

# BRAKE SYSTEM

## SECTION **BR**

### CONTENTS

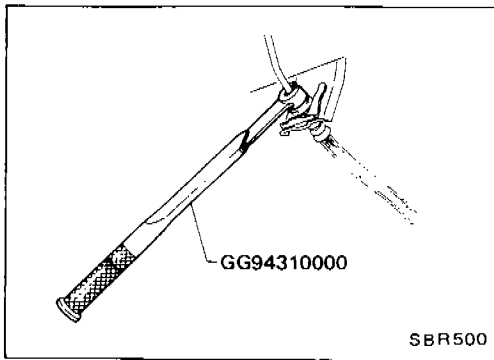
PRECAUTIONS AND PREPARATION .....	BR- 2
CHECK AND ADJUSTMENT .....	BR- 3
BRAKE HYDRAULIC LINE .....	BR- 4
BRAKE PEDAL AND BRACKET .....	BR- 6
BRAKE BOOSTER .....	BR- 8
VACUUM PIPING .....	BR-10
MASTER CYLINDER .....	BR-12
FRONT DISC BRAKE (CL18VB, CL25VA) — Caliper .....	BR-13
FRONT DISC BRAKE (CL18VB, CL25VA) — Rotor .....	BR-17
REAR DISC BRAKE (CL9H) — Caliper .....	BR-18
REAR DISC BRAKE (CL9H) — Rotor .....	BR-22
REAR DISC BRAKE (AD9) — Caliper .....	BR-23
REAR DISC BRAKE (AD9) — Rotor .....	BR-27
PARKING BRAKE CONTROL .....	BR-28
PARKING DRUM BRAKE (DS17HD) — Rear Disc Brake AD9 Model .....	BR-30
ANTI-LOCK BRAKING SYSTEM .....	BR-32
TROUBLE DIAGNOSES .....	BR-37
SERVICE DATA AND SPECIFICATIONS (S.D.S.) .....	BR-62

**BR**

# PRECAUTIONS AND PREPARATION

## Precautions

- Recommended fluid is brake fluid "DOT 3".
- Never reuse drained brake fluid.
- Be careful not to splash brake fluid on painted areas.
- To clean or wash all parts of master cylinder, disc brake caliper and wheel cylinder, use clean brake fluid.
- Never use mineral oils such as gasoline or kerosene. They will ruin rubber parts of hydraulic system.



- Use Tool when removing and installing brake tube.

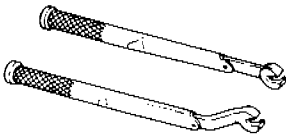
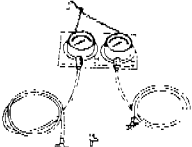
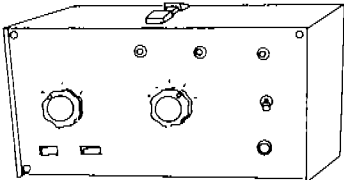
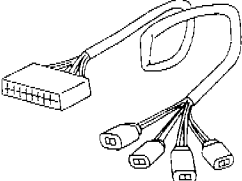
### WARNING:

- Clean brake pads and shoes with a waste cloth, then collect dust with a dust collector.

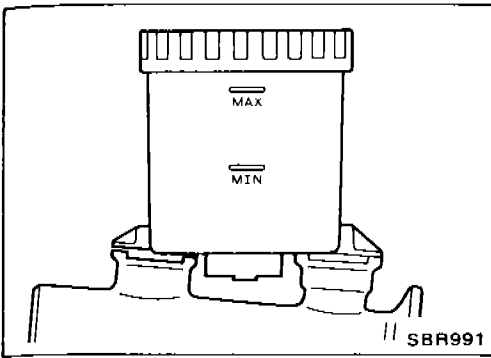
## Preparation

### SPECIAL SERVICE TOOL

\*: Special tool or commercial equivalent

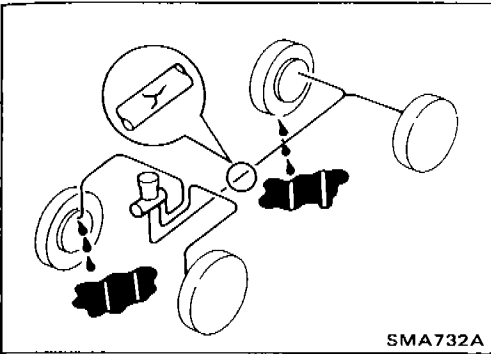
Tool number Tool name	Description
GG94310000* Flare nut torque wrench	 <p>Removing and installing each brake piping</p>
KV991V0010* Brake fluid pressure gauge	 <p>Measuring brake fluid pressure</p>
KV999P1000 A.B.S. checker	 <p>Checking brake fluid pressure of A.B.S. actuator</p>
KV999P1010 A.B.S. checker adapter harness	 <p>Checking brake fluid pressure of A.B.S. actuator</p>

## CHECK AND ADJUSTMENT



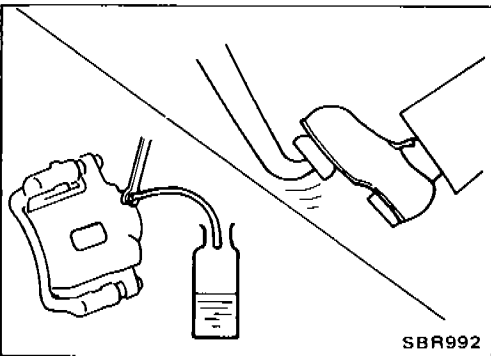
### Checking Brake Fluid Level

- Check fluid level in reservoir tank. It should be between Max. and Min. lines on reservoir tank.
- If fluid level is extremely low, check brake system for leaks.



### Checking Brake System

- Check brake lines (tubes and hoses) for cracks, deterioration or other damage. Replace any damaged parts. If leakage occurs around joints, retighten or, if necessary, replace damaged parts.
- Check for oil leakage by fully depressing brake pedal.

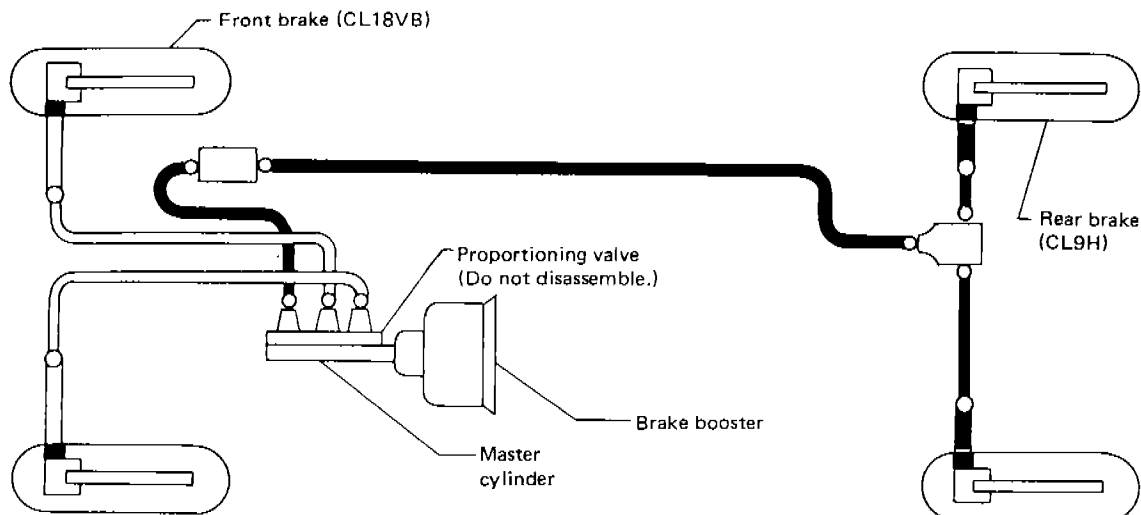


### Changing Brake Fluid

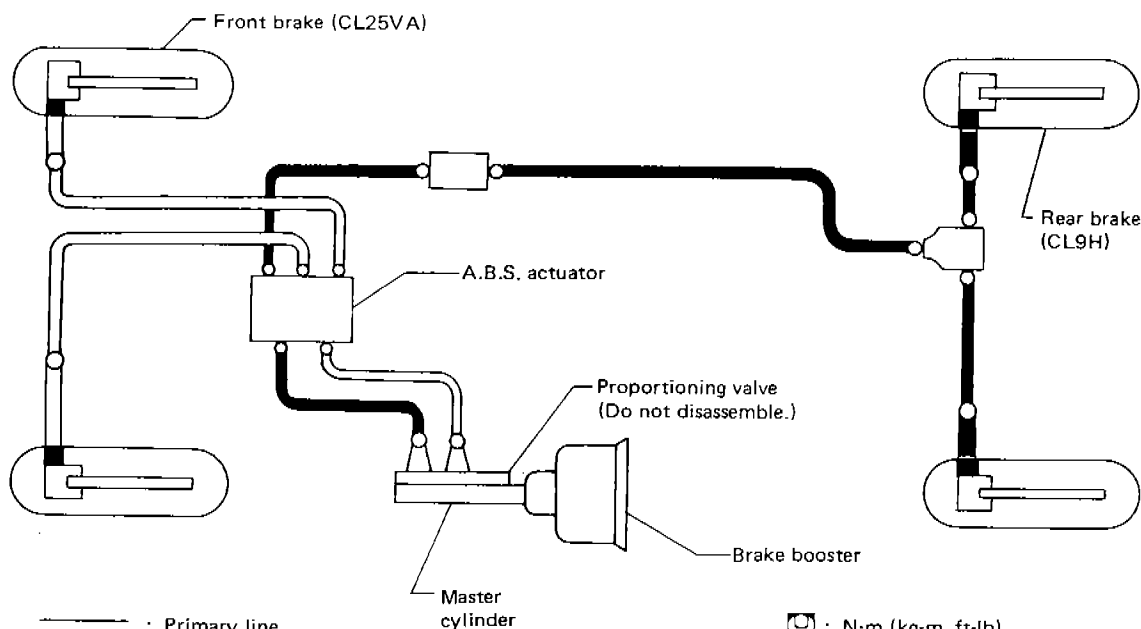
1. Drain brake fluid in each air bleeder valve.
  2. Refill until new brake fluid comes out of each air bleeder valve.
- Use same procedure as in bleeding hydraulic system to refill brake fluid.  
Refer to Bleeding Procedure.
- **Refill with recommended brake fluid "DOT 3".**
  - **Never reuse drained brake fluid.**
  - **Be careful not to splash brake fluid on painted areas.**

# BRAKE HYDRAULIC LINE

## Without Anti-lock Braking System (A.B.S.)



## With Anti-lock Braking System (A.B.S.)

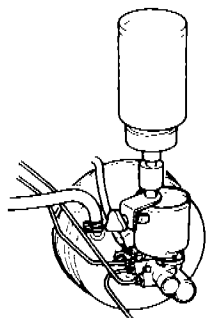


==== : Primary line  
 ——— : Secondary line

⊕ : N·m (kg·m, ft·lb)

○ : Flare nut  
 15 - 18 (1.5 - 1.8, 11 - 13)  
 ■ : Connecting bolt  
 17 - 20 (1.7 - 2.0, 12 - 14)

SBR501A



SBR995

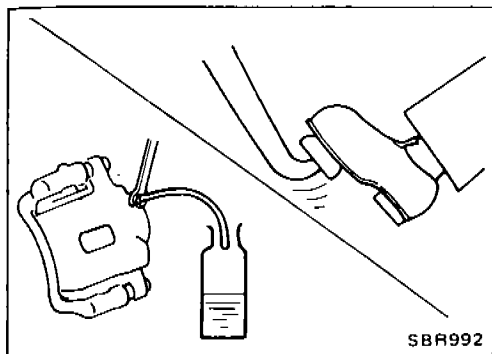
## Bleeding Procedure

### CAUTION:

- Carefully monitor brake fluid level at master cylinder during bleeding operation.
- Fill reservoir with recommended brake fluid. Make sure it is full at all times while bleeding air out of system.
- Place a container beneath master cylinder to avoid spillage of brake fluid.

## BRAKE HYDLAULIC LINE

### Bleeding Procedure (Cont'd)



- Bleed air according to the following procedure.

#### Without Anti-lock Braking System:

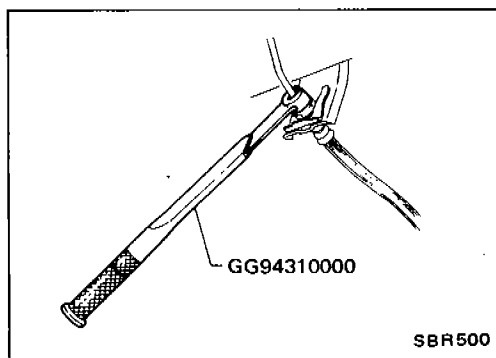
Left rear caliper  
↓  
Right rear caliper  
↓  
Left front caliper  
↓  
Right front caliper

#### With Anti-lock Braking System:

Left rear caliper  
↓  
Right rear caliper  
↓  
Left front caliper  
↓  
Right front caliper  
↓  
Front side air bleeder on A.B.S. actuator  
↓  
Rear side air bleeder on A.B.S. actuator

- To bleed air out of lines, wheel cylinders and calipers, use the following procedure.

- 1) Connect a transparent vinyl tube to air bleeder valve.
- 2) Fully depress brake pedal several times.
- 3) With brake pedal depressed, open air bleeder valve to release air.
- 4) Close air bleeder valve.
- 5) Release brake pedal slowly.
- 6) Repeat steps 2) through 5) until clear brake fluid comes out of air bleeder valve.



### Removal and Installation

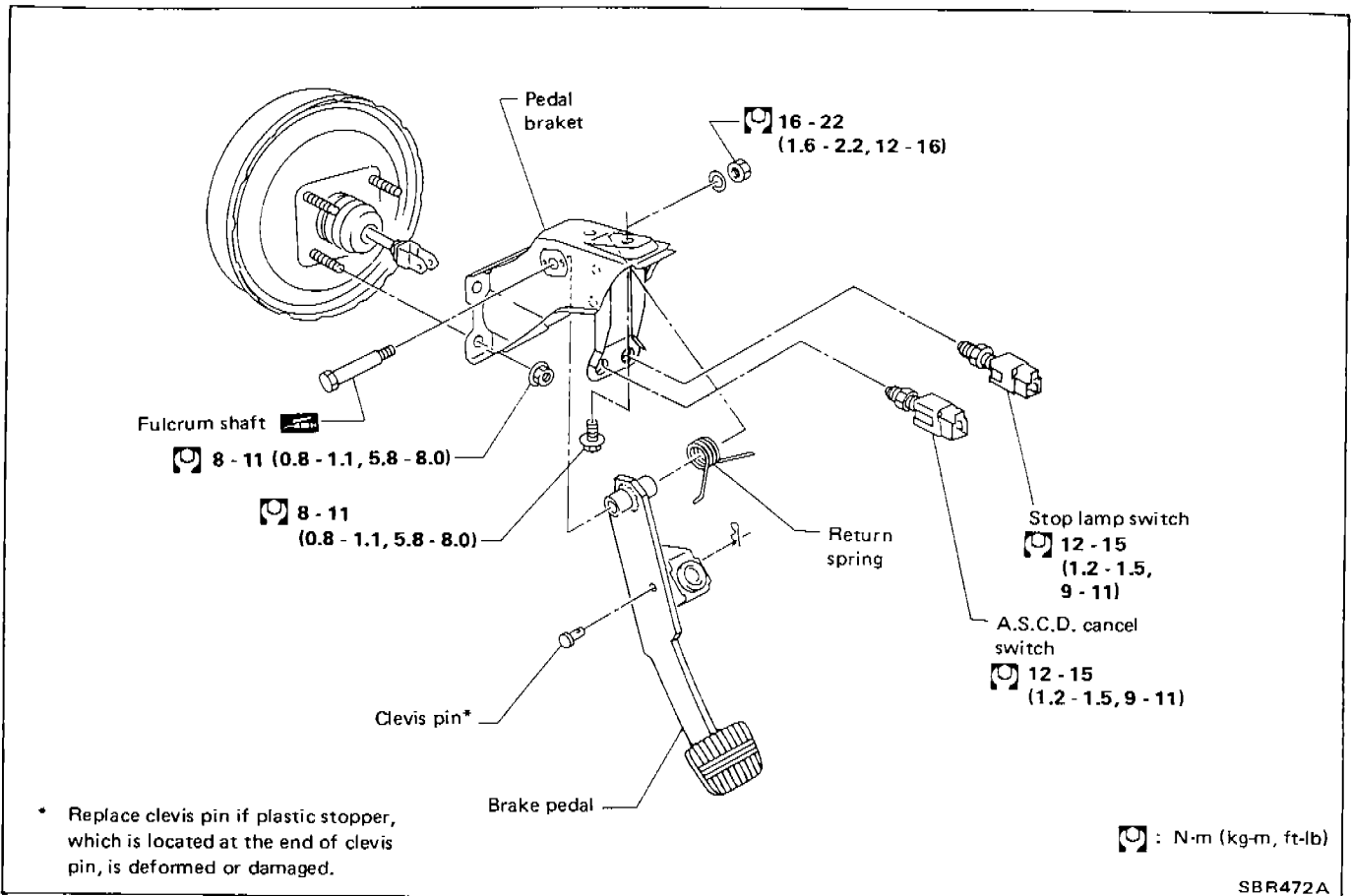
1. To remove brake hose, first remove flare nut securing brake tube to hose, then withdraw lock spring.
2. Cover openings to prevent entrance of dirt whenever disconnecting hydraulic line.
3. All hoses must be free from excessive bending, twisting and pulling.
4. After installing brake lines, check for oil leakage by fully depressing brake pedal.

### Inspection

Check brake lines (tubes and hoses) for cracks, deterioration or other damage. Replace any damaged parts. If leakage occurs around joints, retighten or, if necessary, replace damaged parts.

# BRAKE PEDAL AND BRACKET

## Removal and Installation

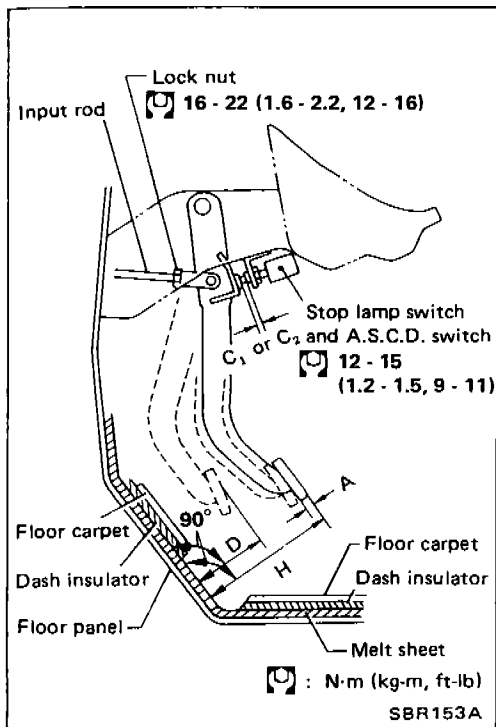


## Inspection

Check brake pedal for following items.

- Brake pedal bend
- Clevis pin deformation
- Crack of any welded portion

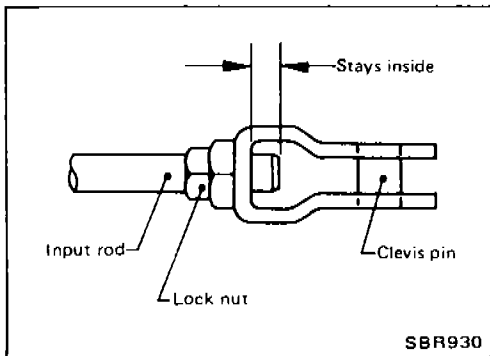
# BRAKE PEDAL AND BRACKET



## Adjustment

Check brake pedal free height from dash reinforcement panel. Adjust if necessary.

- H:** Free height  
Refer to S.D.S.
- D:** Depressed height  
Refer to S.D.S.  
Under force of 490 N (50 kg, 110 lb)  
with engine running
- C<sub>1</sub>:** Clearance between pedal stopper and threaded end of stop lamp switch  
0.3 - 1.0 mm (0.012 - 0.039 in)
- C<sub>2</sub>:** Clearance between pedal stopper and threaded end of A.S.C.D. switch  
0.3 - 1.0 mm (0.012 - 0.039 in)
- A:** Pedal free play  
1 - 3 mm (0.04 - 0.12 in)



1. Adjust pedal free height with brake booster input rod. Then tighten lock nut.

**Make sure that tip of input rod stays inside.**

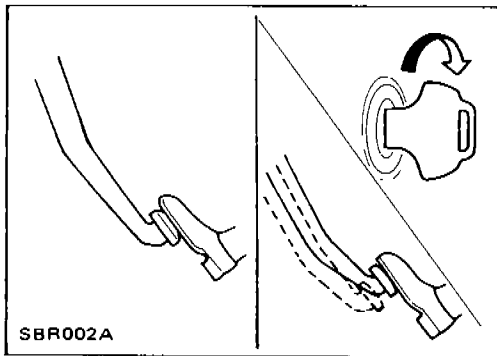
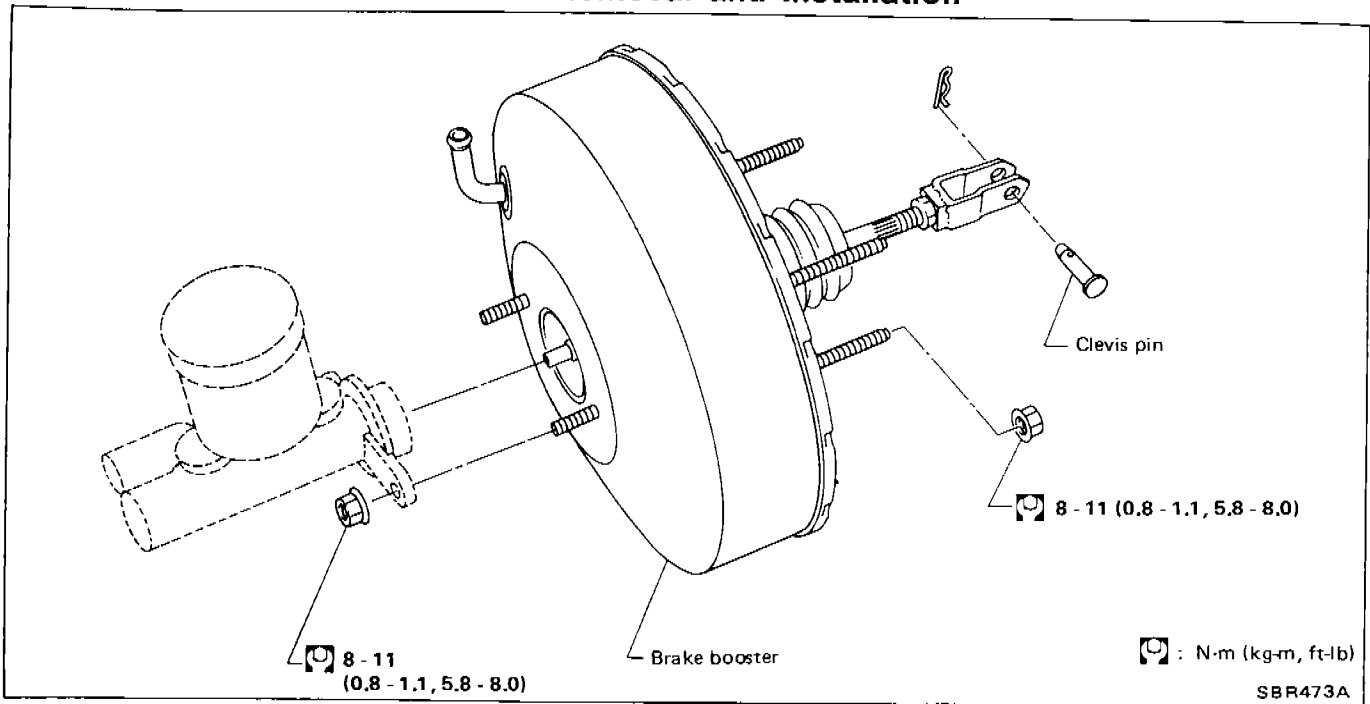
2. Adjust clearance "C<sub>1</sub>" and "C<sub>2</sub>" with stop lamp switch and A.S.C.D. switch respectively. Then tighten lock nuts.
3. Check pedal free play.
4. Check brake pedal's depressed height while engine is running.

**Make sure that stop lamp is off when pedal is released.**

If depressed height is below specified value, check brake system for leaks, accumulation of air or any damage to components (master cylinder, wheel cylinder, etc.); then make necessary repairs.

# BRAKE BOOSTER

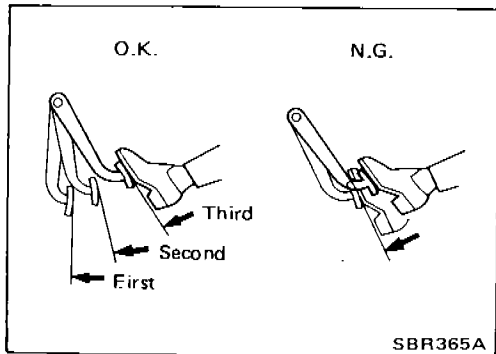
## Removal and Installation



## Inspection

### OPERATING CHECK

- Depress brake pedal several times with engine off, and check that there is no change in pedal stroke.
- Depress brake pedal, then start engine. If pedal goes down slightly, operation is normal.



### AIRTIGHT CHECK

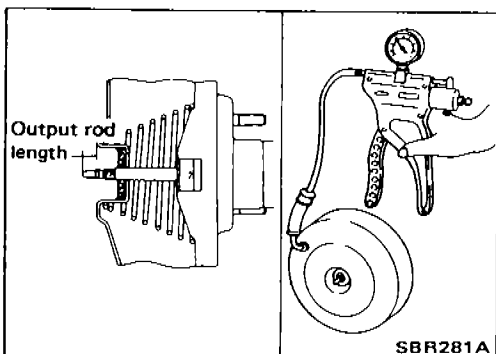
- Start engine, and stop it after one or two minutes. Depress brake pedal several times slowly. If pedal goes further down the first time and gradually rises after second or third time, booster is airtight.
- Depress brake pedal while engine is running, and stop engine with pedal depressed. If there is no change in pedal stroke after holding pedal down **30 seconds**, brake booster is airtight.

### OUTPUT ROD LENGTH CHECK

1. Supply brake booster with vacuum of  $-66.7$  kPa ( $-667$  mbar,  $-500$  mmHg,  $-19.69$  inHg) using a handy vacuum pump.
2. Check output rod length.

#### Specified length:

10.275 - 10.525 mm (0.4045 - 0.4144 in)

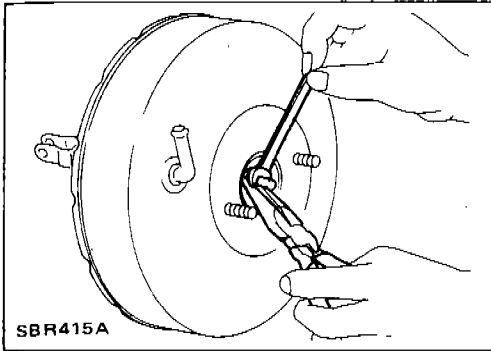




## BRAKE BOOSTER

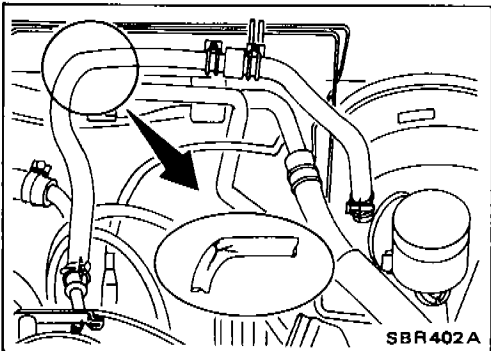
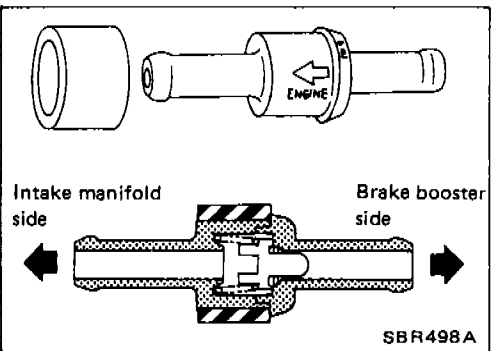
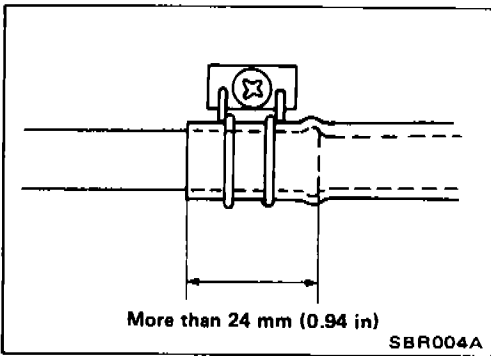
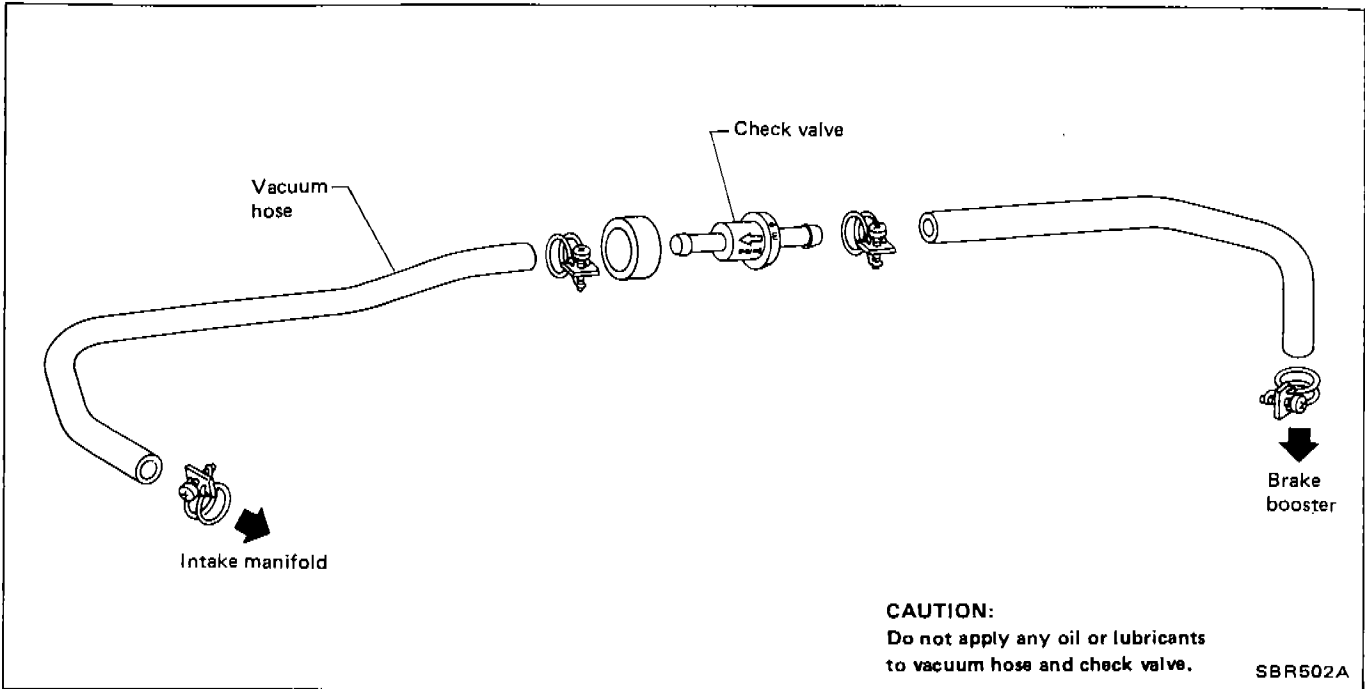
### Inspection (Cont'd)

3. Adjust rod length if necessary.
4. If rod length is without specification, replace brake booster.



# VACUUM PIPING

## Removal and Installation



- Insert vacuum tube into vacuum hose more than 24 mm (0.94 in).

- Install check valve, paying attention to its direction.

## Inspection

### HOSES AND CONNECTORS

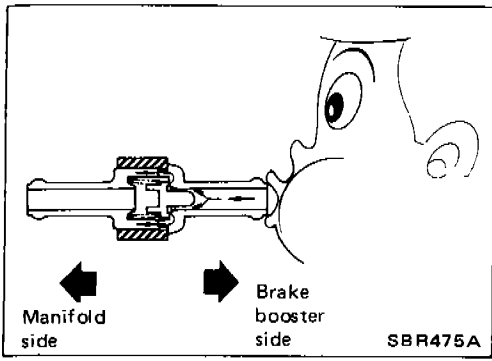
- Check vacuum lines, connections and check valve for airtightness, improper attachment chafing and deterioration.

## VACUUM PIPING

### Inspection (Cont'd)

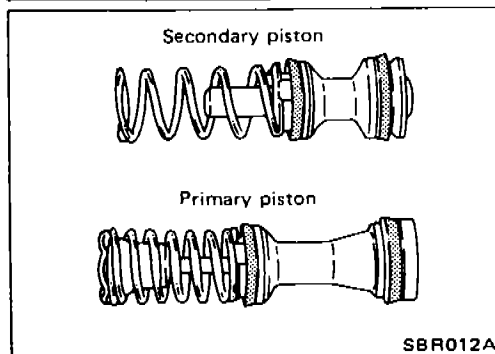
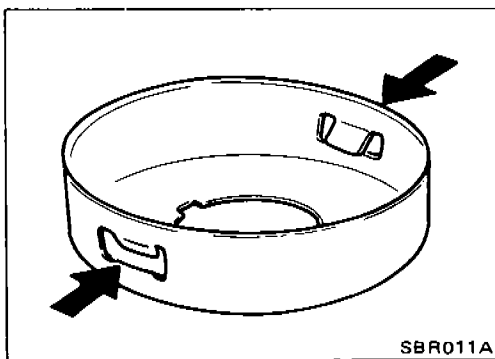
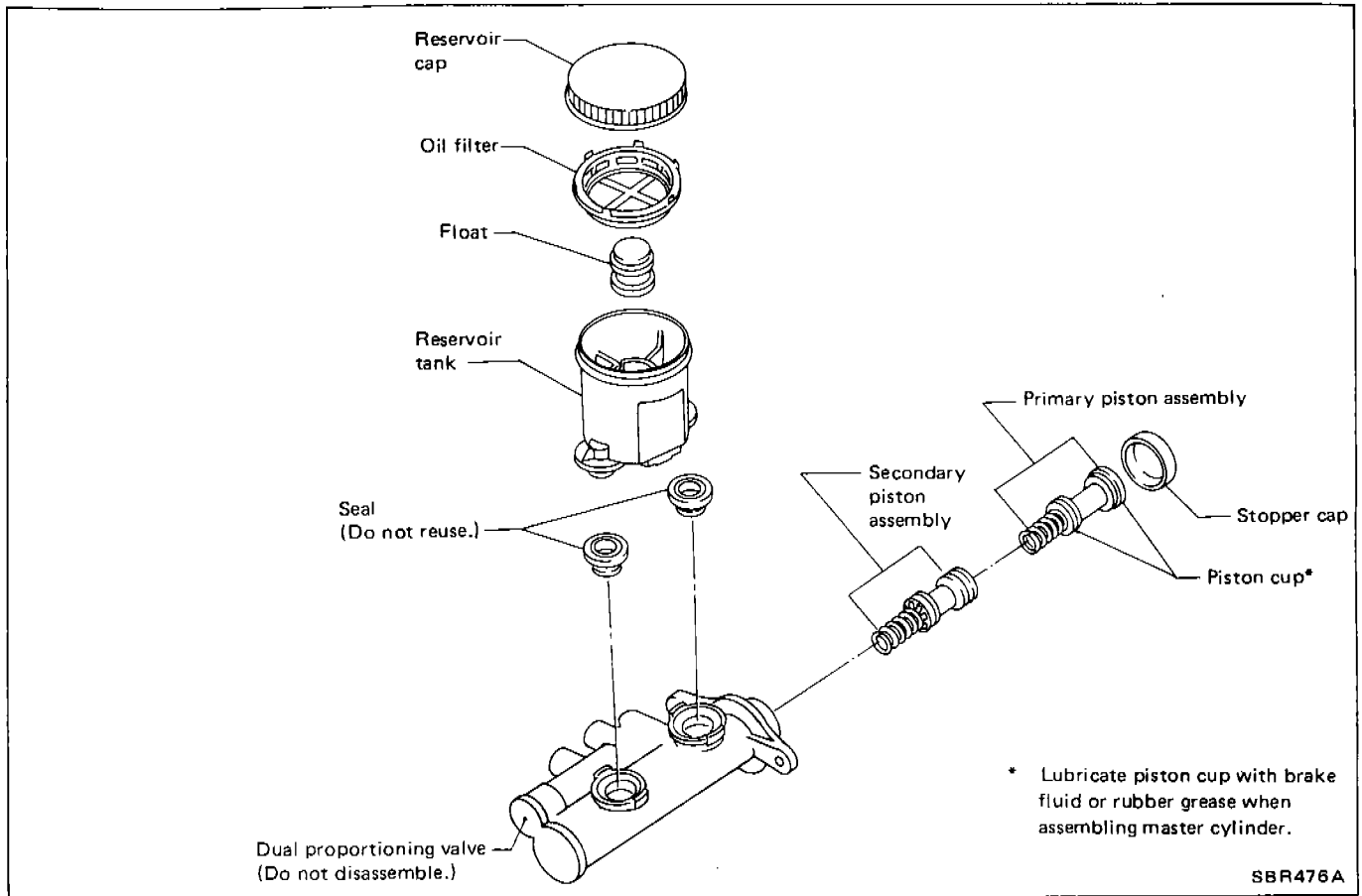
#### CHECK VALVE

- When pressure is applied to brake booster side of check valve and valve does not open, replace check valve with a new one.



# MASTER CYLINDER

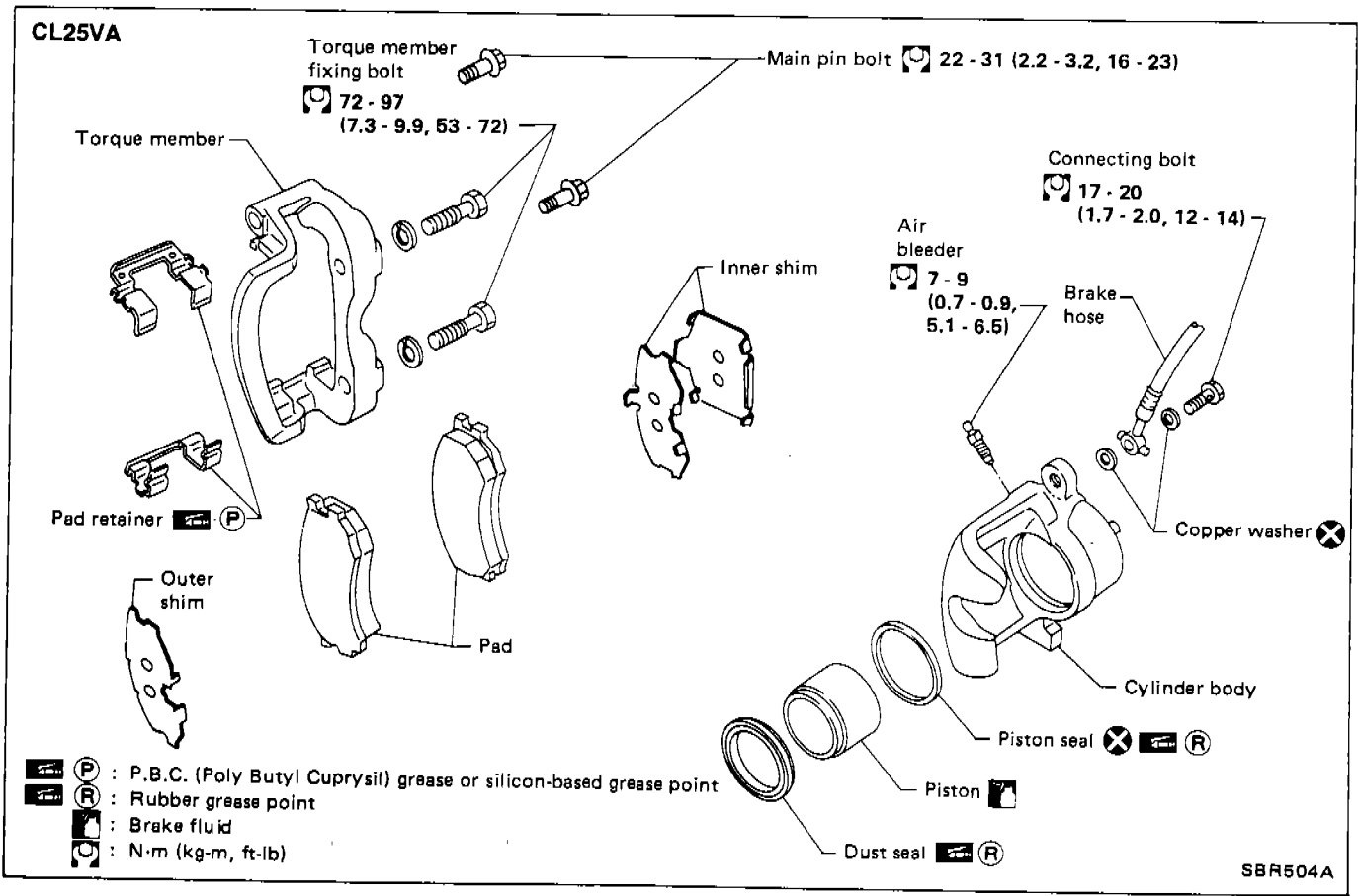
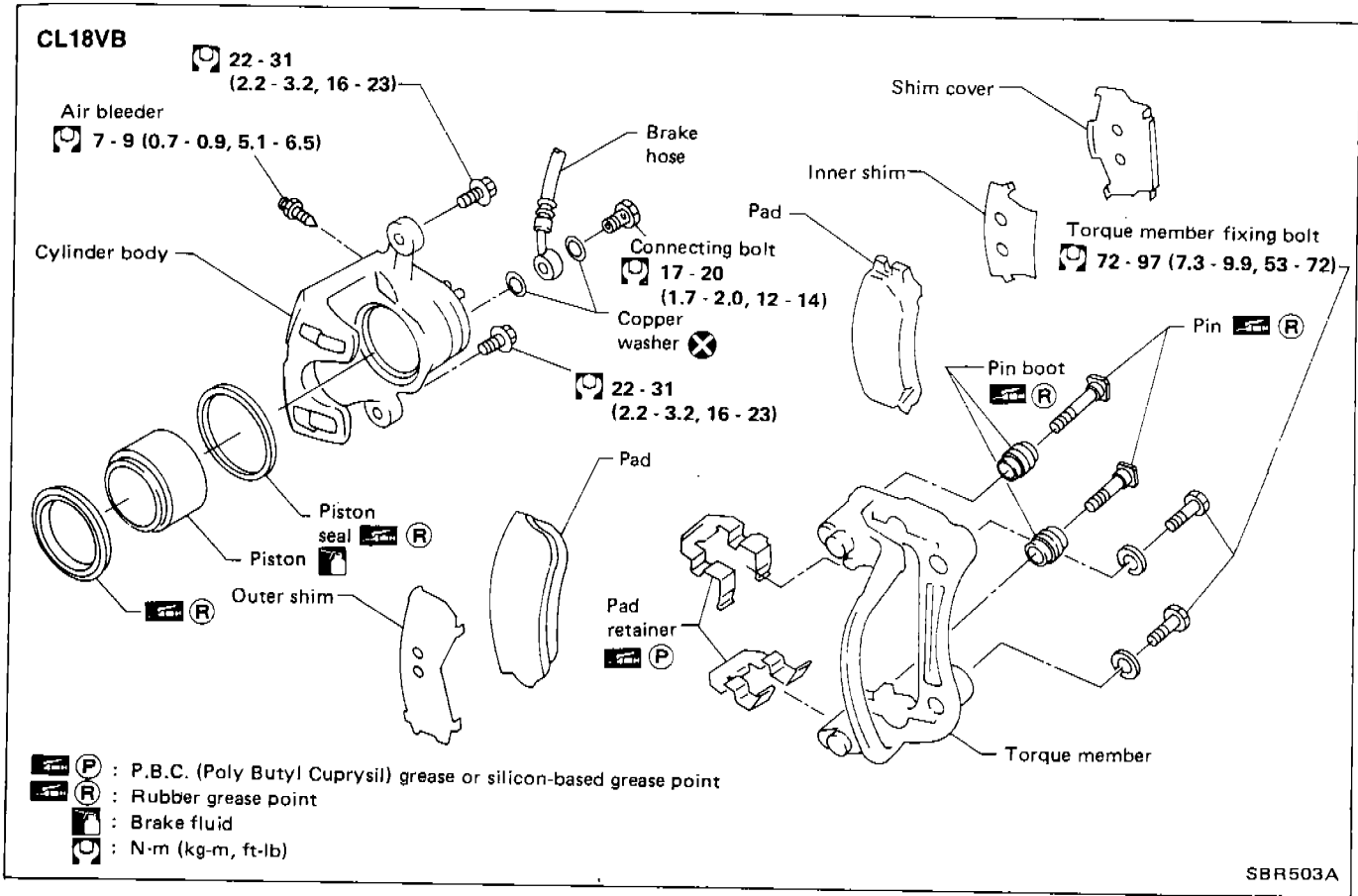
## Removal and Installation

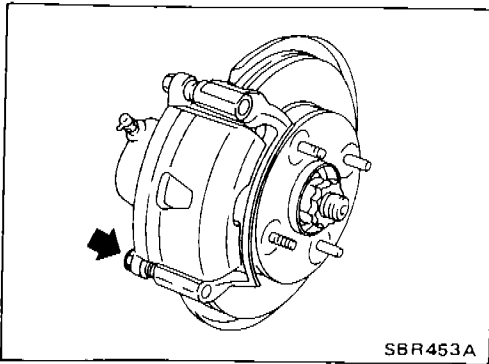


- Replace stopper cap if claw is damaged or deformed.
- Bend claws inward when installing stopper cap.

- Pay attention to direction of piston cups in figure at left.
- Check parts for wear or damage. Replace if necessary.

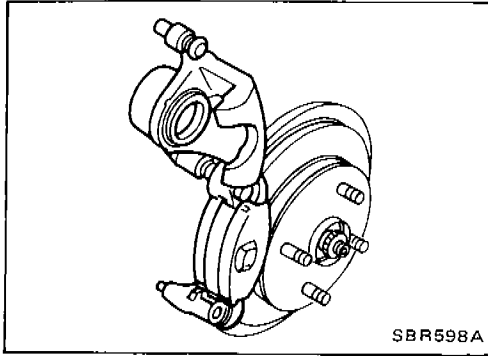
# FRONT DISC BRAKE (CL18VB, CL25VA) — Caliper





### Pad Replacement

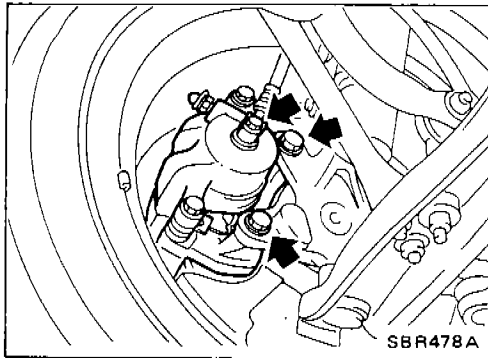
1. Remove pin bolt.



2. Swing cylinder body upward. Then remove pad retainer, and inner and outer shims.

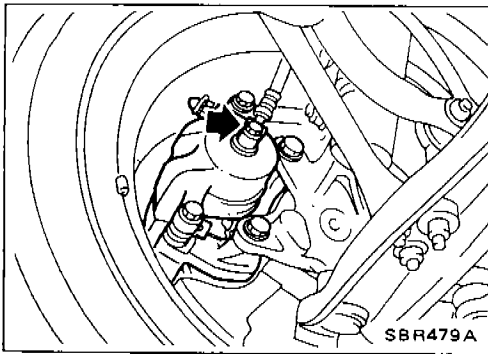
#### CAUTION:

- When cylinder body is swung up, do not depress brake pedal because piston will pop out.
- Be careful not to damage dust seal or get oil on rotor. Always replace shims when replacing pads.

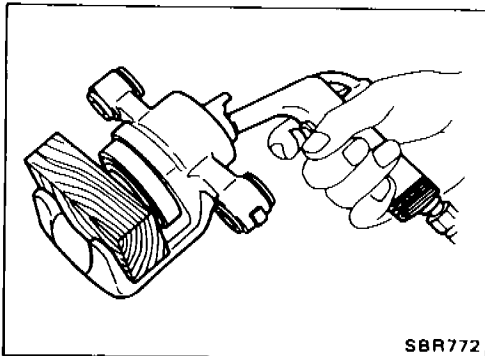


### Removal and Installation

- Remove torque member fixing bolts and union bolt.



- Install brake hose to caliper at protrusions securely.



### Disassembly

Push out piston with dust seal using compressed air.

## Inspection

### CYLINDER BODY

- Check inside surface of cylinder for scoring, rust, wear, damage or foreign materials. Replace if any such condition exists.
- Eliminate minor damage from rust or foreign materials by polishing surface with fine emery paper.

#### CAUTION:

Use brake fluid to clean.

### PISTON

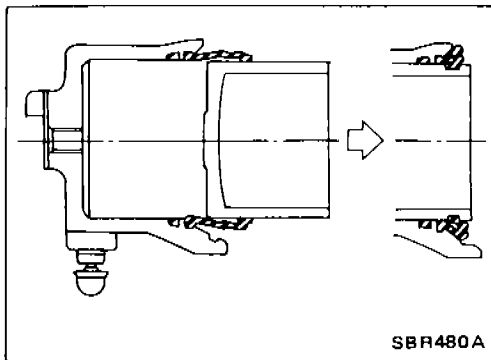
Check piston for scoring, rust, wear, damage or foreign materials. Replace if any condition exists.

#### CAUTION:

Piston sliding surface is plated. Do not polish with emery paper even if rust or foreign materials are stuck to sliding surface.

### PIN, PIN BOLT AND PIN BOOT

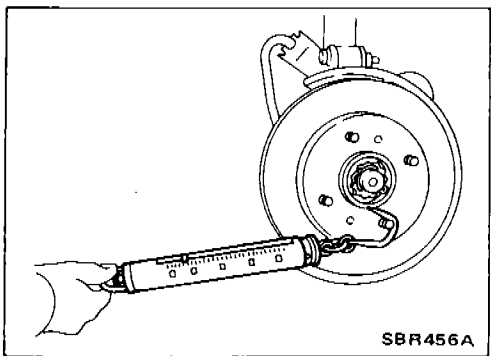
Check for wear, cracks or other damage. Replace if any condition exists.



SBR480A

## Assembly

- Place piston boot over rear of piston. Fit piston boot's lip properly in corresponding groove on cylinder body.
- Insert piston into cylinder body and fit boot's lip properly in corresponding groove on piston.

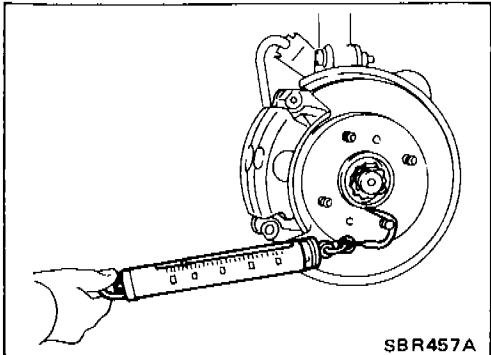


SBR456A

## Inspection (On-vehicle)

### INSPECTION OF BRAKE DRAG FORCE

1. Swing cylinder body upward.
2. Make sure that wheel bearing is adjusted properly. Refer to section FA.
3. Measure rotating force ( $F_1$ ).



SBR457A

4. Install caliper with pads to original position.
5. Depress brake pedal for 5 seconds.
6. Release brake pedal and rotate disc rotor 10 revolutions.
7. Measure rotating force ( $F_2$ ).
8. Calculate brake drag force by subtracting  $F_1$  from  $F_2$ .

**Maximum brake drag force ( $F_2 - F_1$ ):**

**59.8 N (6.1 kg, 13.5 lb)**

If it is not within specification, check main pins and retainer boots in caliper.

## FRONT DISC BRAKE (CL18VB, CL25VA) — Caliper

### Inspection (On-vehicle) (Cont'd)

#### DISC PAD

Check disc pad for wear or damage.

##### CL18VB:

Pad standard thickness (A)

10.0 mm (0.394 in)

Pad wear limit (A)

2.0 mm (0.079 in)

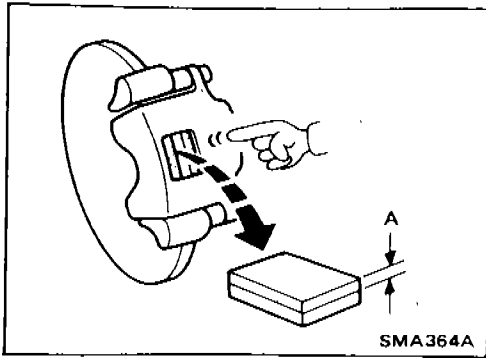
##### CL25VA:

Pad standard thickness (A)

11.0 mm (0.433 in)

Pad wear limit (A)

2.0 mm (0.079 in)

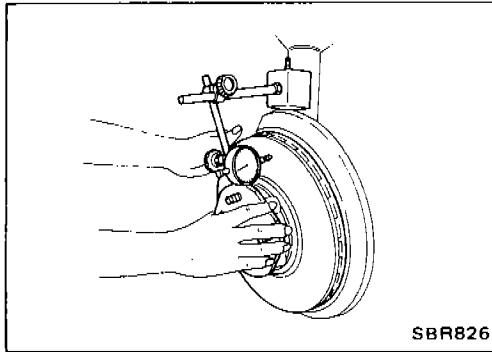




**Inspection**

**RUBBING SURFACE**

Check rotor for roughness, cracks or chips.



**RUNOUT**

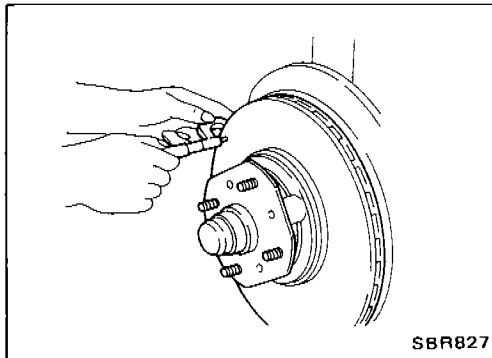
Adjust wheel bearing preload. Check runout using a dial indicator.

**Rotor repair limit:**

**Maximum runout**

**(Total indicator reading at center of rotor pad contact surface)**

**0.07 mm (0.0028 in)**



**THICKNESS**

**CL18VB:**

**Standard thickness**

**18.0 mm (0.709 in)**

**Minimum thickness**

**16.0 mm (0.630 in)**

**CL25VA:**

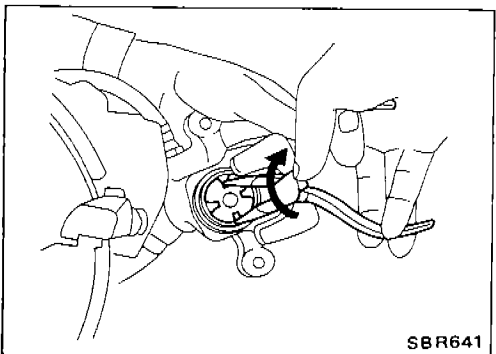
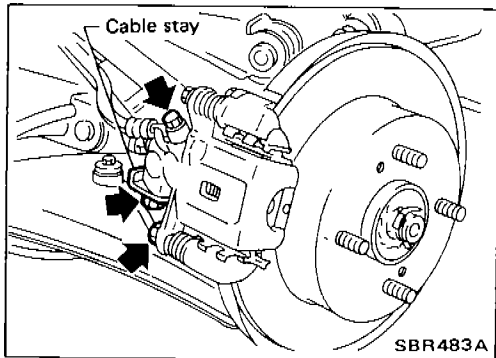
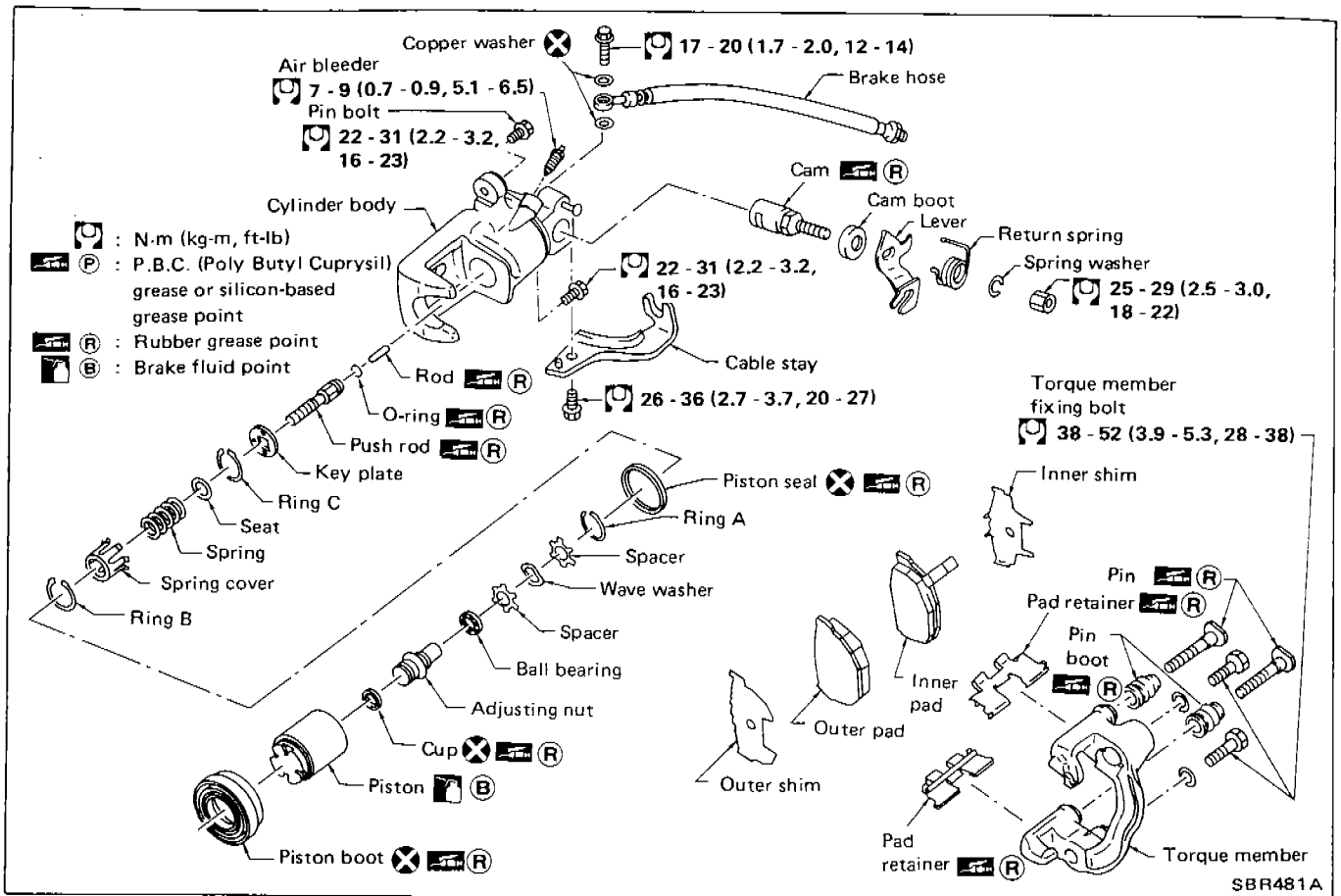
**Standard thickness**

**22.0 mm (0.866 in)**

**Minimum thickness**

**20.0 mm (0.787 in)**

# REAR DISC BRAKE (CL9H) — Caliper



## Pad Replacement

### CAUTION:

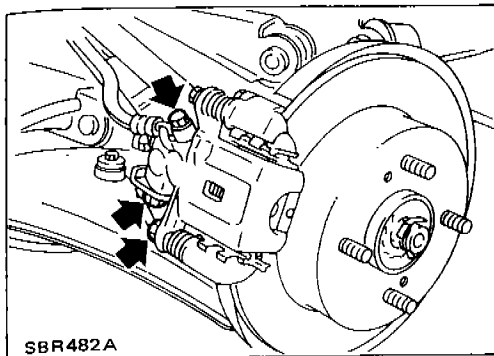
When cylinder body is swung up, do not depress brake pedal because piston will pop out.

- Remove parking cable stay fixing bolt, pin bolts and lock spring. Then remove pad retainers, pads and shims.

- When installing pads, retract piston into cylinder body by turning it clockwise.

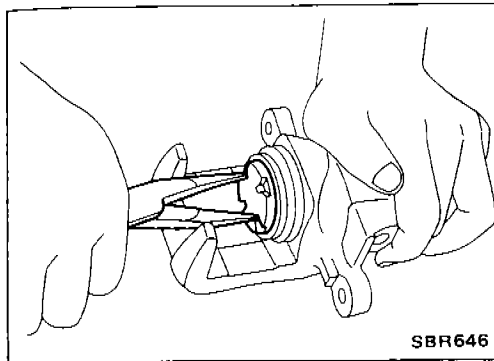
### CAUTION:

Be careful not to damage piston boot or get oil on rotor. Always replace shims when replacing pads.



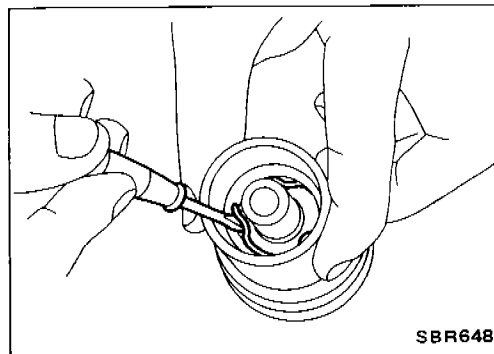
## Removal and Installation

Disconnect parking brake cable and brake hose, then remove caliper assembly.

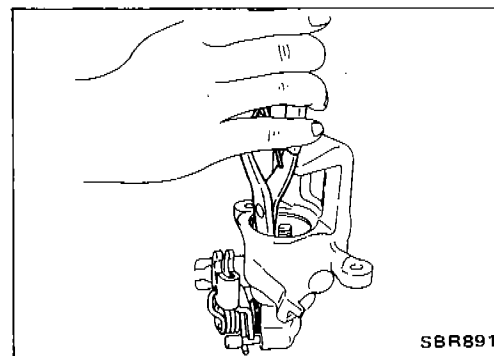


## Disassembly

1. Remove piston by turning it counterclockwise with suitable longnose pliers.

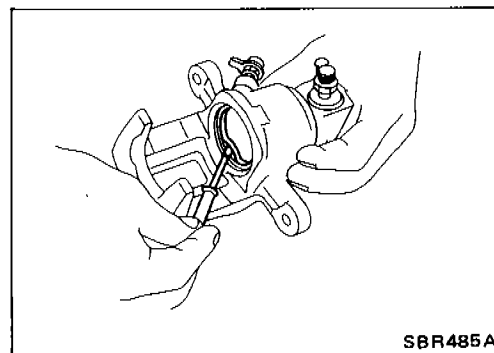


2. Pry off ring A from piston with suitable pliers and remove adjusting nut.



3. Disassemble cylinder body.

- Pry off rings B and C with pliers, then remove spring cover, spring and seat.



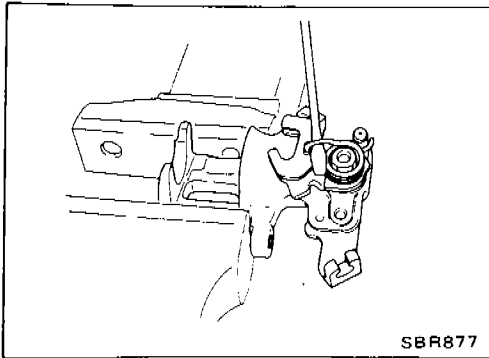
- Remove piston seal.

**Be careful not to damage cylinder body.**

## REAR DISC BRAKE (CL9H) — Caliper

### Disassembly (Cont'd)

4. Remove return spring and lever.



### Inspection

#### CYLINDER BODY

- Check inside surface of cylinder for score, rust, wear or other damage.
- Minor damage from rust of foreign materials may be eliminated by polishing surface with a fine emery paper. Replace if necessary.

#### CAUTION:

Use brake fluid to clean.

#### TORQUE MEMBER

Check for wear, cracks or other damage. Replace if necessary.

#### PISTON

Check piston for score, rust, wear or other damage. Replace if necessary.

#### CAUTION:

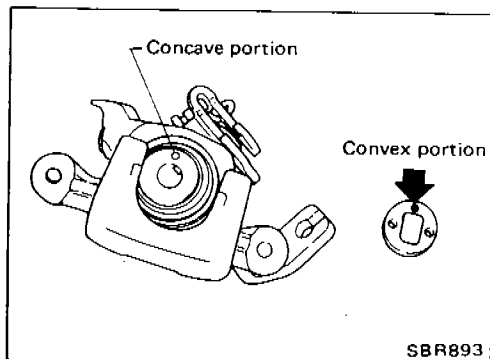
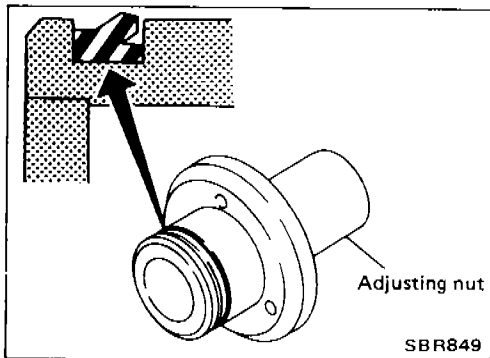
Piston sliding surface is plated. Do not polish with emery paper even if rust or foreign matter is stuck to sliding surface.

#### PIN AND PIN BOOT

Check for wear, cracks or other damage. Replace if necessary.

### Assembly

- Install cup securely in the specified direction.

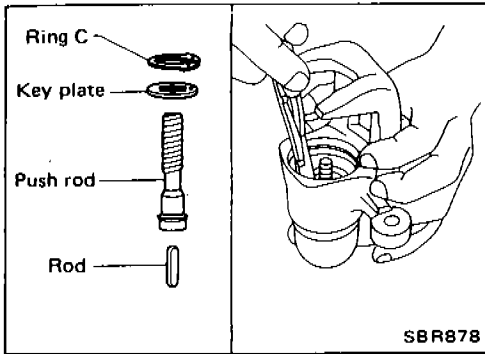


- Fit push rod into square hole in key plate. Also match convex portion of key plate with concave portion of cylinder.

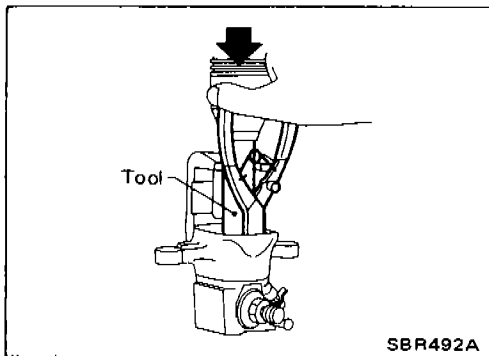
## REAR DISC BRAKE (CL9H) — Caliper

### Assembly (Cont'd)

- Install ring C with suitable tool.



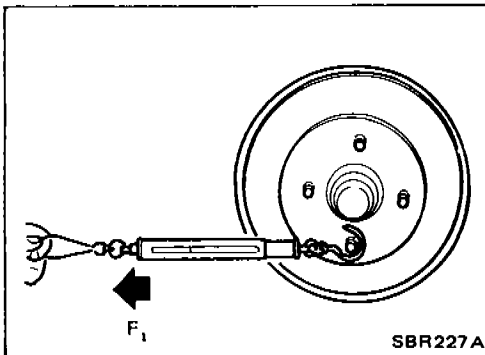
- Install seat, spring, spring cover and ring B with suitable press and drift.



### Inspection (On-vehicle)

#### INSPECTION OF BRAKE DRAG FORCE

1. Swing cylinder body upward.
2. Make sure that wheel bearing is adjusted properly. Refer to section RA.
3. Measure rotating force ( $F_1$ ).

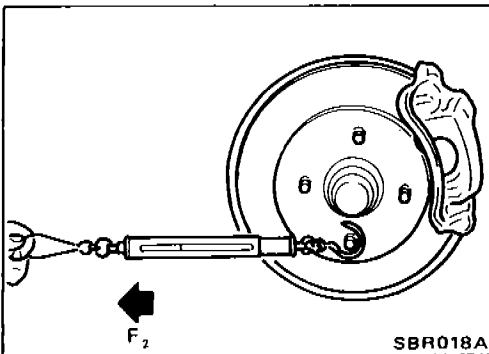


4. Install caliper with pads to original position.
5. Depress brake pedal for 5 seconds.
6. Release brake pedal, rotate disc rotor 10 revolutions.
7. Measure rotating force ( $F_2$ ).
8. Calculate brake drag force by subtracting  $F_1$  from  $F_2$ .

**Maximum brake drag force ( $F_2 - F_1$ ):**

**86.3 N (8.8 kg, 19.4 lb)**

If it is not within specification, check pins and pin boots in caliper.



#### DISC PAD

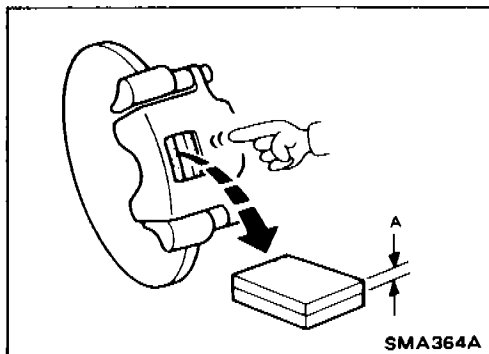
Check disc pad for wear or damage.

**Standard thickness (A):**

**9.5 mm (0.374 in)**

**Pad wear limit (A):**

**2.0 mm (0.079 in)**

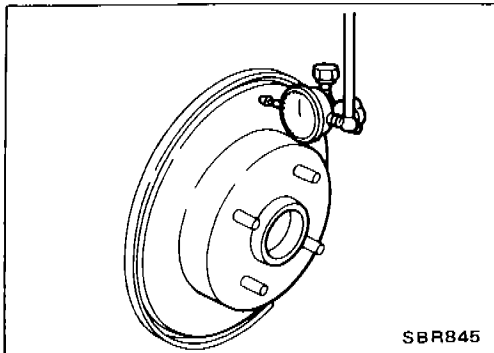


## REAR DISC BRAKE (CL9H) — Rotor

### Inspection

#### RUBBING SURFACE

Check rotor for roughness, cracks or chips.



#### RUNOUT

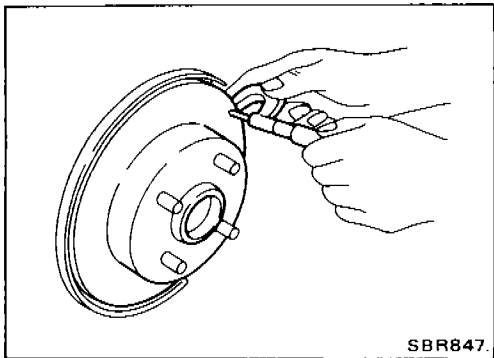
- Check runout using a dial indicator.
- Make sure that axial end play is within the specifications before measuring. Refer to section RA.

##### Rotor repair limit:

##### Maximum runout

(Total indicator reading at center of rotor pad contact surface)

0.07 mm (0.0028 in)



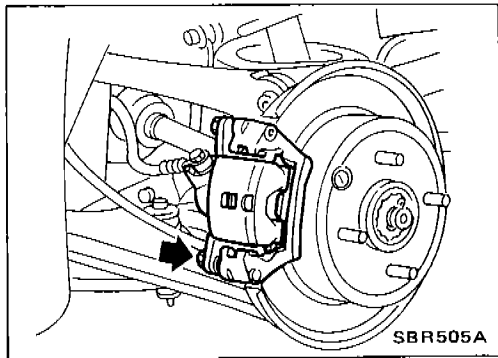
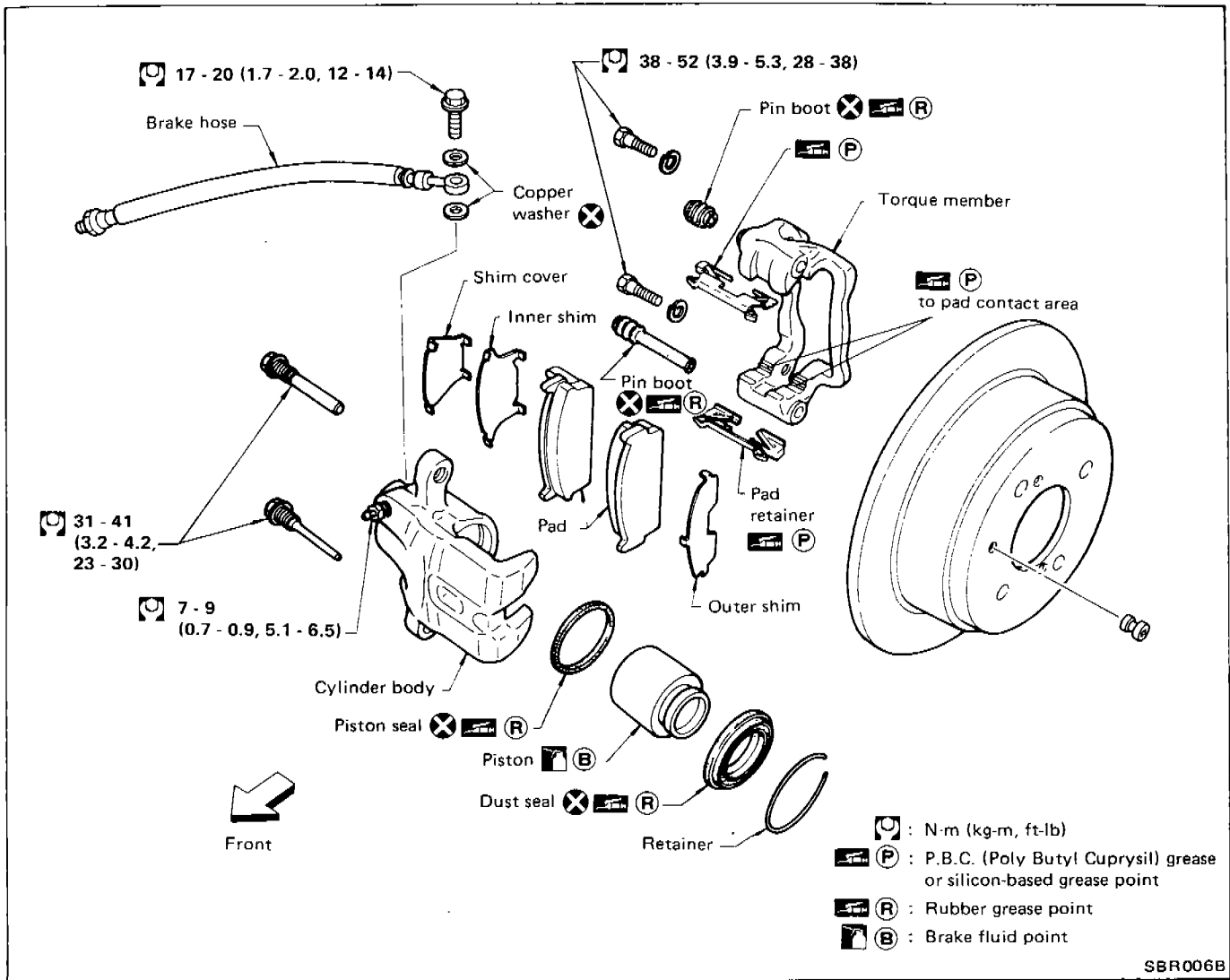
#### THICKNESS

##### Rotor repair limit:

##### Minimum thickness

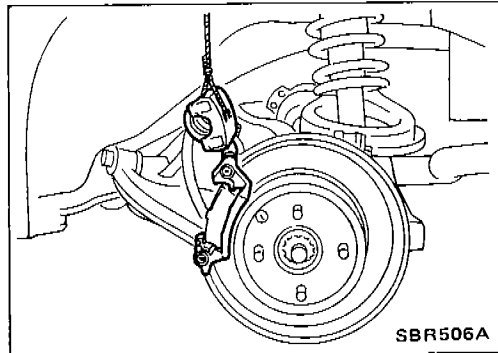
8.0 mm (0.315 in)

# REAR DISC BRAKE (AD9) — Caliper



## Pad Replacement

1. Remove guide pin.

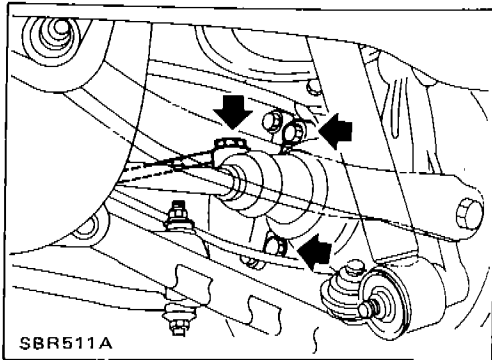


2. Swing cylinder body upward. Then remove pad retainer and inner and outer shims.

### CAUTION:

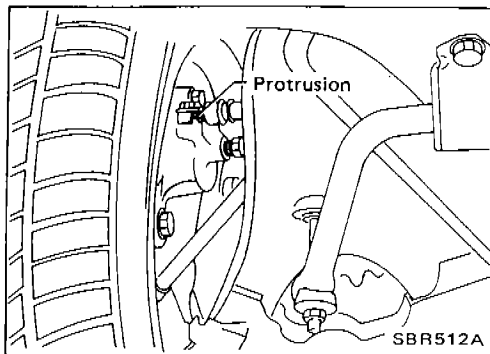
- When cylinder body is swung up, do not depress brake pedal because piston will pop out.
- Be careful not to damage dust seal or get oil on rotor. Always replace shims when replacing pads.

## REAR DISC BRAKE (AD9) — Caliper

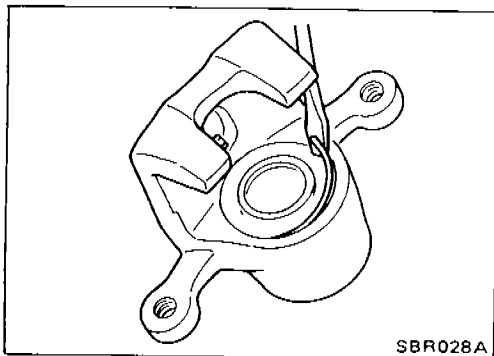


### Removal and Installation

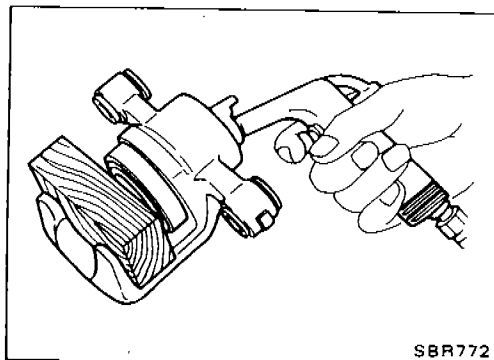
- Remove torque member fixing bolts and eye bolt.



- Install brake hose to caliper securely.



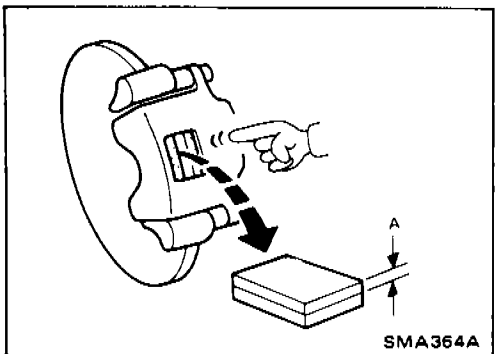
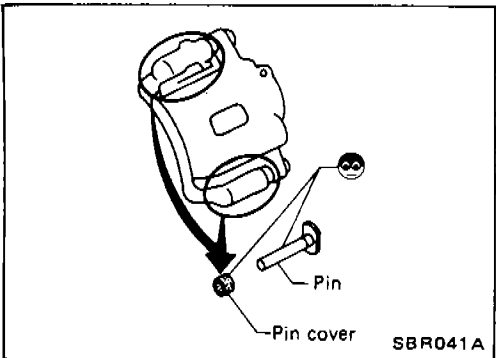
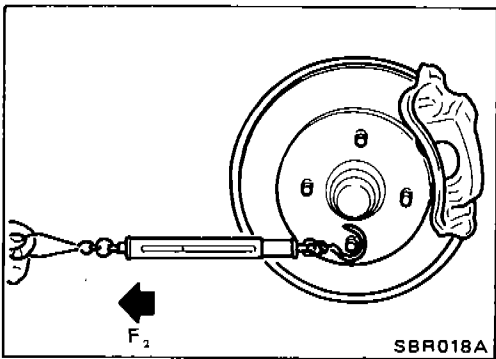
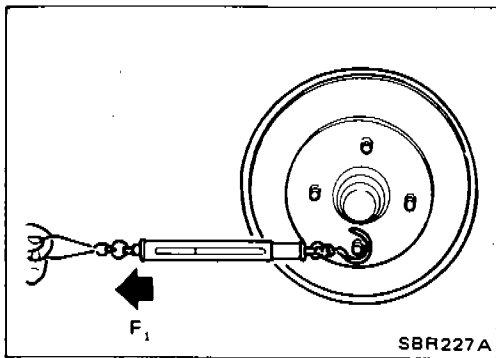
- Remove retainer with a screwdriver.



- Push out piston with dust seal with compressed air.



## REAR DISC BRAKE (AD9) — Caliper



### Inspection

#### INSPECTION OF BRAKE DRAG FORCE

1. Swing cylinder body upward.
2. Make sure that wheel bearing is adjusted properly. Refer to section RA.
3. Measure rotating force ( $F_1$ ).

4. Install caliper with pads to original position.
5. Depress brake pedal for 5 seconds.
6. Release brake pedal, rotate disc rotor 10 revolutions.
7. Measure rotating force ( $F_2$ ).
8. Calculate brake drag force by subtracting  $F_1$  from  $F_2$ .

**Maximum brake drag force ( $F_2 - F_1$ ):**  
**103.0 N (10.5 kg, 23.2 lb)**

If it is not within specification, check pins and pin boots in caliper.

- Make sure that wheel bearing is adjusted properly.
- Disc pads and disc rotor must be dried.

#### DISC PAD

Check disc pad for wear or damage.

**Pad wear limit (A):**  
**2.0 mm (0.079 in)**

#### CYLINDER BODY

- Check inside surface of cylinder body for score, rust, wear, damage or presence of foreign materials. If any of the above conditions are observed, replace cylinder body.
- Minor damage from rust or foreign materials may be eliminated by polishing surface with a fine emery paper. Replace cylinder body if necessary.

#### CAUTION:

Use brake fluid to clean. Never use mineral oil.

### Inspection (Cont'd)

#### PISTON

Check piston for score, rust, wear, damage or presence of foreign materials. Replace if any of the above conditions are observed.

#### CAUTION:

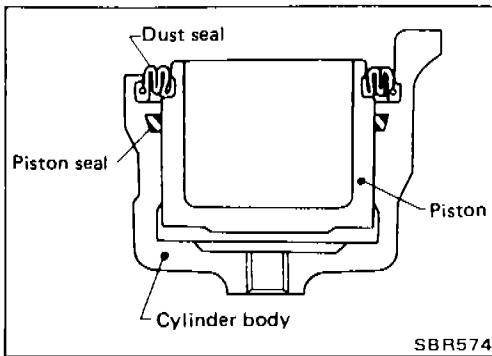
**Piston sliding surface is plated. Do not polish with emery paper even if rust or foreign matter is stuck to sliding surface.**

#### PIN, PIN BOLT, RETAINER, PISTON SEAL, DUST SEAL AND PIN BOOT

Check for wear, cracks or other damage. Replace if any of the above conditions are observed.

#### Assembly

- With dust seal fitted to piston, insert dust seal into groove on cylinder body and install piston.
- Properly secure dust seal.

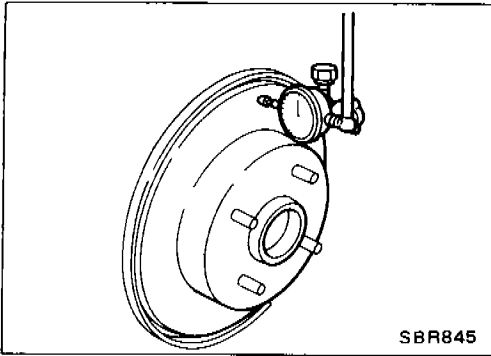


## REAR DISC BRAKE (AD9) — Rotor

### Inspection

#### RUBBING SURFACE

Check rotor for roughness, cracks or chips. Repair or replace if necessary.



#### RUNOUT

Make sure that axial end play is within the specifications before measuring. Refer to section RA.

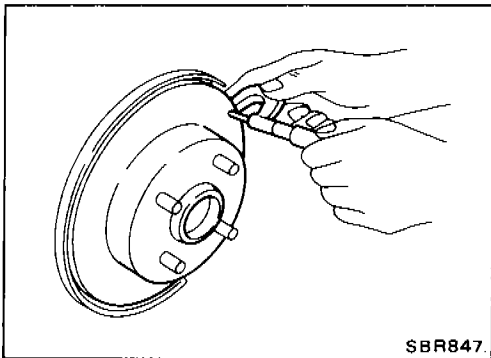
Then check runout using a dial indicator.

#### Rotor repair limit:

##### Maximum runout

(Total indicator reading at center of rotor pad contact surface)

0.07 mm (0.0028 in)



#### THICKNESS

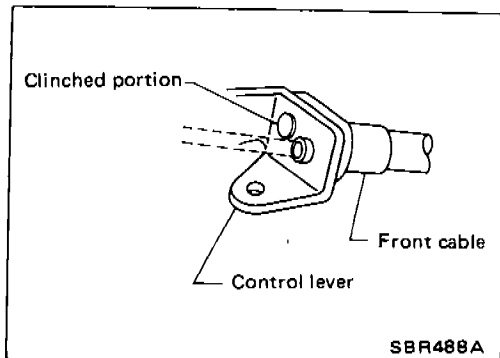
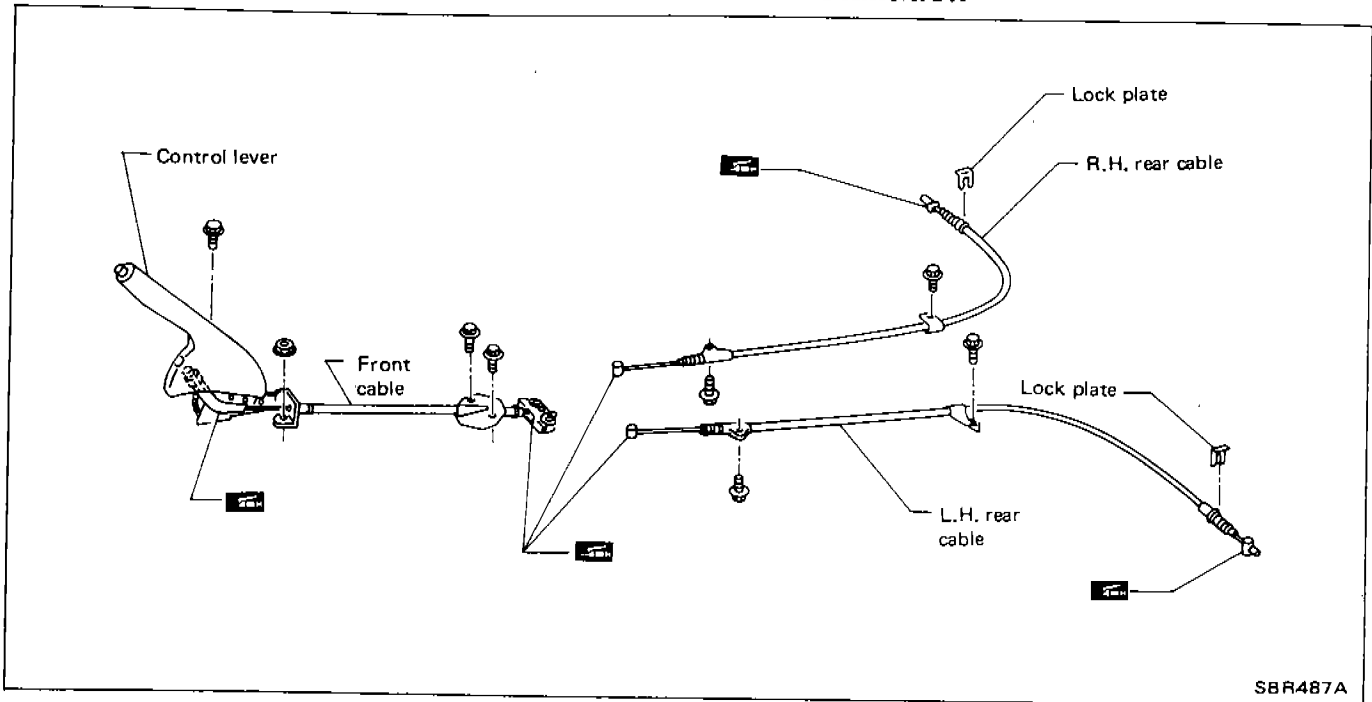
#### Rotor repair limit:

##### Minimum thickness

8.0 mm (0.315 in)

# PARKING BRAKE CONTROL

## Removal and Installation



### REMOVAL

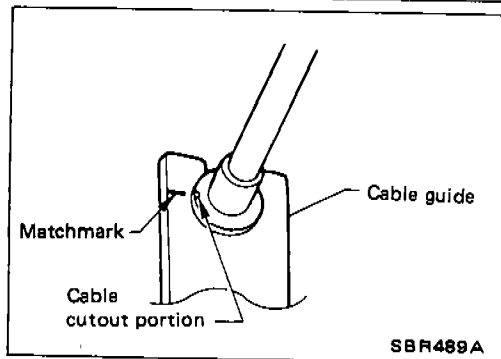
- Before removing parking brake control, remove console box.
- Loosen cable using control lever adjuster, and separate front and rear cables.
- Break clinched portion of control lever using a hammer and chisel as shown in figure at left, and replace cables with new parts.

Apply multi-purpose grease to areas between control lever drum and cables.

### INSTALLATION

Be careful not to damage boot and inner cable.

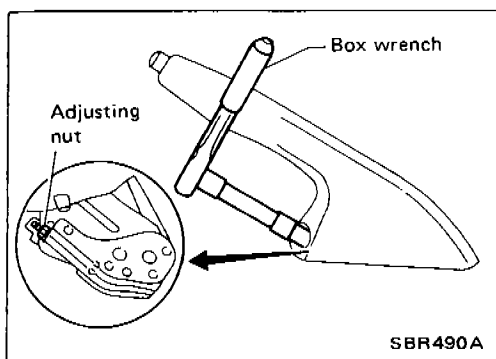
- When installing parking brake cable at rear caliper, make sure to align matchmark on parking cable stay and cable.



### Inspection

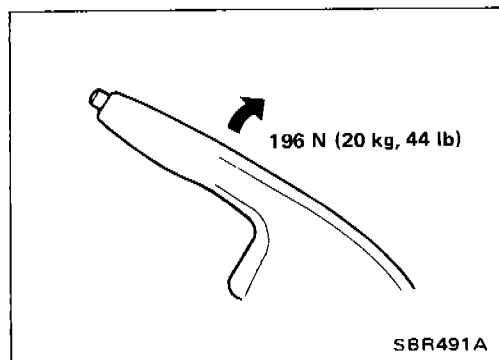
1. Check control lever for wear or other damage. Replace if necessary.
2. Check parking brake cables, lamp and switch. Replace if necessary.
3. Check parts at each connecting portion for deformation or damage. If found, replace.

## PARKING BRAKE CONTROL



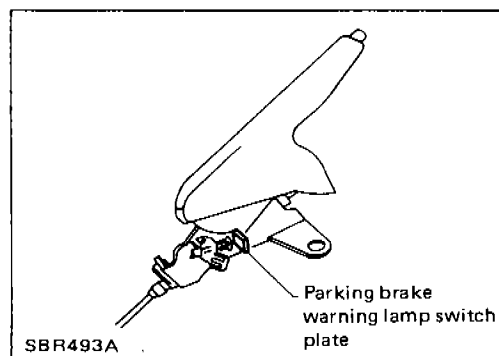
### Adjustment

1. Ensure that parking brake releases when control lever is pulled down completely. If control lever does not release parking brake, proceed as follows:
  - Pull control lever up by 4 or 5 notches.
  - Insert a box wrench into opening in control lever and loosen self-lock adjusting nut to slacken cables. Completely push control lever down.
2. Forcefully depress brake pedal about five times (so that caliper is automatically set in position.).
3. Pull lever up by 4 or 5 notches.
4. Turn adjusting nut as shown in figure at left and adjust lever stroke to specified value.
5. Completely push control lever down and ensure that:
  - Parking brake is released completely.
  - Rear brakes are free from dragging.



6. Pull control lever with specified amount of force. Check lever stroke and ensure smooth operation.

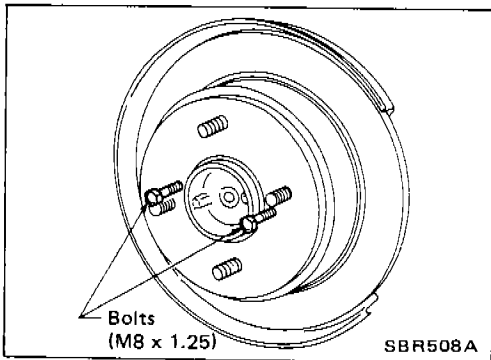
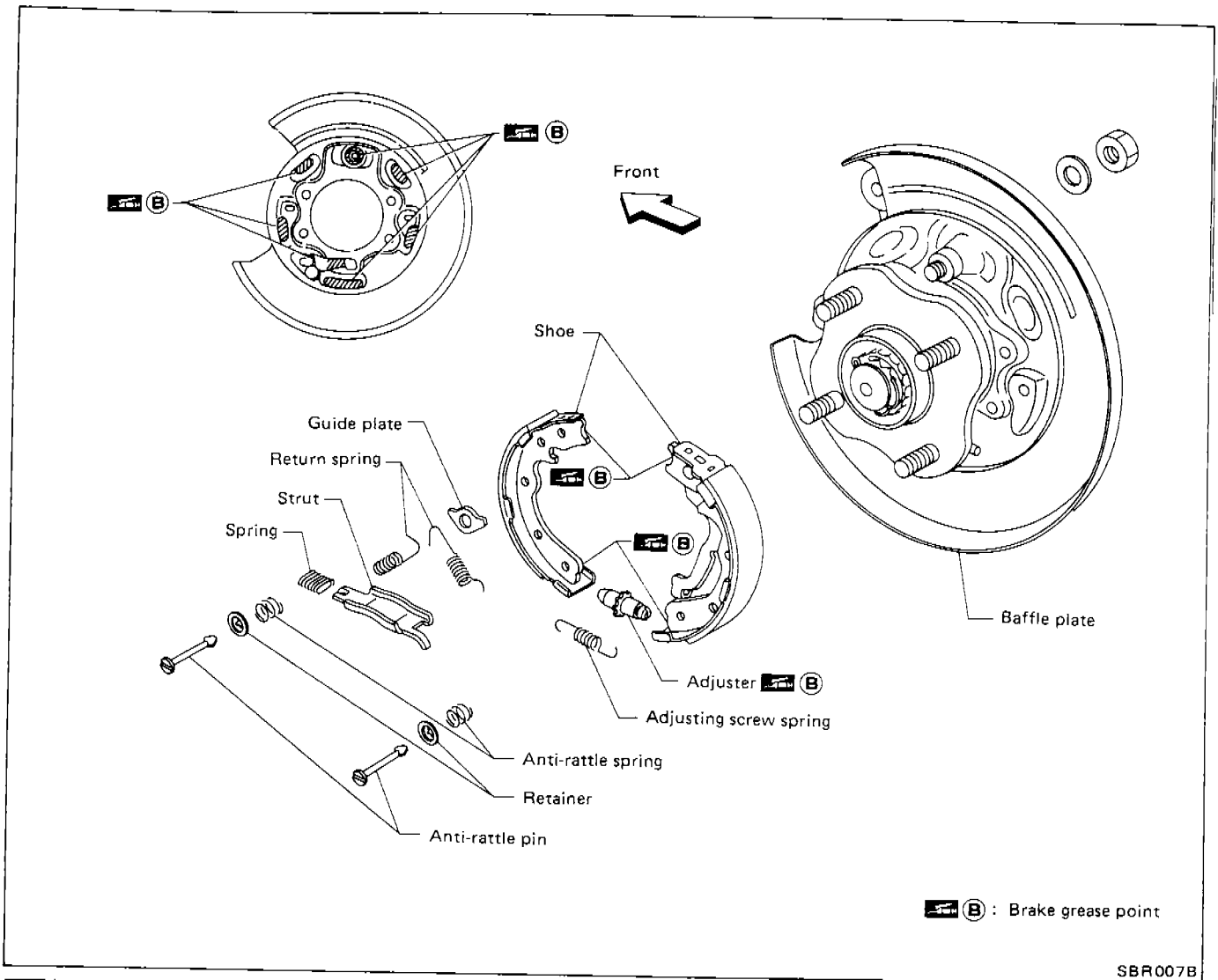
**Number of notches: 6 - 8**



7. Bend parking brake warning lamp switch plate so that brake warning light comes on when ratchet at parking brake lever is pulled "A" notches and goes out when fully released.

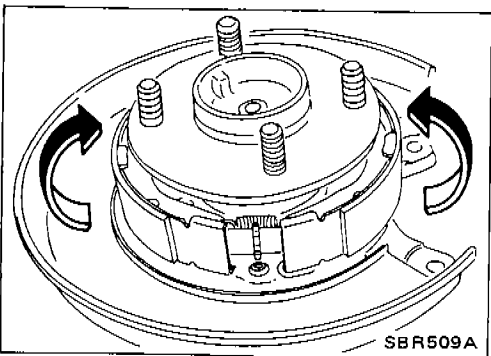
**Number of notches "A": 1**

# PARKING DRUM BRAKE (DS17HD) — Rear Disc Brake AD9 Model



## Shoe Replacement

1. Remove disc rotor (With parking drum brake).  
Tighten two bolts gradually if disc rotor is hard to remove.



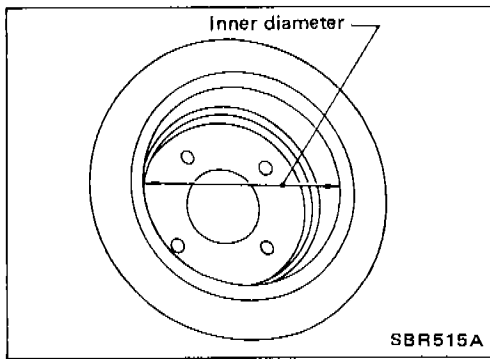
2. After removing retainer, remove spring by rotating shoes.  
**Be careful not to damage parking brake cable when separating it.**

**Breaking in Drum and Lining**

1. Using either low or 2nd transmission speed, drive the unloaded vehicle at approximately 30 km/h (19 MPH) on a safe, level and dry road.
2. Depress the release button of parking brake lever, then pull the lever with a force of 98 N (10 kg, 22 lb).
3. While holding the lever back, continue to drive the vehicle 100 m (328 ft).
4. Repeat steps 1 through 3 two or three times.

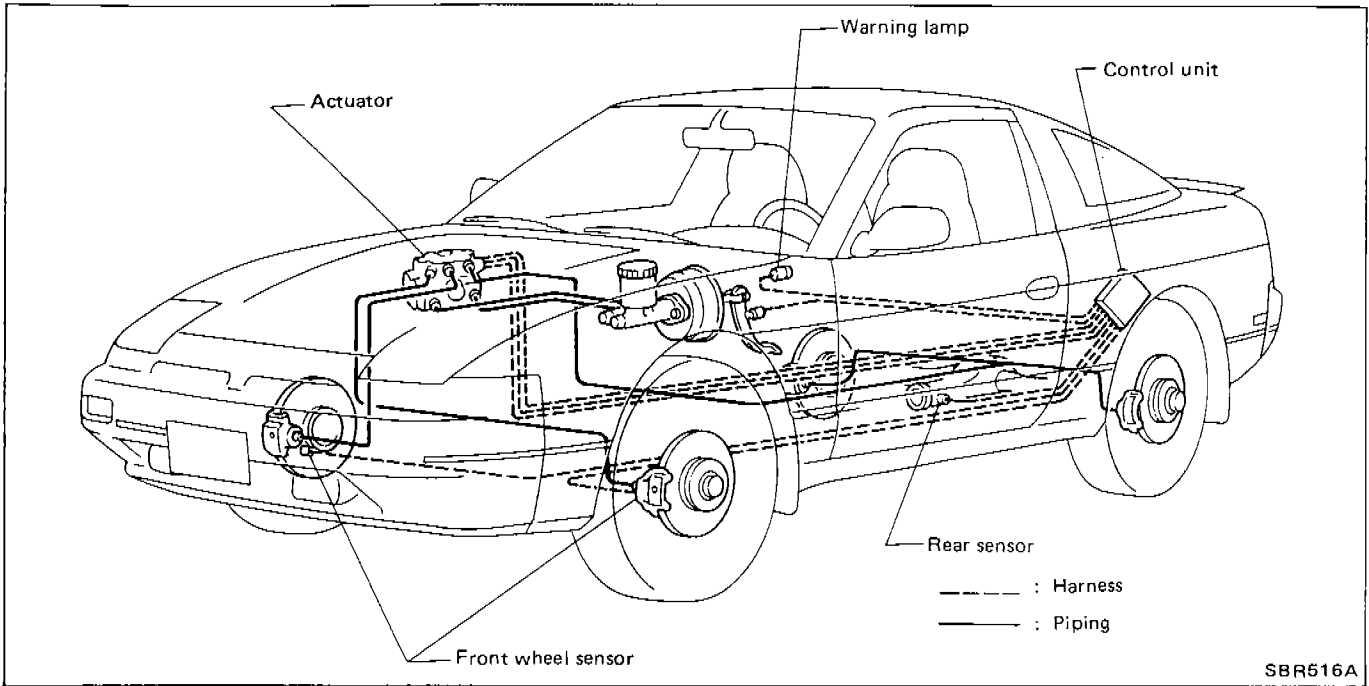
**Drum Inspection**

- Standard inner diameter:**  
172.0 mm (6.77 in)
- Maximum inner diameter:**  
173.0 mm (6.81 in)
- Radial runout (Total indicator reading):**  
0.07 mm (0.0028 in)

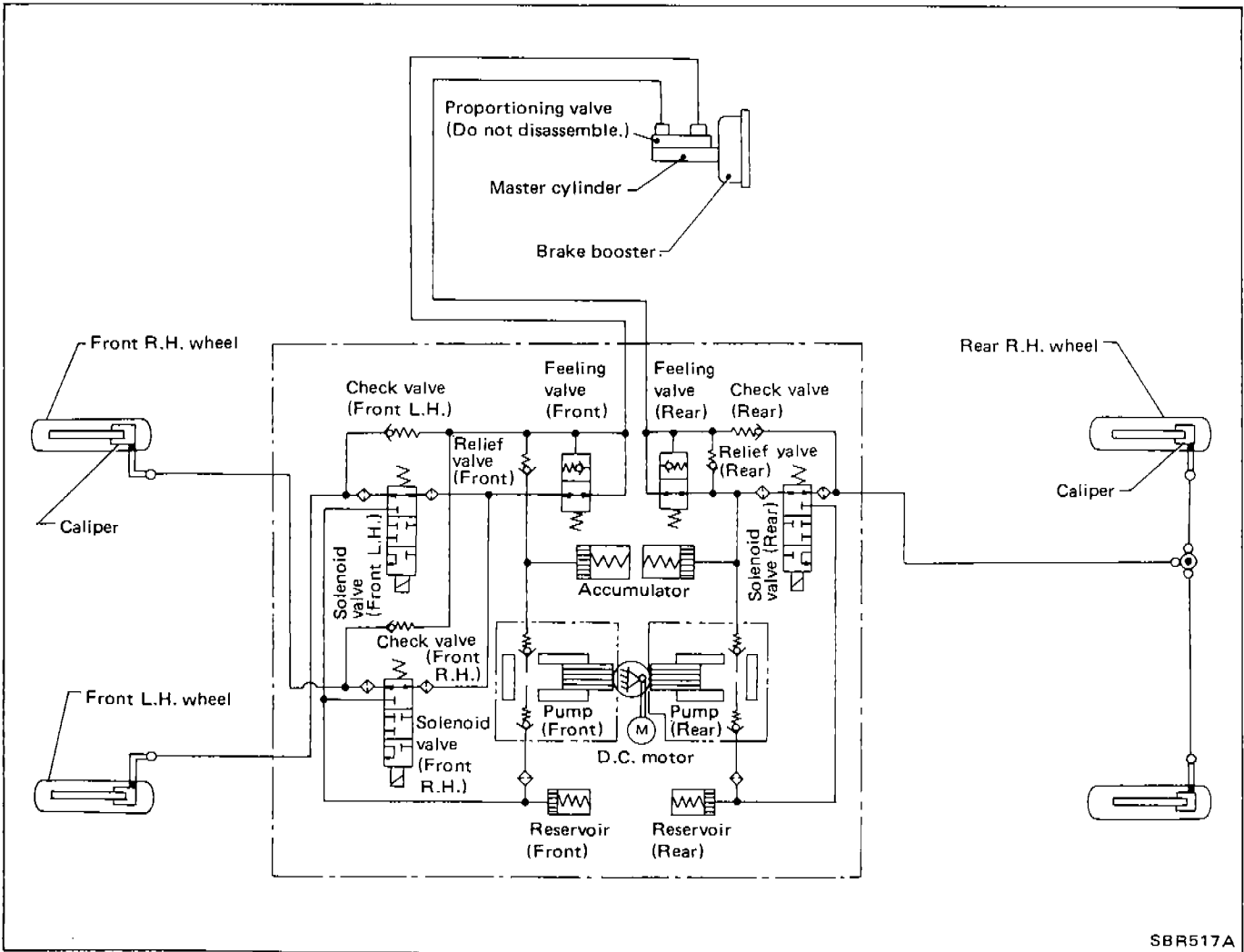


# ANTI-LOCK BRAKING SYSTEM

## System Components



## Hydraulic Circuit

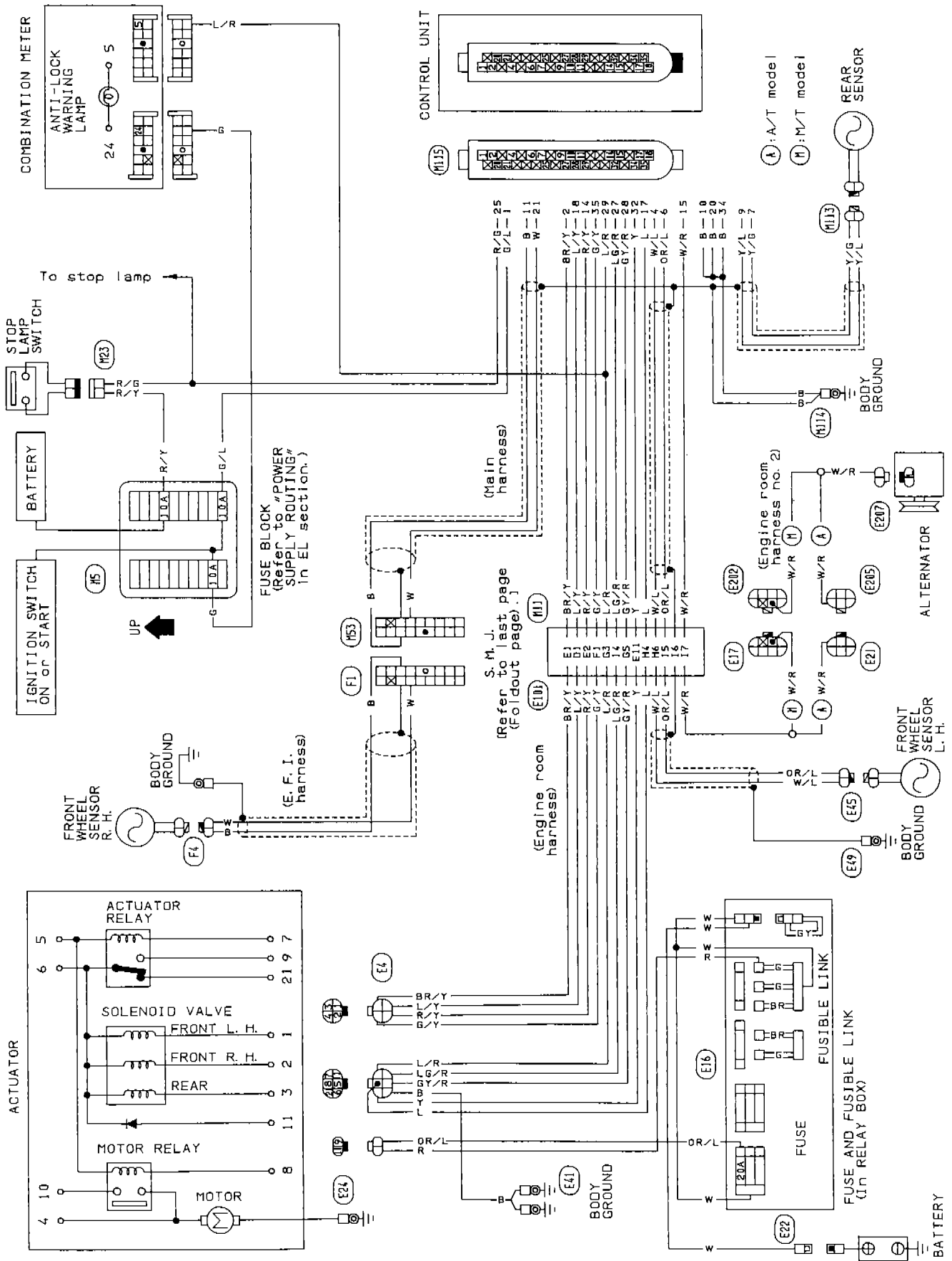




# ANTI-LOCK BRAKING SYSTEM

L.H.D. MODEL

## Wiring Diagram

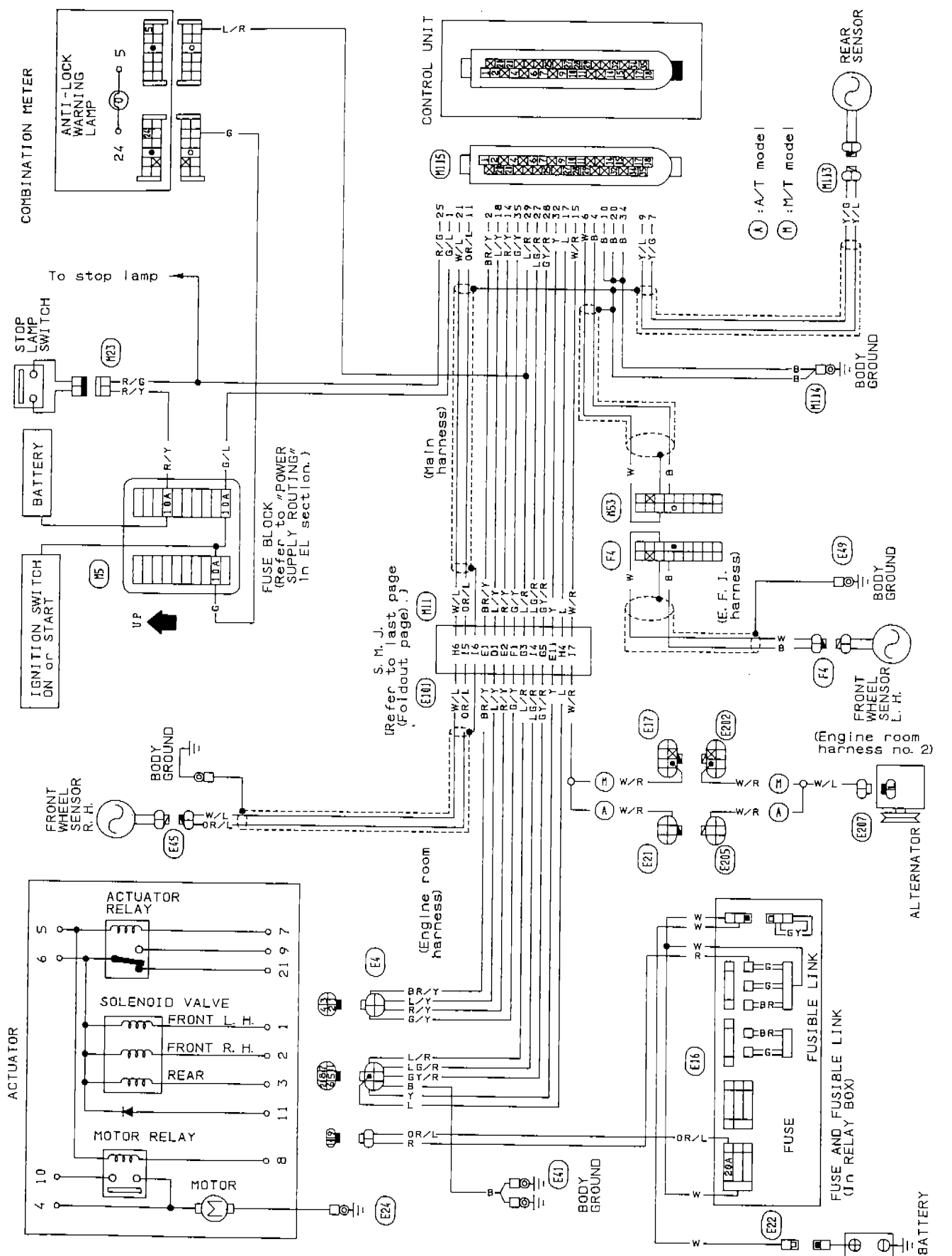


SBR538A

# ANTI-LOCK BRAKING SYSTEM

## Wiring Diagram (Cont'd)

R.H.D. MODEL



SBR563A

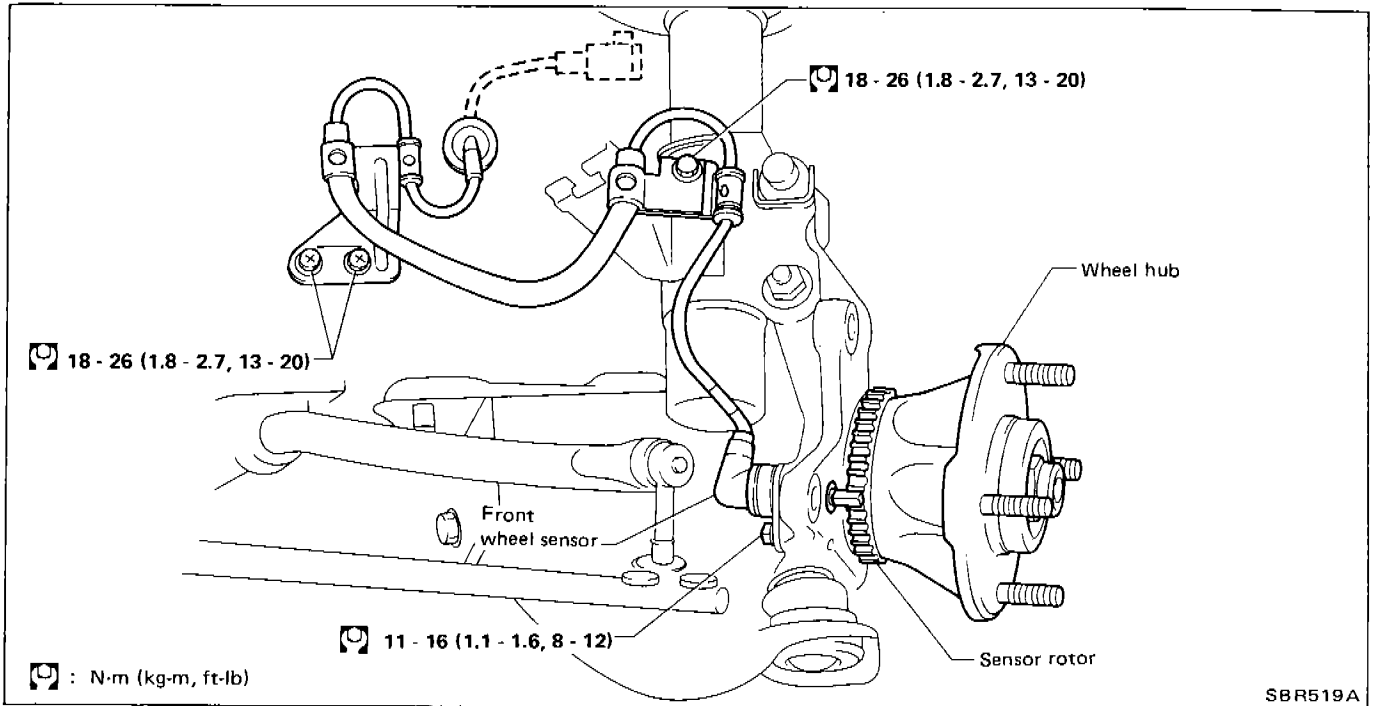
# ANTI-LOCK BRAKING SYSTEM

## Removal and Installation

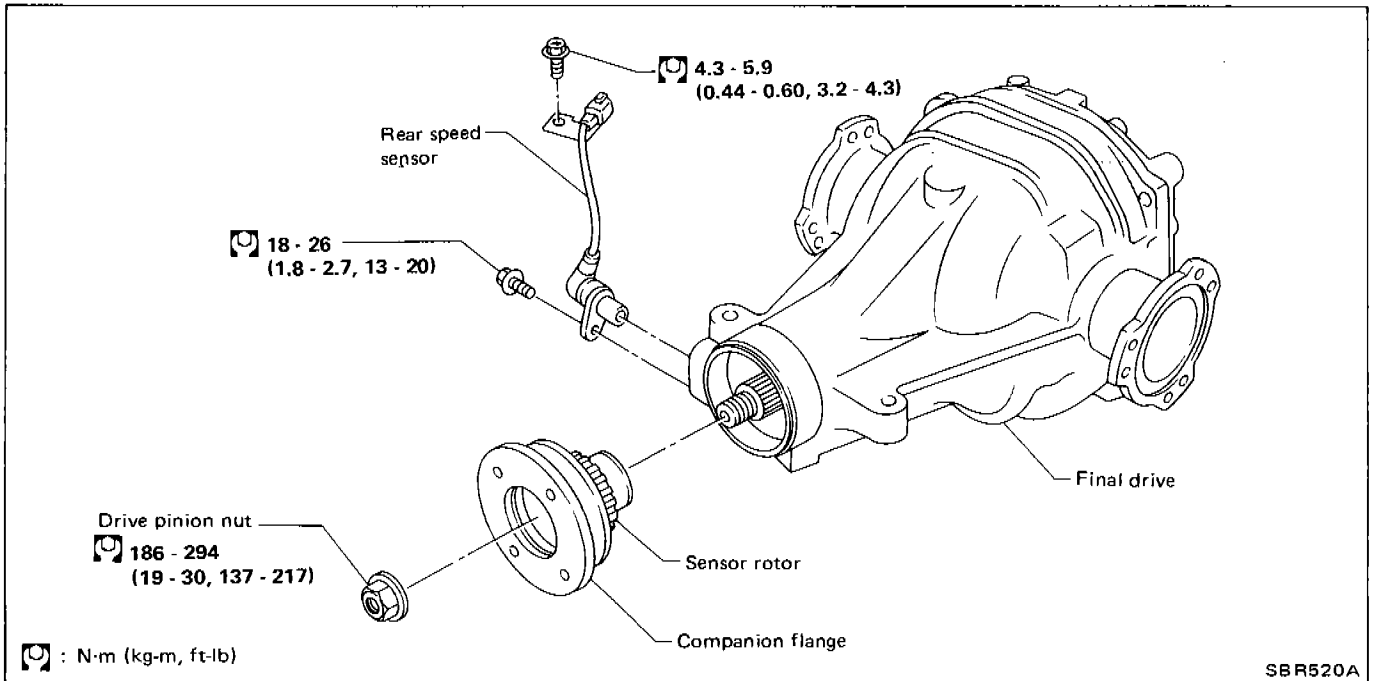
### CAUTION:

Be careful not to damage sensor edge and sensor rotor teeth.

### FRONT WHEEL SENSOR



### REAR SENSOR

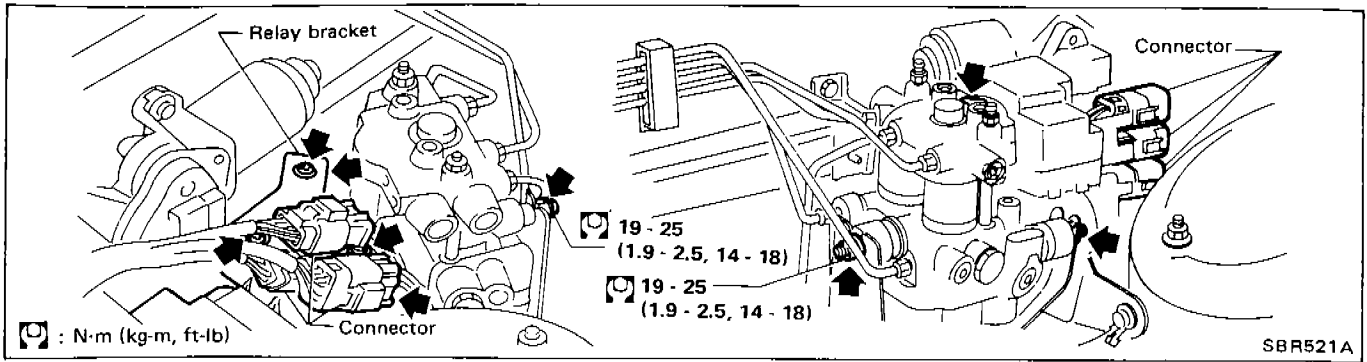


- Remove rear sensor rotor with companion flange after propeller shaft removal. Refer to PD section.

# ANTI-LOCK BRAKING SYSTEM

## Removal and Installation (Cont'd)

### ACTUATOR

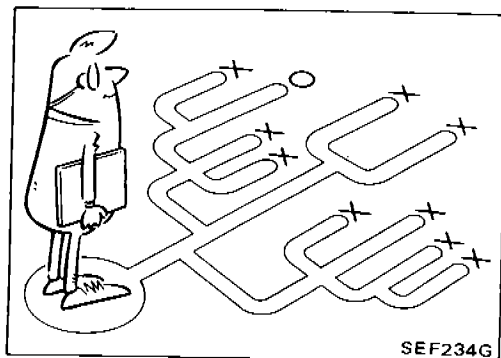
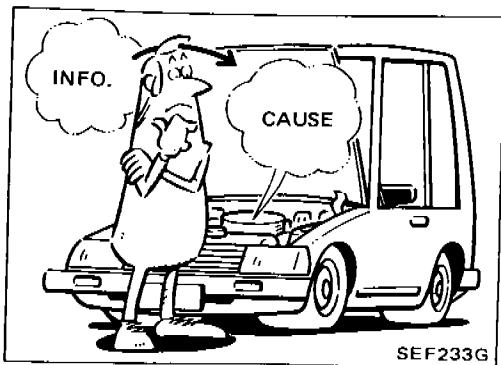


- Disconnect 3 connectors and brake tubes.
- For L.H. only, remove relay bracket 3 screws.
- Remove 3 nuts fixing actuator to bracket.

# TROUBLE DIAGNOSES

## Contents

How to Perform Trouble Diagnoses for Quick and Accurate Repair .....	BR-38
Symptom Chart .....	BR-41
Preliminary Check 1 .....	BR-42
Preliminary Check 2 .....	BR-43
Preliminary Check 3, 4 .....	BR-44
Self-diagnosis .....	BR-45
Component Parts Location .....	BR-46
Harness Connector Location .....	BR-47
Ground Circuit Check .....	BR-48
Circuit Diagram for Quick Pinpoint Check .....	BR-49
Diagnostic Procedure 1 .....	BR-50
Diagnostic Procedure 2 .....	BR-51
Diagnostic Procedure 3 .....	BR-52
Diagnostic Procedure 4 .....	BR-52
Diagnostic Procedure 5 .....	BR-53
Diagnostic Procedure 6 .....	BR-53
Diagnostic Procedure 7 .....	BR-54
Diagnostic Procedure 8 .....	BR-55
Diagnostic Procedure 9 .....	BR-56
Diagnostic Procedure 10 .....	BR-57
Diagnostic Procedure 11 .....	BR-58
Diagnostic Procedure 12 .....	BR-59
Electrical Components Inspection .....	BR-60



## How to Perform Trouble Diagnoses for Quick and Accurate Repair

### INTRODUCTION

The A.B.S. system has an electronic control unit to control major functions. The control unit accepts input signals from sensors and instantly drives actuators. It is essential that both kinds of signals are proper and stable. At the same time, it is important that there are no conventional problems such as air leaks in the booster or lines, lack of brake fluid, or other problems with brake system.

It is much more difficult to diagnose a problem that occurs intermittently rather than continuously. Most intermittent problems are caused by poor electric connections or faulty wiring. In this case, careful checking of suspicious circuits may help prevent the replacement of good parts.

A visual check only may not find the cause of the problems, so a road test should be performed.

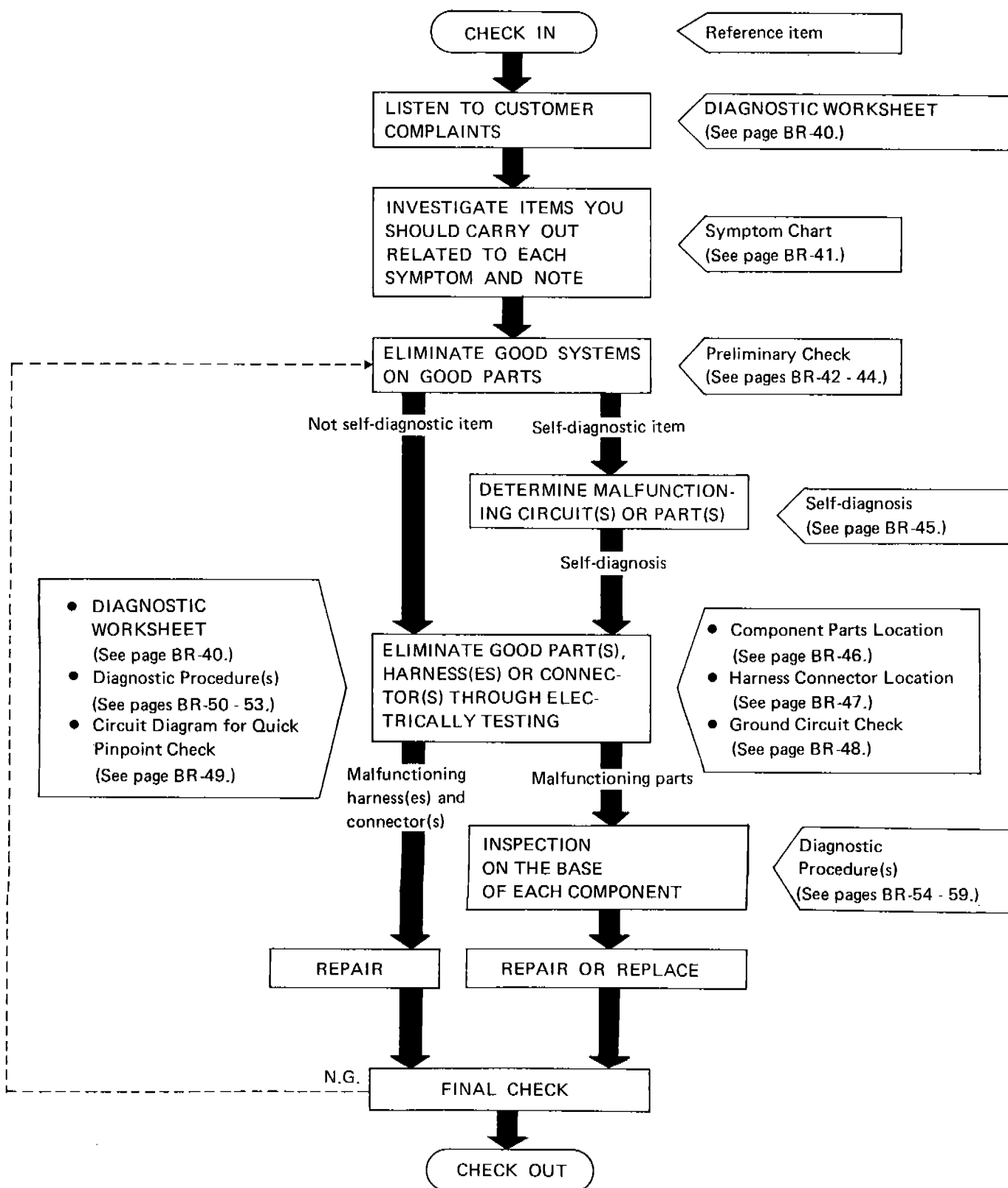
Before undertaking actual checks, take just a few minutes to talk with a customer who approaches with a A.B.S. complaint. The customer is a very good source of information on such problems; especially intermittent ones. Through the talks with the customer, find out what symptoms are present and under what conditions they occur.

Start your diagnosis by looking for "conventional" problems first. This is one of the best ways to troubleshoot brake problems on an A.B.S. controlled vehicle.

# TROUBLE DIAGNOSES

## How to Perform Trouble Diagnoses for Quick and Accurate Repair (Cont'd)

### WORK FLOW



## TROUBLE DIAGNOSES

### How to Perform Trouble Diagnoses for Quick and Accurate Repair (Cont'd)

#### KEY POINTS

**WHAT** ..... Vehicle model  
**WHEN** ..... Date, Frequencies  
**WHERE** ..... Road conditions  
**HOW** ..... Operating conditions,  
Weather conditions,  
Symptoms

#### DIAGNOSTIC WORKSHEET

There are many kinds of operating conditions that lead to customer complaints, even if the system is normal.

A good grasp of such conditions can make trouble-shooting faster and more accurate.

In general, feelings for a problem depend on each customer's information. It is therefore important to fully understand the symptoms or under what conditions a customer complains.

Make good use of a diagnostic worksheet such as the one shown below in order to utilize all the complaints for trouble-shooting.

#### Worksheet sample

Customer name MR/MS		Model & Year			VIN		
Engine #		Trans.			Mileage		
Incident Date		Manuf. Date			In Service Date		
Symptoms	<input type="checkbox"/> Pedal vibration and noise	<input type="checkbox"/> Warning activates	<input type="checkbox"/> Long stopping distance	<input type="checkbox"/> Abnormal pedal action	<input type="checkbox"/> A.B.S. doesn't work	<input type="checkbox"/> A.B.S. works but warning activates	<input type="checkbox"/> A.B.S. works frequently
Engine conditions		<input type="checkbox"/> When starting <input type="checkbox"/> Engine speed: 5,000 rpm or more			<input type="checkbox"/> After starting		
Road conditions		<input type="checkbox"/> Low friction road ( <input type="checkbox"/> Snow <input type="checkbox"/> Gravel <input type="checkbox"/> Other) <input type="checkbox"/> Protrusion					
Driving conditions		<input type="checkbox"/> High speed cornering <input type="checkbox"/> Vehicle speed: Greater than 10 km/h (6 MPH) <input type="checkbox"/> Vehicle speed: 10 km/h (6 MPH) or less <input type="checkbox"/> Vehicle is stopped					
Applying brake conditions		<input type="checkbox"/> Suddenly <input type="checkbox"/> Gradually					
Other conditions		<input type="checkbox"/> Operation of electrical equipment <input type="checkbox"/> Large pedal stroke <input type="checkbox"/> Operation of clutch					



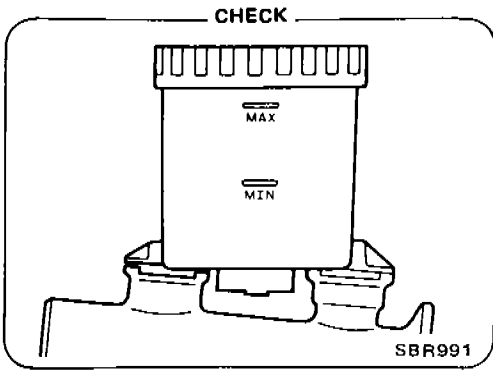
# TROUBLE DIAGNOSES

## Symptom Chart

PROCEDURE	Preliminary Check	Diagnostic Procedure						Diagnostic Procedure (Select inspection with L.E.D. flashing No.)						Ground Circuit Check	Electrical Components Inspection
REFERENCE PAGE	BR-42	Preliminary Check 1													
	BR-43	Preliminary Check 2													
	BR-44	Preliminary Check 3													
	BR-44	Preliminary Check 4													
SYMPTOM		BR-50	Diagnostic Procedure 1												
		BR-51	Diagnostic Procedure 2												
		BR-52	Diagnostic Procedure 3												
		BR-52	Diagnostic Procedure 4												
		BR-53	Diagnostic Procedure 5												
		BR-53	Diagnostic Procedure 6												
		BR-54	L.E.D. flashing 1 - 4												
		BR-55	L.E.D. flashing 5 - 8												
		BR-56	L.E.D. flashing 9												
		BR-57	L.E.D. flashing 10												
		BR-58	L.E.D. flashing 16												
		BR-59	L.E.D. goes off												
		BR-48	Sensor shield												
		BR-48	Motor ground												
		BR-60	Actuator inspection												

# TROUBLE DIAGNOSES

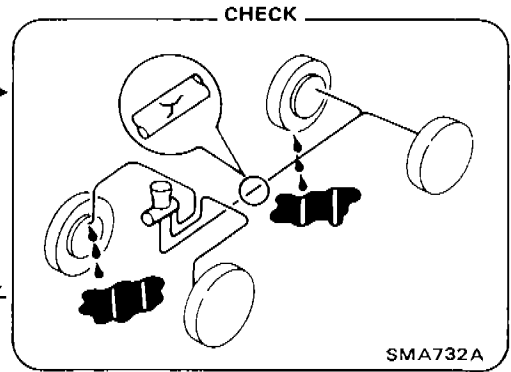
## Preliminary Check 1



Check brake fluid level in reservoir tank.

N.G. → Fill up brake fluid.

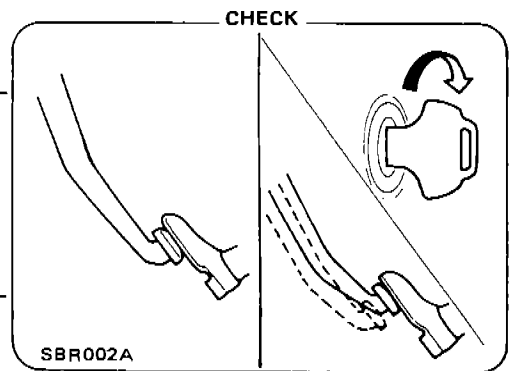
O.K. →



N.G. ← Repair brake system.

Check brake system.  
Refer to CHECK AND ADJUSTMENT.

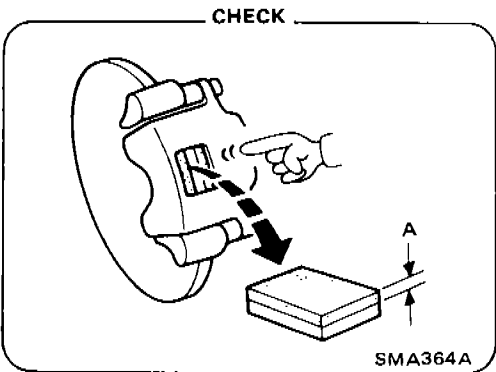
O.K. ↓



N.G. ← Repair or replace booster system.

O.K. →

Check brake booster operation and airtightness.  
Refer to "Inspection" of BRAKE BOOSTER.

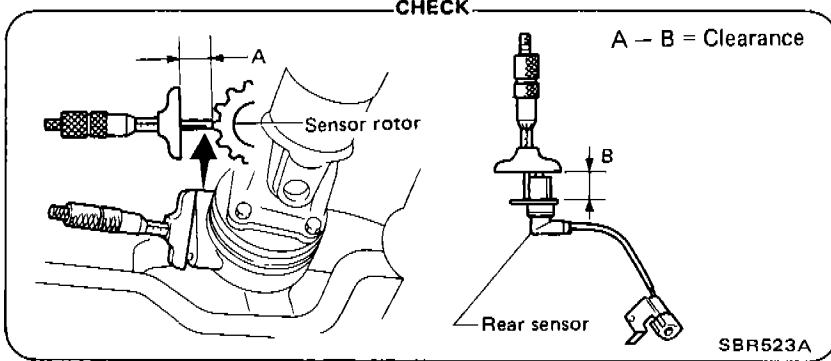
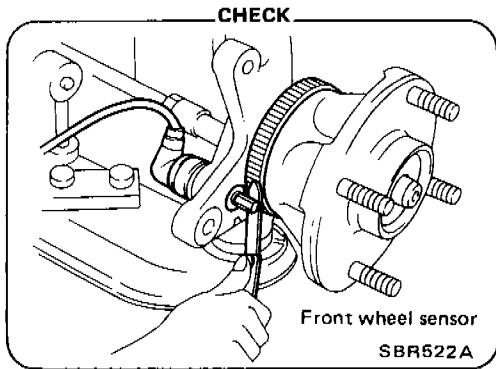


Check brake pads and rotor.  
Refer to "Inspection" of FRONT and REAR DISC BRAKE.

N.G. → Replace malfunctioning parts.

# TROUBLE DIAGNOSES

## Preliminary Check 2



Check sensor clearance.

	Clearance mm (in)
Front wheel sensor	0.275 - 0.75 (0.0108 - 0.0295)
Rear sensor	0.35 - 0.625 (0.0138 - 0.0246)

N.G.

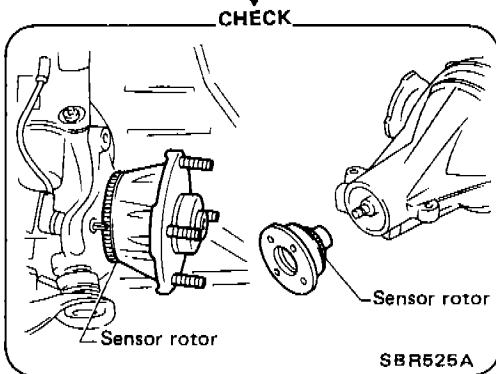
Check sensor for the following items:

- Dust, foreign materials, etc., at fastening portion
- Improper installation
- Breakage

O.K.

N.G.

Repair or replace malfunctioning sensor.



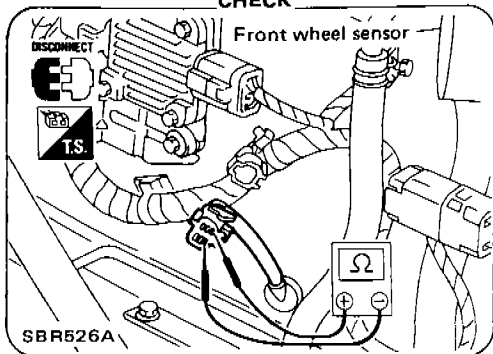
N.G.

Replace sensor rotor with wheel hub or companion flange as a set.

Check sensor rotor for teeth damage.

# TROUBLE DIAGNOSES

## Preliminary Check 3 CHECK



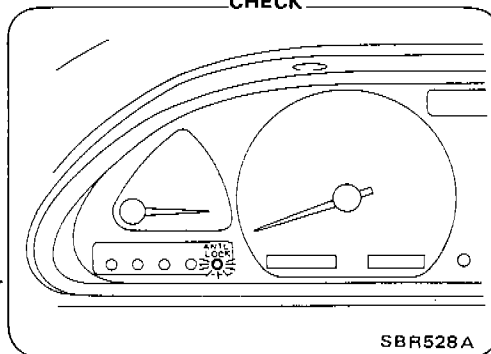
Measure each sensor resistance.  
0.8 - 1.2 kΩ

N.G. → Replace.

O.K. →

## Preliminary Check 3, 4

## Preliminary Check 4 CHECK



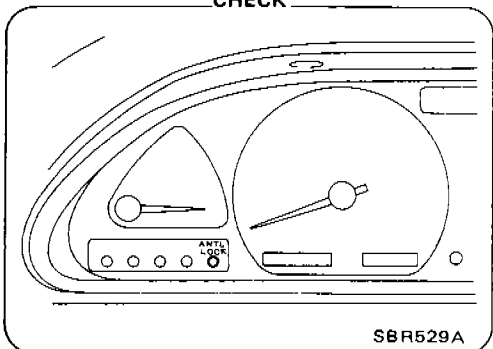
Check warning lamp activation.  
When ignition switch is turned on, warning lamp turns on.

O.K. →

N.G. ↓

Check fuse.  
Check bulb condition and remedy.

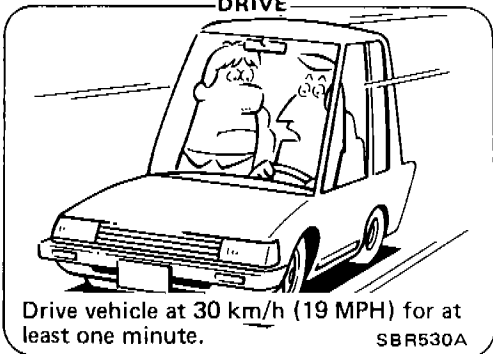
## CHECK



Check warning lamp for deactivation.  
When engine starts, warning lamp deactivates.

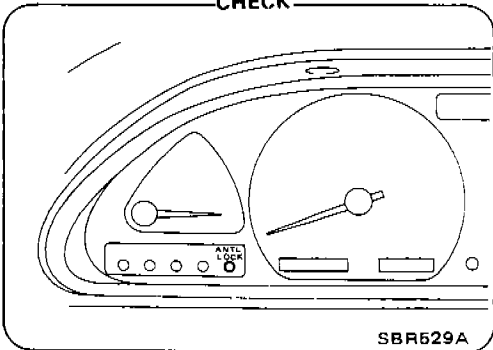
O.K. ↓

## DRIVE



Drive vehicle at 30 km/h (19 MPH) for at least one minute.

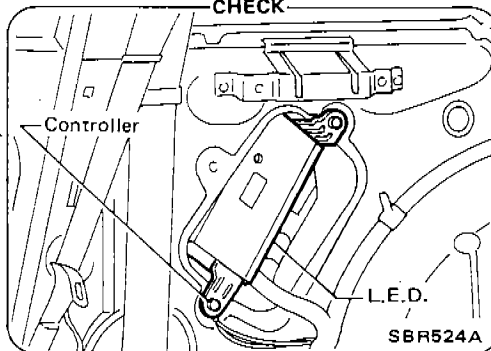
## CHECK



Ensure warning lamp remains off while driving.

N.G. →

## CHECK



- Keep engine on and running.
- Remove rear side finisher.  
R.H. model: R.H. side  
L.H. model: L.H. side
- Count the number of L.E.D. flashes during 5 to 10 second "OFF" period.

Go to Self-diagnosis.  
(See page BR-45.)

N.G. →

O.K. →

If Preliminary Check 2 is not performed and there is abnormal A.B.S. operation, perform Preliminary Check 2.

# TROUBLE DIAGNOSES

## Self-diagnosis

### CHECKING THE NUMBER OF L.E.D. FLASHES

When a problem occurs in the A.B.S., the warning light on the instrument panel comes on. As shown in the Table, the control unit performs self-diagnosis.

To obtain satisfactory self-diagnosing results, the vehicle must be driven above 30 km/h (19 MPH) for at least one minute before the self-diagnosis is performed. After the vehicle is stopped, the number of L.E.D. flashes is counted while the engine is running.

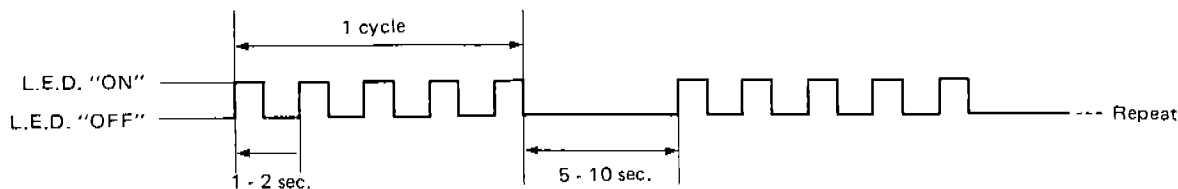
The L.E.D. is located on the control unit, identifying a malfunctioning part or unit by the number of flashes. Both the warning light and the L.E.D. persistently activate, even after a malfunctioning part or unit has been repaired, unless the ignition switch is turned "OFF". After repairs, turn the ignition switch "OFF". Then start the engine and drive the vehicle over 30 km/h (19 MPH) for at least one minute to ensure that the malfunctioning part or unit has been repaired properly.

If more than two circuits malfunction at the same time, the L.E.D. will flash to indicate one of the malfunctioning circuits. After the circuit has been repaired, the L.E.D. will then flash to indicate that the other circuit is malfunctioning.

No. of L.E.D. flashes	Malfunctioning part or unit
1	Left front actuator solenoid circuit
2	Right front actuator solenoid circuit
3 or 4	Rear actuator solenoid circuit
5	Left front rotor sensor circuit
6	Right front rotor sensor circuit
7 or 8	Rear rotor sensor circuit
9	Actuator motor, motor relay circuit
10	Actuator solenoid valve relay
16	Control unit
Warning activates and L.E.D. "OFF"	Power supply or ground circuit for control unit

#### Example

Improper operation of left front rotor sensor circuit

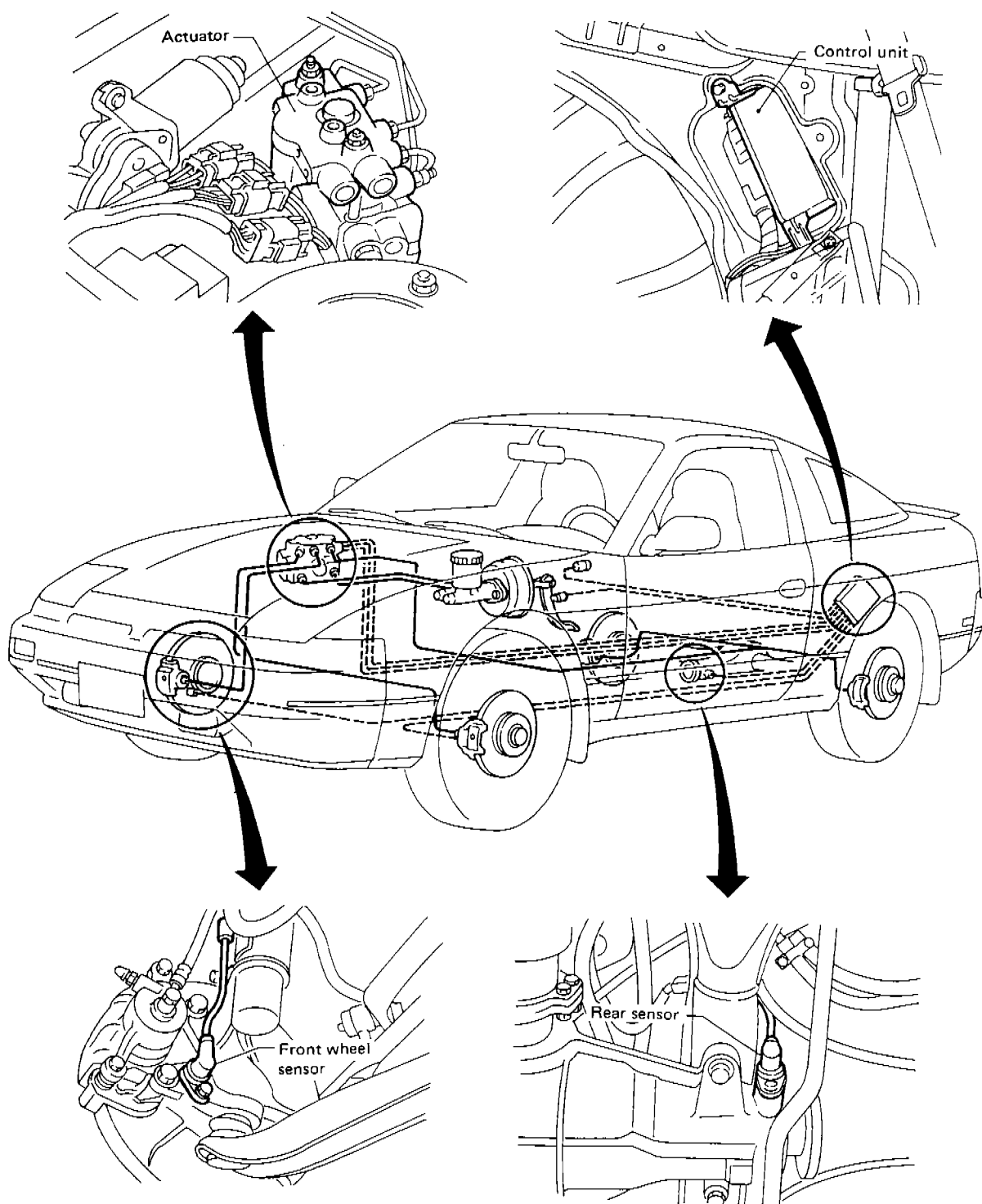


SBR531A

Go to Diagnostic Procedure from 7 to 10, where malfunction portion is concerned.

# TROUBLE DIAGNOSES

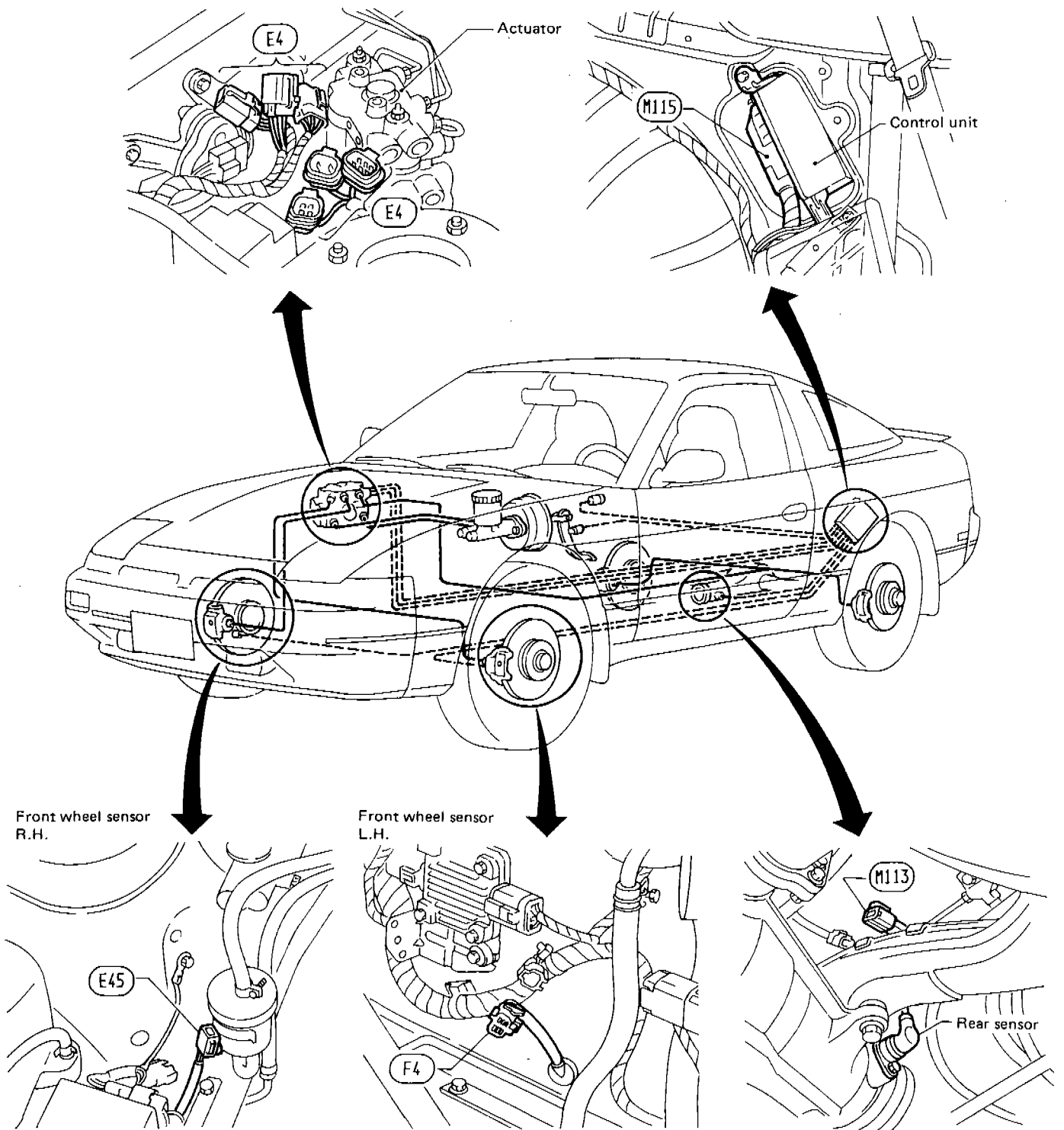
## Component Parts Location



SBR532A

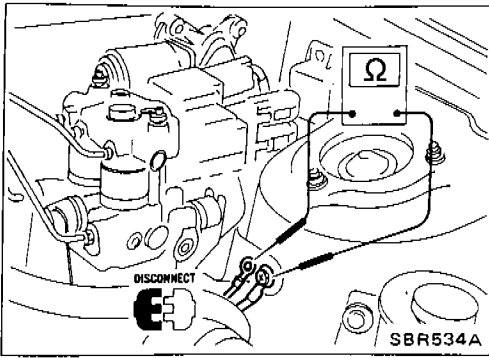
# TROUBLE DIAGNOSES

## Harness Connector Location



SBR533A

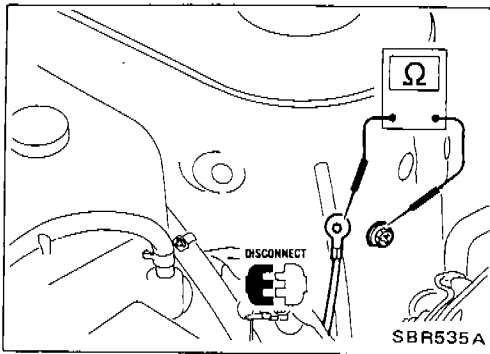
## TROUBLE DIAGNOSES



### Ground Circuit Check

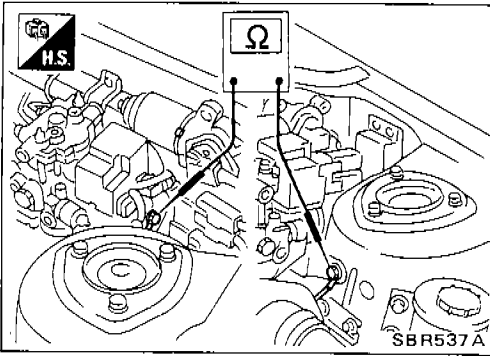
#### FRONT WHEEL SENSOR L.H. SHIELDED WIRE GROUND

- Check resistance between both terminals.  
Resistance:  $0\Omega$



#### FRONT WHEEL SENSOR R.H. SHIELDED WIRE GROUND

- Check resistance between both terminals.  
Resistance:  $0\Omega$



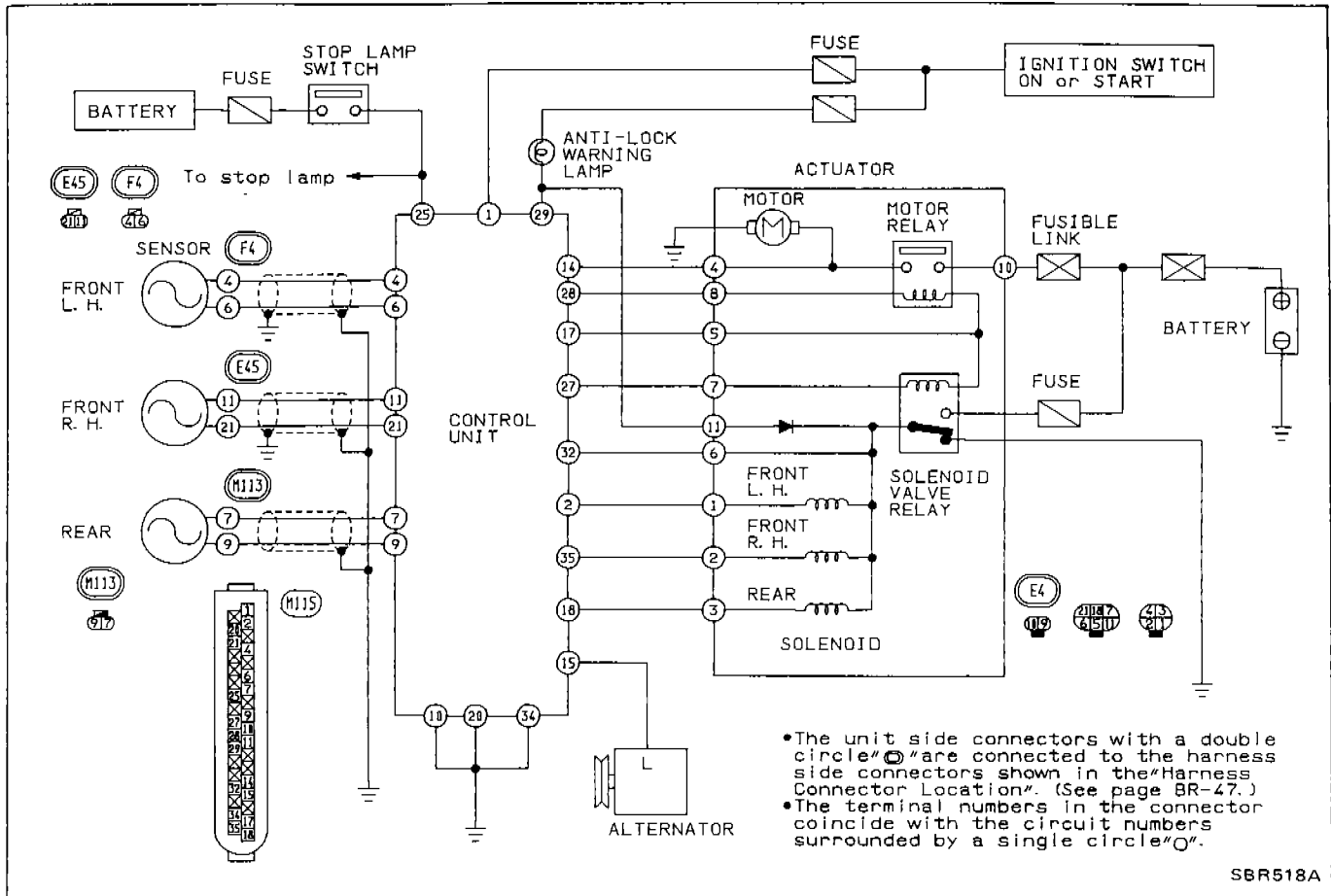
#### ACTUATOR MOTOR GROUND

- Check resistance between both terminals.  
Resistance:  $0\Omega$



# TROUBLE DIAGNOSES

## Circuit Diagram for Quick Pinpoint Check



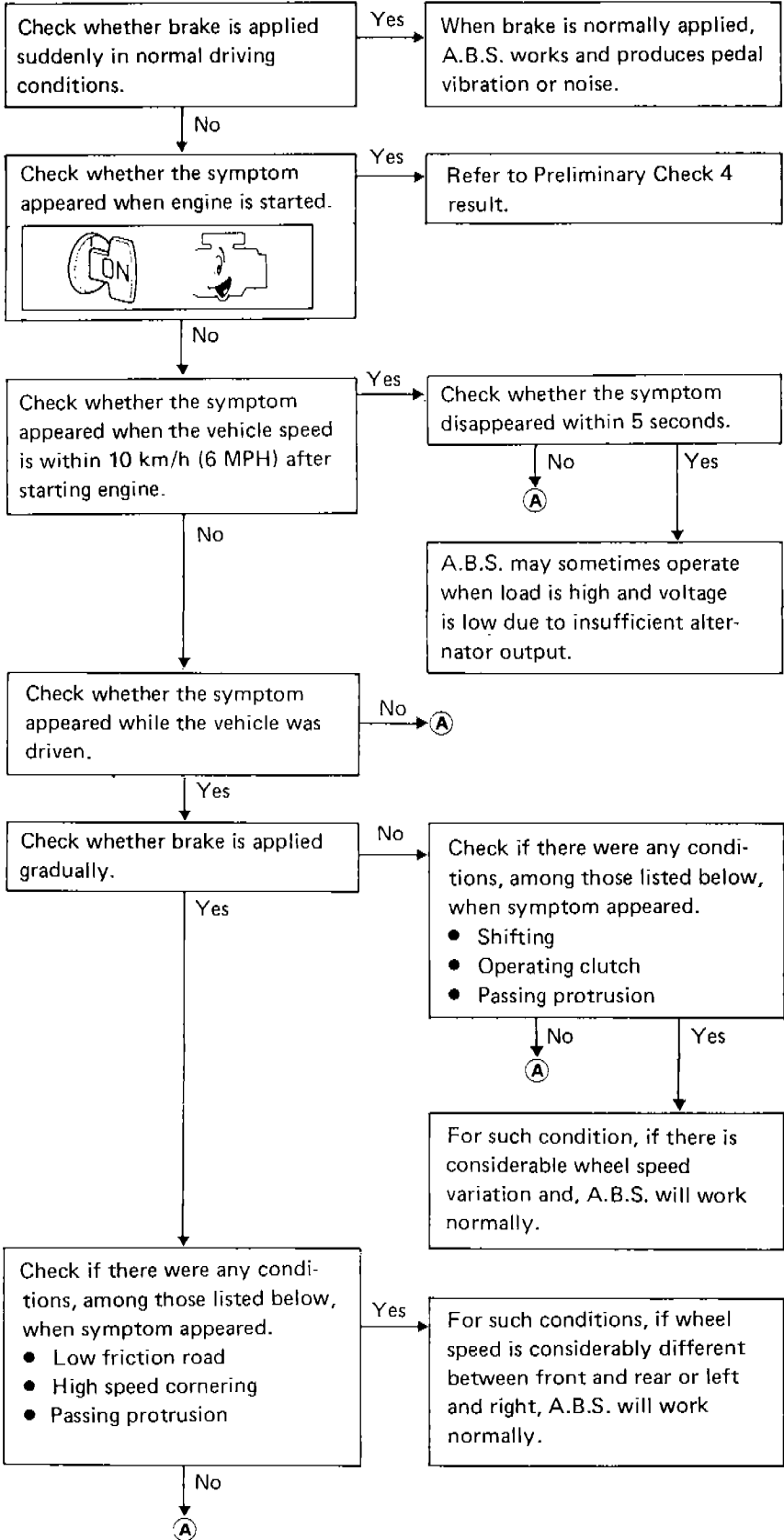
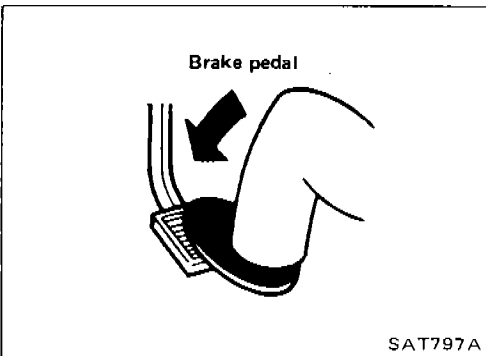
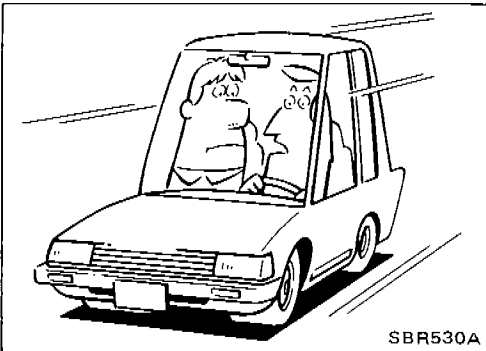
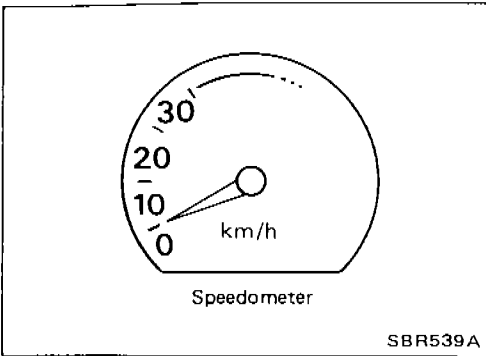
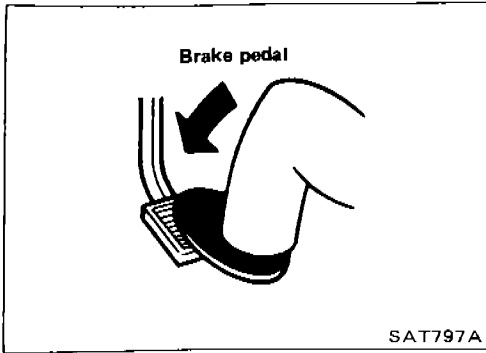
SBR518A

# TROUBLE DIAGNOSES

## Diagnostic Procedure 1

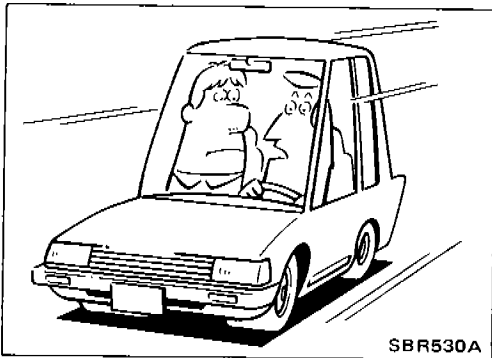
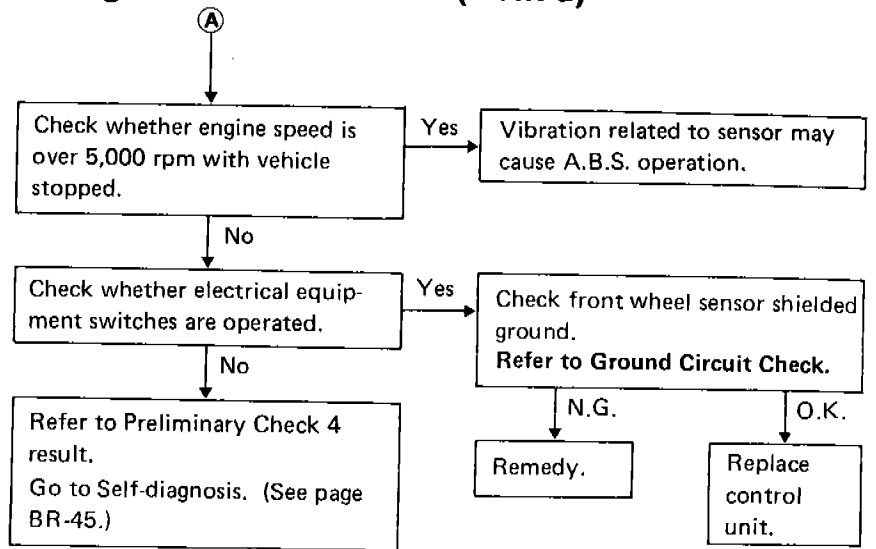
**SYMPTOM: Pedal vibration and noise**

Refer to worksheet results.



# TROUBLE DIAGNOSES

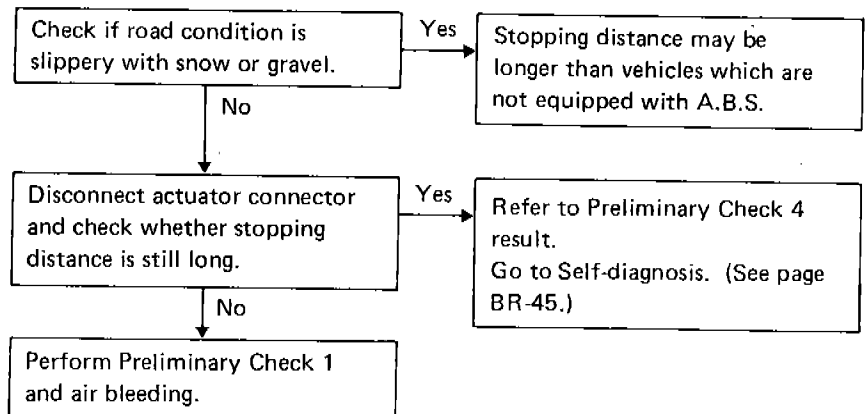
## Diagnostic Procedure 1 (Cont'd)



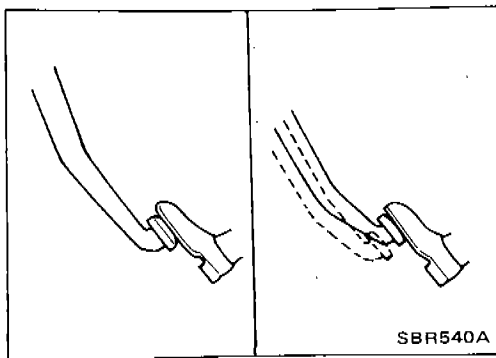
## Diagnostic Procedure 2

**SYMPTOM:** Long stopping distance

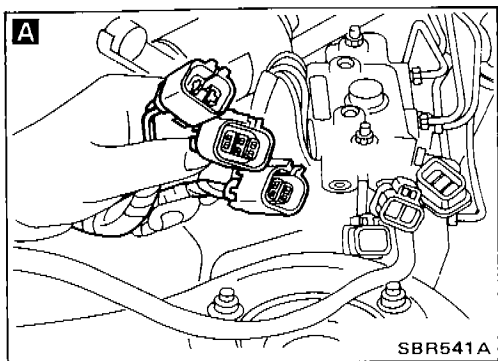
Refer to worksheet results.



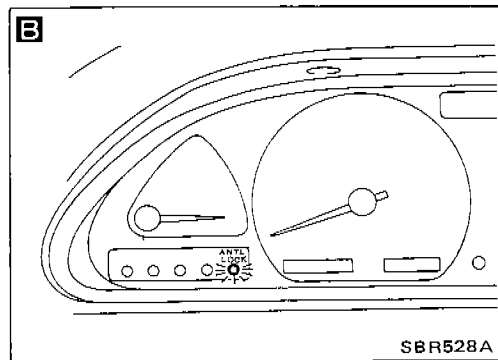
# TROUBLE DIAGNOSES



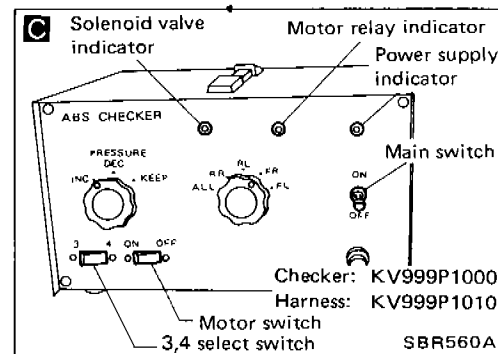
SBR540A



SBR541A



SBR528A

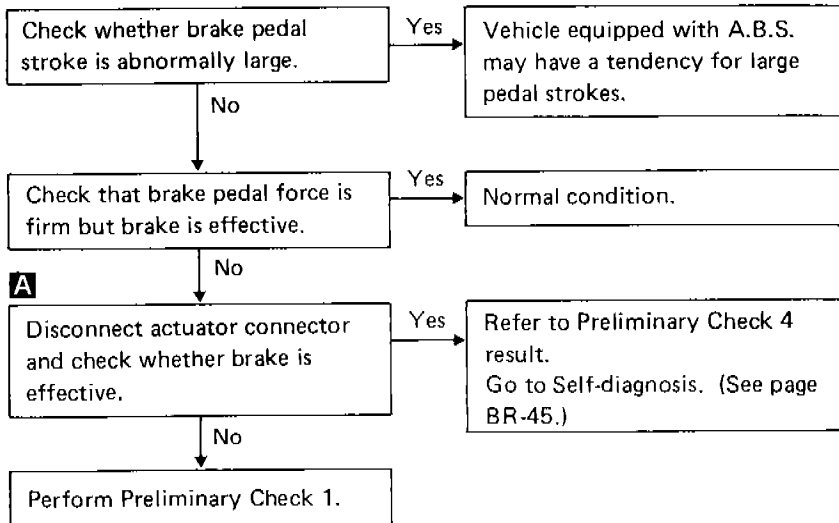


SBR560A

## Diagnostic Procedure 3

**SYMPTOM: Abnormal pedal action**

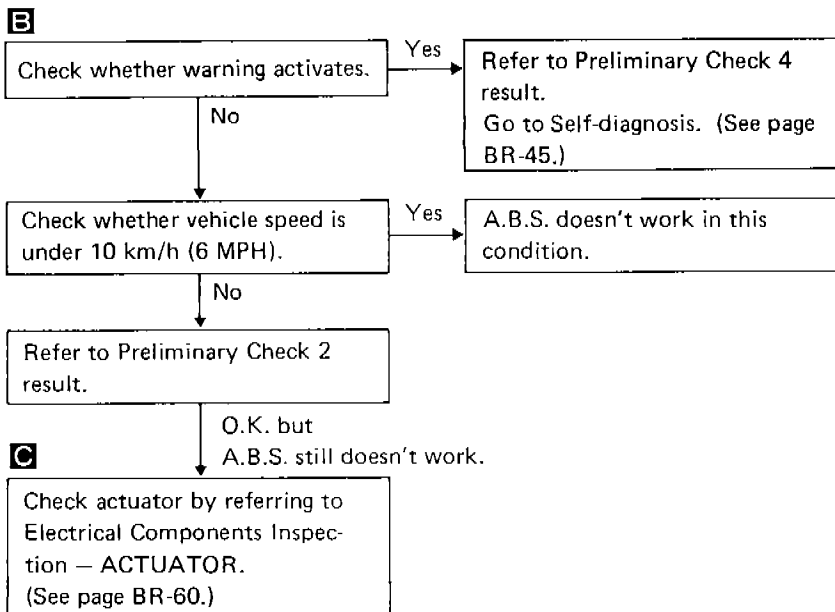
Refer to worksheet results.



## Diagnostic Procedure 4

**SYMPTOM: A.B.S. doesn't work.**

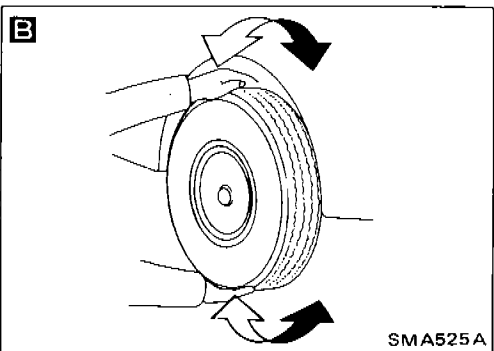
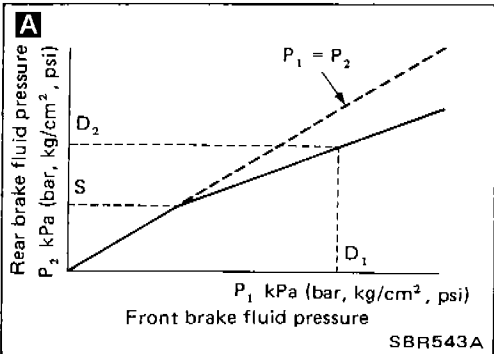
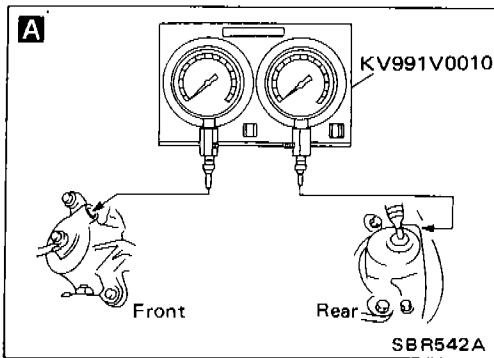
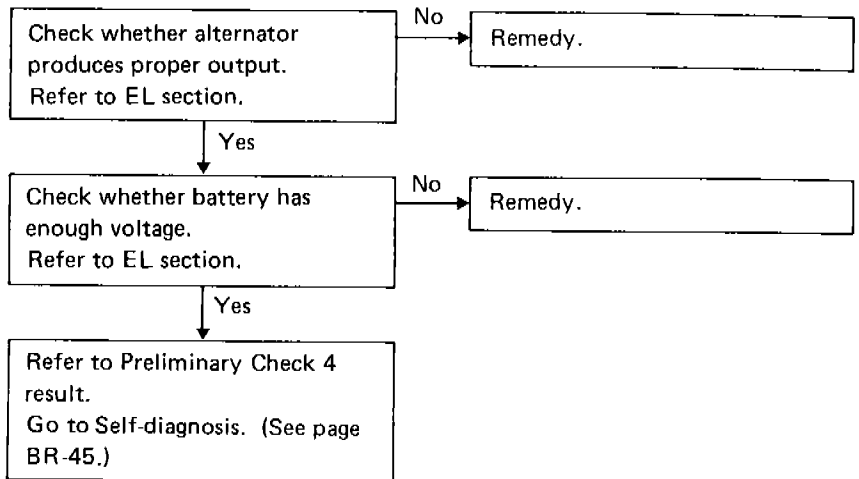
Refer to worksheet results.



# TROUBLE DIAGNOSES

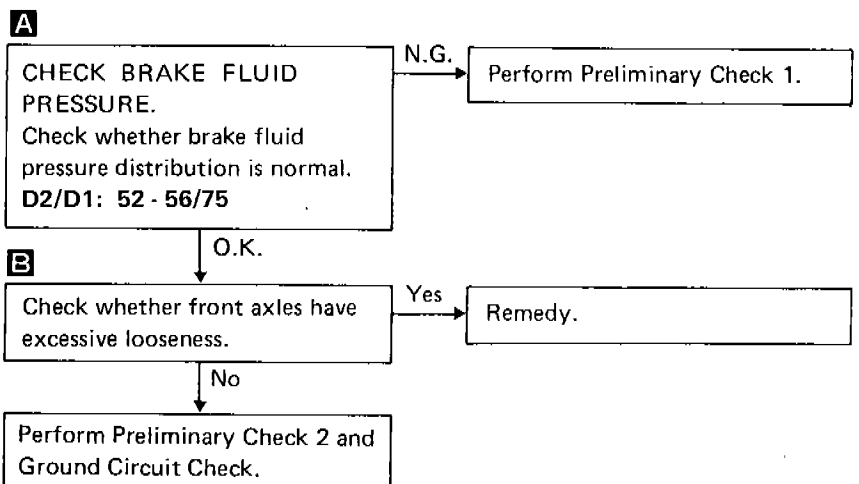
## Diagnostic Procedure 5

**SYMPTOM: A.B.S. works but warning activates.**

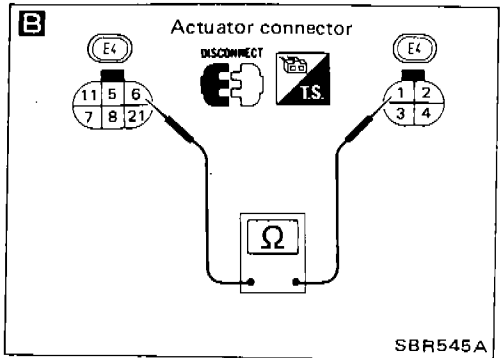
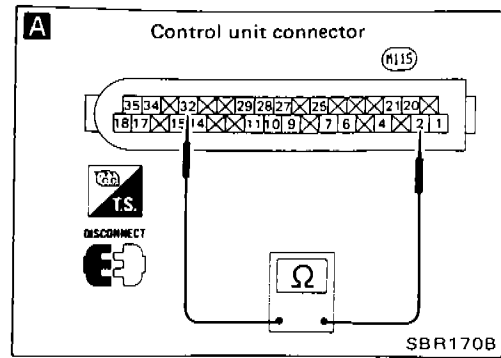


## Diagnostic Procedure 6

**SYMPTOM: A.B.S. works frequently.**



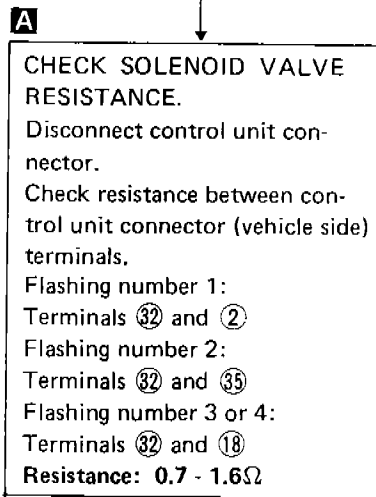
# TROUBLE DIAGNOSES



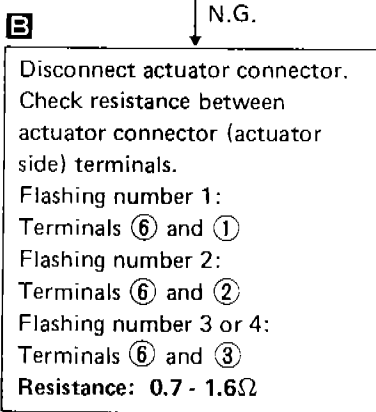
## Diagnostic Procedure 7

### ACTUATOR SOLENOID (L.E.D. flashing number 1 - 4)

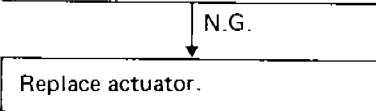
INSPECTION START  
Remove battery negative terminal connector.



O.K. → Replace control unit.



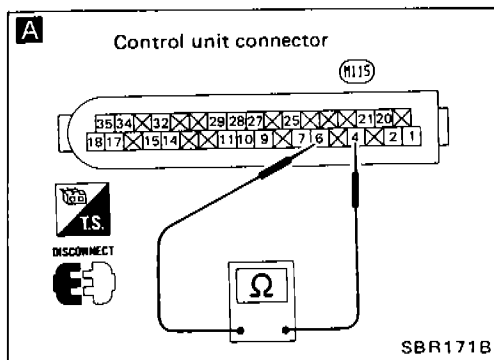
O.K. → Repair harness between actuator connector and control unit connector.



# TROUBLE DIAGNOSES

## Diagnostic Procedure 8

### WHEEL SPEED SENSOR (L.E.D. flashing number 5 - 8)



#### INSPECTION START

Remove battery negative terminal connector.

**A**

#### CHECK SPEED SENSOR RESISTANCE

Disconnect control unit connector.  
Check resistance between control unit connector (vehicle side) terminals.

Flashing number 5:

Terminals ④ and ⑥

Flashing number 6:

Terminals ⑪ and ⑫

Flashing number 7 or 8:

Terminals ⑦ and ⑨

**Resistance: 0.8 - 1.2 kΩ**

O.K.

Replace control unit.

N.G.

Refer to Preliminary Check 3 result.

Check whether sensor has 0.8 - 1.2 kΩ resistance.

N.G.

Replace sensor.

O.K.

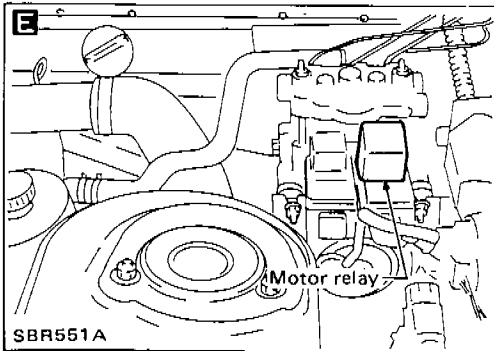
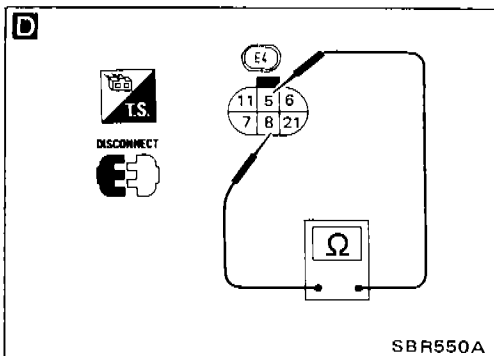
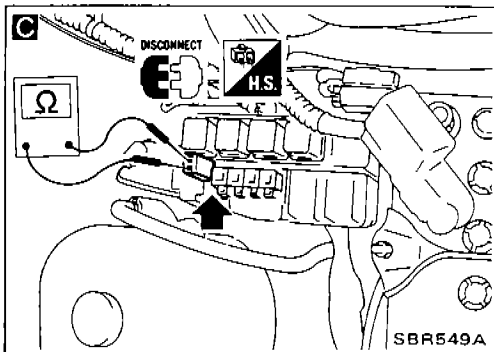
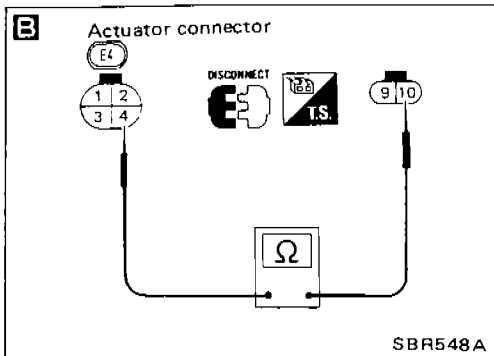
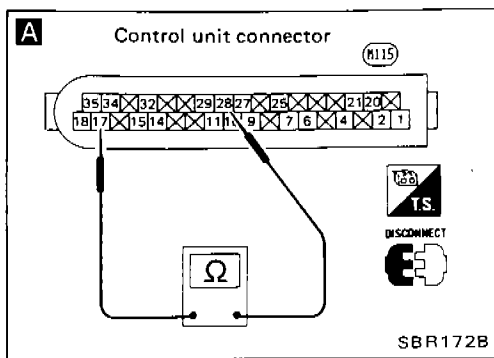
Repair harness between sensor connector and control unit connector.

# TROUBLE DIAGNOSES

## Diagnostic Procedure 9

### ACTUATOR MOTOR RELAY (L.E.D. flashing number 9)

INSPECTION START  
Remove battery negative terminal connector.



**A**  
**CHECK MOTOR RELAY SOLENOID RESISTANCE.**  
Disconnect control unit connector.  
Check resistance between control unit connector (vehicle side) terminals ⑰ and ⑳.  
Resistance: 38 - 45Ω

**B**  
**CHECK MOTOR RELAY DEACTIVATION.**  
Disconnect actuator connector.  
Check continuity between actuator connector (actuator side) terminals ④ and ⑩.

**E**  
Replace motor relay.

**C**  
Check if motor's fusible link is blown.  
Resistance:  
Approximately 0Ω

Yes  
Replace fusible link.

**D**  
Disconnect actuator connector.  
Check resistance between actuator connector (actuator side) terminals ⑧ and ⑤.  
Resistance: 38 - 45Ω

O.K.  
Repair harness between actuator and control unit.

N.G.  
**E**  
Replace motor relay.

No  
Perform Electrical Components Inspection - ACTUATOR. (See page BR-60.)

O.K.  
Replace control unit.

N.G.  
Replace actuator.

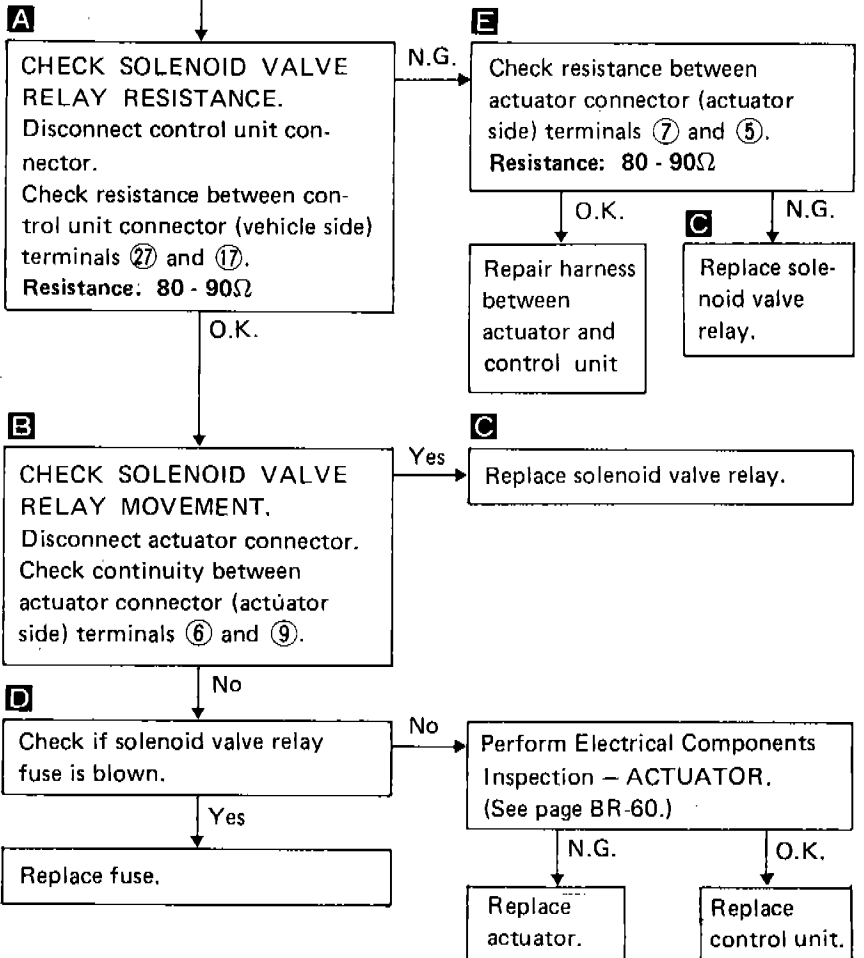
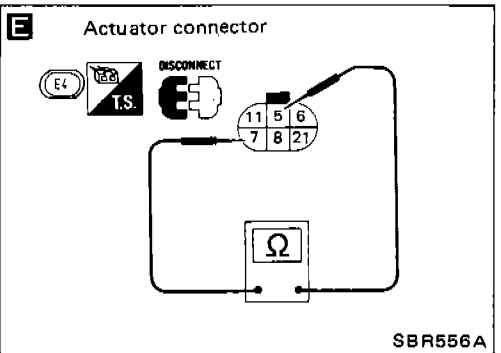
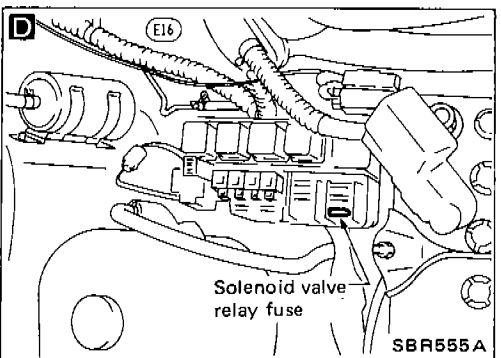
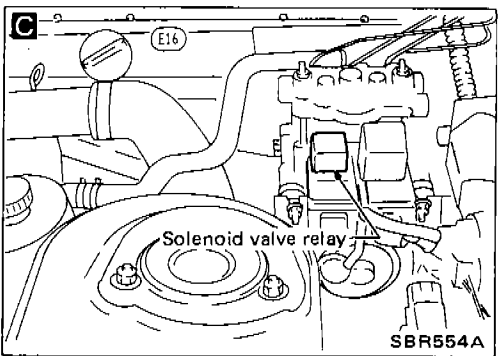
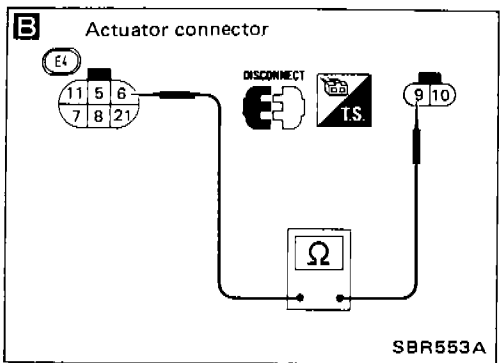
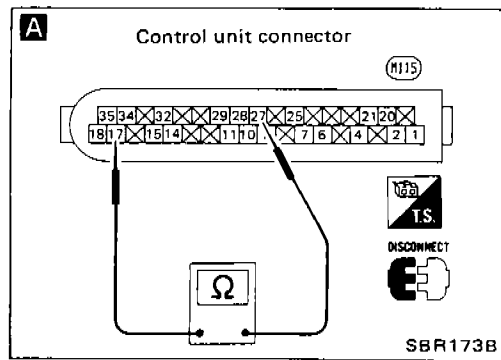


# TROUBLE DIAGNOSES

## Diagnostic Procedure 10

### ACTUATOR SOLENOID VALVE RELAY (L.E.D. flashing number 10)

**INSPECTION START**  
Remove battery negative terminal connector.

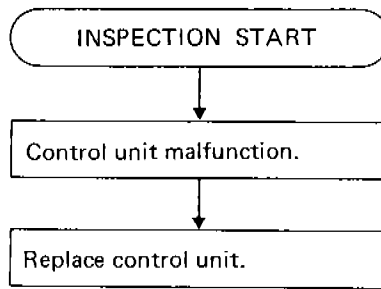


## TROUBLE DIAGNOSES

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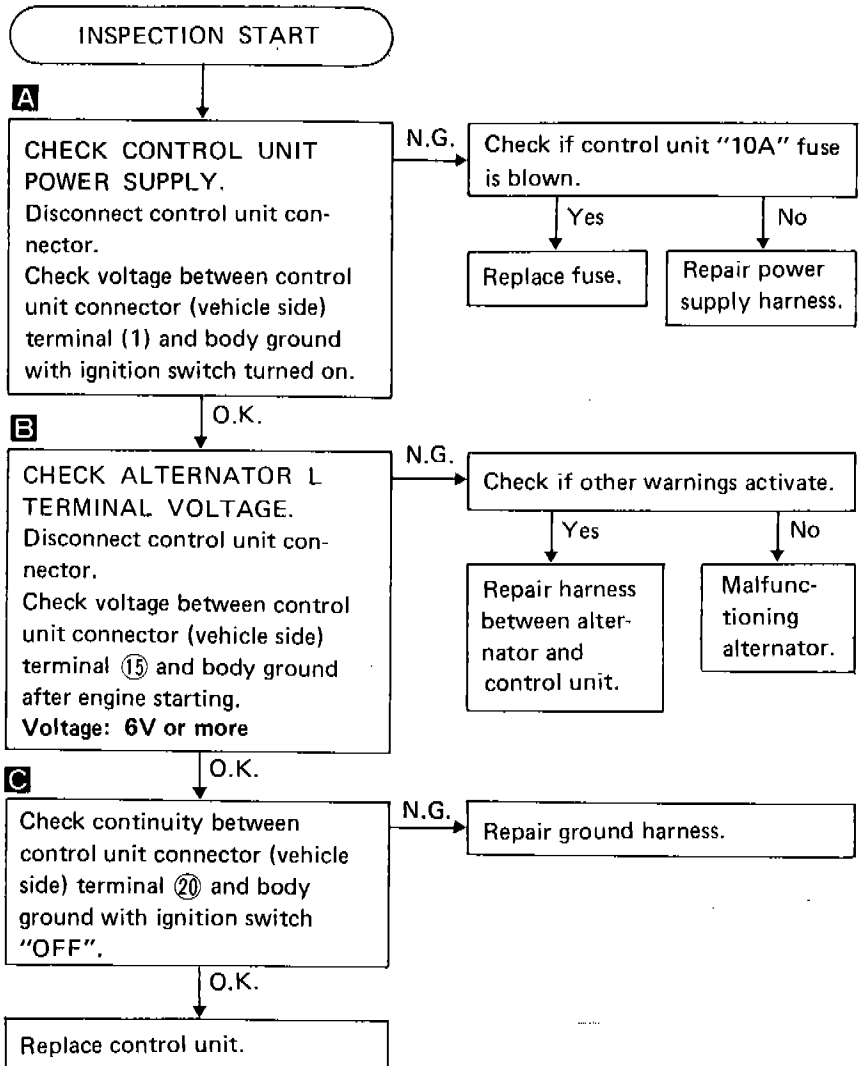
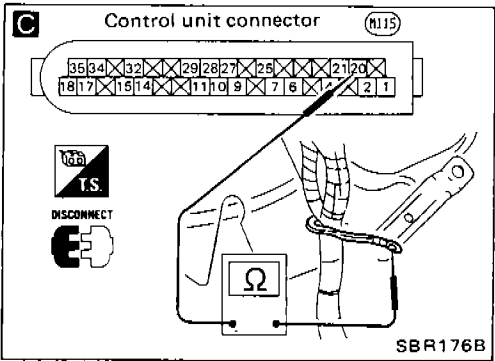
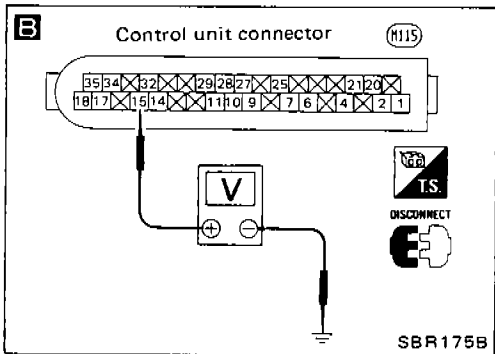
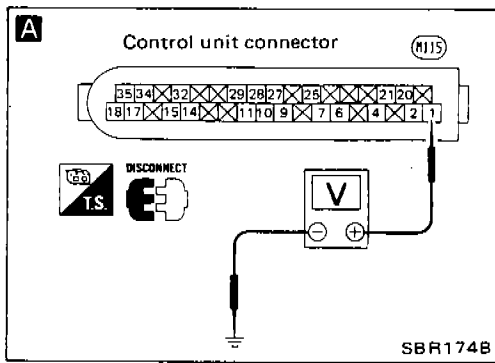
### Diagnostic Procedure 11

CONTROL UNIT (L.E.D. flashing number 16)



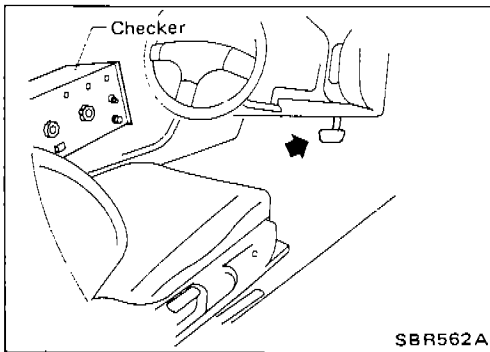
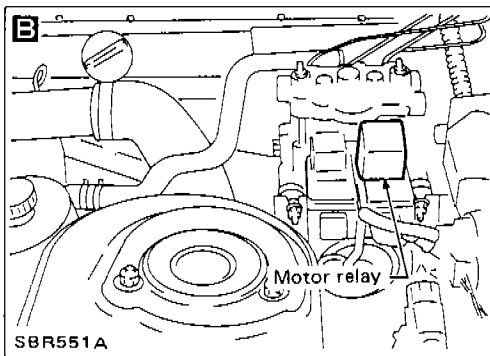
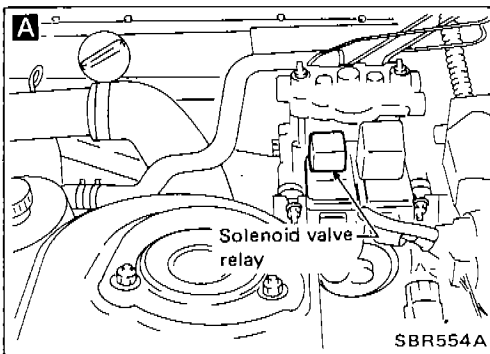
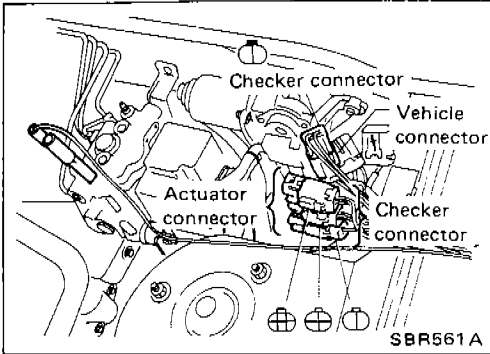
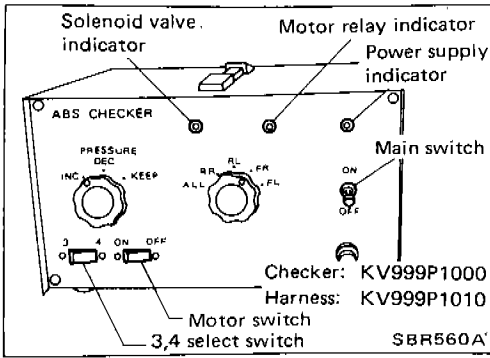
# TROUBLE DIAGNOSES

## Diagnostic Procedure 12 CONTROL UNIT OR POWER SUPPLY AND GROUND CIRCUIT (Warning activates but L.E.D. comes off.)



# TROUBLE DIAGNOSES

## Electrical Components Inspection ACTUATOR (Not self-diagnostic item)



INSPECTION START

Connect A.B.S. checker to actuator connector and vehicle harness with battery terminal connected and all checker switch turning off.  
Use harness for 3 channel.  
Set select switch to 3 channel.

Turn checker power supply switch on.  
Check power supply indicator for coming on.

No → Replace battery with fully charged new one, if checker connection is correct.

Yes → Check checker valve relay indicator for coming on.

No → **A** Replace solenoid valve relay, if checker connection is correct.

Yes → Select one valve.  
Select pressure decreasing position by switch then turn motor switch on.  
Turn motor switch off.  
Select pressure increasing position.

Repeat so that all valve will be performed.

**CAUTION:**  
Do not hold switch at the pressure decreasing position for more than 5 seconds. Otherwise, solenoid valve may be overheated and damaged.

Check motor relay indicator for coming on while motor switch is turned on.

No → **B** Replace motor relay, if checker connection is correct.

Yes → Check motor for operational sound beside the actuator in a quiet place.

No → Replace actuator as assembly, if Diagnostic Procedures 7 - 12 are already performed and checker connection is correct.

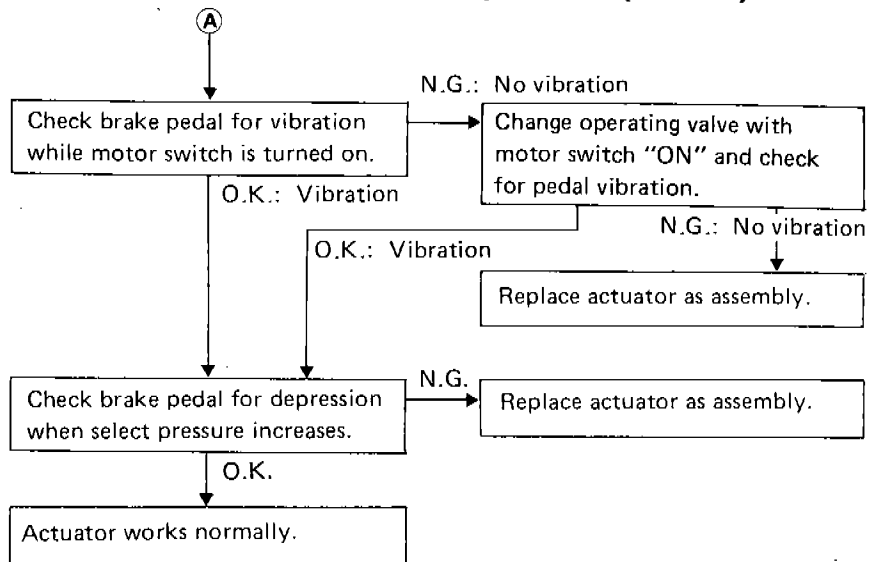
Yes → Bring checker in the vehicle and depress the brake pedal.  
Repeat step **A**.

Valve select switch position RR is used for 4 channel checking. In the case of 3 channels, brake pedal vibration or depression will not occur in position RR. It will occur, however, in position RL.

**A**

# TROUBLE DIAGNOSES

## Electrical Components Inspection (Cont'd)



# SERVICE DATA AND SPECIFICATIONS (S.D.S.)

## General Specifications

Destination	Except Europe	Europe (Without A.B.S.*)	Europe (With A.B.S.*)
<b>Front brake</b>			
Brake model	CL18VB	CL25VA	
Cylinder bore diameter   mm (in)	48.1 (1.894)	57.2 (2.252)	
Pad length x width x thickness mm (in)	100.8 x 44.3 x 10.0 (3.97 x 1.744 x 0.394)	134.1 x 45.3 x 11.0 (5.28 x 1.783 x 0.433)	
Rotor outer diameter x thickness mm (in)	250 x 18 (9.84 x 0.71)	257 x 22 (10.12 x 0.87)	
<b>Rear brake</b>			
Brake model	CL9H	AD9	
Cylinder bore diameter   mm (in)	33.96 (1.3370)	34.93 (1.3752)	
Pad length x width x thickness mm (in)	75.0 x 40.0 x 9.5 (2.953 x 1.575 x 0.374)	93.8 x 33.4 x 10.0 (3.693 x 1.315 x 0.394)	
Rotor outer diameter x thickness mm (in)	258 x 9 (10.16 x 0.35)	266 x 9 (10.47 x 0.35)	
<b>Master cylinder</b>			
Cylinder bore diameter   mm (in)	20.64 (13/16)	22.22 (7/8)	23.81 (15/16)
<b>Control valve</b>			
Valve model	Proportioning valve (within master cylinder)		
Sprit point x reducing ratio kPa (bar, kg/cm <sup>2</sup> , psi)	3,923 (39.2, 40, 569) x 0.4		
<b>Brake booster</b>			
Booster model	M23, G23	M195T	
Diaphragm diameter       mm (in)	230 (9.06)	Primary 205 (8.07) Secondary 180 (7.09)	
<b>Brake fluid</b>			
Recommended brake fluid	DOT 3		
<b>Parking brake</b>			
Control type	Center lever		
<b>Parking drum brake</b>			
Brake model	—	DS17HD	
Lining Width x thickness x length mm (in)	—	154.1 x 25.0 x 3.0 (6.07 x 0.984 x 0.118)	
Drum inner diameter       mm (in)	—	172.0 (6.77)	

\*Anti-lock Braking System

# SERVICE DATA AND SPECIFICATIONS (S.D.S.)

## Inspection and Adjustment

### FRONT DISC BRAKE

Unit: mm (in)

Item \ Brake model	CL18VB	CL25VA
Pad wear limit Minimum thickness	2.0 (0.079)	
Rotor repair limit Minimum thickness	16.0 (0.630)	20.0 (0.787)
Maximum runout	0.07 (0.0028)	

### REAR DISC BRAKE

Unit: mm (in)

Item \ Brake model	CL9H	AD9
Pad wear limit Minimum thickness	2.0 (0.079)	
Rotor repair limit Minimum thickness	8.0 (0.315)	
Maximum runout	0.07 (0.0028)	

### PARKING DRUM BRAKE

Unit: mm (in)

Brake model	DS17H
Lining replacement limit Minimum thickness	1.5 (0.059)
Drum repair limit Maximum inner diameter	173.0 (6.81)

### BRAKE PEDAL

Unit: mm (in)

Model	L.H.D.	R.H.D.
Free height M/T	177.0 - 187.0 (6.97 - 7.36)	178.0 - 188.0 (7.01 - 7.40)
A/T	186.0 - 196.0 (7.32 - 7.72)	188.0 - 198.0 (7.40 - 7.80)
Depressed height [under force of 490 N (50 kg, 110 lb) with engine running] Except Europe M/T	90 (3.54) or more	95 (3.74) or more
A/T	100 (3.94) or more	100 (3.94) or more
Europe M/T	85 (3.35) or more	90 (3.54) or more
A/T	95 (3.74) or more	95 (3.74) or more
Clearance between pedal stopper and threaded end of stop lamp switch	0.3 - 1.0 (0.012 - 0.039)	
Clearance between pedal stopper and threaded end of A.S.C.D. switch	0.3 - 1.0 (0.012 - 0.039)	
Pedal free play at clevis	1 - 3 (0.04 - 0.12)	

### PARKING BRAKE

Control type	Center lever
Item Number of notches [under force of 196 N (20 kg, 44 lb)]	6 - 8
Number of notches (when warning switch comes on)	1