Brake System

GENERAL

EJHA0010

SPECIFICATIONS

Master cylinder	
Type	Tandem type
I.D.	25.4 mm (1.0 in.)
Fluid level sensor	Provided
Brake booster	
Type	Vacuum type with tandem booster
Effective dia.	8 + 9 in.
Boosting ratio	7.0 : 1
Front brake	
Type	Floating type with ventilated disc
Disc O.D.	276 mm (10.87in.)
Disc thickness	26 mm (1.02 in.)
Pad thickness	16.5 mm (0.65 in.)
Cylinder I.D.	42.9 mm (1.689 in.) (X2)
Rear disk brake	
Type	Floating type with solid disc
Disc O.D.	284 mm (11.18 in.)
Disc thickness	10 mm (0.39 in.)
Pad thickness	15 mm (0.59 in.)
Cylinder I.D.	38.2 mm (1.50 in.)
Parking brake	
Type	Mechanical brake acting on rear wheels
Braking type	Foot type
Cable arrangement	V type
Rear drum brake	
Type	Leading-trailing drum
Drum I.D.	254 mm (10 in.)
Cylinder I.D.	20.64 mm (0.81 in.)
Clearance adjustment	Automatic
Lining thickness	5.0 mm (0.20 in.)

O.D. = Outer diameter

I.D. = Inner diameter

SERVICE STANDARD

EJHA0050

Standard value	
Brake pedal height	176±0.3mm
Stop lamp switch outer case to pedal stopper clearance	0.5-1.0 mm (0.020-0.040 in.)
Brake pedal free play	3-8 mm (0.117-0.312 in.)
Booster push rod to master cylinder piston clearance	0 (at 500 mmHg vacuum)
Brake pedal to floor board clearance	44 mm (1.73 in.)
Service limit	
Front disc brake pad thickness	2.0 mm (0.079 in.)
Front disc thickness (minimum)	24.4 mm (0.96 in.)
Front disc runout	0.05 mm (0.0020 in.)
Front disc thickness variation	0.01 mm (0.0004 in.)
Wheel cylinder to piston clearance	0.15 mm (0.006 in.)
Rear disc brake pad thickness	2.0 mm (0.079 in.)
Rear drum I.D.	256 mm (10.08 in.)
Rear disc thciness	8.4 mm (0.33 in.)

TIGHTENING TORQUE

EJHA0100

	Nm	Kg·cm	lb·ft
Master cylinder to booster mounting nut	8-12	80-120	5.9-8.8
Brake booster mounting nut	13-16	130-160	9.4-11.6
Brake booster vacuum hose fitting to surge tank	15-18	150-180	11-13
Bleeder screw	7-9	70-90	5-6.6
Brake tube flare nut, brake hose	13-17	130-170	9-12
Caliper guide rod bolt	22-32	220-320	16-24
Caliper assembly to knuckle			
Front	8-10	80-100	5.8-7.3
Rear	5-6	50-60	3.6-4.3
Brake hose to front caliper	17-20	170-200	12.3-14.5
Wheel cylinder mounting bolt	12-18	120-180	8.8-13

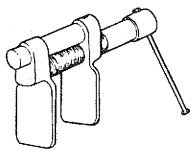
LUBRICANT

EJHA0150

	Recommended lubricant	Quantity
Brake fluid	DOT 3 or equivalent	As required
Brake pedal bushing and brake pedal bolt	Chassis grease SAE J310, NLGI No.0	As required
Clevis pin	Wheel bearing grease SAE J310, NLGI No.2	As required
Parking brake shoe and backing plate contact surfaces	Bearing grease, NLGI No.0-1	As required

SPECIAL TOOLS

EJHA0200

Tool (Number and Name)	Illustration	Use
09581 - 11000 Piston expander	 EJDA043A	Pushing back of the front disc and rear disc brake piston

TROUBLESHOOTING

EJHA0250

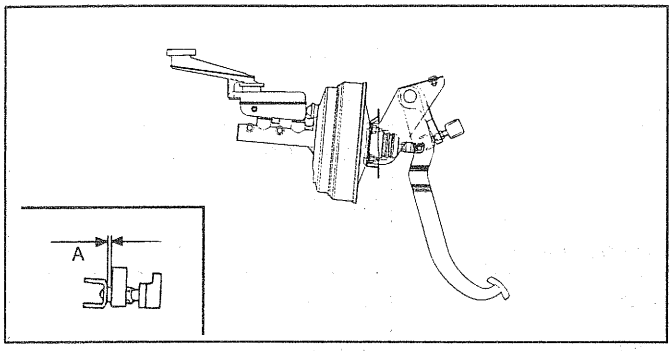
Trouble symptom	Probable cause	Remedy
Noise or vibration when brakes are applied	Caliper improperly mounted	Correct
	Loose caliper mounting bolts	Retighten
	Unevenly worn or cracked brake drum or brake disc	Replace
	Foreign material in brake drum	Clean
	Seized pad or lining contact surface	Replace
	Excessive caliper to pad assembly clearance	Correct
	Uneven pad contact	Correct
	Lack of lubrication in sliding parts	Lubricate
	Loose suspension parts	Retighten
Vehicle pulls to one side when brakes are applied	Difference in left and right tire inflation pressure	Adjust
	Improper front wheel alignment	Adjust
	Inadequate contact of pad or lining	Correct
	Grease or oil on pad or lining surface	Replace
	Drum warpage or uneven wear	Replace
	Incorrect wheel cylinder installation	Correct
	Auto adjuster malfunction	Correct

Trouble symptom	Probable cause	Remedy
Insufficient braking power	Low or deteriorated brake fluid	Refill or change
	Air in the brake system	Bleed the system
	Brake booster malfunction	Correct
	Inadequate contact of pad or lining	Correct
	Grease or oil on pad or lining surface	Replace
	Auto adjuster malfunction	Correct
	Overheated brake rotor due to dragging of pad or lining	Correct
	Restricted brake line	Correct
	Proportioning valve malfunction	Replace
Increased pedal stroke required (Reduced pedal to floor-board clearance)	Air in the brake system	Bleed the system
	Brake fluid leaks	Correct
	Excessive push rod to master cylinder clearance	Adjust
Brake drag	Incomplete release of parking brake	Correct
	Incorrect parking brake adjustment	Adjust
	Worn brake pedal return spring	Replace
	Restricted master cylinder return port	Correct
	Broken rear drum brake shoe return spring	Replace
	Lack of lubrication in sliding parts	Lubricate
	Defective master cylinder check valve or piston return spring	Replace
	Insufficient push rod to master cylinder clearance	Correct
Insufficient parking brake function	Worn brake lining or pad	Replace
	Grease or oil on lining or pad surface	Replace
	Parking brake cable sticking	Replace
	Auto adjuster malfunction	Correct
	Excessive parking brake lever stroke	Adjust the parking brake lever stroke or check the parking brake cable routing
	No air bleeding after lining replacement	Air bleeding

SERVICE BRAKE PEDAL INSPECTION AND ADJUSTMENT EJHA0300

1. Turn the stop lamp switch until the clearance between the outer case of the stop lamp switch and pedal arm reaches the standard value, and then secure the stop lamp switch with the lock nut.

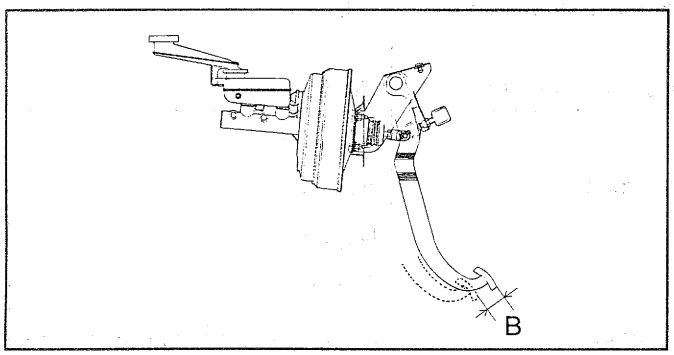
Clearance between pedal and stop lamp switch "A" :
0.5-1.0 mm (0.02-0.039 in.)



EJHA001A

2. Free play of brake pedal.

Brake pedal free play "B" :
3-8 mm (0.12-0.32 in.)



EJHA230A

BRAKE BOOSTER OPERATION TEST WITHOUT A TESTER

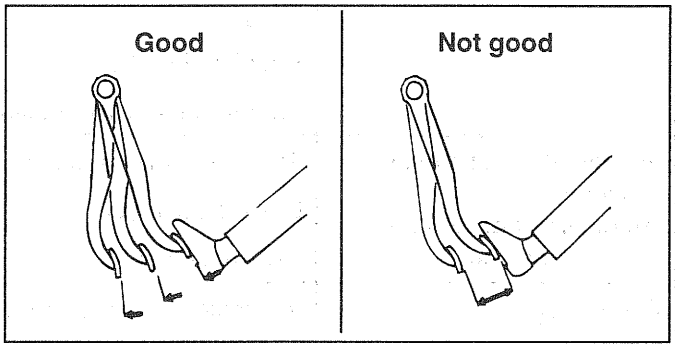
For a simple check of brake booster operation, perform the following tests.

1. Run the engine for one or two minutes, and then shut it off. Depress the brake pedal several times at normal foot pressure. If the pedal goes down further the first time, but gradually rises after the second or third time, the brake booster is functioning properly. Go to step 2.

2. With the engine stopped, depress the brake pedal several times. Depress the brake pedal and start the engine. If the pedal goes down slightly, the booster is in good condition. Go to step 3.

3. With the engine running, depress 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 one of the above three tests is not OK, check the vacuum hoses, the check valve and the brake booster. Make any necessary corrections. If all tests are OK, the unit is in good condition.



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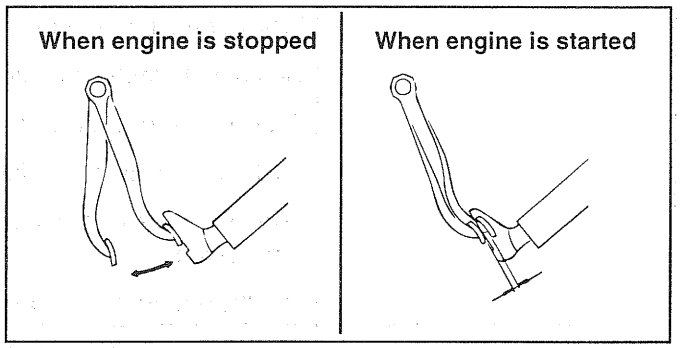


EJA9002B

BLEEDING OF THE BRAKE SYSTEM EJHA2350

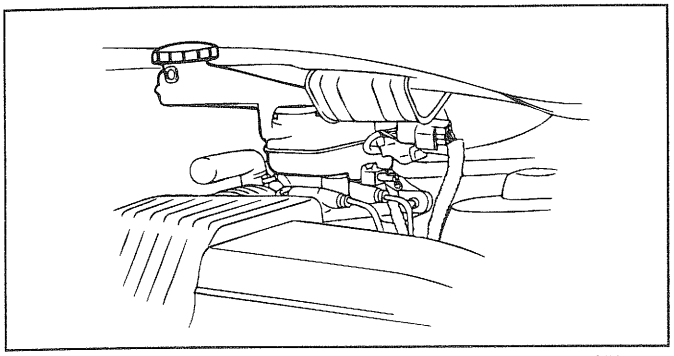
1. Remove the reservoir cap and fill the brake reservoir with brake fluid.

CAUTION

Do not allow brake fluid to remain on a painted surface. Wash it off immediately.

NOTE

When bleeding by pressurized fluid, do not depress the brake pedal.

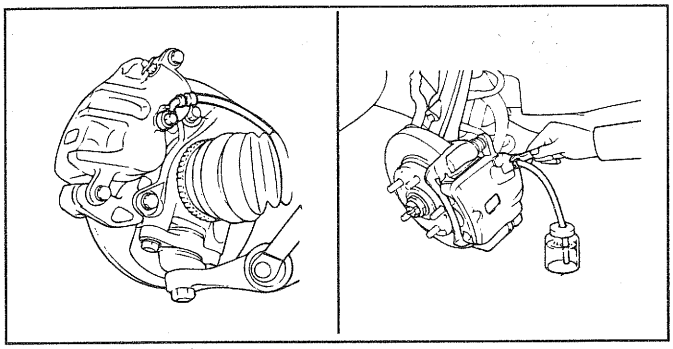


EJHA002A

2. Connect a vinyl tube to the wheel cylinder bleeder plug, and insert the other end of the tube in a container of brake fluid which is half full.

3. Slowly pump the brake pedal several times.

4. While depressing the brake pedal fully, loosen the bleeder plug until fluid starts to run out. Then close the bleeder screw.



KFW8006A

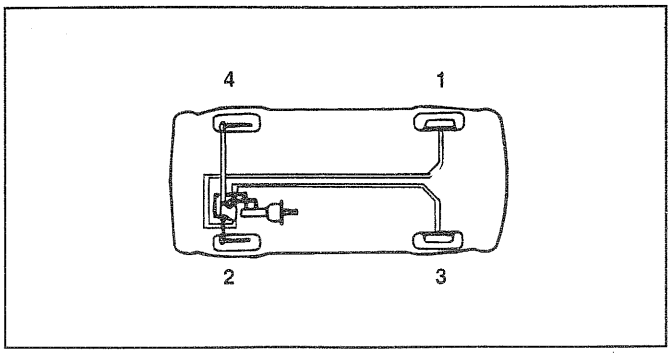
5. Repeat steps 3 and 4 until there are no more bubbles in the fluid.

6. Tighten the bleeder plug screw.

Bleeder screw tightening torque :

7-9 Nm (70-90 kg·cm, 5-6.6 lb·ft)

7. Repeat the above procedure for each wheel in the sequence shown in the illustration.

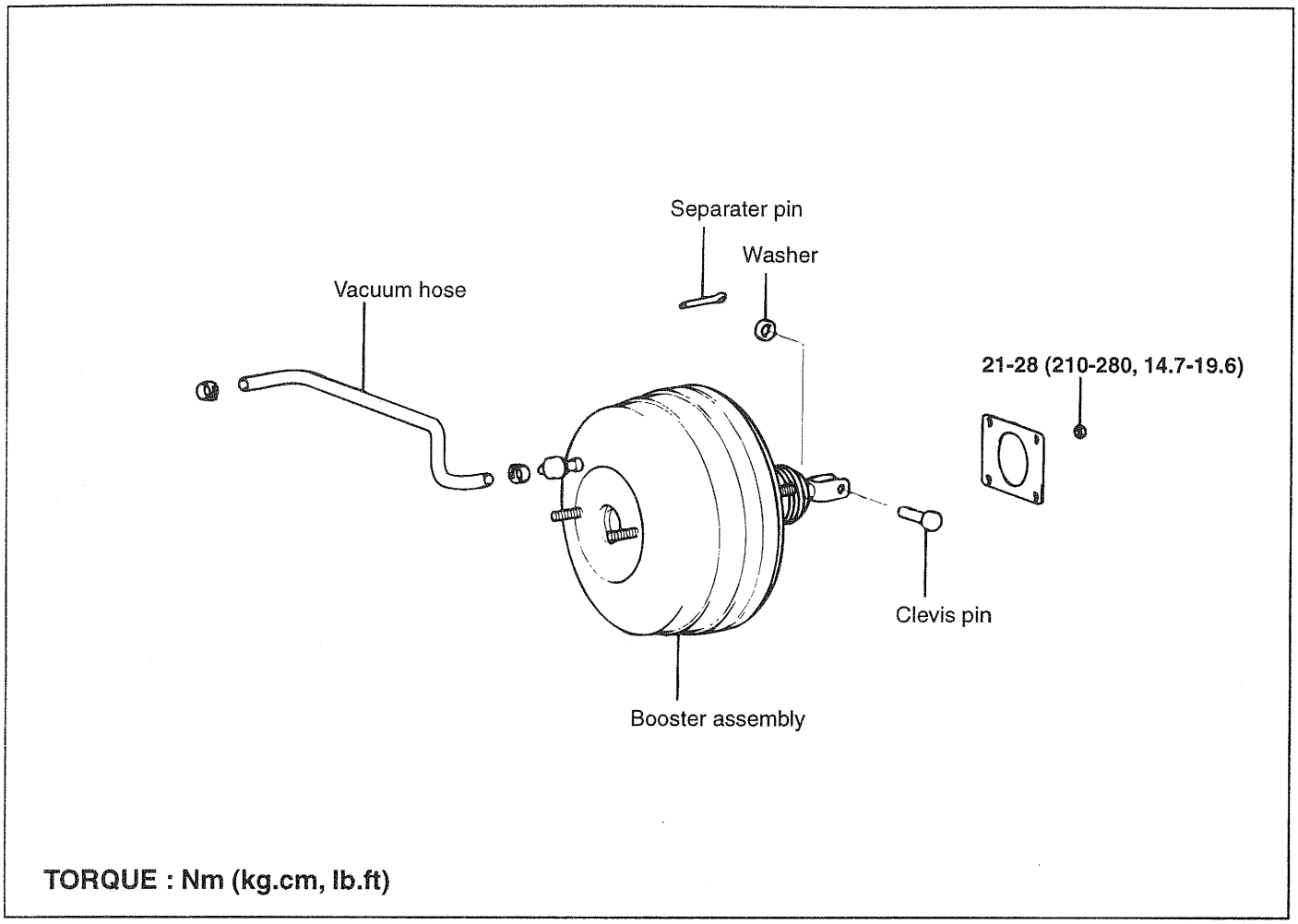


EJA9004A

BRAKE SYSTEM

BRAKE BOOSTER

COMPONENTS EJHA0850



KFW8019A

CHECK VALVE OPERATING TEST EJHA0900

Remove the vacuum hose from the booster

↓

Start the engine

↓

Plug the vacuum hose hole with a finger

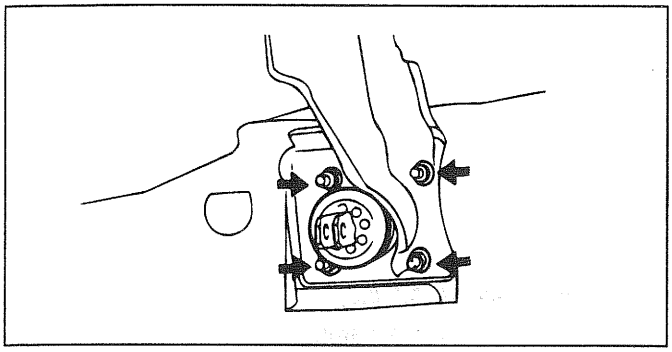
↓

Check that a vacuum is present and is maintained

EJHA285A

REMOVAL EJHA0950

1. Remove the master cylinder.
2. Remove the vacuum hose.
3. Remove the operating rod from the brake pedal.
4. Loosen the booster mounting nuts to remove the booster assembly.



EJA9011B

INSTALLATION EJHA1000

1. Install the master cylinder.
2. Attach the booster and master cylinder to the dash panel.
3. Reinstall the vacuum hose securely to prevent vacuum leaks.
4. Couple the operating rod with the brake pedal.
5. Bleed the system.

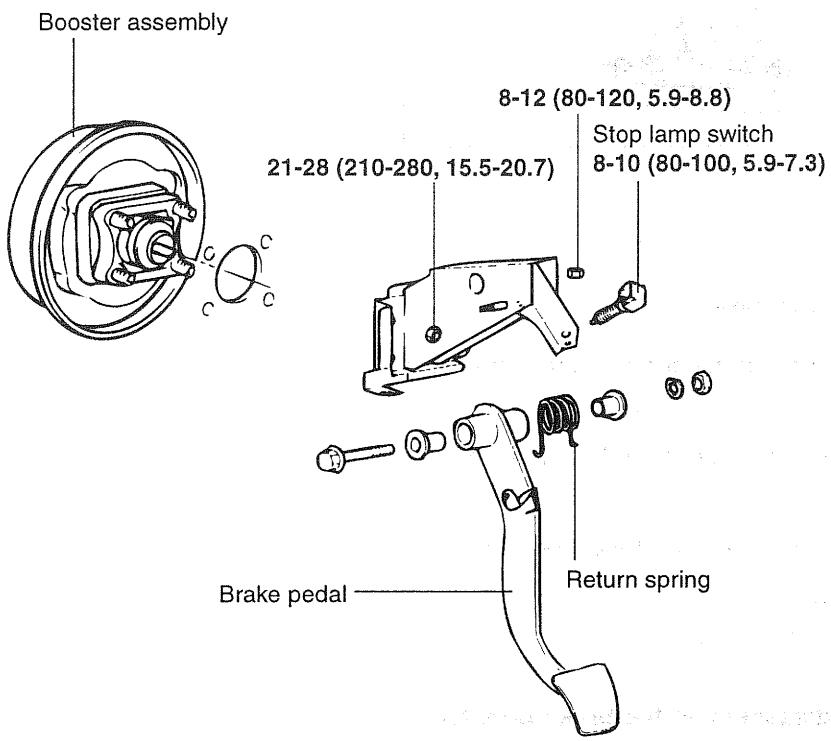
NOTE

Do not attempt to disassemble the brake booster.

BRAKE PEDAL

COMPONENTS EJHA0350

[M/T]



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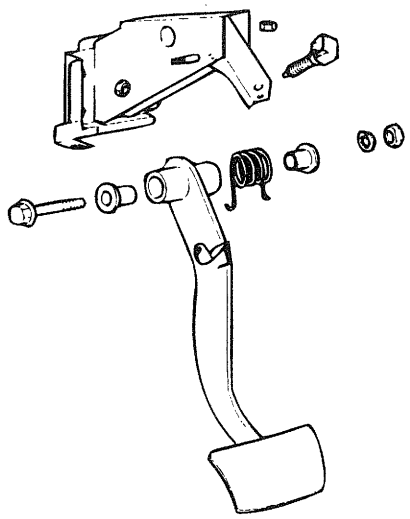
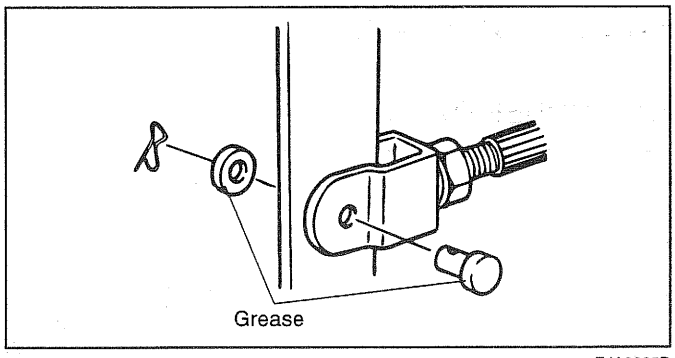


TORQUE : Nm (kg.cm, lb.ft)

KFW8010A

REMOVAL EJHA0400

1. Remove the lower crash pad assembly (Refer to Body Group).
2. Remove the stop lamp switch and disconnect the shift lock cable (Vehicle with automatic speed control system only).
3. Remove the cotter pin and clevis pin.
4. Remove the brake pedal member assembly mounting nut.
5. Remove the brake pedal assembly.



EJA9005B

INSPECTION EJHA0450

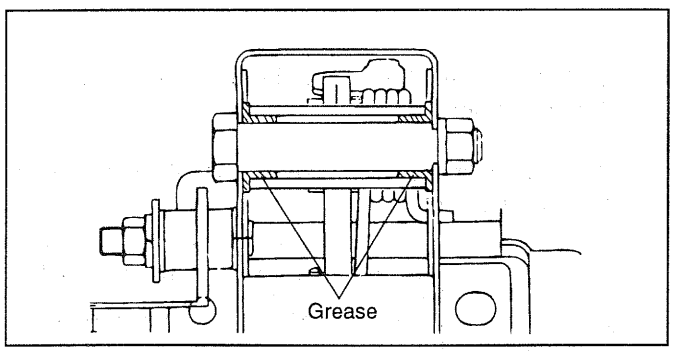
1. Check the bushing for wear.
2. Check the brake pedal for bending or twisting.
3. Check the brake pedal return spring for damage.

INSTALLATION EJHA0500

Installation is the reverse of the removal procedure.

NOTE

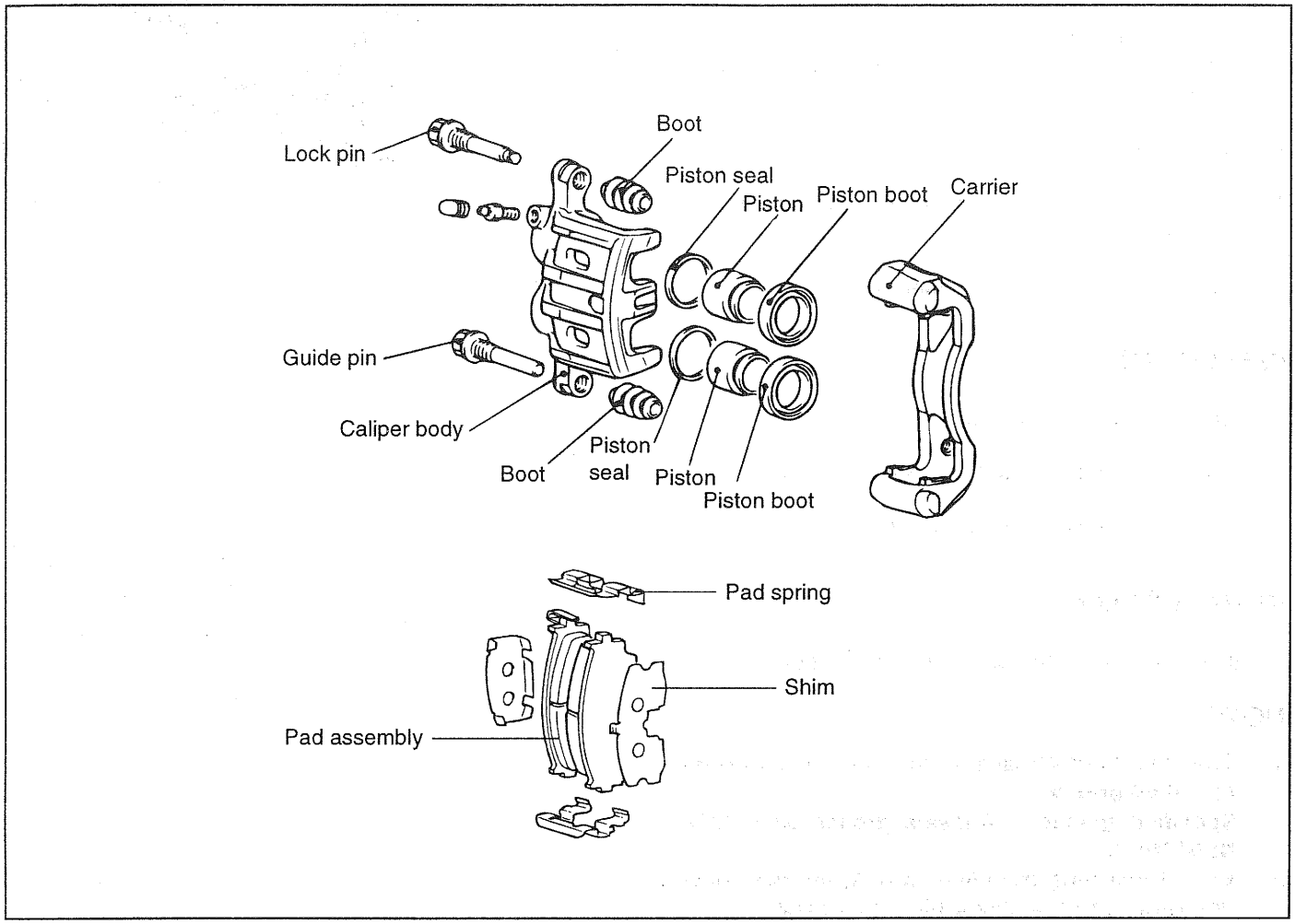
1. **Coat the inner surface of the bushings with the specified grease.**
   Specified grease : Chassis grease SAE J310, NLGI No. 0
2. **Before inserting the clevis pin, apply the specified grease to the clevis pin and washer.**



EJB9003A

FRONT DISC BRAKE

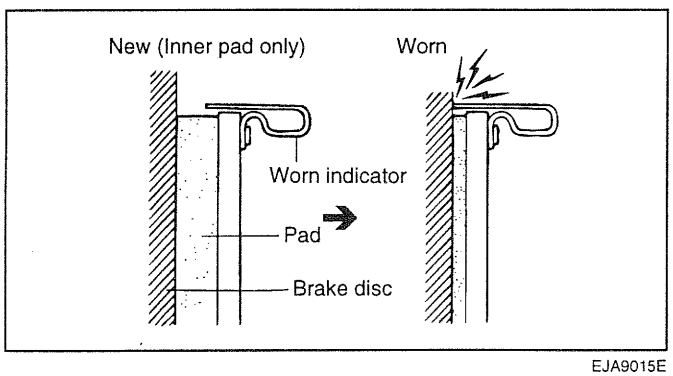
COMPONENTS EJHA1050



EJHA300A

REPLACEMENT OF BRAKE PADS EJHA1100

If a squeaking noise occurs from the front brake while driving and braking, inspect the brake pads.



EJA9015E

2. Check the pad thickness through the cylinder inspection hole.

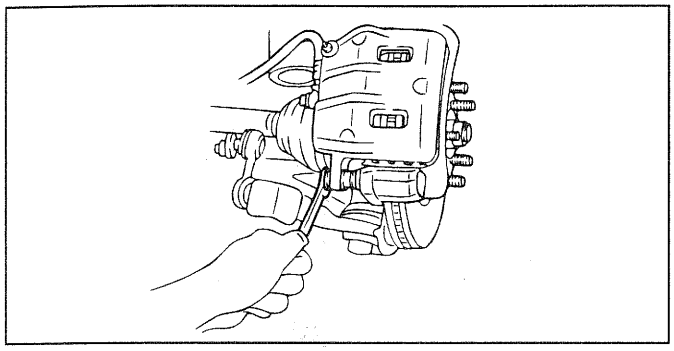
   If the pad lining thickness is out of specification, replace the pads.

	Standard value	Service limit
Pad lining thickness mm (in.)	10.5 (0.413)	2.0 (0.079)

3. Remove two bolts from the carrier and remove the brake cylinder.

REMOVAL EJHA1110

1. Remove the wheel and tire.

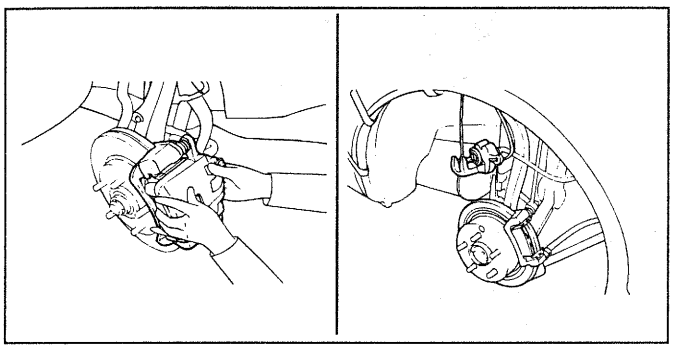


EJHA007B

4. Remove the brake cylinder and suspend it with wire.

NOTE

Do not disconnect the brake hose.

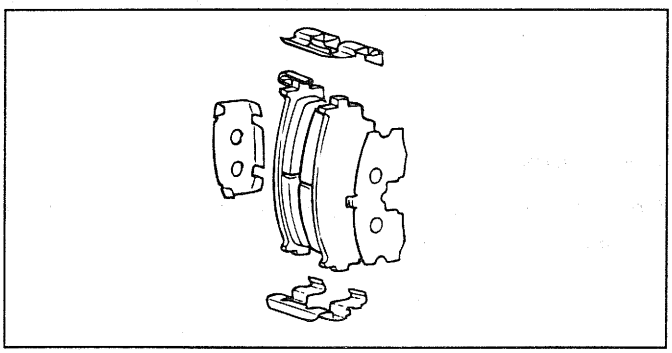


KFW8024A

5. Remove the pads.

NOTE

Be careful not to depress the brake pedal while disassembling the pads.



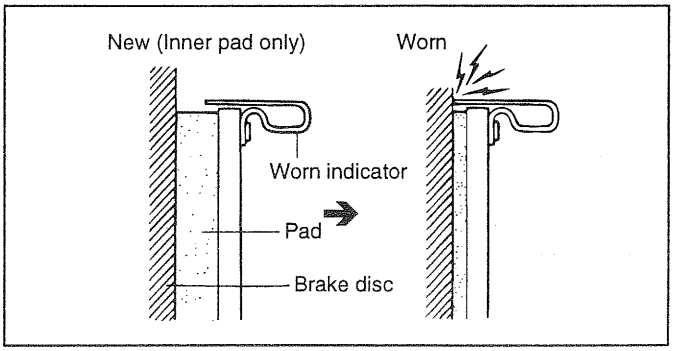
EJA9015D

INSPECTION EJHA1150

1. Check the pads for wear or oil contamination.

   Replace or correct if necessary.

2. Check the shims for damage or deformation.



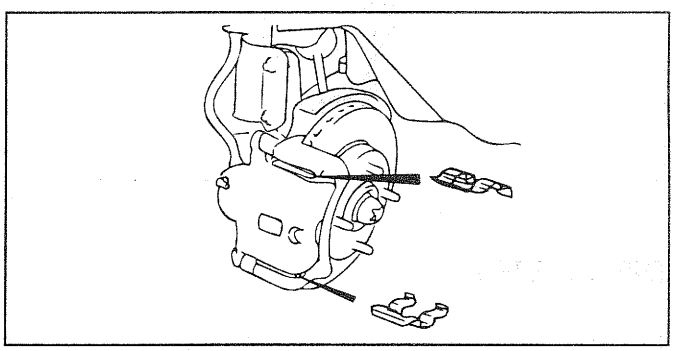
EJA9015E

INSTALLATION EJHA1200

1. Install the pad clips.
2. Install the pads onto each pad clip.

NOTE

a. **All four pads must be replaced as a complete set.**
b. **Position the pad with its pad wear sensor to the piston side and to the upward.**
c. **Remove rust before positioning the pad clip or replace with a new one if it is damaged.**



EJA9015F

3. Press in piston with a hammer handle or equivalent.
4. Lower and insert the brake cylinder carefully so as not to damage the boot.
5. Install the two guide rod bolts and tighten.

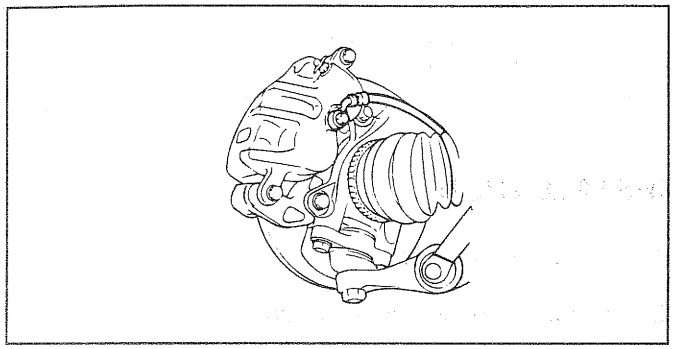
   Tighten the connections to the specified torque.

Guide rod bolt :	22-32 Nm (220-320 kg·cm, 16-24 lb·ft)

CALIPER ASSEMBLY EJHA1250

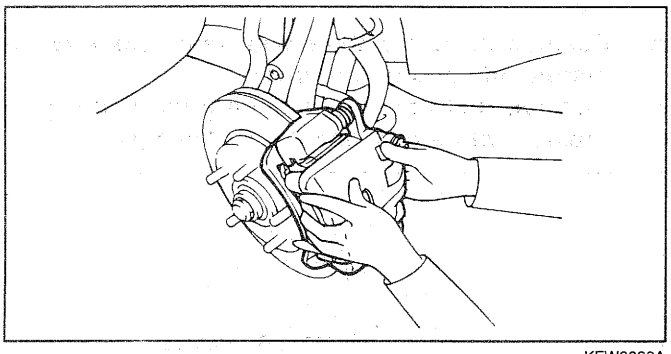
REMOVAL

1. Remove the wheel and tire.
2. Remove the brake hose from the caliper.



KFW8005A

3. Remove the caliper assembly.



KFW8023A

DISASSEMBLY EJHA1300

Front disc brakes should be disassembled with right and left sets separately.

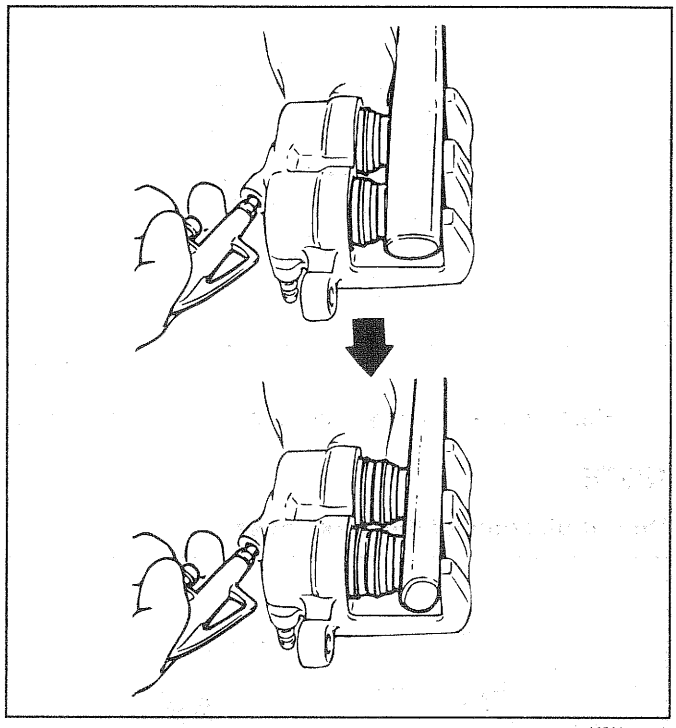
1. Remove the piston boot/piston.

   Blow compressed air into the brake hose seating hose. Remove the piston and the piston boot.

CAUTION

Remove the piston using a plastic hammer handle. Blow air slowly adjusting heights of the two pistons to ensure even push-out.

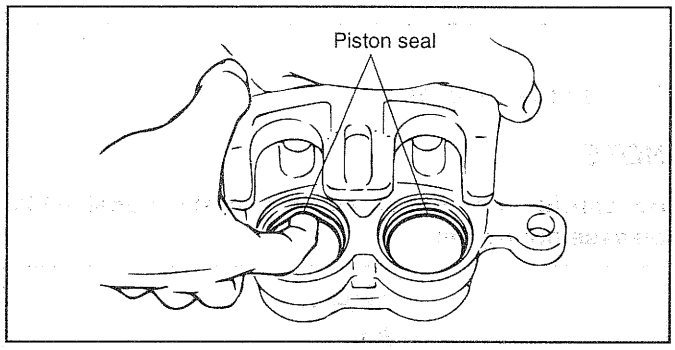
Secondary piston shall not be removed before primary piston is removed completely. Otherwise the secondary piston will be not be removable.



KGX8039A

2. Remove the piston seal.

   1) Remove the piston seal with finger.



KGX8040A

CAUTION

Do not use a screwdriver or another tool. It may damage the cylinder inside.

   2) Clean the piston surface and cylinder inside using the trichloro ethylene, alcohol or specified brake oil.

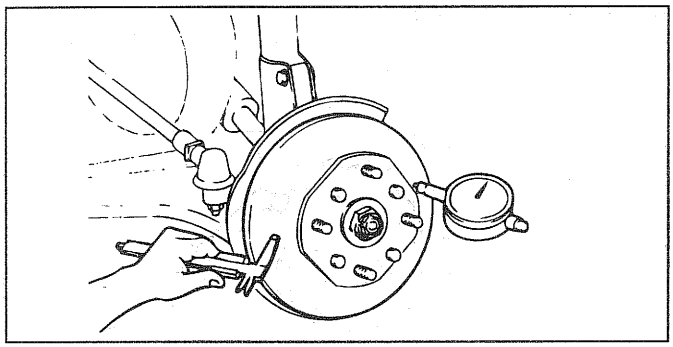
Brake oil : DOT 3 or equivalent

3. Clean the outer surface of the piston and the inner surface of the cylinder with the specified brake fluid.

INSPECTION EJHA1350

1. Check the caliper body cylinder inner surface for wear, damage and/or corrosion.
2. Check the piston for wear, damage and/or corrosion.
3. Check the caliper body and sleeve for wear.
4. Check pads for deformation, metal backing for damage, and for oil on the pads.
5. Check the carrier for damage, rust, wear and cracks.
6. Inspect the brake disc using a dial indicator and micrometer. Machine or replace as necessary.

	Standard value	Standard limit
Thickness of disc mm (in.)	26 (1.02)	24.4 (0.96)
Runout of disc mm (in.)	-	0.05 (0.0020)



EJA9015N

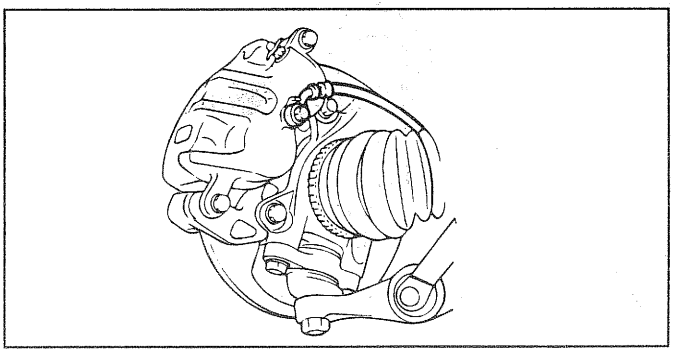
7. If necessary, replace the brake disc.
   1) Jack the vehicle up and support it with jack stands.
   2) Remove the wheel and tire.
   3) Remove the front wheel brake assembly from the knuckle and suspend it with a wire.
   4) Remove the front disc from the hub.

HOW TO CHECK FRONT DISC RUNOUT AND THICKNESS EJHA1400

FRONT BRAKE DISC RUN-OUT CHECK

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

   Clean the disc thoroughly and remove all rust.



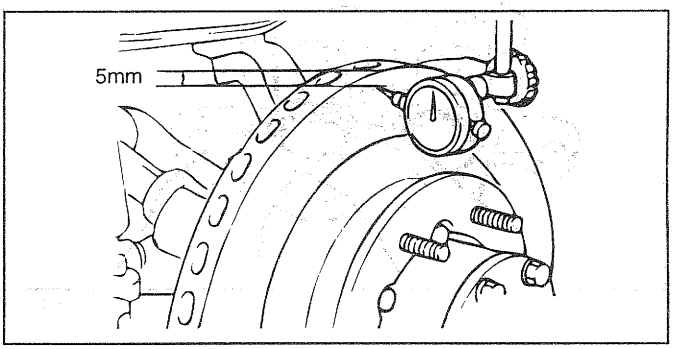
KFW8025A

3. Place a dial gauge approximately 5 mm (0.2 in.) from the outer circumference of the brake disc, and measure the runout of the disc.

   Limit : 0.05 mm (0.0020 in.)

NOTE

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



HE58-16

FRONT BRAKE DISC THICKNESS CHECK

1. Using a micrometer, measure disc thickness at eight positions, approximately 45° apart and 10 mm (0.39 in.) from the outer edge of the disc.

   Brake disc thicknes

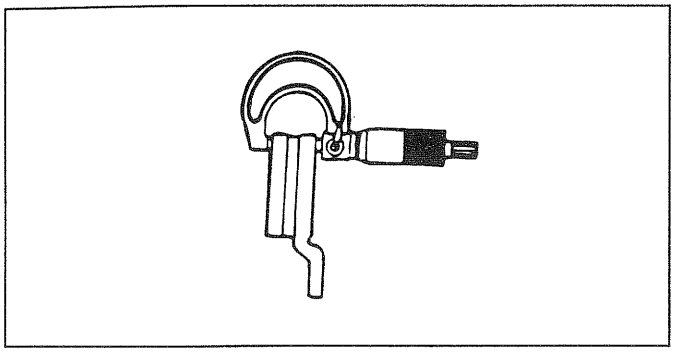
   Standard value : 26 mm (1.02 in.)

   Limit : 24.4 mm (0.96 in.)

   Thickness variation (at least 8 positions)

   The difference between any thickness measurements should not be more than 0.005 mm.

2. If the disc is exceeds the limits for thickness, remove it and install a new one.



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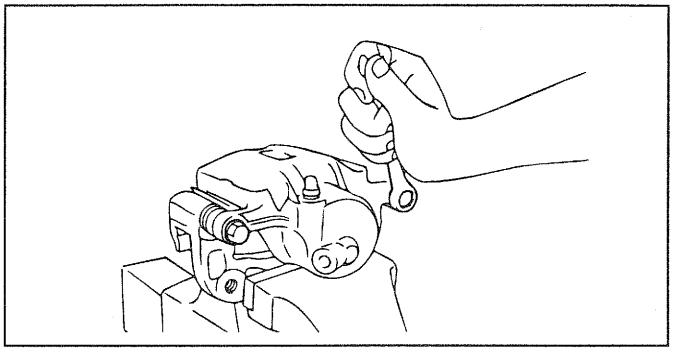
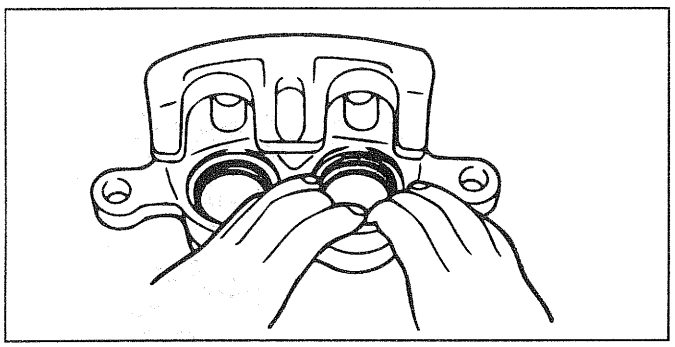


EJA9015J

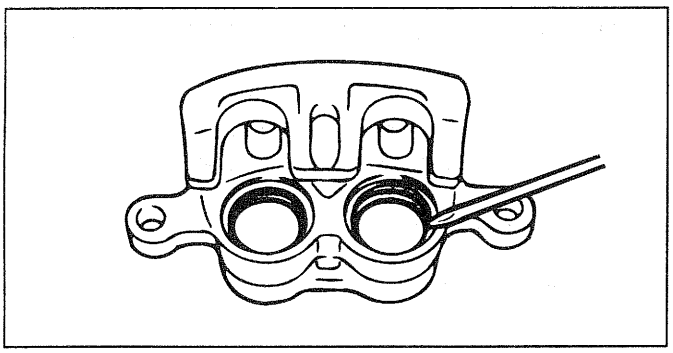
ASSEMBLY EJHA1450

1. Clean the components with isopropyl alcohol except for the pad and shim.
2. Install the piston seal.
3. After applying the specified brake fluid to the piston outer surface, install the piston into the cylinder.



EJHA345A

4. Install the piston boot and boot ring.



EJHA345B

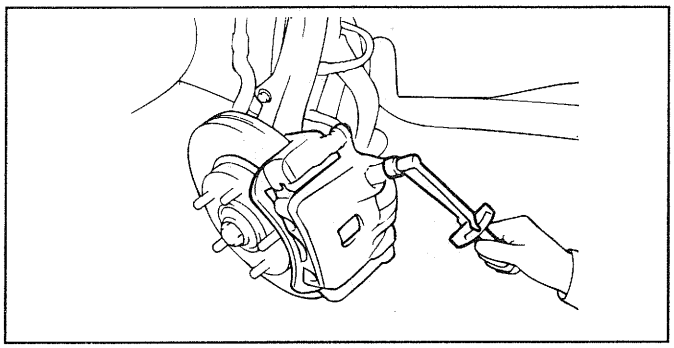
5. Install the guide pin boots and guide pin.

INSTALLATION EJHA1500

1. Install the pads and brake cylinder.
2. Install the brake hose to the caliper.

Bleeder screw tightening torque :
7-9 Nm (70-90 kg·cm, 5-6.6 lb·ft)

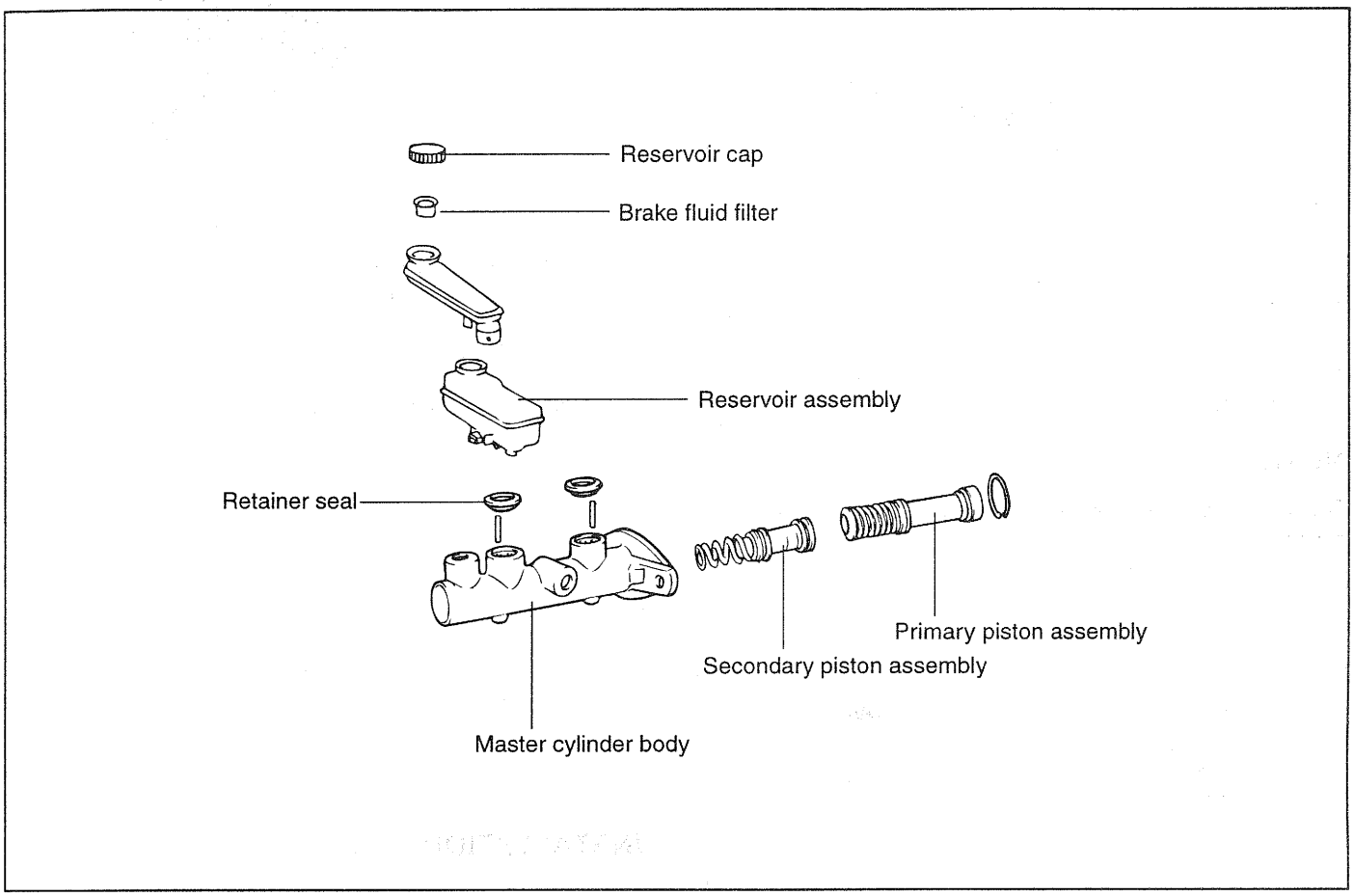
3. Fill the brake reservoir with brake fluid.
4. Bleed the system.



KFW8026A

MASTER CYLINDER

COMPONENTS EJHA0550



EJHA003A

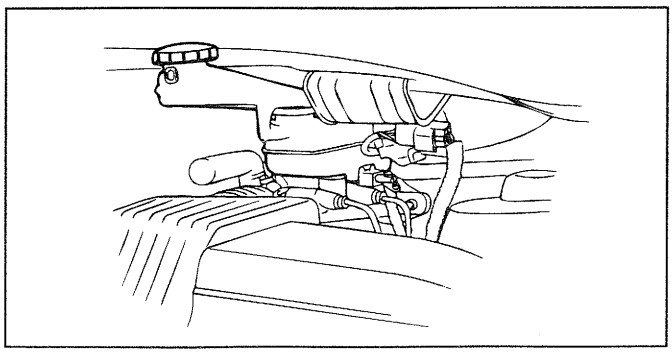
REMOVAL EJHA0600

1. Detach the brake tubes from the master cylinder, and then install the plug.

CAUTION

Do not allow brake fluid to remain on a painted surface. Wash it off immediately.

2. Remove the master cylinder mounting nuts and then lift out the master cylinder.



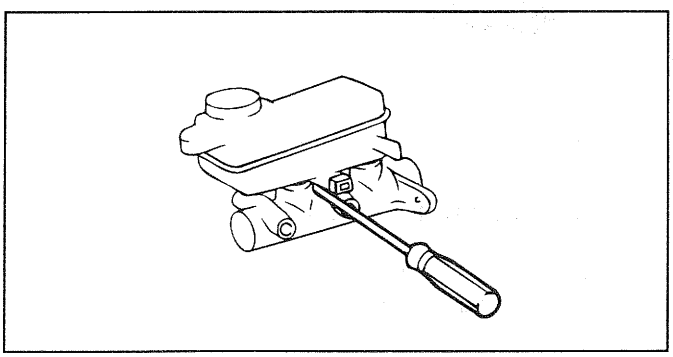
EJHA002A

DISASSEMBLY EJHA0650

1. Remove the reservoir cap and drain the brake fluid into a suitable container.
2. Remove reservoir from the master cylinder.

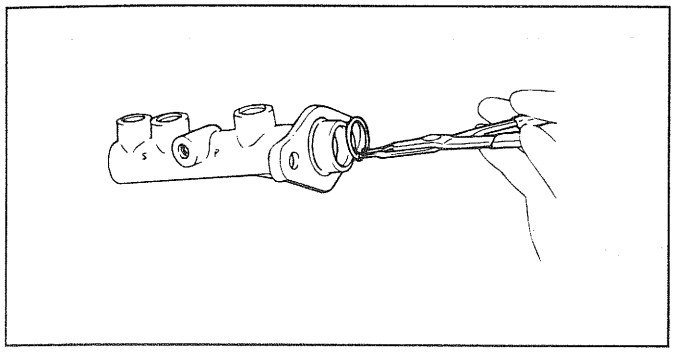
NOTE

When bleeding by pressurized fluid, do not press the brake pedal.



EJHA004A

3. Using snap ring pliers, remove the retaining ring.
4. Remove the primary piston assembly.

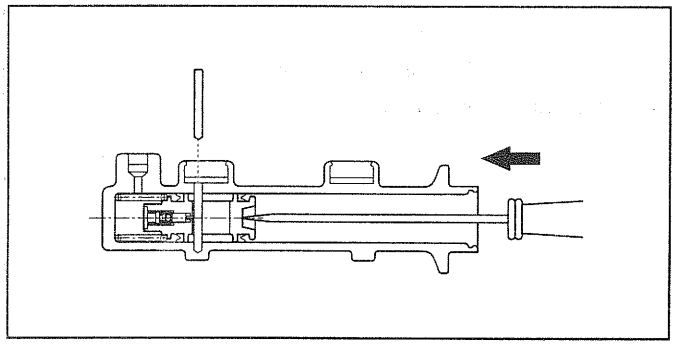


EJA9009C

5. Using a screwdriver, push the secondary piston and remove.

NOTE

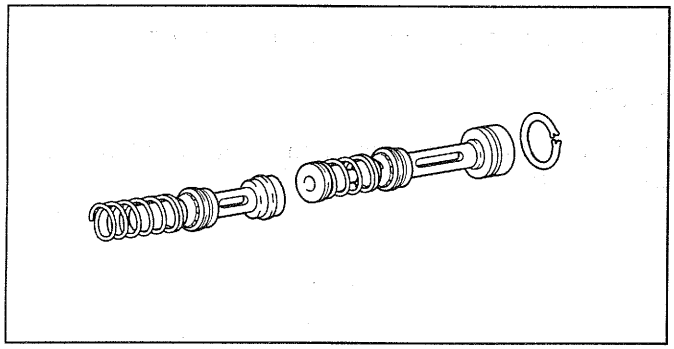
Do not disassemble the primary and secondary piston assembly.



KFW8014A

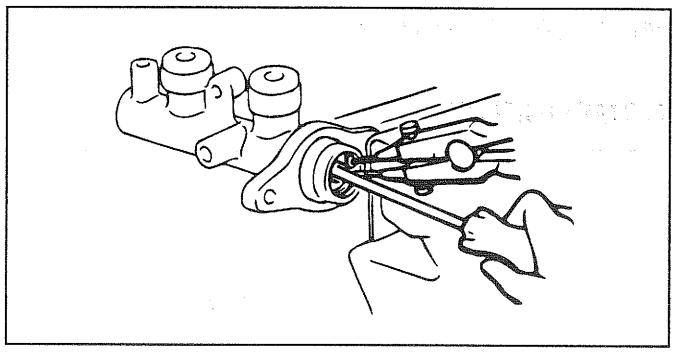
ASSEMBLY EJHA0750

1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.



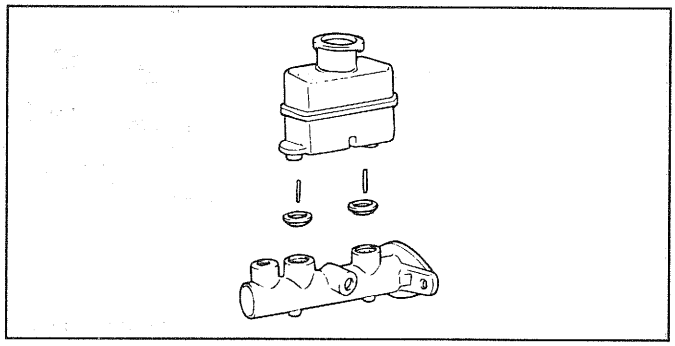
KFW8016A

2. Carefully insert the springs and pistons straight in.
3. Push the pistons in with a screwdriver and install the retaining ring.



HE58-11

4. Using a screwdriver, push the piston all the way and install the piston pin.
5. Mount the two grommets.
6. Install the reservoir in the cylinder.



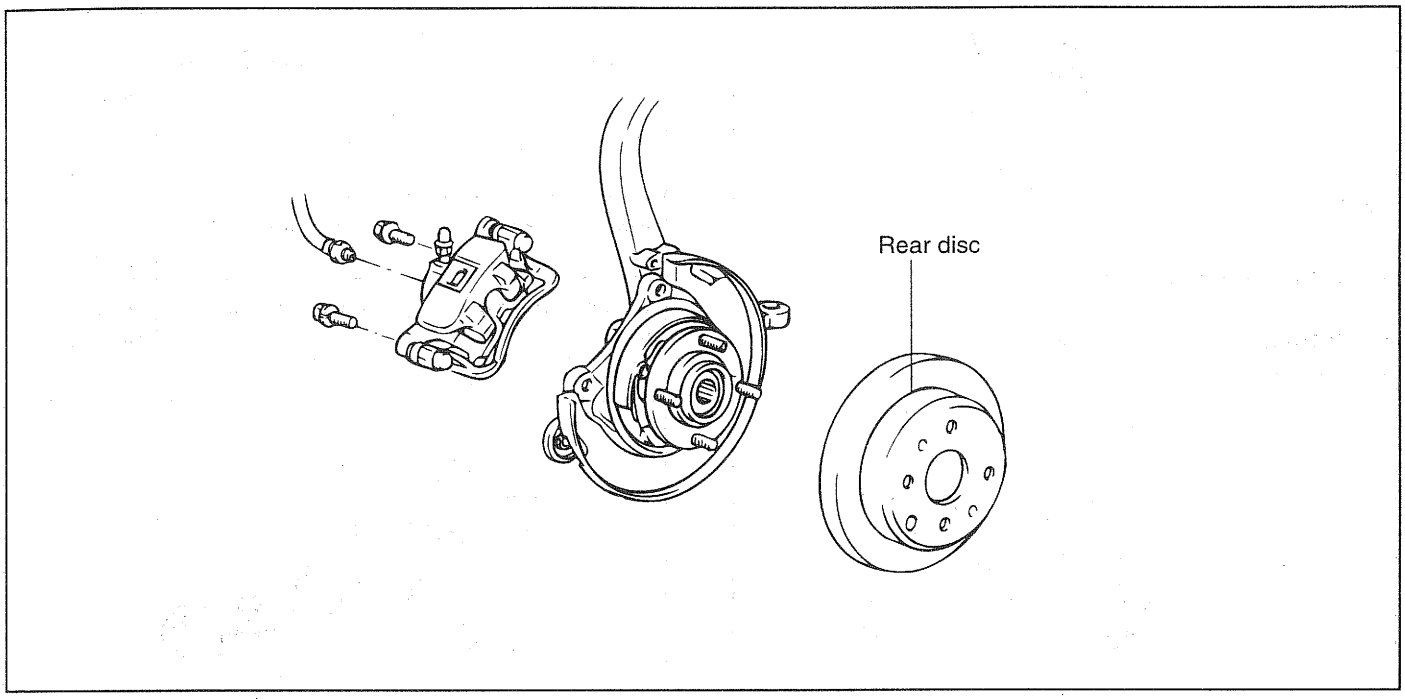
KFW8017A

INSTALLATION EJHA0800

1. Install the master cylinder on the brake booster.
2. Connect the brake tubes to the master cylinder.
3. Fill brake reservoir with brake fluid and bleed the system.

REAR DISC BRAKE

COMPONENTS EJHA1550



EJA9019A

REMOVAL EJHA1600

The procedure is the same with front disc brake pad.

INSPECTION EJHA1650

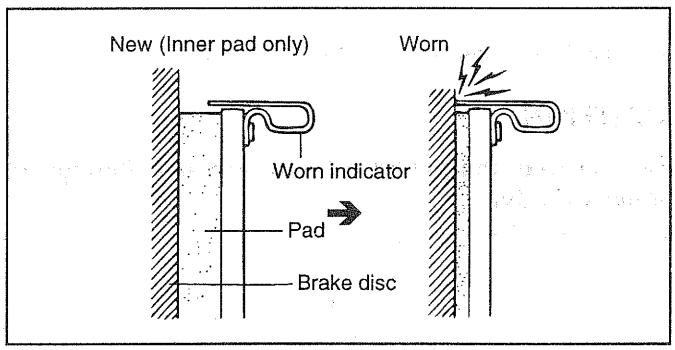
1. Check the pads for wear or oil contamination and replace if necessary.

NOTE

The pads for the right and left wheels should be replaced at the same time.

Pad thickness wear limit : 2.0mm

2. Check for worn or damaged dust boots. If dust or mud has entered the caliper assembly through this seal, the caliper assembly must be replaced or rebuilt.



EJA9015E

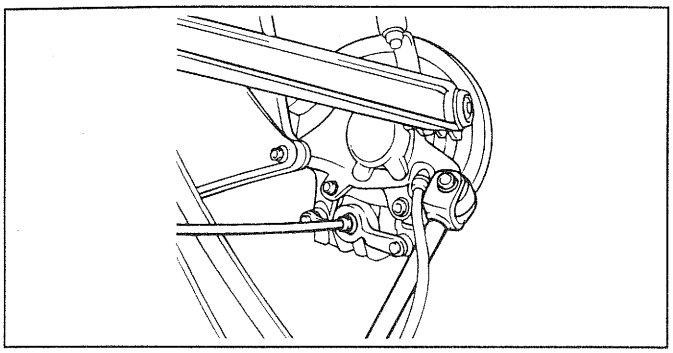
INSPECTION EJHA1700

Before replacing the brake pads, remove the brake fluid from the master cylinder reservoir until it is half full.

CALIPER

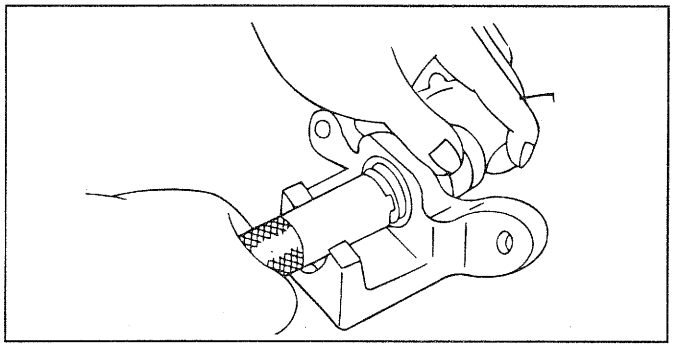
DISASSEMBLY

1. Remove the caliper mounting bolts and the caliper assy.
2. Remove the carrier bolt and the carrier with brake pad.



KFW8027A

3. Remove the piston boot.
4. Remove the piston assy.

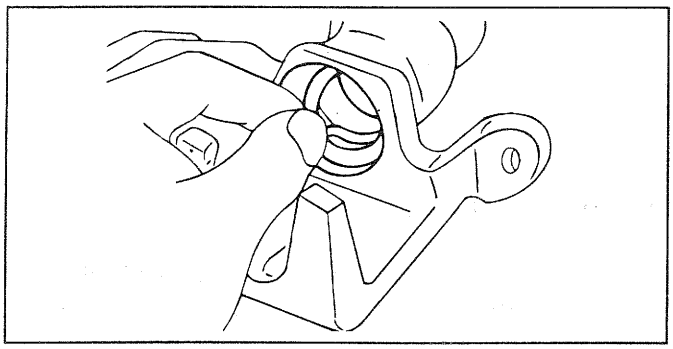


EJA9020C

5. Remove piston seal with finger tip.

CAUTION

Do not use sharpened tools to prevent damage to inner cylinder.



EJA9020D

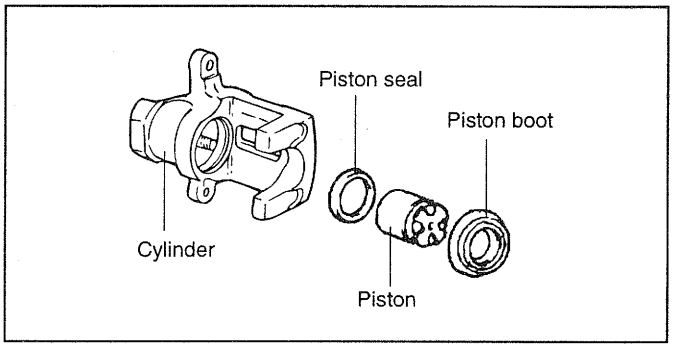
ASSEMBLY

1. Check for worn, damaged, or rusted piston bore and piston.

   Replace the damaged parts if necessary.

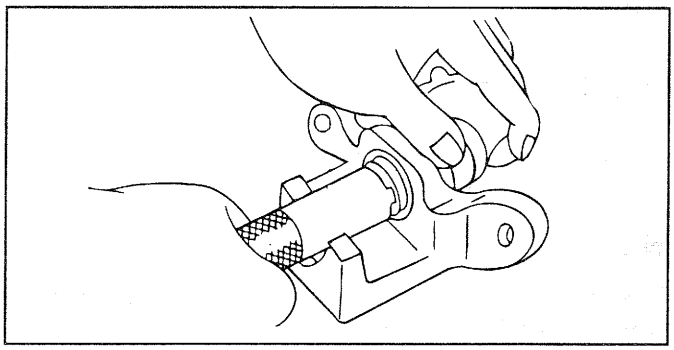
2. Check for damaged piston seal, boot, and pin insulators.
3. Apply a recommended lubricant to the following parts.

Parts	Recommended lubricant	Quantity
Piston seal	Brake fluid (Dot 3)	As required
Cylinder inner side	Brake fluid (Dot 3)	As required
Piston boot	Brake fluid (Dot 3)	As required
Piston outer surface	Brake fluid (Dot 3)	As required
Guide-rod insulators	Rubber grease	As required



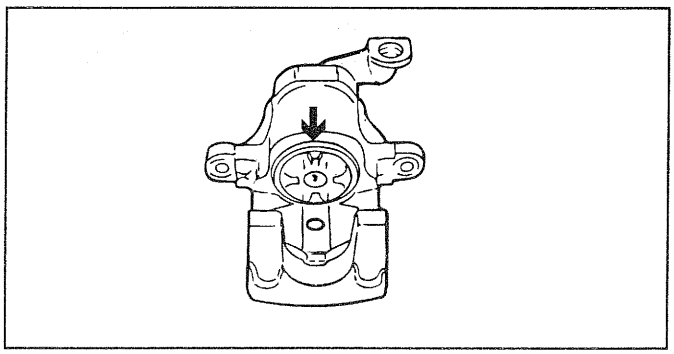
EJA9020F

4. Push the piston into the caliper.



EJA9020G

5. Align the piston mating mark upward as shown in illustration.

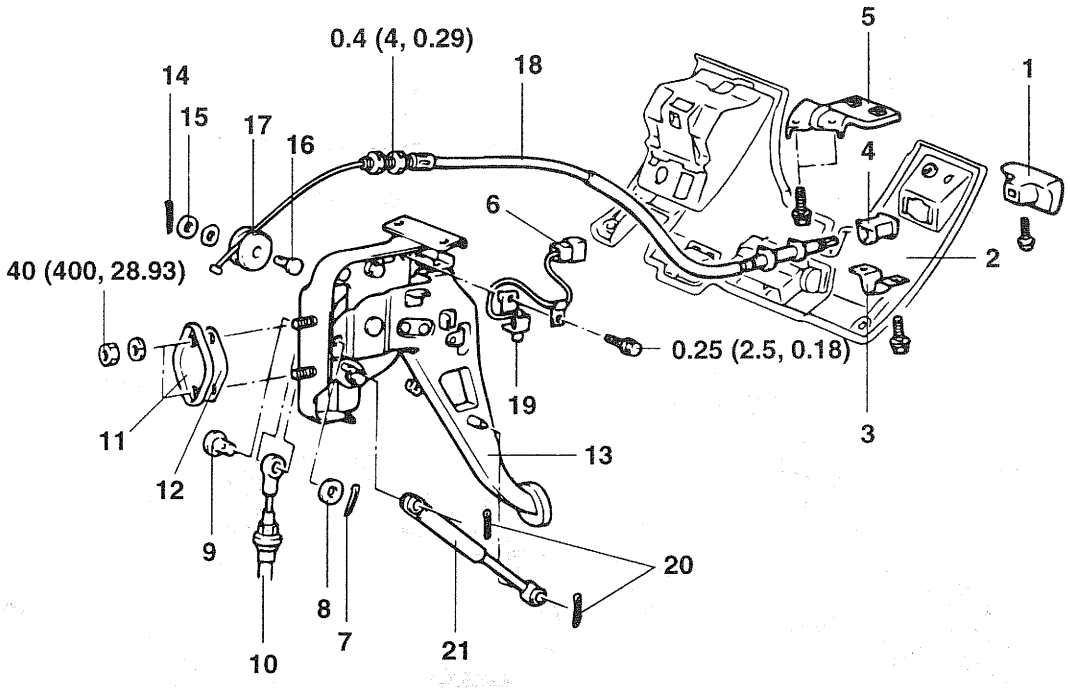


EJA9020H

PARKING BRAKE SYSTEM

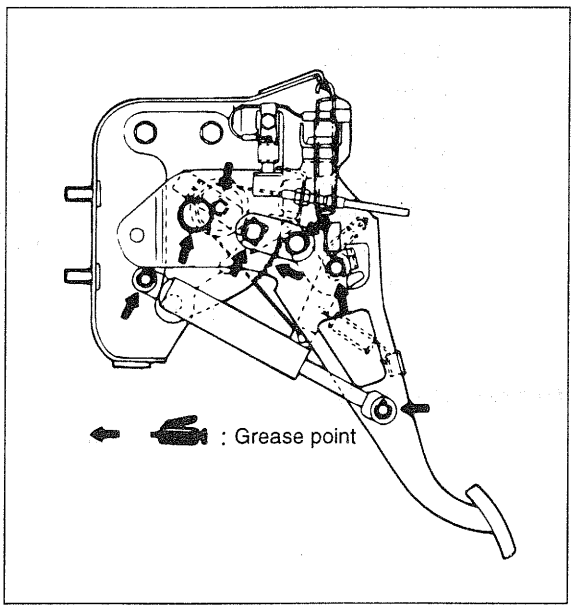
PARKING BRAKE

COMPONENTS EJHA1750



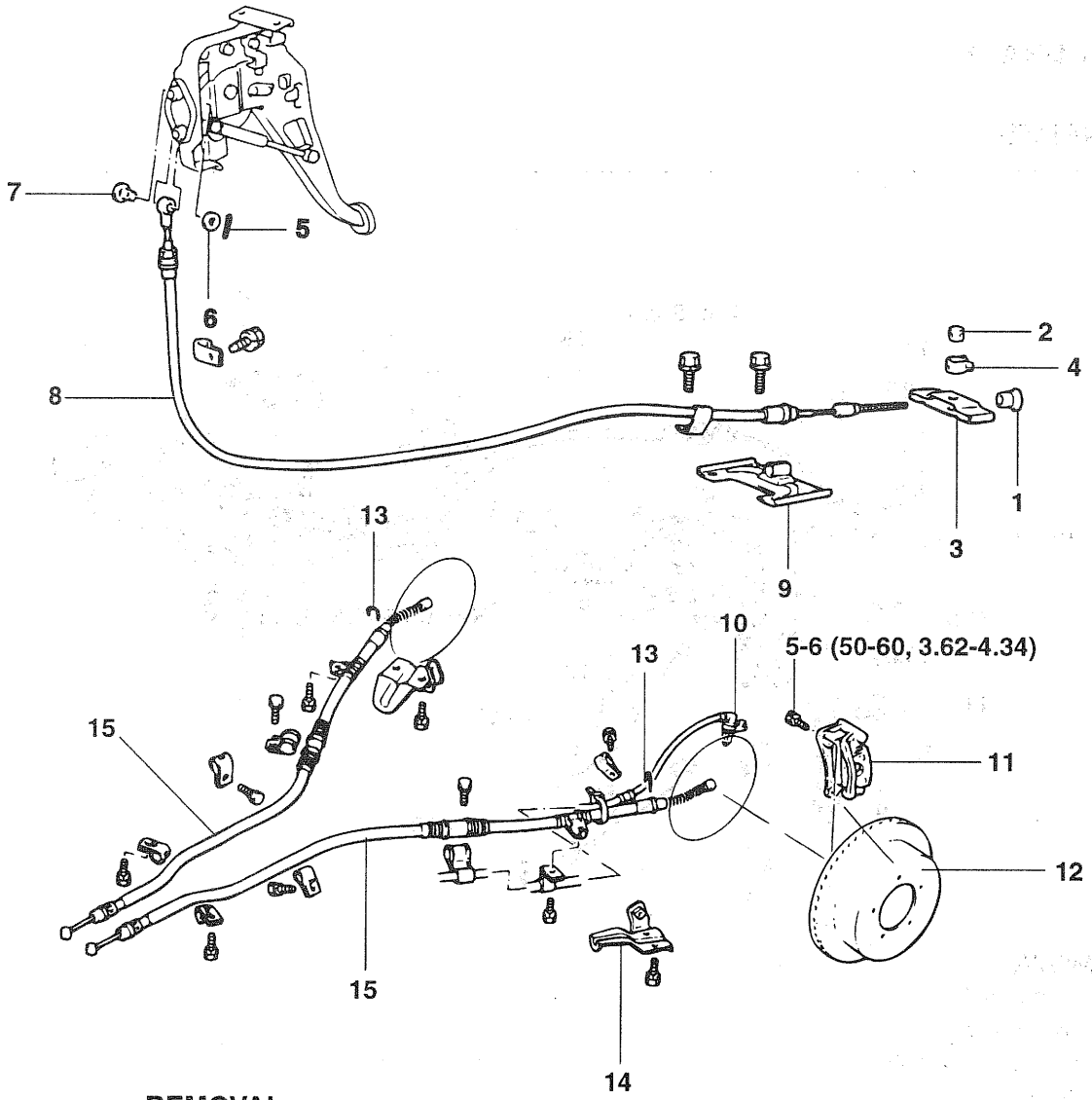
REMOVAL

1. Release nob
2. Lower panel
3. Parking brake plate
4. Bushing
5. Release cable bracket
6. Wiring connector
7. Split pin
8. Washer
9. Clevis pin
10. Front parking brake
11. Plate
12. Sealer
13. Parking brake pedal
14. Split pin
15. Washer
16. Clevis pin
17. Roller
18. Release cable
19. Parking brake switch
20. Split pin
21. Pedal damper



TORQUE : Nm (kg.cm, lb.ft)

EJHA011A



REMOVAL

1. Adjusting nut
2. Pin
3. Equalizer
4. Nut holder
5. Split pin
6. Washer
7. Clevis pin
8. Front parking brake cable
9. Rear cable bracket
10. Rear speed sensor
11. Rear brake assembly
12. Rear brake disc
13. Clip
14. Parking brake protector
15. Parking brake cable

TORQUE : Nm (kg.cm, lb.ft)

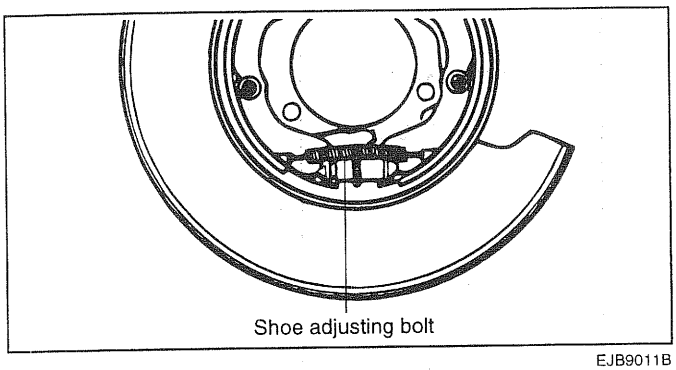
EJHA011B

REMOVAL EJHA1800

Remove the components as shown in illustrations.

INSTALLATION EJHA1850

1. Installation is the reverse of the removal procedure.
2. Set the adjuster lever all the way back when installing the shoe-to-shoe spring.



EJB9011B

3. Apply a coating of the specified grease to each sliding part of the ratchet plate or the ratchet pawl.

Specified grase :

SAE J310, NLGI No.2

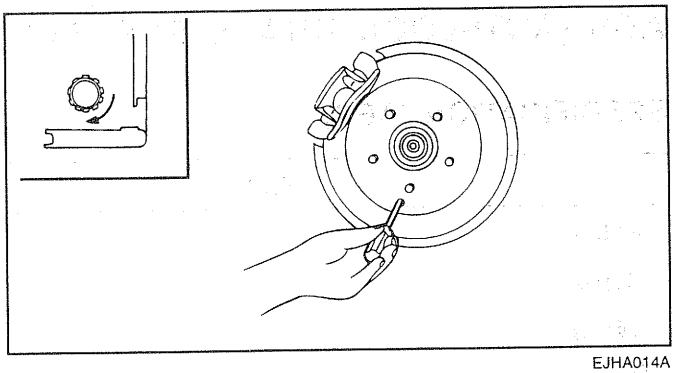
SERVICE ADJUSTMENT EJHA1900

1. Pull the parking brake lever 4–5 times with pull stroke.
2. Adjust parking brake stroke to be 88–98mm (3.47–3.90 in.) by turing the adjusting nut while applying 20kgf to the brake pedal.

CAUTION

Parking brake adjustment must be carried out after adjusting rear shoe clearance.

3. Remove the adjusting hole plug and then turn the adjustor to the direction of the arrow so as not to rotate the disc using a screw driver (flat tip (-)).
4. Rotate the adjustor as much as 5 notches to the opposite direction of the arrow.



EJHA014A

5. After replacing brake lining (Bed-in procedure),
   1) Operate parking brake pedal for 10 kgf effort when the vehicle speed is 60 kPh and then drive the vehicle 500mm.
   2) Repeat the above procedure twice.
6. After adjusting parking brake, it must be free from clearance between adjusting nut and pin.

   Check that the brake does not drag.
7. After assembling, check that all parts move smoothly.

ABS (ANTI-LOCK BRAKE SYSTEM) EJHA2000

SPECIFICATION (ABS)

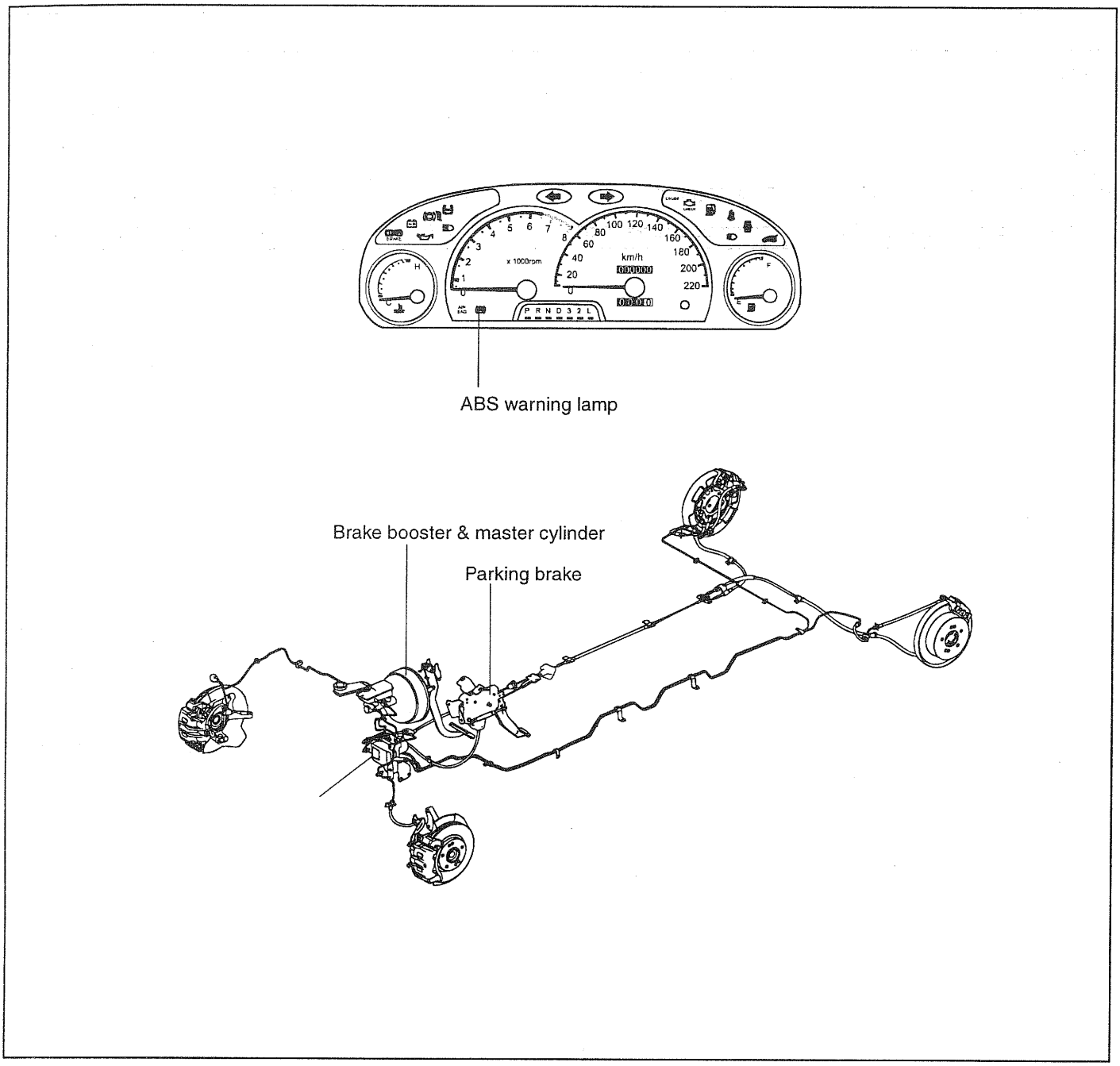
Part	Standard value	Remark
System		
Type	Solenoid/Solenoid	
Mode	ABS + EBD	
ECU		
Operating voltage	10V - 16V	
Operating temperature	-40°C - 110°C	
Warning lamp		
ABS		
Operating current	12V	
EBD		
Consumption current	80mA	
Wheel speed sensor		Min. P/P voltage 130mV
Internal resistance		
Front	1100Ω ± 50%	
Rear	1100Ω ± 50%	
Insulation resistance	Min. 1000kΩ	
Air gap		
Front	0.3-1.2 mm	
Rear	0.2-0.7 mm	
Tone wheel	47T	
HECU (Hydraulic and Electronic Control Unit)		o LPA : Low Pressure, Accumulator o HPA : High Pressure, Accumulator o NO : Normal Open o NC : Normal Close
Pump capacity	2.45 cc/sec	
Accumulator amount		
LPA	3.0cc	
HPA	6.0cc	
NO Solenoid vlave		
Front	Ø0.70mm	
Rear	Ø0.40mm	
NC Solenoid valve		
Front	Ø0.56mm	
Rear	Ø0.40mm	
Pump orifice	Ø0.5mm	

TIGHTENING TORQUE (ABS)

EJHA2050

	Nm	kg.cm	lb.ft
Sensor mounting bolt on the brake plate			
Front	0.4-0.6	4-6	0.29-0.43
Rear	0.4-0.6	4-6	0.29-0.43
Hydraulic & electronic control unit mounting bolt	0.8-1.0	8-10	0.58-0.72
Hydraulic & electronic control unit mounting bracket bolt	1.7-2.6	17-26	1.23-1.88

SYSTEM COMPONENT EJHA2100



EJHA020B

The Anti-Lock Brake System (ABS) controls the hydraulic brake pressure of all four wheels during sudden braking and braking on hazardous road surfaces, preventing the wheels from locking up. ABS provides the following benefits :

1. Enables steering around obstacles with a greater degree of certainty, even during emergency braking.
2. Enables stopping during emergency braking while keeping stability and steerability even on curves.

If a malfunction occurs, a diagnosis function and fail-safe system are included for serviceability.

The integrated control unit (HECU) recieves signals about the vehicle's speed, direction and road conditions from sensors at the wheels and the steering column.

Based on these signals, the control unit will determine the optimum amount of wheel spin.

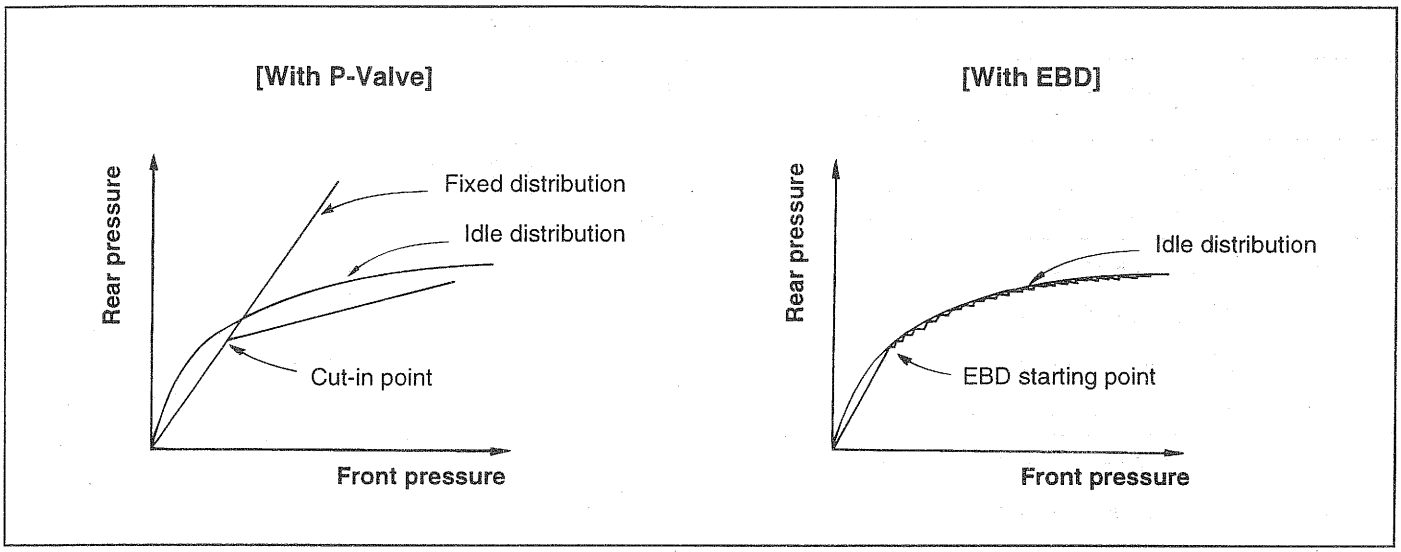
EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION) EJHA2150

EBD is additionally applied, instead of the proportioning valve, to deliver ideal distribution of fluid pressure to the front and rear brakes. This prevents the brakes from skidding in the event of rear wheel lock up and provides higher brake efficiency within the range of brake application.

ADVANTAGES

- Functional improvement of base-brake system
- Compensation of different friction coefficients
- Elimination of proportioning valve
- Failure recognition by warning lamp

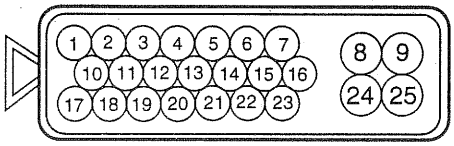
COMPARISON BETWEEN PROPORTIONING VALVE AND EBD



EJA0032A

INSPECTION AT HECU TERMINALS EJHA2200

TERMINAL VOLTAGE CHART

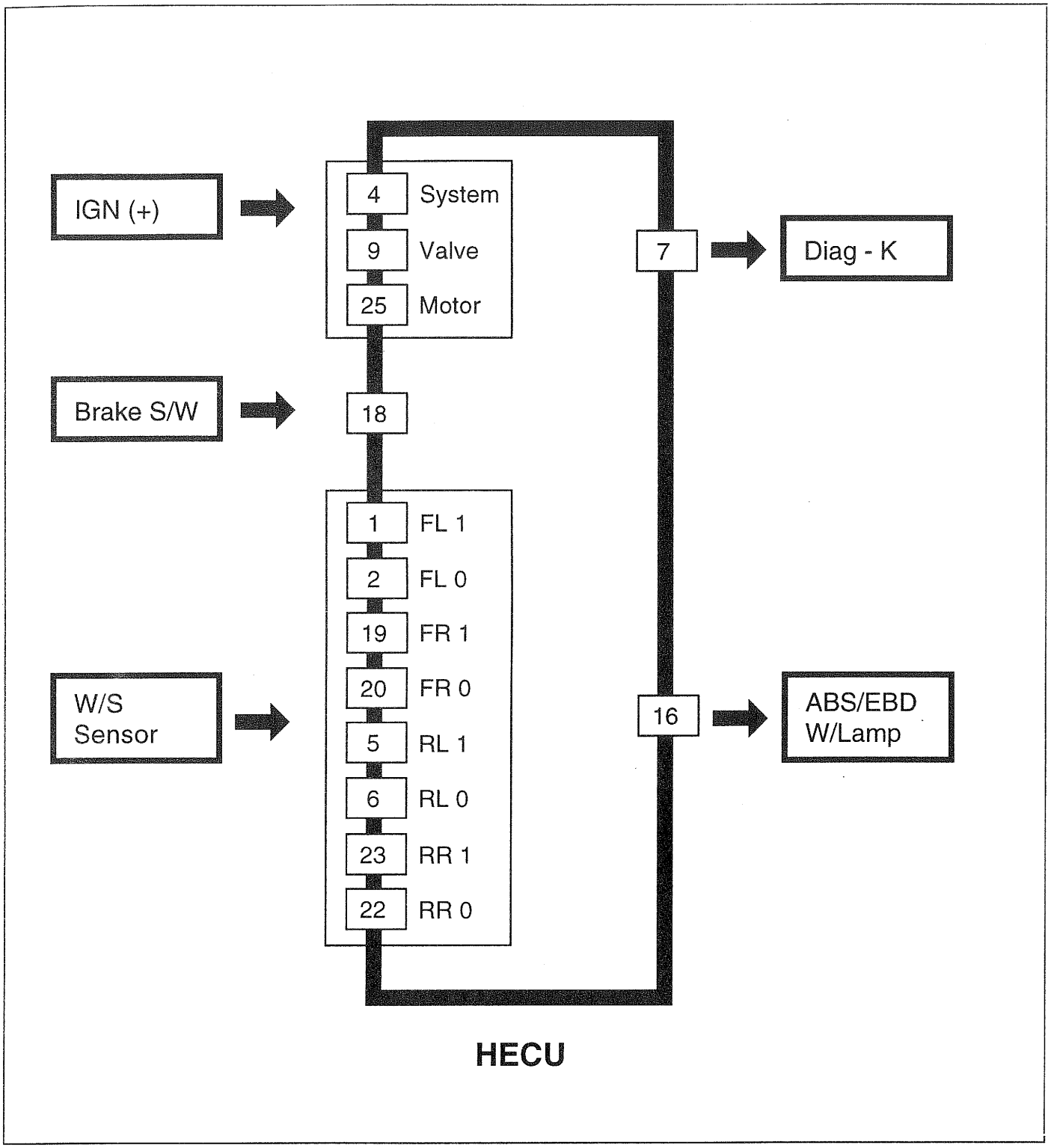


EJHA025A

Terminal No.	Description	Condition	Output
9	• Battery power source 1 • Solenoid valve power source	Always	System voltage
8	Ground	Always - In ABS control	
7	Diagnosis interface terminal (K-Line)	Connect the Hi-Scan	
5 1 19 22	Wheel speed sensor (Left rear) Wheel speed sensor (Left front) Wheel speed sensor (Right front) Wheel speed sensor (Right rear)		Resistance R=1.1kΩ ± 50% Min. detectable voltage V 130mVpp/50Hz (Vpp:Peak to Peak voltage)
6 2 20 23	Wheel speed sensor (Left rear) Wheel speed sensor (Left front) Wheel speed sensor (Right front) Wheel speed sensor (Right rear)		
4	Power input via ignition 2 switch	Ignition 2 condition	Over voltage detection : 16.5±0.5V < V < 20V Suspend voltage detection : 7.0±0.5V < V < 9.5±0.5 V System off : V < 5.5±0.5V
3	Not used		
25	• Battery power source 2 • Motor power source	Always	• System voltage • Max. current 1 < 100A (t < 100mesc.) • Rated current I < 30A (t > 100msec.)
24	Ground	G05	
16	ABS warning lamp	Energize the ABS relay	Max. current I < 200mA Max. voltage 40V
10, 11, 12, 13, 14, 15	Not used		

Terminal No.	Description	Condition	Output
18	Brake lamp switch input terminal		Input voltage threshold 1.00 < V2 < 2.75V 5.00 < VH < 16.00V
17, 21	Not used		

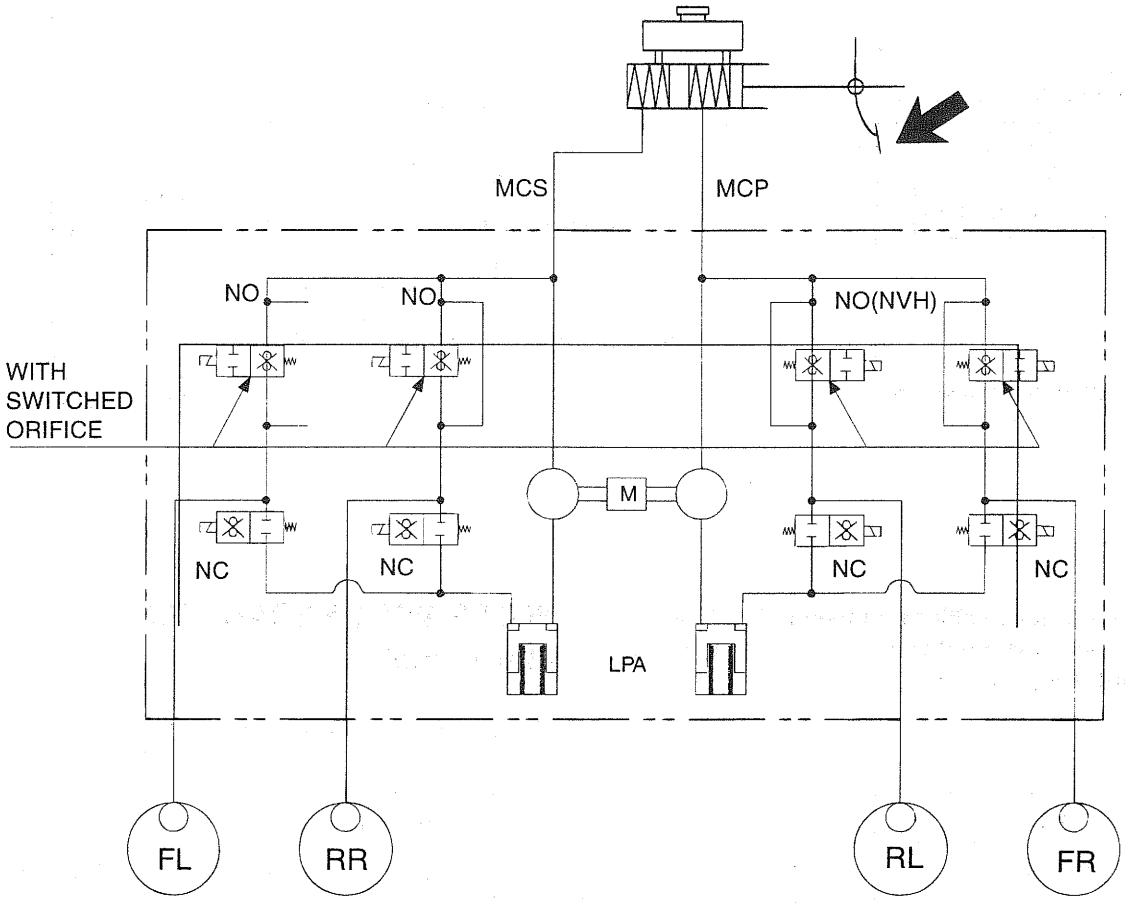
DIAGRAM OF INPUT/OUTPUT FOR HECU EJHA2250



EJHA030B

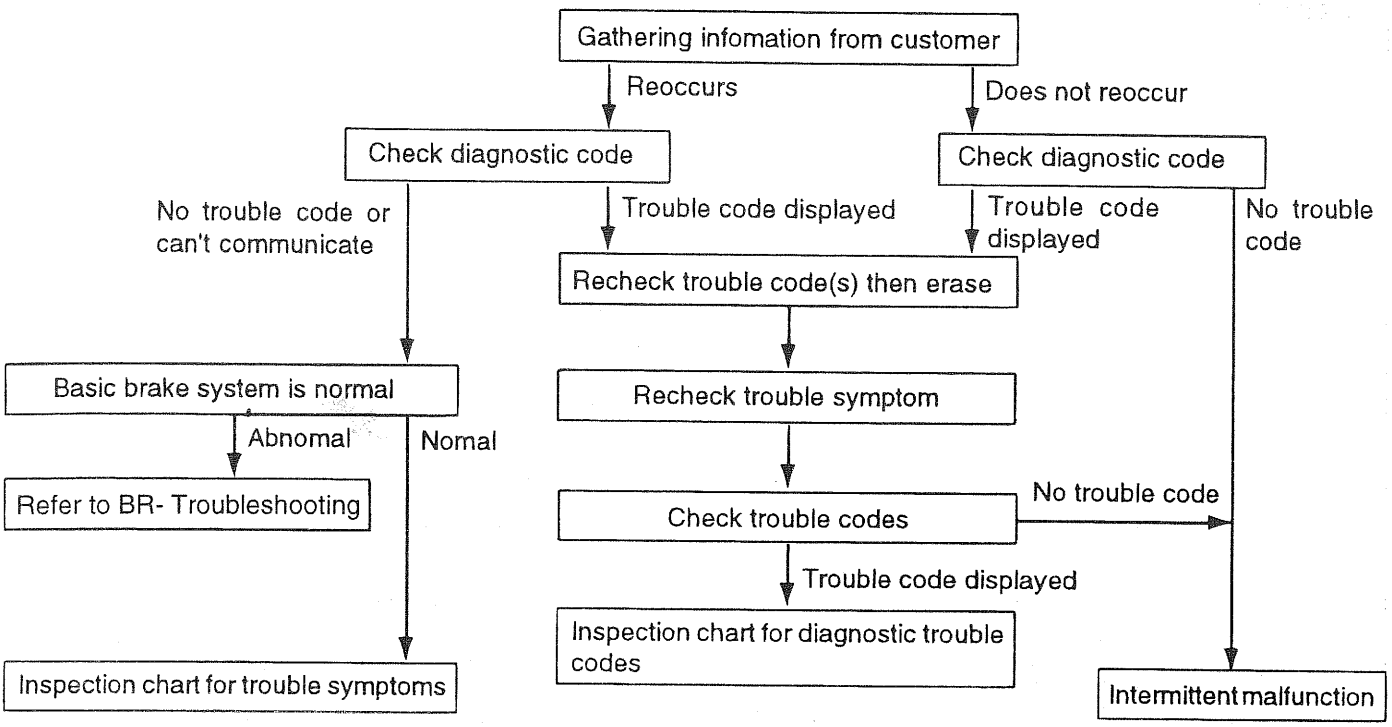
SYSTEM DIAGRAM EJHA2300

[ABS]



EJHA015A

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING EJHA2400



EJDA015A

*** Using the customer problem analysis check sheet for reference, ask the customer as much detail as possible about the problem.**

NOTES WITH REGARD TO DIAGNOSIS EJHA2450

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed, and is not abnormal.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (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 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 by not being too overconfident.
Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.	

ABS CHECK SHEET EJHA2500

ABS Check Sheet

Inspector's Name _____

Customer's Name		Registration No.	
		Registration Year	/ /
		VIN.	
Date Vehicle Brought In	/ /	Odometer	Km Miles

Date the Problem First Occurred	/ /
Frequency of Occurence of Problem	☐ Continuous ☐ Intermittent (times a day)

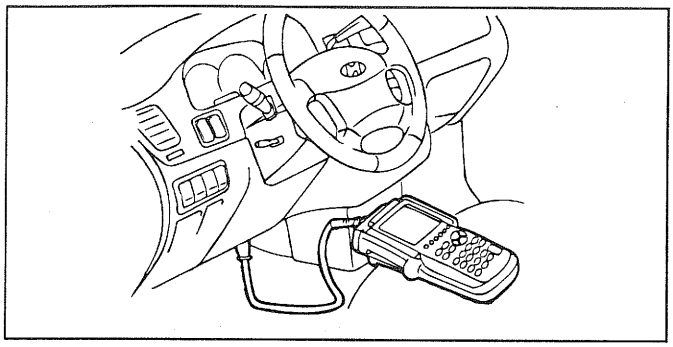
Symptoms	☐ ABS does not operate.	
	☐ ABS does not operate efficiently.	☐ Intermittent (times a day)
	ABS Warning Light Abnormal	☐ Remains ON ☐ Does not light up

Diagnostic Trouble Code Check	1st Time	☐ Normal Code	☐ Malfunction Code (Code)
	2nd Time	☐ Normal Code	☐ Malfunction Code (Code)

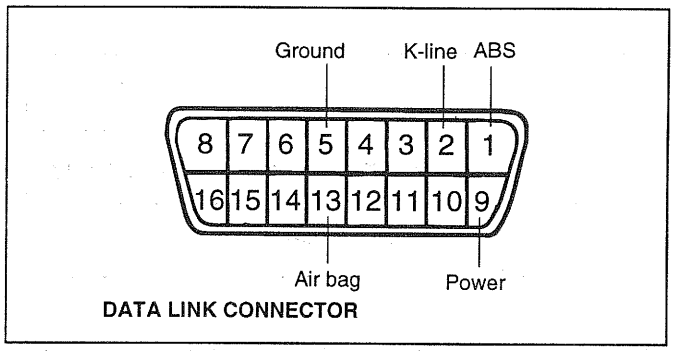
EJDA017A

HI-SCAN CHECK EJHA2550

1. Turn the ignition "OFF".
2. Connect the Hi-scan to the data link connector located underneath low crash pad panel.
3. Turn the ignition "ON".
4. Use the Hi-scan to check the self-diagnosis codes.
5. After completion of the repair or correction of the problems, turn the ignition switch; then erase the stored faults codes using the clear key.
6. Disconnect the Hi-scan.



ERHA006A



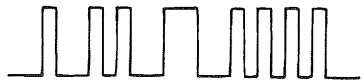
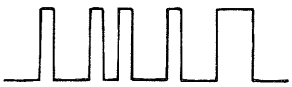
DATA LINK CONNECTOR

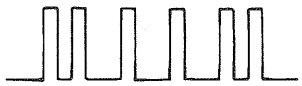
EJHA100A

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES EJHA2600

Inspect according to the inspection chart that is appropriate for the malfunction code.

DTC on Hi-Scan Flash pattern of SRI	Description
C1101  H7BR005A	Battery voltage over volt (18V < V)
C1102  H7BR006A	Battery voltage low volt (< 9V)
C1200  H7BR007A	FL wheel sensor : open or short to GND
C1201  H7BR008A	-Range / Performance : exciter or speed jump error
C1202  H7BR009A	- No signal : air-gab error
C1203  H7BR010A	FR wheel sensor : open or short to GND

DTC on Hi-Scan Flash pattern of SRI	Description
C1204  H7BR011A	- Range / Performace : exciter or speed jump error
C1205  H7BR012A	- No signal : air-gab error
C1206  H7BR013A	RL wheel sensor : open or short to GND
C1207  H7BR014A	- Range / Performanace : exciter or speed jump error
C1208  H7BR015A	Battery voltage over volt (18V < V)
C1209  H7BR016A	RR whel sensor : open or short to GND
C1210  H7BR017A	- Range / Performance : exciter or speed jump error

DTC on Hi-Scan Flash pattern of SRI	Description
C1211  H7BR018A	Battery voltage over volt (18V < V)
C1604  H7BR022A	Harware (including valve failures)
C2112  H7BR023A	Valve relay (including fuse failure)
C2402  H7BR024A	Electrical (Pump-Motor)

ACTUATOR DRIVING

No.	Description	Condition	Recognition	Time
01	Motor	KEY ON · ENG. OFF	Motor pump relay operation (Click sounds)	2 seconds
02	Front left valve (In)		Front left solenoid valve operation (Click sounds)	
03	Front right valve (In)		Front right solenoid valve operation (Click sounds)	
04	Rear left valve (In)		Rear left solenoid valve operation (Click sounds)	
05	Rear right valve (In)		Rear right solenoid valve operation (Click sounds)	
06	Front left valve (Out)		Front left solenoid valve operation (Click sounds)	
07	Front right valve (Out)		Front right solenoid valve operation (Click sounds)	
08	Rear left valve (Out)		Rear left solenoid valve operation (Click sounds)	
09	Rear right valve (Out)		Rear right solenoid valve operation (Click sounds)	

CURRENT DATA

No.	Description	Recognition	Unit
1	Battery	Battery	Voltage
2	FL wheel speed SNSR	Front left wheel speed sensor	km/h
3	FR wheel speed SNSR	Front right wheel speed sensor	
4	RL wheel speed SNSR	Rear left wheel speed sensor	
5	RR wheel speed SNSR	Rear right wheel speed sensor	
6	ABS SRI status	Warning lamp	ON/OFF
7	Brake SW	Brake switch	
8	Motor pump relay	Motor relay	
9	Valve relay	Valve relay	
10	Motor pump status	Motor	
11	FL valve (In)	Front left valve (In)	
12	FR valve (In)	Front right valve (In)	
13	RL valve (In)	Rear left valve (In)	
14	RR valve (In)	Rear right valve (In)	
15	FL valve (Out)	Front left valve (Out)	
16	FR valve (Out)	Front right valve (Out)	
17	RL valve (Out)	Rear left valve (Out)	
18	RR valve (Out)	Rear right valve (Out)	

FAILSAFE SPECIFICATION

Detect timing A : Initial check mode B : Out of control C : ABS control mode D : EBD control mode E : Diagnostic mode

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing				
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E
1	C1101	Power supply	Over voltage of VIGN	When VIGN>18V continue 224ms, ECU detect the failure.	All wheel inhibit	All wheel inhibit	All wheel inhibit	VIGN < 17V	O	O	O	O	O	O	
	C1102		Voltage drop of VIGN	When VIGN<9V or VREF<9V continue 224ms, ECU detect the failure.	ABS inhibit (permit EBD control)	Continue EBD control	ABS inhibit	VIGN>10V and VREF>10V continue 224ms. But in case of ABS control mode, all wheels inhibit until end of ABS control.	O	-	O	O	O	O	
			Voltage drop of VIGN (EBD inhibit)	When VIGN<7.5V or VREF<7.5V continue 70ms, ECU detect the failure.	All wheel inhibit	All wheel inhibit	All wheel inhibit	VIGN>9V and VREF>9V continue 70ms	O	O					
2	C1604	Actuator	Interruptions or short circuit of actuator	Master CPU always sends test pulse (about 200s) to valves, and feedback signal returns into master and slave CPU. When feedback signal is not equal to test signal, CPU recognizes the actuator failure. Monitoring time is 56ms. But while CPU detected voltagedrop or overvoltage, failure of actuator is not detected.	System down	System down	System down	Restart	O	O	O *1	O	O	O	
	C2112 VREF< 6V	Main relay	Interruptions or short circuit of main relay								O *1	O	O	O	

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing				
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E
3	C1604	Main relay	Interruptions or short circuit of Inhibit	While initial check, main CPU checks the functions of sub CPU inhibit signal and custom IC inhibit circuit.	System down	-	-	Restart	O	O	O				
			Interruptions or short circuit of main relay	1) IG-SW ECU checks VREF just after IGN-SW ON, and detects the failure. OFF: 2.5V>VREF, 4.2V<VREF (short or leak) — 105ms ON: VREF<6V (open) — 105ms — While ECU detected un-usual VIGN, failure isn't detected	System down	-	-	Restart	O	O	O				
	C112			When VREF<6V continue 224ms, ECU detects the failure. But while ECU detects voltagedrop or overvoltage, the failure is not detected.	System down	System down	System down	Restart	O	O	O *1	O	O	O	
4	FL : C1200 FR : C1203 RL : C1206 RR : C1209	Wheel speed sensor	Interruptions or short circuit of wheel speed sensor	Main CPU detects the failure by checking voltage of wheel speed sensor mounted the wheel that velocity is 0km/h. Sensor voltage<0.4V or >2.7V Monitoring time=196ms	Manage-ment A	Manage-ment B	Manage-ment C	Restart	O	O *a	O	O	O	O	

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing				
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E
4	FL : C1201 FR : C1204 RL : C1207 RR : C1210	Wheel speed sensor	Intermittently interruptions or short circuit of sensor. Defect of air gap or sensor wheels or clearance of bearing	After wheel velocity change over 30km/h per 7ms (over 120G), in case that there is the difference between calibrated wheel velocity and monitoring velocity continuously beyond the constant, ECU detects the failure.	Management B	Management B	Management C	To meet EC regulation, all wheel inhibit and light ABS WL until vehicle velocity > 20km/h after restart.	O	O *a		O	O	O	O
	FL : C1202 FR : C1205 RL : C1208 RR : C1211		Missing sensor signal Too large air gap Sensor wheel is not installed	When starting the vehicle, ECU detects the failure by the following conditions. 1. $V_{MAX} \geq$ 40km/h and $V_{ref} \leq 0.6 \times V_{MAX}$ Monitoring time 120s.	Management B	Management B	Management C	To meet EC regulation, all wheel inhibit and light ABS WL until vehicle velocity > 20km/h after restart.	O	O *a		O	O	O	
				2. Monitoring V_{ref} from $V_{MAX} > 7$km/h to $V_{MAX} \geq$ 20km/h, in case that V_{ref} is continuously V_{ref} < 6km/h, ECU recognizes the failure of wheels of V_W < 6km/h.	Management B	-	-					O			
				3. During monitoring mode b) (V_{MAX} < 20km/h), 120sec. after over spinning wheel is detected, in case that V_{MAX} < 20km/h and V_{ref} < 6km/h continue for 120sec., ECU recognizes the failure of wheels of V_W < 6km/h.	Management B	-	-					O			
			Too large air gap Long term EMI	In ABS control, when pressure decrease mode and hold mode continue 14sec., ECU detects the failure.	-	-	Management C	To meet EC regulation, all wheel inhibit and light ABS WL until vehicle velocity > 20km/h after restart.	O	O *a			O		
	C1604		Defect of clearance of bearing EMI/IGN noise	When there are over 32 pulses from wheel sensor within 7ms, ECU detects the failure.	System down	System down	System down	Restart	O	O	O	O	O	O	

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing				
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E
5	C2402	Motor Motor relay	Interruption or short circuit of motor/motor relay	Monitoring VMS, ECU detects the failure. > 6.5V — 1785ms < 6.5V — 196ms When VIGN is unusual, ECU does not detect the failure.	ABS inhibit (permit EBD control	Continue EBD control	ABS inhibit	If ECU detects the failure of motor relay output ON or motor lock(see 7-(2)), after checking main relay failure at initial check, ECU unconditionally checks motor and motor relay with motor ON for 560ms. If ECU detects motor lock, ECU repeats the same check. After that, in case of unusual condition, ECU recognizes the failure. This step meets the EC regulation.	O	-	O *2	O *2	O	O	
			Interruption of motor Motor lock	1. Monitoring decrease of VMS, ECU detects the failure. Monitoring VMS every 7ms since motor relay output change from ON to OFF, It is recognized as normal condition in case that ECU detects VMS>5V over 6 times. If it is abnormal, ECU does the same check again with motor ON for 560ms. If it is abnormal again, ECU repeats the same process with motor ON for 553ms. After that, the state is abnormal again, ECU recognizes the failure. After initial check, in case that more than predetermined acceleration continues for a fixed period, ECU checks in the same way as the above with motor ON for 560ms. If that is abnormal, motor ON for 553ms and ECU repeats the same process. After that, in case of abnormal condition, ECU recognizes the failure. If VIGN is abnormal, ECU does not detect the failure.							O *3	O *3	O	O *3	
			Failure of motor relay circuit / motor relay over current	Compare the information of voltage of motor relay monitor and DIAG signal outputted from custom IC, ECU detects the failure. But ECU does not check the failure for 1000ms from motor is turned off.				Restart			O	O	O	O	

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing				
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E
6	C1604	ECU	CPU failure	1.When ECU starts, main and sub CPU execute the following checks : a) ECU checks the value of the result of fixed multiplication whether it becomes the value decided in advance or not. b) ECU executes read/write for RAM. c) ECU executes sum check of ROM.	System down	System down	System down	Restart	O	O	O				O
				2. IGN After IGN ON, main and sub CPU communicate each other for synchronization. When one or the other CPU can't synchronize within 1sec., main CPU shifts system down and sub CPU stops running.	System down	System down	System down	Restart	O	O	O				O
				3.Main and sub CPU always execute the following checks. ECU checks whether program is finished or not	System down	System down	System down	Restart	O	O	O	O	O	O	O

No.	DTC	Failure Locations	Detect mode	Condition for Detection	Management			Conditions for Restoration	ABS W/L	EBD W/L	Detect timing				
					Out of control	EBD control mode	ABS control mode				A	B	C	D	E
6	C1604	ECU	CPU failure	4. In every program cycle, main CPU and sub CPU communicate with each other for synchronization. When one or the other CPU can't synchronize within 300μ sec, main CPU shifts system down and sub CPU stops running.	System down	System down	System down	Restart	O	O	O	O	O	O	O
				5. Sub CPU checks the following : a) Sub CPU always compares the result of AD sent by main CPU with the result of AD calculated by sub CPU, in case that there is a difference above 7 bits for 112ms, ECU recognizes the failure. b) In case that wheel velocity of FL calculated by main CPU is different from that calculated by sub CPU above 10km/h for 504ms, ECU recognizes the failure. c) Sub CPU calculates the slip from Vref calculated by main CPU and wheel velocity of FL calculated by sub CPU. ECU recognizes the failure when main CPU judges ABS phase as pressure decrease phase for 1sec. with no slip calculated by sub CPU.d). When main CPU does not judge ABS phase as pressure decrease phase, in case that main CPU sets the valves as pressure decrease state for 1 sec., ECU recognizes the failure.). When main CPU judges ABS phase as out of ABS control, in which case the valve driven information from main CPU is pressure hold state for 1 sec., ECU recognizes the failure.	System down	System down	System down	Restart	O	O	O	O	O	O	

*1 In case of main relay ON only
*2 In case of motor initial check only, ECU detects the failure of motor relay output ON.
*3 In case of motor initial check only
*a In case of over two wheels failure

Management A

Conditions	Management
Vmax > 5km/h	Management B
Vmax < 5km/h	One front wheel failure defects wheel inhibit
	One rear wheel or over two wheels failure All wheels inhibit

Management B

Conditions	Management
Failure of one wheel	ABS inhibit (permit EBD control)
Failure of over two wheels	System down

Management C

Conditions Management	Management
Failure of one front wheel	ECU discontinues ABS control of defected wheel and continues ABS control of normal wheels. ABS inhibit after end of ABS control.
Failure of two front wheel	ECU discontinues ABS control of defected wheel and continues ABS control of normal wheels. System down after end of ABS control.
Failure of one rear wheel	ECU continues ABS control of rear wheels using information of normal rear wheel and front wheels. System down after end of ABS control.
Failure of two rear wheel	System down
Failure of one front wheel and one rear wheel	ECU discontinues ABS control of defected front wheel, and continues rear wheels using in-formation of normal rear wheel. System down after end of ABS control.
Failure of over three wheels	System down

ADDITIONAL EXPLANATION OF FAILSAFE

1. WL initial lighting time
   1) Immediately after IG-SW ON, WL is lights up for 3 sec. . This term is called 'WL initial lighting time'.
   2) Within this term, in case that ECU detects the failure, WL is lighted continuously.

NOTE

1. System down
   It is the condition that changes to normal brake with WL ON after detecting the failure by software.
   ECU restart is caused by IG-SW OFF → ON once.
   After the failure is corrected, in case of restarting ECU, it returns to a normal mode with WL OFF.
2. All wheel inhibit
   ECU discontinues ABS control of all wheels. (Equivalent to normal brake)
   When the failure is corrected, it returns to normal mode with WL OFF. (But during ABS control, it does not return to a normal mode.)

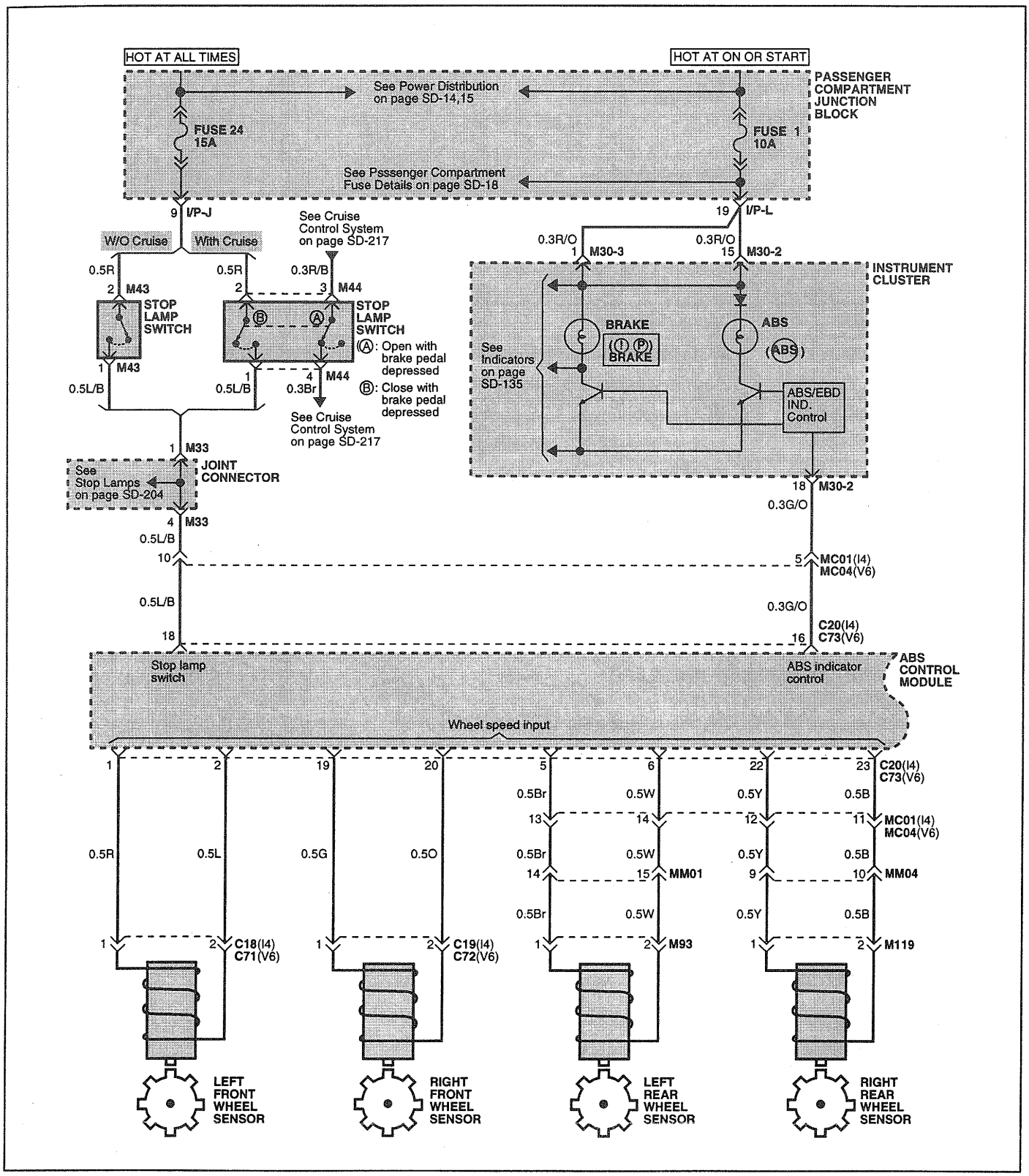
TERM COMMENTARY

VIGN : Terminal voltage of IGN, VREF : Terminal voltage of REF
VMAX : Maximum wheel velocity, Vref : estimated vehicle velocity

EJHA105G

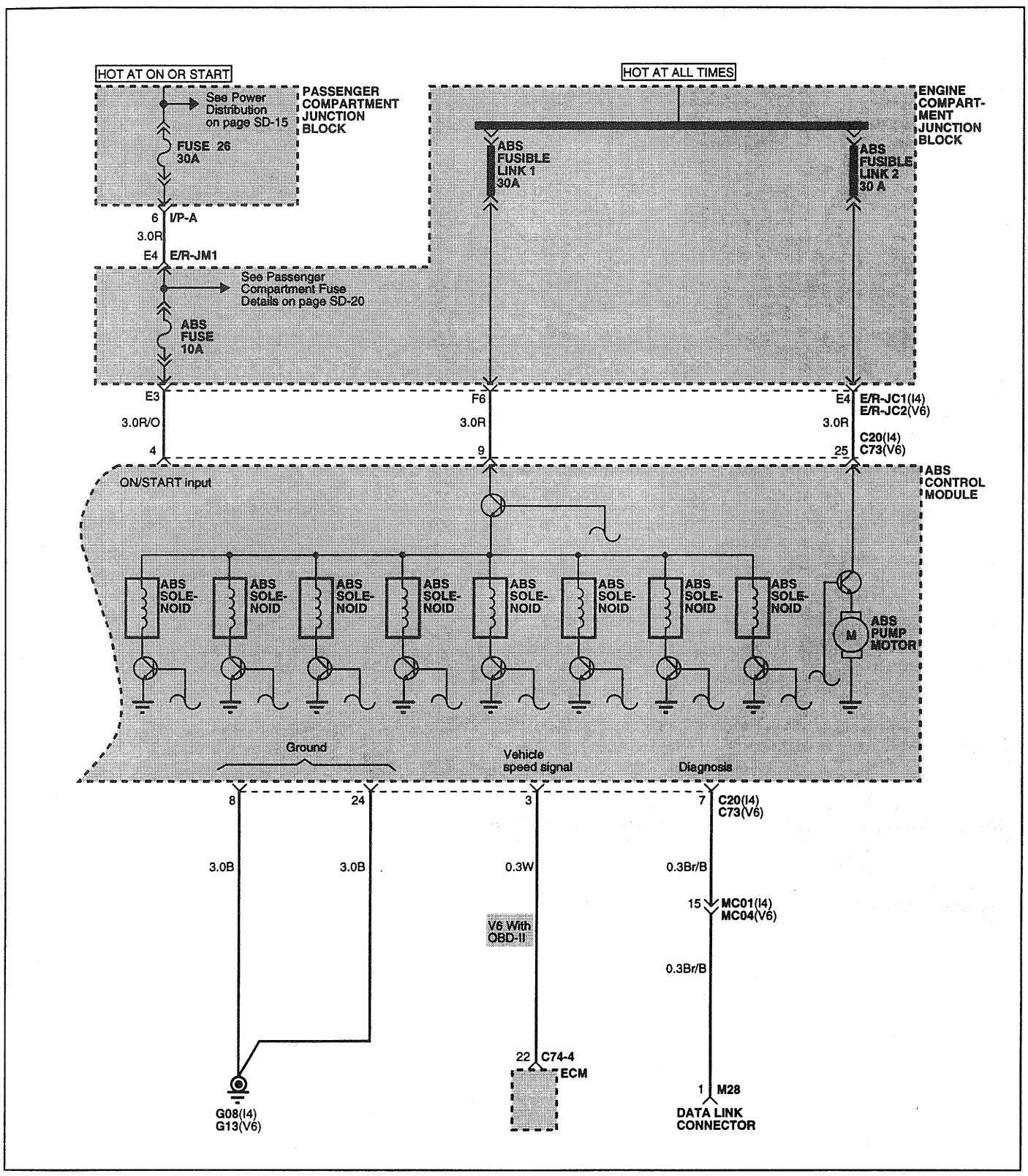
SCHEMATIC DIAGRAM EJHA2650

ABS CIRCUIT (1)



EJHA020C

ABS CIRCUIT (2)

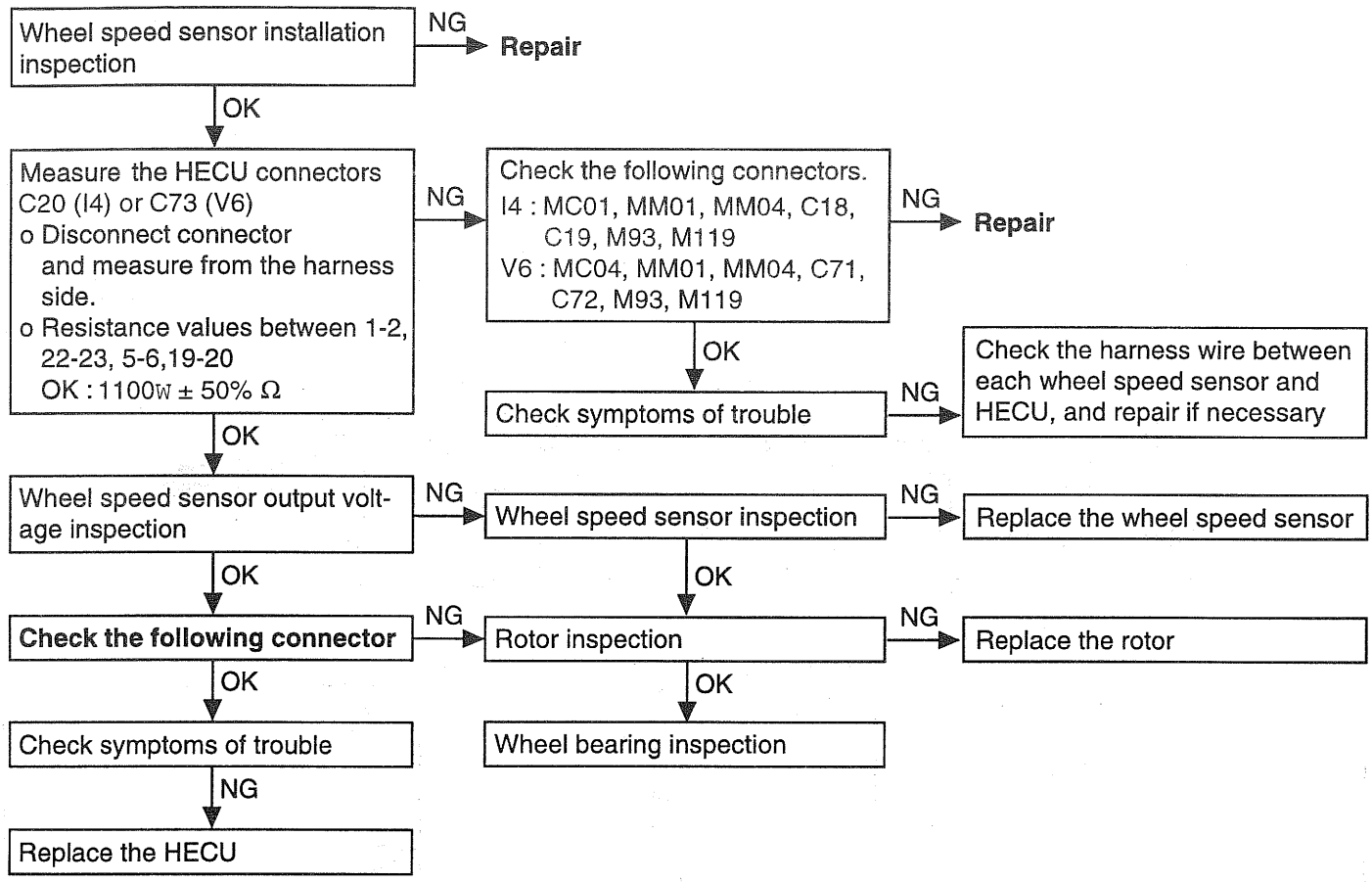


EJHA020D

INSPECTION PROCEDURE FOR DIAGNOSTIC TROUBLE CODES

EJHA2700

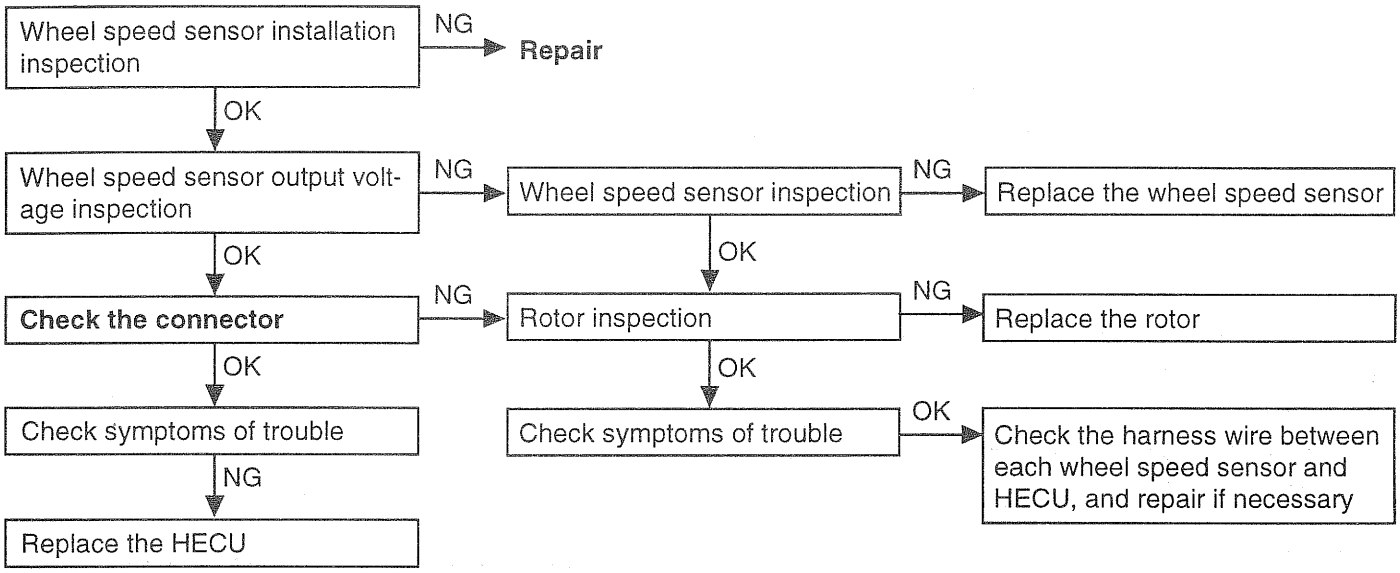
DTC No. C1200, C1203, C1206, C1209 Wheel speed sensor open or short to GND circuit	Probable cause
The HECU determines that an open or short circuit has occured in more than one line of the wheel speed sensors	• Malfunction of wheel speed sensor • Malfunction of wiring harness or connector • Malfunction of HECU



EJHA110A

EJHA2750

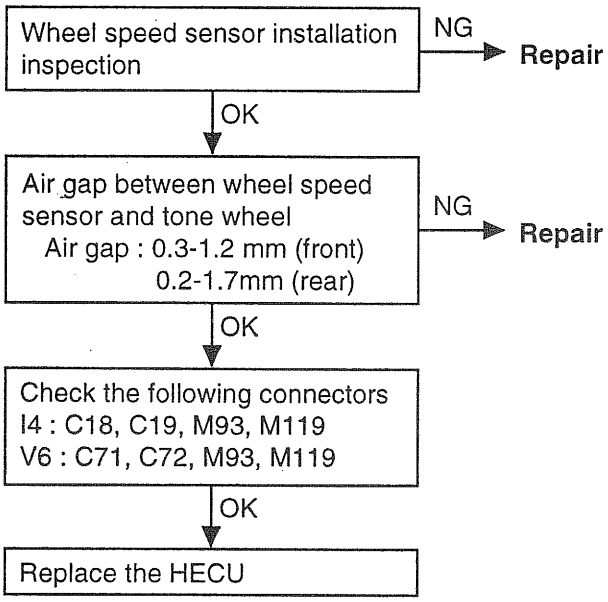
DTC No. C1201, C1204, C1207, C1210 (Speed jump or wrong exciter)	Probable cause
A wheel speed sensor outputs an abnormal signal (other than an open short-circuit).	• Improper installation of wheel speed sensor • Malfunction of wheel speed sensor • Malfunction of rotor • Malfunction of wheel bearing • Malfunction of wiring harness or connector • Malfunction of HECU



EJHA115A

EHJA2800

DTC No. C1202, C1205, C1208, C1211 (Large air gap)	Probable cause
A wheel speed sensor outputs no signal	• Malfunction of wheel speed sensor • Improper installation of wheel speed sensor • Malfunction of rotor (excitor) • Malfunction of wiring harness or connector • Malfunction of HECU



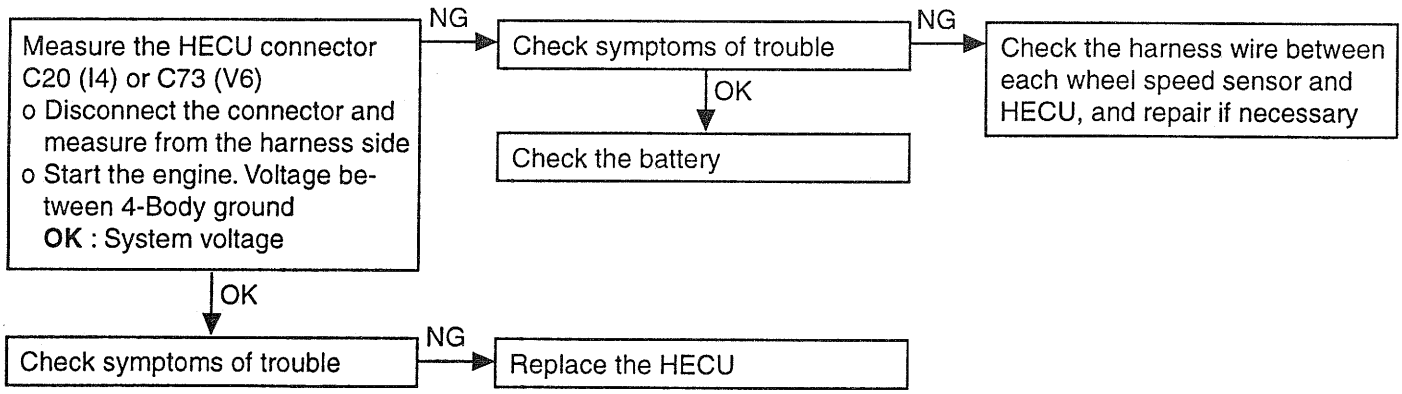
EJHA120A

EJHA2850

DTC No. C1101, C1102 Voltage out of range (Low and over voltage)	Probable cause
The voltage of the HECU power supply drops lower than or rises higher than the specified value. If the voltage returns to the specified value, this code is no longer output.	• Malfunction of wiring harness or connector • Malfunction of HECU.

CAUTION

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



EJHA125A

EJHA2900

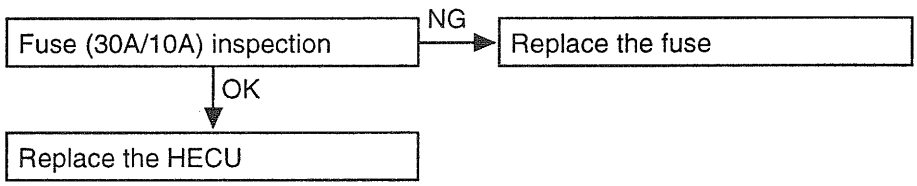
DTC No. C1604 ECU Hardware (EEPROM and ECU failure)	Probable cause
The HECU always monitors the solenoid valve drive circuit. It determines that there is an open or short-circuit in the solenoid coil or in a harness. Even if no current flows in the solenoid even though the HECU is turned on and vice versa.	• Malfunction of wiring harness • Malfunction of hydraulic unit • Malfunction of HECU

EJHA2950

DTC No. C2112 Valve relay (Including fuse failure)	Probable cause
When the ignition switch is turned ON, the HECU switches the valve relay off and on during the initial check. In that way, the HECU compares the signals sent to the valve relay with the voltage in the valve power monitor line. That is how to check if the valve relay is operating normally. The HECU always checks if current flows in the valve power monitor line. It determines that there is an open circuit when no current flows. If no current flows in the valve power monitor line, this diagnosis code is output.	• Malfunction of wiring harness or connector • Malfunction of HECU

NOTE

Whenever reading the diagnosis codes using the ABS warning lamp, this diagnosis code will be output.



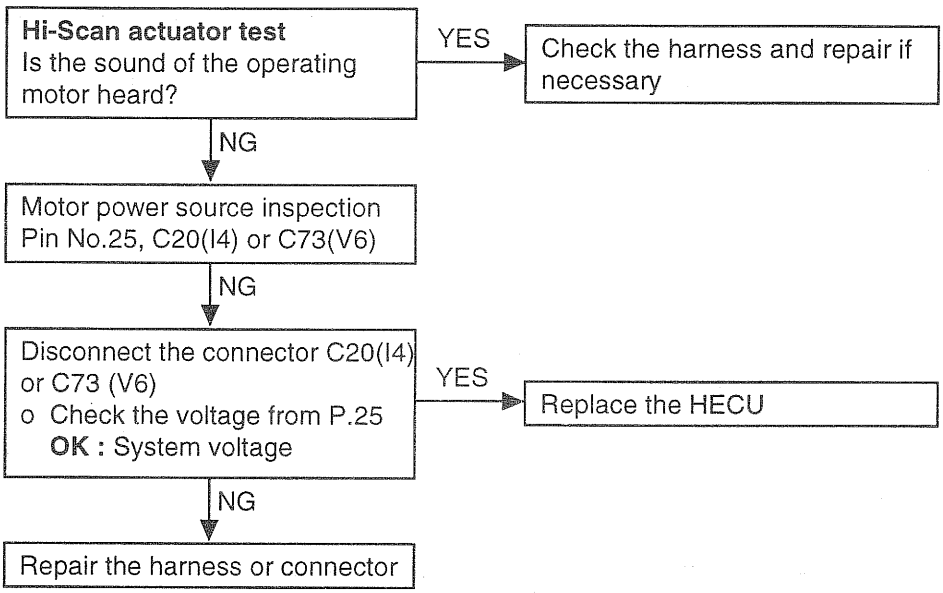
EJFA029B

EJHA3000

DTC No. C2402 Electrical (Motor relay, motor)	Probable cause
When the motor power line is normal but no signal is input to the motor monitor line, it is abnormal.	• Malfunction of hydraulic unit • Malfunction of HECU

CAUTION

Because force-driving of the motor by means of the actuator test will discharge the battery, the engine should be run for a while after testing is completed.

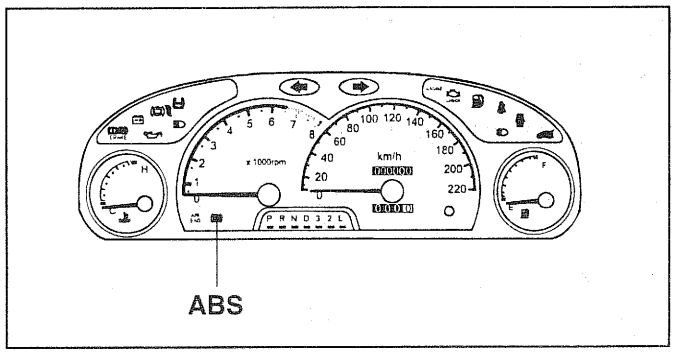


EJHA140A

ABS WARNING LAMP INSPECTION EJHA3050

Check that the ABS warning lamp illuminates as follows.

When the ignition key is turned "ON", the ABS warning lamp comes on for approximately 2 seconds and then goes out.



ERHA003A

INSPECTION CHART FOR TROUBLE SYMPTOMS EJHA3100

Find out the symptoms and check according to the inspection procedure chart.

Trouble system		Inspection procedure No.
Communication with Hi-Scan is not possible	Communication with all system is not possible.	1
	Communication with ABS only is not possible.	2
When the ignition key is turned "ON" (engine stopped), the ABS warning lamp does not illuminate.		3
After the engine start, the lamp remains illuminated.		4
Faulty ABS operation	Unequal braking power on both sides	5
	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

During ABS operation, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.

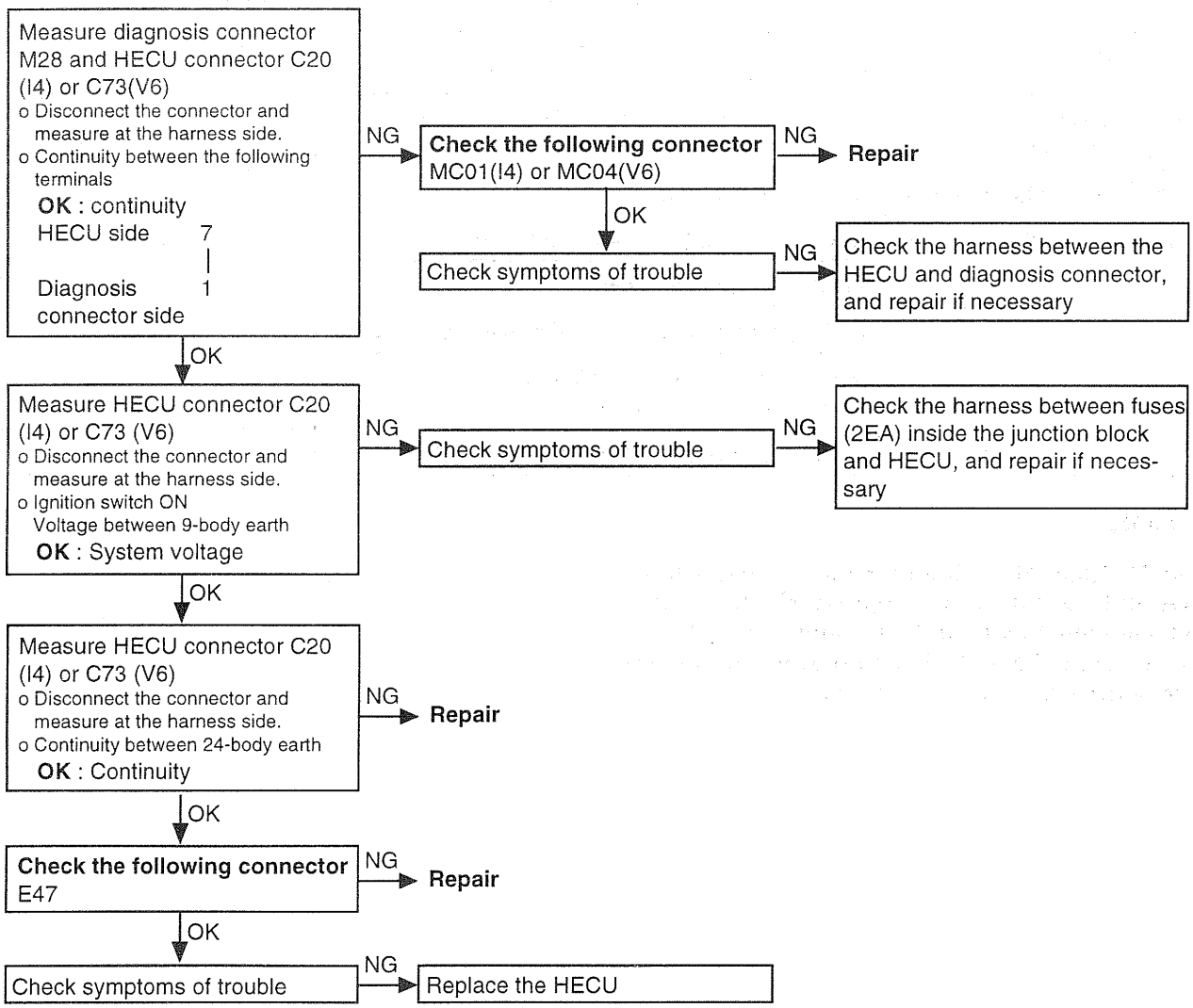
INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS EJHA3150

INSPECTION PROCEDURE 1

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

INSPECTION PROCEDURE 2

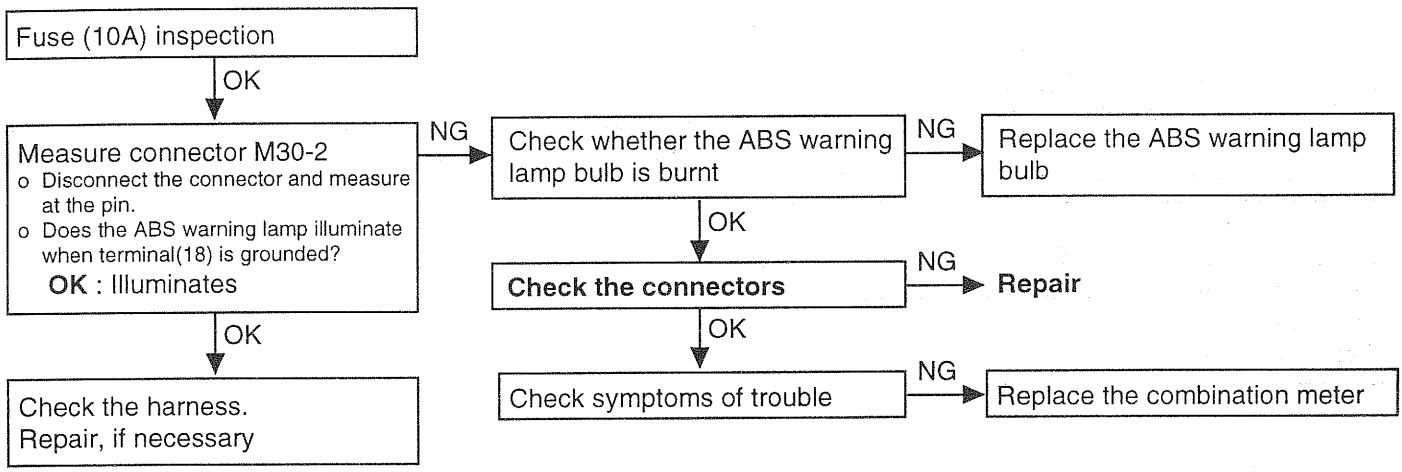
Communication with Hi-Scan is not possible. (Communication with ABS only is not possible.)	Probable cause
When communication with Hi-Scan is not possible, the cause is probably an open circuit in the HECU power circuit or an open circuit in the diagnosis output circuit.	• Blown fuse • Malfunction of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



EJHA155A

INSPECTION PROCEDURE 3

When the ignition key is turned "ON" (engine stopped), ABS warning lamp does not illuminate	Probable cause
When current flows through the HECU, the ABS relay turns from on to off as the initial check. So the ABS warning lamp will illuminate when the ABS relay is "Off" even if there is a problem with the circuit between the ABS warning lamp and the HECU. Therefore, if the lamp does not illuminate, the cause may be an open circuit in the lamp power supply circuit, a blown bulb, or an open circuit in both the circuits between the ABS warning lamp and the HECU and in the circuit between the ABS warning lamp and the ABS relay.	• Blown fuse • Burnt out ABS warning lamp bulb • Malfunction of wiring harness or connector

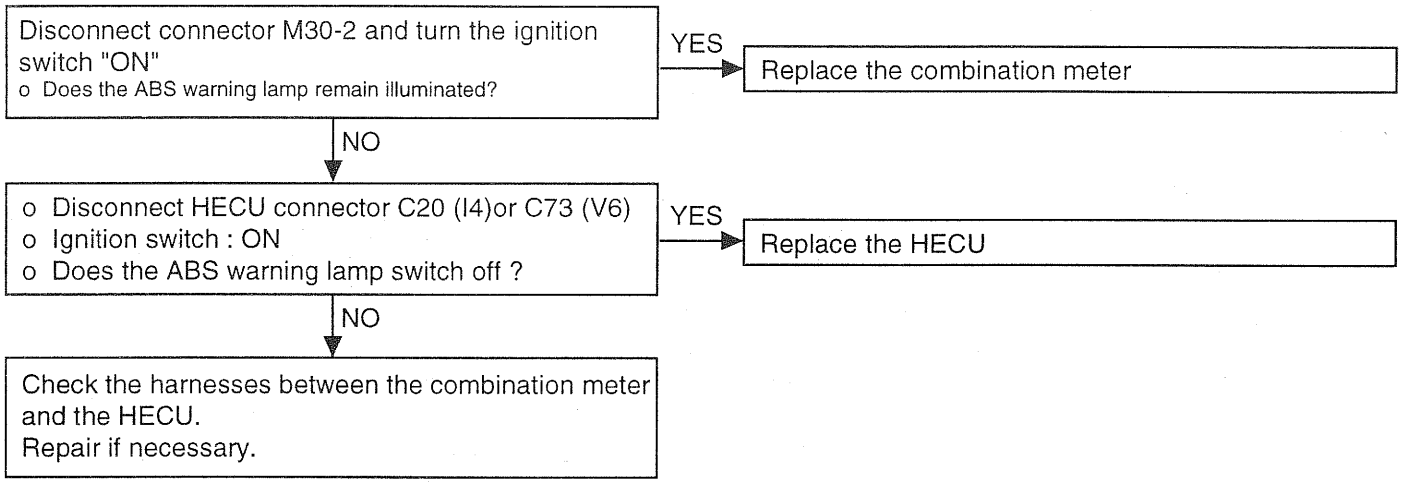


EJHA155B

INSPECTION PROCEDURE 4

Even after the engine is started, the ABS warning lamp remains illuminated	Probable cause
The cause is probably a short-circuit in the ABS warning lamp illumination circuit	• Malfunction of combination meter • Malfunction of HECU • Malfunction of wiring harness

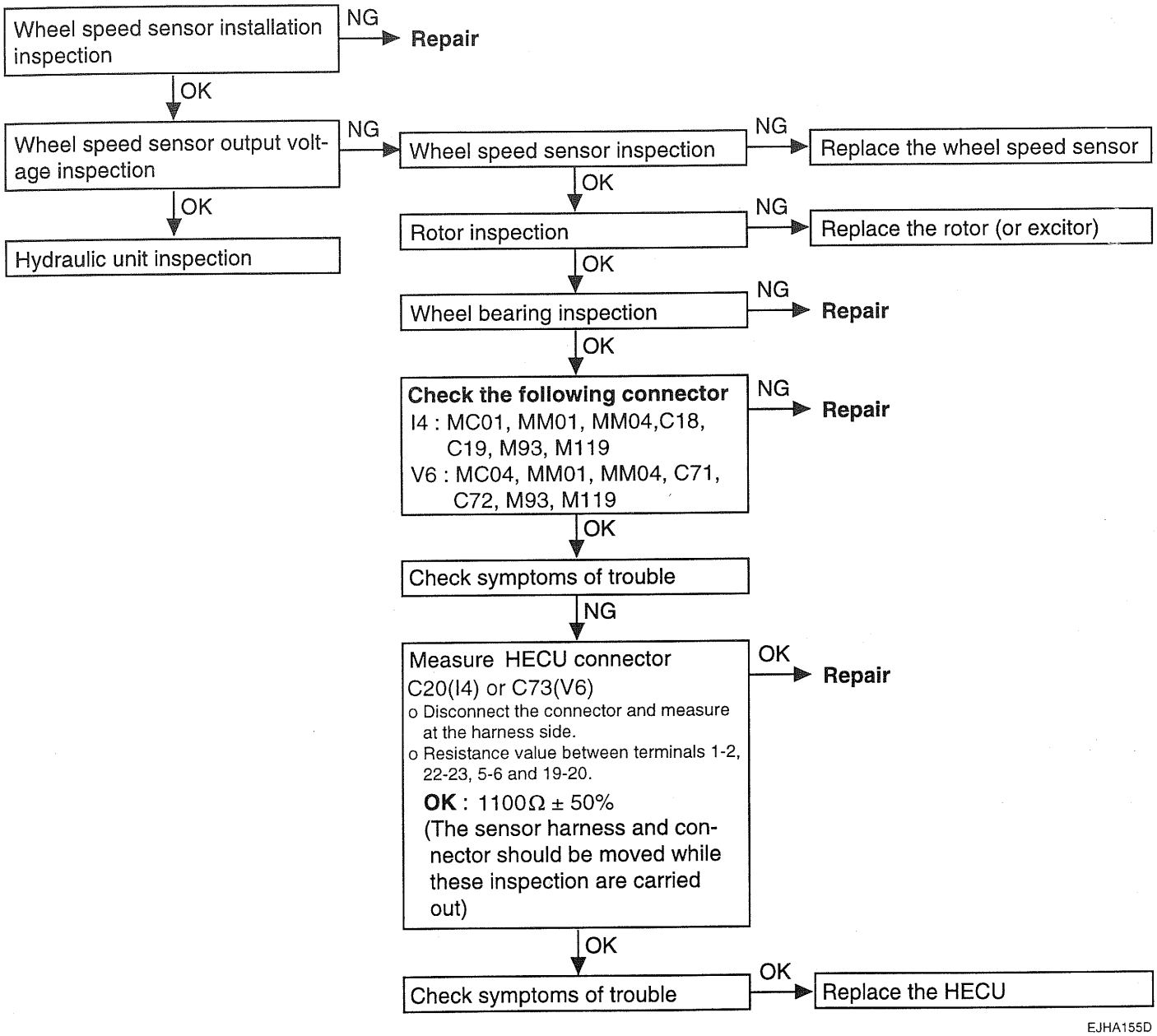
This trouble symptom is limited to cases where communication with the Hi-Scan is possible (HECU power supply is normal) and the diagnosis code is normal.



EJHA155C

INSPECTION PROCEDURE 5

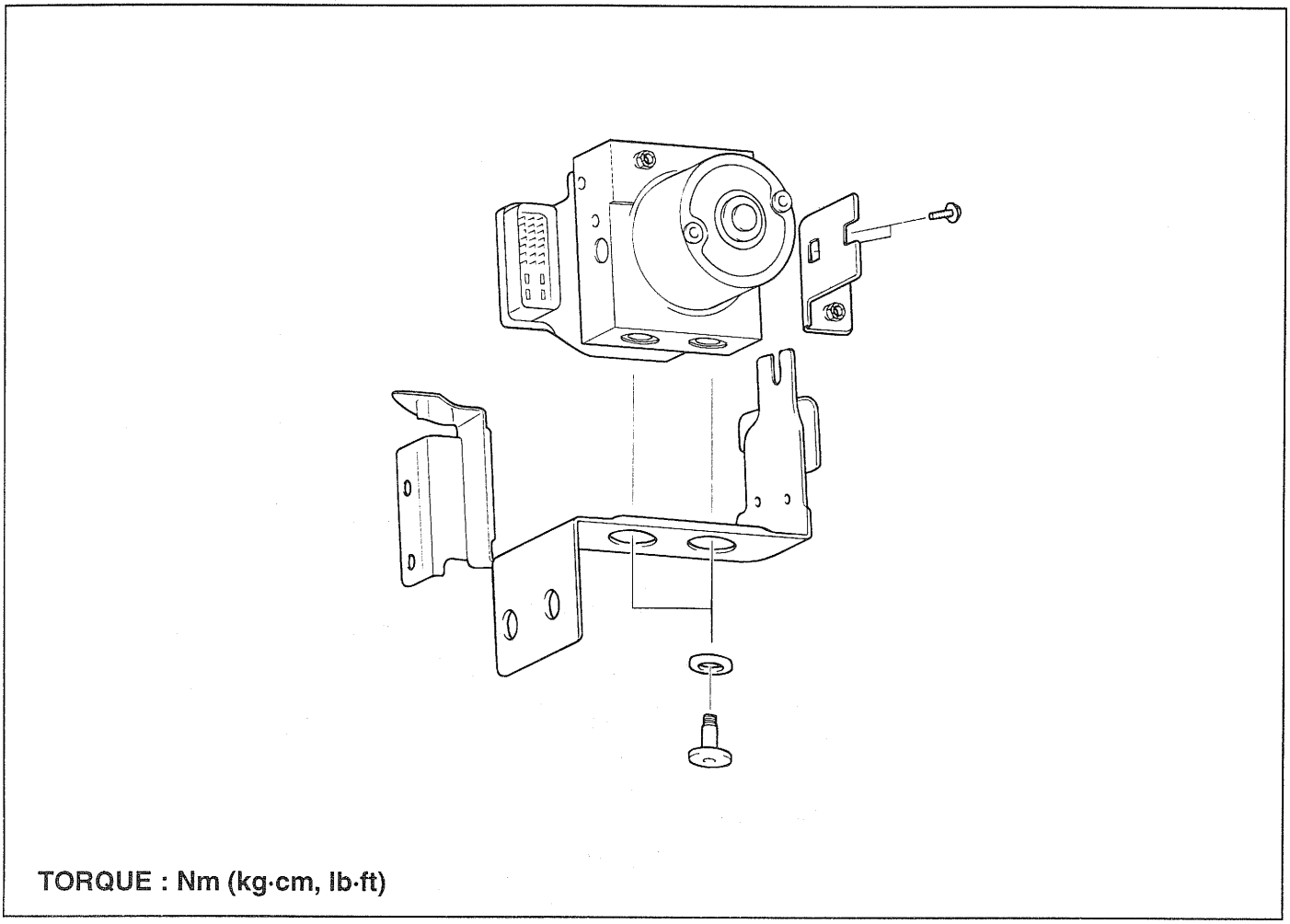
Brake operation is abnormal	Probable cause
This varies depending on driving conditions and road surface conditions, so problem diagnosis is difficult. However, if a normal diagnosis code is displayed, carry out the following inspection.	• Improper installation of wheel speed sensor • Incorrect sensor harness contact • Foreign material adhering to wheel speed sensor • Malfunction of wheel speed sensor • Malfunction of rotor • Malfunction of wheel bearing • Malfunction of hydraulic unit • Malfunction of HECU



EJHA155D

ANTI-LOCK BRAKING SYSTEM CONTROL MODULE

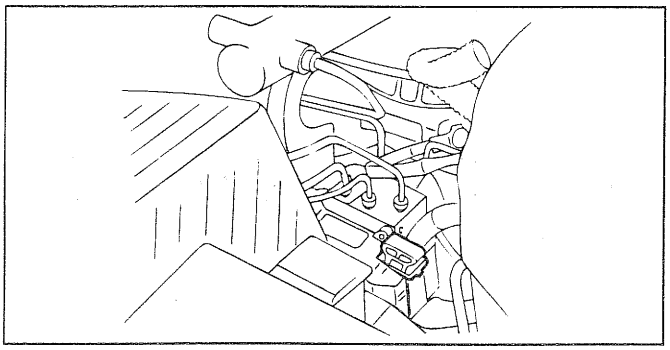
COMPONENTS EJHA3200



EJHA040A

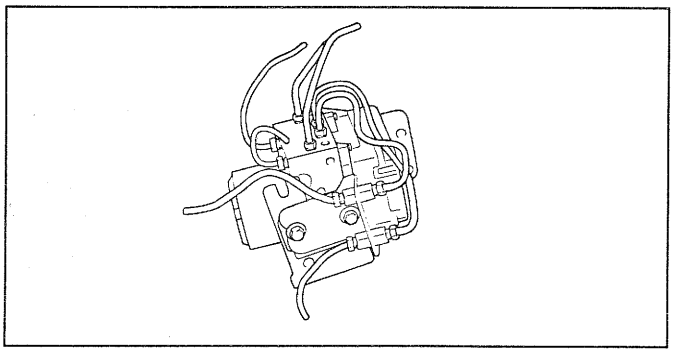
REMOVAL EJHA3250

1. Disconnect the HECU (Hydraulic and electronic Control Unit) and motor connector.



EJHA022A

2. Disconnect the brake tubes from the HECU.



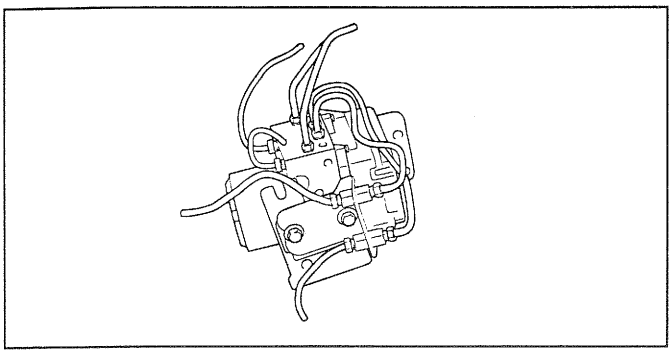
EJHA045A

3. Remove the HECU bracket mounting bolt and the HECU.

CAUTION

1. **Never attempt to disassemble the HECU.**

2. **The HECU must be transported and stored in the upright position and with sealed ports. The HECU must not be drained.**



EJHA045A

INSTALLATION EJHA3300

1. Follow the reverse order of the removal.
2. Tighten the modulator mounting bolts and brake tube nuts to the specified torque.

Tightening toque

HECU mounting bolt :

8-10 Nm (80-100 kg·cm, 5.6-6.9 lb·ft)

Brake tube nut :

13-17 Nm (130-170 kg·cm, 9-12 lb·ft)

ANTI-LOCK BRAKING SYSTEM MODULATOR

HYDRAULIC MODULE INSPECTION EJHA3600

CAUTION

Turn the ignition switch off before connecting or disconnecting the Hi-Scan.

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

CAUTION

1. **The roller of the braking force tester and the tire 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.

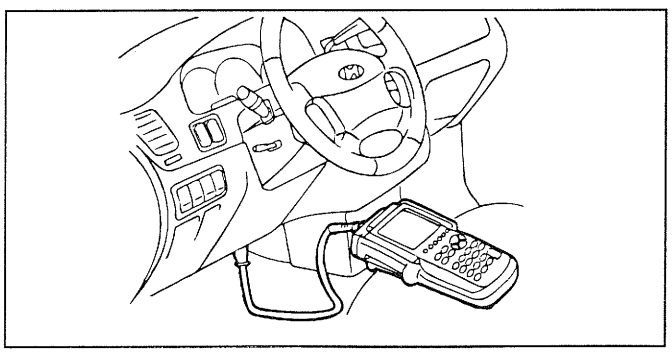
3. Turn the ignition key "OFF" and set the Hi-Scan as shown in the diagram.

4. After checking that the shift lever <M/T> or the selector lever <A/T> is in neutral, start the engine.

NOTE

When the ABS has been interrupted by the fail-safe function, the Hi-Scan actuator testing cannot be used.

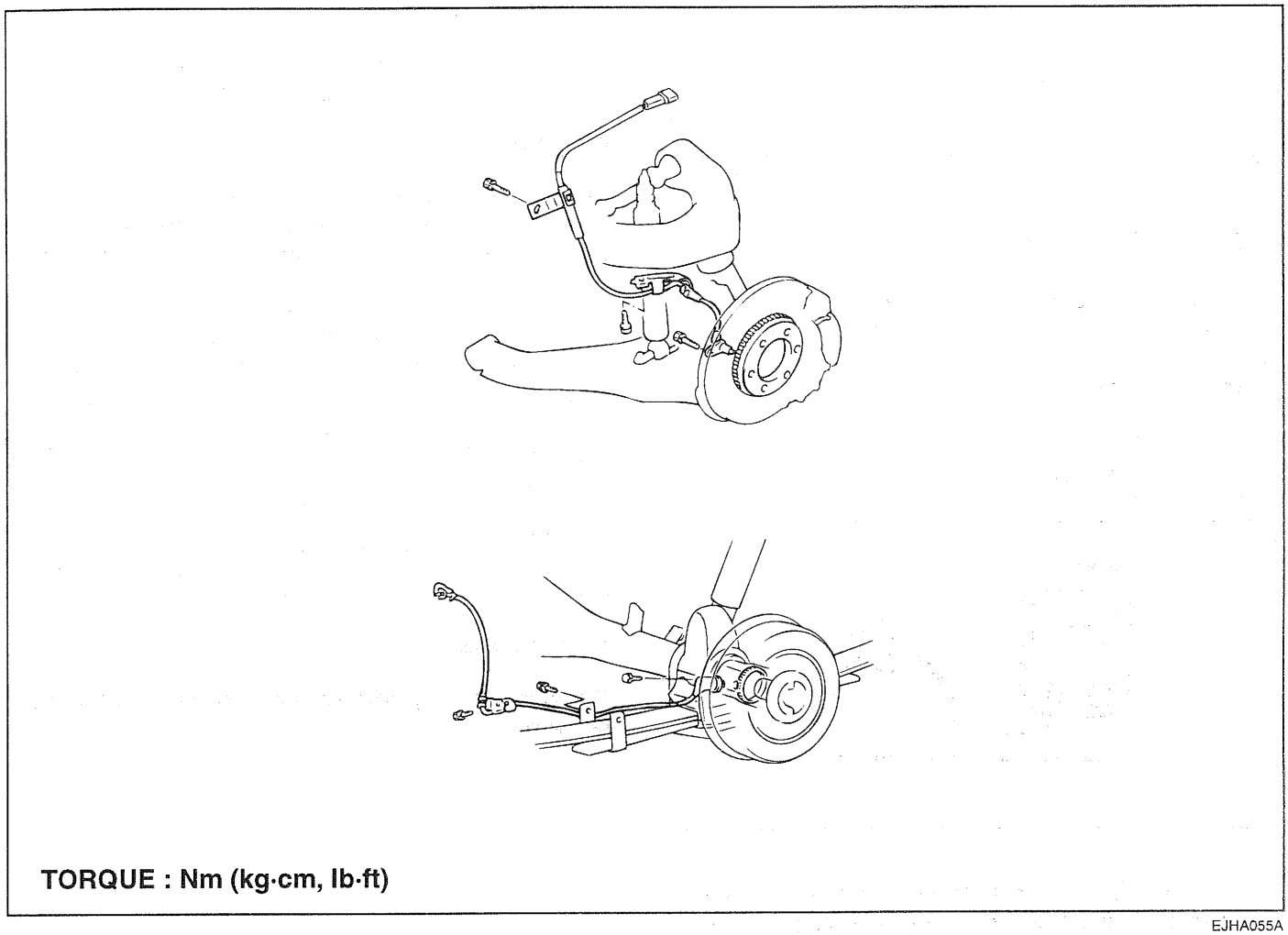
5. Use the Hi-Scan to force-drive the actuator.



ERHA006A

ANTI-LOCK BRAKING SYSTEM WHEEL SPEED SENSOR

COMPONENTS EJHA3350

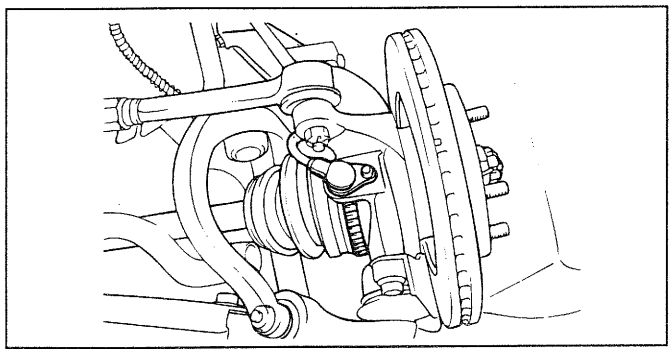


EJHA055A

REMOVAL EJHA3400

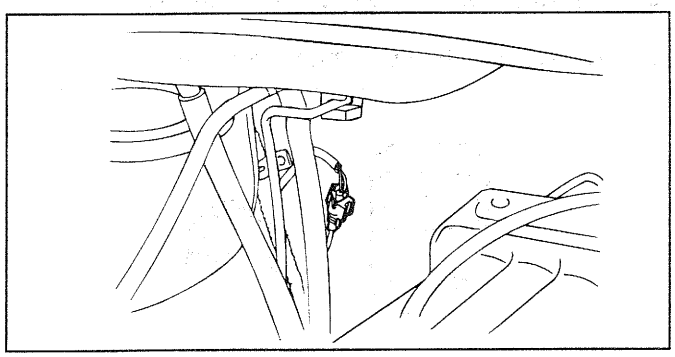
FRONT WHEEL SPEED SENSOR

1. Remove the front wheel speed sensor mounting bolt.



KFW8059A

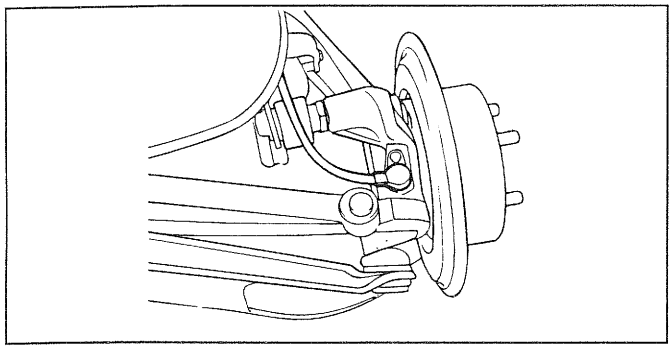
2. Remove the front wheel speed sensor after disconnecting the wheel speed sensor connector.



EJHA023B

REAR WHEEL SPEED SENSOR

Remove the rear wheel speed sensor after disconnection the wheel speed sensor connector.



KFW8060A

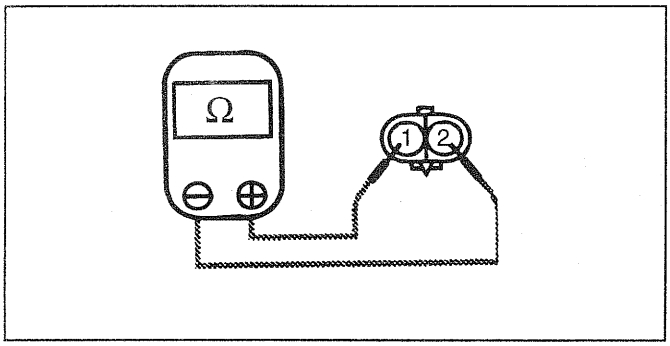
INSPECTION EJHA3450

1. Connect an ohmmeter between the wheel speed sensor terminals and measure the resistance.

Service standard

Front : 1100Ω ± 50%

Rear : 1100Ω ± 50%



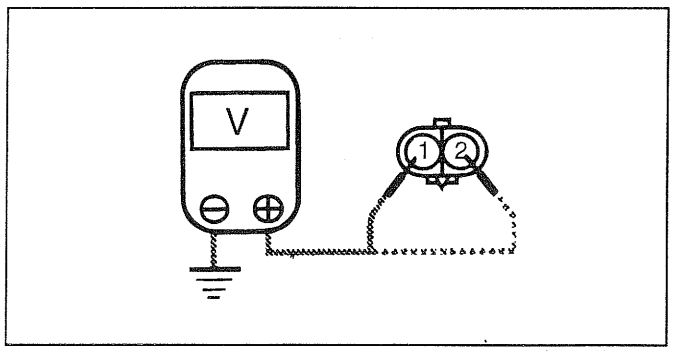
EJA9031E

2. Connect a voltmeter between the wheel speed sensor terminals and measure the voltage by turning the wheel.

NOTE

Set the voltmeter to measure AC voltage.

Service standard : AC voltage detected.



EJA9031F

ABS OPERATION CHECK EJHA3550

WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK

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

CAUTION

Be sure to remove the connector double lock and insert the probe into the harness side. Inserting it into the terminal side will result in a bad connection.

3. Rotate the wheel to be measured at approximately 1/2–1 rotation per second, and check the output voltage using a circuit tester or an oscilloscope.

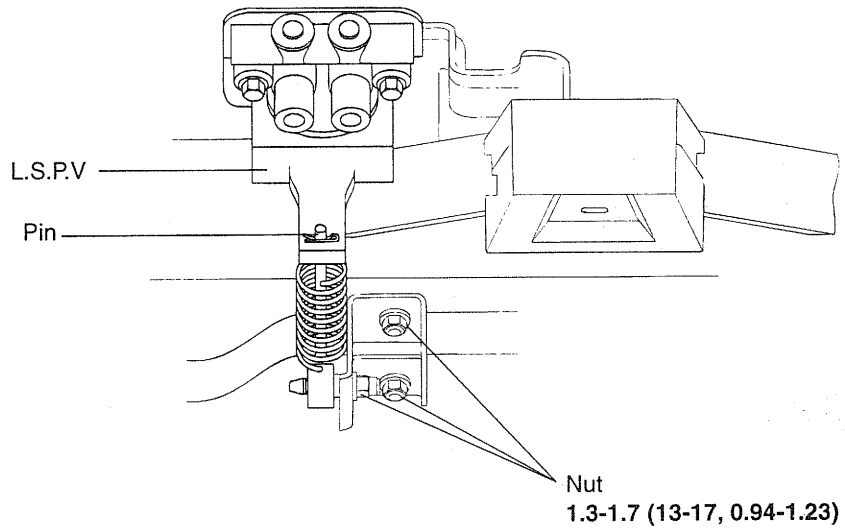
Wheel speed sensor	Front left	Front right	Rear left	Rear right
Terminal No.	1	19	5	22
	2	20	6	23

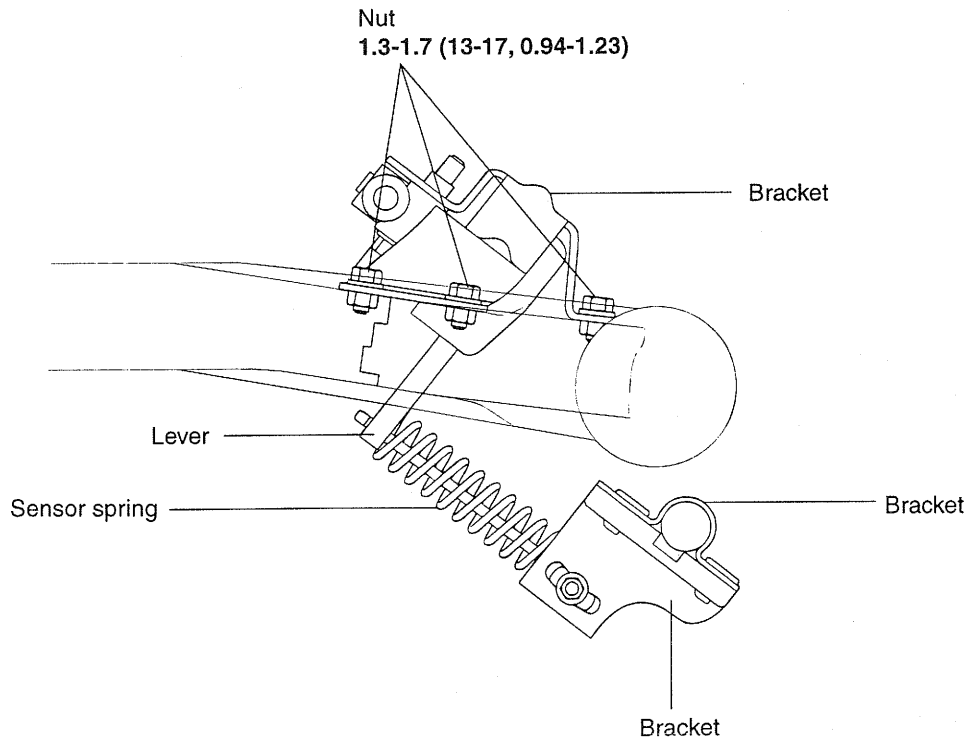
Output voltage

When measuring with an oscilloscope : 130 mV p-p or more

LSPV (LOAD SENSING PROPORTIONING VALVE)

COMPONENTS EJHA3950

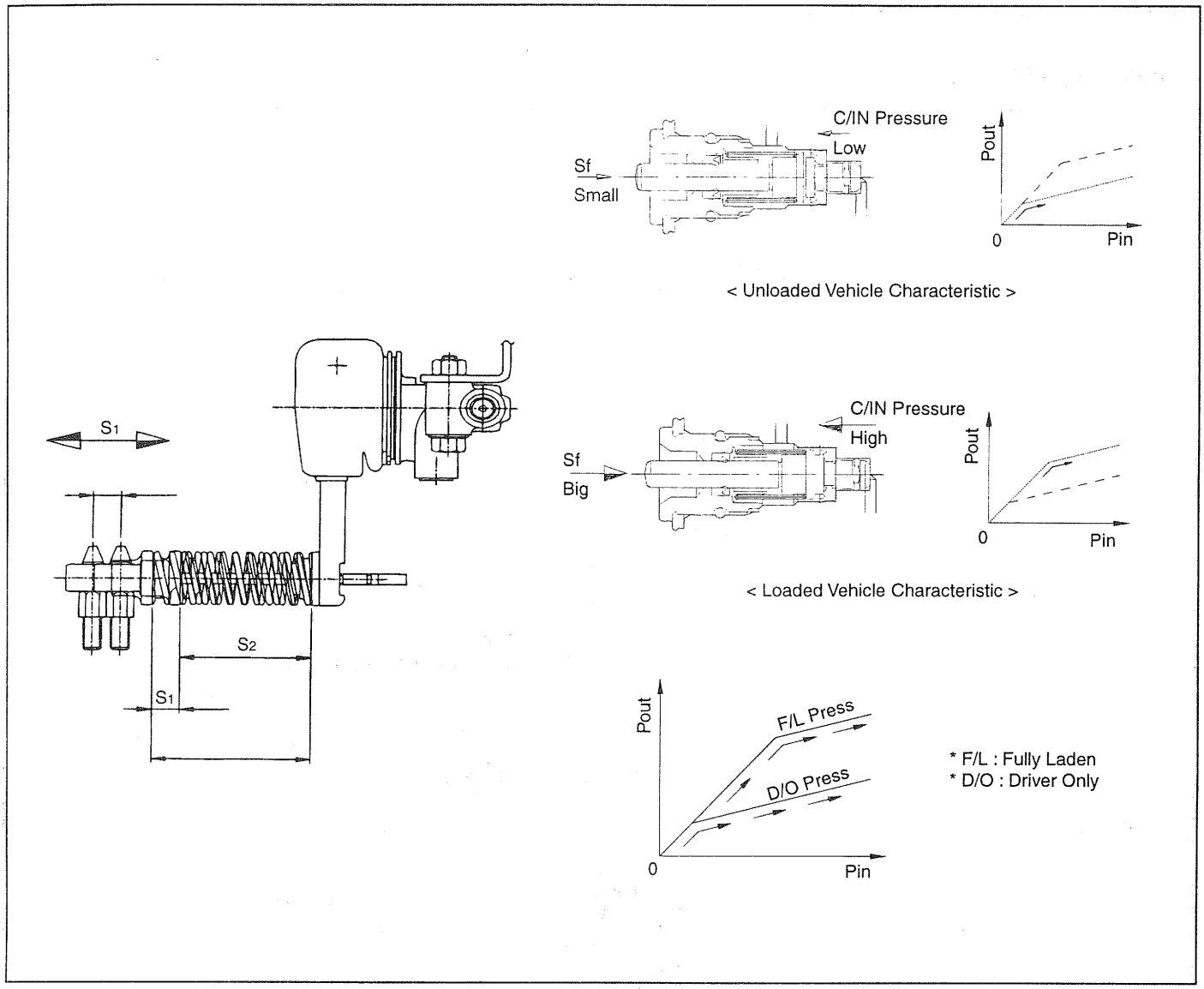




TORQUE : Nm (kg.cm, lb.ft)

EJHA395A

SUMMARY EJHA4000



EJHA030A

L.S.P.V (Load Sensing Proportioning Valve) is a control device for applying the ideal hydraulic line pressure to the rear brake of a vehicle according to the loading of the rear axle. It is a necessary component for stability when braking.

Load sensing is to perceive change of distance between the body and the trailing arm, resulted from change of load according to loadage.

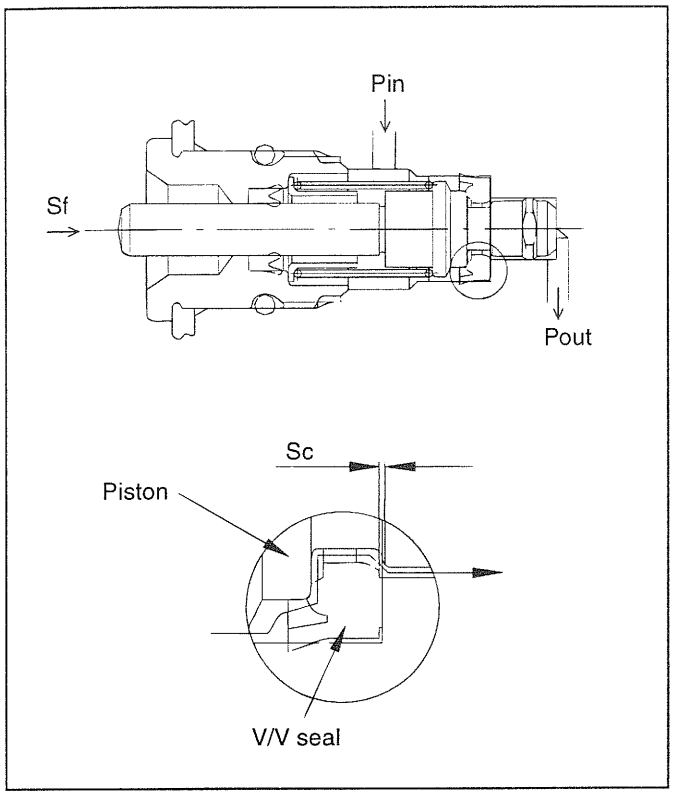
If the vehicle load amount increases, the distance between the chassis frame and trailing arm is reduced, the reduction of the distance causes the length of sensing spring to decrease by S1.

Spring force (Sf) increased by S1 is transmitted to the piston through the lever, resulting in the force applied to the piston increasing in proportion to the cut/in pressure.

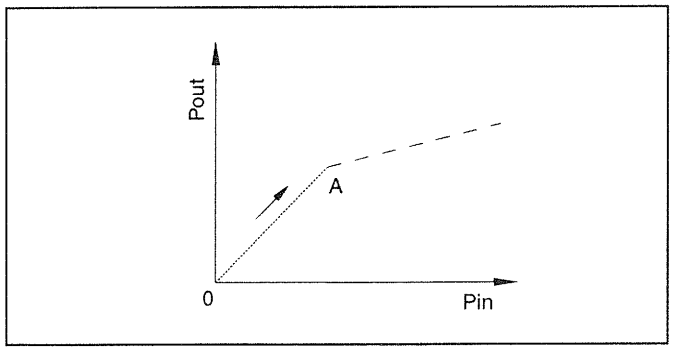
PRINCIPLE OF OPERATION EJHA4050

NON OPERATION (0–A)

Input pressure from master cylinder is lower than Sf applied to the piston, input pressure(Pin) is sent to the rear side without a change in pressure.



EJHA405A



EJHA405B

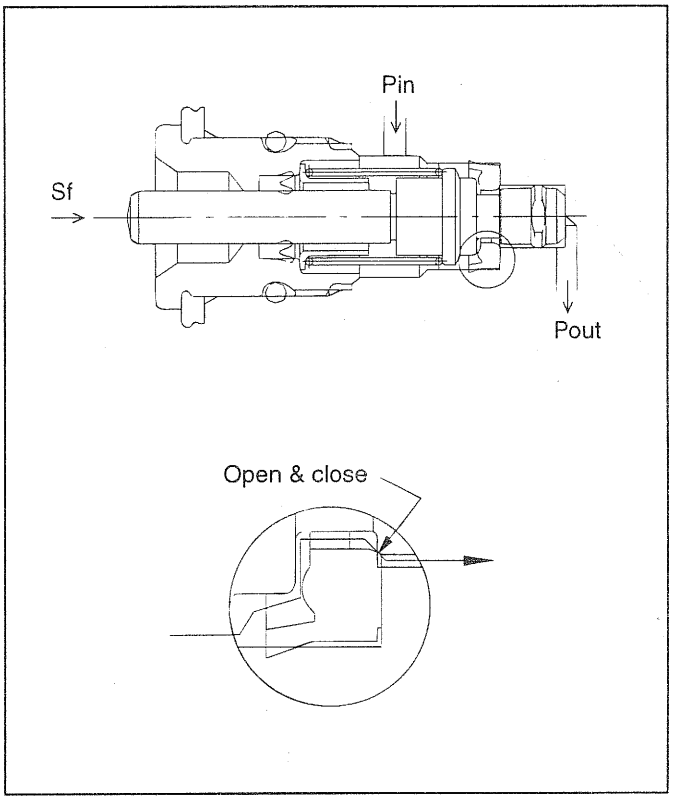
OPERATION

When the Pin increases, the pressure exerted at point A becomes greater than Sf, the piston moves toward the left and the pressure decreases by touching the valve seal.

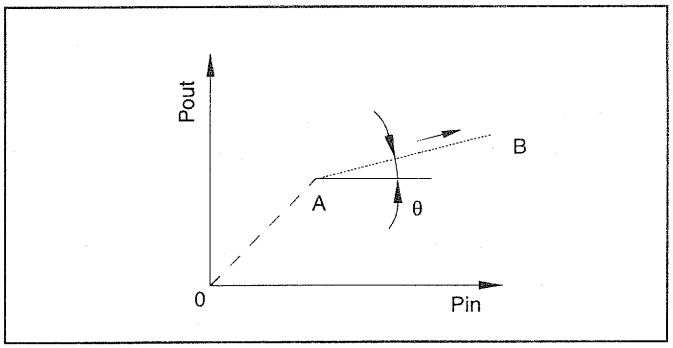
If the Pin increases further, the piston moves to the right again and opens the valve.

At this time, the input pressure and output pressure (Pin and Pout) balances with Sf by repeatedly opening and closing the valve.

As a result, Pout shows decompression characteristics that has a declination of tan θ.



EJHA405C



EJHA405D

REMOVAL EJHA4100

Remove the components refering to the illustration.

INSTALLATION EJHA4150

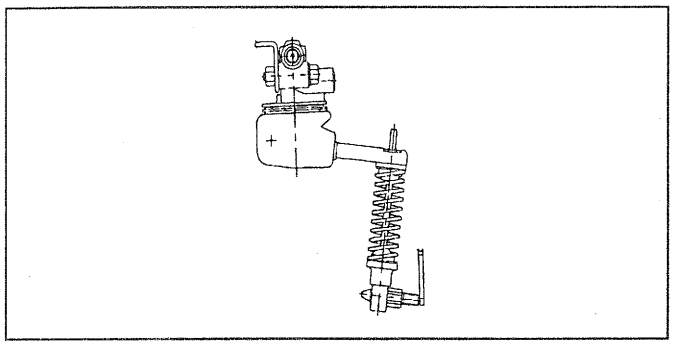
CAUTION

When setting the valve, the vehicle's normal load must be applied to all wheels.

New LSPV is fitted with the setting pin. This pin must be maintained in assembly condition until setting is complete.

1. Fit the valve body to the bracket.

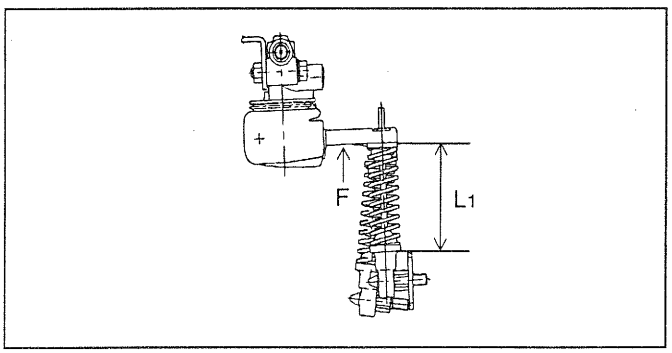
   TORQUE : 11–14 N.m (110–140 kg.cm)



EJHA033A

2. When of pushing the lever to the highest position, tighten the nut after inserting the stud bolt into the slot hole.

   At this time, the sensing spring length L1 should not change while tightening.

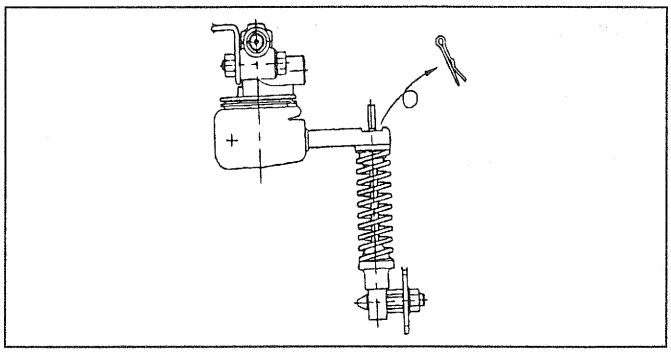


EJHA033B

3. Finish setting after removing the setting pin.

4. Be sure to remove the setting pin after setting is finished.

   If the setting pin is not removed, it can cause malfunction or damage to the components during driving.



EJHA033C