

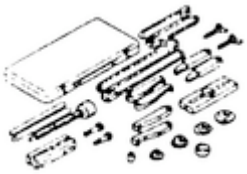
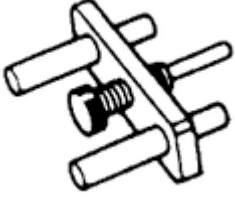
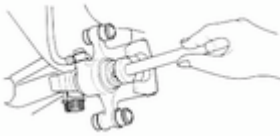


Brake System

General Information



Special tool

Tool (Number and Name)	Illustration	Use
OK130 430 019 Flare nut wrench		Used to remove and install brake pipe.
OK130 430 017 Disc brake expander		Used to assemble disc pad.
OK670 990 AA0 Bearing installer set		Used to remove sensor rotor.
OK9A4 430 001 Adjustment gauge		Used to adjust push rod gap.
OK9A4 263 001 Brake piston wrench		Used to turn in brake caliper piston.
K2CA 089 HSP Hi/Scan pro		Used to diagnose anti-lock brake system.



Troubleshooting guide

Troubleshooting guide	Possible cause	Action
Poor braking	Leakage of brake fluid	Repair
	Air in system	Bleed air
	Worn pad or lining	Replace
	Brake fluid, grease, oil or water on pad or lining	Clean or replace
	Hardening of pad or lining surface or poor contact	Grind or replace
	Malfunction of disc brake piston	Replace
	Malfunction of master cylinder or wheel cylinder	Replace or replace
	Malfunction of power brake unit	Replace
	Malfunction of check valve (vacuum hose)	Replace
	Damaged vacuum hose	Replace
	Deterioration of flexible hose	Replace
	Malfunction of dual proportioning valve (NON ABS only)	Replace
Brakes pull to one side	Worn pad or lining	Replace
	Brake fluid, grease, oil or water on pad or lining	Clean or replace
	Hardening of pad or lining surface or poor contact	Grind or replace
	Abnormal wear or distortion of disc, drum, pad, or lining	Repair or replace
	Malfunction of automatic adjuster	Repair or replace
	Loose backing plate/dust cover mounting bolts	Tighten
	Malfunction of wheel cylinder	Repair or replace
	Improperly adjust wheel alignment	Adjust
	Unequal tire air pressures	Adjust
Brake do not release	No brake pedal play	Adjust
	Improperly adjusted push rod clearance	Adjust
	Clogged master cylinder return port	Clean
	Weak brake pad or shoe return spring	Replace
	Wheel cylinder not returning properly	Clean
	Malfunctioning piston seal on disc brake	Replace
	Excessive run out of disc plate	Replace
	Incorrect shoe position	Clean or replace
	Incorrect adjustment of wheel bearing preload	
Pedal goes too far(too much pedal stroke)	Improperly adjust pedal play	Adjust
	Worn pad or lining	Replace
	Air in pipes	Bleed air
Abnormal noise or	Worn pad or lining	Replace

vibration during braking	Deteriorated pad or lining	Grind or replace
	Brakes do not release	Repair
	Foreign material or scratches on disc plate or drum contact surface	Clean
	Loose backing plate/dust cover or caliper mounting bolts	Tighten
	Damaged disc/drum contact surface	Replace
	Poor contact of pad or lining	Repair or replace
	Insufficient grease on sliding parts	rease
Steering wheel pulls to one side	Dragging brake	Repair
	Malfunction of steering system	
	Damaged or unbalanced wheel(s)	
	Incorrect tire pressure	
	Malfunction of suspension	

Parking brake system

Problem	Possible cause	Remedy
Brakes do not release	Improper return of parking brake cable or improper adjustment	Repair or adjust
Parking brake does not hold well	Excessive lever stroke	Adjust
	Brake cable stuck or damaged	Repair or replace
	Brake fluid or oil on pad or lining	Clean or replace
	Hardening of pad/lining surface or poor contact	Grind or replace



Specification

Model		Specifications
Item		
Brake pedal	Type	Suspended
	Pedal lever ratio	4.12 : 1
	Maximum stroke (in(mm))	5.31 (135)
Master cylinder	Type	Tandem (with level sensor)
	Cylinder inner diameter (in(mm))	0.937 (23.81)
Front disc brake	Type	Ventilated disc
	Cylinder bore (in(mm))	2.12 (54)
	Pad dimensions (area × thickness) (in ² × in (cm ² × cm))	7.15 × 0.39 (46.1 × 1)
	Disc plate dimensions (outer diameter × thickness) (in(mm))	10.2 × 0.79 (258 × 24)
Rear drum brake	Type	Leading-trailing
	Cylinder inner diameter (in(mm))	0.75 (19.05)
	Lining dimensions (depth × outer diameter × thickness) (in(mm))	1.18 × 8.99 × 0.18 (30 × 228.6 × 4.5)
	Drum inner diameter (in(mm))	8.97 (228)
Rear disc brake	Type	Solid disc
	Cylinder bore (in(mm))	1.34 (34)
	Pad dimension (area × thickness) (in ² × in (cm ² × cm))	4.64 × 0.39 × (3000 × 8)
	Disc plate diameter (outer diameter × thickness) (in(mm))	10.3 × 0.39 (261 × 10)
Power brake unit	Type	Boost type
	Outer diameter (in(mm))	7+8 (178+203)
Brake fluid		FMVSS 116: DOT-3, SAE J1703, DOT-4
Parking brake	Type	Mechanical
	Operation system	LH side lever



Brake System

Brake System



Air bleeding

1. Jack up vehicle and support it with safety stands.

CAUTION

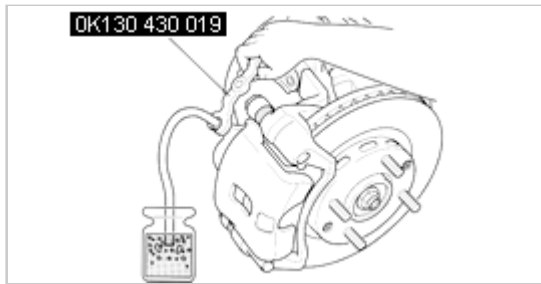
Brake fluid reservoir must be 3/4 full during air bleeding.

2. Remove bleeder cap and attach a vinyl hose to bleeder plug.
3. Place other end of vinyl tube in a clear container.
4. Depress brake pedal a few times, and then hold it in depressed position.
5. Have a second person loosen the bleeder screw, drain out fluid, and retighten screw with SST(OK130 430 019).

Tightening torque: 4.3~6.5 lb-ft(5.9~8.8 Nm, 60~90 kg-cm)

CAUTION

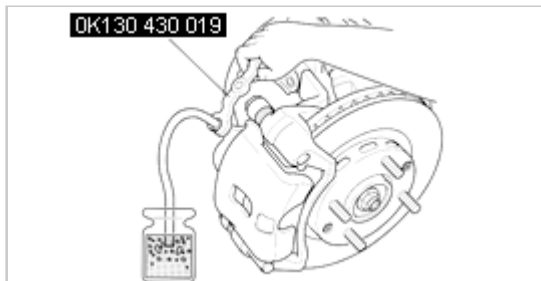
- 1) Both people should stay in voice contact with each other.
- 2) Be sure pedal remains depressed until air bleed screw is tightened.



6. Repeat steps 4 and 5 until no air bubbles are seen.
7. Check for correct brake operation.
8. Verify that there is no fluid leakage. Clean away any spilled fluid with shop towels.
9. After air bleeding, add brake fluid (SAE J1703 DOT-3 or DOT-4) to reservoir to specified level.

NOTICE

Air bleeding must be done from bleeder screw that is farthest from the master cylinder.





Description

Hydraulic brake system

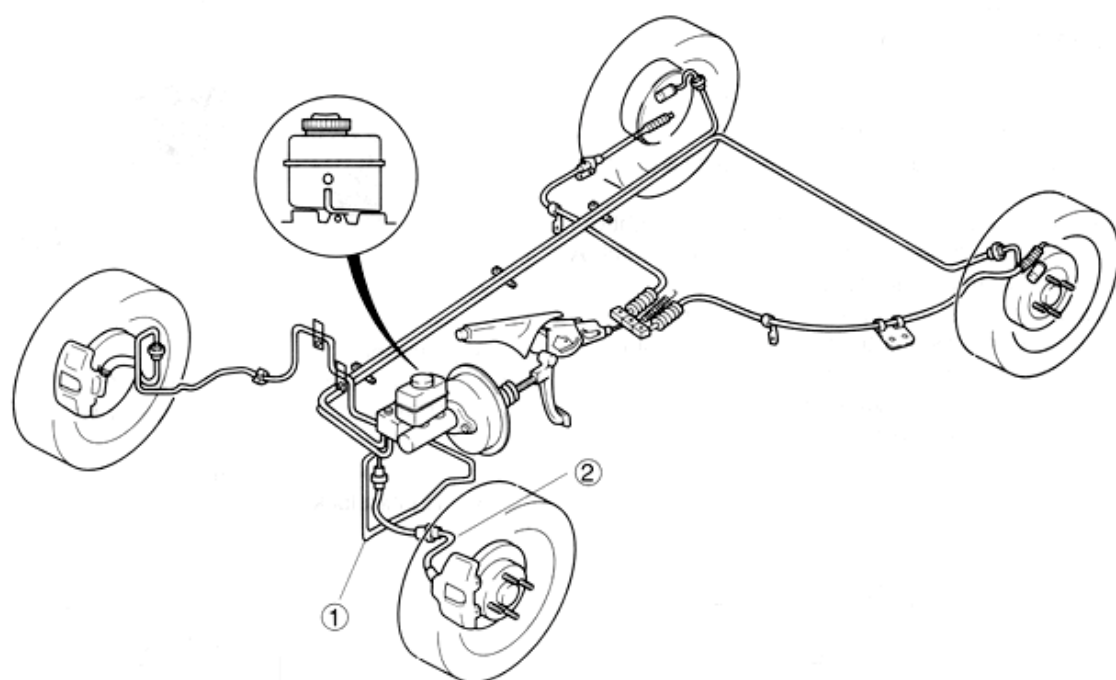
The hydraulic brake system uses principles of fluid power to apply the front and rear brakes. The system operates as follows:

- The brake pedal is connected to a hydraulic servo called the master cylinder.
- When the pedal is pushed, fluid is forced from master cylinder through metal tubing and flexible hoses to rear brake calipers and front disc brake calipers.
- Wheel cylinders are hydraulic actuators which convert hydraulic pressure produced in the master cylinder into motion.
- The front and rear brake caliper piston move inward forcing the brake pads to make contact with metal surface of the brake rotor.
- When the brake pedal is released, pressure in the system is relieved. Brake shoes and piston then return to their neutral or released position.

If brake fluid is lost from one or both circuits, a fluid level sensor in the master cylinder illuminates an indicator lamp in the instrument cluster. The lamp comes on when a float in the master cylinder drops below a specified level and closes a circuit. Once the circuit is closed, the lamp will illuminate and remain ON whenever ignition switch is in ON or START position. If the lamp is ON, make sure parking brake is in the fully released position. The lamp also indicates when the brake fluid level is low and when the parking brake has been applied.



Component



- (1) Brake pipe
- (2) Flexible hose

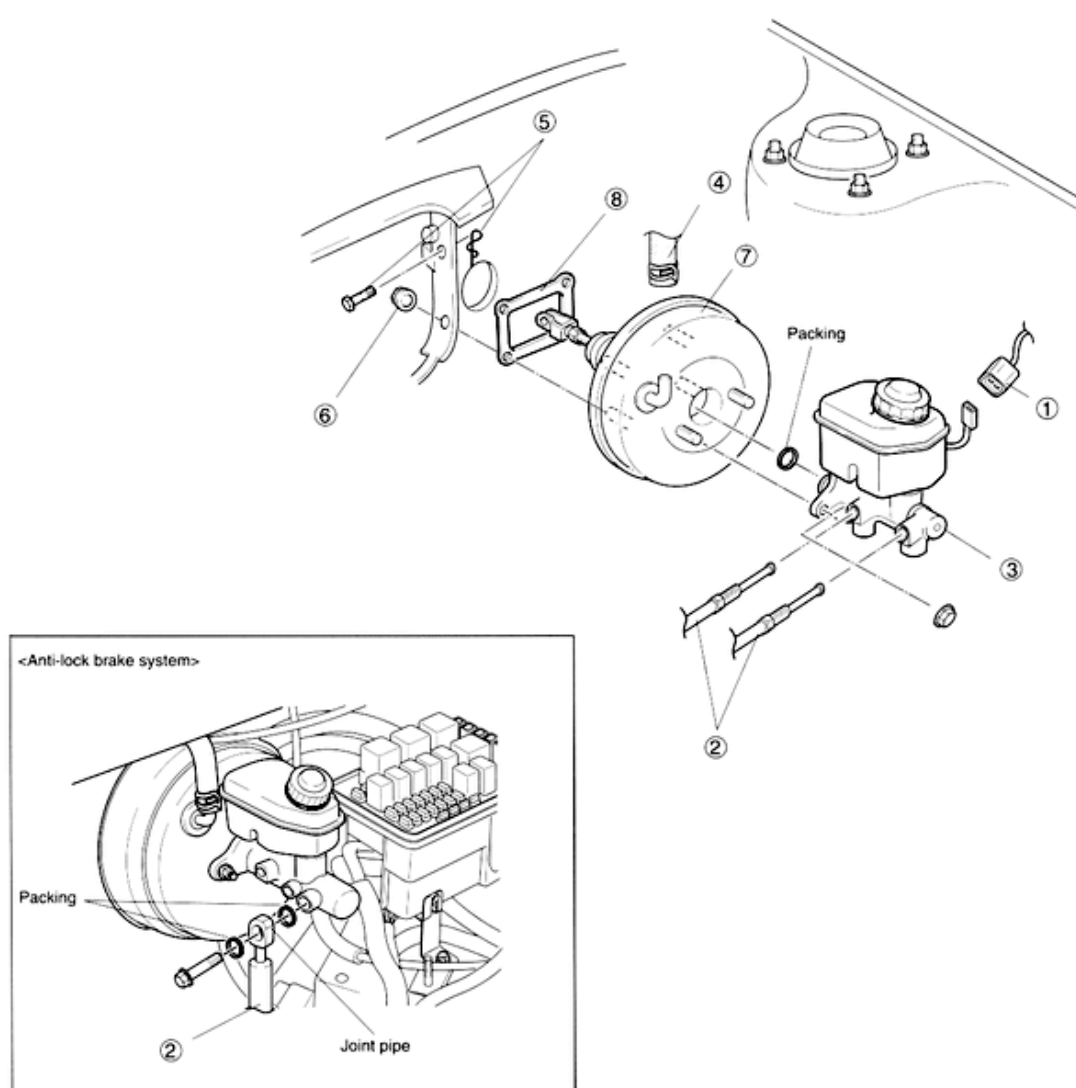


Brake System

Brake System - Brake Booster



Component



- (1) Brake fluid level switch connectors
- (2) Brake lines
- (3) Master cylinder assembly
- (4) Vacuum hose

- (5) Spring clip and clevis pin
- (6) Nut
- (7) Master vacuum
- (8) Gasket (Replace)



Removal

1. Remove brake master cylinder.
2. Disconnect master vacuum hose from master vacuum.
3. Front inside vehicle, remove spring clip from clevis pin.
4. Remove four master vacuum nuts. Secure master vacuum to bulkhead.
5. Remove master vacuum.
6. Remove master vacuum mounting bracket gasket.

Installation

1. Mount master vacuum on vehicle bulkhead (with a new gasket) from inside the vehicle, install four mounting nuts.

Tightening torque: 14~19 lb-ft (19~26 Nm, 1.9~2.6 kg-m)

2. Attach pushrod clevis pin to the brake pedal with a new clevis pin and new spring clip.
3. From engine compartment, attach vacuum hose to the check valve.
4. Adjust piston to push rod clearance.
5. Mount master cylinder onto power brake unit and install two master cylinder mounting nuts.

Tightening torque: 7~12 lb-ft (9.8~16 N-m, 1.0~1.6 kg-m)

6. Connect brake lines. Tighten brake line flare nuts.

Tightening torque: 9~16 lb-ft (13~22 N-m, 1.3~2.2 kg-m)

7. Connect brake fluid switch.
8. Fill reservoir with new fluid to Max. level line.
Brake fluid SAE J1703 DOT-3 or DOT-4.
9. Perform brake lines bleeding.
10. Verify that there is no leakage.
11. Check brake pedal height and free play and adjust as necessary.
12. Perform a road test.

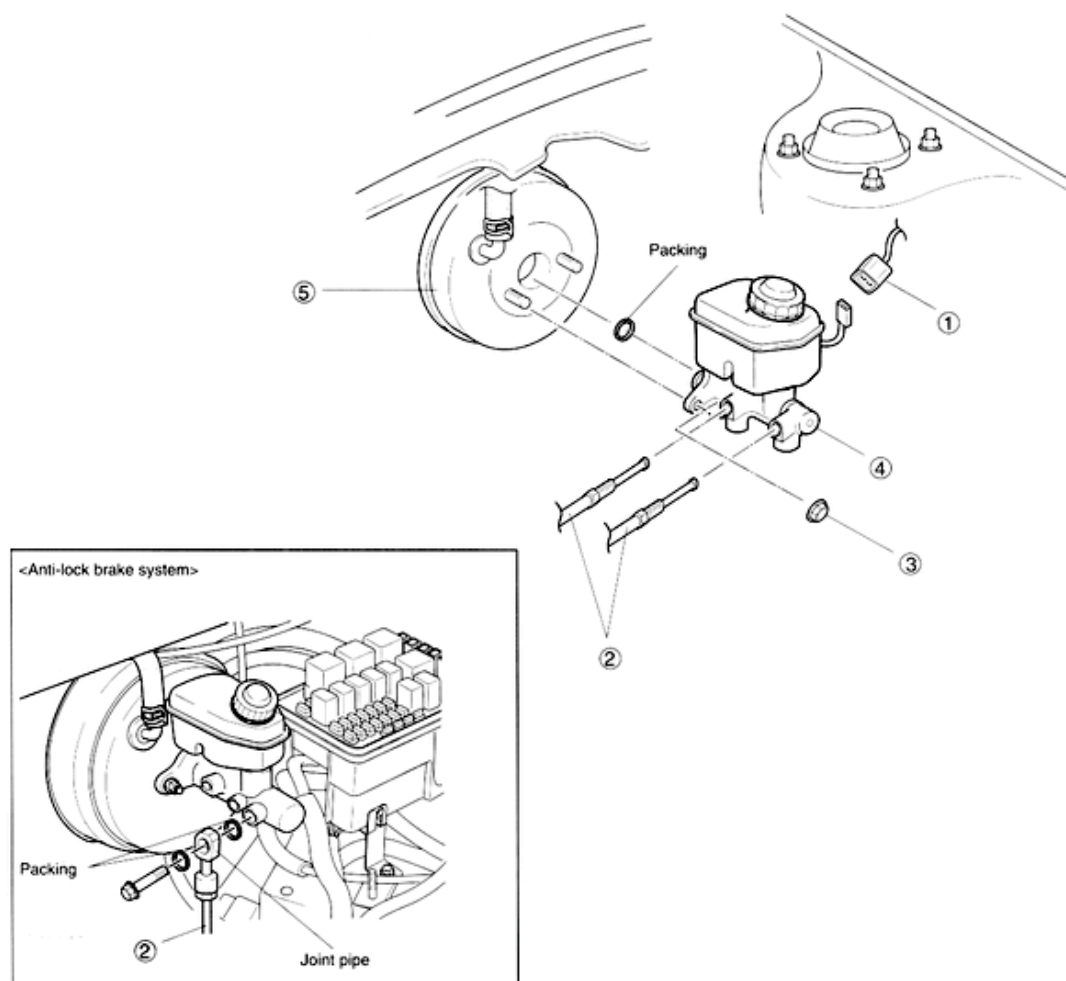


Brake System

Brake System - Master Cylinder



Component



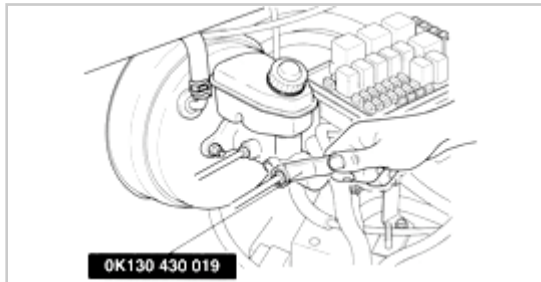


Removal

1. Disconnect negative battery cable.
2. Disconnect brake fluid level switch connectors.
3. Disconnect two brake lines with SST (0K 130 430 019) and plug master cylinder ports to prevent entry of contaminants.

NOTICE

Brake fluid will damage painted surfaces so use a container or shop towels for fluid collection.
If fluid gets on a painted surface, rinse immediately with clean water to prevent damage.



4. Remove two brake master cylinder nuts.
5. Remove brake master cylinder.

Installation

1. If a new brake master cylinder is being installed, adjust master vacuum to master cylinder push rod.
2. Position the master cylinder on the master vacuum and install two brake master cylinder nuts.
3. Tighten two brake master cylinder nuts.

Tightening torque: 7~12 lb-ft (9.8~16 N-m, 1.0~1.6 kg-m)

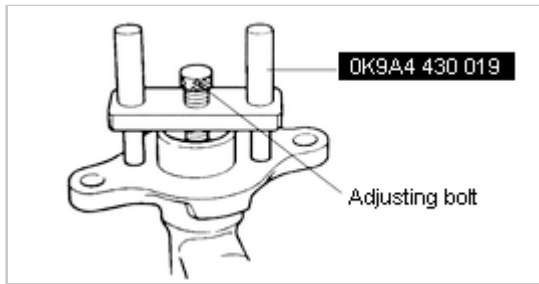
4. Connect two brake lines.
5. Tighten brake lines flare nuts to specification.

Tightening torque: 15.9~21.6 lb-ft(21.5~29.4 N-m, 2.2~3.0 kg-m)

6. Connect brake fluid level switch connectors.
7. Perform brake lines bleeding.
8. Verify that there is no leakage.
9. Connect negative battery cable.
10. Perform a road test.

Piston to push rod clearance

1. Place the SST (0K9A4 430 001) on the master cylinder. Turn the adjusting blot until it bottoms in the push rod hole in the piston.

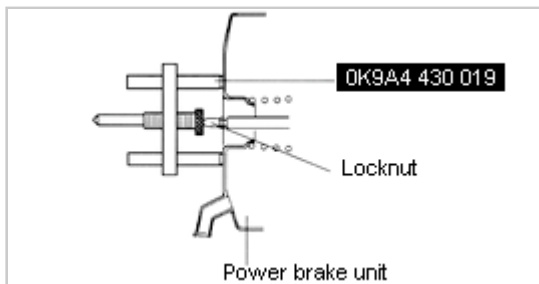


2. Invert the adjustment gauge used in step 1 and place it on the power brake unit.
3. Measure the clearance between the end of the gauge and push rod of the power brake unit. If it is not 0 in (0mm) loosen the push rod locknut and turn the push rod to make the adjustment.

NOTICE

By making the above adjustment, the clearance between the push rod and piston (after installation) of the brake master cylinder to the power brake unit) will be as shown in the below.

Push rod to piston clearance: 0.004~0.016 in (0.1~0.4 mm)



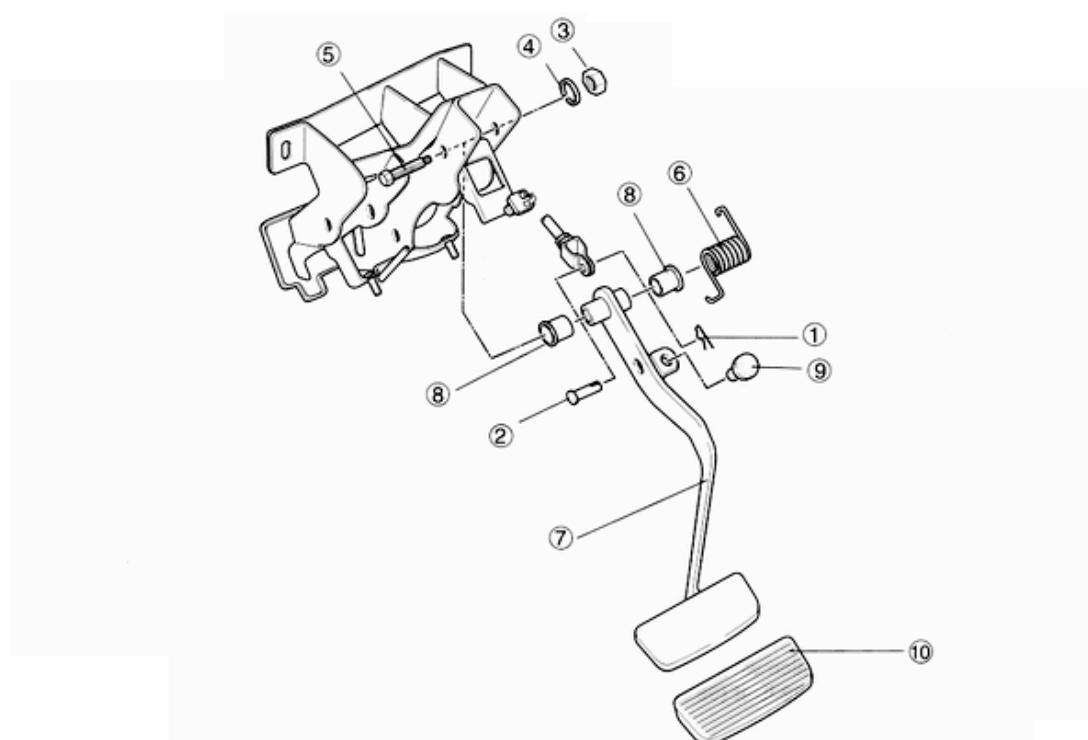


Brake System

Brake System - Brake Pedal



Component



- (1) Spring clip
- (2) Clevis pin
- (3) Nut
- (4) Lock washer
- (5) Pivot bolt

- (6) Return spring
- (7) Pedal
- (8) Brake pedal bushing
- (9) Stopper
- (10) Pad



Inspection

Brake pedal height

1. Verify that distance from the center of the pedal to the engine compartment bulkhead is as specified.

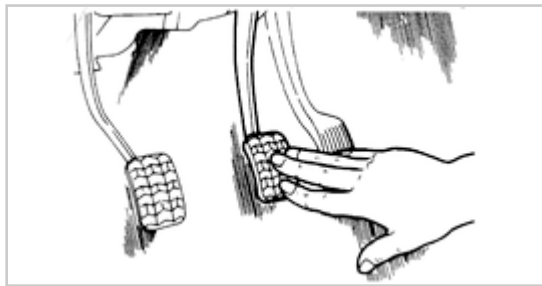
Specification: 7.06~7.72 in (193~196 mm)

Inspection

Brake pedal free play

1. Pump pedal a few times (with engine off) to eliminate any slack in system.
2. To measure pedal free play, gently press pedal by hand until resistance is felt.

Pedal free play: 0.16~0.28 in (4~7 mm)



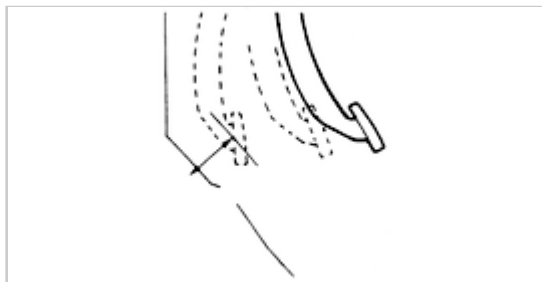
Inspection

Brake pedal-to-floor clearance (Depressed)

1. Verify that clearance from floor to center of the pedal pad is as specified when pedal is pressed with a force of about 132 lb (65 kg).

Pedal- to-floor clearance: Minimum : 2.75 in (70.0 mm)

2. If clearance is less than required, check for the following.
 - A. Air in brake system.
 - B. Malfunctioning automatic adjuster(rear brake drums).

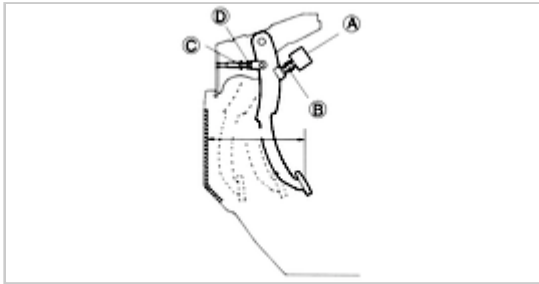


Adjustment

Brake pedal height

1. Disconnect brake pedal switch connector.
2. Loosen locknut B and rotate switch A until it does not contact pedal.

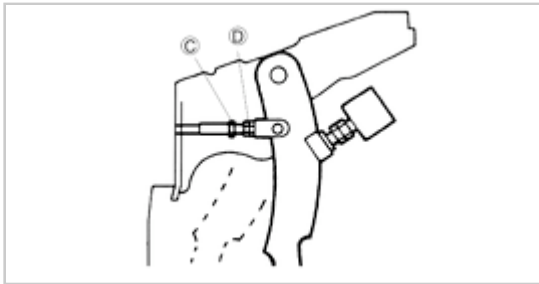
3. Loosen locknut D and turn C to adjust height of to prevent it from contacting pedal.
4. Rotate brake pedal switch A in until plunger is completely compressed, then rotate it out about 1/2 turn. Tighten locknuts B and D.
5. Reconnect brake pedal switch connector.
6. verify operation of stoplights.



Adjustment

Brake pedal free play

1. Loosen locknut D and turn rod C to adjust free play.
(Refer to illustration for brake pedal height adjustment)
2. Verify pedal height and stoplight operation.
3. Tighten locknut D.



Removal

1. Remove spring clip from clevis pin and remove clevis pin.
2. Remove nut, lock washer, and pivot bolt.
3. Remove return spring.
4. If necessary, remove brake pedal bushing, stopper and brake pedal pad.

Installation

1. If necessary, install brake pedal stopper, brake pedal, and brake pedal bushing.
2. Slide pivot bolt through to hold it in position.
3. Position brake pedal return spring on brake pedal.
4. Install lock washer and pivot nut.
5. Install clevis pin and a new cotter pin.
6. After installation, check and adjust pedal height and free play, if necessary.

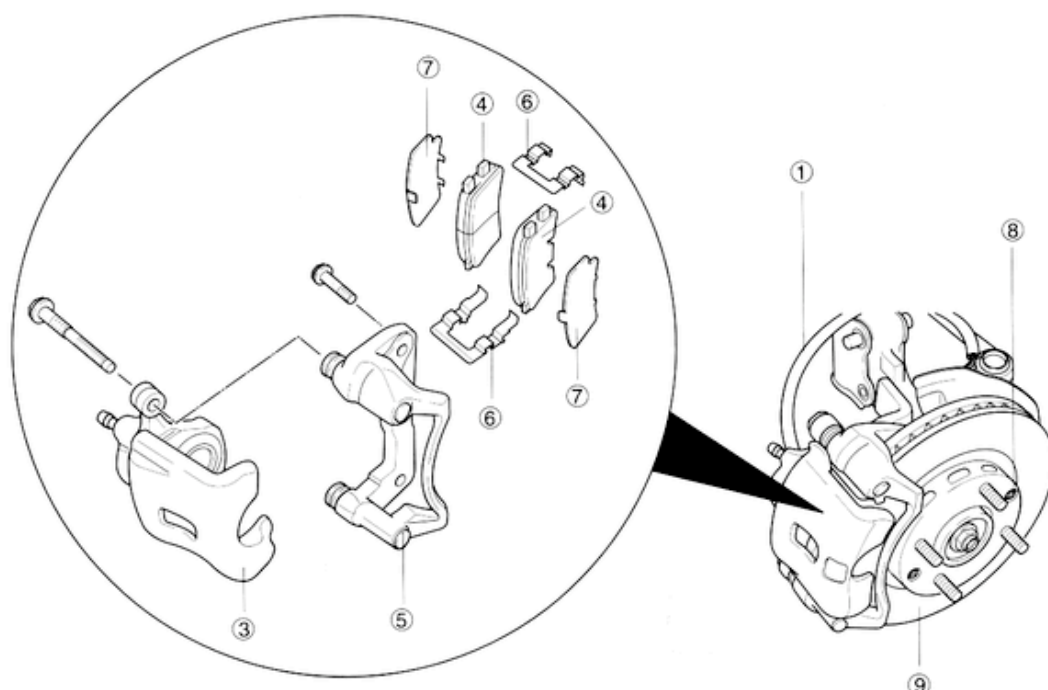


Brake System

Brake System - Front Disc Brake



Component



- (1) Flexible hose
- (2) Bolt
- (3) Caliper
- (4) Disc pad
- (5) Supporting plate

- (6) Guide plate
- (7) Shim
- (8) Screw
- (9) Brake rotor (Disc)



Removal

1. Raise front of vehicle and properly support it.
2. Remove front wheels.
3. Remove two bolts and remove caliper.
4. Remove brake pads and guide plate.
5. Measure brake pad thickness.

Minimum brake pad thickness : 0.08 in (2.0 mm)

6. Prepare to catch any brake fluid. Disconnect brake hose using a flare nut wrench.
7. Remove two bolts and supporting plate.
8. Measure rotor thickness at four or more places.

Minimum rotor pad thickness : 0.86 in (22 mm)

9. Mount a dial indicator and measure runout at the outer braking contact edge of the rotor.

Maximum runout : 0.002 in (0.06 mm)

NOTICE

Excessive runout could be caused by a loose wheel hub bearing.

10. To remove rotor, remove two mounting screws with an impact driver.
11. Resurface or replace rotor as required.

Installation

1. Mount a new or repaired rotor on hub and fasten with two mounting screws.
2. Install the supporting plate, and install the guide plate to the supporting plate.

Tightening torque: 33~49 lb-ft (45~67 N-m, 4.6~6.8 kg-m)

3. Connect the brake hose to the caliper using a flare nut wrench.

Tightening torque: 9~13 lb-ft (13~18 N-m, 1.3~1.8 kg-m)

4. Position brake pads in supporting plate cavity and install caliper onto supporting plate.
5. Install two bolts.

Tightening torque: 19~21 lb-ft (26~28 N-m, 2.6~3.0 kg-m)

6. Bleed system.
7. Inspect system for any leaks.

Inspection

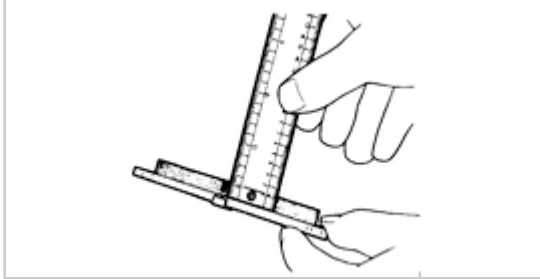
Disc brake pad

1. Check facing for oil or grease abnormal wear, cracks, and deterioration or damage from heat.
Measure thickness of lining.

Specified thickness: 0.39 in (10 mm)

Minimum: 0.08 in (2.0 mm)

2. Visually check for damage or wear on the guide plate.

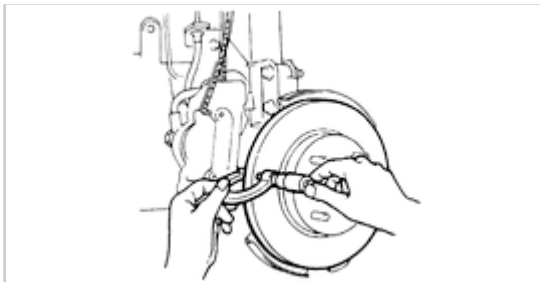


Disc plate

1. Measure thickness of disc plate.

Standard : 0.94 in (24 mm)

Minimum : 0.86 in (22 mm)

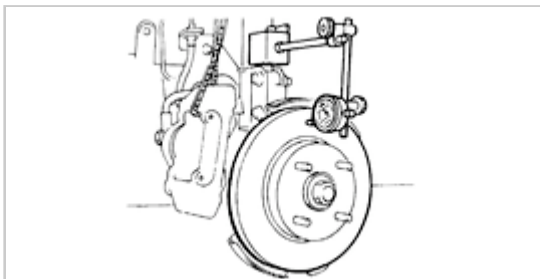


2. Measure runout at 0.32~0.47 in (8~12 mm) inside from outer edge of contact surface of disc pad.

Runout : 0.002 in (0.06 mm) Max.

CAUTION

- 1) There must be no wheel bearing looseness.
- 2) Measurement location is outer edge of disc plate surface.





Brake System

Brake System - Rear Dinode Brake



Removal

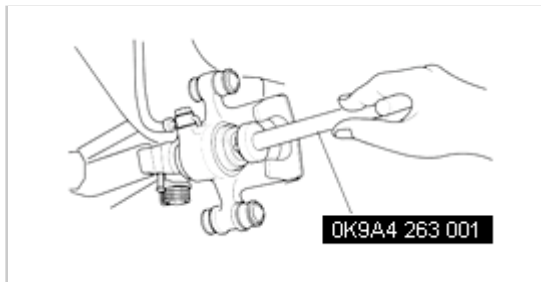
1. Remove parking cable and clip.
2. Remove brake hose connecting bolt from caliper.
3. Clamp rear brake hose.
4. Remove two lock bolts from caliper.
5. Remove caliper from rotor.
6. Remove two V-springs from disc pads.
7. Remove disc pads, shims and guide plates.
8. Remove two bolts from the mounting support.
9. Remove the mounting support from rear wheel spindle.

Installation

1. Position mounting support on rear wheel spindle and install two mounting support bolts.

Tightening torque: 33~49 lb-ft (45~67 Nm, 4.6~6.8 kg-m)

2. Insert guide plate in mounting support.
3. Install disc pads and shim out of disc plate and secure disc pads with V-springs.
4. Turn in brake caliper piston by using SST (0K9A4 263 001) to insert disc pads into brake caliper.



5. Tighten two brake caliper lock bolts.

Tightening torque: 22~29 lb-ft (29~39 N-m, 3.0~4.0 kg-m)

6. Connect brake hose with caliper and install connecting bolt.

Tightening torque: 16~22 lb-ft (22~29 N-m, 2.2~3.0 kg-m)

7. Install parking cable in clip and caliper.
8. Bleed brakes

Inspection

1. Disc pad thickness.

Specified thickness : 0.31 in (8 mm)

Minimum : 0.079 in (2 mm)

2. Disc plate.
-

Runout: Maximum: 0.0039 in (0.08 mm)
Thickness: Specified thickness:0.4 in (10 mm)
Minimum : 0.32 in (8 mm)



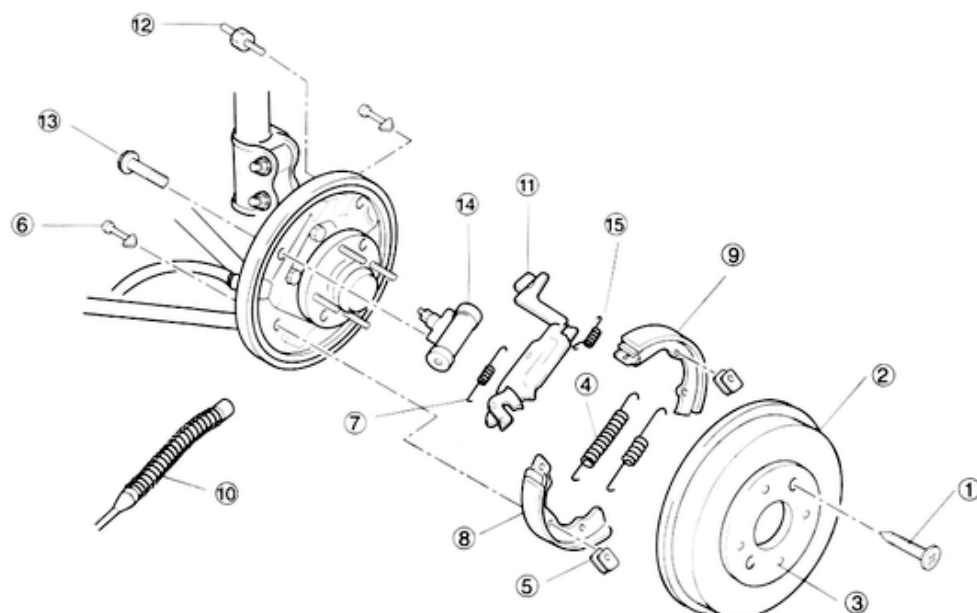
Brake System

Brake System - Rear Drum Brake



Component

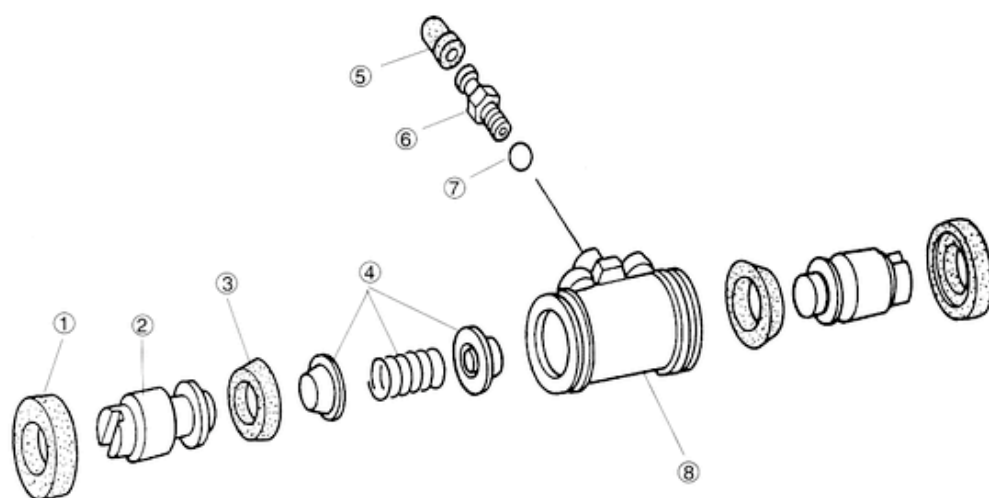
Rear drum brake



- (1) Mounting screws
- (2) Brake drum
- (3) Drum pulling threads
- (4) Return springs
- (5) Spring clips
- (6) Hold down pins
- (7) Adjuster spring
- (8) Brake shoe-leading

- (9) Brake shoe-trailing
- (10) Parking brake cable
- (11) Operating lever assembly
- (12) Brake line
- (13) Bolts
- (14) Wheel cylinder assembly
- (15) Anti-rattle spring

Wheel cylinder



- (1) Dust boots (replace)
- (2) Pistons
- (3) Piston cups (replace)
- (4) Spring and caps

- (5) Rubber cap
- (6) Bleeder screw
- (7) Steel ball
- (8) Wheel cylinder body



Removal

1. Raise and suitably support rear of vehicle.
2. Remove rear wheels and release parking brake.
3. Using an impact driver, remove two mounting screws holding the drum and remove brake the drum.

NOTICE

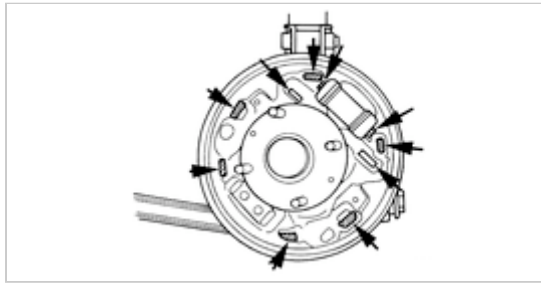
If brake drum is difficult to remove, thread two 0.3 in (8 mm) jacking bolts into two threaded holes provided on drum face and tighten evenly.

4. Remove top return spring.
5. Remove front and rear shoe spring clip and hold down pins.
6. Remove anti-rattle spring and adjuster spring.
7. Note position of operating lever while holding front shoe, then remove bottom return spring.
8. Disconnect parking brake cable from rear shoe by removing clip and washer.
9. Remove front and rear brake shoes.
10. Clean parts with a brake vacuum or solvent and inspect all parts for wear or damage. Replace as necessary.

Installation

1. Using white brake grease, sparingly lubricate all brake shoe contact points:
 - A. Shoe-to wheel cylinder contact points
 - B. Anchor sliding points
 - C. Backing plate-to shoe contact points
2. Rest operating lever behind and on hub in approximate position as noted above in Removal.
3. Place rear brake shoe in position and connect parking brake cable to rear shoe with washer and clip.
4. Position front brake shoe in place and connect front and rear shoes together with bottom return spring.
5. Hold brake shoed assembly on backing plate, with insert hold-down pins through rear of backing plate and into each shoe.
6. Secure front and rear hold-down pins with spring clips.
7. Make sure operating lever is in place and install top return spring.
8. Install anti-rattle spring and adjuster spring.
9. Mount drum and install two mounting retaining screws.
10. Adjust brakes as required.
11. Install rear wheels, and tighten four nuts.

Tightening torque: 65~87 lb-ft (88~118 N-m, 9~12 kg-m)



Inspection

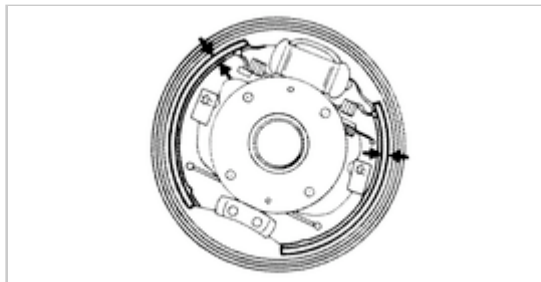
Rear drum brake

1. Raise and suitably support rear of vehicle.
2. Remove rear wheels and release parking brake.
3. Using an impact driver, remove two mounting screws holding brake drum. Remove drum.

NOTICE

If brake drum is difficult to remove, thread two 0.3 in (8 mm) jacking bolts into two threaded holes provided on drum face and tighten evenly.

4. Inspect wheel cylinders for brake fluid leaks.



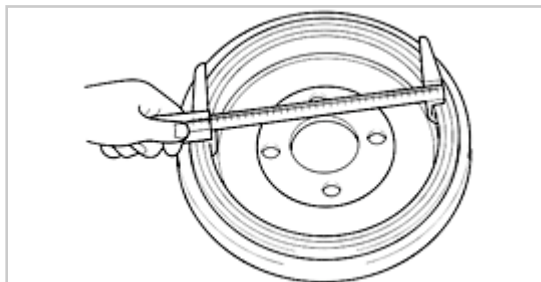
5. Measure lining thickness. Replace both linings if either is less than specification.

Minimum lining thickness : 0.04 in (1.0 mm)

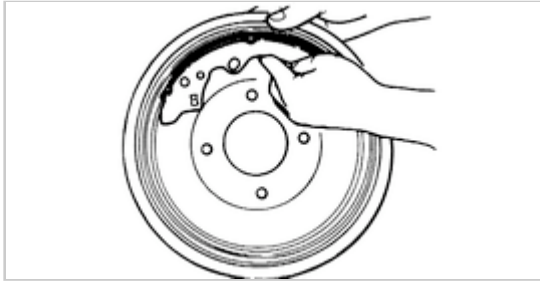
6. Inspect lining for cracks, uneven wear or oil contamination. Repair or replace as necessary.
7. Measure drum inside diameter. Replace drum if diameter is greater than specification.

Maximum diameter : 9.0 in (228.6 mm)

8. Inspect drums for cracks, grooves or uneven wear.
Resurface or replace as necessary.



9. Verify new or repaired drum-to-shoe contact.



Disassembly

Wheel cylinder

1. Remove the brake shoe assembly.
Removal and replacement procedure.
2. Disconnect the brake line using a flare nut wrench.
Be prepared to catch escaping fluid.
3. Remove two wheel cylinder mounting bolts.
Remove the wheel cylinder.
4. Remove dust boots from each end of the cylinder.
5. Remove all internal parts by pushing them through the cylinder body.
6. Remove the rubber cap, bleeder screw them through ball.
7. Thoroughly clean the cylinder bore inlet and bleeder ports with isopropyl alcohol. Inspect for corrosion, scoring or ridges.

NOTICE

Replace the entire wheel cylinder assembly if a problem is found.

Reassembly

Wheel cylinder

1. Make sure that all parts are clean and all cleaning solvents have been removed.
2. Coat all internal parts with clean brake fluid,
3. Install internal parts as shown in diagram.
4. Install steel ball, bleeder screw and rubber cap.
5. Install dust boots over each end of the cylinder.
6. Mount cylinder on backing plate and install the two bolts.

Tightening torque: 9~9 lb-ft (10~13 N-m, 1.0~1.3 kg-m)

7. Connect brake line. Tighten the brake line flare nuts.

Tightening torque: 9~16 lb-ft (12~22 N-m, 1.3~2.2 kg-m)

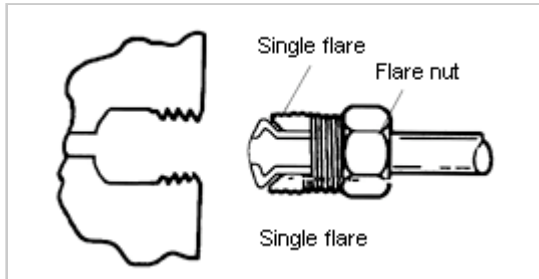
8. To install brake shoe assembly, removal and replacement procedure.



Inspection

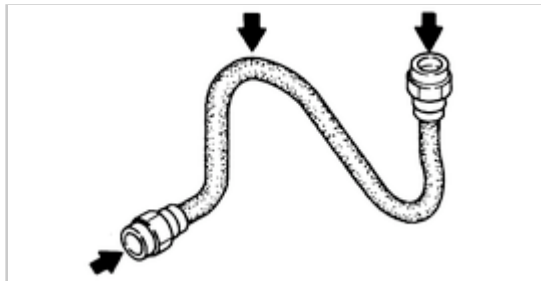
Brake pipe

1. Check for cracks, damage, and corrosion of brake pipe.
Replace pipe or flare nut(s) if necessary.



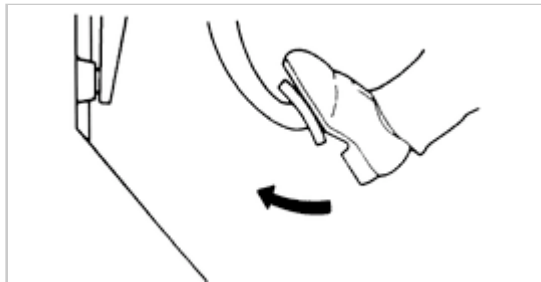
Flexible hose

1. Check for scars, cracks, and swelling of flexible hose.
Replace hose if necessary.



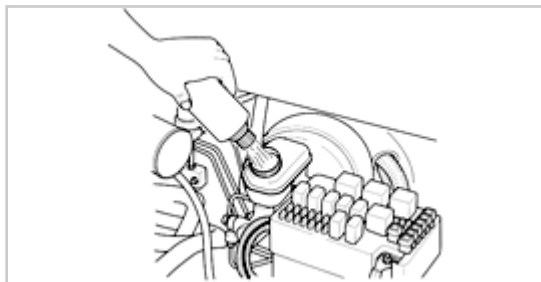
Brake fluid (Leakage inspection)

1. Depress brake pedal several times and inspect for leakage in brake line system.



Brake fluid level (Leakage check)

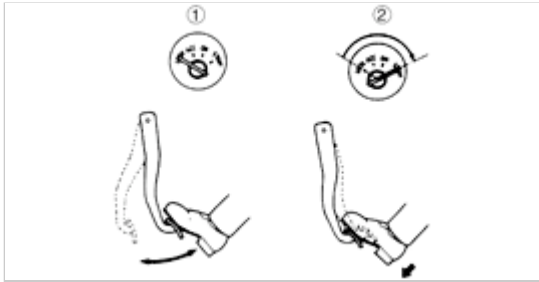
1. Verify that fluid level in reservoir is between Max and Min lines on reservoir.
Add fluid if it is below Min.



Power brake unit function check (simple method)

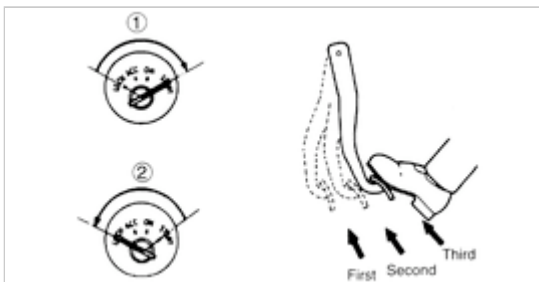
1. Step 1

- (1) With engine off, and depress the pedal a few times.
- (2) Start engine.
- (3) If pedal moves downward immediately after engine starts; it will be an indication for operation of power brake unit.



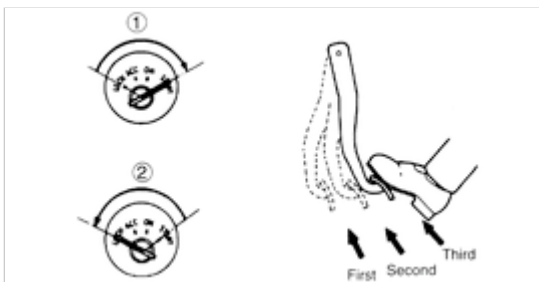
2. Step 2

- (1) Start engine.
- (2) Stop engine after 1 or 2 minutes.
- (3) Depress pedal with usual force.
- (4) If first pedal stroke is long and second stroke is shorter than first stroke, it will be an indication for operation of power brake unit.
- (5) If a problem is found, inspect of check valve or vacuum hose for damage and examine installation. Repair if necessary, and recheck.



3. Step 3

- (1) start engine
- (2) Depress pedal with usual force.
- (3) Stop engine.
- (4) Hold pedal down for about 30 seconds.
- (5) If pedal height does not change, unit is operating.
- (6) If there is a problem, inspect check valve or vacuum hose for damage, and check connection. Repair if necessary, and recheck.



If nature of problem is still under follow more detailed inspection described in "Method using tester". below.

Method using tester

Connect a pressure gauge, vacuum gauge, and pedal depression force gauge as shown in figure below. After bleeding air from pressure gauge, conduct test as described in next 3 steps.

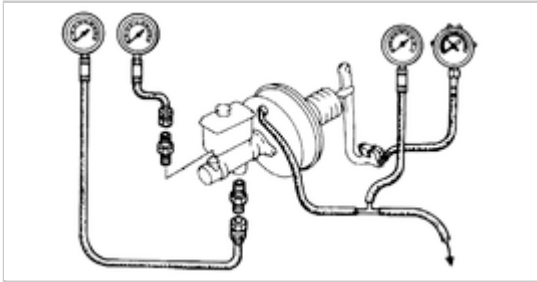
NOTICE

Use commercially available gauges and pedal depression force gauge.

1. Checking for vacuum loss

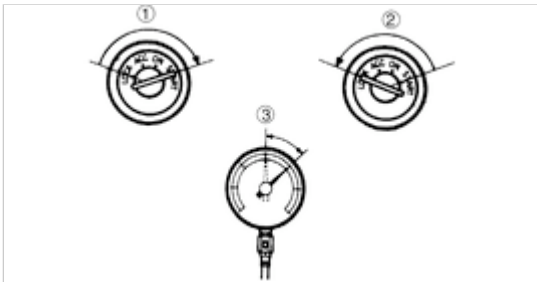
(1) Unloaded condition

A. Start engine.



B. Stop engine when vacuum gauge reading reaches 19.7 inHg (500 mmHg).

C. Observe vacuum gauge for 15 seconds. If gauge shows 18.7~19.7 inHg (475~500 mmHg) unit is operating.



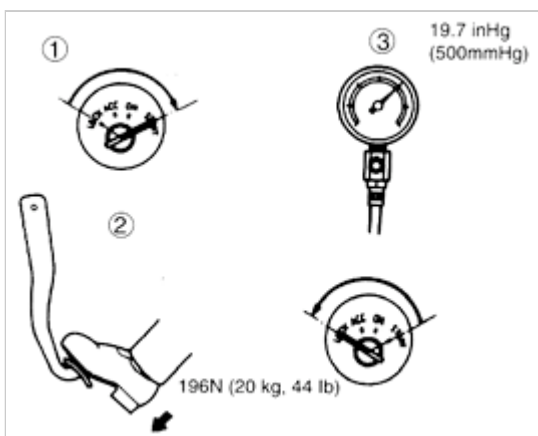
(2) Loaded condition

A. Start engine.

B. Depress brake pedal with a force of 44 lb-ft (196 N-m, 20 kg-m).

C. With brake pedal depressed, stop engine when vacuum gauge reaches 19.7 inHg (500 mmHg).

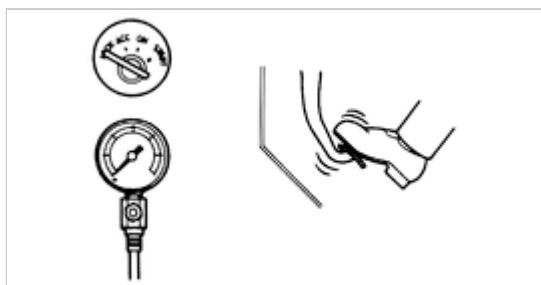
D. Observe vacuum gauge for 15 seconds. If gauge shows 18.7~19.7 inHg (475~500 mmHg) unit is operating.



2. Checking for hydraulic pressure

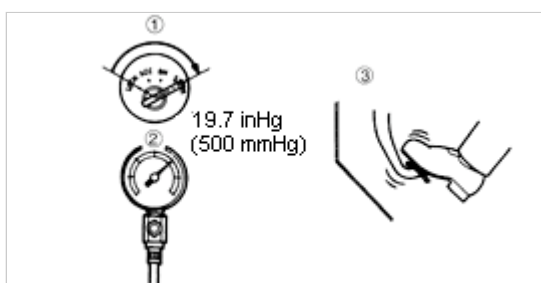
(1) If fluid pressure is within specification(vacuum 0mmHg). When engine is off, the unit is operating properly.

Pedal force	Fluid pressure
44 lb(196 N, 20 kg)	171 psi(1.177 kPa, 12 kg/cm ²) Min



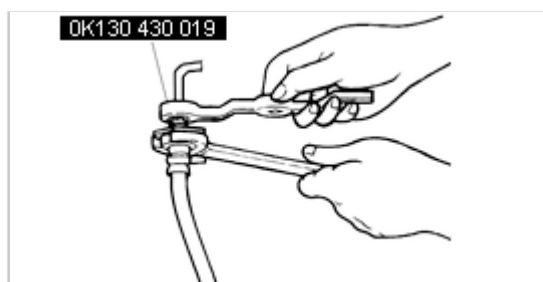
- (2) Start engine. Depress brake pedal when vacuum reaches 19.7 inHg (500 mmHg). If fluid pressure is within specification, unit is operating.

Pedal force	Fluid pressure
44 lb(196 N, 20 kg)	171 psi(1.177 kPa, 12 kg/cm ²) Min



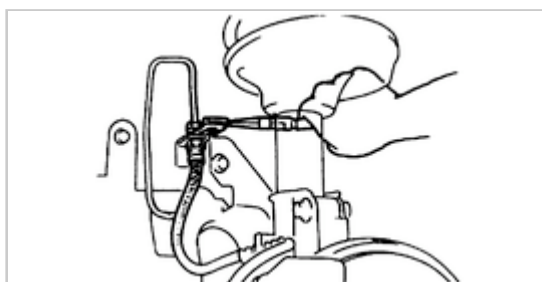
Removal

1. Remove brake pipe with SST(0K 130 430 019).
2. Disconnect clip and removal flexible hose from bracket.



Installation

1. Place flexible hose in bracket and connect it to clip to it.

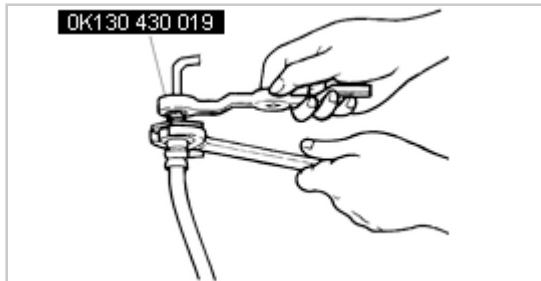


2. Connect flexible hose to brake pipe and tighten flare nut with SST (0K130 430 019).

CAUTION

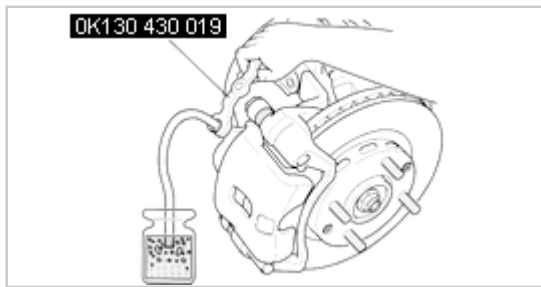
- 1) verify that hose is not twisted.
- 2) verify that hose does not touch other parts when vehicle bounces or when steering wheel is turned fully right or left.

Tightening torque: 9~16 lb-ft (13-22 N-m, 1.3-2.2 kg-m)



Replacement

1. Follow procedure outline in air bleeding.
2. Continue bleeding and replacing the brake fluid until only clean fluid is expelled.
3. Fill reservoir to Max level.



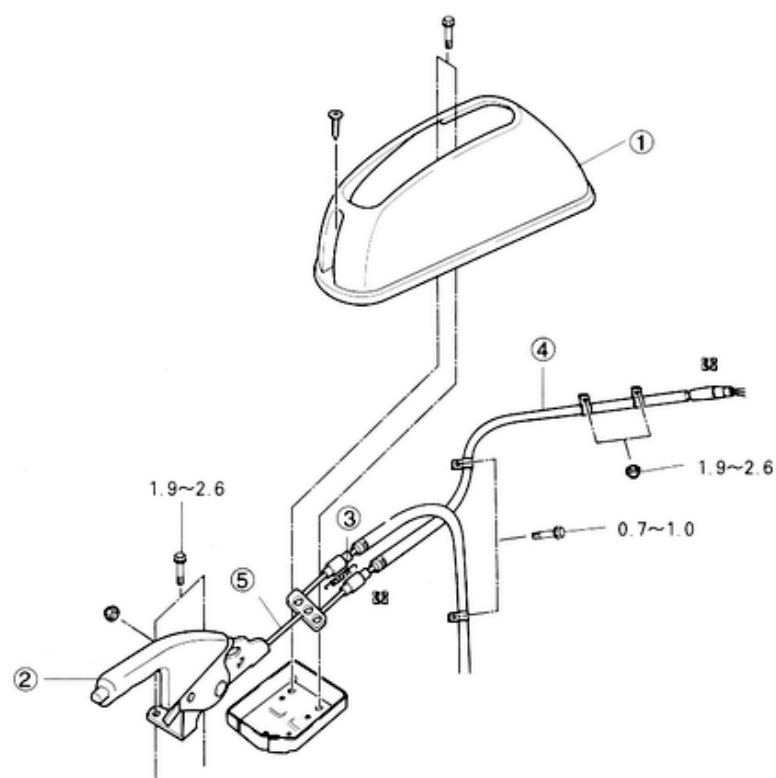


Brake System

Parking Brake System



Component



- (1) Console
- (2) Parking brake lever
- (3) Return spring

- (4) Parking cable-rear
- (5) Parking cable-front



Removal

NOTICE

Install parking brake switch so that it contacts parking brake lever when the lever fully release.

1. Remove the console.
2. Disconnect the parking brake switch.
3. Remove adjuster nut.
4. Remove two mounting bolts holding lever assembly to floorpan.

NOTICE

If vehicle has recently been running, exhaust system will be extremely hot.

5. Remove return spring and unlatch the two rear parking cables from front parking cable balance bar.
6. Pull front parking brake cable out of rubber feed through.
7. If one or both rear parking brake cables are to be removed, remove retaining clip attaching forward end of rear cable to vehicle floor pan.
8. Remove the bolt and two nuts attaching each rear parking cable to floor pan and trailing link.
9. Remove the cable-to-backing plate retaining clip.
10. Disconnect cable and from rear brake shoe and pull cable out of backing plate.
Removal and replacement procedure to remove rear brake shoe.

Installation

1. Feed rear parking cable end into backing plate and install its retaining clip.
2. Attach rear parking cable end to rear brake shoe and install brake assembly.
Removal and replacement procedure.
3. Attach rear parking cable to trailing link and floor pan with bolt and two nuts. Tighten bolts to specification.

Tightening torque:

Bolts : 5.25~7.5 lb-ft (7~10 N-m, 70~100 kg-cm)

Nut: 14~19 lb-ft (19~26 N-m, 1.9~2.6 kg-m)

4. Attach forward end of rear parking cable to floor pan with a push-on clip.
5. If front cable assembly was removed, insert its forward end through grommet and connect rear brake cable to front parking cable's balance bar.
6. Front inside vehicle, insert front cable end into parking brake lever assembly and install cable adjuster nut.
7. Fasten cable adjuster with its clip.
8. If removed, install parking brake switch with its screw.
9. Attach lever assembly to floor pan with two bolts.
Tighten bolts to specification.

Tightening torque: 14~19 lb-ft (19~26 N-m, 1.9~2.6 kg-m)

10. Adjust parking brake.
11. Connect the parking brake switch.

12. Install console.

NOTICE

Turn ignition switch ON and check that parking brake warning lamp illuminates with lever pulled back one notch.

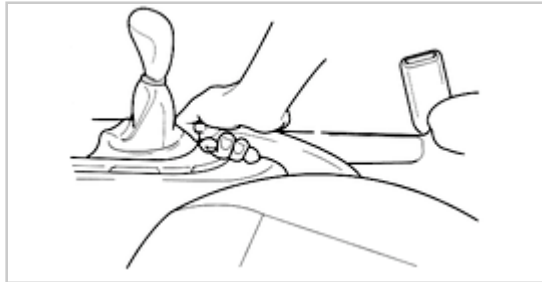


Inspection

Parking brake (Lever type)

1. Check that stroke is within specification when parking brake lever is pulled with a force of 22 lb-ft(98 N-m, 10 kg-m).

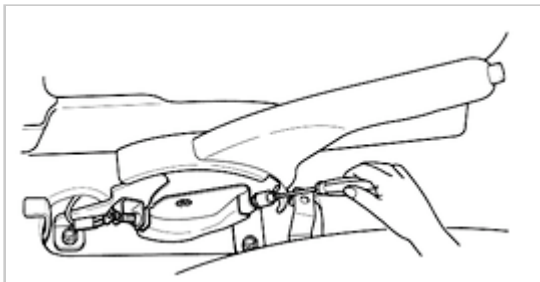
Stroke : 5~7 notches



Adjustment

Parking brake (Lever type)

1. Before adjustment, start engine and depress brake pedal several times while vehicle is moving in reverse.
2. Stop engine.
3. Remove console.
4. Turn adjusting nut at the front of parking cable.
5. After adjustment, check following items:
 - A. Turn ignition switch ON, pull parking brake lever back one notch, and check that parking brake warning lamp illuminates.
 - B. Verify that rear brakes do not drag.



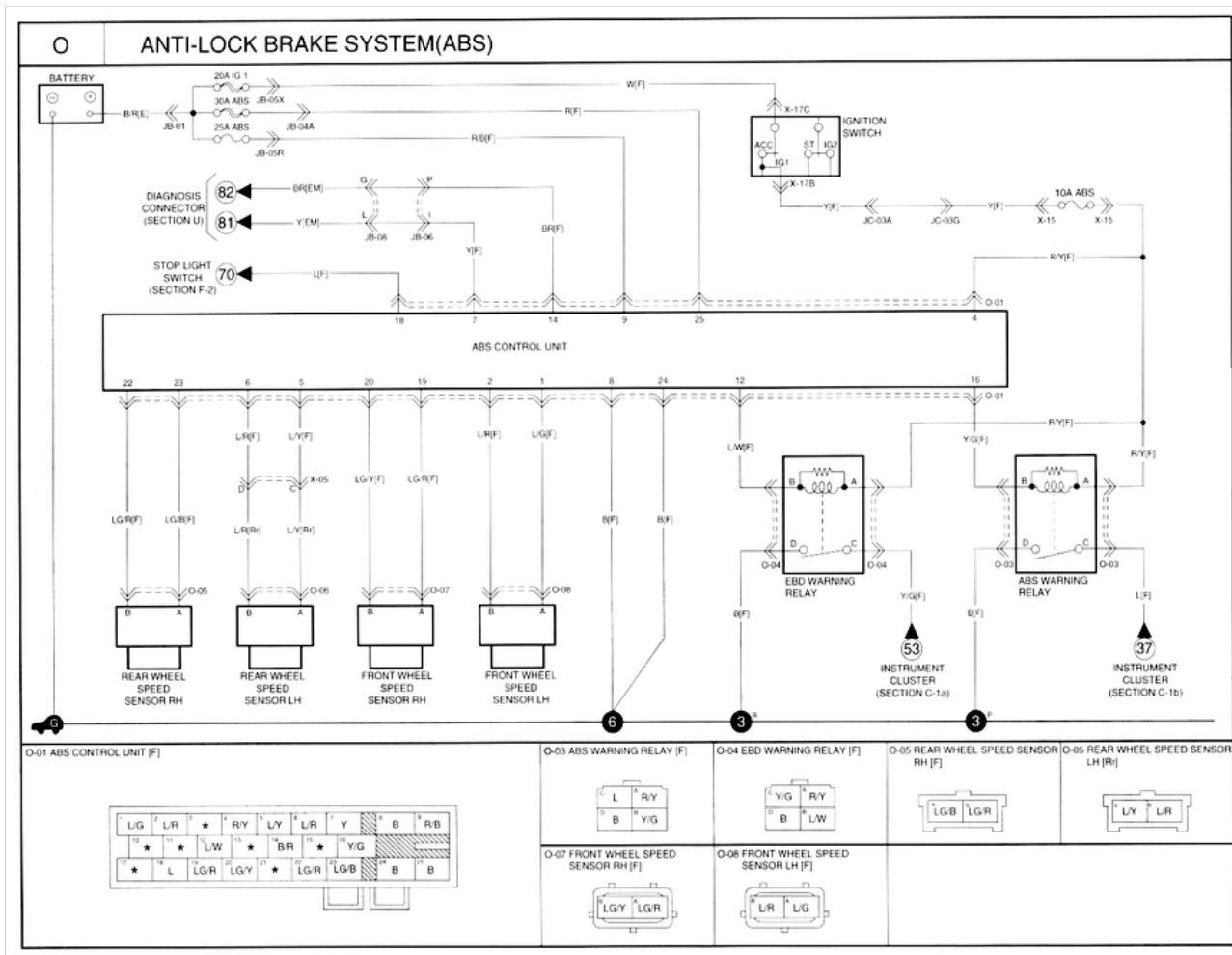


Brake System

ABS(Anti-Lock Brake System)



Wire harness diagram structure





Description and operation

Anti-lock brake system (ABS)

The anti-lock brake system (ABS) is designed for prevents wheels from locking due to excessive brake efforts.

Main functions of the ABS are;

- To reduce braking distance by avoiding wheels from locking.
- To improve stability of steering and handling by avoiding slip during braking.

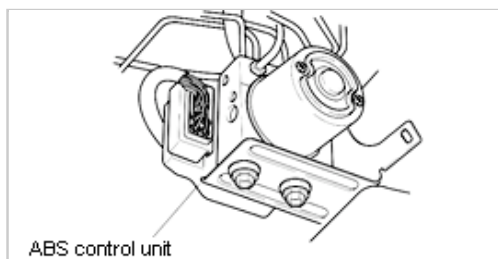
Type of 4-sensors and 3 channel is introduced so that front wheels control each wheel independently and rear wheels control by type of select low (controlling hydraulic pressure on side on which slip is first occurred.)

ABS control unit

The ABS control unit performs the following functions.

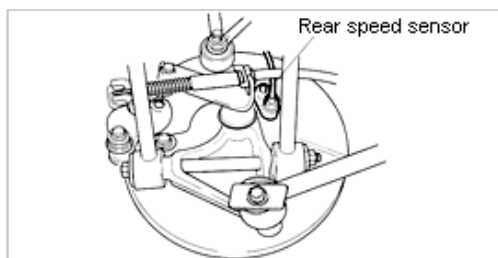
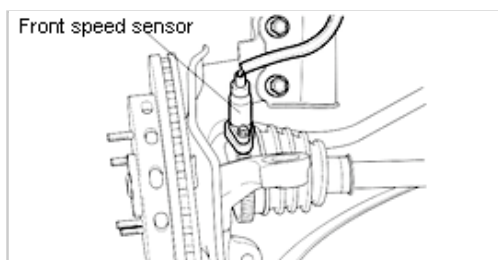
- Controls the ABS
 - Calculates vehicle speed
 - Self-diagnostics: Stores malfunction codes, performs ABS control unit self-diagnostic and fail-safe functions with two separated microprocessors.
1. The ABS control unit continuously checks locking of each wheel and controls each valve to adjust brake fluid pressure if required. The ABS control unit also checks that components are working properly and stops ABS if a malfunction is detected.

Then, it is operated as a standard brake system.



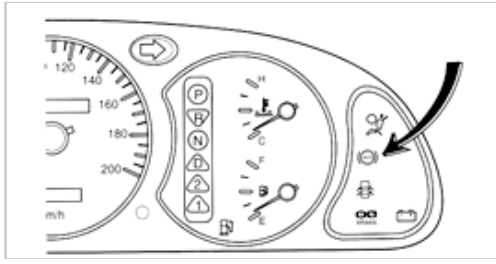
Speed sensor (structure)

1. The speed sensor detects wheel rotation and consists of a permanent magnet and pickup coil. Sensors for the front wheels are attached to drive shaft and rear hub spindle for the rear wheel.



ABS warning lamp

1. The ABS warning lamp in the instrument panel illuminates for 3 seconds after ignition key is turned ON. If the warning lamp does not turn off, or turns on intermittently, there is a malfunction in ABS. When a malfunction of ABS occurs, the ABS will not operate and the brakes will operate as a standard brake system.



Hydraulic control unit (HCU)

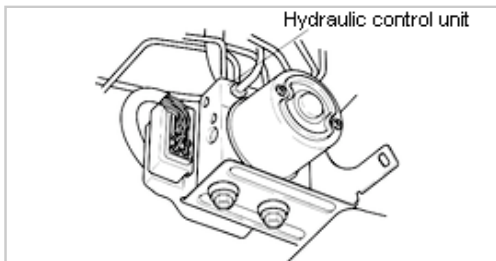
1. The HCU consists of a motor pump assembly in which motor sensor is built, and valve block for controlling ABS pressure.
Motor sensor is built in motor, and output signal, which detects condition of a motor pump assembly, is sent to ABS control unit.

Reference

Diameter of front brake pipe holepitch: FL, RL: 0.47 in (12 mm)

Diameter of rear brake pipe holepitch: FR, RR: 0.39 in (10 mm)

The motor pump is a reciprocal 2-line pump and transmits enough pressure to the wheel system, and the valve block controls fluid pressure to each wheel cylinder.

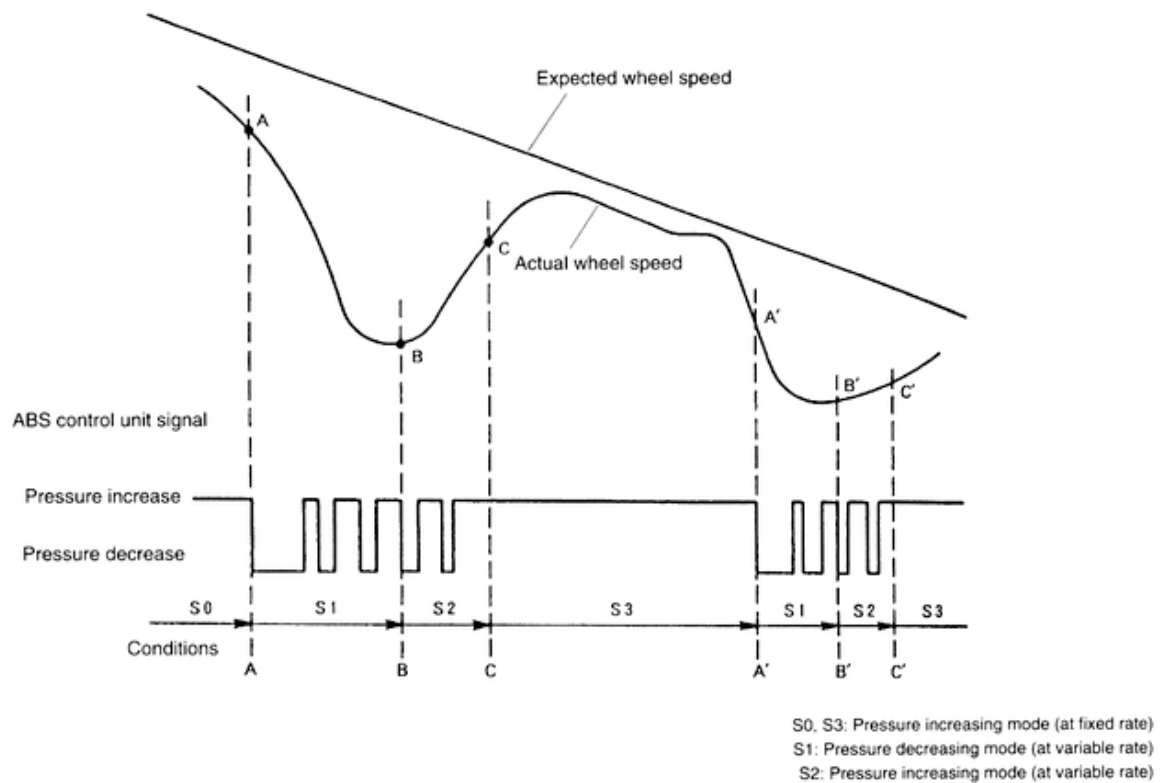


ABS module

The ABS module illuminates the ABS warning lamp when an ABS failure occurs.

Type of operation

Under normal conditions, the standard brake system performs until locking of a wheel is detected by the ABS control unit.

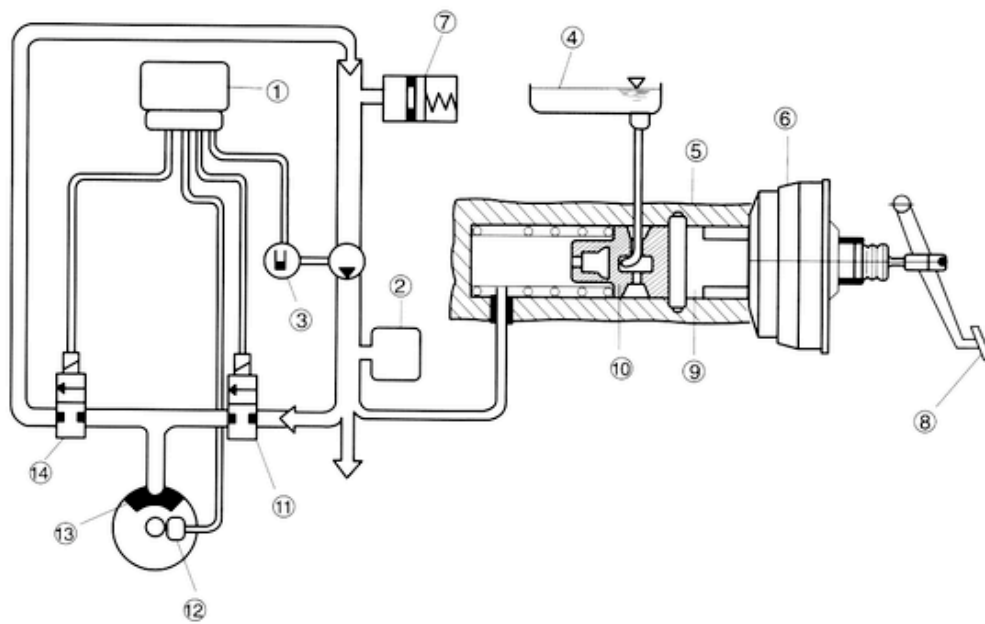


For vehicles with ABS, the following symptoms can occur, but indicate normal operation of the ABS.

Symptom	Descriptions
Motor noise	Noise can be heard when ABS hydraulic unit is operated.
Noise from suspension system	Since braking is done in 3 steps during operation of ABS, noise from suspension system can be heard.
Oscillation of brake pedal	Slight oscillation (kickback) on brake pedal occurs during operation of ABS.

Principle of operation

Standard braking (Non-ABS braking)

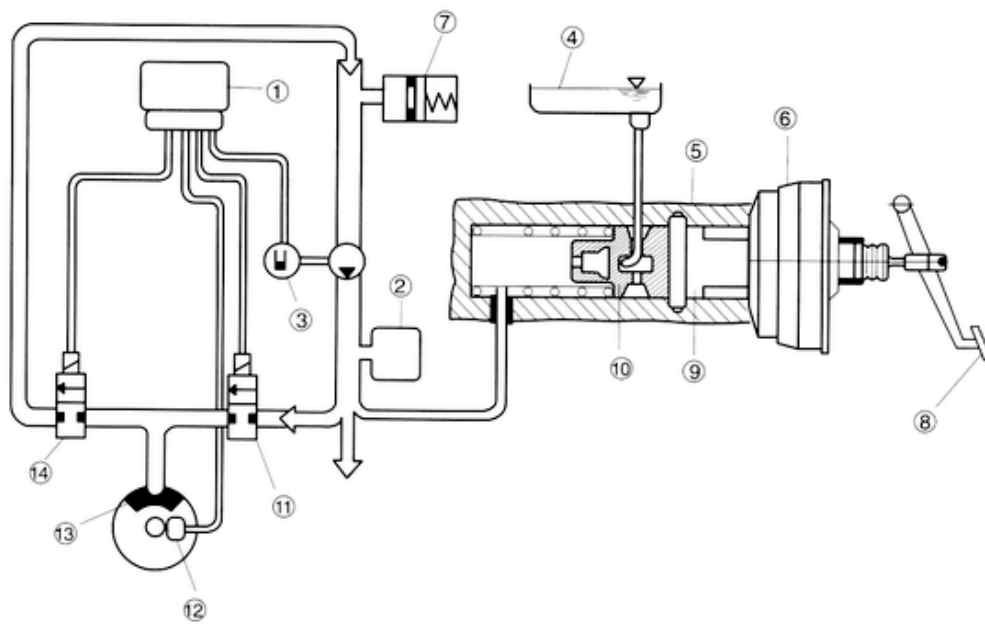


- (1) ABS control unit
- (2) Damping chamber
- (3) Motor pump unit
- (4) Brake reserve tank
- (5) Master cylinder
- (6) Master vacuum
- (7) Pressure accumulator

- (8) Brake pedal
- (9) Primary piston
- (10) Central valve
- (11) Inlet valve
- (12) Wheel speed sensor
- (13) Caliper
- (14) Outlet valve

When the brake pedal is depressed, the power brake unit closes the central valve of the master cylinder and generates pressure on the brake hydraulic pressure line. This opens the solenoid inlet valve and closes the outlet valve and transmits hydraulic pressure from the master cylinder to the wheel cylinders.

ABS braking (2.1 Maintaining pressure)

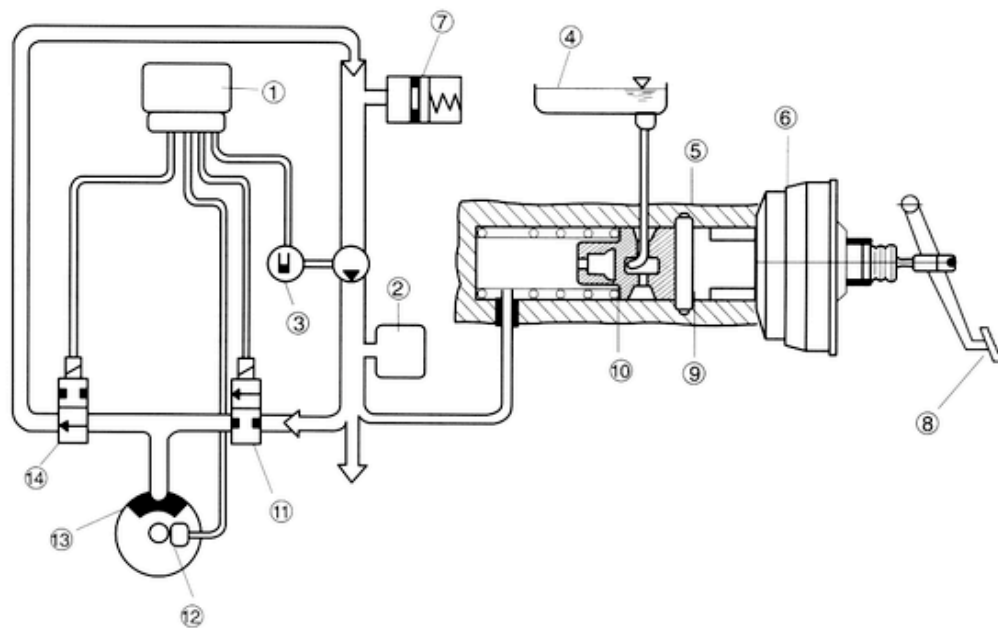


- (1) ABS control unit
- (2) Damping chamber
- (3) Motor pump unit
- (4) Brake reserve tank
- (5) Master cylinder
- (6) Master vacuum
- (7) Pressure accumulator

- (8) Brake pedal
- (9) Primary piston
- (10) Central valve
- (11) Inlet valve
- (12) Wheel speed sensor
- (13) Caliper
- (14) Outlet valve

After the ABS control unit detects wheel lock due to excessively increased pressure, the ABS control unit closes the inlet valve to avoid further increase in hydraulic pressure.

ABS braking (2.2 Decreasing pressure)

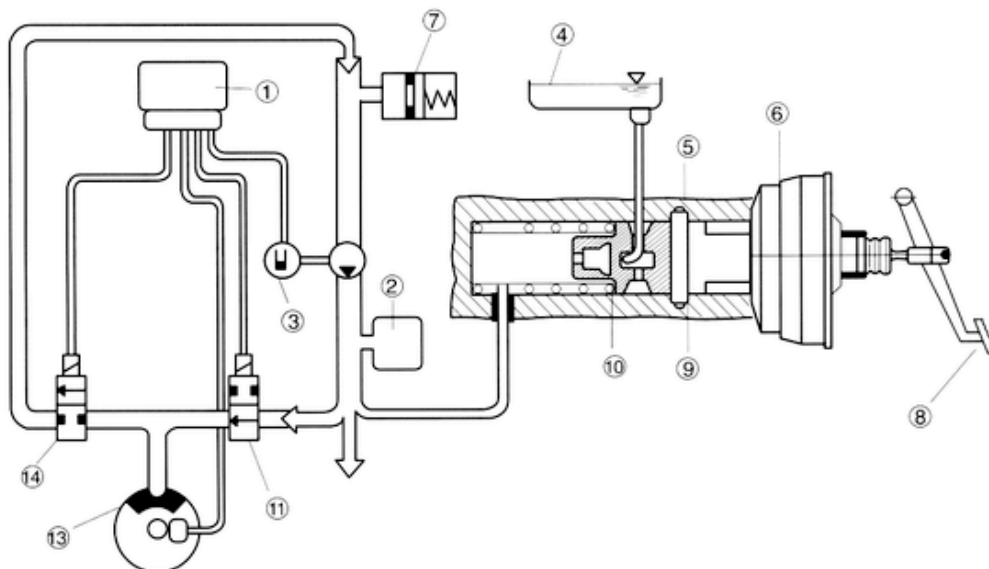


- (1) ABS control unit
- (2) Damping chamber
- (3) Motor pump unit
- (4) Brake reserve tank
- (5) Master cylinder
- (6) Master vacuum
- (7) Pressure accumulator

- (8) Brake pedal
- (9) Primary piston
- (10) Central valve
- (11) Inlet valve
- (12) Wheel speed sensor
- (13) Caliper
- (14) Outlet valve

If lock wheel continues, the ABS control unit opens the corresponding outlet valve so that brake fluids flow to the pressure accumulator. This reduces pressure only for wheels that are locked.

ABS braking (2.3 Increasing pressure)

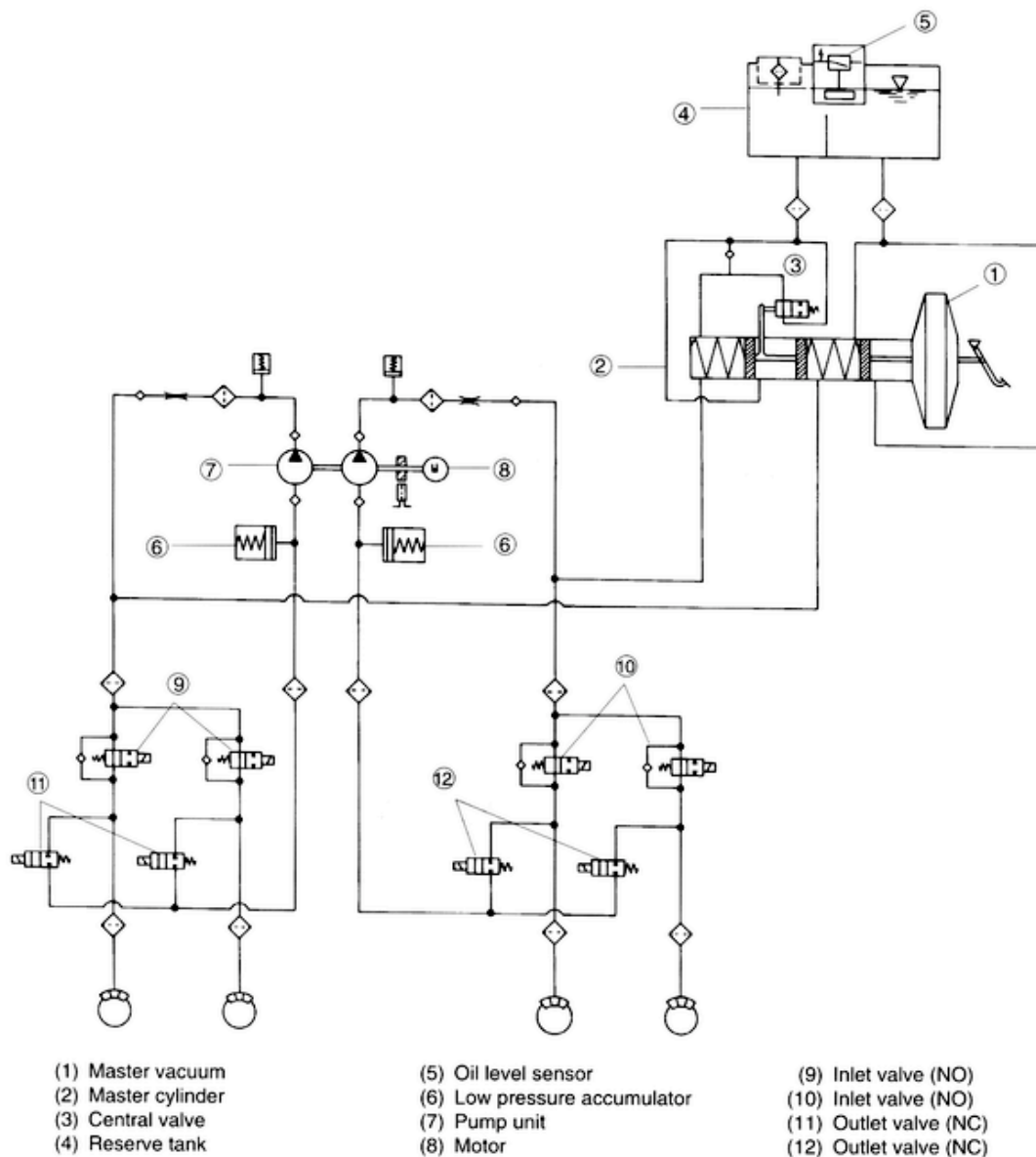


- (1) ABS control unit
- (2) Damping chamber
- (3) Motor pump unit
- (4) Brake reserve tank
- (5) Master cylinder
- (6) Master vacuum
- (7) Pressure accumulator

- (8) Brake pedal
- (9) Primary piston
- (10) Central valve
- (11) Inlet valve
- (12) Wheel speed sensor
- (13) Caliper
- (14) Outlet valve

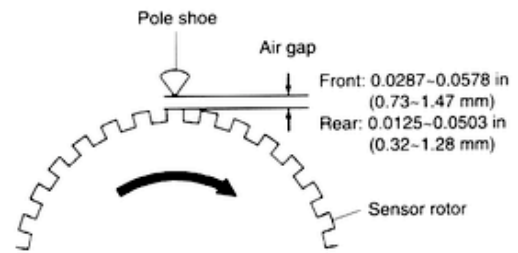
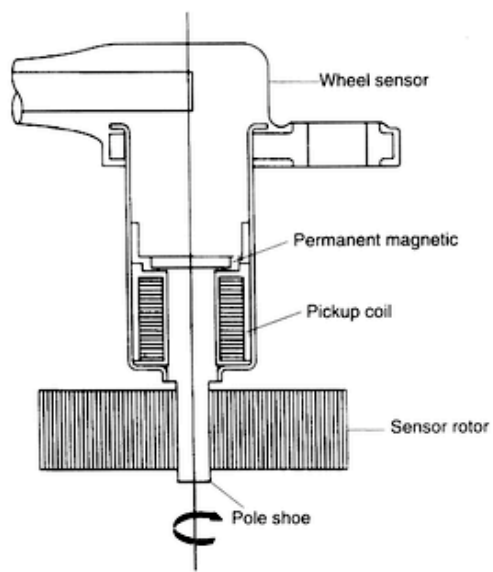
When wheels have been returned to normal speed from locking, the ABS control unit stops operating the solenoid valve and returns to standard braking operation.

Hydraulic circuits



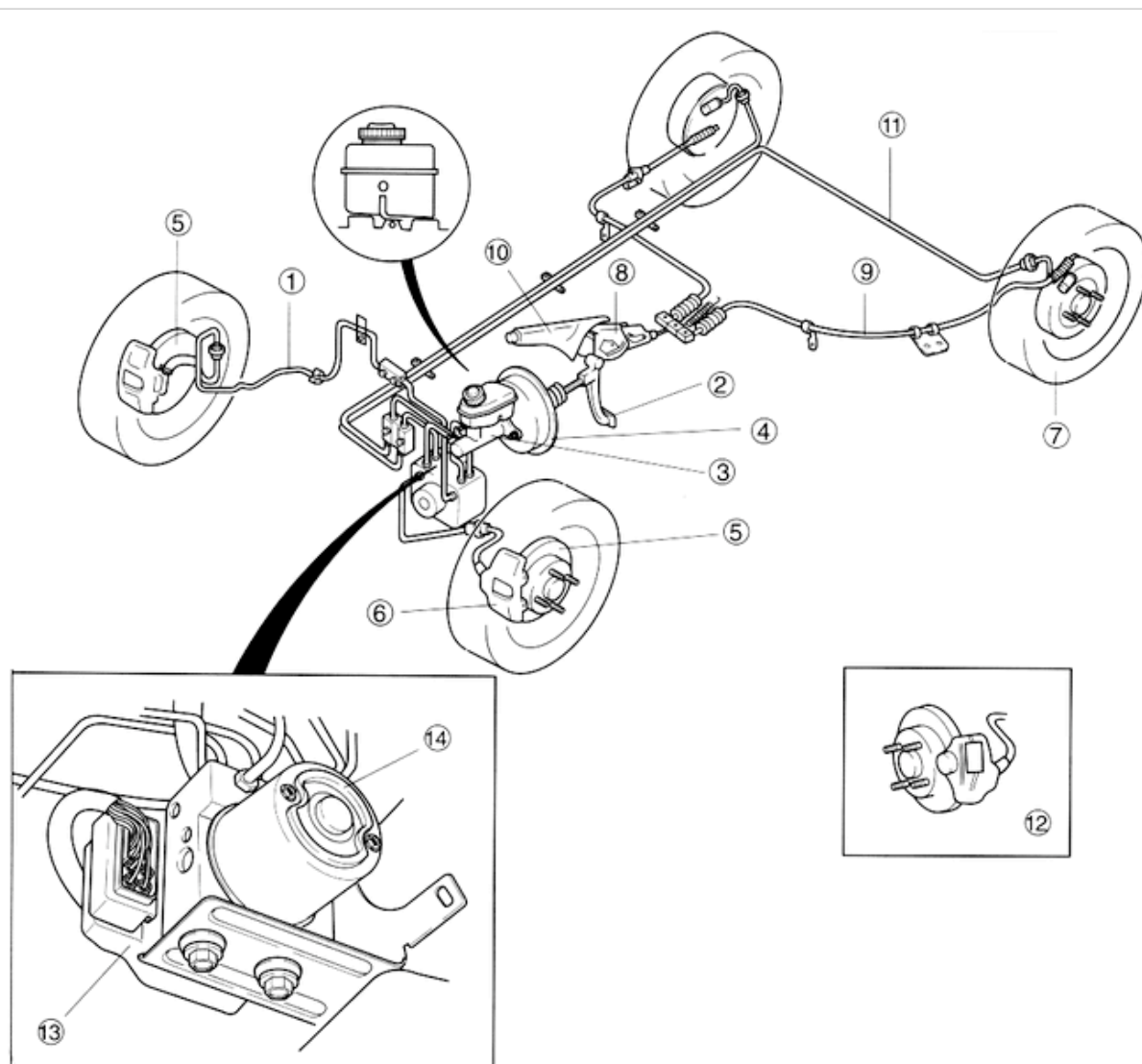
Operation

Since teeth of sensor rotor change magnetic field of sensor, it generates alternative voltage. This Voltage is proportional to rotating speed and its period can be changed. If can sense speed of wheel by detecting period.





Component



- (1) Brake hydraulic line
- (2) Brake pedal
- (3) Master cylinder
- (4) Power brake unit
- (5) Front disc brake
- (6) Caliper
- (7) Rear drum brake

- (8) Parking brake
- (9) Parking brake cable
- (10) Parking brake lever
- (11) Brake hose
- (12) Rear disc brake (ABS)
- (13) ABS control unit (ABS)
- (14) HCU (ABS)



Brake System

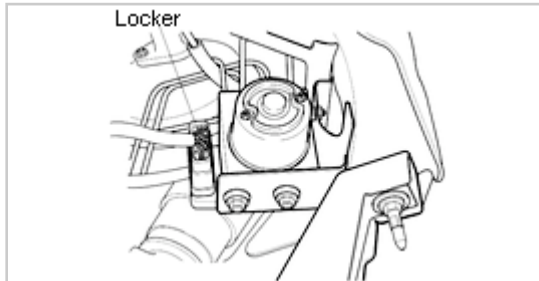
ABS(Anti-Lock Brake System) - ABS Control
Module



Removal

Hydraulic control unit (HCU) assembly

1. Disconnect the negative battery cable from the battery
2. Pull up the locker to remove the unit connector.



3. Disconnect the six brake lines (2 inlet and 4 outlet) using a flare nut wrench. Be prepared to catch escaping brake fluid. Temporarily seal open brake lines with plastic caps or equivalent.
4. Remove hydraulic control unit bracket bolts and nut on the vehicle remove unit bracket.
5. Temporarily seal open brake line ports with plastic plugs or equivalent.
6. Store the hydraulic control unit in a protective container while it is being serviced.

Installation

Hydraulic control unit (HCU) assembly

1. Install Hydraulic Control Unit into position and tighten the bolts and nut.

Tightening torque: 6~9 lb-ft (8~12 N-m, 80~120 kg-cm)

2. Reconnect six brake lines. Be certain that the four lower outlet lines have been connected to the correct ports. Tighten the nuts to specification.

Tightening torque: 9~16 lb-ft (12~22 N-m, 1.3~2.2 kg-m)

3. To hydraulic control unit and connect Hydraulic Control Unit connector. Be certain connectors are fully mated.
4. Bleed the brake system using ABS procedure described in Brake System Bleeding.



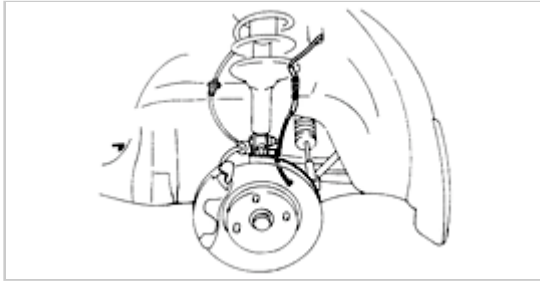
Brake System

ABS(Anti-Lock Brake System) - Front Wheel
Speed Sensor

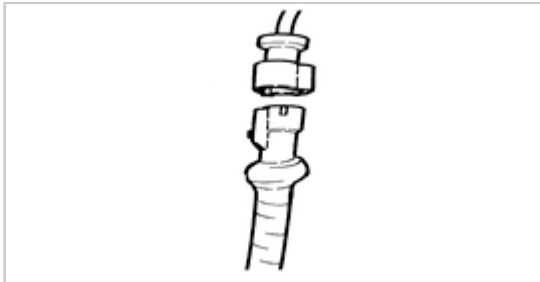


Removal

1. Disconnect the negative battery cable from the battery.

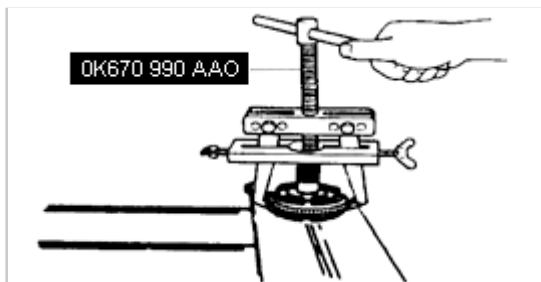


2. After removing trim, remove the wheel speed sensor and connector in the engine room.



Removal

1. Remove the drive shaft assembly from the vehicle.
2. Remove the sensor rotor with SST (0K670 990 AA0).



Installation

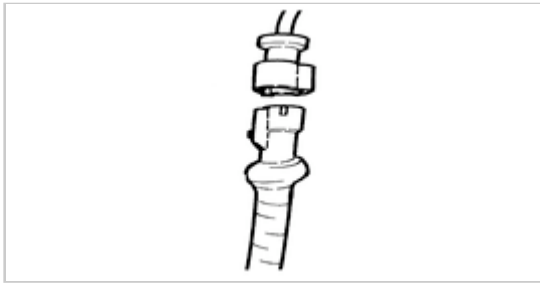
1. Install wheel speed sensor and connector.

Tightening torque: 6~7 lb-ft (8~10 N-m, 0.8~1.0 kg-m)

2. Install trim.
3. Connect the negative battery cable to the battery.

NOTICE

A shield wire is used to prevent interruption of the input signal from the wheel speed sensor. Return the wire to its original position after repair.



Installation

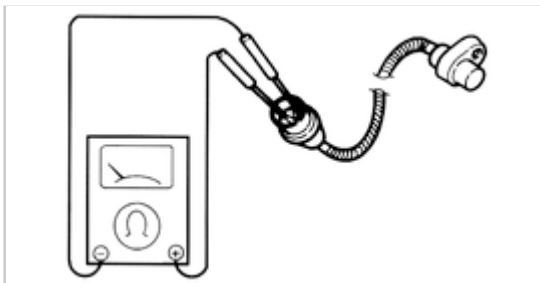
1. Install the sensor rotor with a suitable tool.

Inspection

1. Measure the resistance of the wheel speed sensor.

Resistance : 1.0~1.3 K Ω

2. Replace the wheel speed sensor if necessary.

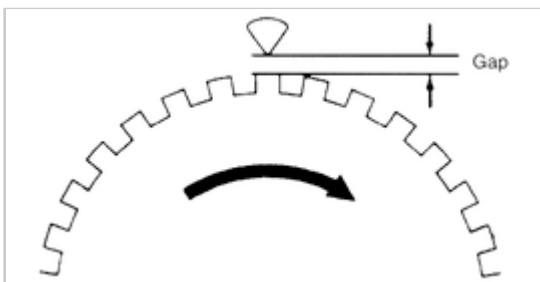


Inspection

1. Check rotor for damage.
2. Check if gap between rotor and sensor meets the specified value.

Gap : 0.0287~0.0578 in (0.73~1.47 mm)

3. Replace the sensor rotor if necessary.





Brake System

ABS(Anti-Lock Brake System) - Rear Wheel
Speed Sensor

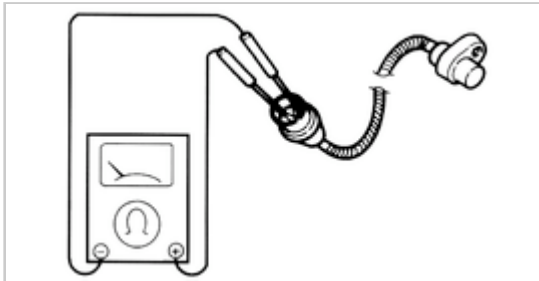


Inspection

1. Measure the resistance of the wheel speed sensor.

Resistance : 1.0~1.3 K Ω

2. Replace the wheel speed sensor if necessary.

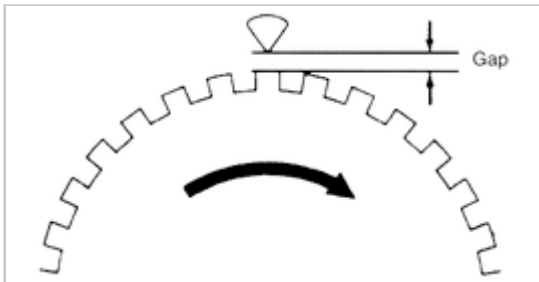


Inspection

1. Check rotor for damage.
2. Check if gap between the rotor and sensor meets the specified value.

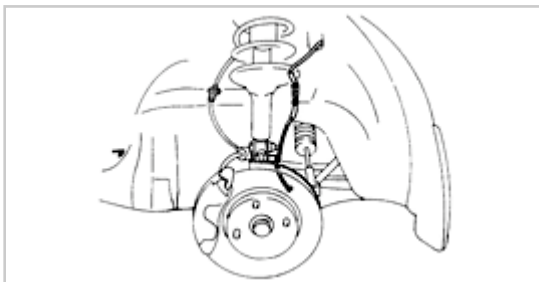
Gap: 0.0125~0.0503 in (0.32 ~ 1.28 mm)

3. Replace the sensor rotor if necessary.

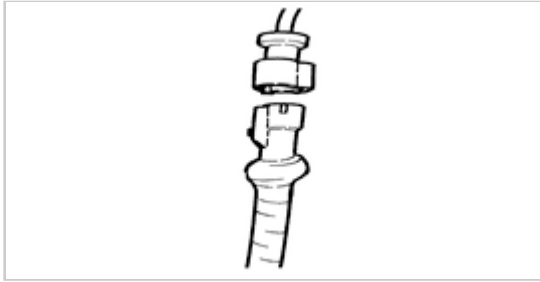


Removal

1. Disconnect the negative battery cable from the battery.

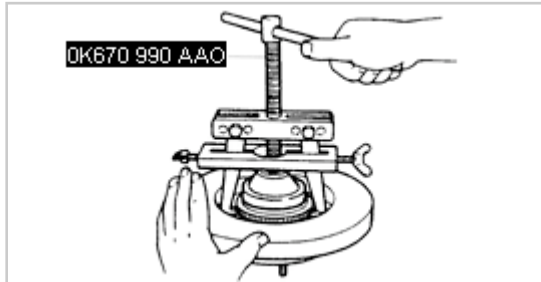


2. After removing trim, remove the wheel speed sensor and connector in the engine room.



Removal

1. Remove the rear wheel hub assembly from the vehicle.
2. Remove the sensor rotor with SST(0K 0670 990AA0).



Installation

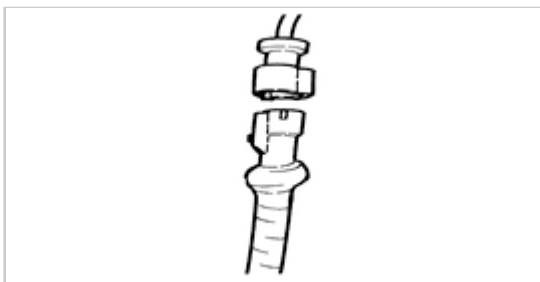
1. Install wheel speed sensor.

Tightening torque: 6~7 lb-ft (8~10 N-m, 0.8~1.0 kg-m)

2. Install wheel sensor connector.
3. Connect battery cable.

NOTICE

A shield wire is used to prevent input signal from the wheel speed sensor. Return the wire to its original position after repair.



Installation

1. Install a sensor rotor with a suitable tool.
2. Install the rear wheel hub assembly.



General diagnostics and tests

Self-diagnosis

The ABS control unit starts self-diagnostic functions after the ignition is switched ON. The ABS control unit detects failure for each circuit and component by comparing condition of the system with limited condition set inside the ABS control unit. The ABS control unit stores the failure code and then outputs the two-digit malfunction code to the diagnosticscan tool (Hi/Scan pro) when the ABS data link connector is connected.

Self-diagnosis procedures

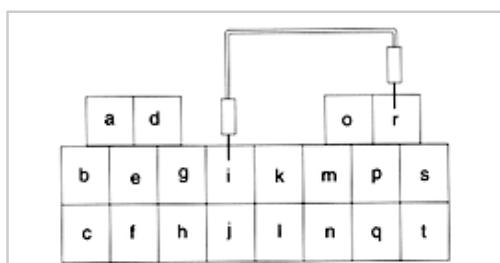
1. With the ignition switch OFF, connect the diagnostic scan tool (Hi/Scan pro) to the data link connector in the engine compartment.
2. Turn the ignition switch ON, then check diagnostic trouble code(s).
3. If a diagnostic trouble code(s) is displayed, check for cause by using number on diagnostic trouble code. Repair as necessary.
4. After repair, perform after-repair procedure to verify that there are no remaining diagnostic trouble codes.



NOTICE

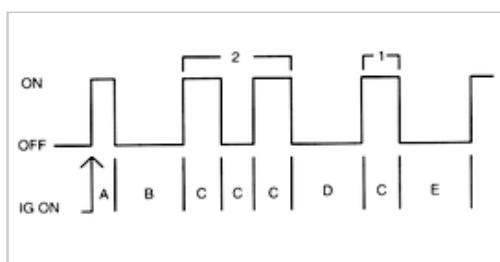
If Hi/Scan pro is not available, check the blinking code by the ABS warning lamp.

- 1) Ground the pin "l" and "r" of data link connector in the engine compartment with the ignition switch OFF.
- 2) Turn ignition switch ON.



NOTICE

- 1) Diagnostic trouble code will be displayed from small number.
- 2) If all memorized diagnostic trouble codes are displayed, it will be resumed from the beginning. (Blinking code. (Ex:21))



A: 0.1 Seconds

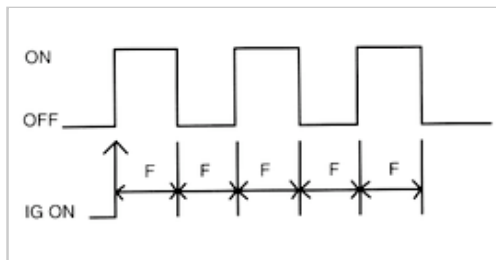
NOTICE

ABS warning lamp is on for 0.1 second at the time of the IG switch ON. It's not error code.

- B: 4 Seconds
- C: 0.5 Seconds
- D: 1.5 Seconds
- E: 2.5 Seconds or 4 Seconds

NOTICE

- The OFF state between diagnostic trouble code display cycles is 4 seconds.
- For several diagnostic trouble codes displayed, the OFF state between codes is 2.5 seconds.
- e) Normal code



F: 0.25 Seconds

NOTICE

If the system is operating normally (no malfunction) the warning lamp will blink once every 0.25 second.

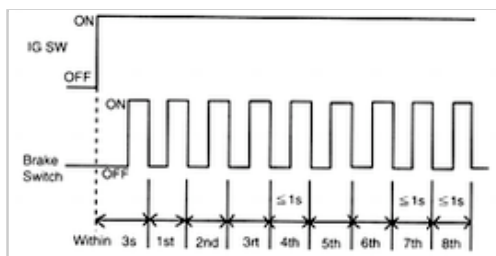
After-repair procedures

1. After repair, erase all diagnostic trouble codes stored in the ABS control unit with Kia power scan. (Refer to Kia power scan operating manual)
2. Verify that no diagnostic trouble codes are displayed.
3. Remove Kia power scan from the data link connector.

NOTICE

If Kia power scan is not available, to erase the diagnostic trouble code from ABS control unit, perform the following instructions.

- 1) Ground the pin "I" and "r" of data link connector in the engine compartment at ignition switch OFF.
- 2) Turn ignition switch ON.
- 3) Activate and deactivate the brake switch within certain timing frame more than 8 times as following so that diagnostic trouble codes can be erased.



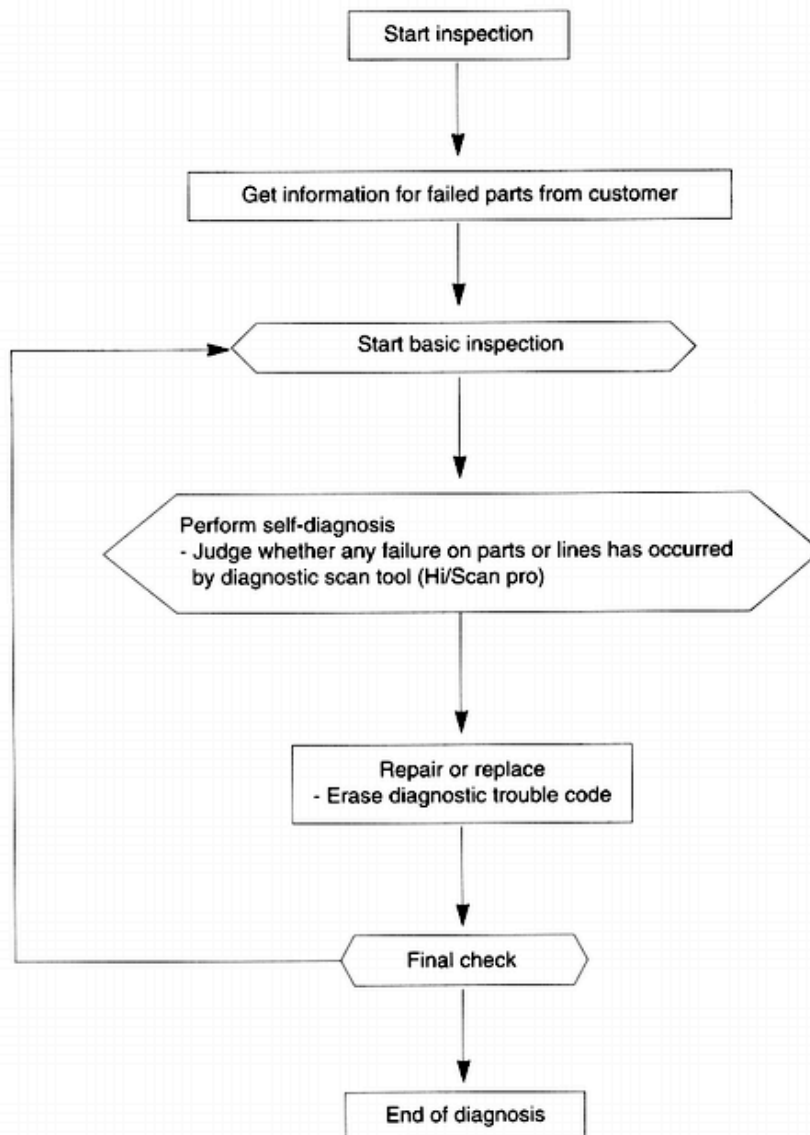
NOTICE

- 1) If the brake switch input is not changed (ON → OFF) within 3 Seconds at the beginning or each of brake input signal change doesn't happen within 1 Second, diagnostic trouble code display mode will be continued. Furthermore, in the case of vehicle speed (Max.) ≥ 6.2 mph (10 km/h), it will be transferred to normal ABS

mode.

- 2) After diagnostic trouble code are erased, if there is still problem in the system, ABS warning lamp will stay as "ON" state. If not, normal code will be read out.

How to use diagnosis and troubleshooting



Precaution before repairing

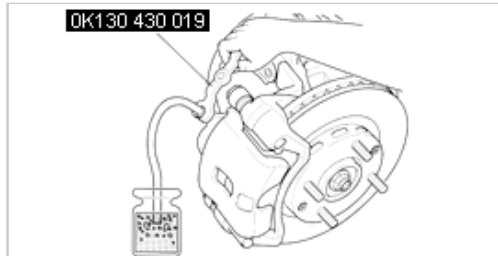
1. To prevent damage to the system, follow procedures below before repair or diagnosis.
 - A. Disconnect or connect each component (ABS CU, HCU assembly, etc.) with ignition switch OFF.
 - B. For failure of components which is not specified for repair, replace those as assembly.
 - C. When using an electric arc welding machine, disconnect each component (ABS CU, HCU assembly).
2. Do not spill brake fluid on painted surfaces, wiring, cables or connectors. If fluids damage painted surfaces of connectors, remove using a mop and water.

Air bleeding (CBS)

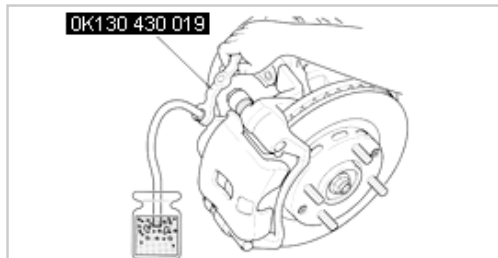
After finishing repair on a hydraulic line (removing brake pipe), bleed air out of the line. Refer to the following:

1. When bleeding air from lines, keep fluid level in reservoir to Max position.
2. Bleed air in the following order:

Right front wheel, Left front wheel,
Right rear wheel, Left rear wheel

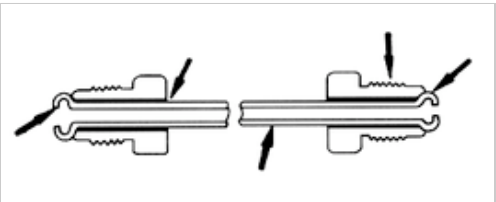


3. During air bleeding, depress brake pedal least ten times, Keep the pedal depressed for three seconds to fill the master cylinder.
4. To avoid brake fluids from spouting, install the cap of the reserve tank prior to air bleeding.
5. Keep vehicle level.



Basic inspection (Visual observation)

Step	Inspection	Actions	
1	Check if parking brake is working properly.	Yes	Go to next step.
		No	- Repair or replace lever/cable. - Inspect parking brake switch - Check operation.
2	Check if brake fluid level in the reservoir tank is between "Max" and "Min". 	Yes	Go to next step.
		No	Fill up brake fluids.
3	Check if brake fluid leak on all hydraulic lines.	Yes	Replace corresponding part.
		No	Go to next step.

			
4	Check if each "ABS" (30A) fuse is properly connected. - Opened or shorted - Connection	Yes	Go to next step.
		No	Replace it.
5	Check if following component is properly connected. - Wheel speed sensor - Hydraulic control unit (Include ECU) - Brake fluids reserve tank - Stop lamp switch - ABS warning module	Yes	Check functions.
		No	Connect it again. Repair or replace it.

Checking functionality

Step	Inspection		Actions
1	Verify if ABS warning lamp turns on for two to four seconds when ignition is switched ON.	Yes	Go to next step.
		No	Go to detail inspection.
2	Verify if brake warning lamp turns off when parking brake is released.	Yes	Go to next step.
		No	- Check level of brake fluids. - Inspect brake pipes, hoses, wheel cylinder, seal and leak at master cylinder.
3	Check for malfunction code using diagnostic tool(Hi/Scan pro).	Yes	Go to corresponding detail inspection.
		No	Go to next step.
4	Go to step 3 again after driving vehicle, and check for a malfunction code.	Yes	Go to corresponding detail inspection.
		No	- Check each connector and connections. - System OK.

Diagnostic trouble codes

DTC	Failed part	Possible cause
00	No error	-
11	Valve relay circuit open	● Open between Fuse Box and ABS control unit.
12	Valve relay circuit short	● Short between Fuse Box and ABS control unit.
13	Motor relay circuit open	● Open between Fuse Box and ABS control unit.
14	Motor relay circuit open	● Short between Fuse Box and ABS control unit.
21	Valve (IFR)	● Open or short between Fuse Box and ABS control unit. ● Valve malfunction.
22	Valve (OFR)	
23	Valve (IFL)	
24	Valve (OFL)	
25	Valve (IRR)	
26	Valve (ORR)	
27	Valve (IRL)	
28	Valve (ORL)	

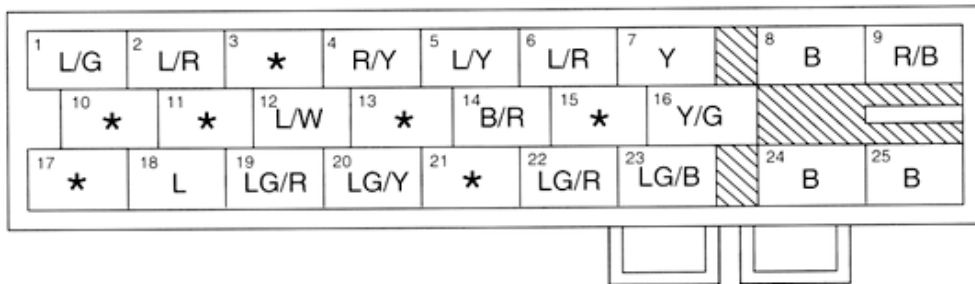
31	Wheel speed sensor (FR)	• Open or short between wheel speed sensor and ABS control unit. • Missing sensor signal because of loosen wheel speed sensor (Sensor not inserted, shorted sensor coil). - Air gap too large. - Tooth wheel not installed.
32	Wheel speed sensor (FL)	
33	Wheel speed sensor (RR)	
34	Wheel speed sensor (RL)	
35	Wheel speed sensor noise (FR)	• Unusual sensor output signal noise.
36	Wheel speed sensor noise (FL)	
37	Wheel speed sensor noise (RR)	
38	Wheel speed sensor noise (RL)	
41	Power supply over voltage	• Over voltage or Low voltage.
49	ECU Internal error	• Internal circuit or connected failed.
51	Motor harness open or Motor lock	• Open between Fuse Box and ABS control unit • Pump motor failed.

ABS CU inspection (Terminal voltage table)

Terminal	Signal	Connected to	Test condition	Measure value
O-01-1	Wheel speed sensor (FL)	Wheel speed sensor (+)	Ignition switch OFF	1.0~1.3 kΩ
O-01-2	Wheel speed sensor (FL)	Wheel speed sensor (-)		
O-01-3	Not used	-	-	-
O-01-4	Power supply	Ignition switch	Ignition switch ON	B+
			Ignition switch OFF	0V
O-01-5	Wheel speed sensor (RL)	Wheel speed sensor (+)	Ignition switch OFF	1.0~1.3 kΩ
O-01-6	Wheel speed sensor (RL)	Wheel speed sensor (-)		
O-01-7	K-Line	Data link connector (H)	Ignition switch ON	B+
O-01-8	Ground	Ground	Constant	0V
O-01-9	Power supply (Solenoid valve)	Battery	Constant	B+
O-01-10	Not used	-	-	-
O-01-11	Not used	-	-	-
O-01-12	Power supply	EBD Warning lamp	Ignition switch OFF	-
			Ignition switch ON	0V
O-01-13	Not used	-	-	-
O-01-14	L-Line	Data link connector (I)	Ignition switch ON	B+
O-01-15	Not used	-	-	-
O-01-16	ABS Warning lamp	ABS warning lamp	Warning lamp OFF	-
			Warning lamp ON	0V
O-01-17	Not used	-	-	-
O-01-18	Brake	Brake switch	Brake pedal released	0V
			Brake pedal depressed	B+
O-01-19	Wheel speed sensor (FR)	Wheel speed sensor (+)	Ignition switch OFF	1.0~1.3 kΩ
O-01-20	Wheel speed sensor (FR)	Wheel speed sensor (-)		
O-01-21	Not used	-	-	-

O-01-22	Wheel speed sensor (RR)	Wheel speed sensor (+)	Ignition switch OFF	1.0~1.3 kΩ
O-01-23	Wheel speed sensor (RR)	Wheel speed sensor (-)		
O-01-24	Ground	Ground	Constant	0V
O-01-25	Power supply (ABS Motor)	Battery	Constant	B+

O-01 ABS CONTROL UNIT CONNECTOR



This connector is connected to the ABS control unit