General Information

Specifications

Item	Specification
Master cylinder	
Type	Tandem type
I.D.	23.81 mm (0.937 in)[CBS] 25.4 mm(1in)[ABS]
Piston stroke	30 ~ 31 mm (1.18 ~ 1.22 in)
Fluid level warning sensor	Provided
Proportioning valve(CBS)	
Cut-in pressure(Split point)	35 kg/㎠ (3.43 MPa, 497.8 psi)
Decompression ratio	0.32 : 1
Brake booster	
Type	Vacuum
Boosting ratio	9 : 1
Front brake(Disc)	
Type	Floating type with ventilated disc
Disc O.D.	280 mm(11.02 in)
Disc I.D.	172 mm(6.77 in)
Disc thickness	26 mm(1.02 in)
Pad thickness	11 mm(0.43 in)
Cylinder type	Single piston
Cylinder I.D.	Ø57.2 mm(2.25 in)
Rear brake(Disc)	
Type	Floating type with solid disc
Disc O.D.	262 mm (10.31 in)
Disc I.D.	185 mm (7.28 in)
Disc thickness	10 mm (0.39 in)
Pad thickness	15 mm (0.59 in)
Cylinder type	Single piston
Cylinder I.D.	Ø34 mm (1.34 in)
Parking brake	
Actuation	Lever
Type	DIH (Drum in hat)
Drum I.D.	168 mm(6.61 in)

NOTICE

ABS : Anti-lock Brake System

CBS : Conventional Brake System

Specification(ABS)

Part	Item	Standard value	Remark
HECU	System	4 Channel 4 Sensor (Solenoid)	
	Type	ABS + EBD	
	Operating Voltage	10 ~ 16 V	
	Operating Temperature	-40 ~ 110 ℃ (-40 ~ 230°F)	
	Motor power	210 W	
Warning lamp	Min. Operating Voltage	12 V	
	Max. Current consumption	120 mA	
Active Wheel speed sensor (ABS)	Supply voltage	DC 12 V	
	Output current low	5.9 ~ 8.4 mA	
	Output current high	11.8 ~ 16.8 mA	
	Output range	1 ~ 2000 Hz	
	Tone wheel	48 teeth	
	Air gap	0.5 ~ 1.5 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 intergrate-d type	
	Operating Voltage	10 ~ 16 V	
	Operating Temperature	-40 ~ 110 ℃(-40 ~ 230°F)	
	Motor power	270 W	
Warning lamp	Min. Operating Voltage	12 V	
	Max. Current consumption	120 mA	
Active Wheel speed sensor (ABS)	Supply voltage	DC 12 V	
	Output current low	5.9 ~ 8.4 mA	Typ. 7 mA
	Output current high	11.8 ~ 16.8 mA	Typ. 14 mA
	Output range	1 ~ 2000 Hz	
	Tone wheel	48 teeth	
	Air gap	0.5 ~ 1.5 mm	
Steering Wheel Angle Sensor	Operating Voltage	9 ~ 16 V	
	Current Consumption	Max. 100 mA	
	Operating Angular velocity	Max. 1500 °/sec	

Part	Item	Standard value	Remark
Yaw rate & Lateral G sensor	Operating Voltage	8 ~ 17 V	
	Current Consumption	Max. 140 mA	
	Output voltage	0.5 ~ 4.5 V	
	Yaw rate sensor measurement range	± 75 °/sec	
	Lateral G sensor measurement range	± 14.75m/s^2	

Service Standard

Item	Standard value
Standard value	
Brake pedal height	171 mm (6.73 in) [LHD] 189.2 mm (7.45 in) [RHD]
Brake pedal stroke	128 mm (5.04 in)
Adjustable brake pedal stroke	76.2 ± 2 mm (3.00 ~ 0.08 in)
Stop lamp switch outer case to pedal stopper clearance	Common pedal : 1.0 ~ 1.5mm(0.04 ~ 0.06in) Adjustable pedal : 1.0 ~ 2.0mm(0.04 ~ 0.08in)
Brake pedal free play	3 ~ 8 mm (0.11 ~ 0.31 in)
Booster push rod to master cylinder piston clearance	0 (at 500 mmHg vacuum)
Parking brake lever stroke when lever assembly is pulled with 235N (24Kg, 53lb force)	8 clicks
Front disc brake pad thickness	11 mm (0.43 in.)
Front disc thickness	26 mm (1.02 in)
Rear disc brake pad thickness	15 mm (0.59 in)
Rear disc brake disc thickness	10 mm (0.4 in)
Rear brake lining thickness	4.3 mm (0.17 in)

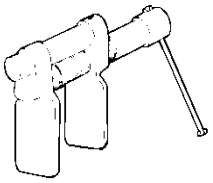
Tightening Torques

Item	N.m	kgf.m	lb-ft
Proportioning valve to master cylinder	34.3 ~ 53.9	3.5 ~ 5.5	25.3 ~ 39.8
Master cylinder to booster mounting nut	12.7 ~ 16.6	1.3 ~ 1.7	9.4 ~ 12.3
Brake booster mounting nut	12.7 ~ 15.7	1.3 ~ 1.6	9.4 ~ 11.6
Bleeder screw	6.9 ~ 12.7	0.7 ~ 1.3	5.1 ~ 9.4
Brake tube nut, brake hose	13.7 ~ 16.6	1.4 ~ 1.7	10.1 ~ 12.3
Caliper guide rod bolt	21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Rear caliper mounting bolt	49 .0 ~ 58.8	5.0 ~ 6.0	36.1 ~ 43.4
Front caliper mounting bolt	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Brake hose to front caliper	24.5 ~ 29.4	2.5 ~ 3.0	18.1 ~ 21.7
Brake pedal member assembly bracket mounting nut (cowl side upper mounting)	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Brake pedal mounting nut	24.5 ~ 34.3	2.5 ~ 3.5	18.1 ~ 25.3
Stop lamp switch mounting nut	7.9 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Wheel speed sensor mounting bolt	6.9 ~ 10.8	0.7 ~ 1.1	5.1 ~ 8.0
HECU mounting bracket bolt	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
HECU union screw	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
HECU bracket mounting nut	5.9 ~ 9.8	0.6 ~ 1.0	4.3 ~ 7.2
Yaw rate & Lateral G sensor mounting bolt	4.9 ~ 7.8	0.5 ~ 0.8	3.6 ~ 5.8

Lubricant

Item	Recommended lubricant	Quantity
Brake fluid	DOT 3	As required
Brake pedal bushing and brake pedal bolt	Chassis grease	As required
Parking brake shoe and backing plate contact surfaces	Bearing grease	As required
Caliper guide rod bolt and boot	RX-2 grease	0.8 ~ 1.3 g
Rear caliper guide rod and boot	Rubber grease	0.8 ~ 1.3 g

SPECIAL TOOLS

Tool (Number and Name)	Illustration	Use
09581 - 11000 Piston expander		Pushing back of the front disc 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	Remedy
Lower pedal or spongy pedal	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Piston seals (Worn or damaged) 4. Master cylinder (Faulty)	Repair Air bleeding Replace Adjust
Brake drag	1. Brake pedal free play (Minimum) 2. Parking brake lever travel (Out of adjustment) 3. Parking brake wire (Sticking) 4. Pad or lining (Cracked or distorted) 5. Piston (Stuck) 6. Piston (Frozen) 7. Return spring (Faulty) 8. Booster system (Vacuum leaks) 9. Master cylinder (Faulty)	Adjust Adjust Repair Replace Replace Replace Replace Repair Replace
Brake pull	1. Piston (sticking) 2. Pad or lining (Oily) 3. Piston (Frozen) 4. Disc (Scored) 5. Pad or lining (Cracked or distorted)	Replace Replace Replace Replace Replace
Hard pedal but brake i-nefficient	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Pad or lining (Worn) 4. Pad or lining (Cracked or distorted) 5. Pad or lining (Oily) 6. Pad or lining (Oily) 7. Pad or lining (Glazed) 8. Disc (Scored) 9. Booster system (Vacuum leaks)	Repair Air bleeding Replace Replace Replace Adjust Replace Replace Repair
Noise from brake	1. Pad or lining (Cracked or distorted) 2. Installation bolt (Loosen) 3. Disc (Scored) 4. Pad retainers (Loosen) 5. Sliding pin (Worn) 6. Pad or lining (Dirty) 7. Pad or lining (Glazed) 8. Return spring (Faulty) 9. Brake pad shim (Damage) 10.Shoe hold-down spring (Damage)	Replace Retighten Replace Retighten Replace Clean Replace Replace Replace Replace
Brake fades	1. Master cylinder	Replace

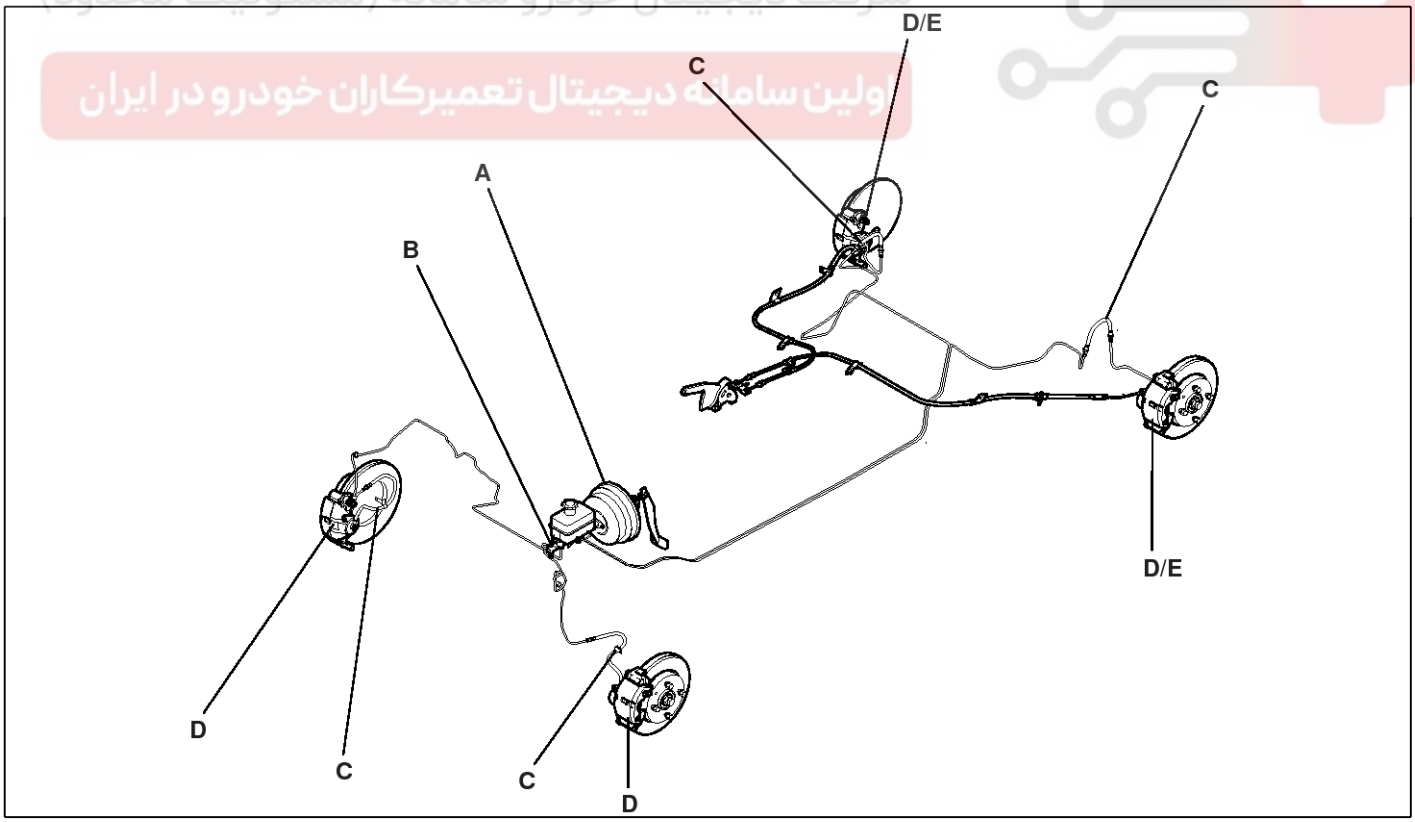
Symptom	Suspect Area	Remedy
Brake vibration, pulsation	1. Brake booster 2. Pedal free play 3. Master cylinder 4. Caliper 5. Master cylinder cap seal 6. Damaged brake lines	Replace Adjust Replace Replace Replace Replace
Brake chatter	Brake chatter is usually caused by loose or worn components, or glazed or burnt linings. Rotors with hard spots can also contribute to brake chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.	

Brake System

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.
Wheel cylinder piston cup and dust cover (E)	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, replace the wheel cylinder.

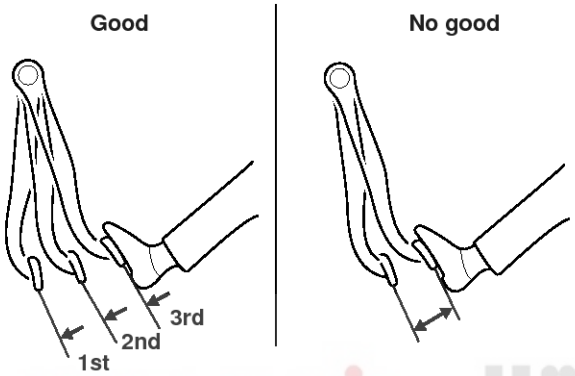


LJLG500A

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 defective.



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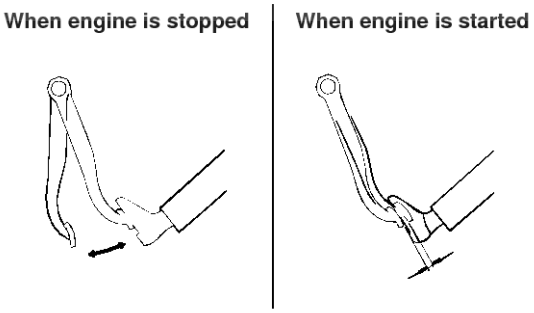
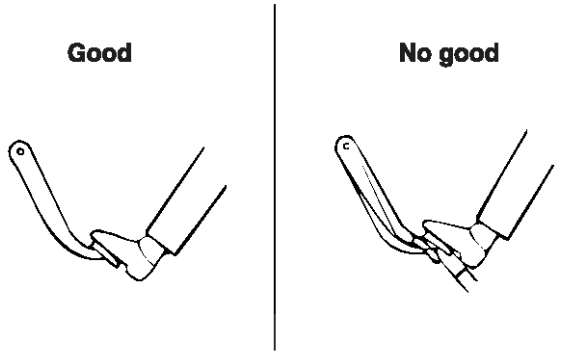
2. With the engine stopped, step on the brake pedal several times. Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is defective.



EGGB700B

3. With the engine running, step on the brake pedal and then stop the engine. Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is defective. 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 defect.



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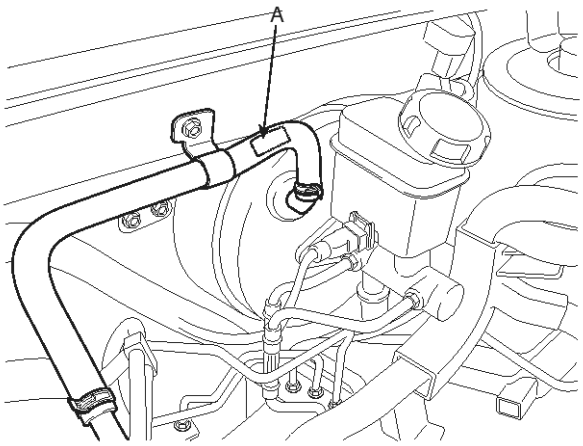
VACUUM HOSE (CHECK VALVE) (M/T)

INSPECTION

1. Disconnect the brake booster vacuum hose (check valve built in) (A) at the booster .
2. Start the engine and let it idle. There should be vacuum available. If no vacuum is available, the check valve is not working properly. Replace the brake booster vacuum hose and check valve and retest.



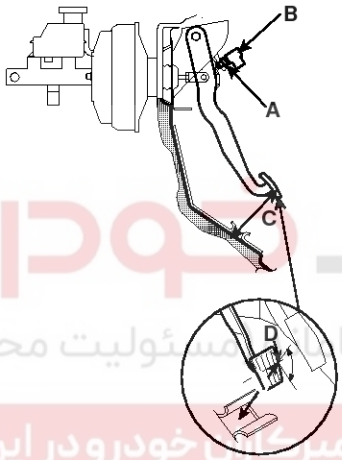
AJLG500B

BRAKE PEDAL & BRAKE SWITCH ADJUSTMENT

PEDAL HEIGHT

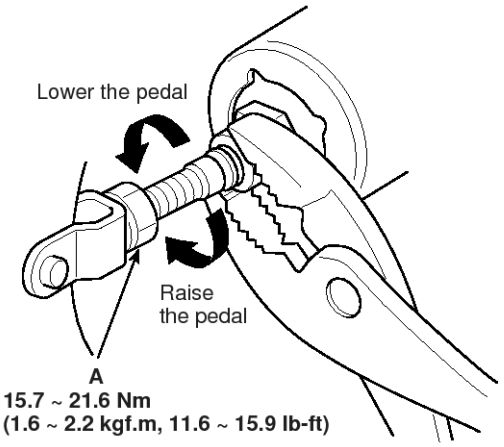
1. Disconnect the brake switch connector, loosen the brake switch locknut (A), and brake off the brake switch (B) until it is no longer touching the brake pedal.
2. Lift up the carpet. At the insulator cutout, measure the pedal height (C) from the middle of the left-side center of the pedal pad (D).

Standard pedal height (with carpet removed) :
171 mm (6.73 in) [LHD]
189.2 mm (7.45 in) [RHD]



EJKE001A

3. Loosen the pushrod locknut (A), and screw the pushrod in or out with pliers until the standard pedal height from the floor is reached. After adjustment, tighten the locknut firmly. Do not adjust the pedal height with the pushrod depressed.



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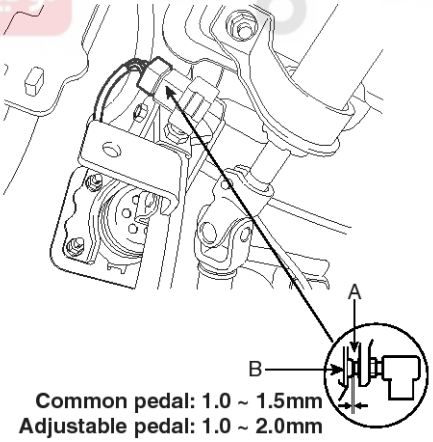
BRAKE SWITCH CLEARANCE

Screw in the brake switch until its plunger is fully depressed (threded end (A) touching the pad (B) on the pedal arm) then brake off the switch 3/4 turn to make 1.0 ~ 1.5mm(0.04 ~ 0.06in) [Adjustable pedal - 1.0 ~ 2.0mm(0.04 ~ 0.08in)] of clearance between the brake switch connector. Make sure that the brake lights go off when the pedal is released.



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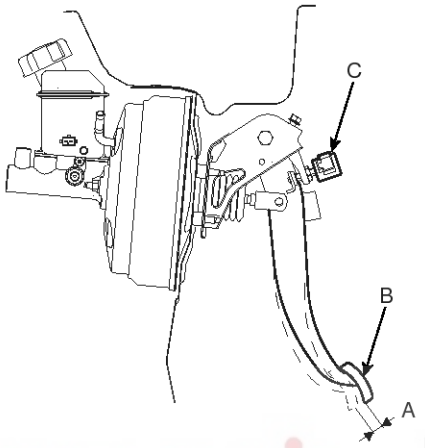
PEDAL FREE PLAY

1. With the engine stopped, depress the brake pedal two or three times. After eliminating the vacuum in the power brake booster, press the pedal(B) down by hand, and confirm that the amount of movement(A) before resistance is met (the free play) is within the standard value.

Standard value : 3 ~ 8 mm (0.117 - 0.312 in.)



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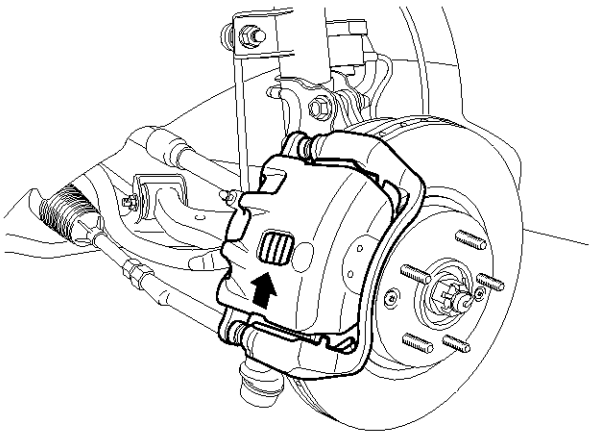
2. If free play does not reach the standard value, check that clearance between the outer case of stop light switch(C) and brake pedal is within the standard value. If free play exceeds the standard value, it is probably due to excessive clearance between the clevis pin and brake pedal arm. Check for excessive clearance and replace faulty parts as required.
3. Start the engine, depress the brake pedal with approximately 120kg(1176.8N, 264.5 lb) of force, and check for oil leakage in the master cylinder, brake line and each connecting part. Repair the faulty parts as required.

INSPECTION OF FRONT DISC BRAKE PAD

1. Check the brake pad thickness through the caliper body inspection hole.

Pad thickness
Standard value : 11.0 mm (0.43 in.)
Service limit : 2.0 mm (0.0787 in.)



AJLG500E

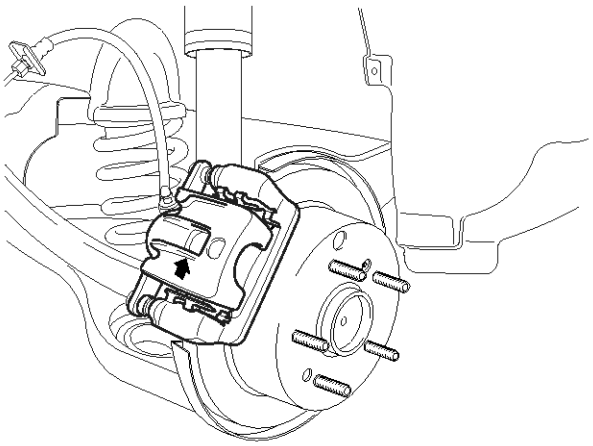
⚠CAUTION

- **If the pad lining thickness is out of specification, left and right pads must be replaced as a complete set.**
- **When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston and the guide rod.**

INSPECTION OF REAR DISC BRAKE PAD

1. Check the brake pad thickness through the caliper body inspection hole.

Pad thickness
Standard value : 10.0 mm (0.39 in.)
Service limit : 2.0 mm (0.0787 in.)



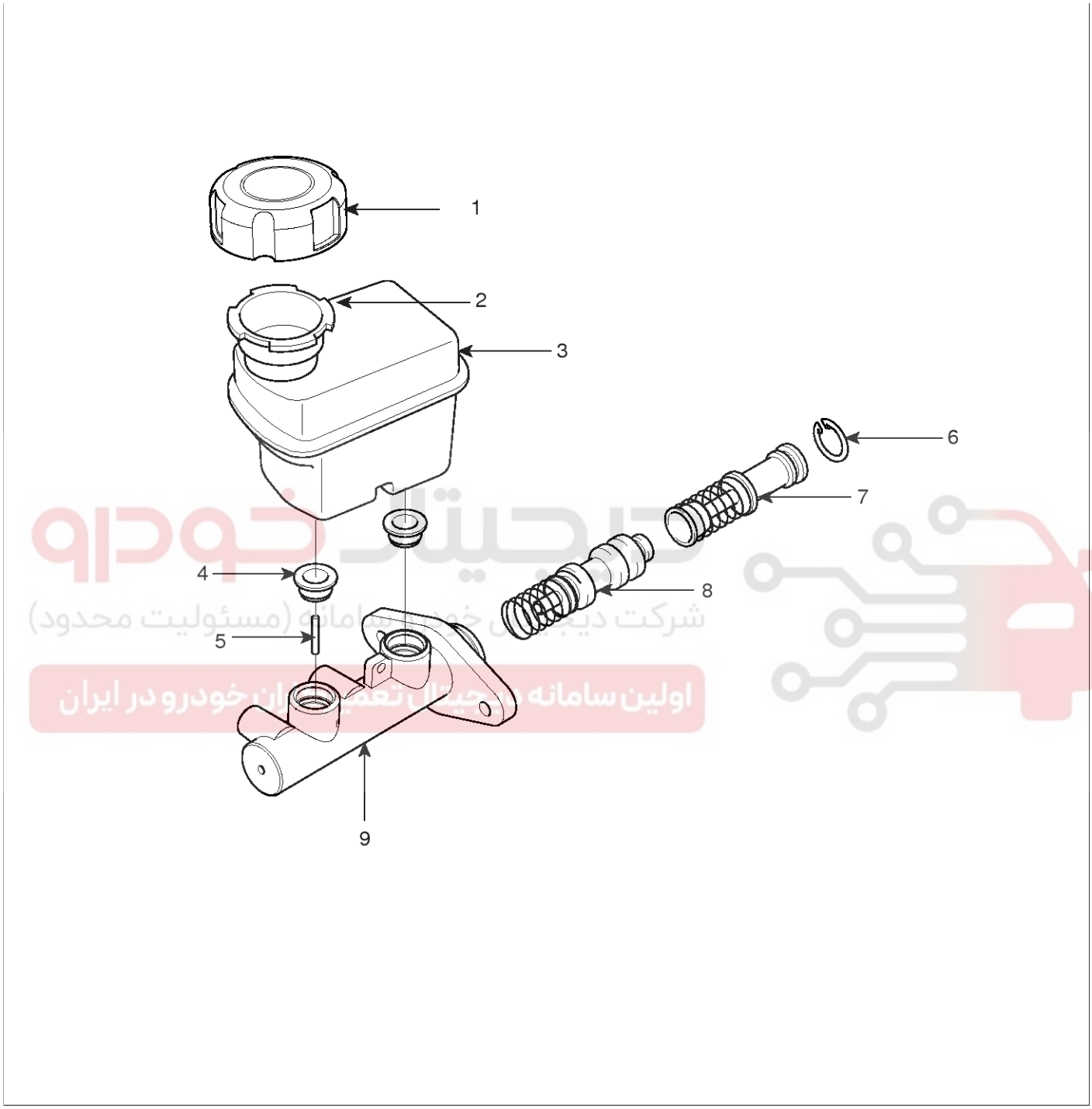
AJLG500F

⚠CAUTION

- **If the pad thickness is out of specification, left and right pads must be replaced as a complete set.**
- **When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston and the guide rod.**

Master Cylinder

COMPONENTS



1. Reservoir cap
2. Brake fluid filter
3. Reservoir
4. Grommet
5. Cylinder pin
6. Retainer
7. Primary piston assembly
8. Secondary piston assembly
9. Master cylinder body

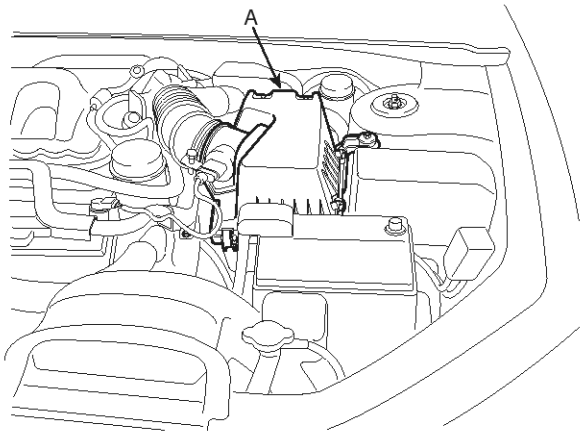
LJLG500L

REMOVAL

NOTICE

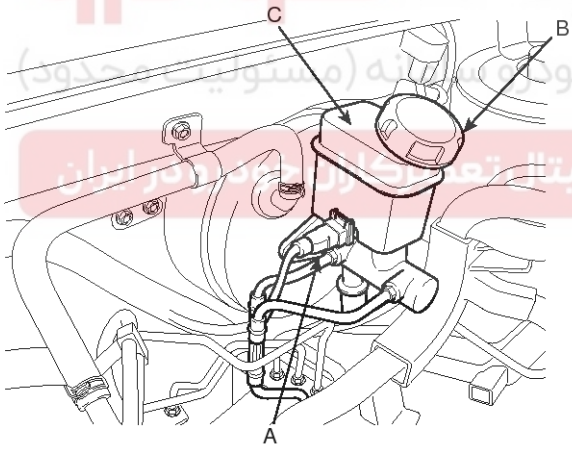
Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

1. Remove air cleaner assembly (A).



AJLG501G

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



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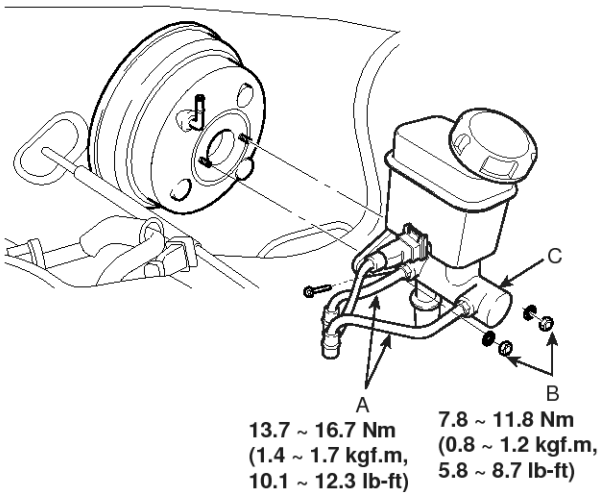
3. Remove the brake fluid from the master cylinder reservoir (C) with a syringe.

4. Disconnect the brake lines (A) from the master cylinder. To prevent spills, cover the hose joints with rags or shop towels.



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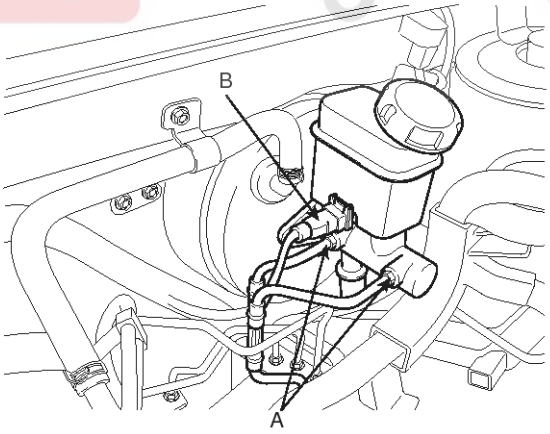
5. Remove the master cylinder mounting nuts (B) and washers.
6. Remove the master cylinder (C) from the brake booster . Be careful not to bend or damage the brake lines when removing the master cylinder.

INSTALLTION

1. Install the master cylinder to the brake booster.
2. Connect the brake tubes (A) and brake level switch connector (B) to the master cylinder.

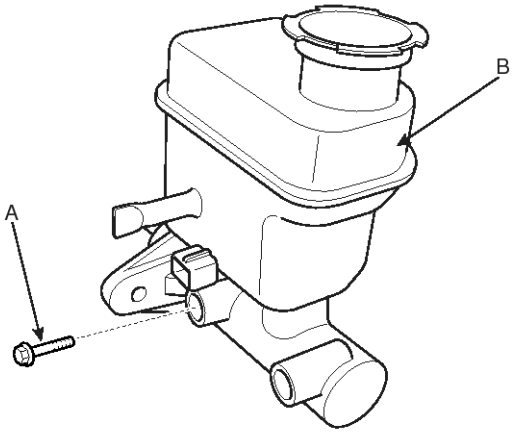


LJLG501S

3. After refill the master cylinder reservoir to the Max line , bleed the brake system.

DISASSEMBLY

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



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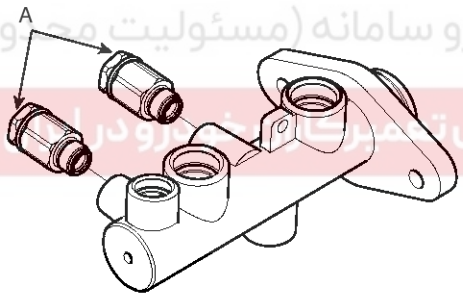
4. Remove the proportioning valves.(Conventional brake system)



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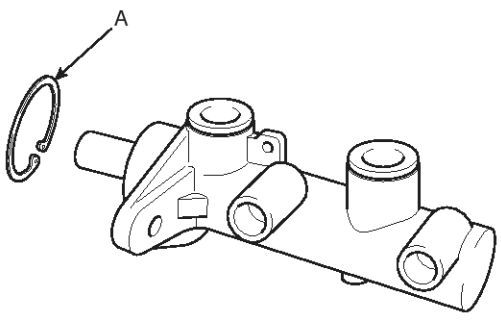
5. Remove the retainer ring (A) by using the snap ring pliers.



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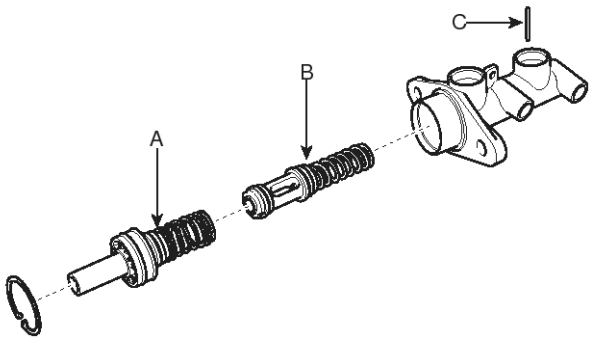
6. Remove the primary piston assembly (A).
7. Remove the pin (C) with the secondary piston (B) pushed completely using a screwdriver. Remove the secondary piston assembly (B).



KJBF528A

NOTICE

Do not disassemble the primary and secondary piston assembly.

INSPECTION

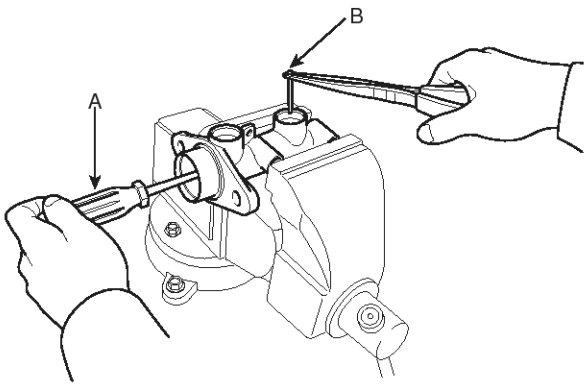
1. Check the master cylinder bore for rust or scratch.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

CAUTION

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

REASSEMBLY

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



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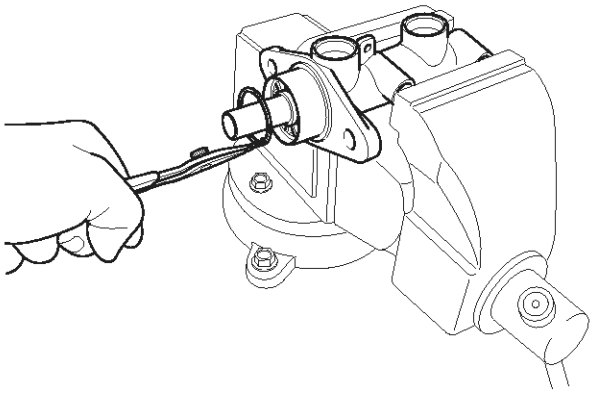
4. Press the piston with a screwdriver and install the retainer ring.



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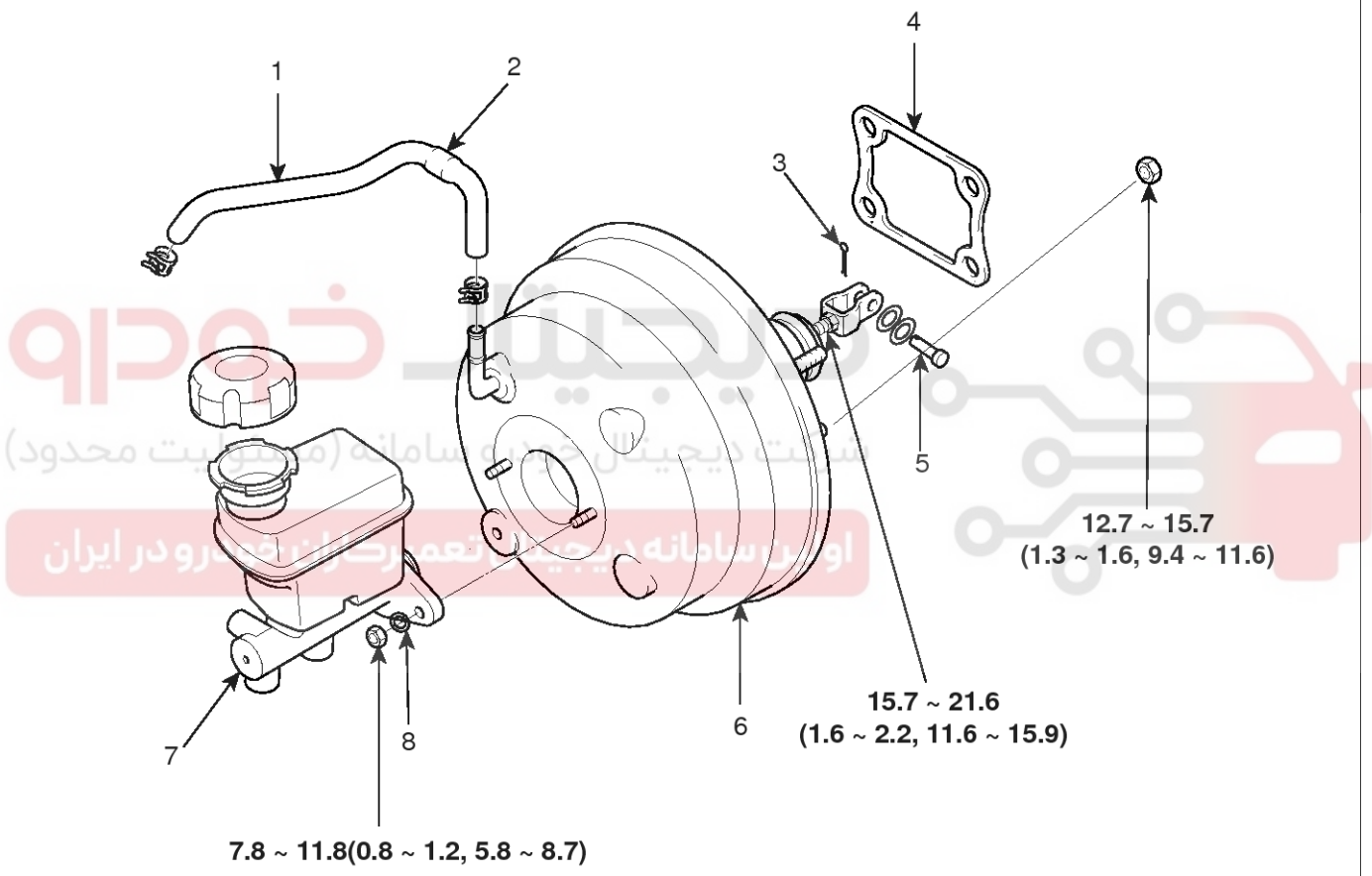
5. Install the proportioning valves.(In case of CBS)
6. Mount two grommets.
7. Install the reservoir on the cylinder.

Brake Booster

COMPONENTS

[M/T]



TORQUE : Nm (kgf.m, lb-ft)

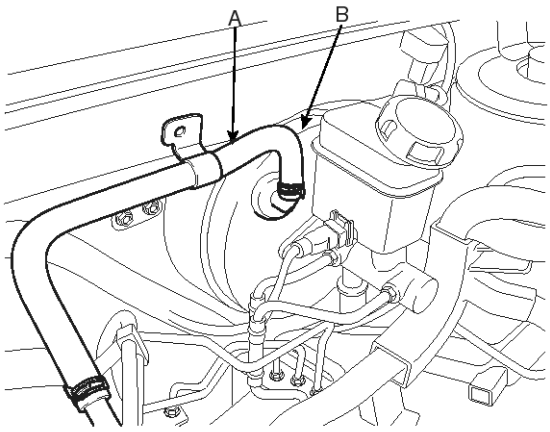
1. Vacuum hose
2. Check valve
3. Snap pin
4. Seal
5. Clevis pin
6. Brake booster
7. Mater cylinder
8. Washer

LJLG500C

REMOVAL

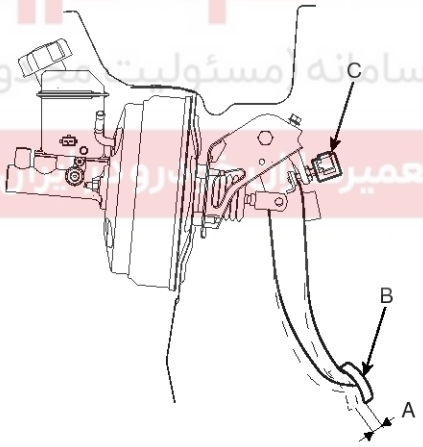
1. Disconnect the vacuum hose (B) from the brake booster (A).

[M/T]



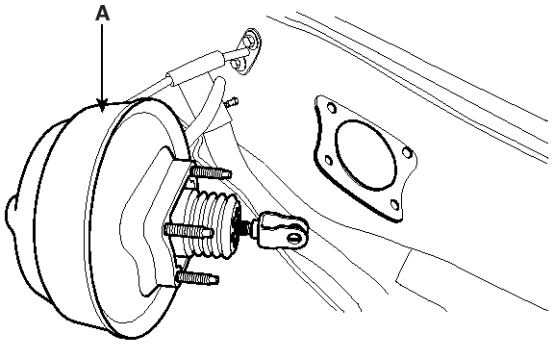
AJLG500G

2. Remove the master cylinder.(Refer to Master cylinder - Removal")
3. Disconnect the vacuum hose (B) from the brake booster (A).



AJLG500D

4. Remove the four booster mounting nuts (C).
5. Remove the brake booster (A) from the engine compartment.

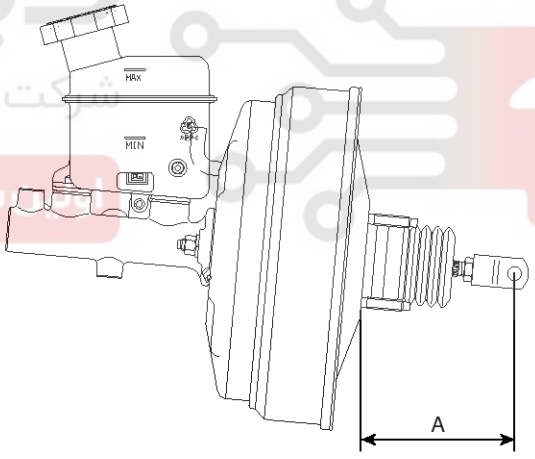


ARJE500H

INSTALLATION

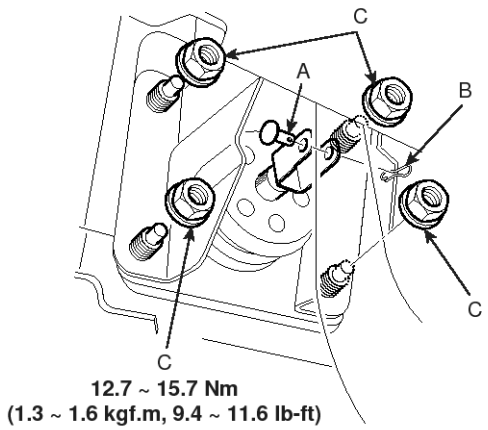
1. Adjust push rod length of the booster, and then install the seal on the booster assembly.

Standard length(A) : 108 ± 0.5 mm (4.25 ± 0.02 in)



AJLG500H

2. Insert the booster and tighten the nuts (C).



LJLG500D

3. Connect the booster push rod and brake pedal with a clevis pin (A) and install a snap pin (B) to the clevis pin (A).

   ⚠CAUTION
   Grease the pin before installing the snap pin.
   Always use a new snap pin.

4. Install the master cylinder, then install the brake tubes to the master cylinder.
5. Connect the vacuum hose to the brake booster.
6. After filling the brake reservoir with brake fluid, bleed the system.
7. Check for fluid leakage.
8. Check and adjust the brake pedal for proper operation.

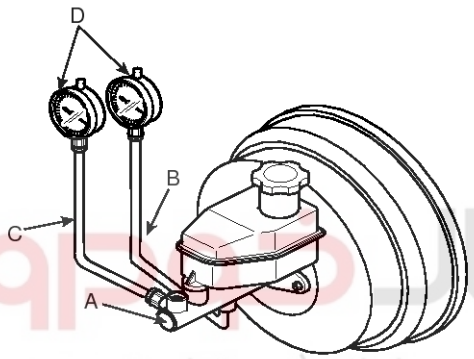
Proportioning Valve

DESCRIPTION

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

INSPECTION

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



EJRF700O

NOTICE

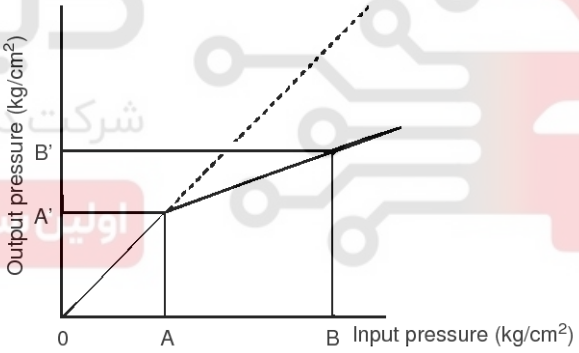
Be sure to bleed the system after connecting the pressure gauges.

3. With the brake applied, measure the front pressure and the rear pressure. If the measured pressures are within the specified range as illustrated, the proportioning valve is good.
4. Reconnect the brake lines in their original positions and bleed the brake system.

NOTICE

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

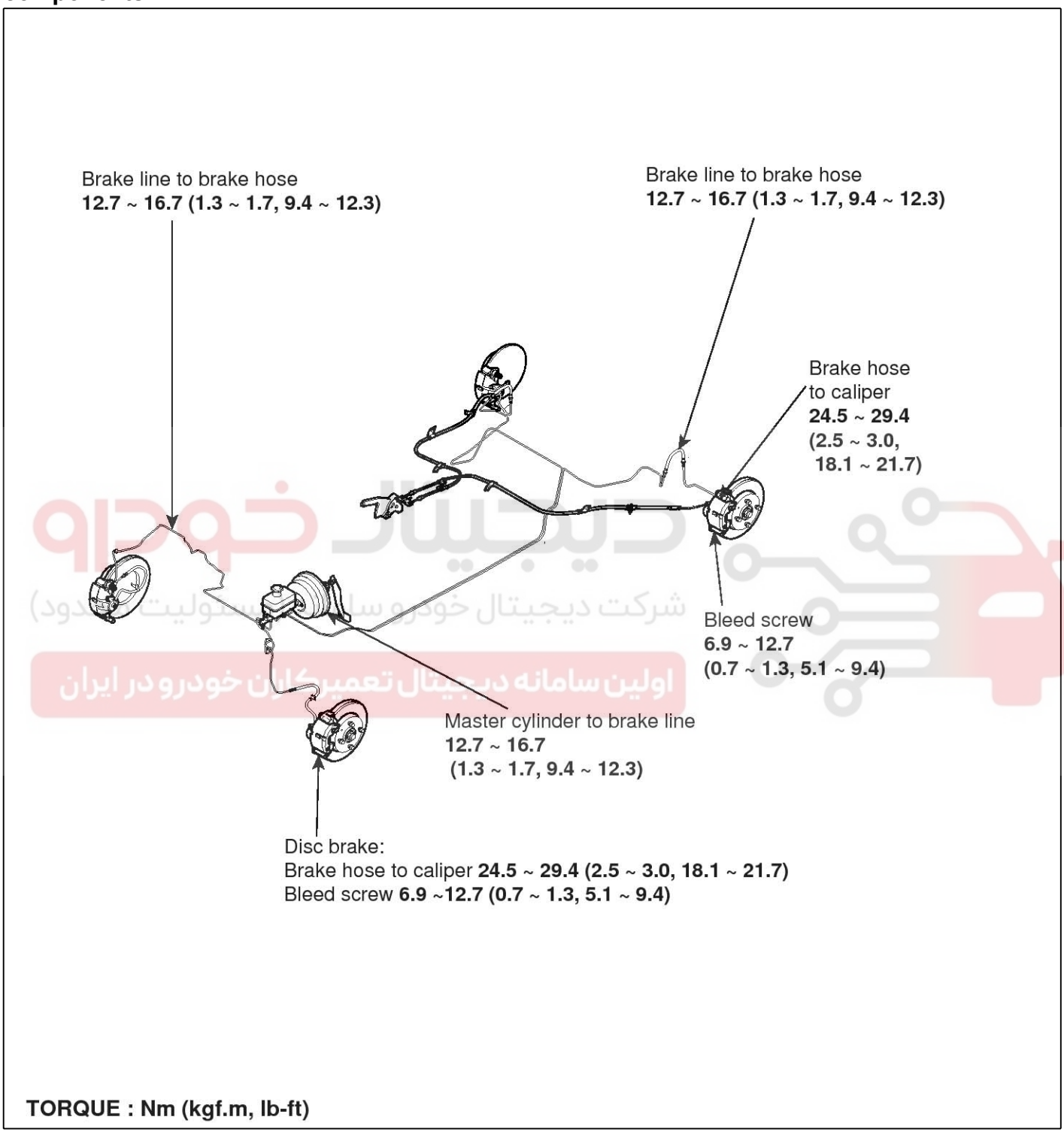
Front *(Output of master cylinder)*	Rear *(Output of proportioning valve)*
A : 35 kg/㎠ *(3.43 MPa, 498 psi)*	A' : 35 kg/㎠ *(3.43 MPa, 498 psi)*
B : 80 kg/㎠ *(7.85 MPa, 1138 psi)*	B' : 49.4 ± 3.0 kg/㎠ *(4.84 ± 0.3 MPa, 703 ± 42.7 psi)*



LJJF500O

Brake Line

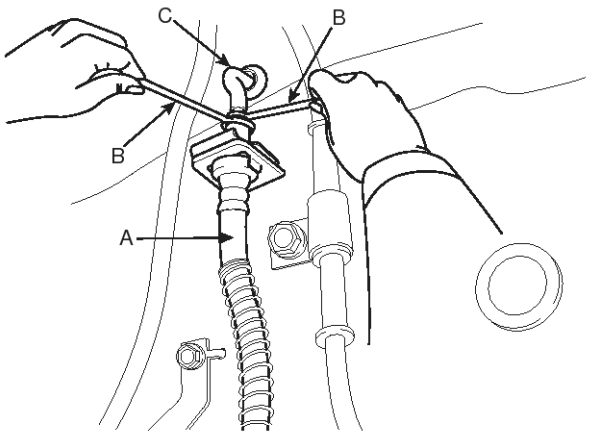
components



LJLG500E

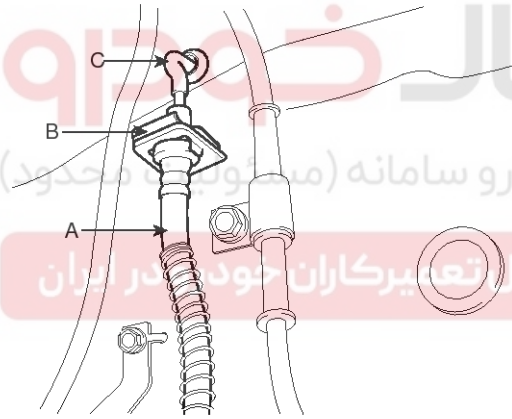
REMOVAL

1. Disconnect the brake hose (C) from the brake line (A) using a flare-nut wrench (B).



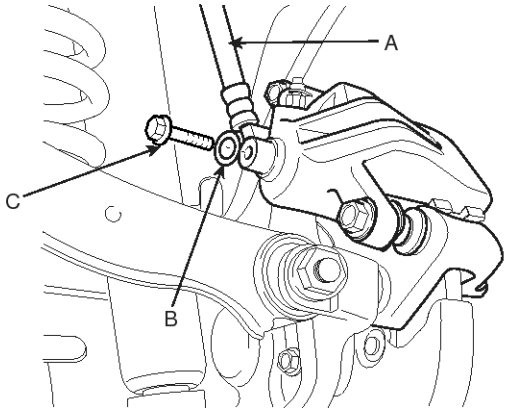
AJLG500O

2. Remove the brake hose clip (B), and then remove the brake hose (A).



AJLG500K

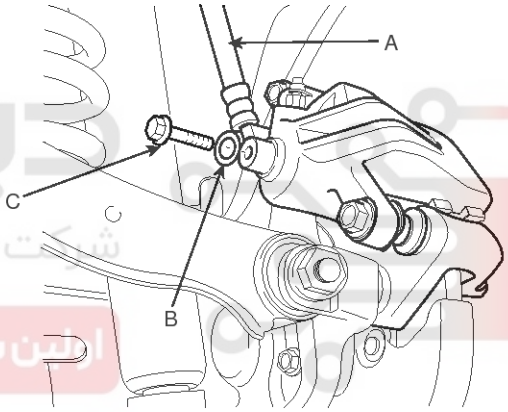
3. Remove the connector bolt (C) from the caliper, and disconnect the brake hose (A) from the caliper.



AJLG500M

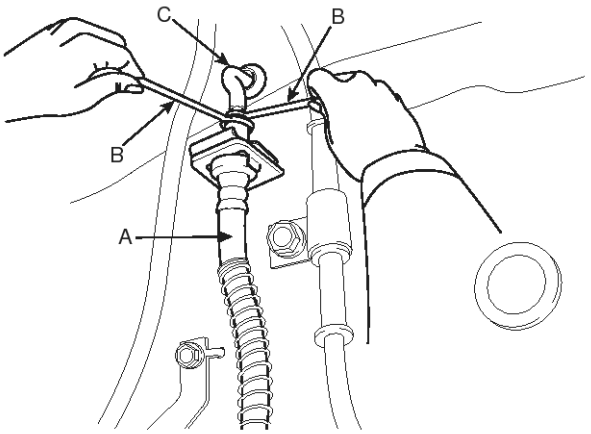
INSTALLATION

1. Install a brake hose (A) on the caliper with tightening brake hose bolt (C) and washer (B).



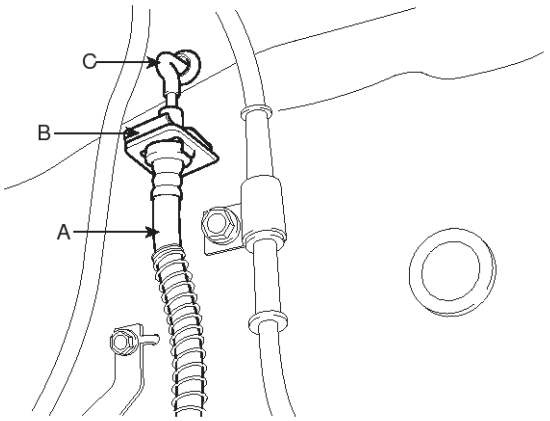
AJLG500M

2. Connect the brake hose (A) to the brake line (C) using a flare-nut wrench (B).



AJLG500O

3. Install the brake hose clip (B) to the brake hose bracket.



AJLG500K

4. After installing the brake hose, bleed the brake system.

CAUTION

- **Check the brake hoses for interference and twisting.**
- **Check the brake hose and line joint for leaks, and tighten if necessary.**

INSPECTION

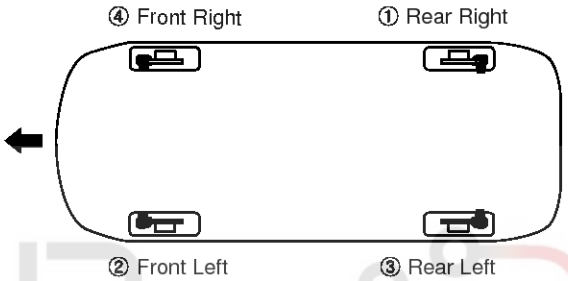
1. Check the brake tubes for cracks, crimps and corrosion.
2. Check the brake hoses for cracks, damaged and oil leakage.
3. Check the brake tube flare nuts for damage and oil leakage.

Brake System Bleeding

NOTICE

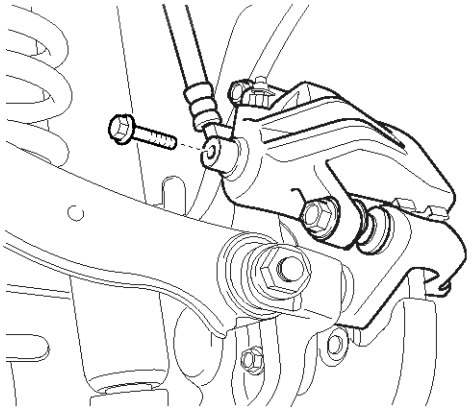
- *Do not reuse the drained fluid.*
- *Always use Genuine DOT 3 or Brake Fluid. Using a non-Genuine DOT3 or brake fluid can cause corrosion and decrease the life of the system.*
- *Make sure no dirt of other foreign matter is allowed to contaminate the brake fluid.*
- *Do not spill brake fluid on the 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 level in the reservoir is at the MAX (upper) level line.
2. Have someone slowly pump the brake pedal several times, and then apply steady pressure.
3. Loosen the right-rear brake bleed screw to allow air to escape from the system. Then tighten the bleed screw securely.
4. Repeat the procedure for each wheel in the sequence shown below until air bubbles no longer appear in the fluid.
5. Refill the master cylinder reservoir to the MAX (upper) level line.



EJKE003B

Front disc brake :

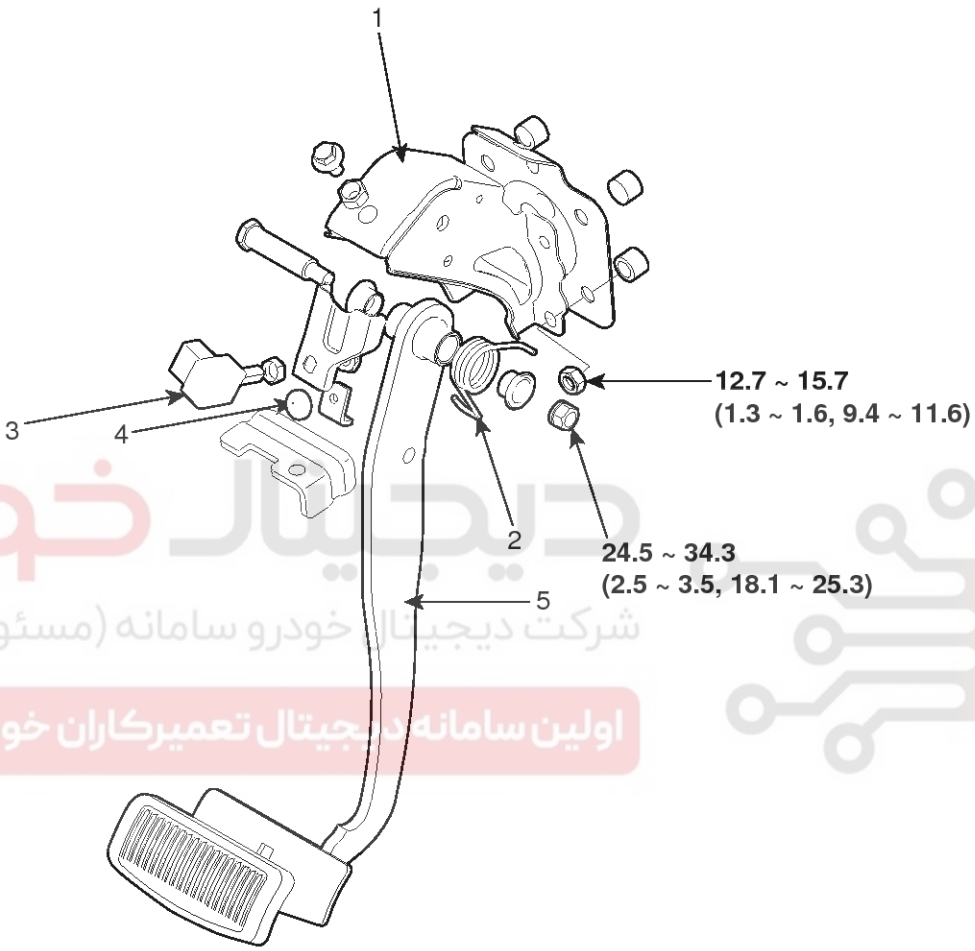


AJLG500Q

Brake Pedal

COMPONENTS(1)

[LHD] - COMMON PEDAL



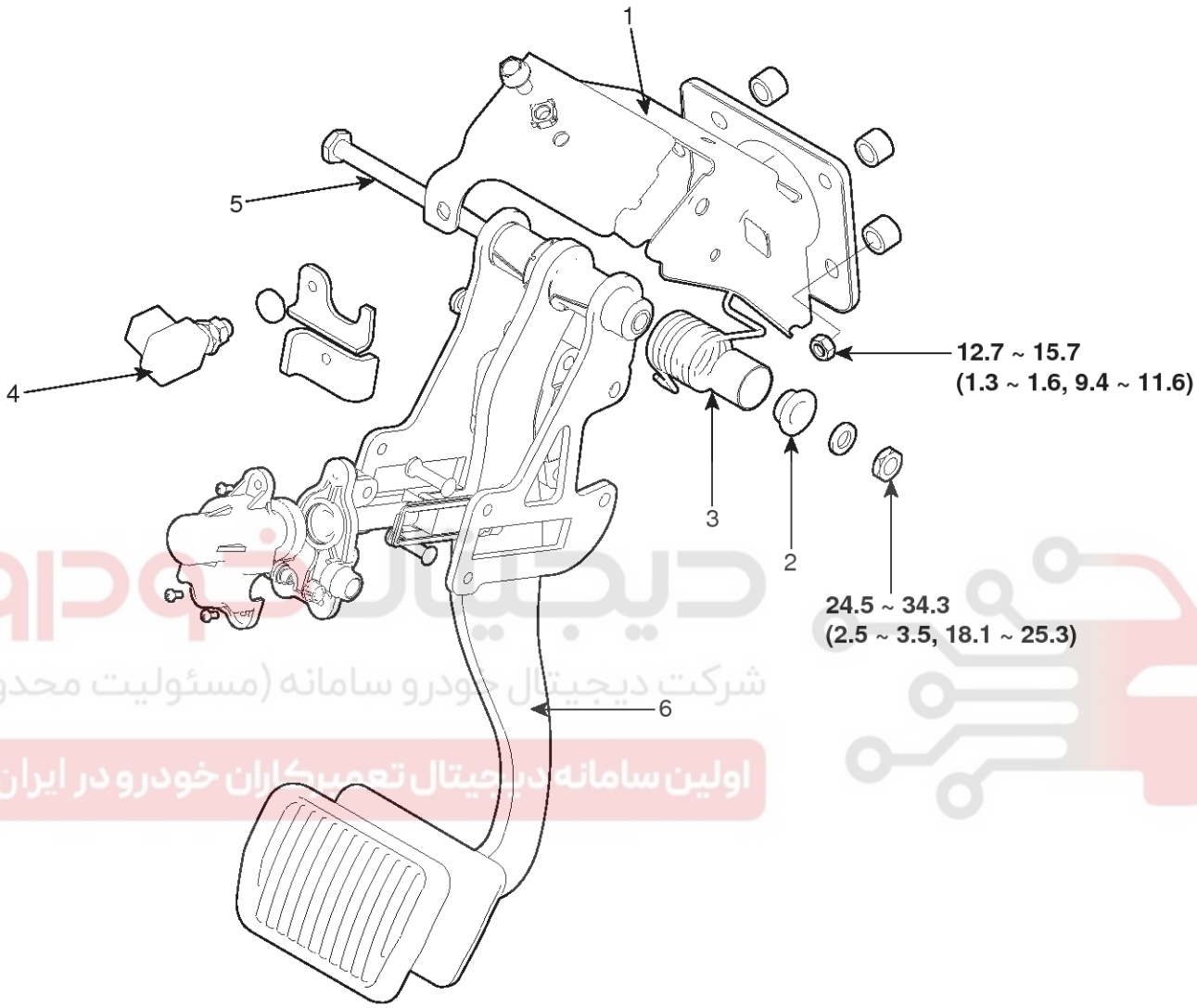
TORQUE : Nm (kgf.m, lb-ft)

1. Member assembly bracket
2. Return spring
3. Stop lamp switch
4. Bushing
5. Brake pedal

LJLG500F

components(2)

[LHD] - ADJUSTABLE PEDAL



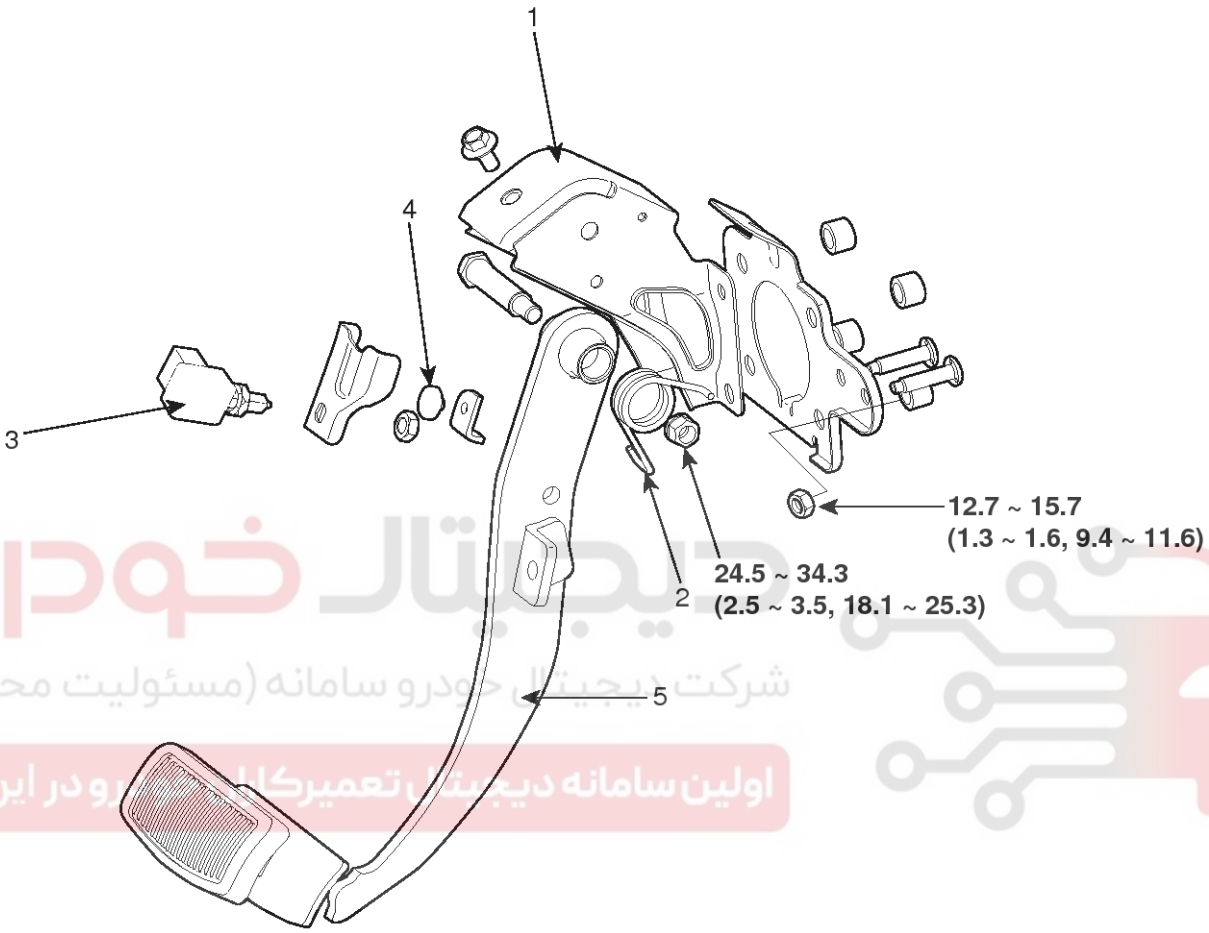
TORQUE : Nm (kgf.m, lb-ft)

1. Member assembly bracket
2. Bushing
3. Return spring
4. Stop lamp switch
5. Shaft bolt
6. Brake pedal

LJLG500G

components(3)

[RHD] - COMMON PEDAL



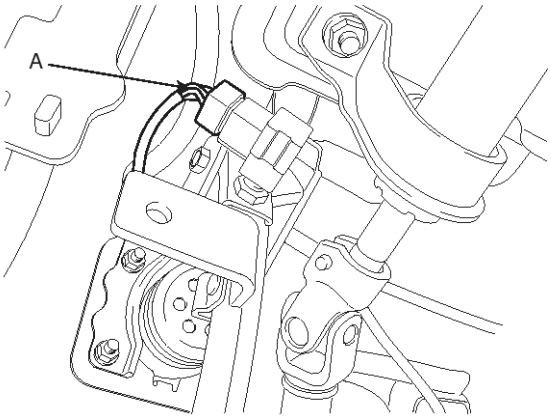
TORQUE : Nm (kgf.m, lb-ft)

1. Member assembly bracket
2. Return spring
3. Stop lamp switch
4. Bushing
5. Brake pedal

LJLG501P

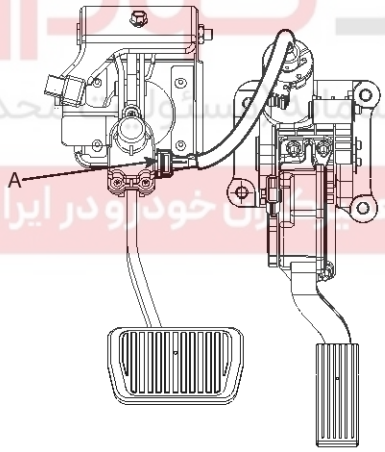
REMOVAL

1. Remove the lower crash pad.(Refer to BD "crash pad")
2. Pull down steering column shaft after removing 4 bolts.
3. Remove the stop lamp switch connector (A).



AJLG500T

4. Remove the motor connector (A) in case of the adjustable brake pedal.



AJLG500U

5. Remove the clevis pin and snap pin.
6. Remove the brake pedal member assembly mounting nuts and then remove the brake pedal assembly.

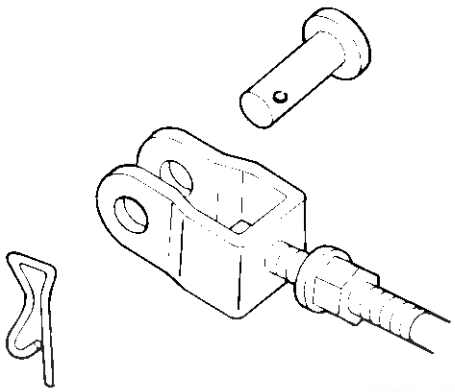
INSTALLATION

1. Installation is the reverse of removal.

Grease : LiG-2

⚠CAUTION
Coat the inner surface of the bushings with the specified grease.

2. Before inserting the pin, apply the specified grease to the joint pin.

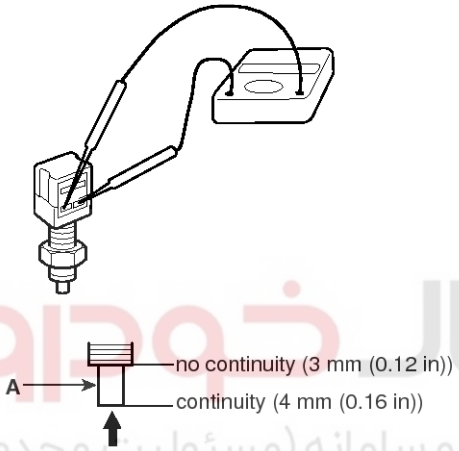


ARJE500U

3. Adjust the brake pedal height and free play.(Refer to "Brake pedal & brake switch adjustment")
4. Install the stop lamp switch.

INSPECTION

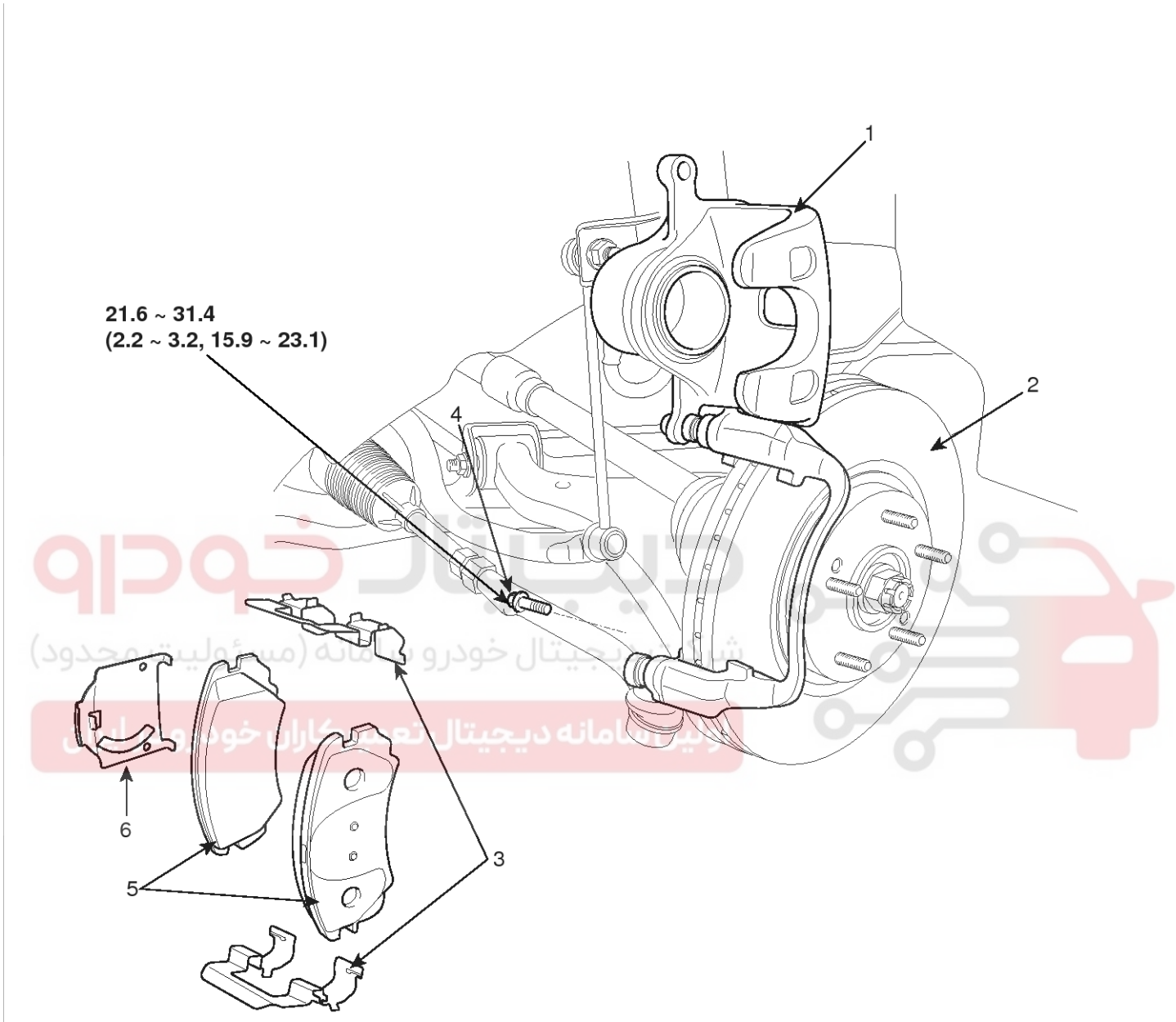
1. Check the bushing for wear.
2. Check the brake pedal for bending or twisting
3. Check all parts for crack and wear.
4. Check the stop lamp switch.
   1) Connect a circuit tester to the connector (1-2 terminals) of stop lamp switch, and check whether or not there is continuity when the plunger of the 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 the plunger is pushed.



EJRF500O

Front Disc Brake

COMPONENTS(1)

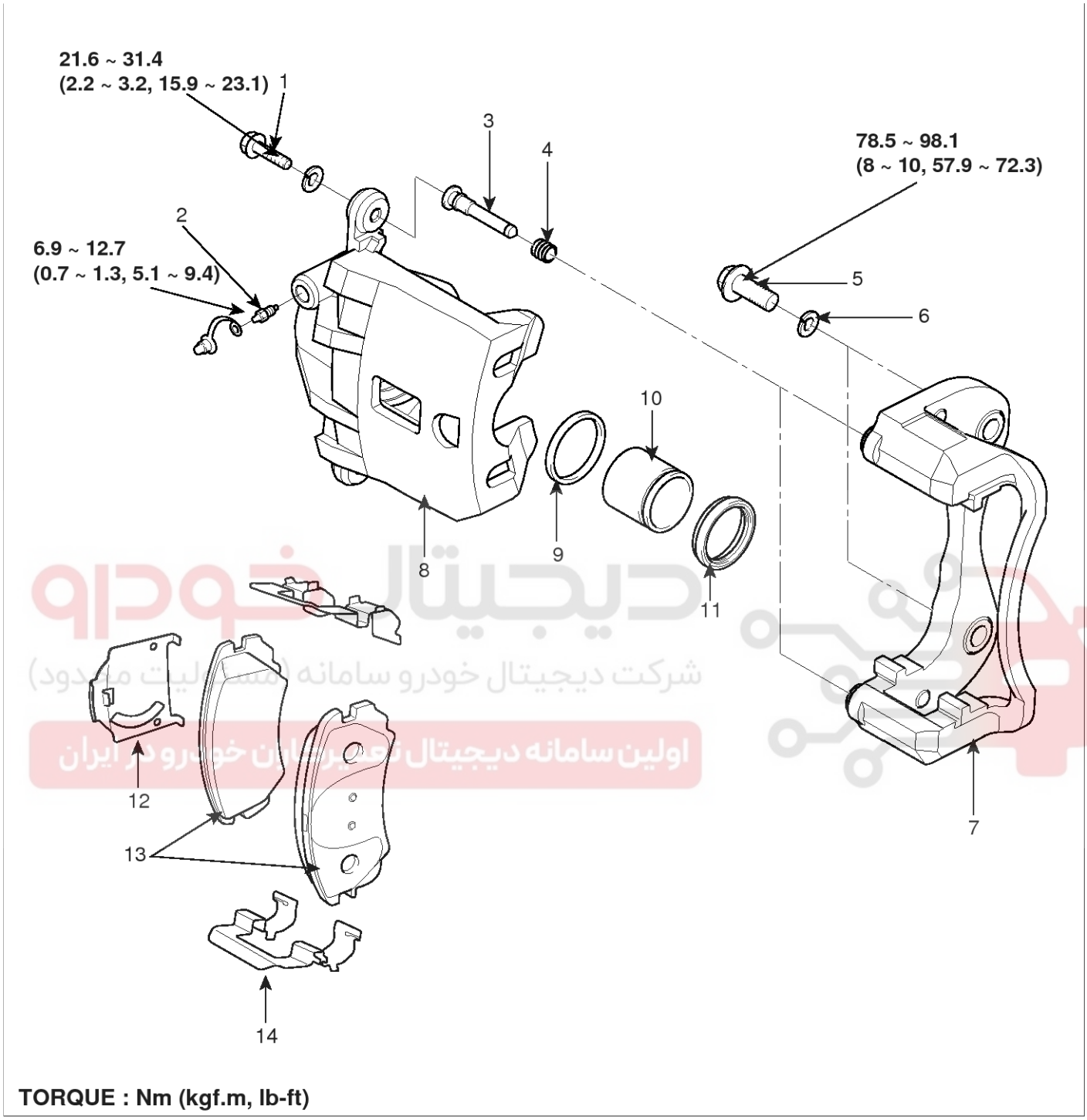


TORQUE : Nm (kgf.m, lb-ft)

1. Brake caliper
2. Brake disc
3. Pad retainer
4. Guide rod bolt
5. Brake pad
6. Brake pad shim

LJLG500H

COMPONENTS(2)



TORQUE : Nm (kgf.m, lb-ft)

1. Guide rod bolt
2. Bleeder screw
3. Guide rod
4. Boot
5. Caliper mounting bolt
6. Washer
7. Caliper bracket
8. Caliper body
9. Piston seal
10. Piston
11. Piston boot
12. Shim
13. Brake pad
14. Pad retainer

LJLG500I

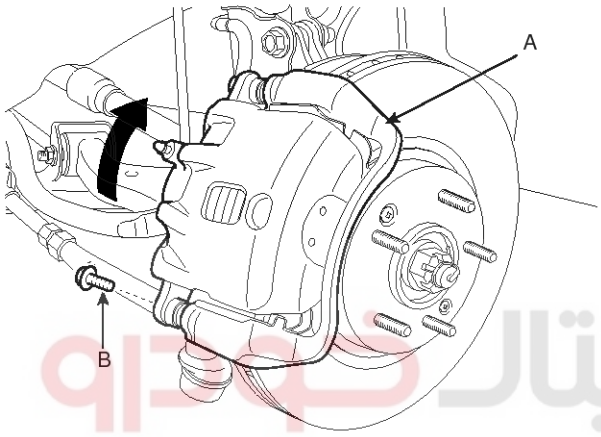
REMOVAL

⚠CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

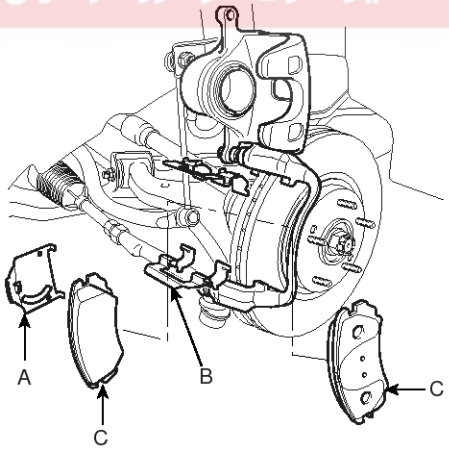
- **Avoid breathing dust particles.**
- **Never use on air hose or brush to clean brake assemblies.**

1. Remove guide rod bolt (B) and raise the caliper (A).Check the hoses and pin boots for damage and deterioration.



AJLG500X

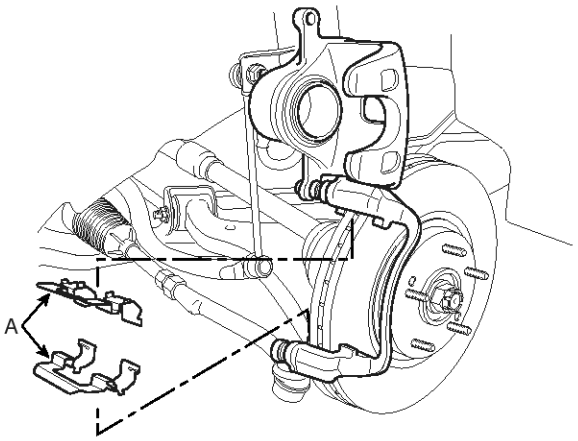
2. Remove the pad shims (A), pad retainers (B) and pads (C).



LJLG501Q

INSTALLATION

1. Install the pad retainers (A) to the caliper.

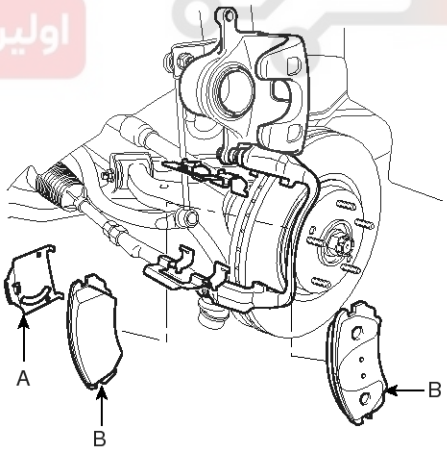


AJLG501C

2. Check the foreign material at the pad shims (A) and the back of the pads (B).

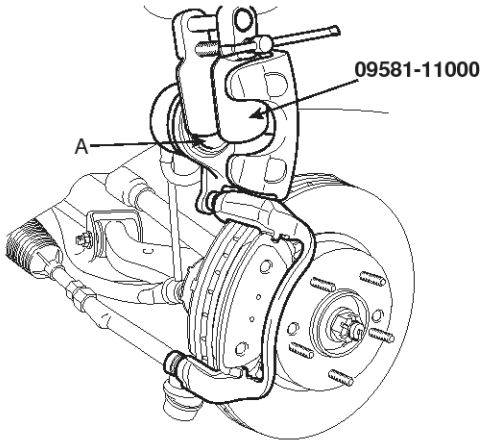
   Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.

3. Install the brake pads (B) and pad shims (A) on the pad retainer correctly. Install the pad with the wear indicator on the inside. If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momentary loss of braking efficiency.



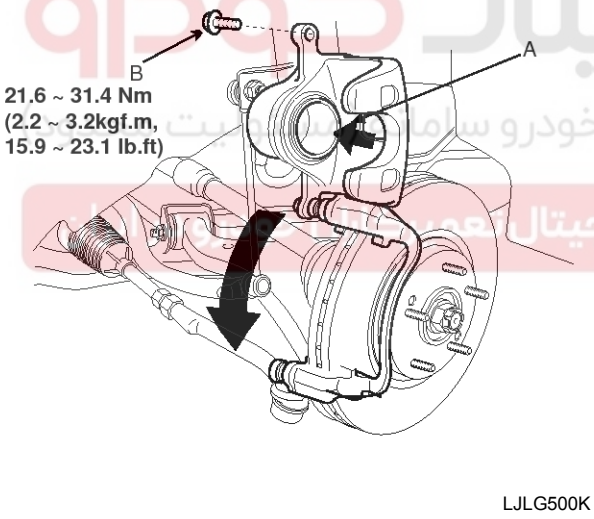
AJLG501D

4. Push in the piston (A) using the SST(09581-11000) so that the caliper will fit over the pads. Make sure that the piston boot is in position to prevent damaging it when pivoting the caliper down.



LJLG501R

5. Pivot the caliper down into position. Being careful not to damage the pin boot (A) , install the guide rod bolt (B) and tighten it to the specified torque.



LJLG500K

6. If caliper assembly was removed, install the brake hose to the caliper.
7. Refill the master cylinder reservoir to the MAX line.
8. Bleed the brake system.(Refer to "Bleeding of brake system"

9. Depress the brake pedal several times to make sure the brakes work, then test-drive.

NOTICE

Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set. Several applications of the brake will restore the normal pedal stroke.

10. After installation, check for leaks at hose and line joints or connections, and retighten if necessary.

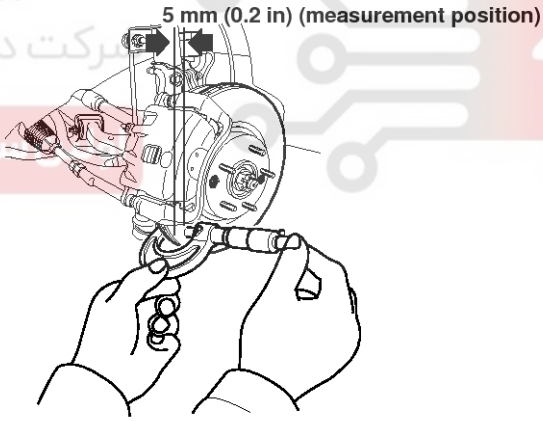
INSPECTION

FRONT BRAKE DISC THICKNESS CHECK

1. Remove all rust and contamination from the disc surface, and then measure the disc thickness at 8 positions at least.

Front brake disc thickness
Standard value : 26.0 mm (1.02 in)
Limit : 24.4 mm (0.96 in)

2. Thickness variation should not exceed 0.005 mm(0.0002 in) (circumference) and 0.01 mm(0.0004 in) (radius) at any directions.
3. If wear exceeds the limit, replace the discs and pad assemblies for left and right of the vehicle.

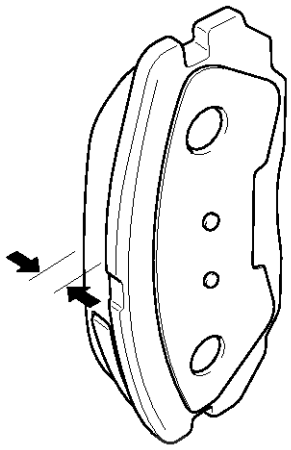


LJLG500J

FRONT BRAKE PAD CHECK

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

Pad thickness
Standard value : 11.0 mm (0.43 in)
Service limit : 2.0 mm (0.0787 in)



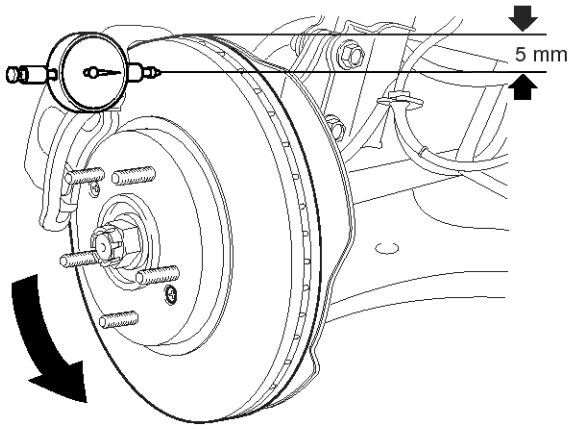
EJRF702K

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

FRONT BRAKE DISC RUN OUT CHECK

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

Brake disc run out
Limit : 0.04 mm (0.0016 in) or less



AJLG501A

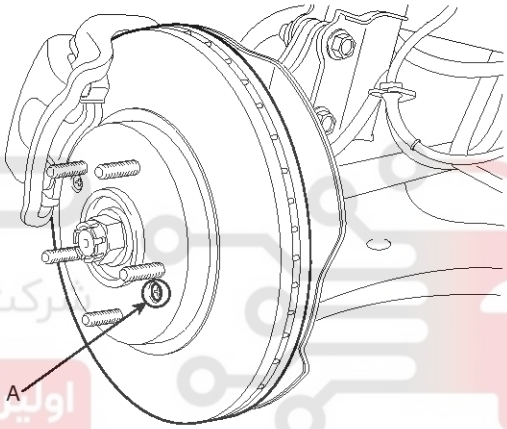
2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
3. If the run out does not exceed the limit specification, install the brake disc after turning it 180° and then check the run out of the brake disc again.
4. If the run out cannot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

SEIZE OF FRONT BRAKE DISC

1. Remove the brake disc from hub using M8 screw(A) if the brake disc has been seized with the hub due to corrosion or overheat.

NOTICE

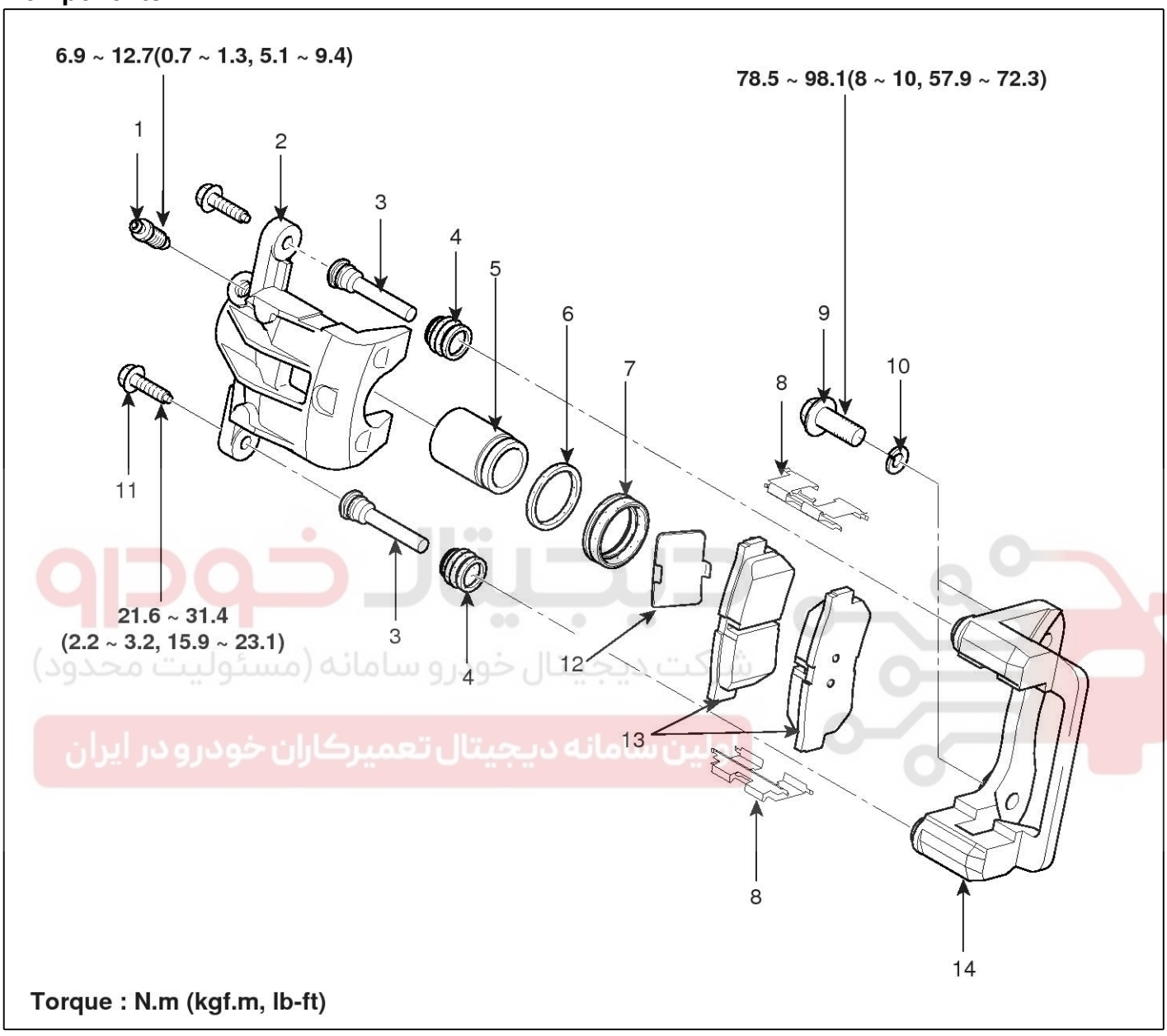
Be careful not to use the hammer. The disc can be damaged if you remove the disc from the hub by hammer.



AJLG501B

Rear Disc Brake

Components

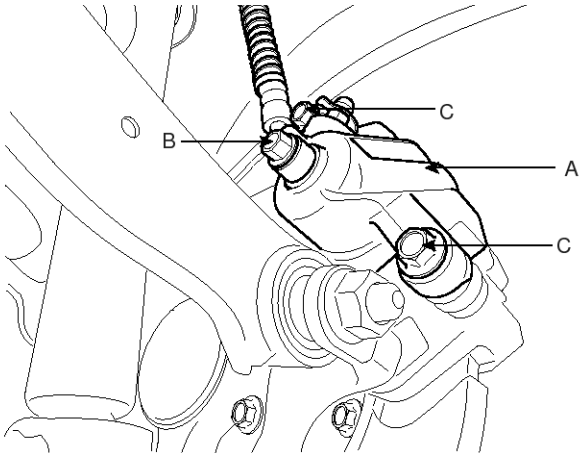


SMGBR9300L

1. Bleeder screw
2. Caliper body
3. Guide rod
4. Boot
5. Piston
6. Piston seal
7. Piston boot
8. Pad retainer
9. Caliper mounting bolt
10. Washer
11. Guide rod bolt
12. Inner shim
13. Brake Pad
14. Caliper bracket

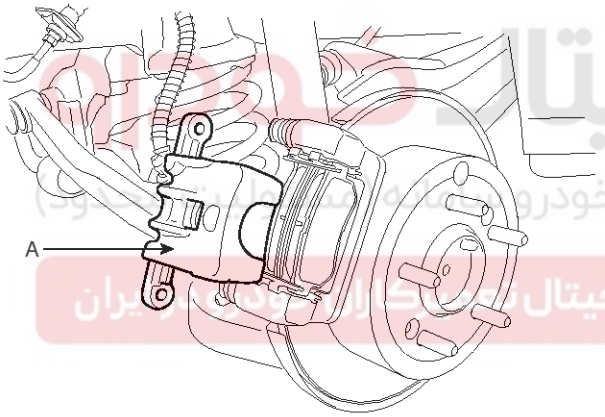
Removal

1. Remove the brake hose bolt (B) and the guide rod bolts (C) from the caliper assembly (A).



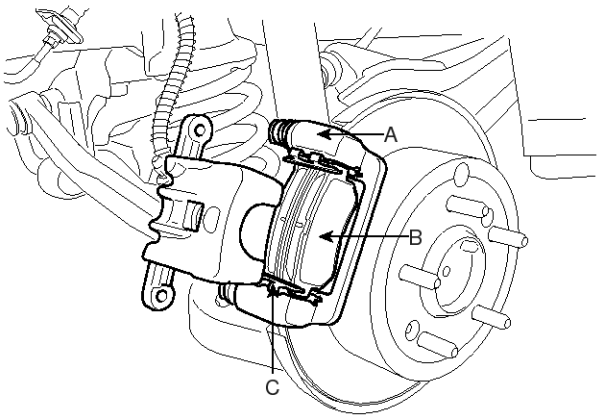
SMGBR8531D

2. Remove the caliper assembly (A).



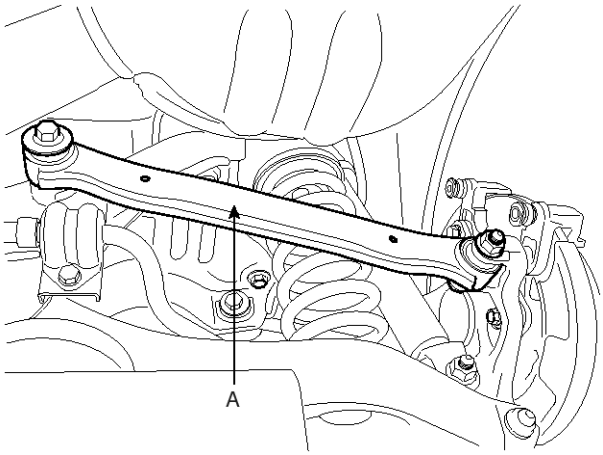
SMGBR8532D

3. Remove the pads (B), the pad shims (C) and the pad retainers (D) from the caliper bracket (A).



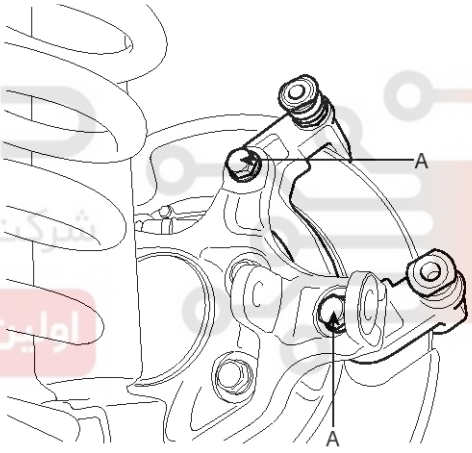
SMGBR8536D

4. Remove the rear upper arm (A).



SMGBR8533D

5. Remove the caliper bracket (B) and the caliper mounting bolts (A).



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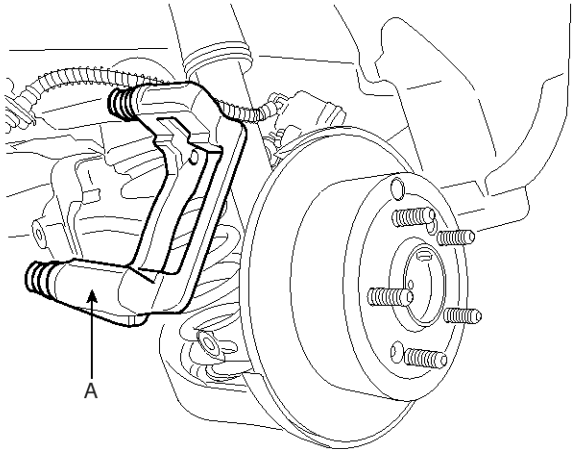
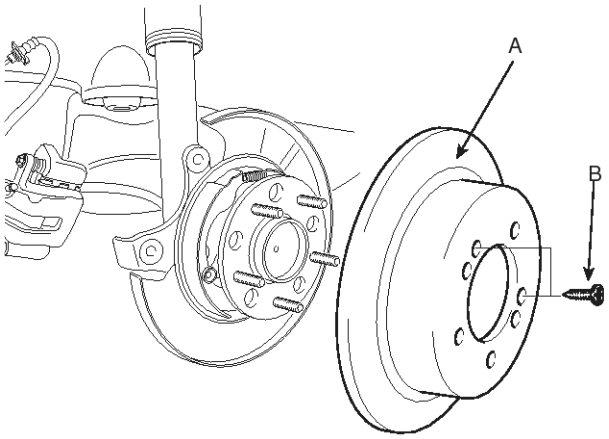


SMGBR8535D

6. Remove the brake disc (A) and the screw (B).

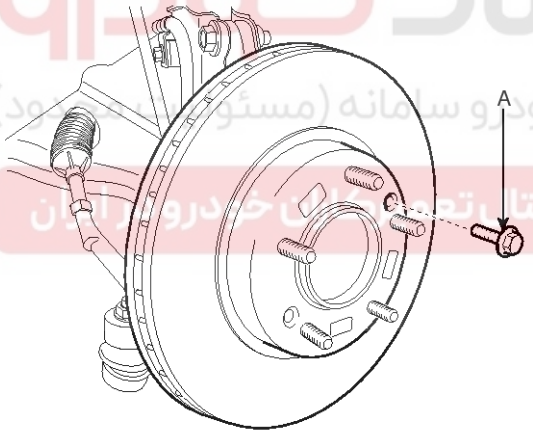


SUNBR6527D

NOTICE

Remove the brake disc from hub using M8 bolt (A) if the brake disc has been seized with the hub due to corrosion or overheat.

Be careful not to use the hammer. The disc can be damaged if you remove the disc from the hub by hammer.



SMGBR8401D

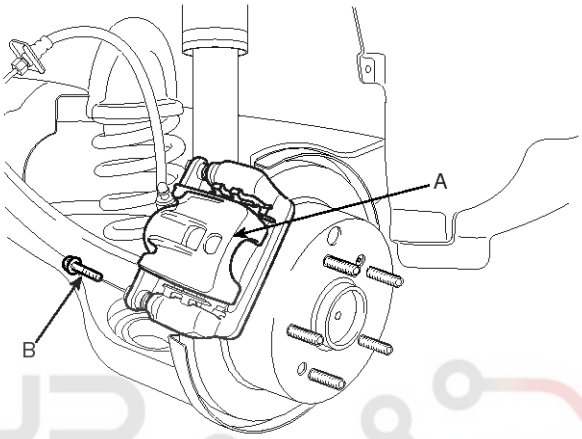
Replacement

CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

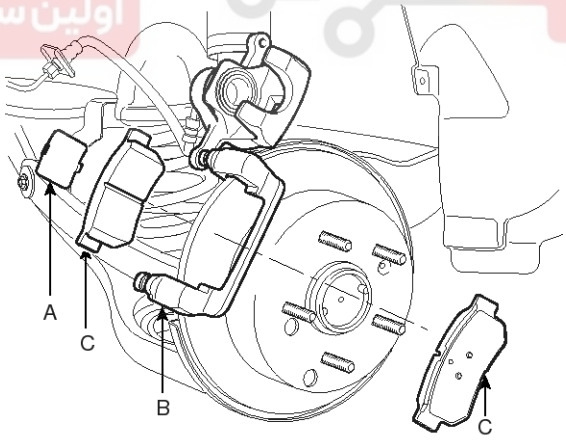
- **Avoid breathing dust particles.**
- **Never use on air hose or brush to clean brake assemblies.**

1. Remove guide rod bolt (B) and raise the caliper assembly (A).



SUNBR6535D

2. Remove the pads (B), the pad shims (C) and the pad retainers (D) from the caliper bracket (A).

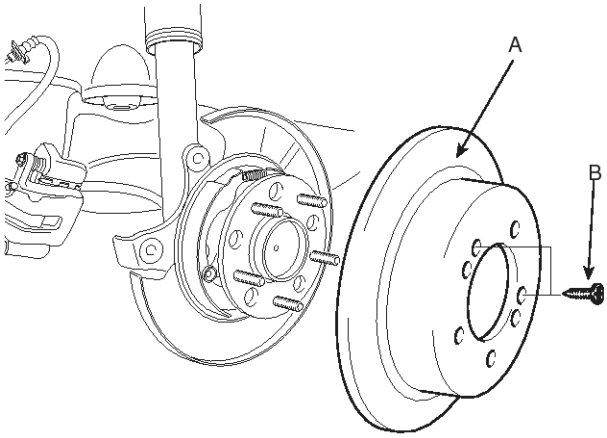


AJLG501L

Installation

1. Install the brake disc (A) and tighten the screw (B).

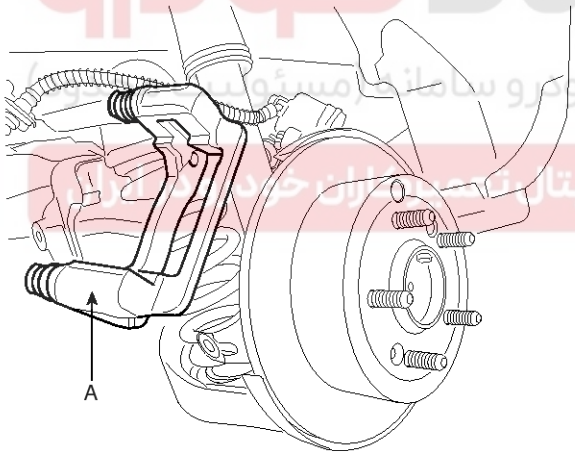
Tightening torque :
4.9~5.9N.m (0.5~0.6kgf.m, 3.6~4.3lb-ft)



SUNBR6527D

2. Install the caliper bracket (B) and tighten the caliper mounting bolts (A).

Tightening torque :
49.0~58.8N.m (5.0~6.0kgf.m, 36.2~43.4lb-ft)



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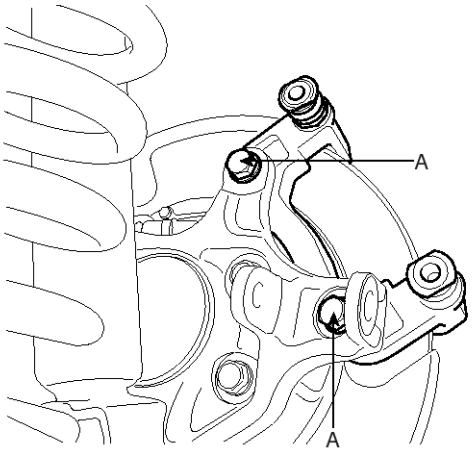
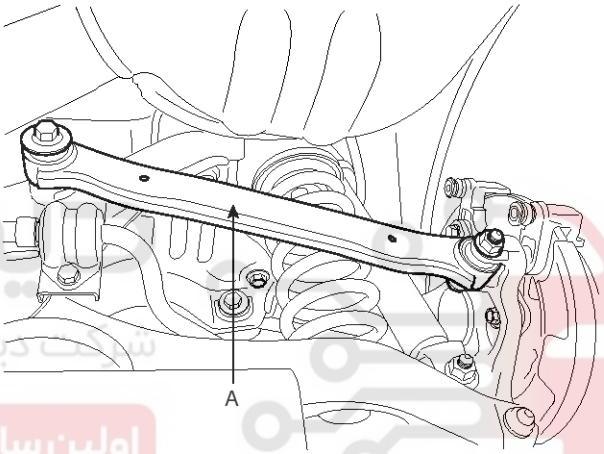


SMGBR8534D

3. Install the rear upper arm (A).



SMGBR8533D

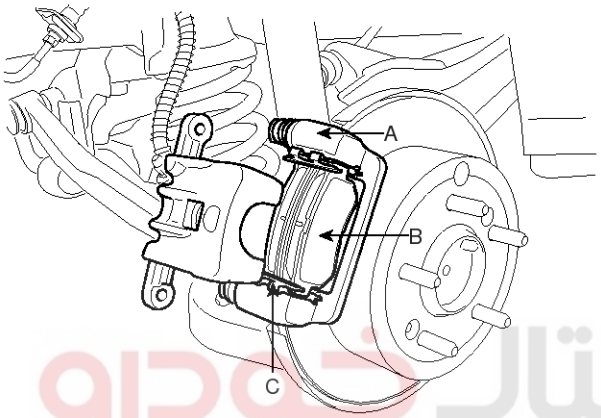
4. Install the pad retainers (D) to the caliper bracket (A).

5. Install the brake pads (B) and pad shims (C) on the pad retainer correctly. Install the pad with the wear indicator on the inside. If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momentary loss of braking efficiency.

NOTICE

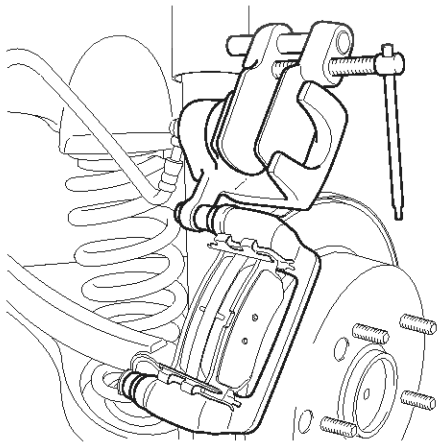
Check the foreign material at the pad shims (A) and the back of the pads (B).

Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.



SMGBR8536D

6. Push in the piston using the SST(09581-11000) so that the caliper will fit over the pads. Make sure that the piston boot is in position to prevent damaging it when installing the caliper.

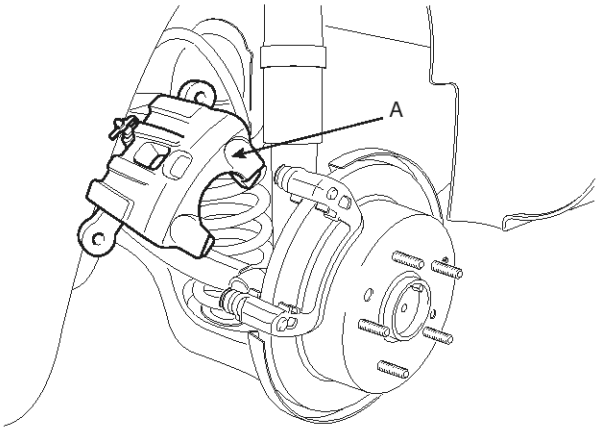


AJLG501P

7. Install the caliper assembly (A).

NOTICE

Be careful not to damage the piston pin boot.



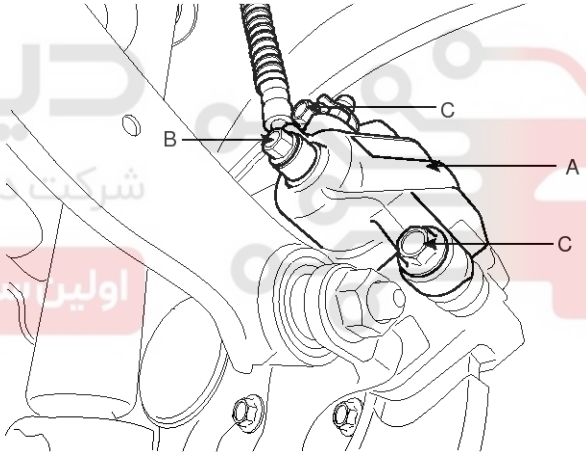
SUNBR6015D

8. Install the brake hose bolt (B) and the guide rod bolts (C) to the caliper assembly (A).

Tightening torque :

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

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



SMGBR8531D

9. Refill the master cylinder reservoir to the MAX line.
10. Bleed the brake system. (Refer to "Bleeding of brake system")
11. Depress the brake pedal several times to make sure the brakes work, then test-drive.

NOTICE

Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set. Several applications of the brake will restore the normal pedal stroke.

12. After installation, check for leaks at hose and line joints or connections, and retighten if necessary.

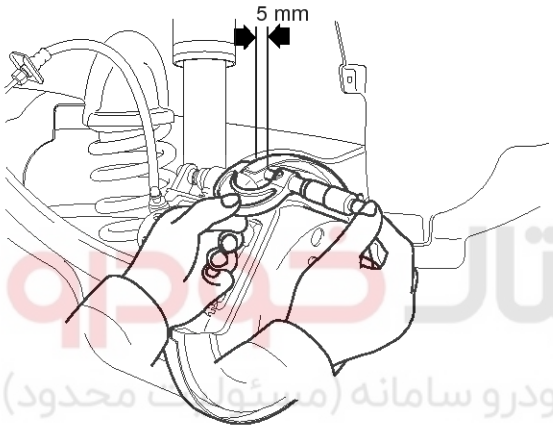
Inspection

Rear Brake Disc Thickness Check

1. Remove all rust and contamination from the disc surface, and then measure the disc thickness at 8 positions at least.

Rear brake disc thickness
Standard value : 10.0 mm (0.39 in)
Limit : 8.0 mm (0.315 in)

2. Thickness variation should not exceed 0.01mm(0.0004 in) (circumference) and 0.01mm(0.0004 in) (radius) at any directions.
3. If wear exceeds the limit, replace the discs and pad assembly for left and right of the vehicle.

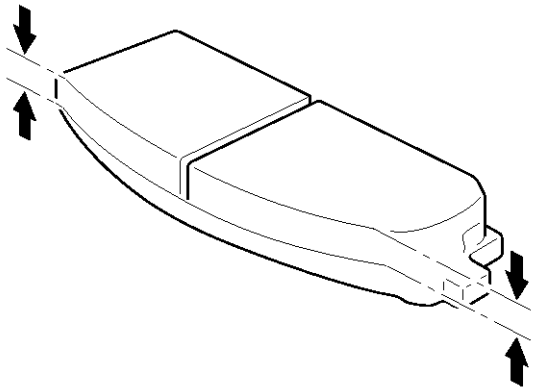


AJLG501M

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 : 15.0 mm (0.59 in)
Service limit : 2.0 mm (0.0787 in)



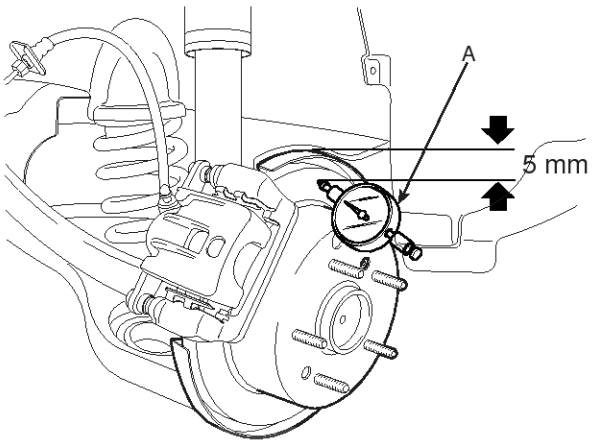
KJRE503B

2. Check that grease is applied, and the pad and backing metal for damage.

Rear Brake Disc Run Out Check

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

Brake disc run out
Limit : 0.03mm (0.0012 in) or less



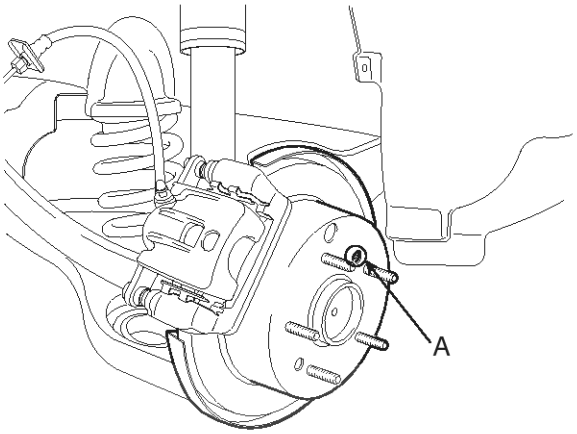
AJLG501N

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

Seize of Rear Brake Disc

1. Remove the brake disc from hub using M8 screw(A) if the brake disc has been seized with the hub due to corrosion or overheat.

NOTICE
Be careful not to use the hammer. The disc can be damaged if you remove the disc from the hub by hammer.



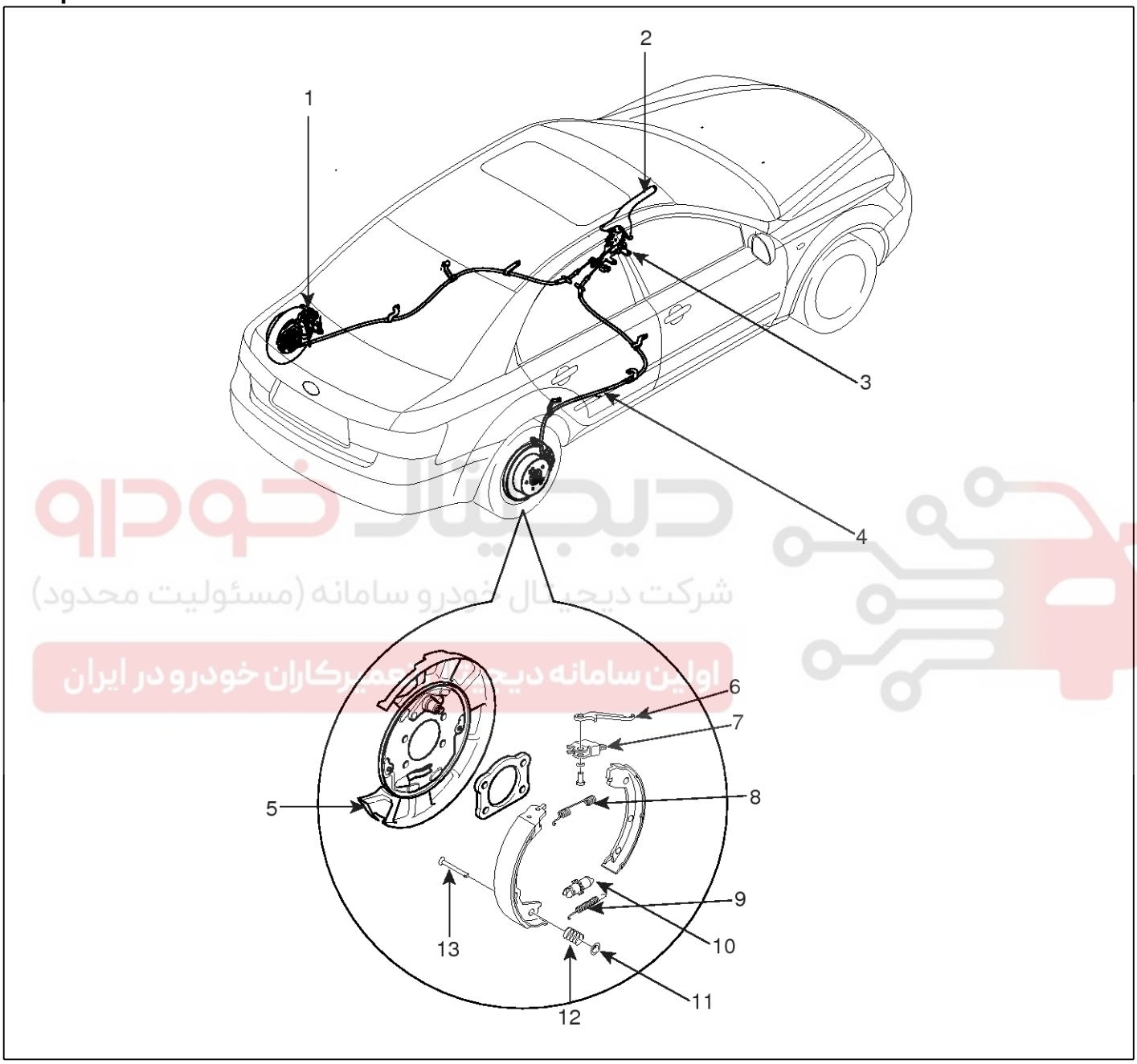
AJLG501O

Parking Brake System

Parking Brake System

Parking Brake Assembly

Components



SMGBR9301L

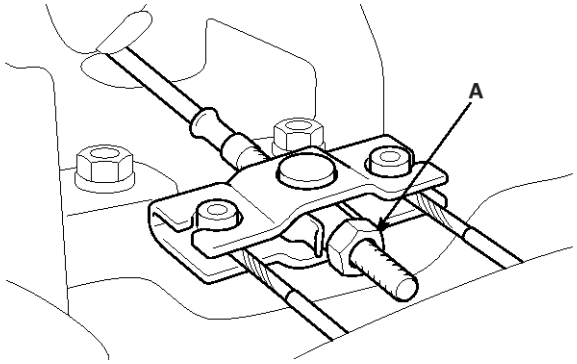
1. Rear brake caliper
2. Parking brake lever
3. Parking brake switch
4. Parking brake cable
5. Backing plate
6. Operating lever
7. Strut
8. Upper spring
9. Lower spring
10. Adjuster
11. .Cup washer
12. Shoe hold down spring
13. Shoe hold down pin

Removal

NOTICE

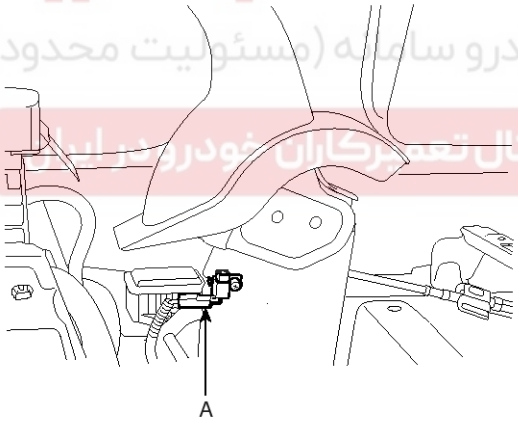
The parking brake cables must not be bent or distorted. This will lead to stiff operation and premature failure.

1. Remove the console.(refer to body group-console)
2. Loosen the adjusting nut (A) and the parking brake cables.



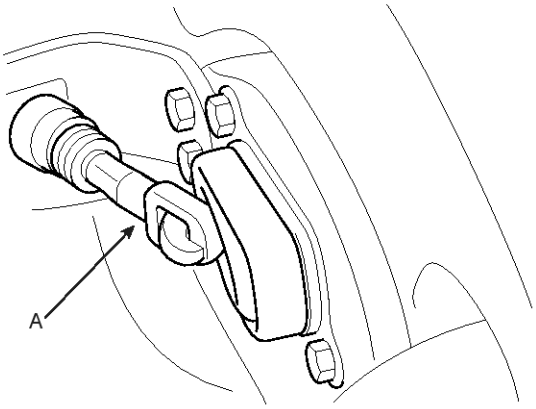
ARJE502S

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



AJLG505Q

4. Remove the parking brake lever assembly with loosening the bolts.
5. Remove the wheel and tire.
6. Remove the brake disc.
7. Remove the brake shoe.
8. Remove the parking brake cable (A).



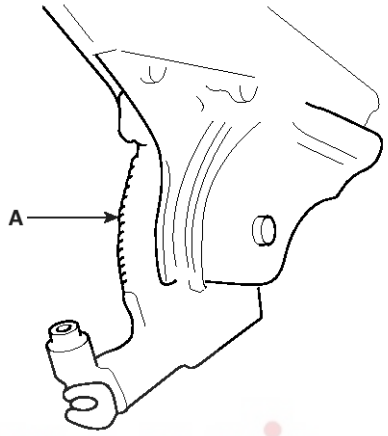
KJRE502V

9. Remove the parking brake cable assembly.

Installation

1. Install the removed parts in the reverse order of removal.
2. Apply a coating of the specified grease to each sliding parts (A) of the ratchet plate or the ratchet pawl.

Specified grease :
Multi purpose grease SAE J310, NLGI No.2



ARJE502X

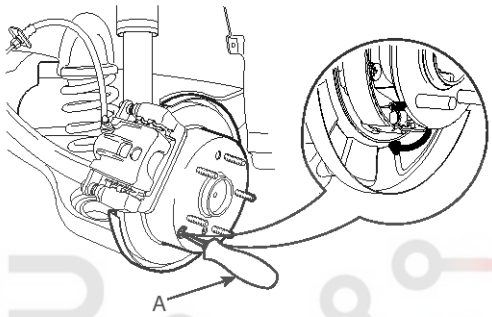
3. After installing the cable adjuster, adjust the parking brake lever stroke.

Adjustment

Parking Brake Shoe Clearance Adjustment

Disc Brake Type

1. Lift the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel.
3. Remove the plug from the disc.
4. Turn the adjusting wheel in arrow direction as shown until the disc won't be rotated by tangential force of 29.4N(3kgf, 6.6lb) using the (-)screw driver (A). Then turn back the adjusting wheel by 3~5 notches.

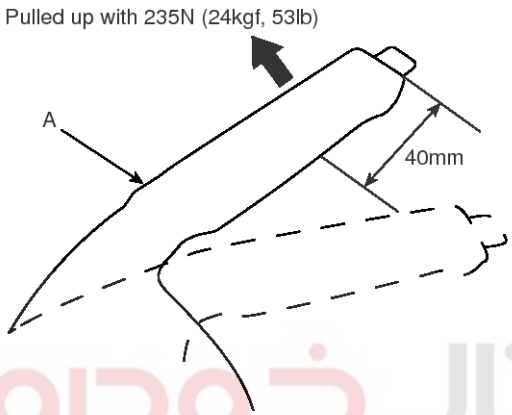


SMGBR8300D

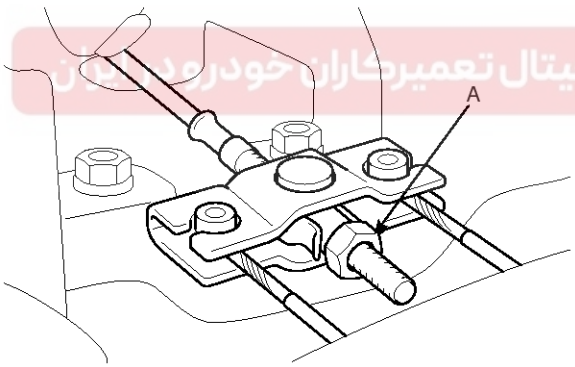
5. Install the rear tire and wheel after installing the plug.

Parking Brake Lever Stroke Adjustment

1. Lift the vehicle, and make sure it is securely supported.
2. Remove the floor console. (Refer to BD Gr. - "Floor console")
3. After the full stroke operation of the brake lever over 3 times for setting the cable, the travel must be between 8 notches when applying a force of 235N(24kgf, 53lb) at 40mm from the end of lever assembly (excluding button) by adjusting nut (A).



SMGBR8301L



SJBBR8302D

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. Parking indicator lamp must be “OFF”when the lever assembly is released. It must be “ON” when the lever assembly is operated by 1 notch.
7. Install the floor console. (Refer to BD Gr. - "Floor console")

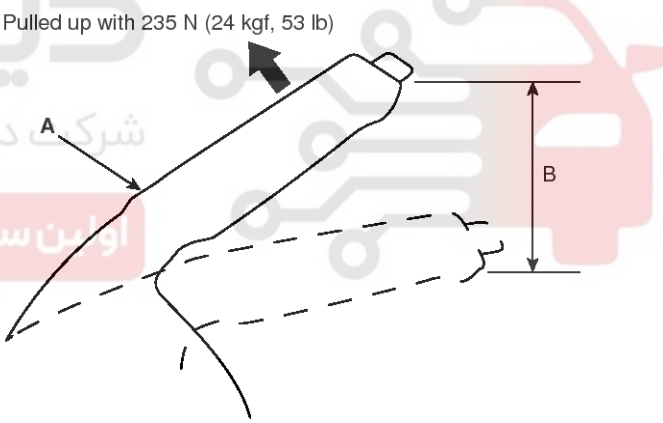
⚠CAUTION

After repairing the parking brake shoe, adjust the brake shoe clearance, and then adjust the parking brake lever stroke.

Inspection

1. Pull the parking brake lever (A) with 235 N (24 kg, 53 lb) force to fully apply the parking brake. The parking brake lever should be locked within the specified number of clicks (B).

Lever locked clicks: 8 clicks



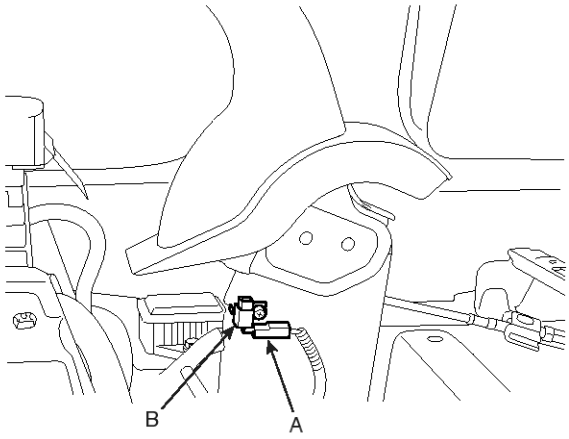
LJLG500R

2. Adjust the parking brake if the lever clicks are out of specification.

Parking Brake Switch

INSPECTION

1. Remove the floor console .(refer to body group-console)
2. Remove the connector (A) from the switch (B).

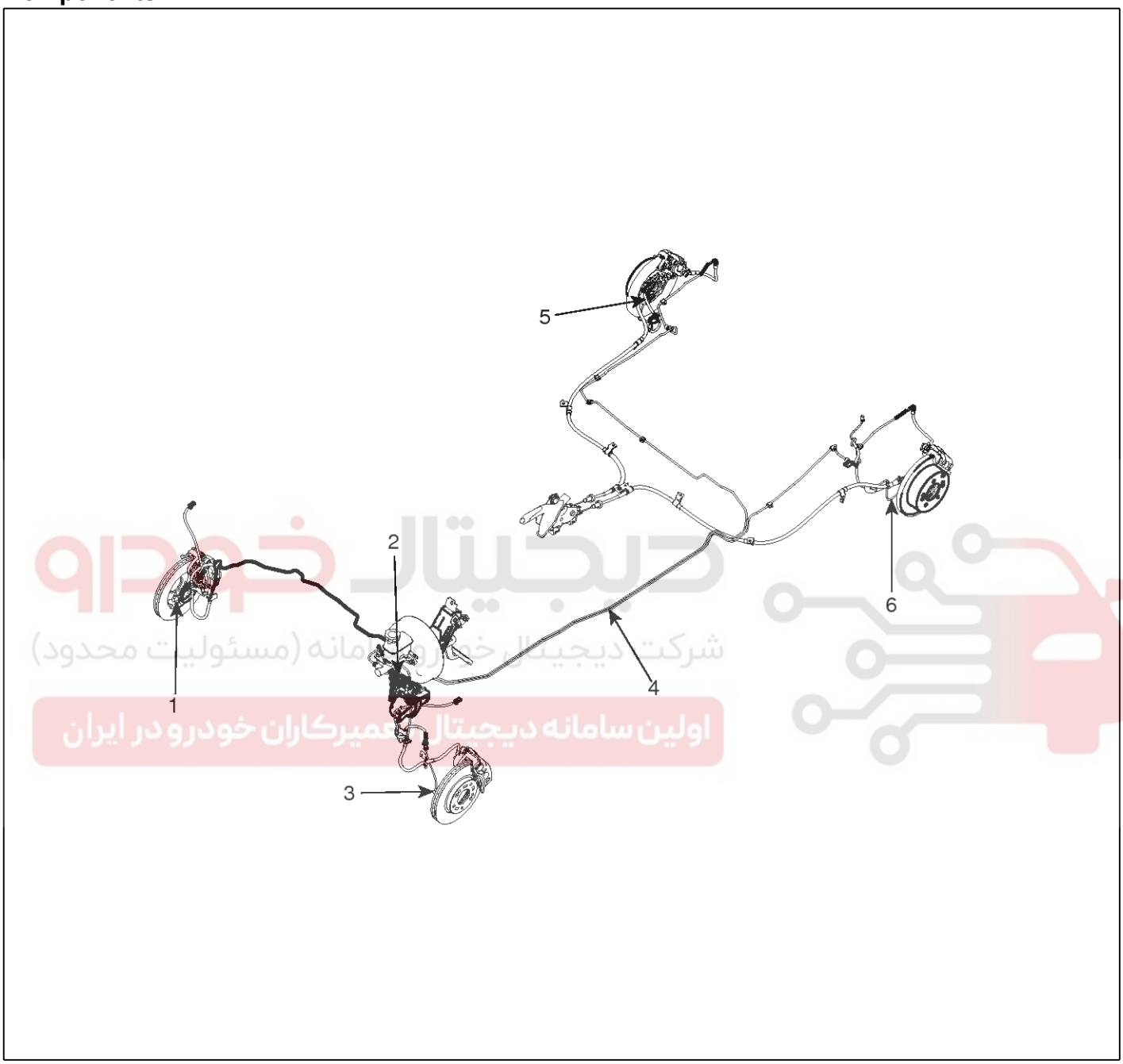


KJRE501C

3. Inspect the continuity between (-) terminal and the ground.
   - When the brake lever is pulled, there should be the continuity between them.
   - When the brake lever is released, there should be no continuity between them.

ABS(Anti-Lock Brake System)

Components



SMGBR9302D

1. Front right wheel speed sensor
2. ABS control module (HECU)
3. Front left wheel speed sensor
4. Brake line
5. Rear right wheel speed sensor
6. Rear left wheel speed sensor

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 10V), ABS control shall be inhibited and the warning lamp shall be turned on.

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

Pump Motor Checking

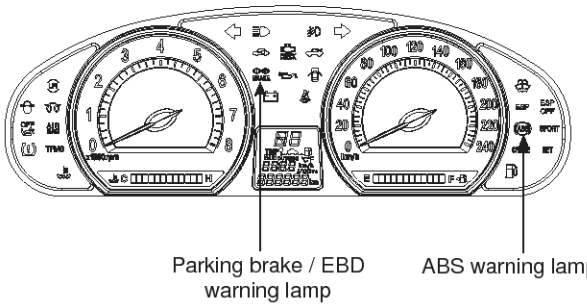
The ECU performs a pump motor test at a speed of 15 km/h(9 MPH) once after IGN is switched on.

Diagnostic Interface

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

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

Warning Lamp Module



LJLG500S

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.

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:

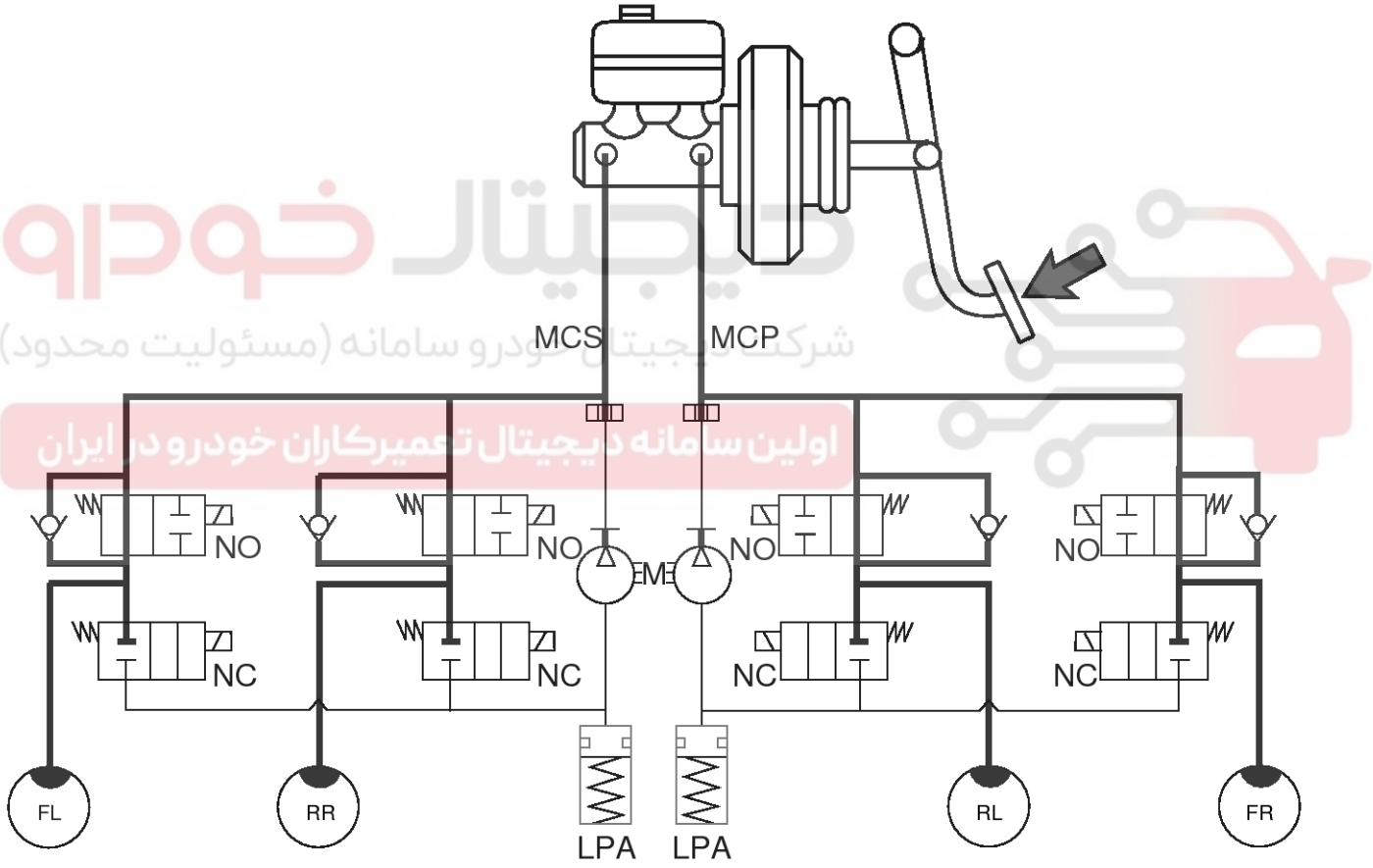
   - During the initialization phase after IGN ON. (continuously 3 seconds).
   - When the Parking Brake Switch is ON or brake fluid level is low.
   - When the EBD function is out of order.
   - During diagnostic mode.
   - When the ECU Connector is seperated from ECU.

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	

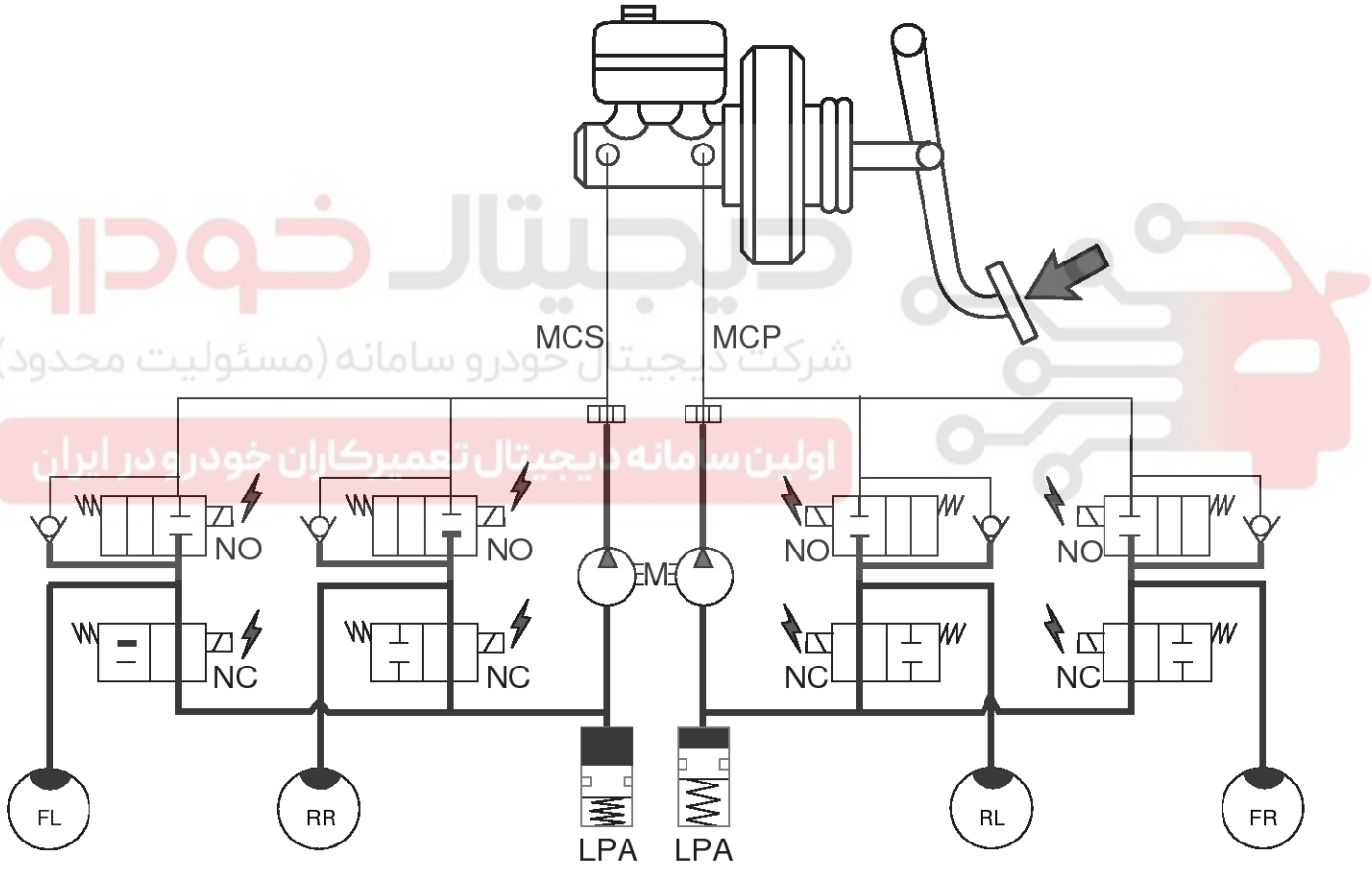


LJJF500W

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	

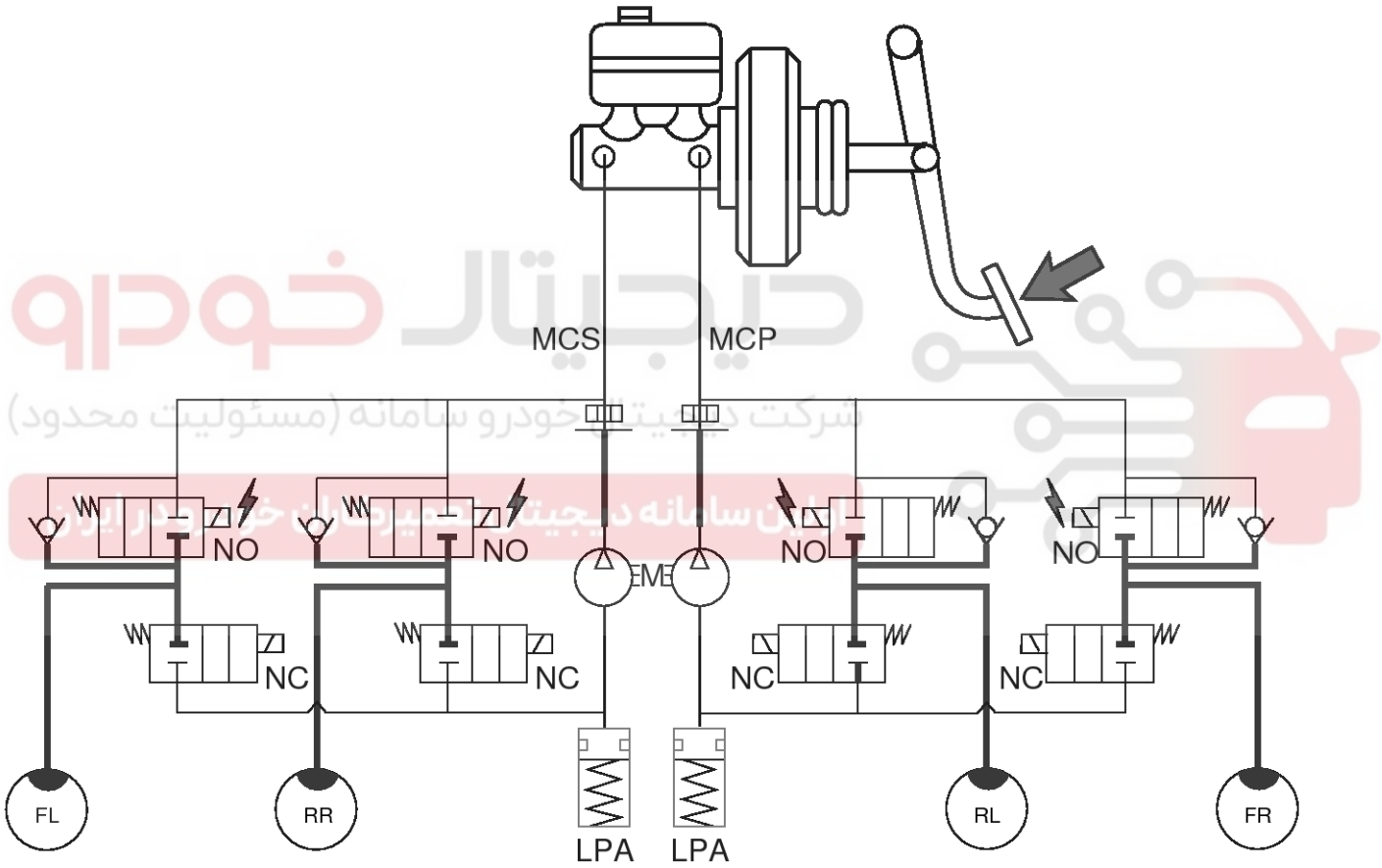


LJJF500X

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	

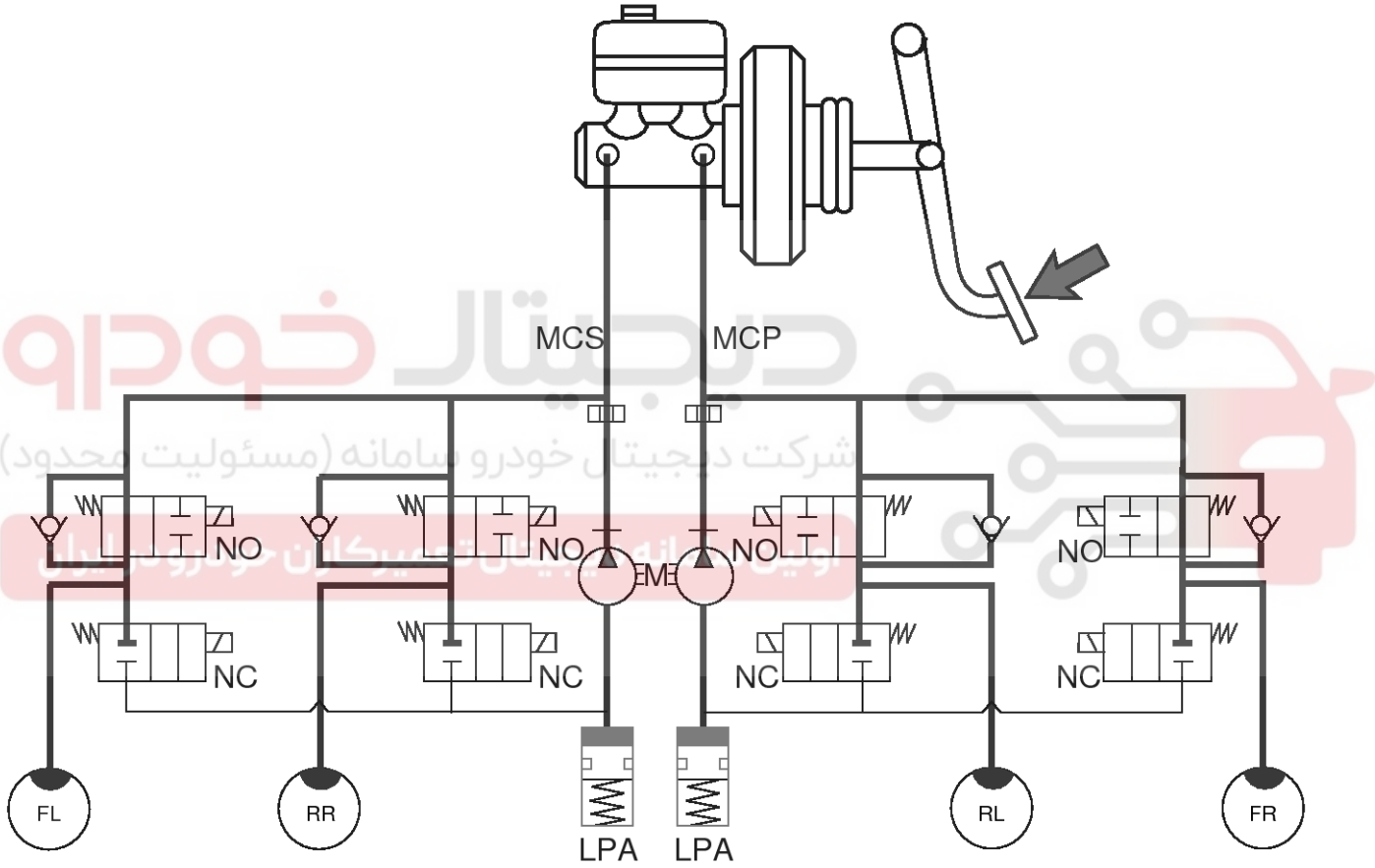


LJJF500Y

4. Increase Mode

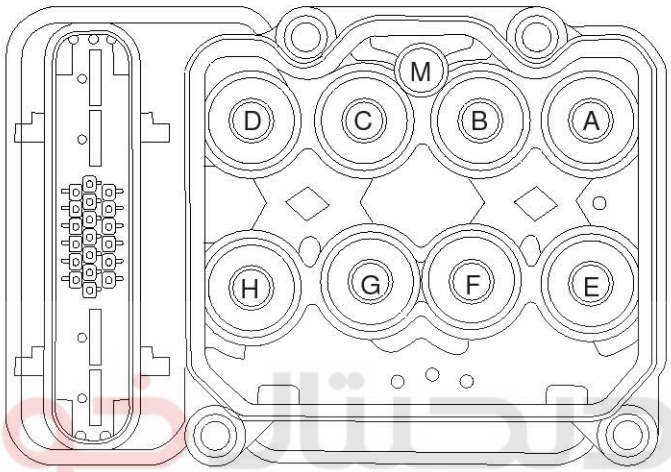
   If HECU determines there's no lock-up in the wheel, HECU cuts voltage to solenoid valve. So voltage is not supplied to each solenoid valve, brake fluid passes through the inlet valve to wheel cylinder, resulting in pressure increase.

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

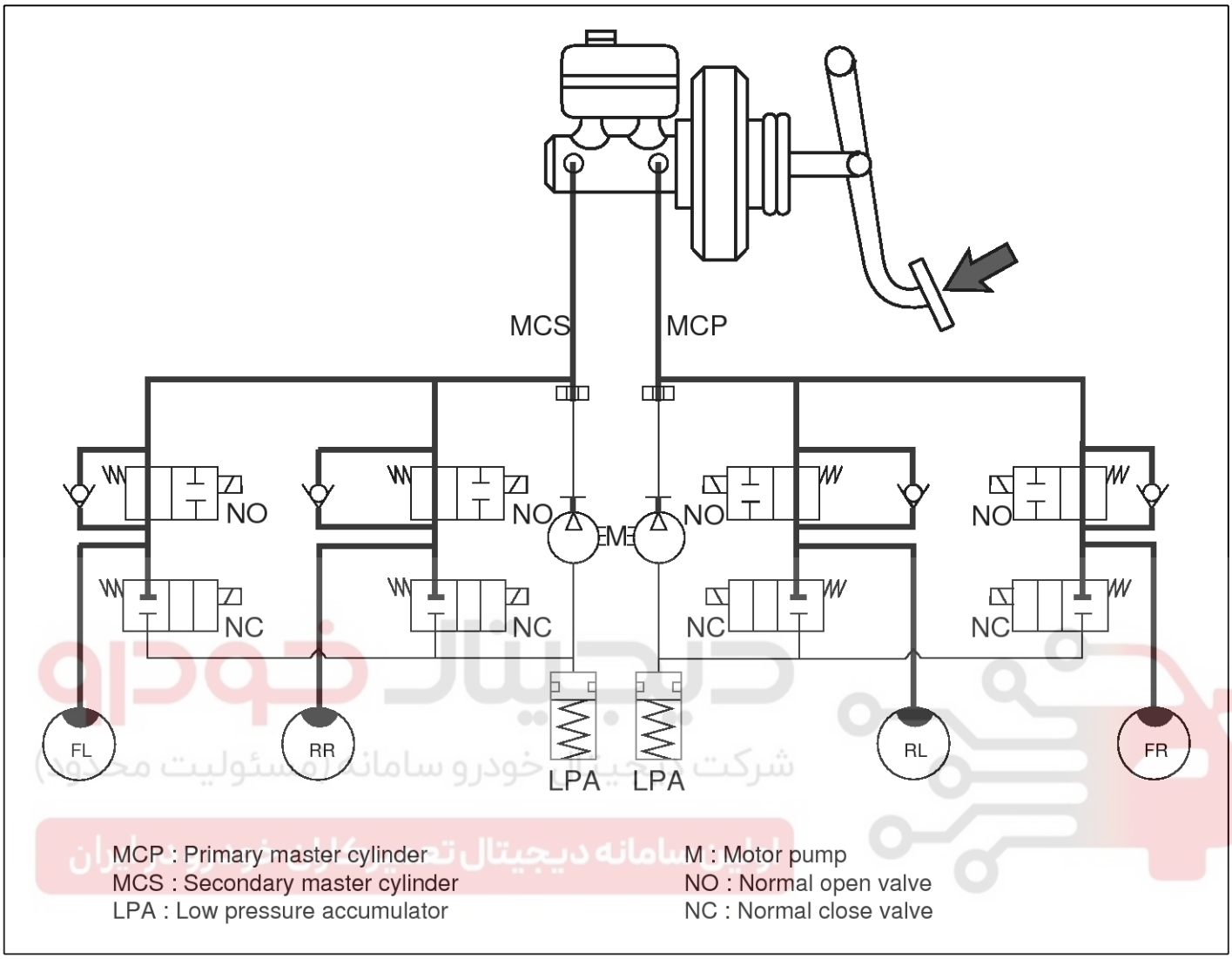
ABS HECU External Diagram



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

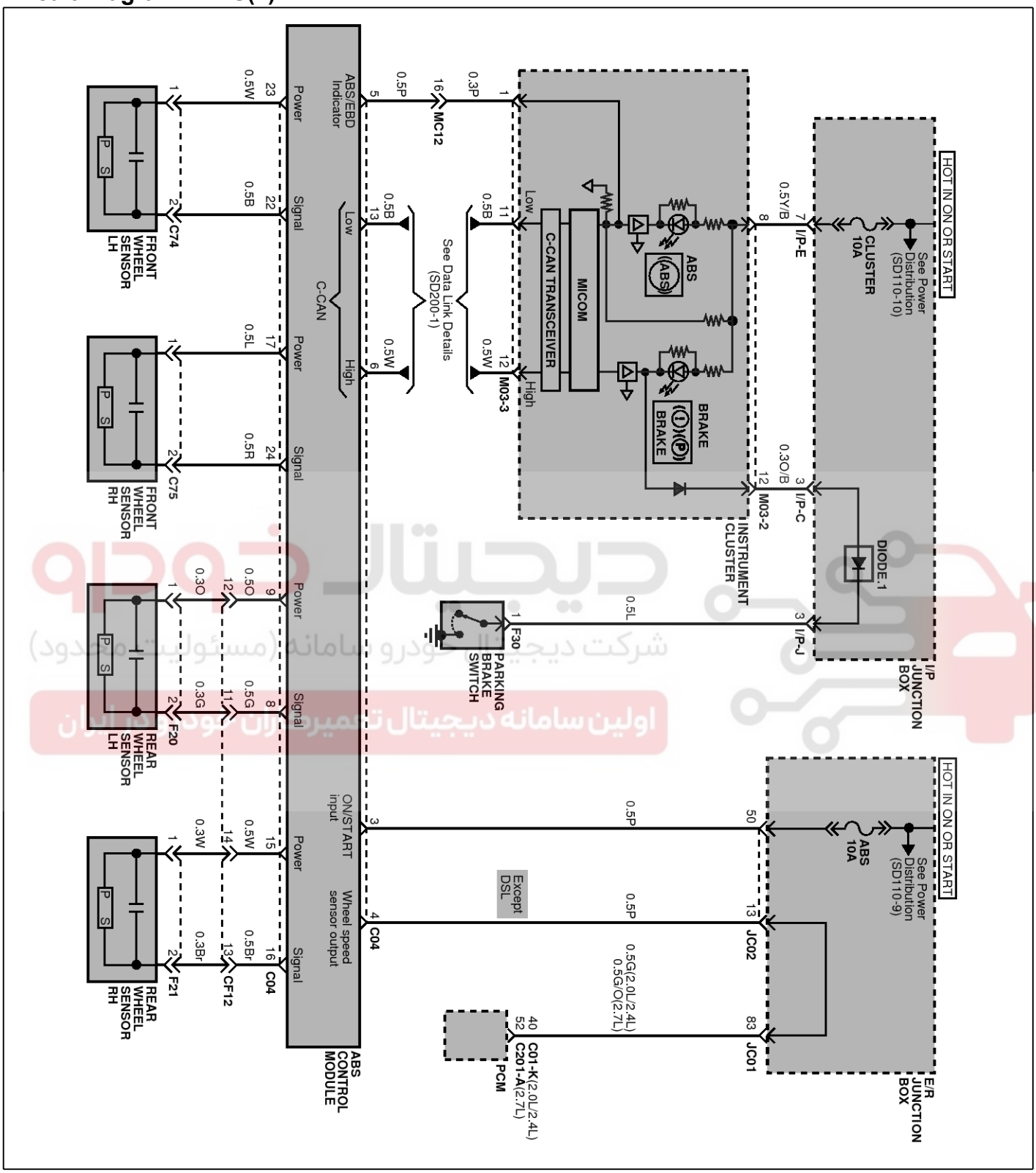
SHMBR8302D

Hydraulic System Diagram



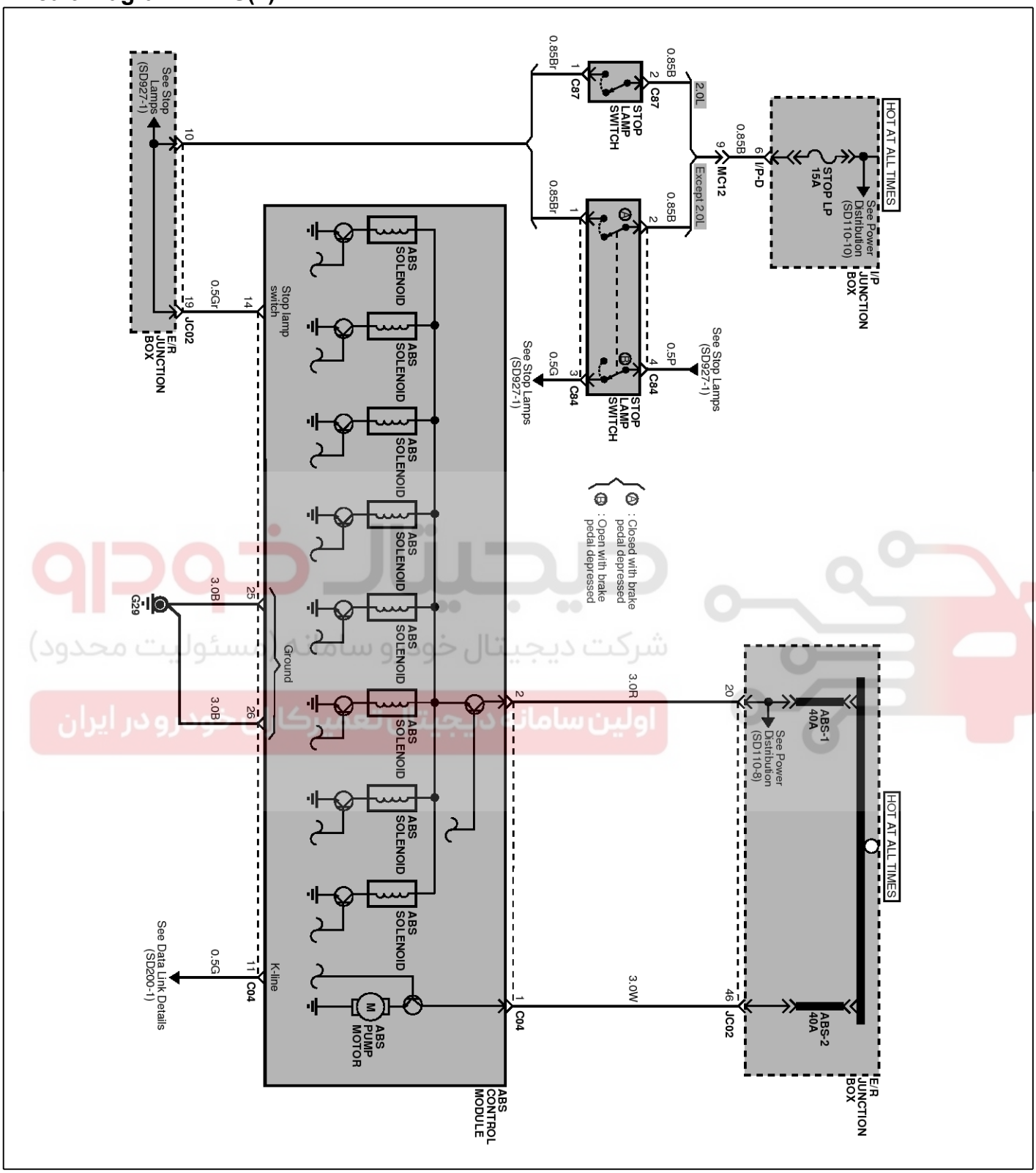
LJJF501B

Circuit Diagram - ABS(1)



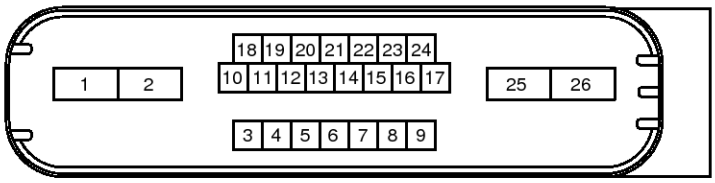
SMGBR9304L

Circuit Diagram - ABS(2)



SMGBR9305L

ABS Connector Input/Output

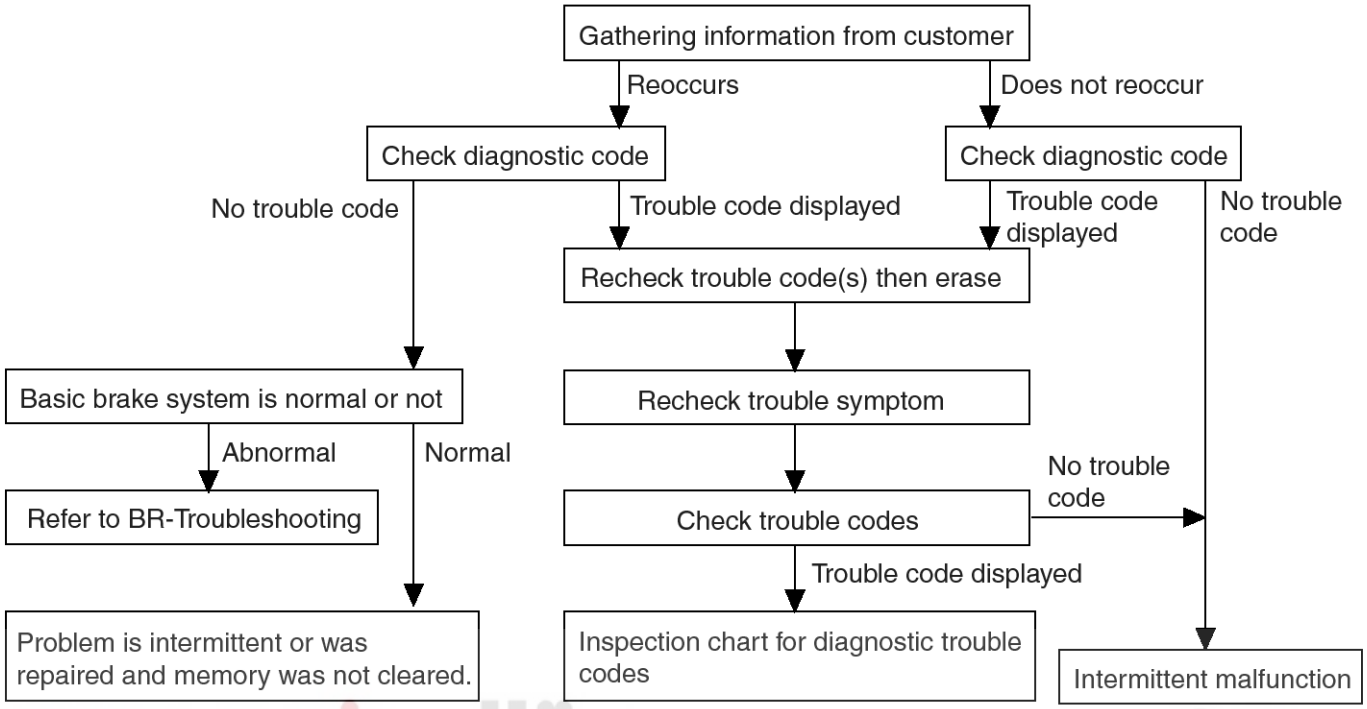


SENBR7602D

Connector Terminal		Specification	Remark
No	Description		
3	IGNITION1(+)	Over voltage range: 17 ± 0.5V Operating voltage range: 9.5 ± 0.5V < V < 17 ± 0.5V Low voltage range: 7.0 ± 0.5V < V < 9.5 ± 0.5V Max. current: I < 300mA	
2	POS. BATTERY.(SOLENOID)	Max leakage current : I < 0.8mA Operating voltage range: 9.5 ± 0.5V < V < 17 ± 0.5V Max current : I < 40A	
1	POS, BATTERY.(MOTOR)	Operating voltage range: 9.5 ± 0.5V < V < 16.5 ± 0.5V Rush current : I < 100A Max current : I < 40A Max leakage current : I < 0.2mA	
26	GROUND	Rated current : I < 300mA Max. current: I < 30A	
25	PUMP MOTOR GROUND	Rush current : I < 100A Max current : I < 40A	
14	BRAKE LIGHT SWITCH	Input voltage low: 0V ≤ V ≤ 3.0V Input voltage High: 7.0V ≤ V ≤ 16.0V	
23	SENSOR FRONT LEFT POWER	- Output voltage : IGN[V] ± 1V - Output current : Max 30mA	
17	SENSOR FRONT RIGHT POWER		
9	SENSOR REAR LEFT POWER		
15	SENSOR REAR RIGHT POWER		
22	SENSOR FRONT LEFT SIGNAL	- Input current LOW : 5.9 ~ 8.4mA - Input current HIGH : 11.8 ~ 16.8mA - Frequency range : 1 ~ 2500Hz - Input duty : 50 ± 20%	
24	SENSOR FRONT RIGHT SIGNAL		
8	SENSOR REAR LEFT SIGNAL		
16	SENSOR REAR RIGHT SIGNAL		
13	CAN BUS LINE (LOW)	Max. current : I < 10mA	
6	CAN BUS LINE (HIGH)		
4	SENSOR FRONT RIGHT OUTPUT	Max. current : I < 16mA External pull up resister : 1kΩ < R Output duty : 50 ± 20%	

Connector Terminal		Specification	Remark
No	Description		
11	DIAGNOSIS INPUT/OUTPUT	Input voltage Low(V) < 0.3 IGN(V) High(V) > 0.7 IGN (V) Output voltage Low(V) < 0.2 IGN(V) High(V) > 0.8 IGN (V)	
5	ABS/EBD W/LAMP DRIVE	Current : I < 300mA(12V) Voltage range : 0 ~ 18V Min. shunt resistance : 500kΩ	

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.

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

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

CAUTION

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

ABS 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 scan tool with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
3. Is the normal code output?

NO ▶ Check the power source circuit.

YES ▶ Erase the DTC and recheck using scan tool.

Check the Power Source Circuit

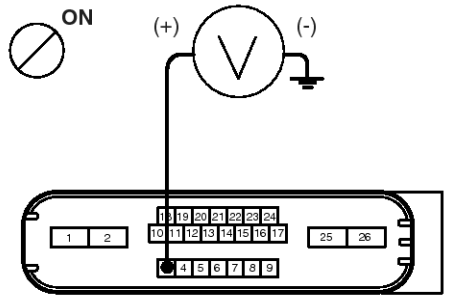
1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 3 of the ABS control module harness side connector and body ground.

Specification: approximately B+

3. Is the voltage within specification?

YES ▶ Check the ground circuit.

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



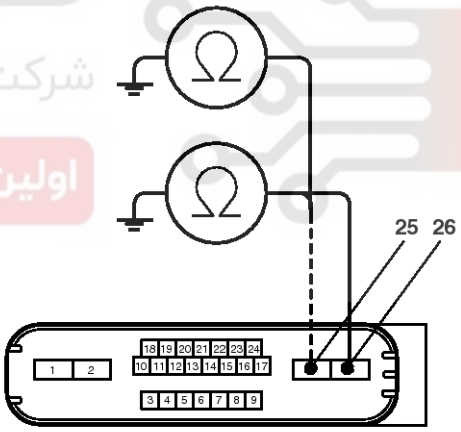
SENBR7603D

Check the Ground Circuit

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

YES ▶ Check the wheel speed sensor circuit.

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



SENBR7604D

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

NO ▶ Check the wheel speed sensor circuit.

YES ▶ Erase the DTC and recheck using scan tool.

Check the Wheel Speed Sensor Circuit

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

YES ▶ Check the stop lamp switch circuit.

NO ▶ Repair or replace the wheel speed sensor.

Check The Stop Lamp Switch Circuit

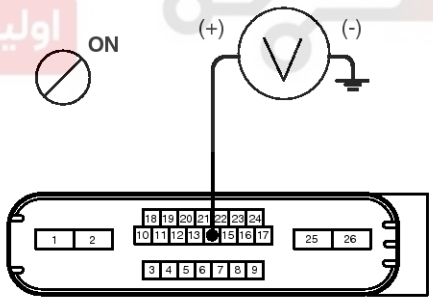
1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.
2. Measure the voltage between terminal 14 of the ABS control module harness side connector and body ground when brake pedal is depressed.

Specification : approximately B+

3. Is the voltage within specification?

YES ▶ Check the hydraulic circuit for leakage.

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



SENBR7605D

Check the Hydraulic Circuit for Leakage

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

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

NO ▶ Repair the hydraulic lines for leakage.

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

STQBR8321L

Detecting Condition

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

Inspection Procedures

Check The Power Supply Circuit For The Diagnosis

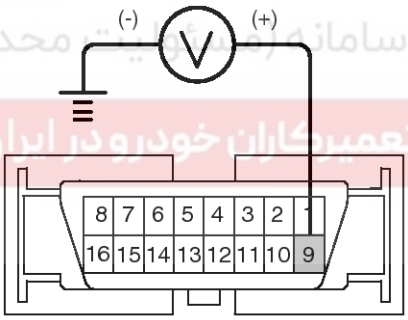
1. Measure the voltage between terminal 9 of the data link connector and body ground.

Specification : approximately B+

2. Is voltage within specification?

YES ▶ Check the ground circuit for the diagnosis.

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

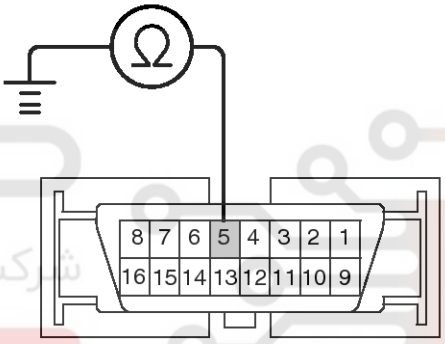


SUNBR6519L

Check the Ground Circuit for the Diagnosis

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

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



SUNBR6520L

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

STQBR8322L

Detecting Condition

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

Inspection Procedures

Check for Continuity in the Diagnosis Line

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 7 of the ABS control module connector and 1 of the data link connector.
3. Is there continuity?

YES ▶ Check the power source of ABS control module.

NO ▶ Repair an open in the wire.

Check the Power Source of ABS Control Module

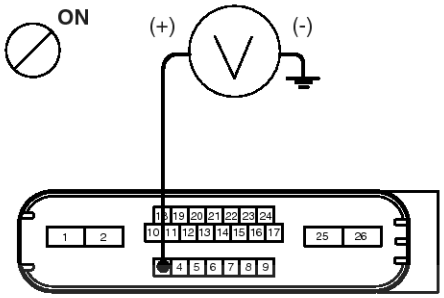
1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 3 of the ABS control module harness side connector and body ground.

Specification : approximately B+

3. Is voltage within specification?

YES ▶ Check for poor ground.

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



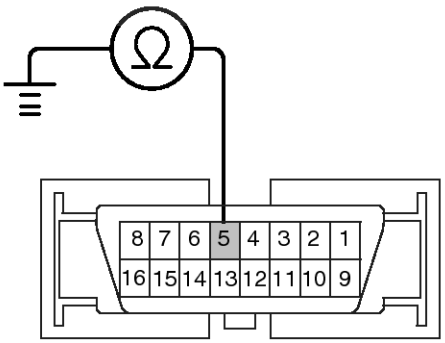
SENBR7603D

Check for Poor Ground

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

YES ▶ Replace the ABS control module and recheck.

NO ▶ Repair an open in the wire or poor ground



SUNBR6520L

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?

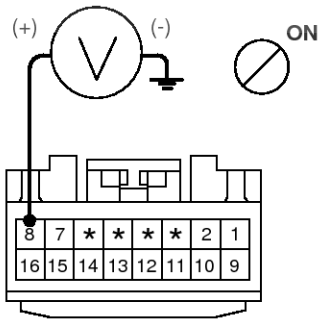
YES ▶ Inspect again after replacing the ABS HECU .

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

Check the Power Source for The ABS Warning Lamp

1. Disconnect the instrument cluster connector (M03-2) and turn the ignition switch ON.
2. Measure the voltage between terminal (M03-2) 8 of the cluster harness side connector and body ground.

Specification : approximately B+



SMGBR9308L

3. Is voltage within specification?

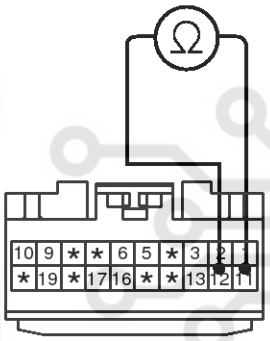
YES ▶ Check the CAN circuit resistance for ABS warning lamp.

NO ▶ Check for blown fuse.

Check the Can Circuit Resistance for ABS Warning Lamp

1. Disconnect the instrument cluster connector (M03-3) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M03-3) 11 and 12 of the cluster harness side connector.

Specification : 60Ω



SMGBR9309L

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 (M03-3) and ABS HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M03-3) 12 of the cluster harness side connector and terminal 6 of ABS HECU harness side.

   Check for continuity between terminal (M03-3) 11 of the cluster harness side connector and terminal 13 of ABS HECU harness side.

Specification : Below 1Ω

3. Is resistance within specification?

YES ▶ Repair short of wiring between terminal 6, 13 of ABS HECU harness connector and ABS warning lamp module.

NO ▶ Repair open of wiring between terminal 6, 13 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 D-TC 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 scan tool to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using scan tool.
3. Is DTC output?

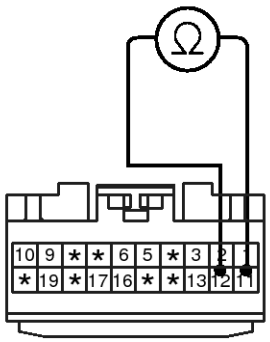
YES ▶ Perform the DTC troubleshooting procedure (Refer to DTC troubleshooting).

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 (M03-3) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M03-3) 11 and 12 of the cluster harness side connector.

Specification : 60Ω



SMGBR9309L

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 (M03-3) and ABS HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M03-3) 12 of the cluster harness side connector and terminal 6 of ABS HECU harness side.

   Check for continuity between terminal (M03-3) 11 of the cluster harness side connector and terminal 13 of ABS HECU harness side.

Specification : Below 1Ω

3. Is there continuity?

YES ▶ Repair short of wiring between terminal 6 , 13 of ABS HECU harness connector and ABS warning lamp module.If no trouble in wiring, inspect again after replacing the ABS HECU.

NO ▶ Repair short of wiring between terminal 6 , 13 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 ABS unit, brake lines and master cylinder with brake fluid.

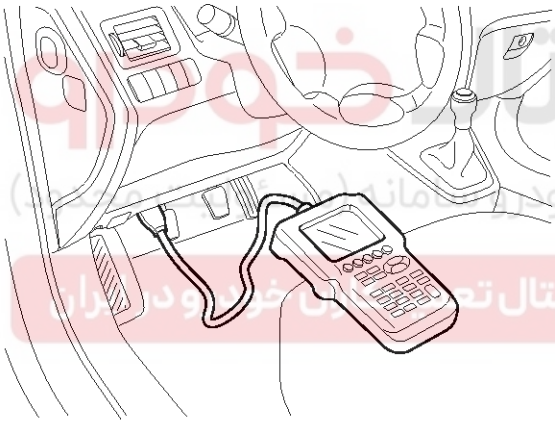
1. Remove the reservoir cap and fill the brake reservoir with brake fluid.

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

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

   Recommended fluid..... DOT3 or DOT4

2. Connect a clear plastic tube to the wheel cylinder bleeder plug and insert the other end of the tube into a half filled clear plastic bottle.
3. Connect the scan tool to the data link connector located underneath the dash panel.



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4. Select and operate according to the instructions on the scan tool screen.

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

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

```
          < PRE BLEEDING >

1. Perform the bleeding of conventiona
   parts certainly.

2. Press [ENTER] key to activate pump
   motor and all NC valves.
```

SUNBR6522L

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

```
 NOW, ALL NC VALVES AND PUMP MOTOR
ARE ACTIVATING. DURING THIS TIME,
IT SHOULD BE REPEATED THAT DEPRESS-
ING THE BRAKE PEDAL UNTIL IT REACHES
TO THE BOTTOM OF FLOOR WITHOUT REA-
CTION AND RELEASING THE BRAKE PEDAL
UNTIL THE KICK BACK SITUATION IS
OVER.
 PLEASE WAIT 120 SECONDS.
```

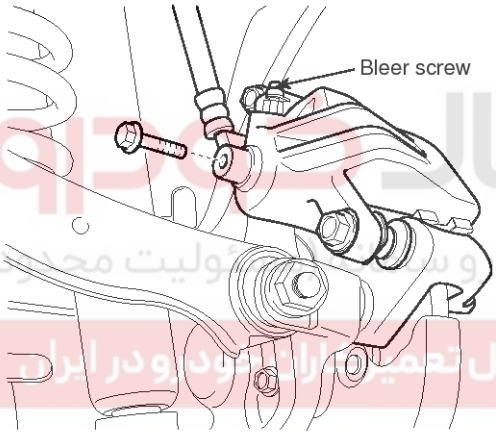
SUNBR6523L

6) Perform the air bleeding.

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

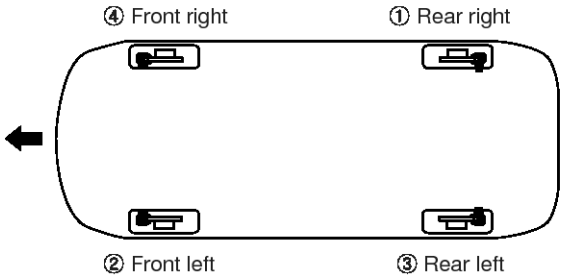
SUNBR6621L

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.



SMGBR9329L

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



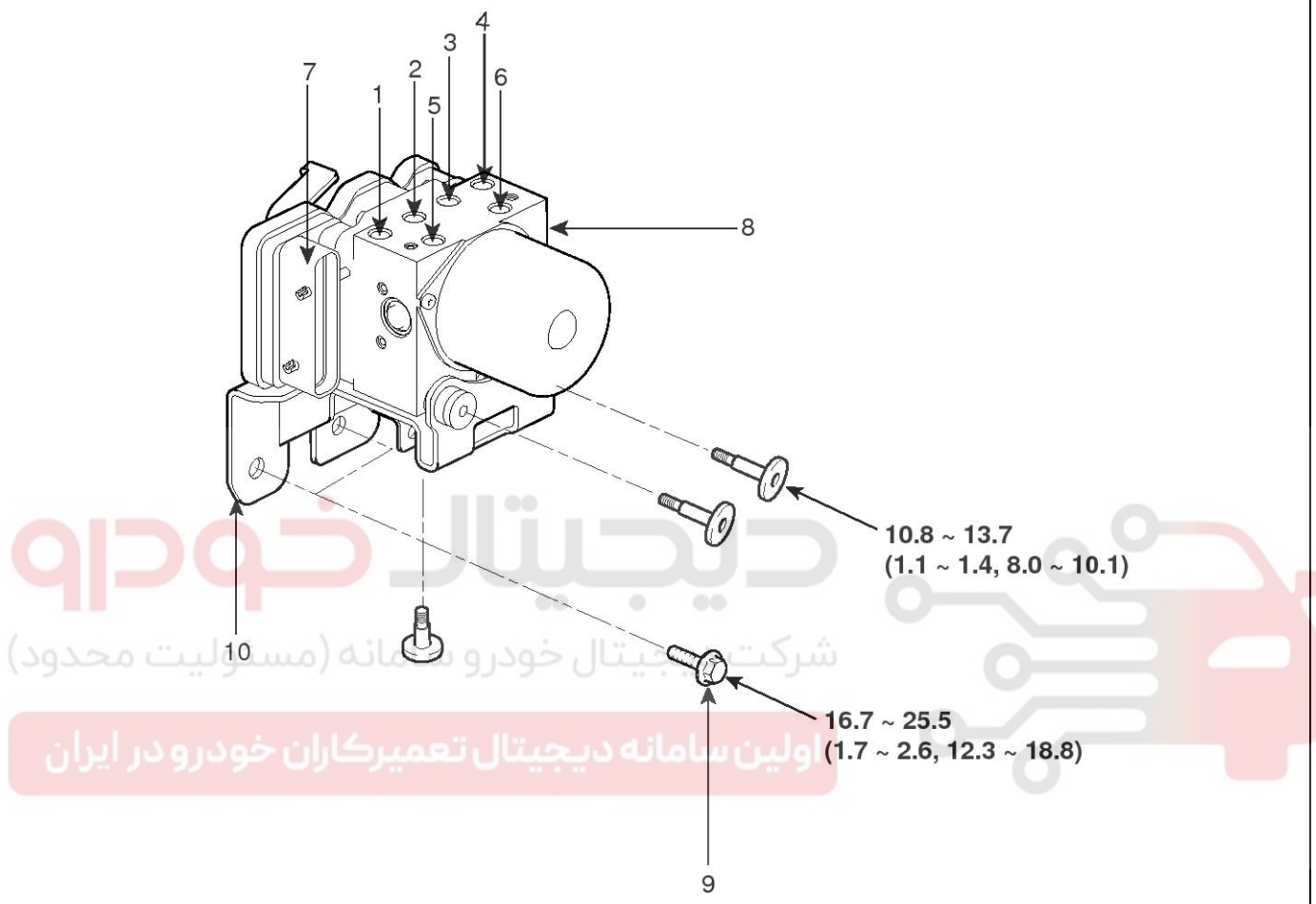
KJKE003B

7. Tighten the bleeder screw.

Bleed screw tightening torque:
6.86 ~ 12.74 N.m (0.7 ~ 1.3 kgf.m, 5.09 ~ 9.45 lb-ft)

ABS Control Module

Components



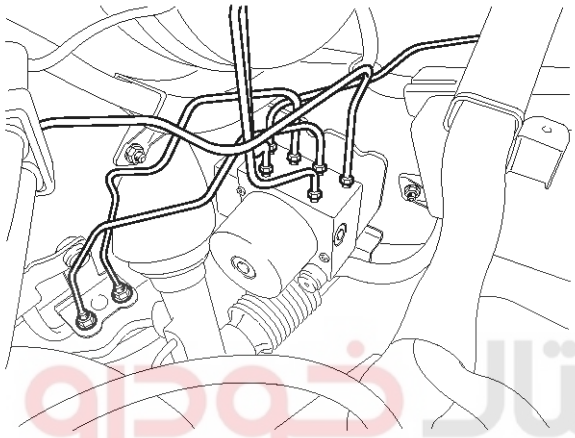
SMGBR9310L

1. Front-left tube
2. Rear -right tube
3. Rear-left tube
4. Front-right tube
5. MC2
6. MC1
7. ABS control module connector (26P)
8. ABS control module (HECU)
9. Damper
10. Bracket

Removal

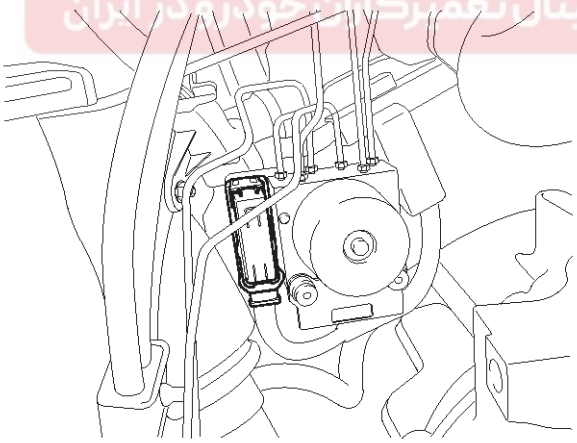
1. Turn the ignition switch OFF.
2. Remove the air cleaner assembly (A).
3. Remove the ECM. (Refer to Fuel system group - ECM)
4. Disconnect the brake tubes from the HECU by unlocking the nuts counterclockwise with a spanner.

Tightening torque:
ABS : 12.7 ~ 16.7N.m(1.3 ~ 1.7kgf.m, 9.4 ~ 12.3lb-ft
ESP : 18.6 ~ 22.6N.m(1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft



SMGBR9306D

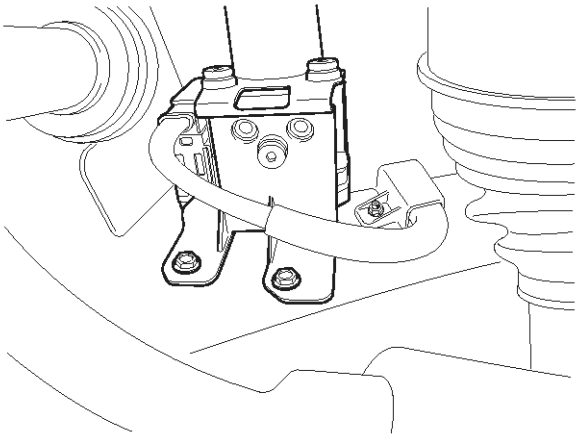
5. Pull up the lock of the ABS control unit 26P connector , then disconnect the connector.



SMGBR9307D

6. Remove the front wheel guard.
7. Loosen the ABS HECU bracket bolt(1EA) and nuts(2EA), then remove HECU and bracket.

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



SMGBR9308D

⚠CAUTION

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

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

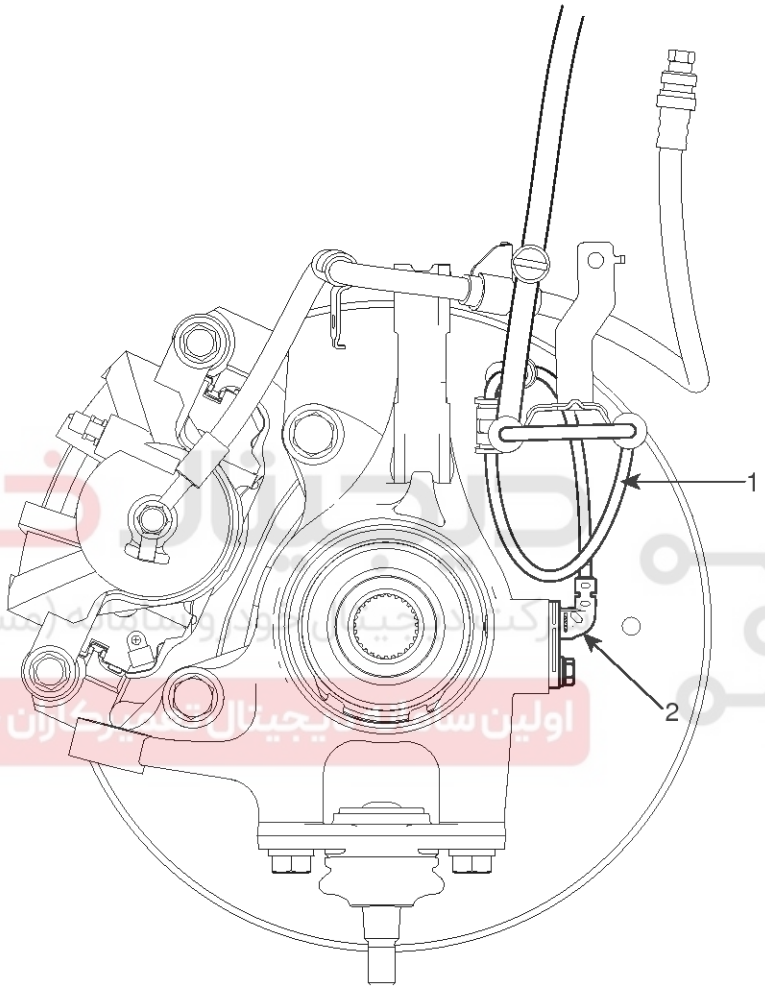
Tightening torque:
10.8 ~ 13.7N.m (1.1 ~ 1.4kgf.m, 8.0 ~ 10.1lb-ft)

Installation

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

Front Wheel Speed Sensor

COMPONENTS

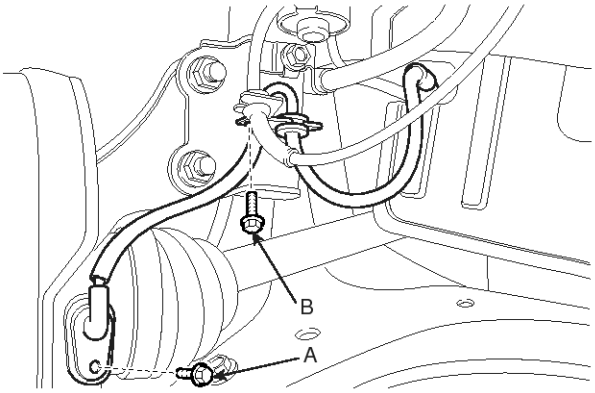


1. Front wheel speed sensor cable
2. Front wheel speed sensor

LJLG501J

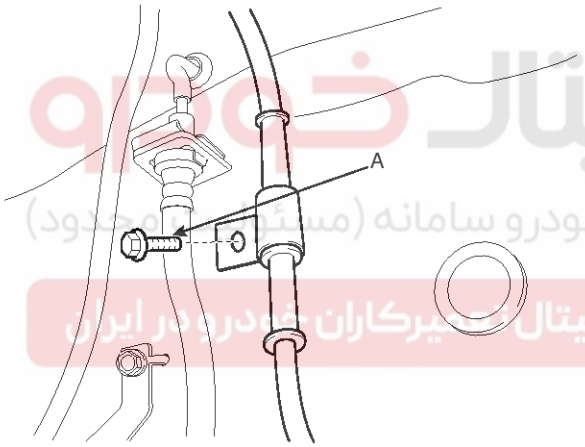
REMOVAL

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



AJLG502D

2. Remove the front wheel speed sensor bracket (A).



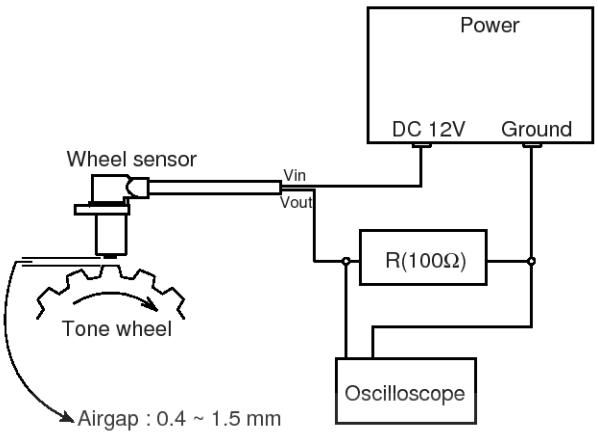
AJLG502E

3. Remove the front wheel guard .
4. Disconnect the front wheel speed sensor connector (A) , then remove the front wheel speed sensor.

INSPECTION

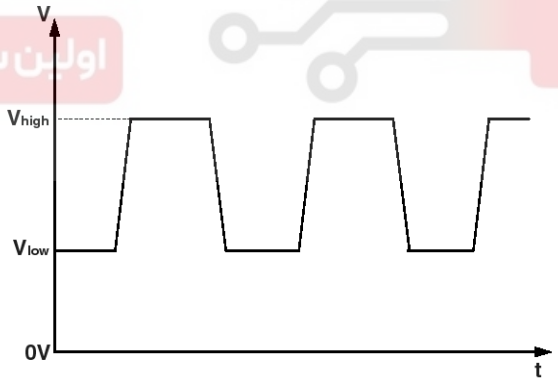
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

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



LJJF501M

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

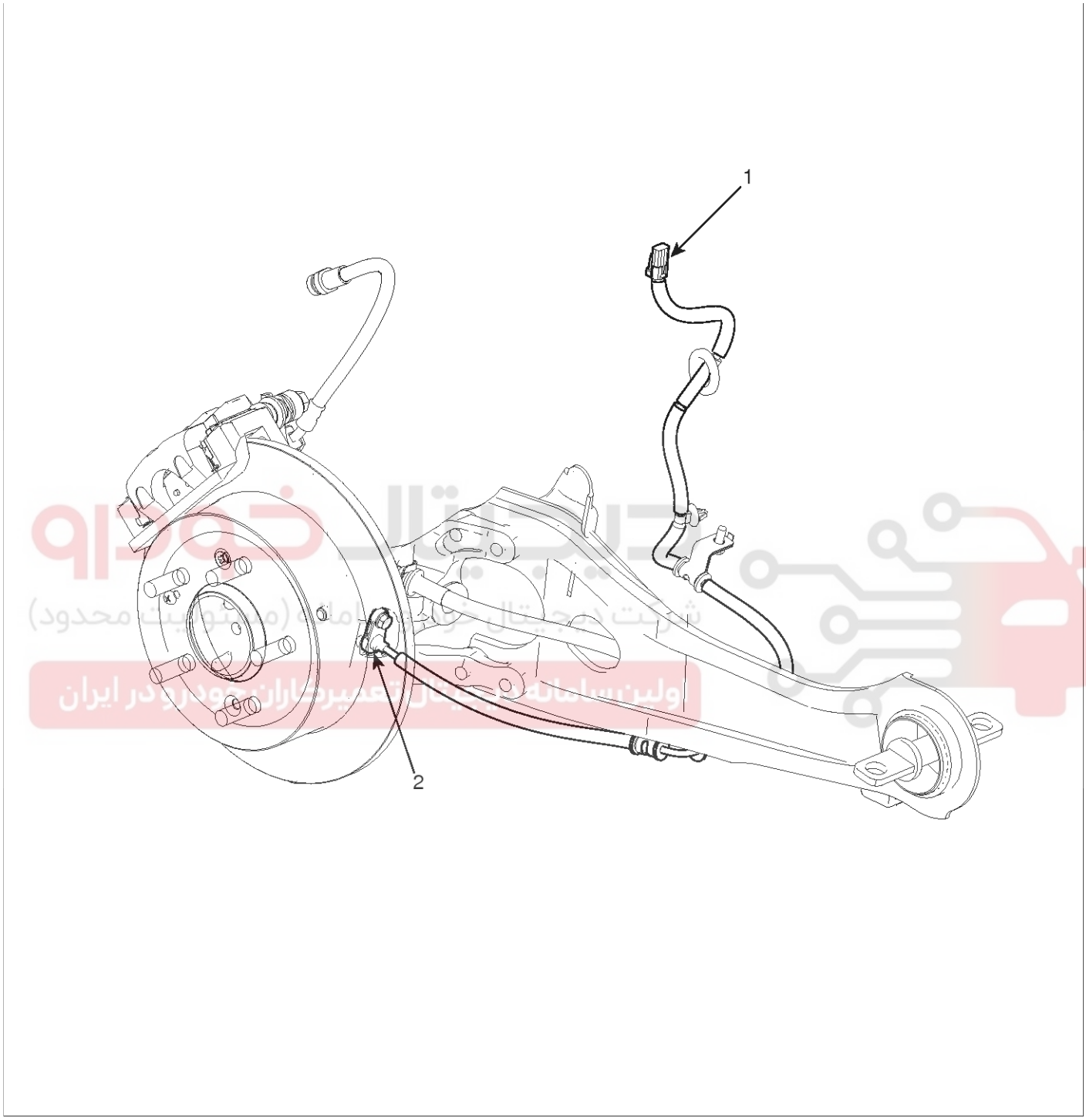


ARJE503Z

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

Rear Wheel Speed Sensor

COMPONENTS

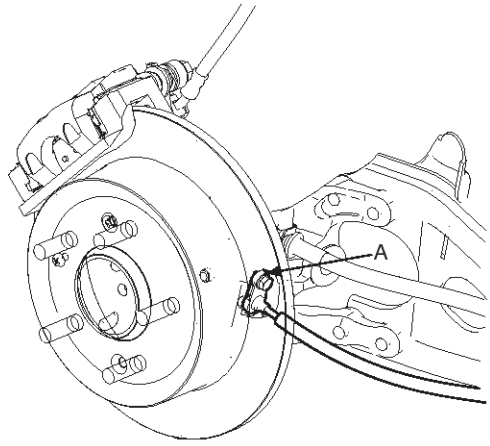


1. Rear wheel speed sensor connector
2. Rear wheel speed sensor

LJLG501K

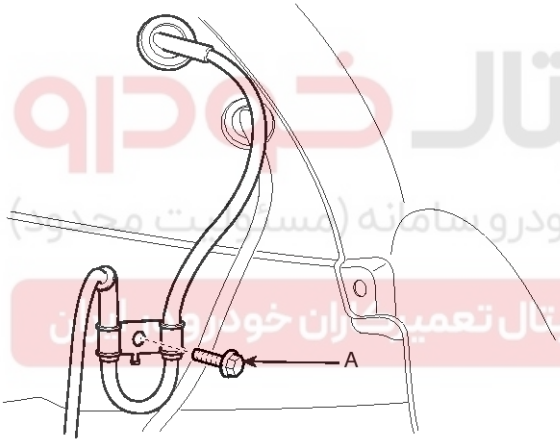
REMOVAL

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



AJLG502H

2. Remove the sensor cable bracket mounting bolt (A).



AJLG502I

3. Disconnect the rear wheel speed sensor connector.

EBD(Electronic Brake-force Distribution)

EBD (Electronic Brake-force Distribution) Operation

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

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

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

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

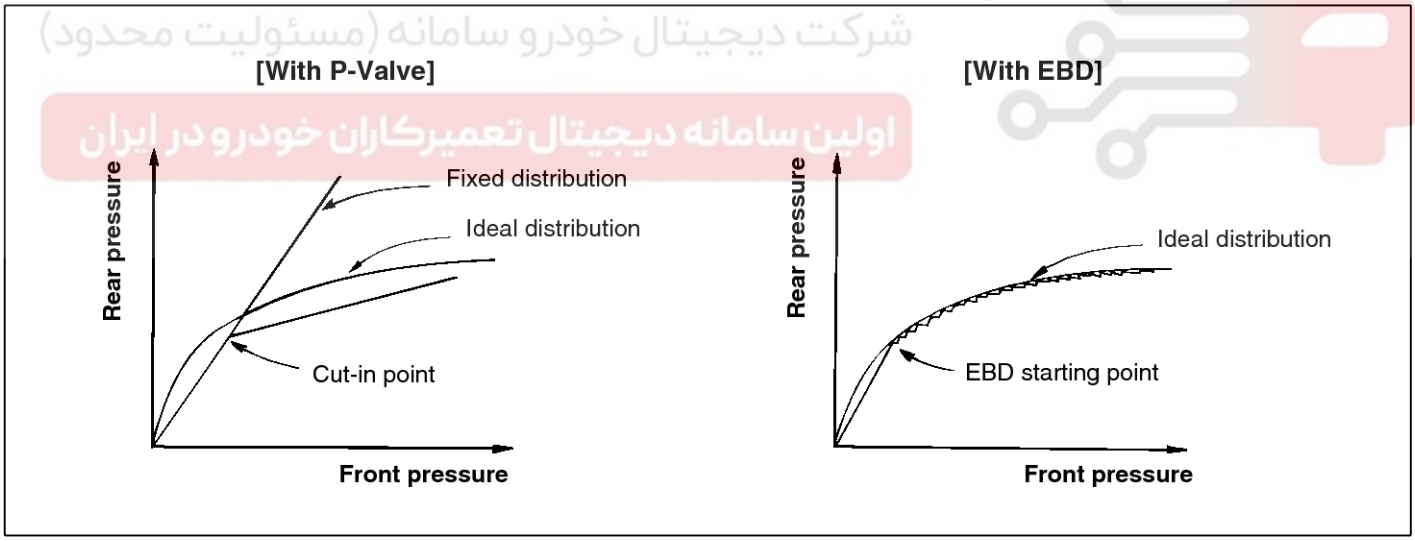
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

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

Advantages

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

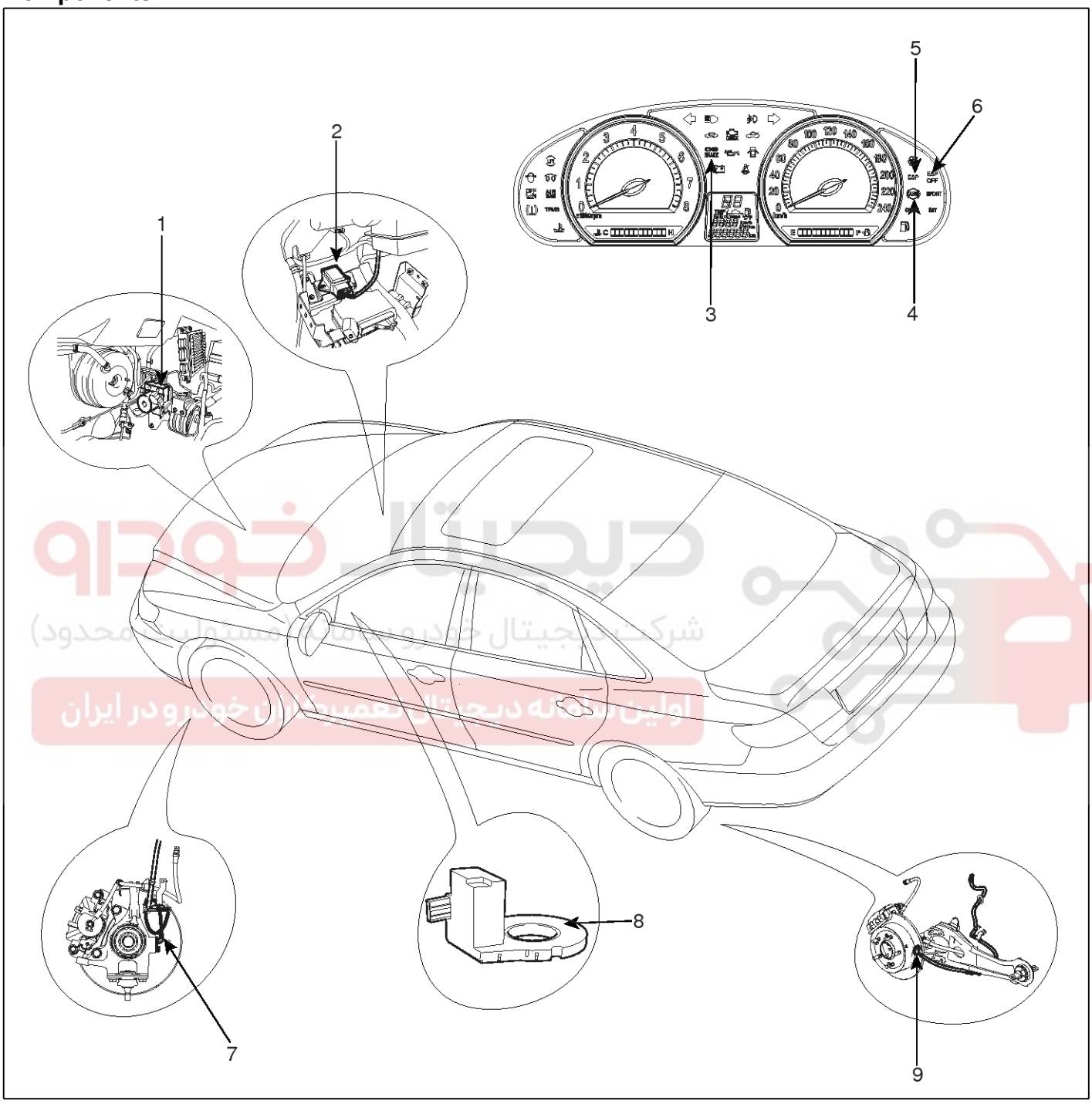
Comparison between Proportioning Valve and EBD



EJA0032A

ESP(Electronic Stability Program) System

Components



SMGBR9311L

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

Description of ESP

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

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

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

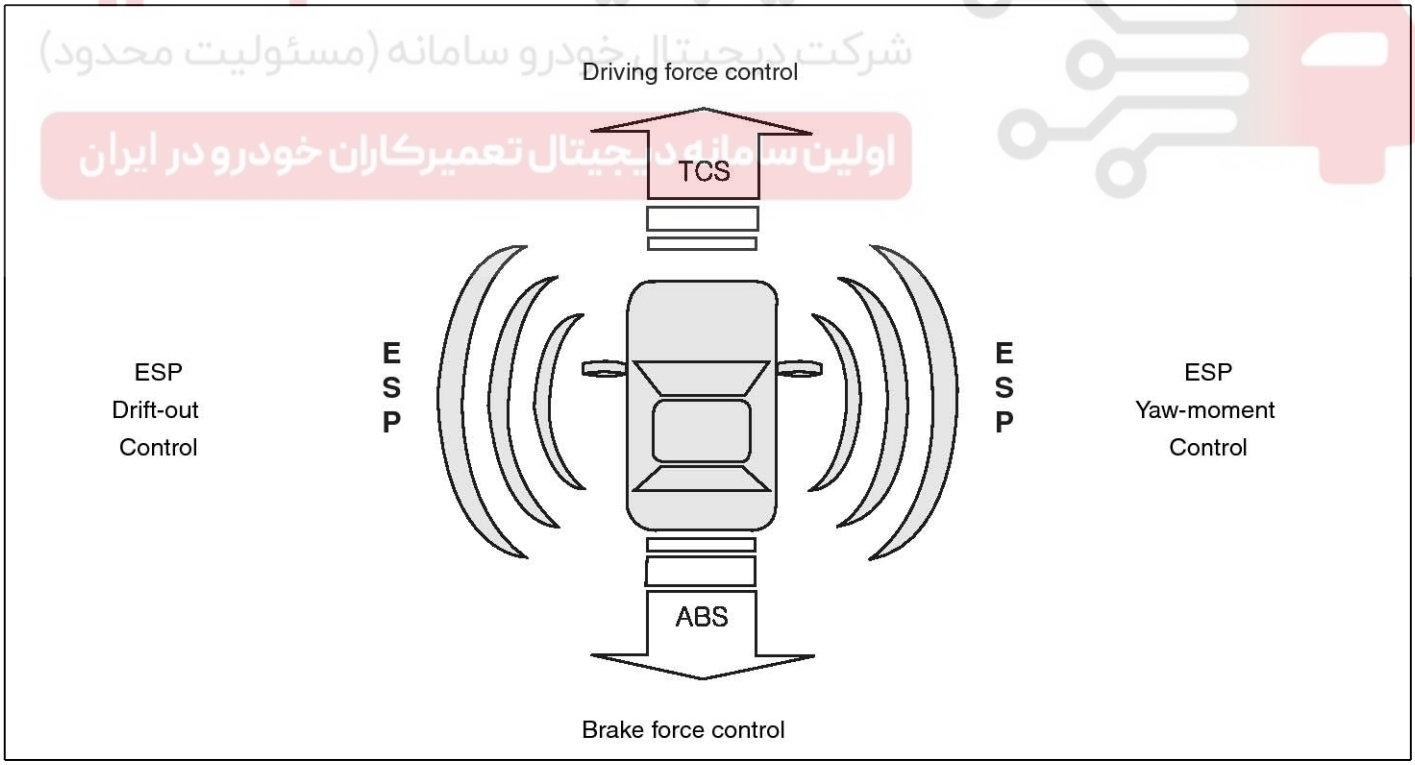
This is achieved by wheel individual brake intervention and adaptation of the momentary engine torque with no need for any action to be taken by the driver.

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

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

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

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



LJCD201A

Description Of ESP Control

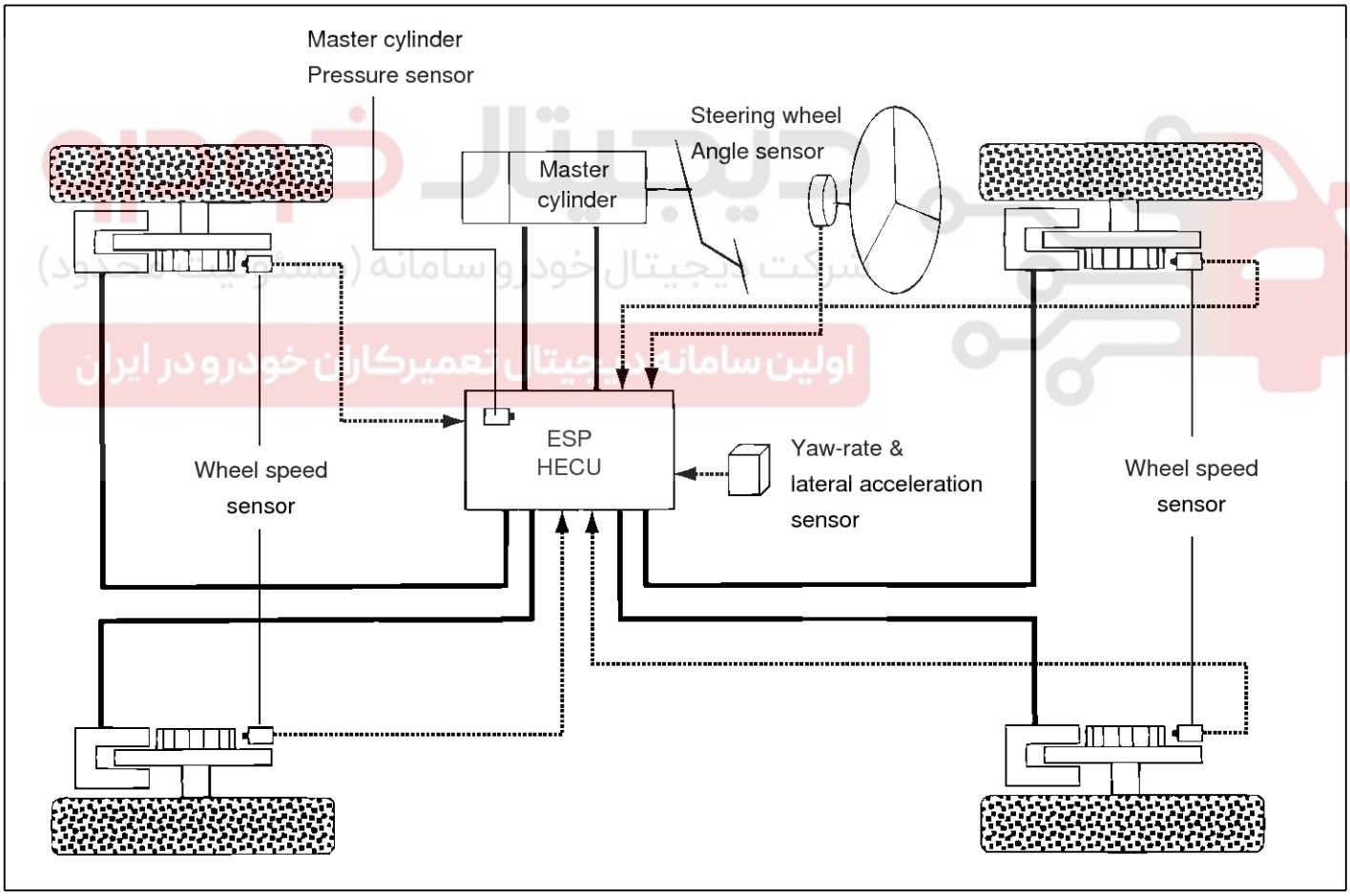
ESP system includes ABS/EBD, TCS and AYC function.

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.

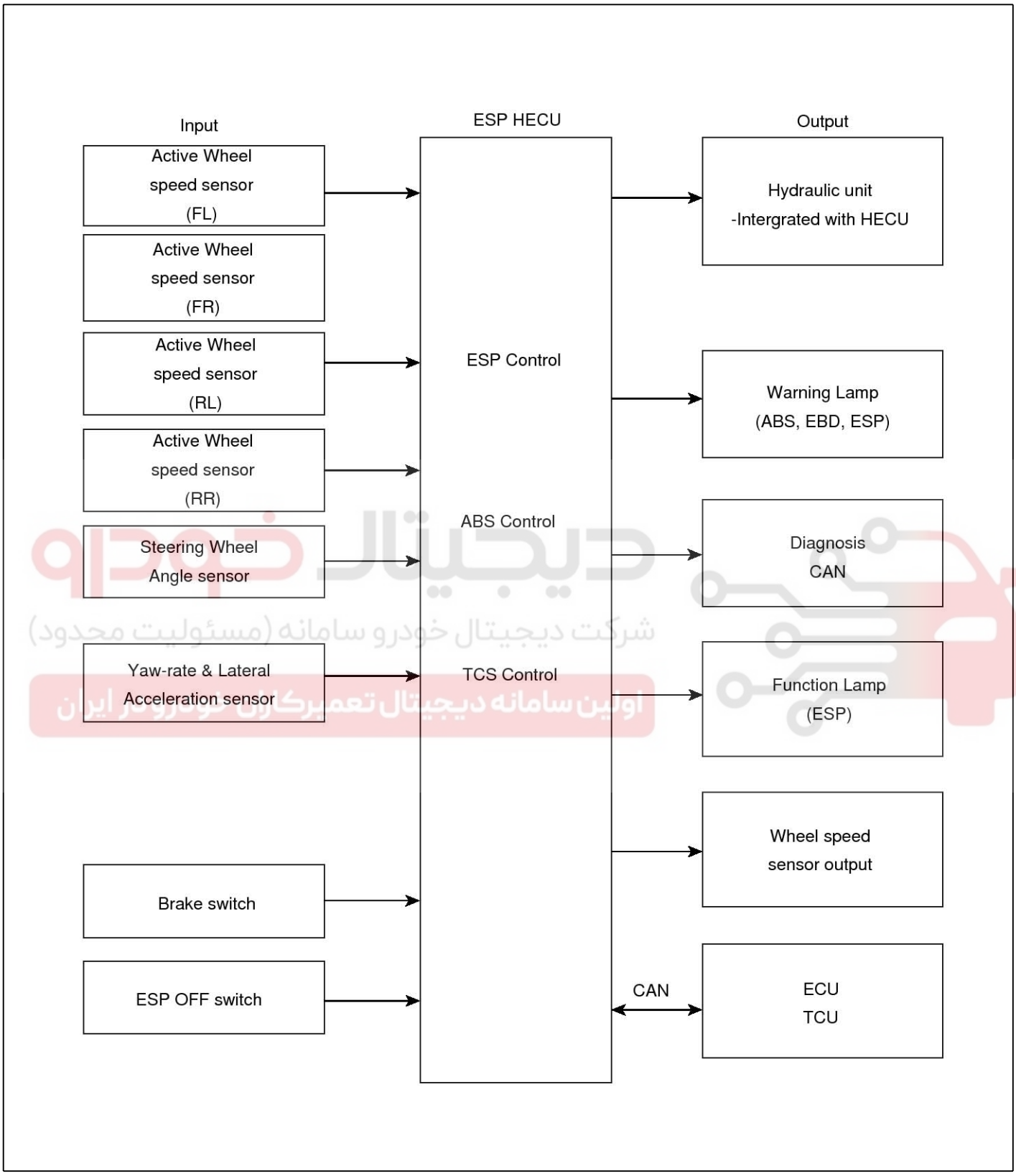
AYC function prevents unstable maneuver of the vehicle. To determine the vehicle maneuver, AYC function uses the maneuver sensor signals(Yaw Rate Sensor, Lateral Acceleration Sensor, Steering Wheel Angle Sensor).If vehicle maneuver is unstable (Over Steer or Under Steer), AYC function applies the brake 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)



SHMBR9332L

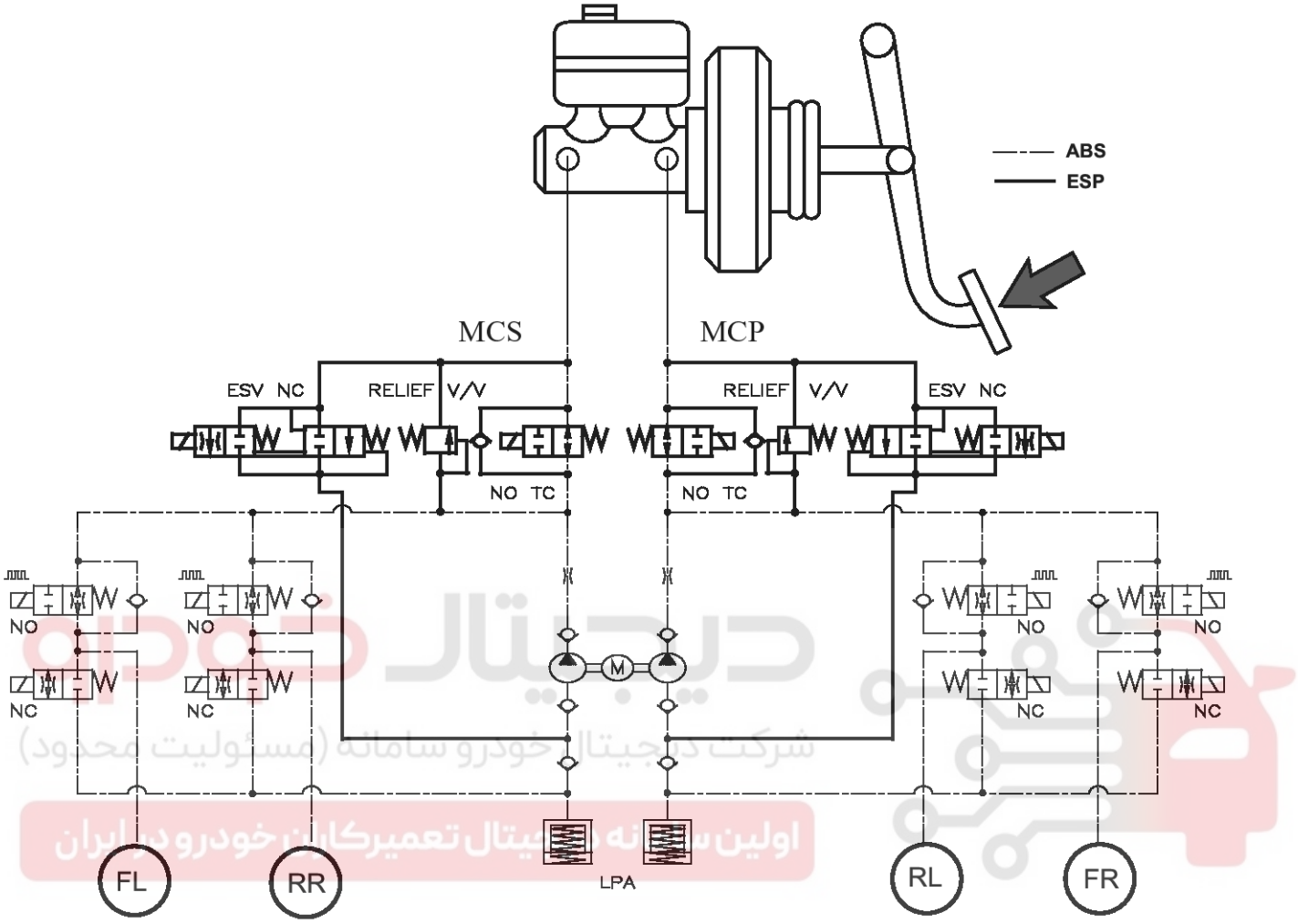
Inputand Output Diagram



SMGBR9312L

ESP Operation Mode

ESP Hydraulic System Diagram



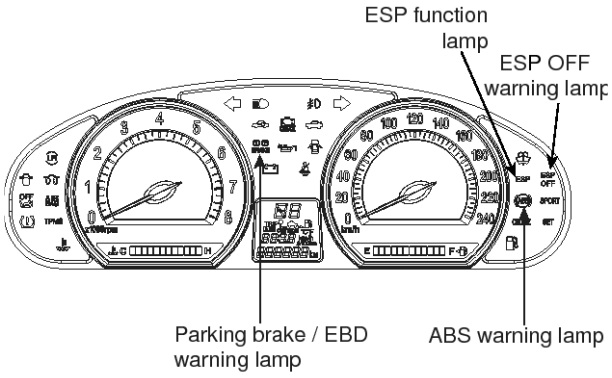
LJJF501P

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		



LJLG501M

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.

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.

ESP Warning Lamp (ESPSystem)

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

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

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

ESP Function Lamp (ESP System)

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

The ESP Function lamp operates under the following conditions :

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

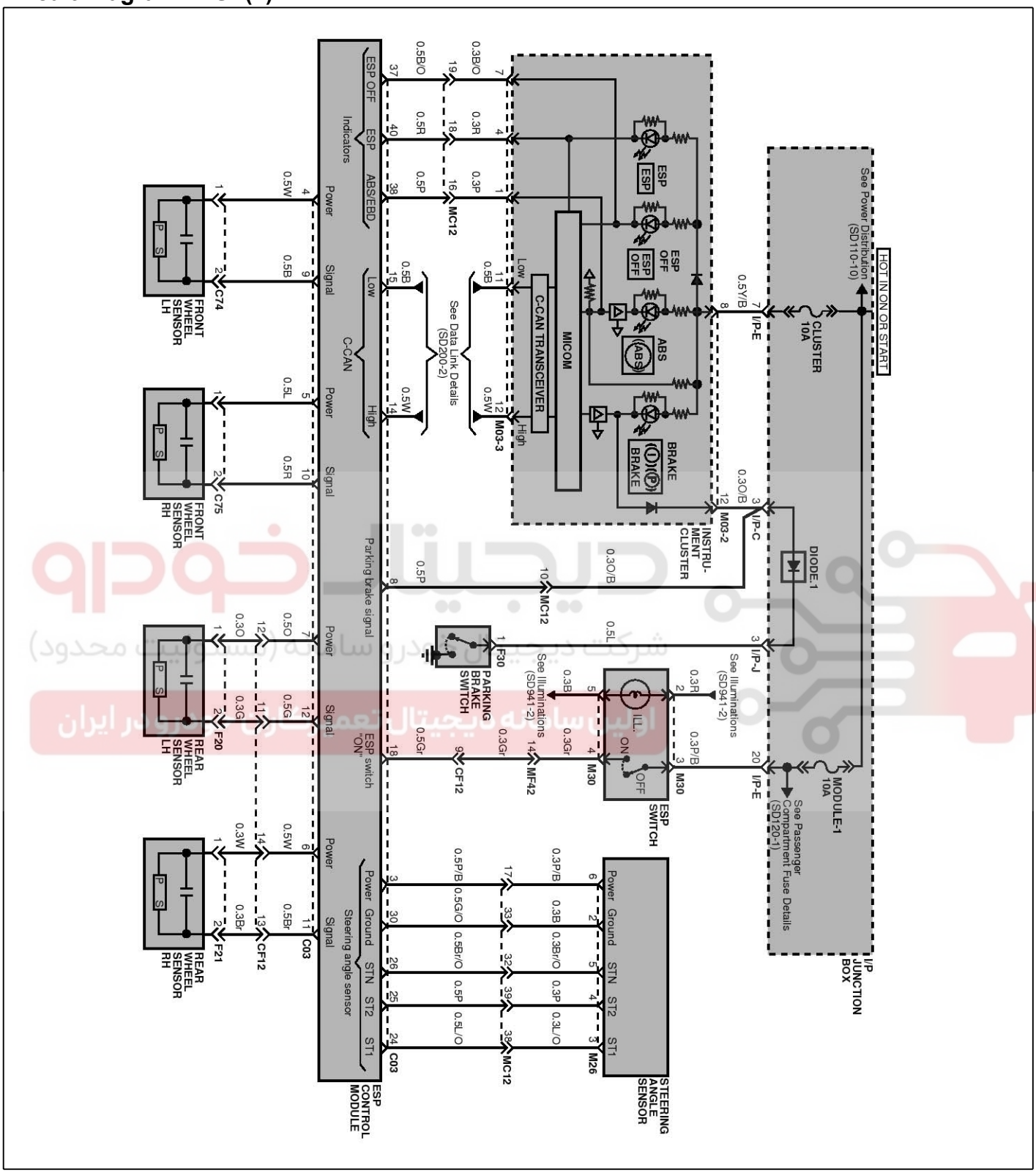
ESP On/Off Switch (ESP System)

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

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

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

Circuit Diagram - ESP(1)



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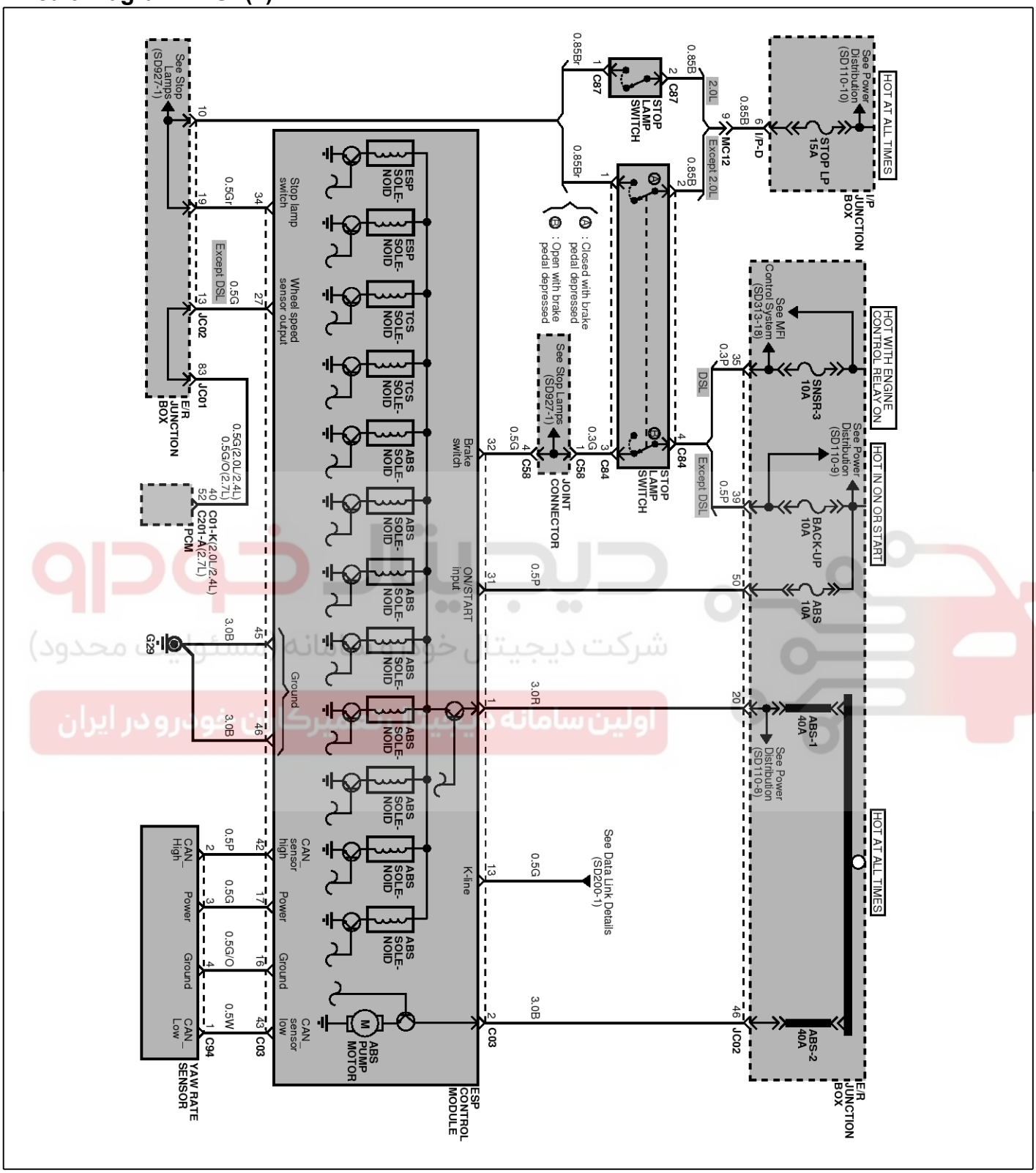
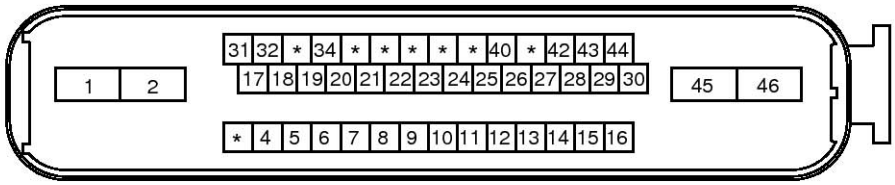
Circuit Diagram - ESP(2)



SMGBR9314L

ESP Connector Input/Output



SHMBR8347D

Connector Terminal		Specification	Remark
No	Description		
31	IGNITION1(+)	Over voltage range : 17 ± 0.5V Operating voltage range : 9.5 ± 0.5V < V < 17 ± 0.5V Low voltage range : 7.0 ± 0.5V < V < 9.5 ± 0.5V Max. current : I < 500mA	
1	POS.BATTERY.(SOLENOID)	Max. leakage current : I < 0.8mA Operating voltage range : 9.5 ± 0.5V < V < 17 ± 0.5V Max. current : I < 40A	
2	POS.BATTERY.(MOTOR)	Operating voltage range: 9.5 ± 0.5V < V < 16.5 ± 0.5V Rush current : I < 100A Max. current : I < 40A Max. leakage current : I < 0.2mA	
46	GROUND	Rated current : I <500mA Max. current: I < 30A	
45	PUMP MOTOR GROUND	Rush current : I < 100A Max. current : I < 30A	
16	YAW & LATERAL G SENSOR GROUND	Rated current : I <150mA	
17	YAW SENSOR POWER	Max. Output current : I < 150mA Max. Output voltage : V(IGN) ± 1V	
34	BRAKE LIGHT SWITCH	Input voltage (Low) : 0V ≤ V ≤ 3.0V Input voltage (High) : 7.0V ≤ V ≤ 16.0V	
32	BRAKE SWITCH		
8	PARKING BRAKE SWITCH	Input voltage (Low) : 0V ≤ V_Low ≤ 3.0V Input voltage (High) : 7.0V ≤ V_High ≤ 16.0V Max. input current : I < 10mA	
27	SENSOR FRONT RIGHT OUTPUT	Max. current : I < 16mA External pull up resistance :1 KΩ < R Output duty :50 ± 20%	

Connector Terminal		Specification	Remark
No	Description		
18	ESP ON/OFF SWITCH	Input voltage (Low) :0V ≤ V ≤ 3.0V Input voltage (High) : 7.0V ≤ V ≤ 16.0V Max. input current:I : < 10mA	
15	CAN BUS LINE(LOW)		
14	CAN BUS LINE(HIGH)		
4	SENSOR FRONT LEFT POWER	Output voltage : IGN (V) ± 1V Output current : Max 30mA	
5	SENSOR FRONT RIGHT POWER		
7	SENSOR REAR LEFT POWER		
6	SENSOR REAR RIGHT POWER		
9	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%	
10	SENSOR FRONT RIGHT SIGNAL		
12	SENSOR REAR LEFT SIGNAL		
11	SENSOR REAR RIGHT SIGNAL		
42	SENSOR CAN BUS LINE (High)		
43	SENSOR CAN BUS LINE (Low)		
37	ESP OFF W/LAMP DRIVE	Current : I < 300mA(12V) Voltage range : 0 ~ 18V Min. shunt resistance : 500kΩ	
38	ABS/EBD W/LAMP DRIVE		
40	ESP F/LAMP DRIVE		
24	STEERING ANGLE SENSOR PHASE 1	Input duty (ST1, ST2) : 50 ± 10% Phase difference (ST1, ST2) : 2 ± 6deg High voltage : 3.0V < V < 4.1V Low voltage : 1.3V < V < 2.0V	
25	STEERING ANGLE SENSOR PHASE 2		
26	STEERING ANGLE SENSOR PHASE N		
3	STEERING ANGLE SENSOR POWER	Max. Output current : I < 100mA Max. Output voltage : V(IGN) ± 1V	
30	STEERING ANGLE SENSOR GROUND	Rated current : I < 100mA	

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

Countermeasures In Fail

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

Warning Lamp ON

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

Yaw-rate and Lateral G Sensor

Description

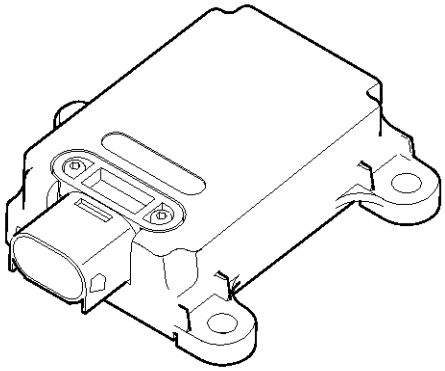
When the vehicle is turning with respect to a vertical axis the yaw rate sensor detects the yaw rate electronically by the vibration change of plate fork inside the yaw rate sensor.

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

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

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

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

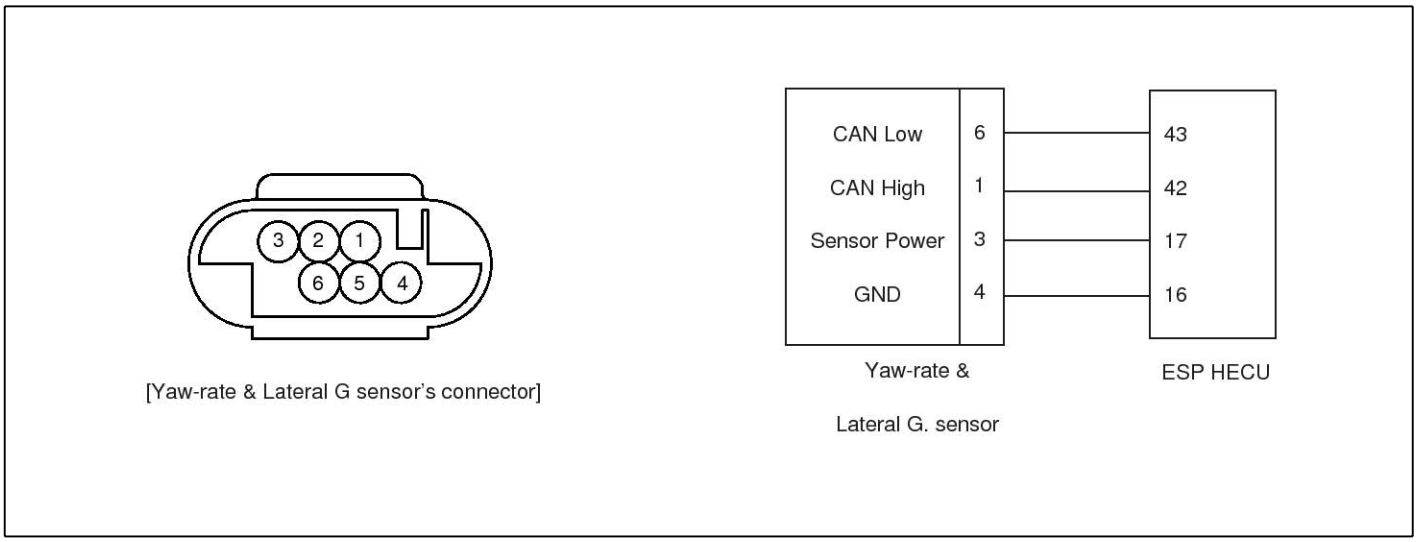


SHMBR8348D

Specifications

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

External Diagram

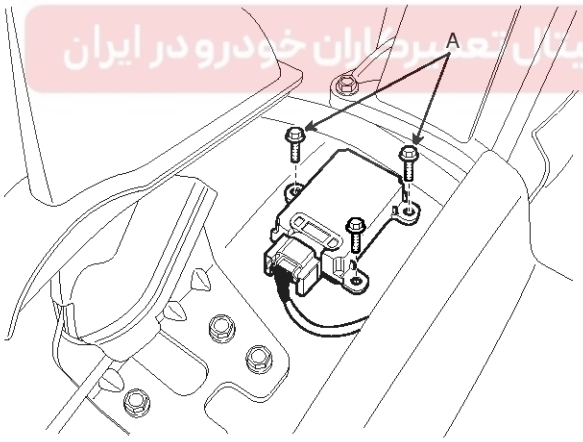


SMGBR9330L

Replacement

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the yaw rate & lateral G sensor connector.
3. Remove the mounting bolts (A).

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



AJLG502N

4. Installation is the reverse of removal.

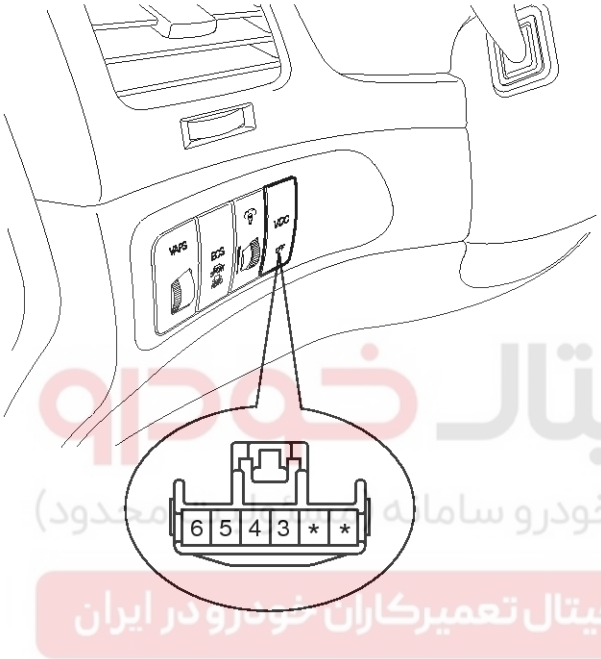
ESP OFF Switch

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. Remove the ESP OFF switch from the switch panel on the center cover of the floor console assembly.



AJLG502O

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

Terminal / Function	2	5	6	3
ON	○	○	○	○
OFF				

LJJF504B

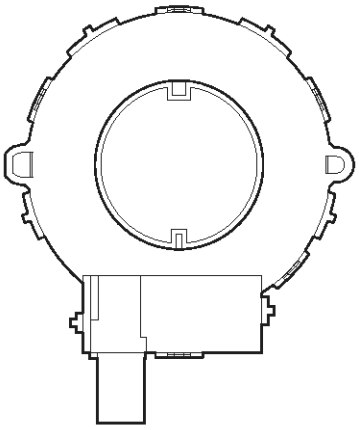
Steering Wheel Angle Sensor

Description

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

Measureing Principle

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

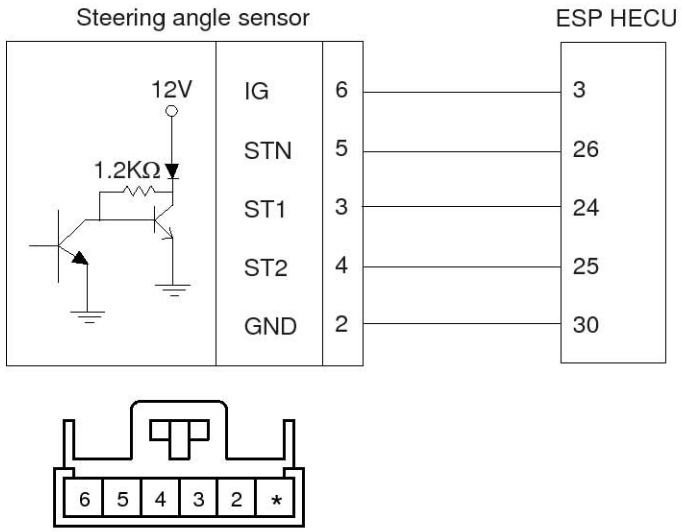


LJJF501V

Specification

Description	Specification
Operating voltage	9 ~ 16 V
Operating temperature	-30 ~ 75 ℃
Current consumption	Max.100 mA
Steering angle velocity	Max. ± 1500 °/sec
Voltage(high)	3.0 V ~ 4.1 V
Voltage(low)	1.3 V ~ 2.0 V
Pulse duty	40 ~ 60 %

Circuit Diagram(Steering Wheel Speed Angle Sensor)



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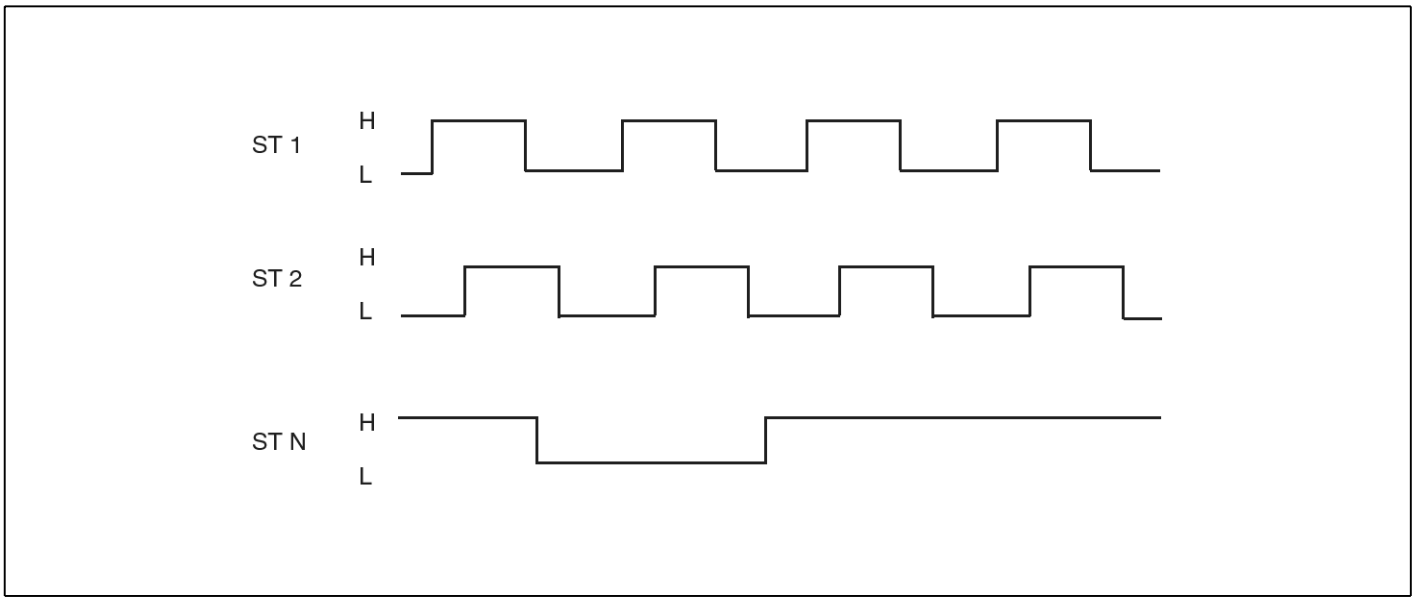
Output Characteristic



ARCD204A

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