

## VELOSTER(FS) > 2012 > G 1.6 GDI > Brake System

### Brake System > General Information > Specifications

#### Specifications

Item		Specification
Master cylinder	Type	Tandem
	Cylinder I.D.	22.22 mm (0.875 in)
	Piston stroke	45 ± 1 mm (1.77 ± 0.039 in)
	Fluid level switch	Provided
Brake booster	Type	Single
	Boosting ratio	8 : 1
Front Disc brake	Type	Ventilated disc
	Disc O.D.	Ø 280 mm (11.02 in)
	Disc thickness	23 mm (0.91 in)
	Caliper piston	Single
	Cylinder I.D.	Ø 57.2mm (2.25 in)
Rear Disc brake	Type	Solid disc
	Disc O.D.	262 mm (10.31 in)
	Disc thickness	10 mm (0.39 in)
	Caliper piston	Single
	Cylinder I.D.	Ø 34 mm (1.34 in)
Parking brake	Type	BIR (Ball-in-Ramp)
	actuation	Lever

#### 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
	Type	Motor, valve relay integrated type	(ABS, EBD, TCS, ESC)
	Operating Voltage	10 ~ 16 V	
	Operating Temperature	-40 ~ 120 °C (-40 ~ 248°F)	
	Motor power	270 W	
Active Wheel speed sensor	Supply voltage	DC 4.5 ~ 20 V	
	Output current low	5.9 ~ 8.4 mA	
	Output current high	11.8~ 16.8 mA	
	Output range	1 ~ 2,500 Hz	
	Tone wheel	Front : 46 teeth, Rear : 47 teeth	
	Air gap	0.4 ~ 1.5 mm	
Yaw rate& Lateral G sensor (CAN TYPE)	Operating Voltage	10 ~ 16 V	
	Current Consumption	Max. 140 mA	
	Yaw rate sensor measurement range	-75 ~ +75 °/sec	
	Lateral G sensor measurement range	-14.715 ~ 14.715 m/s <sup>2</sup>	

**Service Standard**

Items	Standard value
Brake pedal height	191.61 mm (7.54 in)
Brake pedal Full stroke	135 mm (5.31 in)
Stop lamp switch clearance	1.0 ~ 2.0 mm (0.04 ~ 0.08 in)
Brake pedal free play	1.8 ~ 4.2 mm (0.07 ~ 0.17 in)
Front brake disc thickness	23 mm (0.91 in)
Front brake disc pad thickness	10.5 mm (0.41 in)
Rear brake disc thickness	10 mm (0.39 in)
Rear brake disc pad thickness	10 mm (0.39 in)

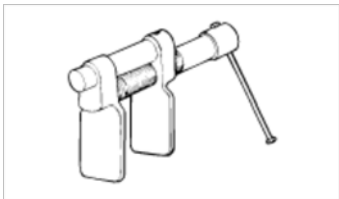
**Tightening Torques**

Items	N.m	kgf.m	lb-ft
Hub nut	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Master cylinder to brake booster	9.8 ~ 15.7	1.0 ~ 1.6	7.2 ~ 11.6
Brake booster mounting nuts	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Air bleeding screw	6.9 ~ 12.7	0.7 ~ 1.3	5.1 ~ 9.4
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	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Rear caliper assembly to knuckle	63.7 ~ 73.5	6.5 ~ 7.5	47.0 ~ 54.2
Brake hose to caliper	24.5 ~ 29.4	2.5 ~ 3.0	18.1 ~ 21.7
Brake pedal member bracket bolts	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Brake pedal shaft nut	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Front wheel speed sensor mounting bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.7 ~ 8.7
Rear wheel speed sensor mounting bolt	6.9 ~ 10.8	0.7 ~ 1.1	5.0 ~ 8.0
HECU bracket mounting nut	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8

**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	0.8 ~ 2.0 g
Rear caliper guide rod and boot	AI-11P	0.8 ~ 2.0 g

**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.

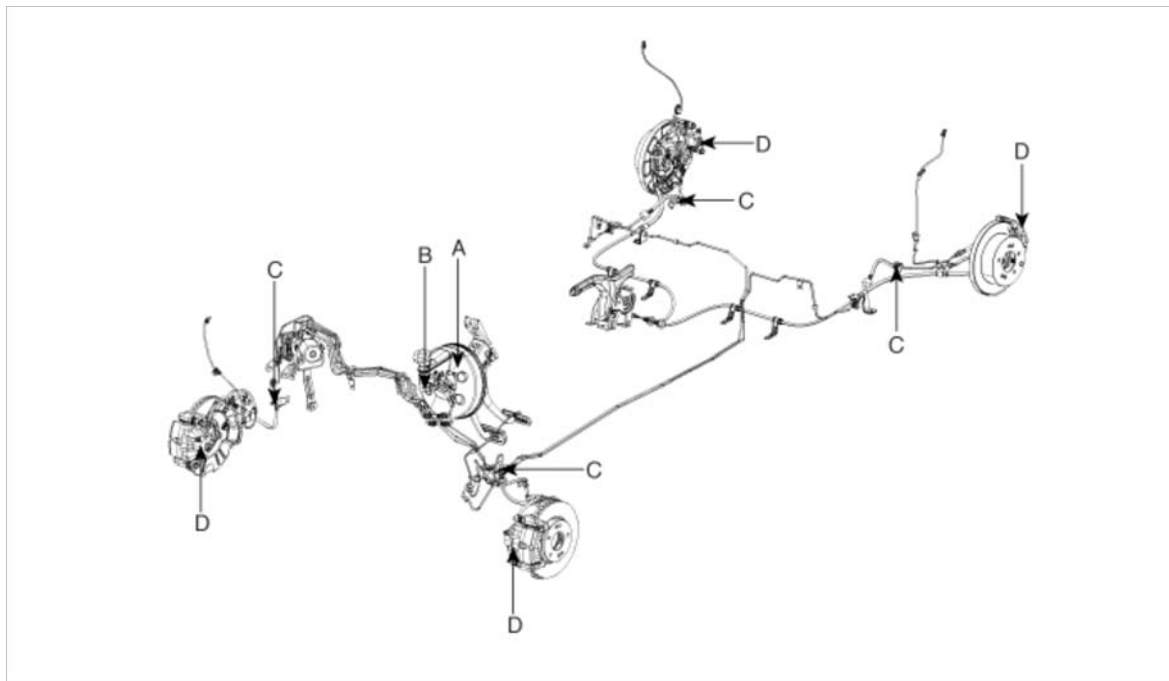
Symptom	Suspect Area	Reference
Lower pedal or spongy pedal	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Piston seals (Worn or damaged) 4. Rear brake shoe clearance (Out of adjustment) 5. Master cylinder (Inoperative)	repair Air bleeding replace adjust replace
Brake drag	1. Brake pedal free play (Minimum) 2. Parking brake lever travel (Out of adjustment) 3. Parking brake wire (Sticking) 4. Pad (Cracked or distorted) 5. Piston (Stuck) 6. Piston (Frozen) 7. Booster system (Vacuum leaks) 8. Master cylinder (Inoperative)	adjust adjust repair replace replace replace replace repair replace
Brake pull	1. Piston (Sticking) 2. Pad (Oily) 3. Piston (Frozen) 4. Disc (Scored) 5. Pad (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 (Worn) 4. Pad (Cracked or distorted) 5. Rear brake shoe clearance (Out of adjustment) 6. Pad (Oily) 7. Pad (Glazed) 8. Disc (Scored) 9. Booster system (Vacuum leaks)	repair Air bleeding replace replace adjust replace replace replace replace repair
Noise from brake	1. Pad (Cracked or distorted) 2. Installation bolt (Loosen) 3. Disc (Scored) 4. Sliding pin (Worn) 5. Pad (Dirty) 6. Pad (Glazed) 7. Brake pad shim (Damage)	replace adjust replace replace clean 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 > Description and Operation

### 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.



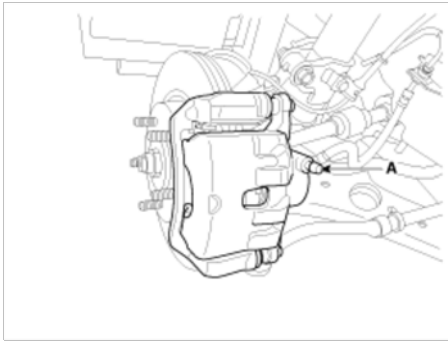
### Brake System Bleeding

#### CAUTION

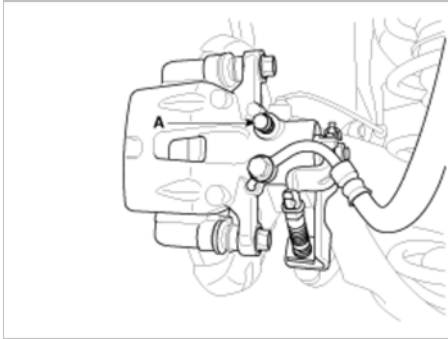
- Do not reuse the drained fluid.
- Always use genuine DOT3/DOT4 brake Fluid.  
Using a non-genuine DOT3/DOT4 brake fluid can cause corrosion and decrease the life of the system.
- Make sure no dirt or other foreign matter is allowed to contaminate the brake fluid.
- Do not spill brake fluid on the vehicle, 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.

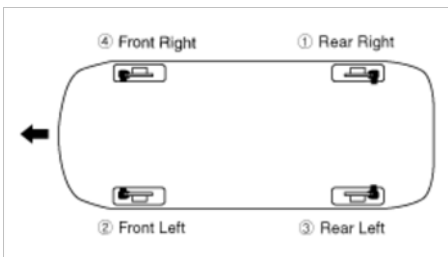
#### [Front disc brake]



[Rear disc brake]



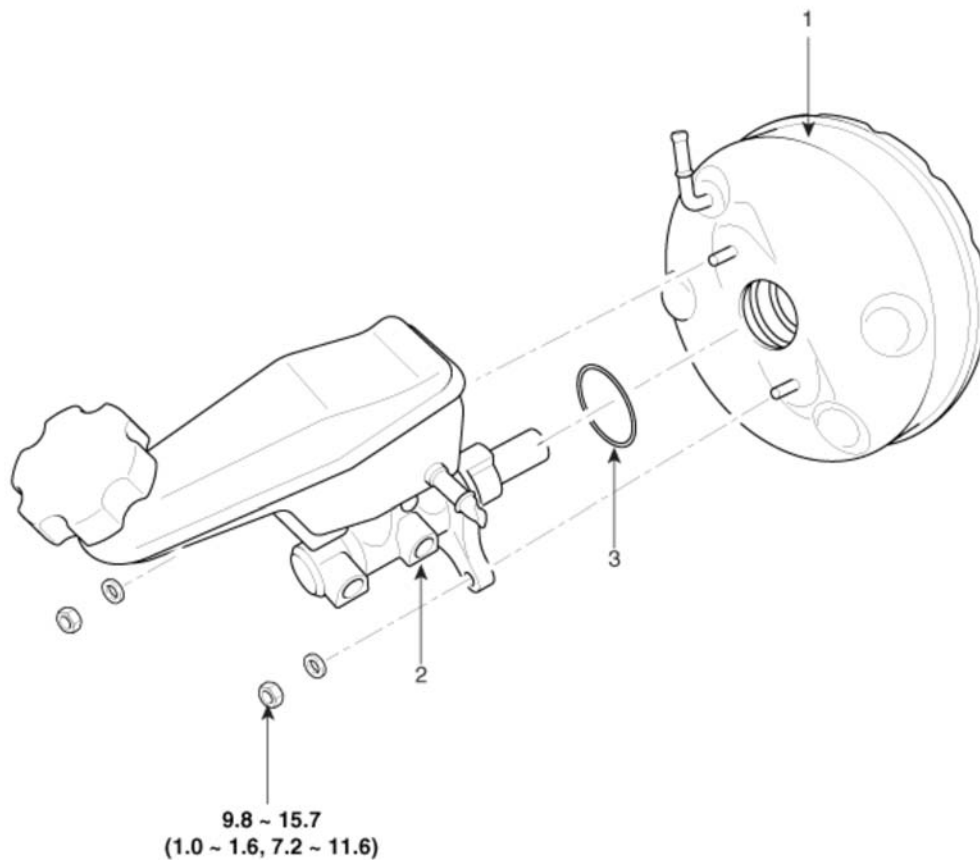
4. Repeat the procedure for wheel in the sequence shown below until air bubbles no longer appear in the fluid.



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  
2. Master cylinder assembly

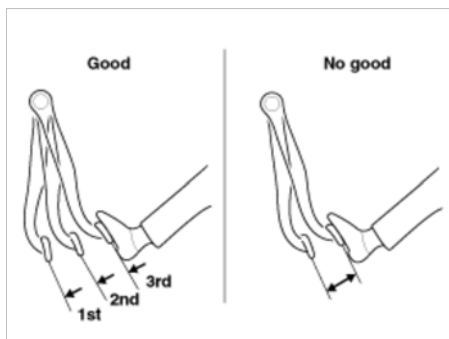
3. O-ring

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

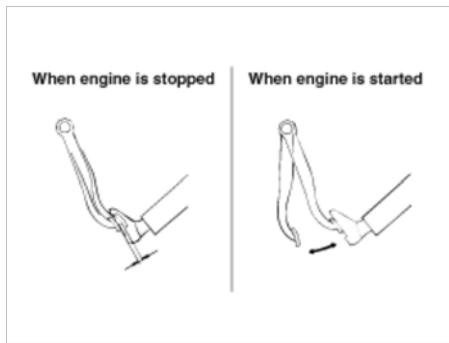
### Brake Booster Operating Test

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

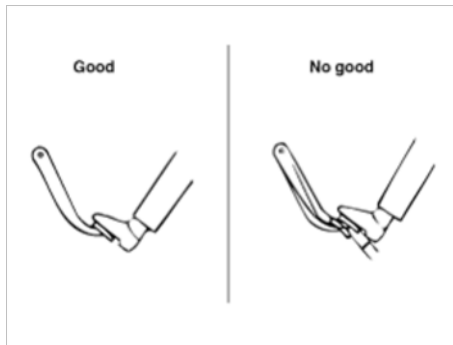
1. Run the engine for one or two minutes, and then stop it. If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly, if the pedal height remains unchanged, the booster is inoperative.



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.

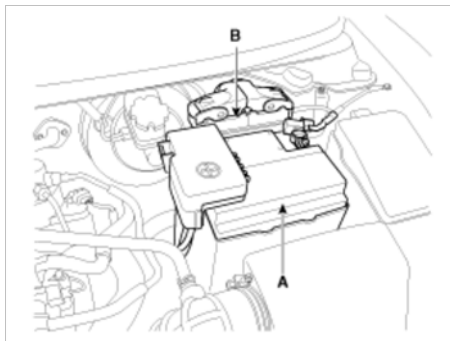


3. With the engine running, step on the brake pedal and then stop the engine.  
Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is inoperative.  
If the above three tests are okay, the booster performance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

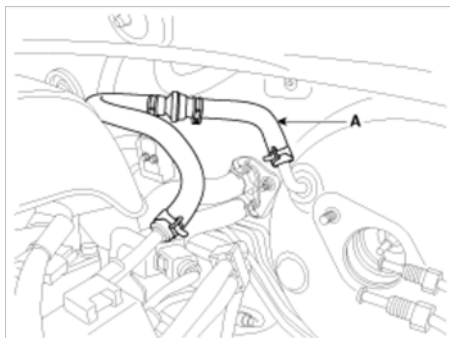


## Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the battery (A) and ECM (B).  
(Refer to the Engine Electrical group - "Battery")



3. Remove the master cylinder.  
(Refer to Master cylinder.)
4. Disconnect the vacuum hose (A) from the brake booster.

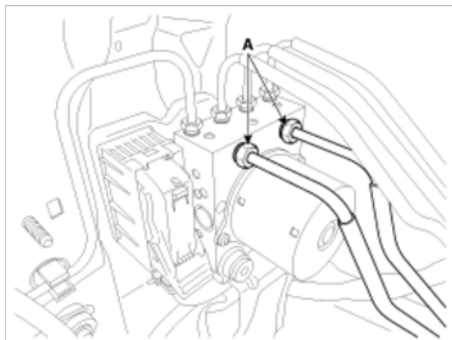


5. Loosen the flare nuts (A) and then remove the brake tube.

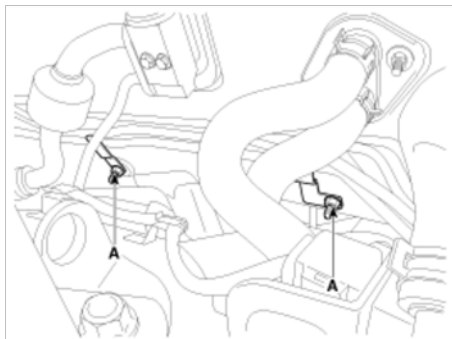
**Tightening torque:**

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

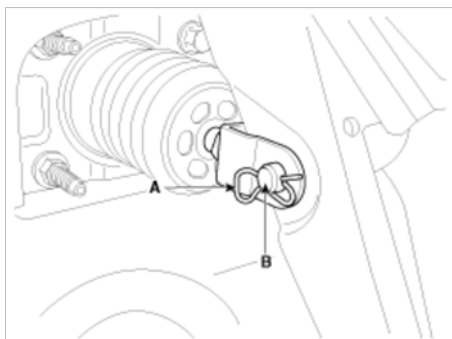
---



6. Loosen the brake tube bracket mounting nuts (B).



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

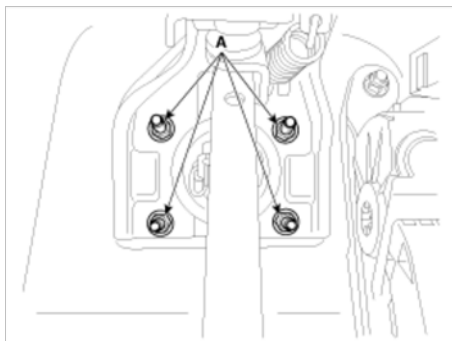


8. Remove the brake booster mounting nuts (A).

**Tightening torque:**

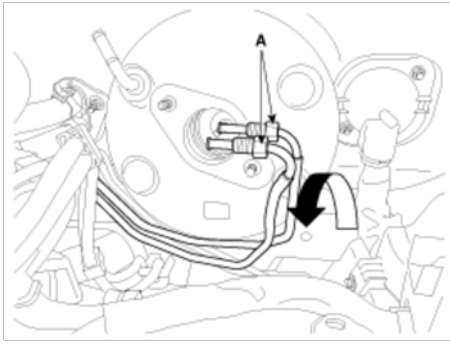
18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)

---



9. Pivot the brake tubes (A) down out of the way.





10. Remove the gear actuator motor.  
(Refer to the DCT system group - "DCT Control System")  
[DCT system only]
11. 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

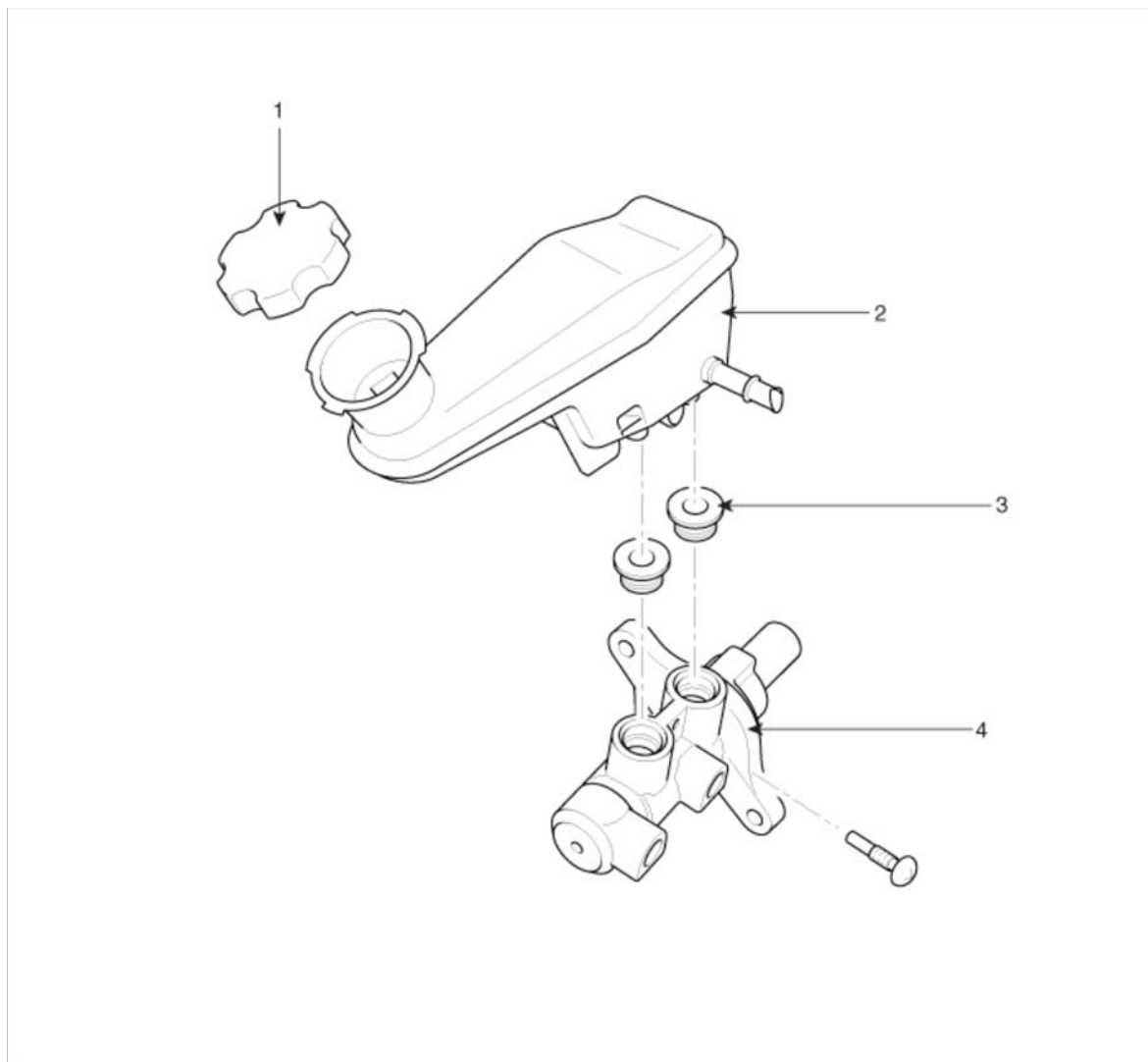
1. Installation is the reverse of removal.

#### CAUTION

- A. **Before installing the pin, apply the grease to the joint pin.**
- B. **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 > Master Cylinder > Components and Components Location**

### Components



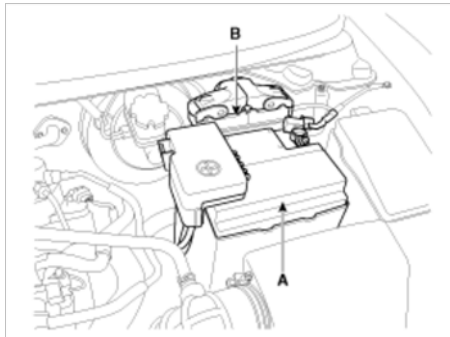
- 1. Reservoir cap
- 2. Reservoir

- 3. Grommet
- 4. Master cylinder assembly

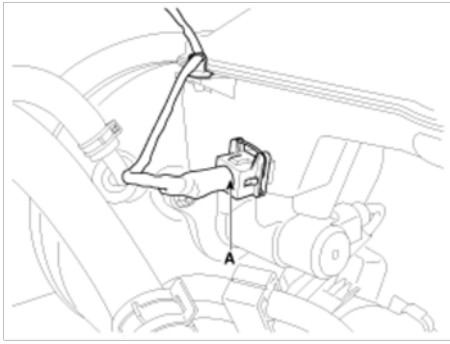
## Brake System > Brake System > Master Cylinder > Repair procedures

### Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the battery (A) and ECM (B).  
(Refer to the Engine Electrical group - "Battery")



3. Disconnect the brake fluid level switch connector (A) from the reservoir.



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

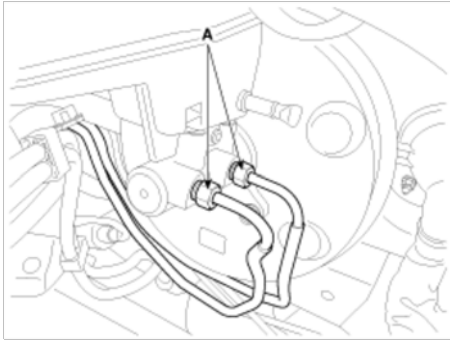
**CAUTION**

- Be sure to completely remove foreign substances from around brake fluid reservoir and cap before opening the reservoir cap. If not, it may cause contamination of brake fluid and deterioration in braking performance.
- 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.

5. Disconnect the brake tube from the master cylinder by loosening the tube flare nut (A).

**Tightening torque:**

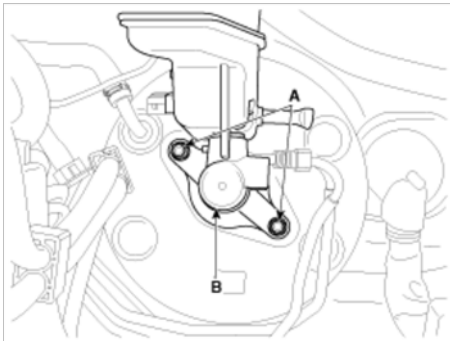
18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



6. Remove the clutch hose (B). [MT Only]
7. Remove the master cylinder (B) from the brake booster after loosening the mounting nuts (C).

**Tightening torque:**

9.3 ~ 15.7 N.m (1.0 ~ 1.6 kgf.m, 7.2 ~ 11.6 lb-ft)

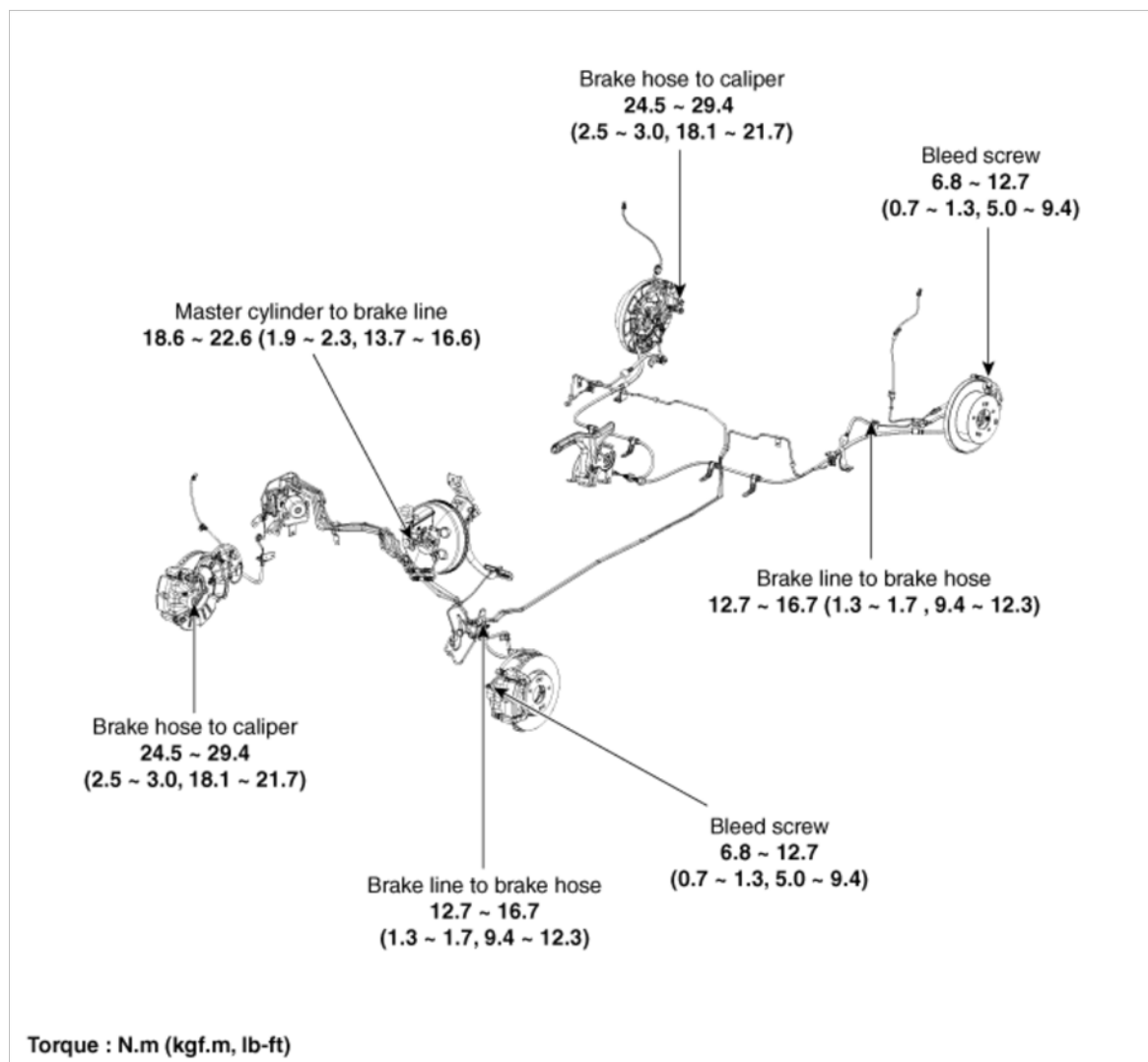


**Installation**

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



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

#### Removal

1. Disconnect the brake fluid level switch connector, and remove the reservoir cap.
2. Remove the brake fluid from the master cylinder reservoir with a syringe.

#### CAUTION

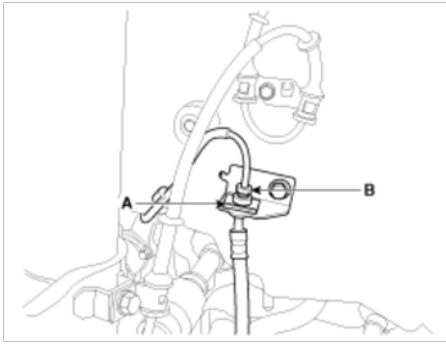
Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

3. Remove the wheel & tire.
4. Loosening the tube flare nut (B).

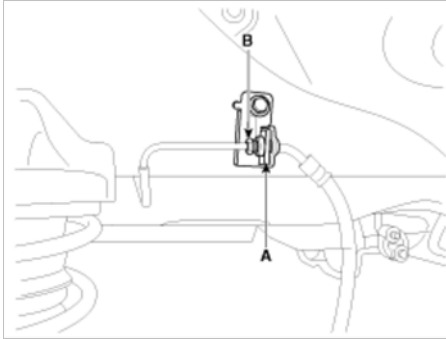
#### Tightening torque:

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

[Front]



[Rear]



5. Disconnect the brake tube by remove the brake hose clip (A).
6. Disconnect the brake hose from the brake caliper by loosening the bolt (C).

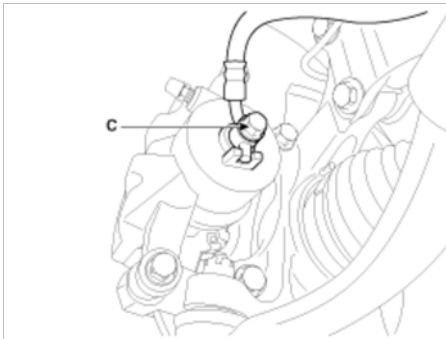
---

**Tightening torque:**

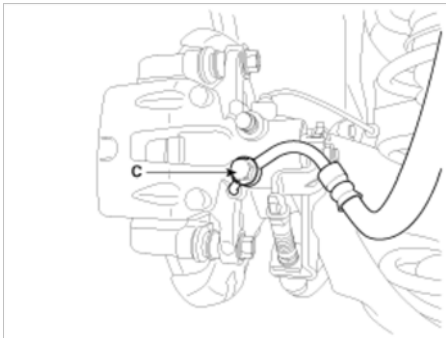
24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)

---

**[Front disc brake]**



**[Rear Disc brake]**



**Inspection**

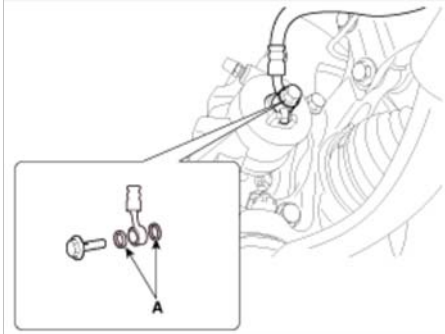
1. Check the brake tubes for cracks, crimps and corrosion.
2. Check the brake hoses for cracks, damage and fluid leakage.
3. Check the brake tube flare nuts for damage and fluid leakage.
4. Check brake hose mounting bracket for crack or deformation.

## Installation

1. Installation is the reverse of removal.

### CAUTION

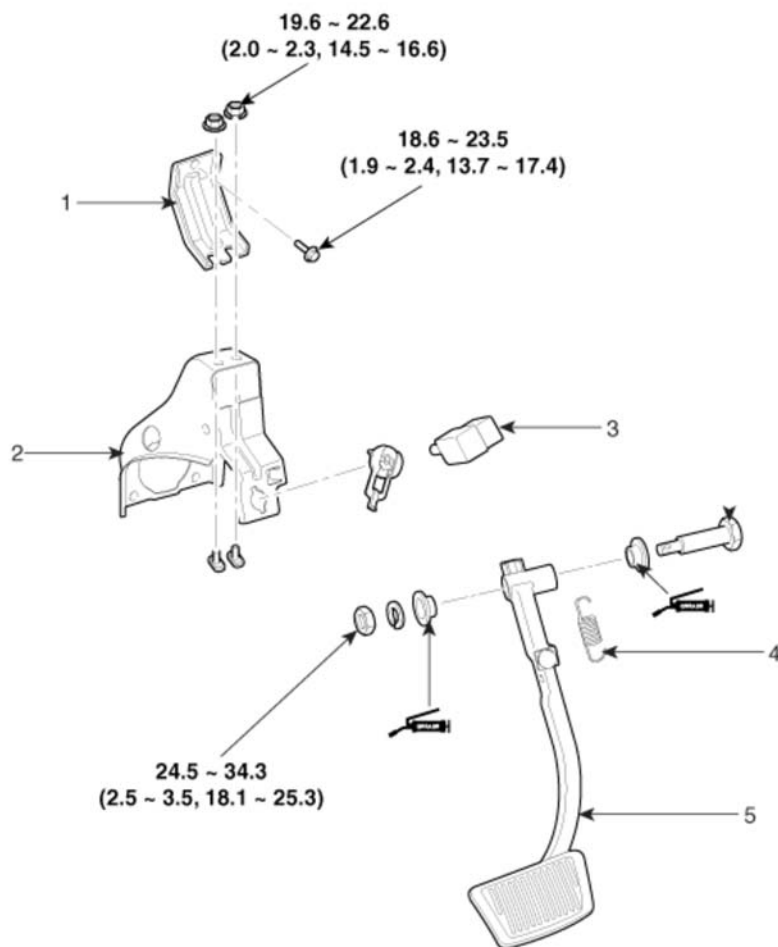
Use a new washer (A) whenever installing.



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)

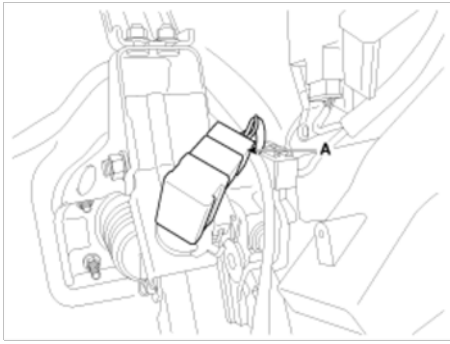
1. Cowl bracket
2. Brake pedal member assembly
3. Stop lamp switch

4. Return spring
5. Brake pedal
6. Brake pedal pad

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

### Removal

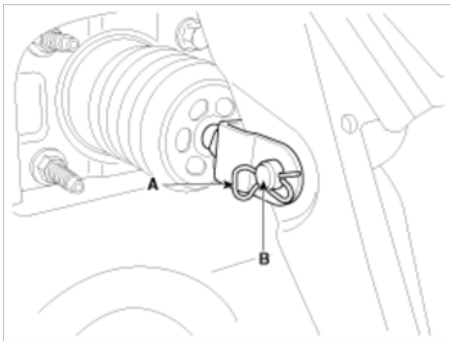
1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the crash pad lower panel.  
(Refer to the Body group - "Crash Pad")
3. Disconnect the stop lamp switch connector (A).



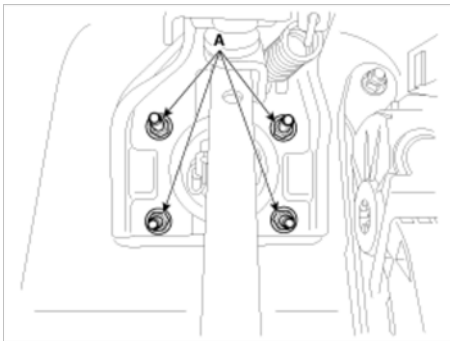
4. Remove the brake pedal member mounting bolt (A).



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



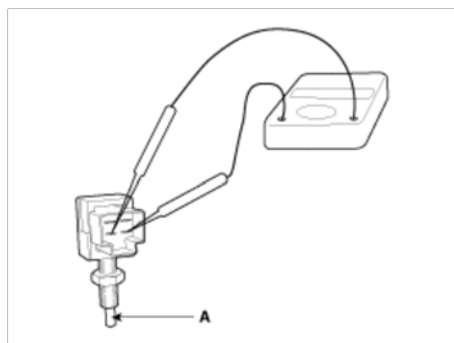
6. Remove the brake pedal member assembly mounting nuts (A) and then remove the brake pedal assembly.



## 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. Pre-tighten the bracket fixing bolt (A) in dash panel.



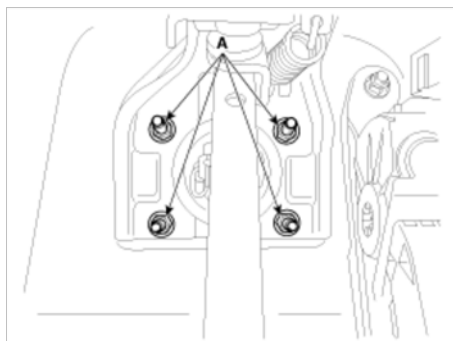
2. Install the brake booster and brake pedal member fixing nuts (A) securely.

---

### Tightening torque:

18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)

---



3. Tighten the bolt (A) securely in dash panel.

---

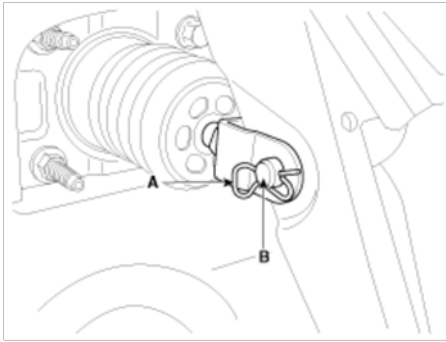
### Tightening torque:

18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)

---



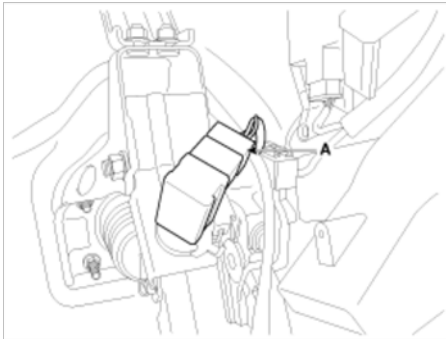
4. Install the snap pin (A) and clevis pin (B).



**CAUTION**

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

5. Install the stop lamp switch securely.
6. Connect the stop lamp switch connector (A).



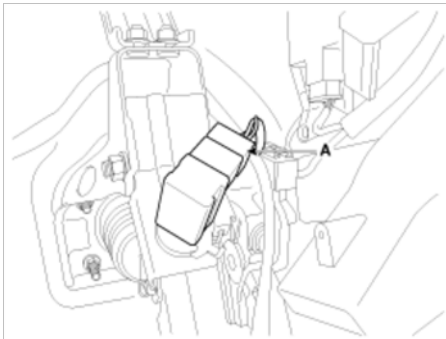
7. Adjust the brake pedal height and free play.
8. Check the brake pedal operation after installing the brake pedal.
9. Install the crash pad lower panel.
10. Reconnect the negative (-) battery cable.

## Adjustment

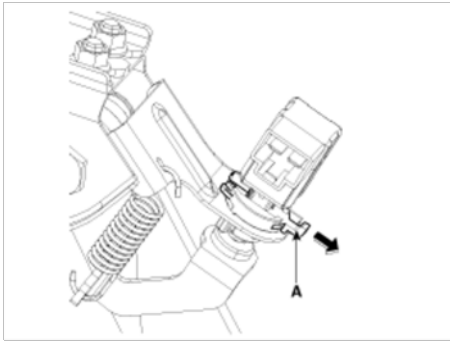
### Stop lamp switch clearance adjustment

If the gap between stop lamp switch and bracket is not 1.0 ~ 2.0mm(0.04~ 0.08in), conform to below.

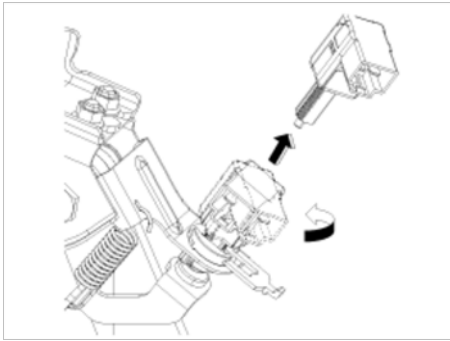
1. Disconnect the stop lamp switch connector (A).



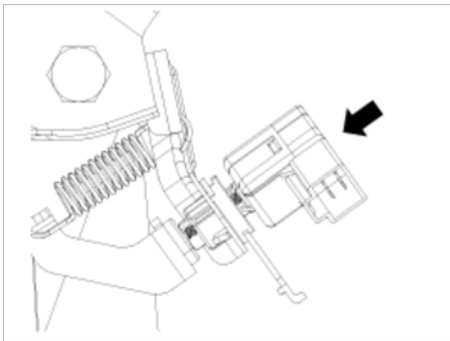
2. Pull the locking plate (A) as indicated by the arrow.



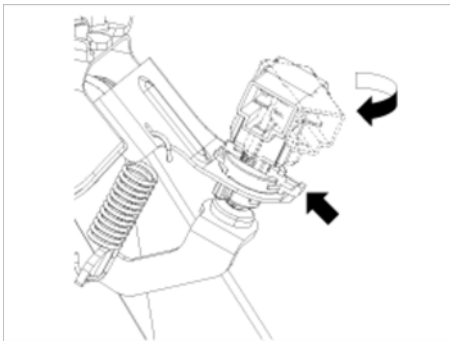
3. Turn stop lamp switch 45° counterclockwise and remove it.



4. Fix the brake pedal arm and insert fully the stop lamp switch as hiding contact part.



5. After inserting, turn the stop switch (A) 45° clockwise, and then assemble locking plate (B) by pushing.



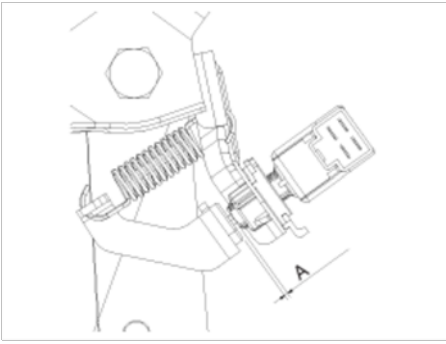
6. Confirm the gap between stop lamp switch and bracket.

---

**Stop lamp clearance:**

1.0 ~ 2.0 mm (0.04~ 0.08 in.)

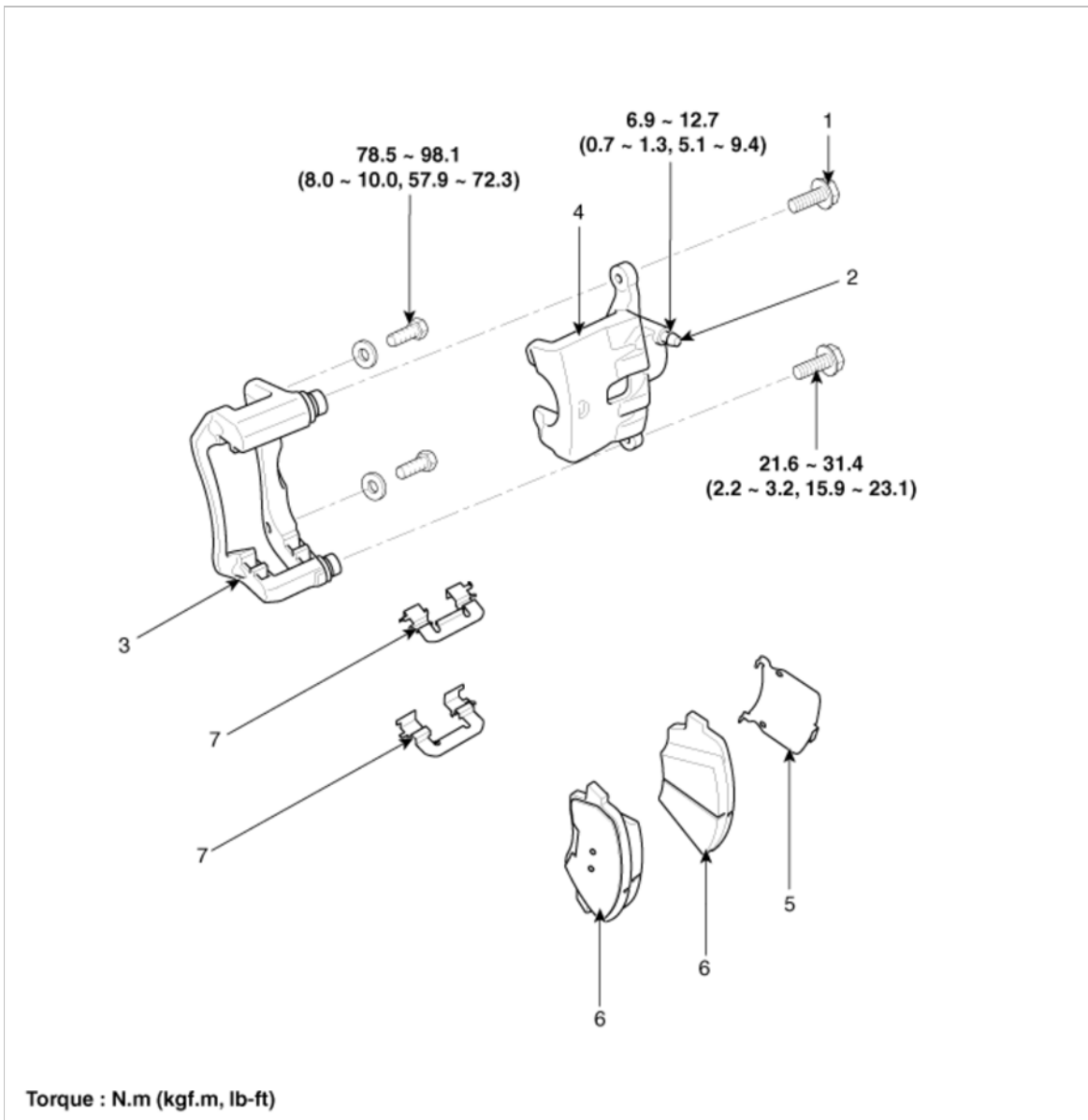
---



7. Connect the stop lamp switch connector.

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

### Components



1. Guide rod bolt
2. Bleed screw
3. Caliper body
4. Caliper carrier

5. Inner pad shim
6. Brake pad
7. Pad retainer

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

### Removal

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 eyebolt (C) and caliper mounting bolts (B), then remove the front caliper assembly (A).

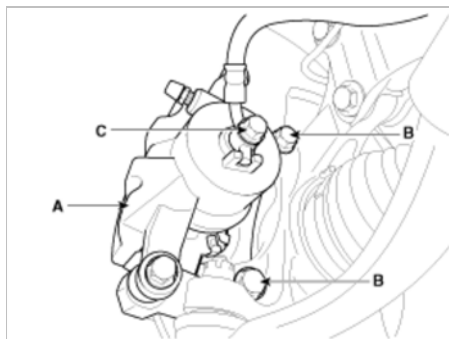
#### Tightening torque:

Brake hose to caliper (C):

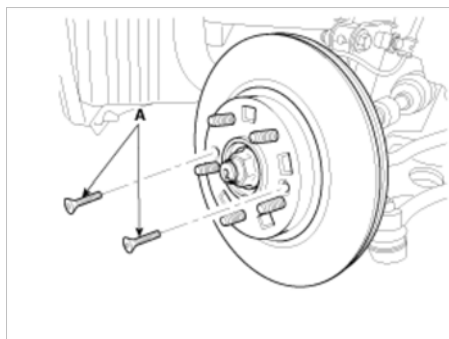
24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)

Caliper assembly to knuckle (B):

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 (A).



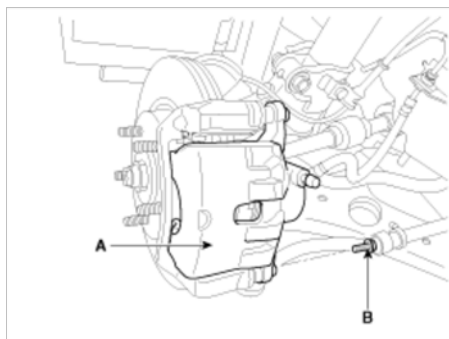
### Replacement

#### Front Brake Pads

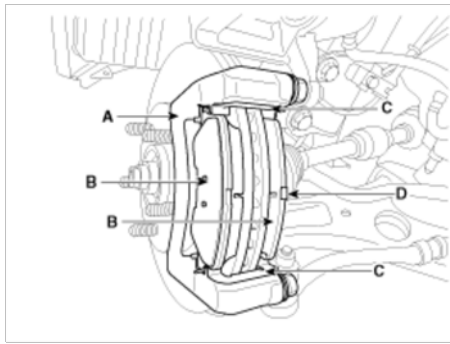
1. Loosen the guide rod bolt (B) and pivot the caliper (A) up out of the way.

#### Tightening torque:

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



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



## 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.

---

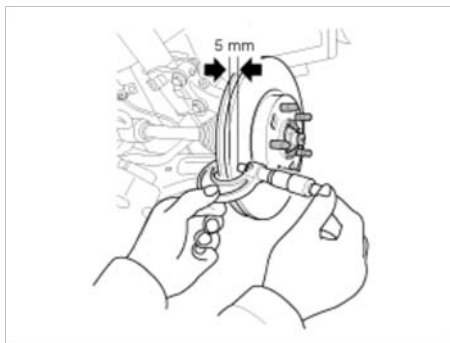
#### Brake disc thickness

Standard: 23 mm (0.906 in)

Service limit: 21.4 mm (0.842 in)

Deviation: Less than 0.005 mm (0.0002 in)

---



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

Standard value: 10.5 mm (0.41 in)

Service limit: 2.0 mm (0.0787 in)

---

2. Check the damage of pad, backing metal and contamination with grease.

### Front Brake Disc Runout Check

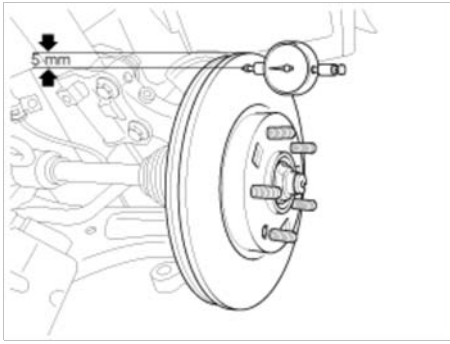
1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the runout of the disc.

---

#### Brake disc runout

Limit: 0.025 mm (0.001 in.) or less (new one)

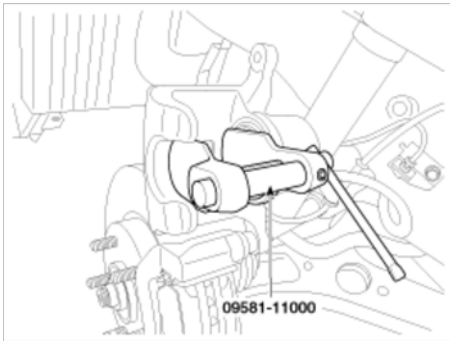
---



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 does not exceed 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

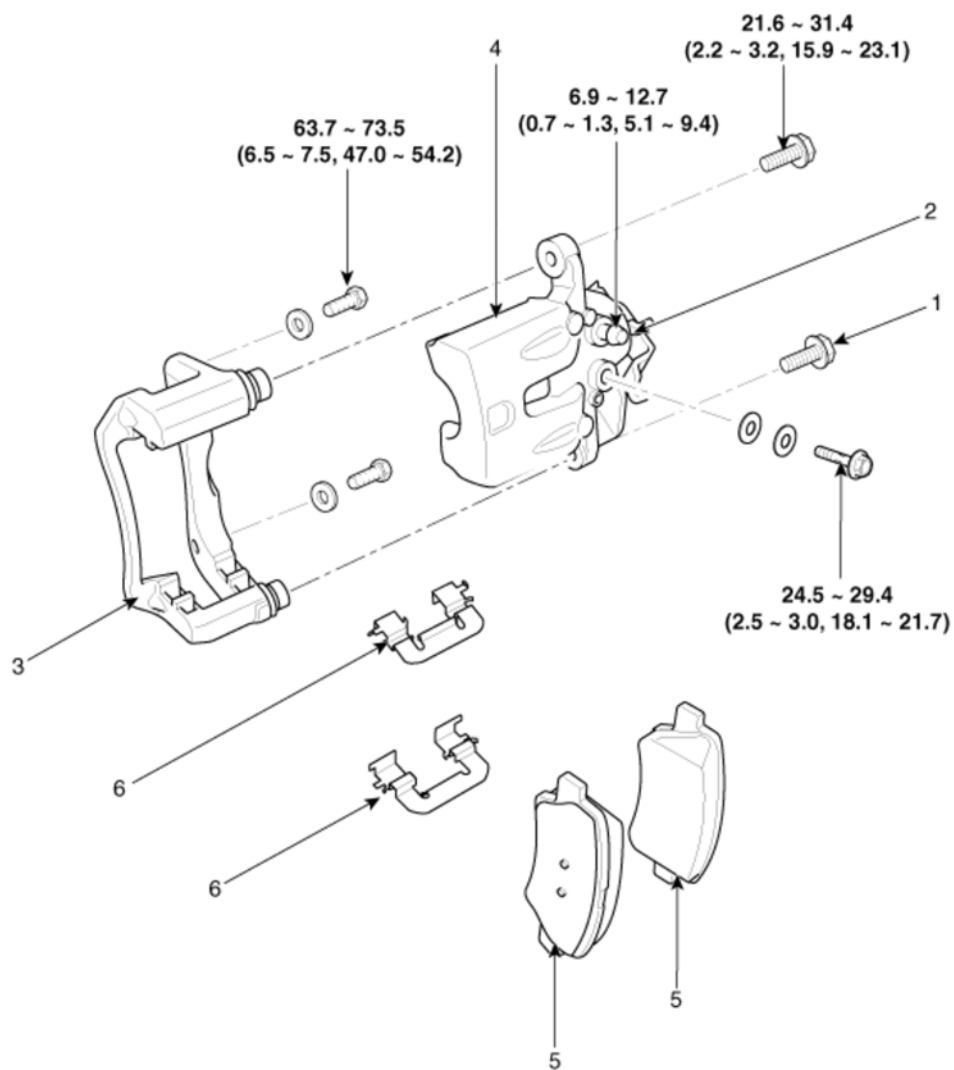
1. Installation is the reverse of removal.
2. Use a SST (09581-11000) when installing the brake caliper assembly.



3. After installation, bleed the brake system.  
(Refer to Brake system bleeding)

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

### Components



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

1. Guide rod bolt
2. Bleed screw
3. Caliper carrier

4. Caliper body
5. Brake pad
6. Pad retainer

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

### Removal

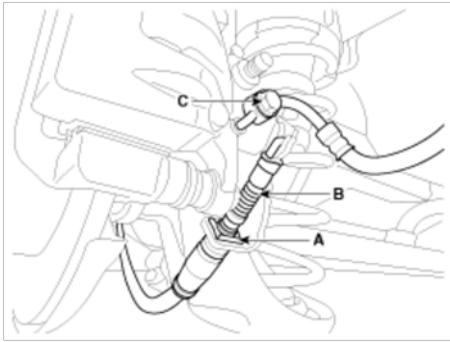
1. Remove the rear wheel & tire.

#### Tightening torque:

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

2. Release the parking lever and parking brake cable is loose.
3. Remove the parking brake cable (B), after removing the clip (A).





**NOTE**

Parking brake lever in the car must be in fully loosened position.

4. Remove the hose eyebolt (C).

**Tightening torque:**

Brake hose to caliper (C):

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

5. Loosen the caliper mounting bolts (B), then remove the rear caliper assembly (A).

**Tightening torque:**

Caliper assembly to carrier:

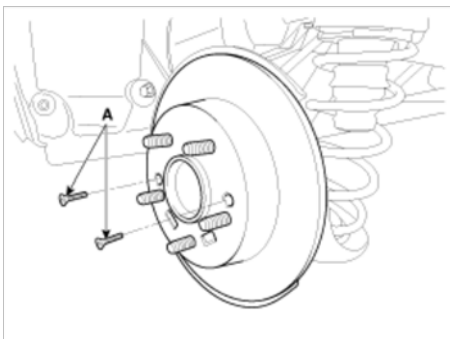
63.7 ~ 73.5 N.m (6.5 ~ 7.5 kgf.m, 47.0 ~ 54.2 lb-ft)



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

**Tightening torque:**

4.9 ~ 5.8 N.m (0.5 ~ 0.6 kgf.m, 3.6 ~ 4.3 lb-ft)



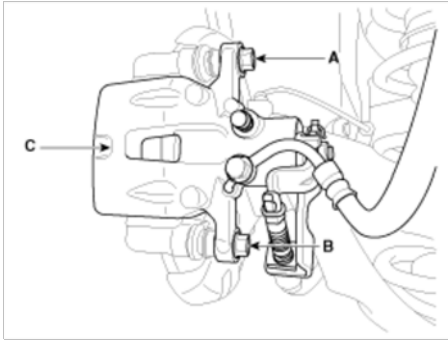
## Replacement

### Rear Brake Pads

1. Loosen the guide rod bolts (A,B) and then remove the rear caliper body (C).

**Tightening torque:**

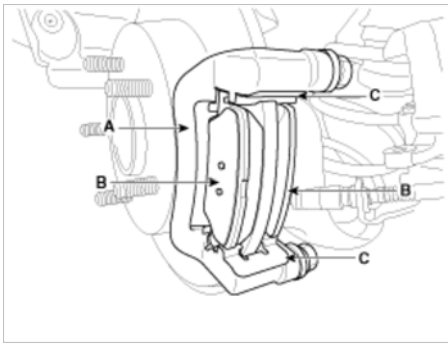
21.6 ~ 31.4 N.m (2.2 ~ 3.2 kgf.m, 15.9 ~ 23.1 lb-ft)



#### NOTE

- Where necessary prevent the guide rods from rotating with an appropriate wrench.
- Be careful not to damage the dust covers.

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



#### NOTE

- Clean the pad retainer surface at the caliper bracket.
- Inspect the piston boots for damage and replace if necessary.
- Check the smooth action of the guide rods, and their dust covers for damage.

## Inspection

### Rear Brake Disc Thickness Check

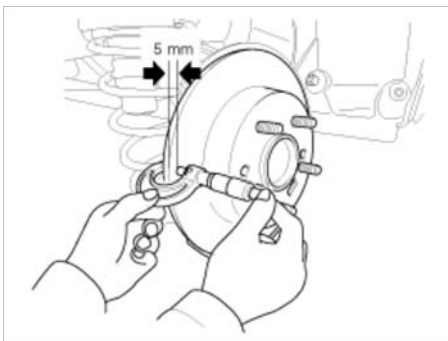
1. Check the brake pads for wear and fade.
2. Check the brake disc for damage and cracks.
3. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

#### Brake disc thickness

Standard: 10 mm (0.394 in)

Service limit: 8.4 mm (0.331 in)

Deviation: less than 0.01 mm (0.00039 in)



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

Standard value: 10 mm (0.394 in)

Service limit: 2.0 mm (0.0787 in)

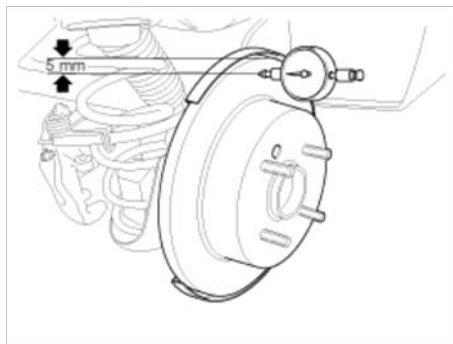
2. Check the damage of pad, backing metal and contamination with grease.

### 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

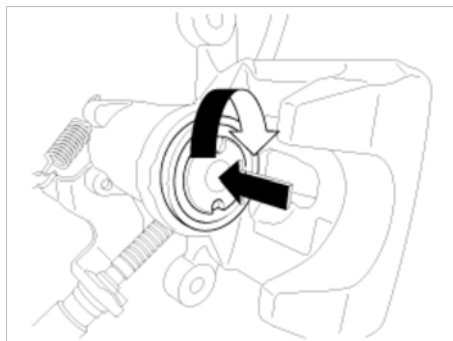
Limit: 0.03 mm (0.0012 in.) or less (new one)



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.

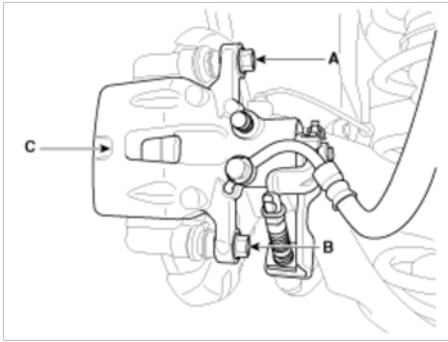
### Installation

1. Installation is the reverse of removal.
2. Rotate the caliper piston and push the direction of the arrow.



#### NOTE

- Wind the piston into the caliper body until it is fully retracted.
- Do not use any power assisted tools for this task.
- Manually insert new screws from the brake pad and tighten the leading-pin bolt(A) first with specified torque, following this tighten the trailing-pin bolt(B) in the same manner.



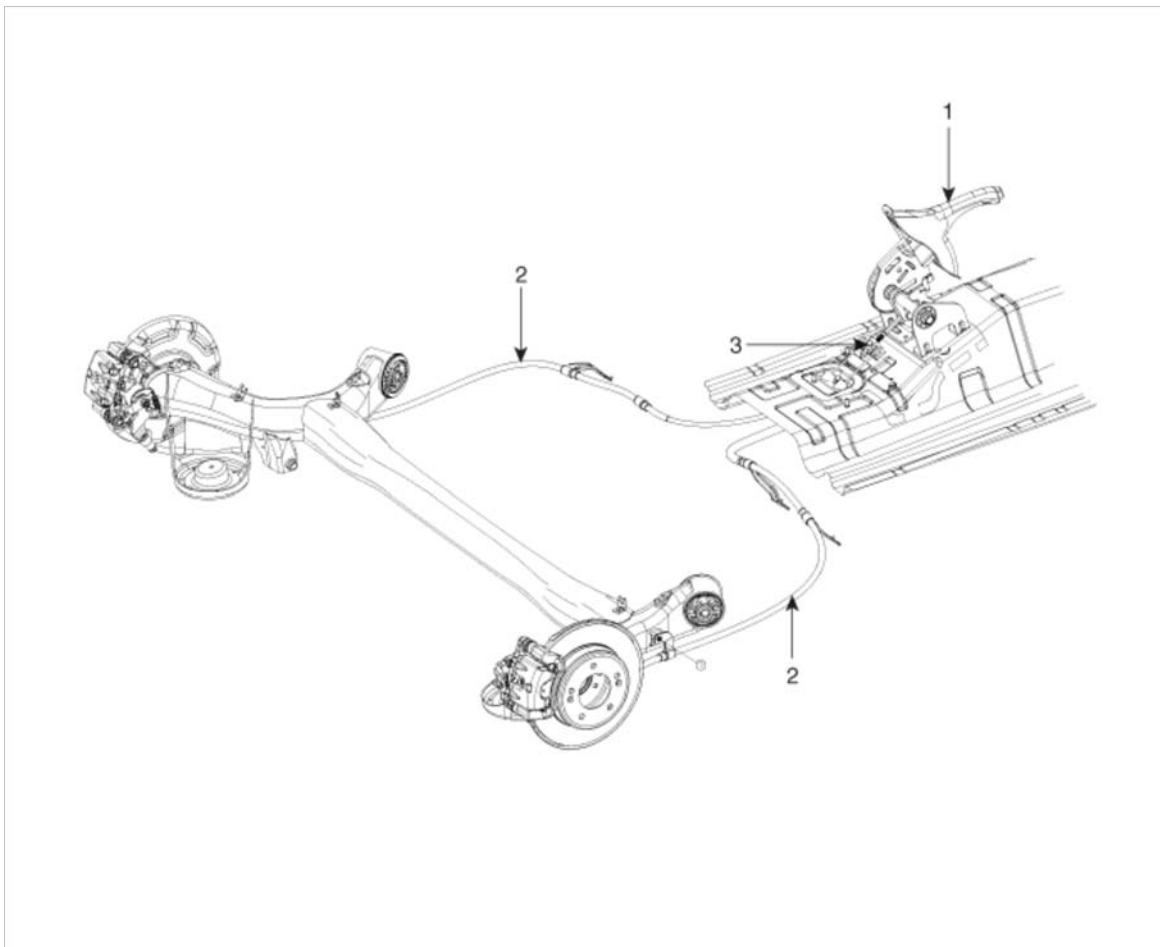
3. After installation, bleed the brake system.  
(Refer to Brake system bleeding)

**NOTE**

- Bring the brake pads in their operating position by pressing the brake pedal down (half of normal pedal travel) several times until there is resistance.
- In order to bed the brake pads to the brake disc and ensure performance and endurance, the vehicle user must be instructed to avoid heavy braking or sustained periods with the brakes applied, for the first 200km(124mile) after installing new pads.
- Re-setting of the parking brake is necessary after overhauling the caliper body, or if the brake calipers, caliper body, parking brake cable or brake discs have been changed.

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

**Components**



1. Parking brake lever  
2. Parking brake cable

3. Equalizer assembly

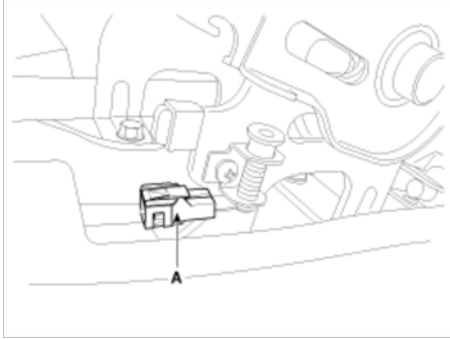
## Brake System > Parking Brake System > Parking Brake Assembly > Repair procedures

### Removal

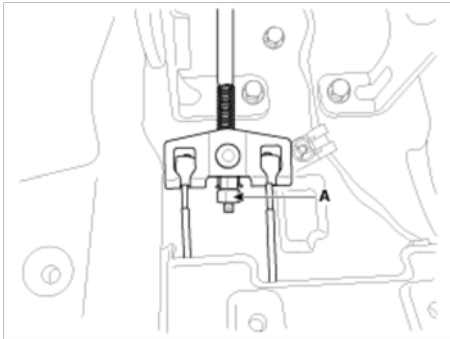
#### NOTE

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



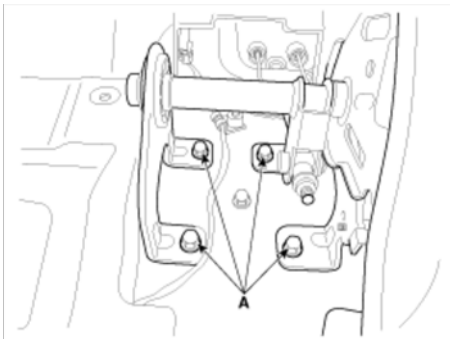
3. Loosen the adjusting nut (A) and the parking brake cables.



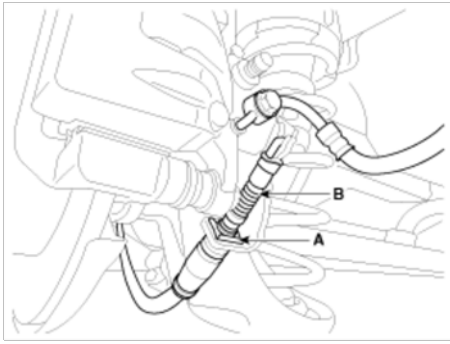
#### NOTE

Parking brake lever in the car must be in fully loosened position.

4. Remove the parking brake lever assembly after removing the bolts (A).



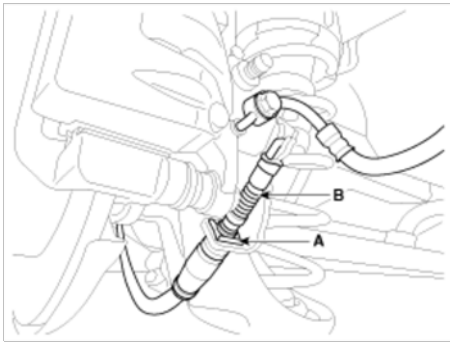
5. Raise the vehicle, and make sure it is securely supported.
6. Remove the rear tire and wheel.
7. Remove the parking brake cable (B), after removing the clip (A).



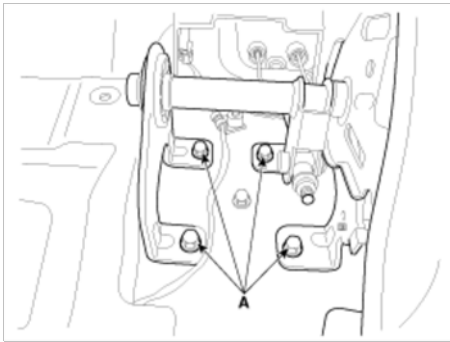
8. Loosen the parking brake cable bracket bolts and remove the parking brake cable.

## Installation

1. Install the parking brake cable.
2. Install the parking brake cable (B), and then install the clip (A).



3. Install the rear tire and wheel.
4. Install the parking brake lever assembly.



5. Install the parking brake cable.



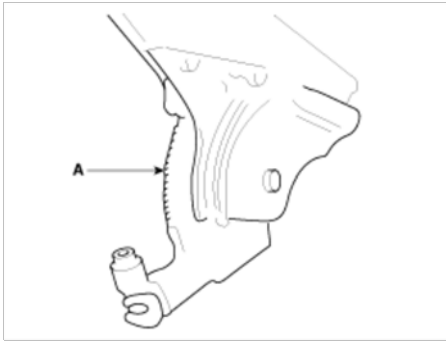
6. Apply a coating of the specified grease to each sliding parts (A) of the ratchet plate or the ratchet pawl.

---

### Specified grease:

Multi purpose grease SAE J310, NLGI No.2

---



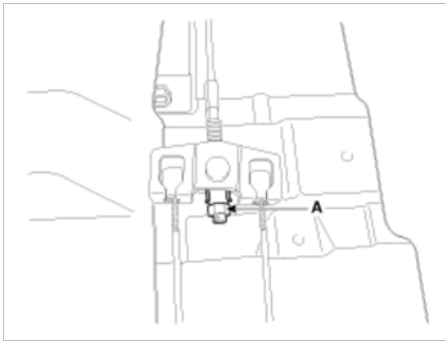
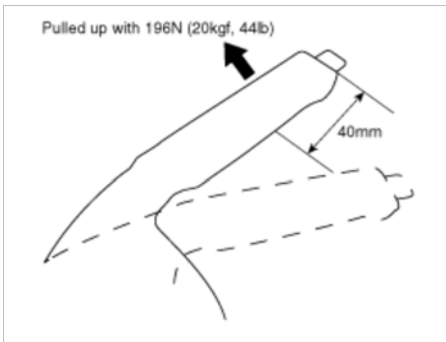
7. Install the parking brake cable adjuster, then adjust the parking brake lever stroke by turning adjusting nut (A).

**Parking brake lever stroke:**

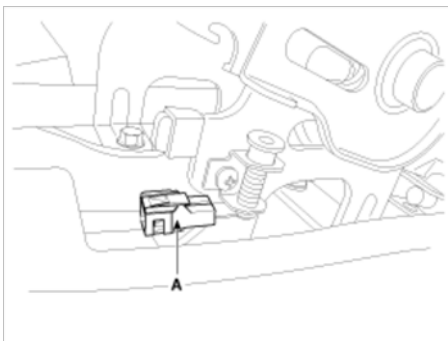
6 ~ 8 clicks (Pull the lever with 196N (20 kgf, 44 lbf))

**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")



8. Release the parking brake lever fully, and check that parking brakes do not drag when the rear wheels are turned. Readjust if necessary.
9. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up fully.
10. 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

---

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

## Adjustment

### Parking Brake Lever Stroke Adjustment

1. Remove the floor console tray mat (A).



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

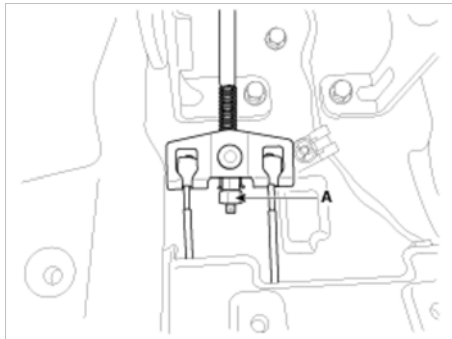
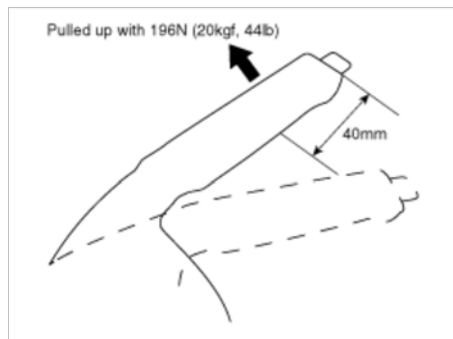
#### Parking brake lever stroke:

6 ~ 8 clicks (Pull the lever with 196N (20 kgf, 44 lbf))

---

#### 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")



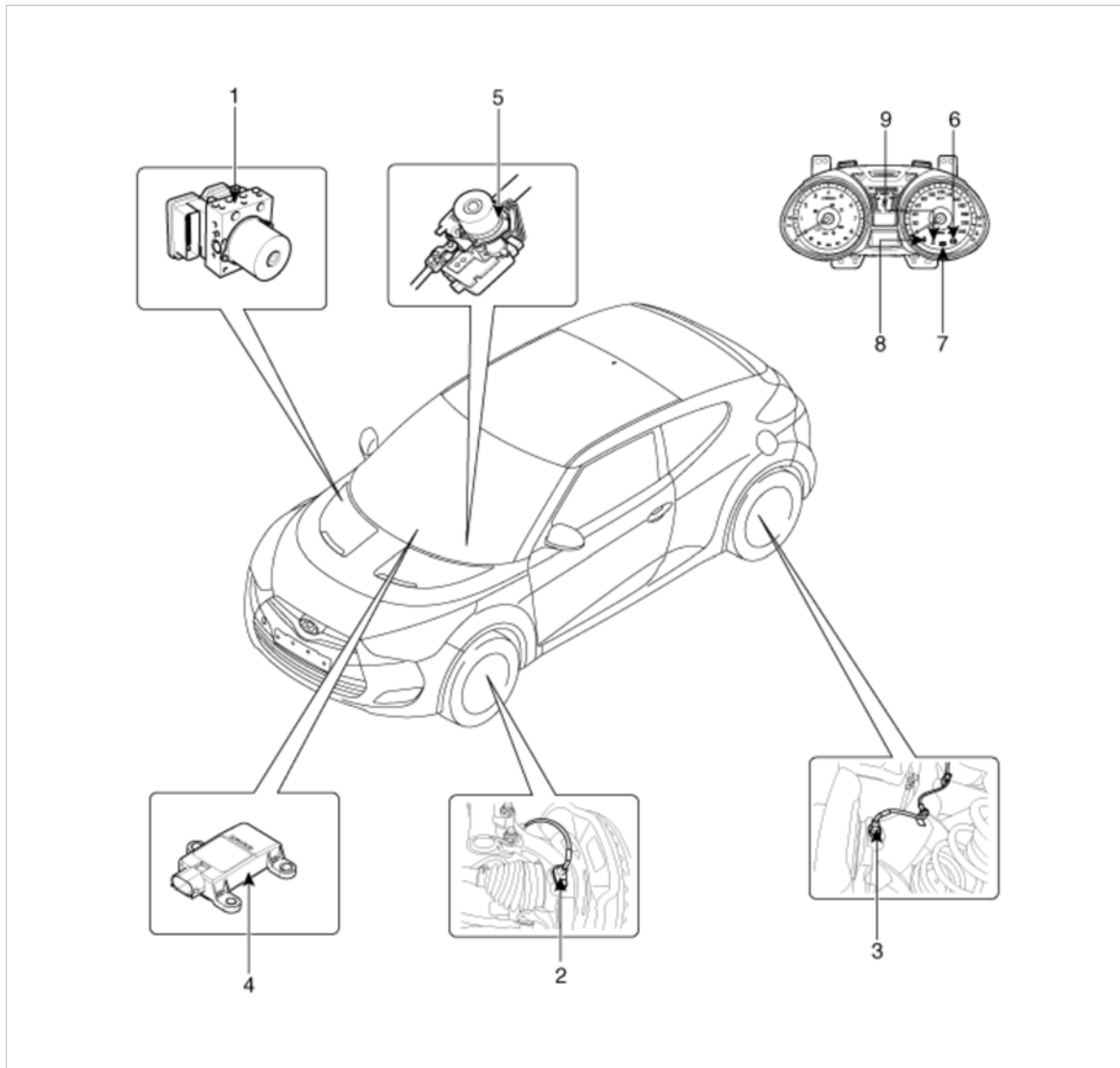
3. Release the parking brake lever fully, and check that parking brakes do not drag when the rear wheels are turned. Readjust if necessary.
4. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up fully.
5. Install the floor console tray mat (A).





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

### Components



1. HECU module
2. Front wheel speed sensor
3. Rear wheel speed sensor
4. Yaw rate & G sensor
5. Steering angle sensor

6. ABS Warning lamp
7. Parking brake/EBD warning lamp
8. ESC OFF lamp
9. 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.

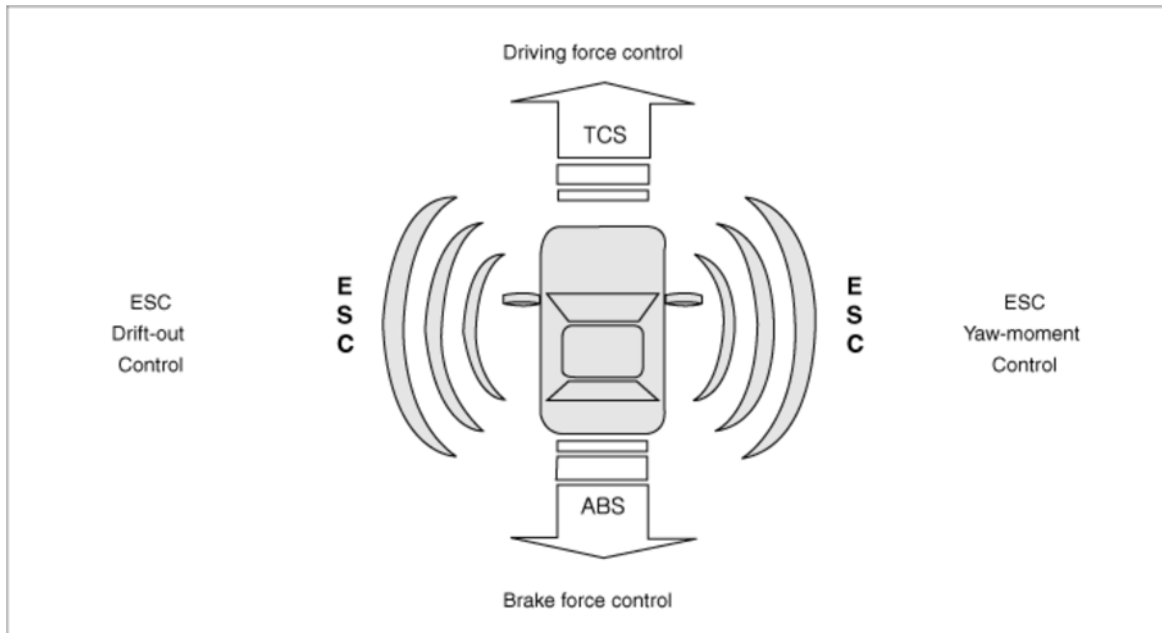
ESC adds a further function known as Active Yaw Control (AYC) to the ABS, TCS, EBD and ESC functions. Whereas the ABS/TCS function controls wheel slip during braking and acceleration and, thus, mainly intervenes in the longitudinal dynamics of the vehicle, active yaw control stabilizes the vehicle about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

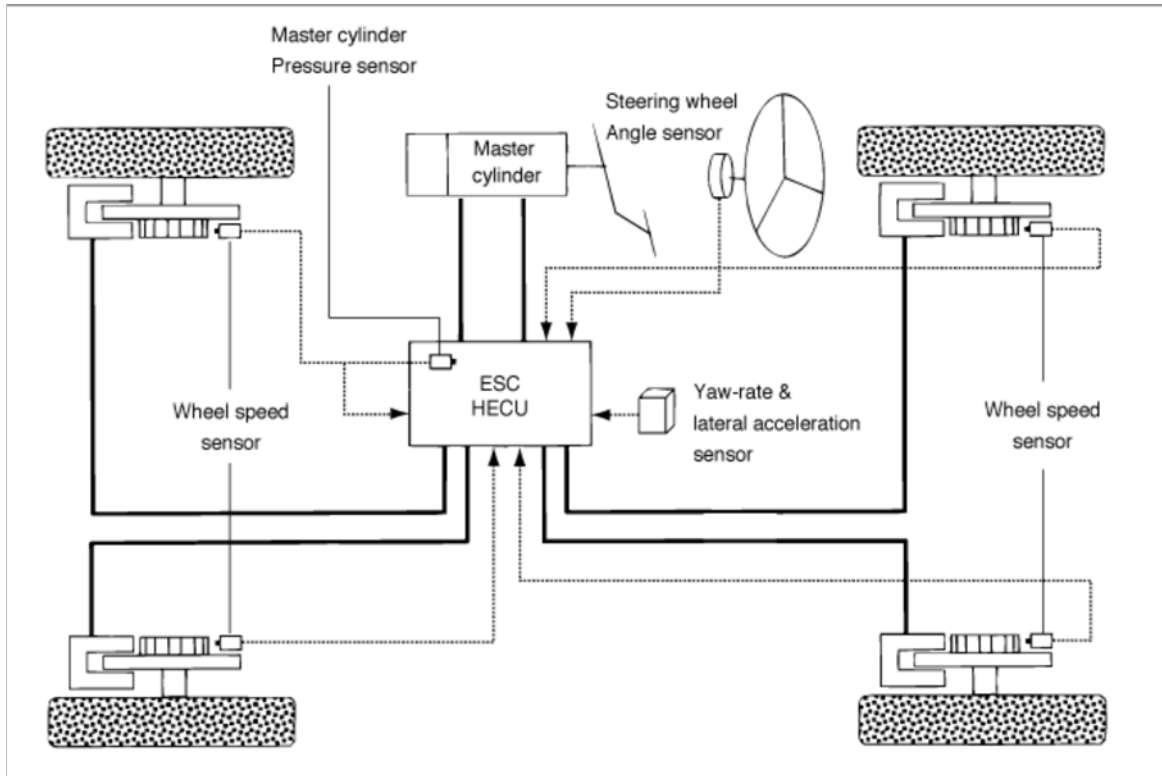
ABS/EBD function : The ECU changes the active sensor signal (current shift) coming from the four wheel sensors to the square wave. By using the input of above signals, the ECU calculates the vehicle speed and the acceleration & deceleration of the four wheels. And, the ECU judges whether the ABS/EBD 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.

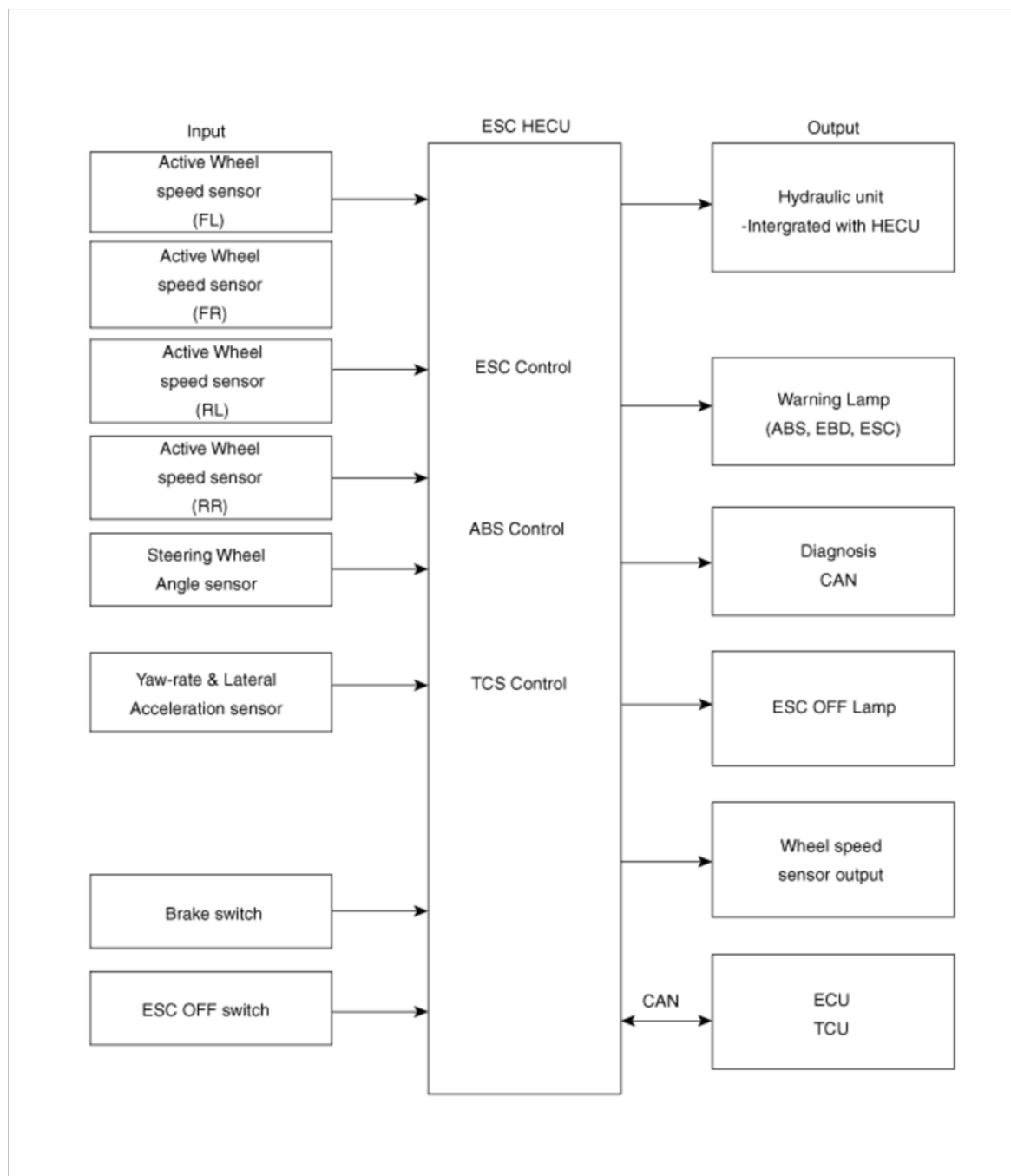
AYC function prevents unstable maneuver of the vehicle. To determine the vehicle maneuver, AYC function uses the maneuver sensor signals(Yaw Rate Sensor, Lateral Acceleration Sensor, Steering Wheel Angle Sensor).

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)

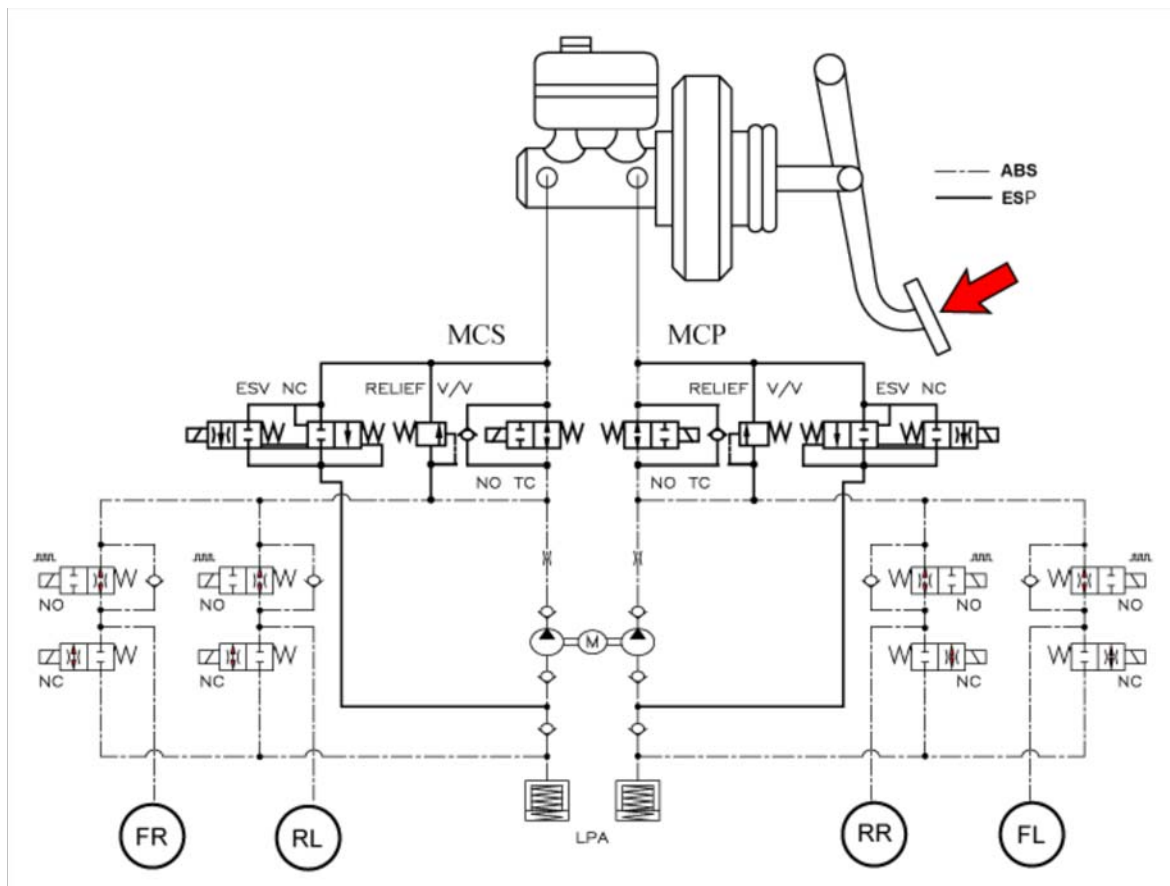


**Input and Output Diagram**



## ESC Operation Mode

### ESC Hydraulic System Diagram

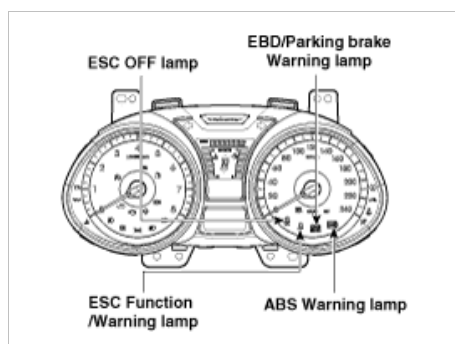


1. ESC Non-operation : Normal braking.

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	ON	ON
	OUT(NC)	OFF		
Oversteering (Only outside of front wheel)	IN(NO)	OFF		
	OUT(NC)	OFF		



## 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.
- Cluster lamp is ON when communication is impossible with CAN module.

### 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.
- Cluster lamp is ON when communication is impossible with CAN module.

### ESC function/warning lamp (ESC system)

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

The ESC function/warning lamp is turned on under the following conditions :

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the ESC function is inhibited by system failure.
- When the ESC control is operating. (Blinking - 2Hz)
- During diagnostic mode.(Except standard mode)
- Cluster lamp is ON when communication is impossible with CAN module.

### ESC Off Lamp (ESC system)

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

The ESC Off lamp operates under the following conditions :

- During the initialization mode after IGN ON. (continuously 3 seconds).
- ESC Off lamp is On when driver input the ESC Off switch.

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

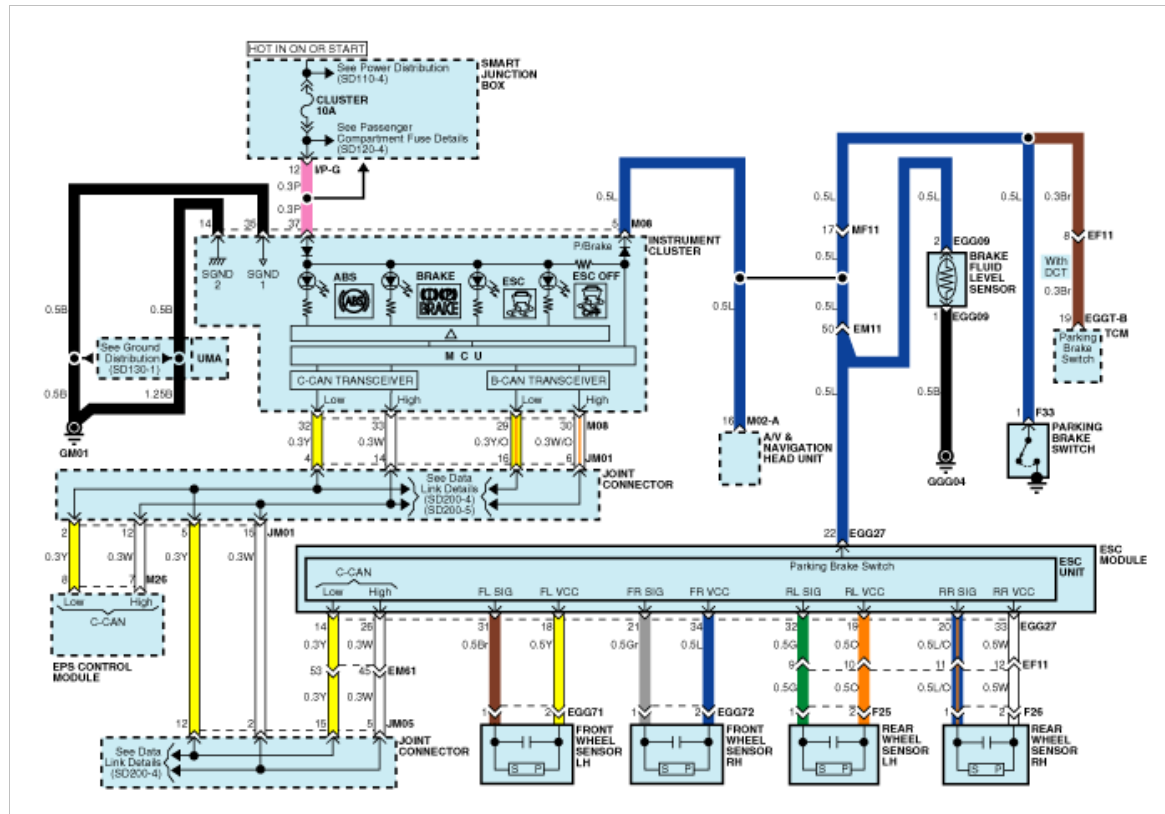
The ESC On/Off Switch shall be used to toggle the ESC function between On/Off states based upon driver input.

The On/Off switch shall be a normally open, momentary contact switch. Closed contacts switch the circuit to ignition.

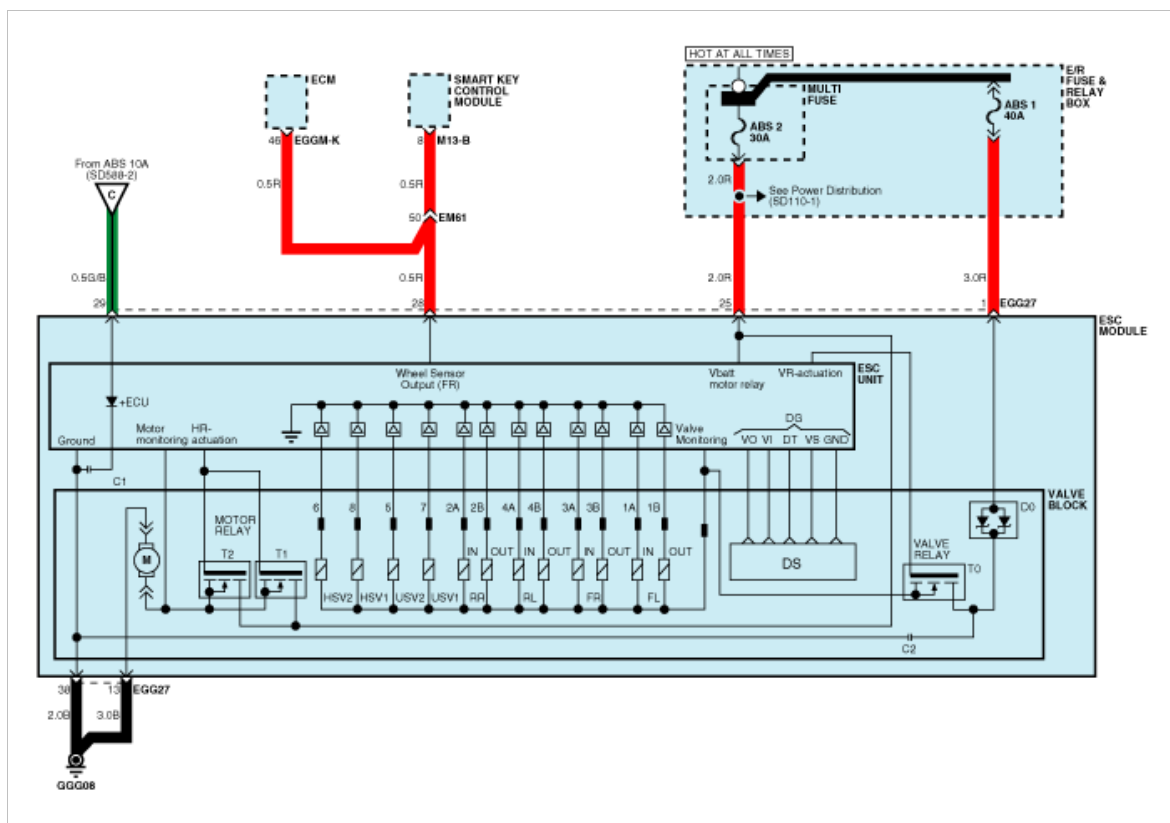
Initial status of the ESC function is on and switch toggle the state.

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

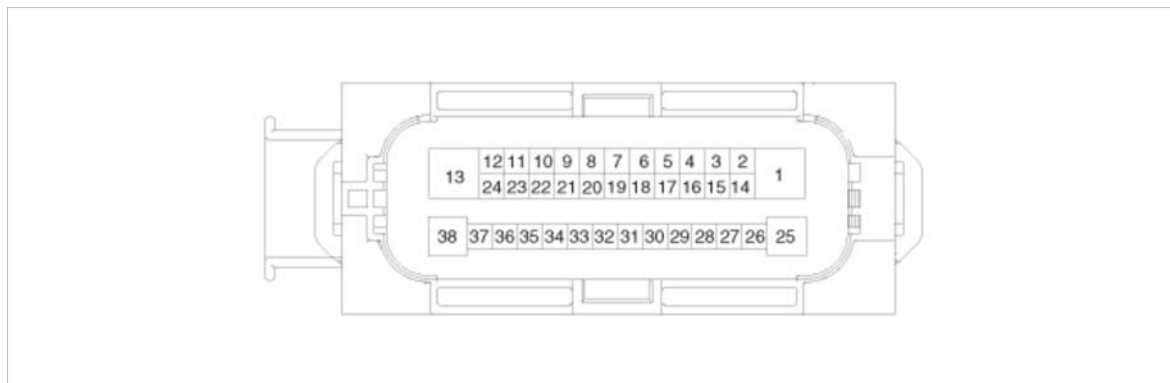
### Circuit Diagram - ESC (1)







## ESC connector input/output



Connector Terminal		Specification	Remark
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 : $I < 0.25mA$	
1	POS. BATTERY 2.(MOTOR)	Operating voltage range: $10.0 \pm 0.5V < V < 16.0 \pm 0.5V$ Rush current : $I < 110A$ Max current : $I < 40A$ Max leakage current : $I < 0.25mA$	



38	GROUND	Rated current : I < 550mA Max. current: I < 40A	
13	PUMP MOTOR GROUND	Rush current : I < 110A Max current : I < 40A	
11	SENSOR GROUND	Rated current : I < 250mA	
4	SENSOR POWER	Max current Capability : I < 250mA Max voltage : V_BAT1 -0.8V	
23	BRAKE LIGHT SWITCH	Input voltage (Low) : V < 2.0V Input voltage (High) : V > 6.0V Max. Input current : I < 3mA (@12.8V)	
10	ESC ON/OFF SWITCH		
9	BRAKE SWITCH		
22	PARKING BRAKE SWITCH	Input voltage (Low) : V < 2.0V Input voltage (High) : V > 6.0V Max input current : I < 5mA (@12.8V)	
28	SENSOR FRONT RIGHT OUTPUT	External pull up resistance : 1 K $\Omega$ < R Output duty : 50 $\pm$ 20%	
14	CAN BUS LINE(LOW)	Max. Input current : I < 10mA	
26	CAN BUS LINE(HIGH)		
18	SENSOR FRONT LEFT POWER	Output voltage : V_BAT1 -0.6V ~ V_BAT1 -1.1V Output current : Max 30mA	
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 ~ 8.4mA Input current HIGH : 11.8 ~ 16.8mA Frequency range : 1 ~ 2,500Hz 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 < 10mA	
24	CAN SENSOR LINE (LOW)		
8	HAC RELAY DRIVE	Max. current : I < 180mA Max output voltage : V < 1.2V	
36	HAC RELAY STATE MONITORING	Input voltage (Low) : V < 2V Input voltage (High) : V > 6V Max input current : I < 10mA (@12.8V)	

## 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. 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.
4. Initial checkup is made in the following cases.
  - (1) When the failure is not detected now
  - (2) When ABS and ESC are not in control.

- (3) Initial checkup is not made after ECU power on.
- (4) If the vehicle speed is over 5 mph(8 km/h) when the brake lamp switch is off.
- (5) When the vehicle speed is over 24.8 mph(40 km/h).
- 5. Though, it keeps on checkup even if the brake lamp switch is on.
- 6. When performing ABS or ESC control before the initial checkup, stop the initial checkup and wait for the HECU power input again.
- 7. Judge failure in the following cases.
  - (1) When the power is normal.
  - (2) From the point in which the vehicle speed reaches 4.9 mph(8 km/h) after HECU power on.

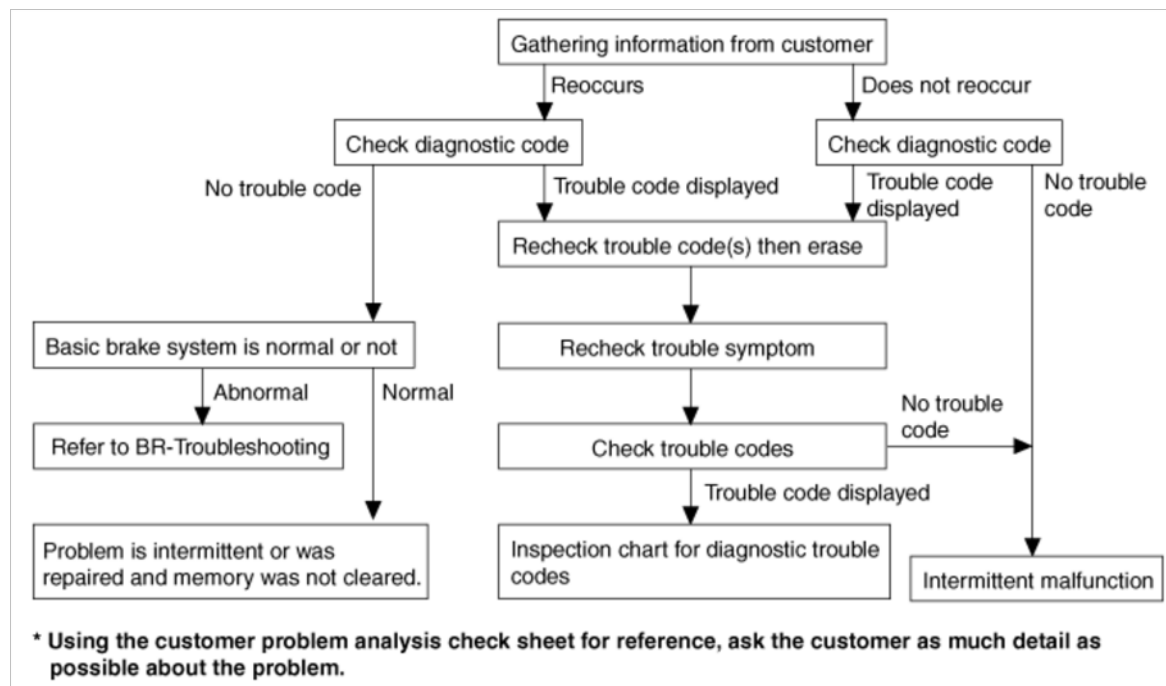
### Countermeasures in Fail

- 1. 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 warning lamp turn on for 3sec after IGN ON.
- 2. ESC function lamp blinks when ESC Act.
- 3. If ESC fail occurred, ESC warning lamp turns ON.
- 4. ESC OFF lamp turn on in case of
  - A. ESC Switch OFF
  - B. 3sec after IGN ON

### Standard Flow of Diagnostic Troubleshooting



### Notes With Regard To Diagnosis

The phenomena listed in the following table are not abnormal.

Condition	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release (Thump : suspension; squeak: tires)

ABS operation (Long braking distance)	For road surfaces such as snow-covered and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed.
Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.	

## ABS Check Sheet

<div style="border: 1px solid black; display: inline-block; padding: 5px 20px;"><b>ABS Check Sheet</b></div>		Inspector's Name _____	
Customer's Name		Registration No.	
		Registration Year	/   /
		VIN.	
Date Vehicle Brought In	/   /	Odometer	Km Miles

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

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

Diagnostic Trouble Code Check	1st Time	<input type="checkbox"/> Normal Code	<input type="checkbox"/> Malfunction Code (Code   )
	2nd Time	<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**

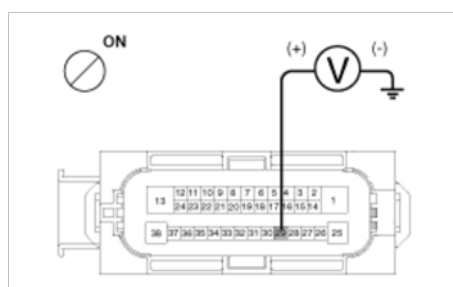
1. Connect the GDS with the data link connector and turn the ignition switch ON.
2. Verify that the DTC code is output.
3. Is the DTC code output?

<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+



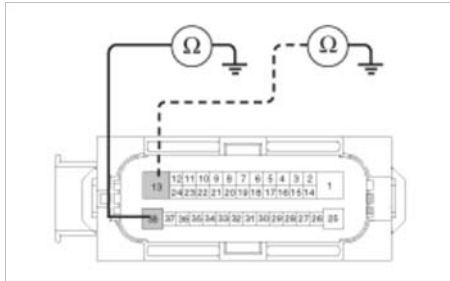
3. Is the voltage within specification?

<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

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 DTC code is output.
3. Is the DTC 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

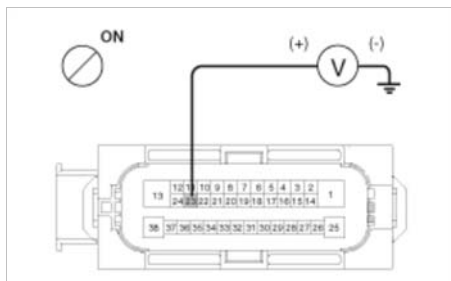
1. Refer to the DTC troubleshooting procedures.
2. Is it normal?

<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.
2. 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+



3. 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

1. Refer to the hydraulic lines.
2. Inspection 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.

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

#### Detecting condition

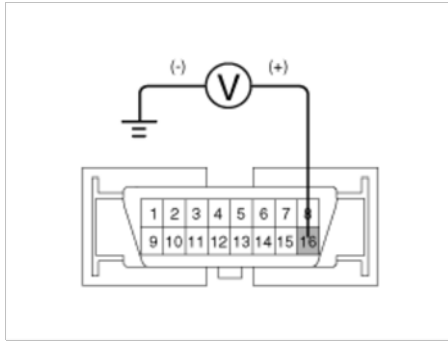
Trouble Symptoms	Possible Cause
Possible defect in the power supply system (including ground) for the diagnosis line.	<ul style="list-style-type: none"> <li>- An open in the wire</li> <li>- Poor ground</li> <li>- Faulty power source circuit</li> </ul>

### Inspection procedures

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

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

**Specification** : approximately B+

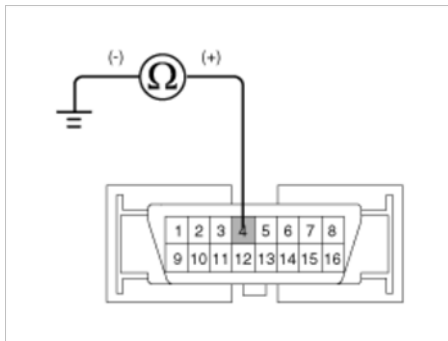


2. Is voltage within specification?

<b>YES</b>	▶ Check the ground circuit for the diagnosis.
<b>NO</b>	▶ Repair an open in the wire. Check and replace fuse 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

Trouble Symptoms	Possible Cause
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 CAN Line

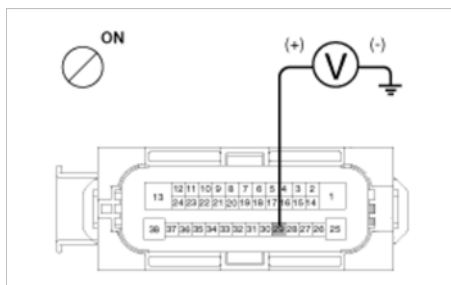
1. Disconnect the connector from the ESC control module.
2. Check for continuity between terminals 26, 14 of the ESC control module connector and 6, 14 of the data link connector.
3. Is there continuity?

<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+

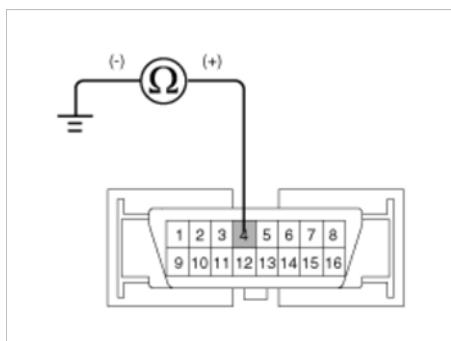


3. Is voltage within specification?

<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?

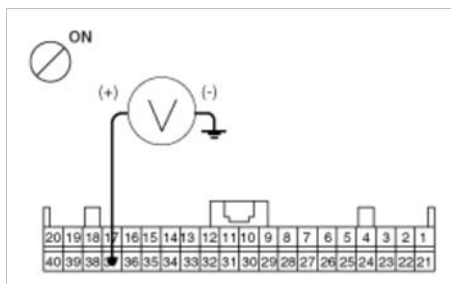
<b>YES</b>	► Inspect again after replacing the ESC HECU.
<b>NO</b>	► Check the power source for the ABS warning lamp.

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

1. Disconnect the instrument cluster connector (M08) and turn the ignition switch ON.
2. Measure the voltage between terminal (M08) 37 of the cluster harness side connector and body ground.

**Specification :** approximately B+





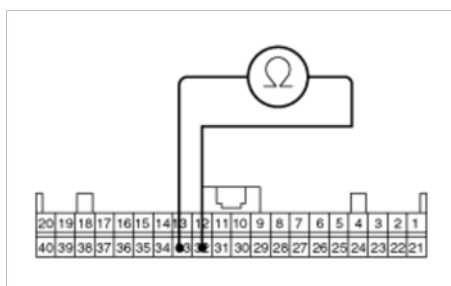
3. Is voltage within specification?

<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 (M08) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M08) 33 and 32 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 (M08) and ESC HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M08) 33 of the cluster harness side connector and terminal 26 of ESC HECU harness side.  
Check for continuity between terminal (M08) 32 of the cluster harness side connector and terminal 14 of ESC HECU harness side.

**Specification** : Below 1Ω

3. Is resistance within specification?

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

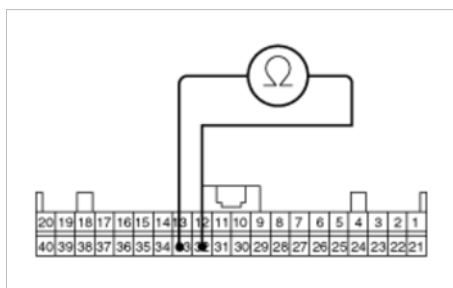
1. Connect the GDS to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using GDS.
3. Is DTC output?

<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 (M08) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M08) 33 and 32 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 (M08) and ESC HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M08) 33 of the cluster harness side connector and terminal 26 of ESC HECU harness side.  
Check for continuity between terminal (M08) 32 of the cluster harness side connector and terminal 14 of ESC HECU harness side.

**Specification :** Below 1Ω

3. Is resistance within specification?

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

## 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. 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.
3. Connect the GDS to the data link connector located underneath the dash panel.
4. Select and operate according to the instructions on the GDS screen.

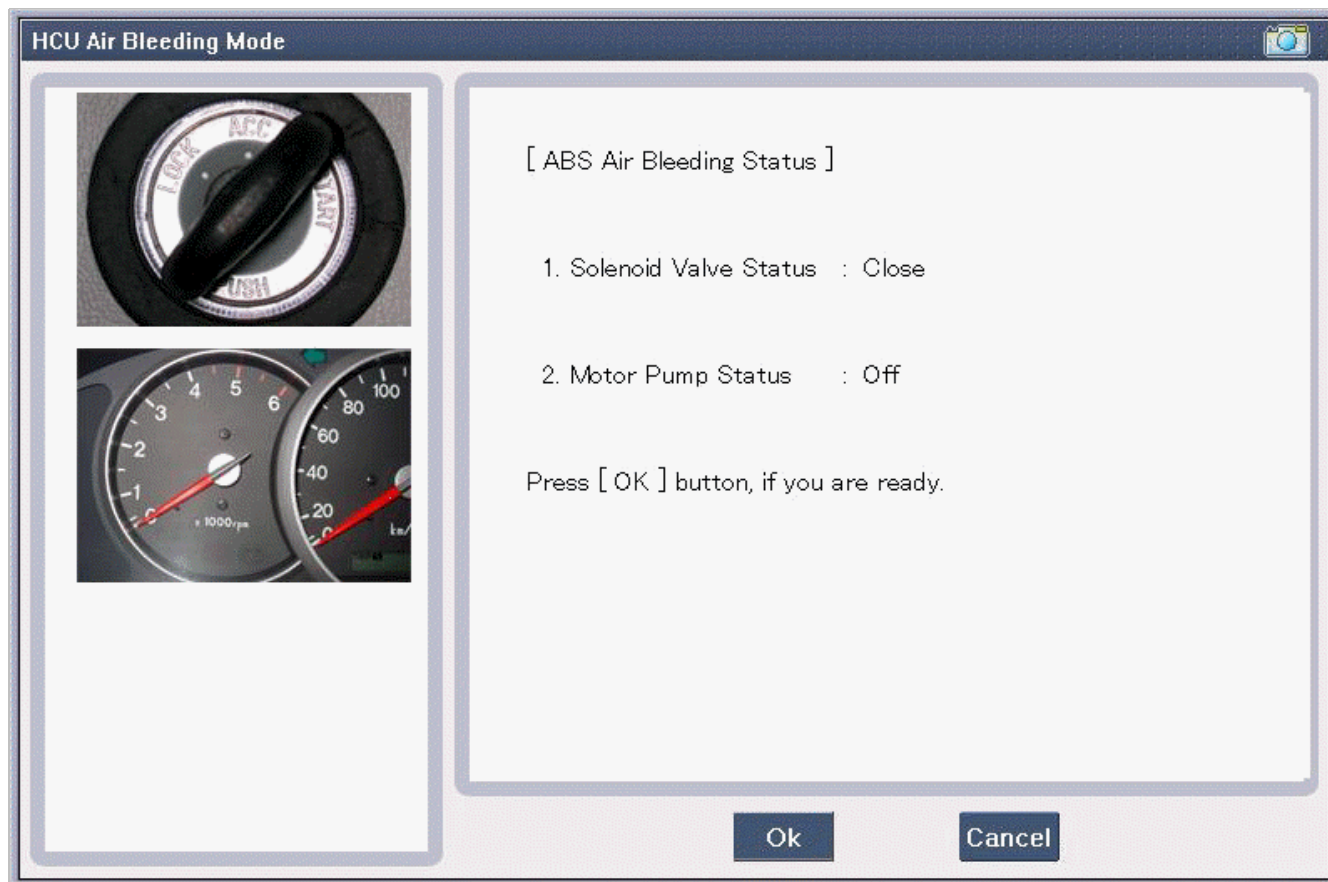
**CAUTION**

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

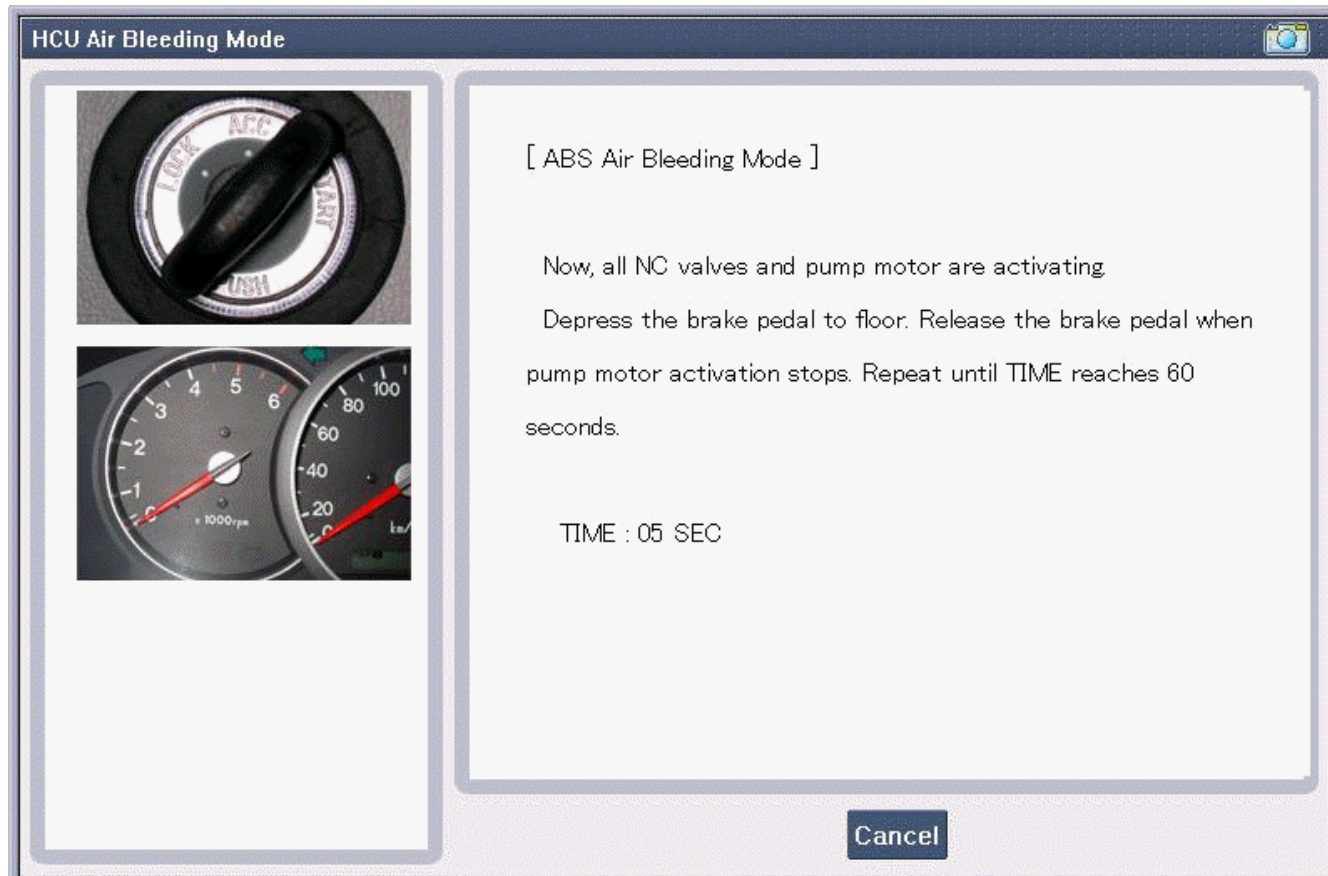
- (1) Select vehicle name.
- (2) Select Anti-Lock Brake system.
- (3) Select HCU air bleeding mode.

The screenshot shows a software interface with two main sections. The first section is titled 'ID Register' and contains a single button labeled 'System Identification' with a right-pointing arrow icon. The second section is titled 'Inspection / Test' and contains a single button labeled 'HCU Air Bleeding Mode' with a right-pointing arrow icon. The buttons are highlighted with a light purple background.

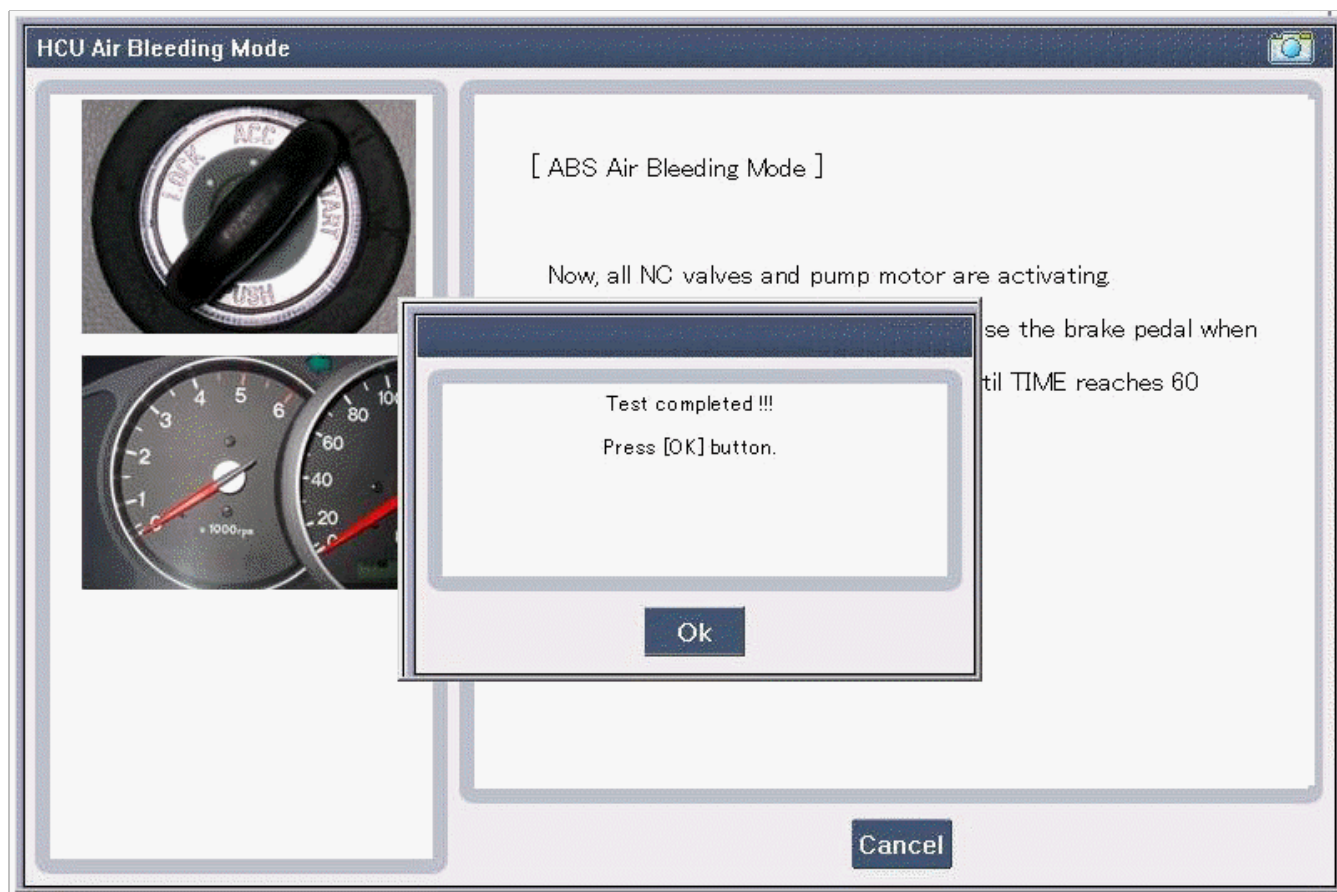
- (4) Press "OK" to operate motor pump and solenoid valve.



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

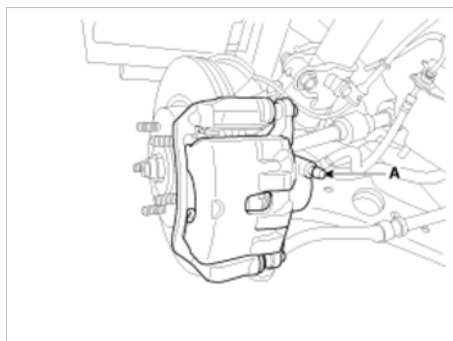


(6) Perform the air bleeding.

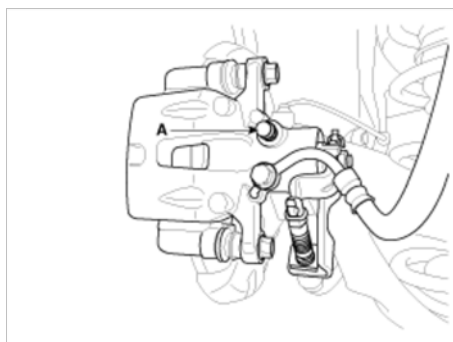


5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw(A).

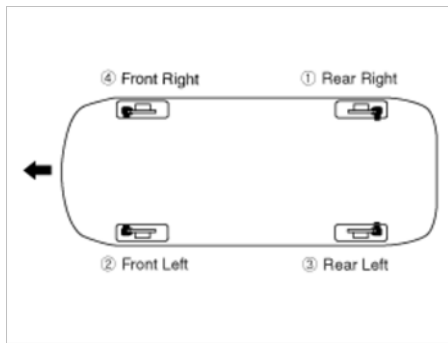
#### Front



#### Rear



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



7. Tighten the bleeder screw.

#### Bleed screw tightening torque:

7 ~ 13 N.m (0.7 ~ 1.3 kgf.m, 5.4 ~ 9.5 lb-ft)

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

### Operation

The EBD system (Electronic Brake force Distribution) as a sub-system of the ABS system is to control the maximum braking effectiveness 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.

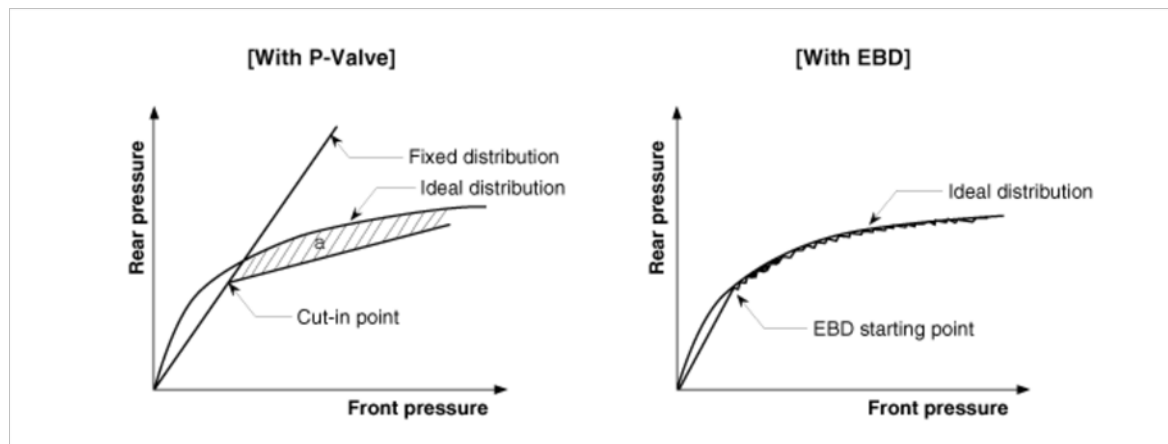
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

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.

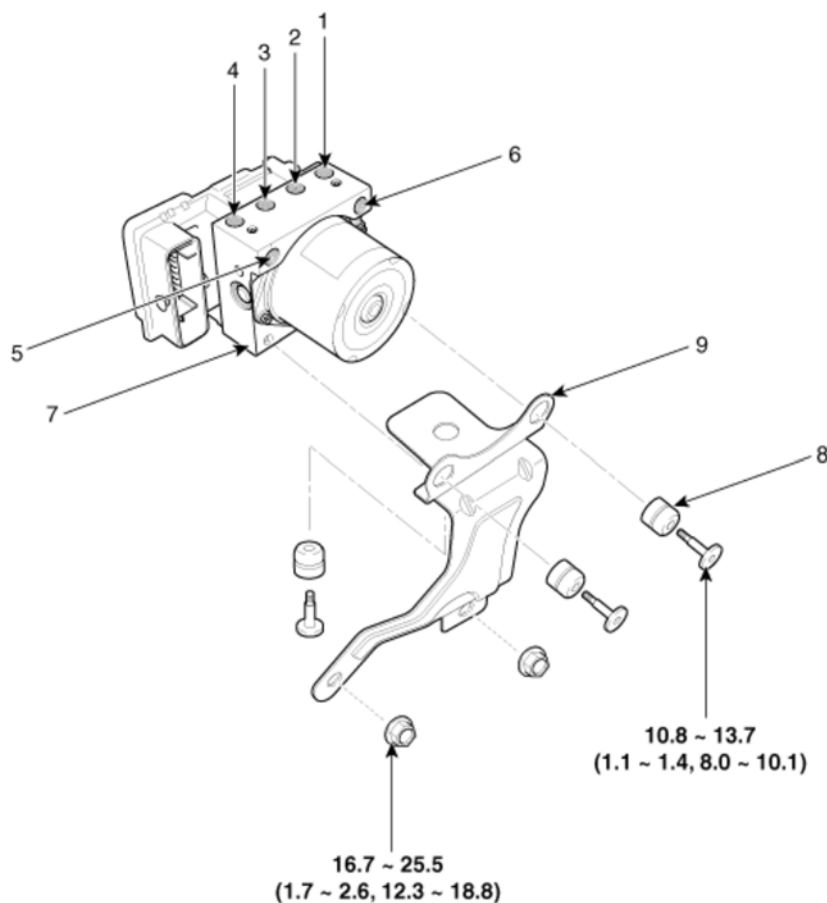
### Comparison between Proportioning Valve and EBD



## 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
2. Rear - right tube
3. Rear - left tube
4. Front - right tube
5. MC2

6. MC1
7. ESC control module (HECU)
8. Damper
9. Bracket

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

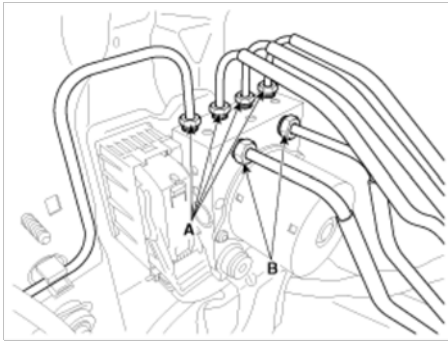
### Removal

1. Turn ignition switch OFF.
2. Disconnect the brake tubes from the HECU by unlocking the nuts counterclockwise with a spanner.

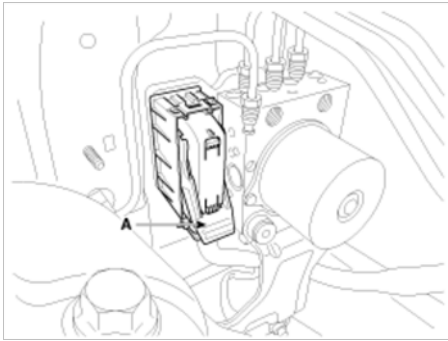
### Tightening torque:

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

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



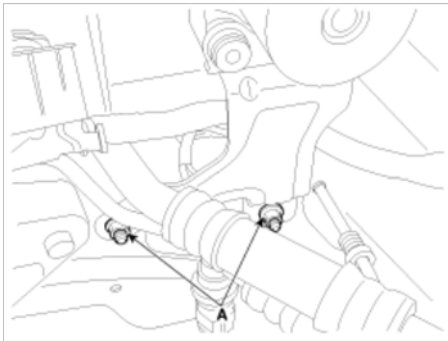
3. Pull up the lock of the HECU connector (A), and then disconnect the connector.



4. Loosen the HECU bracket nuts (A), 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

- Never attempt to disassemble the HECU.
- The HECU must be transported and stored in.
- Never shock to the HECU.

5. Remove the 3 bolts, and then remove the bracket from HECU.

#### Tightening torque:

11 ~ 14 N.m (1.1 ~ 1.4 kgf.m, 8.1 ~ 10.3 lb-ft)

### Installation

1. Installation is the reverse of removal.
2. Tighten the HECU mounting bolts and nuts to the specified torque.
3. After installation, bleed the brake system.  
(Refer to ABS bleeding)

#### NOTE

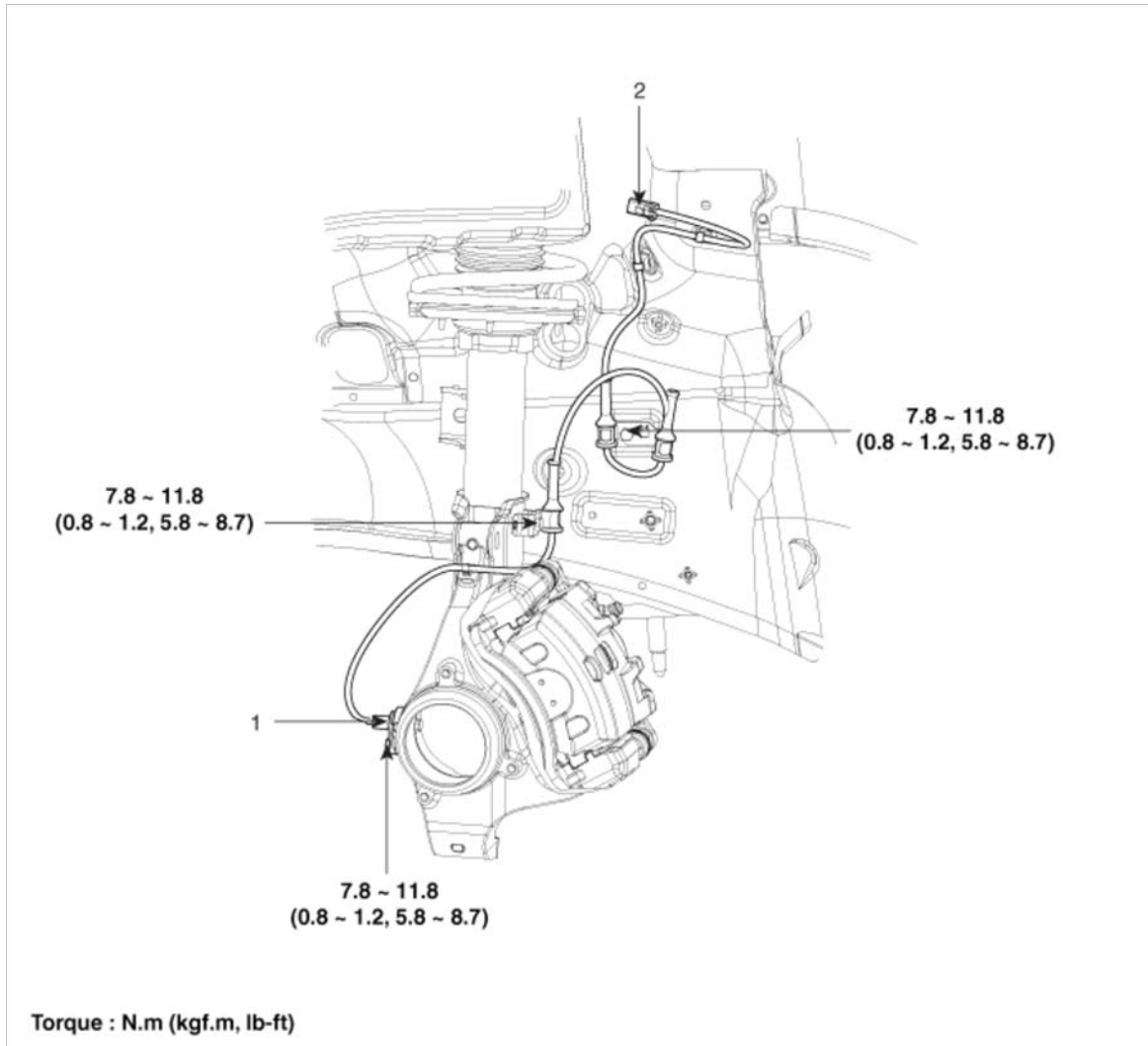
In a case of replacing ESC HECU, operate following functions.



1. "Steering Angle Sensor Calibration" for steering angle sensor offset correction.  
(Refer to the "Steering system")
2. "Longitudinal Sensor Calibration" for Longitudinal sensor offset correction.  
(Refer to the "Yaw-rate and Gsensor")

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

### Components



1. Front wheel speed sensor
2. Front wheel speed sensor connector

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

### Removal

1. Remove the front wheel and tire.

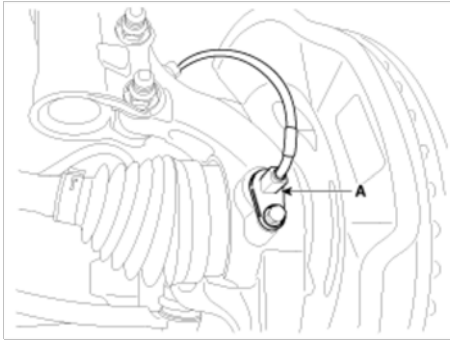
#### Tightening torque:

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

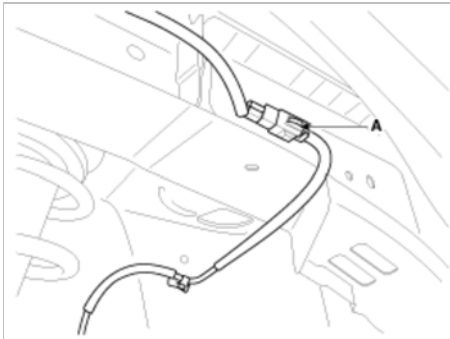
2. Remove the front wheel speed sensor mounting bolt (A).

#### Tightening torque:

7.8 ~ 11.8 N.m (0.8 ~ 1.2 kgf.m, 5.9 ~ 8.7 lb-ft)



3. Remove the front wheel guard.
4. Remove the front wheel speed sensor cable mounting bolt.
5. Disconnect the front wheel speed sensor connector (A) and then remove the front wheel speed sensor.



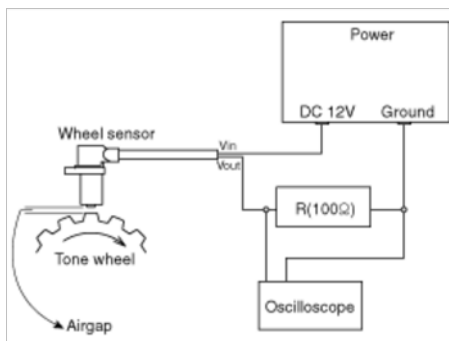
6. Installation is the reverse of removal.

## Inspection

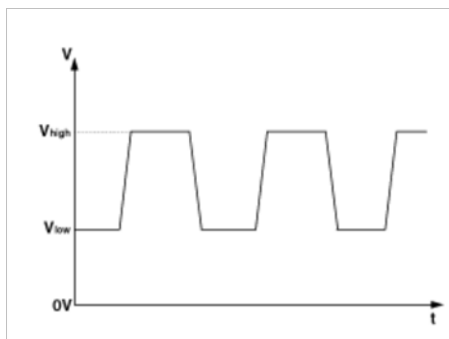
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

### 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.

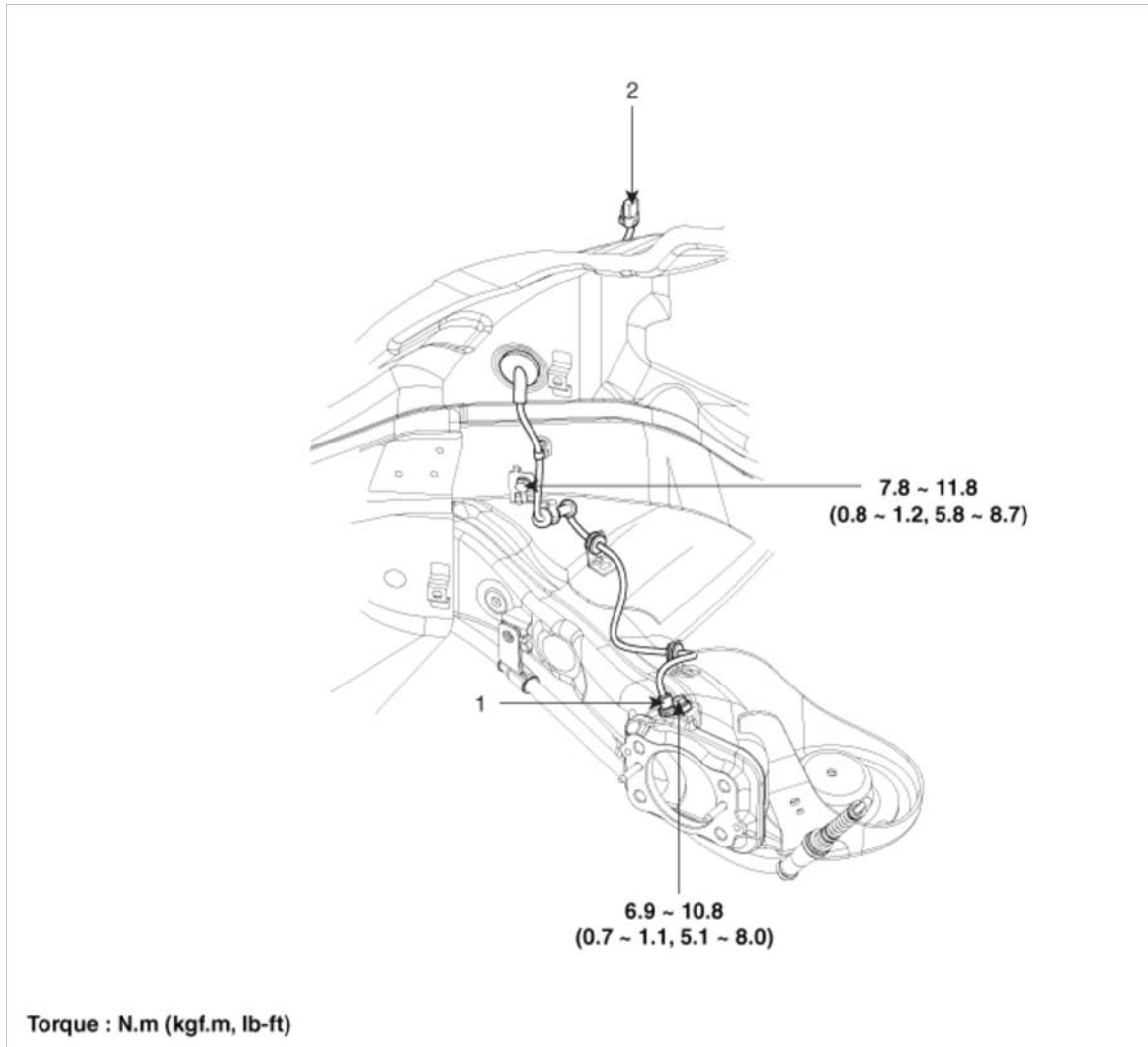


V\_low: 0.59 ~ 0.84 V

**V<sub>high</sub>:** 1.18 V ~ 1.68 V  
**Frequency range:** 1 ~ 2,500 Hz

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

### Components



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

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

### Removal

1. Remove the rear wheel and tire.

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

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

**Tightening torque:**  
6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.0 ~ 8.0 lb-ft)



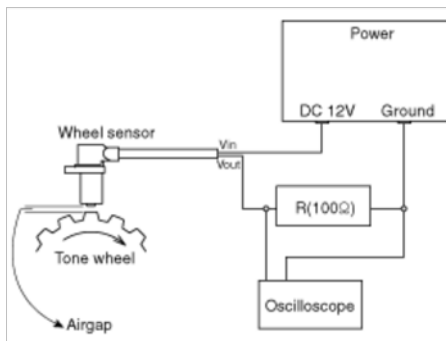
3. Remove the rear seat back.  
(Refer to the Body group - Seat)
4. Remove the rear wheel housing trim.  
(Refer to the Body group – interior trim)
5. Disconnect the rear wheel speed sensor connector.
6. Installation is the reverse of removal.

## Inspection

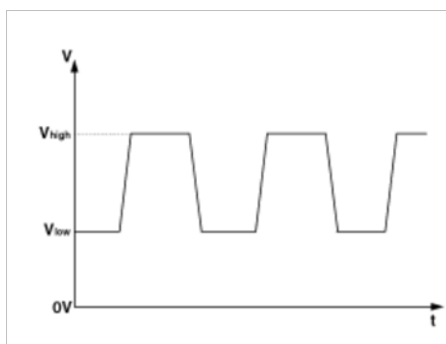
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

### 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:** 0.59 ~ 0.84 V

**V\_high:** 1.18 V ~ 1.68 V

**Frequency range:** 1 ~ 2,500 Hz

## 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.

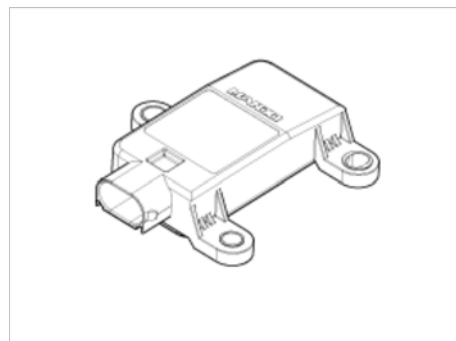
If yaw velocity reaches the specific velocity after it detects the vehicle yawing, the ESC control is reactivated.

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

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

The longitudinal G sensor is installed in the yaw-rate sensor.

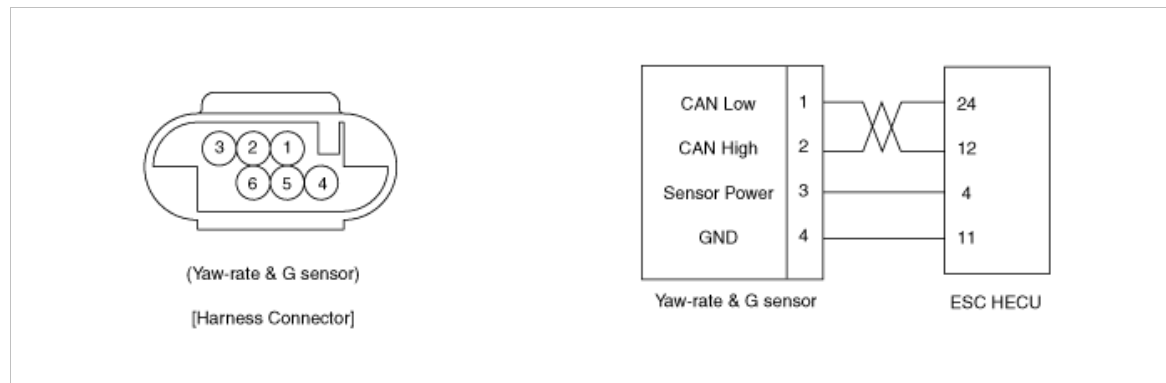
This longitudinal G sensor detects vertical acceleration of the vehicle, while the lateral G sensor detects lateral acceleration of the vehicle. The HECU uses these signals for the Hill start Assist Control function.



#### Specifications

Description		Specification	Remarks
Operating voltage		10 ~ 16V	
Output signal		CAN Interface	
Operating temperature		-40 ~ 85°C (-40 ~ 185°F)	
Yaw-rate sensor	Measurement range	-75 ~ 75°/sec	
	Frequency response	15 ~ 45Hz	
G sensor (Lateral / Longitudinal)	Measurement range	-14.715 ~ +14.715g	
	Frequency response	50Hz ± 60%	

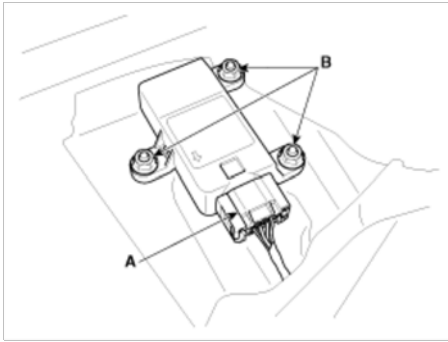
#### External Diagram



### 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 passenger seat assembly.  
(Refer to the Body group - "Seat")
3. Disconnect the yaw rate & lateral G sensor connector (A).



4. Remove the mounting bolts (B).

---

**Tightening torque:**

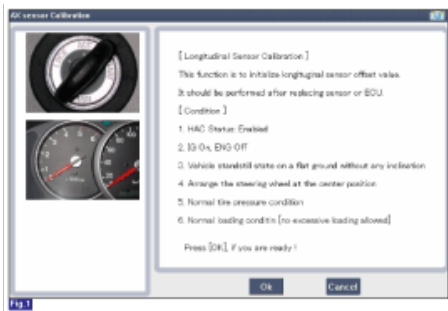
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

---

5. Installation is the reverse of removal.

**■ longitudinal G sensor Calibration**

1. IG ON, ENG OFF
2. Stand the vehicle on a flat ground without any inclination.
3. Set the steering wheel at the center position.
4. Keep the vehicle under normal tire pressure condition and normal loading condition.
5. Connect GDS to Data Link Connector(DLC).
6. Perform Longitudinal G Sensor Calibration.(figure 1).



7. Confirm success or failure of calibration.

<b>Brake System &gt; ESC(Electronic Stability Control) System &gt; ESC OFF Switch &gt; Description and Operation</b>
--

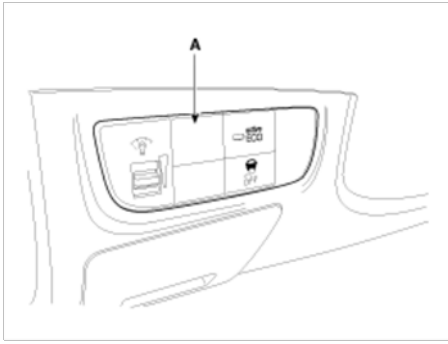
**Description**

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.

<b>Brake System &gt; ESC(Electronic Stability Control) System &gt; ESC OFF Switch &gt; Repair procedures</b>
--

**Inspection**

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the crash pad lower panel.  
(Refer to the Body group - "Crash pad")
3. Remove the crash pad side switch assembly (A).



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

Terminal Position	5	4	3	6
ON				
OFF				

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

**Description**

The Steering Angle Sensor (SAS) is installed in MDPS (Motor Driven Power Steering) and it sends messages to HECU through CAN communication line.

The SAS is used to determine turning direction and speed of the steering wheel.

The HECU uses the signals from the SAS when performing ESC-related calculations.

Components (Steering Angle Sensor, Torque Sensor, Failsafe relay, etc.) of the EPS system are located inside the steering column & EPS unit assembly and the steering column. EPS unit assembly must not be disassemble to be inspected. They must be replaced. (Refer to “ST (Steering system) Gr.”)