BRAKE SYSTEM

SECTION BR

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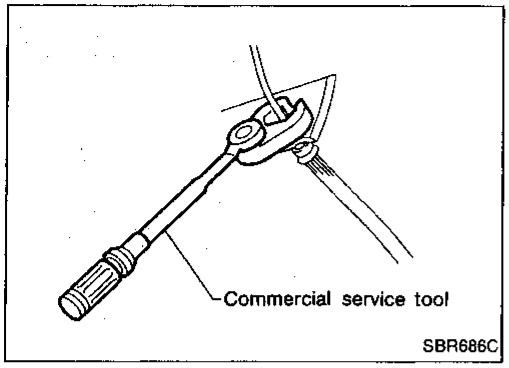


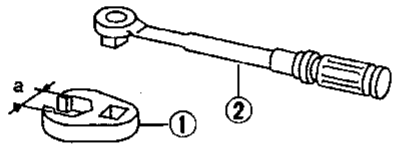
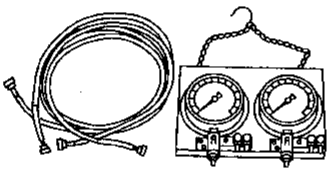
Precautions

- **Recommended fluid is brake fluid "DOT 3".**
- **Never reuse drained brake fluid.**
- **Be careful not to splash brake fluid on painted areas.**
- **To clean or wash all parts of master cylinder, disc brake caliper and wheel cylinder, use clean brake fluid.**
- **Never use mineral oils such as gasoline or kerosene. They will ruin rubber parts of the hydraulic system.**
- **Use flare nut wrench when removing and installing brake tube.**
- **Always torque brake lines when installing.**

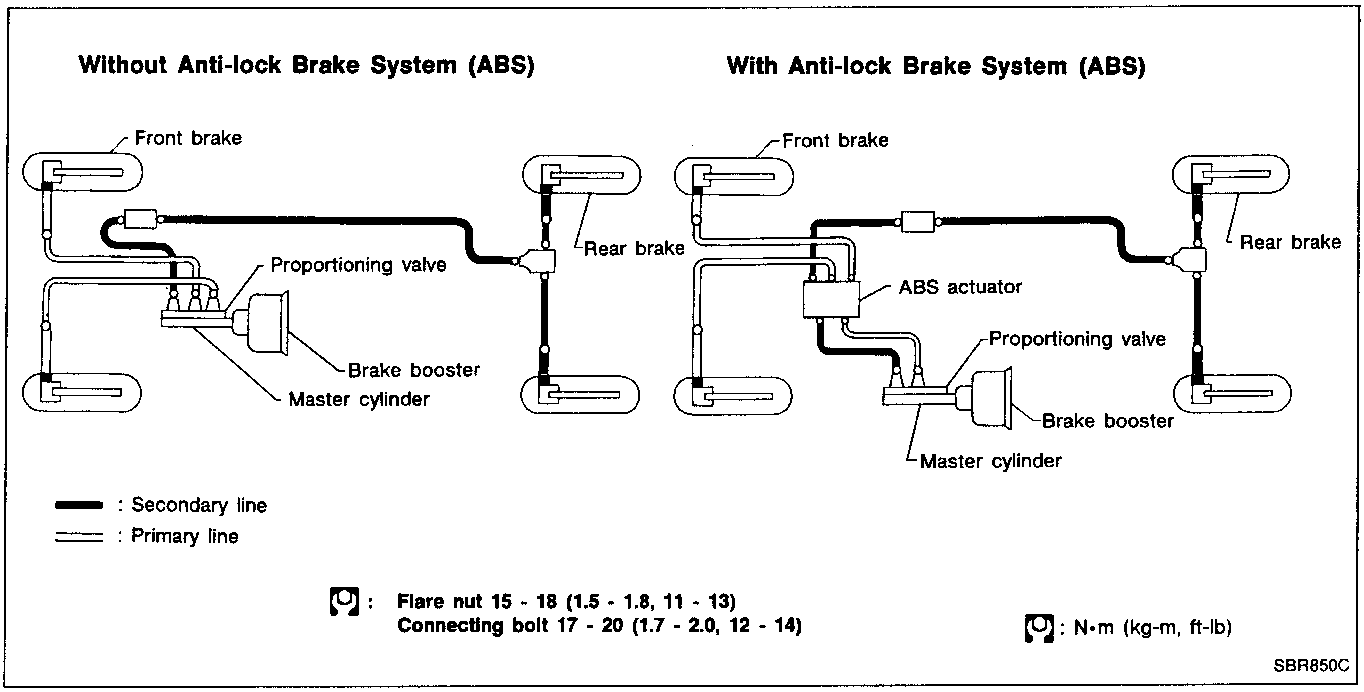
WARNING:

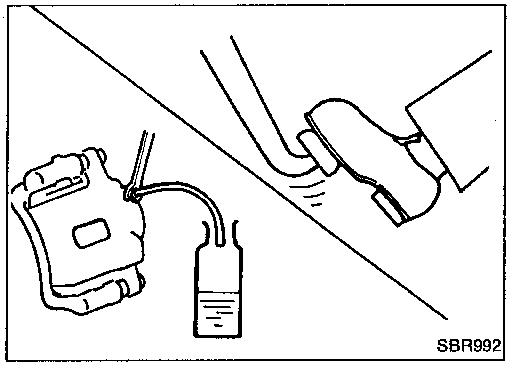
- **Clean brake pads and shoes with a waste cloth, then wipe with a dust collector.**

Commercial Service Tools

Tool name	Description	
① Flare nut crows foot ② Torque wrench	 NT360	Removing and installing each brake piping **a: 10 mm (0.39 in)**
Brake fluid pressure gauge	 NT151	Measuring brake fluid pressure

Brake Hydraulic Line





REMOVAL

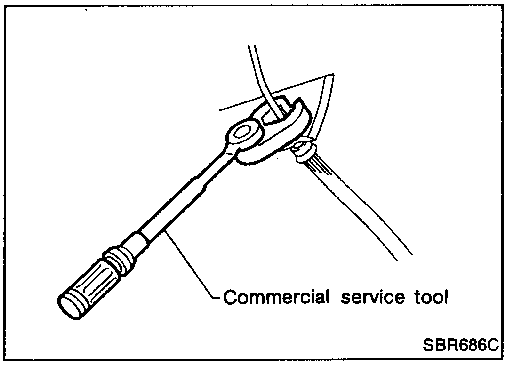
CAUTION:

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

INSPECTION

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



INSTALLATION

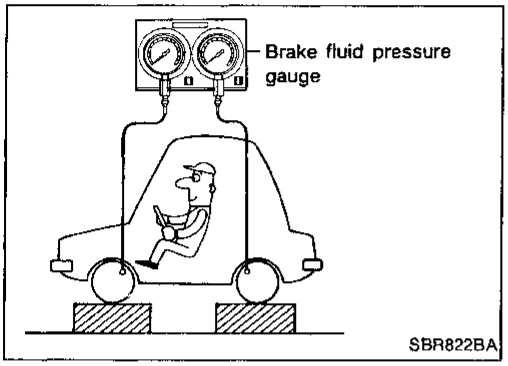
CAUTION:

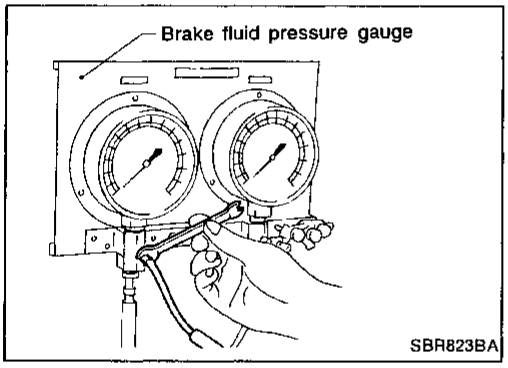
- **Refill with new brake fluid "DOT 3".**
- **Never reuse drained brake fluid.**

1. Tighten all flare nuts and connecting bolts.
   Specification:
   Flare nut
   15 - 18 N·m (1.5 - 1.8 kg-m, 11 - 13 ft-lb)
   Connecting bolt
   17 - 20 N·m (1.7 - 2.0 kg-m, 12 - 14 ft-lb)

Brake Hydraulic Line (Cont'd)

2. Refill until new brake fluid comes out of each air bleeder valve.
3. Bleed air. Refer to "Bleeding Brake System" (BR-5).





Dual Proportioning Valve

INSPECTION

CAUTION:

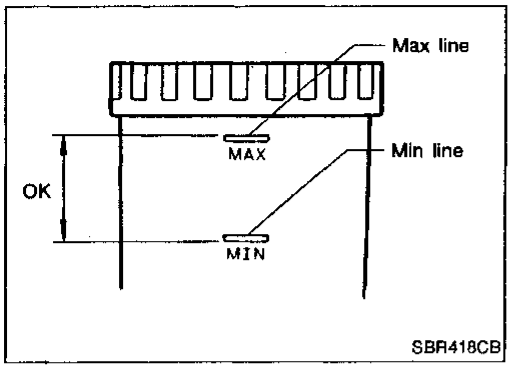
- **Carefully monitor brake fluid level at master cylinder.**
- **Use new brake fluid "DOT 3".**
- **Be careful not to splash brake fluid on painted areas; it may cause paint damage. If brake fluid is splashed on paint areas, wash it away with water immediately.**

1. Connect Tool to air bleeders of front and rear brakes on either LH and RH side.
2. Bleed air from the Tool.
3. Check fluid pressure by depressing brake pedal.

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

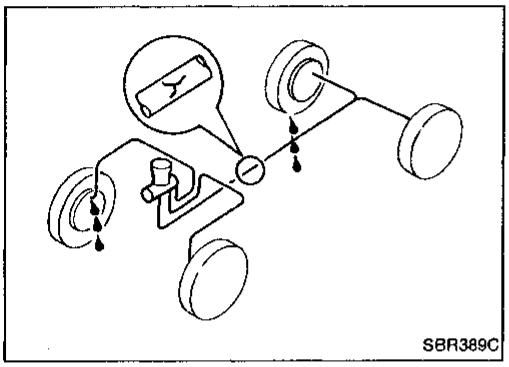
Applied pressure (Front brake)	5,884 (60, 853)
Output pressure (Rear brake)	3,629 - 4,021 (37 - 41, 526 - 583)

4. Bleed air after disconnecting the Tool. Refer to "Bleeding Brake System" (BR-5).



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.
- Release parking brake lever and see if brake warning lamp goes off. If not, check brake system for leaks.

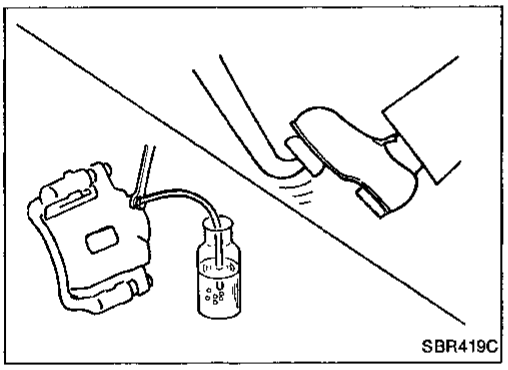


Checking Brake Line

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.

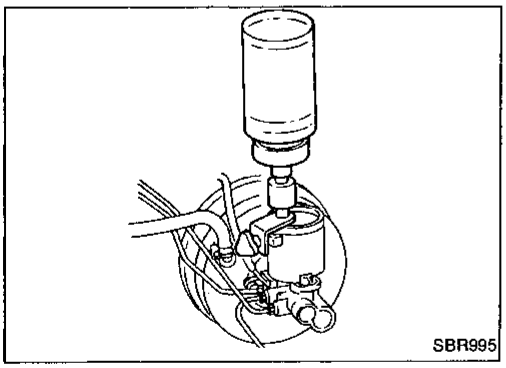


Changing Brake Fluid

CAUTION:

- **Refill with new brake fluid "DOT 3".**
- **Always keep fluid level higher than minimum line on reservoir tank.**
- **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.**

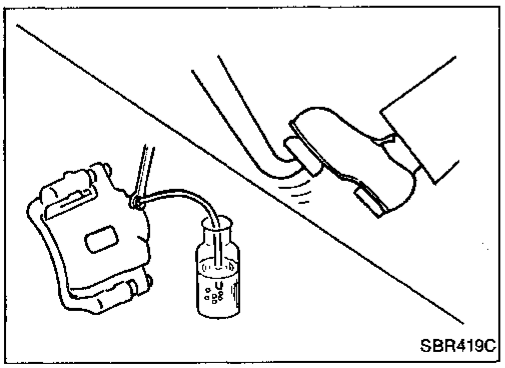
1. Clean inside of reservoir tank, and refill with new brake fluid.
2. Connect a vinyl tube to each air bleeder valve.
3. Drain brake fluid from each air bleeder valve by depressing brake pedal.
4. Refill until brake fluid comes out of each air bleeder valve. Use same procedure as in bleeding hydraulic system to refill brake fluid. Refer to "Bleeding Brake System" (BR-5).



Bleeding Brake System

CAUTION:

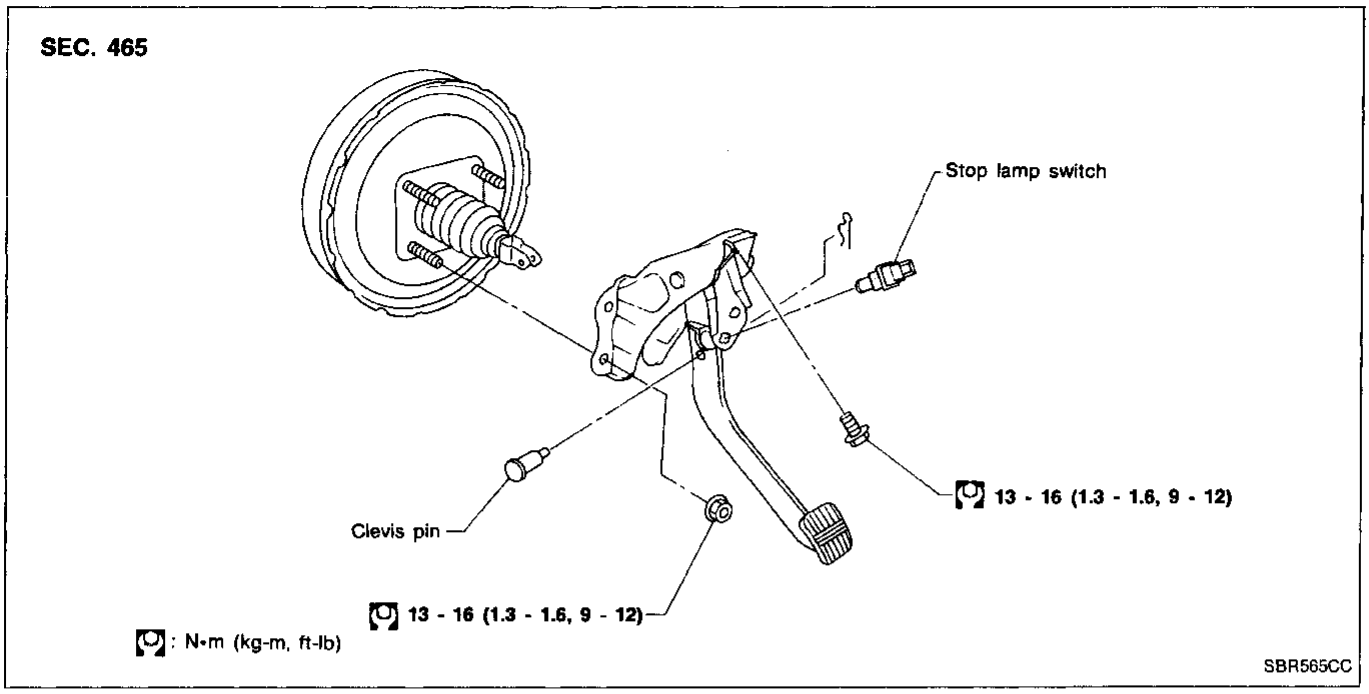
- **Carefully monitor brake fluid level at master cylinder during bleeding operation.**
- **Fill reservoir with new brake fluid "DOT 3". Make sure it is full at all times while bleeding air out of system.**
- **Place a container under master cylinder to avoid spillage of brake fluid.**
- **For models with ABS, turn ignition switch OFF and disconnect ABS actuator connectors or battery ground cable.**

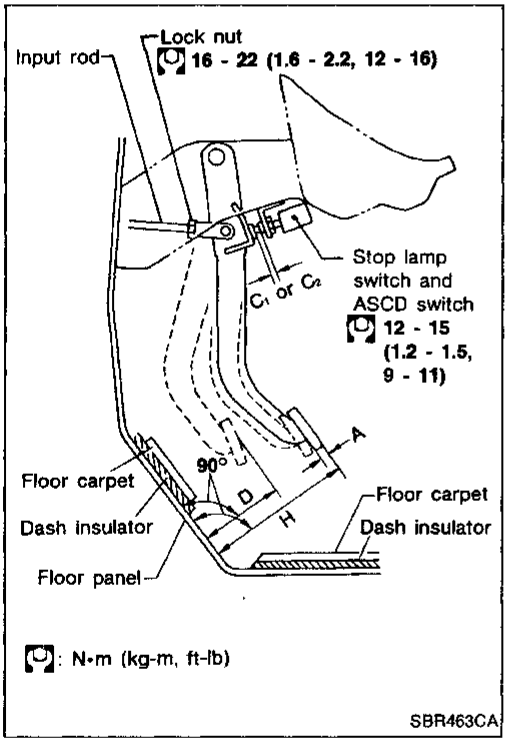


- Bleed air in the following order.
  Right rear brake → Left rear brake →
  Right front brake → Left front brake

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

Removal and Installation





Inspection

Check brake pedal for following items.

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

Adjustment

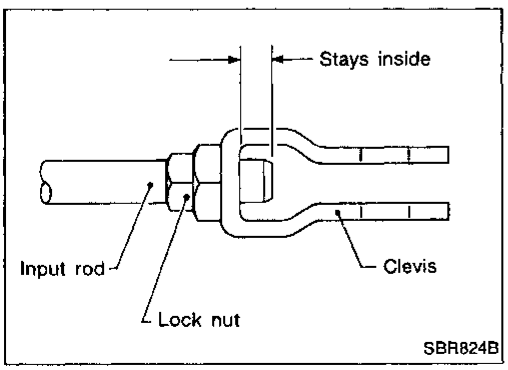
Check brake pedal free height from dash reinforcement panel. Adjust if necessary.

H: **Free height**
Refer to SDS (BR-65).

D: **Depressed height**
Refer to SDS. (BR-65).
Under force of 490 N (50 kg, 110 lb) with engine running

C_1, C_2: **Clearance between pedal stopper and threaded end of stop lamp switch and ASCD switch**
0.3 - 1.0 mm (0.012 - 0.039 in)

A: **Pedal free play**
1 - 3 mm (0.04 - 0.12 in)

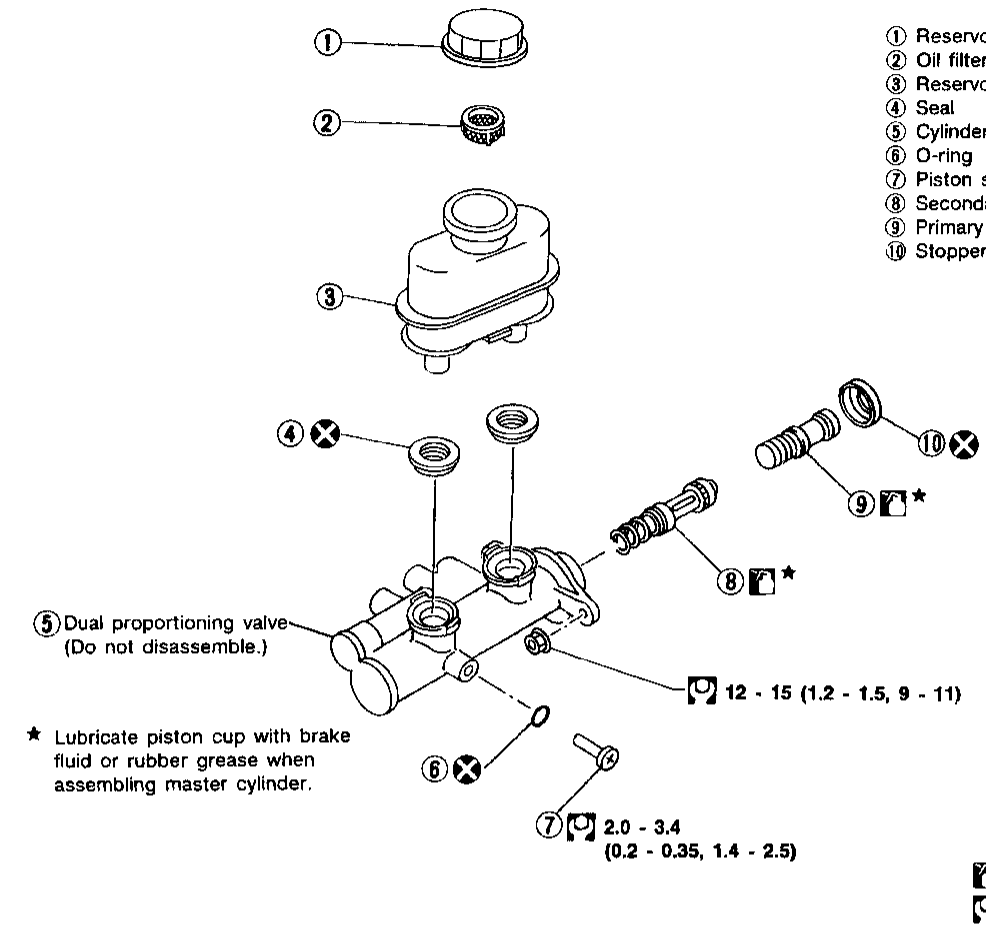


1. Loosen lock nut and adjust pedal free height by turning brake booster input rod. Then tighten lock nut.
2. Check pedal free play.

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

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

SEC. 460

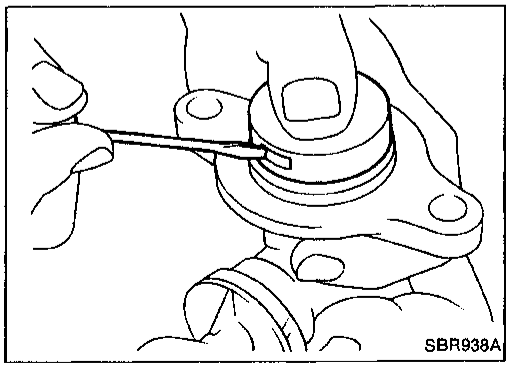


Removal

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.

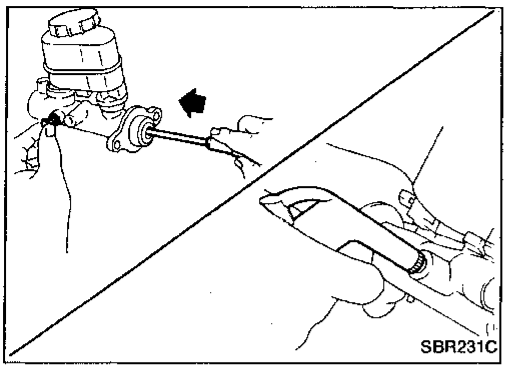
1. Connect a vinyl tube to air bleeder valve.
2. Drain brake fluid from each air bleeder valve, depressing brake pedal to empty fluid from master cylinder.
3. Remove brake pipe flare nuts.
4. Remove master cylinder mounting nuts.



Disassembly

1. Bend claws of stopper cap outward.

Disassembly (Cont'd)



2. Remove valve stopper while piston is pushed into cylinder.
3. Remove piston assemblies.

If it is difficult to remove secondary piston assembly, gradually apply compressed air through fluid outlet.

4. Draw out reservoir tank.

Inspection

Check for the following items.

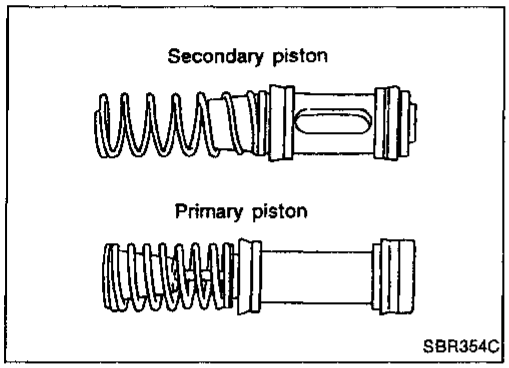
Replace any part if damaged.

Master cylinder:

- Pin holes or scratches on inner wall.

Piston:

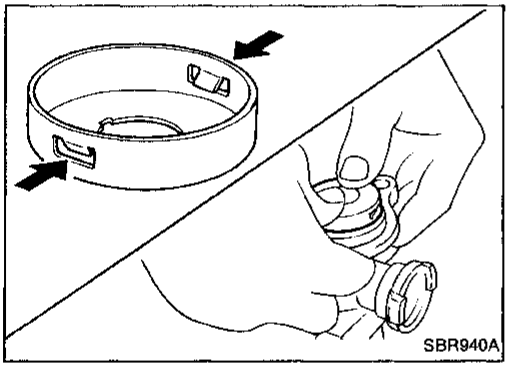
- Deformation of or scratches on piston cups.



Assembly

1. Insert secondary piston assembly. Then insert primary piston assembly.

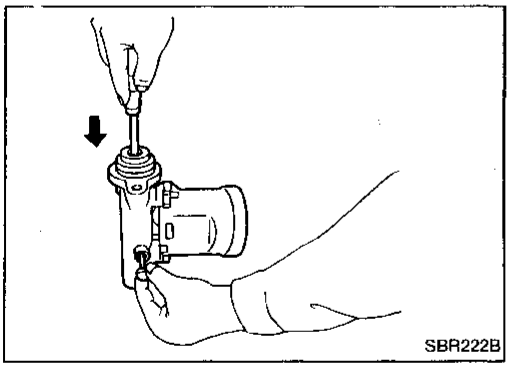
- **Pay attention to alignment of secondary piston slit with valve stopper mounting hole of cylinder body.**



2. Install stopper cap.

Before installing stopper cap, ensure that claws are bent inward.

3. Push reservoir tank seals.
4. Push reservoir tank into master cylinder.



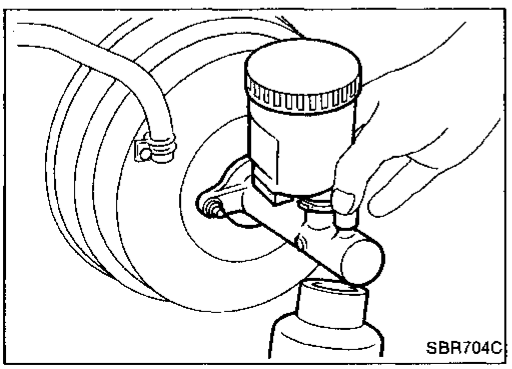
5. Install valve stopper while piston is pushed into cylinder.

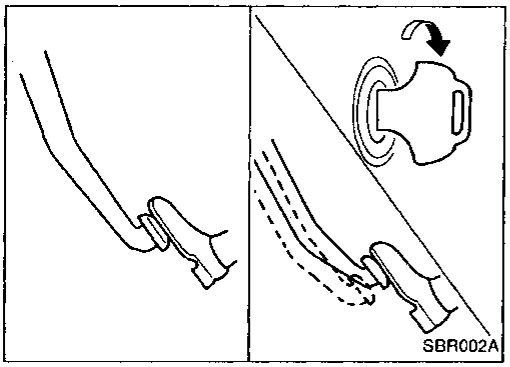
Installation

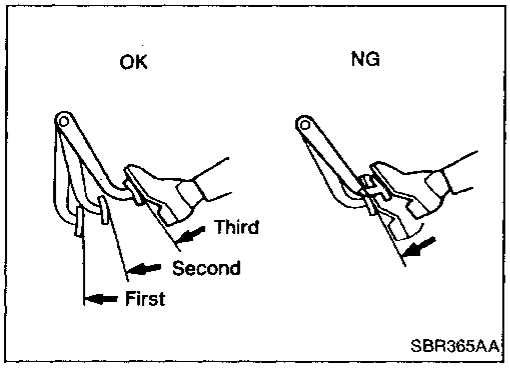
CAUTION:

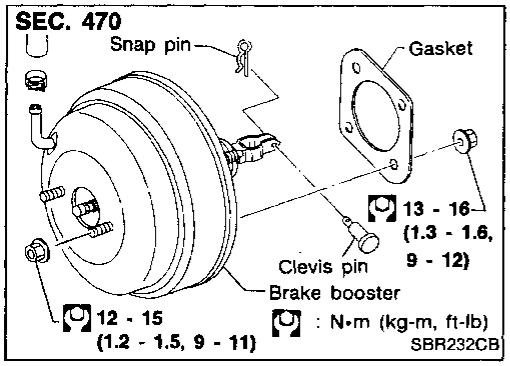
- **Refill with new brake fluid "DOT 3".**
- **Never reuse drained brake fluid.**

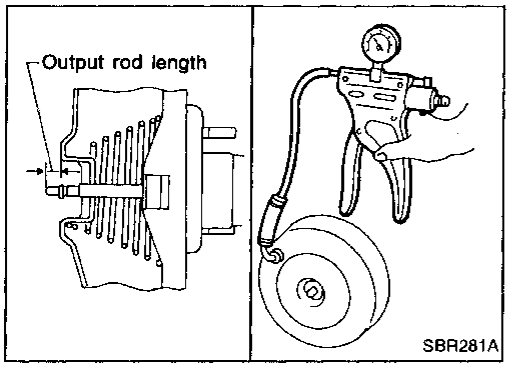
1. Place master cylinder onto brake booster and secure mounting nuts lightly.
2. Torque mounting nuts.
   12 - 15 N·m (1.2 - 1.5 kg-m, 9 - 11 ft-lb)
3. Fill up reservoir tank with new brake fluid.
4. Plug all ports on master cylinder with fingers to prevent air suction while releasing brake pedal.
5. Have driver depress brake pedal slowly several times until no air comes out of master cylinder.
6. Fit brake lines to master cylinder.
7. Tighten flare nuts.
   : 15 - 18 N·m (1.5 - 1.8 kg-m, 11 - 13 ft-lb)
8. Bleed air from brake system. Refer to "Bleeding Brake System" (BR-5).

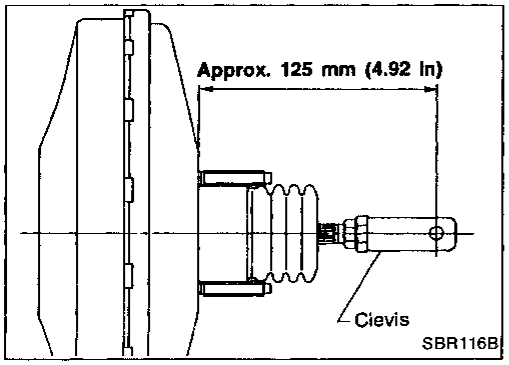












Brake Booster

ON-VEHICLE SERVICE

Operating check

- Stop engine and depress brake pedal several times. Check that pedal stroke does not change.
- 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. The pedal should go further down the first time, and then it should gradually rise thereafter.
- Depress brake pedal while engine is running, and stop engine with pedal depressed. The pedal stroke should not change after holding pedal down for **30 seconds**.

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 (–500 mmHg, –19.69 inHg) to brake booster with a handy vacuum pump.
2. Check output rod length.

   Specified length:

   10.275 - 10.525 mm (0.4045 - 0.4144 in)

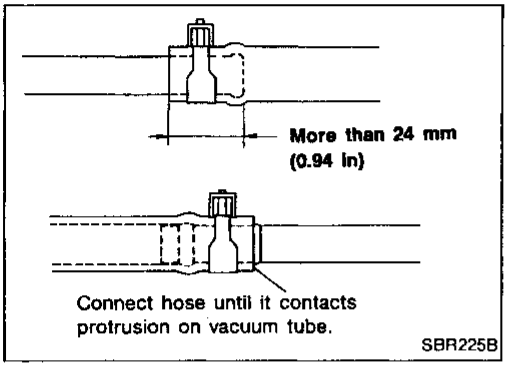
INSTALLATION

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 3".**
- **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 with the dash panel.**

Brake Booster (Cont'd)

1. Before fitting booster, temporarily adjust clevis to dimension shown.
2. Fit booster, then secure mounting nuts (brake pedal bracket to master cylinder) lightly.
3. Connect brake pedal and booster input rod with clevis pin.
4. Secure mounting nuts.
   Specification: 13 - 16 N·m (1.3 - 1.6 kg-m, 9 - 12 ft-lb)
5. Install master cylinder. Refer to "Installation" in "MASTER CYLINDER" (BR-8).
6. Bleed air. Refer to "Bleeding Brake System" (BR-5).



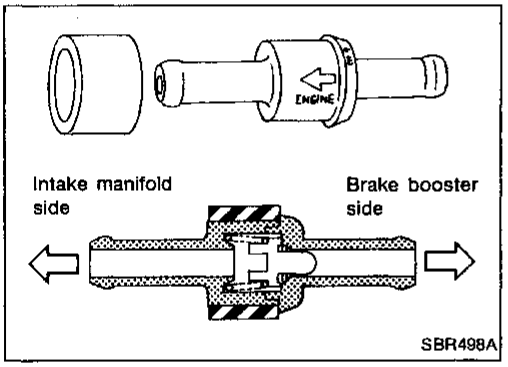
Vacuum Hose

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.**

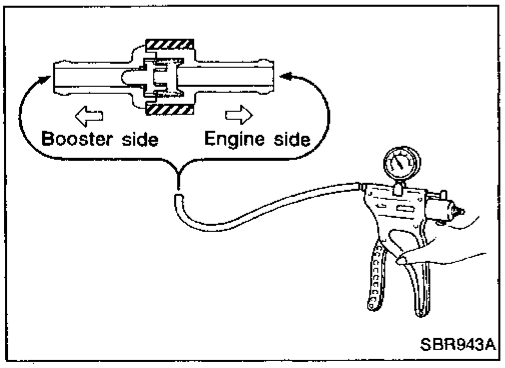


- **Install check valve, paying attention to its direction.**

INSPECTION

Hoses and connectors

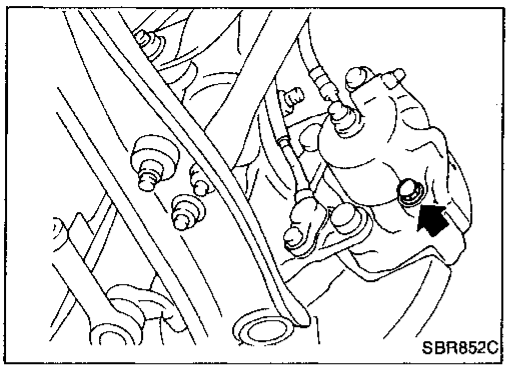
Check vacuum lines, connections and check valve for airtightness, improper attachment chafing and deterioration.

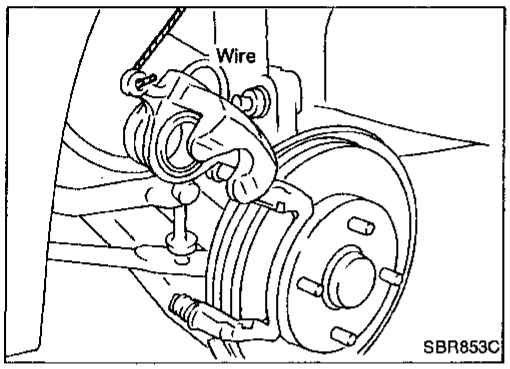


Check valve

Check vacuum with a vacuum pump.

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





Pad Replacement

WARNING:

Clean brake pads with a vacuum dust collector to minimize the hazard of airborne particles or other materials.

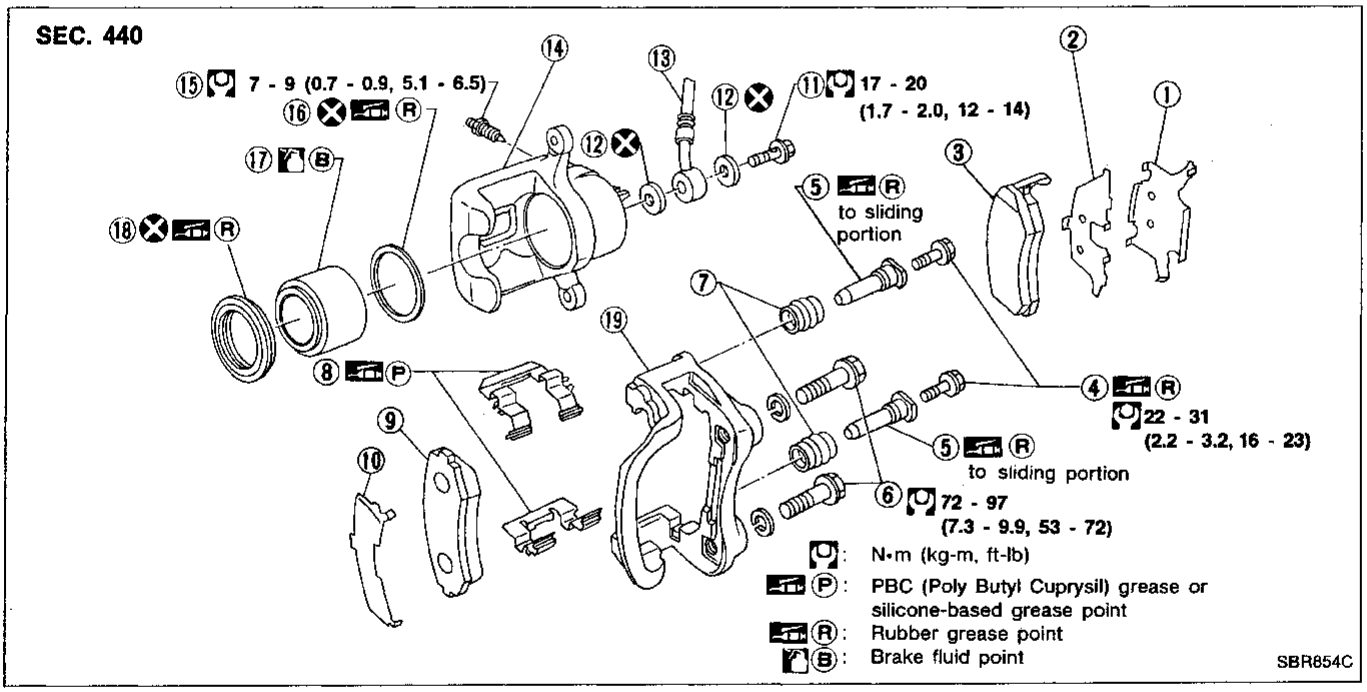
CAUTION:

- **When cylinder body is open, do not depress brake pedal because piston will pop out.**
- **Be careful not to damage piston boot or get oil on rotor. Always replace shims when replacing pads.**
- **If shims are rusted or show peeling of the rubber coat, replace them with new shims.**
- **It is not necessary to remove connecting bolt except for disassembly or replacement of caliper assembly. In this case, suspend cylinder body with wire so as not to stretch brake hose.**

1. Remove master cylinder reservoir cap.
2. Remove pin bolt.
3. Open cylinder body upward. Then remove pad retainers, and inner and outer shims.

Standard pad thickness:
10 mm (0.39 in)
Pad wear limit:
2.0 mm (0.079 in)

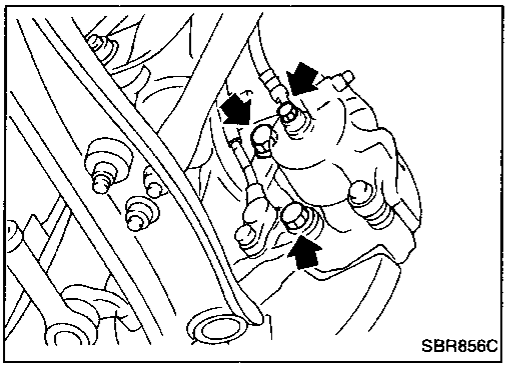
Carefully monitor brake fluid level because brake fluid will return to reservoir when pushing back piston.



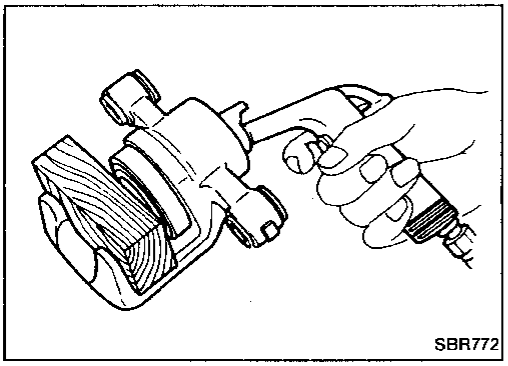
① Shim cover
② Inner shim
③ Inner pad
④ Pin bolt
⑤ Main pin
⑥ Torque member fixing bolt
⑦ Retainer boot
⑧ Pad retainer
⑨ Outer pad
⑩ Outer shim
⑪ Connecting bolt
⑫ Copper washer
⑬ Brake hose
⑭ Cylinder body
⑮ Air bleeder
⑯ Piston seal
⑰ Piston
⑱ Dust seal
⑲ Torque member

Removal

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


SBR856C

Remove torque member fixing bolts and connecting bolt.
It is not necessary to remove connecting bolt except for disassembly or replacement of caliper assembly. In this case, suspend caliper assembly with wire so as not to stretch brake hose.


SBR772

Disassembly

WARNING:
Do not place your fingers in front of piston.
CAUTION:
Do not scratch or score cylinder wall.

1. Push out piston with piston boot with compressed air.
2. Remove piston seal with a suitable tool.

Inspection — Caliper

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 surface with a fine emery paper. Replace cylinder body if necessary.

CAUTION:
Use brake fluid to clean. Never use mineral oil.

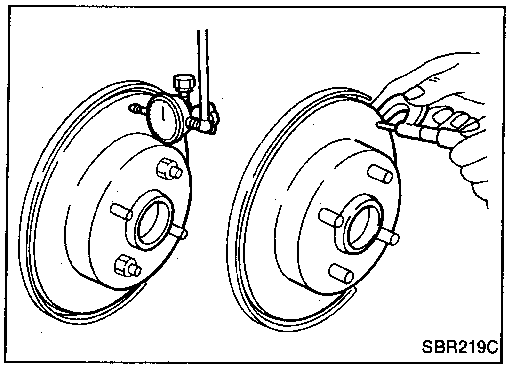
PISTON

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

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

SLIDE PIN, PIN BOLT AND PIN BOOT

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


SBR219C

Inspection — Rotor

RUBBING SURFACE

Check rotor for roughness, cracks or chips.

RUNOUT

1. Secure rotor to wheel hub with at least two nuts (M12 x 1.25).
2. Check runout using a dial indicator.

Make sure that wheel bearing axial end play is within the specifications before measuring. Refer to "Front Wheel Bearing" in FA section.

Maximum runout:
0.07 mm (0.0028 in)

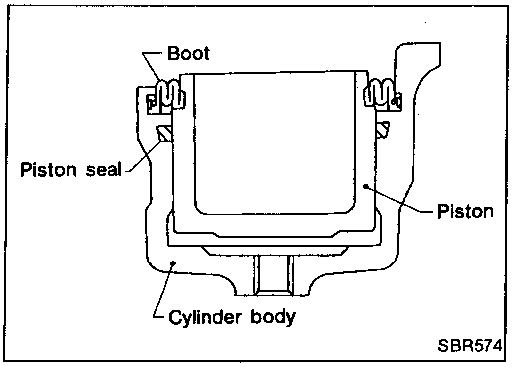
3. If the runout is out of specification, find minimum runout position as follows:
   a. Remove nuts and rotor from wheel hub.
   b. Shift the rotor one hole and secure rotor to wheel hub with nuts.
   c. Measure runout.
   d. Repeat steps a. to c. so that minimum runout position can be found.
4. If the runout is still out of specification, turn rotor with on-car brake lathe ("MAD, DL-8700", "AMMCO 700 and 705" or equivalent).

THICKNESS

Thickness variation (At least 8 positions):
Maximum 0.01 mm (0.0004 in)

If thickness variation exceeds the specification, turn rotor with on-car brake lathe.

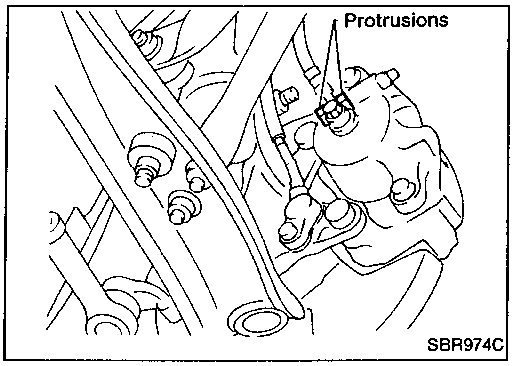
Rotor repair limit:
18.0 mm (0.709 in)



SBR574

Assembly

1. Insert piston seal into groove on cylinder body.
2. With piston boot fitted to piston, insert piston boot into groove on cylinder body and install piston.
3. Properly secure piston boot.



SBR974C

Installation

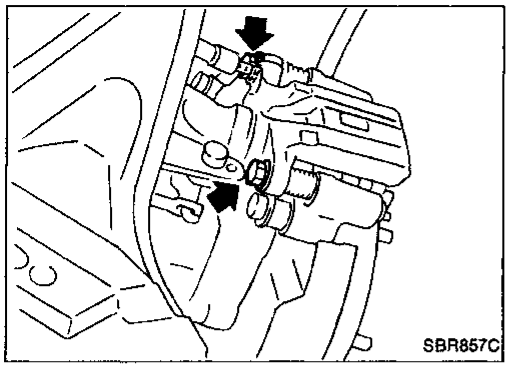
CAUTION:

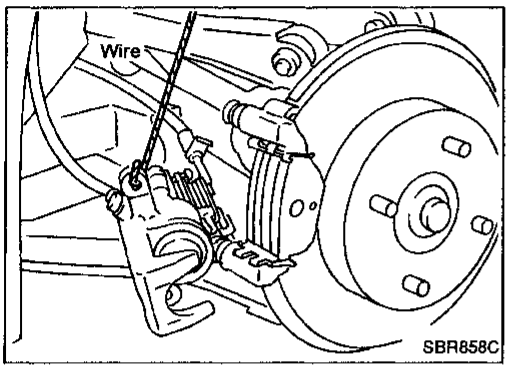
- **Refill with new brake fluid "DOT 3".**
- **Never reuse drained brake fluid.**

1. Install brake hose to caliper securely.

Fit brake hose between the caliper protrusions.

2. Install all parts and secure all bolts.
3. Bleed air. Refer to "Bleeding Brake System" (BR-5).


SBR857C



SBR858C

Pad Replacement

WARNING:

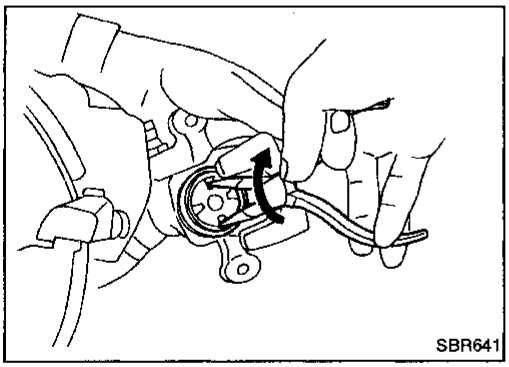
Clean brake pads with a vacuum dust collector to minimize the hazard of airborne particles or other materials.

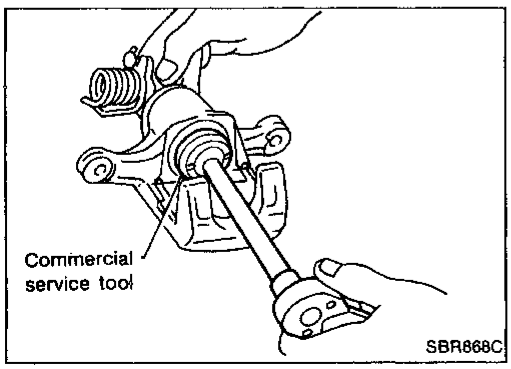
CAUTION:

- **When cylinder body is open, do not depress brake pedal because piston will pop out.**
- **Be careful not to damage piston boot or get oil on rotor. Always replace shims in replacing pads.**
- **If shims are rusted or show peeling of rubber coat, replace them with new shims.**
- **It is not necessary to remove connecting bolt except for disassembly or replacement of caliper assembly. In this case, suspend cylinder body with wire so as not to stretch brake hose.**

1. Remove master cylinder reservoir cap.
2. Release parking brake.
3. Remove brake cable mounting bolts from the rear suspension.
4. Remove pin bolts.
5. Remove cylinder body. Then remove pad retainers, and inner and outer shims.

Standard pad thickness:
9.5 mm (0.374 in)
Pad wear limit:
2.0 mm (0.079 in)


SBR641

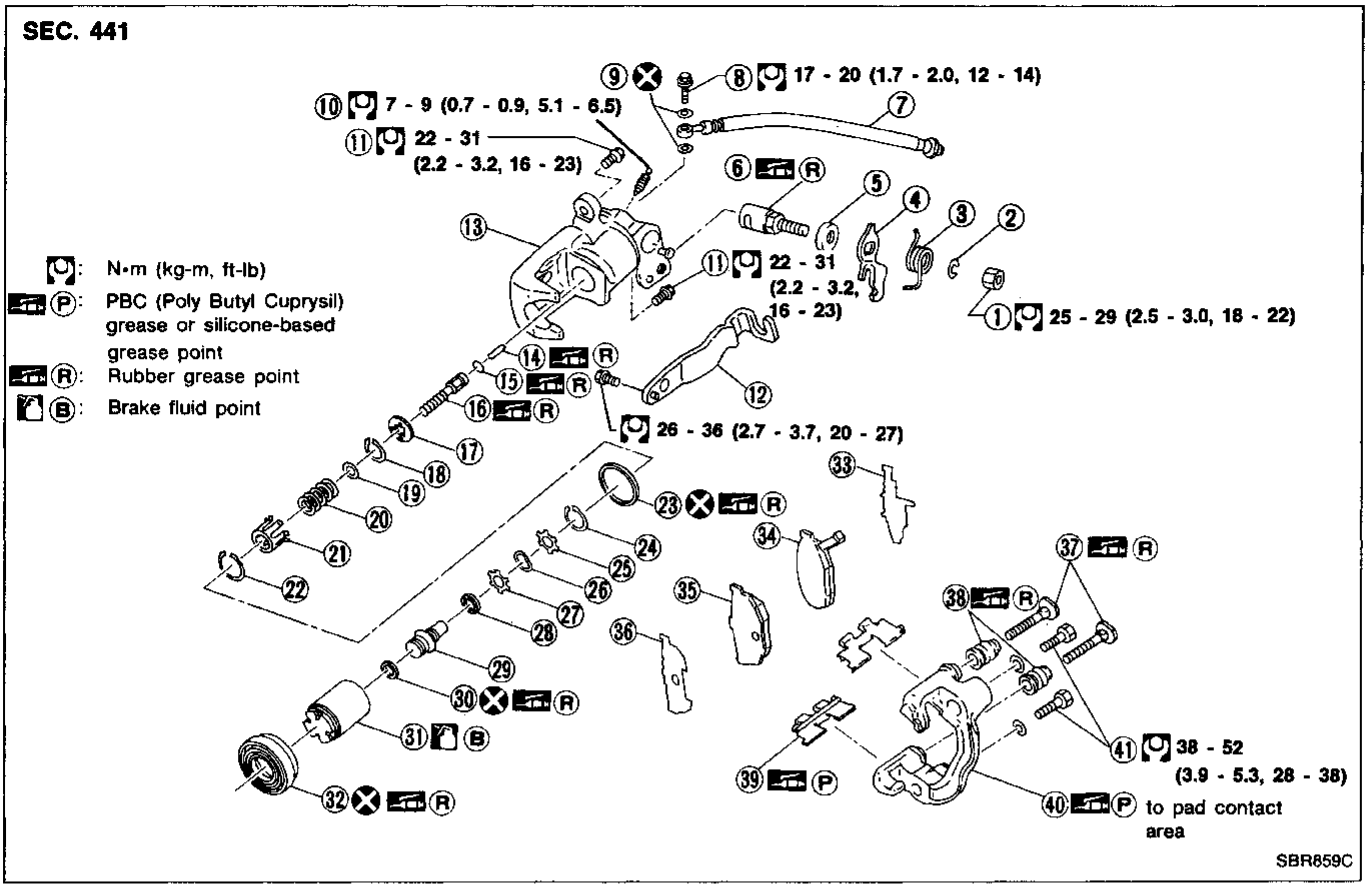


SBR868C

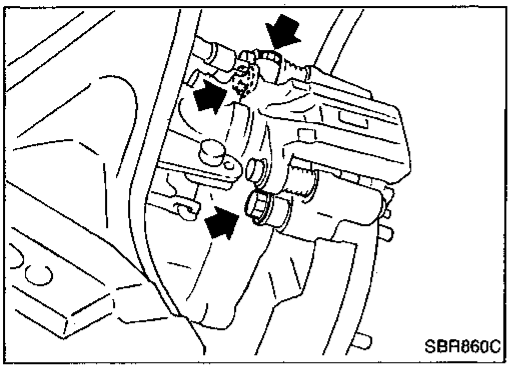
6. When installing new pads, push piston into cylinder body by gently turning piston clockwise, as shown.

Carefully monitor brake fluid level because brake fluid will return to reservoir when pushing back piston.

SEC. 441



① Nut
② Washer
③ Return spring
④ Parking brake lever
⑤ Cam boot
⑥ Cam
⑦ Brake hose
⑧ Connecting bolt
⑨ Copper washer
⑩ Bleed screw
⑪ Pin bolt
⑫ Cable mounting bracket
⑬ Cylinder
⑭ Strut
⑮ O-ring
⑯ Push rod
⑰ Key plate
⑱ Ring C
⑲ Seat
⑳ Spring
㉑ Spring cover
㉒ Ring B
㉓ Piston seal
㉔ Ring A
㉕ Spacer
㉖ Wave washer
㉗ Spacer
㉘ Ball bearing
㉙ Adjusting nut
㉚ Cup
㉛ Piston
㉜ Dust seal
㉝ Inner shim
㉞ Inner pad
㉟ Outer pad
㊱ Outer shim
㊲ Pin
㊳ Pin boot
㊴ Pad retainer
㊵ Torque member
㊶ Torque member fixing bolt


SBR860C

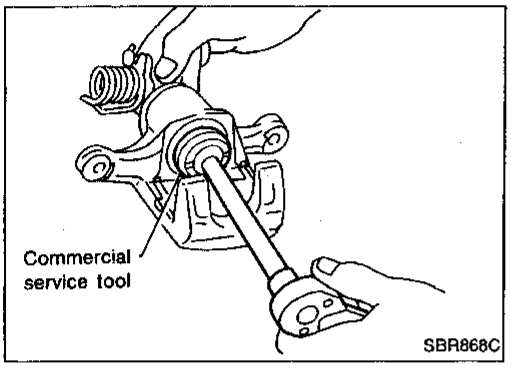
Removal

WARNING:

Clean brake pads with a vacuum dust collector to minimize the hazard of airborne particles or other materials.

1. Remove brake cable mounting bracket bolt and lock spring.
2. Remove torque member fixing bolts and connecting bolt.

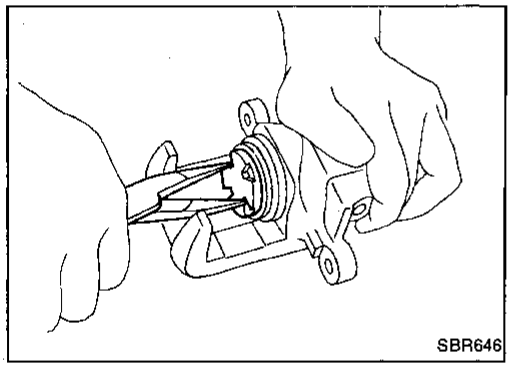
It is not necessary to remove connecting bolt except for disassembly or replacement of caliper assembly. In this case, suspend caliper assembly with wire so as not to stretch brake hose.

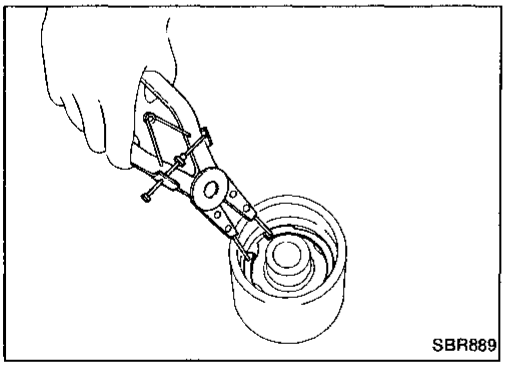


SBR868C

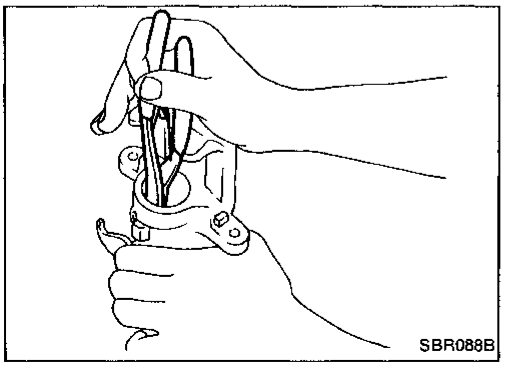
Disassembly

1. Remove piston by turning it counterclockwise with suitable commercial service tool or long nose pliers.


SBR646


SBR889

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

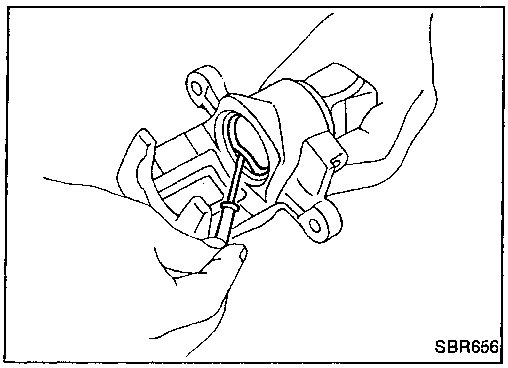

SBR088B

3. Disassemble cylinder body.

a. Pry off ring B with suitable pliers, then remove spring cover, spring and seat.

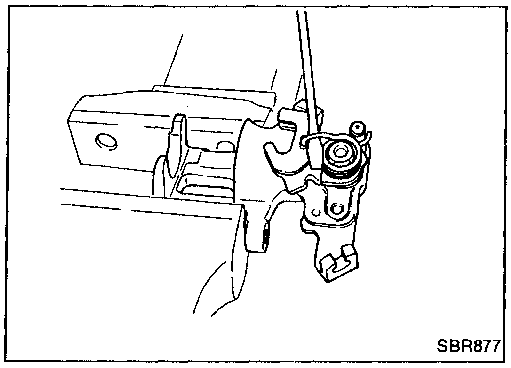
b. Pry off ring C, then remove key plate, push rod and strut.

Disassembly (Cont'd)


SBR656

c. Remove piston seal.

Be careful not to damage cylinder body.


SBR877

4. Remove return spring, stopper bolt and lever.

Inspection — Caliper

CAUTION:

Use brake fluid to clean cylinder. Never use mineral oil.

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 surface with a fine emery paper. Replace cylinder body if necessary.

TORQUE MEMBER

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

PISTON

CAUTION:

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

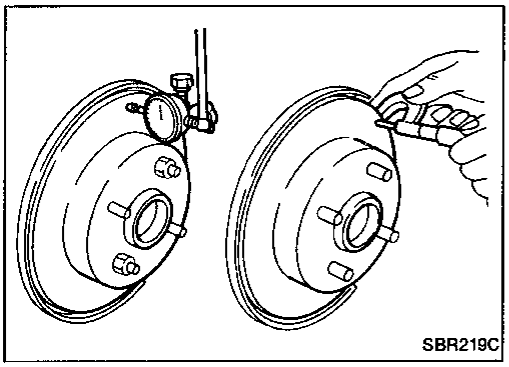
Check piston for score, rust, wear, damage or presence of foreign materials.

Replace if any of the above conditions are observed.

PIN AND PIN BOOT

Check for wear, cracks or other damage.

Replace if any of the above conditions are observed.


SBR219C

Inspection — Rotor

RUBBING SURFACE

Check rotor for roughness, cracks or chips.

RUNOUT

1. Secure rotor to wheel hub with two nuts (M12 x 1.25).
2. Check runout using a dial indicator.

Make sure that axial end play is within the specifications before measuring. Refer to "Rear Wheel Bearing" in RA section.

3. Change relative positions of rotor and wheel hub so that runout is minimized.

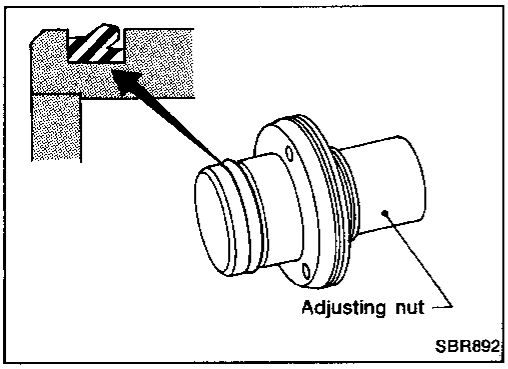
Maximum runout:
0.07 mm (0.0028 in)

THICKNESS

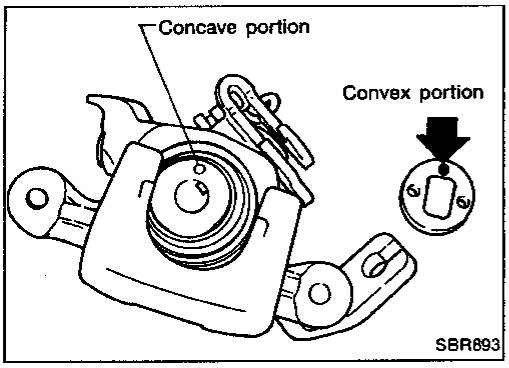
Rotor repair limit:
Standard thickness
9 mm (0.35 in)
Minimum thickness
8 mm (0.31 in)
Thickness variation (At least 8 portions)
Maximum 0.02 mm (0.0008 in)

Assembly

1. Install cup in the specified direction.

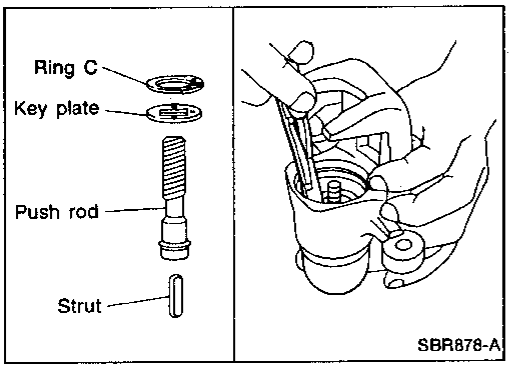


SBR892



SBR893

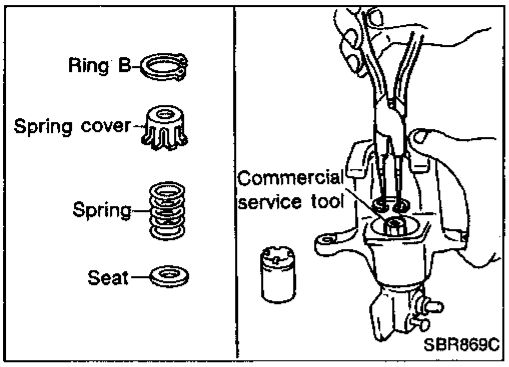
2. Fit push rod into square hole in key plate. Also match convex portion of key plate with concave portion of cylinder.



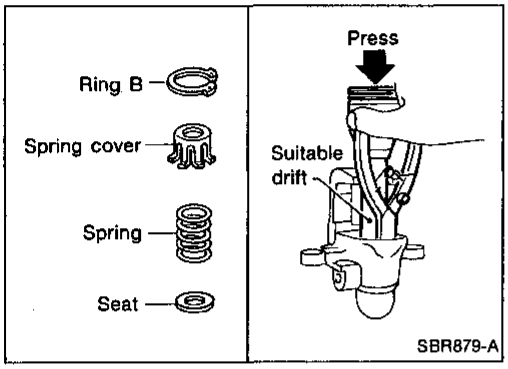
SBR878-A

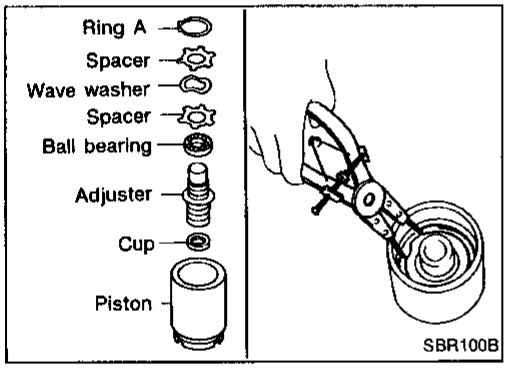
3. Install ring C with a suitable tool.

Assembly (Cont'd)

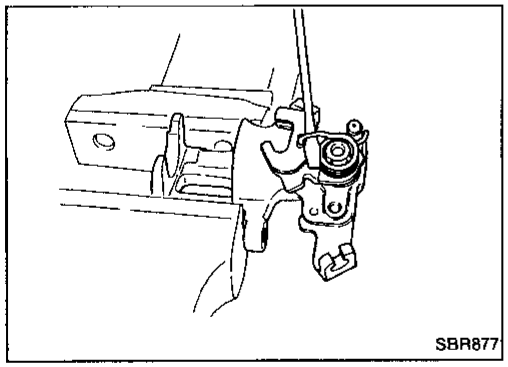


4. Install seat, spring, spring cover and ring B while depressing with suitable commercial service tool or press and drift.





5. Install cup, adjuster, bearing, spacers, washers and ring A with a suitable tool.



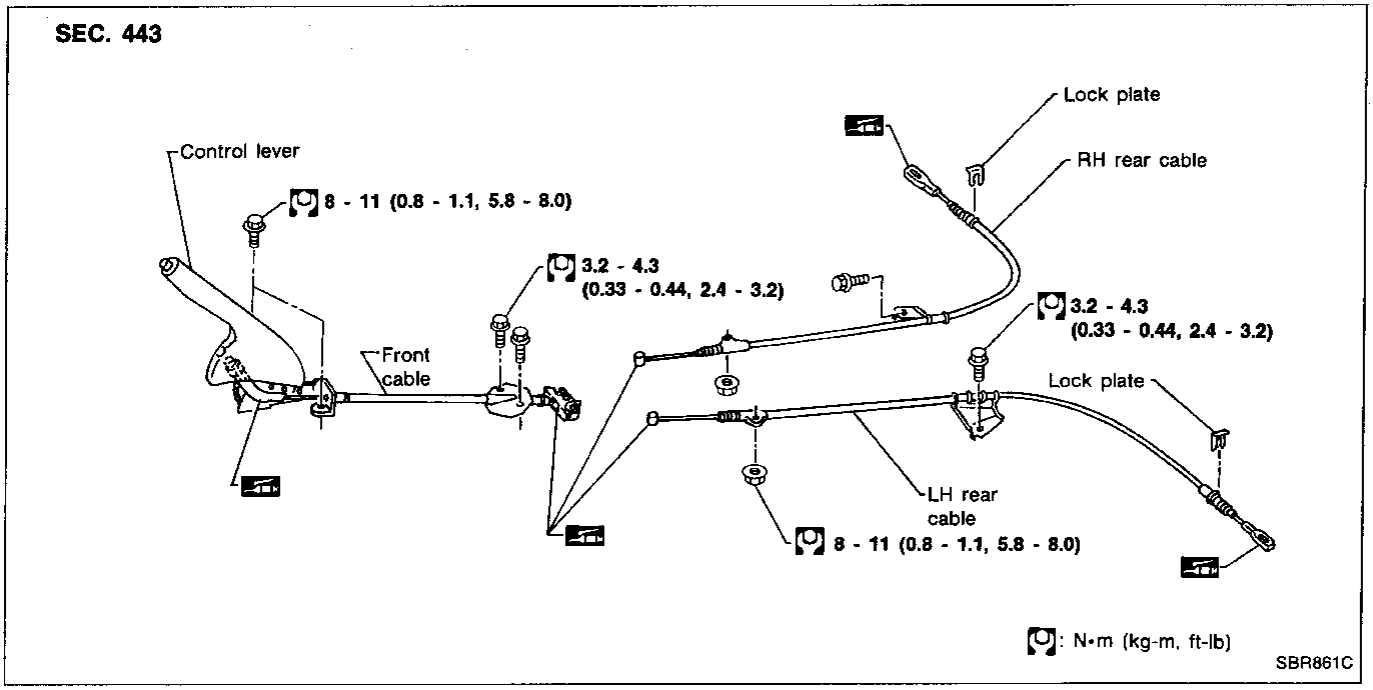
6. Fit lever and tighten stopper bolt.
7. Fit return spring in the order shown.

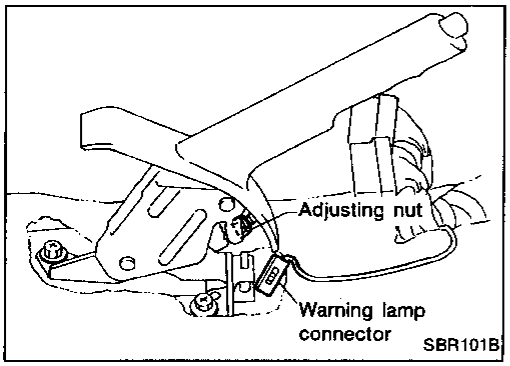
Installation

CAUTION:

- **Refill with new brake fluid "DOT 3".**
- **Never reuse drained brake fluid.**

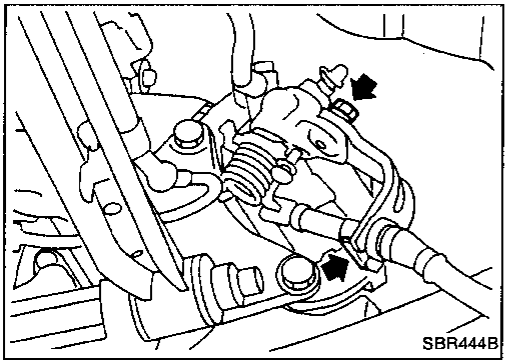
1. Install brake hose to caliper securely.
2. Install all parts and secure all bolts.
3. Bleed air. Refer to "Bleeding Brake System" (BR-5).



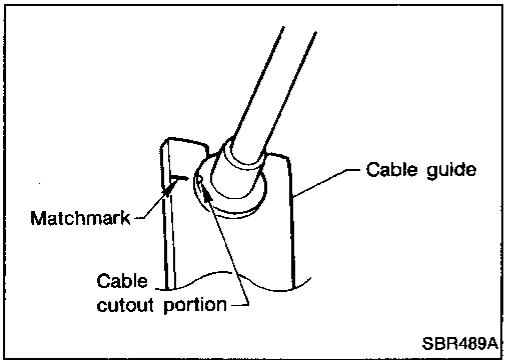


Removal and Installation

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



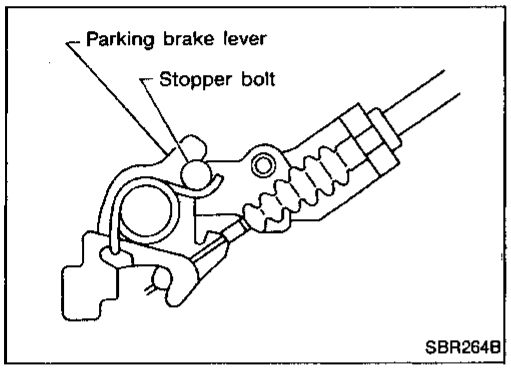
4. Remove lock plate, then disconnect cable from caliper.



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

Inspection

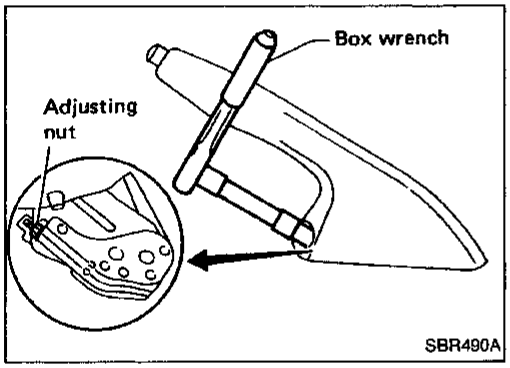
1. Check control lever for wear or other damage. Replace if necessary.
2. Check wires for discontinuity or deterioration. Replace if necessary.
3. Check warning lamp and switch. Replace if necessary.
4. Check parts at each connecting portion and, if found deformed or damaged, replace.



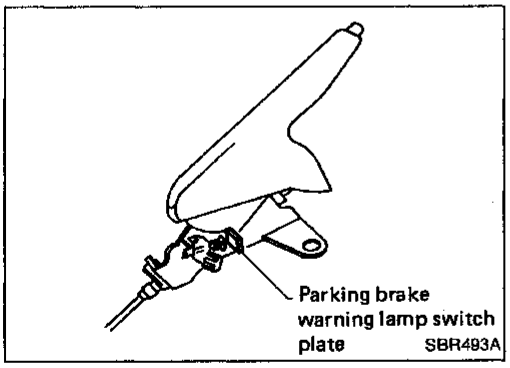
Adjustment

Pay attention to the following points after adjustment.

- There is no drag when control lever is being released.
- Parking brake lever returns to stopper bolt when control lever for rear disc brake is released.



1. Pull control lever up by 4 or 5 notches.
2. Insert a box wrench into opening in control lever and loosen self-lock adjusting nut to slacken cables.
3. Completely push control lever down.
4. Forcefully depress brake pedal about five times (so that caliper is automatically set in position.).
5. Pull lever up by 4 or 5 notches.
6. Turn adjusting nut as shown in figure and adjust lever stroke to specified value.
7. Pull control lever with specified amount of force. Check lever stroke and ensure smooth operation.
   Number of notches : 7 - 9 [196 N (20 kg, 44 lb)]
8. Bend warning lamp switch plate. Warning lamp should come on when lever is pulled "A" notches. It should go off when the lever is fully released.
   Number of "A" notches : 1



Purpose

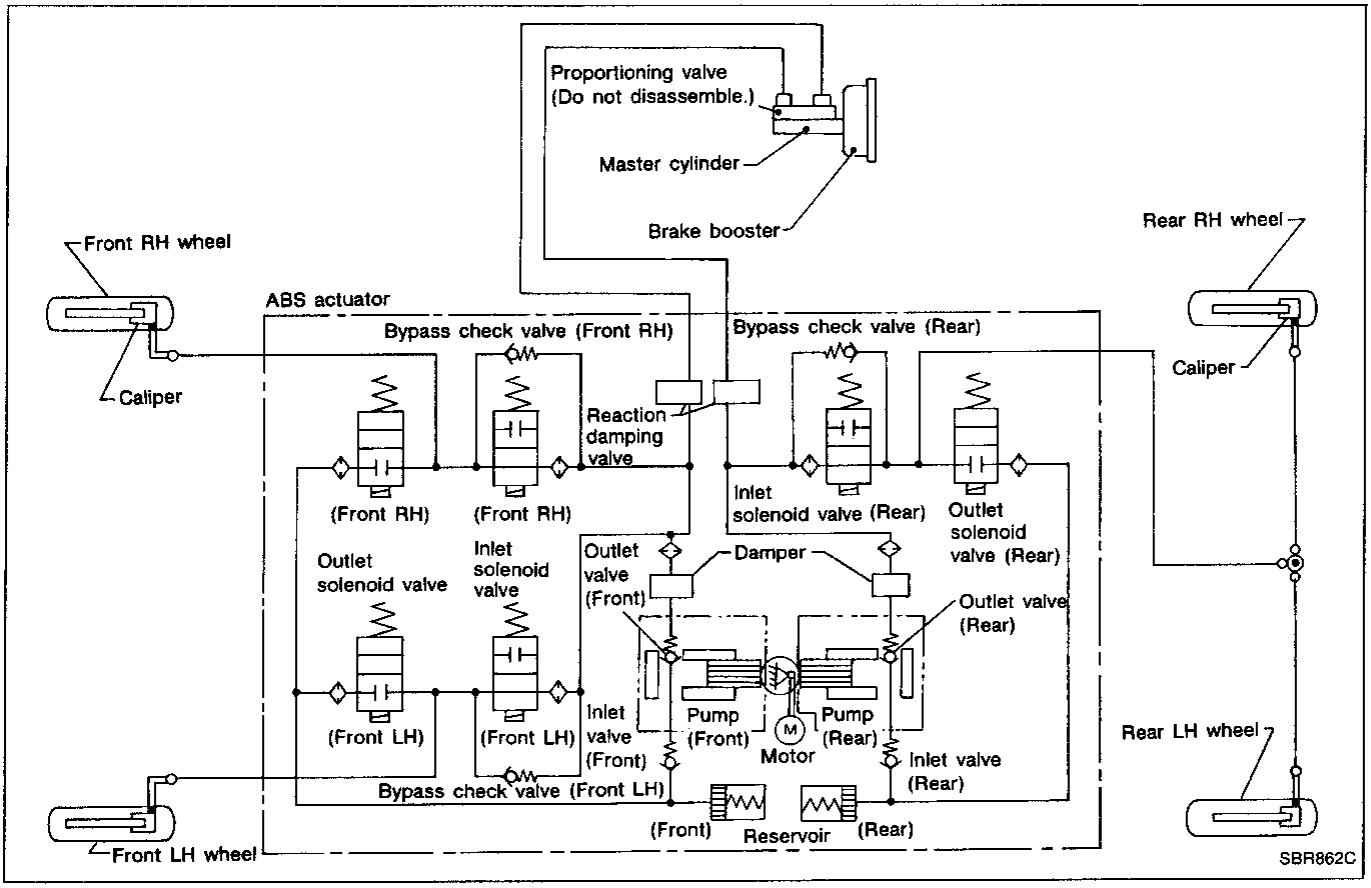
The Anti-Lock Brake System (ABS) consists of electronic and hydraulic components. It allows for control of braking force so that locking of the wheels can be avoided.
The ABS:

1) Improves proper tracking performance through steering wheel operation.
2) Increases obstacle avoidance through steering wheel operation.
3) Improves vehicle stability.

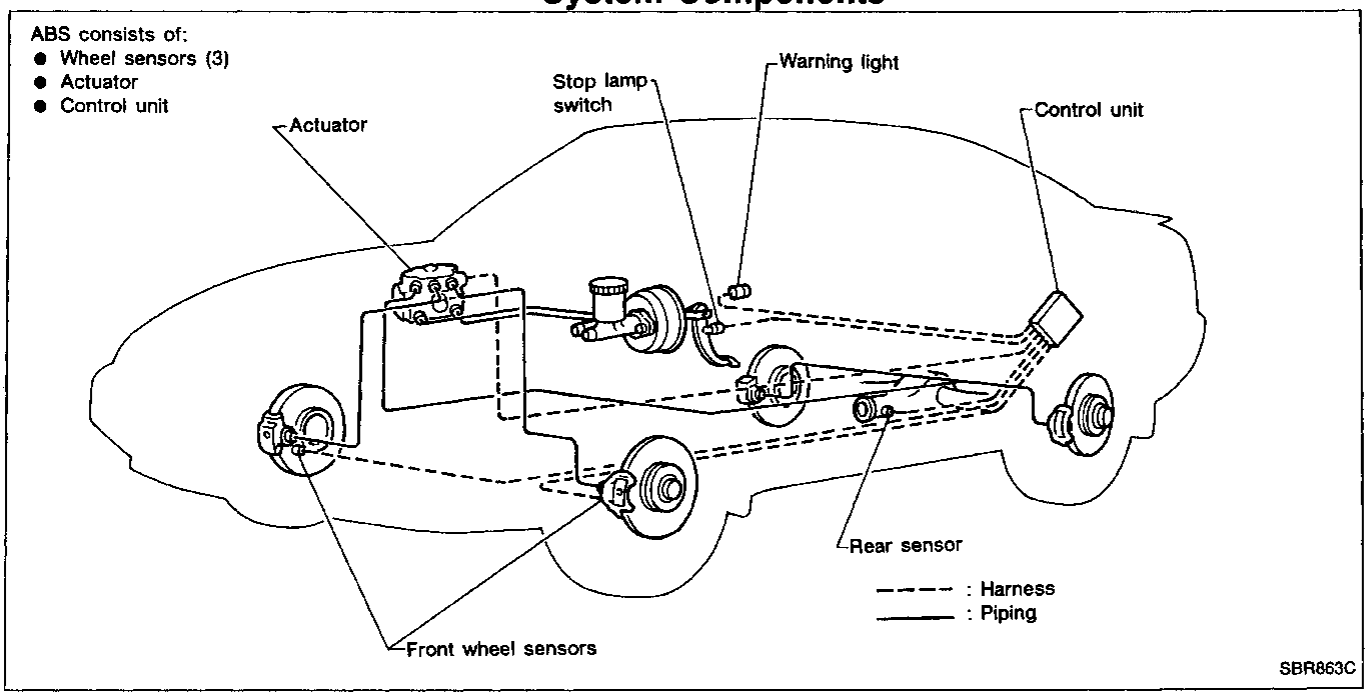
Operation

- The ABS will not operate at speeds below 5 to 10 km/h (3 to 6 MPH) to completely stop the vehicle. (The speeds will vary according to road conditions.)
- The ABS has self-test capabilities. A mechanical noise may be heard as the ABS performs a self-test the first time the vehicle reaches 10 km/h (6 MPH). This is a normal part of the self-test feature. If a malfunction is found during this check, the anti-lock warning light will come on.
- During ABS operation, a mechanical noise may be heard. This is a normal condition.

ABS Hydraulic Circuit



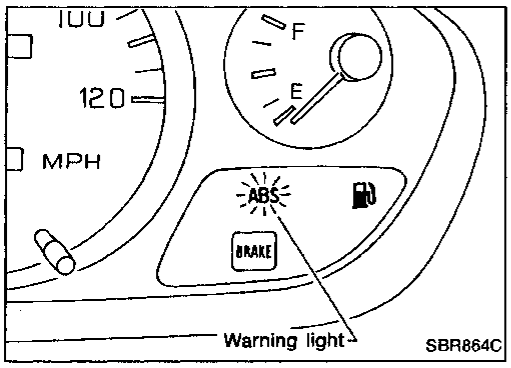
System Components



System Description

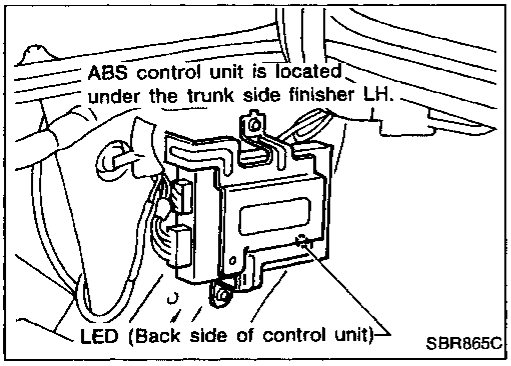
SENSOR

The sensor unit consists of a gear-shaped sensor rotor and a sensor element. The element contains a bar magnet wound with a coil. The sensor is installed on the back side of the brake rotor or the final drive. As the wheel rotates, the sensor generates a sine-wave pattern. The frequency and voltage increase(s) as the rotating speed increases.

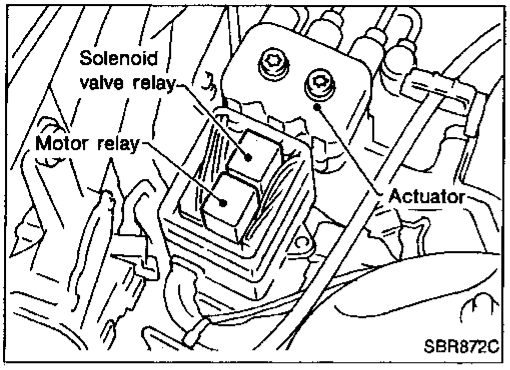


CONTROL UNIT

The control unit computes the wheel rotating speed by the signal current sent from the sensor. Then it supplies a DC current to the actuator solenoid valve. It also controls ON-OFF operation of the solenoid valve relay and motor relay. If any electrical malfunction should be detected in the system, the warning light is turned on. In this condition, the ABS will be deactivated, and the vehicle's brake system reverts to normal operation.



System Description (Cont'd)



ACTUATOR

The actuator contains:

- An electric motor and pump
- Two relays
- Six solenoid valves, each inlet and outlet for
  - — LH front
  - — RH front
  - — LH and RH rear

These components control the hydraulic circuit. The ABS control unit directs the actuator to increase, hold or decrease hydraulic pressure to all or individual wheels.

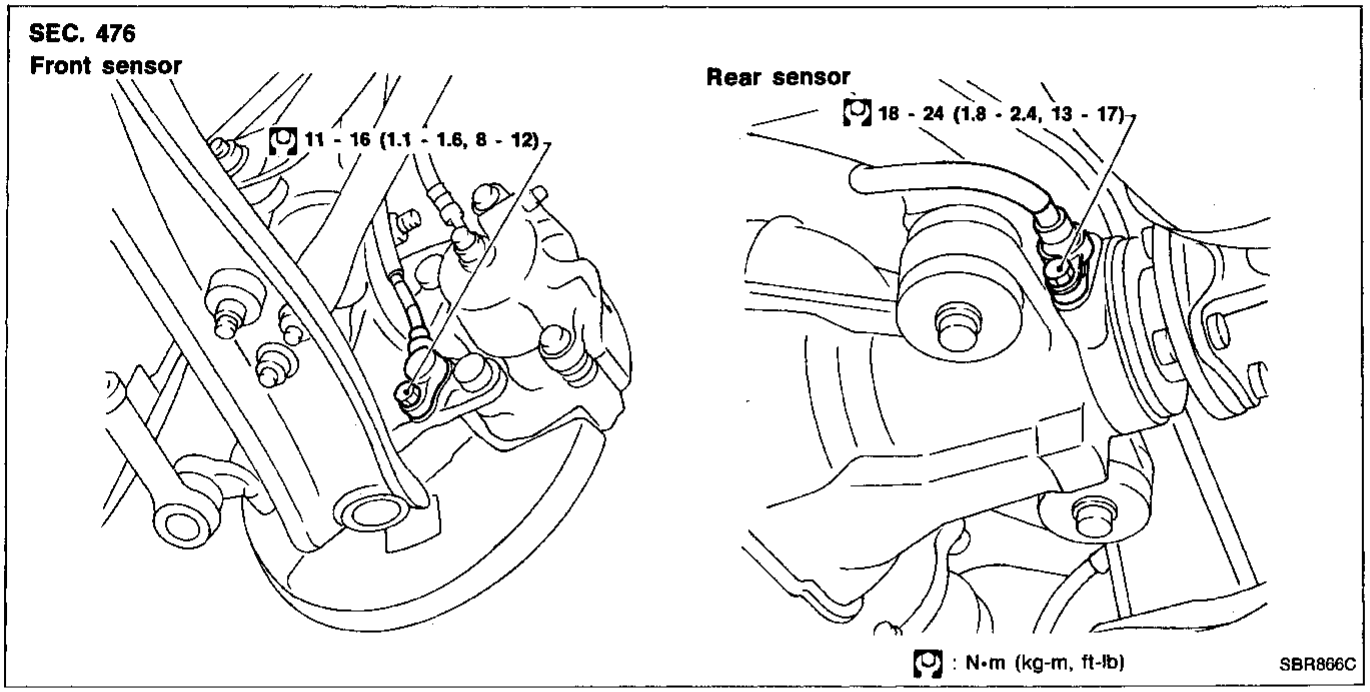
ABS actuator operation

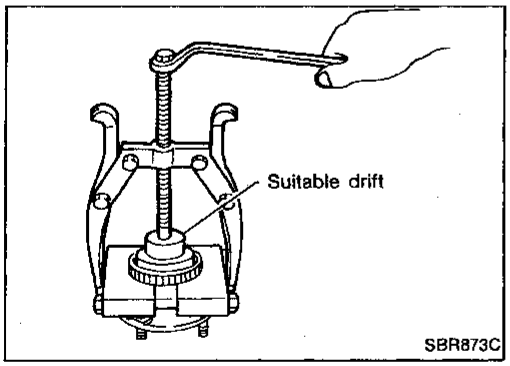
		Inlet solenoid valve	Outlet solenoid valve	
Normal brake operation		OFF (Open)	OFF (Closed)	Master cylinder brake fluid pressure is directly transmitted to caliper via the inlet solenoid valve.
ABS operation	Pressure hold	ON (Closed)	OFF (Closed)	Hydraulic circuit is shut off to hold the caliper brake fluid pressure.
	Pressure decrease	ON (Closed)	ON (Open)	Caliper brake fluid is sent to reservoir via the outlet solenoid valve. Then it is pushed up to the master cylinder by pump.
	Pressure increase	OFF (Open)	OFF (Closed)	Master cylinder brake fluid pressure is transmitted to caliper.

Removal and Installation

CAUTION:
Be careful not to damage sensor edge and sensor rotor teeth. When removing the front wheel hub or final drive assemblies, first remove the ABS wheel sensor from the assembly. Failure to do so may result in damage to the sensor wires making the sensor inoperative.

WHEEL SENSORS

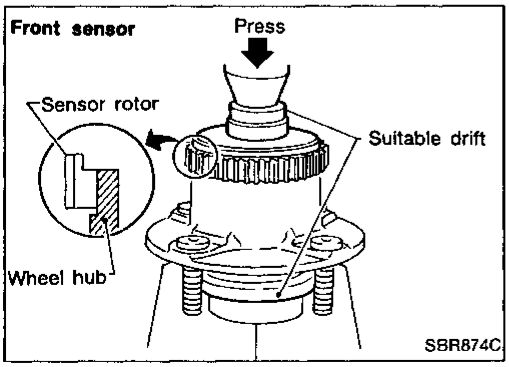




SENSOR ROTOR

Removal

1. Remove the front wheel hub or final drive companion flange. Refer to FA and PD sections.
2. Remove the sensor rotor using suitable puller, drift and bearing replacer.

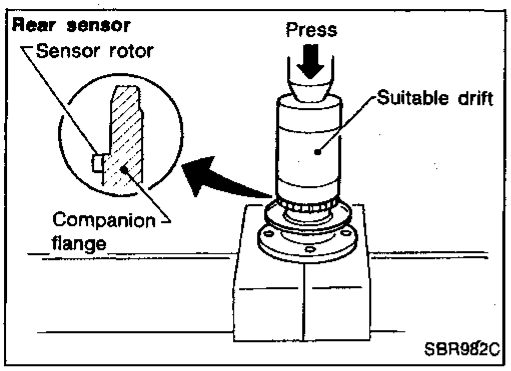


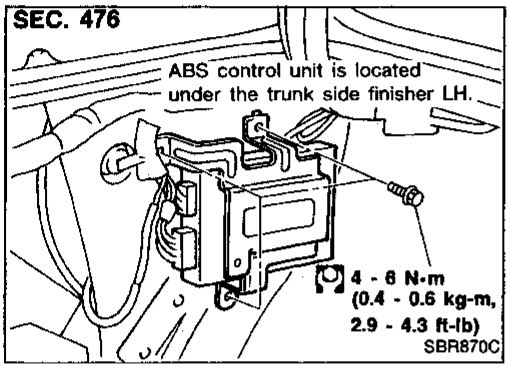
Installation

Install the sensor rotor using suitable drift and press.

- Always replace sensor rotor with new one.
- Pay attention to the direction of front sensor rotor as show in figure.

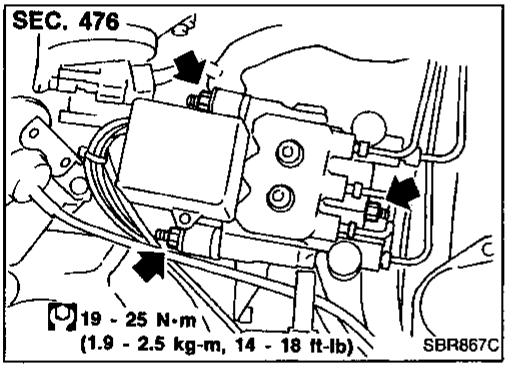
Removal and Installation (Cont'd)





CONTROL UNIT

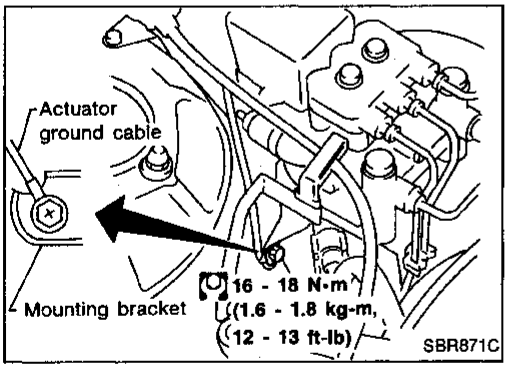
Location: Under trunk side finisher LH.



ACTUATOR

Removal

1. Disconnect battery cable.
2. Drain brake fluid. Refer to "Changing Brake Fluid" (BR-5).
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.



Installation

CAUTION:

After installation, refill brake fluid. Then bleed air. Refer to "Bleeding Brake System" (BR-5).

1. Tighten actuator ground cable.

Place ground cable at a notch of mounting bracket.

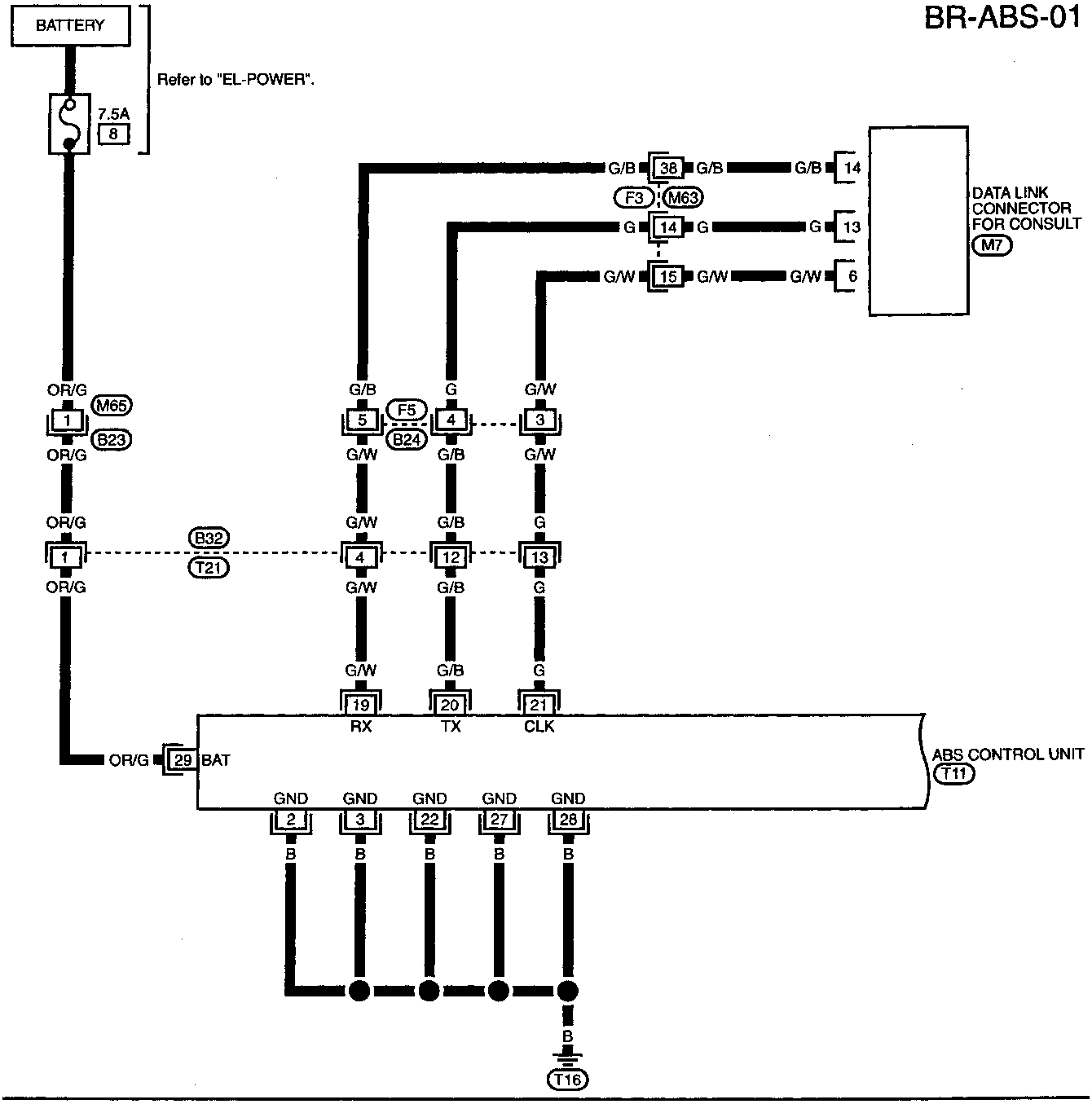
2. Connect brake pipes temporarily.
3. Tighten fixing nuts.
4. Tighten brake pipes.
5. Fix actuator harness clip on the mounting bracket.
6. Connect connector and battery cable.

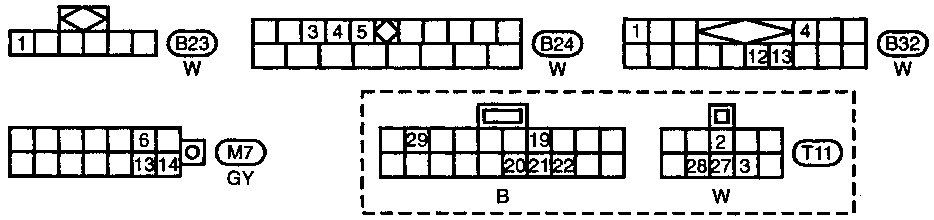
ACTUATOR RELAYS

1. Disconnect battery cable.
2. Remove actuator relay cover.
3. Pull out relays.

Wiring Diagram — ABS —

BR-ABS-01



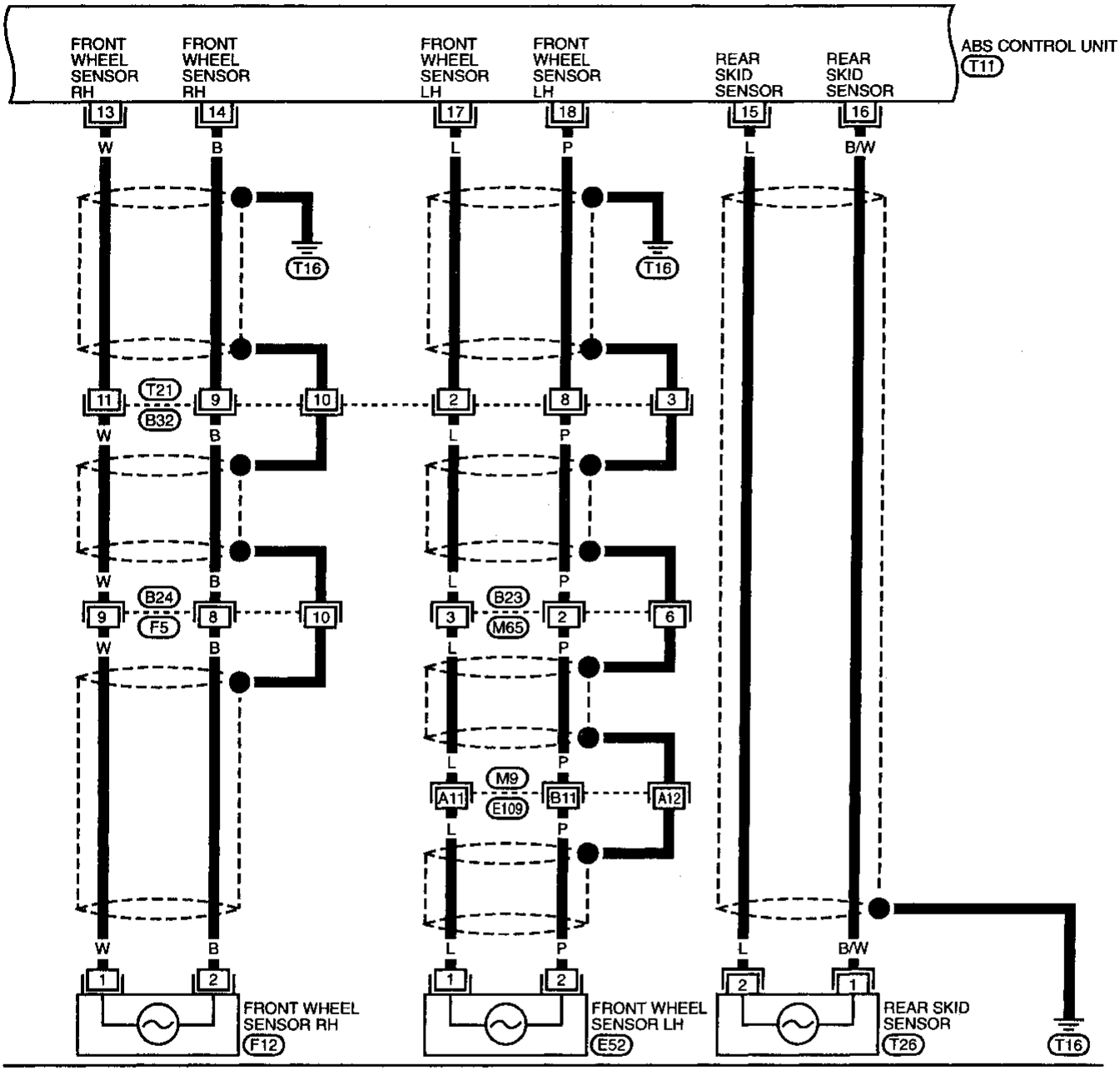


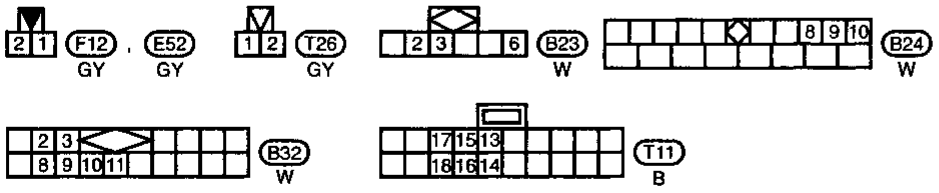
Refer to last page (Foldout page).
F3 , M63

MBR091A

Wiring Diagram — ABS — (Cont'd)

BR-ABS-02





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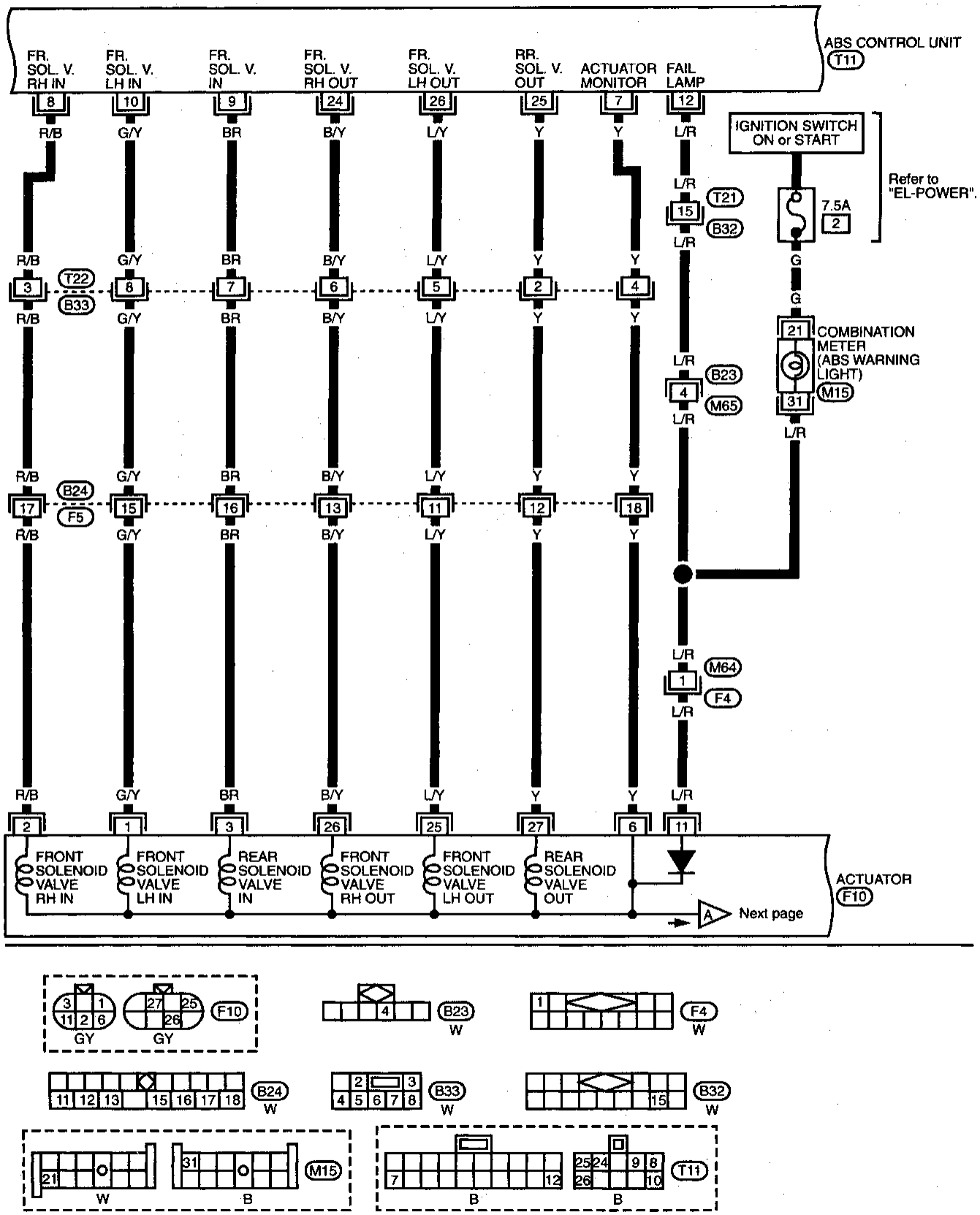
M9 , E109

MBR092A

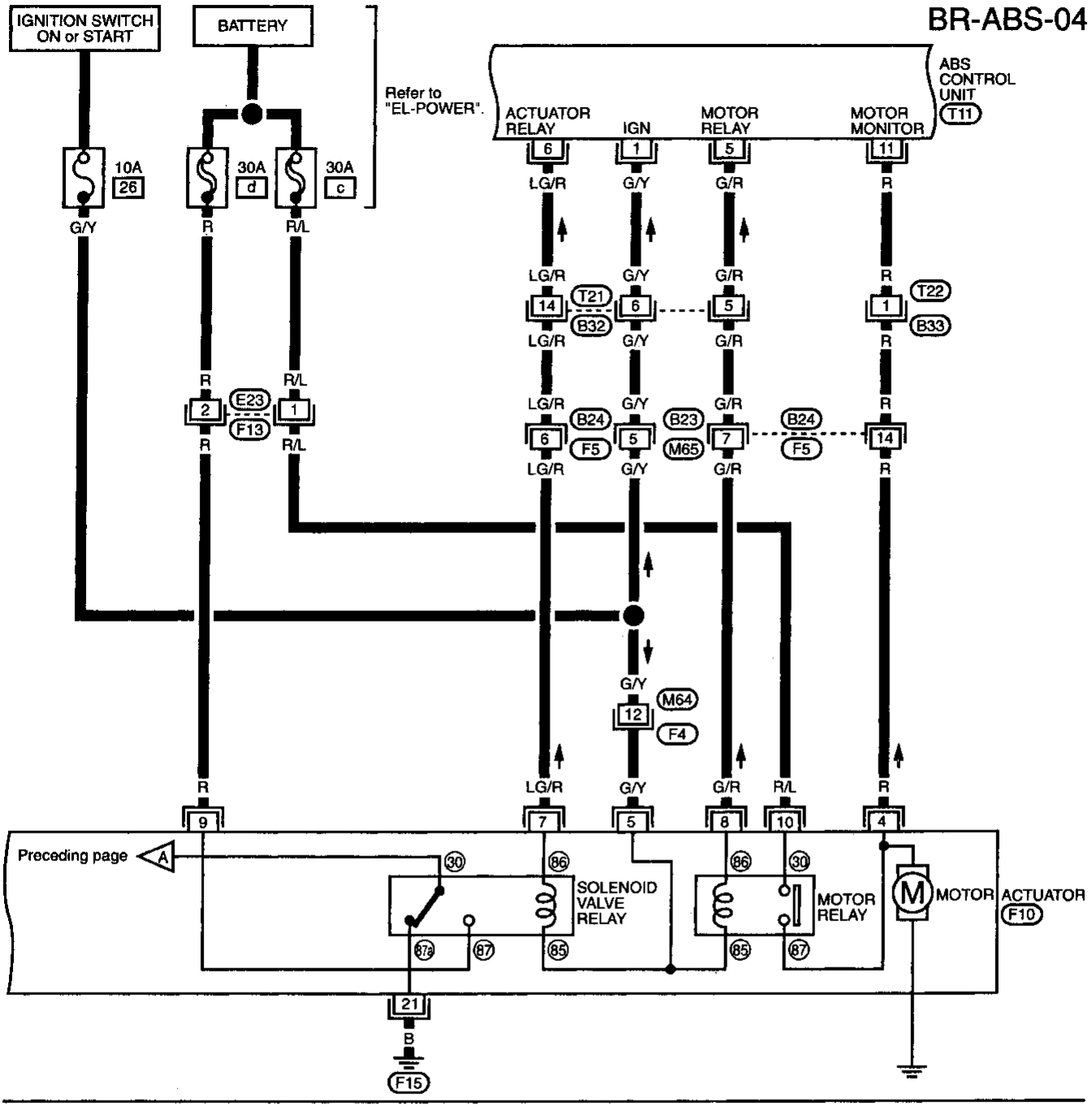
Wiring Diagram — ABS — (Cont'd)

BR-ABS-03



MBR093A

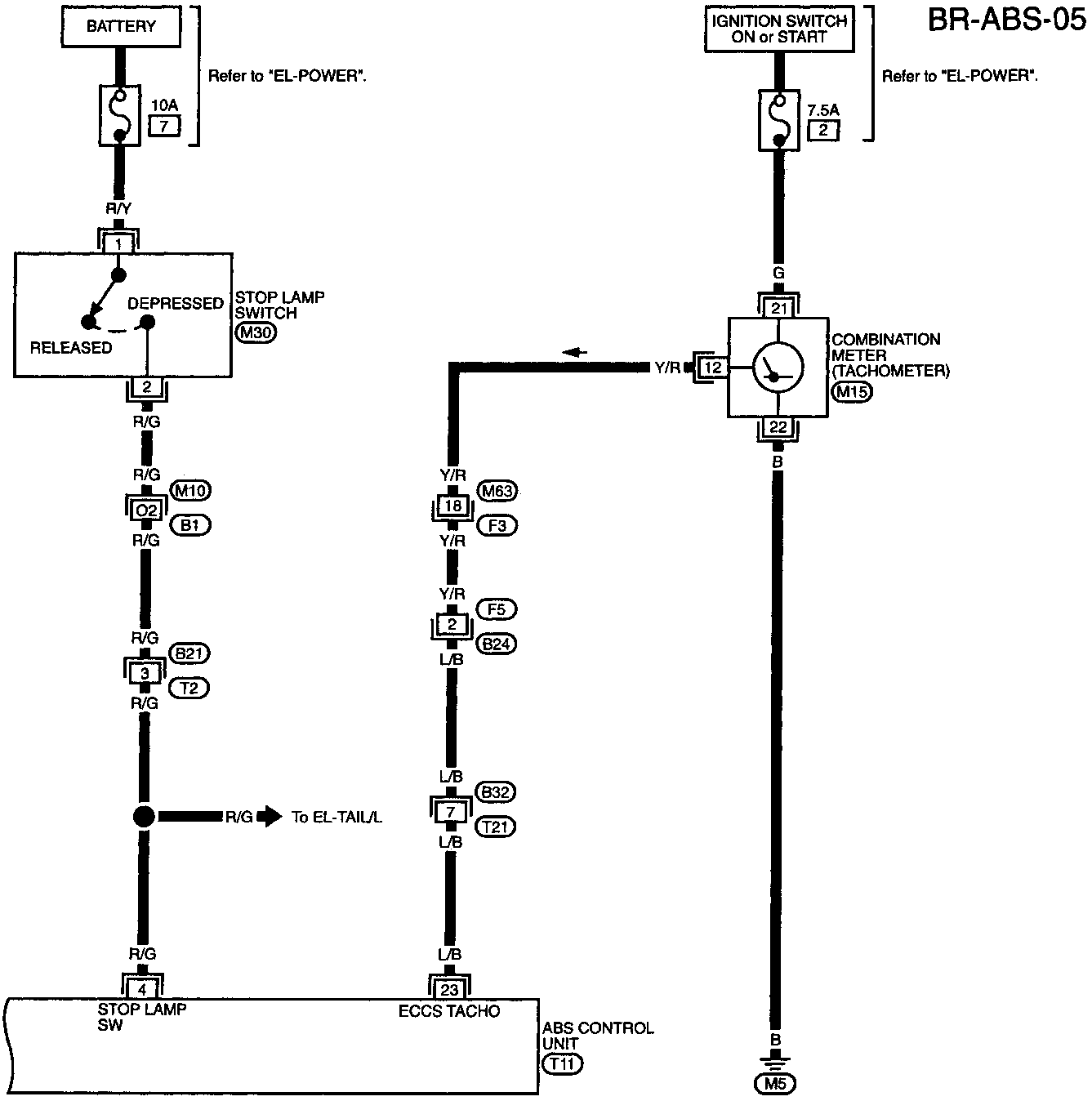
Wiring Diagram — ABS — (Cont'd)

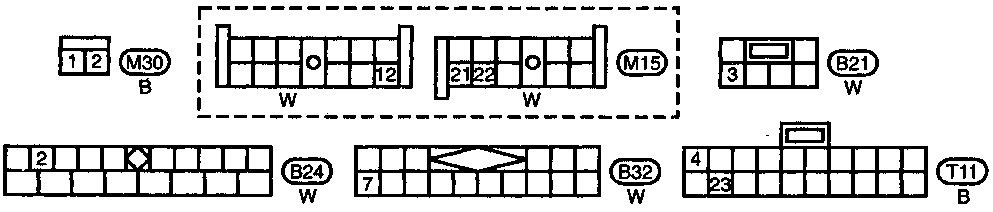


MBR094A

Wiring Diagram — ABS — (Cont'd)

BR-ABS-05





Refer to last page (Foldout page).
M10 , B1
F3 , M63

MBR095A

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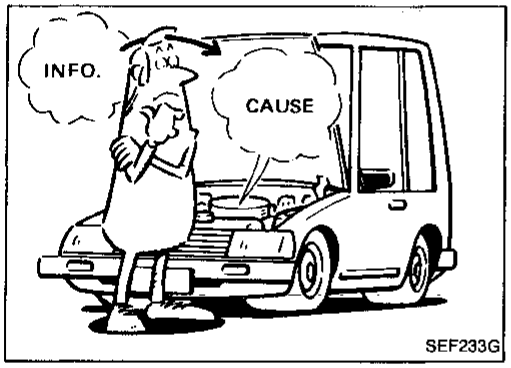
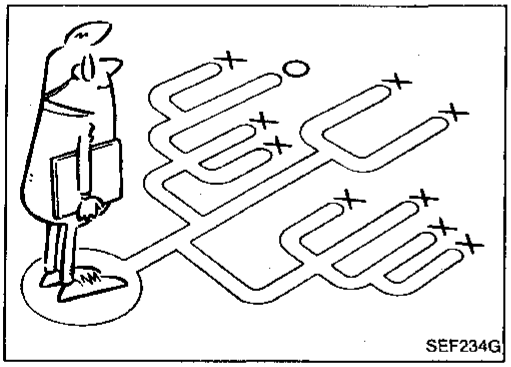




How to Perform Trouble Diagnoses for Quick and Accurate Repair

INTRODUCTION

The ABS 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. It is also important to check for conventional problems: such as air leaks in the booster or lines, lack of brake fluid, or other problems with the brake system.

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

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

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

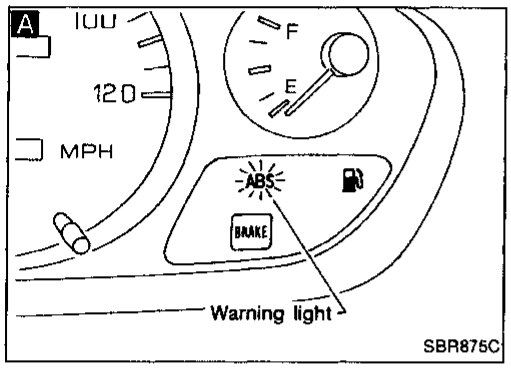
Self-diagnosis

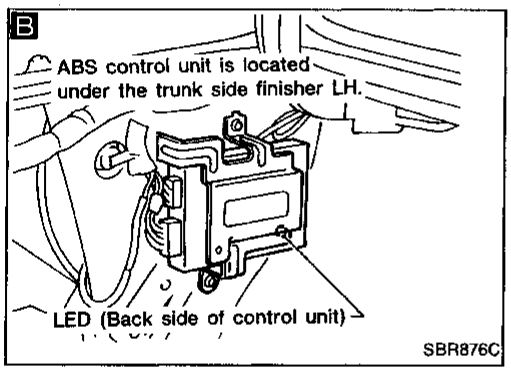
FUNCTION

- When a problem occurs in the ABS, the warning light on the instrument panel comes on.
- A maximum of three malfunctions are stored in the memory of the ABS control unit.

Erase the self-diagnosis results stored in the control unit after malfunctions are repaired (See next page).

- The self-diagnosis results are identified by Consult or LED on the control unit.





SELF-DIAGNOSIS PROCEDURE

Start engine.
Drive vehicle over 15 km/h (9 MPH) for at least one minute.

↓

A

Stop vehicle with engine running.
Make sure that the ABS warning light activates.

↓

B

The LED on the ABS control unit flashes to indicate the malfunction code No.

↓

Verify the location of the malfunction with the malfunction code chart.
Then make necessary repairs following the diagnostic procedures.

↓

After the malfunctions are repaired, erase the self-diagnostic results stored in the control unit.
Disconnect connectors for ABS control unit or the battery negative terminal for at least one minute.

↓

Check warning light for deactivation after driving vehicle over 15 km/h (9 MPH) for at least one minute.

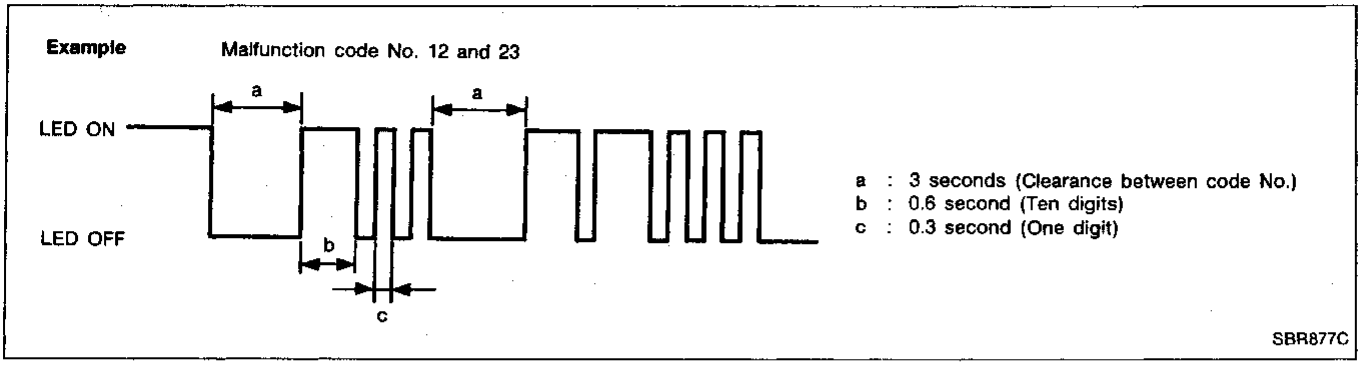
↓

Test the ABS in a safe area to verify that it functions properly.

Self-diagnosis (Cont'd)

HOW TO READ SELF-DIAGNOSTIC RESULTS (Malfunction codes)

- Determine the code No. by counting the number of times the LED flashes on and off.
- The malfunction code chart is given on the next page.



HOW TO ERASE SELF-DIAGNOSTIC RESULTS (Malfunction codes)

- Disconnect ABS control unit connectors or battery negative terminal for at least one minute.
- When using CONSULT, touch "ERASE" on the CONSULT screen with self-diagnostic results mode.

Self-diagnosis (Cont'd)

MALFUNCTION CODE/SYMPTOM CHART

Code No. (No. of LED flashes)	Malfunctioning part and circuit	Diagnostic procedure
01	Front right sensor (open-circuit)	4
02	Front left sensor (open-circuit)	4
03	Rear sensor (open-circuit)	4
05	Front right sensor (short-circuit)	4
06	Front left sensor (short-circuit)	4
07	Rear sensor (short-circuit)	4
11	Actuator front right inlet solenoid valve (open-circuit)	3
12	Actuator front left inlet solenoid valve (open-circuit)	3
13	Actuator rear inlet solenoid valve (open-circuit)	3
15	Actuator front right outlet solenoid valve (open-circuit)	3
16	Actuator front left outlet solenoid valve (open-circuit)	3
17	Actuator rear outlet solenoid valve (open-circuit)	3
21	Actuator front right inlet solenoid valve (short-circuit)	3
22	Actuator front left inlet solenoid valve (short-circuit)	3
23	Actuator rear inlet solenoid valve (short-circuit)	3
25	Actuator front right outlet solenoid valve (short-circuit)	3
26	Actuator front left outlet solenoid valve (short-circuit)	3
27	Actuator rear outlet solenoid valve (short-circuit)	3
41	Solenoid valve relay circuit (unable to turn off)	6
42	Solenoid valve relay circuit (unable to turn on)	6
43	Actuator motor or motor relay (unable to turn off)	5
44	Actuator motor or motor relay (unable to turn on)	5
47	Power supply (High voltage)	7
48	Power supply (Low voltage)	7
45, 46, 77 LED deactivation or continuous activation	Control unit Ground circuit	2
Warning light does not come on when ignition switch is turned on.	Fuse, warning light bulb or warning light circuit Control unit power supply circuit	1
Pedal vibration and noise	—	9
Long stopping distance	—	10
Unexpected pedal action	—	11
ABS does not work.	—	12
ABS works frequently.	—	13

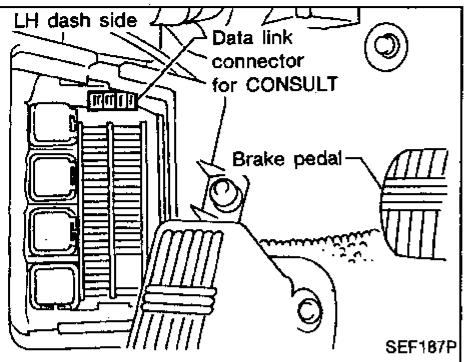
Consult

CONSULT APPLICATION TO ABS

ITEM	SELF-DIAGNOSTIC RESULTS	DATA MONITOR	ACTIVE TEST
Front right wheel sensor	X	X	—
Front left wheel sensor	X	X	—
Rear wheel sensor	X	X	—
Stop lamp switch	—	X	—
Engine revolution signal	—	X	—
Front right inlet solenoid valve	X	X	X
Front right outlet solenoid valve	X	X	X
Front left inlet solenoid valve	X	X	X
Front left outlet solenoid valve	X	X	X
Rear inlet solenoid valve	X	X	X
Rear outlet solenoid valve	X	X	X
Actuator solenoid valve relay	X	X	—
Actuator motor relay (ABS MOTOR is shown on the Data Monitor screen.)	X	X	X
ABS warning light	—	X	—
Battery voltage (SENSOR VOLT is shown on the Data Monitor screen.)	X	X	—

X: Applicable.
—: Not applicable.

A



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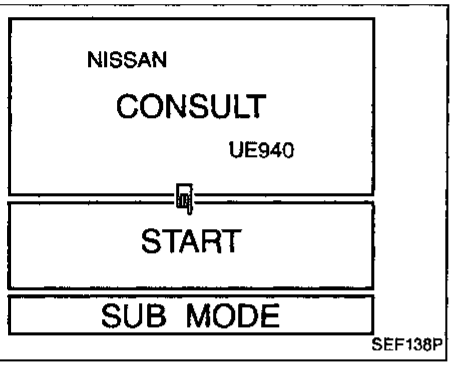

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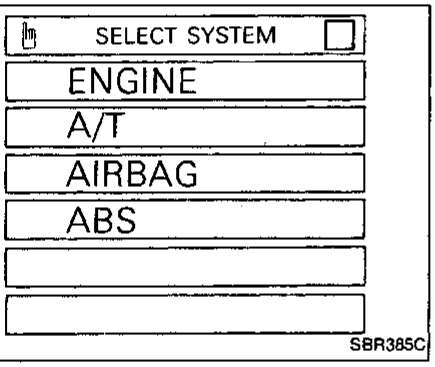
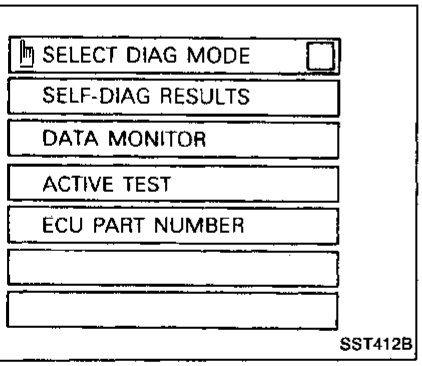
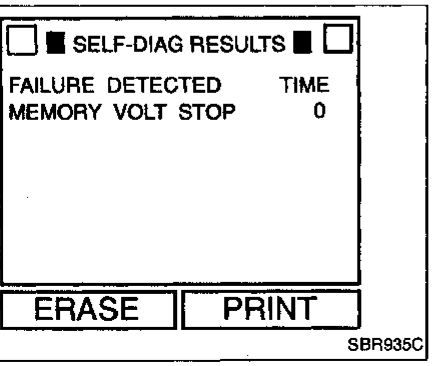


D



E



Consult Inspection Procedure

SELF-DIAGNOSIS PROCEDURE

A

1) Turn ignition switch OFF.
2) Connect Consult to Data Link Connector for Consult.

↓

1) Start engine.
2) Drive vehicle over 15 km/h (9 MPH) for at least one minute.

↓

B 1) Stop vehicle with engine running and touch "START" on Consult screen.
C 2) Touch "ABS".
D 3) Touch "SELF-DIAG RESULTS".
- The screen shows the detected malfunction and the times of ignition switch ON and OFF after it occurred.

↓

Make the necessary repairs following the diagnostic procedures.

↓

E

After the malfunctions are repaired, erase the self-diagnostic results stored in the control unit by touching "ERASE".

↓

Check warning lamp for deactivation after driving vehicle over 15 km/h (9 MPH) for at least one minute.

↓

Test the ABS in a safe area to verify that it functions properly.

Consult Inspection Procedure (Cont'd)

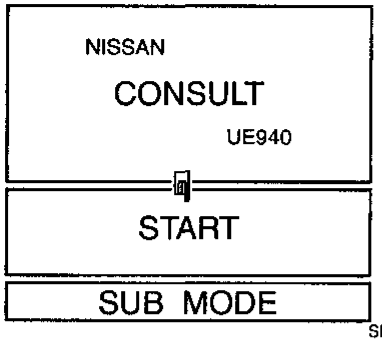
SELF-DIAGNOSTIC RESULTS MODE

Diagnostic item	Diagnostic item is detected when ...	Diagnostic procedure
FR RH SENSOR [OPEN]	• Circuit for front right wheel sensor is open. (An abnormally high input voltage is entered.)	4
FR LH SENSOR [OPEN]	• Circuit for front left wheel sensor is open. (An abnormally high input voltage is entered.)	4
REAR SENSOR [OPEN]	• Circuit for rear sensor is open. (An abnormally high input voltage is entered.)	4
FR RH SENSOR [SHORT]	• Circuit for front right wheel sensor is shorted. (An abnormally low input voltage is entered.)	4
FR LH SENSOR [SHORT]	• Circuit for front left wheel sensor is shorted. (An abnormally low input voltage is entered.)	4
REAR SENSOR [SHORT]	• Circuit for rear sensor is shorted. (An abnormally low input voltage is entered.)	4
FR RH IN ABS SOL [OPEN]	• Circuit for front right inlet solenoid valve is open. (An abnormally low output voltage is entered.)	3
FR LH IN ABS SOL [OPEN]	• Circuit for front left inlet solenoid valve is open. (An abnormally low output voltage is entered.)	3
RR IN ABS SOL [OPEN]	• Circuit for rear inlet solenoid valve is open. (An abnormally low output voltage is entered.)	3
FR RH IN ABS SOL [SHORT]	• Circuit for front right inlet solenoid valve is shorted. (An abnormally high output voltage is entered.)	3
FR LH IN ABS SOL [SHORT]	• Circuit for front left inlet solenoid valve is shorted. (An abnormally high output voltage is entered.)	3
RR IN ABS SOL [SHORT]	• Circuit for rear inlet solenoid valve is shorted. (An abnormally high output voltage is entered.)	3
FR RH OUT ABS SOL [OPEN]	• Circuit for front right outlet solenoid valve is open. (An abnormally low output voltage is entered.)	3
FR LH OUT ABS SOL [OPEN]	• Circuit for front left outlet solenoid valve is open. (An abnormally low output voltage is entered.)	3
RR OUT ABS SOL [OPEN]	• Circuit for rear outlet solenoid valve is open. (An abnormally low output voltage is entered.)	3
FR RH OUT ABS SOL [SHORT]	• Circuit for front right outlet solenoid valve is shorted. (An abnormally high output voltage is entered.)	3
FR LH OUT ABS SOL [SHORT]	• Circuit for front left outlet solenoid valve is shorted. (An abnormally high output voltage is entered.)	3
RR OUT ABS SOL [SHORT]	• Circuit for rear outlet solenoid valve is shorted. (An abnormally high output voltage is entered.)	3
ABS ACTUATOR RELAY [ON FAILURE]	• Actuator solenoid valve relay is ON, even control unit sends off signal.	6
ABS ACTUATOR RELAY [OFF FAILURE]	• Actuator solenoid valve relay is OFF, even control unit sends on signal.	6
ABS MOTOR [ON FAILURE]	• Actuator motor is running, even control unit sends off signal.	5
ABS MOTOR [OFF FAILURE]	• Actuator motor is not running, even control unit sends on signal.	5
BATTERY VOLT [VB-HIGH]	• Power source voltage supplied to ABS control unit is abnormally high.	7
BATTERY VOLT [VB-LOW]	• Power source voltage supplied to ABS control unit is abnormally low.	7
CONTROL UNIT	• Function of calculation in ABS control unit has failed.	2
MEMORY VOLT STOP	• Connectors for ABS control unit or battery terminals are disconnected.	8

Consult Inspection Procedure (Cont'd)

DATA MONITOR PROCEDURE

A

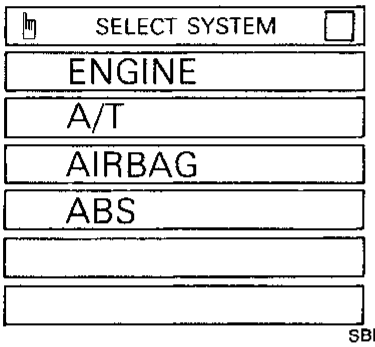


SEF138P

1) Turn ignition switch OFF.
2) Connect Consult to Data Link Connector for Consult.
3) Turn ignition switch ON.

A 1) Touch "START" on Consult screen.
B 2) Touch "ABS".
C 3) Touch "DATA MONITOR".

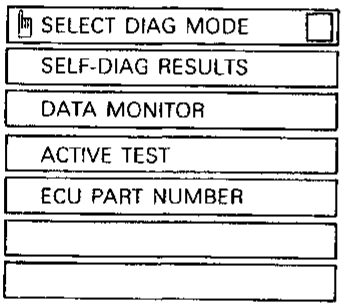
B



SBR385C

D 1) Touch "SETTING" on "SELECT MONITOR ITEM" screen.
E 2) Touch "LONG TIME" on "SET RECORDING COND" screen.
D 3) Touch "START" on "SELECT MONITOR ITEM".

C



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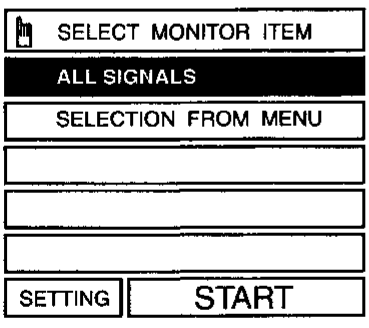
D



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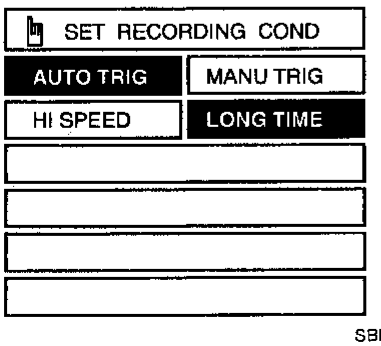
E



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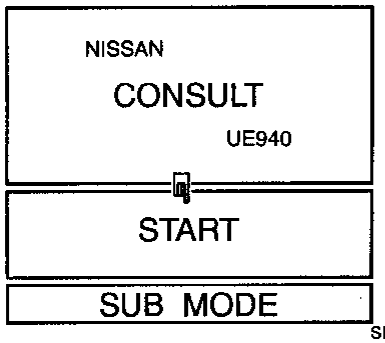
Consult Inspection Procedure (Cont'd)

ACTIVE TEST PROCEDURE

- When conducting Active test, vehicle must be stationary.
- When ABS warning lamp stays on, never conduct Active test.

A



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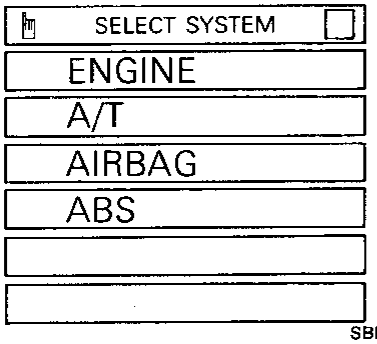
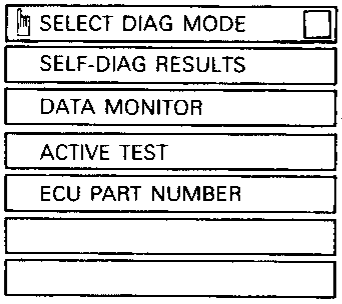
B



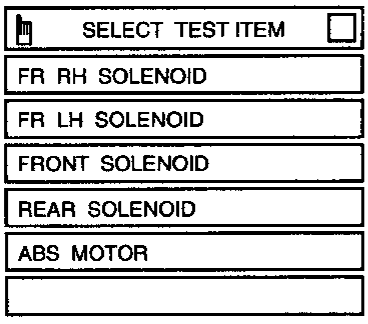
SBR385C

C



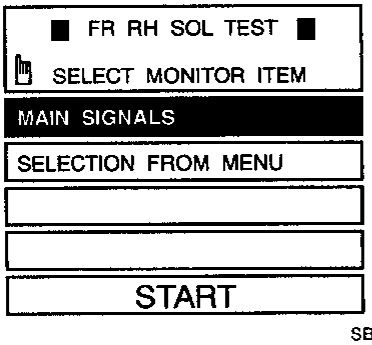
SST412B

D



SBR933C

E



SBR934C

1) Turn ignition switch OFF.
2) Connect Consult to Data Link Connector for Consult.
3) Start engine.

↓

A 1) Touch "START" on Consult screen.
B 2) Touch "ABS".
C 3) Touch "ACTIVE TEST".

↓

D 1) Select active test item by touching screen.
E 2) Touch "START".

↓

Carry out the active test by touching screen key.

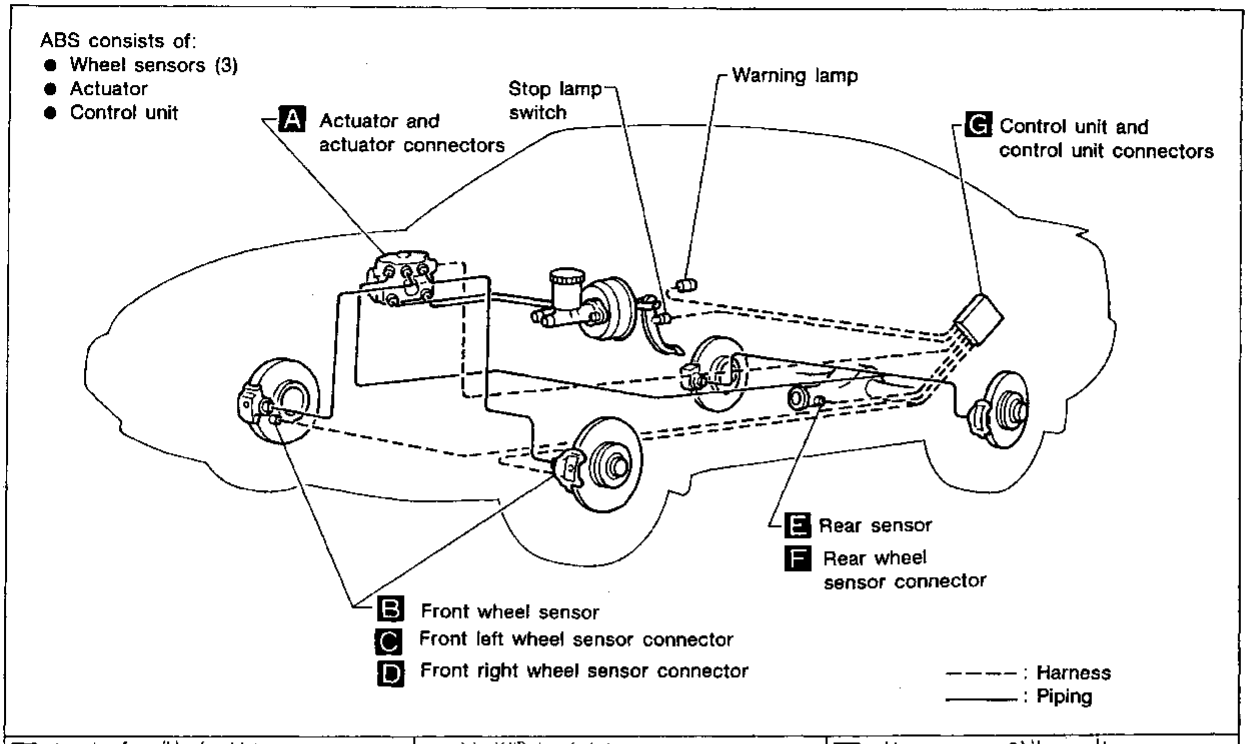
DATA MONITOR MODE

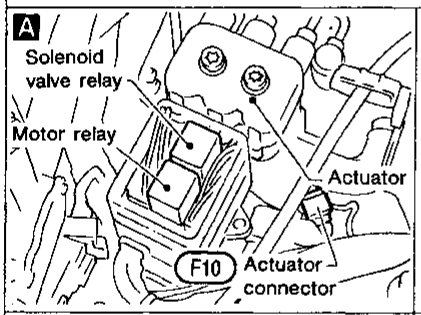
MONITOR ITEM	CONDITION	SPECIFICATION
FR RH SENSOR FR LH SENSOR REAR SENSOR	Drive vehicle. (Each wheel is rotating.)	Wheel speed signal (Almost the same speed as speedometer.)
STOP LAMP SW	Brake is depressed.	Depress the pedal: ON Release the pedal: OFF
ENG RPM SIGNAL	Engine is running.	Engine stops: STOP Engine is running: RUN
FR RH IN SOL FR RH OUT SOL FR LH IN SOL FR LH OUT SOL REAR IN SOL REAR OUT SOL	1. Drive vehicle at speeds over 15 km/h (9 MPH) for at least one minute. 2. Engine is running.	Operating conditions for each solenoid valve are indicated. ABS is not operating: OFF
MOTOR RLY		ABS is not operating: OFF ABS is operating: ON
ACTUATOR RLY	Ignition switch is ON or engine is running.	Ignition switch ON (Engine stops): OFF Engine running: ON
WARNING LAMP		ABS warning lamp is turned on: ON ABS warning lamp is turned off: OFF
SENSOR VOLT		Power supply voltage for control unit

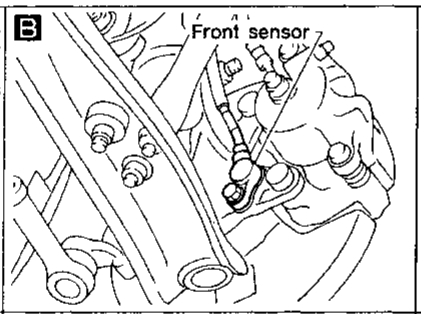
ACTIVE TEST MODE

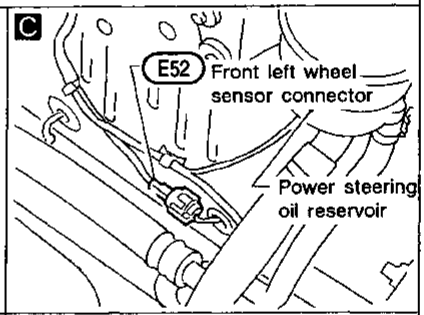
TEST ITEM	CONDITION	JUDGEMENT		
FR RH SOLENOID FR LH SOLENOID FRONT SOLENOID REAR SOLENOID	Engine is running.	Brake fluid pressure control operation		
			IN SOL	OUT SOL
		UP (Increase):	OFF	OFF
		KEEP (Hold):	ON	OFF
		DOWN (Decrease):	ON	ON
ABS MOTOR		ABS actuator motor ON: Motor runs OFF: Motor stops		

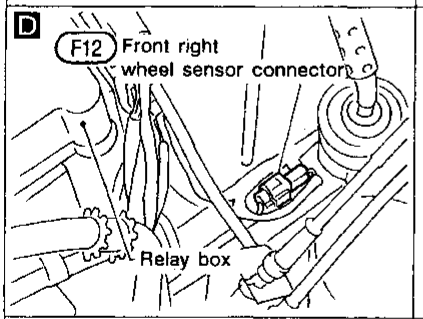
Component Parts and Harness Connector Location

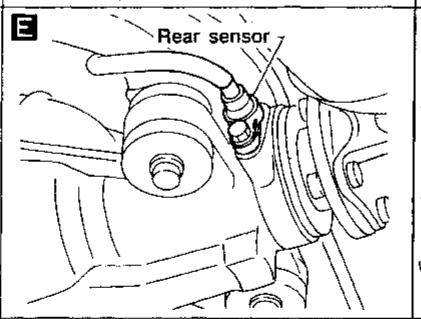


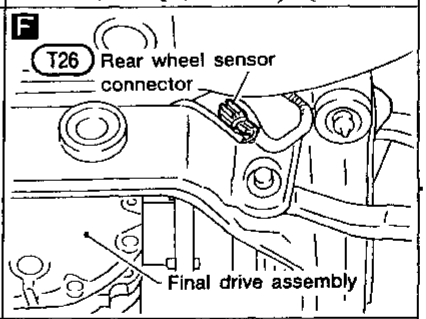


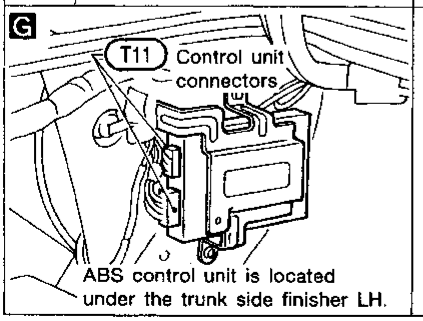






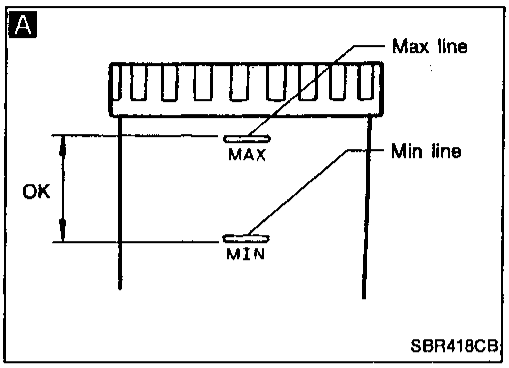


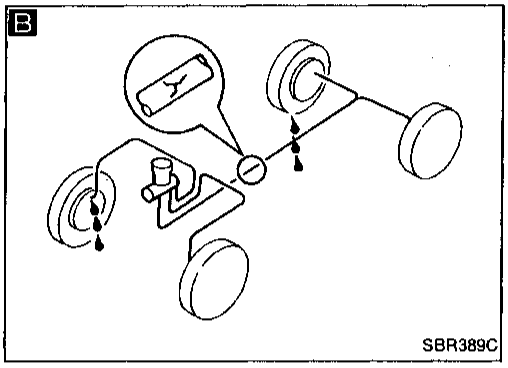


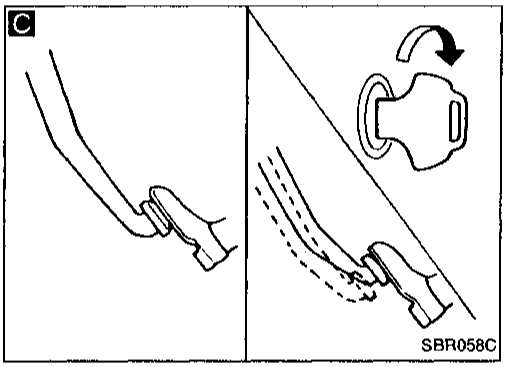


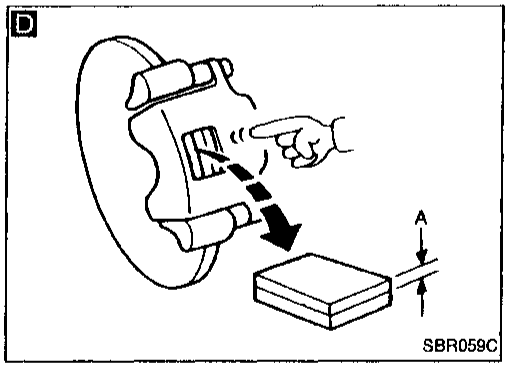
SBR897C

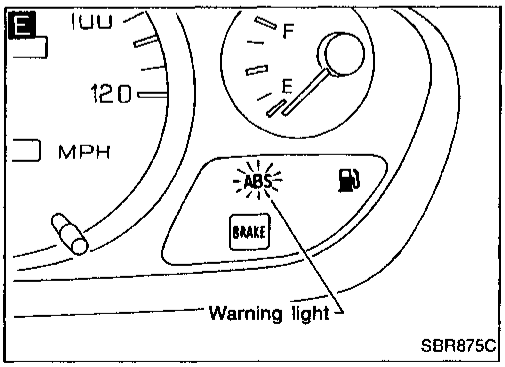
Preliminary Check











A

Check brake fluid level in reservoir tank.

Low fluid level may indicate brake pad wear or leakage from brake line.

B

Check brake line for leakage. — NG → Repair.

OK

C

Check brake booster for operation and air tightness. Refer to (BR-9). — NG → Replace.

OK

D

Check brake pads and rotor. Refer to (BR-11, 14). — NG → Replace.

OK

A

Check brake fluid level in reservoir tank again. — NG → Fill up brake fluid.

OK

E

Check warning light activation. When ignition switch is turned on, warning light turns on. — NG → Check fuse, warning light bulb and warning light circuit.

OK

Check warning light for deactivation after engine is started. — NG → Go to Self-diagnosis (BR-33, 37).

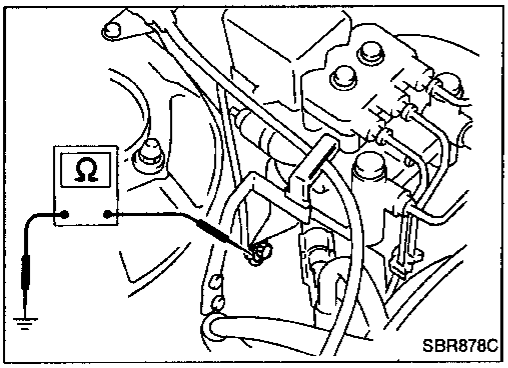
OK

Drive vehicle at speeds over 15 km/h (9 MPH) for at least one minute.

Ensure warning light remains off while driving. — NG → Go to Self-diagnosis (BR-33, 37).

OK

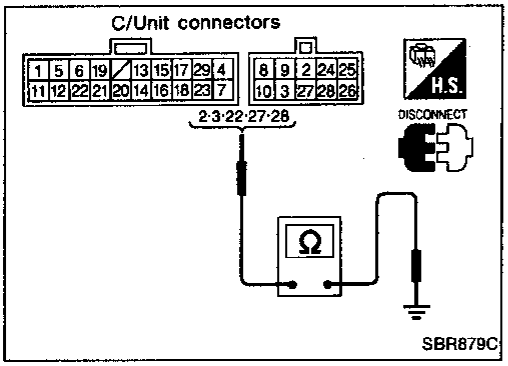
END



Ground Circuit Check

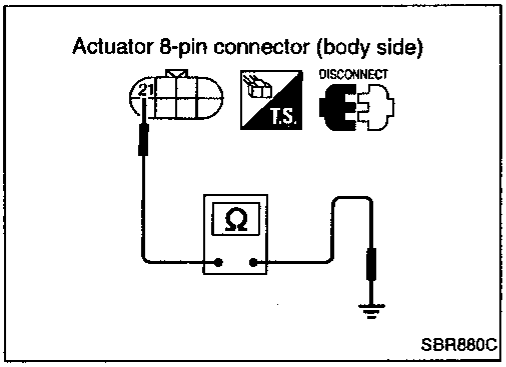
ACTUATOR MOTOR GROUND

- Check resistance between actuator motor ground terminal and body ground.
  Resistance: approximately 0Ω



CONTROL UNIT GROUND

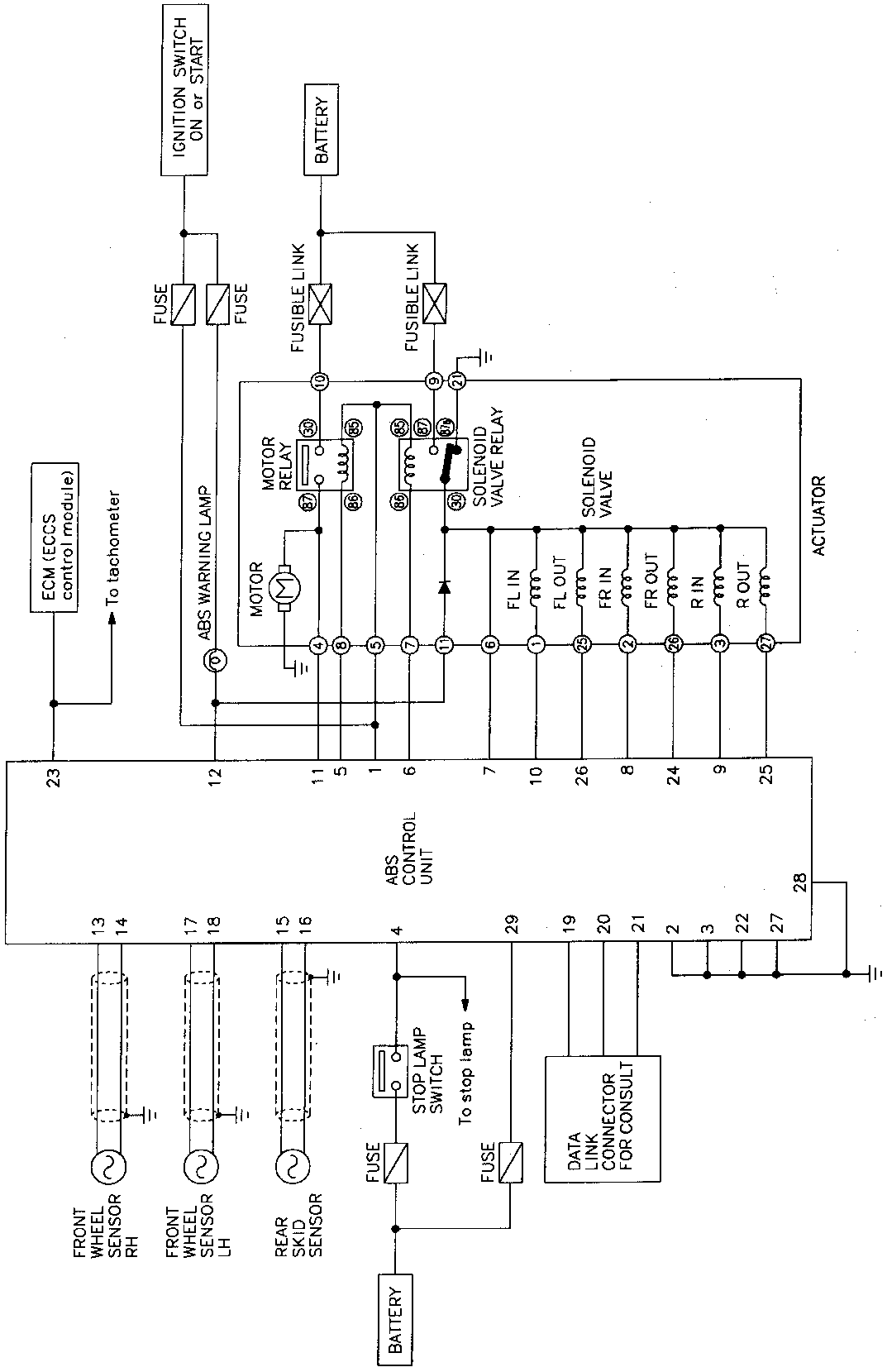
- Check resistance between control unit connector terminals and ground.
  Resistance: approximately 0Ω



ACTUATOR GROUND

- Check resistance between actuator harness 8-pin connector (body side) terminal ㉑ and ground.
  Resistance: approximately 0Ω

Circuit Diagram for Quick Pinpoint Check



MBR090A

Diagnostic Procedure 1 (Not self-diagnostic item)

Warning lamp does not work when ignition switch is turned ON.

WARNING LAMP CIRCUIT CHECK

Check 7.5A fuse [2] for warning lamp. For fuse layout, refer to POWER SUPPLY ROUTING in EL section.

NG → Replace fuse.

OK ↓

A

- Install 7.5A fuse.
- Disconnect connectors from control unit and actuator.
- Check voltage between control unit connector terminal ⑫ and ground after turning ignition switch "ON".

Battery voltage should exist after turning ignition switch "ON".

NG → Check warning lamp bulb.

NG → Replace bulb.

OK → Repair harness and connectors between battery and control unit connector terminal ⑫ (including combination meter).

OK ↓

B

- Turn ignition switch "OFF". Disconnect actuator 6-pin connector.
- Check continuity between control unit connector terminal ⑫ and actuator 6-pin connector (body side) terminal ⑪.

Continuity should exist.

NG → Repair harness and connectors between warning lamp (combination meter) and actuator 6-pin connector (body side) terminal ⑪.

OK ↓

C

- Disconnect actuator 8-pin connector.
- Check continuity between actuator harness 8-pin connector (body side) terminal ㉑ and body ground.

Continuity should exist.

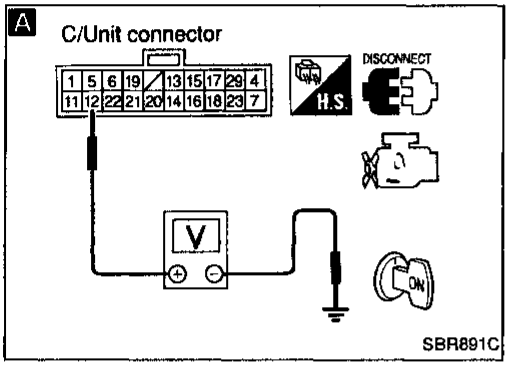
NG → Repair harness and connectors.

OK ↓

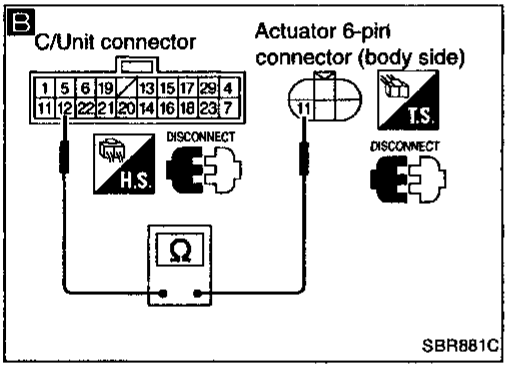
Ⓐ

(Go to next page.)

A



B



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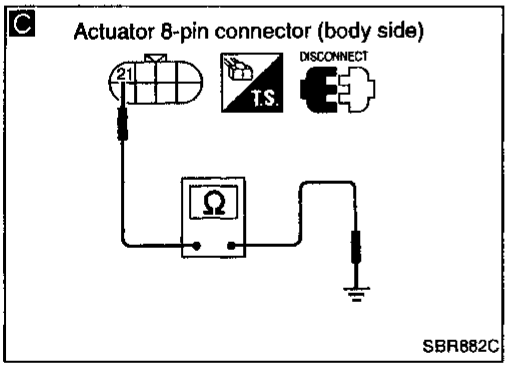
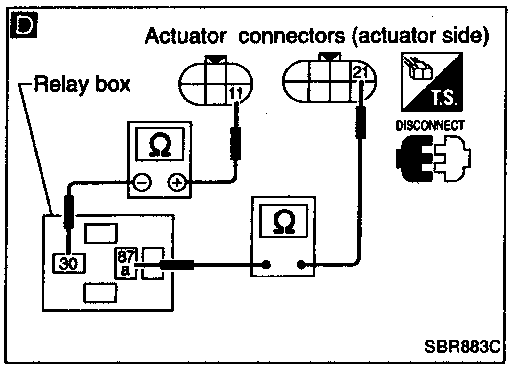


Diagnostic Procedure 1 (Not self-diagnostic item) (Cont'd)



Ⓐ

D

- Disconnect solenoid valve relay.
- Check continuity between actuator connector (actuator side) terminals and solenoid valve relay box terminals.

Actuator	Relay box
11 ⊕	30 ⊖
21	87a

Continuity should exist.
Note: Pay attention to tester polarity*.

NG → Replace actuator assembly.

OK ↓

CHECK SOLENOID VALVE RELAY.

Refer to SOLENOID VALVE RELAY in Electrical Components Inspection (BR-64).

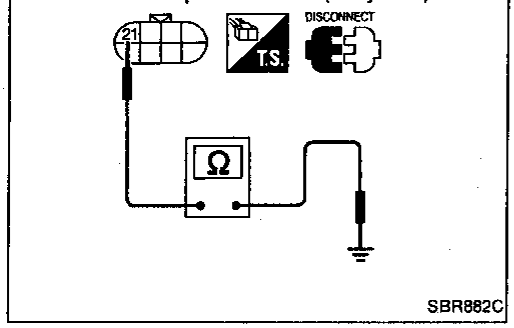
NG → Replace solenoid valve relay.

OK ↓

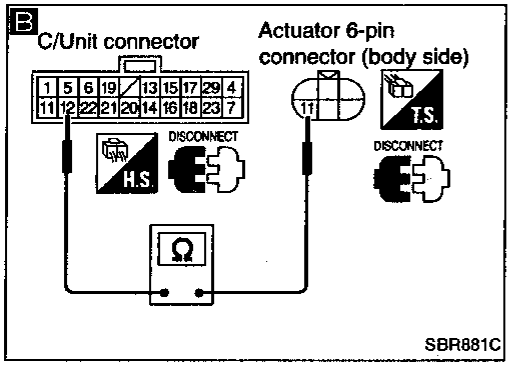
Go to D in Diagnostic Procedure 2.

***: Specifications may vary depending on the type of tester. Before performing this inspection, refer to the instruction manual of the tester.**

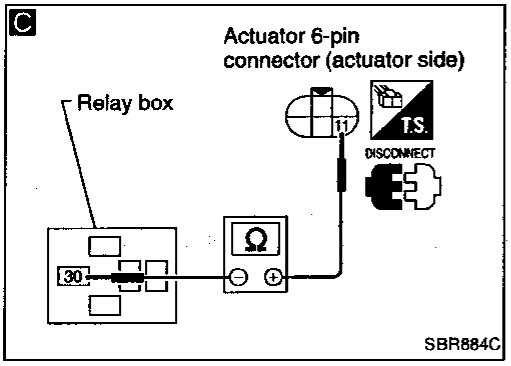
A



B



C



Diagnostic Procedure 2

CONTROL UNIT OR GROUND CIRCUIT

(Malfunction code No. 45, 46, 77, LED deactivation or continuous activation)

- Disconnect connectors from control unit and actuator. Check terminals for damage or connection. Then reconnect connectors.
- Carry out self-diagnosis again.

Does warning light activate again?

No → Inspection end

Yes ↓

SOLENOID VALVE RELAY CHECK

Refer to SOLENOID VALVE RELAY in Electrical Components Inspection (BR-64).

NG → Replace solenoid valve relay.

OK ↓

A

SOLENOID VALVE RELAY GROUND CIRCUIT

- Disconnect actuator 8-pin connector.
- Check continuity between actuator 8-pin connector (body side) terminal ㉑ and body ground.

Continuity should exist.

NG → Repair harness and connectors.

OK ↓

B

- Disconnect control unit connectors and actuator 6-pin connector.
- Check continuity between control unit connector terminal ⑫ and actuator 6-pin connector (body side) terminal ⑪.

Continuity should exist.

NG → Repair harness and connectors.

OK ↓

C

- Check continuity between actuator 6-pin connector (actuator side) terminal ⑪ and solenoid valve relay box terminal ㉚.

Actuator	Relay box	Continuity
11 ⊕	30 ⊖	Yes
11 ⊖	30 ⊕	No

Note: Pay attention to tester polarity*.

NG → Replace actuator assembly.

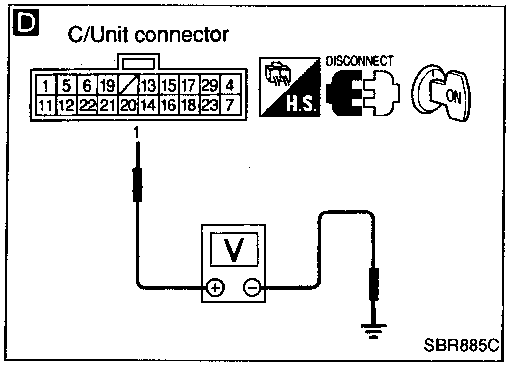
OK ↓

Ⓐ

(Go to next page.)

***: Specifications may vary depending on the type of tester. Before performing this inspection, refer to the instruction manual of the tester.**

Diagnostic Procedure 2 (Cont'd)



Ⓐ

D

CONTROL UNIT POWER SUPPLY CIRCUIT

- Check voltage between control unit connector terminal ① and body ground after turning ignition switch "ON".
  Battery voltage should exist after turning ignition switch "ON".

NG → Check 10A fuse [26] for control unit. For fuse layout, refer to POWER SUPPLY ROUTING in EL section.

NG → Replace fuse.

OK → Repair harness and connectors.

OK

CONTROL UNIT GROUND CIRCUIT

Refer to CONTROL UNIT GROUND in Ground Circuit Check (BR-44).

NG → Repair harness and connectors.

OK

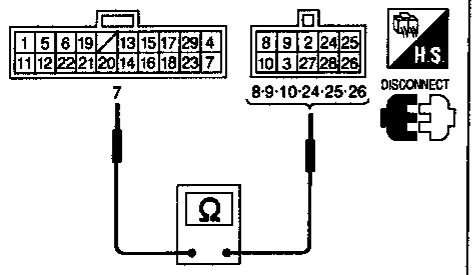
Go to Diagnostic Procedure 4 (BR-51).

OK

Replace ABS control unit.

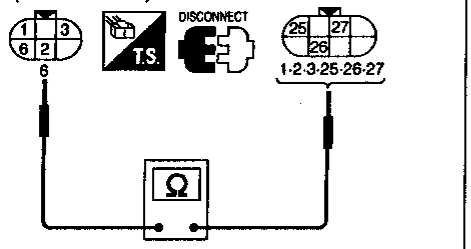
A

C/Unit connectors



B

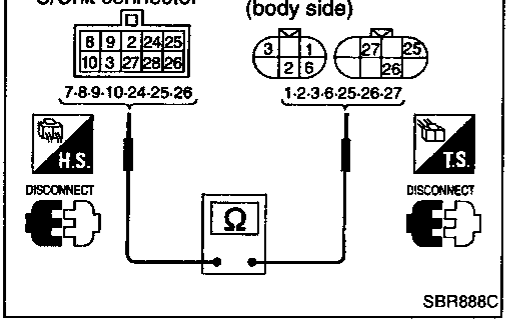
Actuator connectors (actuator side)



C

C/Unit connector

Actuator connectors (body side)



Diagnostic Procedure 3

ACTUATOR SOLENOID VALVE (Malfunction code No. 11 - 13, 15 - 17, 21 - 23, 25 - 27)

- Disconnect connectors from control unit and actuator. Check terminals for damage or loose connection. Then reconnect connectors.
- Carry out self-diagnosis again. **Does warning light activate again?**

No → Inspection end

Yes

A

ACTUATOR SOLENOID VALVE CHECK

OK → Replace control unit.

- Disconnect control unit connectors.
- Check resistance between control unit connector terminals.

Code No. (LED flashes.)	Terminals
11, 21	⑦ - ⑧
12, 22	⑦ - ⑩
13, 23	⑦ - ⑨
15, 25	⑦ - ㉔
16, 26	⑦ - ㉖
17, 27	⑦ - ㉕

Resistance: 3.7 - 8.0Ω

NG

B

- Disconnect actuator connectors.
- Check resistance between actuator connector (actuator side) terminals.

NG → Replace actuator.

Code No. (LED flashes.)	Terminals
11, 21	⑥ - ②
12, 22	⑥ - ①
13, 23	⑥ - ③
15, 25	⑥ - ㉖
16, 26	⑥ - ㉕
17, 27	⑥ - ㉗

Resistance: 3.7 - 8.0Ω

OK

C

- Check continuity between control unit connector terminals and actuator connector (body side) terminals.

NG → Repair harness and connector.

Code No. (LED flashes.)	Control unit	Actuator
11, 21	⑧	②
12, 22	⑩	①
13, 23	⑨	③
15, 25	㉔	㉖
16, 26	㉖	㉕
17, 27	㉕	㉗
42	⑦	⑥

Continuity should exist.

OK

Ⓐ

(Go to next page.)

Diagnostic Procedure 3 (Cont'd)

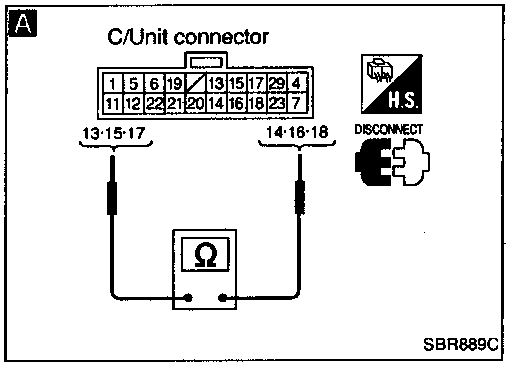
Ⓐ

- Carry out self-diagnosis again. **Does the malfunction code No. indicate actuator solenoid valve?**

Yes → Go to D in Diagnostic Procedure 2.

No ↓

Go to applicable diagnostic procedure for malfunction code No.



Diagnostic Procedure 4

WHEEL SENSOR OR ROTOR

(Malfunction code No. 01 - 03, 05 - 07)

- Disconnect connectors from control unit and wheel sensor of malfunction code No. Check terminals for damage or loose connection. Then reconnect connectors.
- Carry out self-diagnosis again. **Does warning light activate again?**

No → Inspection end

Yes ↓

A

WHEEL SENSOR ELECTRICAL CHECK

OK → Ⓐ (See next page.)

- Disconnect control unit connector.
- Check resistance between control unit connector terminals.
  Code No. 01 or 05 (Front RH wheel)
  Terminals ⑬ and ⑭
  Code No. 02 or 06 (Front LH wheel)
  Terminals ⑰ and ⑱
  Code No. 03 or 07 (Rear wheel)
  Terminals ⑮ and ⑯
  Resistance: 0.6 - 3.3 kΩ

Note: If the result is OK, check it again while moving sensor harness.

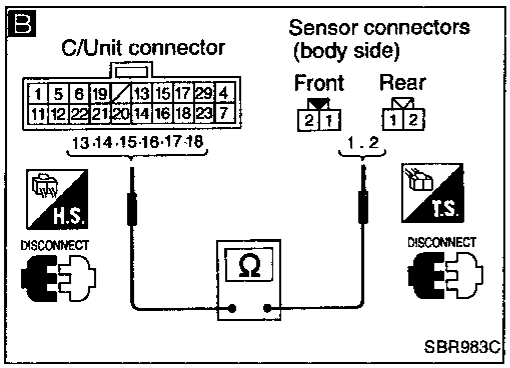
NG ↓

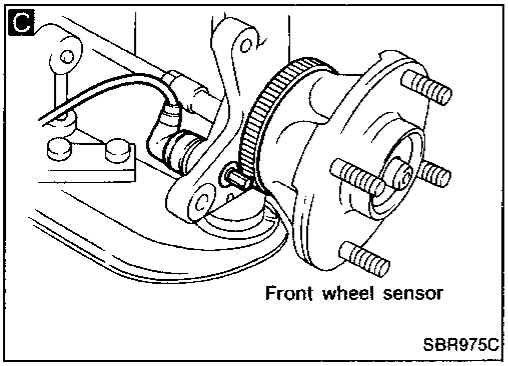
Ⓑ

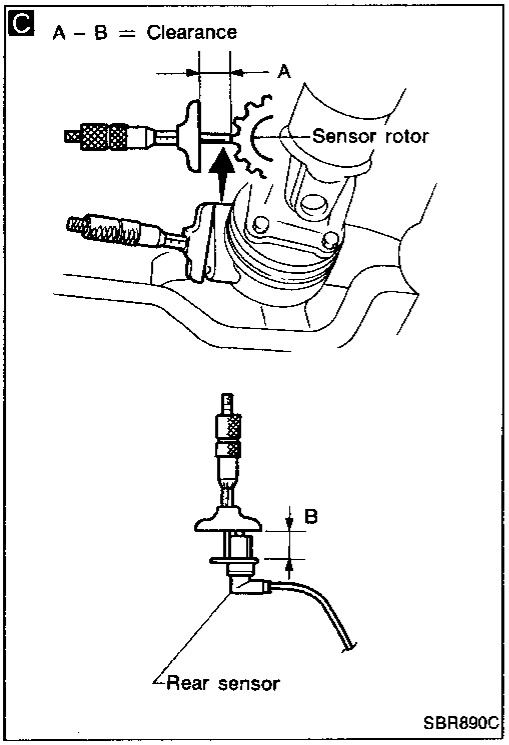
(Go to next page.)

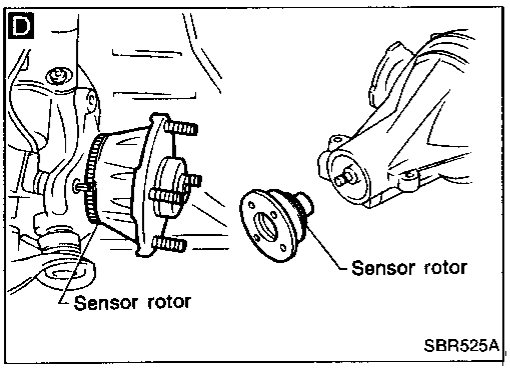
Note: Wheel position should be distinguished by code No. (LED flashes).

Diagnostic Procedure 4 (Cont'd)









Ⓑ

B

- Disconnect wheel sensor connector.
- Check continuity between control unit connector terminals and wheel sensor connector (body side) terminals.

Code No. (LED flashes.)	Control unit	Wheel sensor
01, 05 (Front RH)	⑬	①
	⑭	②
02, 06 (Front LH)	⑰	①
	⑱	②
03, 07 (Rear)	⑮	②
	⑯	①

Continuity should exist.

OK → Note: CHECK WHEEL SENSOR. Refer to WHEEL SENSOR in Electrical Components Inspection (BR-64).

NG → Note: Repair harness and connectors between control unit connector and wheel sensor connector.

Ⓐ

C Note

WHEEL SENSOR MECHANICAL CHECK

Check for any foreign materials and clearance between sensor and rotor.

Clearance:

Front

Make sure the sensor is installed of minimum clearance.

Rear

0.31 - 0.82 mm

(0.0122 - 0.0323 in)

NG → Note: Clean sensor fixing portion, reinstall or replace sensor.

OK

D Note

Check sensor rotor for teeth damage.

NG → Note: Replace sensor rotor.

OK

- Carry out self-diagnosis again. **Does the malfunction code No. (LED flashes) indicate wheel sensor?**

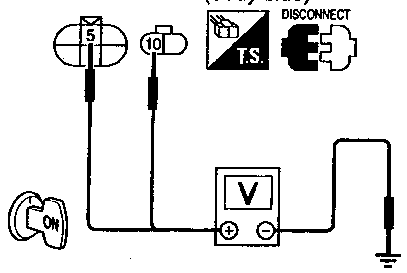
Yes → Go to **D** in Diagnostic Procedure 2.

No → Go to applicable diagnostic procedure for malfunction code No. (LED flashes).

Note: Wheel position should be distinguished by code No. (LED flashes).

A

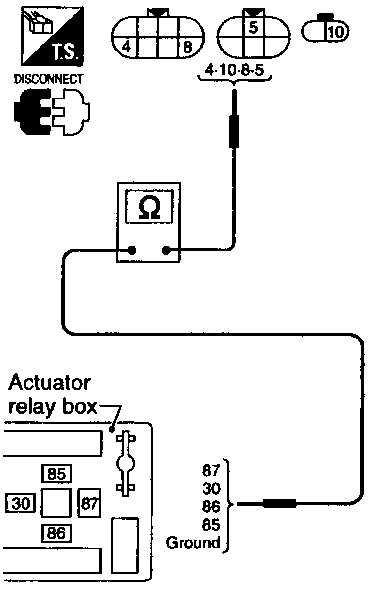
Actuator connectors (body side)



SBR892C

B

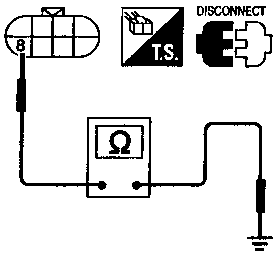
Actuator connectors (actuator side)



SBR893C

C

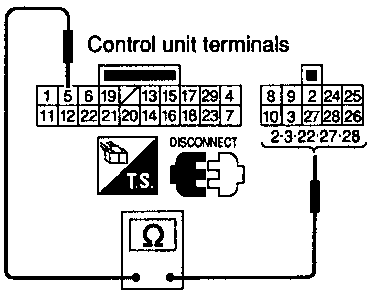
Actuator connector (body side)



SBR900C

D

Control unit terminals



SBR901C

Diagnostic Procedure 5

MOTOR RELAY OR MOTOR

(Malfunction code No. 43, 44)

MOTOR POWER SUPPLY CIRCUIT

- Check 30A fusible link [d] and 10A fuse [26] for actuator. For fusible link and fuse layout, refer to POWER SUPPLY ROUTING in EL section.

NG → Ⓑ (Skip page.)

OK ↓

- Disconnect connectors from control unit and actuator. Check terminals for damage or loose connection. Then reconnect connectors.
- Carry out self-diagnosis again.
  Does warning light activate again?

No → Inspection end

Yes ↓

A

- Disconnect actuator connectors.
- Check voltage between connector (body side) terminals and ground.

Terminals	Ignition switch
⑤ - ground	ON position
⑩ - ground	—

Battery voltage should exist.

NG → Repair harness and connectors between battery and actuator connector (body side) terminals.

OK ↓

B

MOTOR RELAY CIRCUIT

- Remove motor relay.
- Disconnect actuator connectors.
- Check continuity between actuator connector (actuator side) terminals and relay connector terminals or body ground.

Actuator connector	Relay connector	Continuity
④	⑰	Yes
⑩	㉚	Yes
⑧	㊻	Yes
⑤	㊺	Yes
④	Ground	No

NG → Replace actuator assembly.

OK ↓

C

- Check continuity between actuator connector (body side) terminal ⑧ and ground.
  Continuity should not exist.

OK → Ⓐ (Go to next page.)

NG ↓

D

- Disconnect control unit connectors.
- Check continuity between control unit terminals (control unit side) ⑤ and ②, ③, ㉒, ㉗, ㉘.
  Continuity should not exist.

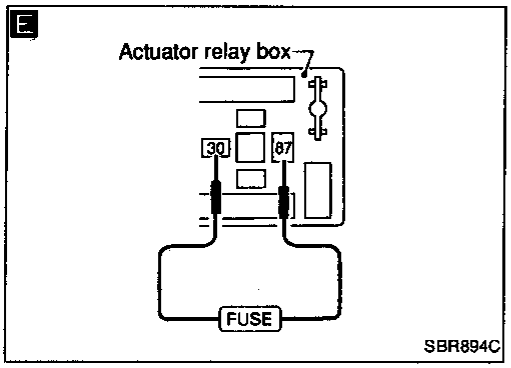
OK → Repair harness and connectors.

NG ↓

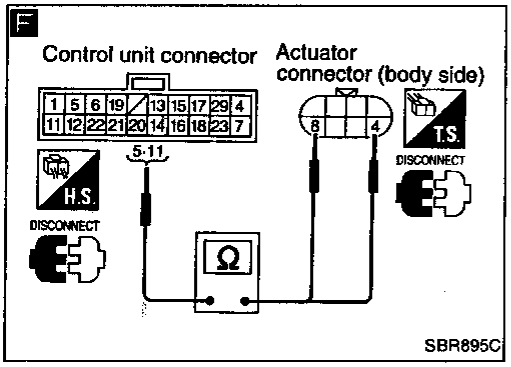
Replace control unit.

Diagnostic Procedure 5 (Cont'd)

E



F



Ⓐ

E

MOTOR CHECK

- Connect actuator connectors.
- Connect suitable wire between relay connector terminals ⑰ and ㉚.

Motor should operate.

Do not connect wire for more than 5 seconds.

NG → Check actuator motor ground (Refer to BR-44).

NG → Repair harness and terminals.

OK → Replace actuator assembly.

OK

MOTOR RELAY CHECK

Refer to MOTOR RELAY in Electrical Components Inspection (BR-64).

NG → Replace motor relay.

OK

F

CIRCUIT CHECK

- Disconnect control unit connector.
- Check continuity between control unit connector terminals and actuator connector (body side) terminals.

Control unit	Actuator
⑤	⑧
⑪	④

Continuity should exist.

NG → Repair harness and connectors.

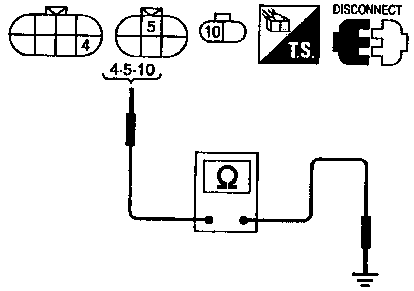
OK

Go to D in Diagnostic Procedure 2.

Diagnostic Procedure 5 (Cont'd)

G

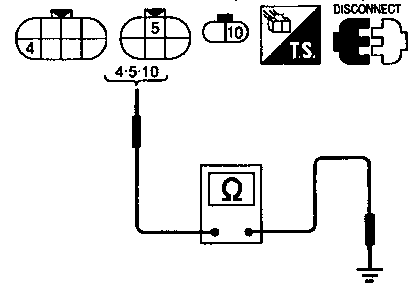
Actuator connectors (body side)



SBR896C

H

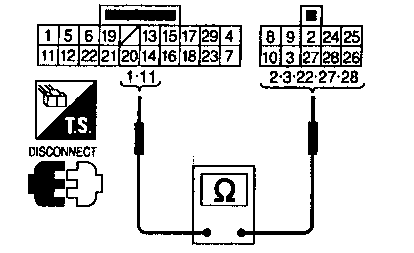
Actuator connectors (actuator side)



SBR898C

I

Control unit terminals



SBR899C

Ⓑ

- Replace fusible link or fuse.
  Is it blown out when it is replaced or ignition switch is turned "ON"?

No → Inspection end

Yes

G

MOTOR POWER SUPPLY CIRCUIT

NG → Repair harness and connector.

- Disconnect connectors from actuator and control unit.
- Check continuity between actuator connector (body side) terminals and ground.

Fuse/Fusible link	Terminals
Fusible link d	④ - ground ⑩ - ground
Fuse 26	⑤ - ground

Continuity should not exist.

OK

H

- Remove motor ground.
- Check continuity between actuator connector (actuator side) terminals and ground.

NG → Replace actuator assembly.

Fuse/Fusible link	Terminals
Fusible link d	④ - ground ⑩ - ground
Fuse 26	⑤ - ground

Continuity should not exist.

OK

I

- Check continuity between control unit terminals.

NG → Replace control unit.

Fuse/Fusible link	Terminals
Fusible link d	⑪ - ②, ③, ㉒, ㉗, ㉘
Fuse 26	① - ②, ③, ㉒, ㉗, ㉘

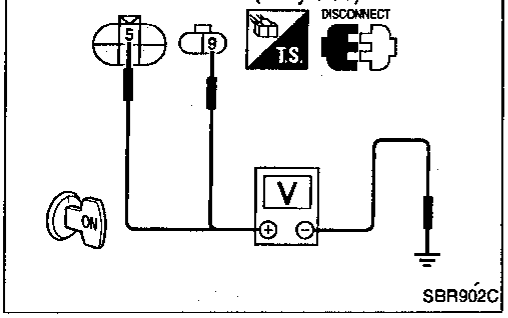
Continuity should not exist.

OK

Replace actuator assembly.

A

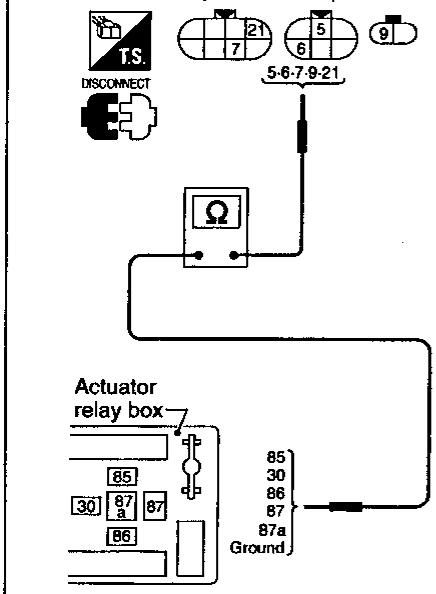
Actuator connectors (body side)



SBR902C

B

Actuator connectors (actuator side)



SBR903C

Diagnostic Procedure 6

SOLENOID VALVE RELAY

(Malfunction code No. 41, 42)

SOLENOID VALVE POWER SUPPLY CHECK

- Check 30A fusible link [c] and 10A fuse [26] for actuator. For fusible link and fuse layout, refer to POWER SUPPLY ROUTING in EL section.

NG → Ⓑ (See next page.)

OK ↓

- Disconnect connectors from control unit and actuator. Check terminals for damage or loose connection. Then reconnect connectors.
- Carry out self-diagnosis again.

Does warning light activate again?

No → Inspection end

Yes ↓

A

SOLENOID VALVE POWER SUPPLY CHECK

- Disconnect connectors from actuator.
- Check voltage between actuator 2-pin connector (body side) terminals and ground.

Terminals	Ignition switch
⑤ - ground	ON position
⑨ - ground	—

Battery voltage should exist.

NG → Repair harness and connector.

OK ↓

SOLENOID VALVE RELAY CHECK

Refer to SOLENOID VALVE RELAY in Electrical Components Inspection (BR-64).

NG → Replace solenoid valve relay.

OK ↓

B

SOLENOID VALVE RELAY CIRCUIT CHECK

Check continuity between relay terminals and actuator connector (actuator side) terminals.

Relay terminals	Connector terminals	Continuity
㉚	⑥	Yes
㉗	⑨	Yes
(87a)	㉑	Yes
㉖	⑦	Yes
㉕	⑤	Yes
Ground	⑦	No

NG → Replace actuator.

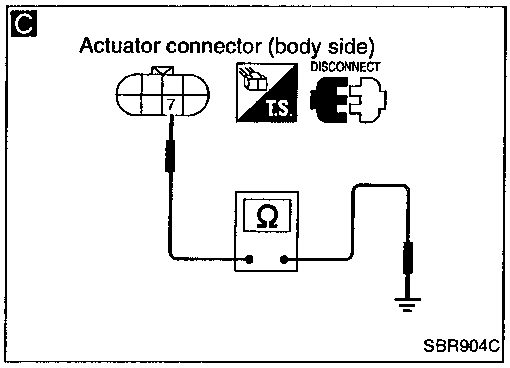
OK ↓

Ⓐ

(Go to next page.)

Diagnostic Procedure 6 (Cont'd)

C



Ⓐ

C

- Check continuity between actuator connector (body side) terminal ⑦ and ground.
  Continuity should not exist.

OK → Ⓒ (See below.)

NG

D

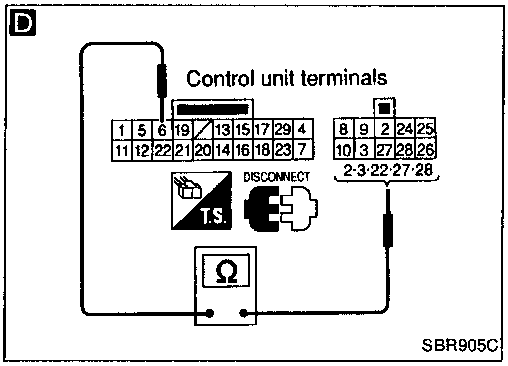
- Disconnect control unit connectors.
- Check continuity between control unit terminals (control unit side) ⑥ and ②, ③, ㉒, ㉗, ㉘.
  Continuity should not exist.

OK → Repair harness and connectors.

NG

Replace control unit.

D



Ⓒ

E

CIRCUIT CHECK

- Disconnect control unit connector.
- Check continuity between control unit connector terminals and actuator connector (body side) terminals.

Control unit	Actuator
⑥	⑦
⑦	⑥
Ground	㉑

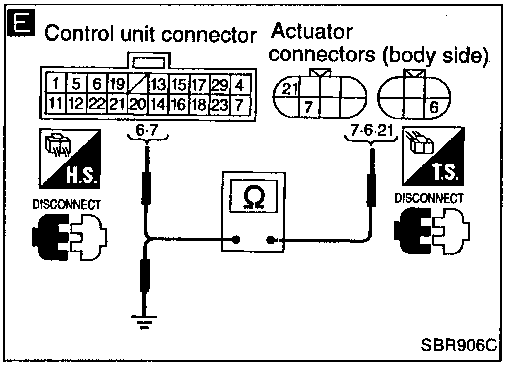
Continuity should exist.

NG → Repair harness and connectors.

OK

Go to D in Diagnostic Procedure 2.

E



Ⓑ

- Replace fusible link or fuse.
  Is it blown out when it is replaced or ignition switch is turned "ON"?

No → Inspection end

Yes

F

ACTUATOR POWER SUPPLY CIRCUIT

- Disconnect connectors from actuator and control unit.
- Check continuity between actuator connector (body side) terminals and ground.

Fuse/Fusible link	Terminals
Fusible link [c]	⑥ - ground
	⑨ - ground
Fuse [26]	⑤ - ground

Continuity should not exist.

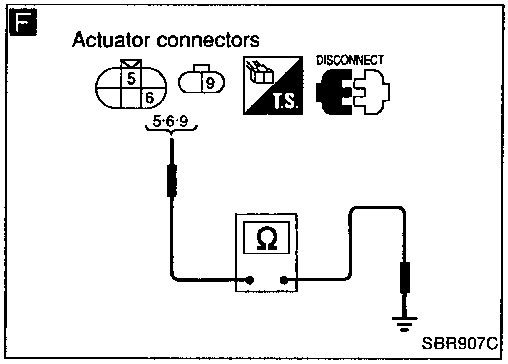
NG → Repair harness and connector.

OK

Ⓓ

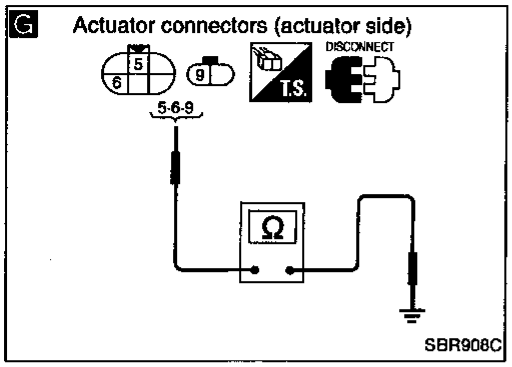
(Go to next page.)

F

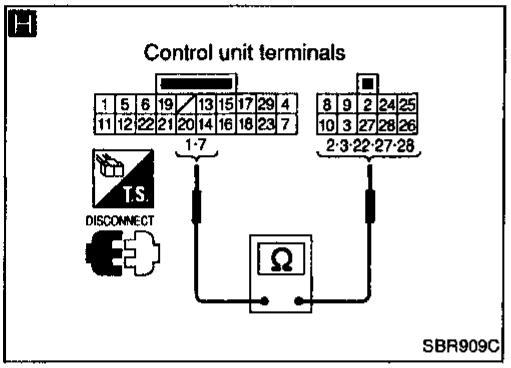


Diagnostic Procedure 6 (Cont'd)

G



H



Ⓓ

G

- Check continuity between actuator connector (actuator side) terminals and ground.

Fuse/Fusible link	Terminals
Fusible link [c]	⑥ - ground ⑨ - ground
Fuse [26]	⑤ - ground

Continuity should not exist.

NG → Replace actuator assembly.

OK ↓

H

- Check continuity between control unit terminals (control unit side).

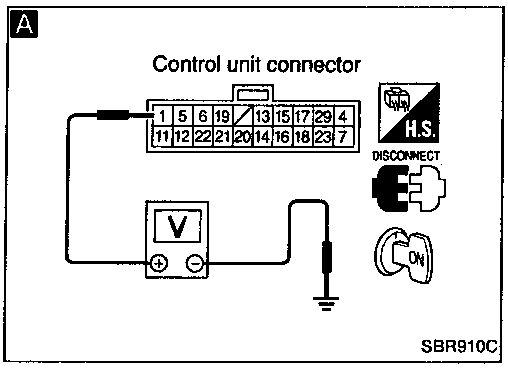
Fuse/Fusible link	Terminals
Fusible link [c]	⑦ - ②, ③, ㉒, ㉗, ㉘
Fuse [26]	① - ②, ③, ㉒, ㉗, ㉘

Continuity should not exist.

NG → Replace control unit.

OK ↓

Replace actuator assembly.



Diagnostic Procedure 7

POWER SUPPLY

(Malfunction code No. 47, 48)

- Disconnect control unit connectors. Check terminals for damage or connection. Then reconnect connectors.
- Carry out self-diagnosis again.

Does warning light activate again?

No → Inspection end

Yes ↓

A

CONTROL UNIT POWER SUPPLY

- Disconnect control unit connectors.
- Check voltage between connector terminal ① and ground when ignition switch is turned ON.

Battery voltage should exist.

NG → Check harness and connectors between battery and control unit connector terminal ①, 10A fuse [26] or battery. For fuse layout, refer to POWER SUPPLY ROUTING in EL section.

OK ↓

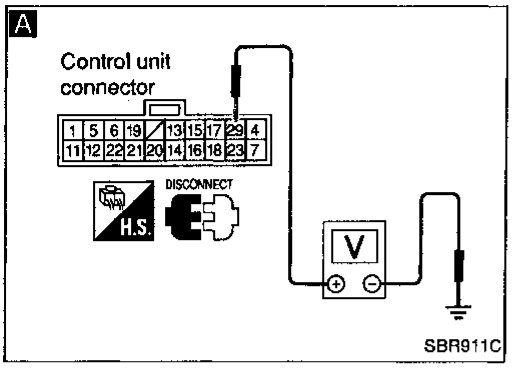
CONTROL UNIT GROUND CIRCUIT

Refer to CONTROL UNIT GROUND in Ground Circuit Check (BR-44).

NG → Repair harness and connectors.

OK ↓

Replace control unit.



Diagnostic Procedure 8

MEMORY VOLT STOP

- Disconnect control unit connectors. Check terminals for damage or loose connection. Then reconnect connectors.
- Turn ignition switch ON and OFF more than two times.
- Carry out self-diagnosis again.

Does warning light activate again?

No → Inspection end

Yes ↓

A

CONTROL UNIT POWER SUPPLY

- Disconnect control unit connectors.
- Check voltage between connector terminal ㉙ and ground.

Battery voltage should exist.

NG → Check harness and connectors between battery and control unit connector terminal ㉙ or 7.5A fuse [8] . For fuse layout, refer to POWER SUPPLY ROUTING in EL section.

OK ↓

CONTROL UNIT GROUND CIRCUIT

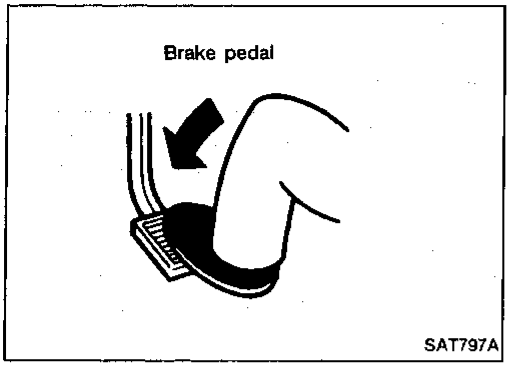
Refer to CONTROL UNIT GROUND in Ground Circuit Check (BR-44).

NG → Repair harness and connectors.

OK ↓

Replace control unit.

Note: MEMORY VOLT STOP is always indicated after disconnecting control unit connector.



Diagnostic Procedure 9

SYMPTOM: Pedal vibration and noise

Check whether the symptom appears only when engine is started.
- Yes → Carry out self-diagnosis. (See page BR-33, 37.)
- No ↓

Check whether the symptom appears when brake is applied gradually under the conditions below.
- Shifting
- Operating clutch
- Passing over bumps/potholes

- Yes → For such conditions, ABS will work due to difference of wheel speeds.
- No ↓

Check if there are any conditions, among those listed below, when symptom appears.
- Low friction road
- High speed cornering
- Passing over bumps/potholes

- Yes → For such conditions, ABS will work due to difference of wheel speeds.
- No ↓

Check whether the symptom appears when engine speed is over 5,000 rpm with vehicle stopped.
- Yes → Vibration related to sensor may cause ABS operation.
- No ↓

Check whether electrical equipment switches are operated.
- No → Go to B in Diagnostic Procedure 11 (BR-62).
- Yes ↓

Check wheel sensor shield ground located under the trunk rear finisher.
- NG → Remedy.
- OK → Replace control unit.

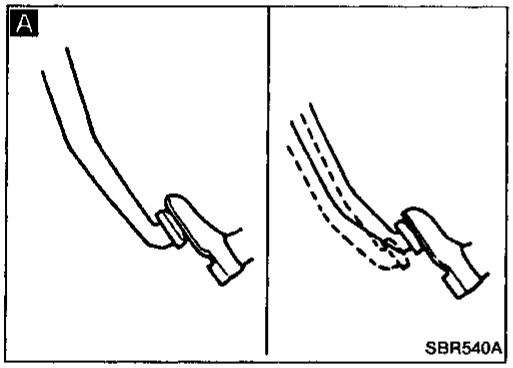
Diagnostic Procedure 10

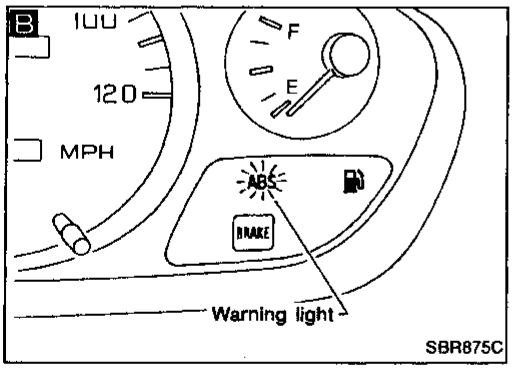
SYMPTOM: Long stopping distance

Check if road condition is slippery with snow or gravel.
- Yes → Stopping distance may be longer than vehicles without ABS.
- No ↓

Disconnect actuator connector and check whether stopping distance is still long.
- No → Go to B in Diagnostic Procedure 11. (See below.)
- Yes ↓

Perform Preliminary Check and air bleeding.





Diagnostic Procedure 11

SYMPTOM: Unexpected pedal action

A

Check whether brake pedal stroke is excessively large.
- Yes → Perform Preliminary Check (BR-43).
- No ↓

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

Disconnect actuator connector and check whether brake is effective.
- No → Perform Preliminary Check (BR-43).
- Yes ↓

B

Ensure warning light remains off while driving.
- NG → Carry out self-diagnosis. (See page BR-33, 37).
- OK ↓

CHECK WHEEL SENSOR.
- NG → Remedy.

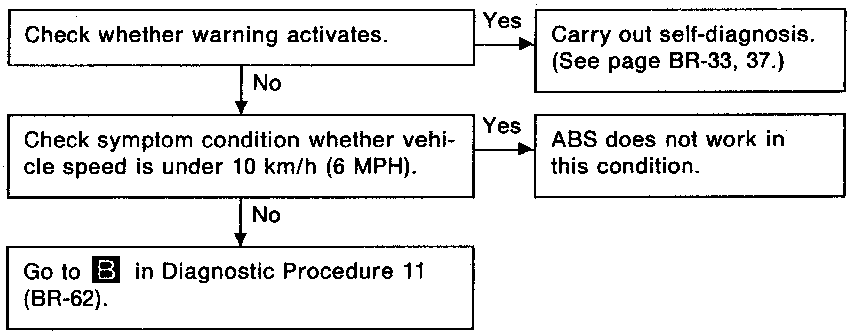
- Check wheel sensor connector for terminal damage or loose connection.
- Perform wheel sensor mechanical check.
  Refer to C and D in Diagnostic Procedure 4. (BR-52)

OK ↓

Replace control unit.

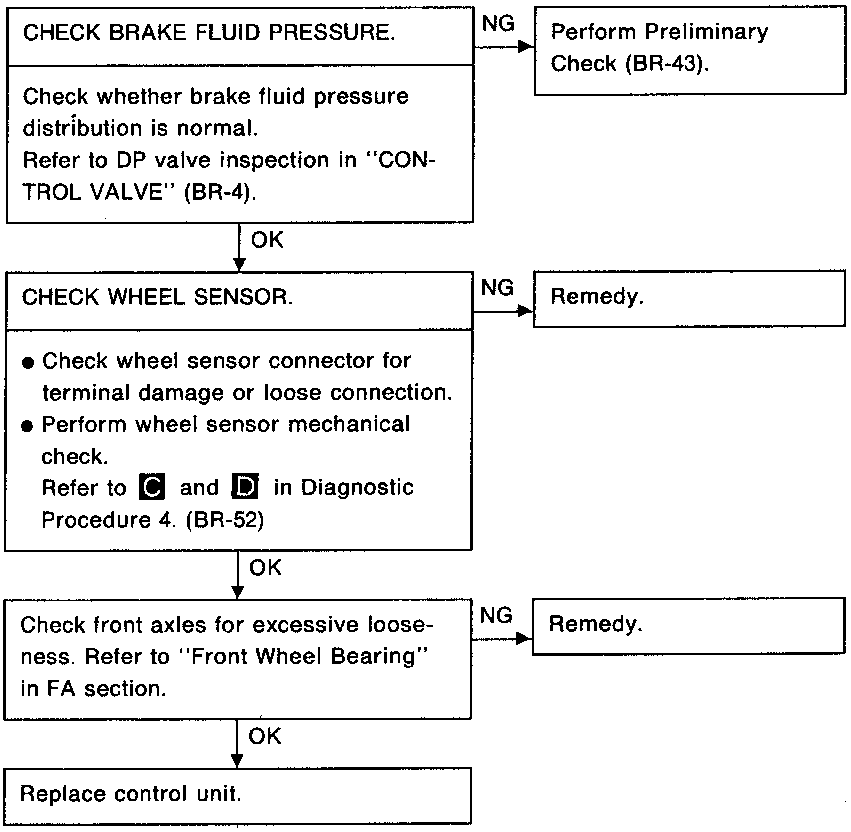
Diagnostic Procedure 12

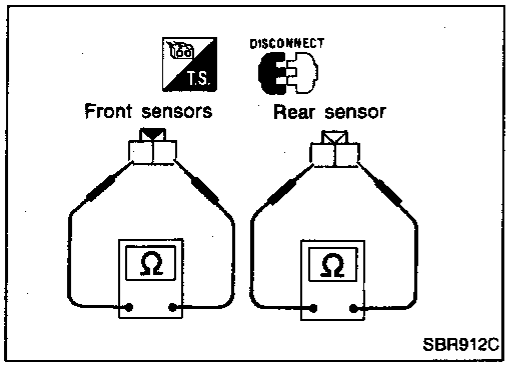
SYMPTOM: ABS does not work.

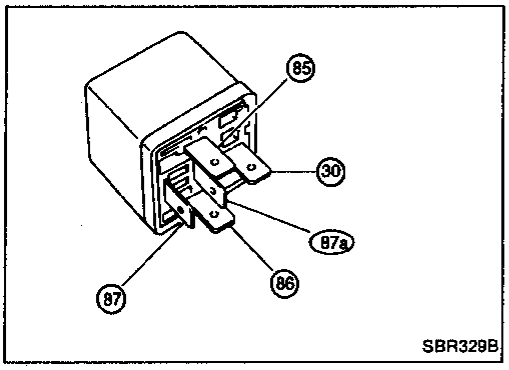


Diagnostic Procedure 13

SYMPTOM: ABS works frequently.







Electrical Components Inspection

WHEEL SENSOR

Check resistance for each sensor.

Resistance: 0.6 - 3.3 kΩ

ACTUATOR MOTOR RELAY AND SOLENOID VALVE RELAY

	Solenoid valve relay	Actuator motor relay solenoid valve relay
Condition	Continuity existence between terminals 30 and 87a	Continuity existence between terminals 30 and 87
Battery voltage not applied between terminals 85 and 86.	Yes	No
Battery voltage applied between terminals 85 and 86.	No	Yes

General Specifications

Front brake	
Brake model	CL22VF disc brake
Cylinder bore diameter mm (in)	54.0 (2.126)
Pad mm (in) Length x width x thickness	112.8 x 44.8 x 10.0 (4.44 x 1.764 x 0.394)
Rotor outer diameter x thickness mm (in)	252 x 20 (9.92 x 0.79)
Rear brake	
Brake model	CL11H disc brake
Cylinder bore diameter mm (in)	38.18 (1.5031)
Pad mm (in) Length x width x thickness	75.0 x 40.0 x 9.5 (2.953 x 1.575 x 0.374)
Rotor outer diameter x thickness mm (in)	258 x 9 (10.16 x 0.35)

Model	Without ABS		With ABS
	M/T	A/T	
Master cylinder			
Cylinder bore diameter mm (in)	22.22 (7/8)	23.81 (15/16)	
Control valve			
Valve model	Proportioning valve (built into master cylinder)		
Split point kPa (kg/cm^2, psi) x reducing ratio	1,961 (20, 284) x 0.4		
Brake booster			
Booster model	M23	M195T	
Diaphragm diameter mm (in)	230 (9.06)	Primary: 205 (8.07) Secondary: 180 (7.09)	
Recommended brake fluid	DOT 3		

Inspection and Adjustment

DISC BRAKE

Brake model	CL22VF	CL11H
Pad wear limit mm (in)		
Minimum thickness	2.0 (0.079)	
Rotor repair limit mm (in)		
Minimum thickness	18.0 (0.709)	8 (0.31)

PARKING BRAKE

Type	Center lever
Number of notches	
[under force of 196 N (20 kg, 44 lb)]	7 - 9
Number of notches	
when warning lamp switch comes on	1

BRAKE PEDAL

Free height "H" mm (in)	
M/T	181 - 191 (7.13 - 7.52)
A/T	191 - 201 (7.52 - 7.91)
Depressed height "D" mm (in)	
[under force of 490 N (50 kg, 110 lb) with engine running]	110 (4.33)
Pedal free play "A" mm (in)	1 - 3 (0.04 - 0.12)
Clearance "C" between pedal stopper and threaded end of stop lamp switch or ASCD switch mm (in)	0.3 - 1.0 (0.012 - 0.039)