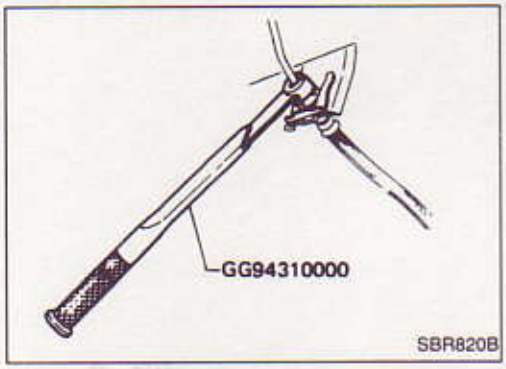
BRAKE SYSTEM

SECTION **BR**

CONTENTS

Precautions

- **Use brake fluid "DOT 4".**
- **Never reuse drained brake fluid.**
- **Be careful not to splash brake fluid on painted areas; it may cause paint damage. If brake fluid is splashed on painted areas, wash it away with water immediately.**
- **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.**



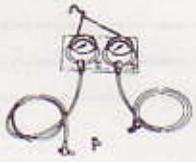
- **Use Tool when removing and installing brake tube.**

WARNING:

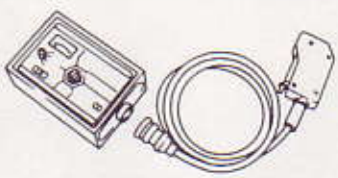
- **Clean brake pads and shoes with a vacuum dust collector to minimize the hazard of airborne asbestos or other materials.**

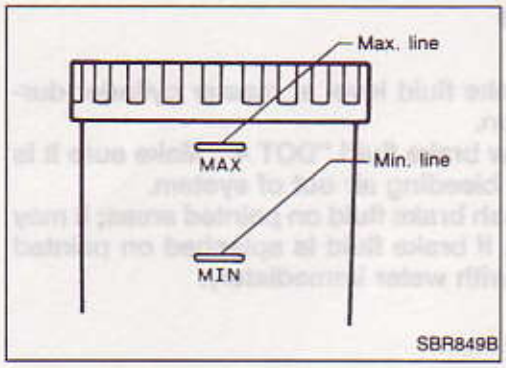
Preparation

SPECIAL SERVICE TOOLS

Tool number Tool name	Description	
GG94310000 Flare nut torque wrench		Removing and installing each brake piping
KV991V0010 Brake fluid pressure gauge		Measuring brake fluid pressure

COMMERCIAL SERVICE TOOL

Tool number Tool name	Description	
A.B.S. checker (KDAS0003)		Checking A.B.S.



Checking Brake Fluid Level

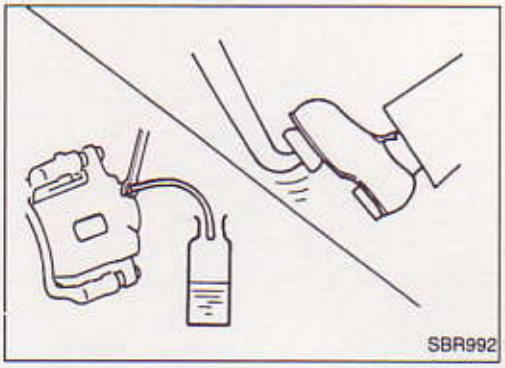
- Check fluid level in reservoir tank. It should be between Max. and Min. lines on reservoir tank.
- If fluid level is extremely low, check brake system for leaks.
- When brake warning lamp comes on even when parking brake lever is released, check brake system for leaks.

Checking Brake Line

CAUTION:

If leakage occurs around joints, retighten or, if necessary, replace damaged parts.

1. Check brake lines (tubes and hoses) for cracks, deterioration or other damage. Replace any damaged parts.
2. Check for oil leakage by fully depressing brake pedal while engine is running.

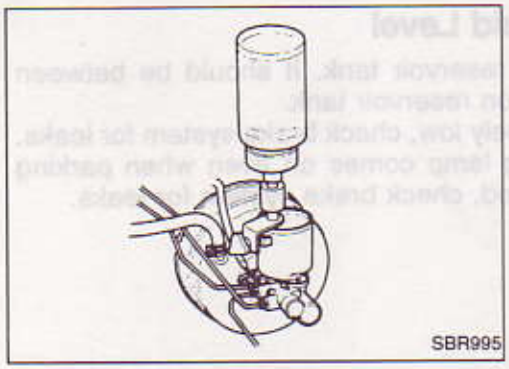


Changing Brake Fluid

CAUTION:

- **Refill with new brake fluid "DOT 4".**
- **Never reuse drained brake fluid.**
- **Be careful not to splash brake fluid on painted areas; it may cause paint damage. If brake fluid is splashed on painted areas, wash it away with water immediately.**

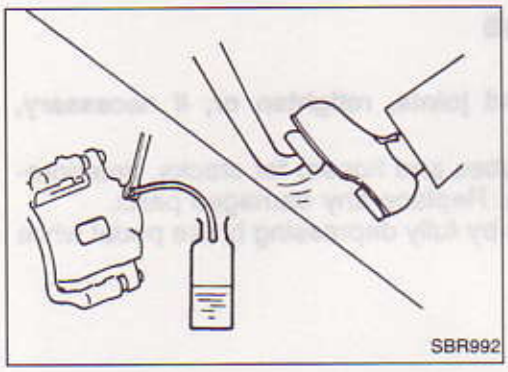
1. Connect a vinyl tube to each air bleeder valve.
2. Drain brake fluid from each air bleeder valve by depressing brake pedal.
3. Refill until new brake fluid comes out of each air bleeder valve.
   Use same procedure as in bleeding hydraulic system to refill brake fluid. Refer to "Bleeding Procedure" in "AIR BLEEDING".



Bleeding Procedure

CAUTION:

- **Carefully monitor brake fluid level at master cylinder during bleeding operation.**
- **Fill reservoir with new brake fluid "DOT 4". Make sure it is full at all times while bleeding air out of system.**
- **Be careful not to splash brake fluid on painted areas; it may cause paint damage. If brake fluid is splashed on painted areas, wash it away with water immediately.**

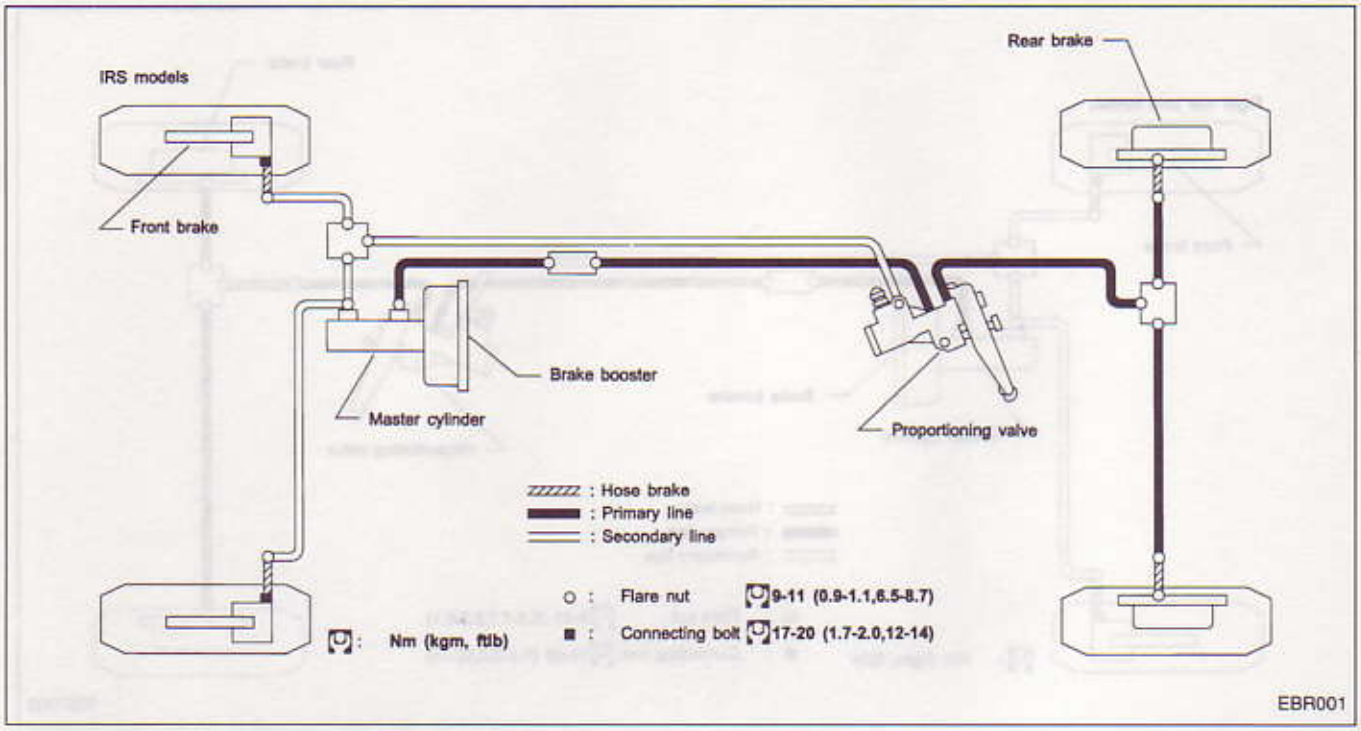


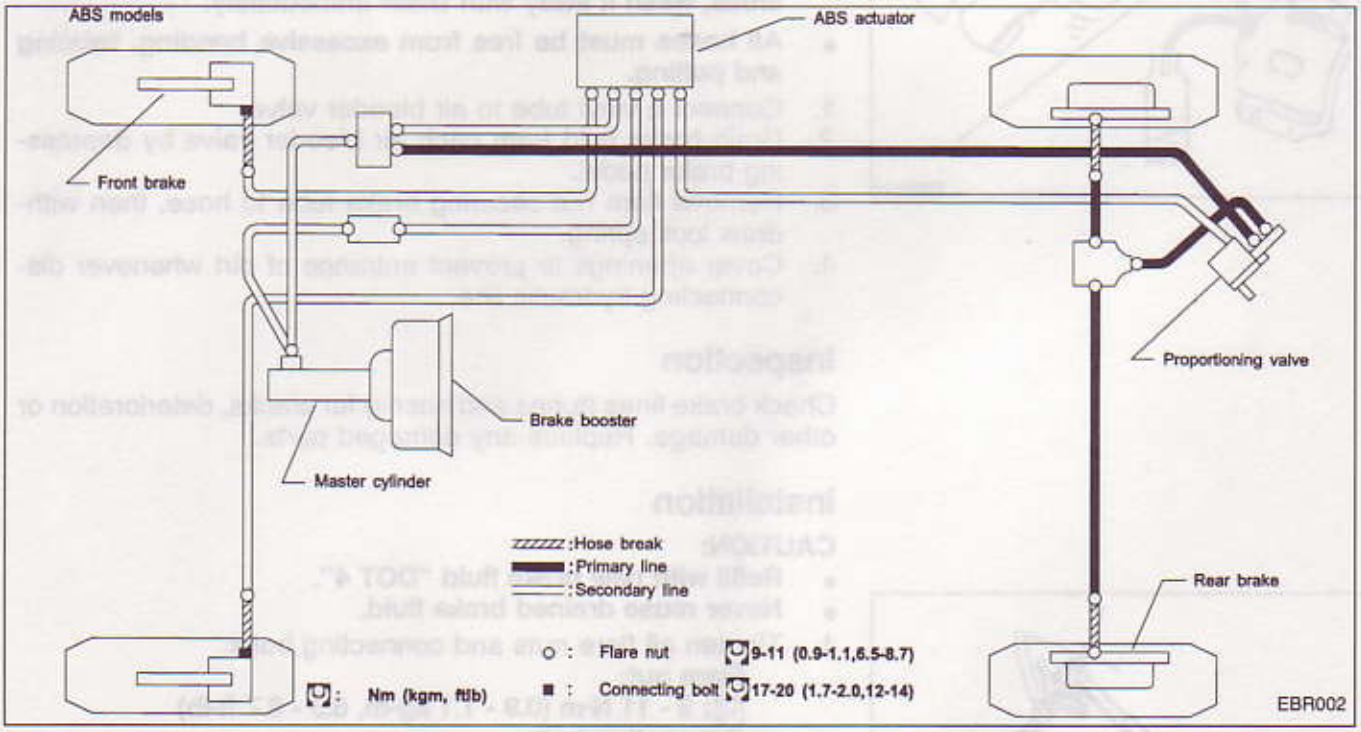
1. Connect a transparent vinyl tube to air bleeder valve.
2. Fully depress brake pedal several times.
3. With brake pedal depressed, open air bleeder valve to release air.
4. Close air bleeder valve.
5. Release brake pedal slowly.
6. Repeat steps 2. through 5. until clear brake fluid comes out of air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

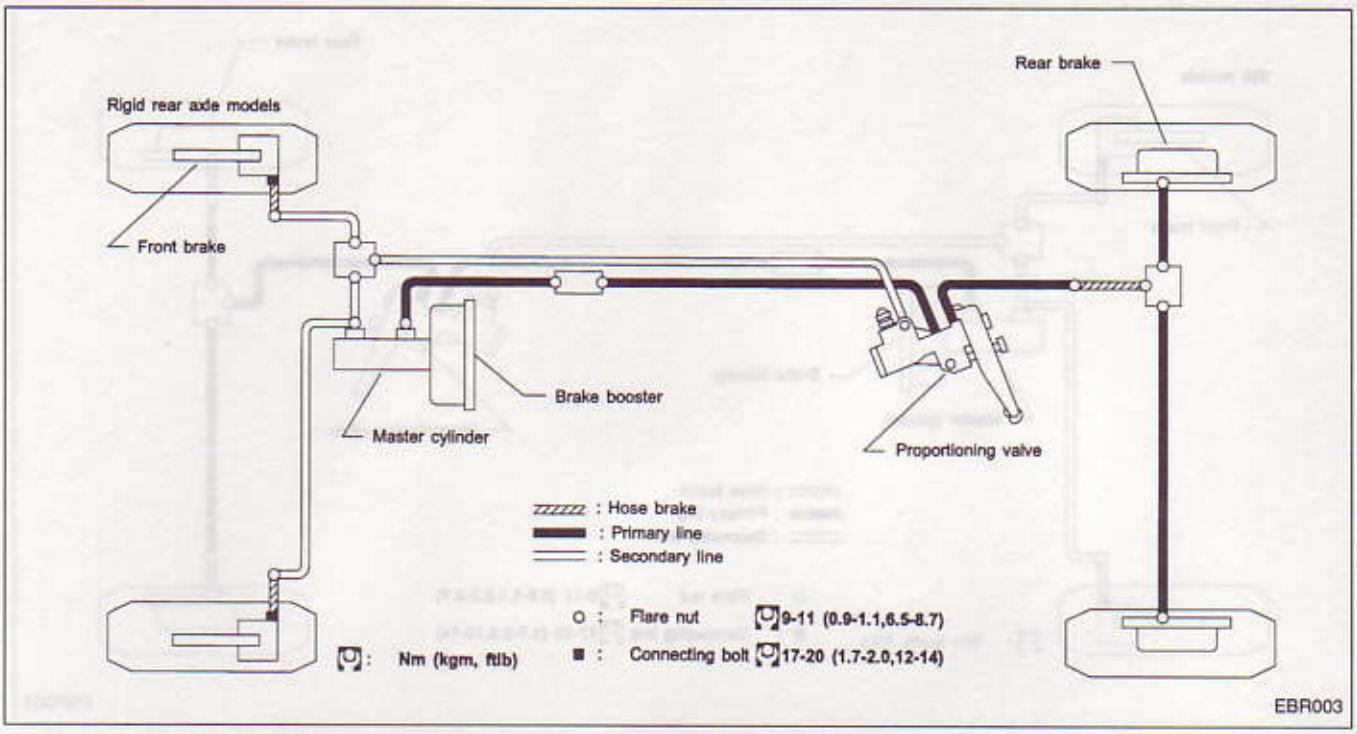
- Bleed air in the following order.

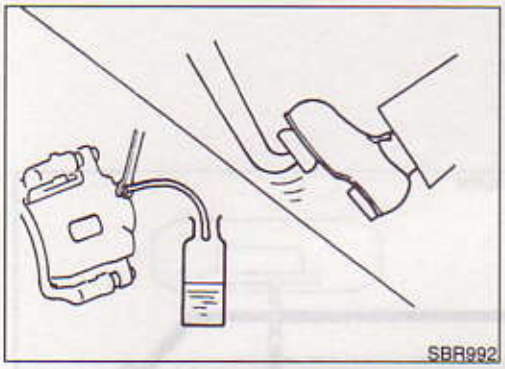
Left rear brake
↓
Right rear brake
↓
Left front brake
↓
Right front brake

BRAKE HYDRAULIC LINE









Removal

CAUTION:

- **Be careful not to splash brake fluid on painted areas; it may cause paint damage. If brake fluid is splashed on painted areas, wash it away with water immediately.**
- **All hoses must be free from excessive bending, twisting and pulling.**

1. Connect a vinyl tube to air bleeder valve.
2. Drain brake fluid from each air bleeder valve by depressing brake pedal.
3. Remove flare nut securing brake tube to hose, then withdraw lock spring.
4. Cover openings to prevent entrance of dirt whenever disconnecting hydraulic line.

Inspection

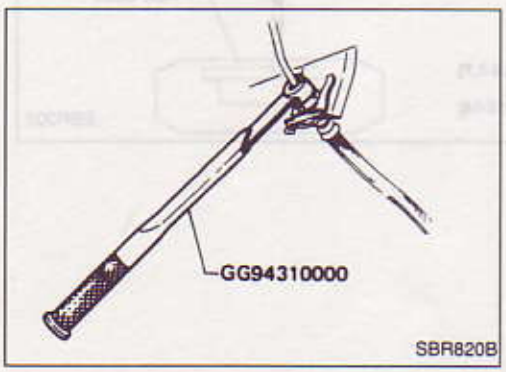
Check brake lines (tubes and hoses) for cracks, deterioration or other damage. Replace any damaged parts.

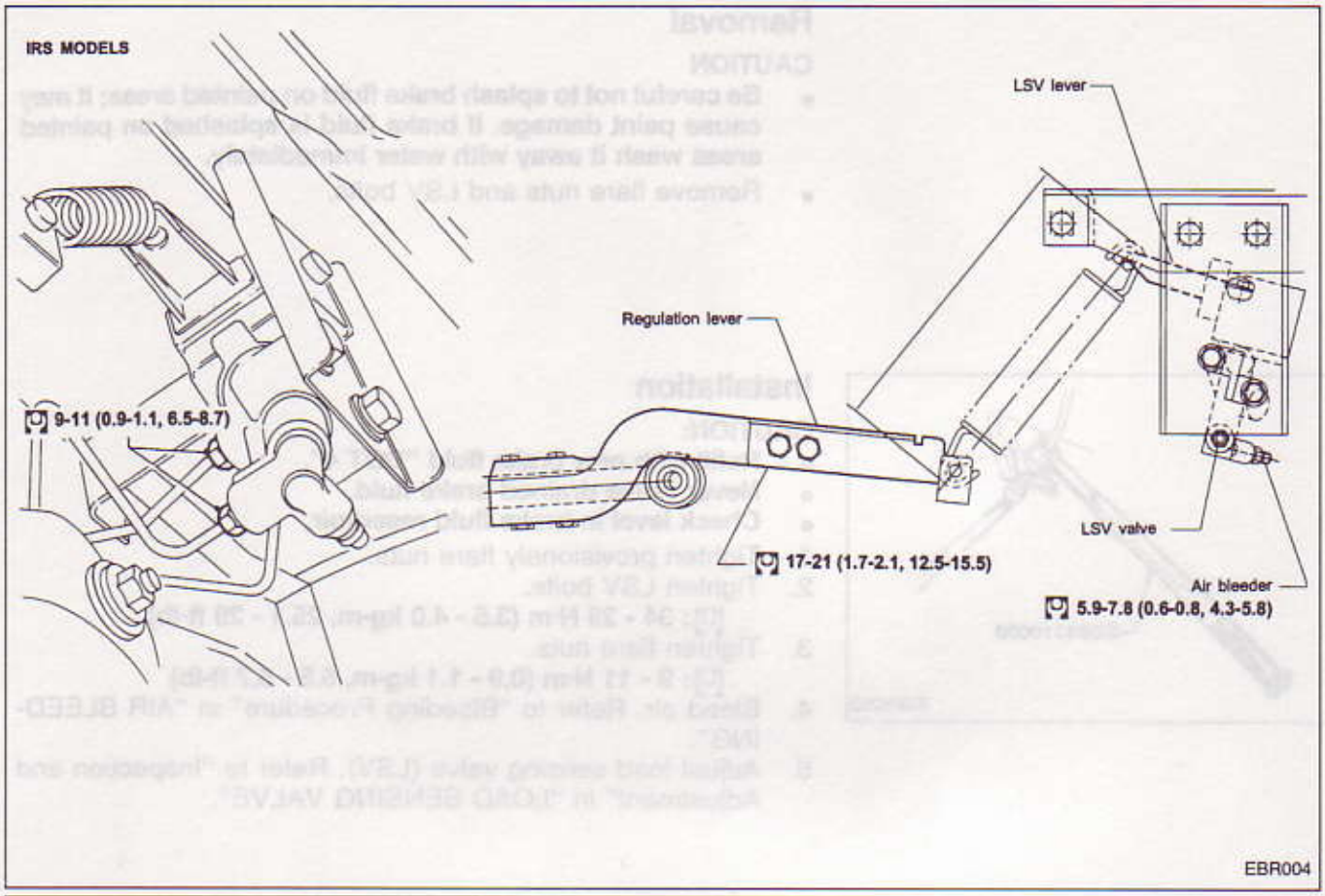
Installation

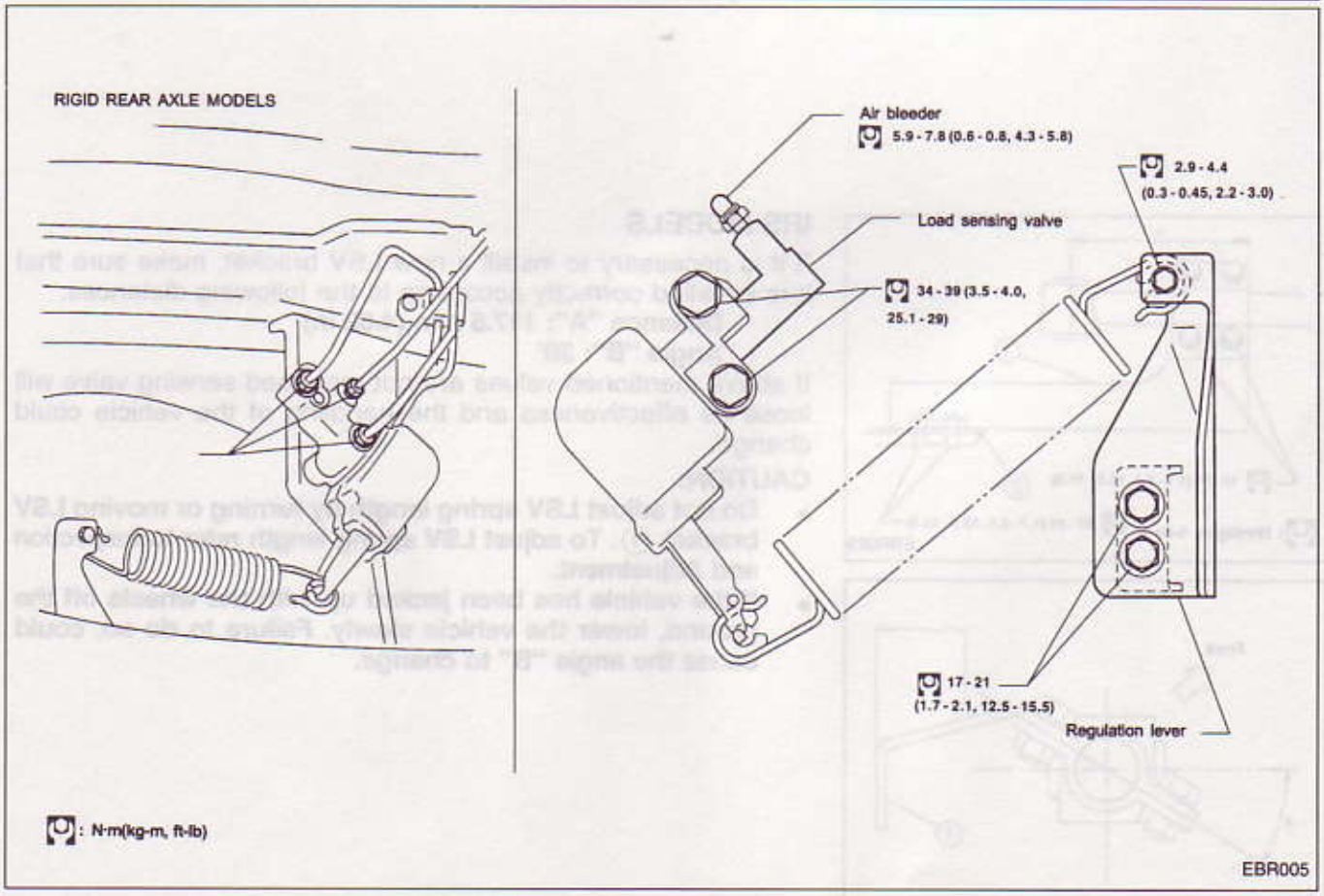
CAUTION:

- **Refill with new brake fluid "DOT 4".**
- **Never reuse drained brake fluid.**

1. Tighten all flare nuts and connecting bolts.
   Flare nut:
   : 9 - 11 N·m (0.9 - 1.1 kg-m, 6.5 - 8.7 ft-lb)
   Connecting bolt:
   : 17 - 20 N·m (1.7 - 2.0 kg-m, 12 - 14 ft-lb)
2. Refill until new brake fluid comes out of each air bleeder valve.
3. Bleed air. Refer to "Bleeding Procedure" in "AIR BLEEDING".



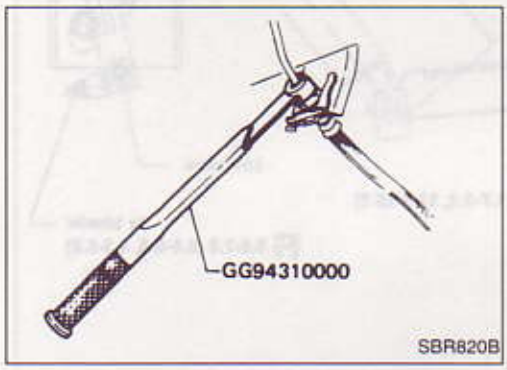

IRS MODELS
LSV lever
Regulation lever
9-11 (0.9-1.1, 6.5-8.7)
17-21 (1.7-2.1, 12.5-15.5)
LSV valve
Air bleeder
5.9-7.8 (0.6-0.8, 4.3-5.8)
EBR004


RIGID REAR AXLE MODELS
Air bleeder
5.9 - 7.8 (0.6 - 0.8, 4.3 - 5.8)
2.9 - 4.4
(0.3 - 0.45, 2.2 - 3.0)
Load sensing valve
34 - 39 (3.5 - 4.0,
25.1 - 29)
17 - 21
(1.7 - 2.1, 12.5 - 15.5)
Regulation lever
: N·m(kg-m, ft-lb)
EBR005

Removal

CAUTION

- **Be careful not to splash brake fluid on painted areas; it may cause paint damage. If brake fluid is splashed on painted areas wash it away with water immediately.**
- Remove flare nuts and LSV bolts.

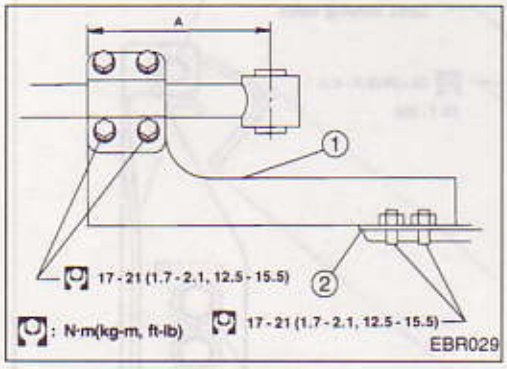


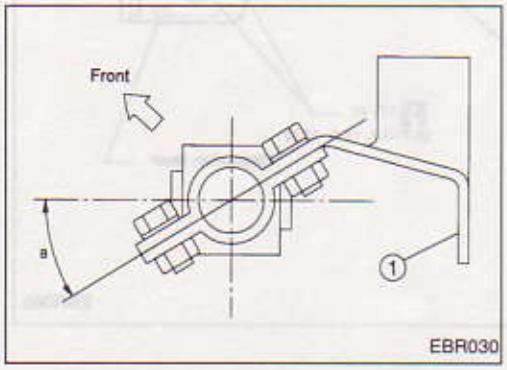
Installation

CAUTION:

- **Refill with new brake fluid "DOT 4".**
- **Never reuse drained brake fluid.**
- **Check level in brake fluid reservoir.**

1. Tighten provisionaly flare nuts.
2. Tighten LSV bolts.
   : 34 - 39 N·m (3.5 - 4.0 kg-m, 25.1 - 29 ft-lb)
3. Tighten flare nuts.
   : 9 - 11 N·m (0.9 - 1.1 kg-m, 6.5 - 8.7 ft-lb)
4. Bleed air. Refer to "Bleeding Procedure" in "AIR BLEEDING".
5. Adjust load sensing valve (LSV). Refer to "Inspection and Adjustment" in "LOAD SENSING VALVE".





IRS MODELS

If it is necessary to install a new LSV bracket, make sure that it is installed correctly according to the following distances:

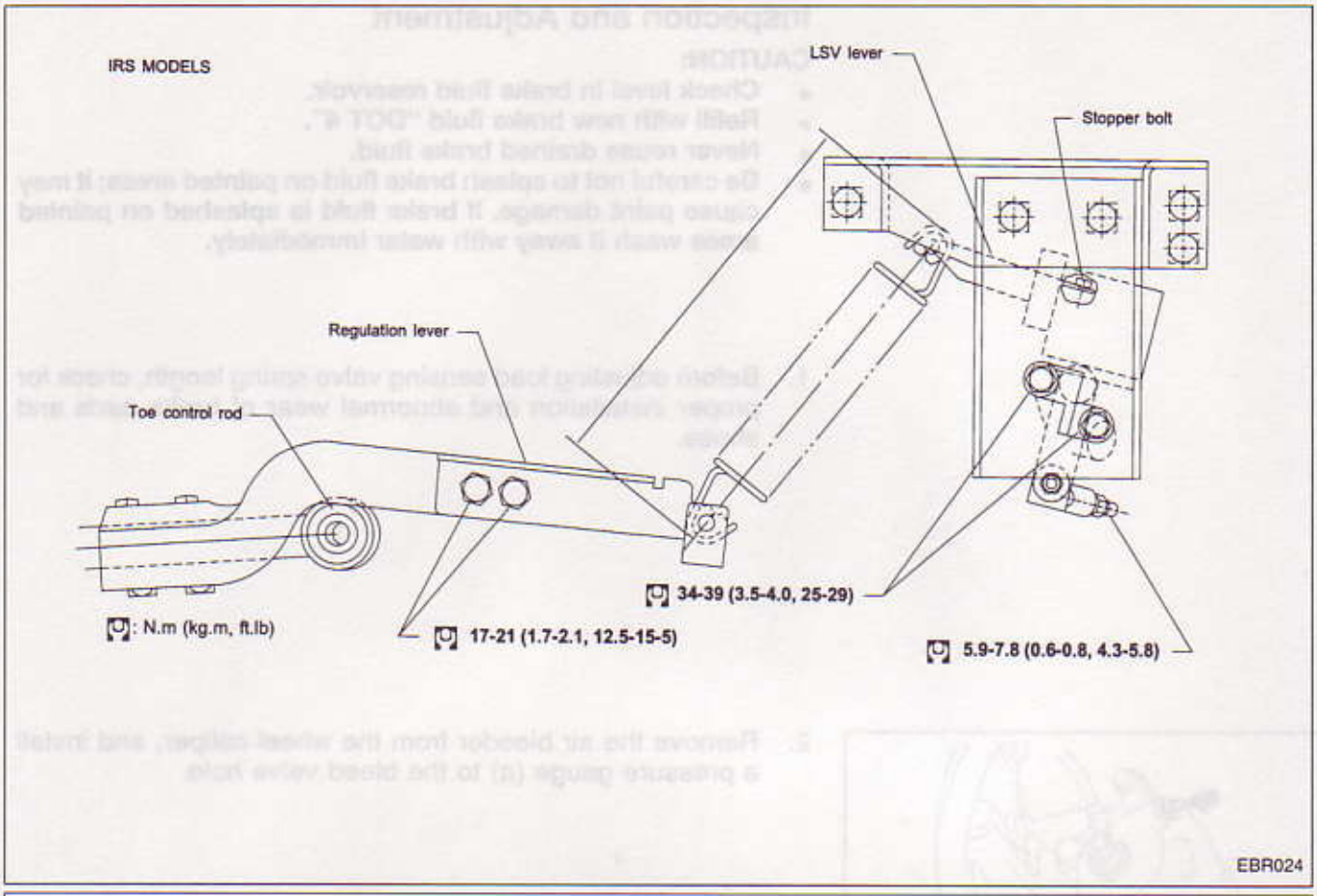
Distance "A": 117.5 mm (4.62 in)
Angle "B": 30°

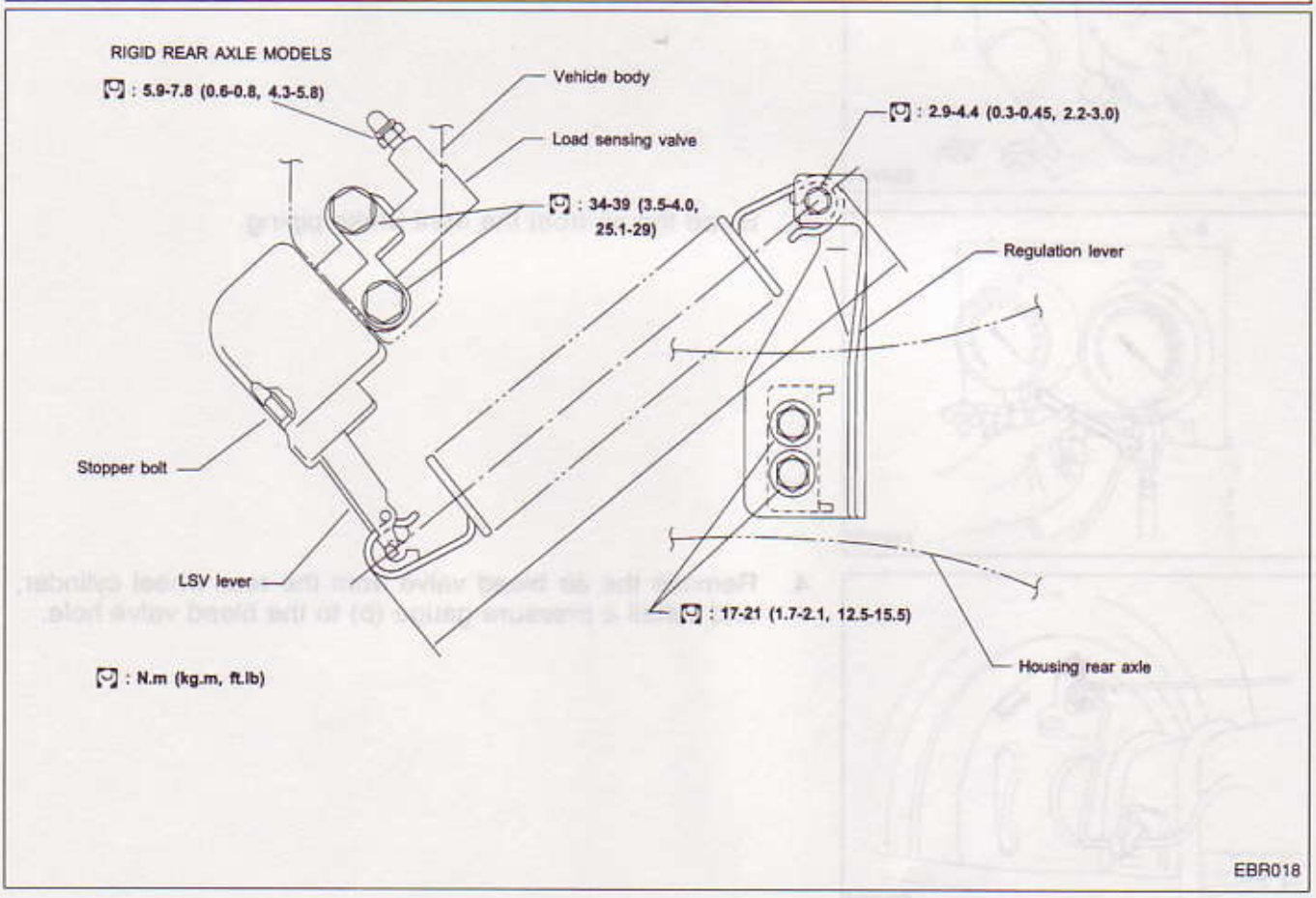
If above mentioned values are not met, load sensing valve will loose its effectiveness and the handling of the vehicle could change.

CAUTION:

- **Do not adjust LSV spring length by turning or moving LSV bracket ①. To adjust LSV spring length refer to Inspection and Adjustment.**
- **If the vehicle has been jacked up with the wheels off the ground, lower the vehicle slowly. Failure to do so, could cause the angle "B" to change.**

Installation (Cont'd)



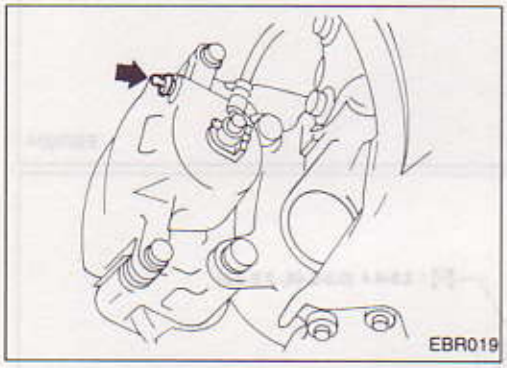


Inspection and Adjustment

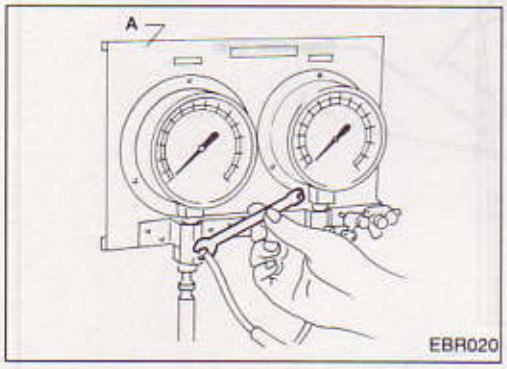
CAUTION:

- **Check level in brake fluid reservoir.**
- **Refill with new brake fluid "DOT 4".**
- **Never reuse drained brake fluid.**
- **Be careful not to splash brake fluid on painted areas; it may cause paint damage. If brake fluid is splashed on painted areas wash it away with water immediately.**

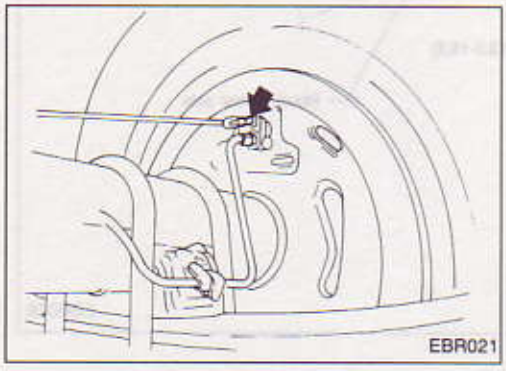
1. Before adjusting load sensing valve spring length, check for proper installation and abnormal wear of brake pads and shoes.



2. Remove the air bleeder from the wheel caliper, and install a pressure gauge (a) to the bleed valve hole.

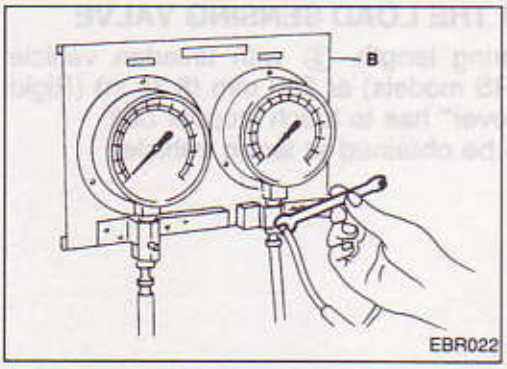


3. Bleed the air from the front brake piping.

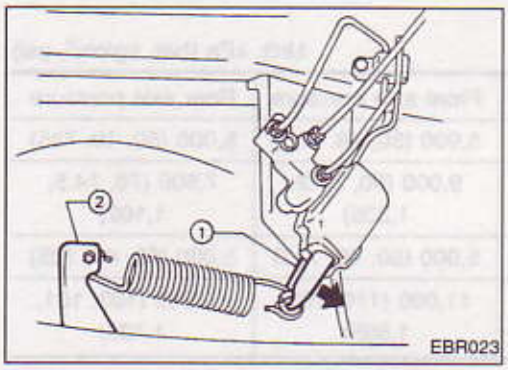


4. Remove the air bleed valve from the rear wheel cylinder, and install a pressure gauge (b) to the bleed valve hole.

Inspection and Adjustment (Cont'd)



5. Bleed the air from the rear brake piping.



6. The "Load Sensing Valve" is attached to the body, over the rear axle. To adjust the LSV correctly, proceed as follows:

a. With unladen vehicle (engine full of water and oil, fuel of 5 liters, with spare tyre and without tools) check the length of LSV spring.

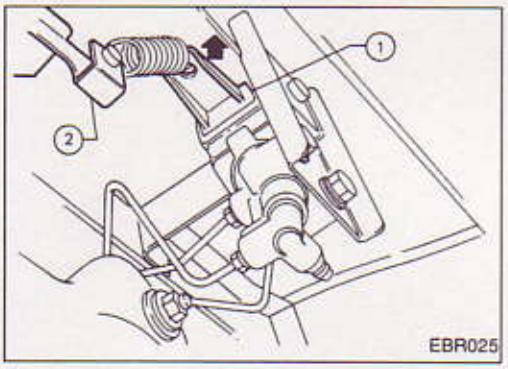
b. If the spring length is different from that specified, move the regulation lever (2) until the specified value is obtained. Move the LSV lever (1) until it contacts with the stopper bolt and recheck the spring length.

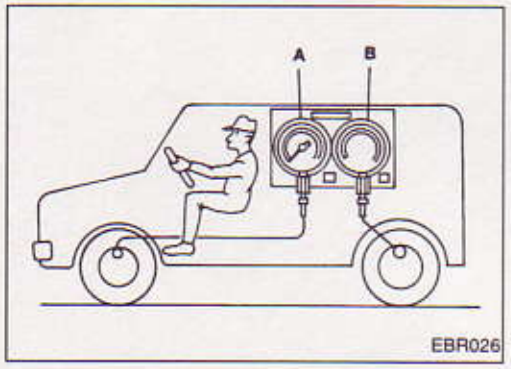
Sensor spring length "L":

IRS models: 206.5 mm (8.12 in)

Rigid rear axle models: 213 mm (8.38 in)

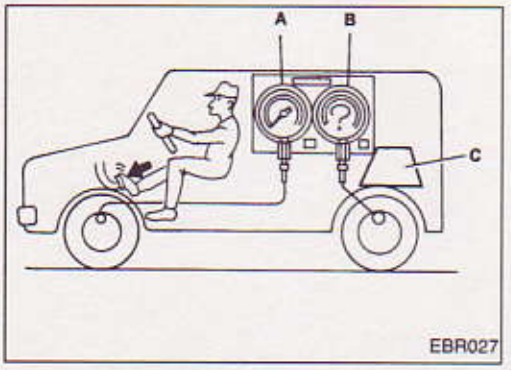
NOTE: Do not disturb stopper bolt.





c. Start the engine and run it at idling speed.

d. Slowly depress the brake pedal until an input pressure of 5,000 kPa (50 bar, 49 kg/cm^2, 725 psi) is obtained (at the front axle pressure gauge) and an output pressure of 5,000 kPa (50 bar, 49 kg/cm^2, 725 psi) bar is obtained (at the rear axle pressure gauge) (see Table on next page).



e. Place a weight (C) in the center at the rear of the vehicle, above the rear axle, so that the LSV spring ③ has a new lenght "L'".

f. With the engine running at idling speed, depress the brake pedal until obtaining the following pressures:

Unit: kPa (bar, kg/cm^2, psi)

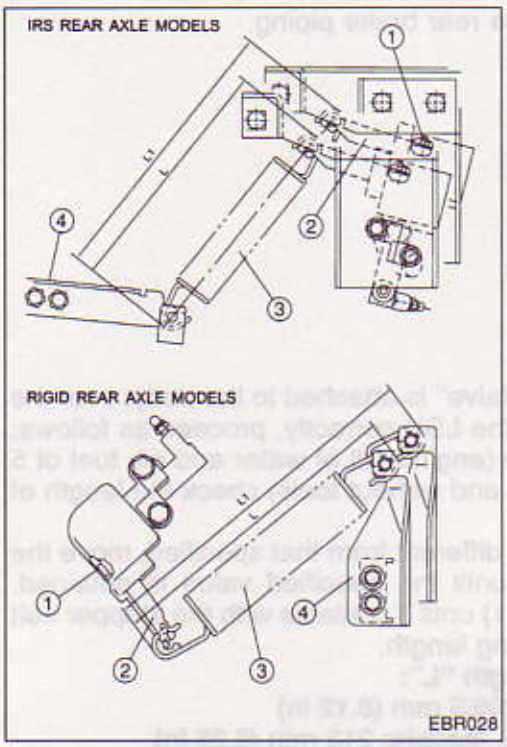
	Front axle pressure	Rear axle pressure
IRS models	9,000 (90, 88.2, 1,305)	7,600 (76, 74.5, 1,102)
Rigid rear axle models	11,000 (110, 108, 1,595)	10,300 (103, 101, 1,493)

See Table on next page

Inspection and Adjustment (Cont'd)

INFORMATION ABOUT THE LOAD SENSING VALVE

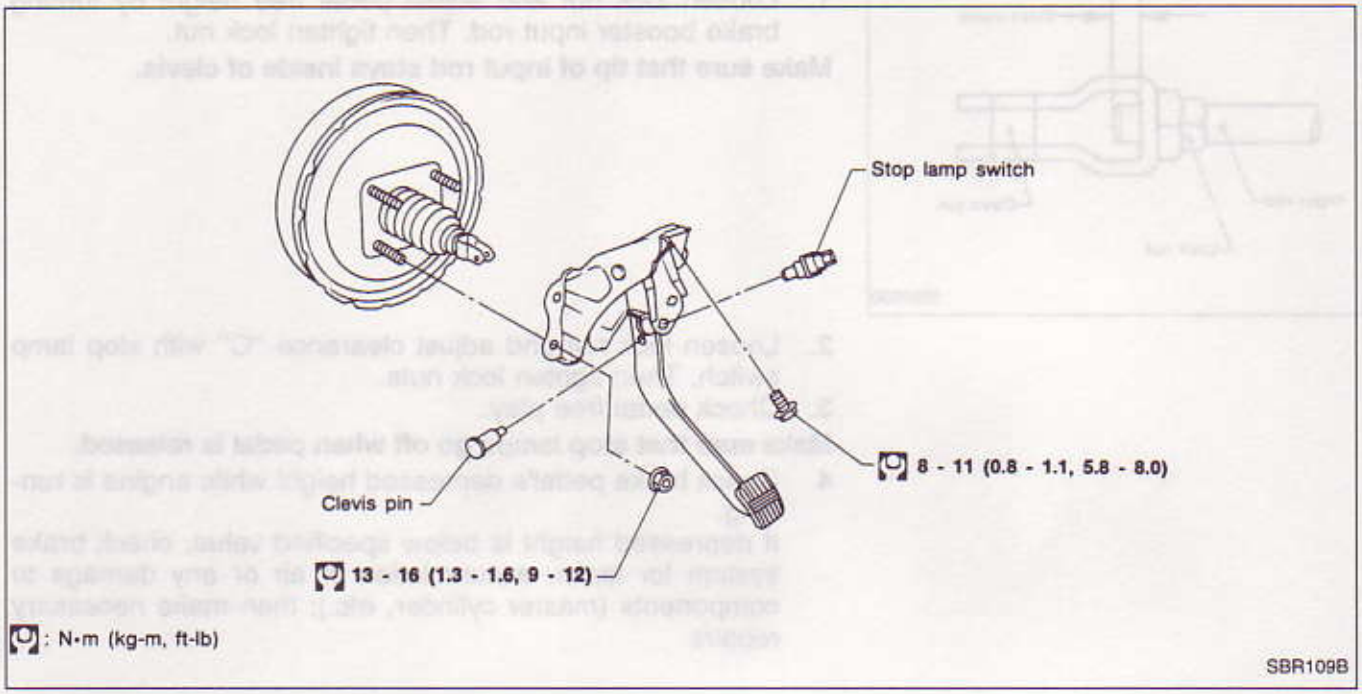
When adjusting LSV spring length ③ with unladen vehicle L=206.5 mm (8.12 in) (IRS models) or 213 mm (8.38 in) (Rigid rear axle models), LSV "lever" has to touch stopper bolt. Spring lenght "L'" has to be obtained at laden vehicle.

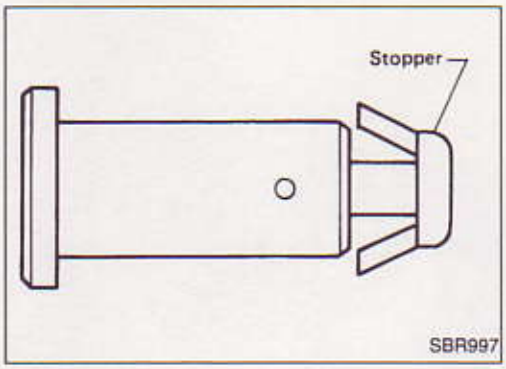


Unit: kPa (bar, kg/cm², psi)

	Vehicle load	Front axle pressure	Rear axle pressure
IRS models	Unladen	5,000 (50, 49, 725)	5,000 (50, 49, 725)
	Laden	9,000 (90, 88.2, 1,305)	7,600 (76, 74.5, 1,102)
Rigid rear axle models	Unladen	5,000 (50, 49, 725)	5,000 (50, 49, 725)
	Laden	11,000 (110, 108, 1,595)	10,300 (103, 101, 1,493)

Removal and Installation

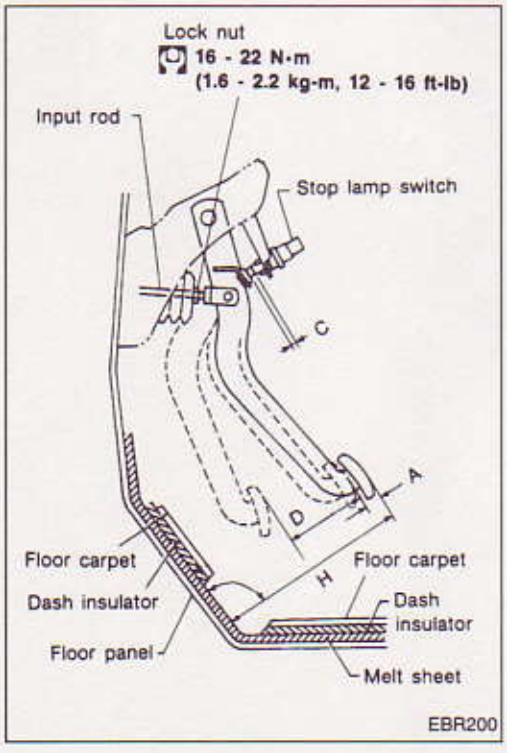




Inspection

Check brake pedal for following items:

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



Adjustment

Check brake pedal free height from dash reinforcement panel.

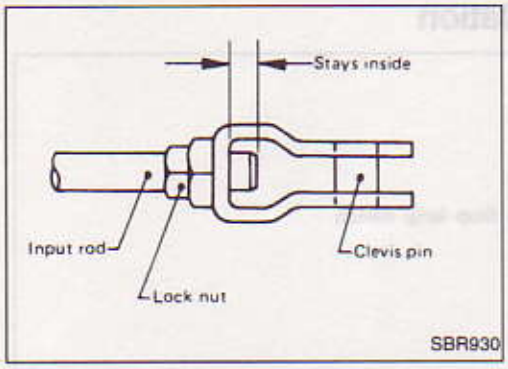
H: **Free height**
Refer to S.D.S.

D: **Full stroke**
Refer to S.D.S.

C: **Clearance between pedal stopper and threaded end of stop lamp switch**
0.3 - 1.0 mm (0.012 - 0.039 in)

A: **Pedal free play**
1.0 - 3.0 mm (0.039 - 0.118 in)

Adjustment (Cont'd)



If necessary, adjust brake pedal free height.

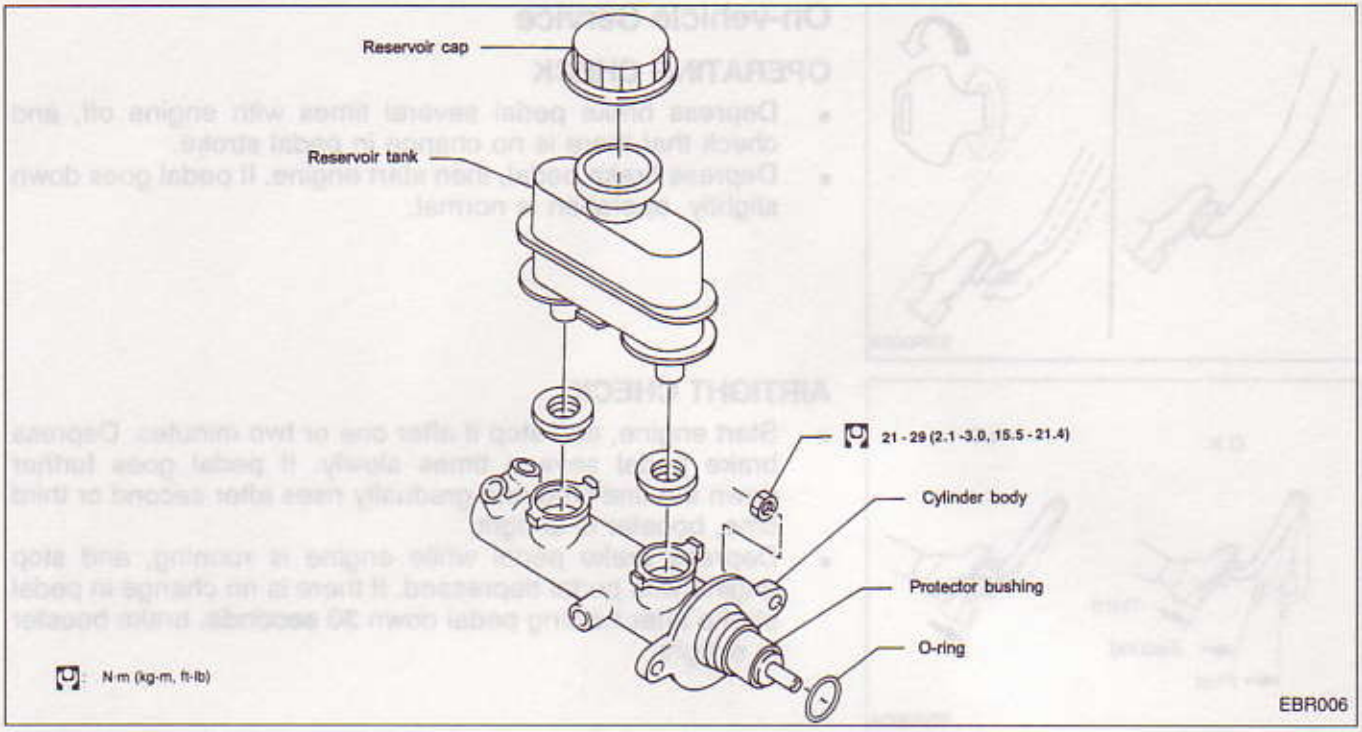
1. Loosen lock nut and adjust pedal free height by turning brake booster input rod. Then tighten lock nut.

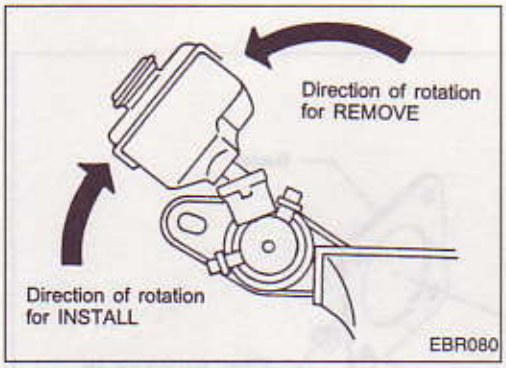
Make sure that tip of input rod stays inside of clevis.

2. Loosen lock nut and adjust clearance "C" with stop lamp switch. Then tighten lock nuts.
3. Check pedal free play.

Make sure that stop lamps go off when pedal is released.

4. Check brake pedal's depressed height while engine is running.
   If depressed height is below specified value, check brake system for leaks, accumulation of air or any damage to components (master cylinder, etc.); then make necessary repairs.





Removal

CAUTION:
Be careful not to splash brake fluid on painted areas; it may cause paint damage. If brake fluid is splashed on painted areas, wash it away with water immediately.

1. Connect a vinyl tube to air bleeder valve.
2. Drain brake fluid from each air bleeder valve, depressing brake pedal to empty fluid from master cylinder.
3. Remove brake pipe flare nuts.
4. Remove master cylinder mounting nuts.
5. Remove protector of master cylinder, and avoid scratching the surface of master cylinder during removal.

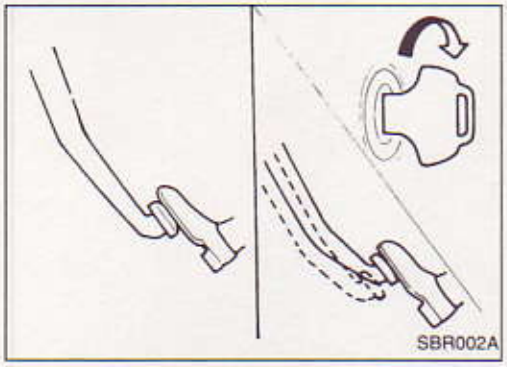
CAUTION:
Do not disassemble master cylinder.
NOTE:
If it is necessary to change the brake fluid reservoir, remove it as shown in the illustration on the left, while holding the seals with one hand.
It is not necessary to replace the seals if they are in a good condition.

Installation

CAUTION:

- **Refill with new brake fluid "DOT 4".**
- **Never reuse drained brake fluid.**

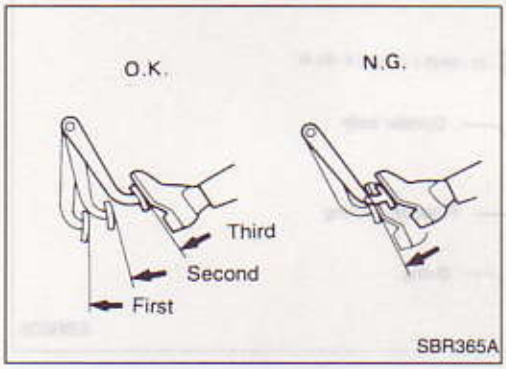
1. Place master cylinder onto brake booster and secure mounting nuts lightly.
2. Fit flare nuts to master cylinder.
3. Tighten mounting nuts.
   : 21 - 29 N·m (2.1 - 3.0 kg-m, 15.5 - 21.4 ft-lb)
4. Tighten flare nuts.
   : 9 - 11 N·m (0.9 - 1.1 kg-m, 6.5 - 8.7 ft-lb)
5. Bleed air. Refer to "Bleeding Procedure" in "AIR BLEEDING".



On-vehicle Service

OPERATING CHECK

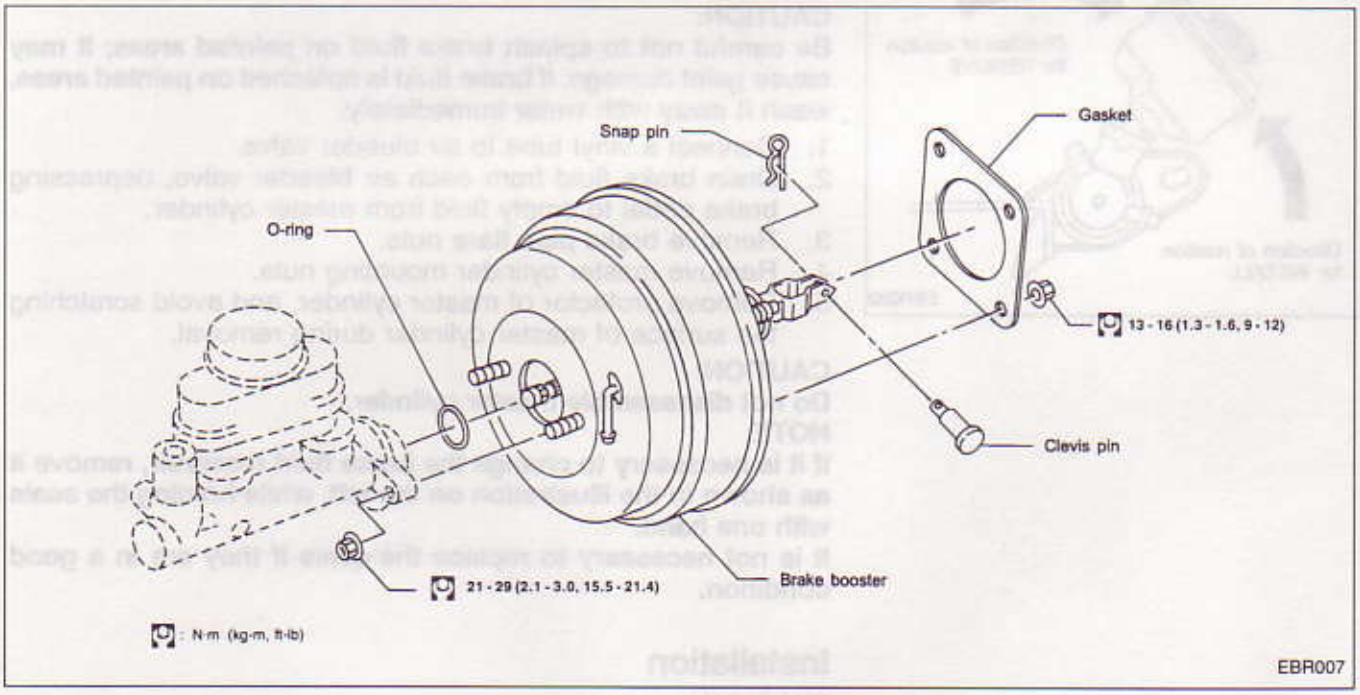
- Depress brake pedal several times with engine off, and check that there is no change in pedal stroke.
- Depress brake pedal, then start engine. If pedal goes down slightly, operation is normal.



AIRTIGHT CHECK

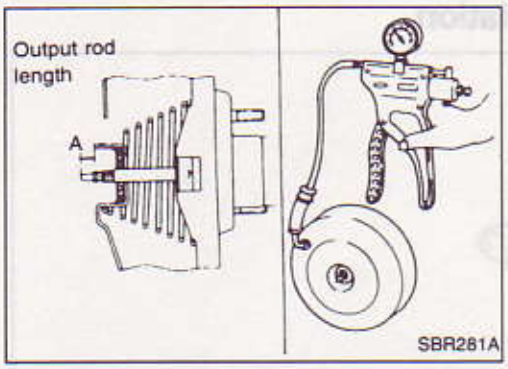
- Start engine, and stop it after one or two minutes. Depress brake pedal several times slowly. If pedal goes further down the first time and gradually rises after second or third time, booster is airtight.
- Depress brake pedal while engine is running, and stop engine with pedal depressed. If there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

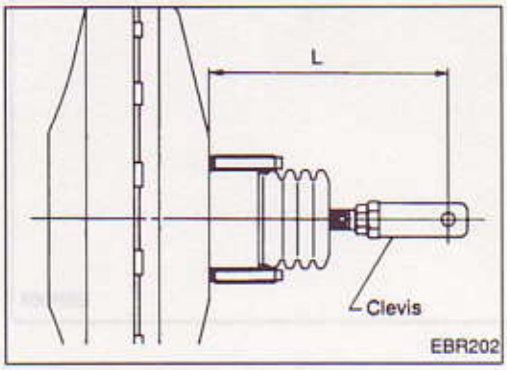
Removal



CAUTION:

- **Be careful not to splash brake fluid on painted areas; it may cause paint damage. If brake fluid is splashed on painted areas, wash it away with water immediately.**
- **Be careful not to deform or bend brake pipes, during removal of booster.**





Inspection

OUTPUT ROD LENGTH CHECK

1. Apply vacuum of −66.7 kPa (−667 mbar, −500 mmHg, −19.69 inHg) to brake booster with a handy vacuum pump and check output rod length "A".
   Specified length "A": 22.3 ± 0.15 mm (0.87 ± 0.005 in)
2. Check output rod length "L" when brake booster doesn't work.
   Specified length "L":
   RHD models: 136 mm (5.35 in)
   LHD models: 126 mm (4.96 in)

NOTE:
In brake booster with attachment type, the measure is measured from outside sharp of attachment.

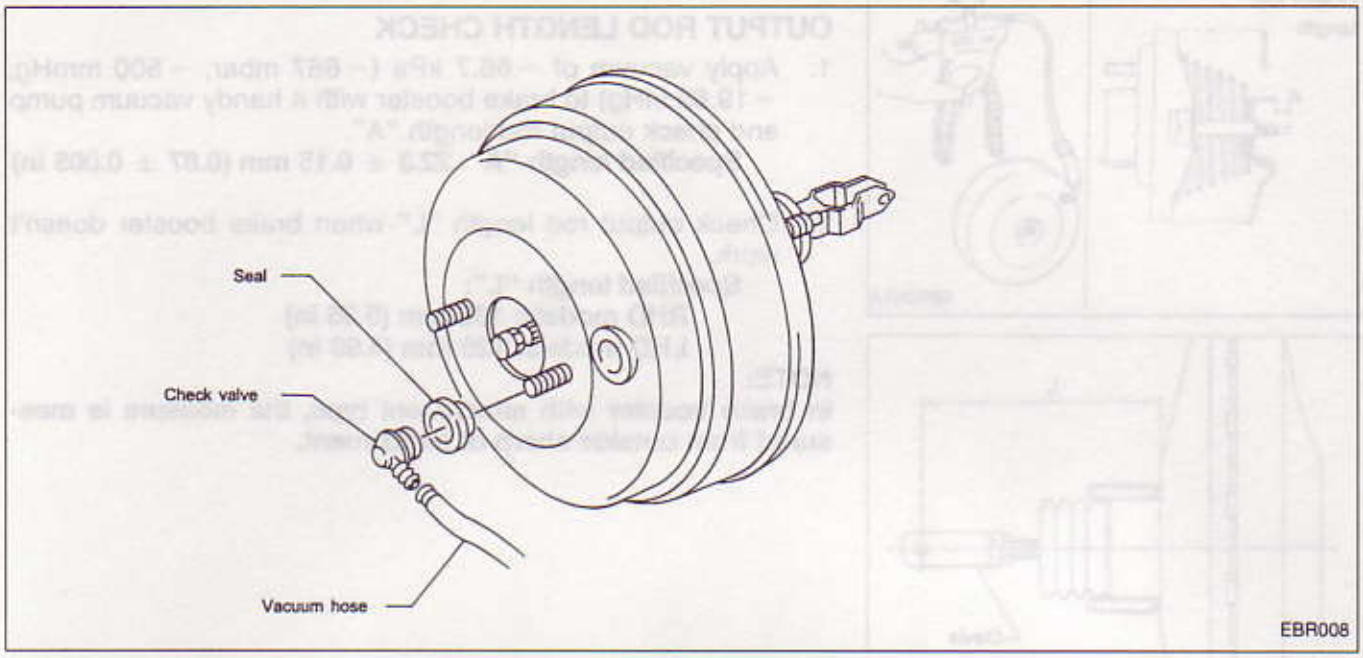
Installation

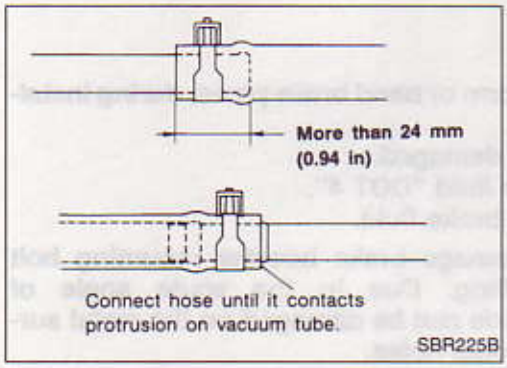
CAUTION:

- **Be careful not to deform or bend brake pipes, during installation of booster.**
- **Replace clevis pin if damaged.**
- **Refill with new brake fluid "DOT 4".**
- **Never reuse drained brake fluid.**
- **Take care not to damage brake booster mounting bolt thread when installing. Due to the acute angle of installation, the threads can be damaged on the metal surrounding the dash panel holes.**

1. Before fitting booster, temporarily adjust clevis to dimension shown. (Does not apply to vehicles fitted with ABS)
2. Fit booster, then secure mounting nuts (brake pedal bracket to brake booster) lightly.
3. Connect brake pedal and booster input rod with clevis pin.
4. Secure mounting nuts.
   : 13 - 16 N·m (1.3 - 1.6 kg-m, 9 - 12 ft-lb)
5. Install master cylinder. Refer to "Installation" in "MASTER CYLINDER".
6. Bleed air. Refer to "Bleeding Procedure" in "AIR BLEEDING".

Removal and Installation





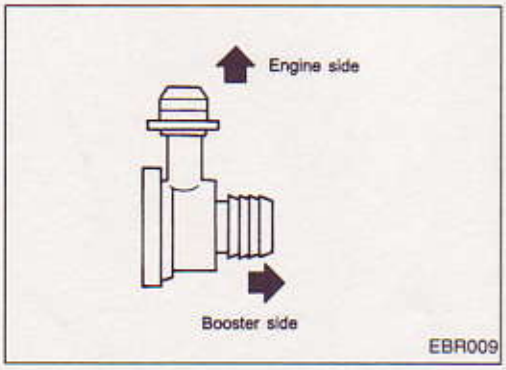
CAUTION:
When installing vacuum hoses, pay attention to the following points.

- **Do not apply any oil or lubricants to vacuum hose and check valve.**
- **Insert vacuum tube into vacuum hose as shown.**

Inspection

HOSES AND CONNECTORS

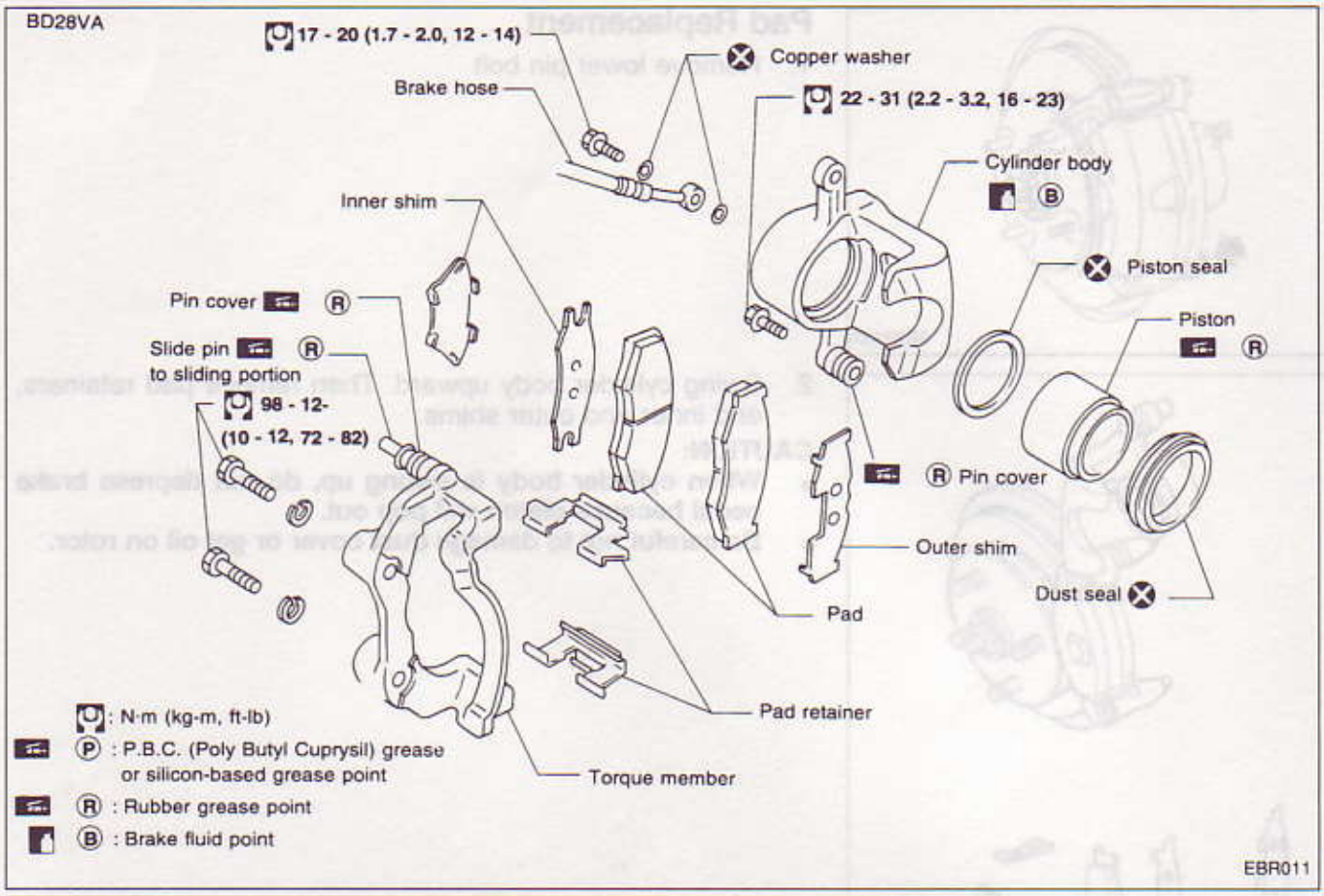
Check vacuum lines, connections and check valve for airtightness, improper attachment, chafing and deterioration.

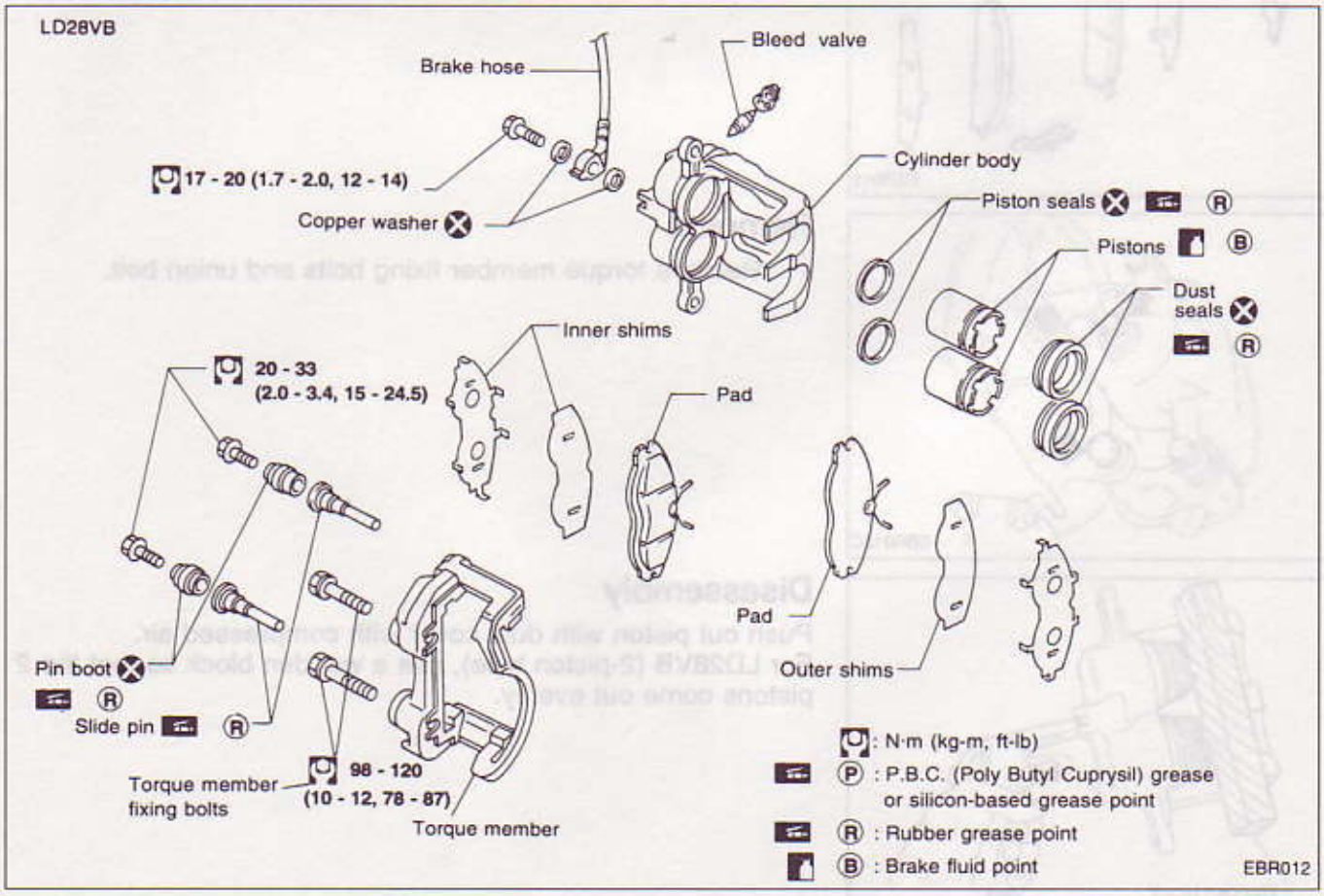


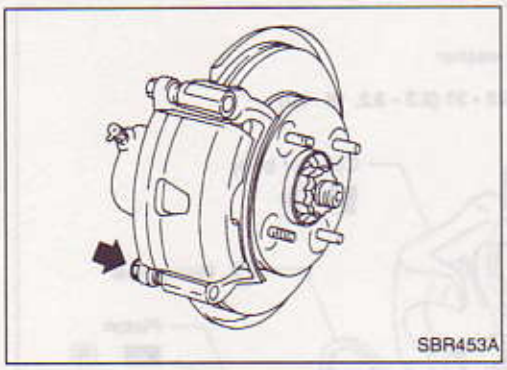
CHECK VALVE

Check vacuum with a vacuum pump.

Connect to booster side	Vacuum should exist.
Connect to engine side	Vacuum should not exist.

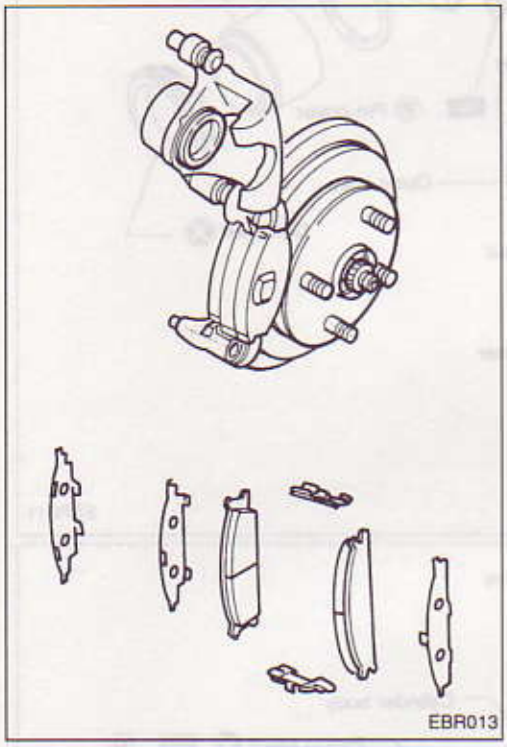

BD28VA
17 - 20 (1.7 - 2.0, 12 - 14)
Copper washer
Brake hose
22 - 31 (2.2 - 3.2, 16 - 23)
Cylinder body
B
Inner shim
Piston seal
Pin cover
R
Piston
Slide pin
R
to sliding portion
98 - 12-
(10 - 12, 72 - 82)
R Pin cover
Outer shim
Dust seal
Pad
Pad retainer
Torque member
: N·m (kg-m, ft-lb)
P : P.B.C. (Poly Butyl Cuprysil) grease or silicon-based grease point
R : Rubber grease point
B : Brake fluid point
EBR011


LD28VB
Bleed valve
Brake hose
Cylinder body
17 - 20 (1.7 - 2.0, 12 - 14)
Piston seals
R
Copper washer
Pistons
B
Dust seals
R
Inner shims
20 - 33
(2.0 - 3.4, 15 - 24.5)
Pad
Pad
Outer shims
Pin boot
R
Slide pin
R
Torque member fixing bolts
98 - 120
(10 - 12, 78 - 87)
Torque member
: N·m (kg-m, ft-lb)
P : P.B.C. (Poly Butyl Cuprysil) grease or silicon-based grease point
R : Rubber grease point
B : Brake fluid point
EBR012


SBR453A

Pad Replacement

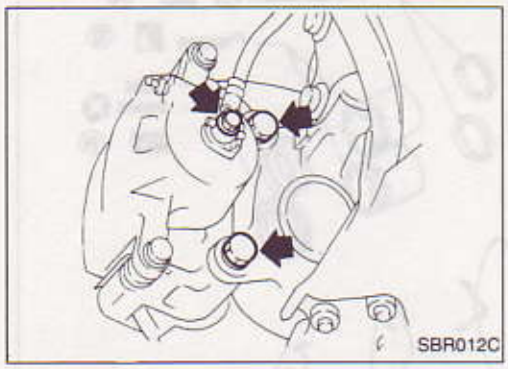
1. Remove lower pin bolt


EBR013

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

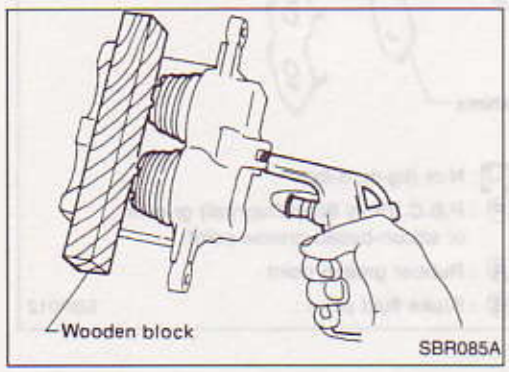
CAUTION:

- **When cylinder body is swung up, do not depress brake pedal because piston will pop out.**
- **Be careful not to damage dust cover or get oil on rotor.**


SBR012C

Removal

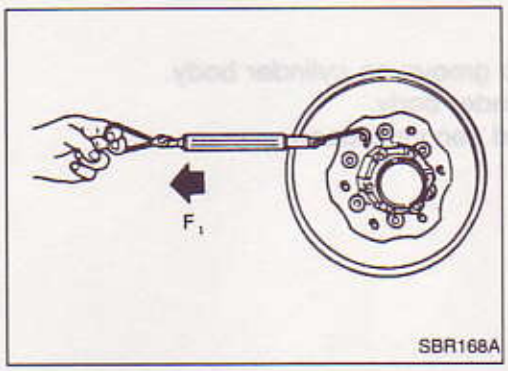
- Remove torque member fixing bolts and union bolt.



SBR085A

Disassembly

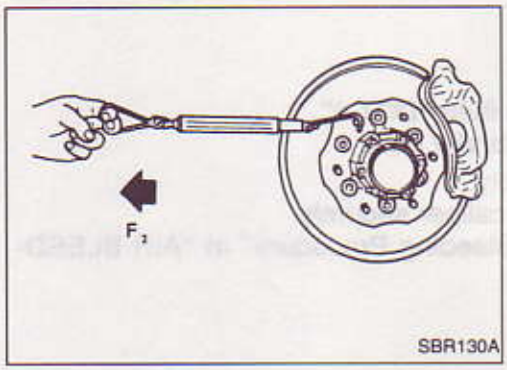
Push out piston with dust cover with compressed air.
For LD28VB (2-piston type), use a wooden block so that the 2 pistons come out evenly.



Inspection

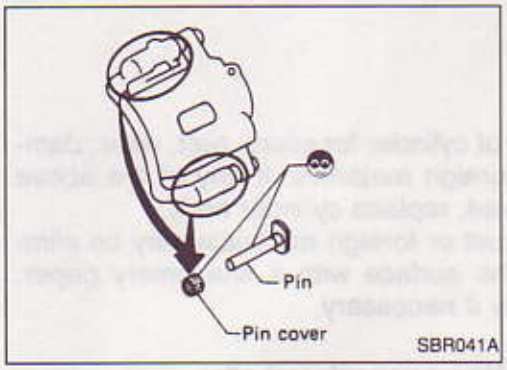
INSPECTION OF BRAKE DRAG FORCE

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



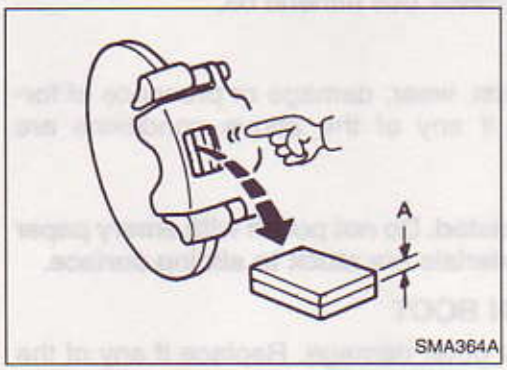
(4) Install caliper with pads to the original position.
(5) Depress brake pedal for 5 seconds.
(6) Release brake pedal, rotate disc rotor 10 revolutions.
(7) Measure rotating force (F_2).
(8) Calculate brake drag force by subtracting F_1 from F_2.

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.

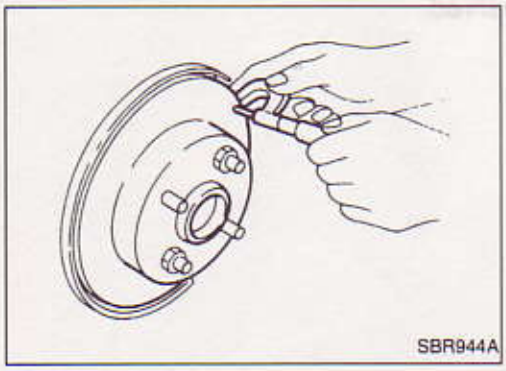
- **Make sure that wheel bearing is adjusted properly.**
- **Disc pads and disc rotor must be dried.**



DISC PAD

Check disc pad for wear or damage.

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

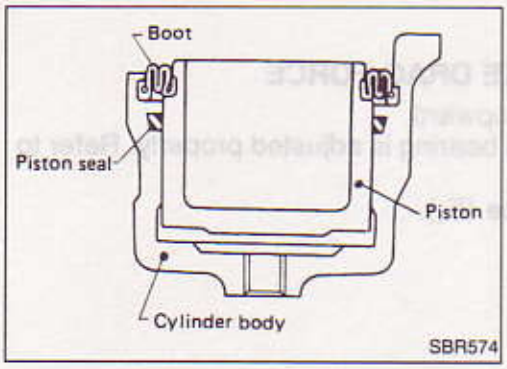


ROTOR

Thickness

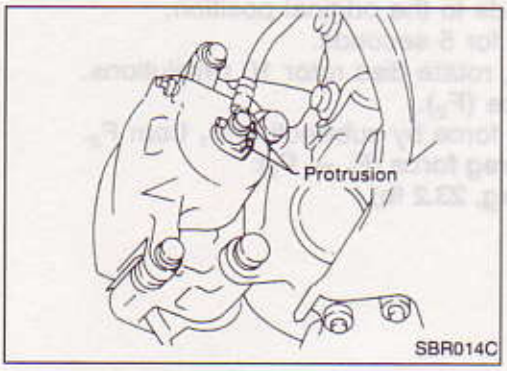
Standard thickness:
BD28VA 22.0 mm (0.86 in)
LD28VB 26.0 mm (1.02 in)

Minimum thickness:
BD28VA 20.0 mm (0.78 in)
LD28VB 24.0 mm (0.94 in)



Assembly

1. Insert piston seal into groove on cylinder body.
2. Install piston into cylinder body.
3. Install piston boot and secure properly.



Installation

CAUTION:

- **Refill with new brake fluid "DOT 4".**
- **Never reuse drained brake fluid.**

1. Install caliper assembly.
2. Install brake hose to caliper securely.
3. Bleed air. Refer to "Bleeding Procedure" in "AIR BLEEDING".

Inspection

CYLINDER BODY

- Check inside surface of cylinder 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 the surface with a fine emery paper. Replace cylinder body if necessary.

CAUTION:

Use brake fluid to clean. Never use mineral oil.

PISTON

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

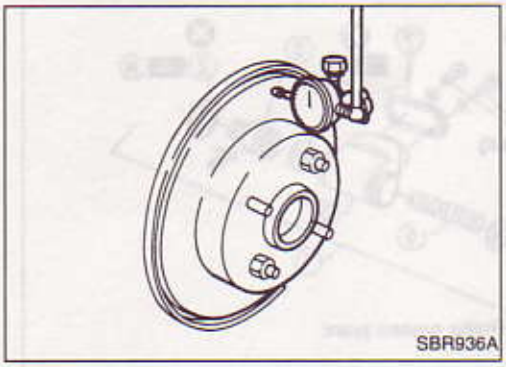
CAUTION:

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

PIN, PIN BOLT AND PIN BOOT

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

Inspection (Cont'd)



ROTOR

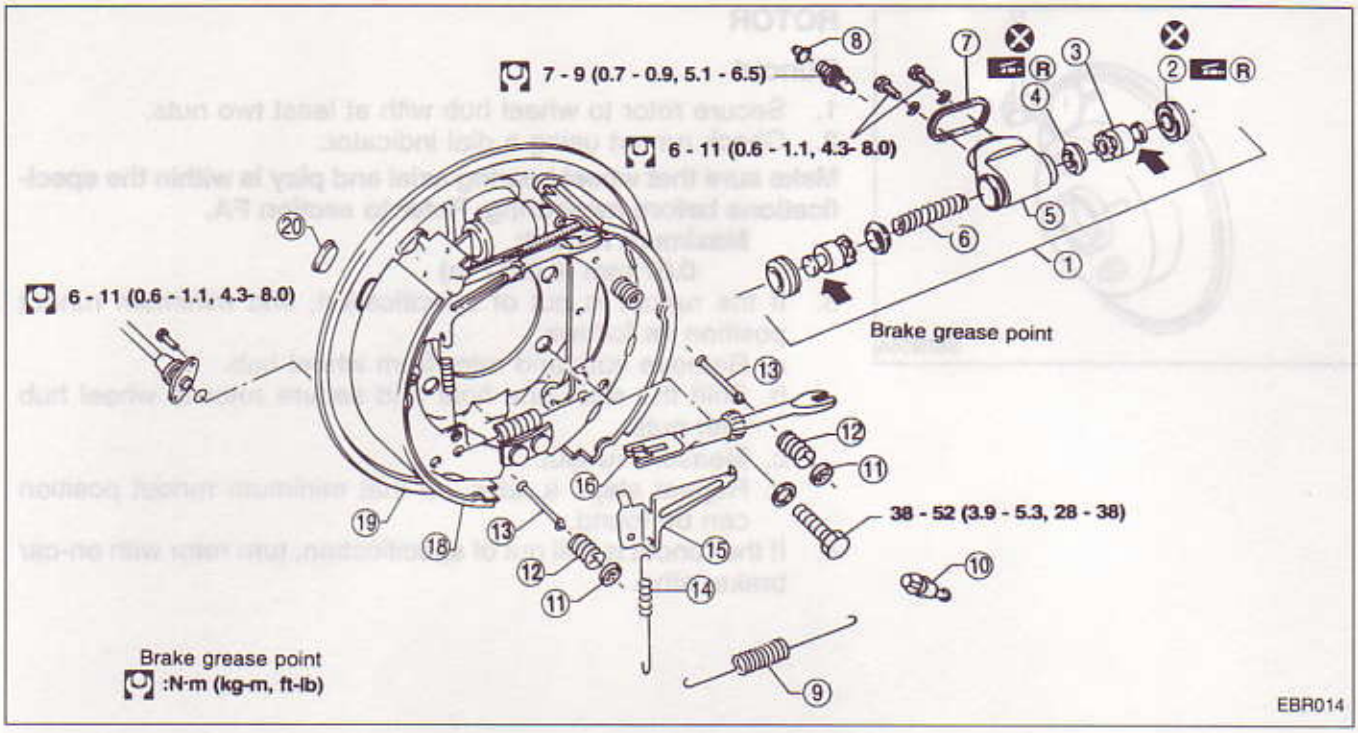
Runout

1. Secure rotor to wheel hub with at least two nuts.
2. Check runout using a dial indicator.

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

Maximum runout:
0.07 mm (0.0027 in)

3. If the runout is out of specification, find minimum runout position as follows:
   a. Remove nuts and rotor from wheel hub.
   b. Shift the rotor one hole and secure rotor to wheel hub with nuts.
   c. Measure runout.
   d. Repeat steps a. to c. so that minimum runout position can be found.
4. If the runout is still out of specification, turn rotor with on-car brake lathe.

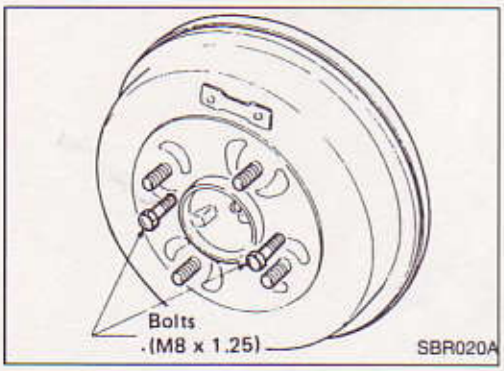


① Wheel cylinder assembly
② Boot
③ Piston
④ Piston cup
⑤ Cylinder body
⑥ Spring
⑦ Gasket
⑧ Dust cap
⑨ Return spring
⑩ Handbrake lever stop
⑪ Retainer
⑫ Shoe hold-down spring
⑬ Shoe hold-down pin
⑭ Pawl return spring
⑮ Pawl
⑯ Adjuster assembly
⑰ Trailing shoe
⑱ Leading shoe
⑲ Backplate
⑳ Plug

Removal

WARNING:
Clean brake lining with a vacuum dust collector to minimize the hazard of airborne asbestos or other materials.

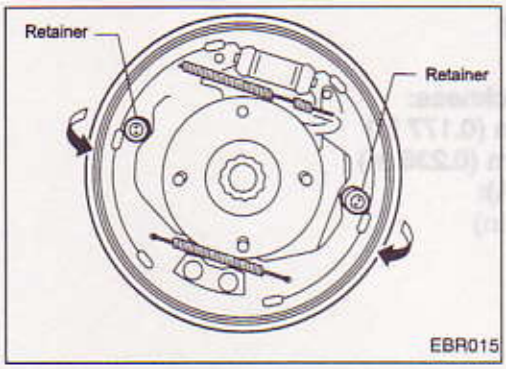
CAUTION:
Make sure parking brake lever is released completely.



1. Release parking brake lever fully, then remove drum.

If drum is hard to remove, screw two bolts in the provided holes of the drum and tighten them gradually.
If the drum cannot be removed after carrying out this operation, refer to "Inspection" in "PARKING BRAKE CONTROL".

Removal (Cont'd)

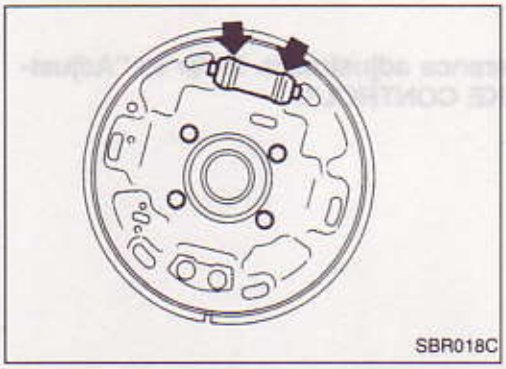


2. After removing retainer and shoe hold-down spring, remove return and adjuster springs.

Be careful not to damage parking brake cable when separating it.

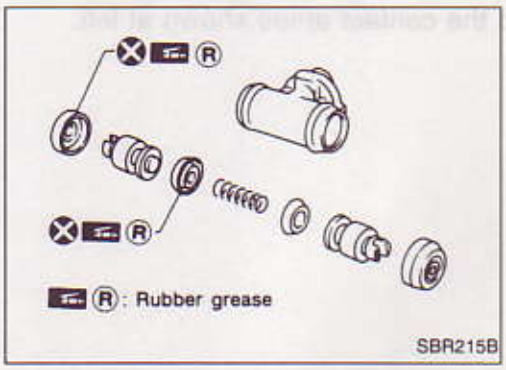
3. Remove adjuster.
4. Disconnect parking brake cable from toggle lever.

Inspection — Wheel Cylinder



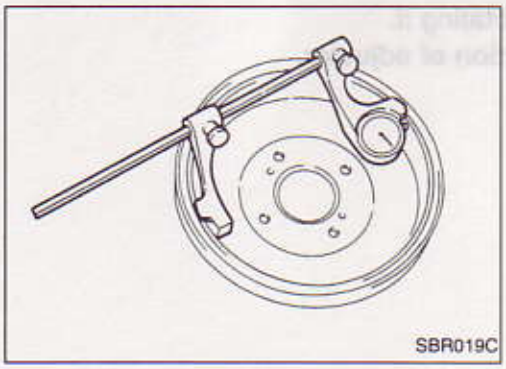
- Check wheel cylinder for leakage.
- Check for wear, damage and loose conditions. Replace if any such condition exists.

Wheel Cylinder Overhaul



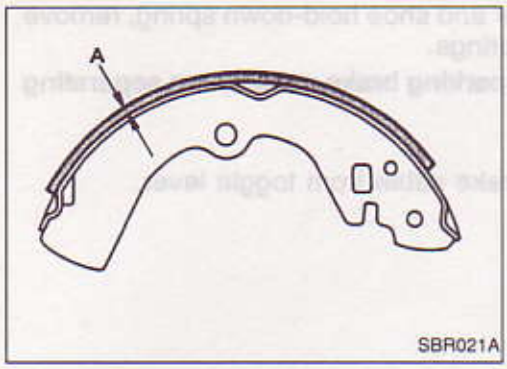
Pay attention so as not to scratch cylinder when installing pistons.

Inspection — Drum



Maximum inner diameter:
255.5 mm (10.05 in)
Out-of-roundness:
0.05 mm (0.0019 in) or less

- Contact surface should be fine finished with No. 120 to 150 emery paper.
- Using a drum lathe, lathe brake drum if it shows scoring, partial wear or stepped wear.
- After brake drum has been completely reconditioned or replaced, check drum and shoes for proper contact pattern.



Inspection — Lining

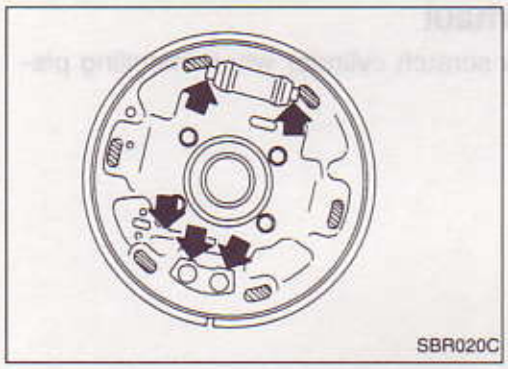
Check lining thickness.

Standard lining thickness:
Trailing 4.5 mm (0.177 in)
Leading 6.0 mm (0.236 in)
Lining wear limit (A):
1.5 mm (0.059 in)

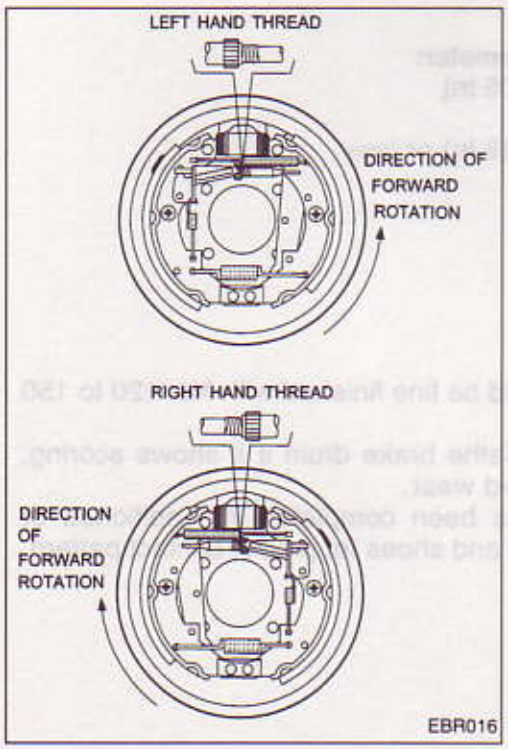
Installation

Always perform shoe clearance adjustment. Refer to "Adjustment" in "PARKING BRAKE CONTROL".

1. Fit adjuster assembly.



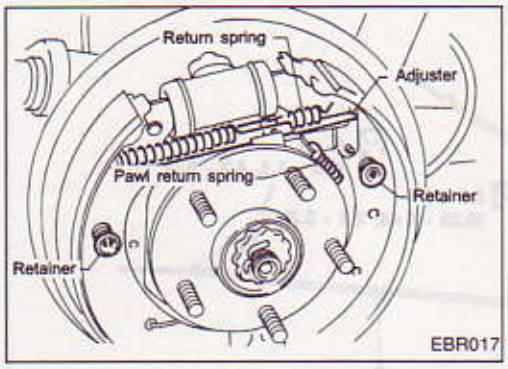
2. Apply brake grease to the contact areas shown at left.



3. Shorten adjuster by rotating it.

- **Pay attention to direction of adjuster.**

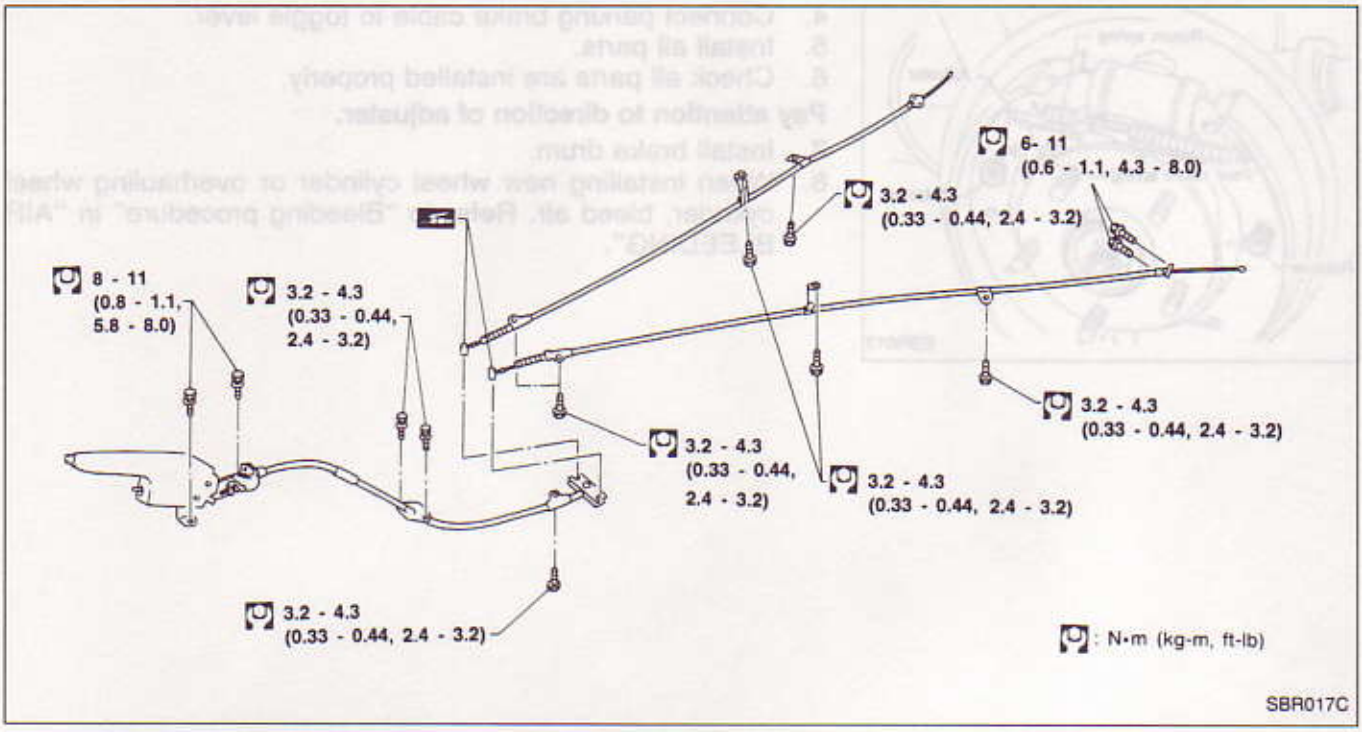
Installation (Cont'd)

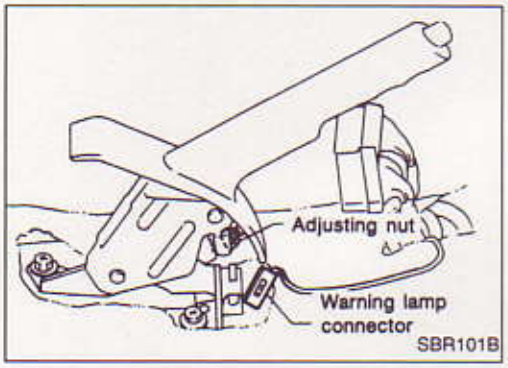


4. Connect parking brake cable to toggle lever.
5. Install all parts.
6. Check all parts are installed properly.

Pay attention to direction of adjuster.

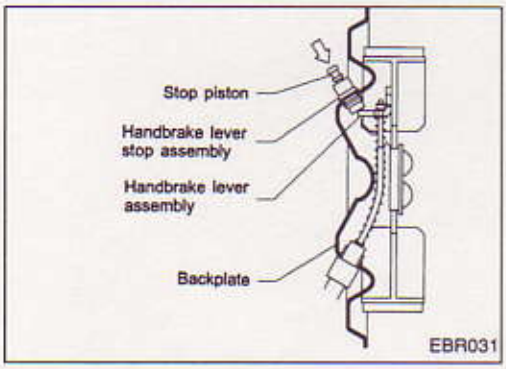
7. Install brake drum.
8. When installing new wheel cylinder or overhauling wheel cylinder, bleed air. Refer to "Bleeding procedure" in "AIR BLEEDING".





Removal and Installation

1. To remove parking brake cable, first remove center console.
2. Disconnect warning lamp connector.
3. Remove bolts, slacken off and remove adjusting nut.



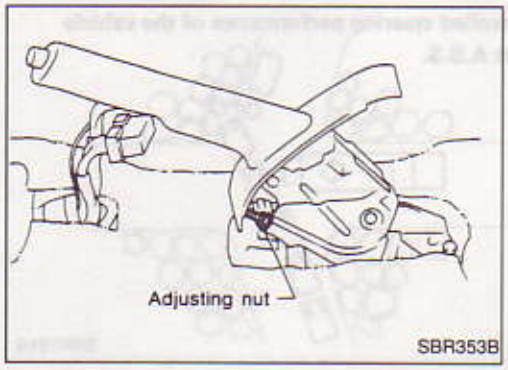
Inspection

1. Check control lever for wear or other damage. Replace if necessary.
2. Check wires for discontinuity or deterioration. Replace if necessary.
3. Check warning lamp and switch. Replace if necessary.
4. Check parts at each connecting portion and, if deformed or damaged, replace.
5. With the parking brake applied, check if the parking brake lever stop can be pushed in.

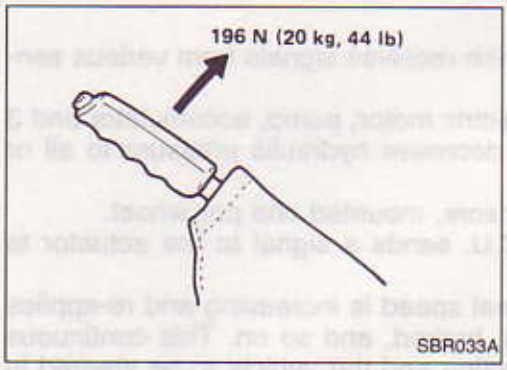
NOTE:
When the brake drum has been worn excessively, it can be hard to remove it. In this case brake the parking brake lever stop by forcing it inside the brake drum, so the brake shoes will move to the center at minimum stroke. After the drum has been removed install new parking brake lever stop.

Adjustment

1. Adjust clearance between shoe and drum as follows:
a. Release parking brake lever and loosen adjusting nut.
b. Depress brake pedal fully at least 10 times with engine running.



2. Pull control lever 4 - 5 notches. Then adjust control lever by turning adjusting nut.



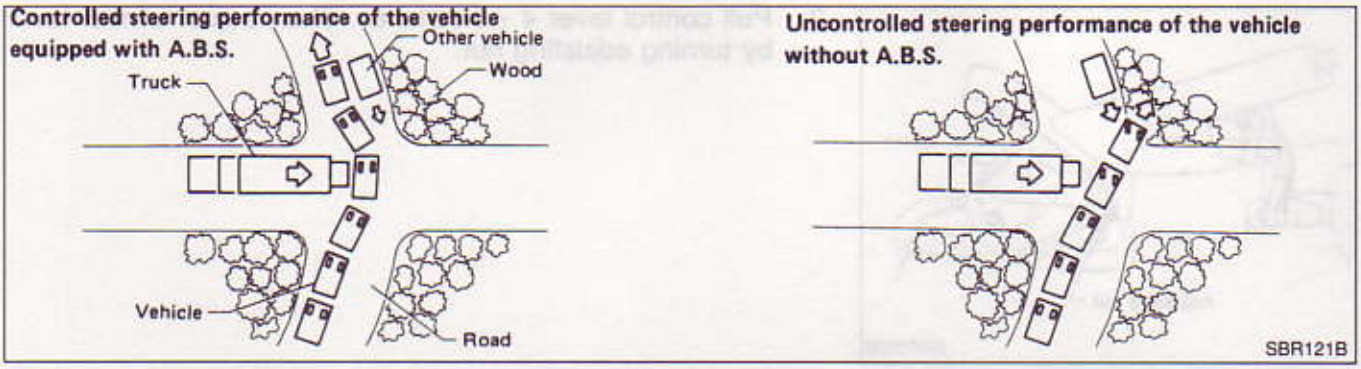
3. Pull control lever with specified amount of force. Check lever stroke and ensure smooth operation.
Number of notches:
9 - 10

4. Bend parking brake warning lamp switchplate so that brake warning lamp comes on when parking brake lever is pulled "A" notches.
Number of "A" notches : 1 or less

Purpose

- Excessive braking in any condition (Dry or wet) will adversely affect the normal turning of the vehicle's wheels and they may lock up.
- When the front wheels are locked, a vehicle cannot be controlled by the steering system.
- When the rear wheels are locked, the vehicle will enter a flat spin.

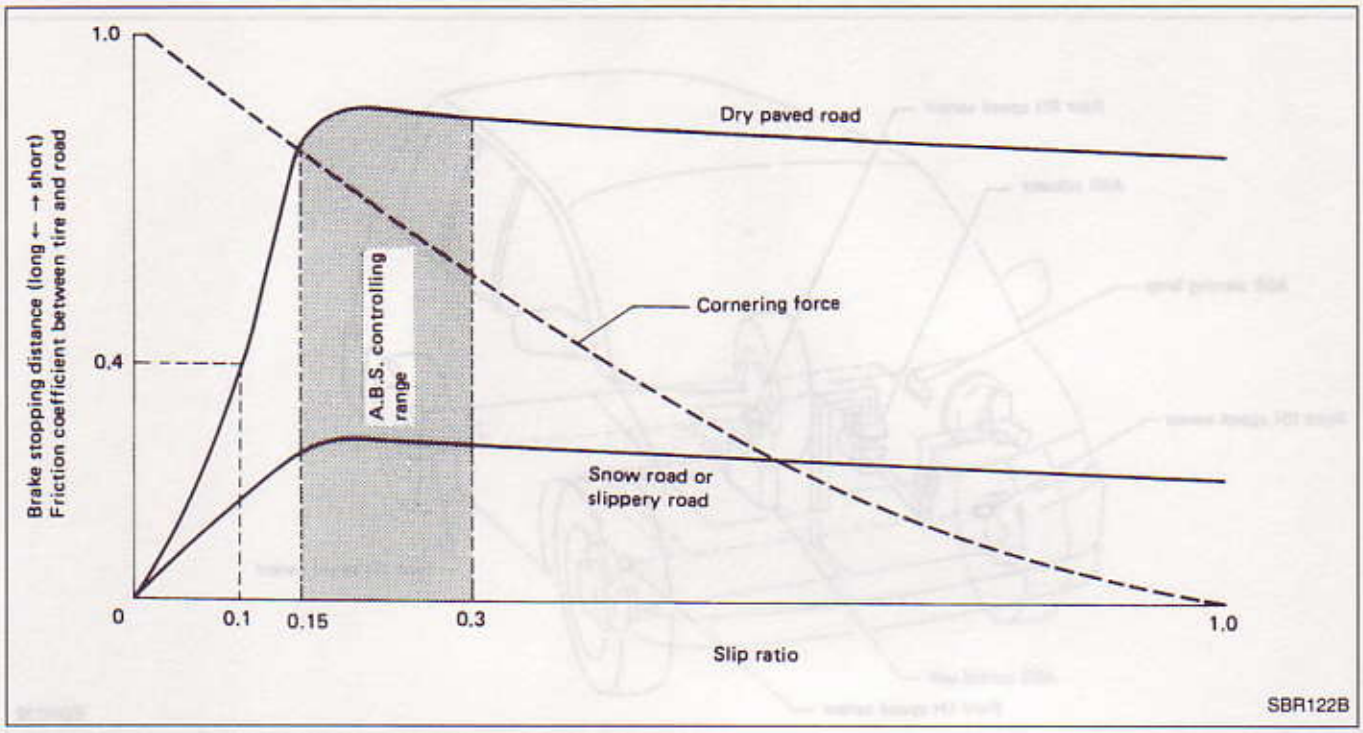
The A.B.S., by the use of electronic and hydraulic components, allows for control of braking force so that locking of the wheels can be avoided in the circumstances described above.
The A.B.S.:
1) Ensures proper tracking performance through steering wheel operation.
2) Enables obstacles to be avoided through steering wheel operation.
3) Ensures vehicle stability by preventing flat spins.



Operation

The A.B.S. is controlled by an electronic control unit (E.C.U.), which receives signals from various sensors relating to vehicle condition, speed, etc.
The hydraulic circuit is controlled by an actuator containing an electric motor, pump, accumulator and 3 solenoids. The E.C.U. directs the actuator to increase, hold or decrease hydraulic pressure to all or individual wheels.
The E.C.U. receives information regarding wheel speed from sensors, mounted one per wheel.
When excessive braking force causes a wheel to lock, the E.C.U. sends a signal to the actuator to release the locked wheel.
As the wheel unlocks, it can be steered. The E.C.U. senses wheel speed is increasing and re-applies hydraulic pressure. The wheel locks again, is released, steered, braked, and so on. This continuous locking and unlocking of the wheels allows for rapid speed reduction and the vehicle to be steered in the correct manner.
The hydraulic pressure can also be "held" constant by a signal sent from the E.C.U. to the actuator.
The rear wheels utilize a load-sensing valve to further prevent wheel locking, especially under minimum vehicle load conditions.
However, when the vehicle speed is less than 10 km/h (6MPH), this system does not work.

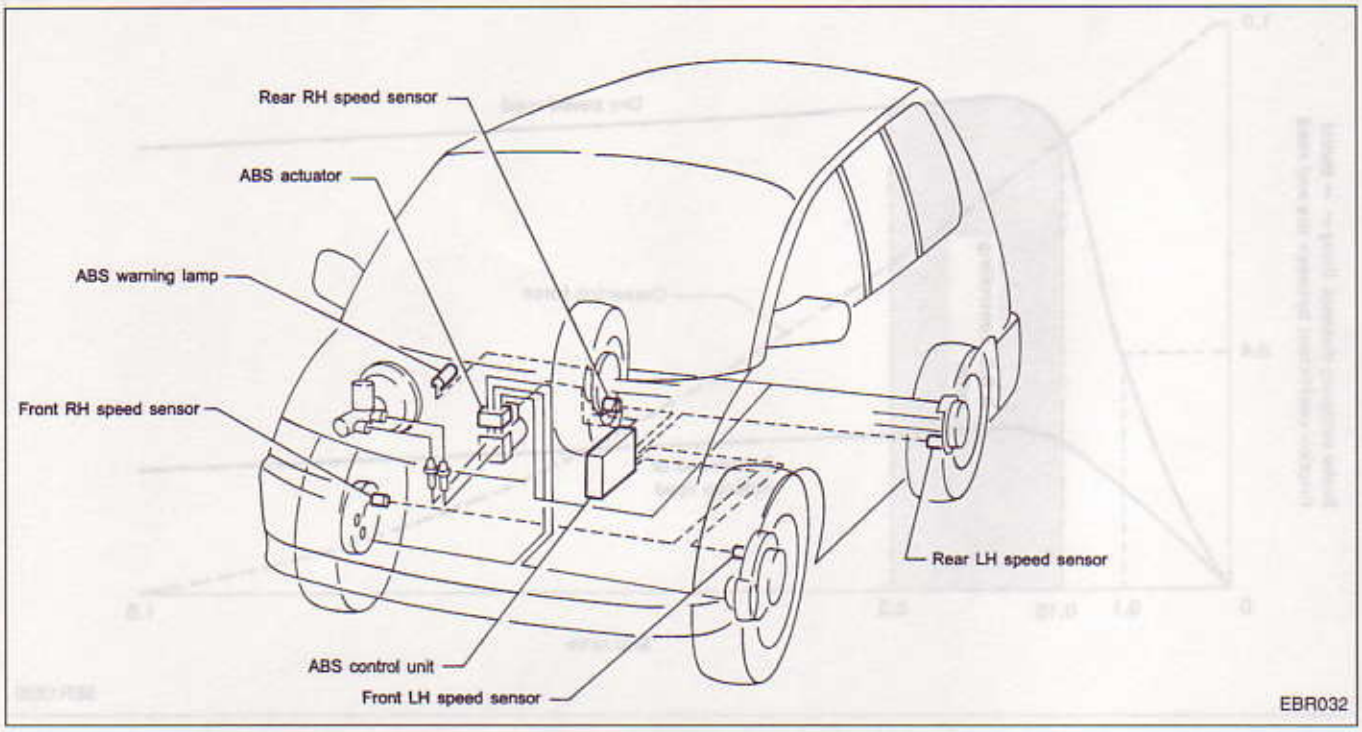
Operation (Cont'd)

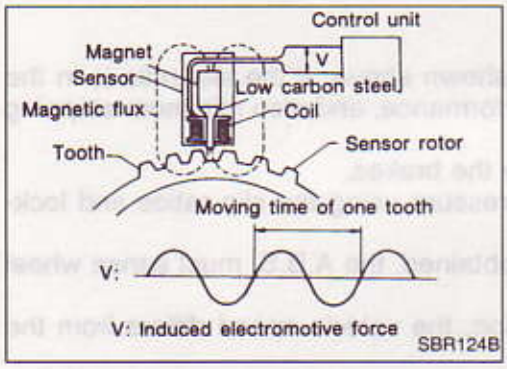


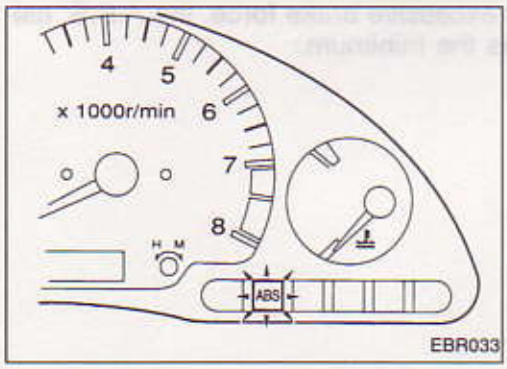
$$\text{SLIP RATIO} = \frac{\text{VEHICLE SPEED} - \text{WHEEL SPEED}}{\text{VEHICLE SPEED}}$$

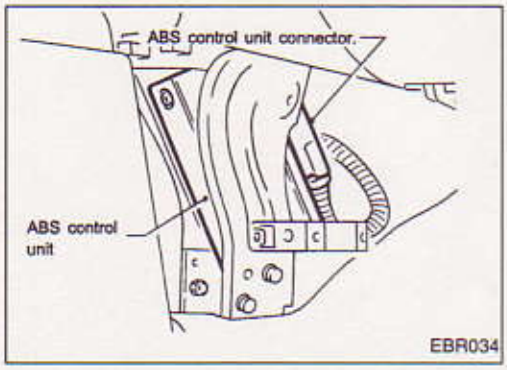
- The applied brake condition is expressed by a slip ratio, as shown above. If the slip ratio is in the range from 0.15 to 0.3, the wheel has adequate cornering performance, and also minimum stopping distance can be achieved.
- The slip ratio formula indicates the control of wheel speed by the brakes.
  The Anti-lock Braking System (A.B.S.) controls brake fluid pressure using the slip ratios and locking condition calculation contained in the A.B.S. control unit.
- To adjust wheel speed so that the optimum slip ratio can be obtained, the A.B.S. must sense wheel speed and vehicle speed through a wheel speed sensor.
  If the brake is applied, especially in the locked wheel condition, the vehicle speed differs from the wheel speed.
- After the wheel speed changes from the vehicle speed due to excessive brake force, the A.B.S. calculates vehicle speed when the reduced wheel speed reaches the minimum.

System Components









System Description

SENSOR

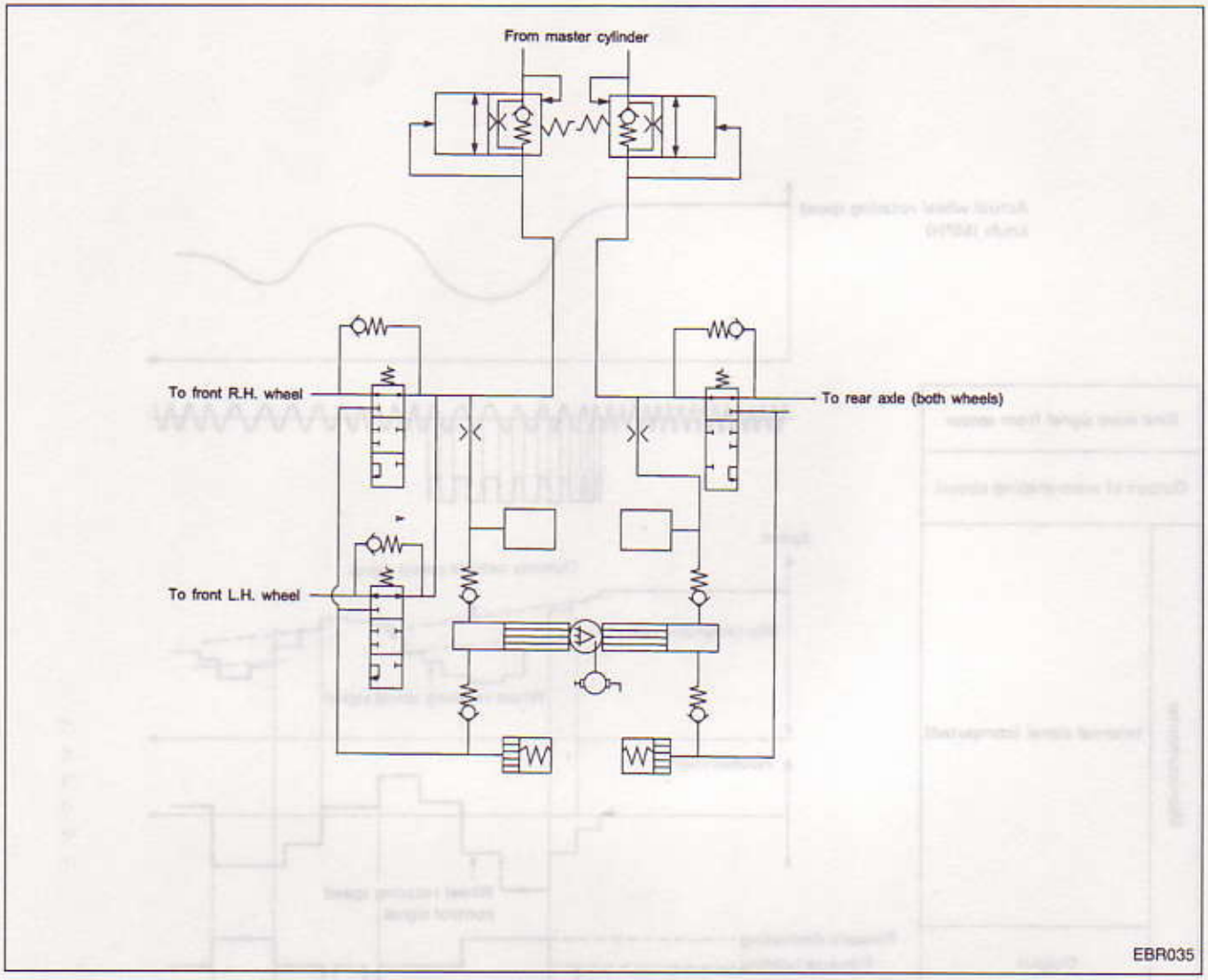
The sensor unit consists of a gear-shaped rotor and a sensor element which contains a bar magnet around which a coil is wound. The sensor is installed on the back side of the brake rotor. Sine-wave current is generated by the sensor as the wheel rotates. The frequency and voltage increase(s) as the rotating speed increases.

CONTROL UNIT

The control unit computes the rotating speed of the wheel by the signal current sent from the sensor, and supplies a DC current to the actuator solenoid valve provided for each front wheel and rear axle by changing its internal resistance. It also controls ON-OFF operation of the valve relay and pump relay. If any electrically detectable malfunction should occur in the system, the control unit causes the warning light to light up. In this condition, the A.B.S. will be deactivated by the control unit, and the vehicle's braking system reverts to normal operation.

System Description (Cont'd)

ACTUATOR

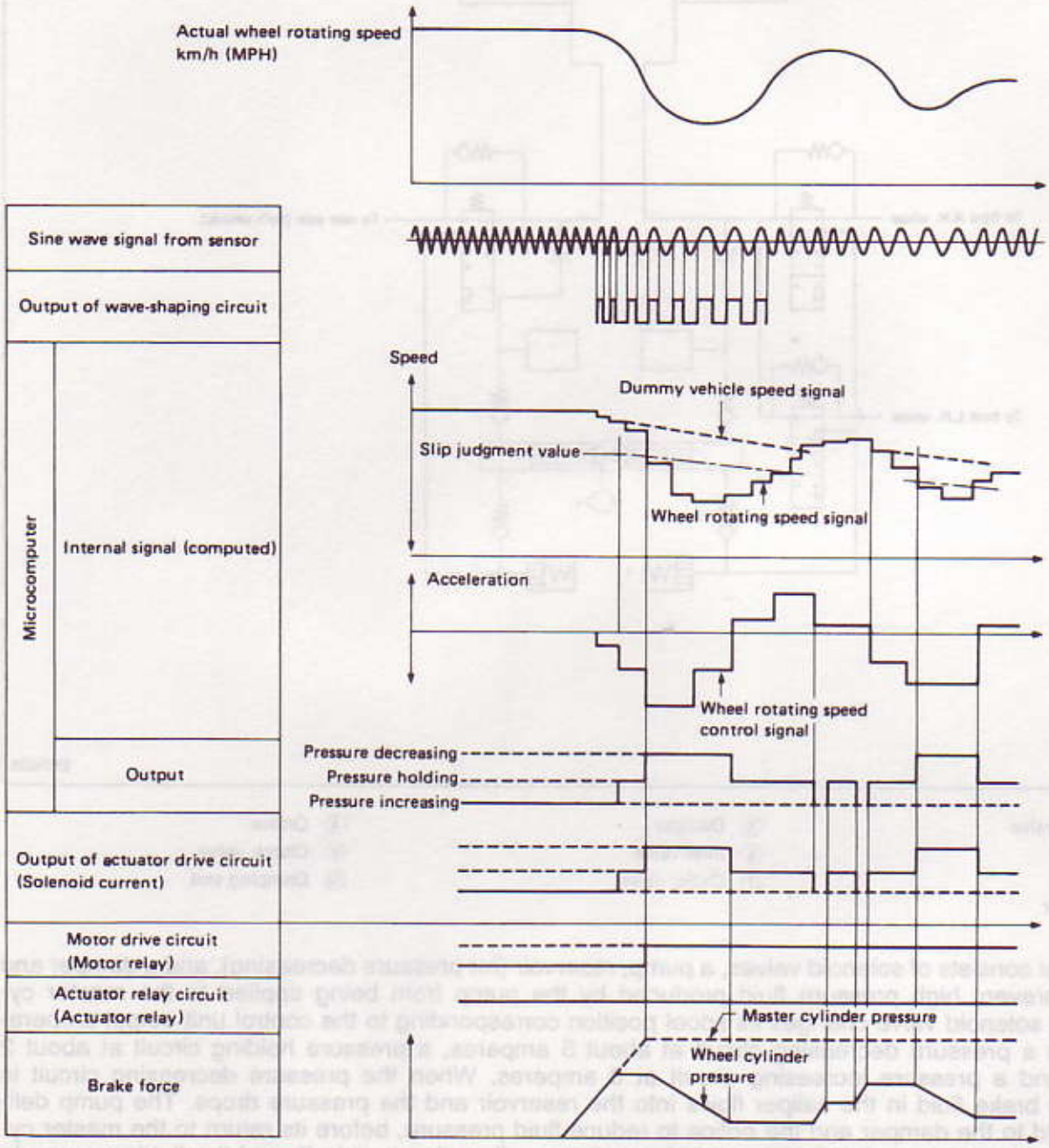


① Solenoid valve
② Reservoir
③ Pump
④ D.C. motor
⑤ Damper
⑥ Inlet valve
⑦ Outlet valve
⑧ Orifice
⑨ Check valve
⑩ Damping unit

The actuator consists of solenoid valves, a pump, reservoir (for pressure decreasing), and a damper and orifice (to prevent high pressure fluid produced by the pump from being applied to the master cylinder). The solenoid valve changes its spool position corresponding to the control unit output amperage: it forms a pressure decreasing circuit at about 5 amperes, a pressure holding circuit at about 2 amperes, and a pressure increasing circuit at 0 amperes. When the pressure decreasing circuit is formed, the brake fluid in the caliper flows into the reservoir and the pressure drops. The pump delivers the fluid to the damper and the orifice to reduce fluid pressure, before its return to the master cylinder. When the pressure holding circuit is formed, the caliper line is cut off, and the fluid pressure in the caliper is kept constant.

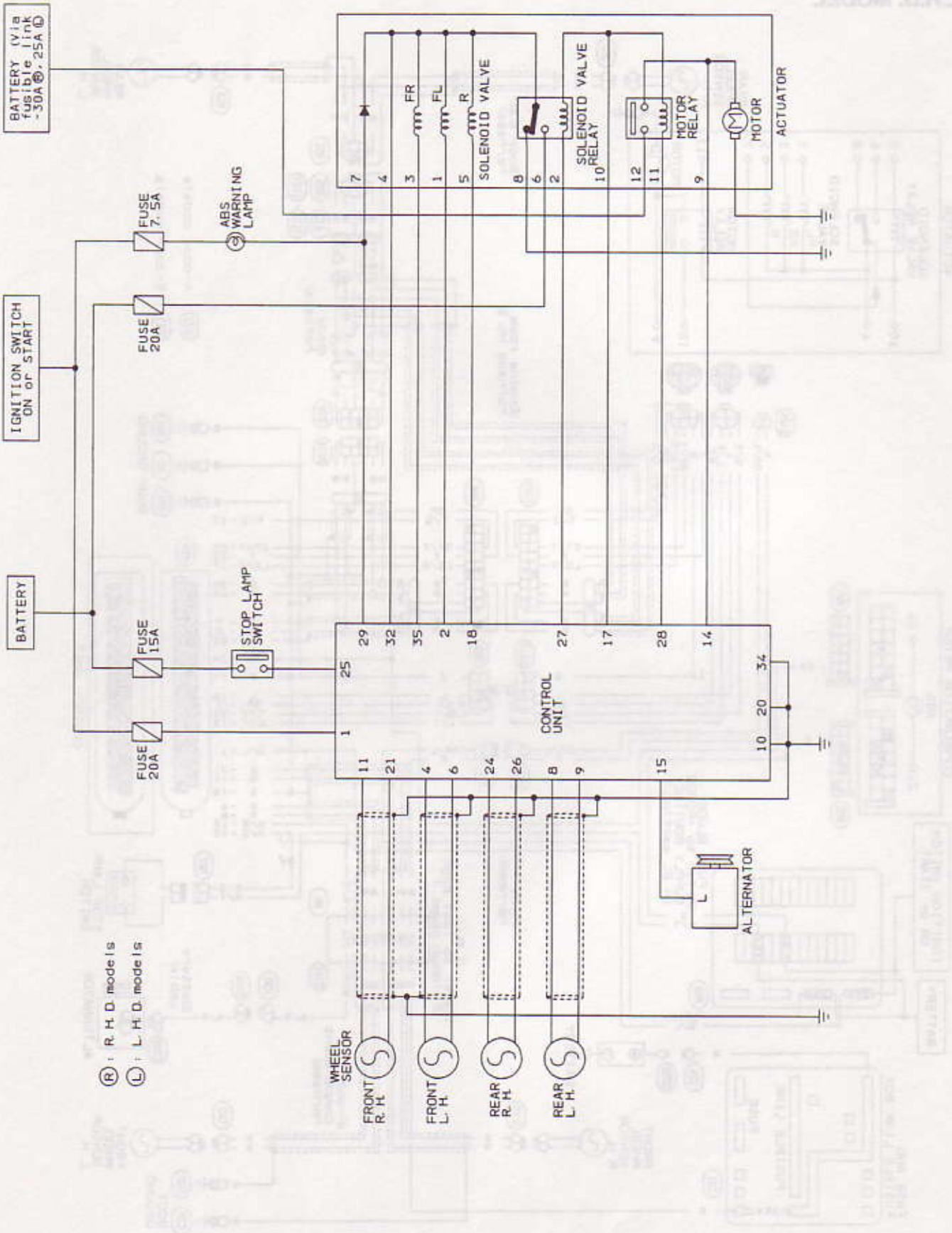
System Description (Cont'd)

CONTROL UNIT CONTROL CHART



EBR203

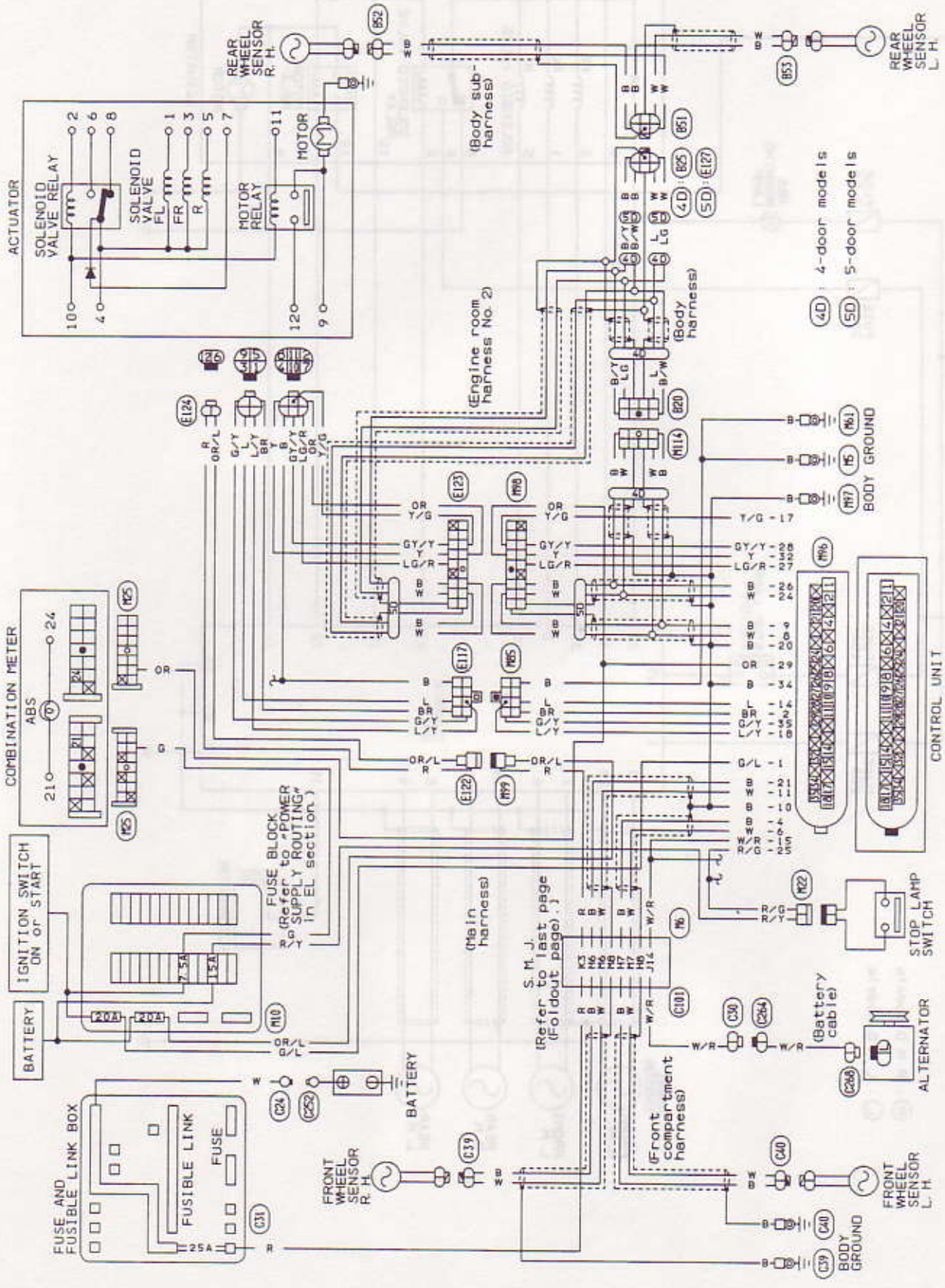
Circuit Diagram



MBR048A

Wiring Diagram

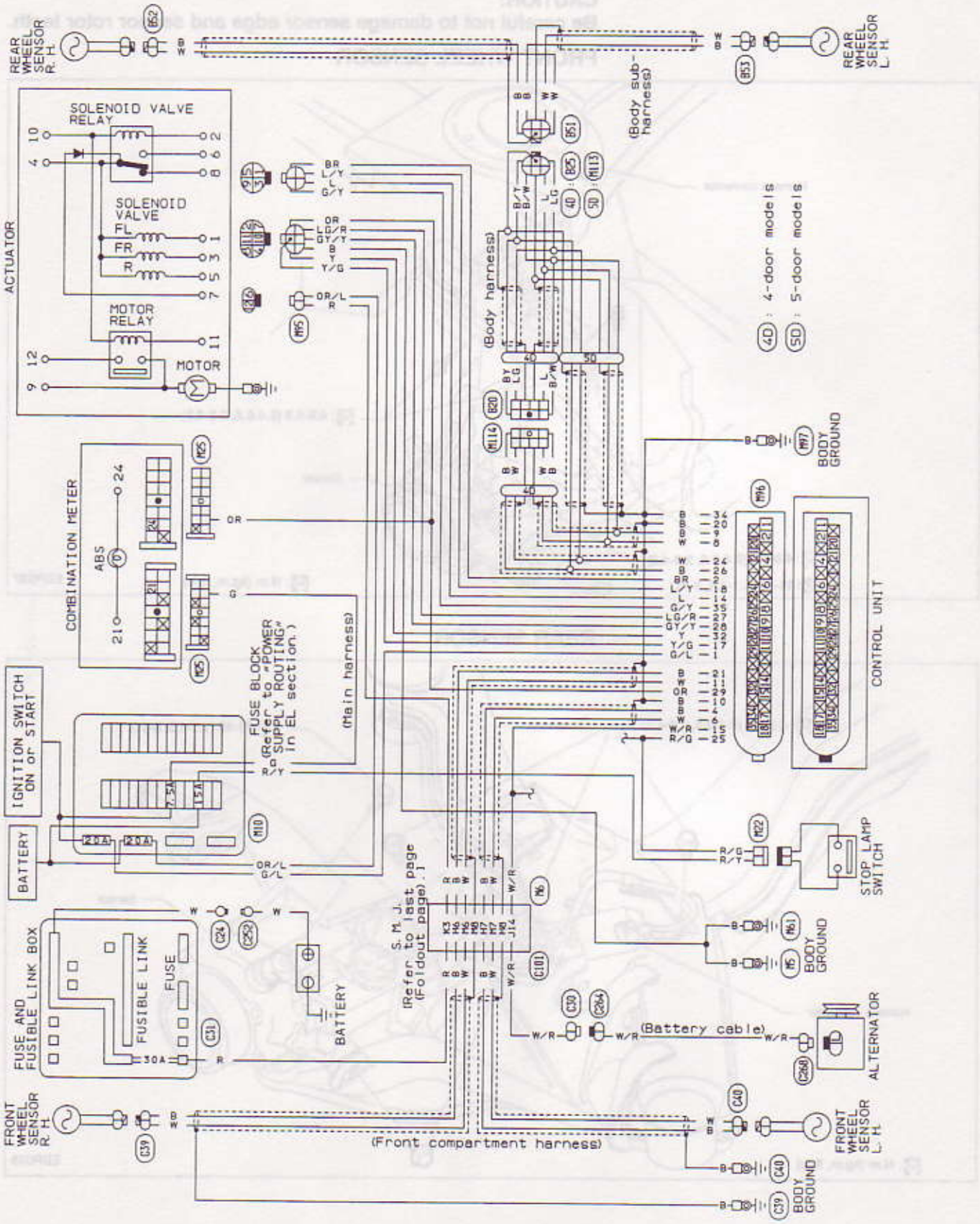
L.H.D. MODEL



MBR050A

Wiring Diagram (Cont'd)

R.H.D. MODEL

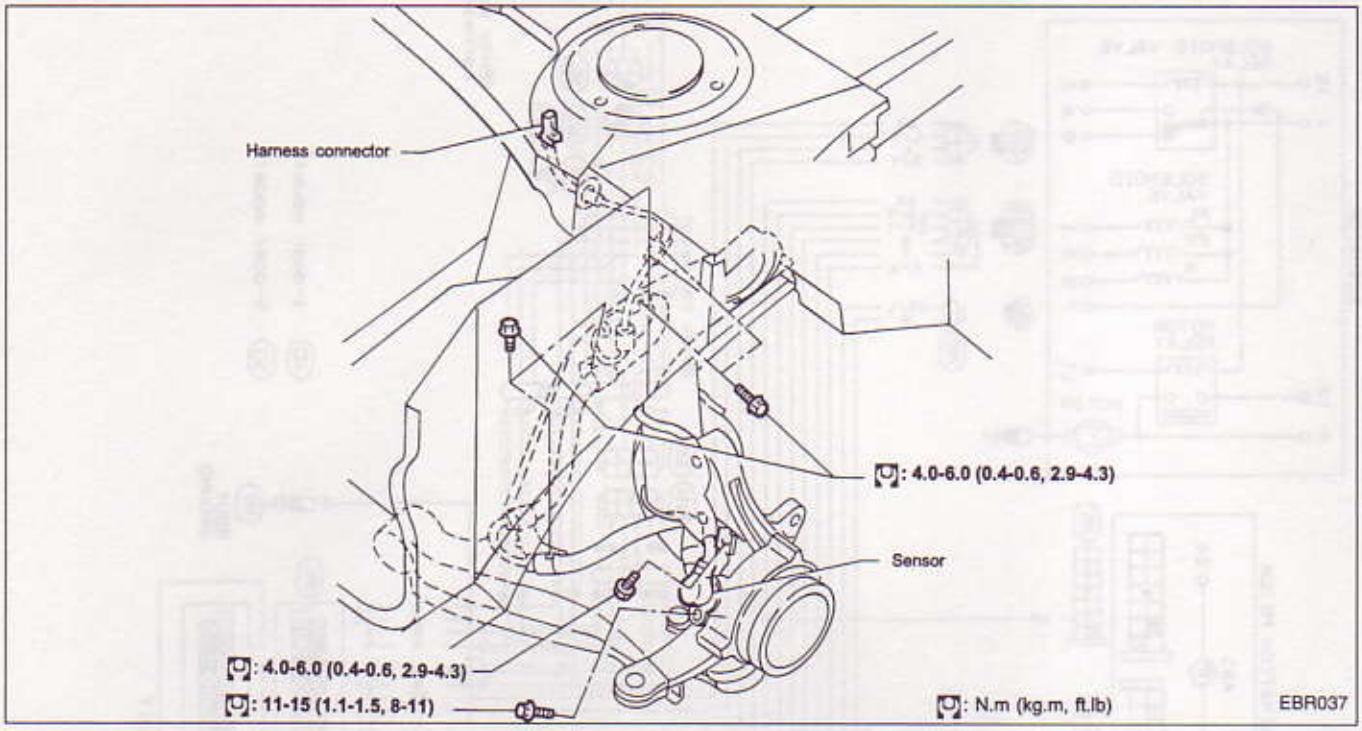


MBR049A

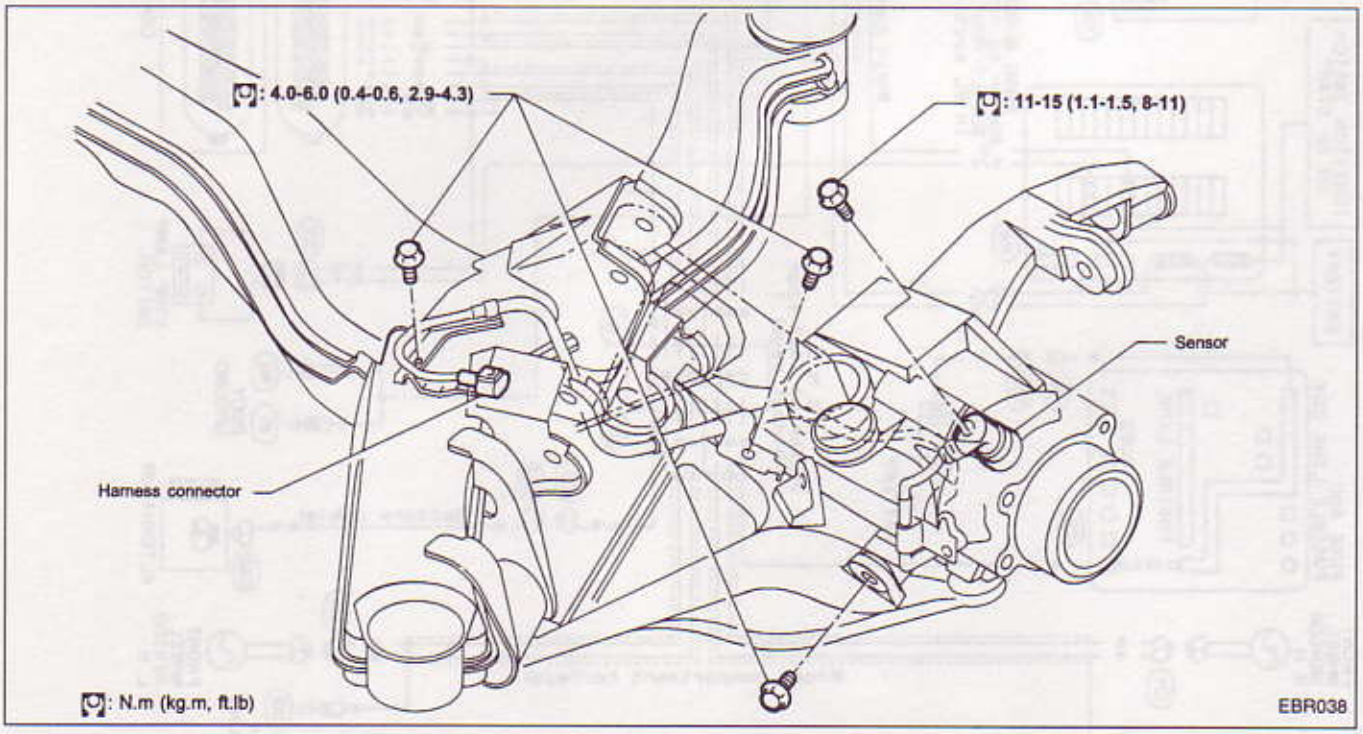
Removal and Installation

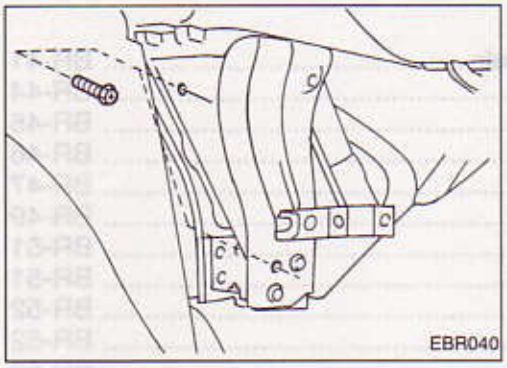
CAUTION:
Be careful not to damage sensor edge and sensor rotor teeth.

FRONT WHEEL SENSOR



REAR SENSOR





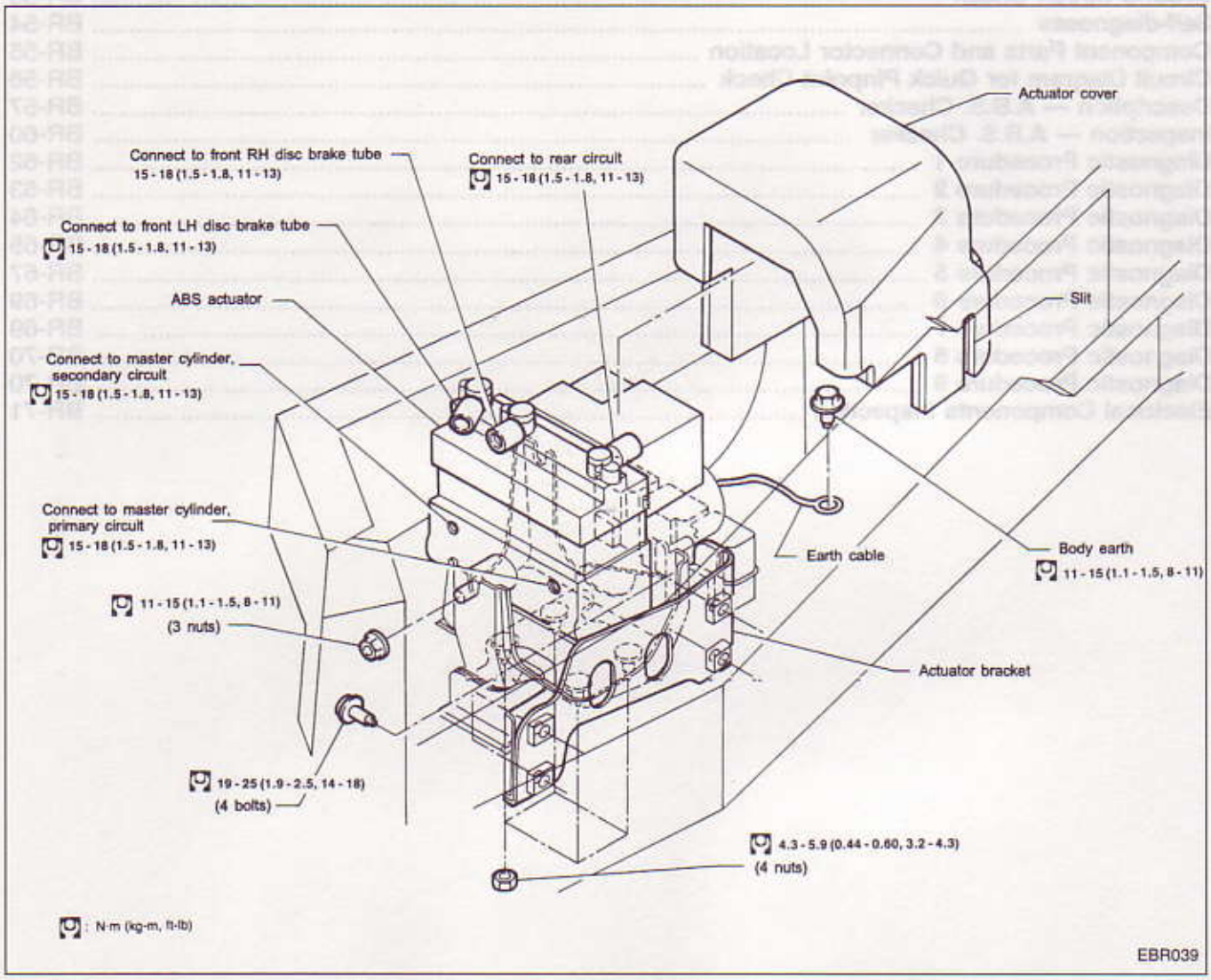
CONTROL UNIT

Location: Center console under dash panel.

Removal

ACTUATOR

1. Disconnect battery cable.
2. Drain brake fluid. Refer to "Changing Brake Fluid" in "CHECK AND ADJUSTMENT".
3. Apply different colored paint to each pipe connector and actuator to prevent incorrect connection.



4. Disconnect connector, brake pipes and remove fixing nuts and actuator ground cable.

- **Use flare nut wrench to remove flare nuts.**
- **Be careful not to damage surface of brake pipes.**
- **If the actuator will not be installed directly after removal, plug brake fluid inlets and outlets to prevent entering dust into actuator.**

Installation

CAUTION:

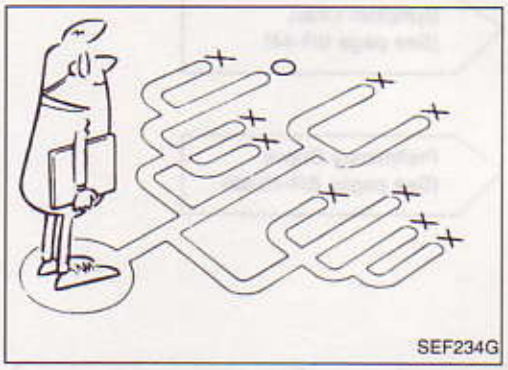
After installation, refill brake fluid. Then bleed air. Refer to "CHECK AND ADJUSTMENT" and "AIR BLEEDING" respectively.

1. Tighten actuator ground cable.
2. Connect brake pipes temporarily.
3. Tighten fixing nuts.
4. Tighten brake pipes.
5. Connect connector and battery cable.

- Tighten flare nuts of brake pipes to the specified torque.

Contents

SEF233G


SEF234G

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 carried out.

Before undertaking actual checks, take just a few minutes to talk to a customer who approaches with an 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.

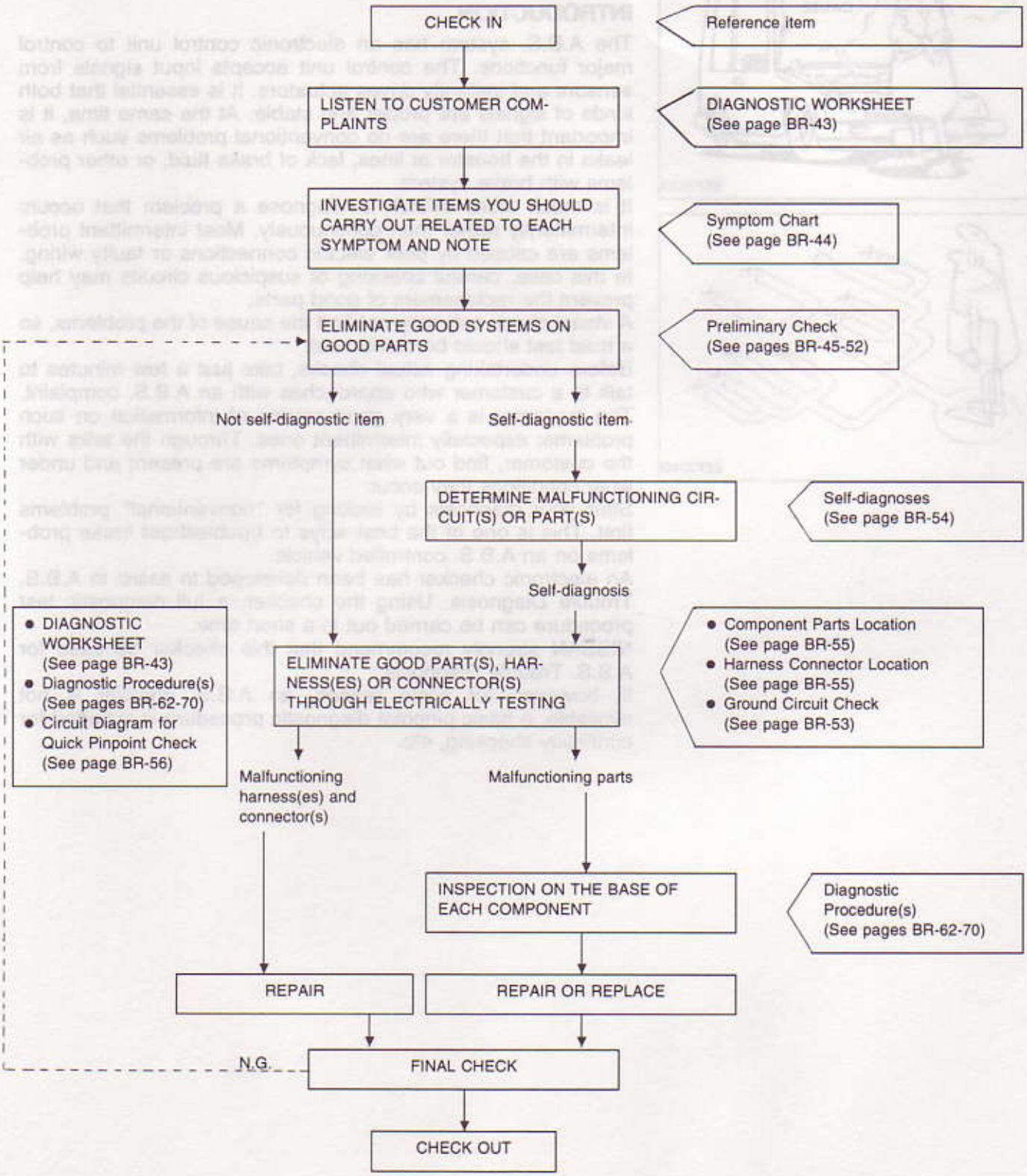
An electronic checker has been developed to assist in A.B.S. Trouble Diagnosis. Using the checker, a full diagnostic test procedure can be carried out in a short time.

NISSAN strongly recommend that this checker be used for A.B.S. Trouble Diagnosis.

If, however, for some reason, an A.B.S. checker is not available, a basic pinpoint diagnostic procedure is included for continuity checking, etc.

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

WORK FLOW



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.

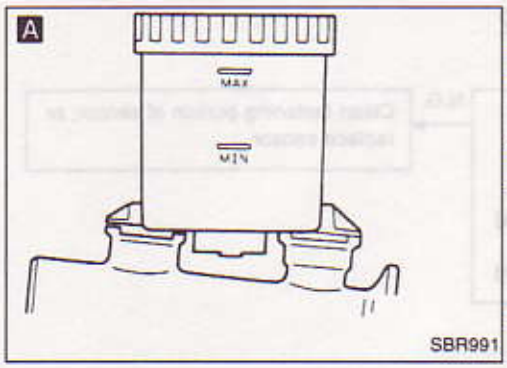
Worksheet sample

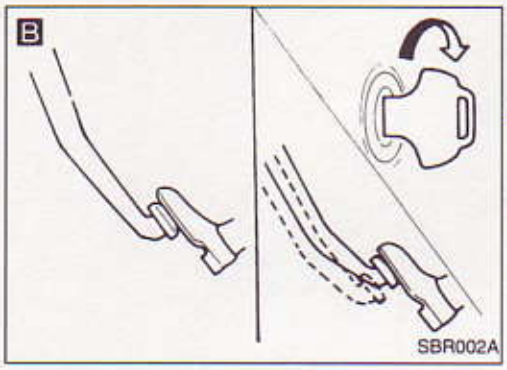
Customer name MR/MS		Model & Year			VIN		
Engine #		Trans.			Mileage		
Incident Date		Manuf. Date			In Service Date		
Symptoms	☐ Pedal vibration and noise	☐ Warning activates	☐ Long stopping distance	☐ Abnormal pedal action	☐ A.B.S. doesn't work	☐ A.B.S. works but warning activates	☐ A.B.S. works frequently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

Symptom Chart

When not using "Checker", it is necessary to perform diagnostic procedures 1 to 9. In addition, it is also necessary to perform "active check".

Procedure		Reference Page	SYMPTOM	Pedal vibration & noise	Warning activates	Long stopping distance	Abnormal pedal action	A.B.S. does not work	A.B.S. works but warning activates
Diagnostic Procedure	Without Checker	BR-70	Diagnostic Procedure 9	O	O	O	O	O	O
		BR-70	Diagnostic Procedure 8	O	O	O	O	O	O
		BR-69	Diagnostic Procedure 7	O	O	O	O	O	O
		BR-69	Diagnostic Procedure 6	O	O	O	O	O	O
		BR-67	Diagnostic Procedure 5	O	O	O	O	O	O
		BR-65	Diagnostic Procedure 4	O	O	O	O	O	O
		BR-64	Diagnostic Procedure 3	O	O	O	O	O	O
		BR-63	Diagnostic Procedure 2	O	O	O	O	O	O
		BR-62	Diagnostic Procedure 1	O	O	O	O	O	O
	With Checker	BR-60	Inspection	O	O	O	O	O	O
		BR-57	Description	O	O	O	O	O	O
		BR-56	Circuit Diagram for Quick Pinpoint Check	O	O	O	O	O	O
		BR-55	Component Parts and Connector Location	O	O	O	O	O	O
Ground Circuit Check		BR-53	ABS Actuator Ground						O
		BR-53	ABS Actuator Motor Ground					O	
Preliminary Check		BR-52	Preliminary Check 8						O
		BR-52	Preliminary Check 7					O	
		BR-51	Preliminary Check 6				O		
		BR-51	Preliminary Check 5			O			
		BR-49	Preliminary Check 4	O		O			
		BR-47	Preliminary Check 3	O	O	O	O	O	O
		BR-46	Preliminary Check 2		O			O	
		BR-45	Preliminary Check 1			O	O		





Preliminary Check 1

A

Check fluid level in reservoir tank. — N.G. → Ⓐ

O.K. ↓

B

Check braker booster operation and airtightness.
Refer to "On-vehicle Service" of BRAKE BOOSTER. — N.G. → Repair or replace brake booster.

O.K. ↓

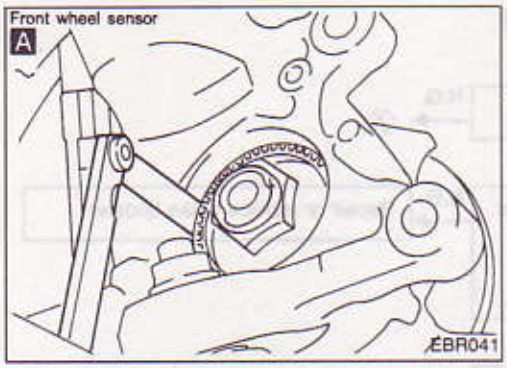
Check brake pads, rotor, lining and drum.
Refer to FRONT DISC BRAKE and REAR DRUM BRAKE.

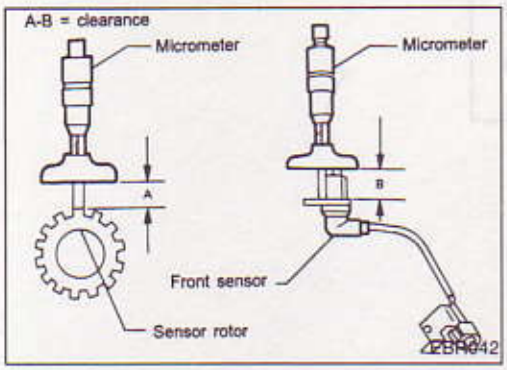
Ⓐ ↓

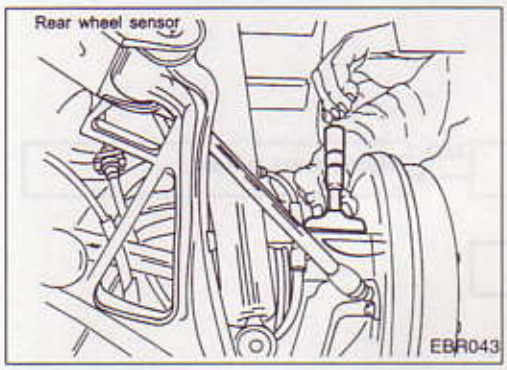
Check fluid leakage. — N.G. → Repair brake system.

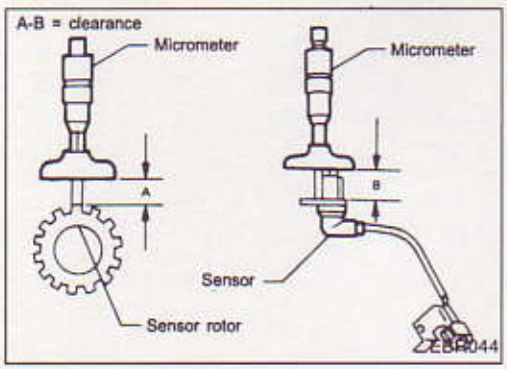
O.K. ↓

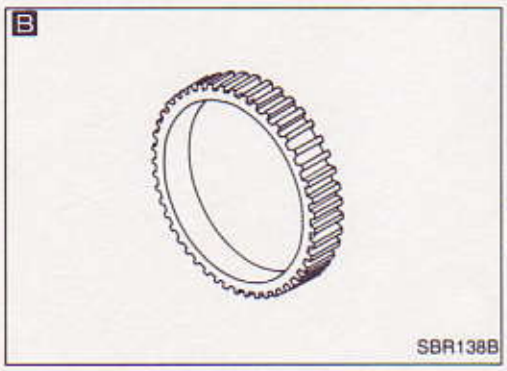
Refill fluid and check again.











Preliminary Check 2

A

Check clearance between sensor and top of rotor.
Clearance should be:
Front
0.21 - 0.71 mm (0.0083 - 0.0280 in)
Rear
0.25 - 0.87 mm (0.0098 - 0.0343 in)

N.G. → Clean fastening portion of sensor, or replace sensor.

O.K.

B

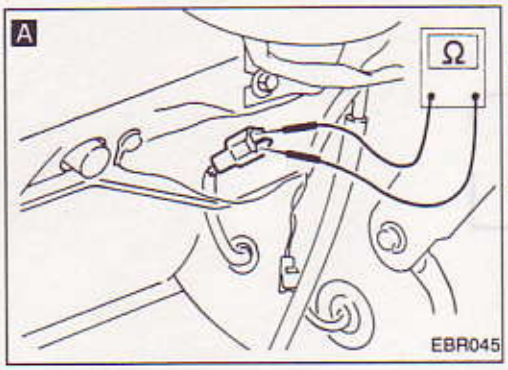
Check rotor for teeth damage and number of teeth.
Number of teeth should be:
Front 46
Rear 46

N.G. → Replace rotor.

O.K.

Check wheel bearing play.
Refer to sections FA and RA.

Preliminary Check 3

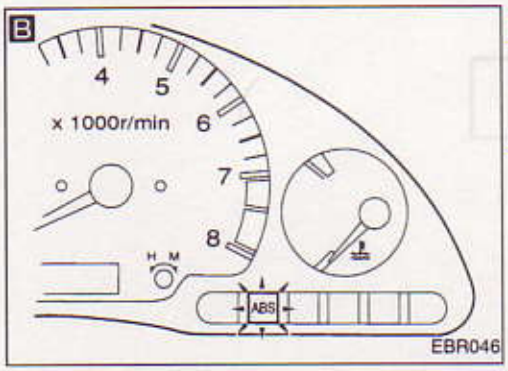


A

Check resistance of each sensor.
Sensor resistance:
0.8 - 1.2 kΩ

N.G. → Repair or replace.

O.K. ↓

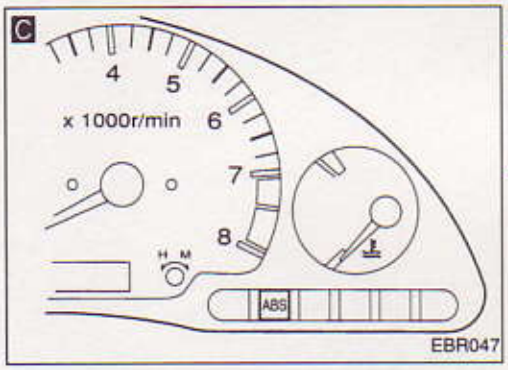


B

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

N.G. → Check fuse.
Check bulb condition.

O.K. ↓

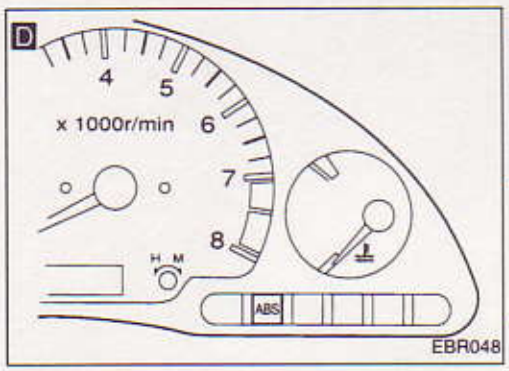


C

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

N.G. → Ⓐ

O.K. ↓



D

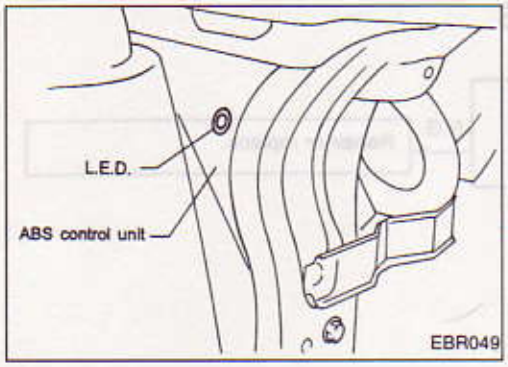
Perform a driving test at 30 km/h (19 MPH) for at least one minute.
Ensure warning lamp remains off while driving.

N.G. → Ⓐ

O.K. ↓

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

Preliminary Check 3 (Cont'd)

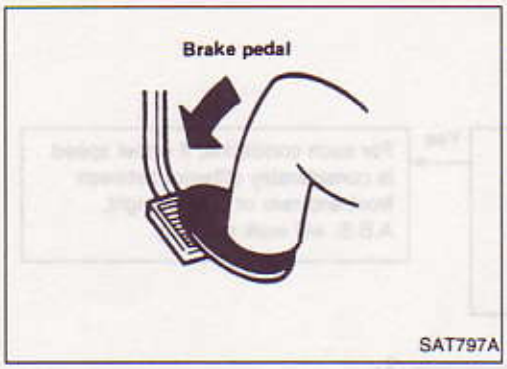


Ⓐ

- Start engine
- Count the number of L.E.D. flashes during 5 to10 second "OFF" period.

O.K.

- Perform Self-diagnoses (See page BR-54)



Preliminary Check 4

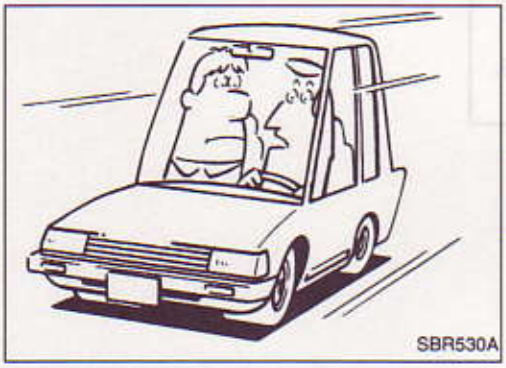
Check whether the symptom appears only when brake is applied suddenly.
- Yes → When brake is normally applied, A.B.S. works and produces pedal vibration or noise.
- No ↓

Check whether the symptom appears only when engine is started.

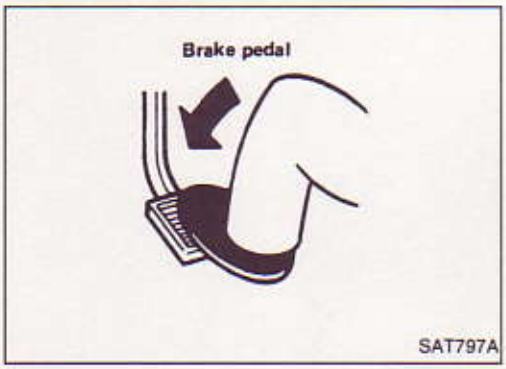
- Yes → With A.B.S. checker: Perform inspection with checker. (Go to A.B.S. checker, page BR-57.) Without A.B.S. checker: Perform pinpoint check. (Go to diagnostic procedures 1 to 9, page BR-62)
- No ↓

Check whether the symptom appears only when the vehicle speed is within 10 km/h (6 MPH) after starting engine.)
- Yes → Check whether the symptom disappears within 5 seconds.
  - No → Ⓐ
  - Yes → A.B.S. may sometimes operate when load is high and voltage is low due to insufficient alternator output.
- No ↓

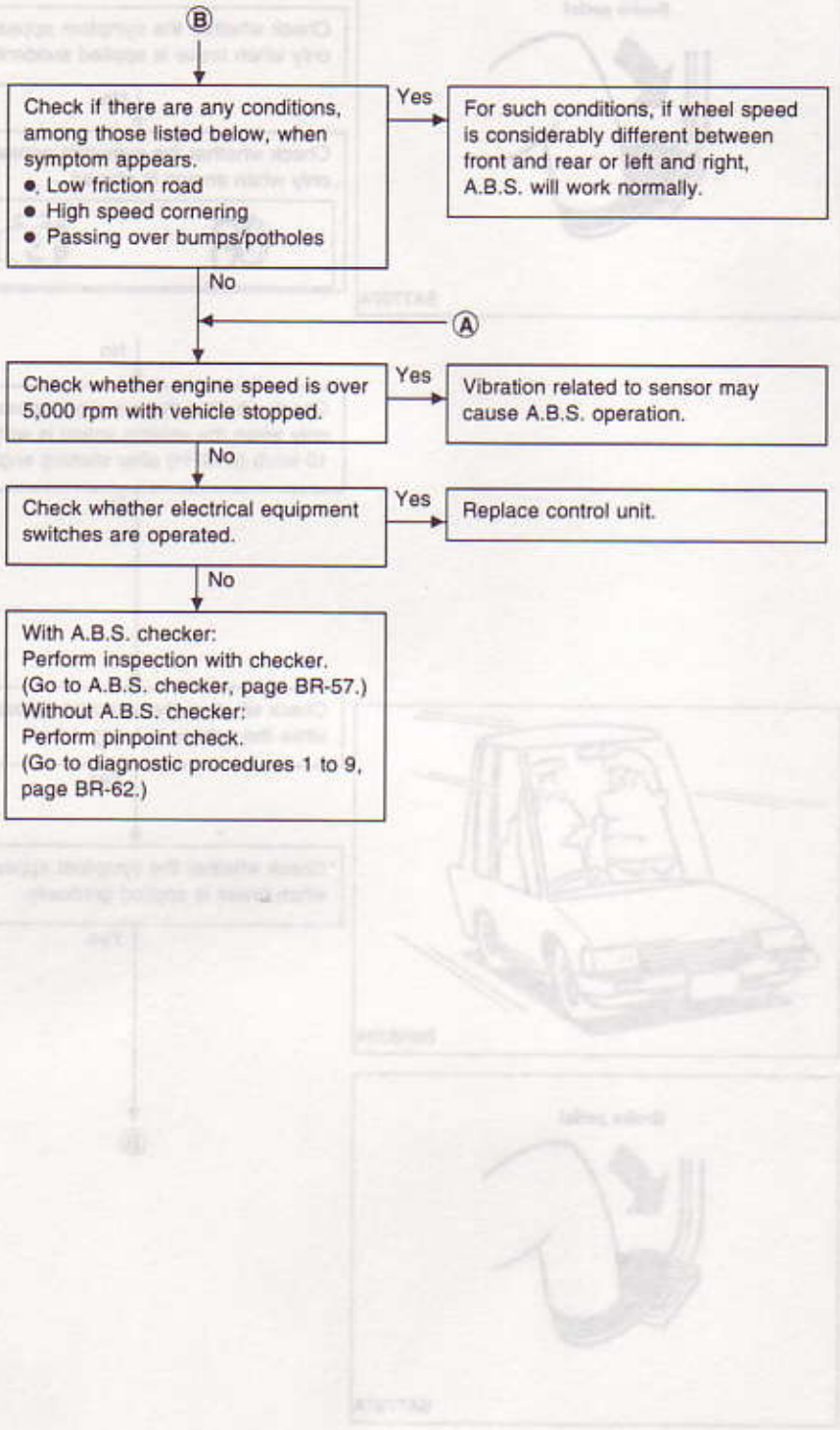
Check whether the symptom appears while the vehicle is being driven.
- No → Ⓐ
- Yes ↓



Check whether the symptom appears when brake is applied gradually.
- No (Appears when brake is not applied.) → Check if there are any conditions, among those listed below, when symptom appears.
  - Shifting
  - Operating clutch
  - Passing over bumps/potholes
  - No → Ⓐ
  - Yes → Under these conditions individual wheel speed can change suddenly. This may sometimes cause the A.B.S. to operate.
- Yes ↓ Ⓑ



Preliminary Check 4 (Cont'd)




SBR530A

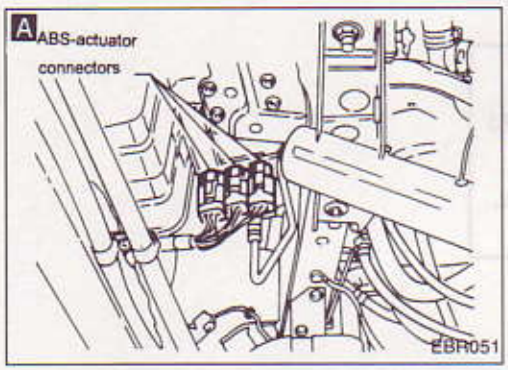
Preliminary Check 5

Check if road condition is slippery with snow or gravel.
- Yes → Stopping distance may be longer than vehicles which are not equipped with A.B.S.
- No ↓

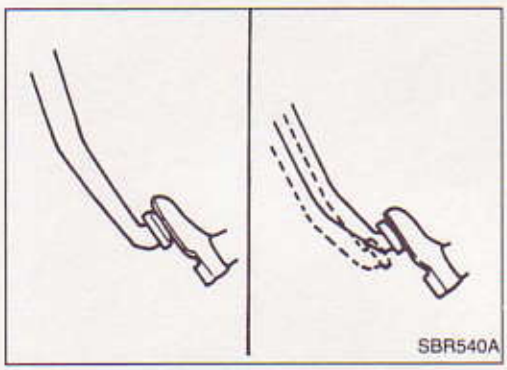
A

Disconnect actuator connectors and check whether stopping distance is still long.
- Yes → With A.B.S. checker: Perform inspection with checker. (Go to A.B.S. checker, page BR-57.) Without A.B.S. checker: Perform pinpoint check. (Go to diagnostic procedures 1 to 9, page BR-62.)
- No ↓

Perform Preliminary Check 1 and air bleeding.



EBR051


SBR540A

Preliminary Check 6

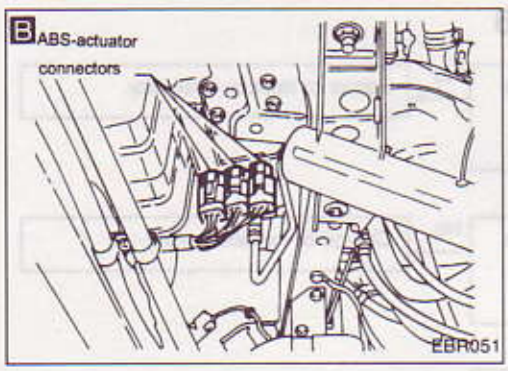
Check whether brake pedal stroke is excessive.
- Yes → Vehicle equipped with A.B.S. may have a tendency for excessive pedal strokes.
- No ↓

Check that brake pedal force is firm but brake is effective.
- Yes → Normal condition.
- No ↓

A

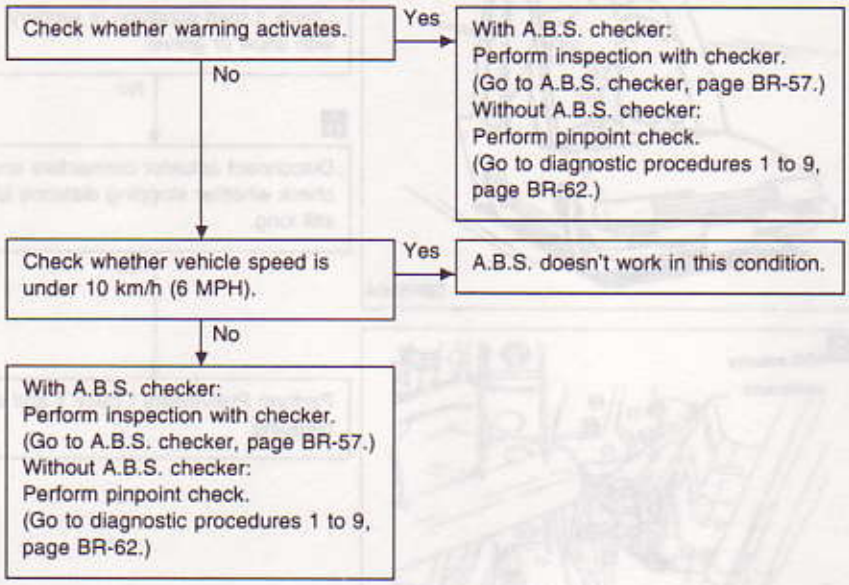
Disconnect actuator connector and check whether brake is effective.
- Yes → With A.B.S. checker: Perform inspection with checker. (Go to A.B.S. checker, page BR-57.) Without A.B.S. checker: Perform pinpoint check. (Go to diagnostic procedures 1 to 9, page BR-62.)
- No ↓

Perform Preliminary Check 1.

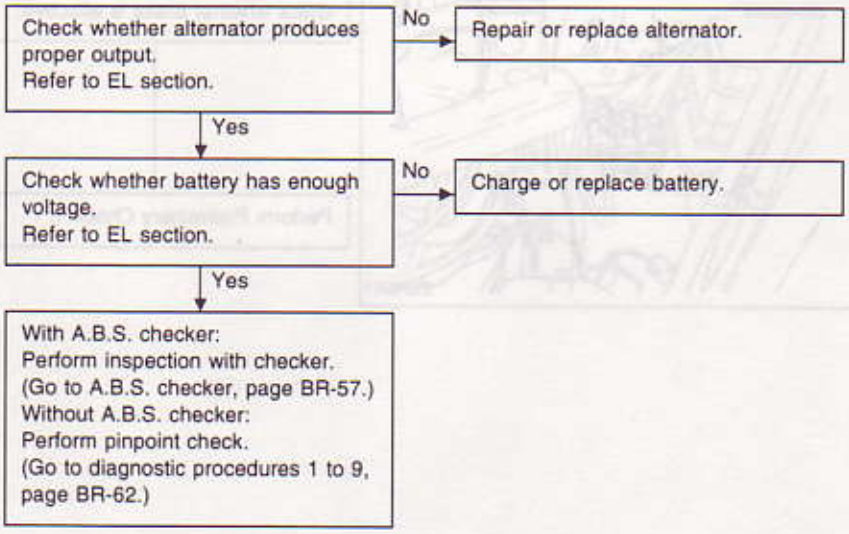


EBR051

Preliminary Check 7

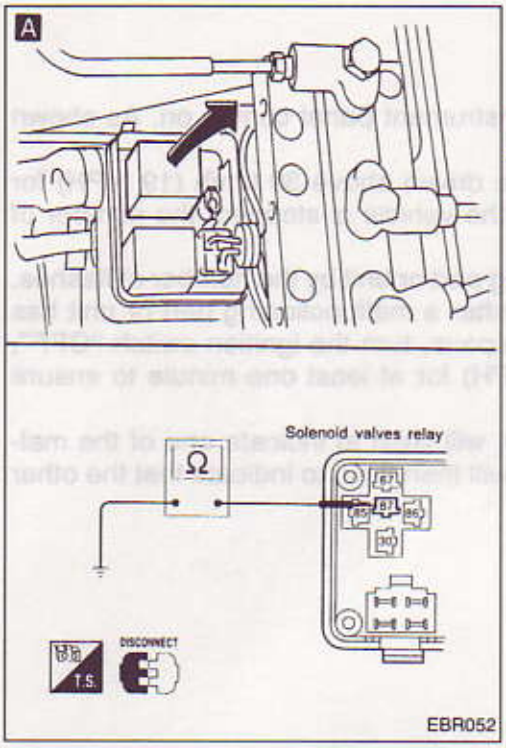


Preliminary Check 8



Ground Circuit Check

ABS ACTUATOR GROUND



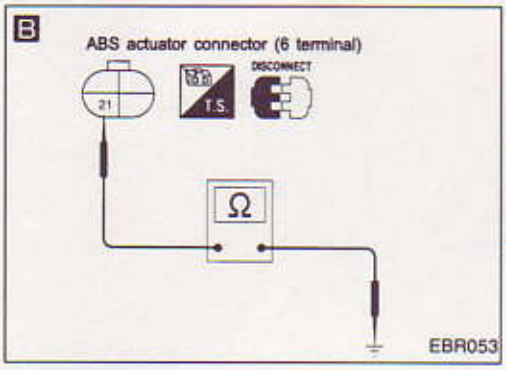
A

- Remove solenoid valve relay.
- Check continuity between terminal (87a) of fuse box and ground.

Continuity should exist.

O.K. → Inspection end.

N.G.



B

- Disconnect actuator connector.
- Check continuity between terminal (21) and ground.

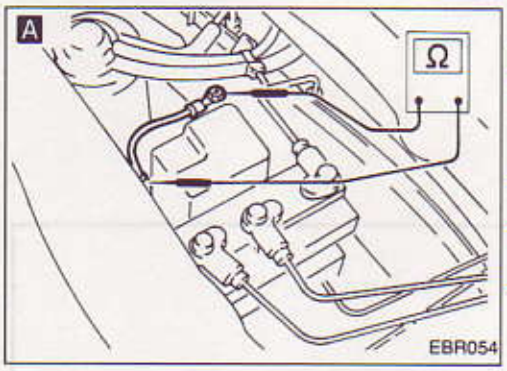
Continuity should exist.

O.K. → Replace actuator assembly.

N.G.

Replace or repair harness.

ABS ACTUATOR MOTOR GROUND



A

- Check resistance between both terminals, as shown in illustration.

Continuity should exist.

N.G.

Repair or replace harness.

Self-diagnoses

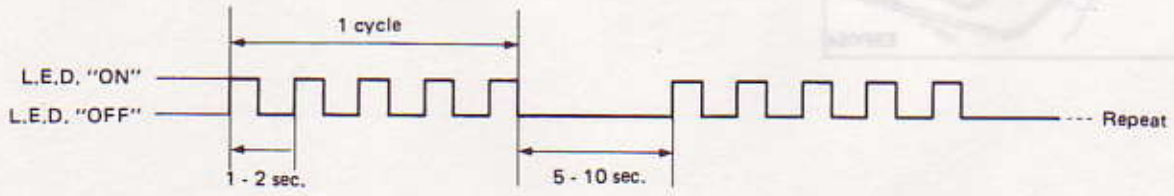
CHECKING THE NUMBER OF L.E.D. FLASHES

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 peforms 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	Left rear rotor sensor circuit
8	Right rear rotor sensor circuit
9	Actuator motor, motor relay circuit
10	Actuator solenoid valve relay
16 or continuous	Control unit
Warning activates and L.E.D. "OFF"	Power supply or ground circuit for control unit

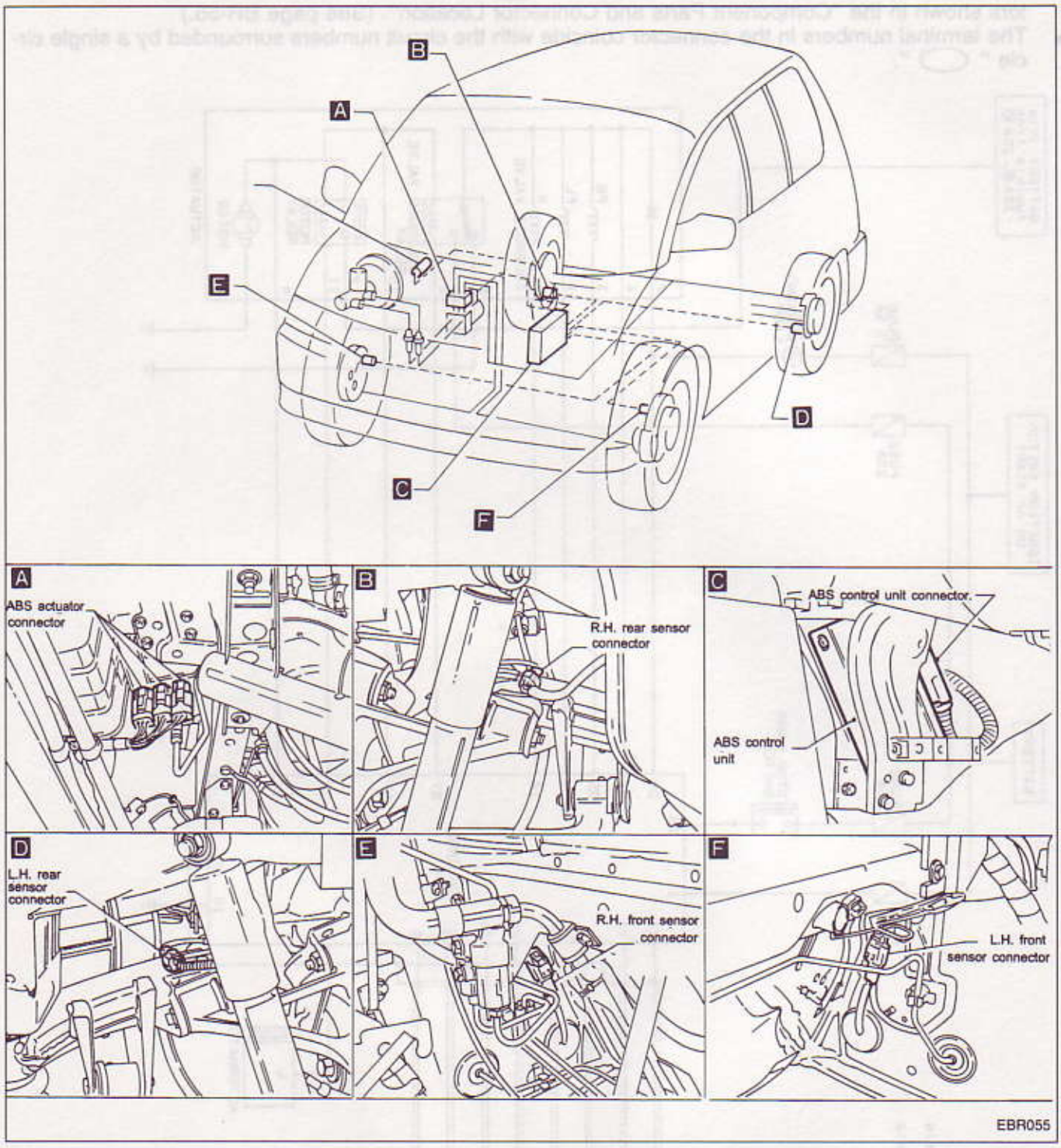
Example

Improper operation of left front rotor sensor circuit



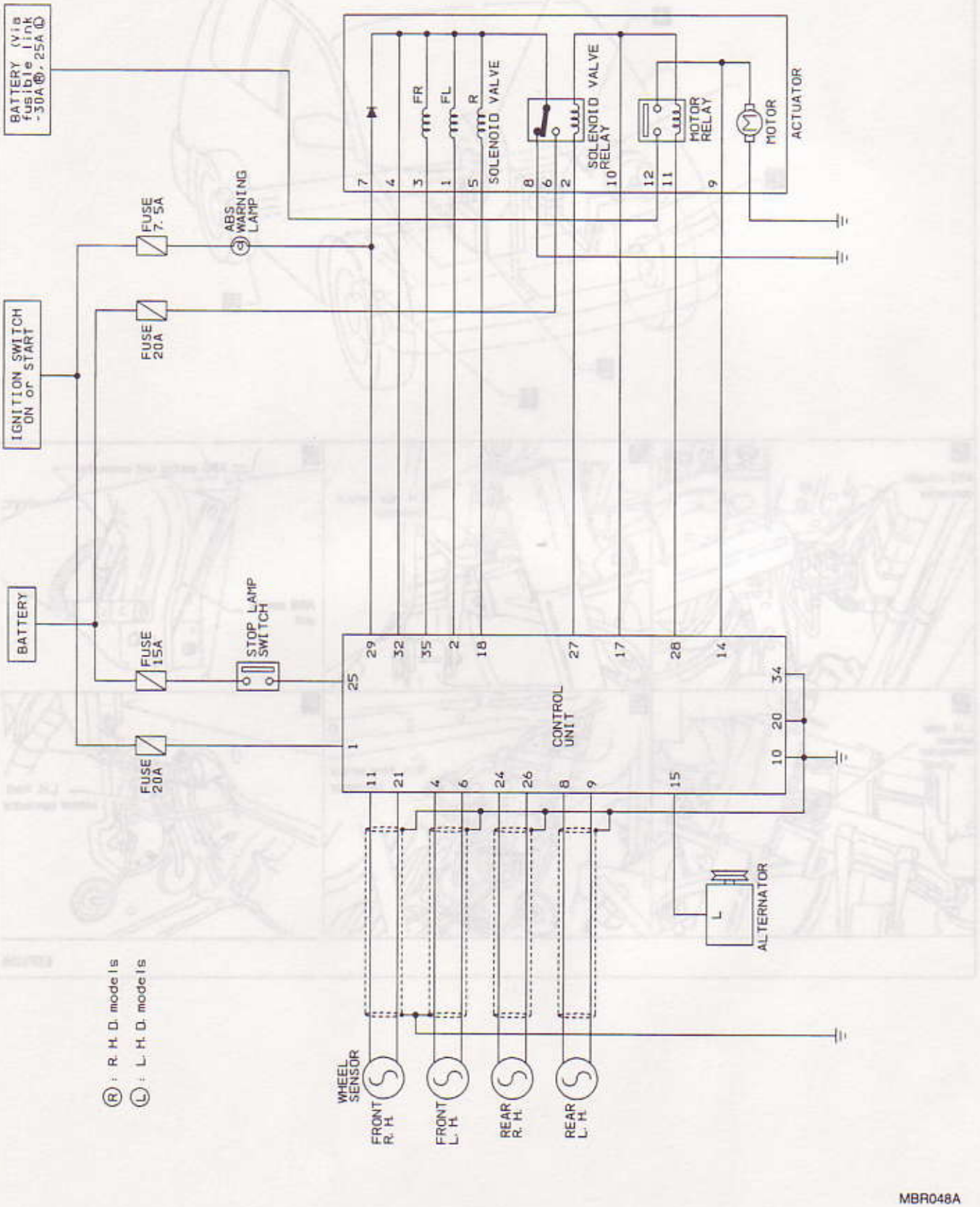
SBR531A

Component Parts and Connector Location



Circuit Diagram for Quick Pinpoint Check

- The unit side connectors with a double circle " ◎ " are connected to the harness side connectors shown in the "Component Parts and Connector Location". (See page BR-55.)
- The terminal numbers in the connector coincide with the circuit numbers surrounded by a single circle " ○ ".



MBR048A

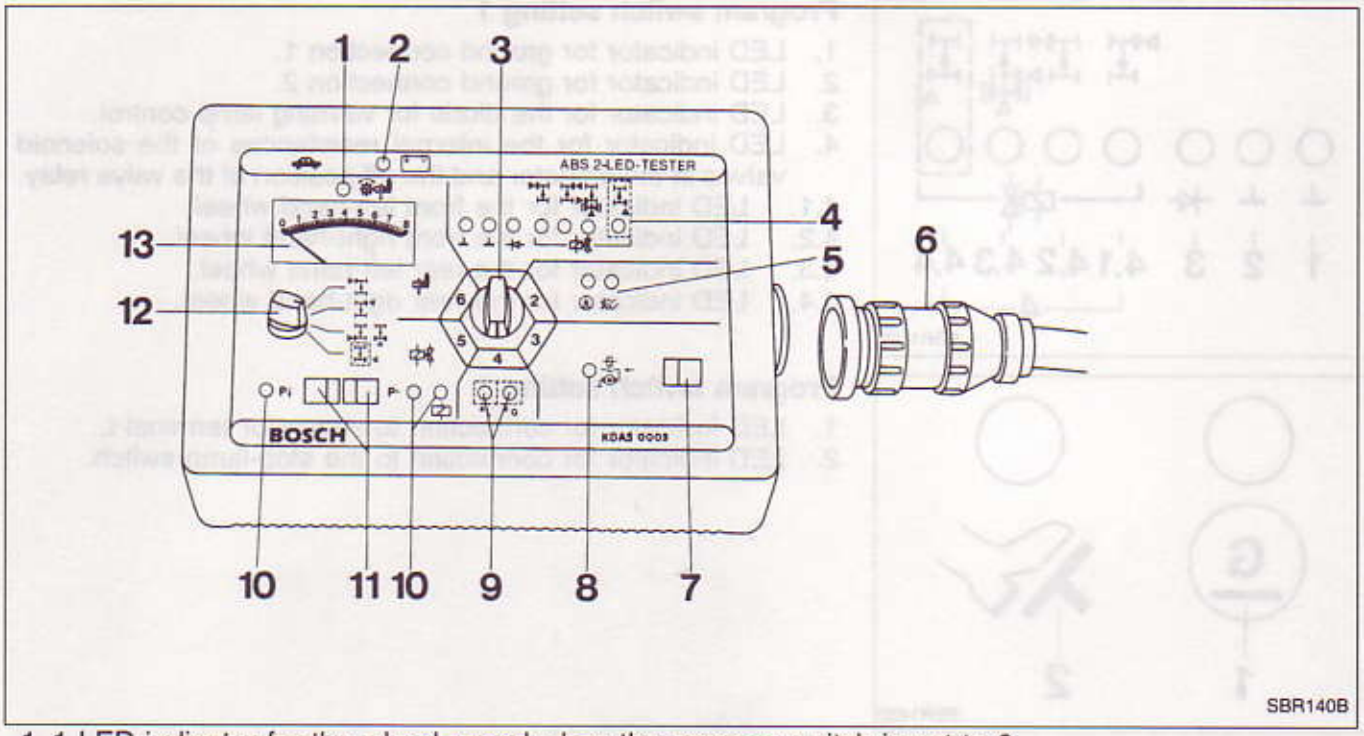
Description — A.B.S. Checker

OUTLINE

The A.B.S. tester can check the A.B.S. electrical component circuits and hydraulic brake system (Active test).

- Motor relay circuit
- Solenoid valve circuit
- Power supply and ground circuit
- Stop lamp switch signal circuit
- Actuator active test
- Solenoid valve relay circuit
- Wheel sensor circuit
- Warning lamp circuit
- Alternator output circuit

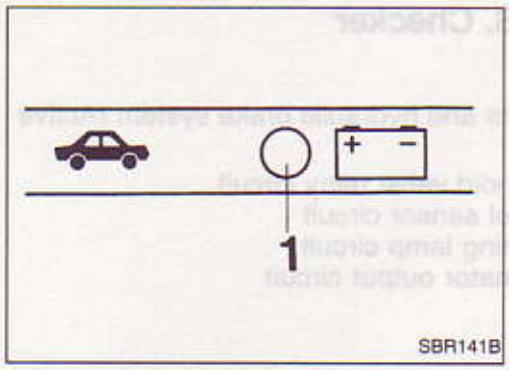
DESCRIPTION



1. 1 LED indicator for the wheel speed when the program switch is set to 6.
2. 1 LED indicator for the battery voltage.
3. Program switch.
4. 7 LED indicators for program switch setting 1.
5. 2 LED indicators for program switch setting 2.
6. Adapter lead for connection to the A.B.S. wiring harness in the vehicle.
7. Push button for motor relay control when the program switch is set to 3.
8. 1 LED indicator for program switch setting 3.
9. Not used.
10. 3 LED indicators for program switch setting 5.
11. 2 Push buttons for triggering off the "Hold pressure" and "Decrease pressure" solenoid-valve functions when the program switch is set to 5.
12. Rotary switch for the selection of single wheels. This is operable when the program switch is set to 5 and 6.
13. Pointer instrument for program switch setting 6.

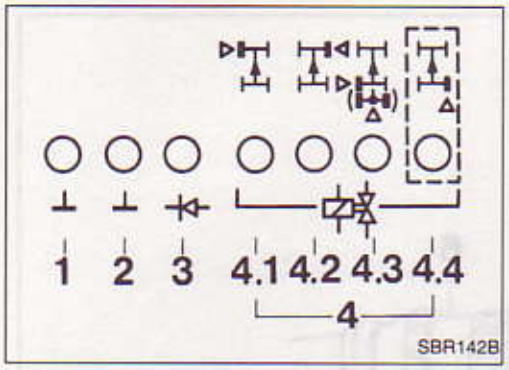
Description — A.B.S. Checker (Cont'd)

CHECK ITEMS



Description of symbols

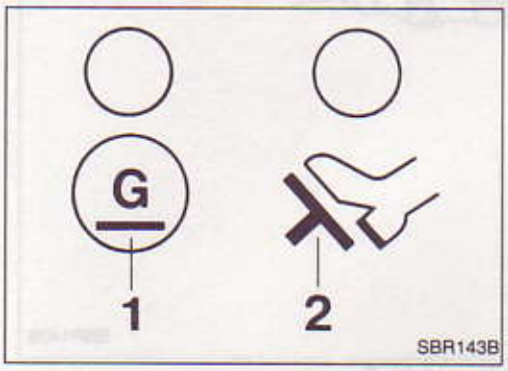
The tester obtains supply voltage from the vehicle's battery. This supply voltage is monitored during the entire testing sequence and in all program switch settings.
One LED (1) is constantly lit to indicate that the voltage is sufficient.



Program switch setting 1

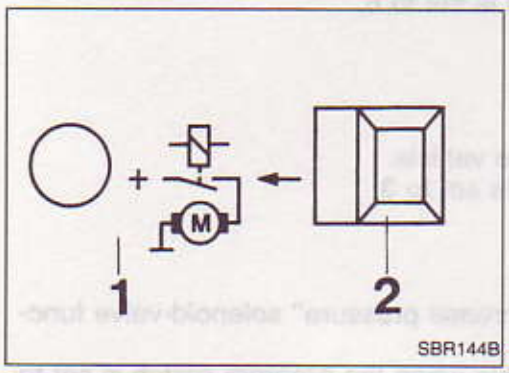
1. LED indicator for ground connection 1.
2. LED indicator for ground connection 2.
3. LED indicator for the diode for warning lamp control.
4. LED indicator for the internal resistances of the solenoid valves in the actuator and the off position of the valve relay.

4.1. LED indicator for the front left-hand wheel.
4.2. LED indicator for the front right-hand wheel.
4.3. LED indicator for the rear left-hand wheel.
4.4. LED indicator for the rear right-hand wheel.



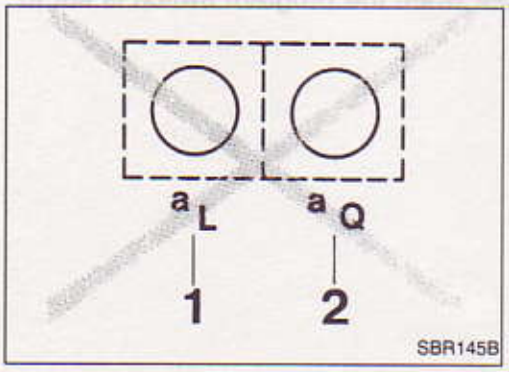
Program switch setting 2

1. LED indicator for connection to alternator terminal L.
2. LED indicator for connection to the stop-lamp switch.



Program switch setting 3

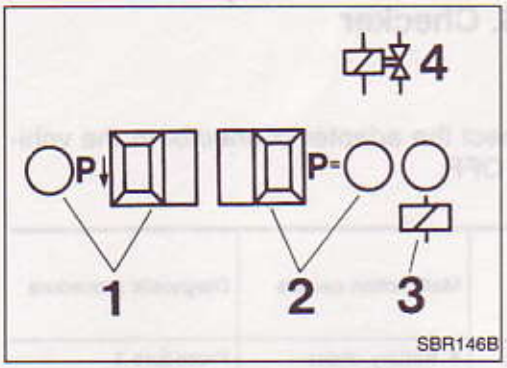
1. LED indicator for the motor relay and pump in the actuator.
2. Push button for control of the motor relay. The LED indicator does not light up until the push-button is operated.



Program switch setting 4

Not used.

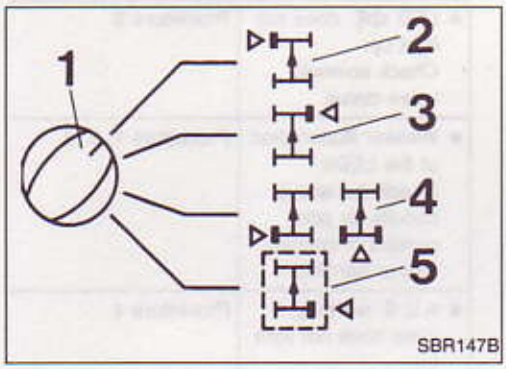
Description — A.B.S. Checker (Cont'd)



Program switch setting 5

Active check of the solenoid valves and valve relay in the actuator.
Checking that the solenoid valves' channel assignments are correct.

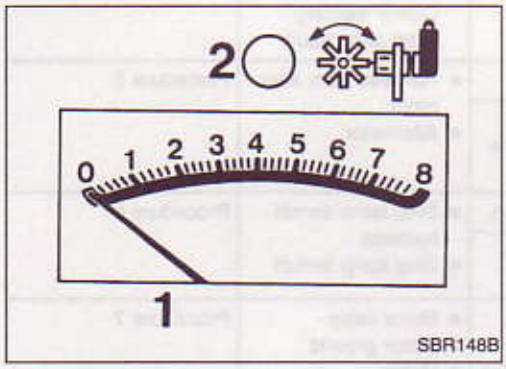
1. Push button and LED indicator for the "Decrease pressure" function.
   The LED must light up after operating of the push-button.
2. Push button and LED indicator for the "Hold pressure" function.
   The LED must light up after operation of the push-button.
3. LED indicator for functioning of the valve relay. This LED must light up continuously when the program switch is set to 5.
4. Symbol for solenoid valves.



Wheel-selection switch

When the program switch is set to 5 and 6, the switch can be adjusted to the wheel to be inspected.

1. Rotary switch for wheel selection.
2. Front left wheel.
3. Front right wheel.
4. Rear left wheel.
5. Rear right wheel.



Program switch setting 6

Checking of the wheel sensor signal and clearance between the wheel sensor and rotor. Check of the wheel sensors for incorrect connection.

1. Pointer instrument.
2. LED indicator for rotary motion of the wheels. This LED lights up continuously when the inspection speed is adequate. Only then must the instrument indication be read off.

Inspection — A.B.S. Checker

WARNING:
Never drive with the tester connected.
Before peforming trouble-diagnosis with the A.B.S. checker, connect the adapter connector to the vehicle harness connector for control unit while the ignition switch is OFF.

CHECKING ITEMS

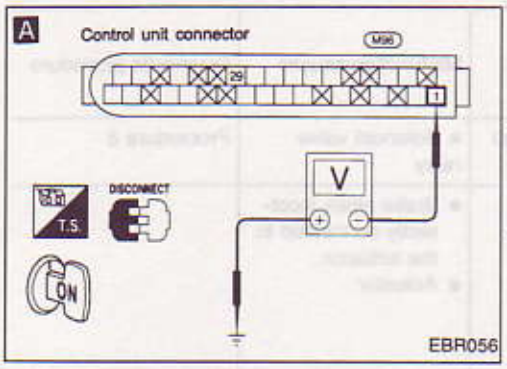
Program switch setting	Checking: Items	Checking: Terminals	Checking condition	Indication	Malfunction causes	Diagnostic procedure
All set	Power supply	⑳, ①	Ignition ON	LED [+ −] lights up continuously.	• Battery undercharged. • Excessive voltage drops. • Fuse blown.	Procedure 1
1	Ground circuit, diode for warning lamp, solenoid valve circuit, solenoid valve relay off.	㉞, ⑩ ㉙, ㉜ ②, ㉟ ⑱, ⑲	Ignition ON	All 7 LEDs light up at the same time. A.B.S. warning lamp in the vehicle must light up.	• LED ⊥ does not light up: Check ground circuit.	Procedure 1
					• LED ⊣◇ does not light up: Check diode and solenoid valve relay ground circuit.	Procedure 2
					• LED ⊂◇ does not light up: Check solenoid valve circuit.	Procedure 3
					• Weaker illumination of the LEDs: Check the above circuits for poor contact of connectors or harness.	Procedure 1, 2, 3
					• A.B.S. warning lamp does not light up: Check warning lamp and circuit.	Procedure 4
2	Alternator output	⑮	Ignition ON	LED ⓐ lights up.	• Harness from alternator • Alternator	Procedure 5
			Start engine	LED ⓐ is extinguished when engine is running.		
	Stop lamp switch	㉕	Ignition ON	LED lights up.	• Stop lamp switch harness • Stop lamp switch	Procedure 6
			Operate brake pedal	LED is extinguished.		
3	Motor relay, motor in actuator.	⑭, ㉘	Ignition ON, keep push-button depressed	LED lights up, motor is running. LED continues to light up after the pushbutton is released due to afterrunning of the motor.	• Motor relay • Motor ground • Motor	Procedure 7

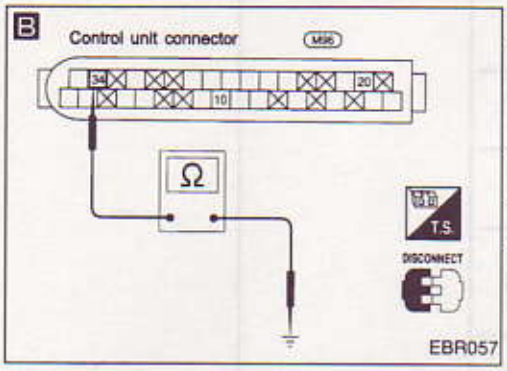
Inspection — A.B.S. Checker (Cont'd)

Program switch setting	Checking: Items	Checking: Terminals	Checking condition	Indication	Malfunction causes	Diagnostic procedure
5	Solenoid valve relay	㉗	Ignition ON	LED ⇕ lights up	• Solenoid valve relay	Procerdure 8
	Actuator operation and correct connection. Note: Carry out checking consecutively for each wheel. Keep to the operating sequence.	—	Jack up the vehicle. Engine is running. The checked wheel must be capable of being freely rotated by hand. Set the wheel selection switch to the wheel to be checked.	—	• Brake pipes incorrectly connected to the actuator. • Actuator	—
	"Hold pressure" function		1. Keep pushbutton P = depressed	LED P = Lights up		
			2. Keep brake pedal depressed	Wheel is rotated by hand.		
			3. Release pushbutton P =	LED P = is extinguished, wheel locked.		
	"Decrease pressure" function		4. Operate pushbutton P = ↓	LED P↓ lights up, wheel is rotated by hand.		
			5. Release pushbutton P↓	LED P↓ is extinguished, wheel locked.		
			6. Release brake pedal			
6	Wheel sensor for proper functioning and correct connection. Note: Carry out checking consecutively for each wheel.	⑤, ④ ⑪, ㉑ ⑦, ⑨ ㉔, ㉖	Jack up the vehicle. Ignition ON. The wheel to be checked must be capable of being freely rotated by hand. When checking, the wheels not being checked must be held. Set the wheel selection switch to the wheel to be checked.		• Wheel sensor circuit • Excessive clearance between wheel sensor and rotor • Rotor teeth • Excessive wheel bearing play or rotor looseness	Procedure 9
			Turn the wheel by hand until the LED above the instrument lights up, but not flickers.	Minimum indication scale: **More than 3**		

Program switch setting 5 means "ACTIVE CHECK".

The final check is in the form of a test drive. With the engine running, the control lamp must go out. Drive at a speed of at least 30 km/h (20 MPH) for longer than 20 secs. During this period, the warning lamp must not light up again!





Diagnostic Procedure 1 (Power Supply and Ground Circuit Check)

A

Check voltage between terminal ① or ㉙ and ground.
Battery voltage should exist.

N.G. → Repair harness or connectors.

O.K.

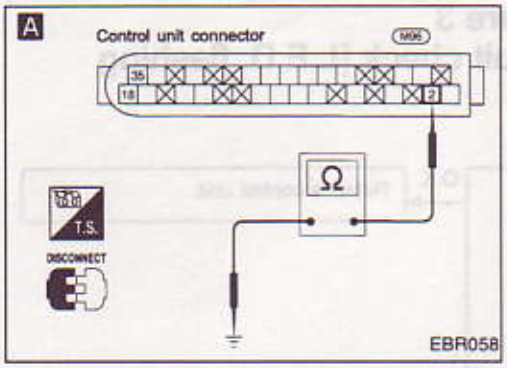
B

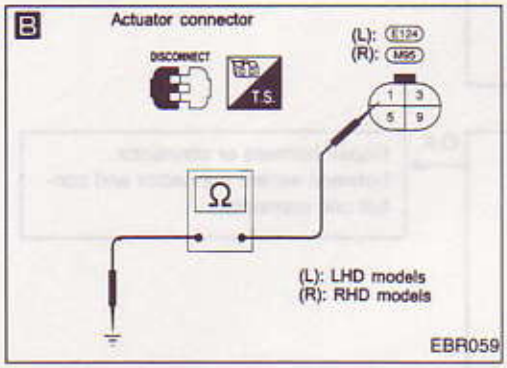
Check continuity between terminal ⑩, ㉘ or ㉞ and ground.
Continuity should exist.

N.G. → Repair harness or connectors.

O.K.

END





Diagnostic Procedure 2 (Solenoid Valve Circuit Check [L.E.D.flashing number 1-4])

A

Check continuity.
Front left (flashing number 1):
② and Ground
Front right (flashing number 2):
㉟ and Ground
Rear (flashing number 3 or 4):
⑱ and Ground
Continuity should exist.

O.K. → Replace control unit.

N.G. ↓

B

Check continuity.
Front left (flashing number 1):
① and Ground
Front right (flashing number 2):
③ and Ground
Rear (flashing number 3 or 4):
⑤ and Ground
Continuity should exist.

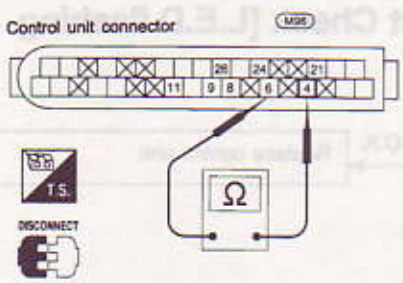
N.G. → Replace actuator.

O.K. ↓

Repair harness or connector.

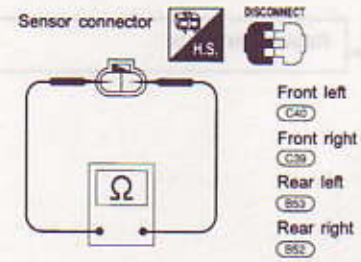
	Terminal for C/U	Terminal for actuator
Front left	②	①
Front right	㉟	③
Rear	⑱	⑤

A



EBR060

B



EBR061

Diagnostic Procedure 3 (Wheel sensor circuit check [L.E.D. flashing number 5 - 8])

A

Check resistance.
Front left (flashing number 5):
④ and ⑥
Front right (flashing number 6):
⑪ and ㉑
Rear left (flashing number 7):
⑧ and ⑨
Rear right (flashing number 8):
㉔ and ㉖
Resistance should be 0.8 - 1.2 kΩ

O.K. → Replace control unit.

N.G. ↓

B

- Disconnect harness connector from sensor.
- Check resistance (sensor side).

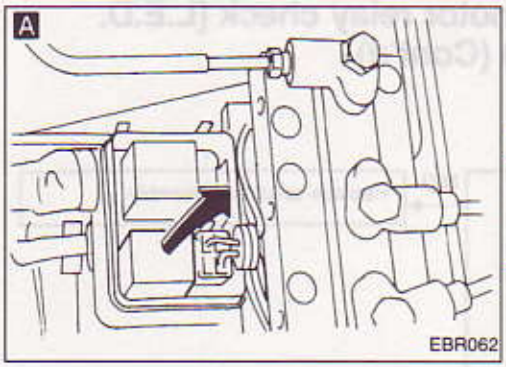
Front left (flashing number 5):
④ and ⑥
Front right (flashing number 6):
⑪ and ㉑
Rear left (flashing number 7):
⑧ and ⑨
Rear right (flashing number 8):
㉔ and ㉖
Resistance should be 0.8 - 1.2 kΩ

O.K. → Repair harness or connector. between sensor connector and control unit connector.

N.G. ↓

Replace sensor.

Diagnostic Procedure 4 (Pump motor and motor relay check [L.E.D. flashing number 9])



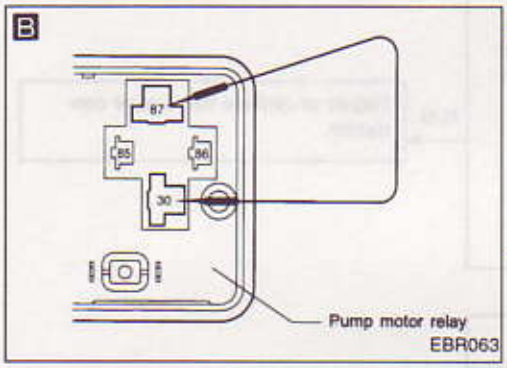
A

- Remove pump motor relay.
- Check voltage at terminal (87).

Battery voltage should exist.

N.G. → (A) See next page.

O.K.



B

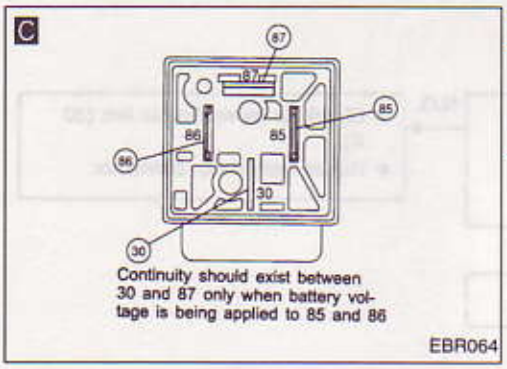
- Remove pump motor relay.
- When connecting terminal (30) and (87) of relay box, check wether motor runs or no.

Motor should operate.

Do not connect for more than 5 seconds to prevent damage.

N.G. → Replace actuator assembly.

O.K.



C

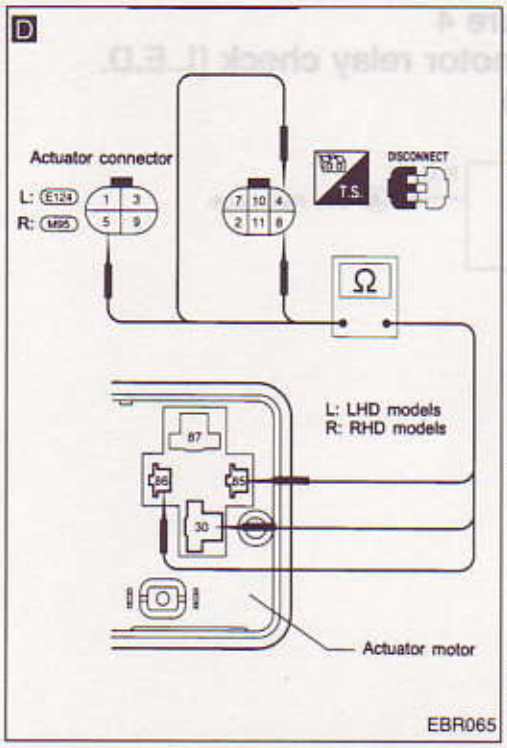
Check motor relay.
Refer to Electrical Components Inspection.

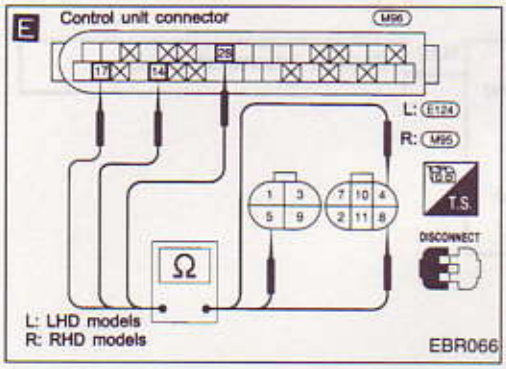
N.G. → Replace relay.

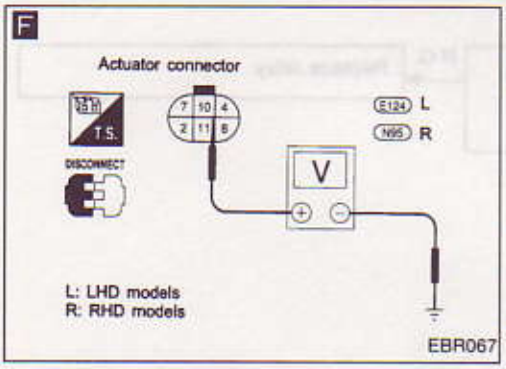
O.K.

(B) See next page

Diagnostic Procedure 4 (Pump motor and motor relay check [L.E.D. flashing number 9]) (Cont'd)







Ⓑ

D

- Disconnect harness connector from actuator.
- Check resistance between terminals from actuator connector and corresponding terminals of relay box, as listed below:
  - ㊸ and ㉚
  - ⑤ and ㊻
  - ⑧ and ㊺

Continuity should exist.

N.G. → Replace actuator assembly.

O.K. ↓

E

- Disconnect actuator connector and control unit connector.
- Check resistance between terminals from actuator connector and corresponding terminals from control unit connector, as listed below:
  - ④ and ⑭
  - ⑧ and ㉘
  - ⑤ and ⑰

Continuity should exist.

N.G. → Repair or replace harness or connector.

O.K. ↓

Replace control unit.

Ⓐ

F

- Disconnect harness connector from actuator.
- Check voltage at terminal ⑩

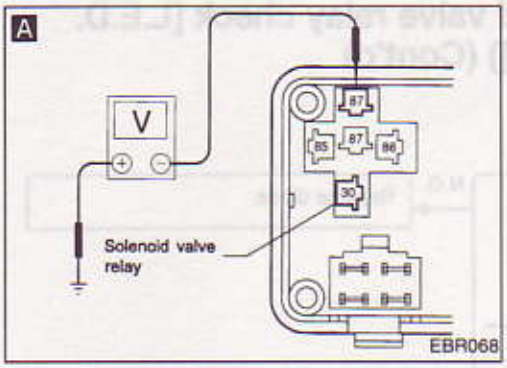
Battery voltage should exist.

N.G. →
- Check for blown fusible link (30 A).
- Repair harness or connector.

O.K. ↓

Replace actuator assembly.

Diagnostic Procedure 5 (Diode and solenoid valve relay check [L.E.D. flashing number 10])



A

- Remove solenoid valve relay.
- Check voltage at terminal (87).

Battery voltage should exist.

N.G. → (A) See next page.

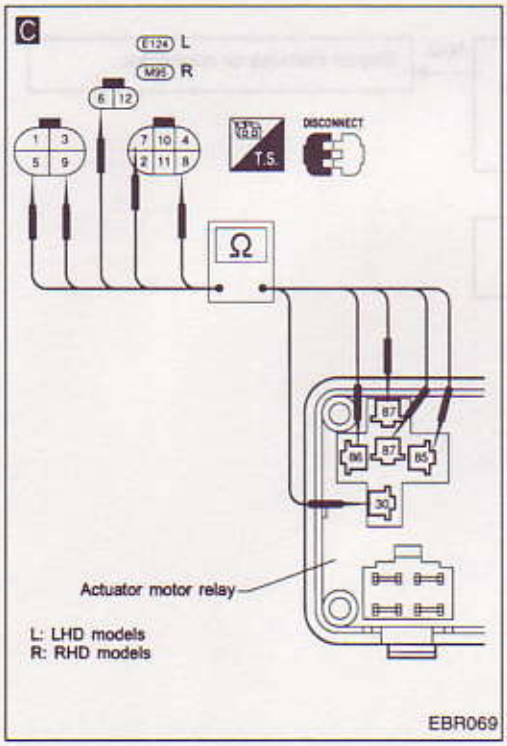
O.K. ↓

B

Check solenoid valve relay. Refer to Electrical Component Inspection.

N.G. → Replace relay.

O.K. ↓



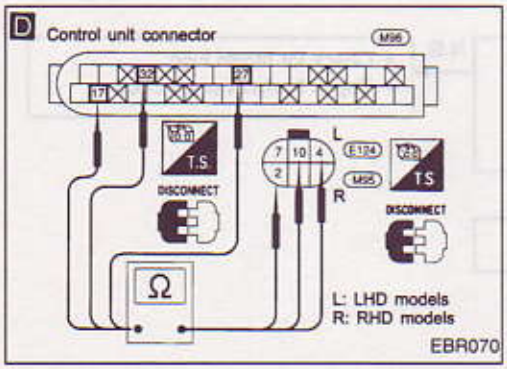
C

- Disconnect actuator connectors.
- Check continuity between terminals of fuse box and corresponding terminals of actuator connector, as listed below:
  - (9) and (87)
  - (7) and (85)
  - (6) and (30)
  - (5) and (86)
  - (8) and (87)

Continuity should exist.

N.G. → Replace actuator assembly.

O.K. ↓



D

- Disconnect control unit connector.
- Check continuity between terminals of actuator connector and corresponding terminals of control unit connector, as listed below:
  - (2) and (27)
  - (4) and (32)
  - (10) and (17)

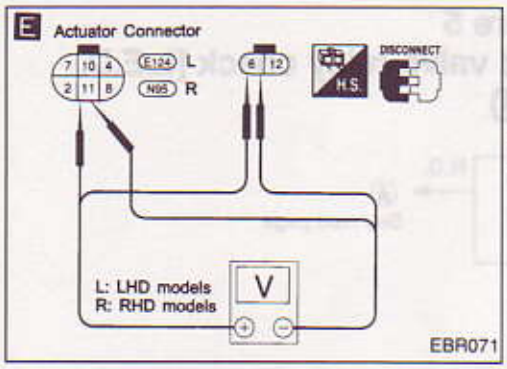
Continuity should exist.

N.G. → Replace harness or connector.

↓ (B) See next page.

Diagnostic Procedure 5 (Diode and solenoid valve relay check [L.E.D. flashing number 10]) (Cont'd)

E



Ⓑ

E

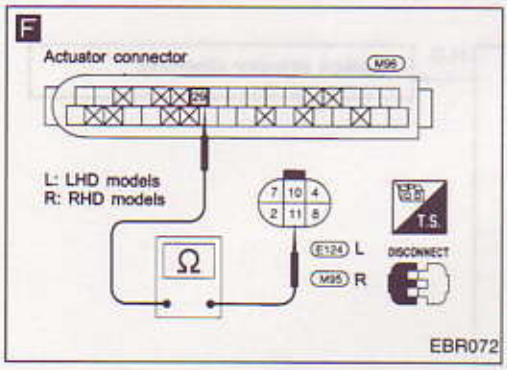
- Check diode functioning as follows:
  Check continuity between terminals of actuator connector as listed in chart below:

+	−	Continuity
⑪	⑥	Does not exist
⑥	⑪	Exists

N.G. → Replace diode.

O.K.

F



F

Check continuity between terminal ⑪ of actuator connector and terminal ㉙ of control unit connector.
Continuity should exist.

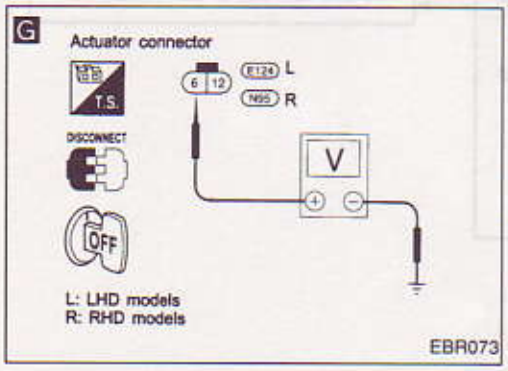
N.G. → Repair harness or connector.

O.K.

Replace control unit for a known good one.

Ⓐ

G



G

- Disconnect actuator connector.
- Check voltage at terminal ⑥ of actuator connector.

Battery voltage should exist.

N.G. →
- Check for blown fuse.
- Repair harness or connector.

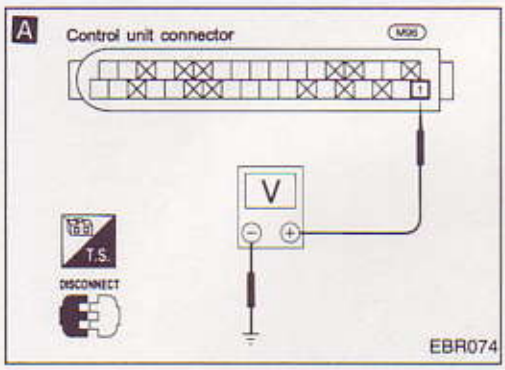
O.K.

Replace actuator assembly.

Diagnostic Procedure 6
(Control Unit [L.E.D. flashing number 16 or continuous])

- Check if control unit is malfunctioning. — N.G. → Replace control unit by a known good one.

Diagnostic Procedure 7
(Control unit or power supply and ground circuit [Warning activates but L.E.D. comes off])



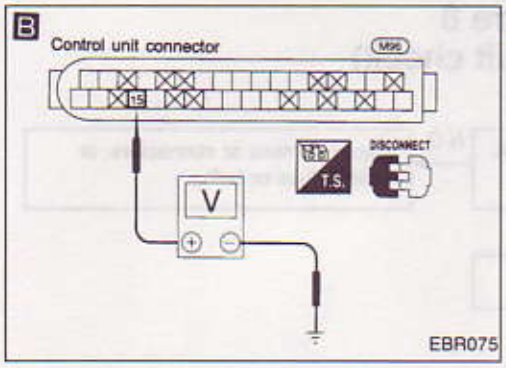
A

- Disconnect control unit connector.
- Check voltage between terminal ① and body ground with ignition switch turned on.

Battery voltage should exist.

N.G. → • Check for blown fuse. • Repair or replace harness.

O.K.



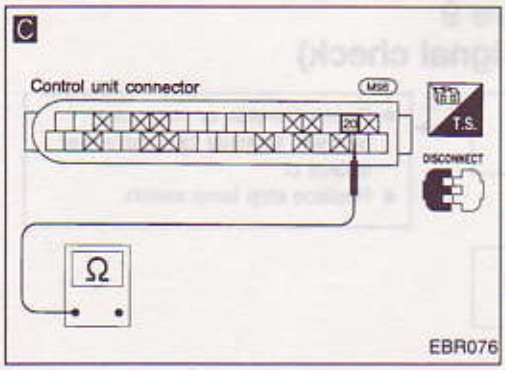
B

- Check alternator output by measuring voltage at terminal (15), after engine has been started.

Voltage: 6 V or more.

N.G. → Ⓐ See next page

O.K.



C

- With ignition switch "OFF", check continuity between terminal (20) and ground.

Continuity should exist.

N.G. → Repair or replace ground harness.

O.K.

Replace control unit by a known good one.

Diagnostic Procedure 7
(Control unit or power supply and ground circuit [Warning activates but L.E.D. comes off]) (Cont'd)

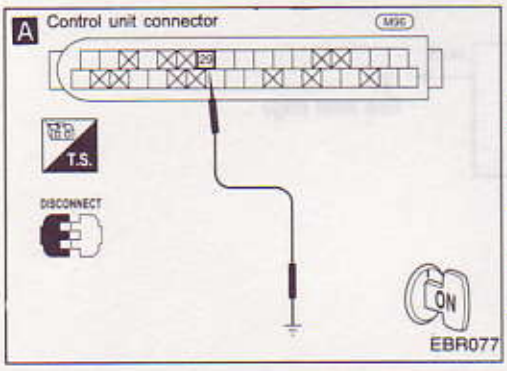
Ⓐ

- Check continuity between terminal ⑮ of control unit connector and terminal L of alternator.
  Continuity should exist.

N.G. → Repair or replace harness.

O.K. ↓

Repair alternator.
Refer to section EL.



Diagnostic Procedure 8
(Warning lamp circuit check)

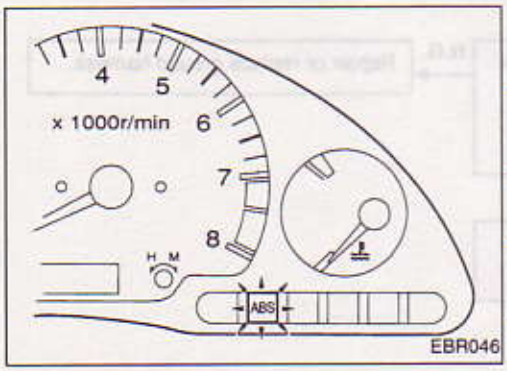
Ⓐ

Check whether warning lamp comes on when grounding terminal ㉙.

N.G. → Repair harness or connectors, or replace fuse or bulb.

O.K. ↓

End



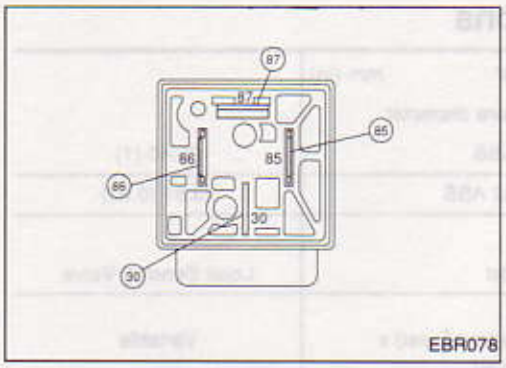
Diagnostic Procedure 9
(Stop lamp switch signal check)

Check whether stop lamps go on when depressing brake pedal.

N.G. →
- Repair harness or connector between terminal ㉕ and power source or
- Replace stop lamp switch.

O.K. ↓

Repair harness between terminal ㉕ and stop lamp switch.



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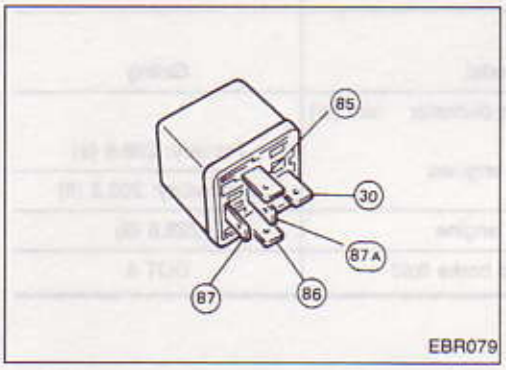

EBR079

Electrical Components Inspection

ACTUATOR MOTOR RELAY

- Check continuity between terminals ㉚ and ㉗, when putting battery voltage at terminals ㉕ and ㉖.

	Continuity between ㉚ and ㉗
Battery voltage at ㉕ and ㉖	yes
No battery voltage at ㉕ and ㉖	no

ACTUATOR SOLENOID VALVE RELAY

- Check continuity between terminals ㉚ and ㉗, and ㉚ and ㉗a, when putting battery voltage at terminals ㉕ and ㉖.

	Continuity between ㉚ and ㉗	Continuity between ㉚ and ㉗a
Battery voltage at ㉕ and ㉖	yes	no
No battery voltage at ㉕ and ㉖	no	yes

General Specifications

Front brake		
Brake model	BD28VA	LD28VB
Cylinder bore diameter mm (in)	60.6 (2.38)	42.8 x 2 (1.68 x 2)
Pad mm (in) Length x width x thickness	130 x 44.5 x 17 (5.11 x 1.75 x 0.66)	145 x 48.5 x 15.5 (5.70 x 1.90 x 0.61)
Rotor mm (in) Outer diameter x thickness	250 x 22 (9.84 x 0.86)	257 x 26 (10.11 x 1.02)
Rear brake		
Brake model		
IRS models	LT25LC	
Rigid rear axle models	LT25LB	
Cylinder bore diameter mm (in)	23.8 (0.93)	
Lining mm (in) Length x width x thickness		
Leading	263 x 55 x 6 (10.35 x 2.16 x 0.23)	
Trailing	243 x 55 x 4.5 (9.56 x 2.16 x 0.17)	
Drum inner diameter mm (in)	254 (10.00)	

Master cylinder mm (in)	
Cylinder bore diameter	
With ABS	25.40 (1)
Without ABS	23.81 (0.93)
Control valve	
Valve model	Load Sensing Valve
Split point kPa (bar, kg/cm^2, psi) x reducing ratio	Variable
Brake booster	
Booster model	Girling
Diaphragm diameter mm (in)	
Petrol engines	Primary: 228.6 (9)
	Secondary: 203.2 (8)
Diesel engine	228.6 (9)
Recommended brake fluid	DOT 4

Inspection and Adjustment

DISC BRAKE

Unit: mm (in)

Brake model	BD28VA	LD28VB
Pad wear limit		
Minimum thickness	2.0 (0.079)	
Rotor repair limit		
Minimum thickness	20.0 (0.78)	24.0 (0.94)

DRUM BRAKE

Unit: mm (in)

Lining wear limit	
Minimum thickness	1.5 (0.059)
Drum repair limit	
Maximum inner diameter	255.5 (10.05)
Out-of-roundness	0.05 (0.0019) or less

BRAKE PEDAL

Unit: mm (in)

Free height	
L.H.D. models	208.5 - 218.5 (8.21 - 8.60)
R.H.D. models	212.5 - 222.5 (8.37 - 8.76)
Full stroke	145 (5.708)
Clearance between pedal stopper and threaded end of stop lamp switch	0.3 - 1.0 (0.012 - 0.039)
Pedal free play at clevis	1 - 3 (0.039 - 0.118)

PARKING BRAKE

Item \ Control type	Center lever
Number of notches [under force of 196 N (20 kg, 44 lb)]	9 - 10
Number of notches (when warning switch comes on)	1