SERVICE BRAKES

CONTENTS

BASIC BRAKE SYSTEM

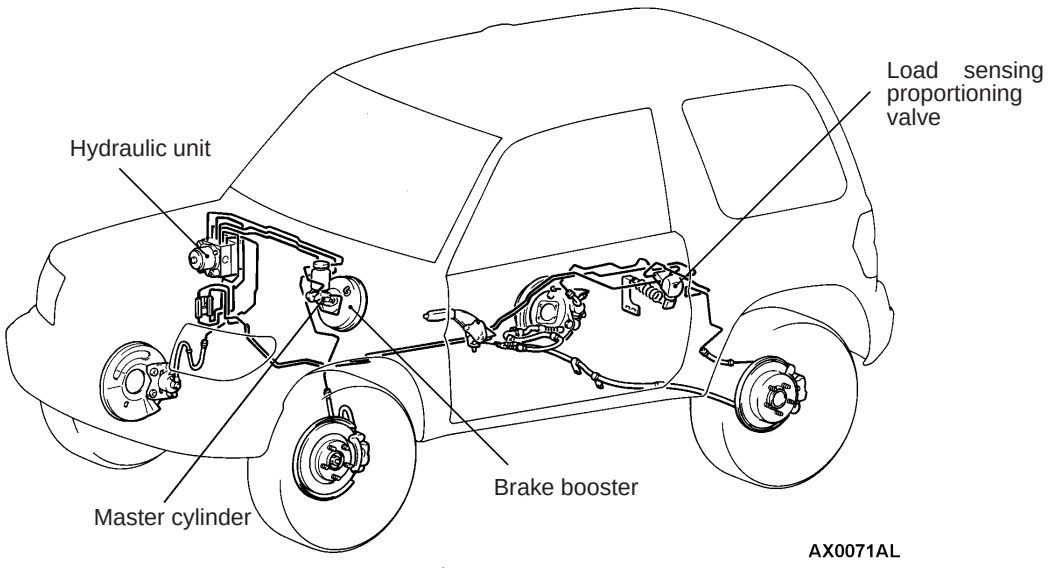
CONTENTS

GENERAL INFORMATION

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

Items		Specifications
Master cylinder	Type	Tandem type
	I.D. mm	22.2
Brake booster	Type	Vacuum type, single
	Effective dia. of power cylinder mm	230
	Boosting ratio	4.5
Load sensing proportioning valve	Type	Dual type
	Decompression ratio	0.25
Front disc brakes	Type	Floating caliper, 1-piston, ventilated disc
	Disc effective dia. × thickness mm	236 × 22
	Wheel cylinder I.D. mm	57.2
	Pad thickness mm	10.0
	Clearance adjustment	Automatic
Rear disc brakes	Type	Floating caliper,1-piston, solid disc
	Disc effective dia. × thickness	222 × 9.4
	Wheel cylinder I.D. mm	34.93
	Pad thickness mm	10.0
	Clearance adjustment	Automatic
Brake fluid		DOT3 or DOT4

CONSTRUCTION DIAGRAM



SERVICE SPECIFICATIONS

Items			Standard value	Limit
Brake pedal height mm	L.H. drive vehicles		201 – 204	–
	R.H. drive vehicles		201.7 – 204.7	–
Brake pedal play mm			3 – 8	–
Brake pedal to floorboard clearance when the brake pedal is depressed mm			105 or more	–
Brake booster push rod protrusion amount mm		L.H. drive vehicles with ABS	22.7 – 22.9	–
		L.H. drive vehicles without ABS and R.H. drive vehicles	23.93 – 24.18	–
Load sensing proportioning valve output fluid pressure (Input fluid pressure) MPa	When load sensing spring length is 199 mm (when unladen)		4.2 – 6.0 (9.8)	–
	When load sensing spring length is 217 mm (when laden)		9.7 – 10.5 (9.8)	–
			14.5 – 16.3 (16.7)	–
	Output fluid pressure difference between left and right MPa		–	0.39
Load sensing spring length <Distance between spring ends> mm			194 – 198	–
Front disc brake	Pad thickness mm		10.0	2.0
	Disc thickness mm		22.0	20.4
	Disc runout mm		–	0.06
	Drag force N		69	–
Rear disc brake	Pad thickness mm		10.0	2.0
	Disc thickness mm		9.4	7.8
	Disc runout mm		–	0.08
	Drag force N		34	–
Front hub end play mm			–	0.2
Rear hub end play mm			–	0.025

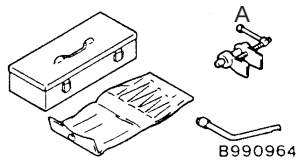
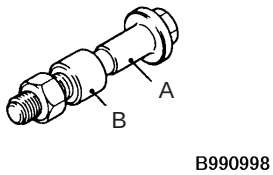
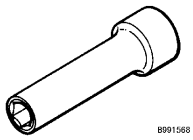
LUBRICANTS

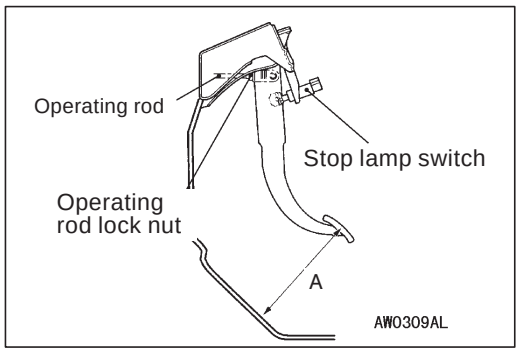
Items	Specified Lubricant	Quantity
Brake fluid	DOT3 or DOT4	As required
Vacuum sensor grommet	Silicone grease	
Brake booster seal		
Piston boot, piston seal	Repair kit grease	
Guide pin, lock pin		
Piston, wheel cylinder body	DOT3 or DOT4	

SEALANT

Items	Specified sealant	Remarks
Fitting	3M ATD Part No. 8661 or equivalent	Semi-drying sealant

SPECIAL TOOLS

Tool	Number	Name	Use
	MB990964 A: MB990520	Brake tool set	Pushing-in of the disc brake piston
	A: MB990998 B: MB991000	A: Front hub remover and installer B: Spacer	When bearing provisional holding MB991000, which belongs to MB990998, should be used as a spacer.
	MB991568	Push rod adjusting socket	Adjustment of the brake booster push rod protrusion amount



ON-VEHICLE SERVICE

BRAKE PEDAL CHECK AND ADJUSTMENT

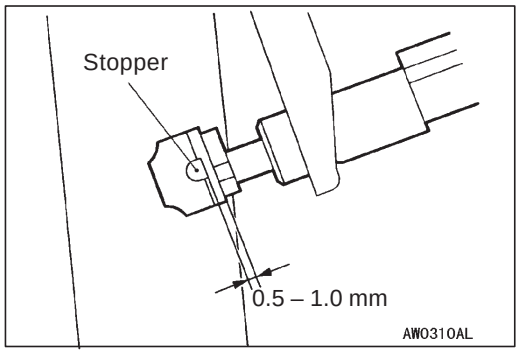
BRAKE PEDAL HEIGHT

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

   Standard value (A):
   <L.H. drive vehicles> 201 – 204 mm
   <R.H. drive vehicles> 201.7 – 204.7 mm

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

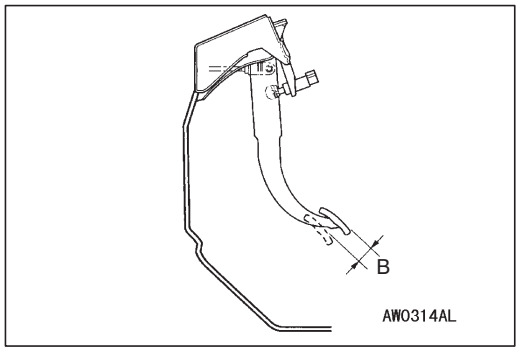
   NOTE
   When the clevis is turned 180°, the pedal height is changed approximately 2.3 mm.



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

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

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

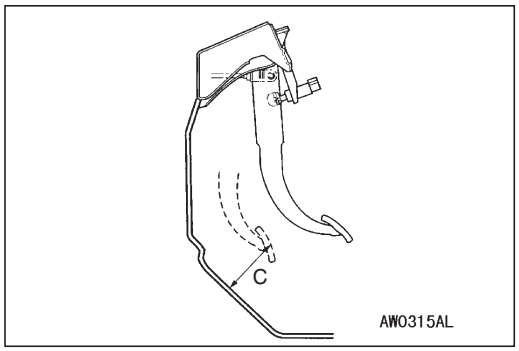


BRAKE PEDAL FREE PLAY

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

   Standard value (B): 3 – 8 mm

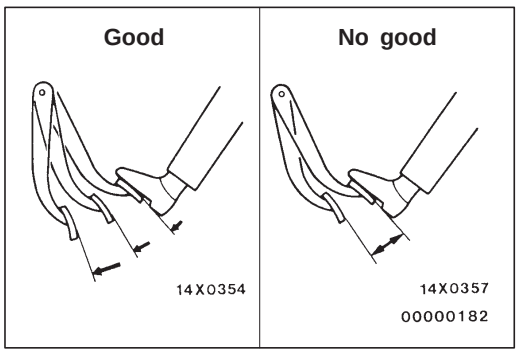
2. If the brake pedal play is not within the standard value, check the following, and adjust or replace if necessary:
   - Excessive play between the brake pedal and the clevis pin, or between the clevis pin and the brake booster operating rod
   - Brake pedal height
   - Installation position of the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



CLEARANCE BETWEEN BRAKE PEDAL AND FLOOR BOARD

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

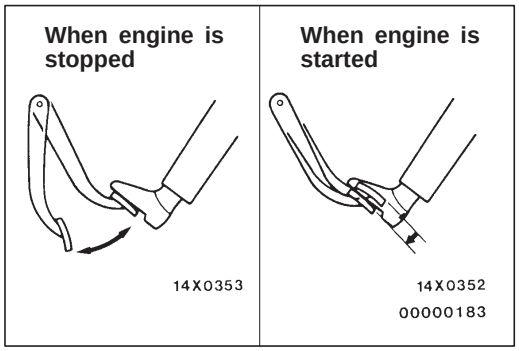
   Standard value (C): 105 mm or more
3. If the clearance is outside the standard value, check for air trapped in the brake line, thickness of the disc brake pad or the drum brake lining and dragging in the parking brake.
   Adjust and replace defective parts as required.
4. Return the carpet, etc.



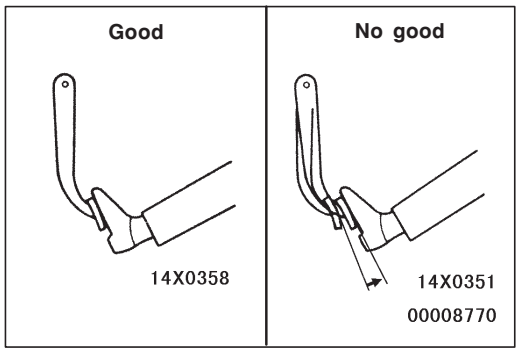
BRAKE BOOSTER OPERATING TEST

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

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



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



3. With the engine running, step on the brake pedal and then stop the engine.
   Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition.
   If the pedal rises, the booster is defective.

If the above three tests are okay, the booster performance can be determined as good.
If one of the above three tests is not okay at least, the check valve, vacuum hose, or booster will be defective.

CHECK VALVE OPERATION CHECK

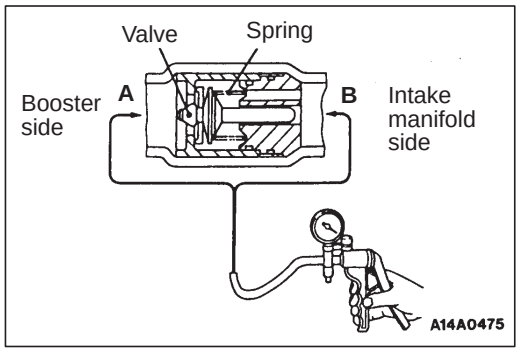
1. Remove the vacuum hose. (Refer to P.35A-15, 16.)

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

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

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

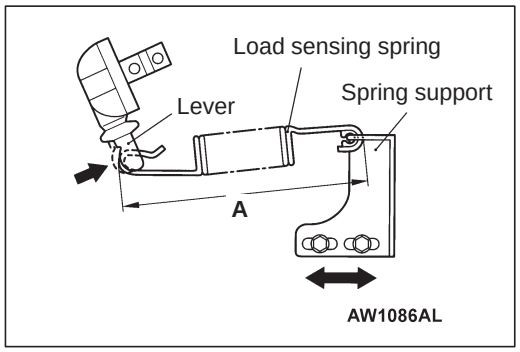
Caution
If the check valve is defective, always replace it as an assembly unit together with the vacuum hose.



LOAD SENSING SPRING LENGTH CHECK AND ADJUSTMENT

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

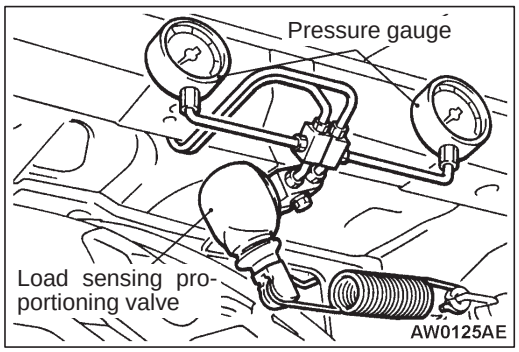
   Caution
   Never support the vehicle with jacks or other similar means.



2. With the lever pressed all the way to the load sensing proportioning valve side, check whether or not the length (shown in the figure) of the spring (the length between its ends) is the standard value.

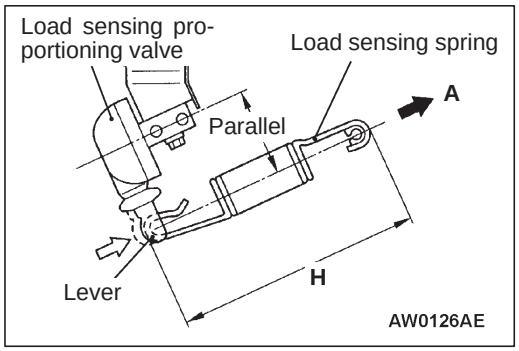
   Standard value (A): 194 – 198 mm

3. If the spring length is not within the standard value, loosen the bolt attaching the support and adjust the distance by moving the support.



LOAD SENSING PROPORTIONING VALVE FUNCTION TEST

1. Connect pressure gauges to the input and output ports of the load sensing proportioning valve.
2. Bleed the system. (Refer to P.35A-10.)
3. Disconnect the spring at the support side.



4. Place the spring so that it is in parallel with the load sensing proportioning valve, and then pull in the direction indicated by arrow A so that its length H shown in the figure (the length between its ends) is as noted below.

   NOTE
   At this time the lever is pressed all the way to the load sensing proportioning valve side.

5. Check at this time whether or not the output fluid's pressure, relative to the load sensing proportioning valve's input fluid pressure, is within the standard value.

   Standard value:

Spring length H mm	Input fluid pressure MPa	Output fluid pressure MPa
199*1	9.8	4.2 – 6.0
217*2	9.8	9.7 – 10.5
	16.7	14.5 – 16.3

   NOTE
   *1 and *2 indicate the applicable lengths for unladen and laden vehicles respectively.

6. Measure each output fluid pressure at both valves, and check that the difference between the two is at the limit value or less.

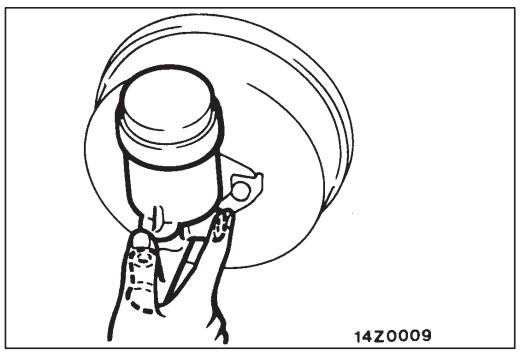
   Limit: 0.39 MPa

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

BLEEDING

Caution

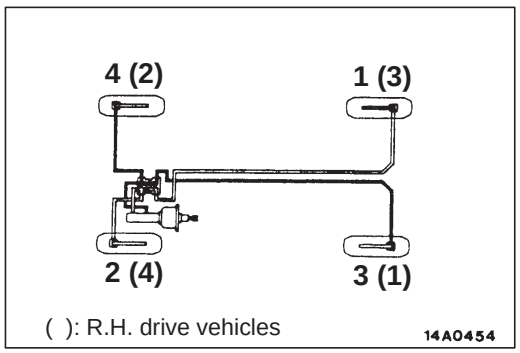
Specified brake fluid: DOT3 or DOT4
Always use the specified brake fluid. Avoid using a mixture of the specified brake fluid and other fluid.



MASTER CYLINDER BLEEDING

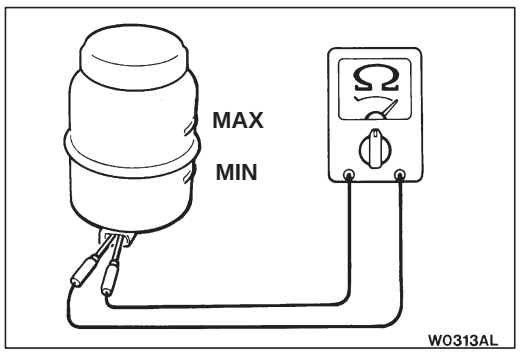
The master cylinder used has no check valve, so if bleeding is carried out by the following procedure, bleeding of air from the brake pipeline will become easier. (When brake fluid is not contained in the master cylinder.)

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



BRAKE PIPE LINE BLEEDING

Bleed the air in the sequence shown in the figure.

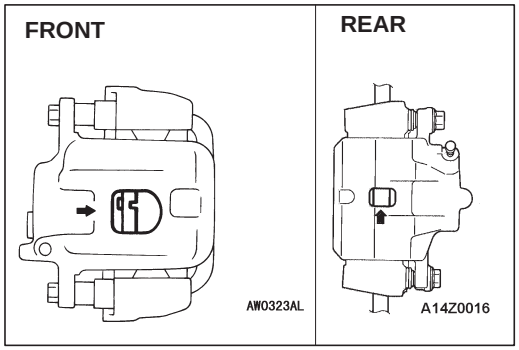


BRAKE FLUID LEVEL SENSOR CHECK

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

DISC BRAKE PAD CHECK AND REPLACEMENT

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

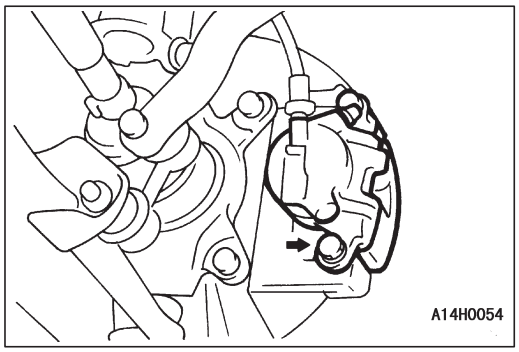


1. Check the brake pad thickness through the caliper body check port.

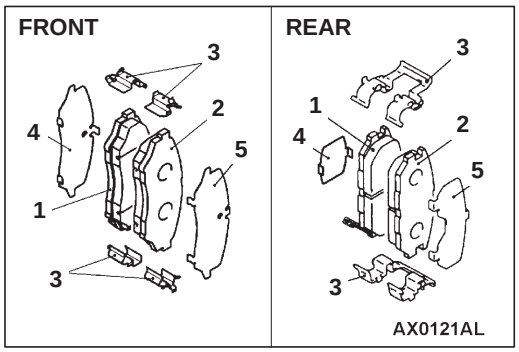
   Standard value: 10.0 mm

   Limit: 2.0 mm

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



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



4. Remove the following parts from the caliper support.
   1. Pad and wear indicator assembly
   2. Pad assembly
   3. Clip
   4. Inner shim
   5. Outer shim

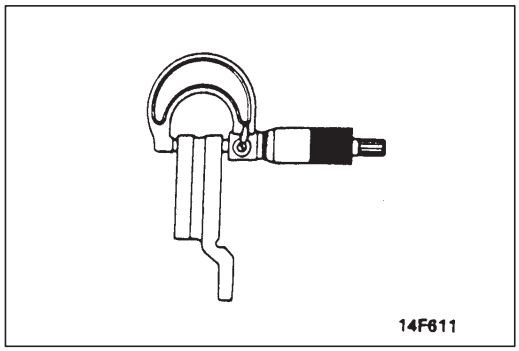
5. In order to measure the brake drag force after pad installation, measure the rotary-sliding resistance of the hub with the pads removed. (Refer to P.35A-20, 25.)
6. Install the pads and caliper assembly, and then check the brake drag force. (Refer to P.35A-21, 26.)

DISC BRAKE ROTOR CHECK

Caution
When servicing disc brakes, it is necessary to exercise caution to keep the disc brakes within the allowable service values in order to maintain normal brake operation.

Before re-finishing or re-processing the brake disc surface, the following conditions should be checked.

Inspection items	Remarks
Scratches, rust, saturated lining materials and wear	● If the vehicle is not driven for a certain period, the sections of the discs that are not in contact with lining will become rusty, causing noise and shuddering. ● If grooves resulting from excessive disc wear and scratches are not removed prior to installing a new pad assembly, there will momentarily be inappropriate contact between the disc and the lining (pad).
Run-out or drift	Excessive run-out or drift of the discs will increase the pedal depression resistance due to piston knock-back.
Change in thickness (parallelism)	If the thickness of the disc changes, this will cause pedal pulsation, shuddering and surging.
Inset or warping (flatness)	Overheating and improper handling while servicing will cause inset or warping.



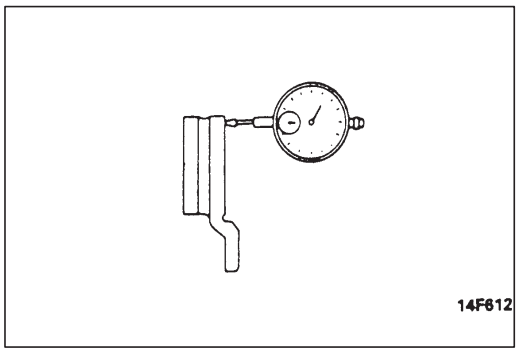
BRAKE DISC THICKNESS CHECK

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

   Brake disc thickness

Item	Standard value	Limit
Front	22.0	20.4
Rear	9.4	7.8

   Thickness variation (at least 8 positions)
   The difference between any thickness measurements should not be more than 0.015 mm.
2. If the disc is beyond the limits for thickness, remove it and install a new one. If thickness variation exceeds the specification, replace the brake disc or grind it with on-the-car type brake lathe (“MAD, DL-8700PF” or equivalent).



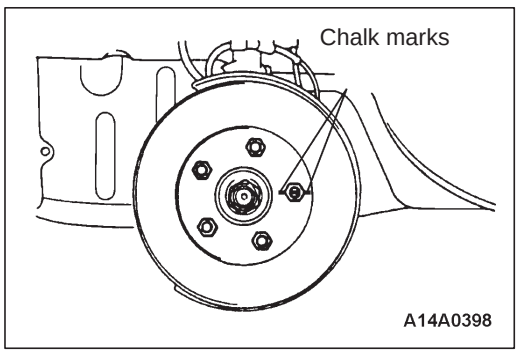
BRAKE DISC RUN-OUT CHECK AND CORRECTION

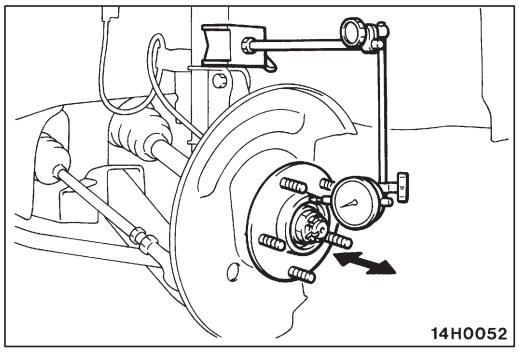
1. Remove the brake assembly, and then hold it with wire.
2. Place a dial gauge approximately 5 mm from the outer circumference of the brake disc, and measure the run-out of the disc.

   Limit: <Front> 0.06 mm or less,
   <Rear> 0.08 mm or less

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

   (1) Chalk phase marks on the wheel stud and the brake disc, which run-out is excessive as shown.





   (2) Remove the brake disc. Then place a dial gauge as shown, and measure the end play by pushing and pulling the wheel hub.

   Limit: <Front> 0.2 mm, <Rear> 0.025 mm

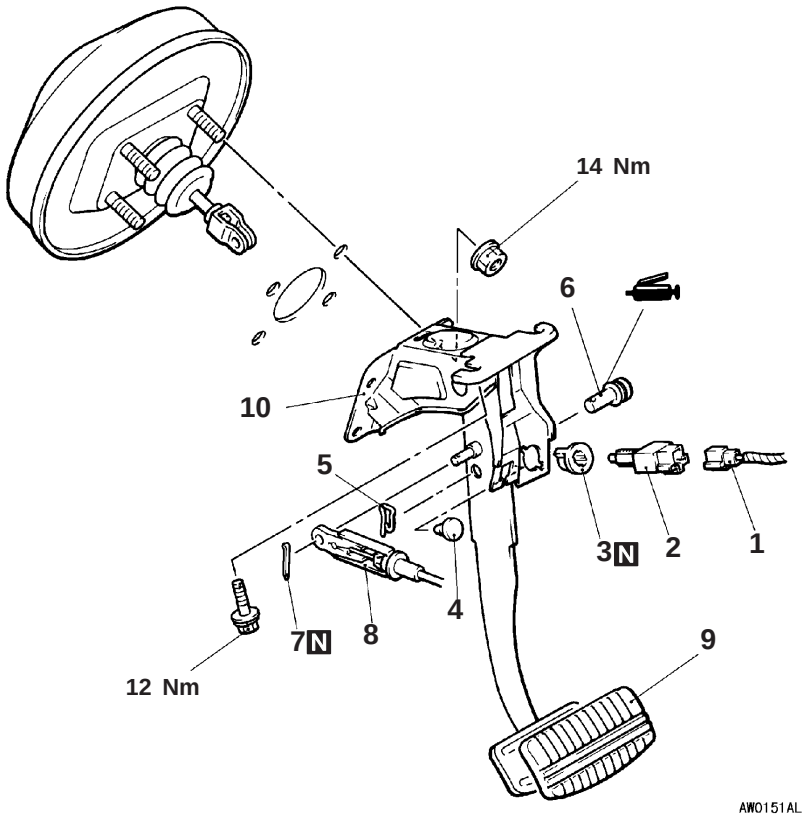
   (3) If the end play exceeds the limit, disassemble the hub and knuckle assembly to check each part.
   (4) If the end play does not exceed the limit, dephase the brake disc and secure it. Then recheck the brake disc run-out.

4. If the run-out cannot be corrected by changing the phase of the brake disc, replace the brake disc or grind it with the on-the-car type brake lathe (”MAD, DL-8700PF” or equivalent).

BRAKE PEDAL

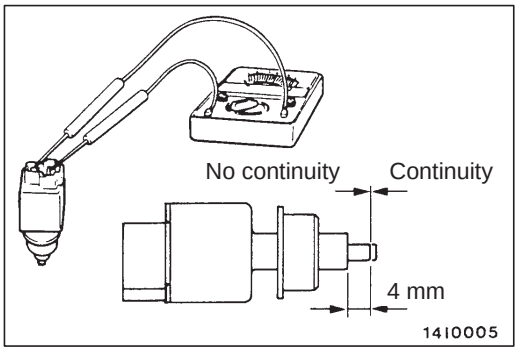
REMOVAL AND INSTALLATION

Post-installation Operation
Brake Pedal Adjustment (Refer to P.35A-6.)



Removal steps

1. Harness connector
2. Stop lamp switch
3. Adjuster
4. Pedal stopper
5. Snap pin
6. Pin assembly
7. Split pin <A/T>
8. Shift lock cable connection <A/T>
9. Pedal pad
10. Brake pedal and pedal support member



INSPECTION

STOP LAMP SWITCH CHECK

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

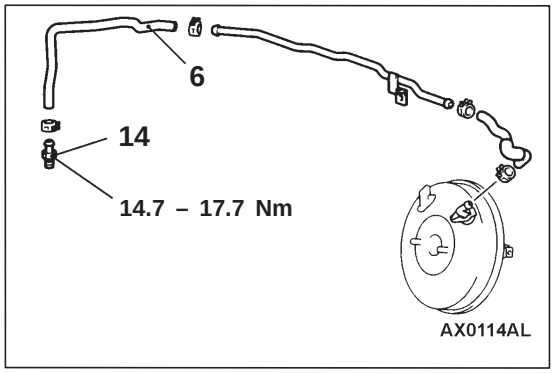
MASTER CYLINDER AND BRAKE BOOSTER

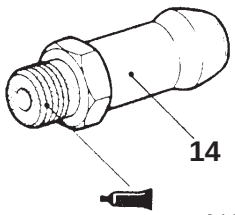
REMOVAL AND INSTALLATION

<L.H. drive vehicles with ABS>

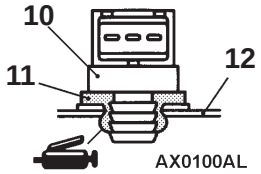
Pre-removal Operation
Brake Fluid Draining

Post-installation Operation
- Brake Fluid Supplying and Air Bleeding (Refer to P.35A-10.)
- Brake Pedal Adjustment (Refer to P.35A-6.)

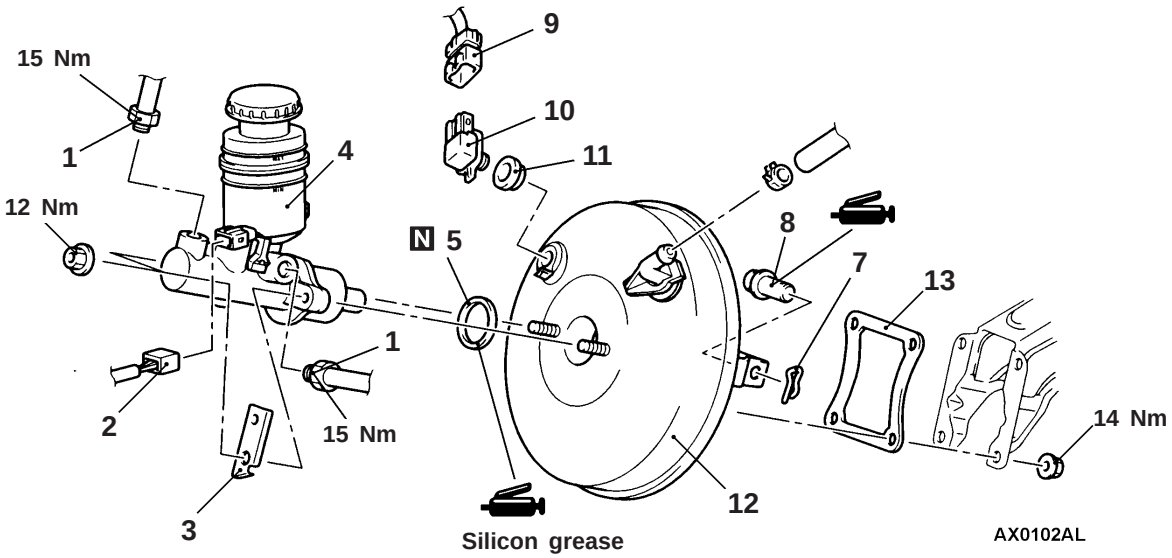




Specified Sealant: 3M ATD Part No.8661 or equivalent



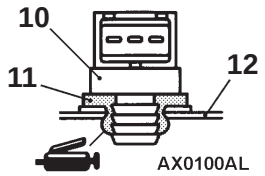
Grease: Silicone grease



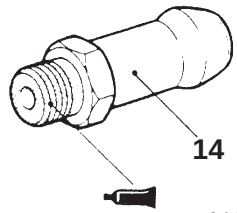
<L.H. drive vehicles without ABS and R.H. drive vehicles>

Pre-removal Operation
Brake Fluid Draining

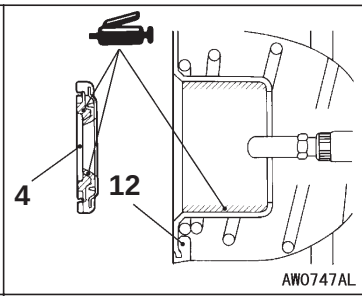
Post-installation Operation
- Brake Fluid Supplying and Air Bleeding (Refer to P.35A-10.)
- Brake Pedal Adjustment (Refer to P.35A-6.)



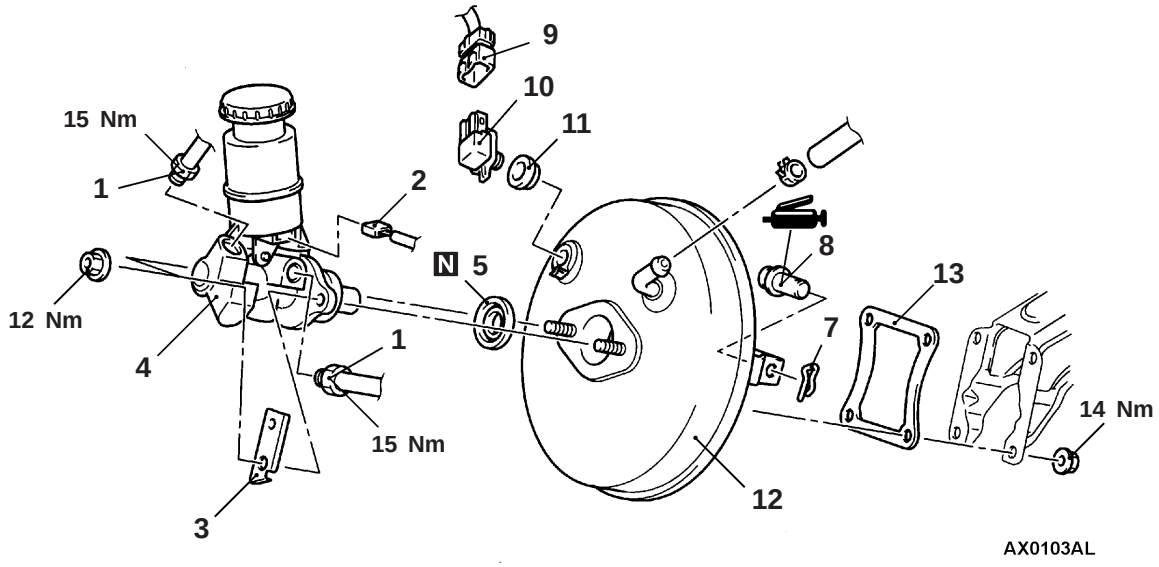
Grease: Silicone grease



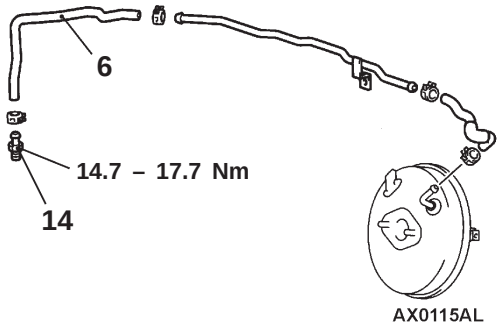
Specified Sealant: 3M ATD Part No.8661 or equivalent



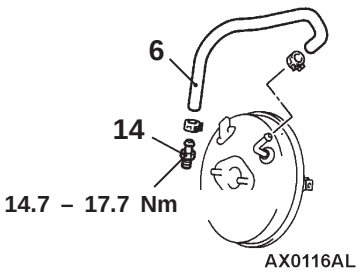
Grease: Silicone grease



<L.H. drive vehicles>



<R.H. drive vehicles>



Master cylinder removal steps

1. Brake pipe connection
2. Brake fluid level sensor connector
3. Bracket <L.H. drive vehicles>
4. Master cylinder
- ▶C◀ 5. Seal

Brake booster removal steps

1. Brake pipe connection
2. Brake fluid level sensor connector
3. Bracket <L.H. drive vehicles>
4. Master cylinder
- ▶C◀ 5. Seal
- ▶B◀ ● Push rod protrusion amount check and adjustment

- ▶A◀ 6. Vacuum hose (With built-in check valve)
7. Snap pin
8. Pin assembly
9. Vacuum sensor connector
10. Vacuum sensor
11. Grommet
12. Brake booster
13. Sealer

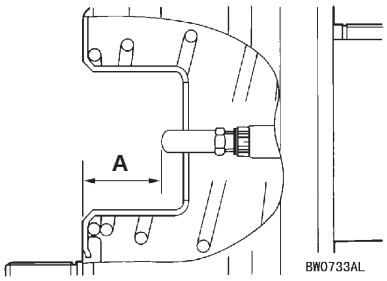
Fitting removal

14. Fitting

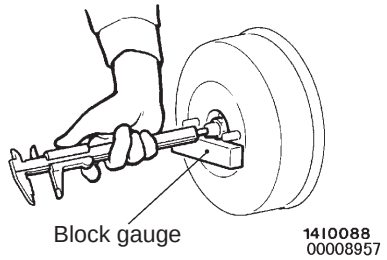
INSTALLATION SERVICE POINTS

▶A◀ VACUUM HOSE CONNECTION

Insert the vacuum hose to the fitting with its paint mark facing forward <L.H. drive vehicles>/upward <R.H. drive vehicles> until the hose end reaches the edge of the hexagonal part of the fitting, and then secure the hose by using the hose clip.



Measuring distance A

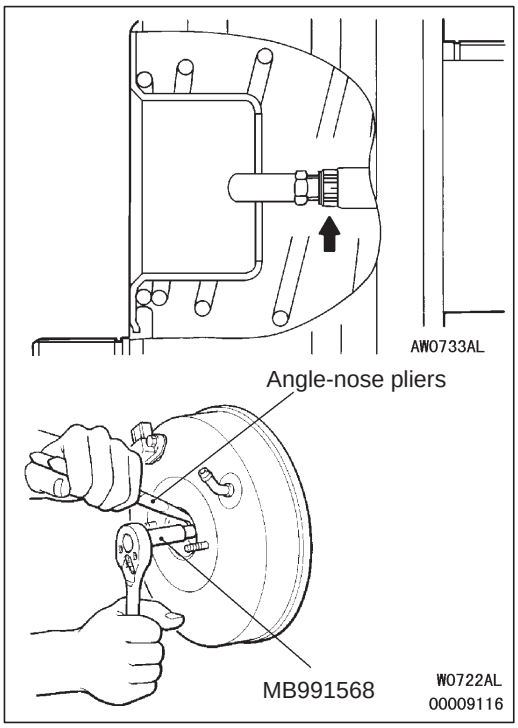


▶B◀ PUSH ROD PROTRUSION AMOUNT CHECK AND ADJUSTMENT

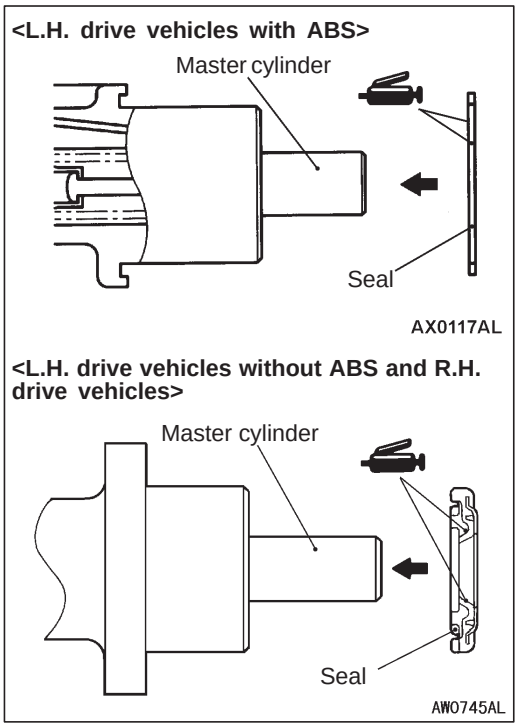
1. Measure dimension (A).

Standard value (A) :
<L.H. drive vehicles with ABS> 22.7 – 22.9 mm
<L.H. drive vehicles without ABS and R.H. drive vehicles> 23.93 – 24.18 mm

NOTE
When a negative pressure of 66.7 kPa is applied to the brake booster, the push rod should protrude 22.2 – 22.4 mm <L.H. drive vehicles with ABS>/23.48 – 23.73 mm <L.H. drive vehicles without ABS and R.H. drive vehicles>.



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



▶C◀ SEAL INSTALLATION

1. Apply silicone grease to the seal.
2. Install the seal to the master cylinder as shown.

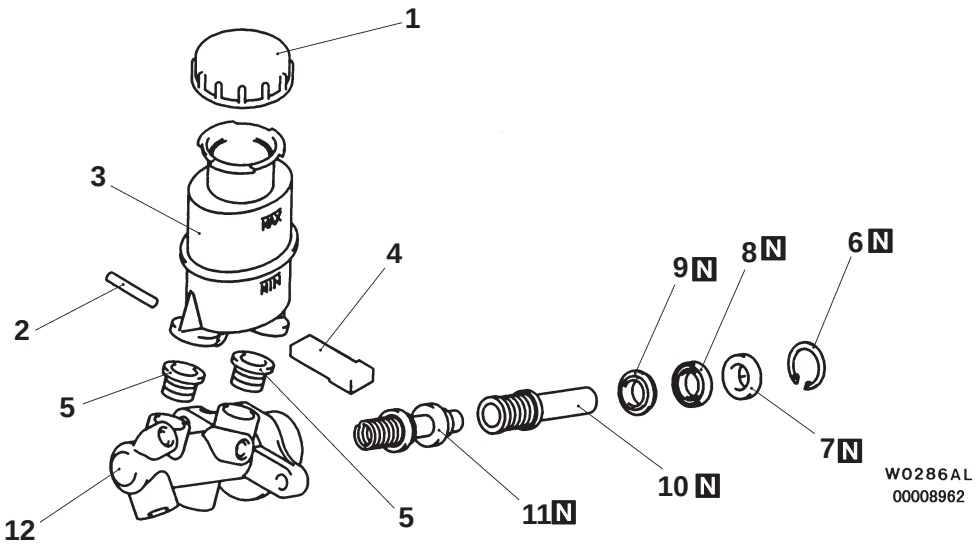
INSPECTION

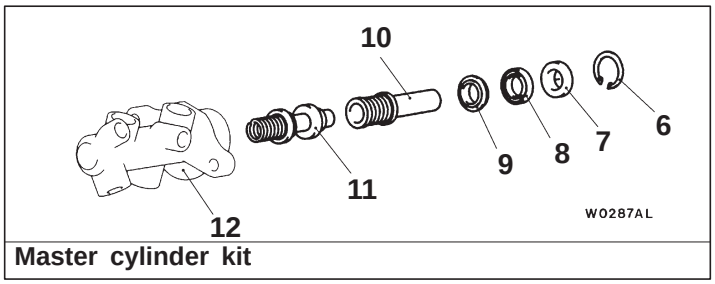
VACUUM SENSOR CHECK

Refer to GROUP 13A – Troubleshooting.

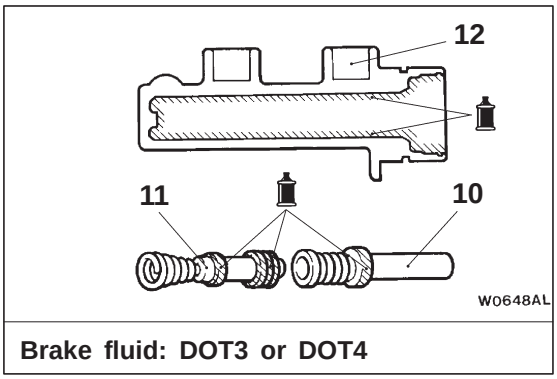
NOTE
The vacuum sensor is monitored by the engine-ECU. Diagnosis code is output when the vacuum sensor has a malfunction.

MASTER CYLINDER <L.H. drive vehicles without ABS and R.H. drive vehicles>
DISASSEMBLY AND REASSEMBLY





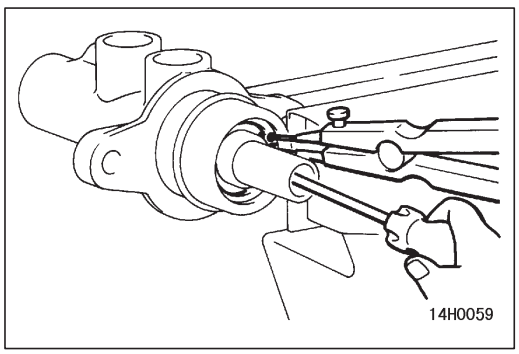
Master cylinder kit



Brake fluid: DOT3 or DOT4

Disassembly steps

1. Reservoir cap
2. Pin
3. Reservoir tank
4. Brake fluid level sensor
5. Reservoir seal
- ◀A▶ 6. Stopper ring
7. Piston guide
8. Cylinder cup
9. Plate
10. Primary piston assembly
11. Secondary piston assembly
12. Master cylinder body



DISASSEMBLY SERVICE POINT

◀A▶ STOPPER RING REMOVAL

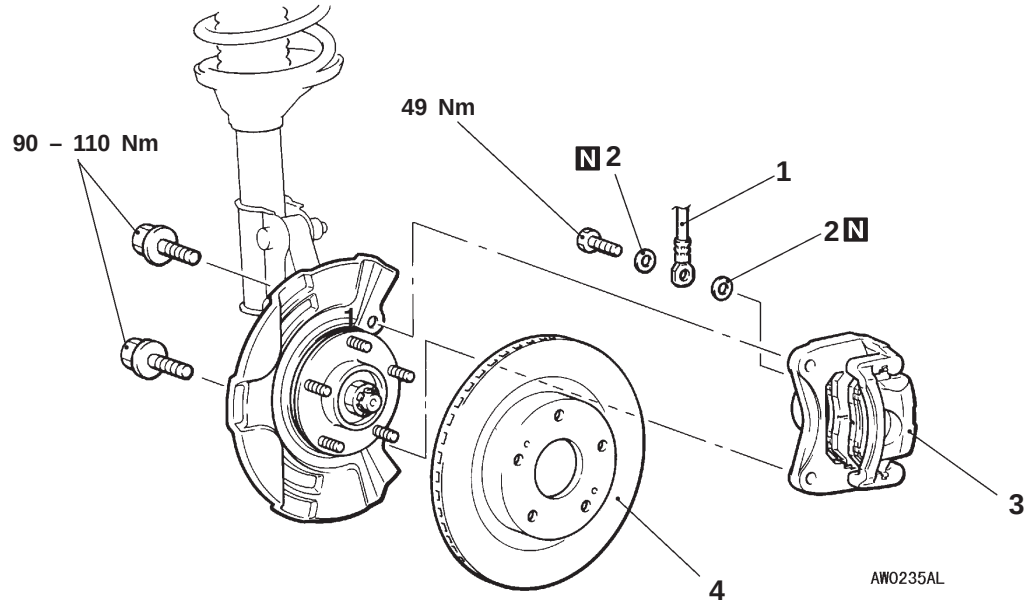
Push the primary piston assembly and remove the stopper ring.

FRONT DISC BRAKE

REMOVAL AND INSTALLATION

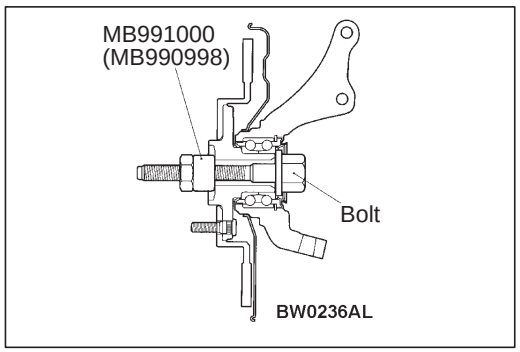
Pre-removal Operation
Brake Fluid Draining

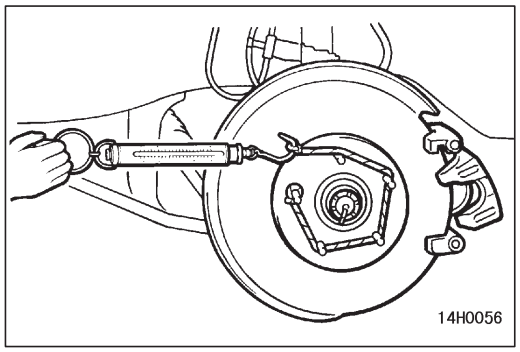
Post-installation Operation
Brake Fluid Supplying and Air Bleeding
(Refer to P.35A-10.)



Removal steps

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





INSTALLATION SERVICE POINT

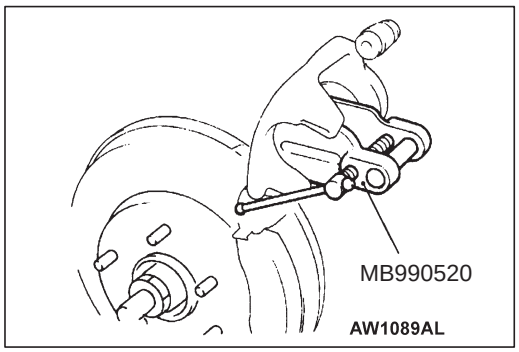
▶A◀ DISC BRAKE ASSEMBLY INSTALLATION

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

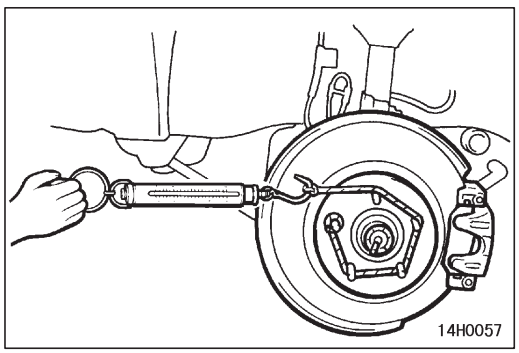
   Tightening torque: 196 – 255 Nm

   (3) Use a spring balance to measure the rotary-sliding resistance of the hub in the forward direction.
2. Install the caliper support to the knuckle, and then assemble the pad clip and the pad to the caliper support.

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



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

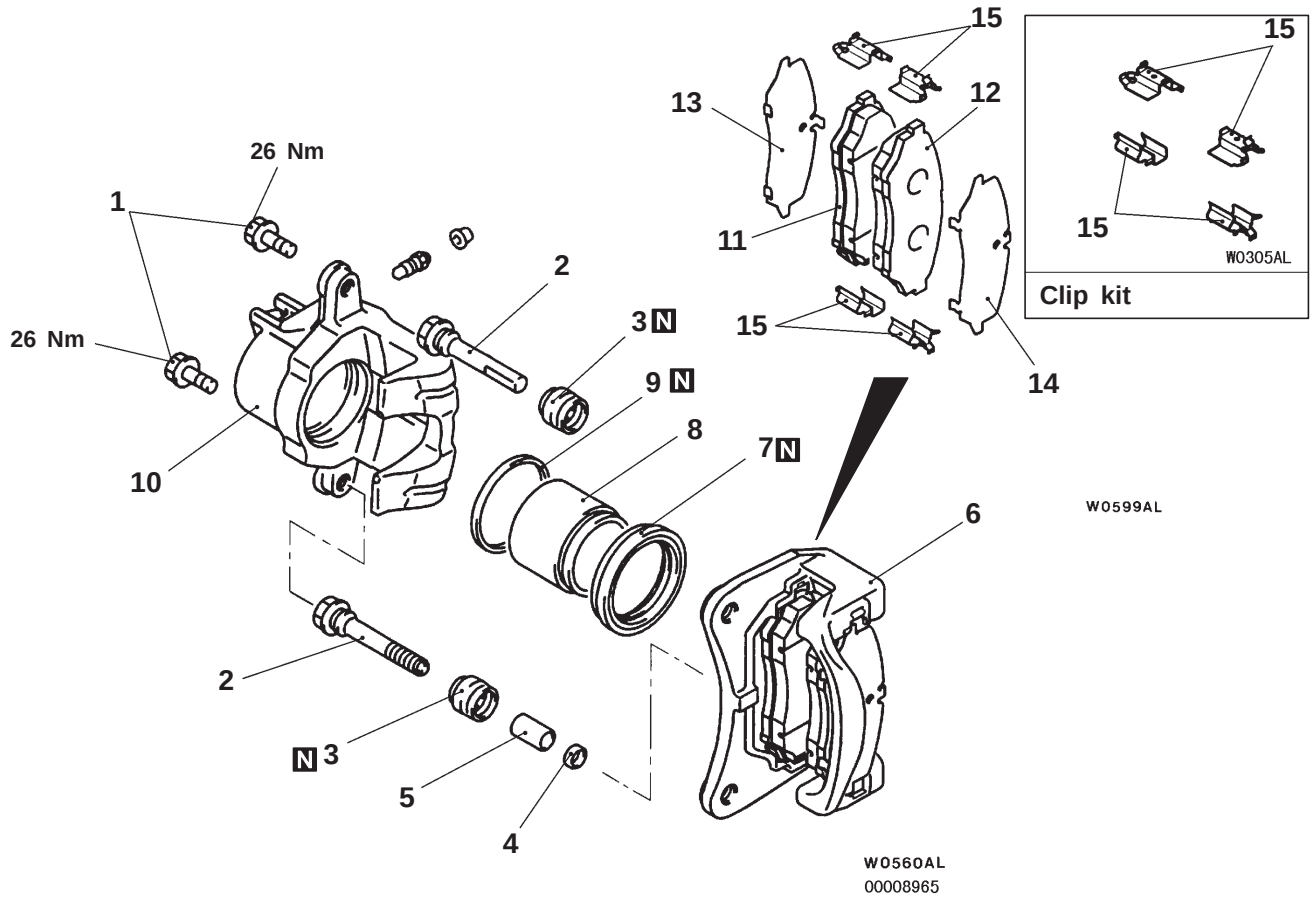


7. Use a spring balance to measure the rotary-sliding resistance of the hub.
8. Calculate the drag force of the disc brake [difference between the values measured at steps 1 and 7].

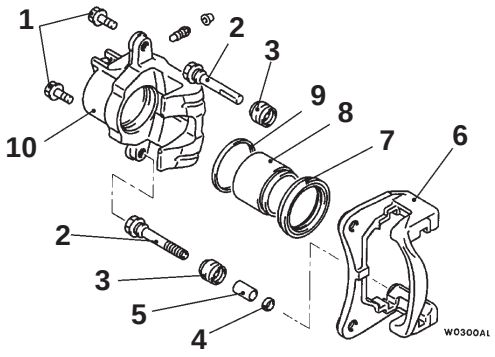
   Standard value: 69 N

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

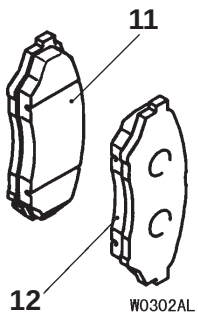
DISASSEMBLY AND REASSEMBLY



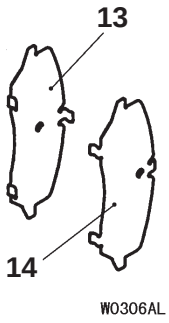
Clip kit



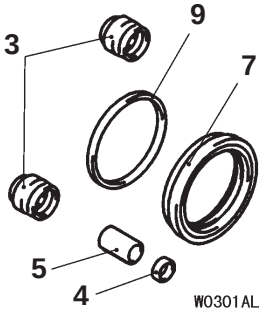
Brake caliper kit



Pad set



Shim kit



Seal and boot kit

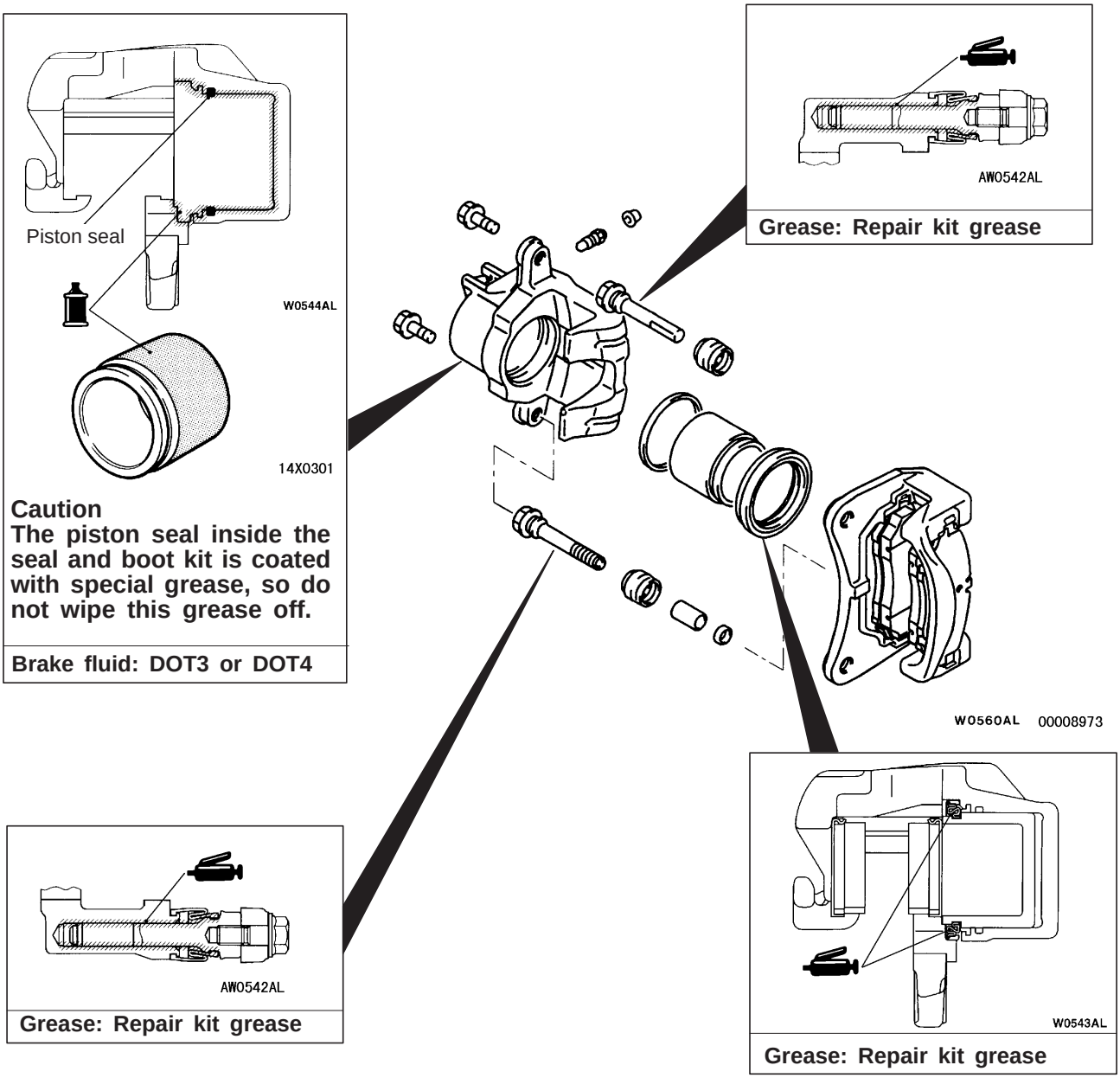
Disassembly steps

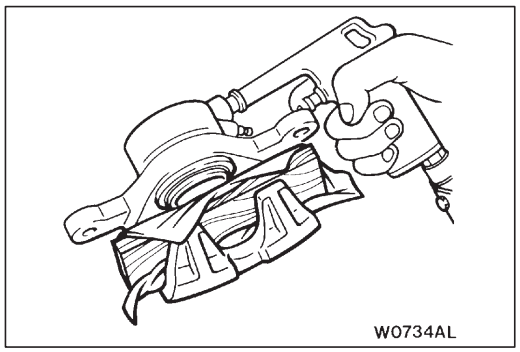
1. Guide pin lock bolt
2. Guide pin
3. Boot
4. Bushing
5. Bushing retainer
6. Caliper support (including pad, clip, and shim)

◀A▶ 7. Piston boot

◀A▶ ◀B▶ 8. Piston
9. Piston seal
10. Caliper body
11. Pad and wear indicator assembly
12. Pad assembly
13. Inner shim
14. Outer shim
15. Clip

LUBRICATION POINTS



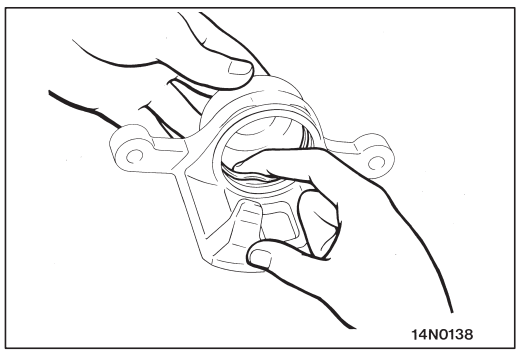


DISASSEMBLY SERVICE POINTS

◀A▶ PISTON BOOT/PISTON REMOVAL

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

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



◀B▶ PISTON SEAL REMOVAL

1. Remove the piston seal with finger tip.

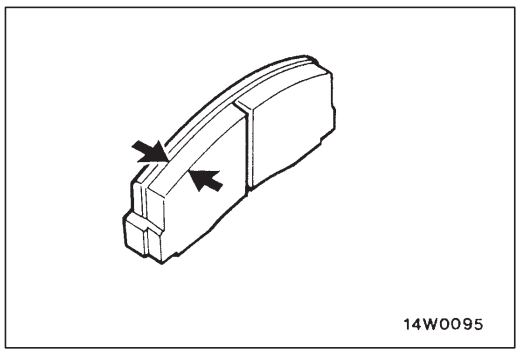
   Caution
   Do not use a flat-tipped screwdriver or other tool to prevent damage to inner cylinder.

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

   Specified brake fluid: DOT3 or DOT4

INSPECTION

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



PAD WEAR CHECK

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

Standard value: 10 mm

Limit: 2.0 mm

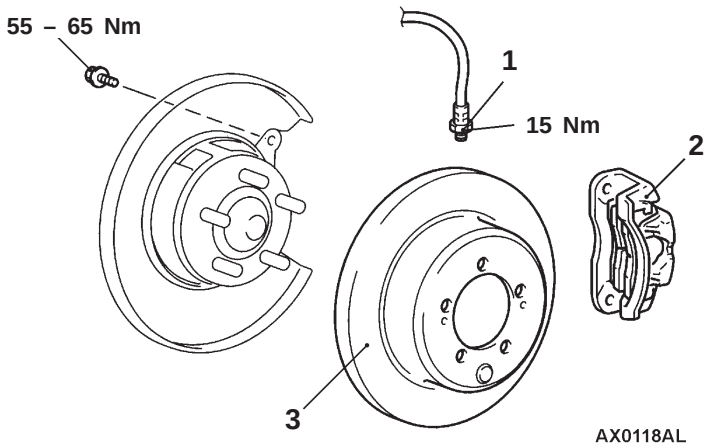
Caution
1. **Always replace the brake pads as an axle set.**
2. **If an excessive difference is found in the thickness between the right and left brake pads, check moving parts.**

REAR DISC BRAKE

REMOVAL AND INSTALLATION

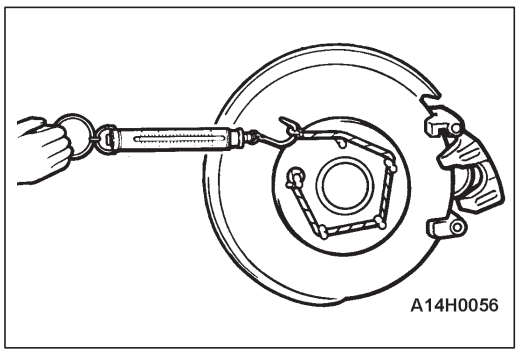
Pre-removal Operation
- Brake Fluid Draining

Post-installation Operation
- Brake Fluid Supplying and Air Bleeding (Refer to P.35A-10.)



Removal steps

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

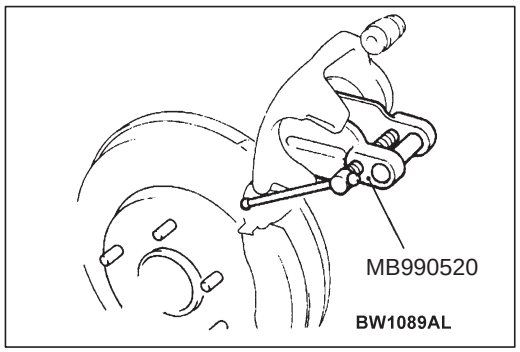


INSTALLATION SERVICE POINT

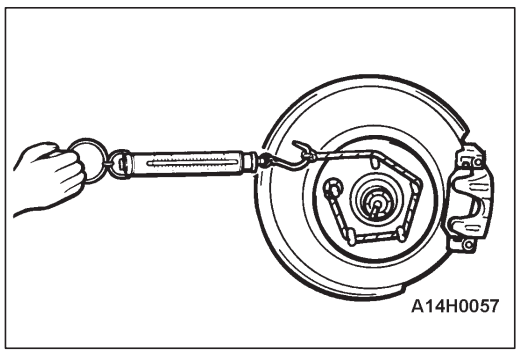
▶A◀ DISC BRAKE ASSEMBLY INSTALLATION

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

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



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

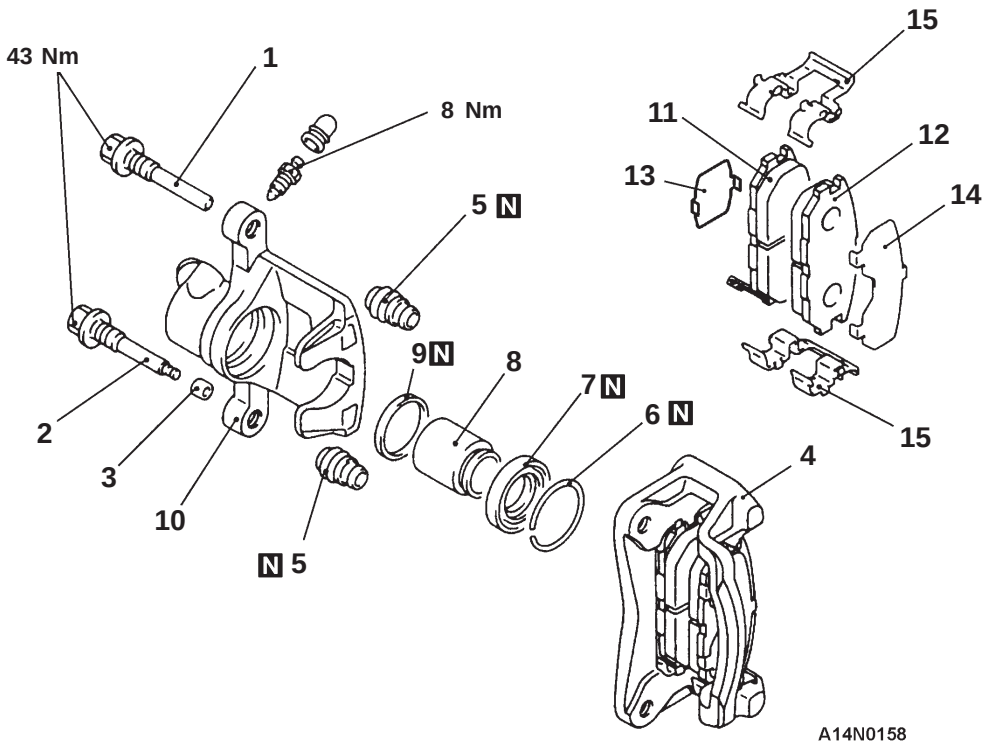


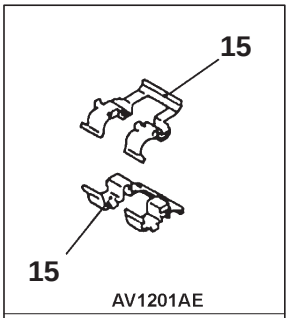
7. Use a spring balance to measure the rotary-sliding resistance of the hub.
8. Calculate the drag force of the disc brake [difference between the values measured at steps 1 and 7].

   Standard value: 34 N

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

DISASSEMBLY AND REASSEMBLY





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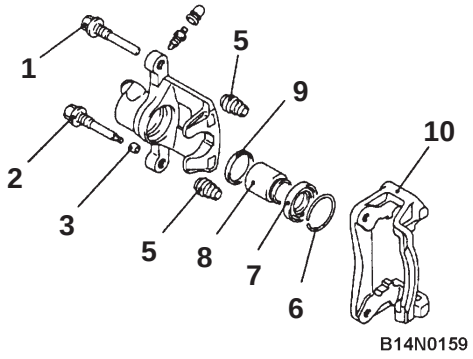
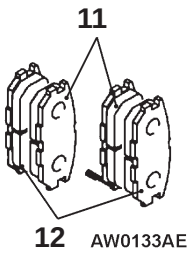
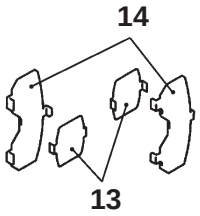


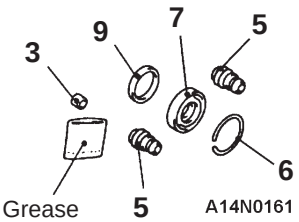
Brake caliper kit



Pad set



Shim set

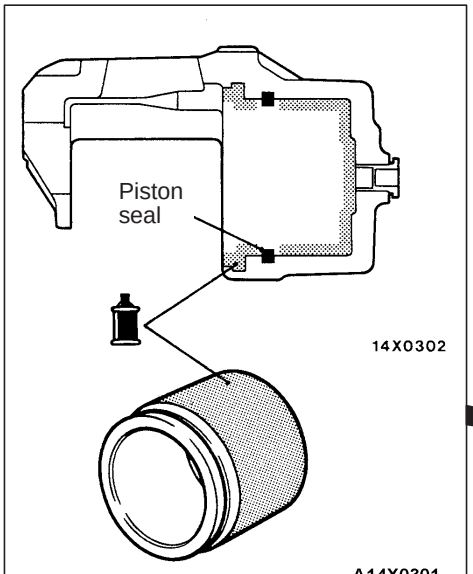


Seal and boots kit

Disassembly steps

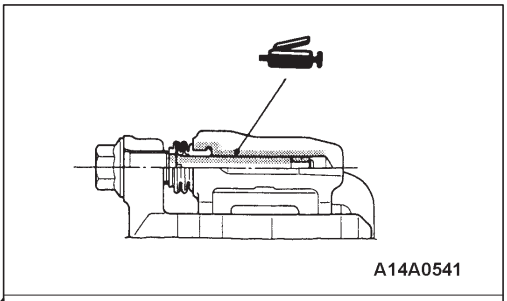
- ▶A◀ 1. Guide pin
- ▶A◀ 2. Lock pin
- 3. Bushing
- 4. Caliper support (pad, clip, shim)
- 5. Pin boot
- 6. Boot ring
- ◀A▶ 7. Piston boot
- ◀A▶ 8. Piston
- ◀B▶ 9. Piston seal
- 10. Caliper body
- 11. Pad and wear indicator assembly
- 12. Pad assembly
- 13. Inner shim
- 14. Outer shim
- 15. Clip

LUBRICATION POINTS

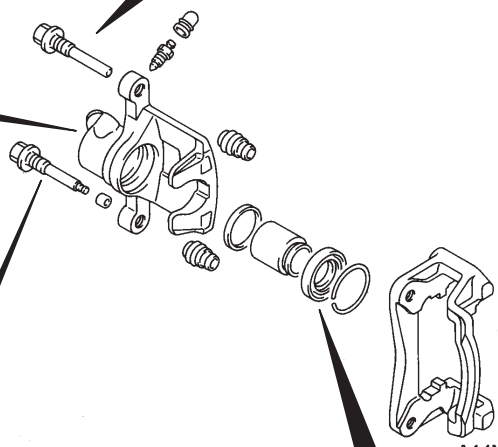


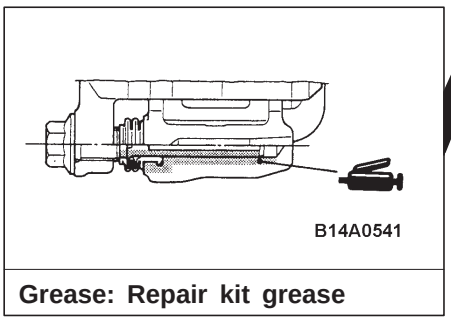
Caution
The piston seal inside the seal and boot kit is coated with special grease, so do not wipe this grease off.

Brake fluid: DOT3 or DOT4

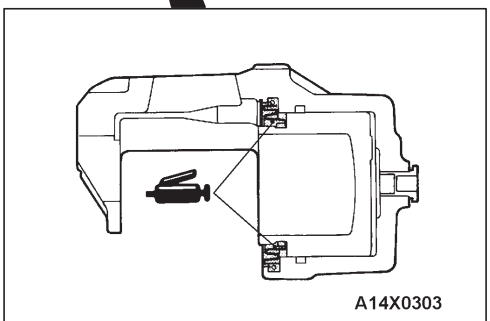


Grease: Repair kit grease

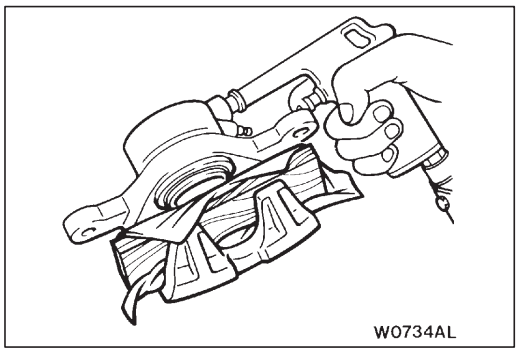


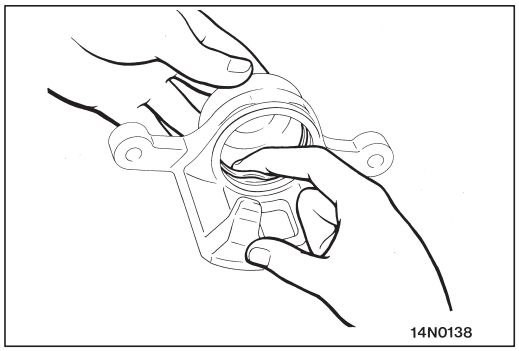


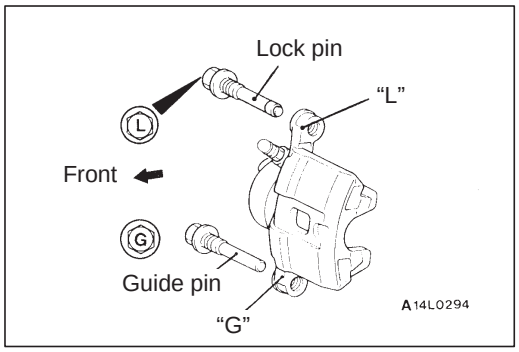
Grease: Repair kit grease



Grease: Repair kit grease







DISASSEMBLY SERVICE POINTS

◀A▶ PISTON BOOT/PISTON REMOVAL

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

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

◀B▶ PISTON SEAL REMOVAL

1. Remove the piston seal with finger tip.

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

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

   Specified brake fluid: DOT3 or DOT4

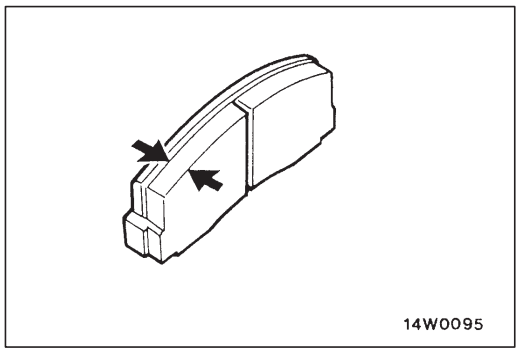
REASSEMBLY SERVICE POINT

▶A◀ LOCK PIN/GUIDE PIN INSTALLATION

Install the guide pin and lock pin as illustrated that each head mark of the guide pin and the lock pin matches the indication mark ("G" or "L") located on the caliper body.

INSPECTION

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



PAD WEAR CHECK

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

Standard value: 10 mm

Limit: 2.0 mm

Caution

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

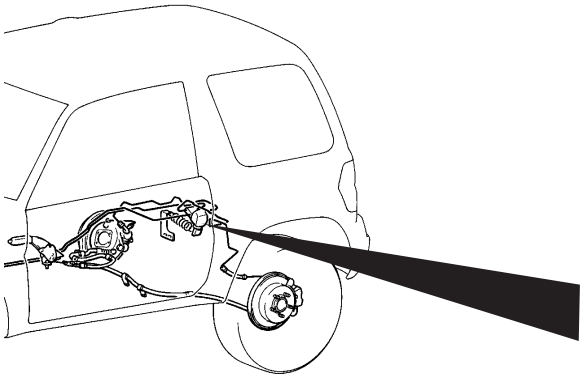
LOAD SENSING PROPORTIONING VALVE

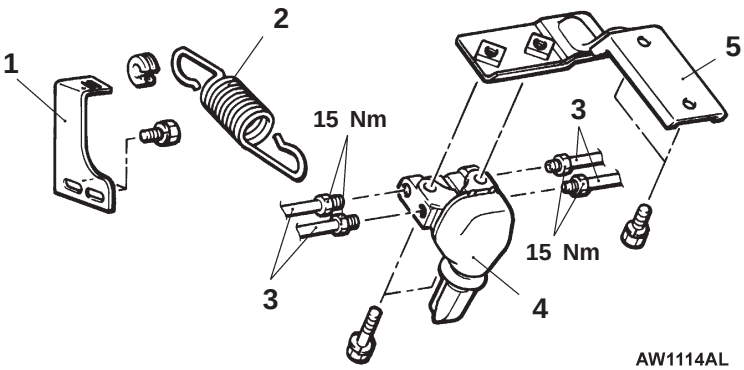
REMOVAL AND INSTALLATION

Caution
Do not disassemble the load sensing proportioning valve.

Pre-removal Operation
Brake Fluid Draining

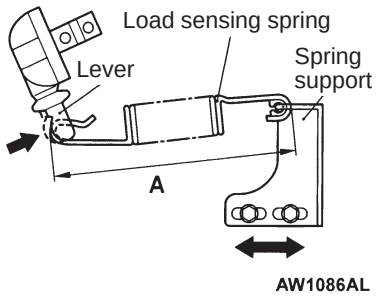
Post-installation Operation
- Brake Fluid Supplying
- Brake Line Bleeding (Refer to P.35A-10.)





Removal steps

▶A◀ 1. Spring support
2. Load sensing spring
3. Brake pipe connection
4. Load sensing proportioning valve
5. Bracket



INSTALLATION SERVICE POINT

▶A◀ SPRING SUPPORT INSTALLATION

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

   Standard value (A): 194 – 198 mm

NOTES

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

CONTENTS

CONTINUED ON NEXT PAGE

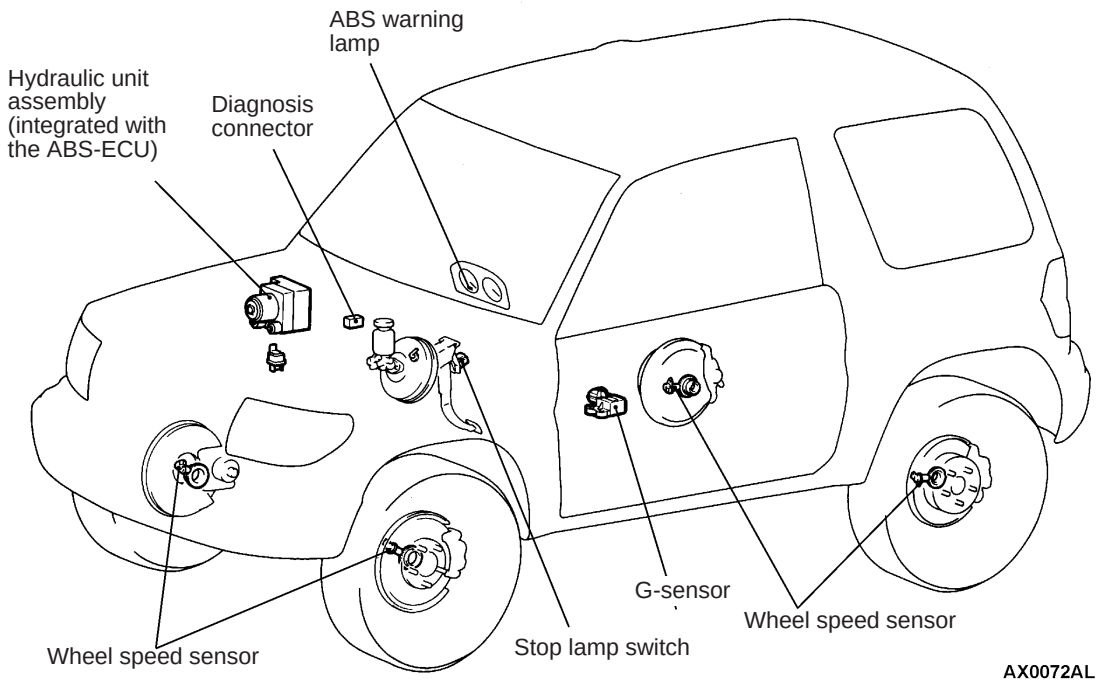
GENERAL INFORMATION

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

WHEEL SPEED SENSOR

Type	Magnet coil type
ABS rotor teeth	43

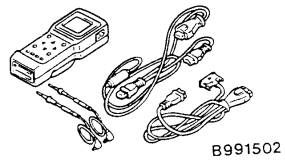
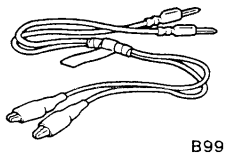
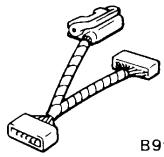
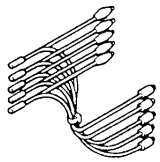
CONSTRUCTION DIAGRAM



SERVICE SPECIFICATIONS

Items		Standard value
Wheel speed sensor internal resistance kΩ		1.30 – 1.58
Wheel speed sensor insulation resistance kΩ		100 or more
G sensor output voltage V	When labeled surface is faced to vertical direction	2.4 – 2.6
	When labeled surface is faced straight down	3.3 – 3.7

SPECIAL TOOLS

Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub assembly	For checking of ABS (Diagnosis code display when using the MUT-II)
 B991529	MB991529	Diagnosis code check harness	For checking of ABS (Diagnosis code display when using the ABS warning lamp)
 B991547	MB991547	ABS check harness	For measuring of ABS-ECU terminal voltage
 B991348	MB991348	Test harness set	For checking of G sensor

TROUBLESHOOTING

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

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

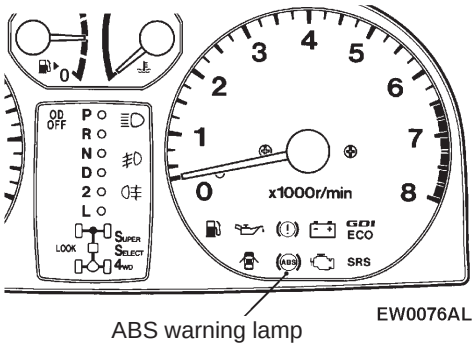
NOTES WITH REGARD TO DIAGNOSIS

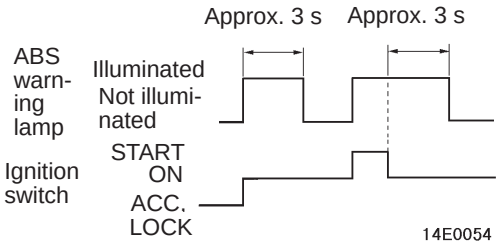
1. The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation of phenomenon
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment, but this is because the system operation check is being performed, and is not an abnormality.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation. (whine) 2. Sound is the generated along with vibration of the brake pedal. (scraping) 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release. (Thump: suspension; squeak: tyres)
System check sound	When depressing the brake pedal during driving, a shock is sometime felt.

2. For road surfaces such as snow-covered roads and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed and not being too overconfident.
3. Diagnosis detection condition can vary depending on the diagnosis code.
   Make sure that checking requirements listed in the “Comment” are satisfied when checking the trouble symptom again.

Caution
Use the special tool (MB991547) when checking the terminal voltage and resistance of ABS-ECU.





ABS WARNING LAMP INSPECTION

Check that the ABS warning lamp illuminates as follows.

1. When the ignition key is turned to “ON”, the ABS warning lamp illuminates for approximately 3 seconds and then switches off.
2. When the ignition key is turned to “START”, the ABS warning lamp remains illuminated.
3. When the ignition key is turned from “START” back to “ON”, the ABS warning lamp illuminates for approximately 3 seconds and then switches off.

   NOTE
   The ABS warning lamp may remain on until the vehicle reaches a speed of several km/h. This is limited to cases where diagnosis code Nos.21 to 24, 53 or 55 have been recorded because of a previous problem occurring. In this case, the ABS-ECU keeps the warning lamp illuminated until the problem corresponding to that diagnosis code can be detected.

4. If the illumination is other than the above, check the diagnosis codes.

DIAGNOSIS FUNCTION

READING DIAGNOSIS CODES

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

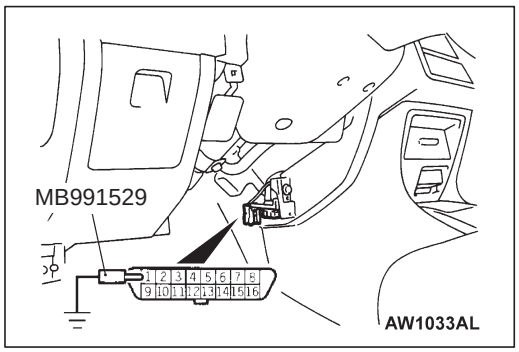
NOTE
Connect the MUT-II to the diagnosis connector (16-pin).

ERASING DIAGNOSIS CODES

When using the MUT-II

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

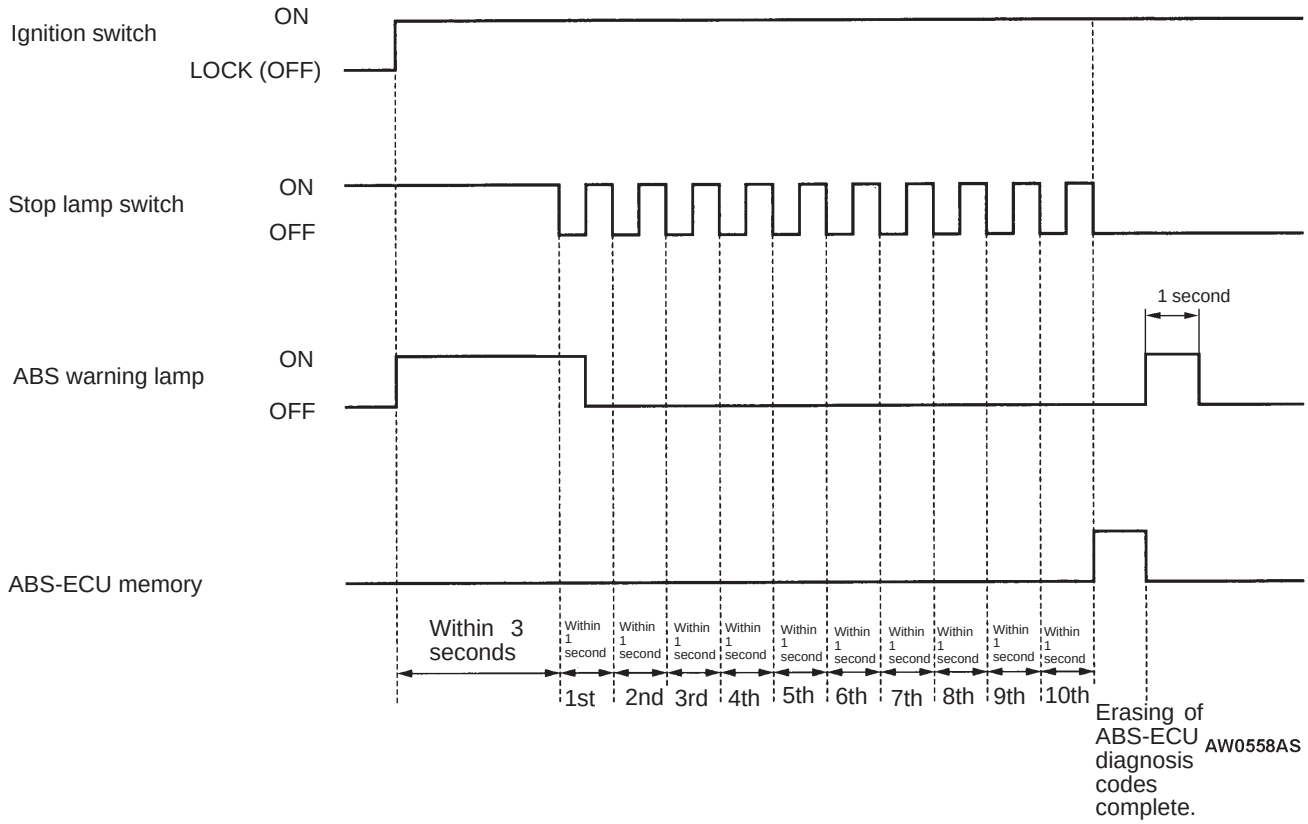
Caution
Turn the ignition key to the LOCK (OFF) position before connecting or disconnecting the MUT-II.



When not using the MUT-II

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

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



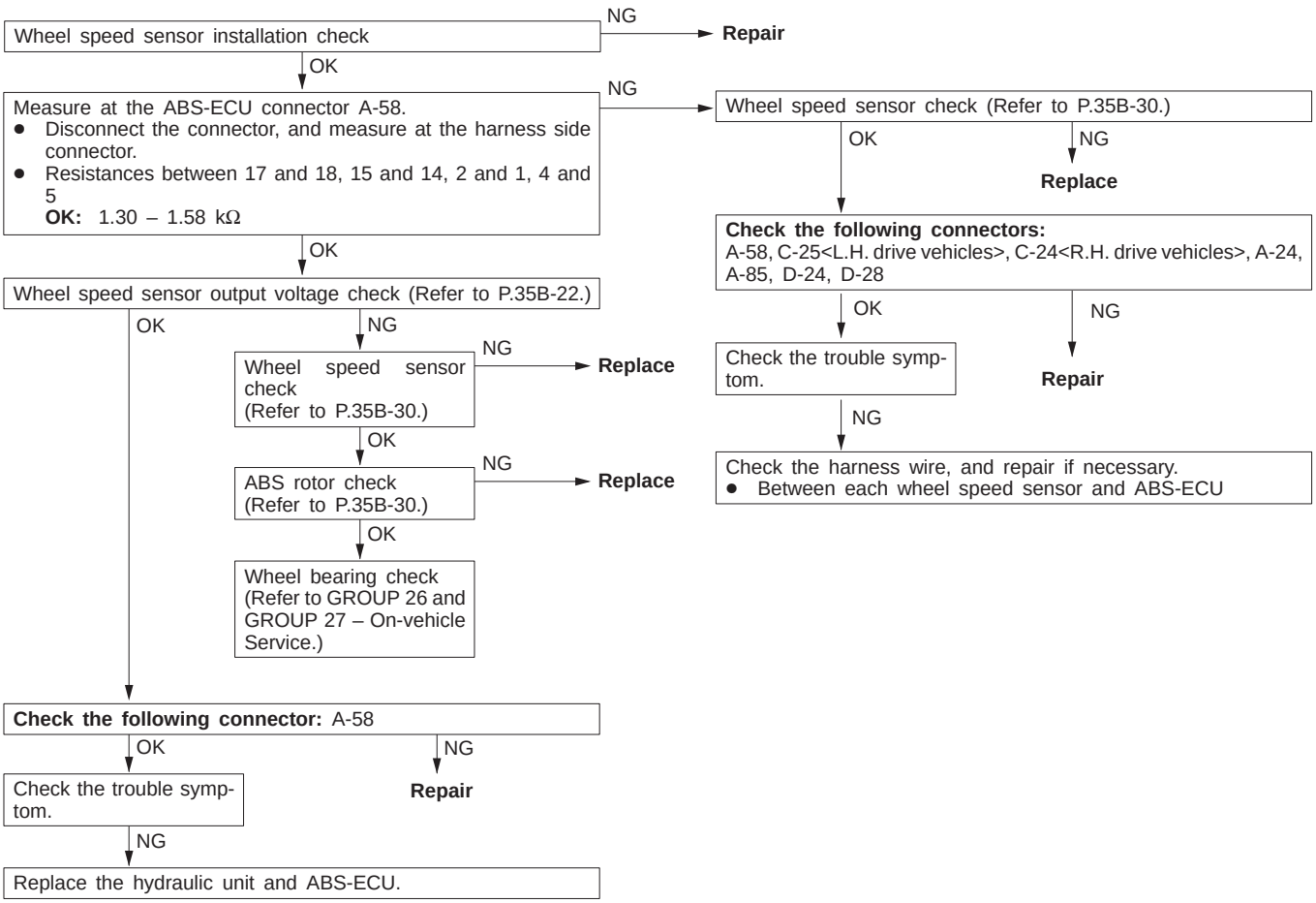
INSPECTION CHART FOR DIAGNOSIS CODES

Diagnosis code No.	Inspection item		Reference page
11	Front right wheel speed sensor (Open circuit or short circuit)		35B-9
12	Front left wheel speed sensor (Open circuit or short circuit)		35B-9
13	Rear right wheel speed sensor (Open circuit or short circuit)		35B-9
14	Rear left wheel speed sensor (Open circuit or short circuit)		35B-9
15	Wheel speed sensor (Abnormal output signal)		35B-10
16*	ABS-ECU power supply system (Abnormal voltage drop or rise)		35B-11
21	Front right wheel speed sensor		35B-9
22	Front left wheel speed sensor		35B-9
23	Rear right wheel speed sensor		35B-9
24	Rear left wheel speed sensor		35B-9
32	G sensor system		35B-12
33	Stop lamp switch system		35B-13
41	Front right solenoid valve	The diagnosis codes are output when there is no response to the drive signals for respective solenoid valves or the ABS-ECU power supply system is defective.	35B-13
42	Front left solenoid valve		
43	Rear right solenoid valve		
44	Rear left solenoid valve		
51	Valve relay problem (stays on)		35B-26, 27 (Replace the hydraulic unit and ABS-ECU.)
52	Valve relay problem (stays off) or ABS-ECU power supply system problem		35B-13
53	Motor relay problem (stays off) or ABS-ECU power supply system problem		
54	Motor relay problem (stays on)		35B-26, 27 (Replace the hydraulic unit and ABS-ECU.)
55	Motor system (seized pump motor) or ABS-ECU power supply system problem		35B-13
63	ABS-ECU		35B-26, 27 (Replace the hydraulic unit and ABS-ECU.)

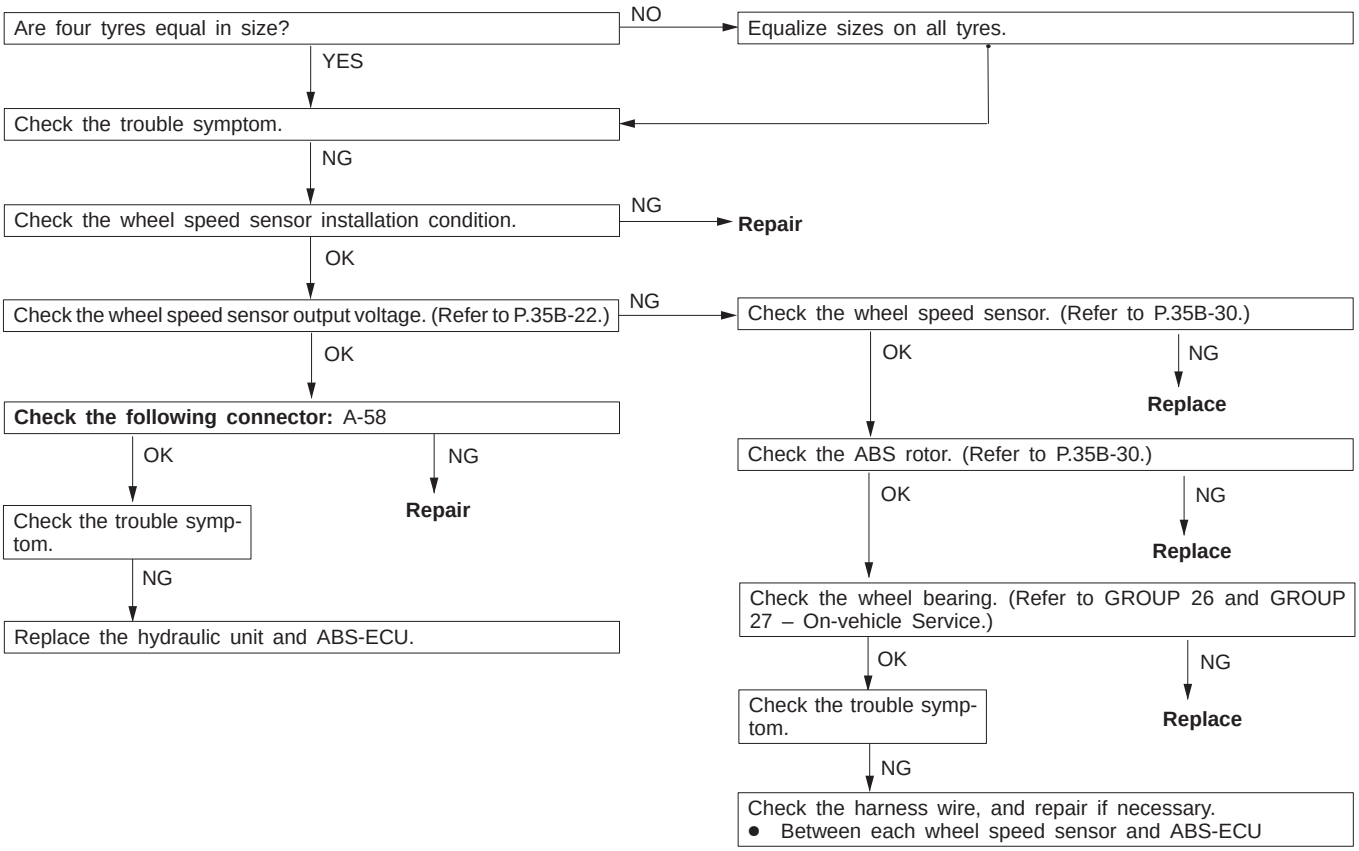
NOTE
*: Turning the ignition switch to ACC will erase the diagnosis code No.16.

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

Code Nos.11, 12, 13 and 14 Wheel speed sensor (open circuit or short circuit) **Code Nos.21, 22, 23 and 24 Wheel speed sensor**	**Probable cause**
Code Nos. 11, 12, 13 and 14 are output if the ABS-ECU detects an open circuit or short-circuit in the (+) wire or (–) wire in any one of the four wheel speed sensors.	● Malfunction of wheel speed sensor ● Malfunction of wiring harness or connector ● Malfunction of hydraulic unit and ABS-ECU
Code Nos. 21, 22, 23 and 24 are output in the following cases. ● When there is no input from any one of the four wheel speed sensors when travelling at several km/h or more, even though open circuit can not be verified. ● When a chipped or blocked-up ABS rotor is detected and if the anti-lock system operates continuously because a malfunctioning sensor or a warped ABS rotor is causing sensor output to drop.	● Malfunction of wheel speed sensor ● Malfunction of wiring harness or connector ● Malfunction of ABS rotor ● Too much gap between the sensor and the ABS rotor ● Malfunction of hydraulic unit and ABS-ECU ● Malfunction of wheel bearing

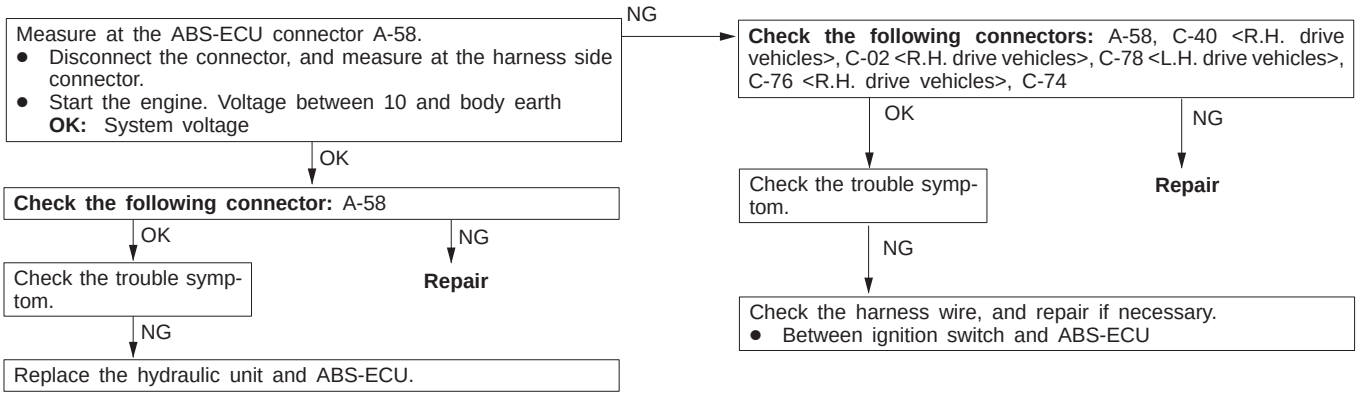


Code No.15 Wheel speed sensor (Abnormal output signal)	Probable cause
This code is output if the output signal of any wheel speed sensor is abnormal (other than an open circuit or short circuit).	● Unequal tyre size ● Improper installation of wheel speed sensor ● Malfunction of wheel speed sensor ● Malfunction of wiring harness or connector ● Malfunction of ABS rotor ● Malfunction of wheel bearing ● Malfunction of hydraulic unit and ABS-ECU

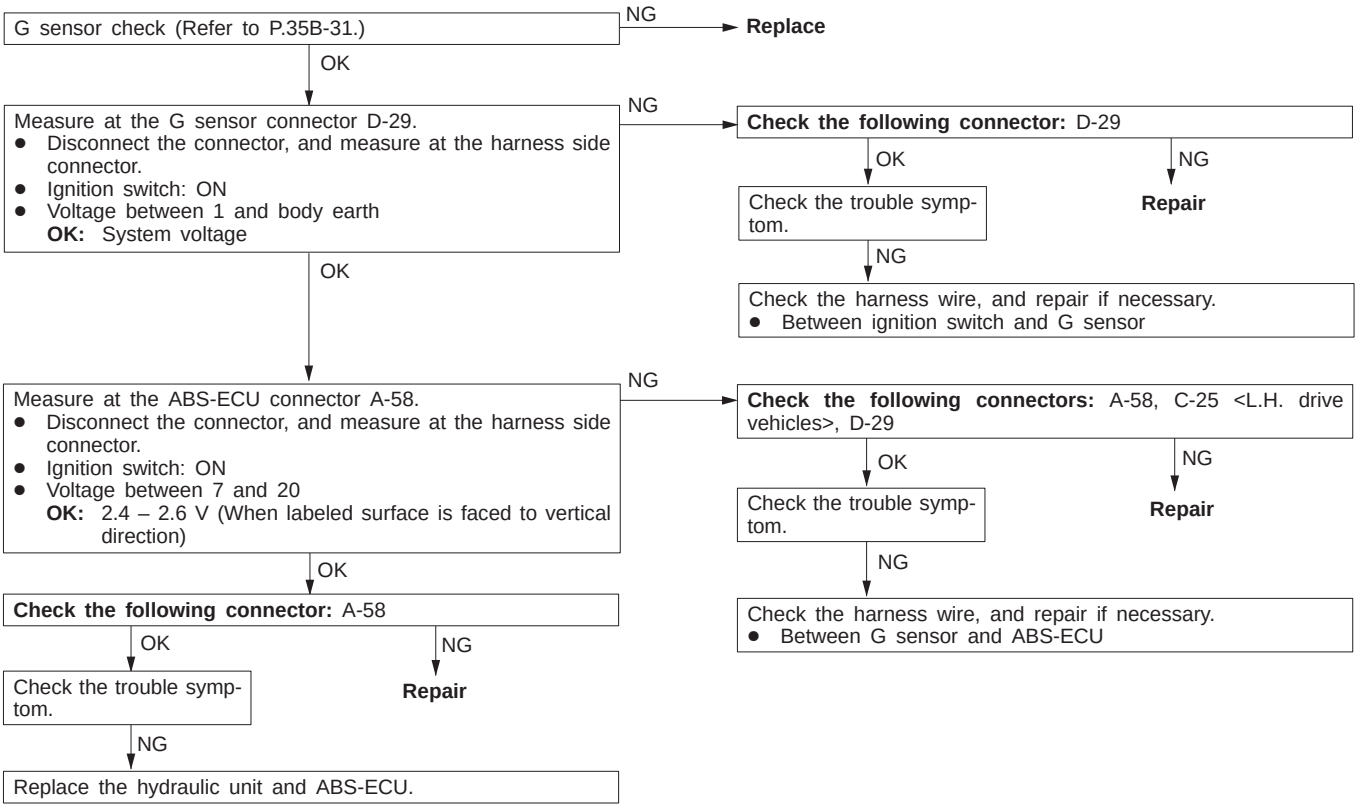


Code No.16 ABS-ECU power supply system (abnormal voltage drop or rise)	Probable cause
This code is output if the ABS-ECU power supply voltage drops below or rises above the rated values. Furthermore, turning the ignition switch to ACC will erase this code.	• Malfunction of battery • Malfunction of wiring harness or connector • Malfunction of hydraulic unit and ABS-ECU

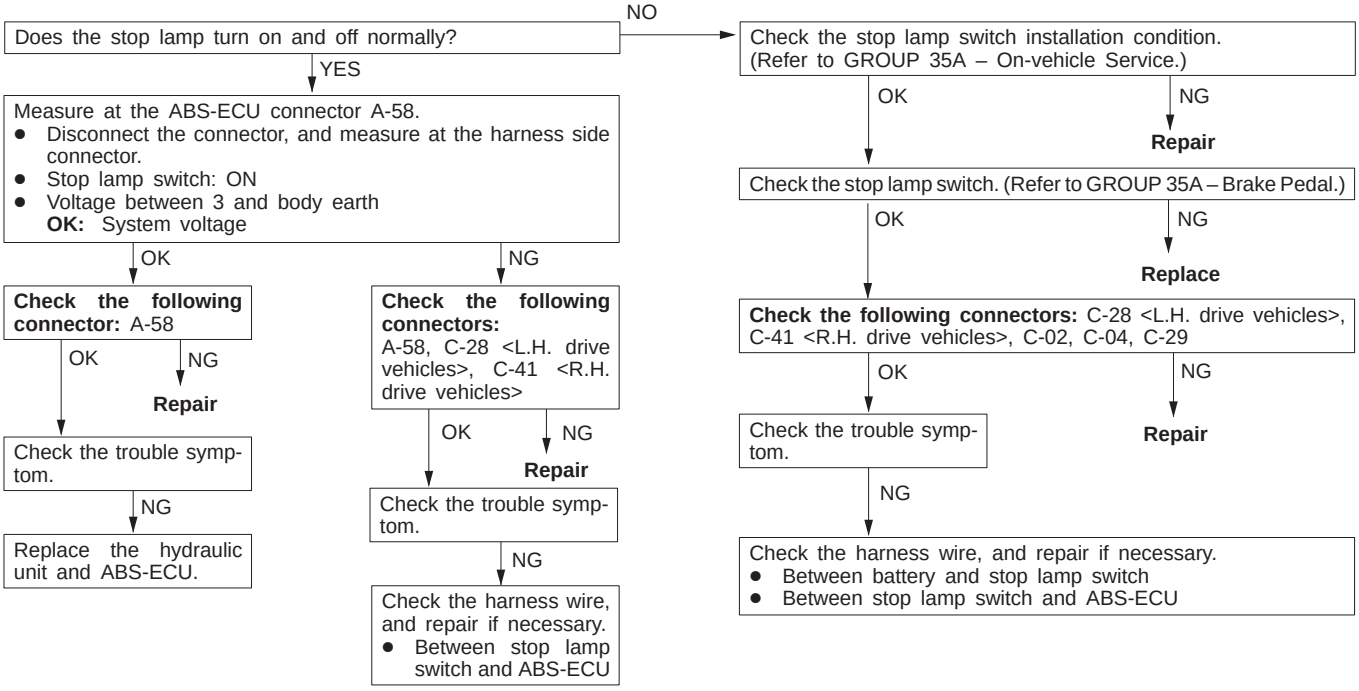
Caution
If battery voltage drops or rises during inspection, this code will be output as well. If the voltage returns to standard value, this code is no longer output.
Before carrying out the following inspection, check the battery level, and refill it if necessary.



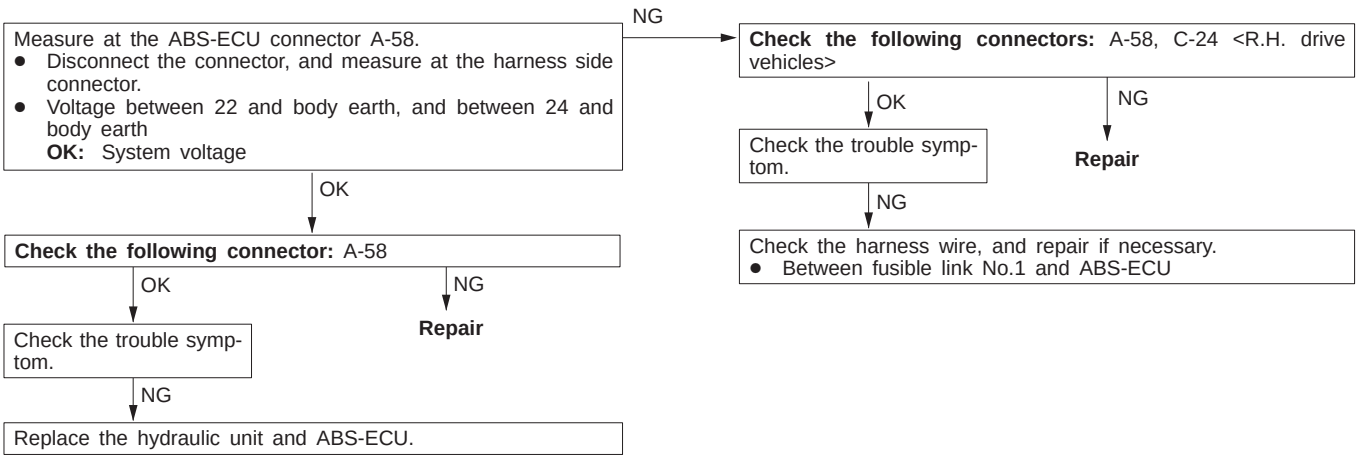
Code No.32 G sensor system	Probable cause
This code is output in the following cases. ● G sensor output voltage is less than 0.5 V or more than 4.5 V. (An open or short circuit is present in the G sensor circuit.) ● G sensor output voltage does not change. (G sensor output voltage is abnormal.)	● Malfunction of G sensor ● Malfunction of wiring harness or connector ● Malfunction of hydraulic unit and ABS-ECU



Code No.33 Stop lamp switch system	Probable cause
This code is output in the following cases. ● If the stop lamp switch is continuously on for 15 minutes or more even though the ABS system is not operating. ● If there is an open circuit in the stop lamp switch input circuit harness.	● Malfunction of stop lamp switch ● Malfunction of wiring harness or connector ● Malfunction of hydraulic unit and ABS-ECU



Code Nos.41, 42, 43 and 44 Solenoid valve Code No.52 Valve relay problem (stays off) Code No.53 Motor relay problem (stays off) Code No.55 Motor system (seized pump motor)	Probable cause
These codes are output if there is an open circuit or short-circuit in the ABS-ECU power supply circuit (power supply circuit for solenoid valve and motor), or the internal circuit in the hydraulic unit and ABS-ECU is defective.	● Malfunction of wiring harness or connector ● Malfunction of hydraulic unit and ABS-ECU



INSPECTION CHART FOR TROUBLE SYMPTOMS

Trouble symptoms	Inspection procedure No.	Reference page
Communication between the MUT-II and the whole system is not possible.	1	35B-14
Communication between the MUT-II and the ABS-ECU is not possible.	2	35B-15
When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate.	3	35B-16
Even after the engine is started, the ABS warning lamp remains illuminated.	4	35B-17
Faulty ABS operation	5	35B-18

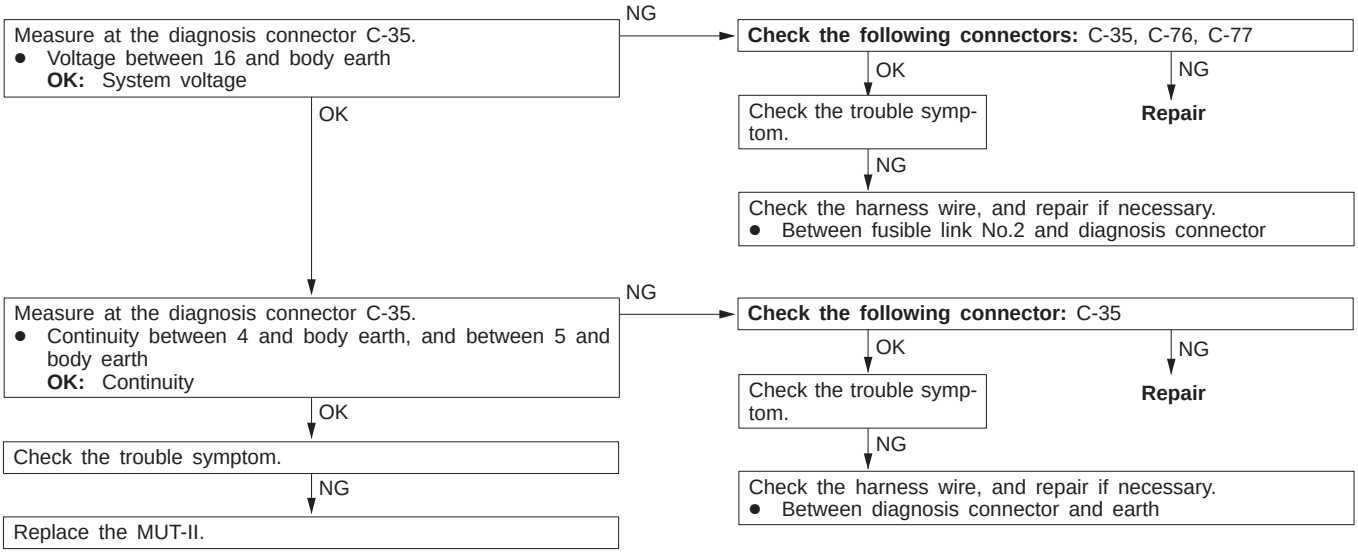
Caution

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

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

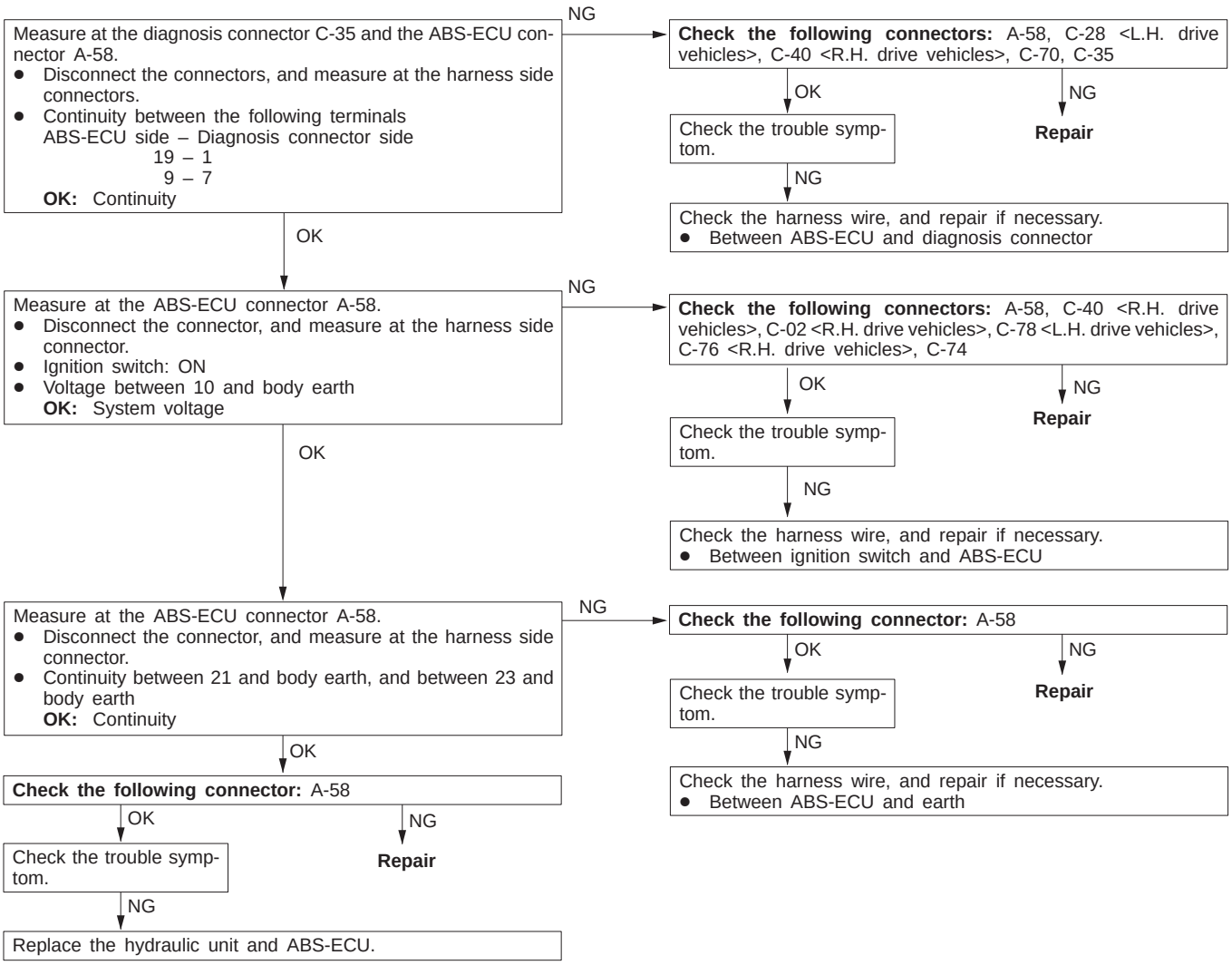
Inspection Procedure 1

Communication between the MUT-II and the whole system is not possible.	**Probable cause**
The cause may be a malfunction of the power supply circuit or the earth circuit of the diagnosis connector.	• Malfunction of diagnosis connector • Malfunction of wiring harness or connector



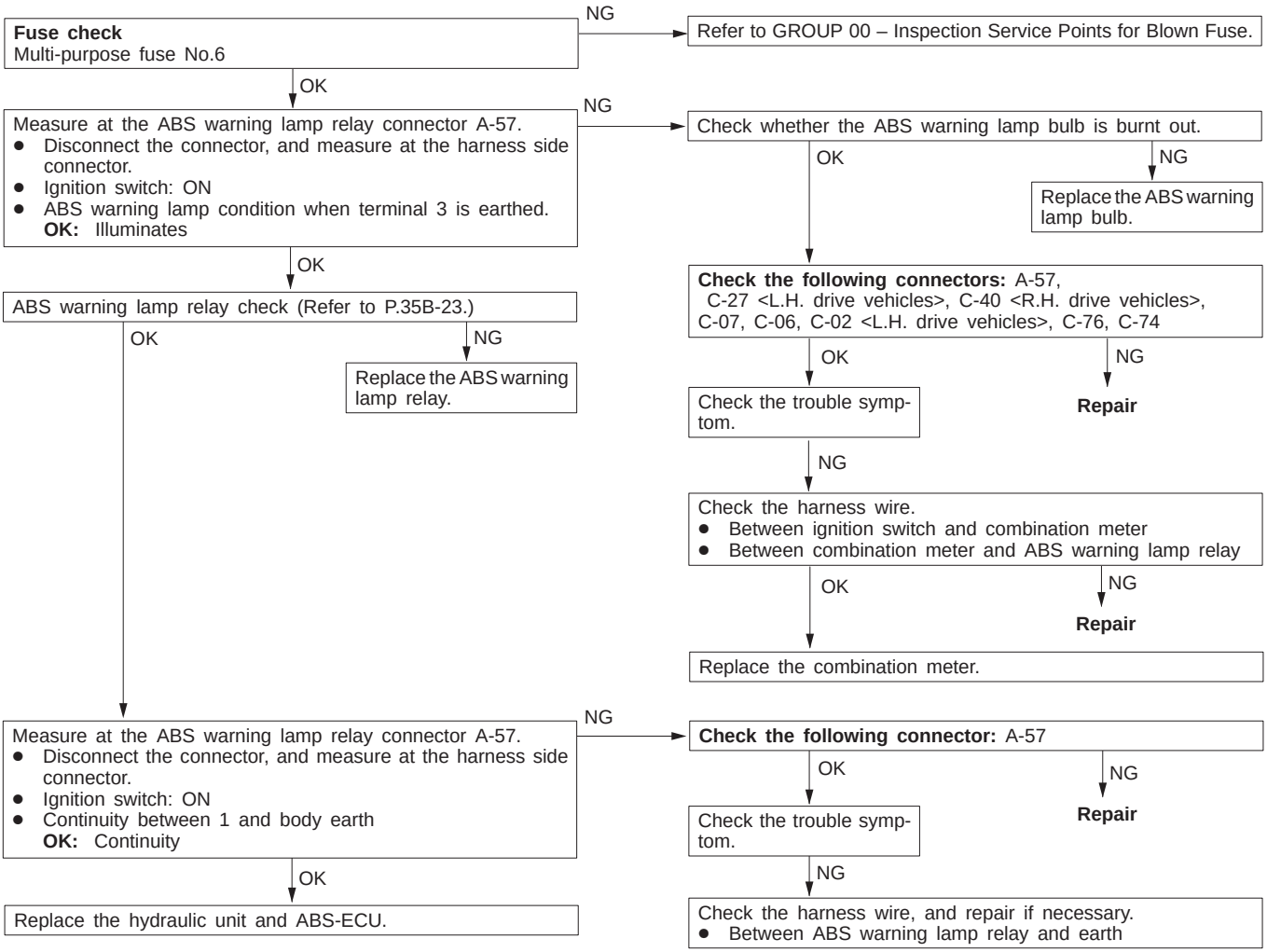
Inspection Procedure 2

Communication between MUT-II and the ABS-ECU is not possible.	Probable cause
The cause may be an open circuit in the ABS-ECU power supply circuit or an open circuit in the diagnosis output circuit.	• Blown fuse • Malfunction of wiring harness or connector • Malfunction of hydraulic unit and ABS-ECU



Inspection Procedure 3

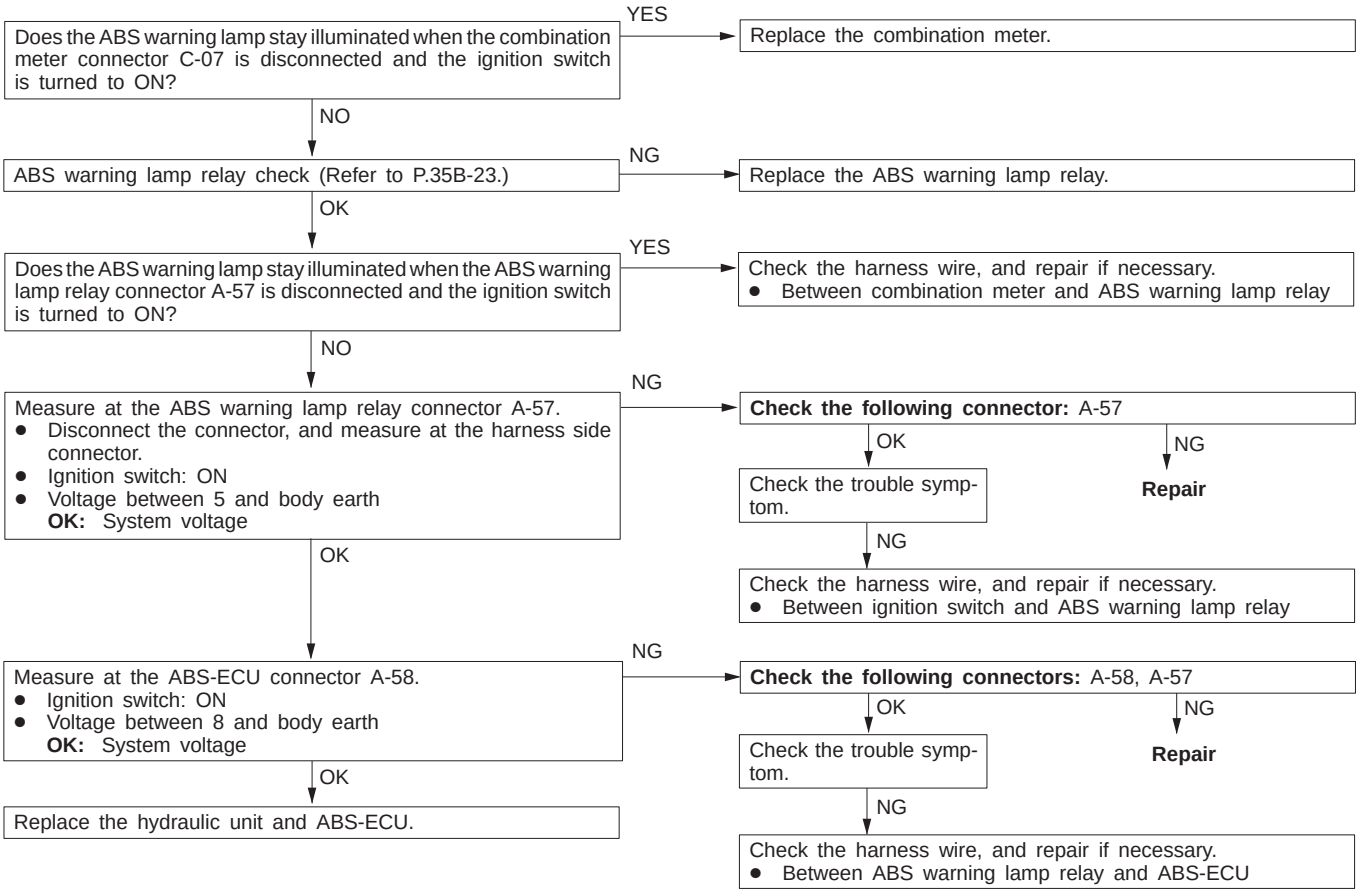
When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate.	Probable cause
The cause may be an open circuit in the lamp power supply circuit, a blown lamp, a malfunction of the ABS warning lamp relay or an open circuit between the ABS warning lamp and the earth.	• Blown fuse • Burn out ABS warning lamp bulb • Malfunction of ABS warning lamp relay • Malfunction of wiring harness or connector • Malfunction of hydraulic unit and ABS-ECU



Inspection Procedure 4

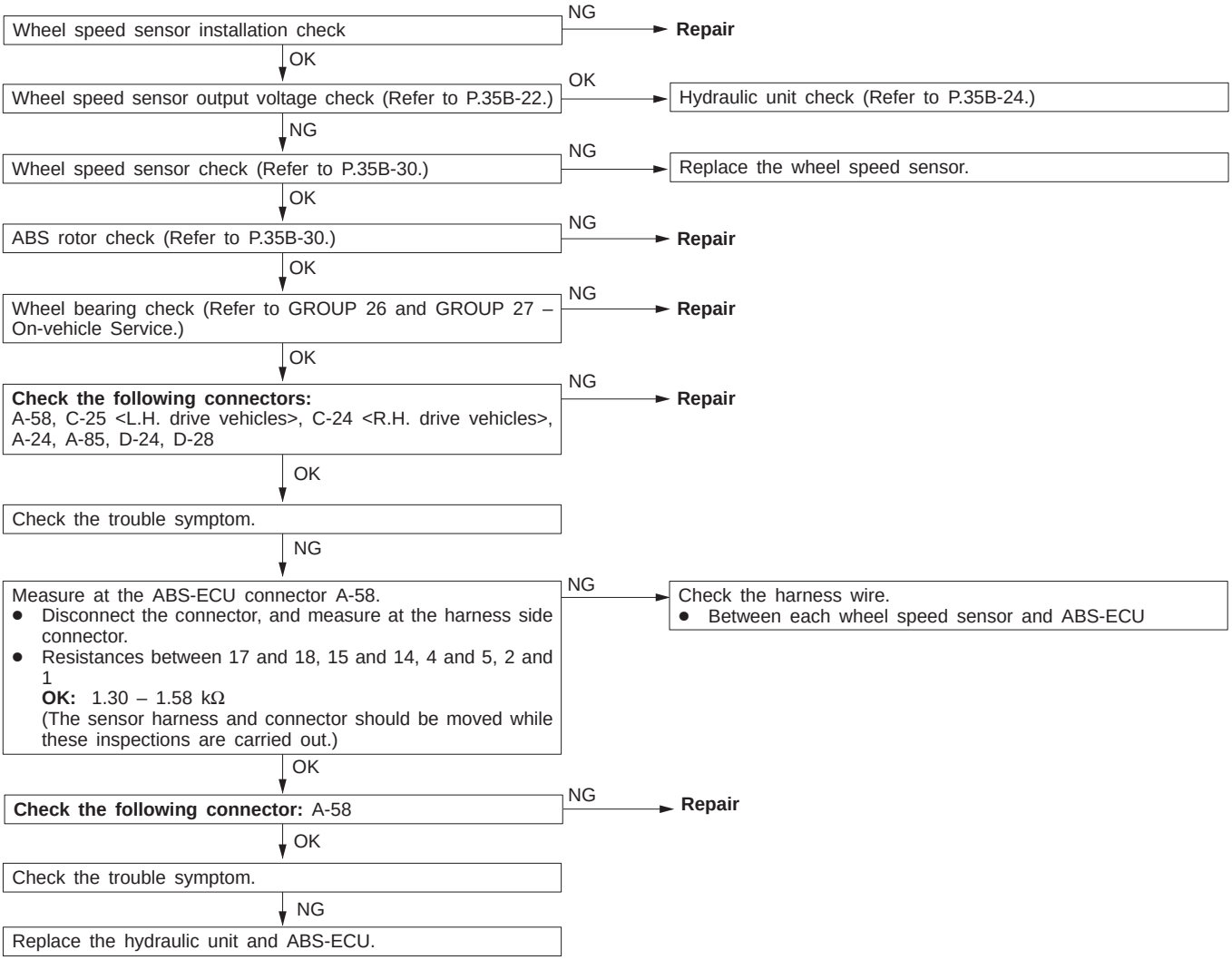
Even after the engine is started, the ABS warning lamp remains illuminated.	Probable cause
The cause is probably a short-circuit in the ABS warning lamp illumination circuit.	● Malfunction of combination meter ● Malfunction of ABS warning lamp relay ● Malfunction of wiring harness (short circuit) ● Malfunction of hydraulic unit and ABS-ECU

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



Inspection Procedure 5

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



DATA LIST REFERENCE TABLE

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

1. When the system is normal

Item No.	Check item	Checking requirements	Normal value
11	Front-right wheel speed sensor	Perform a test run	Vehicle speeds displayed on the speedometer and MUT-II are identical.
12	Front-left wheel speed sensor		
13	Rear-right wheel speed sensor		
14	Rear-left wheel speed sensor		
16	ABS-ECU power supply voltage	Ignition switch: ON	9.2 – 17.5 V
32	G sensor	Vehicle is stopped.	2.4 – 2.6 V
		Vehicle is running.	0.5 – 4.5 V
33	Stop lamp switch	Depress the brake pedal.	ON
		Release the brake pedal.	OFF

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

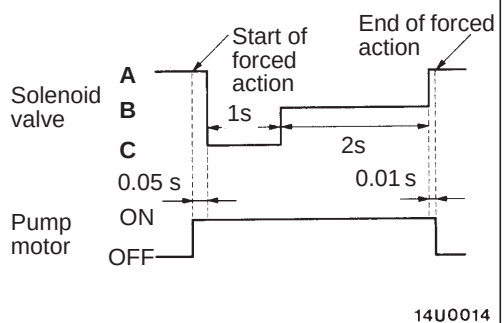
When the diagnosis system stops the ABS-ECU, the MUT-II display data will be unreliable.

ACTUATOR TEST REFERENCE TABLE

The MUT-II activates the following actuators for testing.

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

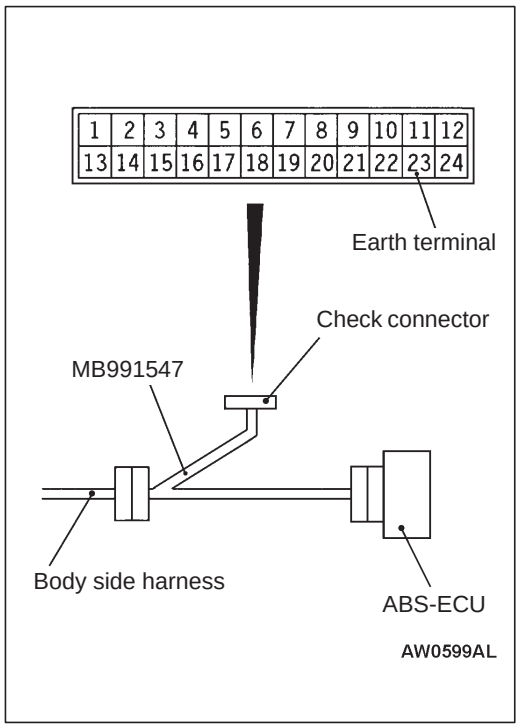
Activation pattern



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

ACTUATOR TEST SPECIFICATIONS

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

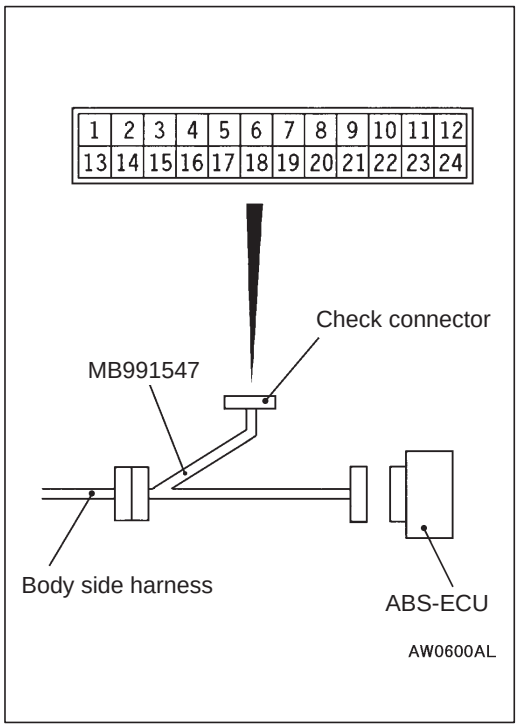


CHECK AT ABS-ECU

TERMINAL VOLTAGE CHECK CHART

1. Disconnect the ABS-ECU connector. (Refer to P. 35B-27.)
2. Use the special tool to measure the voltage between each terminal and earth (terminal No.23).
3. The terminal layout is shown in the illustration.

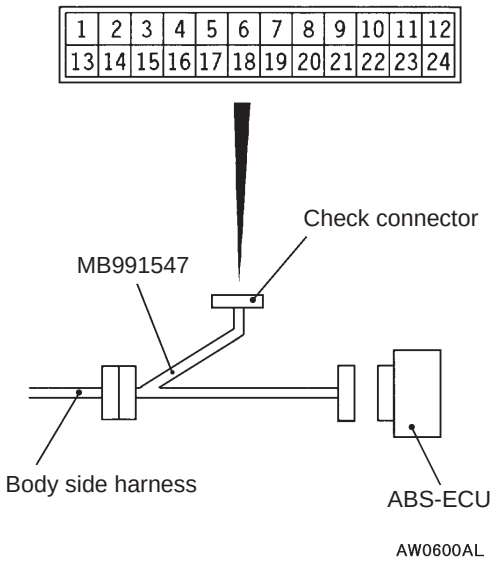
Terminal No.	Check item	Checking requirements		Normal condition
3	Stop lamp switch input	Ignition switch: ON	Stop lamp switch: ON	System voltage
			Stop lamp switch: OFF	1 V or less
7	Input from G sensor	Ignition switch: ON Vehicle is horizontal		2.4 – 2.6 V
8	ABS warning lamp relay transistor output	Ignition switch: ON	When the lamp is switched off	2 V or less
			When the lamp is illuminated	System voltage
9	MUT-II	When the MUT-II is connected		Serial communication with MUT-II
		When the MUT-II is not connected		1 V or less
10	ABS-ECU power supply	Ignition switch: ON		System voltage
		Ignition switch: START		0 V
19	Diagnosis changeover input	When the MUT-II is connected		0 V
		When the MUT-II is not connected		Approx. 12 V
20	G sensor earth	Always		0 V
22	Solenoid valve power supply	Always		System voltage
24	Motor power supply	Always		System voltage



RESISTANCE AND CONTINUITY BETWEEN HARNESS-SIDE CONNECTOR TERMINALS

1. Turn the ignition key to the LOCK (OFF) position.
2. Disconnect the ABS-ECU connector. (Refer to P. 35B-27.)
3. Use the special tool to check the resistance and continuity between the terminals indicated in the table below.
4. The terminal layout is shown in the illustration.

ABS–ECU terminal No.	Signal	Normal condition
1 – 2	Wheel speed sensor (rear left)	1.30 – 1.58 kΩ
4 – 5	Wheel speed sensor (rear right)	
14 – 15	Wheel speed sensor (front left)	
17 – 18	Wheel speed sensor (front right)	
21 – Body earth	Earth	Continuity
23 – Body earth	Earth	



ON-VEHICLE SERVICE

WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK

1. Lift up the vehicle and release the parking brake.
2. Disconnect the ABS-ECU connector and then connect the special tool to the harness side connector. (Refer to P. 35B-27.)
3. Rotate the wheel to be measured at approximately 1/2 – 1 rotation per second, and check the output voltage using a circuit tester or an oscilloscope.

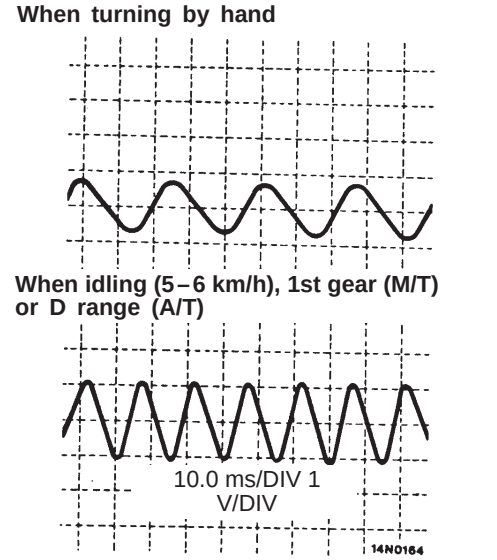
Wheel speed sensor	Front left	Front right	Rear left	Rear right
Terminal No.	15	17	2	4
	14	18	1	5

Output voltage

When measuring with a circuit tester:
42 mV or more

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

4. The followings are suspected if the output voltage is lower than the value described above. Check the wheel speed sensor, and replace if necessary.
   - Too large clearance between the pole piece of the wheel speed sensor and ABS rotor
   - Faulty wheel speed sensor



Inspecting Waveforms With An Oscilloscope

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

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

NOTE

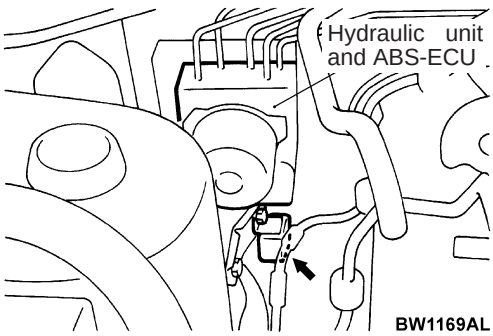
1. The waveform measurements can also be taken while the vehicle is actually moving.
2. The output voltage will be small when the wheel speed is low, and similarly it will be large when the wheel speed is high.

Points In Waveform Measurement

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

Caution
Because the wheel speed sensor cables move together with the front and rear suspension, they vibrate greatly when driving over poor road surfaces. As a result, the sensor harnesses should also be shaken when monitoring of output waveforms of the wheel speed sensors in order to simulate conditions such as driving over poor road surfaces.

<L.H. drive vehicles>



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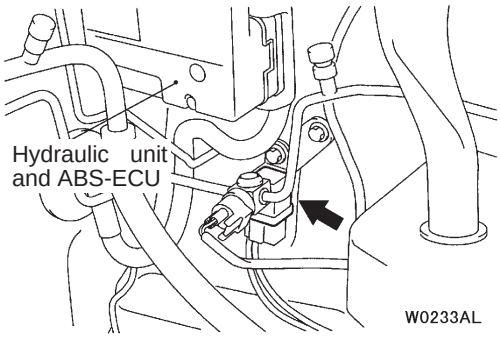

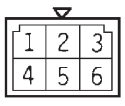

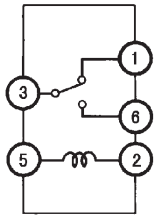

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ABS WARNING LAMP RELAY CONTINUITY CHECK

Battery voltage	Terminal No.			
	1	2	3	5
Power is not supplied	○		○	
		○		○
Power is supplied	⊕		⊖	

HYDRAULIC UNIT CHECK

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

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

2. Turn the ignition key to the LOCK (OFF) position and set the MUT-II.

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

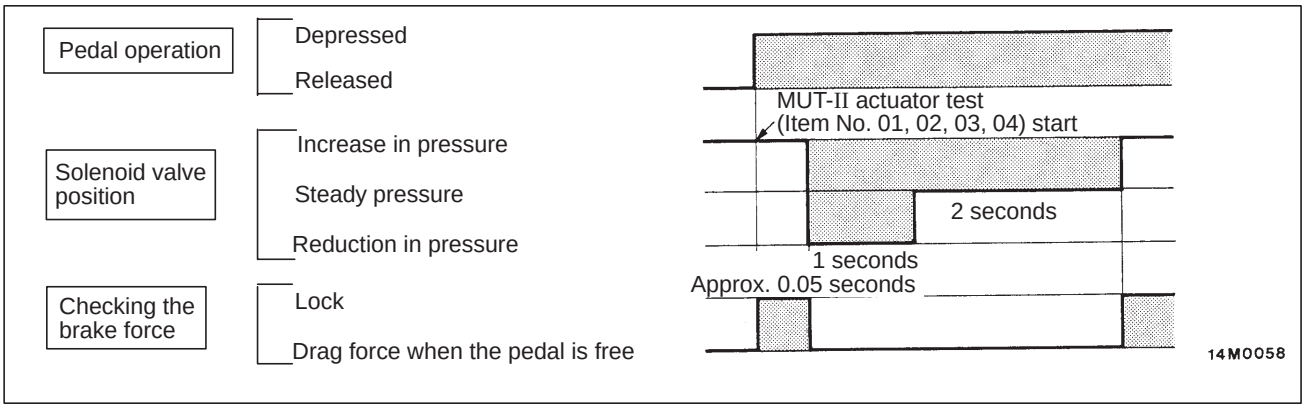
3. After checking that the shift lever <M/T> or the selector lever <A/T> is in neutral, start the engine.
4. Use the MUT-II to force-drive the actuator.

   NOTE
   (1) During the actuator test, the ABS warning lamp will illuminate and the anti-skid control will be cancelled.
   (2) When the ABS has been interrupted by the fail-safe function, the MUT-II actuator testing cannot be used.

5. Turn the wheel by hand and check the change in braking force when the brake pedal is depressed. When using the braking force tester, depress the brake pedal until the braking force is at the following values, and check that the braking force decreases when the actuator is force-driven.

Front wheel	785 – 981 N
Rear wheel	588 – 784 N

The result should be as shown in the following diagram.



6. If the result of inspection is abnormal, correct according to the “Diagnosis Table”.

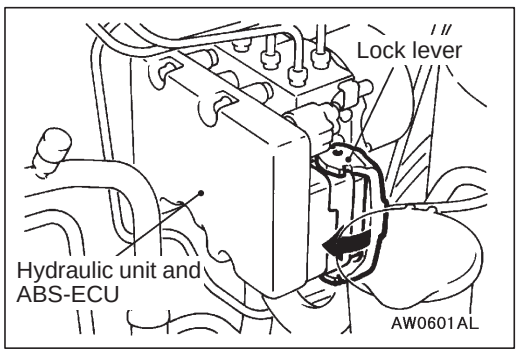
Diagnosis Table

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

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

REMEDY FOR A FLAT BATTERY

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



DISCONNECTING ABS-ECU CONNECTOR

Move the lock lever of the ABS-ECU connector as shown in the illustration, and then disconnect the ABS-ECU connector.

HYDRAULIC UNIT AND ABS-ECU

REMOVAL AND INSTALLATION

Pre-removal Operation
- Brake Fluid Draining
- Air Cleaner Removal (Refer to GROUP 15.)

Post-installation Operation
- Brake Fluid Supplying and Brake Line Bleeding (Refer to GROUP 35A – On-vehicle Service.)
- Hydraulic Unit Inspection (Refer to P.35B-24.)
- Air Cleaner Installation (Refer to GROUP 15.)

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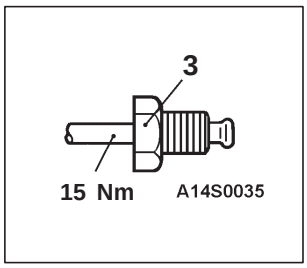

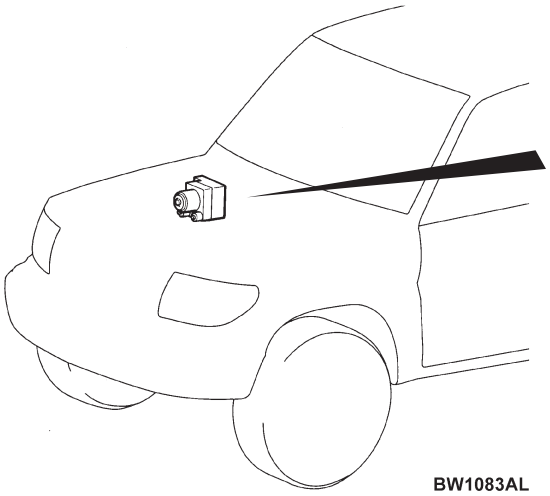

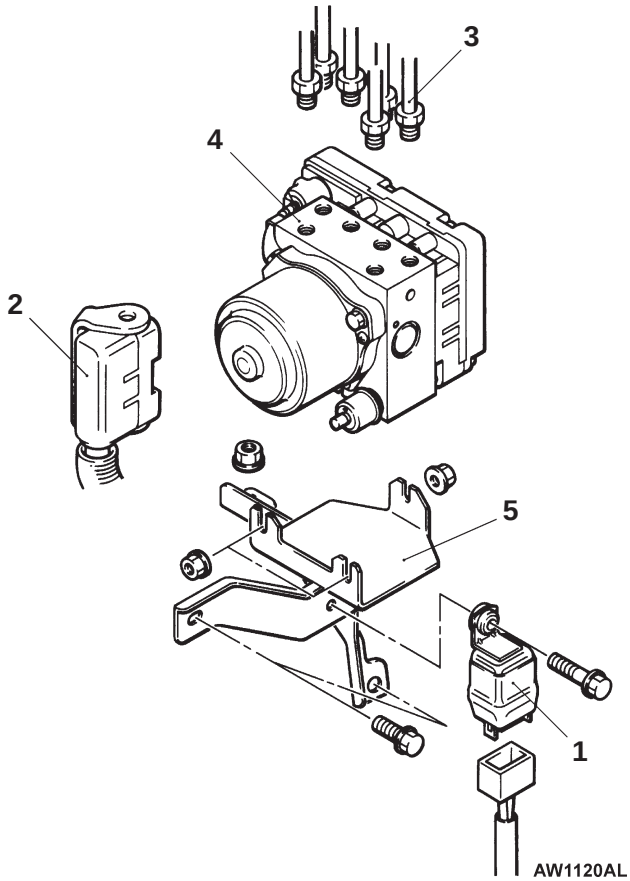

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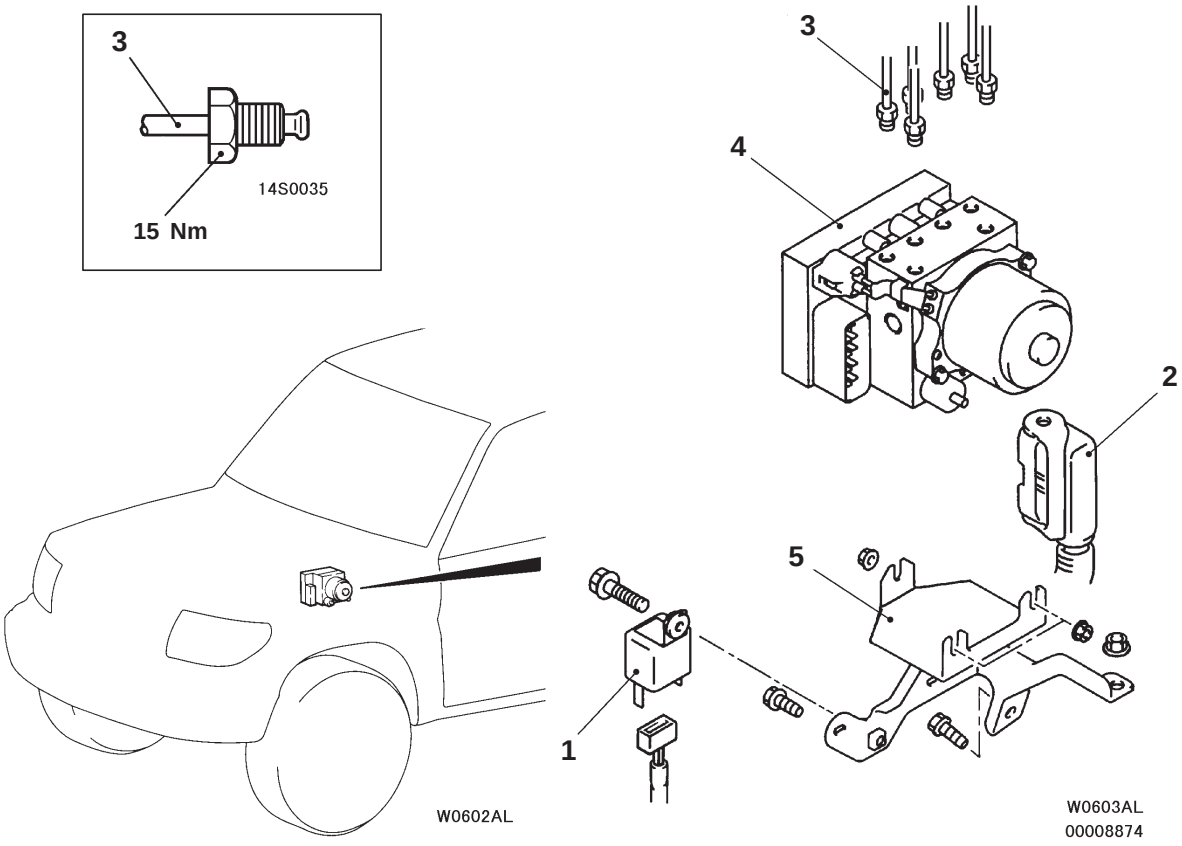
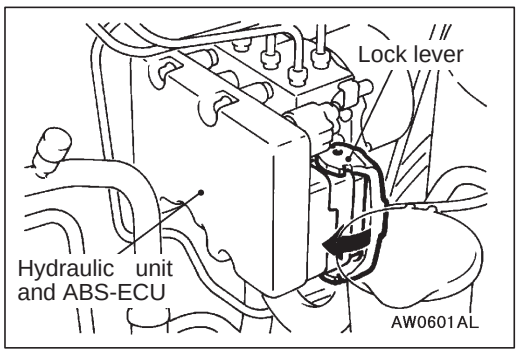


Removal steps

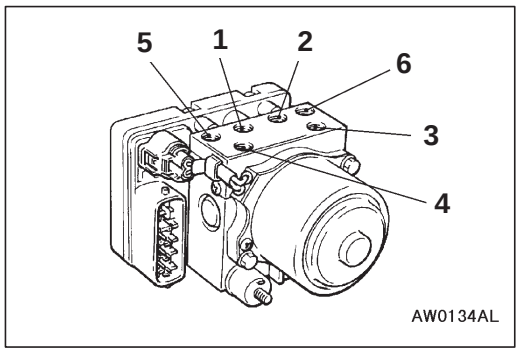
1. ABS warning lamp relay
◀A▶ 2. Harness connector
▶A◀ 3. Brake pipe connection
◀B▶ 4. Hydraulic unit and ABS-ECU
5. Hydraulic unit bracket assembly



REMOVAL SERVICE POINTS

◀A▶ HARNESS CONNECTOR DISCONNECTION

Move the lock lever of the ABS-ECU connector as shown in the illustration, and then disconnect the harness connector.



◀B▶ HYDRAULIC UNIT AND ABS-ECU REMOVAL

Caution

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

INSTALLATION SERVICE POINT

▶A◀ BRAKE PIPE CONNECTION

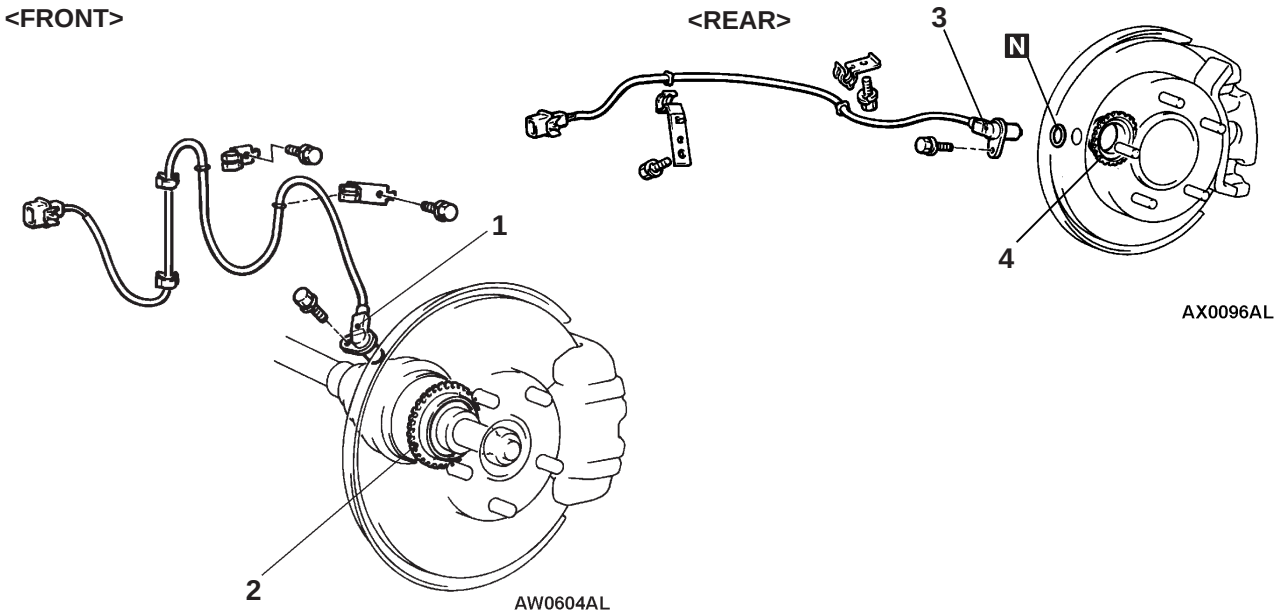
Connect the pipes to the hydraulic unit assembly as shown in the illustration.

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

WHEEL SPEED SENSOR

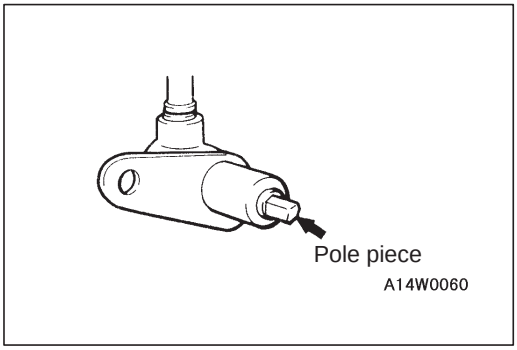
REMOVAL AND INSTALLATION

Post-installation Operation
Wheel Speed Sensor Output Voltage Check
(Refer to P.35B-22.)



◀A▶ 1. Front wheel speed sensor
2. Front ABS rotor (Refer to GROUP 26 – Drive Shaft.)
◀A▶ 3. Rear wheel speed sensor
4. Rear ABS rotor (Refer to GROUP 27 – Axle Shaft.)

NOTE
The front ABS rotor is integrated with the drive shaft. Do not disassemble it.



REMOVAL SERVICE POINT

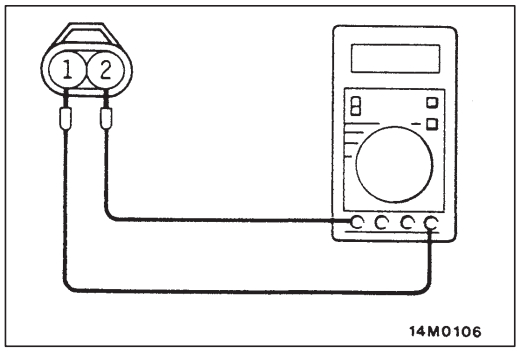
◀A▶ FRONT WHEEL SPEED SENSOR/REAR WHEEL SPEED SENSOR REMOVAL

Caution
Do not strike the pole piece at the tip of the wheel speed sensor against the ABS rotor tooth surface or other parts when removing the wheel speed sensor.

INSPECTION

CHECK OF RESISTANCE BETWEEN WHEEL SPEED SENSOR TERMINALS

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

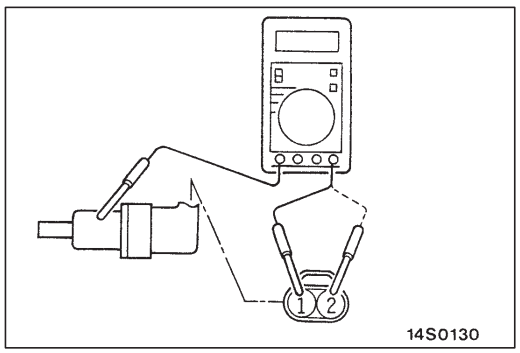


1. Measure the resistance between the wheel speed sensor terminals.

   Standard value: 1.30 – 1.58 kΩ

   If the internal resistance of the wheel speed sensor is not within the standard value, replace with a new wheel speed sensor.
2. Check the wheel speed sensor cable for breakage, damage or disconnection; replace with a new one if a problem is found.

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



WHEEL SPEED SENSOR INSULATION INSPECTION

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

   Standard value: 100 kΩ or more
2. If the speed sensor insulation resistance is outside the standard value range, replace with a new speed sensor.

ABS ROTOR CHECK

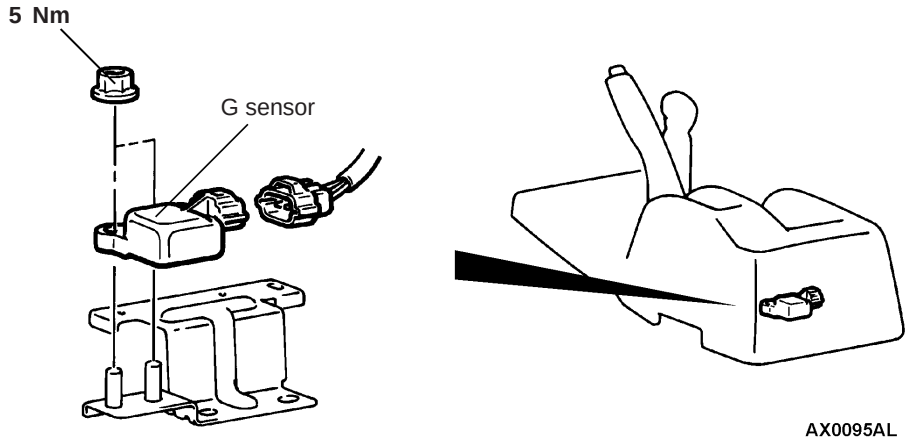
Check whether ABS rotor teeth are broken or deformed, and, if so, replace the B.J. assembly or the ABS rotor.

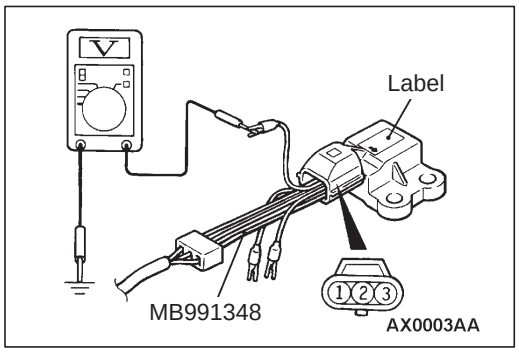
G SENSOR

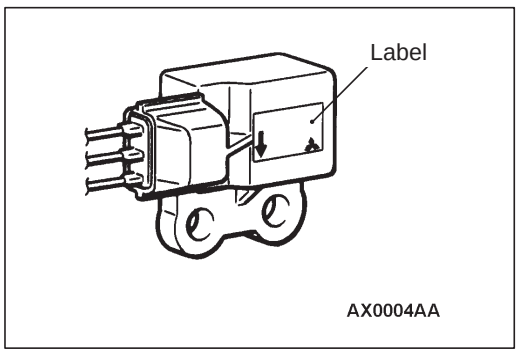
REMOVAL AND INSTALLATION

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

Pre-removal and Post-installation Operation
Rear floor console removal and installation
(Refer to Group 52A.)







INSPECTION

1. Remove the G sensor.
2. Connect the special tool between the disconnected connectors, and then place the G sensor horizontally as shown in the illustration.
3. Turn on the ignition switch, and then measure the voltage between terminal No.2 and body earth.

   Standard value: 2.4 – 2.6 V

4. Face the labeled surface straight down with the special tool still connected. Measure the voltage between terminal No.2 and body earth with the labeled surface faced straight down.

   Standard value: 3.3 – 3.7 V

5. If not within the standard value, check the power supply line and earth condition, and then replace the G sensor.

NOTES