

## Brake System



## 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)      |                               |

**NOTICE**

O.D. : Outer Diameter

I.D : Inner Diameter

**Specification (ESC)**

| Part         | Item                   | Standard value                      | Remark                                |
|--------------|------------------------|-------------------------------------|---------------------------------------|
| HECU         | System                 | 4 Channel 4 Sensor (Solenoid)       | Total control<br>(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<br>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)<br>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<br>6.9 ~ 12.7  | 0.7 ~ 1.3  | 5.1 ~ 9.4   |
|                                   | Brembo<br>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<br>78.5 ~ 98.1 | 8.0 ~ 10.0 | 57.9 ~ 72.3 |
|                                   | Brembo<br>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

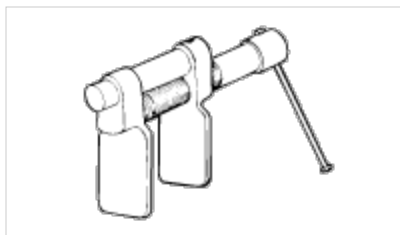
| Items   | Recommended            | Quantity    |
|---|------------------------|-------------|
| Brake fluid   | DOT 3 or DOT 4         | As required |
| Brake pedal bushing and bolt                            | Chassis grease         | As required |
| Parking brake shoe and backing plate contacting 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



### Special Service Tools

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



## Brake System



### 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 | <ol style="list-style-type: none"> <li>1. Brake system (Fluid leaks)</li> <li>2. Brake system (Air in)</li> <li>3. Piston seals (Worn or damaged)</li> <li>4. Rear brake shoe clearance (Out of adjustment)</li> <li>5. Master cylinder (Inoperative)</li> </ol>   | repair<br>air-bleed<br>replace<br>adjust<br>replace   |
| Brake drag                  | <ol style="list-style-type: none"> <li>1. Brake pedal free play (Minimum)</li> <li>2. Parking brake lever travel (Out of adjustment)</li> <li>3. Parking brake wire (Sticking)</li> <li>4. Rear brake shoe clearance (Out of adjustment)</li> <li>5. Pad or lining (Cracked or distorted)</li> <li>6. Piston (Stuck)</li> <li>7. Piston (Frozen)</li> <li>8. Anchor or Return spring (Inoperative)</li> <li>9. Booster system (Vacuum leaks)</li> <li>10. Master cylinder (Inoperative)</li> </ol> | adjust<br>adjust<br>repair<br>adjust<br>replace<br>replace<br>replace<br>replace<br>repair<br>replace |
| Brake pull                  | <ol style="list-style-type: none"> <li>1. Piston (Sticking)</li> <li>2. Pad or lining (Oily)</li> <li>3. Piston (Frozen)</li> <li>4. Disc (Scored)</li> <li>5. Pad or lining (Cracked or distorted)</li> </ol>   | replace<br>replace<br>replace<br>replace<br>replace   |
|                             | <ol style="list-style-type: none"> <li>1. Brake system (Fluid leaks)</li> <li>2. Brake system (Air in)</li> </ol>  | repair<br>air-bleed   |

|  |  |   |
|--|--|---|
| Hard pedal but<br>brake<br>inefficient | <ol style="list-style-type: none"> <li>3. Pad or lining (Worn)</li> <li>4. Pad or lining (Cracked or distorted)</li> <li>5. Rear brake shoe clearance(Out of adjustment)</li> <li>6. Pad or lining (Oily)</li> <li>7. Pad or lining (Glazed)</li> <li>8. Disc (Scored)</li> <li>9. Booster system (Vacuum leaks)</li> </ol>  | <p>replace</p> <p>replace</p> <p>adjust</p> <p>adjust</p> <p>replace</p> <p>replace</p> <p>repair</p>                               |
| Noise from brake                       | <ol style="list-style-type: none"> <li>1. Pad or lining (Cracked or distorted)</li> <li>2. Installation bolt (Loosen)</li> <li>3. Disc (Scored)</li> <li>4. Sliding pin (Worn)</li> <li>5. Pad or lining (Dirty)</li> <li>6. Pad or lining (Glazed)</li> <li>7. Anchor or Return spring (Faulty)</li> <li>8. Brake pad shim (Damage)</li> <li>9. Shoe hold-down spring (Damage)</li> </ol> | <p>replace</p> <p>adjust</p> <p>replace</p> <p>replace</p> <p>clean</p> <p>replace</p> <p>replace</p> <p>replace</p> <p>replace</p> |
| Brake fades                            | <ol style="list-style-type: none"> <li>1. master cylinder</li> </ol>   | <p>replace</p>  |
| Brake vibration,<br>pulsation          | <ol style="list-style-type: none"> <li>1. brake booster</li> <li>2. pedal free play</li> <li>3. master cylinder</li> <li>4. caliper</li> <li>5. master cylinder cap seal</li> <li>6. damaged brake lines</li> </ol>  | <p>replace</p> <p>adjust</p> <p>replace</p> <p>replace</p> <p>replace</p>   |
| Brake Chatter                          | <p>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.</p>  |   |

### Brake System



## Operation and Leakage Check

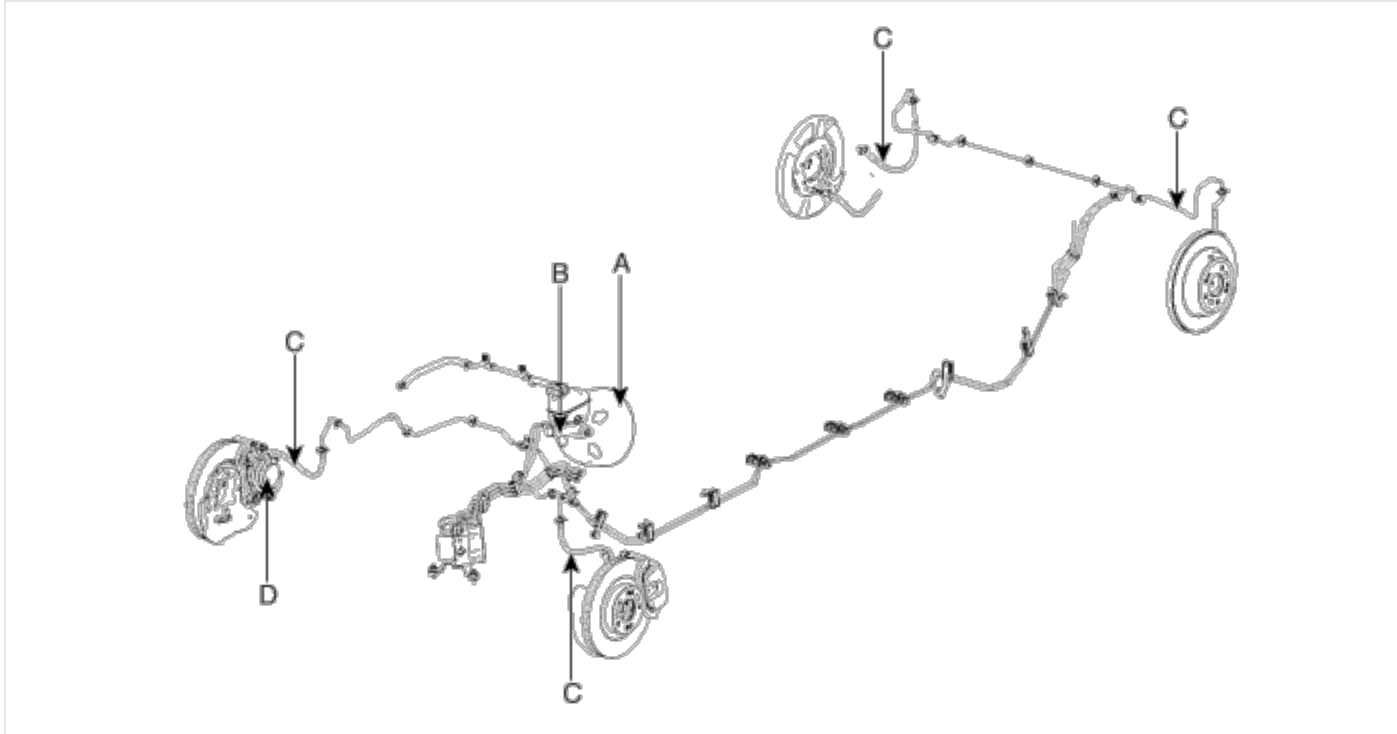
### Check all of the following items

| Component                                     | Procedure   |
|---|---|
| Brake Booster (A)                             | Check brake operation by applying the brakes during a test drive. If the brakes do not work properly, check the brake booster. Replace the brake booster as an assembly if it does not work properly or if there are signs of leakage.  |
| Piston cup and pressure<br>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

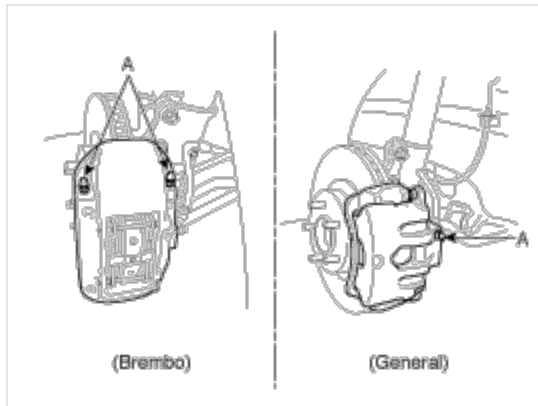
### ⚠ CAUTION

- 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.

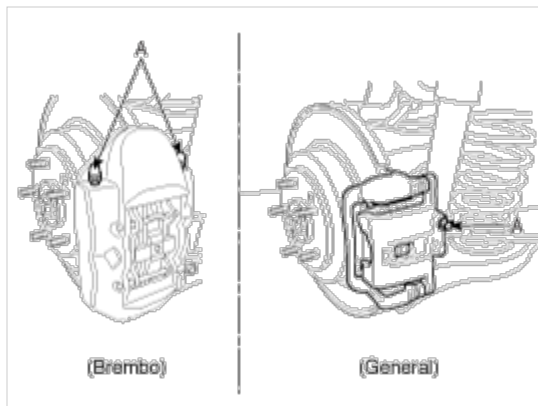
1. Make sure the brake fluid in the reservoir is at the MAX(upper) level line.

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.

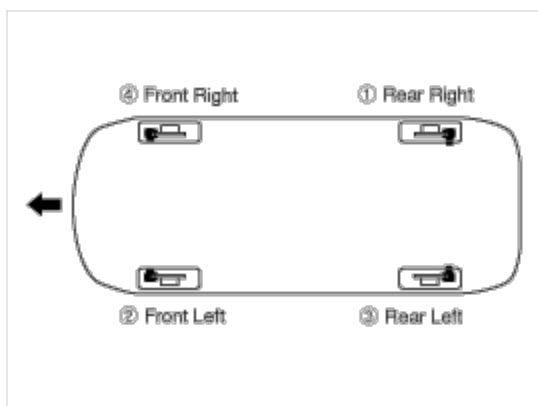
### Front



### Rear



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

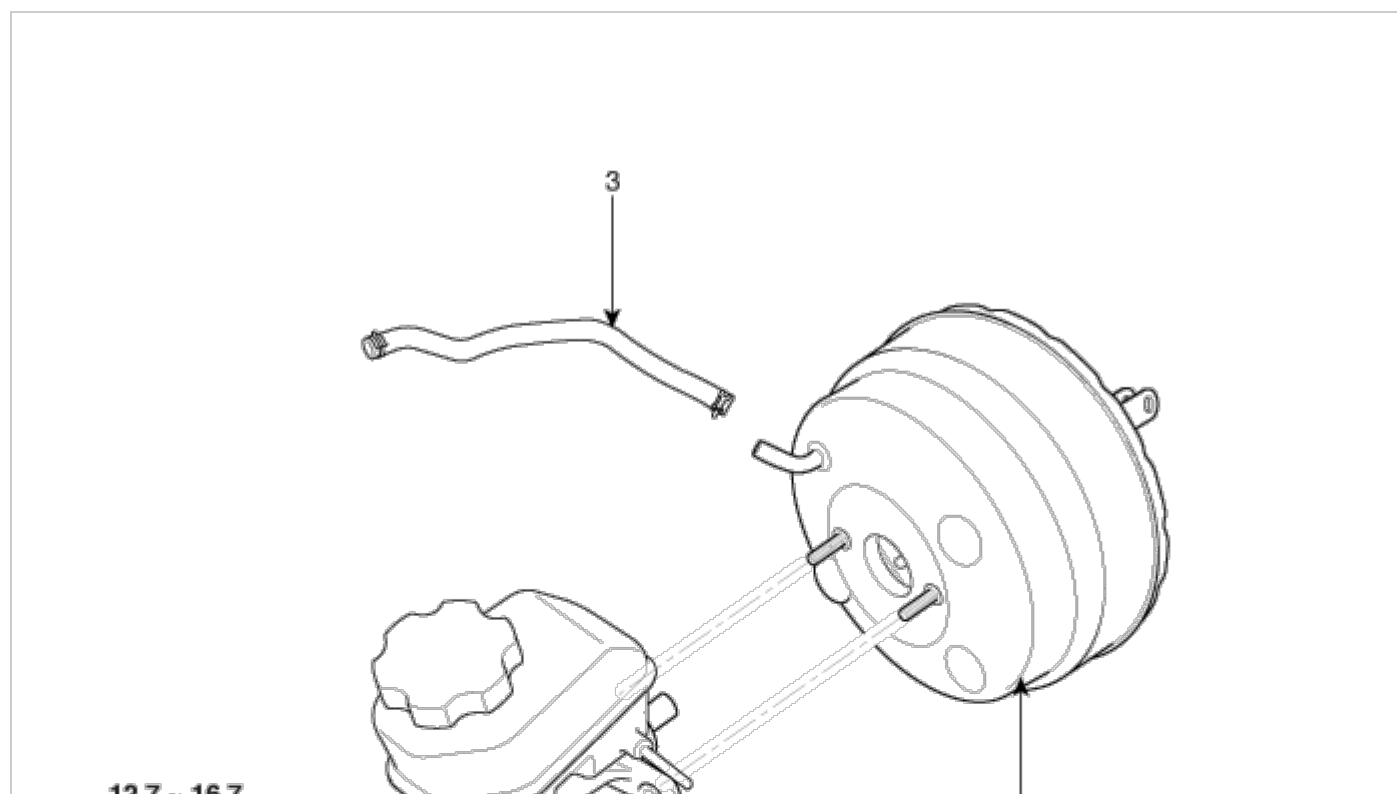


5. Refill the master cylinder reservoir to MAX(upper) level line.

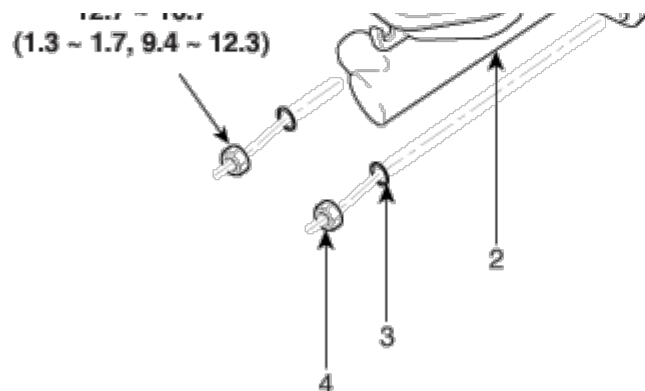
Brake System



## Components







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

1. Brake booster
2. Master cylinder assembly
3. Washer

4. Nut
5. Vacuum hose

### Brake System



### 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



### 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.

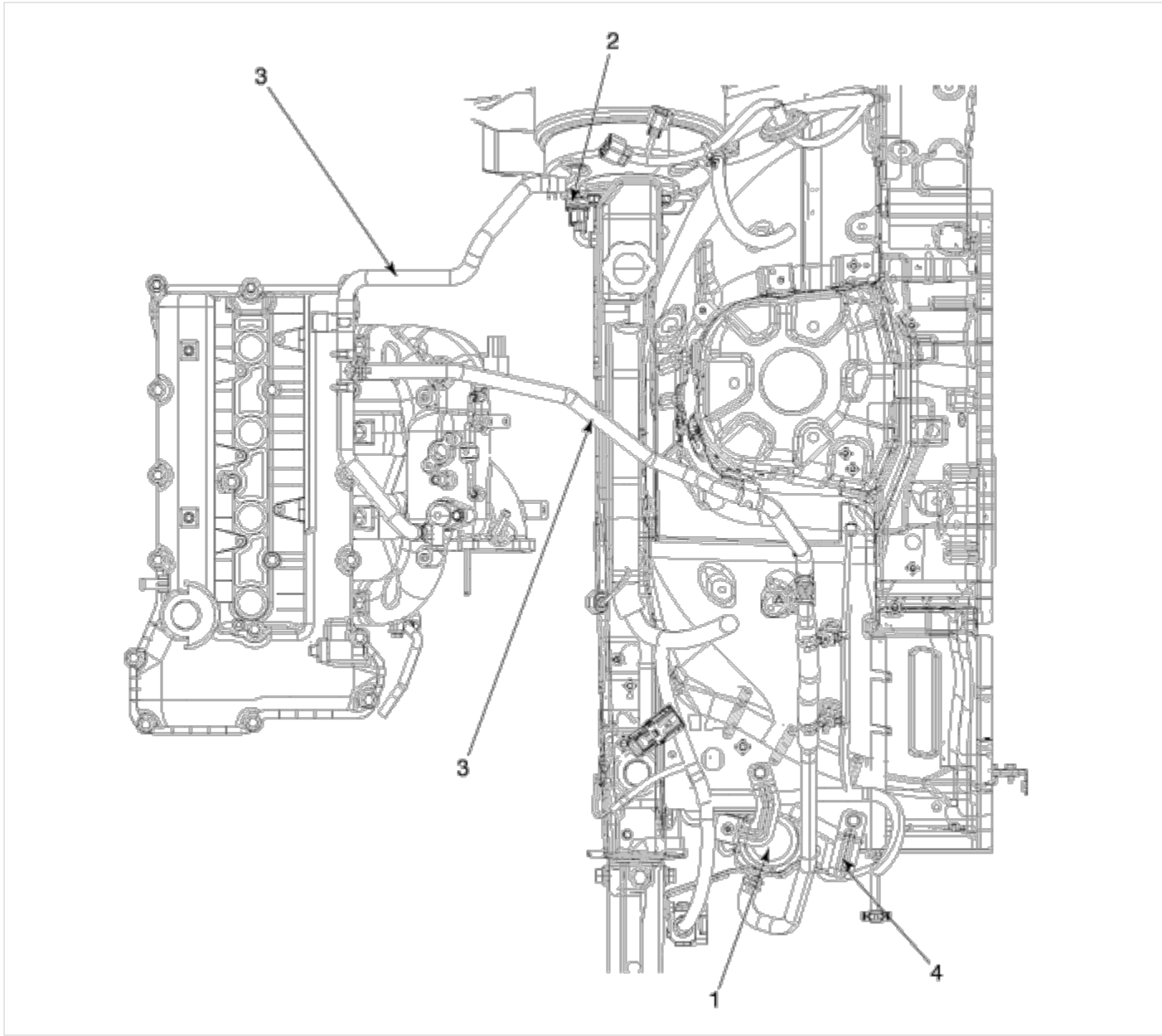
If the vacuum is not sufficient to press the brake pedal, the HECU senses it through the vacuum switch, which is installed on booster. And then the HECU supplies the power to the vacuum pump by grounding the circuit of the vacuum pump relay. When the vacuum pump is supplied with electric power, it makes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

## Brake System

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### Components

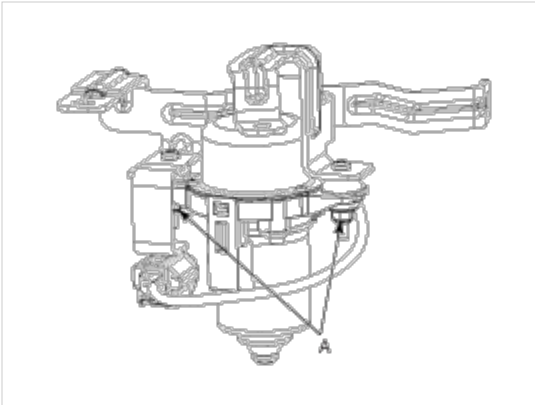


1. Vacuum pump  
2. Vacuum switch

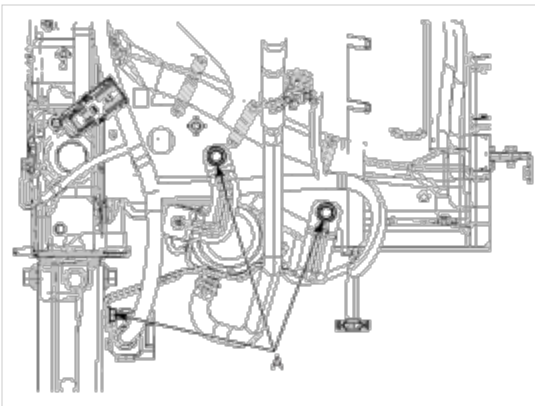
3. Vacuum hose  
4. Vacuum pump bracket

**Brake System****Installation**

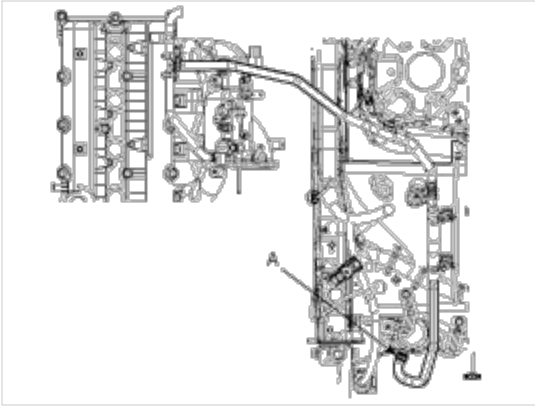
1. Install the Vacuum pump to the bracket.



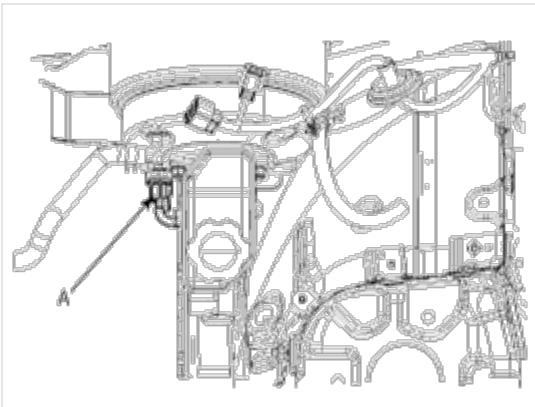
2. Install the Vacuum pump & bracket bolt.



3. Install the Vacuum hose.



4. Connect the Vacuum pump connector.

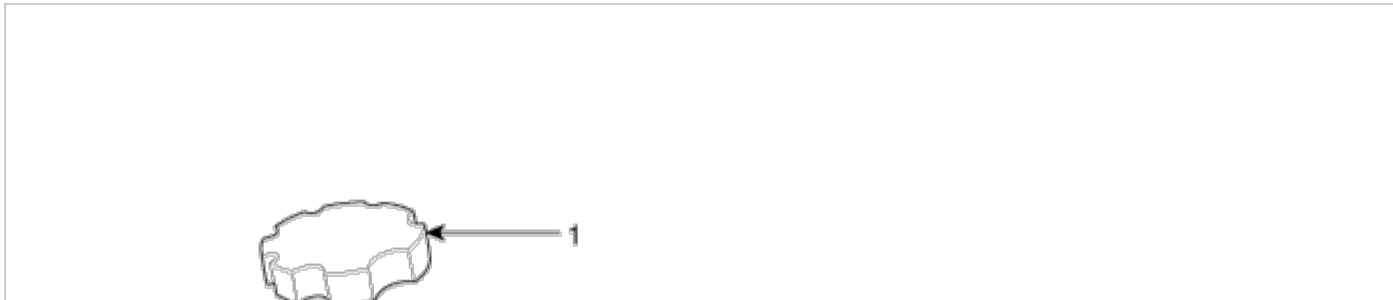


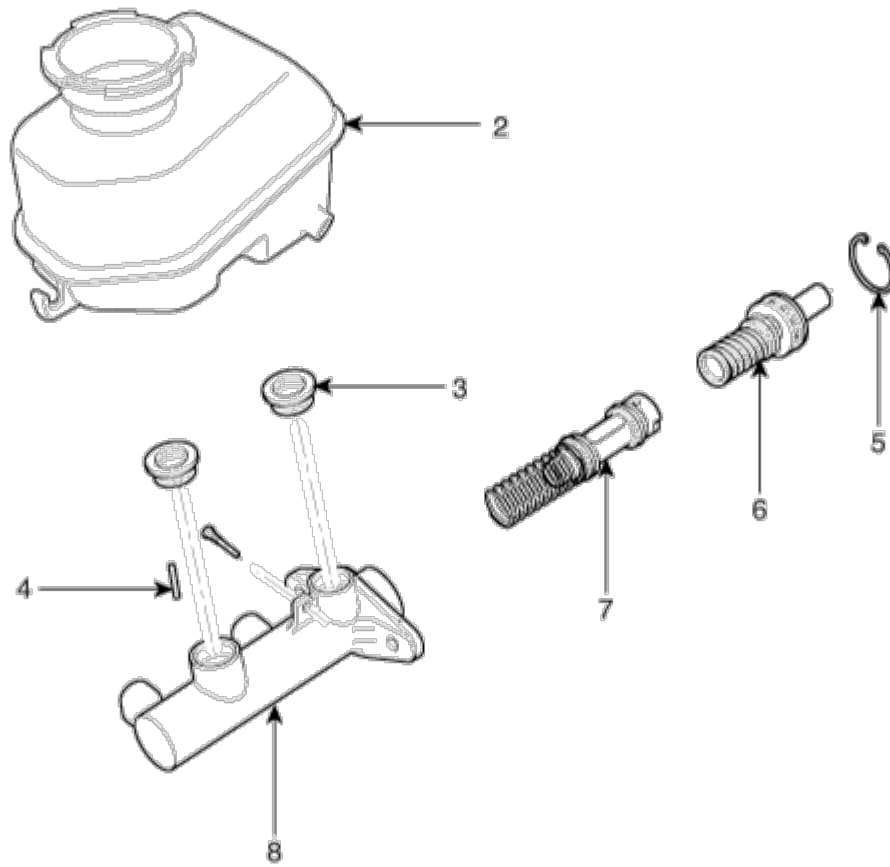
5. Install the front bumper cover.  
(Refer to Body group - "Bumper")

**Brake System**



**Components**





1. Reservoir cap
2. Reservoir
3. Grommet
4. Cylinder pin

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



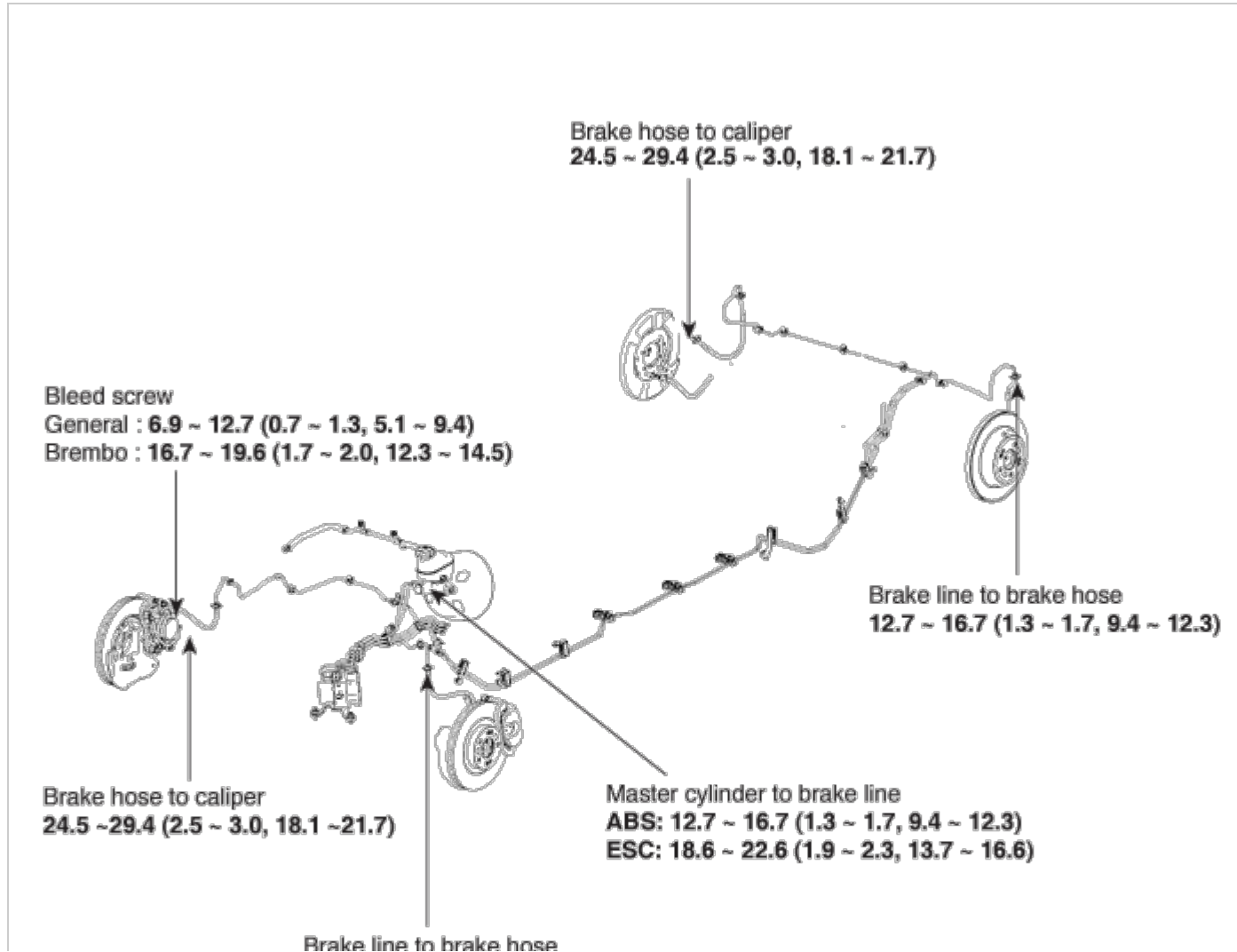
## Installation

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

### Brake System



## Components



12.7 ~ 16.7 (1.3 ~ 1.7, 9.4 ~ 12.3)

**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

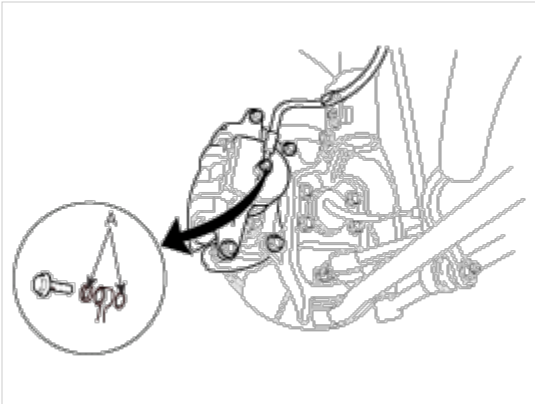


## Installation

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.

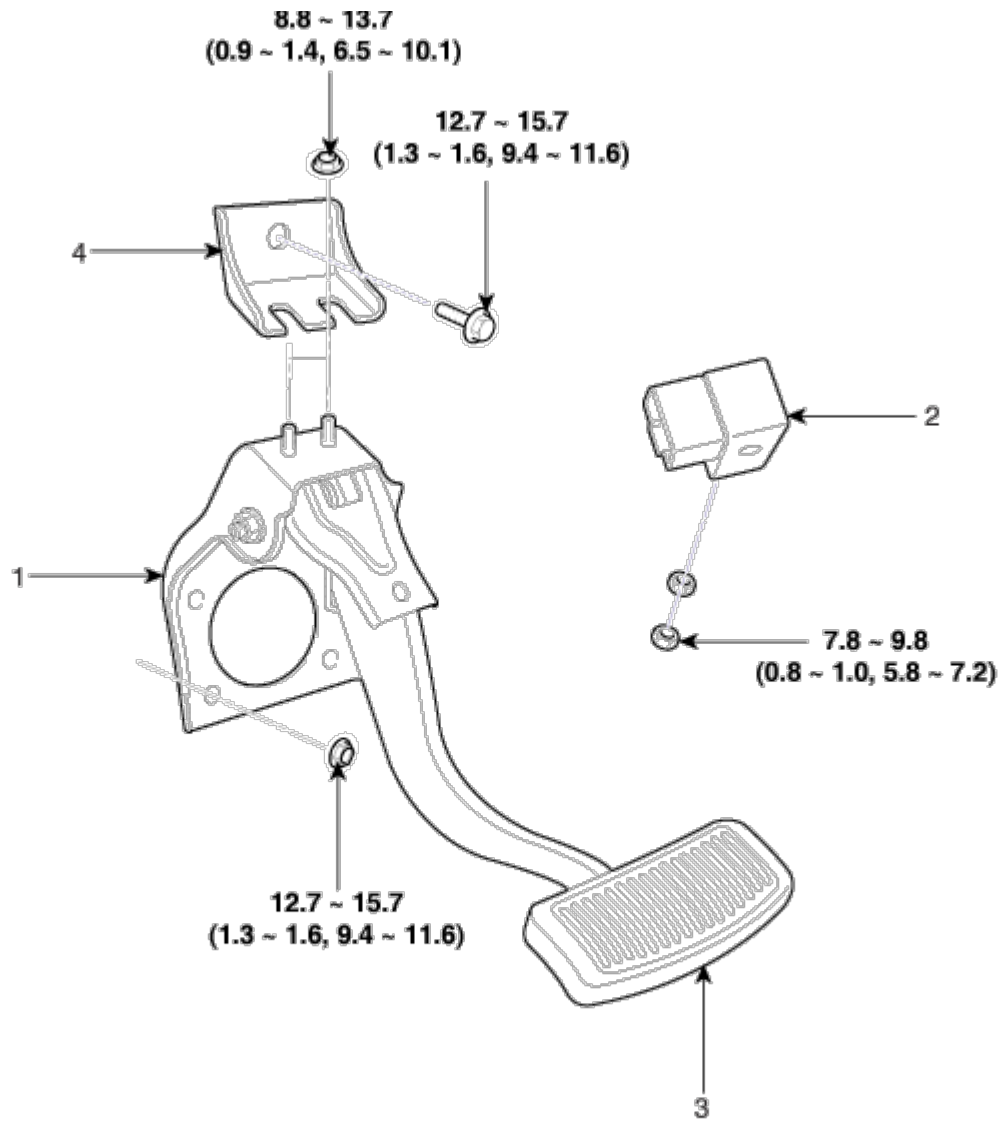
Brake System



## Components







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

1. Brake pedal member assembly
2. Stop lamp switch

3. Brake pedal
4. Brake bracket

## Brake System



### Installation

1. Installation is the reverse of removal.

#### **CAUTION**

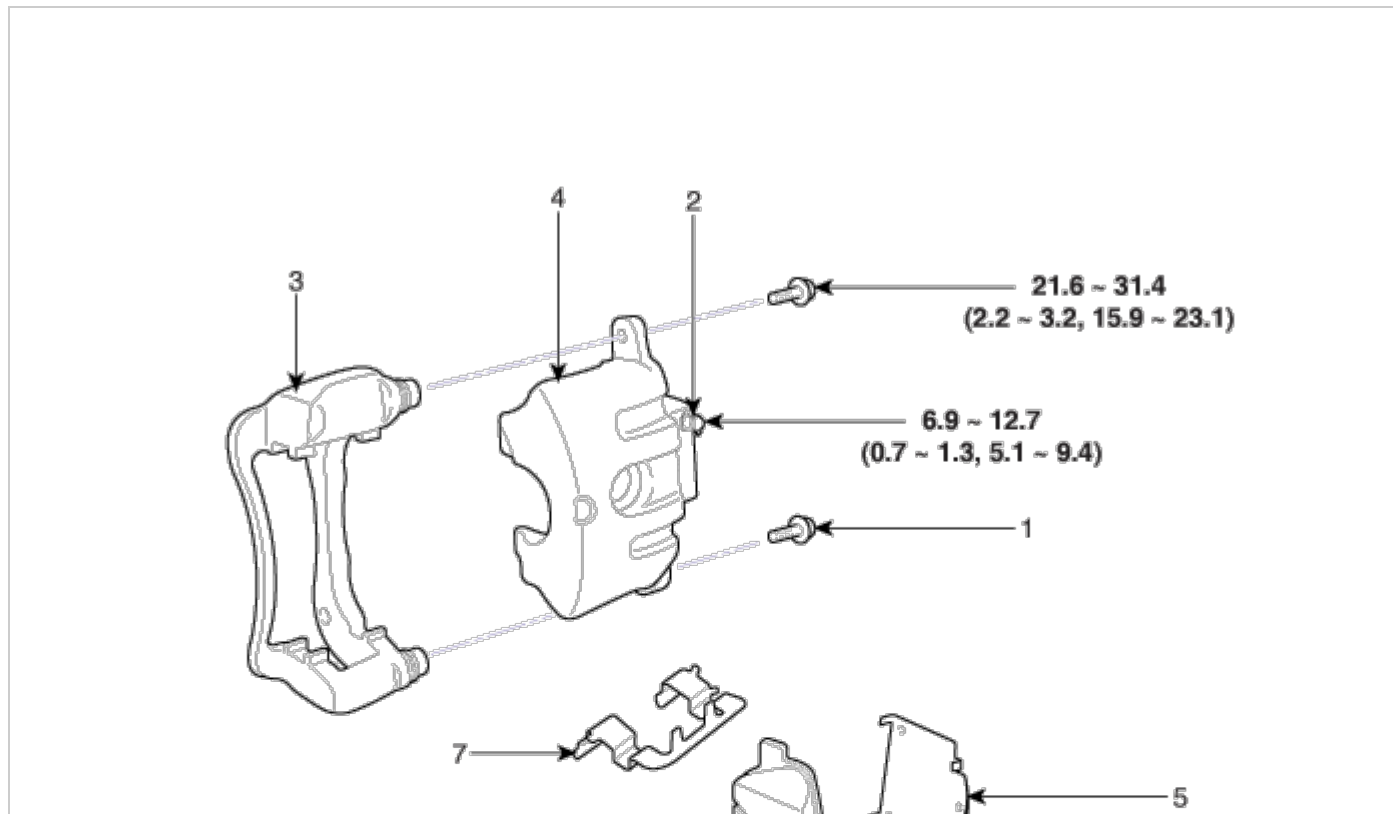
- Before installing the pin, apply the grease to the clevis pin.
- Use a new snap pin whenever installing.

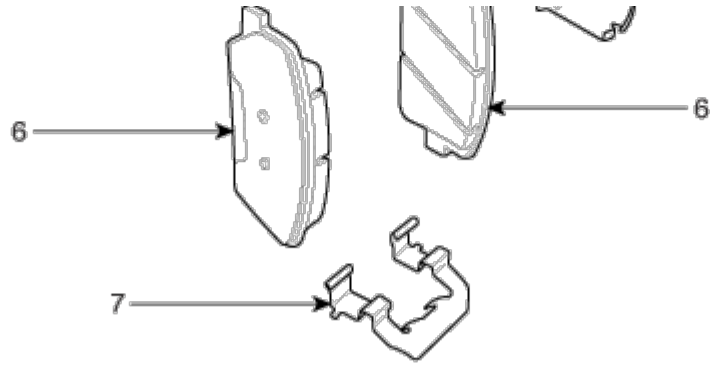
2. Check the brake pedal operation.

## Brake System



### Components (1)



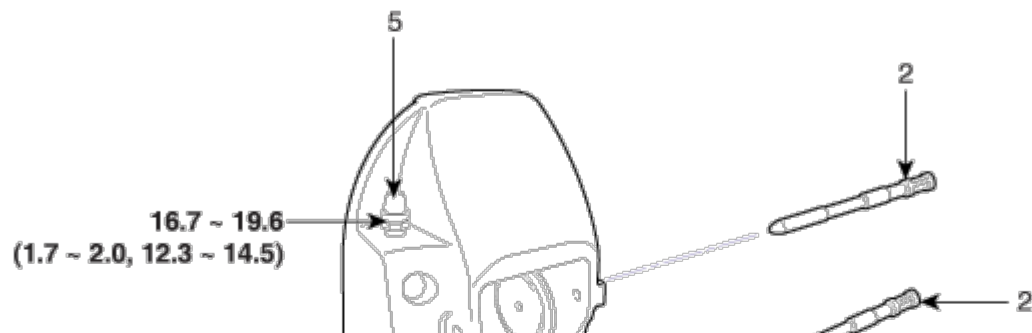


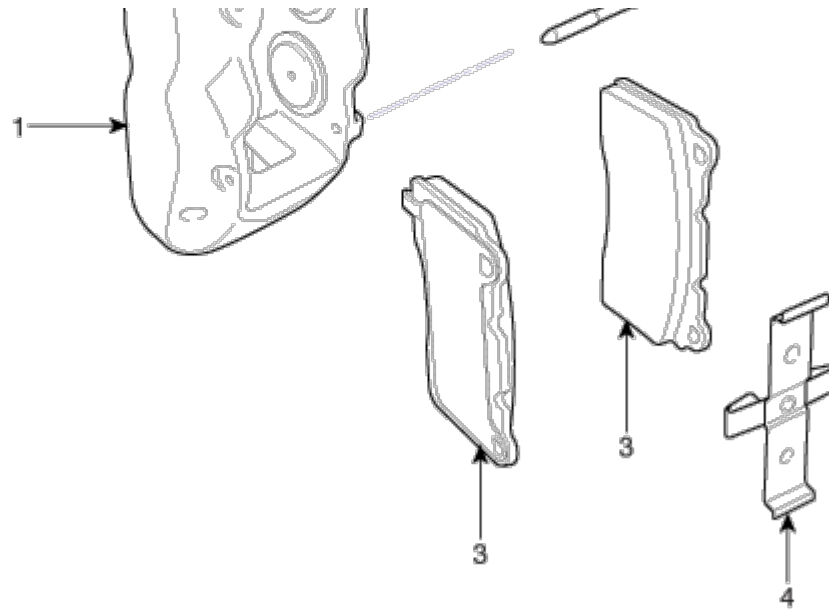
**Torque : N.m (kgf.m, lb-ft)**

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

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

**Components (2)**





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

1. Caliper body
2. Guide pin
3. Brake pad

4. Retraction spring
5. Bleed screw

## Brake System



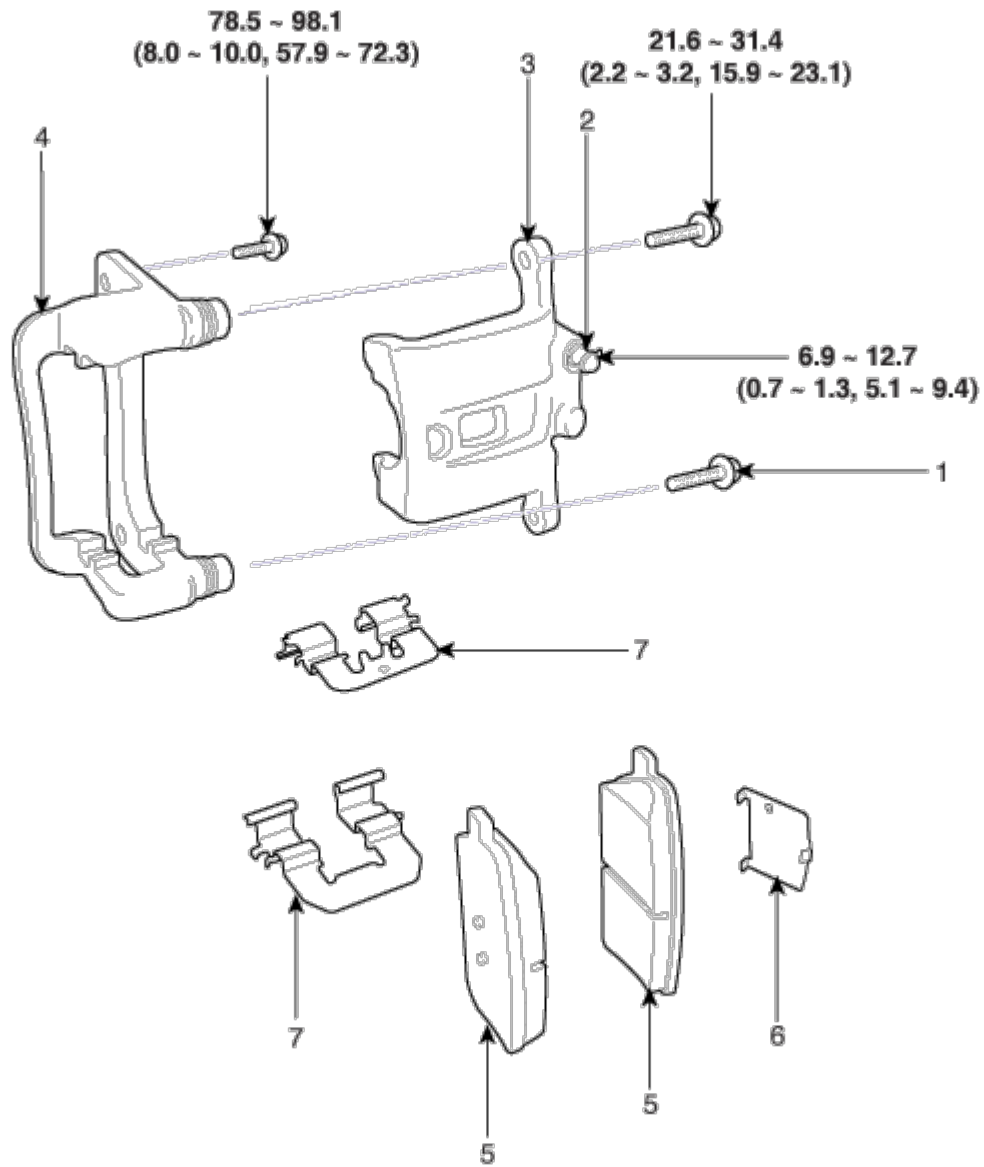
### Installation

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



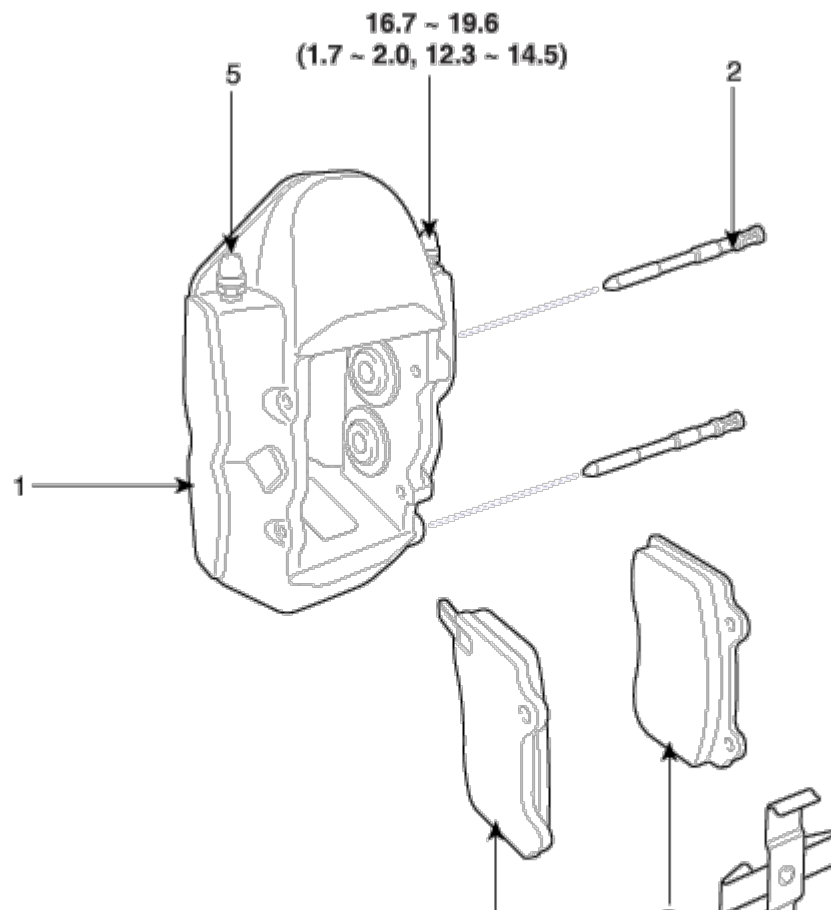
### Components (1)



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

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

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

**Components (2)**



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

1. Caliper body
2. Guide pin
3. Brake pad

4. Retraction spring
5. Bleed screw

#### Brake System



### Installation

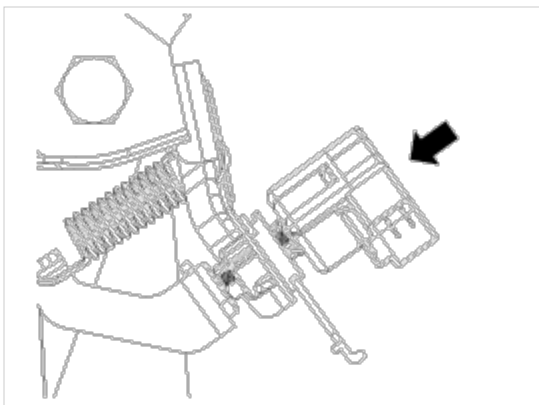
1. Installation is the reverse of removal.
2. Use a SST (09581-11000) when installing the brake caliper assembly.
3. After installation, bleed the brake system.  
(Refer to Brake system bleeding)

#### Brake System

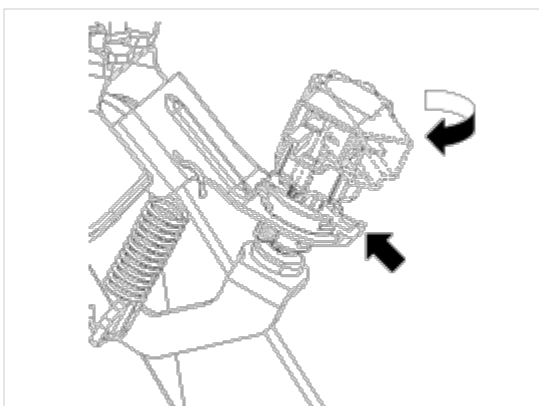


### Installation

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



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

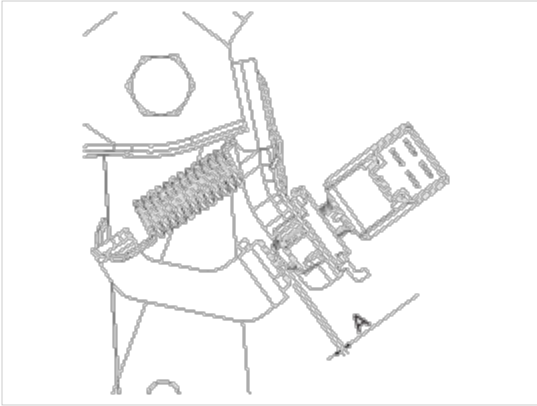


3. Confirm the gap between stop lamp switch and bracket.

**Stop lamp clearance** :1.0 ~ 2.0 mm (0.04~ 0.08 in.)

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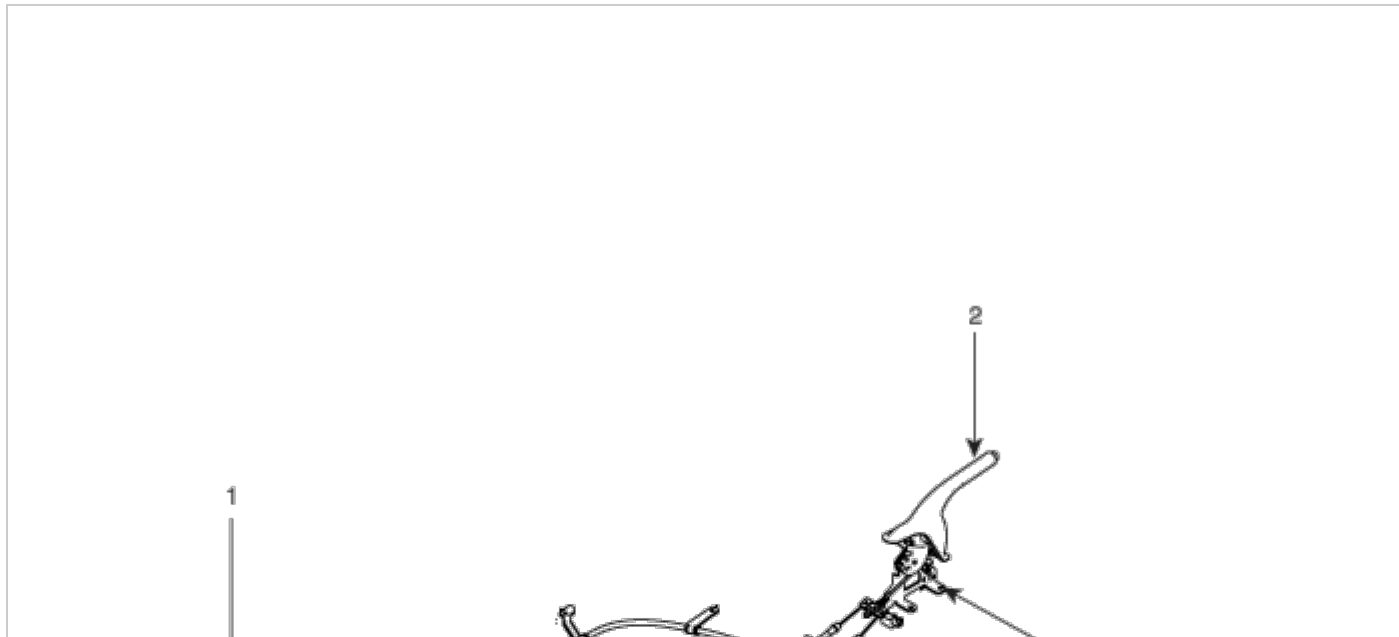


4. Connect the stop lamp switch connector.

**NOTICE**

If the gap between stop lamp switch and bracket is not 1.0 ~ 2.0mm(0.04~ 0.08in), perform the above process again.

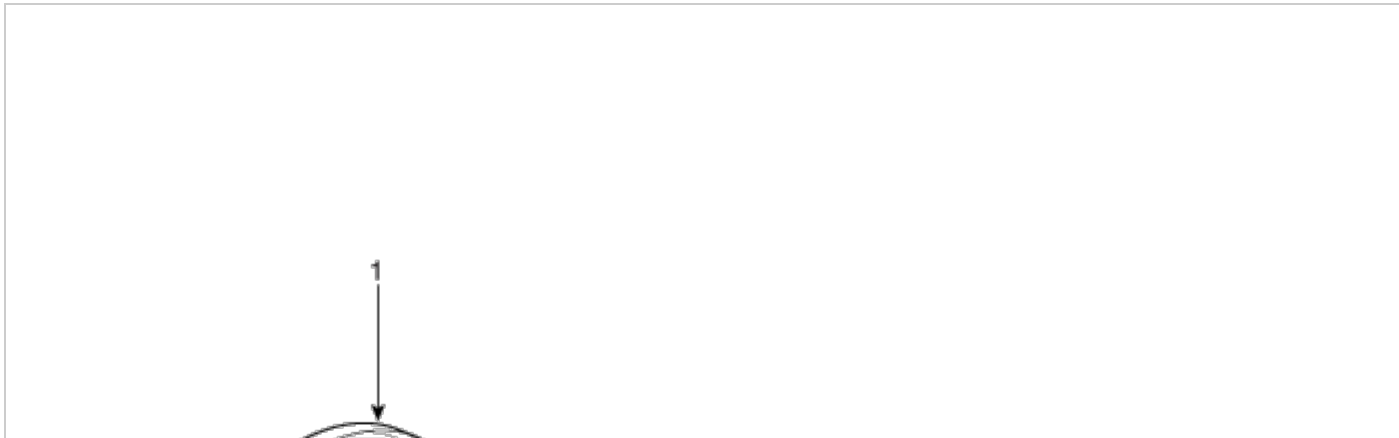
5. Install the lower crash pad.  
(Refer to the Body - "Crash Pad")

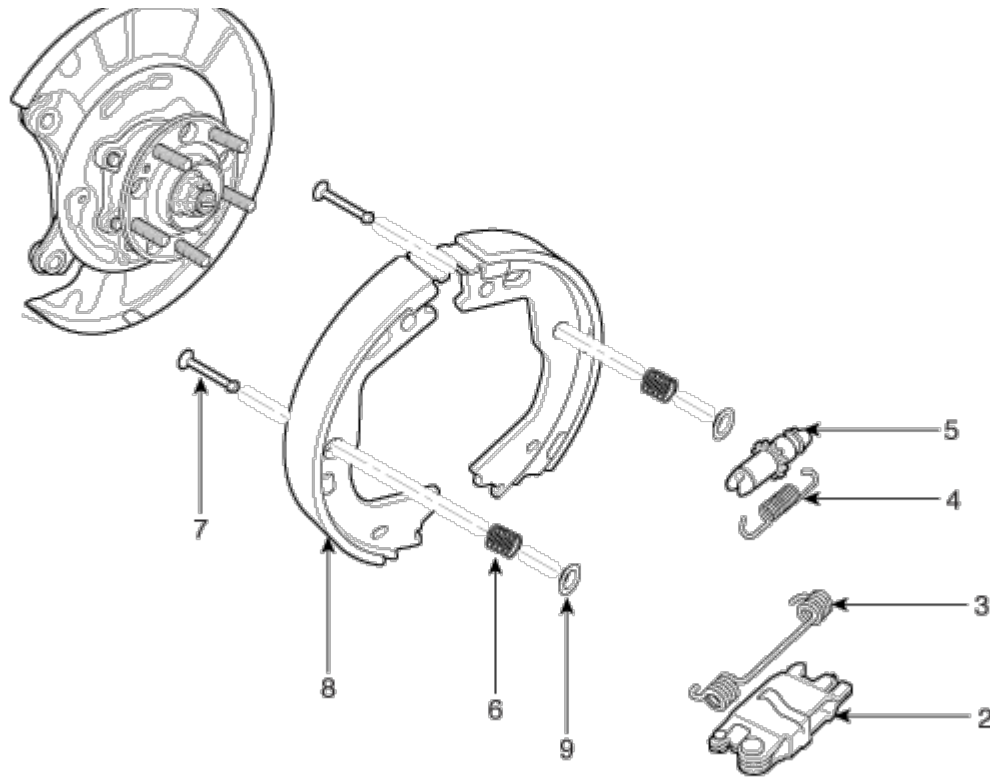
**Brake System****Components (1)**



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

### Components (2)





1. Backing plate  
2. Operating lever  
3. Upper spring

4. Lower spring  
5. Adjuster  
6. Shoe hold down spring

7. Shoe hold down pin  
8. Parking brake shoe  
9. Cup washer

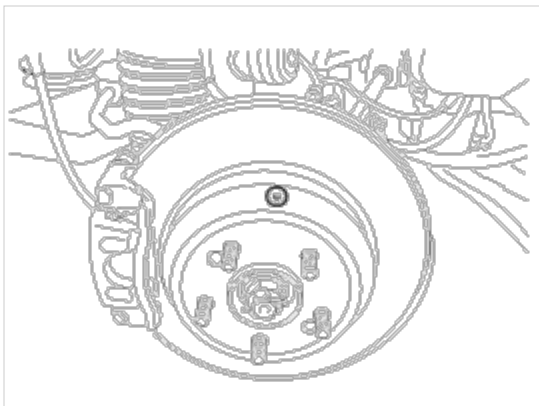
## Brake System



### 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

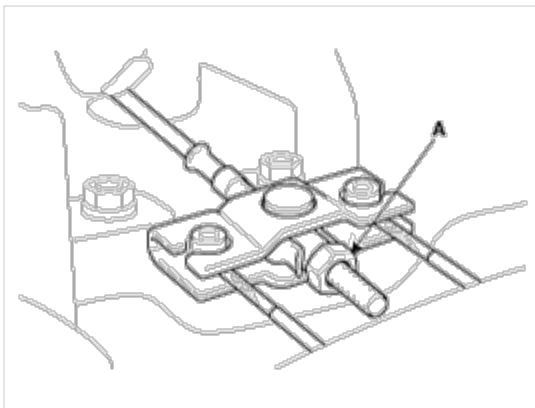
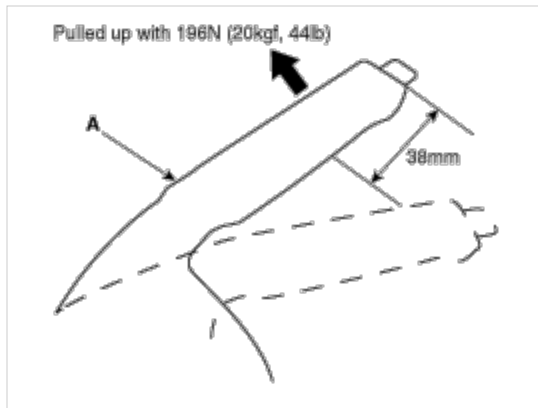
1. Raise the vehicle, and make sure it is securely supported.
2. Remove the floor console.  
(Refer to Body group - "Floor console")
3. Adjust the parking brake lever stroke by turning adjusting nut (A).

### Parking brake lever stroke :

5 clics (Pull the lever with 20kg)

### **NOTICE**

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")



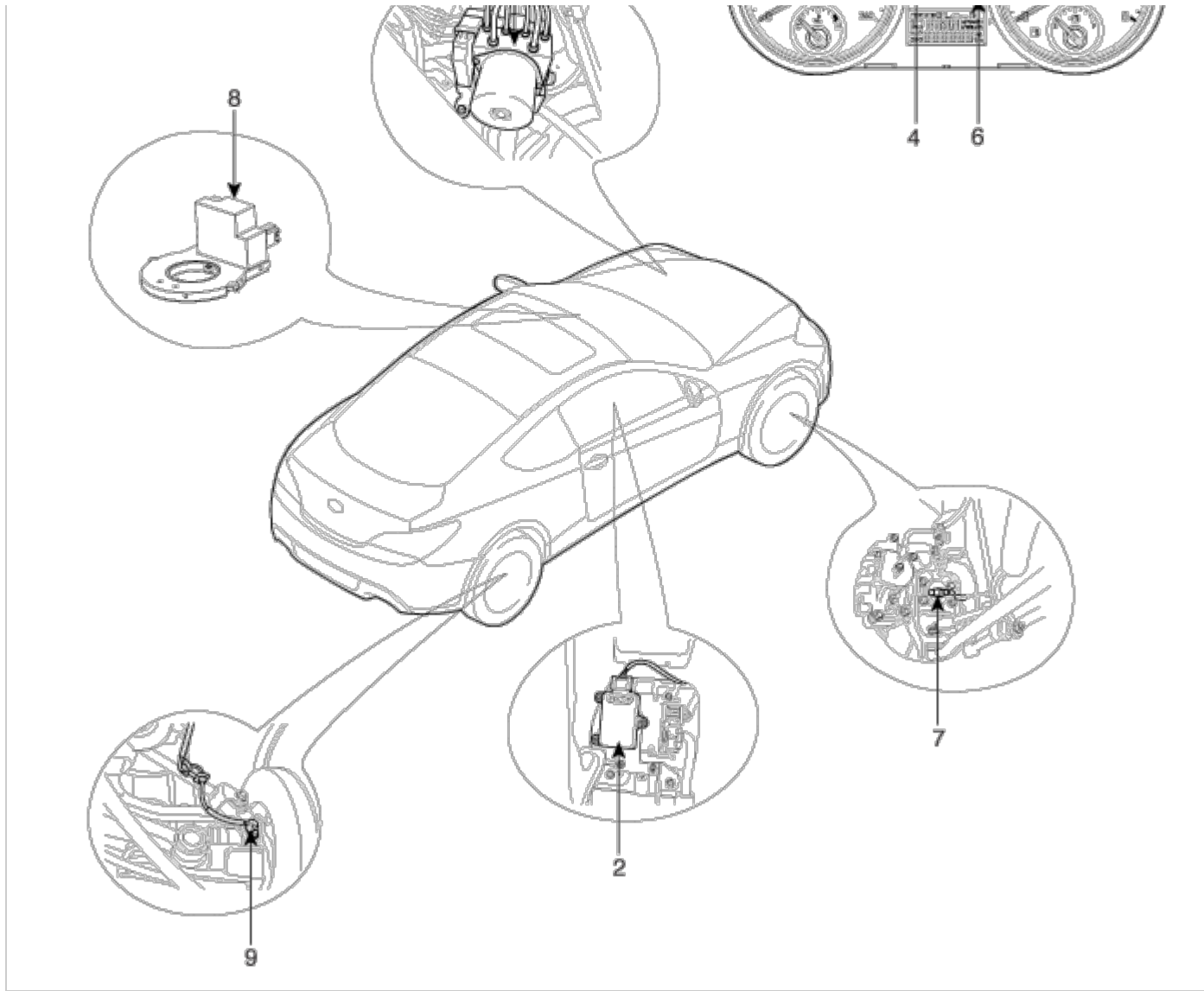
4. Release the parking brake lever fully, and check that parking brakes do not drag when the rear wheels are turned. Readjust if necessary.
5. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up fully.
6. Install the floor console.  
(Refer to Body group - "Floor console")

### Brake System



### Components





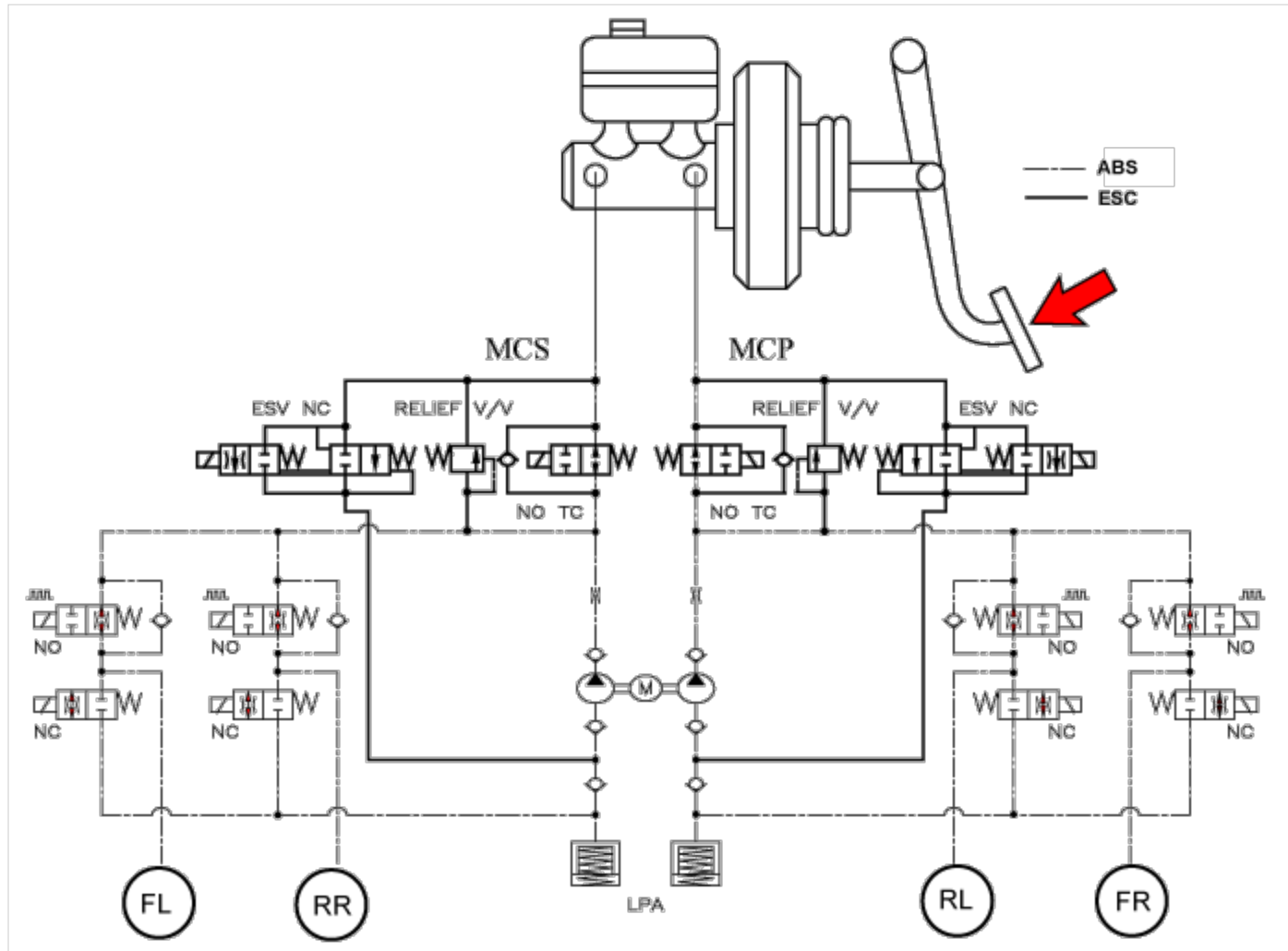
- 1. HECU module
- 2. Yaw rate & Lateral G sensor
- 3. Parking brake/EBD warning lamp
- 4. ABS warning lamp
- 5. ESC function / warning lamp

- 6. ESC OFF warning lamp
- 7. Front wheel speed sensor
- 8. Steering angle sensor
- 9. Rear wheel speed sensor



### ESC Operation mode

ESC Hydraulic system diagram



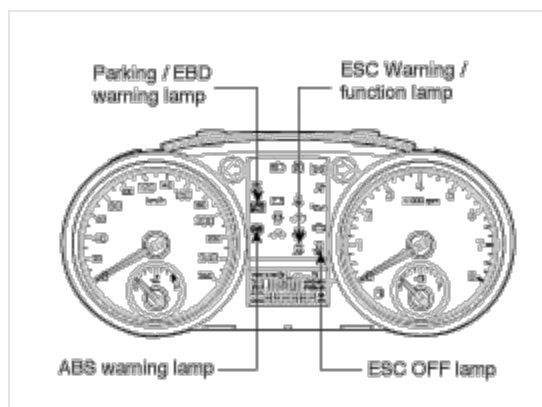
1. ESC Non-operation : Normal braking.

| 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<br>(Only inside of<br>rear wheel)  | IN(NO)  | OFF        | OPEN  | ON         | ON       |
|  | OUT(NC) | OFF        | CLOSE |            |          |
| Oversteering<br>(Only outside<br>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 seperated 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 trun 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.

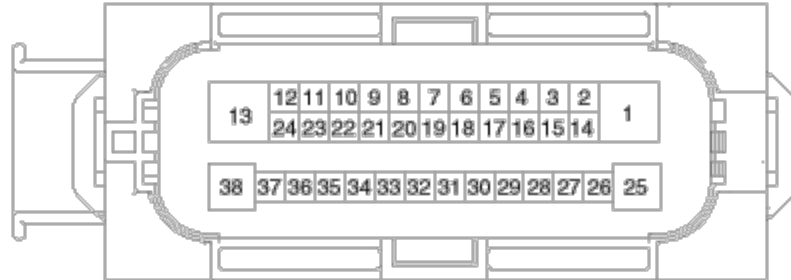
Initial status of the ESC function is on and switch toggle the state.

**Brake System**



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## **ESP Connector Input/Output**



| Connector Terminal |                           | Specification   |
|--------------------|---------------------------|---|
| No                 | Description               |   |
| 29                 | IGNITION1(+)              | High level of wake up voltage : $4.5V < V < 16.0V$<br>Low level of wake up voltage : $V < 2.4V$<br>Max. current : $I < 50mA$  |
| 25                 | POS. BATTERY 1.(SOLENOID) | Over voltage range : $17.0 \pm 0.5V$<br>Operating voltage range : $10.0 \pm 0.5V < V < 16.0 \pm 0.5V$<br>Low voltage range : $7.0 \pm 0.5V < V < 9.5 \pm 0.5V$<br>Max. current : $I < 40A$<br>Max. leakage current : $I < 0.25mA$ |
| 1                  | POS. BATTERY 2.(MOTOR)    | Operating voltage range: $10.0 \pm 0.5V < V < 16.0 \pm 0.5V$<br>Rush current : $I < 110A$<br>Max. current : $I < 40A$<br>Max. leakage current : $I < 0.25mA$  |
| 38                 | GROUND                    | Rated current : $I < 550mA$<br>Max. current: $I < 40A$  |
| 13                 | PUMP MOTOR GROUND         | Rush current : $I < 110A$<br>Max. current : $I < 40A$   |
| 23                 | BRAKE LIGHT SWITCH        | Input voltage (Low) : $V < 2V$  |
| 9                  | BRAKE SWITCH              | Input voltage (High) : $V > 6V$   |
| 11                 | SENSOR GROUND             | Max. Input current : $I < 3mA$<br>Rated current : $I < 250mA$   |
| 4                  | SENSOR POWER              | Max. current Capability : $I < 250mA$<br>Max. voltage : $V\_BAT1 -0.8V$   |
| 10                 | ESC ON/OFF SWITCH         |   |

|    |                               |   |
|----|-------------------------------|---|
| 22 | PARKING BRAKE SWITCH          | Input voltage (Low) : $V < 2V$  |
| 37 | VACCUM SWITCH                 | Input voltage (High) : $V > 6V$<br>Max input current : $I < 5mA$ (@12.8V)   |
| 8  | VACCUM PUMP DRIVE             | Max. Input current : 200mA<br>Max. output voltage (Low) : $V < 1.2V$  |
| 28 | SENSOR FRONT RIGHT OUTPUT     | External pull up resistance : $1 K\Omega < R$   |
| 17 | SENSOR REAR RIGHT OUTPUT      | 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 : $V_{BAT1} - 0.6V \sim V_{BAT1} - 1.1V$<br>Output current : Max. 30mA   |
| 34 | SENSOR FRONT RIGHT POWER      |   |
| 19 | SENSOR REAR LEFT POWER        |   |
| 33 | SENSOR REAR RIGHT POWER       | Input current Low : 5.9 ~ 8.4mA<br>Input current High : 11.8 ~ 16.8mA<br>Frequency range : 1 ~ 2500Hz<br>Input duty : $50 \pm 10\%$   |
| 31 | SENSOR FRONT LEFT SIGNAL      |   |
| 21 | SENSOR FRONT RIGHT SIGNAL     |   |
| 32 | SENSOR REAR LEFT SIGNAL       |   |
| 20 | SENSOR REAR RIGHT SIGNAL      | Max. input current : $I < 10mA$<br>Input duty (STG A, STG B) : $50 \pm 10\%$<br>phase Difference (STG A, STG B) $2 \pm 0.6deg$<br>High voltage : $3.0V < V_H < 4.1V$<br>Low voltage : $1.3V < V_L < 2.0V$ |
| 12 | CAN SENSOR LINE (HIGH)        |   |
| 24 | CAN SENSOR LINE (LOW)         |   |
| 15 | STEERING ANGLE SENSOR PHASE A |   |
| 16 | STEERING ANGLE SENSOR PHASE B |   |
| 27 | STEERING ANGLE SENSOR PHASE Z |   |

## Brake System



### 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.

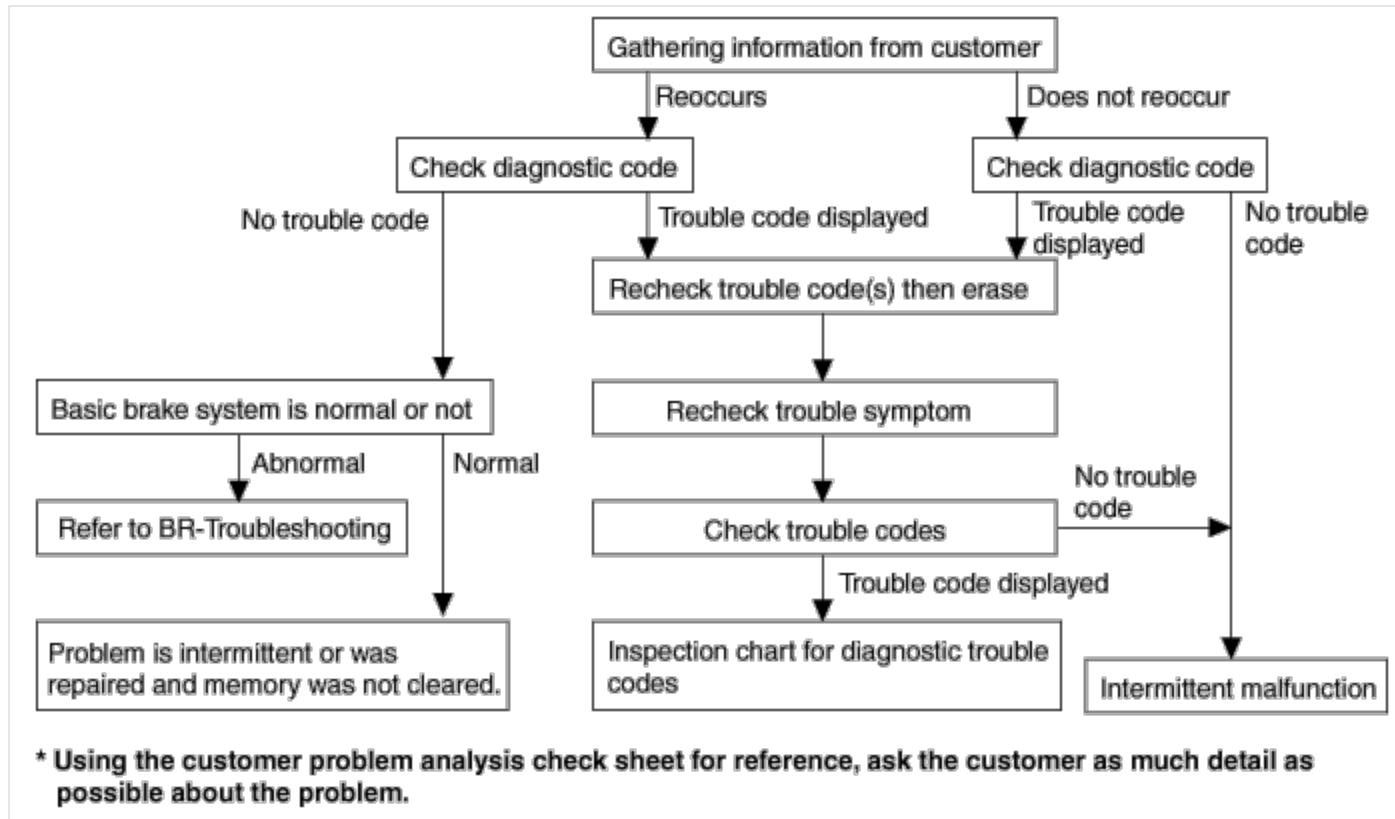
### **Countermeasures In Fail**

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<br/>(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.

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

|   |  |  |             |
|---|--|--|-------------|
| <b>ABS Check Sheet</b>                    |  | Inspector's<br>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<br>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.<br>1. Check the DTC reconfirming that the normal code is output.<br>2. Power source circuit.<br>3. Speed sensor circuit.<br>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.<br>1. Check the DTC reconfirming that the normal code is output.<br>2. Wheel speed sensor circuit.<br>3. Stop lamp switch circuit.<br>4. Check the hydraulic circuit for leakage. |
| Communication with GDS is not possible.<br>(Communication with any system is not possible) | 1. Power source circuit<br>2. CAN line  |
| Communication with GDS is not possible.<br>(Communication with ABS only is not possible)   | 1. Power source circuit<br>2. CAN line<br>3. HECU   |
| When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.       | 1. ABS warning lamp circuit<br>2. HECU  |
| Even after the engine is started, the ABS warning lamp remains ON.                         | 1. ABS warning lamp circuit<br>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

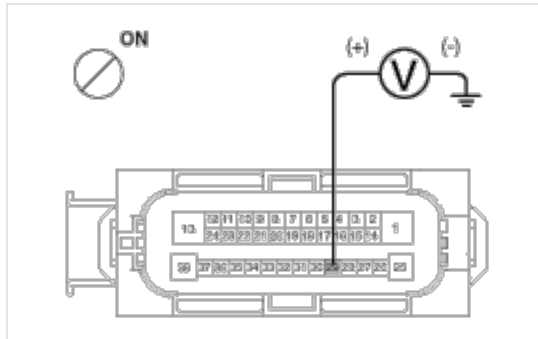
1. Disconnect the connector from the ESC control module.
2. Turn the ignition switch ON, measure the voltage between terminal 29 of the ESC control module harness side connector and body ground.

**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. |

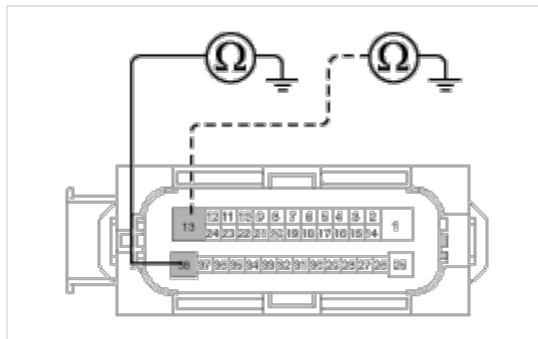




### Check the ground circuit

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. |

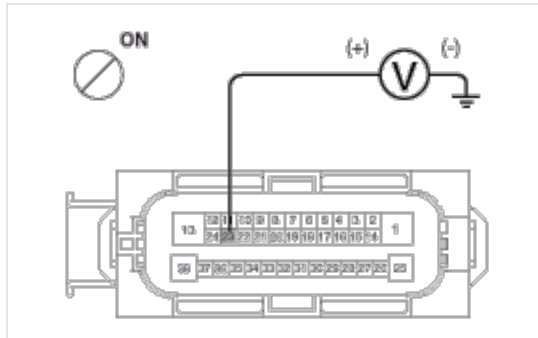
### **Check the stop lamp switch circuit**

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

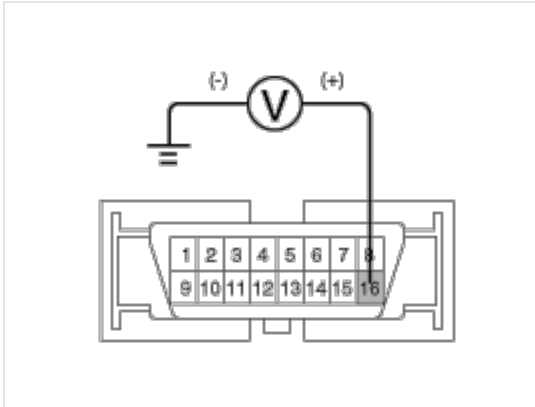
#### Check The Power Supply Circuit For The Diagnosis

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

**Specification** :approximately B+

2. Is voltage within specification?

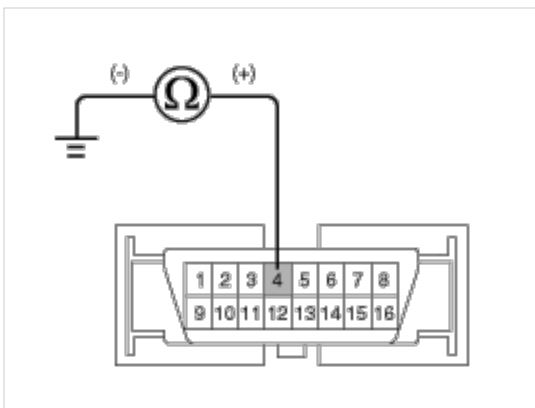
|            |  |
|------------|--|
| <b>YES</b> | ▶ Check the ground circuit for the diagnosis.  |
| <b>NO</b>  | ▶ Repair an open in the wire. Check and replace fuse (15A) from the engine compartment junction block. |



### 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

| 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 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.                   |

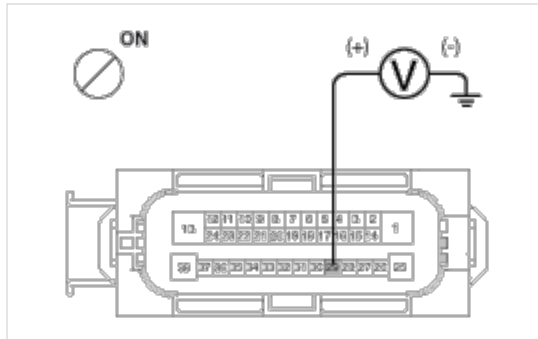
### Check the power source of ESC control module

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?

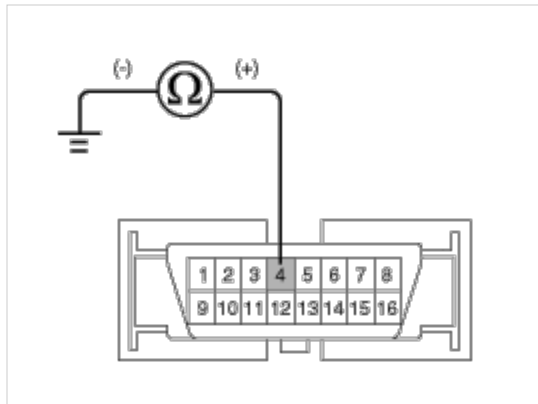
|            |   |
|------------|---|
| <b>YES</b> | ▶ Check for poor ground.  |
| <b>NO</b>  | ▶ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ESC control module. Repair if necessary. |



### 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

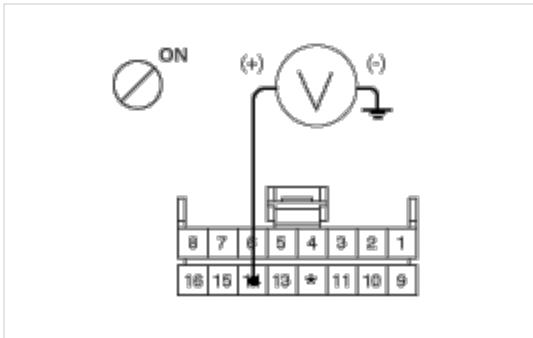
1. Disconnect the connector from the ESC control module and turn the ignition switch ON.
2. Does the ABS warning lamp light up?

|            |  |
|------------|--|
| <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+



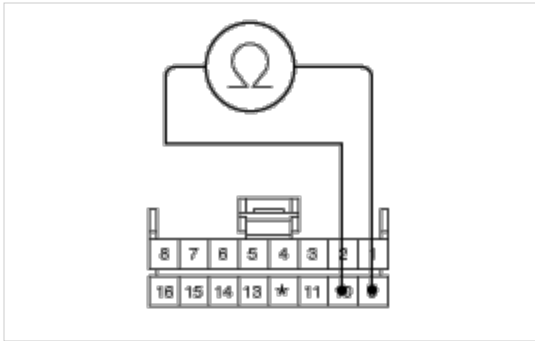
3. Is voltage within specification?

|            |  |
|------------|--|
| <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



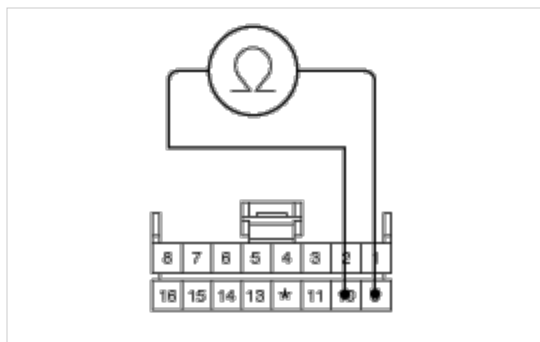
1. Connect the GDS to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using GDS.
3. Is DTC output?

|            |   |
|------------|---|
| <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.

### **NOTICE**

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.