# SERVICE BRAKES

## CONTENTS

35109000081

# BASIC BRAKE SYSTEM

## CONTENTS

35109000074

# GENERAL INFORMATION

35100010052

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

## MASTER CYLINDER

| | |
|---|---|
| Type | Tandem type |
| I.D. mm | 22. 22 |

## BRAKE BOOSTER

| | |
|---|---|
| Type | Vacuum type, single |
| Effective dia. of power cylinder mm | 225 |
| Boosting ratio | 5.0 |

## PROPORTIONING VALVE

| | |
|---|---|
| Decompression ratio | 0.25 |

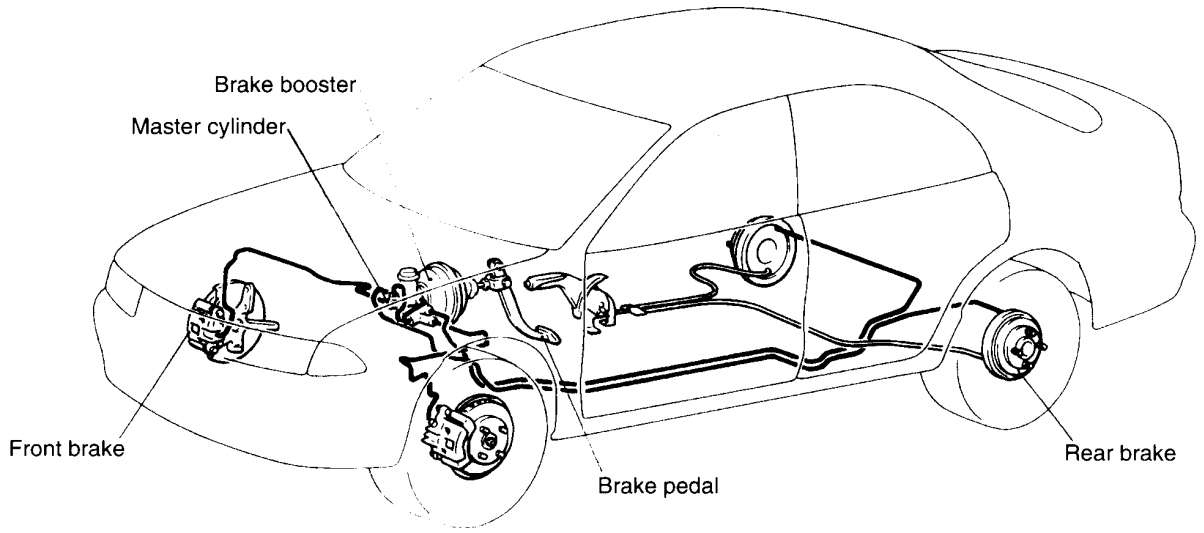
## FRONT BRAKES

| Items | 1600 | 1800 |
|---|---|---|
| Type | Ventilated disc | Ventilated disc |
| Disc effective dia. × thickness mm | 190.8 × 18 | 211.0 × 24 |
| Wheel cylinder I.D. mm | 53.97 | 53.97 |
| Pad thickness mm | 10.0 | 10.0 |
| Clearance adjustment | Automatic | Automatic |

## REAR DRUM BRAKE

| | |
|---|---|
| Type | Leading trailing |
| Drum I.D. mm | 203 |
| Wheel cylinder I.D. mm | 19.05 |
| Lining thickness mm | 4.4 |
| Clearance adjustment | Automatic |

## CONSTRUCTION DIAGRAM




## SERVICE SPECIFICATIONS

35100030058

| Items | | | Standard value | Limit |
|---|---|---|---|---|
| Brake pedal height mm | L.H. drive vehicles | | 163.5–166.5 | – |
| | R.H. drive vehicles | | 162.5–165.5 | – |
| Brake pedal free play mm | | | 3–8 | – |
| Brake pedal to floor board clearance mm | | | 80 | – |
| Proportioning valve | Split point MPa | 1600 | 3.43 ± 0.25 | – |
| | | 1800 | 3.92 ± 0.25 | – |
| | Output fluid pressure (Input fluid pressure) MPa | 1600 | 5.03 ± 0.4 (9.81) | – |
| | | 1800 | 5.39 ± 0.4 (9.81) | – |
| | Output fluid pressure difference between left and right MPa | | – | 0.8 |
| Brake booster push rod to master cylinder piston clearance mm | | | 0.6–0.8 | – |
| Front disc brake | Pad thickness mm | | 10.0 | 2.0 |
| | Disc thickness mm | 1600 | 18.0 | 16.4 |
| | | 1800 | 24.0 | 22.4 |
| | Disc runout mm | | – | 0.07 |
| | Drag force (tangential force of wheel mounting bolts) N | | 40 or less | – |

| Items | | Standard value | Limit |
|---|---|---|---|
| Rear drum brake | Lining thickness mm | 4.4 | 1.0 |
| | Drum inside diameter mm | 203 | 205 |

## LUBRICANTS

35100040044

| Items | Specified Lubricant |
|---|---|
| Brake fluid | DOT3 or DOT4 |
| Wheel cylinder body inner surfaces | Repair kit grease |
| Rear brake shoe and backing plate contact surfaces | Brake grease SAE J310, NLGI No.1 |
| Shoe assembly and auto adjuster assembly contact surfaces | |
| Shoe and lever assembly and auto adjuster assembly contact surfaces | |

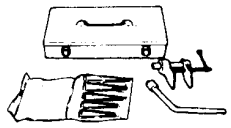
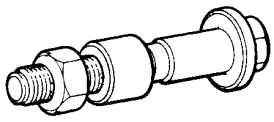
## SEALANTS

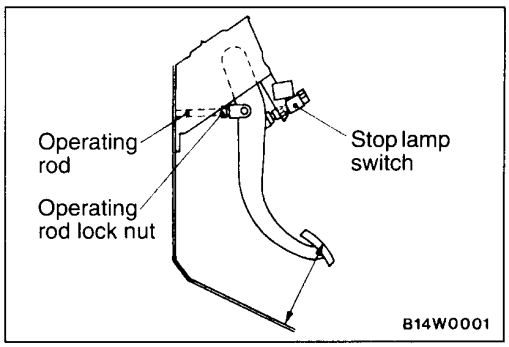
35100050047

| Items | Specified sealant | Remarks |
|---|---|---|
| Thread part fitting | 3M ATD Part No. 8661 or equivalent | Semi-drying sealant |
| Shoe hold-down pin | 3M ATD Part No. 8513 or equivalent | Drying sealant |

## SPECIAL TOOLS

35100060040

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MB990964<br>MB990520<br>MB990773 | Brake tool set | Pushing-in of the disc brake piston<br>Installation of drum brake wheel cylinder piston cup |
|  | MB990998 | Front hub remover and installer | Provisional holding of the wheel bearing |



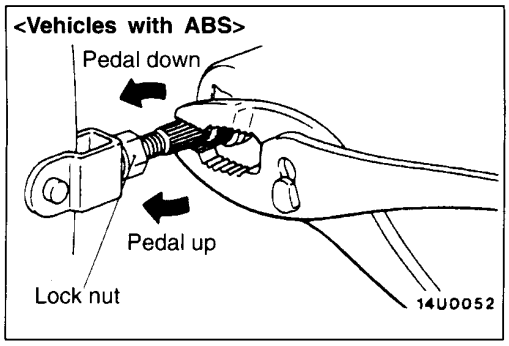

# ON-VEHICLE SERVICE

35100090049

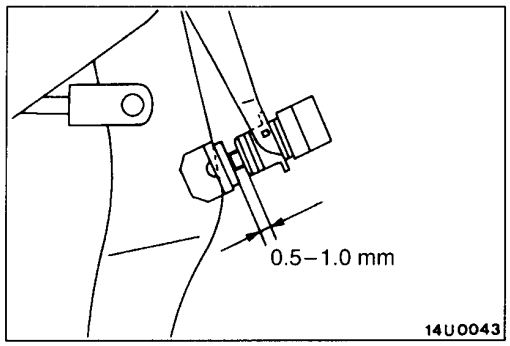
## BRAKE PEDAL CHECK AND ADJUSTMENT

1. Measure the brake pedal height as illustrated. If the brake pedal height is not within the standard value, adjust or replace.

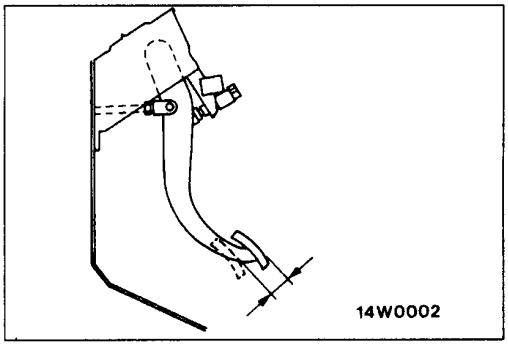
   **Standard value:**
   **<L.H. drive vehicles> 163.5–166.5 mm**
   **<R.H. drive vehicles> 162.5–165.5 mm**

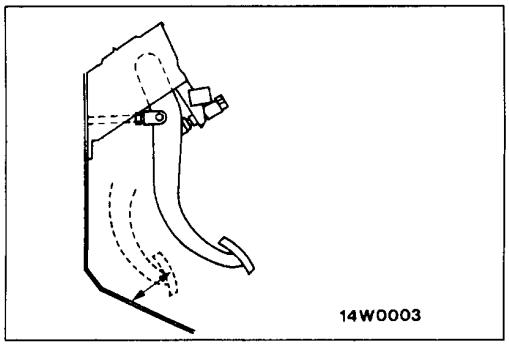



(1) Disconnect the stop lamp switch connector.
(2) Adjust the brake pedal height by turning the operating rod with pliers (with the operating rod lock nut loosened), until the correct brake pedal height is obtained. <Vehicles with ABS>
(3) Secure by tightening the lock nut of the operating rod. <Vehicles with ABS>




(4) Push the stop lamp switch in the direction of the pedal stroke until it stops. (The switch will slide if it is pushed firmly.)
(5) Lift up the pedal until the operating rod is fully extended, and then slide the stop lamp switch back to the required position. Adjust the position of the switch by turning it until the distance shown in the illustration is correct.
(6) Connect the connector of the stop lamp switch.
(7) Check that the stop lamp is not illuminated with the brake pedal unpressed.




2. With the engine stopped, depress the brake pedal two or three times. After eliminating the vacuum in the power brake booster, press the pedal down by hand, and confirm that the amount of movement before resistance is met (the free play) is within the standard value range.

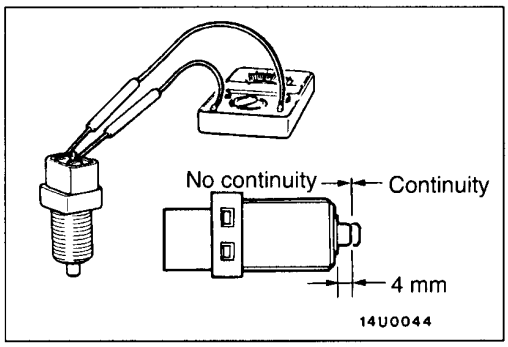
   **Standard value: 3–8 mm**

   If the free play exceeds the standard value, it is probably due to excessive play between the retaining ring bolt and brake pedal arm.
   Check for excessive clearance and replace faulty parts as required.

3. Start the engine, depress the brake pedal with approximately 490 N of force, and measure the clearance between the brake pedal and the floorboard.

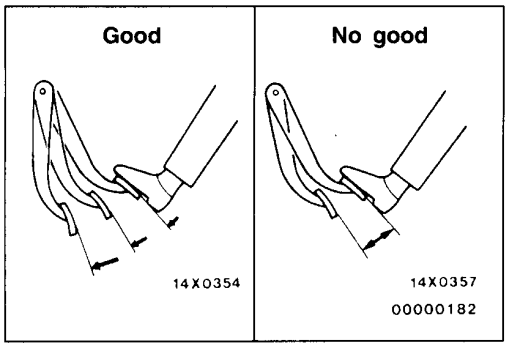
   **Standard value: 80 mm or more**

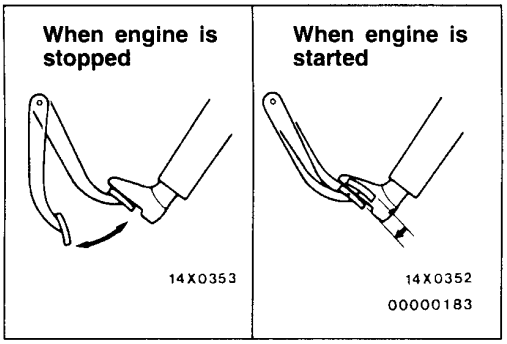
   If the clearance is outside the standard value, check for air trapped in the brake line, clearance between the lining and the drum and dragging in the parking brake.
   Adjust and replace defective parts as required.




## STOP LAMP SWITCH CHECK 35100890045

Connect a circuit tester to the stop lamp switch, and check whether or not there is continuity when the plunger of the stop lamp switch is pushed in and when it is released. The stop lamp switch is in good condition if there is no continuity when the plunger is pushed in to a depth of within 4 mm from the outer case edge surface, and if there is continuity when it is released.




## BRAKE BOOSTER OPERATING TEST 35100100049

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

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

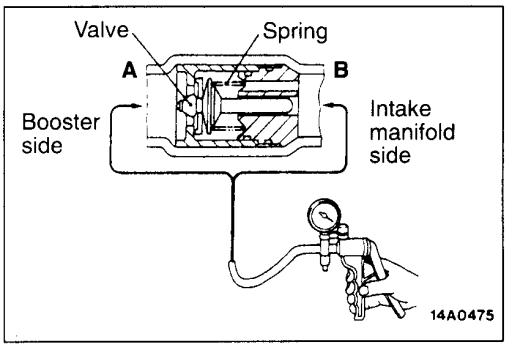
2. With the engine stopped, step on the brake pedal several times.
   Then step on the brake pedal and start the engine.
   If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is defective.

3. With the engine running, step on the brake pedal and then stop the engine.
   Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is defective.
   If the above three tests are okay, the booster performance can be determined as good.
   If one of the above three tests is not okay at last, the check valve, vacuum hose, or booster will be defective.

## CHECK VALVE OPERATION CHECK 35100900052

1. Remove the vacuum hose. (Refer to P.35A-17.)

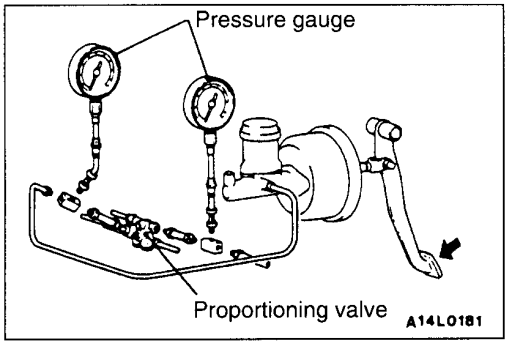
   **Caution**
   - **The check valve should not be removed from the vacuum hose.**

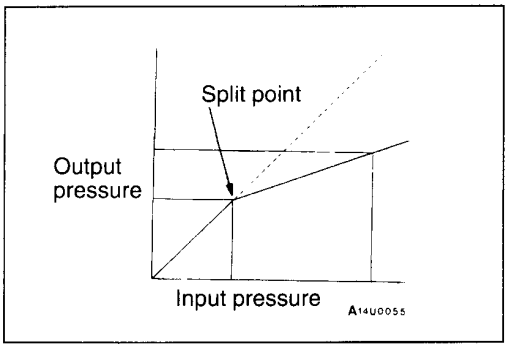



2. Check the operation of the check valve by using a vacuum pump.

| Vacuum pump connection | Accept/reject criteria |
|---|---|
| Connection at the brake booster side (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, replace it as an assembly unit together with the vacuum hose.**




## PROPORTIONING VALVE FUNCTION TEST

35100110059

1. Connect two pressure gauges, one each to the input side and output side of the proportioning valve, as shown.
2. Bleed the air in the brake line and the pressure gauge.
3. While gradually depressing the brake pedal, make the following measurements and check to be sure that the measured values are within the allowable range.

(1) Output pressure begins to drop relative to input pressure (split point).

**Standard value:**

MPa

| 1600 | 1800 |
|---|---|
| 3.43 ± 0.25 | 3.92 ± 0.25 |

(2) Check to be sure that the output fluid pressure is at the standard value when the pedal depression force is increased so that the input fluid pressure is at the values shown in the table below.

**Standard value:**

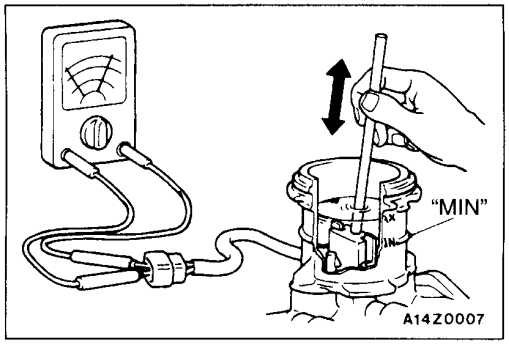
MPa

| | 1600 | 1800 |
|---|---|---|
| Output fluid pressure (Input fluid pressure) | 5.03 ± 0.4 (9.81) | 5.39 ± 0.4 (9.81) |

(3) Output pressure difference between left and right brake lines.

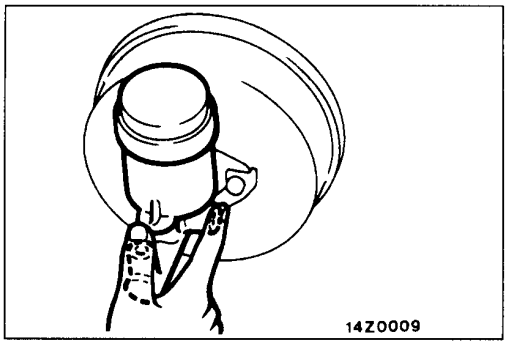
**Limit: 0.8 MPa**

4. If the measured pressures are not within the permissible ranges, replace the proportioning valve.




## BRAKE FLUID LEVEL SENSOR CHECK 35100910048

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".




## BLEEDING 35100140041

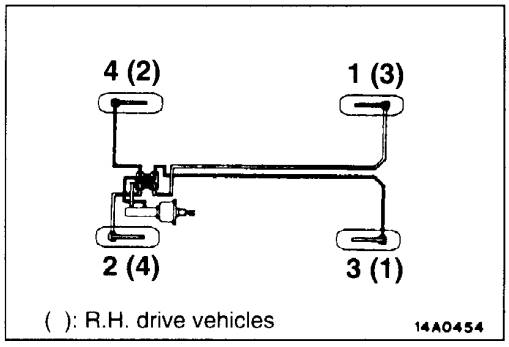
**Caution**
**Use the specified brake fluid. Avoid using a mixture of the specified brake fluid and other fluid.**

**Specified brake fluid: DOT3 or DOT4**

### MASTER CYLINDER BLEEDING

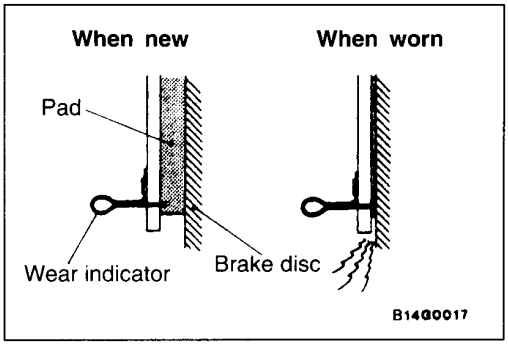
The master cylinder used has no check valve, so if bleeding is carried out by the following procedure, bleeding of air from the brake pipeline will become easier. (When brake fluid is not contained in the master cylinder.)

(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 steps2.–4. three or four times to fill the inside of the master cylinder with brake fluid.




### BRAKE PIPE LINE BLEEDING

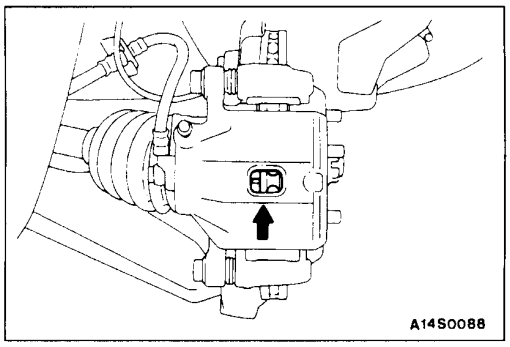
Bleed the air in the sequence shown in the figure.




## FRONT DISC BRAKE PAD CHECK AND REPLACEMENT

35100150044

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

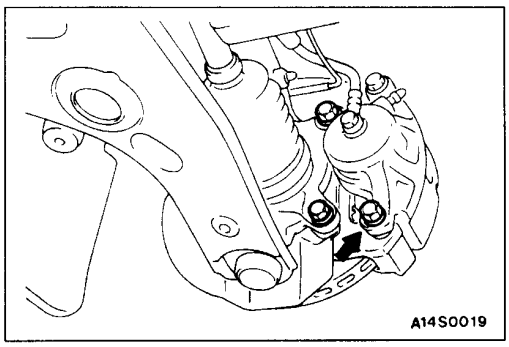



1. Check brake pad thickness through caliper body check port.

   **Standard value: 10 mm**

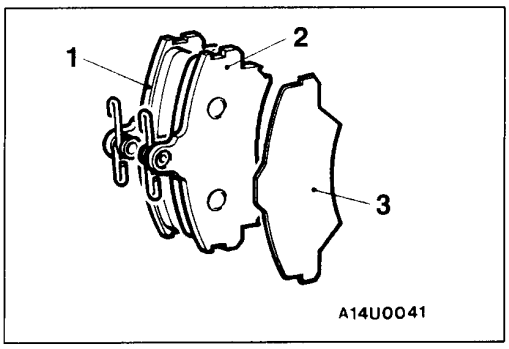
   **Limit: 2.0 mm**

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



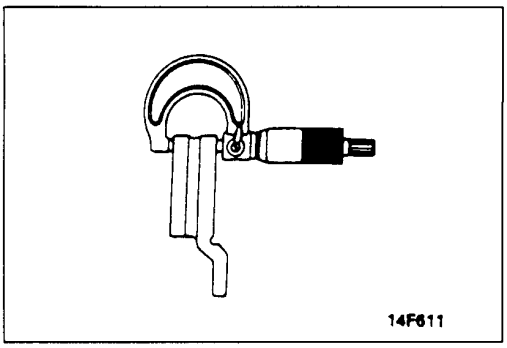

2. Remove lock pin. Lift caliper assembly and retain with wires.

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




3. Remove the following parts from caliper support.
   1. Pad & wear indicator assembly
   2. Pad assembly
   3. Outer shim

4. In order to measure the brake drag torque after pad installation, measure the rotary-sliding resistance of the hub (A) with the pads removed. (Refer to P.35A-20.)
5. Install the pads and the caliper assembly, and then check the brake drag torque. (Refer to P.35A-20.)




## BRAKE DISC THICKNESS CHECK 35100160047

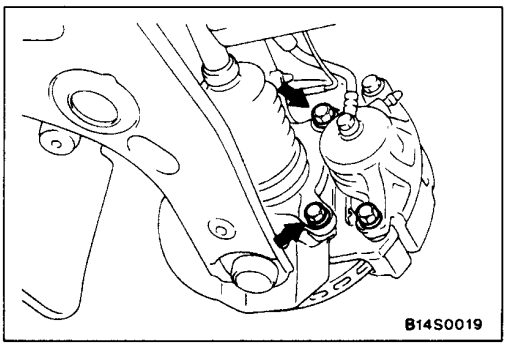
1. Using a micrometer, measure disc thickness at eight positions, approximately 45° apart and 10 mm in from the outer edge of the disc.

   **Brake disc thickness**

   **Standard value:**
   **<1600> 18.0 mm**
   **<1800> 24.0 mm**

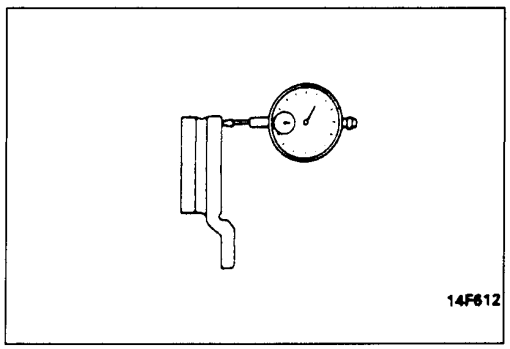
   **Limit:**
   **<1600> 16.4 mm**
   **<1800> 22.4 mm**

   Thickness variation (at least 8 positions)
   The difference between any thickness measurements should not be more than 0.015 mm.
2. 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 turn rotor with on the car type brake lathe ("MAD, DL-8700PF" or equivalent).




## BRAKE DISC RUN-OUT CHECK 35100170040

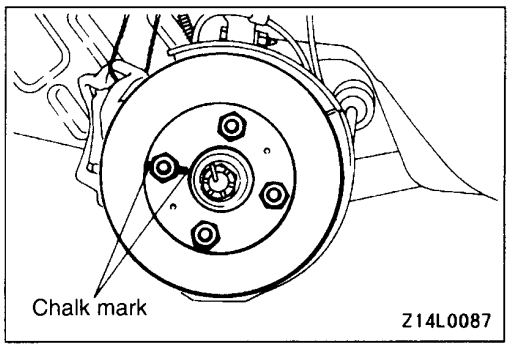
1. Remove the caliper support; then raise the caliper assembly upward and secure by using wire.
2. Inspect the disc surface for grooves, cracks and rust. Clean the disc thoroughly and remove all rust.




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

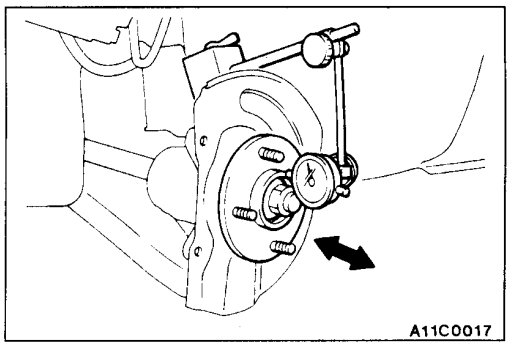
   **Limit: 0.07 mm or less**

   NOTE
   Tighten the nuts in order to secure the disc to the hub.




## BRAKE DISC RUN-OUT CORRECTION 35100180043

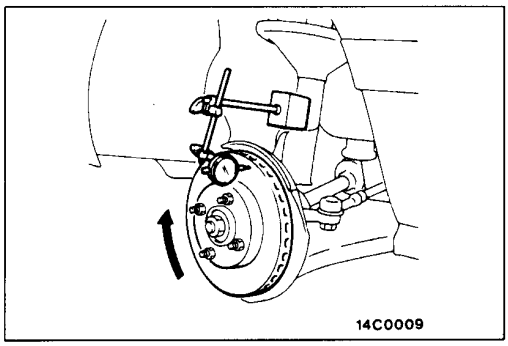
1. If the run-out of the brake disc is equivalent to or exceeds the limit specification, change the phase of the disc and hub, and then measure the run-out again.
   (1) Before removing the brake disc, chalk both sides of the wheel stud on the side at which run-out is greatest.




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

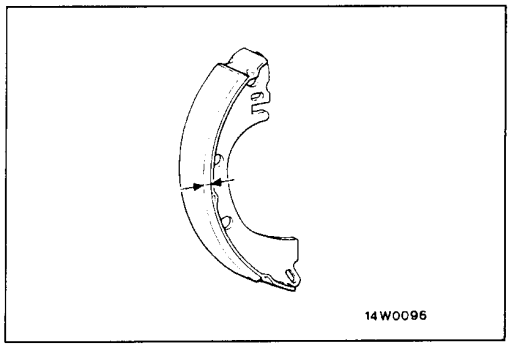
   **Limit: 0.05 mm**

   If the play is equivalent to or exceeds the limit, disassemble the hub knuckle and check each part.




   (3) If the play does not exceed the limit specification, install the brake disc at a position 180° away from the chalk mark, and then check the run-out of the brake disc once again.

2. If the run-out cannot be corrected by changing the phase of the brake disc, replace the disc or turn rotor with on the car type brake lathe ("MAD, DL-8700PF or equivalent).




## BRAKE LINING THICKNESS CHECK 35100300050

1. Remove the brake drum.
2. Measure the wear of the brake lining at the place worn the most.

   **Standard value: 4.4 mm**

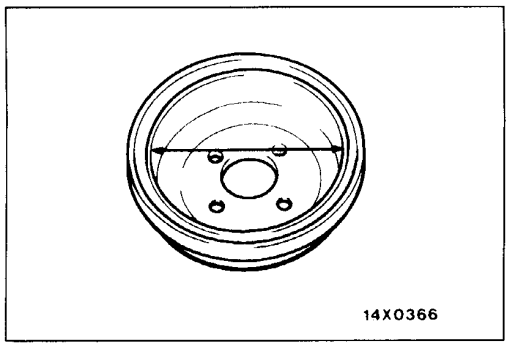
   **Limit: 1.0 mm**

   Replace the shoe and lining assembly if brake lining thickness is less than the limit if it is not worn evenly. For information concerning the procedures for installation of the shoe and lining assembly, refer to P.35A-22.

   **Caution**

   **1. Whenever the shoe and lining assembly is replaced, replace both RH and LH assemblies as a set to prevent car from pulling to one side when braking.**

2. **If there is a significant difference in the thickness of the shoe and lining assemblies on the left and right sides, check the sliding condition of the piston.**



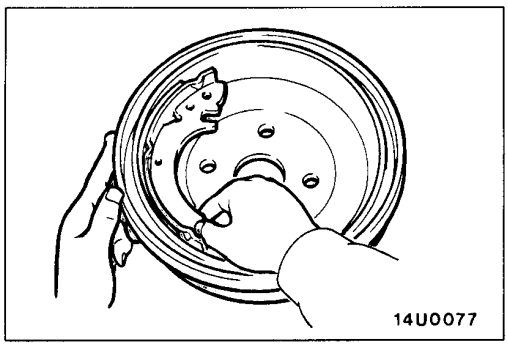

## BRAKE DRUM INSIDE DIAMETER CHECK

35100320049

1. Remove the brake drum.
2. Measure the inside diameter of the brake drum at two or more locations.

   **Standard value: 203 mm**

   **Limit: 205 mm**
3. Replace brake drums, shoe and lining assembly when wear exceeds the limit value or is badly imbalanced.




## BRAKE LINING AND BRAKE DRUM CONNECTION CHECK

35100310053

1. Remove the brake drum.
2. Remove the shoe and lining assembly. (Refer to P.35A-22.)
3. Chalk inner surface of brake drum and rub with shoe and lining assembly.
4. Replace shoe and lining assembly or brake drums if there are any irregular contact area.

   NOTE
   Clean off chalk after check.

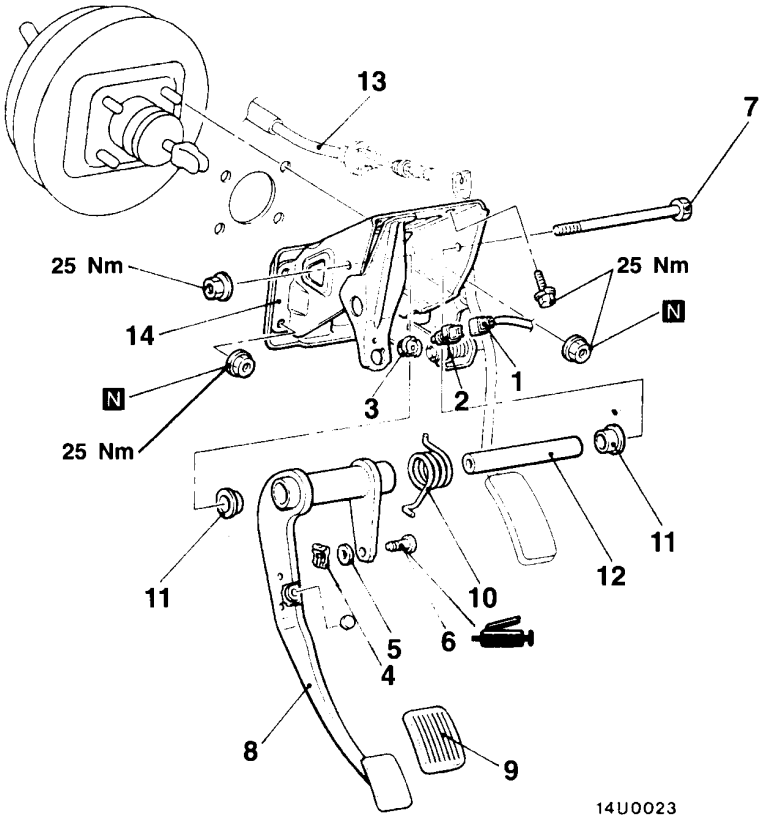
# BRAKE PEDAL

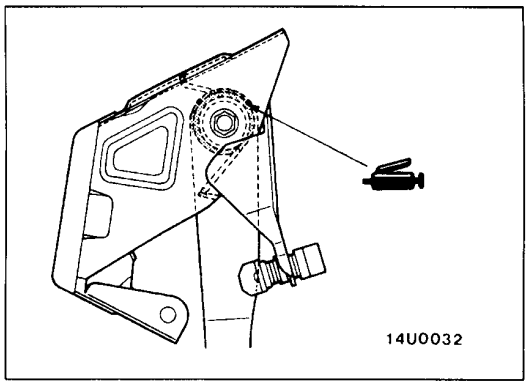
35100340076

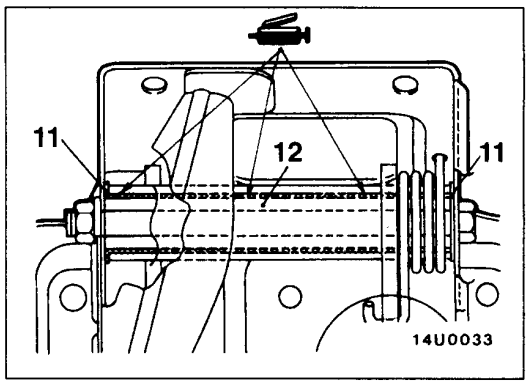
## REMOVAL AND INSTALLATION <L.H. drive vehicles>

**Pre-removal Operation**
- Instrument Under Cover Removal (Refer to GROUP 52A – Instrument Panel.)
- Steering Column Assembly Removal (Refer to GROUP 37A – Steering Wheel and Shaft.)
- Relay Box Removal

**Post-installation Operation**
- Relay Box Installation
- Steering Column Assembly Installation (Refer to GROUP 37A – Steering Wheel and Shaft.)
- Instrument Under Cover Installation (Refer to GROUP 52A – Instrument Panel.)
- Brake Pedal Adjustment (Refer to P.35A-6.)

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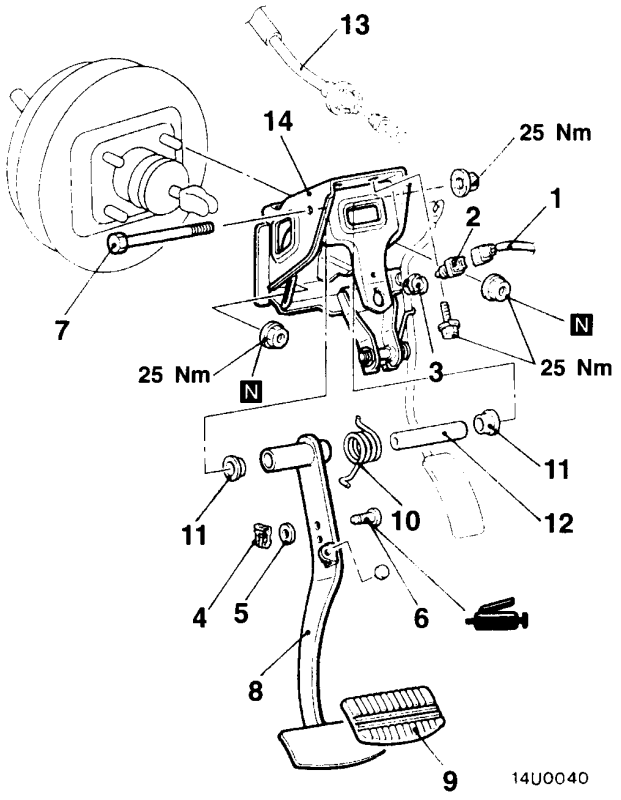
**Removal steps**

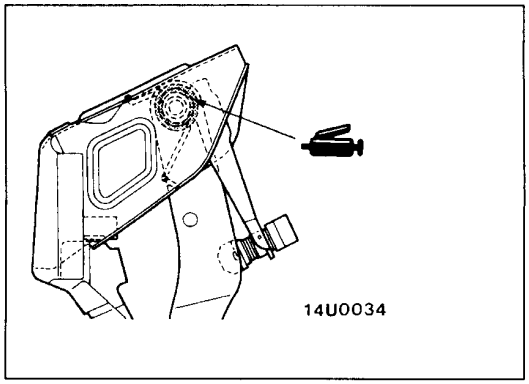
1. Stop lamp switch connector
2. Stop lamp switch
3. Ring
4. Retaining clip
5. Washer
6. Retaining ring bolt
7. Brake pedal shaft bolt
8. Brake pedal
9. Brake pedal pad
10. Brake pedal return spring
11. Bushing
12. Pipe
13. Accelerator cable connection
14. Pedal support member

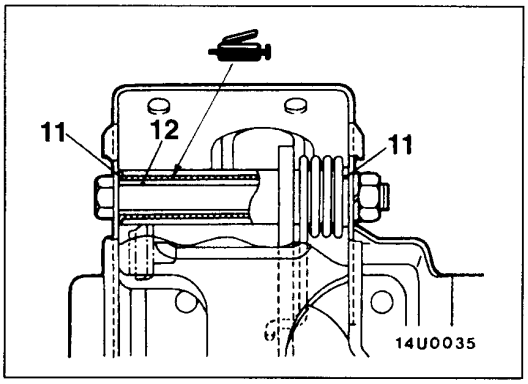
## REMOVAL AND INSTALLATION <R.H. drive vehicles>

**Pre-removal Operation**
- Instrument Under Cover Removal (Refer to GROUP 52A – Instrument Panel.)
- Steering Column Assembly Removal (Refer To GROUP 37A – Steering Wheel and Shaft.)
- Relay Box Removal

**Post-installation Operation**
- Relay Box Installation
- Steering Column Assembly Installation (Refer to GROUP 37A – Steering Wheel and Shaft.)
- Instrument Under Cover Installation (Refer to GROUP 52 – Instrument Panel.)
- Brake Pedal Adjustment (Refer to P.35A-6.)

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**Removal steps**
1. Stop lamp switch connector
2. Stop lamp switch
3. Ring
4. Retaining clip
5. Washer
6. Retaining ring bolt
7. Brake pedal shaft bolt
8. Brake pedal
9. Brake pedal pad
10. Brake pedal return spring
11. Bushing
12. Pipe
13. Accelerator cable connection
14. Pedal support member

# MASTER CYLINDER AND BRAKE BOOSTER

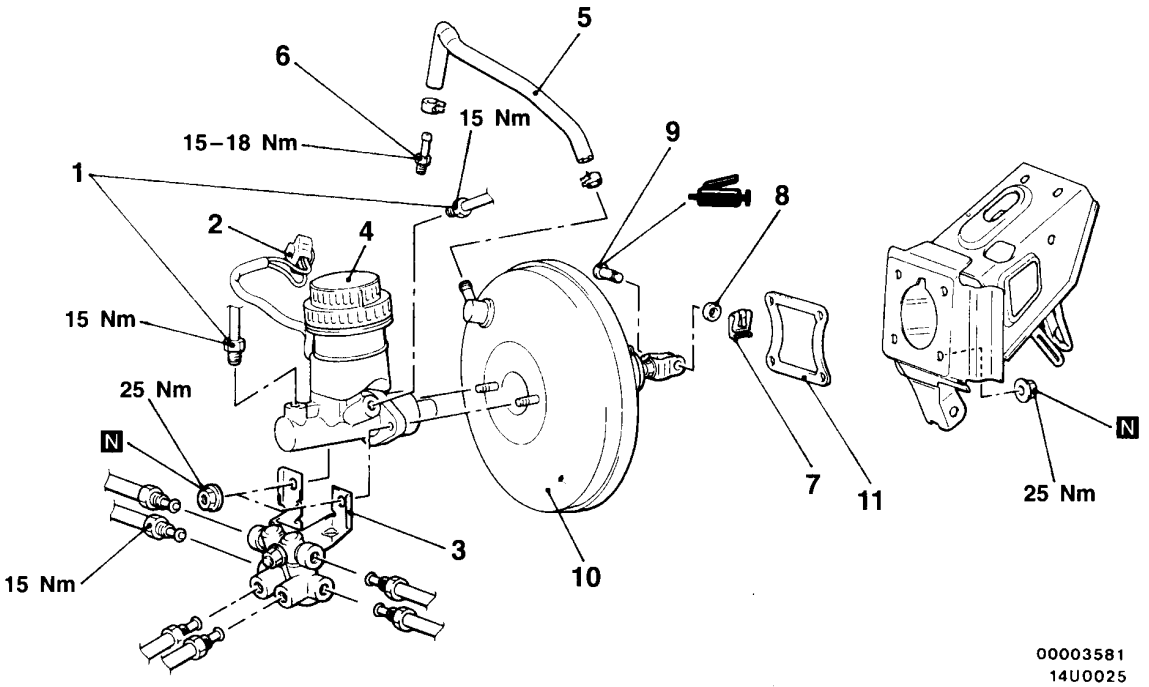
35100370068

## REMOVAL AND INSTALLATION

**<L.H. drive vehicles>**

**Pre-removal Operation**
- Brake Fluid Draining

**Post-installation Operation**
- Brake Fluid Supplying
- Brake Line Bleeding (Refer to P.35A-9.)
- Brake Pedal Adjustment (Refer to P.35A-6.)

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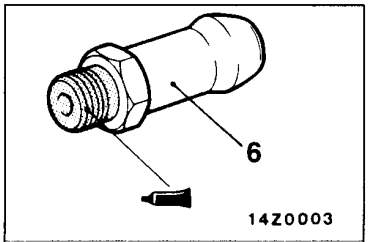



**Sealant: 3M ATD Part No. 8661 or equivalent**

**Removal steps**

1. Brake pipe connection
2. Brake fluid level sensor connector
3. Proportioning valve bracket
4. Master cylinder assembly

▶B◀ • Clearance adjustment between brake booster push rod and primary piston

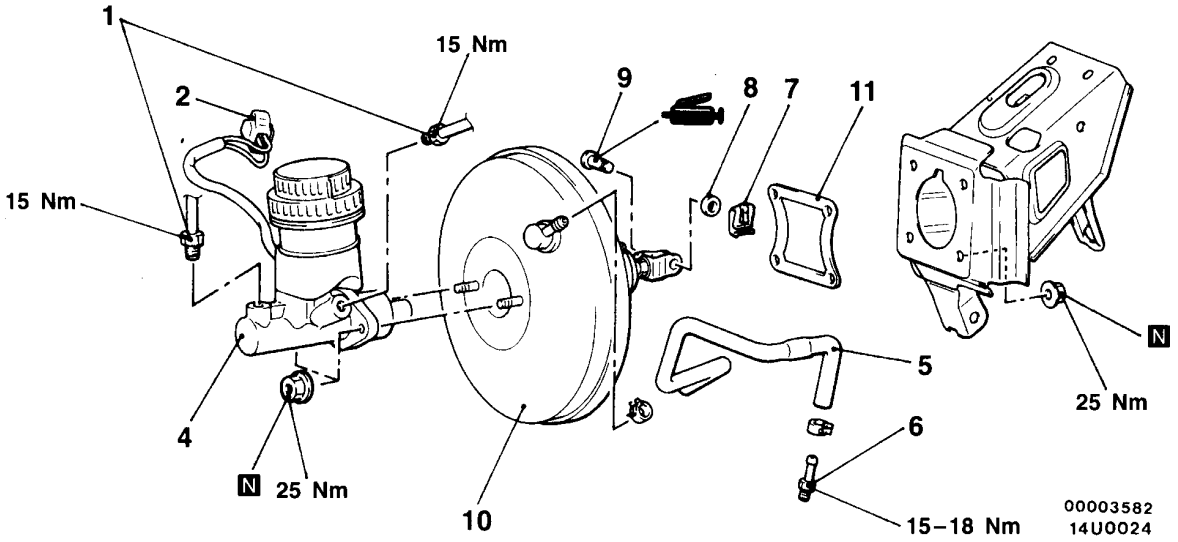
▶A◀ 5. Vacuum hose (With built-in check valve)

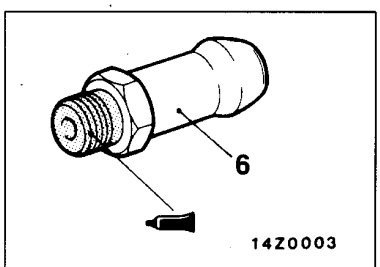
6. Fitting
7. Retaining clip
8. Washer
9. Retaining ring bolt
10. Brake booster
11. Sealer

**<R.H drive vehicles>**

**Pre-removal Operation**
- Brake Fluid Draining

**Post-installation Operation**
- Brake Fluid Supplying
- Brake Line Bleeding (Refer to P.35A-9.)
- Brake Pedal Adjustment (Refer to P.35A-6.)




**Sealant: 3M ATD Part No.8661 or equivalent**

**Removal Steps**

1. Brake pipe connection
2. Brake fluid level sensor connector
4. Master cylinder assembly

▶B◀ • Clearance adjustment between brake booster push rod and primary piston

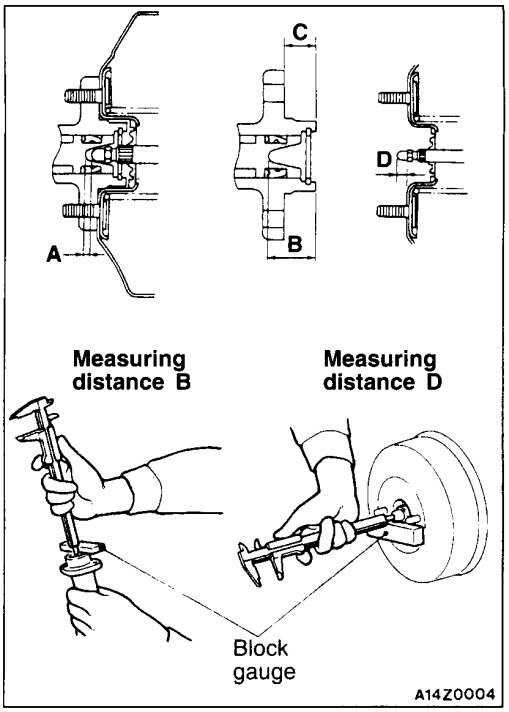
▶A◀ 5. Vacuum hose (With built-in check valve)

6. Fitting
7. Retaining clip
8. Washer
9. Retaining ring bolt
10. Brake booster
11. Sealer

## INSTALLATION SERVICE POINTS

### ▶A◀ VACUUM HOSE CONNECTION

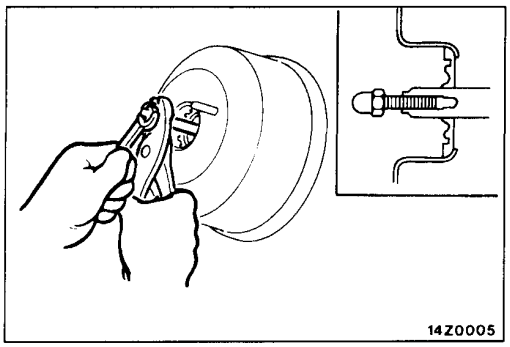
Insert securely and completely until the vacuum hose at the engine side contacts the edge of the hexagonal part of the fitting, and then secure by using the hose clip.




### ▶B◀ CLEARANCE ADJUSTMENT BETWEEN BRAKE BOOSTER PUSH ROD AND PRIMARY PISTON

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

**Standard value: 0.6–0.8 mm**




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

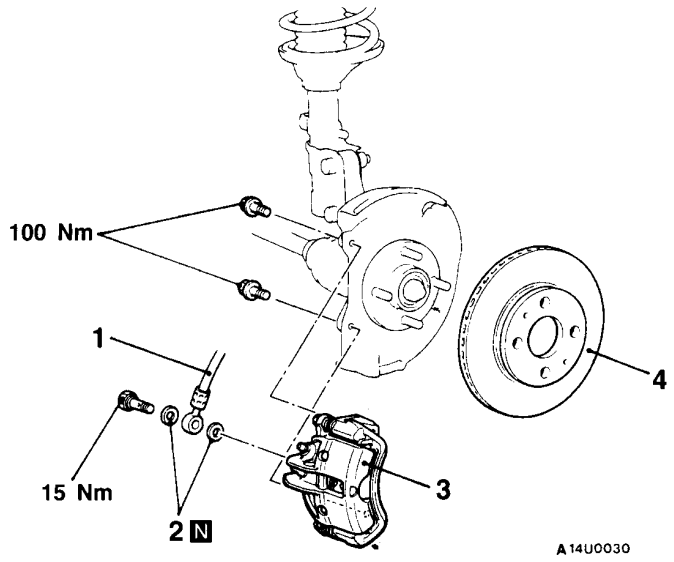
# FRONT DISC BRAKE

35100600051

## REMOVAL AND INSTALLATION

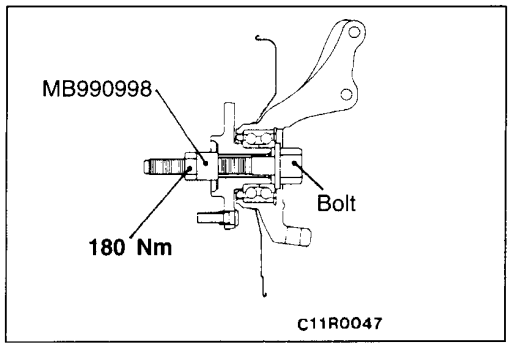
**Pre-removal Operation**
- Brake Fluid Draining

**Post-installation Operation**
- Brake Fluid Supplying
- Brake Line Bleeding (Refer to P.35A-9.)




**Removal steps**

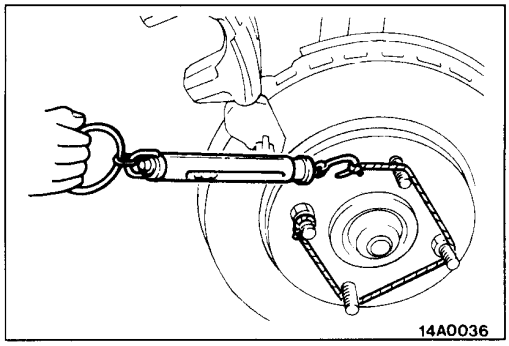
1. Brake hose connection
2. Gasket
▶A◀ 3. Disc brake assembly
4. Brake disc




## INSTALLATION SERVICE POINT

### ▶A◀ DISC BRAKE ASSEMBLY INSTALLATION

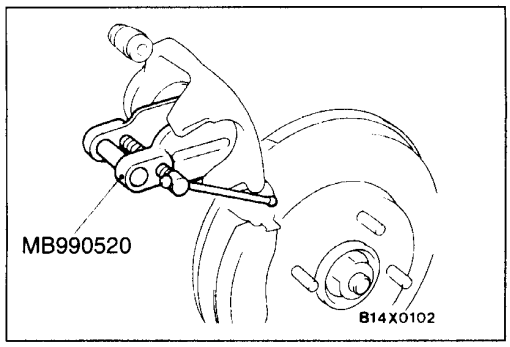
1. In order to measure the brake drag torque after pad installation, measure the rotary-sliding resistance of the hub (A) by the following procedure with the pads removed.
   (1) Remove the drive shaft. (Refer to GROUP 26 – Front Axle.)
   (2) Attach the special tool to the front hub assembly as shown in the illustration, and tighten it to the specified torque.
   (3) Use a spring balance to measure the rotary-sliding resistance of the hub in the forward direction.



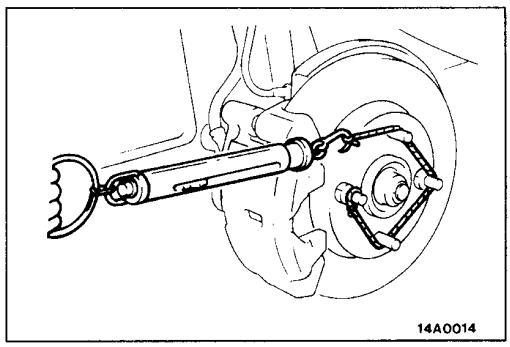

2. After installing the caliper support to the knuckle, install the pad clips and the pads to the caliper support.

**Caution**

- **Do not let any oil, grease or other contamination get onto the friction surfaces of the pads and brake discs.**




3. Clean piston and insert into cylinder with special tool.
4. Be careful that the piston boot does not become caught, when lowering the caliper assembly and install the lock pin.
5. Check brake drag torque as follows.
   (1) Start the engine and then depress the brake pedal 2-3 times.
   (2) Stop engine.
   (3) Turn brake disc forward 10 times.




6. Check hub torque (B) with spring balance.
7. Calculate the drag torque of the disc brake [difference between hub torque (B) and hub torque (A)].

   **Standard value: 40 N or less**

8. If the difference between brake drag torque and hub torque exceeds the standard value, replace the disc brake assembly.

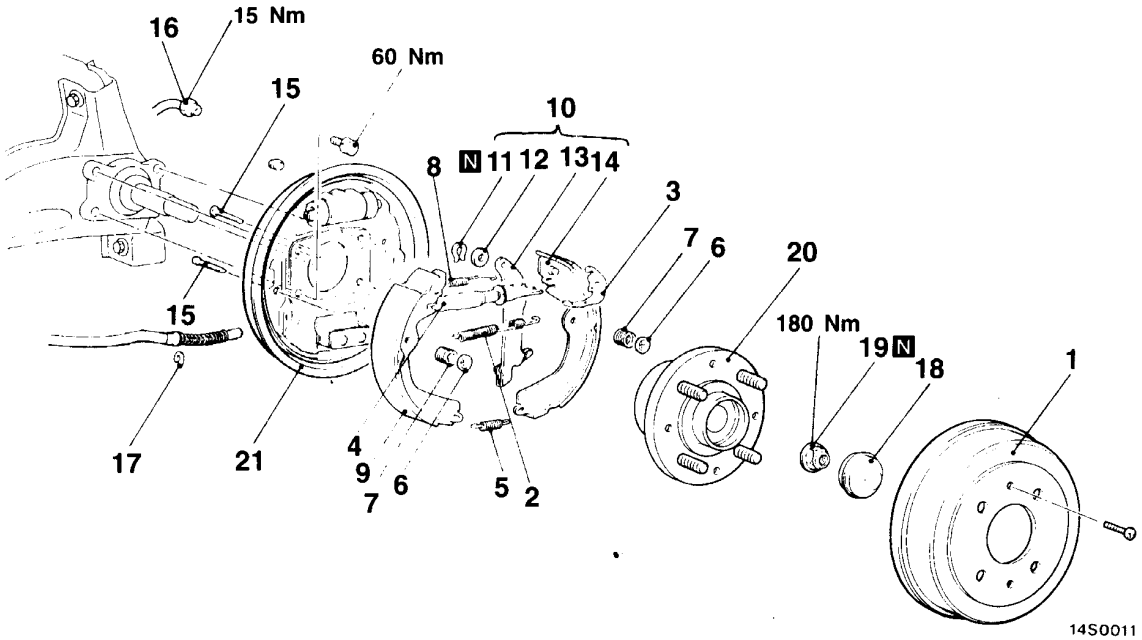
# REAR DRUM BRAKE

35100750053

## REMOVAL AND INSTALLATION

**Pre-removal Operation**
- Loosening the Parking Brake Cable Adjusting Nut.
- Brake Fluid Draining

**Post-installation Operation**
- Brake Line Bleeding (Refer to P.35A–9.)
- Parking Brake Lever Stroke Adjustment (Refer to GROUP 36 – On-vehicle Service.)

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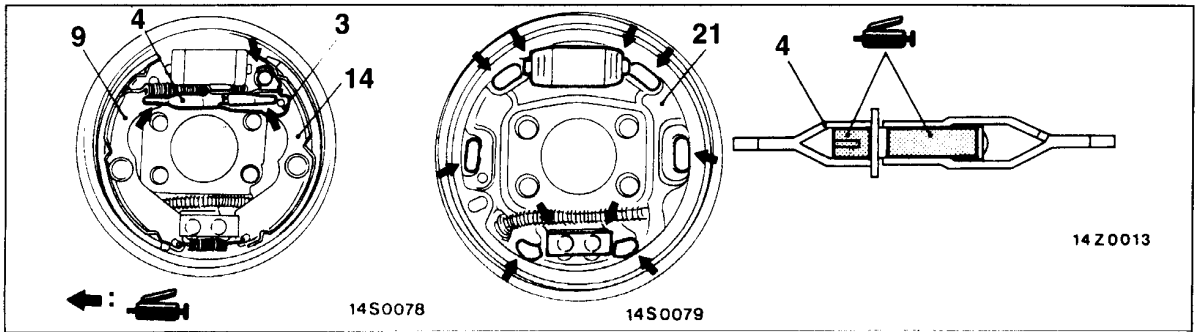


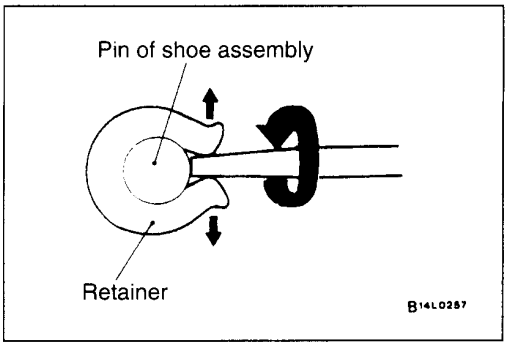

**Specified grease: Brake grease SAE J310, NLGI No.1**

**Rear drum brake removal steps**

1. Brake drum
2. Shoe-to-lever spring
3. Adjuster lever
4. Auto adjuster assembly
5. Retainer spring
6. Shoe hold-down cup
7. Shoe hold-down spring
8. Shoe-to-shoe spring
9. Shoe and lining assembly
10. Shoe, lining and lever assembly

◀A▶ ▶B◀ 11. Retainer

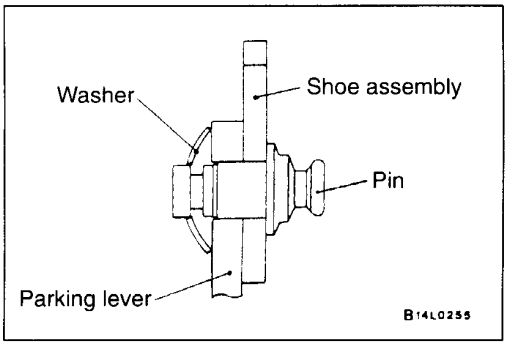
▶A◀ 12. Wave washer
13. Parking lever
14. Shoe and lining assembly
15. Shoe hold-down pin
16. Brake pipe connection
17. Snap ring
18. Hub cap
19. Flange nut
20. Rear hub assembly
21. Backing plate




## REMOVAL SERVICE POINT

### ◀A▶ RETAINER REMOVAL

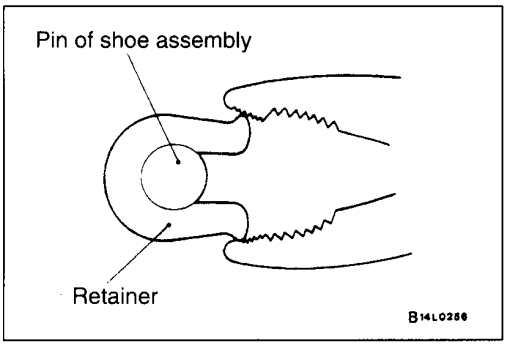
Use a flat-tipped screwdriver or the like to open up the retainer joint, and remove retainer.




## INSTALLATION SERVICE POINTS

### ▶A◀ WAVE WASHER INSTALLATION

Install the washer in the direction shown in the illustration.

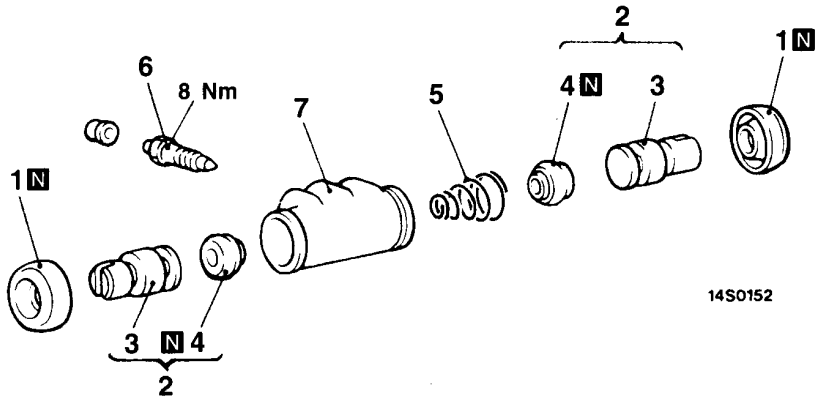



### ▶B◀ RETAINER INSTALLATION

Use pliers or the like to install the retainer or the pin positively.

## WHEEL CYLINDER
## DISASSEMBLY AND REASSEMBLY

35100770042

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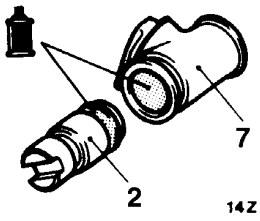
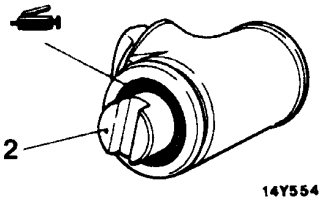
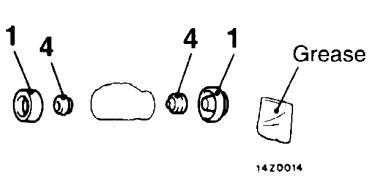
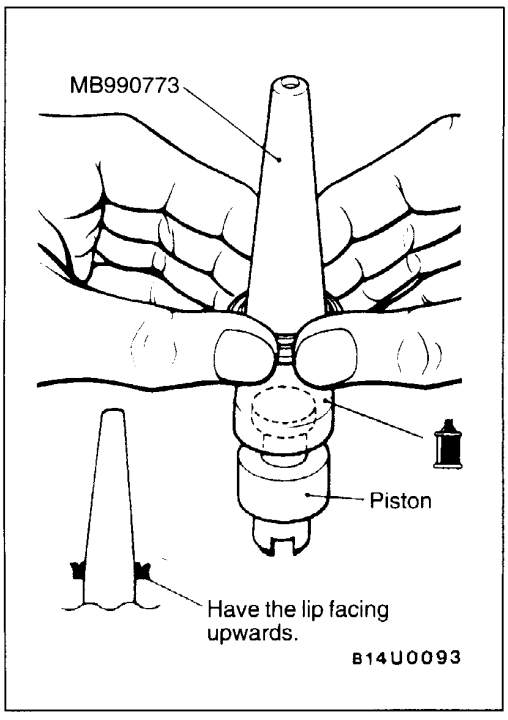
| | | |
|---|---|---|
|  |  |  |
| Brake fluid: DOT3 or DOT4 | Grease: Repair kit grease | Wheel cylinder repair kit |

**Disassembly steps**

1. Boots
2. Piston assembly
3. ▶A◀ Pistons
4. ▶A◀ Piston cups
5. Spring
6. Bleeder
7. Wheel cylinder body




## REASSEMBLY SERVICE POINT

### ▶A◀ PISTON CUP/PISTON REASSEMBLY

(1) Use alcohol or specified brake fluid to clean the wheel cylinder and the piston.

(2) Apply the specified brake fluid to the piston cups and the special tool.

**Specified brake fluid: DOT3 or DOT4**

(3) Set the piston cup on the special tool with the lip of the cup facing up, fit the cup onto the special tool, and then slide it down the outside of the tool into the piston groove.

**Caution**
**In order to keep the piston cup from becoming twisted or slanted, slide the piston cup down the tool slowly and carefully, without stopping.**

## INSPECTION

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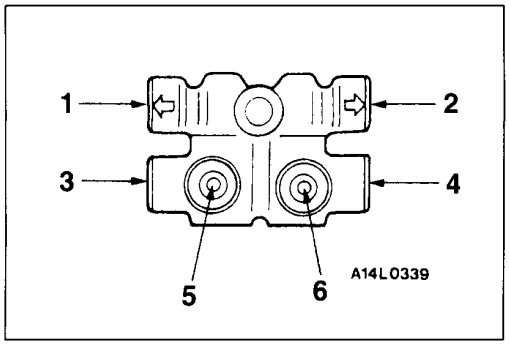
Check the piston and wheel cylinder walls for rust or damage, and if there is any abnormality, replace the entire wheel cylinder assembly.




# PROPORTIONING VALVE

35100570055

## INSTALLATION SERVICE POINT

### BRAKE PIPE CONNECTION

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

1. Proportioning valve – Rear brake (L.H.)
2. Proportioning valve – Rear brake (R.H.)
3. Proportioning valve – Front brake (R.H.)
4. Proportioning valve – Front brake (L.H.)
5. Proportioning valve – Master cylinder (secondary)
6. Proportioning valve – Master cylinder (primary)

# ANTI-SKID BRAKING SYSTEM (ABS) <2WD>

## CONTENTS

35209000053



CONTINUED ON NEXT PAGE

**WARNINGS REGARDING SERVICING OF SUPPLEMENTAL RESTRAINT SYSTEM (SRS) EQUIPPED VEHICLES**

**WARNING!**

**(1) Improper service or maintenance of any component of the SRS, or any SRS-related component, can lead to personal injury or death to service personnel (from inadvertent firing of the air bag) or to the driver and passenger (from rendering the SRS inoperative).**

**(2) Service or maintenance of any SRS component or SRS-related component must be performed only at an authorized MITSUBISHI dealer.**

**(3) MITSUBISHI dealer personnel must throughly review this manual, and especially its GROUP 52B – Supplemental Restraint System (SRS) before begining any service or maintenance of any component of the SRS or any SRS-related component.**

NOTE
The SRS includes the following components: SRS-ECU, SRS warning lamp, air bag module, clock spring and interconnecting wiring. Other SRS-related components (that may have to be removed/installed in connection with SRS service or maintenance) are indicated in the table of contents by an asterisk (*).

# GENERAL INFORMATION

35200010055

The ABS consists of components such as the wheel speed sensors, stop lamp switch, hydraulic unit assembly (integrated with the ABS-ECU) and the ABS warning lamp. If a problem occurs in the system, the malfunctioning component can be identified and the trouble symptoms will be memorized by the diagnosis function.
In addition, reading of diagnosis codes and service data and actuator testing are possible by using the MUT-II.

## MASTER CYLINDER

| | |
|---|---|
| Type | Tandem type |
| I.D. mm | 23.81 |

## BRAKE BOOSTER

| | |
|---|---|
| Type | Vacuum type, tandem |
| Effective dia. of power cylinder mm | 190±217 |
| Boosting ratio | 6.0 |

## PROPORTIONING VALVE

| | |
|---|---|
| Decompression ratio | 0.25 |

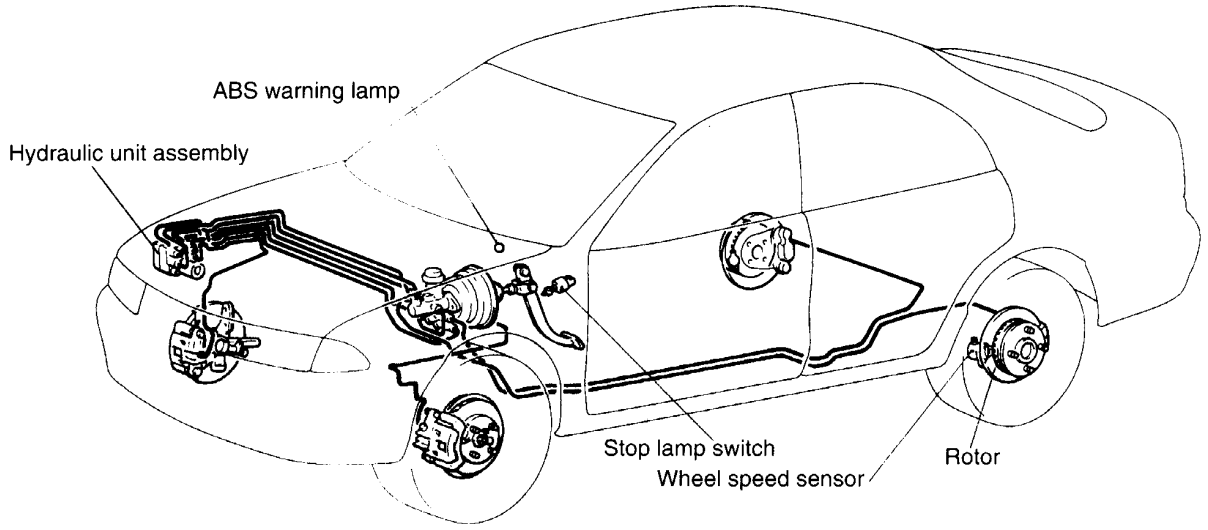
## REAR DISC BRAKE

| Item | 1600 | 1800 |
|---|---|---|
| Type | Solid disc | Solid disc |
| Disc effective dia.×thickness mm | 200.0×10 | 224.0×10 |
| Wheel cylinder I.D. mm | 34.92 | 34.92 |
| Pad thickness mm | 9.5 | 9.5 |
| Clearance adjustment | Automatic | Automatic |

## WHEEL SPEED SENSOR

| | |
|---|---|
| Type | Magnet coil type |
| Rotor teeth | 43 |

## CONSTRUCTION DIAGRAM




## SERVICE SPECIFICATIONS

35200030051

| Items | | | Standard value | Limit |
|---|---|---|---|---|
| Proportioning valve | Split point MPa | 1600 | 3.92±0.25 | – |
| | | 1800 | 3.43±0.25 | – |
| | Output fluid pressure MPa (Input fluid pressure MPa) | 1600 | 5.39±0.4 (9.81) | – |
| | | 1800 | 5.03±0.4 (9.81) | – |
| | Output fluid pressure difference between left and right MPa | | – | 0.8 |
| Rear disc brake | Pad thickness mm | | 9.5 | 2.0 |
| | Disc thickness mm | | 10.0 | 8.4 |
| | Disc runout mm | | – | 0.08 |
| | Drag force (tangential force of wheel mounting bolts) N | | 20 or less | – |
| Booster push rod to master cylinder piston clearance mm | | | 0.4–0.6 | – |
| Wheel speed sensor's internal resistance kΩ | | | 1.28–1.92 | – |
| Wheel speed sensor insulation resistance kΩ | | | 100 or more | – |

## LUBRICANTS

35200040016

| Items | Specified lubricant |
|---|---|
| Brake fluid | DOT3 or DOT4 |
| Brake piston seal | Repair kit grease |
| Guide pin boot inner surfaces | |
| Lock pin boot inner surfaces | |
| Piston boot mounting grooves | |
| Brake piston boot inner surfaces | |
| Pad assembly and shim contact surfaces | |
| Lock pin sleeve | |

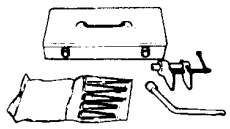
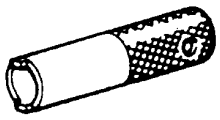
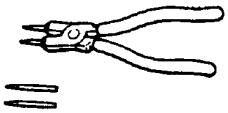
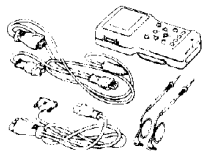
## SEALANT

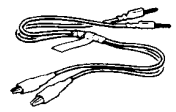
35200050033

| Item | Specified sealant | Remark |
|---|---|---|
| Thread part fitting | 3M ATD Part No. 8661 or equivalent | Semi-drying sealant |

## SPECIAL TOOLS

35200060050

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MB990964<br>MB990520 | Brake tool set | Pushing-in of the disc brake piston |
|  | MB990652 | Rear disc brake piston driver | Pressing of the rear disc brake pistons |
|  | MB991041 | Snap ring pliers | Removal of the rear disc brake circlips |
|  | MB991502 | MUT-II sub assembly | For checking of ABS (Diagnosis code display when using the MUT-II) |

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MB991529 | Diagnosis code check harness | For checking of ABS (Diagnosis code display when using the ABS warning lamp) |

# TROUBLESHOOTING

35200070039

## STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

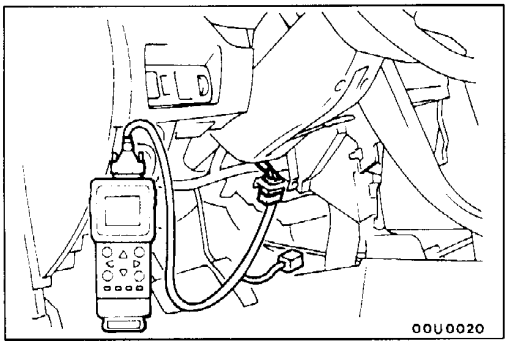
Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

## NOTES WITH REGARD TO DIAGNOSIS

The phenomena listed in the following table are not abnormal.

| Phenomenon | Explanation of phenomenon |
|---|---|
| System check sound | When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment, but this is because the system operation check is being performed, and is not an abnormality. |
| ABS operation sound | 1. Sound of the motor inside the ABS hydraulic unit operation. (whine)<br>2. Sound is the generated along with vibration of the brake pedal. (scraping)<br>3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release.<br>(Thump: suspension; squeak: tyres) |
| ABS operation (Long braking distance) | For road surfaces such as snow-covered roads and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed and not being too overconfident. |

Diagnosis detection condition can vary depending on the diagnosis code.
Make sure that checking requirements listed in the "Comment" are satisfied when checking the trouble symptom again.



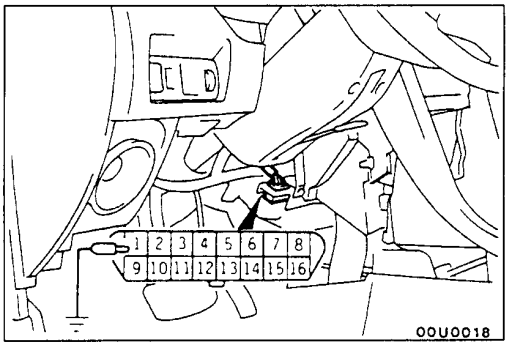

## DIAGNOSIS FUNCTION

### DIAGNOSIS CODES CHECK

**With the MUT-II**

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

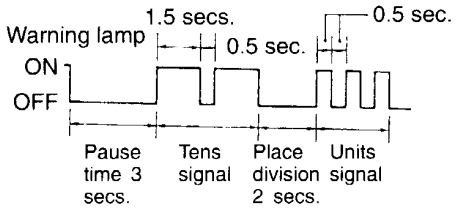
**Caution**
**Turn the ignition switch off before connecting or disconnecting the MUT-II.**



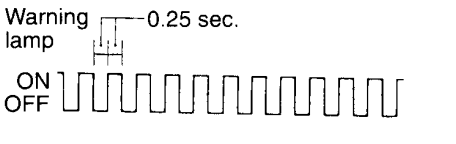

**Without the MUT-II**

1. Use the special tool to earth diagnosis connector terminal No. 1.

**When diagnosis code No. 23 is output**




**When no diagnosis code is output**



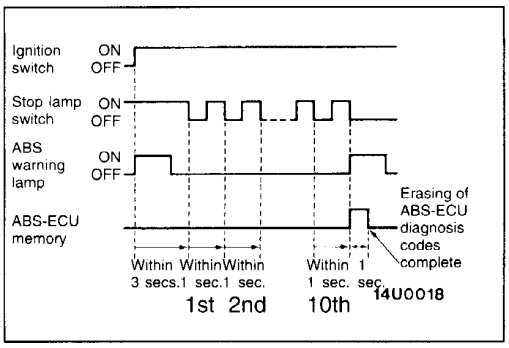

14U0017

2. Turn the ignition switch to ON and then take a reading of the diagnosis codes from the flashing of the ABS warning lamp.

## ERASING DIAGNOSIS CODES

**With the MUT-II**

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




**Without the MUT-II**

The diagnosis codes can only be erased by operating the brake switch ten times according to the pattern shown in the illustration at left while the ABS is active and while driving at a speed of 10 km/h or less.

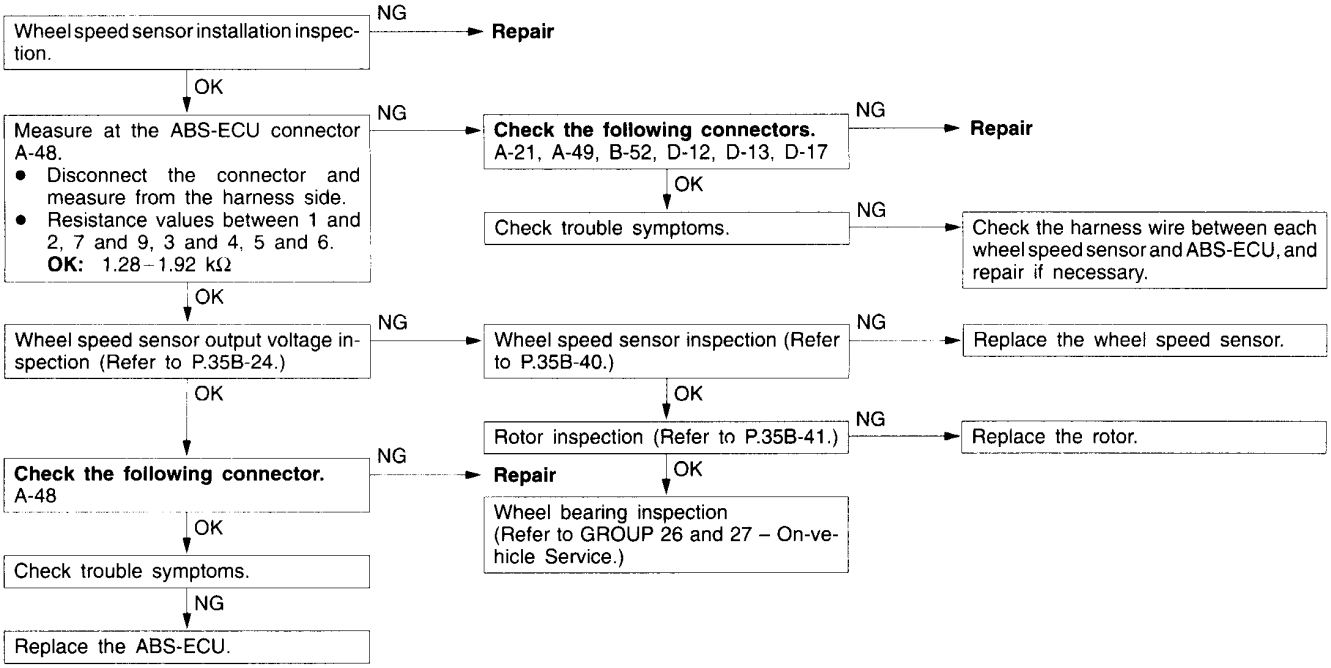
## INSPECTION CHART FOR DIAGNOSIS CODES

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

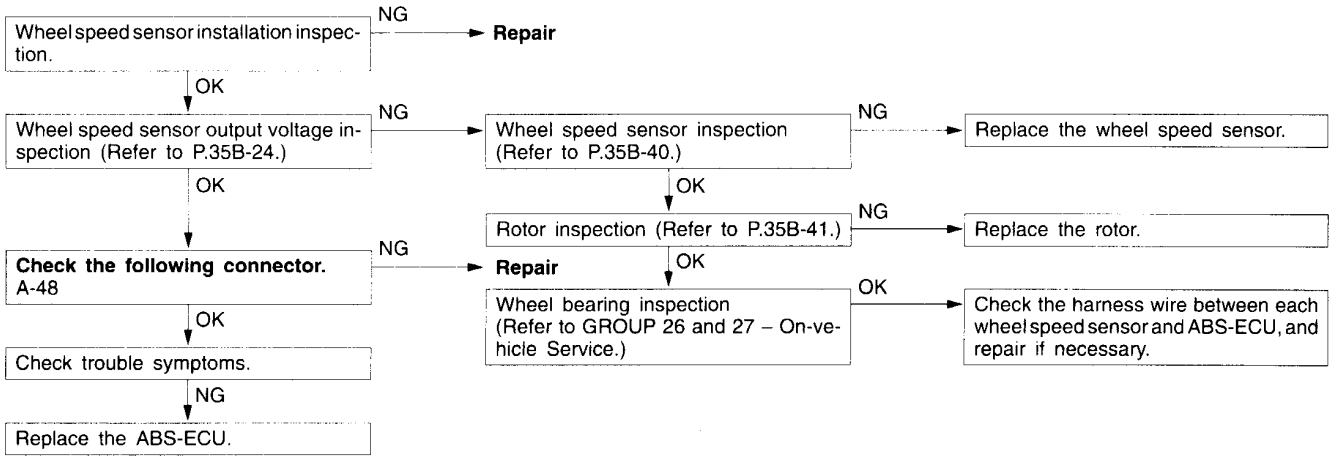
| Diagnosis code No. | Inspection item | Diagnosis content | Reference page |
|---|---|---|---|
| 11 | Front right wheel speed sensor | Open circuit | 35B-9 |
| 12 | Front left wheel speed sensor | | |
| 13 | Rear right wheel speed sensor | | |
| 14 | Rear left wheel speed sensor | | |
| 15 | Wheel speed sensor | Abnormal output signal | 35B-10 |
| 16 | Power supply system | | 35B-10 |
| 21 | Front right wheel speed sensor | Short circuit | 35B-11 |
| 22 | Front left wheel speed sensor | | |
| 23 | Rear right wheel speed sensor | | |
| 24 | Rear left wheel speed sensor | | |
| 38 | Stop lamp switch system | | 35B-12 |
| 41 | Front right inlet solenoid valve | | 35B-37 (Replace the HU assembly) |
| 42 | Front left inlet solenoid valve | | |
| 43 | Rear right inlet solenoid valve | | |
| 44 | Rear left inlet solenoid valve | | |
| 45 | Front right outlet solenoid valve | | 35B-37 (Replace the HU assembly) |
| 46 | Front left outlet solenoid valve | | |
| 47 | Rear right outlet solenoid valve | | |
| 48 | Rear left outlet solenoid valve | | |
| 51 | Valve power supply | | 35B-12 |
| 53 | Pump motor | | 35B-13 |
| 63 | ABS-ECU | | 35B-37 (Replace the ABS-ECU) |

## INSPECTION PROCEDURE FOR DIAGNOSIS CODES

| Code No. 11, 12, 13, 14 Wheel speed sensor open circuit | Probable cause |
|---|---|
| The ABS-ECU determines that an open circuit occurs in more than one line of wheel speed sensors. | • Malfunction of wheel speed sensor<br>• Malfunction of wiring harness or connector<br>• Malfunction of ABS-ECU |

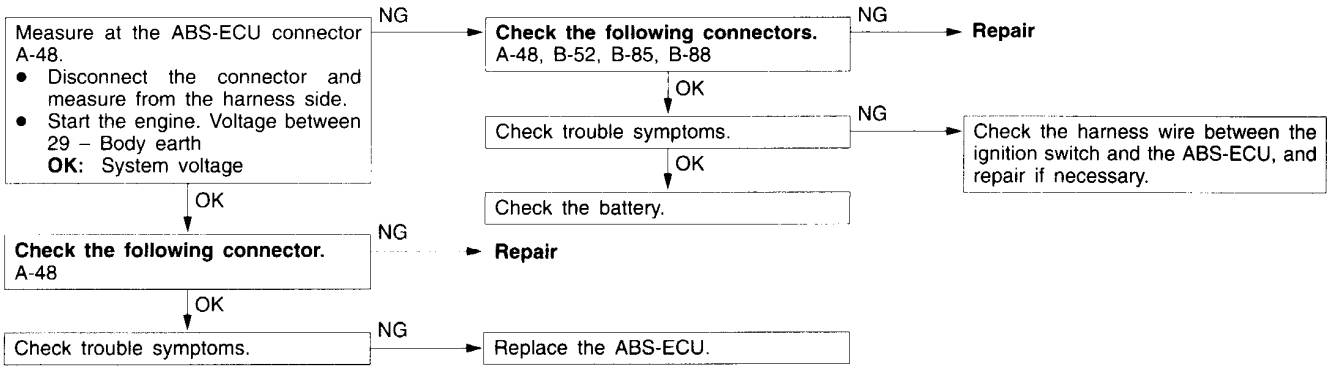


| Code No. 15 Wheel speed sensor (Abnormal output signal) | Probable cause |
|---|---|
| A wheel speed sensor outputs an abnormal signal (other than an open or short-circuit). | • Improper installation of wheel speed sensor<br>• Malfunction of wheel speed sensor<br>• Malfunction of rotor<br>• Malfunction of wheel bearing<br>• Malfunction of wiring harness or connector<br>• Malfunction of ABS-ECU |

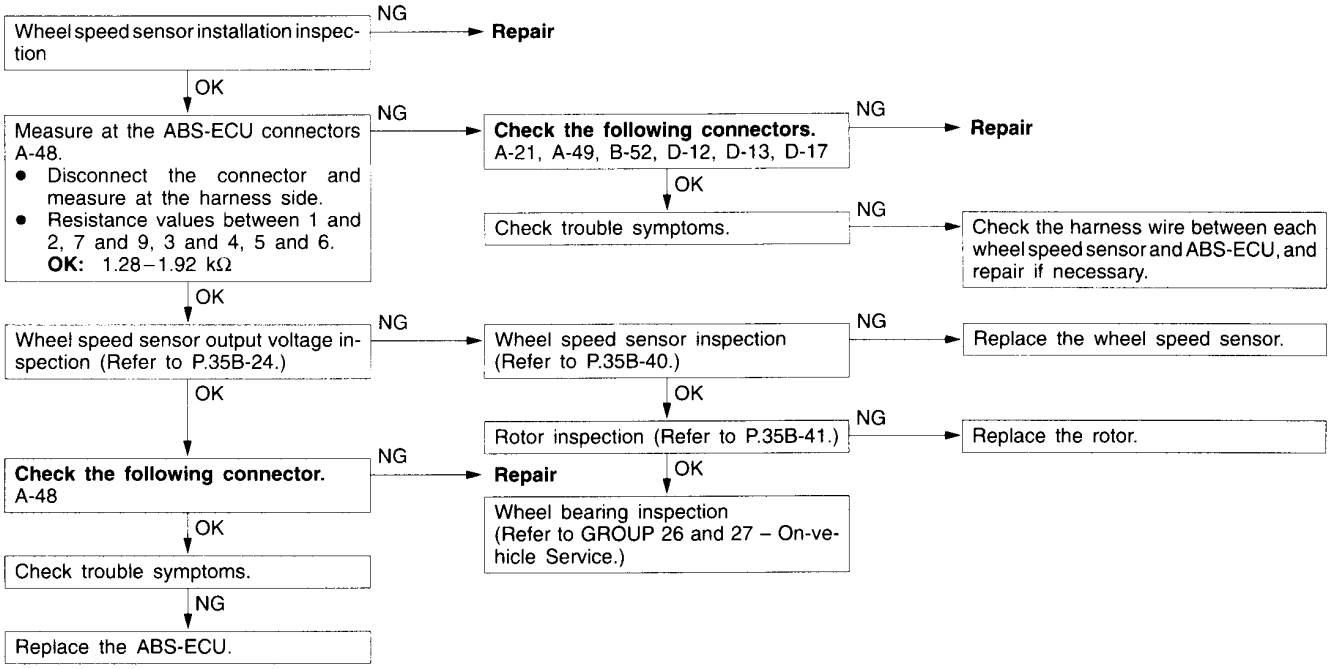



| Code No. 16 Power supply system | Probable cause |
|---|---|
| The voltage of the ABS-ECU power supply drops lower or rises higher than the specified value.<br>If the voltage returns to the specified value, this code is no longer output. | • Malfunction of wiring harness or connector.<br>• Malfunction of ABS-ECU |

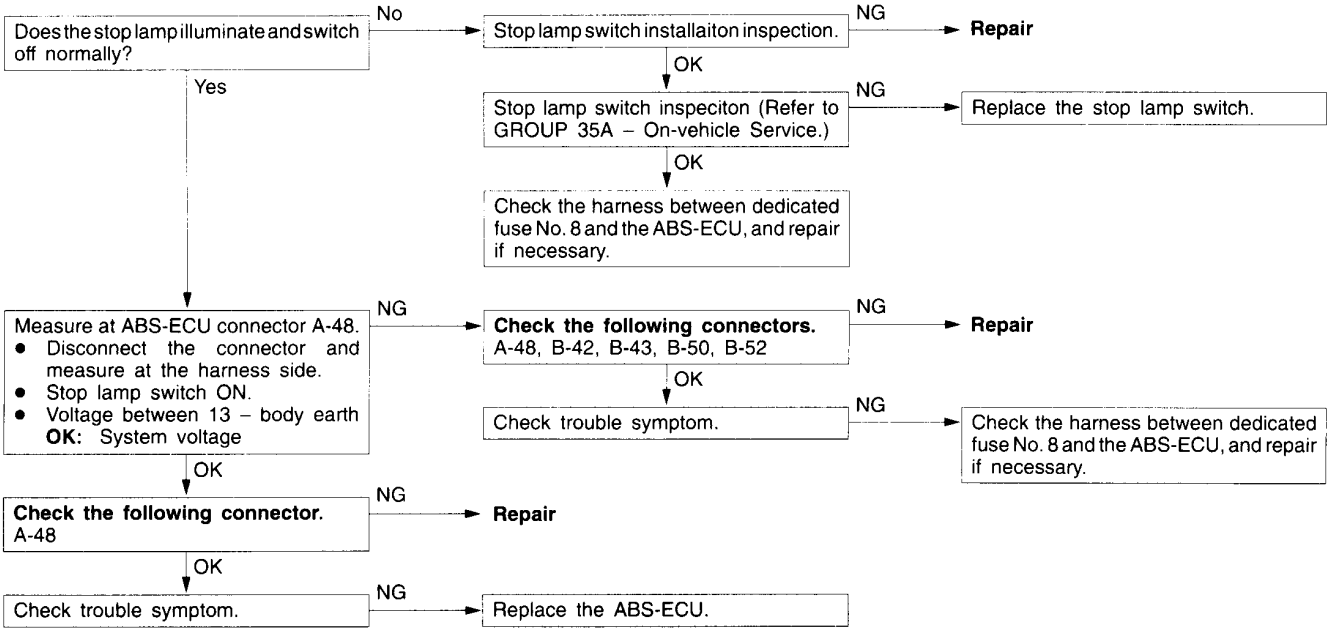
**Caution**
**If battery voltage drops or rises during inspection, this code will be output as well. If the voltage returns to standard value, this code is no longer output.**
**Before carrying out the following inspection, check the battery level, and refill it if necessary.**



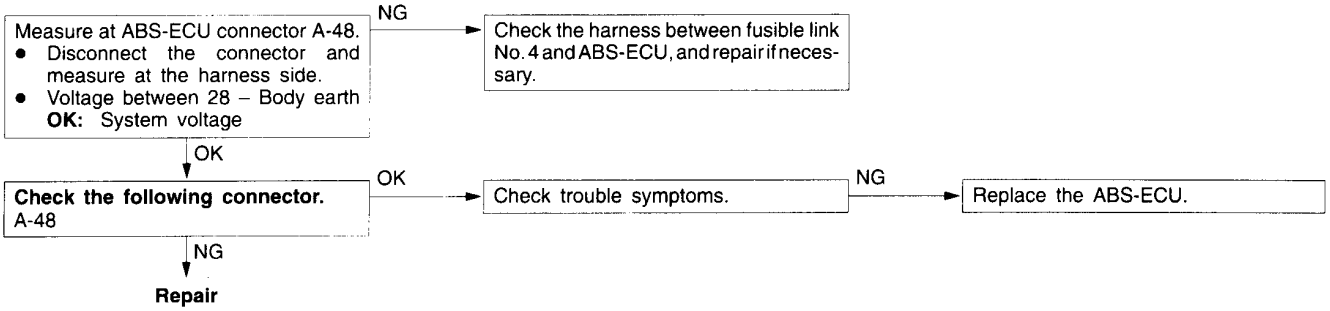
| Code No. 21, 22, 23, 24 Wheel speed sensor short circuit | Probable cause |
|---|---|
| These codes are output at the following times:<br>• When an open circuit cannot be found, but more than one wheel speed sensor does not output any signal during driving at 12 km/h or higher.<br>• When a chipped or plugged-up rotor tooth, etc. is detected.<br>• When the input signal from the wheel speed sensor is interrupted for a moment during driving at 12 km/h or higher. | • Malfunction of wheel speed sensor<br>• Malfunction of rotor<br>• Malfunction of wheel bearing<br>• Malfunction of wiring harness or connector<br>• Malfunction of ABS-ECU |



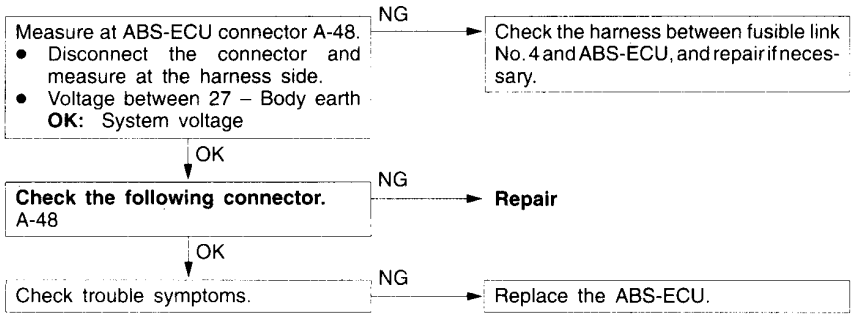
| Code No. 38 Stop lamp switch system | Probable cause |
|---|---|
| These codes are output at the following times:<br>• When the stop lamp switch is not be turned off (when the stop lamp switch stays on for 15 minutes or more although the ABS is not operating).<br>• When the ABS-ECU determines that there is an open circuit in harness of the stop lamp switch system. | • Malfunction of stop lamp switch<br>• Malfunction of harness or connector<br>• Malfunction of ABS-ECU |

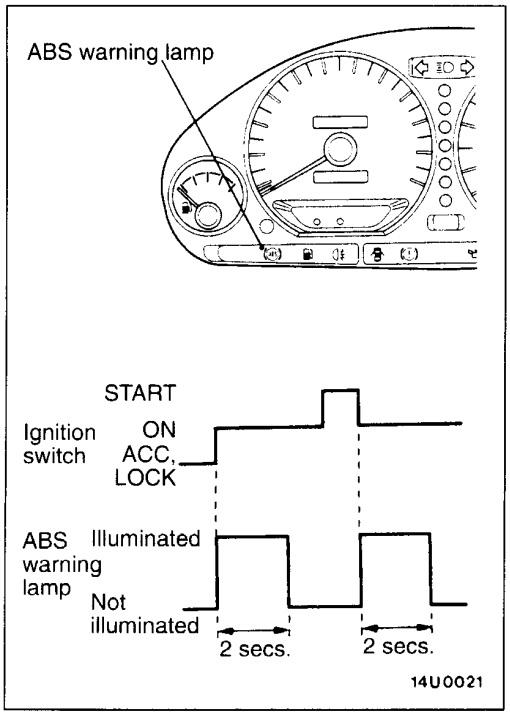



| Code No. 51 Valve power supply | Probable cause |
|---|---|
| This code is output when there is an abnormality in the solenoid valve power supply system. | • Malfunction of wiring harness or connector<br>• Malfunction of ABS-ECU |



| Code No. 53 Pump motor | Probable cause |
|---|---|
| This code is output when there is an abnormality in the pump motor system. | • Malfunction of wiring harness or connector<br>• Malfunction of hydraulic unit<br>• Malfunction of ABS-ECU |




## ABS WARNING LAMP INSPECTION

**Check that the ABS warning lamp illuminates as follows.**

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

## INSPECTION CHART FOR TROUBLE SYMPTOMS

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

| Trouble symptoms | | Inspection procedure No. | Reference page |
|---|---|---|---|
| Communication with MUT-II is not possible. | Communication with all systems is not possible. | 1 | 35B-15 |
| | Communication with ABS only is not possible. | 2 | 35B-15 |
| When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate. | | 3 | 35B-16 |
| After the engine starts, the lamp remains illuminated. | | 4 | 35B-16 |
| Faulty ABS operation | Unequal braking power on both sides | 5 | 35B-17 |
| | Insufficient braking power | | |
| | ABS operates under normal braking conditions | | |
| | ABS operates before vehicle stops under normal braking conditions | | |
| | Large brake pedal vibration (Caution 2.) | – | – |

**Caution**

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

# INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

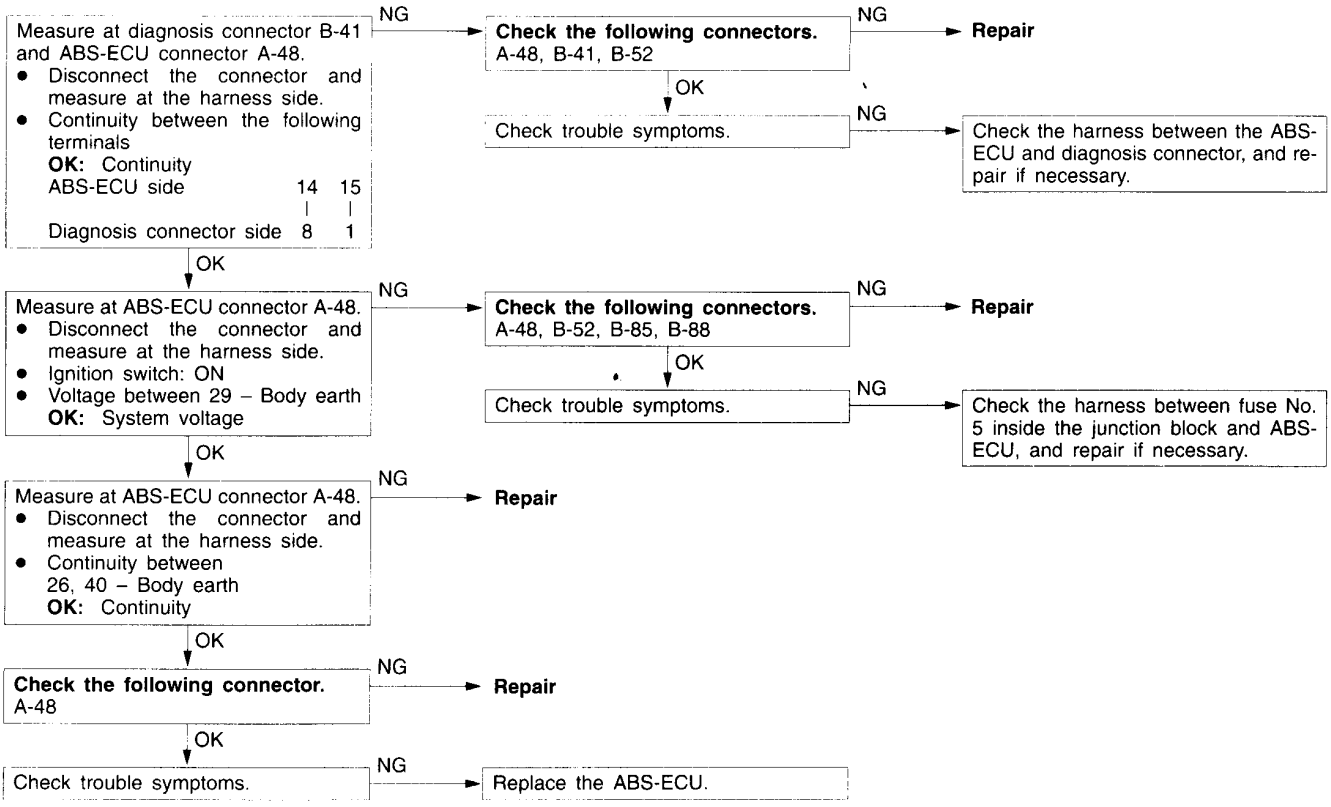
## Inspection Procedure 1

| Communication with MUT-II is not possible. (Communication with all systems is not possible.) | Probable cause |
|---|---|
| The reason is probably defect in the power supply system (including earth) for the diagnosis line. | • Malfunction of wiring harness or connector |

Refer to GROUP 13A – Troubleshooting.

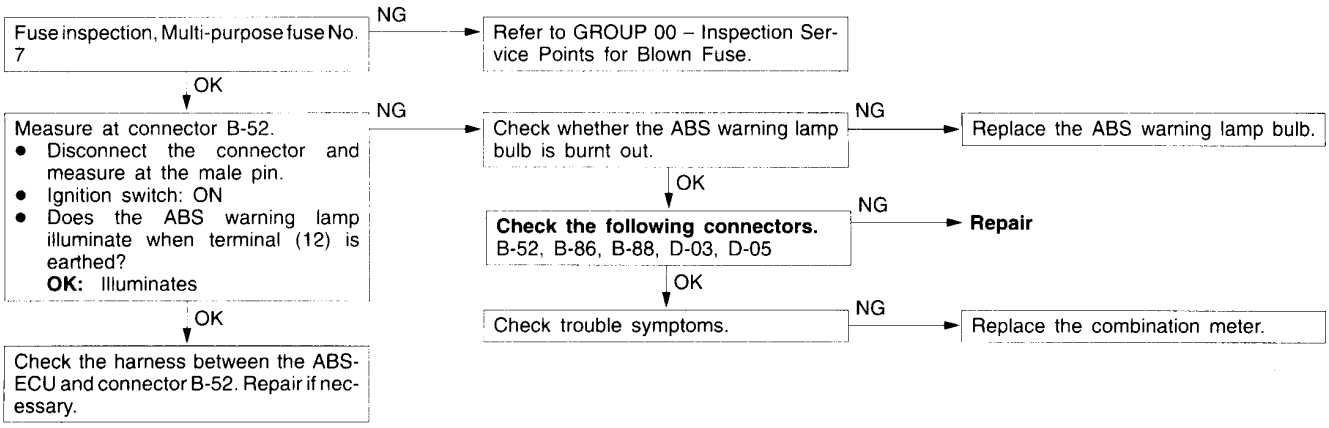
## Inspection Procedure 2

| Communication with MUT-II is not possible. (Communication with ABS only is not possible.) | Probable cause |
|---|---|
| When communication with the MUT-II is not possible, the cause is probably an open circuit in the ABS-ECU power circuit or an open circuit in the diagnosis output circuit. | • Blown fuse<br>• Malfunction of wiring harness or connector<br>• Malfunction of ABS-ECU |



## Inspection Procedure 3

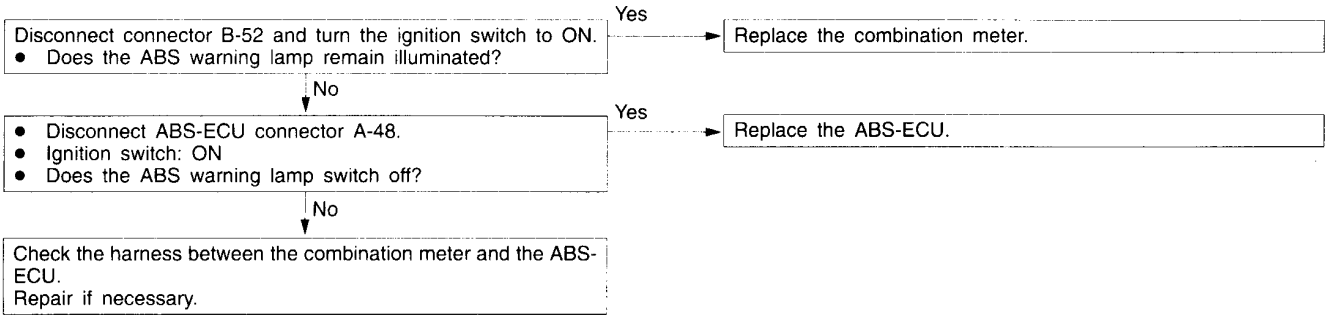
| When ignition key is turned to "ON" (engine stopped), ABS warning lamp does not illuminate. | Probable cause |
|---|---|
| The cause may be: an open circuit in the lamp power supply circuit, a blown lamp bulb, an open circuit in both the circuit between the ABS warning lamp and the ABS-ECU. | • Blown fuse<br>• Burnt out ABS warning lamp bulb<br>• Malfunction of wiring harness or connector |




## Inspection Procedure 4

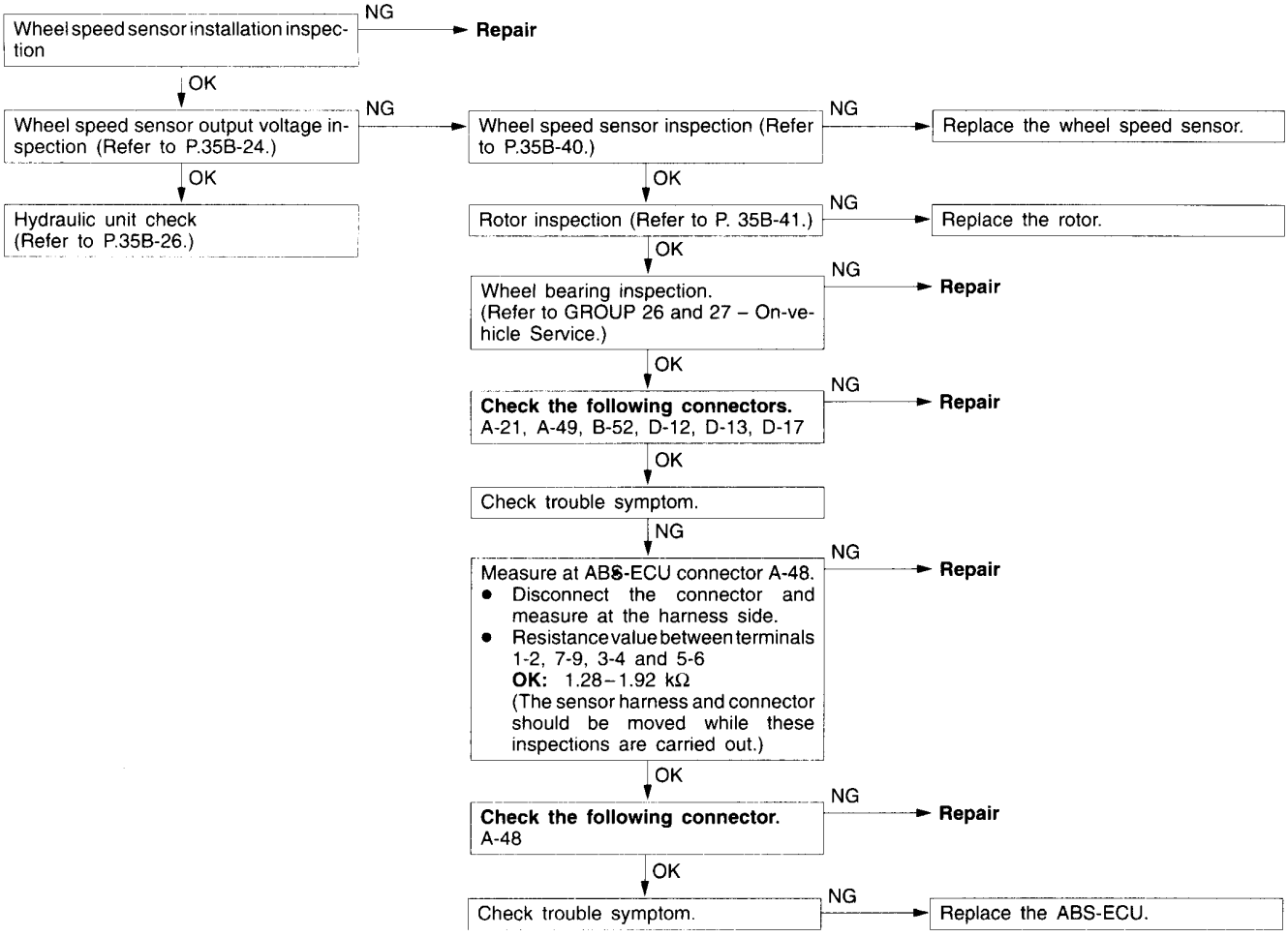
| Even after the engine is started, the ABS warning lamp remains illuminated. | Probable cause |
|---|---|
| The cause is probably a short-circuit in the ABS warning lamp illumination circuit. | • Malfunction of combination meter<br>• Malfunction of ABS-ECU<br>• Malfunction of wiring harness |

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



## Inspection Procedure 5

| Brake operation is abnormal. | Probable cause |
|---|---|
| This varies depending on the driving conditions and the road surface conditions, so problem diagnosis is difficult. However, if a normal diagnosis code is displayed, carry out the following inspection. | • Improper installation of wheel speed sensor<br>• Incorrect sensor harness contact<br>• Foreign material adhering to wheel speed sensor<br>• Malfunction of wheel speed sensor<br>• Malfunction of rotor<br>• Malfunction of wheel bearing<br>• Malfunction of hydraulic unit<br>• Malfunction of ABS-ECU |



## SERVICE DATA REFERENCE TABLE

The following items can be read by the MUT-II from the ABS-ECU input data.

### 1. When the system is normal

| Item No. | Check item | Checking requirements | Normal value |
|---|---|---|---|
| 11 | Front-right wheel speed sensor | Perform a test run | Vehicle speeds displayed on the speedometer and MUT-II are identical. |
| 12 | Front-left wheel speed sensor | | |
| 13 | Rear-right wheel speed sensor | | |
| 14 | Rear-left wheel speed sensor | | |
| 16 | ABS-ECU power supply voltage | Ignition switch power supply voltage and valve monitor voltage | 9–16 V |
| 38 | Stop lamp switch | Depress the brake pedal. | ON |
| | | Release the brake pedal. | OFF |

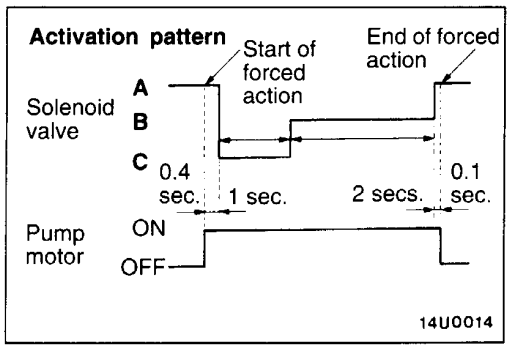
### 2. When the ABS-ECU shut off ABS operation.

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

## ACTUATOR TEST REFERENCE TABLE

The MUT-II activates the following actuators for testing.

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




### ACTUATOR TEST SPECIFICATIONS

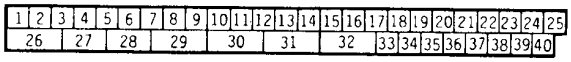
| No. | Item | |
|---|---|---|
| 01 | Solenoid valve for front-left wheel | Solenoid valves and pump motors in the hydraulic unit (simple inspection mode) |
| 02 | Solenoid valve for front-right wheel | |
| 03 | Solenoid valve for rear-left wheel | |
| 04 | Solenoid valve for rear-right wheel | |

NOTE
A: Hydraulic pressure increase
B: Hydraulic pressure holds
C: Hydraulic pressure decrease

## CHECK AT ABS-ECU

### TERMINAL VOLTAGE CHECK CHART

1. Measure the voltages between terminals (26) and (40) (earth terminals) and each respective terminal.
2. The terminal layouts are shown in the illustrations below.

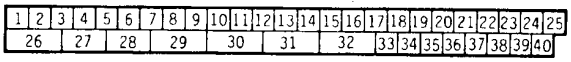



14U0036

| Connector terminal No. | Signal | Checking requirements | | Normal condition |
|---|---|---|---|---|
| 13 | Input from stop lamp switch | Ignition switch: ON | Stop lamp switch: ON | System voltage |
| | | | Stop lamp switch: OFF | 1 V or less |
| 14 | MUT-II | Connect the MUT-II. | | Serial communication with MUT-II |
| | | Do not connect the MUT-II. | | 1 V or less |
| 15 | Input from diagnosis indication selection | Connect the MUT-II. | | 0 V |
| | | Do not connect the MUT-II. | | Approx. 12 V |
| 25 | Output to ABS warning lamp | Ignition switch: ON | The lamp is switched off. | System voltage |
| | | | The lamp is illuminated. | 0–2 V |
| 27 | Solenoid valve power supply | Always | | System voltage |
| 28 | Pump motor power supply | Always | | System voltage |
| 29 | ABS-ECU power supply | Ignition switch: ON | | System voltage |
| | | Ignition switch: START | | 0 V |

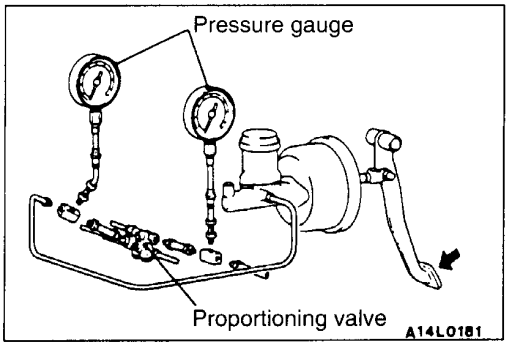
### RESISTANCE AND CONTINUITY BETWEEN HARNESS-SIDE CONNECTOR TERMINALS

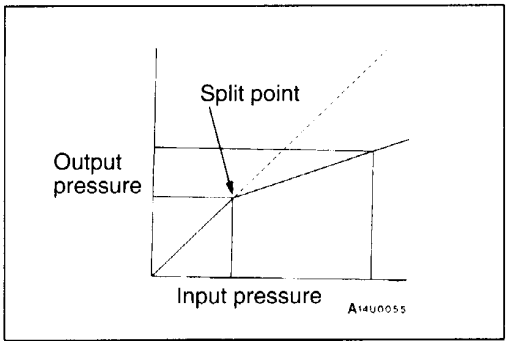
1. Turn the ignition switch off and disconnect the ABS-ECU connectors before checking resistance and continuity.
2. Check them between the terminals indicated in the table below.
3. The terminal layouts are shown in the illustrations below.




14U0036

| Connector terminal No. | Signal | Normal condition |
|---|---|---|
| 1-2 | Front-left wheel speed sensor (+ wire) | 1.28–1.92 kΩ |
| 3-4 | Rear-left wheel speed sensor (+ wire) | 1.28–1.92 kΩ |
| 5-6 | Rear-right wheel speed sensor (+ wire) | 1.28–1.92 kΩ |
| 7-9 | Front-right wheel speed sensor (+ wire) | 1.28–1.92 kΩ |
| 26 – Body earth | ABS-ECU earth | Continuity |
| 40 – Body earth | | |




## ON-VEHICLE SERVICE

35200120017

### PROPORTIONING VALVE FUNCTION TEST

1. Connect two pressure gauges, one each to the input side and output side of the proportioning valve, as shown.
2. Air bleed the brake line and the pressure gauge.
3. While gradually depressing the brake pedal, make the following measurements and check that the measured values are within the allowable range.

(1) Output pressure begins to drop relative to input pressure (split point).

**Standard value:**
**<1600> 3.92±0.25 MPa**
**<1800> 3.43±0.25 MPa**

(2) Check that the output fluid pressure is at the standard value when the pedal depression force is increased so that the input fluid pressure is at the values shown in the table below.

**Standard value:**

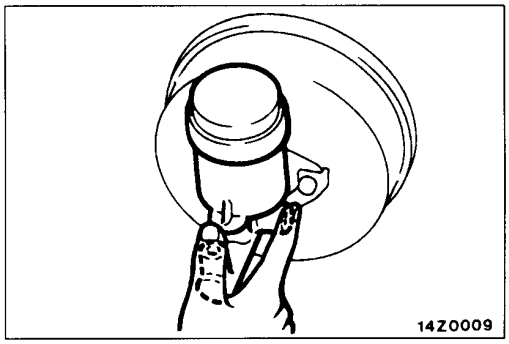
MPa

| Items | 1600 | 1800 |
|---|---|---|
| Output fluid pressure | 5.39±0.4 | 5.03±0.4 |
| Input fluid pressure | 9.81 | 9.81 |

(3) Output pressure difference between left and right brake lines

**Limit: 0.8 MPa**

4. If the measured pressures are not within the permissible ranges, replace the proportioning valve.




## BLEEDING

35200150030

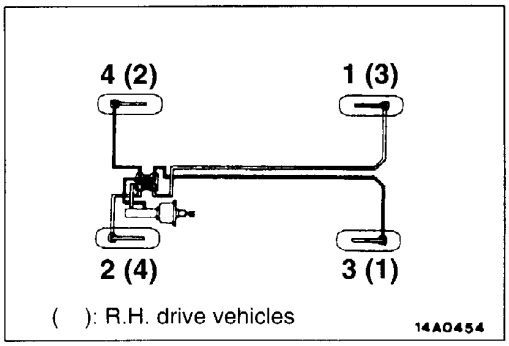
**Caution**
**Use the specified brake fluid. Avoid using a mixture of the specified brake fluid and other fluid.**

**Specified brake fluid: DOT3 or DOT4**

### 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.)

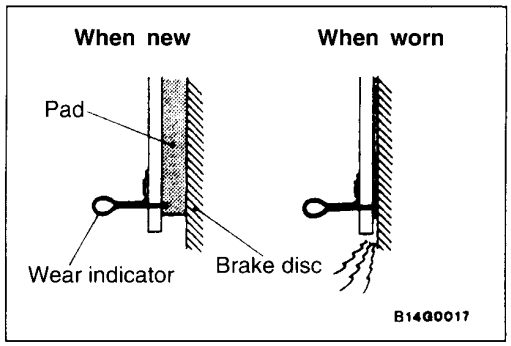
(1) Fill the reserve tank with brake fluid.
(2) Keep the brake pedal depressed.
(3) Have another person cover the master cylinder outlet with a finger.
(4) With the outlet still closed, release the brake pedal.
(5) Repeat steps 2.–4. three or four times to fill the inside of the master cylinder with brake fluid.




### BRAKE PIPE LINE BLEEDING

Start the engine and bleed the air in the sequence shown in the figure.

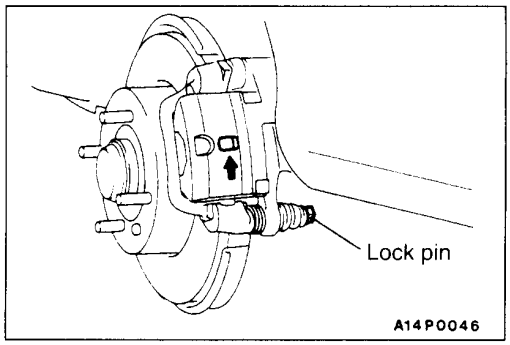
**Caution**
**For vehicles with ABS, be sure to install a filter to the master cylinder reservoir tank when supplying brake fluid.**




## REAR DISC BRAKE PAD CHECK AND REPLACEMENT

35200240027

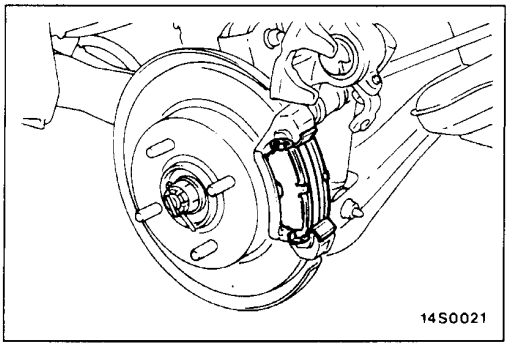
NOTE
The brake pads have wear indicators that contact the brake disc when the brake pad thickness becomes 2 mm and emit a squealing sound to warn the driver.




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

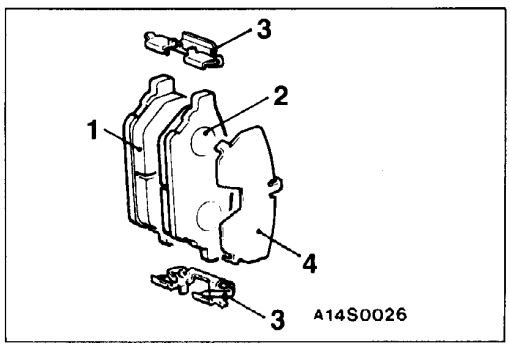
   **Standard value: 9.5 mm**
   **Limit: 2.0 mm**

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

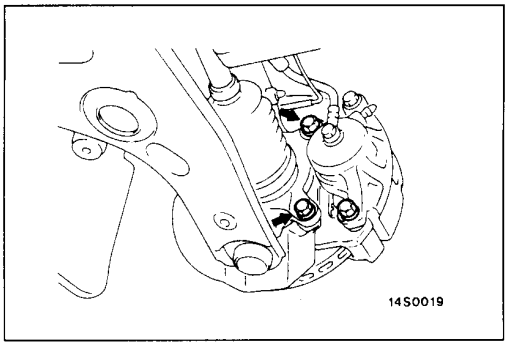



2. Remove lock pin. Lift caliper assembly and retain with wires.

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

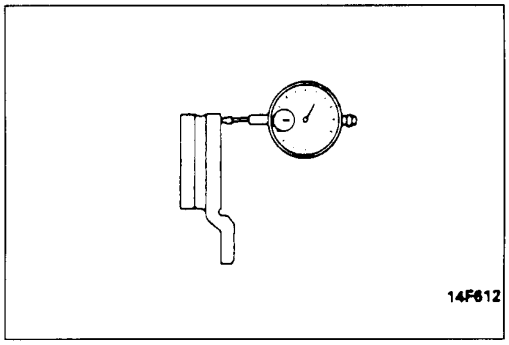



3. Remove the following parts from caliper support.
   1. Pad & wear indicator assembly
   2. Pad assembly
   3. Clip
   4. Outer shim
4. In order to measure the brake drag torque after pad installation, measure the rotary-sliding resistance (A) of the hub with the pads removed. (Refer to P.35B-32.)
5. Install the pads and the caliper assembly, and then check the brake drag torque. (Refer to P.35B-32.)




## BRAKE DISC RUN-OUT CHECK 35200300015

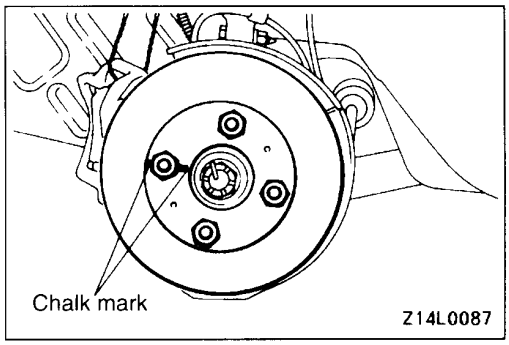
1. Remove the caliper support; then raise the caliper assembly upward and secure by using wire.
2. Inspect the disc surface for grooves, cracks and rust. Clean the disc thoroughly and remove all rust.




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

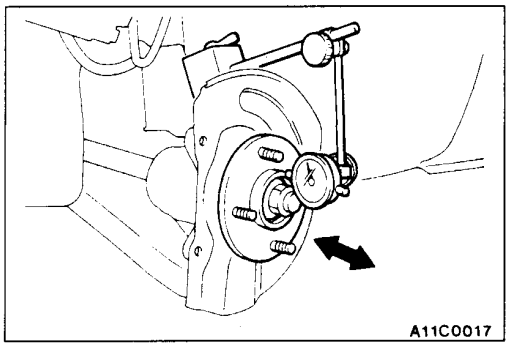
   **Limit: 0.08 mm or less**

   NOTE
   Tighten the nuts in order to secure the disc to the hub.




## BRAKE DISC RUN-OUT CORRECTION 35200310018

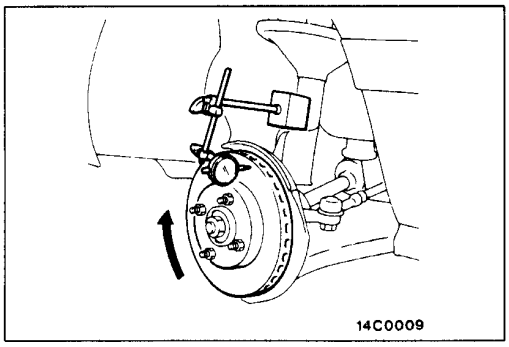
1. If the run-out of the brake disc is equivalent to or exceeds the limit specification, change the phase of the disc and hub, and then measure the run-out again.
   (1) Before removing the brake disc, chalk both sides of the wheel stud on the side at which run-out is greatest.




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

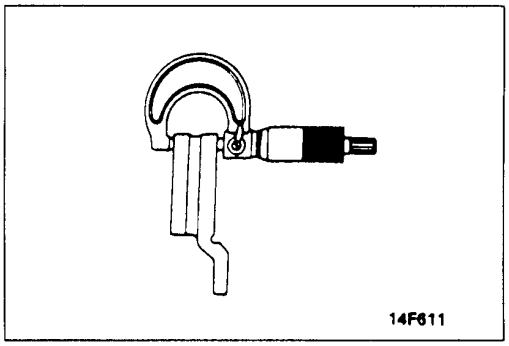
   **Limit: 0.05 mm**

   If the play is equivalent to or exceeds the limit, disassemble the hub knukle and check each part.




   (3) If the play does not exceed the limit specification, install the brake disc at a posiiton 180° away from the chalk mark, and then check the run-out of the brake disc once again.

2. If the run-out cannot be corrected by changing the phase of the brake disc, replace the disc or turn rotor with on the car type brake lathe ("MAD, DL-8700PF or equivalent).




## BRAKE DISC THICKNESS CHECK

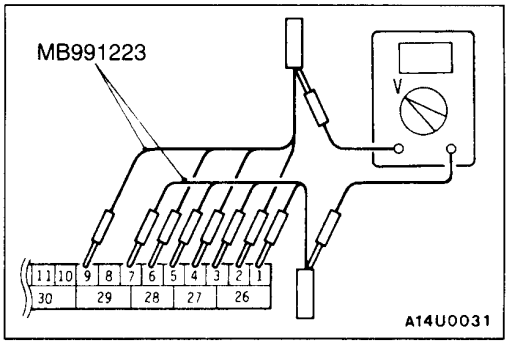
35200290015

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

   **Standard value: 10.0 mm**
   **Limit: 8.4 mm**

   Thickness variation (at least 8 positions)
   The difference between any thickness measurements should not be more than 0.015 mm.

2. 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 turn rotor with on the car type brake lathe ("MAD, DL-8700PF" or equivalent).




## WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK

35200160071

1. Lift up the vehicle and release the parking brake.
2. Disconnect the ABS-ECU connector, and then use the special tool (inspection harness for connector pin contact pressure) to measure the output voltage at the harness-side connector.

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

| Wheel speed sensor | Front left | Front right | Rear left | Rear right |
|---|---|---|---|---|
| Terminal No. | 1 | 7 | 3 | 5 |
| | 2 | 9 | 4 | 6 |

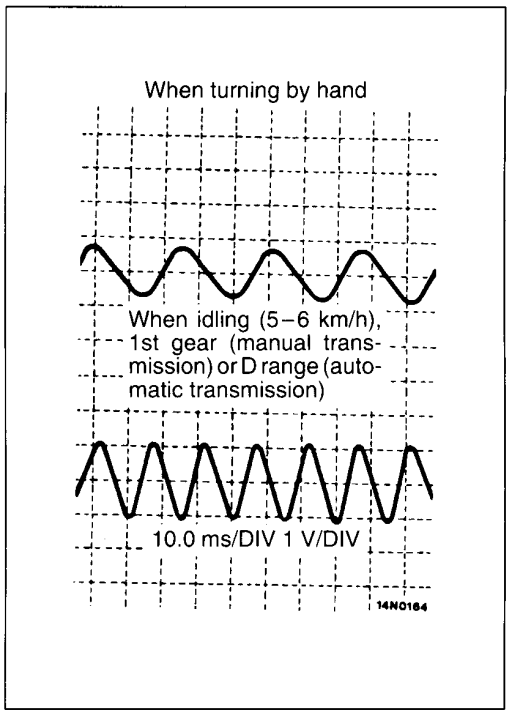
**Output voltage**

**When measuring with a circuit tester:**
**50 mV or more**

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

4. If the output voltage is lower than the above values, the reason could be as follow:
   - Faulty wheel speed sensor.

   So replace the wheel speed sensor.




### Inspecting Waveforms With An Oscilloscope

Use the following method to observe the output voltage waveform from each wheel sensor with an oscilloscope.

- Start the engine, and rotate the front wheels by engaging 1st gear (vehicles with manual transmission) or D range (vehicles with automatic transmission). Turn the rear wheels manually so that they rotate at a constant speed.

NOTE

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

### Points In Waveform Measurement

| Symptom | Probable causes | Remedy |
|---|---|---|
| Too small or zero waveform amplitude | Faulty wheel speed sensor | Replace sensor |
| Waveform amplitude fluctuates excessively (this is no problem if the minimum amplitude is 100 mV or more) | Axle hub eccentric or with large runout | Replace hub |
| Noisy or disturbed waveform | Open circuit in sensor | Replace sensor |
| | Open circuit in harness | Correct harness |
| | Incorrectly mounted wheel speed sensor | Mount correctly |
| | Rotor with missing or damaged teeth | Replace rotor |

NOTE

The wheel speed sensor cable moves following motion of the front or rear suspension. Therefore, it is likely that it has an open circuit only when driving on rough roads and it functions normally on ordinary roads. It is, therefore, recommended to observe sensor output voltage waveform also under special conditions, such as rough road driving.

## HYDRAULIC UNIT (HU) CHECK

35200170081

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

1. Jack up the vehicle and support the vehicle with rigid racks placed at the specified jack-up points or place the wheels which are checked on the rollers of the braking force tester.

   **Caution**
   **1. The roller of the braking force tester and the tyre should be dry during testing.**
   **2. When testing the front brakes, apply the parking brake, and when testing the rear brakes, stop the front wheels by chocking them.**

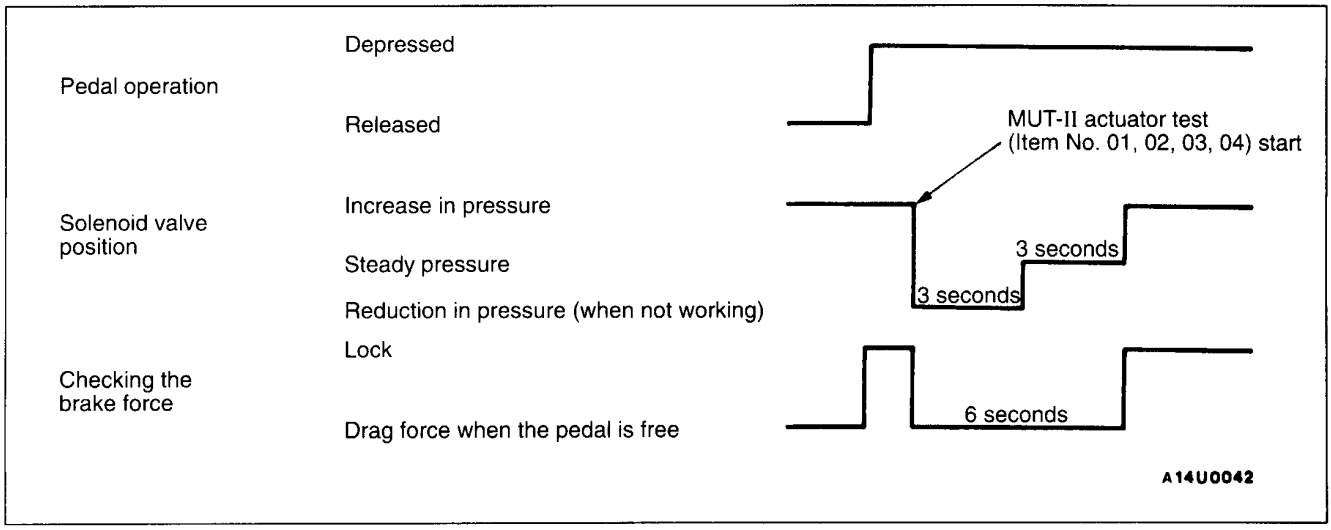
2. Release the parking brake, and feel the drag force (drag torque) on each road wheel.
   When using the braking force tester, take a reading of the brake drag force.
3. Turn the ignition key to the OFF position and set the MUT-II.
4. After checking that the shift lever <M/T> or the selector lever <A/T> is in neutral, start the engine.

   NOTE
   1. At this time, the ABS system will switch to the MUT-II mode and the ABS warning lamp will illuminate.
   2. When the ABS has been interrupted by the fail-safe function, the MUT-II actuator testing cannot be used.

5. Use the MUT-II to force-drive the actuator.
6. Turn the wheel by hand and check the change in braking force when the brake pedal is depressed. When using the braking force tester, depress the brake pedal until the braking force is at the following values, and check that the braking force changes to the brake drag force inspected in step 2 when the actuator is force-driven.

| | |
|---|---|
| Front wheel | 785–981 N |
| Rear wheel | 294–490 N |

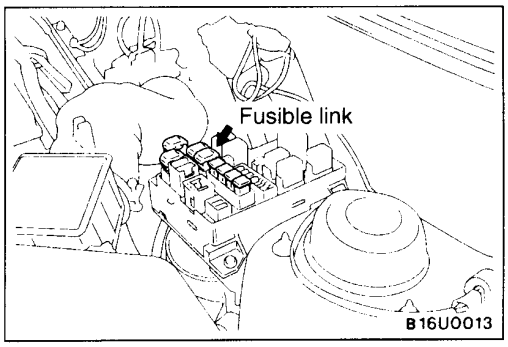
   The result should be as shown in the following diagram.
7. If the result of inspection is abnormal, correct according to the "Diagnosis Table".



**Diagnosis Table**

| No. | Operation | Judgement – Normal | Judgement – Abnormal | Probable cause | Remedy |
|---|---|---|---|---|---|
| 01 | (1) Depress brake pedal to lock wheel.<br>(2) Using the MUT-II, select the wheel to be checked and force the actuator to operate.<br>(3) Turn the selected wheel manually to check the change of brake force. | Brake force released for 1 seconds after locking. | Wheel does not lock when brake pedal is depressed. | Clogged brake line other than HU | Check and clean brake line |
| 02 | | | | Clogged hydraulic circuit in HU | Replace HU assembly |
| 03 | | | Brake force is not released | Incorrect HU brake tube connection | Connect correctly |
| 04 | | | | HU solenoid valve not functioning correctly | Replace HU assembly |

8. After inspection, disconnect the MUT-II immediately after turning the ignition switch to OFF.




## REMEDY FOR A FLAT BATTERY 35200350058

When booster cables are used to start the engine when the battery is completely flat and then the vehicle is immediately driven without waiting for the battery to recharge itself to some extent, the engine may misfire, and driving might not be possible.
This happens because ABS consumes a great amount of current for its self-check function; the remedy is to either allow the battery to recharge sufficiently, or to remove the fusible link for ABS circuit, thus disabling the anti-skid brake system. The ABS warning lamp will illuminate when the fusible link (for ABS) is removed.
After the battery has sufficiently recharged, install the fusible link (for ABS) and restart the engine; then check to be sure the ABS warning lamp is not illuminated.

# MASTER CYLINDER AND BRAKE BOOSTER

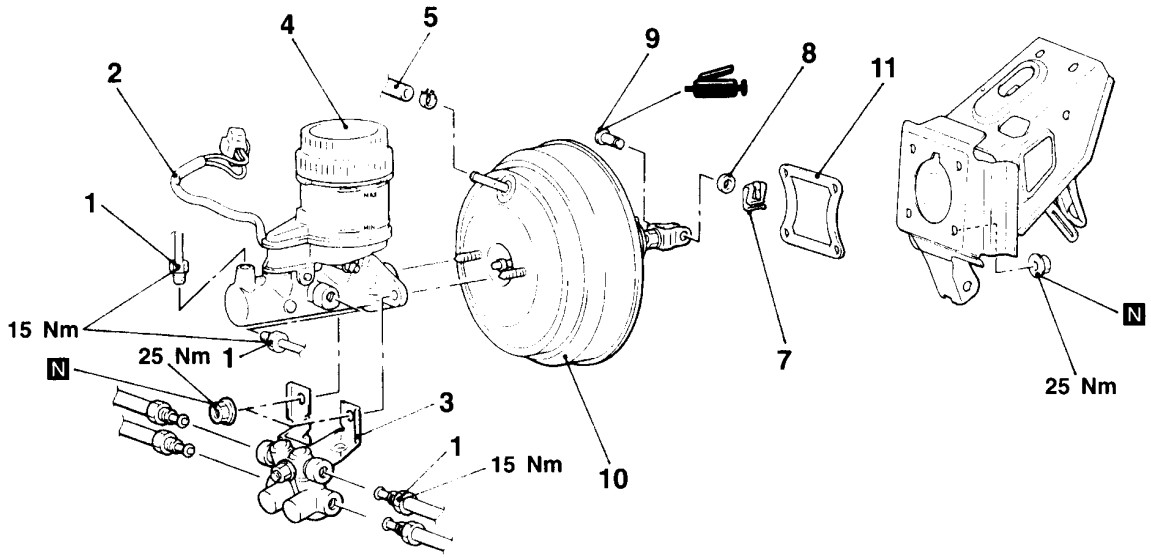
35200400098

## REMOVAL AND INSTALLATION

### <L.H. drive vehicles>

**Pre-removal Operation**
- Brake Fluid Draining

**Post-installation Operation**
- Brake Fluid Supplying
- Brake Line Bleeding
  (Refer to GROUP 35A – On-vehicle Service.)
- Brake Pedal Adjustment
  (Refer to GROUP 35A – On-vehicle Service.)

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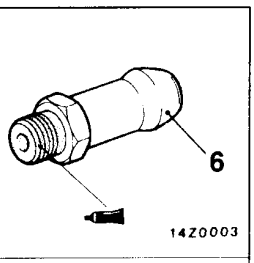
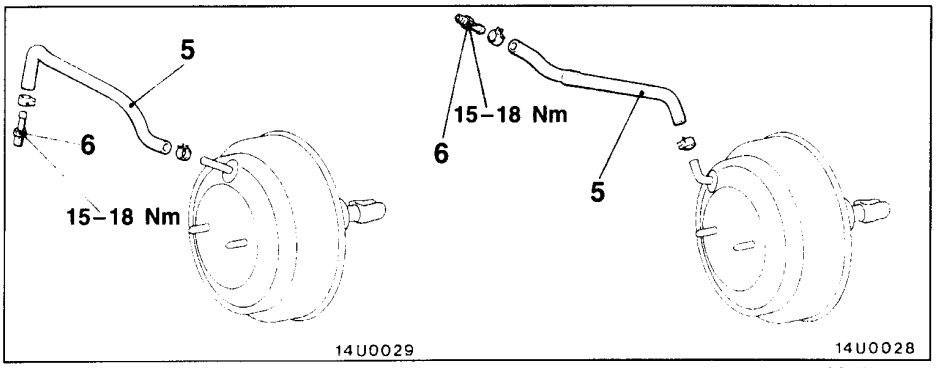



Sealant: 3M ATD Part No. 8661 or equivalent




00003662

**Removal steps**

1. Brake pipe connection
2. Brake fluid level sensor connector
3. Proportioning valve bracket
4. Master cylinder assembly

▶B◀ • Clearance adjustment between brake booster push rod and primary piston

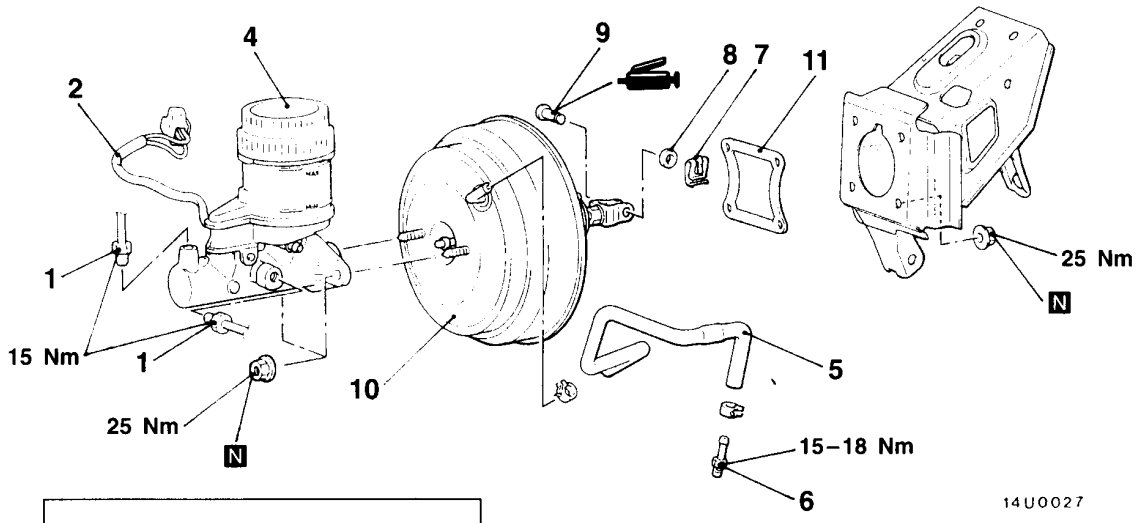
▶A◀ 5. Vacuum hose
(With built-in check valve)

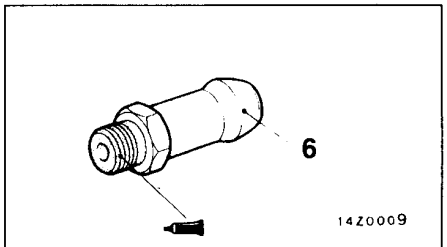
6. Fitting
7. Retaining clip
8. Washer
9. Retaining ring bolt
10. Brake booster
11. Sealer

<R.H. drive vehicles>

**Pre-removal Operation**
- Brake Fluid Draining

**Post-installation Operation**
- Brake Fluid Supplying
- Brake Line Bleeding
  (Refer to GROUP 35A – On-vehicle Service.)
- Brake Pedal Adjustment
  (Refer to GROUP 35A – On-vehicle Service.)




**Sealant: 3M ATD Part No. 8661 or equivalent**

00003663

**Removal steps**

1. Brake pipe connection
2. Brake fluid level sensor connector
4. Master cylinder assembly
▶B◀ • Clearance adjustment between brake booster push rod and primary piston
▶A◀ 5. Vacuum hose (With built-in check valve)
6. Fitting
7. Retaining clip
8. Washer
9. Retaining ring bolt
10. Brake booster
11. Sealer

## INSTALLATION SERVICE POINTS

### ▶A◀ VACUUM HOSE CONNECTION

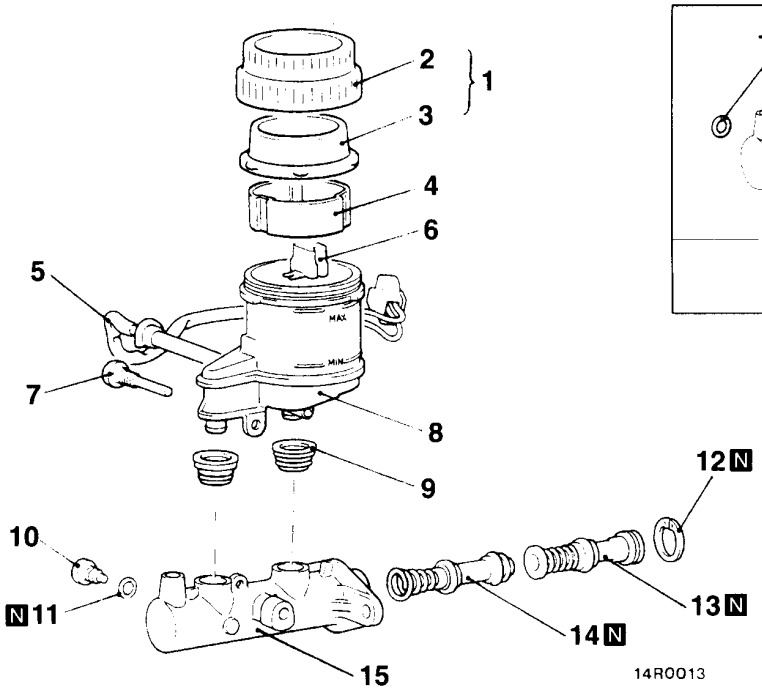
Refer to GROUP 35A – Master Cylinder and Brake Booster.

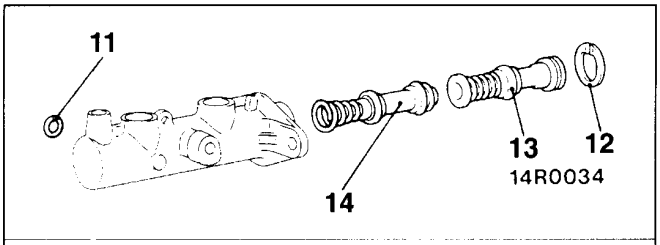
### ▶B◀ CLEARANCE ADJUSTMENT BETWEEN BRAKE BOOSTER PUSH ROD AND PRIMARY PISTON

Refer to GROUP 35A – Master Cylinder and Brake Booster.

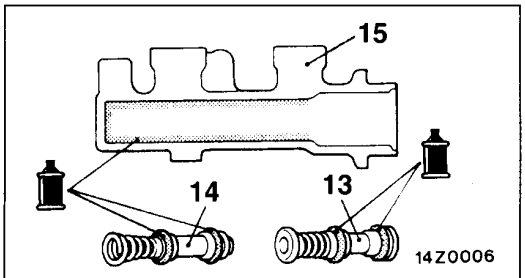
## MASTER CYLINDER
## DISASSEMBLY AND REASSEMBLY

35200450062



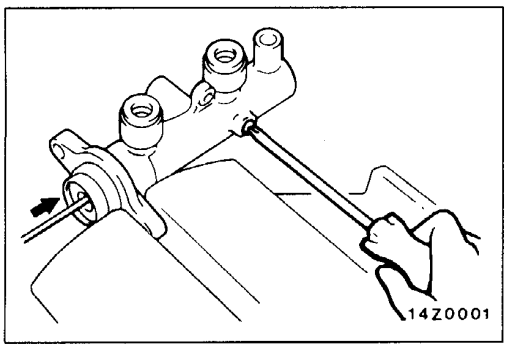

**Master cylinder kit**

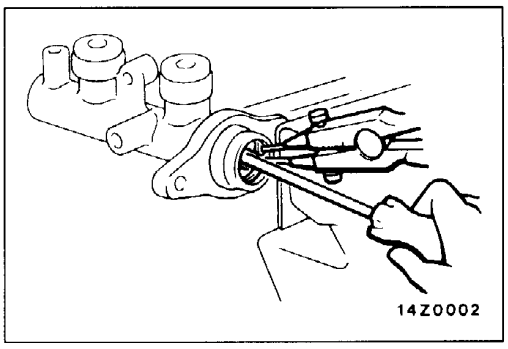



**Brake fluid: DOT3 or DOT4**

**Disassembly steps**

1. Reservoir cap assembly
2. Reservoir cap
3. Diaphragm
4. Filter
5. Brake fluid level sensor
6. Float
7. Reservoir stopper bolt
8. Reservoir tank
9. Reservoir seal
◀A▶ 10. Piston stopper bolt
11. Gasket
◀B▶ 12. Piston stopper ring
13. Primary piston assembly
14. Secondary piston assembly
15. Master cylinder body




## DISASSEMBLY SERVICE POINTS

### ◀A▶ PISTON STOPPER BOLT DISASSEMBLY

Remove the piston stopper bolt, while depressing the piston.

### ◀B▶ PISTON STOPPER RING DISASSEMBLY

Remove the piston stopper ring, while depressing the piston.

## INSPECTION

35200460027

- Check the inner surface of master cylinder body for rust or pitting.
- Check the primary and secondary pistons for rust, scoring, wear, damage or wear.
- Check the diaphragm for cracks and wear.

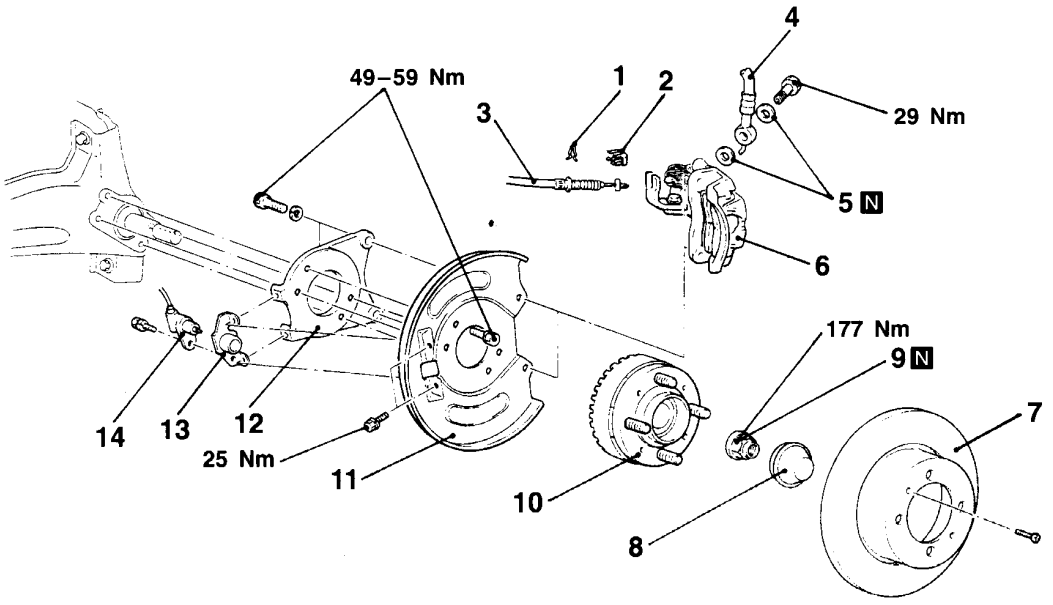
# REAR DISC BRAKE

35200650028

## REMOVAL AND INSTALLATION

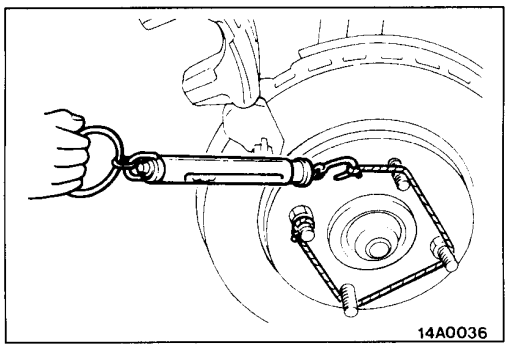
**Pre-removal Operation**
- Brake Fluid Draining

**Post-installation Operation**
- Brake Fluid Supplying
- Brake Line Bleeding
  (Refer to GROUP 35A – On-vehicle Service.)




**Removal steps**

1. Clip
2. Retainer spring
3. Parking brake cable connection
4. Brake hose connection
5. Gasket
▶A◀ 6. Disk brake assembly
7. Brake disc
8. Hub cap
9. Self locking nut
10. Rear hub assembly (Refer to GROUP 27 – Rear Axle Hub.)
11. Dust shield
12. Disc brake adapter
13. Sensor bracket
    (Refer to P.35B-38.)
14. Rear speed sensor
    (Refer to P.35B-38.)



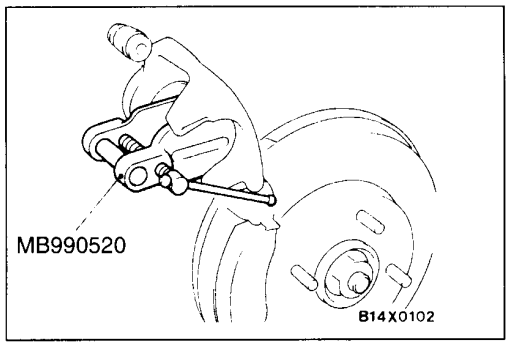

## INSTALLATION SERVICE POINT

### ▶A◀ DISC BRAKE ASSEMBLY INSTALLATION

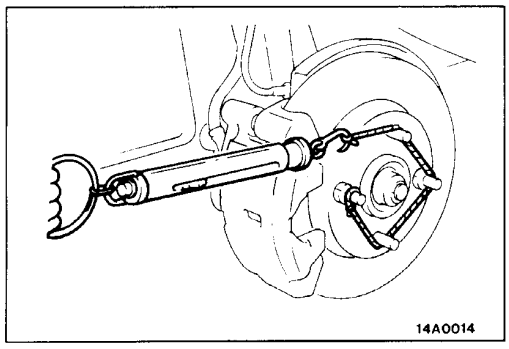
1. In order to measure the brake drag torque after pad installation, use a spring balance to measure the rotary-sliding resistance (A) of the hub in the forward direction with the pads removed.
2. After installing the caliper support to the knuckle, install the pad clips and the pads to the caliper support.

**Caution**

- **Do not let any oil, grease or other contamination get onto the friction surfaces of the pads and brake discs.**




3. Clean piston and insert into cylinder with special tool.
4. Be careful that the piston boot does not become caught, when lowering the caliper assembly and install the lock pin.
5. Check brake drag torque as follows.
   (1) Start the engine and then depress the brake pedal 2→3 times.
   (2) Stop engine.
   (3) Turn brake disc forward 10 times.



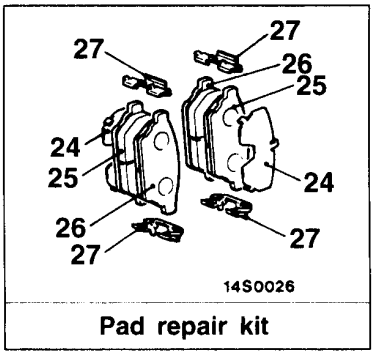

6. Check hub torque (B) with spring balance.
7. Calculate the drag torque of the disc brake [difference between hub torque (B) and hub torque (A)].

   **Standard value: 20 N or less**

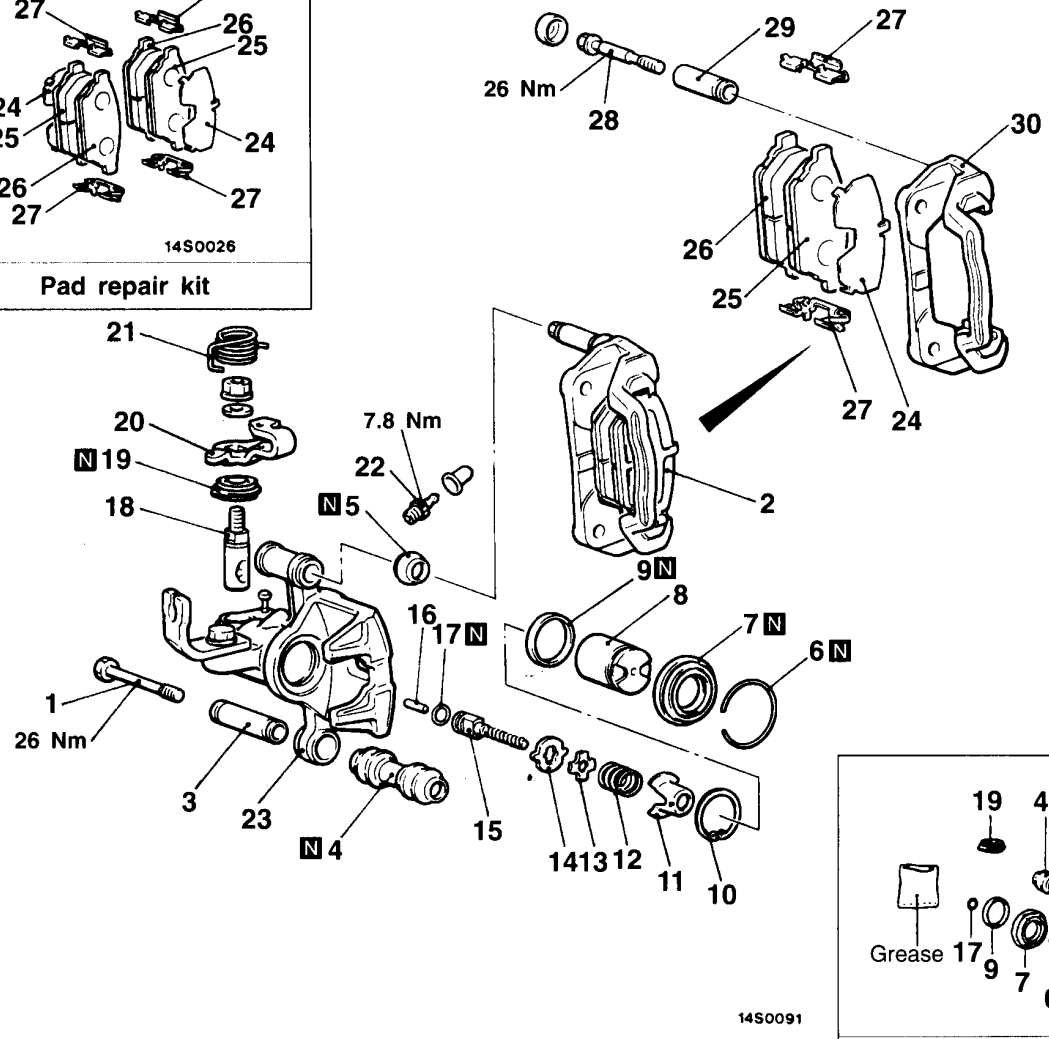
8. If the difference between brake drag torque and hub torque exceeds the standard vlaue, disassemble piston and clean the piston. Check for corrosion or worn piston seal, and check the sliding condition of the lock pin and guide pin.

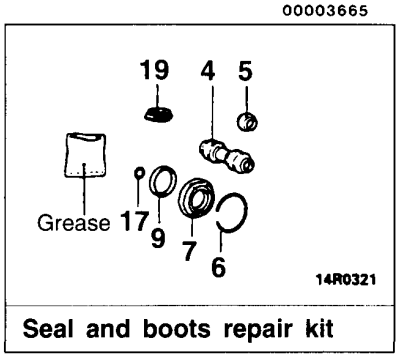
## DISASSEMBLY AND REASSEMBLY

35200670024




Pad repair kit




Seal and boots repair kit

**Caliper assembly disassembly steps**

1. Lock pin
2. Caliper support (pad, clip, shim)
3. Lock pin sleeve
4. Lock pin boot
5. Guide pin boot
6. Boot ring
7. Piston boot

◀A▶ ▶B◀ 8. Piston assembly

◀B▶ 9. Piston seal

◀C▶ ▶A◀ 10. Snap ring

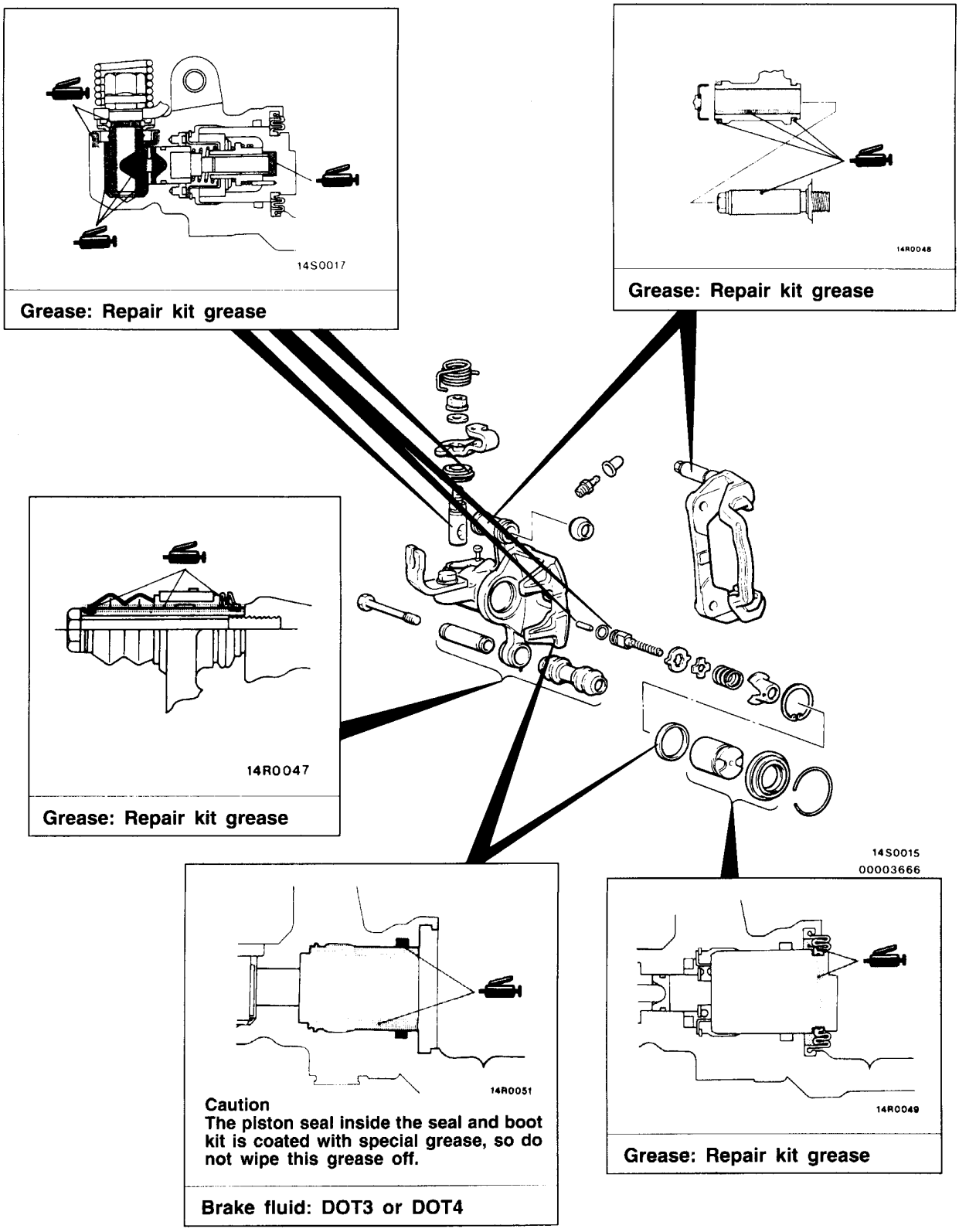
11. Spring case
12. Return spring
13. Stopper plate
14. Stopper
15. Adjuster spindle
16. Connecting link
17. O-ring
18. Spindle lever
19. Lever boot
20. Parking brake lever
21. Return spring
22. Bleeder screw
23. Caliper body

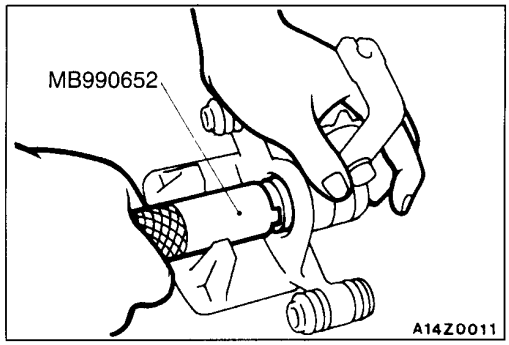
**Pad assembly disassembly steps**

1. Lock pin
2. Caliper support (pad, clip, shim)
24. Outer shim
25. Pad assembly
26. Pad and wear indicator assembly
27. Clip
28. Guide pin
29. Guide pin sleeve
30. Support mounting

## Lubrication points

**<Rear disc brake>**

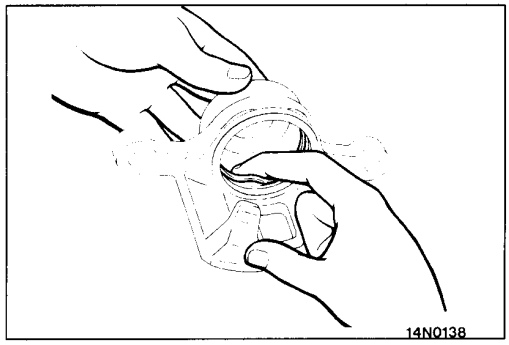





## DISASSEMBLY SERVICE POINTS

### ◀A▶ PISTON ASSEMBLY REMOVAL

Use the special tool to twist the piston out of the caliper body.



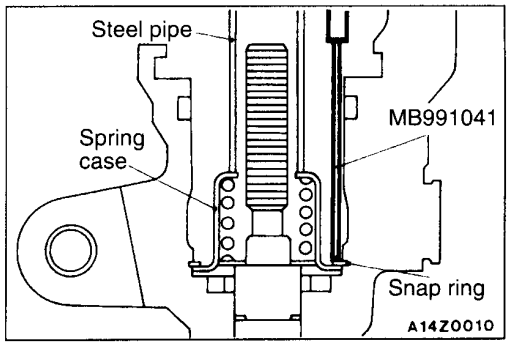

### ◀B▶ PISTON SEAL REMOVAL

(1) Remove 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 cylinder with trichloroethylene, alcohol or specified brake fluid.

**Specified brake fluid: DOT3 or DOT4**




### ◀C▶ SNAP RING REMOVAL

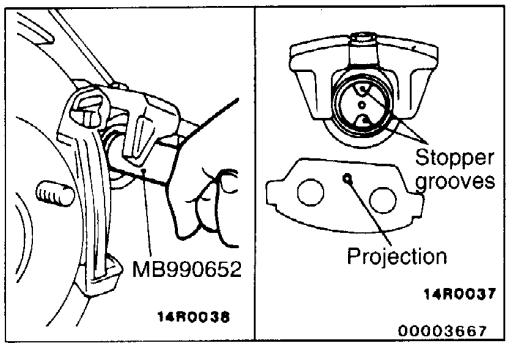
While using a 19 mm diameter steel pipe to press the spring case into the caliper body, use the special tool to remove the snap ring from the caliper body.

## REASSEMBLY SERVICE POINTS

### ▶A◀ SNAP RING INSTALLATION

Use a steel pipe with a diameter of approximately 19 mm and the special tool in the same way as for removal to install the snap ring.

**Caution**
**Attach the snap ring to the caliper body with the opening facing the bleeder.**




### ▶B◀ PISTON ASSEMBLY INSTALLATION

(1) Push the piston into the caliper with special tool.

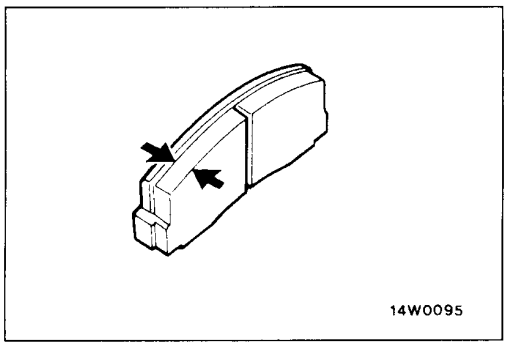
NOTE
Align the grooves as illustrated.

(2) The pins on the back side of the brake pad must be placed in the grooves in the position.

## INSPECTION

35200680027

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



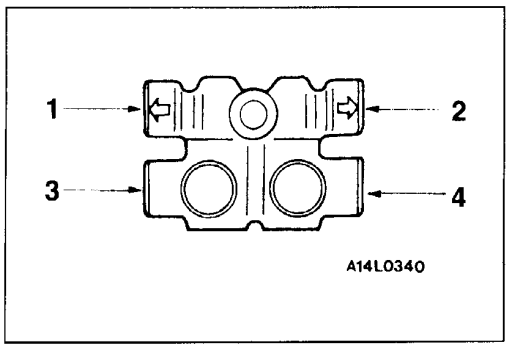

### PAD WEAR CHECK

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

**Standard value: 9.0 mm**
**Limit value: 2.0 mm**

**Caution**

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




# PROPORTIONING VALVE

35200570041

## INSTALLATION SERVICE POINT

### BRAKE PIPE CONNECTION

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

1. Proportioning valve – Rear brake (L.H.)
2. Proportioning valve – Rear brake (R.H.)
3. Proportioning valve – Hydraulic unit
4. Proportioning valve – Hydraulic unit

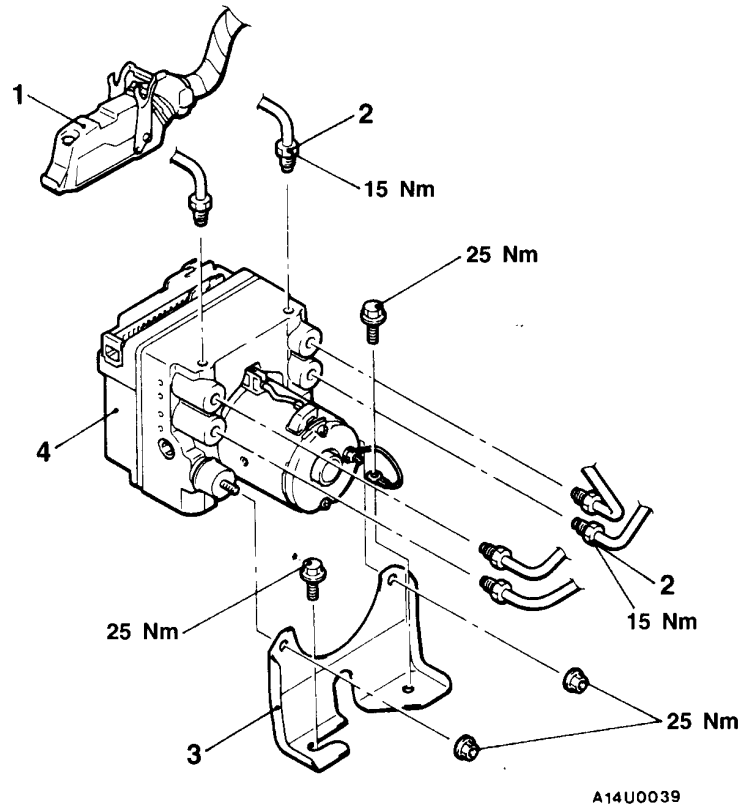
# HYDRAULIC UNIT

35200860070

## REMOVAL AND INSTALLATION

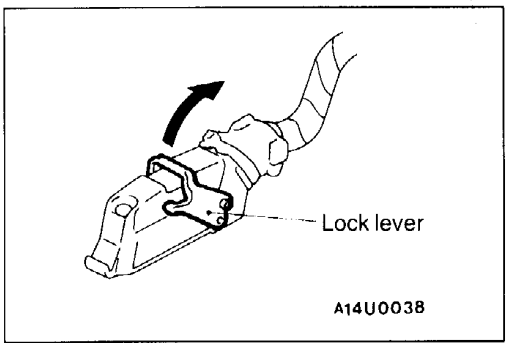
**Pre-removal Operation**
- Brake Fluid Draining
- A/C Relay Box Removal

**Post-installation Operation**
- A/C Relay Box Installation
- Brake Fluid Supplying
- Brake Line Bleeding
  (Refer to GROUP 35A – On-vehicle Service.)
- Brake Pedal Adjustment
  (Refer to GROUP 35A – On-vehicle Service.)




**Removal steps**

◀A▶ 1. ABS-ECU connector
▶A◀ 2. Brake pipe connection
3. Hydraulic unit bracket
◀B▶ 4. Hydraulic unit assembly




## REMOVAL SERVICE POINTS

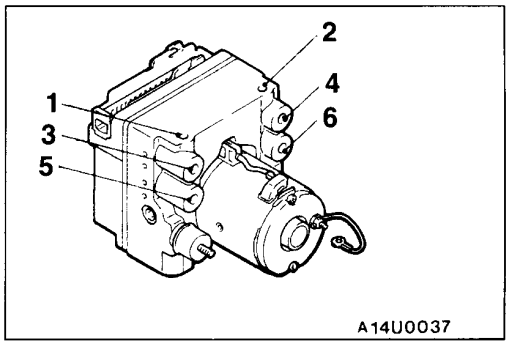
### ◀A▶ ABS-ECU CONNECTOR REMOVAL

Raise the lock lever in the direction of the arrow to unlock the connector, and then disconnect the connector.

### ◀B▶ HYDRAULIC UNIT ASSEMBLY REMOVAL

**Caution**

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




## INSTALLATION SERVICE POINT

### ▶A◀ BRAKE PIPE CONNECTION

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

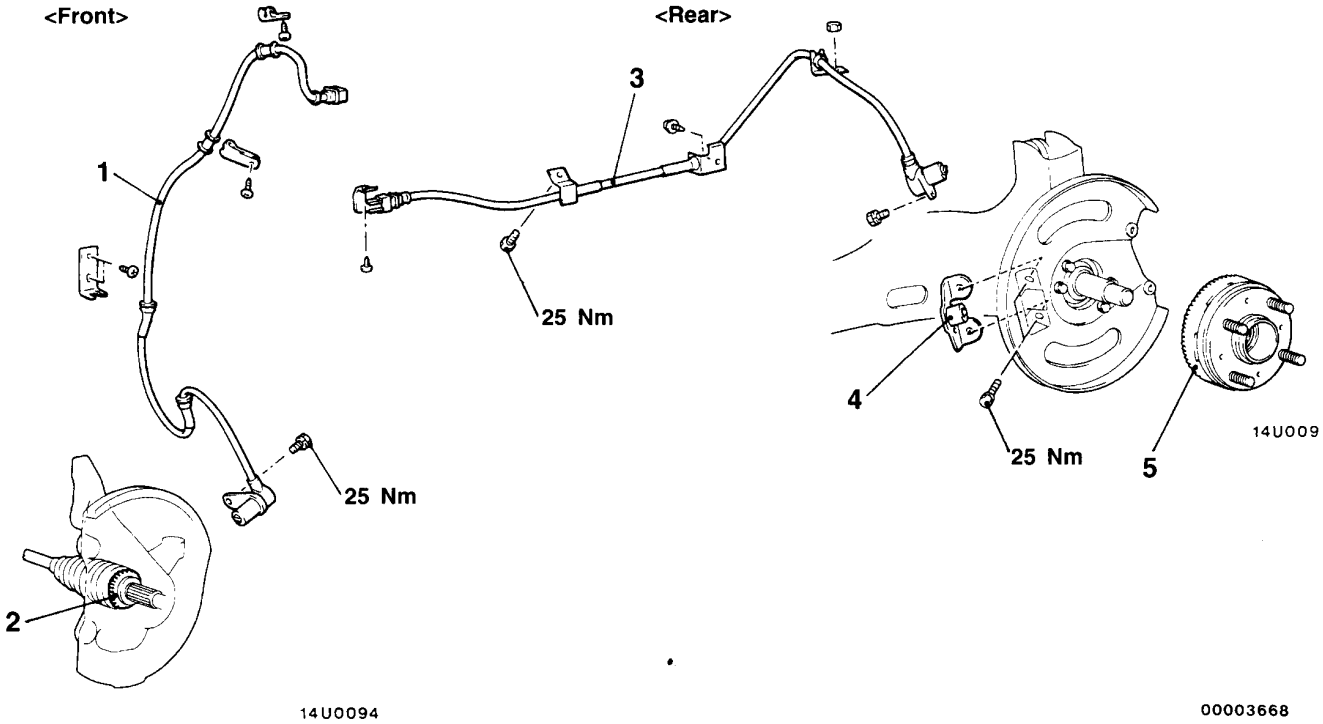
1. From the master cylinder (Primary)
2. From the master cylinder (Secondary)
3. To the proportioning valve (RH)
4. To the proportioning valve (LH)
5. To the front brake (LH)
6. To the front brake (RH)

# WHEEL SPEED SENSOR

35200830064

## REMOVAL AND INSTALLATION

**Post-installation Operation**
- Wheel Speed Sensor Output Voltage Check (Refer to P.35B-23.)



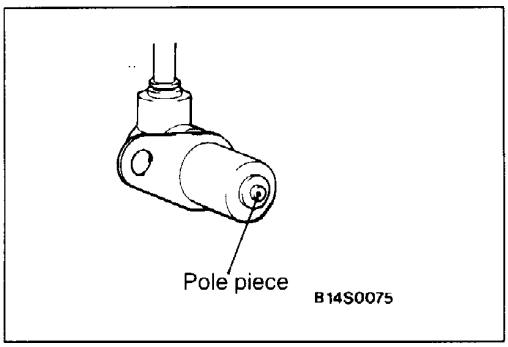

**Front speed sensor removal steps**

◀A▶ 1. Front speed sensor
2. Front rotor
(Refer to GROUP 26 – Drive shaft.)

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

**Rear speed sensor removal steps**

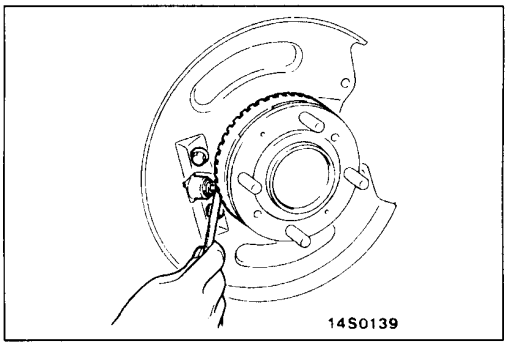
◀A▶ ▶A◀ 3. Rear speed sensor
4. Sensor bracket
5. Rear rotor
(Refer to GROUP 27 – Rear Axle Hub.)




## REMOVAL SERVICE POINT

### ◀A▶ FRONT SPEED SENSOR/REAR SPEED SENSOR REMOVAL

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




## INSTALLATION SERVICE POINT

### ▶A◀ REAR SPEED SENSOR INSTALLATION

**Caution**
**Be careful that the pole piece at the end of the speed sensor and the rotor teeth do not become damaged by striking them against the metal parts.**

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

**Standard value: 0.3–0.9 mm**

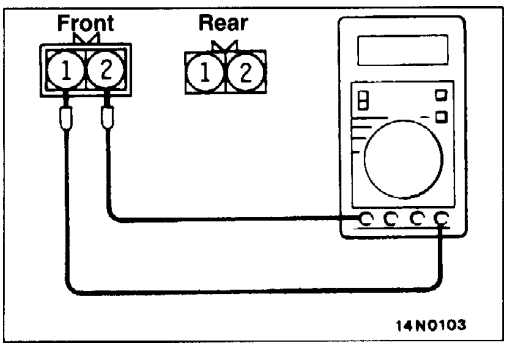
## INSPECTION

35200840067

### SPEED SENSOR

(1) Check whether any metallic foreign material has adhered to the pole piece at the speed sensor tip, and if so, remove it.
Also check whether the pole piece is damaged, and if so, replace it with a new one.

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



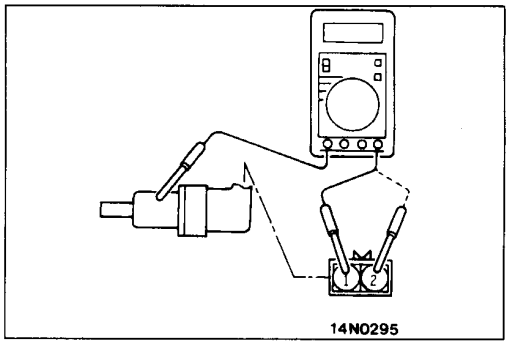

(2) Measure the resistance between the speed sensor terminals.

**Standard value: 1.28–1.92 kΩ**

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

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

NOTE
When checking for cable damage, remove the cable clamp part from the body and then bend and pull the cable near the clamp to check whether or not temporary disconnection occurs.




**SPEED SENSOR INSULATION INSPECTION**

(1) Remove all connections from the speed sensor, and then measure the resistance between terminals (1) and (2) and the body of the speed sensor.

**Standard value: 100 kΩ or more**

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

**TOOTHED ROTOR**

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