

**GENESIS COUPE(BK) > 2013 > G 3.8 GDI > Brake System****Brake System > General Information > Specifications**

## Specifications

Item		Specification	
Master cylinder	Type	Tandem	
	Cylinder I.D.	23.81mm (0.94in)	
	Piston stroke	43±1mm (1.69±0.039in)	
	Fluid level switch	Provided	
Brake booster	Type	7" + 8" Tandem	
	Boosting ratio	9 : 1	
Front Disc brake	Caliper Type	General Disc Brake	Brembo Disc Brake
	Type	Ventilated disc	Ventilated disc
	Disc O.D	320mm(12.60in)	340mm(13.39in)
	Disc thickness	28mm(1.10in)	28mm(1.10in)
	Caliper piston	Single	4piston
	Cylinder I.D	Φ60mm(2.36in)	Φ(42mm+42mm(1.65in+1.65in))X2
Rear Disc brake	Caliper Type	General Disc Brake	Brembo Disc Brake
	Type	Solid disc	Ventilated disc
	Disc O.D	314mm(12.36in)	330mm(12.99in)
	Disc thickness	13mm(0.51in)	20mm(0.79in)
	Caliper piston	Single	4piston
	Cylinder I.D	Φ42.9mm(1.69in)	Φ(32mm+28mm(1.26in+1.10in))X2
Parking brake	Type	DIH (Drum in hat)	
	Drum I.D.	Ø 190mm (7.48in)	

**NOTE**

O.D. : Outer Diameter

I.D : Inner Diameter

**Specification (ESC)**

Part	Item	Standard value	Remark
HECU	System	4 Channel 4 Sensor (Solenoid)	Total control (ABS, EBD, TCS, ESC)
	Type	Motor, valve relay intergrated type	
	Operating Voltage	10 ~ 16V	
	Operating Temperature	-40 ~ 120°C(-40 ~ 248°F)	
	Motor power	270W	
Warning lamp	Min. Operating Voltage	12V	
	Max. Current consumption	Max. 200mA	
Active Wheel speed sensor	Supply voltage	DC 4.5 ~ 20V	
	Output current low	5.9 ~ 8.4mA	
	Output current high	11.8~ 16.8mA	
	Output range	1 ~ 2500Hz	
	Tone wheel	Front : 46 teeth Rear : 47 teeth	
	Air gap	0.5 ~ 1.5mm	
Steering Wheel Angle Sensor	Operating Voltage	8 ~ 16V	
	Current consumption	Max. 100mA	
	Output measurement range	-780 ~ +799.9°	
	Operating Angular velocity	1500°/sec	
Yaw rate& Lateral G sensor (CAN TYPE)	Operating Voltage	8 V ~ 17V	
	Current Consumption	Max. 140mA	
	Yaw rate sensor measurement range	-75 ~ 75°/sec	
	Lateral G sensor measurement range	-1.5 ~ 1.5gN	

## Service Standard

Items			Standard vale
Brake pedal stroke			AT : 132.1mm (5.20in) MT : 132.9mm (5.23in)
Stop lamp clearance			1.0 ~ 1.5mm (0.04 ~ 0.06in)
Brake pedal free play			3 ~ 8 mm (0.12 ~ 0.13in)
Parking brake lever stroke when lever assembly is pulled with 196N (20Kg, 44lb force)			5 Notch
Front brake disc	disc thickness	General	28mm(1.10in)
		Brembo	28mm(1.10in)
	pad thickness	General	11mm(0.43in)
		Brembo	8.5mm(0.33in)
Rear brake disc	disc thickness	General	13mm(0.51in)
		Brembo	20mm(0.79in)
	pad thickness	General	9mm(0.35in)
		Brembo	9.1mm(0.36in)

### Tightening Torques

Items		N.m	kgf.m	lb-ft
Master cylinder to brake booster		12.7 ~ 16.7	1.3 ~ 1.7	9.4 ~ 12.3
Brake booster mounting nuts		12.7 ~ 15.7	1.3 ~ 1.6	9.4 ~ 11.6
Air bleeding screw	General	6.9 ~ 12.7	0.7 ~ 1.3	5.1 ~ 9.4
	Brembo	16.7 ~ 19.6	1.7 ~ 2.0	12.3 ~ 14.5
Brake tube flare nuts		12.7 ~ 16.7	1.3 ~ 1.7	9.4 ~ 12.3
Front caliper guide rod bolts		21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Rear caliper guide rod bolts		21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Front caliper assembly to knuckle	General	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
	Brembo	88.3 ~ 103.0	9.0 ~ 10.5	65.1 ~ 75.9
Rear caliper assembly to knuckle		78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Brake hose to caliper		24.5 ~ 29.4	2.5 ~ 3.0	18.1 ~ 21.7
Brake pedal member bracket bolts		12.7 ~ 15.7	1.3 ~ 1.6	9.4 ~ 11.6
Brake pedal shaft nut		8.8 ~ 13.7	0.9 ~ 1.4	6.5 ~ 10.1
Stop lamp switch lock nut		7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Wheel speed sensor mounting bolt		6.9 ~ 10.8	0.7 ~ 1.1	5.1 ~ 8.0
HECU bracket mounting bolt		16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8

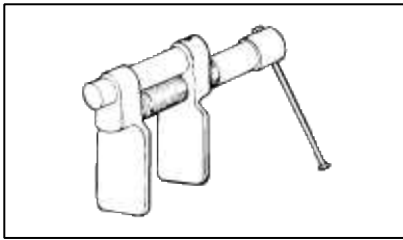
Yaw rate&G sensor mounting bolts	7.8 ~ 10.8	0.8 ~ 1.1	5.8 ~ 8.0
----------------------------------	------------	-----------	-----------

### Lubricants

Items	Recommended	Quantity
Brake fluid	DOT 3 or DOT 4	As required
Brake pedal bushing and bolt	Chassis grease	As required
Parking brake shoe and backing plate contacting surface	Heat resistance grease	As required
Front caliper guide rod and boot	AI-11P	1.2 ~ 1.7g
Rear caliper guide rod and boot	AI-11P	0.8 ~ 1.3g

### Brake System > General Information > Special Service Tools

#### Special Service Tools

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

### Brake System > General Information > Troubleshooting

#### Troubleshooting

#### Problem Symptoms Table

Use the table below to help you find the cause of the problem. The numbers indicate the priority of the like cause of the problem. Check each part in order.

If necessary, replace these parts.

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 free play (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)	adjust adjust repair adjust replace replace replace

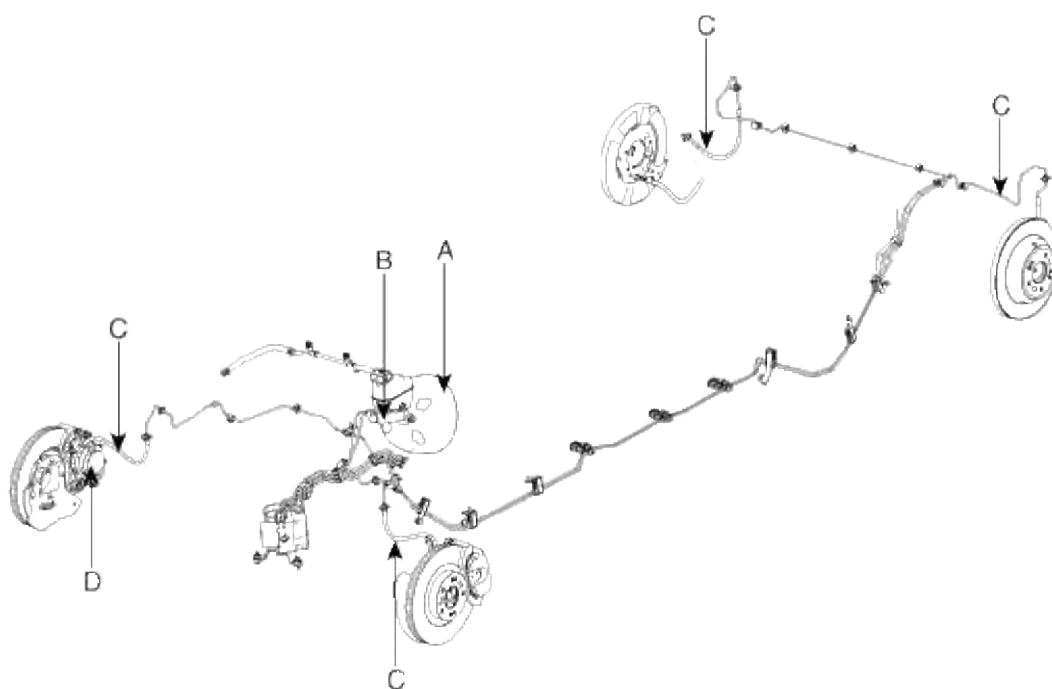
	8. Anchor or Return spring (Inoperative) 9. Booster system (Vacuum leaks) 10. Master cylinder (Inoperative)	replace repair replace
Brake pull	1. Piston (Sticking) 2. Pad or lining (Oily) 3. Piston (Frozen) 4. Disc (Scored) 5. Pad or lining (Cracked or distorted)	replace replace replace replace replace
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 5. master cylinder cap seal 6. damaged brake lines	replace adjust replace replace 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.	

### Brake System > Brake System > Repair procedures

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)	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> </ul>
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.



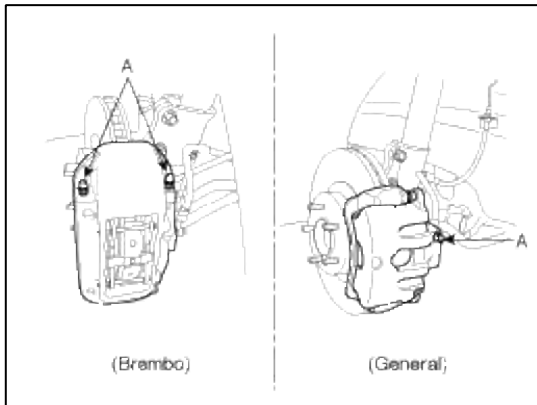
### Brake System Bleeding

#### CAUTION

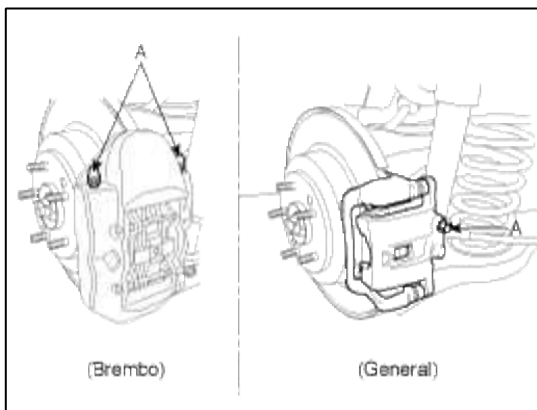
- Do not reuse the drained fluid.
- Always use genuine DOT3/DOT4 brake Fluid.  
Using a non-genuine DOT3/DOT4 brake fluid can cause corrosion and decrease the life of the system.
- Make sure no dirt or other foreign matter is allowed to contaminate the brake fluid.
- Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.
- The reservoir on the master cylinder must be at the MAX (upper) level mark at the start of bleeding procedure and checked after bleeding each brake caliper. Add fluid as required.

1. Make sure the brake fluid in the reservoir is at the MAX(upper) level line.
2. Have someone slowly pump the brake pedal several times, and then apply pressure.
3. Loosen the right-rear brake bleed screw (A) to allow air to escape from the system. Then tighten the bleed screw securely.

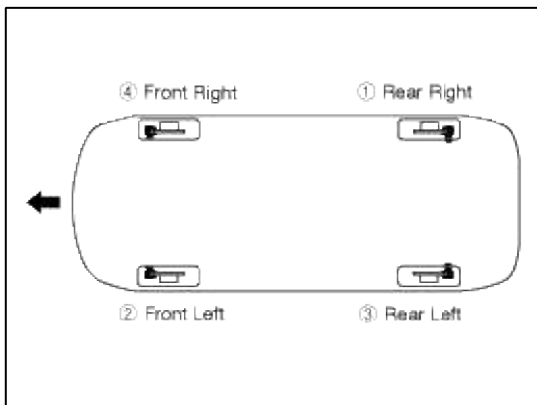
#### Front



#### Rear



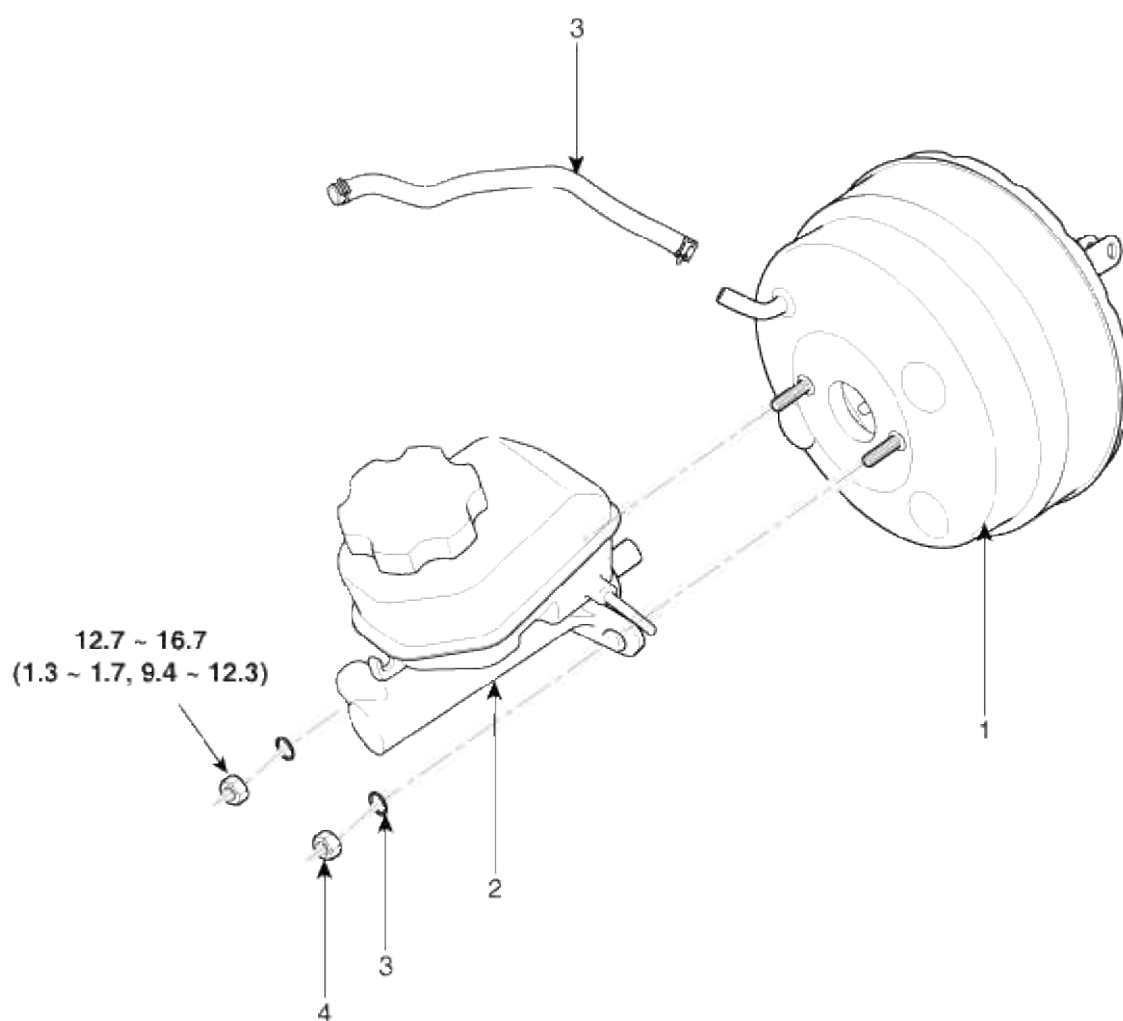
4. Repeat the procedure for wheel in the sequence shown below until air bubbles no longer appear in the fluid.



5. Refill the master cylinder reservoir to MAX(upper) level line.

### Brake System > Brake System > Brake Booster > Components and Components Location

#### Components



**Torque : N.m (kgf.m, lb-ft)**

1. Brake booster	4. Nut
2. Master cylinder assembly	5. Vacuum hose
3. Washer	

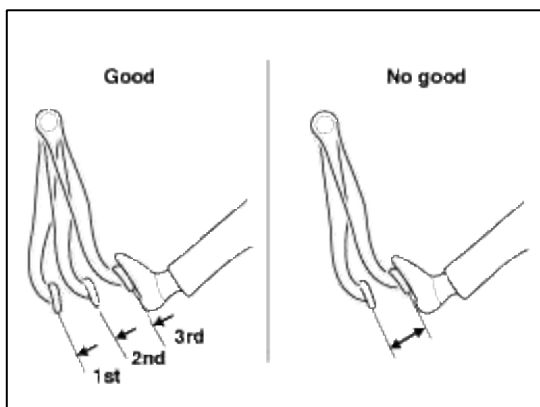
### Brake System > Brake System > Brake Booster > Repair procedures

#### Brake Booster Operating Test

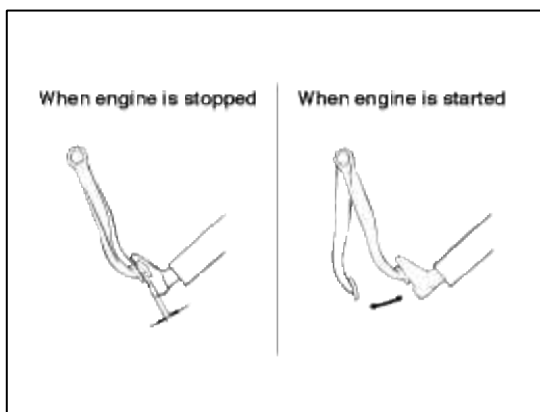
For simple checking of the brake booster operation, carry out the following tests.



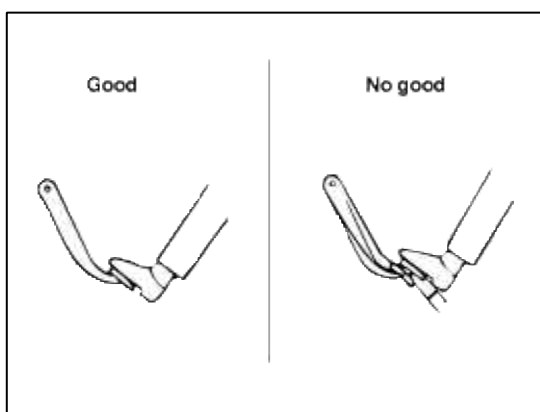
1. Run the engine for one or two minutes, and then stop it. If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly, if the pedal height remains unchanged, the booster is inoperative.



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.



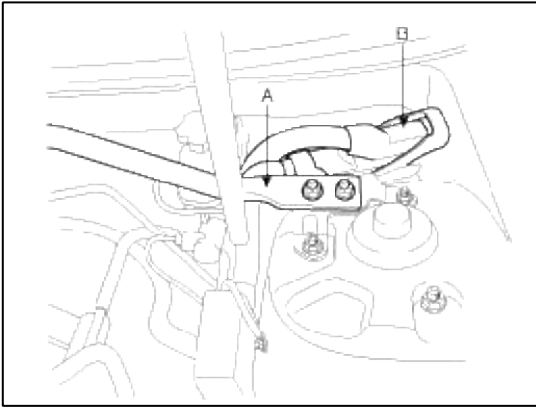
3. With the engine running, step on the brake pedal and then stop the engine. Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is inoperative.
- If the above three tests are okay, the booster performance can 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.



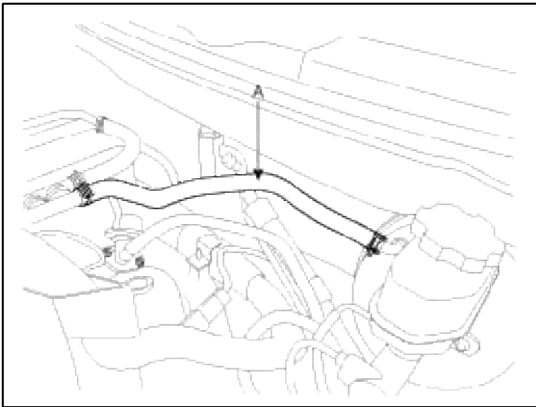
## Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.

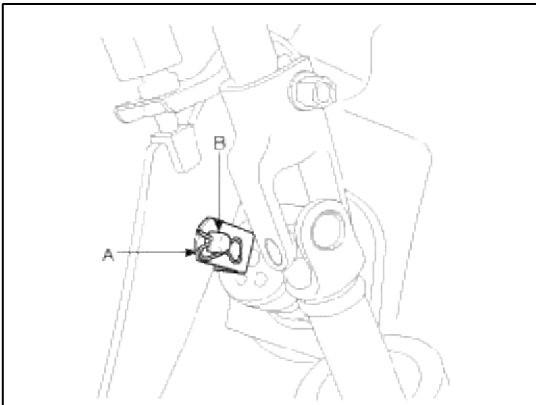
2. Remove the strut bar (A).



3. Disconnect the ECM connector (B). And then take the protector of control harness off.
4. Disconnect the vacuum hose (A) from the brake booster.



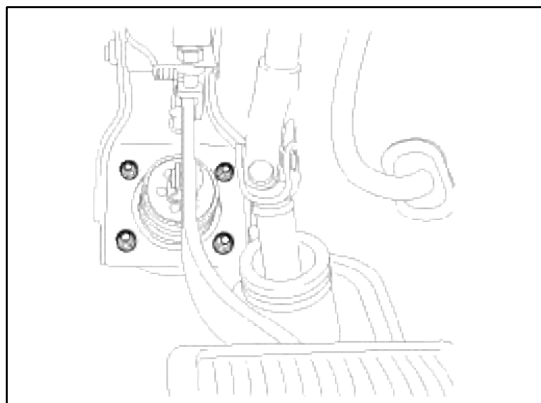
5. Remove the master cylinder.  
(Refer to Master cylinder)
6. Remove the snap pin (A) and clevis pin (B).



7. Remove the mounting nuts.

### Tightening torque :

12.7 ~ 15.7 N.m (1.3 ~ 1.6 kgf.m, 9.4 ~ 11.6 lb-ft)



8. Remove the brake booster.

### Inspection

1. Inspect the check valve in the vacuum hose.

#### CAUTION

Do not remove the check valve from the vacuum hose.

2. Check the boot for damage.

### Installation

1. Installation is the reverse of removal.

#### CAUTION

- Before installing the pin, apply the grease to the joint pin.
- Use a new snap pin whenever installing.

2. After installing, bleed the brake system.

(Refer to Brake system bleeding)

3. Adjust the brake pedal height and free play.

(Refer to Brake pedal height and free play adjustment)

## Brake System > Brake System > Vacuum Pump (2.0 A/T & ESC Only) > Description and Operation

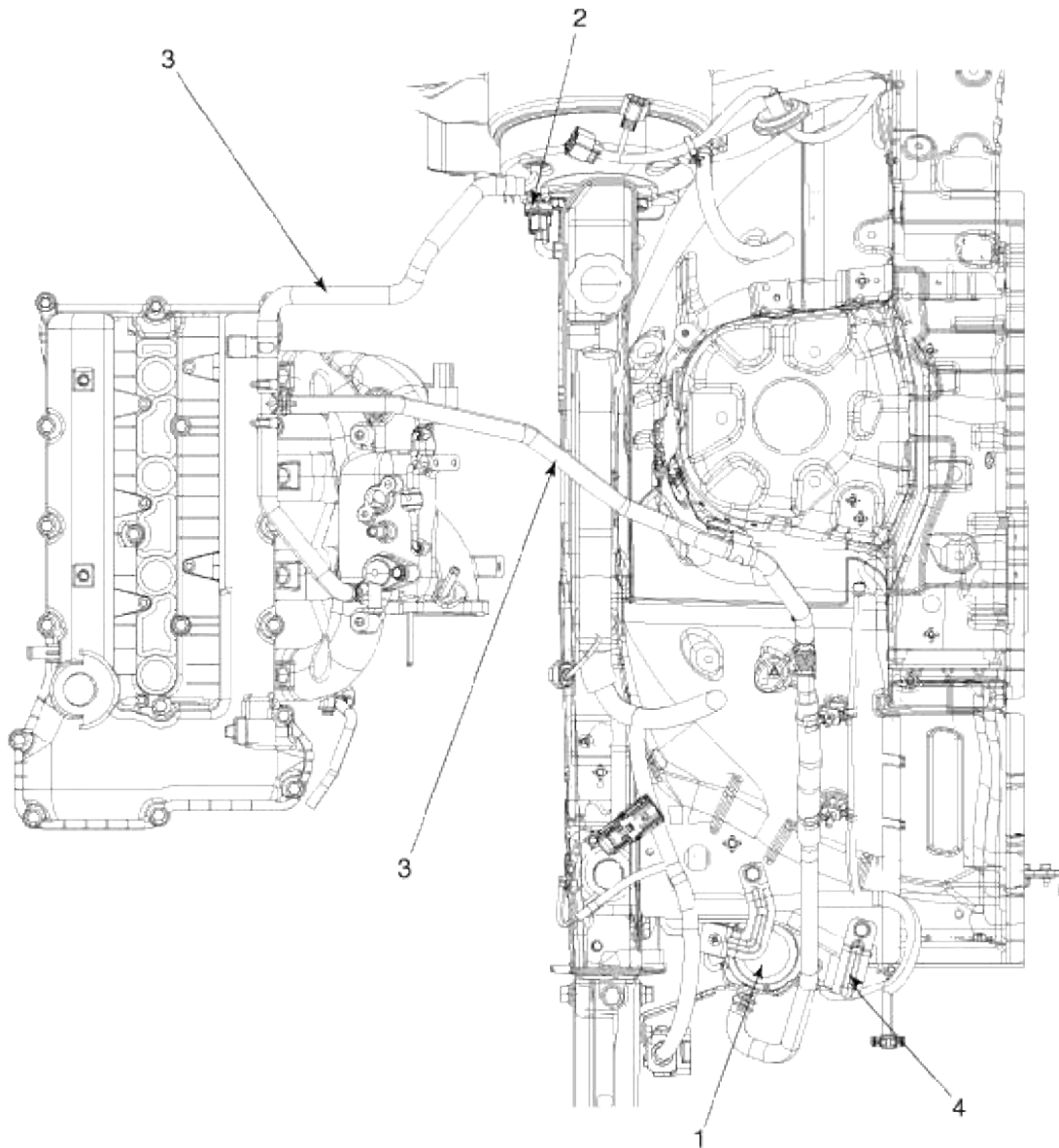
### Description

The Vacuum Pump System is set up in a vehicle in order to make the vacuum enough when a driver presses the brake pedal on the high ground. To operate this system, the vacuum pump is installed on a vehicle.

If the vacuum is not sufficient to press the brake pedal, the HECU senses it through the vacuum switch, which is installed on booster. And then the HECU supplies the power to the vacuum pump by grounding the circuit of the vacuum pump relay. When the vacuum pump is supplied with electric power, it makes the vacuum and supplements it to the booster.

## Brake System > Brake System > Vacuum Pump (2.0 A/T & ESC Only) > Components and Components Location

### Components



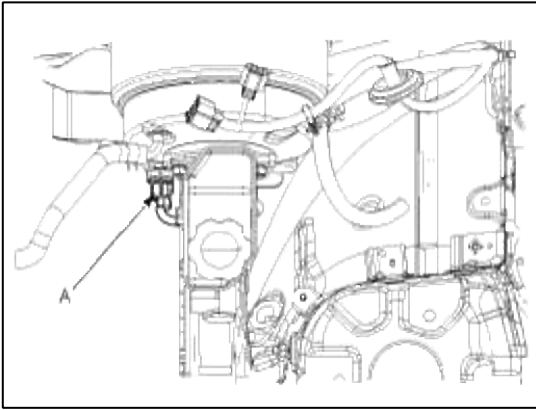
- |                  |                        |
|------------------|------------------------|
| 1. Vacuum pump   | 3. Vacuum hose         |
| 2. Vacuum switch | 4. Vacuum pump bracket |

## Brake System > Brake System > Vacuum Pump (2.0 A/T & ESC Only) > Repair procedures

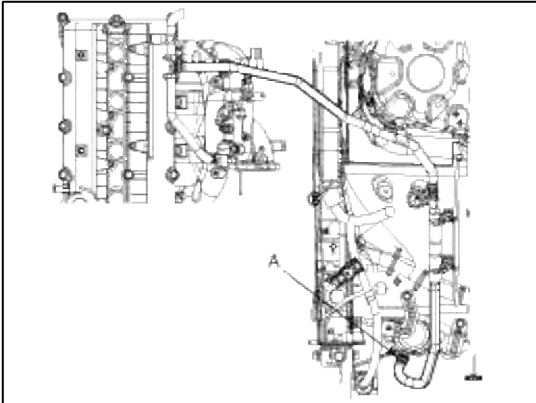
### Removal

1. Remove the front bumper cover.  
(Refer to Body group – "Bumper")

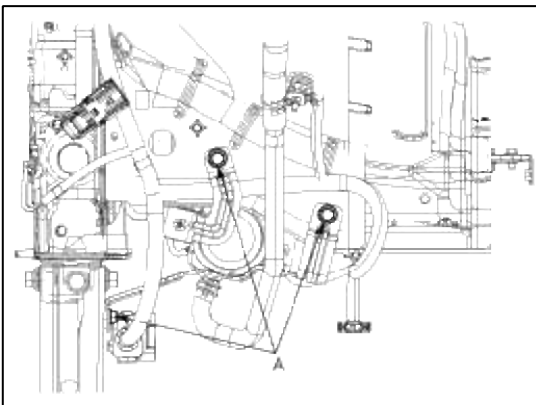
2. Disconnect the Vacuum pump connector (A).



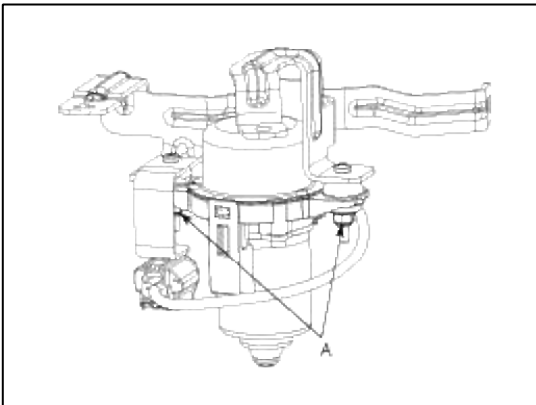
3. Remove the Vacuum hose (A).



4. Remove the mounting bracket bolt (A).

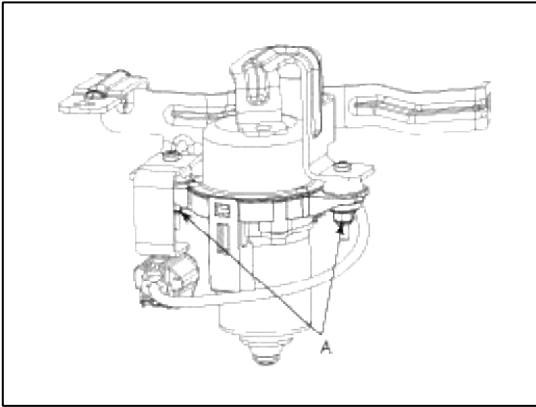


5. Remove the 2 nuts (A) and then remove the bracket from Vacuum pump.

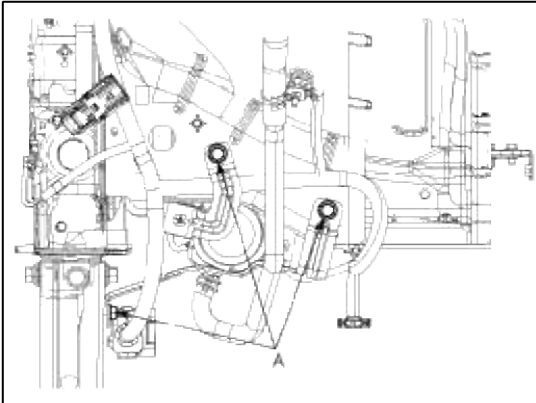


## Installation

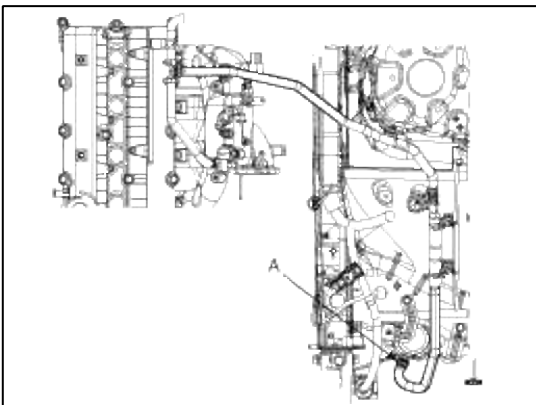
1. Install the Vacuum pump to the bracket.



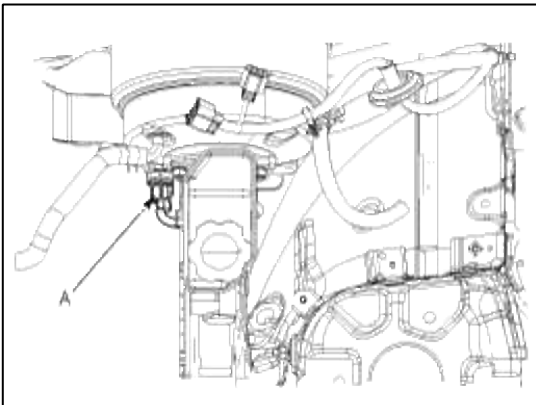
2. Install the Vacuum pump & bracket bolt.



3. Install the Vacuum hose.

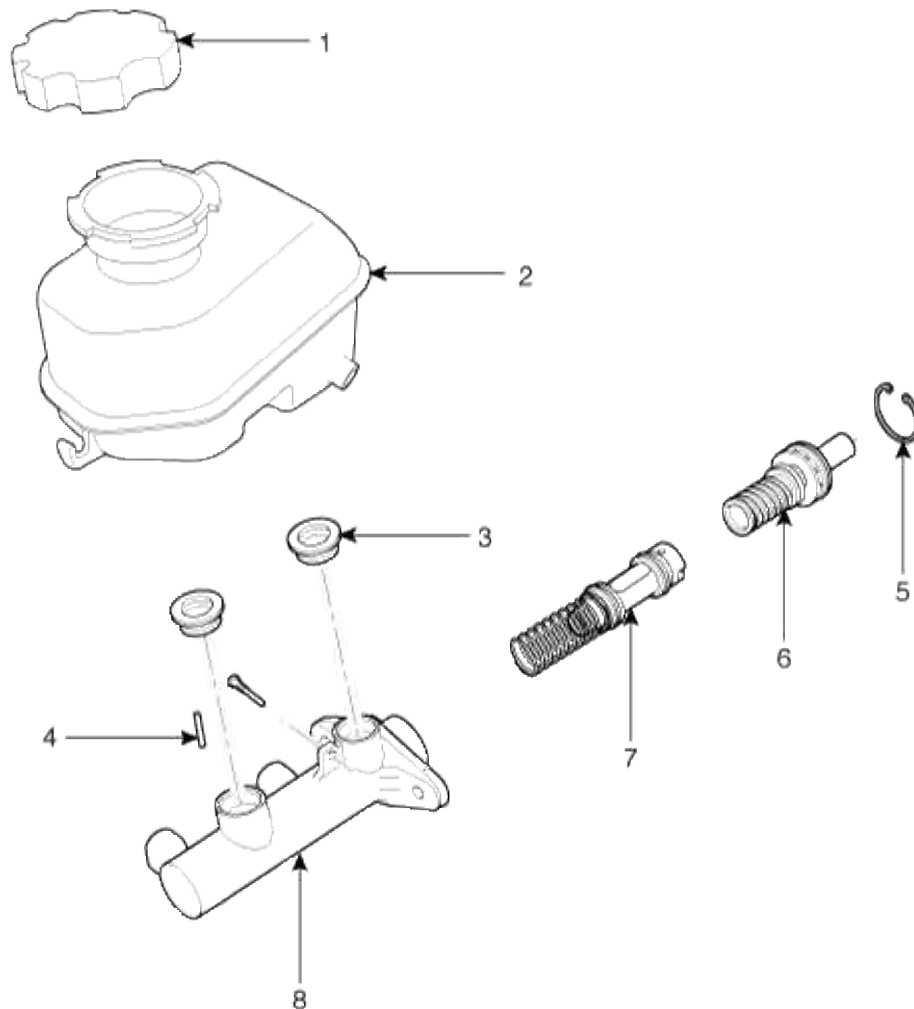


4. Connect the Vacuum pump connector.



5. Install the front bumper cover.  
(Refer to Body group – "Bumper")

## Components

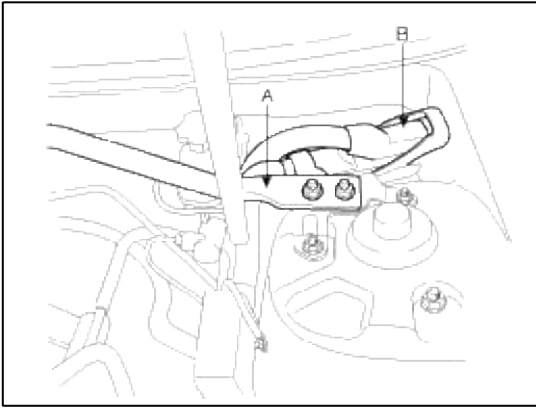


- |                  |                              |
|------------------|------------------------------|
| 1. Reservoir cap | 5. Retainer                  |
| 2. Reservoir     | 6. Primary piston assembly   |
| 3. Grommet       | 7. Secondary piston assembly |
| 4. Cylinder pin  | 8. Master cylinder body      |

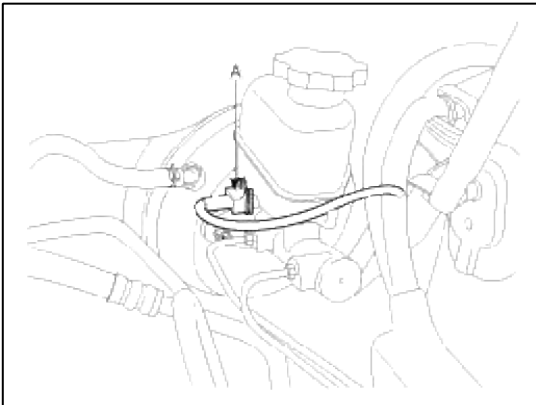
**Brake System > Brake System > Master Cylinder > Repair procedures**

## Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the strut bar (A).



3. Disconnect the ECM connector (B). And then take the protector of control harness off.
4. Disconnect the brake fluid level switch connector (A) from the reservoir.



5. Remove the brake fluid from the master cylinder reservoir with a syringe.

**CAUTION**

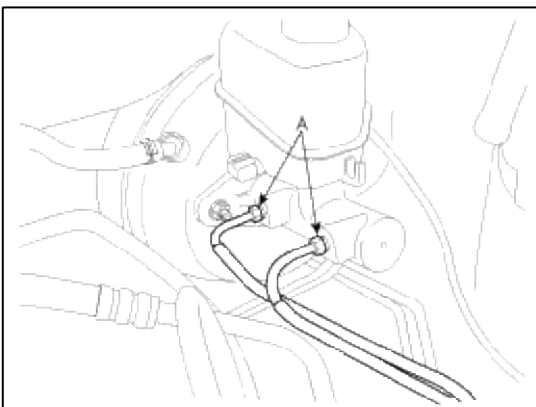
- Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

6. Disconnect the brake tube (B) from the master cylinder by loosening the tube flare nut.

**Tightening torque :**

ABS : 12.7 ~ 16.7 N.m (1.3 ~ 1.7 kgf.m, 9.4 ~ 12.3 lb-ft)

ESC : 18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.7 lb-ft)

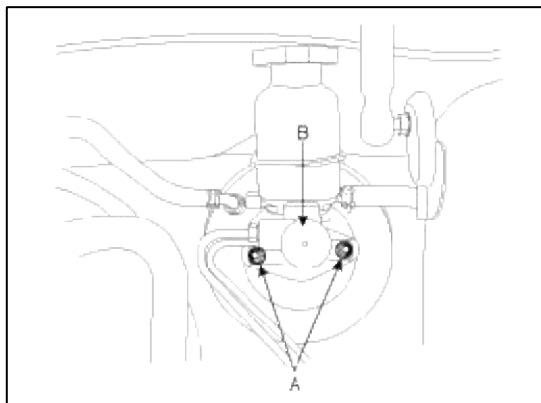




7. Remove the master cylinder (B) from the brake booster after loosening the mounting nuts (C).

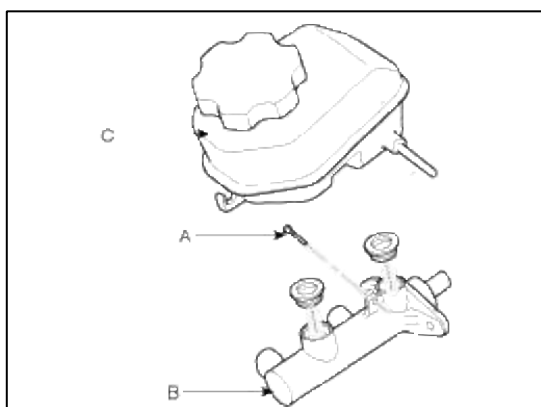
### Tightening torque :

12.7 ~ 16.7 N.m (1.3 ~ 1.7 kgf.m, 9.4 ~ 12.3 lb-ft)

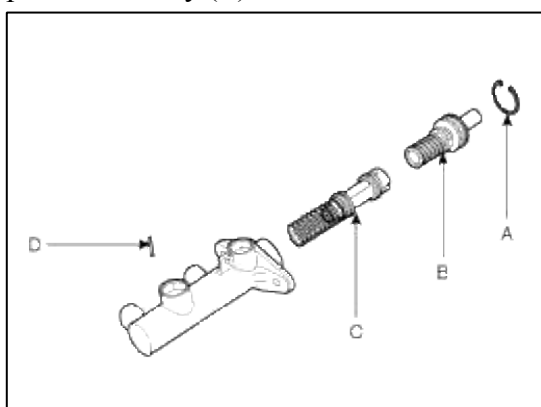


### Disassembly

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



3. Remove the retainer ring (A) by using the snap ring pliers.
4. Remove the primary piston assembly (B).
5. Remove the pin (D) with the secondary piston (C) pushed completely using a screwdriver. Remove the secondary piston assembly (C).



### NOTE

Do not disassemble the primary and secondary piston assembly.

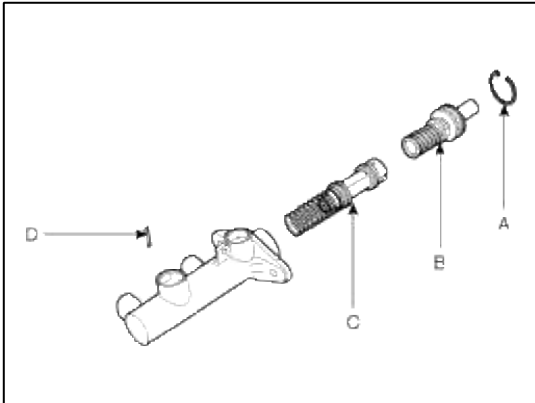
1. Check the master cylinder bore for rust or scratching.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

#### CAUTION

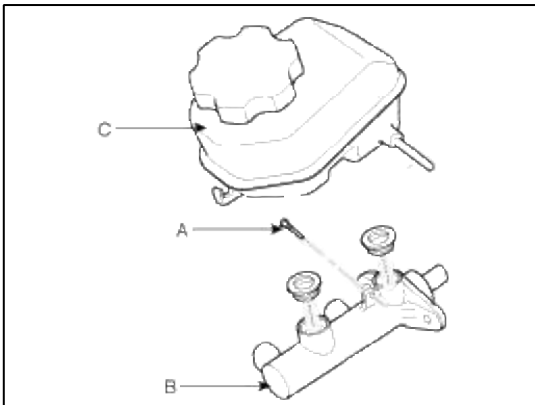
- If the cylinder bore is damaged, replace the master cylinder assembly.
- Wash the contaminated parts in alcohol.

#### 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 secondary piston (C) with a screwdriver and install the cylinder pin (D).



4. Install the retainer ring (A) after installing primary piston assembly (B).
5. Mount two grommets.
6. Install the reservoir (C) on the cylinder (B), and then install the mounting screw (A).

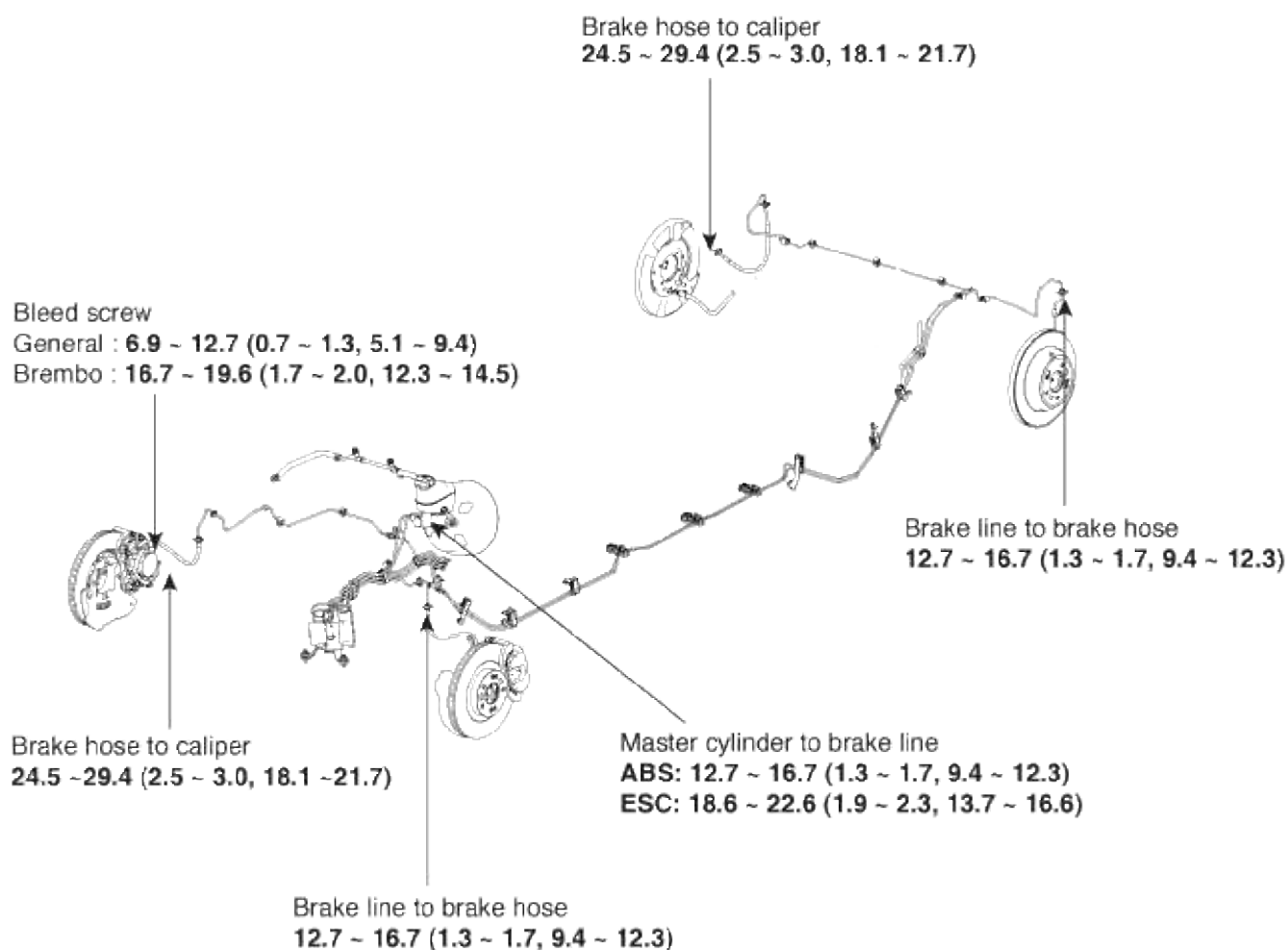


#### Installation

1. Installation is the reverse of removal.
2. After installation, bleed the brake system.  
(Refer to Brake system bleeding)

### Brake System > Brake System > Brake Line > Components and Components Location

#### Components



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

#### **WARNING**

When installing brake hose, be sure to comply with the torque specification to prevent twisted hose.

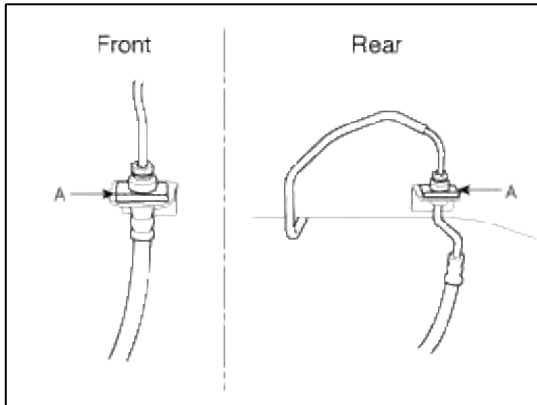
### **Brake System > Brake System > Brake Line > Repair procedures**

#### **Removal**

1. Remove the wheel & tire.

2. Remove the brake hose clip (A).

Front



3. Disconnect the brake tube by loosening the tube flare nut.

**Tightening torque :**

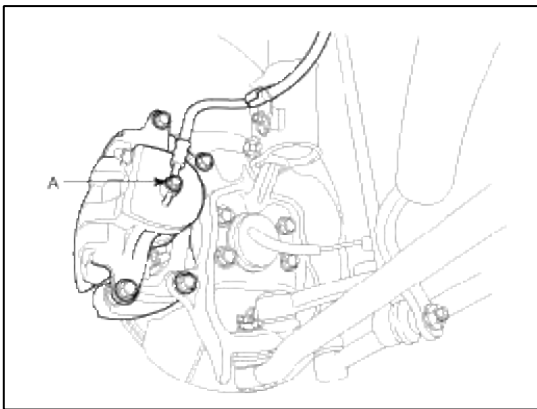
12.7 ~ 16.7 N.m (1.3 ~ 1.7 kgf.m, 9.4 ~ 12.3 lb-ft)

4. Disconnect the brake hose from the brake caliper by loosening the bolt.

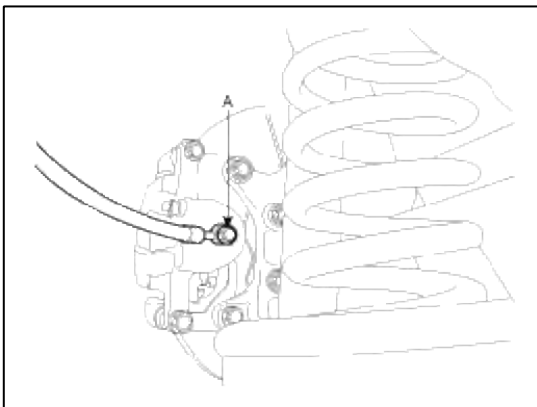
**Tightening torque :**

24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)

Front



Rear



Inspection

1. Check the brake tubes for cracks, crimps and corrosion.

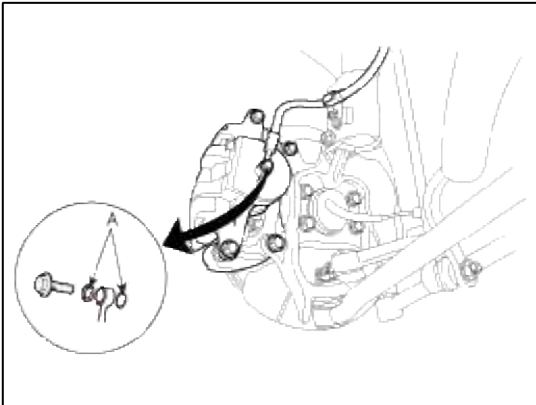
2. Check the brake hoses for cracks, damage and fluid leakage.
3. Check the brake tube flare nuts for damage and fluid leakage.
4. Check the brake hose mounting bracket for crack or deformation.

#### Installation

1. Installation is the reverse of removal.

##### CAUTION

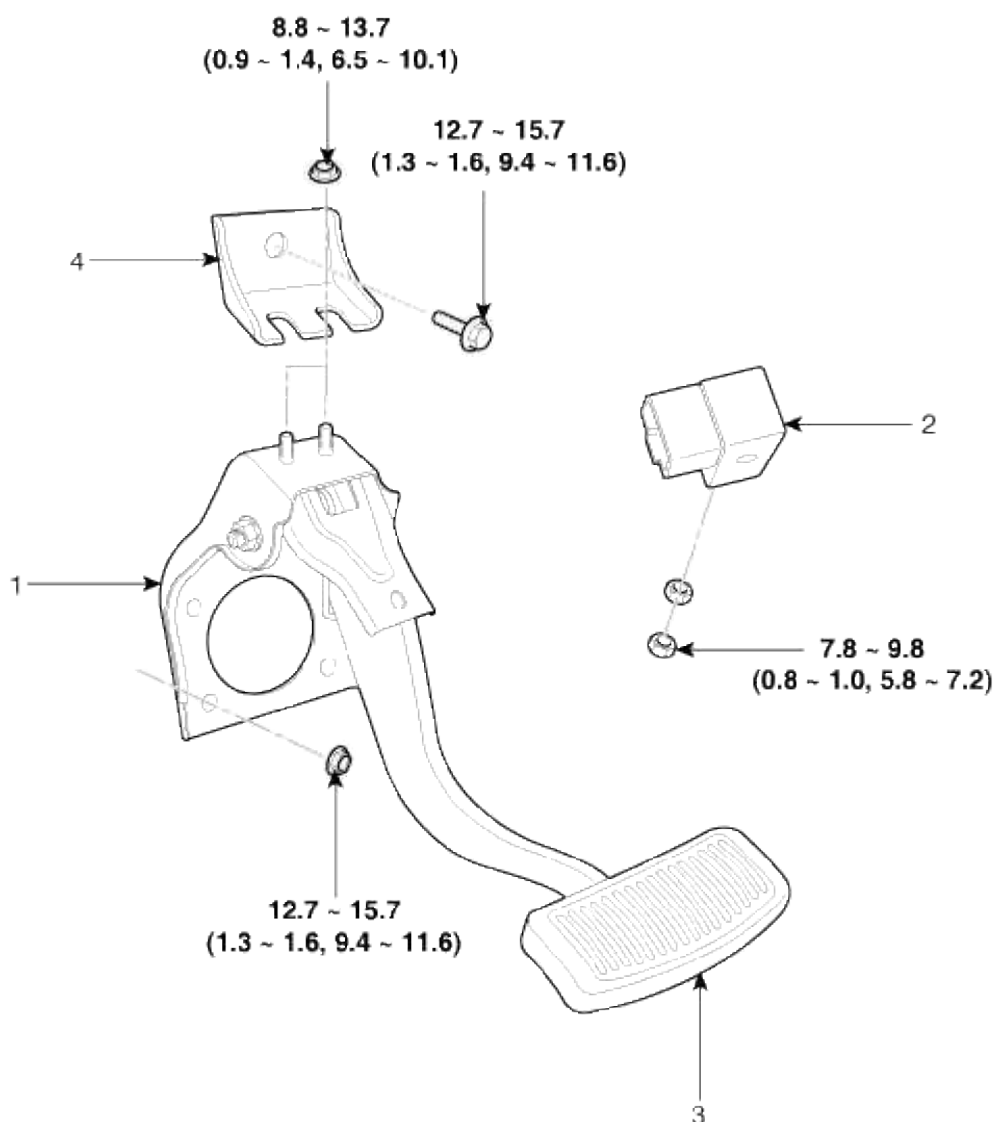
Use a new washer (A) whenever installing.



2. After installation, bleed the brake system.  
(Refer to Brake system bleeding)
3. Check the spilled brake oil.

#### Brake System > Brake System > Brake Pedal > Components and Components Location

##### Components



**Torque : N.m (kgf.m, lb-ft)**

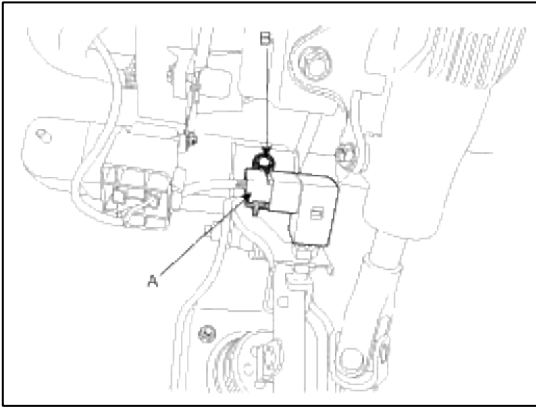
1. Brake pedal member assembly	3. Brake pedal
2. Stop lamp switch	4. Brake bracket

### Brake System > Brake System > Brake Pedal > Repair procedures

#### Removal

1. Remove the lower crash pad.  
(Refer to Body group - "Crash pad")

2. Disconnect the stop lamp switch connector (A).



3. Remove the mounting bracket bolt (B).

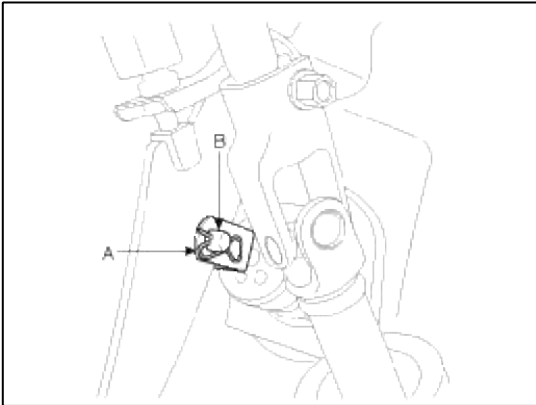
---

**Tightening torque :**

12.7 ~ 15.7 N.m (1.3 ~ 1.6 kgf.m, 9.4 ~ 11.6 lb-ft)

---

4. Remove the snap pin (A) and clevis pin (B).



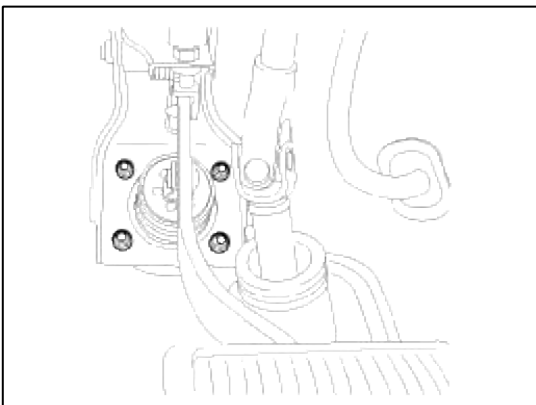
5. Remove the brake pedal member assembly mounting nuts and then remove the brake pedal assembly.

---

**Tightening torque :**

12.7 ~ 15.7 N.m (1.3 ~ 1.6 kgf.m, 9.4 ~ 11.6 lb-ft)

---

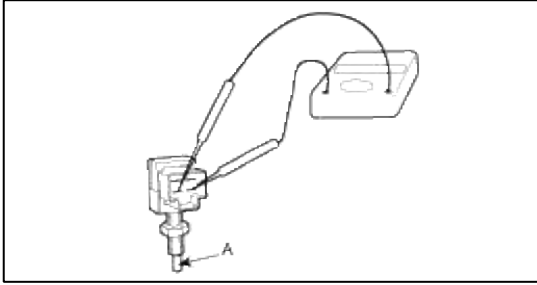


**Inspection**

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.



#### Installation

1. Installation is the reverse of removal.

##### CAUTION

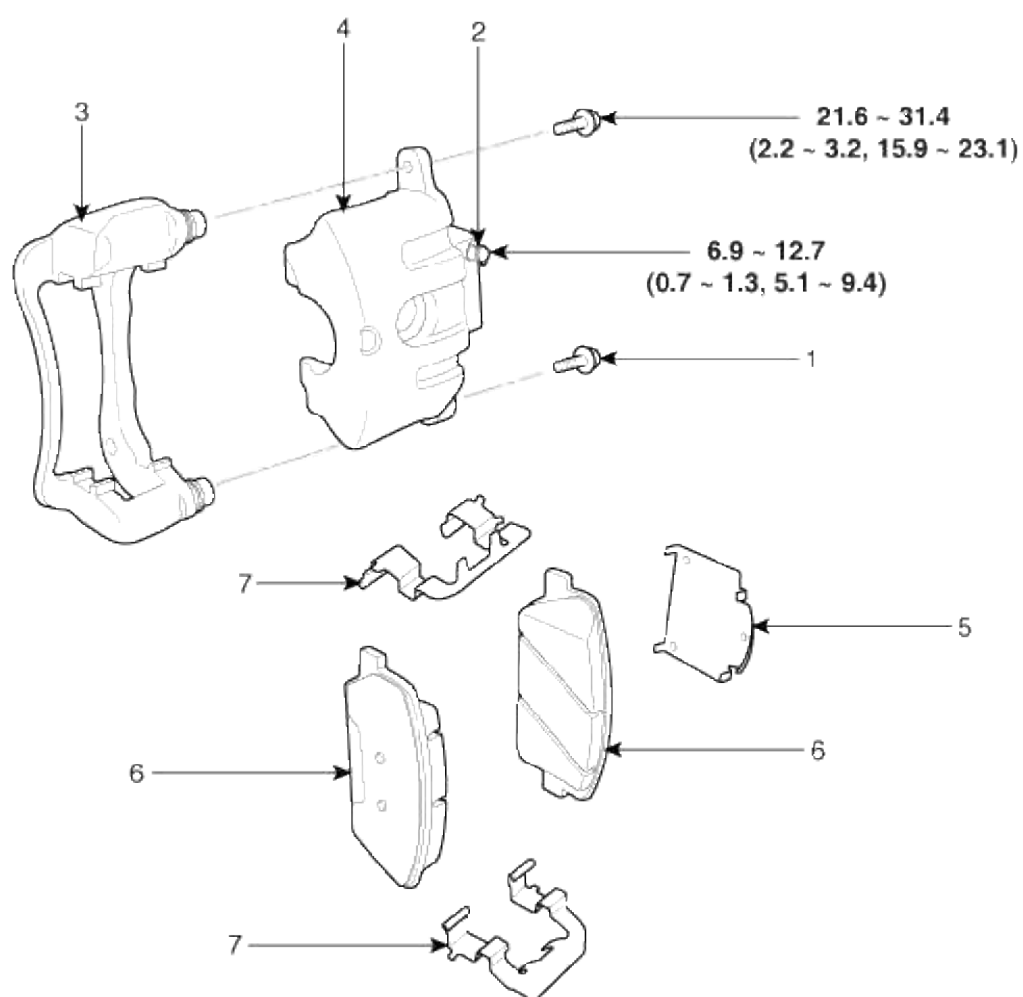
- Before installing the pin, apply the grease to the clevis pin.
- Use a new snap pin whenever installing.

2. Check the brake pedal operation.

**Brake System > Brake System > Front Disc Brake > Components and Components Location**

#### Components (1)

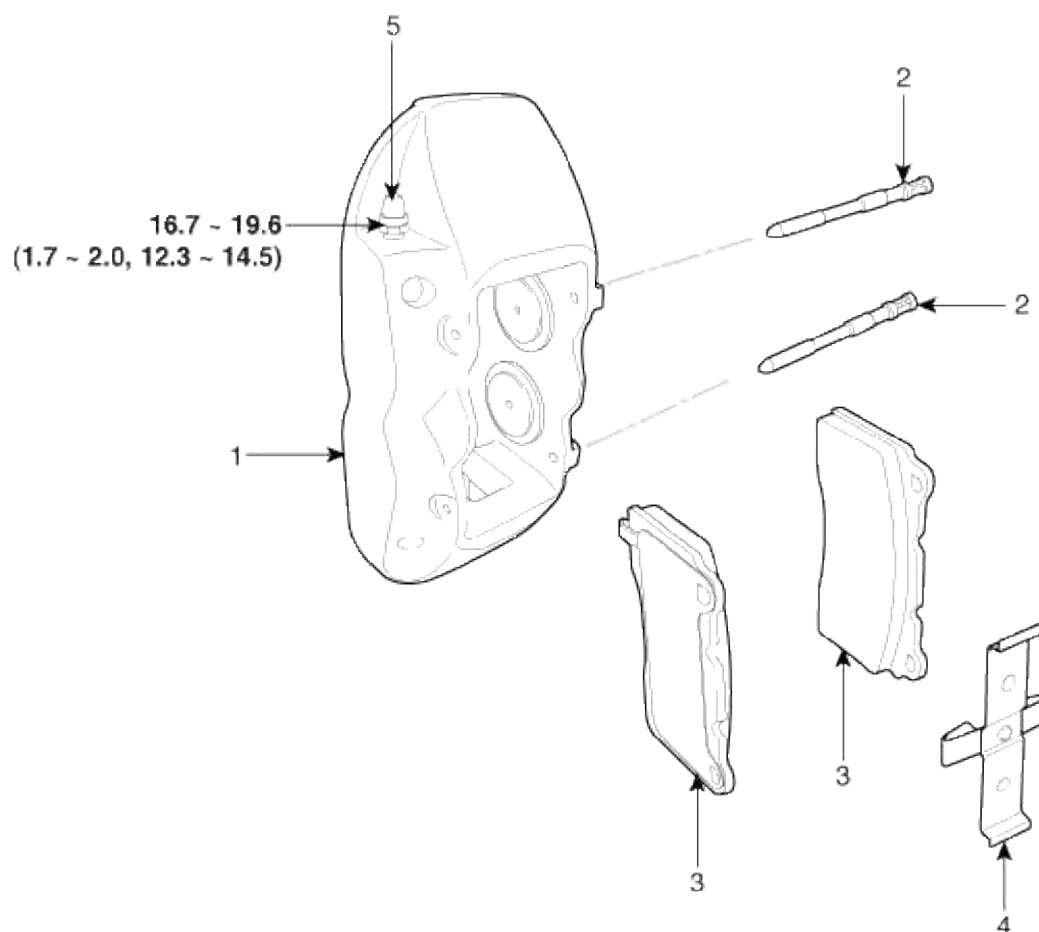




**Torque : N.m (kgf.m, lb-ft)**

1. Guide rod bolt	5. Inner pad shim
2. Bleed screw	6. Brake pad
3. Caliper bracket	7. Pad retainer
4. Caliper body	

Components (2)



**Torque : N.m (kgf.m, lb-ft)**

1. Caliper body	4. Retraction spring
2. Guide pin	5. Bleed screw
3. Brake pad	

### Brake System > Brake System > Front Disc Brake > Repair procedures

#### Removal

##### General caliper type

1. Remove the front wheel & tire.

#### Tightening torque :

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)

2. Loosen the hose eye-bolt (B) and caliper mounting bolts (C), then remove the front caliper assembly (A).

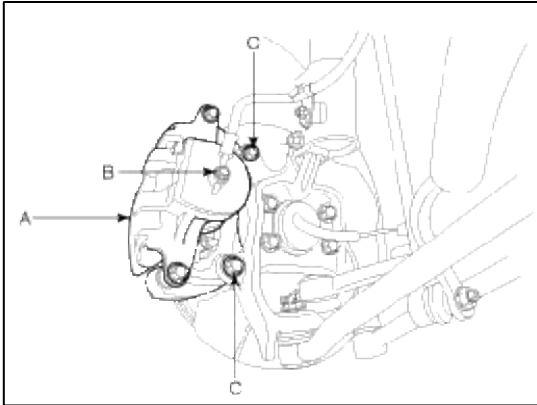
### Tightening torque

Brake hose to caliper (B):

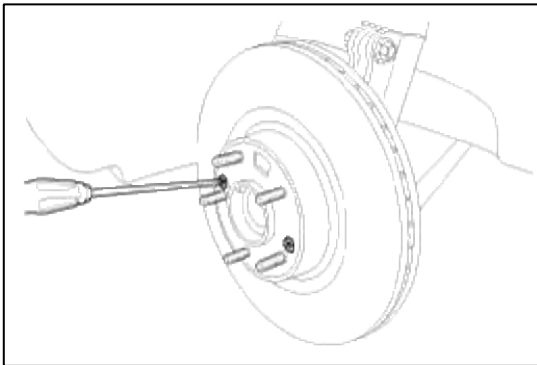
24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)

Caliper assembly to knuckle (C):

78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)



3. Remove the front brake disc by loosening the screws.



Brembo caliper type

1. Remove the front wheel & tire.

### Tightening torque :

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)

2. Loosen the hose eye-bolt (B) and caliper mounting bolts (C), then remove the front caliper assembly (A).

---

**Tightening torque**

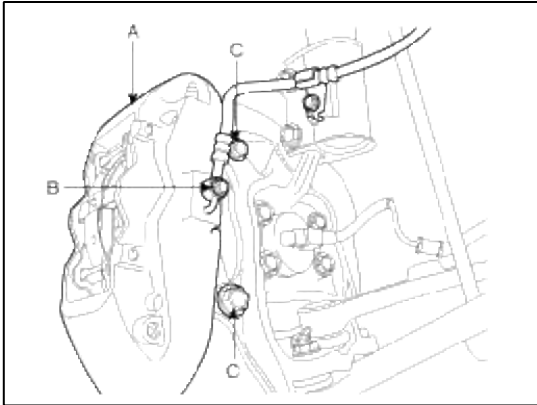
Brake hose to caliper (B):

24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)

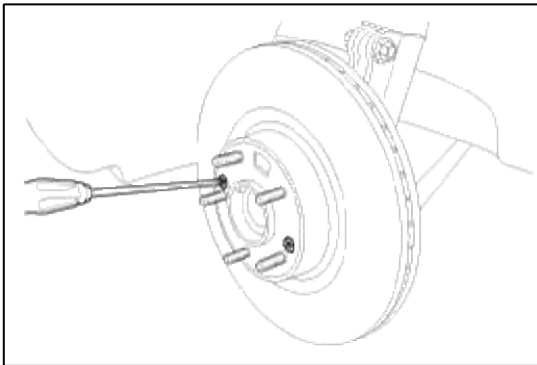
Caliper assembly to knuckle (C):

88.3 ~ 103.0 N.m (9.0 ~ 10.5 kgf.m, 65.1 ~ 75.9 lb-ft)

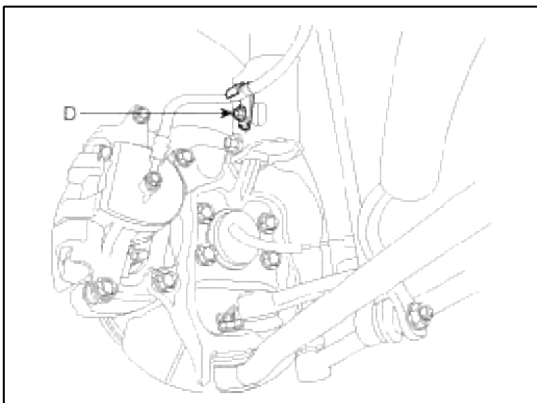
---



3. Remove the front brake disc by loosening the screws.

**Replacement****Front Brake Pads (General caliper type)**

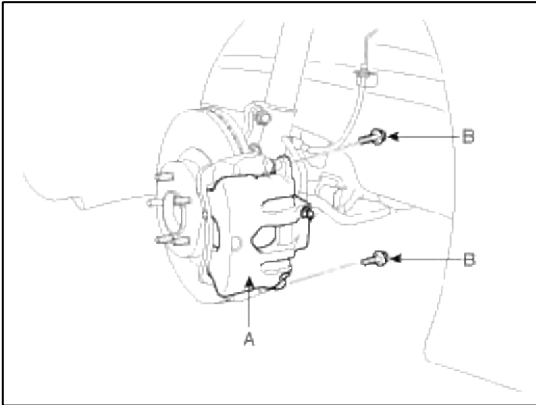
1. Remove the brake hose mounting bracket (knuckle mounting part : D).



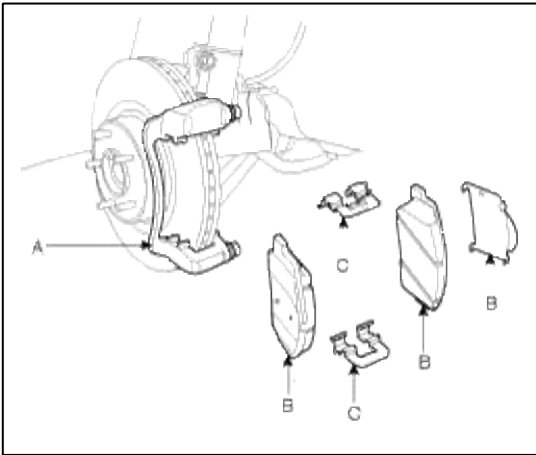
2. Loosen the guide rod bolt (B) and remove the caliper body (A).

**Tightening torque :**

21.6 ~ 31.4 N.m (2.2 ~ 3.2 kgf.m, 15.9 ~ 23.1 lb-ft)

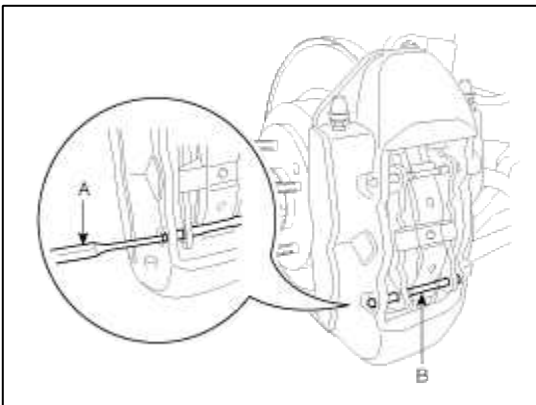


3. Replace pad shim (B), pad retainers (C) and brake pads (B) in the caliper bracket (A).

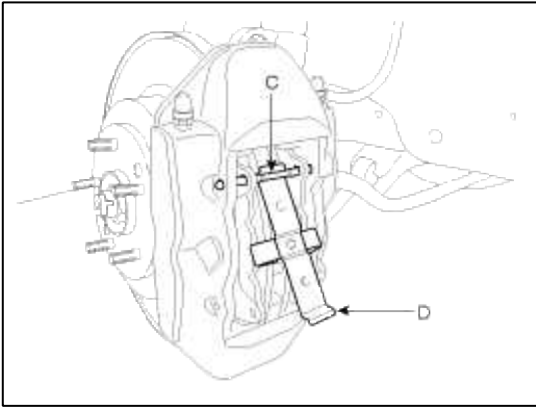


**Front Brake Pads (Brembo caliper type)**

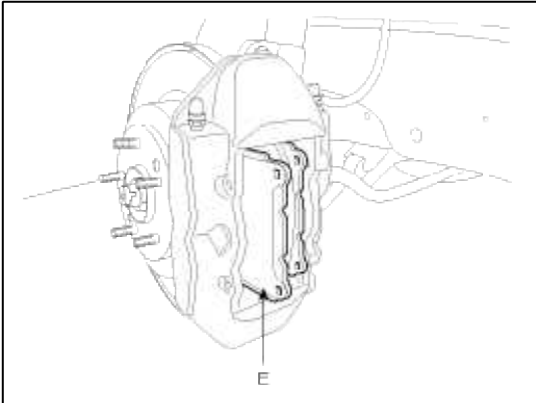
1. Remove the guide pin (B) of the lower part with the pin punch (A).



2. Remove the guide pin (C) of the upper part and retraction spring (D).



3. Replace brake pads (E) at the caliper body.



## Inspection

### Front Brake Disc Thickness Check

1. Check the brake pads for wear and fade.
2. Check the brake disc for damage and cracks.
3. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

---

### Brake disc thickness

#### General caliper type

Standard: 28mm (1.10in)

Service limit: 26.4mm (1.04in)

Deviation: Less than 0.005mm (0.0002in) - circumference

Less than 0.01mm (0.0004in) - radius

#### Brembo caliper type

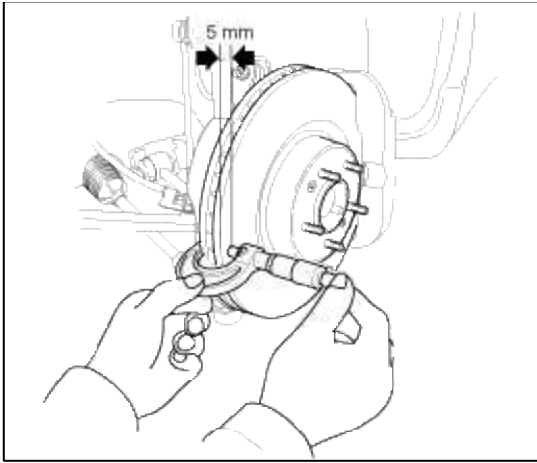
Standard: 28mm (1.10in)

Service limit: 26mm (1.02in)

Deviation: Less than 0.01mm (0.0004in) - circumference

Less than 0.04mm (0.0016in) - radius

---



4. If wear exceeds the limit, replace the discs and pad assembly left and right 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**

General caliper type

Standard value : 11mm (0.43in)

Service limit : 2.0mm (0.0787in)

Brembo caliper type

Standard value : 8.5mm (0.33in)

Service limit : 2.0mm (0.0787in)

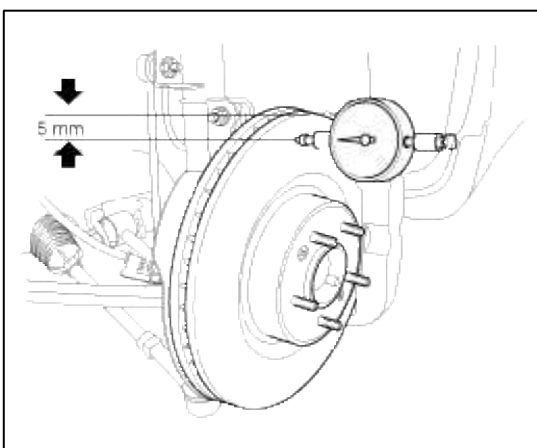
2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

#### Front Brake Disc Runout Check

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

##### **Brake disc runout**

Limit : 0.035mm (0.00137in.) or less (new one)



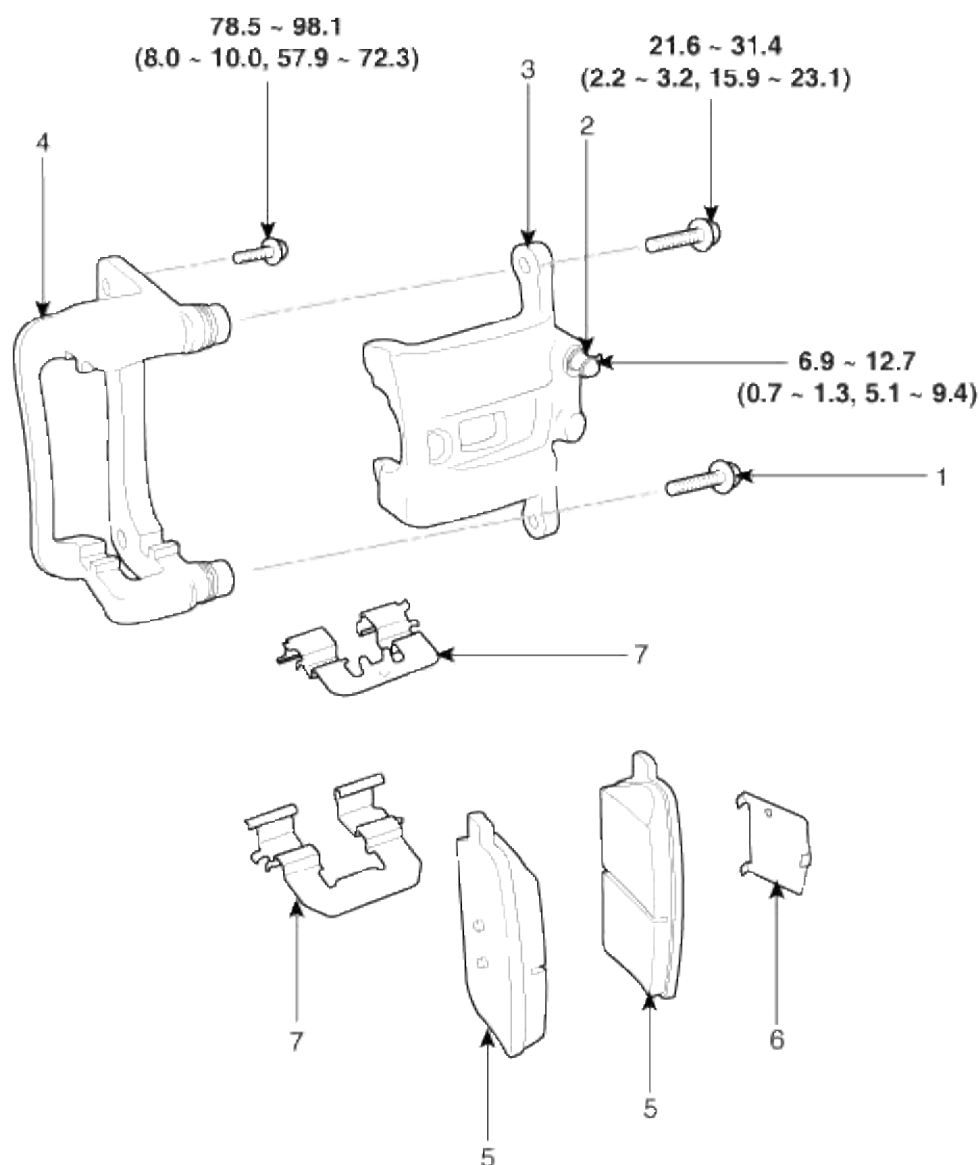
2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
3. If the run out does not exceed the limit specification, install the brake disc after turning it and then check the run out of the brake disc again.
4. If the run out cannot be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

#### Installation

1. Installation is the reverse of removal.
2. Use a SST (09581-11000) when installing the brake caliper assembly.
3. After installation, bleed the brake system.  
(Refer to Brake system bleeding)

## Brake System > Brake System > Rear Disc Brake > Components and Components Location

### Components (1)

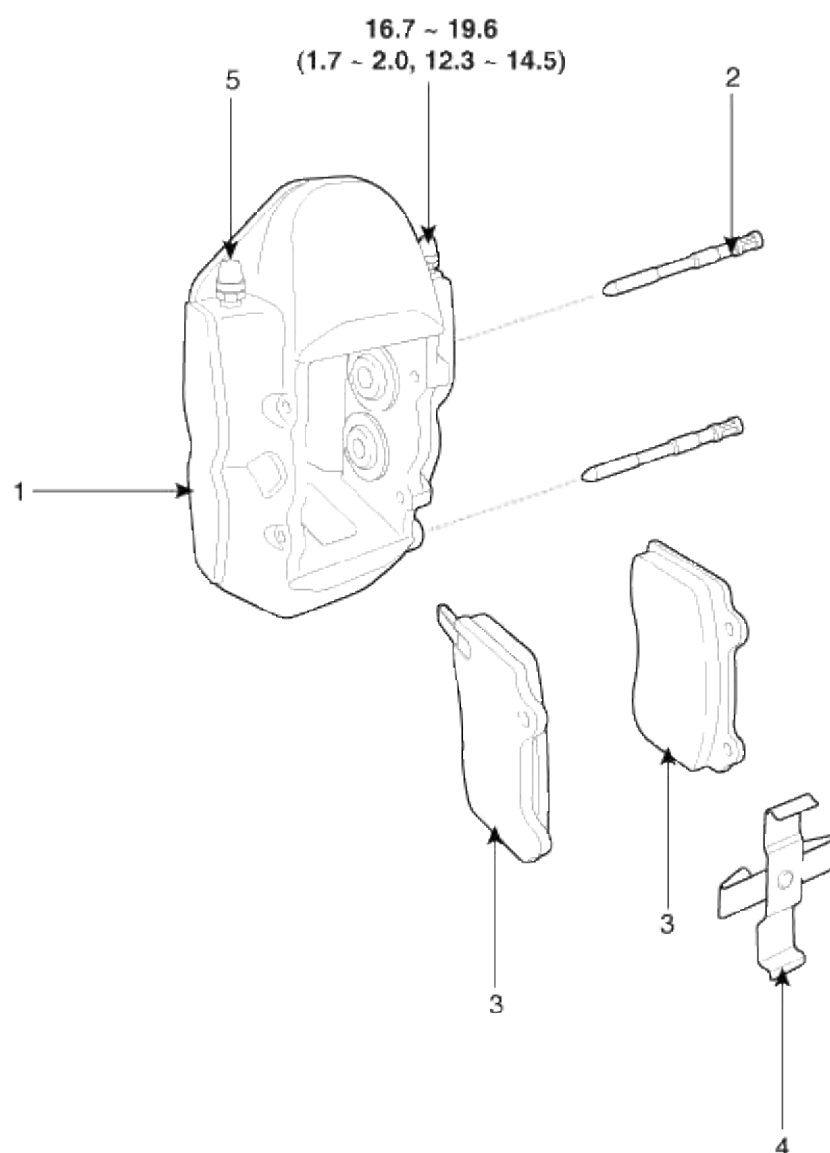


**Torque : N.m (kgf.m, lb-ft)**

1. Guide rod bolt	5. Inner pad shim
2. Bleed screw	6. Brake pad
3. Caliper body	7. Pad retainer
4. Caliper bracket	



## Components (2)



**Torque : N.m (kgf.m, lb-ft)**

1. Caliper body	4. Retraction spring
2. Guide pin	5. Bleed screw
3. Brake pad	

### Brake System > Brake System > Rear Disc Brake > Repair procedures

#### Removal

#### General caliper type

1. Remove the rear wheel & tire.

---

**Tightening torque :**

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)

---

2. Loosen the hose eye-bolt (B) and caliper mounting bolts (C), then remove the rear caliper assembly (A).

---

**Tightening torque**

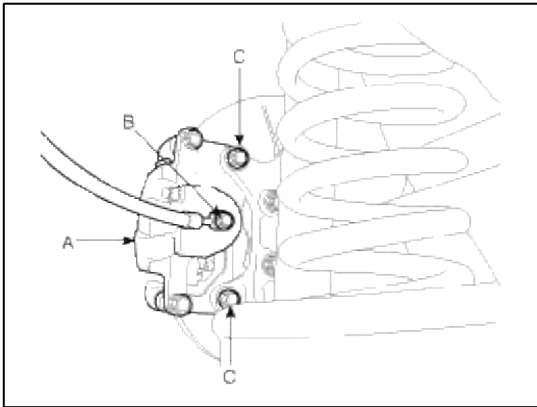
Brake hose to caliper (B):

24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)

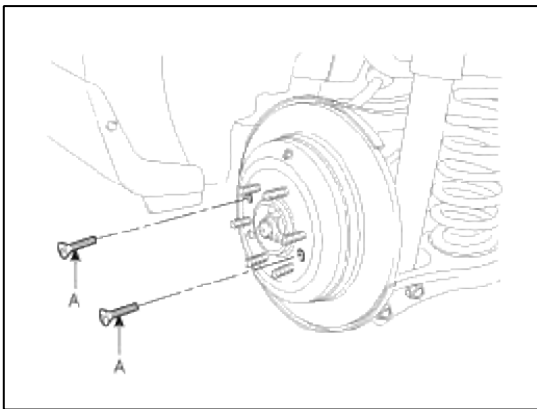
Caliper assembly to carrier (C):

78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)

---



3. Remove the rear brake disc by loosening the screws (A).



Brembo caliper type

1. Remove the rear wheel & tire.

---

**Tightening torque :**

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)

---

- Loosen the hose eye-bolt (B) and caliper mounting bolts (C), then remove the rear caliper assembly (A).

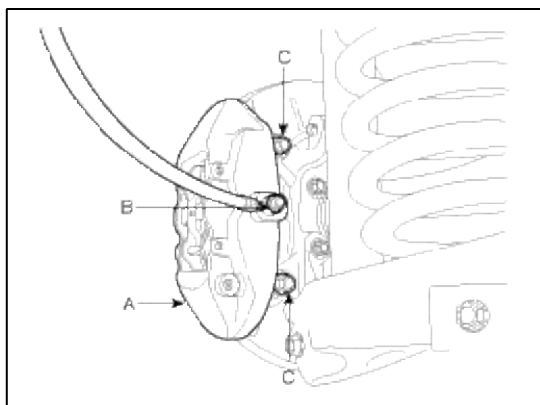
### Tightening torque

Brake hose to caliper (B):

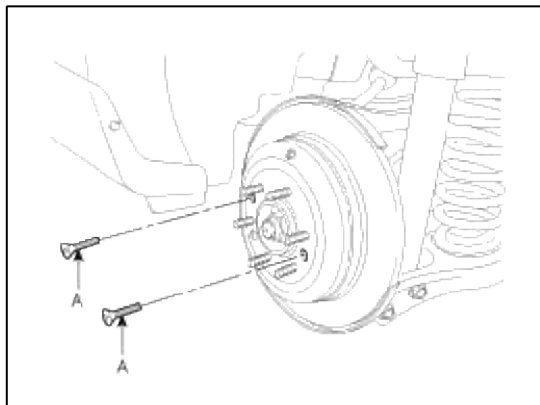
24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)

Caliper assembly to carrier (C):

78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)



- Remove the rear brake disc by loosening the screws (A).



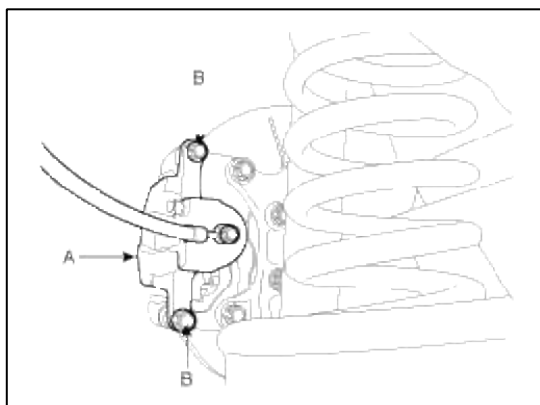
### Replacement

#### Rear Brake Pads (General caliper type)

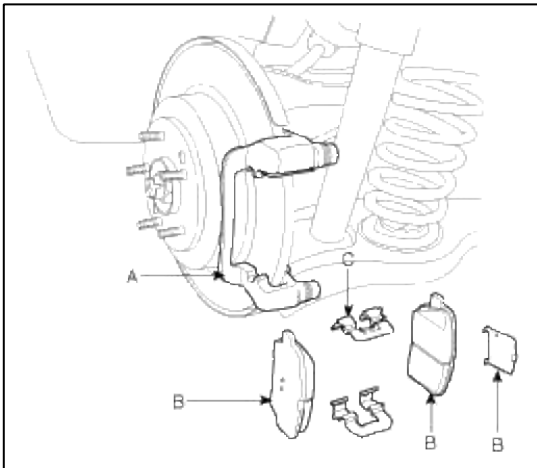
- Loosen the guide rod bolt (B) and remove the caliper body (A).

### Tightening torque :

21.6 ~ 31.4 N.m (2.2 ~ 3.2 kgf.m, 15.9 ~ 23.1 lb-ft)



2. Replace pad shim, pad retainers (C) and brake pads (B) in the caliper bracket (A).

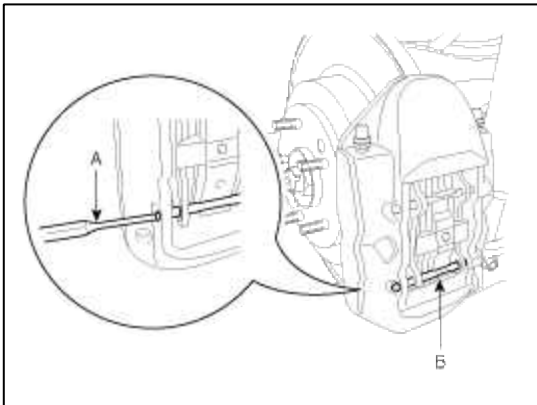


#### Rear Brake Pads (Brembo caliper type)

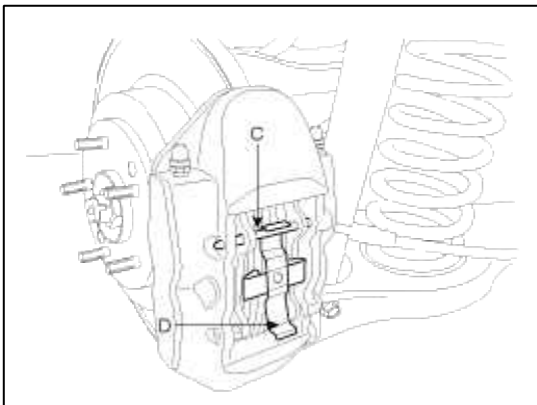
1. Remove the guide pin (B) of the lower part with the pin punch (A).

#### Tightening torque :

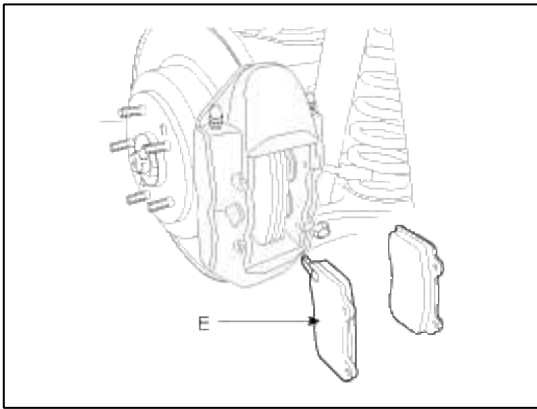
21.6 ~ 31.4 N.m (2.2 ~ 3.2 kgf.m, 15.9 ~ 23.1 lb-ft)



2. Remove the guide pin (C) of the upper part and the retraction spring (D).



### 3. Replace brake pads (E) at the caliper body.



### Inspection

#### Rear Brake Disc Thickness Check

1. Check the brake pads for wear and fade.
2. Check the brake disc for damage and cracks.
3. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

#### Brake disc thickness

General caliper type

Standard: 13mm (0.51in)

Service limit: 11.4mm (0.45in)

Deviation: Less than 0.005mm (0.0002in) - circumference

Less than 0.01mm (0.00039in) - radius

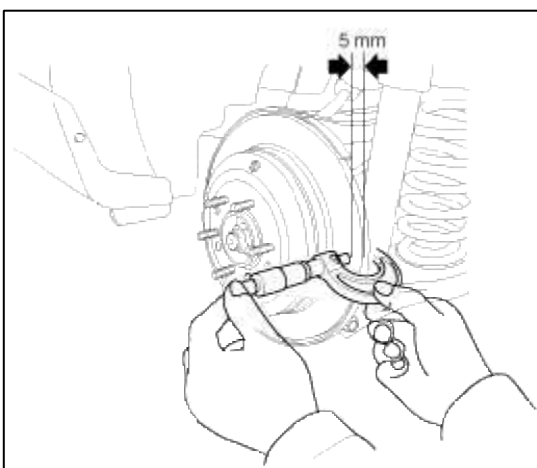
Brembo caliper type

Standard: 20mm (0.79in)

Service limit: 18mm (0.71in)

Deviation: Less than 0.01mm (0.0004in) - circumference

Less than 0.04mm (0.0016in) - radius



4. If wear exceeds the limit, replace the discs and pad assembly 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

General caliper type

Standard value: 9mm (0.354in)

Service limit : 2.0mm (0.0787in)

Brembo caliper type

Standard value : 9.1mm (0.358in)

Service limit : 2.0mm (0.0787in)

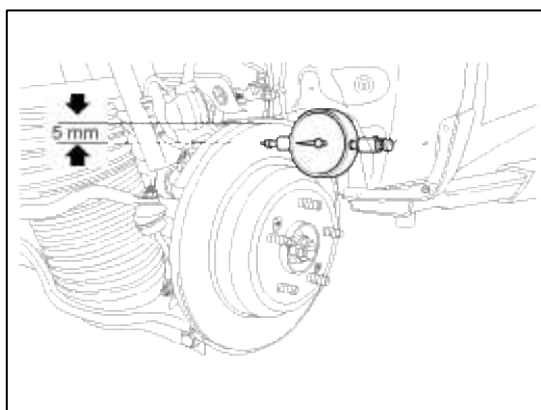
2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

### Rear Brake Disc Runout Check

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

### Brake disc runout

Limit: 0.035mm (0.00137in.) or less (new one)



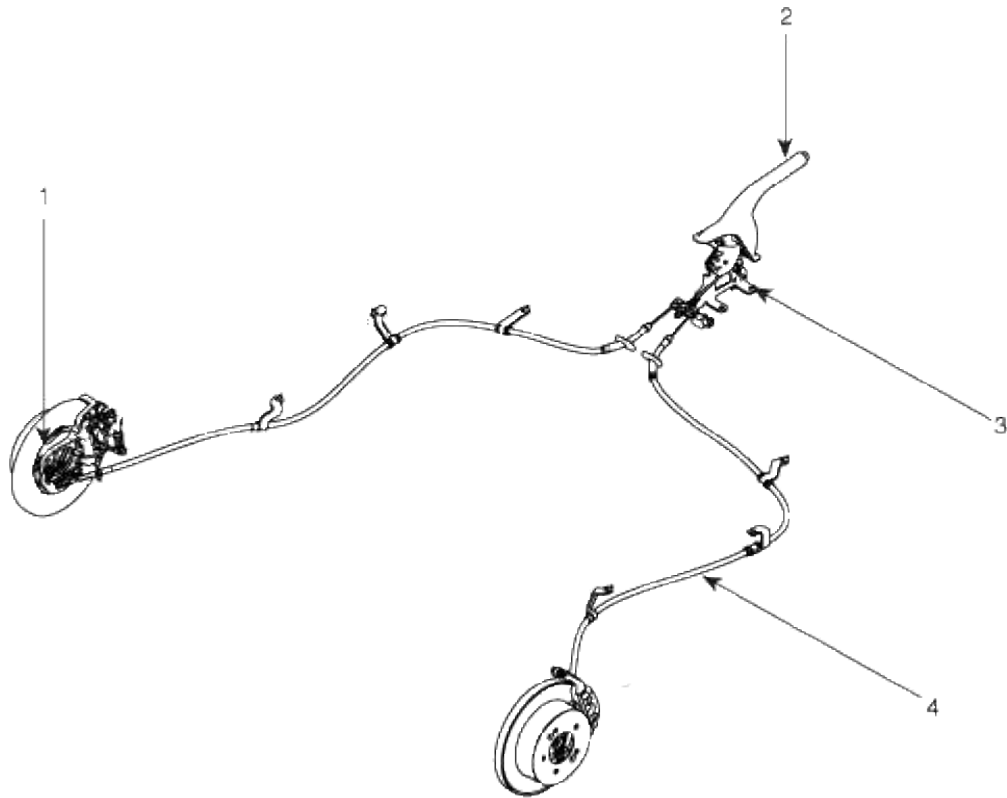
2. If the runout of the brake disc exceeds the limit specification, replace the disc, and then measure the runout again.
3. If the runout exceeds the limit specification, install the brake disc after turning it 180° and then check the runout of the brake disc again.
4. If the runout cannot be corrected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

### Installation

1. Installation is the reverse of removal.
2. Use a SST (09581-11000) when installing the brake caliper assembly.
3. After installation, bleed the brake system.  
(Refer to Brake system bleeding)

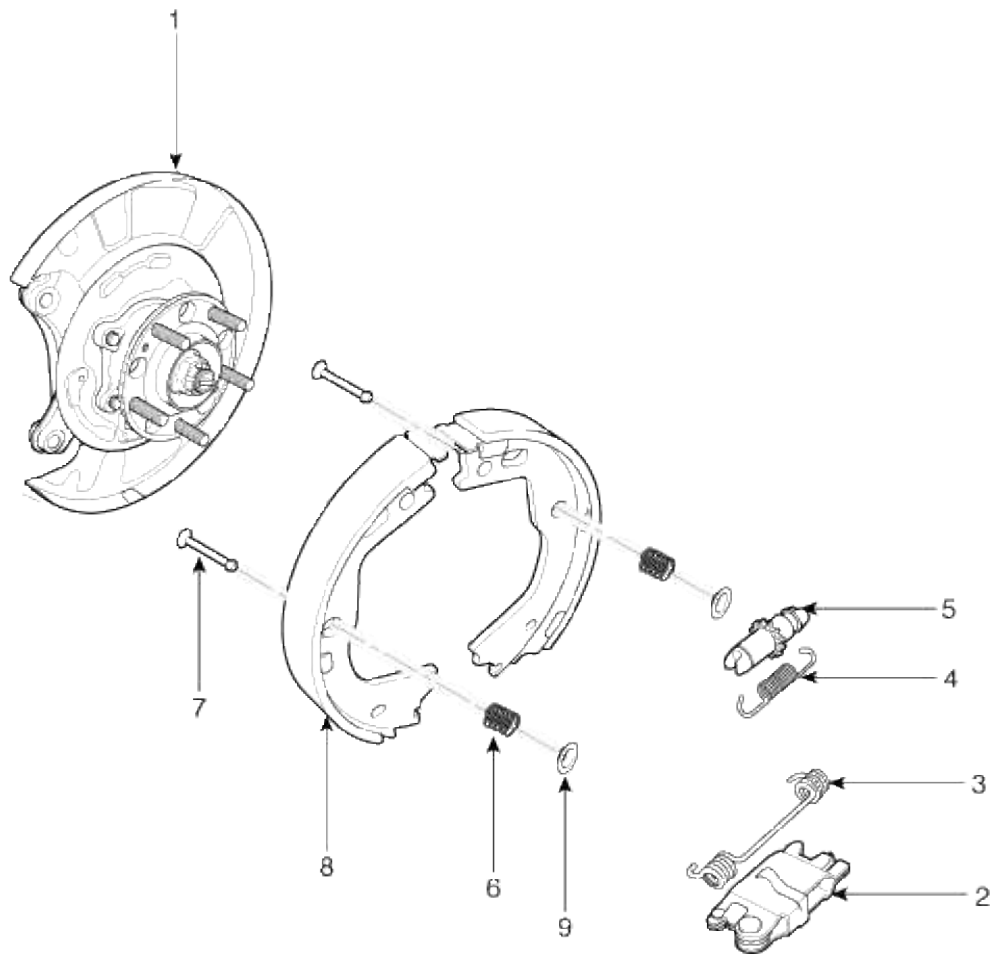
## Brake System > Parking Brake System > Parking Brake Assembly > Components and Components Location

### Components (1)



1. Rear parking brake	3. Parking brake switch
2. Parking brake lever	4. Parking brake cable

Components (2)



1. Backing plate	4. Lower spring	7. Shoe hold down pin
2. Operating lever	5. Adjuster	8. Parking brake shoe
3. Upper spring	6. Shoe hold down spring	9. Cup washer

### Brake System > Parking Brake System > Parking Brake Assembly > Repair procedures

#### Removal

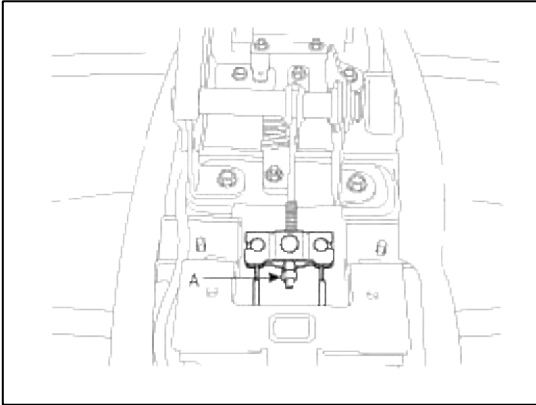
#### Parking Brake Lever

##### NOTE

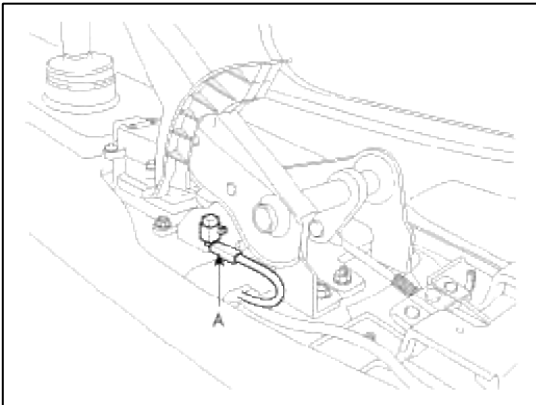
The parking brake cables must not be bent or distorted. This will lead to stiff operation and premature failure.



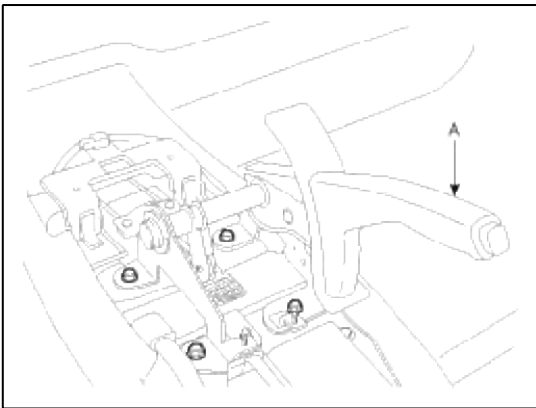
1. Remove the floor console.  
(Refer to Body group - "Floor console")
2. Loosen the adjusting nut (A) and the parking brake cables.



3. Disconnect the connector (A) of parking brake switch.



4. Remove the parking brake lever assembly (A) with loosening the bolts.



#### Parking Brake Shoe

1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel.
3. Remove the brake caliper and Rear disc brake.  
(Refer to "Rear disc brake removal")

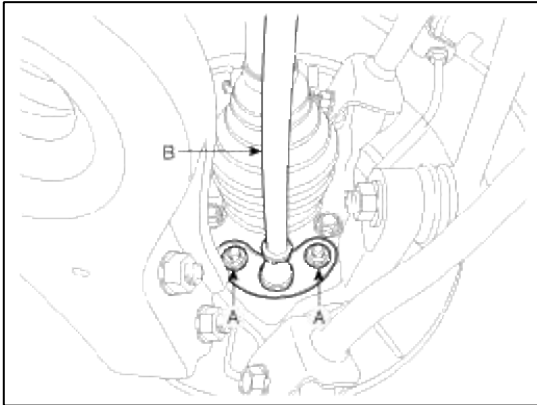
4. Remove the parking brake cable (B), after removing the bolt (A).

---

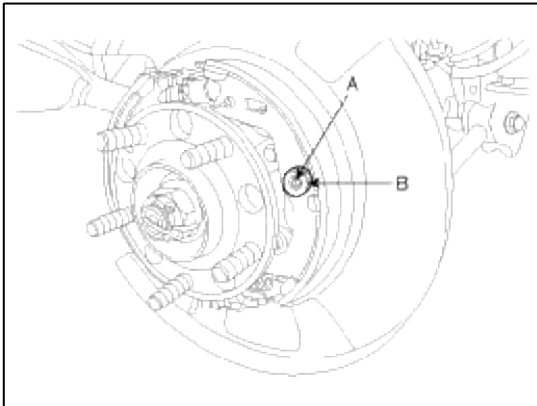
**Tightening torque :**

53.9 ~ 63.7 N.m (5.5 ~ 6.5 kgf.m, 39.8 ~ 47.0 lb-ft)

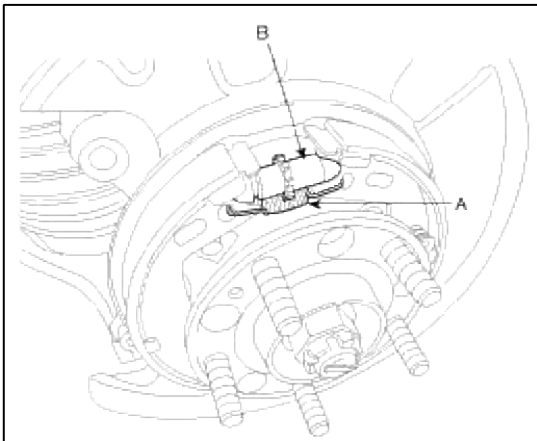
---



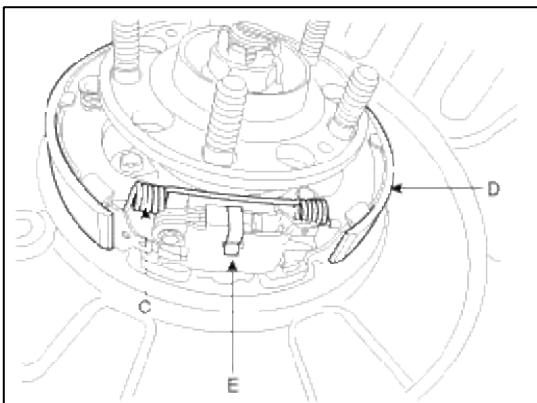
5. Remove the shoe hold down pin (A) and the spring (B) by pushing the retainer spring and turning the pin.



6. Remove the adjuster assembly (B) and the lower return spring (A).



7. Remove the upper return spring (C) and the brake shoes (D).

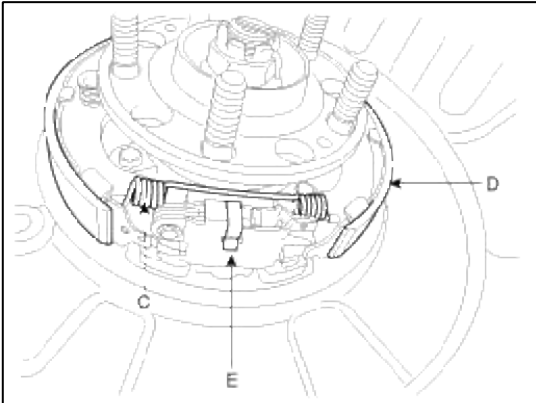


8. Remove the operating lever assembly (E).

## Installation

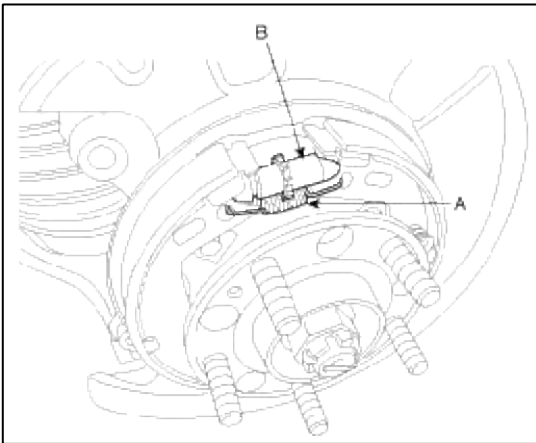
### Parking Brake Shoe

1. Install the operating lever assembly (E).

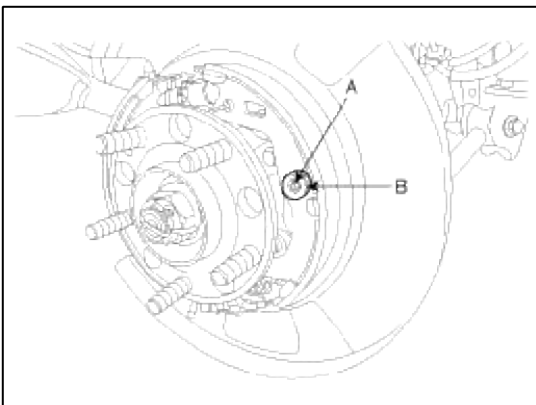


2. Install the upper return spring (C) and the brake shoes (D).

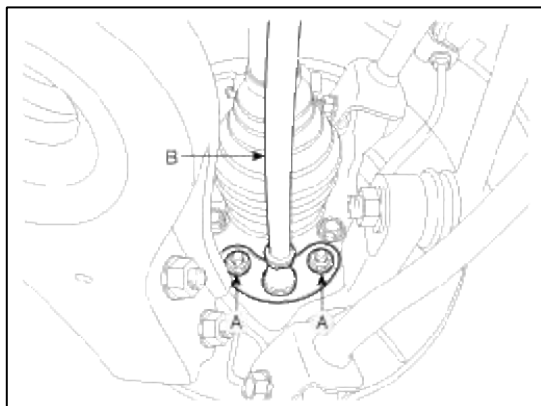
3. Install the adjuster assembly (B) and the lower return spring (A).



4. While pressing the spring, install the brake shoe hold down pin (A) and spring (B).



5. Install the parking brake cable (B), then install the bolt (A).



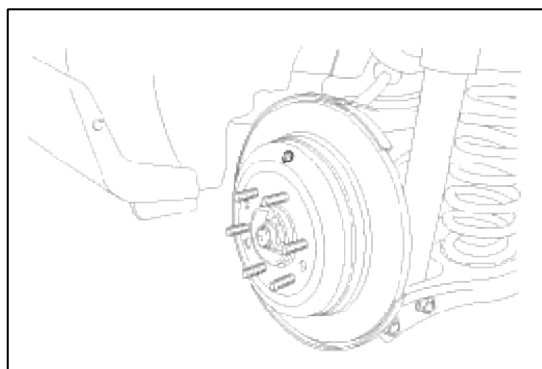
#### NOTE

How to install the DIH cable (Quick Fit type)

1. Put the inner cable into the knuckle hole in DIH lever operating direction when installing the cable (B).
2. Confirm by pulling the cable that cable is fixed certainly before installing the bolt (A).

6. Install the rear brake disc, then adjust the rear brake shoe clearance.

- (1) Remove the plug from the disc.



- (2) Rotate the toothed wheel of adjuster by a screw driver until the disc is not moving, and then return it by 5 notches in the opposite direction.

- (3) Install the plug.

7. Install the brake caliper assembly. (Refer to "Rear brake installation")

8. Install the tire and wheel.

9. If the parking brake shoe or the brake disc are replaced a newly one, perform the brake shoe bed-in procedure.

- (1) While operating the parking brake pedal for 69N (7kgf, 15lbf) effort, drive the vehicle 500 meters (0.31 miles) at the speed of 60kph (37.3 mph).
- (2) Repeat the above procedure more than two times.
- (3) Must be held on at 30% uphill.

#### CAUTION

After adjusting parking brake, notice following matter;

1. Must be free from troubles when the parking pedal is operated at 686 N (70 kgf, 154 lb).
2. Check that all parts move smoothly.
3. The parking brake indicator lamp must be on after the parking pedal is worked and must be off after the pedal is released.

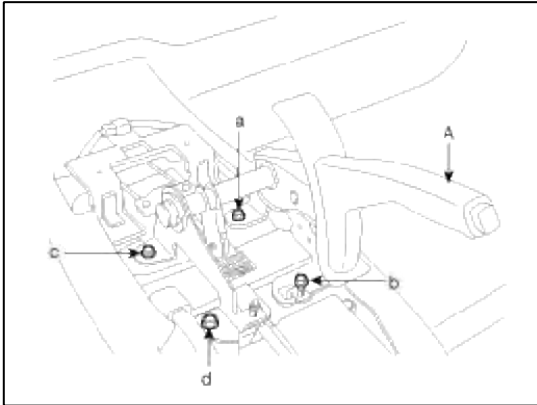
1. Install the parking brake lever assembly, then tighten the mounting bolts in alphabetic order.

---

**Tightening torque :**

8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)

---



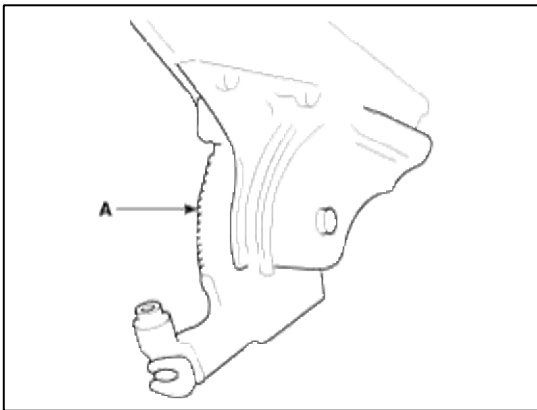
2. Apply a coating of the specified grease to each sliding parts (A) of the ratchet plate or the ratchet pawl.

---

**Specified grease :**

Multi purpose grease RheoGel 429 (MS511-54, LT2)

---



3. Install the parking brake cable adjuster, then adjust the parking brake lever stroke by turning adjusting nut (A).

---

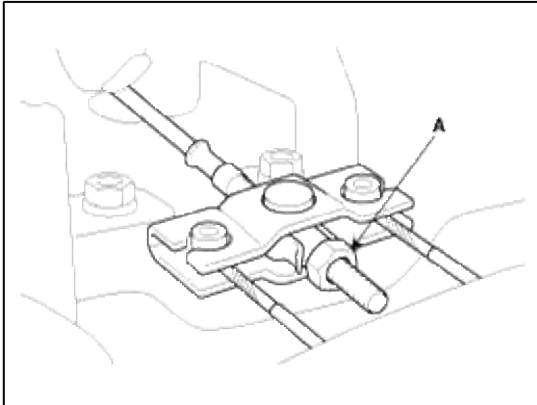
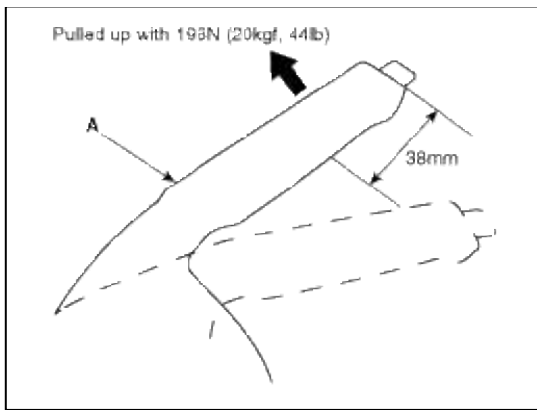
**Parking brake lever stroke :**

5 clicks (Pull the lever with 20kg)

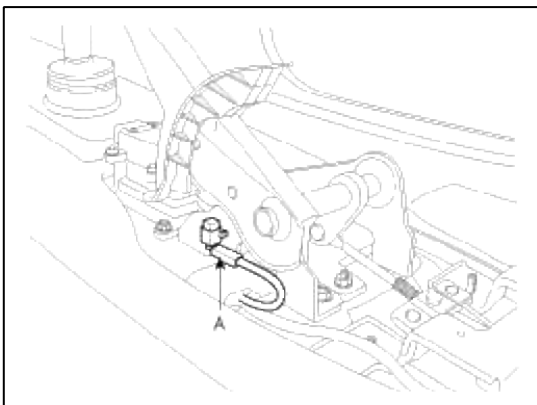
---

**NOTE**

After repairing the parking brake shoe, adjust the brake shoe clearance, and then adjust the parking brake lever stroke. (Refer to "Parking brake shoe installation")



4. Release the parking brake lever fully, and check that parking brakes do not drag when the rear wheels are turned. Readjust if necessary.
5. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up fully.
6. Reconnect the connector (A) of parking brake switch.



#### NOTE

Inspect the continuity of parking brake switch.

When the brake lever is pulled : continuity

When the brake lever is released : no continuity

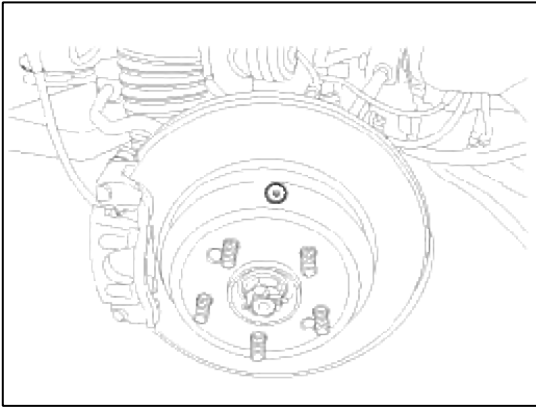
7. Install the floor console.  
(Refer to Body group - "Floor console")

#### Adjustment

##### Parking Brake Shoe Clearance Adjustment

1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel.

3. Remove the plug from the disc.



4. Rotate the toothed wheel of adjuster by a screw driver until the disc is not moving, and then return it by 5 notches in the opposite direction.
5. Install the plug on disc and then rear wheel & tire.

#### Parking Brake Lever Stroke Adjustment

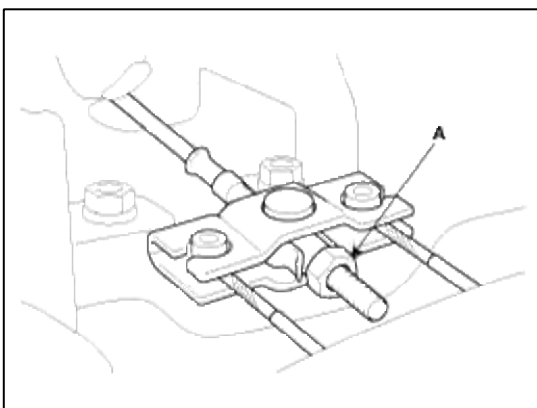
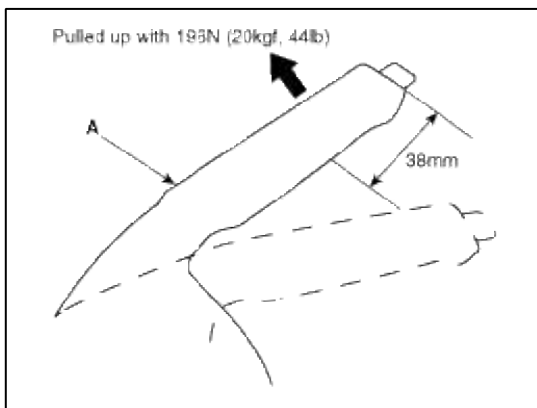
1. Raise the vehicle, and make sure it is securely supported.
2. Remove the floor console.  
(Refer to Body group - "Floor console")
3. Adjust the parking brake lever stroke by turning adjusting nut (A).

#### Parking brake lever stroke :

5 clicks (Pull the lever with 20kg)

#### NOTE

After repairing the parking brake shoe, adjust the brake shoe clearance, and then adjust the parking brake lever stroke. (Refer to "Parking brake shoe installation")

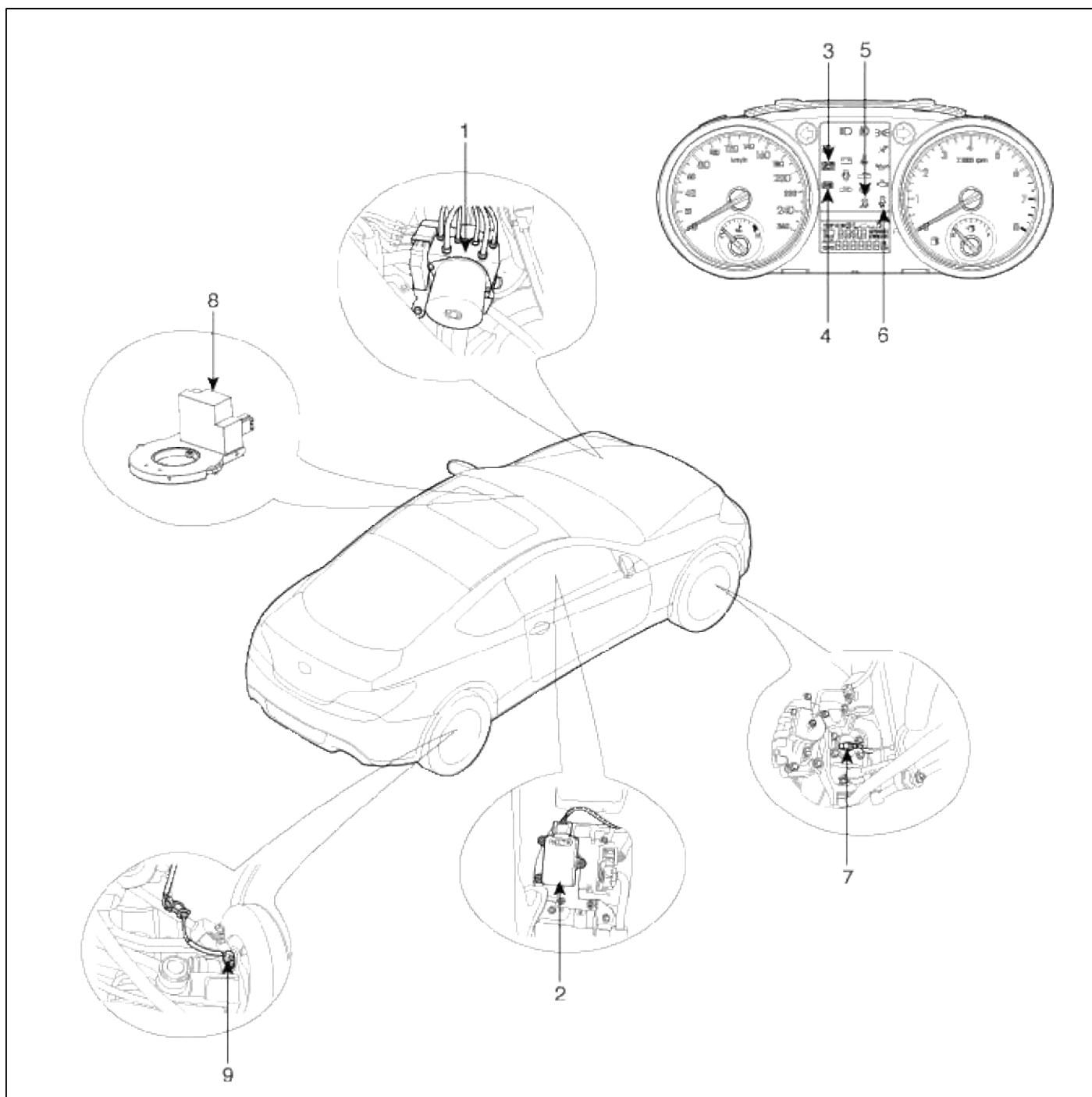


4. Release the parking brake lever fully, and check that parking brakes do not drag when the rear wheels are turned. Readjust if necessary.

5. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up fully.
6. Install the floor console.  
(Refer to Body group - "Floor console")

## Brake System > ESC(Electronic Stability Control) System > Components and Components Location

### Components



- |                                   |                             |
|-----------------------------------|-----------------------------|
| 1. HECU module                    | 6. ESC OFF warning lamp     |
| 2. Yaw rate & Lateral G sensor    | 7. Front wheel speed sensor |
| 3. Parking brake/EBD warning lamp | 8. Steering angle sensor    |
| 4. ABS warning lamp               | 9. Rear wheel speed sensor  |
| 5. ESC function / warning lamp    |                             |



## Brake System > ESC(Electronic Stability Control) System > Description and Operation

### Description of ESC

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

ESC recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention.

ESC adds a further function known as AYC(Active Yaw Control) to the ABS, TCS, EBD and EDC functions.

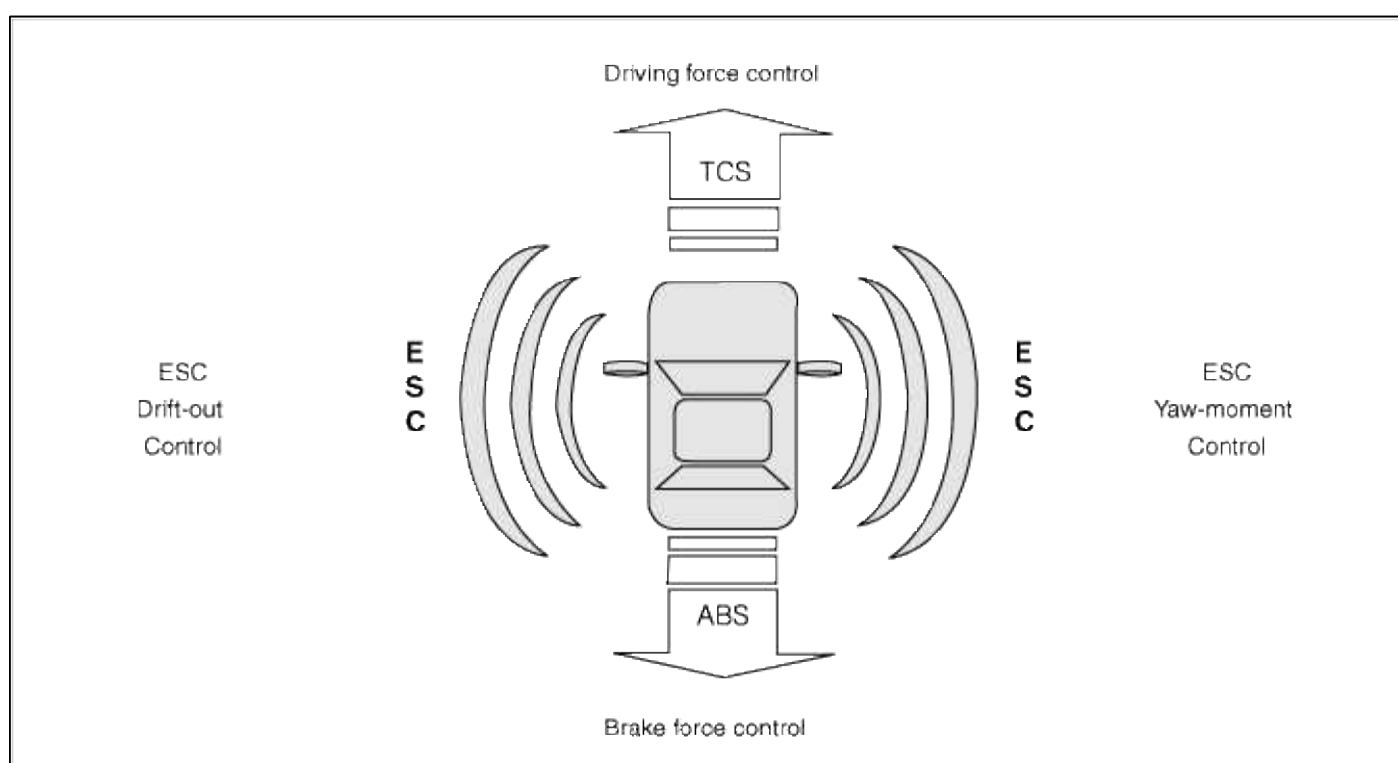
Whereas the ABS/TCS function controls wheel slip during braking and acceleration and, thus, mainly intervenes in the longitudinal dynamics of the vehicle, active yaw control stabilizes the vehicle about its vertical axis.

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.

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 ESC 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 ESC control

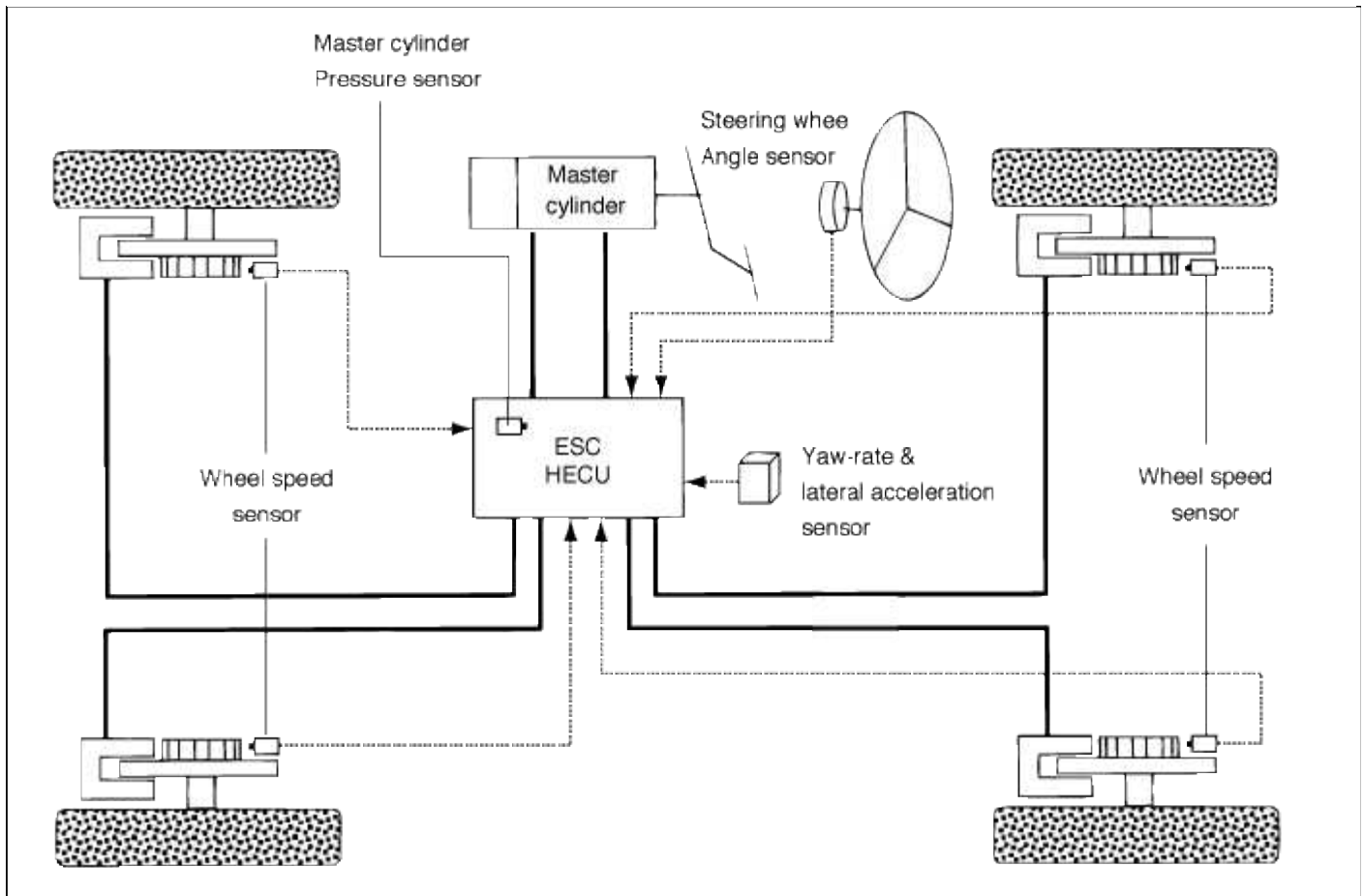
ESC system includes ABS/EBD, TCS and AYC function.

**ABS/EBD function :** The ECU changes the active sensor signal (current shift) coming from the four wheel sensors to the square wave. 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.

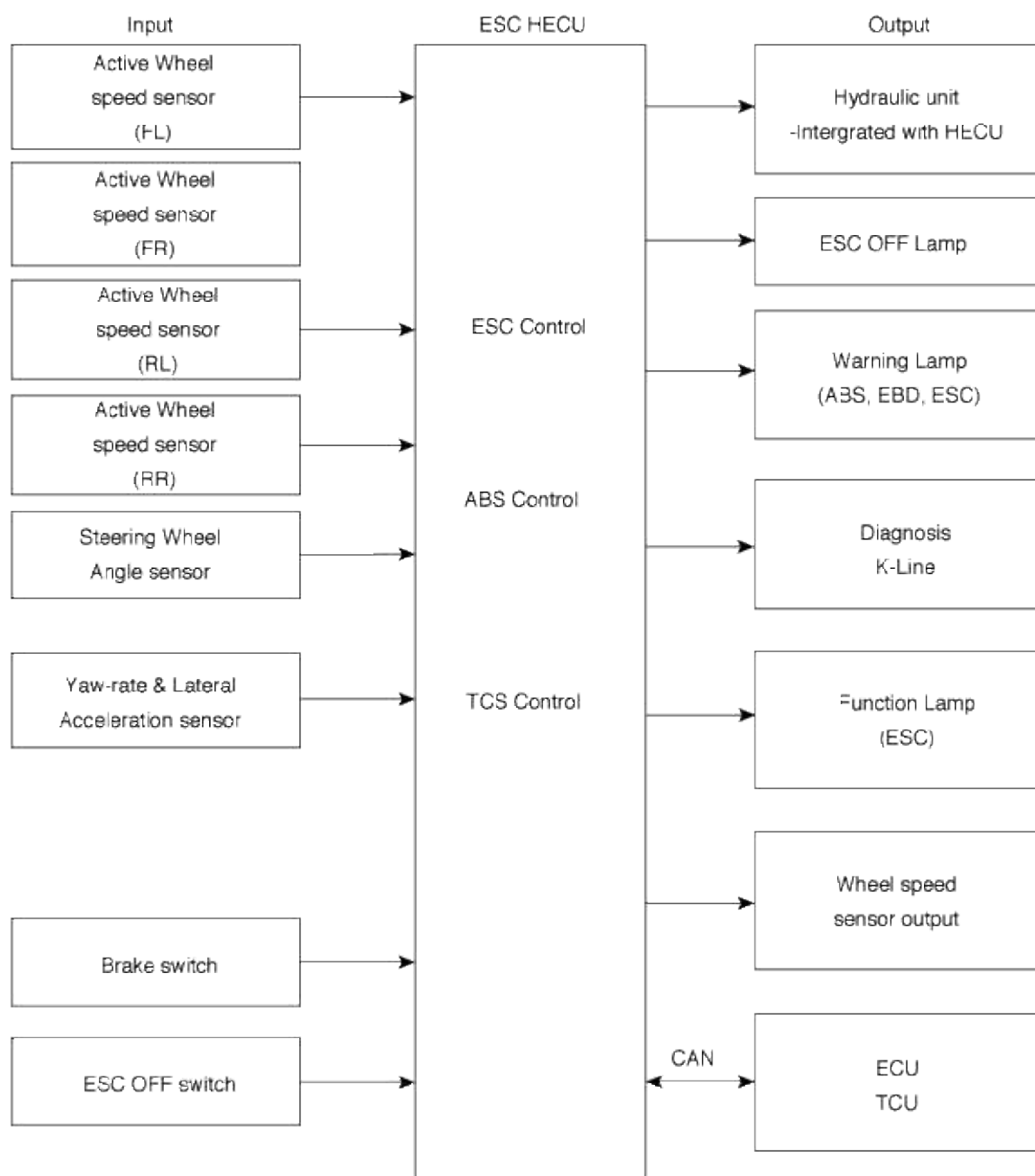
**TCS function** prevents the wheel slip of drive direction by adding the brake pressure and engine torque reduction via CAN communication. TCS function uses the wheel speed sensor signal to determine the wheel slip as far as ABS function.

**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/ESC warning lamp. (fail-safe warning)

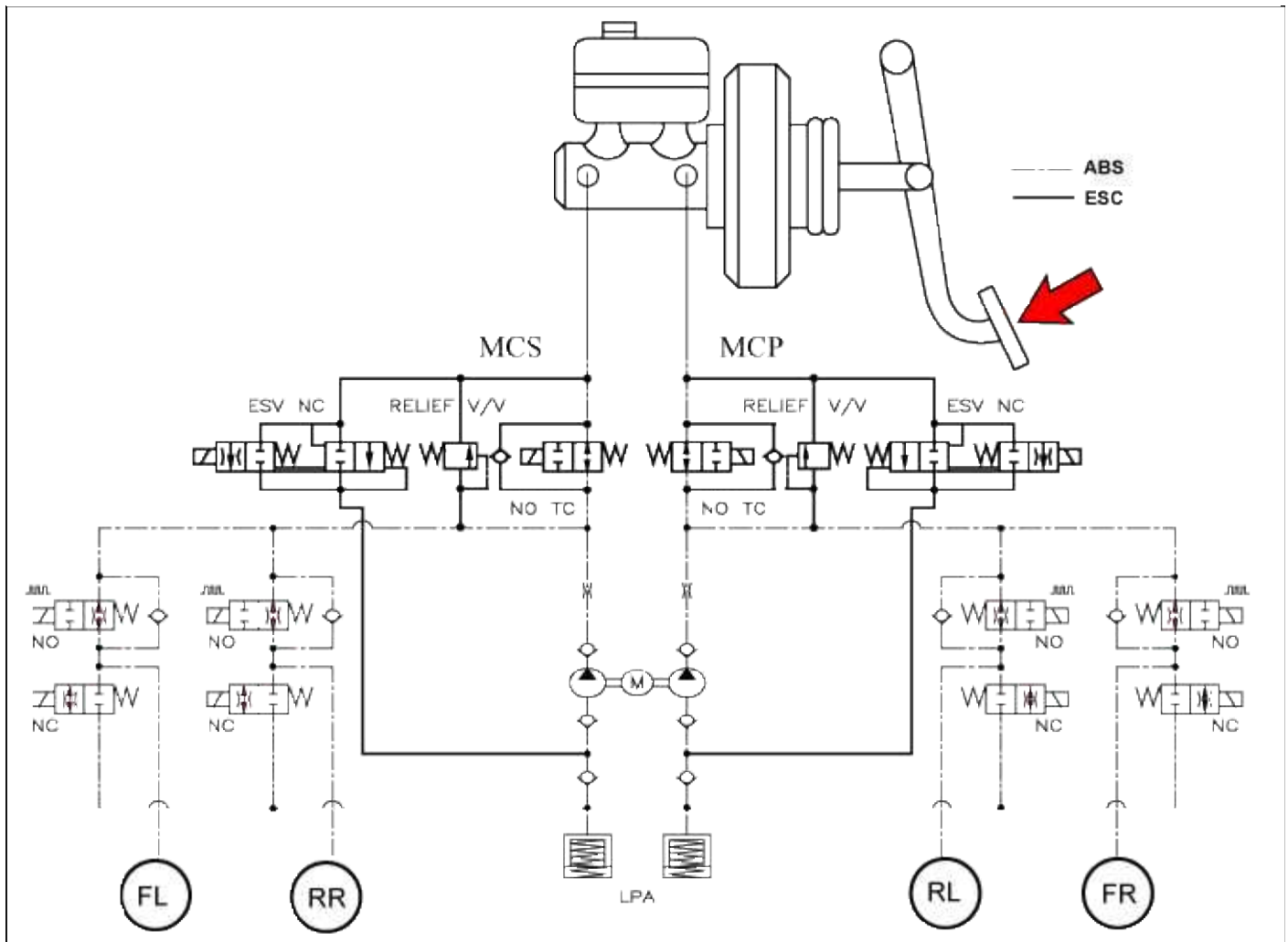


Input and output diagram



ESC Operation mode

## ESC Hydraulic system diagram

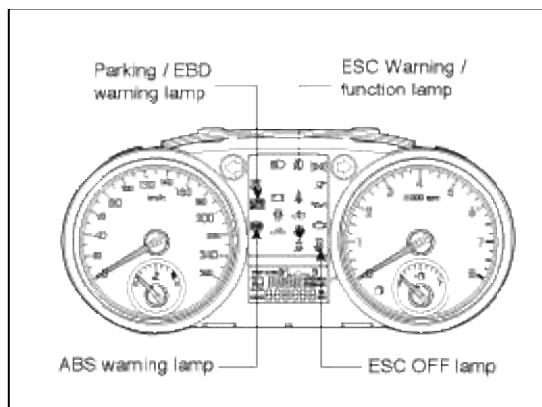


### 1. ESC Non-operation : Normal braking.

Solenoid valve	Continuity	Valve	Motor pump	TC Valve
IN (NO)	OFF	OPEN	OFF	OFF
OUT (NC)	OFF	CLOSE		

### 2. ESC operation

Solenoid valve		Continuity	Valve	Motor pump	TC Valve
Understeering (Only inside of rear wheel)	IN(NO)	OFF	OPEN	ON	ON
	OUT(NC)	OFF	CLOSE		
Oversteering (Only outside of front wheel)	IN(NO)	OFF	OPEN		
	OUT(NC)	OFF	CLOSE		



#### 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.

#### ESC Warning lamp (ESC system)

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

The ESC 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 ESC functions by failure.
- When driver turn off the ESC function by on/off switch.
- During diagnostic mode.

#### ESC Function lamp (ESC system)

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

The ESC Function lamp operates under the following conditions :

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

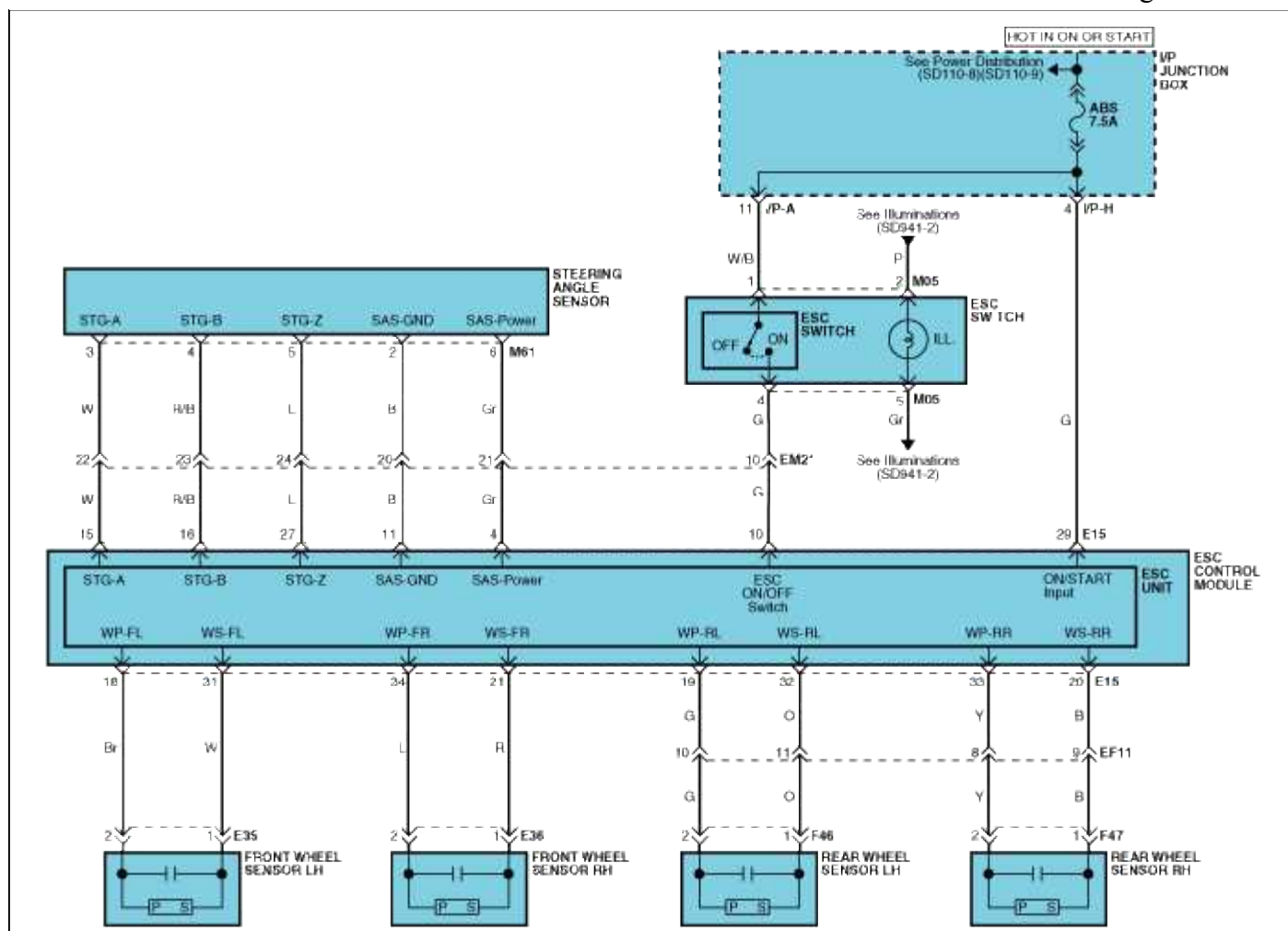
#### ESC On/Off switch (ESC system)

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

The On/Off switch shall be a normally open, momentary contact switch. Closed contacts switch the circuit to ignition. Initial status of the ESC function is on and switch toggle the state.

### Brake System > ESC(Electronic Stability Control) System > Schematic Diagrams

#### Circuit Diagram - ESC (1)



Circuit Diagram - ESC (2)



The diagram illustrates the seating arrangement in a 38-seat bus. The bus is oriented horizontally with the front on the left. There are two main rows of seats. The top row consists of 13 seats, numbered 12 through 1 from left to right, with seat 13 located at the front of this row. The bottom row consists of 25 seats, numbered 38 through 26 from left to right, with seat 38 at the front of this row. The bus features a front door on the left side and a rear door on the right side. There are also smaller side doors or exits at the front and rear of the bus.

Connector Terminal		Specification
No	Description	
29	IGNITION1(+)	High level of wake up voltage : $4.5V < V < 16.0V$ Low level of wake up voltage : $V < 2.4V$ Max. current : $I < 50mA$
25	POS. BATTERY 1.(SOLENOID)	Over voltage range : $17.0 \pm 0.5V$ Operating voltage range : $10.0 \pm 0.5V < V < 16.0 \pm 0.5V$ Low voltage range : $7.0 \pm 0.5V < V < 9.5 \pm 0.5V$ Max. current : $I < 40A$



		Max. leakage current : $I < 0.25\text{mA}$
1	POS. BATTERY 2.(MOTOR)	Operating voltage range: $10.0 \pm 0.5\text{V} < V < 16.0 \pm 0.5\text{V}$ Rush current : $I < 110\text{A}$ Max. current : $I < 40\text{A}$ Max. leakage current : $I < 0.25\text{mA}$
38	GROUND	Rated current : $I < 550\text{mA}$ Max. current: $I < 40\text{A}$
13	PUMP MOTOR GROUND	Rush current : $I < 110\text{A}$ Max. current : $I < 40\text{A}$
23	BRAKE LIGHT SWITCH	Input voltage (Low) : $V < 2\text{V}$
9	BRAKE SWITCH	Input voltage (High) : $V > 6\text{V}$ Max. Input current : $I < 3\text{mA}$
11	SENSOR GROUND	Rated current : $I < 250\text{mA}$
4	SENSOR POWER	Max. current Capability : $I < 250\text{mA}$ Max. voltage : $V_{\text{BAT1}} - 0.8\text{V}$
10	ESC ON/OFF SWITCH	Input voltage (Low) : $V < 2\text{V}$
22	PARKING BRAKE SWITCH	Input voltage (High) : $V > 6\text{V}$
37	VACCUM SWITCH	Max input current : $I < 5\text{mA}$ (@12.8V)
8	VACCUM PUMP DRIVE	Max. Input current : $200\text{mA}$ Max. output voltage (Low) : $V < 1.2\text{V}$
28	SENSOR FRONT RIGHT OUTPUT	External pull up resistance : $1\text{K}\Omega < R$
17	SENSOR REAR RIGHT OUTPUT	Output duty : $50 \pm 20\%$
14	CAN BUS LINE(LOW)	Max. Input current : $I < 10\text{mA}$
26	CAN BUS LINE(HIGH)	
18	SENSOR FRONT LEFT POWER	Output voltage : $V_{\text{BAT1}} - 0.6\text{V} \sim V_{\text{BAT1}} - 1.1\text{V}$ Output current : Max. $30\text{mA}$
34	SENSOR FRONT RIGHT POWER	
19	SENSOR REAR LEFT POWER	
33	SENSOR REAR RIGHT POWER	
31	SENSOR FRONT LEFT SIGNAL	Input current Low : $5.9 \sim 8.4\text{mA}$ Input current High : $11.8 \sim 16.8\text{mA}$ Frequency range : $1 \sim 2500\text{Hz}$ Input duty : $50 \pm 10\%$
21	SENSOR FRONT RIGHT SIGNAL	
32	SENSOR REAR LEFT SIGNAL	
20	SENSOR REAR RIGHT SIGNAL	
12	CAN SENSOR LINE (HIGH)	Max. input current : $I < 10\text{mA}$
24	CAN SENSOR LINE (LOW)	
15	STEERING ANGLE SENSOR PHASE A	Input duty (STG A, STG B) : $50 \pm 10\%$ phase Differenoe (STG A, STG B) $2 \pm 0.6\text{deg}$ High voltage : $3.0\text{V} < V_H < 4.1\text{V}$ Low voltage : $1.3\text{V} < V_L < 2.0\text{V}$
16	STEERING ANGLE SENSOR PHASE B	
27	STEERING ANGLE SENSOR PHASE Z	

## Brake System > ESC(Electronic Stability Control) System > Troubleshooting

### Failure Diagnosis

1. In principle, ESC and TCS controls are prohibited in case of ABS failure.
2. When ESC or TCS fails, only the failed system control is prohibited.
3. However, when the solenoid valve relay should be turned off in case of ESC failure, refer to the ABS fail-safe.
4. Information on ABS fail-safe is identical to the fail-safe in systems where ESC 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 far 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.

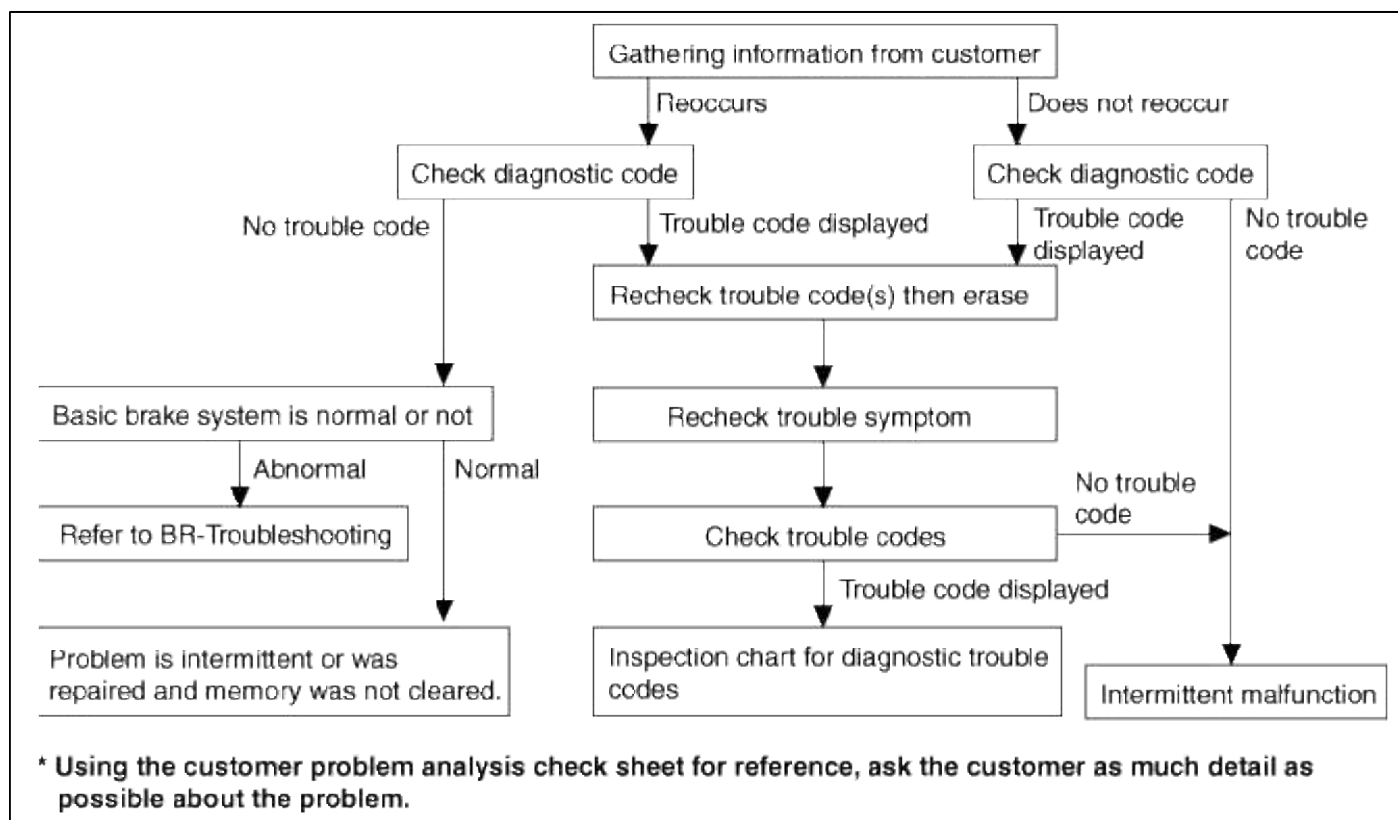
### Countermeasures In Fail

1. Turn the system down and perform the following actions and wait for HECU power OFF.
2. Turn the valve relay off.
3. Stop the control during the operation and do not execute any until the normal condition recovers.

### Warning Lamp ON

1. ESC operation lamp turn on for 3sec after IGN ON.
2. ESC operation lamp blinks when ESC Act.
3. ESC OFF lamp turn on in case of
  - A. ESC Switch OFF
  - B. ESC Failure Detect
  - C. 3sec after IGN ON

### Standard flow of diagnostic troubleshooting



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	<ol style="list-style-type: none"> <li>1. Sound of the motor inside the ABS hydraulic unit operation (whine).</li> <li>2. Sound is generated along with vibration of the brake pedal (scraping).</li> <li>3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release (Thump : suspension; squeak: tires)</li> </ol>
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.
<p>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.</p>	

## ABS Check sheet

## ABS Check Sheet

 Inspector's  
Name \_\_\_\_\_

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

<b>Date the Problem First Occurred</b>	/      /
<b>Frequency of Occurrence of Problem</b>	<input type="checkbox"/> Continuous <input type="checkbox"/> Intermittent (      times a day)

<b>Symptoms</b>	<input type="checkbox"/> ABS does not operate.		
	<input type="checkbox"/> ABS does not operate efficiently.		<input type="checkbox"/> Intermittent (      times a day)
	<b>ABS Warning Light Abnormal</b>	<input type="checkbox"/> Remains ON	<input type="checkbox"/> Does not light up

<b>Diagnostic Trouble Code Check</b>	<b>1st Time</b>	<input type="checkbox"/> Normal Code	<input type="checkbox"/> Malfunction Code (Code      )
	<b>2nd Time</b>	<input type="checkbox"/> Normal Code	<input type="checkbox"/> 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 normal code is output. 2. Wheel speed sensor circuit. 3. Stop lamp switch circuit. 4. Check the hydraulic circuit for leakage.
Communication with GDS is not possible. (Communication with any system is not possible)	1. Power source circuit 2. CAN line
Communication with GDS is not possible. (Communication with ABS only is not possible)	1. Power source circuit 2. CAN 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 ESC control module.	<ul style="list-style-type: none"> <li>- Faulty power source circuit</li> <li>- Faulty wheel speed sensor circuit</li> <li>- Faulty hydraulic circuit for leakage</li> <li>- Faulty HECU</li> </ul>

## Inspection procedures

**DTC Inspection**

1. Connect the GDS with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
3. Is the normal code output?

<b>NO</b>	Check the power source circuit.
<b>YES</b>	Erase the DTC and recheck using GDS.

## Check the power source circuit

1. Disconnect the connector from the ESC control module.
2. Turn the ignition switch ON, measure the voltage between terminal 29 of the ESC control module harness side connector and body ground.

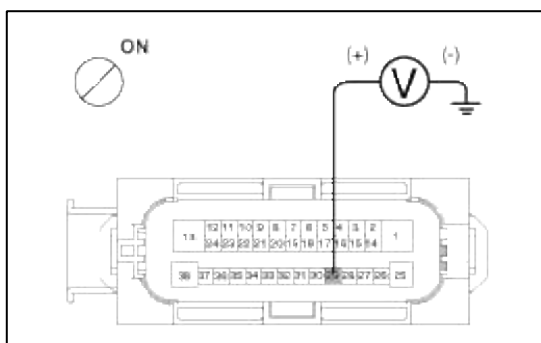
---

**Specification:** approximately B+

---

3. Is the voltage within specification?

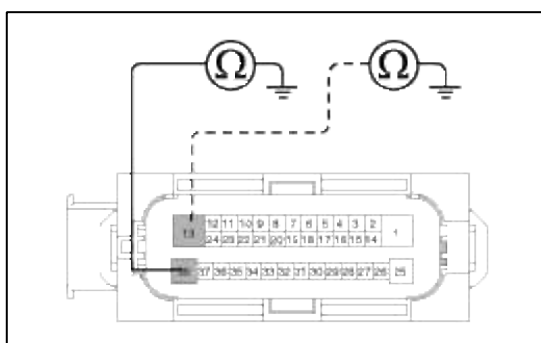
<b>YES</b>	Check the ground circuit.
<b>NO</b>	Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ESC control module. Repair if necessary.



## Check the ground circuit

1. Disconnect the connector from the ESC control module.
2. Check for continuity between terminals 13, 38 of the ESC control module harness side connector and ground point.
3. Is there continuity?

<b>YES</b>	Check the wheel speed sensor circuit.
<b>NO</b>	Repair an open in the wire and ground point.



## Check the wheel speed sensor circuit

1. Refer to the DTC troubleshooting procedures.
2. Is it normal?

<b>YES</b>	Check the hydraulic circuit for leakage.
<b>NO</b>	Repair or replace the wheel speed sensor.

Check the hydraulic circuit for leakage

1. Refer to the hydraulic lines.
2. Inspect leakage of the hydraulic lines.
3. Is it normal?

<b>YES</b>	The problem is still occurring, replace the ESC control module.
<b>NO</b>	Repair the hydraulic lines for leakage.

### **ABS Does Not Operate (Intermittently).**

#### **Detecting condition**

<b>Trouble Symptoms</b>	<b>Possible Cause</b>
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 ESC control module.	<ul style="list-style-type: none"> <li>- Faulty power source circuit</li> <li>- Faulty wheel speed sensor circuit</li> <li>- Faulty hydraulic circuit for leakage</li> <li>- Faulty HECU</li> </ul>

Inspection procedures

#### **DTC Inspection**

1. Connect the GDS with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
3. Is the normal code output?

<b>NO</b>	Check the wheel speed sensor circuit.
<b>YES</b>	Erase the DTC and recheck using GDS.

Check the wheel speed sensor circuit

1. Refer to the DTC troubleshooting procedures.
2. Is it normal?

<b>YES</b>	Check the stop lamp switch circuit.
<b>NO</b>	Repair or replace the wheel speed sensor.

Check the stop lamp switch circuit

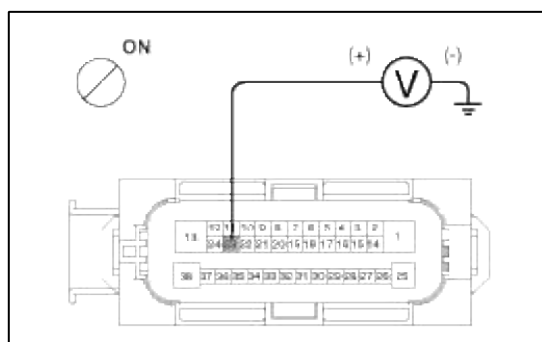
1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.

- Measure the voltage between terminal 23 of the ESC control module harness side connector and body ground when brake pedal is depressed.

**Specification :** approximately B+

- Is the voltage within specification?

<b>YES</b>	Check the hydraulic circuit for leakage.
<b>NO</b>	Repair the stop lamp switch. Repair an open in the wire between the ESC control module and the stop lamp switch.



Check the hydraulic circuit for leakage

- Refer to the hydraulic lines.
- Inspection leakage of the hydraulic lines.
- Is it normal?

<b>YES</b>	The problem is still occurring, replace the ESC control module.
<b>NO</b>	Repair the hydraulic lines for leakage.

**Communication with GDS is not possible.**  
**(Communication with any system is not possible)**

### Detecting condition

Trouble Symptoms	Possible Cause
Possible defect in the power supply system (including ground) for the diagnosis line.	<ul style="list-style-type: none"> <li>- An open in the wire</li> <li>- Poor ground</li> <li>- Faulty power source circuit</li> </ul>

### Inspection procedures

#### Check The Power Supply Circuit For The Diagnosis

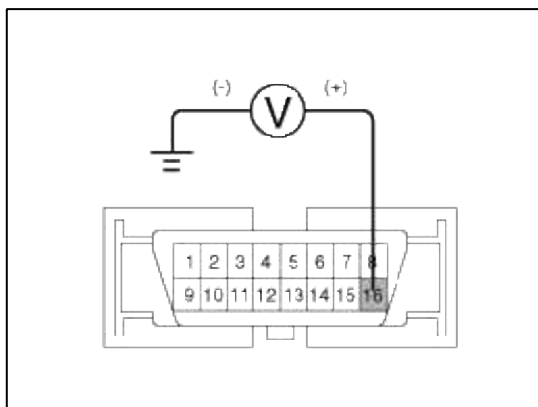
- Measure the voltage between terminal 16 of the data link connector and body ground.

**Specification :** approximately B+



## 2. Is voltage within specification?

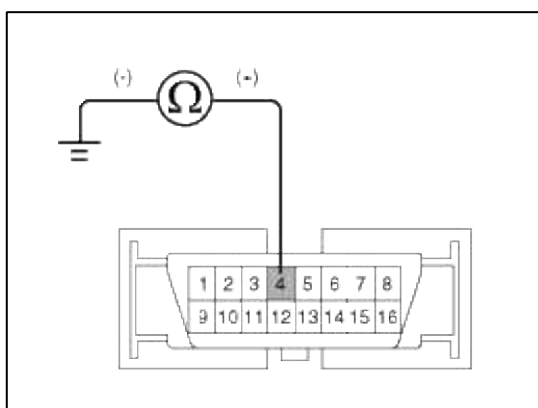
<b>YES</b>	Check the ground circuit for the diagnosis.
<b>NO</b>	Repair an open in the wire. Check and replace fuse (15A) from the engine compartment junction block.



Check the ground circuit for the diagnosis

1. Check for continuity between terminal 4 of the data link connector and body ground.
2. Is there continuity?

<b>NO</b>	Repair an open in the wire between terminal 4 of the data link connector and ground point.
-----------	--



**Communication with GDS is not possible.**  
**(Communication with ABS only is not possible)**

**Detecting condition**

<b>Trouble Symptoms</b>	<b>Possible Cause</b>
When communication with GDS is not possible, the cause may be probably an open in the HECU power circuit or an open in the diagnosis output circuit.	<ul style="list-style-type: none"> <li>- An open in the wire</li> <li>- Faulty HECU</li> <li>- Faulty power source circuit</li> </ul>

## Inspection procedures

**Check for Continuity in the Diagnosis Line**

1. Disconnect the connector from the ESC control module.
2. Check for continuity between terminals 26, 14 of the ESC control module connector and 6, 14 of the data link connector.

3. Is there continuity?

<b>YES</b>	Check the power source of ESC control module.
<b>NO</b>	Repair an open in the wire.

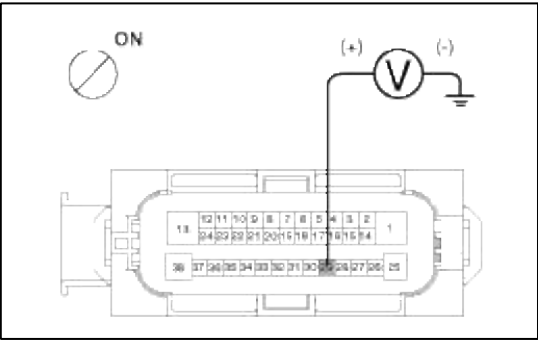
Check the power source of ESC control module

- 1. Disconnect the connector from the ESC control module.
- 2. Turn the ignition switch ON, measure the voltage between terminal 29 of the ESC control module harness side connector and body ground.

**Specification :** approximately B+

3. Is voltage within specification?

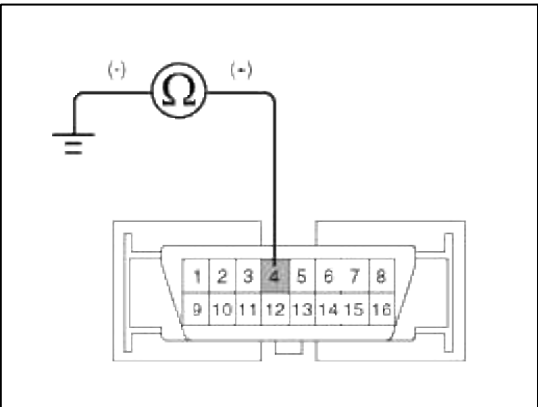
<b>YES</b>	Check for poor ground.
<b>NO</b>	Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ESC control module. Repair if necessary.



Check for poor ground

- 1. Check for continuity between terminal 4 of the data link connector and ground point.

<b>YES</b>	Replace the ESC control module and recheck.
<b>NO</b>	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 faulty HECU.	<ul style="list-style-type: none"> <li>- Faulty ABS warning lamp bulb</li> <li>- Blown fuse is related to ABS in the engine compartment junction block</li> <li>- Faulty ABS warning lamp module</li> <li>- Faulty HECU</li> </ul>

### Inspection procedures

#### Problem verification

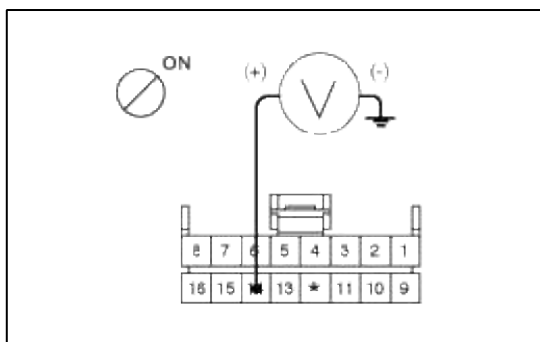
1. Disconnect the connector from the ESC control module and turn the ignition switch ON.
2. Does the ABS warning lamp light up?

<b>YES</b>	Inspect again after replacing the ESC HECU.
<b>NO</b>	Check the power source for the ABS warning lamp.

#### Check the power source for the ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and turn the ignition switch ON.
2. Measure the voltage between terminal (M11-B) 14 of the cluster harness side connector and body ground.

**Specification :** approximately B+



3. Is voltage within specification?

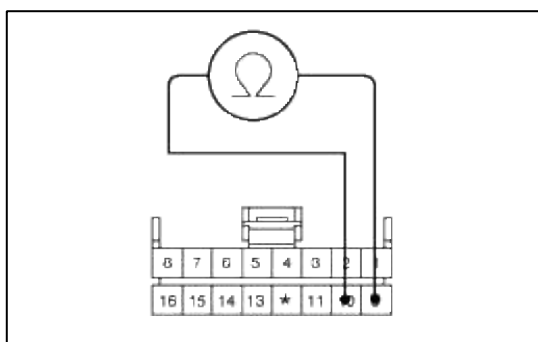
<b>YES</b>	Check the CAN circuit resistance for ABS warning lamp.
<b>NO</b>	Check for blown fuse.

#### Check the can circuit resistance for ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and turn the ignition switch OFF.

2. Measure the resistance between terminal (M11-B) 9 and 10 of the cluster harness side connector.

**Specification : 60Ω**



3. Is resistance within specification?

<b>YES</b>	Repair ABS warning lamp bulb or instrument cluster assembly.
<b>NO</b>	Check the CAN circuit wiring for ABS warning lamp.

Check the can circuit wiring for ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M11-B) 9 of the cluster harness side connector and terminal 14 of HECU harness side.  
Check for continuity between terminal (M11-B) 10 of the cluster harness side connector and terminal 26 of HECU harness side.

**Specification : Below 1Ω**

3. Is resistance within specification?

<b>YES</b>	Repair short of wiring between terminal 14, 26 of HECU harness connector and ABS warning lamp module.
<b>NO</b>	Repair open of wiring between terminal 14, 26 of HECU harness connector and ABS warning lamp module.

**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.	<ul style="list-style-type: none"> <li>- An open in the wire</li> <li>- Faulty instrument cluster assembly</li> <li>- Faulty ABS warning lamp module</li> <li>- Faulty HECU</li> </ul>

Inspection procedures

### Check DTC Output

1. Connect the GDS to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using GDS.

## 3. Is DTC output?

<b>YES</b>	Perform the DTC troubleshooting procedure (Refer to DTC troubleshooting).
<b>NO</b>	Check the CAN circuit resistance for ABS warning lamp.

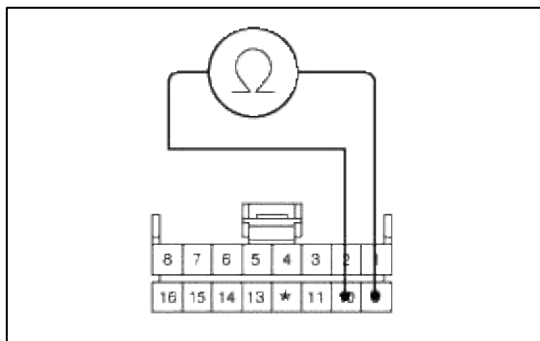
## Check the can circuit resistance for ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M11-B) 9 and 10 of the cluster harness side connector.

---

**Specification : 60Ω**


---



## 3. Is resistance within specification?

<b>YES</b>	Repair ABS warning lamp bulb or instrument cluster assembly.
<b>NO</b>	Check the CAN circuit wiring for ABS warning lamp.

## Check the can circuit wiring for ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M11-B) 9 of the cluster harness side connector and terminal 14 of ESC HECU harness side.  
Check for continuity between terminal (M11-B) 10 of the cluster harness side connector and terminal 26 of ESC HECU harness side.

---

**Specification : Below 1Ω**


---

## 3. Is there continuity?

<b>YES</b>	Repair short of wiring between terminal 14, 26 of HECU harness connector and ABS warning lamp module. If no trouble in wiring, inspect again after replacing the HECU.
<b>NO</b>	Repair short of wiring between terminal 14, 26 of HECU harness connector and ABS warning lamp module. If no trouble in wiring, inspect again after replacing the HECU.

## Bleeding of Brake System

This procedure should be followed to ensure adequate bleeding of air and filling of the ESC unit, brake lines and master cylinder with brake fluid.

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.

**NOTE**

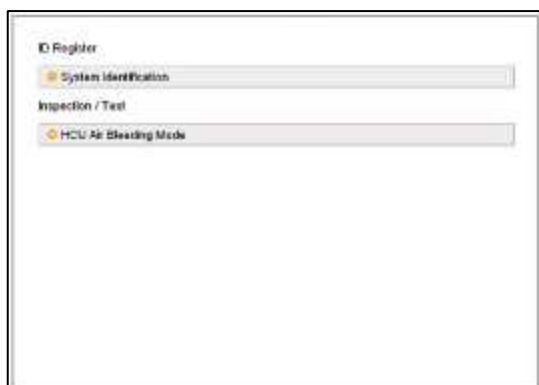
When pressure bleeding, do not depress the brake pedal.  
Recommended fluid..... DOT3 or DOT4

2. Disconnect the vacuum switch connector.  
(2.0 AT & ESC Only)
3. Connect a clear plastic tube to the wheel cylinder bleeder plug and insert the other end of the tube into a half filled clear plastic bottle.
4. Connect the GDS to the data link connector located underneath the dash panel.
5. Select and operate according to the instructions on the GDS screen.

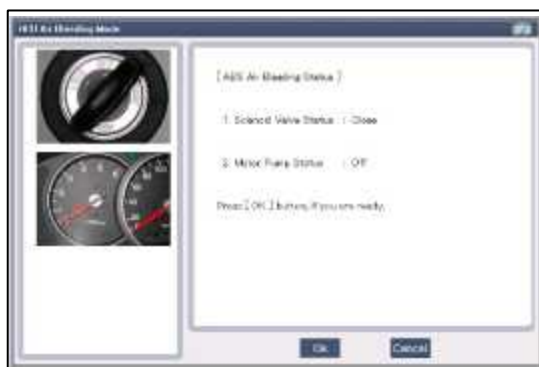
**CAUTION**

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

- (1) Select vehicle name.
- (2) Select Anti-Lock Brake system.
- (3) Select HCU air bleeding mode.



- (4) Press "OK" to operate motor pump and solenoid valve.



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

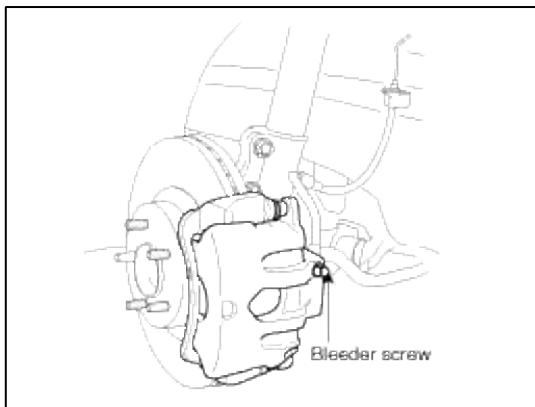


- (6) Perform the air bleeding.

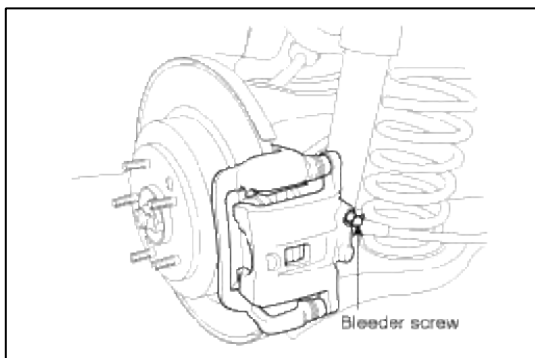


6. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw.

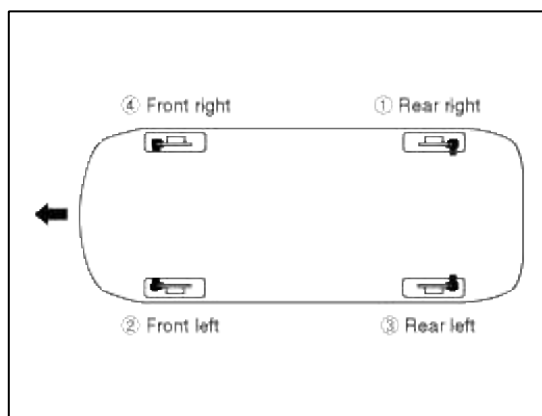
Front



Rear



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



8. Tighten the bleeder screw.

---

**Bleed screw tightening torque:**

6.9 ~ 12.7N.m (0.7 ~ 2.0kgf.m, 5.1 ~ 9.5lb-ft)

---

9. Connect the vacuum switch connector.  
(2.0 AT & ESC Only)

**Brake System > ESC(Electronic Stability Control) System > EBD(Electronic Brake-force Distribution) > Description and Operation**

**EBD(Electronic brake-force distribution) Operation**

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.

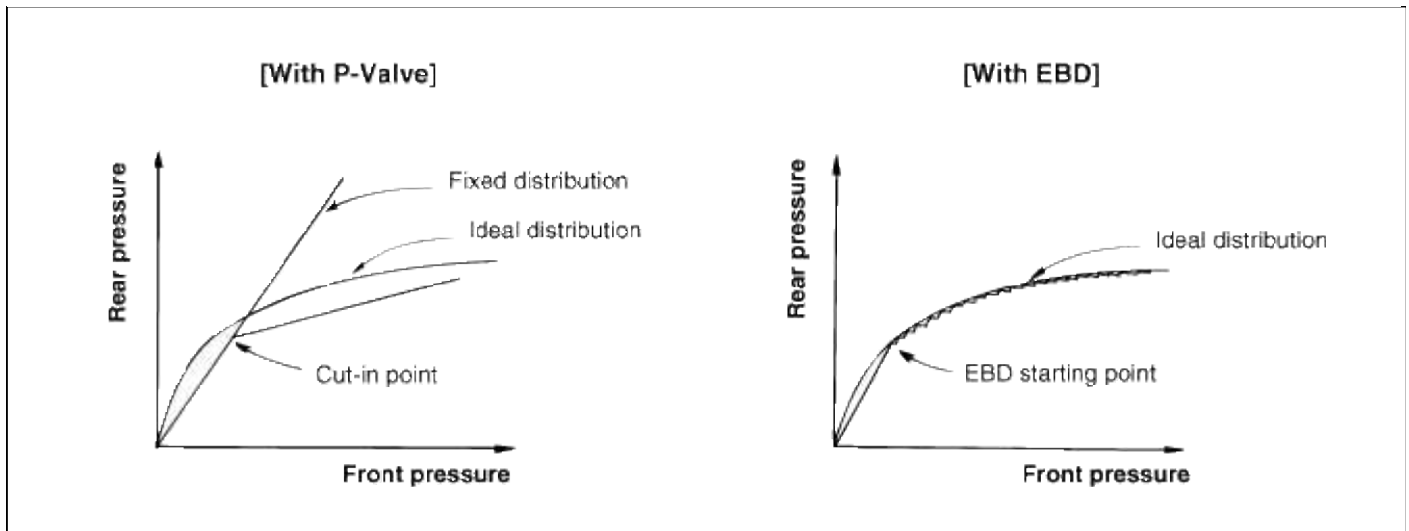
If the EBD fails, the EBD warning lamp (Parking brake lamp) lights up.

**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.

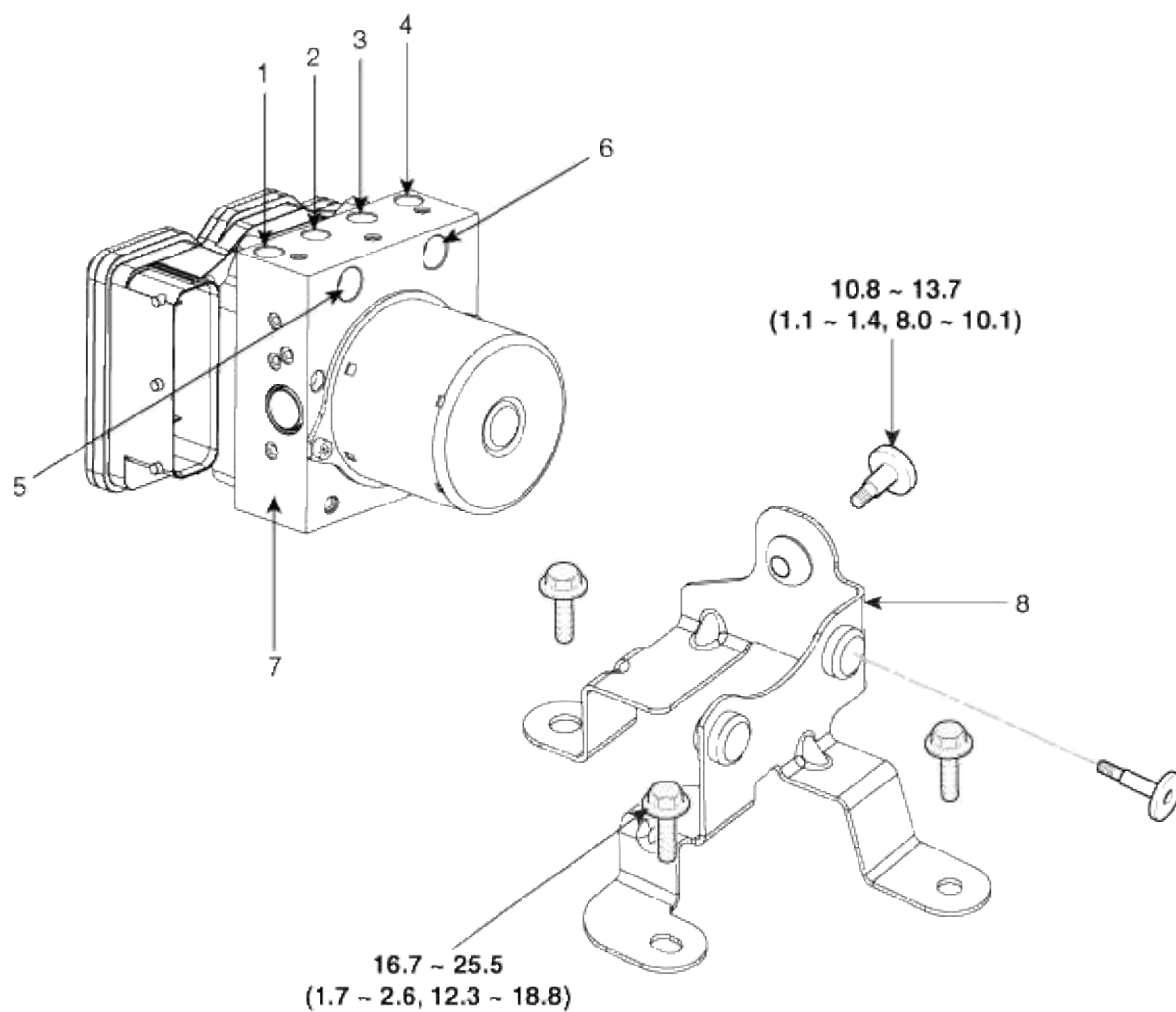
Comparison between proportioning valve and EBD





### Brake System > ESC(Electronic Stability Control) System > ESC Control Module > Components and Components Location

Components



**Torque : N.m (kgf.m, lb-ft)**

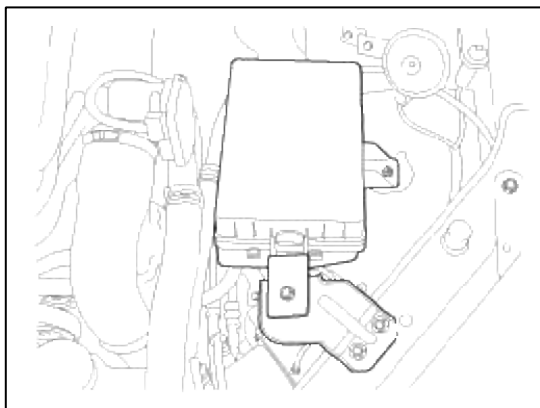
1. Front-left tube	5. MC2
2. Rear -right tube	6. MC1
3. Rear-left tube	7. ESC control module (HECU)
4. Front-right tube	8. Bracket

### **Brake System > ESC(Electronic Stability Control) System > ESC Control Module > Repair procedures**

#### **Removal**

1. Turn the ignition switch OFF and disconnect the negative (-) battery cable.

2. Remove the engine room junction box and bracket.

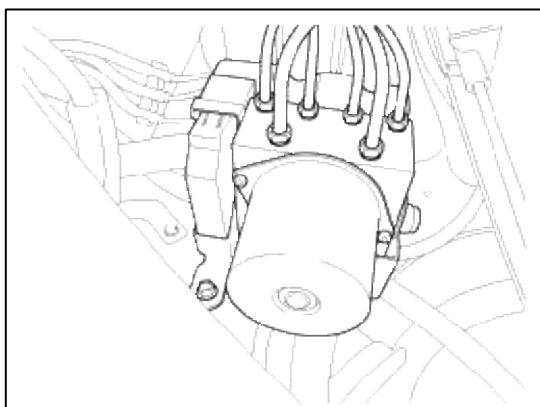


3. Disconnect the brake tubes from the HECU by unlocking the nuts counterclockwise with a spanner.

**Tightening torque:**

ABS : 12.7 ~ 16.7 N.m (1.3 ~ 1.7 kgf.m, 9.4 ~ 12.3 lb-ft)

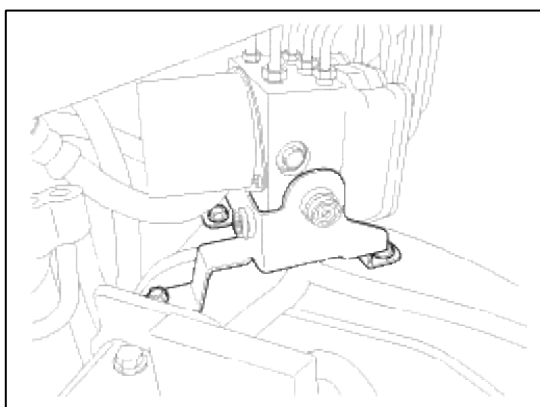
ESC : 18.6 ~ 22.6 N.m(1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



4. Pull up the lock of the HECU connector, then disconnect the connector.
5. Loosen the HECU bracket bolt(3EA), then remove HECU and bracket.

**Tightening torque:**

16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)



**CAUTION**

1. Never attempt to disassemble the HECU.
2. The HECU must be transported and stored in.
3. Never shock to the HECU.

6. Remove the 3 bolts, then remove the bracket from HECU.

---

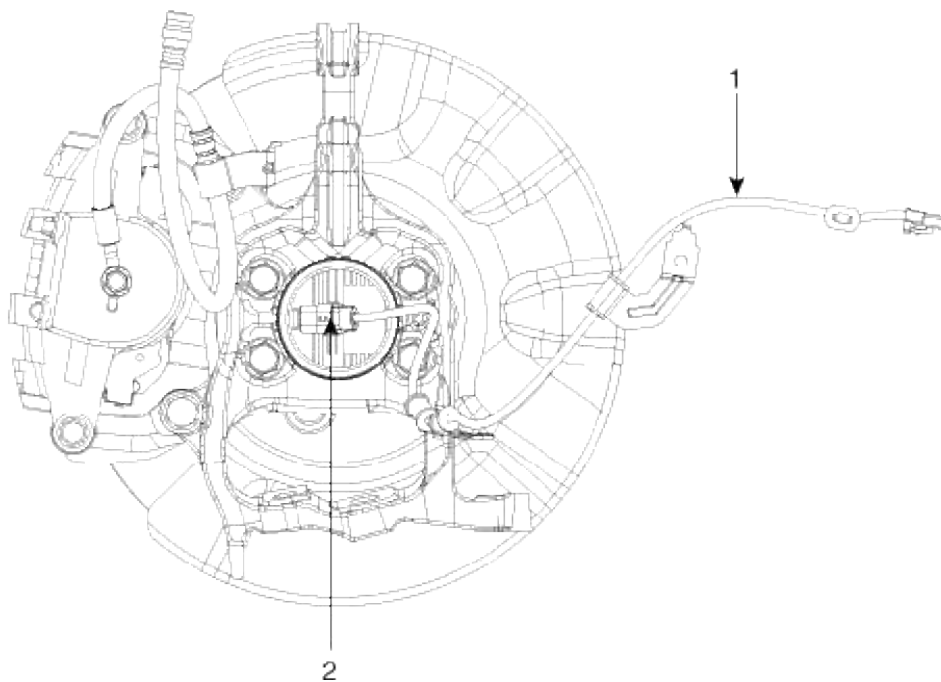
**Tightening torque:**

10.8 ~ 13.7 N.m (1.1 ~ 1.4 kgf.m, 8.0 ~ 10.1 lb-ft)

---

**Installation**

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

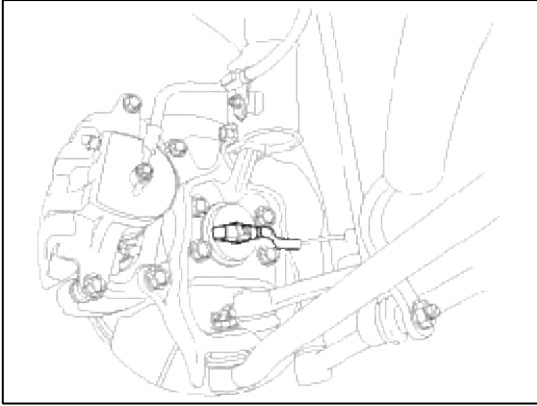
**Brake System > ESC(Electronic Stability Control) System > Front Wheel Speed Sensor > Components and Components Location****Components**

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

## Brake System > ESC(Electronic Stability Control) System > Front Wheel Speed Sensor > Repair procedures

### Removal

1. Remove the connector after removing the front wheel speed sensor clip.



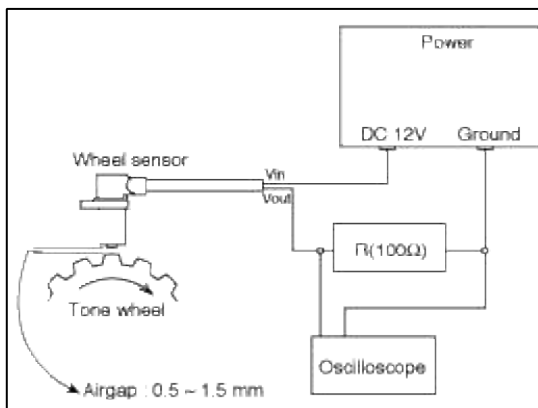
2. Remove the front wheel speed sensor.  
(Refer to Driveshaft and axle group - "Front axle assembly")
3. Installation is the reverse of removal.

### Inspection

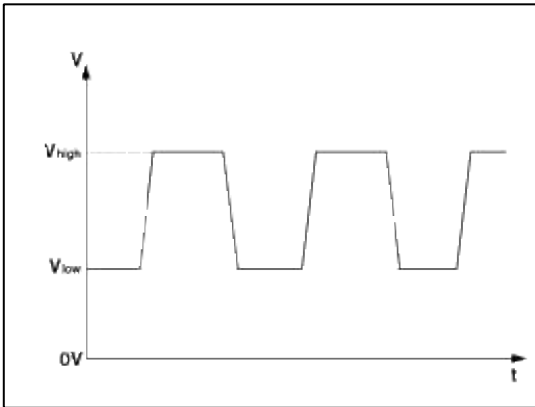
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

#### CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 100  $\Omega$  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.



---

$V_{low}$  : 0.59V ~ 0.84V

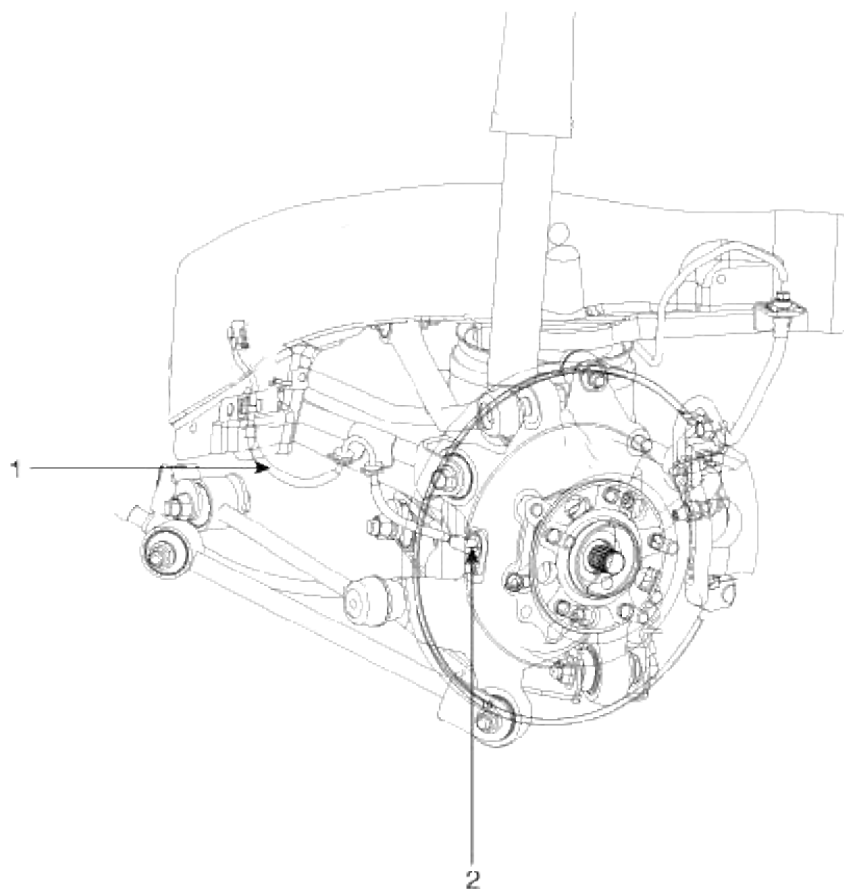
$V_{high}$  : 1.18V ~ 1.68V

Frequency range : 1 ~ 2,500Hz

---

**Brake System > ESC(Electronic Stability Control) System > Rear Wheel Speed Sensor > Components and Components Location**

Components



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

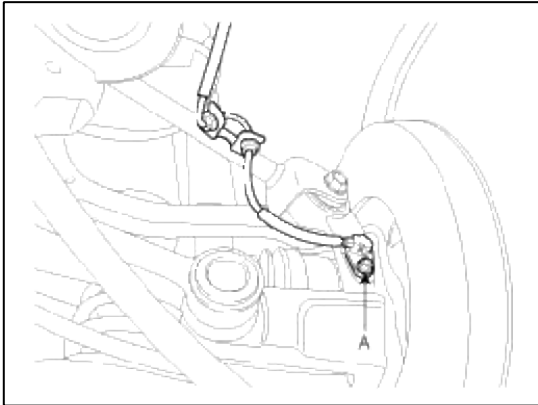
### **Brake System > ESC(Electronic Stability Control) System > Rear Wheel Speed Sensor > Repair procedures**

#### **Removal**

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

### Tightening torque:

6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



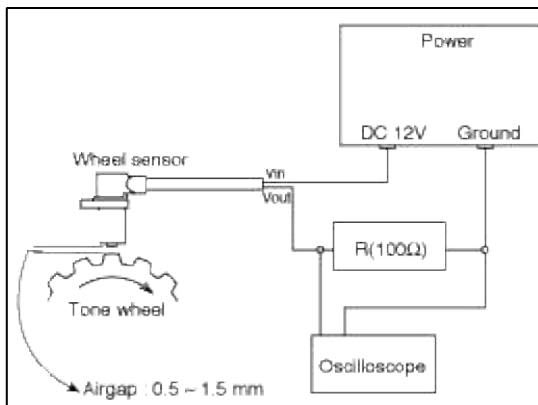
2. Remove the rear wheel guard.
3. Disconnect the rear wheel speed sensor connector (A). And remove the rear wheel speed sensor.
4. Installation is the reverse of removal.

### Inspection

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

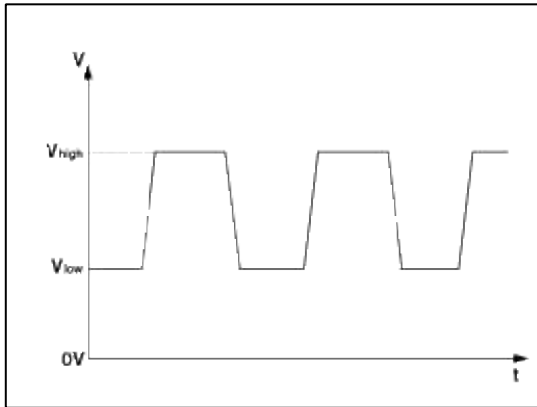
#### CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 100  $\Omega$  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.



$V_{low} : 0.59V \sim 0.84V$

$V_{high} : 1.18V \sim 1.68V$

Frequency range : 1 ~ 2,500Hz

### Brake System > ESC(Electronic Stability Control) System > Yaw-rate and Lateral G Sensor > Description and Operation

#### Description

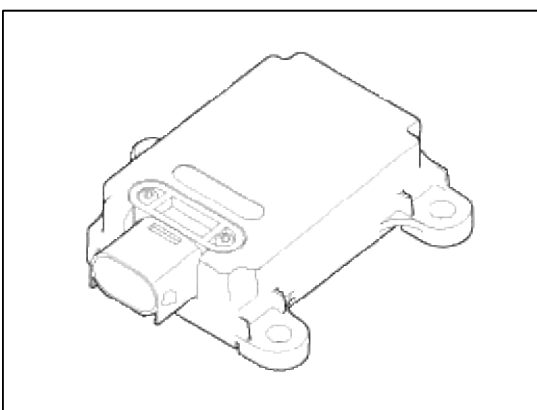
When the vehicle is turning with respect to a vertical axis the yaw rate sensor detects the yaw rate electronically by the vibration change of plate fork inside the yaw rate sensor.

If yaw velocity reaches the specific velocity after it detects the vehicle' yawing, the ESC control is reactivated.

The later G sensor senses vehicle's lateral G. A small element inside the sensor is attached to a deflectable lever arm by later G.

Direction and magnitude of lateral G loaded to vehicle can be known with electrostatic capacity changing according to lateral G.

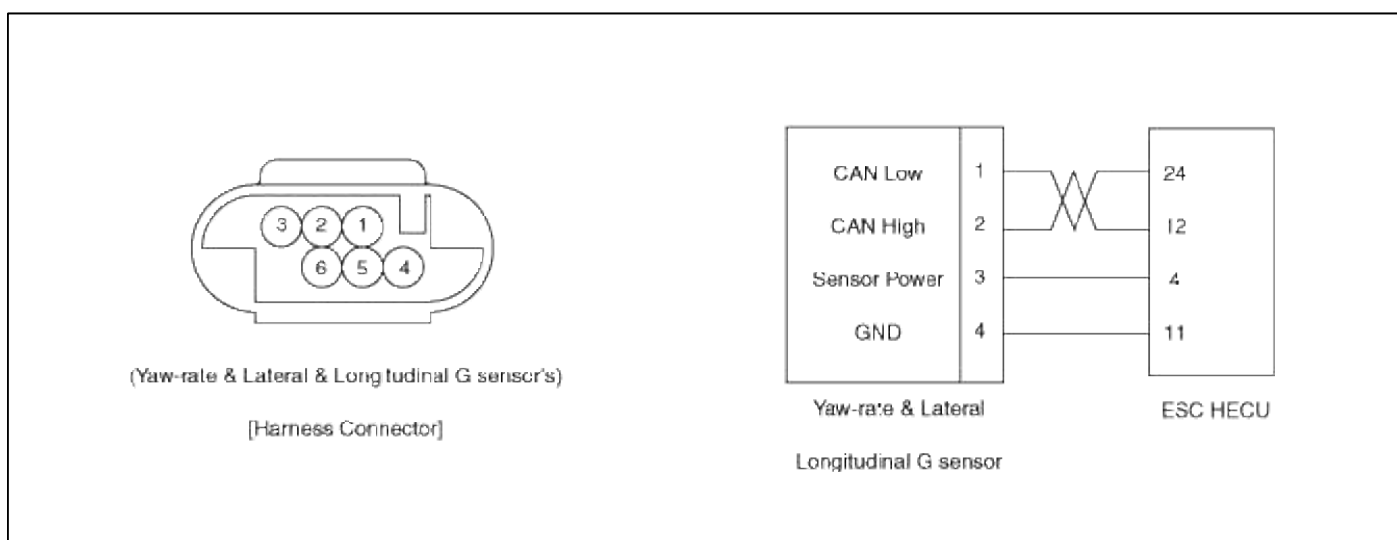
It interchanges signals with HECU through extra CAN line which only used for communication between HECU and sensor.



#### Specifications

Description		Specification	Remarks
Operating voltage		8 ~ 17V	
Output signal		CAN Interface	
Operating temperature		-40 ~ 85°C(-40 ~ 185°F)	
Yaw-rate sensor	Measurement range	-75 ~ 75°/sec	
	Frequency response	18 ~ 22Hz	
Lateral G sensor	Measurement range	-1.5 ~ 1.5g	
	Frequency response	50Hz±60%	

### External Diagram



## Brake System > ESC(Electronic Stability Control) System > Yaw-rate and Lateral G Sensor > Repair procedures

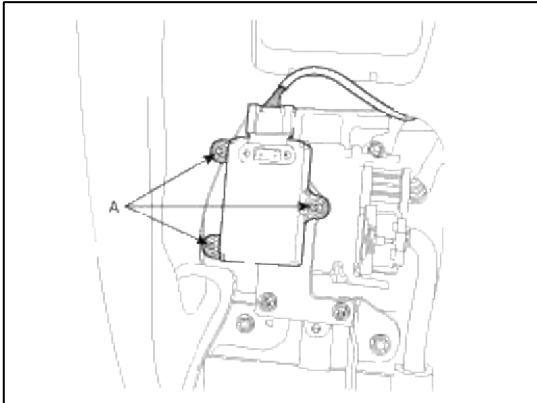
### Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the floor console.  
(Refer to Body group - "Console")
3. Disconnect the yaw rate & lateral G sensor connector.

4. Remove the mounting bolts (A).

#### Tightening torque:

7.9 ~ 10.8 N.m (0.8 ~ 1.1 kgf.m, 5.8 ~ 8.0 lb-ft)



5. Installation is the reverse of removal.

### Brake System > ESC(Electronic Stability Control) System > ESP OFF Switch > Description and Operation

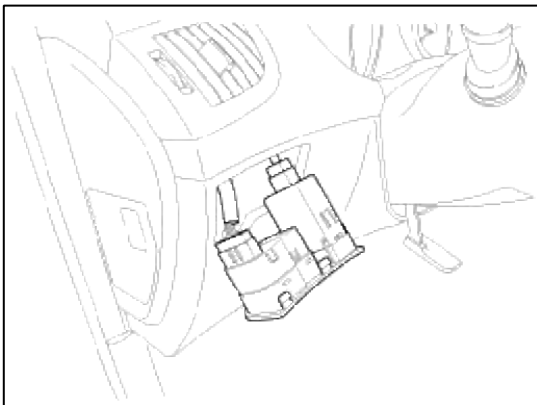
#### Description

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

### Brake System > ESC(Electronic Stability Control) System > ESP OFF Switch > Repair procedures

#### Inspection

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the crash pad side cover.  
(Refer to Body group - "Crash pad")
3. Remove the crash pad lower panel.  
(Refer to Body group - "Crash pad")
4. Remove the lower crash pad switch assembly by using the scraper and then disconnect the connectors.



5. Check the continuity between the switch terminals as the ESC OFF switch is engaged.

Terminal Position	1	4	2	5
ON	○	○	○	○
OFF			○	○

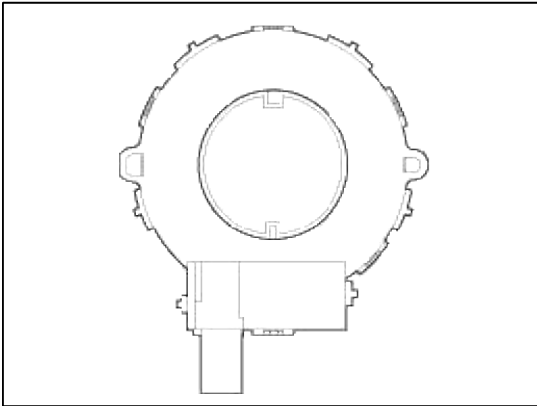
## Brake System > ESC(Electronic Stability Control) System > Steering Wheel Angle Sensor > Description and Operation

### Description

The steering angle sensor detects the angle of the steering wheel in order to which direction a user chooses. The sensor is detached on the MPS(Mutil-Function Switch) under the steering wheel.

### Measuring principle

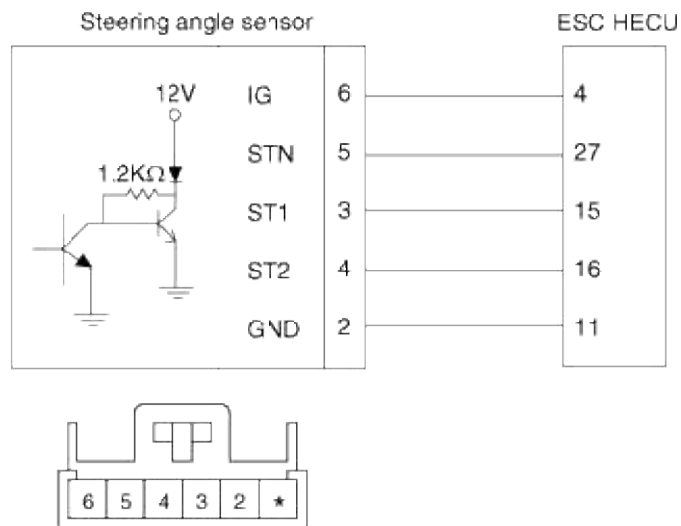
The split of the steering angle sensor detects a steering angle of the steering wheel by a ON/OFF pulse caused by whether or not the LED lights go through the hole of the split, rotating as the steering wheel revolves. There are three LEDs, two(ST1, ST2) for detecting a steering direction, and the other for the neutral position. The HECU calculates the steering angle by the pulse from the steering angle sensor.



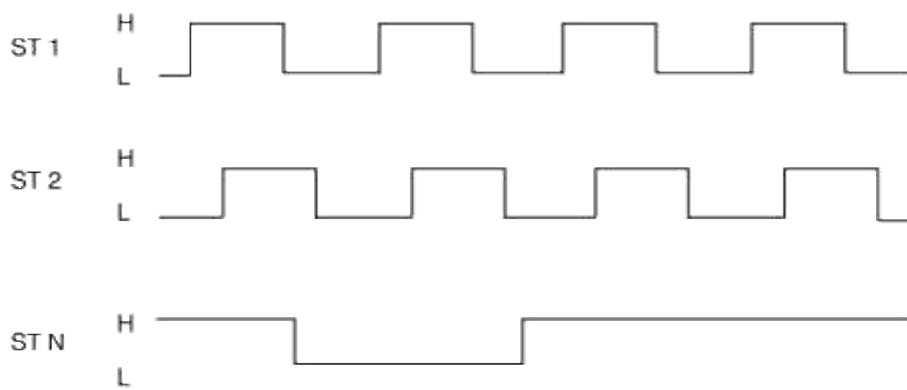
### Specification

Description	Specification
Operating voltage	8 ~ 16 V
Operating temperature	-30 ~ 75 °C
Current consumption	Max.100 mA
Steering angle velocity	Max. $\pm 1500$ °/sec

Circuit diagram(Steering wheel angle sensor)



### Output characteristic



No.	Input		Output	Steering direction	Remark
1	ST1	L	L	Right	
	ST2	L	H		
	ST1	L	H	Left	
	ST2	L	L		
2	ST1	L	L	Left	
	ST1	H	L		
	ST1	L	H	Right	
	ST2	H	H		
3	ST1	H	H	Left	
	ST2	L	H		

3	ST1	H	L	Right	
	ST2	L	L		
4	ST1	H	H	Right	
	ST2	H	L		
	ST1	H	L	Left	
	ST2	H	H		