

SERVICE BRAKES

CONTENTS

BASIC BRAKE SYSTEM 35A

ANTI-SKID BRAKING SYSTEM (ABS) <4WD> 35B



BASIC BRAKE SYSTEM

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GENERAL INFORMATION

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

SERVICE PRECAUTION <VEHICLES WITH BREMBO BRAKING SYSTEM>

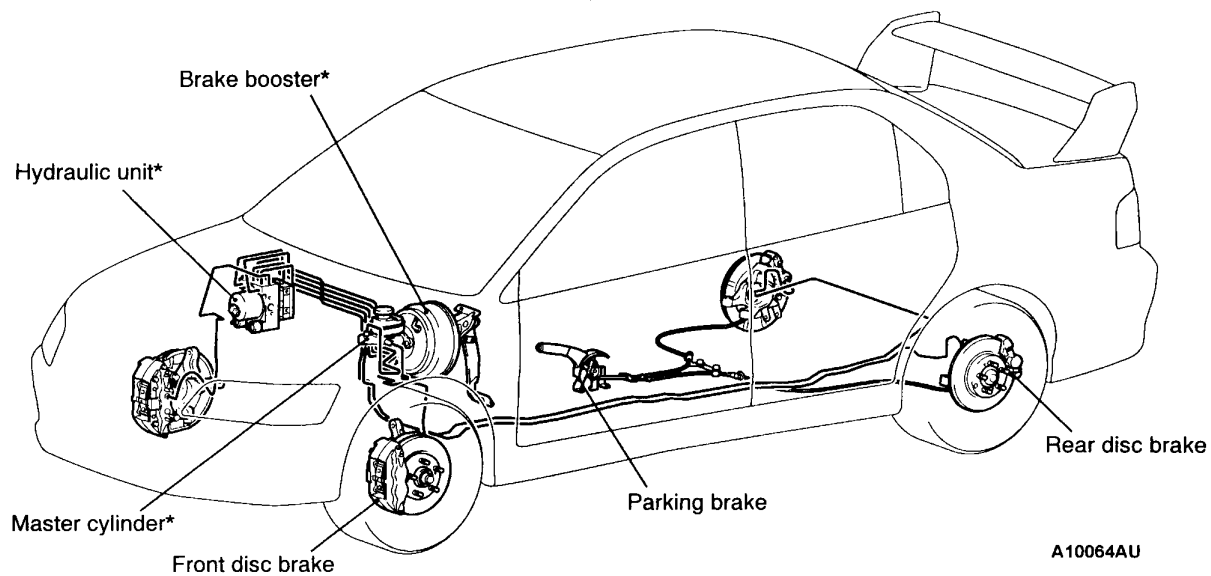
Take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

SPECIFICATIONS

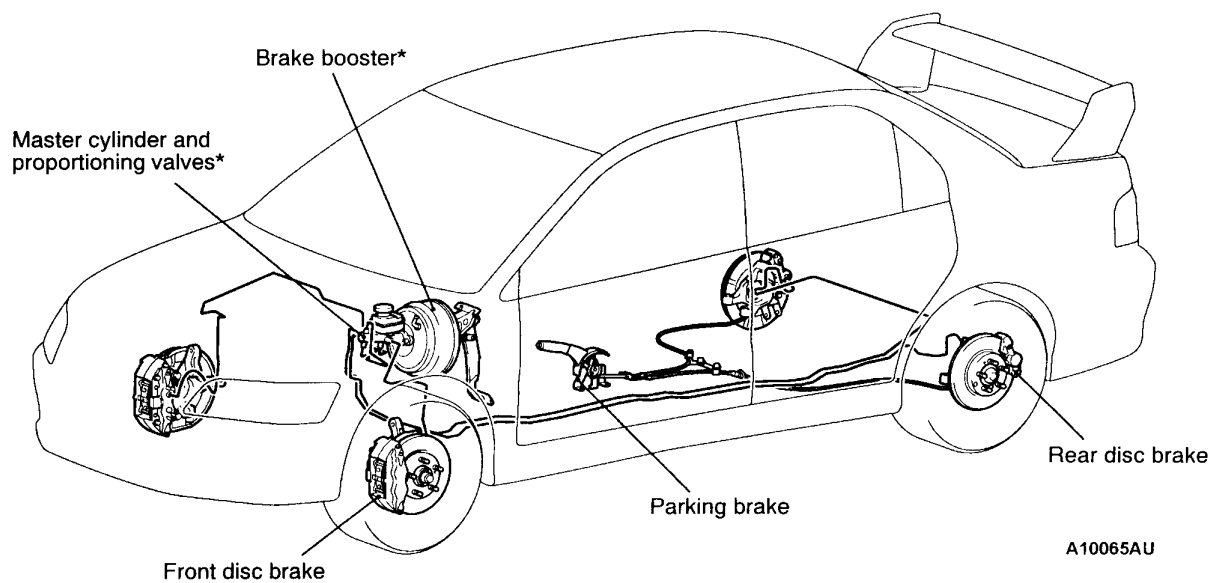
Items		Specifications
Master cylinder	Type	Tandem type
	I.D. mm	26.9
Brake booster	Type	Vacuum type, tandem
	Effective dia. of power cylinder mm	205 + 230
	Boosting ratio	4.5 (Pedal depressing force: 230 N)
Rear wheel hydraulic control method	Vehicles with ABS <RS, RS- II >	Electronic brake-force distribution (EBD)
	Vehicles without ABS <RS>	Proportioning valves
Proportioning valves <Vehicles without ABS>	Type	Single type × 2
	Decompression ratio	0.25
Front brakes <RS (standard)>	Type	Floating caliper, 2 piston, ventilated disc
	Disc effective dia. × thickness mm	227 × 24
	Wheel cylinder I.D. mm	42.9 (×2)
	Pad thickness mm	10.0
	Clearance adjustment	Automatic
Front brakes <RS (option), RS-II>	Type	4 opposed piston, ventilated disc <Brembo braking system>
	Disc effective dia. × thickness mm	263 × 32
	Wheel cylinder I.D. mm	40.0 (×2), 46.0 (×2)
	Pad thickness mm	10.0
	Clearance adjustment	Automatic
Rear brakes <RS (standard)>	Type	Floating caliper, 1 piston, ventilated disc
	Disc effective dia. × thickness mm	237 × 20
	Wheel cylinder I.D. mm	34.9
	Pad thickness mm	10.0
	Clearance adjustment	Automatic
Rear brakes <RS (option), RS-II>	Type	2 opposed piston, ventilated disc <Brembo braking system>
	Disc effective dia. × thickness mm	252 × 22
	Wheel cylinder I.D. mm	40.0 (×2)
	Pad thickness mm	9.0
	Clearance adjustment	Automatic
Brake fluid		DOT3 or DOT4

CONSTRUCTION DIAGRAM

<Vehicles with ABS>



<Vehicles without ABS>



NOTE

For R.H. drive vehicles, only the position indicated by the * is symmetrical.

SERVICE SPECIFICATIONS

Items		Standard value	Limit
Brake pedal height mm		169.1 – 172.1	–
Brake pedal play mm		3 – 8	–
Brake pedal to floorboard clearance when the brake pedal is depressed mm		90 or more	–
Brake booster push rod protrusion amount mm		8.98 – 9.23	–
Proportioning valve <Vehicles without ABS>	Split point MPa	2.70 – 3.19	–
	Output fluid pressure MPa <Input fluid pressure: 6.86Mpa>	3.68 – 4.17	–
	Output fluid pressure difference between left and right MPa	–	0.49
Front disc brake <RS (standard)>	Pad thickness mm	10.0	2.0
	Disc thickness mm	24.0	22.4
	Disc run-out mm	–	0.03
	Drag force N	51 or less	–
Brembo front disc brake <RS (option), RS-II>	Pad thickness mm	10.0	2.0
	Disc thickness mm	32.0	29.8
	Disc run-out mm	–	0.03
	Drag force N	69 or less	–
Rear disc brake <RS (standard)>	Pad thickness mm	10.0	2.0
	Disc thickness mm	20.0	18.4
	Disc run-out mm	–	0.03
	Drag force N	69 or less	–
Brembo rear disc brake <RS (option), RS-II>	Pad thickness mm	9.0	2.0
	Disc thickness mm	22.0	20.4
	Disc run-out mm	–	0.03
	Drag force N	69 or less	–
Front wheel bearing axial play mm		–	0.06
Rear wheel bearing axial play mm		–	0.05

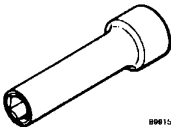
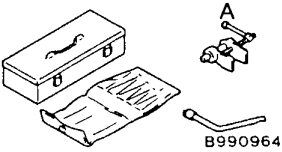
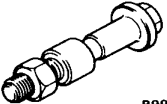
LUBRICANTS

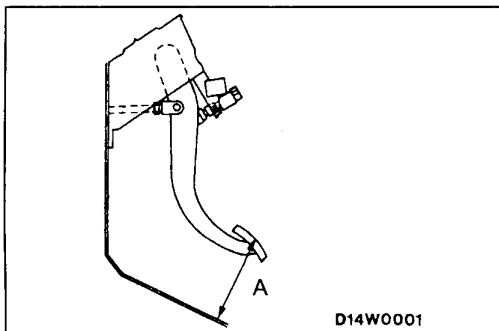
Items	Specified Lubricant	Quantity
Brake fluid	DOT3 or DOT4	As required
Piston, wheel cylinder body		
Piston boot, piston seal, shim	Repair kit grease	
Guide pin, lock pin, pin boot <Except for Brembo disc brake>		
Pad assembly <Brembo disc brake>		

SEALANT

Items	Specified sealant	Remarks
Fitting	3M ATD Part No. 8661, 8663 or equivalent	Semi-drying sealant

SPECIAL TOOLS

Tool	Number	Name	Use
 B991568	MB991568	Push rod adjusting socket	Adjustment of the brake booster push rod protrusion amount
 B990964	MB990964 A: MB990520	Brake tool set	Pushing-in of the disc brake piston ● Disc brake piston pushing-in
 B990998	MB990998	Front hub remover and installer	Provisional holding of the wheel bearing



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.

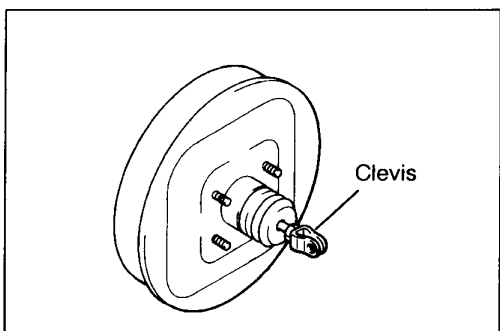
Standard value (A): 169.1 – 172.1 mm

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 brake booster. (Refer to P.35A-17.)

NOTE

With the master cylinder and brake pipe connected, remove the brake booster only.

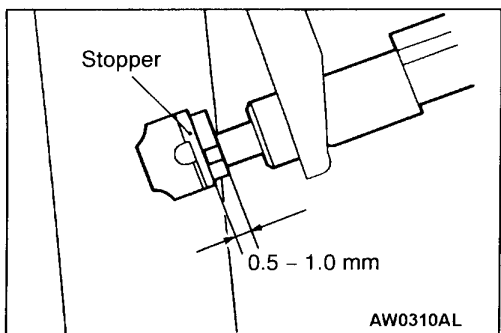


- (4) Adjust the brake pedal height by turning the clevis.

NOTE

When the clevis is turned 180°, the pedal height is changed approximately 2.4 mm.

- (5) Install the brake booster. (Refer to P.35A-17.)
- (6) Measure brake pedal height, and ensure that the measured value is within the specified value. When it is out of the specified value, repeat Step (3) – (6).



- (7) Insert the stop lamp switch until its thread part touches the stopper. Then 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.

- (8) Connect the connector at the stop lamp switch.

Caution

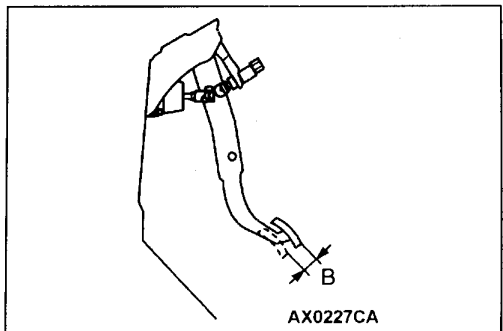
Check that the stop lamp does not illuminate when the brake pedal is not depressed.

4. Return the carpet, etc.

BRAKE PEDAL FREE PLAY

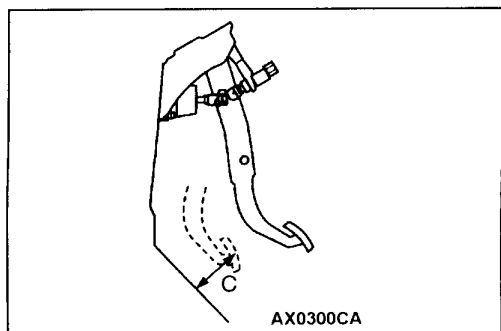
1. With the engine stopped, depress the brake pedal two or three times. After eliminating the vacuum in the power brake booster, press the pedal down by hand, and confirm that the amount of movement before resistance is met (the free play) is within the standard value.

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 500 N of force, and measure the clearance between the brake pedal and the floorboard.

Standard value (C): 90 mm or more

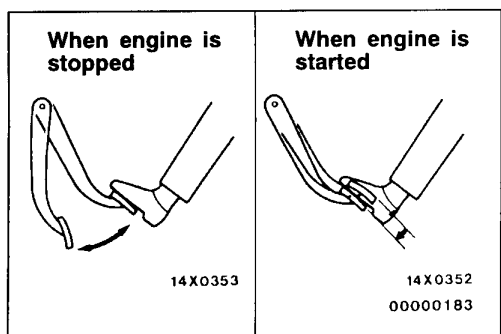
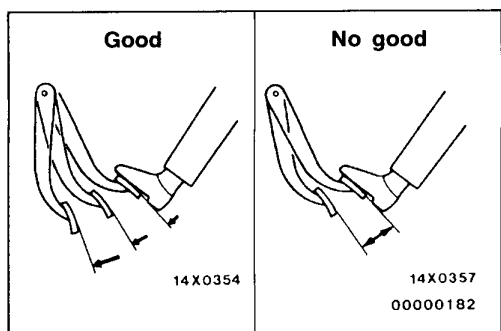
3. If the clearance is outside the standard value, check for air trapped in the brake line and thickness of the disc brake pad and dragging in the parking brake. Adjust and replace defective parts as required.
4. Return the carpet, etc.

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.

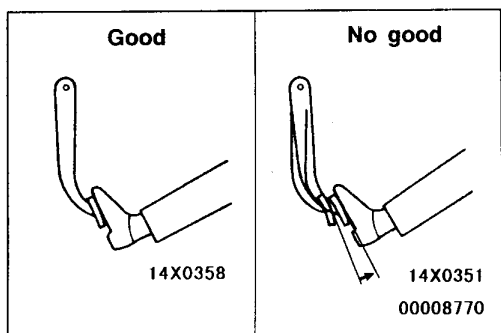
If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly. If the pedal height remains unchanged, the booster is defective.



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-17.)

Caution

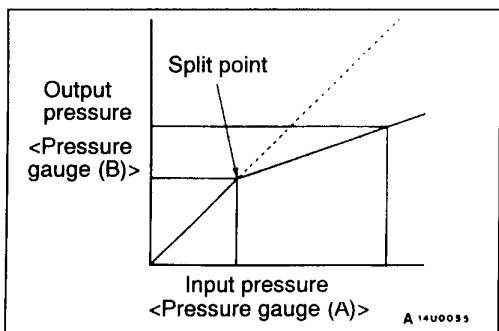
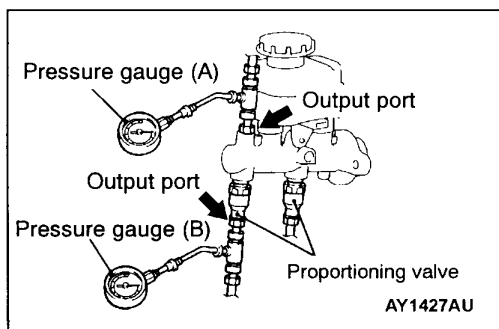
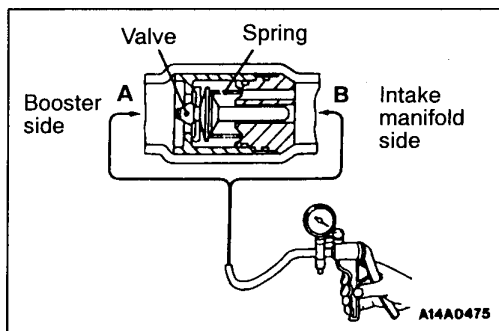
The check valve should not be disassembled from the vacuum hose as they are united as one part.

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.

PROPORTIONING VALVE FUNCTION TEST
<Vehicles without ABS>**Caution**

The proportioning valves are installed independently for the right and left brake lines. Always measure each valve.

1. Connect two pressure gauges to the output port of the master cylinder and output port of the proportioning valve.
2. Bleed the brake line and the pressure gauges. (Refer to P.35A-10.)

3. Depress the brake pedal gradually. Then check that the split point, where the output fluid pressure begins to drop in proportion to the output fluid pressure, is at the standard value.

Standard value: 2.70 – 3.19 MPa

4. Depress the brake pedal more strongly than at the above step. Then check that the output fluid pressure is at the standard value when the input fluid pressure is 6.86 MPa.

Standard value: 3.68 – 4.17 MPa

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

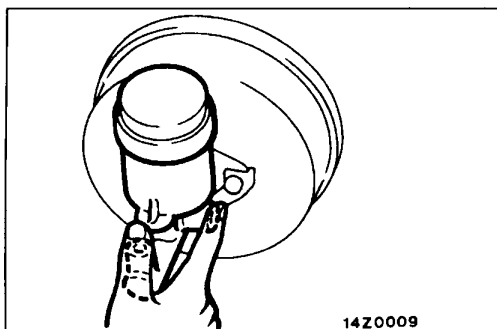
Limit: 0.49 MPa

6. If the measured pressure exceeds the limit, replace the proportioning valve.

BLEEDING**Caution**

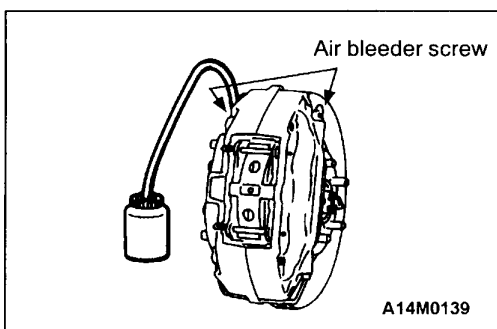
Specified brake fluid: DOT3 or DOT4

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.

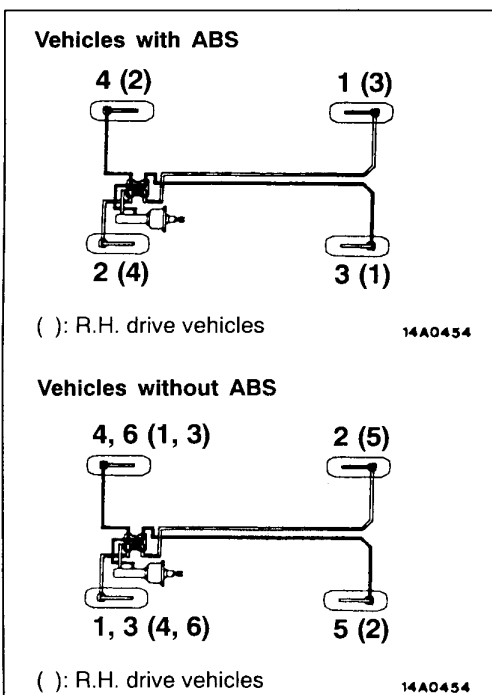
**BREMBO DISC BRAKE BLEEDING****Caution**

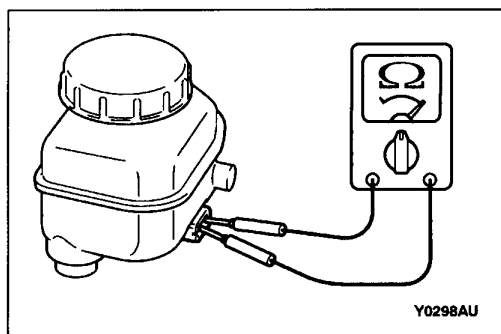
Take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.

Connect a vinyl tube to the outer end of the air bleeder screw to bleed the circuit of air. Then, connect the vinyl tube to the inner end and bleed the circuit of air. Except for these, the conventional procedures shall be followed. After the circuit has been bled of air, tighten both air bleeder screws securely.

BRAKE PIPE LINE BLEEDING

Bleed the air in the sequence shown in the figure.





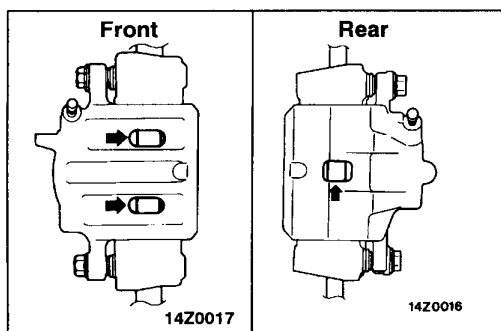
BRAKE FLUID LEVEL SENSOR CHECK

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 <Except for Brembo disc brake>

NOTE

The wear indicator contacts the brake disc when the brake pad thickness reaches approximately 2 mm and emit a squealing sound to warn the driver.

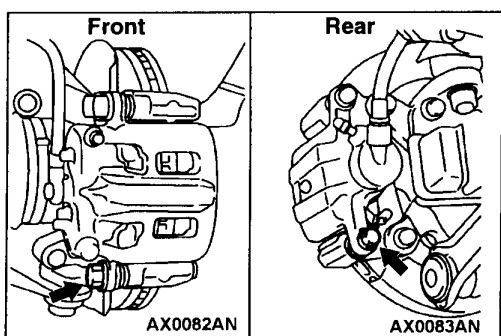


1. Check the brake pad thickness through the caliper body check port.

Standard value: 10.0 mm

Limit: 2.0 mm

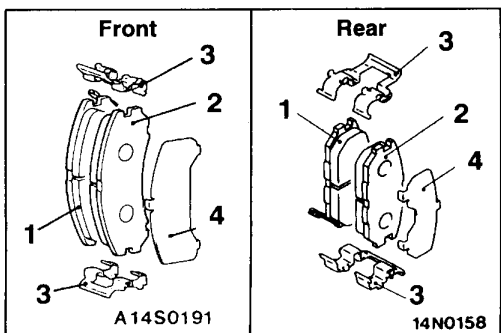
2. When the thickness is less than the limit, always replace the pads at an axle set.



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

Caution

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



4. Remove the following parts from the caliper support.
 1. Pad and wear indicator assembly
 2. Pad assembly
 3. Clip
 4. 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-21.)
6. Install the pads and caliper assembly, and then check the brake drag force. (Refer to P.35A-21.)

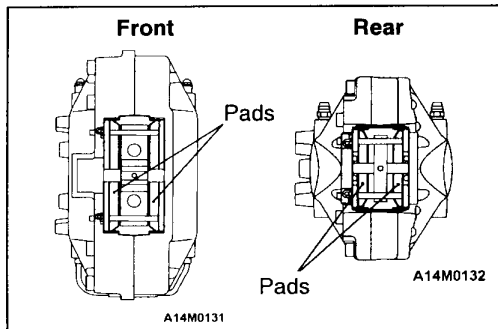
<Brembo disc brake>

Caution

Take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.

NOTE

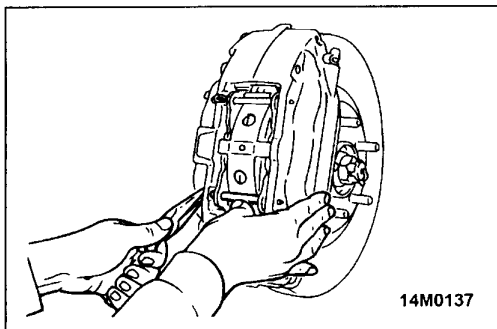
The wear indicator contacts the brake disc when the brake pad thickness reaches approximately 2 mm and emit a squealing sound to warn the driver.



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

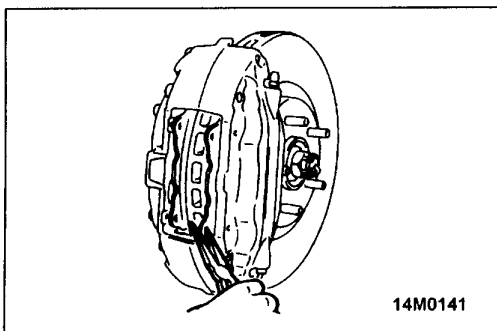
Standard value: 10.0 mm <Front>, 9.0 mm <Rear>

Limit: 2.0 mm

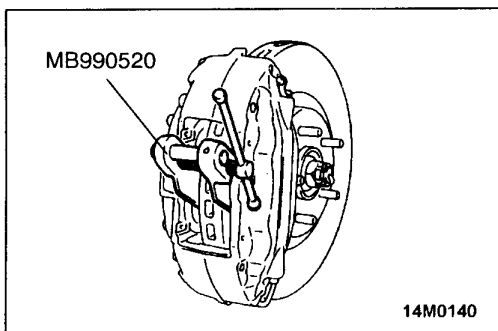


2. When the thickness is less than the limit, always replace the pads at an axle set.

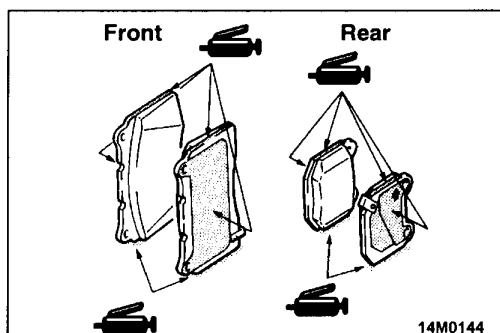
- (1) Holding the cross spring with one hand, pull the pin out of the caliper.



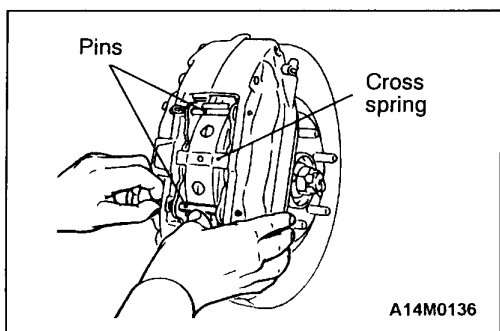
- (2) Remove the pad from the caliper.
- (3) To measure brake drag force after new pads have been installed, use a spring balance to measure the turning sliding resistance of the hub with the pads removed. (Refer to P.35A-21.)



- (4) Clean the piston and, using the special tool, push the piston into the cylinder.



- (5) Apply repair kit grease to the portions of the pads indicated on the left. At this time, make sure that the grease will not be applied to any other surfaces.
- (6) Mount the pads to the caliper so that its side with the wear indicator is on the outside of the vehicle. With the rear pads, ensure that the arrow on the pad faces in the same direction as the brake disc turns when the vehicle moves forward.



- (7) Holding the cross spring with one hand, fit pins in the caliper.
- (8) Using a spring balance, measure the turning sliding resistance of the hub in the forward direction.
- (9) Find the brake disc drag force [the difference in measurements taken in step(3) and in step(8)].

Standard value: 69 N or less

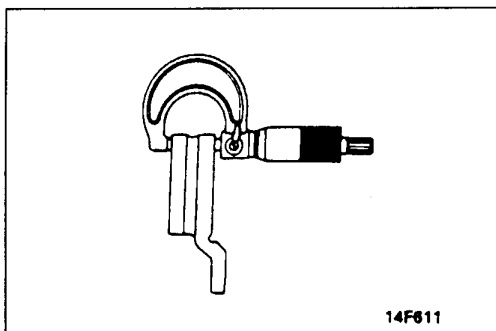
DISC BRAKE ROTOR CHECK

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

Caution: Brembo disc brake

Take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.

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 <Except for Brembo disc brake>
 Standard value: 24.0 mm <Front>, 20.0 mm <Rear>
 Limit: 22.4 mm <Front>, 18.4 mm <Rear>

Brake disc thickness <Brembo disc brake>
 Standard value: 32.0 mm <Front>, 22.0 mm <Rear>
 Limit: 29.8 mm <Front>, 20.4 mm <Rear>

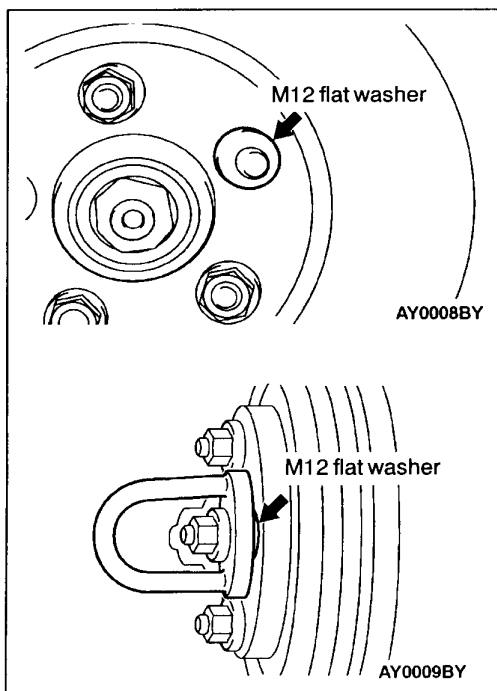
Thickness variation (at least 8 positions)

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).

Caution

- (1) After a new brake disc is installed, always grind the brake disc with on-the-car type brake lathe. If this step is not carried out, the brake disc run-out exceeds the specified value, resulting in judder.
- (2) When the on-the-car type lathe is used, first install M12 flat washer on the stud bolt in the brake disc side according to the figure, and then install the adapter. If the adapter is installed with M12 flat washer not seated, the brake disc rotor may be deformed, resulting in inaccurate grinding.
- (3) Grind the brake disc with all wheel nuts diagonally and equally tightened to the specified torque 100 N·m. When all numbers of wheel nuts are not used, or the tightening torque is excessive or not equal, the brake disc rotor or drum may be deformed, resulting in judder.

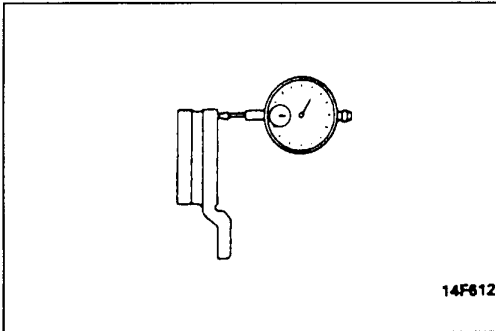


BRAKE DISC RUN-OUT CHECK AND CORRECTION

Caution: Brembo disc brake

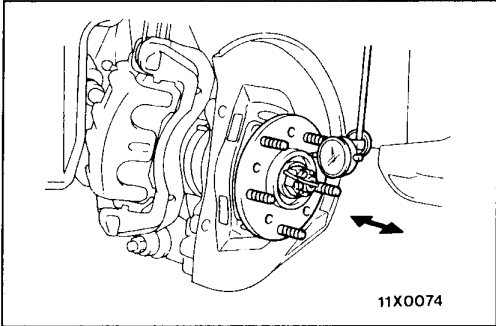
Take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.

1. Remove the brake assembly, and then hold it with wire.
2. Temporarily install the disc with the hub nut.



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

Limit: 0.03 mm or less



4. 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.
- (2) Remove the brake disc. Then place a dial gauge as shown, and measure the wheel bearing axial play by pushing and pulling the wheel hub.

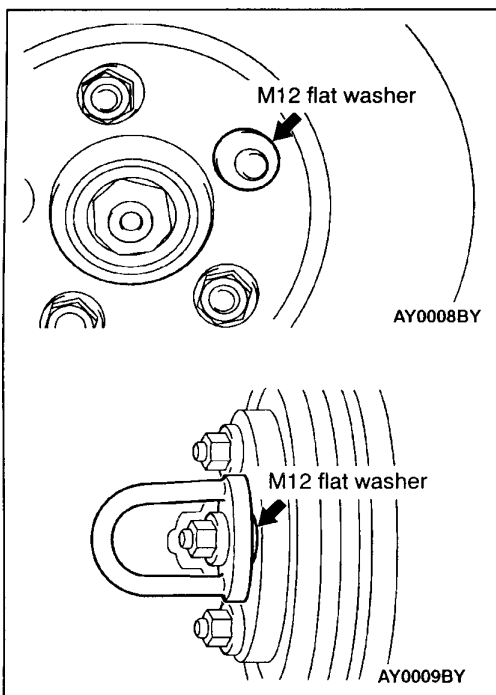
Limit: 0.06 mm <Front>, 0.05 mm <Rear>

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

5. 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).

Caution

- (1) After a new brake disc is installed, always grind the brake disc with on-the-car type brake lathe. If this step is not carried out, the brake disc run-out exceeds the specified value, resulting in judder.

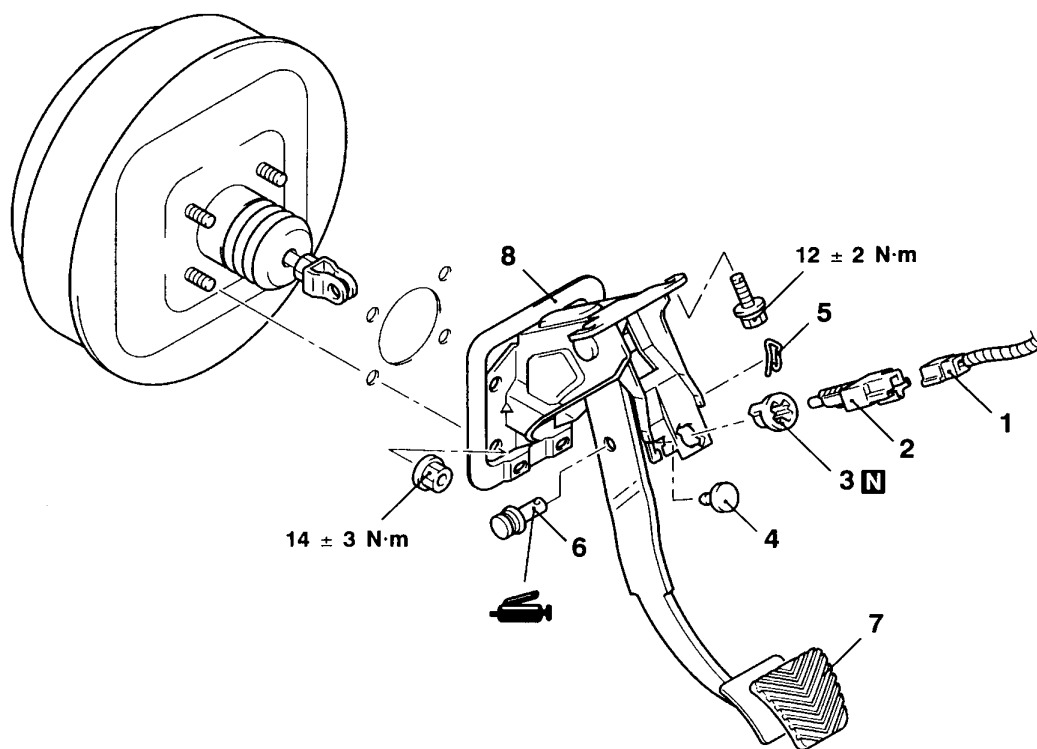


- (2) When the on-the-car type lathe is used, first install M12 flat washer on the stud bolt in the brake disc side according to the figure, and then install the adapter. If the adapter is installed with M12 flat washer not seated, the brake disc rotor may be deformed, resulting in inaccurate grinding.
- (3) Grind the brake disc with all wheel nuts diagonally and equally tightened to the specified torque 100 N·m. When all numbers of wheel nuts are not used, or the tightening torque is excessive or not equal, the brake disc rotor or drum may be deformed, resulting in judder.

BRAKE PEDAL

REMOVAL AND INSTALLATION

Post-installation Operation
Brake Pedal Adjustment (Refer to P.35A-7.)

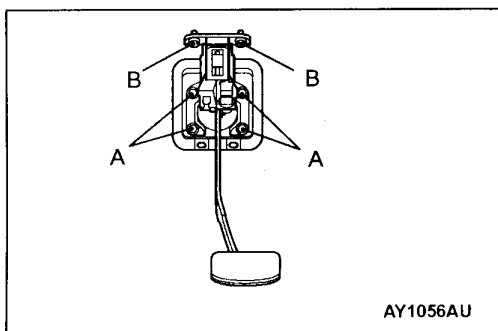


A10071AU

Removal steps

1. Harness connector
2. Stop lamp switch
3. Adjuster
4. Pedal stopper
5. Snap pin

6. Pin assembly
7. Pedal pad
- ▶A◀ 8. Brake pedal and pedal support member



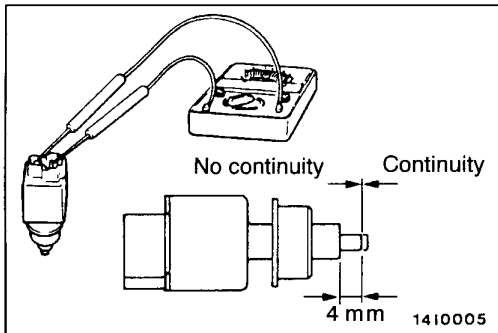
AY1056AU

INSTALLATION SERVICE POINT**▶A◀ BRAKE PEDAL AND PEDAL SUPPORT MEMBER INSTALLATION**

Tighten the brake booster mounting nuts (A), and then the brake pedal mounting bolts (B).

NOTE

The pedal support member can not be positioned correctly if the pedal mounting bolts (B) are tightened first as the their holes are oblong holes.



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.

PROPORTIONING VALVE, MASTER CYLINDER AND BRAKE BOOSTER

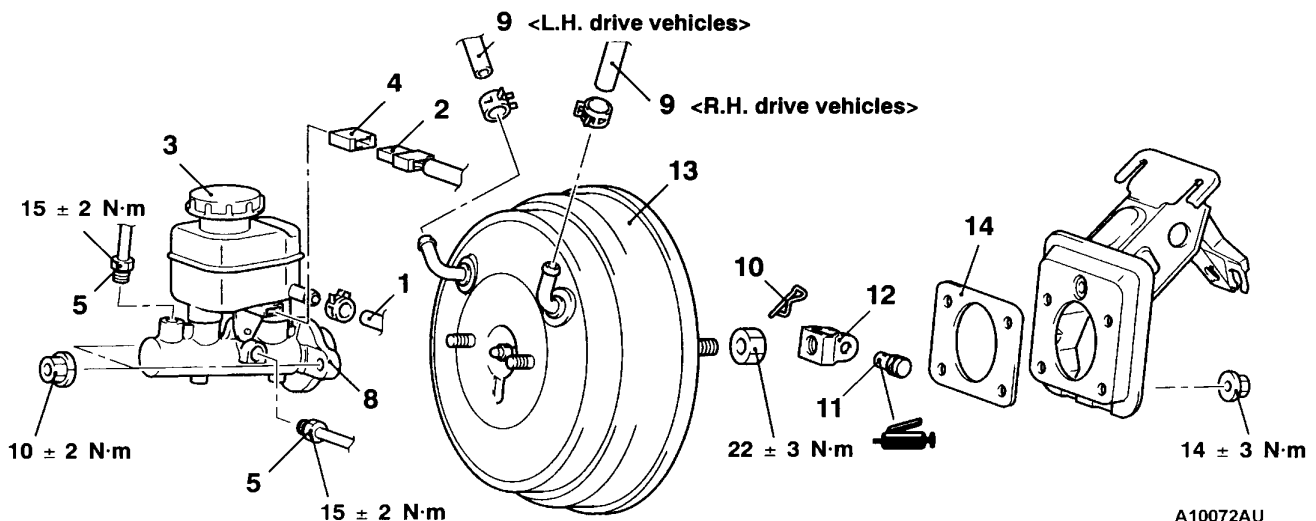
REMOVAL AND INSTALLATION

Pre-removal Operation

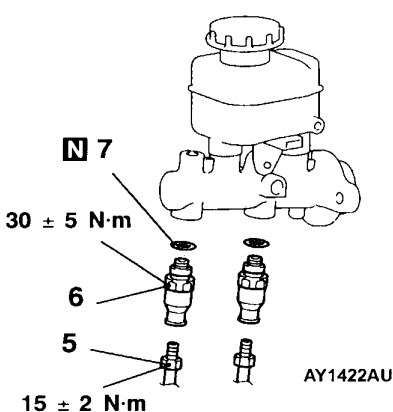
- Air Intake Hose and Air Cleaner Removal <L.H. drive vehicles>
- Strut Tower Bar Removal (Refer to GROUP 42.)
- Brake Fluid Draining

Post-installation Operation

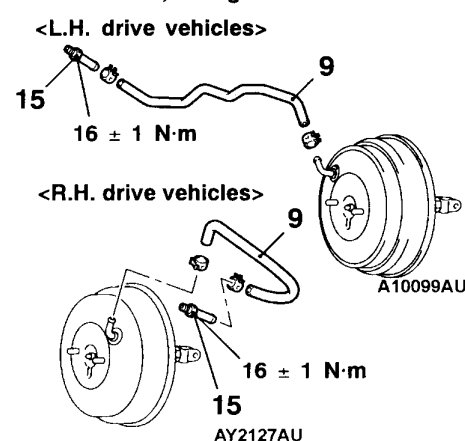
- Brake Fluid Supplying and Air Bleeding (Refer to P.35A-10.)
- Brake Pedal Adjustment (Refer to P.35A-7.)
- Air Intake Hose and Air Cleaner Installation <L.H. drive vehicles>
- Strut Tower Bar Installation (Refer to GROUP 42.)



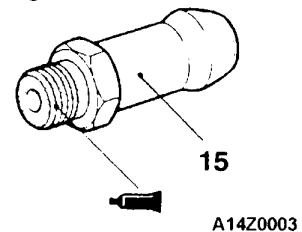
Proportioning valves <Vehicles without ABS>



Vacuum hose, fitting



Fitting



Specified Sealant: 3M ATD
Part No.8661, 8663 or
equivalent

Master cylinder removal steps

1. Clutch hose connection
2. Brake fluid level sensor connector
3. Reservoir cap assembly
4. Brake fluid level sensor
5. Brake pipe connection
6. Proportioning valve
7. O ring <Vehicles without ABS>
8. Master cylinder

**Proportioning valve removal steps
<Vehicles without ABS>**

5. Brake pipe connection
6. Proportioning valve
7. O ring

Brake booster removal steps

1. Clutch hose connection
2. Brake fluid level sensor connector

5. Brake pipe connection
8. Master cylinder
- ▶B◀ • Push rod protrusion amount check and adjustment
- ▶A◀ 9. Vacuum hose
(With built-in check valve)
10. Snap pin
11. Pin assembly
12. Clevis
- Remove A/C liquid pipe B from the retaining clip. (Refer to GROUP 55A – Refrigerant Line.)
13. Brake booster
14. Sealer

Fitting removal steps

- ▶A◀ 9. Vacuum hose
(With built-in check valve)
15. Fitting

INSTALLATION SERVICE POINTS**▶A◀ VACUUM HOSE CONNECTION**

Insert the vacuum hose to the brake booster with its paint mark facing upward, and then secure the hose by using the hose clip.

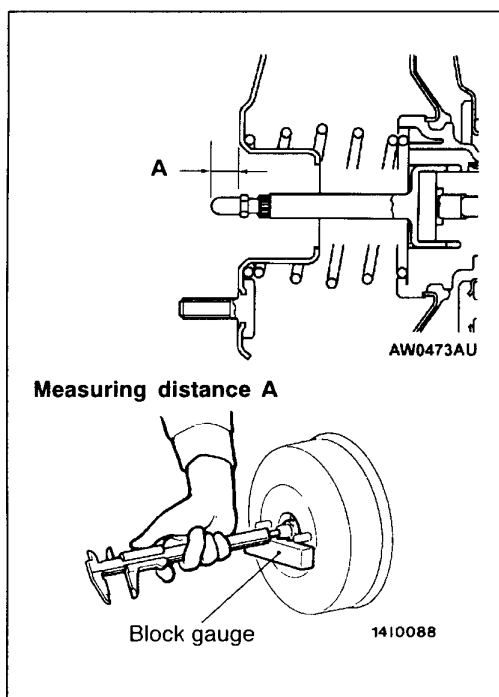
▶B◀ PUSH ROD PROTRUSION AMOUNT CHECK AND ADJUSTMENT

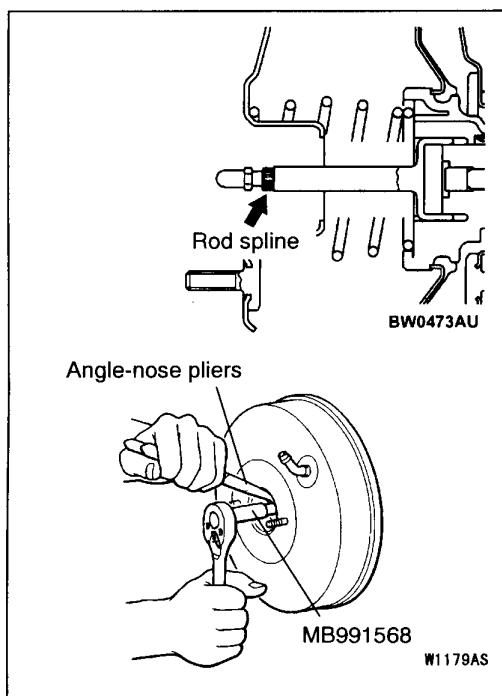
1. Measure dimension (A).

Standard value (A) : 8.98 – 9.23 mm

NOTE

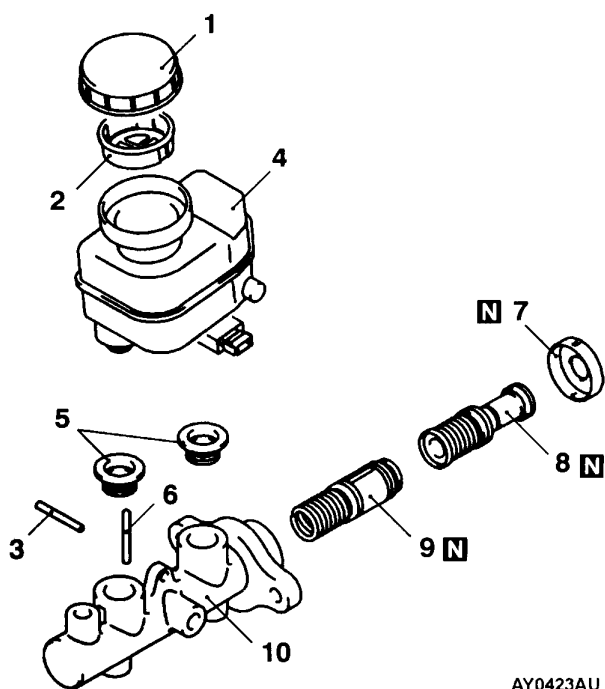
When a negative pressure of 66.7 kPa is applied to the brake booster, the push rod should protrude 10.27 – 10.53 mm.





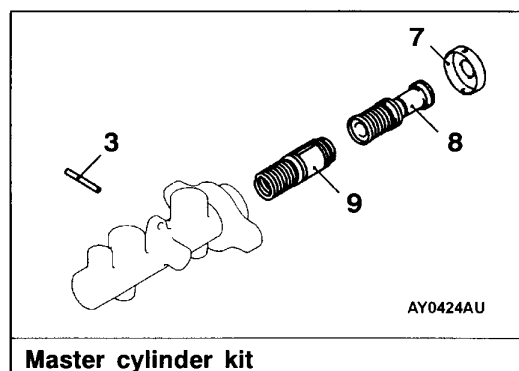
2. If the protrusion amount is not within the standard value range, adjust the push rod length by turning the push rod. Use the special tool to turn the push rod while holding the rod spline with angle-nose pliers.

MASTER CYLINDER DISASSEMBLY AND REASSEMBLY

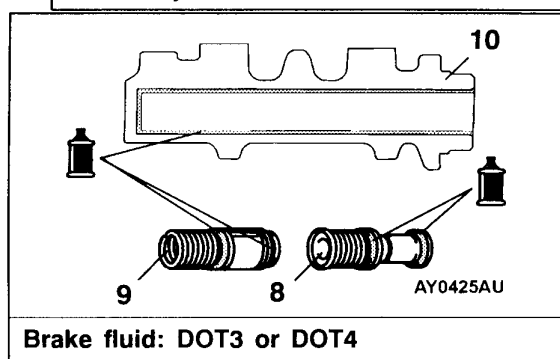


Disassembly steps

1. Reservoir cap
2. Filter <Vehicles with ABS>
3. Spring pin
4. Reservoir tank
5. Reservoir seal



Master cylinder kit



Brake fluid: DOT3 or DOT4

6. Pin <Vehicles with ABS>
7. Piston retainer
8. Primary piston assembly
9. Secondary piston assembly
10. Master cylinder body

DISC BRAKE

REMOVAL AND INSTALLATION

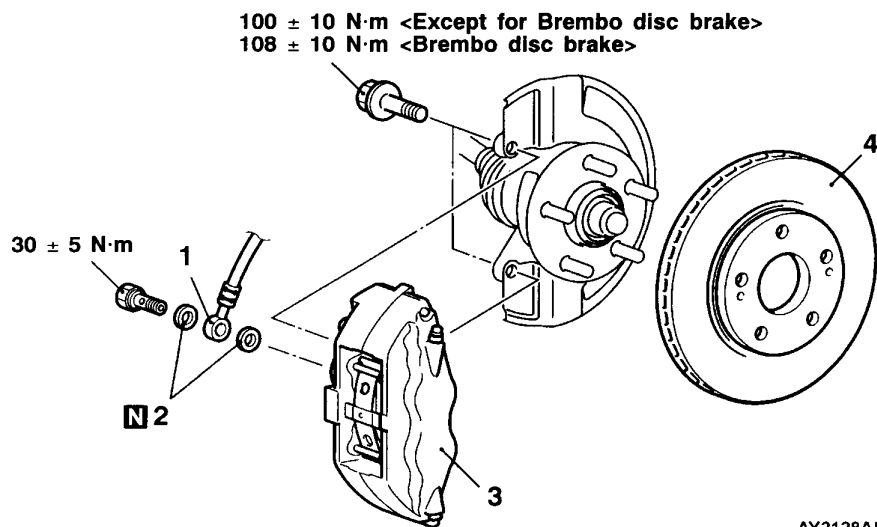
Caution

If the vehicle is equipped with the Brembo disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.

Pre-removal Operation
Brake Fluid Draining

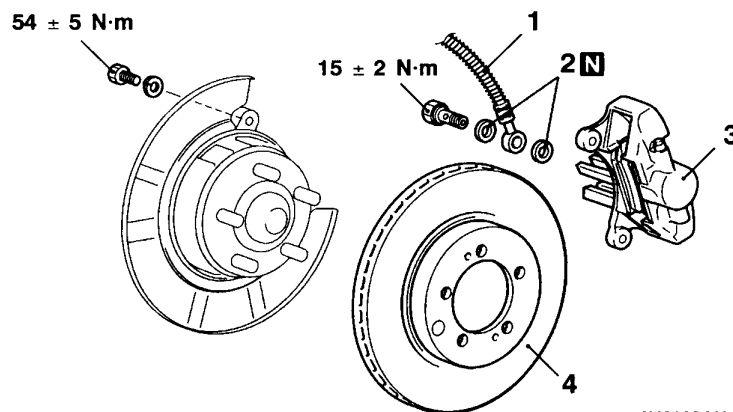
Post-installation Operation
Brake Fluid Supplying and Air Bleeding
(Refer to P.35A-10.)

<Front>



AY2128AU

<Rear>

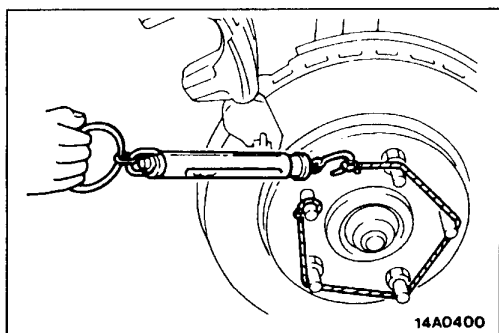
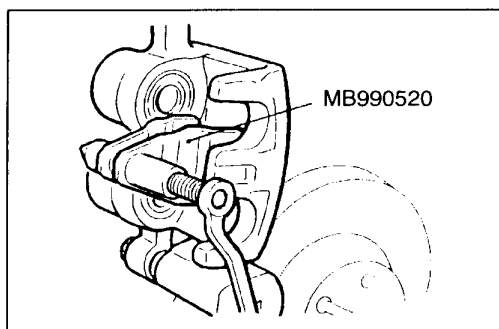
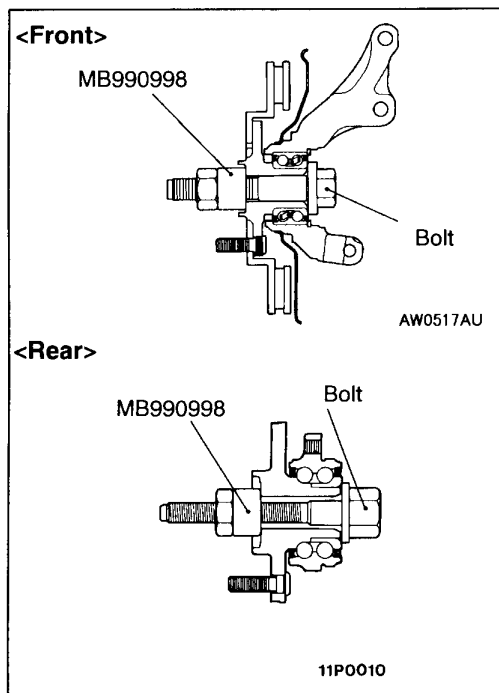


AY2129AU

Removal steps

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





INSTALLATION SERVICE POINT

►A◀DISC BRAKE ASSEMBLY INSTALLATION

<Except for Brembo disc brake>

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, 27.)
 - (2) Attach the special tool to the front hub assembly as shown in the illustration, and tighten it to the specified torque.

Tightening torque:

245 ± 29 N·m <Front>, 225 ± 25 N·m <Rear>

- (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 and the clip 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 in the forward direction.
8. Calculate the drag force of the disc brake [difference between the values measured at steps 1 and 7].

Standard value:

51 N or less <Front>, 69 N or less <Rear>

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 slide pins slide smoothly.

<Brembo disc brake>

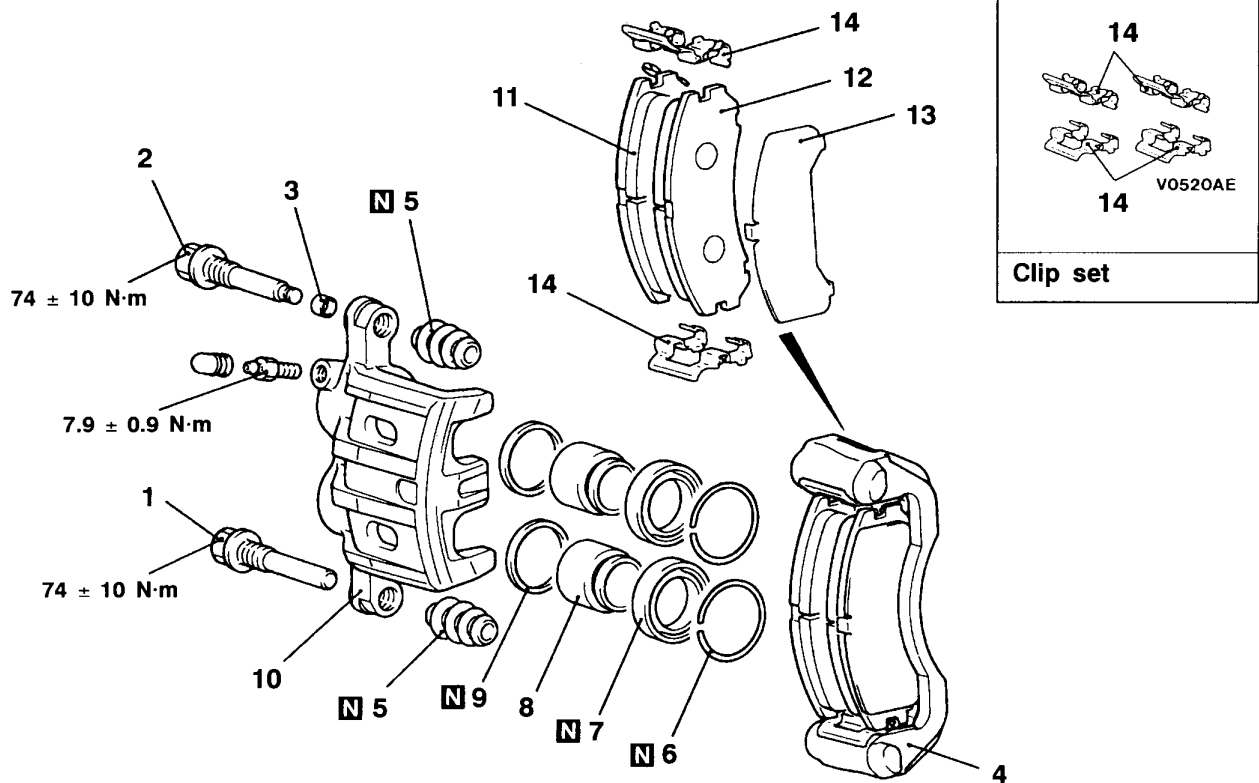
1. Find the drag force of the disc brake. (Refer to P.35A-13.)

Standard value: 69 N or less

2. 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.

DISASSEMBLY AND REASSEMBLY

Front <Except for Brembo disc brake>

14S0190
00007225

Brake caliper kit	Pad set	Shim set	Seal and boot kit

Disassembly steps



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



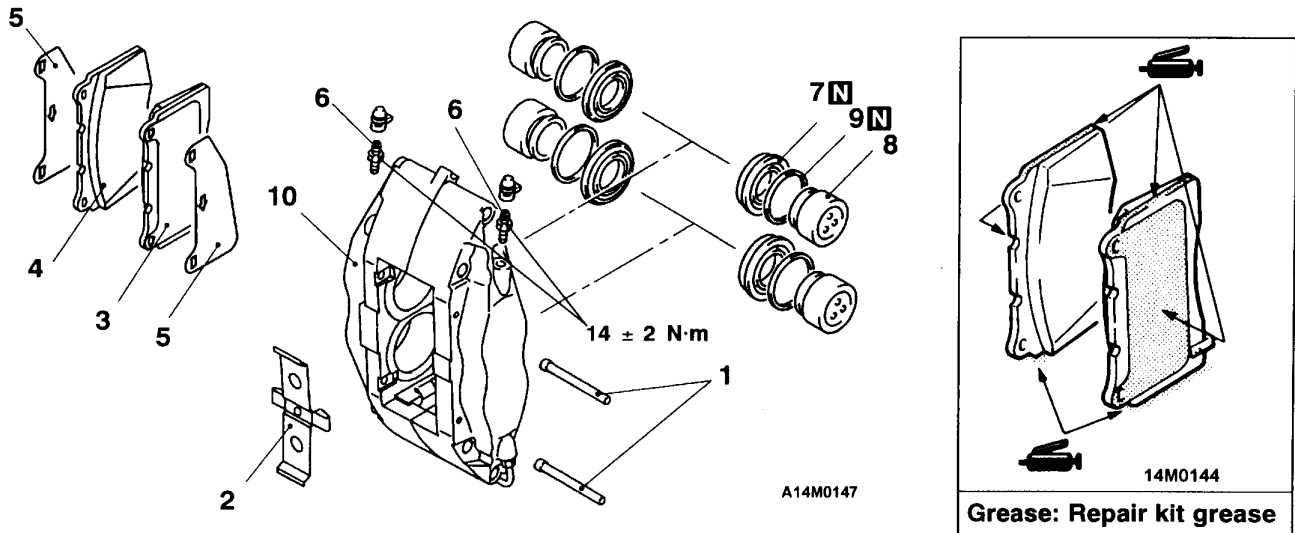
8. Piston
9. Piston seal
10. Caliper body
11. Pad and wear indicator assembly
12. Pad assembly
13. Outer shim
14. Clip



Front <Brembo disc brake>

Caution

Take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.



A14M0148	A14M0152	A14M0149
Brake caliper kit	Seal and boot kit	Shim set
A14M0150	A14M0151	
Clip set	Pad set	

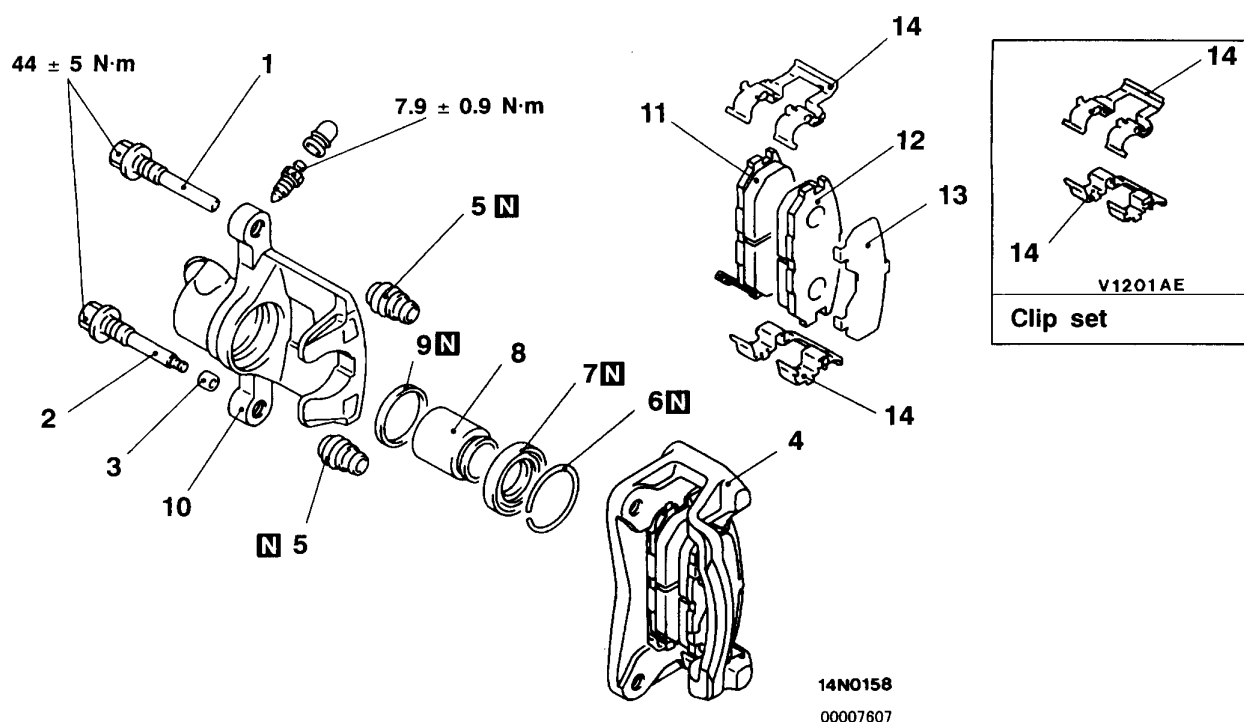
Disassembly steps

1. Pin
2. Cross spring
3. Pad and wear indicator assembly
4. Pad assembly
5. Shim



6. Air bleeder screw
7. Piston boot
8. Piston
9. Piston seal
10. Caliper body

Rear <Except for Brembo disc brake>



Brake caliper kit	Pad set	Shim set	Seal and boot kit

Disassembly steps



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



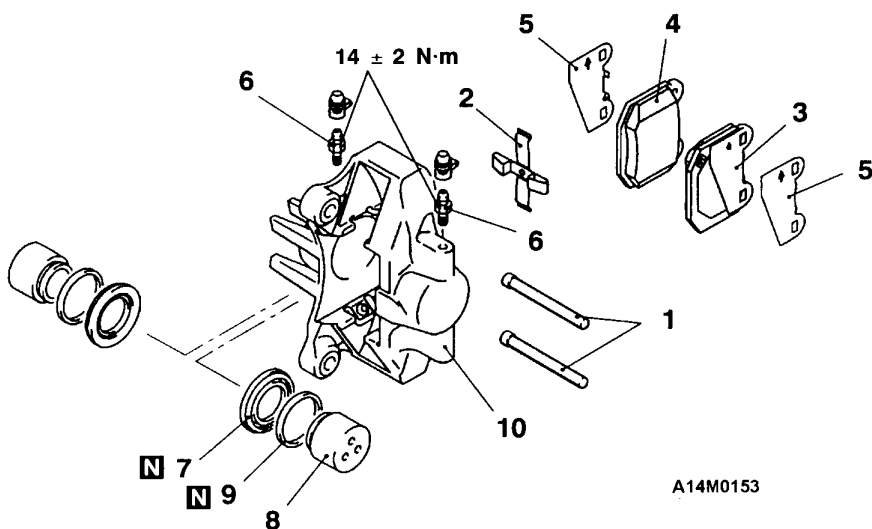
8. Piston
9. Piston seal
10. Caliper body
11. Pad and wear indicator assembly
12. Pad assembly
13. Outer shim
14. Clip



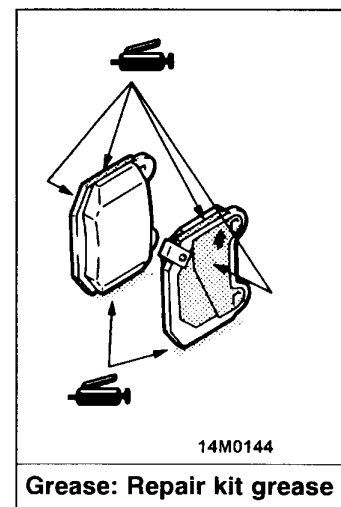
Rear <Brembo disc brake>

Caution

Take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.

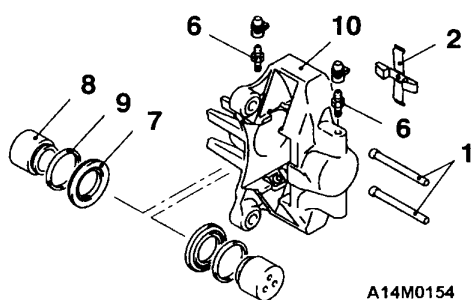


A14M0153

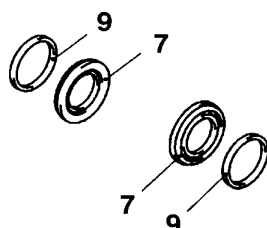


14M0144

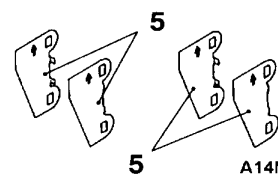
Grease: Repair kit grease



A14M0154



A14M0155

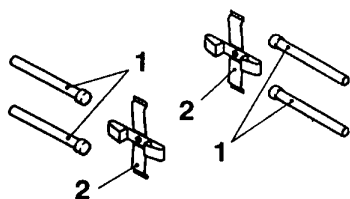


A14M0158

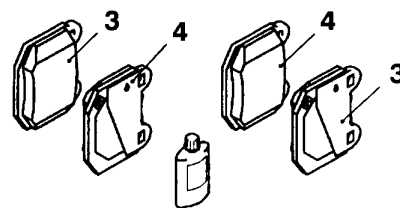
Brake caliper kit

Seal and boot kit

Shim set



A14M0156



A14M0157

Clip set

Pad set

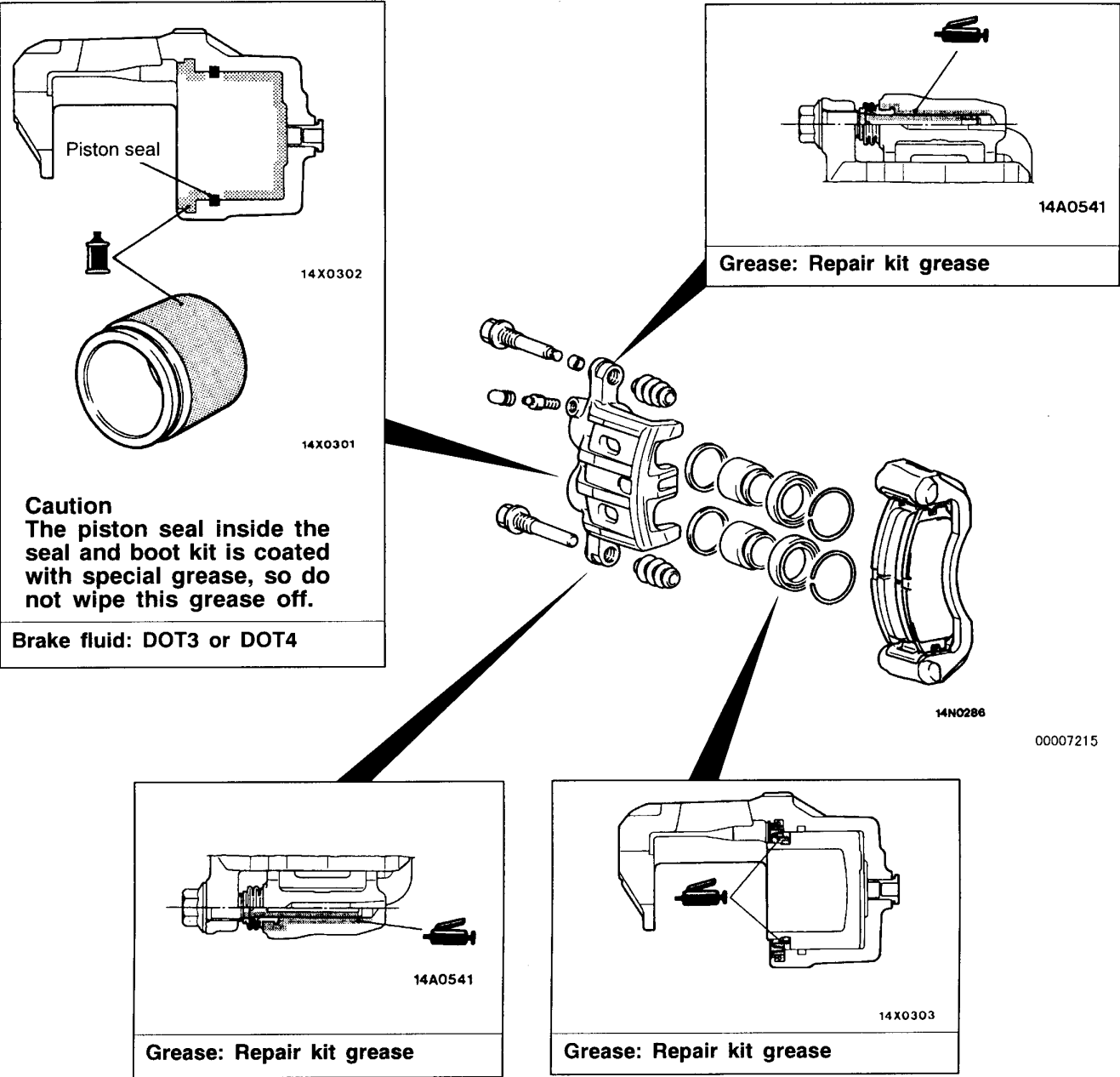
Disassembly steps

1. Pin
2. Cross spring
3. Pad and wear indicator assembly
4. Pad assembly
5. Shim



6. Air bleeder screw
7. Piston boot
8. Piston
9. Piston seal
10. Caliper body

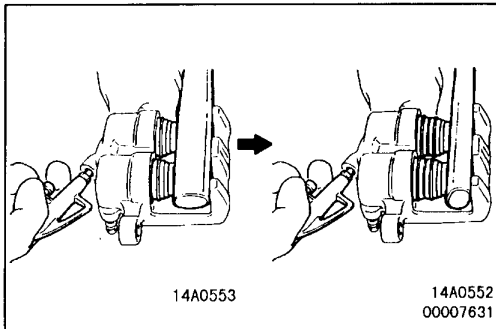
LUBRICATION POINTS <Except for Brembo disc brake>



DISASSEMBLY SERVICE POINTS

Caution: Brembo disc brake

Take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.



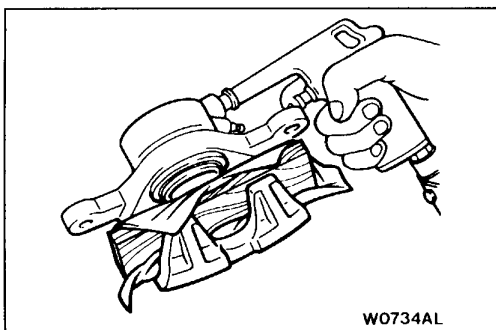
◀A▶ PISTON BOOT/PISTON REMOVAL

<Front>

Remove the piston boot by pumping in air slowly from the brake hose connection. Be sure to use the handle of a plastic hammer and adjust the height of the two pistons while so that the pistons protrude evenly.

Caution

Do not remove one piston completely before trying to remove the other piston, because it will become impossible to remove the second piston.

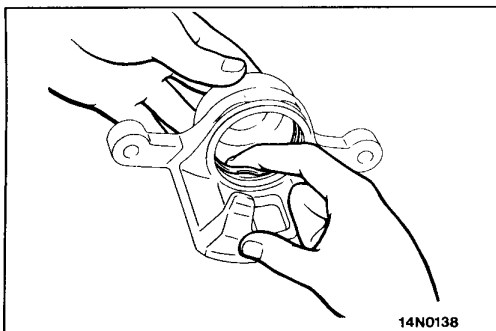


<Rear>

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.

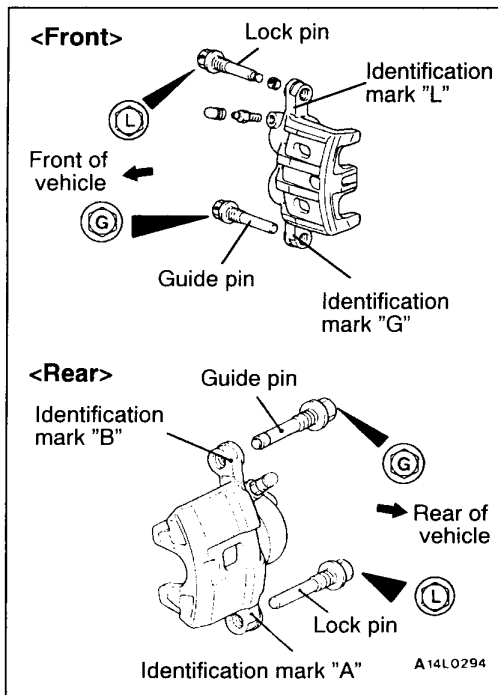
2. Clean piston surface and inner bore with trichloroethylene, alcohol or the specified brake fluid.

Specified brake fluid: DOT3 or DOT4

REASSEMBLY SERVICE POINT

Caution: Brembo disc brake

Take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.



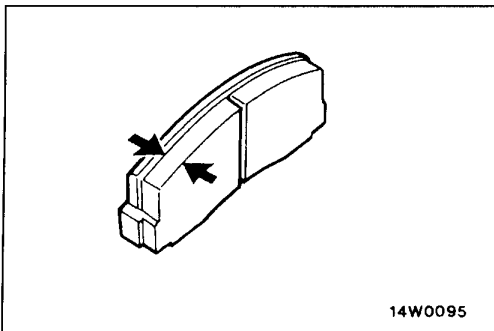
►A◄ LOCK PIN/GUIDE PIN INSTALLATION

<Except for Brembo disc brake>

As shown in the illustration, align the identification mark on the caliper body and the head mark of the guide pin/lock pin, then install the guide pin/lock pin.

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:

10.0 mm <Front, Rear (Except for Brembo disc brake)>,
9.0 mm <Rear (Brembo disc brake)>

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.

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

CONTENTS

GENERAL INFORMATION	2	Disc Brake Rotor Check ... Refer to GROUP 35A
SERVICE SPECIFICATIONS	3	Brake Disc Thickness Check Refer to GROUP 35A
LUBRICANTS	Refer to GROUP 35A	Brake Disc Run-out Check and Correction Refer to GROUP 35A
SEALANT	Refer to GROUP 35A	Wheel Speed Sensor Output Voltage Check 26
SPECIAL TOOLS	4	Hydraulic Unit Check 28
TROUBLESHOOTING	4	Remedy for a Flat Battery 29
ON-VEHICLE SERVICE	26	BRAKE PEDAL Refer to GROUP 35A
Brake Pedal Check and Adjustment Refer to GROUP 35A		MASTER CYLINDER AND BRAKE BOOSTER Refer to GROUP 35A
Brake Booster Operating Test Refer to GROUP 35A		DISC BRAKE Refer to GROUP 35A
Check Valve Operation Check Refer to GROUP 35A		HYDRAULIC UNIT AND ABS-ECU 30
Bleeding Refer to GROUP 35A		WHEEL SPEED SENSOR 33
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Disc Brake Pad Check and Replacement Refer to GROUP 35A		

GENERAL INFORMATION

ABS has been adopted as optional equipment in RS-II to maintain directional stability and steering performance during sudden braking or braking on slippery road surfaces.

The ABS control method is a 4-sensor, 4-channel method which provides independent control for all wheels.

Following system for Lancer EVOLUTION-VII has been modified from Lancer EVOLUTION-VI Tommi Makinen Edition.

- By adding lateral G sensor, longitudinal G sensor and steering wheel sensor, optimized ABS control at the time of cornering.
- By inputting parking brake switch signal to ABS-ECU with pulling parking brake lever, ABS control has been optimized.
- ABS-ECU outputs ABS signal to 4WD-ECU.
- G sensor (lateral), steering wheel sensor and parking brake switch have been added to the diagnosis and service data.
- ABS-ECU connector has been changed.

EBD CONTROL

In ABS, electronic control method is used by which the rear wheel brake hydraulic pressure during braking is regulated by rear wheel control solenoid valves in accordance with the vehicle's rate of deceleration and the front and rear wheel slippage which are calculated from the each wheel speed sensor's signal. EBD control is a control system which provides a high level of control for both vehicle braking force and vehicle stability. The system has the following features:

- Because the system provides the optimum rear wheel braking force regardless of the vehicle

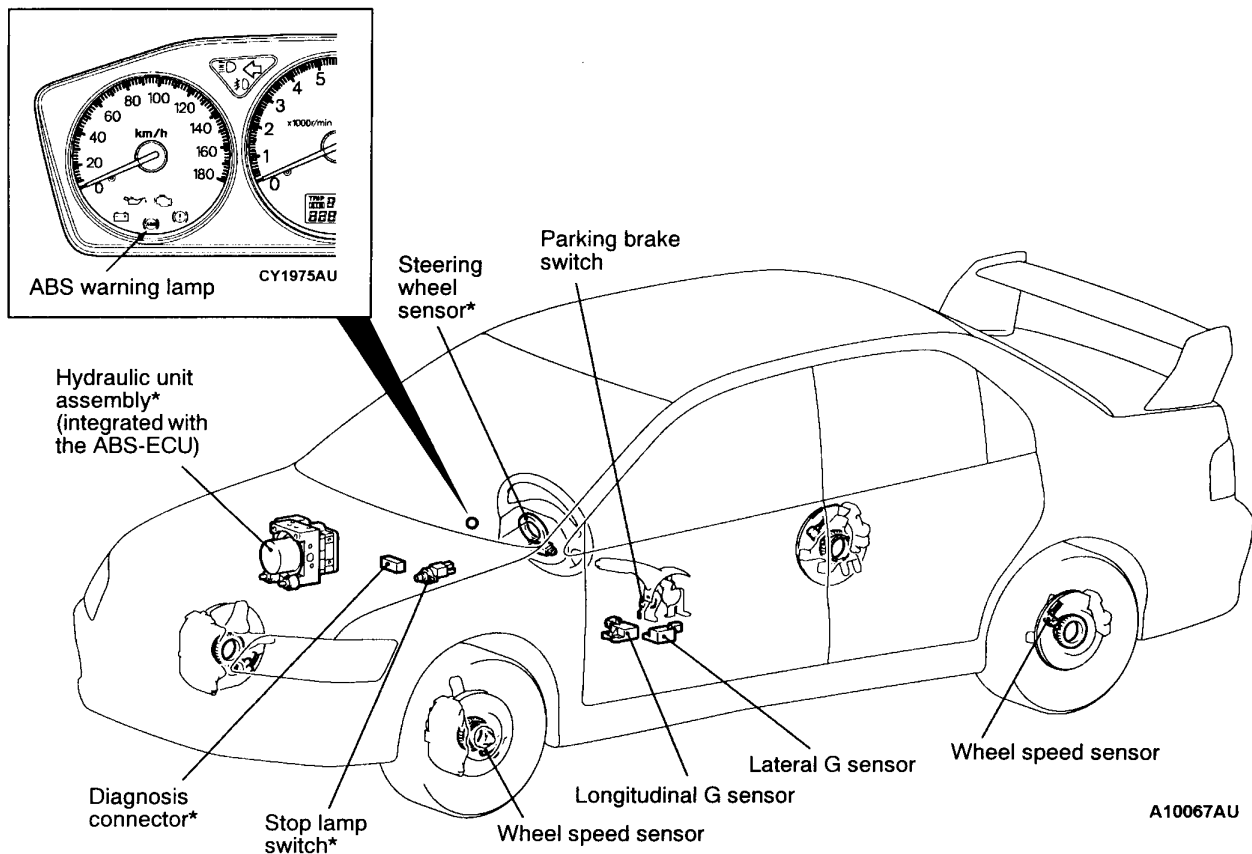
laden condition and the condition of the road surface, the system reduces the required pedal depression force, particularly when the vehicle is heavily laden or driving on road surfaces with high frictional coefficients.

- Because the duty placed on the front brakes has been reduced, the increases in pad temperature can be controlled to improve the wear resistance characteristics of the pad, during front brakes applying.
- Control valves such as the proportioning valve are no longer required.

SPECIFICATIONS

Item		Specifications
ABS control method		4-sensor, 4-channel
No. of ABS rotor teeth	Front	43
	Rear	43
ABS speed sensor	Type	Magnet coil type
	Gap between sensor and rotor mm	0.85 <front>/ 0.60 <rear> (non-adjustable type)

CONSTRUCTION DIAGRAM



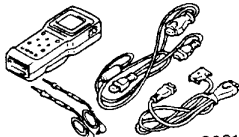
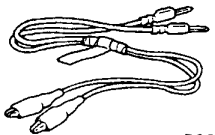
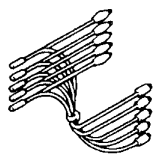
NOTE

For R.H. drive vehicles, only the position indicated by the * is symmetrical.

SERVICE SPECIFICATIONS

Items		Standard value
Wheel speed sensor internal resistance $k\Omega$		1.24 – 1.64
Wheel speed sensor insulation resistance $k\Omega$		100 or more
Lateral G sensor/Longitudinal G sensor output voltage V	On stationary vehicle	2.4 – 2.6
	With front mark downward	3.4 – 3.6

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)
 B991348	MB991348	Test harness set	For checking of G sensor

TROUBLESHOOTING

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

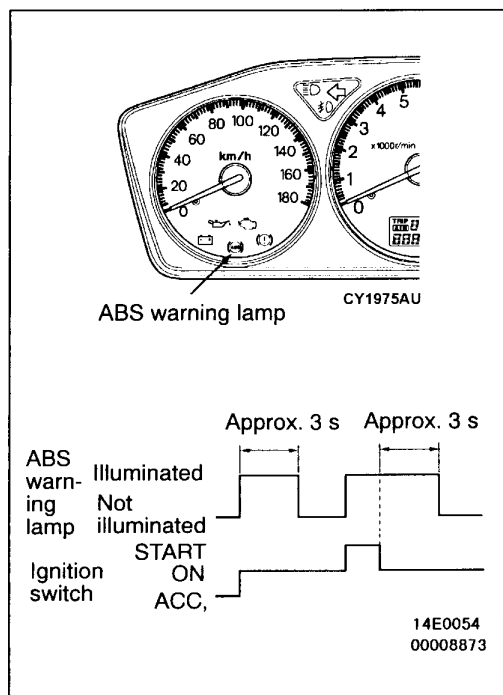
Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

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.



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, 41 to 44, 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).

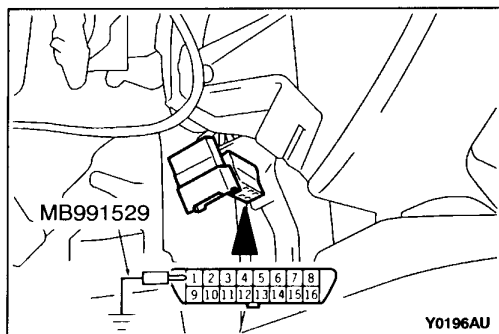
ERASING DIAGNOSIS CODES

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.

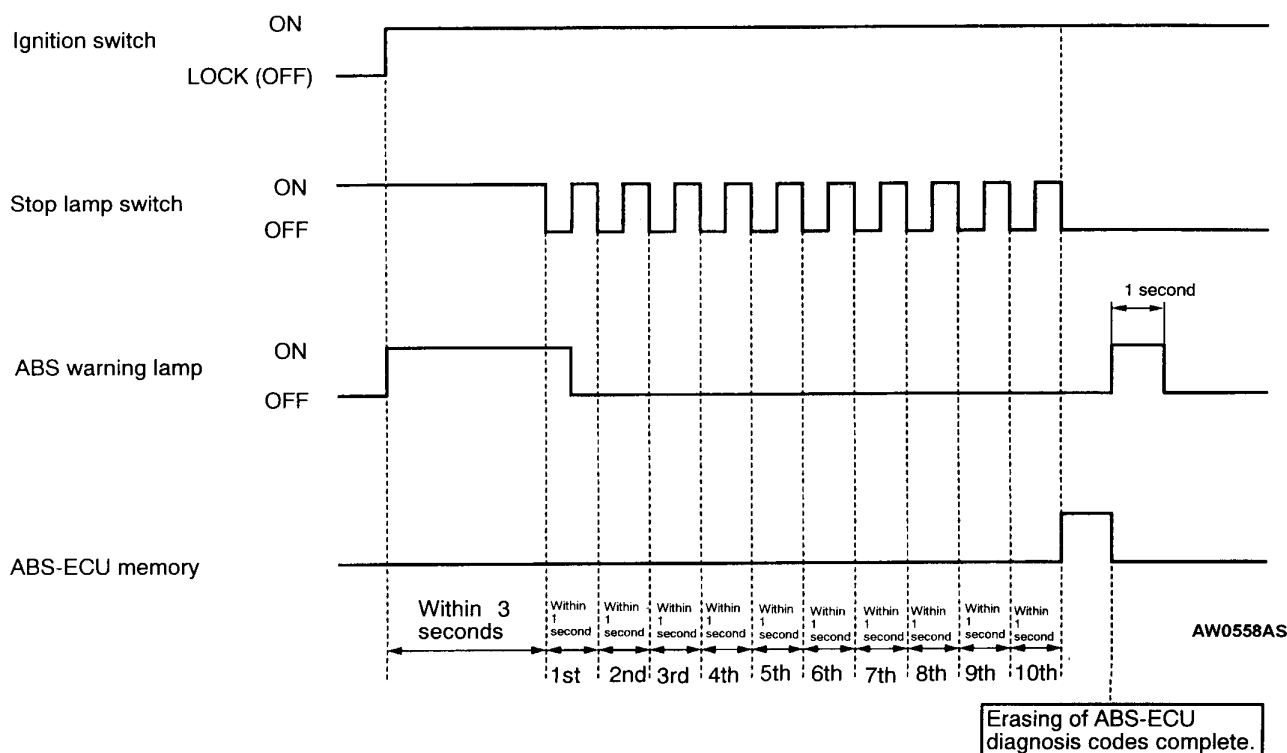


When not using the MUT-II

NOTE

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

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.



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)		
13	Rear right wheel speed sensor (Open circuit or short circuit)		
14	Rear left wheel speed sensor (Open circuit or short circuit)		
16*	ABS-ECU power supply system (Abnormal voltage drop or rise)		35B-10
21	Front right wheel speed sensor		35B-9
22	Front left wheel speed sensor		
23	Rear right wheel speed sensor		
24	Rear left wheel speed sensor		
32	Longitudinal G sensor system		35B-11
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-12
42	Front left solenoid valve		
43	Rear right solenoid valve		
44	Rear left solenoid valve		
51	Valve relay problem (stays on)		35B-30, 31 (Replace the hydraulic unit and ABS-ECU.)
52	Valve relay problem (stays off) or ABS-ECU power supply system problem		35B-12
53	Motor relay problem (stays off) or ABS-ECU power supply system problem		
54	Motor relay problem (stays on)		35B-30, 31 (Replace the hydraulic unit and ABS-ECU.)
55	Motor system (seized pump motor) or ABS-ECU power supply system problem		35B-12
63	ABS-ECU		35B-30, 31 (Replace the hydraulic unit and ABS-ECU.)
71	Lateral G sensor system		35B-13

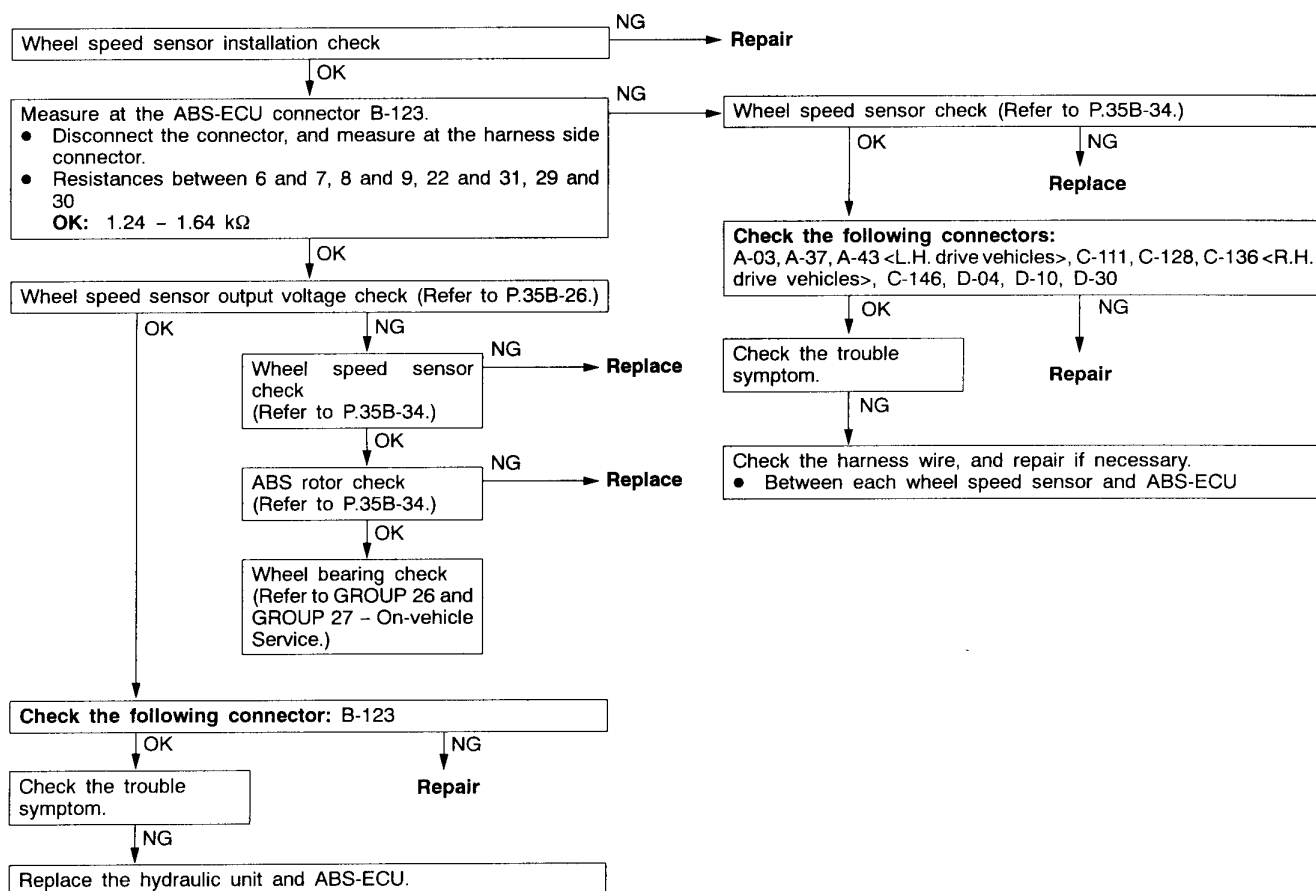
Diagnosis code No.	Inspection item	Reference page
81	Steering wheel sensor (ST-1) system (Open circuit or short circuit)	35B-14
82	Steering wheel sensor (ST-2) system (Open circuit or short circuit)	
83	Steering wheel sensor (ST-N) system (Open circuit or short circuit)	

NOTE: diagnosis code No.16, 52, 63

1. Code No. 16 is cleared from the memory by turning the ignition switch to ACC position. When the system is properly reset, this code is also cleared from the memory.
2. Code No. 52 and 63 are cleared from the memory by turning the ignition switch to ACC position.

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

Code Nos.11, 12, 13 and 14 Wheel speed sensor (open circuit or short circuit)	Probable cause
Code Nos.21, 22, 23 and 24 Wheel speed sensor	
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

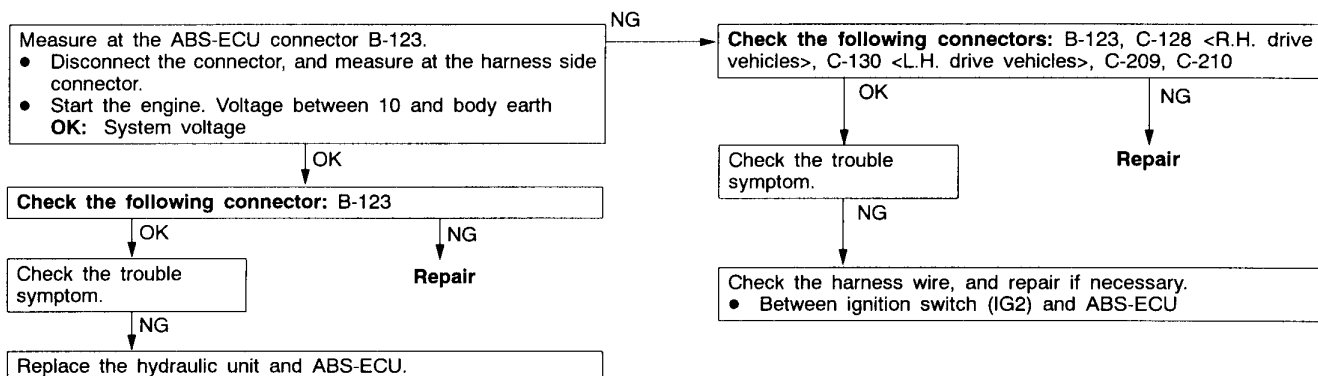


Code No.16 ABS-ECU power supply system (abnormal voltage drop or rise)	Probable cause
This code is output if the ABS-ECU power supply voltage drops below or rises above the rated values. Furthermore, turning the ignition switch to ACC will erase this code.	• Malfunction of battery • Malfunction of wiring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

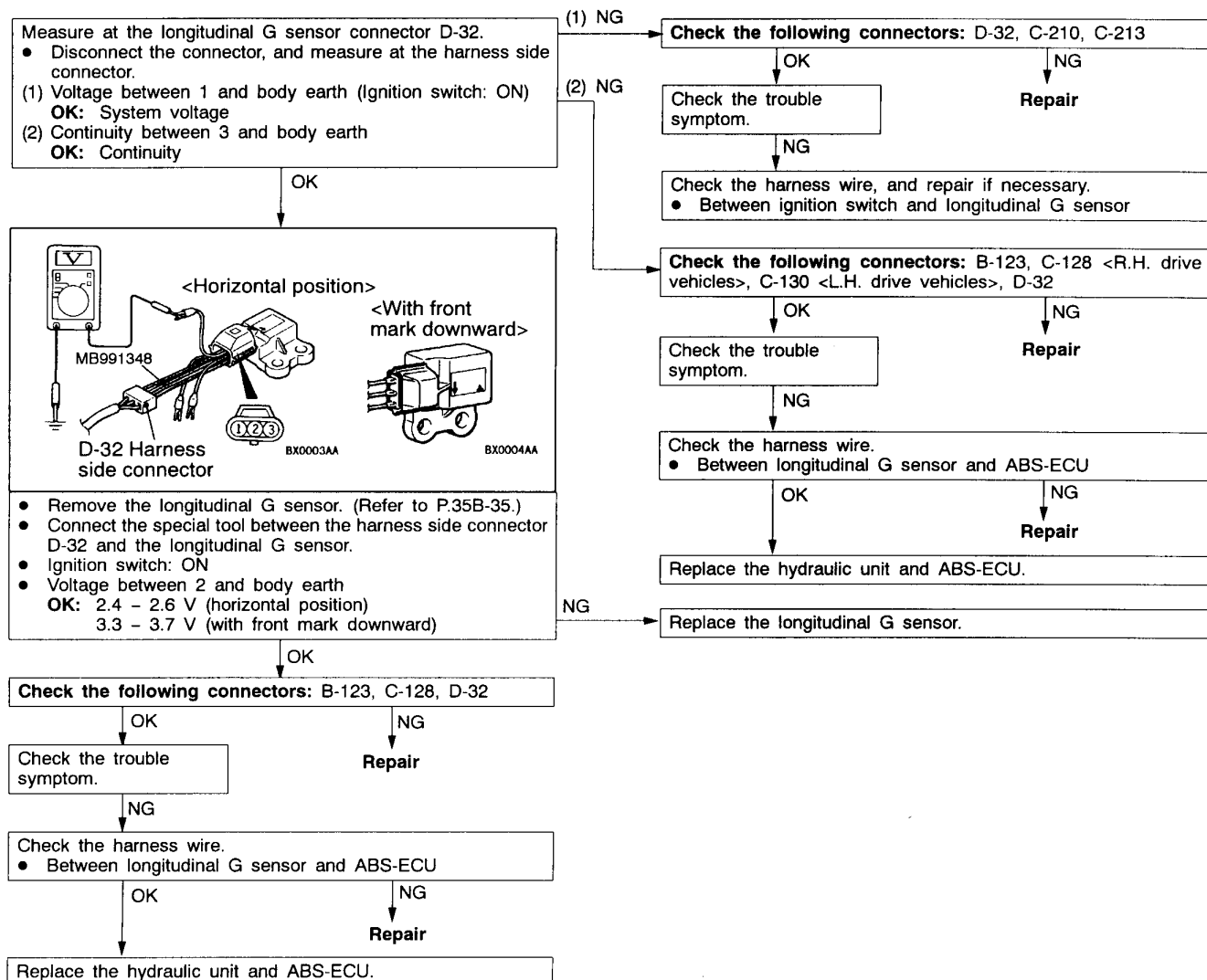
Caution

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.

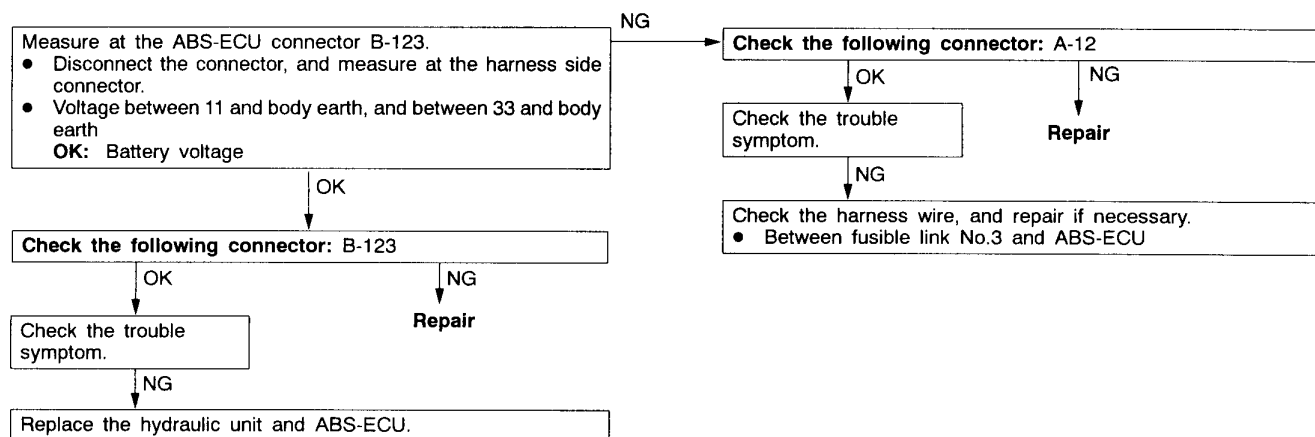
Before carrying out the following inspection, check the battery level, and refill it if necessary.



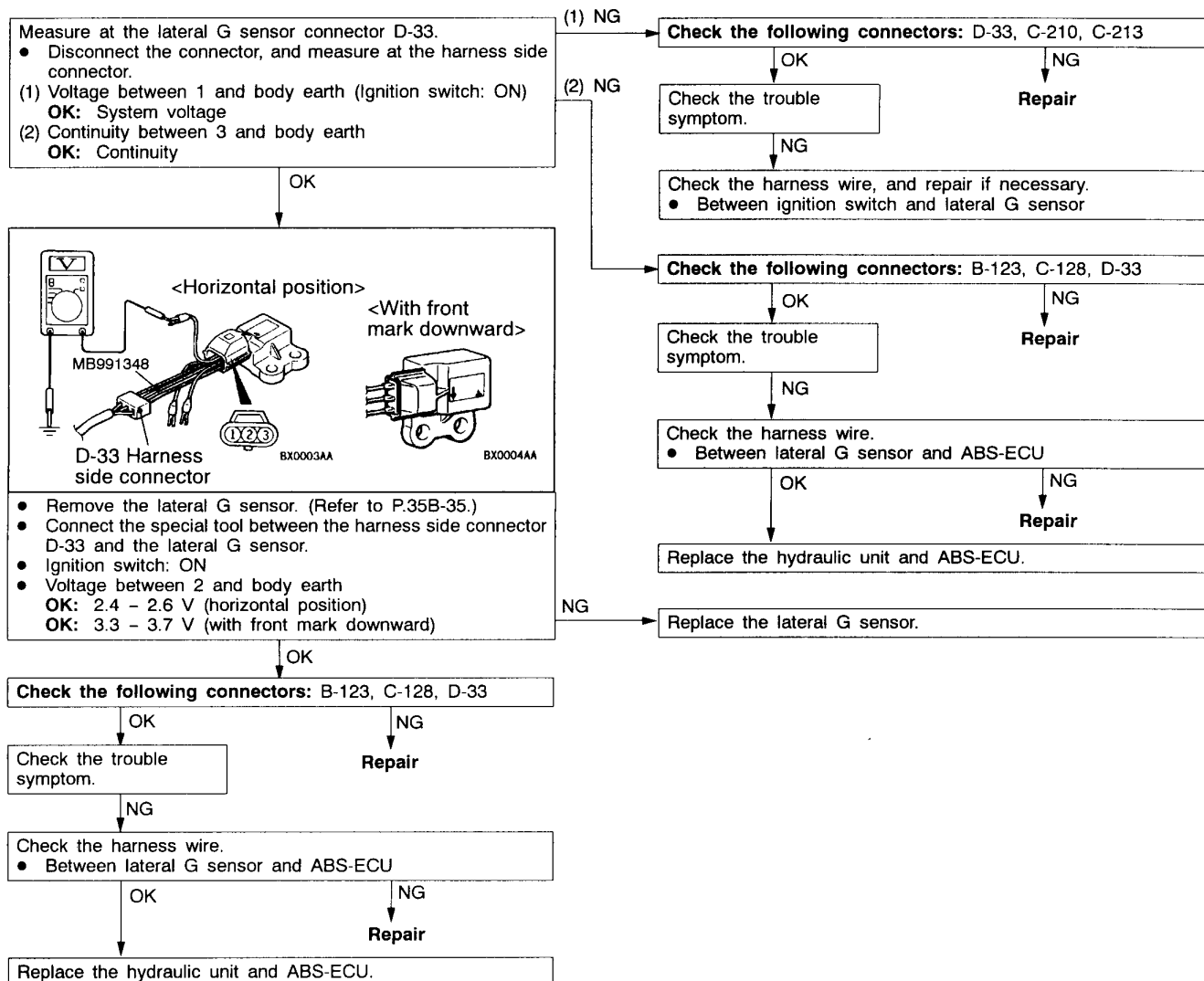
Code No.32 Longitudinal G sensor system	Probable cause
This code is output in the following cases. - If the longitudinal G sensor output voltage is less than 0.5 V or more than 4.5 V <open circuit or short circuit of longitudinal G sensor circuit> - If the longitudinal G sensor output voltage does not change <longitudinal G sensor output voltage: fixed>	- Malfunction of longitudinal G sensor - Malfunction of wiring harness or connector - Malfunction of hydraulic unit and ABS-ECU



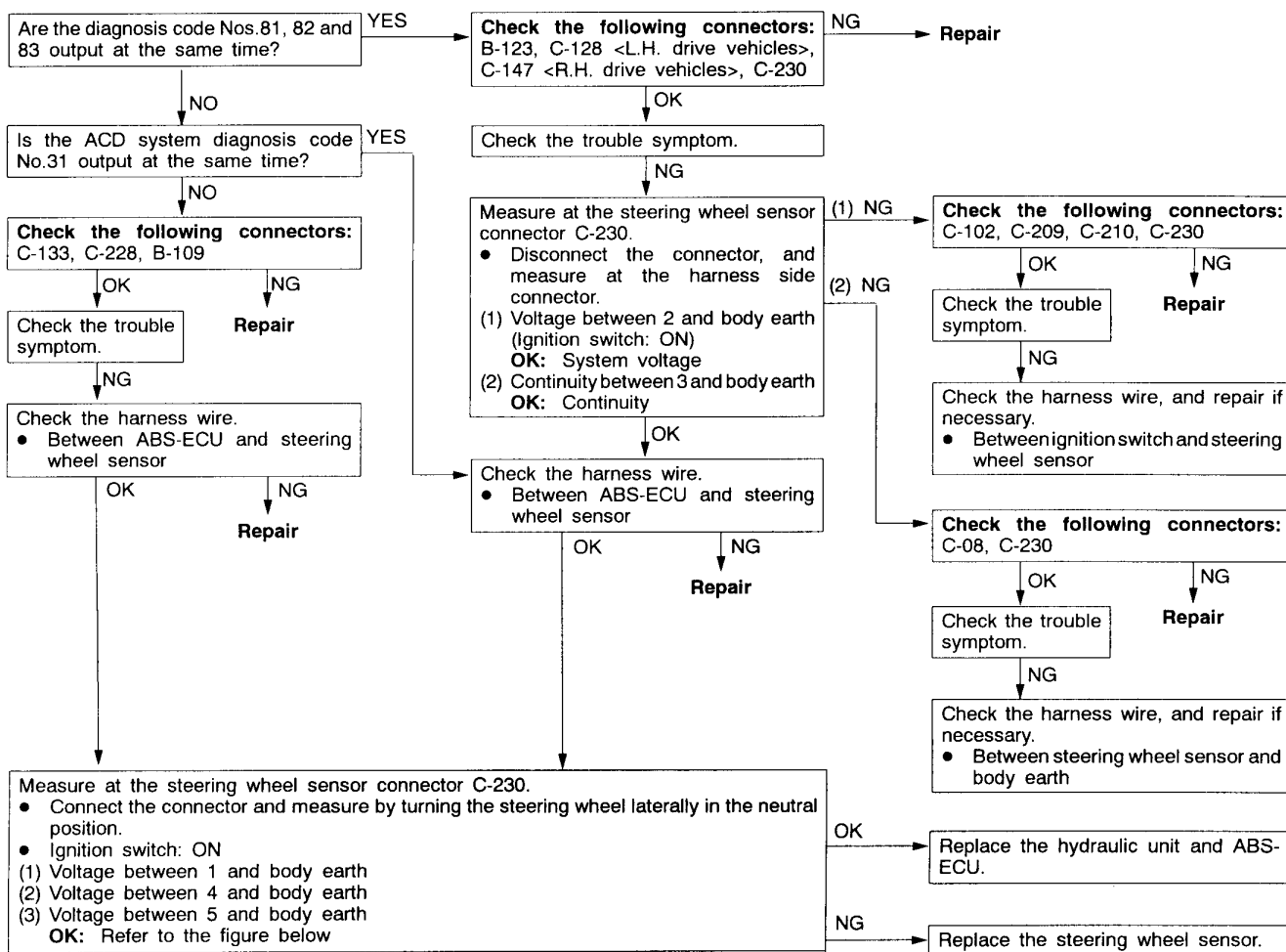
Code Nos.41, 42, 43 and 44 Solenoid valve	Probable cause
Code No.52 Valve relay problem (stays off)	
Code No.53 Motor relay problem (stays off)	
Code No.55 Motor system (seized pump motor)	
These codes are output if there is an open circuit or short-circuit in the ABS-ECU power supply circuit (power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



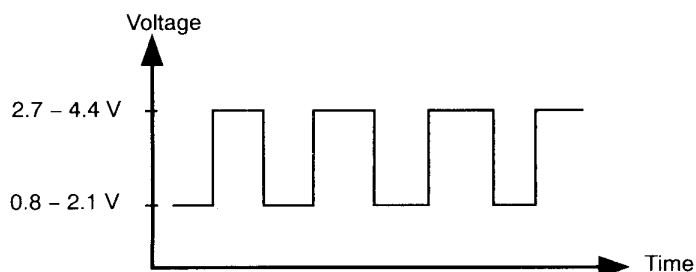
Code No.71 Lateral G sensor system	Probable cause
This code is output in the following cases. - If lateral G sensor output voltage is less than 0.5 V or more than 4.5 V <open circuit or short circuit in the lateral G sensor circuit> - If the lateral G sensor output voltage do not change <lateral G sensor output voltage: fixed>	- Malfunction of lateral G sensor - Malfunction of wiring harness or connector - Malfunction of hydraulic unit and ABS-ECU



Code No.81 Steering wheel sensor (ST-1) system (open circuit or short circuit)	Probable cause
Code No.82 Steering wheel sensor (ST-2) system (open circuit or short circuit)	
Code No.83 Steering wheel sensor (ST-N) system (open circuit or short circuit)	
These codes are output if there is a fault in the steering wheel sensor, an open circuit or short circuit in the steering signal line, or the internal circuit in the hydraulic unit and ABS-ECU is defective.	● Malfunction of steering wheel sensor ● Malfunction of wiring harness or connector ● Malfunction of hydraulic unit and ABS-ECU



Variations in voltage when turning the steering wheel laterally



Y2356AU

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-16
Communication between the MUT-II and the ABS-ECU is not possible.	2	35B-17
When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate.	3	35B-18
Even after the engine is started, the ABS warning lamp remains illuminated.	4	35B-18
In the inspection with MUT-II service data, the parking brake switch is not turned ON or turn OFF.	5	35B-19
The neutral position learning of the steering wheel sensor is not finished.	6	35B-20
Faulty ABS operation	7	35B-21

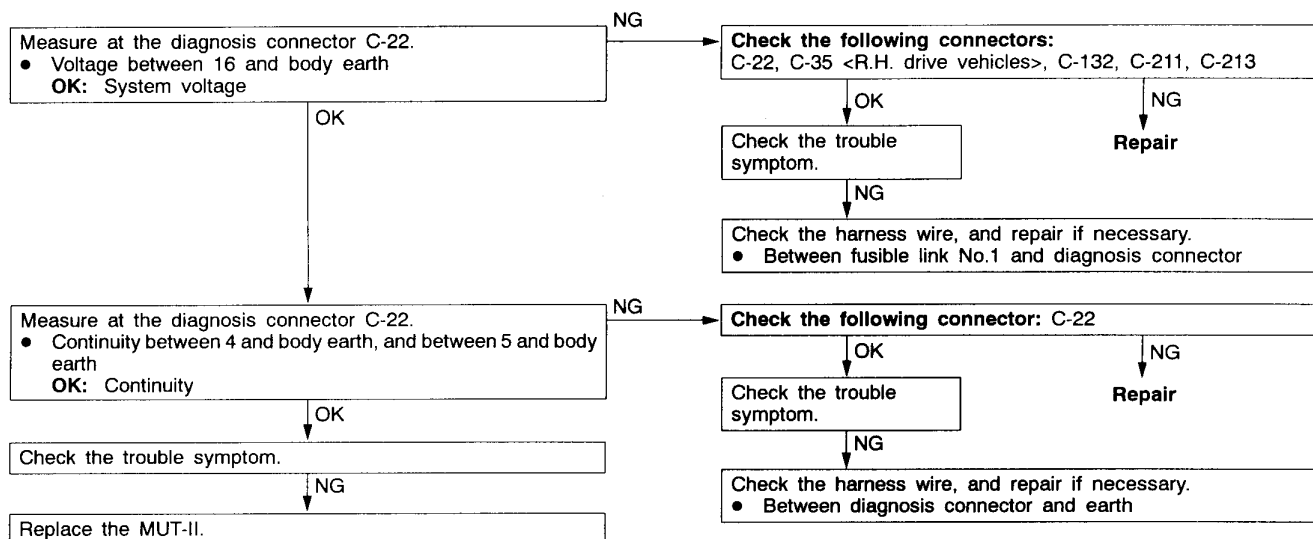
Caution

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

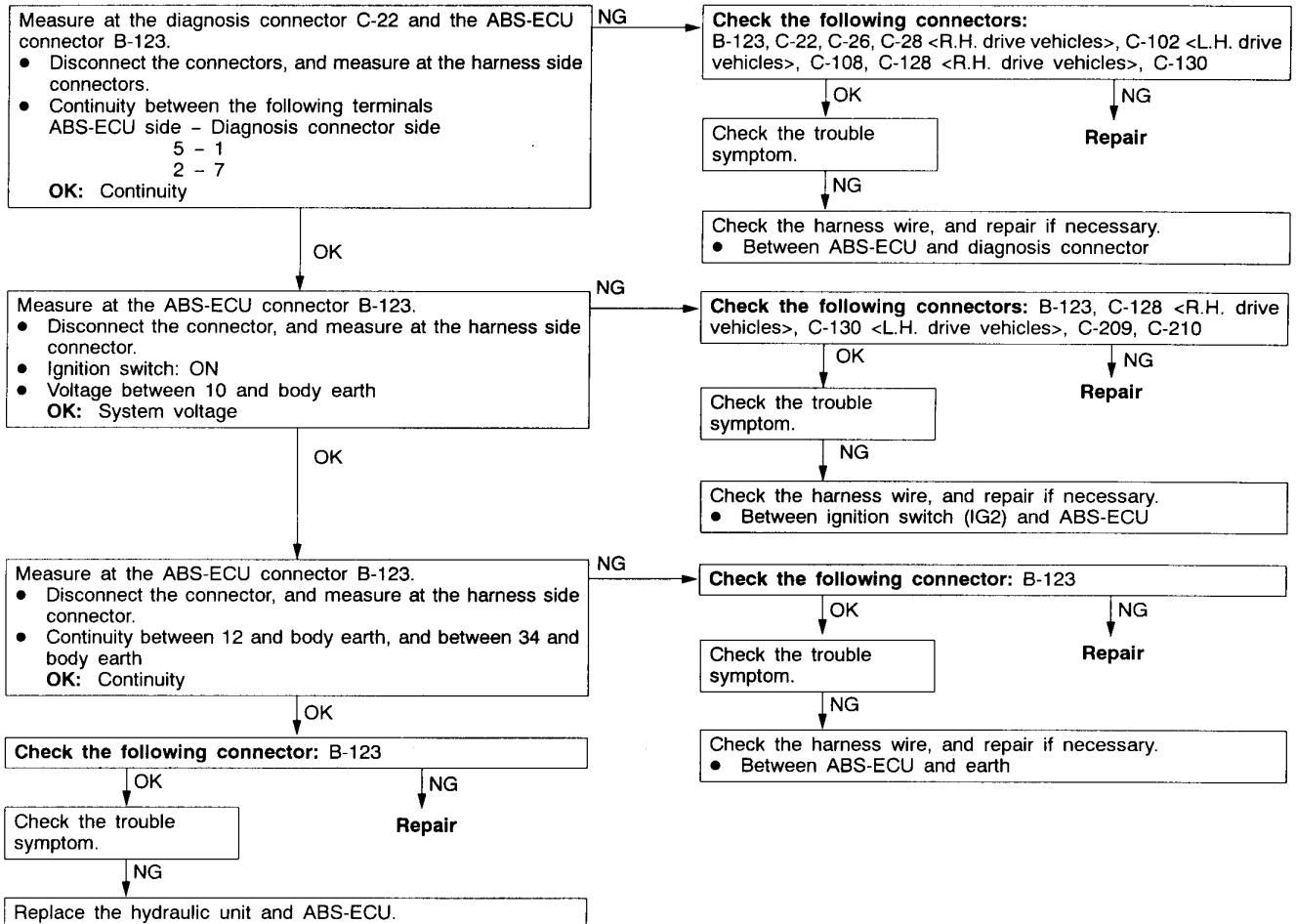
Inspection Procedure 1

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



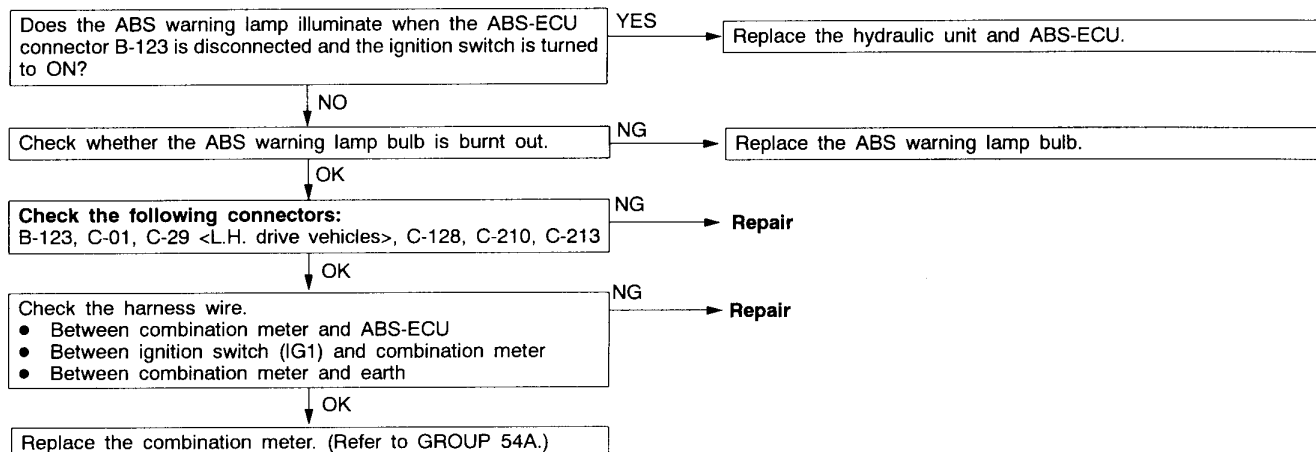
Inspection Procedure 2

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, or an open circuit between the ABS warning lamp and the earth.	• Blown fuse • Burn out ABS warning lamp bulb • Malfunction of combination meter • Malfunction of wiring harness or connector • Malfunction of hydraulic unit and ABS-ECU

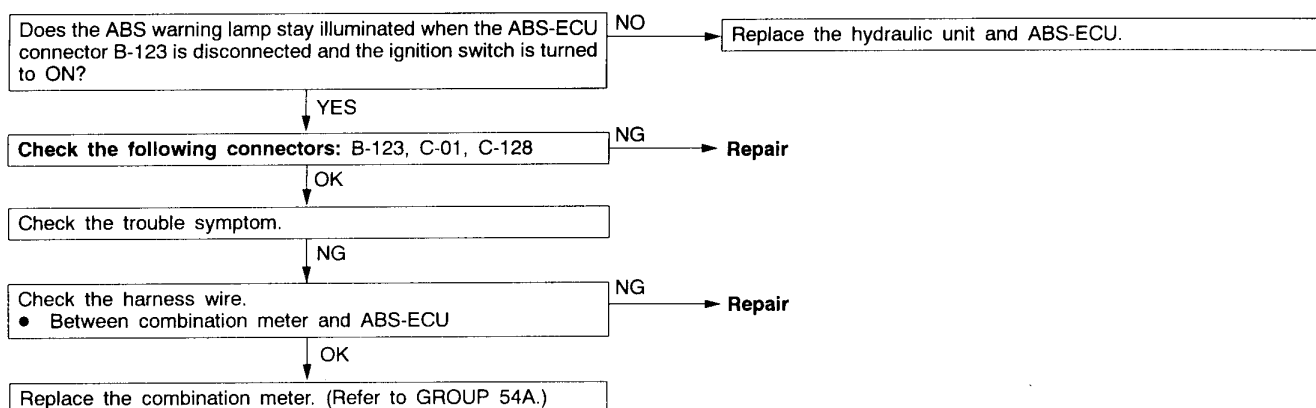


Inspection Procedure 4

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 wiring harness (short circuit) • Malfunction of hydraulic unit and ABS-ECU

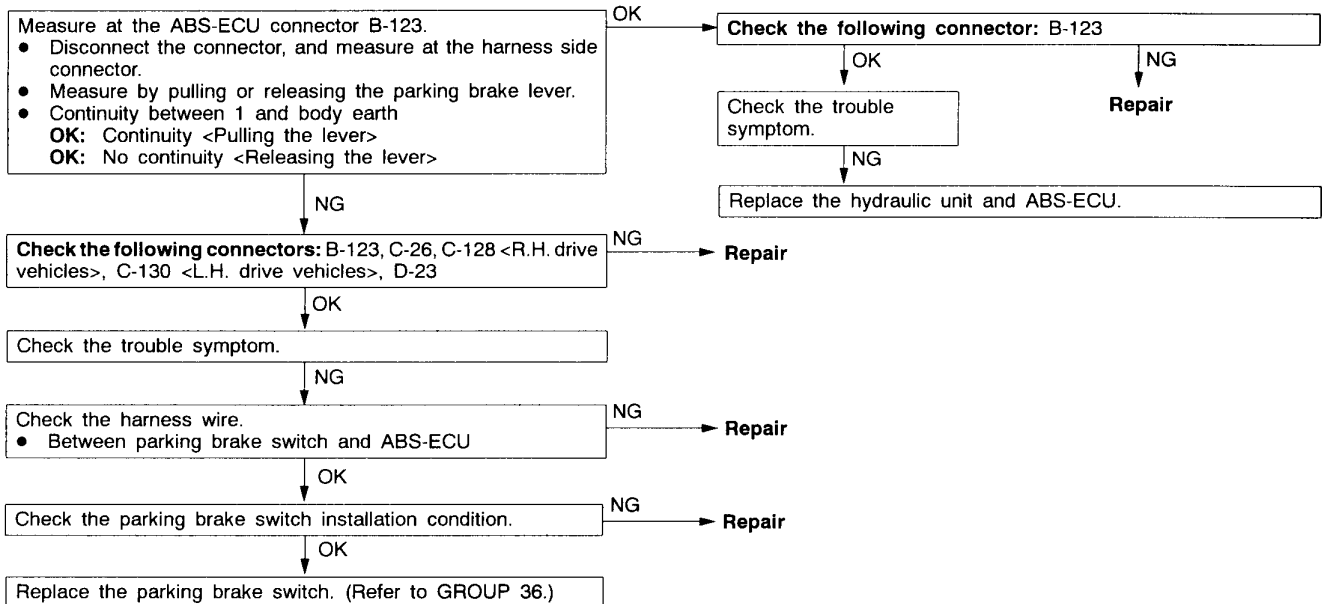
NOTE

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.



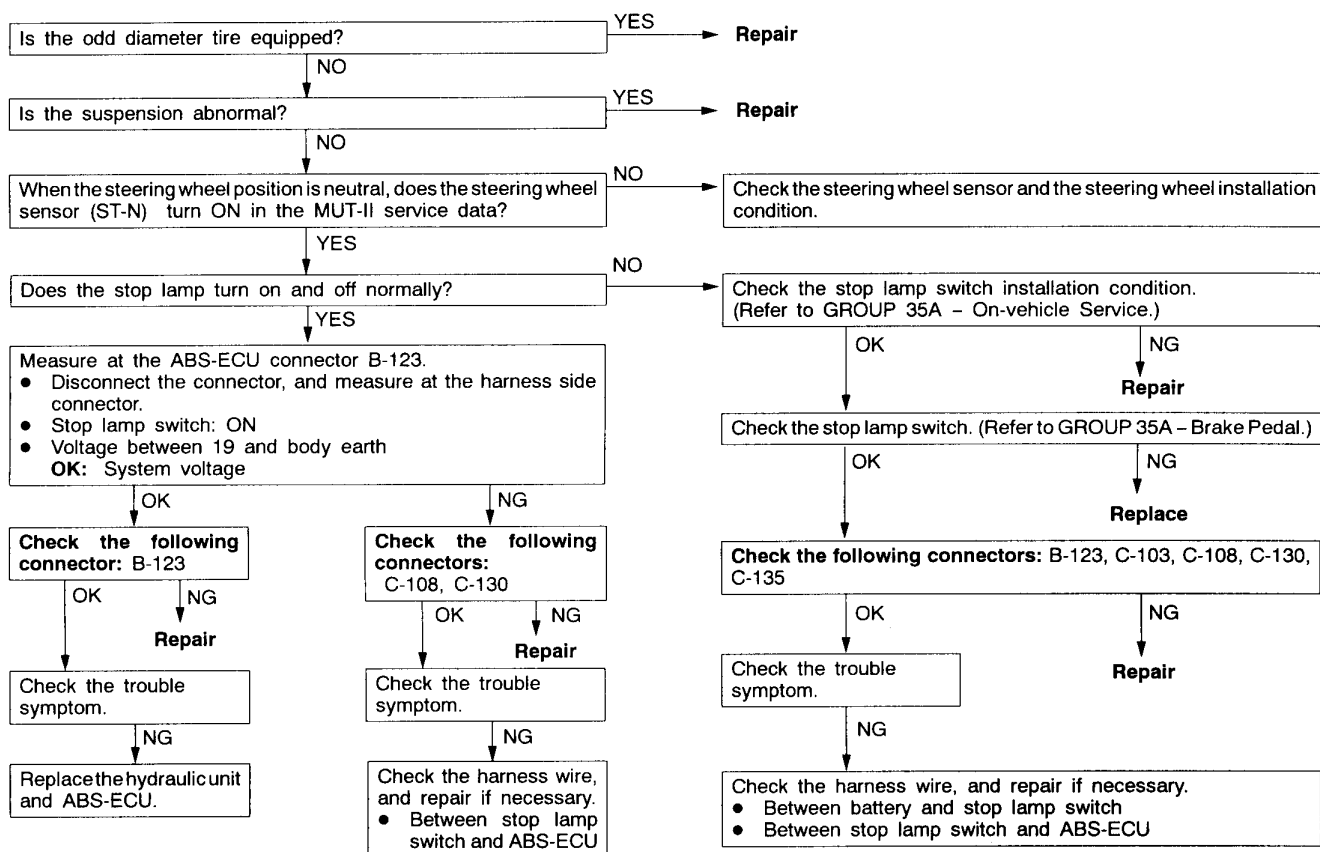
Inspection Procedure 5

In the inspection by MUT-II service data, the parking brake switch is not turned ON or turn OFF.	Probable cause
ABS-ECU optimizes the ABS control when pulling the parking brake lever, parking brake switch signal is used as support. If there is a fault in the parking brake switch system, ABS control is not optimized.	• Malfunction of parking brake switch • Malfunction of wiring harness or connector • Malfunction of hydraulic unit and ABS-ECU



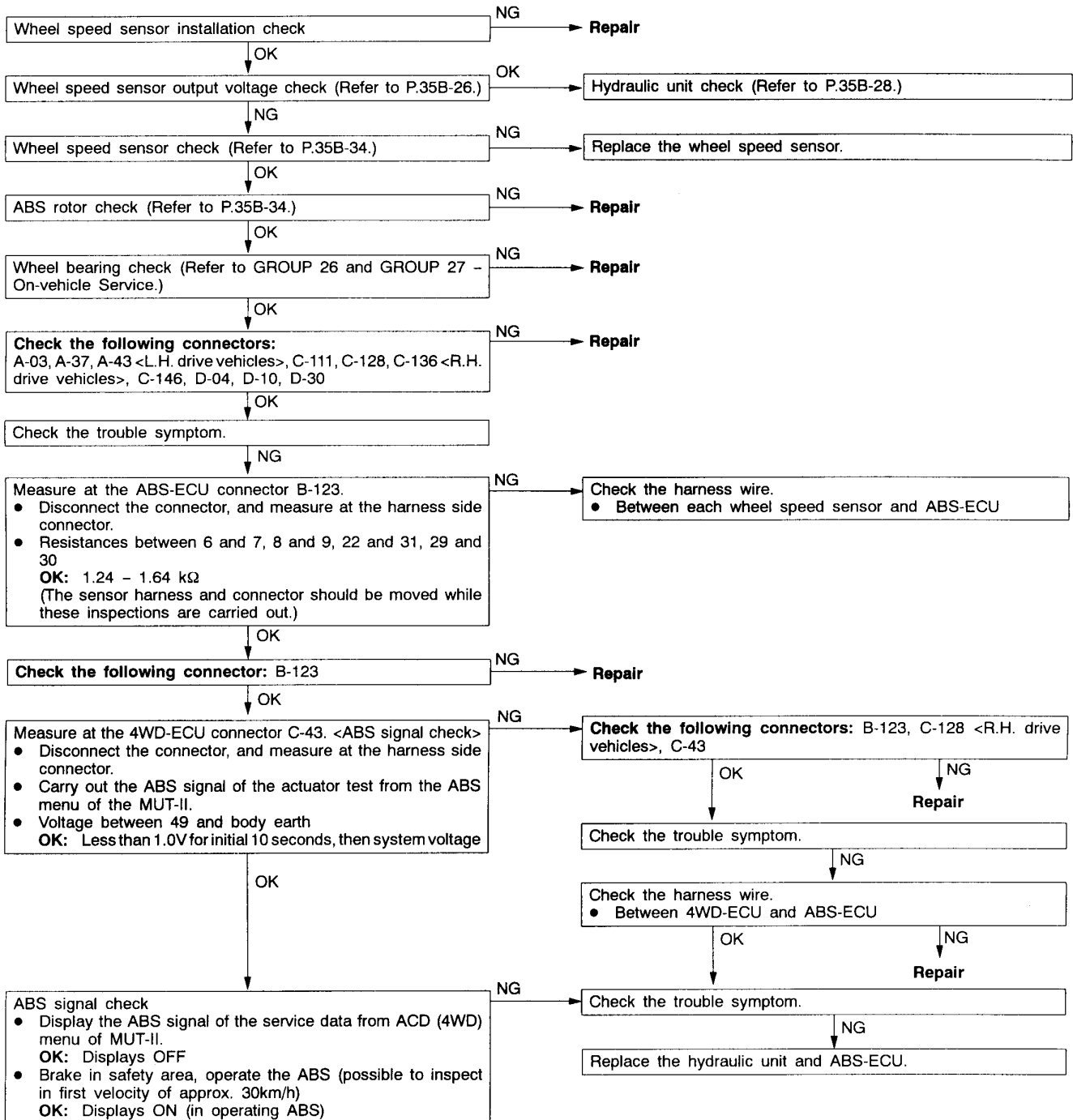
Inspection Procedure 6

The neutral position learning of the steering wheel sensor is not finished.	Probable cause
The diagnosis is difficult because it depends on driving condition and road surface, if the diagnosis code displays the normal code, carry out the following check.	• Equipment the odd diameter tyre • Malfunction of suspension • Malfunction of steering wheel sensor installation • Malfunction of stop lamp switch system • Malfunction of hydraulic unit and ABS-ECU



Inspection Procedure 7

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			
21	Power supply voltage	Ignition switch: ON		10 – 16 V
29	Parking brake switch	Pull the parking brake lever.		ON
		Release the parking brake lever.		OFF
36	Stop lamp switch	Depress the brake pedal.		ON
		Release the brake pedal.		OFF
37	Steering wheel sensor neutral position learning	After driving straightly with vehicle speed more than 10km/h		ON
		Before driving with ignition switch ON		OFF
71	Lateral G sensor	When vehicle stops		2.4 – 2.6 V
		When vehicle drives		1.0 – 4.0 V
74	Steering wheel sensor (ST-N)	Ignition switch: ON	Steering: Neutral position and position near by $\pm 360^\circ$	ON
			Steering: Except for above	OFF
75	Steering wheel sensor (ST-1)	Ignition switch: ON	Steering: Turn laterally slowly	Display ON and OFF alternately
76	Steering wheel sensor (ST-2)			
86	Steering degree	Ignition switch: ON Steering wheel sensor neutral position learning is finished (service data No. 37 displays ON)	Steering: Steer by 90° to the right	+ 90°
			Steering: Neutral	OFF
			Steering: Steer by 90° to the left	- 90°

2. When the ABS-ECU shut off ABS operation

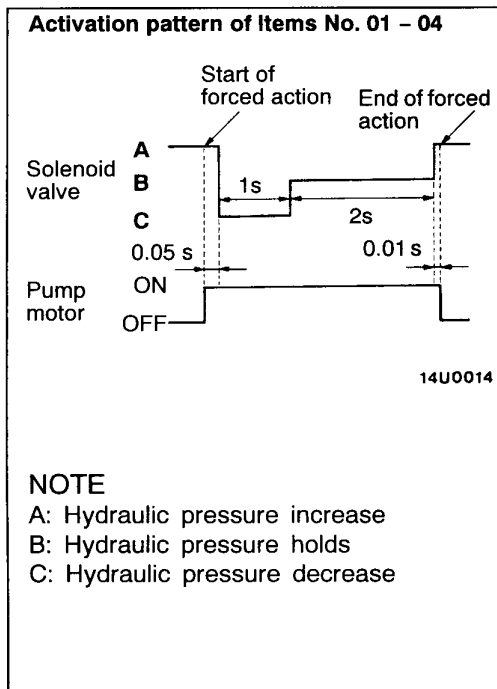
When the diagnosis system stops the ABS-ECU, the MUT-II display data will be unreliable.

ACTUATOR TEST REFERENCE TABLE

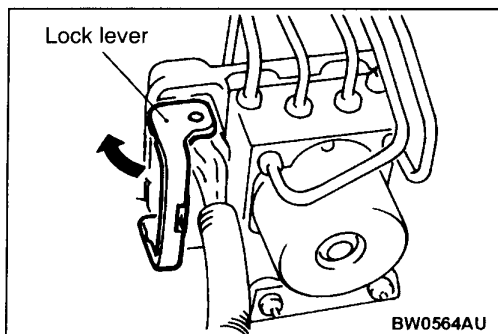
The MUT-II activates the following actuators for testing.

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.

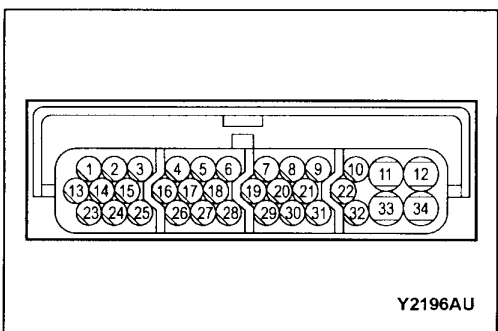
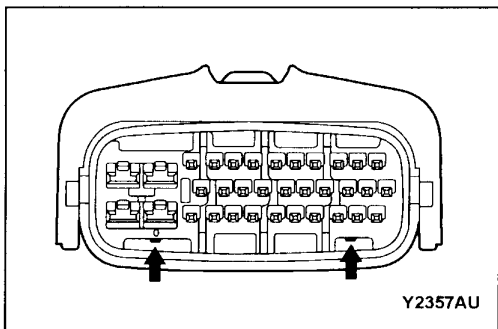
**ACTUATOR TEST SPECIFICATIONS**

Item No.	Checking item	Activation
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	
05	ABS signal	ABS signal (voltage: less than 1.0V) is output for 10 seconds

**CHECK AT ABS-ECU**

Use the following steps to remove the connector cover and measure the terminal voltage.

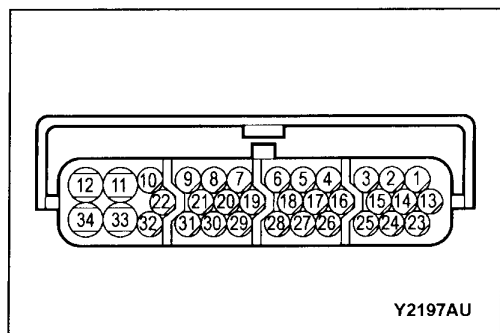
1. Move the lock lever of the ABS-ECU connector as shown in the illustration, and then disconnect the ABS-ECU connector.
2. Push up and unlock the hooks of the ABS-ECU connector shown in the illustration, then remove the connector cover.

**TERMINAL VOLTAGE CHECK CHART**

1. Measure the voltage between each terminal and earth (terminal No.12).
2. The terminal layout is shown in the illustration.

Terminal No.	Check item	Checking requirements		Normal condition
1	Parking brake switch input	Parking brake switch: ON		1 V or less
		Parking brake switch: OFF		System voltage
2	MUT-II	When the MUT-II is connected		Serial communication with MUT-II
		When the MUT-II is not connected		1 V or less
3	ABS ON output to 4WD-ECU	With ABS active (reference)		(0.5 V or less)
		With ABS not active		System voltage
4	Steering wheel sensor (ST-N) input	Ignition switch: ON	Steering wheel: Neutral position and position near by $\pm 360^\circ$	0.8 – 2.1 V
			Steering wheel: Except for above	2.7 – 4.4 V
5	Diagnosis changeover input	When the MUT-II is connected		0 V
		When the MUT-II is not connected		Approx. 12 V

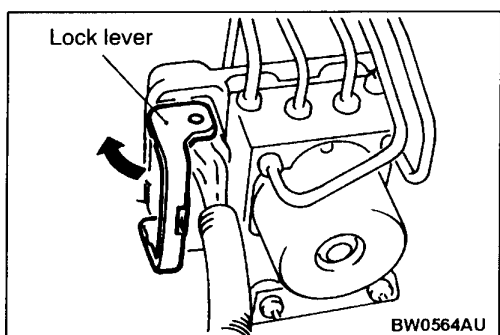
Terminal No.	Check item	Checking requirements		Normal condition
10	ABS-ECU power supply	Ignition switch: ON		System voltage
		Ignition switch: START or ACC		0 V
11	Solenoid valve power supply	Always		System voltage
14	Lateral G sensor input	Ignition switch: ON		2.4 – 2.6 V (horizontal position)
15	Longitudinal G sensor earth	Always		0 V
17	Steering wheel sensor (ST-2) input	Ignition switch: ON	Steering wheel: Turn laterally	Variation in the voltage value 0.8 – 2.1 V and 2.7 – 4.4 V
18	Wheel speed sensor (front right) output	Moving forward slowly		0 – 5 V
19	Stop lamp monitor input	Ignition switch: ON	Stop lamp switch: ON	System voltage
			Stop lamp switch: OFF	1 V or less
20	Wheel speed sensor (rear left) output	Moving forward slowly		0 – 5 V
21	Wheel speed sensor (rear right) output	Moving forward slowly		0 – 5 V
24	Lateral G sensor earth	Always		0 V
25	Longitudinal G sensor input	Ignition switch: ON		2.4 – 2.6 V (horizontal position)
26	Steering wheel sensor (ST-1) input	Ignition switch: ON	Steering wheel: Turn laterally	Variation in the voltage value 0.8 – 2.1 V and 2.7 – 4.4 V
27	ABS warning lamp transistor output	Ignition switch: ON	When the lamp is switched off	1 V or less
			When the lamp is illuminated	7 V or more
32	Wheel speed sensor (front left) output	Moving forward slowly		0 – 5 V
33	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.
3. Check the resistance and continuity between the terminals indicated in the table below.
4. The terminal layout is shown in the illustration.

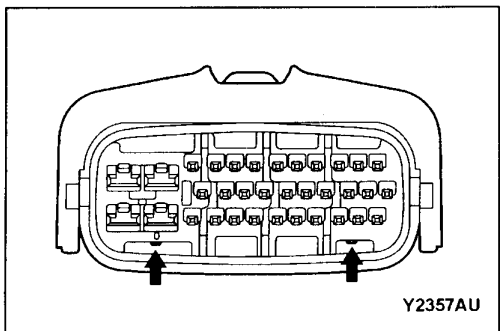
ABS-ECU terminal No.	Signal	Normal condition
6 – 7	Wheel speed sensor (rear left)	1.24 – 1.64 kΩ
8 – 9	Wheel speed sensor (rear right)	
22 – 31	Wheel speed sensor (front left)	
29 – 30	Wheel speed sensor (front right)	
12 – Body earth	Earth	Continuity
34 – Body earth	Earth	

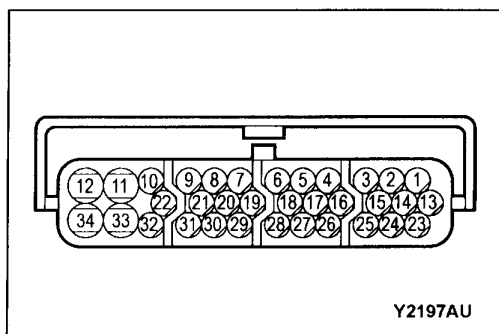


ON-VEHICLE SERVICE

WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK

1. Lift up the vehicle and release the parking brake.
2. Move the lock lever of the ABS-ECU connector as shown in the illustration, and then disconnect the ABS-ECU connector.
3. Push up and unlock the hooks of the ABS-ECU connector shown in the illustration, then remove the connector cover.





4. 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.	22 31	29 30	6 7	8 9

Output voltage

When measuring with a circuit tester:
42 mV or more

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

5. 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

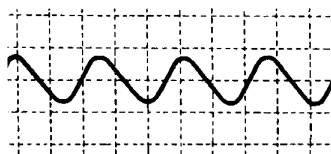
Use the following method to observe the output voltage waveform from each wheel speed sensor with an oscilloscope.

- Start the engine, and rotate the front wheels by engaging 1st gear. Turn the rear wheels manually so that they rotate at a constant speed.

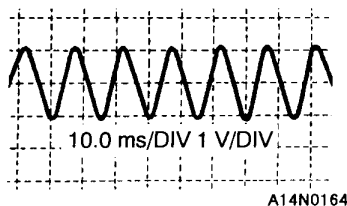
NOTE

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.

When turning by hand



When idling (5–6 km/h), 1st gear



A14N0164

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

Symptom	Probable causes	Remedy
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.

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 is in neutral, start the engine.
4. Use the MUT-II to force-drive the actuator.

NOTE

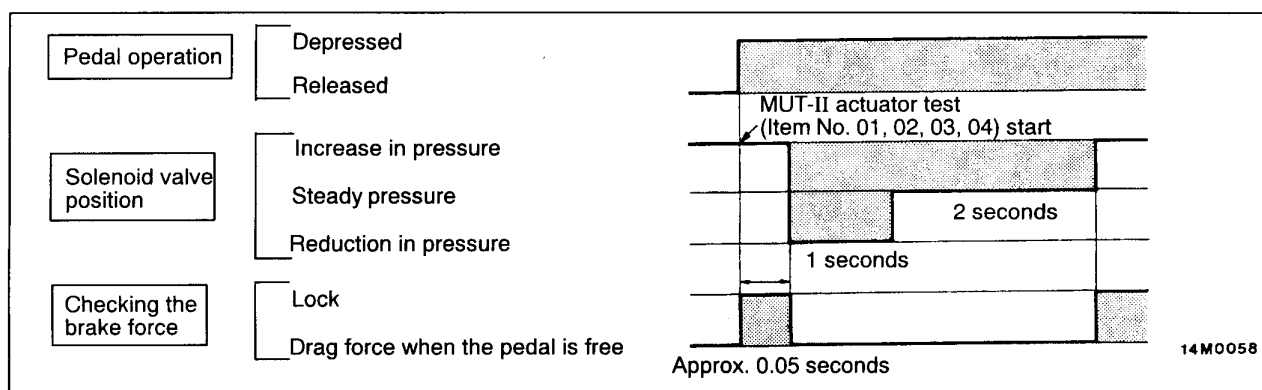
(1) During the actuator test, the ABS warning lamp will illuminate and the anti-skid control will be cancelled.

(2) When the ABS has been interrupted by the fail-safe function, the MUT-II actuator testing cannot be carried out.

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 following "Diagnosis Table."

Diagnosis Table

No.	MUT-II display	Operation	Judgement		Probable cause	Remedy
			Normal	Abnormal		
01	FR VALVE	(1) Depress the brake pedal to lock wheel. (2) Using the MUT-II, select the wheel to be checked and force the actuator to operate. (3) Check the brake force for the selected wheel using a brake force tester or by rotating the wheel by hand.	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	FL VALVE				Clogged hydraulic circuit in hydraulic unit	Replace hydraulic unit assembly.
03	RR VALVE			Brake force is not released.	Incorrect hydraulic unit brake tube connection	Connect correctly.
04	RL VALVE				Hydraulic unit solenoid valve not functioning correctly	Replace hydraulic unit assembly.

7. After checking, turn the ignition switch to the "LOCK" (OFF) position and then disconnect the MUT-II.

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. If this happens, recharge the battery fully.

Caution

The vehicle posture will be unstable during braking, so do not drive the vehicle with the ABS-ECU connector disconnected or with the ABS not operating for any other reason.

HYDRAULIC UNIT AND ABS-ECU

REMOVAL AND INSTALLATION

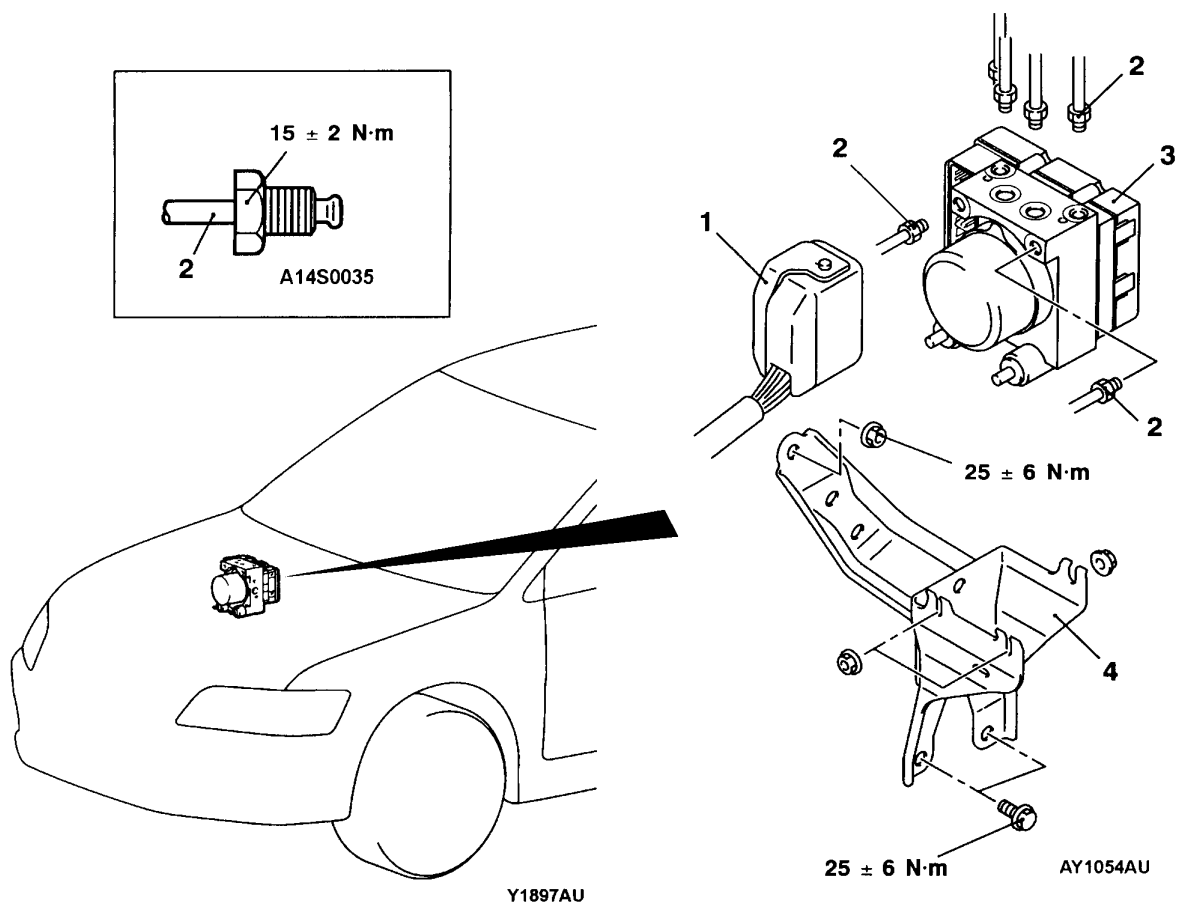
<L.H. drive vehicles>

Pre-removal Operation

- Strut Tower Bar Removal (Refer to GROUP 42.)
- Brake Fluid Draining

Post-installation Operation

- Brake Fluid Supplying and Brake Line Bleeding (Refer to GROUP 35A – On-vehicle Service.)
- Hydraulic Unit Check (Refer to P.35B-28.)
- Strut Tower Bar Installation (Refer to GROUP 42.)

**Removal steps**

◀A▶

▶A◀

1. Harness connector
2. Brake pipe connection

◀B▶

3. Hydraulic unit and ABS-ECU
4. Hydraulic unit bracket assembly

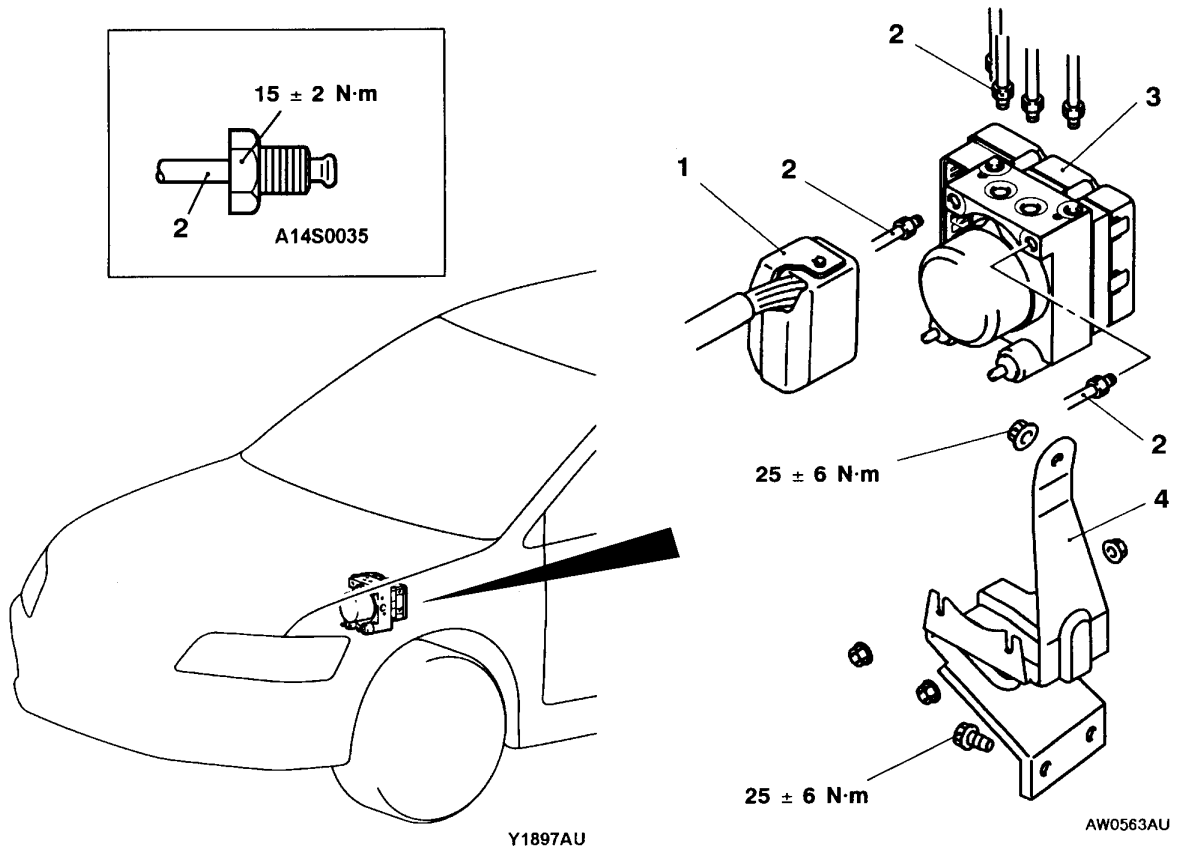
<R.H. drive vehicles>

Pre-removal Operation

- Strut Tower Bar Removal (Refer to GROUP 42.)
- Brake Fluid Draining
- Air Intake Hose and Air Cleaner Removal

Post-installation Operation

- Brake Fluid Supplying and Brake Line Bleeding (Refer to GROUP 35A – On-vehicle Service.)
- Hydraulic Unit Check (Refer to P.35B-28.)
- Air Intake Hose and Air Cleaner Installation
- Strut Tower Bar Installation (Refer to GROUP 42.)

**Removal steps**

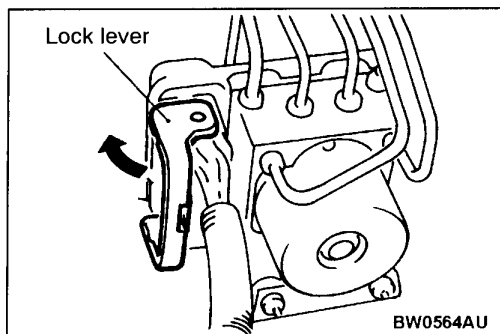
◀A▶

▶A◀

1. Harness connector
2. Brake pipe connection

◀B▶

3. Hydraulic unit and ABS-ECU
4. Hydraulic unit bracket assembly

**REMOVAL SERVICE POINTS****◀A▶ HARNESS CONNECTOR DISCONNECTION**

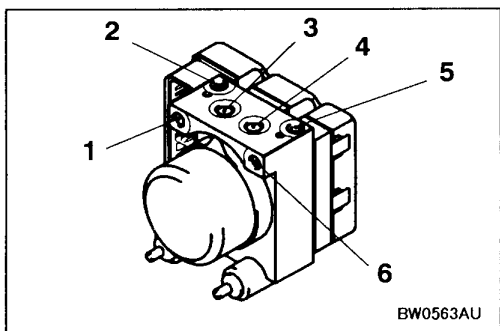
Move the lock lever of the ABS-ECU connector as shown in the illustration, and then disconnect the harness connector.

◀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. From the master cylinder (Secondary)
2. To the front brake (LH)
3. To the rear brake (RH)
4. To the rear brake (LH)
5. To the front brake (RH)
6. From the master cylinder (Primary)

WHEEL SPEED SENSOR

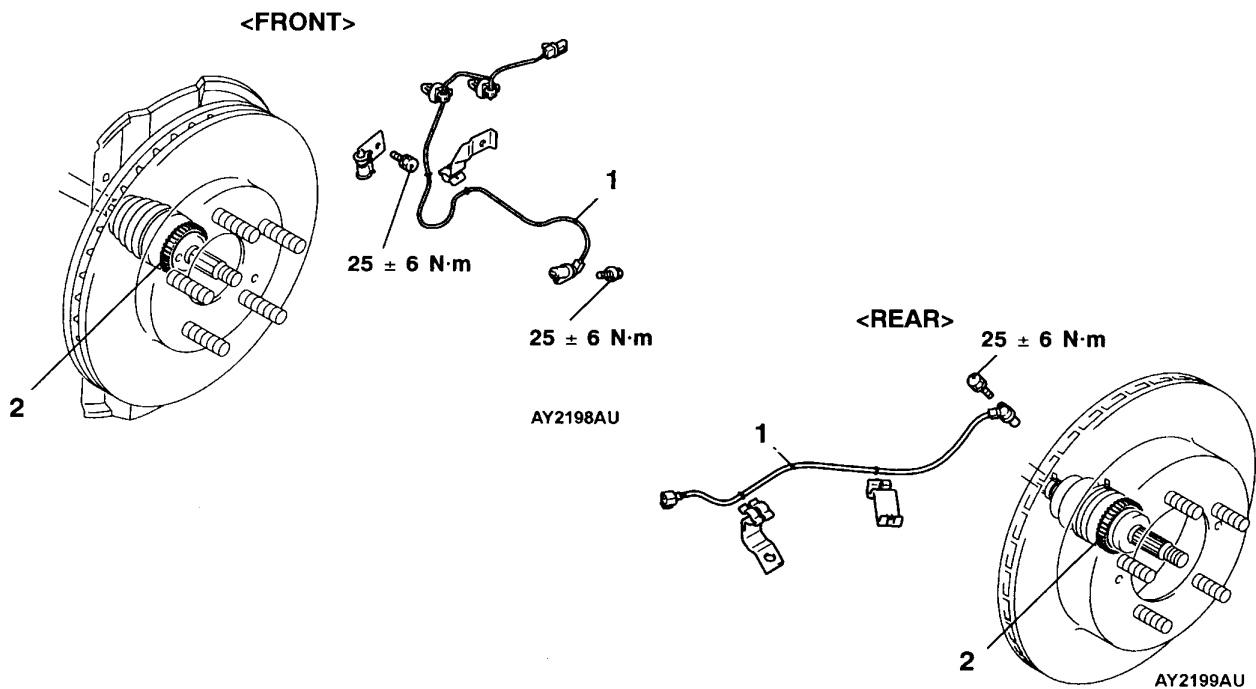
REMOVAL AND INSTALLATION

Caution

If the vehicle is equipped with the Brembo disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched. And if there is brake fluid on the caliper, wipe out quickly.

Post-installation Operation

Wheel Speed Sensor Output Voltage Check
(Refer to P.35B-26.)

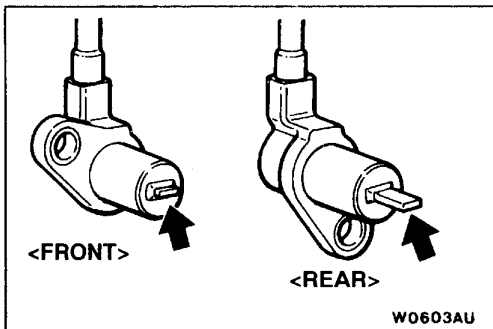


Removal steps

- ◀A▶ ▶A▶
1. Wheel speed sensor
 2. ABS rotor
(Refer to GROUP 26/27 – Drive Shaft.)

NOTE

The ABS rotors are integrated with the drive shaft and cannot be disassembled.

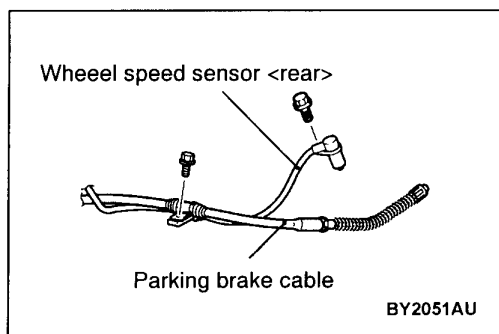


REMOVAL SERVICE POINT

◀A▶ 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.



INSTALLATION SERVICE POINT

►◄ WHEEL SPEED SENSOR <REAR> INSTALLATION

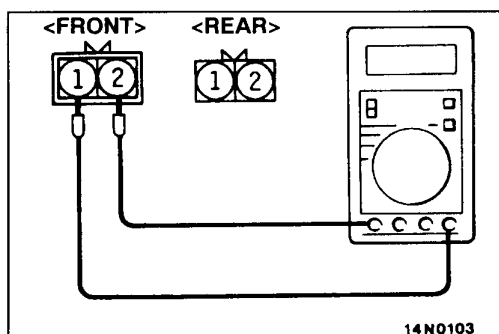
Install the wheel speed sensor crossing with the parking brake cable.

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: 1.24 – 1.64 k Ω

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. Also check the connection of the connector and that the terminals are inserted correctly.

ABS ROTOR CHECK

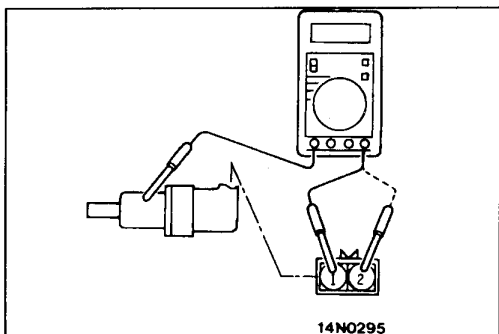
Check whether ABS rotor teeth are broken or deformed, and, if so, replace the ABS rotor.

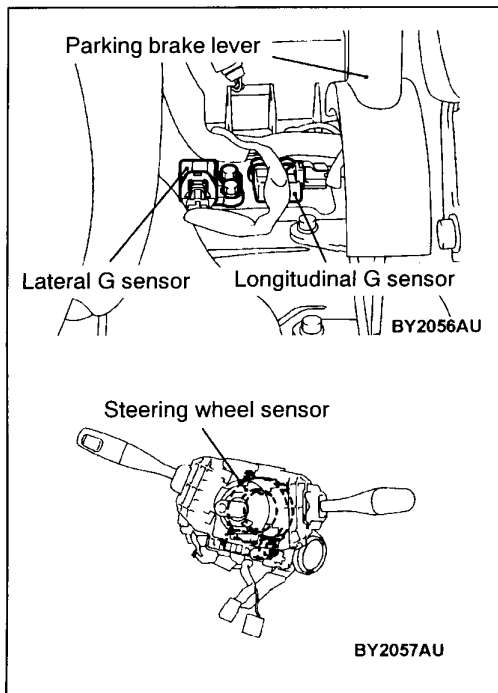
WHEEL SPEED SENSOR INSULATION INSPECTION

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

Standard value: 100 k Ω or more

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





G SENSORS AND STEERING WHEEL SENSOR

REMOVAL AND INSTALLATION

Refer to GROUP 22 – Sensor, Switch and Relay.