General Information

Specifications

Item	Specification		
Master cylinder • Type • Cylinder • Pistion stroke • Fluid level switch	CBS	ABS/ESP	
	Tandem 20.64 mm (0.813 in) 45 ± 1mm (1.77 ± 0.039in) Provided	Tandem 22.22 mm (0.875 in) 45 ± 1mm (1.77 ± 0.039in) Provided	
Brake booster • Type • Boosting ratio	LHD	RHD	
	11" Single 9 : 1	8+9" Tandem 9 : 1	
Front disc brake • Type • Disc O.D. • Disc thickness • Pad thickness • Caliper piston • Cylider I.D.	Ventilated disc Ø 280 mm (11.81 in) 26mm 11mm (0.43 in) Single Ø 60.0 mm (2.36 in)	Ventilated disc Ø 300 mm (11.81 in) 28mm 11mm (0.43 in) Single Ø 60.0 mm (2.36 in)	Ventilated disc Ø 320 mm (12.60 in) 28mm 11mm (0.43 in) Singie Ø 60.0 mm (2.36 in)
Rear disc brake • Type • Disc O.D. • Disc thickness • Pad thickness • Caliper piston • Cylider I.D.	Solid disc Ø 262mm (11.18 in) 10mm (0.39 in) 10mm (0.39 in) Single Ø 34.0 mm (1.34 in)	Solid disc Ø 284mm (11.18 in) 10mm (0.39 in) 10mm (0.39 in) Single Ø 34.0 mm (1.34 in)	Solid disc Ø 284mm (11.18 in) 10mm (0.39 in) 10mm (0.39 in) Single Ø 38.2mm (1.50 in)
Parking brake • Type • Drum I.D.	DIH(Drum in hat) Ø 168 mm (6.61 in)		

NOTICE

O.D. : Outer Diameter

I.D : Inner Diameter

Specification(ABS)

Part	Item	Standard value		Remark
HECU	System	4 Channel 4 Sensor (Solenoid)		Total control (ABS, EBD)
	Type	Motor, valve relay integrated type		
	Operating Voltage	10 ~ 16 V		
	Operating Temperature	-40 ~ 120 °C (-40 ~ 248°F)		
	Motor power	270W		
Active Wheel speed sensor	Supply voltage	DC 4.5 ~ 20 V		
	Output current low	5.9 ~ 8.4 mA		
	Output current high	11.8~ 16.8 mA		
	Output range	1 ~ 2500 Hz		
	Tone wheel	Front: 48 teeth, Rear: 47 teeth		
	Air gap	Front	0.4 ~ 1.5 mm	
		Rear	0.4 ~ 1.0 mm	

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 ~ 16 V		
	Operating Temperature	-40 ~ 120 °C (-40 ~ 248°F)		
	Motor power	270 W		
Active Wheel speed sensor	Supply voltage	DC 4.5 ~ 20 V		
	Output current low	5.9 ~ 8.4 mA		
	Output current high	11.8~ 16.8 mA		
	Output range	1 ~ 2500 Hz		
	Tone wheel	Front: 48 teeth, Rear: 47 teeth		
	Air gap	Front	0.4 ~ 1.5 mm	
		Rear	0.4 ~ 1.0 mm	
Yaw rate & Lateral G sensor (CAN TYPE)	Operating Voltage	7 ~ 18 V		
	Current Consumption	Max. 150 mA		
	Yaw rate sensor measurement range	-75 ~ +75 °/sec		
	Lateral G sensor measurement range	-14.715 ~ 14.715 m/s²		

Service Standard

Items	Standard value
Brake pedal Full stroke	135 mm (5.31 in)
Stop lamp switch clearance	1.0 ~ 2.0 mm (0.04 ~ 0.08 in)
Brake pedal free play	3 ~ 8 mm (0.12 ~ 0.31 in)
Front brake disc thickness	26 mm (1.02 in), 28 mm (1.10 in)
Front brake disc pad thickness	11 mm (0.43 in)
Rear brake disc thickness	10 mm (0.39 in)
Rear brake disc pad thickness	10 mm (0.39 in)

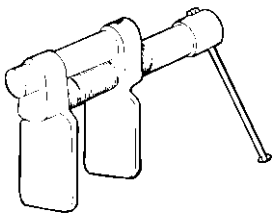
Tightening Torques

Items	N.m	kgf.m	lb-ft
Hub nut	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Master cylinder to brake booster	12.7 ~ 16.7	1.3 ~ 1.7	9.4 ~ 12.3
Brake booster mounting nuts	12.7 ~ 15.7	1.3 ~ 1.6	9.4 ~ 11.6
Air bleeding screw	6.9 ~ 12.7	0.7 ~ 1.3	5.1 ~ 9.4
Brake tube flare nuts	12.7 ~ 16.7	1.3 ~ 1.7	9.4 ~ 12.3
Front caliper guide rod bolts	21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Rear caliper guide rod bolts	21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Front caliper assembly to knuckle	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Rear caliper assembly to knuckle	63.7 ~ 73.5	6.5 ~ 7.5	47.0 ~ 54.2
Brake hose to caliper	24.5 ~ 29.4	2.5 ~ 3.0	18.1 ~ 21.7
Brake pedal member bracket bolts	9.8 ~ 14.7	1.0 ~ 1.5	7.2 ~ 10.8
Brake pedal shaft nut	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Wheel speed sensor mounting bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
HECU bracket mounting bolt and nut	19.6 ~ 29.4	2.0 ~ 3.0	14.5 ~ 21.7
Yaw rate & G sensor mounting bolts	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3

Lubricants

Items	Recommended	Quantity
Brake fluid	DOT 3 or DOT 4	As required
Brake pedal bushing and bolt	Chassis grease	As required
Parking brake shoe and backing plate contacting surface	Heat resistance grease	As required
Front Caliper guide rod and boot	AI-11P	1.2g ~ 1.7g (Trailing) 1.0g ~ 1.5g (Leading)
Rear Caliper guide rod and boot	AI-11P	0.8 g ~ 1.3g

Special Service Tools

Tool(Number and Name)	Illustration	Use
09581-11000 Piston expander	 EJDA043A	Spreading the front and rear disc brake piston.

Troubleshooting

Problem Symptoms Table

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

If necessary, replace these parts.

Symptom	Suspect Area	Reference
Lower pedal or spongy pedal	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Piston seals (Worn or damaged) 4. Rear brake shoe clearance(Out of adjustment) 5. Master cylinder (Inoperative)	repair air·bleed replace adjust replace
Brake drag	1. Brake pedal free play (Minimum) 2. Parking brake lever travel (Out of adjustment) 3. Parking brake wire (Sticking) 4. Rear brake shoe clearance(Out of adjustment) 5. Pad or lining (Cracked or distorted) 6. Piston (Stuck) 7. Piston (Frozen) 8. Anchor or Return spring (Inoperative) 9. Booster system (Vacuum leaks) 10. Master cylinder (Inoperative)	adjust adjust repair adjust replace replace replace replace replace replace
Brake pull	1. Piston (Sticking) 2. Pad or lining (Oily) 3. Piston (Frozen) 4. Disc (Scored) 5. Pad or lining (Cracked or distorted)	replace replace replace replace replace
Hard pedal but brake inefficient	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Pad or lining (Worn) 4. Pad or lining (Cracked or distorted) 5. Rear brake shoe clearance(Out of adjustment) 6. Pad or lining (Oily) 7. Pad or lining (Glazed) 8. Disc (Scored) 9. Booster system (Vacuum leaks)	repair air·bleed replace replace adjust replace replace replace replace

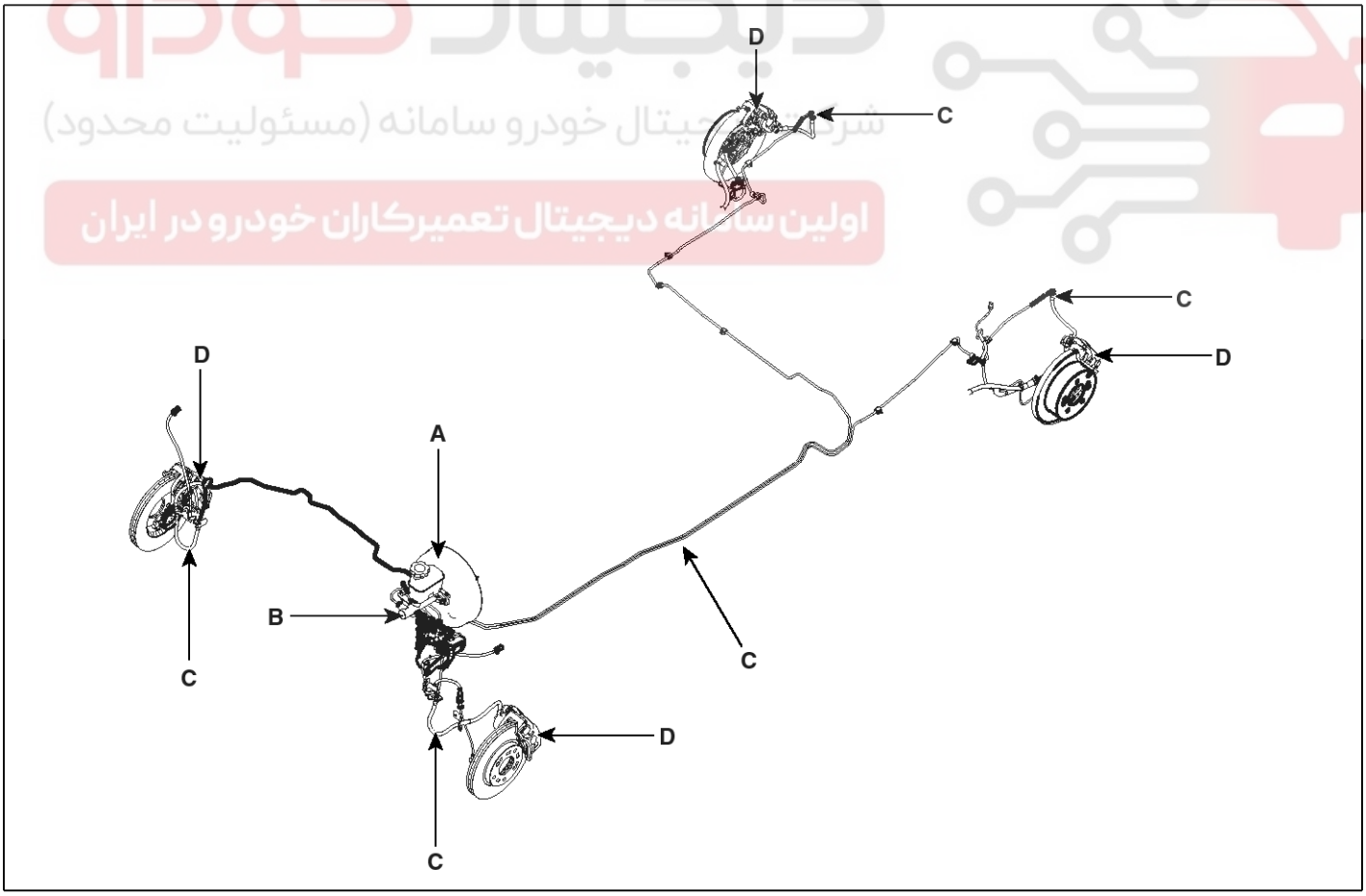
Symptom	Suspect Area	Reference
Noise from brake	1. Pad or lining (Cracked or distorted) 2. Installation bolt (Loosen) 3. Disc (Scored) 4. Sliding pin (Worn) 5. Pad or lining (Dirty) 6. Pad or lining (Glazed) 7. Anchor or Return spring (Faulty) 8. Brake pad shim (Damage) 9. Shoe hold-down spring (Damage)	replace adjust replace replace clean replace replace replace replace
Brake fades	1. Master cylinder (Inoperative)	replace
Brake vibration, pulsation	1. Brake booster (Vacuum leaks) 2. Pedal free play 3. Master cylinder (Inoperative) 4. Caliper (Damage) 5. Master cylinder cap seal 6. Damaged brake lines	replace adjust replace replace replace replace
Brake Chatter	Brake chatter is usually caused by loose or worn components, or glazed or burnt linings. Rotors with hard spots can also contribute to brake chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.	

Brake System

Operation and Leakage Check

Check all of the following items:

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



SYFBR0003D

Brake System Bleeding

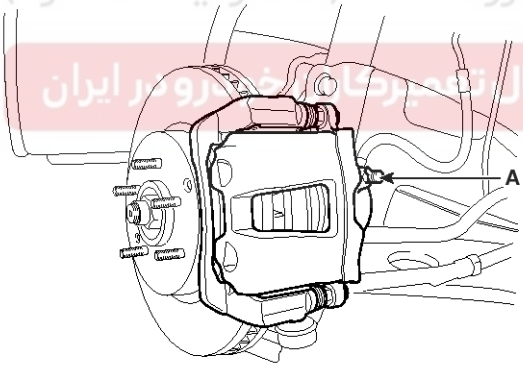
⚠CAUTION

- **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.**

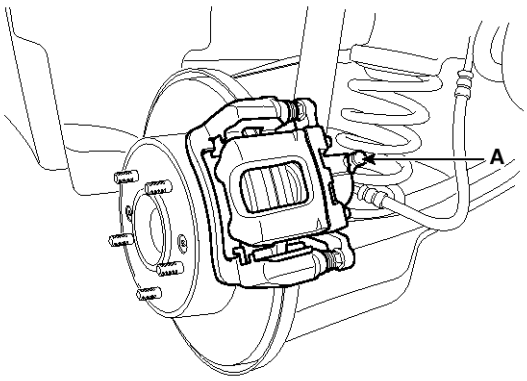
1. Make sure the brake fluid in the reservoir is at the MAX(upper) level line.
2. Have someone slowly pump the brake pedal several times, and then apply pressure.
3. Loosen the right-rear brake bleed screw (A) to allow air to escape from the system. Then tighten the bleed screw securely.

Front



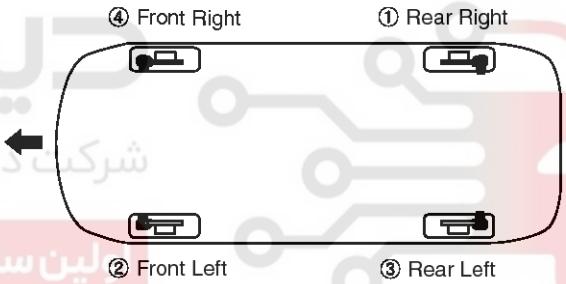
STFBR1001D

Rear



STFBR1002D

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

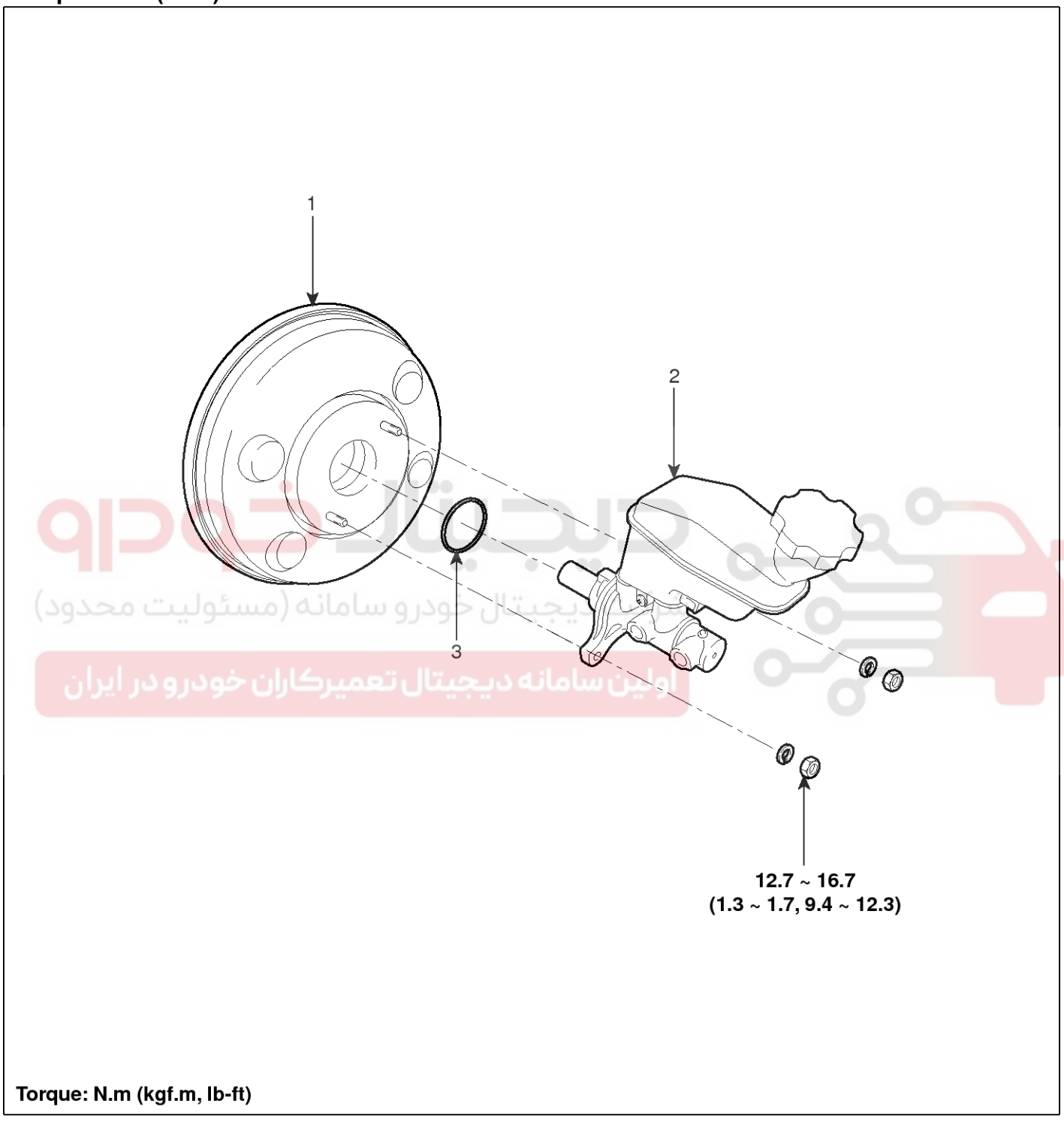


EJKE003B

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

Brake Booster

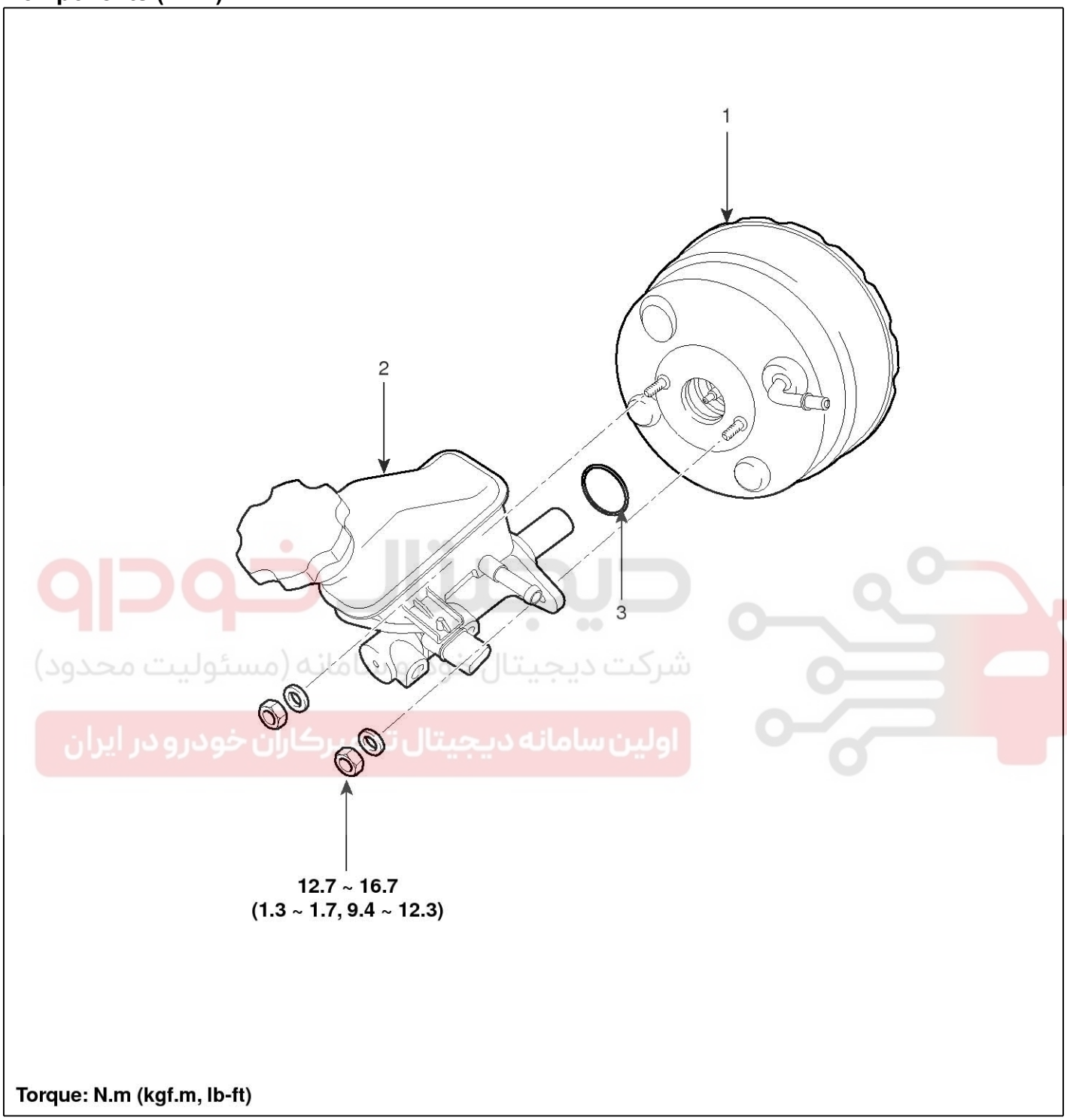
Components (LHD)



STFBR1010N

1. Brake booster
2. Master cylinder assembly
3. O-ring

Components (RHD)



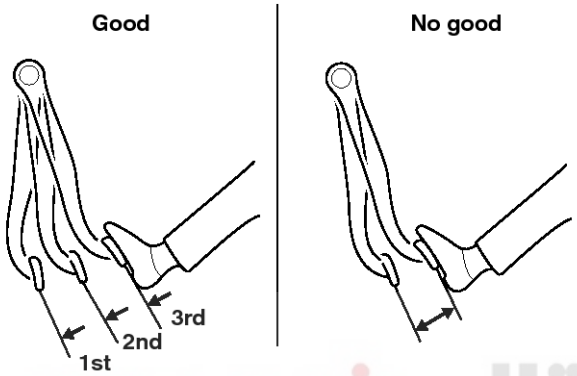
STFBR1010R

1. Brake booster
2. Master cylinder assembly
3. O-ring

Brake Booster Operating Test

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

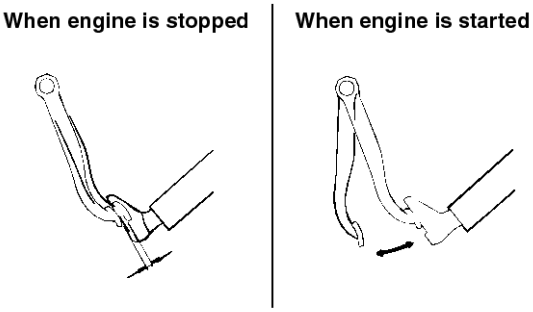
1. Run the engine for one or two minutes, and then stop it. If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly, if the pedal height remains unchanged, the booster is inoperative.



EJRF500B

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.

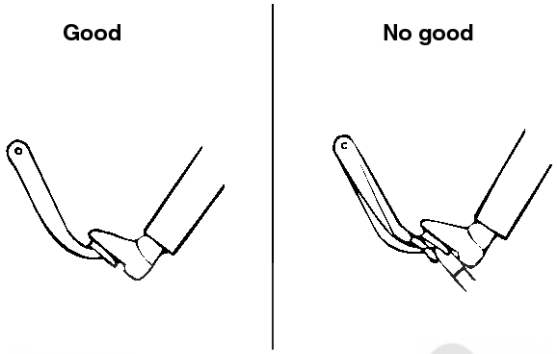


SCMBR6500L

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 falls, 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.

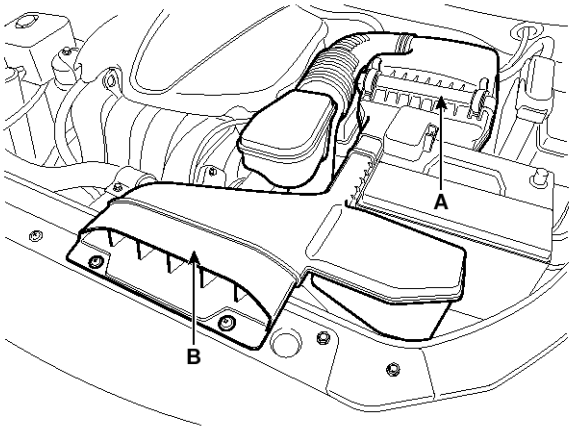


EJRF500C

Removal

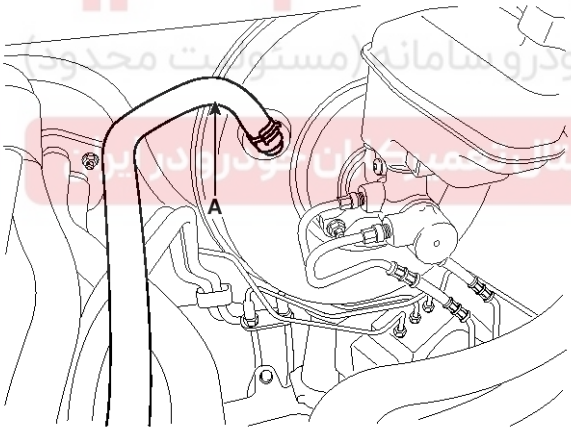
[LHD]

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the air duct (B) and air cleaner assembly (A).



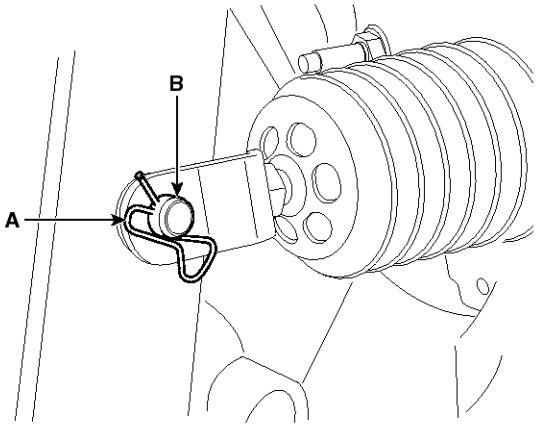
STFBR1011D

3. Disconnect the vacuum hose (A) from the brake booster.



STFBR1012D

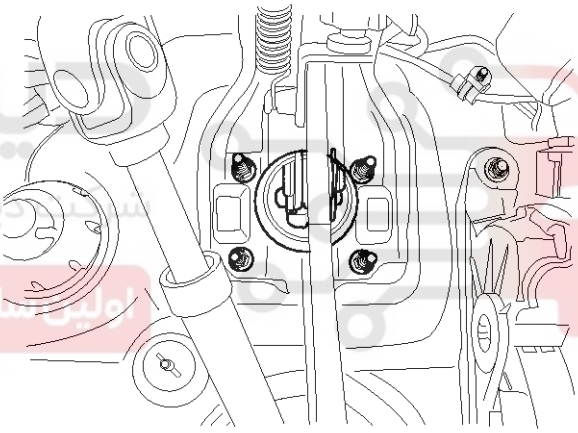
4. Remove the master cylinder. (Refer to Master Cylinder)
5. Remove the snap pin (A) and clevis pin (B).



SYFBR0013D

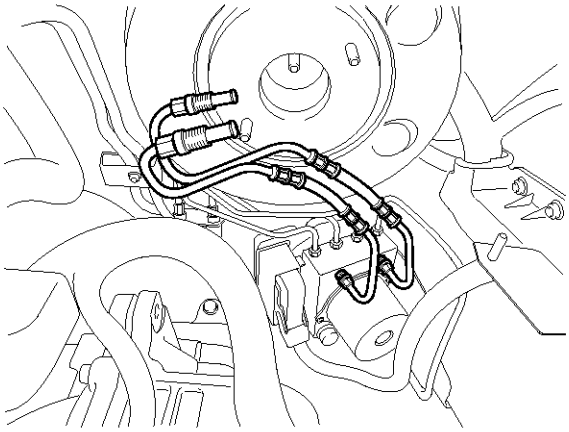
6. Remove the mounting nuts.

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



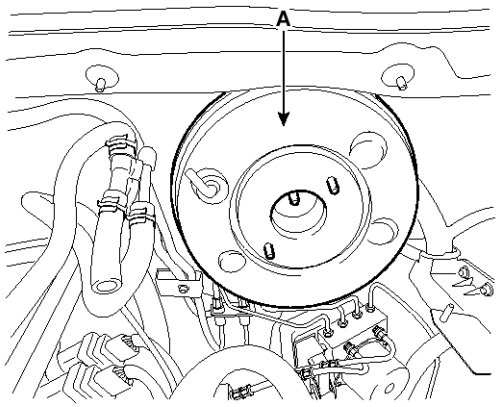
SYFBR0014D

7. Remove the brake tube.



STFBR1015D

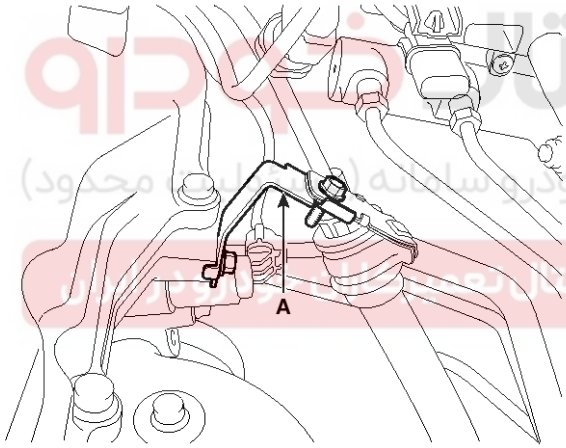
8. Remove the brake booster.



STFBR1016D

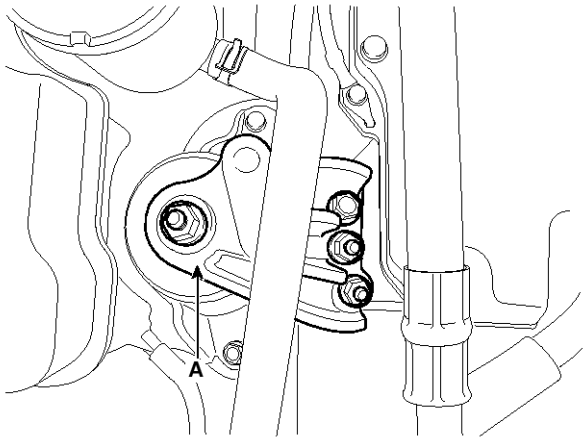
[RHD]

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the power steering hose bracket (A).



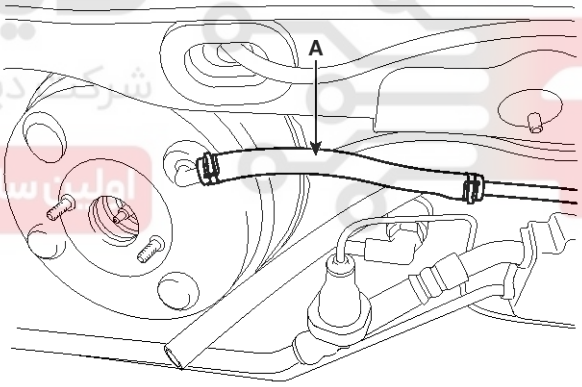
STFBR1013R

3. Support the engine and transaxle assembly with jack, and then remove the engine mounting bracket (A). Put the engine down slightly.



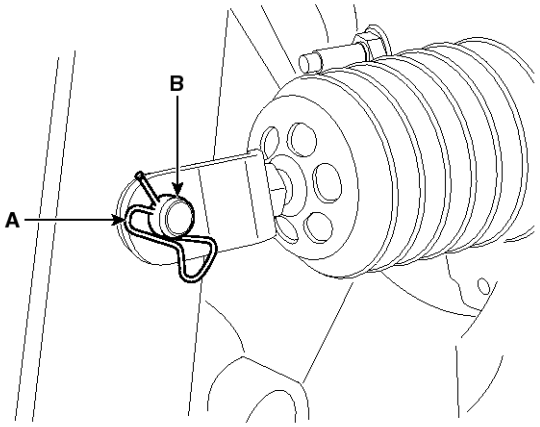
STFBR1014R

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



STFBR1012R

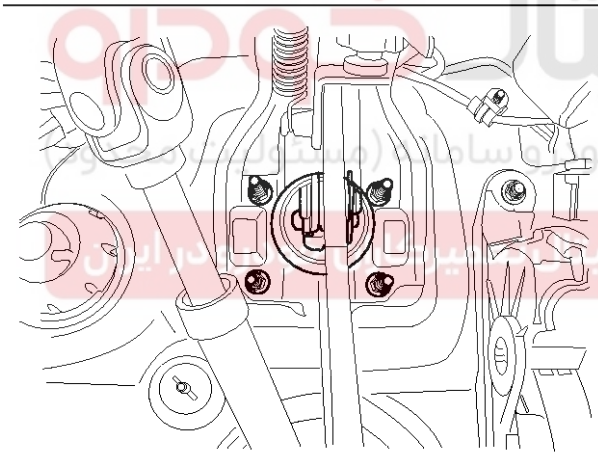
6. Remove the clutch master cylinder. (Refer to the clutch system – clutch pedal) [MT only]
7. Remove the snap pin (A) and clevis pin (B).



SYFBR0013D

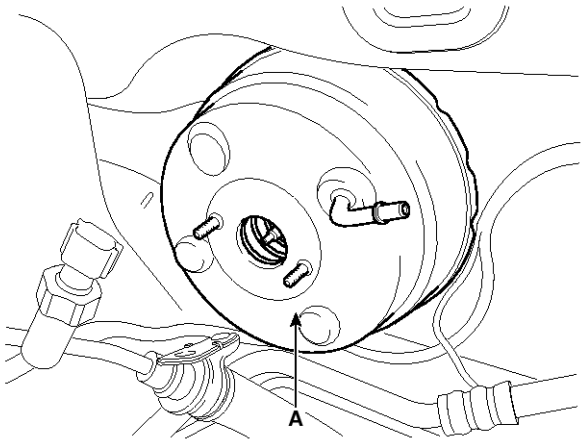
8. Remove the mounting nuts.

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



SYFBR0014D

9. Remove the brake booster.



STFBR1017R

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

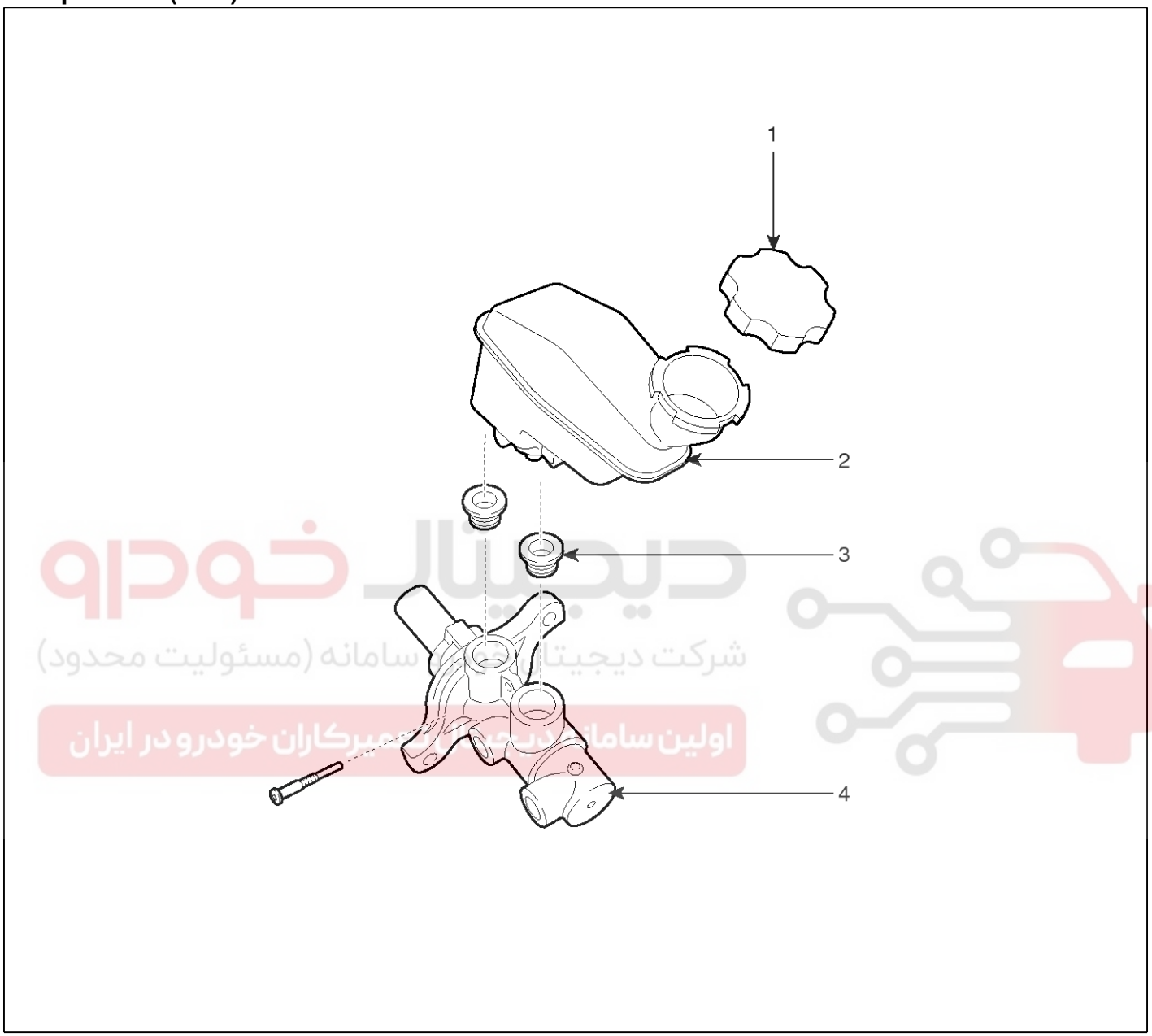
1. Installation is the reverse of removal.

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

2. Adjust the brake pedal height and free play.
   (Refer to Brake pedal height and free play adjustment)
3. After installing, bleed the brake system. (Refer to Brake system bleeding.)

Master Cylinder

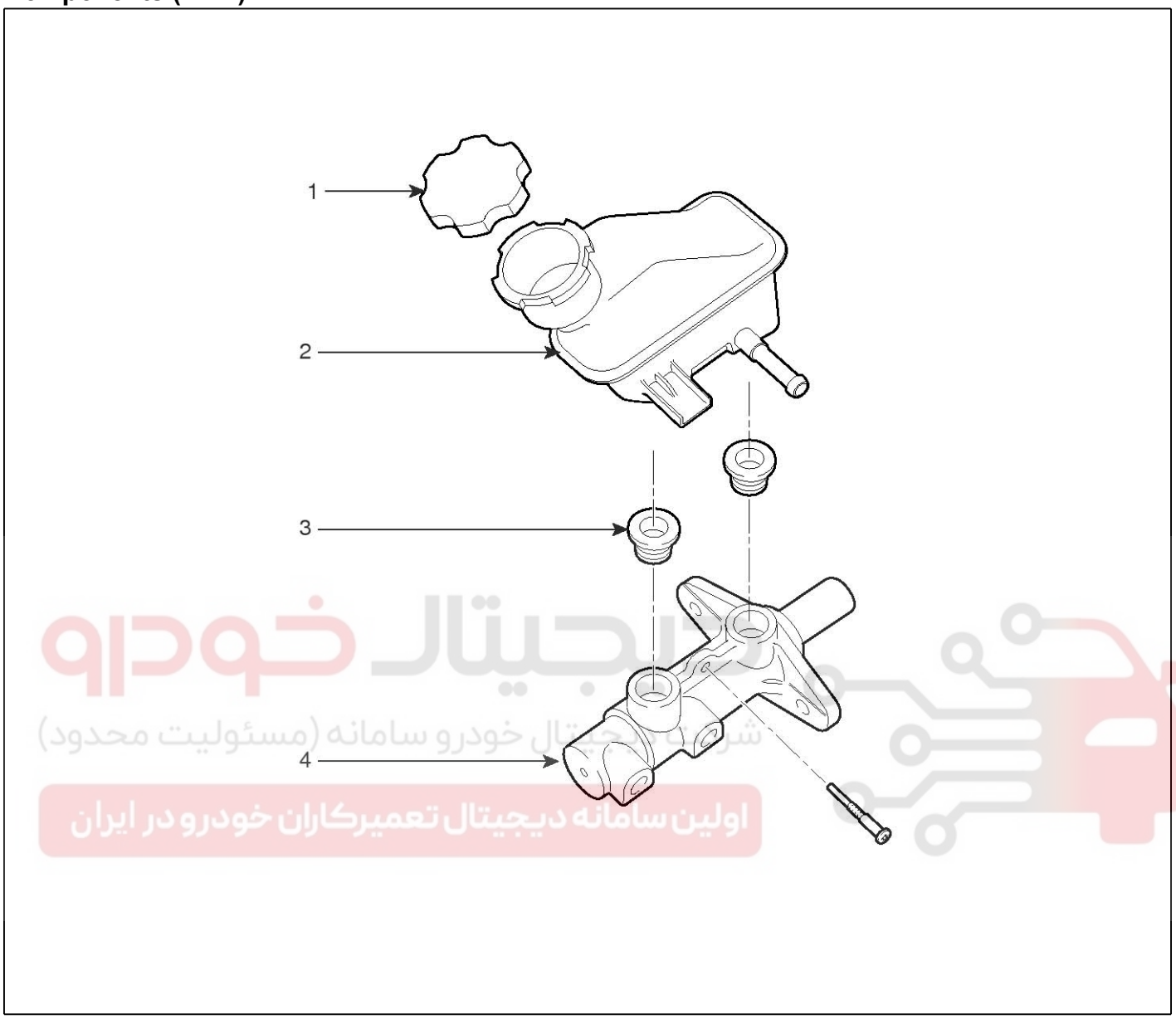
Components (LHD)



STFBR1020N

1. Reservoir cap
2. Reservoir
3. Grommet
4. Master cylinder

Components (RHD)

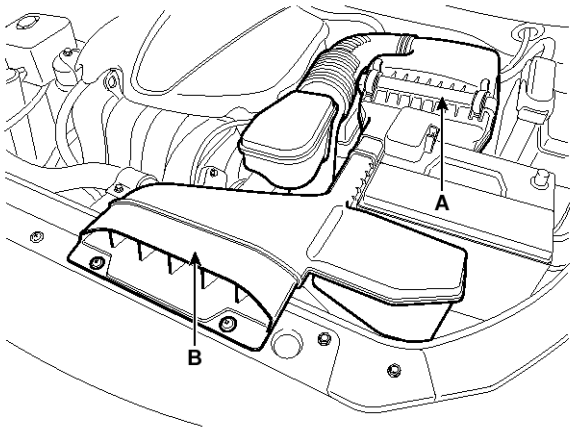


STFBR1020R

1. Reservoir cap
2. Reservoir
3. Grommet
4. Master cylinder

Removal

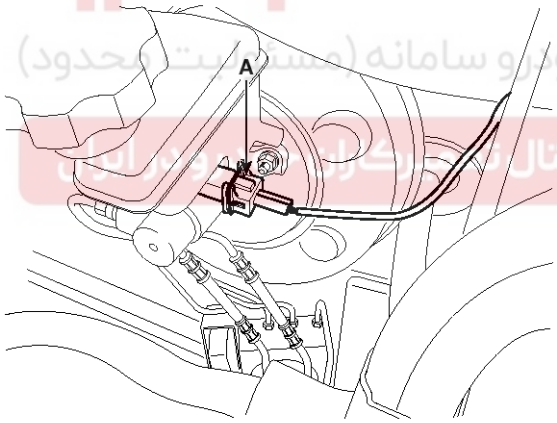
1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the air duct (B) and air cleaner assembly (A). [LHD only]



STFBR1011D

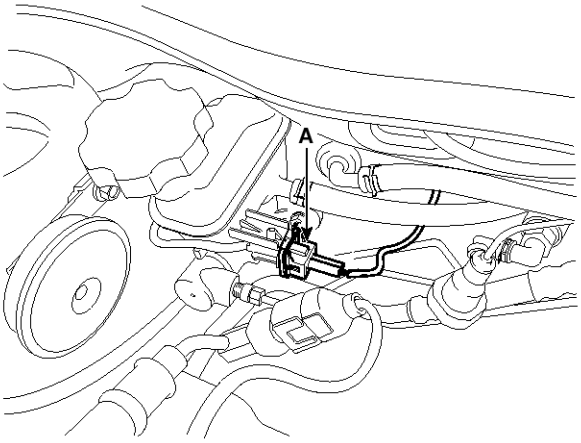
3. Disconnect the brake fluid level switch connector (A), and remove the reservoir cap.

[LHD]



STFBR1021D

[RHD]



STFBR1021R

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

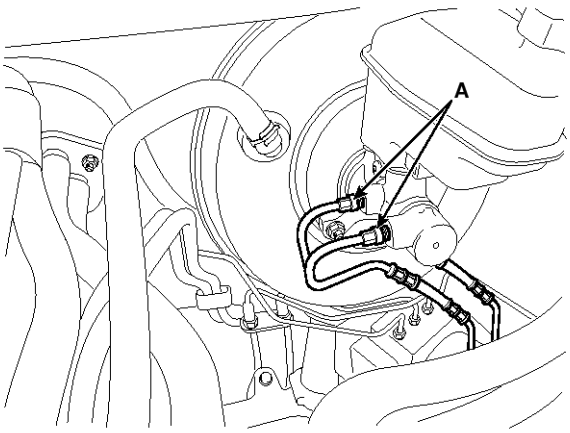
⚠CAUTION

- **Be sure to completely remove foreign substances from around brake fluid reservoir and cap before opening the reservoir cap. If not, it may cause contamination of brake fluid and deterioration in braking performance.**
- **Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.**

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

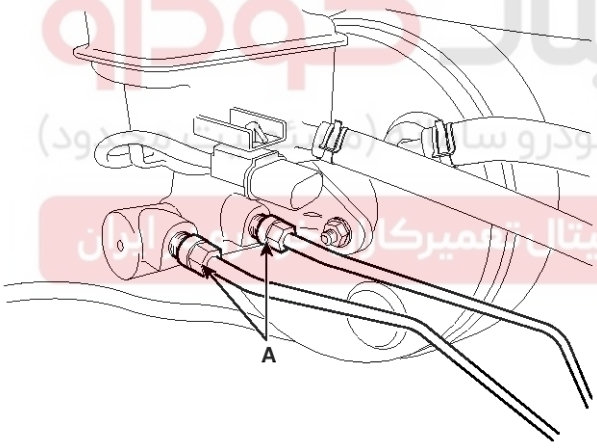
Tightening torque:
18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)

[LHD]



STFBR1022D

[RHD]

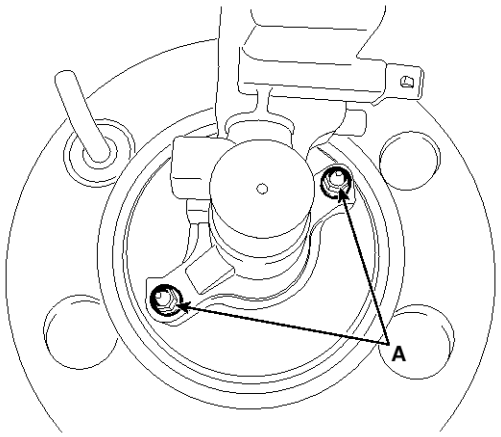


STFBR1022R

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

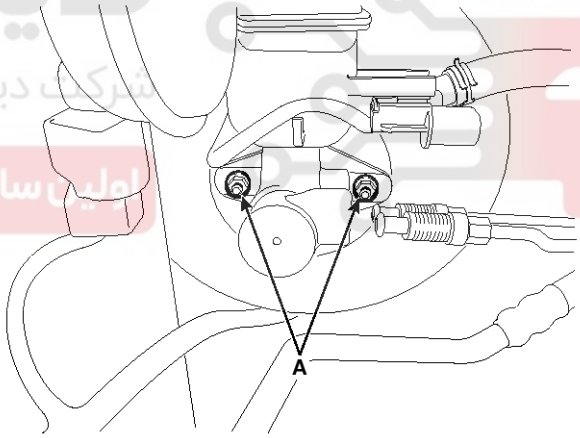
Tightening torque:
12.7 ~ 16.7 N.m (1.3 ~ 1.7 kgf.m, 9.4 ~ 12.3 lb-ft)

[LHD]



STFBR1023D

[RHD]



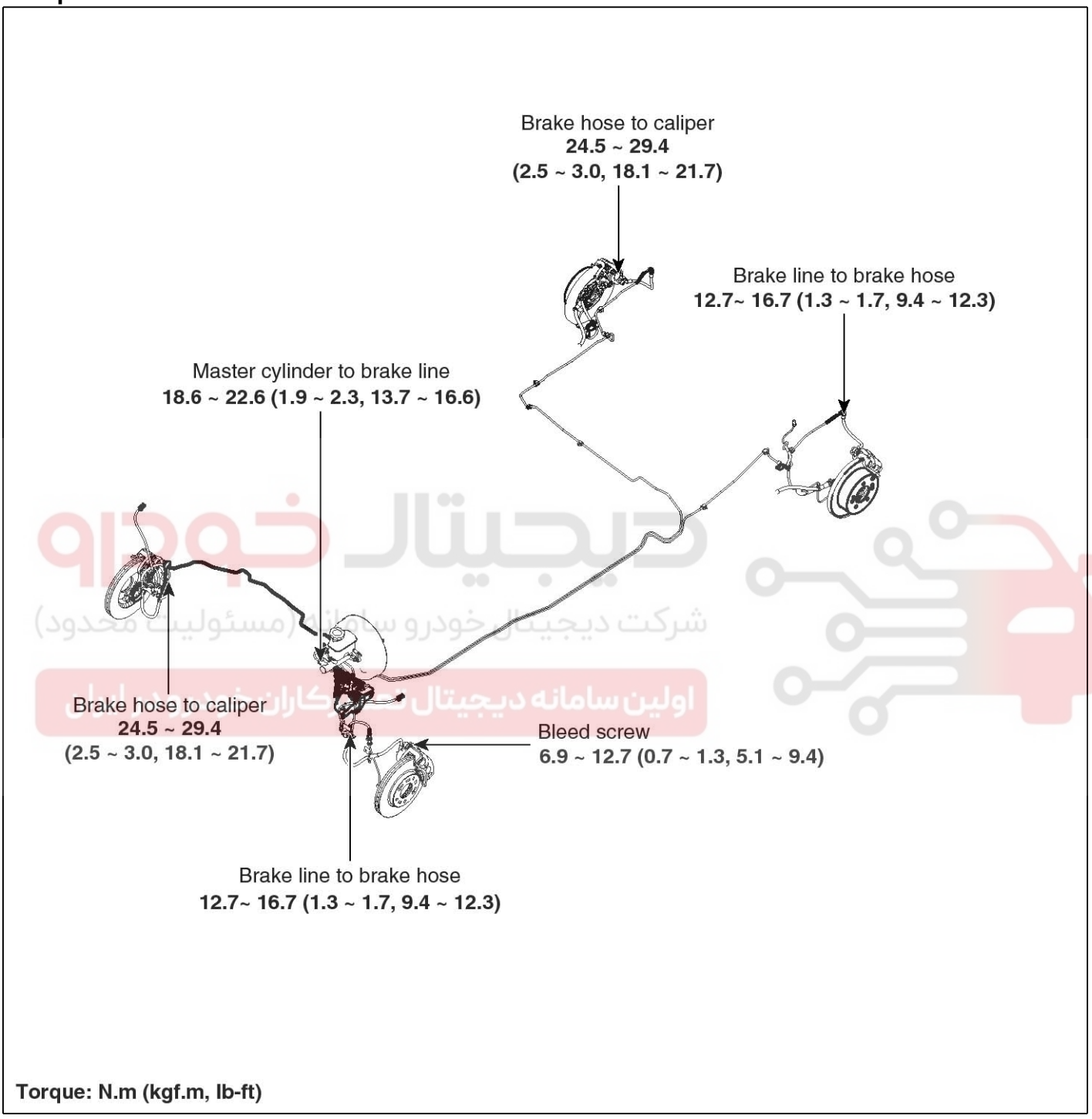
STFBR1023R

Installation

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

Brake Line

Components



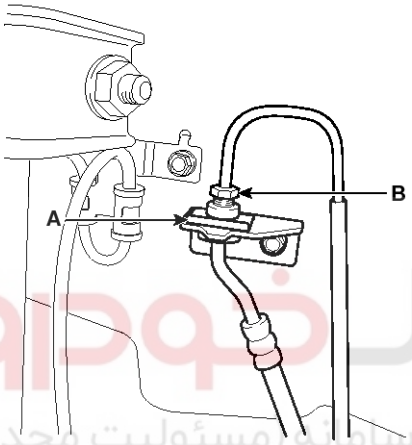
STFBR1040N

Removal

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

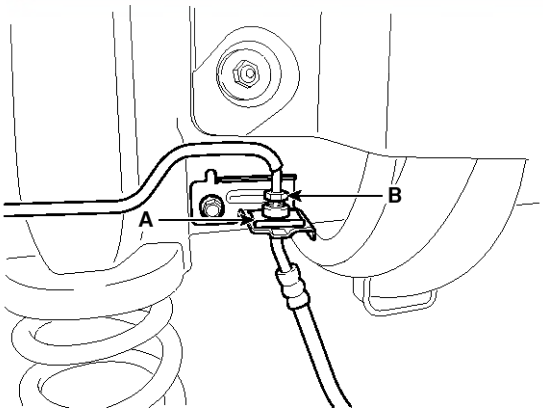
   ⚠CAUTION
   Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.
3. Remove the wheel & tire.
4. Remove the brake hose clip (A).

[Front]



STFBR1041D

[Rear]



STFBR1042D

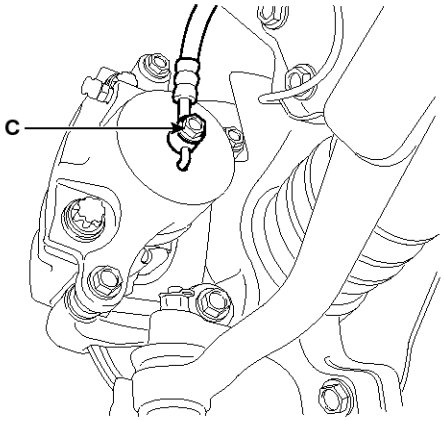
5. Disconnect the brake tube by loosening the tube flare nut (B).

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

6. Disconnect the brake hose from the brake caliper by loosening the bolt (C).

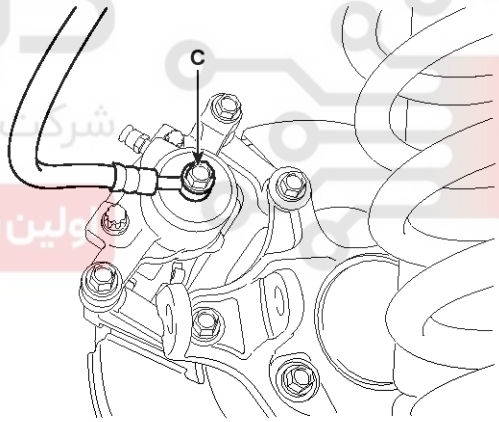
Tightening torque:
24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)

[Front]



STFBR1043D

[Rear]



STFBR1044D

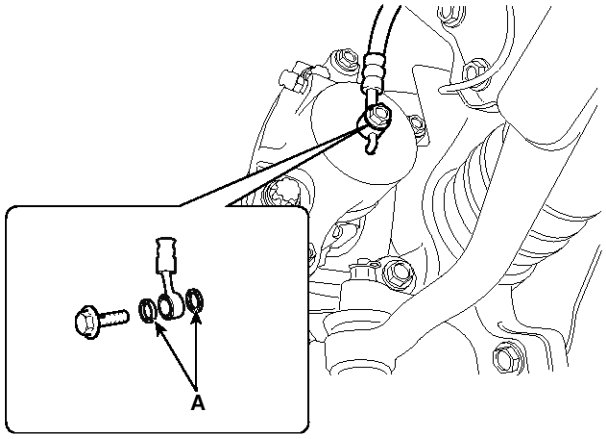
Inspection

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

Installation

1. Installation is the reverse of removal.

⚠CAUTION
Use a new washer (A) whenever installing.

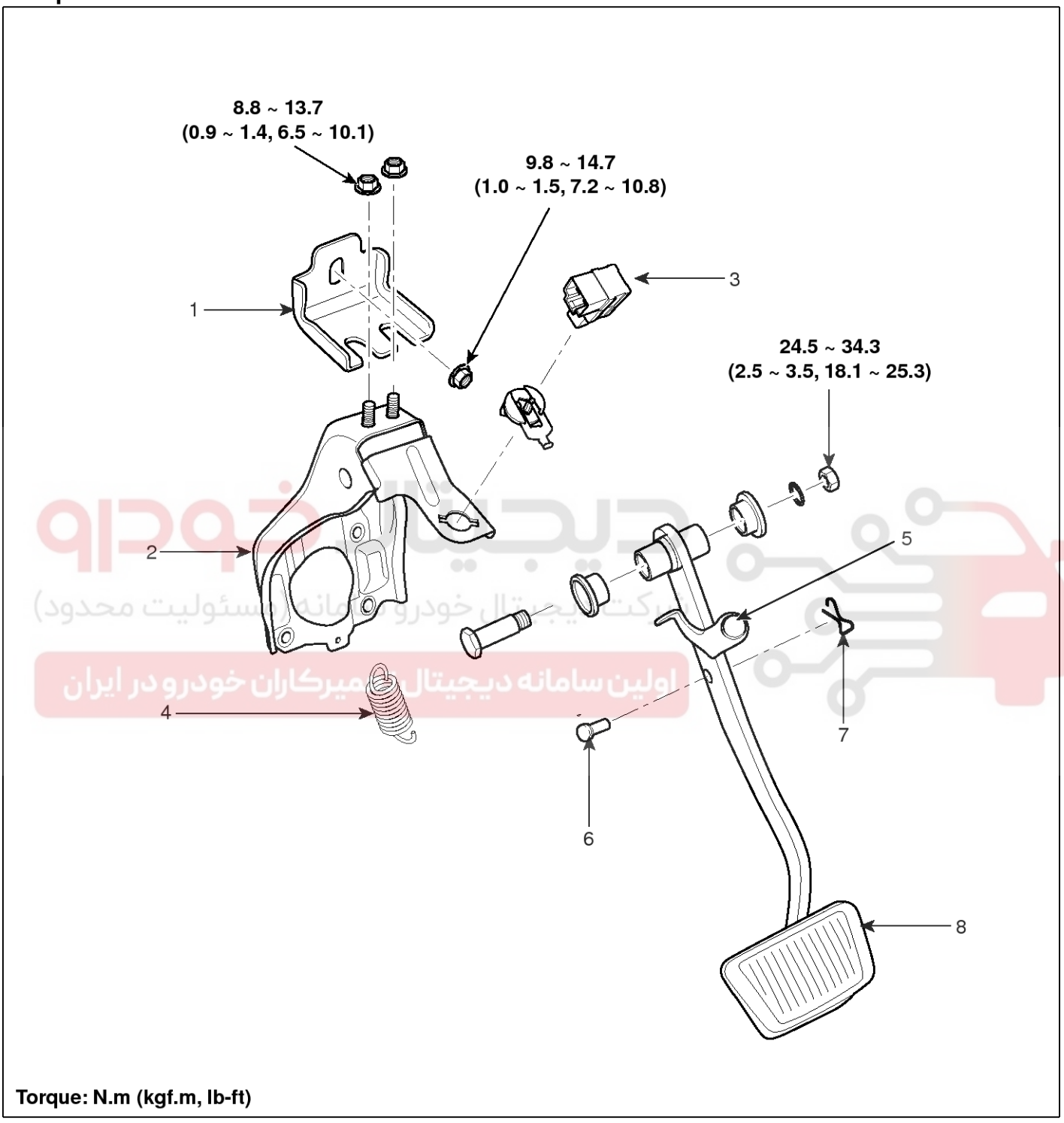


STFBR1045D

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

Brake Pedal

Components

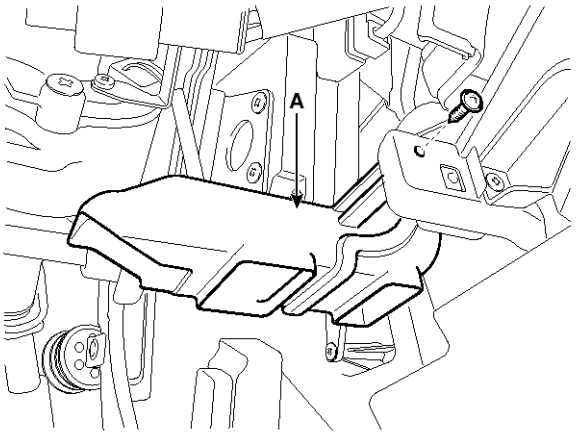


STFBR1050N

1. Cowl bracket
2. Brake pedal member assembly
3. Stop lamp switch
4. Return spring
5. Brake pedal stopper
6. Clevis pin
7. Snap pin
8. Brake pedal

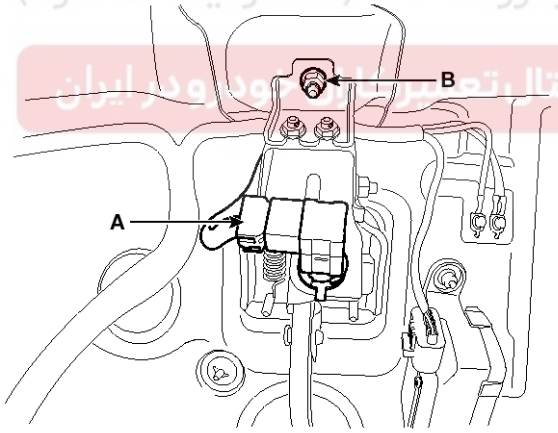
Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the crash pad lower panel and reinforcing panel. (Refer to the Body group- crash pad).
3. Remove the shower duct (A). [LHD only]



STFBR1051D

4. Pull down steering column shaft after removing bolts and nuts. (Refer to the steering group - Steering columm & shaft)
5. Disconnect the stop lamp switch connector (A).

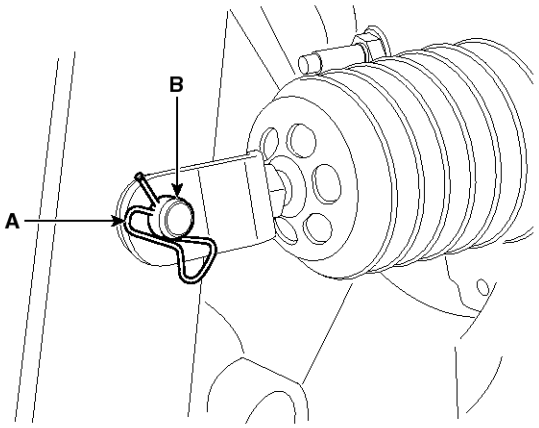


STFBR1052D

6. Remove the brake pedal member mounting nut (B).

Tightening torque:
9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)

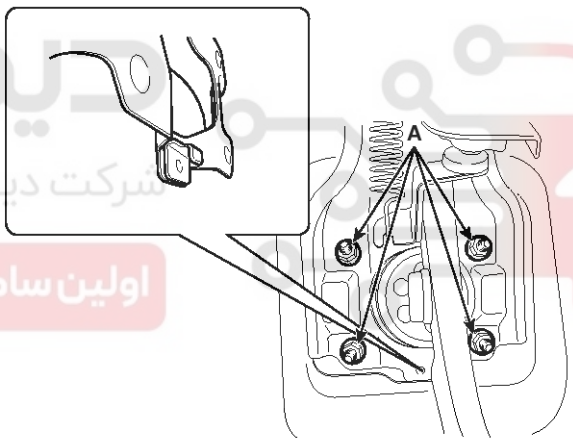
7. Remove the snap pin (A) and clevis pin (B).



SYFBR0013D

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

Tightening torque:
12.7 ~ 15.6 N.m (1.3 ~ 1.6 kgf.m, 9.4 ~ 11.6 lb-ft)

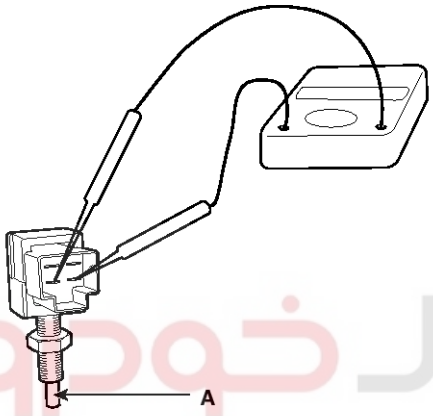


STFBR1053N

NOTICE
Push the brake booster and then remove the hook after raising the brake pedal when removing the brake pedal assembly.

Inspection

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



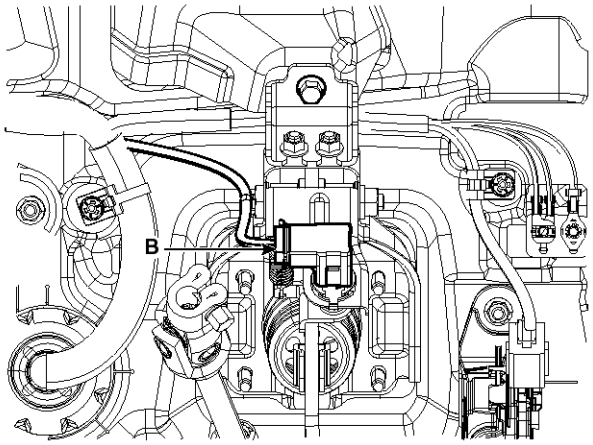
SCMBR6530D

Adjustment

Stop lamp switch clearance adjustment

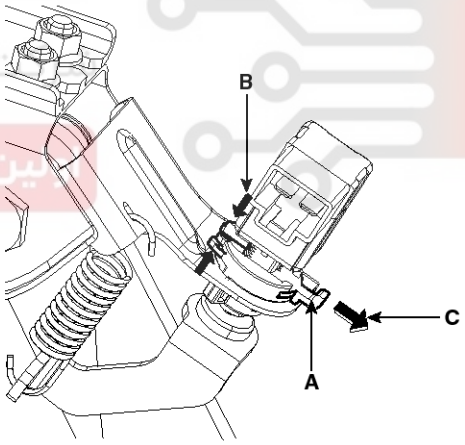
If the gap between stop lamp switch and bracket is not 1.0 ~ 2.0mm(0.04~ 0.08in), conform to below.

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



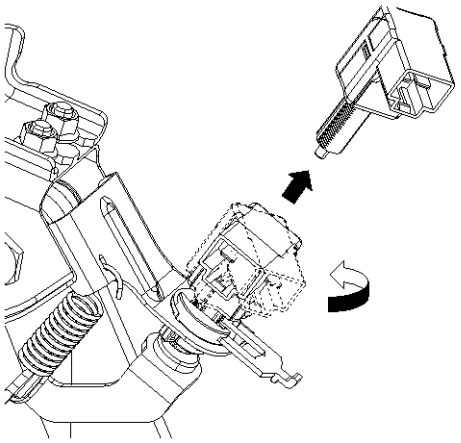
SYFBR0054N

2. Release locking plate by pushing the hooks (B) carefully, and then pull the locking plate (A) as indicated by the arrow (C).



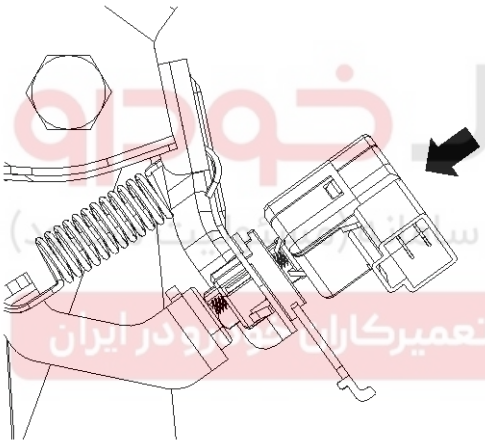
SYFBR0055N

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



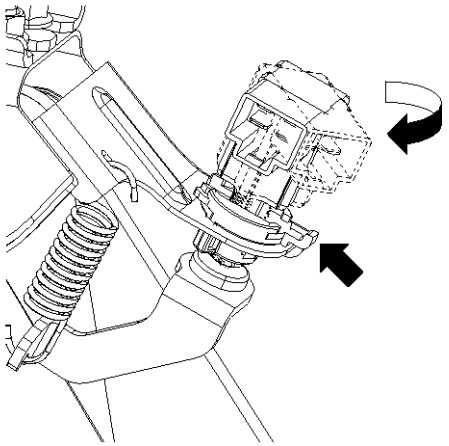
SYFBR0056N

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



SYFBR0057N

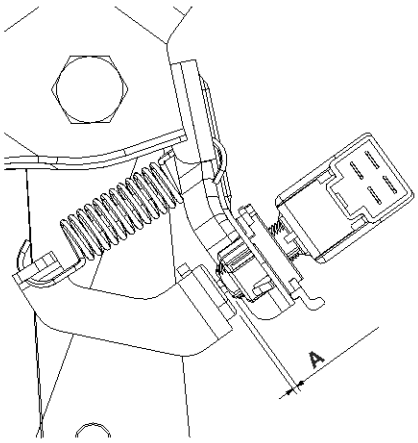
5. After inserting, turn the stop switch (A) 45° clockwise, and then assemble locking plate (B) by pushing.



SYFBR0058N

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

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

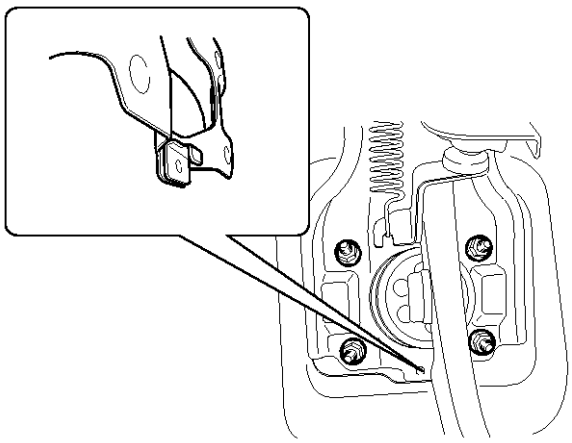


SYFBR0059N

7. Connect the stop lamp switch connector.

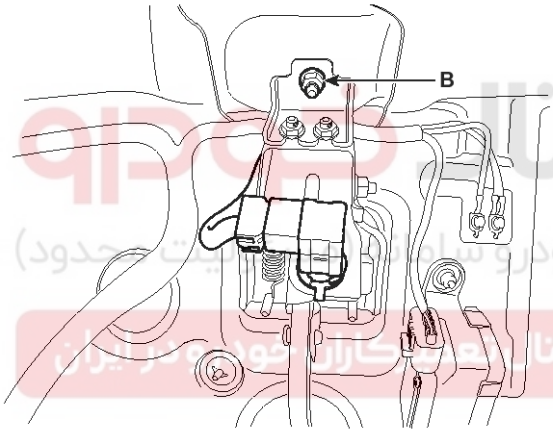
Installation

1. Install the brake pedal assembly in dash panel.



STFBR1053D

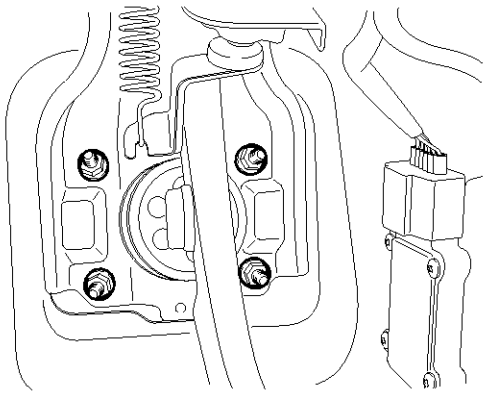
2. Pre-tighten the bracket fixing bolt(B) in dash panel.



STFBR1054D

3. Install the brake booster and brake pedal member fixing nut securely.

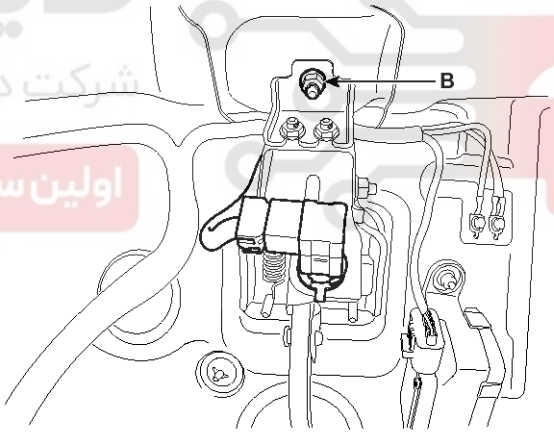
Tightening torque:
12.7 ~ 15.7 N.m (1.3 ~ 1.6 kgf.m, 9.4 ~ 11.6 lb-ft)



STFBR1056D

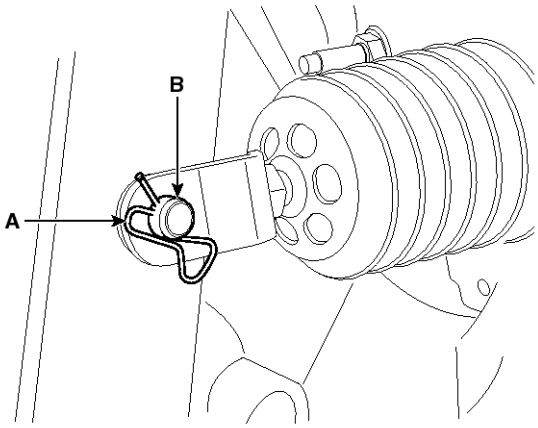
4. Tighten the bolt (B) securely in dash panel.

Tightening torque:
9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



STFBR1054D

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

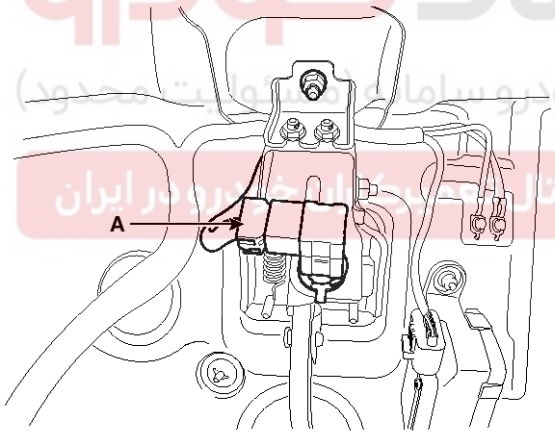


SYFBR0013D

⚠CAUTION

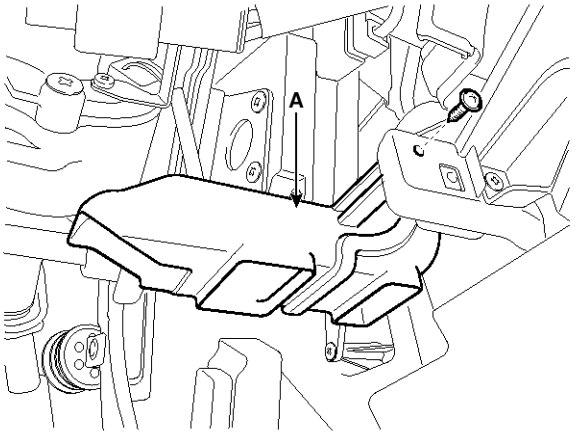
- **Before installing the pin, apply the grease to the clevis pin.**
- **Use a new snap pin whenever installing.**

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



STFBR1055D

8. Adjust the brake pedal height and free play.
9. Check the brake pedal operation after installing the brake pedal.
10. Install the steering column shaft assembly.
11. Install the shower duct (A). [LHD only]

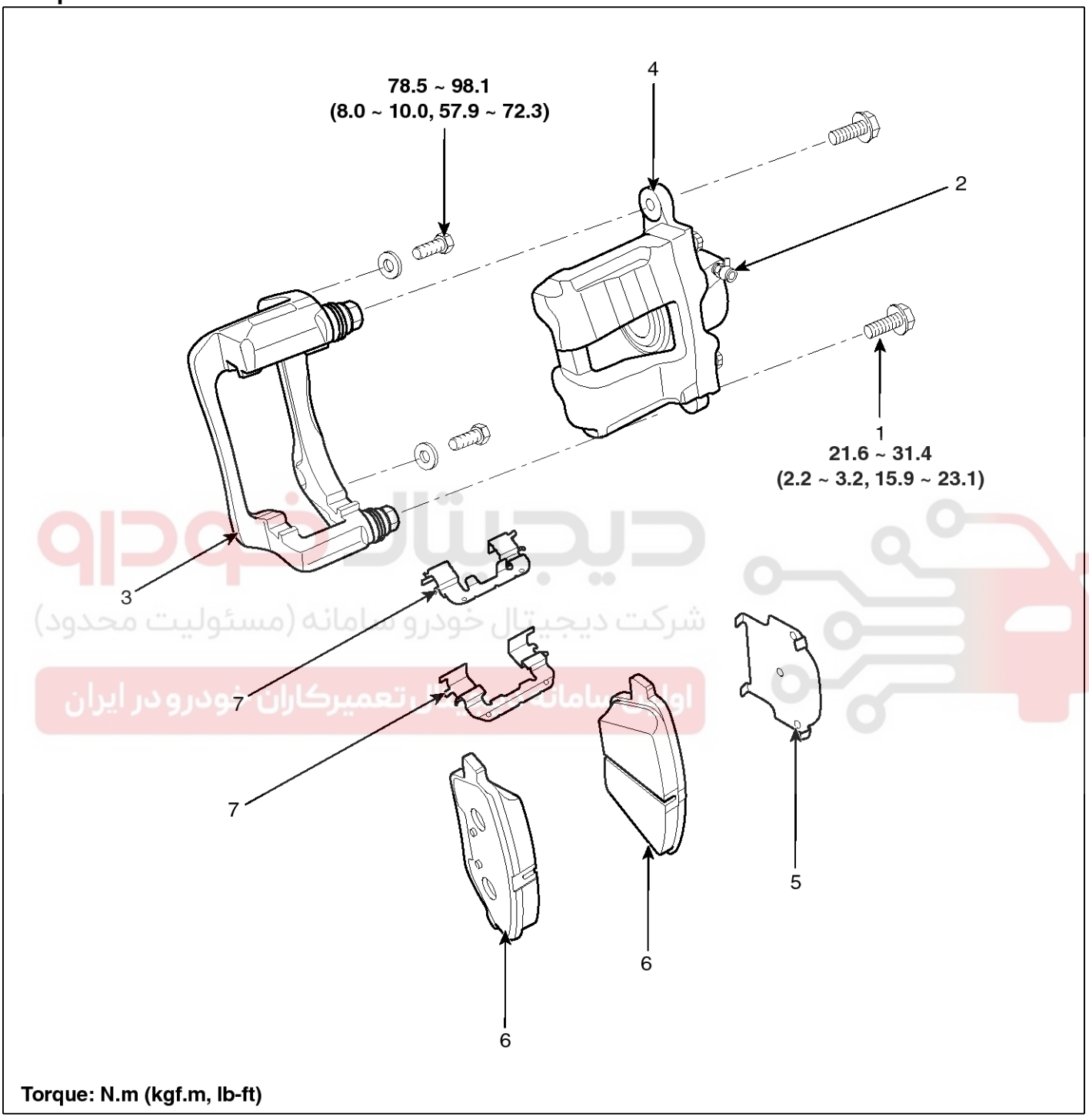


STFBR1051D

12. Install the reinforcing panel and crash pad lower panel.
13. Reconnect the battery negative cable.

Front Disc Brake

Components



SYFBR0060N

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

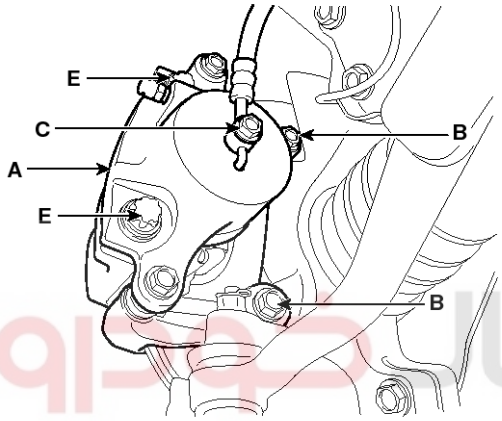
Removal

1. Remove the front wheel & tire.

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

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

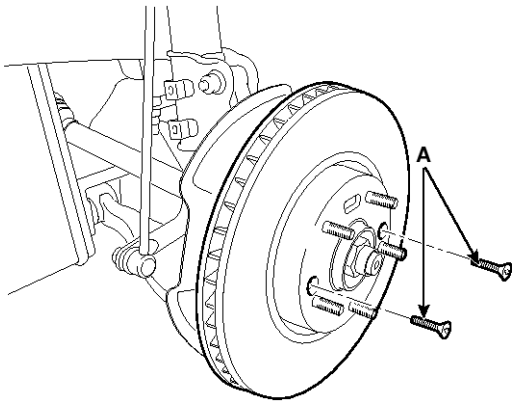
Tightening torque:
Brake hose to caliper (C):
24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)
Caliper assembly to knuckle (B):
78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)



STFBR1061D

⚠CAUTION
Do not loosen the bolts(E) instead of guide rod bolt.

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



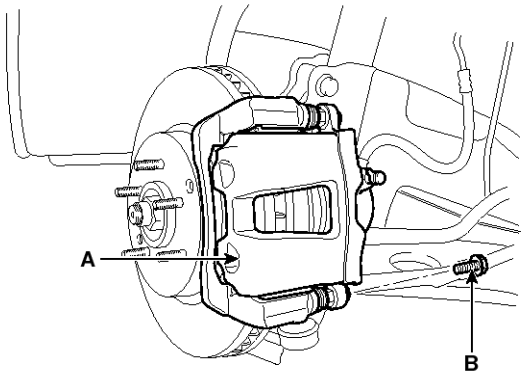
STFBR1062D

Replacement

Front brake pads

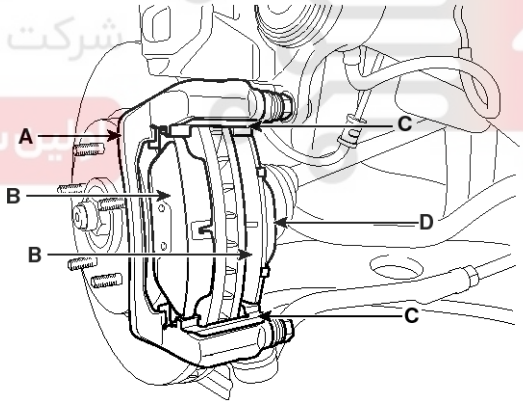
1. Loosen the guide rod bolt (B) and pivot the caliper (A) up out of the way.

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



STFBR1063D

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



STFBR1064D

Inspection

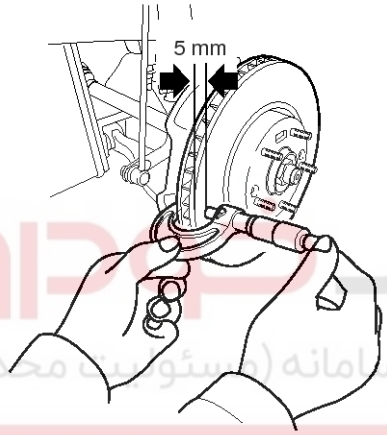
Front brake disc thickness check

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.

Front brake disc thickness

- Standard: 28 mm (1.10 in)
- Service Limit: 26.4 mm (1.04 in)
- Standard: 26 mm (1.02 in)
- Service Limit: 24.4 mm (0.96 in)

Deviation: Less than 0.005mm (0.0002in)



STFBR1065D

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

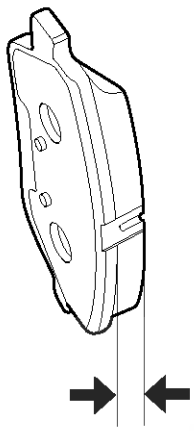
Front Brake Pad Check

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

Pad thickness

Standard value: 11 mm (0.43 in)
Service limit: 2.0 mm (0.0787 in)

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

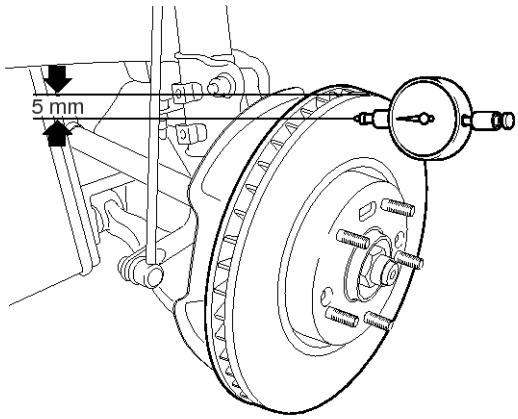


SYFBR0067N

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: 0.04 mm (0.0016 in.) or less (new one)

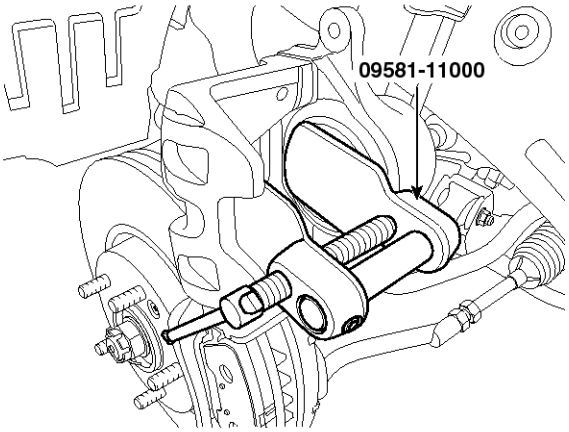


STFBR1067D

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

Installation

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



SYFBR0069N

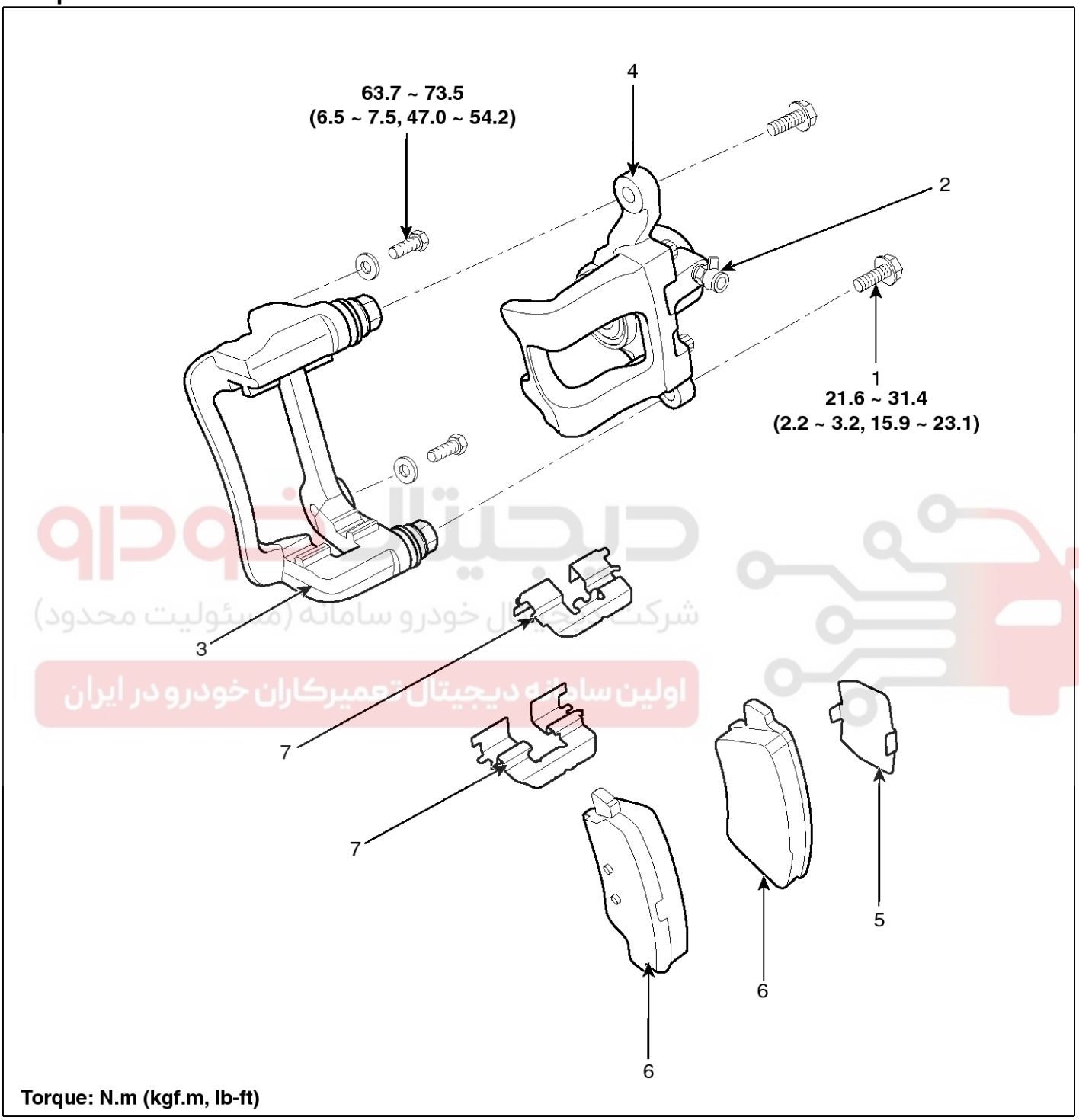
3. After installation, bleed the brake system. (Refer to Brake system bleeding)

⚠CAUTION

- **Do not hit piston end by hammer or prying directly against piston face with screwdriver to push in piston.**
- **Use wood or a used pad to protect piston end. Pushing on the wood or used pad is recommended.**
- **When spreading a piston, all area of piston end face should be protected from using the SST.**

Rear Disc Brake

Components



SYFBR0080N

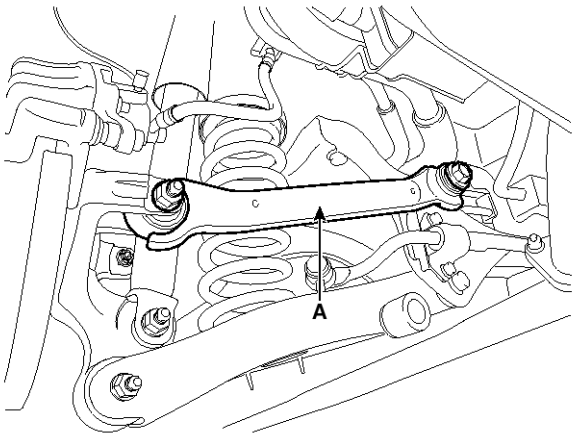
1. Guide rod bolt
2. Bleed screw
3. Caliper carrier
4. Caliper body
5. Inner pad shim
6. Brake pad
7. Pad retainer

Removal

1. Remove the rear wheel & tire.

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

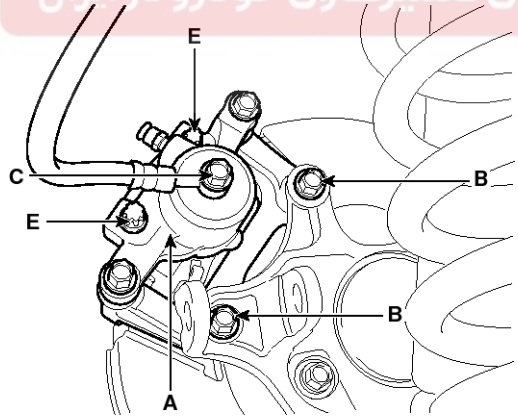
2. Remove the rear upper arm (A).



STFBR1081D

3. Loosen the hose eyebolt (C) and caliper mounting bolts (B), then remove the rear caliper assembly (A).

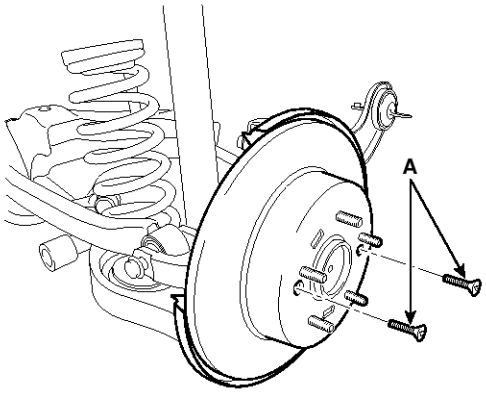
Tightening torque:
Brake hose to caliper (C):
24.5 ~ 29.4 N.m (2.5 ~ 3.0 kgf.m, 18.1 ~ 21.7 lb-ft)
Caliper assembly to carrier (B):
63.7 ~ 73.5 N.m (6.5 ~ 7.5 kgf.m, 47.0 ~ 54.2 lb-ft)



STFBR1082D

⚠CAUTION
Do not loosen the bolts (E) instead of guide rod bolt.

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



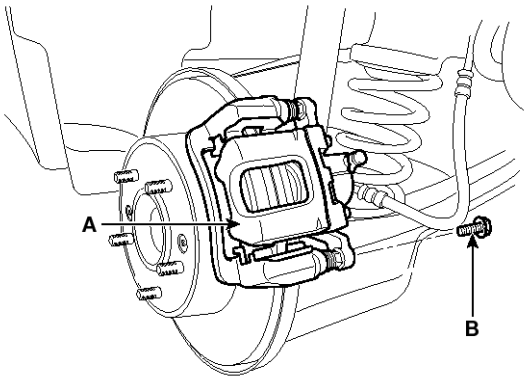
STFBR1083D

Replacement

Rear brake pads

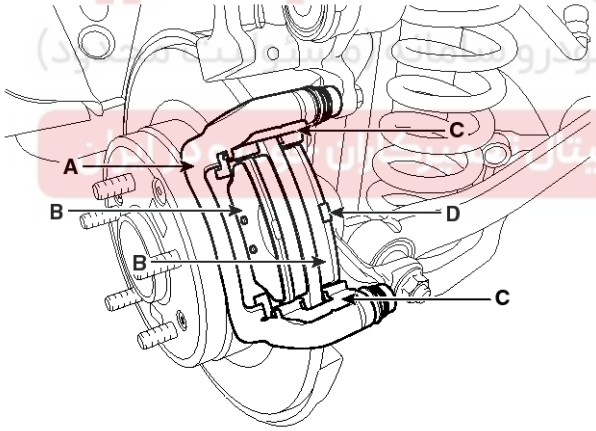
1. Loosen the guide rod bolt (B) and pivot the caliper (A) up out of the way.

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



STFBR1084D

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



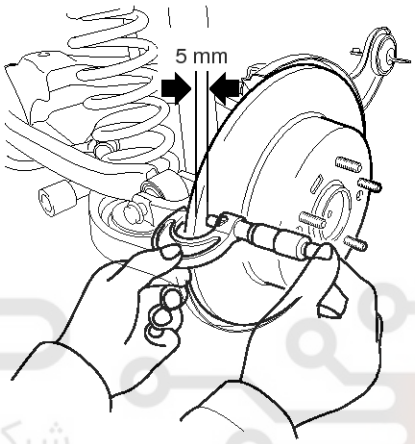
STFBR1085D

Inspection

Rear Brake Disc Thickness Check

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

Brake disc thickness
Standard: 10 mm (0.39 in)
Service limit: 8.4 mm (0.33 in)
Deviation: less than 0.01 mm (0.0004 in)



STFBR1086D

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

Rear Brake Pad Check

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

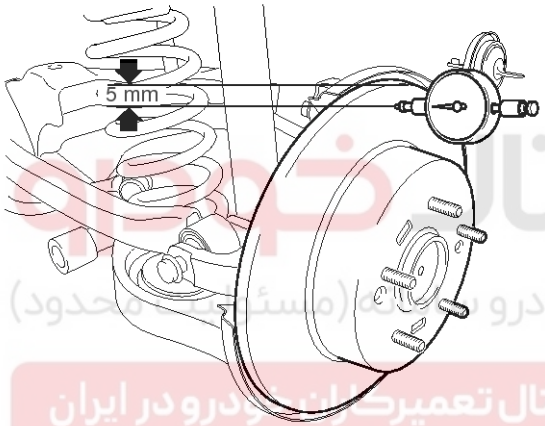
Pad thickness
Standard value: 10 mm (0.393 in)
Service limit: 2.0 mm (0.0787 in)

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

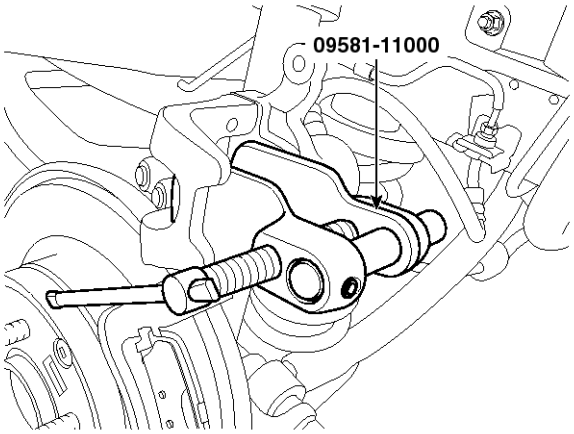


STFBR1087D

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.



SYFBR0088N

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

⚠CAUTION

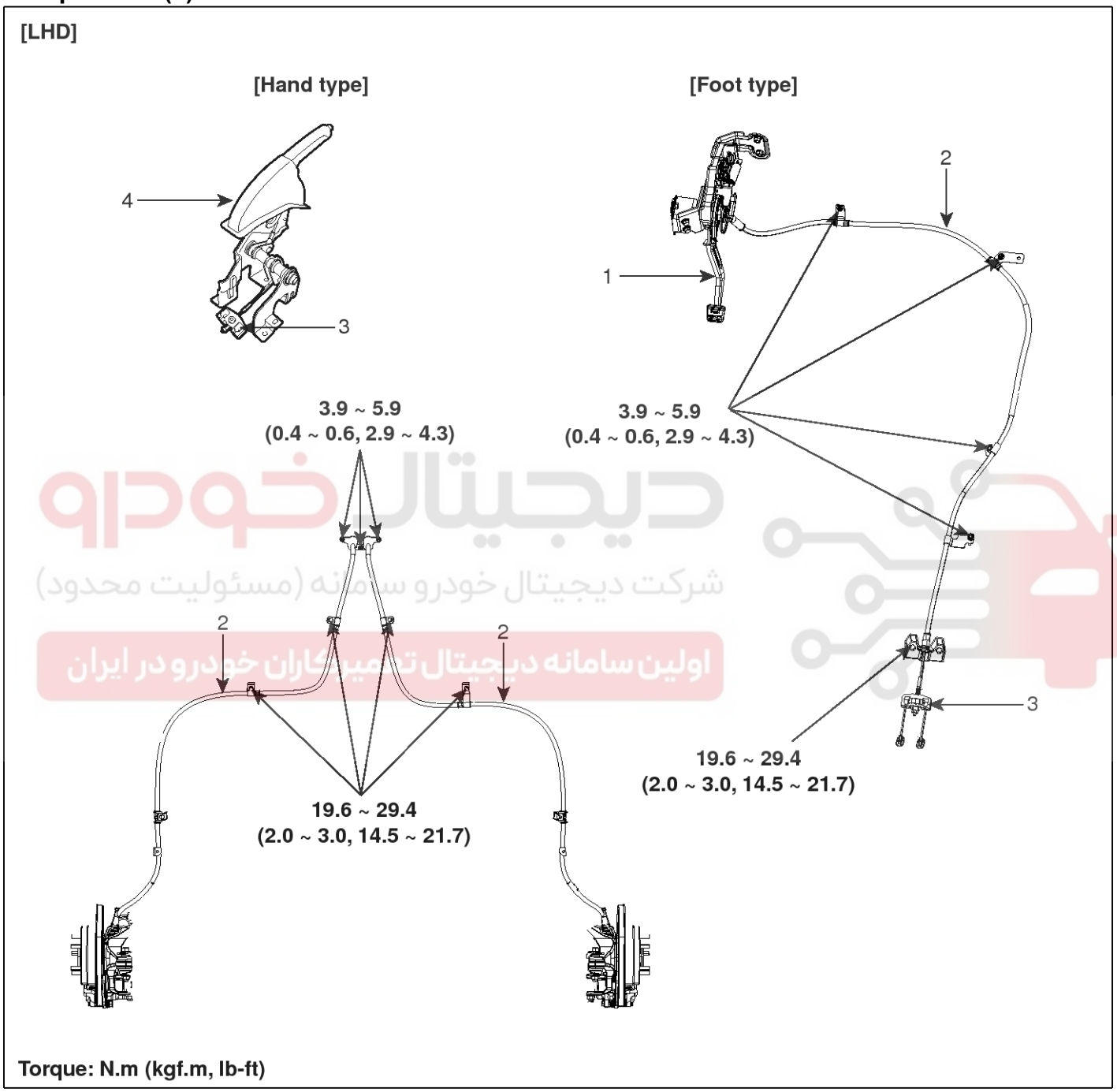
- **Do not hit piston end by hammer or prying directly against piston face with screwdriver to push in piston.**
- **Use wood or a used pad to protect piston end. Pushing on the wood or used pad is recommended.**
- **When spreading a piston, all area of piston end face should be protected from using the SST.**

Parking Brake System

Parking Brake System

Parking Brake Assembly

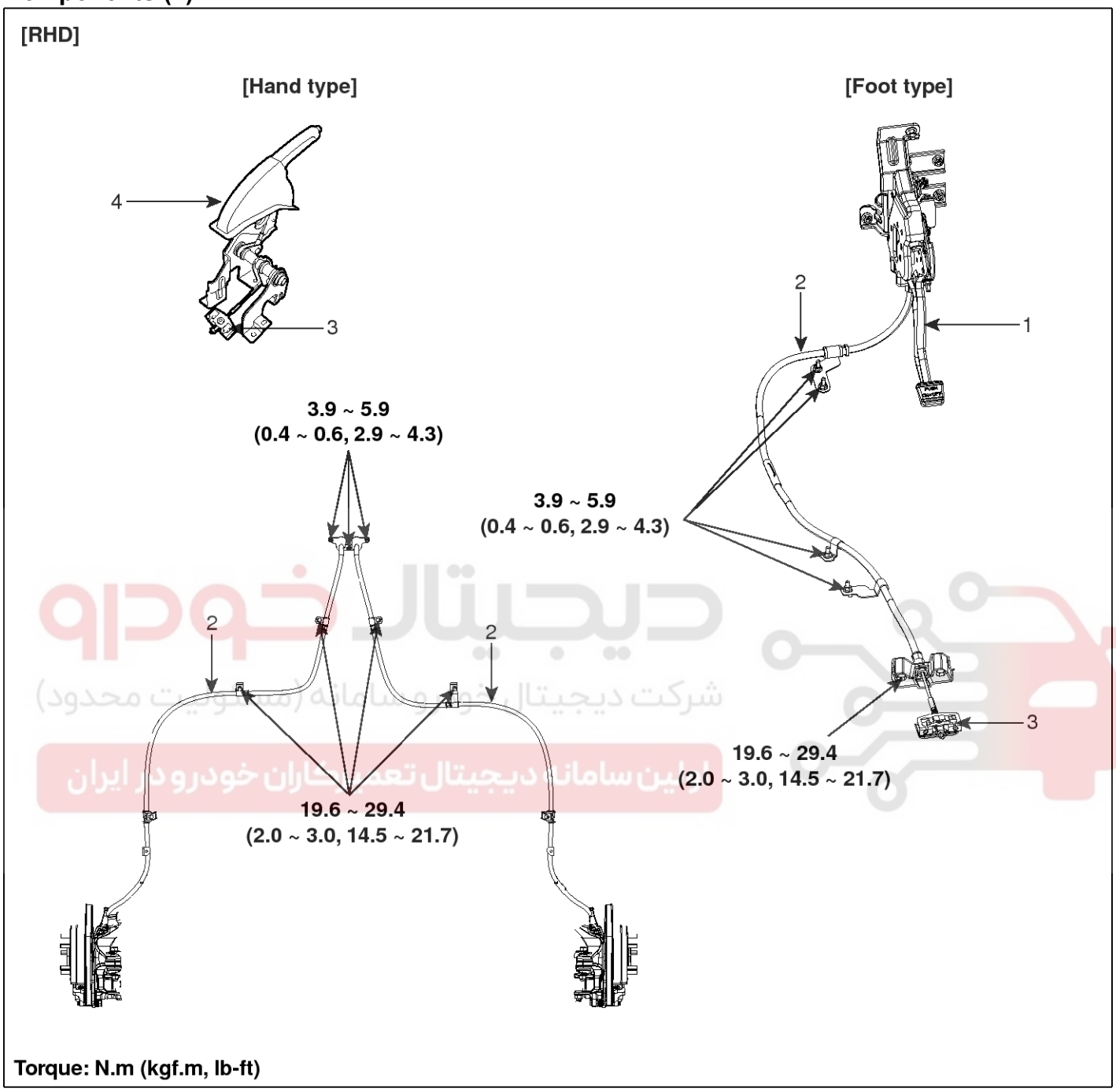
Components (1)



STFBR1100L

1. Parking brake pedal
2. Parking brake cable
3. Equalizer assembly
4. Parking brake lever assembly

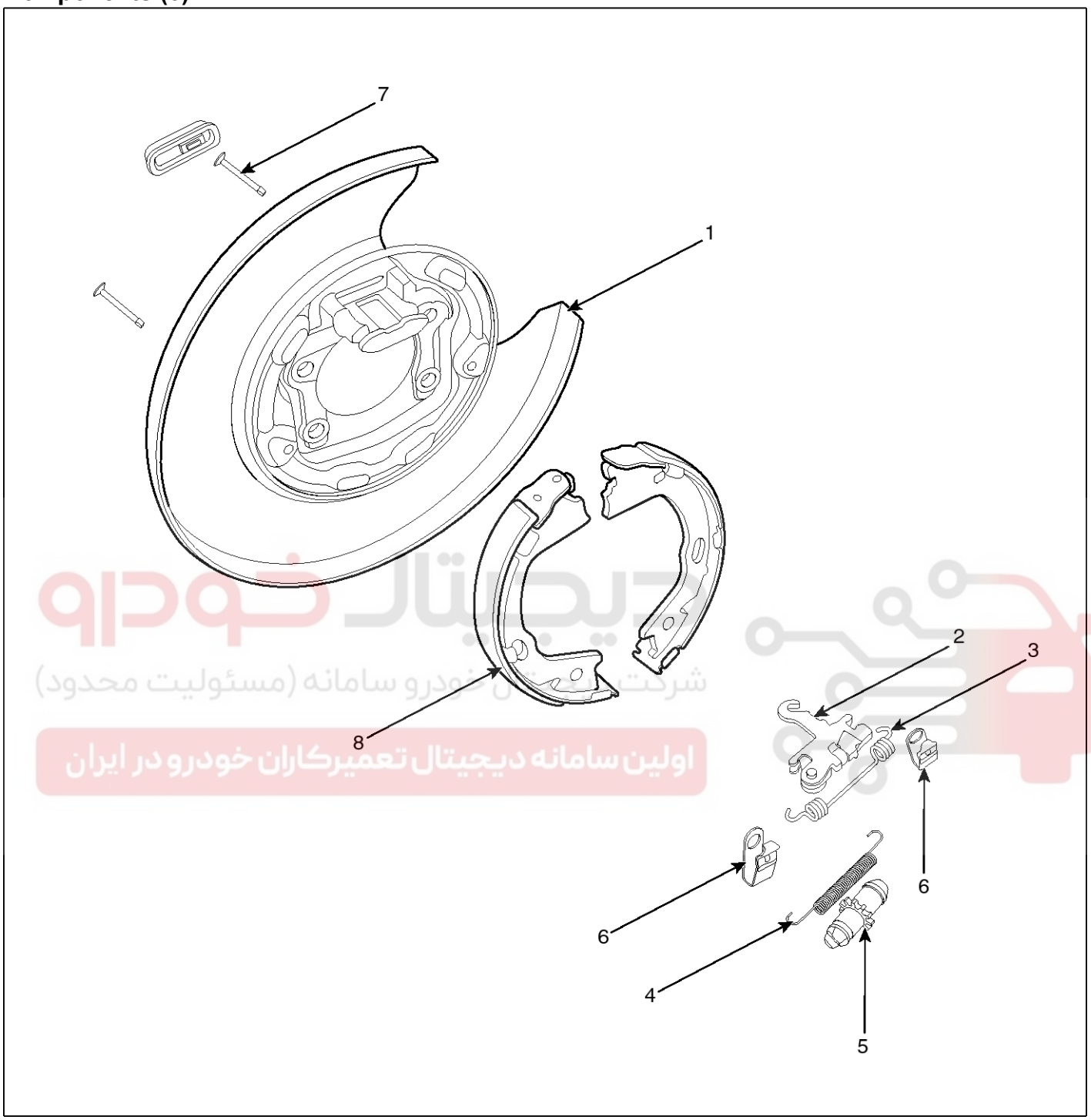
Components (2)



STFBR1100R

1. Parking brake pedal
2. Parking brake cable
3. Equalizer assembly
4. Parking brake lever assembly

Components (3)



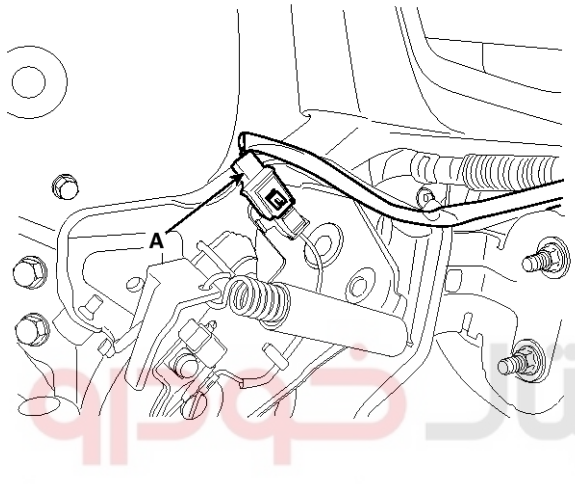
SYFBR0101N

1. Backing plate
2. Operating lever
3. Upper spring
4. Lower spring
5. Adjuster
6. Shoe hold down spring
7. Shoe hold down pin
8. Shoe

Removal

Parking Brake Pedal [Foot type]

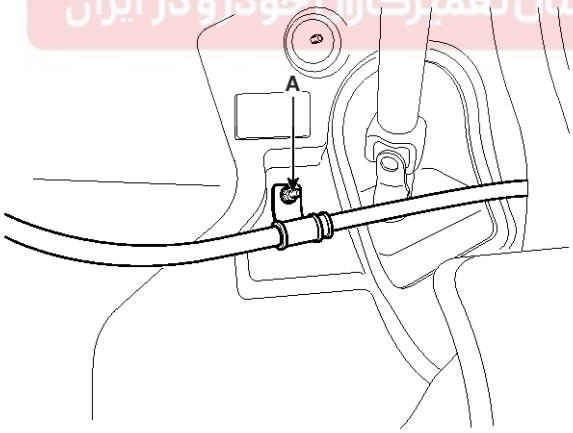
1. Turn ignition OFF and disconnect the negative (-) battery cable.
2. Remove the crash pad lower panel and reinforcing panel. (Refer to the Body group-crash pad)
3. Remove the junction box. (Refer to the Body Electrical System group - Fuses and Relays) [LHD only]
4. Disconnect the parking brake switch connector (A).



SYFBR0111D

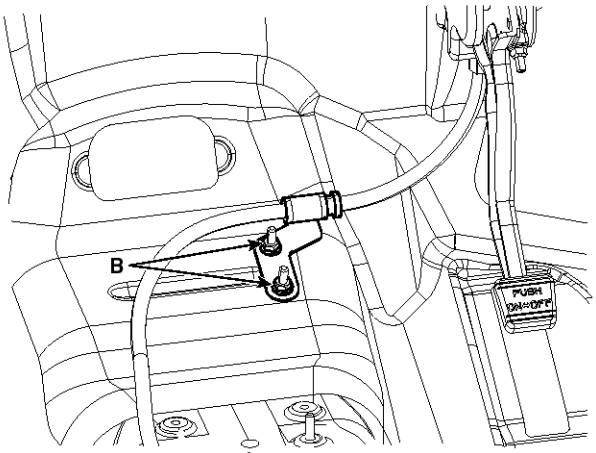
5. Remove the parking brake cable mounting nut (A).

[LHD]



STFBR1112D

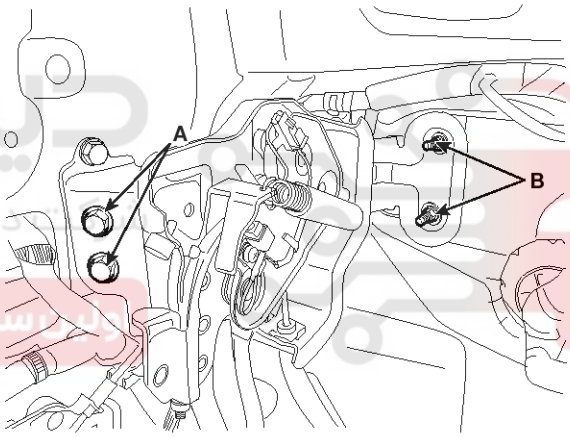
[RHD]



STFBR1112R

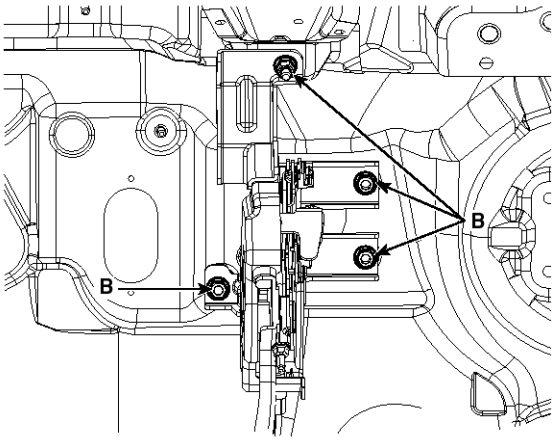
6. Remove the parking brake pedal mounting bolts (A) and nuts (B).

[LHD]



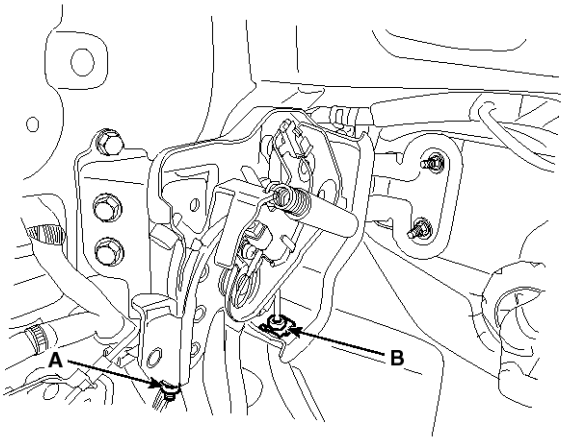
STFBR1113D

[RHD]



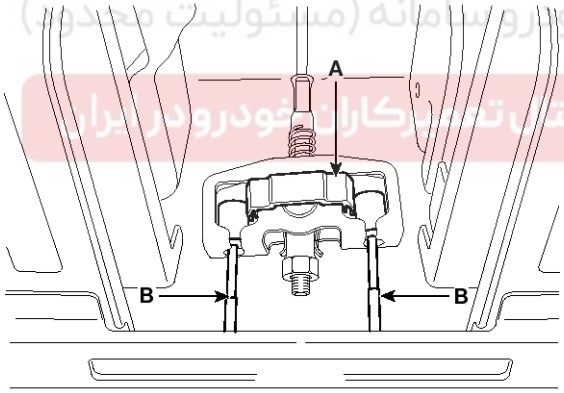
STFBR1113R

7. Remove the parking brake cable adjusting nut (A) and the fixing clip (B), and then remove the parking brake pedal.



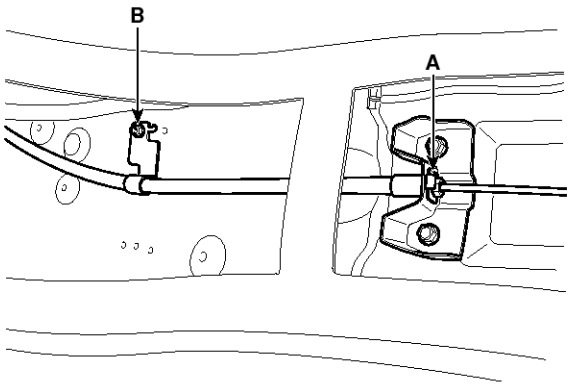
SYFBR0113D

8. Remove the floor console. (Refer to the Body group - Console)
9. Remove the shift lever assembly. (Refer to the Automatic Transaxle group - shift lever)
10. Remove the paring brake cable (B) after removing the cable retainer (A).

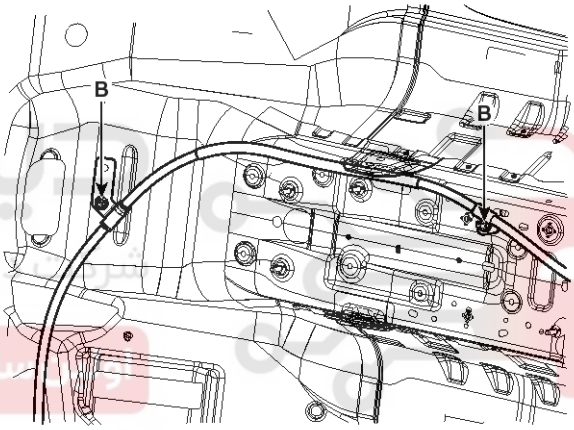


STFBR1102D

11. Remove the parking brake cable fixing clip (A) and bolts (B). And then remove the front parking brake cable.



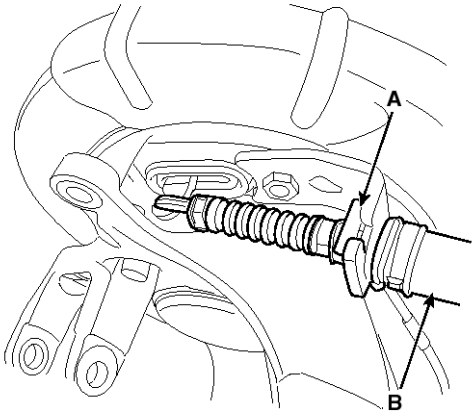
STFBR1114D



STFBR1120D

12. Raise the vehicle, and make sure it is securely supported.

13. Remove the parking brake cable (B) after removing the fixing clip (A).

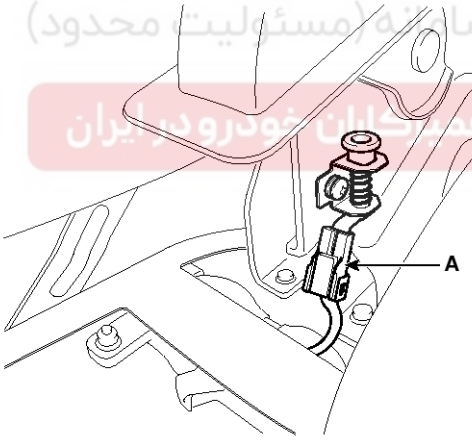


SYFBR0109D

14. Loosen the parking brake cable bracket bolts and remove the rear parking brake cable.

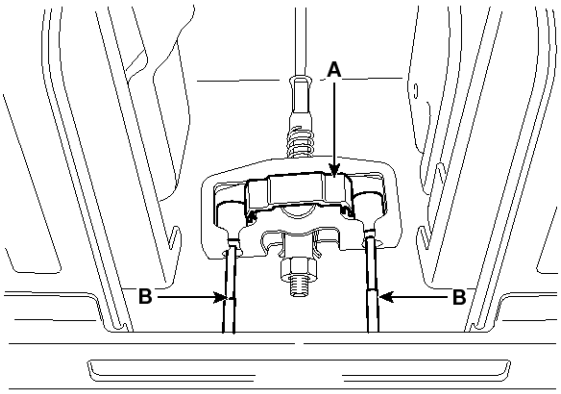
Parking Brake Lever [Hand type]

1. Remove the floor console. (Refer to the Body group - Console)
2. Disconnect the parking brake switch connector (A).



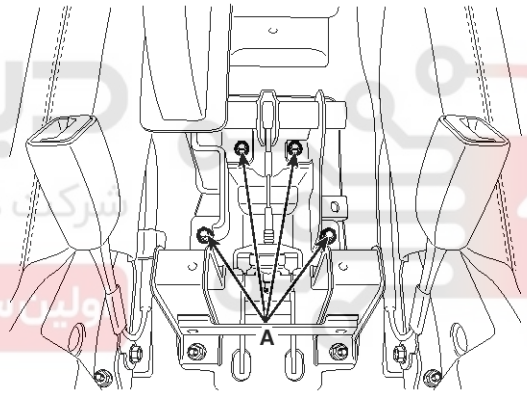
STFBR1101D

3. Remove the parking brake cable (B) after removing the cable retainer (A).



STFBR1102D

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

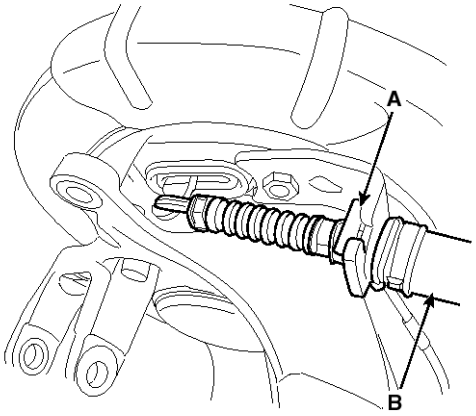


STFBR1103D

5. Raise the vehicle and make sure it is securely supported.
6. Remove the rear wheel & tire.

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

7. Remove the parking brake cable (B) after removing the fixing clip (A).

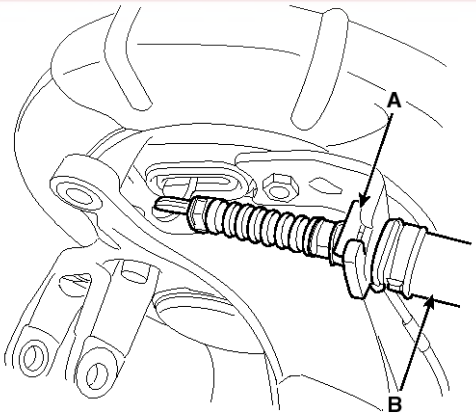


SYFBR0109D

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

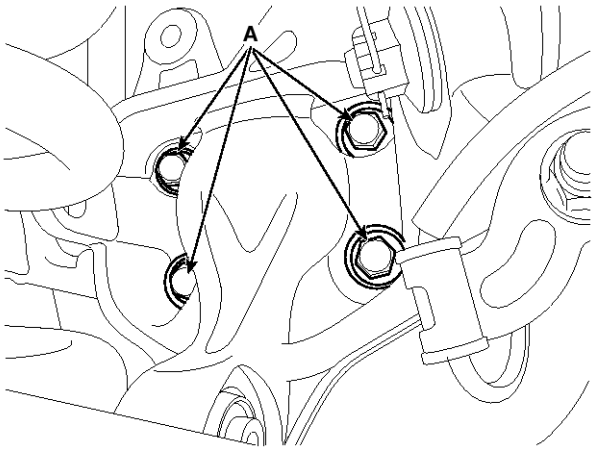
Parking Brake Shoe

1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel.
3. Remove the rear brake caliper and Rear disc brake. (Refer to "Rear disc brake removal")
4. Remove the parking brake cable (B), after removing the fixing clip (A).



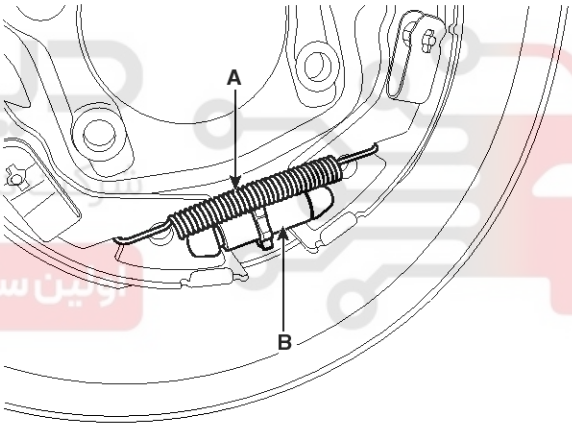
SYFBR0109D

5. Loosen the hub assembly mounting bolts (A), and then remove the hub assembly and parking brake assembly.



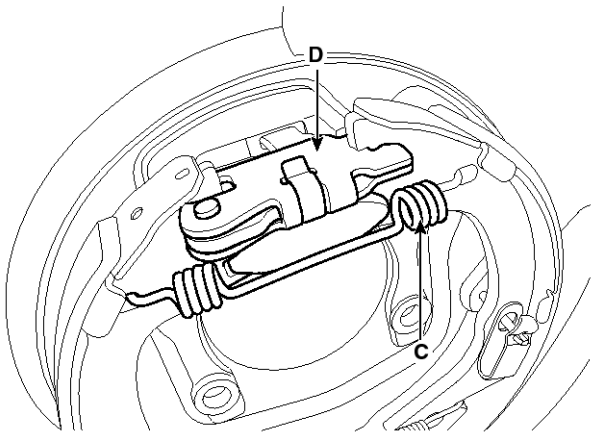
SYFBR0114N

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



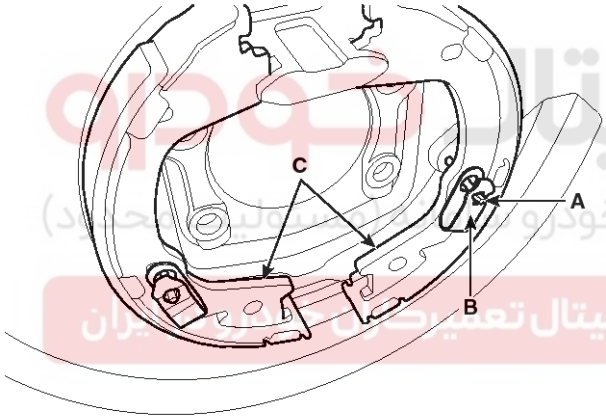
SYFBR0115N

7. Remove the upper return spring (C) operating lever assembly (D).



SYFBR0116N

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



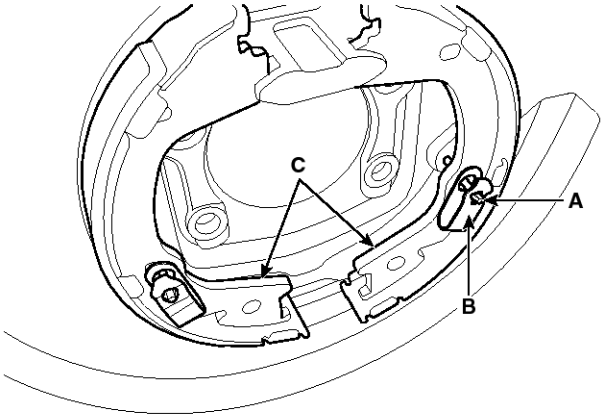
SYFBR0117N

9. Remove the brake shoes (C).

Installation

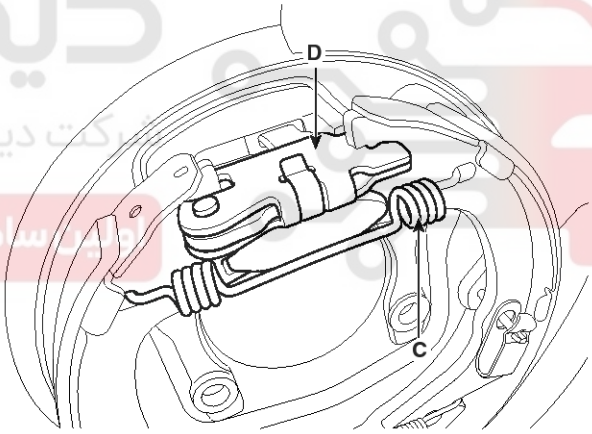
Parking Brake Shoe

1. Install the shoe hold down pin (A) and spring (B) by pressing and rotating the spring.



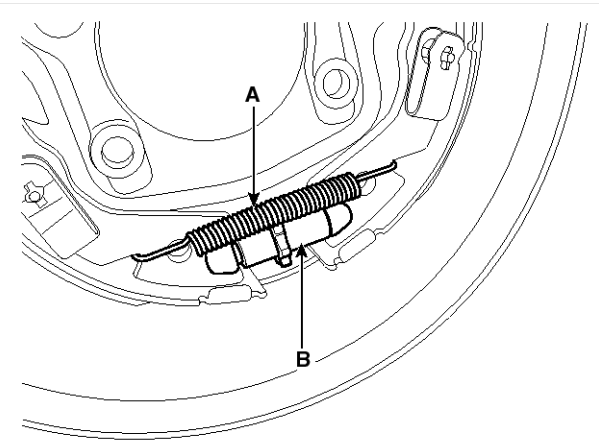
SYFBR0117N

2. Install the operating lever assembly (D) and the upper return spring (C).



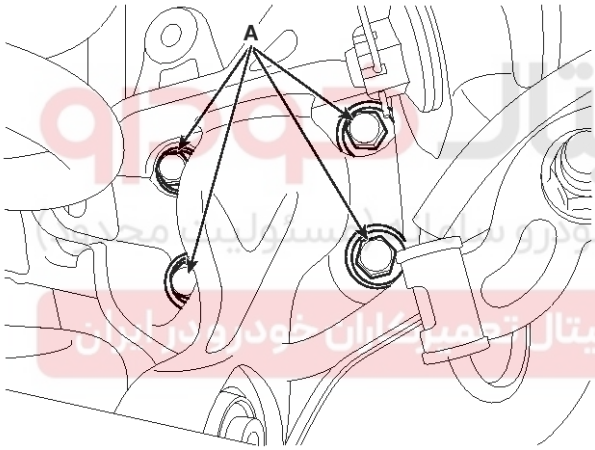
SYFBR0116N

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



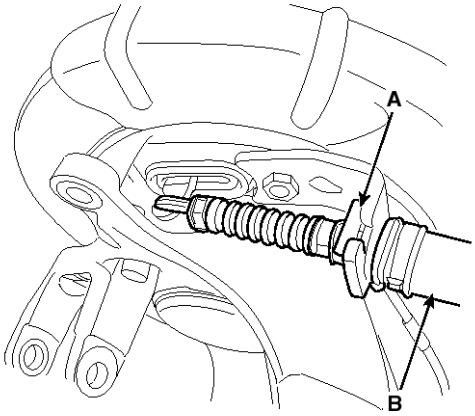
SYFBR0115N

4. Install the hub assembly and the parking brake assembly, and then install mounting bolts (A).



SYFBR0114N

5. Install the parking brake cable (B), and then install the fixing clip (A).



SYFBR0109D

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 7~8 notches in the opposite direction.
7. Install the brake caliper assembly. (Refer to "Rear brake installation")
8. Install the tire and wheel, after installing the plug on the disc.
9. If the parking brake shoe or the brake disc are replaced a newly one, perform the brake shoe bed-in procedure.
   1) Hand type - While operating the parking brake pedal for 68.6N (7kgf, 15.4 lbf) effort, drive the vehicle 500 meters (0.31 miles) at the speed of 60kph (37 mph).

      Foot type - While operating the parking brake lever for 98N (10kgf, 22lbf) effort, drive the vehicle 500 meters (0.31 miles) at the speed of 60kph (37 mph).
   2) Repeat the above procedure more than three times.
   3) Must be held on 30% uphill.

⚠CAUTION

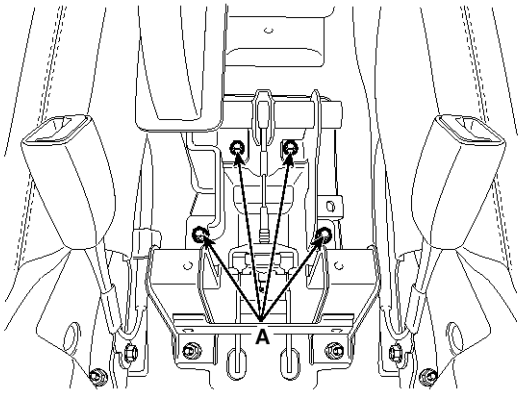
After adjusting parking brake, notice following matter;

1. **Must be free from troubles when the parking pedal is operated at 686.5 N (70 kgf, 154 lbf).**
2. **Check that all parts move smoothly.**
3. **The parking brake indicator lamp must be on after the parking pedal is worked and must be off after the pedal is released.**

Parking Brake Lever [Hand Type]

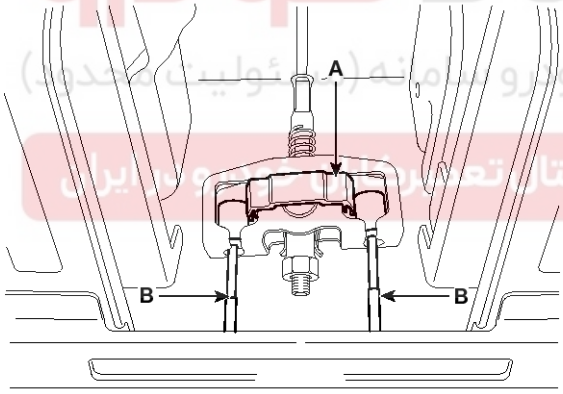
1. Install the parking brake lever assembly, then tighten the mounting bolts.

Tightening torque:
19.6 ~ 29.4 N.m (2.0 ~ 3.0 kgf.m, 14.5 ~ 21.7 lb-ft)



STFBR1103D

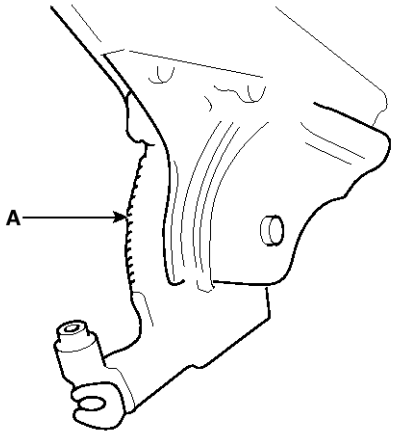
2. Install the parking brake cable (B) and then cable retainer (A).



STFBR1102D

3. 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

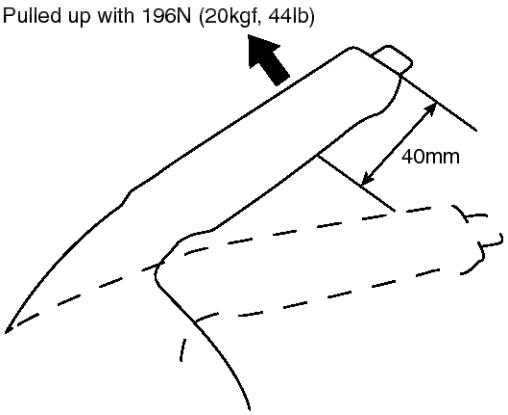


ARJE502X

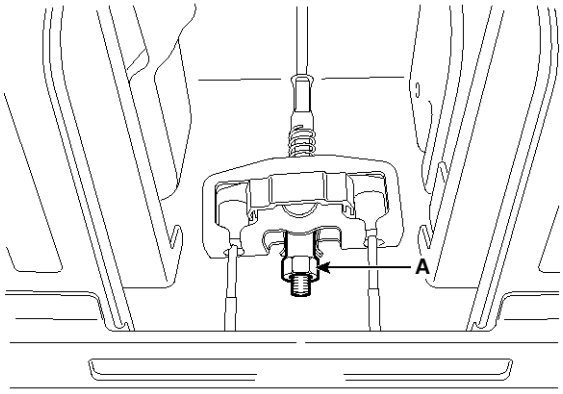
4. Install the parking brake cable adjuster, then adjust the parking brake lever stroke by turning adjusting nut (A).

Parking brake lever stroke:
4 clicks (Pull the lever with 20kgf)

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")



SXMBR0118L



STFBR1119D

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

NOTICE

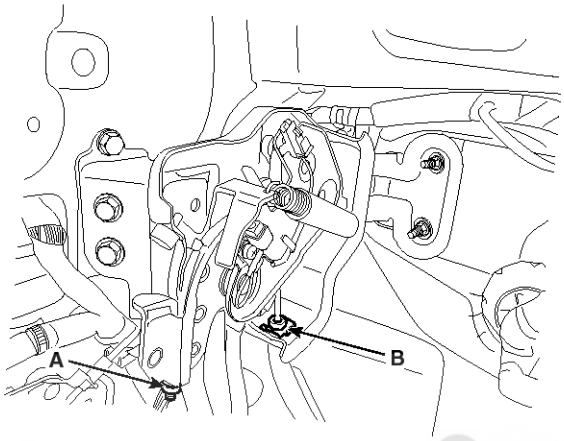
Inspect the continuity of parking brake switch.

When the brake lever is pulled: continuity
When the brake lever is released: no continuity

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

Parking Brake Pedal [Foot type]

1. Install the parking brake cable.
2. Install the shift lever assembly. (Refer to the Automatic Transaxle group - shift lever)
3. Install the floor console. (Refer to the Body group - console)
4. Install the holding clip (B) and the cable adjusting nut(A) after fixing the parking brake cable.

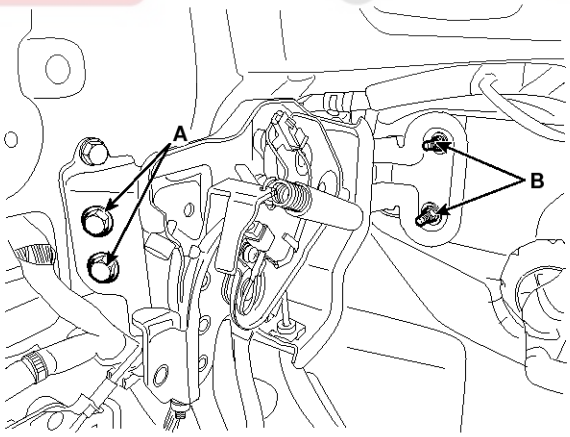


SYFBR0113D

5. Install the parking brake pedal, and then install the parking brake pedal mounting bolts (A) and nuts (B).

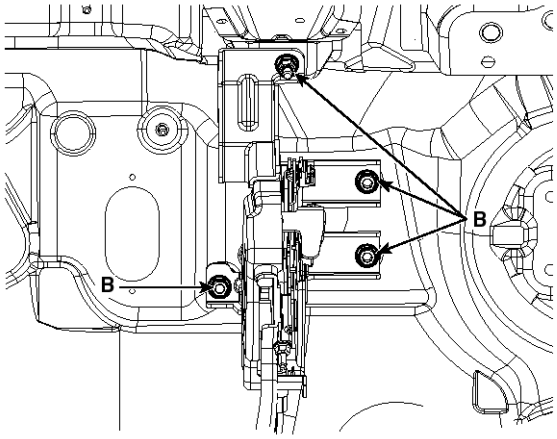
Tightening torque:
9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)

[LHD]



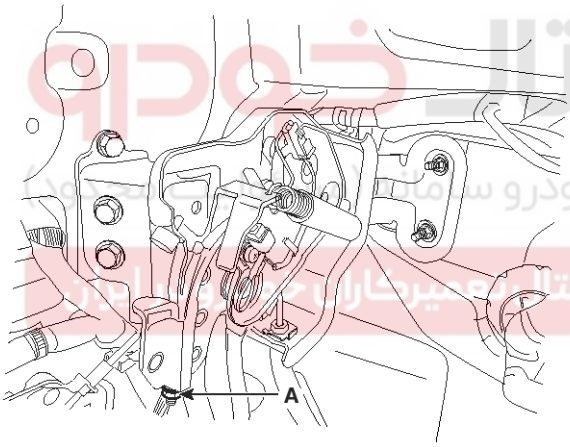
STFBR1113D

[RHD]



STFBR1113R

6. Adjust the parking brake pedal stroke by turning the adjusting nut (A).
   1) Operate the parking brake pedal through a full stroke over 3 times for setting the parking cables.



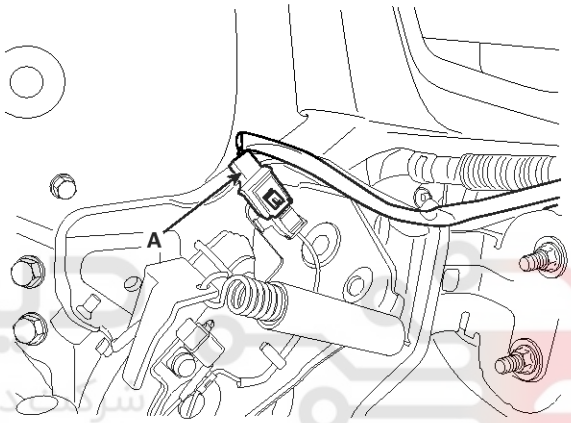
SYFBR0118D

   2) Adjust the adjusting nut (A) for parking brake pedal stroke 4~5notches when operating effort is 196N(20kgf.44lb).

⚠CAUTION

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

7. Reconnect the parking brake switch connector(A).



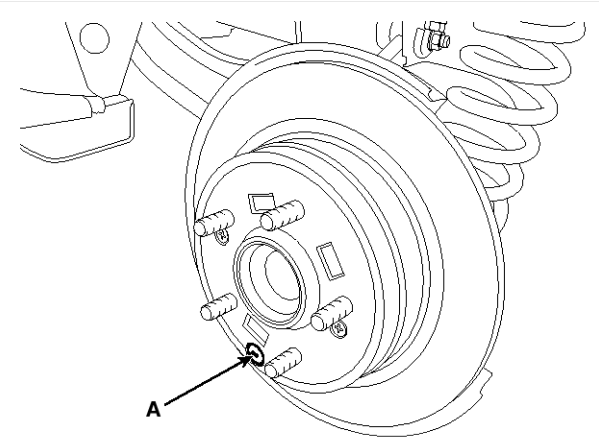
SYFBR0111D

8. Install the junction box. (Refer to the Body Electrical System group - Fuses and Relays)
9. Install the reinforcing panel and crash pad lower panel. (Refer to Body group - Crash pad)

Adjustment

Parking Brake Shoe Clearance Adjustment

1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel.
3. Remove the plug (A) from the disc.

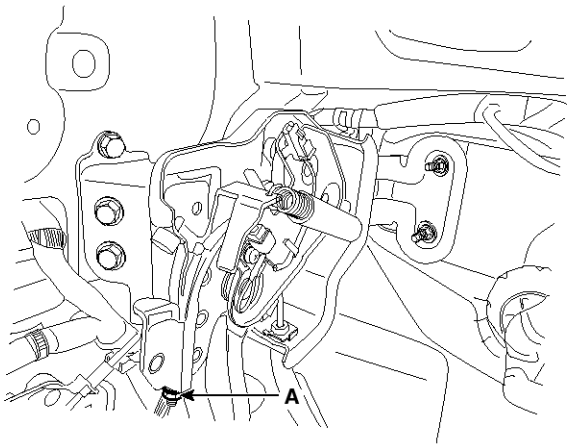


SYFBR0125N

4. Rotate the toothed wheel of adjuster by a screw driver until the disc is not moving, and then return it by 7~8 notches in the opposite direction.
5. Install the rear wheel & tire after installing the plug on the disc.

Parking Brake Pedal Stroke Adjustment

1. Operate the parking brake pedal through a full stroke over 3 times for setting the parking cables.
2. Adjust the adjusting nut(A) for parking barke pedal stoke 4~5 notches when operating effort is 196N(20kgf, 44lbf)



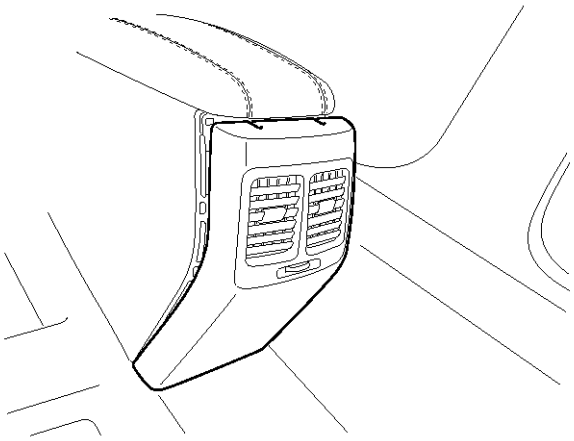
SYFBR0118D

⚠CAUTION

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

Parking Brake Lever Stroke Adjustment

1. Raise the vehicle, and make sure it is securely supported.
2. Loosen the mounting screws, then remove the console rear cover.

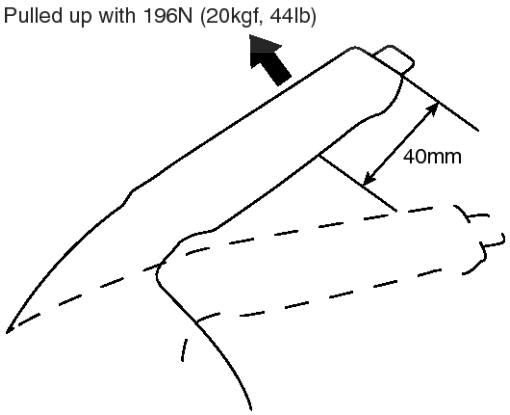


STFBR1118D

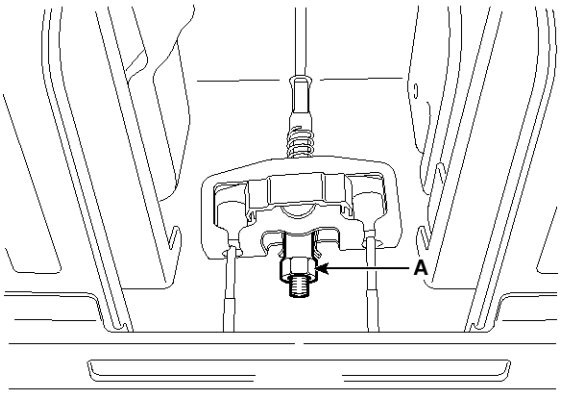
3. Adjust the parking brake lever stroke by turning adjusting nut (A).

Parking brake lever stroke :
4 clicks (Pull the lever with 20kgf)

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")



SXMBR0118L

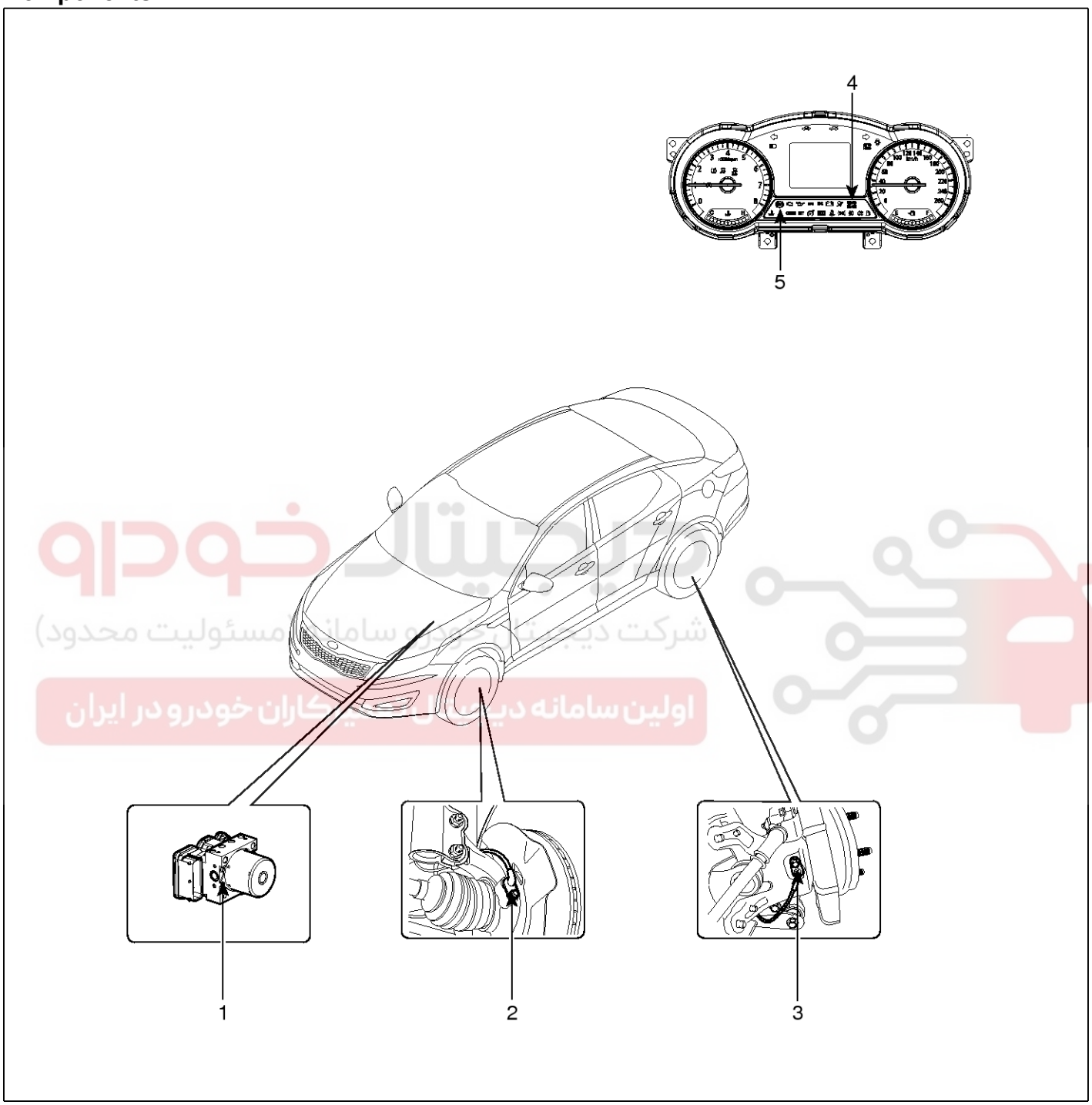


STFBR1119D

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 console rear cover.

ABS(Anti-Lock Brake System)

Components



STFBR1130D

1. ABS control module (HECU)
2. Front wheel speed sensor
3. Rear wheel speed sensor
4. Parking brake/ EBD warning lamp
5. ABS warning lamp

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 MCU.

Solenoid Valve Control

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

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

Voltage Limits

- Overvoltage

  When overvoltage is detected(above 17 ± 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 9.5±0.5V), 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

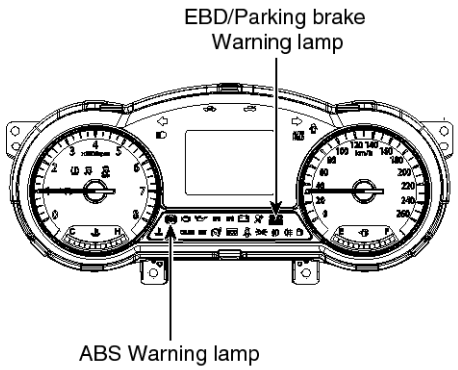
The ECU performs a pump motor test at a speed once after IGN is switched on.

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).

Warning Lamp Module



STFBR1131L

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 seperated from ECU.
   - Cluster lamp is ON when communication is impossible with CAN module.

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:

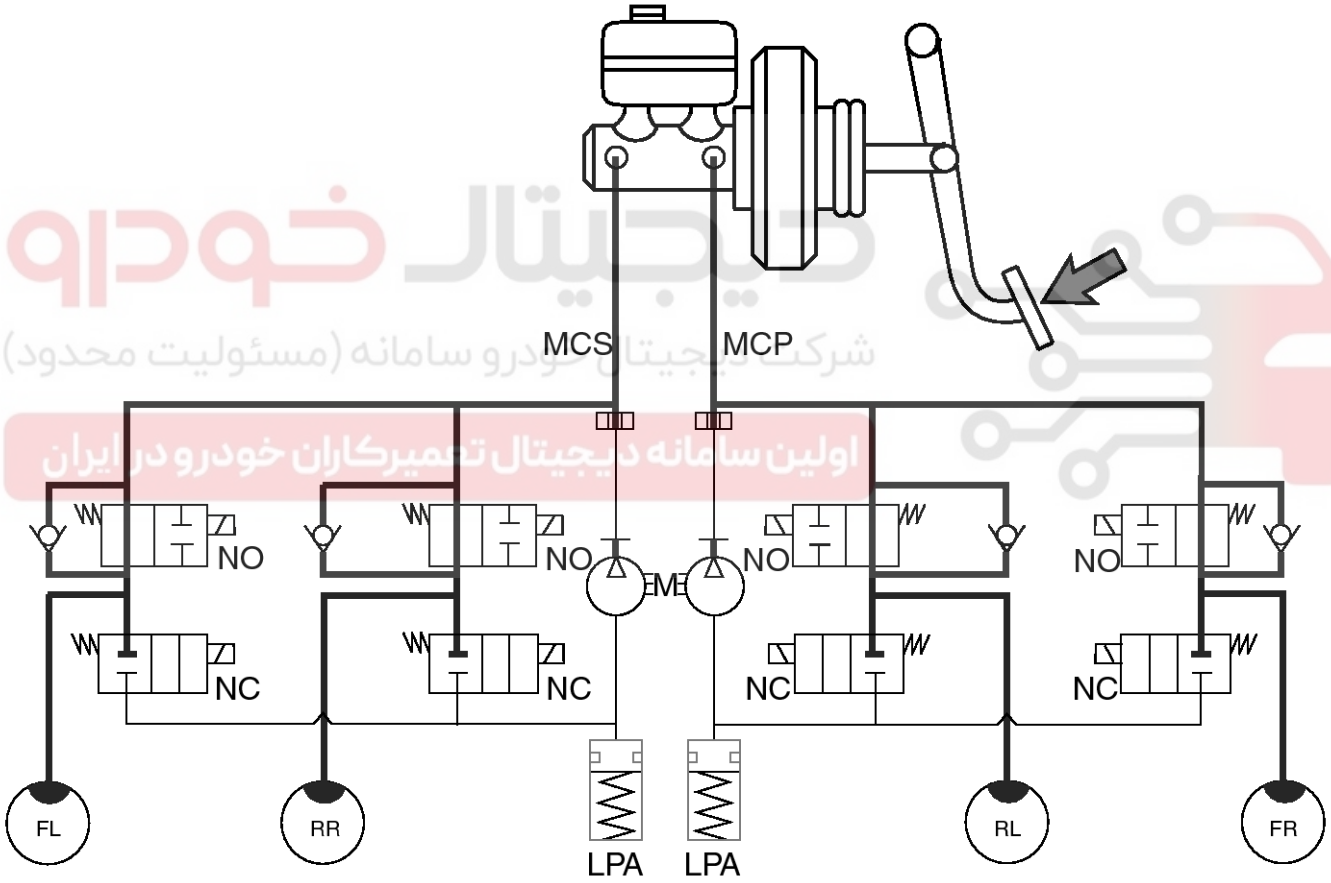
   - During the initialization phase after IGN ON. (continuously 3 seconds).
   - When the Parking Brake Switch is ON or brake fluid level is low.
   - When the EBD function is out of order.
   - During diagnostic mode.
   - When the ECU Connector is seperated from ECU.
   - Cluster lamp is ON when communication is impossible with CAN module.

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	

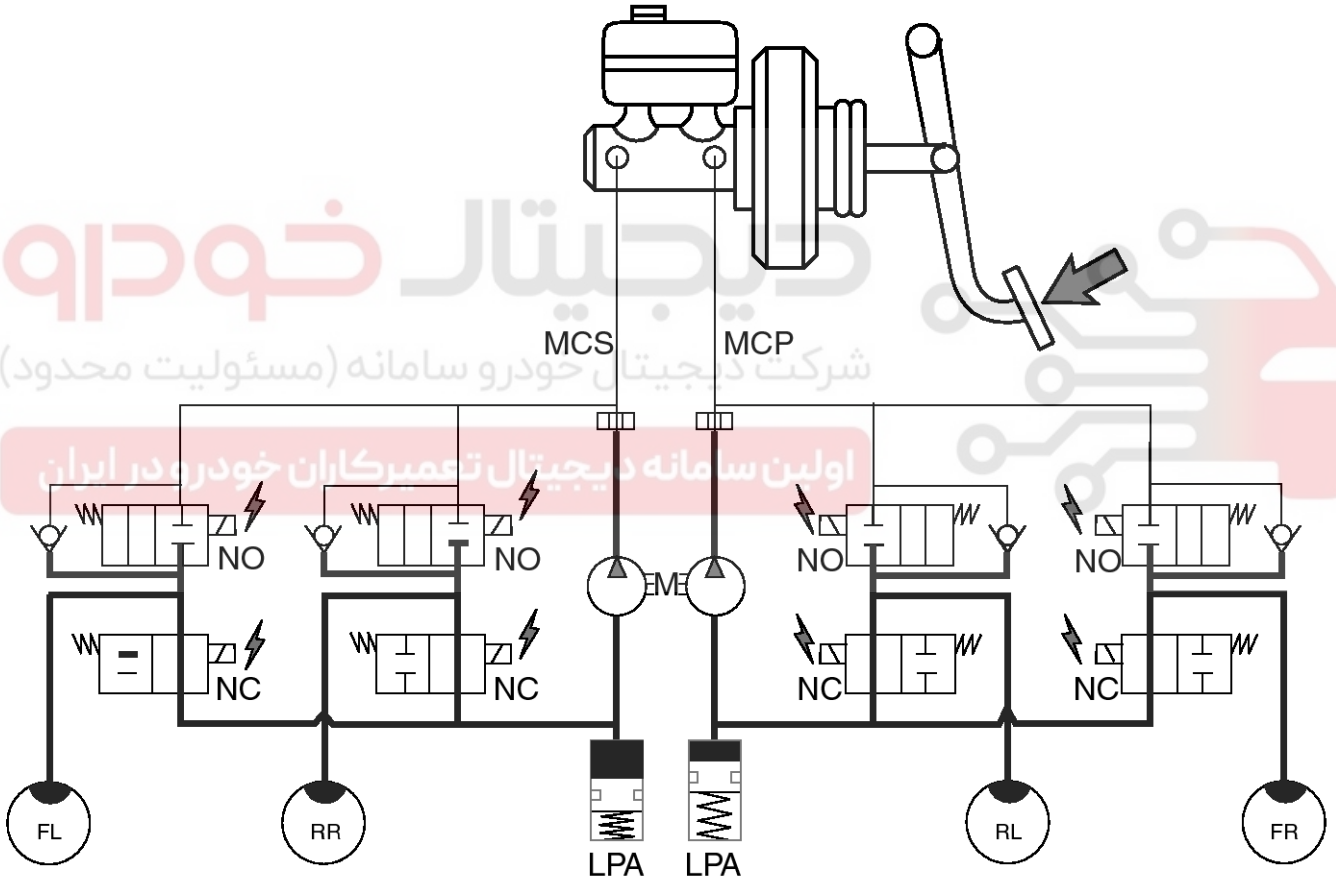


LJJF500W

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	

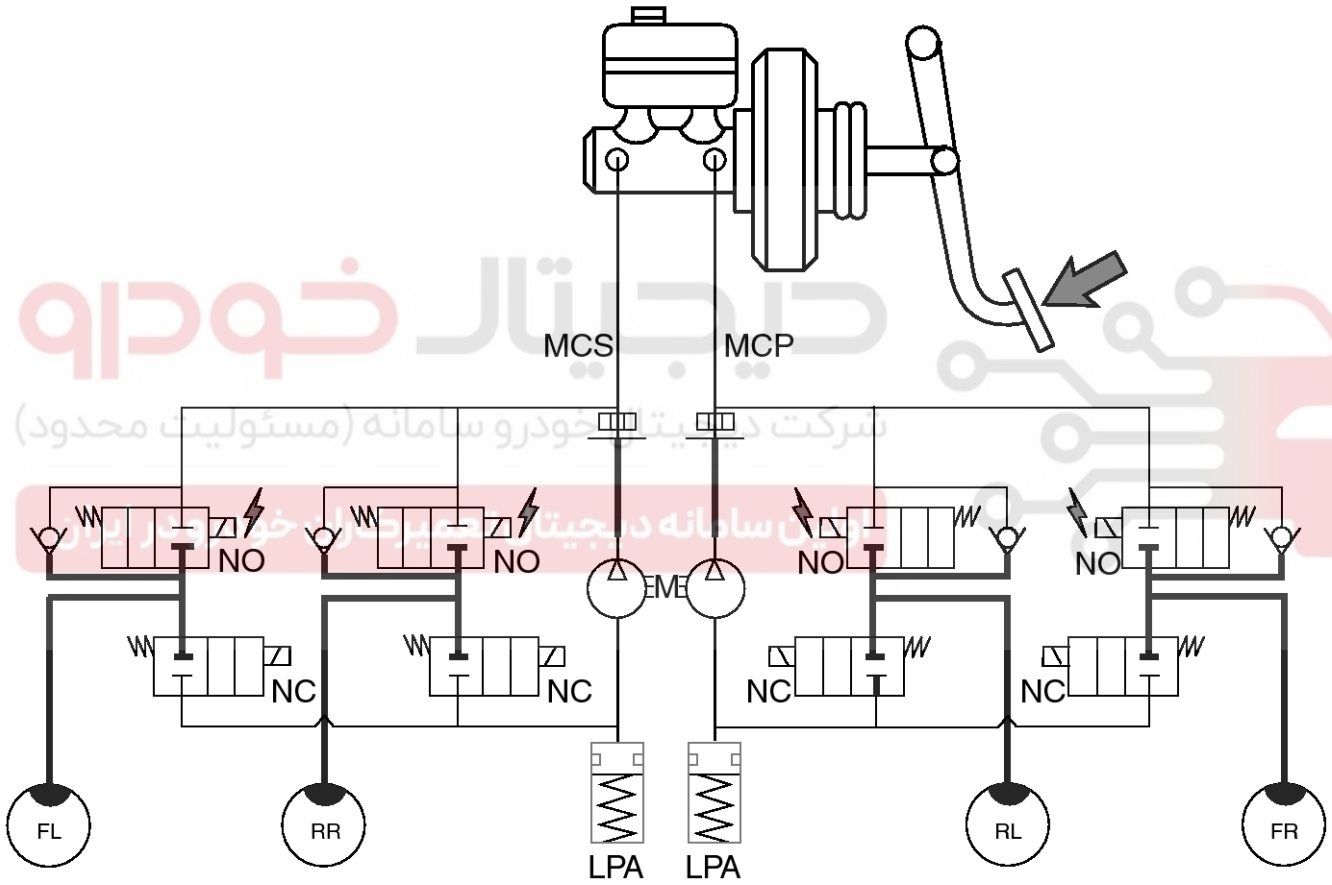


LJJF500X

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	

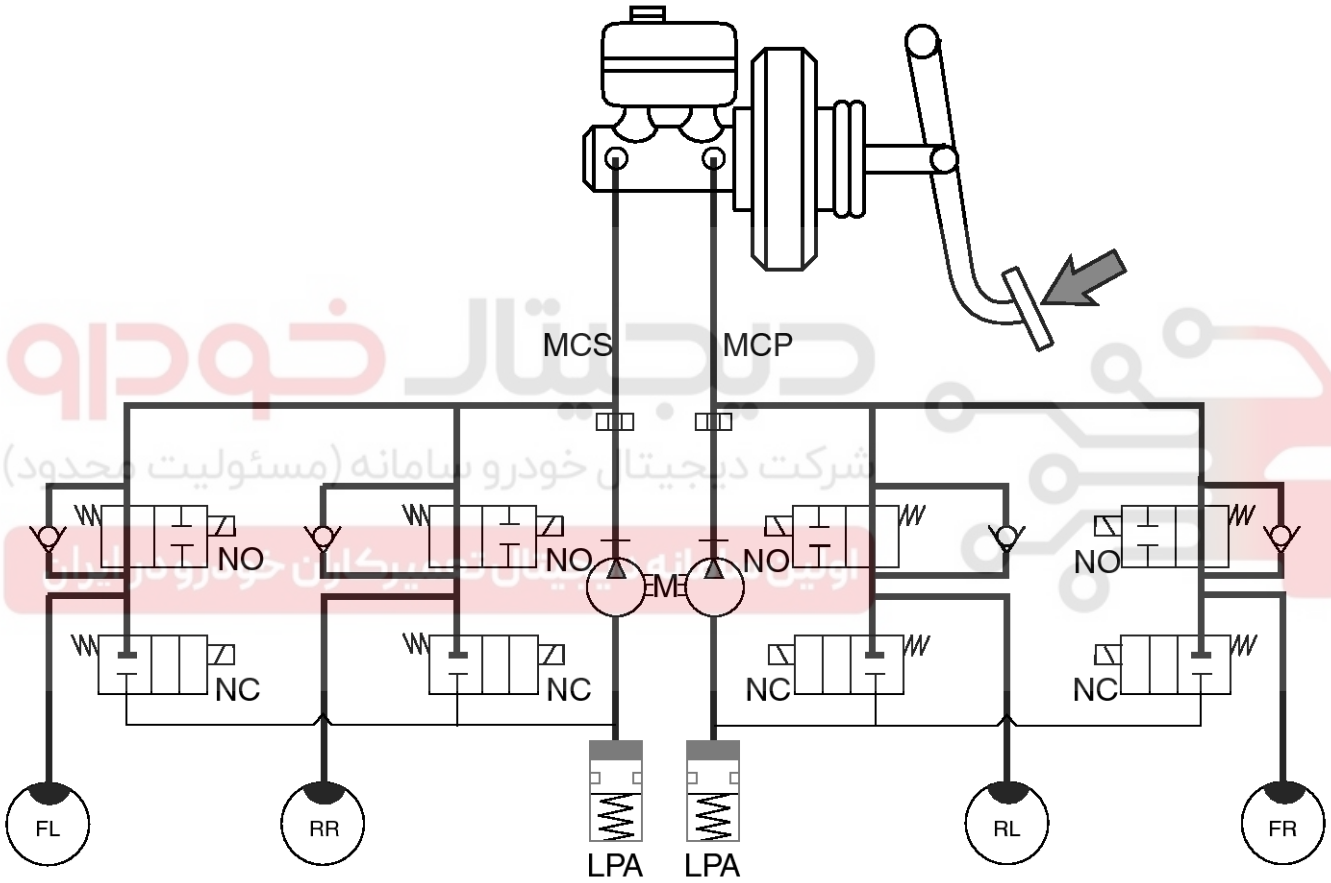


LJJF500Y

4. Increase Mode

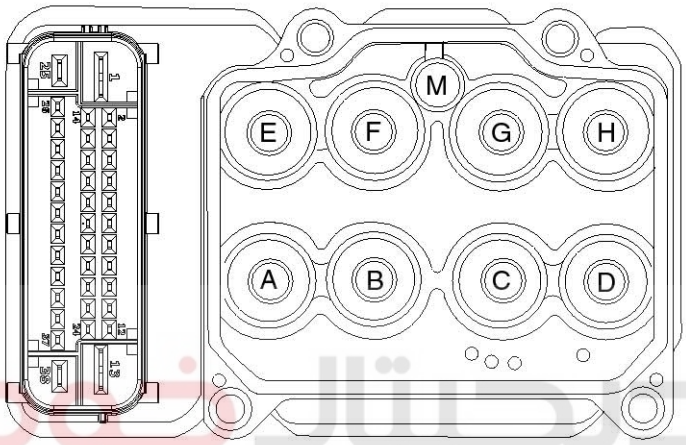
If HECU determines there's no lock-up in the wheel, HECU cuts voltage to solenoid valve. So voltage is not supplied to each solenoid valve, brake fluid passes through the inlet valve to wheel cylinder, resulting in pressure increase.

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

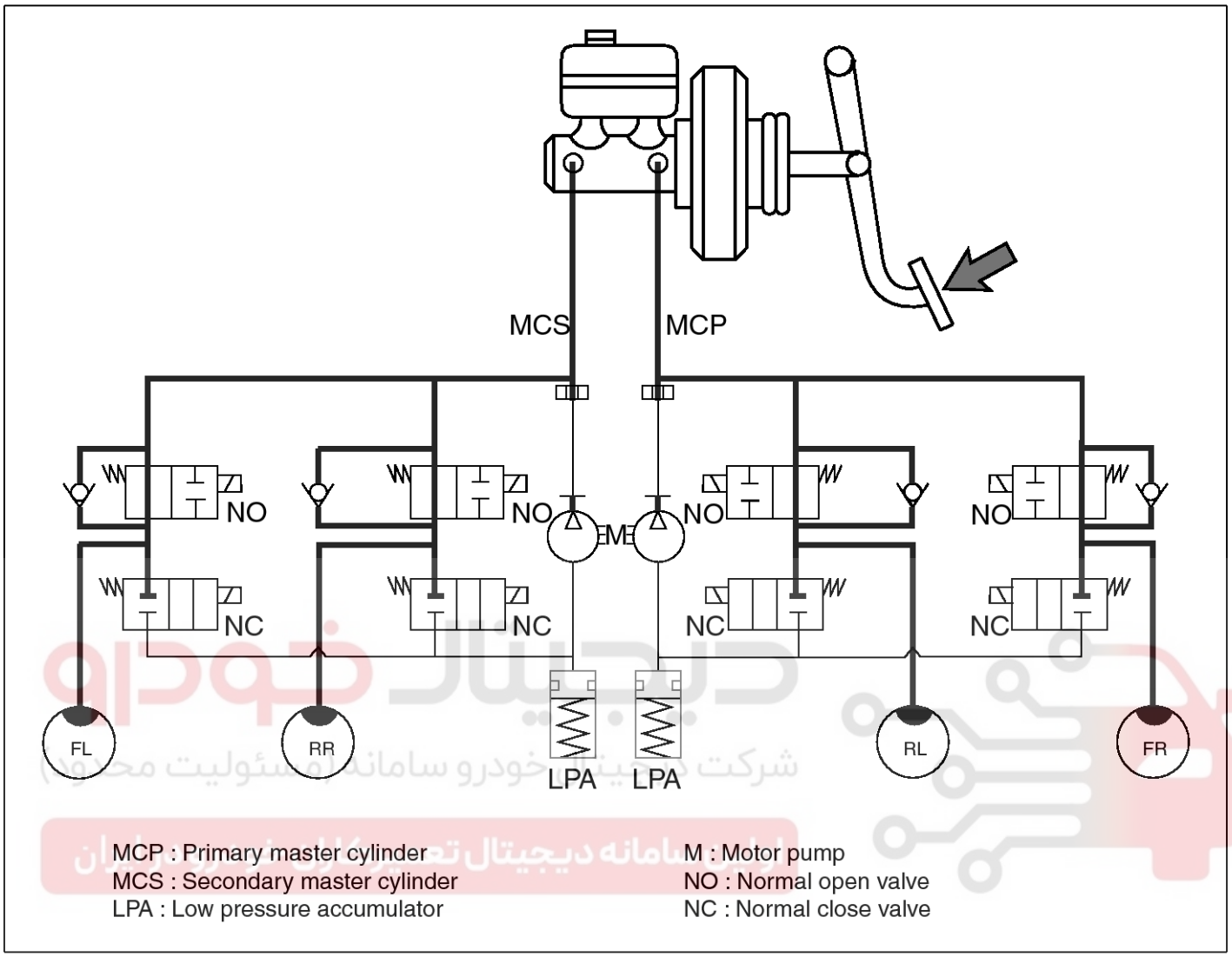
ABS HECU External Diagram



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

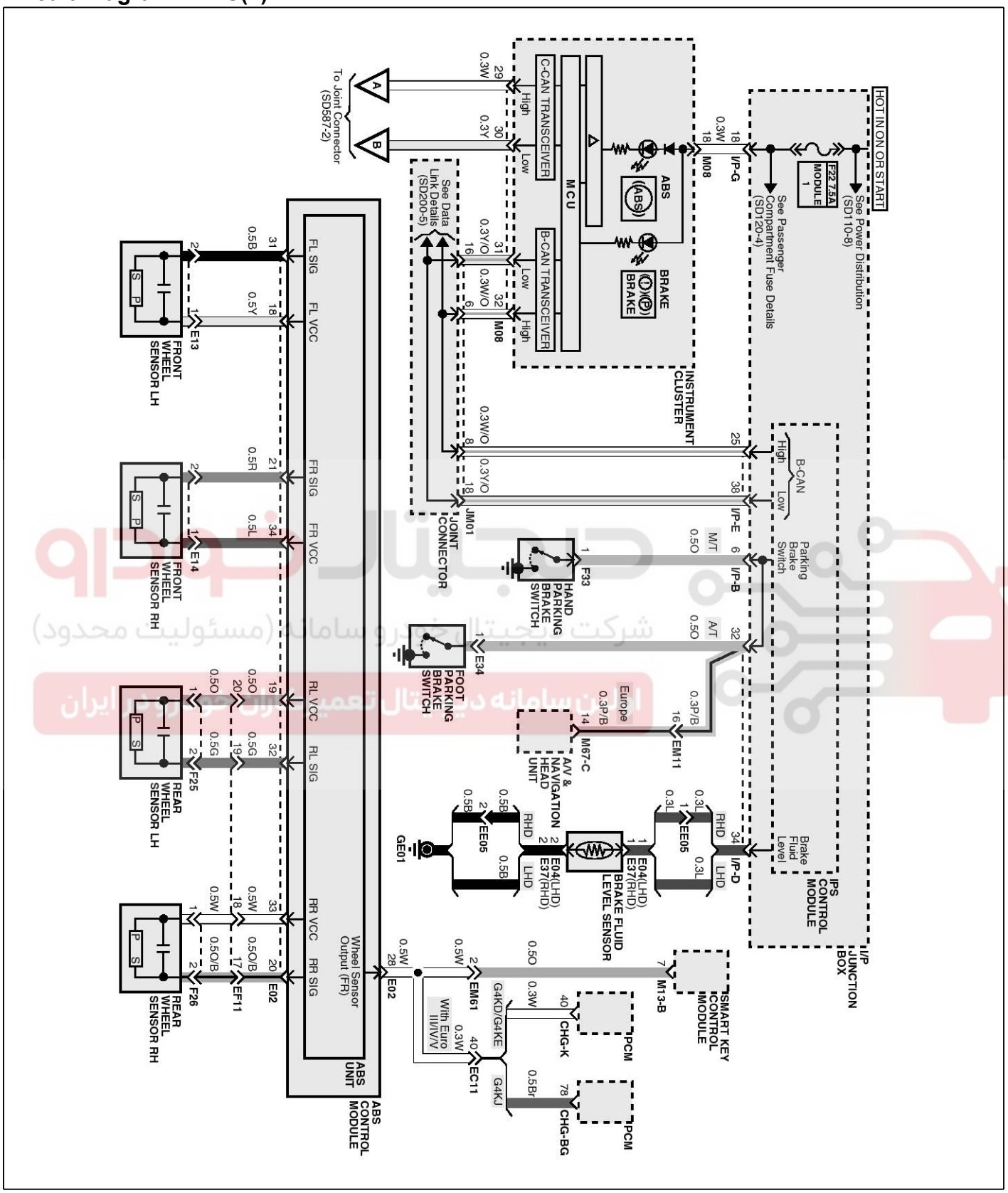
SHMBR0135D

Hydraulic System Diagram



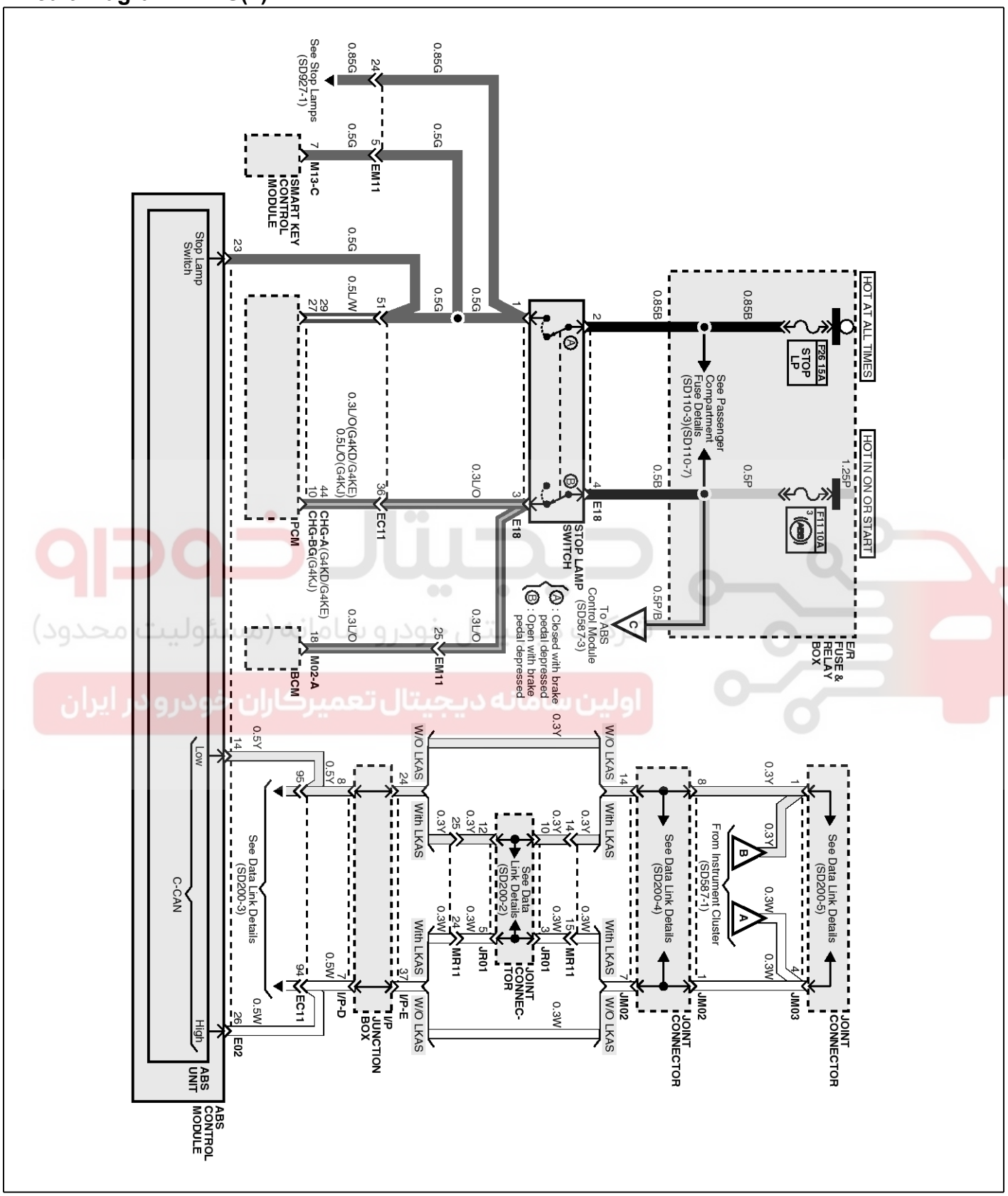
LJJF501B

Circuit Diagram - ABS(1)



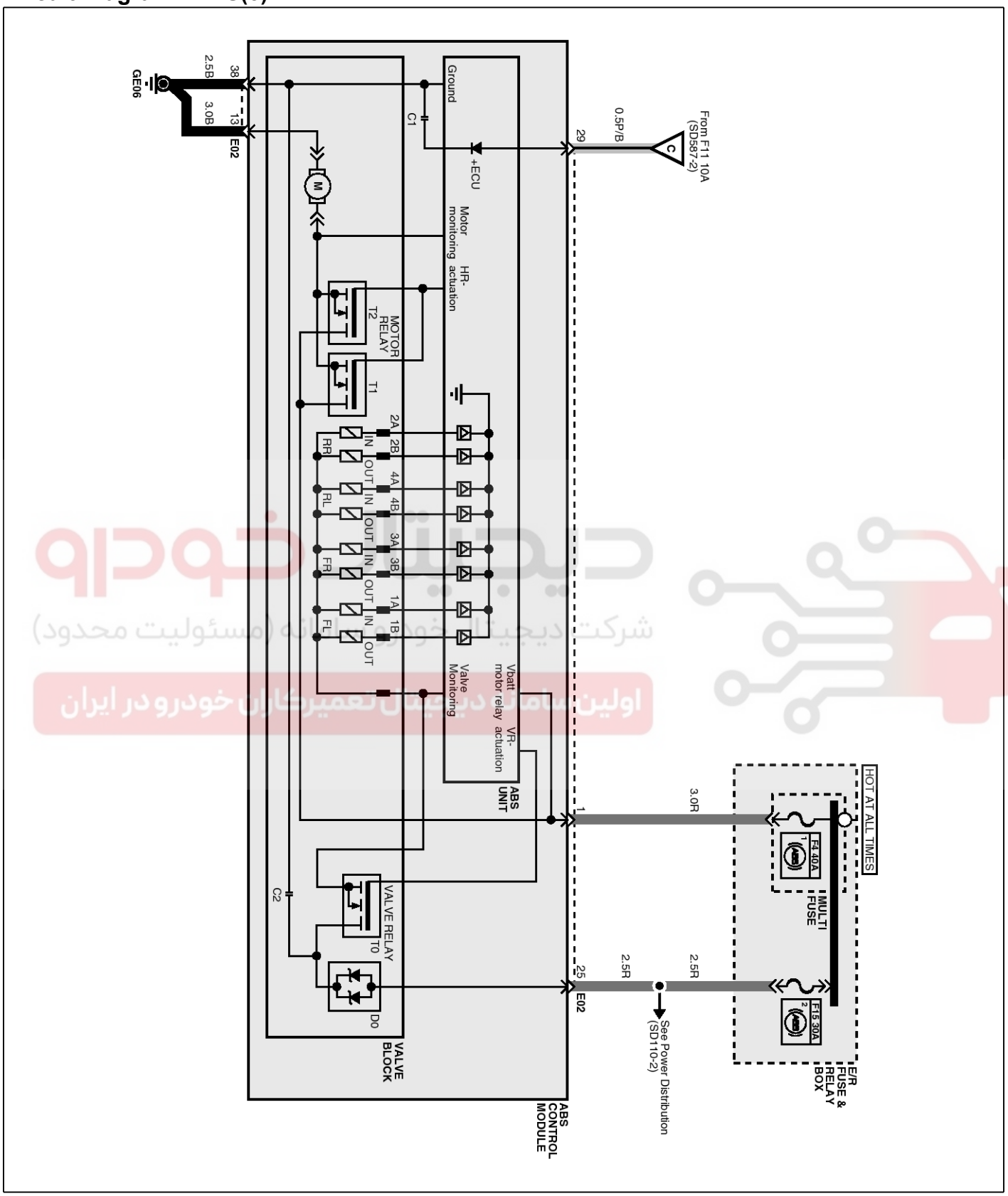
STFBR1132L

Circuit Diagram - ABS(2)



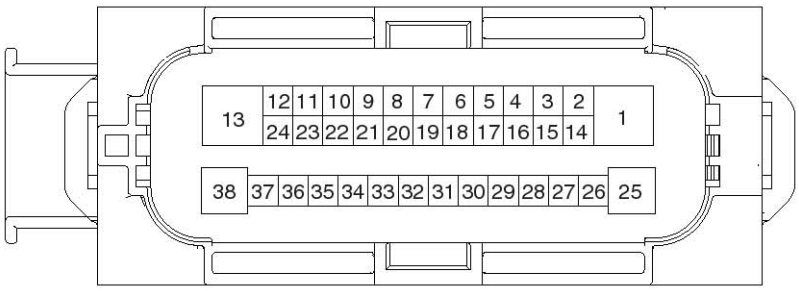
STFBR1133L

Circuit Diagram - ABS(3)



STFBR1134L

ABS connector input/output

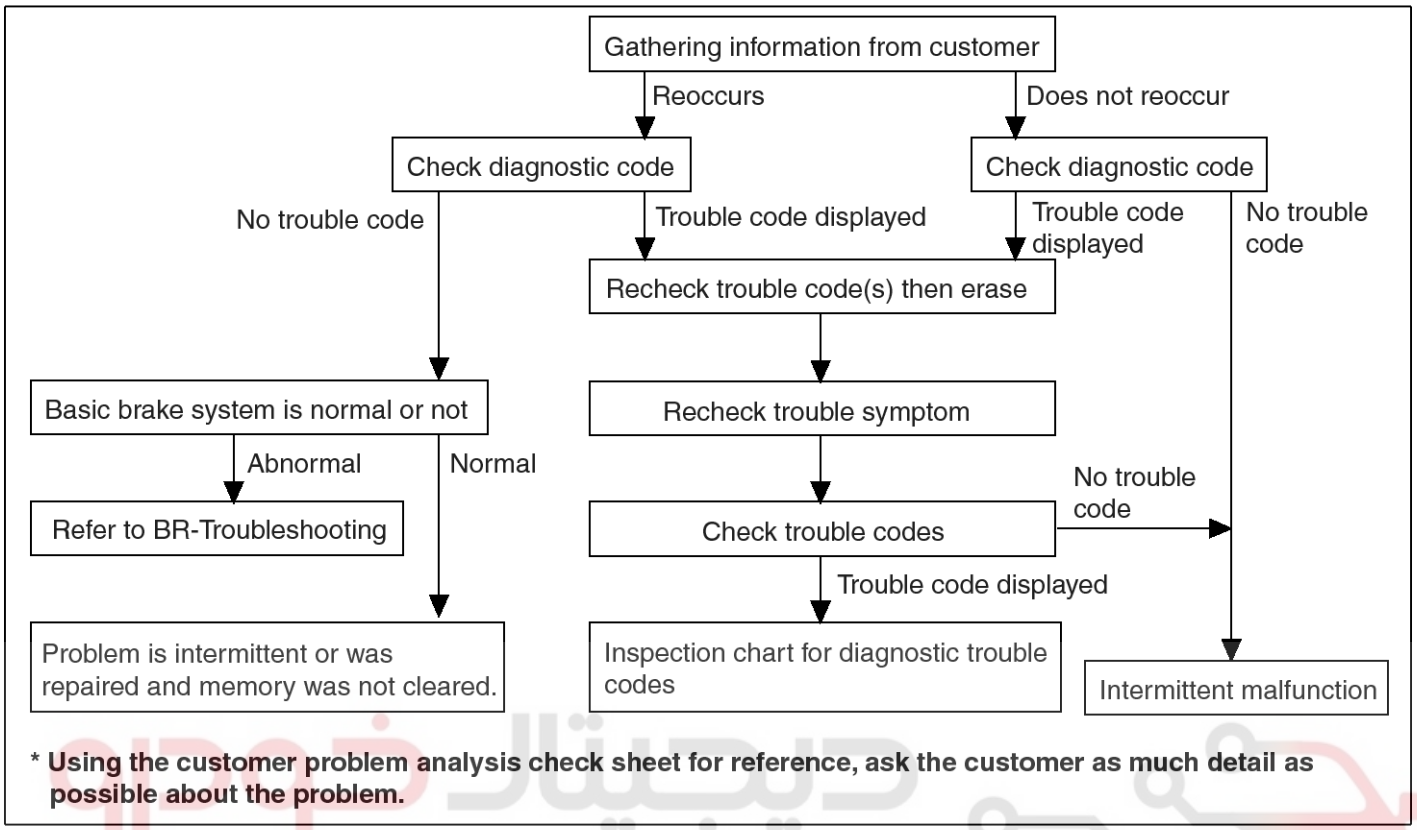


SKMBR0134D

Connector Terminal		Specification
No	Description	
29	IGNITION1(+)	High level of wake up voltage : 4.5V < V < 16.0V Low level of wake up voltage : V < 2.4V Max. current : I < 50mA
25	POS. BATTERY 1.(SOLENOID)	Over voltage range : 17.0 ± 0.5V Operating voltage range : 10.0 ± 0.5V < V < 16.0 ± 0.5V Low voltage range : 7.0 ± 0.5V < V < 9.5 ± 0.5V Max. current : I < 25A Max. leakage current : I < 0.25mA
1	POS. BATTERY 2.(MOTOR)	Operating voltage range: 10.0 ± 0.5V < V < 16.0 ± 0.5V Rush current : I < 110A Max current : I < 40A Max leakage current : I < 0.25mA
38	GROUND	Rated current : I <550mA Max. current: I < 25A
13	PUMP MOTOR GROUND	Rush current : I < 110A Max current : I < 40A
23	BRAKE LIGHT SWITCH	Input voltage (Low) : V < 2V Input voltage (High) : V > 6V Max. Input current : I < 3mA (@12.8V)
28	SENSOR FRONT RIGHT OUTPUT	External pull up resistance :1 KΩ < R Output duty :50 ± 20%
14	CAN BUS LINE(LOW)	Max. Input current : I < 10mA
26	CAN BUS LINE(HIGH)	

Connector Terminal		Specification
No	Description	
18	SENSOR FRONT LEFT POWER	Output voltage : V_BAT1 -0.6V ~ V_BAT1 -1.1V Output current : Max 30mA
34	SENSOR FRONT RIGHT POWER	
19	SENSOR REAR LEFT POWER	
33	SENSOR REAR RIGHT POWER	
31	SENSOR FRONT LEFT SIGNAL	Input current LOW : 5.9 ~ 8.4mA Input current HIGH :11.8 ~ 16.8mA Frequency range :1 ~ 2500Hz Input duty : 50 ± 10%
21	SENSOR FRONT RIGHT SIGNAL	
32	SENSOR REAR LEFT SIGNAL	
20	SENSOR REAR RIGHT SIGNAL	

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.**

EJKB055A

Notes With Regard To Diagnosis

The phenomena listed in the following table are not abnormal.

Condition	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release (Thump : suspension; squeak: tires)
ABS operation (Long braking distance)	For road surfaces such as snow-covered and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed.
Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.	

ABS Check Sheet

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 Occurence of Problem	☐ Continuous	☐ Intermittent (times a day)

Symptoms	☐ ABS does not operate.		
	☐ ABS does not operate efficiently.		☐ Intermittent (times a day)
	ABS Warning Light Abnormal	☐ Remains ON	☐ Does not light up

Diagnostic Trouble Code Check	1st Time	☐ Normal Code	☐ Malfunction Code (Code)
	2nd Time	☐ Normal Code	☐ Malfunction Code (Code)

EJDA017A

Problem Symptoms Table

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

⚠CAUTION

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

ABS Does Not Operate.

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.	- Faulty power source circuit - Faulty wheel speed sensor circuit - Faulty hydraulic circuit for leakage - Faulty HECU

Inspection procedures

DTC Inspection

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

NO ▶ Check the power source circuit.

YES ▶ Erase the DTC and recheck using GDS.

Check the power source circuit

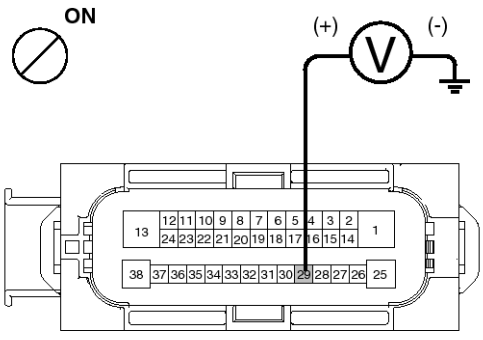
1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 29 of the ABS control module harness side connector and body ground.

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.



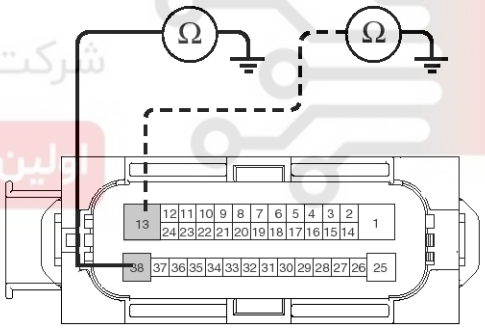
SKMBR0140D

Check the ground circuit

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 13, 38 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.



SKMBR0141D

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.

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.	- Faulty power source circuit - Faulty wheel speed sensor circuit - Faulty hydraulic circuit for leakage - Faulty HECU

Inspection procedures

DTC Inspection

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

NO ▶ Check the wheel speed sensor circuit.

YES ▶ Erase the DTC and recheck using GDS.

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

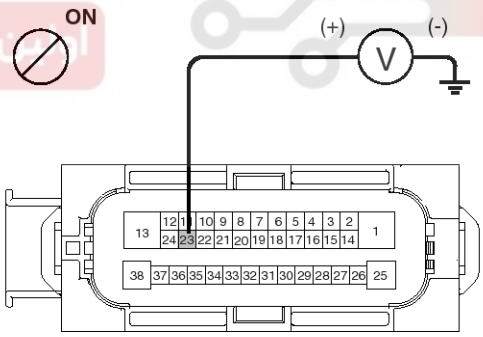
1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.
2. Measure the voltage between terminal 23 of the ABS control module harness side connector and body ground when brake pedal is depressed.

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.



SKMBR0142D

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.

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

SVIBR0321L

Detecting condition

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

Inspection procedures

Check The Power Supply Circuit For The Diagnosis

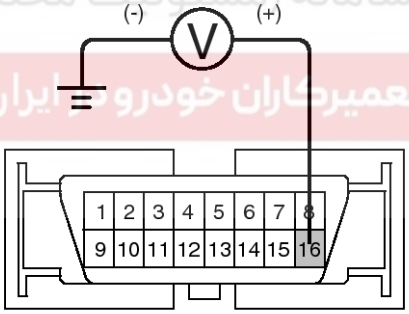
1. Measure the voltage between terminal 16 of the data link connector and body ground.

Specification : approximately B+

2. Is voltage within specification?

YES ▶ Check the ground circuit for the diagnosis.

NO ▶ Repair an open in the wire. Check and replace fuse from the engine compartment junction block.

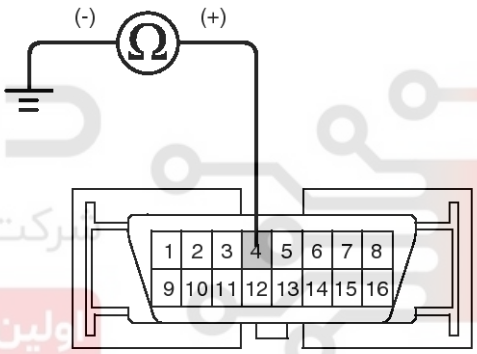


STFBR1138N

Check the ground circuit for the diagnosis

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

NO ▶ Repair an open in the wire between terminal 4 of the data link connector and ground point.



STFBR1139N

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

SVIBR0322L

Detecting condition

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

Inspection procedures

Check for Continuity in the CAN Line

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 26, 14 of the ABS control module connector and 3, 11 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

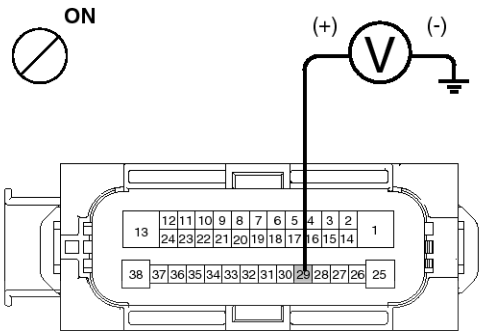
1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 29 of the ABS control module harness side connector and body ground.

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.



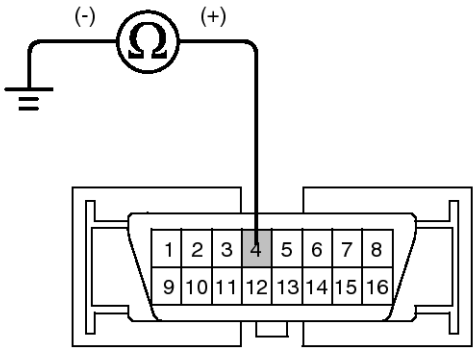
SKMBR0140D

Check for poor ground

1. Check for continuity between terminal 4 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



STFBR1139N

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.	- Faulty ABS warning lamp bulb - Blown fuse is related to ABS in the engine compartment junction block - Faulty ABS warning lamp module - Faulty HECU

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?

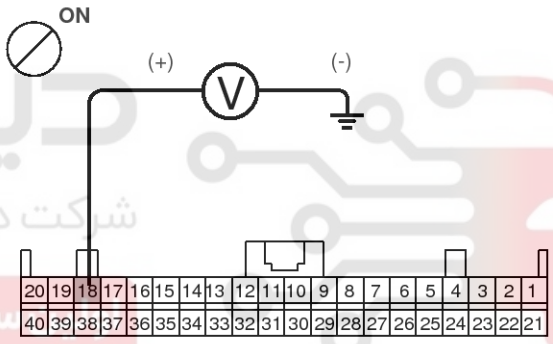
YES ▶ Inspectagain after replacing the ABS HECU.

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 (M08) and turn the ignition switch ON.
2. Measure the voltage between terminal (M08) 18 of the cluster harness side connector and body ground.

Specification : approximately B+



STFBR1135D

3. Is voltage within specification?

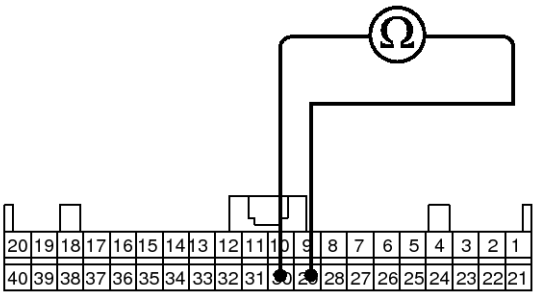
YES ▶ Check the CAN circuit resistance for ABS warning lamp.

NO ▶ Check for blown fuse.

Check the CAN circuit resistance for ABS warning lamp

1. Disconnect the instrument cluster connector (M08) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M08) 29 and 30 of the cluster harness side connector.

Specification : 60Ω



STFBR1136D

3. Is resistance within specification?

YES ▶ Repair ABS warning lamp bulb or instrument cluster assembly.

NO ▶ Check the CAN circuit wiring for ABS warning lamp.

Check the CAN circuit wiring for ABS warning lamp

1. Disconnect the instrument cluster connector (M08) and ABS HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M08) 29 of the cluster harness side connector and terminal 26 of ABS HECU harness side.

   Check for continuity between terminal (M08) 30 of the cluster harness side connector and terminal 14 of ABS HECU harness side.

Specification : Below 1Ω

3. Is resistance within specification?

YES ▶ Repair short of wiring between terminal 26, 14 of ABS HECU harness connector and ABS warning lamp module.

NO ▶ Repair open of wiring between terminal 26, 14 of ABS HECU harness connector and ABS warning lamp module.

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.	- An open in the wire - Faulty instrument cluster assembly - Faulty ABS warning lamp module - Faulty HECU

Inspection procedures

Check DTC Output

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

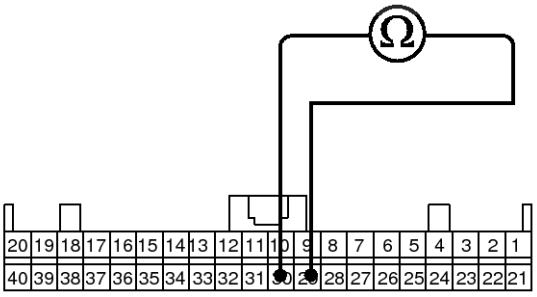
YES ▶ Perform the DTC troubleshooting procedure (Refer to DTC troubleshooting).

NO ▶ Check the CAN circuit resistance for ABS warning lamp.

Check the CAN circuit resistance for ABS warning lamp

1. Disconnect the instrument cluster connector (M08) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M08) 29 and 30 of the cluster harness side connector.

Specification : 60Ω



STFBR1136D

3. Is resistance within specification?

YES ▶ Repair ABS warning lamp bulb or instrument cluster assembly.

NO ▶ Check the CAN circuit wiring for ABS warning lamp.

Check the CAN circuit wiring for ABS warning lamp

1. Disconnect the instrument cluster connector (M08) and ABS HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M08) 29 of the cluster harness side connector and terminal 26 of ABS HECU harness side.

   Check for continuity between terminal (M08) 30 of the cluster harness side connector and terminal 14 of ABS HECU harness side.

Specification : Below 1Ω

3. Is resistance within specification?

YES ▶ Repair short of wiring between terminal 26, 14 of ABS HECU harness connector and ABS warning lamp module.

NO ▶ Repair open of wiring between terminal 26, 14 of ABS HECU harness connector and ABS warning lamp module.

Bleeding of Brake System

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

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

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

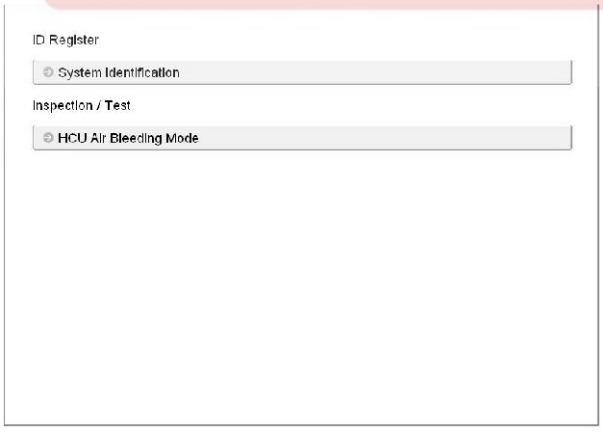
   NOTICE
   When pressure bleeding, do not depress the brake pedal.

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

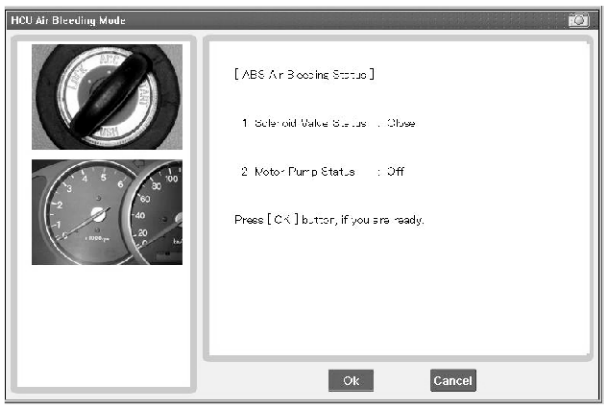
   ⚠CAUTION
   You must obey the maximum operating time of the ABS motor with the GDS to prevent the motor pump from burning.

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



SBKBR9141N

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

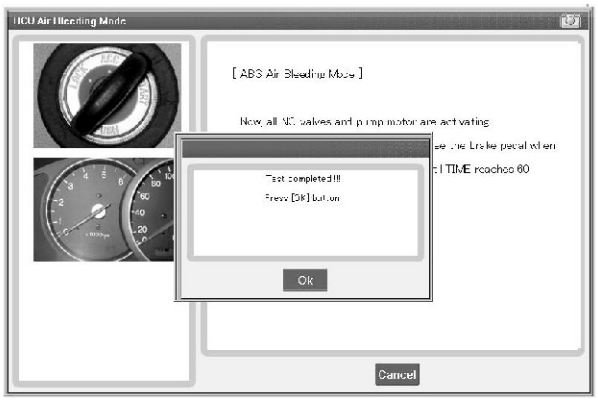


SBKBR9142N

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

SBKBR9143N

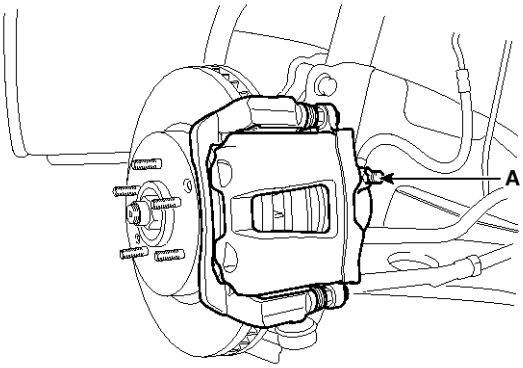
   6) Perform the air bleeding.



SBKBR9144N

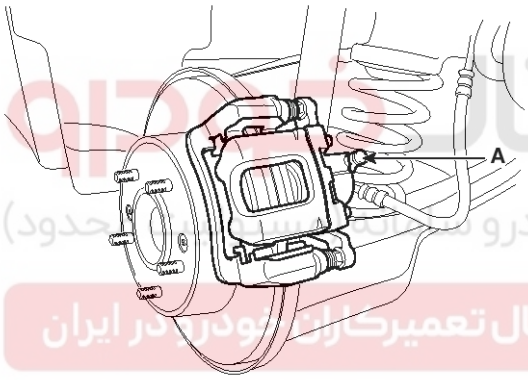
5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw(A).

Front



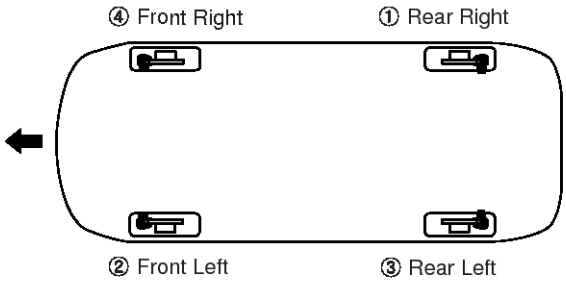
STFBR1001D

Rear



STFBR1002D

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



SKMBR7302L

7. Tighten the bleeder screw.

Bleed screw tightening torque:
7 ~ 13 N.m (0.7 ~ 1.3 kgf.m, 5.4 ~ 9.5 lb-ft)

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 maximum braking effectiveness by the rear wheels.

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

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

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

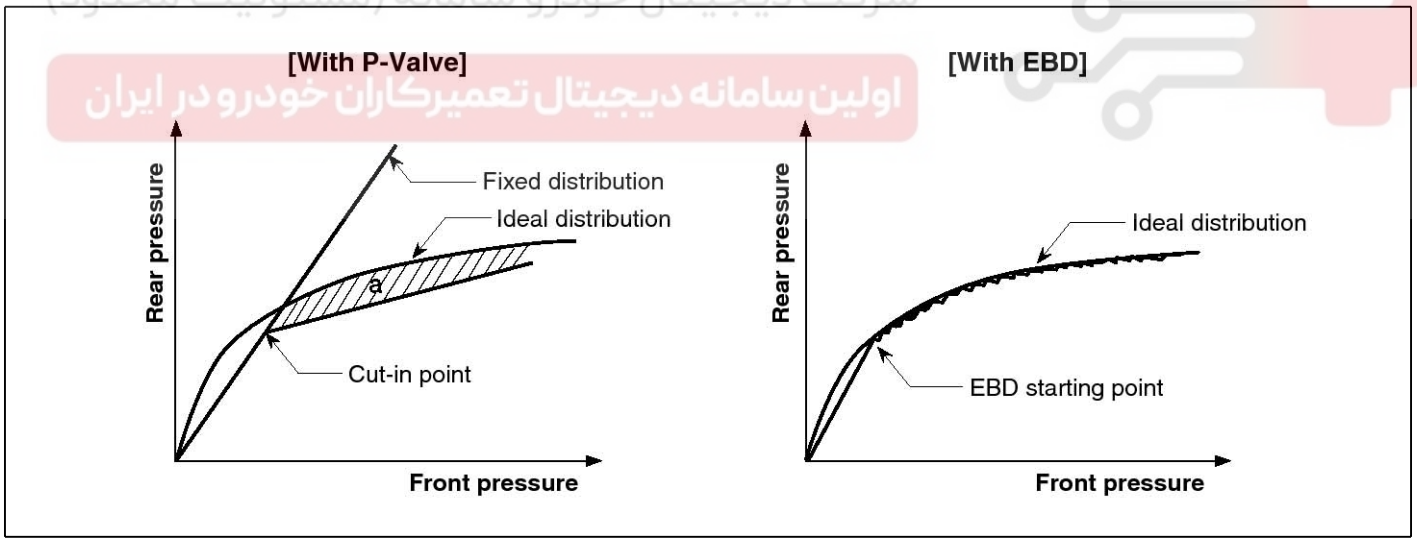
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

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

Advantages

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

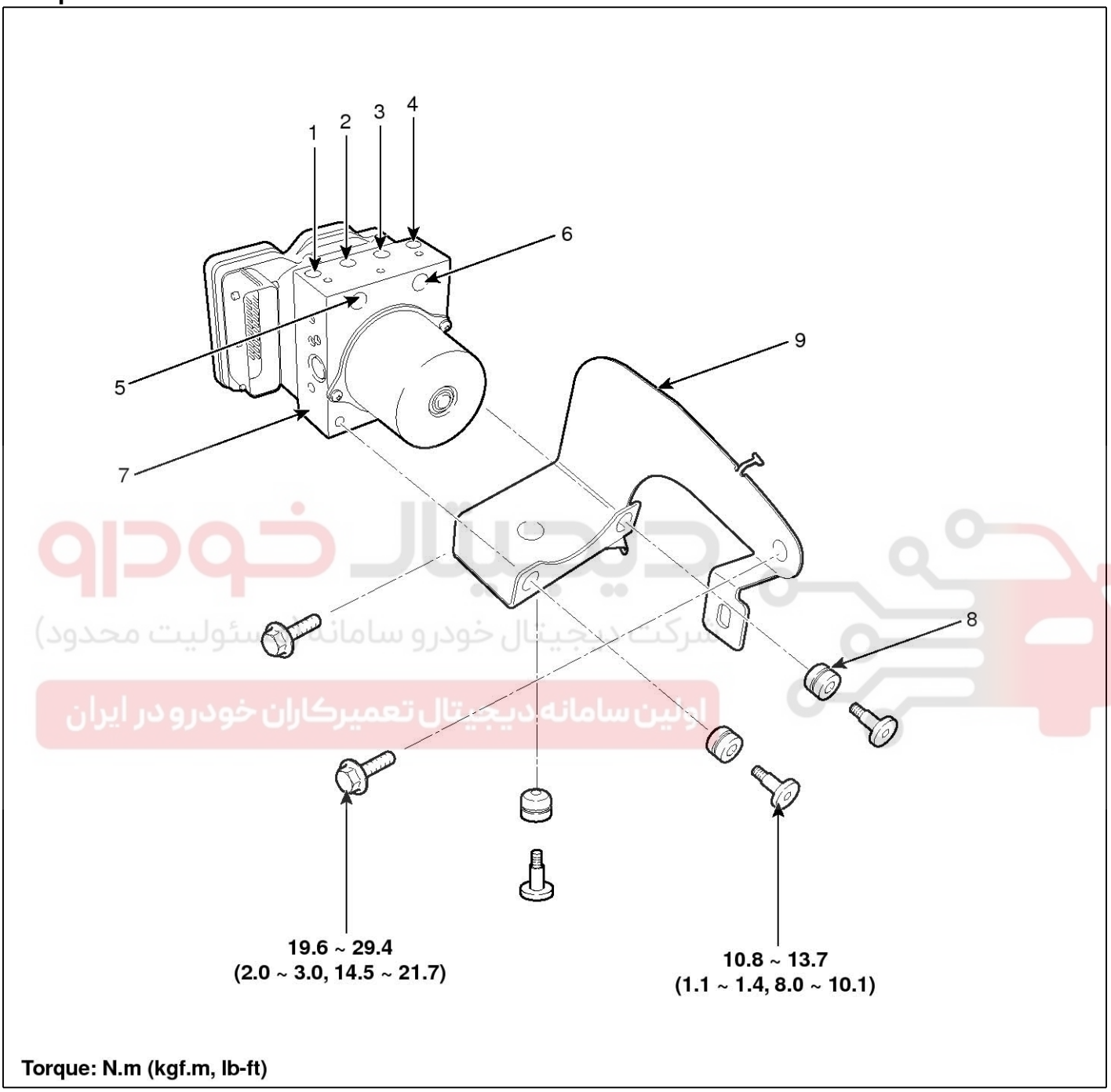
Comparison between Proportioning Valve and EBD



EJA0032A

ABS Control Module

Components

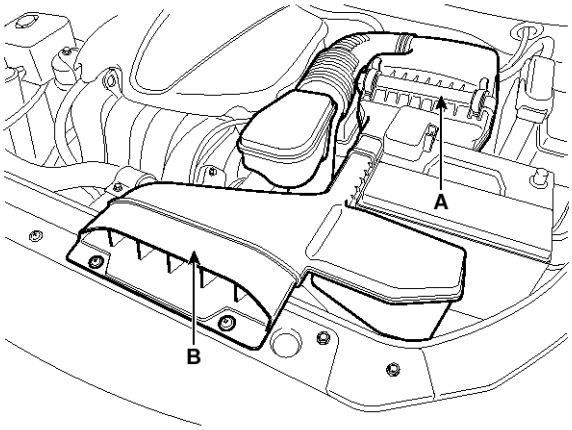


STFBR1160N

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

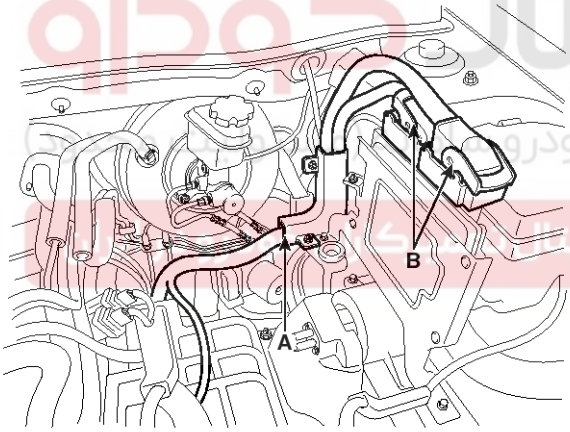
Removal

1. Turn the ignition switch OFF.
2. Remove the air duct (B) and air cleaner assembly (A).



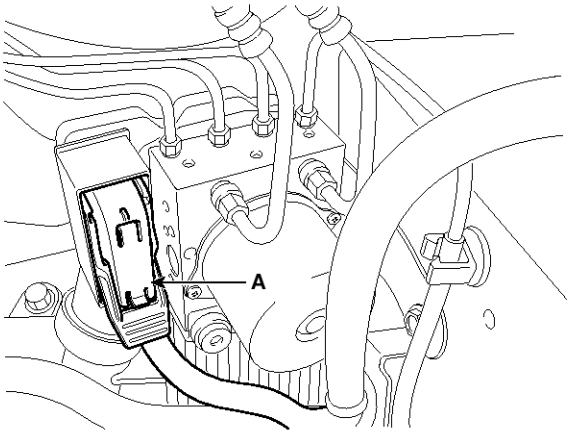
STFBR1011D

3. Remove the ECM connector (B) and the arrange the wiring harness (A).



STFBR1162N

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



STFBR1162D

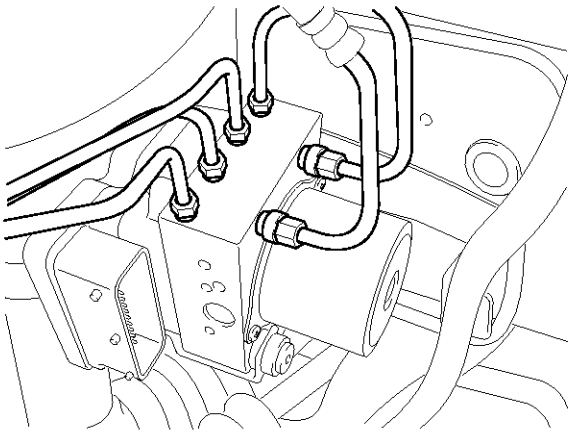
5. Remove the brake fluid from the master cylinder reservoir with a syringe.

⚠CAUTION

- **Be sure to completely remove foreign substances from around brake fluid reservoir and cap before opening the reservoir cap. If not, it may cause contamination of brake fluid and deterioration in braking performance.**
- **Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.**

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

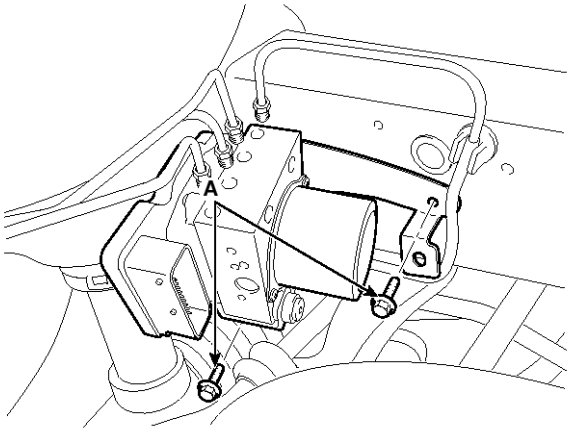
Tightening torque:
M10: 11.7 ~ 15.7 N.m (1.2 ~ 1.6 kgf.m, 8.7 ~ 11.6 lb-ft)
M12: 18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



STFBR1163D

7. Loosen the HECU bracket bolts (A), then remove HECU and bracket.

Tightening torque :
19.6 ~ 29.4 N.m(2.0 ~ 3.0 kgf.m, 14.5 ~ 21.7 lb-ft)



STFBR1164D

CAUTION

1. **Never attempt to disassemble the HECU.**
2. **Never shock the HECU.**

8. Remove the 2 nuts (B), then remove the bracket from HECU.

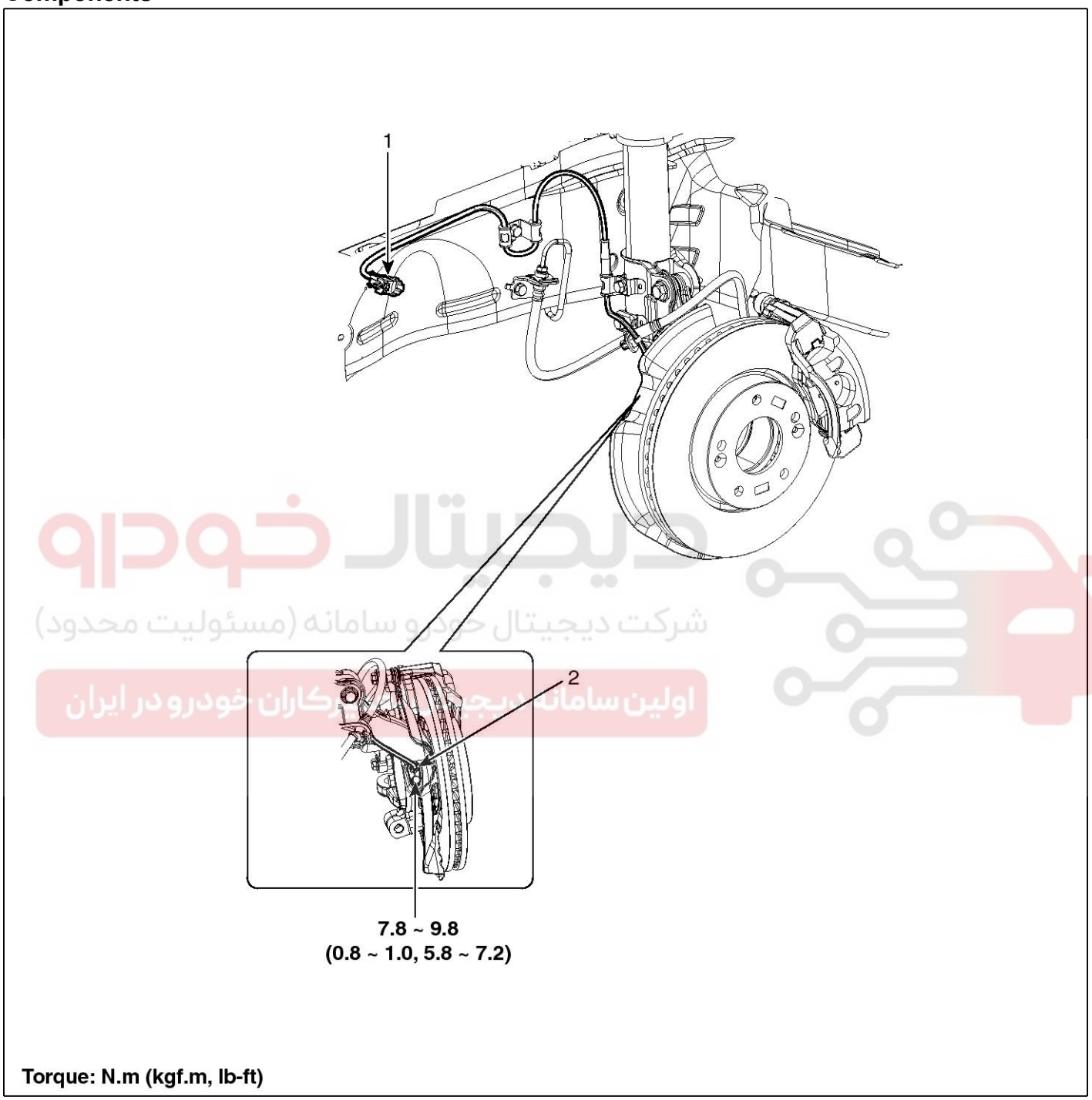
Tightening torque :
10.8 ~ 13.7 N.m (1.1 ~ 1.4 kgf.m, 8.0 ~ 10.1 lb-ft)

Installation

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

Front Wheel Speed Sensor

Components



SYFBR0170N

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

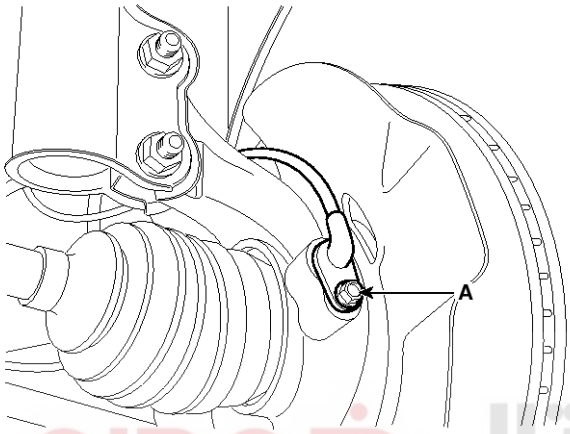
Removal

1. Remove the front wheel and tire.

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

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

Tightening torque:
7.8 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.8 ~ 7.2 lb-ft)



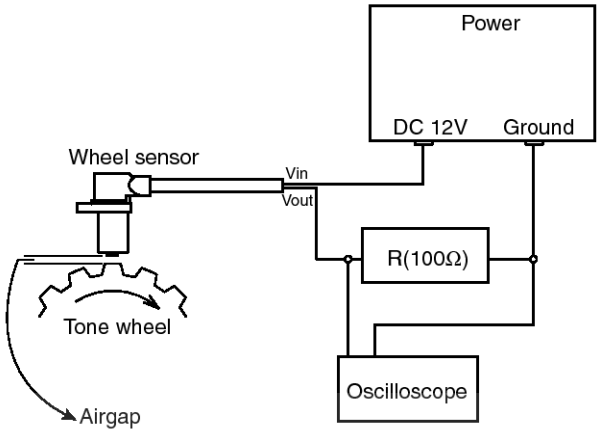
STFBR1171D

3. Remove the front wheel guard .
4. Remove the front wheel speed sensor cable mounting bolt.
5. Disconnect the front wheel speed sensor connector, then remove the front wheel speed sensor.
6. Installation is the reverse of removal.

Inspection

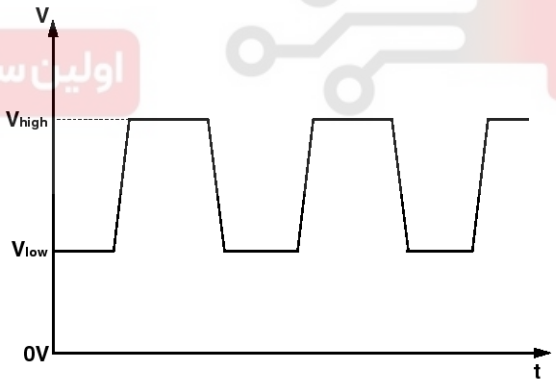
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

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



SYFBR0172N

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

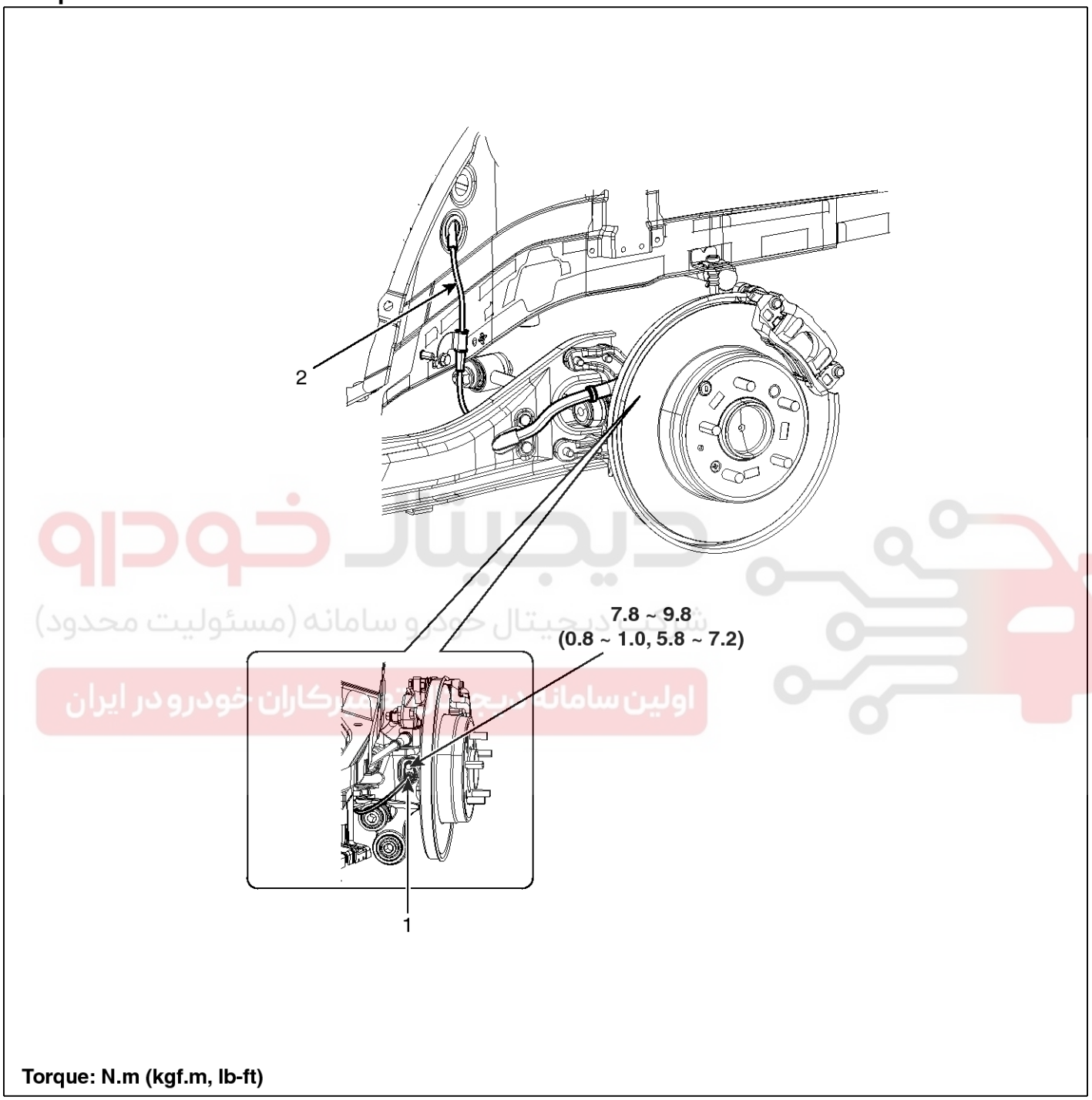


ARJE503Z

V_low : 0.59V ~ 0.84V
V_high : 1.18V ~ 1.68V
Frequency range : 1 ~ 2,500Hz

Rear Wheel Speed Sensor

Components



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

SYFBR0180N

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

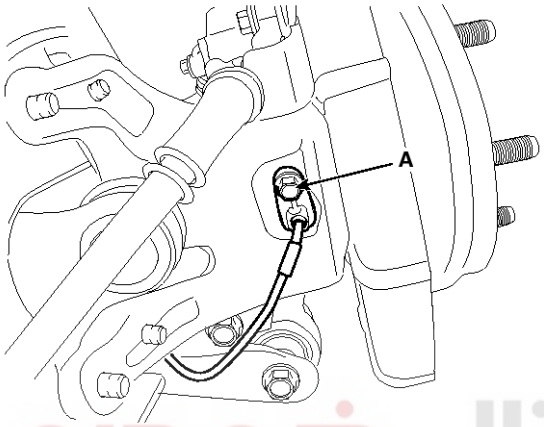
Removal

1. Remove the rear wheel and tire.

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

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

Tightening torque:
7.8 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.8 ~ 7.2 lb-ft)



SYFBR0181D

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

⚠CAUTION

Install the rear sensor after lubricating the O-ring of sensor with the assembly fluid(RAREMAX AF-1).

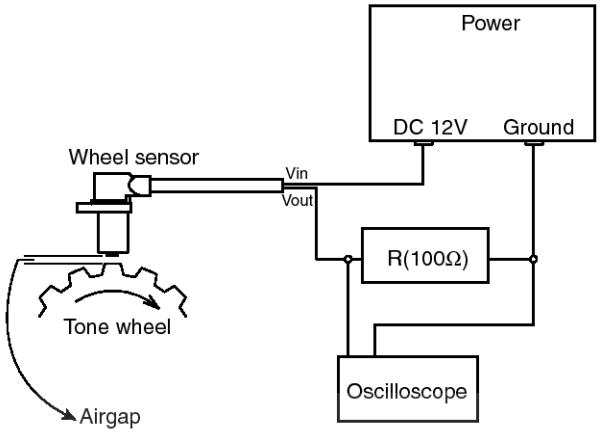
When inserting the sensor, take care the O-ring not to be damaged.

Inspection

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

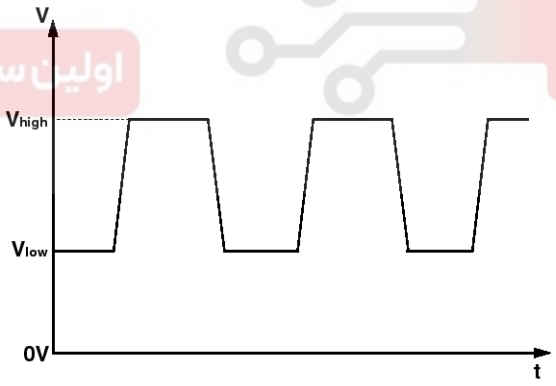
⚠CAUTION

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



SYFBR0172N

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

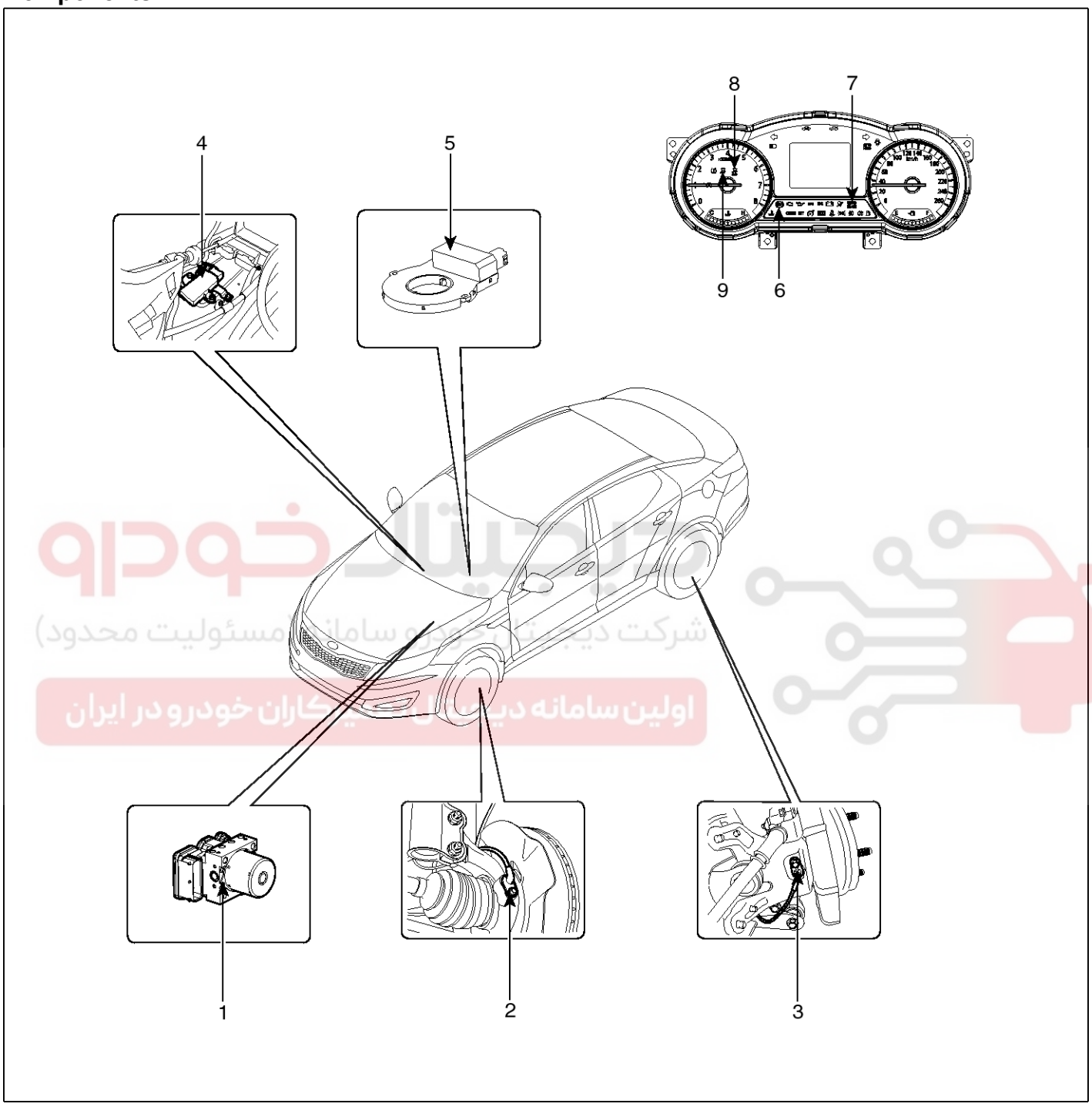


ARJE503Z

V_low : 0.59V ~ 0.84V
V_high : 1.18V ~ 1.68V
Frequency range : 1 ~ 2,500Hz

ESP(Electronic Stability Program) System

Components



STFBR1200D

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

Description of ESP

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

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

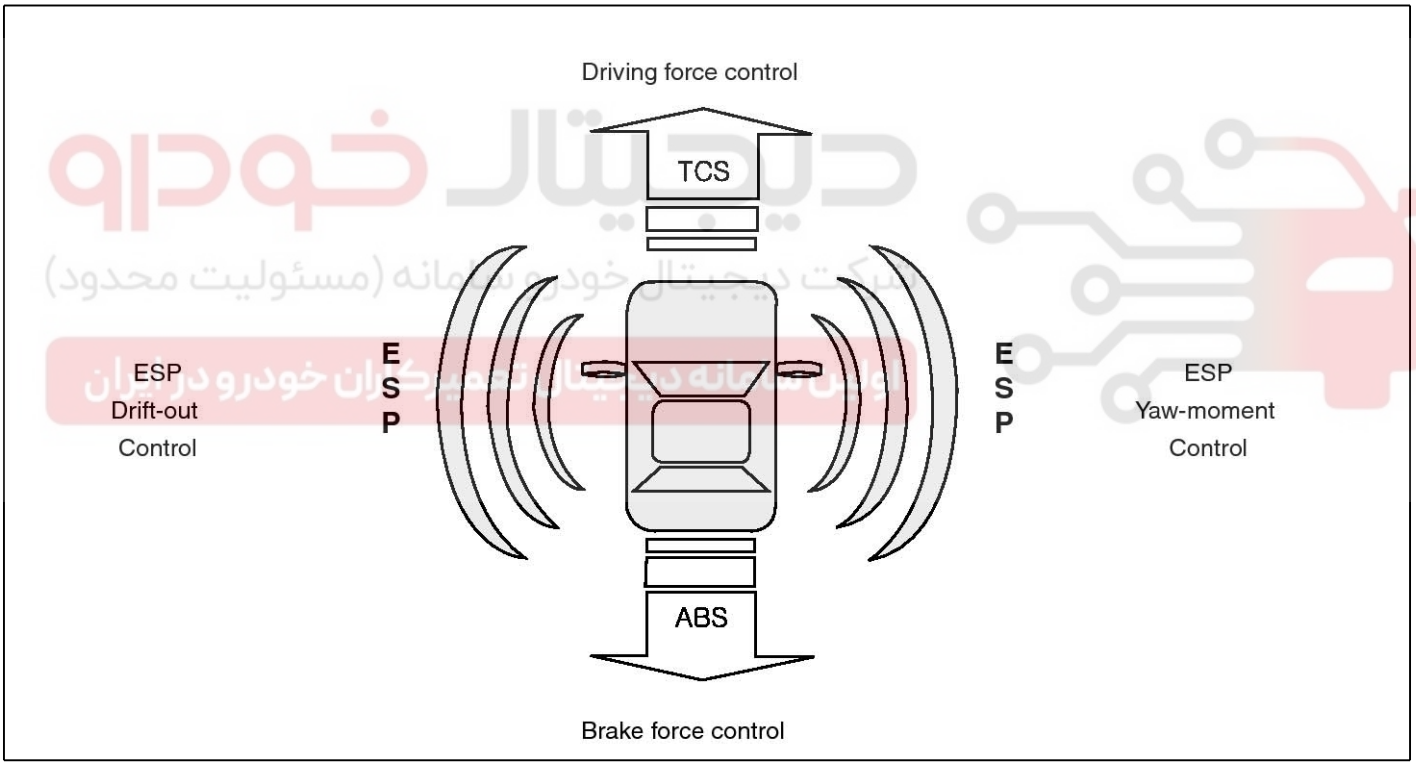
ESP adds a further function known as Active Yaw Control (AYC) to the ABS, TCS, EBD and ESP functions. Whereas the ABS/TCS function controls wheel slip during braking and acceleration and, thus, mainly intervenes in the longitudinal dynamics of the vehicle, active yaw control stabilizes the vehicle about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

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

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

The stability control feature works under all driving and operating conditions. Under certain driving conditions, the ABS/TCS function can be activated simultaneously with the 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.



LJCD201A

Description of ESP Control

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

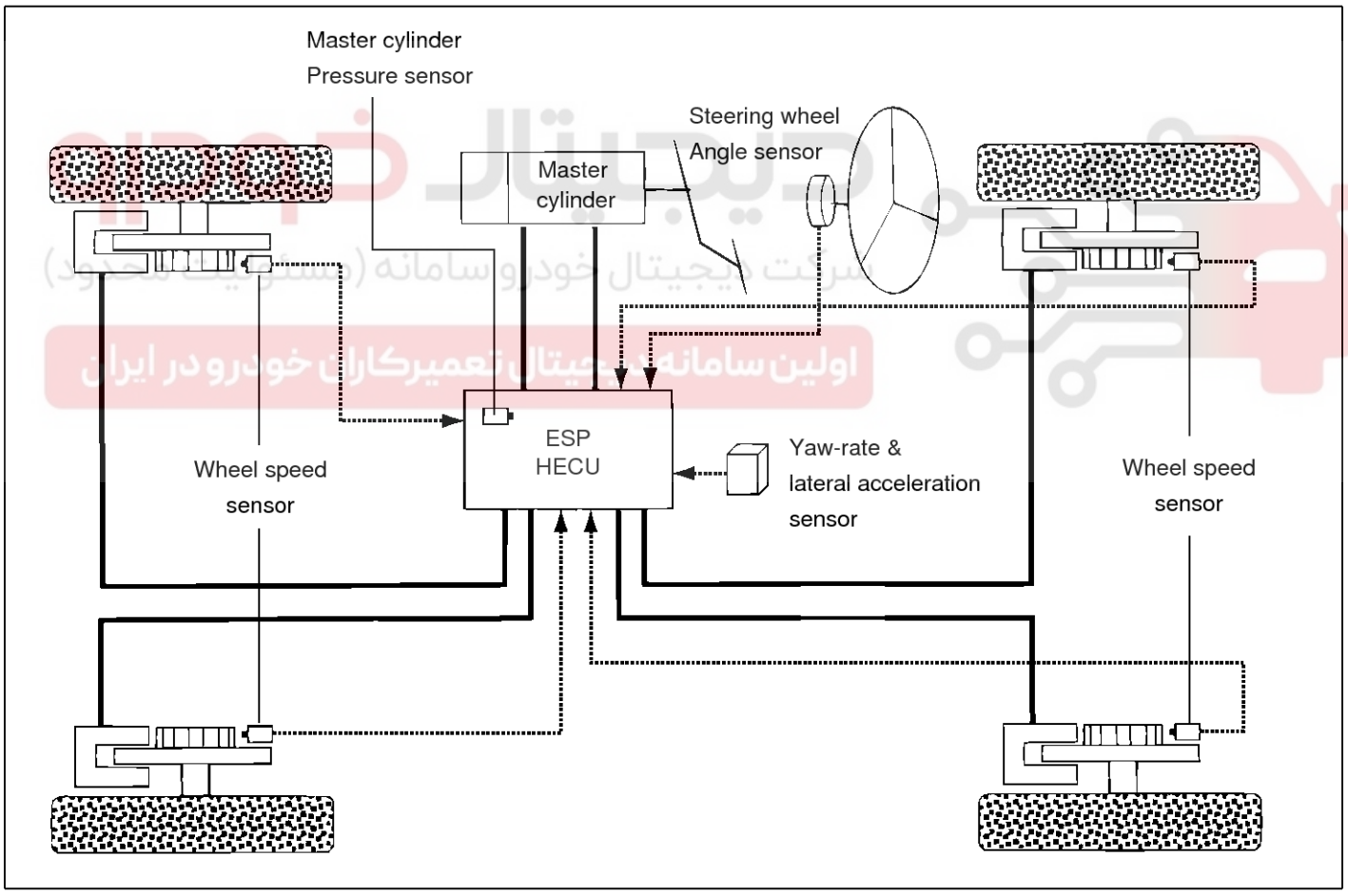
ABS/EBD function : The ECU changes the active sensor signal (current shift) coming from the four wheel sensors to the square wave. By using the input of above signals, the ECU calculates the vehicle speed and the acceleration & deceleration of the four wheels. And, the ECU judges whether the ABS/EBD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



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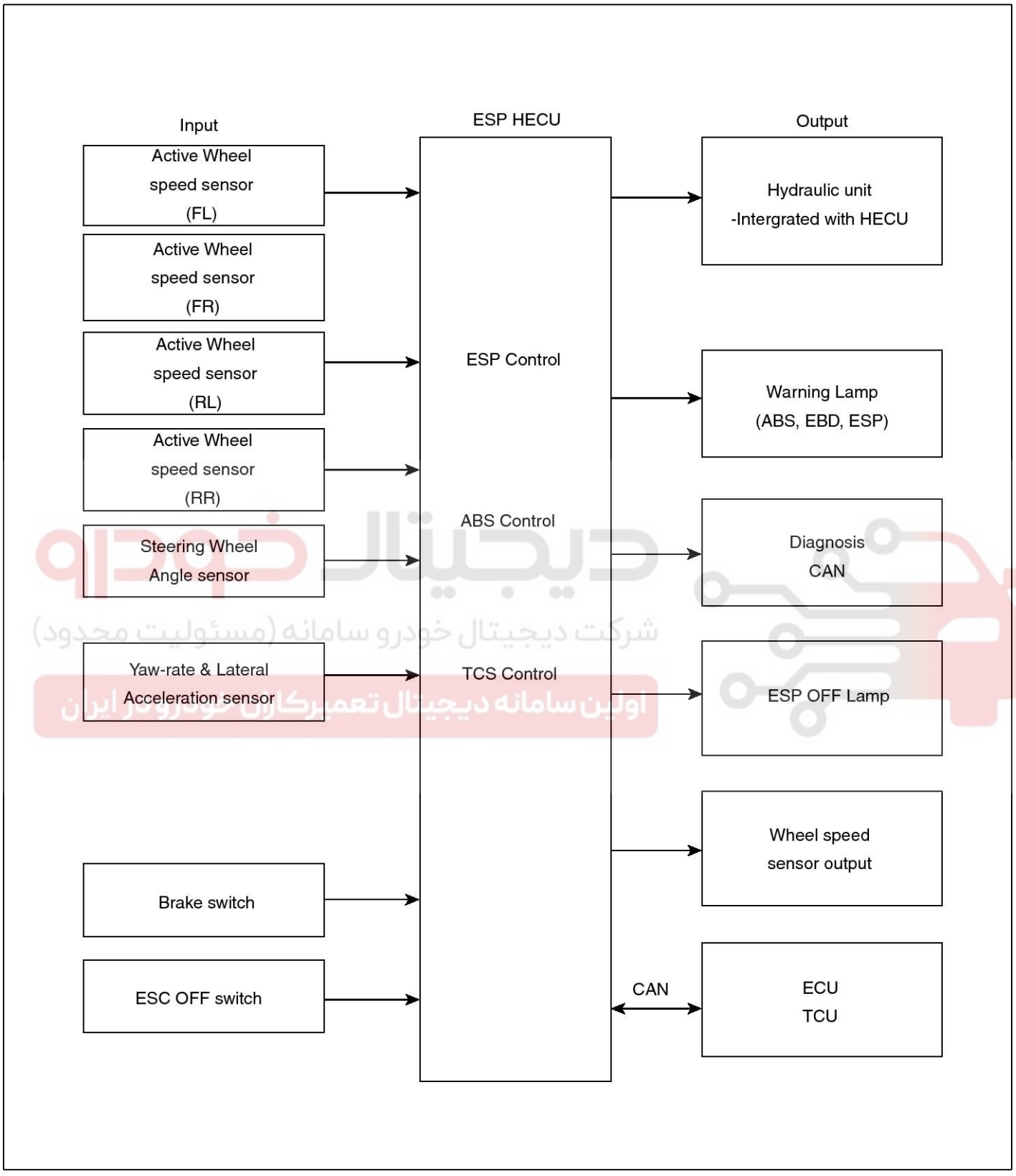
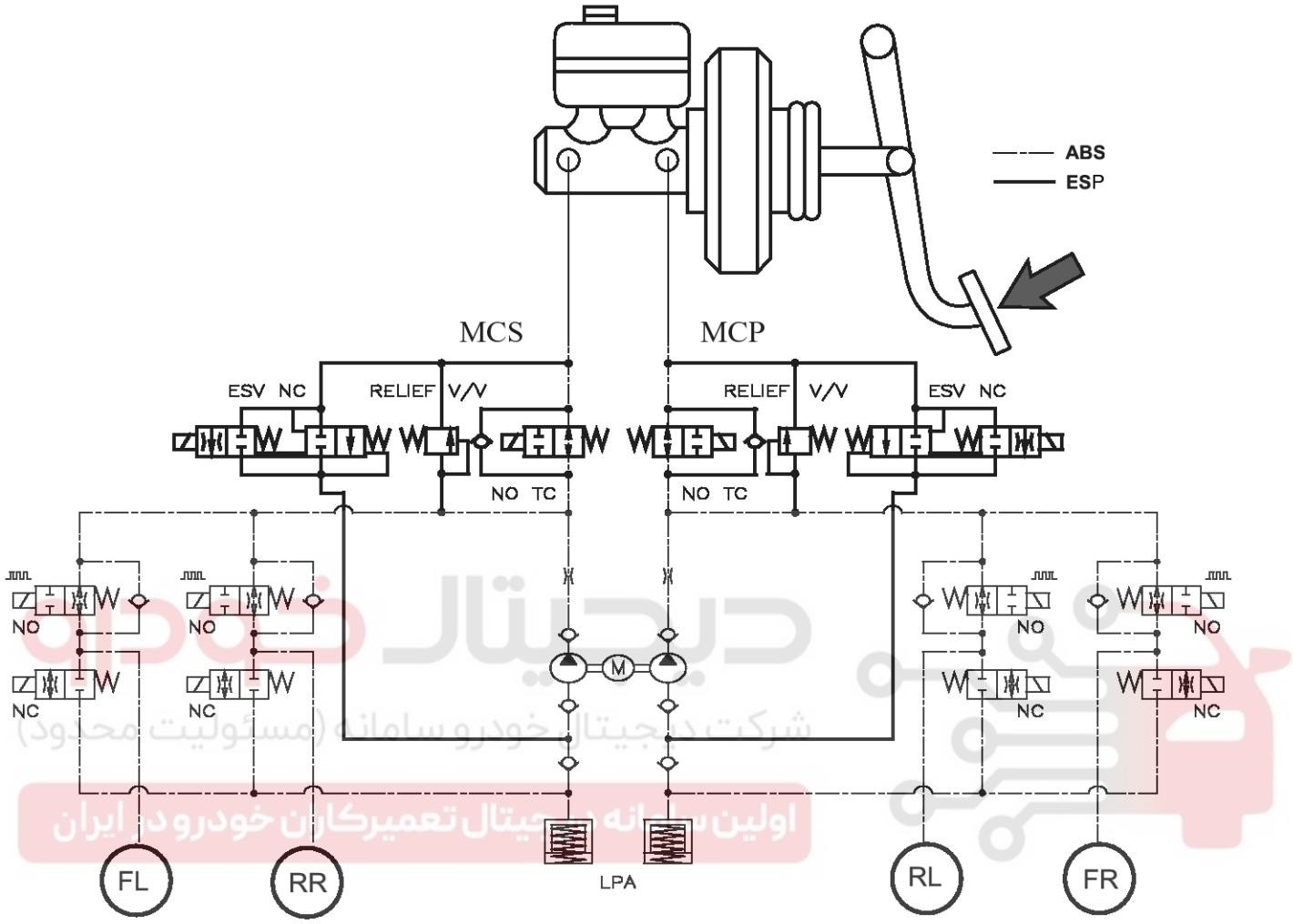
Input and Output Diagram



STFBR1209L

ESP Operation Mode

ESP Hydraulic System Diagram



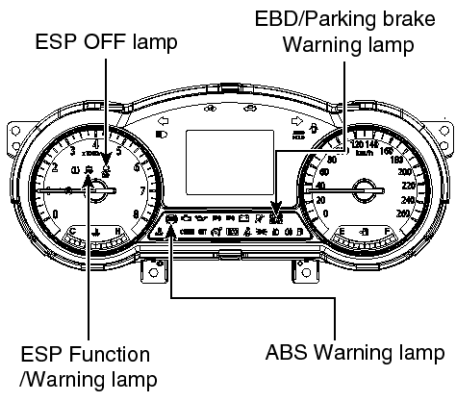
LJJF501P

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



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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 seperated from ECU.
- Cluster lamp is ON when communication is impossible with CAN module.

EBD/Parking Brake Warning Lamp Module

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

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the Parking Brake Switch is ON or brake fluid level is low.
- When the EBD function is out of order .
- During diagnostic mode.
- When the ECU Connector is seperated from ECU.
- Cluster lamp is ON when communication is impossible with CAN module.

ESP Function/Warning Lamp (ESP system)

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

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

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

ESP Off Lamp (ESP system)

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

The ESP Off lamp operates under the following conditions :

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

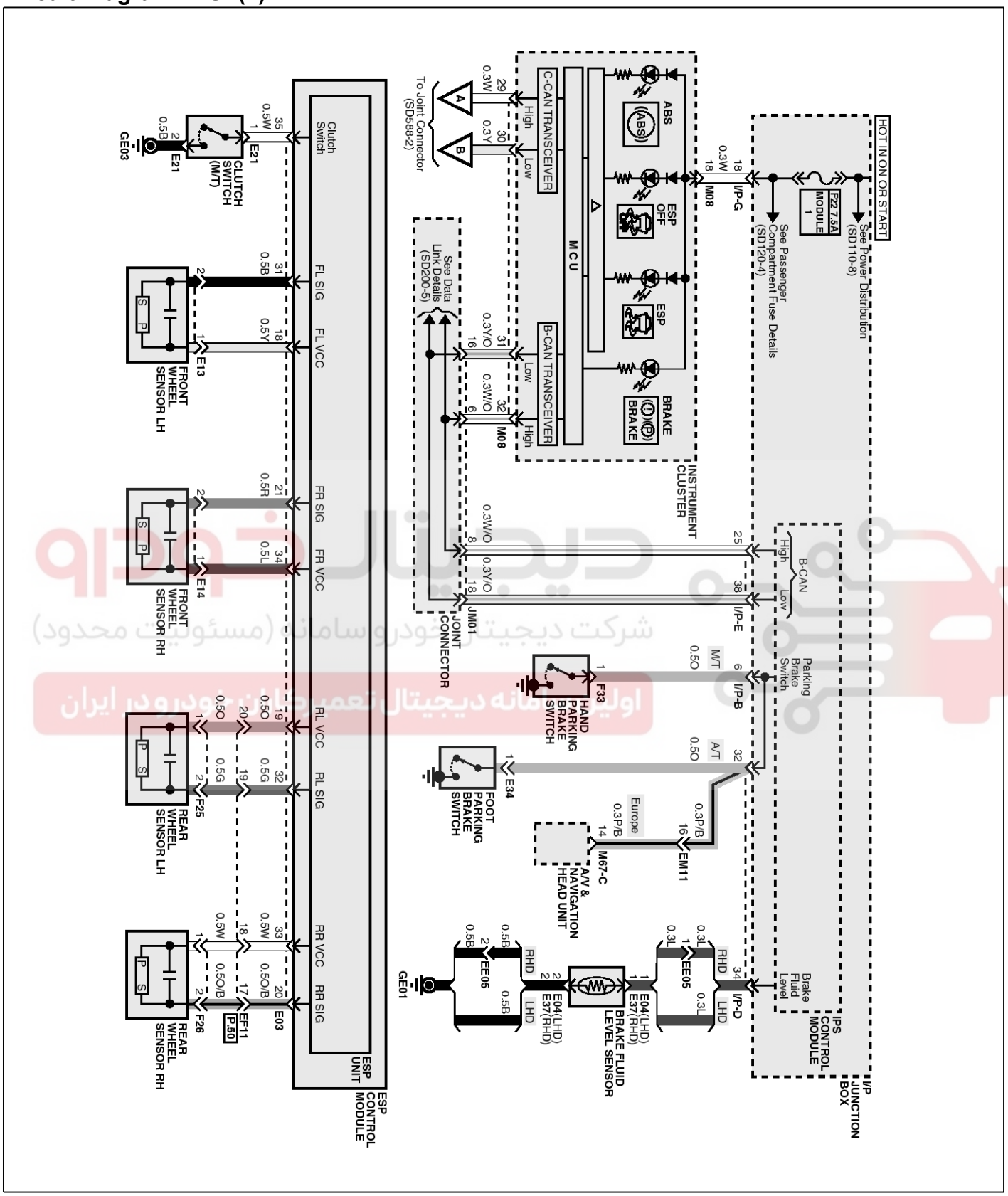
ESP On/Off Switch (ESP system)

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.

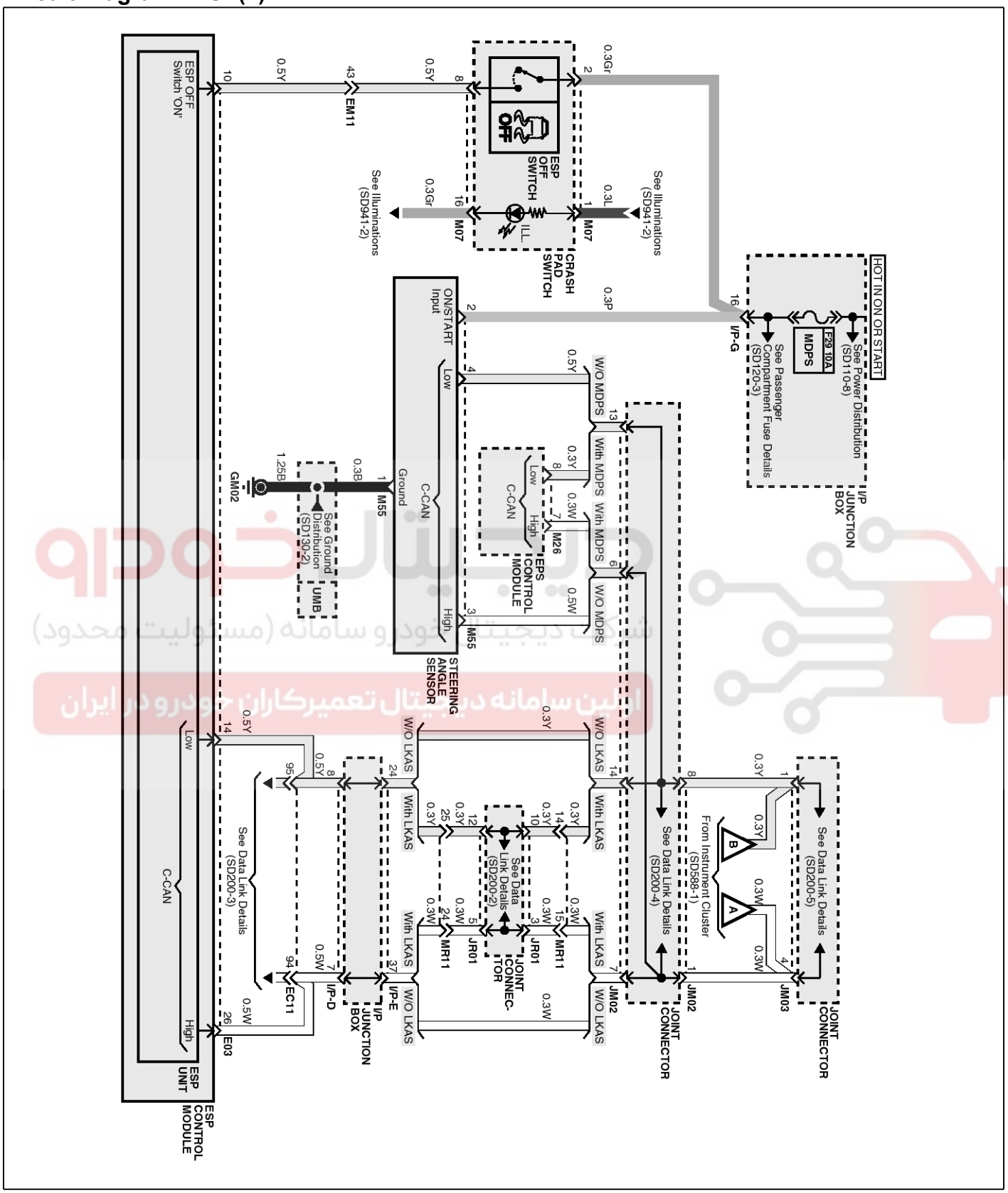
Initial status of the ESP function is on and switch toggle the state.

Circuit Diagram - ESP(1)



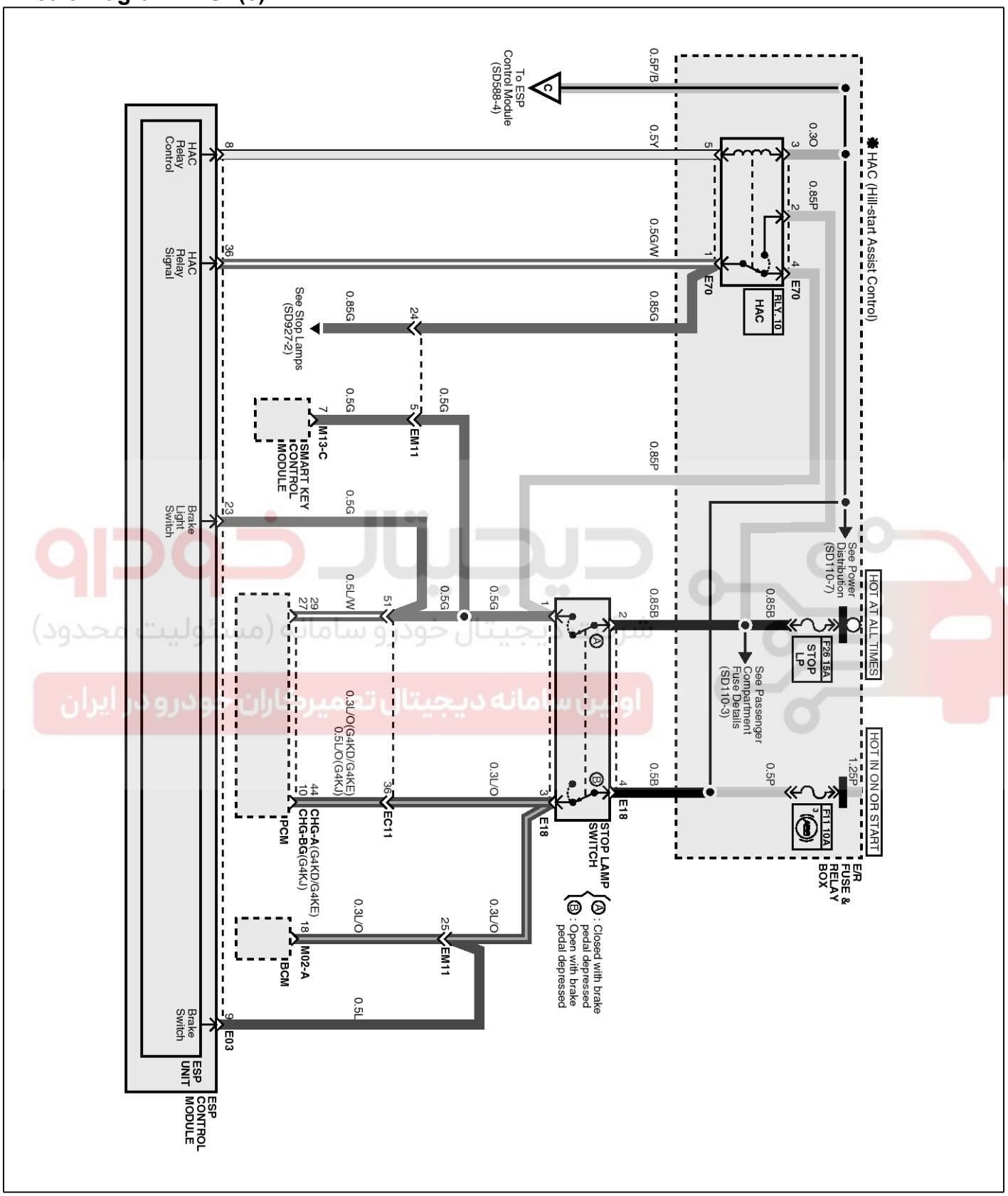
STFBR1202L

Circuit Diagram - ESP(2)



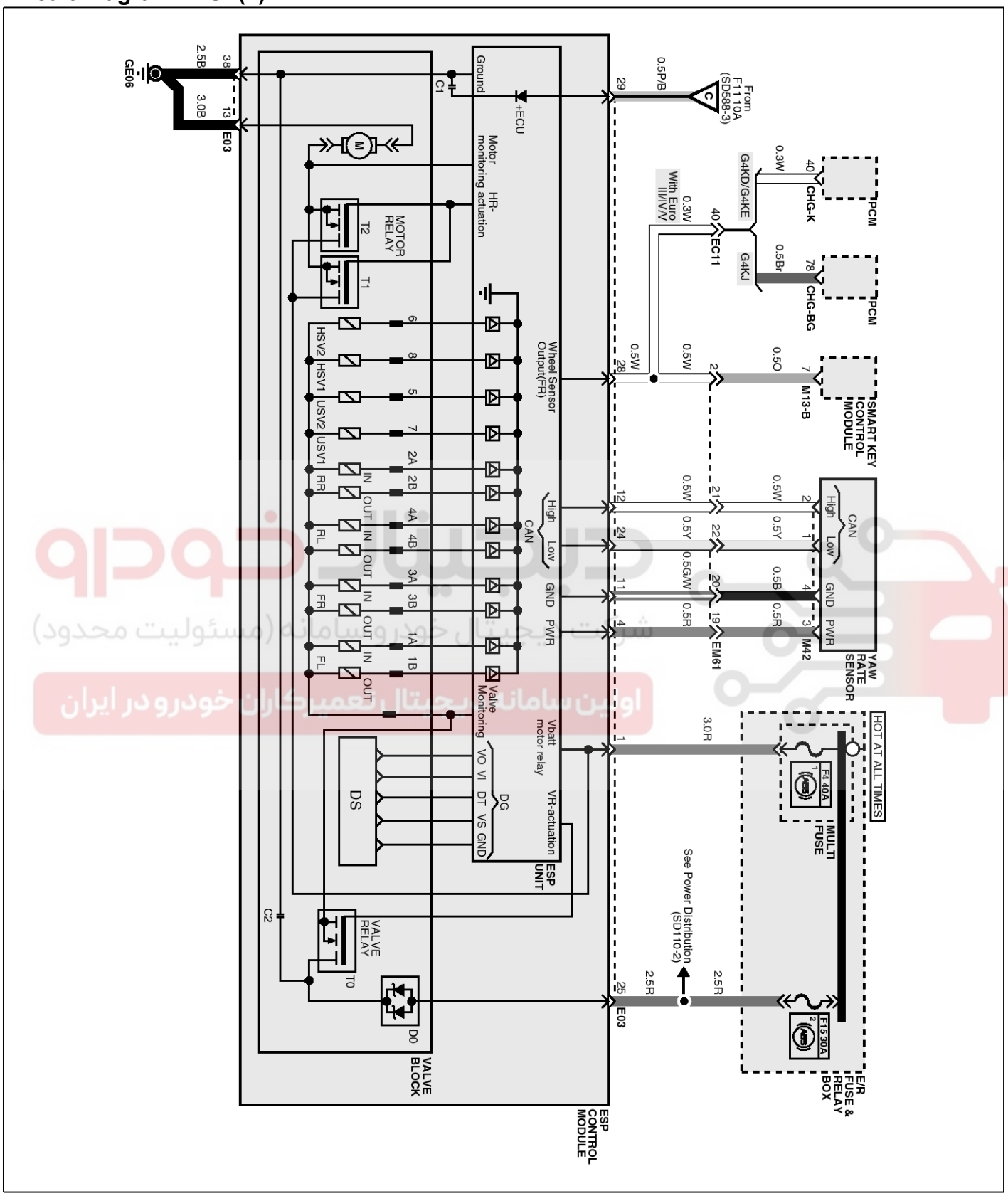
STFBR1203L

Circuit Diagram - ESP(3)



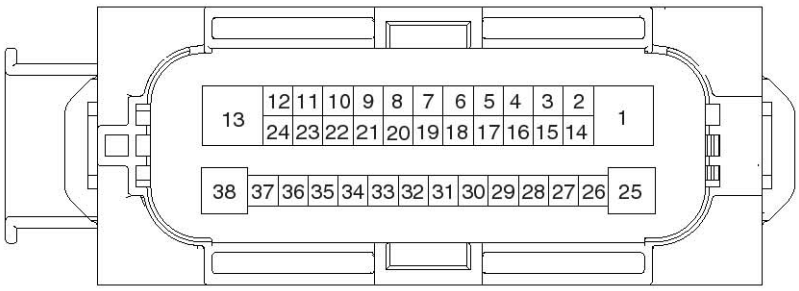
STFBR1204L

Circuit Diagram - ESP(4)



STFBR1205L

ESP connector input/output



SKMBR0134D

Connector Terminal		Specification	Remark
No	Description		
29	IGNITION1(+)	High level of wake up voltage : 4.5V < V < 16.0V Low level of wake up voltage : V < 2.4V Max. current : I < 50mA	
25	POS. BATTERY 1.(SOLENOID)	Over voltage range : 17.0 ± 0.5V Operating voltage range : 10.0 ± 0.5V < V < 16.0 ± 0.5V Low voltage range : 7.0 ± 0.5V < V < 9.5 ± 0.5V Max. current : I < 40A Max. leakage current : I < 0.25mA	
1	POS. BATTERY 2.(MOTOR)	Operating voltage range: 10.0 ± 0.5V < V < 16.0 ± 0.5V Rush current : I < 110A Max current : I < 40A Max leakage current : I < 0.25mA	
38	GROUND	Rated current : I < 550mA Max. current: I < 40A	
13	PUMP MOTOR GROUND	Rush current : I < 110A Max current : I < 40A	
11	SENSOR GROUND	Rated current : I < 250mA	
4	SENSOR POWER	Max current Capability : I < 250mA Max voltage : V_BAT1 -0.8V	
23	BRAKE LIGHT SWITCH	Input voltage (Low) : V < 2V Input voltage (High) : V > 6V Max. Input current : I < 3mA (@12.8V)	
9	BRAKE SWITCH		

Connector Terminal		Specification	Remark
No	Description		
35	CLUTCH SWITCH (M/T Only)	Input voltage (Low) : V < 2V Input voltage (High) : V > 6V Max input current : I < 5mA (@12.8V)	
28	SENSOR FRONT RIGHT OUTPUT	External pull up resistance : 1 KΩ < R Output duty :50 ± 20%	
10	ESP ON/OFF SWITCH	Input voltage (Low) : V < 2V Input voltage (High) : V > 6V Max input current : I <3mA	
14	CAN BUS LINE(LOW)	Max. Input current : I < 10mA	
26	CAN BUS LINE(HIGH)		
18	SENSOR FRONT LEFT POWER	Output voltage : V_BAT1 -0.6V ~ V_BAT1 -1.1V Output current : Max 30mA	
34	SENSOR FRONT RIGHT POWER		
19	SENSOR REAR LEFT POWER		
33	SENSOR REAR RIGHT POWER		
31	SENSOR FRONT LEFT SIGNAL	Input current LOW : 5.9 ~ 8.4mA Input current HIGH : 11.8 ~ 16.8mA Frequency range : 1 ~ 2500Hz Input duty : 50 ± 10%	Typ. 7mA Typ. 14mA
21	SENSOR FRONT RIGHT SIGNAL		
32	SENSOR REAR LEFT SIGNAL		
20	SENSOR REAR RIGHT SIGNAL		
12	CAN SENSOR LINE (HIGH)	Max. input current : I < 10mA	
24	CAN SENSOR LINE (LOW)		
8	BRAKE RELAY	Max. Current : I < 180mA Max.Output Low Voltage : V < 1.2V	
36	RELAY STATE MONITORING	Input voltage (Low) : V < 2V Input voltage (High) : V > 6V Max. Input current : I < 10mA	

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 warning lamp turn on for 3sec after IGN ON.
2. ESP function lamp blinks when ESP Act.
3. If ESP fail occured, ESP warning turns ON.
4. ESP OFF lamp turn on in case of
   - ESP Switch OFF
   - 3sec after IGN ON

Yaw-rate and G Sensor

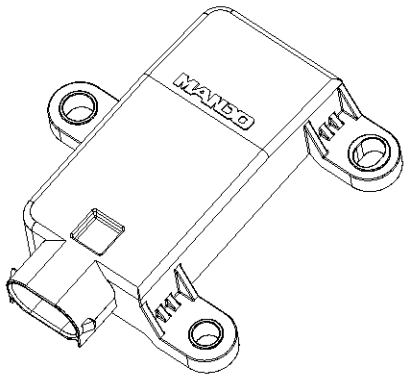
Description

When the vehicle is turning with respect to a vertical axis the yaw rate sensor detects the yaw rate electroniclly 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 leverarm by later G.

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

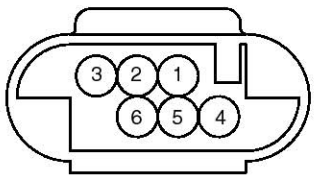


SKMBR0230D

Specifications

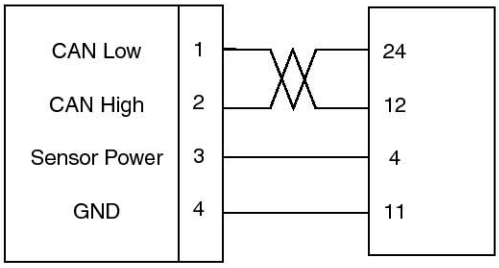
Description		Specification	Remarks
Operating voltage		10 ~ 16V	
Output signal		CAN Interface	
Current Consumption		Max.140mA	
Operating temperature		-40 ~ 85°C (-40 ~ 185°F)	
Yaw-rate sensor	Measurement range	-75 ~ 75°/sec	
	Frequency response	15 ~ 45Hz	
Lateral G sensor	Measurement range	-14.715 ~ 14.715m/s²	
	Frequency response	50Hz ± 60% (±3dB)	

External Diagram



(Yaw-rate & G sensor)

[Harness Connector]



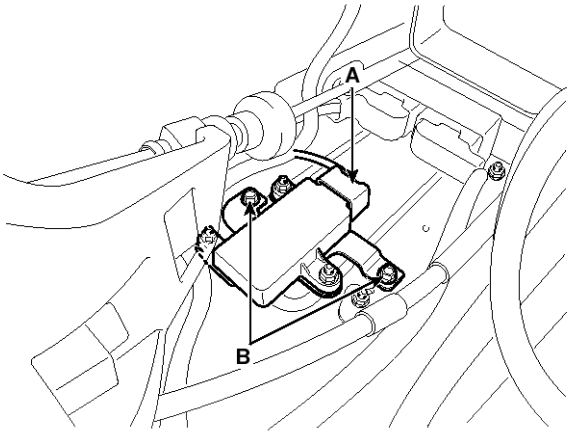
Yaw-rate & G sensor

ESP HECU

SLMBR0232L

Removal

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



STFBR1231D

4. Remove the mounting bolts (B).

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

5. Installation is the reverse of removal.

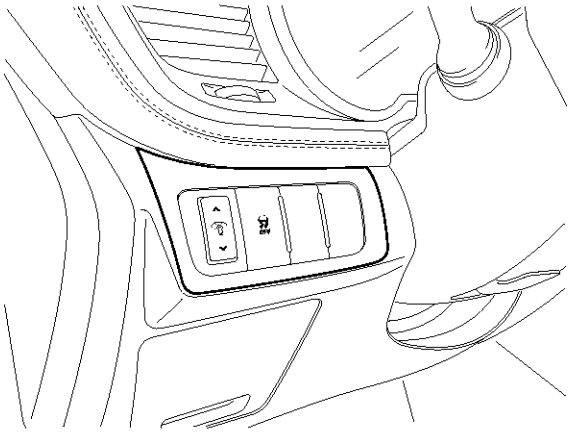
ESP OFF Switch

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 crash pad side switch assembly.



STFBR1250D

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

Terminal / Position	2	8	16	1
ON	○	○	○	○
OFF			○	○

STFBR1251N

Steering Angle Sensor (MDPS Only)

Description

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

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

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

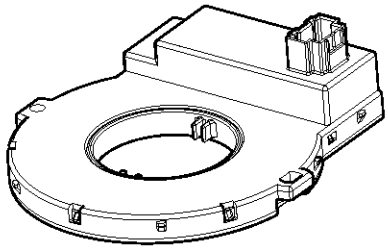
Components (Steering Angle Sensor, Torque Sensor, Failsafe relay, etc.) of the EPS system are located inside the steering column & EPS unit assembly and the steering column. EPS unit assembly must not be disassembled to be inspected. They must be replaced. (Refer to “ST (Steering system) Gr.”)

Steering Angle Sensor (Except MDPS)

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.

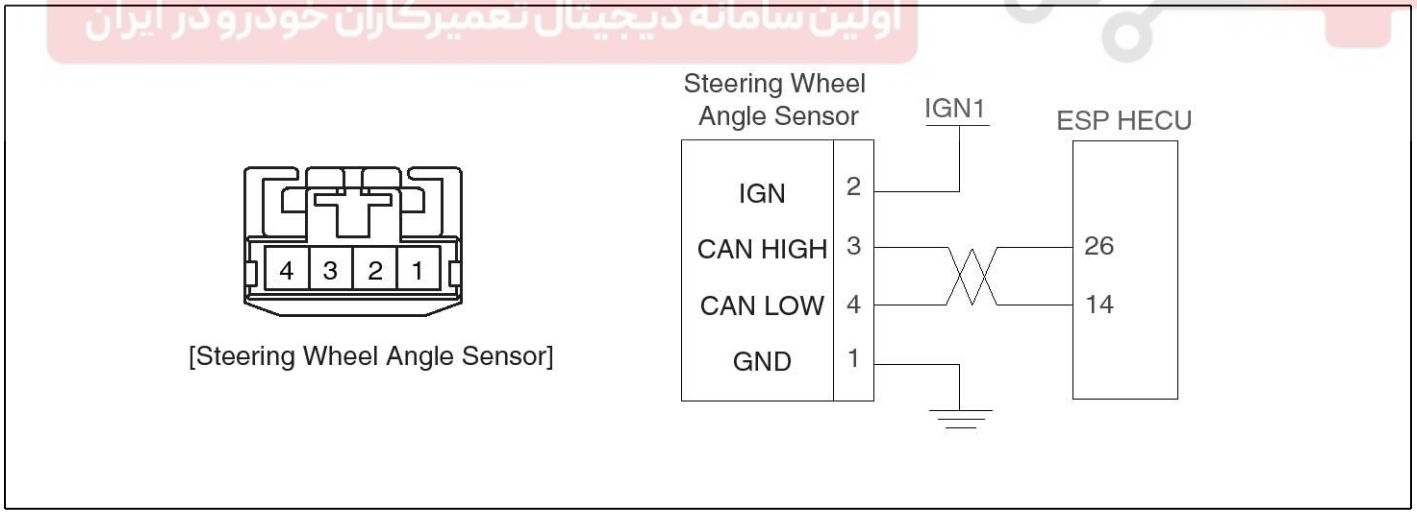


SVIBR9270D

Specification

Description		Specification
Operating voltage		8 ~ 16V
Operating temperature		-40 ~ 85℃
Current consumption		Max.150mA
Measuring range	Angle	-780 ~ 779.9˚
	Angular velocity	0 ~ 1016˚/sec

Circuit Diagram



SPBBR9305L

Calibration (Setting up the zero angle)

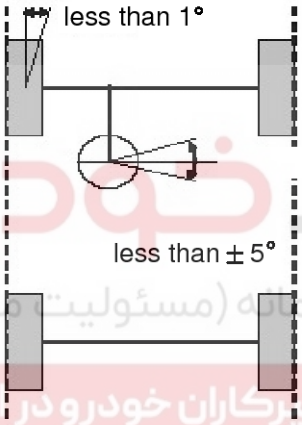
Steering Wheel Angle Sensor of a absolute angle type (CAN type) measures the angle under the standard of the zero angle set.

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

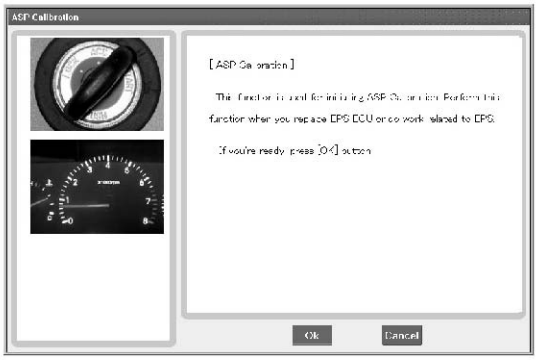
Calibration procedure

Perform wheel alignment and stand the steering wheel in a line within ±5˚error.



SHMBR9327L

1. Connect the GDS.(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)



SVQBR0275L

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.