BRAKES
12

CONTENTS

BASE BRAKES

GENERAL INFORMATION

Description

The base brake system consists of the following components:
- Brake pedal
- Power brake booster
- Master cylinder
- Brake tubes and hoses
- Disc brakes (front)
- Disc brakes (rear)
- Parking brake

The disc brake assembly consists of the following major components:
- Caliper
- Caliper adapter bracket
- Brake Pads
- Rotor

CAUTION:
- **Use DOT 4 brake fluid or equivalent from a tightly sealed container. Do not use petroleum-based fluids, which would cause seal damage in the brake system.**
- **Brake fluid will damage painted surfaces. If brake fluid is spilled on any painted surfaces, wash it off immediately with water.**
- **Never use gasoline, kerosene, alcohol, motor oil, transmission fluid, or any fluid containing mineral oil to clean system components. These fluids damage rubber cups and seals.**
- **During service procedures, grease or any other foreign material must be kept off the caliper assembly, brake linings, brake rotor and external surfaces of the hub.**
- **When handling the brake rotor and caliper, be careful to avoid damaging the brake rotor and caliper, and scratching or nicking the brake shoe lining.**

Operation

Applying the brake pedal uses lever action to push a rod into the brake booster, which through the use of vacuum, boosts the force of the rod and then transmits this force into the master cylinder. This produces hydraulic pressure in the master cylinder. On vehicles not equipped with ABS, the hydraulic pressure is transmitted by brake fluid through the brake tubes to the individual brake calipers or wheel cylinders. On vehicles equipped with ABS, the hydraulic pressure is transmitted by brake fluid through the brake tubes to the ABS hydraulic control unit (HCU), which then distributes that pressure to the individual brake calipers and wheel cylinders. The brake calipers use hydraulic pressure to apply the brake pads. The application of the brake pads or shoes will cause the rotation of the wheels to slow or stop depending on how much brake pressure is applied. The parking brakes carry out the same function except that they are mechanically actuated by a cable that connects only to the rear brakes.

Specifications

Torque Specifications

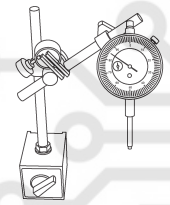
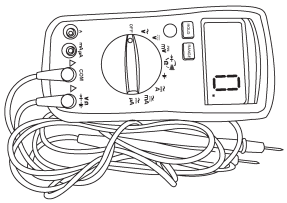
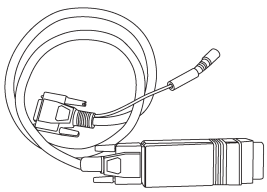
DESCRIPTION	TORQUE (N·m)
Brake Flex Hose Fitting – Front Caliper	19
Brake Flex Hose Banjo Bolt - Rear Caliper	20
Brake Pedal/Booster Mounting Nuts	25
Brake Tube Nuts	10
Disc Brake Caliper Adapter Bracket (To Knuckle) - Front	63
Disc Brake Caliper Adapter Bracket (To Support) - Rear	63
Disc Brake Caliper Guide Pin Bolts - Front	23
Disc Brake Caliper Guide Pin Bolts - Rear	23

DESCRIPTION	TORQUE (N·m)
Disc Brake Caliper Bleeder Screw	8-13
Fluid Reservoir Mounting Screw	11
Master Cylinder Mounting Nuts	23
Parking Brake Lever Mounting Nuts	30
Wheel Mounting Nuts	110

Rotor Specifications

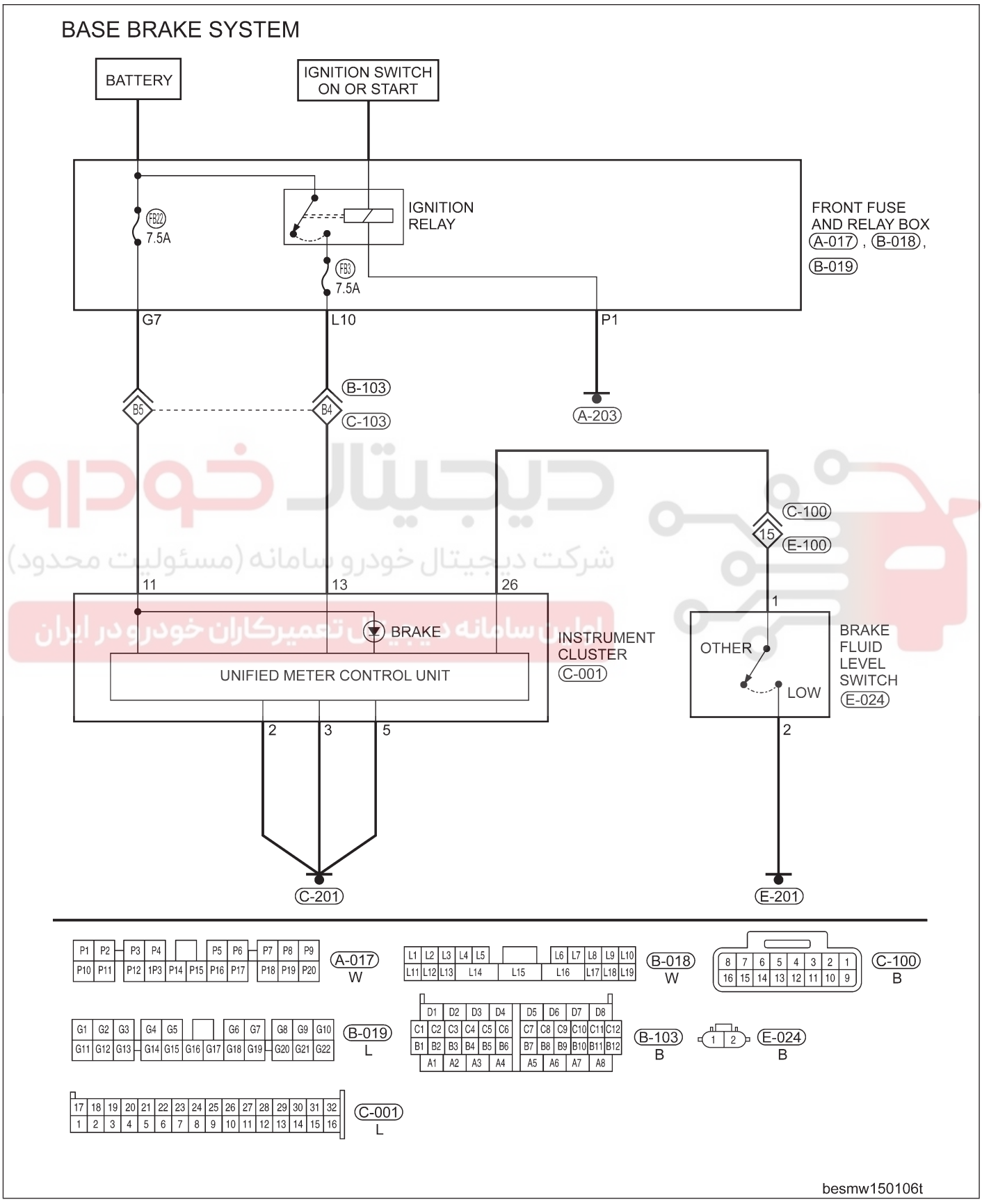
BRAKE ROTOR	ROTOR THICKNESS	MINIMUM ROTOR THICKNESS	ROTOR THICKNESS VARIATION	ROTOR RUNOUT
Front Rotor	22 mm	20 mm	0.005 mm	0.03 mm
Rear Rotor	10 mm	7 mm	0.015 mm	0.03 mm

Special Tools

Dial Indicator	 besm120026
Digital Multimeter Fluke 15B & 17B	 besm030002
CAN-BUS II Diagnostic Connector	 besm120036

Electrical Schematics

Brake System (Page 1 of 1)



DIAGNOSIS & TESTING

Diagnostic Help

Brake diagnosis involves determining if the concern is related to a mechanical, hydraulic, electrical or vacuum operated component.

NOTE :
The brake reservoir fluid level will decrease in proportion to normal lining wear.

NOTE :
Brake fluid tends to darken over time. This is normal and should not be mistaken for contamination.

Preliminary Brake Check:

- Check the condition of the tires and wheels. Damaged wheels and worn, damaged or under inflated tires can cause a pull, shudder, vibration and a condition similar to brake grab.
- If a complaint was based on noise while braking, check the suspension components. Jounce the front and the rear of vehicle and listen for anything that might be caused by a loose, worn or damaged suspension or steering component.
- Inspect the brake fluid level and condition.
    1. If the fluid level is abnormally low, look for any evidence of leaks at the calipers, brake lines, master cylinder and at the Antilock Brake System (ABS) Hydraulic Control Unit (HCU).
    2. If the fluid appears to be contaminated, drain a sample to examine.
- The system will have to be flushed if the fluid is separated into layers, or contains a substance other than brake fluid. The system seals, cups, hoses, master cylinder and HCU will also have to be replaced after flushing. Use clean brake fluid to flush the system.
- Check the parking brake operation. Verify free movement and full release of the cables and the lever. Also note if the vehicle was being operated with the parking brake partially applied.
- Check the brake pedal operation. Verify that the pedal does not bind and has adequate free play. If the pedal lacks free play, check the pedal and the power booster for looseness or for a binding condition. DO NOT road test the vehicle until the condition is located and corrected.
- Check the vacuum booster check valve and vacuum supply hose.
- If the preliminary checks appear to be OK, road test the vehicle.

Brake Noise

CONDITION	POSSIBLE CAUSES	CORRECTION
Disc Brake Chirp	· Excessive brake rotor runout. · Small particles	· Diagnose and correct as necessary.
Disc Brake Rattle Or Clunk	· Broken or missing spring clips. · Caliper guide pin bolts loose. · Missing abutment shims. · Small metal particles	· Replace brake pads · Tighten guide pin bolts. · Replace missing abutment shims.
Disc Brake Squeak At Low Speed (While Applying Light Brake Pedal Effort)	· Brake shoe linings.	· Replace brake pads.
Scraping Or Whirring	· ABS wheel speed sensor hitting tone wheel.	· Inspect, correct or replace faulty component(s).

Braking Concerns

CONDITION	POSSIBLE CAUSES	CORRECTION
Excessive Pedal Effort	· Obstruction of brake pedal. · Low power brake booster assist. · Glazed brake linings. · Brake pad lining transfer to brake rotor.	· Inspect, remove or move obstruction. · Refer to Power Brake Booster in this section. · Resurface or replace brake rotors as necessary. Replace brake pads. · Resurface or replace brake rotors as necessary. Replace brake pads.
Excessive Pedal Effort (Hard Pedal —Unable To Lock-Up Wheels)	· Power brake booster runout (vacuum assist).	· Check booster vacuum hose and engine tune for adequate vacuum supply.
Excessive Pedal Travel (Vehicle Stops OK)	· Air in brake lines.	· Bleed brakes.
Pedal Pulsates/Surges During Braking	· Disc brake rotor has excessive thickness variation.	· Isolate condition as rear or front. Resurface or replace brake rotors as necessary.
Pedal Is Spongy	· Air in brake lines.	· Bleed brakes.
Vehicle Pulls To Right Or Left On Braking	· Frozen brake caliper piston. · Contaminated brake pad/shoe lining (most likely front lining). · Pinched brake lines. · Leaking piston seal. · Suspension problem.	· Replace frozen piston or caliper. Bleed brakes. · Inspect and clean, or replace pads/shoes. Repair source of contamination. · Replace pinched line. · Replace piston seal or brake caliper. · See the Suspension section.
Parking Brake—Excessive Handle Travel	· Rear brakes out of adjustment.	· Adjust rear parking brake shoes on vehicles with rear disc brakes.

ON-VEHICLE SERVICE

Brake Bleeding Procedure

Brake Bleeding Information

WARNING!
When bleeding the brake system, wear safety glasses. A clear bleed tube must be attached to the bleeder screws and submerged in a clear container filled partially with clean brake fluid. Direct the flow of brake fluid away from yourself and the painted surfaces of the vehicle. Brake fluid at high pressure may come out of the bleeder screws when opened.

CAUTION:
Before removing the master cylinder cap, wipe it clean to prevent dirt and other foreign matter from dropping into the master cylinder reservoir. Use brake fluid or an equivalent from a fresh, tightly sealed container. Brake fluid must conform to DOT 4 specifications.

NOTE :
During the brake bleeding procedure, be sure the brake fluid level remains close to the ″MAX″ level in the master cylinder fluid reservoir. Check the fluid level periodically during the bleeding procedure and add brake fluid as required.

NOTE :
Do not pump the brake pedal at any time while having a bleeder screw open during the bleeding process. This will only increase the amount of air in the system and make additional bleeding necessary. Do not allow the master cylinder reservoir to run out of brake fluid while bleeding the system. An empty reservoir will allow additional air into the brake system. Check the fluid level frequently and add fluid as needed. The following wheel circuit sequence for bleeding the brake hydraulic system should be used to ensure adequate removal of all trapped air from the hydraulic system.

Brake Bleeding Procedure

The following wheel circuit sequence for bleeding the brake hydraulic system should be used to ensure adequate removal of all trapped air from the hydraulic system:

- Left rear wheel
- Right front wheel
- Right rear wheel
- Left front wheel

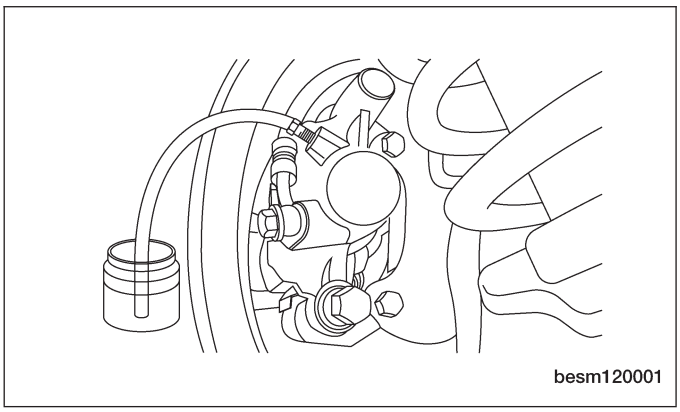
Manual Bleeding

NOTE :
To bleed the brakes manually, the aid of a helper will be required.

Fill the brake master cylinder reservoir to the proper level with brake fluid.

NOTE :
Never allow the brake master cylinder to empty of brake fluid while bleeding the brake system.

Attach a clear plastic hose to the bleeder screw and feed the hose into a clear jar containing enough fresh brake fluid to submerge the end of the hose.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1. Turn the ignition switch off.
2. Have a helper pump the brake pedal three or four times and hold it in the down position.
3. With the pedal in the down position, open the bleeder screw at least one full turn.
4. Once the brake pedal has dropped, close the bleeder screw. After the bleeder screw is closed, release the brake pedal.
5. Repeat the above steps until all trapped air is removed from that wheel circuit (usually four or five times).
6. Bleed the remaining wheel circuits in the same manner until all air is removed from the brake system. Monitor the fluid level in the master cylinder reservoir to make sure it does not go dry.
7. Check and adjust brake fluid level to the ″MAX″ mark.
8. Check the brake pedal travel. If pedal travel is excessive or has not been improved, some air may still be trapped in the system. Re-bleed the brakes as necessary.
9. Test drive the vehicle to verify the brakes are operating properly and pedal feel is correct.

Pressure Bleeding

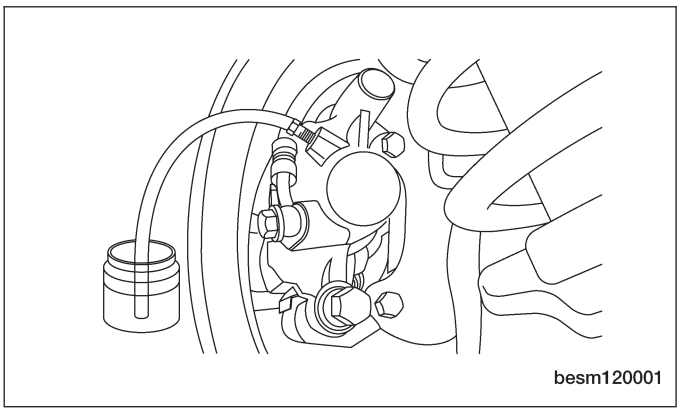
NOTE :
Follow pressure bleeder manufacturer's instructions for use of pressure bleeding equipment.

Fill the brake master cylinder reservoir to the proper level with brake fluid.

Attach the pressure bleeding equipment to the master cylinder.

NOTE :
Never allow the brake master cylinder to empty of brake fluid while bleeding the brake system.

Attach a clear plastic hose to the bleeder screw and feed the hose into a clear jar containing enough fresh brake fluid to submerge the end of the hose.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1. Turn the ignition switch off.
2. Open the bleeder screw at least one full turn or more to obtain a steady stream of brake fluid.
3. After approximately 120–240 ml of fluid have been bled through the brake circuit and an air-free flow is maintained in the clear plastic hose and jar, close the bleeder screw.
4. Repeat this procedure at all the remaining bleeder screws.
5. Check and adjust brake fluid level to the ″MAX″ mark on the reservoir.

6. Check the brake pedal travel. If pedal travel is excessive or has not been improved, some air may still be trapped in the system. Re-bleed the brakes as necessary.
7. Test drive the vehicle to verify the brakes are operating properly and pedal feel is correct.

Master Cylinder - LHD

Description

The master cylinder body is an anodized aluminum casting. It has a machined bore to accept the master cylinder pistons and also has threaded ports with seats for hydraulic brake tube connections. The master cylinder has the brake fluid reservoir mounted on top of it and supplies brake fluid to the master cylinder as required. On manual transaxle model vehicles, the brake fluid reservoir also feeds the clutch hydraulic circuit. The reservoir is made of clear plastic and it houses the brake fluid level switch.

Operation

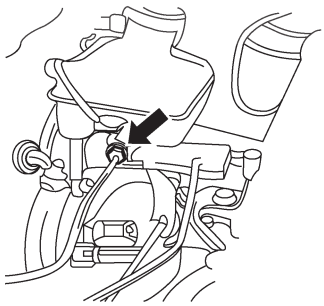
When the brake pedal is pressed, the master cylinder pistons apply brake pressure through the chassis brake tubes to each brake assembly. The brake fluid reservoir supplies the brake hydraulic system with the necessary fluid to operate properly.

Removal & Installation

CAUTION:

The vacuum in the power brake booster must be pumped down before removing the master cylinder to avoid damaging the master cylinder and to prevent the booster from sucking in any contamination. This can be done by pumping the brake pedal while the engine is not running until a firm brake pedal is achieved.

1. Turn the ignition switch off.
2. Siphon out as much brake fluid as possible from the master cylinder.
3. With the engine off, pump the brake pedal 4-5 strokes until the pedal feel is firm.
4. Disconnect the negative battery cable.
5. Disconnect the brake fluid level switch electrical connector in the master cylinder brake fluid reservoir.
6. Disconnect the brake tubes at the master cylinder outlet ports. Install plugs at all of the open brake tube outlets on the master cylinder.
   (Tighten: Brake tube nuts to 10 N·m)



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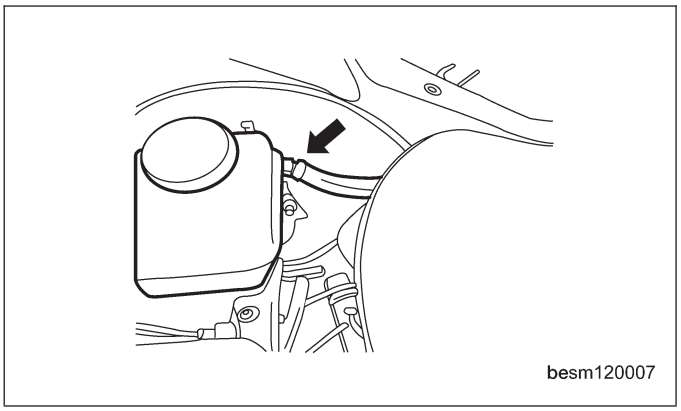
7. If equipped with a manual transaxle, remove the clamp and slide the clutch actuator hose off the reservoir port.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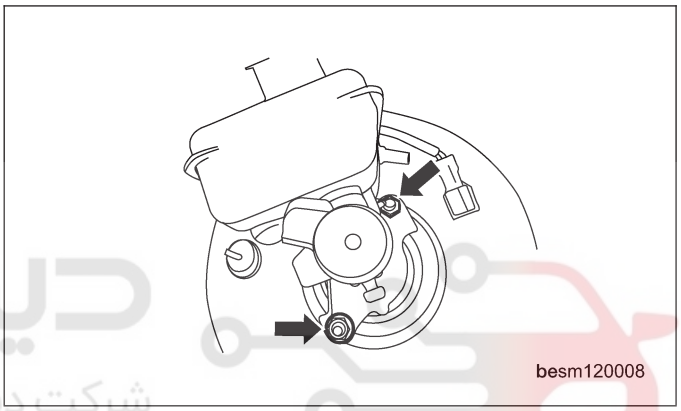
8. Clean the area around where the master cylinder attaches to the power brake booster using a suitable brake cleaner such as Brake Parts Cleaner or an equivalent.
9. Remove the two nuts attaching the master cylinder to the power brake booster.
(Tighten: Master cylinder mounting nuts to 23 N·m)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10. Slide the master cylinder straight out of the power brake booster.
11. Installation is in the reverse order of removal.

NOTE :
After installation, bleed the master cylinder or bleed the whole brake system as necessary.

Master Cylinder - RHD

Description

The master cylinder body is an anodized aluminum casting. It has a machined bore to accept the master cylinder pistons and also has threaded ports with seats for hydraulic brake tube connections. The master cylinder has the brake fluid reservoir mounted on top of it and supplies brake fluid to the master cylinder as required. On manual transaxle model vehicles, the brake fluid reservoir also feeds the clutch hydraulic circuit. The reservoir is made of clear plastic and it houses the brake fluid level switch.

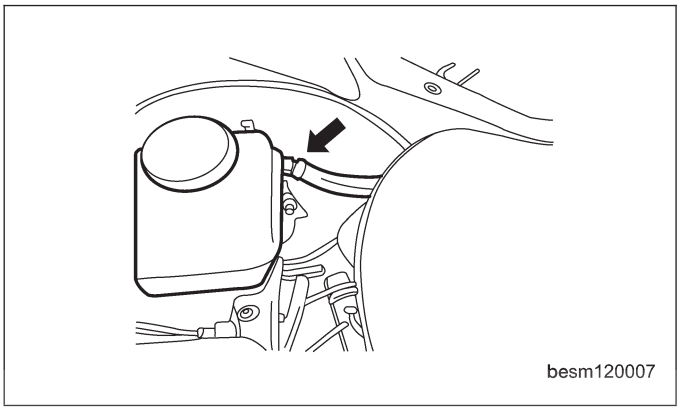
Operation

When the brake pedal is pressed, the master cylinder pistons apply brake pressure through the chassis brake tubes to each brake assembly. The brake fluid reservoir supplies the brake hydraulic system with the necessary fluid to operate properly.

Removal & Installation

CAUTION:
The vacuum in the power brake booster must be pumped down before removing the master cylinder to avoid damaging the master cylinder and to prevent the booster from sucking in any contamination. This can be done by pumping the brake pedal while the engine is not running until a firm brake pedal is achieved.

1. Turn the ignition switch off.
2. Siphon out as much brake fluid as possible from the master cylinder.
3. With the engine off, pump the brake pedal 4-5 strokes until the pedal feel is firm.
4. Disconnect the negative battery cable.
5. Disconnect the brake fluid level switch electrical connector from the master cylinder brake fluid reservoir.
6. Disconnect the brake tubes at the master cylinder outlet ports. Install plugs at all of the open brake tube outlets on the master cylinder.
   (Tighten: Brake tube nuts to 10 N·m)
7. If equipped with a manual transaxle, remove the clamp and slide the clutch actuator hose off the reservoir port.



8. Clean the area around where the master cylinder attaches to the power brake booster using a suitable brake cleaner such as Brake Parts Cleaner or an equivalent.
9. Remove the two nuts attaching the master cylinder to the power brake booster.
   (Tighten: Master cylinder mounting nuts to 23 N·m)
10. Slide the master cylinder straight out of the power brake booster.
11. Installation is in the reverse order of removal.

NOTE :
After installation, bleed the master cylinder or bleed the entire brake system as necessary.

Power Brake Booster - LHD

Description

The power brake booster is mounted to the engine compartment side of the dash panel. The master cylinder is bolted to the front of the booster.

Operation

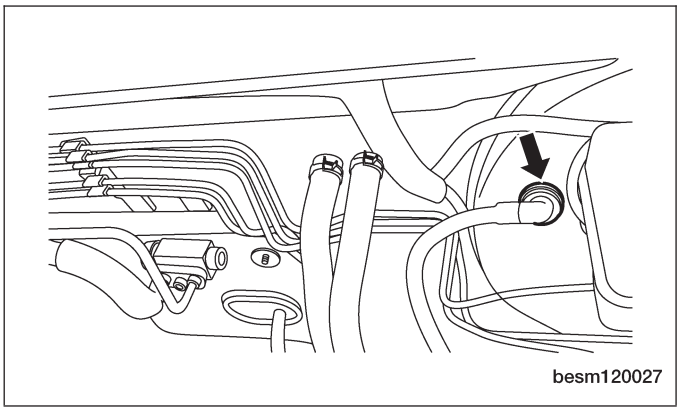
A vacuum line connects the check valve to engine source vacuum. The booster input rod extends through the dash panel and connects to the brake pedal.

Removal & Installation

CAUTION:
The vacuum in the power brake booster must be pumped down before removing the master cylinder to avoid damaging the master cylinder and to prevent the booster from sucking in any contamination. This can be done by pumping the brake pedal while the engine is not running until a firm brake pedal is achieved.

1. Remove the master cylinder (See Master Cylinder Removal & Installation in Section 12 Brakes).

2. Disconnect the vacuum hose from the check valve on the power brake booster.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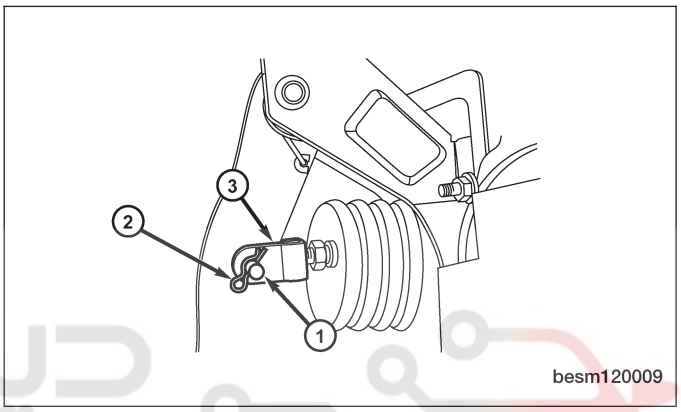
3. Remove the spring-type cotter pin (2) and clevis pin (1) from the brake booster rod (3).



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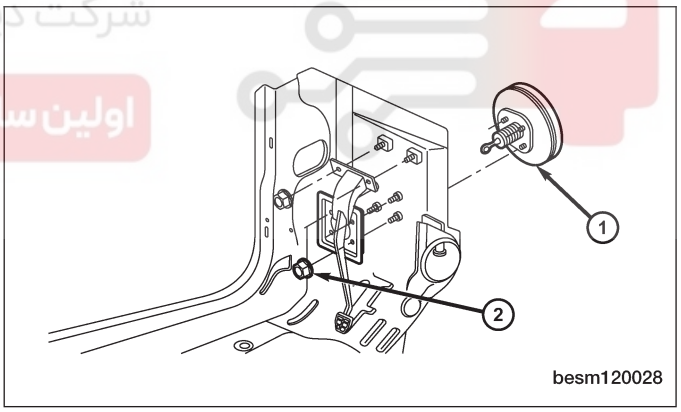
4. Remove the nuts (2) attaching the power brake booster to the dash panel.
   (Tighten: Brake pedal/Power brake booster mounting nuts to 25 N·m)
5. Slide the power brake booster (1) forward until its mounting studs clear the dash panel, then remove it through the engine compartment.
6. Installation is in the reverse order of removal.



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Power Brake Booster - RHD

Description

The power brake booster is mounted to the engine room side of the dash panel. The master cylinder is bolted to the front of the booster.

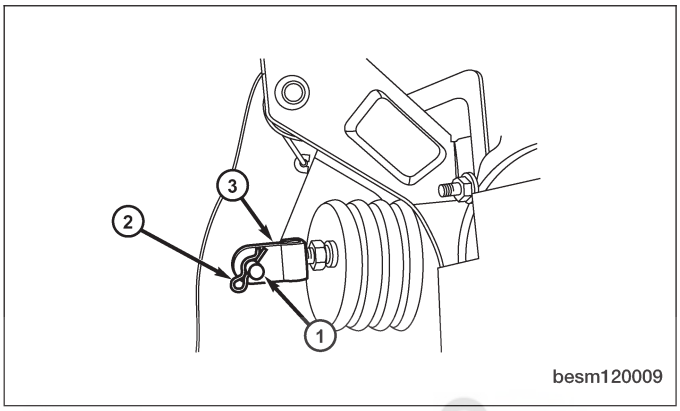
Operation

A vacuum line connects the check value to engine source vacuum. The booster input rod extends through the dash panel and connects to the brake pedal.

Removal & Installation

CAUTION:
The vacuum in the power brake booster must be pumped down before removing the master cylinder to avoid damaging the master cylinder and to prevent the booster from sucking in any contamination. This can be done by pumping the brake pedal while the engine is not running until a firm brake pedal is achieved.

1. Remove the master cylinder (See Master Cylinder Removal & Installation in Section 12 Brakes).
2. Disconnect the vacuum hose from the check valve on the power brake booster.
3. Remove the spring-type cotter pin (2) and clevis pin (1) from the brake booster rod (3).



4. Remove the nuts attaching the power brake booster to the dash panel.
   (Tighten: Brake pedal/Power brake booster mounting nuts to 25 N·m)
5. Slide the power brake booster forward until its mounting studs clear the dash panel, then remove it through the engine compartment.
6. Installation is in the reverse order of removal.

Front Brake Caliper

Description

The calipers are a single piston type. The calipers are free to slide laterally on the anchor, this allows continuous compensation for lining wear. The calipers are directly bolted to the wheel hub with mounting bolts. The disc brake rotor dust shield is mounted to the hub.

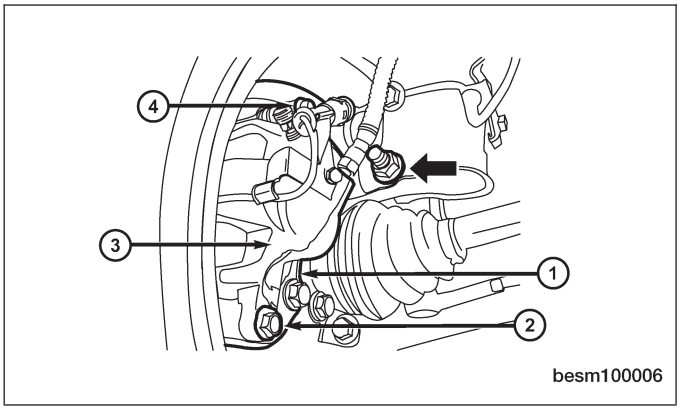
Operation

When the brakes are applied, fluid pressure is exerted against the caliper piston. The fluid pressure is exerted equally and in all directions. This means pressure exerted against the caliper piston and within the caliper bores will be equal. Fluid pressure applied to the pistons is transmitted directly to the inboard brake pad. This forces the pad lining against the inner surface of the disc brake rotor. At the same time, fluid pressure within the piston bores forces the caliper to slide inward on the slide pins. This action brings the outboard brake pad lining into contact with the outer surface of the disc brake rotor.

Removal & Installation

1. Using a brake pedal holding tool, depress the brake pedal past its first 25 mm of travel and hold it in this position. This will isolate the master cylinder from the brake hydraulic system and will not allow the brake fluid to drain out of the master cylinder reservoir when the lines are opened.
2. Raise the vehicle.
3. Remove the wheel mounting nuts and the tire and wheel assembly.
   (Tighten: Wheel mounting nuts to 110 N·m)

4. Remove the front brake hose from the front brake caliper.
   (Tighten: Front caliper brake hose to 19 N·m)
5. Remove the front caliper guide pin bolts (2, 4).
   (Tighten: Front caliper guide pin bolts to 23 N·m)
6. Slide the front brake caliper (3) from the disc brake adapter bracket (1) and brake pads and remove.
7. Installation is in the reverse order of removal.



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Installation Notes:

- Completely retract the caliper piston back into the bore of the caliper.
- After installation bleed the caliper as necessary.

Rear Brake Caliper

Description

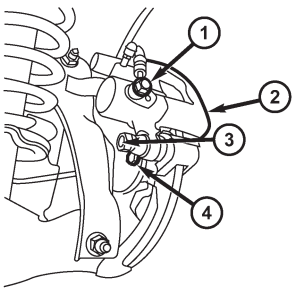
The rear disc brakes consist of fixed single piston style calipers and solid rotors. The rear caliper is mounted to the rear wheel hub. The calipers are directly bolted to the wheel hub with mounting bolts. The disc brake rotor dust shield is mounted to the hub. The disc brake rotor has a built in drum used for the parking brakes. The parking brake shoes are mounted to the wheel hub.

Operation

When the brakes are applied, fluid pressure is exerted against the caliper piston. The fluid pressure is exerted equally and in all directions. This means pressure exerted against the caliper piston and within the caliper bores will be equal. Fluid pressure applied to the pistons is transmitted directly to the inboard brake pad. This forces the pad lining against the inner surface of the disc brake rotor. At the same time, fluid pressure within the piston bores forces the caliper to slide inward on the slide pins. This action brings the outboard brake pad lining into contact with the outer surface of the disc brake rotor.

Removal & Installation

1. Using a brake pedal holding tool, depress the brake pedal past its first 25 mm of travel and hold it in this position. This will isolate the master cylinder from the brake hydraulic system and will not allow the brake fluid to drain out of the master cylinder reservoir when the lines are opened.
2. Raise the vehicle.
3. Remove the wheel mounting nuts and the tire and wheel assembly.
   (Tighten: Wheel mounting nuts to 110 N·m)
4. Remove the banjo bolt (1) connecting the brake hose to the rear brake caliper (2).
   (Tighten: Rear caliper banjo bolt to 20 N·m)
5. Remove the rear caliper guide pin bolt (3).
   (Tighten: Rear caliper guide pin bolts to 23 N·m)
6. Remove rear brake caliper adapter mounting bolts (4).
   (Tighten: Rear brake caliper adapter mounting bolts to 63 N·m)
7. Slide the rear brake caliper from the disc brake adapter bracket and brake pads and remove.



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8. Installation is in the reverse order of removal.

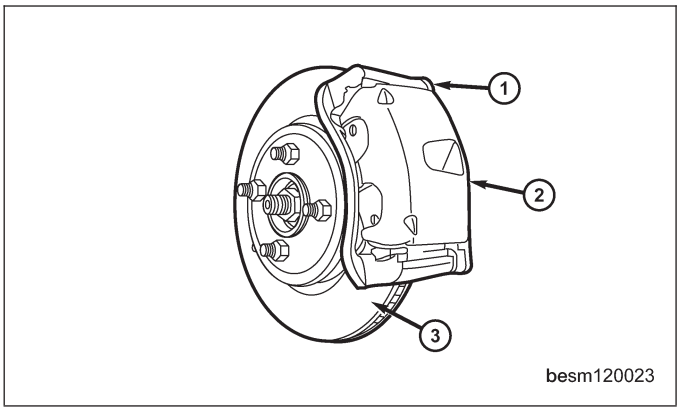
Installation Notes:

- Completely retract the caliper piston back into the bore of the caliper.
- After installation bleed the caliper as necessary.

Front Brake Rotor

Removal & Installation

1. Raise and support the vehicle.
2. Remove the wheel mounting nuts and the tire and wheel assembly. (Tighten: Wheel mounting nuts to 110 N·m)
3. Remove front caliper (2) and adapter (1) together (See Front Caliper Removal & Installation in Section 12 Brakes).
4. Slide the front brake rotor (3) off the hub and bearing.
5. Installation is in the reverse order of removal.



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Inspection

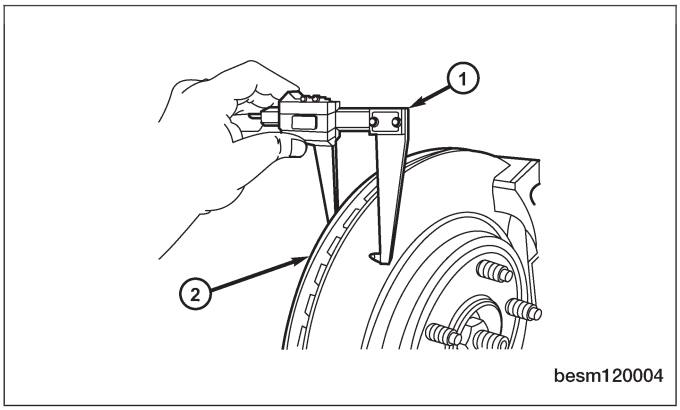
Excessive runout or wobble in a rotor can increase pedal travel due to piston knock-back. This increases guide pin sleeve wear due to the tendency of the caliper to follow the rotor wobble.

Braking Surface Inspection

Light braking surface scoring and wear is acceptable. If heavy scoring or warping is evident, the rotor must be resurfaced or replaced. Excessive wear and scoring of the rotor can cause improper lining contact on the rotor's braking surface. If the ridges on the rotor are not removed before new brake linings are installed, improper wear of the shoes will result. Some discoloration or wear of the rotor surface is normal and does not require resurfacing when linings are replaced. If cracks or burned spots are evident, the rotor must be replaced.

Rotor Minimum Thickness

Measure the rotor thickness (1) at the center of the brake pad contact surface. Replace the rotor (2) if it is worn below minimum thickness or if machining the rotor will cause its thickness to fall below specifications.



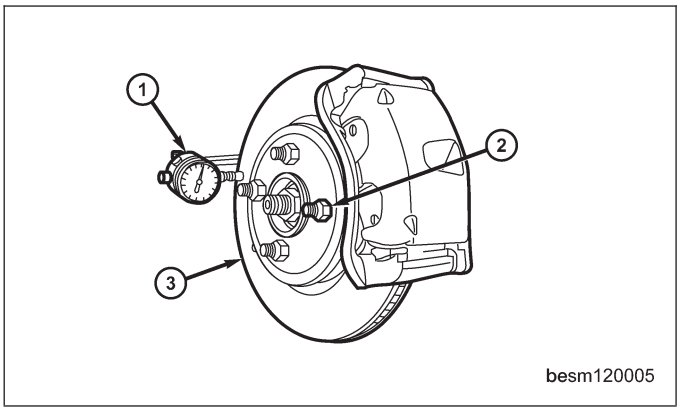
besm120004

CAUTION:
Do not machine the rotor if it will cause the rotor to fall below minimum thickness.

Rotor Runout

1. Install standard wheel mounting nuts, flat side to rotor, on all the wheel studs (2). Progressively tighten the

nuts in a crisscross pattern to 110 N·m.
2. Mount a dial indicator (1), with wheel, or equivalent, to the knuckle. Position the dial indicator wheel to contact the rotor braking surface approximately 10 mm from the outer edge of the rotor.
3. Slowly rotate the brake rotor (3) checking lateral runout, marking the low and high spots. Record these measurements.
4. Check and record the runout on the opposite side of the rotor in the same fashion, marking the low and high spots.
5. Compare runout measurement to specification.
6. If runout is in excess of specifications, check the lateral runout of the hub face.



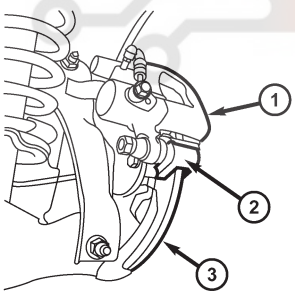
besm120005

BRAKE ROTOR	ROTOR THICKNESS	MINIMUM ROTOR THICKNESS	ROTOR THICKNESS VARIATION	ROTOR RUNOUT
Front Rotor	22 mm	20 mm	0.005 mm	0.03 mm

Rear Brake Rotor

Removal & Installation

1. Raise and support the vehicle.
2. Remove the wheel mounting nuts and the tire and wheel assembly. (Tighten: Wheel mounting nuts to 110 N·m)
3. Remove rear caliper (1) and adapter (2) together (See Rear Caliper Removal & Installation in Section 12 Brakes).
4. Slide the rear brake rotor (3) off the hub and bearing.
5. Installation is in the reverse order of removal.



besm120030

Inspection

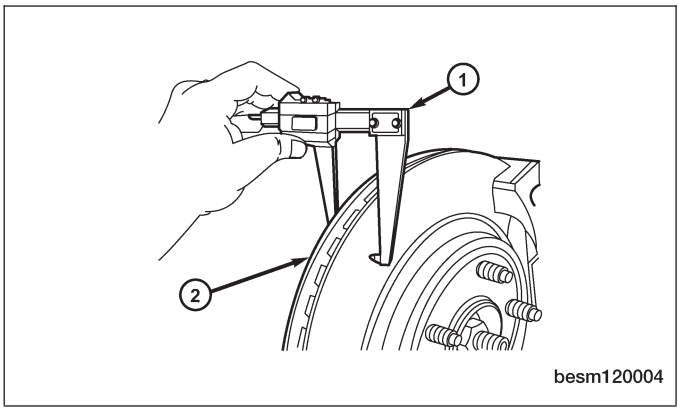
Excessive runout or wobble in a rotor can increase pedal travel due to piston knock-back. This increases guide pin sleeve wear due to the tendency of the caliper to follow the rotor wobble.

Braking Surface Inspection

Light braking surface scoring and wear is acceptable. If heavy scoring or warping is evident, the rotor must be resurfaced or replaced. Excessive wear and scoring of the rotor can cause improper lining contact on the rotor's braking surface. If the ridges on the rotor are not removed before new brake linings are installed, improper wear of the shoes will result. Some discoloration or wear of the rotor surface is normal and does not require resurfacing when linings are replaced. If cracks or burned spots are evident, the rotor must be replaced.

Rotor Minimum Thickness

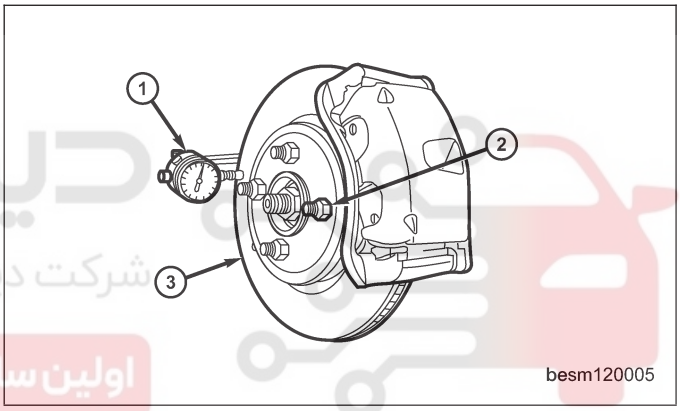
Measure the rotor thickness (1) at the center of the brake pad contact surface. Replace the rotor (2) if it is worn below minimum thickness or if machining the rotor will cause its thickness to fall below specifications.



CAUTION:
Do not machine the rotor if it will cause the rotor to fall below minimum thickness.

Rotor Runout

1. Install standard wheel mounting nuts, flat side to rotor, on all the wheel studs (2). Progressively tighten the nuts in a crisscross pattern to 110 N·m.
2. Mount a dial indicator (1), with wheel, or equivalent, to the knuckle. Position the dial indicator wheel to contact the rotor braking surface approximately 10 mm from the outer edge of the rotor.
3. Slowly rotate the brake rotor (3) checking lateral runout, marking the low and high spots. Record these measurements.
4. Check and record the runout on the opposite side of the rotor in the same fashion, marking the low and high spots.
5. Compare runout measurement to specification.
6. If runout is in excess of specifications, check the lateral runout of the hub face.



BRAKE ROTOR	ROTOR THICKNESS	MINIMUM ROTOR THICKNESS	ROTOR THICKNESS VARIATION	ROTOR RUNOUT
Rear Rotor	10 mm	7 mm	0.015 mm	0.03 mm

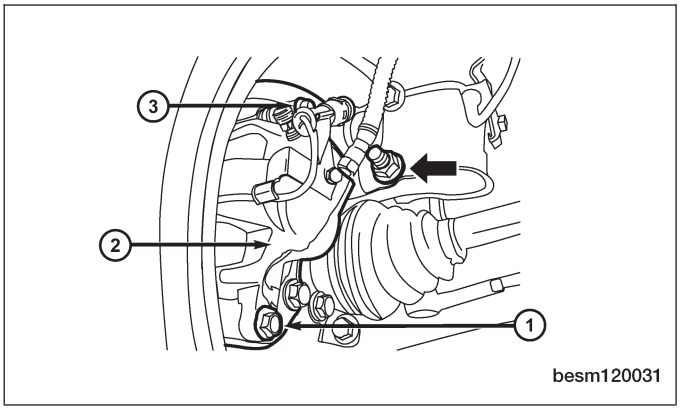
Front Brake Pads

Removal & Installation

1. Raise and support the vehicle.
2. Remove the wheel mounting nuts and the tire and wheel assembly. (Tighten: Wheel mounting nuts to 110 N·m)

NOTE :
In some cases, it may be necessary to retract the caliper piston in its bore a small amount in order to provide sufficient clearance between the pads and the rotor.

3. Remove the front caliper guide pin bolts (1, 3).
   (Tighten: Front caliper guide pin bolts to 23 N·m)
4. Remove the disc brake caliper (2) from the disc brake adapter bracket and hang it out of the way using wire. Use care not to over extend the brake hose when doing this.



5. Remove the inboard brake pad from the caliper adapter bracket.
6. Remove the outboard brake pad from the caliper by prying the brake pad retaining clip over the raised area on the caliper. Slide the brake pad off of the brake caliper.
7. Installation is in the reverse order of removal.

Installation Notes:

- Before installing brake pads, completely retract the caliper piston back into the bore of the caliper.
- After installation and before moving the vehicle, pump the brake pedal several times to set the pads to the brake rotor.
- Check and adjust the brake fluid level in the reservoir as necessary.
- Road test the vehicle and make several stops to wear off any foreign material on the brakes and to seat the brake pads.
- After installation and before moving the vehicle, pump the brake pedal several times to set the pads to the brake rotor.

Inspection

Visually inspect brake pads for uneven lining wear. Also inspect for excessive lining deterioration. Check the clearance between the tips of the wear indicators (if equipped) on the pads and the brake rotors. If a visual inspection does not adequately determine the condition of the lining, a physical check will be necessary. To check the amount of lining wear, remove the disc brake pads from the vehicle. Measure the brake pad minimum thickness. Brake pads must be replaced when usable material on a brake pad lining measured at its thinnest point measures one millimeter or less. Replace both disc brake pads (inboard and outboard) at each caliper. It is also necessary to replace the pads on the opposite side of the vehicle as well as the pads failing inspection to maintain proper braking characteristics. If the brake pad assemblies do not require replacement, be sure to reinstall the brake pads in the original position from which they were removed.

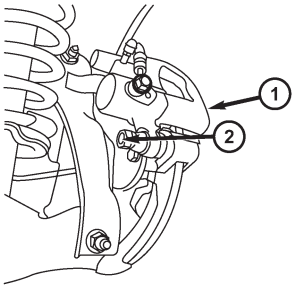
Rear Brake Pads

Removal & Installation

1. Raise and support the vehicle.
2. Remove the wheel mounting nuts and the tire and wheel assembly.
   (Tighten: Wheel mounting nuts to 110 N·m)

NOTE :
In some cases, it may be necessary to retract the caliper piston in its bore a small amount in order to provide sufficient clearance between the pads and the rotor.

3. Remove the lower rear caliper guide pin bolt (2). (Tighten: Rear caliper guide pin bolt to 23 N·m) **CAUTION:When moving rear brake caliper upward, use extreme care not to damage or overextend the flex hose.**
4. Rotate the caliper (1) upward hinging off the upper guide pin bolt. Rotate the caliper upward just enough to allow brake pad removal.



besm120032

5. Slide the rear brake pads off of the brake caliper adapter.

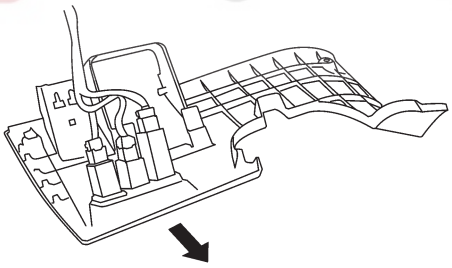
Inspection

Visually inspect brake pads for uneven lining wear. Also inspect for excessive lining deterioration. Check the clearance between the tips of the wear indicators (if equipped) on the pads and the brake rotors. If a visual inspection does not adequately determine the condition of the lining, a physical check will be necessary. To check the amount of lining wear, remove the disc brake pads from the vehicle. Measure the brake pad minimum thickness. Brake pads must be replaced when usable material on a brake pad lining measured at its thinnest point measures one millimeter or less. Replace both disc brake pads (inboard and outboard) at each caliper. It is also necessary to replace the pads on the opposite side of the vehicle as well as the pads failing inspection to maintain proper braking characteristics. If the brake pad assemblies do not require replacement, be sure to reinstall the brake pads in the original position from which they were removed.

Brake Pedal - LHD

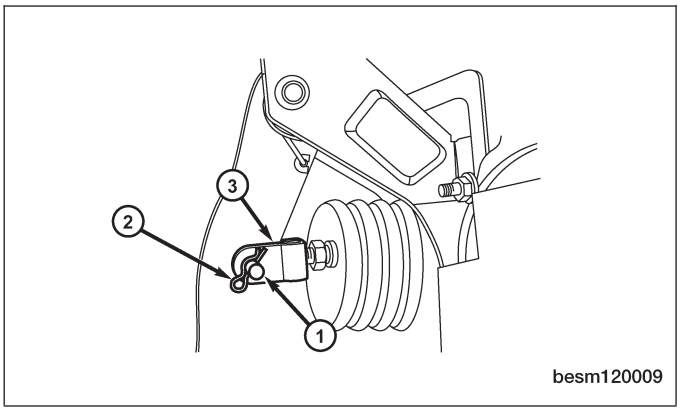
Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the instrument panel lower shroud then disconnect electrical connectors.

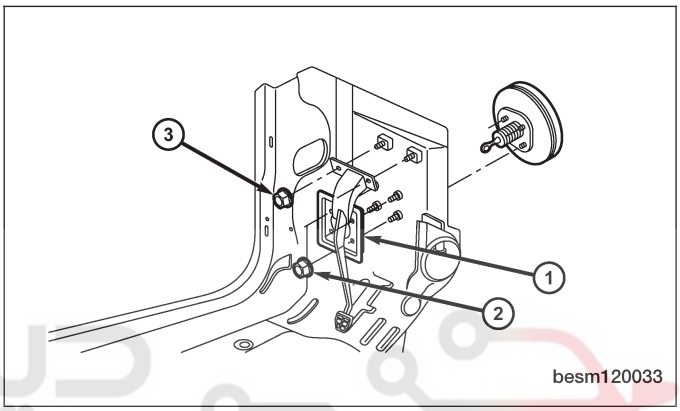

besm150112

3. Disconnect the stop lamp switch electrical connector.
4. Remove the stop lamp switch.

5. Remove the spring-type cotter pin (2) and clevis pin (1) from the brake booster rod (3).



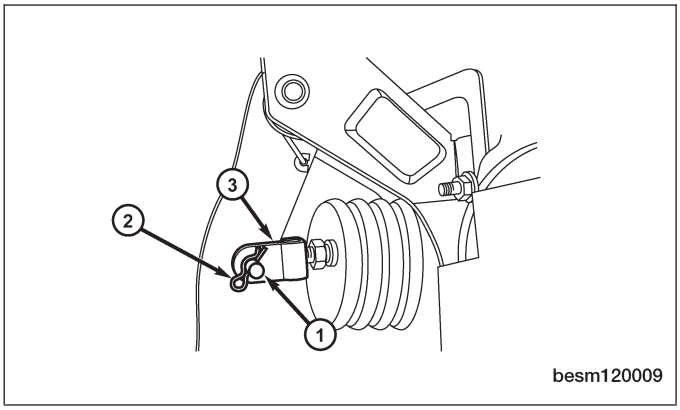
6. Remove the nuts (2) attaching the brake pedal (1) and power brake booster to the dash panel.
(Tighten: Brake pedal/Power brake booster mounting nuts to 25 N·m)
7. Remove the remaining nut (3) attaching the brake pedal (1) to the dash panel.
(Tighten: Brake pedal/Power brake booster mounting nut to 25 N·m)
8. Remove the brake pedal (1).
9. Installation is in the reverse order of removal.



Brake Pedal - RHD

Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the instrument panel lower shroud then disconnect electrical connectors.
3. Disconnect the stop lamp switch electrical connector.
4. Remove the stop lamp switch.
5. Remove the spring-type cotter pin (2) and clevis pin (1) from the brake booster rod (3).

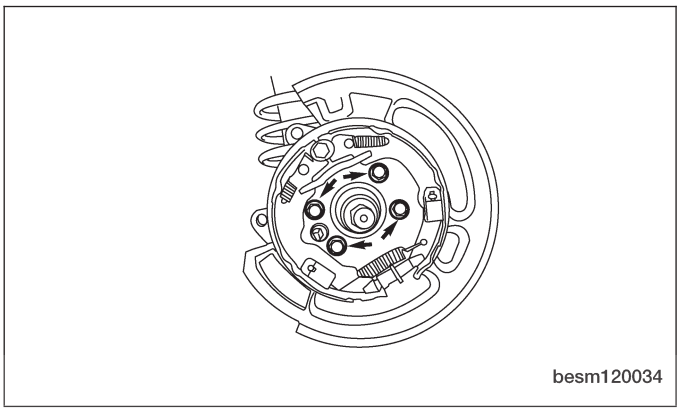


6. Remove the nuts attaching the brake pedal and power brake booster to the dash panel.
(Tighten: Brake pedal/Power brake booster mounting nuts to 25 N·m)
7. Remove the remaining nut attaching the brake pedal to the dash panel.
(Tighten: Brake pedal/Power brake booster mounting nut to 25 N·m)
8. Remove the brake pedal.
9. Installation is in the reverse order of removal.

Rear Brake Backing Plate

Removal & Installation

1. Raise and support the vehicle.
2. Remove the wheel mounting nuts and the tire and wheel assembly. (Tighten: Wheel mounting nuts to 110 N·m)
3. Remove rear brake rotor (See Rear Brake Rotor Removal & Installation in Section 12 Brakes).
4. Remove rear hub and bearing (See Rear Hub and Bearing Removal and Installation in Section 09 Axle).
5. Remove four bolts that mount rear brake backing plate to trailing link.
6. Remove the rear brake backing plate assembly.



7. Installation is in the reverse order of removal.

UNIT REPAIR

Front Brake Caliper

Disassemble

Before disassembling the brake caliper, clean and inspect it.

WARNING!

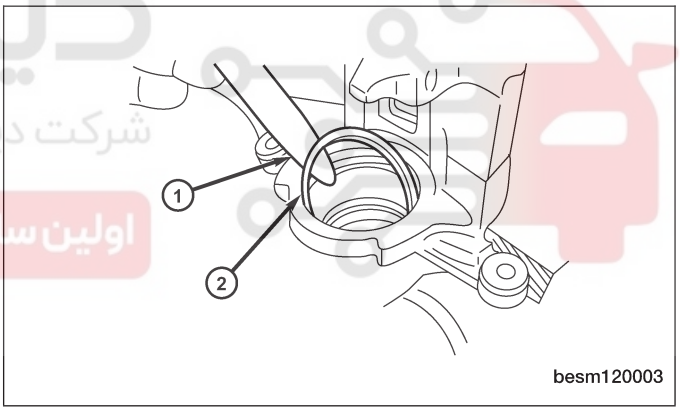
- **Under no condition should high pressure air ever be used to remove a piston from a caliper bore. Personal injury could result from such a practice.**
- **Do not place face or hands near caliper and piston if using compressed air pressure to remove piston. Do not use high pressure.**

1. Place a wooden block in the caliper.
2. If necessary, apply low pressure compressed air to the caliper fluid inlet in short spurts to force the piston out.
3. Remove the piston from the caliper.
4. Remove the dust boot from the piston and discard it.

CAUTION:

Do not use a screw driver or other metal tool for seal removal. Using such tools can scratch the bore or leave burrs on the seal groove edges.

5. Using a soft tool such as a plastic trim stick (1), work the piston seal (2) out of its groove in caliper piston bore. Discard the used seal.



6. Clean the piston bore and drilled passage ways with alcohol or a suitable solvent. Wipe it dry using only a lint-free cloth.
7. Inspect both the piston and bore for scoring or pitting. Bores that show light scratches or corrosion can usually be cleared of the light scratches or corrosion using crocus cloth.

Inspection

Remove deposits on the piston using a soft brass wire brush or a rough shop towel. Do not clean piston with a polishing or emery cloth because this will damage the chrome-plated surface. Replace the piston if the chrome plated surface is damaged. If the piston is jammed or if the cylinder bores are scored or rusted, replace the complete brake caliper. Remove small, light rust spots in the cylinder bore with a polishing cloth. Remove heavy rust spots in front of the groove for the piston seal using fine-grit emery paper (grit size 380 to 500).

Assemble

NOTE :

- Always have clean hands when assembling a brake caliper.
- Always use fresh, clean brake fluid when assembling a brake caliper.
- Never use an old piston seal.
- Bleed the brakes as necessary.

Perform the following procedure to assemble the brake caliper:

1. Lubricate the caliper piston, piston seals and piston bore with clean brake fluid.
2. Install the new piston seal into the seal groove.

NOTE :
Verify seal is fully seated into seal groove and not twisted.

3. Install the new dust boot on the caliper piston and seat the dust boot lip into the piston groove.
4. Stretch the dust boot rearward to straighten the boot folds, then move the boot forward until the fold snaps into place.
5. Install the piston into the caliper bore and press the piston down to the bottom of the caliper bore by hand or with the handle of a hammer.

CAUTION:
When assembling, the force applied to the piston to seat it in the bore, must be applied uniformly to avoid cocking and binding of the piston.

6. Seat the dust boot in caliper.
7. Install the new caliper bleed screw.
8. Install the caliper (See Front Brake Caliper Removal & Installation in Section 12 Brakes).

Rear Brake Caliper

Disassemble

Before disassembling the brake caliper, clean and inspect it.

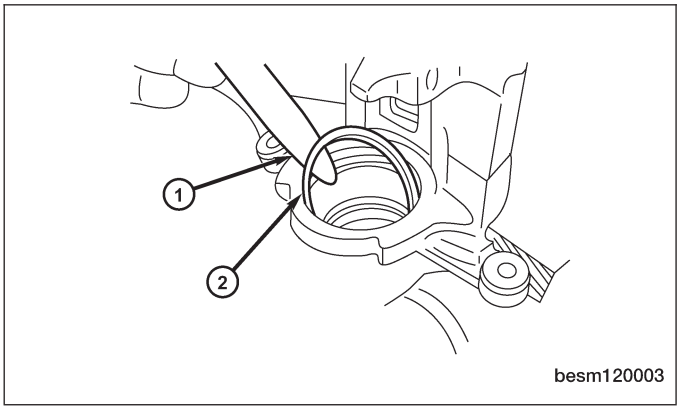
WARNING!

- **Under no condition should high pressure air ever be used to remove a piston from a caliper bore. Personal injury could result from such a practice.**
- **Do not place face or hands near caliper and piston if using compressed air pressure to remove piston. Do not use high pressure.**

1. Place a wooden block in the caliper.
2. If necessary, apply low pressure compressed air to the caliper fluid inlet in short spurts to force the piston out.
3. Remove the piston from the caliper.
4. Remove the dust boot from the piston and discard it.

CAUTION:
Do not use a screw driver or other metal tool for seal removal. Using such tools can scratch the bore or leave burrs on the seal groove edges.

5. Using a soft tool such as a plastic trim stick (1), work the piston seal (2) out of its groove in caliper piston bore. Discard the used seal.



6. Clean the piston bore and drilled passage ways with alcohol or a suitable solvent. Wipe it dry using only a lint-free cloth.
7. Inspect both the piston and bore for scoring or pitting. Bores that show light scratches or corrosion can usually be cleared of the light scratches or corrosion using crocus cloth.

Inspection

Remove deposits on the piston using a soft brass wire brush or a rough shop towel. Do not clean piston with a polishing or emery cloth because this will damage the chrome-plated surface. Replace the piston if the chrome plated surface is damaged. If the piston is jammed or if the cylinder bores are scored or rusted, replace the complete brake caliper. Remove small, light rust spots in the cylinder bore with a polishing cloth. Remove heavy rust spots in front of the groove for the piston seal using fine-grit emery paper (grit size 380 to 500).

Assemble

NOTE :

- Always have clean hands when assembling a brake caliper.
- Always use fresh, clean brake fluid when assembling a brake caliper.
- Never use an old piston seal.
- Bleed the brakes as necessary.

Perform the following procedure to assemble the brake caliper:

1. Lubricate the caliper piston, piston seals and piston bore with clean brake fluid.
2. Install the new piston seal into the seal groove.

NOTE :

Verify seal is fully seated into seal groove and not twisted.

3. Install the new dust boot on the caliper piston and seat the dust boot lip into the piston groove.
4. Stretch the dust boot rearward to straighten the boot folds, then move the boot forward until the fold snaps into place.
5. Install the piston into the caliper bore and press the piston down to the bottom of the caliper bore by hand or with the handle of a hammer.

CAUTION:

When assembling, the force applied to the piston to seat it in the bore must be applied uniformly to avoid cocking and binding of the piston.

6. Seat the dust boot in caliper.
7. Install the new caliper bleed screw.
8. Install the caliper (See Front Brake Caliper Removal & Installation in Section 12 Brakes).

ANTILOCK BRAKES

GENERAL INFORMATION

Description

This Antilock Brake System (ABS) uses components of the base brake system, but also features the following components:

- Hydraulic Control Unit and Antilock Brake System Module (ABS module)
- Wheel Speed Sensors (wheel speed sensor) - Four sensors (one sensor at each wheel making it a four-channel system)

The purpose of the ABS is to prevent wheel lockup under braking conditions on virtually any type of road surface. Antilock braking is desirable because a vehicle that is stopped without locking the wheels retains directional stability and some steering capability. This allows the driver to retain greater control of the vehicle during braking.

Operation

ABS Braking

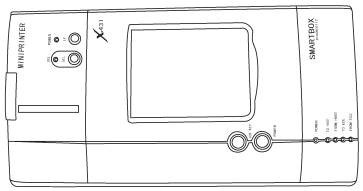
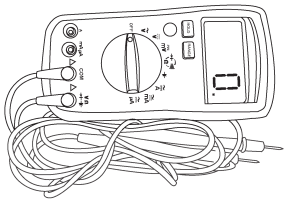
- ABS operation is activated when any wheel becomes locked while applying the brake pedal. If a wheel locking tendency is detected during a brake application, the brake system enters the ABS mode. During ABS braking, hydraulic pressure in the four wheel circuits is modulated to prevent any wheel from locking. Each wheel circuit is designed with a set of electric solenoids to allow modulation. The system can build and release pressure at each wheel, depending on signals generated by the wheel speed sensors at each wheel and received at the ABS Module.
- There are a few performance characteristics of the ABS that may at first seem abnormal, but in fact are normal. These characteristics are described below.
  - If the electrical system malfunctions, the Fail-Safe function is activated, the ABS becomes inoperative and the ABS warning lamp turns on.
  - During ABS operation, the brake pedal may vibrate lightly and a mechanical noise may be heard. This is normal.
  - Stopping distance may be longer than that of vehicles without ABS when vehicle drives on rough, gravel, or snow-covered (fresh, deep snow) roads.

Specifications

Torque Specifications

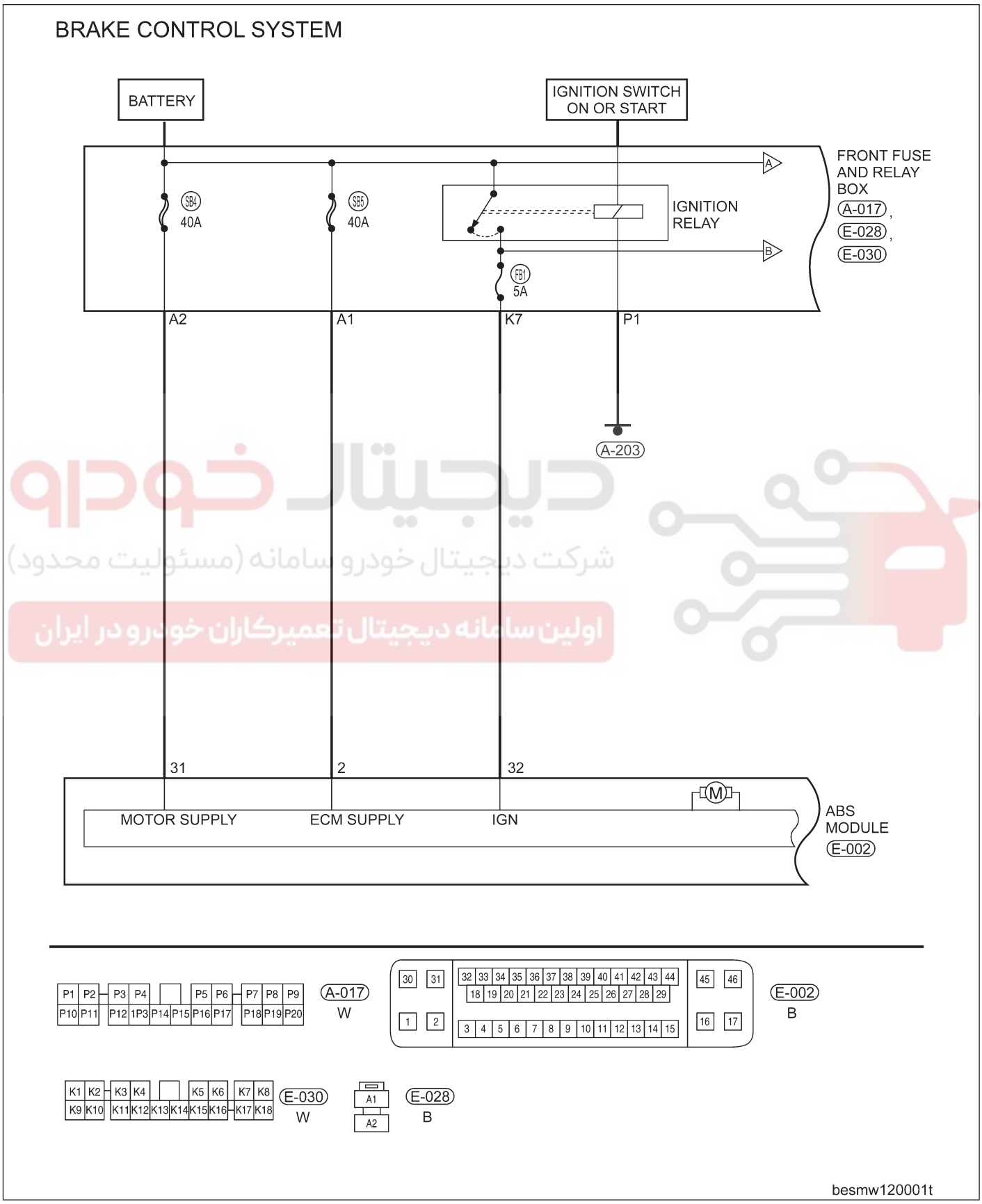
DESCRIPTION	TORQUE (N·m)
ABS Mounting Bolt (To Bracket)	10
ABS Mounting Bracket Screws (To Frame)	20
ABS Mounting Bracket Screw And Nut (To Frame)	20
ABS Wheel Speed Sensor Head Mounting Screw - Rear	10
Brake Tube Nuts	10
Wheel Mounting Nuts	110

Special Tools

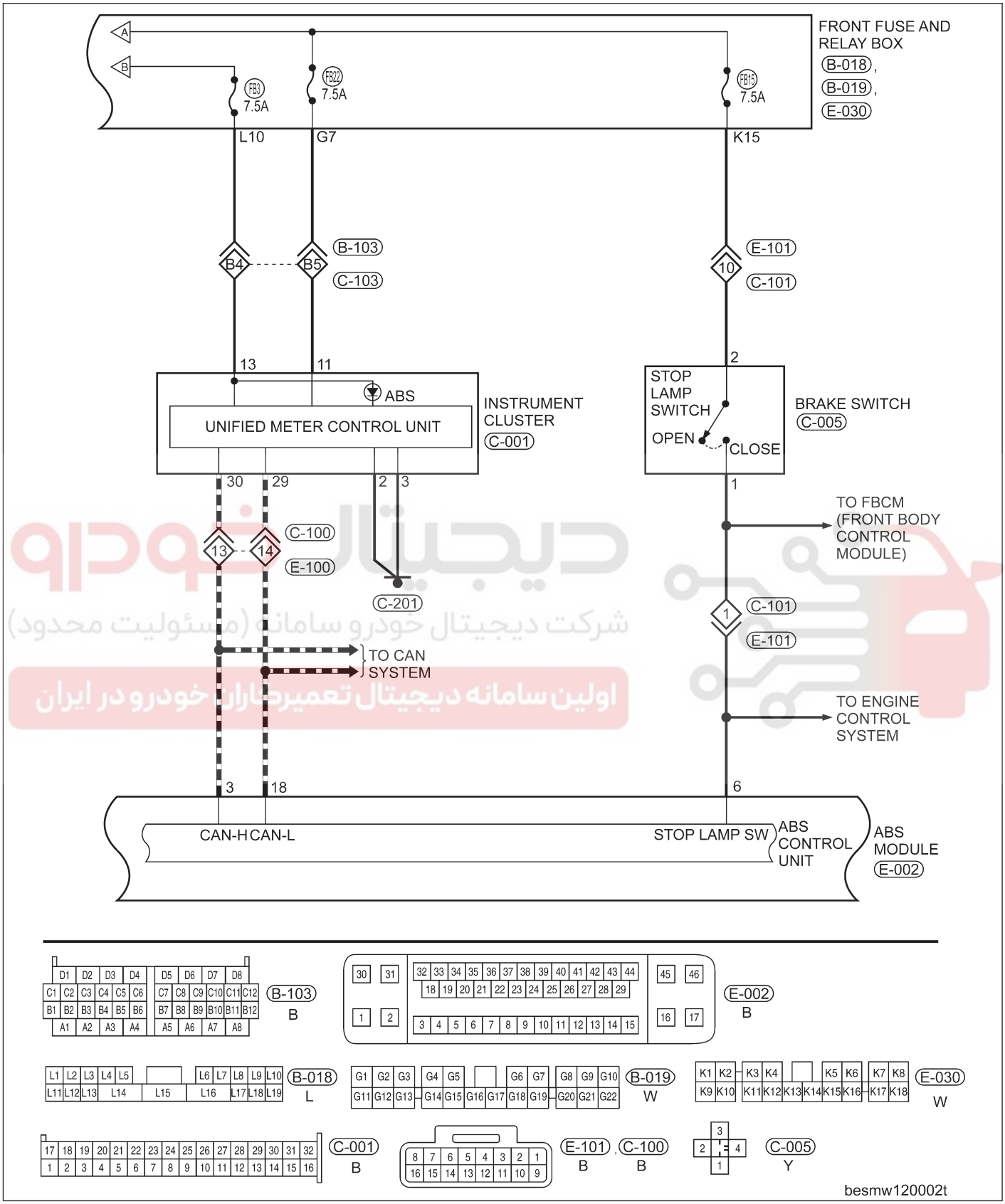
Diagnostic Scan Tool X-431	 besm030001
Digital Multimeter Fluke 15B & 17B	 besm030002

Electrical Schematics

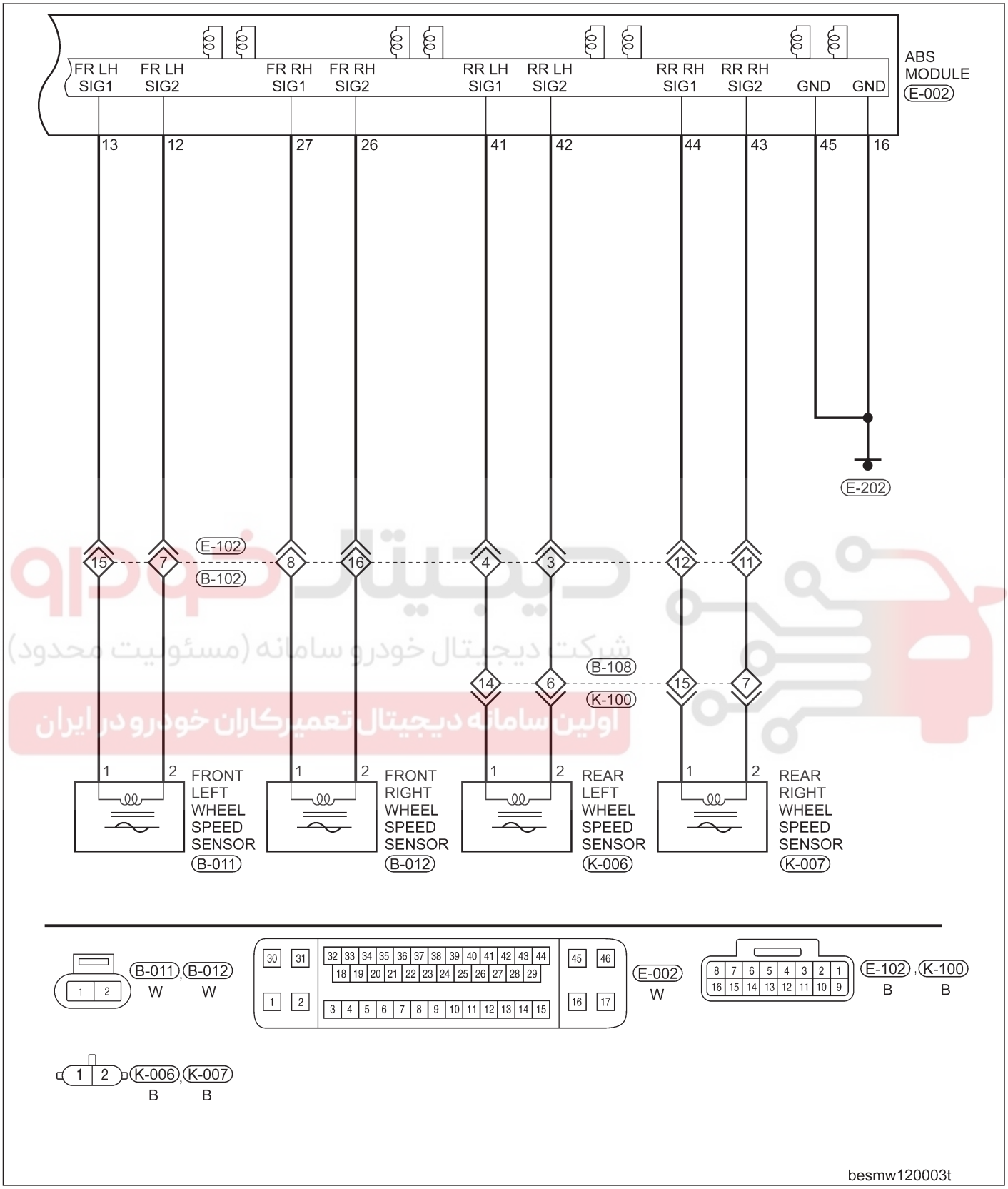
Antilock Brake System (Page 1 of 3)



Antilock Brake System (Page 2 of 3)



Antilock Brake System (Page 3 of 3)



DIAGNOSIS & TESTING

Diagnostic Help

1. The X-431 scan tool connects to the Data Link Connector (DLC) and communicates with the vehicle electronic modules through the class two serial data circuit.
2. Confirm that the malfunction is current and carry-out the diagnostic tests and repair procedures.
3. If the Diagnostic Trouble Code (DTC) cannot be deleted, it is a current fault.
4. Use only a digital multimeter to perform voltage readings on electronic systems.
5. Refer to any Technical Service Bulletins that may apply to the failure.
6. Visually inspect the related wiring harness.
7. Perform a voltage drop test on the related circuits between the suspected component and the ABS module.
8. Inspect and clean all ECM, ABS, engine, and chassis grounds that are related to the most current DTC.
9. If numerous trouble codes were set, use a wiring schematic and look for any common ground circuits or voltage supply circuits that may apply to the DTC.
10. For any wheel speed sensor DTCs, inspect for dirt/metal debris.
11. Use the scan tool to perform a System Test if one applies to the failed component.

DTC Definitions

The following shows the circuit explanation of many DTCs:

- Circuit Low - Circuit shorted to ground
- Circuit High - Circuit shorted to voltage
- Circuit Failure - Circuit open or multi-circuit malfunction

Intermittent DTC Troubleshooting

If the failure is intermittent perform the following:

- Check for loose connectors.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Monitor the scan tool data relative to this circuit.
- Wiggle the related wiring harness and connectors while looking for an interrupted signal on the affected circuit.
- If possible, try to duplicate the conditions under which the DTC set.
- Look for the data to change or for the DTC to reset during the wiggle test.
- Look for broken, bent, pushed out or corroded terminals.
- Inspect the sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material.
- A data recorder, and/or oscilloscope should be used to help diagnose intermittent conditions.
- Remove the ABS module from the troubled vehicle and install in a new vehicle and test. If the DTC can not be deleted, the ABS module is malfunctioning. If the DTC can be deleted, return the ABS module to the original vehicle and inspect the system again.

Diagnostic Tools

Diagnostic Scan Tool X-431

Perform the following when connecting the X-431 scan tool:

- Connect the scan tool to the data link connector (DLC) for communication with the vehicle.
- The DLC is located on the driver side compartment under the steering column (it is attached to the instrument panel and accessible from the driver seat).
- The DLC is rectangular in design and capable of accommodating up to 16 terminals.
- The electrical connector has keying features to allow easy connection.

Antilock Brake System (ABS) Module Connector Pin-Out Table

PIN	CIRCUIT IDENTIFICATION	PIN	CIRCUIT IDENTIFICATION
1	—	24	—
2	ECM Supply	25	—
3	CAN-H	26	FR RH SIG2
4	—	27	FR RH SIG1
5	—	28	—
6	Stop Lamp Switch	29	—
7	—	30	—
8	—	31	Motor Supply
9	—	32	Ignition
10	—	33	—
11	—	34	—
12	FR LH SIG2	35	—
13	FR LH SIG1	36	—
14	—	37	—
15	—	38	—
16	Ground	39	—
17	—	40	—
18	CAN-L	41	RR LH SIG1
19	—	42	RR LH SIG2
20	—	43	RR RH SIG2
21	—	44	RR RH SIG1
22	—	45	Ground
23	—	46	—

Diagnostic Trouble Code (DTC) List

Antilock Brake System DTC List

DTC	DTC DEFINITION
C0001	WSS_Open_Front_Left
C0002	WSS_Open_Front_Right
C0003	WSS_Open_Rear_Left
C0004	WSS_Open_Rear_Right
C0005	WSS_Short_Front_Left
C0006	WSS_Short_Front_Right
C0007	WSS_Short_Rear_Left
C0008	WSS_Short_Rear_Right
C0009	WSS_Missing_Front_Left
C0010	WSS_Missing_Front_Right
C0011	WSS_Missing_Rear_Left
C0012	WSS_Missing_Rear_Right

DTC	DTC DEFINITION
C0013	WSS_Erratic_Front_Left
C0014	WSS_Erratic_Front_Right
C0015	WSS_Erratic_Rear_Left
C0016	WSS_Erratic_Rear_Right
C0017	WSS_Dropout_Front_Left
C0018	WSS_Dropout_Front_Right
C0019	WSS_Dropout_Rear_Left
C0020	WSS_Dropout_Rear_Right
C0021	Excessive_WSS_Failure
C0022	Mismatch_Tire
C0023	Sol_Open_ISO_Front_Left
C0024	Sol_Open_ISO_Front_Right
C0025	Sol_Open_ISO_Rear_Left
C0026	Sol_Open_ISO_Rear_Right
C0027	Sol_Open_Dump_Front_Left
C0028	Sol_Open_Dump_Front_Right
C0029	Sol_Open_Dump_Rear_Left
C0030	Sol_Open_Dump_Rear_Right
C0031	Driver_Short_ISO_Front_Left
C0032	Driver_Short_ISO_Front_Right
C0033	Driver_Short_ISO_Rear_Left
C0034	Driver_Short_ISO_Rear_Right
C0035	Driver_Short_Dump_Front_Left
C0036	Driver_Short_Dump_Front_Right
C0037	Driver_Short_Dump_Rear_Left
C0038	Driver_Short_Dump_Rear_Right
C0039	Sol_Short_ISO_Front_Left
C0040	Sol_Short_ISO_Front_Right
C0041	Sol_Short_ISO_Rear_Left
C0042	Sol_Short_ISO_Rear_Right
C0043	Sol_Short_Dump_Front_Left
C0044	Sol_Short_Dump_Front_Right
C0045	Sol_Short_Dump_Rear_Left
C0046	Sol_Short_Dump_Rear_Right
C0047	Sol_Overtemp_ISO_Front_Left
C0048	Sol_Overtemp_ISO_Front_Right
C0049	Sol_Overtemp_ISO_Rear_Left
C0050	Sol_Overtemp_ISO_Rear_Right
C0051	Sol_Overtemp_Dump_Front_Left
C0052	Sol_Overtemp_Dump_Front_Right
C0053	Sol_Overtemp_Dump_Rear_Left
C0054	Sol_Overtemp_Dump_Rear_Right
C0055	Power_Switch_Open

DIAGNOSIS & TESTING

DTC	DTC DEFINITION
C0056	Power_Switch_Short
C0057	ABS_Motor_Open
C0058	ABS_Motor_Locked
C0059	Bist_Fault
C0060	ROM_Failure
C0061	RAM_Failure
C0062	Stack_Fault
C0063	Overrun_Failure
C0064	Ext_Watchdog_Fail
C0065	Ignition_Volt_Low
C0066	Ignition_Volt_High
C0067	Ignition_Volt_Excessive_High
C0068	Unimplemented_Interrupt
C0069	Unexpected_Exception
C0070	Solenoid_Timeout_Failure
C0071	HET_Periodic_Interrupt_Failure
C0072	HET_Watchdog_Timeout
C0073	HET_Program_Error
C0074	HET_Program_Overflow
C0075	SPI_Failure
C0076	SPI_Queue_Overflow_Error
C0077	Brake_Sw_Failed_Always_Active
C0078	Brake_Sw_Failed_Never_Active
C0079	Controlled_Shutdown_Failure
U0080	CAN_Device_0_Bus_Off
U0081	CAN_Device_0_RAM_Fault
U0082	CAN_Device_0_HW_Init
U0083	Input_Packet_1_Timeout

Diagnostic Trouble Code (DTC) Tests

C0001: Left Front Wheel Speed Sensor Circuit Open

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Front Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is missing.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Turn the ignition switch off.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_OPEN_FRONT_LEFT active?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Turn the ignition switch on.
Using a 12-volt test light connected to battery (+), probe the LF wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Repair the LF wheel speed sensor signal circuit(s) for a short to ground.

No >> • Go to the next step.

Step 4.

Connect a jumper wire between ground and the LF wheel speed sensor signal circuits in the ABS module harness connector.
Using a 12-volt test light connected to battery (+), probe the LF wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Go to the next step.

No >> • Repair the LF wheel speed sensor signal circuit(s) for an open.

Step 5.

Replace the LF wheel speed sensor (See Front Wheel Speed Sensor Removal & Installation in Section 12 Brakes).

WARNING!

To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_OPEN_FRONT_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0002: Right Front Wheel Speed Sensor Circuit Open

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Front Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is missing.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Turn the ignition switch off.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_OPEN_FRONT_RIGHT active?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Turn the ignition switch on.
Using a 12-volt test light connected to battery (+), probe the RF wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Repair the RF wheel speed sensor signal circuit(s) for a short to ground.

No >> • Go to the next step.

Step 4.

Connect a jumper wire between ground and the RF wheel speed sensor signal circuits in the ABS module harness connector.
Using a 12-volt test light connected to battery (+), probe the RF wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Go to the next step.

No >> • Repair the RF wheel speed sensor signal circuit(s) for an open.

Step 5.

Replace the RF wheel speed sensor (See Front Wheel Speed Sensor Removal & Installation in Section 12 Brakes).

WARNING!

To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_OPEN_FRONT_RIGHT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0003: Left Rear Wheel Speed Sensor Circuit Open

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Rear Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is missing.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Turn the ignition switch off.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_OPEN_REAR_LEFT active?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Turn the ignition switch on.
Using a 12-volt test light connected to battery (+), probe the LR wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Repair the LR wheel speed sensor signal circuit(s) for a short to ground.

No >> • Go to the next step.

Step 4.

Connect a jumper wire between ground and the LR wheel speed sensor signal circuits in the ABS module harness connector.
Using a 12-volt test light connected to battery (+), probe the LR wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Go to the next step.

No >> • Repair the LR wheel speed sensor signal circuit(s) for an open.

Step 5.

Replace the LR wheel speed sensor (See Rear Wheel Speed Sensor Removal & Installation in Section 12 Brakes).

WARNING!

To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_OPEN_REAR_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0004: Right Rear Wheel Speed Sensor Circuit Open

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Rear Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is missing.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Turn the ignition switch off.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_OPEN_REAR_RIGHT active?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Turn the ignition switch on.
Using a 12-volt test light connected to battery (+), probe the RR wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Repair the RR wheel speed sensor signal circuit(s) for a short to ground.

No >> • Go to the next step.

Step 4.

Connect a jumper wire between ground and the RR wheel speed sensor signal circuits in the ABS module harness connector.
Using a 12-volt test light connected to battery (+), probe the RR wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Go to the next step.

No >> • Repair the RR wheel speed sensor signal circuit(s) for an open.

Step 5.

Replace the RR wheel speed sensor (See Rear Wheel Speed Sensor Removal & Installation in Section 12 Brakes).

WARNING!

To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_OPEN_REAR_RIGHT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0005: Left Front Wheel Speed Sensor Circuit Shorted

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Front Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is shorted to ground or shorted to other circuits.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Turn the ignition switch off.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_SHORT_FRONT_LEFT active?

Yes >>
- Go to the next step.

No >>
- The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >>
- Repair as necessary.

No >>
- Go to the next step.

Step 3.

Turn the ignition switch on.
Using a 12-volt test light connected to battery (+), probe the LF wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Repair the LF wheel speed sensor signal circuit(s) for a short to ground.

No >> • Go to the next step.

Step 4.

Remove 12-volt test light.
Measure the resistance between the LF wheel speed sensor SIG1 circuit and the LF wheel speed sensor SIG2 circuit.

Is the resistance above 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the LF wheel speed sensor SIG1 circuit and the LF wheel speed sensor SIG2 circuit for a short together.

Step 5.

Replace the LF wheel speed sensor (See Front Wheel Speed Sensor Removal & Installation in Section 12 Brakes).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_SHORT_FRONT_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0006: Right Front Wheel Speed Sensor Circuit Shorted

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Front Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is shorted to ground or shorted to other circuits.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Turn the ignition switch off.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_SHORT_FRONT_RIGHT active?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Turn the ignition switch on.
Using a 12-volt test light connected to battery (+), probe the RF wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Repair the RF wheel speed sensor signal circuit(s) for a short to ground.

No >> • Go to the next step.

Step 4.

Remove 12-volt test light.
Measure the resistance between the RF wheel speed sensor SIG1 circuit and the RF wheel speed sensor SIG2 circuit.

Is the resistance above 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the RF wheel speed sensor SIG1 circuit and the RF wheel speed sensor SIG2 circuit for a short together.

Step 5.

Replace the RF wheel speed sensor (See Front Wheel Speed Sensor Removal & Installation in Section 12 Brakes).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_SHORT_FRONT_RIGHT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0007: Left Rear Wheel Speed Sensor Circuit Shorted

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Rear Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is shorted to ground or shorted to other circuits.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Turn the ignition switch off.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_SHORT_REAR_LEFT active?

Yes >>
- Go to the next step.

No >>
- The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >>
- Repair as necessary.

No >>
- Go to the next step.

Step 3.

Turn the ignition switch on.
Using a 12-volt test light connected to battery (+), probe the LR wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Repair the LR wheel speed sensor signal circuit(s) for a short to ground.

No >> • Go to the next step.

Step 4.

Remove 12-volt test light.
Measure the resistance between the LR wheel speed sensor SIG1 circuit and the LR wheel speed sensor SIG2 circuit.

Is the resistance above 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the LR wheel speed sensor SIG1 circuit and the LR wheel speed sensor SIG2 circuit for a short together.

Step 5.

Replace the LR wheel speed sensor (See Rear Wheel Speed Sensor Removal & Installation in Section 12 Brakes).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_SHORT_REAR_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0008: Right Rear Wheel Speed Sensor Circuit Shorted

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Rear Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is shorted to ground or shorted to other circuits.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Turn the ignition switch off.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_SHORT_REAR_RIGHT active?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Turn the ignition switch on.
Using a 12-volt test light connected to battery (+), probe the RR wheel speed sensor signal circuits.

Does the test light illuminate brightly?

Yes >> • Repair the RR wheel speed sensor signal circuit(s) for a short to ground.

No >> • Go to the next step.

Step 4.

Remove 12-volt test light.
Measure the resistance between the RR wheel speed sensor SIG1 circuit and the RR wheel speed sensor SIG2 circuit.

Is the resistance above 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the RR wheel speed sensor SIG1 circuit and the RR wheel speed sensor SIG2 circuit for a short together.

Step 5.

Replace the RR wheel speed sensor (See Rear Wheel Speed Sensor Removal & Installation in Section 12 Brakes).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_SHORT_REAR_RIGHT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0009: Left Front Wheel Speed Sensor Signal Missing

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Front Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is missing.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.
- If any Left Front Wheel Speed Sensor circuit DTCs are present, they must be repaired before continuing.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

Does the scan tool display: WSS_MISSING_FRONT_LEFT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the scan tool select: View ABS Data Stream.

Start the engine.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Slowly accelerate as straight as possible from a stop.

Is the LF wheel speed sensor speed showing 0 km/h (0 mph) or showing missing?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Inspect the LF wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.

Replace the LF wheel bearing assembly (See Front Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.

Road test the vehicle over 40 km/h (25 mph).

NOTE :

Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.

With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_MISSING_FRONT_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.

• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0010: Right Front Wheel Speed Sensor Signal Missing

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Front Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is missing.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.
- If any Right Front Wheel Speed Sensor circuit DTCs are present, they must be repaired before continuing.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

Does the scan tool display: WSS_MISSING_FRONT_RIGHT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the scan tool select: View ABS Data Stream.

Start the engine.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Slowly accelerate as straight as possible from a stop.

Is the RF wheel speed sensor speed showing 0 km/h (0 mph) or showing missing?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Inspect the RF wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.

Replace the RF wheel bearing assembly (See Front Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.

Road test the vehicle over 40 km/h (25 mph).

NOTE :

Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.

With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_MISSING_FRONT_RIGHT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.

• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0011: Left Rear Wheel Speed Sensor Signal Missing

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Rear Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is missing.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.
- If any Left Rear Wheel Speed Sensor circuit DTCs are present, they must be repaired before continuing.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

Does the scan tool display: WSS_MISSING_REAR_LEFT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the scan tool select: View ABS Data Stream.

Start the engine.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Slowly accelerate as straight as possible from a stop.

Is the LR wheel speed sensor speed showing 0 km/h (0 mph) or showing missing?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Inspect the LR wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.

Replace the LR wheel bearing assembly (See Rear Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.

Road test the vehicle over 40 km/h (25 mph).

NOTE :

Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.

With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_MISSING_REAR_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.

• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0012: Right Rear Wheel Speed Sensor Signal Missing

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Rear Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is missing.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.
- If any Right Rear Wheel Speed Sensor circuit DTCs are present, they must be repaired before continuing.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

Does the scan tool display: WSS_MISSING_REAR_RIGHT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the scan tool select: View ABS Data Stream.

Start the engine.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Slowly accelerate as straight as possible from a stop.

Is the RR wheel speed sensor speed showing 0 km/h (0 mph) or showing missing?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Inspect the RR wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.

Replace the RR wheel bearing assembly (See Rear Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.

Road test the vehicle over 40 km/h (25 mph).

NOTE :

Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.

With the X-431 scan tool, read ABS DTCs.

Did DTC: WSS_MISSING_REAR_RIGHT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.

• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0013: Left Front Wheel Speed Sensor Signal Erratic

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Front Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is intermittently missing while vehicle speed is above 40 km/h (25 mph), or erratic wheel speed signal during acceleration, or sensed wheel speed is different from other wheels.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

NOTE :
If DTC wheel speed sensor_OPEN_FRONT_LEFT or wheel speed sensor_SHORT_FRONT_LEFT is present it must be repaired before continuing.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

Does the scan tool display: WSS_ERRATIC_FRONT_LEFT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the scan tool select: View ABS Data Stream.

Start the engine.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Slowly accelerate as straight as possible from a stop.

Is the LF wheel speed sensor speed showing 0 km/h (0 mph) or showing missing?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.
Check and adjust the tire pressure in the Left Front tire (check for a slow leak).
Check and adjust all other tire pressures.
Inspect for mismatched tires on the vehicle.

Is the LF tire improperly inflated or mismatched tires on the vehicle?

Yes >> • Repair the Left Front tire as necessary.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Inspect the LF wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.
Replace the LF wheel bearing assembly (See Front Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!

To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC: WSS_ERRATIC_FRONT_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0014: Right Front Wheel Speed Sensor Signal Erratic

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Front Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is intermittently missing while vehicle speed is above 40 km/h (25 mph), or erratic wheel speed signal during acceleration, or sensed wheel speed is different from other wheels.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

NOTE :
If DTC wheel speed sensor_OPEN_FRONT_RIGHT or wheel speed sensor_SHORT_FRONT_RIGHT is present it must be repaired before continuing.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

Does the scan tool display: WSS_ERRATIC_FRONT_RIGHT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the scan tool select: View ABS Data Stream.

Start the engine.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Slowly accelerate as straight as possible from a stop.

Is the RF wheel speed sensor speed showing 0 km/h (0 mph) or showing missing?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.
Check and adjust the tire pressure in the Right Front tire (check for a slow leak).
Check and adjust all other tire pressures.
Inspect for mismatched tires on the vehicle.

Is the RF tire improperly inflated or mismatched tires on the vehicle?

Yes >> • Repair the Right Front tire as necessary.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Inspect the RF wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.
Replace the RF wheel bearing assembly (See Front Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!

To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC WSS_ERRATIC_FRONT_RIGHT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0015: Left Rear Wheel Speed Sensor Signal Erratic

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Rear Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is intermittently missing while vehicle speed is above 40 km/h (25 mph), or erratic wheel speed signal during acceleration, or sensed wheel speed is different from other wheels.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

NOTE :
If DTC wheel speed sensor_OPEN_REAR_LEFT or wheel speed sensor_SHORT_REAR_LEFT is present it must be repaired before continuing.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

Does the scan tool display: WSS_ERRATIC_REAR_LEFT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the scan tool select: View ABS Data Stream.

Start the engine.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Front Wheel Speed.
- Right Rear Wheel Speed.

Slowly accelerate as straight as possible from a stop.

Is the LR wheel speed sensor speed showing 0 km/h (0 mph) or showing missing?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.
Check and adjust the tire pressure in the Left Rear tire (check for a slow leak).
Check and adjust all other tire pressures.
Inspect for mismatched tires on the vehicle.

Is the LR tire improperly inflated or mismatched tires on the vehicle?

Yes >> • Repair the Left Rear tire as necessary.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Inspect the LR wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.
Replace the LR wheel bearing assembly (See Rear Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!

To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC: WSS_ERRATIC_REAR_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0016: Right Rear Wheel Speed Sensor Signal Erratic

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Rear Wheel Speed Sensor input signal to the Antilock Brake System (ABS) module is intermittently missing while vehicle speed is above 40 km/h (25 mph), or erratic wheel speed signal during acceleration, or sensed wheel speed is different from other wheels.

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

NOTE :
If DTC wheel speed sensor_OPEN_REAR_RIGHT or wheel speed sensor_SHORT_REAR_RIGHT is present it must be repaired before continuing.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool select: View ABS Data Stream.

Does the scan tool display: WSS_ERRATIC_REAR_LEFT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the scan tool select: View ABS Data Stream.

Start the engine.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Front Wheel Speed.
- Right Rear Wheel Speed.

Slowly accelerate as straight as possible from a stop.

Is the RR wheel speed sensor speed showing 0 km/h (0 mph) or showing missing?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.
Check and adjust the tire pressure in the Right Rear tire (check for a slow leak).
Check and adjust all other tire pressures.
Inspect for mismatched tires on the vehicle.

Is the RR tire improperly inflated or mismatched tires on the vehicle?

Yes >> • Repair the Right Rear tire as necessary.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Inspect the RR wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.
Replace the RR wheel bearing assembly (See Front Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!

To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC: WSS_ERRATIC_REAR_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0017: Left Front Wheel Speed Sensor Signal Dropout

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Front Wheel Speed Sensor signal drops out while vehicle speed is above 40 km/h (25 mph).

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_DROPOUT_FRONT_LEFT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the X-431 scan tool select: View ABS data stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Is the LF wheel speed sensor speed showing 0 km/h (0 mph) or showing dropout behavior?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.
- Inspect the wheel speed sensor two signal circuits between the wheel speed sensor and ABS module for open, short to ground, short to voltage or short together.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Inspect the LF wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.
Replace the LF wheel bearing assembly (See Front Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC: WSS_DROPOUT_FRONT_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0018: Right Front Wheel Speed Sensor Signal Dropout

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Front Wheel Speed Sensor signal drops out while vehicle speed is above 40 km/h (25 mph).

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_DROPOUT_FRONT_RIGHT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the X-431 scan tool select: View ABS data stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Is the RF wheel speed sensor speed showing 0 km/h (0 mph) or showing dropout behavior?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.
- Inspect the wheel speed sensor two signal circuits between the wheel speed sensor and ABS module for open, short to ground, short to voltage or short together.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Inspect the RF wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.
Replace the RF wheel bearing assembly (See Front Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC: WSS_DROPOUT_FRONT_RIGHT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0019: Left Rear Wheel Speed Sensor Signal Dropout

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Left Rear Wheel Speed Sensor signal drops out while vehicle speed is above 40 km/h (25 mph).

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_DROPOUT_REAR_LEFT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the X-431 scan tool select: View ABS Data Stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Is the LR wheel speed sensor speed showing 0 km/h (0 mph) or showing dropout behavior?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.
- Inspect the wheel speed sensor two signal circuits between the wheel speed sensor and ABS module for open, short to ground, short to voltage or short together.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Remove the LR wheel speed sensor (See Rear Wheel Speed Sensor Removal & Installation in Section 12 Brakes).
Inspect the LR wheel speed sensor for the following:

- Check and remove any metallic material around the speed sensor tip.
- Check and replace the pole piece if it is damaged.
- The circuit should be open between terminals (1) and (2) and the body of the wheel speed sensor. If the circuit is not open, replace with a new wheel speed sensor.
- Check the wheel speed sensor circuit for an open, damage or disconnection.

Were there any problems found?

Yes >>
- If there is metallic material on the speed sensor tip, remove the foreign material.
- If the pole piece is damaged, replace sensor and hub assembly.
- If the internal resistance of the wheel speed sensor is not within the standard specification, replace the wheel speed sensor.

No >>
- Go to the next step.

Step 5.

Inspect for mismatched tires on the vehicle.

Are the tires mismatched?

Yes >>
- Repair as necessary.

No >>
- Go to the next step.

Step 6.

Disassemble the rear wheel bearing assembly (See Rear Hub and Bearing Removal & Installation in Section 09 Axle).
Inspect the LR Tone Wheel for damage, missing teeth, cracks, corrosion or looseness.

NOTE :
The tone wheel teeth should be perfectly square, not bent, or nicked.

Is the LR Tone Wheel damaged?

Yes >>
- Repair the LR tone wheel as necessary.

No >>
- Go to the next step.

Step 7.

Inspect the LR wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.
Replace the LR wheel bearing assembly (See Rear Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC: WSS_DROPOUT_REAR_LEFT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

C0020: Right Rear Wheel Speed Sensor Signal Dropout

- **When Monitored:** With the vehicle speed above 40 km/h (25 mph).
- **Set Condition:** When the Right Rear Wheel Speed Sensor signal drops out while vehicle speed is above 40 km/h (25 mph).

NOTE :
- This DTC must be active for the results of this test to be valid.
- Before connecting or disconnecting the X-431 scan tool, turn the ignition switch to the OFF position.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.

Turn the ignition switch on.

With the scan tool, record and erase stored DTCs in the ABS module.

Cycle the ignition switch from off to on.

Start the engine. With the scan tool connected to the DLC, drive the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the scan tool, read active DTCs in the ABS module.

Does the scan tool display: WSS_DROPOUT_REAR_RIGHT active?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the X-431 scan tool select: View ABS data stream.

With an assistant driving the vehicle, check the following data stream list items while driving the vehicle over 40 km/h (25 mph).

- Left Front Wheel Speed.
- Right Front Wheel Speed.
- Left Rear Wheel Speed.
- Right Rear Wheel Speed.

Is the RR wheel speed sensor speed showing 0 km/h (0 mph) or showing dropout behavior?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time.
- See Diagnostic Help in Section 12 Brakes for more information on Intermittent DTC Troubleshooting.
- Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Turn the ignition switch off.

Disconnect the ABS module electrical connector and disconnect the wheel speed sensor electrical connector, and inspect the following:

- Inspect the ABS module and wheel speed sensor harness and electrical connector terminals for broken, bent, pushed out, or corroded terminals.
- Inspect the wheel speed sensor for looseness or excessive corrosion.
- Inspect the wheel speed sensor two signal circuits between the wheel speed sensor and ABS module for open, short to ground, short to voltage or short together.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Remove the RR wheel speed sensor (See Rear Wheel Speed Sensor Removal & Installation in Section 12 Brakes).
Inspect the RR wheel speed sensor for the following:

- Check and remove any metallic material around the speed sensor tip.
- Check and replace the pole piece if it is damaged.
- The circuit should be open between terminals (1) and (2) and the body of the wheel speed sensor. If the circuit is not open, replace with a new wheel speed sensor.
- Check the wheel speed sensor circuit for an open, damage or disconnection.

Were there any problems found?

Yes >>
- If there is metallic material on the speed sensor tip, remove the foreign material.
- If the pole piece is damaged, replace sensor and hub assembly.
- If the internal resistance of the wheel speed sensor is not within the standard specification, replace the wheel speed sensor.

No >>
- Go to the next step.

Step 5.

Inspect for mismatched tires on the vehicle.

Are the tires mismatched?

Yes >>
- Repair as necessary.

No >>
- Go to the next step.

Step 6.

Disassemble the rear wheel bearing assembly (See Rear Hub and Bearing Removal & Installation in Section 09 Axle).
Inspect the RR Tone Wheel for damage, missing teeth, cracks, corrosion or looseness.

NOTE :
The tone wheel teeth should be perfectly square, not bent, or nicked.

Is the RR Tone Wheel damaged?

Yes >>
- Repair the RR tone wheel as necessary.

No >>
- Go to the next step.

Step 7.

Inspect the RR wheel bearing for excessive runout or clearance before replacing the wheel bearing assembly.
Replace the RR wheel bearing assembly (See Rear Hub and Bearing Removal & Installation in Section 09 Axle).

WARNING!
To avoid personal injury or death, verify vehicle braking before road testing.

Connect the module and sensor connectors.
Road test the vehicle over 40 km/h (25 mph).

NOTE :
Vehicle must be driven above 40 km/h (25 mph) for fault setting conditions to be met.
With the X-431 scan tool, read ABS DTCs.

Did DTC: WSS_DROPOUT_REAR_RIGHT reset?

Yes >> • Replace the ABS module (See ABS Module Removal & Installation in Section 12 Brakes).

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

ON-VEHICLE SERVICE

Antilock Brake System (ABS) Bleeding Procedure

ABS Bleeding Information

WARNING!

When bleeding the brake system, wear safety glasses. A clear bleed tube must be attached to the bleeder screws and submerged in a clear container filled partially with clean brake fluid. Direct the flow of brake fluid away from yourself and the painted surfaces of the vehicle. Brake fluid at high pressure may come out of the bleeder screws when opened.

CAUTION:
Before removing the master cylinder cap, wipe it clean to prevent dirt and other foreign matter from dropping into the master cylinder reservoir. Use brake fluid or an equivalent from a fresh, tightly sealed container. Brake fluid must conform to DOT 4 specifications.

NOTE :
During the brake bleeding procedure, be sure the brake fluid level remains close to the ″MAX″ level in the master cylinder fluid reservoir. Check the fluid level periodically during the bleeding procedure and add brake fluid as required.

NOTE :
Do not pump the brake pedal at any time while having a bleeder screw open during the bleeding process. This will only increase the amount of air in the system and make additional bleeding necessary. Do not allow the master cylinder reservoir to run out of brake fluid while bleeding the system. An empty reservoir will allow additional air into the brake system. Check the fluid level frequently and add fluid as needed. The following wheel circuit sequence for bleeding the brake hydraulic system should be used to ensure adequate removal of all trapped air from the hydraulic system.

ABS Bleeding Instructions

When bleeding the ABS system, the following bleeding sequence must be followed to insure complete and adequate bleeding:

1. Make sure all hydraulic fluid lines are installed and properly torqued.
2. Connect the X-431 scan tool to the diagnostics connector.
3. Using the scan tool, check to make sure the ABS module does not have any fault codes stored. If it does, clear them.
4. Bleed the base brake system.

NOTE :
Pressure bleeding is recommended to bleed the base brake system to ensure all air is removed from the brake system.

5. Using the scan tool, access ABS bleeding. Follow the instructions displayed. When finished, disconnect the scan tool and proceed.
6. Bleed the base brake system a second time. Check brake fluid level in the reservoir periodically to prevent emptying, causing air to enter the hydraulic system.
7. Fill the master cylinder fluid reservoir to the ″MAX″ level.
8. Test drive the vehicle to be sure the brakes are operating correctly and that the brake pedal does not feel spongy.

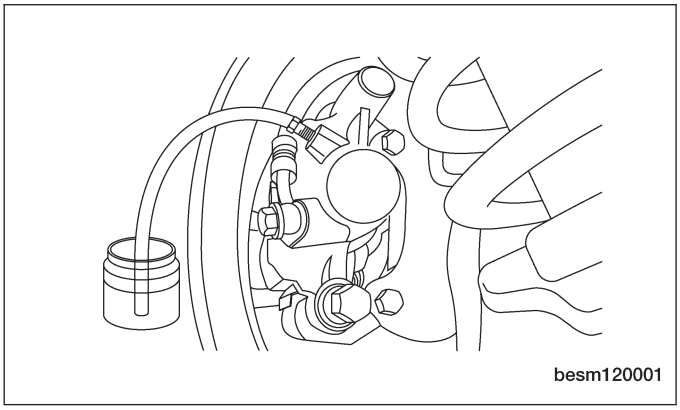
Manual Bleeding Instructions

NOTE :
To bleed the brakes manually, the aid of a helper will be required.

Fill the brake master cylinder reservoir to the proper level with brake fluid.

NOTE :
Never allow the brake master cylinder to empty of brake fluid while bleeding the brake system.

Attach a clear plastic hose to the bleeder screw and feed the hose into a clear jar containing enough fresh brake fluid to submerge the end of the hose.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1. Turn the ignition switch off.
2. Have a helper pump the brake pedal three or four times and hold it in the down position.
3. With the pedal in the down position, open the bleeder screw at least one full turn.
4. Once the brake pedal has dropped, close the bleeder screw. After the bleeder screw is closed, release the brake pedal.
5. Repeat the above steps until all trapped air is removed from that wheel circuit (usually four or five times).
6. Bleed the remaining wheel circuits in the same manner until all air is removed from the brake system. Monitor the fluid level in the master cylinder reservoir to make sure it does not go dry.
7. Check and adjust brake fluid level to the ″MAX″ mark.
8. Check the brake pedal travel. If pedal travel is excessive or has not been improved, some air may still be trapped in the system. Re-bleed the brakes as necessary.
9. Test drive the vehicle to verify the brakes are operating properly and pedal feel is correct.

Pressure Bleeding Instructions

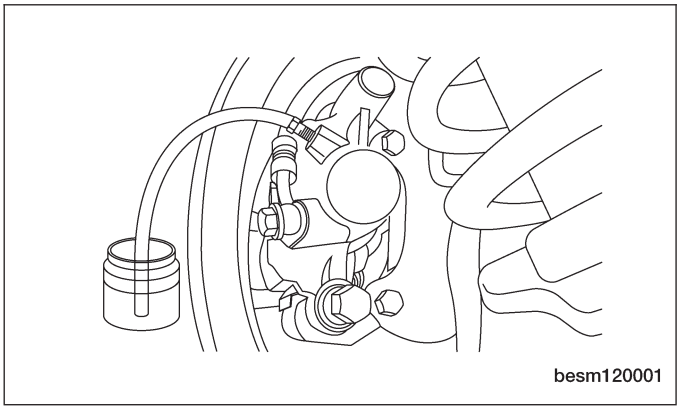
NOTE :
Follow pressure bleeder manufacturer's instructions for use of pressure bleeding equipment.

Fill the brake master cylinder reservoir to the proper level with brake fluid.

Attach the pressure bleeding equipment to the master cylinder.

NOTE :
Never allow the brake master cylinder to empty of brake fluid while bleeding the brake system.

Attach a clear plastic hose to the bleeder screw and feed the hose into a clear jar containing enough fresh brake fluid to submerge the end of the hose.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1. Turn the ignition switch off.
2. Open the bleeder screw at least one full turn or more to obtain a steady stream of brake fluid.
3. After approximately 120–240 ml of fluid have been bled through the brake circuit and an air-free flow is maintained in the clear plastic hose and jar, close the bleeder screw.
4. Repeat this procedure at all the remaining bleeder screws.
5. Check and adjust brake fluid level to the ″MAX″ mark on the reservoir.

6. Check the brake pedal travel. If pedal travel is excessive or has not been improved, some air may still be trapped in the system. Re-bleed the brakes as necessary.
7. Test drive the vehicle to verify the brakes are operating properly and pedal feel is correct.

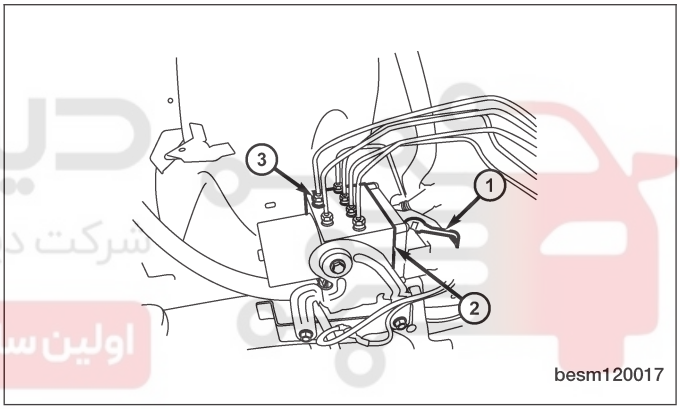
Antilock Brake System (ABS) Module

Removal & Installation

NOTE :
The following special tools are required to perform the repair procedure:
- Diagnostic Scan Tool X-431

NOTE :
The ABS module is comprised of the Hydraulic Control Unit (HCU) and the Electronic Control Unit (ECU). These are serviced as a complete unit and cannot be serviced separately.

1. Disconnect the negative battery cable.
2. Turn the ignition switch off.
3. Using a brake pedal holding tool, depress the brake pedal past its first 25 mm of travel and hold it in this position. This will isolate the master cylinder from the brake hydraulic system and will not allow the brake fluid to drain out of the master cylinder reservoir while the lines are disconnected.
4. Remove the brake tubes (3) at the hydraulic control unit.
   (Tighten: Brake tube nuts to 10 N·m)
5. Disconnect the ABS module electrical connector (1).
6. Remove the mounting bolts attaching the HCU (2) mounting bracket to vehicle.
   (Tighten: ABS mounting bracket bolts to 20 N·m)



7. Position the brake tubes as necessary without bending them.
8. Remove the ABS HCU from vehicle.
9. Remove the ABS mounting bolts and mounting bracket as necessary.
   (Tighten: ABS mounting bolts to 10 N·m)
10. Installation is in the reverse order of removal.

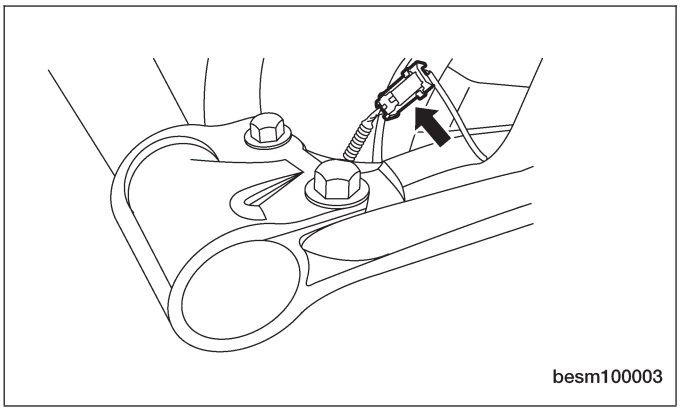
Installation Notes:
- After installation connect the X-431 scan tool to initialize the ABS module and bleed the brake system (See Antilock Brake System (ABS) Bleeding Procedure in Section 12 Brakes).

Front Wheel Speed Sensor

Removal & Installation

1. Disconnect the negative battery cable.
2. Raise and support the vehicle.
3. Remove the wheel mounting nuts and the tire and wheel assembly.
   (Tighten: Wheel mounting nuts to 110 N·m)

4. Disconnect the wheel speed sensor electrical connector.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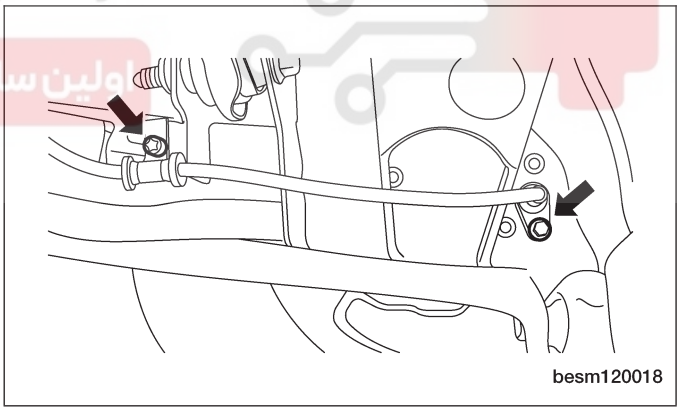
5. Remove the front hub and bearing assembly (See Front Hub and Bearing (ABS) Removal & Installation in Section 09 Axle).
6. Remove the front wheel speed sensor.
   NOTE: The front wheel speed sensor is integrated into the front hub and bearing assembly as a one piece sealed unit.

Rear Wheel Speed Sensor

Removal & Installation

1. Disconnect the negative battery cable.
2. Raise and support the vehicle.
3. Remove the wheel mounting nuts and the tire and wheel assembly.
   (Tighten: Wheel mounting nuts to 110 N·m)
4. Disconnect the rear wheel speed sensor electrical connector.
5. Remove the rear wheel speed sensor mounting bolts.
   (Tighten: Rear wheel speed sensor mounting bolts to 10 N·m)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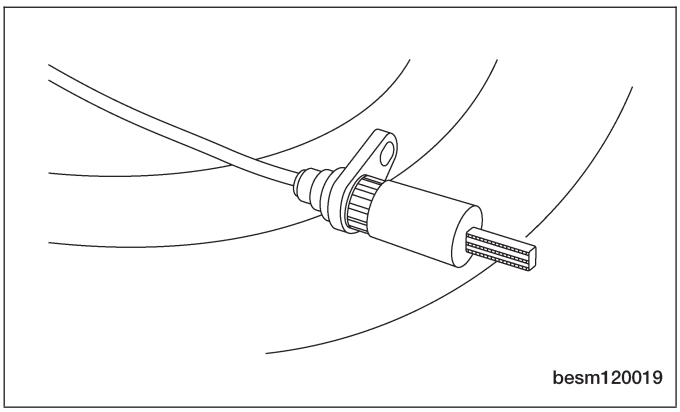
6. Remove the rear wheel speed sensor.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PARKING BRAKE

GENERAL INFORMATION

Description

The parking brakes consist of the following components:
- Hand-operated parking brake lever
- Parking brake cables (one each side)
- Parking brake controls

Operation

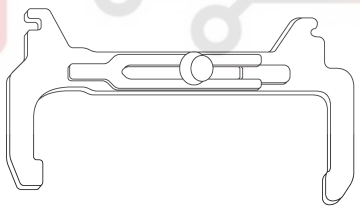
All vehicles are equipped with a center-mounted, hand-operated parking brake lever mounted between the front seats. A tensioner is built into the equalizer mounted on the end of the lever's output cable. There is an individual parking brake cable for each rear wheel that joins a parking brake cable equalizer, attached to the parking brake lever, to the rear parking brakes. The parking brake cables are made of flexible steel cable.

Specifications

Torque Specifications

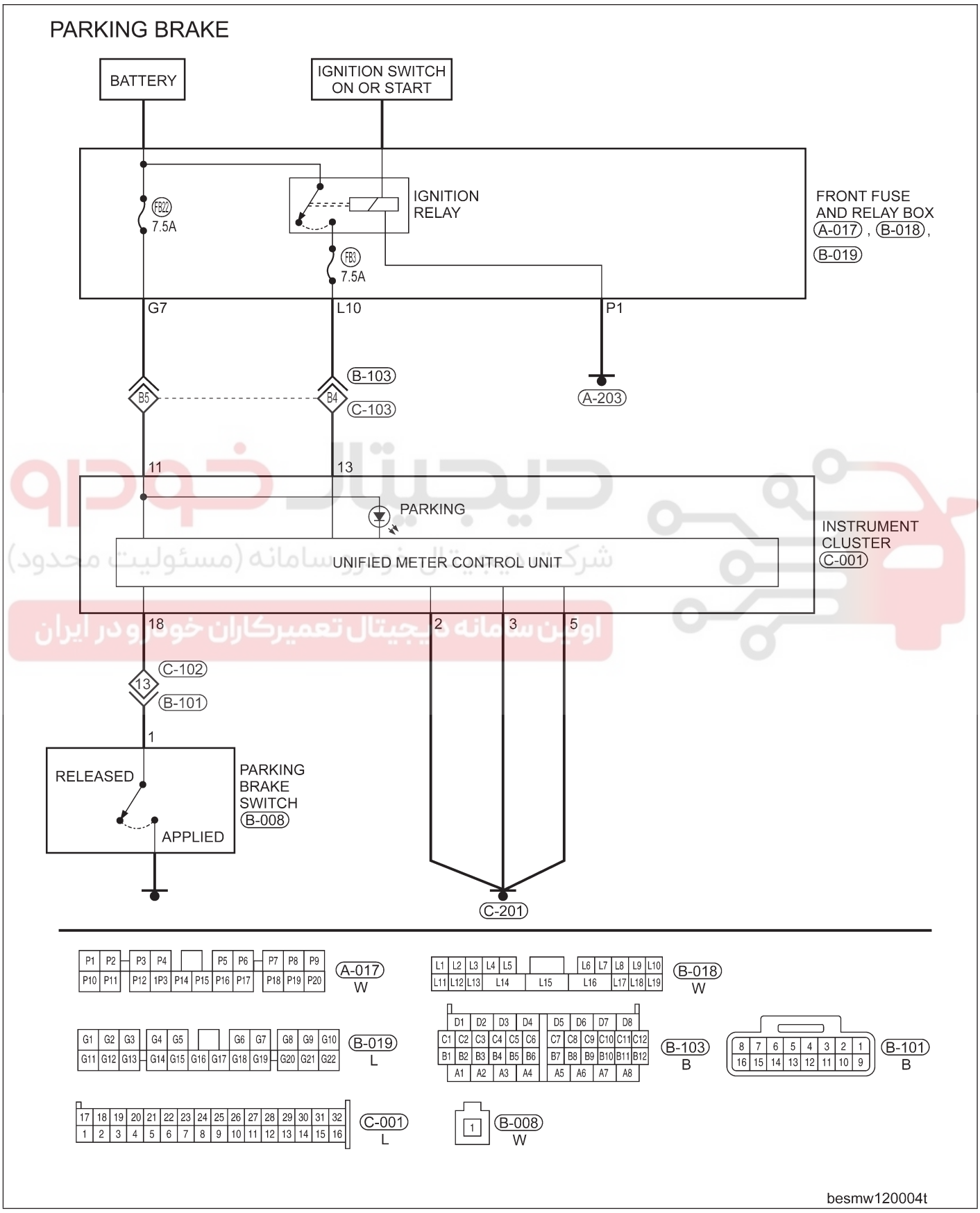
DESCRIPTION	TORQUE (N·m)
Parking Brake Cable Routing Clamp Bolt	12
Parking Brake Cable Bracket Bolts	12
Parking Brake Lever Nuts	30
Wheel Mounting Nuts	110

Special Tools

Brake Measuring Gauge	 besm120025

Electrical Schematics

Parking Brake System (Page 1 of 1)



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DIAGNOSIS & TESTING

Parking Brake Warning Light

The parking brake switch is in circuit with the red warning lamp in the dash. The switch will cause the lamp to illuminate only when the parking brakes are applied. If the lamp remains on after parking brake release, the switch or circuit is faulty.

Parking Brake Operation

The leading cause of improper parking brake operation, is excessive clearance between the parking brake shoes and the shoe braking surface. Excessive clearance is a result of lining and/or drum wear, drum surface machined oversize.

In most cases, the actual cause of an improperly functioning parking brake (too loose/too tight/won't hold), can be traced to a parking brake component.

Inspect the following when diagnosing a parking brake problem:

- Brake shoe wear
- Drum surface (in rear rotor) machined oversize
- Front cable not secured to lever
- Rear cable not attached to actuator
- Rear cable seized
- Parking brake lever not seated
- Parking brake lever bind

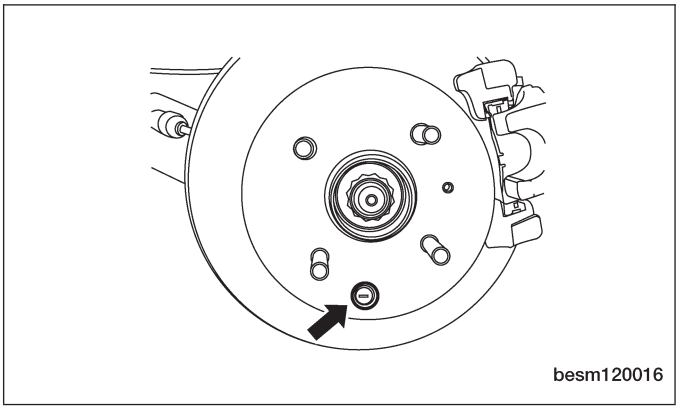
Parking Brake Adjustment

Adjust the parking brake only if the parking brake lever can be pulled up more than 3 notches without having an adequate solid braking effect.

NOTE :

Excessive parking brake lever travel (sometimes described as a loose lever or too loose condition), could be the result of worn brake shoes, improper brake shoe adjustment, or improperly assembled brake parts. A too loose condition can also be caused by inoperative or improperly assembled parking brake components. Always confirm that the parking brake components are assembled properly. Perform the following procedure to adjust the parking brake:

1. Verify the parking brake lever is in the released (down) position.
2. Raise and support the vehicle.
3. Remove the wheel mounting nuts and the rear tire and wheel assemblies.
4. Utilizing the access hole in the rotors, adjust the parking brake shoes.
5. Reach inside the vehicle and fully apply and release the parking brake.
6. With the parking brake lever in the fully applied (up) position, attempt to rotate the rear rotors by hand (to ensure that the parking brake shoes are working properly).
7. With the parking brake lever in the released (down) position, attempt to rotate the rear rotors by hand (to ensure that the parking brake shoes are not dragging).
8. Install both rear tire and wheel assemblies and the wheel mounting nuts.
   (Tighten: Wheel mounting nuts to 110 N·m)
9. Lower the vehicle.

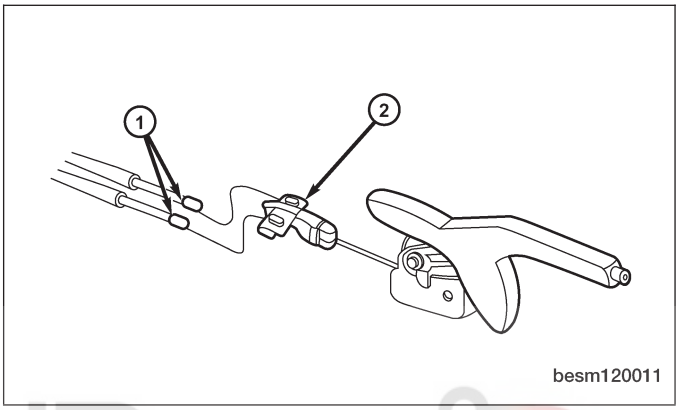


ON-VEHICLE SERVICE

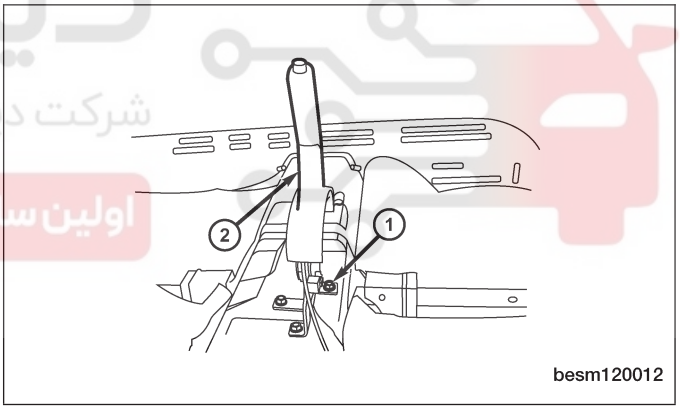
Parking Brake Lever

Removal & Installation

1. Disconnect the negative battery cable.
2. Block the tire and wheel assemblies so the vehicle does not move once the vehicle parking brake lever is released.
3. Remove the center console (See Center Console Removal & Installation in Section 15 Body & Accessories).
4. Release and lower the parking brake lever.
5. Loosen the adjusting nut on the lever's output cable, taking tension off parking brake cables.
6. Back the nut off until it is flush with the end of the output cable.
7. Remove the screws connecting the rear air outlet and bracket.
8. Remove the bolts connecting the bracket and floor plate and remove the bracket.
9. Remove the parking brake cables (1) from the parking brake cable equalizer (2).



10. Disconnect the electrical connector from the parking brake switch.
11. Remove the bolts (1) attaching the parking brake lever to the vehicle.
    (Tighten: Parking brake lever nuts to 30 N·m)
12. Remove the parking brake assembly (2).
13. Installation is in the reverse order of removal.



Installation Notes:

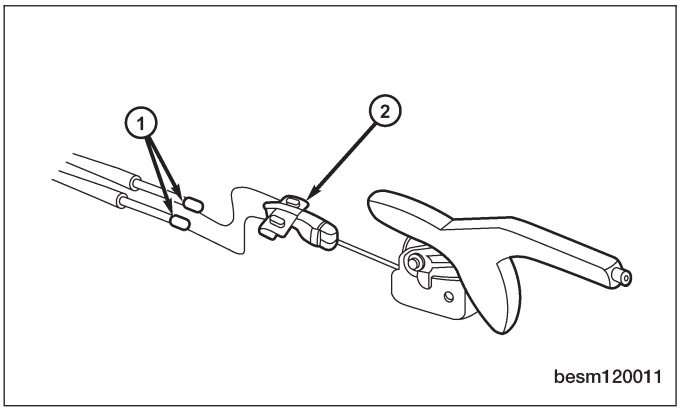
- After installation, adjust the parking brake cable as necessary (See Parking Brake Adjustment in Section 12 Brakes).

Parking Brake Cable

Removal & Installation

1. Disconnect the negative battery cable.
2. Block the tire and wheel assemblies so the vehicle does not move once the vehicle parking brake lever is released.
3. Remove the center console (See Center console Removal & Installation in Section 15 Body & Accessories).
4. Release and lower the parking brake lever.
5. Loosen the adjusting nut on the lever's output cable taking tension off the parking brake cables. Back the nut off until it is flush with the end of the output cable.
6. Remove the screws connecting the rear air outlet and bracket.
7. Remove the bolts connecting bracket and floor plate and remove the bracket.

8. Remove the parking brake cables (1) from the parking brake cable equalizer (2).
9. Fold the rear carpeting forward to expose the parking brake cables at the end of the rear floor.
10. Remove the bolts connecting the parking brake cable bracket and floor plate, and remove the cable from the bracket.
    (Tighten: Parking brake cable bracket bolts to 12 N·m)
11. Raise and support the vehicle.
12. Remove the rear wheel mounting nuts and both rear tire and wheel assemblies.
    (Tighten: Wheel mounting nuts to 110 N·m)
13. Access and remove the parking brake shoes (See Parking Brake Shoes Removal & Installation in Section 12 Brakes).
14. Remove the parking brake cable from brake arm.
15. Pull the parking brake cable from the support plate.



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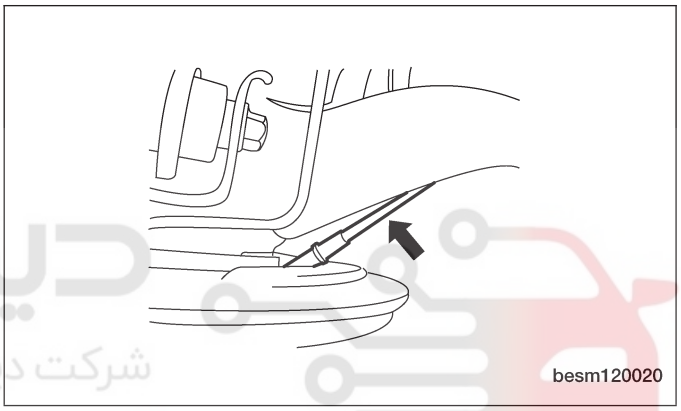
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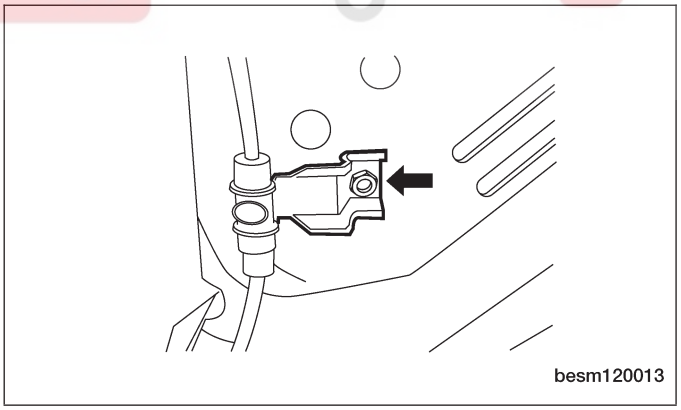
16. Remove the bolt securing the parking brake cable routing clamp to the body.
    (Tighten: Parking brake cable routing clamp bolt to 12 N·m)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17. Remove the parking brake cable with sealing grommet through the hole in the floor pan of the vehicle.
18. Installation is in the reverse order of removal.

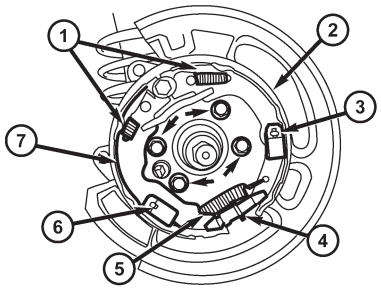
Installation Notes:

- After installation, adjust the parking brake cable as necessary (See Parking Brake Adjustment in Section 12 Brakes).

Parking Brake Shoes

Removal & Installation

1. Raise and support the vehicle.
2. Remove the rear wheel mounting nuts and both rear tire and wheel assemblies. (Tighten: Wheel mounting nuts to 110 N·m)
3. Access and remove rear brake rotor (See Rear Brake Rotor Removal & Installation in Section 12 Brakes).
4. Turn the brake shoe adjuster wheel until the adjuster is at shortest length.
5. Remove the brake shoe hold-down springs (3) and pins (6). Rotate the pins 90° to disengage.
6. Remove the parking brake cable from the arm on the rear parking brake shoe.
7. Remove the brake shoes (2, 7), adjuster (4) and lower return spring (5) as an assembly from the support plate.
8. Remove the lower return spring (5) and adjuster (4) from the shoes (2, 7).
9. Remove the parking brake shoes.



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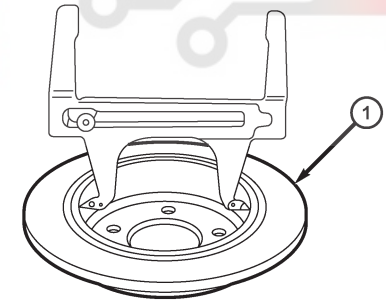
10. Installation is in the reverse order of removal.

Installation Notes:

- Perform the following to measure and adjust parking brake shoes:
  1. Using a brake measuring gauge or equivalent, measure the inside diameter of parking brake drum (1).
  2. Place the brake measuring gauge over the parking brake shoes at their widest point.
  3. Using the adjuster wheel, adjust the parking brake shoes until the linings on both parking brake shoes just touch the jaws on the brake measuring gauge.
- After installation, adjust the parking brake cable as necessary (See Parking Brake Adjustment in Section 12 Brakes).



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