
SERVICE BRAKES

CONTENTS

35109000135

BASIC BRAKE SYSTEM	35A
ANTI-SKID BRAKING SYSTEM (ABS)	35B



BASIC BRAKE SYSTEM

CONTENTS

35109000142

GENERAL INFORMATION	2	Front Disc Brake Rotor Check	13
SERVICE SPECIFICATIONS	3	Front Brake Disc Run-out Check	13
LUBRICANTS	4	Front Brake Disc Run-out Correction	14
SEALANT	4	Rear Disc Brake Pad Check and Replacement	14
SPECIAL TOOLS	4	Rear Brake Disc Thickness Check	15
TROUBLESHOOTING	5	Rear Brake Disc Run-out Check	15
ON-VEHICLE SERVICE	7	Rear Brake Disc Run-out Correction	15
Brake Pedal Check and Adjustment	7	Brake Lining Thickness Check	16
Stop Lamp Switch Check	8	Brake Drum Inside Diameter Check	16
Brake Booster Operating Test	8	Brake Lining and Brake Drum Connection Check	16
Check Valve Operation Check	9	BRAKE PEDAL	17
Proportioning Valve Function Test	10	MASTER CYLINDER AND BRAKE BOOSTER	18
Brake Fluid Level Sensor Check	10	FRONT DISC BRAKE	21
Bleeding	11	REAR DISC BRAKE	27
Front Disc Brake Pad Check and Replacement	11	PROPORTIONING VALVE	31
Front Brake Disc Thickness Check	12		

GENERAL INFORMATION

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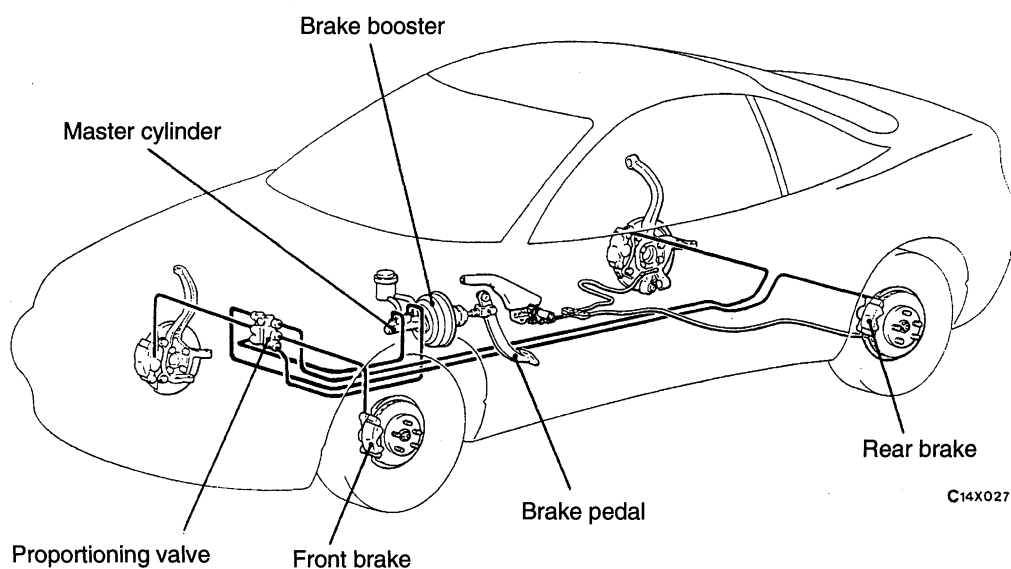
The brake system has high reliability and durability which maintains excellent braking performance.

The main features are as follows.

- A dual type master cylinder is equipped on all models.
- A tandem type brake booster has been adopted.
- Disc brakes has been adopted as the front brakes. [Floating caliper, single-piston and ventilated disc (V4-S60)]
- Disc brakes has been adopted as the rear brakes. [Floating caliper, single-piston and solid disc (S4-S35P)]

Items		Specifications
Master cylinder	I.D. mm	25.4
Brake booster	Effective diameter of power cylinder mm	180+205
	Boosting ratio	6.5
Proportioning valve	Decompression ratio	0.25
Front brakes	Disc effective diameter mm	204
	Wheel cylinder I.D. mm	60.3
Rear disc brakes	Disc effective diameter mm	222
	Wheel cylinder I.D. mm	34.9

CONSTRUCTION DIAGRAM



SERVICE SPECIFICATIONS

35100030089

Items	Standard value	Limit
Brake pedal height mm	175–180	–
Brake pedal free play mm	3–8	–
Brake pedal to floor board clearance mm	80 or more	–
Output pressure of proportioning valve split point MPa	2.70–3.19	–
Output pressure of proportioning valve output fluid pressure MPa	3.92–4.41	–
Left/right proportioning valve output pressure difference MPa	–	0.4
Front disc brake pad thickness mm	10	2.0
Front disc brake drag force (tangential force of wheel mounting bolts) N	69 or less	–
Front brake disc run-out mm	–	0.08
Front hub end play mm	–	0.05
Front brake disc thickness mm	24	22.4
Rear disc brake pad thickness mm	10	2.0
Rear disc brake drag force (tangential force of wheel mounting bolts) N	69 or less	–
Rear brake disc thickness mm	10	8.4
Rear brake disc run-out mm	–	0.08
Rear hub end play mm	–	1.0
Booster push rod to master cylinder piston clearance mm	0.6–0.8	–

LUBRICANTS

35100040075

Items	Specified lubricant
Brake fluid	Brake Fluid DOT3 or DOT4
Brake piston seal	Repair kit grease
Slide pin boot and slide pin bush inner surfaces	
Brake piston boot inner surfaces	
Lock pin boot inner surfaces	
Guide pin boot inner surfaces	
Piston boot mounting grooves	
Piston cup surface	

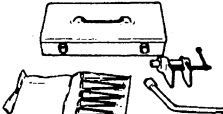
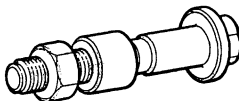
SEALANT

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

SPECIAL TOOLS

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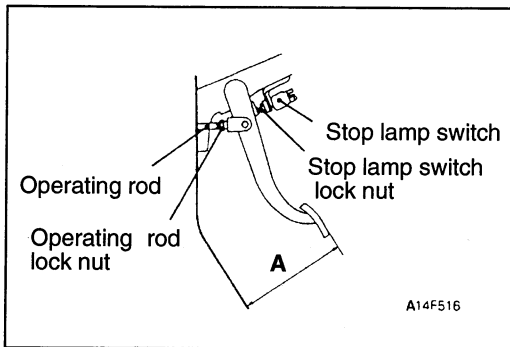
Tool	Number	Name	Application
	MB990964 MB990520	Brake tool set	Compressing front disc brake piston
	MB990998	Front hub remover and installer	Removal and installation of front hub

TROUBLESHOOTING

35100070067

Symptom	Probable cause	Remedy
Vehicle pulls to one side when brakes are applied	Grease or oil on pad or lining surface	Replace
	Inadequate contact of pad or lining	Correct
	Auto adjuster malfunction	Adjust
Insufficient braking power	Low or deteriorated brake fluid	Refill or change
	Air in brake system	Bleed air from system
	Overheated brake rotor due to dragging of pad or lining	Correct
	Inadequate contact of pad or lining	
	Brake booster malfunction	
	Clogged brake line	
	Grease or oil on pad or lining surface	Replace
	Proportioning valve malfunction	
	Auto adjuster malfunction	Adjust
Increased pedal stroke (Reduced pedal to floorboard clearance)	Air in brake system	Bleed air from system
	Worn lining or pad	Replace
	Broken vacuum hose	
	Faulty master cylinder	
	Brake fluid leaks	Correct
	Auto adjuster malfunction	Adjust
	Excessive push rod to master cylinder clearance	
Brake drag	Clogged master cylinder return port	Correct
	Incorrect push rod to master cylinder clearance	Adjust
	Faulty master cylinder piston return spring	Replace
	Worn brake pedal return spring	
	Lack of lubrication in sliding parts	Lubricate
Scraping or grinding noise when brakes are applied	Worn brake pad	Replace
	Caliper to wheel interference	Correct or replace
	Dust cover to disc interference	
	Bent brake backing plate	
	Cracked brake disc	

Symptom	Probable cause	Remedy
Squealing, groaning or chattering noise when brakes are applied	Missing or damaged brake pad anti-squeak shim	Replace
	Brake discs and pads worn or scored	Correct or replace
	Incorrect parts	
	Burred or rusted calipers	Clean or deburr
	Incorrect brake pedal or booster push rod setting	Adjust
Squealing noise when brakes are not applied	Poor return of brake booster, master cylinder or wheel cylinder	Replace
	Loose or extra brake parts	Retighten
	Improper positioning of pads in caliper	Correct
	Improper installation of support mounting to caliper body	
	Disc brakes-rusted, stuck	Lubricate or replace
	Worn, damaged or insufficiently lubricated wheel bearings	
	Incorrect brake pedal or booster push rod setting	Adjust
Groaning clicking or rattling noise when brakes are not applied	Stones or foreign material trapped inside wheel covers	Remove stones, etc.
	Loose wheel nuts	Retighten
	Disc brakes-loose installation bolt	
	Worn, damaged or dry wheel bearings	Lubricate or replace
	Disc brakes-failure of anti-rattle shim	Replace
	Disc brakes-wear on sleeve	
	Incorrect brake pedal or booster push rod setting	Adjust



ON-VEHICLE SERVICE BRAKE PEDAL CHECK AND ADJUSTMENT

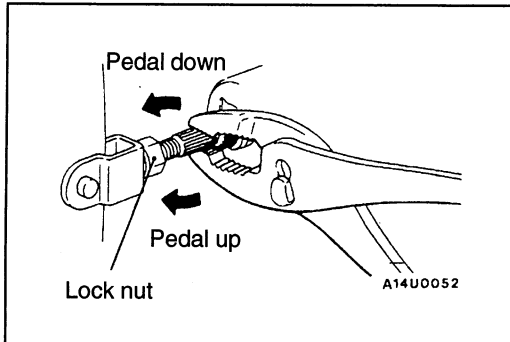
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1. BRAKE PEDAL HEIGHT

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

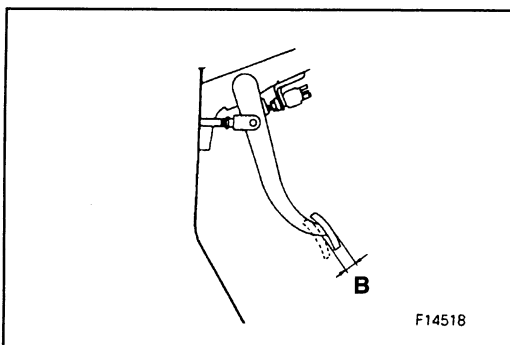
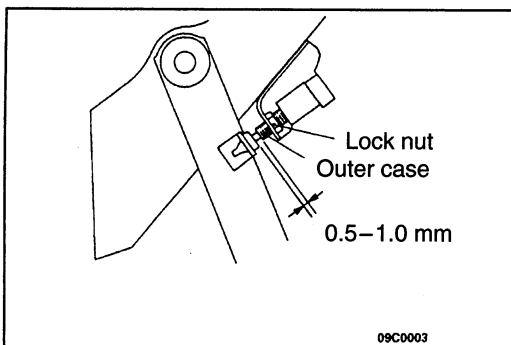
Standard value (A): 175–180 mm

- (3) If the brake pedal height is not within the standard value, adjust as follows.



- (a) Disconnect the stop lamp switch connector, loosen the lock nut, and move the stop lamp switch to a position where it does not contact the brake pedal arm.
- (b) Adjust the brake pedal height by turning the operating rod with pliers (with the operating rod lock nut loosened), until the correct brake pedal height is obtained.
- (c) Screw in the stop lamp switch until it contacts the brake pedal stopper (just before the brake pedal is caused to move). Back off the stop lamp switch 1/2 to 1 turn and secure by tightening the lock nut.
- (d) Connect the connector of the stop lamp switch.
- (e) Check to be sure that the stop lamp is not illuminated with the brake pedal released.

- (4) Turn back the carpet, etc.

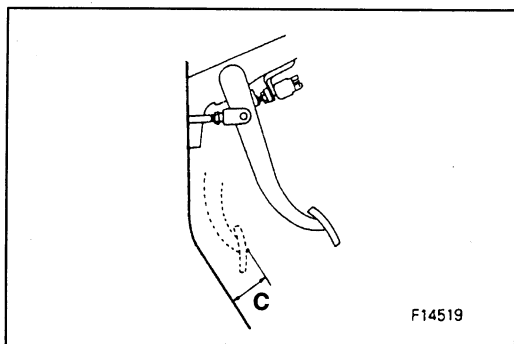


2. BRAKE PEDAL FREE PLAY

- (1) With the engine stopped, press 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 feeling resistance (the free play) is within the standard value range.

Standard value (B): 3–8 mm

- (2) If the free play exceeds the standard value, it is probably due to excessive play between the clevis pin and brake pedal arm. Check for excessive clearance and replace faulty parts as required.



3. 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.

Standard value (C): 80 mm or more

- (3) If the clearance is less than the standard value, check for air trapped in the brake line, thickness of brake disc pad and dragging in the parking brake. Adjust and replace defective parts as required.
- (4) Turn back the carpet, etc.

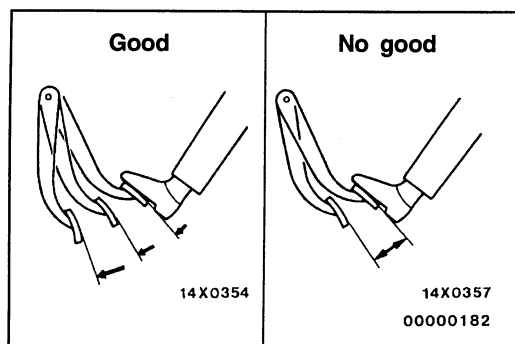
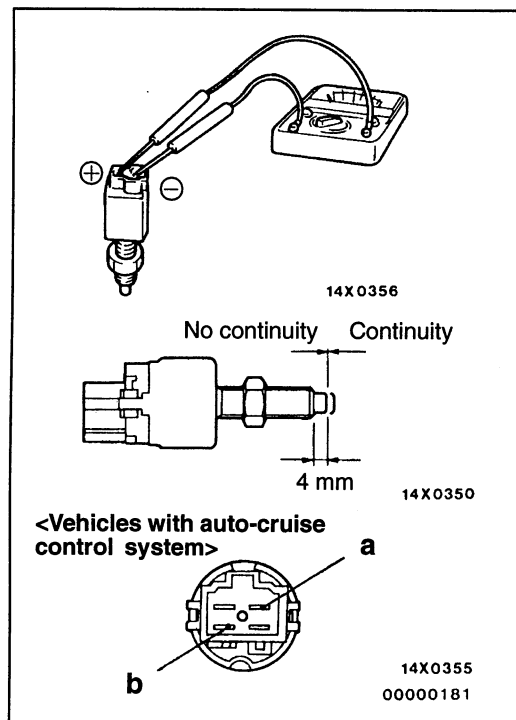
STOP LAMP SWITCH CHECK

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Connect a circuit tester to the stop lamp switch, and check whether or not there is continuity when the plunger of the stop lamp switch is pushed in and when it is released.

The stop lamp switch is in good condition if there is no continuity when the plunger is pushed in to a depth of within 4 mm from the outer case edge surface, and if there is continuity when it is released.

For vehicles with auto-cruise control system, the check for continuity should be made at connectors "a" and "b" of the stop lamp switch.



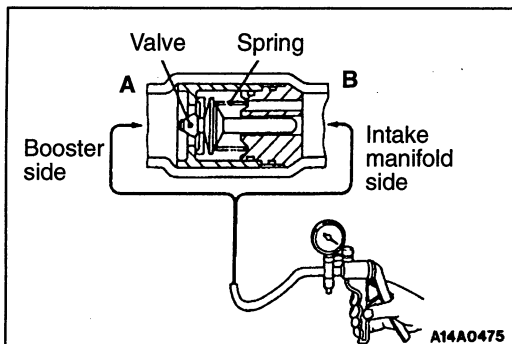
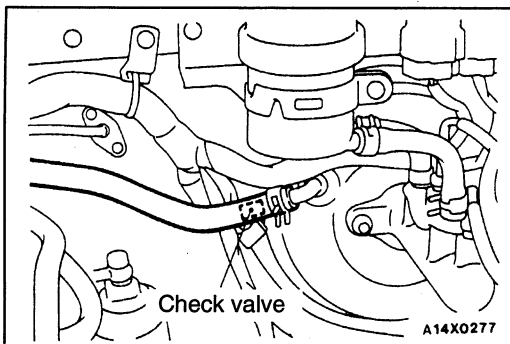
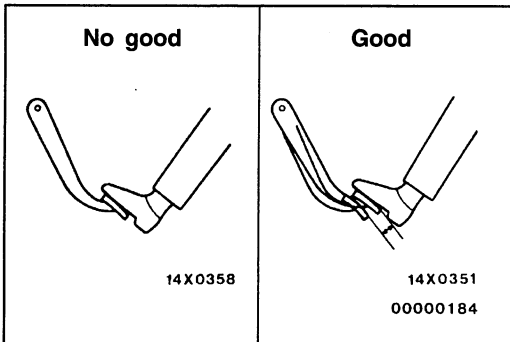
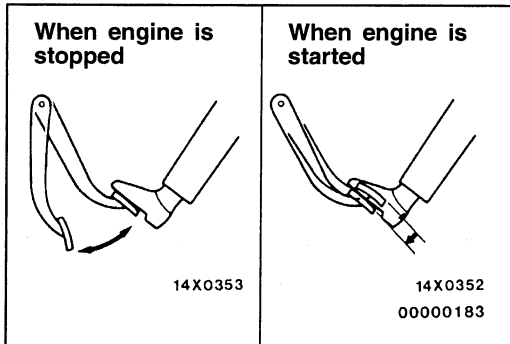
BRAKE BOOSTER OPERATING TEST

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

1. Run the engine for one or two minutes, and then turn the engine off.

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.



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

- 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.
Brake booster performance is satisfactory if it passes all three operating tests.
If the brake booster does not pass all three tests, there may be a fault in the check valve, vacuum hose or in the booster itself.

CHECK VALVE OPERATION CHECK

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When checking the check valve, keep the check valve fit in the vacuum hose.

- Remove the vacuum hose.

NOTE

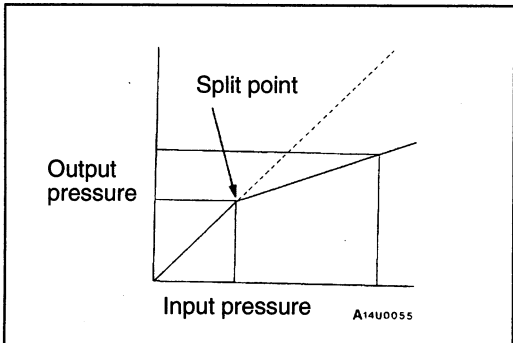
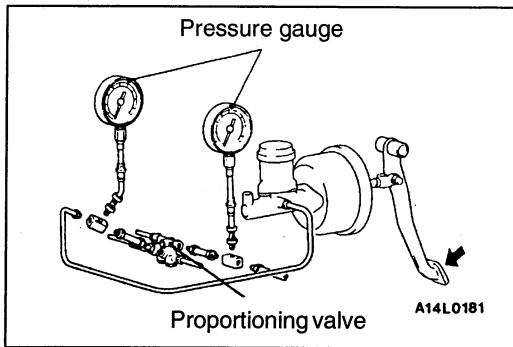
The check valve is press-fitted inside the vacuum hose.

- 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, replace it as an assembly unit together with the vacuum hose.



PROPORTIONING VALVE FUNCTION TEST

35100110073

1. Connect two pressure gauges, one each to the input side and output side of the proportioning valve, as shown.
2. Air bleed the brake line and the pressure gauge.
3. While gradually depressing the brake pedal, make the following measurements and check to be sure that the measured values are within the allowable range.

- (1) Output pressure begins to drop relative to input pressure (split point).

Standard value: 2.70–3.19 MPa

- (2) Check that the output fluid pressure is at the standard value when the input fluid pressure increases according to the table below.

Standard value:

MPa

Items	Specifications
Input fluid pressure	6.86
Output fluid pressure	3.92–4.41

- (3) Output pressure difference between left and right brake lines

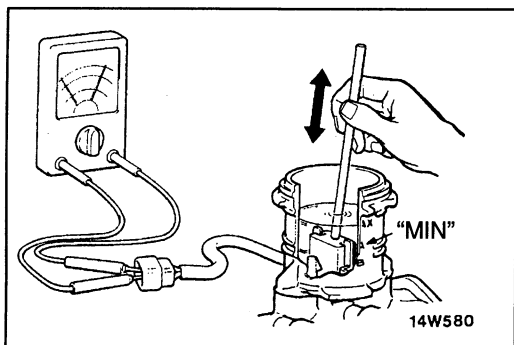
Limit: 0.4 MPa

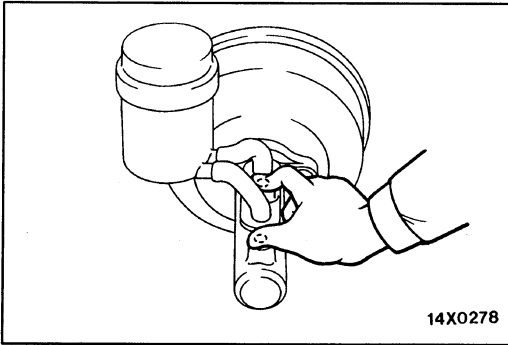
4. If the measured pressures are not within allowable ranges, replace the proportioning valve.

BRAKE FLUID LEVEL SENSOR CHECK

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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".





BLEEDING

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Caution

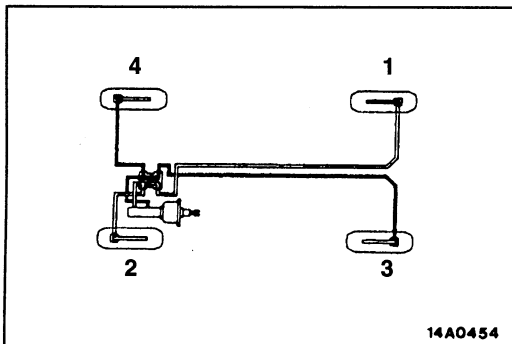
Use the specified brake fluid. Don't use a mixture of the specified brake fluid and another non-specified fluid.

Specified fluid: Brake Fluid DOT3 or DOT4

MASTER CYLINDER BLEEDING

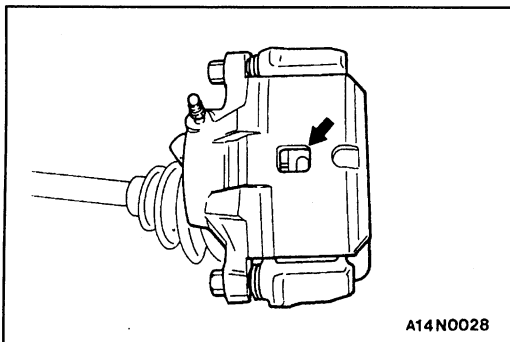
The master cylinder has no check valve, so if bleeding is carried out by the following procedure, bleeding of air from the brake line will become easier.

- (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 LINE BLEEDING

Start the engine and bleed the air in the sequence shown in the figure.



FRONT DISC BRAKE PAD CHECK AND REPLACEMENT

35100150082

NOTE

The brake pads have wear indicators that contact the brake disc when the brake pad thickness becomes 2 mm.

The wear indicators emit a squealing sound to warn the driver to have the pads replaced and to have the brake system checked.

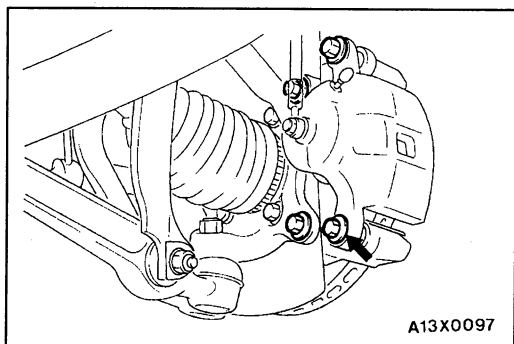
1. Check brake pad thickness through caliper body check port.

Standard value: 10 mm

Limit: 2.0 mm

Caution

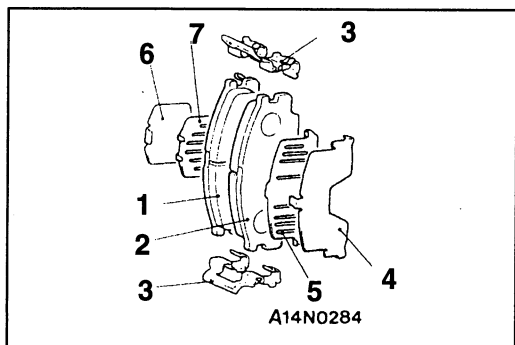
1. When the limit is exceeded, the brake pads on both the left and right wheels must be replaced as a set.
2. If there is a significant difference in the thicknesses of the pads on the left and right sides, check the sliding condition of the piston, lock pin and guide pin.



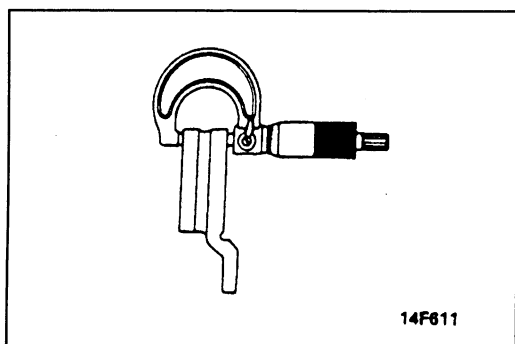
2. Remove guide pin. Lift caliper assembly, slide the assembly toward the inside of the wheel well until separated from the lock pin. Support it with wires.

Caution

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



3. Remove the following parts from caliper support.
 1. Pad and wear indicator assembly
 2. Pad assembly
 3. Clip
 4. Outer shim (stainless)
 5. Outer shim (coated with rubber)
 6. Inner shim (stainless)
 7. Inner shim (coated with rubber)
4. In order to measure the brake drag torque after pad installation, measure the rotary-sliding resistance of the hub with the pads removed. (Refer to P.35A-21.)
5. Install the pads and the caliper assembly, and then check the brake drag torque. (Refer to P.35A-22.)



FRONT BRAKE DISC THICKNESS CHECK

35100160078

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

Standard value: 24 mm

Limit: 22.4 mm

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 turn rotor with an on the car type brake lathe ("MAD, DL-8700PF" or equivalent). Be sure to follow the exact brake lathe manufacturer instructions.

FRONT DISC BRAKE ROTOR CHECK

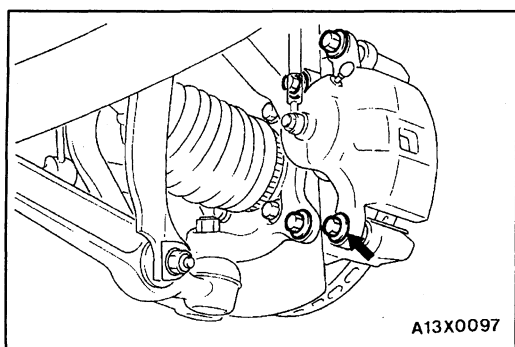
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Caution

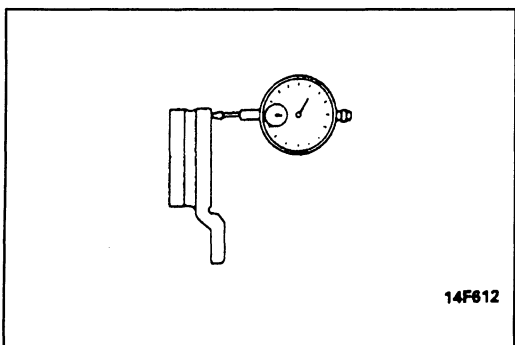
To maintain safe braking performance, the disc brake rotors must be kept within allowable service specifications.

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.

**FRONT BRAKE DISC RUN-OUT CHECK** 35100170071

1. Remove the caliper support bolts, then raise the caliper assembly upward and secure by using wire.
2. Inspect the disc surface for grooves, cracks, and rust. Clean the disc thoroughly and remove all rust.

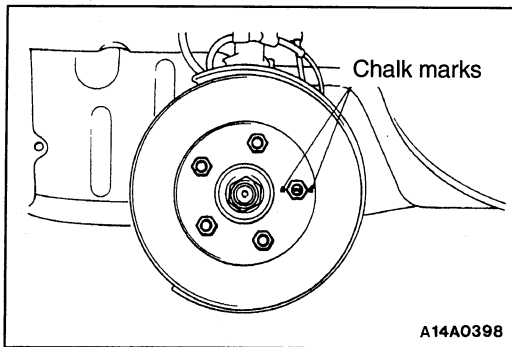


3. Place a dial gauge approximately 5 mm from the outer circumference of the brake disc, and measure the runout of the disc

Limit: 0.08 mm

NOTE

Tighten the nuts in order to secure the disc to the hub.



FRONT BRAKE DISC RUN-OUT CORRECTION

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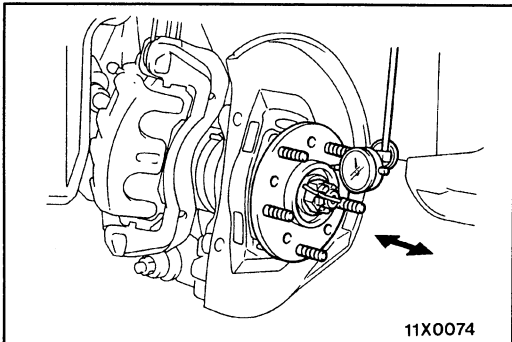
1. If the run-out of the brake disc is equivalent to or exceeds the limit specification, change the phase of the disc and hub, and then measure the run-out again.

- (1) Before removing the brake disc, chalk both sides of the wheel stud on the side at which run-out is greatest.

- (2) Remove the brake disc, and then place a dial gauge as shown in the illustration; then move the hub in the axial direction and measure the play.

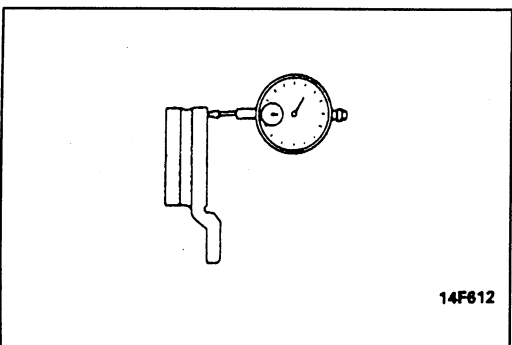
Limit: 0.05 mm

If the play is equivalent to or exceeds the limit, disassemble the hub knuckle and check each part.



- (3) If the play does not exceed the limit specification, install the brake disc at a position 180° away from the chalk mark, and then check the run-out of the brake disc once again.

2. If the run-out cannot be corrected by changing the phase of the brake disc, replace the brake disc or turn rotor with an on the car type brake lathe ("MAD, DL-8700PF" or equivalent). Be sure to follow the exact brake lathe manufacturer instructions. Rotors turned on the vehicle will often have a lower run-out than a new brake disc.



REAR DISC BRAKE PAD CHECK AND REPLACEMENT

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NOTE

The brake pads have wear indicators that contact the brake disc when the brake pad thickness becomes 2 mm. The wear indicators emit a squealing sound to warn the driver to have the pads replaced and to have the brake system checked.

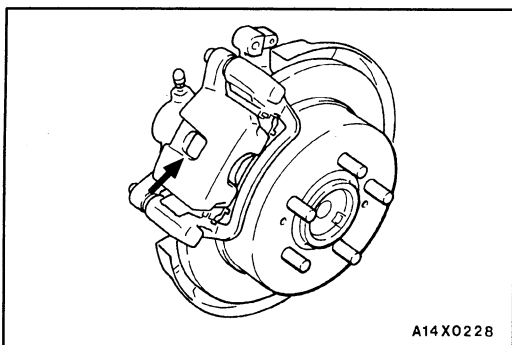
1. Check brake pad thickness through caliper body check port.

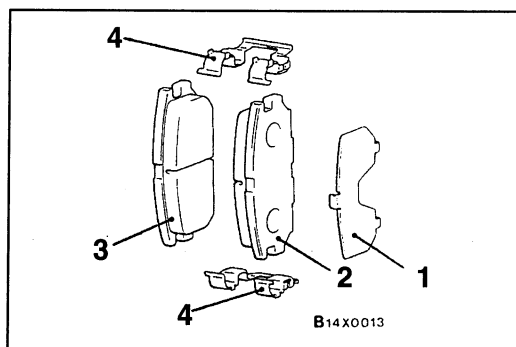
Standard value: 10 mm

Limit: 2.0 mm

Caution

1. When the limit is exceeded, the brake pads on both the left and right wheels must be replaced as a set.
2. If there is a significant difference in the thicknesses of the pads on the left and right sides, check the sliding condition of the piston, lock pin sleeve and guide pin sleeve.



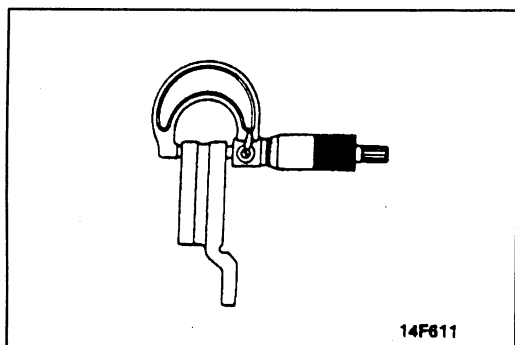


2. Remove guide pin. Lift caliper assembly, slide the assembly toward the inside of the wheel well until separated from the lock pin. Support it with wires.

Caution

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

3. Remove the following parts from caliper support.
 1. Outer shim
 2. Pad assembly
 3. Pad and wear indicator assembly
 4. Clip
4. In order to measure the brake drag torque after pad installation, measure the rotary-sliding resistance of the hub with the pads removed. (Refer to P.35A-21.)
5. Install the pads and the caliper assembly, and then check the brake drag torque. (Refer to P.35A-22.)

**REAR BRAKE DISC THICKNESS CHECK**

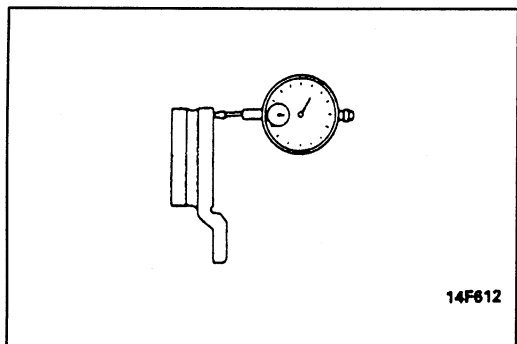
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1. Remove dirt and rust from brake disc surface.
2. Measure disc thickness at 4 locations or more.

Standard value: 10 mm

Limit: 8.4 mm

Replace the discs and pad assembly for both sides left and right of the vehicle if they are worn beyond the specified limit.

**REAR BRAKE DISC RUN-OUT CHECK**

35100210056

1. Remove the caliper support, raise the caliper assembly, and secure it by using a wire, etc.
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: 0.08 mm

NOTE

To secure the disc to the hub, tighten the nuts.

REAR BRAKE DISC RUN-OUT CORRECTION

35100220059

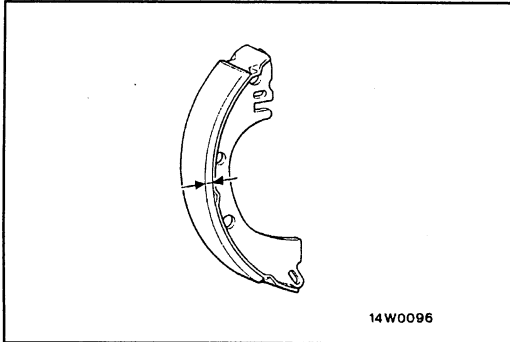
1. If the run-out of the brake disc is equivalent to or exceeds the limit specification, change the phase of the disc and hub, and then measure the run-out again.

NOTE

The procedures for checking and changing the rear disc phase are the same as those for the front brake discs. However, the play (limit value) in the hub axial direction is different. (Refer to P.35A-14.)

Limit: 1.0 mm

2. If the problem cannot be corrected by changing the phase of the brake disc, replace the disc or turn rotor using an on the car type brake lathe. Be sure to follow the exact brake lathe manufacturer instructions. Rotors turned on the vehicle will often have a lower run-out than a new brake disc.



BRAKE LINING THICKNESS CHECK

35100300098

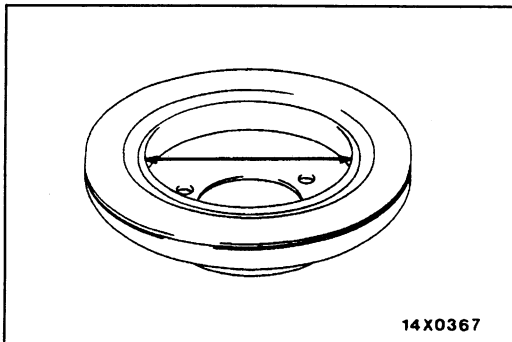
1. Remove the rear brake assembly and hold it with wire.
2. Remove the brake drum.
3. Measure the wear of the brake lining at the place worn the most.

Limit: 1.0 mm

Replace the shoe and lining assembly if brake lining thickness is less than the limit if it is not worn evenly.

Caution

Whenever the shoe and lining assembly is replaced, replace both RH and LH assemblies as a set to prevent car from pulling to one side when braking.



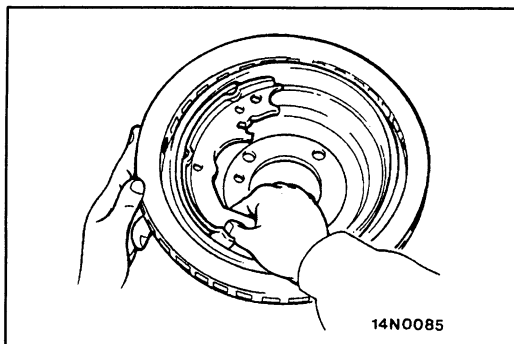
BRAKE DRUM INSIDE DIAMETER CHECK

35100320070

1. Remove the rear brake assembly and hold it with wire.
2. Remove the brake drum.
3. Measure the inside diameter of the brake drum at two or more locations.

Limit: 169.0 mm

4. Replace brake drums, shoe and lining assembly when wear exceeds the limit value or is badly imbalanced.



BRAKE LINING AND BRAKE DRUM CONNECTION CHECK

35100310084

1. Remove the rear brake assembly and hold it with wire.
2. Remove the brake drum.
3. Remove the shoe and lining assembly. (Refer to GROUP 36.)
4. Chalk inner surface of brake drum and rub with shoe and lining assembly.
5. Replace shoe and lining assembly or brake discs if there are any irregular contact area.

NOTE

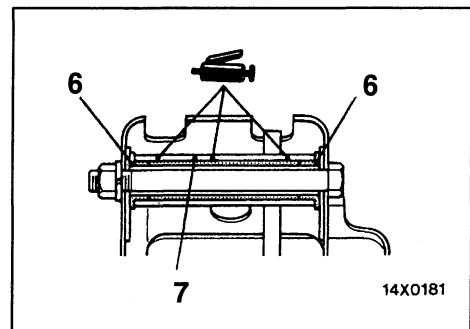
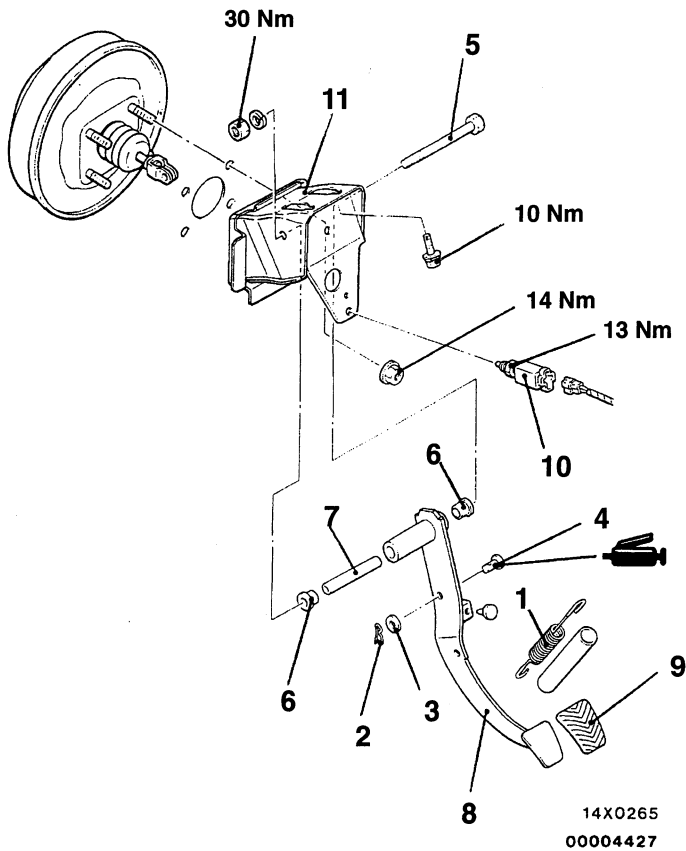
Clean off chalk after check.

BRAKE PEDAL

35100340120

REMOVAL AND INSTALLATION**Post-installation Operation**

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

**Removal steps**

1. Brake pedal return spring
2. Split pin
3. Washer
4. Clevis pin
5. Brake pedal shaft bolt
6. Bushing

7. Spacer
8. Brake pedal
9. Pedal pad
10. Stop lamp switch
11. Pedal support member assembly

MASTER CYLINDER AND BRAKE BOOSTER

35100370129

REMOVAL AND INSTALLATION

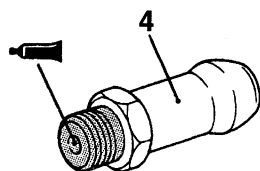
Pre-removal Operation

- (1) Brake Fluid Draining
- (2) Clutch Fluid Reservoir Bracket (Refer to GROUP 21)
- (3) Centermember Assembly Mounting Bolts Removal (Refer to GROUP 32)
- (4) Engine Mount Bracket Removal (Refer to GROUP 32)
- (5) Air Conditioning Compressor Mounting Bolts Removal (Refer to GROUP 55)
- (6) Air Conditioning High-Pressure Hose Clamp Mounting Bolts Removal
- (7) Power Steering Pressure Hose, Pipe and Return Pipe Clamp Mounting Bolts Removal (Refer to GROUP 37)

Post-installation Operation

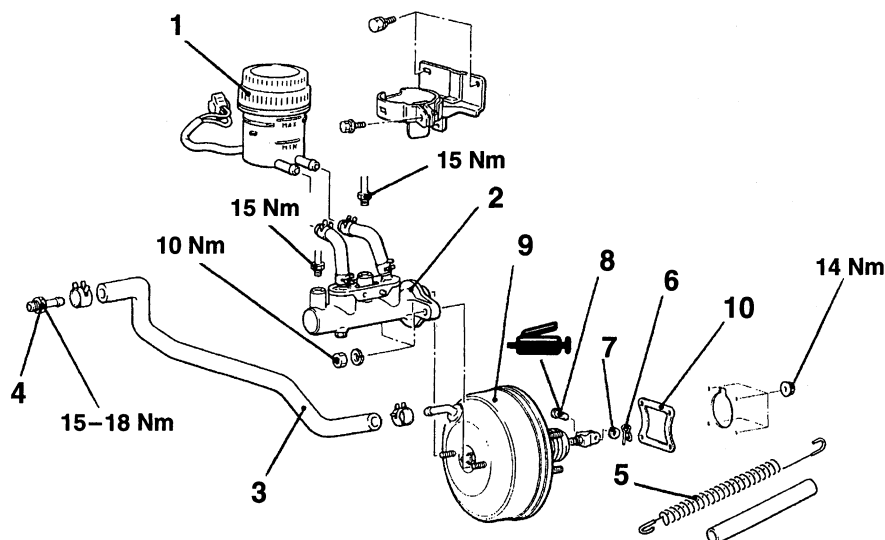
- (1) Power Steering Pressure Hose, Pipe and Return Pipe Clamp Mounting Bolts Installation (Refer to GROUP 37A.)
- (2) Air Conditioning High-Pressure Hose Clamp Mounting Bolts Installation
- (3) Air Conditioning Compressor Mounting Bolts Installation (Refer to GROUP 55)
- (4) Engine Mount Bracket Installation (Refer to GROUP 32)
- (5) Centermember Assembly Mounting Bolts Installation (Refer to GROUP 32)
- (6) Clutch Fluid Reservoir Bracket (Refer to GROUP 21)
- (7) Brake Fluid Supplying
- (8) Brake Line Bleeding (Refer to P.35A-11.)
- (9) Brake Pedal Adjustment (Refer to P.35A-7.)

Fitting



14X0346

Sealant: 3M ATD Part No. 8661 or equivalent



14X0248

00004460

Master cylinder removal steps

1. Reservoir
 2. Master cylinder
- B◄ • Adjustment of clearance between brake booster push rod and primary piston

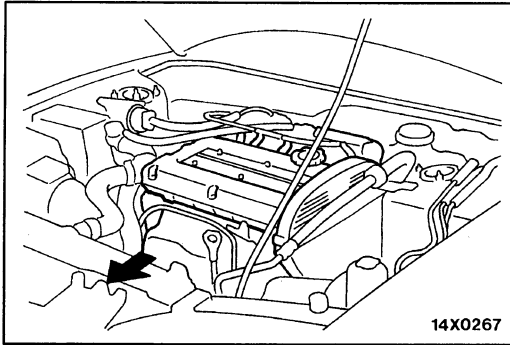
Caution

The check valve should not be removed from the vacuum hose. If the check valve is defective, replace it together with the vacuum hose.

Brake booster removal steps

2. Master cylinder
- B◄ • Adjustment of clearance between brake booster push rod and primary piston
- A◄ 3. Vacuum hose (With built-in check valve)
4. Fitting
 5. Brake pedal return spring
 6. Split pin
 7. Washer
 8. Clevis pin
 9. Brake booster
 10. Sealer

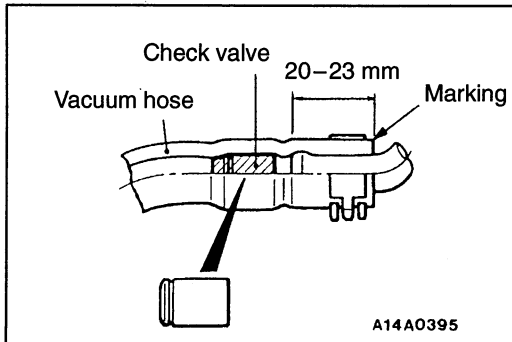
◄A►



REMOVAL SERVICE POINT

◀▶ BRAKE BOOSTER REMOVAL

Slide the engine forward and remove the brake booster from the body.



INSTALLATION SERVICE POINTS

▶▶ VACUUM HOSE CONNECTION

- (1) Install the vacuum hose to the brake booster nipple as shown in the figure. Secure the hose with the hose clip.

Caution

1. The check valve and the pipe part of the brake booster must not contact each other.
2. Connect so that the marking faces upwards.

- (2) Install the other end of the vacuum hose fully onto its port on the engine. Secure the hose using the hose clip.

▶▶ CLEARANCE ADJUSTMENT BETWEEN BRAKE BOOSTER PUSH ROD AND PRIMARY PISTON

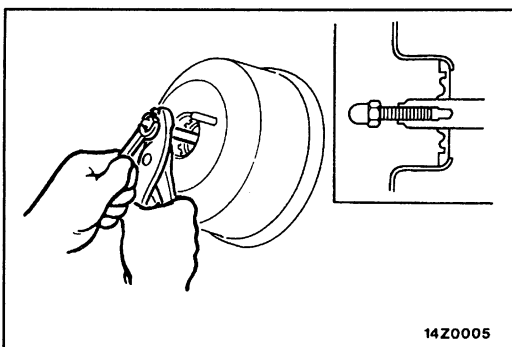
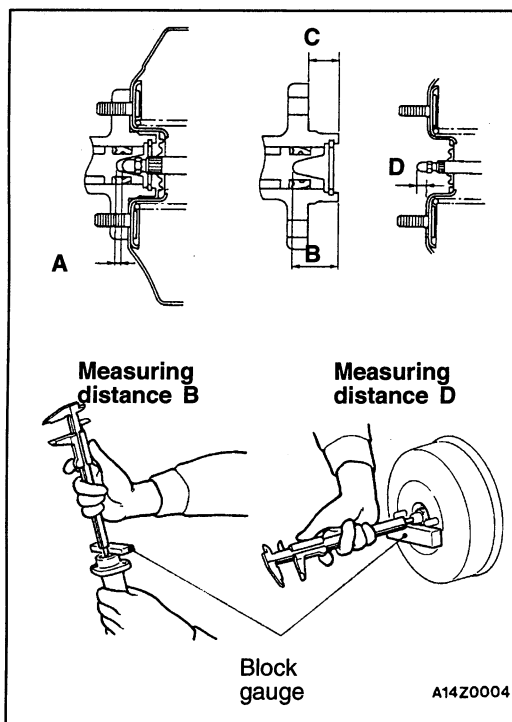
- (1) Calculate clearance A from the B, C and D measurements.

$$A = B - C - D$$

Standard value: 0.6–0.8 mm

NOTE

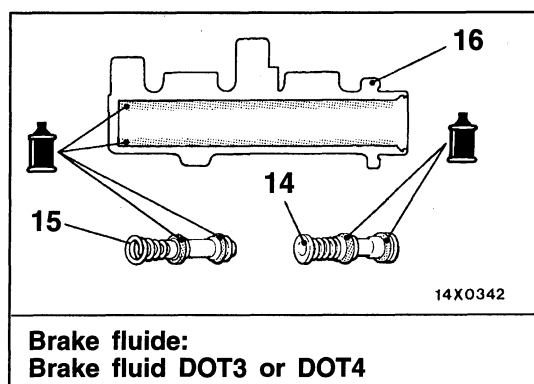
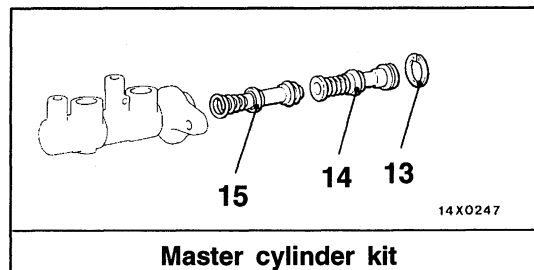
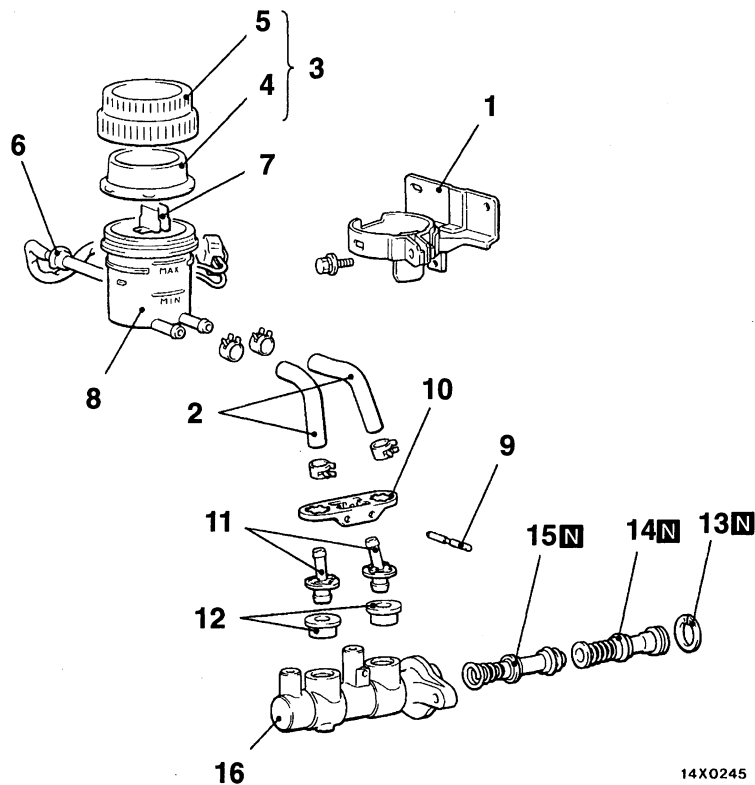
When brake booster negative pressure 66.7 KPa is applied, clearance value A will become 0.1–0.3 mm



- (2) If the clearance is not within the standard value range, turn the push rod screw to achieve desired length.

MASTER CYLINDER DISASSEMBLY AND REASSEMBLY

35100420084



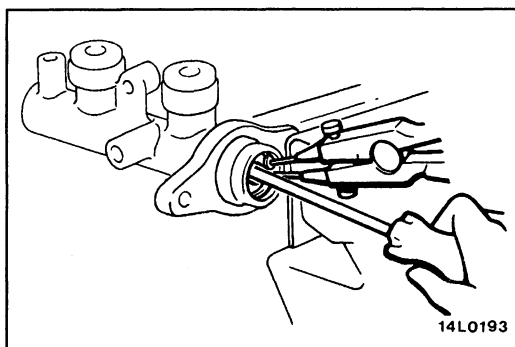
Disassembly steps

1. Reservoir bracket
2. Reservoir hoses
3. Reservoir cap assembly
4. Diaphragm
5. Reservoir cap
6. Brake fluid level sensor
7. Float
8. Reservoir
9. Pin
10. Retainer



11. Connector
12. Grommet
13. Piston stopper ring
14. Primary piston assembly
15. Secondary piston assembly
16. Master cylinder body

Caution
Do not disassemble the primary and secondary piston assemblies.



DISASSEMBLY SERVICE POINT

◀A▶ PISTON STOPPER RING DISASSEMBLY

Remove the piston stopper ring, while depressing the piston.

INSPECTION

35100430049

- Check the inner surface of master cylinder body for rust or pitting.
- Check the primary and secondary pistons for rust, scoring, wear, damage or wear.
- Check the diaphragm for cracks and wear.

35100600082

FRONT DISC BRAKE

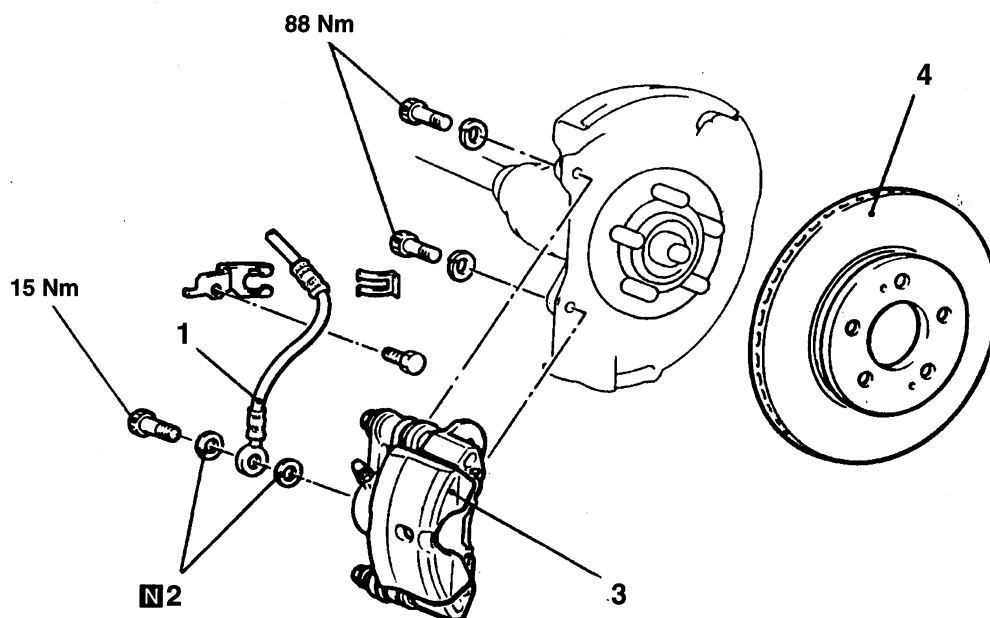
REMOVAL AND INSTALLATION

Pre-removal Operation

- Brake Fluid Draining

Post-installation Operation

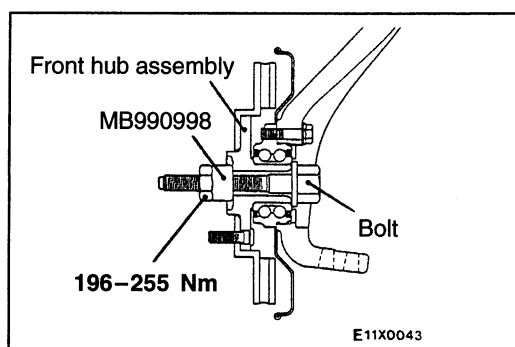
- (1) Brake Fluid Supplying
- (2) Brake Line Bleeding (Refer to P.35A-11.)



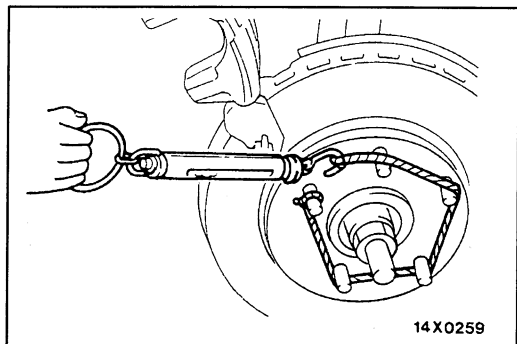
A14X0283

Removal steps

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

**INSTALLATION SERVICE POINT****►A◄ DISC BRAKE ASSEMBLY INSTALLATION**

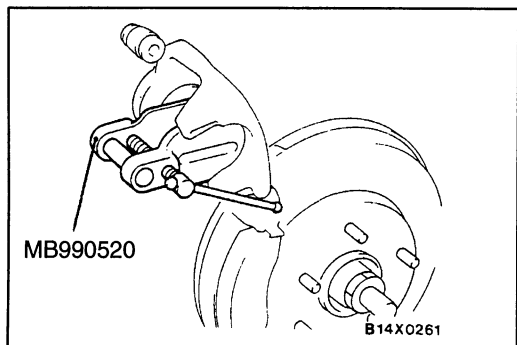
1. In order to measure the brake drag torque after pad installation, measure the rotary-sliding resistance of the hub by the following procedure with the pads removed.
 - (1) Take out the drive shaft. (Refer to GROUP 26.)
 - (2) Set the special tool to the front hub assembly as shown in the illustration.



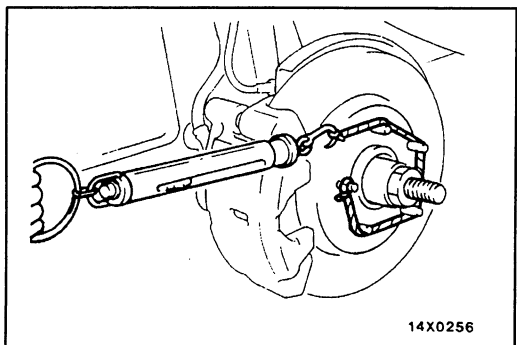
- (3) Use a spring balance to measure the rotary-sliding resistance (A) of the hub in the forward direction.
2. After installing the caliper support to the knuckle, install the pad clips and the pads to the caliper support.

Caution

- Do not let any oil, grease or other contamination get onto the friction surfaces of the pads and brake discs.



3. Clean piston and insert into cylinder (caliper) with special tool.
4. Be careful that the piston boot does not catch and tear as the caliper assembly and lock pin are installed.
5. Check brake drag torque as follows.
 - (1) Start engine and hold brake pedal down for 5 seconds. [Pedal depression force: approx. 196 N]
 - (2) Stop engine.
 - (3) Turn brake disc forward 10 times.



6. Check hub torque (B) with spring scale.
7. Calculate the drag torque of the disc brake [difference between hub torque (B) and hub torque (A)].

Standard value: 69 N [4 Nm] or less

8. If the difference between brake drag torque and hub torque exceeds the standard value, disassemble piston and clean the piston. Check for corrosion or worn piston seal, and check the sliding condition of the lock pin and guide pin.
9. Reinstall the drive shaft (Refer to GROUP 26.)

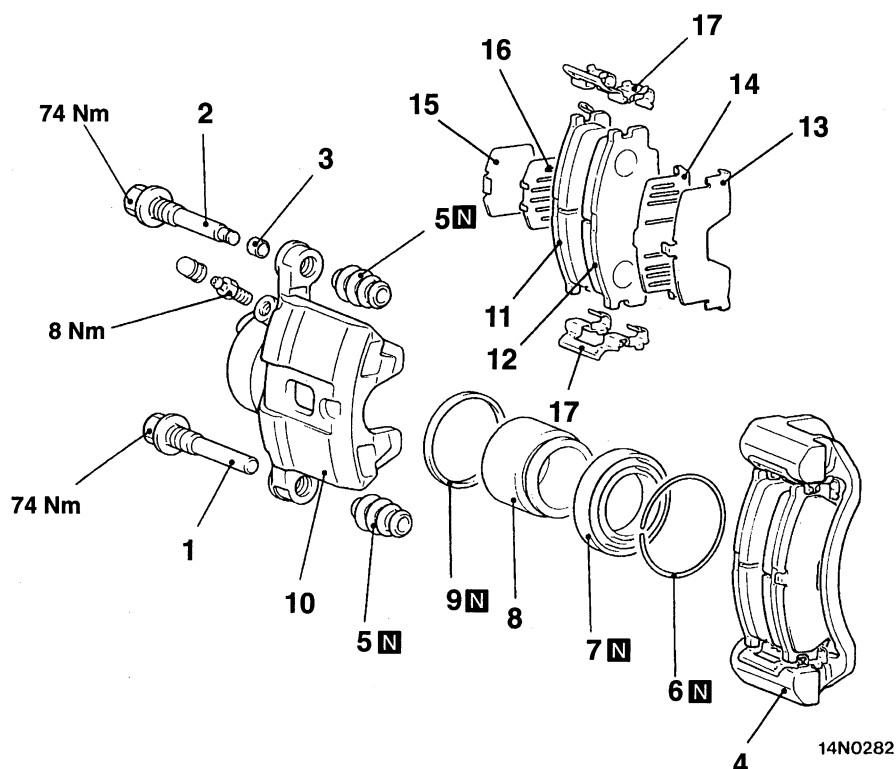
INSPECTION

35100610047

Check the brake disc for damage.

DISASSEMBLY AND REASSEMBLY

35100620095



Brake caliper kit	Pad repair kit	Seal and boots repair kit

00000070

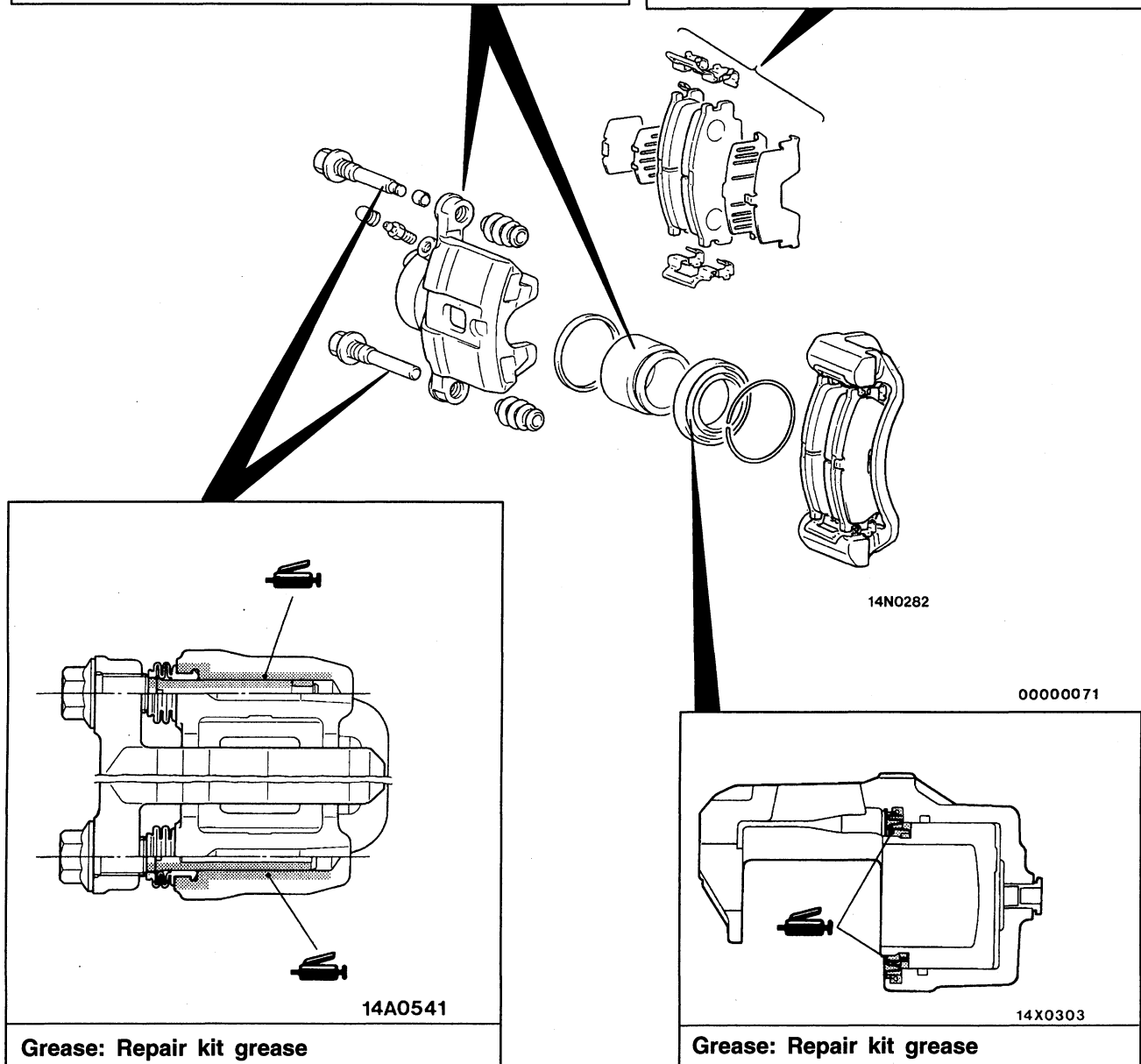
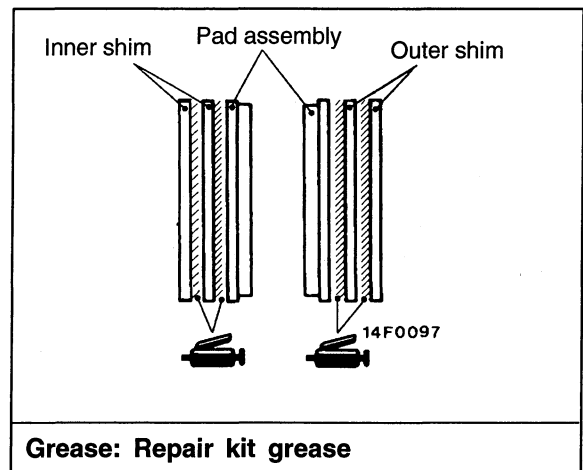
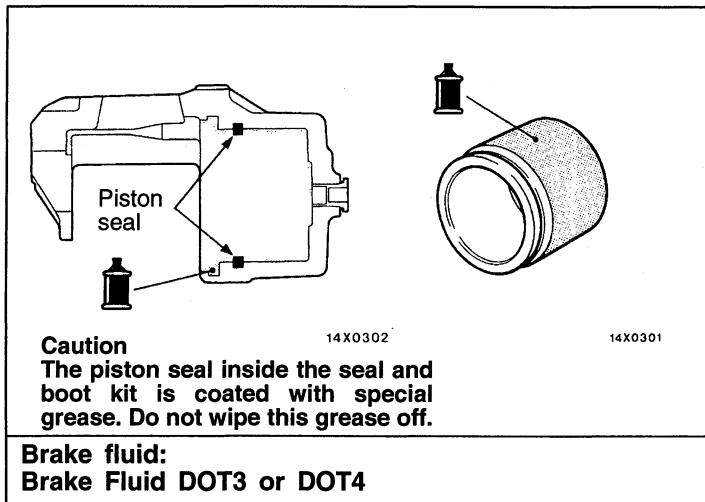
Caliper assembly disassembly steps

- ▶A◀ 1. Guide pin
- ▶A◀ 2. Lock pin
- ▶A◀ 3. Bushing
- ▶A◀ 4. Caliper support (pad, clip, shim)
- ▶A◀ 5. Boot
- ▶A◀ 6. Boot ring
- ▶A◀ 7. Piston boot
- ▶A◀ 8. Piston
- ▶A◀ 9. Piston seal
- ▶A◀ 10. Caliper body

Pad assembly disassembly steps

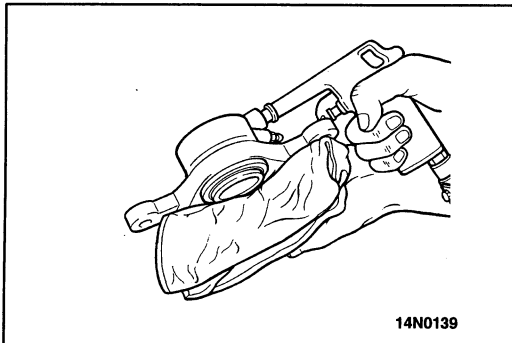
- ▶A◀ 1. Guide pin
- ▶A◀ 2. Lock pin
- ▶A◀ 3. Bushing
- ▶A◀ 4. Caliper support (pad, clip, shim)
- ▶A◀ 11. Pad and wear indicator assembly
- ▶A◀ 12. Pad assembly
- ▶A◀ 13. Outer shim (stainless)
- ▶A◀ 14. Outer shim (coated with rubber)
- ▶A◀ 15. Inner shim (stainless)
- ▶A◀ 16. Inner shim (coated with rubber)
- ▶A◀ 17. Clip

LUBRICATION POINTS



DISASSEMBLY SERVICE POINTS

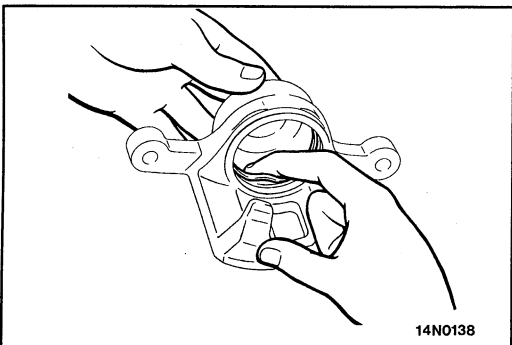
When disassembling the disc brakes, disassemble both sides (left and right) as a set.

**◀A▶ PISTON BOOT/PISTON REMOVAL**

Protect caliper body with cloth. Blow compressed air through brake hose to remove piston boot and piston.

Caution

Blow compressed air gently.

**◀B▶ PISTON SEAL REMOVAL**

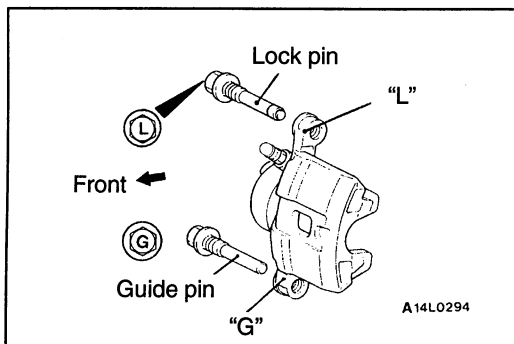
- (1) Remove piston seal with finger tip.

Caution

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

- (2) Clean piston surface and inner cylinder with trichloroethylene, alcohol, or specified brake fluid.

Specified fluid: Brake Fluid DOT3 or DOT4

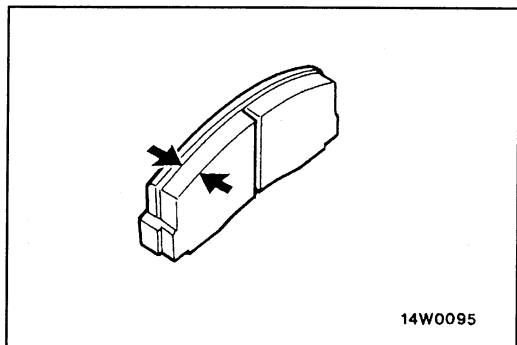
**REASSEMBLY SERVICE POINTS****▶A◀ BOOT/LOCK PIN/GUIDE PIN INSTALLATION**

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

35100630074

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

**PAD WEAR CHECK**

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

Standard value: 10 mm

Limit value: 2.0 mm

Caution

1. When the limit is exceeded, the brake pads on both the left and right wheels must be replaced as a set.
2. If there is a significant difference in the thicknesses of the pads on the left and right sides, check the sliding condition of the piston, lock pin and guide pin.

REAR DISC BRAKE

35100700072

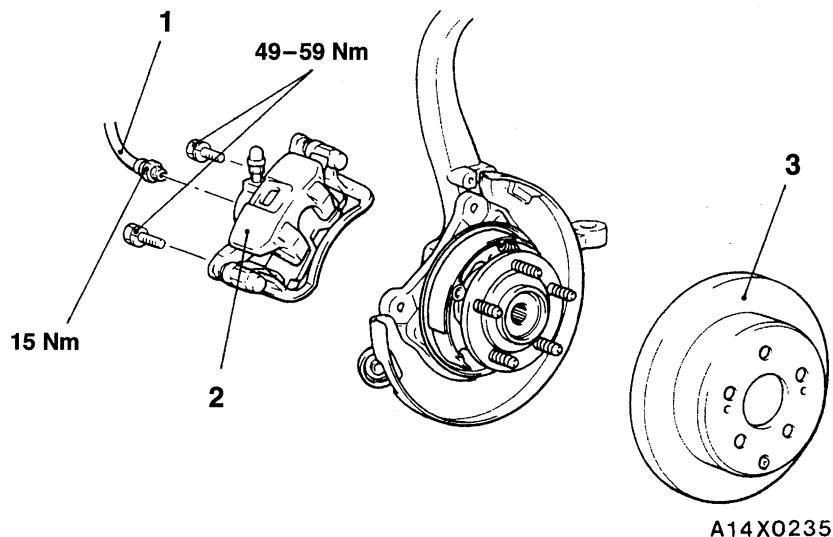
REMOVAL AND INSTALLATION

Pre-removal Operation

- (1) Loosening Parking Brake Cable Adjusting Nut.
- (2) Brake Fluid Draining

Post-installation Operation

- (1) Brake Fluid Filling and Air Bleeding
(Refer to P.35A-11.)
- (2) Parking Brake Lever Stroke Adjustment
(Refer to GROUP 36.)



Removal steps



1. Brake hose connection
2. Rear brake assembly
3. Brake disc

INSTALLATION SERVICE POINT

►A◄ REAR BRAKE ASSEMBLY INSTALLATION

Install the rear brake assembly and measure the disc brake drag torque. (Refer to P.35A-22.)

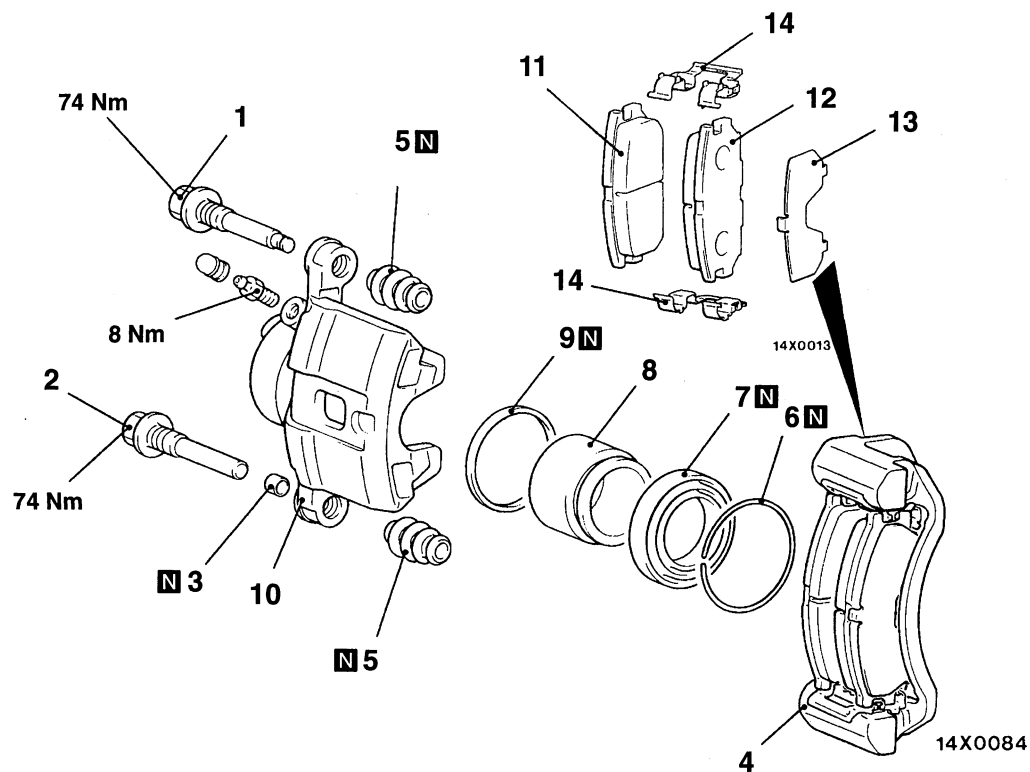
INSPECTION

35100710044

- Check the brake disc for damage.
- Check the brake disc for thickness.
- Check the brake disc for run-out.

DISASSEMBLY AND REASSEMBLY

35100720061



Brake caliper kit	Pad repair kit	Seal and boots repair kit

00000072

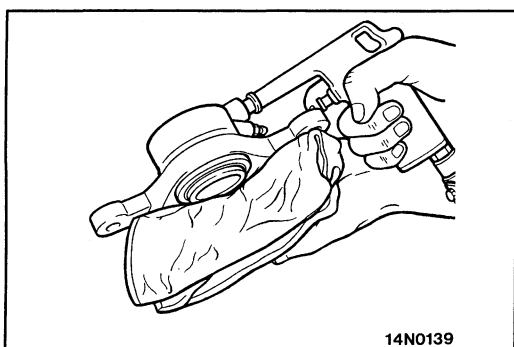
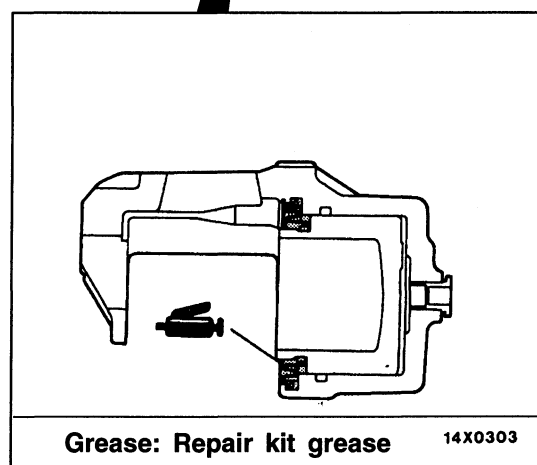
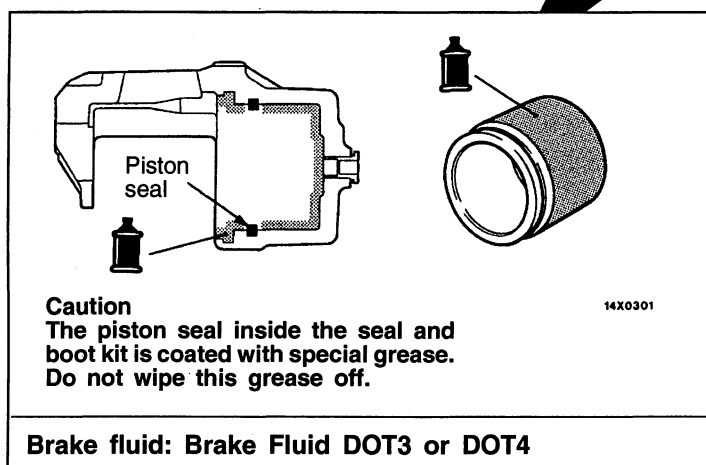
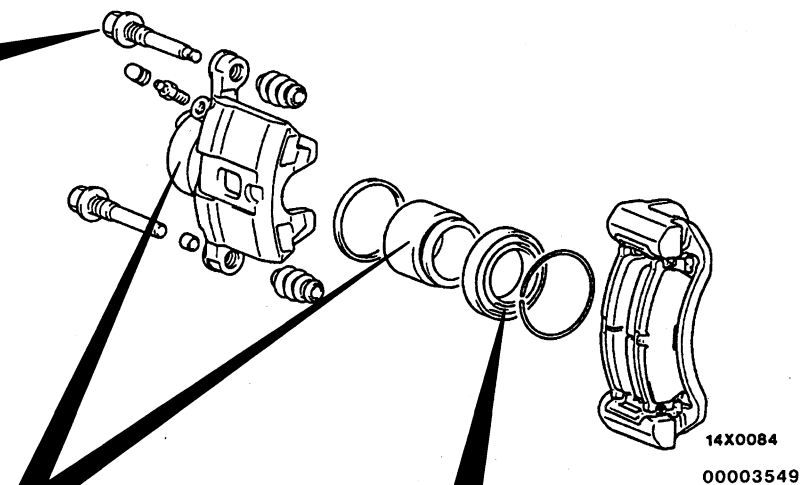
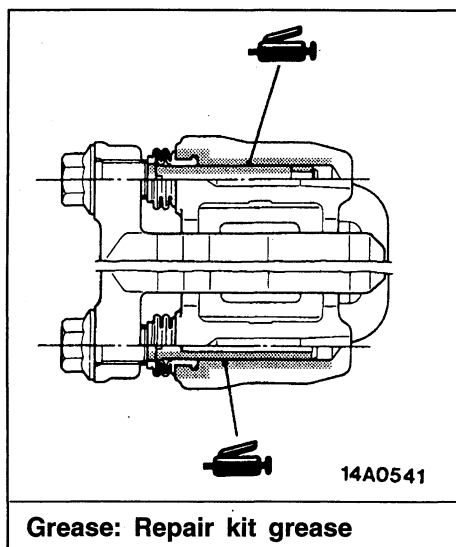
Caliper assembly disassembly steps

- ▶A◀ 1. Guide pin
- ▶A◀ 2. Lock pin
- ▶A◀ 3. Bushing
- ▶A◀ 4. Caliper support (pad, clip, shim)
- ▶A◀ 5. Boot
- ▶A◀ 6. Boot ring
- ▶A◀ 7. Piston boot
- ▶A◀ 8. Piston
- ▶A◀ 9. Piston seal
- ▶A◀ 10. Caliper body

Pad assembly disassembly steps

- ▶A◀ 1. Guide pin
- ▶A◀ 2. Lock pin
- ▶A◀ 3. Bushing
- ▶A◀ 4. Caliper support (pad, clip, shim)
- ▶A◀ 11. Pad and wear indicator assembly
- ▶A◀ 12. Pad assembly
- ▶A◀ 13. Outer shim
- ▶A◀ 14. Clip

LUBRICATION POINTS



DISASSEMBLY SERVICE POINTS

When disassembling the disc brakes, disassemble both sides (left and right) as a set.

◀A▶ PISTON BOOT/PISTON REMOVAL

Protect caliper body with cloth. Blow compressed air through brake hose to remove piston boot and piston.

Caution

Blow compressed air gently.

◀B▶ PISTON SEAL REMOVAL

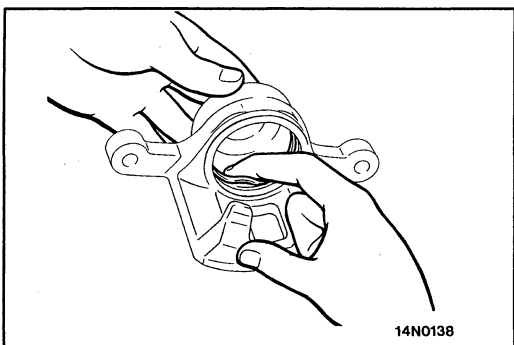
- (1) Remove piston seal with finger tip.

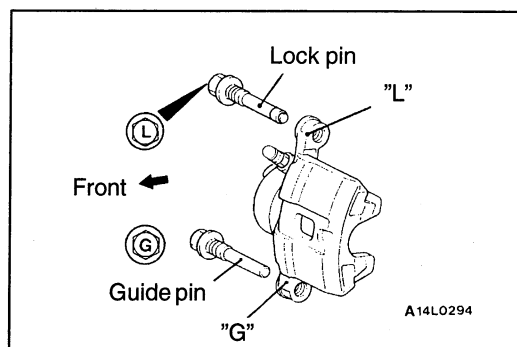
Caution

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

- (2) Clean piston surface and inner cylinder with trichloroethylene, alcohol or specified brake fluid.

Specified brake fluid: Brake Fluid DOT3 or DOT4





REASSEMBLY SERVICE POINT

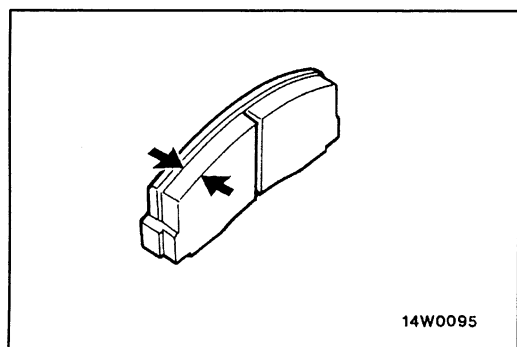
►A◄ BOOT/LOCK PIN/GUIDE PIN INSTALLATION

Install the guide pin and lock pin as illustrated so 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

35100730064

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



PAD WEAR CHECK

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

Standard value: 10 mm

Limit value: 2.0 mm

Caution

1. When the limit is exceeded, the brake pads on both the left and right wheels must be replaced as a set.
2. If there is a significant difference in the thicknesses of the pads on the left and right sides, check the sliding condition of the piston, lock pin and guide pin.

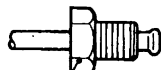
35100570086

PROPORTIONING VALVE**REMOVAL AND INSTALLATION****Pre-removal Operation**

- (1) Brake Fluid Draining
- (2) Link Assembly Mounting Bolts Removal
(Refer to GROUP 17 – Auto-Cruise Control)

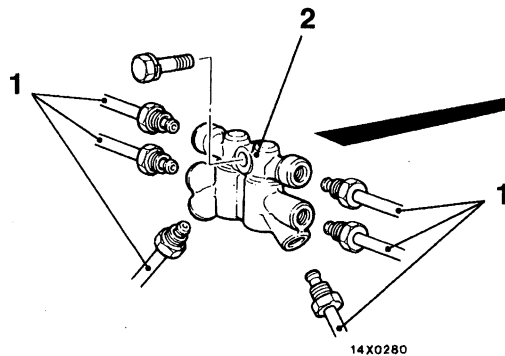
Post-installation Operation

- (1) Brake Fluid Supplying
- (2) Brake Line Bleeding (Refer to P.35A-11.)
- (3) Link Assembly Mounting Bolts Installation
(Refer to GROUP 17 – Auto-Cruise Control)

Flared brake line nuts

15 Nm

14X0343

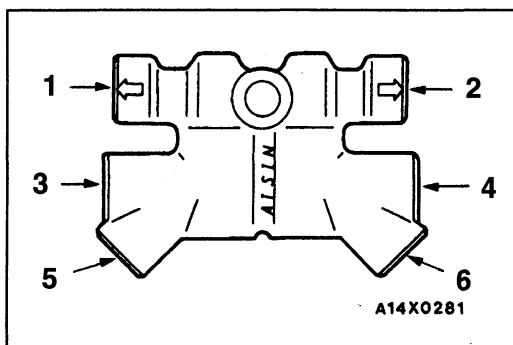


14X0276

00000074

Removal steps

- A◄
1. Brake pipe connection
 2. Proportioning valve

**INSTALLATION SERVICE POINT****►A◄BRAKE PIPE CONNECTION**

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

1. Proportioning valve – Rear brake (L.H.)
2. Proportioning valve – Rear brake (R.H.)
3. Proportioning valve – Front brake (R.H.)
4. Proportioning valve – Front brake (L.H.)
5. Proportioning valve – Master cylinder (secondary)
6. Proportioning valve – Master cylinder (primary)

NOTES

ANTI-SKID BRAKING SYSTEM (ABS) <2WD>

CONTENTS

35209000091

GENERAL INFORMATION	2	MASTER CYLINDER AND BRAKE BOOSTER	29
SERVICE SPECIFICATIONS	3	PROPORTIONING VALVE	31
SPECIAL TOOLS	3	HYDRAULIC UNIT	32
TROUBLESHOOTING	4	WHEEL SPEED SENSOR	34
ON-VEHICLE SERVICE	23	ABS-ECU	36
Bleeding	23		
ABS Operation Check	23		

WARNINGS REGARDING SERVICING OF SUPPLEMENTAL RESTRAINT SYSTEM (SRS) EQUIPPED VEHICLES

WARNING!

- (1) Improper service or maintenance of any component of the SRS, or any SRS-related component, can lead to personal injury or death to service personnel (from inadvertent firing of the air bag) or to the driver and passenger (from rendering the SRS inoperative).
- (2) Service or maintenance of any SRS component or SRS-related component must be performed only at an authorized MITSUBISHI dealer.
- (3) MITSUBISHI dealer personnel must thoroughly review this manual, and especially its GROUP 52B – Supplemental Restraint System (SRS) before beginning any service or maintenance of any component of the SRS or any SRS-related component.

NOTE

The SRS includes the following components: SRS-ECU, SRS warning lamp, air bag module, clock spring and interconnecting wiring. Other SRS-related components (that may have to be removed/installed in connection with SRS service or maintenance) are indicated in the table of contents by an asterisk (*).

GENERAL INFORMATION

35200010093

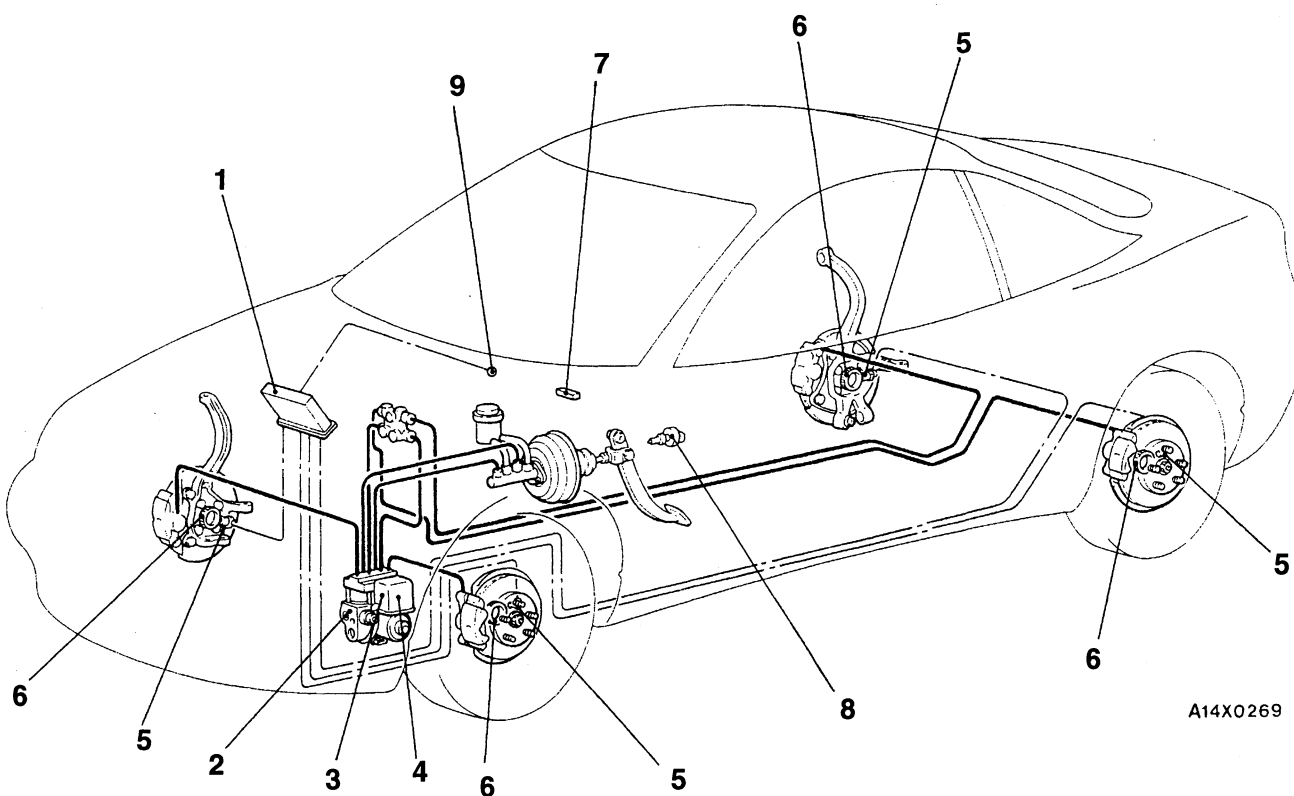
The ABS consists of wheel speed sensors, stop lamp switch, hydraulic unit and the ABS-ECU. If a problem occurs in the system, the malfunctioning system can be identified by means of the diagnostic function.

The diagnosis code will not be erased even if the ignition switch is turned to OFF.

In addition, reading of diagnosis codes, service data and actuator testing are possible using the scan tool.

Items	Specifications
Wheel speed sensor	Magnet coil type
Front toothed rotor	43 teeth
Rear toothed rotor	43 teeth

CONSTRUCTION DIAGRAM



A14X0269

1. ABS-ECU
2. Hydraulic unit
3. ABS valve relay
4. ABS motor relay
5. Wheel speed sensor

6. Rotor
7. Diagnosis connector
8. Stop lamp switch
9. ABS warning lamp

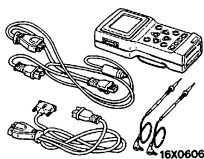
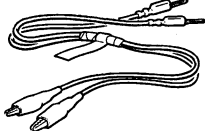
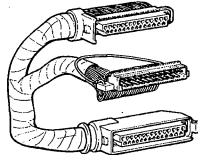
SERVICE SPECIFICATIONS

35200030105

Items	Standard value
Hydraulic unit solenoid valve internal resistance Ω	1.0–1.3
Wheel speed sensor internal resistance $k\Omega$	1.0–1.2
Clearance between the wheel speed sensor mounting surface and the toothed rotor mm	28.2–28.5
Wheel speed sensor insulation resistance $k\Omega$	100 or more

SPECIAL TOOLS

35200060104

Tool	Number	Name	Application
	MB991502	MUT-II sub assembly	• Reading diagnosis codes • Erasing diagnosis codes • ABS system inspection
	MB991529	Diagnosis code check harness	ABS inspection with ABS warning lamp
	MB991356	ABS check harness	ABS-ECU terminal voltage measurement

TROUBLESHOOTING

35200070046

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

35201110112

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

NOTES WITH REGARD TO DIAGNOSIS

The condition listed in the following table are considered normal.

Condition	Explanation of condition
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. This is considered normal.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operating (whine) 2. Sound is 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: tires)
ABS operation (Long braking distance)	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 overconfident.

Diagnosis detection condition depends on the diagnosis code.

Make sure that checking requirements listed in the "Comment" are satisfied when checking the trouble symptom again after the diagnosis code has been erased.

DIAGNOSTIC FUNCTION

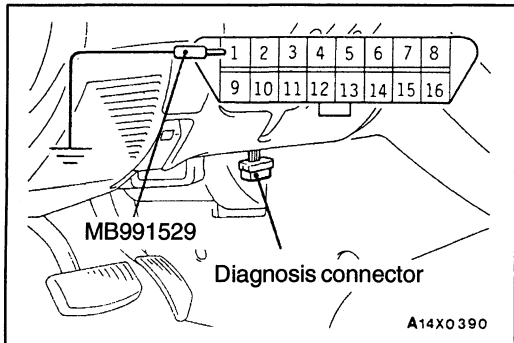
35201120085

DIAGNOSIS CODES CHECK**With the MUT-II**

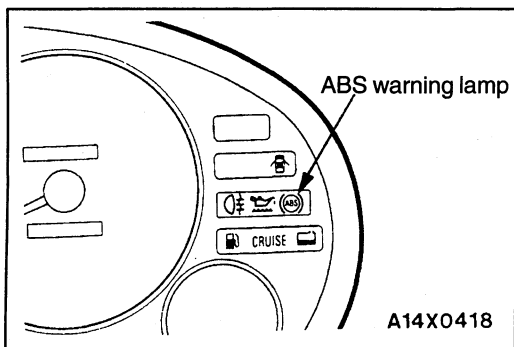
Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

With the ABS Warning Lamp

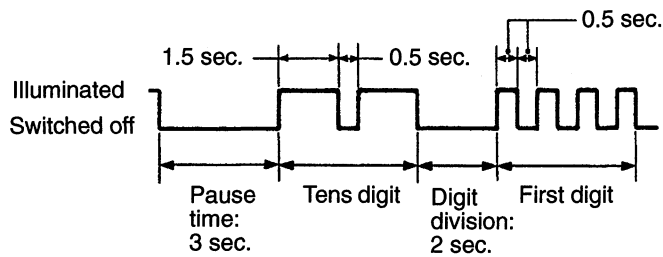
- (1) Use the special tool (diagnosis code check harness) to ground the terminal (1) of the diagnosis connector.



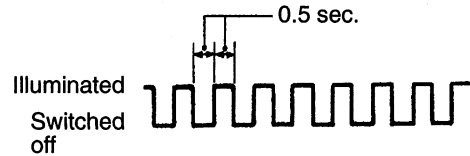
- (2) Take a reading of the diagnosis code from the flashing of the ABS warning lamp.



Diagnosis code No. 24 is output



No diagnosis code is output



03X0114

NOTE

Diagnosis code No. 16 can be output when the ABS system fails because of a battery surge.

ERASING DIAGNOSIS CODES**With the MUT-II**

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

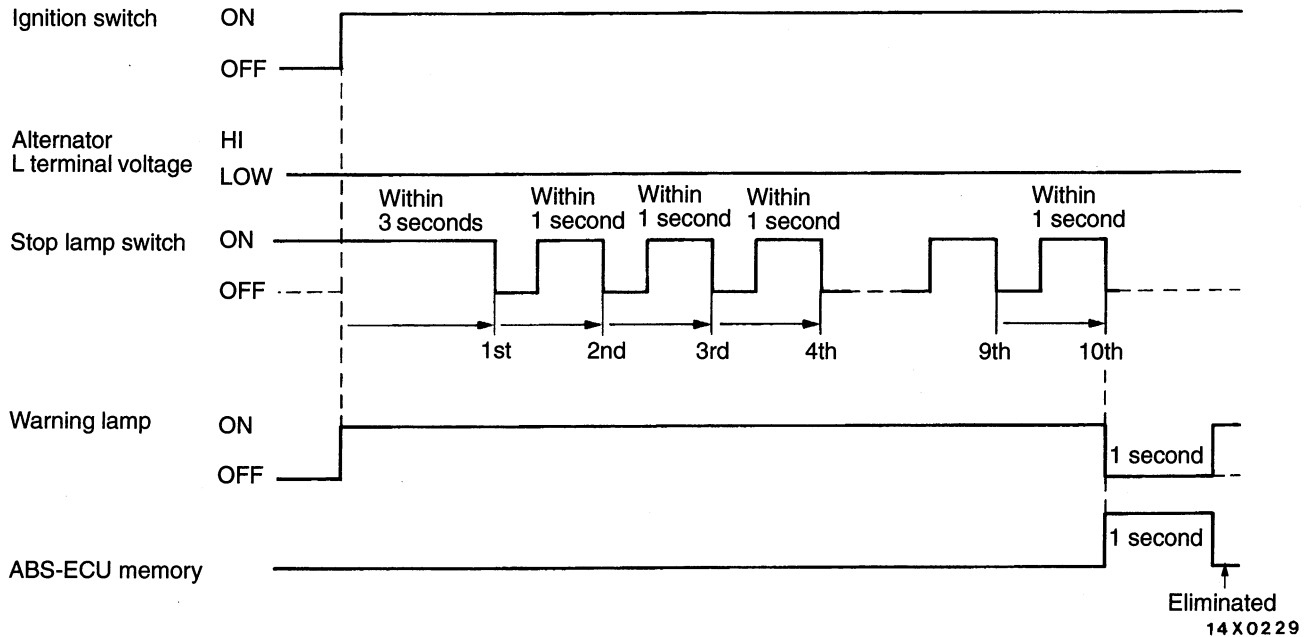
With the ABS Warning Lamp

When the ignition switch is turned on while the stop lamp switch is on, the stop lamp switch will operate 10 times in succession according to the timing given below.

Caution

The memory cannot be erased under the following conditions.

- (1) When the stop lamp switch is not turned on and off according to the table below.
- (2) When the generator L terminal voltage increased (HI state).



INSPECTION CHART FOR DIAGNOSIS CODES

35201130125

Check according to the inspection chart that is appropriate for the diagnosis code.

Diagnosis code No.	Inspection item	Diagnosis content	Detection conditions	Reference page
11	Right front wheel speed sensor	Open circuit in positive wire	A, B	35B-8
12	Left front wheel speed sensor			
13	Right rear wheel speed sensor			
14	Left rear wheel speed sensor			
15	Wheel speed sensor system	Abnormal output signal	B	35B-9
16	Power supply system	Abnormal battery positive voltage	A, B	35B-10
21	Right front wheel speed sensor	Excessive gap or short	B	35B-10
22	Left front wheel speed sensor			
23	Right rear wheel speed sensor			
24	Left rear wheel speed sensor			
38	Stop lamp switch system	Open circuit or ON malfunction	A, B	35B-11
41	Right front solenoid valve system	No response to solenoid valve drive signal	A, B	35B-12
42	Left front solenoid valve system			
43	Rear solenoid valve system			
51	Valve relay system	Valve relay OFF failure	A, B	35B-13
53	Motor relay or motor system	Motor relay OFF failure and motor drive failure	B	35B-14
63	ABS-ECU	Malfunction in ABS-ECU (program maze, etc.)	A, B	—

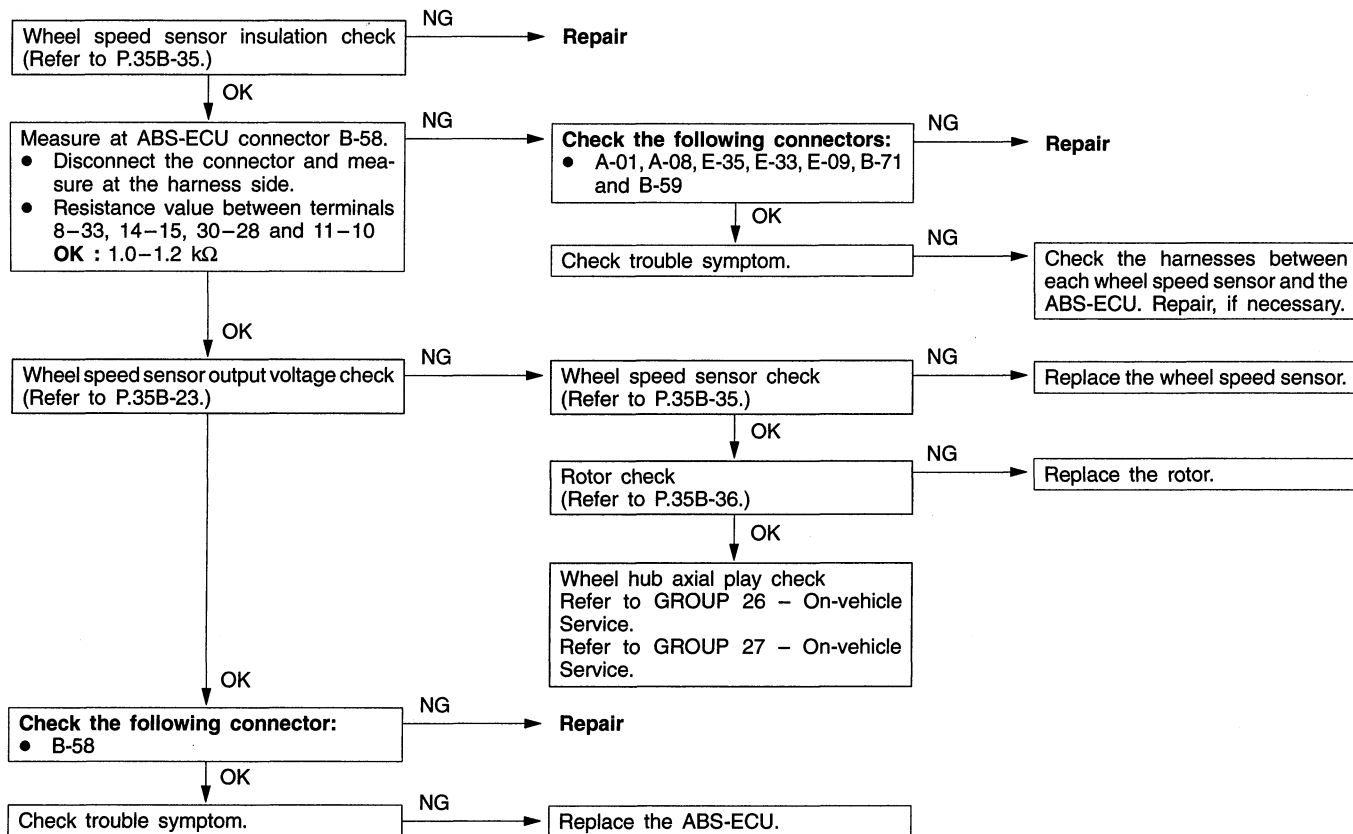
Detection conditions

A: During system check immediately after starting

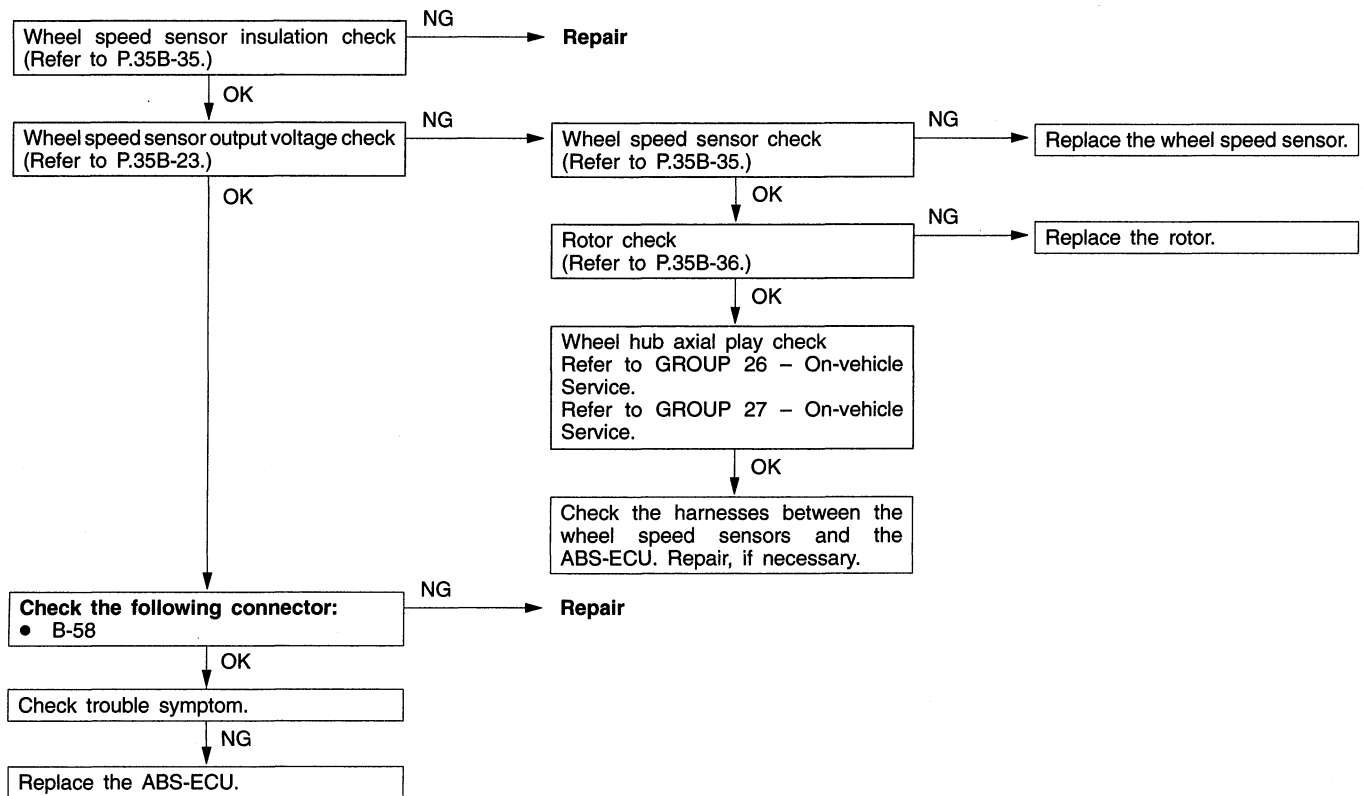
B: When driving

INSPECTION PROCEDURE CLASSIFIED BY DIAGNOSTIC TROUBLE

Code No. 11, 12, 13, 14 Wheel speed sensor open circuit+ wire	Probable cause
The ABS-ECU detects breaks in the wheel speed sensor wire. In addition to an open circuit in the wheel speed sensor, also check whether the sensor gap is too large, sensor harness wire is broken, or sensor harness and body connector are not properly connected.	• Malfunction of wheel speed sensor • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



Code No. 15 Wheel speed sensor system	Probable cause
This diagnosis code is output when there is a malfunction (other than broken wire or short circuit) in any of the wheel speed sensor output signals while driving. The following can be considered as the cause of the wheel speed sensor output malfunction. • Distortion of rotor, teeth missing • Low frequency noise interference when sensor harness wire is broken • Noise interference in sensor signal • Sensor output signal is below the standard value or amplitude modulation is over the standard value. Using an oscilloscope to measure the wave shape of the wheel speed sensor output signal is very effective. • Broken sensor harness • Poor connection of connector	• Malfunction of wheel speed sensor • Malfunction of wiring harness • Malfunction of rotor • Malfunction of wheel bearing • Malfunction of ABS-ECU

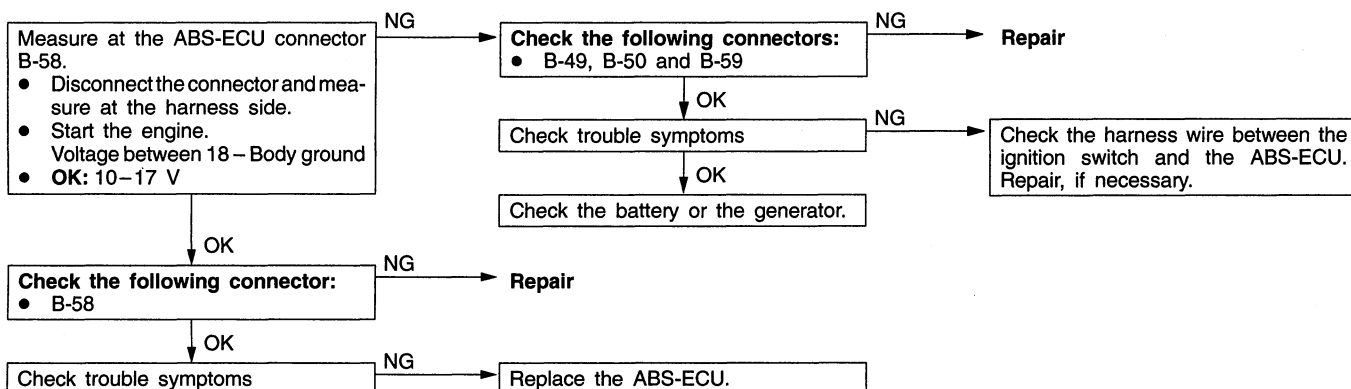


Code No. 16 Power supply system	Probable cause
This diagnosis code is output when the ABS-ECU power voltage is outside the standard value. Furthermore, if the voltage returns to normal, this diagnostic trouble code will not be output.	• Malfunction of wiring harness or connector. • Malfunction of battery or generator • Malfunction of ABS-ECU

Caution

If the battery voltage drops during check, this code will be output as a current problem, and correct diagnostic of the problem cannot be made.

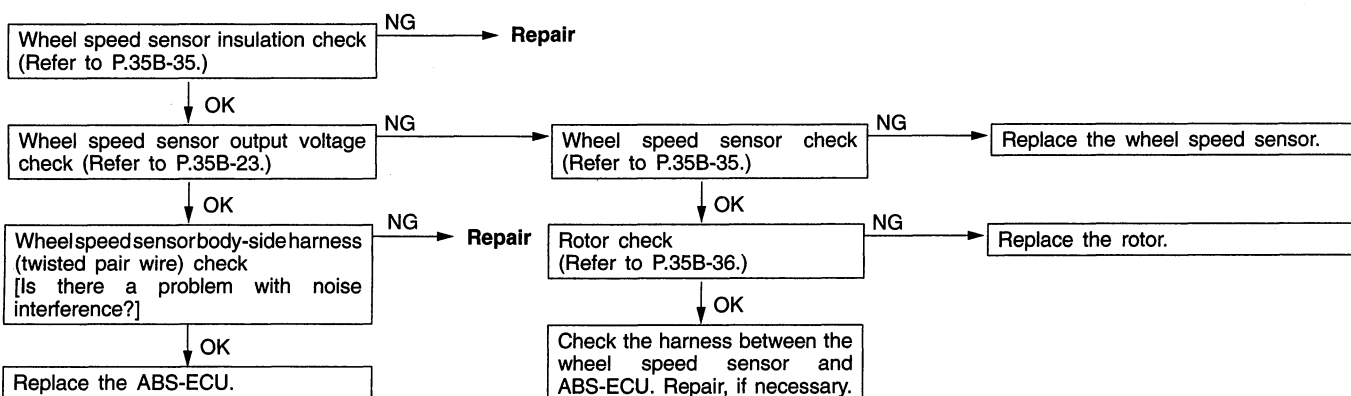
Before carrying out the following check, check the battery condition, and recharge it if necessary.



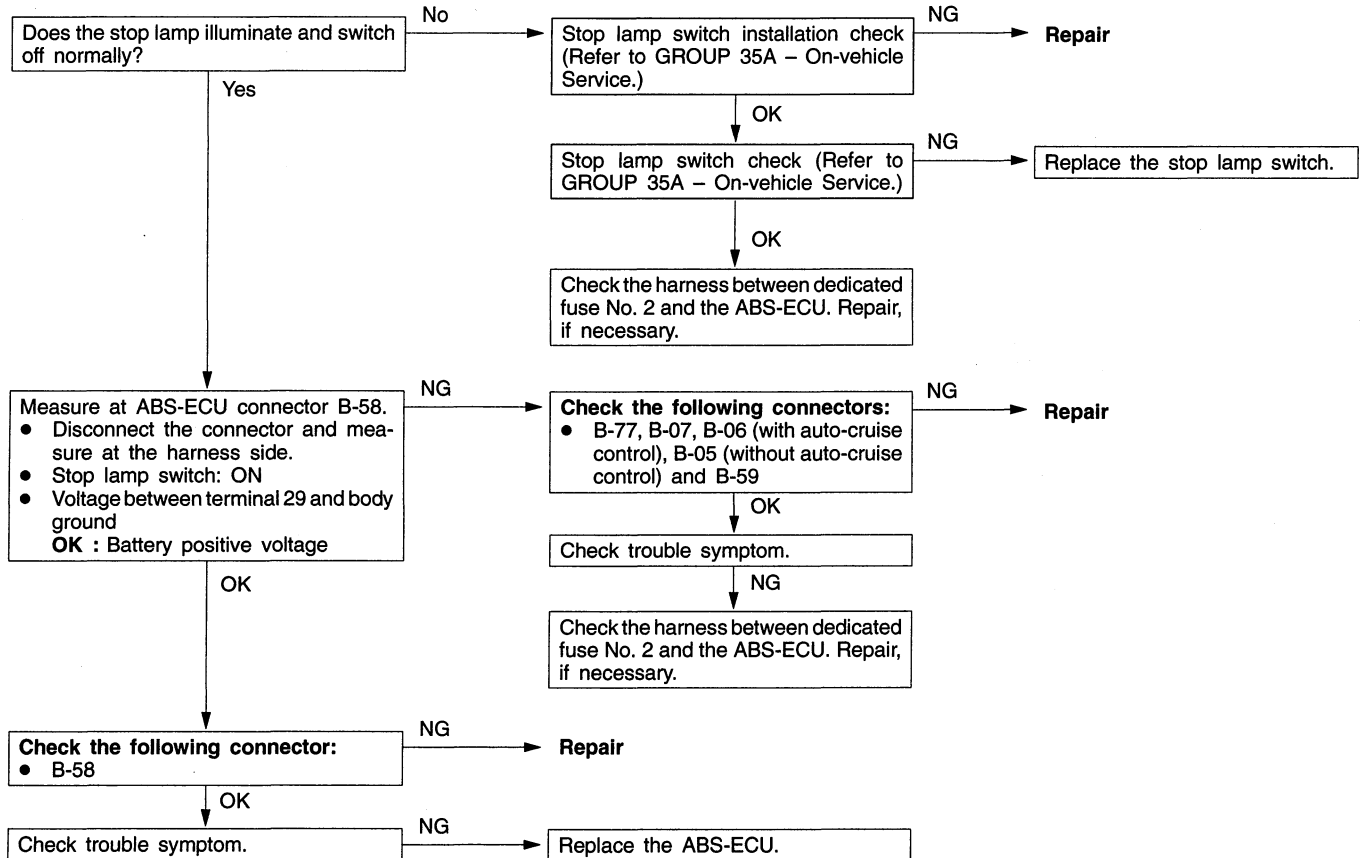
Code No. 21, 22, 23, 24 Wheel speed sensor excessive gap or short	Probable cause
These diagnosis codes are output when the detection speed of the wheel speed sensors is below the standard value.	• Improper installation of wheel speed sensor • Malfunction of wheel speed sensor (intermittent open circuit or short circuit) • Malfunction of rotor (chipped tooth or rotor not installed) • Noise interference in wheel speed sensor • Malfunction of ABS-ECU

NOTE

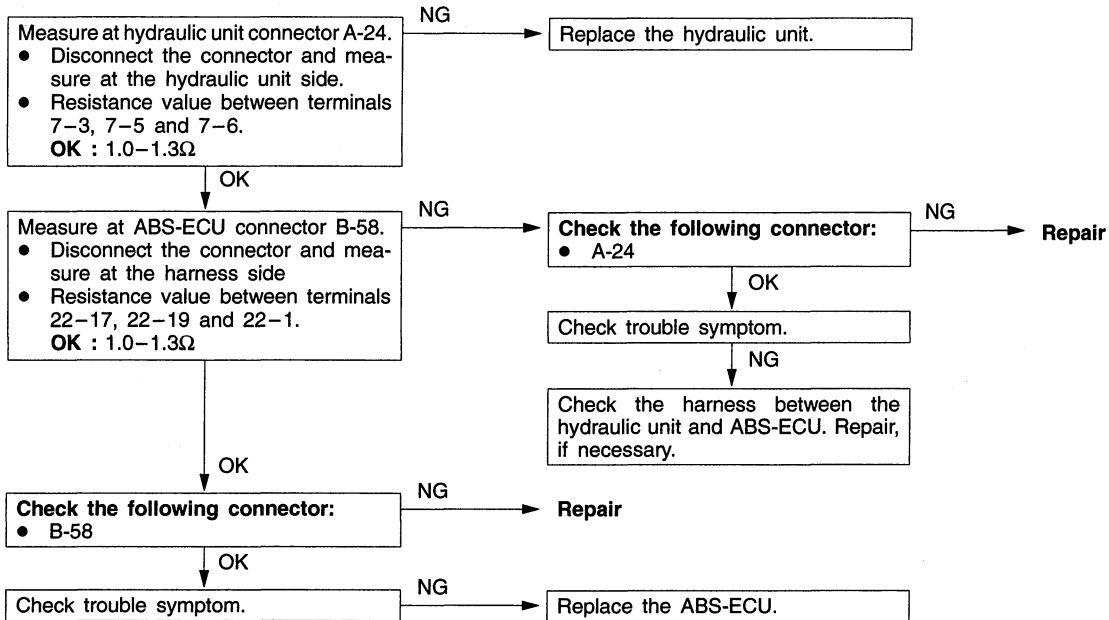
1. Momentary interruptions within approximately 100 ms are not detected.
2. To inspect the twisted pair wires in the wheel speed sensor, check if there is any damage to the cables, and flex the cables to check for any open circuits.



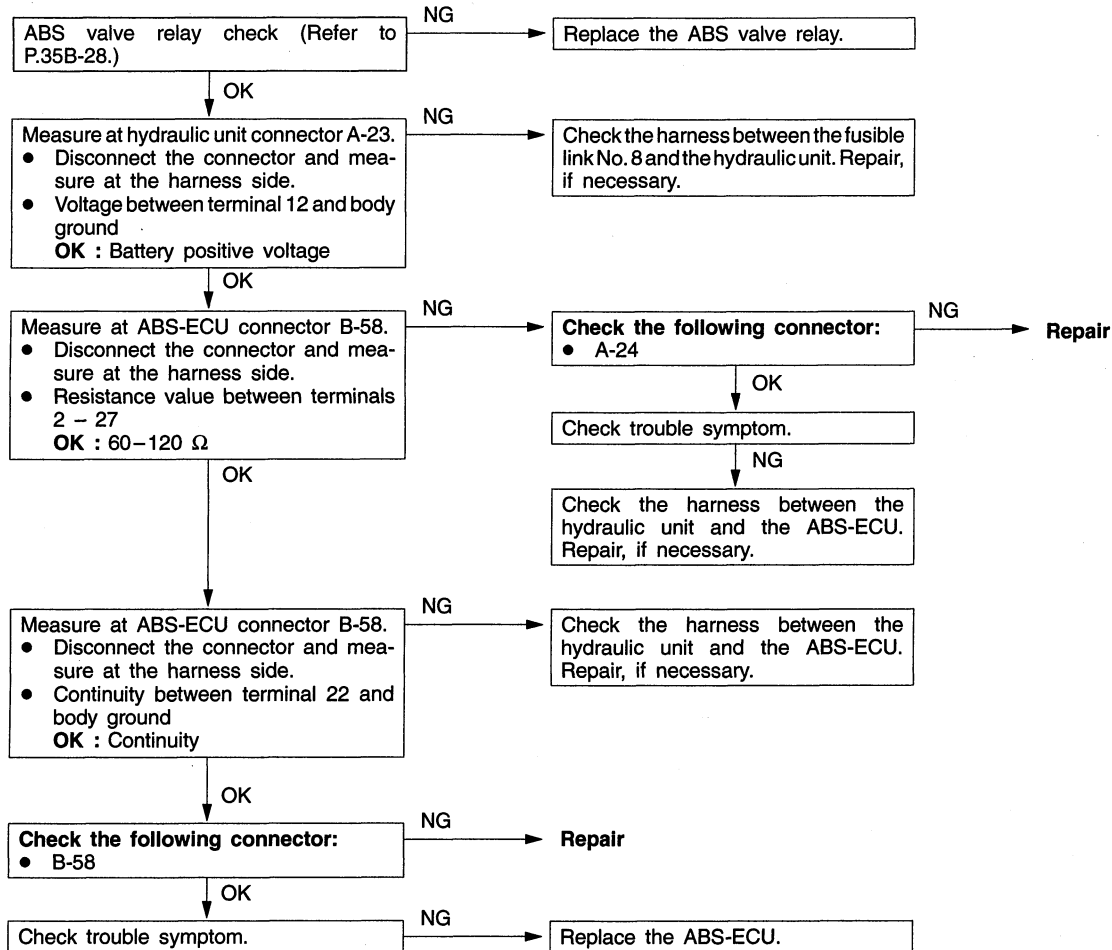
Code No. 38 Stop lamp switch system	Probable cause
The ABS-ECU outputs this diagnosis code in the following cases. • Stop lamp switch remains on for more than 15 minutes while the ABS is not functioning. • The harness wire for the stop lamp switch may be open-circuited. If the stop lamp operates normally, there is an open circuit in the harness for the stop lamp switch input circuit or there is a malfunction in the ABS-ECU.	• Malfunction of stop lamp switch • Malfunction of harness or connector • Malfunction of ABS-ECU



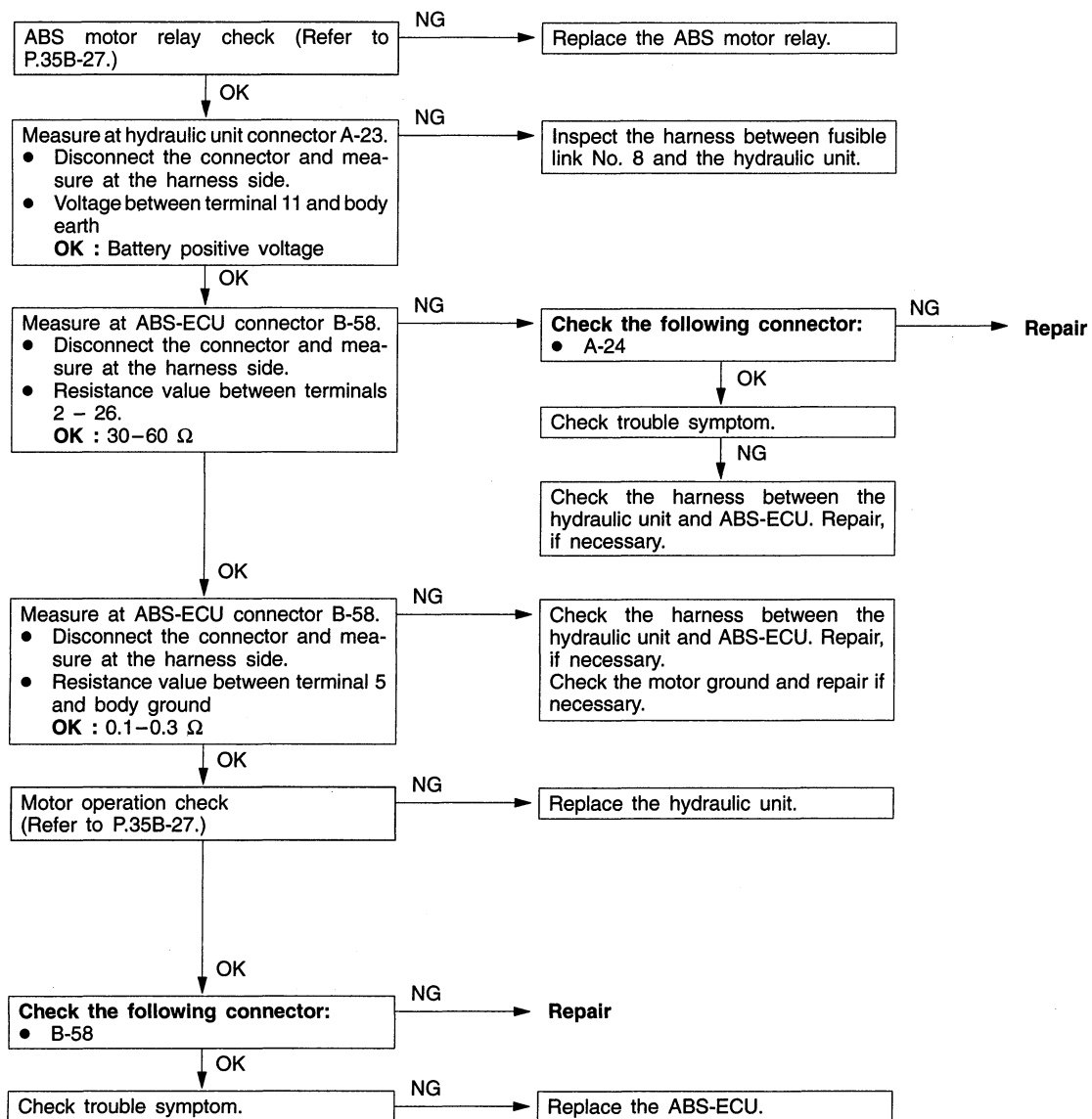
Code No. 41, 42, 43 Solenoid valve system	Probable cause
The ABS-ECU normally monitors the solenoid valve drive circuit. If no current flows in the solenoid even if the ECU turns the solenoid ON or if it continues to flow even when turned OFF, the ECU determines the solenoid coil wire is broken/short-circuited or the harness is broken/ short-circuited, and then these diagnosis codes are output.	• Malfunction of hydraulic unit • Malfunction of wiring harness or connector • Malfunction of ABS-ECU

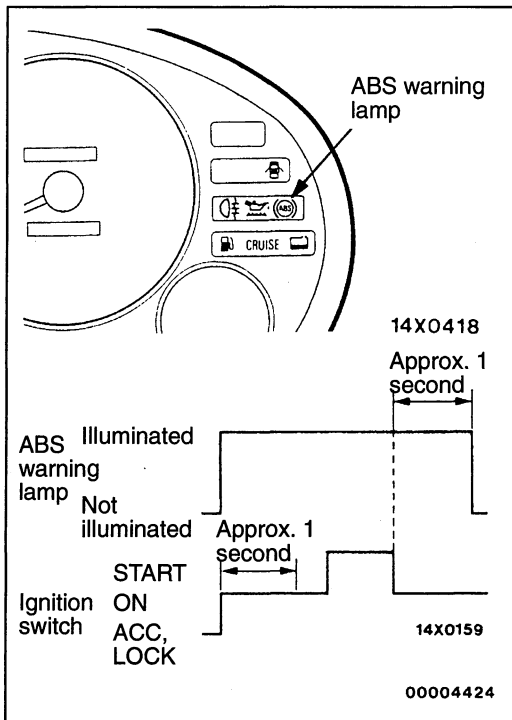


Code No. 51 Valve relay system	Probable cause
When the ignition switch is turned ON, the ABS-ECU switches the valve relay OFF and ON for an initial check, compares the voltage of the signal to the valve relay and valve power monitor line voltage to check whether the valve relay operation is normal. In addition, normally it monitors whether or not there is power in the valve power monitor line since the valve relay is normally ON. If the supply of power to the valve power monitor line is interrupted, this diagnosis code will be output.	• Malfunction of ABS valve relay • Malfunction of wiring harness or connector • Malfunction of hydraulic unit • Malfunction of ABS-ECU



Code No. 53 Motor relay, motor system	Probable cause
The ABS-ECU outputs this diagnosis code for the motor relay and motor in the following cases. - When motor relay is ON and no signal is input to the motor monitor line (when motor is not operating, etc.) - When motor relay is OFF and signal is input to the motor monitor line for approximately 5 seconds or more (when motor continues operating, etc.) - When the motor relay does not function	- Malfunction of ABS motor relay - Malfunction of wiring harness or connector - Malfunction of hydraulic unit - Malfunction of ABS-ECU



**ABS WARNING LAMP CHECK**

35201200048

Check that the ABS warning lamp illuminates as follows.

1. When the ignition switch is turned to "ON", the ABS warning lamp illuminates.
2. When the ignition switch is turned to "START", to start the engine, the ABS warning lamp switches off after approx. 1 second.
3. If the illumination is other than the above, check the diagnosis codes.

INSPECTION CHART FOR TROUBLE SYMPTOMS

35201140111

Get an understanding of the trouble symptoms and check according to the inspection procedure chart.

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is not possible.	Communication with all systems is not possible.	1	35B-16
	Communication with ABS only is not possible.	2	35B-16
When the ignition key is turned to "ON" (engine stopped), the ABS warning lamp does not illuminate.		3	35B-17
After the engine starts, the ABS warning lamp remains illuminated.		4	35B-17
When the ignition key is turned to "START", the ABS warning lamp does not illuminate.		5	35B-18
After the ignition key is turned to "ON", the ABS warning lamp blinks once, and when turned to "START", it illuminates. When returned to "ON", the lamp flashes once, and then switches off.		6	35B-18
Faulty ABS operation	Unequal braking power on both sides	7	35B-19
	Insufficient braking power		
	ABS operates under normal braking conditions		
	ABS operates before vehicle stops under normal braking conditions		
	Large brake pedal vibration (Caution 2.)	—	—

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, changes in the feeling of the brake pedal (vibration may occur or pedal may not be able to be depressed). Such changes are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking, and is considered normal.

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

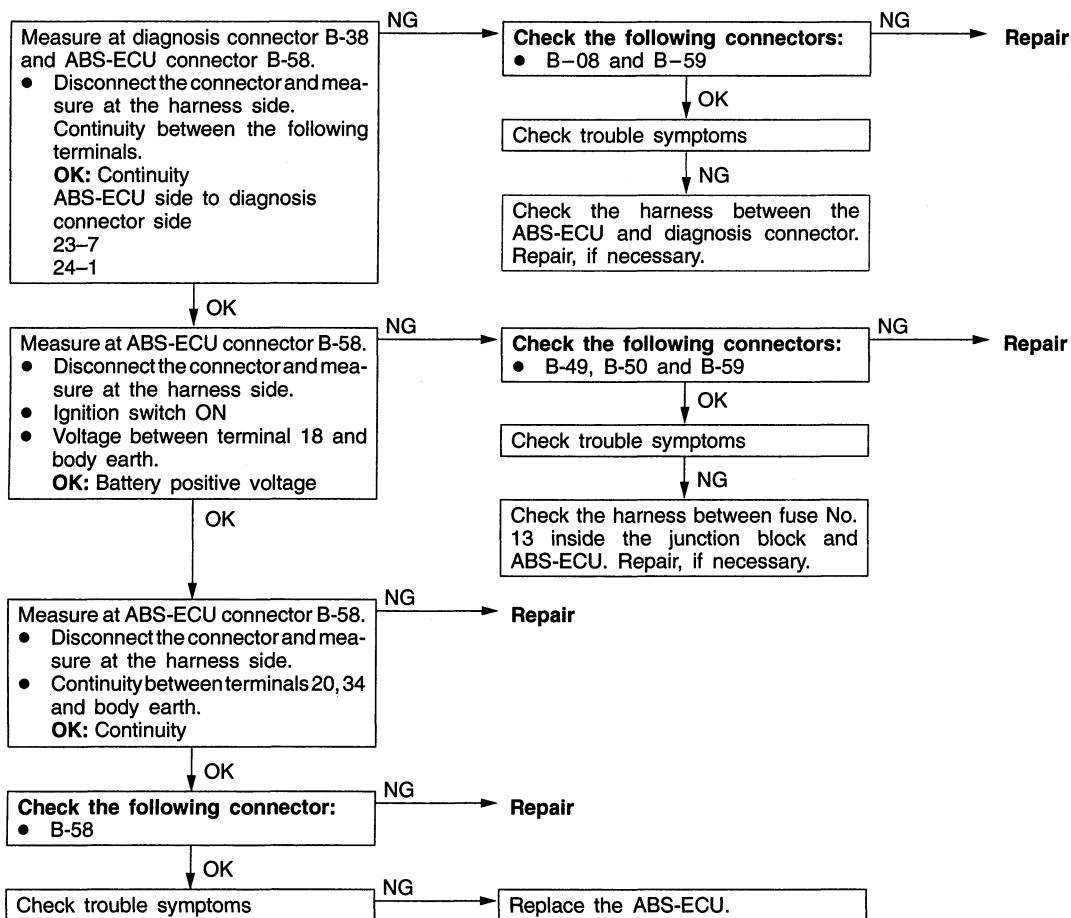
INSPECTION PROCEDURE 1

Communication with MUT-II is not possible. (Communication with all systems is not possible.)	Probable cause
The reason is probably a defect in the power supply system (including earth) for the diagnosis line.	• Malfunction of connector • Malfunction of harness

Refer to GROUP 13A – Troubleshooting.

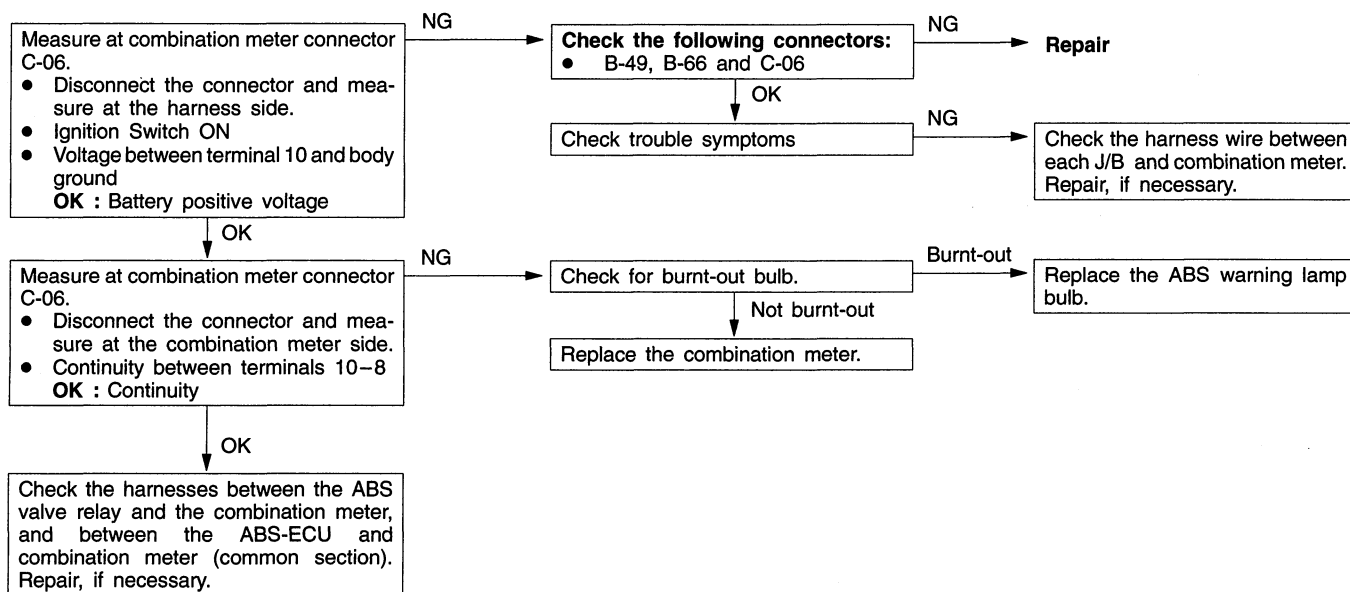
INSPECTION PROCEDURE 2

Communication with MUT-II is not possible. (Communication with ABS only is not possible.)	Probable cause
When communication with the MUT-II is not possible, the cause is probably an open circuit in the ABS-ECU power circuit or an open circuit in the diagnosis output circuit.	• Blown fuse • Malfunction of wiring harness or connector • Malfunction of ABS-ECU



INSPECTION PROCEDURE 3

When ignition key is turned to "ON" (engine stopped), ABS warning light does not illuminate	Probable cause
When power is supplied to the ABS-ECU, the valve relay changes from ON to OFF ON by the initial check, and thus even if there is a problem with the circuit between ABS warning lamp and ABS-ECU, the lamp will illuminate once when the valve relay is OFF. Accordingly, the cause of the lamp not illuminating is probably an open circuit in the lamp power circuit, a blown lamp bulb, or an open circuit in both the circuit between the ABS warning lamp and the ABS-ECU and the circuit between the ABS warning lamp and the ABS valve relay. When other warning lamps also do not illuminate, the cause is probably a blown fuse.	• Blown fuse • Burnt out ABS warning lamp bulb • Malfunction of wiring harness or connector

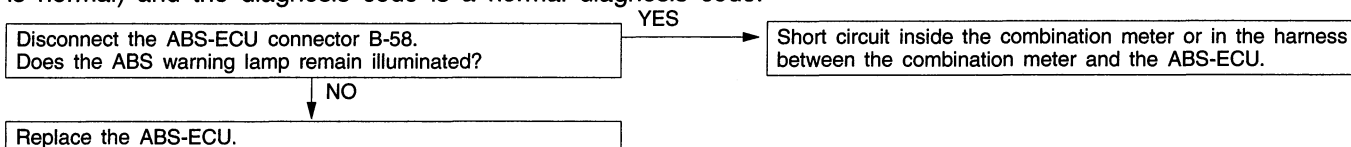


INSPECTION PROCEDURE 4

Even after the engine is started, the ABS warning lamp remains illuminated.	Probable cause
There is probably a short in the ABS warning lamp illumination circuit.	• Malfunction of combination meter • Malfunction of ABS valve relay • Malfunction of ABS-ECU • Malfunction of wiring

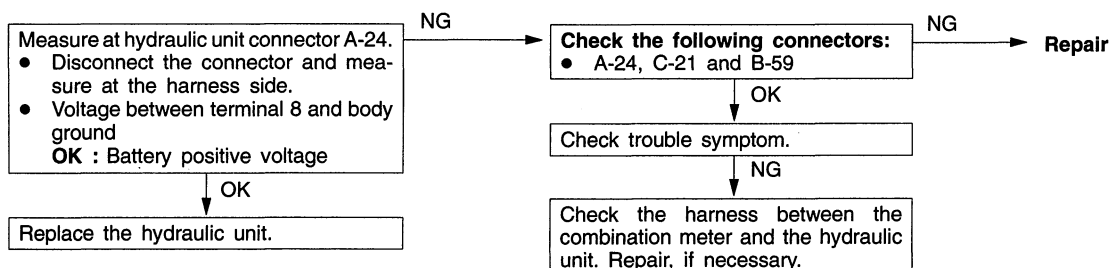
NOTE

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.



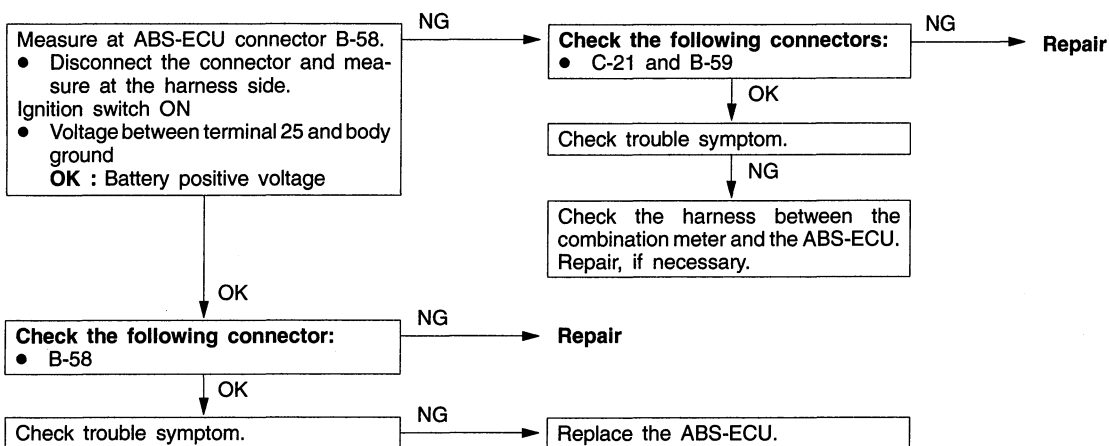
INSPECTION PROCEDURE 5

When ignition key is turned to "START", ABS warning lamp does not illuminate.	Probable cause
The ABS-ECU uses the power to the IG2 which is cut when the ignition switch is turned to "START". The ABS warning lamp uses IG1 power which is not cut even when the ignition switch is turned to "START". Accordingly, because the power to the ABS-ECU is stopped in "START" position, if the warning lamp does not illuminate at this time, the cause is a problem in the lamp illumination circuit in the valve relay.	• Malfunction of wiring harness or connector • Malfunction of hydraulic unit



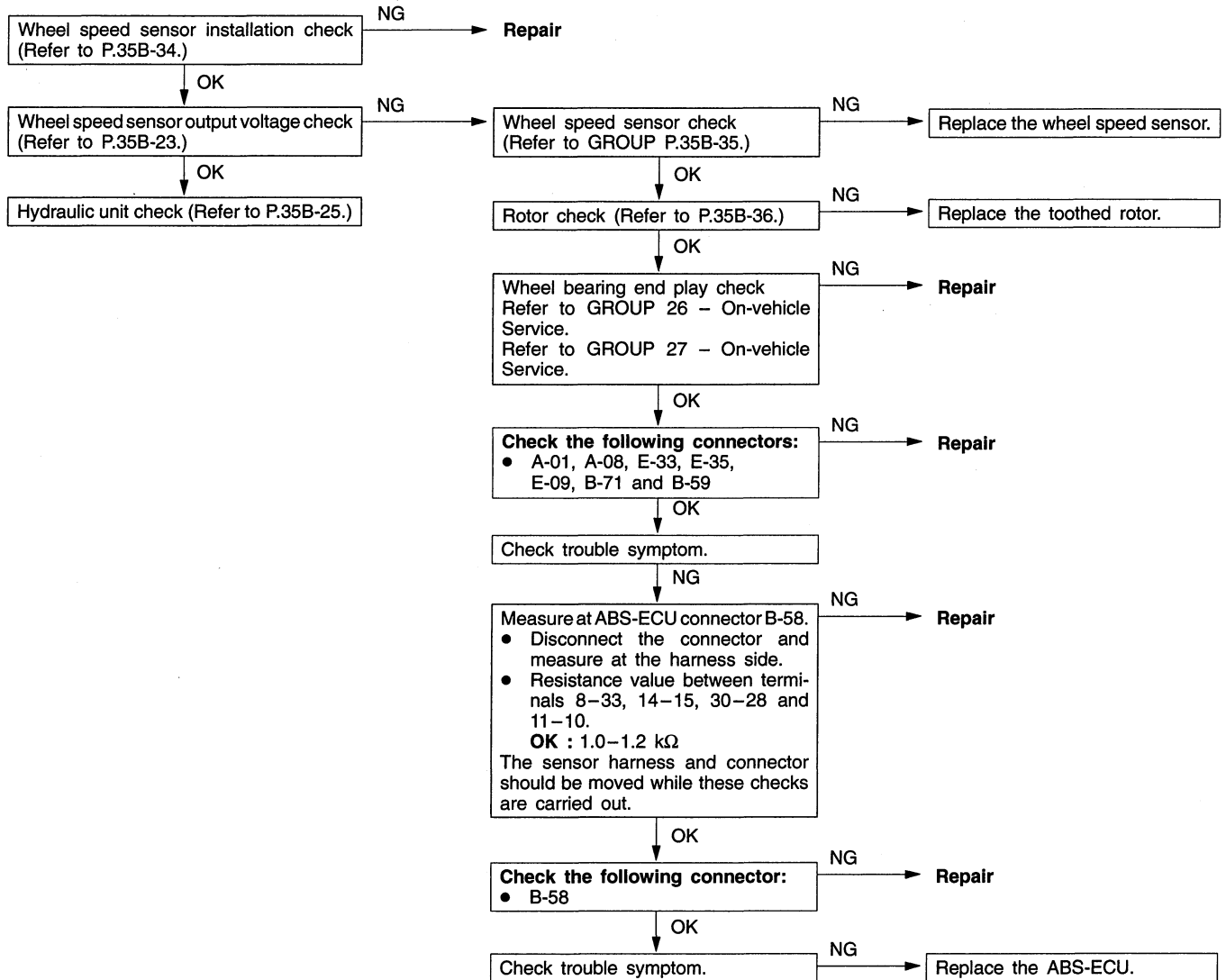
INSPECTION PROCEDURE 6

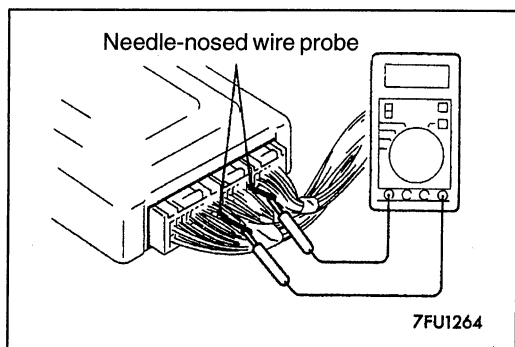
The ABS warning lamp flashes once after the ignition key is turned to "ON". The lamp illuminates when the ignition key is turned to "START", and when the key is returned to "ON", it flashes once.	Probable cause
When power flows, the ABS-ECU turns on the warning lamp for approximately 1 second while it performs a valve relay test. If there is a break in the harness between the ECU and the warning lamp illuminates only when the valve relay is off in the valve relay test, etc.	• Malfunction of wiring harness or connector • Malfunction of ABS-ECU



INSPECTION PROCEDURE 7

Break operation is abnormal	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.	• Malfunction of wheel speed sensor • Malfunction of rotor • Malfunction of wheel bearing • Malfunction of hydraulic unit • Malfunction of ABS-ECU





ABS-ECU CHECK

35201180090

TERMINAL VOLTAGE CHECK CHART

1. Connect a needle-nosed wire probe (paper clip etc.) to a voltmeter probe.
2. Insert the needle-nosed wire probe into each of the ABS-ECU connector terminals from the wire side, and measure the voltage while referring to the check chart.

NOTE

1. Measure voltage with the ABS-ECU connectors connected.
2. You may find it convenient to pull out the ABS-ECU to make it easier to reach the connector terminals.
3. Checks don't have to be carried out in the order given in the chart.

Caution

Short-circuiting the positive (+) probe between a connector terminal and earth could damage the vehicle wiring, the sensor, ABS-ECU, or all three. Use care to prevent this!

3. If voltmeter shows any division from standard value, check the corresponding sensor, actuator and related electrical wiring, then repair or replace.
4. After repair or replacement, recheck with the voltmeter to confirm that the repair has corrected the problem.

Connector terminal arrangement for troubleshooting

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	

14X0184

Terminal arrangement shown on the special tool connector

18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	

14X0185

00000076

ABS-ECU Connector Terminal Arrangement

Caution

1. Use the special tool (MB991356) to check the ABS-ECU terminal voltage and resistance.
2. The ABS-ECU connector terminal arrangement for troubleshooting is different from the terminal arrangement shown on the special tool connector. So take the readings from the terminal numbers of the special tool when checking.

Example

ABS-ECU connector terminal number for troubleshooting	Terminal number shown on the special tool connector
18	1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	

14X0184

Terminal No.	Check point	Check condition	Normal condition
1	Rear solenoid valve (Output)	Ignition switch: OFF	0 V
		Ignition switch: ON	System voltage
2	Relay power supply (Output)	Ignition switch: OFF	0 V
		Ignition switch: ON	System voltage
4	Alternator (Input)	Ignition switch: ON (while engine is stopped)	2–5 V
		Ignition switch: ON (while engine is running)	System voltage
17	F.L. solenoid valve (Output)	Ignition switch: OFF	0 V
		Ignition switch: ON	System voltage
18	Ignition switch (Input)	Ignition switch: ON	System voltage
		Ignition switch: START	0 V
19	F.R. solenoid valve (Output)	Ignition switch: OFF	0 V
		Ignition switch: ON	System voltage
22	Valve relay monitor (Input)	Ignition switch: OFF	0 V
		Ignition switch: ON	System voltage
23	Diagnosis communication (Input/Output)	MUT-II: connected	Serial communication with the MUT-II
		MUT-II: disconnected	1 V or less
24	Diagnosis selection (Input)	MUT-II: connected	0 V
		MUT-II: disconnected	Approx. 12 V
25	ABS warning lamp (Output)	Ignition switch: ON	System voltage
29	Stop lamp switch (Input)	Ignition switch: ON (stop lamp switch ON)	5 V or more
		Ignition switch: OFF (stop lamp switch OFF)	1.5 V or more

TERMINAL RESISTANCE AND CONTINUITY CHECK

1. Turn the ignition switch to OFF.
2. Disconnect the ABS-ECU connector.
3. Measure the resistance and check for continuity between the terminals of the ABS-ECU harness-side connector while referring to the check chart.

NOTE

1. When measuring resistance and checking continuity, a harness for checking contact pin pressure should be used instead of inserting a test probe.
2. Checks do not have to be carried out in the order given in this chart.

Caution

If resistance or continuity checks are performed on the wrong terminals, damage to the vehicle wiring, sensors, ABS-ECU, and/or ohmmeter may occur. Use care to prevent this!

4. If the ohmmeter shows any deviation from the normal condition, check the corresponding sensor, actuator and related electrical wiring, and then repair or replace.
5. After repair or replacement, recheck with the ohmmeter to confirm that the repair or replacement has corrected the problem.

18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	

14X0310

Terminal No.	Check point	Check condition	Normal condition
5–earth	Motor monitor	At all times	Continuity
8–33	F.R.sensor	Ignition switch: OFF	1.0–1.2 kΩ
11–10	R.L. sensor	Ignition switch: OFF	1.0–1.2 kΩ
14–15	F.L. sensor	Ignition switch: OFF	1.0–1.2 kΩ
20–earth	ABS-ECU earth	At all times	Continuity
26–2	Motor relay	Ignition switch: OFF	Approx. 50 Ω
27–2	Valve relay	Ignition switch: OFF	Approx. 100 Ω
30–28	R.R. sensor	Ignition switch: OFF	1.0–1.2 kΩ
34–earth	ABS-ECU earth	At all times	Continuity

ON-VEHICLE SERVICE

BLEEDING

35200150061

Caution

Use the specified brake fluid. Avoid using a mixture of the specified brake fluid and other fluid.

Specified fluid: Brake DOT3 or DOT4

MASTER CYLINDER BLEEDING

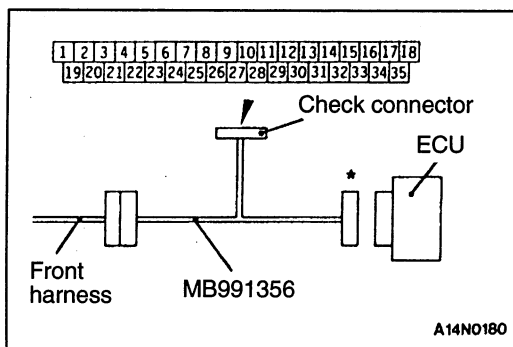
Refer to GROUP 35A – On-vehicle Service.

BRAKE LINE BLEEDING

Refer to GROUP 35A – On-vehicle Service.

Caution

For vehicles with ABS, be sure to filter/strain the brake fluid being added to the master cylinder reservoir tank. Debris may damage the HU.



ABS OPERATION CHECK

35200160125

WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK

1. Lift up the vehicle and release the parking brake.
2. Disconnect the ECU harness connector and measure from the harness side connector.

Caution

Set the special tool and use the check connector to check. Do not connect the connector (Special Tool) marked with "*" except when recording the waveform on a driving test. In such a case, connect the connector to the ECU.

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.

Wheels	Front left	Front right	Rear left	Rear right
Terminal No.	4	21	9	26
	5	11	8	24

Output voltage

When measuring with a voltmeter:

70 mV or more

When measuring with an oscilloscope:

200 mV p-p or more

Connector terminal arrangement

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	

14X0184

Terminal arrangement shown on the special tool connector

18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	

14X0185

00000076

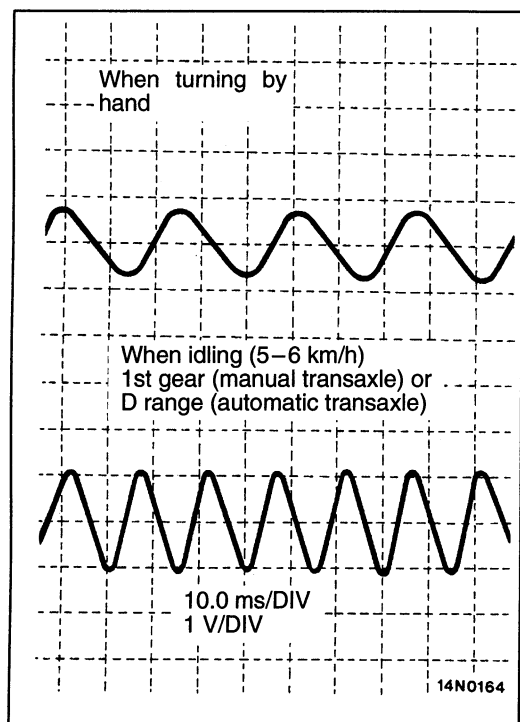
Caution

1. Use the special tool (MB991356) to check the ABS-ECU terminal voltage and resistance.
2. The ABS-ECU connector terminal arrangement for troubleshooting is different from the terminal arrangement shown on the special tool connector. So take the readings from the terminal numbers of the special tool when checking.

Example

ABS-ECU connector terminal number	Terminal number shown on the special tool connector
18	1

4. If the output voltage is lower than the above values, the reason could be as follows:
 - Faulty wheel speed sensor.

**Inspecting Wave Forms With An Oscilloscope**

Use the following method to observe the output voltage wave form from each wheel sensor with an oscilloscope

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

NOTE

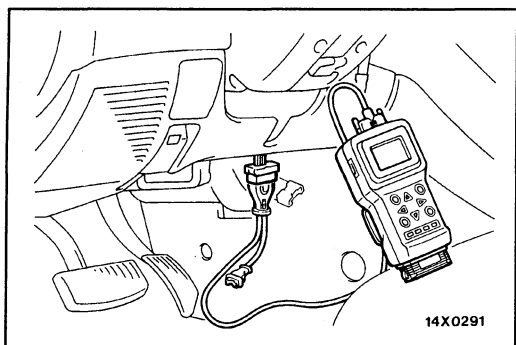
1. Check the connection of the sensor harness and connector before using the oscilloscope.
2. The wave form measurements can also be taken while the vehicle is actually moving.
3. The output voltage will be low when the wheel speed is low, and similarly it will be higher as the wheel speed increases.

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
Noisy or disturbed waveform	Open circuit in sensor	Replace sensor
	Open circuit in harness	Correct harness
	Incorrectly mounted wheel speed sensor	Mount correctly
	Rotor with missing or damaged teeth	Replace toothed rotor

NOTE

The wheel speed sensor cable moves following motion of the front or rear suspension. Therefore, it is likely that it has an open circuit only when driving on rough roads and it functions normally on ordinary roads. It is, therefore, recommended to observe sensor output voltage waveform also under special conditions, such as rough road driving.



HYDRAULIC UNIT (HU) CHECK

35200170135

Caution

Always connect and disconnect the scan tool with the ignition switch in the OFF position.

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. Release the parking brake, and feel the drag force (drag torque) on each road wheel.
When using the braking force tester, take a reading of the brake drag force.
3. Turn the ignition key to the OFF position and set the MUT-II as shown in the diagram.
4. After checking that the shift lever is in neutral, start the engine.

NOTE

1. At this time, the ABS system will switch to the scan tool mode and the ABS warning lamp will illuminate.
2. When the ABS has been interrupted by the fail-safe function, the MUT-II actuator testing cannot be used.
5. Use the MUT-II to force-drive the actuator.

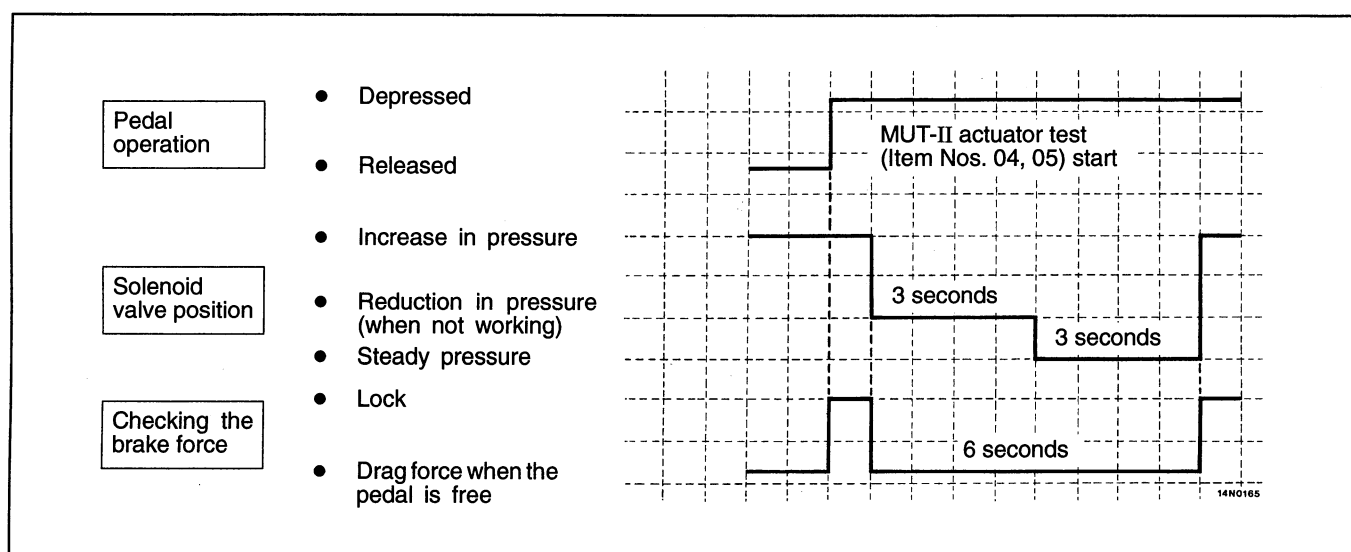
6. Turn the wheel by hand and check the change in braking force when the brake pedal is depressed.
When using the braking force tester, depress the brake pedal until the braking force is at the following values, and check to be sure that the braking force changes to the brake drag force inspected in step 2 when the actuator is force-driven.

N

Front wheel	785–981
Rear wheel	588–785

The result should be as shown in the following diagram.

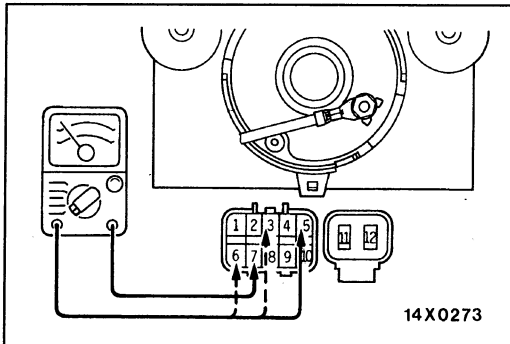
7. If the result of inspection is abnormal, correct according to the "Diagnosis Table."



Diagnosis Table

No.	Operation	Judgement–Normal	Judgement–Abnormal	Probable cause	Remedy
04	(1) Depress brake pedal to lock wheel. (2) Using the MUT-II, select the wheel to be checked and force the actuator to operate.	Brake force released for 6 seconds after locking.	Wheel does not lock when brake pedal is depressed.	Clogged brake line other than HU	Check and clean brake line
				Clogged hydraulic circuit in HU	Replace HU assembly
05	(3) Turn the selected wheel manually to check the change of brake force.		Brake force is not released	Incorrect HU brake tube connection	Connect correctly
				HU solenoid valve not functioning correctly	Replace HU assembly

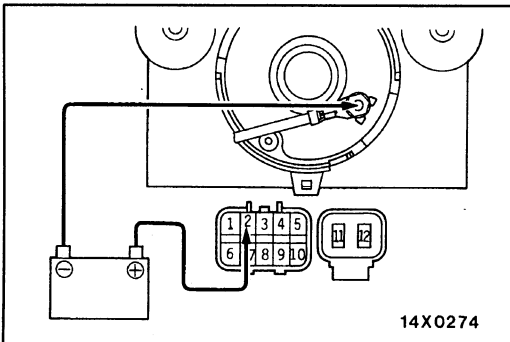
8. After inspection, disconnect the MUT-II immediately after turning the ignition switch to OFF.

**SOLENOID VALVE CHECK**

35201070106

Measure the resistance between terminals.

Standard value: 1.0–1.3Ω

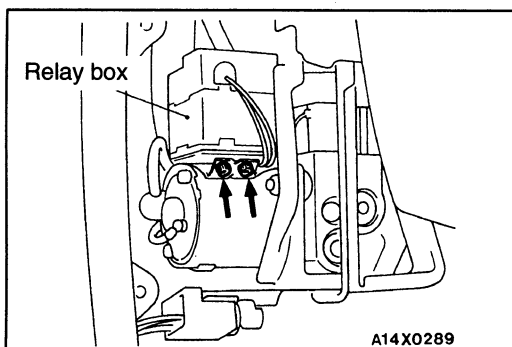
**MOTOR OPERATION CHECK**

35200180107

Connect the battery and check to be sure that the sound of the hydraulic unit motor operating can be heard.

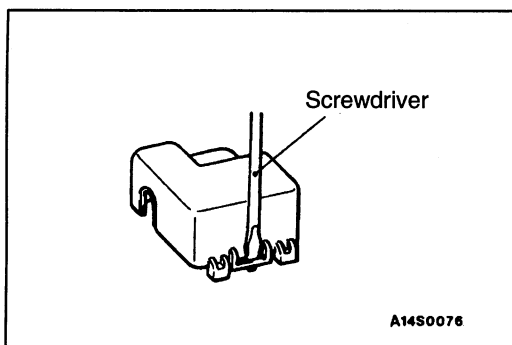
Caution

The battery power should not be applied for more than 1 second.

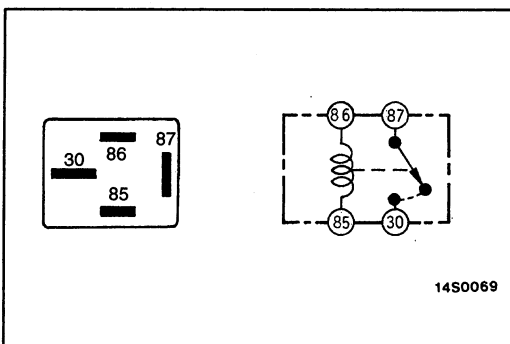
**ABS MOTOR RELAY AND ABS VALVE RELAY CHECK**

35201090102

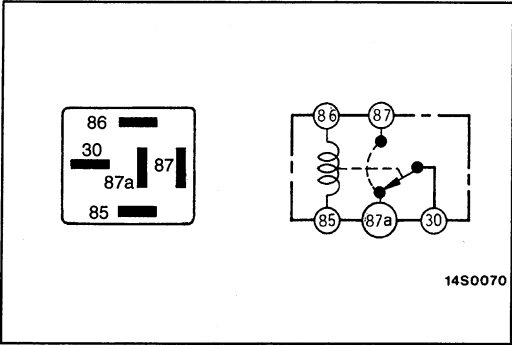
1. Remove the splash shield.
(Refer to GROUP 42 – Fender.)
2. Remove the relay box mounting bolts.



3. Insert the tip of a screwdriver into the space between the hydraulic unit and the relay box cover and use it to open the tab at one place, and then remove the cover.
4. Take out all of the relays from the relay box and check the continuity between the terminals when power is not supplied and when power is supplied.

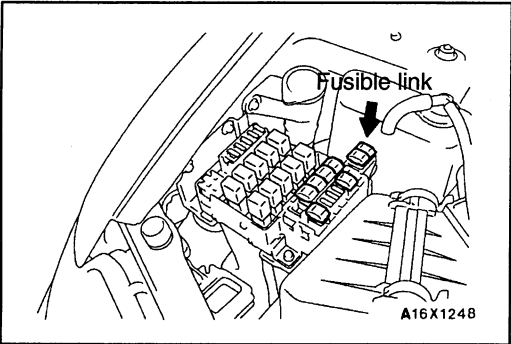
ABS Motor Relay

When no current flows	Between terminals 85–86	30–60 Ω
	Between terminals 30–87	No continuity (∞ Ω)
When current flows between terminals 85–86	Between terminals 30–87	Continuity (approx. 0 Ω)



ABS Valve Relay

When no current flows	Between terminals 85-86	60-120 Ω
	Between terminals 30-87a	Continuity (approx. 0 Ω)
	Between terminals 30-87	No continuity ($\infty \Omega$)
When current flows between terminals 85-86	Between terminals 30 - 87a	No continuity ($\infty \Omega$)
	Between terminals 30 - 87	Continuity (approx. 0 Ω)



REMEDY FOR A DISCHARGED BATTERY

35200350096

When booster cables are used to start the engine when the battery is completely discharged and then the vehicle is immediately driven without waiting for the battery to recharge itself to some extent, the engine may misfire or stall, making driving difficult.

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 remove the fusible link for ABS circuit, thus disabling the anti-skid brake system.

The ABS warning lamp will illuminate when the fusible link (for ABS) is removed.

After the battery has sufficiently charged, install the fusible link (for ABS) and restart the engine; then check to be sure the ABS warning lamp is not illuminated.

MASTER CYLINDER AND BRAKE BOOSTER

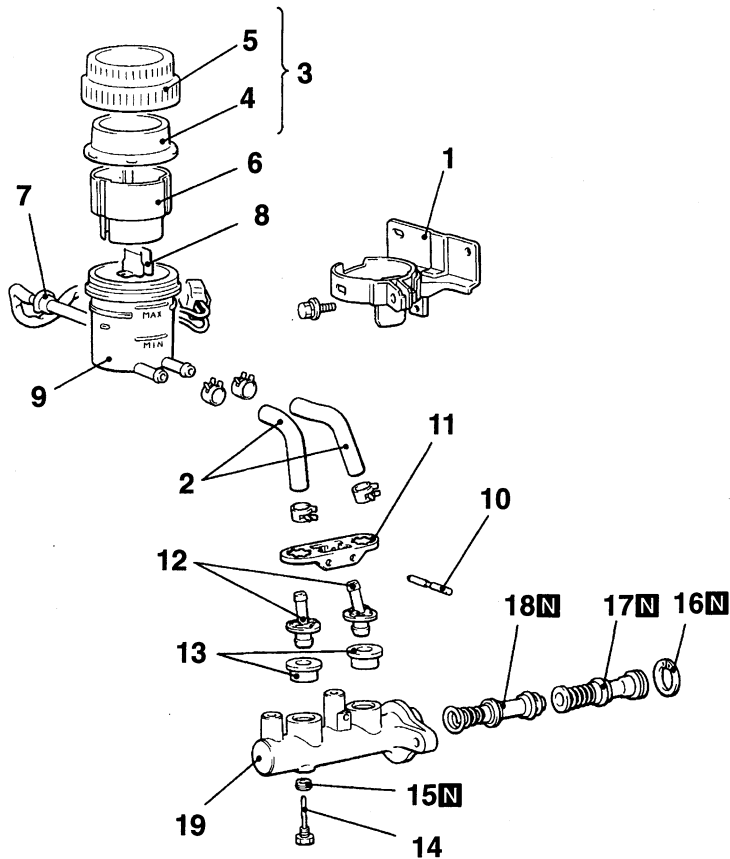
35200400135

REMOVAL AND INSTALLATION

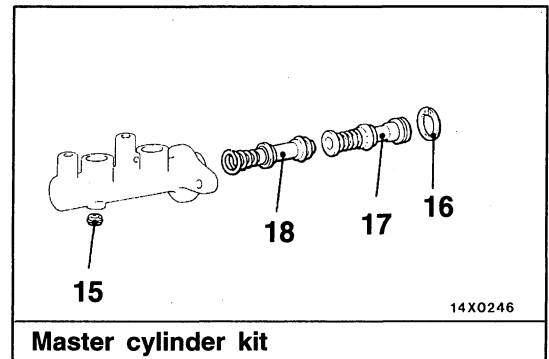
(Refer to GROUP 35A – Master Cylinder and Brake Booster.)

MASTER CYLINDER

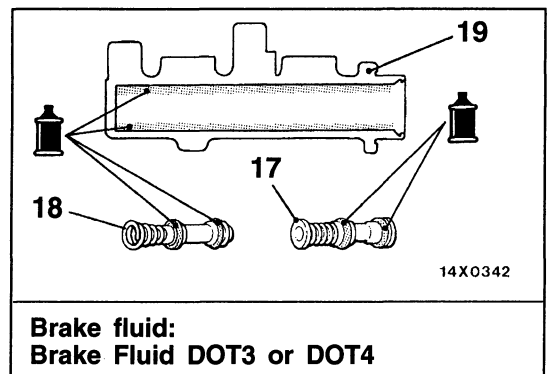
35200450086

DISASSEMBLY AND REASSEMBLY

14X0244



14X0246



14X0342

Disassembly steps

1. Reservoir bracket
2. Reservoir hose
3. Reservoir cap assembly
4. Diaphragm
5. Reservoir cap
6. Filter
7. Brake fluid level sensor
8. Float
9. Reservoir
10. Pin

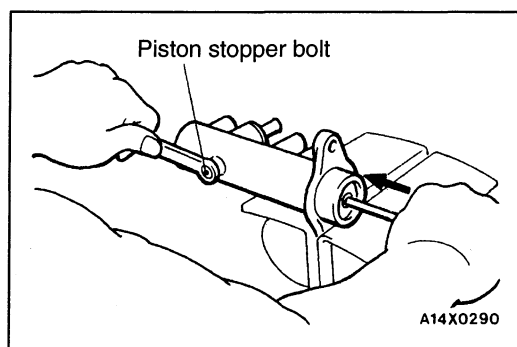


11. Retainer
12. Connector
13. Grommet
14. Piston stopper bolt
15. Gasket
16. Piston stopper ring
17. Primary piston assembly
18. Secondary piston assembly
19. Master cylinder body

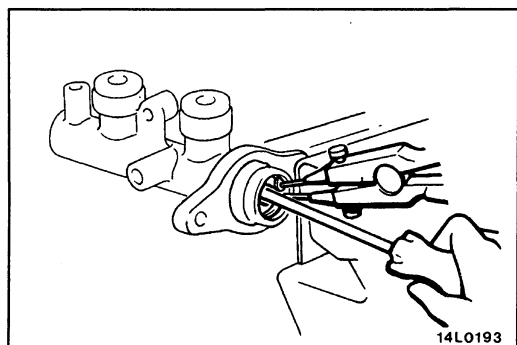
Caution

Do not disassemble the primary and secondary piston assembly.

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**DISASSEMBLY SERVICE POINTS****◀A▶ PISTON STOPPER BOLT DISASSEMBLY**

Remove the piston stopper bolt, while depressing the piston.

**◀B▶ PISTON STOPPER RING DISASSEMBLY**

Remove the piston stopper ring, while depressing the piston.

INSPECTION

35200460041

- Check the inner surface of master cylinder body for corrosion or pitting.
- Check the primary and secondary pistons for corrosion, scoring, damage or wear.
- Check the diaphragm for cracks and wear.

35200570072

PROPORTIONING VALVE REMOVAL AND INSTALLATION

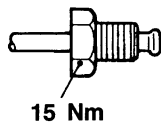
Pre-removal Operation

- (1) Brake Fluid Draining
- (2) Link Assembly Mounting Bolts Removal
(Refer to GROUP 17 – Auto-cruise Control.)

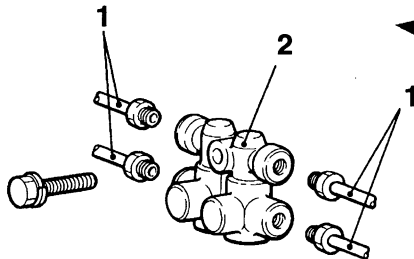
Post-installation Operation

- (1) Brake Fluid Supplying
- (2) Brake Lines Bleeding (Refer to P.35B-23.)
- (3) Link Assembly Mounting bolts Installation
(Refer to GROUP 17 – Auto-cruise Control.)

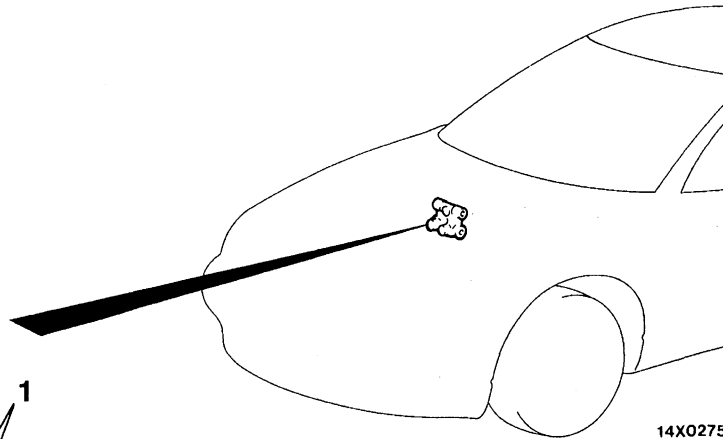
Flared brake line nuts



14X0343



14X0255



14X0275

00000078

Removal steps

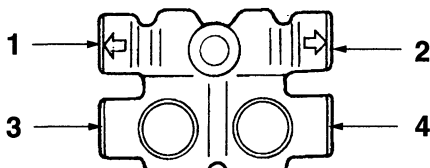
- A◄
1. Brake pipe
 2. Proportioning valve

INSTALLATION SERVICE POINT

►A◄BRAKE PIPE CONNECTION

Connect the pipes to the proportioning valve as shown in the illustration.

1. Proportioning valve – Rear brake (L.H.)
2. Proportioning valve – Rear brake (R.H.)
3. Proportioning valve – Hydraulic unit
4. Proportioning valve – Hydraulic unit



14L0340

HYDRAULIC UNIT

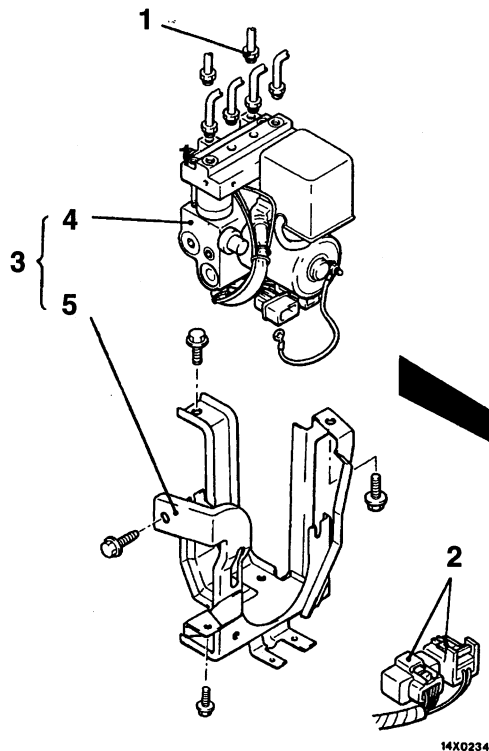
REMOVAL AND INSTALLATION

Pre-removal Operation

- (1) Brake Fluid Draining
- (2) Splash Shield (L.H.) Removal
(Refer to GROUP 42 – Fender)
- (3) Headlamp Assembly (L.H.) Removal
(Refer to GROUP 54)
- (4) Power Steering Oil Reservoir Mounting Bolts Removal (Refer to GROUP 37A)
- (5) Power Steering Pressure Pipe and Return Pipe Clamp Mounting Bolts Removal
(Refer to GROUP 37A.)

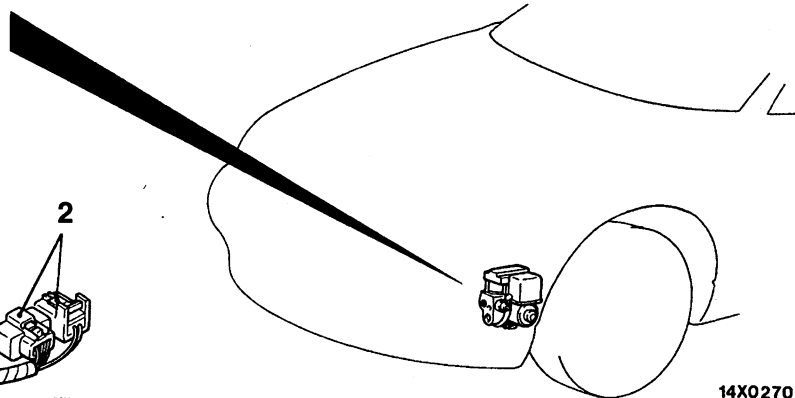
Post-installation Operation

- (1) Power Steering Pressure Pipe and Return Pipe Clamp Mounting Bolts Installation
(Refer to GROUP 37A.)
- (3) Power Steering Oil Reservoir Mounting Bolts Installation
(Refer to GROUP 37A)
- (3) Headlamp Assembly (L.H.) Installation
(Refer to GROUP 54)
- (4) Splash Shield (L.H.) Installation
(Refer to GROUP 42 – Fender.)
- (5) Brake Fluid Supplying
- (6) Brake Lines Bleeding (Refer to P.35B-23)
- (7) Hydraulic Unit Check (Refer to P.35B-25)

**Flared brake line nuts**

15 Nm

14X0343

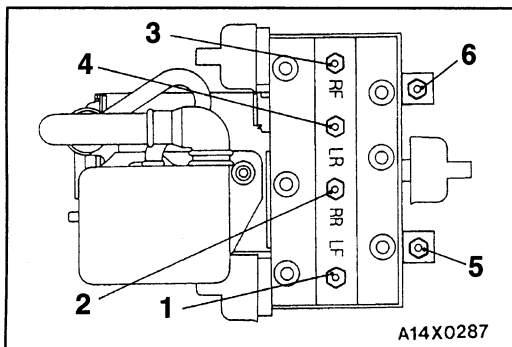
**Removal steps**

- A◄
1. Brake pipe connection
 2. Harness connector
 3. Hydraulic unit assembly
 4. Hydraulic unit
 5. Hydraulic unit bracket

◄A►

REMOVAL SERVICE POINT**◀A▶ HYDRAULIC UNIT REMOVAL****Caution**

1. The hydraulic unit is heavy, and so care should be taken when removing it.
2. The hydraulic unit is not to be disassembled; its nuts and bolts must not be loosened.
3. The hydraulic unit must not be dropped or otherwise subjected to impact shocks.
4. The hydraulic unit 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 as shown in the illustration.

1. Hydraulic unit – Front brake (L.H.)
2. Hydraulic unit – Rear brake (R.H.)
3. Hydraulic unit – Front brake (R.H.)
4. Hydraulic unit – Rear brake (L.H.)
5. Hydraulic unit – Master cylinder (Secondary)
6. Hydraulic unit – Master cylinder (Primary)

WHEEL SPEED SENSOR

REMOVAL AND INSTALLATION

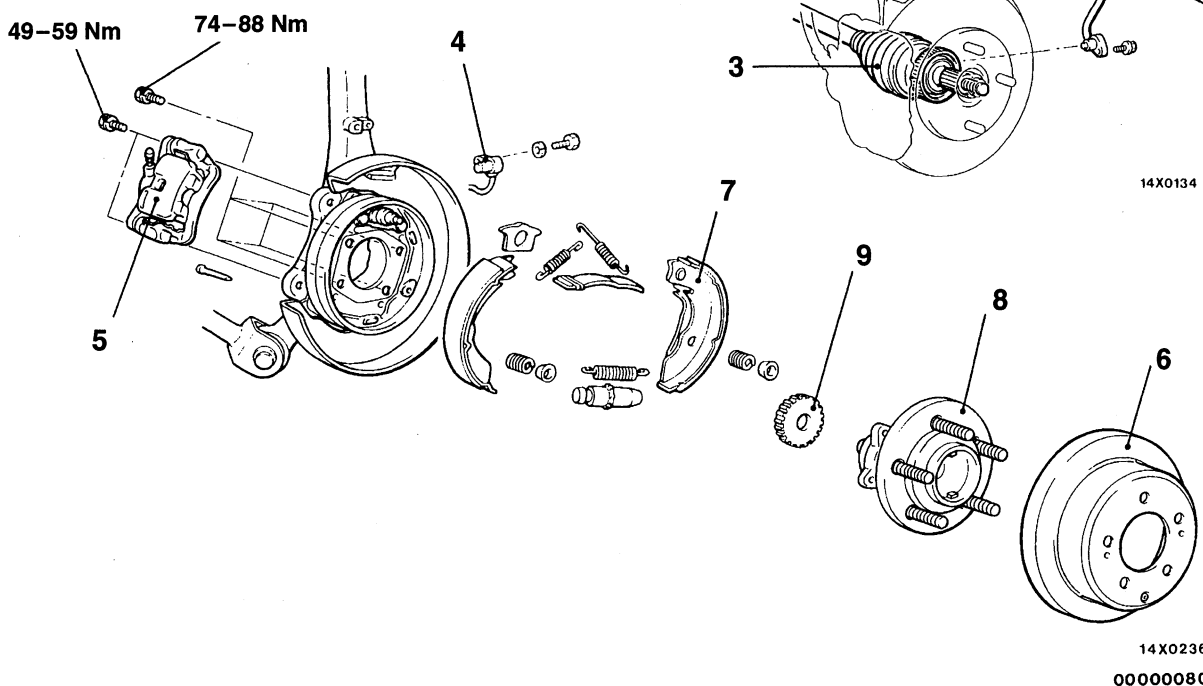
Pre-removal Operation

- Splash Shield Removal <Front only>
(Refer to GROUP 42 – Fender.)

Post-installation Operation

- (1) Wheel speed Sensor Output Voltage Check
(Refer to P.35B-23.)
- (2) Installation Splash Shield <Front only>
(Refer to GROUP 42 – Fender.)

Rear



Front wheel speed sensor removal steps

- A◄
1. Clip
 2. Front wheel speed sensor

Front rotor removal

3. Drive shaft <Front rotor>
(Refer to GROUP 26.)

Rear wheel speed sensor removal

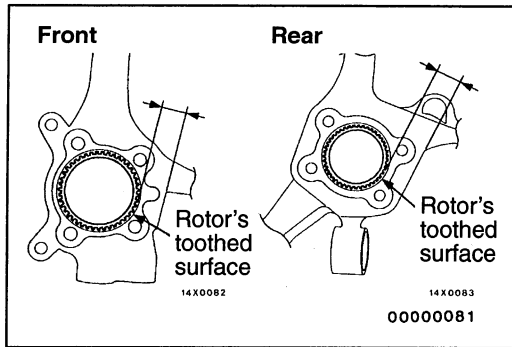
- A◄
4. Rear wheel speed sensor

Rear rotor removal steps

5. Caliper assembly
6. Brake disc
7. Shoe and lining assembly
(Refer to GROUP 36 – Parking Brake Drum.)
8. Rear hub assembly
9. Rear rotor

NOTE

The front rotor, integrated with the drive shaft, can not be disassembled.

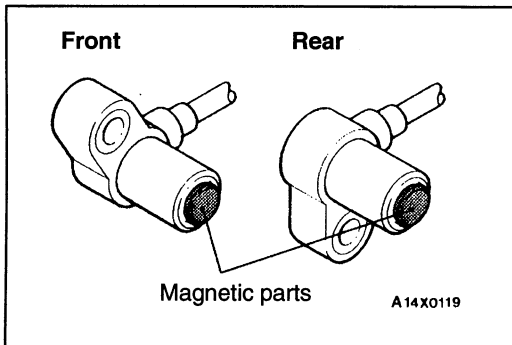


INSTALLATION SERVICE POINT

►A◄ FRONT WHEEL SPEED SENSOR/REAR WHEEL SPEED SENSOR INSTALLATION

The clearance between the wheel speed sensor and the rotor's toothed surface is not adjustable, but measure the distance between the sensor installation surface and the rotor's toothed surface.

Standard value: 28.2–28.5 mm



INSPECTION

35200840104

WHEEL SPEED SENSOR CHECK

- (1) Check whether any metallic foreign material has adhered to the parts shown in the illustration at the wheel speed sensor tip, and if so, remove it.

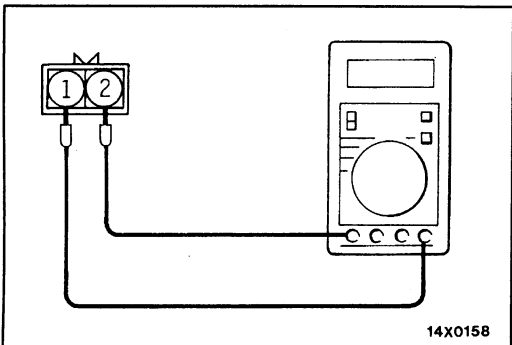
NOTE

The section shown in the illustration can become magnetized because of the magnet built into the wheel speed sensor, with the result that foreign metallic material is attached to it.

- (2) Measure the resistance between the wheel speed sensor terminals.

Standard value: 1.0–1.2 kΩ

If the internal resistance of the wheel speed sensor is not within the standard value, replace with a new wheel speed sensor.



- (3) Check the wheel speed sensor cable for breakage, damage or disconnection; replace with a new one if a problem is found.

NOTE

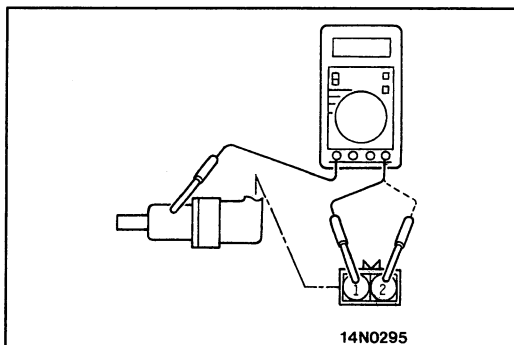
When checking for cable damage, remove the cable clamp part from the body and then bend and pull the cable near the clamp to check whether or not an intermittent contact results. Check the connector connection and the terminal insertion.

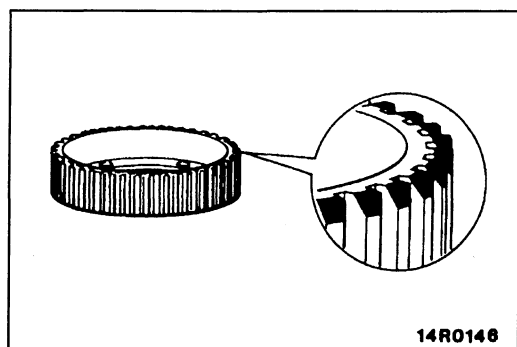
WHEEL SPEED SENSOR INSULATION CHECK

- (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 wheel speed sensor insulation resistance is outside the standard value range, replace with a new wheel speed sensor.



**TOOTHED ROTOR CHECK**

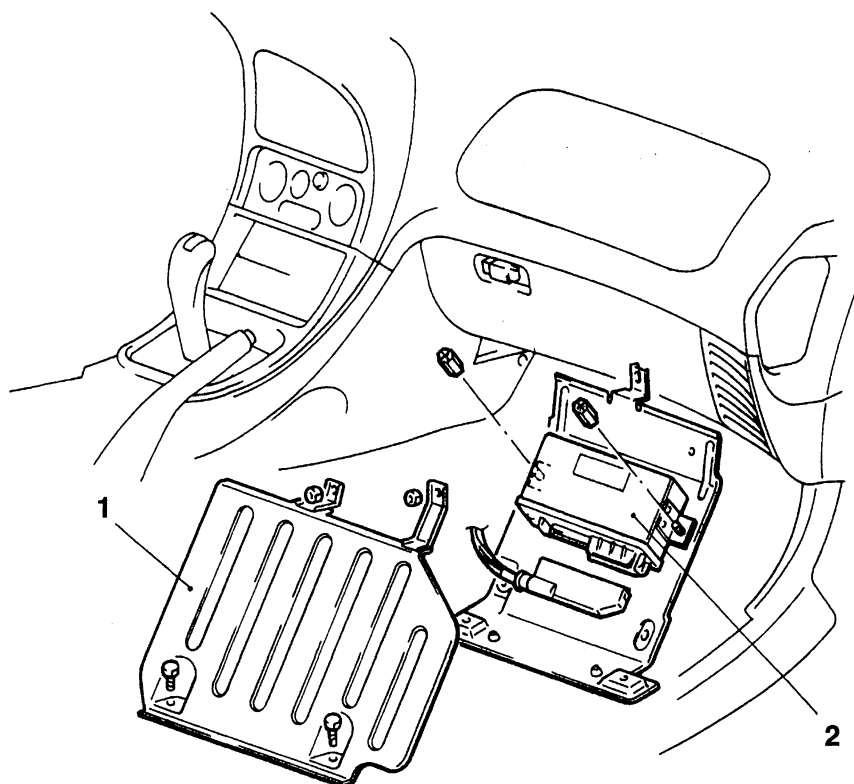
Check whether toothed rotor is broken or deformed, and, if so, replace the rotor.

ABS-ECU

35200980110

REMOVAL AND INSTALLATION**Pre-removal and Post-installation Operation**

- Cowl Side Trim (R.H.) and Front Scuff Plate (Refer to GROUP 52A – Trims.)



A14X0264

Removal steps

1. Control unit cover
2. ABS-ECU

INSPECTION**ABS-ECU CHECK**

Refer to P.35B-20.

35200990076