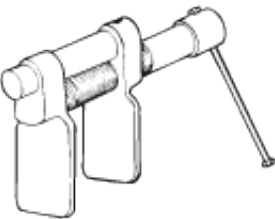




Brake System

General Information

**SPECIAL TOOL**

Tool(Number and Name)	Illustration	Use
09581-11000 Piston expander		Spreading the front disc brake piston



TROUBLESHOOTING

PROBLEM SYMPTOMS TABLE

Symptom	Suspect Area	Reference
Lower pedal or spongy pedal	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Piston seals (Worn or damaged) 4. Rear brake shoe clearance(Out of adjustment) 5. Master cylinder (Inoperative)	repair air-bleed replace adjust replace
Brake drag	1. Brake pedal freeplay (Minimum) 2. Parking brake lever travel (Out of adjustment) 3. Parking brake wire (Sticking) 4. Rear brake shoe clearance(Out of adjustment) 5. Pad or lining (Cracked or distorted) 6. Piston (Stuck) 7. Piston (Frozen) 8. Anchor or Return spring (Inoperative) 9. Booster system (Vacuum leaks) 10. Master cylinder (Inoperative)	adjust adjust repair adjust replace replace replace replace repair replace
Brake pull	1. Piston (Sticking) 2. Pad or lining (Oily) 3. Piston (Frozen) 4. Disc (Scored) 5. Pad or lining (Cracked or distorted)	replace replace replace replace replace
Hard pedal but brake inefficient	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Pad or lining (Worn) 4. Pad or lining (Cracked or distorted) 5. Rear brake shoe clearance(Out of adjustment) 6. Pad or lining (Oily) 7. Pad or lining (Glazed) 8. Disc (Scored) 9. Booster system (Vacuum leaks)	repair air-bleed replace replace adjust adjust replace replace repair
Noise from brake	1. Pad or lining (Cracked or distorted) 2. Installation bolt (Loosen) 3. Disc (Scored) 4. Sliding pin (Worn) 5. Pad or lining (Dirty) 6. Pad or lining (Glazed) 7. Anchor or Return spring (Faulty) 8. Brake pad shim (Damage) 9. Shoe hold-down spring (Damage)	replace adjust replace replace clean replace replace replace replace
Brake fades	1. master cylinder	replace
Brake vibration, pulsation	1. brake booster 2. pedal free play 3. master cylinder 4. caliper	replace adjust replace replace replace

	5. master cylinder cap seal 6. damaged brake lines	replace replace
Brake Chatter	Brake chatter is usually caused by loose or worn components, or glazed or burnt linings. Rotors with hard spots can also contribute to brake chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.	



SPECIFICATIONS

Item	Specification
Master cylinder · Type · I.D. mm(in) · Piston stroke mm(in) · Fluid level warning sensor	Tandem type 26.99/(1.063) 30(1.18) Provided
Brake booster · Type · Boosting ratio	8 + 9 in Tandem 9.0 : 1
Front brake(Disc) · Type · Disc O.D. · Disc thickness · Pad thickness · Cylinder type · Cylinder I.D.	Floating type with ventilated disc 298 mm (11.73 in) 28 mm (1.10 in) 10.5 mm (0.41 in) Double piston Ø48 mm (Ø1.89 in)
Rear brake(Disc) · Type · Disc O.D. · Disc thickness · Pad thickness · Cylinder type · Cylinder I.D.	Floating type with solid disc 302 mm (11.89 in) 12 mm (0.47 in) 10 mm (0.39 in) Single piston Ø42.9 mm (Ø1.69 in)
Parking brake · Type · Actuation · Drum	DIH(Drum in hat) Foot brake Ø190 mm (Ø7.48 in)

O.D=Outer Diameter

I.D=Inner Diameter

NOTICE

ABS : Anti-lock Brake System
ESP : Electronic Stability Program

SERVICE STANDARD

Items	Standard value
Brake pedal height	192.4 mm(7.57 in)
Brake pedal full stroke	122 mm (4.8 in)
Adjust Brake pedal full stroke	60 mm (2.36 in)
Brake pedal free play	3 ~ 8 mm(0.11 ~ 0.31 in)
Stop lamp switch outer case to pedal stopper clearance	1.0 ~ 1.5 mm (0.04 ~ 0.06 in)
Booster push rod to master cylinder piston clearance	0.6 ~ 1.7(0.02 ~ 0.07 in)(at 500 mmHg)
Parking brake pedal stroke when pedal assembly is depressed with 294N (30kgf, 66lb force)	145 mm (5.71 in) above
Front disc brake pad thickness	10.5 mm (0.41 in)
Front disc thickness	28 mm (1.10 in)
Rear disc brake pad thickness	10 mm (0.39 in)
Rear disc brake disc thickness	12 mm (0.47 in)
Rear parking brake liner thickness	4 mm (0.16 in)

TIGHTENING TORQUE

Items	Nm	kgf.m	lb-ft
Master cylinder to booster mounting nut	8 ~ 12	0.8 ~ 1.2	5.8 ~ 8.7
Brake booster mounting nut	13 ~ 16	1.3 ~ 1.6	9.4 ~ 11.6
Bleeder screw	7 ~ 13	0.7 ~ 1.3	5.06 ~ 9.4
Brake tube nut, brake hose	13 ~ 17	1.3 ~ 1.7	9.4 ~ 12.3
Caliper guide rod bolt (Front)	22 ~ 32	2.2 ~ 3.2	15.9 ~ 23.1
Caliper guide rod bolt (Rear)	22 ~ 32	2.2 ~ 3.2	15.9 ~ 23.1
Caliper assembly to knuckle (Front)	85 ~ 100	8.5 ~ 10	61.5 ~ 72.3
Caliper assembly to knuckle (Rear)	50 ~ 60	5.0 ~ 6.0	36.2 ~ 43.4
Brake hose to front caliper	25 ~ 30	2.5 ~ 3.0	18.1 ~ 21.7
Brake pedal assembly bracket mounting nut	10 ~ 15	1.0 ~ 1.5	7.2 ~ 10.8
Brake pedal mounting nut	13 ~ 16	1.3 ~ 1.6	9.4 ~ 11.6
Stop lamp switch mounting nut	8 ~ 10	0.8 ~ 1.0	5.8 ~ 7.23
Active wheel speed sensor mounting bolt on the brake plate	7 ~ 10	0.7 ~ 1.0	5.1 ~ 7.2
HECU mounting bracket bolt	17 ~ 26	1.7 ~ 2.6	12.3 ~ 18.8
HECU mounting nut	6 ~ 10	0.6 ~ 1.0	4.3 ~ 7.2
Yaw rate & lateral acceleration sensor bolt	5 ~ 8	0.5 ~ 0.8	3.62 ~ 5.8

SPECIFICATION (ABS)

Part	Item		Standard value	Remark
HECU(Hydraulic and Electronic Control Unit)	System		4 channel 4 sensor (Solenoid)	·ABS system:ABS & EBD control
	Type		Motor, valve relay intergrated type	
	Operating voltage		8 V ~ 16 V(DC)	
	Operating temperature		-40 ~ 120 °C (-40 ~ 248 °F)	
Warning lamp	Operating voltage		12 V	·ABS W/L:ABS failure ·Brake W/L:Parking, brake oil, EBD failure
	Current consumption		80 mA	
Acitve wheel speed sensor	Supply voltage		DC 4.5 ~ 2.0 V	
	Operating temperature		-40 ~ 150 °C	
	Output current low		5.9 ~ 8.4 mA	Typ.7 mA
	Output current High		11.8 ~ 16.8 mA	Typ.14 mA
	Frequency range		1 ~ 2500 HZ	
	Air gap	Front	0.15 ~ 1.5 mm	Typ.0.7 mm
		Rear	0.2 ~ 1.2 mm	Typ.0.7 mm
	Tone wheel		48 teeth	
	Output duty		30~70 %	

SPECIFICATION(ESP)

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Part	Item		Standard Value	Remark
HECU(Hydraulic and Electronic Control Unit)	System		4 channel 4 sensor(Solenoid)	·Total control(ABS, EBD, TCS, ESP)
	Type		Motor, valve relay intergrated type	
	Operating voltage		8 V ~ 16 V(DC)	
	Operating temperature		-40 ~ 120 °C(-40 ~ 248 °F)	
Warning lamp	Operating voltage		12 V	·ESP Operating Lamp
	Current consumption		80 mA	·ESP Warning Lamp
Active wheel speed sensor	Supply voltage		DC 4.5 ~ 20V	
	Operating temperature		-40 ~ 150 °C	
	Output current low		5.9 ~ 8.4 mA	
	Output current high		11.8 ~ 16.8 mA	
	Tone wheel		48 teeth	
	Frequency range		1 ~ 2500 HZ	
	Airgap	Front	0.15 ~ 1.5 mm	Typ. 0.7 mm
		Rear	0.2 ~ 1.2 mm	Typ. 0.7 mm
Steering Wheel Angle Sensor	Operating Voltage		8V ~ 16 V	
	Current Consumption		Max 150 mA	
	Operating Angular velocity		Max ± 780 °/sec	
Yaw-rate & Lateral G sensor	Operating Voltage		8 V ~ 16 V	
	Current Consumption		Max. 120 mA	
	Output Voltage high		4.35 V~ 4.65 V	Typ. 4.5 V
	Output Voltage low		0.35 ~ 0.65 V	Typ. 0.5 V
	Yaw Sensor Operating Range		±100 ° /s	
	G Sensor Operating Range		±1.8 G	
	Reference voltage output		2.464 ~ 2.536 V	Typ. 2.5 V

LUBRICANT

Item	Recommended lubricant	Quantity
Brake fluid	DOT 3 or DOT 4	As required
Brake pedal bushing and brake pedal bolt	Chassis grease	As required
Parking brake shoe and backing plate contact surfaces	Bearing grease	As required
Caliper guide rod and boot	RX-2 grease	0.8 ~ 1.3 g
Rear caliper guide rod and boot	Rubber grease	0.8 ~ 1.3g

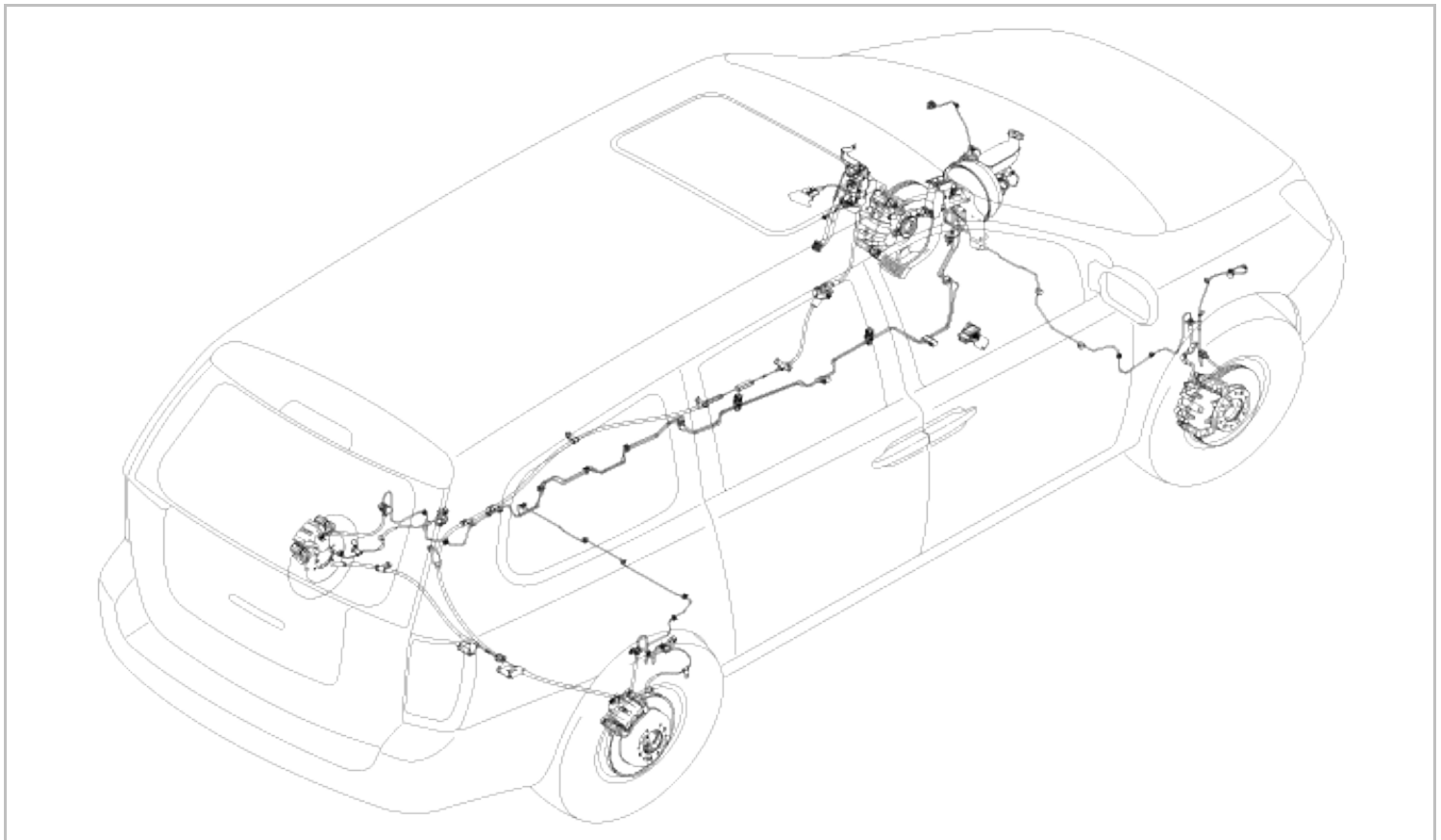
Brake System

Brake System - Brake System

Operation and Leakage Check

Check all of the following items:

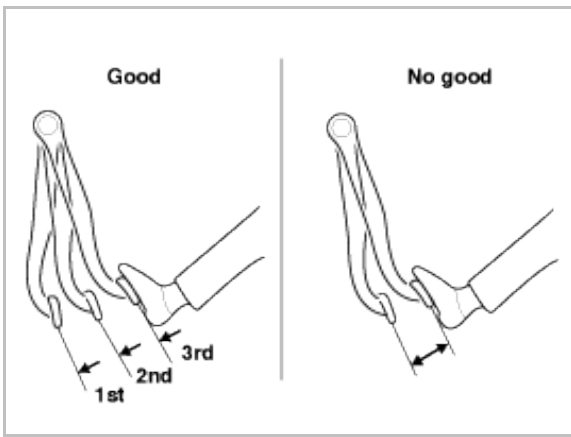
Component	Procedure
Brake Booster (A)	Check brake operation by applying the brakes during a test drive. If the brakes do not work properly, check the brake booster. Replace the brake booster as an assembly if it does not work properly or if there are signs of leakage.
Piston cup and pressure cup inspection (B)	• Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. Replace the master cylinder as an assembly if the pedal does not work properly or if there is damage or signs of fluid leakage. • Check for a difference in brake pedal stroke between quick and slow brake applications. Replace the master cylinder if there is a difference in pedal stroke.
Brake hoses (C)	Look for damage or signs of fluid leakage. Replace the brake hose with a new one if it is damaged or leaking.
Caliper piston seal and piston boots (D)	Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. If the pedal does not work properly, the brakes drag, or there is damage or signs of fluid leakage, disassemble and inspect the brake caliper. Replace the boots and seals with new ones whenever the brake caliper is disassembled.



BRAKE BOOSTER OPERATING TEST

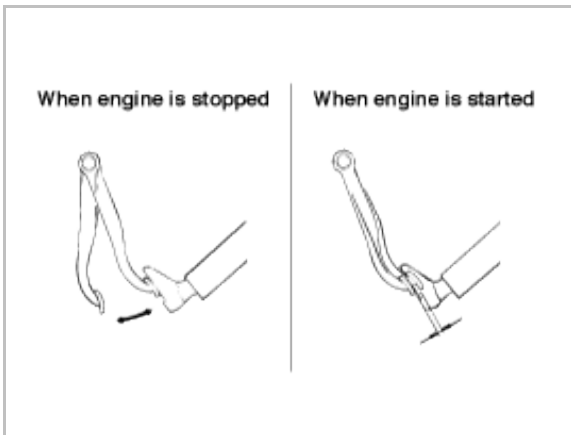
For simple checking of the brake booster operation, carry out the following tests

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



2. With the engine stopped, step on the brake pedal several times.

Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is inoperative.

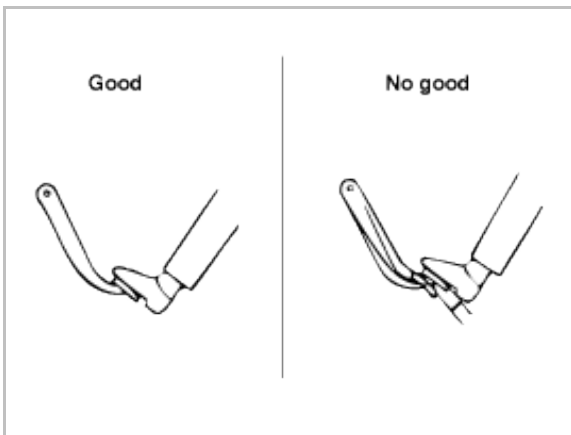


3. With the engine running, step on the brake pedal and then stop the engine.

Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is inoperative.

If the above three tests are okay, the booster performance can be determined as good.

Even if one of the above three tests is not okay, check the check valve, vacuum hose and booster for malfunction.

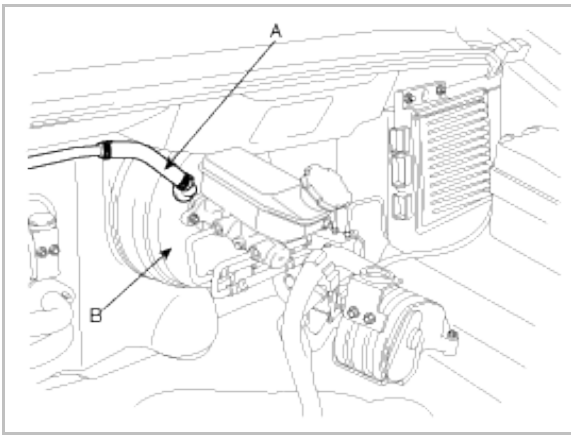


VACUUM HOSE (CHECK VALVE)

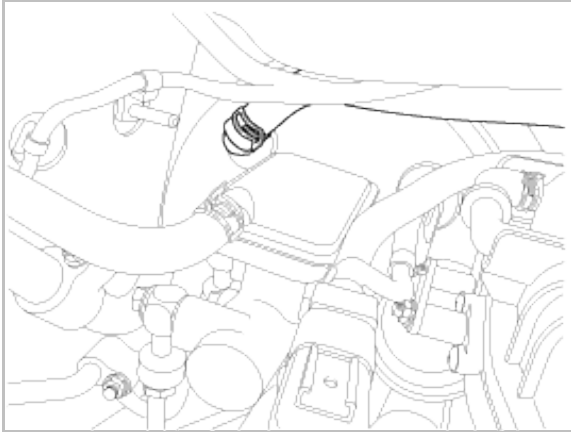
INSPECTION

1. Disconnect the brake booster vacuum hose (check valve built in) (A) at the booster (B).
2. Start the engine and let it idle. There should be vacuum available. If no vacuum is available, the check valve is not working properly. Replace the back booster vacuum hose and check valve and retest.

[LHD]



[RHD]

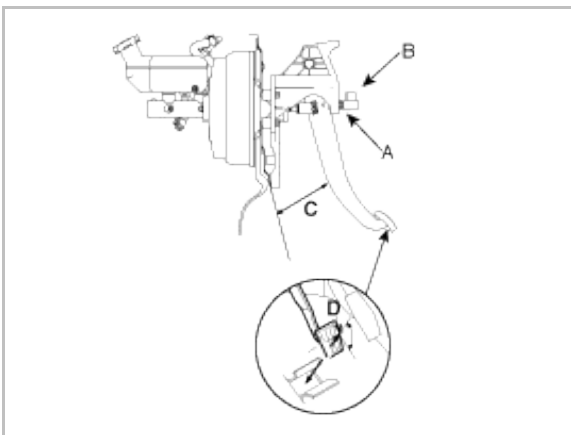


BRAKE PEDAL BRAKE SWITCH ADJUSTMENT

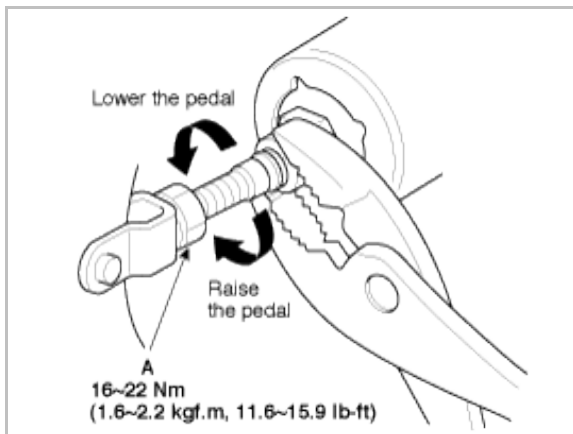
PEDAL HEIGHT

1. Disconnect the brake switch connector, loosen the brake switch locknut (A), and brake off the brake switch (B) until it is no longer touching the brake pedal.
2. Lift up the carpet. At the insulator cutout, measure the pedal height (C) from the middle of the left-side center of the pedal pad (D).

Standard pedal height(with carpet removed): 192.4 mm(7.57 in.)

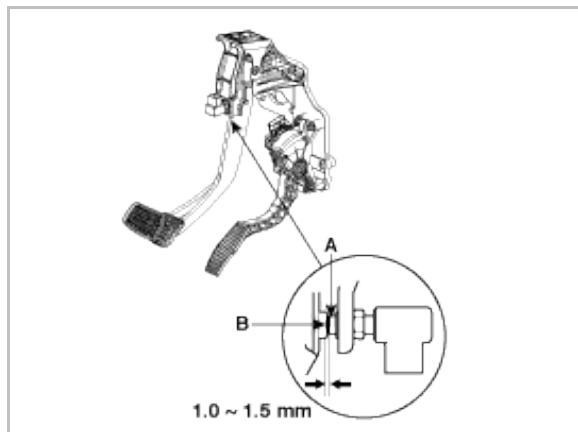


3. Loosen the pushrod locknut (A), and screw the pushrod in or out with pliers until the standard pedal height from the floor is reached. After adjustment, tighten the locknut firmly. Do not adjust the pedal height with the pushrod depressed.



BRAKE SWITCH CLEARANCE

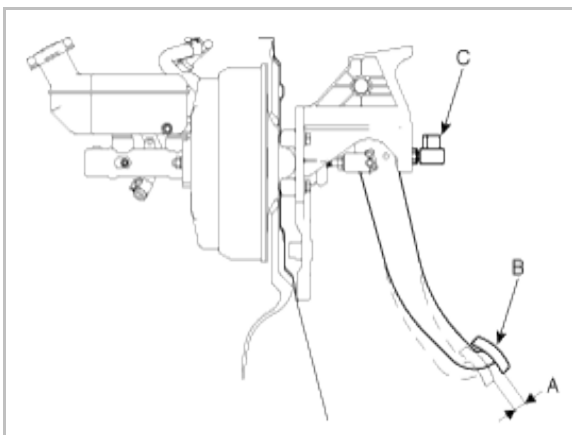
Screw in the brake switch until its plunger is fully depressed (threded end (A) touching the pad (B) on the pedal arm) then brake off the switch 3/4 turn to make 1.0 ~ 1.5mm(0.04 ~ 0.06in) of clearance between the brake switch connector. Make sure that the brake lights go off when the pedal is released.



PEDAL FREE PLAY

1. With the engine off, inspect the pedal free play (A) on the pedal pad (B) by pushing the pedal by hand.

Free play: 3 ~ 8 mm (0.12 ~ 0.31 in.)



2. If the pedal free play is out of specification, adjust the brake switch (C). If the pedal free play is insufficient, it may result in brake drag.

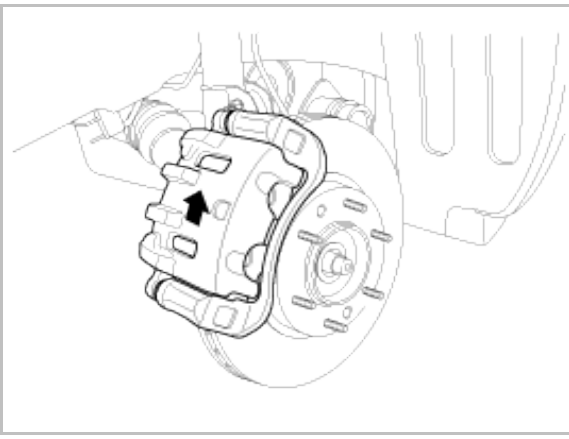
INSPECTION OF FRONT DISC BRAKE PAD

1. Check the brake pad thickness through the caliper body inspection hole.

Pad thickness

Standard value : 10.5 mm (0.41 in)

Service limit : 2 mm (0.0787 in)



CAUTION

- If the pad thickness is out of specification, left and right pads must be replaced as a complete set.
- When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston and the guide rod.

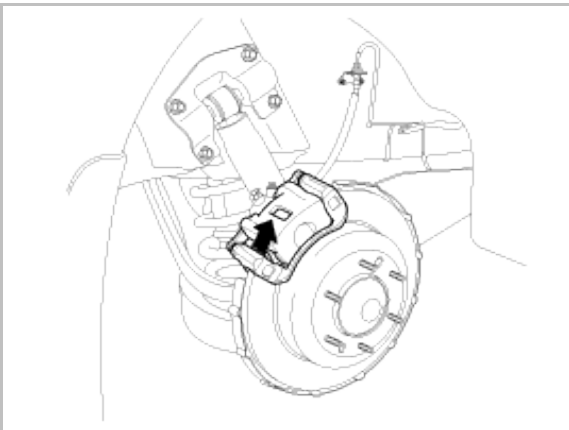
INSPECTION OF REAR DISC BRAKE PAD

1. Check the rear disc brake pad thickness through the caliper body inspection hole.

Pad thickness

Standard value : 10.0 mm (0.39 in)

Service limit : 2.0 mm (0.0787 in)



CAUTION

- If the pad thickness is out of specification, left and right pads must be replaced as a complete set.
- When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston and the guide rod.

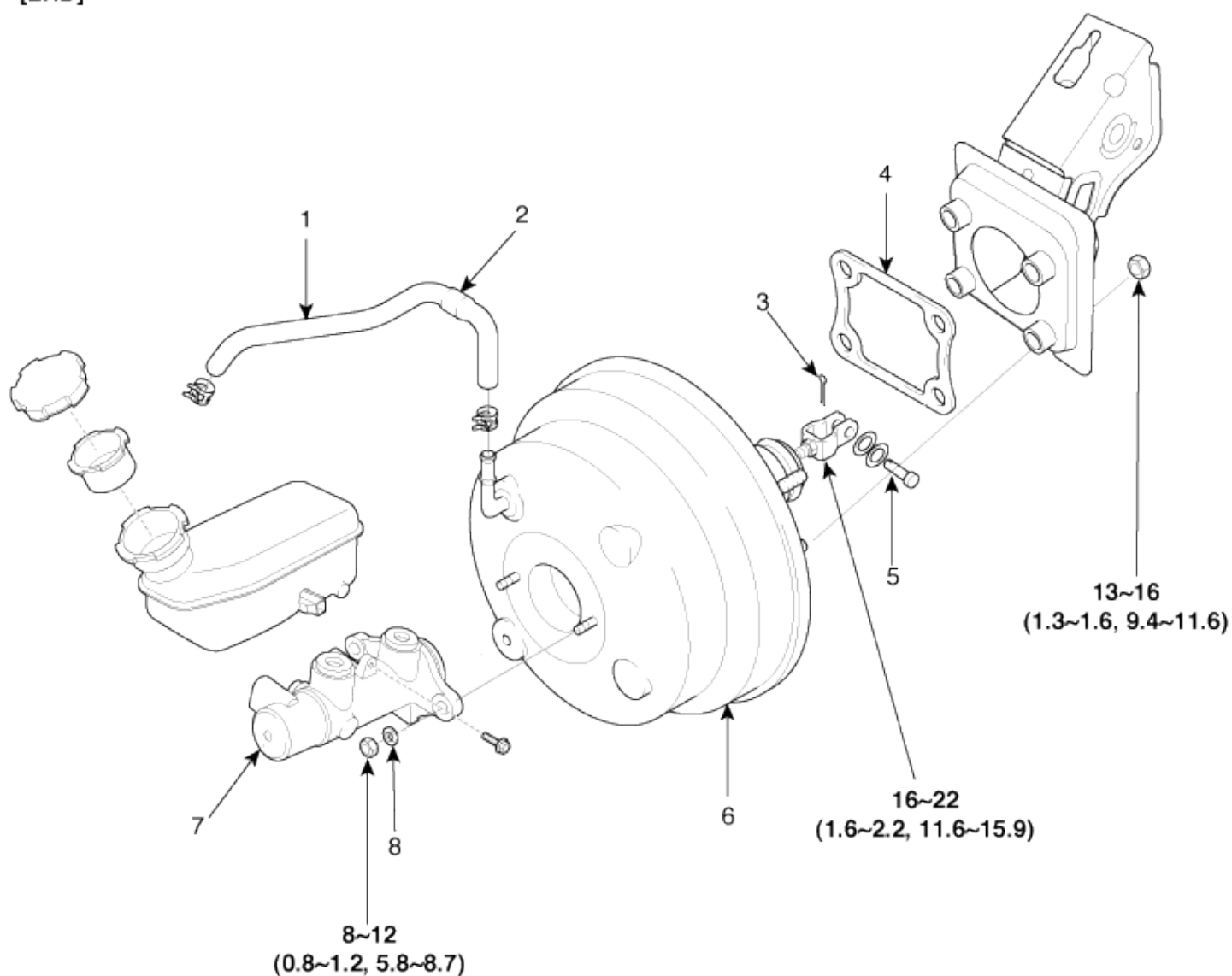


Brake System

Brake System - Brake Booster

COMPONENTS

[LHD]



TORQUE : Nm (kgf.m, lb-ft)

1. Vacuum hose
2. Check valve
3. Snap pin
4. Seal

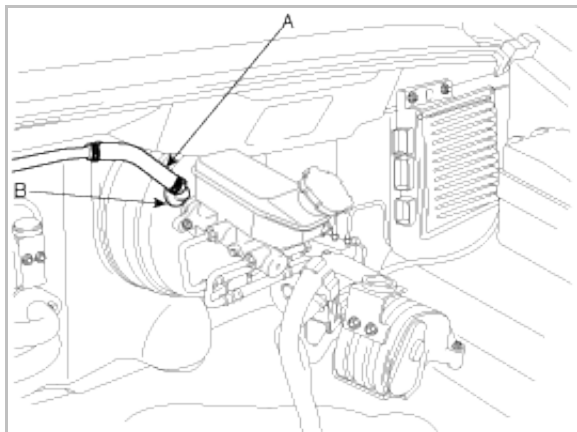
5. Clevis pin
6. Brake booster
7. Master cylinder
8. Washer



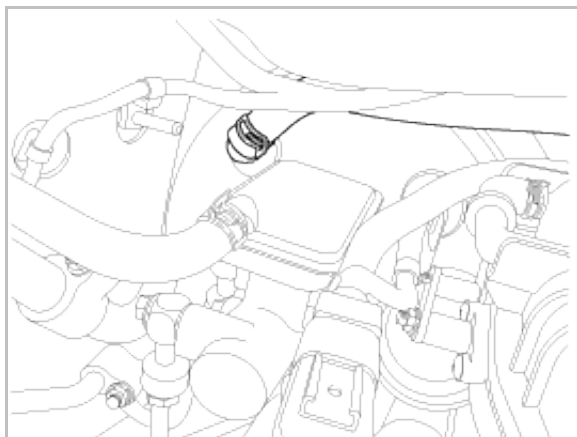
Removal

1. Disconnect the vacuum hose (A) from the brake booster (B).

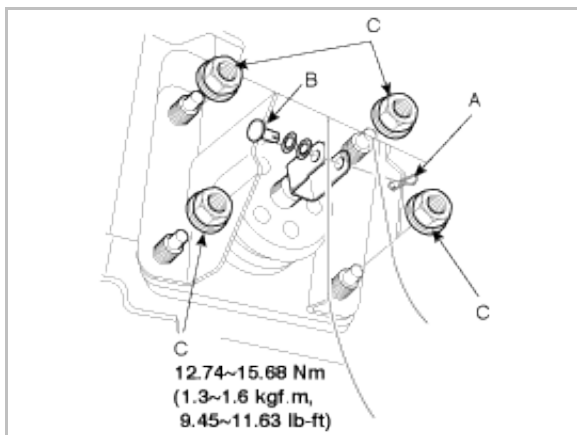
[LHD]



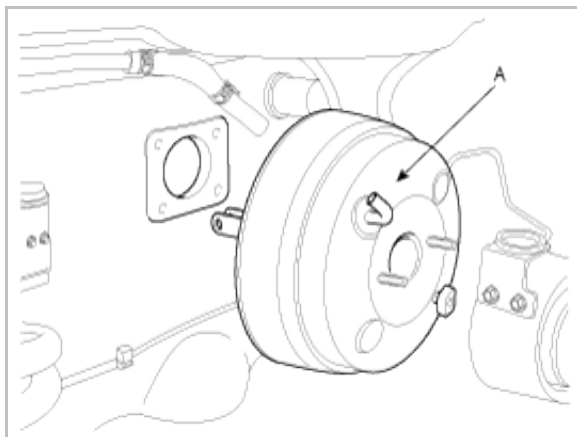
[RHD]



2. Remove the master cylinder (Refer to 'Master cylinder removal').
3. Remove the snap pin (A) and clevis pin (B).



4. Remove the four booster mounting nuts (C).
5. Remove the brake booster (A).



INSTALLATION

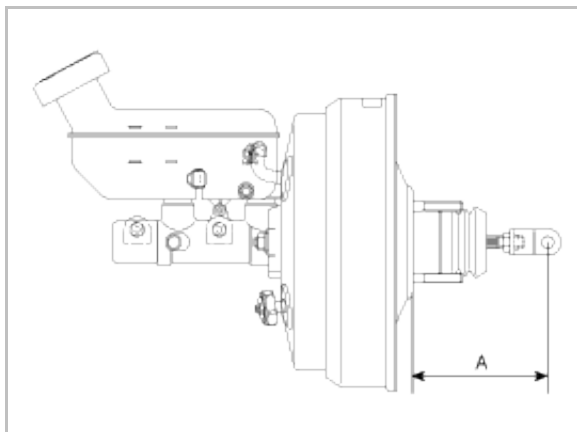
1. Adjust push rod length of the booster, and then install the seal on the booster assembly.

Standard length (A):

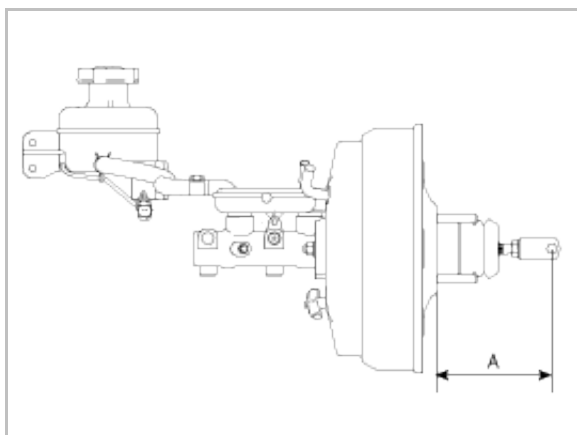
LHD : 112 ± 0.5 mm (4.43 ± 0.019 in.)

RHD : 115 ± 0.5 mm (4.53 ± 0.019 in.)

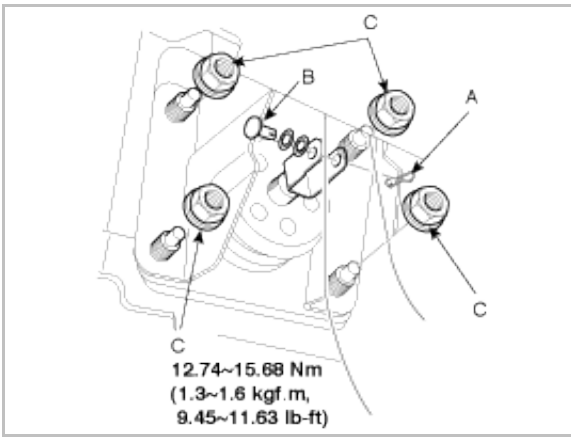
[LHD]



[RHD]



2. Insert the booster and tighten the nuts (C).



3. Connect the booster push rod and brake pedal with a pin (B) and install a snap clevis pin (A) to the clevis pin (B).

CAUTION

Grease the pin before installing the snap pin.
Always use a new snap pin.

4. Install the master cylinder.
5. Connect the vacuum hose to the brake booster.
6. After filling the brake reservoir with brake fluid, bleed the system (Refer to 'Bleeding of brake system',).
7. Check for fluid leakage.
8. Check and adjust the brake pedal for proper operation.

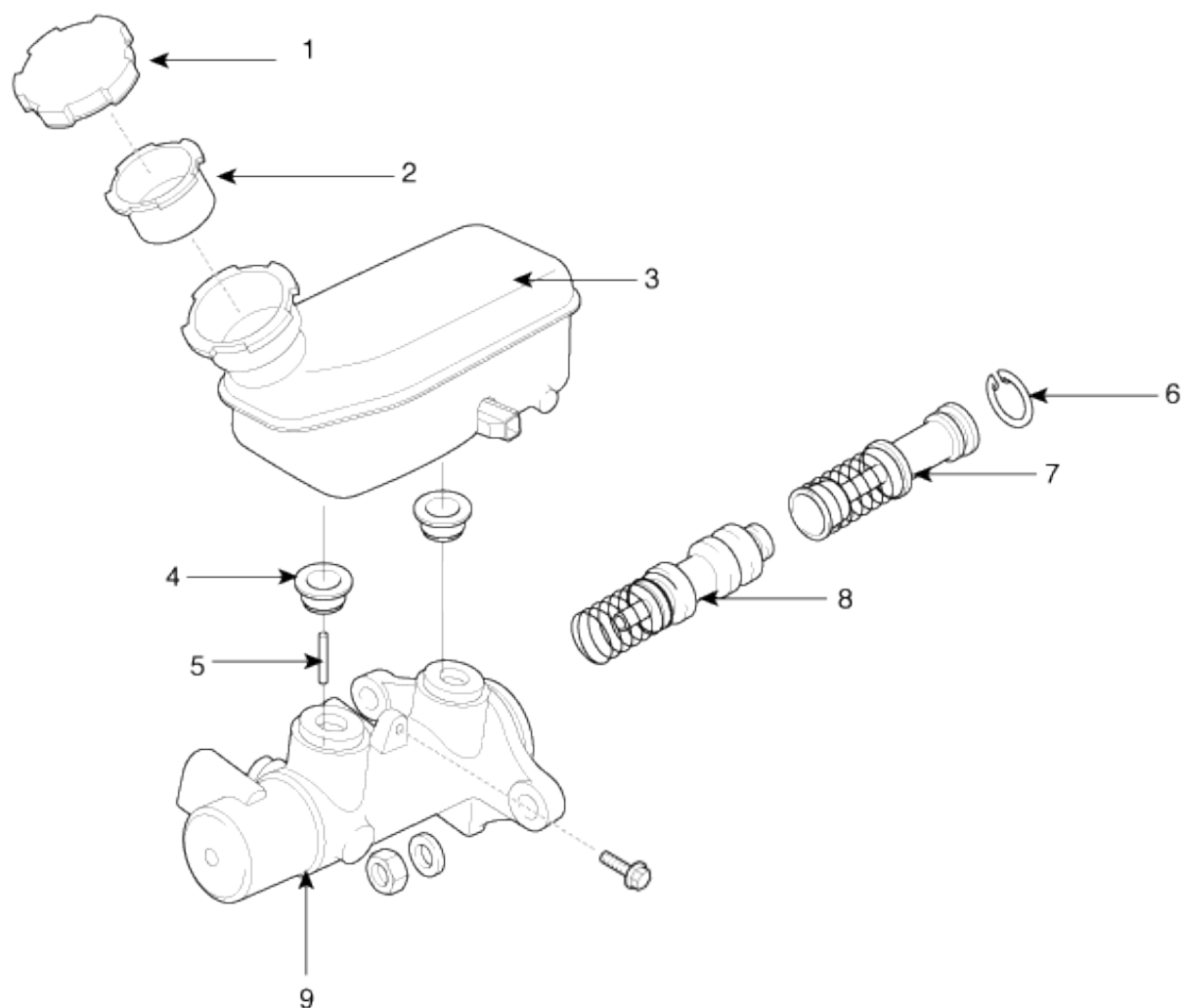


Brake System

Brake System - Master Cylinder

COMPONENTS

[LHD]



- 1. Reservoir cap
- 2. Brake fluid filter
- 3. Reservoir
- 4. Grommet
- 5. Cylinder pin

- 6. Retainer
- 7. Primary piston assembly
- 8. Secondary piston assembly
- 9. Master cylinder body

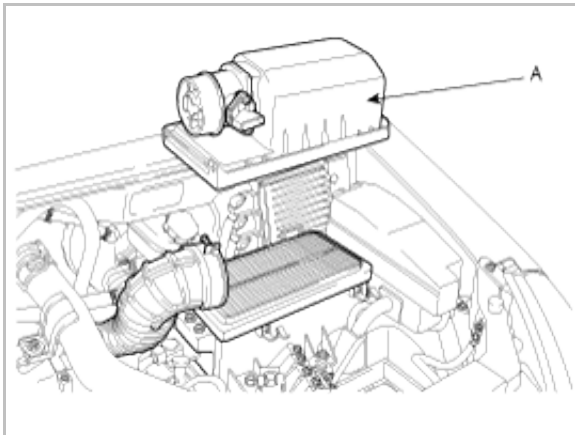


REMOVAL

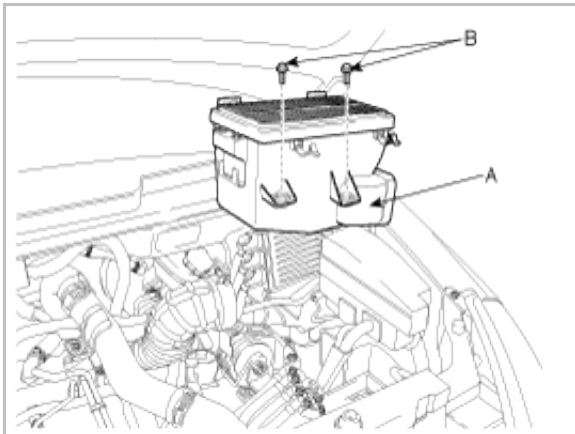
NOTICE

Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

1. Remove air cleaner mounting bolts (B) from the air cleaner mounting bracket and air cleaner body (A).(LHD)

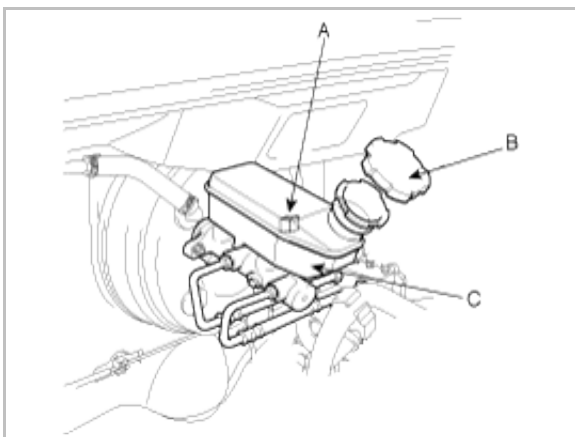


2. Remove the air cleaner assembly (A) by removing the air cleaner mounting bolt (B) from the bracket.(LHD)

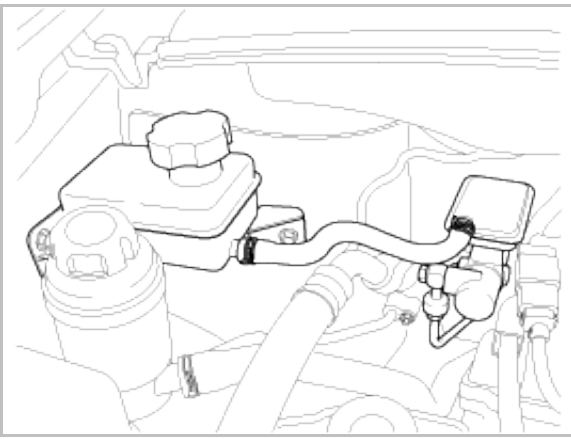


3. Remove the surge tank.(Refer to EM Gr.)
(RHD-GSL 3.8)
4. Disconnect the brake fluid level switch connector (A), and remove the reservoir cap (B).

[LHD]

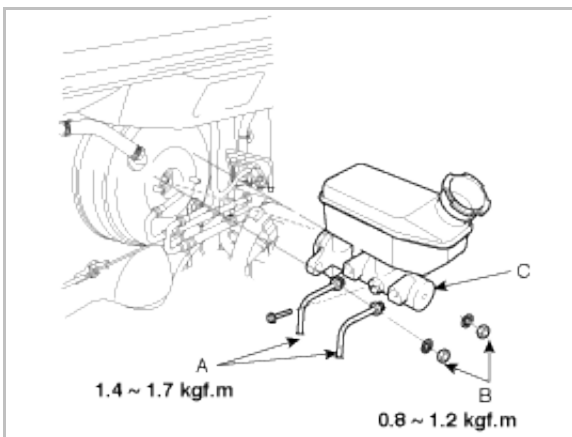


[RHD]

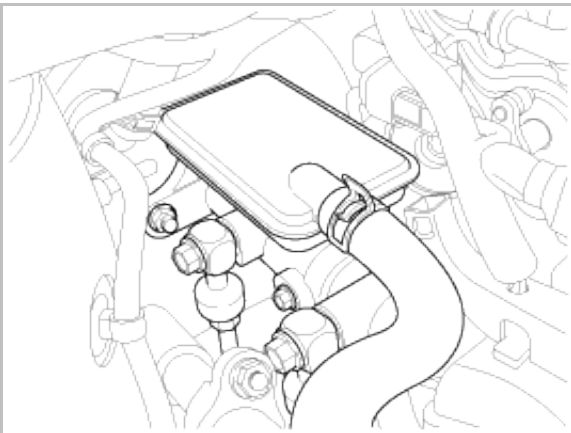


5. Remove the brake fluid from the master cylinder reservoir (C) with a syringe.
6. Disconnect the brake lines (A) from the master cylinder. To prevent spills, cover the hose joints with rags or shop towels.
7. Remove the master cylinder mounting nuts (B) and washers.

[LHD]



[RHD]

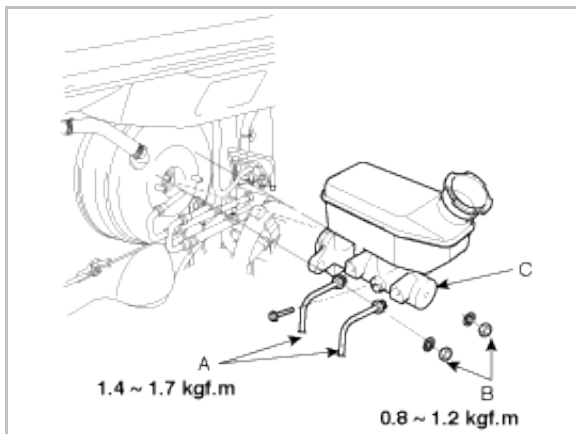


8. Remove the master cylinder(C) from the brake booster. Be careful not to bend or damage the brake lines when removing the master cylinder.

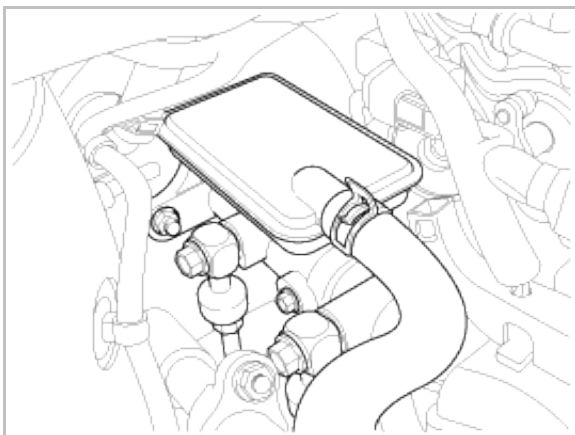
INSTALLATION

1. Install the master cylinder on the brake booster with 2 nuts.
2. Connect the two brake tubes and the brake fluid level sensor connector.

[LHD]



[RHD]

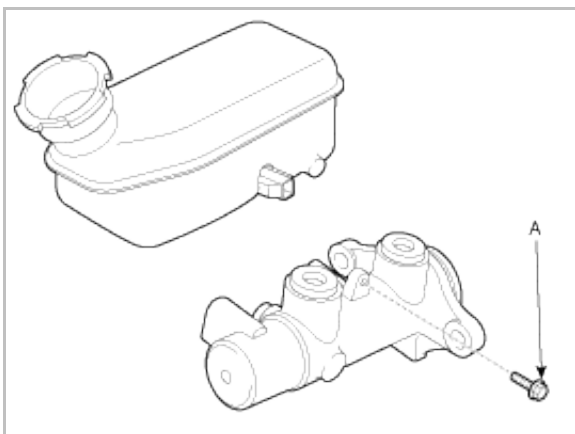


3. Fill the brake reservoir with the brake fluid and bleed the brake system (Refer to 'Bleeding of brake system').

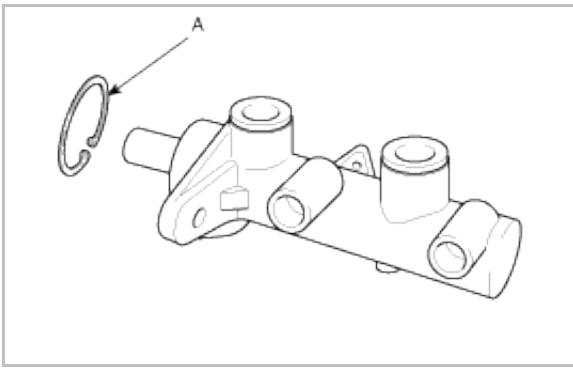
DISASSEMBLY

1. Remove the reservoir cap and drain the brake fluid into a suitable container.
2. Remove the fluid level sensor.
3. Remove the reservoir from the master cylinder, after remove mounting screw (A).

[LHD]

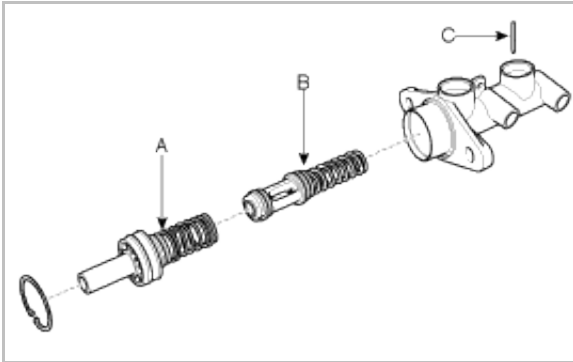


4. Remove the retainer ring (A) by using the snap ring pliers.



5. Remove the primary piston assembly (A).

6. Remove the pin (C) with the secondary piston (B) pushed completely using a screwdriver. Remove the secondary piston assembly (B).



NOTICE

Do not disassemble the primary and secondary piston assembly.

INSPECTION

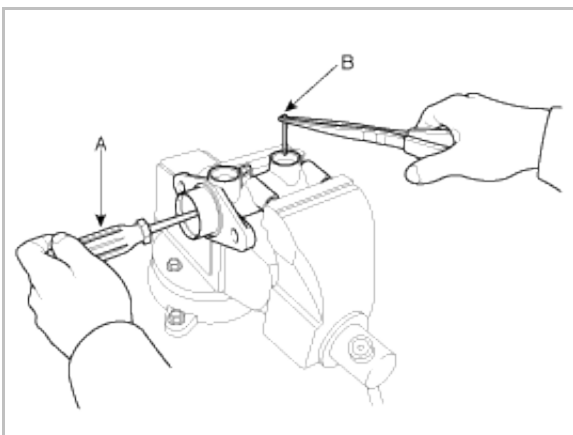
1. Check the master cylinder bore for rust or scratching.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

CAUTION

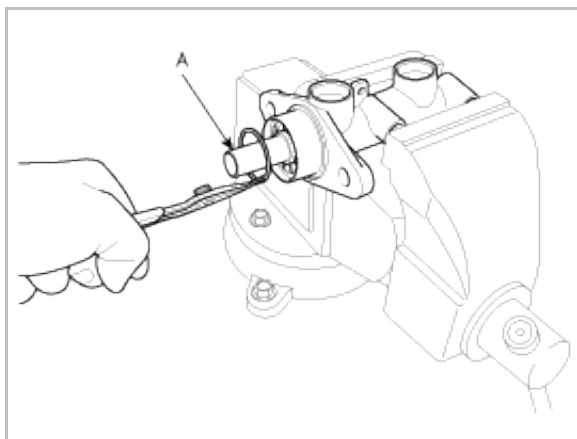
- If the cylinder bore is damaged, replace the master cylinder assembly.
- Wash the contaminated parts in alcohol.

REASSEMBLY

1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.
2. Carefully insert the springs and pistons in the proper direction.
3. Press the piston with a screwdriver (A) and install the cylinder pin (B).



4. Install the retainer ring (A) after installing primary piston assembly.



5. Mount two grommets.

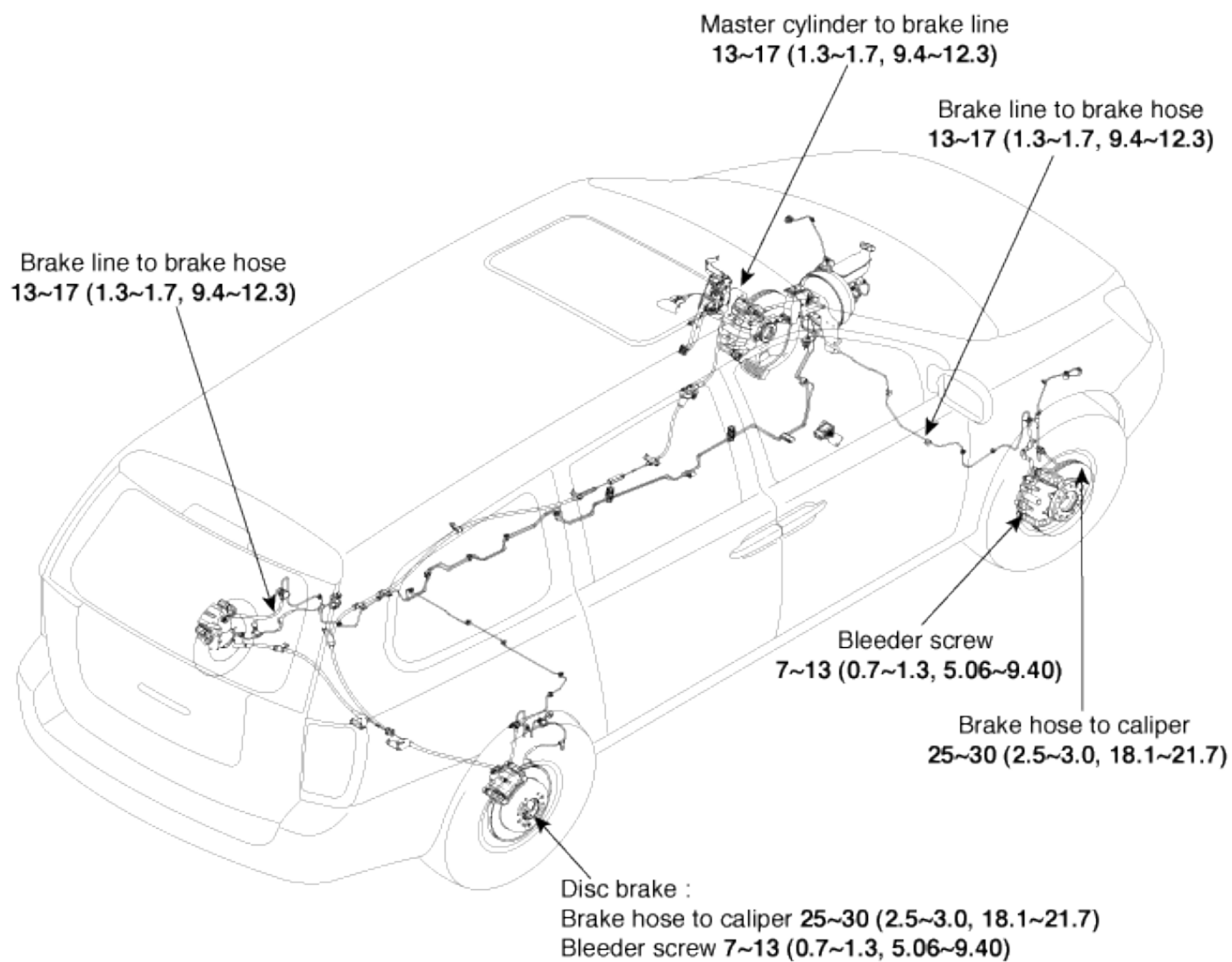
6. Install the reservoir on the cylinder.



Brake System

Brake System - Brake Line

COMPONENT

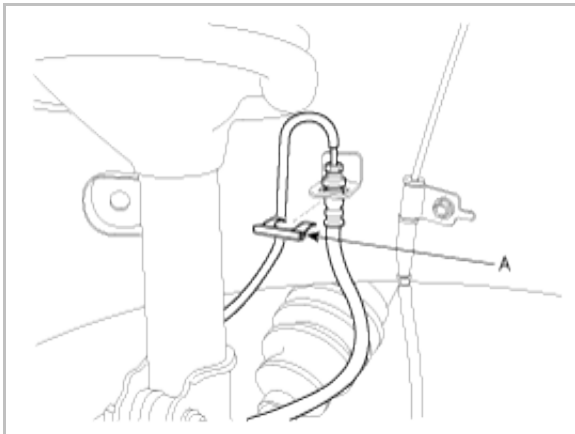


TORQUE : Nm (kgf.m, lb-ft)

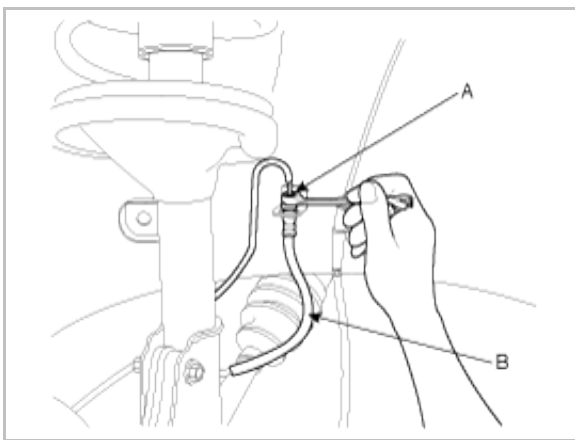


REMOVAL

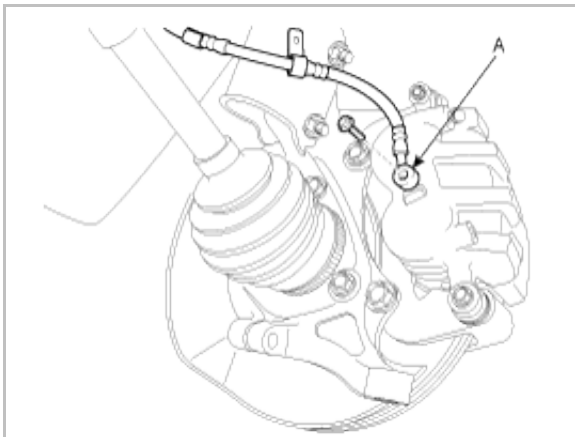
1. Remove the brake hose clip (A).



2. Loosen the brake tube (A) nut holding the brake hose (B) nut with a wrench.

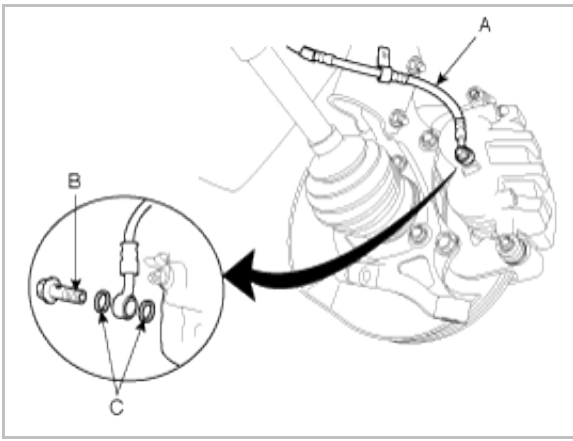


3. Remove the brake hose (B).
4. Remove the brake hose connecting bolt (A) from the caliper assembly.

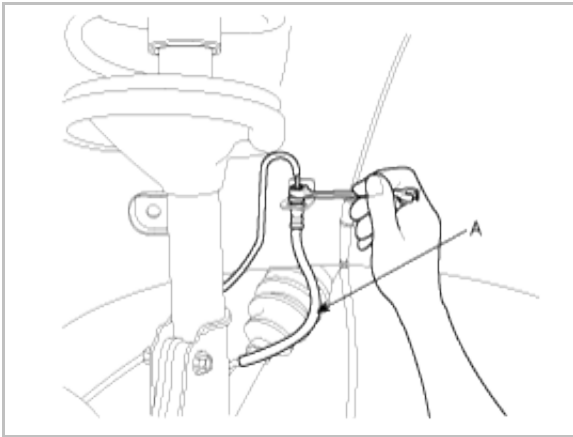


INSTALLATION

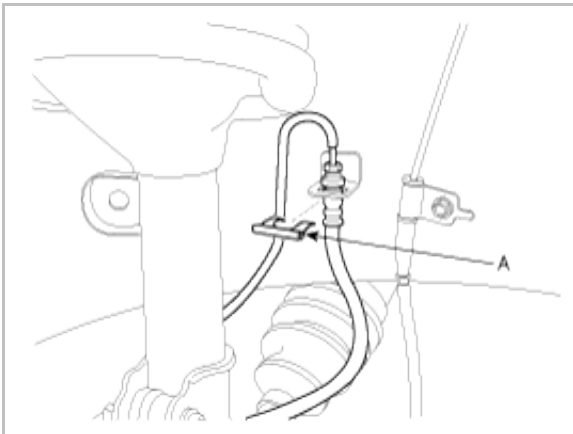
1. Install the brake hose (A) connecting bolt (B) and washer (C).



2. Tighten the brake tube (A) nut holding the brake hose (B) nut with a wrench.



3. Install the brake hose clip (A).



4. After installation, bleed the air in the brake system.

CAUTION

Be careful not to damage the brake hose by sharp edges or tools.

INSPECTION

- Check the brake tubes for cracks, crimps and corrosion.
- Check the brake hoses for cracks, damaged and oil leakage.
- Check the brake tube flare nuts for damage and oil leakage.

INSPECTION

- Check the brake tubes for cracks, crimps and corrosion.
- Check the brake hoses for cracks, damaged and oil leakage.
- Check the brake tube flare nuts for damage and oil leakage.

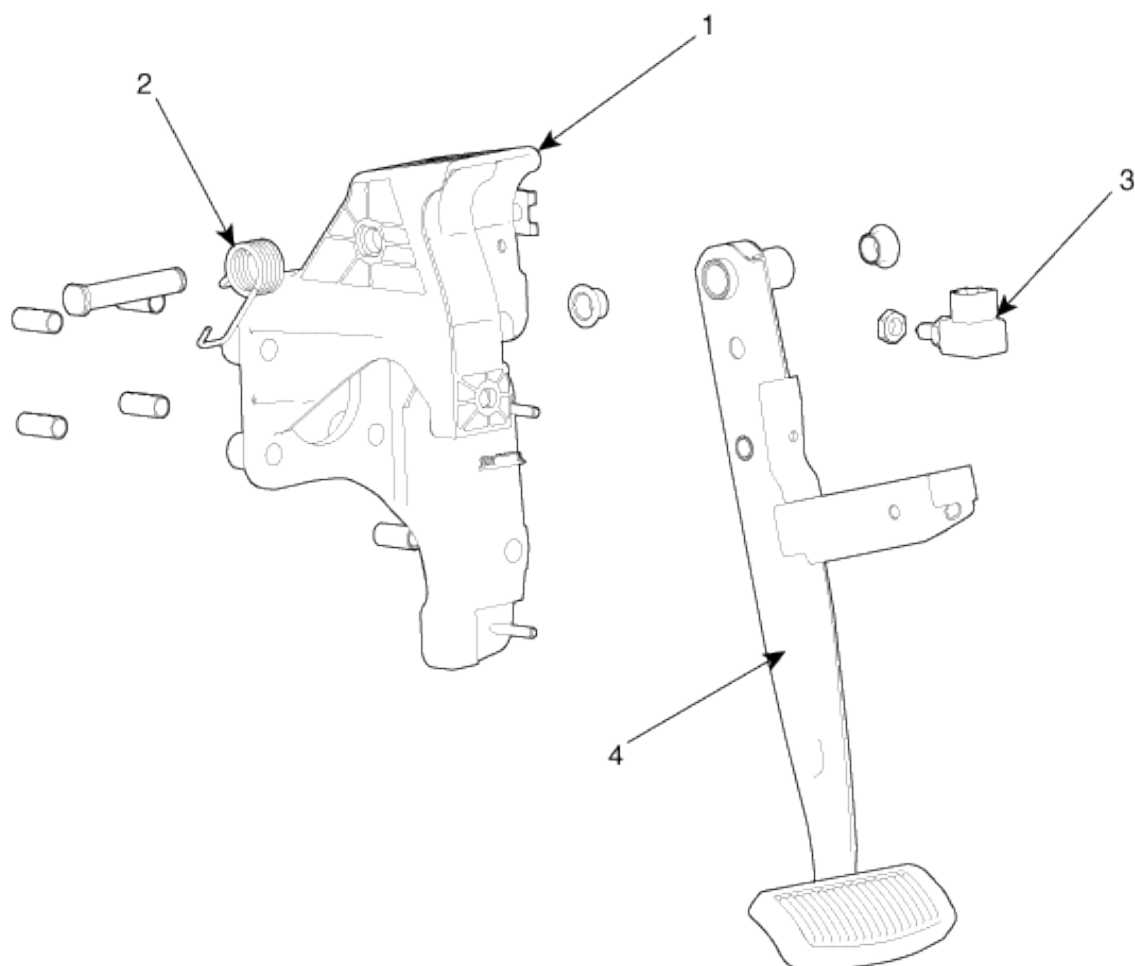


Brake System

Brake System - Brake Pedal

COMPONENTS

[LHD]

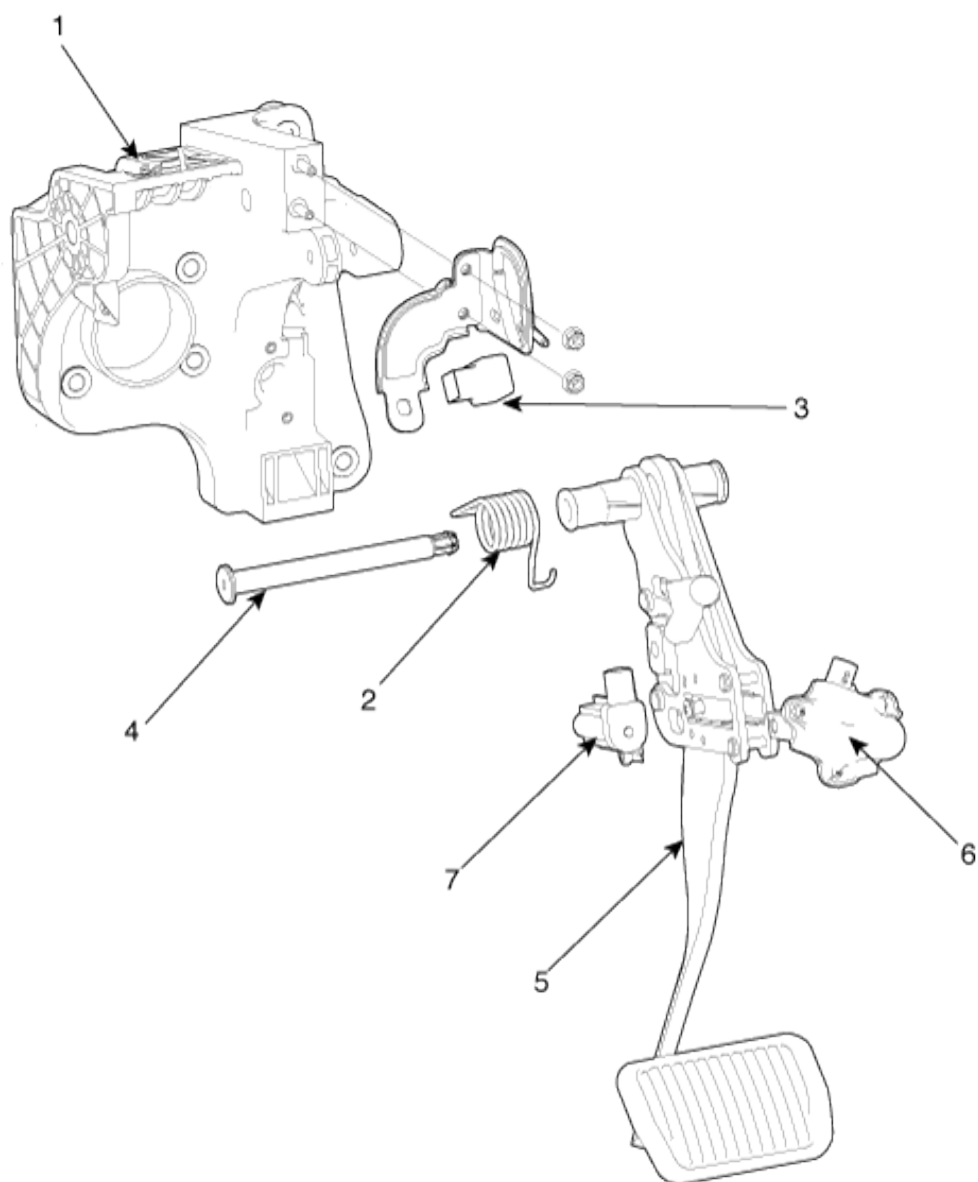


1. Member assembly bracket
2. Return spring

3. Stop lamp switch
4. Brake pedal

COMPONENTS (ADJUSTABLE PEDAL)

[LHD]



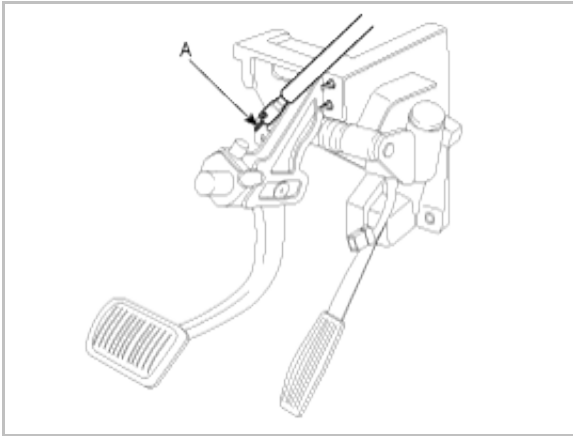
- 1. Member assembly bracket
- 2. Return spring
- 3. Stop lamp switch
- 4. Shaft bolt

- 5. Brake pedal
- 6. Arm yoke assembly
- 7. Arm yoke assembly (memory)
(for IMS only)

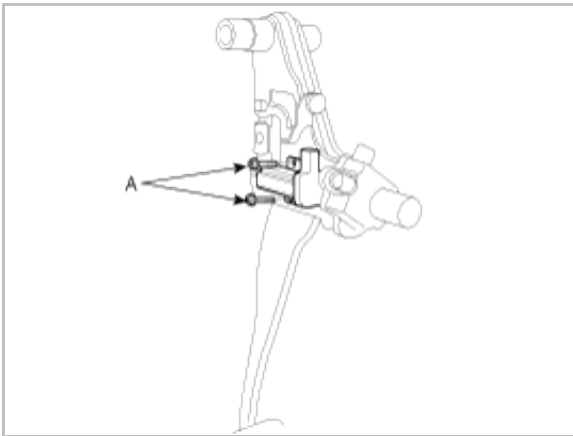


REMOVAL

1. Remove the lower crash pad. (Refer to BD group 'Crash pad')
2. Remove the brake switch connector.
3. Remove the trans cable (A) in case of the adjustable brake pedal.



4. Remove the mounting bolt(A) of the pedal position sensor connector in case of the adjustable brake pedal.



5. Remove the snap pin connecting the booster.
6. Remove the hinge shaft connecting the pedal tray.
7. Remove the brake pedal.

INSTALLATION

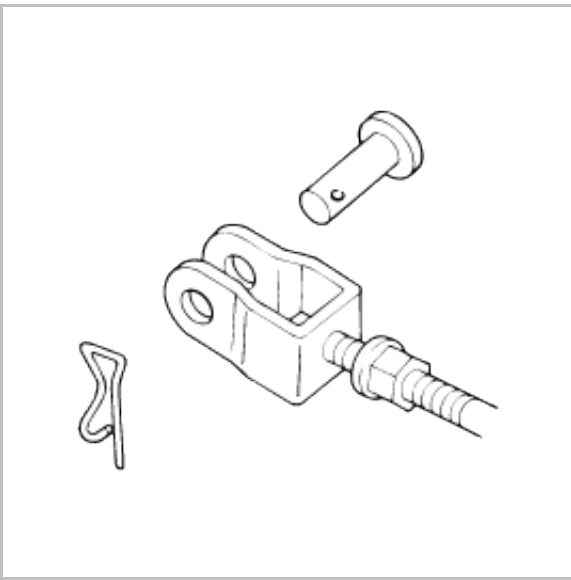
1. Installation is the reverse of removal.

CAUTION

Coat the inner surface of the bushings with the specified grease.

Specified grease : Lig-2

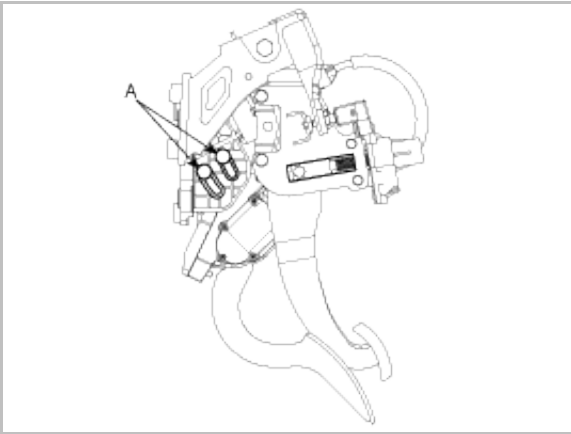
2. Before inserting the pin, apply the specified grease to the clevis pin.



3. Install the snap pin.
4. Adjust the brake pedal height and free play.

CAUTION

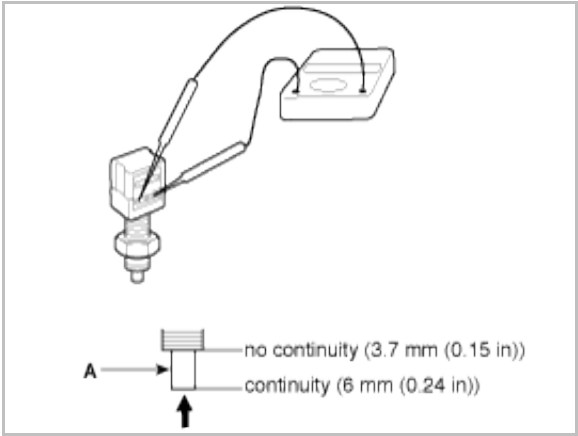
Before connecting trans cable, be sure that position of pivot pin (A) is initializen.



5. Install the stop lamp switch.

INSPECTION

1. Check the bushing for wear.
2. Check the brake pedal for bending or twisting.
3. Check the brake pedal return spring for damage.
4. Check the stop lamp switch.
 - (1) Connect a circuit tester to the connector of stop lamp switch, and check whether or not there is continuity when the plunger of the stop lamp switch is pushed in and when it is released.
 - (2) The stop lamp switch is in good condition if there is no continuity when plunger(A) is pushed.

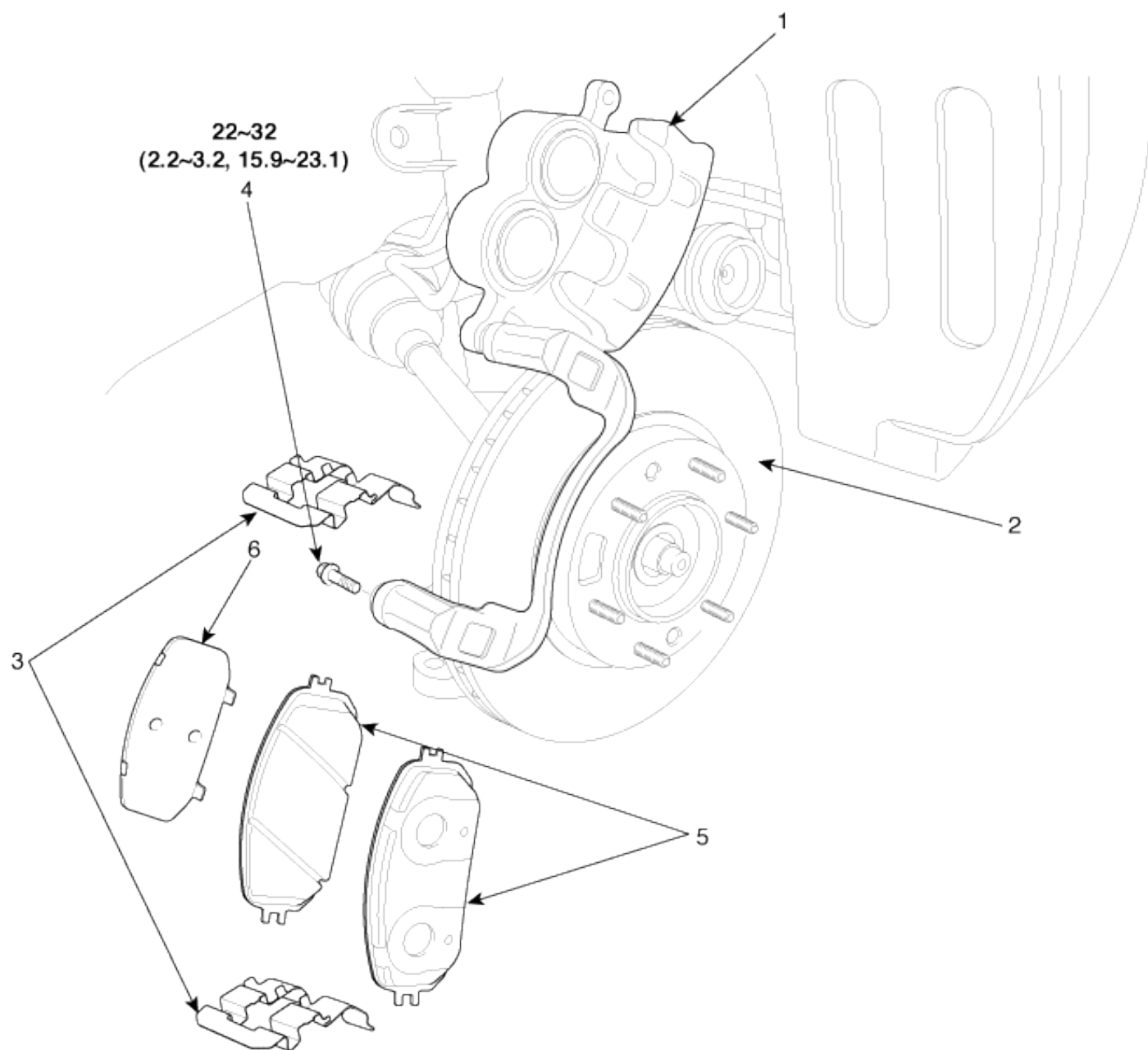




Brake System

Brake System - Front Disc Brake

COMPONENTS

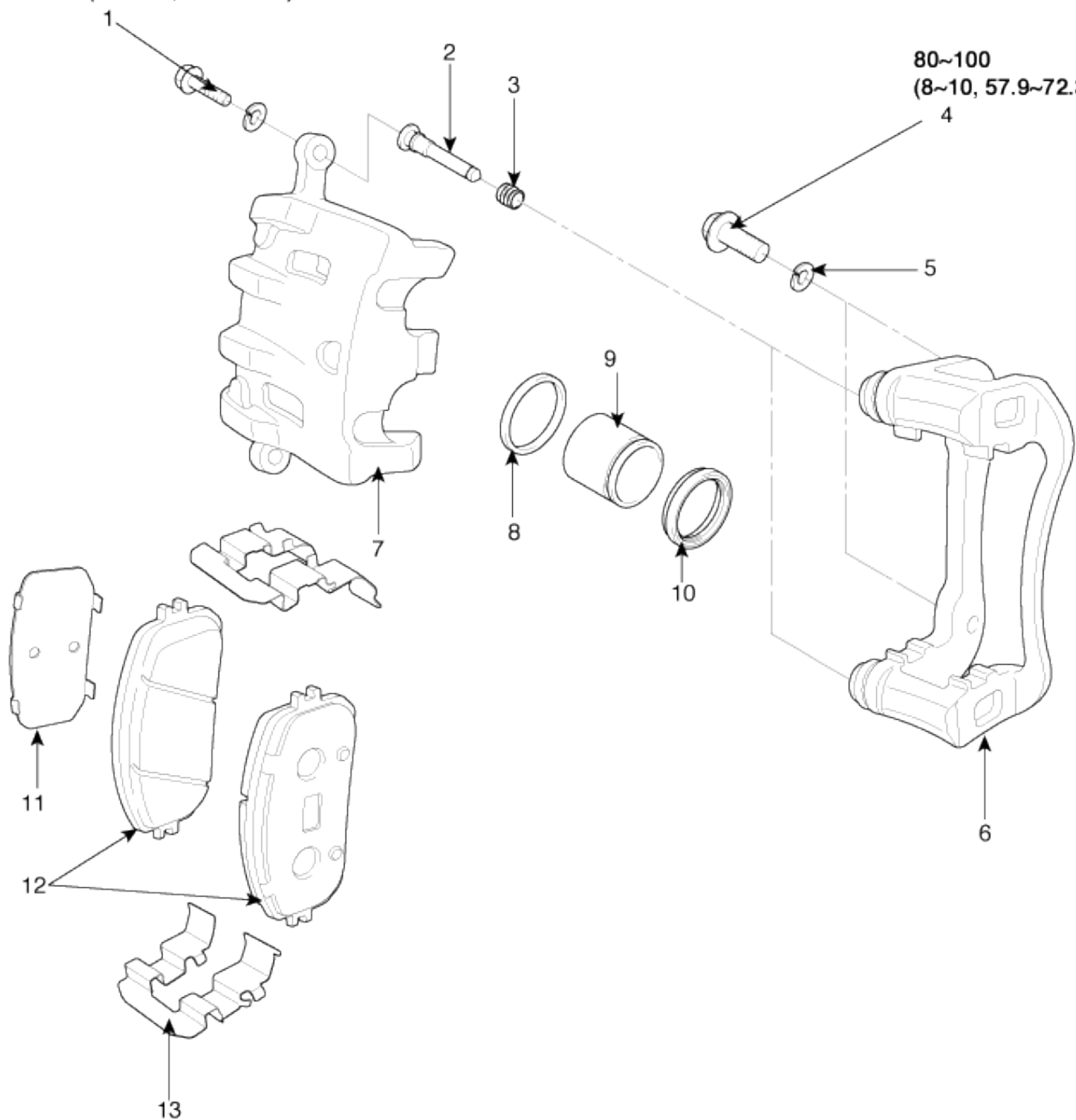
**TORQUE: Nm (kgf.m, lb-ft)**

- 1. Brake caliper
- 2. Brake disc
- 3. Pad retainers

- 4. Guide rod bolt
- 5. Brake pads
- 6. Brake pad shims

22~32 (2.2~3.2, 15.9~23.1)

80~100
(8~10, 57.9~72.3)



TORQUE : Nm (kgf.m, lb-ft)

- | | | |
|--------------------------|--------------------|------------------|
| 1. Guide rod bolt | 7. Caliper bracket | 11. Piston boot |
| 3. Guide rod | 8. Caliper body | 12. Inner shim |
| 4. Boot | 9. Piston seal | 13. Brake pad |
| 5. Caliper mounting bolt | 10. Piston | 14. Pad retainer |
| 6. Washer | | |



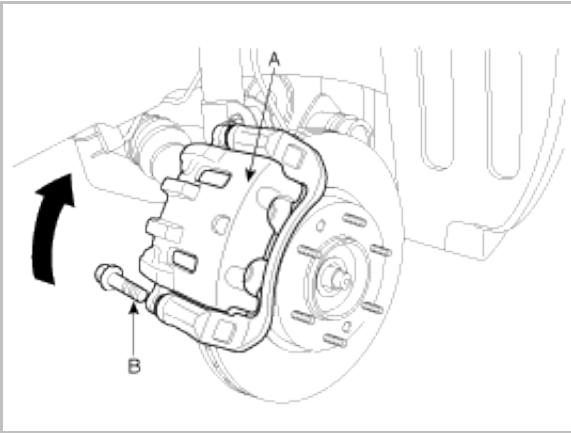
REMOVAL

CAUTION

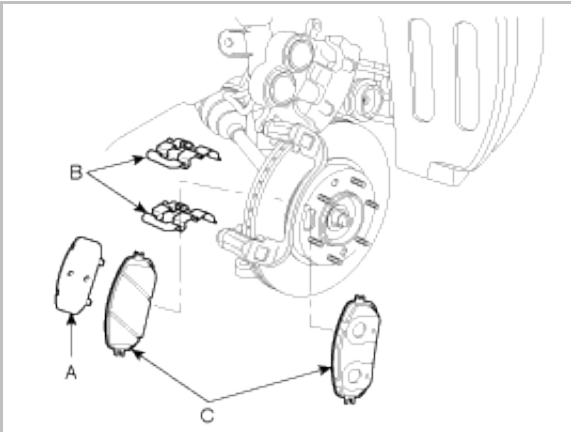
Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- Avoid breathing dust particles.
- Never use on air hose or brush to clean brake assemblies.

1. Loosen the front wheel nuts slightly. Raise the front of the vehicle, and make sure it is securely supported. Remove the front wheels.
2. Remove the guide rod bolt (B), After raise the caliper assembly (A), support it with a wire.

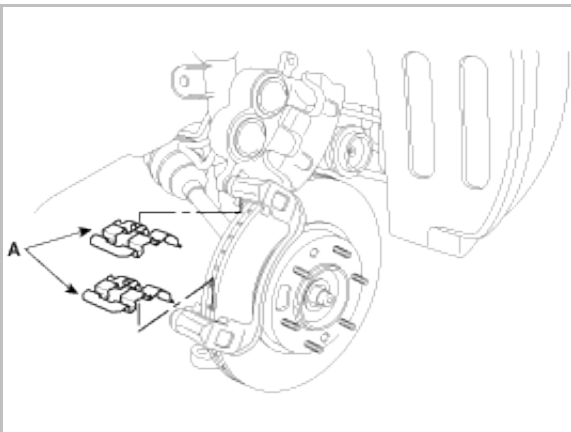


3. Remove pad shim (A), pad retainer (B) and pad assembly (C) in the caliper bracket.



INSTALLATION

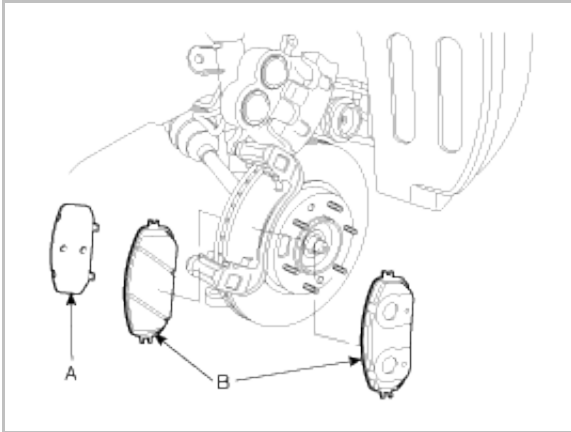
1. Install the pad retainers (A) on the caliper bracket.



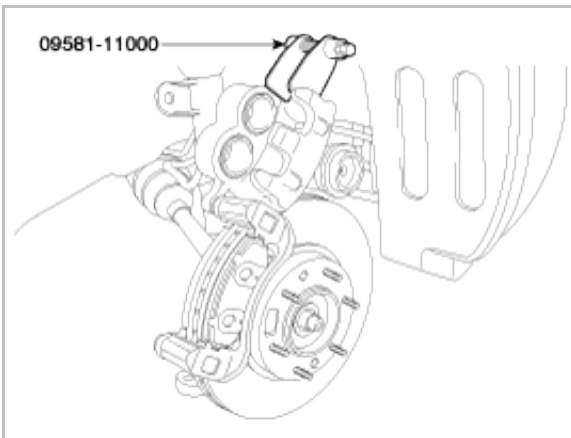
2. Install pad shims (A) and the brake pads (B) with the wear indicator on the inside.

CAUTION

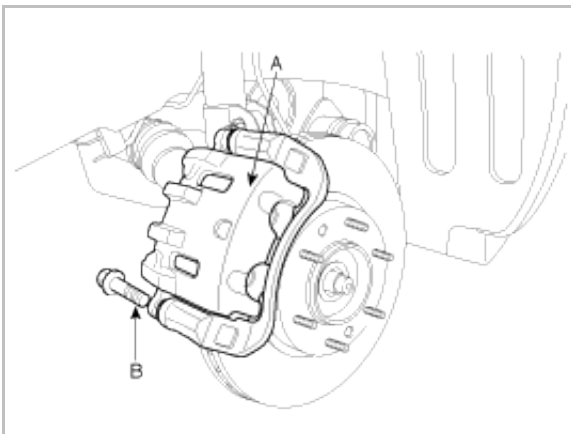
If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momentary loss of braking efficiency.



3. Insert the piston in the cylinder using the special tool (09581-11000).



4. Push in the piston (A) so that the caliper will fit over the pads. Make sure that the piston boot is in position to prevent damaging it when pivoting the caliper down.
5. Being careful not to damage the pin boot, install the guide rod bolt (B) with the specified torque.



6. If caliper assembly was removed, install the brake hose to the caliper.
7. Refill the master cylinder reservoir to the MAX line.
8. Bleed the brake system.(Refer to 'Bleeding of ABS system')
9. Depress the brake pedal several times to make sure the brakes work, then test-drive.

NOTICE

Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set. Several applications of the brake will restore the normal pedal stroke.

10. After installation, check for leaks at hose and line joints or connections, and retighten if necessary.

INSPECTION

FRONT BRAKE DISC THICKNESS CHECK

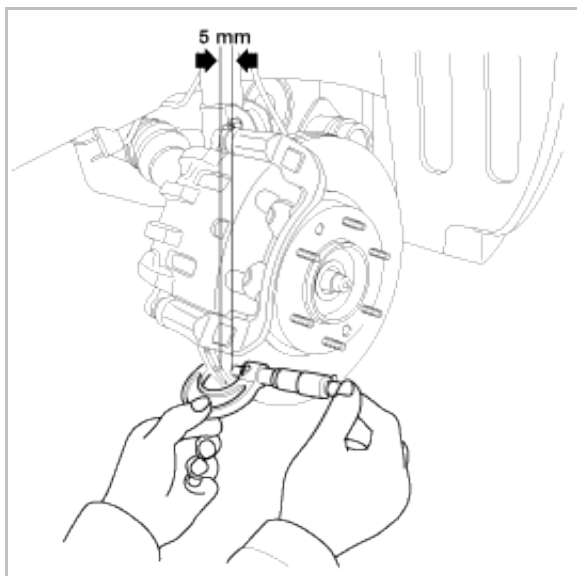
1. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) front the brake disc outer circle.

Front brake disc thickness

Standard value : 28 mm(1.10 in)

Limit : 26 mm(1.02 in)

2. Thickness variation should not exceed 0.005mm (0.0002 in) (circumference) and 0.01 mm (0.0004 in)(radius) at any directions.
3. If wear exceeds the limit, replace the discs and pad assemblies on the left and right sides of the vehicle.



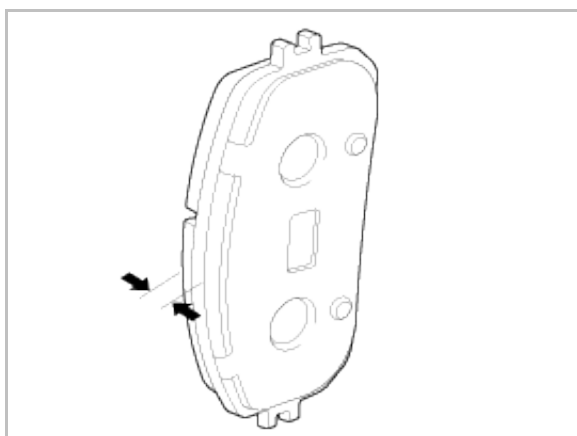
FRONT BRAKE PAD CHECK

1. Check the pad wear. Measure the pad thickness and replace it, if it is less than the specified value.

Pad thickness

Standard value : 11 mm (0.43 in)

Service limit : 2 mm (0.0787 in)



2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

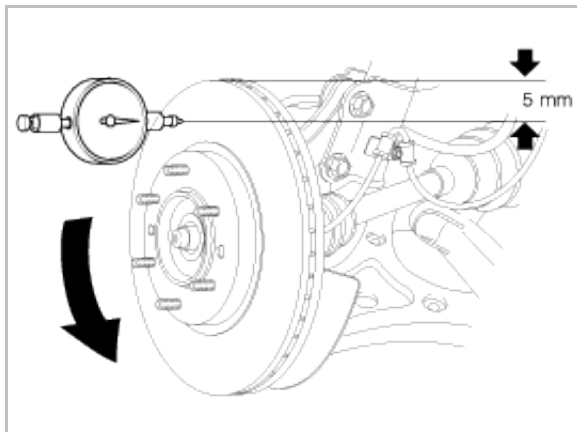
FRONT BRAKE DISC RUN OUT CHECK

1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the run out of the disc.
-

Brake disc run out

Limit : 0.03 mm (0.0012 in.) or less (new one)

2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
3. If the run out does not exceed the limit specification, install the brake disc after turning it 180° and then check the run out of the brake disc again.
4. If the run out cannot be corrected by changing the position of the brake disc, replace the brake disc.

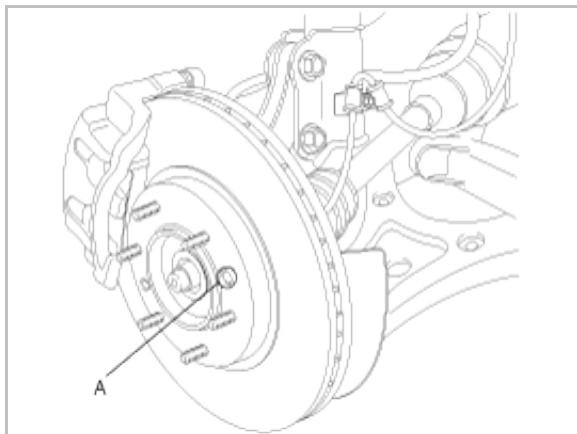


Seizing of Front brake disc

1. Remove the brake disc from hub using an M8 screw(A) if the brake disc has been seized with the hub due to corrosion or overheating.

NOTICE

Be careful not to use a hammer. The disc can be damaged if you remove the disc from the hub by hammering.





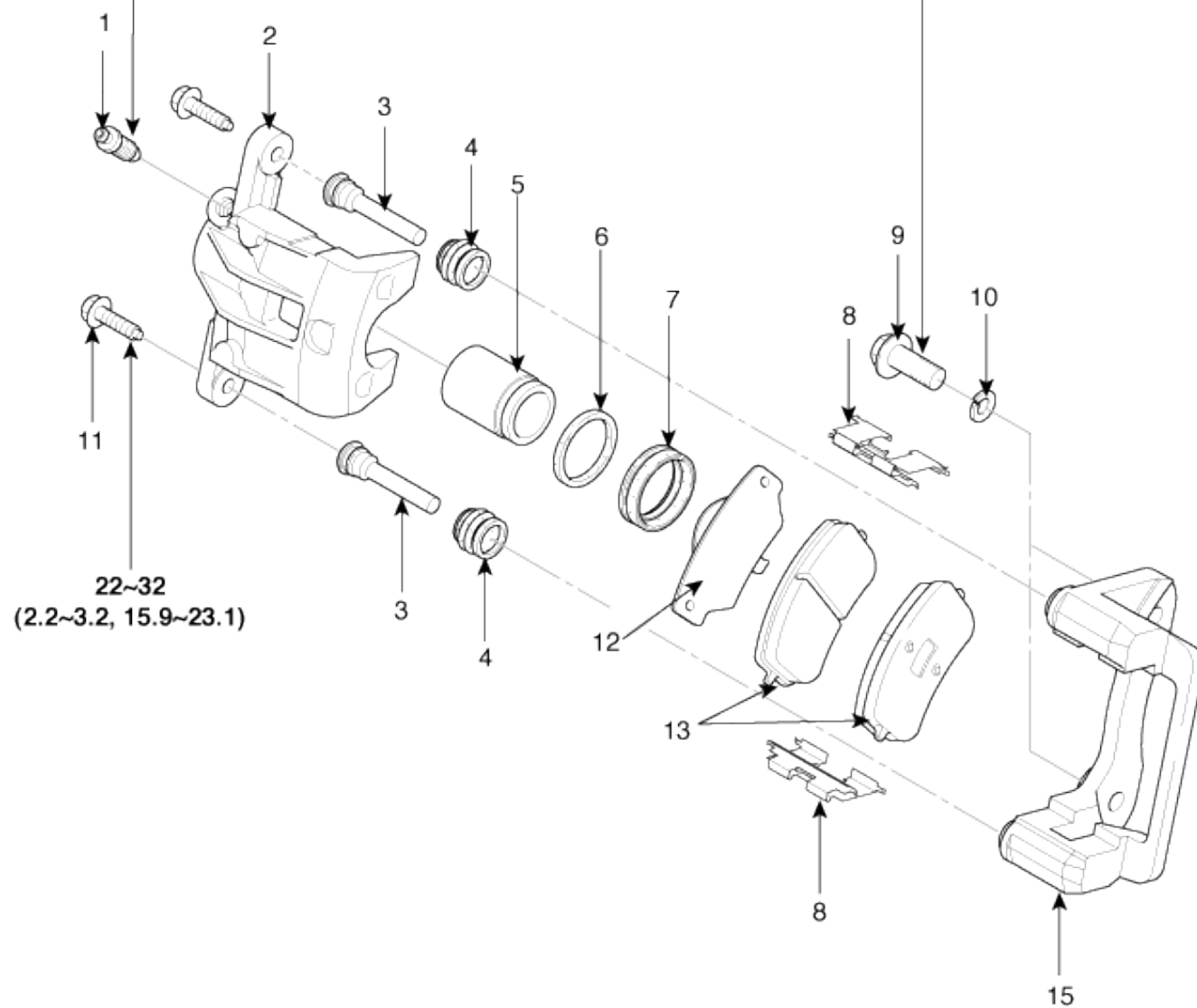
Brake System

Brake System - Rear Disc Brake

COMPONENTS

7~13 (0.7~1.3, 5.06~9.40)

50~60 (5~6, 36.2~43.4)



TORQUE : Nm (kgf.m, lb-ft)

1. Bleeder screw
2. Caliper body
3. Guide rod
4. Boot
5. Piston

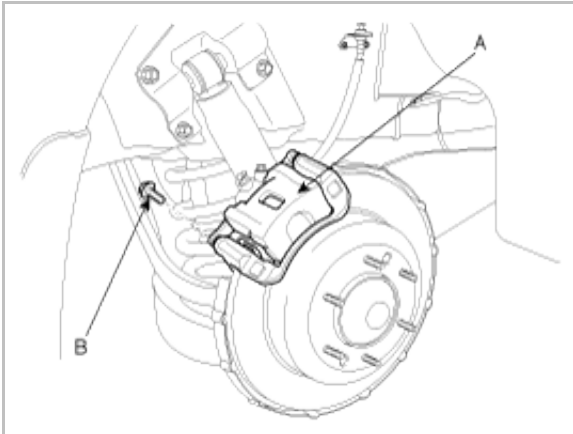
6. Piston seal
7. Piston boot
8. Pad retainer
9. Caliper mounting bolt
10. Washer

11. Guide rod bolt
12. Inner shim
13. Brake Pad
14. Outer shim
15. Caliper bracket

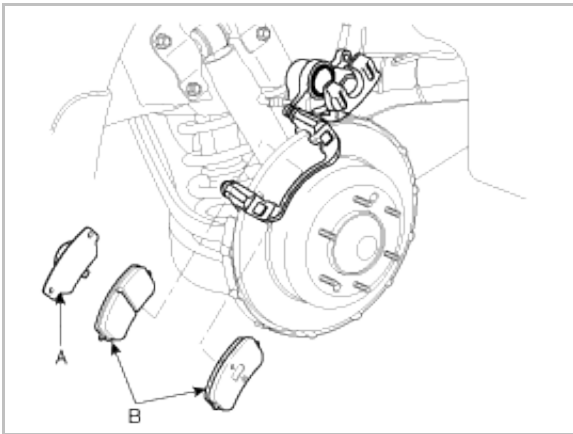


REMOVAL

1. Raise the rear of the vehicle and make sure it is securely supported. Remove the rear wheel.
2. Remove the guide rod bolt(B), After raising the caliper assembly (A), support it with a wire.

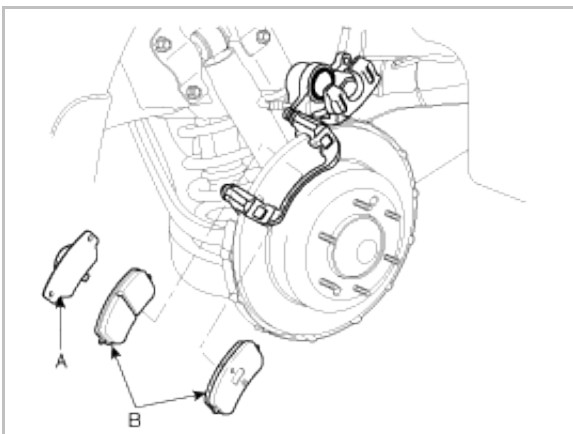


3. Remove pad shim (A), pad retainer (B) and pad assembly (C) in the caliper bracket.



INSTALLATION

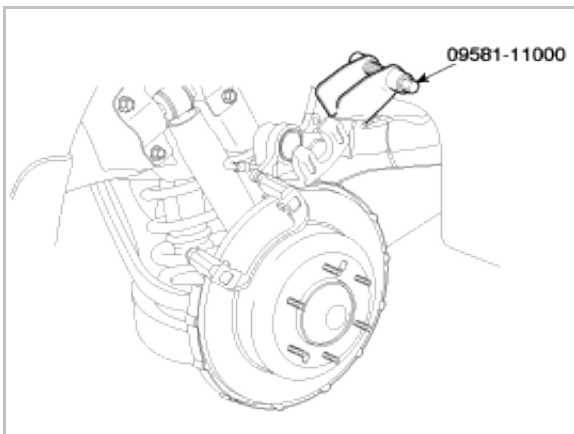
1. Install the pad retainer (A) to the caliper bracket.
2. Install the brake pads (B) and pad shims (A) and Install the pad with the wear indicator (C) on the inside.



CAUTION

If you reuse the pads, check for foreign material between the pad shim (A) and the back of the pads (B) and reinstall the brake pads in their original position to prevent a momentary loss of braking efficiency.

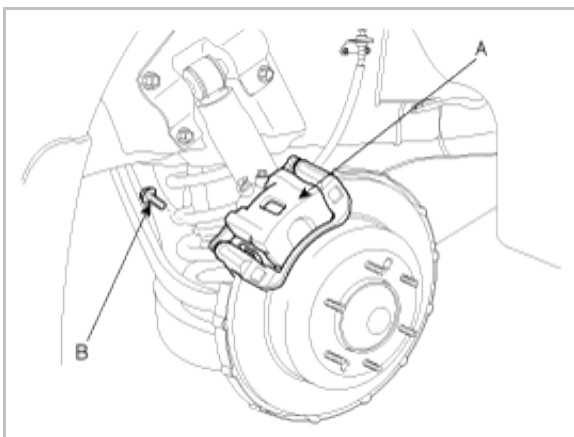
3. Press in the piston with the special tool (09581-11000).



4. Grease the piston boot to prevent from twisting.
5. Install the guide rod.
6. Install the cylinder assembly (A) to the disc plate.

CAUTION

Be careful not to damage the piston boot.



7. Install the guide rod bolt (B).

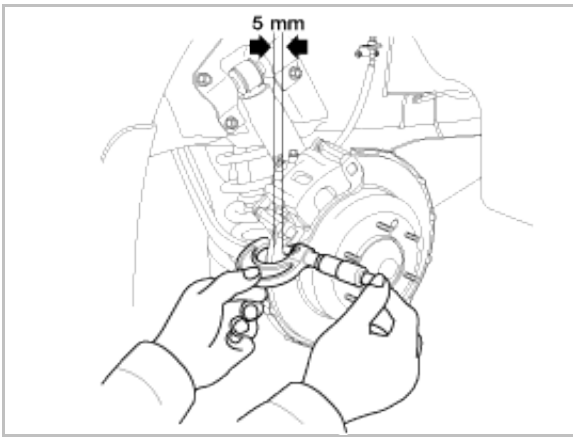
Tightening torque Nm(kgf.m,lb-ft) :
22 ~ 32 (2.2 ~ 3.2, 15.9 ~ 23.1)

INSPECTION

REAR BRAKE DISC THICKNESS CHECK

1. Remove all rust and contamination from the disc surface, and then measure the disc thickness at 8 points, at least, of the same distance (5 mm(0.12 in)) from the brake disc outer circle.

Rear brake disc thickness
Standard value : 12.0 mm (0.47 in)
Limit : 10.4 mm (0.41 in)
2. Thickness variation should not exceed 0.01 mm(0.0004 in) (circumference) and 0.01 mm(0.0004 in) (radius) at any directions.
3. If wear exceeds the limit, replace the discs and pad assembly for left and right of the vehicle.



REAR BRAKE PAD CHECK

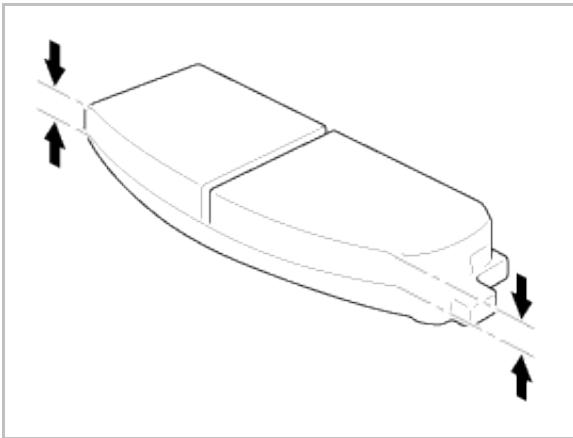
1. Check the pad wear. Measure the pad thickness and replace it, if it is less than the specified value.

Pad thickness

Standard value :

10.0 mm (0.39 in)

Service limit : 2.0 mm (0.08 in)



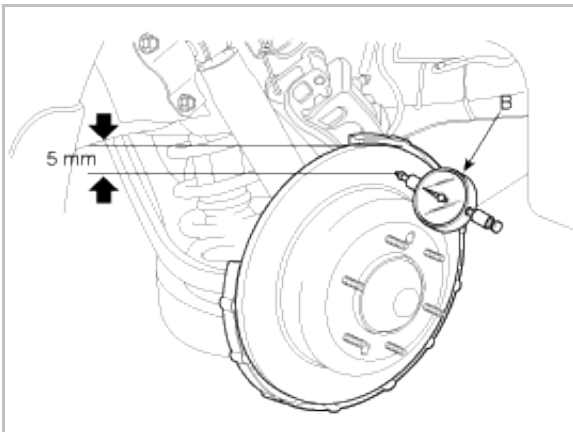
2. Check that grease is applied, and the pad and backing metal for damage.

REAR BRAKE DISC RUN OUT CHECK

1. Place a dial gauge about 5 mm (0.2 in) from the outer circumference of the brake disc, and measure the run out of the disc.

Brake disc run out

Limit : 0.05 mm (0.002 in) or less (new one)



2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.

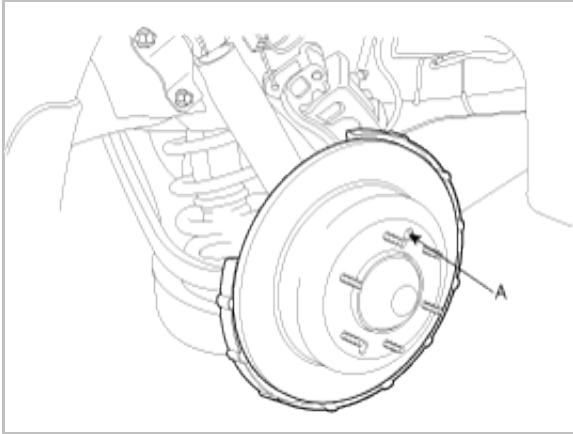
3. If the run out does not exceed the limit specification, install the brake disc after turning it 180° and then check the run out of the brake disc again.
4. If the run out cannot be corrected by changing the position of the brake disc, replace the brake disc.

Seizing of Rear brake disc

1. Remove the brake disc from hub using an M8 screw (A) if the brake disc has been seized with the hub due to corrosion or overheating.

NOTICE

Be careful not to use a hammer. The disc can be damaged if you remove the disc from the hub by hammering.



Brake System

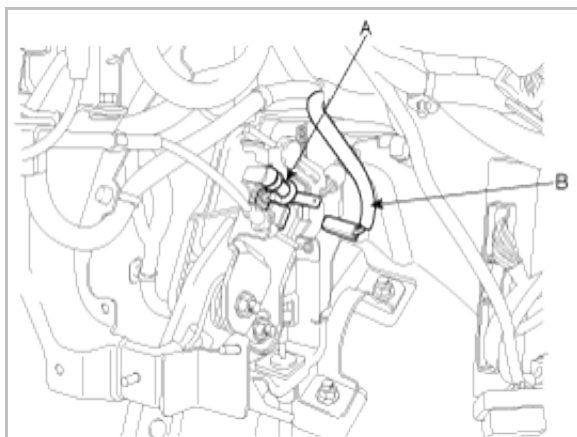
Parking Brake System - Parking Brake
Switch



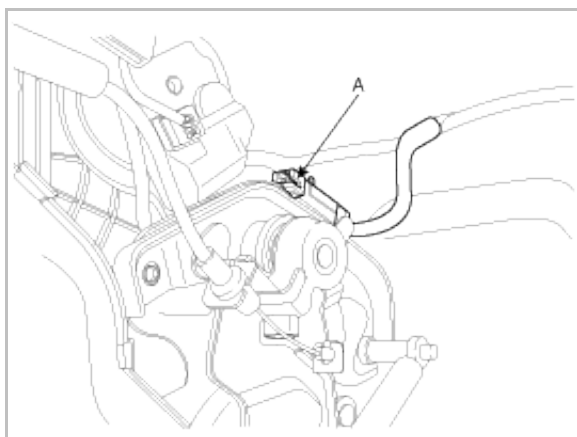
INSPECTION

1. Remove the floor console and the connector (B) from the switch (A).

[LHD]



[RHD]



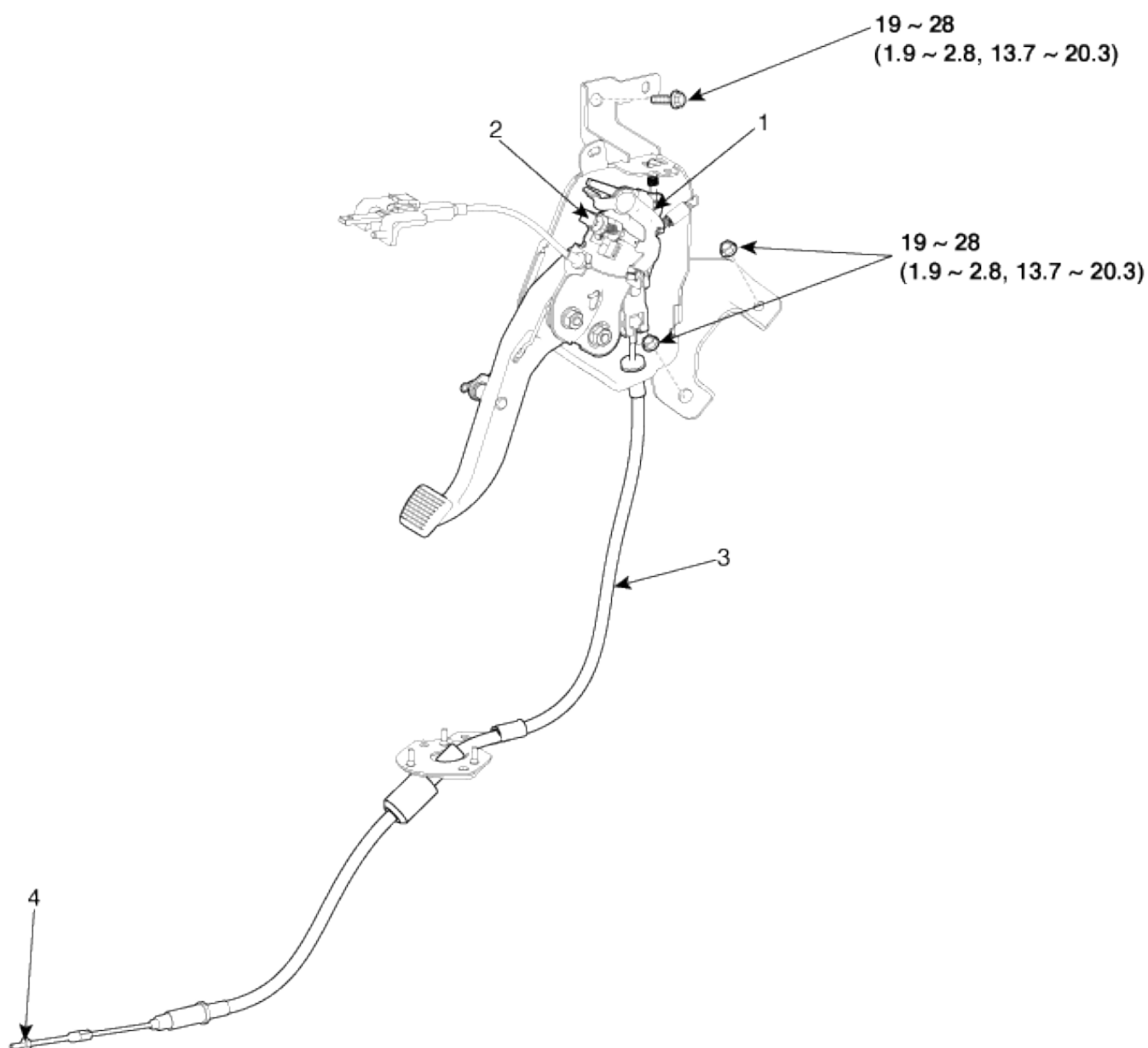
2. Inspect the continuity between (-) terminal and the ground.
 - A. When the brake lever is pulled, there should be the continuity between them.
 - B. When the brake lever is released, there should be no continuity between them.

Brake System

Parking Brake System - Parking Brake
Assembly

COMPONENTS(1)

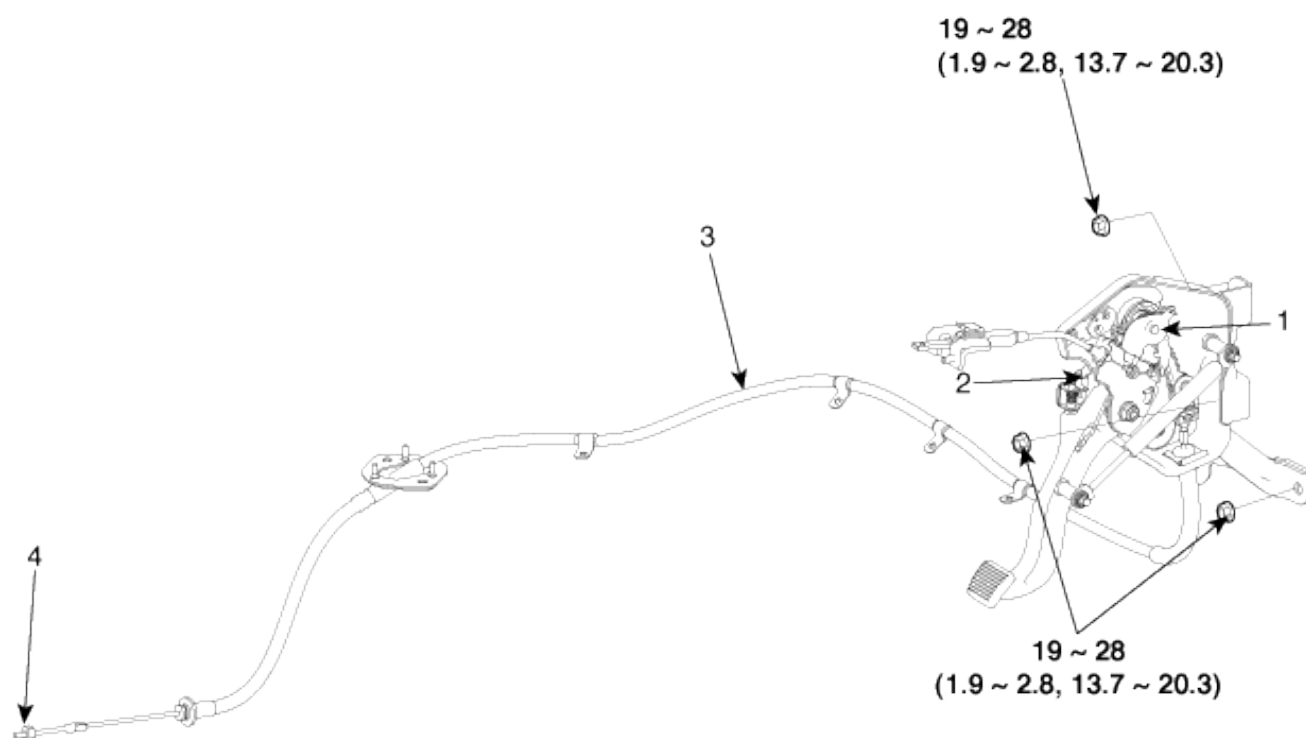
[LHD]

**TORQUE : Nm (kgf.m, lb-ft)**

1. Parking brake pedal assembly
2. Parking brake switch assembly
3. Parking brake cable
4. Adjusting nut

COMPONENTS(2)

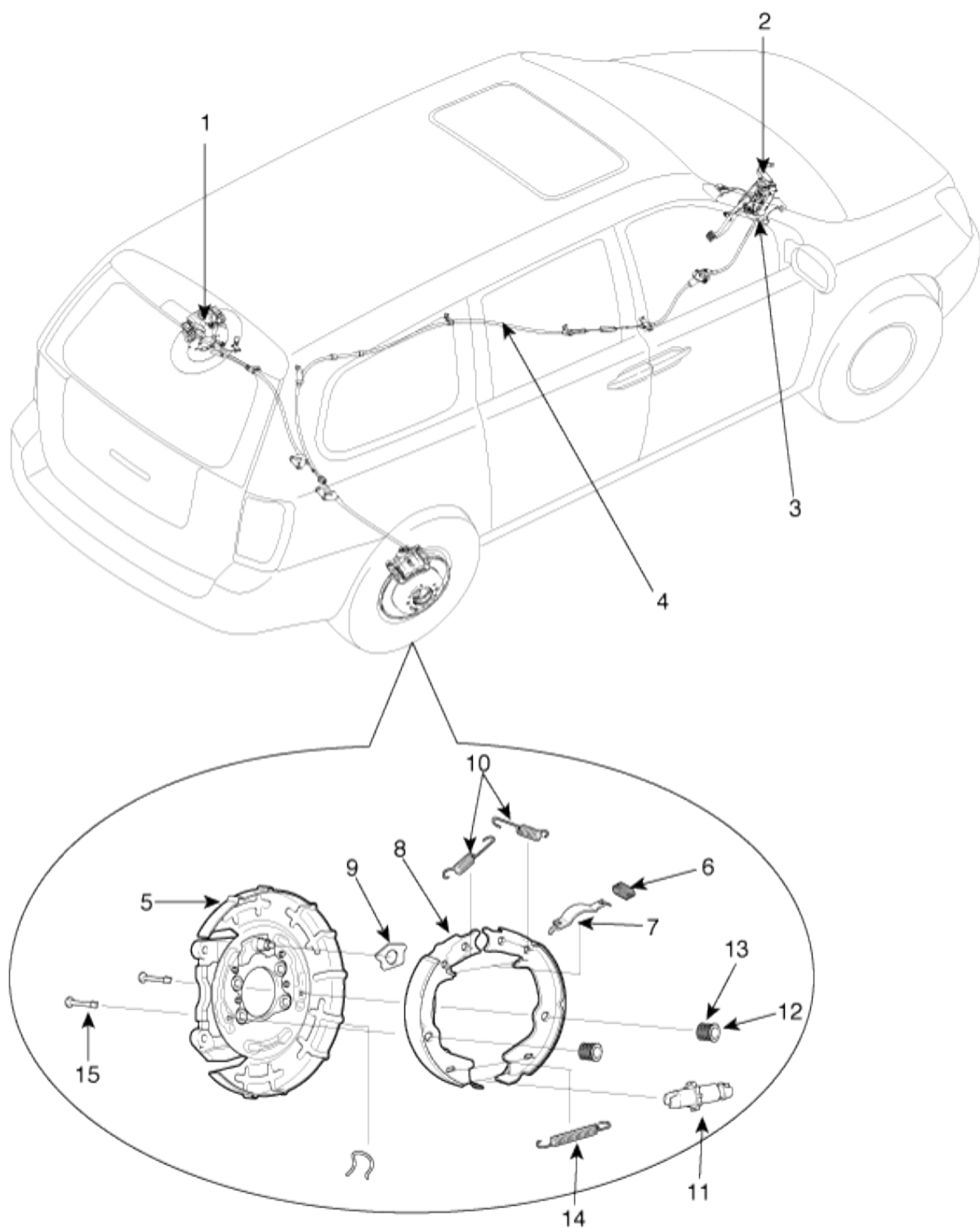
[RHD]



TORQUE : Nm (kgf.m, lb-ft)

1. Parking brake pedal assembly
2. Parking brake switch assembly
3. Parking brake cable
4. Adjusting nut

COMPONENTS(3)



1. Rear brake caliper
2. Parking brake lever
3. Parking brake switch
4. Parking brake cable
5. Backing plate

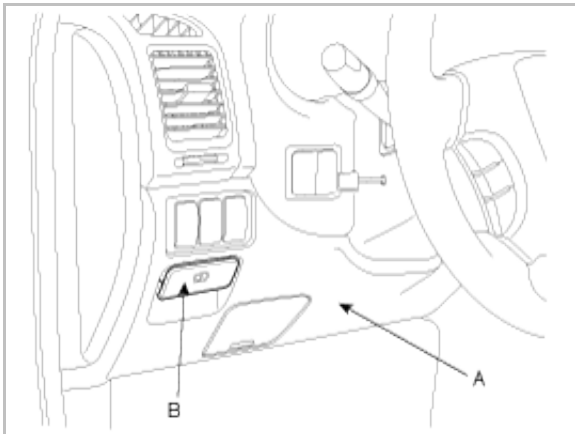
6. Strut spring
7. Strut
8. Shoe & lining
9. Shoe guide
10. Return spring

11. Adjuster
12. Cup washer
13. Shoe hold down spring
14. Return spring
15. Shoe hold down pin



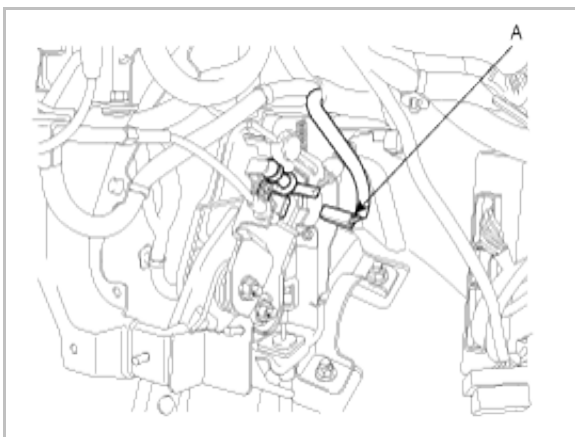
REMOVAL

1. Remove the lower panel (A), after loosening the parking lever. (Refer to BD group 'Crash pad')

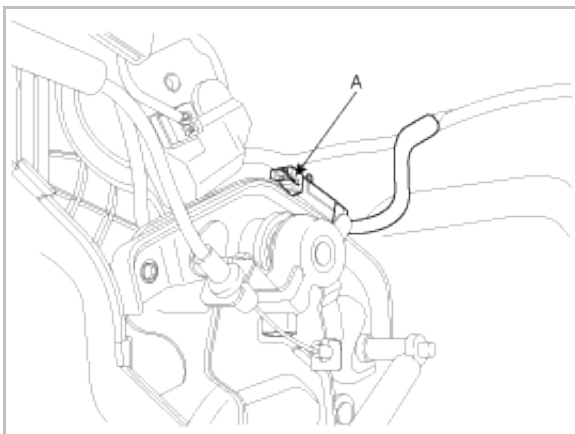


2. Remove the parking release nose (B).
3. Remove the parking brake switch (A).

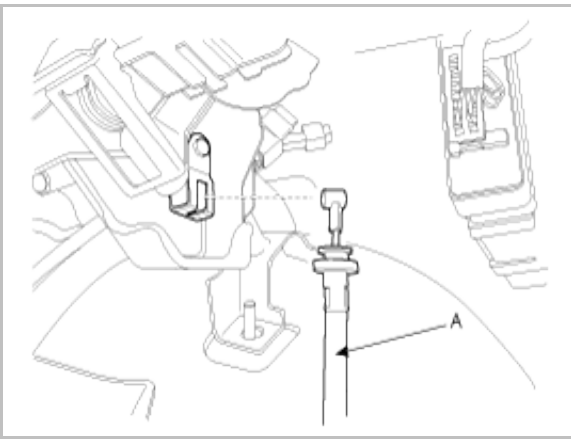
[LHD]



[RHD]

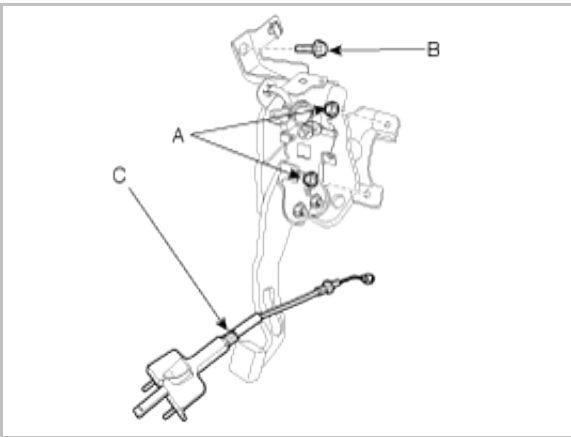


4. Remove the parking brake cable (A).

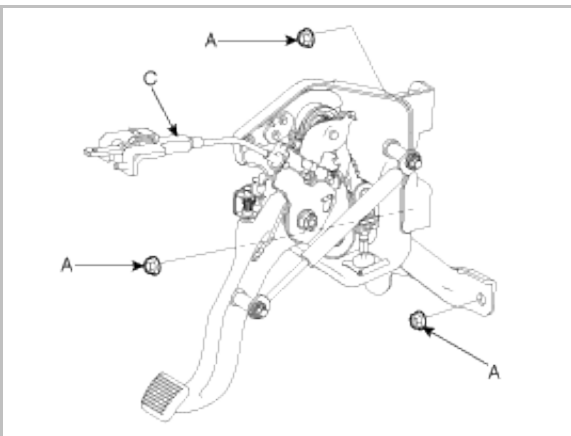


5. Remove the mounting nuts (A) and bolt (B) of the parking brake bracket.

[LHD]



[RHD]



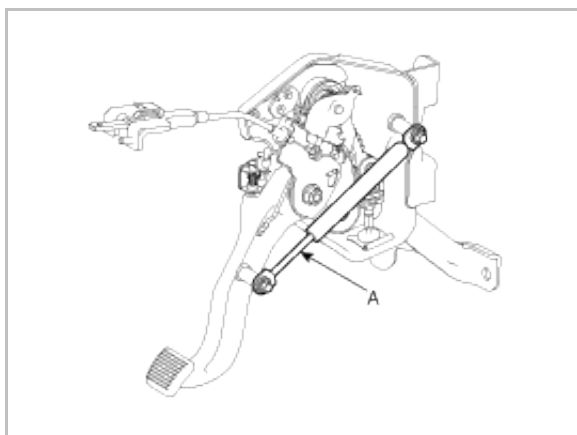
6. Remove the release cable assembly (C).

7. Remove the damper assembly (A).

[LHD]

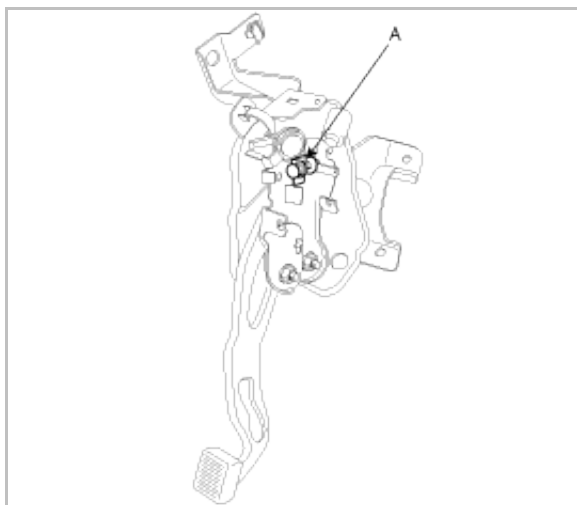


[RHD]



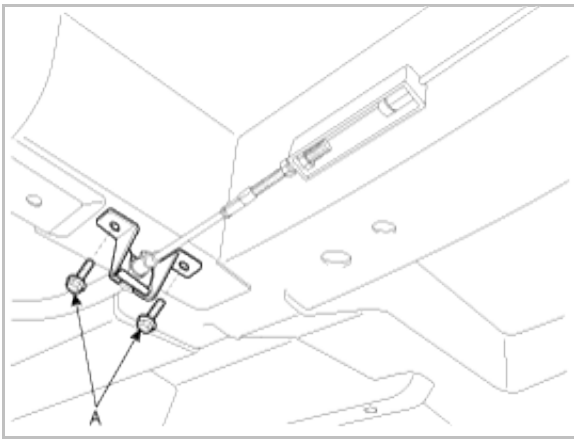
8. Remove the parking brake lamp switch (A).

[LHD]

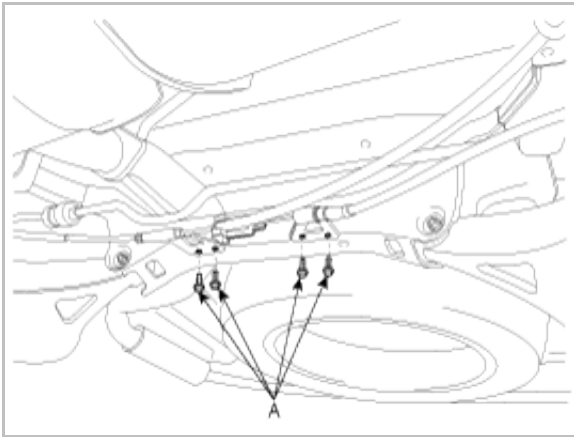


9. Raise the rear of the vehicle and make sure it is securely supported.

10. Remove the mounting bolt (A) of the parking brake wire bracket from the body.

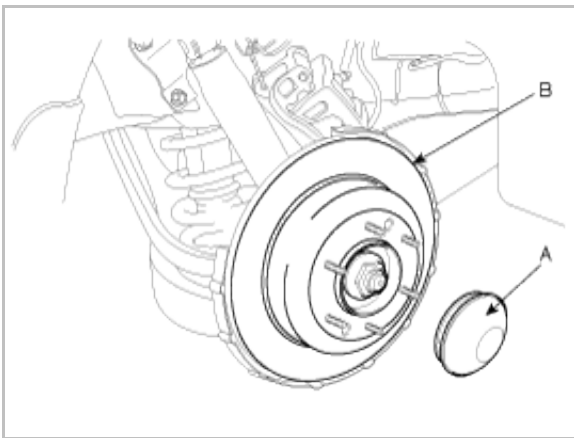


11. Remove the four mounting bolts (A) of the parking brake wire bracket from the rear cross member.

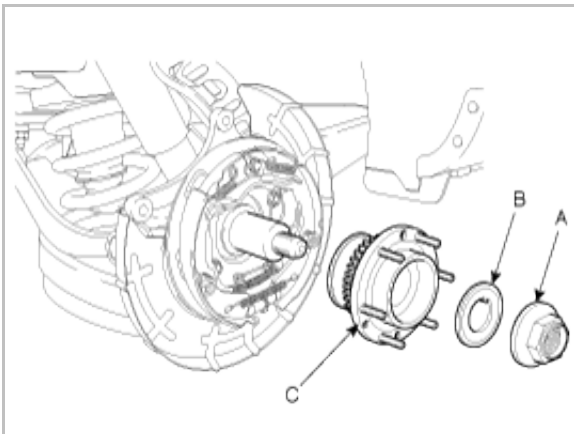


12. Remove the rear wheels and tires from the rear hubs.

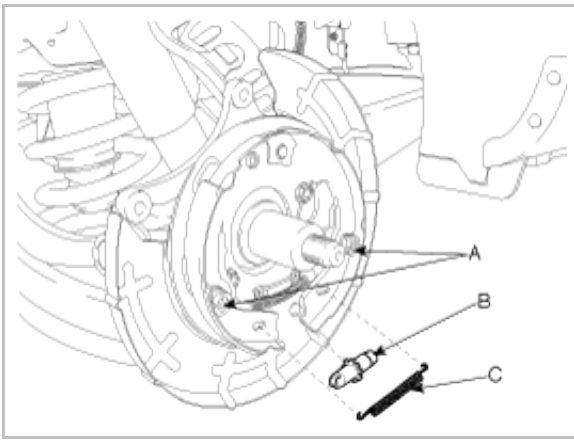
13. Remove the hub cap (A) and the disc (B).



14. Remove the hub nut (A) and washer (B) and remove the rear hub (C).

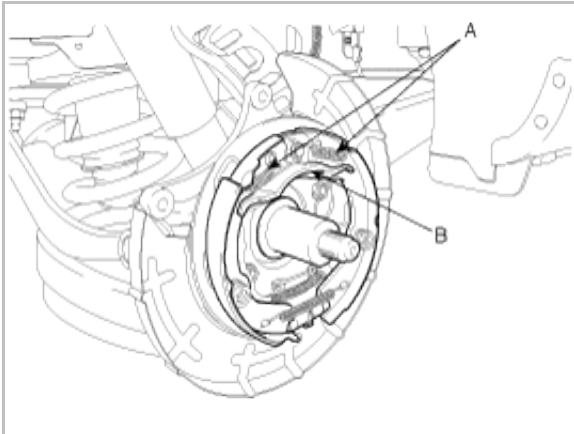


15. Remove the shoe hold down pin and spring (A) by pressing and rotating the spring.

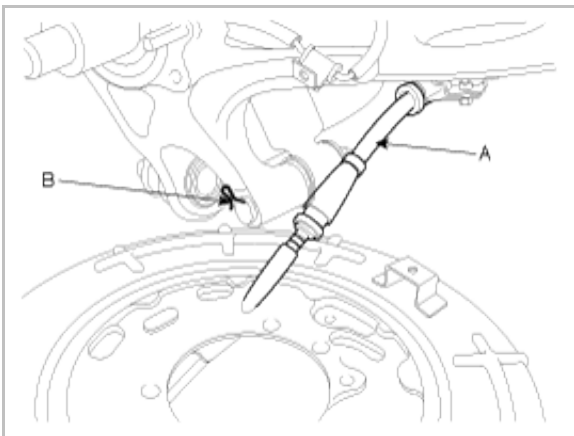


16. Remove the adjuster assembly (B) and the lower return spring (C).

17. Remove the strut (B) and the upper return spring (A).



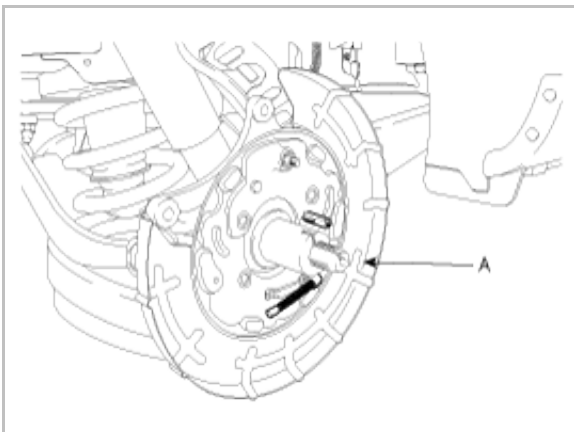
18. Remove the retaining ring (B) of the parking brake wire (A) from back of the backing plate.



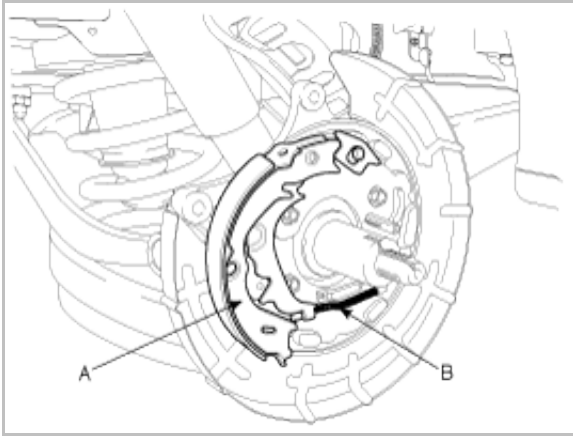
19. Disconnect the parking brake wire from the brake shoe.

INSTALLATION

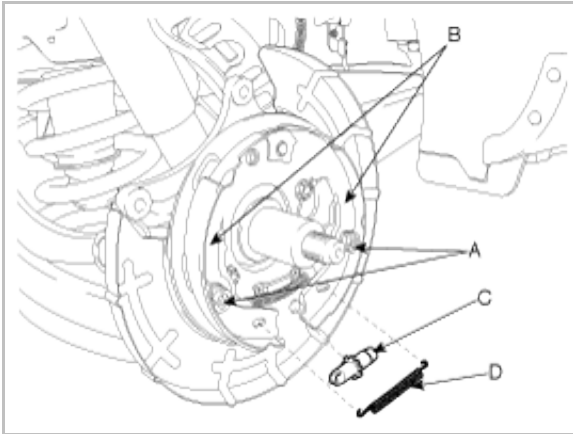
1. Install the backing plate (A).



2. Connect the parking brake wire (B) to the brake shoe (A).

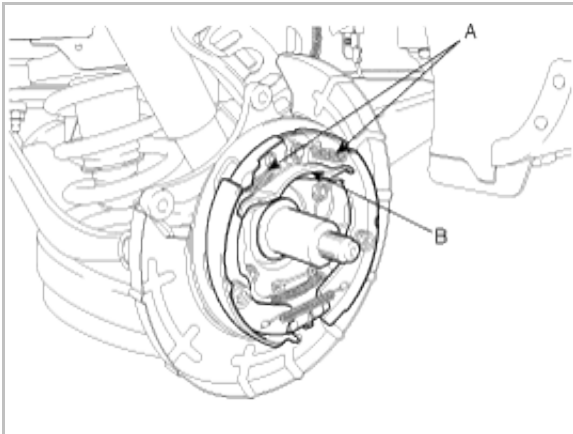


3. Install the shoe hold down pin and spring (A) to hold the brake shoe (B).



4. Install the adjuster assembly (B) and the lower return spring (C).

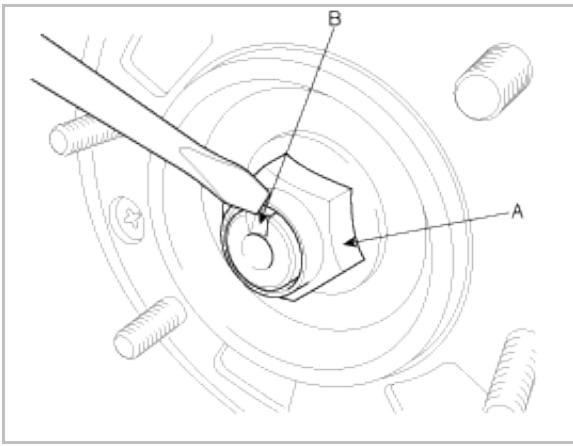
5. Install the upper return spring (A) and strut (B).



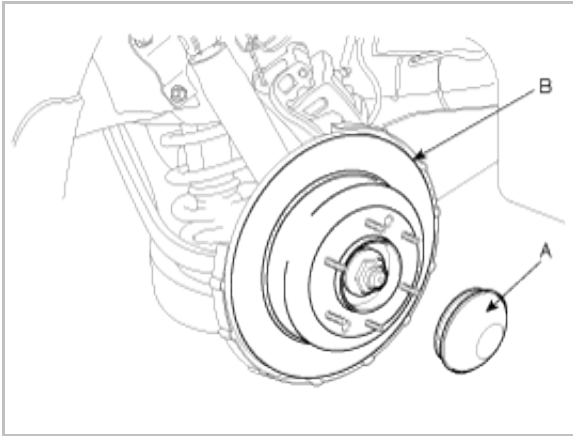
6. Grease where is necessary.

7. Install the rear hubs.

8. Install the hub nut (A). After installation, lock the nut to the spindle as shown in the illustration.



9. Install the hub cap (A) and the disc (B).



10. Install the rear wheels and tires from the rear hubs.

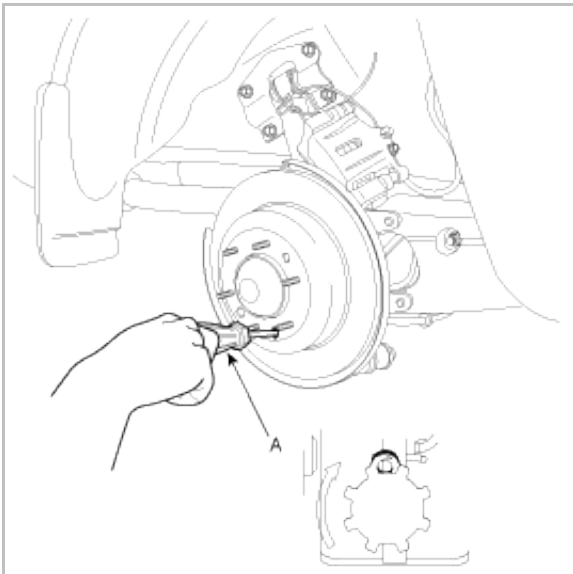
11. Tighten the parking brake adjusting nut.

12. Install the parking brake wire and the pedal assembly.

ADJUSTMENT

ADJUSTMENT OF REAR BRAKE SHOE CLEARANCE

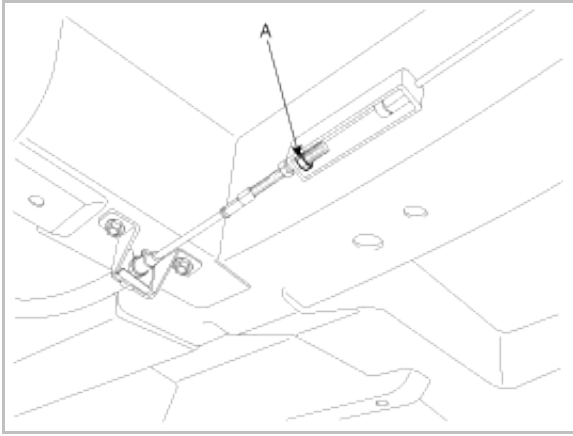
1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear wheel and tire from the rear hub.
3. After removing the plug from the disc, rotate the toothed wheel by a screw driver until the disc is not moving, and then return it by 5 notches.



ADJUSTMENT PRECEDURE OF DIH FOOT PARKING BRAKE

1. Adjust the adjusting nut (A) so that parking pedal stroke is to be 88 ~ 98 mm(3.46 ~ 3.86 in) when operating effort

is 200 N(20 kgf, 44 lb) after full stroke operation of parking pedal over 3 times for setting parking wire.



CAUTION

1. The parking brake adjustment must be carried out after adjusting the rear shoe.
2. After adjusting parking brake, notice following matter;
 - 1) Must be free from clearance between adjusting nut and pin.
 - 2) Check securely that the brake is not dragging

BED-IN PROCEDURE FOR DIH FOOT PARKING BRAKE

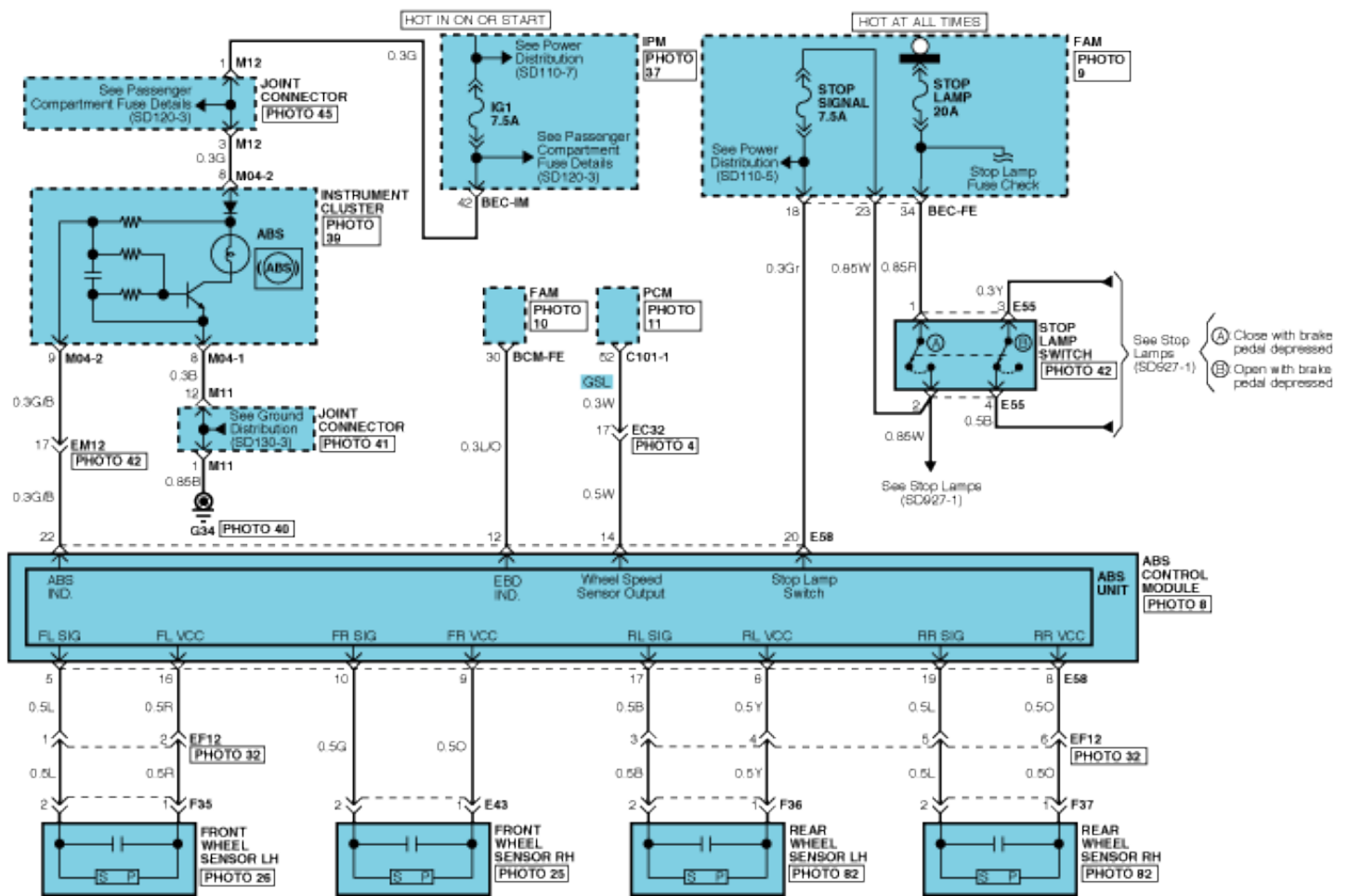


Brake System

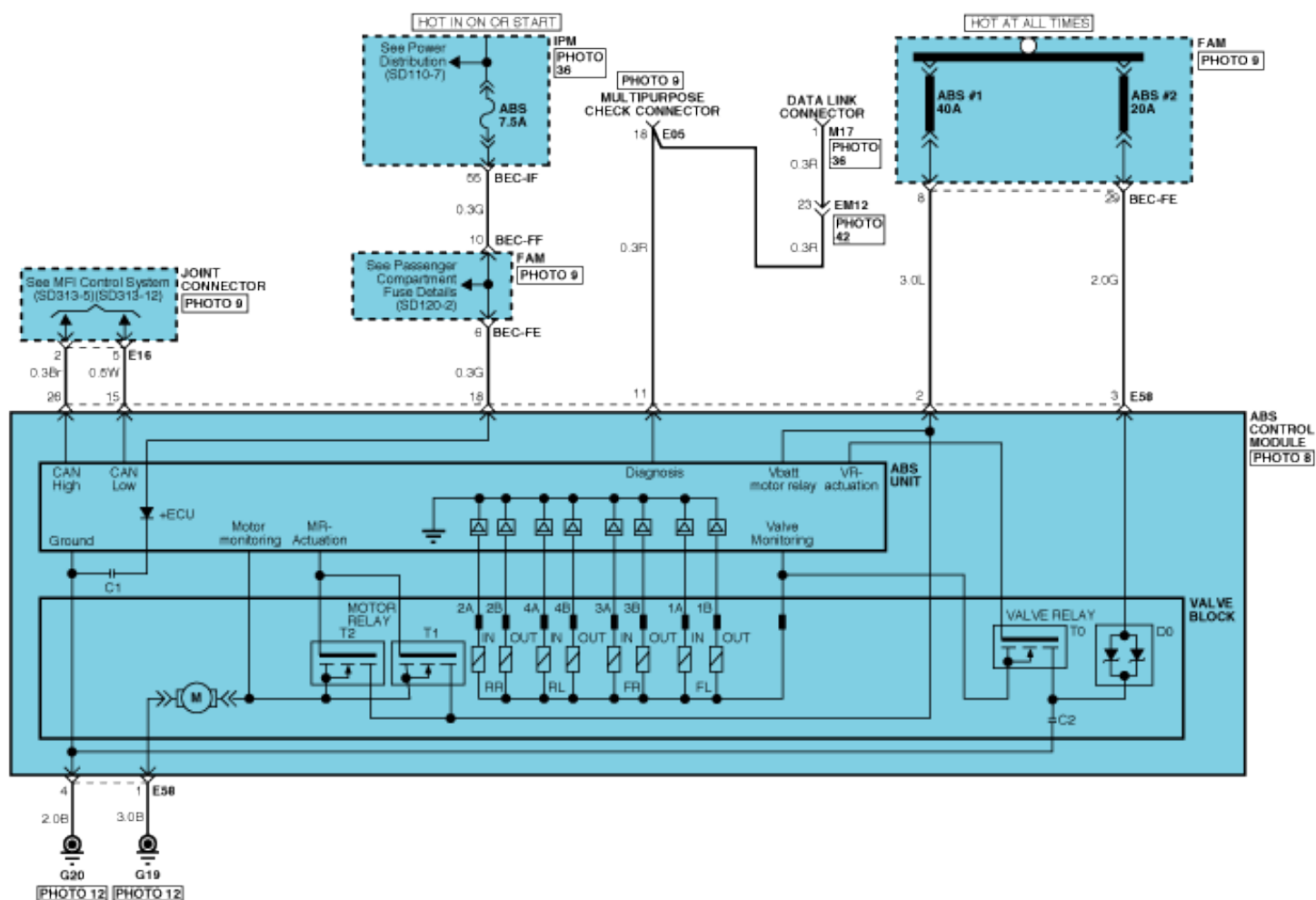
ABS(Anti-Lock Brake System)



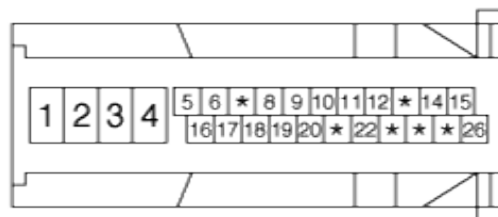
ABS CIRCUIT DIAGRAM(1)



ABS CIRCUIT DIAGRAM(2)



ECU CONNECTOR INPUT/OUTPUT(ABS)



Wire No.	Designation	Current		max.permissible wire resistance R _L (mΩ)	min.leakage resistance R _P (kΩ)
		max	min		
1	Ground for recirculation pump	20~39 A	10 A	10	
4	Ground for solenoid valves and ECU	5~15 A	2.5 A	10	
2	Voltage supply for pump motor	20~39 A	10 A	10	200
3	Voltage supply for solenoid valves	5~15 A	2 A	10	200
18	Voltage for hybrid ECU	1 A	500 mA	60	200

5,10,17,19	signal wheel speed sensor FL, FR, RL,RR	6 mA	16 mA	250	200 to ground 1.5M to bat
16,9,6,8	Voltage supply for the active wheel speed sensor FL,FR, RL, RR	6 mA	16 mA	250	200 to ground 1.5M to bat
14,24	wheel speed sensor output (FR, RL)	20 mA	10 mA	250	200
11	Diagnostic wire K	6 mA	3 mA	250	200
22	ABS-warning lamp actuation	30 mA	5 mA	250	200
12	EBD-warning lamp actuation	30 mA	5 mA	250	200
20	brake light switch	10 mA	5 mA	250	200
15	CAN Low	30 mA	20 mA	250	200
26	CAN High	30 mA	20 mA	250	200

ABS HECU CONNECTOR

Connector terminal		Specification	Condition
Number	Description		
1	Ground for recirculation pump	Current range: Min.10A Max.20~39A	Always
4	Ground for solenoid valves and ECU	Current range: Min.2.5A Max.5~15A	Always
2	Voltage supply for pump motor	Battery voltage	Always
3	Voltage supply for solenoid valves		
16	Voltage supply for the active wheel speed sensor FL,FR, RL, RR	Battery voltage	IG ON
9			
6			
8			
5	signal wheel speed sensor FL, FR, RL,RR	Voltage(High) : 0.89~1.26 V Voltage (Low) : 0.44~0.63 V	On driving
10			
17			
19			
11	Diagnostic wire K	Voltage (High) $\geq 0.8 * \text{IG ON}$ Voltage (Low) $\leq 0.2 * \text{IG ON}$	On SCAN TOOL communication
18	Voltage for hybrid ECU	Battery voltage	KEY ON/OFF
20	Brake light switch	Voltage (High) $\geq 0.8 * \text{IG ON}$ Voltage (Low) $\leq 0.3 * \text{IG ON}$	BRAKE ON/OFF

SENSOR OUTPUT ON SCAN TOOL(ABS)

	Description	Abbreviation	Unit	Remarks
1	Vehicle speed sensor	VEH. SPD	Km/h	
2	Battery voltage	BATT. VOL	V	
3	FL Wheel speed sensor	FL WHEEL	Km/h	
4	FR Wheel speed sensor	FR WHEEL	Km/h	

5	RL Wheel speed sensor	RL WHEEL	Km/h	
6	RR Wheel speed sensor	RR WHEEL	Km/h	
7	ABS Warning lamp	ABS LAMP	-	
8	EBD Warning lamp	EBD LAMP	-	
9	Brake Lamp	B/LAMP	-	
10	Pump relay state	PUMP RLY	-	
11	Valve relay state	VALVE RLY	-	
12	Motor	MOTOR	-	
13	Front Left valve(IN)	FL INLET	-	
14	Front Right valve (IN)	FR INLET	-	
15	Rear Left valve (IN)	RL INLET	-	
16	Rear Right valve (IN)	RR INLET	-	
17	Front Left valve (OUT)	FL OUTLET	-	
18	Front Right valve (OUT)	FR OUTLET	-	
19	Rear Left valve(OUT)	RL OUTLET	-	
20	Rear Right valve (OUT)	RR OUTLET	-	



DESCRIPTION

This specification applies to HCU(Hydraulic Control Unit) and ECU(Electronic Control Unit) of the HECU.(Hydraulic and Electronic Control Unit)

This specification is for the wiring design and installation of ABS/TCS/ESC ECU.

This unit has the functions as follows.

- Input of signal from Pressure sensor, Steering angle sensor, Yaw & Lateral G sensor, the wheel speed sensors attached to each wheel.
- Control of braking force / traction force/ yaw moment.
- Failsafe function.
- Self diagnosis function.
- Interface with the external diagnosis tester.

Installation position : engine compartment

- Brake tube length from Master cylinder port to HECU inlet port should be max. 1m
- The position should not be close to the engine block and not lower than the wheel.

OPERATION

The ECU shall be put into operation by switching on the operating voltage (IGN).

On completion of the initialization phase, the ECU shall be ready for operation.

In the operating condition, the ECU shall be ready, within the specified limits (voltage and temperature), to process the signals offered by the various sensors and switches in accordance with the control algorithm defined by the software and to control the hydraulic and electrical actuators.

Wheel Sensor signal processing

The ECU shall receive wheel speed signal from the four active wheel sensors.

The wheel signals are converted to voltage signal by the signal conditioning circuit after receiving current signal from active wheel sensors and given as input to the MCU.

Solenoid Valve Control

When one side of the valve coil is connected to the positive voltage that is provided through the valve relay and the other side is connected to the ground by the semiconductor circuit, the solenoid valve goes into operation.

The electrical function of the coils are always monitored by the valve test pulse under normal operation conditions.

Voltage limits

- Overvoltage

When overvoltage is detected(above 16.8 V), the ECU switches off the valve relay and shuts down the system.

When voltage is returned to operating range, the system goes back to the normal condition after the initialization phase.

- Undervoltage

In the event of undervoltage(below 9.3 V), ABS control shall be inhibited and the warning lamp shall be turned on.

When voltage is returned to operating range, the warning lamp is switched off and ECU returns to normal operating mode.

Pump Motor Checking

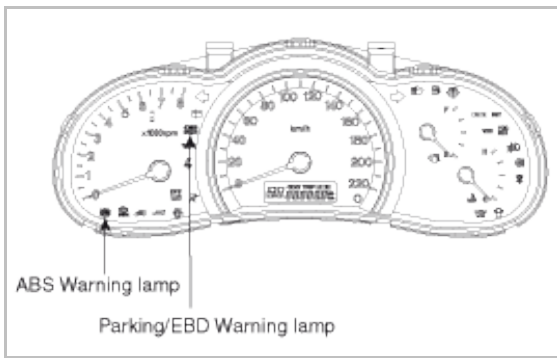
The ECU performs a pump motor test at a speed of 15km/h once after IGN is switched on.

Diagnostic Interface

Failures detected by the ECU are encoded on the ECU, stored in a EEPROM and read out by diagnostic equipment when the ignition switch is turned on.

The diagnosis interface can also be used for testing the ECU during production of the ECU and for actuating the HCU (Air-bleeding line or Roll and Brake Test line).

Warning Lamp module



1. ABS WARNING LAMP MODULE

The active ABS warning lamp module indicates the selftest and failure status of the ABS. The ABS warning lamp shall be on:

- A. During the initialization phase after IGN ON. (continuously 3 seconds).
- B. In the event of inhibition of ABS functions by failure.
- C. During diagnostic mode.
- D. When the ECU Connector is separated from ECU.

2. PARKING/EBD WARNING LAMP MODULE

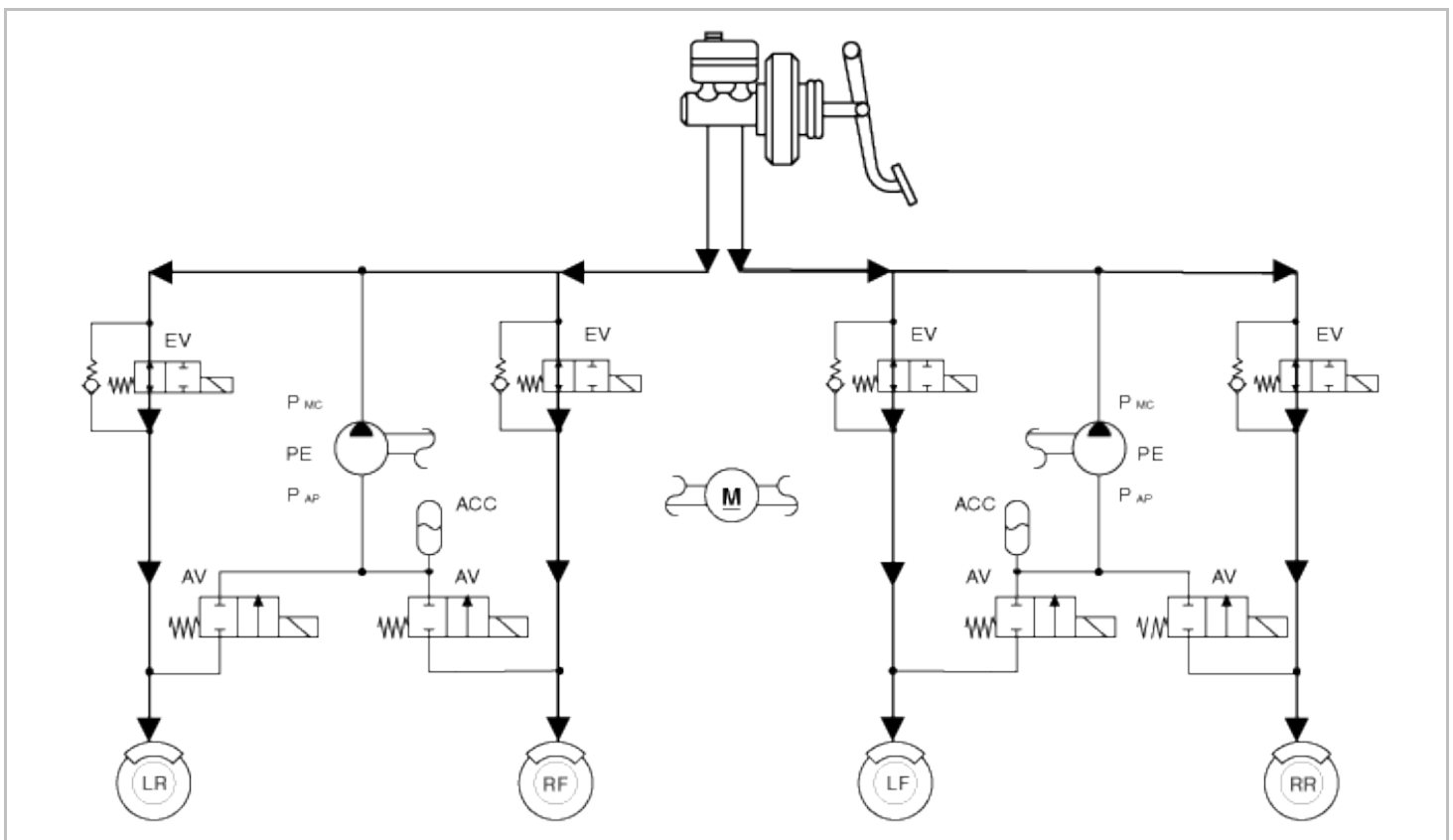
The active EBD warning lamp module indicates the selftest and failure status of the EBD. However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions. The EBD warning lamp shall be on:

- A. During the initialization phase after IGN ON. (continuously 3 seconds).
- B. When the Parking Brake Switch is ON or brake fluid level is low.
- C. When the EBD function is out of order.
- D. During diagnostic mode.
- E. When the ECU Connector is separated from ECU.

ABS CONTROL

1. NORMAL BRAKING without ABS

	Inlet valve(EV)	Outlet valve(AV)	Pump motor
Operation	Open	Close	OFF

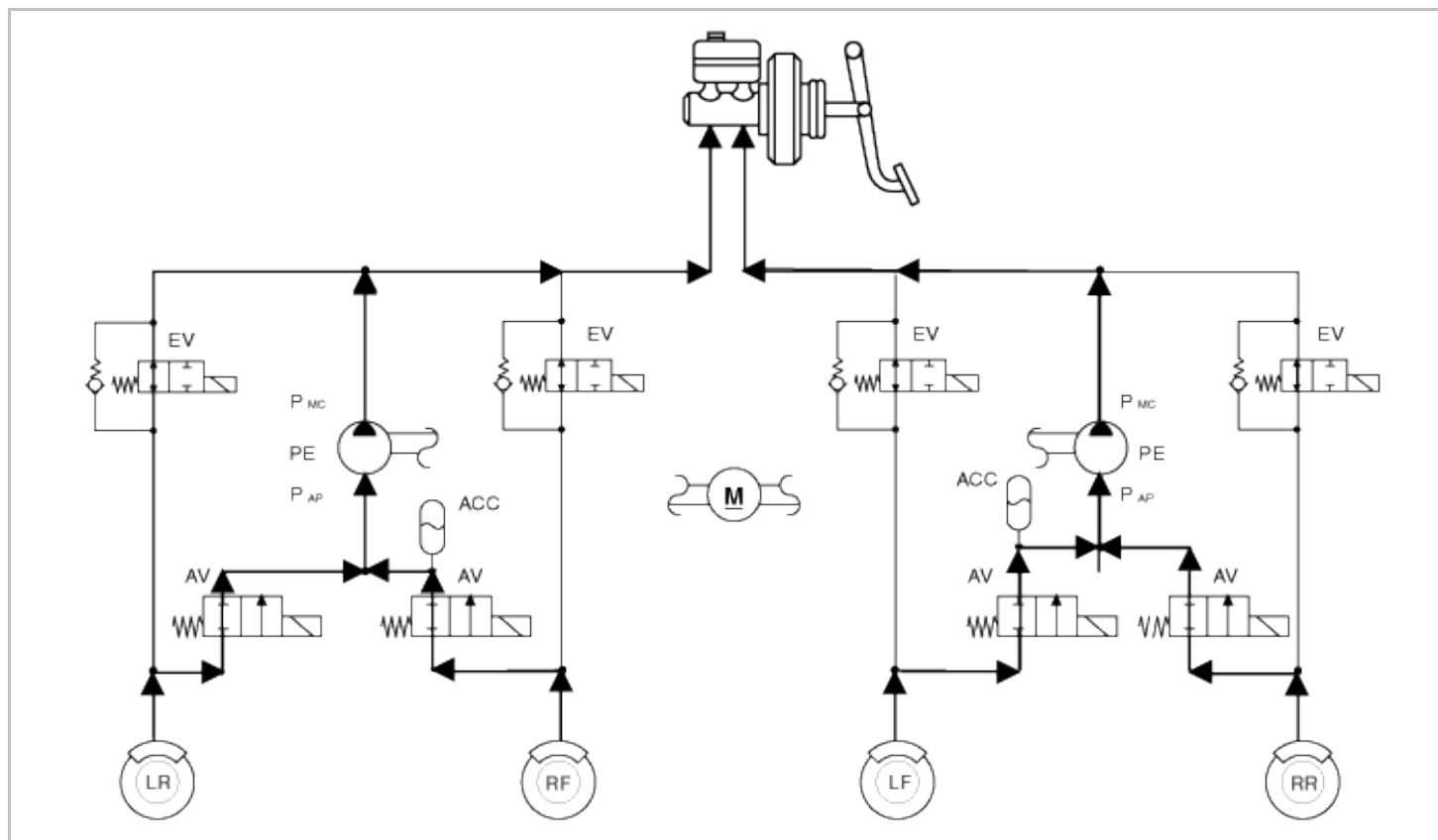


NOTICE

EV : Inlet Valve
 AV : Outlet Valve
 LR : Rear left wheel
 RF : Front right wheel
 LF : Front left wheel
 RR : Rear right wheel
 PE : Pump motor

2. DECREASE MODE

	Inlet valve(EV)	Outlet valve(AV)	Pump motor
Operation	Close	Open	ON(Motor speed control)

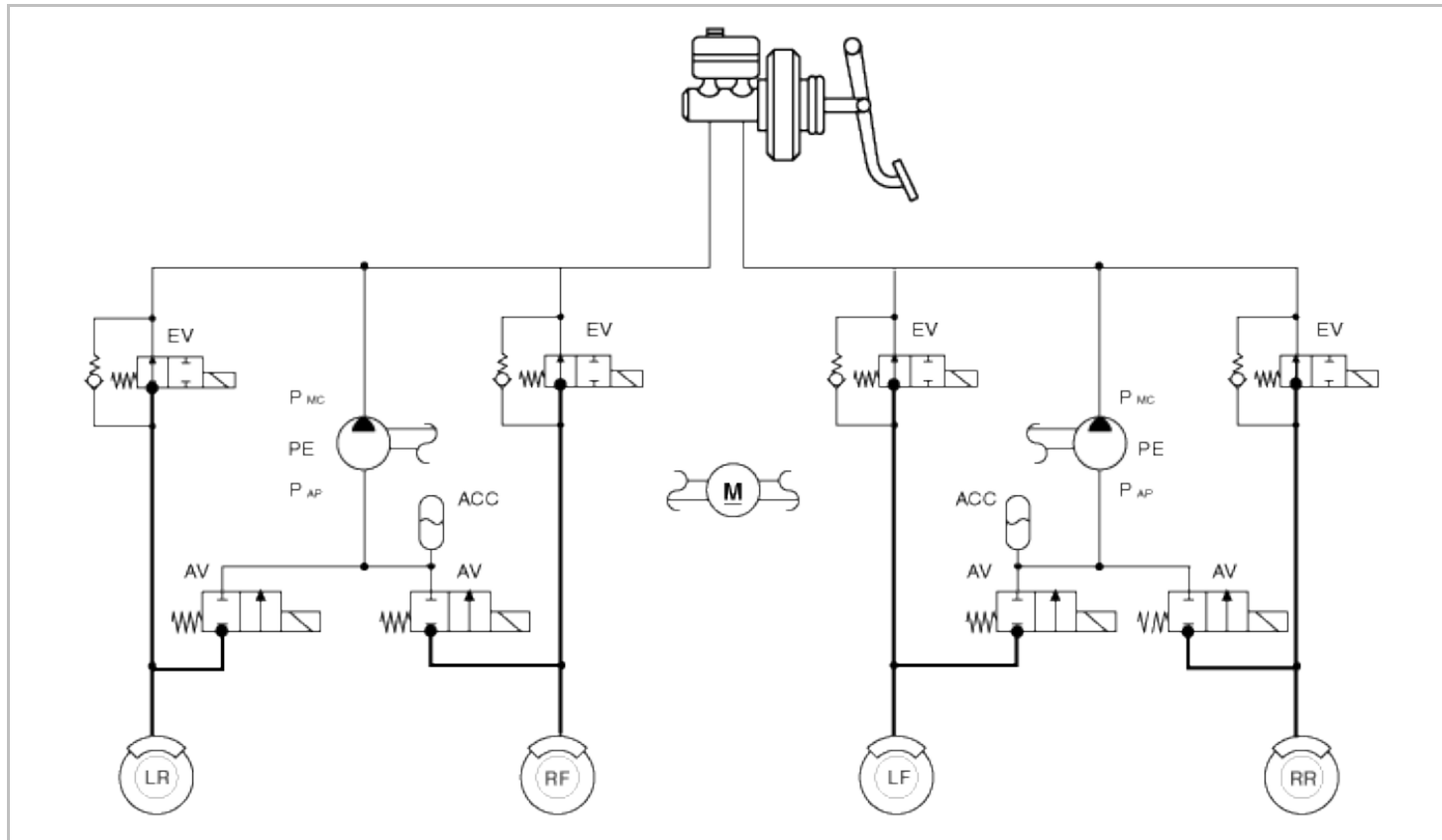


NOTICE

EV : Inlet Valve
 AV : Outlet Valve
 LR : Rear left wheel
 RF : Front right wheel
 LF : Front left wheel
 RR : Rear right wheel
 PE : Pump motor

3. HOLD MODE

	Inlet valve(EV)	Outlet valve(AV)	Pump motor
Operation	Close	Close	OFF

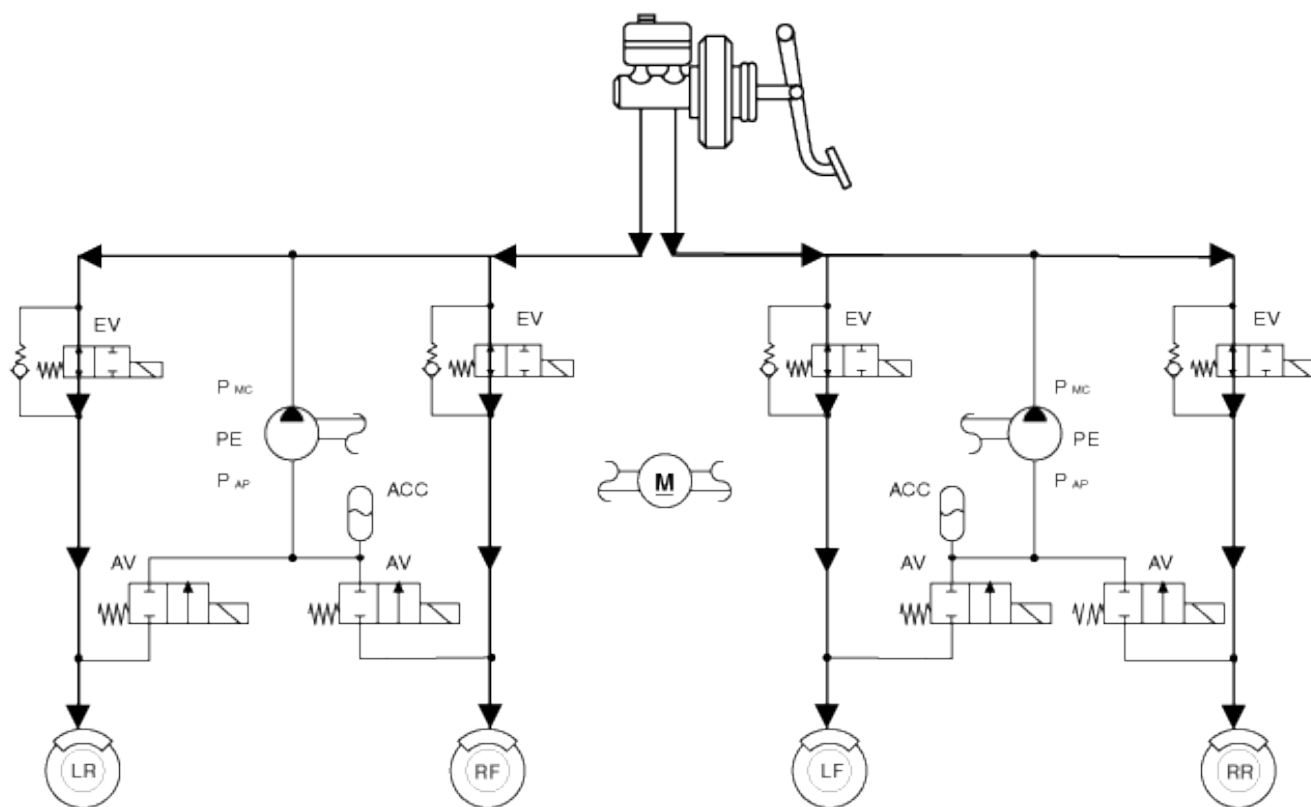


NOTICE

EV : Inlet Valve
 AV : Outlet Valve
 LR : Rear left wheel
 RF : Front right wheel
 LF : Front left wheel
 RR : Rear right wheel
 PE : Pump motor

4. INCREASE MODE

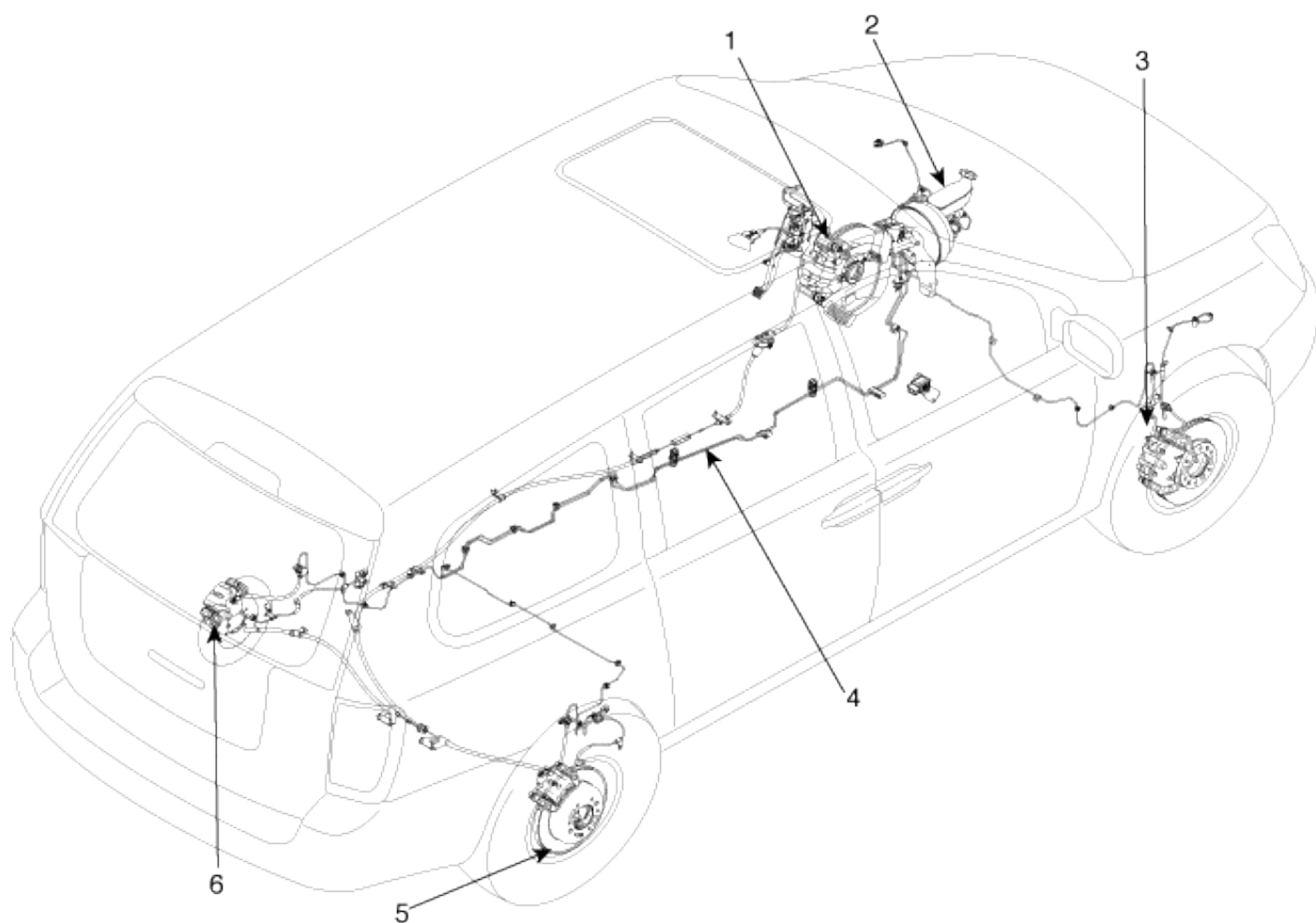
	Inlet valve(EV)	Outlet valve(AV)	Pump motor
Operation	Open	Close	OFF



NOTICE

EV : Inlet Valve
 AV : Outlet Valve
 LR : Rear left wheel
 RF : Front right wheel
 LF : Front left wheel
 RR : Rear right wheel
 PE : Pump motor

COMPONENTS

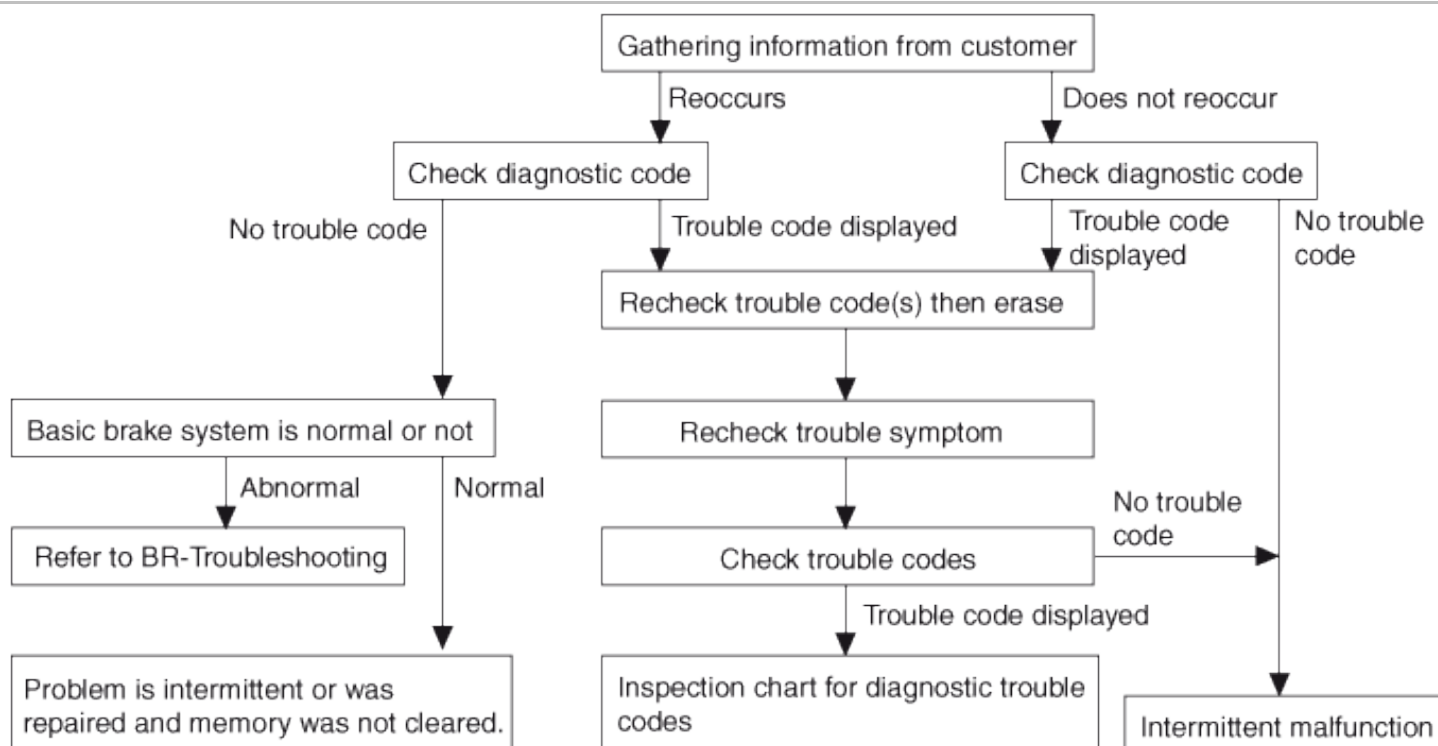


1. Front left wheel speed sensor
2. ABS control module(HECU)
3. Front right wheel speed sensor

4. Hydraulic line
5. Rear right wheel speed sensor
6. Rear left wheel speed sensor



STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING



* 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

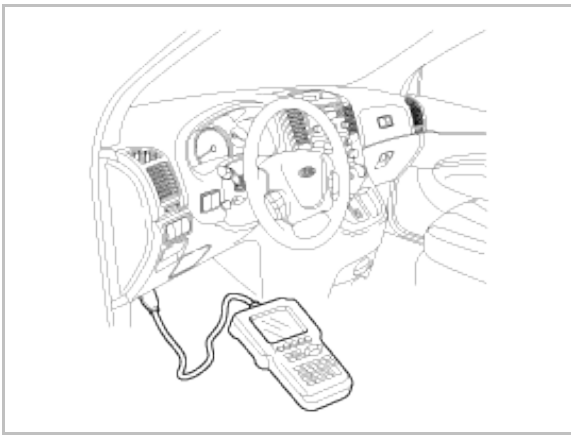
The phenomena listed in the following table are not abnormal.

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.
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.

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.

SCAN TOOL (PRO) CHECK

1. Turn the ignition switch OFF.
2. Connector the Scan tool to the 16P data link connector located the driver's side kick panel.



3. Turn the ignition switch ON.
4. Check for DTC using the Scan tool
5. After completion trouble of the repair or correction of the problem, erase the stored fault codes using the scan tool.
6. Disconnect the Scan tool from the 16P data link connector.

ABS CHECK SHEET

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 Occurrence 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)

PROBLEM SYMPTOMS TABLE

Symptom	Suspect Area
ABS does not operate.	Only when 1. -4. are all normal and the problem is still occurring, replace the HECU. 1. Check the DTC reconfirming that the normal code is output. 2. Power source circuit. 3. Speed sensor circuit.

	4. Check the hydraulic circuit for leakage.
ABS does not operate intermittently.	Only when 1. -4. are all normal and the problem is still occurring, replace the ABS actuator assembly. 1. Check the DTC reconfirming that the system is operating to specifications. 2. Wheel speed sensor circuit. 3. Stop lamp switch circuit. 4. Check the hydraulic circuit for leakage.
Communication with Scan tool is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line
Communication with Scan tool is not possible. (Communication with ABS only is not possible)	1. Power source circuit 2. Diagnosis line 3. HECU
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU
Even after the engine is started, the ABS warning lamp remains ON.	1. ABS warning lamp circuit 2. HECU

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.

ABS Does Not Operate.

DETECTING CONDITION

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	- Inoperative power source circuit - Inoperative wheel speed sensor circuit - Inoperative hydraulic circuit for leakage - Inoperative HECU

INSPECTION PROCEDURES

DTC INSPECTION

1. Connect the Scan Tool with the data link connector and turn the ignition switch ON.

2. Verify that the system is operating to specifications.

Is the system operating to specifications?

NO

► Check the power source circuit.

YES

► Erase the DTC and recheck using Scan Tool.

CHECK THE POWER SOURCE CIRCUIT.

1. Disconnect the connector from the ABS control module.

2. Turn the ignition switch ON, measure the voltage between terminal 18 of the ABS control module harness side connector and body ground.

Specification: approximately B+

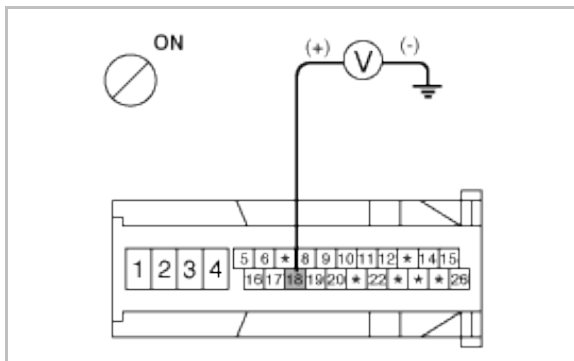
Is the voltage within specification?

YES

► Check the ground circuit.

NO

► Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ABS control module. Repair if necessary.



CHECK THE GROUND CIRCUIT.

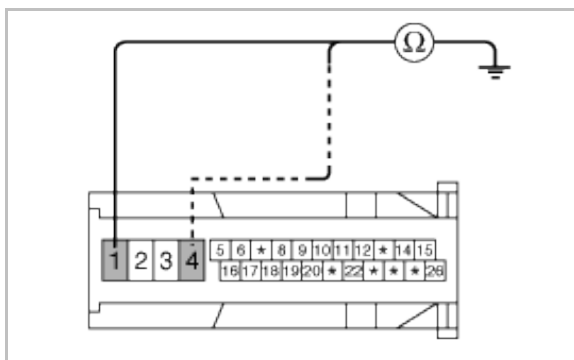
1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 1,4 of the ABS control module harness side connector and ground point.
Is there continuity?

YES

► Check the wheel speed sensor circuit.

NO

► Repair an open in the wire and ground point.



CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.

Is the system operating to specifications?

YES

► Check the hydraulic circuit for leakage.

NO

► Repair or replace the wheel speed sensor.

CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines.

Inspect leakage of the hydraulic lines.

Is the system operating to specifications?

YES

► The problem is still occurring, replace the ABS control module.

NO

► Replace the leaking hydraulic lines.

ABS Does Not Operate (Intermittently).

DETECTING CONDITION

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	- Inoperative power source circuit - Inoperative wheel speed sensor circuit - Inoperative hydraulic circuit for leakage - Inoperative HECU

INSPECTION PROCEDURES

DTC INSPECTION

1. Connect the Scan Tool with the data link connector and turn the ignition switch ON.
2. Verify that the system is operating to specifications.
Is the system operating to specifications?

NO

- ▶ Check the wheel speed sensor circuit.

YES

- ▶ Erase the DTC and recheck using Scan Tool.

CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.

Is the system operating to specifications?

YES

- ▶ Check the stop lamp switch circuit.

NO

- ▶ Repair or replace the wheel speed sensor.

CHECK THE STOP LAMP SWITCH CIRCUIT.

1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.
2. Measure the voltage between terminal 20 of the ABS control module harness side connector and body ground when brake pedal is depressed.

Specification: approximately B+

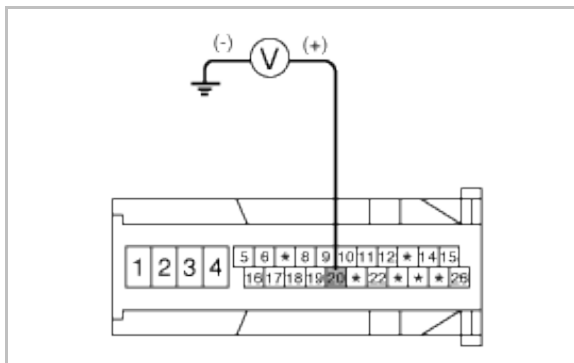
Is the voltage within specification?

YES

- ▶ Check the hydraulic circuit for leakage.

NO

- ▶ Repair the stop lamp switch. Repair an open in the wire between the ABS control module and the stop lamp switch.



CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines.

Inspect leakage of the hydraulic lines.

Is the system operating to specifications?

YES

► The problem is still occurring, replace the ABS control module.

NO

► Replace the leaking hydraulic lines.

**Communication with Scan-Tool is not possible.
(Communication with any system is not possible)**

DETECTING CONDITION

Trouble Symptoms	Possible Cause
Possible malfunction in the power supply system (including ground) for the diagnosis line.	- An open in the wire - Poor ground - Inoperative power source circuit

INSPECTION PROCEDURES

CHECK THE POWER SUPPLY CIRCUIT FOR THE DIAGNOSIS

Measure the voltage between terminal 9 of the data link connector and body ground.

Specification: approximately B+

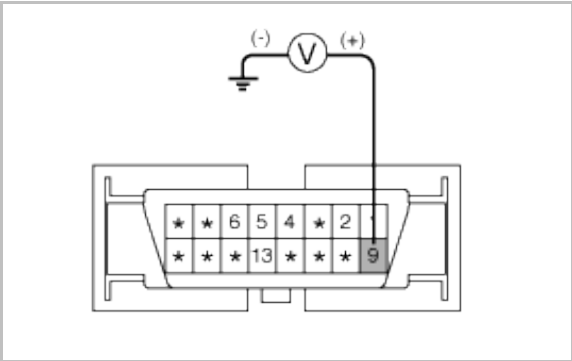
Is voltage within specification?

YES

► Check the ground circuit for the diagnosis.

NO

► Repair an open in the wire. Check and replace fuse (15A) from the engine compartment junction block.



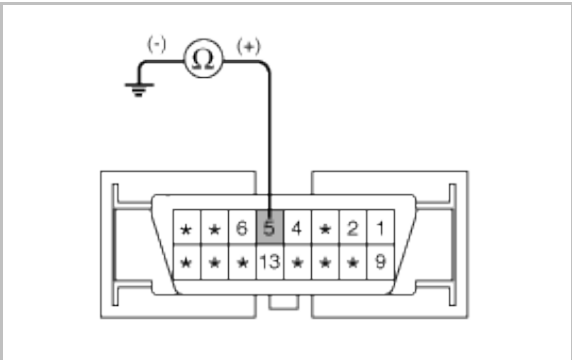
CHECK THE GROUND CIRCUIT FOR THE DIAGNOSIS

Check for continuity between terminal 5 of the data link connector and body ground.

Is there continuity?

NO

► Repair an open in the wire between terminal 5 of the data link connector and ground point.



**Communication with Scan Tool is not possible.
(Communication with ABS only is not possible)**

DETECTING CONDITION

Trouble Symptoms	Possible Cause
When communication with Scan Tool is not possible, the cause may be probably an open in the HECU power circuit or an open in the diagnosis output circuit.	- An open in the wire - Inoperative HECU - Inoperative power source circuit

INSPECTION PROCEDURES

CHECK FOR CONTINUITY IN THE DIAGNOSIS LINE

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 11 of the ABS control module connector and 1 of the data link connector.
Is there continuity?

YES

- ▶ Check the power source of ABS control module.

NO

- ▶ Repair an open in the wire.

CHECK THE POWER SOURCE OF ABS CONTROL MODULE

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 18 of the ABS control module harness side connector and body ground.

Specification: approximately B+

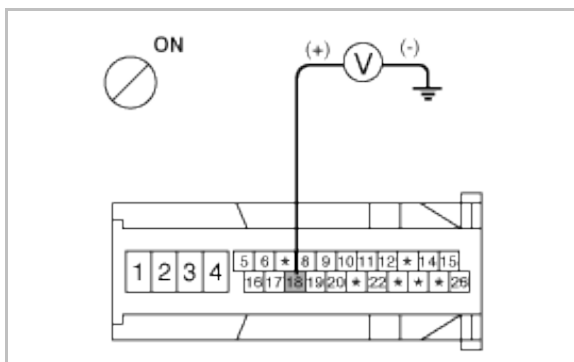
Is voltage within specification?

YES

- ▶ Check for poor ground.

NO

- ▶ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ABS control module. Repair if necessary.



CHECK FOR POOR GROUND

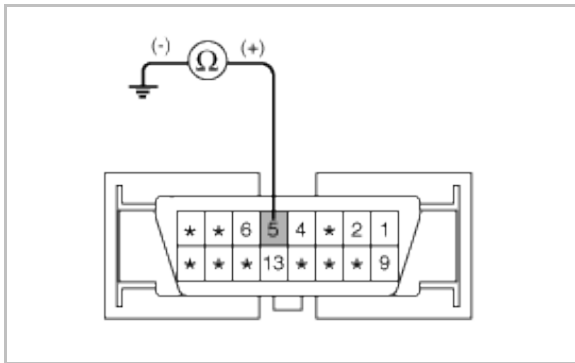
Check for continuity between terminal 5 of the data link connector and ground point.

YES

- ▶ Replace the ABS control module and recheck.

NO

- ▶ Repair an open in the wire or poor ground.



When Ignition Key Is Turned ON (engine OFF), The ABS Warning Lamp Does Not Light Up.

DETECTING CONDITION

Trouble Symptoms	Possible Cause
When current flows in the HECU the ABS warning lamp turns from ON to OFF as the initial check. Therefore if the lamp does not light up, the cause may be an open in the lamp power supply circuit, a blown bulb, an open in the both circuits between the ABS warning lamp and the HECU, and the inoperative HECU.	- Inoperative ABS warning lamp bulb - Blown No.2 fuse (10A) in the engine compartment junction block - Inoperative ABS warning lamp module - Inoperative HECU

INSPECTION PROCEDURES

PROBLEM VERIFICATION

Disconnect the connector from the ABS control module and turn the ignition switch ON.

Does the ABS warning lamp light up?

YES

► It is normal. Recheck the ABS control module.

NO

► Check the power source for the ABS warning lamp.

CHECK THE POWER SOURCE FOR THE ABS WARNING LAMP

1. Disconnect the instrument cluster connector and turn the ignition switch ON.
2. Measure the voltage between terminal 8 of the cluster harness side connector and body ground.

Specification: approximately B+

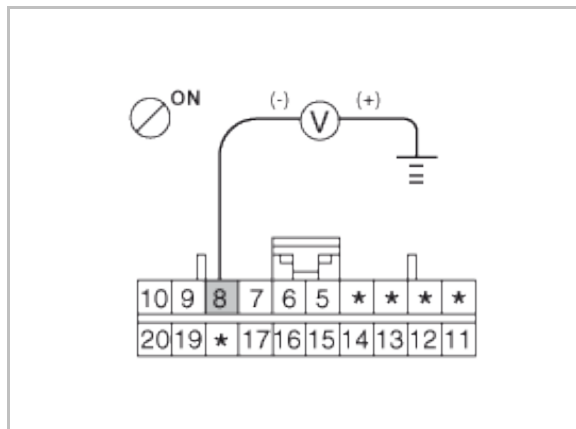
Is voltage within specification?

YES

► Repair bulb or instrument cluster assembly.

NO

► Check for blown fuse.



CHECK FOR BLOWN FUSE

Check continuity of fuse (10A) from the engine compartment junction block.

Is there continuity?

YES

► Repair an open in the wire between ABS fuse and 1 of cluster connector.

NO

► Replace the blown fuse.

Even After The Engine Is Started, The ABS Warning Lamp Remains ON.

DETECTING CONDITION

Trouble Symptoms	Possible Cause
If the HECU detects trouble, it lights the ABS warning lamp while at the same time prohibiting ABS control. At this time, the HECU records a DTC in memory. Even though the normal code is output, the ABS warning lamp remains ON, then the cause may be probably an open or short in the ABS warning lamp circuit.	- An open in the wire - Inoperative instrument cluster assembly - Inoperative ABS warning lamp module - Inoperative HECU

INSPECTION PROCEDURES

CHECK DTC OUTPUT.

1. Connect the Scan Tool to the 16P data link connector located behind the driver's side kick panel.

2. Check the DTC output using Scan Tool.

Is DTC output?

YES

► Repair circuit indicated by code output.

NO

► Check instrument cluster.

CHECK INSTRUMENT CLUSTER

Disconnect the cluster connector and turn the ignition switch ON.

Does the ABS warning lamp remains ON?

YES

► Replace the instrument cluster.

NO

► Check for open the wire.

CHECK FOR OPEN IN THE WIRE

Check for continuity in the wire between cluster and ABS control module.

Is there continuity?

YES

► Replace the ABS control module and recheck.

NO

► Repair an open in the wire between cluster and ABS control module.

BLEEDING OF BRAKE SYSTEM

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

CAUTION

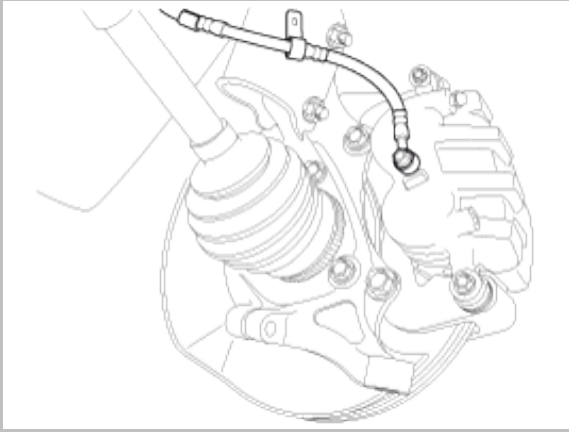
If there is any brake fluid on any painted surface, wash it off immediately.

NOTICE

When pressure bleeding, do not depress the brake pedal.

Recommended fluid..... DOT3 or DOT4

2. Connect a clear plastic tube to the brake caliper bleeder plug and insert the other end of the tube into a half filled clear plastic bottle.



3. Connect the scan tool to the data link connector located underneath the dash panel.

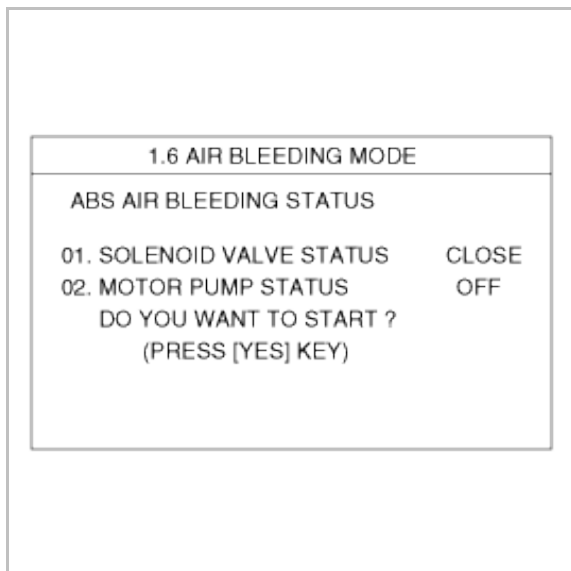


4. Select and operate according to the instructions on the scan tool screen.

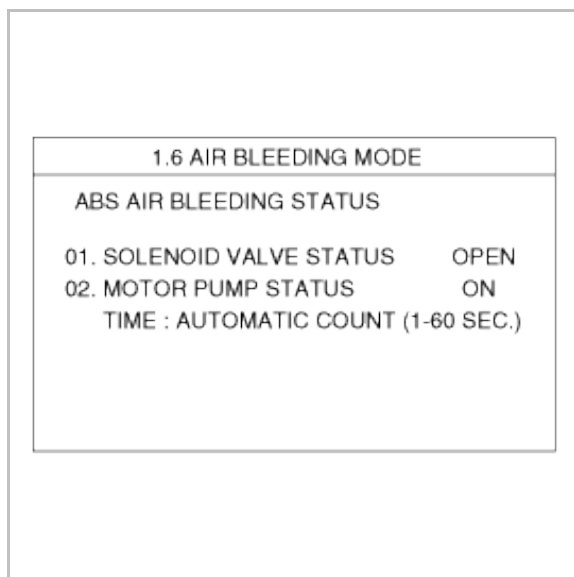
CAUTION

You must obey the maximum operating time of the ABS motor with the scan tool to prevent the motor pump from burning.

- (1) Select kia vehicle diagnosis.
- (2) Select vehicle name.
- (3) Select Anti-Lock Brake system.
- (4) Select air bleeding mode.
- (5) Press "YES" to operate motor pump and solenoid valve.

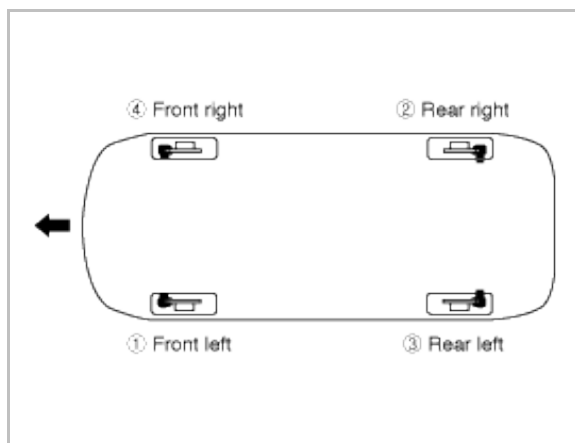


(6) Wait 60 sec. before operating the air bleeding again. (If not, you may damage the motor.)



5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw.

6. Repeat step 5 until there are no more bubbles in the fluid for each wheel.



7. Tighten the bleeder screw.

Bleed screw tightening torque:

7~13 Nm (0.7 ~1.3 kgf·m, 5.06 ~ 9.4 lb-ft)

DIAGNOSTIC TROUBLE CODE CHART(DTC)

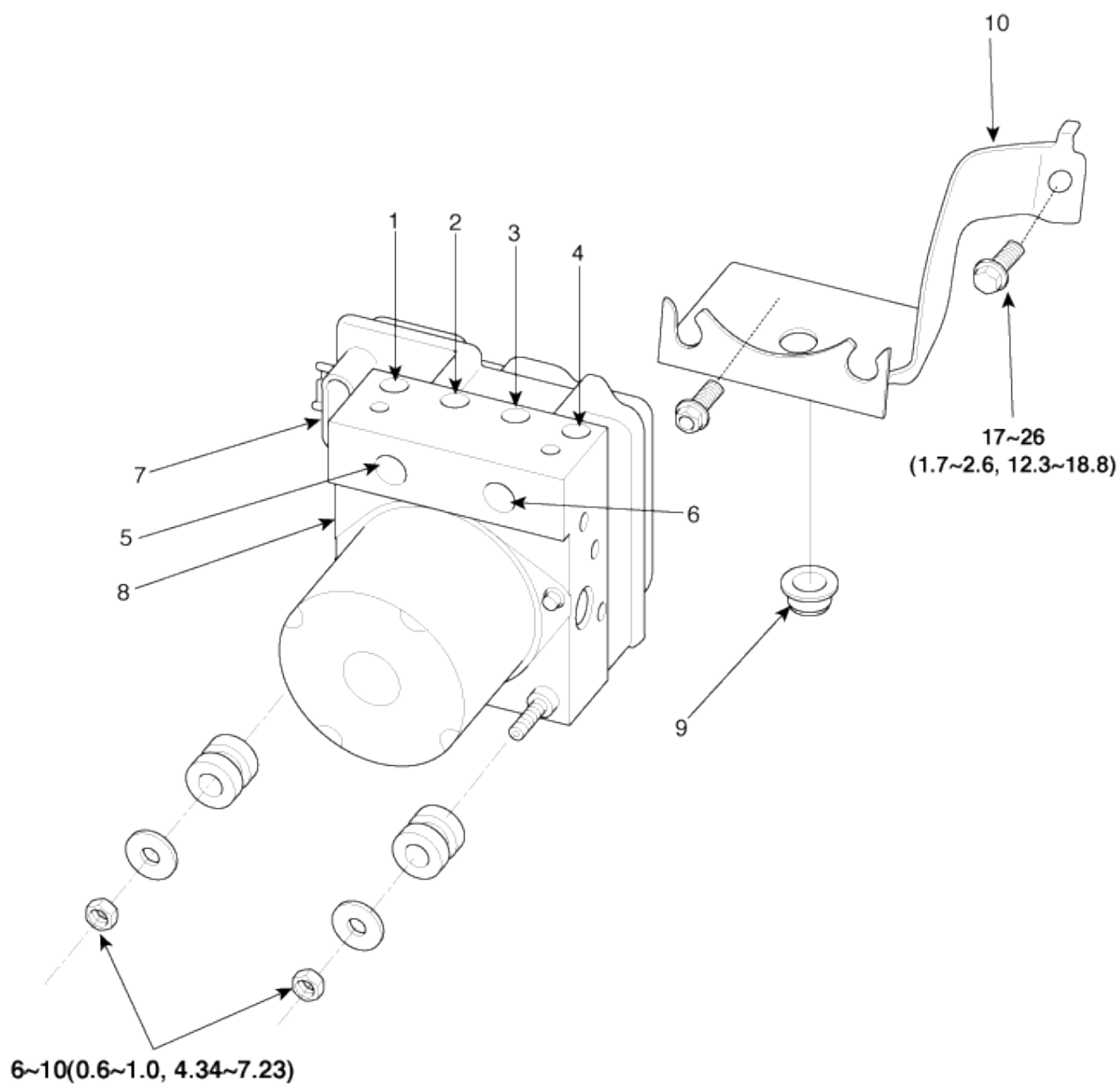
DTC	DESCRIPTION	WARNING LAMP			REMARK
		ABS	EBD	ESC	
C1101	BATTERY VOLTAGE HIGH	O	O	O	
C1102	BATTERY VOLTAGE LOW	O		O	
C1200	FL WHEEL SPEED SENSOR- OPEN/SHORT	O		O	
C1201	FL WHEEL SENSOR- RANGE/ PERFORMANCE	O		O	
C1202	FL WHEEL WHEEL SPEED SENSOR-NO SIGNAL	O		O	
C1203	FR WHEEL SPEED SENSOR- OPEN/SHORT	O		O	
C1204	FR WHEEL SENSOR- RANGE/ PERFORMANCE	O		O	
C1205	FR WHEEL SPEED SENSOR-NO SIGNAL	O		O	
C1206	RL WHEEL SPEED SENSOR- OPEN/SHORT	O		O	
C1207	RL WHEEL SENSOR- RANGE/ PERFORMANCE	O		O	

C1208	RL WHEEL SPEED SENSOR-NO SIGNAL	O		O	
C1209	RR WHEEL SPEED SENSOR- OPEN/SHORT	O		O	
C1210	RR WHEEL SENSOR- RANGE/ PERFORMANCE	O		O	
C1211	RR WHEEL SPEED SENSOR-NO SIGNAL	O		O	
C1213	WHEEL SPEED FREQUENCY ERROR	O		O	
C1235	PRESSURE SENSOR-ELECTRICAL			O	ESP
C1237	PRESSURE SENSOR-SIGNAL FAULT			O	ESP
C1260	STEERING ANGLE SENSOR-SIGNAL			O	ESP
C1261	STEERING ANGLE SENSOR NOT CALIBRATED			O	ESP
C1282	YAW RATE & LATERAL G SENSOR-ELECTRICAL			O	ESP
C1283	YAW RATE & LATERAL G SENSOR-SIGNAL			O	ESP
C1503	ESP SWITCH ERROR			O	ESP
C1513	BRAKE LIGHT SWITCH MALFUNCTION			O	
C1604	ECU HARDWARE ERROR	O	O	O	
C1605	CAN CONTROL HARDWARE ERROR			O	ESP
C1611	CAN TIME OUT-PCM(ECM)			O	ESP
C1612	CAN TIME OUT-PCM(TCM)			O	ESP
C1616	CAN BUS OFF			O	ESP
C1623	CAN TIMEOUT STEERING ANGLE SENSOR			O	ESP
C1625	CAN TIME OUT-ESP			O	ESP
C1626	IMPLAUSIBLE CONTROL	O		O	ESP
C1702	VARIANT CODING	O	O	O	ESP
C2112	VALVE RELAY MALFUNCTION	O	O	O	
C2308	FL INLET VALVE MALFUNCTION	O	O	O	
C2312	FL OUTLET VALVE MALFUNCTION	O	O	O	
C2316	FR INLET VALVE MALFUNCTION	O	O	O	
C2320	FR OUTLET VALVE MALFUNCTION	O	O	O	
C2324	RL INLET VALVE MALFUNCTION	O	O	O	
C2328	RL OUTLET VALVE MALFUNCTION	O	O	O	
C2332	RR INLET VALVE MALFUNCTION	O	O	O	
C2336	RR OUTLET VALVE MALFUNCTION	O	O	O	
C2366	TC VALVE PRIMARY(USV1) ERROR	O	O	O	ESP
C2370	TC VALVE SECONDARY (USV2) ERROR	O	O	O	ESP
C2372	ESP VALVE 1(HSV1) ERROR	O	O	O	ESP
C2374	ESP VALVE 2 (HSV2) ERROR	O	O	O	ESP
C2402	MOTOR-ELECTRICAL	O	O	O	

Brake System

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

COMPONENTS



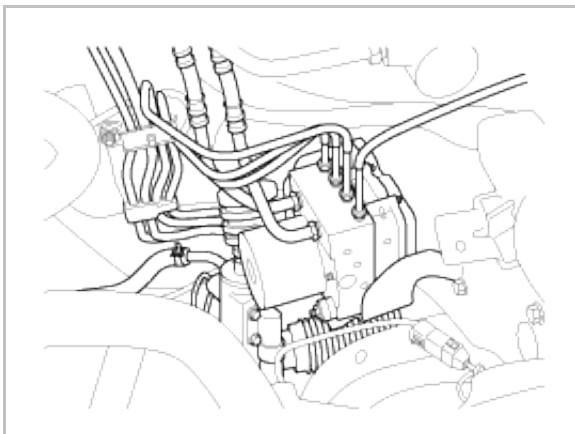
TORQUE : Nm (kgf.m, lb-ft)

- | | |
|---------------------------|--------------------------------------|
| 1. Front-right tube | 6. Master cylinder tube 1 |
| 2. Rear-left tube | 7. ABS control module connector(26P) |
| 3. Rear-right tube | 8. ABS control module(HECU) |
| 4. Front-left tube | 9. Damper |
| 5. Master cylinder tube 2 | 10. Bracket |

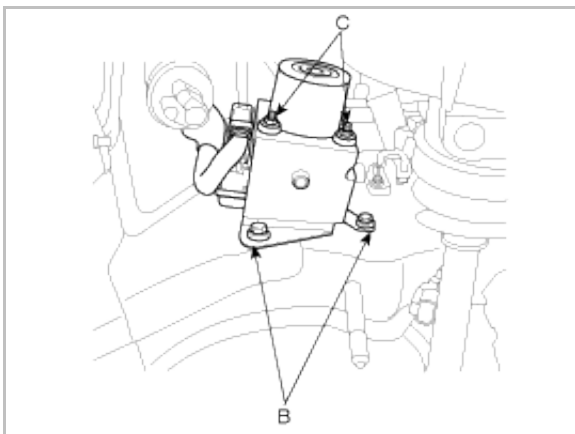
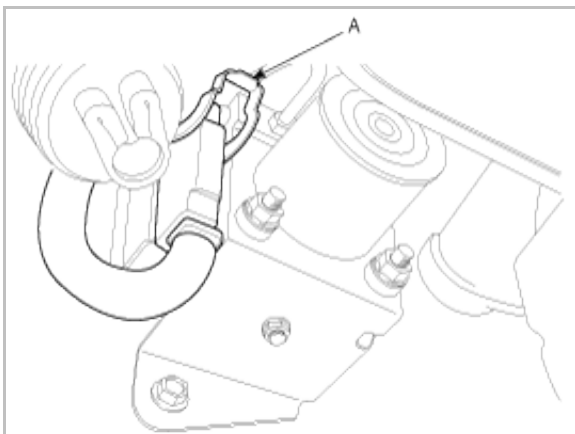


REMOVAL

1. Remove the air cleaner. (Refer to 'Master cylinder Removal')
2. Disconnect the brake tube from the HECU by unlocking the nuts counterclockwise with a spanner.



3. Disconnect the connector(A) from the HECU.



4. Remove the two HECU brake mounting bolts(B) , and then disassemble the HECU with the bracket.

CAUTION

1. Never attempt to disassemble the HECU.
2. The HECU must be protected during storage and transport, and must not be subjected to excessive shock.

5. Remove the two HECU mounting nuts (C) and washer, and then remove the bracket.

INSTALLATION

1. Installation is the reverse of removal.
2. Tighten the HECU mounting bolts and brake tube nuts to the specified torque.

Tightening torque

HECU mounting nut :

6~10 Nm (0.6~1.0 kgf·m, 4.34~7.23 lb-ft)

HECU bracket mounting bolt:

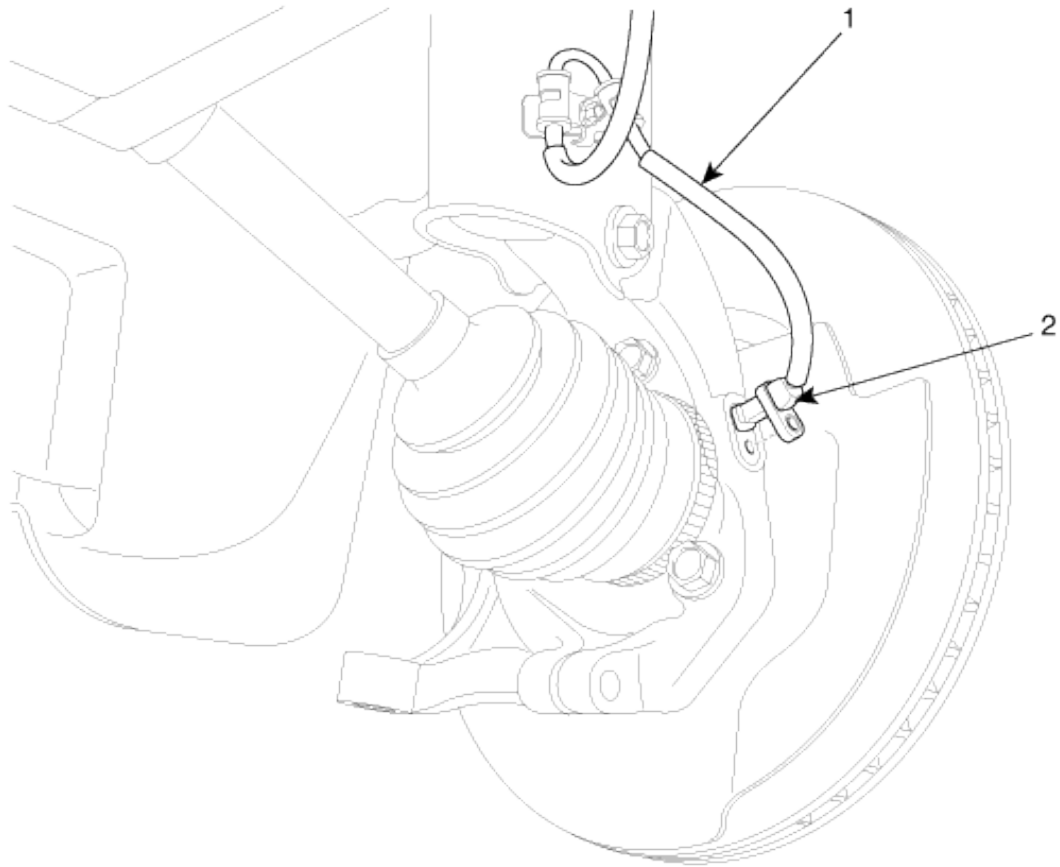
17~26 Nm (1.7~2.6 kgf·m, 12.3~18.8 lb-ft)



Brake System

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

COMPONENTS

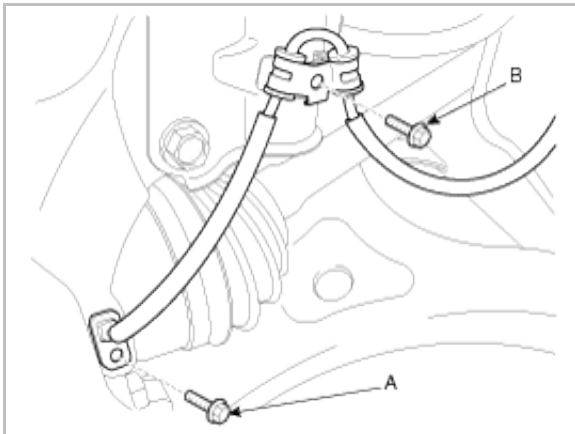


- 1. Front wheel speed sensor cable
- 2. Front wheel speed sensor

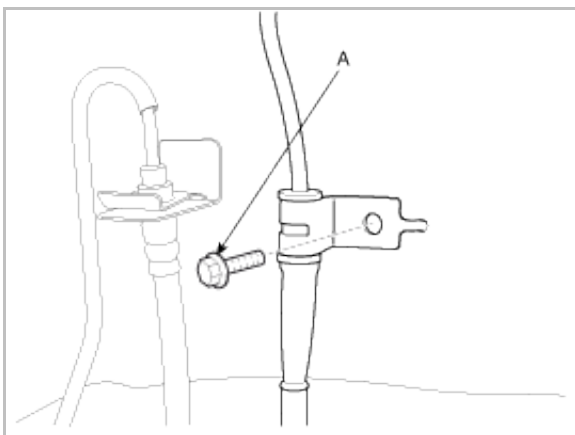


REMOVAL

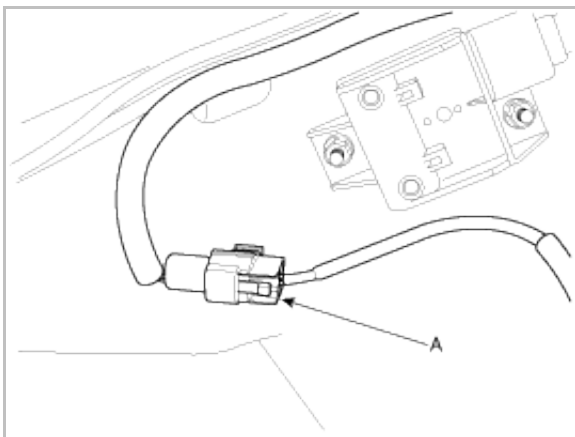
1. Remove the front wheel speed sensor mounting bolt (A) and the wire bracket mounting bolt (B)..



2. Remove the wire bracket bolt (A).



3. Remove the front wheel guard.
4. Remove the front wheel speed sensor after disconnecting the wheel speed sensor connector (A).

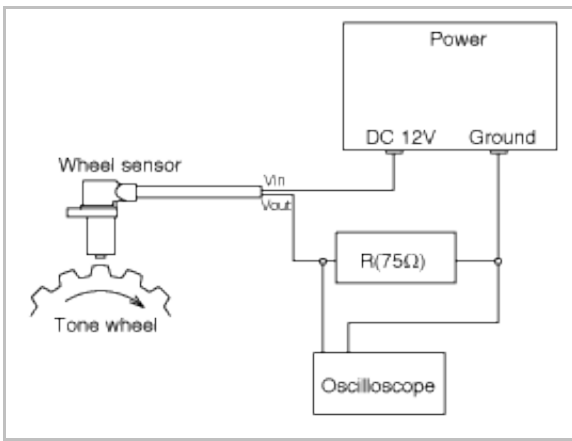


INSPECTION

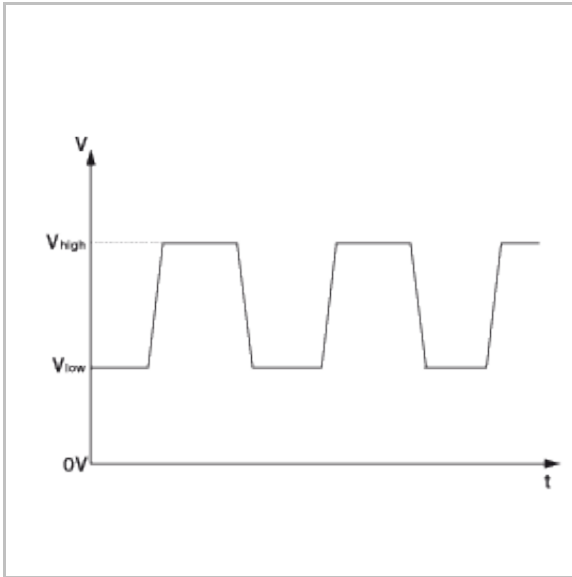
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 75Ω resistor must be used as shown.



2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.

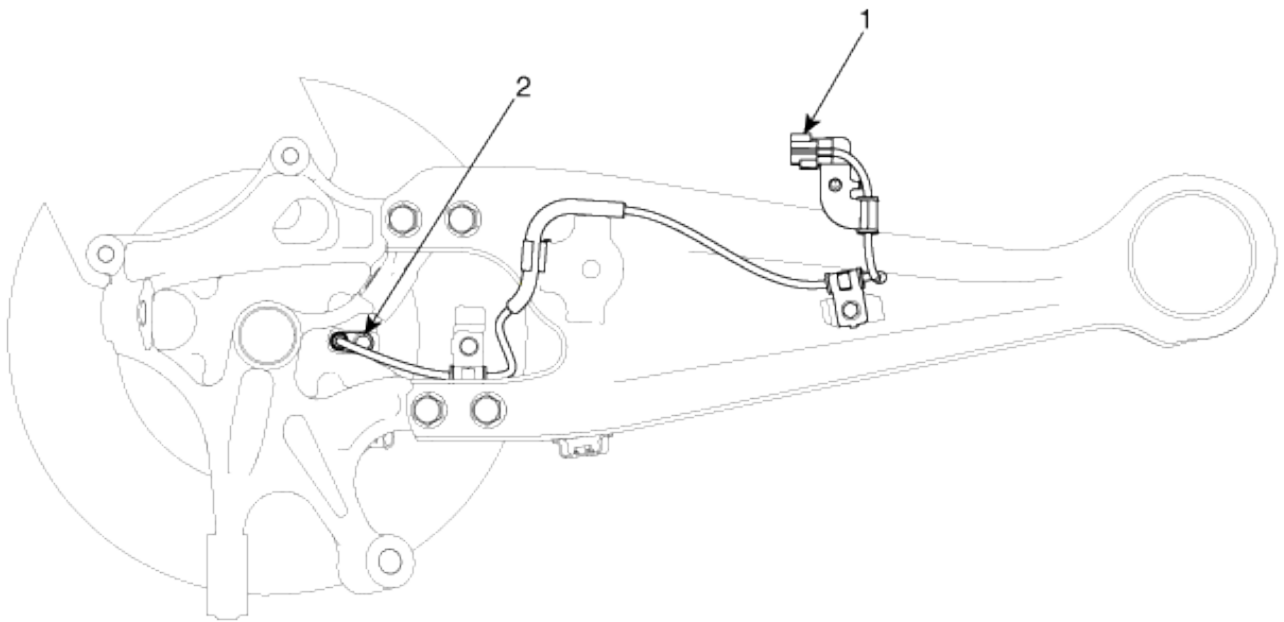


- A. V_{low} : 0.44 V ~ 0.63 V
- B. V_{high} : 0.885 V ~ 1.26 V
- C. Frequency range : 1~2,500 Hz

Brake System

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

COMPONENTS

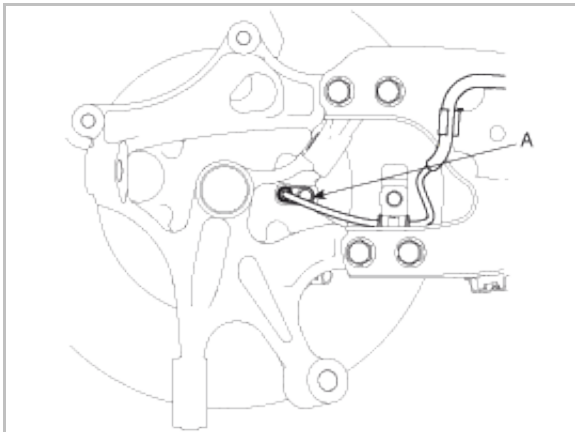


1. Rear wheel speed sensor connector
2. Rear wheel speed sensor

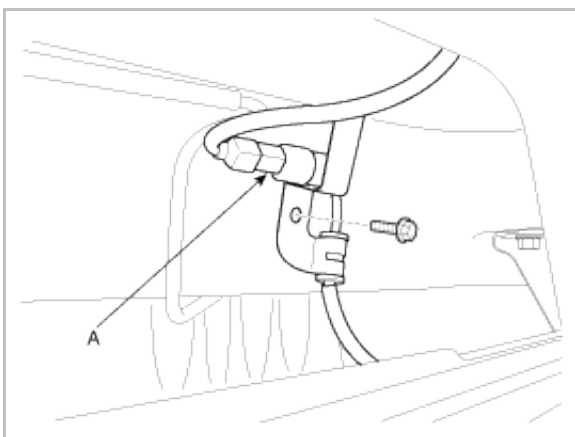


REMOVAL

1. Remove the rear wheel speed sensor mounting bolt (A).



2. Remove the rear seat side pad then disconnect the rear wheel speed sensor connector (A).

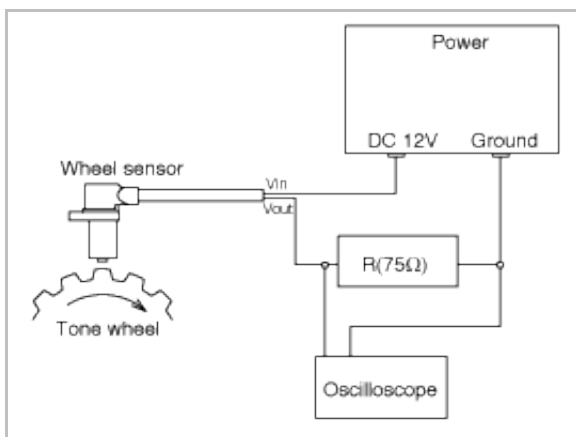


INSPECTION

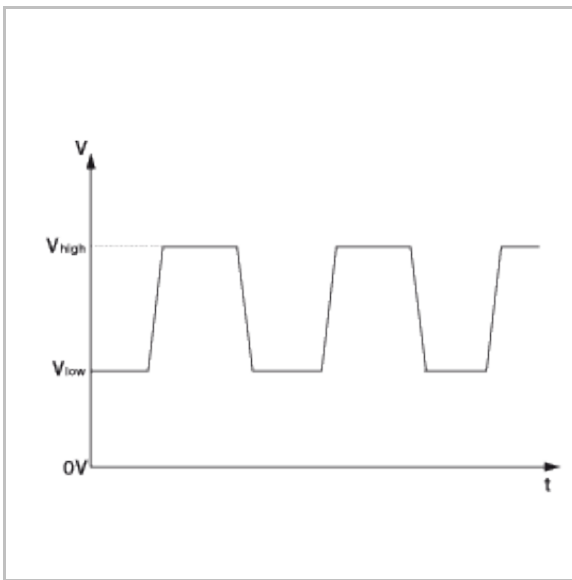
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 75Ω resistor must be used as shown.



2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.



A. V_{low} : 0.44 V ~ 0.63 V

B. V_{high} : 0.885 V ~ 1.26 V

C. Frequency range : 1~2,500 Hz



Brake System

ABS(Anti-Lock Brake System) - EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION)

DESCRIPTION

The EBD system (Electronic Brake force Distribution) as a sub-system of the ABS system is to control the effective adhesion utilization by the rear wheels.

It further utilizes the efficiency of highly developed ABS equipment by controlling the slip of the rear wheels in the partial braking range.

The brake force is moved even closer to the optimum and controlled electronically, thus dispensing with the need for the proportioning valve.

The proportioning valve, because of a mechanical device, has limitations to achieve an ideal brake force distribution to the rear wheels as well as to carry out the flexible brake force distribution proportioning to the vehicle load or weight increasing. And in the event of malfunctioning, driver cannot notice whether it fails or not.

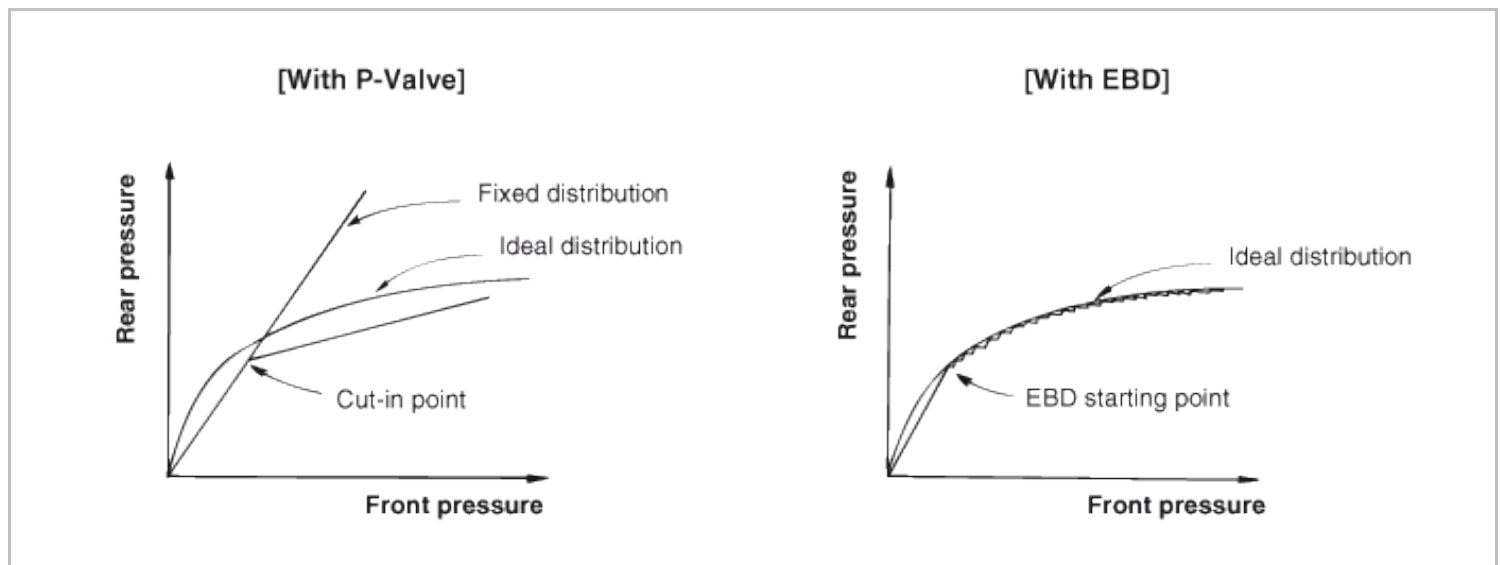
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

If the EBD fails, the EBD warning lamp (Parking brake lamp) lights up.

ADVANTAGES

- Function improvement of the base-brake system.
- Compensation for the different friction coefficients.
- Elimination of the proportioning valve.
- Failure recognition by the warning lamp.

Comparison between Proportioning valve and EBD

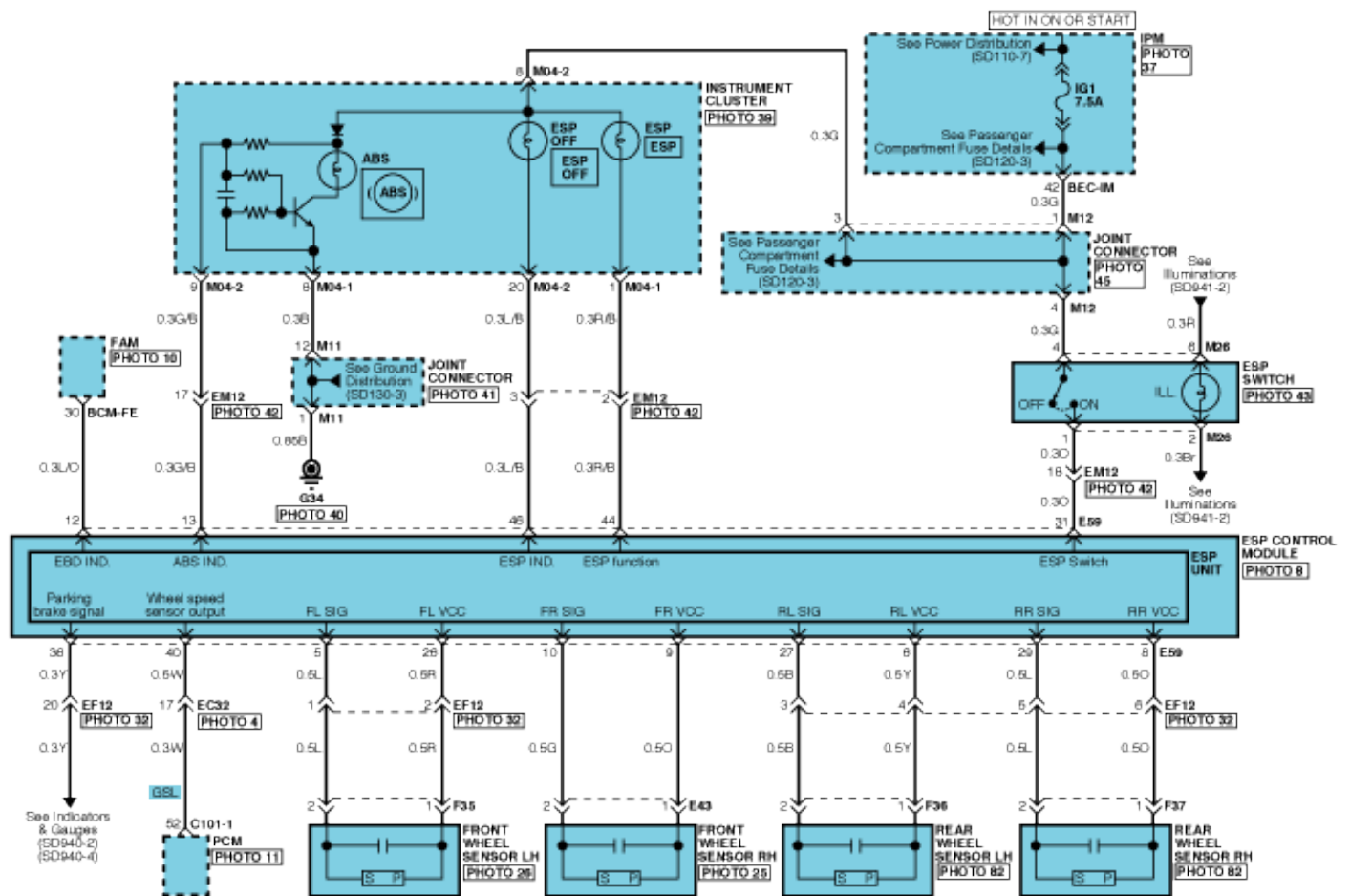


Brake System

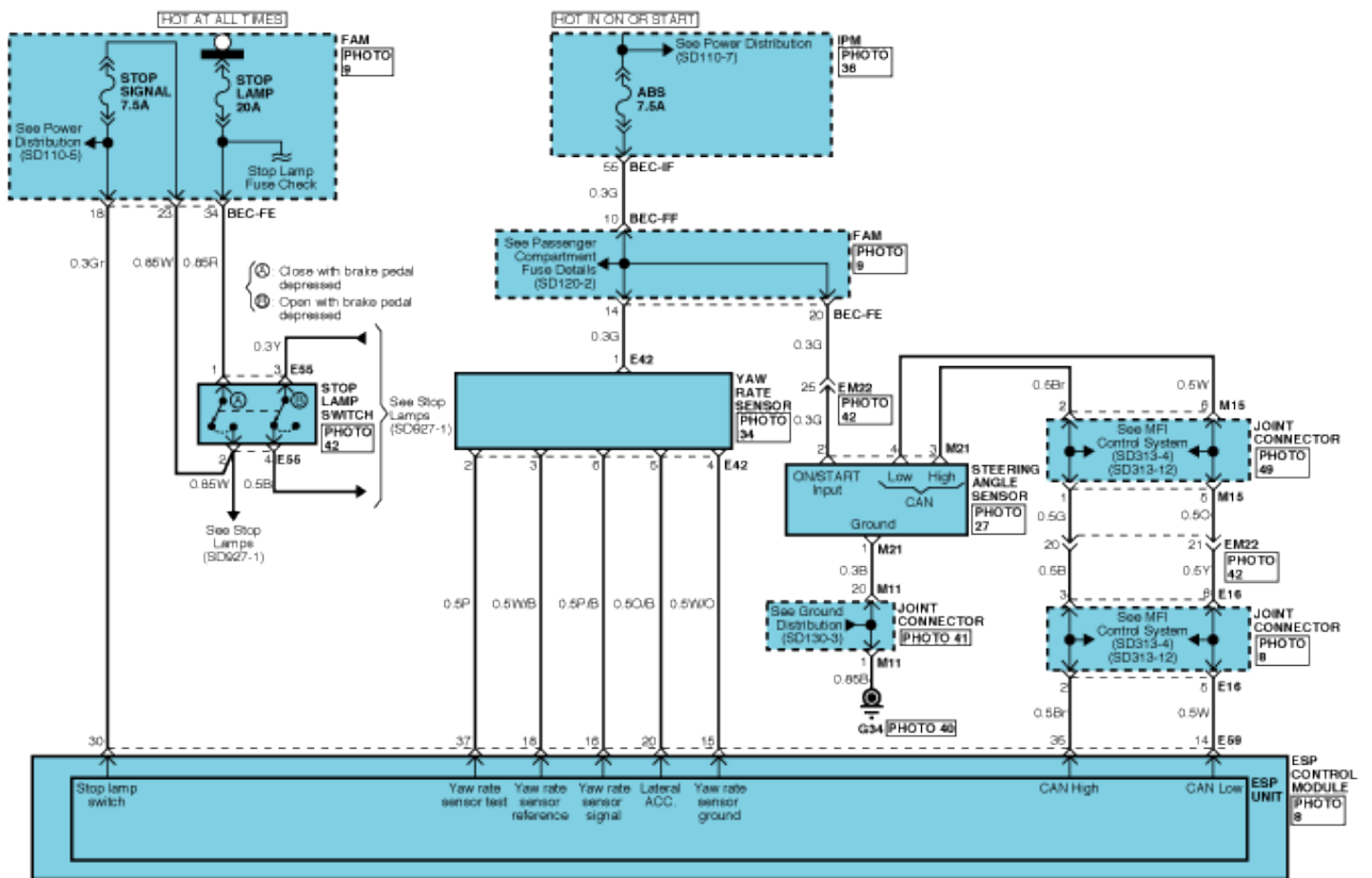
EPS (Electronic Stability System)



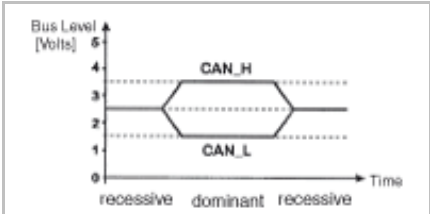
ESP circuit DIAGRAM(1)



ESP circuit DIAGRAM(2)



ESP circuit DIAGRAM(3)

26	Wheel sensor voltage(FL)	Battery voltage	IG ON
9	Wheel sensor voltage(FR)		
6	Wheel sensor voltage(RL)		
8	Wheel sensor voltage(RR)		
5	Wheel sensor signal(FL)	Voltage(High) : 0.89~1.26 V Voltage(Low) : 0.44~0.63 V	RUNNING
10	Wheel sensor signal(FR)		
27	Wheel sensor signal(RL)		
29	Wheel sensor signal(RR)		
11	Diagnosis Input/oupput	Voltage(High) : 0.8 * IG ON more Voltage(Low) : 0.2 * IG ON lower	SCAN TOOL Communication
28	Ignition	Battery voltage	KEY ON/OFF
31	ESP Passive switch	Voltage(High) : 0.6 * IG ON more Voltage(Low) : 0.4 * IG ON lower	Switch ON/OFF
36	Hand brake switch	Voltage(High) : 0.7 * IG ON more Voltage(Low) : 0.3 * IG ON lower	Switch ON/OFF
37	Yaw Rate Sensor Test	Voltage(High) : 4.1 V more Voltage(Low) : 1 V lower	IG ON
18	Yaw Rate Sensor Reference	2.464 V ~ 2.536 V	IG ON
16	Yaw Rate Sensor Signal	Offset voltage :2.5 V range : 0.35 V ~ 4.65 V(-100 ~ 100 °/s)	IG ON
20	Acceleration Sensor Signal	Offset voltage :2.5 V range : 0.35 V ~ 4.65 V(-1.8 g ~ 1.8 g)	IG ON
15	Yaw Rate Sensor Ground	GND LEVEL	Always
35	CAN High	not communicating:2.5 ± 0.5 V communication : 	IG ON
14	CAN Low		
30	BRAKE LIGHT SWITCH	voltage(High) : 0.8 * IG ON more voltage(Low) : 0.3 * IG ON lower	BRAKE ON/OFF

description of ESP

Optimum driving safety now has a name : ESP, the Electronic Stability Control.

ESP recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention with no need for actuating the brake or the gas pedal.

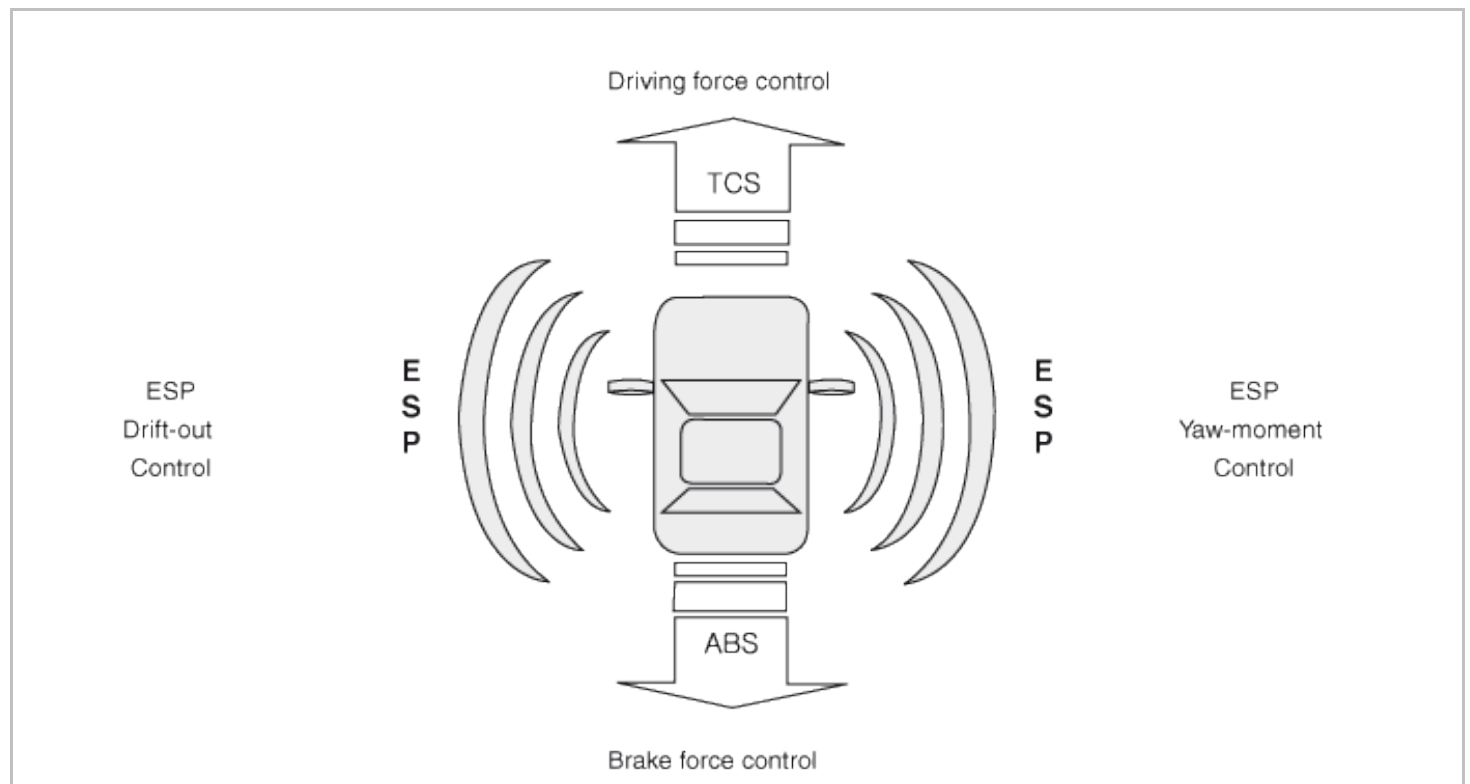
ESP adds a further function known as Active Yaw Control (AYC) to the ABS, TCS, EBD and ESP functions. Whereas the ABS/TCS function controls wheel slip during braking and acceleration and, thus, mainly intervenes in the longitudinal dynamics of the vehicle, active yaw control stabilizes the vehicle about its vertical axis.

This is achieved by wheel individual brake intervention and adaptation of the momentary engine torque with no need for any action to be taken by the driver.

ESC essentially consists of three assemblies : the sensors, the electronic control unit and the actuators.

Of course, the stability control feature works under all driving and operating conditions. Under certain driving conditions, the ABS/TCS function can be activated simultaneously with the ESP function in response to a command by the driver.

In the event of a failure of the stability control function, the basic safety function, ABS, is still maintained.



DESCRIPTION OF ESP CONTROL

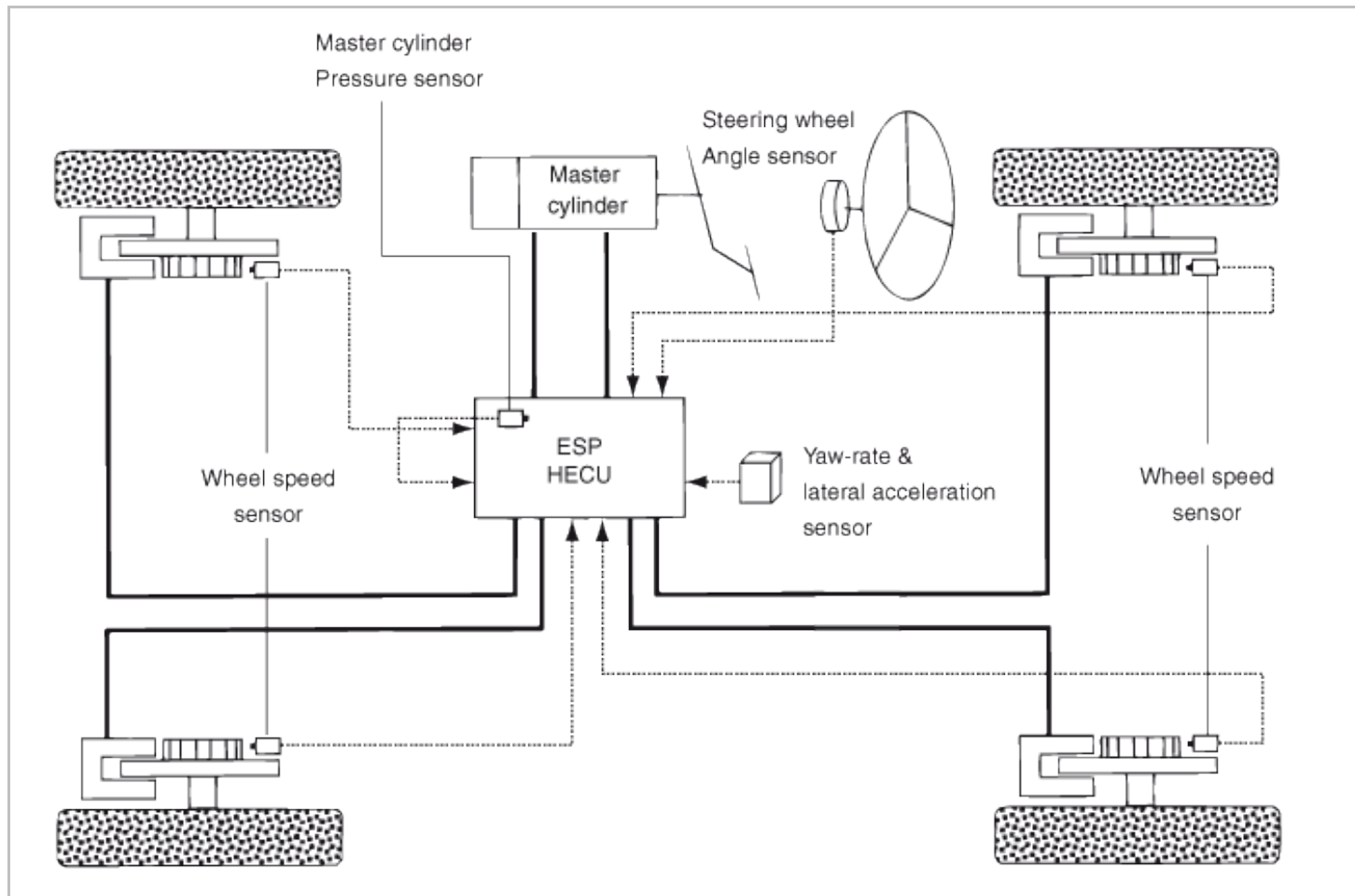
ESP system includes ABS/EBD, TCS and AYC (Active yaw control) function.

ABS/EBD function : The ECU changes the active sensor signal (current shift) coming from the four wheel sensors to the square waveform. By using the input of above signals, the ECU calculates the vehicle speed and the acceleration & deceleration of the four wheels. And, the ECU judges whether the ABS/EBD should be actuated or not.

TCS function prevents the wheel slip of drive direction by adding the brake pressure and engine torque reduction via CAN communication. TCS function uses the wheel speed sensor signal to determine the wheel slip as far as ABS function.

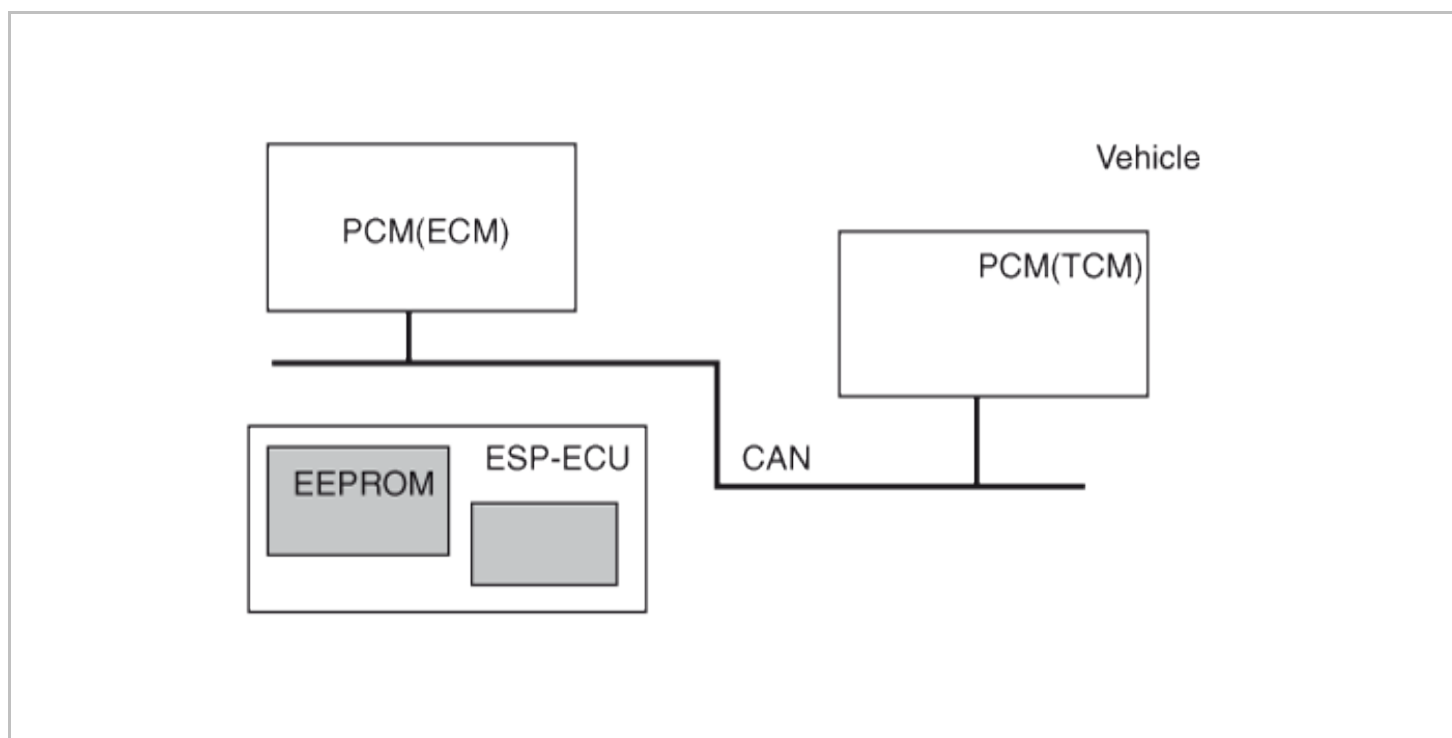
AYC function prevents unstable maneuver of the vehicle. To determine the vehicle maneuver, AYC function uses the maneuver sensor signals (Yaw Rate Sensor, Lateral Acceleration Sensor, Steering Wheel Angle Sensor). If vehicle maneuver is unstable (Over Steer or Under Steer), AYC function applies the brake pressure on certain wheel, and send engine torque reduction signal by CAN.

After the key-on, the ECU continually diagnoses the system failure. (self-diagnosis) If the system failure is detected, the ECU informs driver of the system failure through the BRAKE/ABS/ESP warning lamp. (fail-safe warning)



VARIANT CODING

The HECU is programmed with a variant code based on the vehicle powertrain configuration. This variant code is used to determine the appropriate ESP calculations. Variant code programming should be performed whenever an HECU is replaced.



PROCEDURE OF VARIANT CODING

1. Install a PCM(ECM & TCM)/ESP normally.
2. Connect the scan tool to the data link connector located underneath the dash panel.
3. Select vehicle name.
4. Select ANTI-LOCK BRAKE SYSTEM.

5. Select the variant coding.

1. KIA VEHICLE DIAGNOSIS ▲

MODEL : VQ 05-
SYSTEM : ANTI - LOCK BRAKE SYSTEM

04. ACTUATION TEST
05. SIMU - SCAN
06. AIR BLEEDING MODE
07. SOLENOID VALVES TEST
08. IDENTIFICATION CHECK
09. STEERING ANGLE SENSOR
10. VARIANT CODING
11. DATA SETUP(UNIT CONV.)

6. Follow the next procedure according to the comment .

1. 10 .VARIANT CODING

★ AIM
THIS FUNCTION RESET VARIANT CODE
AND INPUT THE NEW ONE IN EST.
PERFORM THIS FUNCTION WHEN YOU
REPLACE USED ESP FROM OTHER
VEHICLE OR OCCUR C1702 WITH
MIL ON.(ESP/EBD/ABS)

IF YOU READY, PRESS [ENTER] KEY.

7. Confirm the condition , and then push the "REST".

1. 10 .VARIANT CODING

VARIANT CODING	
CONDITION	IG. KEY ON ENGINE STOP

PRESS [REST], IF YOU ARE READY !

REST

8. If the procedure is finished, the screen is displayed as shown below.

1.10 . VARIANT CODING

VARIANT CODING

IG. KEY ON

CALIBRATION COMPLETION!
TURN IG.KEY OFF AND ON 2TIMES.

PRESS [REST], IF YOU ARE READY !

REST

9. IGN off.

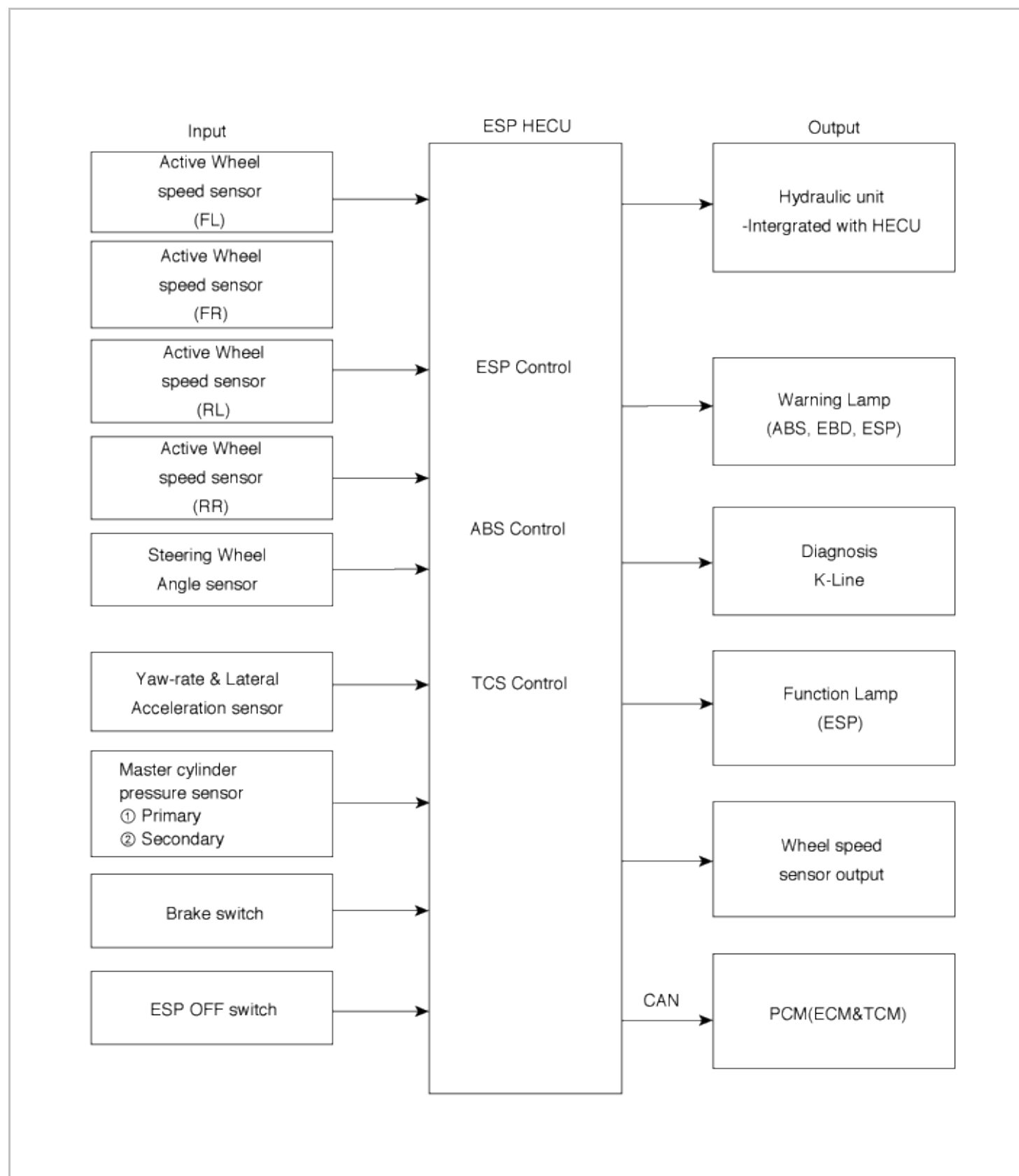
10. IGN on.

11. The variant coding is completed.

CAUTION

If the warning lamp(ESP, EBD, ABS) is illuminated, follow the "Variant coding" again.

INPUT AND OUTPUT DIAGRAM



ESP OPERATION MODE

1. STEP 1

The ESP analyzes the intention of the driver.

Position of steering wheel
+ Vehicle speed
+ Acceleration pedal

ECU decides the intention of the driver.

2. STEP 2

It analyzes the movement of the ESP vehicle.

Vehicle rotation speed
+ Operated power to the side

ECU decides movement of the ESP vehicle.

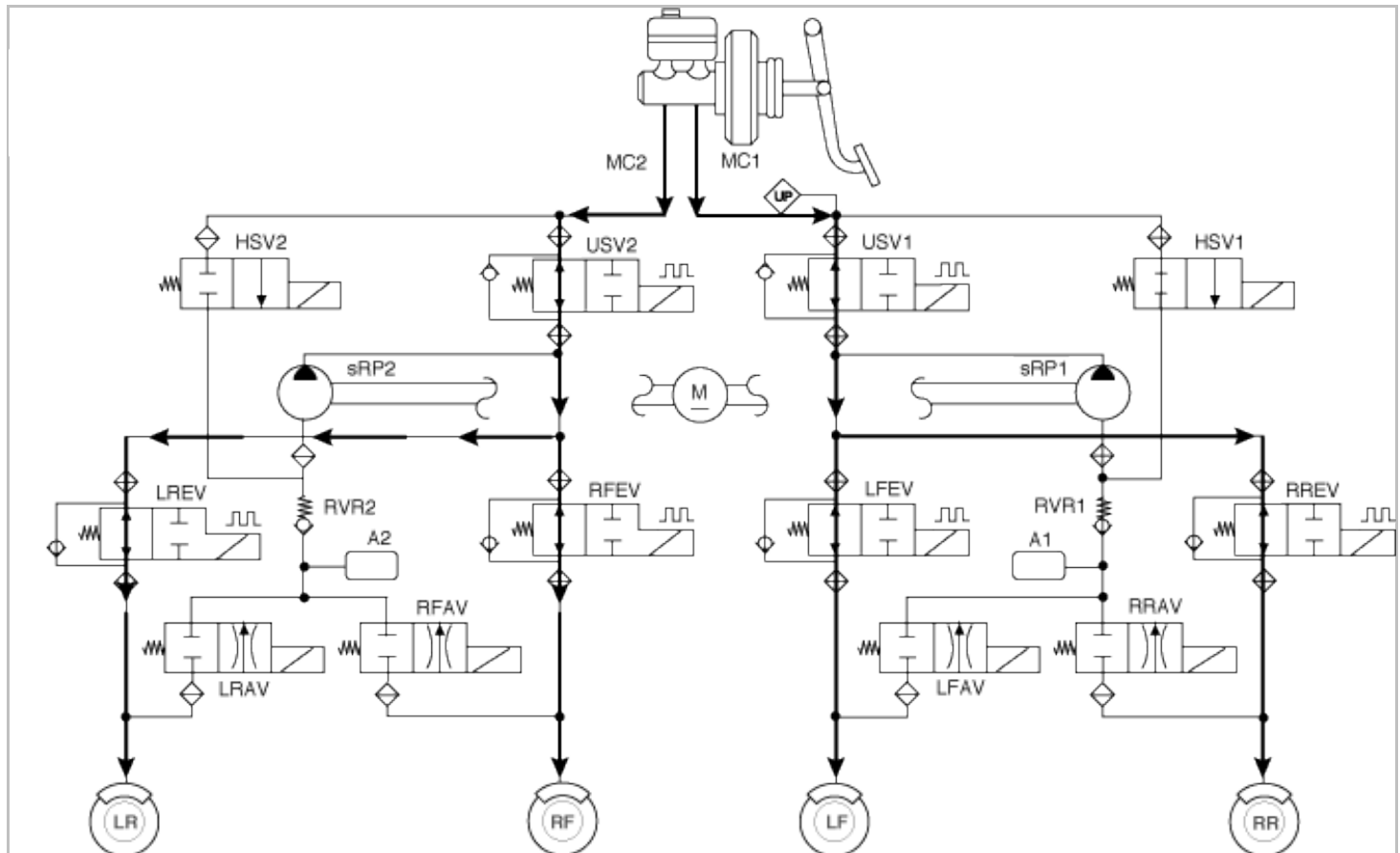
3. STEP 3

The HECU calculates the required strategy, then actuates the appropriate valves and sends torque control requests via CAN to maintain vehicle stability.

ESP OPERATION MODE

1. ESP Non-operation-Normal braking.

	Inlet valve(EV)	Outlet valve(AV)	Pilot valve(USV)	High pressure switch valve(HSV)	Pump motor
Normal braking	Open	Close	Open	Close	OFF



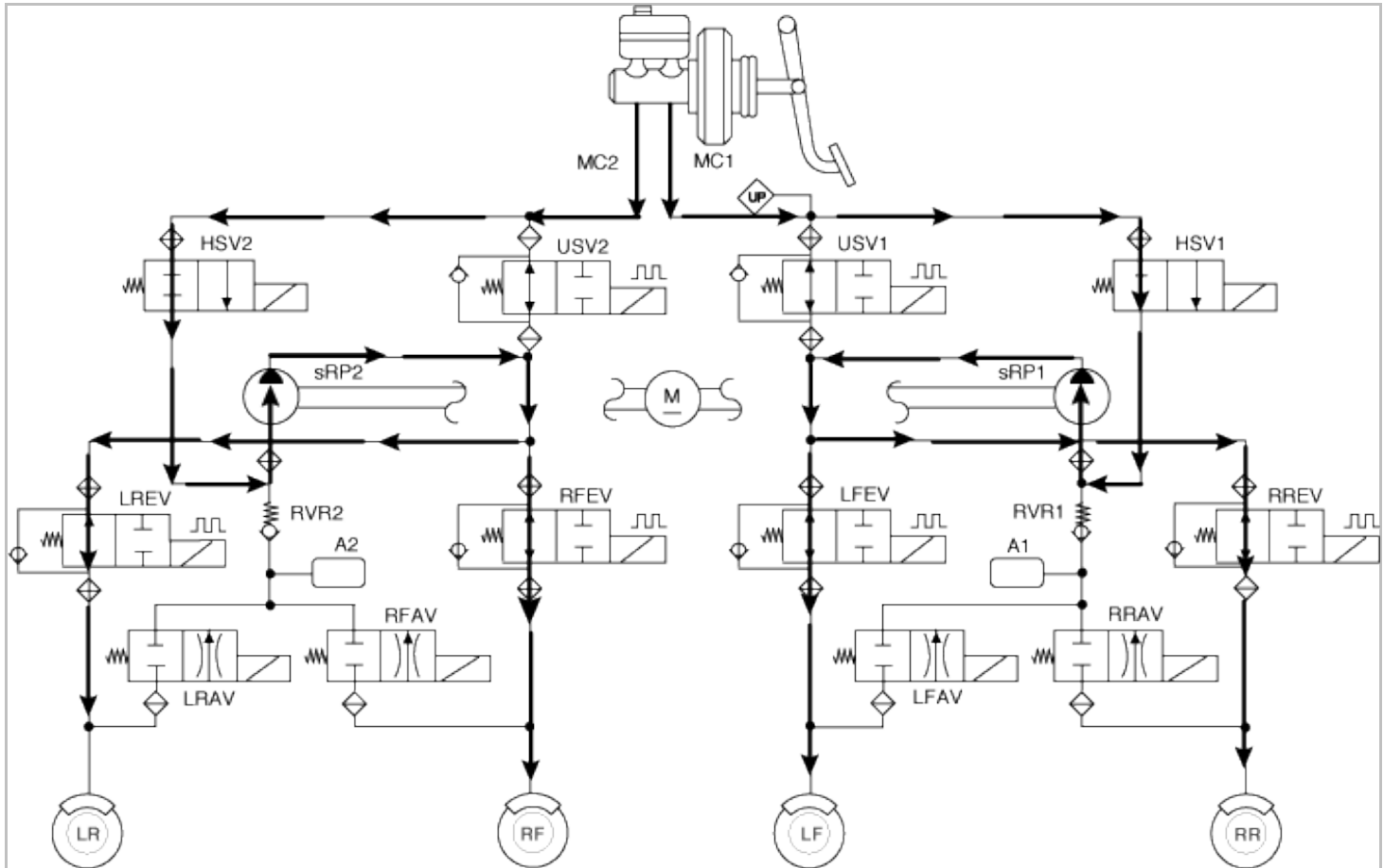
NOTICE

EV : Inlet Valve
AV : Outlet Valve
LR : Rear left wheel
RF : Front right wheel
LF : Front left wheel
RR : Rear right wheel
PE : Pump motor

USV : Pilot Valve
 HSV : High pressure Switch Valve

2. ESP INCREASE MODE

	Inlet valve(EV)	Outlet valve(AV)	Pilot valve(USV)	High pressure switch valve(HSV)	Pump motor
Normal braking	Open	Close	Close(Partial)	Open	ON(Motor speed control)

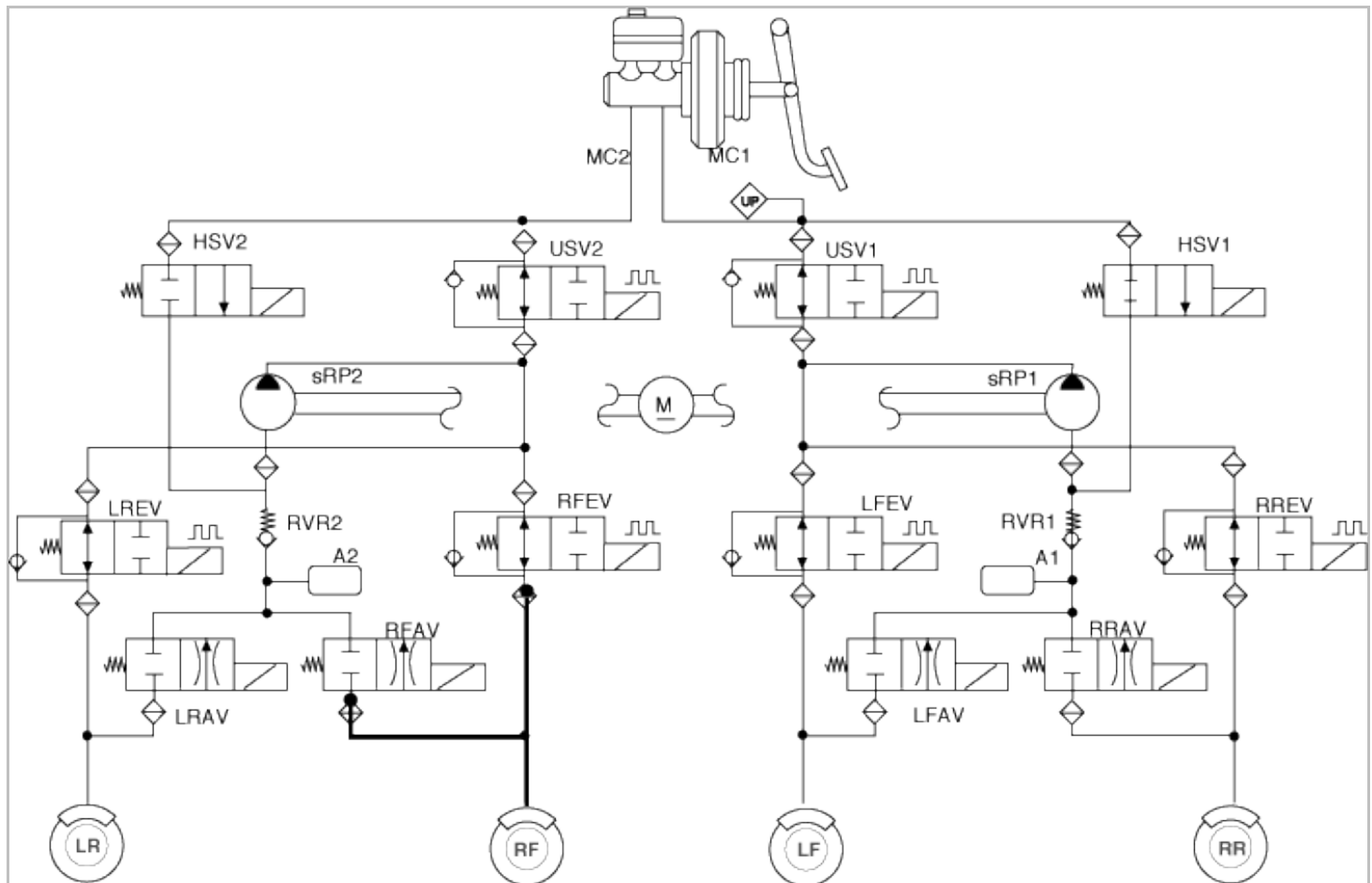


NOTICE

EV : Inlet Valve
 AV : Outlet Valve
 LR : Rear left wheel
 RF : Front right wheel
 LF : Front left wheel
 RR : Rear right wheel
 PE : Pump motor
 USV : Pilot Valve
 HSV : High pressure Switch Valve

3. ESP HOLD MODE (FR is only controlled.)

	Inlet valve(EV)	Outlet valve(AV)	Pilot valve(USV)	High pressure switch valve(HSV)	Pump motor
Normal braking	Close	Close	Close(Partial)	Open	ON(Motor speed low control)

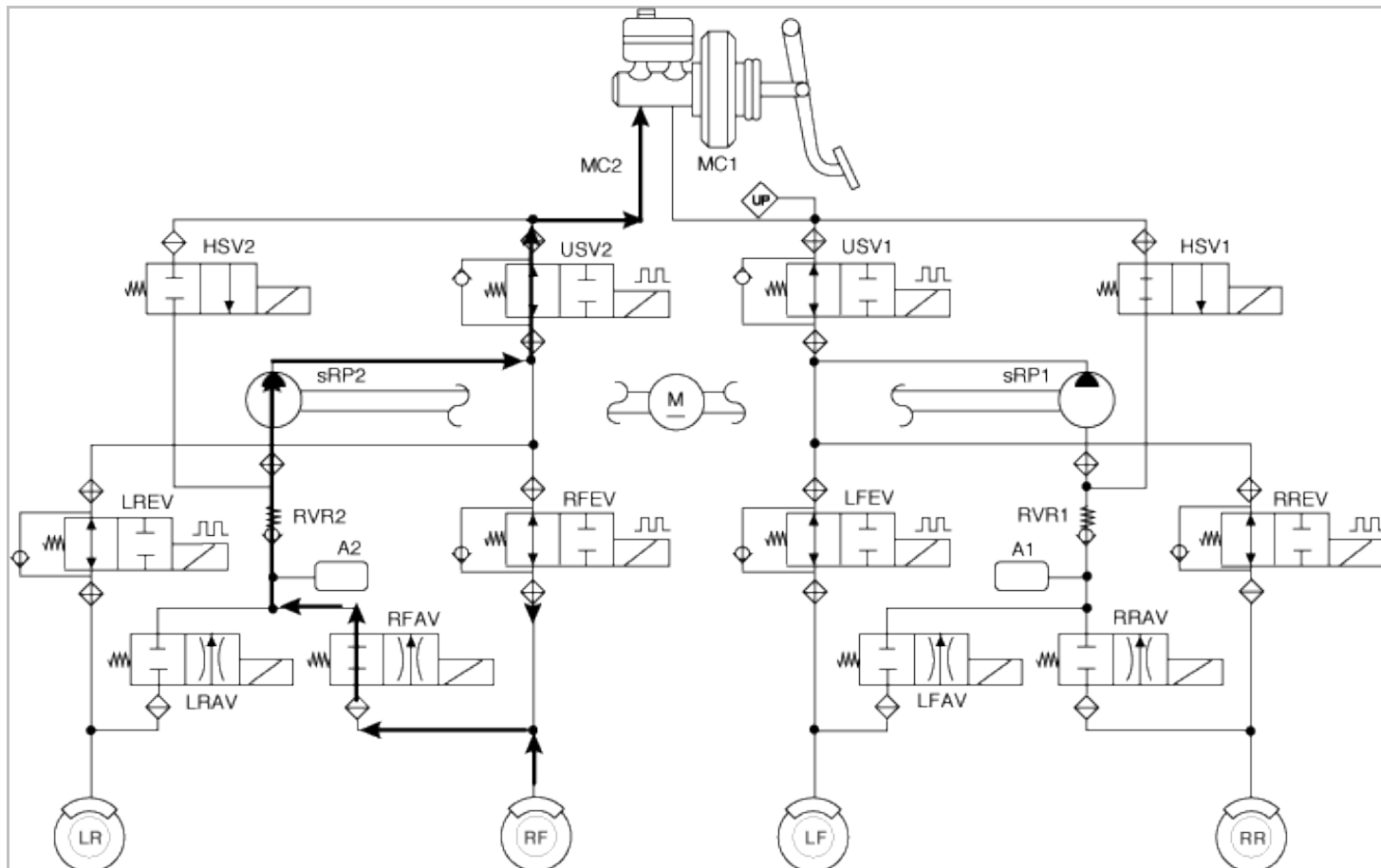


NOTICE

EV : Inlet Valve
 AV : Outlet Valve
 LR : Rear left wheel
 RF : Front right wheel
 LF : Front left wheel
 RR : Rear right wheel
 PE : Pump motor
 USV : Pilot Valve
 HSV : High pressure Switch Valve

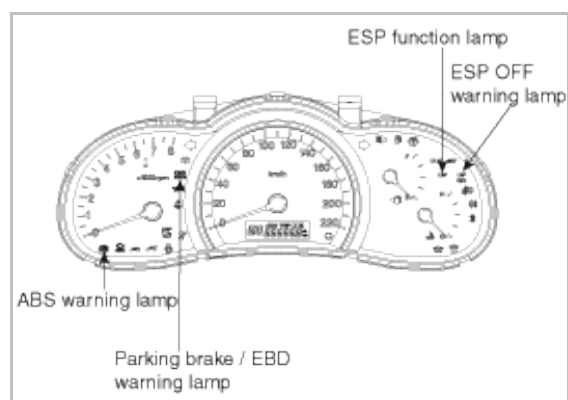
4. ESP DECREASE MODE (FR is only controlled)

	Inlet valve(EV)	Outlet valve(AV)	Pilot valve(USV)	High pressure switch valve(HSV)	Pump motor
Normal braking	Close	Open	Close(Partial)	Open	ON(Motor speed low control)



NOTICE

EV : Inlet Valve
 AV : Outlet Valve
 LR : Rear left wheel
 RF : Front right wheel
 LF : Front left wheel
 RR : Rear right wheel
 PE : Pump motor
 USV : Pilot Valve
 HSV : High pressure Switch Valve



ABS Warning Lamp module

The active ABS warning lamp module indicates the self-test and failure status of the ABS. The ABS warning lamp shall be on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of ABS functions by failure.
- During diagnostic mode.
- When the ECU Connector is separated from ECU.

EBD/PARKING BRAKE WARNING LAMP MODULE

The active EBD warning lamp module indicates the self-test and failure status of the EBD. However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions. The EBD warning lamp shall be on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the Parking Brake Switch is ON or brake fluid level is low.
- When the EBD function is out of order .
- During diagnostic mode.
- When the ECU Connector is separated from ECU.

ESP Warning Lamp (ESP system)

The ESP warning lamp indicates the self-test and failure status of the ESP.

The ESP warning lamp is turned on under the following conditions :

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of ESP functions by failure.
- When driver turn off the ESP function by on/off switch.
- During diagnostic mode.

ESC Function Lamp (ESC system)

The ESP function lamp indicates the self-test and operating status of the ESP.

The ESP Function lamp operates under the following conditions :

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the ESP control is operating. (Blinking - 2Hz)

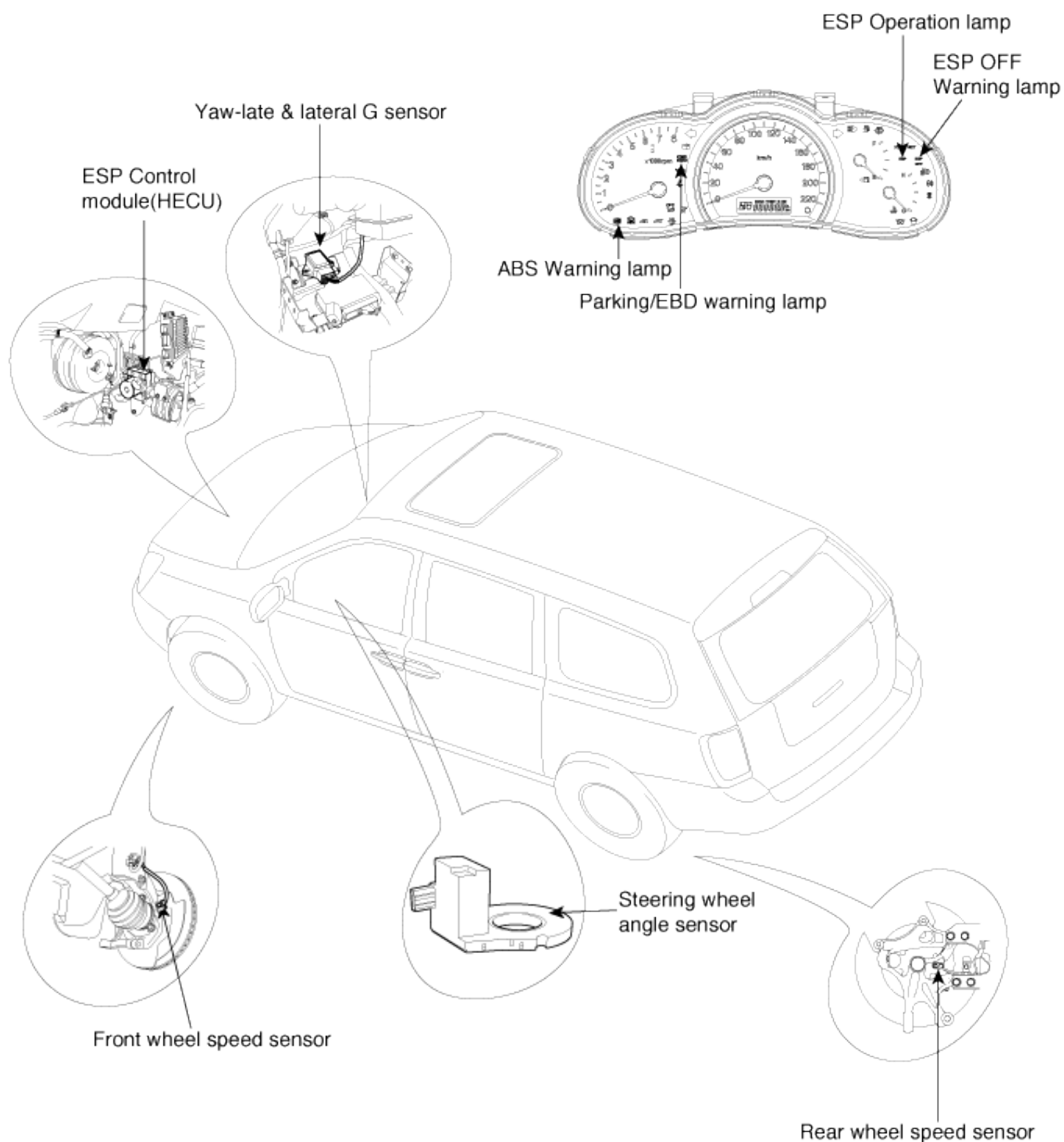
ESP On/Off Switch (ESP system)

The ESP On/Off Switch shall be used to toggle the ESP function between On/Off states based upon driver input.

The On/Off switch shall be a normally open, momentary contact switch.

Initial status of the ESP function is on and the switch is used to request an ESC status change.

COMPONENTS





FAILURE DIAGNOSIS

1. In principle, ESP and TCS controls are prohibited in case of ABS failure.
2. When ESP or TCS fails, only the failed system control is prohibited.
3. However, when the solenoid valve relay should be turned off in case of ESP failure, refer to the ABS fail-safe.
4. Information on ABS fail-safe is identical to the fail-safe in systems where ESP is not installed.

MEMORY OF FAIL CODE

1. It keeps the code as far as the backup lamp power is connected. (O)
2. It keeps the code as long as the HCU power is on. (X)

FAILURE CHECKUP

1. Initial checkup is performed immediately after the HECU power on.
2. Valve relay checkup is performed immediately after the IG2 ON.
3. It executes the checkup all the time while the IG2 power is on.
4. Initial checkup is made in the following cases.
 - (1) When no failure is detected
 - (2) When ABS and ESP are not in control.
 - (3) Initial checkup is not made after ECU power on.
 - (4) If the vehicle speed is over 5 mph(8 km/h) when the brake lamp switch is off.
 - (5) When the vehicle speed is over 24.8 mph(40 km/h).
5. Though, it keeps on checkup even if the brake lamp switch is on.
6. When performing ABS or ESP control before the initial checkup, stop the initial checkup and wait for the HECU power input again.
7. Judge failure in the following cases.
 - (1) When the power is normal.
 - (2) From the point in which the vehicle speed reaches 4.9 mph(8 km/h) after HECU power on.

COUNTERMEASURES IN FAIL

1. Shut the system down and perform the following actions and wait for HECU power OFF.
2. Turn the valve relay off.
3. Do not perform any ABS/TCS/ESC functions until normal operating condition is restored.

WARNING LAMP ON

1. ABS warning lamp turns on when ABS is malfunctioning.
2. ESP operation lamp turns on when ESP is malfunctioning.

When power voltage and valve relay voltage are abnormal, input/output related failure judgment is not made.

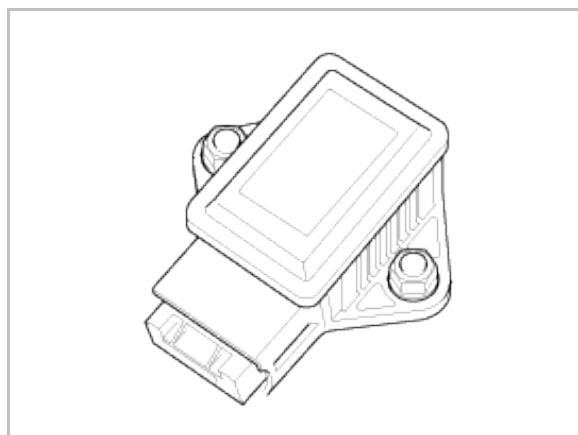
Brake System

EPS (Electronic Stability System) - Yaw-rate
And Lateral G Sensor



DESCRIPTION

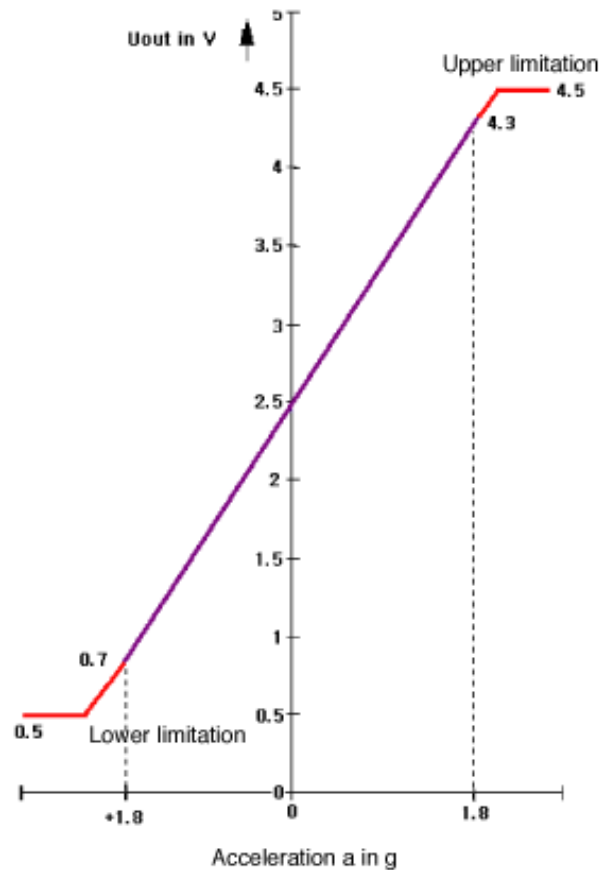
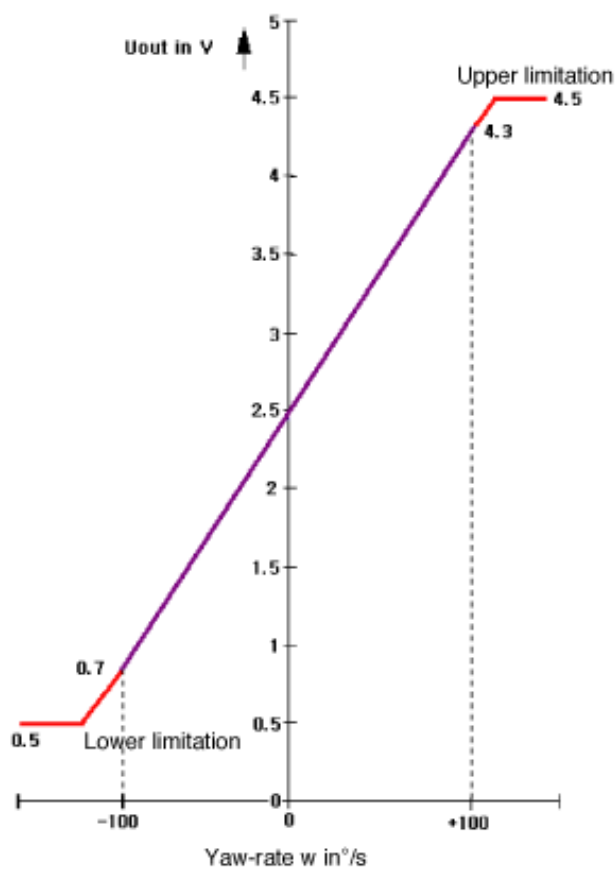
1. The yaw-rate & lateral G sensor is applied for the ESP system.
2. The yaw-rate is the angular velocity, when a vehicle turns a corner, and the lateral G is the acceleration to move a vehicle out of the way when cornering.
3. The sensor is located in the crash pad lower floor on vehicle.



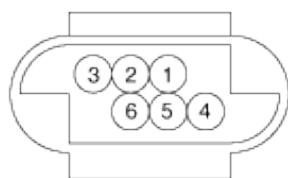
SPECIFICATION

Description			Specification	Remark
Nominal supply voltage			11.5 ~ 12.5 V	
Supply voltage range			8 ~ 16 V	
Supply current			Max. 120 mA	Typ. 75 mA
Reference Voltage Output			2.464 ~ 2.536 V	Typ. 2.5 V
Operating temperature range			-40 ~ 85°C	
Yaw-rate sensor	Measurement range	+w direction, left turn	Min.100 °/s	Typ. 111 °/S
		-w direction, right turn	Min.100 °/s	Typ. 111 °/S
	Non-linearity		-1 ~ 1 %	
	Offset (within life,within operating temperature)		3.75 °/S	
	Upper cut-off frequency		Min. 45 Hz	Typ. 60 Hz
Lateral G sensor	Measurement range	+y direction, left turn	Min.1.8 g	Typ. 2 g
		-y direction, right turn	Min. -1.8 g	Typ. 2 g
	Non-linearity		-4 ~ 4 %	
	Offset (within life,within operating temperature)		-0.09 ~ 0.09 g	
	Upper cut-off frequency		Min. 20 Hz	Typ. 40 Hz

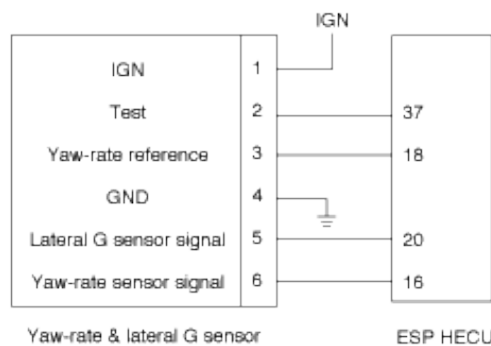
OUTPUT CHARACTERISTIC



CIRCUIT DIAGRAM (YAW-RATE & LATERAL G SENSOR)



[Yaw-rate & lateral G sensor connector]



Brake System

EPS (Electronic Stability System) - EPS OFF
Switch



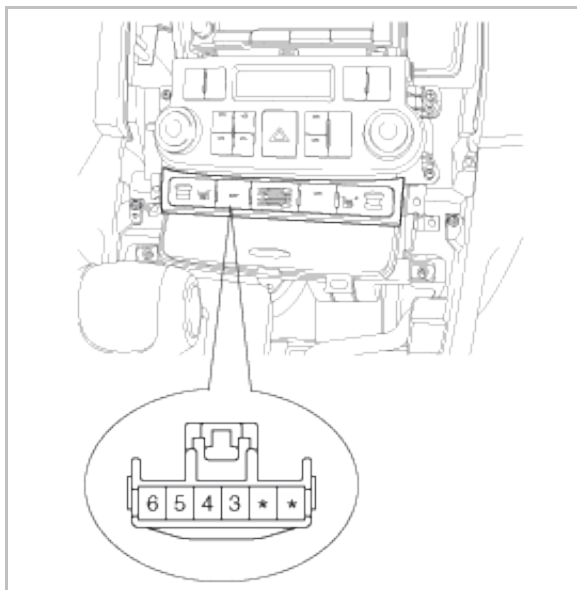
DESCRIPTION

1. The ESP OFF switch is for the user to turn off the ESP system.
2. The ESP OFF lamp is on when ESP OFF switch is engaged.



INSPECTION

1. Remove the ESP OFF switch from the switch panel on the crach pad of the driver's side.



2. Check the continuity between the switch terminals as the ESP OFF switch is engaged.

Terminal Position	5	6	3	4
ON				
OFF				

Brake System

EPS (Electronic Stability System) - Steering
Angle Sensor



DESCRIPTION

GENERAL DATA

The steering angle speed sensor detects the angle of the steering wheel in order to which direction a user chooses.

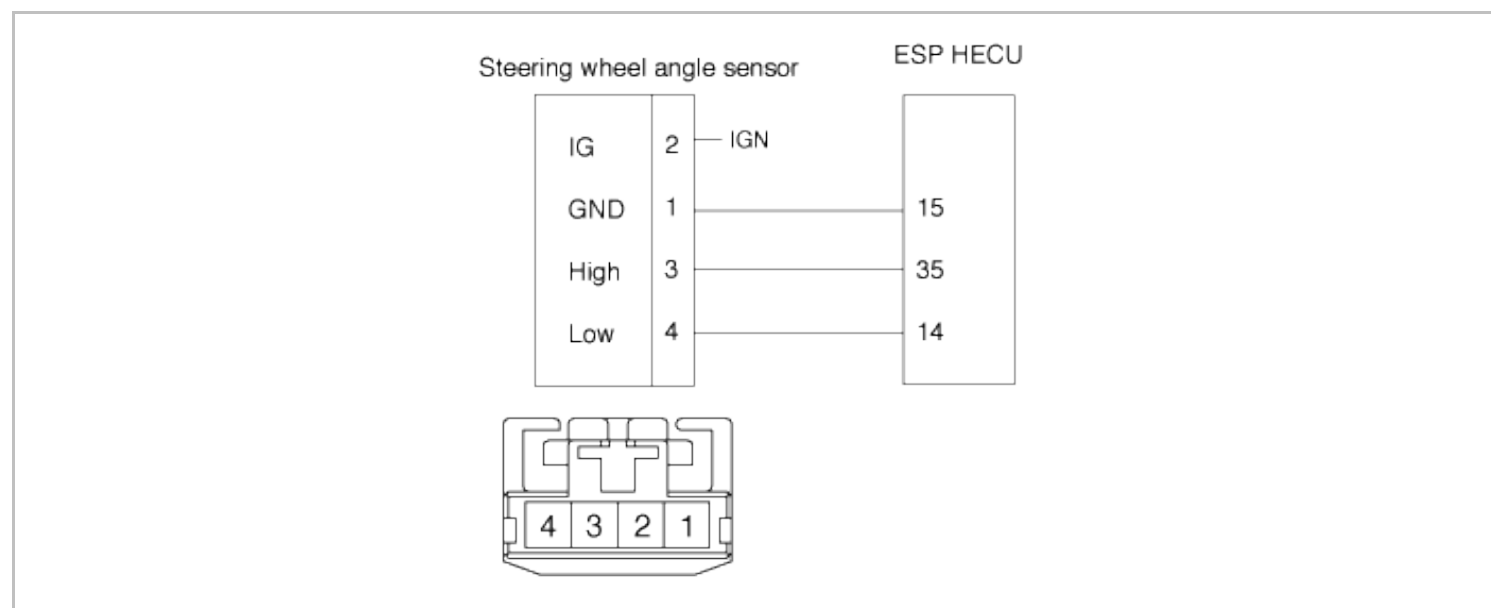
MEASUREING PRINCIPLE

A non contact, analog angle sensor carrying out absolute measuring by the use of the Anisotropic-Magneto-Resistive effect (AMR). Measuring of the absolute angle by means of a toothed measuring gear with magnetic properties in combination with different ratios. Corresponding AMR elements that change their electrical resistance according to the magnetic field direction detect the angle position of the measuring gears. A micro-controller decodes the measured voltage signals after A/D converting with the help of a mathematical function. Output of the digital angle value and velocity via CAN-interface.

SPECIFICATION

Description		Specification
Operating voltage		8~16 V
Operating temperature		-40 ~ 85 °C
Current consumption		Max.150 mA
Steering angle velocity		Max. ± 2000 °/sec
Connection delay time		$t < 200$ ms
Reverse voltage		-13.5 V
Measuring range	Angle	-780 ° ~ 779 °
	Angular velocity	0~ 1016 °/s
Nonlinearity angle		-2.5 ° ~ +2.5 °
Hysteresis angle		0 ° ~ 5 °
Rotational friction torque measuring		10 °/s

CIRCUIT DIAGRAM(STEERING WHEEL SPEED ANGLE SENSOR)



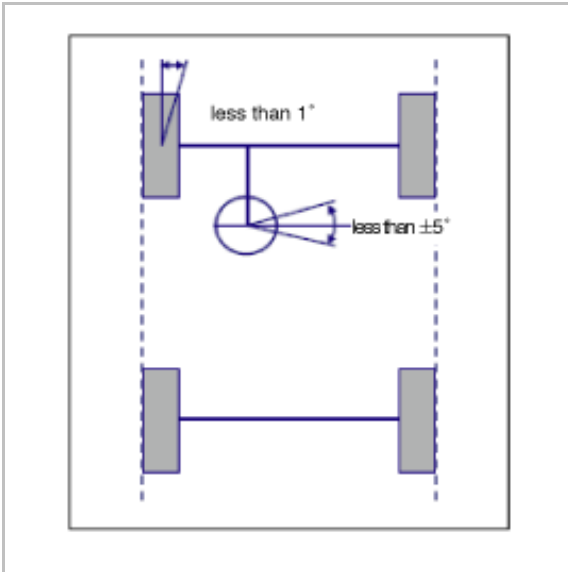
STEERING ANGLE SENSOR (SAS) calibration

1. PURPOSE OF calibration

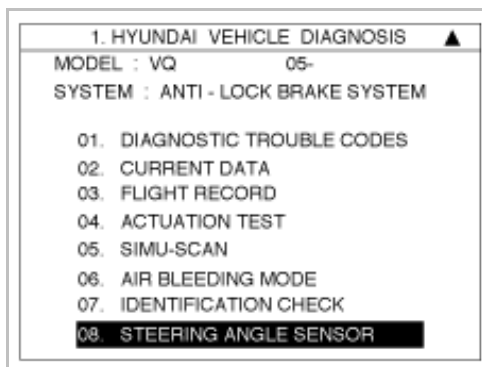
- On vehicle control, an ESP analyzes the intention of the driver.
- An ESP recognizes a steering angle which a driver rotates through the steering angle sensor.

C. A steering angle sensor used in ESP adjusts 0° setting of steering wheel through K-line or CAN communication.

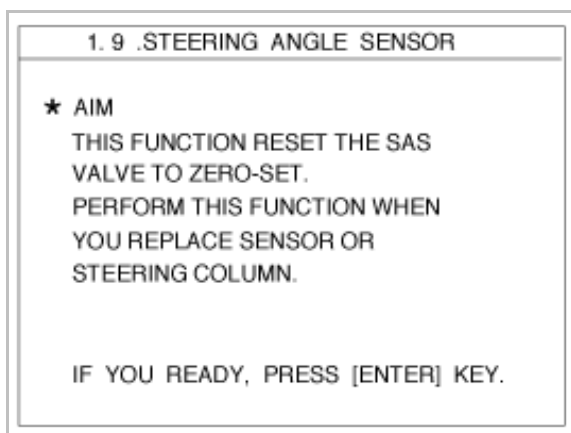
2. STEERING ANGLE SENSOR (SAS) CALIBRATION METHOD



- (1) Align the wheel to the straight line. (steering wheel $< \pm 5^\circ$)
ex) Perform the wheel alignment first.
Align the wheel to the straight line.
A driver moves the vehicle to the front and back about 5 meters twice or three times.
- (2) Connect Scan tool to the vehicle.
- (3) Select Brake system.
- (4) Select Steering angle sensor(SAS) calibration.



- (5) Perform the Steering angle sensor(SAS) calibration.



- (6) Perform the procedure continuously.

1.9 STEERING ANGLE SENSOR	
STEERING ANGLE SENSOR	
CONDITION	STRAIGHTEN THE FRONT TIRE, AND ARRANGE THE STEERING WHEEL AT THE CENTER POSITION. IG.KEY ON, ENGINE STOP
PRESS [REST], IF YOU ARE READY!	
REST	

(7) The procedure is finished. Push the "ESC" key.

1.9 STEERING ANGLE SENSOR	
STEERING ANGLE SENSOR	
CONDITION	STRAIGHTEN THE FRONT TIRE, CALIBRATION COMPLETION! PRESS [ESC] KEY. IG.KEY ON, ENGINE STOP
PRESS [REST], IF YOU ARE READY!	
REST	

(8) Scanner OFF.

(9) Remove the scanner from the vehicle.

(10) Confirm the Steering angle sensor(SAS) calibration as driving the vehicle.(turn left once, turn right once)