

**BR-2****Brake System****General Information****Specifications**

Item	Specification
Master cylinder Type I.D. Piston stroke Fluid level warning sensor	Tandem type 20.64 mm (0.813 in) 45 mm (1.77 in) Provided
Brake booster Type Boosting ratio	Vacuum 7.5 : 1
Front brake(Disc) Type Disc O.D. Disc I.D. Disc thickness Pad thickness Cylinder type Cylinder I.D.	Floating type with ventilated disc 280 mm (11.02 in) 172 mm (6.77 in) 26 mm (1.02 in) 11 mm (0.43 in) Single piston Ø57.15 mm (2.25 in)
Rear brake(Disc) Type Disc O.D. Disc I.D. Disc thickness Pad thickness Cylinder type Cylinder I.D.	Floating type with solid disc 262 mm (10.31 in) 185 mm (7.28 in) 10 mm (0.39 in) 10 mm (0.39 in) Single piston Ø31 mm (1.22in)
Rear brake(Drum) Type Drum I.D. Brake lining thickness Clearance adjustment	Leading trailing Ø203 mm (7.99 in) 4.3 mm (0.17 in) Automatic
Parking brake (Disc type) Actuation Type Drum I.D.	DIH (Drum in hat) Lever 168 mm(6.61 in)

**NOTICE**

O.D. : Outer Diameter

I.D : Inner Diameter

# General Information

# BR-3

## Specification(ABS)

Part	Item	Standard value	Remark
HECU	System	4 Channel 4 Sensor (Solenoid)	
	Type	Motor, valve relay intergrated type	
	Operating Voltage	10 ~ 16 V	
	Operating Temperature	-40 ~ 110 °C (-40 ~ 230°F)	
	Motor power	210 W	
Warning lamp	Min. operating Voltage	12V	
	Max. Current consumption	Max. 100mA	
Active Wheel speed sensor (ABS)	Supply voltage	DC 4.5 ~ 20V	
	Output current low	5.9 ~ 8.4mA	
	Output current high	11.8~ 16.8mA	
	Output range	1 ~ 2500 Hz	
	Tone wheel	46 teeth	
	Air gap	0.5 ~ 1.5 mm	

# دیجیتال خودرو

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## BR-4

## Brake System

## Specification (ESP)

Part	Item	Standard value	Remark
HECU	System	4 Channel 4 Sensor (Solenoid)	Total control (ABS, EBD, TCS, ESP)
	Type	Motor, valve relay intergrated type	
	Operating Voltage	10 ~ 16V	
	Operating Temperature	-40 ~ 110°C(-40 ~ 230°F)	
	Motor power	270W	
Warning lamp	Min. Operating Voltage	12V	
	Max. Current consumption	Max. 100mA	
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	46 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	10 V ~ 16V	
	Current Consumption	Max. 150mA	
	Yaw rate sensor measurement range	-75 ~ 75°/sec	
	Lateral G sensor measurement range	-1.5 ~ 1.5gN	

# General Information

# BR-5

## Service Standard

Item	Standard value
Brake pedal height	LHD : 190.7 mm (7.51 in)
	RHD : 167.5 mm (6.59 in)
Brake pedal stroke	135 mm (5.31 in)
Stop lamp switch outer case to pedal stopper clearance	LHD : 1.0 ~ 2.0 mm (0.04 ~ 0.08 in)
	RHD : 0.5 ~ 1.0 mm (0.02 ~ 0.04 in)
Brake pedal free play	3 ~ 8 mm (0.08 ~ 0.20 in)
Booster push rod to master cylinder piston clearance	0.6 ~ 1.4 mm (at 500 mmHg vacuum)
Parking brake lever stroke when lever assembly is pulled with 196N (20Kg, 44lb force)	6 ~ 8 clicks
Front disc brake pad thickness	11 mm (0.43 in.)
Front disc thickness	26 mm (1.02 in)
Rear disc brake pad thickness	10 mm (0.35 in)
Rear disc brake disc thickness	10 mm (0.39 in)
Rear brake lining thickness	3 mm (0.12 in)

## Tightening Torques

Item	N.m	kgf.m	lb-ft
Master cylinder to booster mounting nut	9.8 ~ 15.7	1.0 ~ 1.6	7.2 ~ 11.6
Brake booster mounting nut	12.7 ~ 15.7	1.3 ~ 1.6	9.4 ~ 11.6
Bleeder screw	6.9 ~ 12.7	0.7 ~ 1.3	5.1 ~ 9.4
Brake tube to HECU-ABS	14.0 ~ 18.0	1.3 ~ 1.7	9.4 ~ 12.3
Brake tube to HECU-ESP	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Caliper guide rod bolt	21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Caliper mounting bolt (Front)	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Caliper mounting bolt (Rear)	63.7 ~ 73.6	6.5 ~ 7.5	47.0 ~ 54.3
Brake hose to caliper	24.5 ~ 29.4	2.5 ~ 3.0	18.1 ~ 21.7
Brake pedal member assembly bracket mounting nut	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Brake pedal member bracket to booster mounting nut	12.7 ~ 15.7	1.3 ~ 1.6	9.4 ~ 11.6
Stop lamp switch mounting nut	7.9 ~ 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 mounting bracket bolt	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Yaw rate & Lateral G sensor mounting bolt	5.0 ~ 8.0	0.51 ~ 0.81	3.7 ~ 5.8

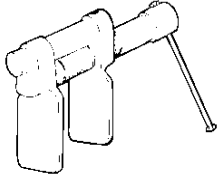
## BR-6

## Brake System

## Lubricant

Item	Recommended lubricant	Quantity
Brake fluid	DOT 3 or DOT 4	As required
Brake pedal bushing and brake pedal bolt	Chassis grease	As required
Parking brake shoe and backing plate contact surfaces	Bearing grease	As required
Caliper guide rod bolt and boot	AI-11P grease	0.8 ~ 2.0

## Special Service Tools

Tool (Number and Name)	Illustration	Use
09581 - 11000 Piston expander	 ARJE504I	Pushing back of the front disc and rear disc brake piston

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# General Information

# BR-7

## 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	Remedy
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. Master cylinder (Faulty)</li> </ol>	Repair Air bleeding Replace 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. Pad or lining (Cracked or distorted)</li> <li>5. Piston (Stuck)</li> <li>6. Piston (Frozen)</li> <li>7. Return spring (Faulty)</li> <li>8. Booster system (Vacuum leaks)</li> <li>9. Master cylinder (Faulty)</li> </ol>	Adjust Adjust Repair Replace Replace Replace Replace Replace 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 Replace Replace Replace Replace
Hard pedal but brake inefficient	<ol style="list-style-type: none"> <li>1. Brake system (Fluid leaks)</li> <li>2. Brake system (Air in)</li> <li>3. Pad or lining (Worn)</li> <li>4. Pad or lining (Cracked or distorted)</li> <li>5. Pad or lining (Oily)</li> <li>6. Pad or lining (Glazed)</li> <li>7. Disc (Scored)</li> <li>8. Booster system (Vacuum leaks)</li> </ol>	Repair Air bleeding Replace Replace Replace Replace Replace Replace
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. Return spring (Faulty)</li> <li>8. Brake pad shim (Damage)</li> <li>9. Shoe hold-down spring (Damage)</li> </ol>	Replace Retighten Replace Replace Clean Replace Replace Replace Replace
Brake fades	<ol style="list-style-type: none"> <li>1. Master cylinder</li> </ol>	Replace
Brake vibration, pulsation	<ol style="list-style-type: none"> <li>1. Disc (Excessive thickness variation)</li> <li>2. Disc (Faulty run-out)</li> <li>3. Disc (Uneven worn or crack)</li> <li>4. Pad or lining (Uneven worn and contact)</li> <li>5. Caliper (Faulty pad sliding)</li> </ol>	Replace Replace Replace Replace Replace

## BR-8

## Brake System

Symptom	Suspect Area	Remedy
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.	

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# Brake System

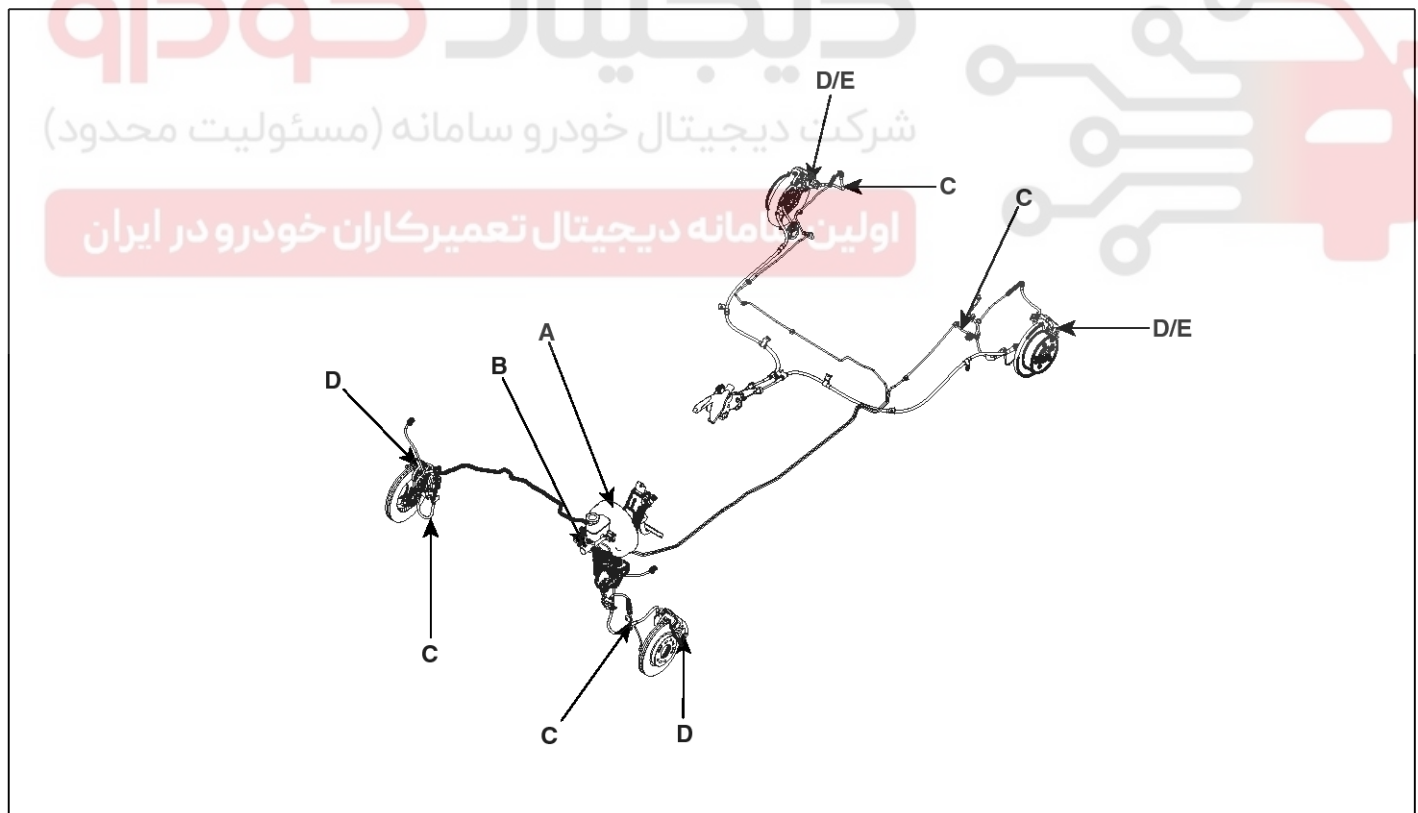
BR-9

## Brake System

### Operation and Leakage Check

Check all of the following items

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



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# BR-10

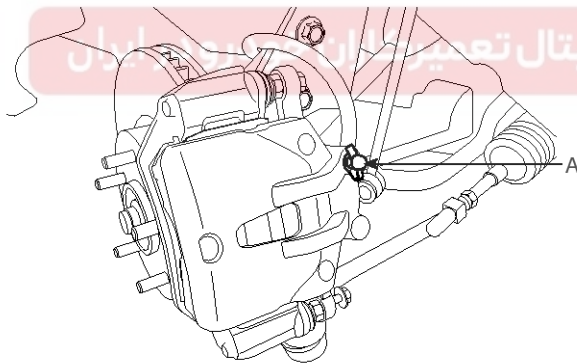
# Brake System

## Brake System Bleeding

### ⚠ CAUTION

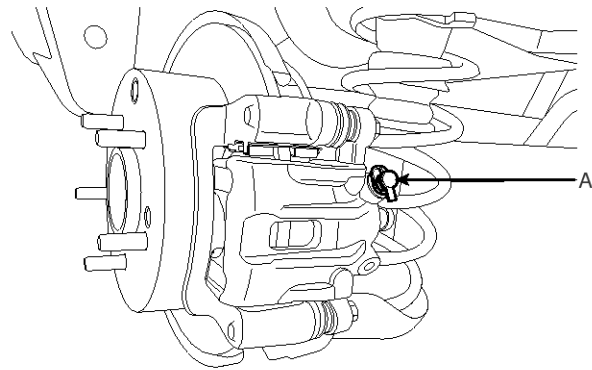
- Do not reuse the drained fluid.
  - Always use genuine DOT3/DOT4 brake Fluid.  
Using a non-genuine DOT3/DOT4 brake fluid can cause corrosion and decrease the life of the system.
  - Make sure no dirt or other foreign matter is allowed to contaminate the brake fluid.
  - Do not spill brake fluid on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



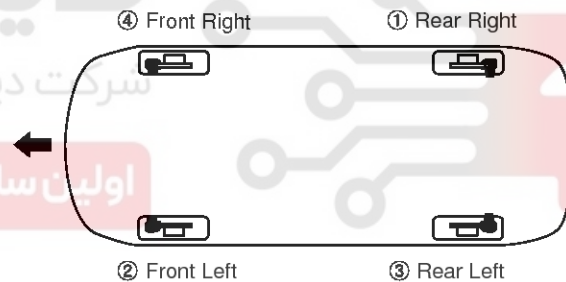
STDBR9001D

### Rear



STDBR9002D

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



EJKE003B

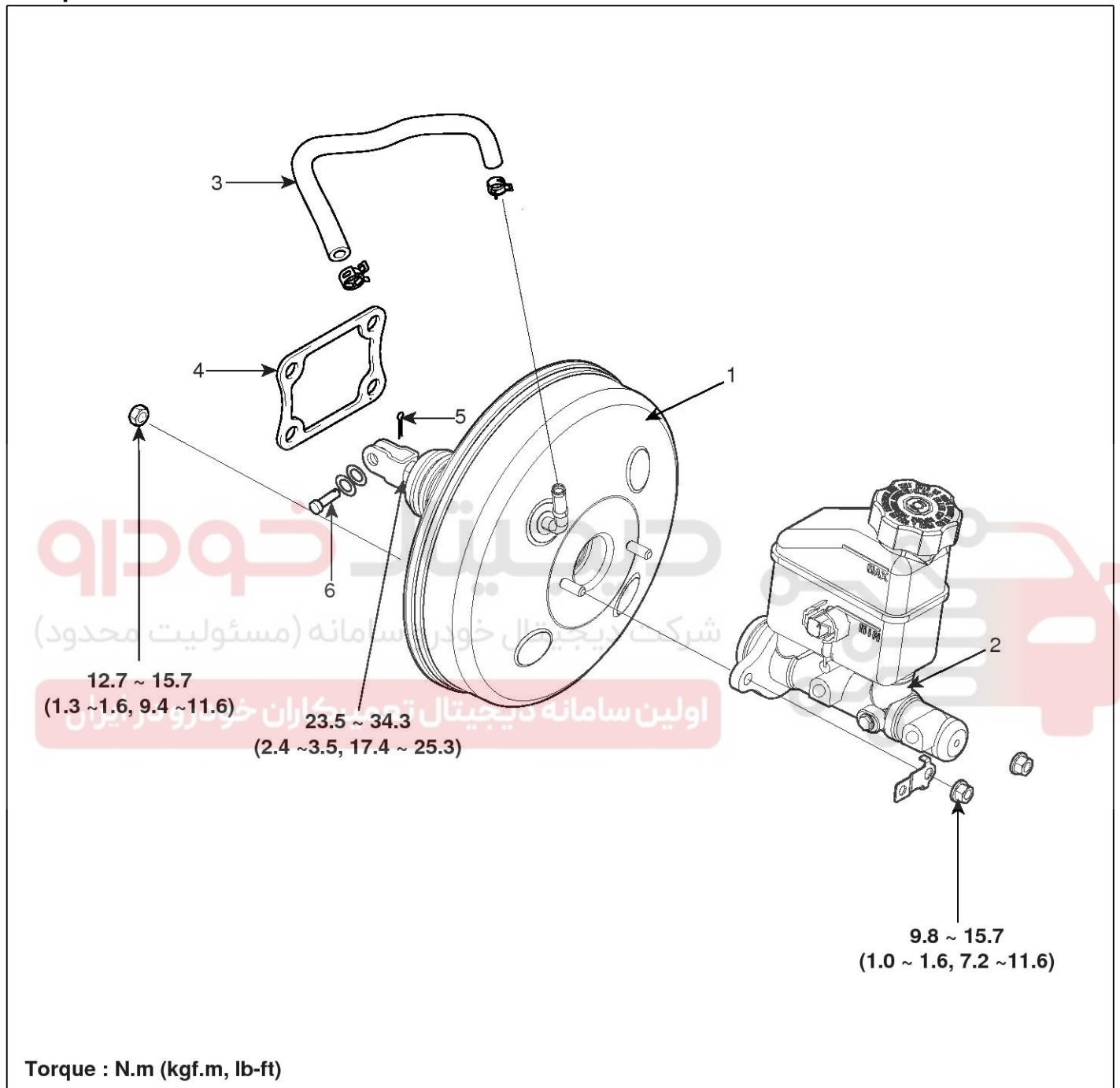
5. Refill the master cylinder reservoir to MAX(upper) level line.

# Brake System

# BR-11

## Brake Booster

### Components



STDBR9001L

- 1. Brake booster
- 2. Master cylinder assembly
- 3. Vacuum hose

- 4. Seal
- 5. Snap pin
- 6. Clevis pin

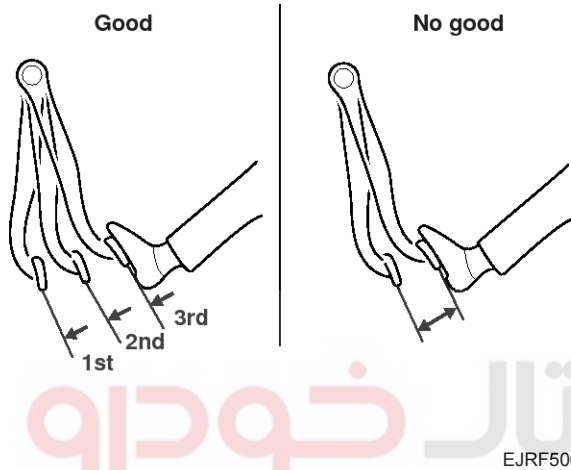
# BR-12

# Brake System

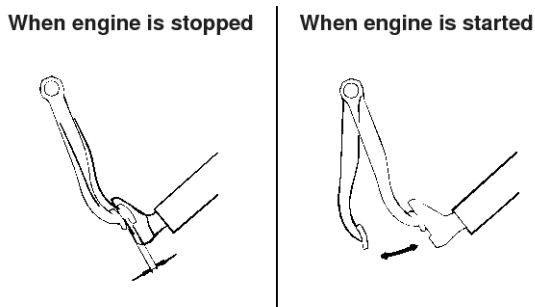
## Brake Booster Operating Test

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.

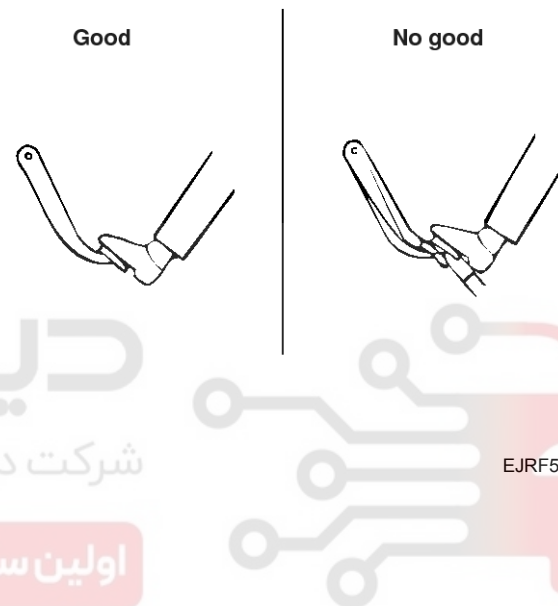


3. With the engine running, step on the brake pedal and then stop the engine.

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.

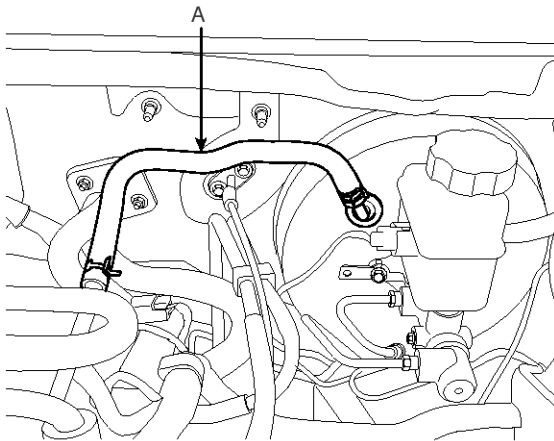


# Brake System

## BR-13

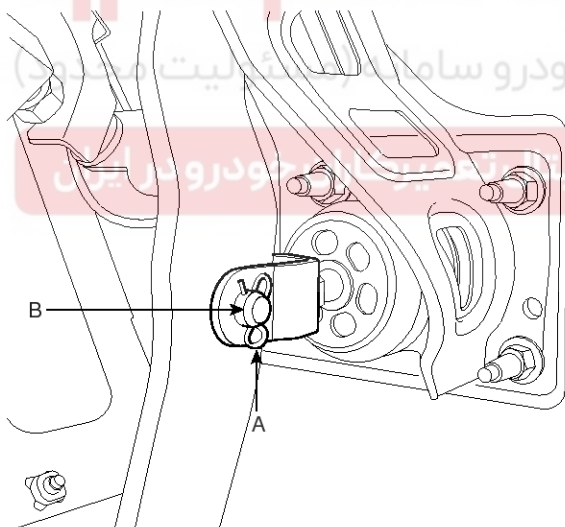
### Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the vacuum hose (A) from the brake booster.



STDBR9011D

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

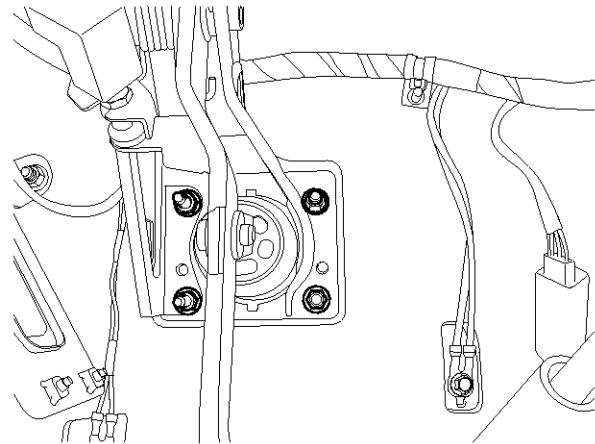


STDBR9012D

5. Remove the mounting nuts.

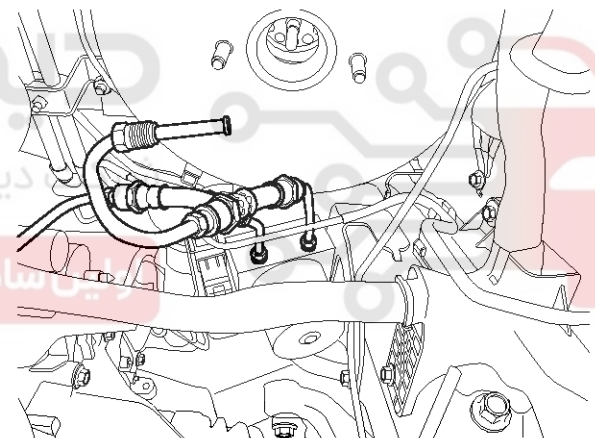
### Tightening torque :

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



STDBR9013D

6. Remove the brake booster after disconnecting the brake tubes(2EA) from the HECU.



STDBR9014D

## BR-14

## Brake System

### Inspection

1. Inspect the check valve in the vacuum hose.

**⚠ CAUTION**

Do not remove the check valve from the vacuum hose.

2. Check the boot for damage.

### Installation

1. Installation is the reverse of removal.

**⚠ CAUTION**

- Before installing the pin, apply the grease to the joint pin.

- Use a new snap pin whenever installing.

2. After installing, bleed the brake system. (Refer to Brake system bleeding)

3. Adjust the brake pedal height and free play.

(Refer to Brake pedal height and free play adjustment)

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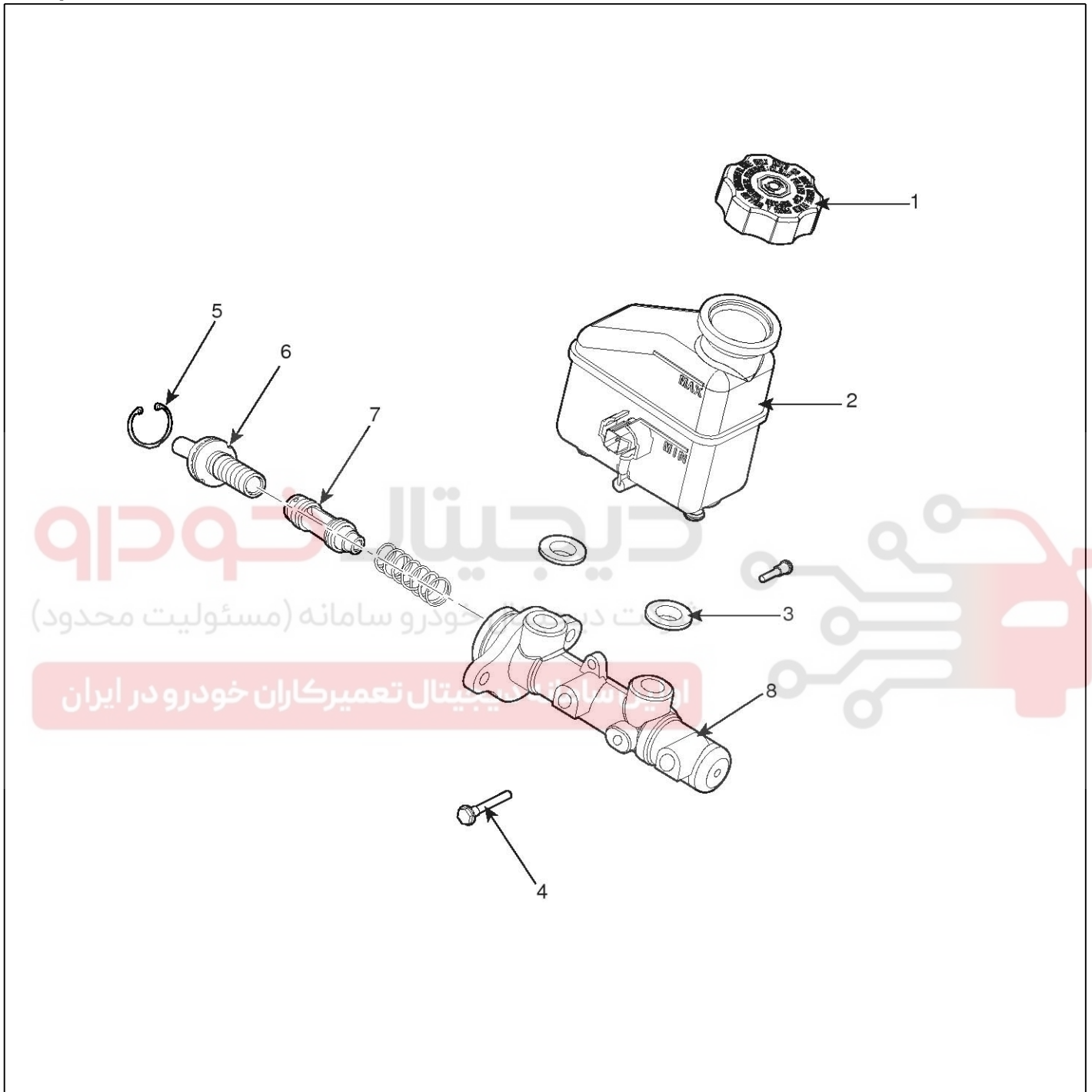


# Brake System

# BR-15

## Master Cylinder

### Components



STDBR9020D

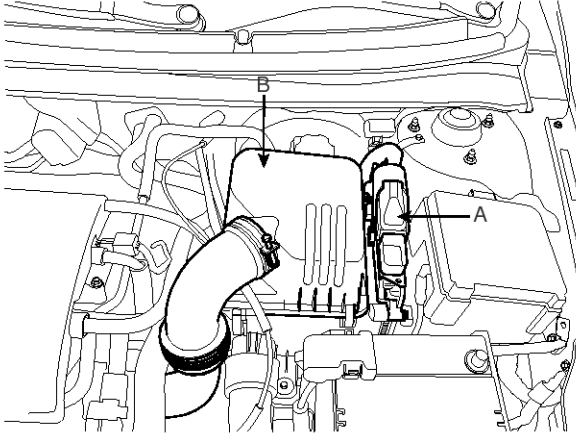
- |                  |                              |
|------------------|------------------------------|
| 1. Reservoir cap | 5. Retainer                  |
| 2. Reservoir     | 6. Primary piston assembly   |
| 3. Grommet       | 7. Secondary piston assembly |
| 4. Cylinder pin  | 8. Master cylinder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

## BR-16

## Brake System

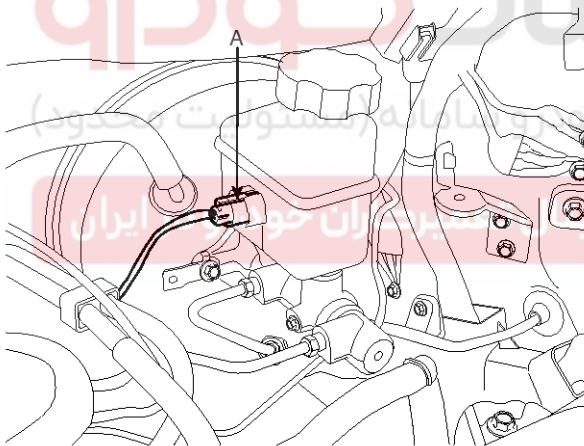
## Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the air cleaner assembly. (Refer to the Engine group-Engine and Transaxle assembly)



STDBR9021D

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



STDBR9022D

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

**CAUTION**

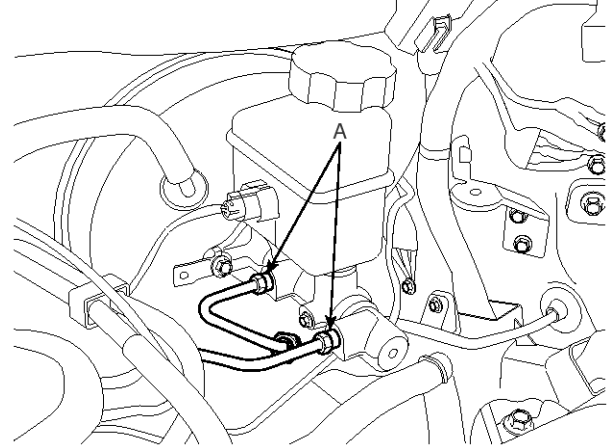
- Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

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

**Tightening torque :**

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

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

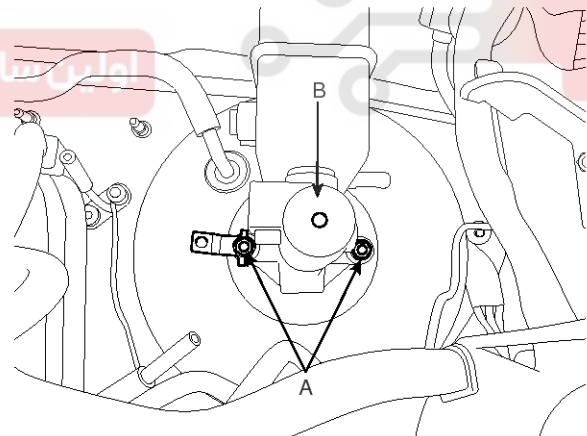


STDBR9023D

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

**Tightening torque :**

9.8 ~ 15.7N.m (1.0 ~ 1.6 kgf.m, 7.2 ~ 11.6lb-ft)



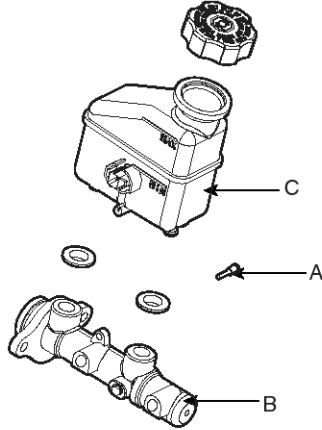
STDBR9024D

# Brake System

## BR-17

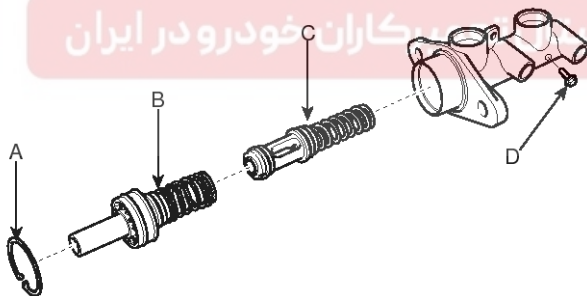
### Disassembly

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



SEDBR7511L

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



SUNBR6515D

### NOTICE

Do not disassemble the primary and secondary piston assembly.

### Inspection

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

### CAUTION

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



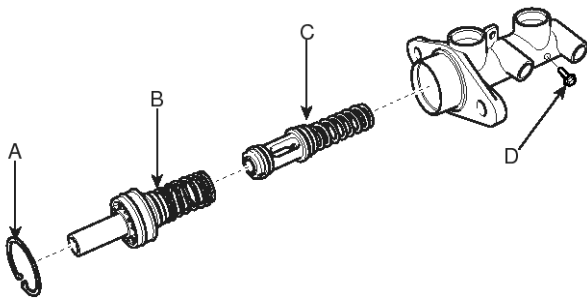


## BR-18

## Brake System

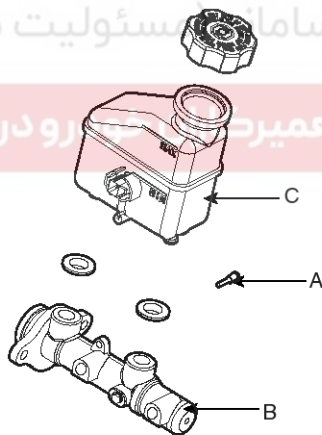
## Reassembly

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



SUNBR6515D

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



SEDBR7511L

## Installation

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



# Brake System

# BR-19

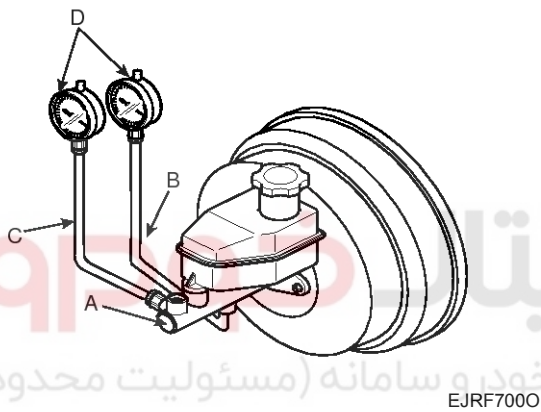
## Proportioning Valve

### Description

Do not disassemble the proportioning valve. The proportioning valve makes the ideal distribution of fluid pressure to the front and rear brakes to prevent the brakes from skidding in the event of rear wheel lock up and to obtain higher brake efficiency within the range of service brake application.

### Inspection

1. Remove the front brake tube (B) and rear brake tube (C) from the master cylinder (A).
2. Connect two pressure gauges (D); one to the output valve of the front (B) and rear (C) brake.



### NOTICE

Be sure to bleed the system after connecting the pressure gauges.

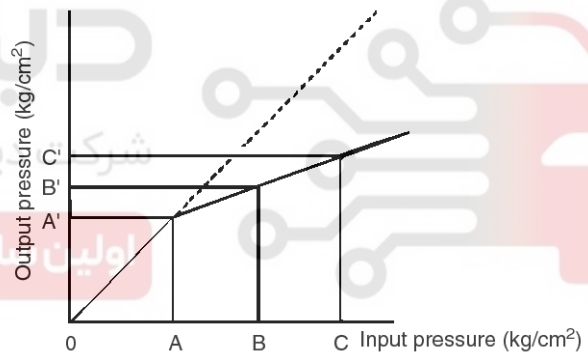
3. With the brake applied, measure the front pressure and the rear pressure. If the measured pressures are within the specified range as illustrated, the proportioning valve is good.

4. Reconnect the brake lines in their original positions and bleed the brake system.

### NOTICE

This table shows characteristics of the proportioning valve as the pressure increases.

Front (Output of master cylinder)	Rear (Output of proportioning valve)
A : 25 kg/cm <sup>2</sup> (2.45 MPa, 356 psi)	A' : 25 kg/cm <sup>2</sup> (2.45 MPa, 356 psi)
B : 60 kg/cm <sup>2</sup> (5.88 MPa, 853 psi)	B' : 34.5 ± 2 kg/cm <sup>2</sup> (3.83 ± 0.20 MPa, 491 ± 28 psi)
B : 100 kg/cm <sup>2</sup> (9.81 MPa, 1422 psi)	B' : 45.3 ± 3.5 kg/cm <sup>2</sup> (4.44 ± 0.34 MPa, 644 ± 50 psi)



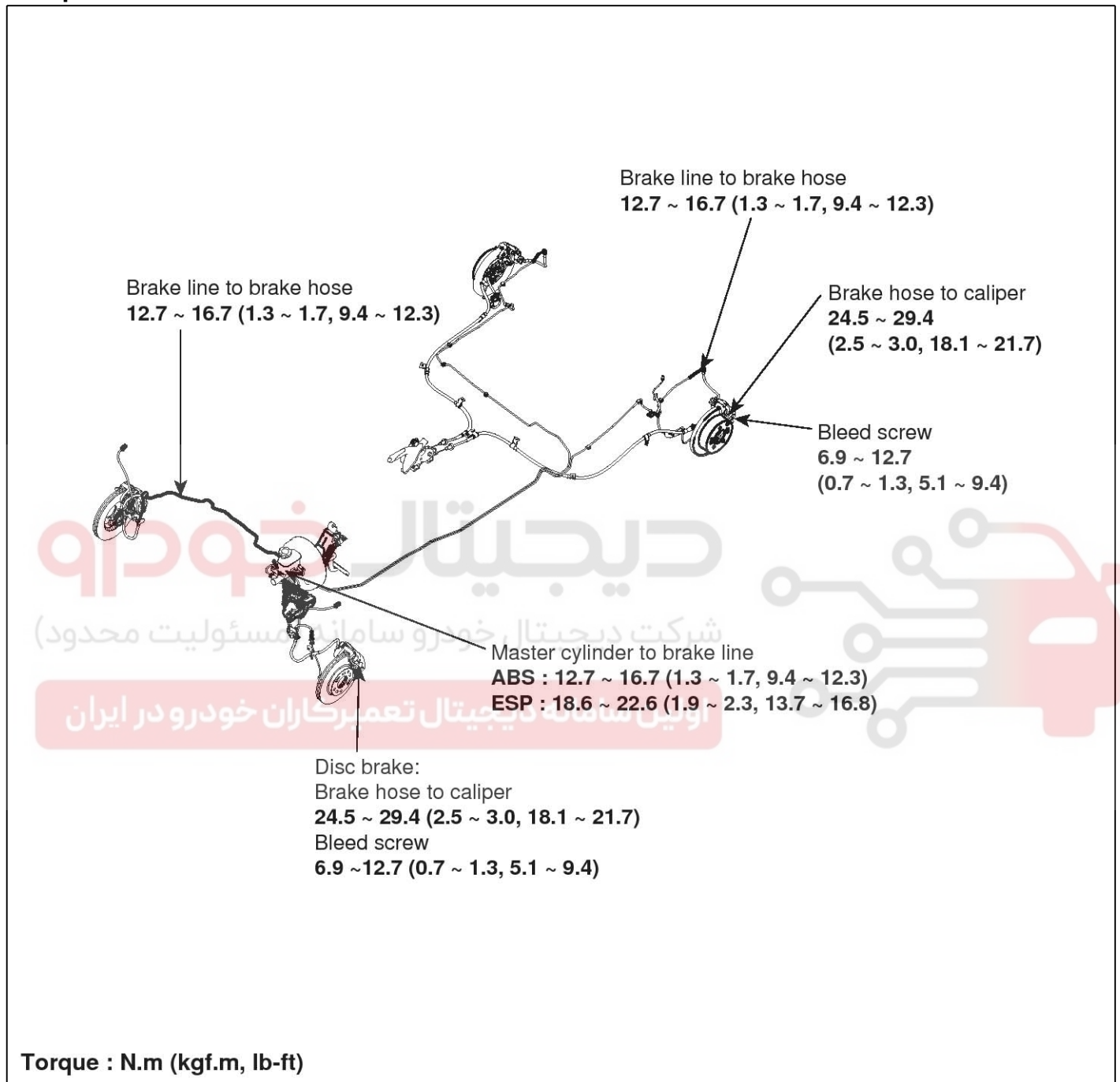
SHDBR6571L

# BR-20

# Brake System

## Brake Line

### Components



STDBR9070L

### ⚠WARNING

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

# Brake System

## BR-21

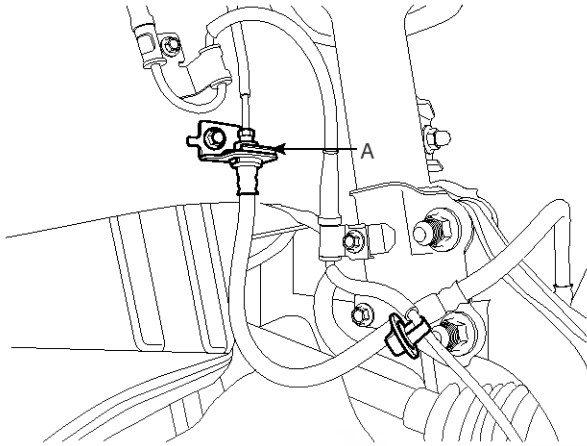
### Removal

1. Remove the wheel & tire.
2. Disconnect the brake tube by loosening the tube flare nut (B).

### Tightening torque :

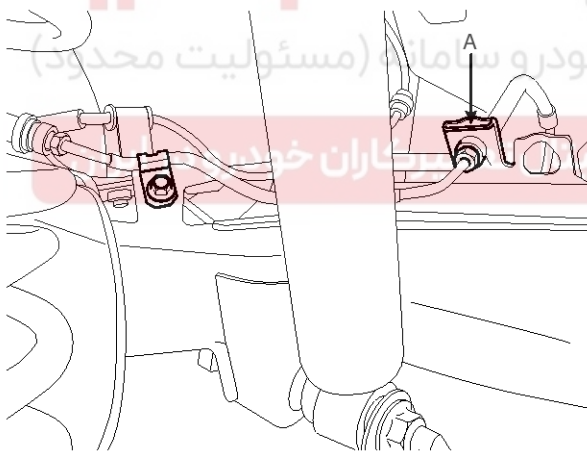
12.7 ~ 16.7N.m (1.3 ~ 1.7kgf.m, 9.4 ~ 12.3lb-ft)

### Front



STDBR9041D

### Rear



STDBR9042D

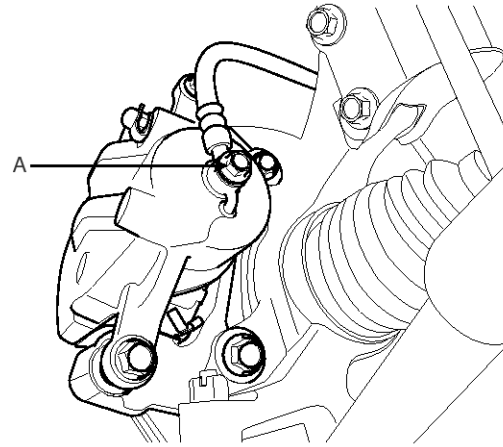
3. Remove the brake hose clip (A).

4. Disconnect the brake hose from the brake caliper by loosening the bolt (A).

### Tightening torque :

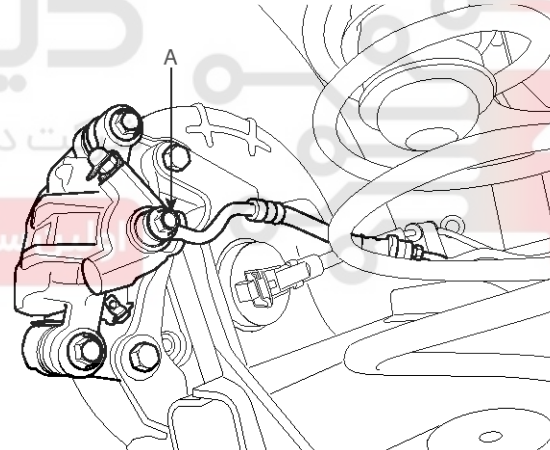
24.5 ~ 29.4N.m (2.5 ~ 3.0kgf.m, 18.1 ~ 21.7lb-ft)

### Front



STDBR9043D

### Rear



STDBR9044D

**BR-22****Brake System****Inspection**

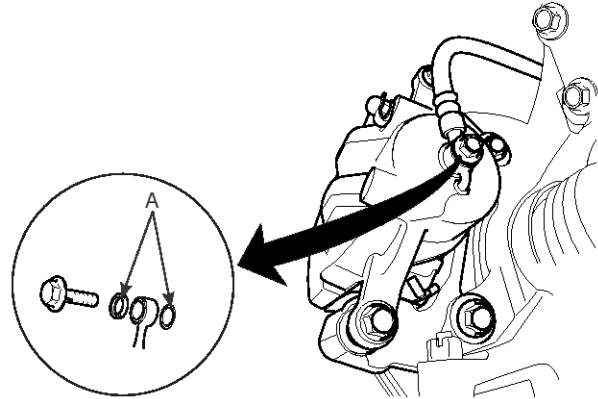
1. Check the brake tubes for cracks, crimps and corrosion.
2. Check the brake hoses for cracks, damage and fluid leakage.
3. Check the brake tube flare nuts for damage and fluid leakage.
4. Check the brake hose mounting bracket for crack or deformation.

**Installation**

1. Installation is the reverse of removal.

**CAUTION**

Use a new washer(A) whenever installing.

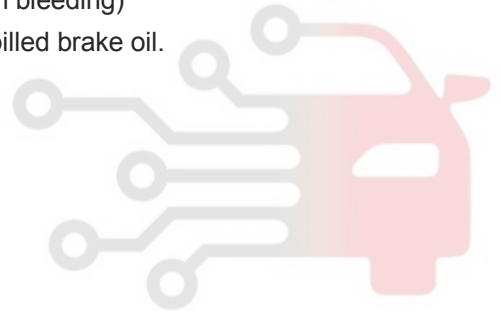


STDBR9045D

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

دیجیتال خودرو  
شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

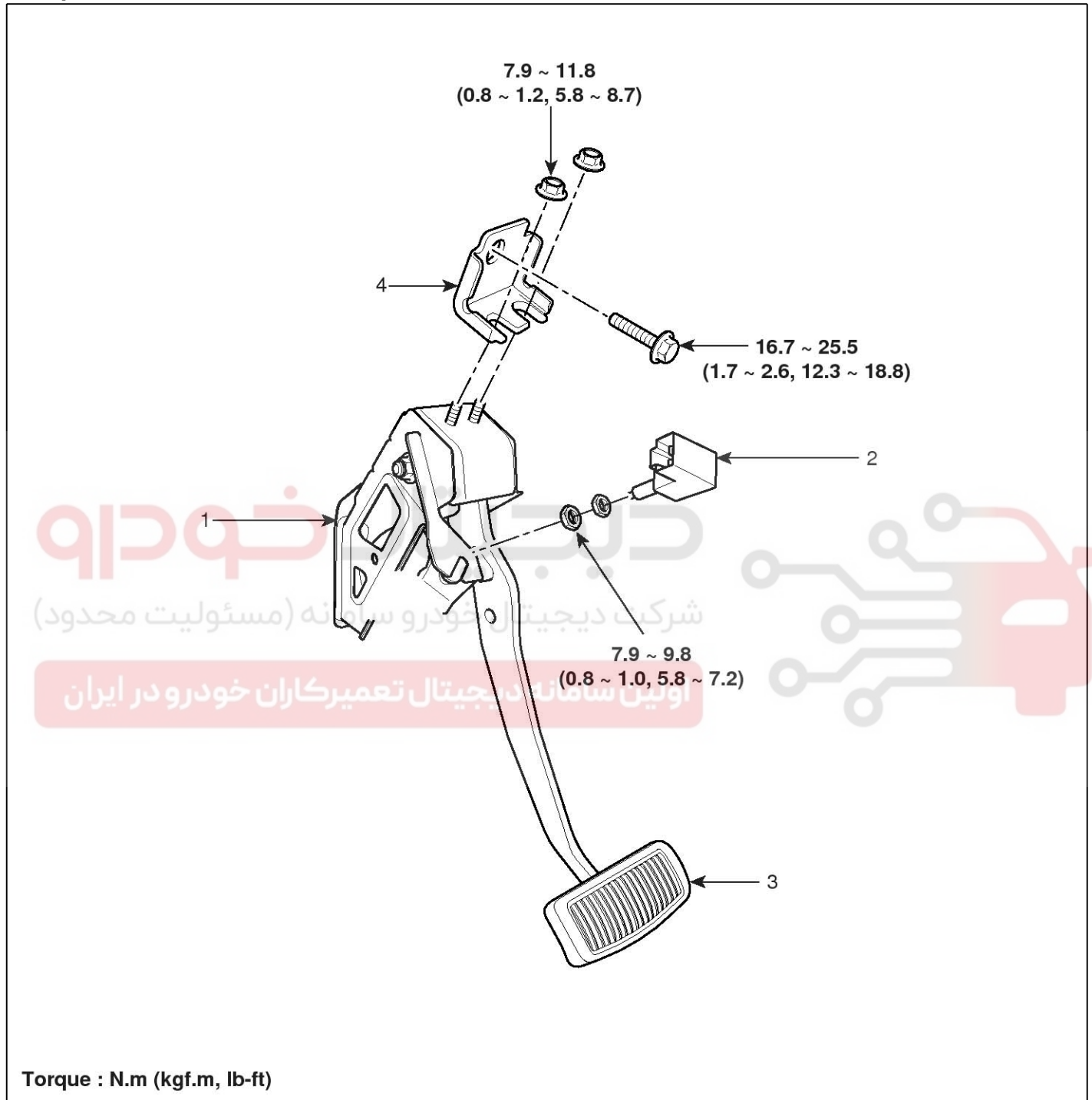


# Brake System

# BR-23

## Brake Pedal

### Components



STDBR9050L

- 1. Brake pedal member assembly
- 2. Stop lamp switch

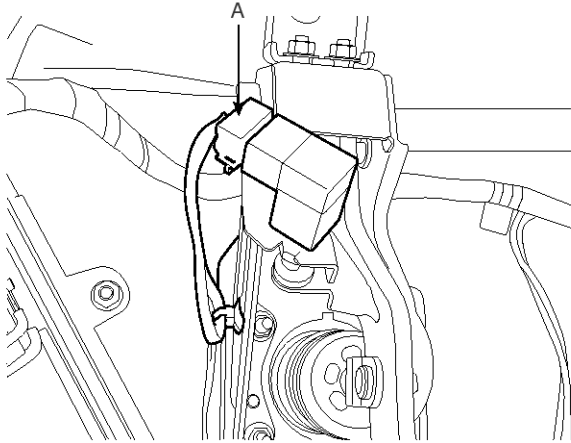
- 3. Brake pedal
- 4. Mounting bracket

# BR-24

# Brake System

## Removal

1. Remove the lower crash pad. (Refer to the Body group- crash pad).
2. Disconnect the stop lamp switch connector (A).

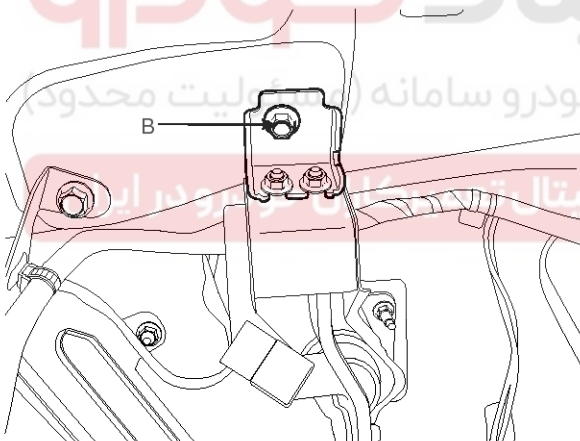


STDBR9051D

3. Remove the mounting bracket bolt (B).

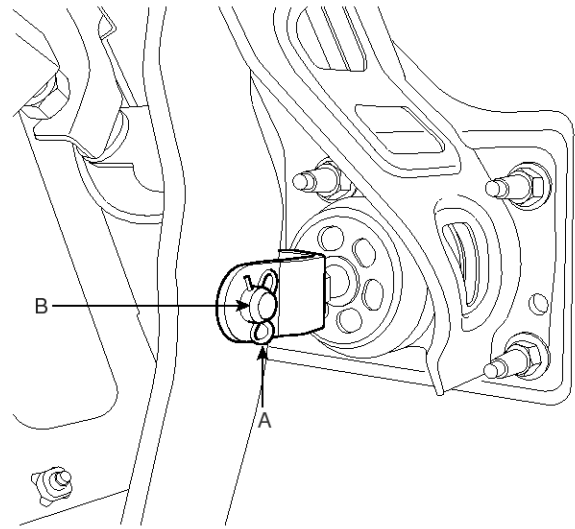
### Tightening torque :

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



STDBR9052D

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

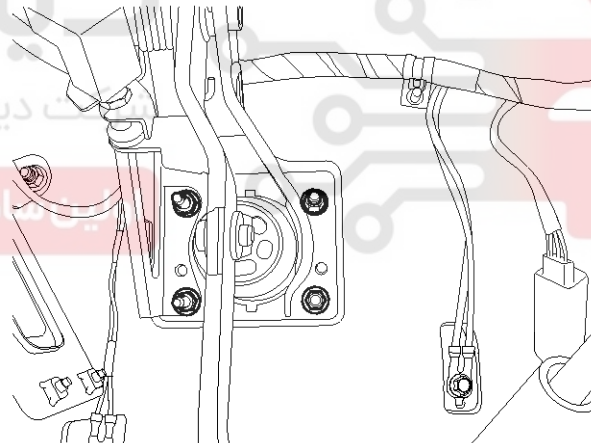


STDBR9012D

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

### Tightening torque :

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



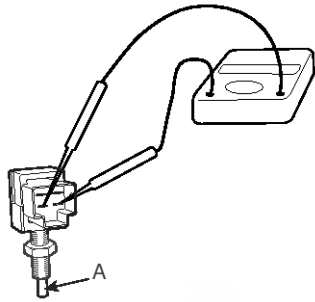
STDBR9013D

# Brake System

# BR-25

## 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.



SCMBR6530D

## 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.



دیجیتال خودرو  
شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

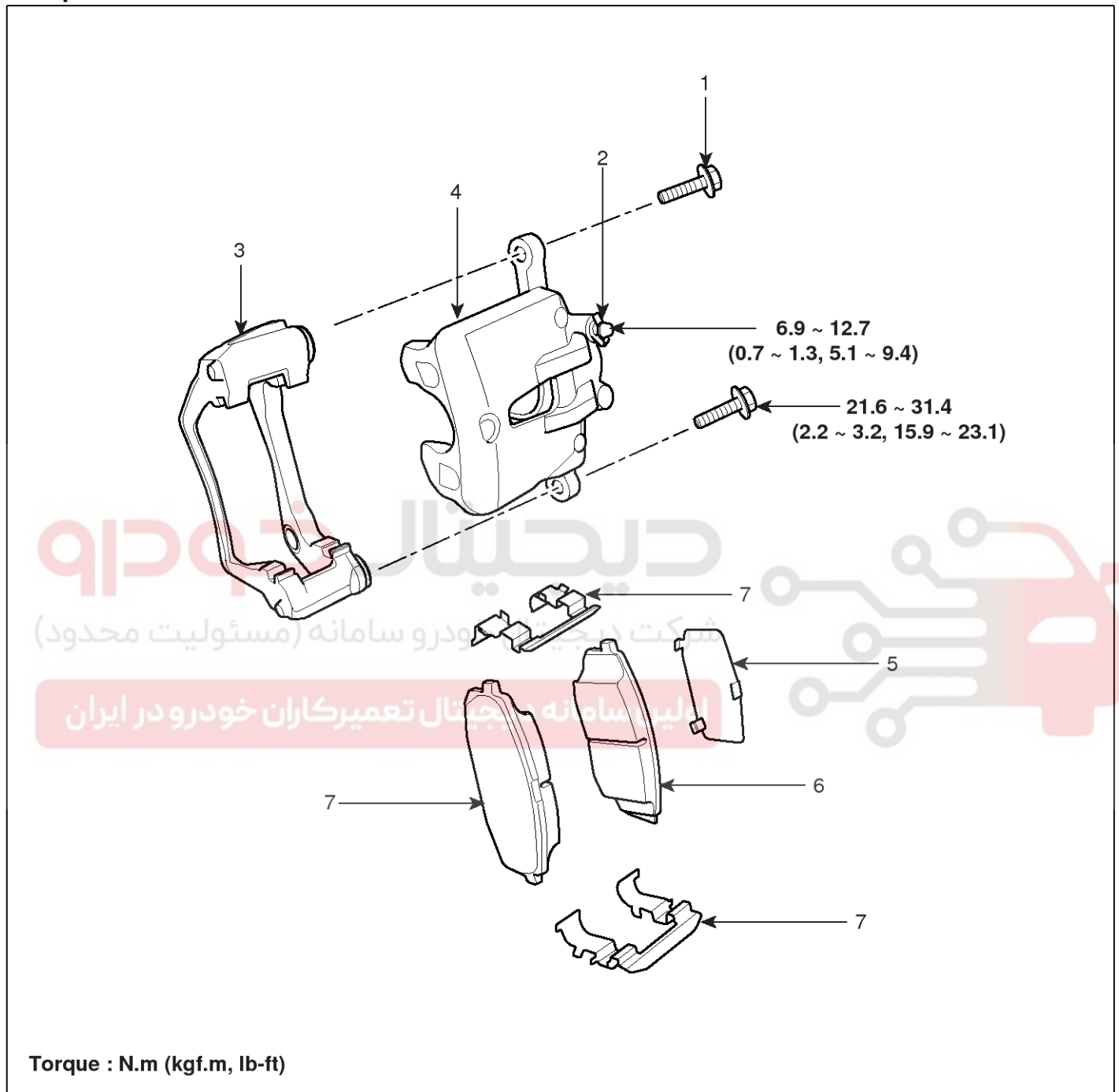


# BR-26

# Brake System

## Front Disc Brake

### Components



STDBR9060L

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

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

# Brake System

# BR-27

## Removal

1. Remove the front wheel & tire.

### Tightening torque :

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

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

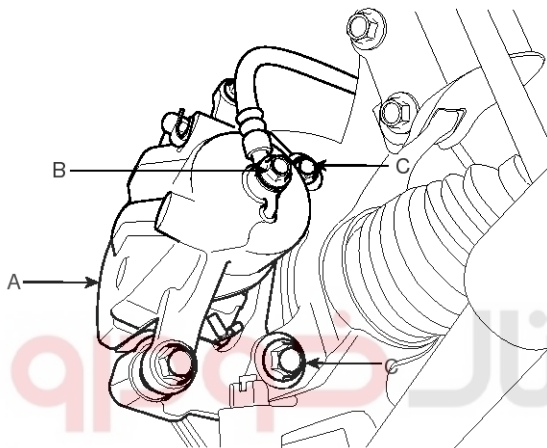
### Tightening torque

Brake hose to caliper(B):

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

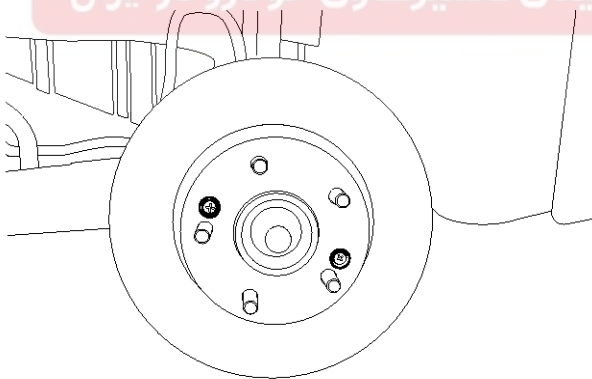
Caliper assembly to knuckle(C):

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



STDBR9061D

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



STDBR9062D

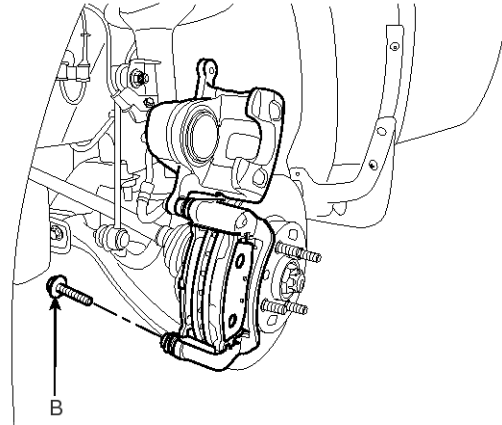
## Replacement

### Front Brake Pads

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

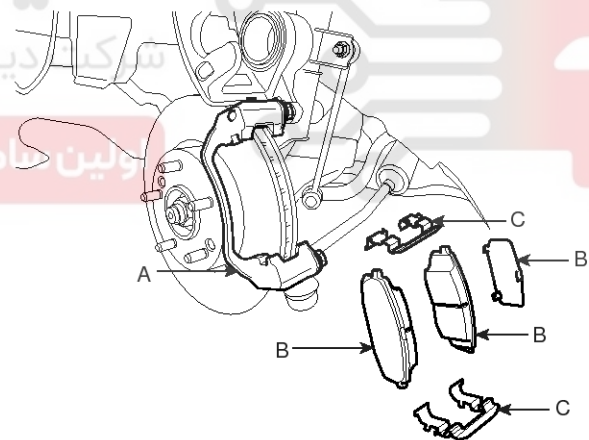
### Tightening torque :

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



SPBBR9064L

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



STDBR9064D

## BR-28

## Brake System

### Inspection

#### Front Brake Disc Thickness Check

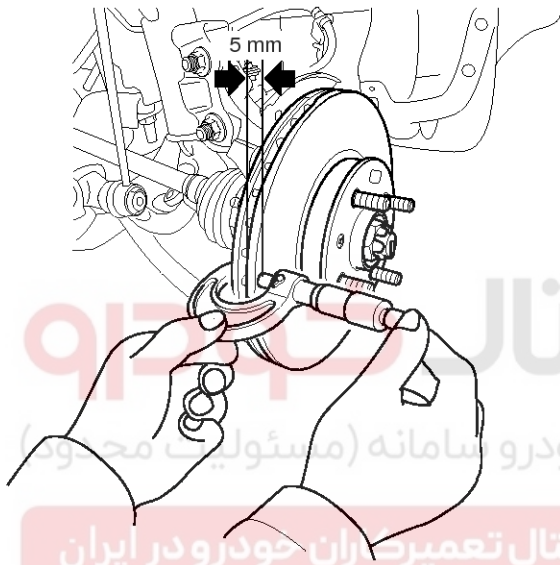
1. Check the brake pads for wear and fade.
2. Check the brake disc for damage and cracks.
3. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

#### Brake disc thickness

Standard: 26mm (1.02in)

Service limit: 24.4mm (0.96in)

Deviation: Less than 0.005mm (0.0002in)



SPBBR9066L

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 : 11mm (0.43in)

Service limit : 2.0mm (0.0787in)

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



# Brake System

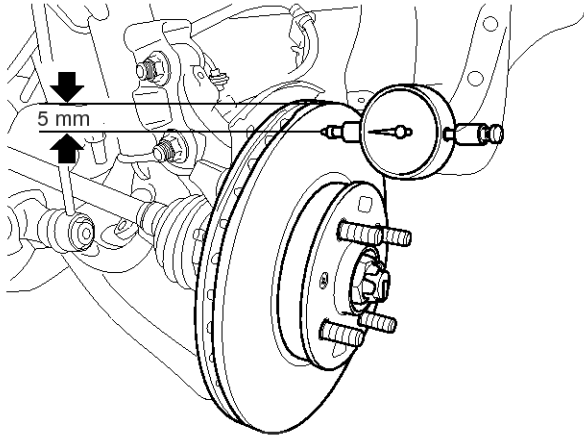
## BR-29

### 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 : 0.04mm (0.00157in.) or less (new one)



SPBBR9067L

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

### Installation

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

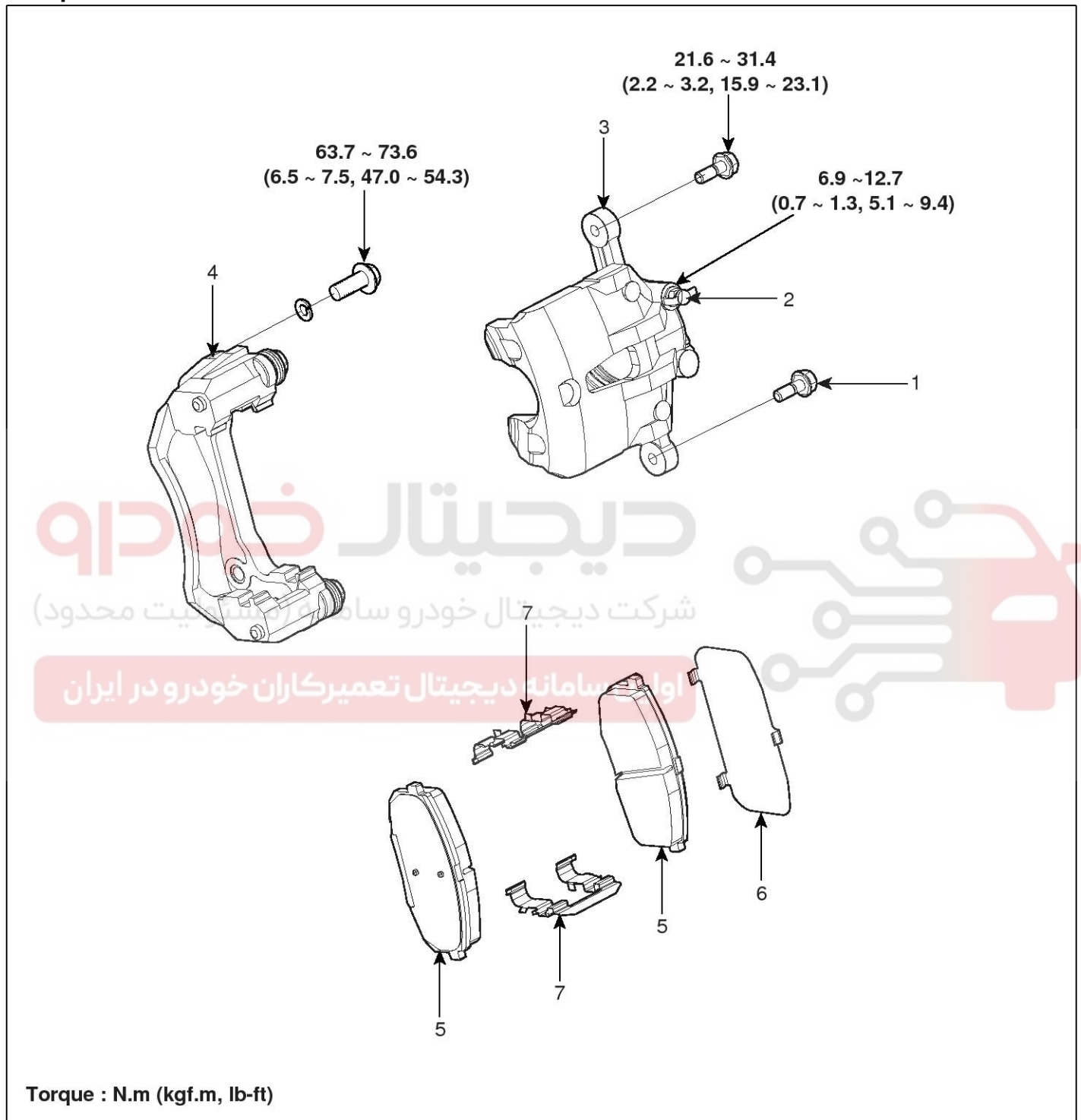


# BR-30

# Brake System

## Rear Disc Brake

### Components



STDBR9080L

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

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

# Brake System

# BR-31

## Removal

1. Remove the rear wheel & tire.

### Tightening torque :

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

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

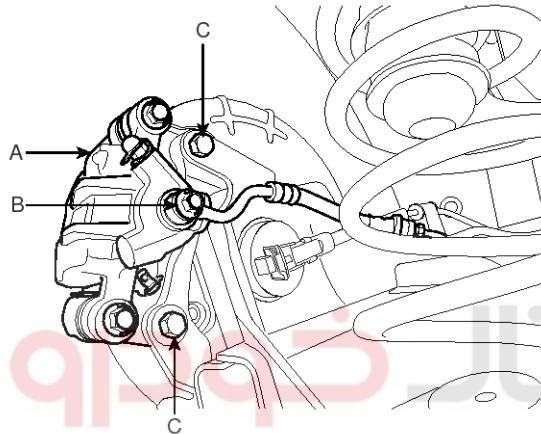
### Tightening torque

Brake hose to caliper(B):

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

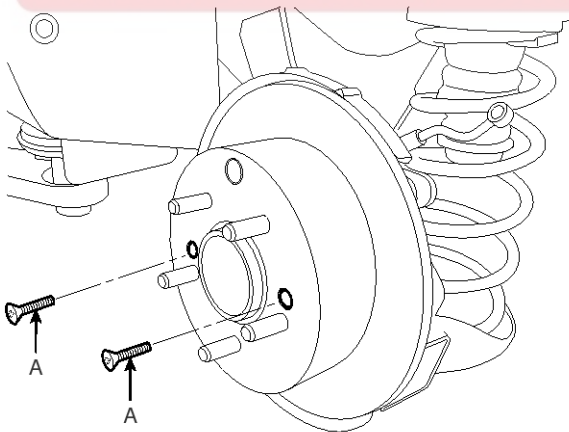
Caliper assembly to carrier(C):

63.7 ~ 73.6N.m (6.5 ~ 7.5kgf.m, 47.0 ~ 54.3lb-ft)



STDBR9081D

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



STDBR9082D

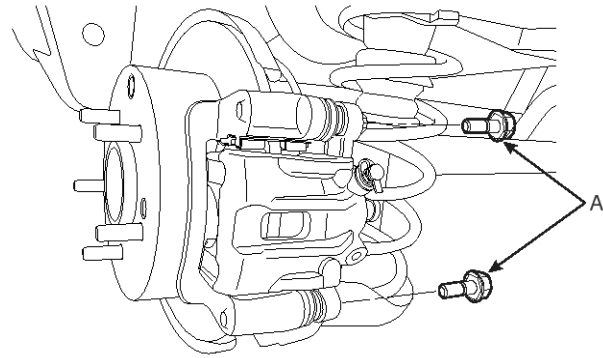
## Replacement

### Rear Brake Pads

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

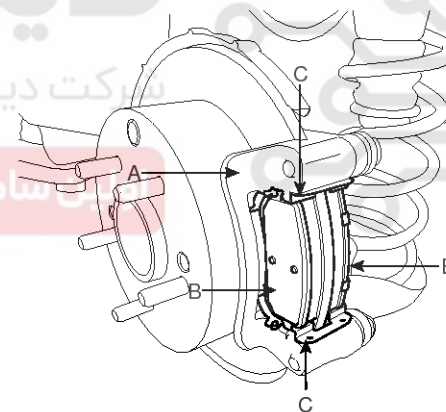
### Tightening torque :

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



STDBR9083D

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



STDBR9084D

## BR-32

## Brake System

### Inspection

#### Rear Brake Disc Thickness Check

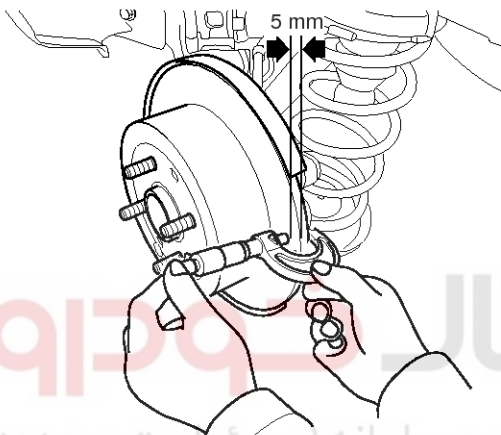
1. Check the brake pads for wear and fade.
2. Check the brake disc for damage and cracks.
3. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

#### Brake disc thickness

Standard: 10mm (0.39in)

Service limit: 8.4mm (0.33in)

Deviation: less than 0.01mm (0.00039in)



SPBBR9085L

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: 10mm (0.39 in)

Service limit: 2.0 mm (0.0787 in)

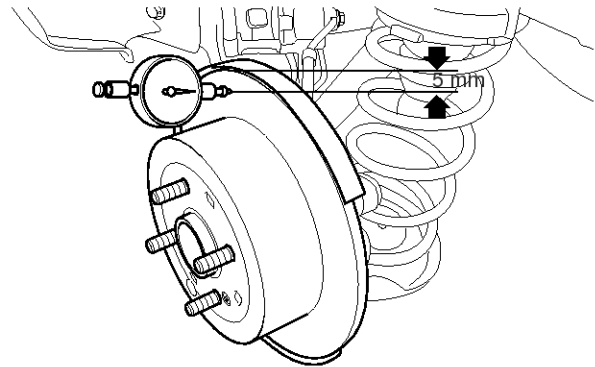
2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

#### Rear Brake Disc Runout Check

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

#### Brake disc runout

Limit: 0.05mm (0.00197in.) or less (new one)



SPBBR9086L

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

#### Installation

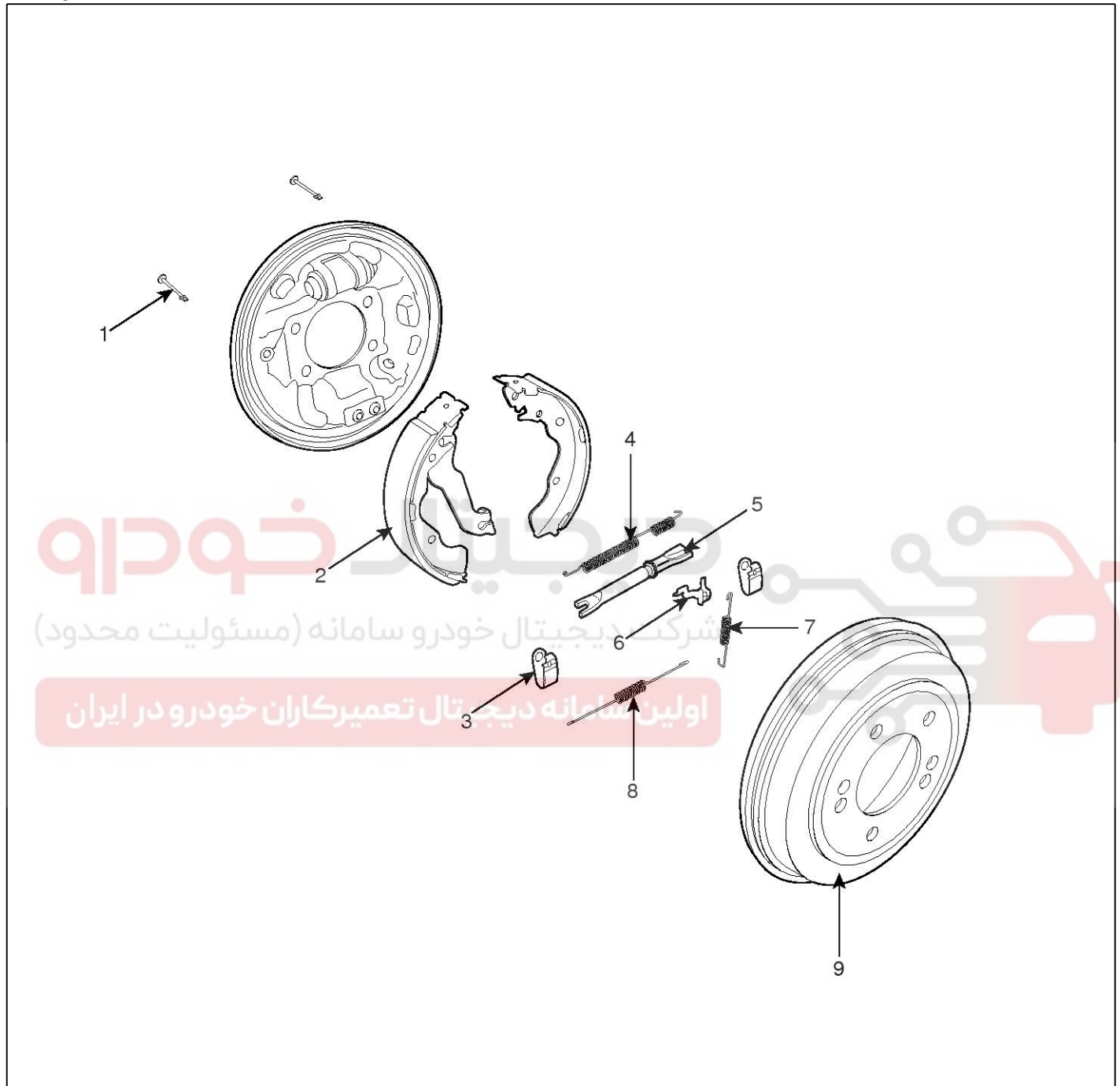
1. Installation is the reverse of removal.
2. Use a SST (09581-11000) when installing the brake caliper assembly.
3. After installation, bleed the brake system. (Refer to Brake system bleeding)

# Brake System

## BR-33

### Rear Drum Brake

#### Components



STDBR9301D

- 1. Shoe hold down pin
- 2. Shoe
- 3. Shoe hold spring
- 4. Upper return spring
- 5. Shoe adjuster

- 6. Adjusting lever
- 7. Adjusting lever spring
- 8. Lower return spring
- 9. Brake drum



# BR-34

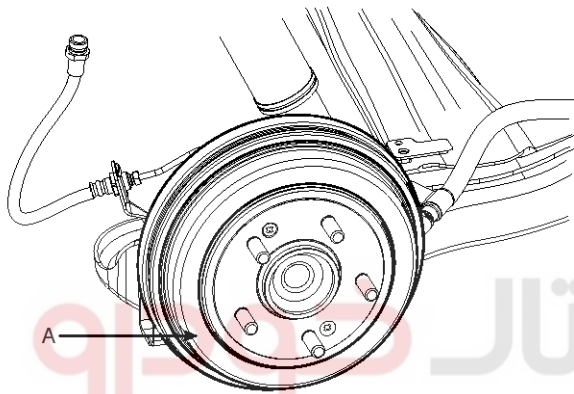
# Brake System

## Removal

### ⚠ CAUTION

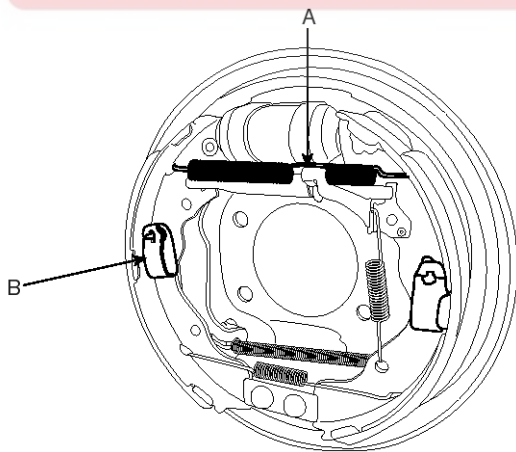
- Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.
- Avoid breathing dust particles.
- Never use an air hose or brush to clean brake assemblies.

1. Release the parking brake.
2. Remove the rear tire and wheel.
3. Remove the rear brake drum (A).



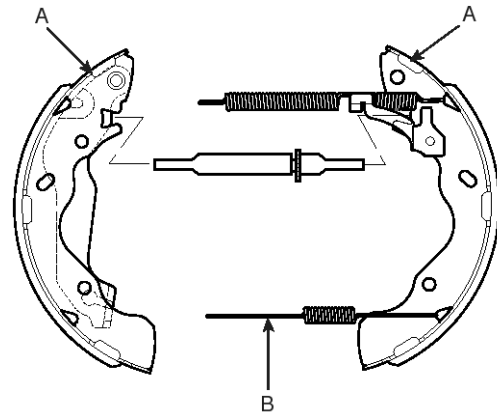
STDBR9090D

4. Remove the shoe hold spring and shoe hold pin (B).
5. Remove the upper return spring (A).



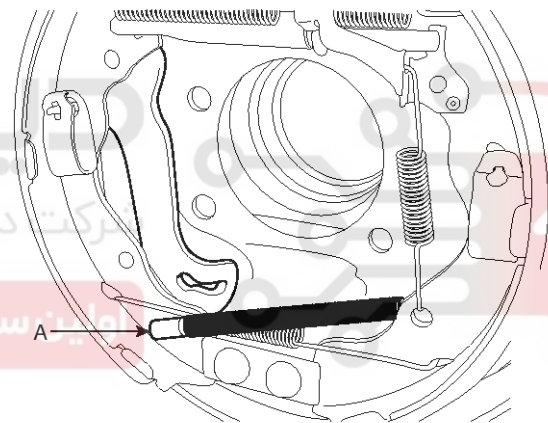
SHDBR6529D

6. Lower the brake shoe assembly (A), and remove the lower return spring (B). Make sure not to damage the dust cover on the wheel cylinder.



SHDBR6530D

7. Remove the parking brake cable (A) from the brake assembly.



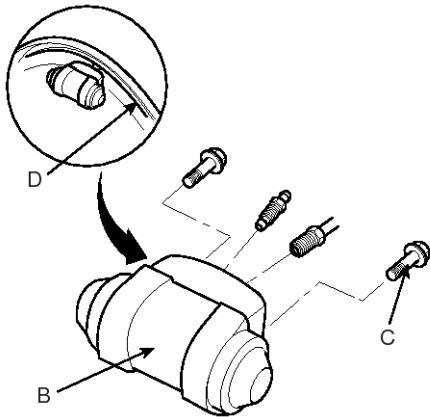
SHDBR6532D

8. Remove the brake shoe assembly.
9. Disconnect brake tubes (A) from the wheel cylinder (B).

# Brake System

## BR-35

10. Remove the bolt (C) and the wheel cylinder (B) from the backing plate (D).



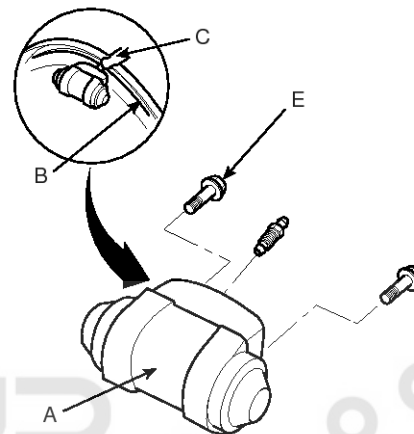
STDBR9303D

### Installation

#### NOTICE

- Do not spill brake fluid on the vehicle: it may damage the paint; if brake fluid does contact the paint. Wash it off immediately with water.
- To prevent spills, cover the hose joints with rags or shop towels.
- Use only a genuine wheel cylinder special bolt.

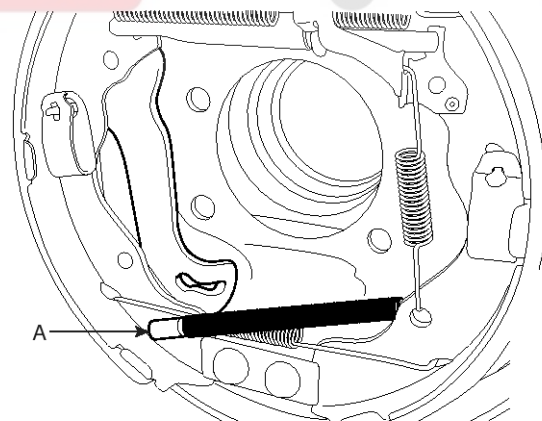
1. Apply sealant (C) between the wheel cylinder (A) and backing plate (B), and install the wheel cylinder.



STDBR9091D

2. Connect the brake tubes (D) to the wheel cylinder.

3. Connect the parking brake cable (A) to the brake assembly.

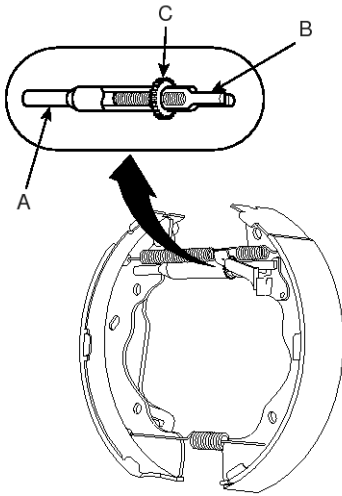


SHDBR6532D

# BR-36

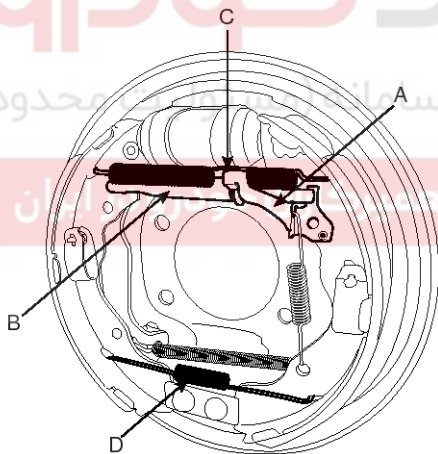
# Brake System

4. Clean the threaded portions of adjuster sleeve (A) and push rod female (B). Coat the threads of the adjuster assembly with grease. To shorten the clevises, turn the adjuster bolt (C).



SHDBR6533D

5. Hook the shoe adjuster lever (A), then install it to the brake shoe.

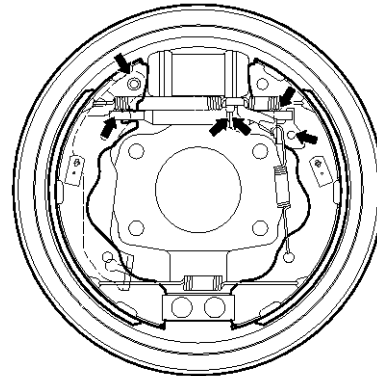


SHDBR6534D

6. Install the adjuster assembly (B) and upper return spring (C) as right direction. Be careful not to damage the wheel cylinder dust covers.
7. Install the lower return spring (D).

8. Apply brake cylinder grease or equivalent rubber grease to the sliding surfaces shown. Don't get grease on the brake linings.

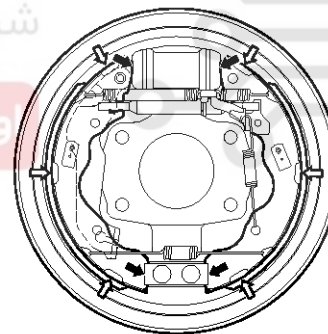
➡ Sliding surface



SHDBR6509L

9. Apply brake cylinder grease or equivalent rubber grease to the brake shoe ends and opposite edges of the shoes shown. Don't get grease on the brake linings.

➡ Opposite edge of the shoe  
 ⇨ Brake shoe ends (shoe side ends and backing plate contact surface)



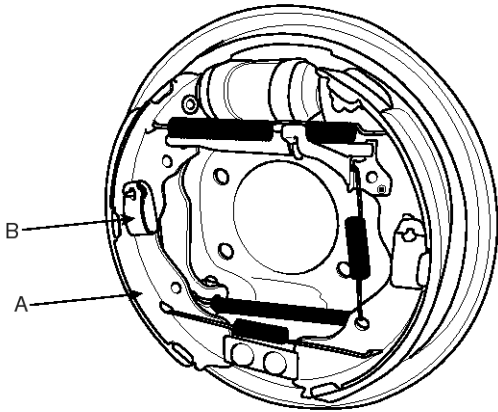
SHDBR6510E

10. Install the brake shoes (A) onto the backing plate. Be careful not to damage the wheel cylinder dust covers.

# Brake System

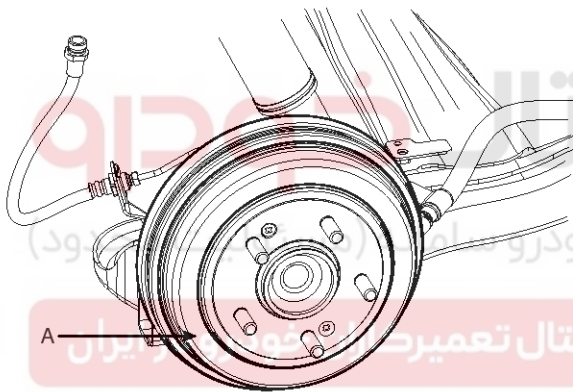
## BR-37

11. Install the shoe hole down pins (B) and the shoe hole down springs.



SHDBR6543D

12. Install the rear brake drum (A).



STDBR9090D

13. If the wheel cylinder has been removed, bleed the brake system.  
 14. Depress the brake pedal several times to set the self-adjusting brake.  
 15. Adjust the parking brake.

## Inspection

### ⚠ CAUTION

- Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.
- Avoid breathing dust particles.
- Never use an air hose or brush to clean brake assemblies.

### 📌 NOTICE

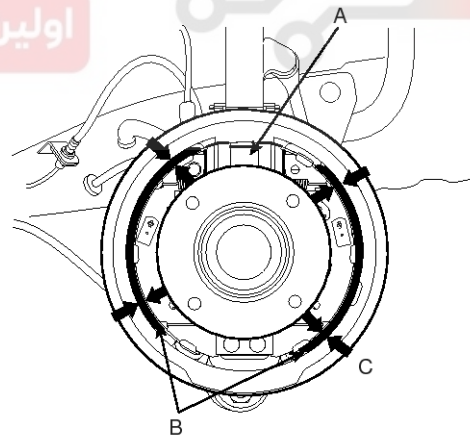
- Contaminated brake linings or drums reduce stopping ability.
- Block the front wheels before jacking up the rear of the vehicle.

1. Raise the rear of the vehicle, and make sure it is securely supported.
2. Release the parking brake, and remove the rear brake drum.
3. Check the wheel cylinder (A) for leakage.
4. Check the brake linings (B) for cracking, glazing, wear, and contamination.
5. Measure the brake lining thickness (C).  
Measurement does not include brake shoe thickness.

### Brake lining thickness

Standard : 4.3 mm (0.17 in)

Service limit : 1.0 mm (0.039 in)



AJJF603N

6. If the brake lining thickness is less than the service limit, replace the brake shoes as a set.
7. Check the bearings in the hub unit for smooth operation. If it requires servicing, replace it.

**BR-38****Brake System**

8. Measure the inside diameter of the brake drum with inside vernier calipers.

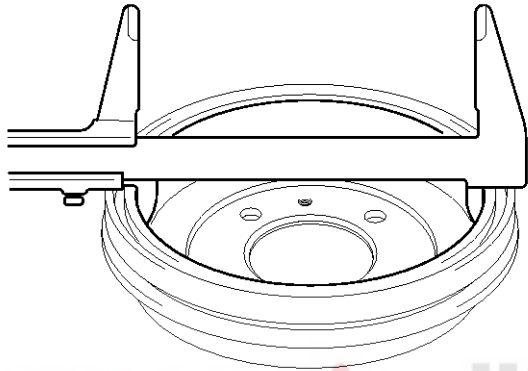
**Drum inside diameter**

Standard : 203.2 mm (8.0 in)

Service limit : 205.2 mm (8.08 in)

**Drum roundness**

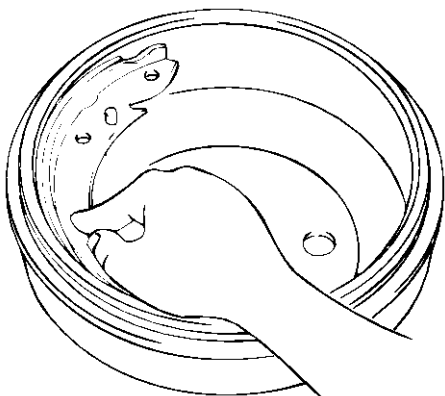
Service limit : 0.06 mm(0.00236 in)



دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود) EJKE800B

9. If the inside diameter of the brake drum is more than the service limit, replace the brake drum.
10. Check the brake drum for scoring, grooves, and cracks.
11. Inspect the brake lining and drum for proper contact.



EJDA038C

12. Inspect the wheel cylinder outside for excessive wear and damage.

13. Inspect the backing plate for wear or damage.



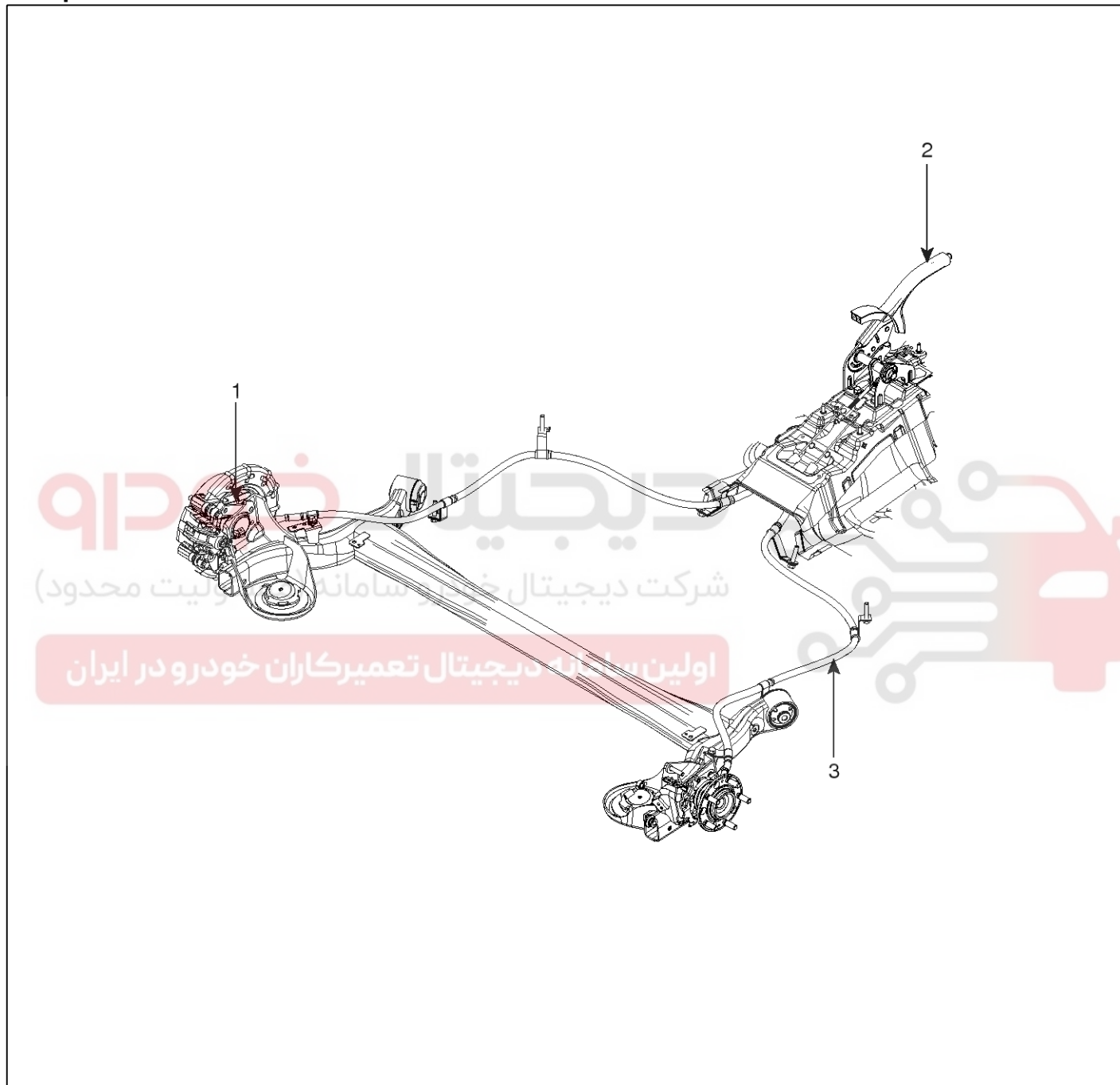
# Parking Brake System

BR-39

## Parking Brake System

### Parking Brake Assembly

#### Component Location



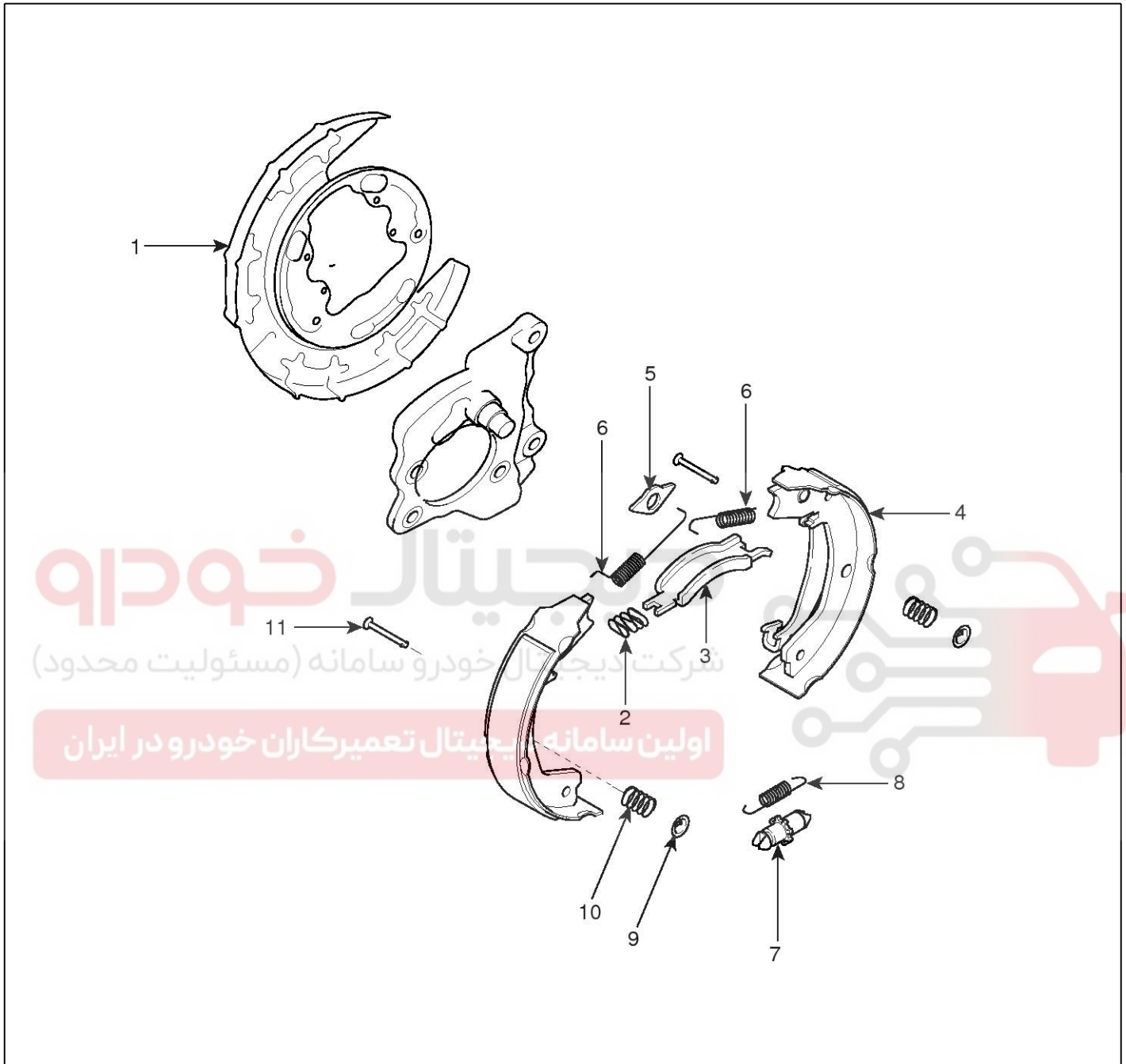
STDBR9100D

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

# BR-40

# Brake System

Component  
Disc Brake Type



STDBR9101D

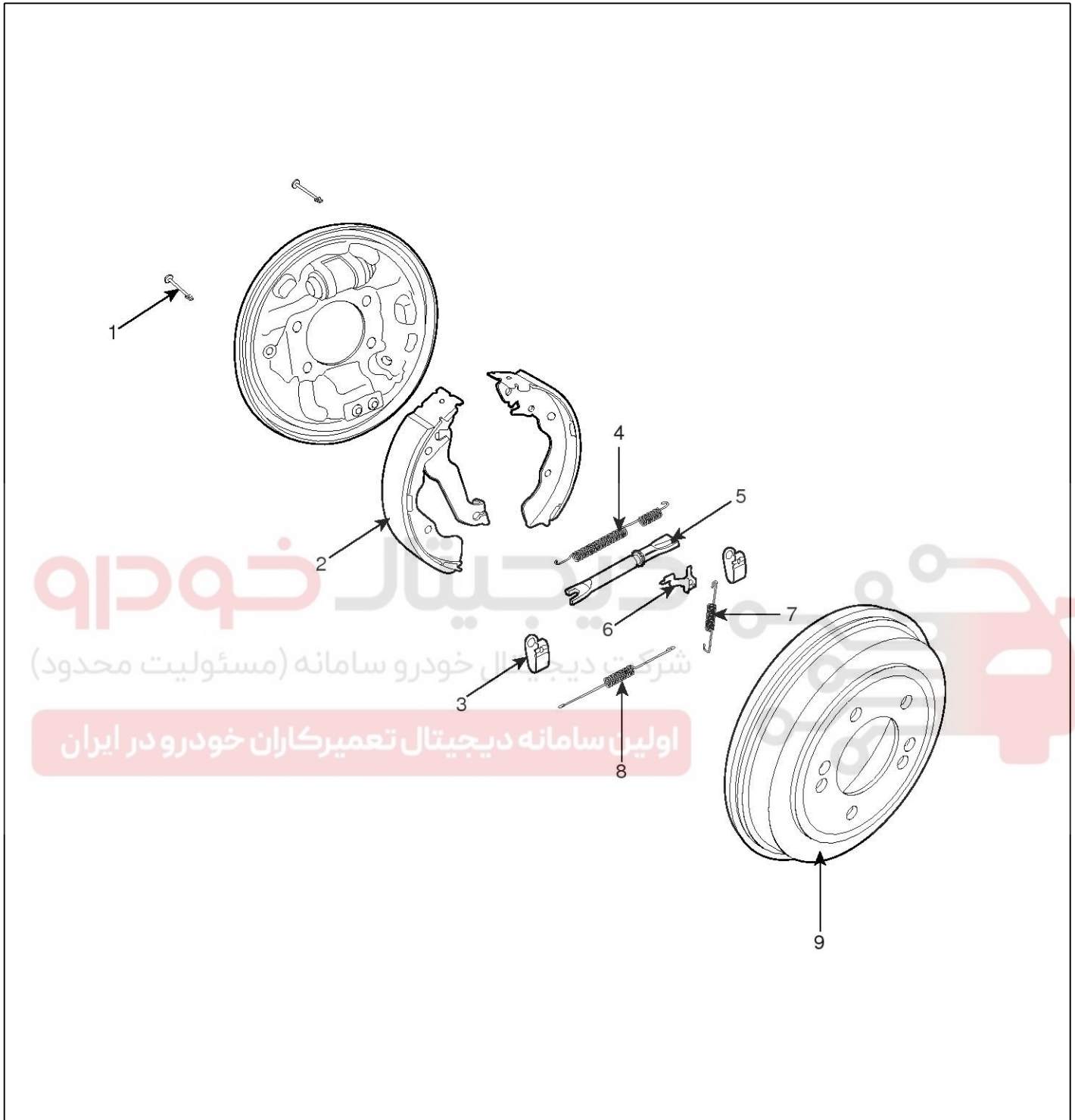
- 1. Back plate
- 2. Strut spring
- 3. Strut
- 4. Shoe & lining
- 5. Shoe guide

- 6. Return spring
- 7. Adjuster
- 8. Return spring
- 9. Cup washer
- 10. Shoe hold down spring
- 11. Shoe hold down pin

# Parking Brake System

# BR-41

## Drum Brake Type



STDBR9102D

- 1. Shoe hold down pin
- 2. Shoe
- 3. Shoe hold spring
- 4. Upper return spring
- 5. Shoe adjuster

- 6. Adjusting lever
- 7. Adjusting lever spring
- 8. Lower return spring
- 9. Brake drum



## BR-42

## Brake System

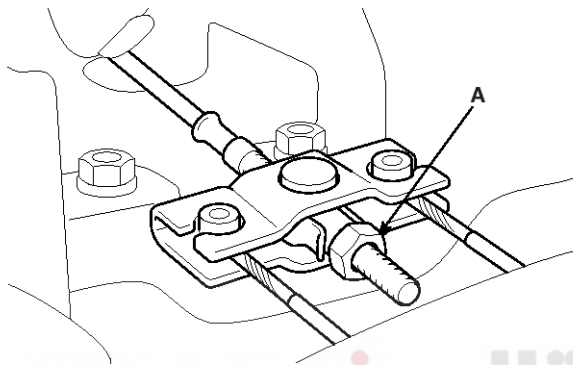
## Removal

## Parking Brake Lever

## NOTICE

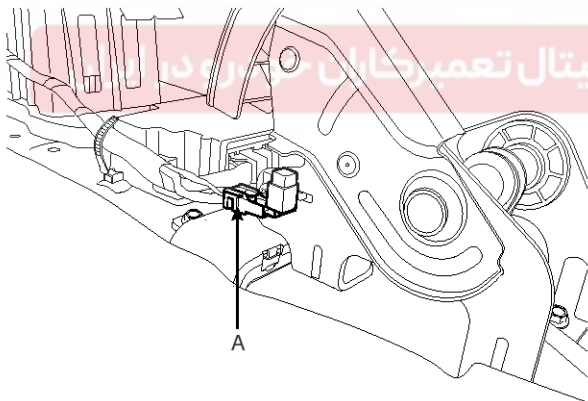
The parking brake cables must not be bent or distorted. This will lead to stiff operation and premature failure.

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



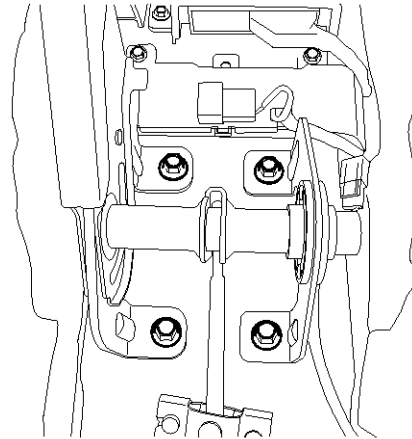
ARJE502S

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



STDBR9104D

4. Remove the parking brake lever assembly with loosening the bolts.



STDBR9105D

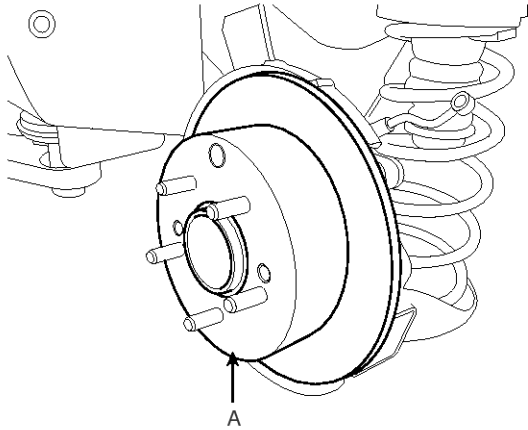


# Parking Brake System

# BR-43

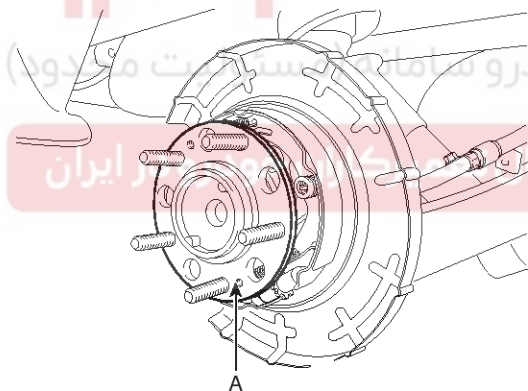
## Parking Brake Shoe (Disc Brake Type)

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



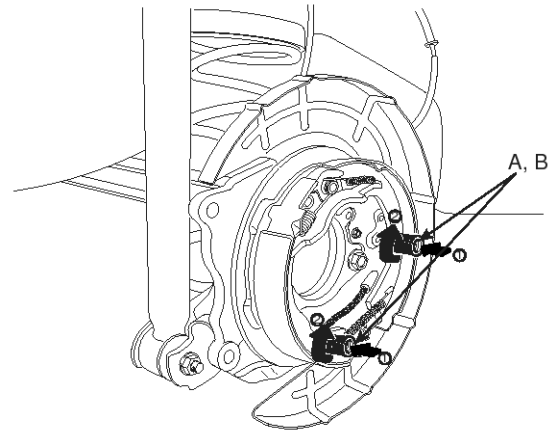
STDBR9106D

4. Remove the rear hub unit bearing (A).



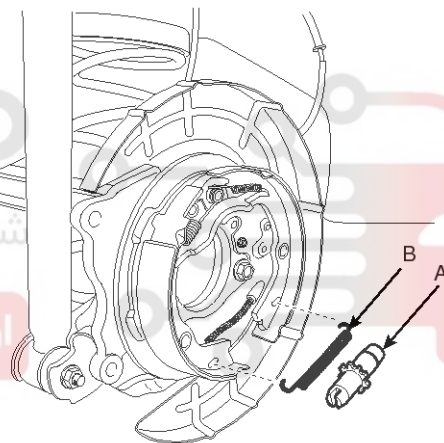
STDBR9107L

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



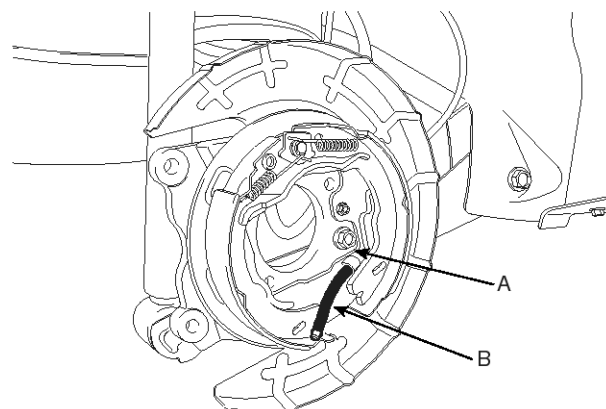
STDBR9108D

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



STDBR9109D

7. Remove the parking brake cable (B) from the brake shoe (A).

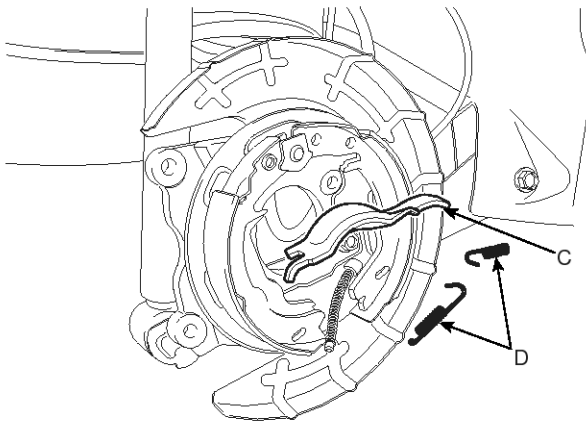


STDBR9110D

# BR-44

# Brake System

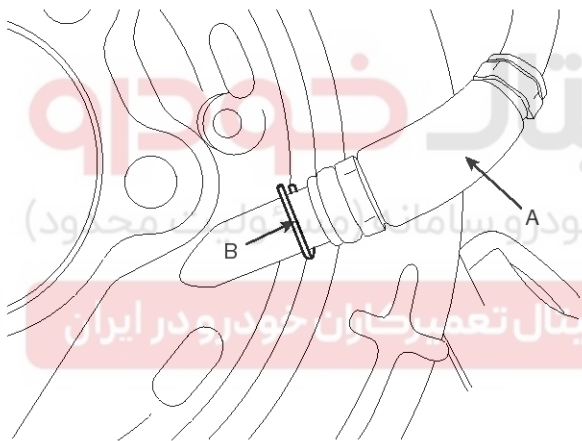
8. Remove the strut (C) and the strut spring (D).



STDBR9111D

9. Remove the brake shoe.

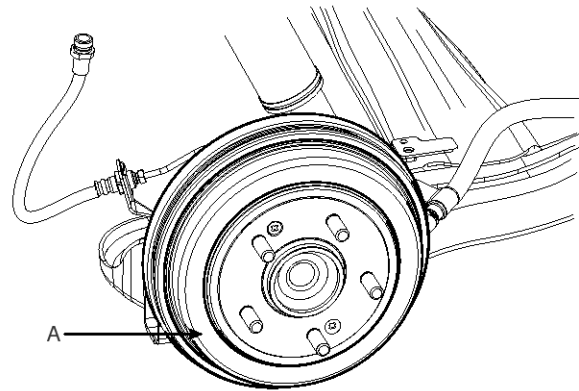
10. Remove the parking brake cable retaining (B), from the parking brake cable (A).



STDBR9112D

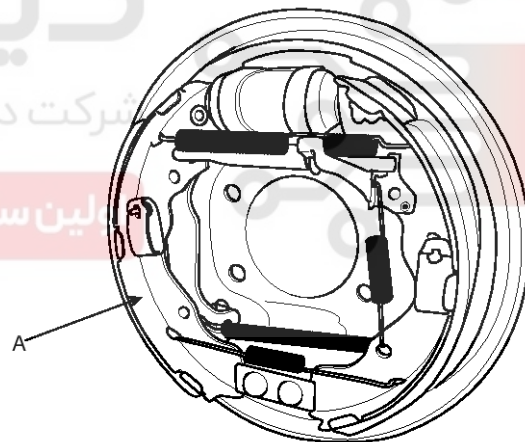
## Parking Brake Shoe (Drum Brake Type)

1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel, then remove the brake drum (A).



STDBR9090D

3. Remove the brake shoe (A). (Refer to "Rear drum brake removal")



SHDBR6527D

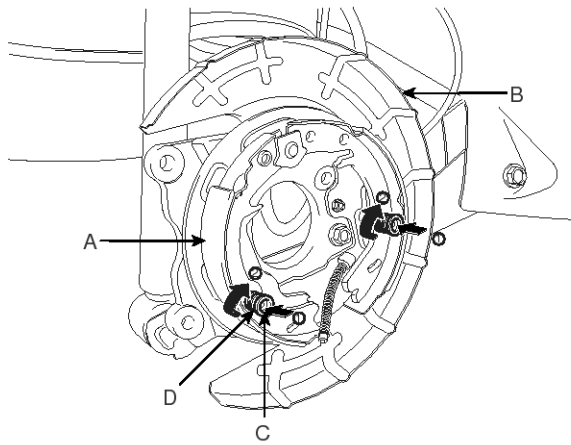
# Parking Brake System

# BR-45

## Installation

### Parking Brake Shoe (Disc Brake Type)

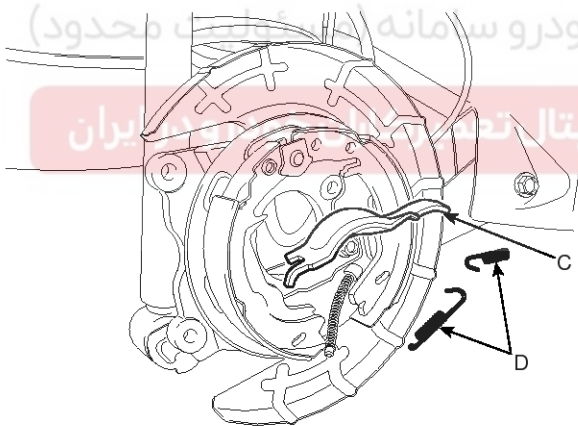
1. Install the brake shoe(A) to the back plate(B).



STDBR9115D

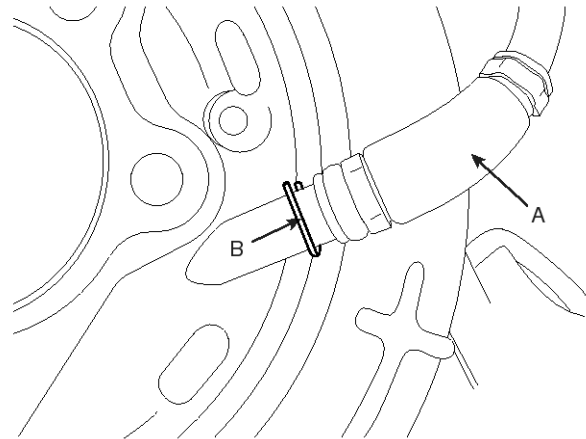
2. Install the shoe hold down pin(C) and the spring(D) by pushing the retainer spring (D) and turning the pins.

3. After installing the strut (A) and upper return spring (B), install the adjuster assembly (C) and the lower return spring (D).



STDBR9111D

4. Install the parking brake cable (A), then install the retaining (B).

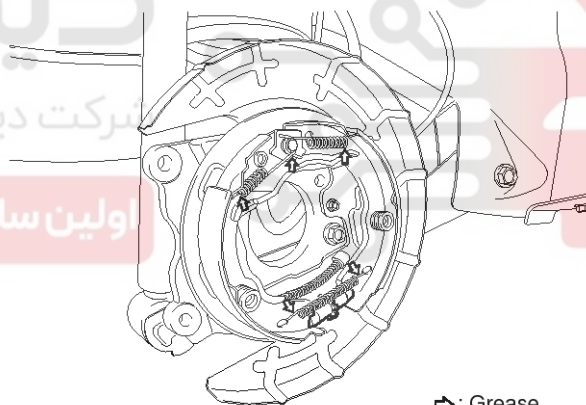


STDBR9112D

5. Apply a coating of the specified grease to each sliding parts of parking brake as shown.

### Specified grease :

Multi purpose grease SAE J310, NLGI No.2



⇨ : Grease

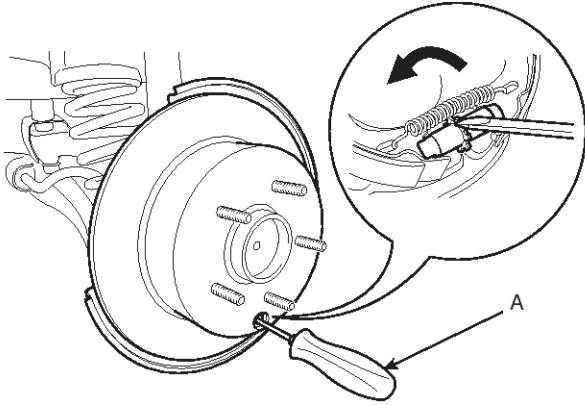
BJJF501H

## BR-46

## Brake System

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

- 1) Remove the plug from the disc.
- 2) Rotate the toothed wheel of adjuster by a screw driver until the disc is not moving, and then return it by 3~5 notches in the opposite direction.

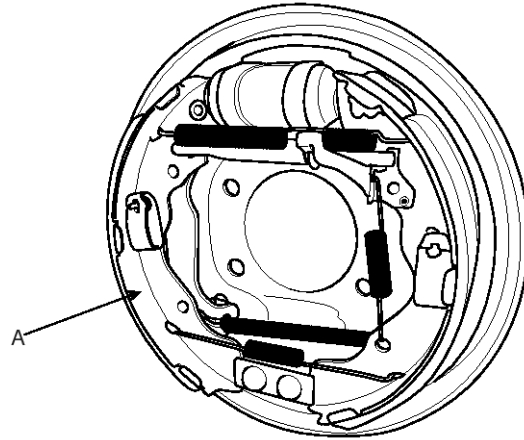


SUNBR6029D

7. Install the brake caliper. (Refer to "Rear brake installation")
8. Install the tire and wheel.
9. Adjust the parking brake lever.

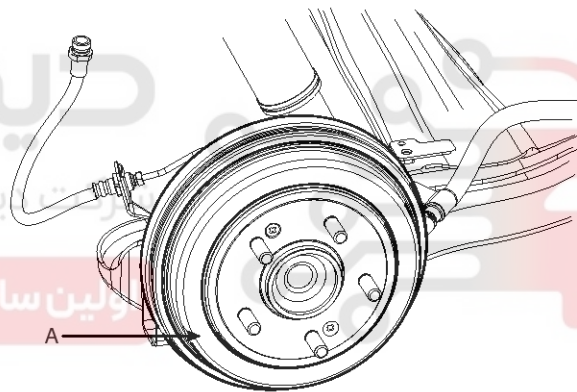
## Parking Brake Shoe (Drum Brake Type)

1. Install the brake shoe (A). (Refer to "Rear drum brake installation")



SHDBR6527D

2. Install the brake drum (A).



STDBR9090D

3. Depress the brake pedal several times to set the self-adjusting brake.
4. Adjust the parking brake lever.

# Parking Brake System

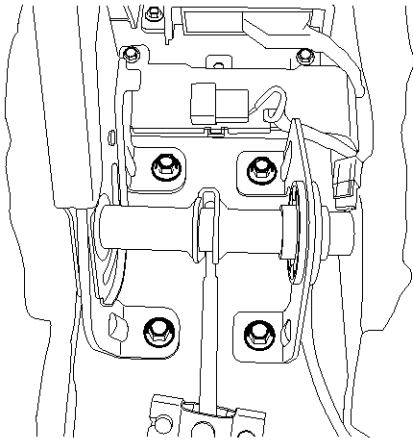
## BR-47

### Parking Brake Lever

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

#### Tightening torque :

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

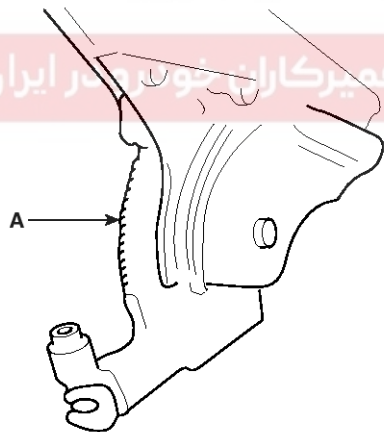


STDBR9105D

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

#### Specified grease :

Multi purpose grease SAE J310, NLGI No.2



ARJE502X

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

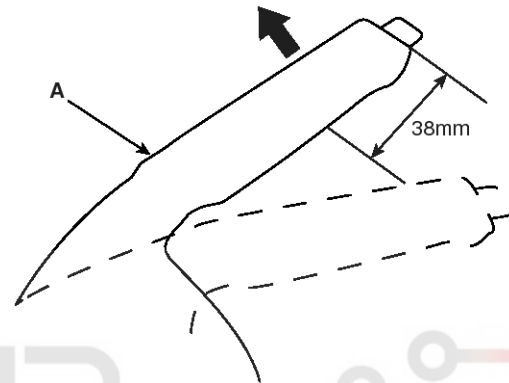
#### Parking brake lever stroke :

6 ~ 8 cliks (Pull the lever with 20kg)

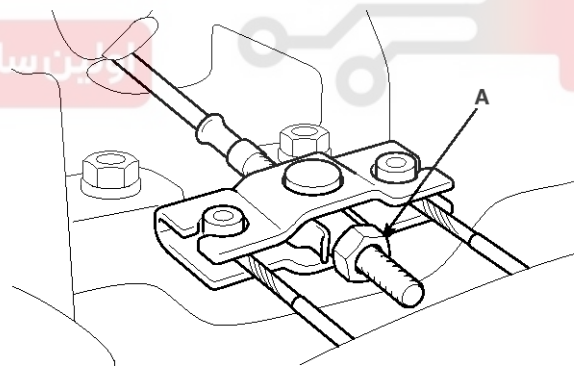
#### NOTICE

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")

Pulled up with 196N (20kgf, 44lb)



SPBBR9115L



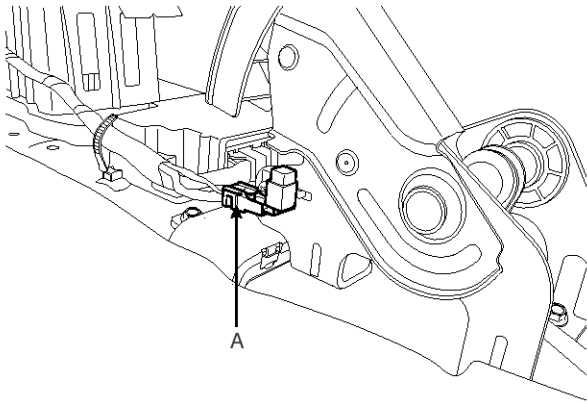
ARJE502S

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.

## BR-48

## Brake System

6. Reconnect the connector (A) of parking brake switch.



STDBR9104D

**NOTICE**

*Inspect the continuity of parking brake switch.*

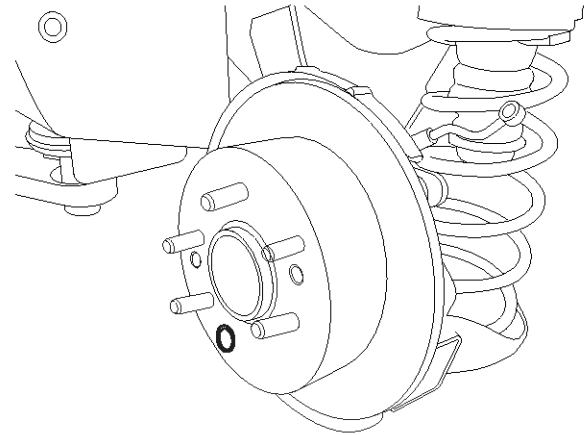
When the brake lever is pulled : continuity

When the brake lever is released : no continuity

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

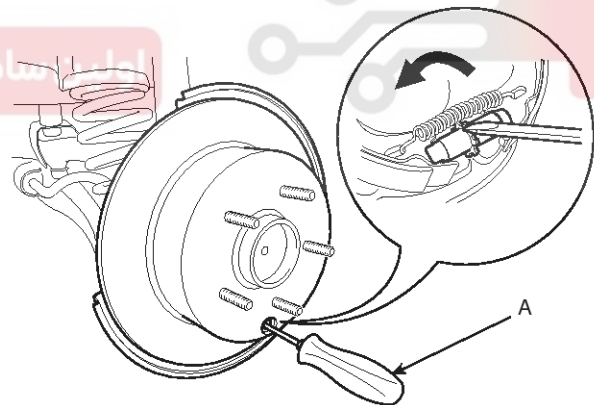
**Adjustment****Parking Brake Shoe Clearance Adjustment****Disc Brake Type**

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.



STDBR9116D

4. Rotate the toothed wheel of adjuster by a screw driver until the disc is not moving, and then return it by 3~5 notches in the opposite direction.



SUNBR6029D

# Parking Brake System

## BR-49

### Parking Brake Shoe Clearance Adjustment Drum Brake Type

1. Depress the brake pedal several times to set the self-adjusting brake.

#### **NOTICE**

For Drum Brake type, shoe clearance is automatically adjusted by the adjuster and adjusting lever.

### 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).

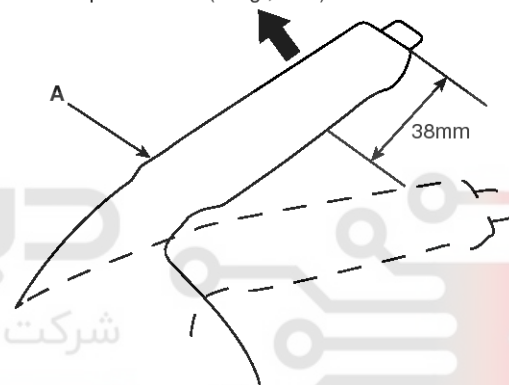
#### **Parking brake lever stroke :**

6~8 cliks (Pull the lever with 20kg)

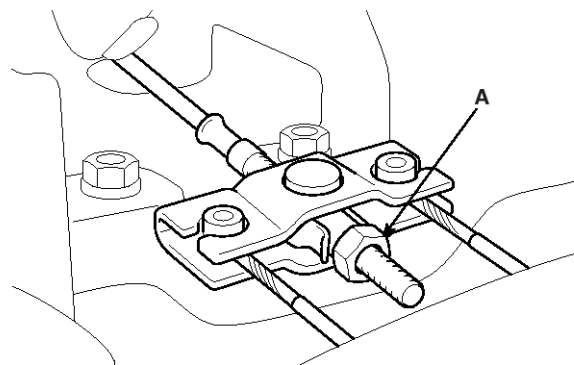
#### **NOTICE**

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")

Pulled up with 196N (20kgf, 44lb)



SPBBR9115L



ARJE502S



## BR-50

## Brake System

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")

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

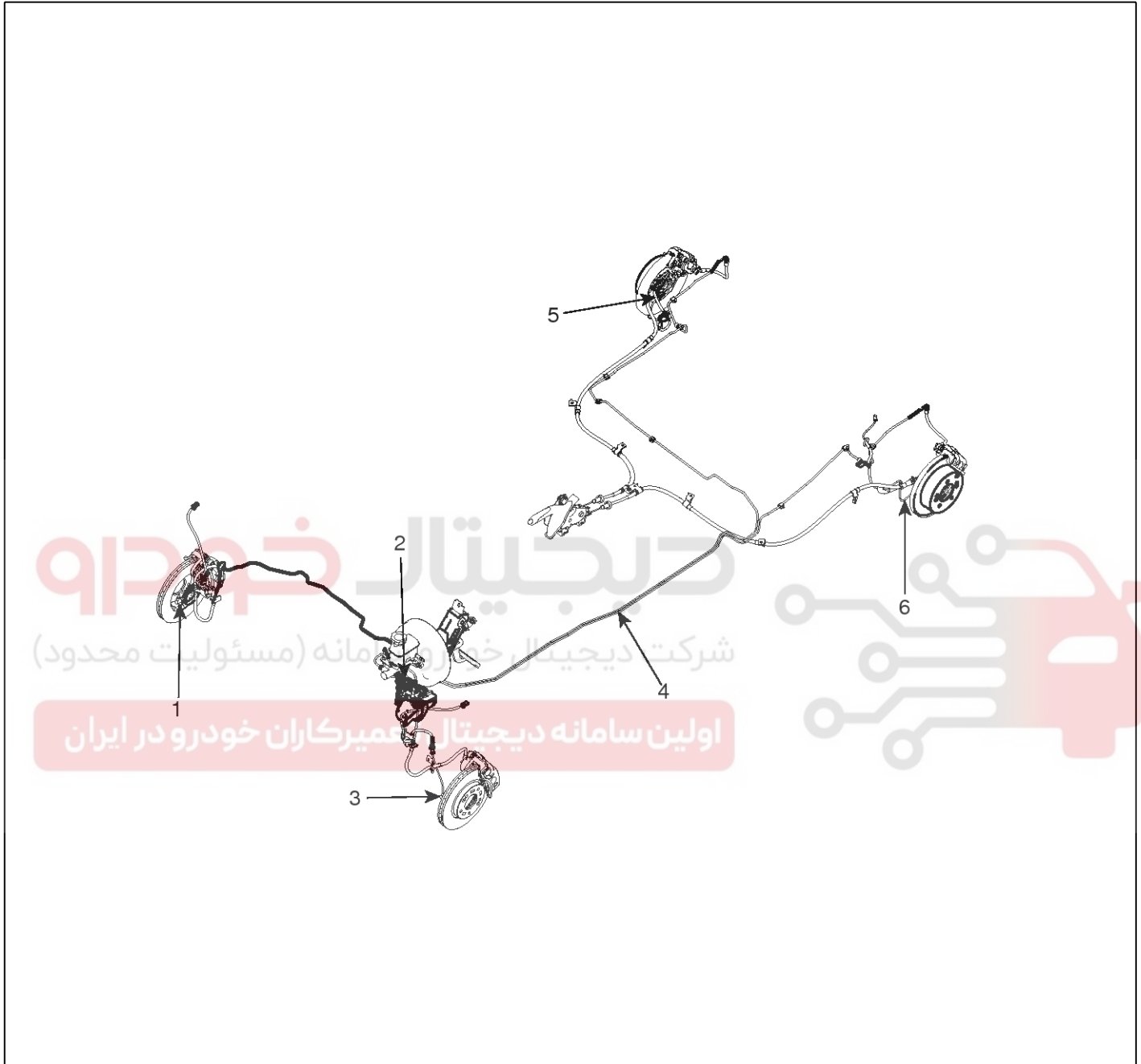


# ABS(Anti-Lock Brake System)

**BR-51**

## ABS(Anti-Lock Brake System)

### Components



SMGBR9302D

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

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

## BR-52

## Brake System

### Description

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

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

This unit has the functions as follows.

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

### Installation position : engine compartment

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

### Operation

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

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

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

### Wheel sensor signal processing

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

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

### Solenoid valve control

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

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

### Voltage limits

- Overvoltage

When overvoltage is detected(above  $17 \pm 0.5$  V), the ECU switches off the valve relay and shuts down the system.

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

- Undervoltage

In the event of undervoltage(below 10V), ABS control shall be inhibited and the warning lamp shall be turned on.

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

### Pump motor checking

The ECU performs a pump motor test at a speed of 15 km/h(9 MPH) once after IGN is switched on.

### Diagnostic interface

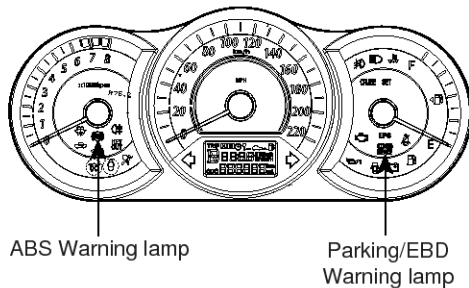
Failures detected by the ECU are encoded on the ECU, stored in a EEPROM and read out by diagnostic equipment when the ignition switch is turned on.

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

# ABS(Anti-Lock Brake System)

BR-53

## Warning lamp module



STDBR9131L

### 1. 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.

### 2. PARKING/EBD 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.



# BR-54

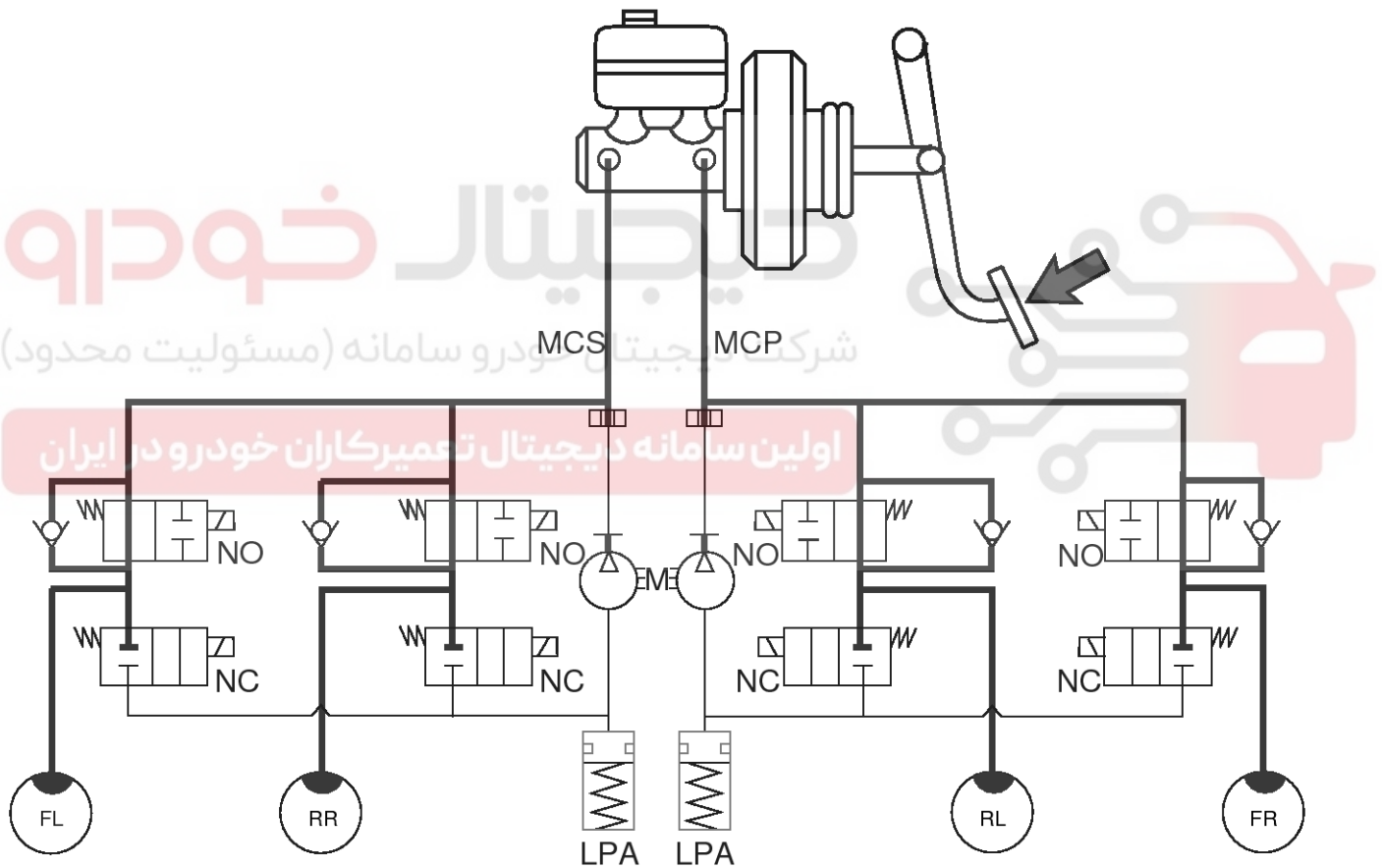
# Brake System

## ABS Control

### 1. NORMAL BRAKING without ABS

Under the normal braking, voltage is not supplied to solenoid valve, inlet valve is opened and outlet valve is closed. When the brake is depressed, brake fluid is supplied to the wheel cylinder via solenoid valve to activate the brake. When the brake is released, brake fluid is back to the master cylinder via inlet valve and check valve.

Solenoid valve	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	Open	Master cylinder ⇔ Wheel cylinder	OFF
Outlet valve (NC)	OFF	Close	Wheel cylinder ⇔ Reservoir	



LJF500W

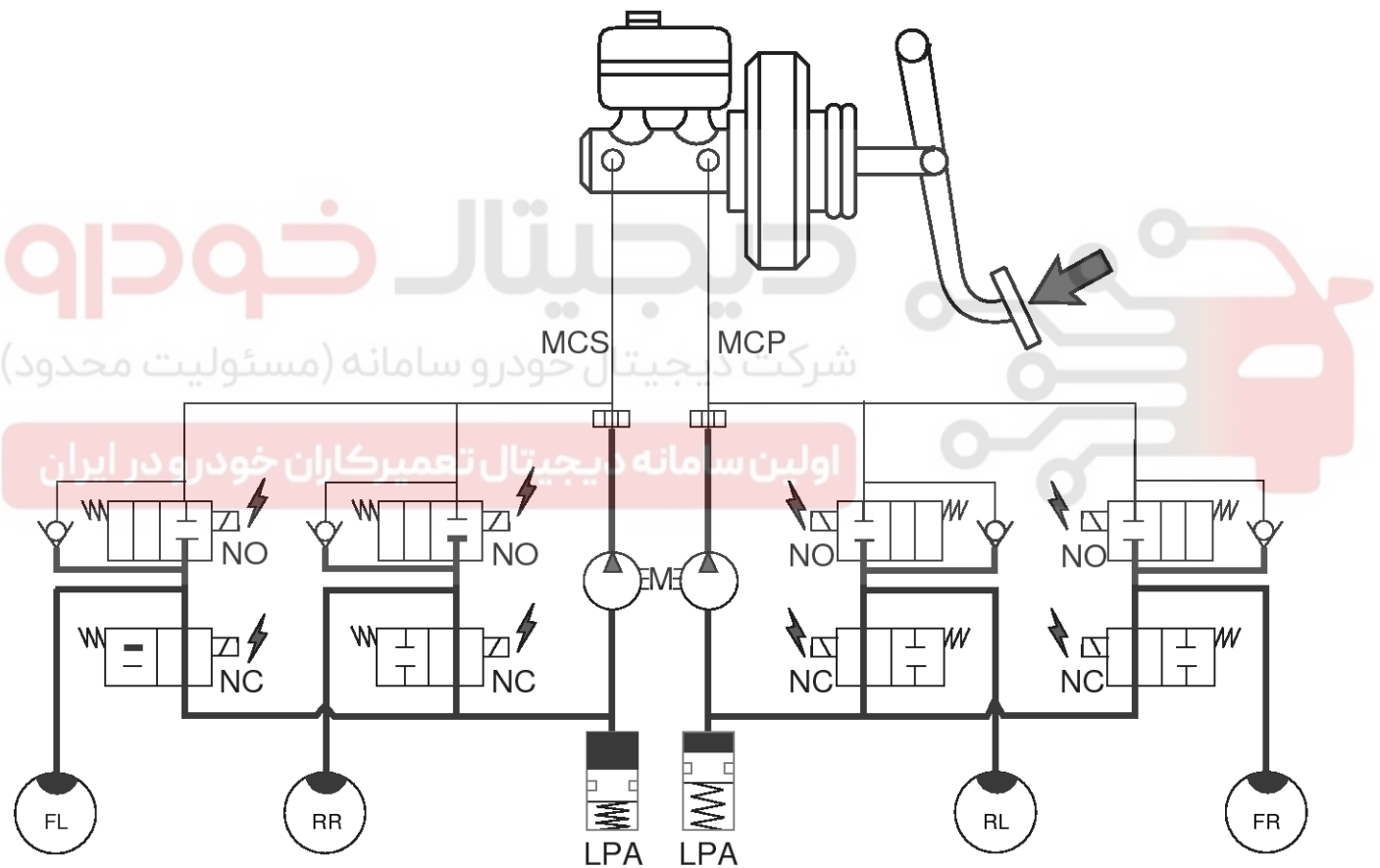
# ABS(Anti-Lock Brake System)

## BR-55

### 2. Dump Mode

Under the emergency braking, if the wheels start to lock up, HECU sends a signal to the solenoid valve to decrease the brake fluid, then voltage is supplied to each solenoid. At this time inlet valve is closed and brake fluid is blocked from the master cylinder. Conversely outlet valve is opened and brake fluid passes through wheel cylinder to reservoir, resulting in pressure decrease.

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	Close	Master cylinder ⇔ Wheel cylinder	ON
Outlet valve (NC)	ON	Open	Wheel cylinder ⇔ Reservoir	



LJJF500X

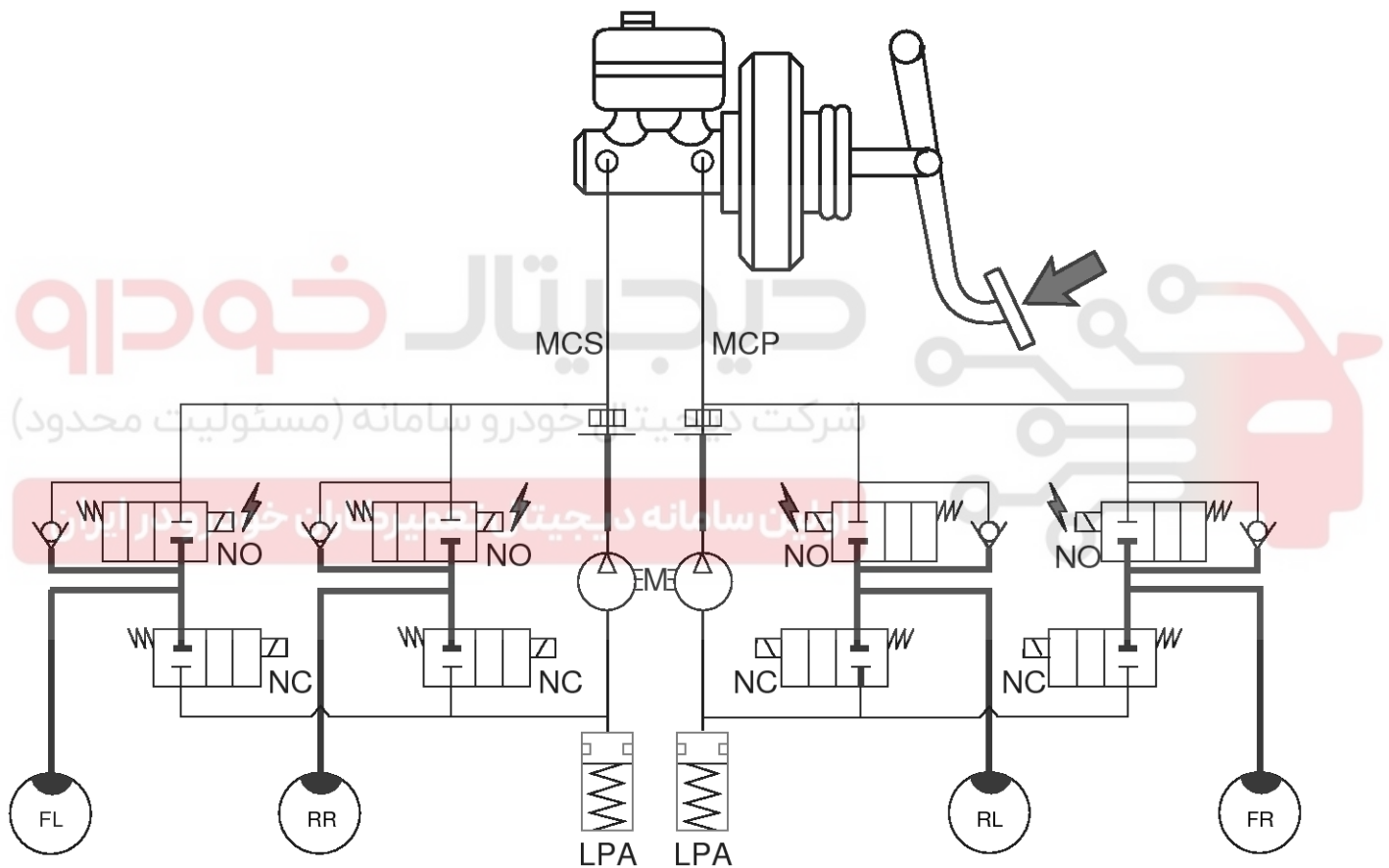
# BR-56

# Brake System

### 3. Hold Mode

When the brake fluid pressure is maximally decreased in wheel cylinder, HECU sends a signal to solenoid valve to keep the fluid pressure, voltage is supplied to inlet valve but it is not supplied to outlet valve. At this time inlet and outlet valves are closed and brake fluid is kept in wheel cylinder.

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	Close	Master cylinder ⇔ Wheel cylinder	OFF
Outlet valve (NC)	OFF	Close	Wheel cylinder ⇔ Reservoir	



LJJF500Y

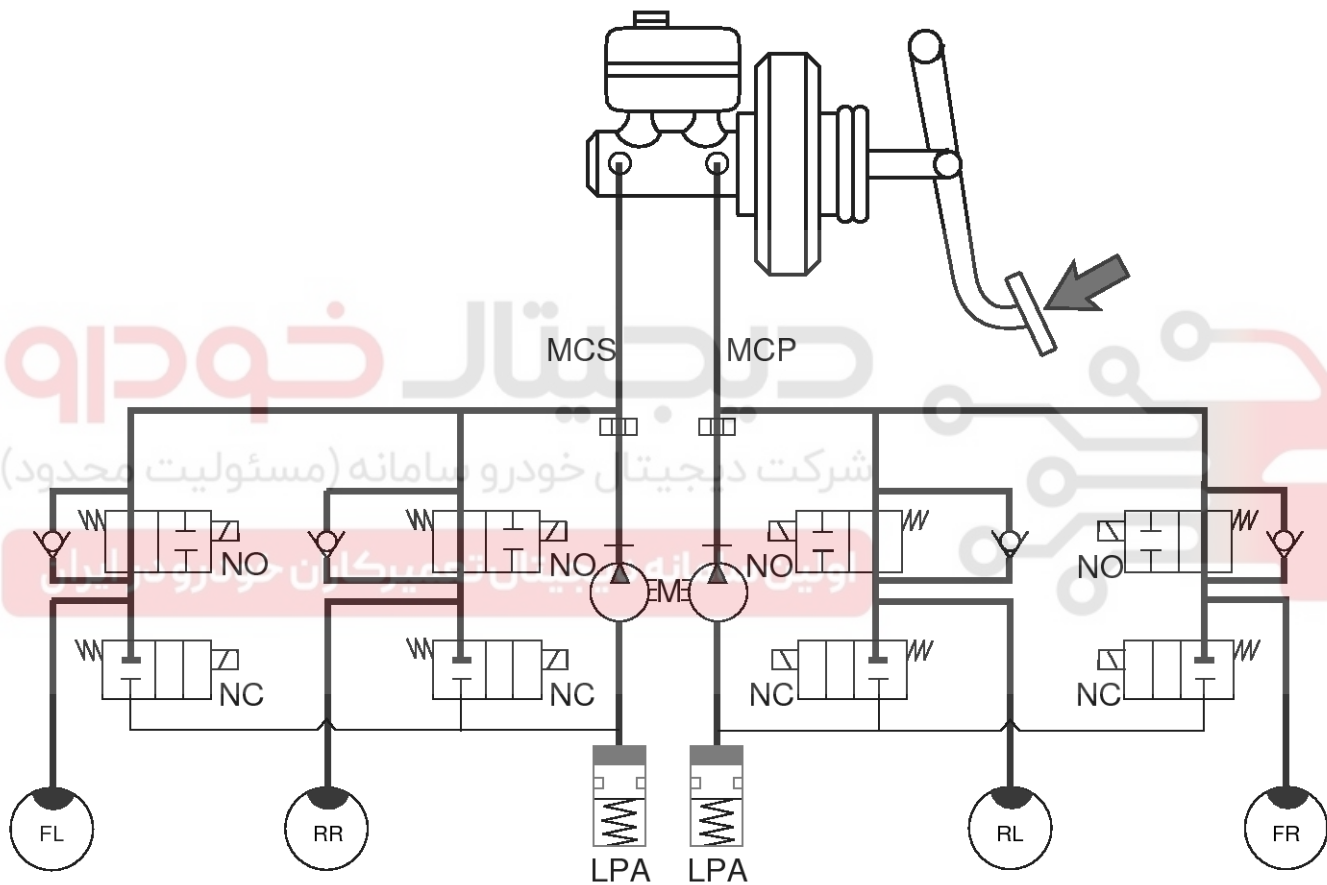
# ABS(Anti-Lock Brake System)

## BR-57

### 4. Increase Mode

If HECU determines there's no lock-up in the wheel, HECU cuts voltage to solenoid valve. So voltage is not supplied to each solenoid valve, brake fluid passes through the inlet valve to wheel cylinder, resulting in pressure increase.

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	Open	Master cylinder ⇔ Wheel cylinder	ON
Outlet valve (NC)	OFF	Close	Wheel cylinder ⇔ Reservoir	



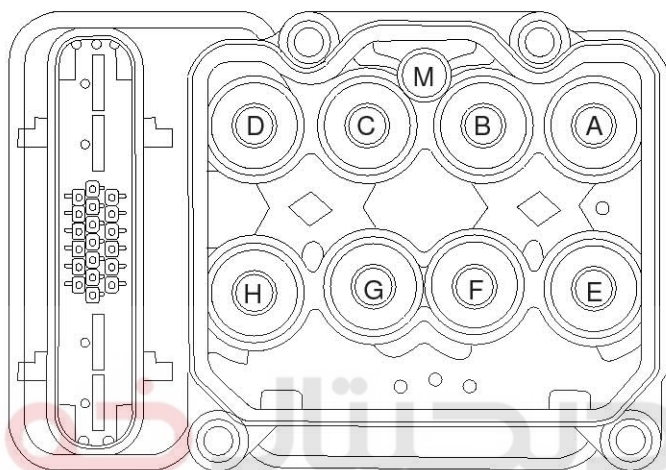
LJJF500Z



## BR-58

## Brake System

## ABS HECU External Diagram



- A : INLET VALVE (FR)
- B : INLET VALVE (RL)
- C : INLET VALVE (RR)
- D : INLET VALVE (FL)
- E : OUTLET VALVE (FR)
- F : OUTLET VALVE (RL)
- G : OUTLET VALVE (RR)
- H : OUTLET VALVE (FL)
- M : MOTOR Connector



شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

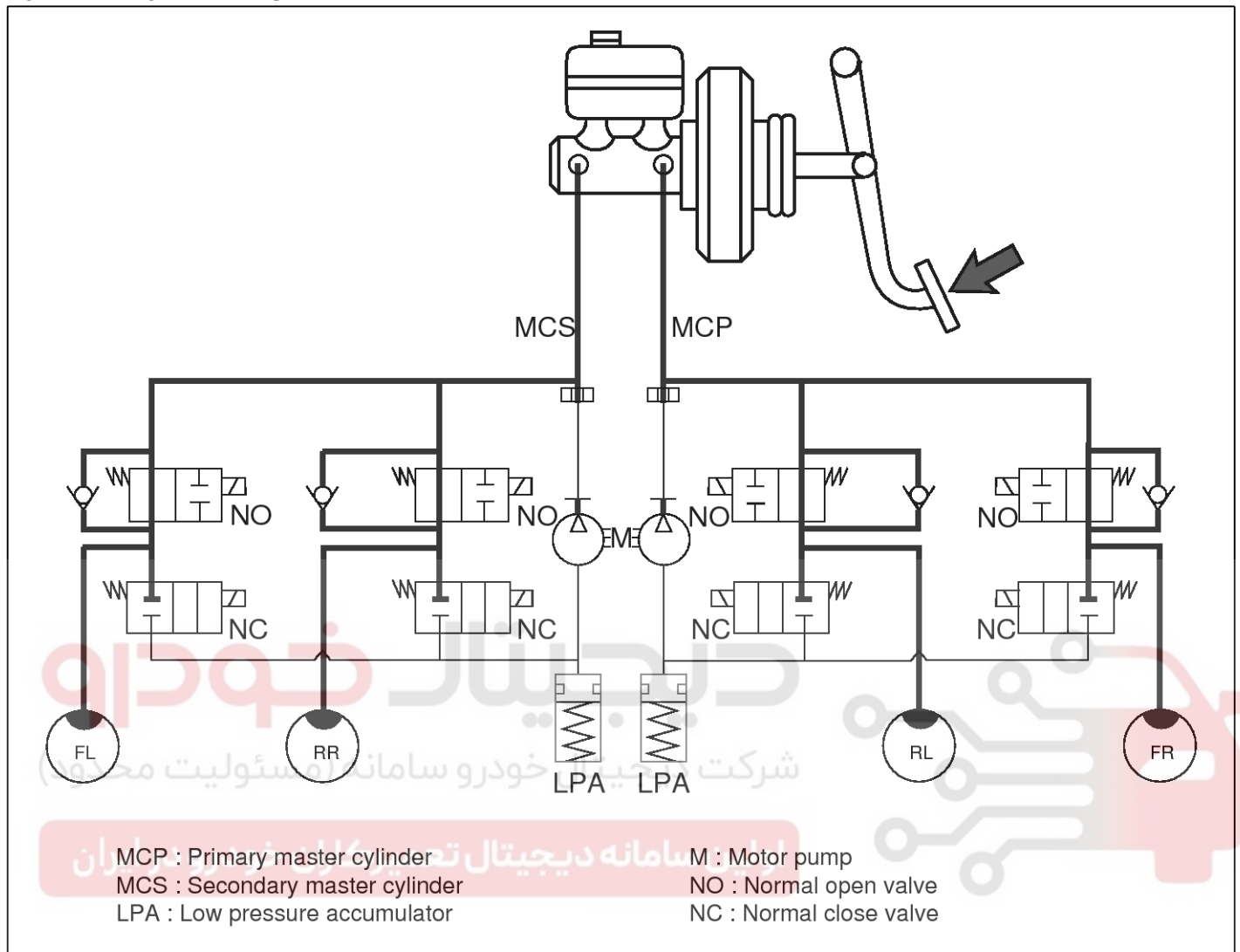
اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

SHMBR8302D

# ABS(Anti-Lock Brake System)

BR-59

Hydraulic System Diagram



LJJF501B

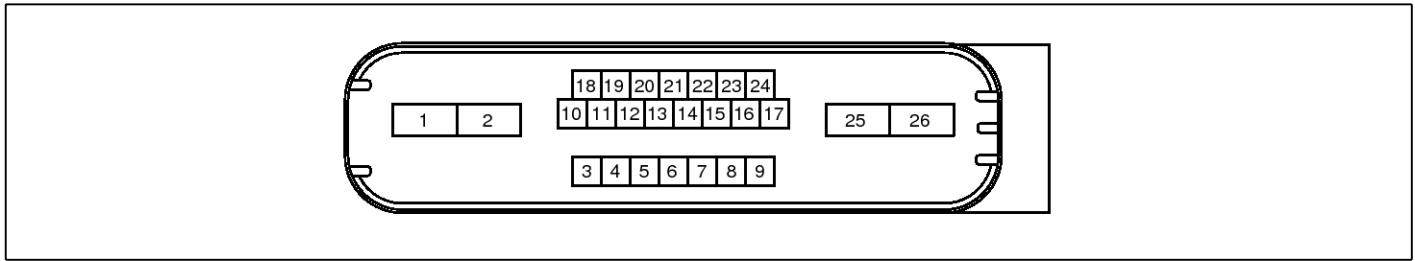




# BR-62

# Brake System

## ABS Connector Input / Output



SENBR7602D

Connector Terminal		Specification	Remark
No	Description		
3	IGNITION1(+)	Over voltage range: $17 \pm 0.5V$ Operating voltage range: $9.5 \pm 0.5V < V < 17 \pm 0.5V$ Low voltage range: $7.0 \pm 0.5V < V < 9.5 \pm 0.5V$ Max. current: $I < 300mA$ Hardware shutdown voltage : $V < 6.0V$	
2	POS. BATTERY.(SOLENOID)	Max leakage current : $I < 0.8mA$ Operating voltage range: $9.5 \pm 0.5V < V < 17 \pm 0.5V$ Max current : $I < 40A$	
1	POS, BATTERY.(MOTOR)	Operating voltage range: $9.5 \pm 0.5V < V < 16.5 \pm 0.5V$ Rush current : $I < 100A$ Max current : $I < 40A$ Max leakage current : $I < 0.2mA$	
26	GROUND	Rated current : $I < 300mA$ Max. current: $I < 40A$	
25	PUMP MOTOR GROUND	Rush current : $I < 100A$ Max current : $I < 40A$	
14	BRAKE LIGHT SWITCH	Input voltage low: $0V \leq V \leq 3.0V$ Input voltage High: $7.0V \leq V \leq 16.0V$	
23	SENSOR FRONT LEFT POWER	Output voltage : $IGN[V] \pm 1V$ Output current : Max 30mA	
17	SENSOR FRONT RIGHT POWER		
9	SENSOR REAR LEFT POWER		
15	SENSOR REAR RIGHT POWER		
22	SENSOR FRONT LEFT SIGNAL	Input current LOW : $5.9 \sim 8.4mA$ Input current HIGH : $11.8 \sim 16.8mA$ Frequency range : $1 \sim 2500Hz$ Input duty : $50 \pm 20\%$	
24	SENSOR FRONT RIGHT SIGNAL		
8	SENSOR REAR LEFT SIGNAL		
16	SENSOR REAR RIGHT SIGNAL		
13	CAN BUS LINE (LOW)		
6	CAN BUS LINE (HIGH)		

# ABS(Anti-Lock Brake System)

## BR-63

Connector Terminal		Specification	Remark
No	Description		
4	SENSOR FRONT RIGHT OUTPUT	Max. current : $I < 16\text{mA}$ External pull up resister : $1\text{k}\Omega < R$ Output duty : $50 \pm 20\%$	
5	ABS/EBD W/LAMP DRIVE	Max. current : $I < 200\text{mA}$ Operating voltage : $0\sim 18\text{V}$ Min. Shunt resistance : $500\text{k}\Omega$ Max. Output low voltage : $V < 0.5\text{V}$	

# دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

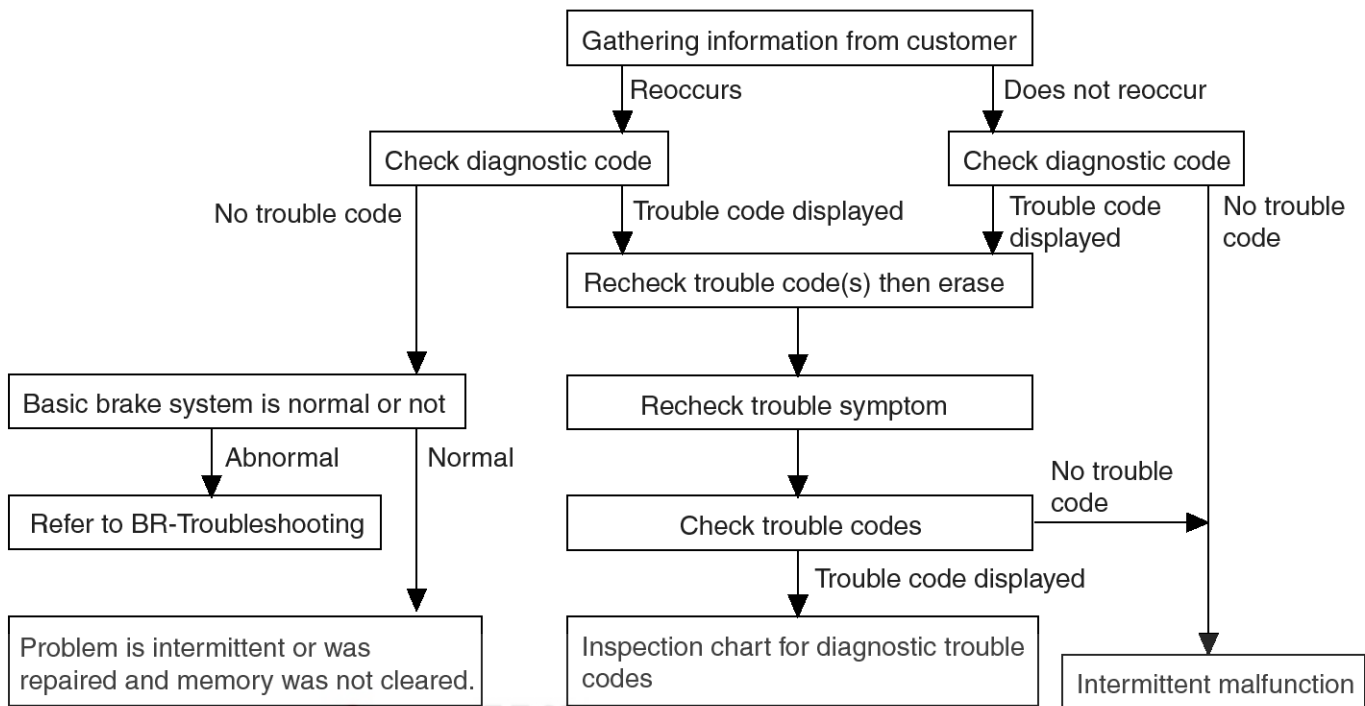
اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



BR-64

Brake System

Standard flow of diagnostic troubleshooting



\* Using the customer problem analysis check sheet for reference, ask the customer as much detail as possible about the problem.

Notes with regard to diagnosis

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release (Thump : suspension; squeak: tires)
ABS operation (Long braking distance)	For road surfaces such as snow-covered and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed.

Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.

# ABS(Anti-Lock Brake System)

## BR-65

### ABS Check sheet

#### ABS Check Sheet

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

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

Date the Problem First Occurred	/ /
Frequency of Occurrence of Problem	<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)
	<b>ABS Warning Light Abnormal</b> <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    )

EJDA017A



## BR-66

## Brake System

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 Hi-scan (pro) is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line
Communication with Hi-scan (pro) is not possible. (Communication with ABS only is not possible)	1. Power source circuit 2. Diagnosis line 3. HECU
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU
Even after the engine is started, the ABS warning lamp remains ON.	1. ABS warning lamp circuit 2. HECU

**⚠ CAUTION**

During ABS operation, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.

# ABS(Anti-Lock Brake System)

# BR-67

**ABS Does Not Operate.**

STQBR8319L

### Detecting condition

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	<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 scan tool 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?

**NO** ▶ Check the power source circuit.

**YES** ▶ Erase the DTC and recheck using scan tool.

#### Check the power source circuit

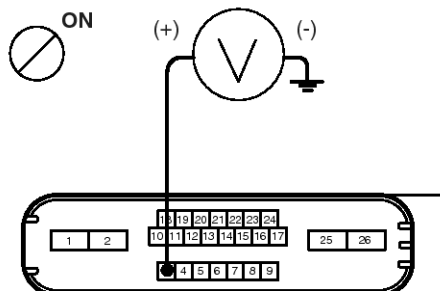
1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 3 of the ABS control module harness side connector and body ground.

**Specification:** approximately B+

3. Is the voltage within specification?

**YES** ▶ Check the ground circuit.

**NO** ▶ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ABS control module. Repair if necessary.



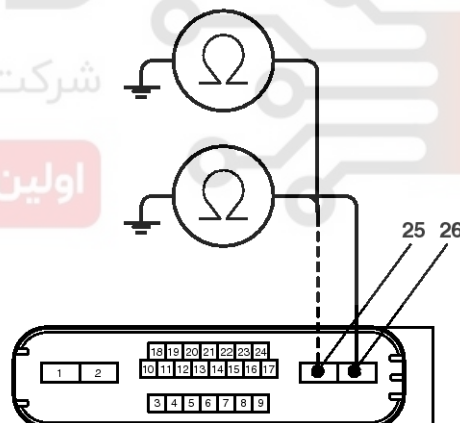
SENBR7603D

#### Check the ground circuit

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 25, 26 of the ABS control module harness side connector and ground point.
3. Is there continuity?

**YES** ▶ Check the wheel speed sensor circuit.

**NO** ▶ Repair an open in the wire and ground point.



SENBR7604D

**BR-68****Brake System****Check the wheel speed sensor circuit**

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

**YES** ▶ Check the hydraulic circuit for leakage.

**NO** ▶ 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?

**YES** ▶ The problem is still occurring, replace the ABS control module.

**NO** ▶ Repair the hydraulic lines for leakage.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



# ABS(Anti-Lock Brake System)

## BR-69

### ABS Does Not Operate (Intermittently).

STQBR8320L

#### Detecting condition

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	<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 scan tool 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?

**NO** ▶ Check the wheel speed sensor circuit.

**YES** ▶ Erase the DTC and recheck using scan tool.

##### Check the wheel speed sensor circuit

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

**YES** ▶ Check the stop lamp switch circuit.

**NO** ▶ Repair or replace the wheel speed sensor.

##### Check the stop lamp switch circuit

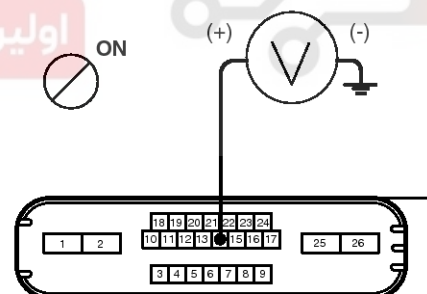
1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.
2. Measure the voltage between terminal 14 of the ABS control module harness side connector and body ground when brake pedal is depressed.

**Specification** : approximately B+

3. Is the voltage within specification?

**YES** ▶ Check the hydraulic circuit for leakage.

**NO** ▶ Repair the stop lamp switch. Repair an open in the wire between the ABS control module and the stop lamp switch.



SENBR7605D

##### Check the hydraulic circuit for leakage

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

**YES** ▶ The problem is still occurring, replace the ABS control module.

**NO** ▶ Repair the hydraulic lines for leakage.

# BR-70

# Brake System

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

STQBR8321L

### 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

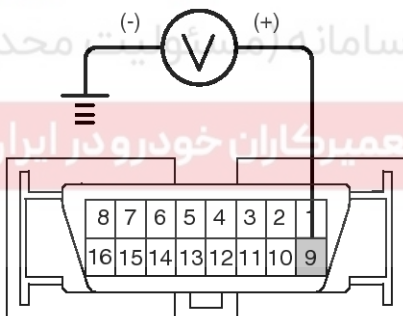
1. Measure the voltage between terminal 9 of the data link connector and body ground.

**Specification :** approximately B+

2. Is voltage within specification?

**YES** ▶ Check the ground circuit for the diagnosis.

**NO** ▶ Repair an open in the wire. Check and replace fuse (15A) from the engine compartment junction block.

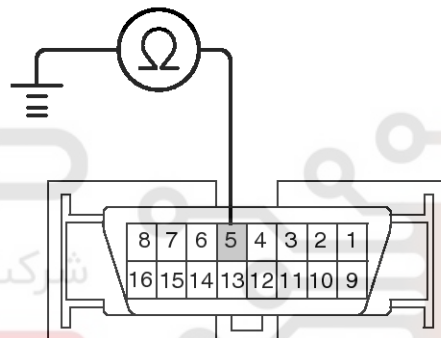


SUNBR6519L

#### Check the ground circuit for the diagnosis

1. Check for continuity between terminal 5 of the data link connector and body ground.
2. Is there continuity?

**NO** ▶ Repair an open in the wire between terminal 5 of the data link connector and ground point.



SUNBR6520L

# ABS(Anti-Lock Brake System)

BR-71

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

STQBR8322L

## Detecting condition

Trouble Symptoms	Possible Cause
When communication with Hi-Scan (pro) 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 ABS control module.
2. Check for continuity between terminals 7 of the ABS control module connector and 1 of the data link connector.
3. Is there continuity?

**YES** ▶ Check the power source of ABS control module.

**NO** ▶ Repair an open in the wire.

### Check the power source of ABS control module

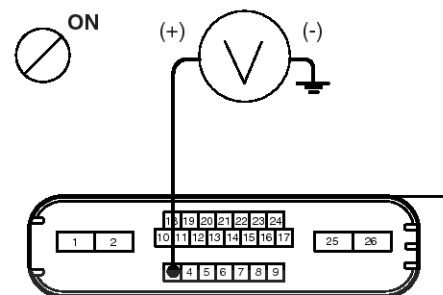
1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 3 of the ABS control module harness side connector and body ground.

**Specification** : approximately B+

3. Is voltage within specification?

**YES** ▶ Check for poor ground.

**NO** ▶ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ABS control module. Repair if necessary.



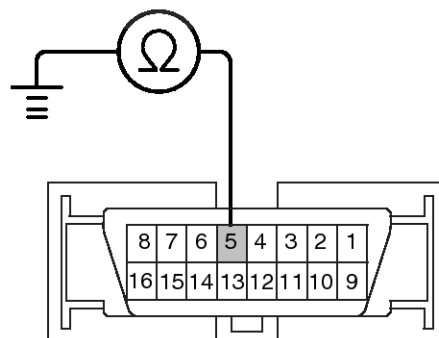
SENBR7603D

### Check for poor ground

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

**YES** ▶ Replace the ABS control module and recheck.

**NO** ▶ Repair an open in the wire or poor ground.



SUNBR6520L

# BR-72

# Brake System

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

STQBR8323L

### 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 ABS control module and turn the ignition switch ON.
2. Does the ABS warning lamp light up?

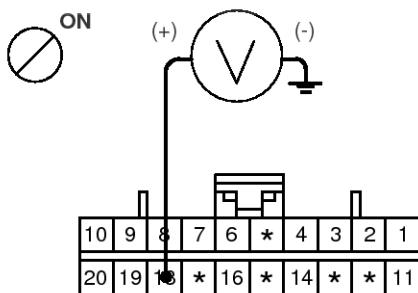
**YES** ▶ Inspect again after replacing the ABS HECU

**NO** ▶ Check the power source for the ABS warning lamp.

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

1. Disconnect the instrument cluster connector (M01-A2) and turn the ignition switch ON.
2. Measure the voltage between terminal (M01-A2) 18 of the cluster harness side connector and body ground.

**Specification :** approximately B+



STDBR9136D

3. Is voltage within specification?

**YES** ▶ Check the CAN circuit resistance for ABS warning lamp.

**NO** ▶ Check for blown fuse.

#### Check for blown fuse

1. Check continuity of fuse (10A) from the engine compartment junction block.
2. Is there continuity?

**YES** ▶ Repair an open in the wire between cluster fuse and 18 of cluster connector(M01-A2).

**NO** ▶ Replace the blown fuse.



# ABS(Anti-Lock Brake System)

## BR-73

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

STQBR8324L

### 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 Scan tool to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using Scan Tool.
3. Is DTC output?

**YES** ▶ Repair circuit indicated by code output.

**NO** ▶ Check instrument cluster.

#### Check instrument cluster

1. Disconnect the cluster connector and turn the ignition switch ON.
2. Does the ABS warning lamp remains ON?

**YES** ▶ Replace the instrument cluster.

**NO** ▶ Check for open the wire.

#### Check for open in the wire

1. Check for continuity in the wire between cluster and ABS control module.
2. Is there continuity?

**YES** ▶ Replace the ABS control module and recheck.

**NO** ▶ Repair an open in the wire between cluster and ABS control module.





## BR-74

## Brake System

**Bleeding of Brake System**

This procedure should be followed to ensure adequate bleeding of air and filling of the ABS 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. 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 scan tool to the data link connector located underneath the dash panel.
4. Select and operate according to the instructions on the scan tool screen.

**CAUTION**

You must obey the maximum operating time of the ABS motor with the hi-scan (Pro) to prevent the motor pump from burning.

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

**< PRE BLEEDING >**

1. Perform the bleeding of conventional parts certainly.
2. Press [ENTER] key to activate pump motor and all NC valves.

SUNBR6522L

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

NOW, ALL NC VALVES AND PUMP MOTOR ARE ACTIVATING. DURING THIS TIME, IT SHOULD BE REPEATED THAT DEPRESSING THE BRAKE PEDAL UNTIL IT REACHES TO THE BOTTOM OF FLOOR WITHOUT REACTION AND RELEASING THE BRAKE PEDAL UNTIL THE KICK BACK SITUATION IS OVER.

PLEASE WAIT 120 SECONDS.

SUNBR6523L

- 6) Perform the air bleeding.

**< FINAL BLEEDING >**

1. Perform the bleeding of conventional parts certainly.
2. If the brake pedal stroke is not so good after above procedure, perform the all procedure more some times and recheck the brake pedal stroke.
3. Press [ENTER] key to return the first bleeding mode.

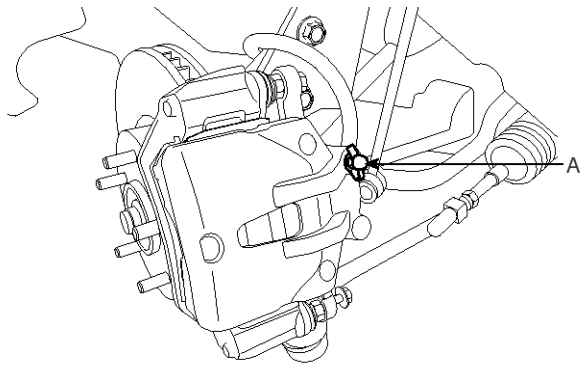
SUNBR6621L

# ABS(Anti-Lock Brake System)

# BR-75

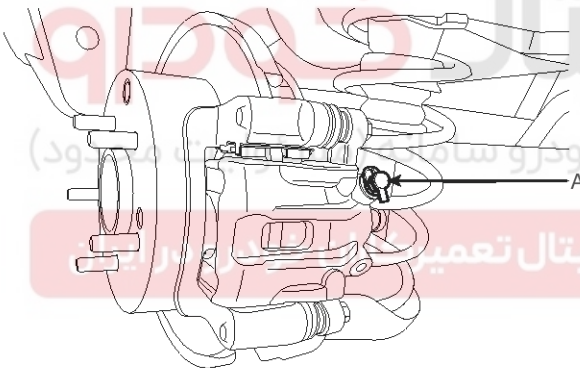
5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw(A).

### Front



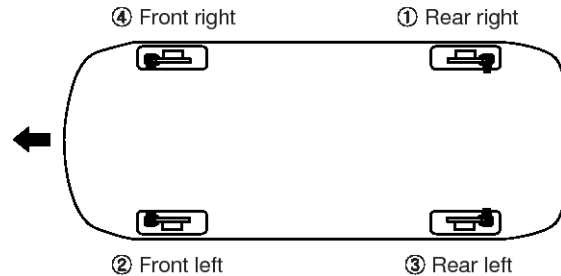
STDBR9001D

### Rear



STDBR9002D

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



KJKE003B

7. Tighten the bleeder screw.

**Bleed screw tightening torque:**

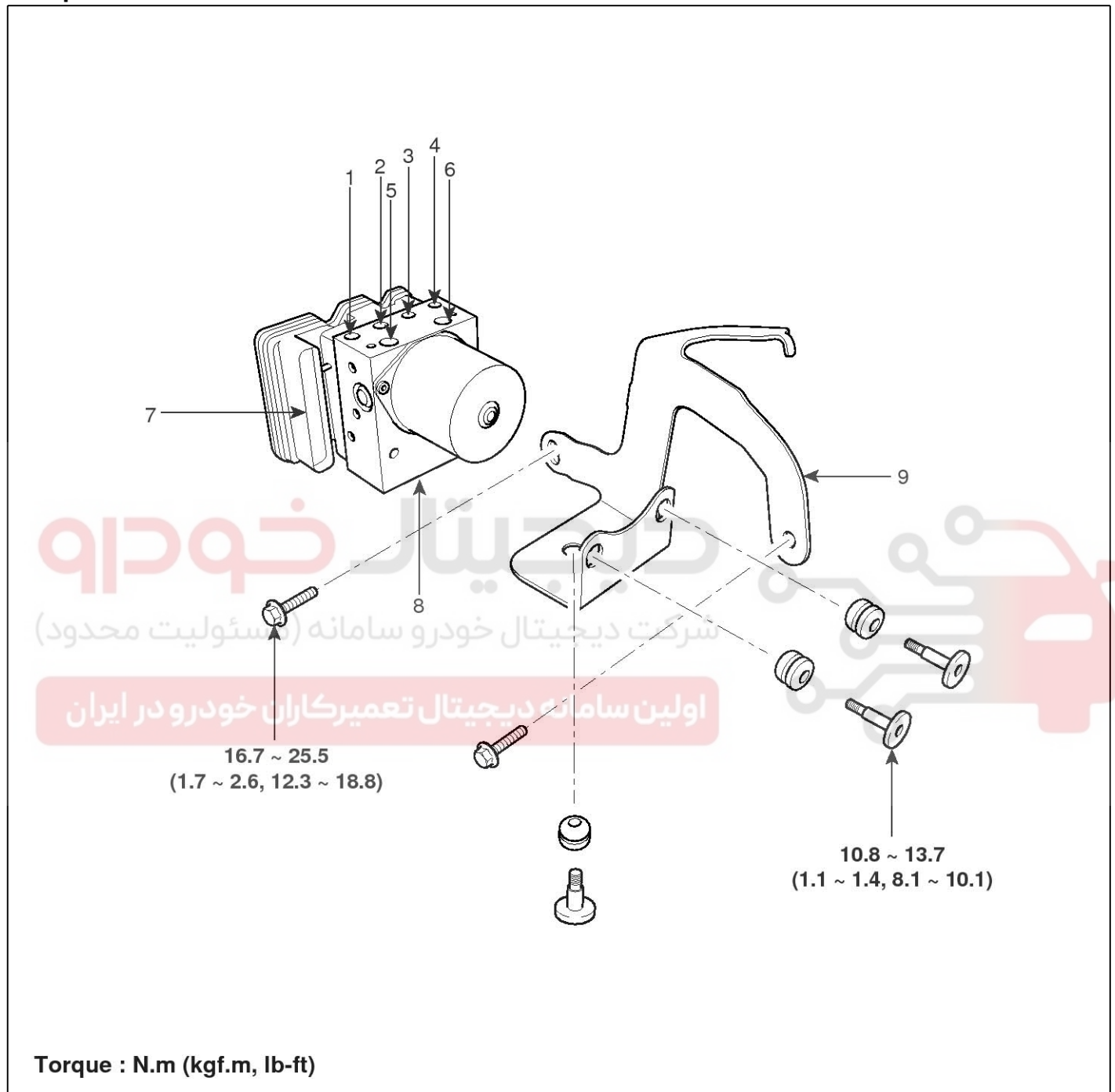
6.9 ~ 12.7N.m (0.7 ~ 1.3kgf.m, 5.1 ~ 9.4lb-ft)

# BR-76

# Brake System

## ABS Control Module

### Components



STDBR9160L

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

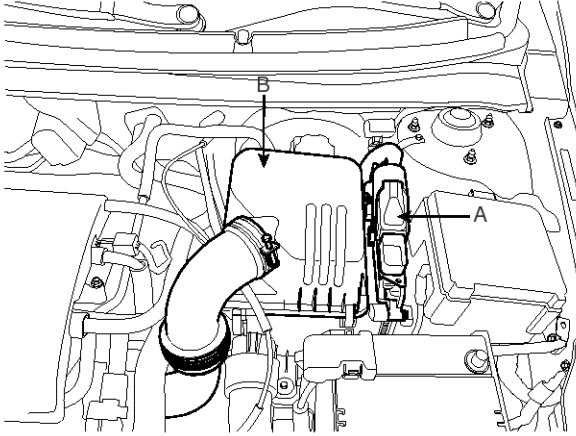
- 6. MC1
- 7. ABS control module connector
- 8. ABS control module (HECU)
- 9. Bracket

# ABS(Anti-Lock Brake System)

## BR-77

### Removal

1. Turn the ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the air cleaner assembly. (Refer to the Engine group - Engine and Transaxle assembly)



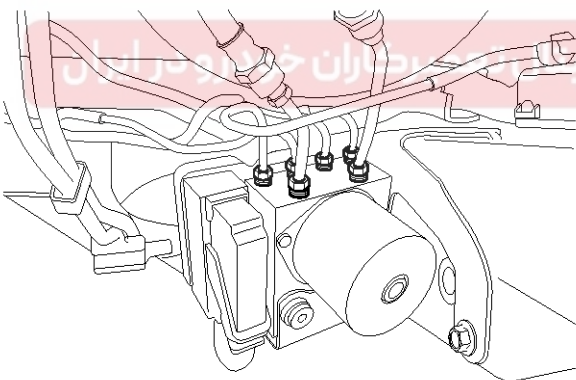
STDBR9021D

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

### Tightening torque:

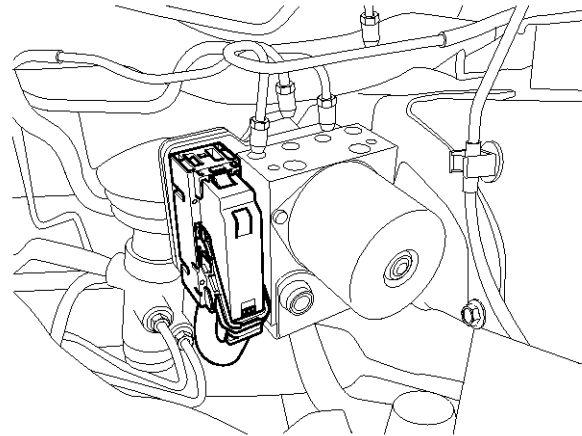
ABS : 12.7 ~ 16.7N.m(1.3 ~ 1.7kgf.m, 9.4 ~ 12.3lb-ft)

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



STDBR9161D

4. Pull up the lock of the ABS control unit connector, then disconnect the connector.

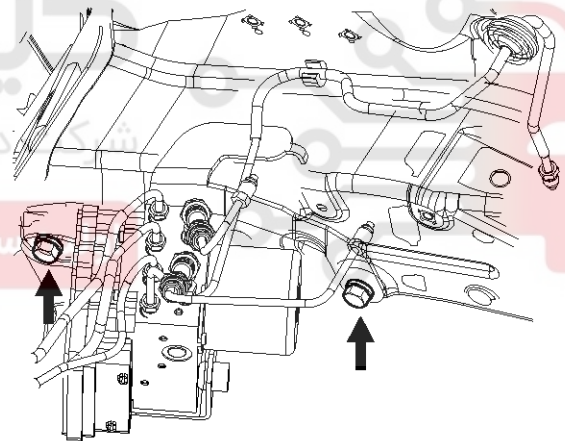


STDBR9163D

5. Loosen the ABS HECU bracket bolt(3EA), then remove HECU and bracket.

### Tightening torque:

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



STDBR9162D

### CAUTION

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

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

### Tightening torque:

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

### Installation

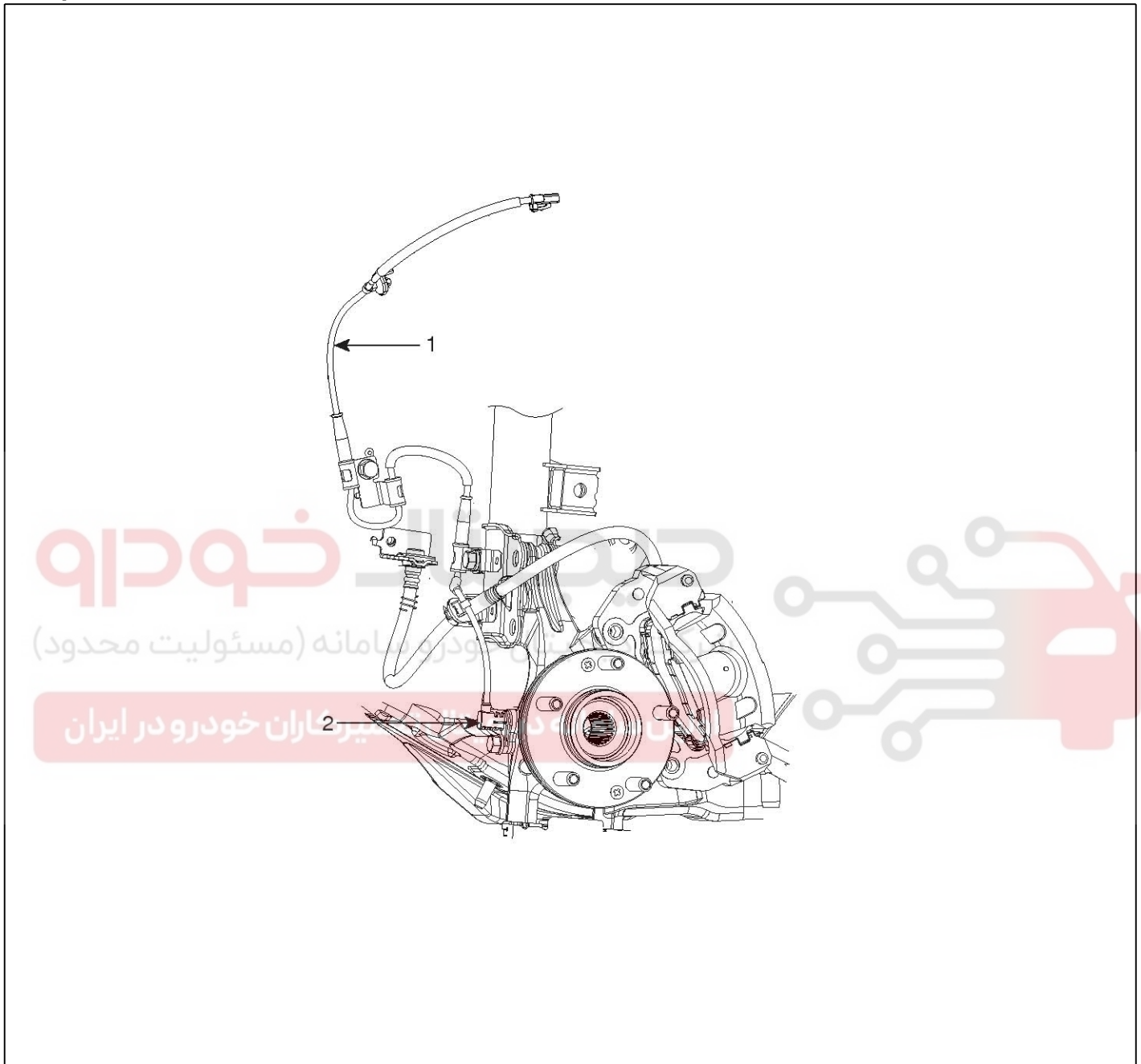
1. Installation is the reverse of removal.
2. Tighten the HECU mounting bolts and nuts to the specified torque.

# BR-78

# Brake System

## Front Wheel Speed Sensor

### Components



STDBR9170D

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

# ABS(Anti-Lock Brake System)

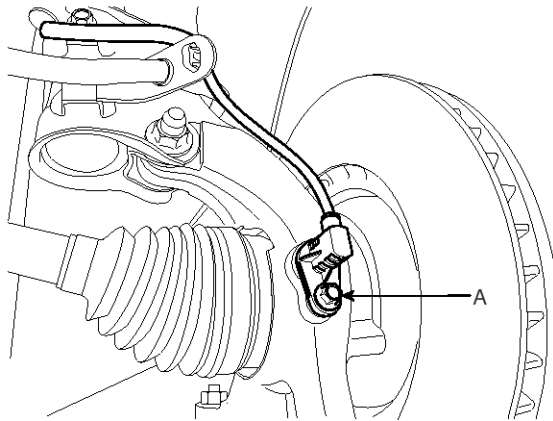
# BR-79

## Removal

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

### Tightening torque:

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



STD9171D

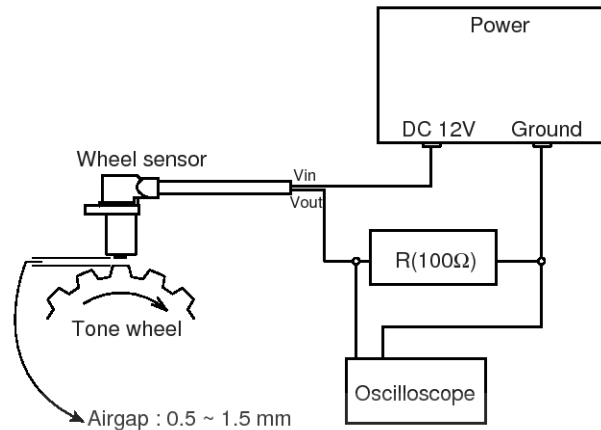
2. Remove the front wheel guard.
3. Disconnect the front wheel speed sensor connector. And remove the front wheel speed sensor.
4. Installation is the reverse of removal.

## Inspection

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

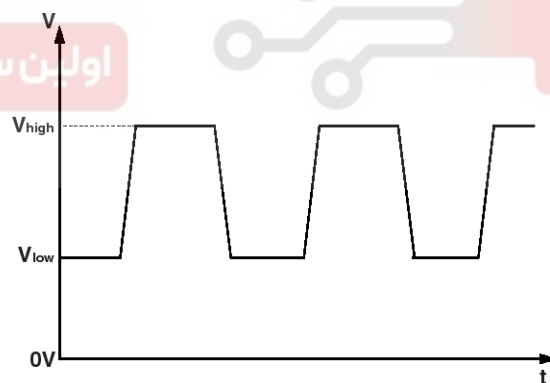
### CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 100 Ω resistor must be used as shown.



SHMBR9322L

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



ARJE503Z

V\_low : 0.59V ~ 0.84V

V\_high : 1.18V ~ 1.68V

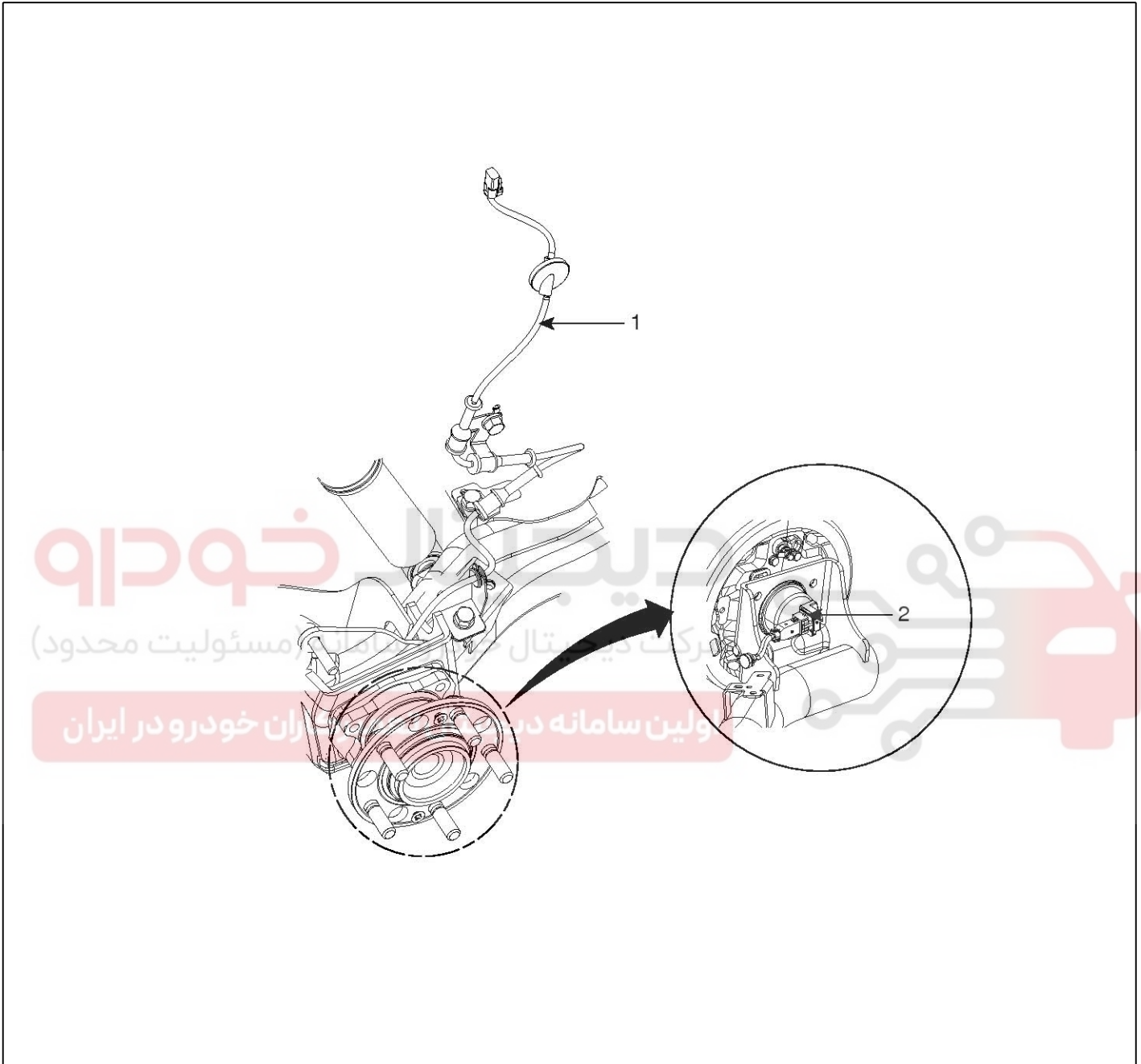
Frequency range : 1 ~ 2,500Hz

# BR-80

# Brake System

## Rear Wheel Speed Sensor

### Components



STDBR9180D

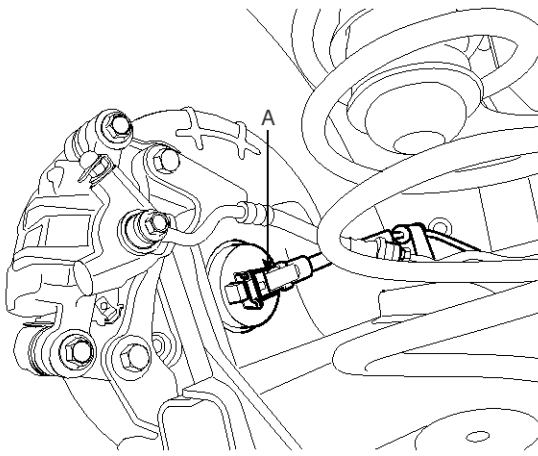
- 1. Rear wheel speed sensor cable
- 2. Rear wheel speed sensor

# ABS(Anti-Lock Brake System)

# BR-81

## Removal

1. Remove the connector after(A) removing the rear wheel speed sensor clip.



STD9181D

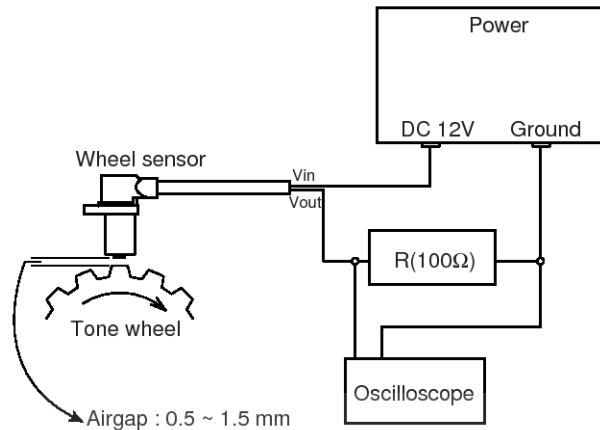
2. Remove the rear wheel speed sensor. (Refer to Driveshaft and axle group - Rear axle assembly)
3. Installation is the reverse of removal.

## Inspection

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

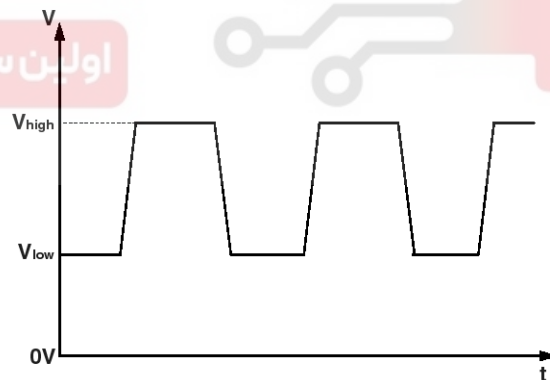
### CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 100 Ω resistor must be used as shown.



SHMBR9322L

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



ARJE503Z

$V_{low} : 0.59V \sim 0.84V$   
 $V_{high} : 1.18V \sim 1.68V$   
 Frequency range : 1 ~ 2,500Hz



## BR-82

## Brake System

## EBD(Electronic Brake-force Distribution)

EBD (Electronic brake-force distribution)  
Operation

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

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

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

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

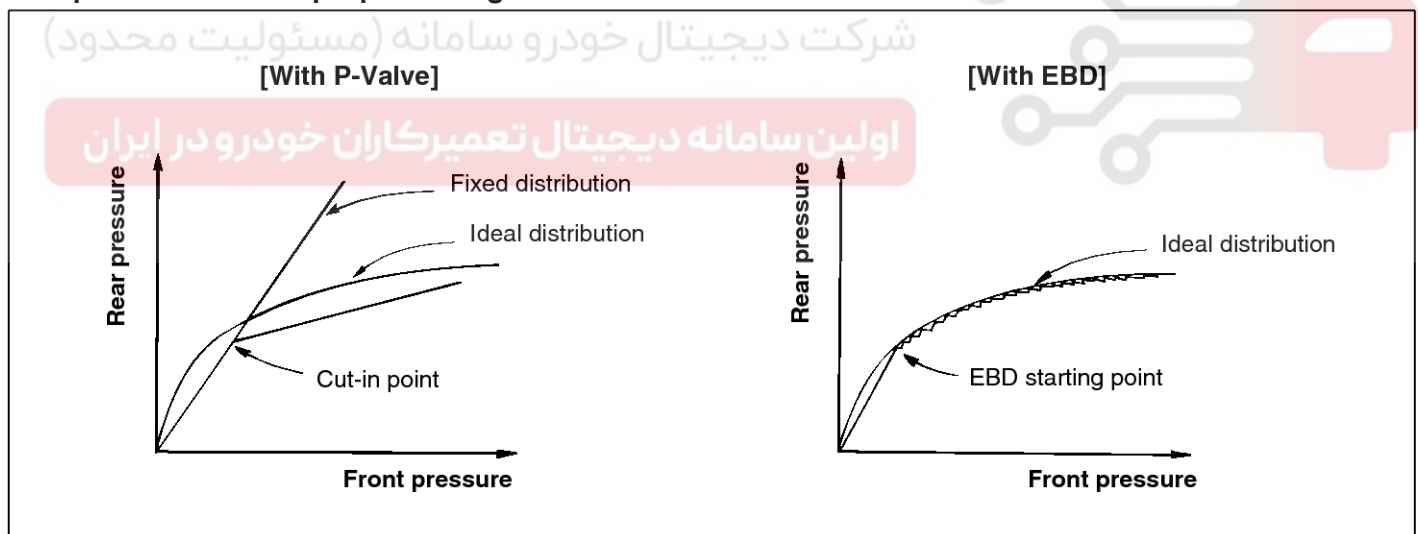
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

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

**Advantages**

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

## Comparison between proportioning valve and EBD



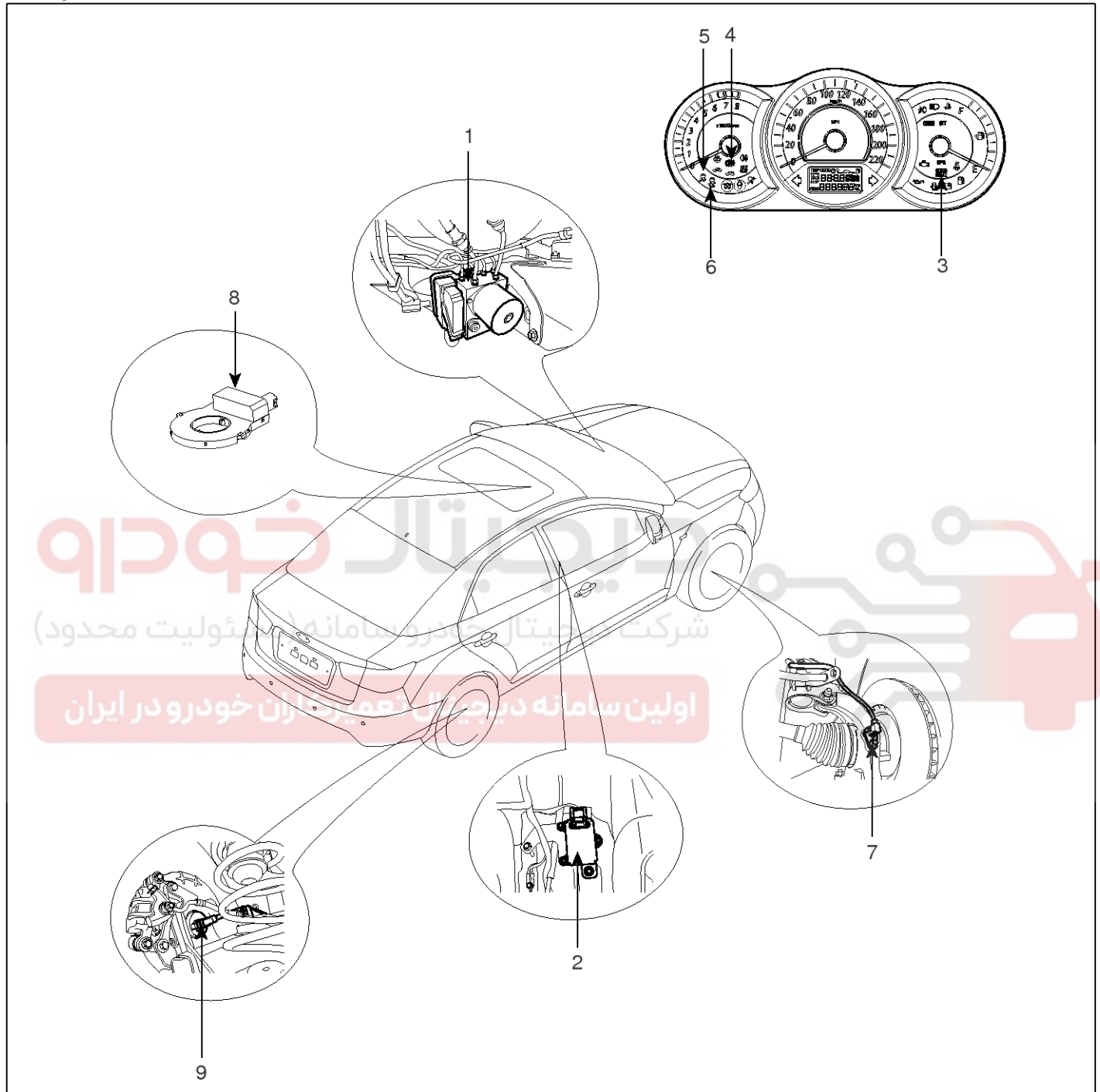
EJA0032A

# ESP(Electronic Stability Program) System

BR-83

## ESP(Electronic Stability Program) System

### Components



STDBR9201L

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

- 6. ESP OFF / Warning lamp
- 7. Front wheel speed sensor
- 8. Steering angle sensor
- 9. Rear wheel speed sensor

# BR-84

# Brake System

## Description of ESP

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

ESP is based on the MGH 40 ABS Hydraulic System. ESP recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention with no need for actuating the brake or the gas pedal.

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

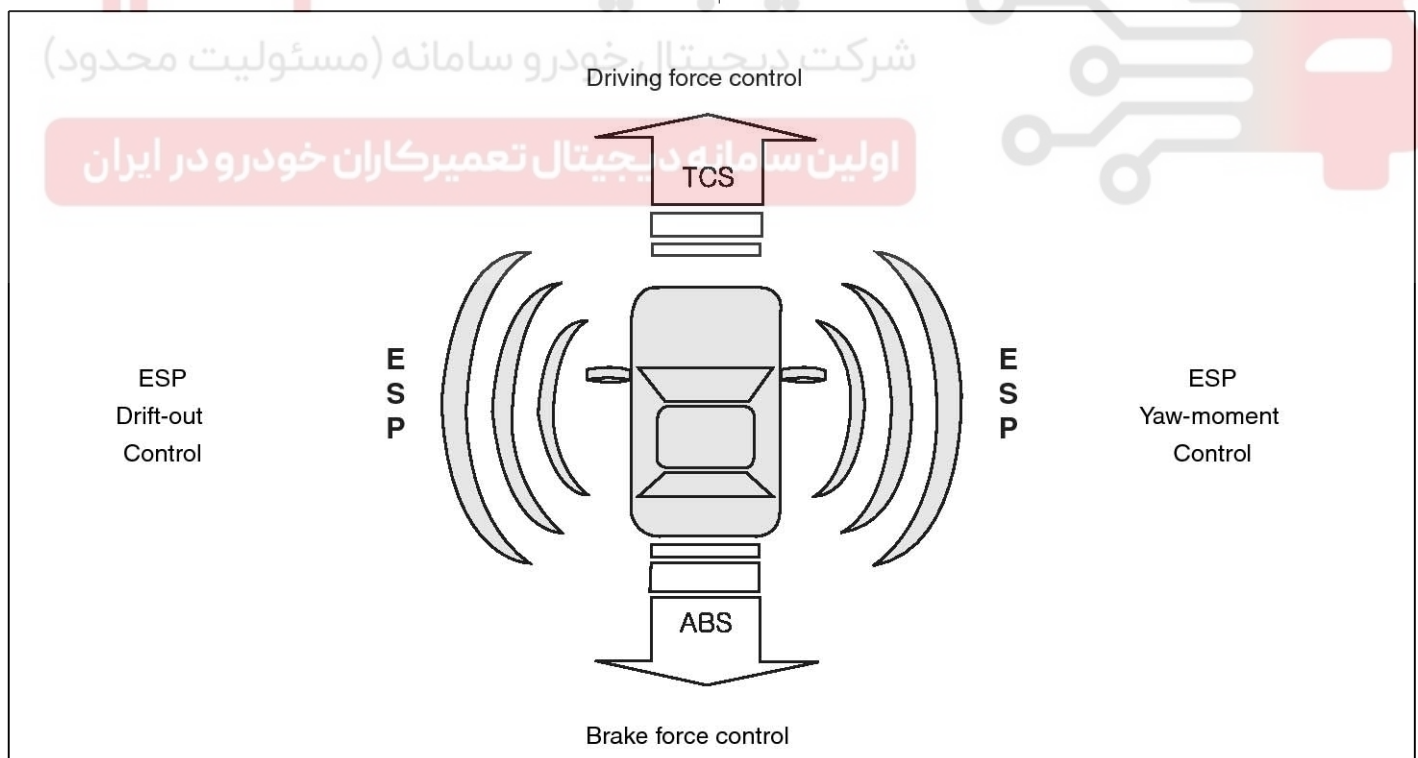
This is achieved by wheel individual brake intervention and adaptation of the momentary engine torque with no need for any action to be taken by the driver.

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

The electronic control unit incorporates the technological experience accumulated in connection with the MGH 40 system, but has been substantially expanded in terms of capacity and monitoring concept in order to permit the additional sensor signals and arithmetic operations to be processed and converted into corresponding valve, pump and engine control commands. Two 16-bit processors and one 8-bit processor, which monitor each other, cooperate to handle these requirements.

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

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



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# ESP(Electronic Stability Program) System

# BR-85

## Description of ESP control

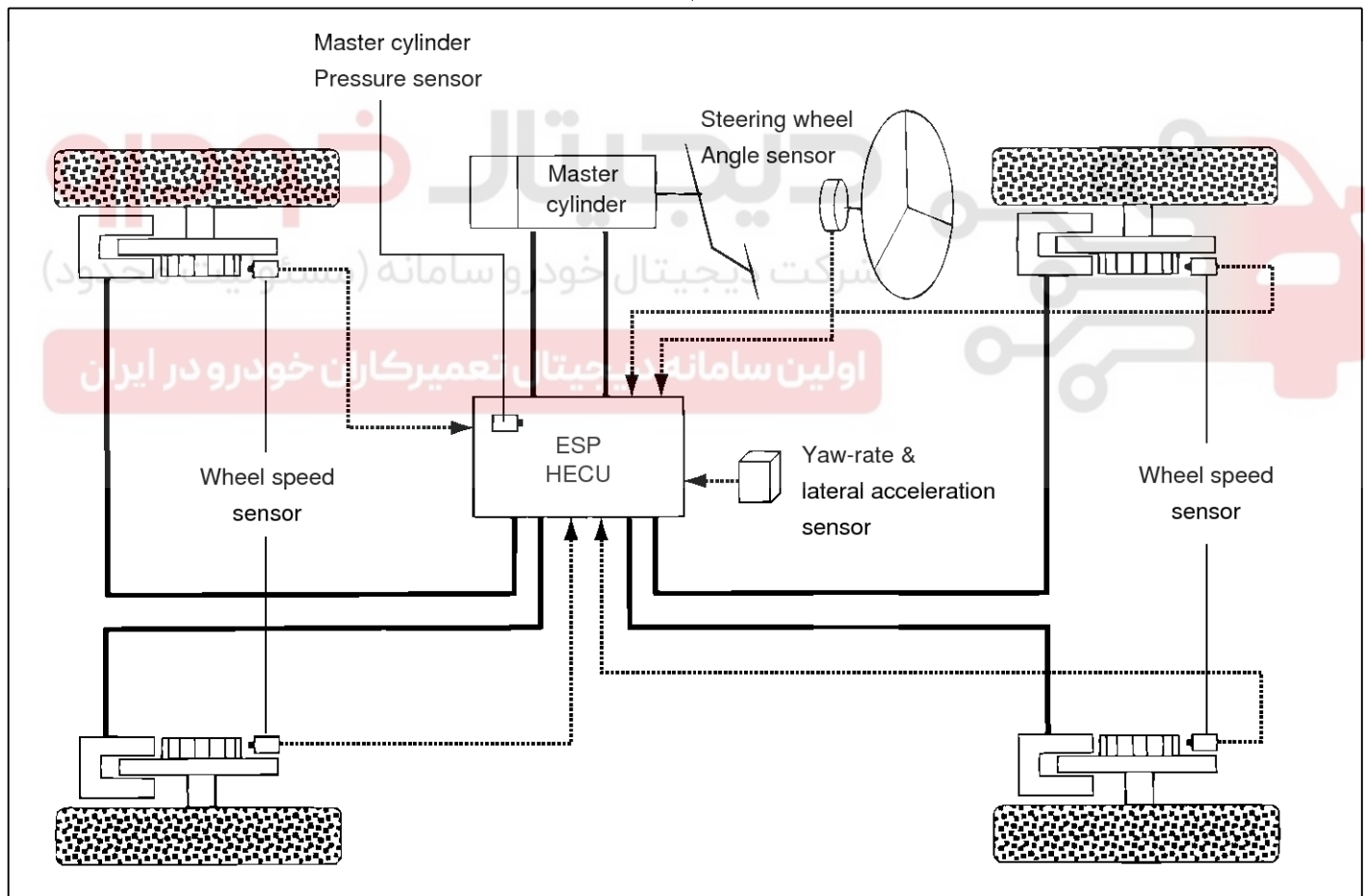
ESP system includes ABS/EBD, TCS and AYC function.

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

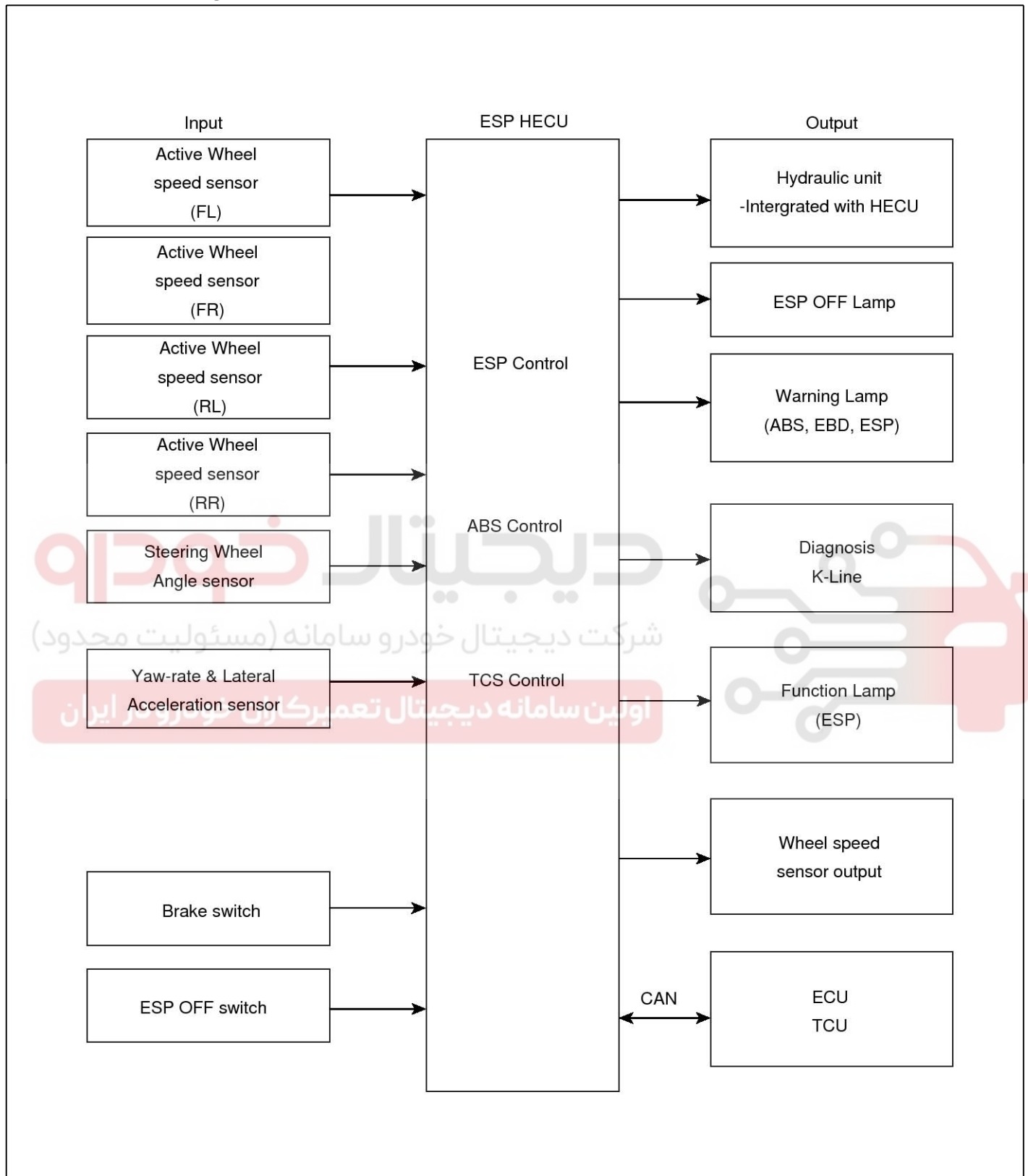


SHMBR9332L

BR-86

Brake System

Input and output diagram



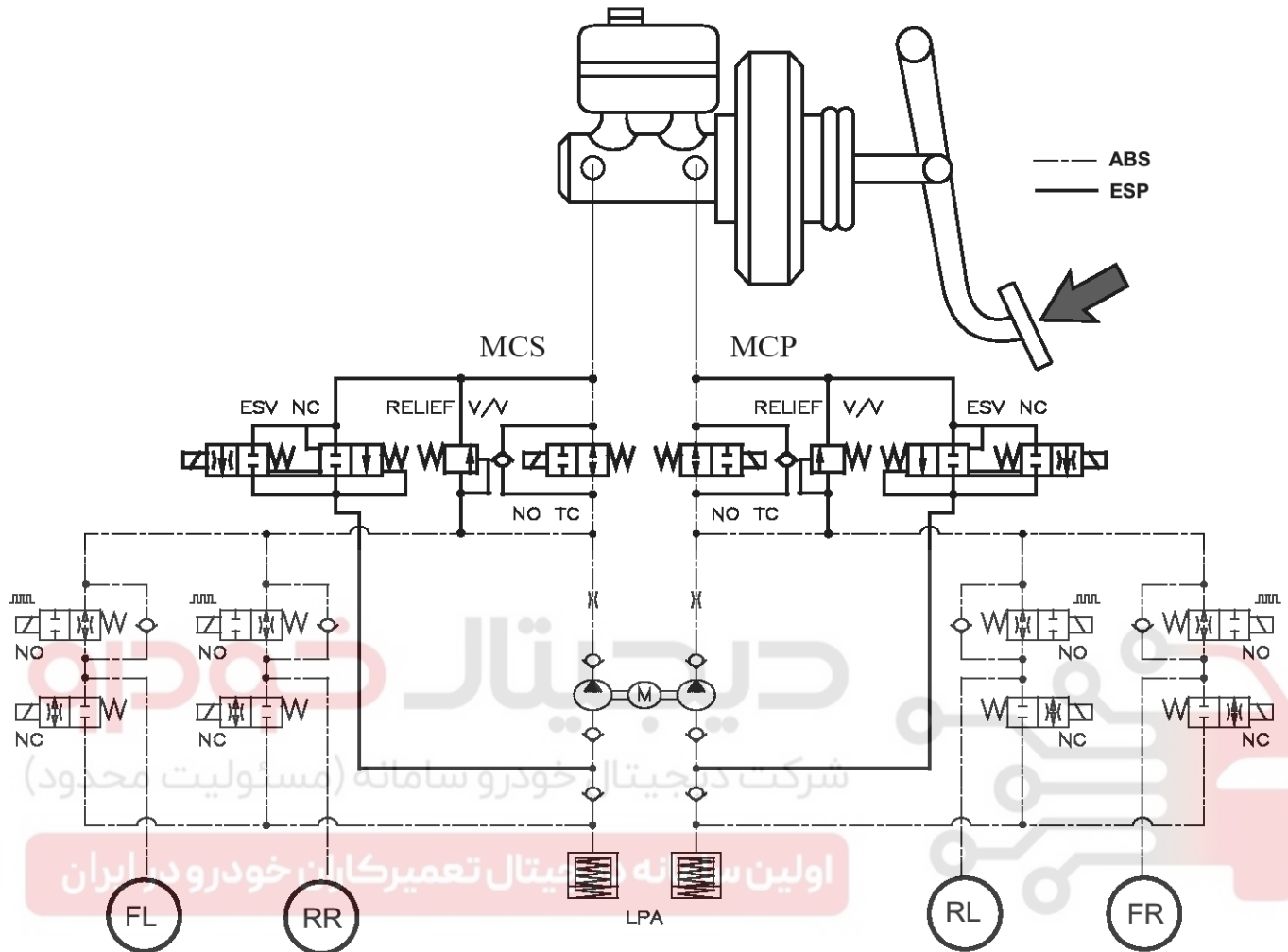
SAMBR9209L

# ESP(Electronic Stability Program) System

# BR-87

## ESP Operation mode

### ESP Hydraulic system diagram



LJJF501P

1. ESP Non-operation : Normal braking.

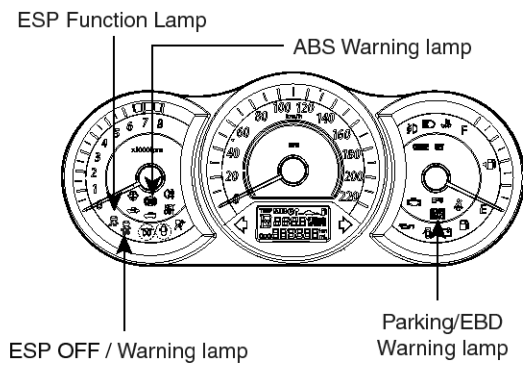
Solenoid valve	Continuity	Valve	Motor pump	TC Valve
IN (NO)	OFF	OPEN	OFF	OFF
OUT (NC)	OFF	CLOSE		

2. ESP 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		

## BR-88

## Brake System



STDBR9200L

**ABS Warning lamp module**

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

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

**EBD/Parking brake warning lamp module**

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

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

**ESP OFF / Warning lamp (ESP system)**

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

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

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

**ESP Function lamp (ESP system)**

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

The ESP Function lamp operates under the following conditions :

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

**ESP On/Off switch (ESP system)**

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

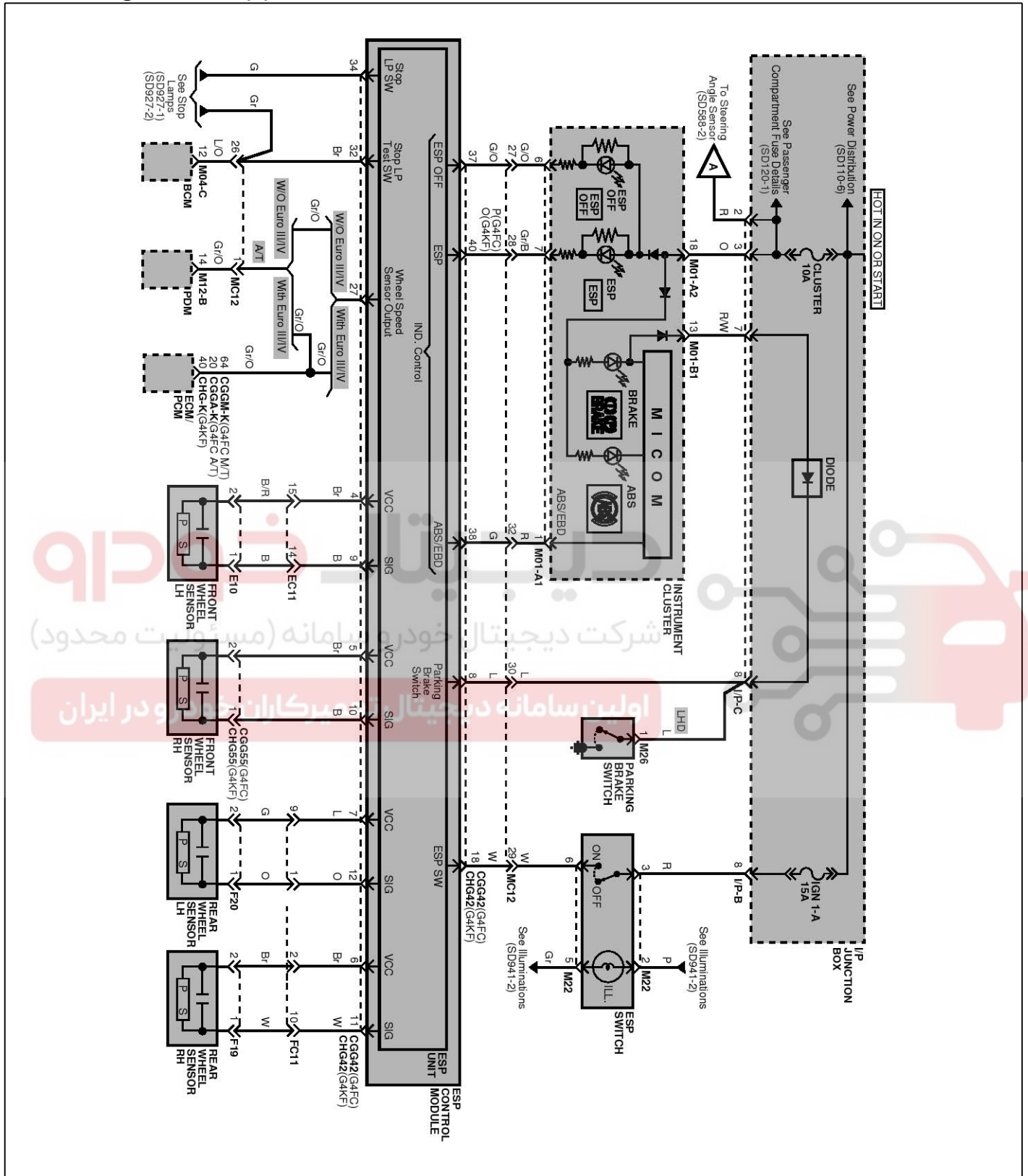
The On/Off switch shall be a normally open, momentary contact switch. Closed contacts switch the circuit to ignition.

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

# ESP(Electronic Stability Program) System

# BR-89

## Circuit Diagram - ESP(1)



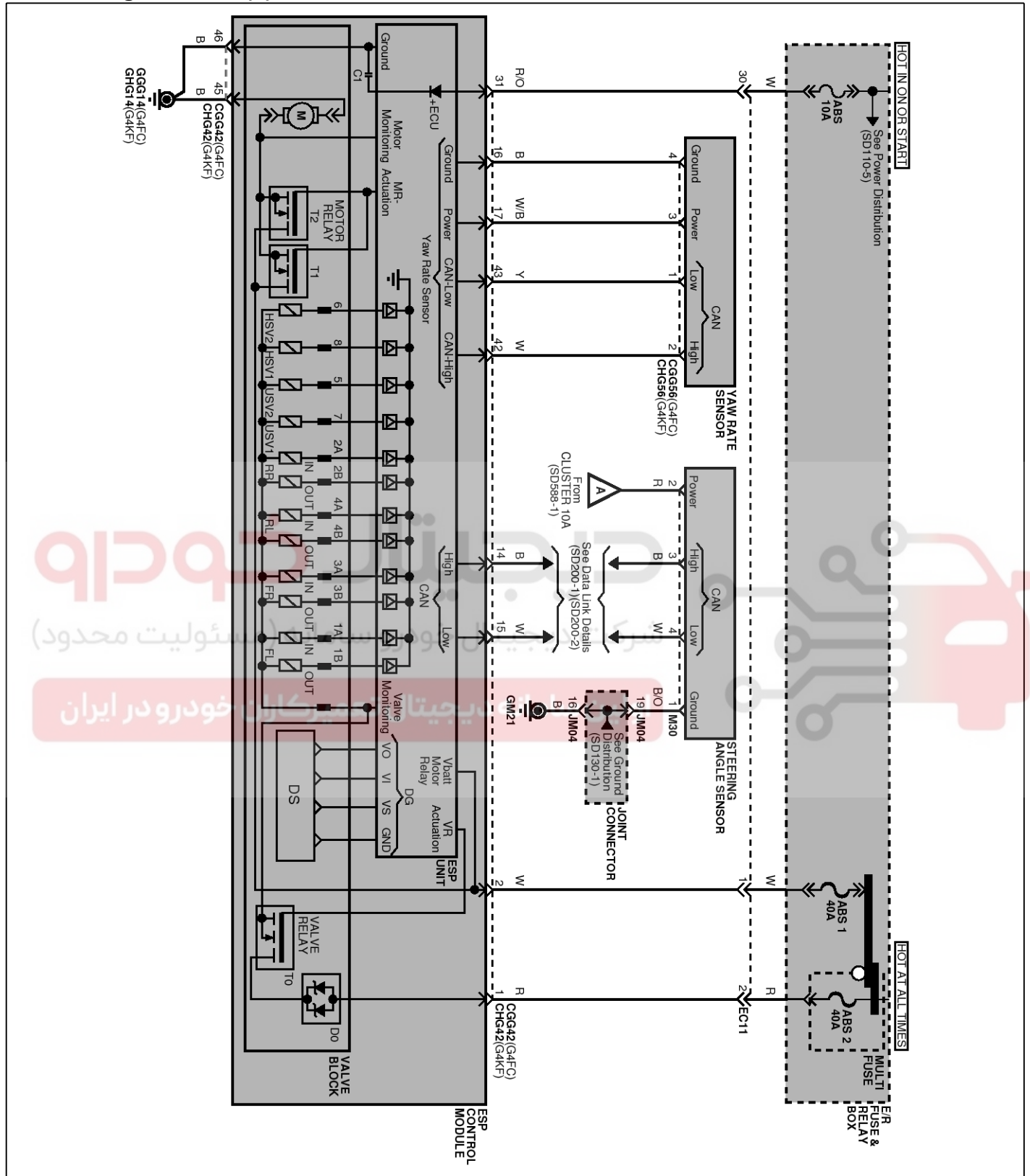
STDBR9203L



# BR-90

# Brake System

### Circuit Diagram - ESP(2)

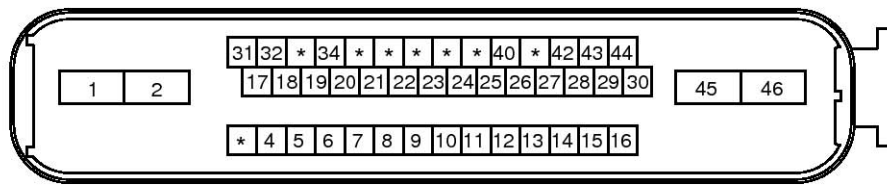


STDBR9204L

# ESP(Electronic Stability Program) System

# BR-91

## ESP Connector Input/Output



SHMBR8347D

Connector Terminal		Specification	Remark
No	Description		
31	IGNITION1(+)	Over voltage range : $17 \pm 0.5V$ Operating voltage range : $9.5 \pm 0.5V < V < 17 \pm 0.5V$ Low voltage range : $7.0 \pm 0.5V < V < 9.5 \pm 0.5V$ Max. current : $I < 500mA$	
1	POS.BATTERY.(SOLENOID)	Max leakage current : $I < 0.8mA$ Operating voltage range : $9.5 \pm 0.5V < V < 17 \pm 0.5V$ Max. current : $I < 40A$ Hardware shutdown voltage : $V < 6.0V$	
2	POS.BATTERY.(MOTOR)	Operating voltage range: $9.5 \pm 0.5V < V < 16.5 \pm 0.5V$ Rush current : $I < 100A$ Max current : $I < 40A$ Max leakage current : $I < 0.2mA$	
46	GROUND	Rated current : $I < 500mA$ Max. current: $I < 40A$	
45	PUMP MOTOR GROUND	Rush current : $I < 100A$ Max current : $I < 40A$	
16	YAW & LATERAL G SENSOR GROUND	Rated current : $I < 150mA$	
17	YAW SENSOR POWER	Max Output current : $I < 150mA$ Max Output voltage : $V(IGN) \pm 1V$	
34	BRAKE LIGHT SWITCH	Input voltage (Low) : $0V \leq V \leq 3.0V$ Input voltage (High) : $7.0V \leq V \leq 16.0V$	
32	BRAKE SWITCH		
8	PARKING BRAKE SWITCH	Input voltage (Low) : $0V \leq V_{Low} \leq 3.0V$ Input voltage (High) : $7.0V \leq V_{High} \leq 16.0V$ Max input current : $I < 10mA$	
27	SENSOR FRONT RIGHT OUTPUT	Max current : $I < 16mA$ External pull up resistance : $1 K\Omega < R$ Output duty : $50 \pm 20\%$	

## BR-92

## Brake System

Connector Terminal		Specification	Remark
No	Description		
18	ESP ON/OFF SWITCH	Input voltage (Low) : $0V \leq V \leq 3.0V$ Input voltage (High) : $7.0V \leq V \leq 16.0V$ Max input current: : $I < 10mA$	
15	CAN BUS LINE(LOW)		
14	CAN BUS LINE(HIGH)		
4	SENSOR FRONT LEFT POWER		
5	SENSOR FRONT RIGHT POWER	Output voltage : $IGN (V) \pm 1V$ Output current : Max 30mA	
7	SENSOR REAR LEFT POWER		
6	SENSOR REAR RIGHT POWER		
9	SENSOR FRONT LEFT SIGNAL		
10	SENSOR FRONT RIGHT SIGNAL	Input current LOW : $5.9 \sim 8.4mA$ Input current HIGH : $11.8 \sim 16.8mA$ Frequency range : $1 \sim 2500Hz$ Input duty : $50 \pm 20\%$	
12	SENSOR REAR LEFT SIGNAL		
11	SENSOR REAR RIGHT SIGNAL		
42	SENSOR CAN BUS LINE (High)		
43	SENSOR CAN BUS LINE (Low)		
37	ESP OFF/WARNING LAMP DRIVER	Max. current : $I < 200mA$ Operating voltage : $0 \sim 16V$ Min. shunt resistance : $500k\Omega$ Max. output low voltage : $V < 0.5V$	
38	ABS/EBD WARNING LAMP DRIVER		
40	ESP FUNCTION LAMP DRIVER		

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# ESP(Electronic Stability Program) System

## BR-93

### Failure Diagnosis

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

### Memory of Fail Code

1. It keeps the code as far as the backup lamp power is connected. (O)
2. It keeps the code as 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. ESP operation lamp turn on for 3sec after IGN ON.
2. ESP operation lamp blinks when ESP Act.
3. ESP OFF warning lamp turn on in case of
  - ESP Switch OFF
  - ESP Failure Detect
  - 3sec after IGN ON



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# BR-94

# Brake System

## Yaw-rate and Lateral G Sensor

### Description

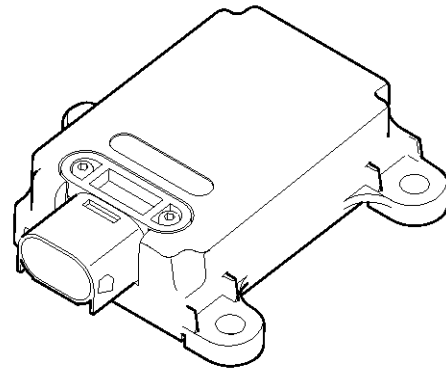
When the vehicle is turning with respect to a vertical axis the yaw rate sensor detects the yaw rate electronically by the vibration change of plate fork inside the yaw rate sensor.

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

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

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

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



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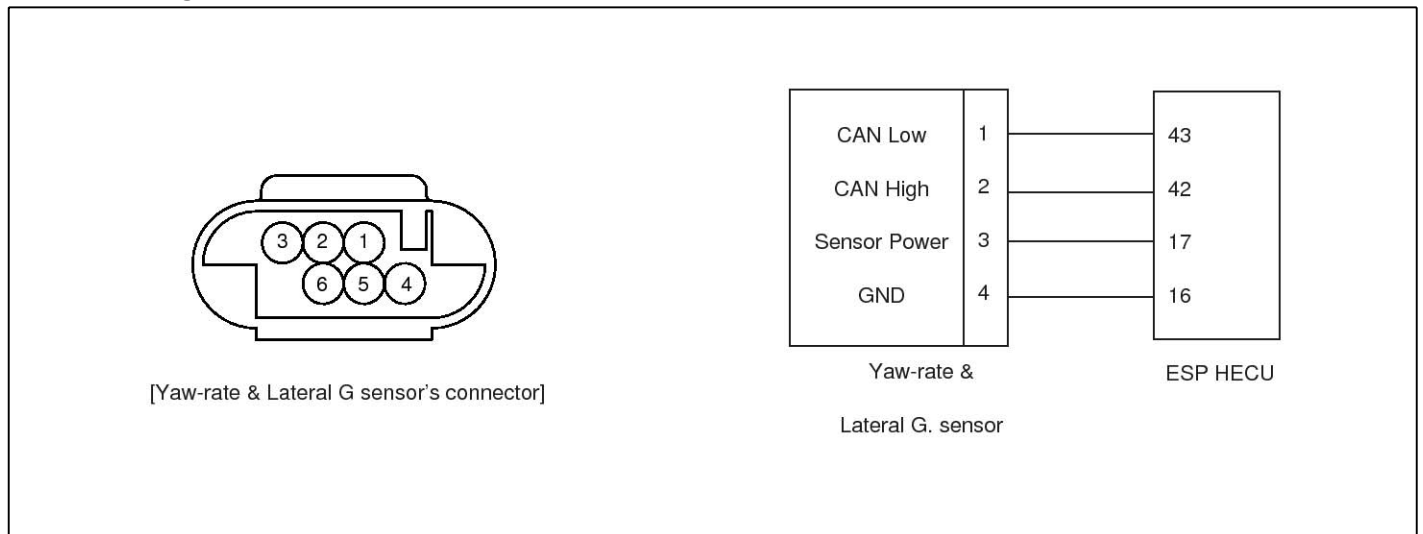
### Specifications

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	18 ~ 22Hz	
Lateral G sensor	Measurement range	-1.5 ~ 1.5g	
	Frequency response	50Hz±60%	

# ESP(Electronic Stability Program) System

# BR-95

## External Diagram



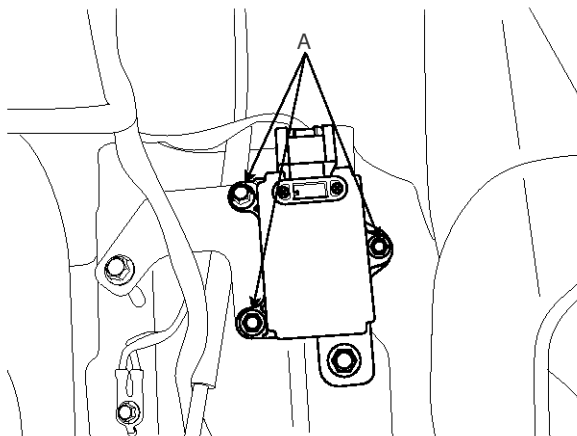
SENB7559L

## Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the crash pad assembly. (Refer to the Body group - Crash pad)
3. Remove the heater & blower unit. (Refer to the heater & A/C group - Blower)
4. Disconnect the yaw rate & lateral G sensor connector.
5. Remove the mounting bolts (A).

### Tightening torque:

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



STDBR9232D

6. Installation is the reverse of removal.

## BR-96

## Brake System

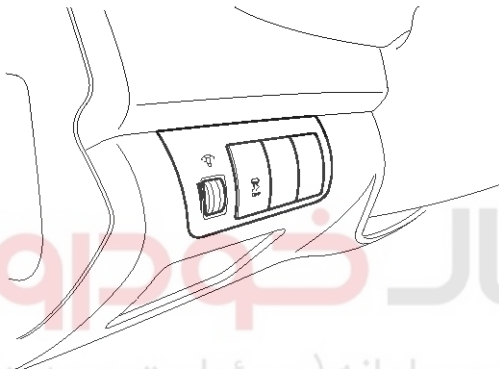
### ESP OFF Switch

#### Description

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

#### Inspection

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the lower crash pad switch assembly by using the scraper and then disconnect the connectors.



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STDBR9302D

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

Terminal \ Position	3	6	2	5
ON	○	○	○	○
OFF			○	○

STDBR9250L

# ESP(Electronic Stability Program) System

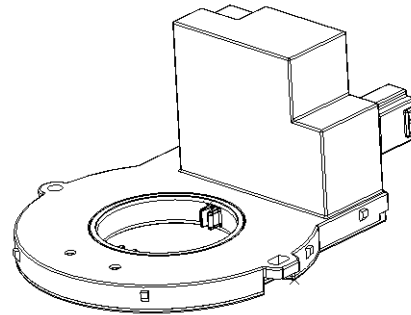
# BR-97

## Steering Wheel Angle Sensor

### Description

Steering Wheel Angle Sensor detects rotating direction of the vehicle. Rotating direction detected by the sensor is communicated with HECU as CAN signal involving information about the angle through CAN communication line.

HECU detects speed of the steering wheel handling and the angle with this CAN signal. HECU also uses this signal as the input signal to control anti-roll.

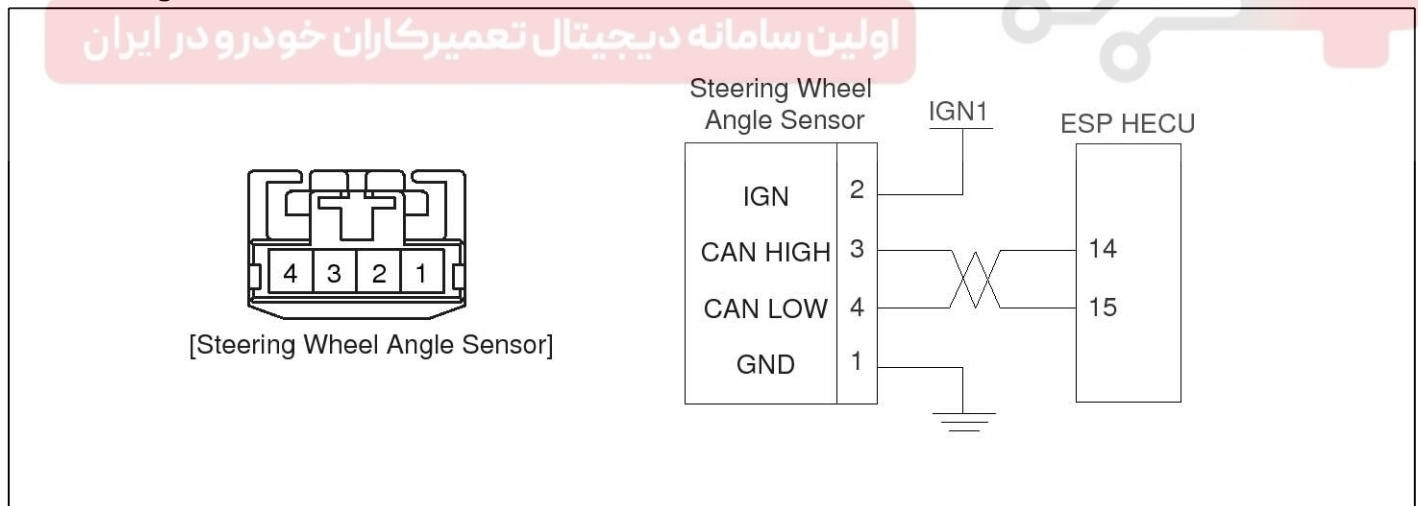


SHMBR8358D

### Specification

Description		Specification
Operating voltage		8 ~ 16V
Operating temperature		-30 ~ 75°C (-22 ~ 167°F)
Current consumption		Max.100mA
Measuring range	Angle	-780 ~ 779.9°
	Angular velocity	1500°/sec
Output signal		CAN Interface

### Circuit Diagram



SHMBR9326L



## BR-98

## Brake System

**Calibration (Setting up the zero angle)**

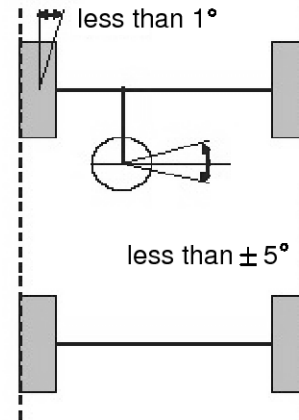
Steering Wheel Angle Sensor of a absolute angle type (CAN type) measures the angle under the standard of the zero angle set.

Calibration must be performed as following cases.

- Replacement of the Steering Wheel Angle Speed Sensor
- Replacement or repair of the Steering column
- Detection of DTC codes (C1260, C1261)
- Replacement of the sensor cluster
- Replacement of HECU

**Calibration procedure**

Perform wheel alignment and stand the steering wheel in a line within  $\pm 5^\circ$  error.



SHMBR9327L

1. Connect the scan tool.(CAN line or OBD connector)
2. Turn ignition switch on.
3. Press calibration button of the Steering Wheel Angle Sensor.
4. HECU calibration procedure is performed.  
(Calibration records, DTC codes erasure)
5. Turn ignition switch off after calibration procedure.
6. Confirm success or failure of calibration.
  - Warning lamp must not be lighted when driving test (Turning left and right).
  - ESP lights ESP OFF warning lamp when making an error in comparison with values of other sensors.