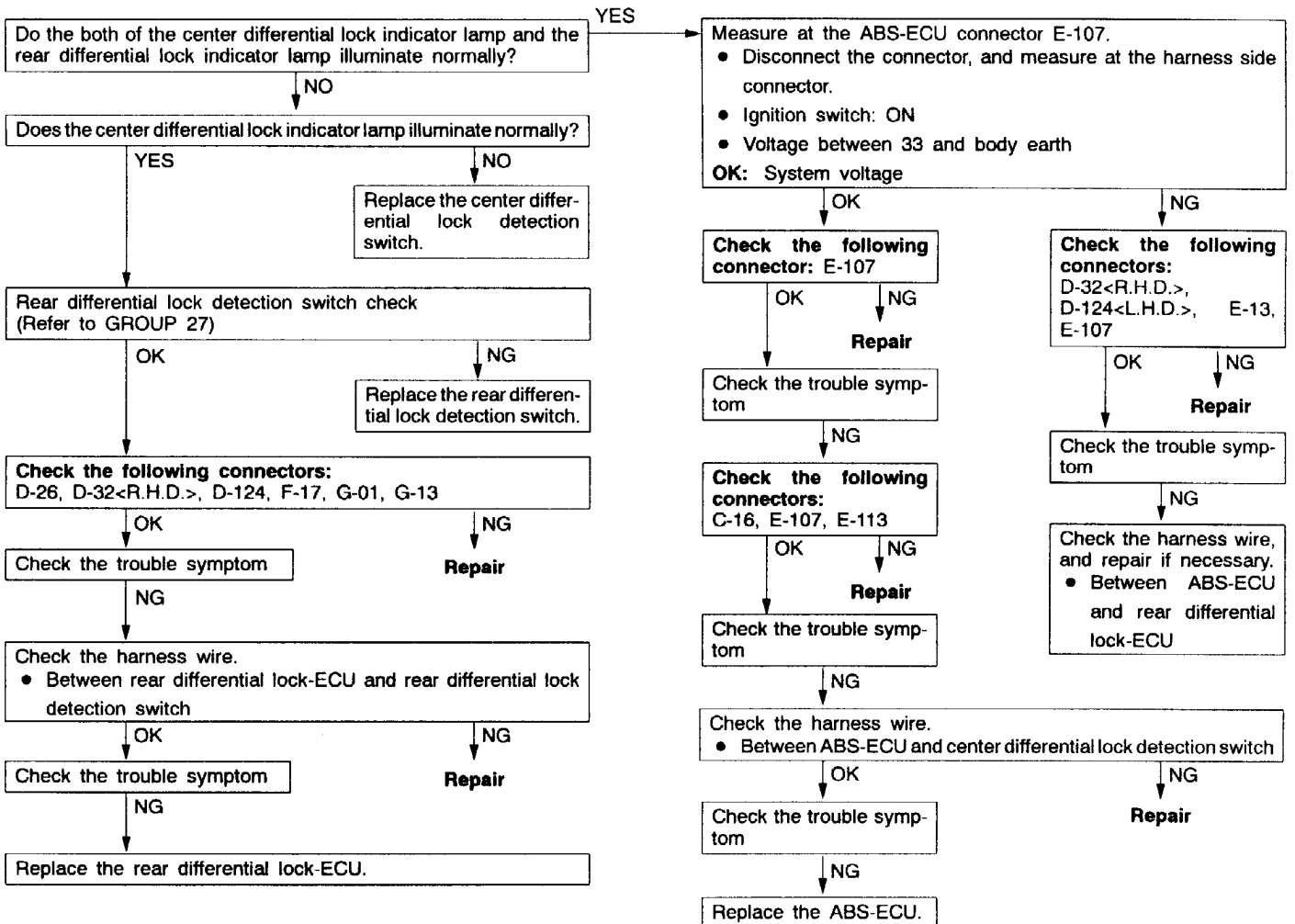
## &lt;Vehicles without rear differential lock system&gt;

| Code No. 26 Center differential lock switch system                                                                                                                                                                                                                                                                                                                                                            | Probable cause                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Code No. 27 Rear differential lock switch system                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                            |
| The ABS-ECU is designed to accommodate the fitting of a rear differential lock. Because of this, for vehicles which are not equipped with a rear differential lock, system voltage is applied to terminal (33) of the ABS-ECU instead of the rear differential lock switch signal. If there is an open circuit in the lines by which this system voltage is applied, the ABS-ECU outputs code Nos. 26 and 27. | <ul style="list-style-type: none"><li>● Malfunction of harness or connector</li><li>● Malfunction of the ABS-ECU</li></ul> |



## &lt;Vehicles with rear differential lock system&gt;

| Code No.26 Center differential lock detection switch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Probable cause                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code No.27 Rear differential lock detection switch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                      |
| <p>On vehicles with rear differential lock system, these codes will be set under the following conditions:</p> <ul style="list-style-type: none"> <li>• The ABS-ECU detects an open-circuit in the center differential lock detection switch and the rear differential lock detection switch systems, so no signal is sent.</li> <li>• The vehicle has been driven at 20 km/h or more for five minutes or more while the center differential lock detection switch is off and the rear differential lock detection switch is on, and then the vehicle speed decreases to 2 km/h in that condition.</li> </ul> | <ul style="list-style-type: none"> <li>• Malfunction of harness or connector</li> <li>• Malfunction of the center differential lock detection switch</li> <li>• Malfunction of the rear differential lock detection switch</li> <li>• Malfunction of the rear differential lock-ECU</li> <li>• Malfunction of the ABS-ECU</li> </ul> |



| Code No. 32 G sensor system                                                                                                                                                                                                                                                                                            | Probable cause                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>This code is output at the following cases:</p> <ul style="list-style-type: none"> <li>When the G sensor output is lower than 0.5 V or higher than 4.5 V (Open circuit or short-circuit in G sensor circuit)</li> <li>When there is no variation in the G sensor output voltage (G sensor output seized)</li> </ul> | <ul style="list-style-type: none"> <li>Malfunction of G sensor</li> <li>Malfunction of harness or connector</li> <li>Malfunction of the ABS-ECU</li> </ul> |

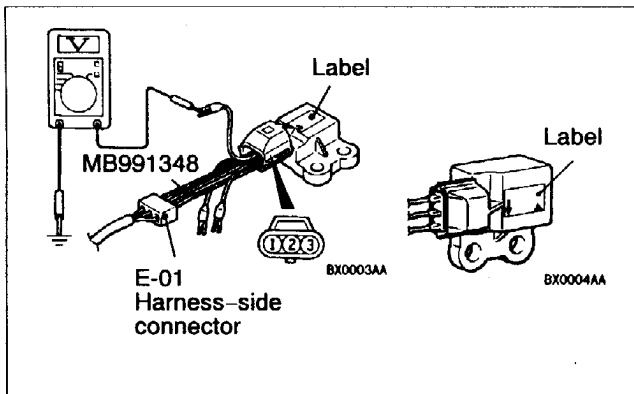
Measure at G sensor connector E-01.

- Disconnect the connector and measure at the harness side.

(1) Voltage between terminal 1 and body earth (Ignition switch: ON)  
**OK:** System voltage

(2) Continuity between terminal 3 and body earth  
**OK:** Continuity

OK



- Remove the G sensor (Refer to P.35B-36).
- Connect the special tool between the G sensor harness-side connector E-01 and the G sensor.
- Ignition switch: ON
- Voltage between terminal 2 and body earth when the G sensor is placed on a level surface  
**OK:** 2.4 – 2.6 V
- Voltage between terminal 2 and body earth when the G sensor is placed so that the label is facing straight up  
**OK:** 3.3 – 3.7 V

OK

Check the following connectors: E-01, E-106, E-113

OK

Check the trouble symptoms.

NG

Check the harness wire, and repair if necessary.

- Between the G sensor and ABS-ECU

OK

Replace the ABS-ECU.

(1)NG

Check the following connectors: D-32<L.H.D.>, D-208, D-210, E-01, E-115

OK

Check the trouble symptoms.

NG

Check the harness wire, and repair if necessary.

- Between ignition switch and G sensor

Repair

(2)NG

Check the following connectors: E-01, E-106, E-113

OK

Check the trouble symptoms.

NG

Check the harness wire, and repair if necessary.

- Between the G sensor and ABS-ECU

OK

Replace the ABS-ECU.

Repair

NG

Replace the G sensor.

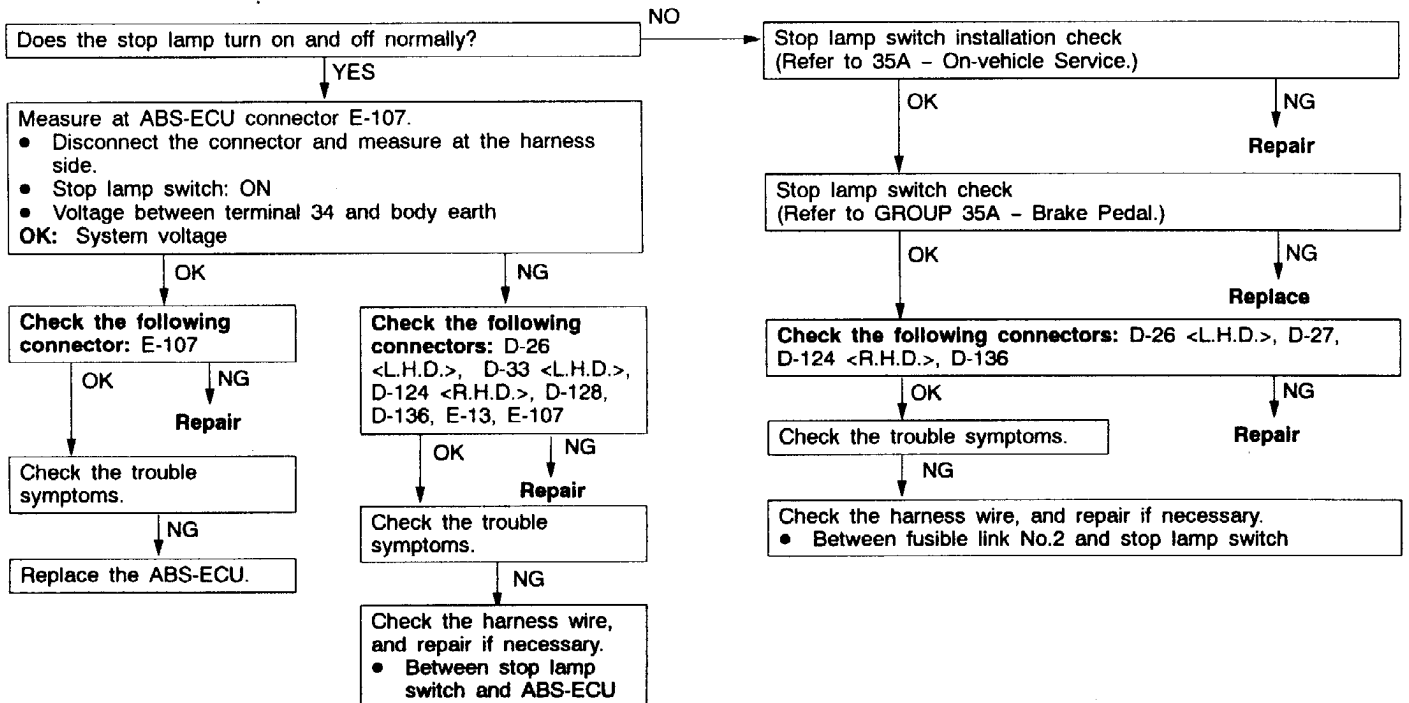
NG

Repair

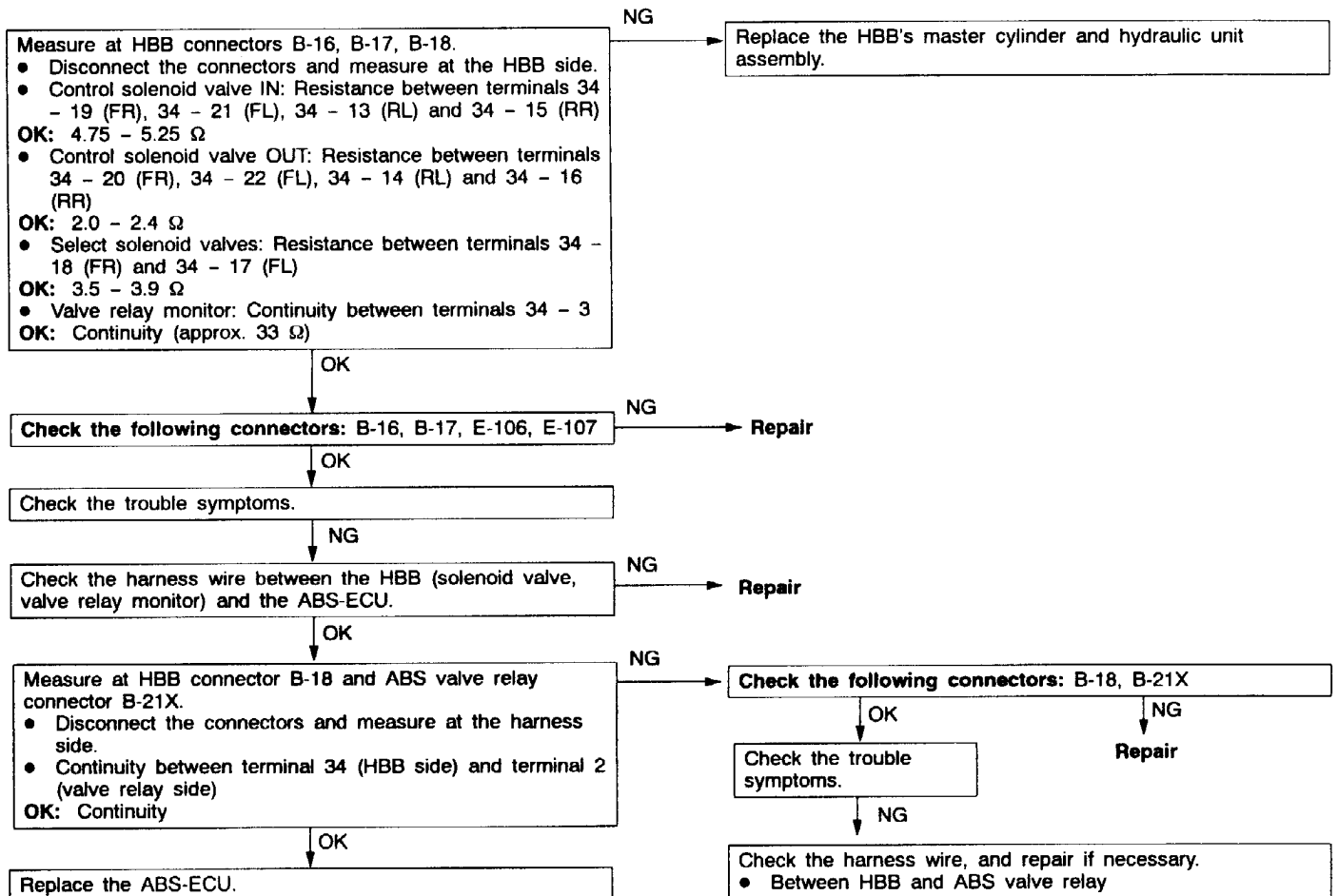
NG

Repair

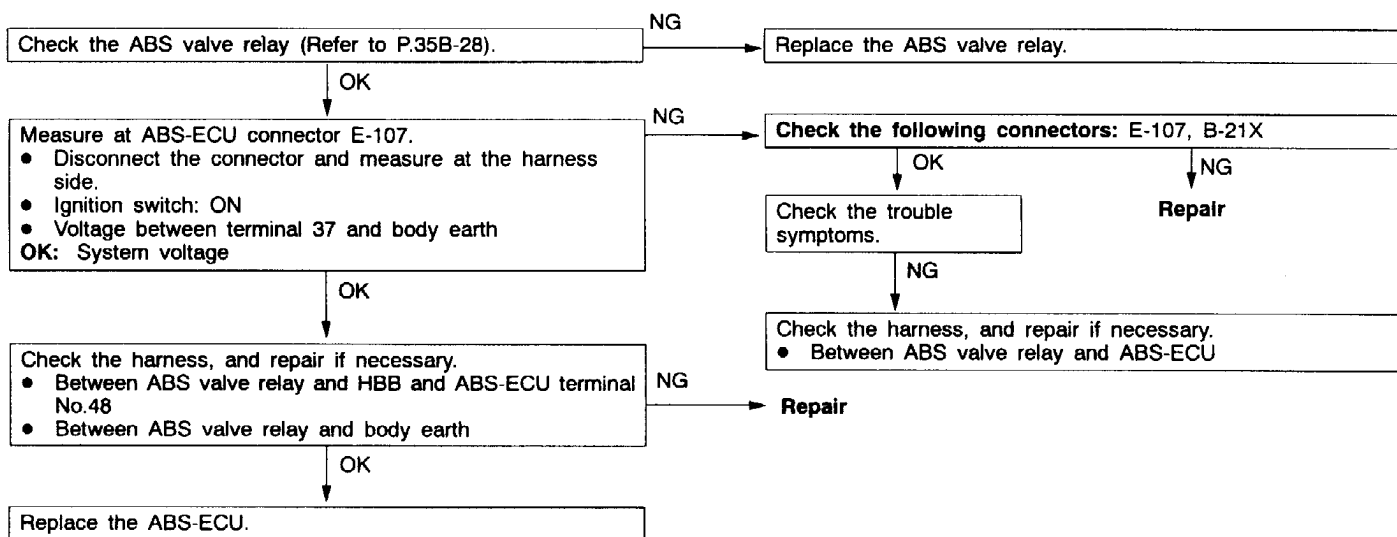
| Code No. 33 Stop lamp switch system (open circuit or ON problem)                                                                                                                                                                                                     | Probable cause                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This code is output at the following cases: <ul style="list-style-type: none"> <li>• If the stop lamp switch is continuously on for 15 minutes or more while driving</li> <li>• If there is an open circuit in the stop lamp switch input circuit harness</li> </ul> | <ul style="list-style-type: none"> <li>• Malfunction of stop lamp switch</li> <li>• Malfunction of harness or connector</li> <li>• Malfunction of ABS-ECU</li> </ul> |



|                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Code No. 41, 42, 43, 44 Control solenoid valve system</b>                                                                                                                                                                                                                                                                                                           | <b>Probable cause</b>                                                                                                                                                                                 |
| <b>Code No. 45, 46 Select solenoid valve system</b>                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                       |
| The ABS-ECU constantly monitors the solenoid valve drive circuits. These codes are output if the ABS-ECU judges that there is an open circuit or short-circuit in a solenoid coil or harness because the solenoid valve is on but no current flows to the solenoid valve, or if current continues flowing to the solenoid valve even though the solenoid valve is off. | <ul style="list-style-type: none"><li>● Malfunction of harness or connector</li><li>● Malfunction of HBB's master cylinder and hydraulic unit assembly</li><li>● Malfunction of the ABS-ECU</li></ul> |



| Code No. 51 Valve relay system (ON problem)                                                                                                                                                                                                                                                       | Probable cause                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This code is output when the ABS-ECU judges during the initial check when the ignition switch is turned to the ON position and the valve relay is OFF that there is a fused relay contact or a short-circuit in the valve relay drive circuit when power is being supplied to the solenoid valve. | <ul style="list-style-type: none"> <li>• Malfunction of harness or connector</li> <li>• Malfunction of ABS valve relay</li> <li>• Malfunction of the ABS-ECU</li> </ul> |

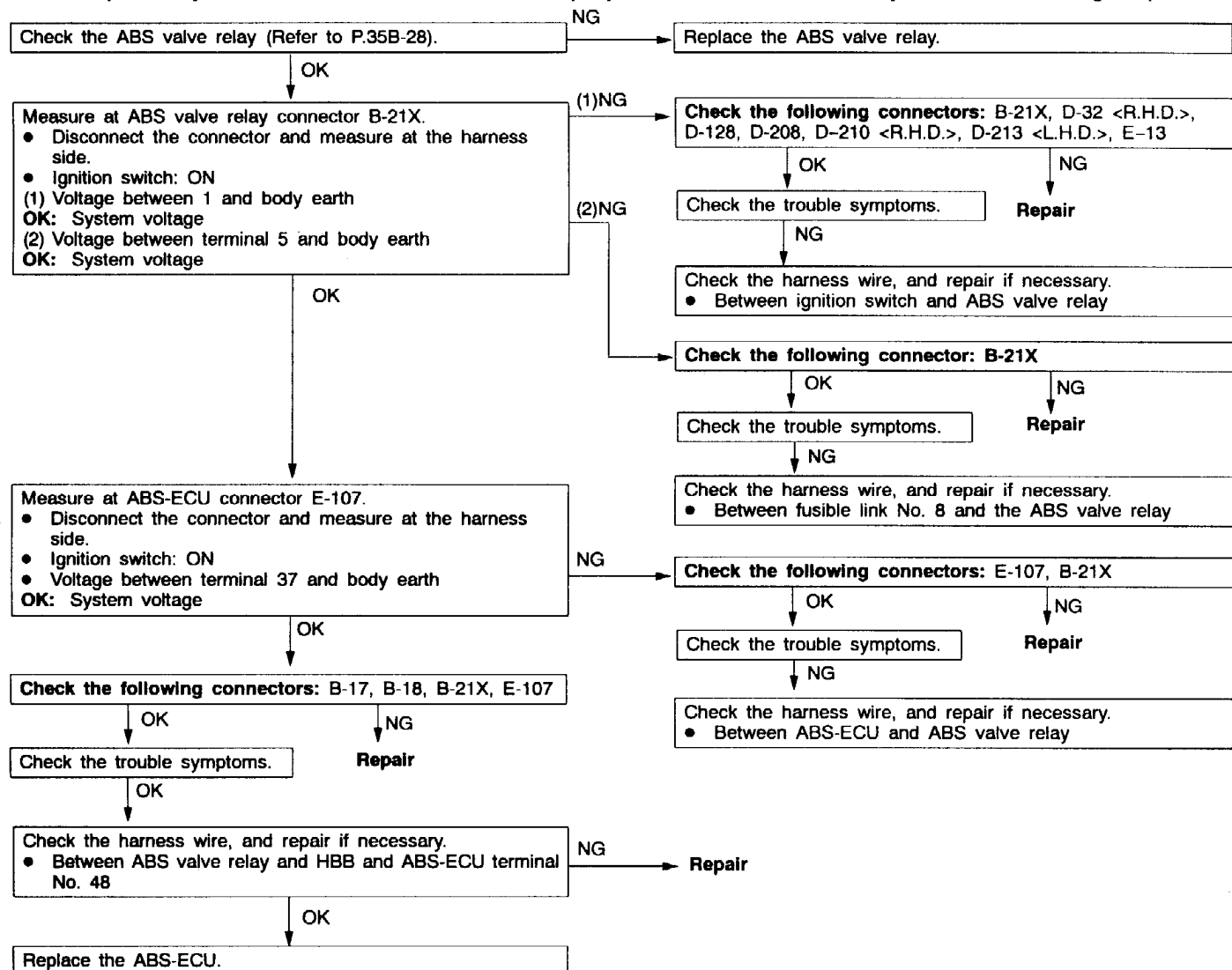


| Code No. 52 Valve relay system (OFF problem)                                                                                                              | Probable cause                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This code is output if the ABS-ECU judges that there is a valve relay OFF problem when the valve relay is on and power is supplied to the solenoid valve. | <ul style="list-style-type: none"> <li>• Malfunction of harness or connector</li> <li>• Malfunction of ABS valve relay</li> <li>• Malfunction of the ABS-ECU</li> </ul> |

**NOTE**

When reading the diagnosis codes using the ABS warning lamp (Refer to P.35B-5.), the valve relay connector is disconnected during inspection, with the result that this problem code will be output in addition to any other problem codes.

After the problem locations indicated by the problem diagnosis codes have been checked and repaired but the ABS warning lamp remains illuminated and no diagnosis codes other than code No. 52 are displayed, there is probably a malfunction of the valve relay system. In this case, carry out the following inspection.



## INSPECTION CHART FOR TROUBLE SYMPTOMS

| Trouble Symptom                                                                                    | Inspection procedure No. | Reference page |
|----------------------------------------------------------------------------------------------------|--------------------------|----------------|
| Communication with MUT-II is not possible.                                                         | 1                        | 35B-18         |
| Communication with MUT-II and the ABS-ECU is not possible.                                         | 2                        | 35B-19         |
| The ABS warning lamp does not illuminate when the ignition key is turned to ON (engine stopped).   | 3                        | 35B-20         |
| The ABS warning lamp remains illuminated after the engine has started.                             | 4                        | 35B-20         |
| The brake warning lamp does not illuminate when the ignition switch is turned ON (engine stopped). | Refer to GROUP 35A.      |                |
| The brake warning lamp remains illuminated after the engine has started.                           |                          |                |
| Abnormal brake operation                                                                           | 5                        | 35B-21         |

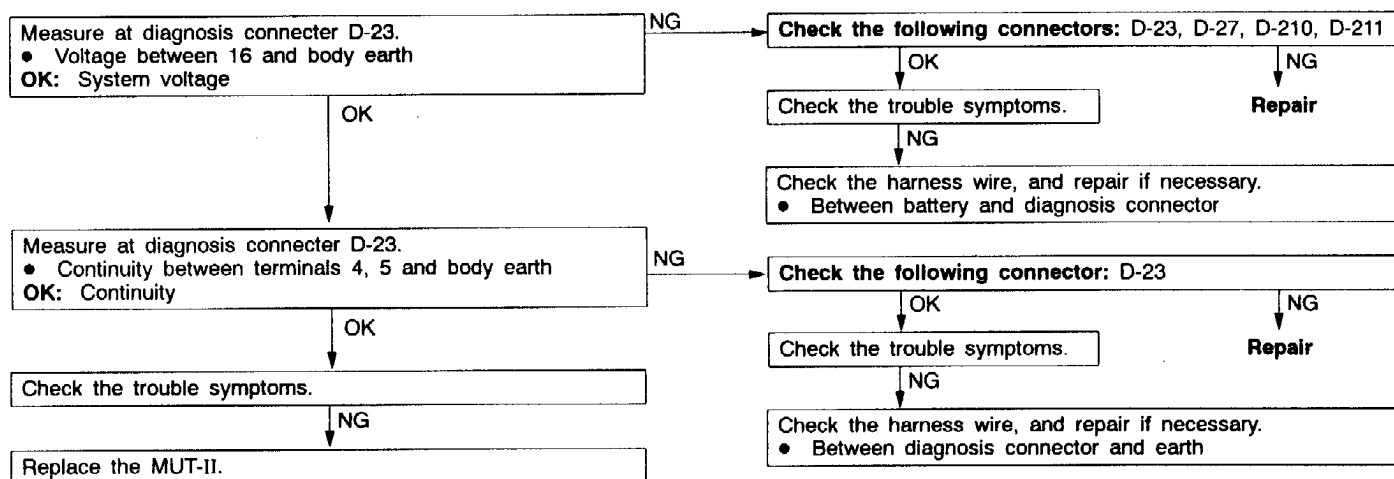
**Caution**

- (1) Because the ABS may also operate at times when sudden braking is not being carried out, such as when driving on low frictional coefficient roads, when turning at high speed or during high-speed overtaking, check with the customer that the problems are not occurring when driving under conditions such as these.
- (2) When the ABS is operating, changes in the brake pedal feel (vibration and difficulty depressing the pedal) may occur. This happens because the hydraulic pressure inside the brake line is continually changing in order to stop the wheels from locking up, and is not a malfunction.

## INSPECTION PROCEDURES FOR TROUBLE SYMPTOMS

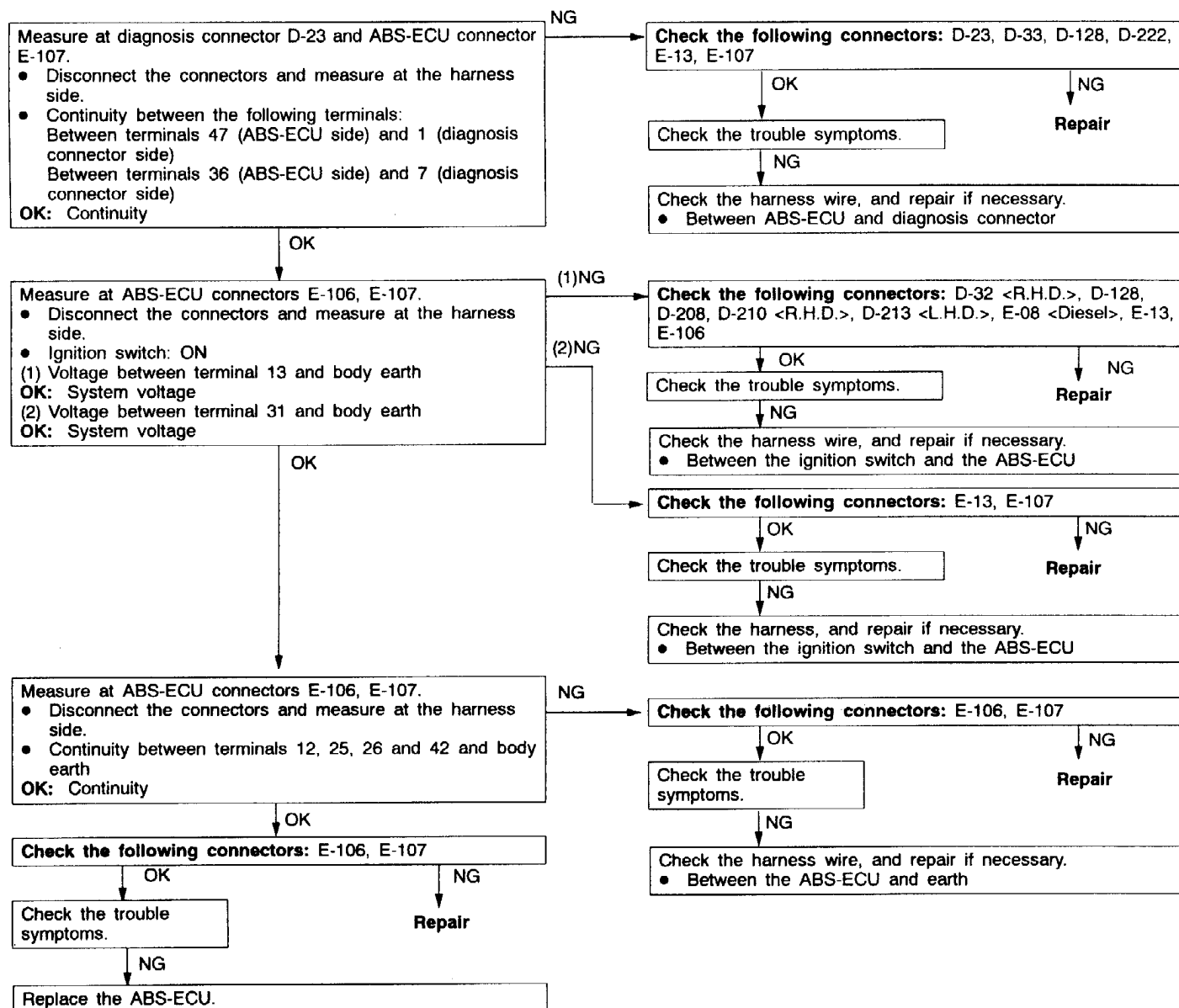
## Inspection procedure 1

| Communication with MUT-II is not possible.                                                            | Probable cause                                                                                                                        |
|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| The cause is probably a malfunction of the diagnosis connector power supply circuit or earth circuit. | <ul style="list-style-type: none"> <li>• Malfunction of diagnosis connector</li> <li>• Malfunction of harness or connector</li> </ul> |



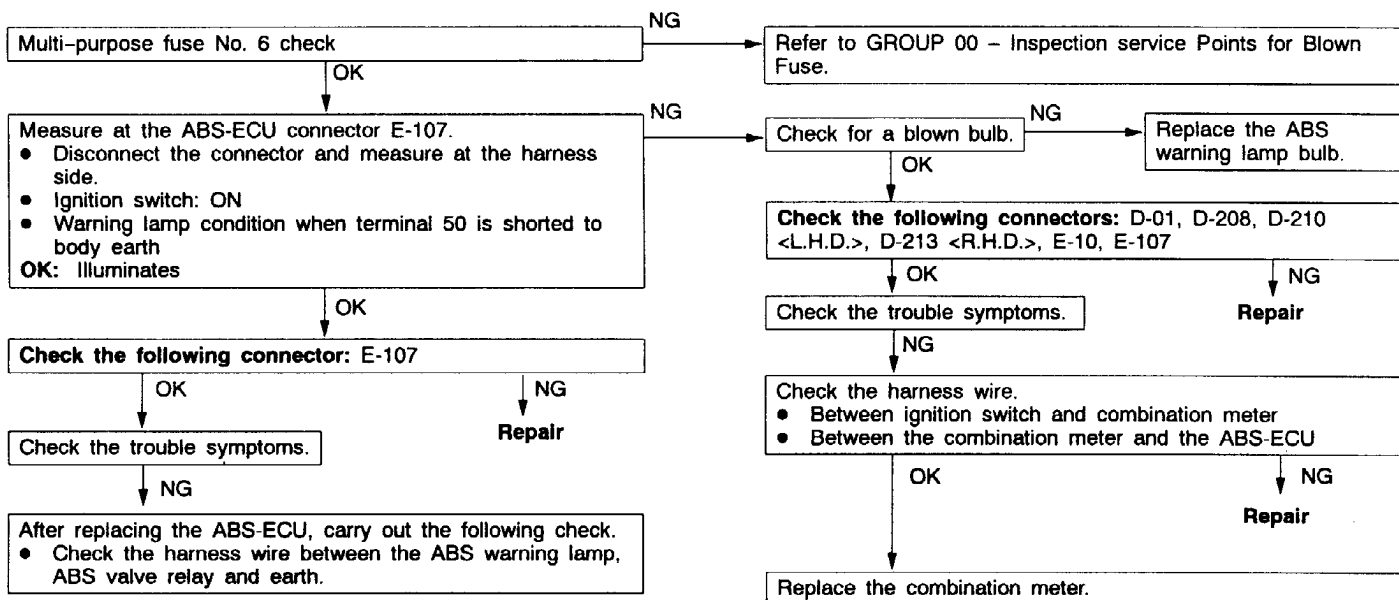
## Inspection procedure 2

| Communication with MUT-II and the ABS-ECU is not possible.                                                                    | Probable cause                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| The cause is probably an open circuit in the ABS-ECU power supply circuit or an open circuit in the diagnosis output circuit. | <ul style="list-style-type: none"> <li>• Blown fuse</li> <li>• Malfunction of harness or connector</li> <li>• Malfunction of the ABS-ECU</li> </ul> |



## Inspection procedure 3

| The ABS warning lamp does not illuminate when the ignition key is turned to ON (engine stopped).                                                                                                                                                                                                                                                                                               | Probable cause                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| When power is first supplied to the ABS-ECU, the ABS-ECU turns the ABS-ECU valve relay from off to on, off and back to on again as part of its initial check. Accordingly, if the ABS warning lamp does not illuminate, the cause is probably an open circuit in the ABS warning lamp power supply circuit, a blown lamp bulb or an open circuit between the ABS warning lamp and the ABS-ECU. | <ul style="list-style-type: none"> <li>• Blown fuse</li> <li>• Blown ABS warning lamp bulb</li> <li>• Malfunction of ABS valve relay</li> <li>• Malfunction of harness or connector</li> <li>• Malfunction of combination meter</li> <li>• Malfunction of the ABS-ECU</li> </ul> |

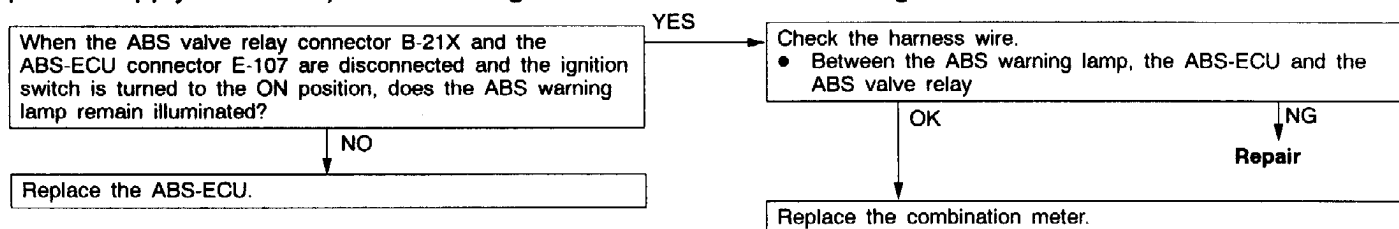


## Inspection procedure 4

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

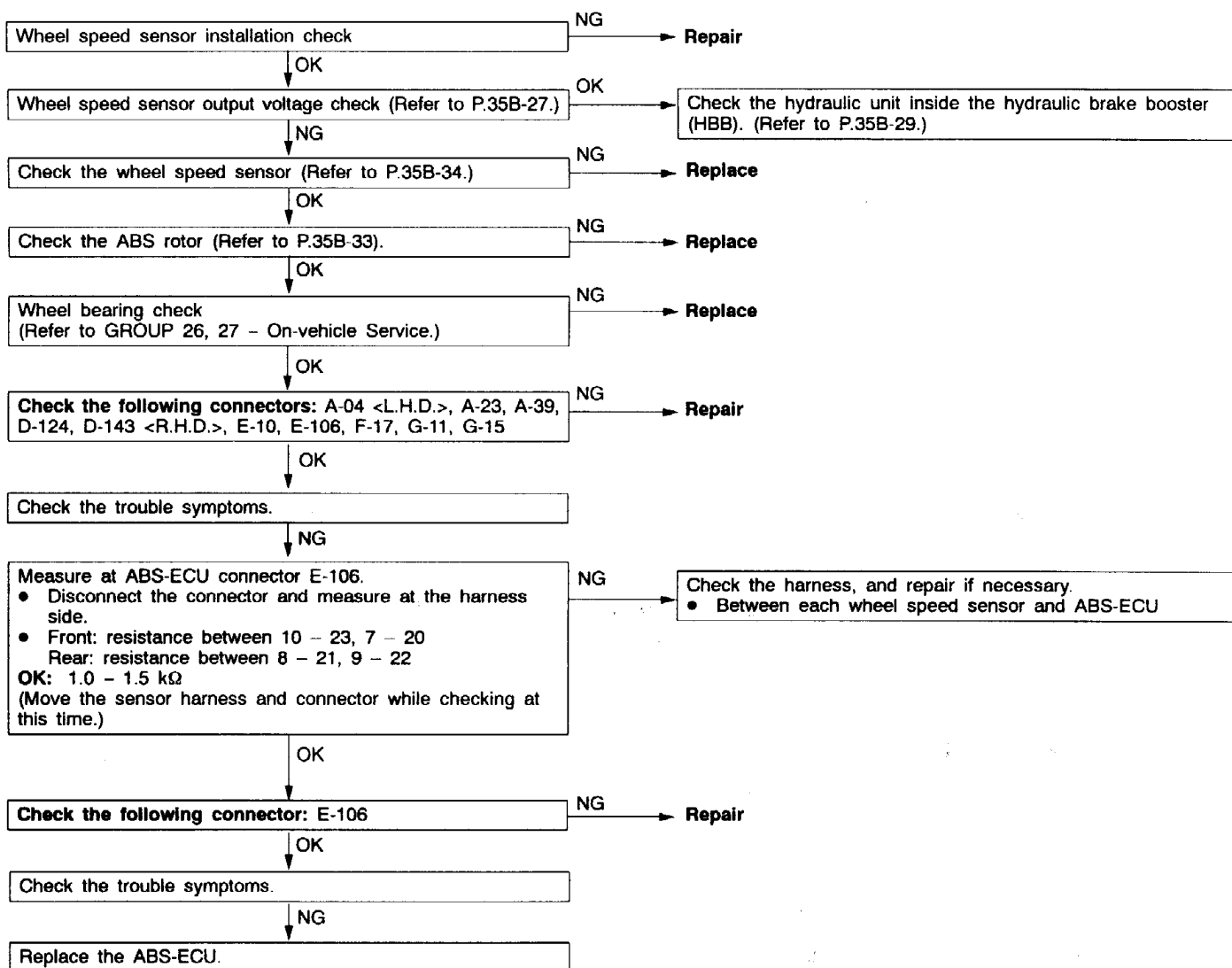
## NOTE

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

| Abnormal brake operation                                                                                                                                                                                                                  | Probable cause                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Braking operation varies depending on the driving conditions and the road surface, which can make it difficult to diagnose a problem. However, if the diagnosis codes displayed are normal, carry out the following inspection procedure. | <ul style="list-style-type: none"> <li>• Incorrect wheel speed sensor installation</li> <li>• Malfunction of harness or connector</li> <li>• Malfunction of wheel speed sensor</li> <li>• Malfunction of ABS rotor</li> <li>• Foreign material adhering to speed sensor</li> <li>• Malfunction of wheel bearing</li> <li>• Malfunction of HBB</li> <li>• Malfunction of the ABS-ECU</li> </ul> |



**DATA LIST REFERENCE TABLE**

The following ECU input data items can be read using the MUT-II.

(1) When system is normal

| Item No. | Check item                      | Inspection conditions                                                                                             |                                              | Normal condition                                      |
|----------|---------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------------------------|
| 11       | Front-right wheel speed         | When vehicle is being driven                                                                                      |                                              | Speedometer display and MUT-II display are identical. |
| 12       | Front-left wheel speed          |                                                                                                                   |                                              |                                                       |
| 13       | Rear-right wheel speed          |                                                                                                                   |                                              |                                                       |
| 14       | Rear-left wheel speed           |                                                                                                                   |                                              |                                                       |
| 16       | System voltage                  | Ignition switch: ON                                                                                               |                                              | 6.5–22.3 V                                            |
| 26       | Center differential lock switch | Ignition switch: ON                                                                                               | Transfer selector lever position: 2H, 4H     | OFF                                                   |
|          |                                 |                                                                                                                   | Transfer selector lever position: 4HLc, 4LLc | ON                                                    |
| 27       | Rear differential lock switch   | Ignition switch: ON                                                                                               |                                              | OFF                                                   |
| 32       | G sensor                        | <ul style="list-style-type: none"> <li>Ignition switch: ON</li> <li>When vehicle is stationary (level)</li> </ul> |                                              | 2.4–2.6 V                                             |
|          |                                 | When vehicle is being driven                                                                                      |                                              | 1.0–4.0 V                                             |
| 33       | Stop lamp Switch                | Ignition switch: ON                                                                                               | When brake pedal is depressed                | ON                                                    |
|          |                                 |                                                                                                                   | When brake pedal is released                 | OFF                                                   |

(2) When system is interrupted by the ECU

When the diagnosis function has caused the operation of the ABS-ECU to be stopped, the MUT-II display data may be different from the actual condition.

**ACTUATOR TEST TABLE**

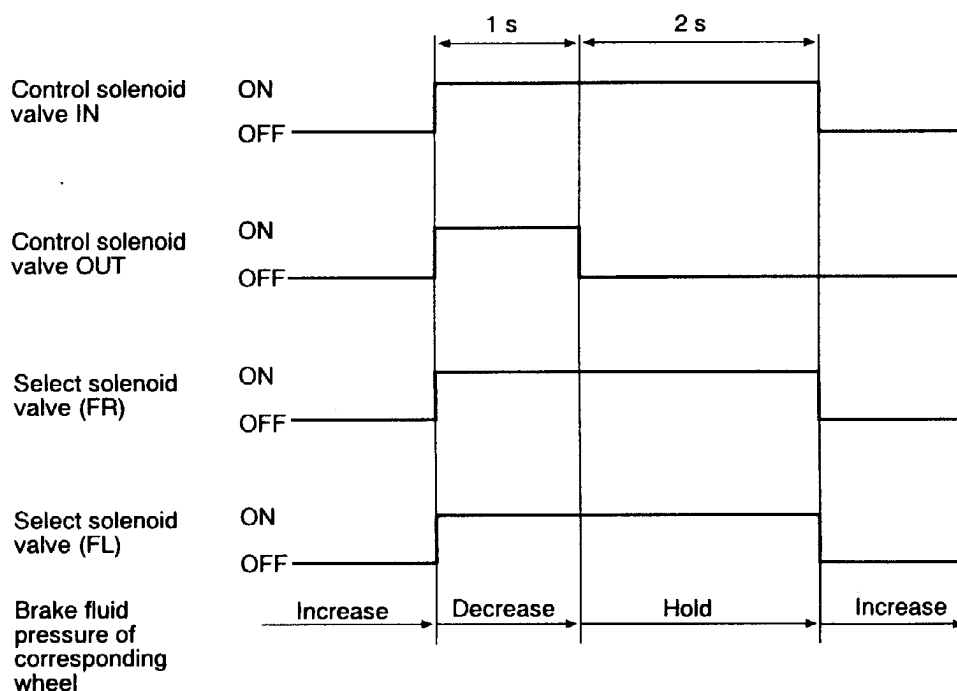
The following actuators can be force-driven using the MUT-II.

**NOTE**

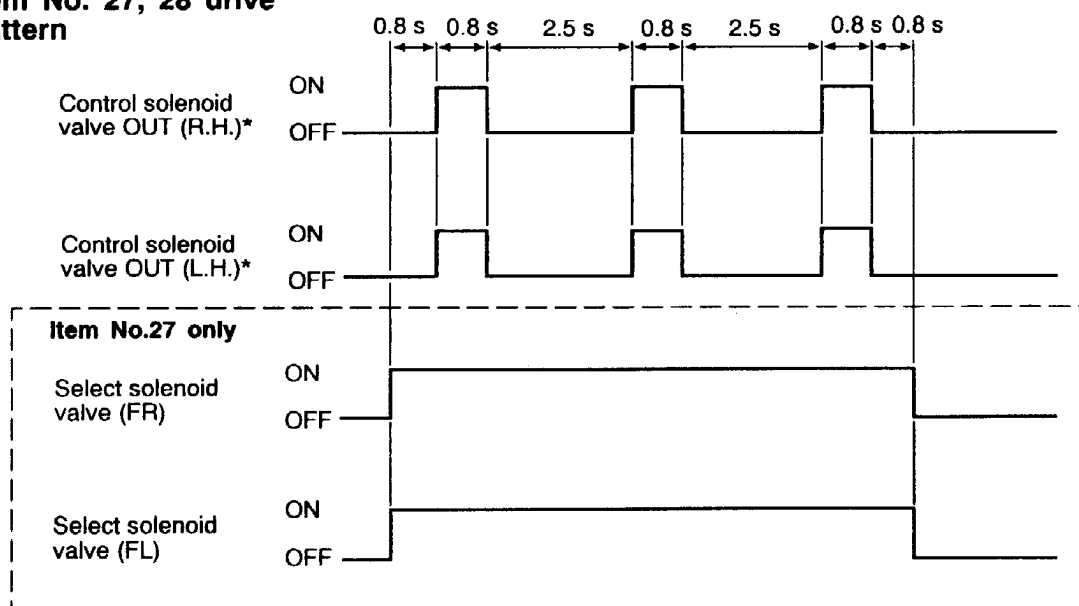
- (1) Actuator tests cannot be carried out when the operation of the ABS-ECU has been stopped by the fail-safe function.
- (2) Actuator tests can only be carried out while the vehicle is stopped.

**ACTUATOR TEST SPECIFICATIONS**

| Item No. | Check item              | Drive Contents                                                                    |
|----------|-------------------------|-----------------------------------------------------------------------------------|
| 01       | FR wheel solenoid valve | HBB select solenoid valves and control solenoid valves for the respective channel |
| 02       | FL wheel solenoid valve |                                                                                   |
| 03       | RR wheel solenoid valve |                                                                                   |
| 04       | RL wheel solenoid valve |                                                                                   |
| 27       | Air bleeding (1)        | HBB select solenoid valves and control solenoid valve OUT (FR, FL)                |
| 28       | Air bleeding (2)        | HBB control solenoid valve OUT (RR, RL)                                           |

**Item No. 01 – 04 drive pattern**

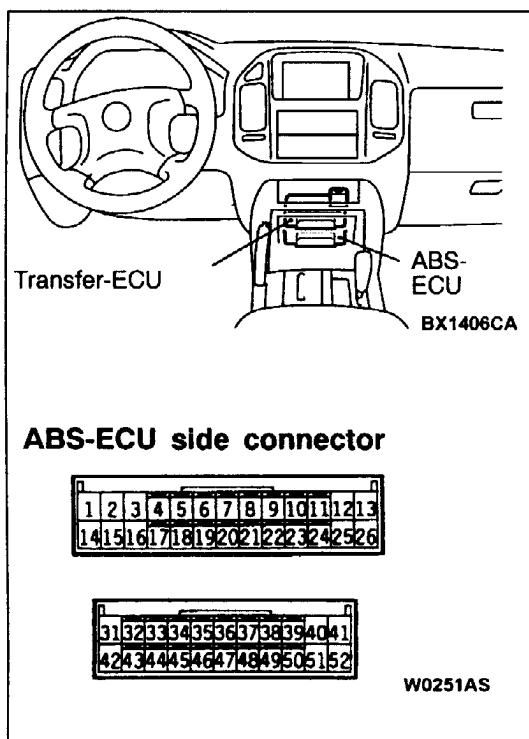
X1266CA

**Item No. 27, 28 drive pattern**

X1267CA

**NOTE**

\*: When carrying out item No. 27, the front wheels are driven, and when carrying out item No. 28, the rear wheels are driven.

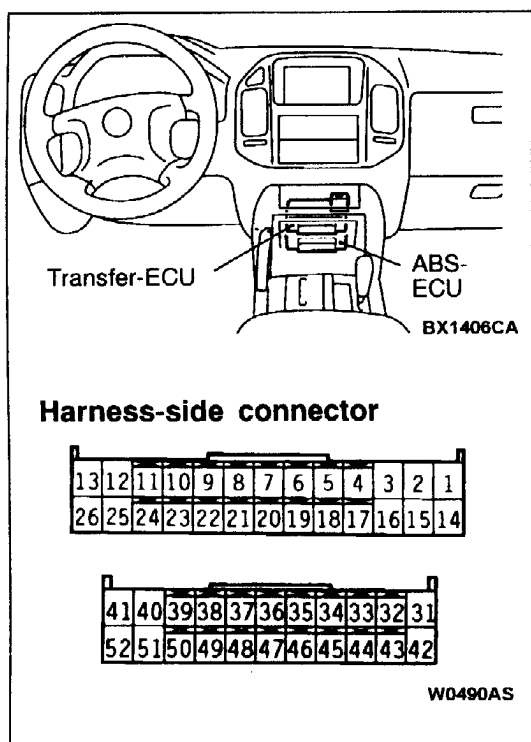
**CHECK AT ABS-ECU TERMINAL****TERMINAL VOLTAGE TABLE****NOTE**

There are two ECUs with the same shape inside the floor console, one above the other. The upper ECU is the ABS-ECU and has a blue connector. The lower ECU is the transfer-ECU and has a green connector.

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

| Terminal No. | Check item                      | Inspection conditions                              |                       | Normal condition                     |
|--------------|---------------------------------|----------------------------------------------------|-----------------------|--------------------------------------|
| 1            | Control solenoid valve OUT (FL) | Ignition switch: ON                                |                       | System voltage                       |
| 2            | Control solenoid valve OUT (RR) | Ignition switch: ON                                |                       | System voltage                       |
| 3            | Select solenoid valve (FL)      | Ignition switch: ON                                |                       | System voltage                       |
| 4            | G sensor input                  | Ignition switch: ON<br>Vehicle horizontal position |                       | 2.4 – 2.6 V                          |
| 13           | ABS-ECU power supply            | Ignition switch: ON                                |                       | System voltage                       |
|              |                                 | Ignition switch: START                             |                       | 0 V                                  |
| 14           | Control solenoid valve IN (FL)  | Ignition switch: ON                                |                       | System voltage                       |
| 15           | Control solenoid valve IN (RR)  | Ignition switch: ON                                |                       | System voltage                       |
| 16           | Select solenoid valve (FR)      | Ignition switch: ON                                |                       | System voltage                       |
| 18           | G sensor earth                  | At all times                                       |                       | 0.5 V or less                        |
| 31           | ABS-ECU power supply            | Ignition switch: ON                                |                       | System voltage                       |
|              |                                 | Ignition switch: START                             |                       | 0 V                                  |
| 33           | Rear differential lock switch   | Ignition switch: ON                                |                       | System voltage                       |
| 34           | Stop lamp switch input          | Ignition switch: ON                                | Stop lamp switch: ON  | System voltage                       |
|              |                                 |                                                    | Stop lamp switch: OFF | 2 V or less                          |
| 36           | MUT-II                          | When the MUT-II is connected                       |                       | Serial communication with the MUT-II |
|              |                                 | When the MUT-II is not connected                   |                       | 1 V or less                          |

| Terminal No. | Check item                                                  | Inspection conditions            |                                                       | Normal condition |
|--------------|-------------------------------------------------------------|----------------------------------|-------------------------------------------------------|------------------|
| 37           | ABS valve relay output                                      | Ignition switch: ON              | When system abnormality is detected and relay is off  | System voltage   |
|              |                                                             |                                  | When relay is on approx. 1 second after engine starts | 2 V or less      |
| 39           | Brake warning lamp output                                   | Ignition switch: ON              | When lamp is switched off                             | 2 V or less      |
|              |                                                             |                                  | When lamp is illuminated                              | System voltage   |
| 40           | Control solenoid valve OUT (RL)                             | Ignition switch: ON              |                                                       | System voltage   |
| 41           | Control solenoid valve OUT (FR)                             | Ignition switch: ON              |                                                       | System voltage   |
| 46           | Center differential lock switch input <Super Select 4WD-II> | Ignition switch: ON              | Transfer selector lever position: 2H, 4H              | System voltage   |
|              |                                                             |                                  | Transfer selector lever position: 4HLc, 4LLc          | 2 V or less      |
|              | 4WD detection switch input <Part time 4WD>                  | Ignition switch: ON              | Transfer selector lever position: 2H                  | System voltage   |
|              |                                                             |                                  | Transfer selector lever position: 4H                  | 2 V or less      |
| 47           | Diagnosis select input                                      | When the MUT-II is connected     |                                                       | 1 V or less      |
|              |                                                             | When the MUT-II is not connected |                                                       | Approx. 12 V     |
| 48           | Valve relay monitor                                         | Ignition switch: ON              |                                                       | System voltage   |
| 50           | ABS warning lamp output                                     | Ignition switch: ON              | When lamp is switched off                             | System voltage   |
|              |                                                             |                                  | When lamp is illuminated                              | 2 V or less      |
| 51           | Control solenoid valve IN (RL)                              | Ignition switch: ON              |                                                       | System voltage   |
| 52           | Control solenoid valve IN (FR)                              | Ignition switch: ON              |                                                       | System voltage   |



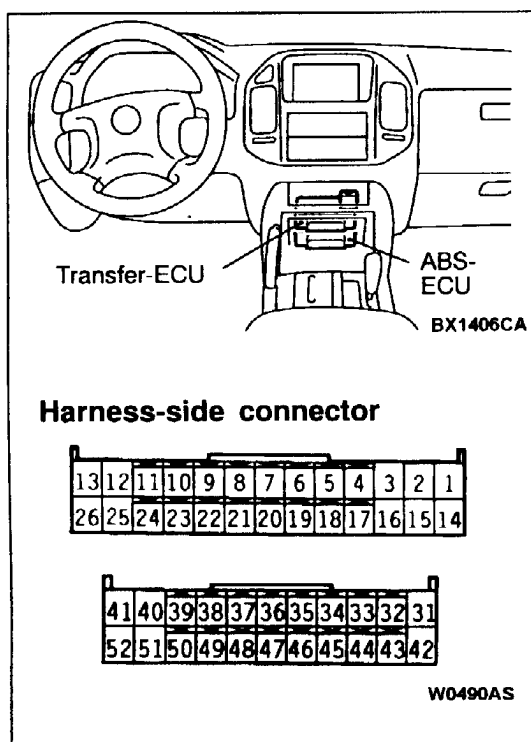
### CHECK CHART FOR RESISTANCE AND CONTINUITY BETWEEN TERMINALS

#### NOTE

There are two ECUs with the same shape inside the floor console, one above the other. The upper ECU is the ABS-ECU and has a blue connector. The lower ECU is the transfer-ECU and has a green connector.

- (1) Turn the ignition switch to the LOCK (OFF) position.
- (2) Check the resistances and continuity with the ABS-ECU connector disconnected.
- (3) Check the resistances and continuity between the terminals listed in the table below.
- (4) The terminal layout is shown in the illustration.

| Terminal No.                       | Signal name             | Normal condition |
|------------------------------------|-------------------------|------------------|
| 7 – 20                             | Wheel speed sensor (FL) | 1.0 – 1.5 kΩ     |
| 8 – 21                             | Wheel speed sensor (RR) |                  |
| 9 – 22                             | Wheel speed sensor (RL) |                  |
| 10 – 23                            | Wheel speed sensor (FR) |                  |
| Between terminal 12 and body earth | Earth                   | Continuity       |
| Between terminal 25 and body earth | Earth                   |                  |
| Between terminal 26 and body earth | Earth                   |                  |
| Between terminal 42 and body earth | Earth                   |                  |



## ON-VEHICLE SERVICE

### WHEEL SPEED SENSOR OUTPUT VOLTAGE MEASUREMENT

#### NOTE

There are two ECUs with the same shape inside the floor console, one above the other. The upper ECU is the ABS-ECU and has a blue connector. The lower ECU is the transfer-ECU and has a green connector.

- (1) Lift up the vehicle and release the parking brake.
- (2) Disconnect the ABS-ECU connector and measure at the harness-side connector.
- (3) Rotate the wheel to be measured by 1/2 to 1 turn, and use a multimeter (AC mV range) or an oscilloscope to check the output voltage at this time.

#### Terminal No.

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

#### Output voltage:

**42 mV or higher when measured using a multimeter**

**120 mVP-P or more when measured using an oscilloscope**

- (4) If the output voltage is lower than that given above, the cause may be the following, so check or replace the wheel speed sensor if necessary.
  - Excessive clearance between pole piece of wheel speed sensor and ABS rotor
  - Malfunction of wheel speed sensor

### WAVE PATTERN INSPECTION USING AN OSCILLOSCOPE

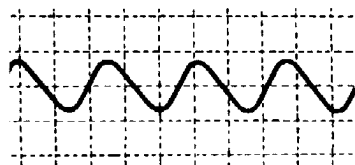
After checking the connection of the wheel speed sensor harness and the connector, take a reading of the output voltage wave patterns for each wheel speed sensor using an oscilloscope as follows.

Start the engine, move the transfer selector lever to the 4H position and the transmission selector lever to D range (A/T) or 1st gear (M/T), and then spin the wheel.

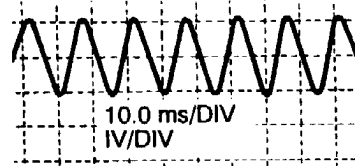
#### NOTE

- (1) You can also take a reading of the wave pattern by actually driving the vehicle in this condition.
- (2) The output voltage will be lower when the wheel speed is lower, and will become higher as the wheel speed becomes higher.

#### When rotated by hand



#### When engine is idling (5 – 6 km/h) D range (A/T) or 1st gear (M/T)



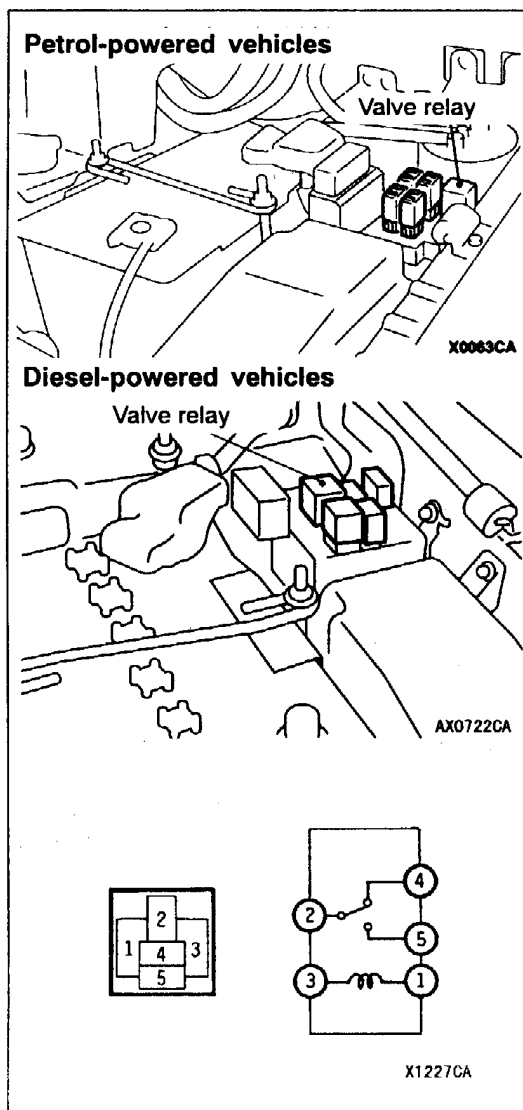
A14N0184

## WAVE PATTERN OBSERVATION POINTS

| Symptom                                                                                                                         | Cause                                     | Remedy                        |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-------------------------------|
| Wave pattern amplitude is too small or is non-existent.                                                                         | Malfunction of wheel speed sensor         | Replace the sensor.           |
| Excessive variation in wave pattern amplitude<br>(However, this is not a problem if the minimum amplitude is 120 mV or higher.) | Excessive axle hub runout or offset       | Replace the hub.              |
|                                                                                                                                 | Malfunction of ABS-ECU earth              | Repair                        |
| Noise appearing in wave pattern, or distorted wave pattern                                                                      | Open circuit in sensor                    | Replace the sensor.           |
|                                                                                                                                 | Open circuit in harness                   | Repair the harness.           |
|                                                                                                                                 | Incorrect wheel speed sensor installation | Install the sensor correctly. |
|                                                                                                                                 | Chipped or broken ABS rotor teeth         | Replace the ABS rotor.        |

**Caution**

The wheel speed sensor cables move together with the movement of the front and rear suspension. Accordingly, you should shake the sensor harnesses while observing the wheel speed sensor output voltage wave patterns.



## ABS VALVE RELAY CONTINUITY CHECK

| Battery voltage             | Terminal No. |   |   |   |   |
|-----------------------------|--------------|---|---|---|---|
|                             | 1            | 2 | 3 | 4 | 5 |
| When no current is supplied | ○            | ○ | ○ | ○ |   |
| When current is supplied    | ⊕            | ○ | ⊖ |   | ○ |

**HYDRAULIC BRAKE BOOSTER (HBB) – HYDRAULIC UNIT CHECK****Caution**

Turn the ignition switch to the **LOCK (OFF)** position when connecting and disconnecting the **MUT-II**.

- (1) Jack up the vehicle, and support it in the specified location using a rigid rack, or place the vehicle on the rollers of a brake force tester.

**Caution**

1. The rollers of the brake force tester and the vehicle tyres should be dry during checking.
  2. If using a brake force tester, apply the parking brake when testing the front brakes, and use a wheel lock to lock the front wheels when testing the rear brakes.
- (2) Turn the ignition switch to the **LOCK (OFF)** position, and connect the **MUT-II** to the diagnosis connector.
- (3) After checking that the selector lever is in the **N** position, start the vehicle's engine.
- (4) Operate the **MUT-II** to carry out the actuator tests.

**NOTE**

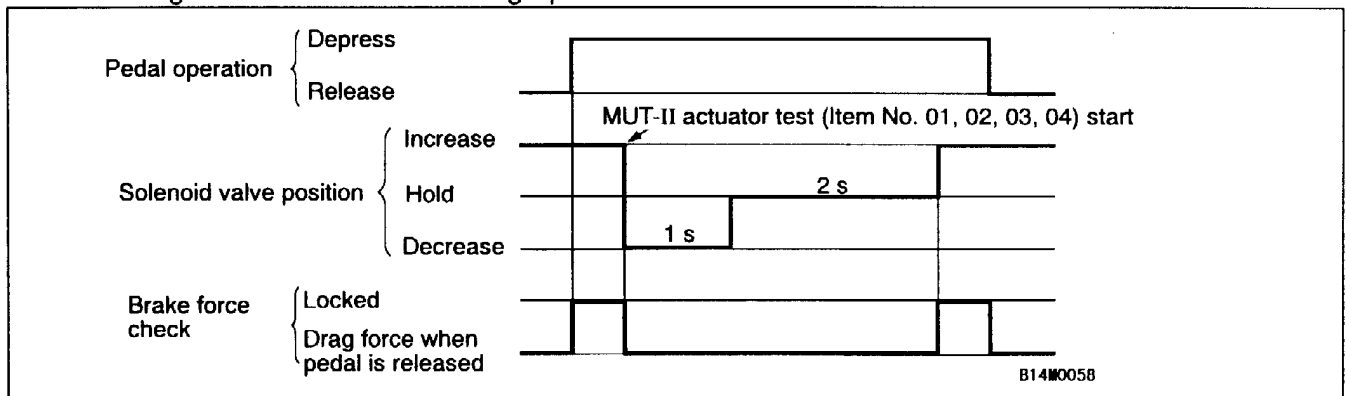
- 1) When actuator tests are being carried out, the **ABS** warning lamp will illuminate and **ABS** control will be stopped.
  - 2) **MUT-II** actuator tests cannot be carried out when the operation of the **ABS-ECU** has been stopped by the fail-safe function.
- (5) Rotate the wheel by hand and check that the brake force changes when the brake pedal is depressed. If using a brake force tester, depress the brake pedal until the brake force reaches the following value, and then check that the brake force changes when the actuator test is carried out.

|              |             |
|--------------|-------------|
| Front wheels | 785 – 981 N |
| Rear wheels  | 785 – 981 N |

**Caution**

The solenoid valves should be driven one wheel at a time, and the brake pedal should be released each time a wheel is checked.

The following illustration shows this in graphical form.

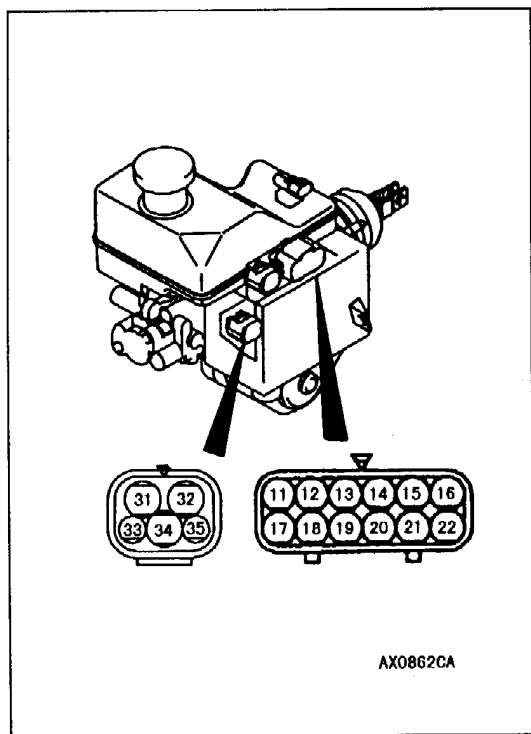


(6) If the results of checking show an abnormality, fix the problem by following the “Judgment Table” below.

**Judgment Table**

| No. | MUT-II display | Operation                                                                                                                                                                                                                                                    | Judgment                                         |                                                    | Cause                                  | Remedy                          |
|-----|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------------|----------------------------------------|---------------------------------|
|     |                |                                                                                                                                                                                                                                                              | Normal                                           | Problem                                            |                                        |                                 |
| 01  | FR valve       | (1) Depress the brake pedal to lock the wheels.<br>(2) Use the MUT-II to select the wheel to be checked, and then force-drive the actuator.<br>(3) Check the brake force for the selected wheel using a brake force tester or by rotating the wheel by hand. | Brake force lessens for 3 seconds after locking. | Wheel does not lock when brake pedal is depressed. | Blocked brake line other than HBB line | Check and clean the brake line. |
| 02  | FL valve       |                                                                                                                                                                                                                                                              |                                                  | Brake force does not lessen.                       | Blocked hydraulic circuit inside HBB   | Replace the HBB.                |
| 03  | RR valve       |                                                                                                                                                                                                                                                              |                                                  |                                                    | HBB brake tubes connected incorrectly  | Connect the tubes correctly.    |
| 04  | RL valve       |                                                                                                                                                                                                                                                              |                                                  |                                                    | Malfunction of HBB solenoid valve      | Replace the HBB.                |

(7) After checking, turn the ignition switch to the LOCK (OFF) position and then disconnect the MUT-II.



### SOLENOID VALVE CHECK

Measure the resistance between the following solenoid valve terminals.

- Control solenoid valve IN (FR):  
Between terminals 19 – 34
- Control solenoid valve OUT (FR):  
Between terminals 20 – 34
- Control solenoid valve IN (FL)  
: Between terminals 21 – 34
- Control solenoid valve OUT (FL)  
: Between terminals 22 – 34
- Control solenoid valve IN (RR)  
: Between terminals 15 – 34
- Control solenoid valve OUT (RR)  
: Between terminals 16 – 34
- Control solenoid valve IN (RL)  
: Between terminals 13 – 34
- Control solenoid valve OUT (RL)  
: Between terminals 14 – 34
- Select solenoid valve (FR)  
: Between terminals 18 – 34
- Select solenoid valve (FL)  
: Between terminals 17 – 34

#### Standard value:

Control solenoid valve IN: 4.75 – 5.25  $\Omega$

Control solenoid valve OUT: 2.0 – 2.4  $\Omega$

Select solenoid valve: 3.5 – 3.9  $\Omega$

**WHEN THE BATTERY IS FLAT**

If the engine is started using a booster cable when the battery is completely flat, and the vehicle is then driven without waiting for the battery to be recharged, the engine may misfire and it may not be possible to drive the vehicle. This is because the ABS consumes a large amount of current when carrying out its initial checks. If this happens, recharge the battery fully.

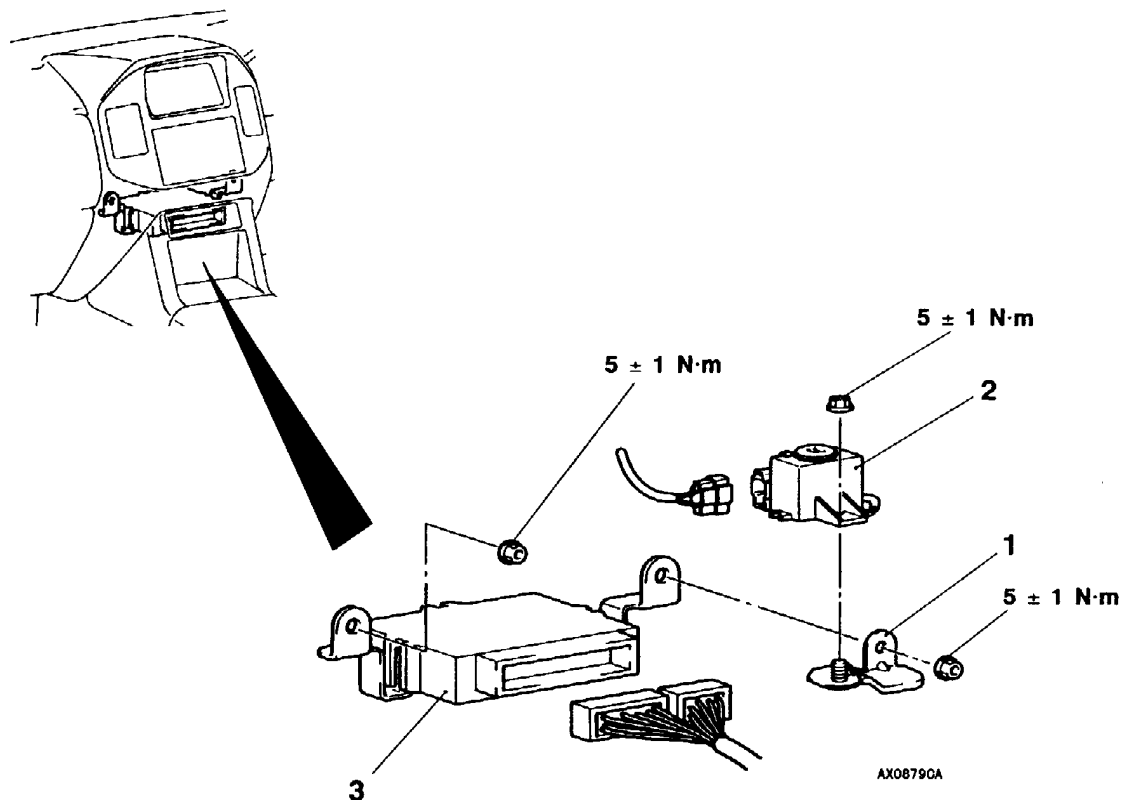
**Caution**

**The vehicle posture will be unstable during braking, so do not drive the vehicle with the ABS-ECU connector disconnected or with the ABS not operating for any other reason.**

## ABS-ECU

### REMOVAL AND INSTALLATION

**Pre-removal and Post-installation Operations**  
Indicator panel and front panel removal and installation  
(Refer to GROUP 52A - Floor Console.)



#### Removal steps

1. Buzzer bracket
2. Buzzer
3. ABS-ECU

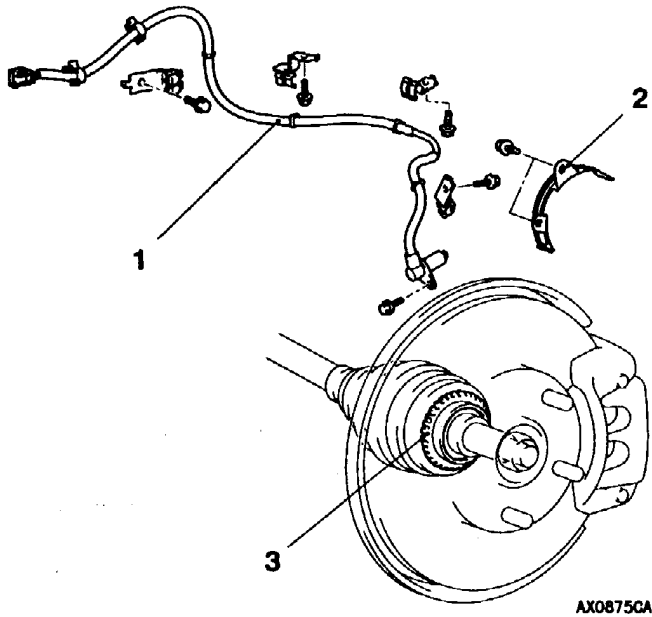
## WHEEL SPEED SENSOR

### REMOVAL AND INSTALLATION

#### Post-Installation Operations

Wheel speed sensor output voltage measurement  
(Refer to P.35B-27.)

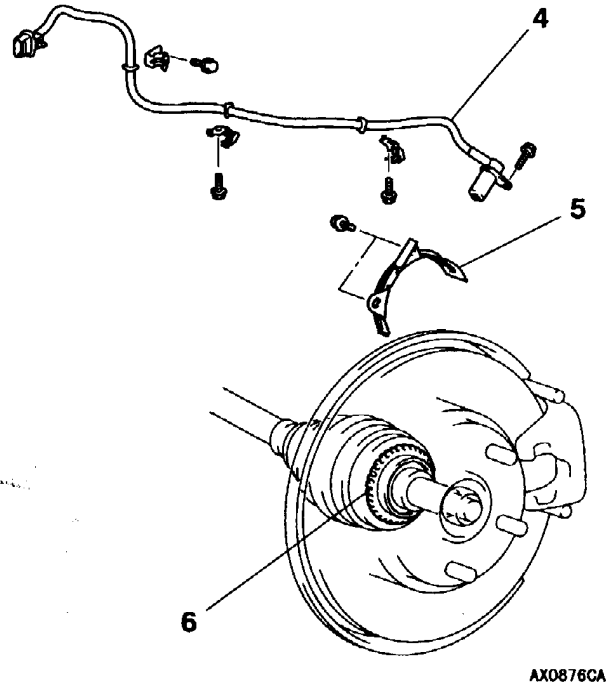
#### Front



#### Front wheel speed sensor removal steps

1. Front wheel speed sensors
2. Front ABS rotor protector
3. Front ABS rotor  
(Refer to GROUP 26 - Drive Shaft.)

#### Rear

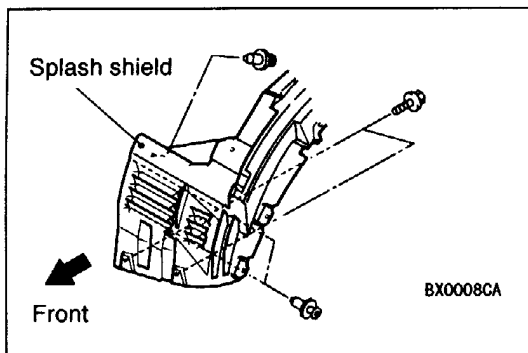


#### Rear wheel speed sensor removal steps

4. Rear wheel speed sensor
5. Rear ABS rotor protector
6. Rear ABS rotor  
(Refer to GROUP 27 - Drive Shaft.)

#### NOTE

The front and rear ABS rotors are integrated with the drive shaft and cannot be disassembled.



## REMOVAL SERVICE POINTS

### ◀A▶ FRONT WHEEL SPEED SENSOR REMOVAL

- (1) Remove the three splash shield clips and the two bolts shown in the illustration, and then disconnect the front wheel speed sensor connector.
- (2) Remove the front wheel speed sensor.

#### Caution

When removing the wheel speed sensor, be careful not to strike the pole piece at the end against the teeth of the ABS rotor or against any other nearby parts.

### ◀B▶ REAR WHEEL SPEED SENSOR REMOVAL

#### Caution

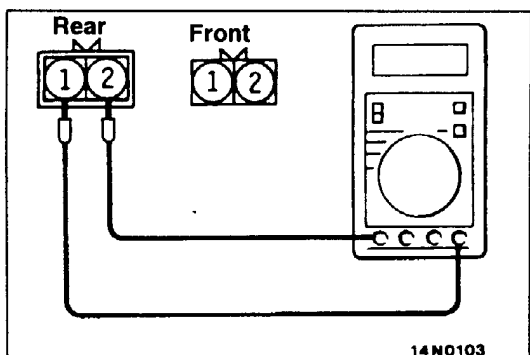
When removing the wheel speed sensor, be careful not to strike the pole piece at the end against the teeth of the ABS rotor or against any other nearby parts.

## INSPECTION

### WHEEL SPEED SENSOR TERMINAL RESISTANCE CHECK

#### Caution

The wheel speed sensors have magnets built into the sensors which magnetize the pole pieces. Because of this, care should be taken not to let metallic foreign particles get onto the pole pieces. In addition, if the poles become damaged, the sensors may not be able to detect the wheel speed correctly.



- (1) Measure the resistance between the wheel speed sensor terminals.

**Standard value: 1.0 – 1.5 k $\Omega$**

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

- (2) Check for open circuits in the wheel speed sensor cable. If a problem is found, replace the cable with a new one.

**NOTE**

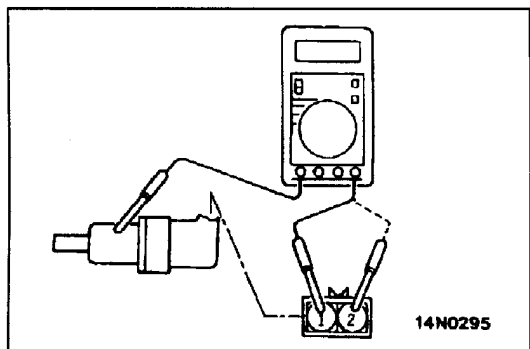
When carrying out open circuit checks, remove the cable clamps from the vehicle, and flex the cable near the clamp locations to see if there are any transient open circuits. Also check the connection of the connector and that the terminals are inserted correctly.

**WHEEL SPEED SENSOR INSULATION CHECK**

- (1) After removing the wheel speed sensor, measure the insulation resistance between terminals (1) and (2) and the wheel speed sensor body.

**Standard value: 100 k $\Omega$  or more**

- (2) If the wheel speed sensor insulation resistance is outside the standard value range, replace the sensor with a new one.



**ABS ROTOR CHECK**

Check that none of the ABS rotor teeth are chipped, broken or bent. If any damage is found, replace the ABS rotor with a new one.

## G SENSOR

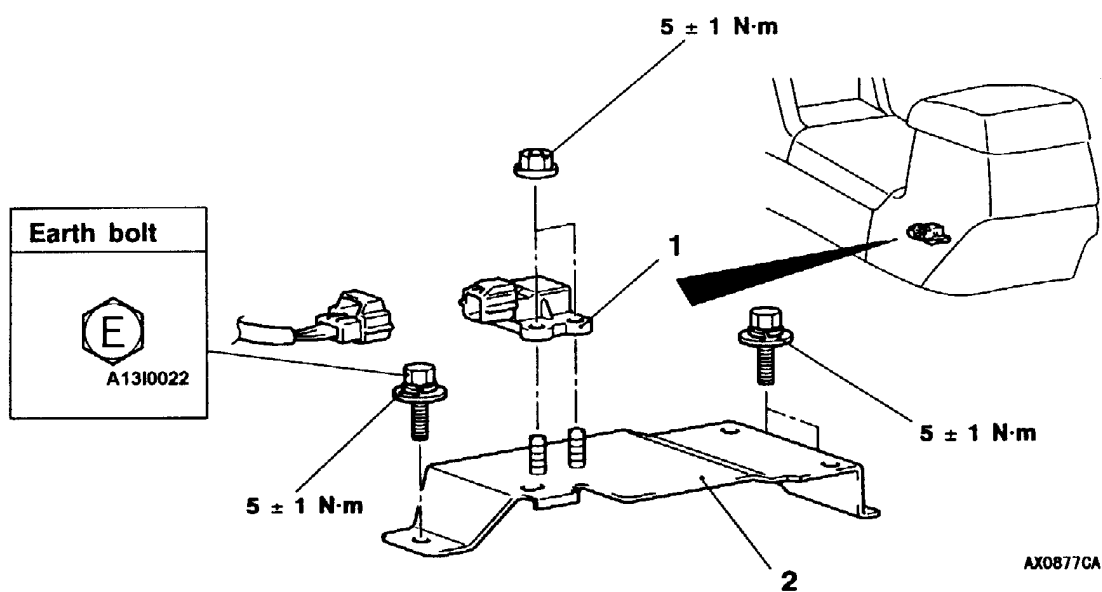
### REMOVAL AND INSTALLATION

#### Caution

Do not drop the G sensor or subject it to any shocks.

#### Pre-removal and Post-installation Operations

Floor console removal and installation  
(Refer to GROUP 52A.)



#### Removal steps

1. G sensor
2. G sensor bracket