

Disc Brakes

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Bleeder Valve	12 N·m	106 lb in
Brake Caliper Mounting Bracket Bolt	100 N·m	74 lb ft
Brake Hose Bolt	40 N·m	30 lb ft
Caliper Guide Pin Bolt	31 N·m	23 lb ft
Wheel Nut	140 N·m	100 lb ft

Component Specifications

Application	Specification	
	Metric	English
Front Brakes		
Discard Thickness (See Important)	30.7 mm	1.209 in
Maximum Lateral Runout	0.13 mm	0.005 in
Minimum Thickness After Refinish	31.08 mm	1.223 in
Minimum Wear Thickness	31.08 mm	1.223 in
Rotor Thickness (New)	32 mm	1.26 in
Thickness Variation	0.013 mm	0.0005 in
Rear Brakes		
Discard Thickness	24.51 mm	0.965 in
Maximum Lateral Runout	0.15 mm	0.006 in
Minimum Wear Thickness	24.89 mm	0.980 in
Rotor Thickness (New)	25.90 mm	1.020 in
Minimum Thickness After Refinish	24.89 mm	0.980 in
Rear Axle Shaft Flange	0.05 mm	0.002 in
Thickness Variation	0.013 mm	0.0005 in
Important: All brake rotors have a discard dimension cast into the rotor. Replace any rotor that does not meet this specification. After refinishing the rotor, replace any rotor that does not meet the maximum or minimum thickness after refinish specifications.		

GM SPO Group Numbers

Application	GM SPO Group Number
Brake Caliper (Front)	4.000
Brake Caliper (Rear)	4.000
Brake Caliper Bracket (Front)	4.000
Brake Caliper Bracket (Rear)	4.000
Brake Pads (Front)	5.000
Brake Pads (Rear)	5.000
Brake Rotor Front	5.000
Brake Rotor (Rear)	5.000

Diagnostic Information and Procedures

Brake Rotor Thickness Variation Check

Measure the rotor thickness at four or more points around the circumference of the rotor in order to inspect the thickness variation. Use a micrometer calibrated in ten-thousandths of an inch. Inspect each measurement at the same distance from the edge of the rotor.

A rotor that varies in thickness by more than 0.013 mm (0.0005 in) may cause pedal pulsation or front end vibration during brake applications. Refinish or replace a rotor that does not meet the above specifications.

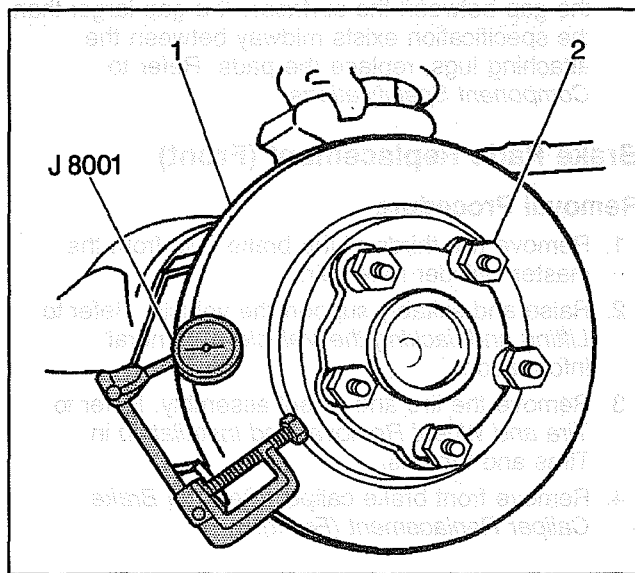
Brake Rotor Lateral Runout Check

Removal Procedure

Tools Required

J 8001 Dial Indicator Set

Notice: Any time the brake rotor is separated from the wheel bearing flange, clean any rust or foreign material from the mating surfaces of the wheel bearing flange and the rotor. Failure to do so can result in increased lateral runout of the rotor and brake pulsation.



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1. Clean the rotor surface (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Reinstall the wheel nuts (2) in order to retain the rotor.

Tighten

Tighten the wheel nuts in a star pattern to 140 N·m (100 lb ft).

3. Fasten the J 8001 to the steering knuckle for front or to the brake mounting flange on the rear axle for rear so that the indicator button contacts the rotor surface about 13 mm (0.5 in) from the rotor edge.
4. Set the J 8001 to zero.

5. Turn the rotor one complete revolution. Inspect the runout indicated on the dial. If the TIR exceeds 0.15 mm (0.006 in), refinish or replace the rotor.

In some cases, excessive lateral runout of the rotor may be improved by indexing the rotor on the hub, one or two bolt positions from the original position. Indexing the rotor requires removal and installation of the front brake caliper. For removal of the front brake rotor, refer to *Brake Rotor Replacement (Front)*. For rear brake rotor replacement, refer to *Brake Rotor Replacement (Rear)*.

If the lateral runout cannot be corrected by indexing the front rotor, inspect the hub and the front wheel bearing for excessive lateral runout or looseness. If the hub lateral runout exceeds 0.040 mm (0.015 in), replace the hub and bearing. If lateral runout of the hub and bearing is within specifications, refinish or replace the rotor as necessary.

If the lateral runout cannot be corrected by indexing the rear rotor, inspect the rear axle shaft flange for excessive lateral runout. If the axle flange lateral runout exceeds 0.040 mm (0.015 in), replace the axle shaft. If lateral runout of the axle flange hub is within specifications, refinish or replace the rotor as necessary.

Brake Rotor Tolerance

Tolerances of the braking surfaces for the following conditions are held closely during the manufacture of the brake rotor:

- Flatness
- Parallelism
- Lateral runout

The maintenance of close tolerances on the shape of the braking surfaces is necessary in order to prevent brake roughness or pulsation. The surface finish must be held to a specified range of a 60 degree radius of roughness or less. A new rotor conforms to the above specifications, as will a correctly refinished rotor. For front brake rotors, refer to *Refinishing Brake Rotors (Front)*. For rear brake rotors, refer to *Refinishing Brake Rotors (Rear)*. Control of the braking surface finish will eliminate the following problems:

- Hard pedal application
- Excessive brake fade
- Pulls
- Erratic performance.

Control of the braking surface finish will improve lining life.

Light scoring of the rotor surfaces not exceeding 1.5 mm (0.060 in) in depth is not detrimental to brake operation. Normal use may cause light scoring.

Repair Instructions

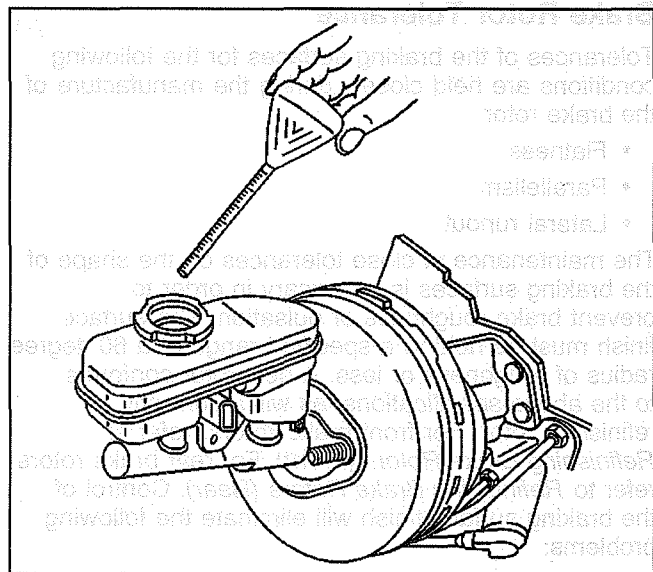
Brake Pad Inspection

- Inspect the disc brake pads every 10,000 km (6,000 miles) and anytime the wheels are removed.
- Inspect both ends of the outer pad by looking in at each end of the caliper. The highest rate of wear normally occurs at the ends.
- Inspect the thickness of the inner pad in order to ensure that it has not worn prematurely. Look through the window in the top of the caliper in order to view the inner pad.
- Both front and rear disc brakes have wear indicators that make a noise when the pads wear below specifications. The wear indicator is an integral part of the outer pad. When the pad is worn the wear indicator contacts the rotor and produces a warning noise as indicated in the illustration above.
- Replace the pads when the thickness is worn below specification. Replace all pads in axle sets. Refer to *Component Specifications*.
- Measure the flatness of the inner and outer pads. Place the pad surfaces together and measure the gap between the surfaces. If a gap larger than the specification exists midway between the attaching lugs, replace the pads. Refer to *Component Specifications*.

Brake Pads Replacement (Front)

Removal Procedure

1. Remove two-thirds of the brake fluid from the master cylinder reservoir.
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
4. Remove front brake caliper. Refer to *Brake Caliper Replacement (Front)*.



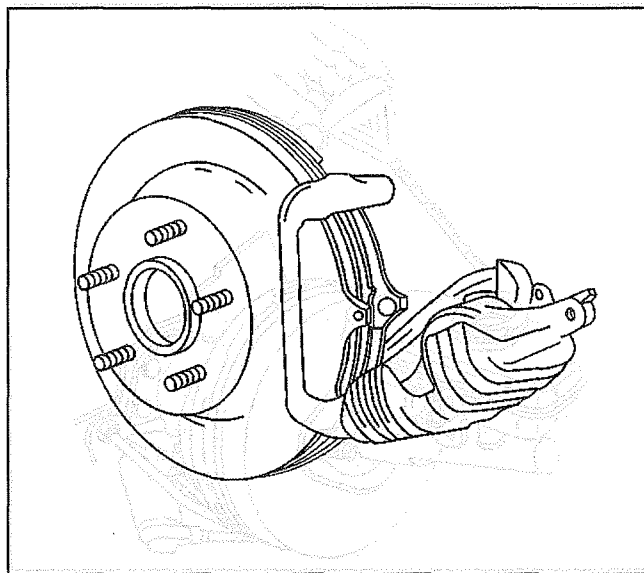
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- Excessive brake fade
- Pulls
- Braking performance

Control of the braking surface (brake) will improve lining life.

Light scoring of the rotor surfaces not exceeding 1.5 mm (0.060 in) depth is not detrimental to brake operation. Normal use may cause light scoring.

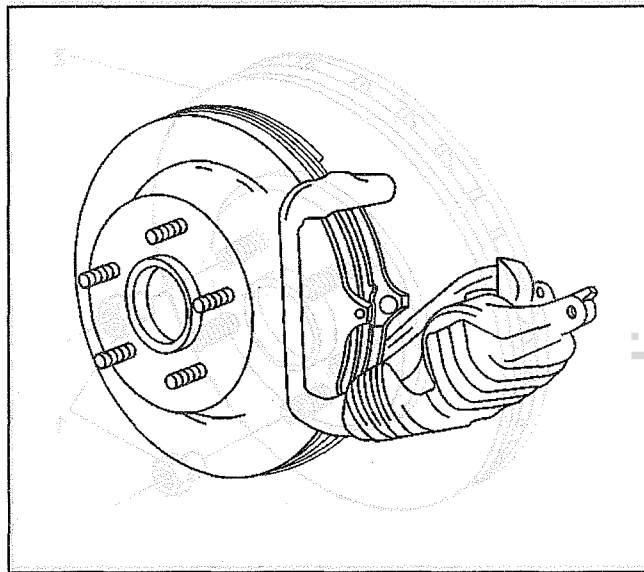
5. Remove the inner and outer brake pads from the caliper mounting plate.
Use a screwdriver if necessary to remove the pads from their installed position.
6. Inspect the caliper guide pins for free movement in the caliper mounting plate.
7. Inspect the caliper guide pin boots for proper seating in the retaining groove of the caliper guide pin and the rear caliper mounting plate.
8. Replace the caliper guide pins and/or guide pin boots if any of the following conditions exist:
 - Excessive Corrosion
 - Excessive Wear
 - Visible Damage



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Installation Procedure

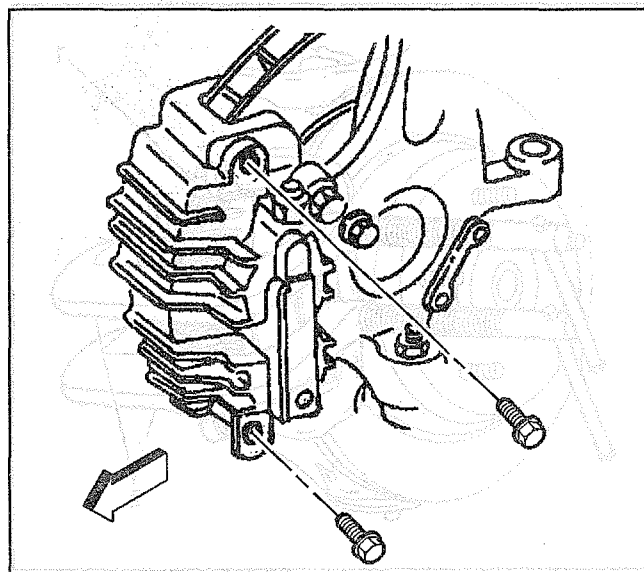
1. Install the inner and outer pads into the caliper mounting plate. Ensure that the wear sensor is at the trailing edge of the outer brake pad when the wheel is rotating forward. If the wear sensor is not at the trailing edge, the outer brake pad is on the wrong side.
2. Install the front brake caliper. Refer to *Brake Caliper Replacement (Front)*.



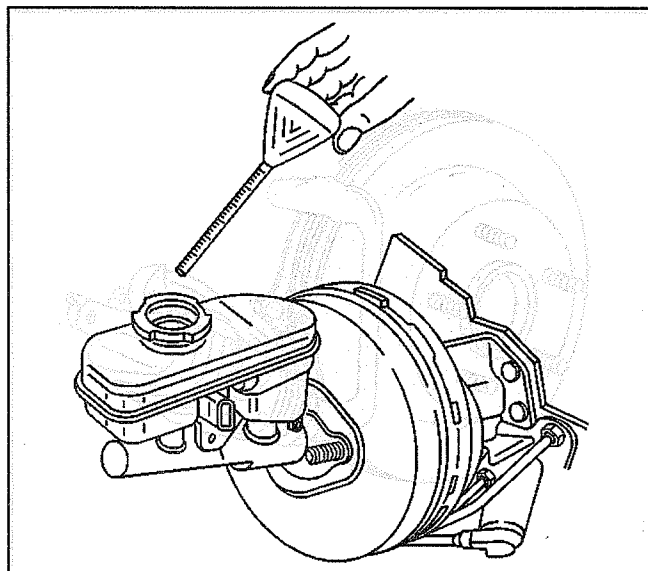
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Notice: Refer to *Fastener Notice* in Cautions and Notices.

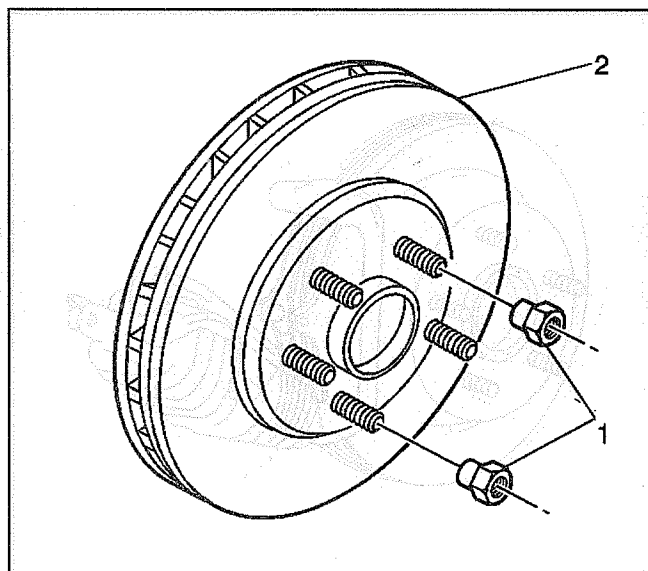
3. Install the caliper mounting pin bolts.
Tighten
Tighten the mounting pin bolts to 31 N·m (23 lb ft).
4. With the engine running, pump the brake pedal slowly and firmly until the inner and outer brake pads are positioned against rotor (firm pedal).
5. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
6. Lower the vehicle.
7. Refill the master cylinder to the proper level with clean, fresh brake fluid.
8. Inspect the hydraulic brake system for brake fluid leaks.
9. Burnish the new pads. Refer to *Burnishing Pads and Rotors*.



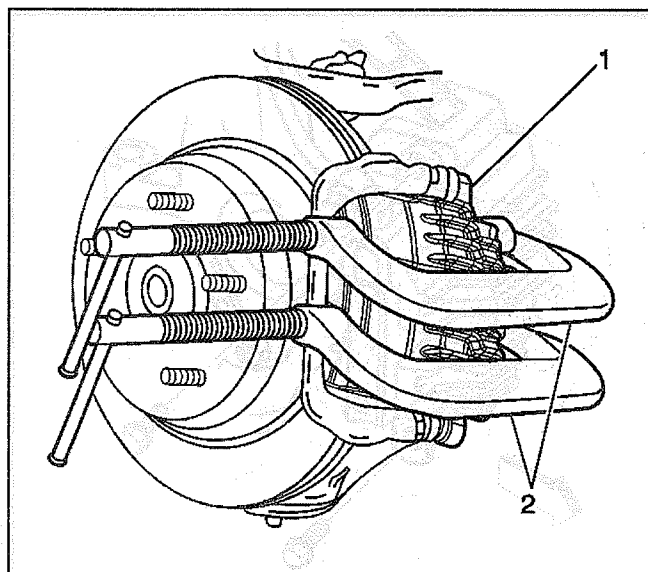
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Brake Pads Replacement (Rear)

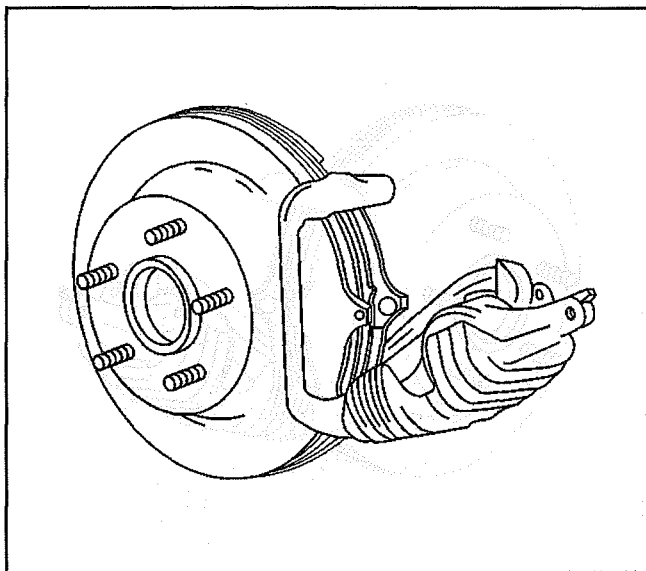
Removal Procedure

1. Remove two-thirds of the brake fluid from the master cylinder.
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation in Tires and Wheels*.

4. Install two wheel nuts (1) in order to retain the rotor (2).

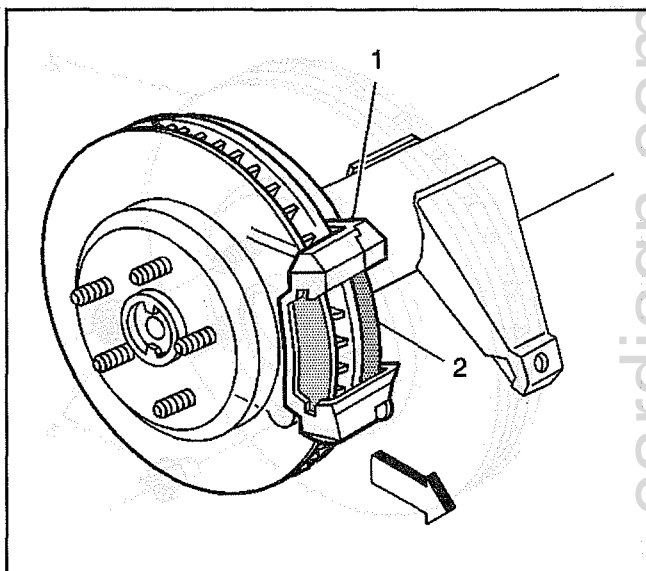
5. Position a C-clamp (2) over the caliper housing (1).
6. Tighten the C-clamp until the caliper piston bottoms in the base of the brake caliper. Verify that one end of the C-clamp rests on the brake hose fitting bolt/screw and the other end rests against the outer pad.

7. Remove the rear brake caliper from the mounting plate. Refer to *Brake Caliper Replacement (Rear)*. Ensure that weight of caliper is adequately supported.



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8. Remove the inner and outer brake pads (2) from the mounting plate (1).
9. Clean all the residue from the shoe guide surfaces on the caliper mounting plate and the rear brake caliper.
10. Inspect the caliper guide pins for free movement in the caliper mounting plate.
11. Inspect the caliper guide pin boot for proper seating in the retaining groove of the guide pin and the caliper mounting plate. Replace the caliper guide pins or the guide pin boots, if corrosion or damage exists. Refer to *Brake Caliper Overhaul (Rear)*.

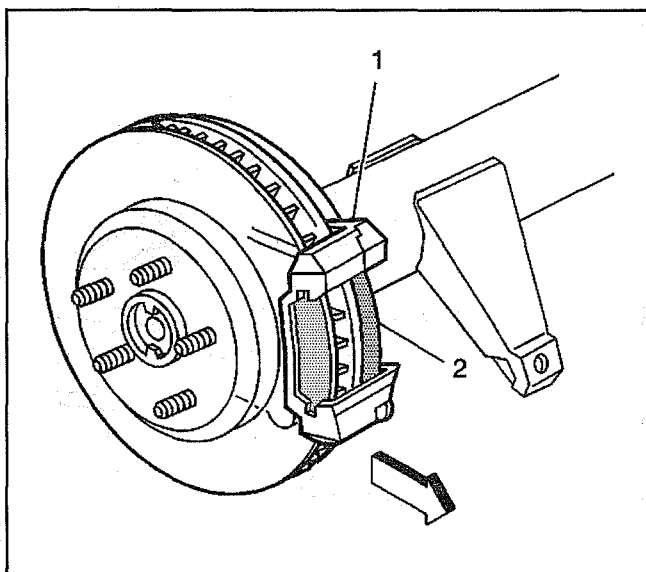


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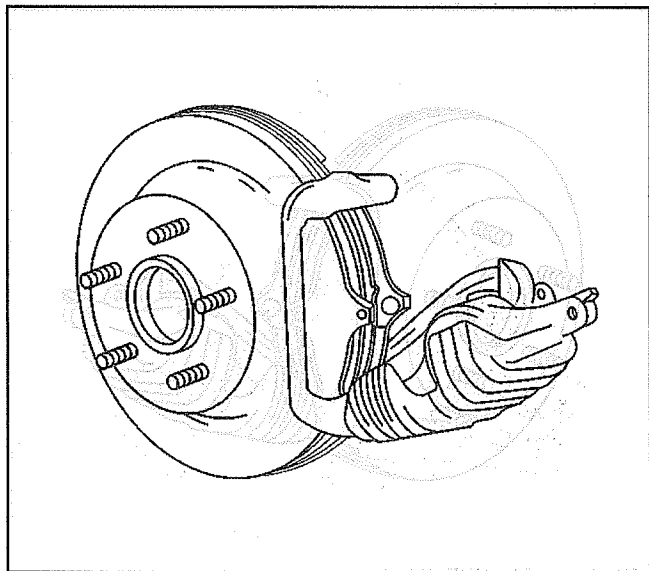
Installation Procedure

Important:

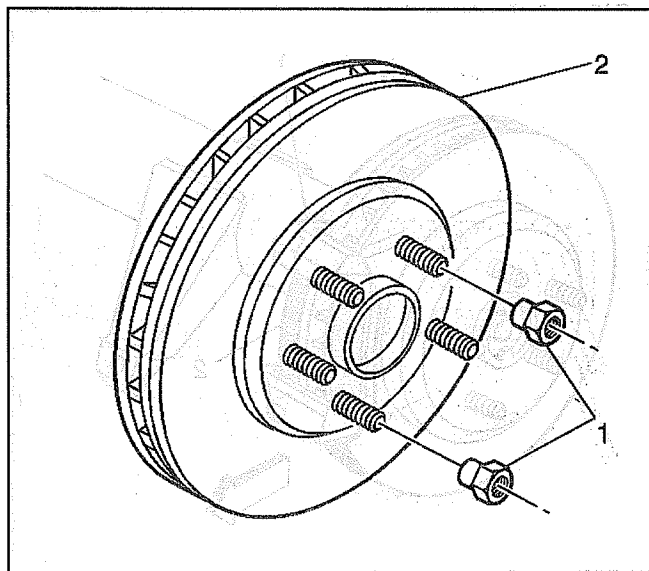
- Install the inner pad with wear sensor near the piston.
 - Ensure that the wear sensor is on the leading edge of the inner pad during forward wheel rotation. If the wear sensor is not on the leading edge, use the other inner pad in the replacement kit.
 - Replace the inner and outer pads in axle sets only.
1. Install new inner and outer pads (2) into mounting plate (1).



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2. Install the rear brake caliper to the mounting plate. Refer to *Brake Caliper Replacement (Rear)*.

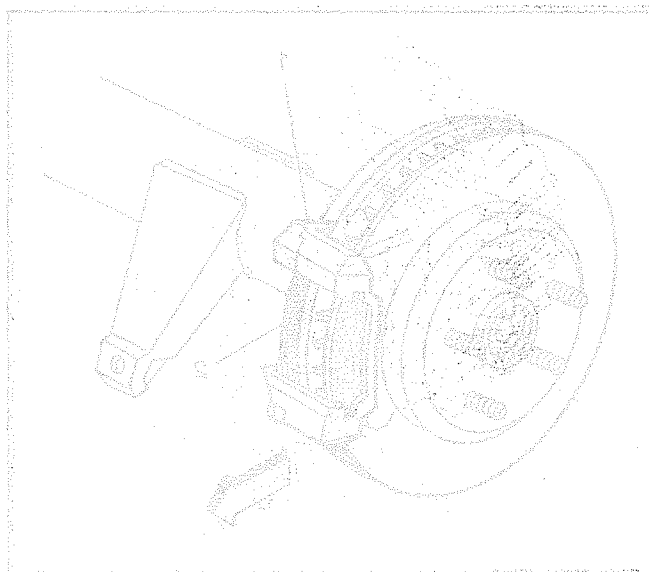
3. Remove the wheel nuts (1) securing the rotor (2).
4. Install the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
5. Lower the vehicle.
6. With engine running, pump brake pedal until brake pads are positioned against rotor (firm brake pedal).
7. Verify that there are no leaks in the brake hydraulic system.
8. Burnish the new pads. Refer to *Burnishing Pads and Rotors*.

Burnishing Pads and Rotors

Burnish the new braking surface after the brake pads have been replaced and the rotors have been refinished or replaced.

Burnishing "breaks in" the new pads or rotors. Burnishing also removes light corrosion on the rotors.

Burnish the brakes by making 20 stops from 48 km/h (30 mph) using medium to firm pressure on the brake pedal. Allow 0.8 km (0.5 miles) between stops in order to avoid overheating the brakes.

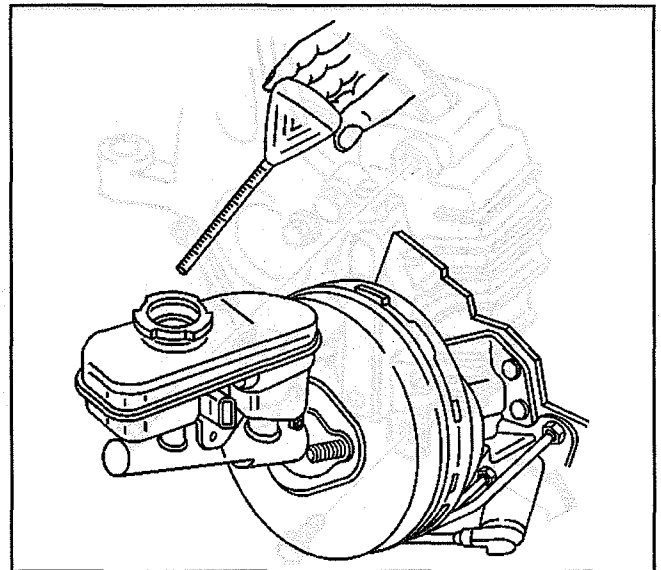


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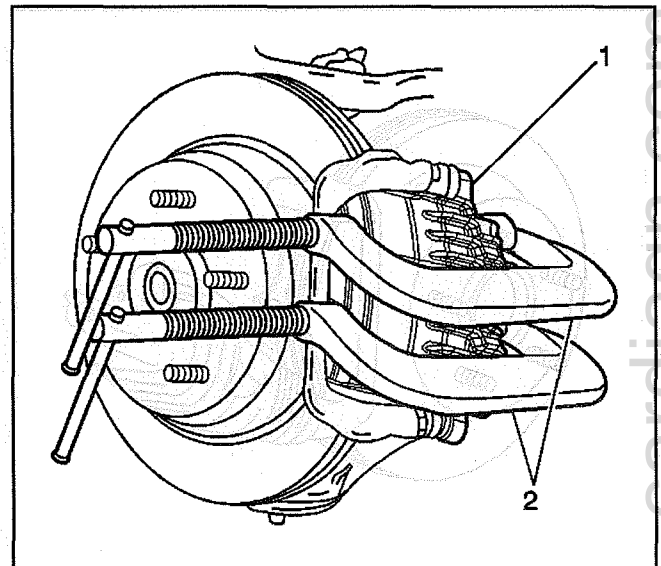
Brake Caliper Replacement (Front)

Removal Procedure

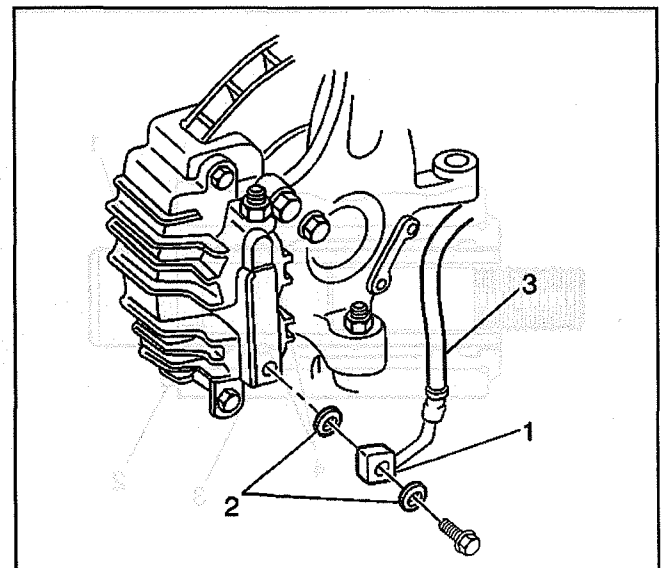
1. Remove two-thirds of the brake fluid from the master cylinder.
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
4. Push the piston into the housing bore in order to provide clearance between the pads and the rotor.
 - 4.1. Install a large C-clamp (2) over the top of the caliper housing (1) and against the back of the outboard pad.
 - 4.2. Slowly tighten the C-clamp until the piston is pushed into the caliper bore enough to slide the caliper off the rotor. Do not overtighten the C-clamp. Overtightening the C-clamp will deform the outboard shoe.
5. Complete the following steps if the caliper is being removed from the vehicle for overhaul or replacement:
 - 5.1. Remove the brake hose bolt attaching the brake hose fitting to the caliper.
 - 5.2. Remove the following components:
 - The brake hose fitting (1)
 - The copper gaskets (2)
 Discard the copper gaskets.
 - The brake hose from the caliper (3)
 - 5.3. Plug the openings in the caliper housing and the hose in order to prevent loss or contamination of the brake fluid.
6. If the caliper is being removed for service of the mounting plate or the brake pads, do not disconnect the inlet fitting



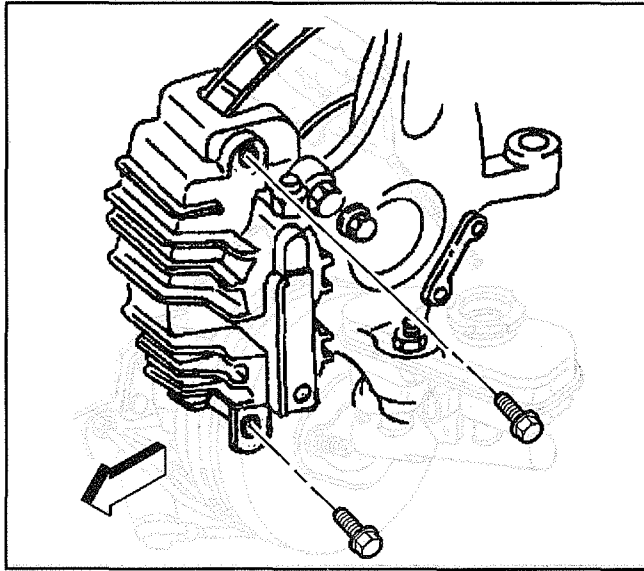
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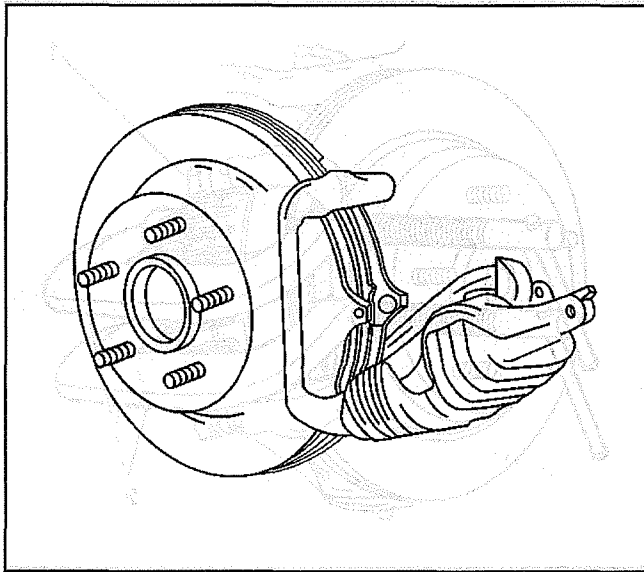


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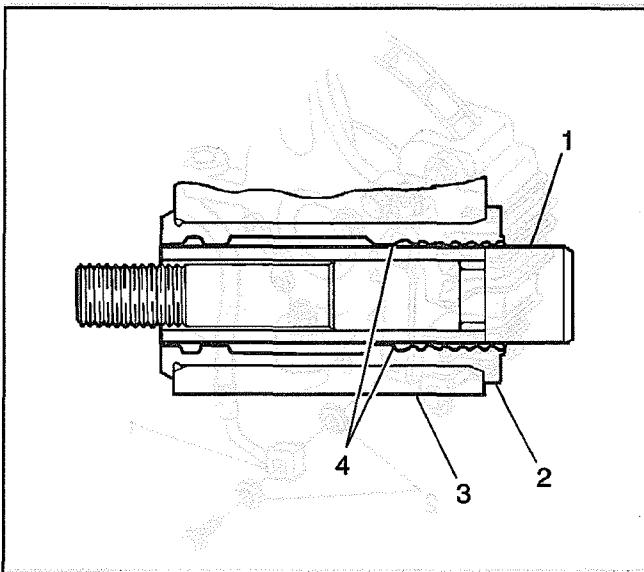
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7. Remove the brake caliper guide pin bolts.

Removal Procedure

1. Remove two-thirds of the brake fluid from the master cylinder.
2. Raise and safely support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
3. Remove the tire and wheel. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.

8. Remove the caliper housing from the rotor and the brake caliper mounting bracket.

If the caliper is not being removed from the vehicle, suspend the caliper from the front suspension using a fabricated wire hook.

9. Remove the caliper guide pin bolts and discard.

10. Inspect the following parts for corrosion, cuts, nicks or blockage. Replace any damaged parts.

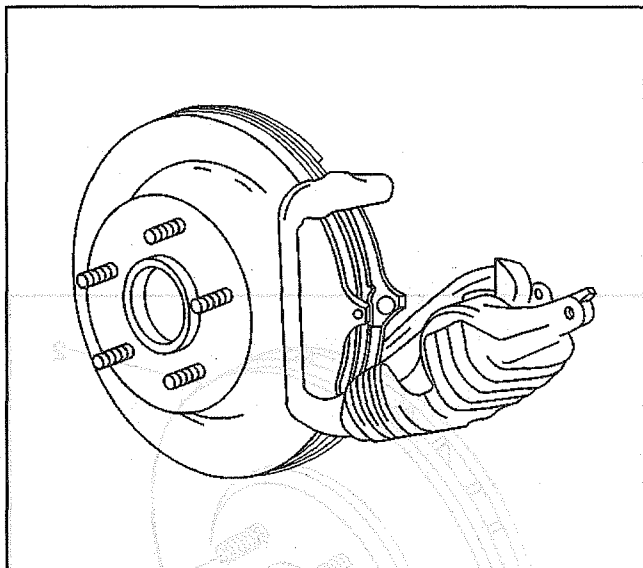
- The caliper guide pin bushings
- The brake hose fitting

If corrosion and/or excessive wear is found, use new parts, including bushings, when installing the caliper. Do not attempt to polish away corrosion.

Installation Procedure

1. Lubricate the inner diameters of the caliper bolt bushings (2) with silicone grease.
2. Lubricate the caliper bolts (1). Use silicone grease. Do not lubricate the threads.
3. Inspect the caliper guide pins.
 - The caliper pin should slide through the pin bushings and caliper pin bores using only hand pressure.
 - If greater force is required, remove the caliper pin and the bushings.
4. Inspect the mounting bores for corrosion.
 - If corrosion exists, remove the corrosion using a 1-inch wheel cylinder brush.
 - Clean the mounting bores using clean denatured alcohol.
5. Replace the caliper pin and bushings. Refer to *Brake Caliper Overhaul (Front)*.

6. Install the caliper and pads onto the mounting bracket.



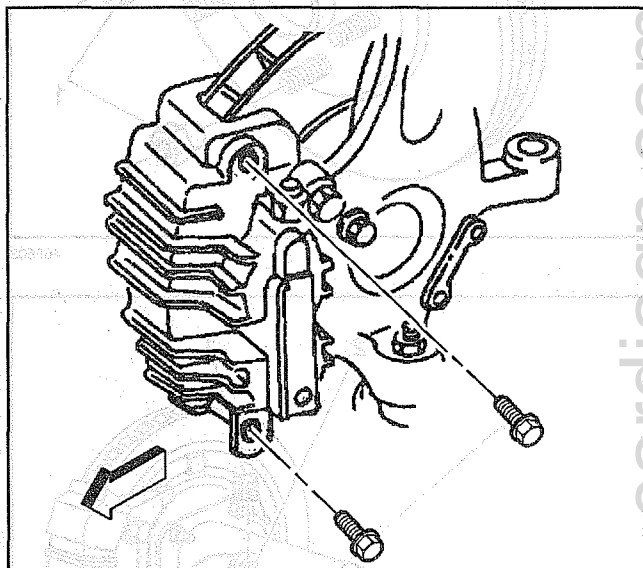
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Notice: Refer to *Fastener Notice* in Cautions and Notices.

7. Install the front brake caliper guide pin bolts.

Tighten

Tighten the front brake caliper guide pin bolts to 31 N·m (23 lb ft).



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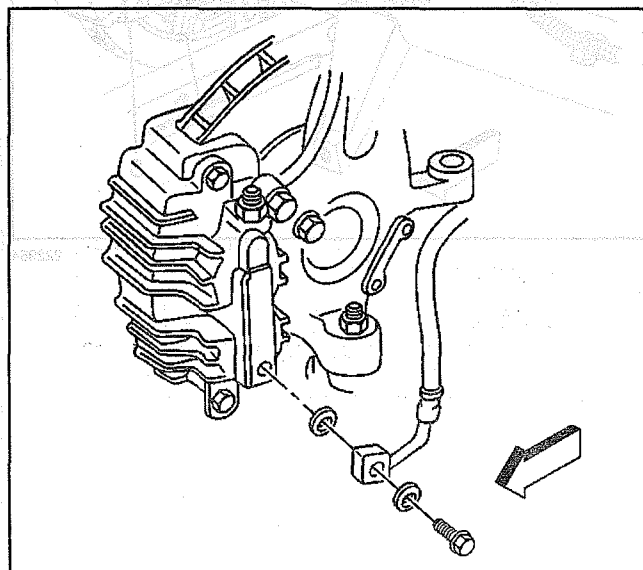
8. If the following components were removed, install them onto the caliper housing using new copper gaskets:

- The brake hose fitting
- The brake hose

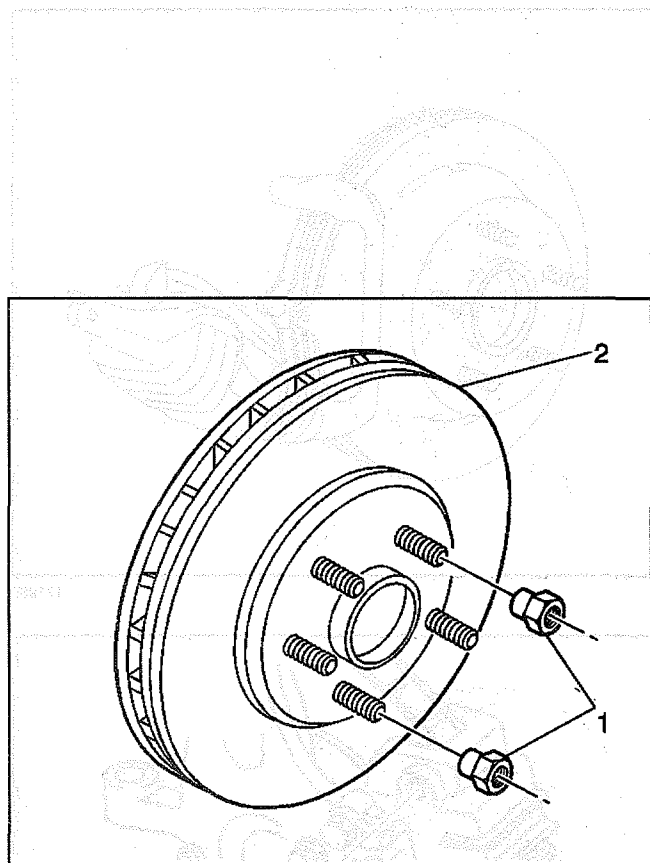
Tighten

Tighten the front brake hose fitting to 40 N·m (30 lb ft).

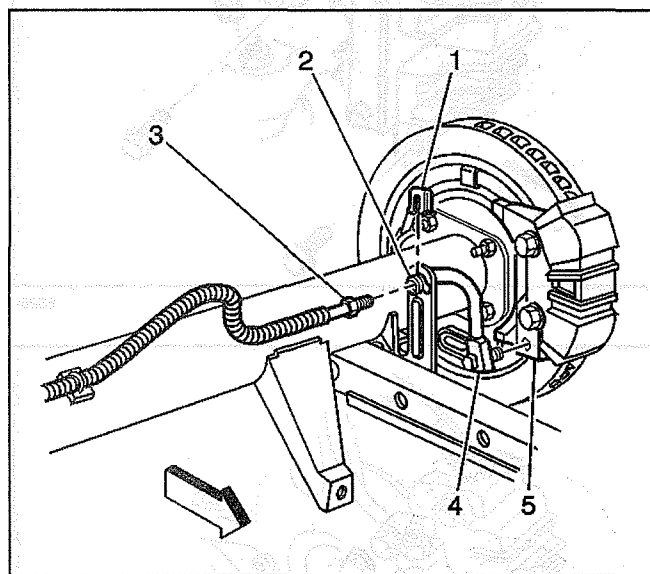
9. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
10. Lower the vehicle.



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Important: If the brake hose was removed, bleed the caliper. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* in Hydraulic Brakes.

11. Fill the master cylinder reservoir to the proper level with clean brake fluid.
12. With engine running, pump brake pedal until firm brake pedal is attained.
13. Check for leaks.

Brake Caliper Replacement (Rear)

Removal Procedure

1. Raise and suitably the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Reinstall two wheel nuts (1) in order to secure the rotor (2).

4. Complete the following steps if you are removing the caliper (5) from the vehicle:

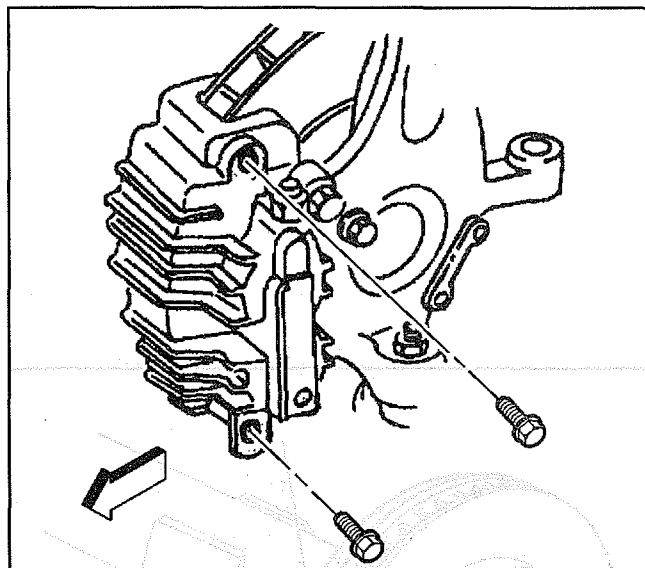
- 4.1. Remove the brake hose bolt attaching the brake hose fitting (4).

- 4.2. Remove the following items:

- The brake hose fitting (4)
- The copper gaskets
Discard the copper gaskets.
- The brake hose from the caliper

- 4.3. Plug the openings in the caliper housing and the hose in order to prevent loss or contamination of the brake fluid.

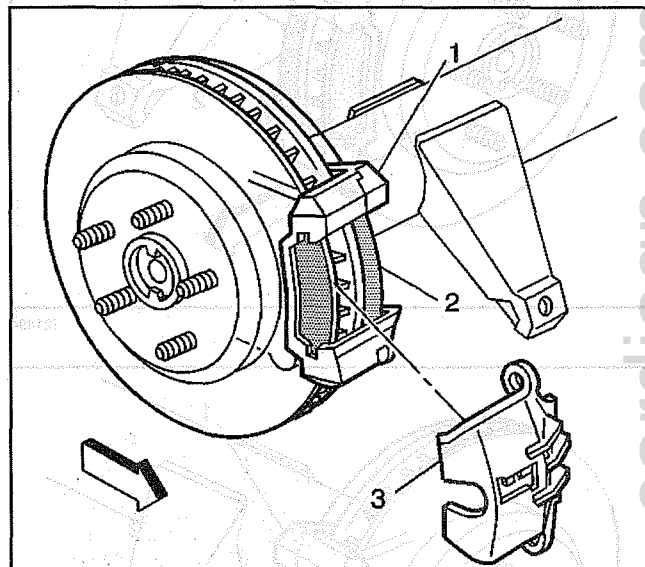
5. Remove the brake caliper guide pin bolts and discard.



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6. Remove the rear brake caliper (3) from the inner and outer pads (2) and mounting plate (1).

If the caliper is not being removed from the vehicle for unit repair, suspend the caliper from the rear suspension using a fabricated wire hook.



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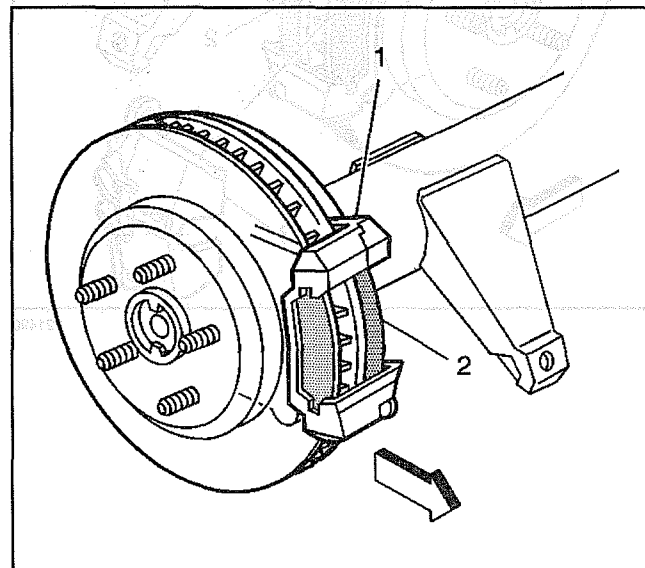
7. Remove the inner and outer brake pads (2) from the mounting plate (1) if the following conditions exist:

- The brake pads are also being replaced.
- The brake caliper mounting plate is also being removed.

8. Inspect the caliper guide pins for free movement in the caliper mounting plate.
9. Inspect the caliper guide pin boot for proper seating in the retaining groove of the caliper guide pin and the rear caliper mounting plate.

10. Replace the guide pins or guide pin boots if the following conditions exist:

- Excessive Corrosion
- Significant Wear
- Visible Damage

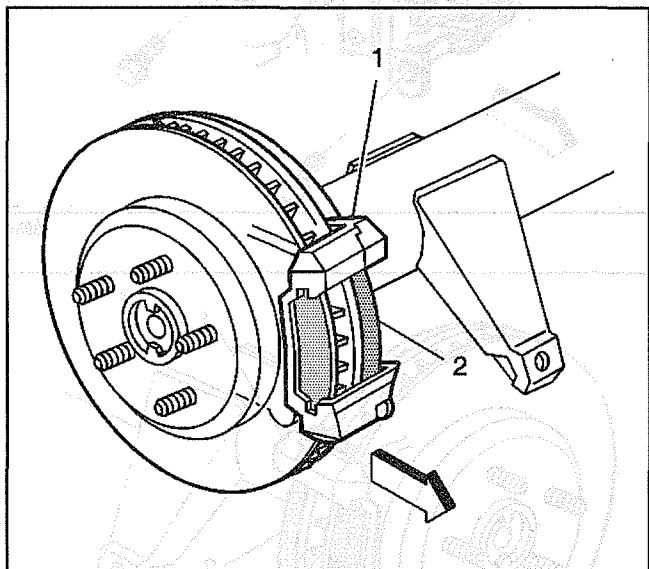


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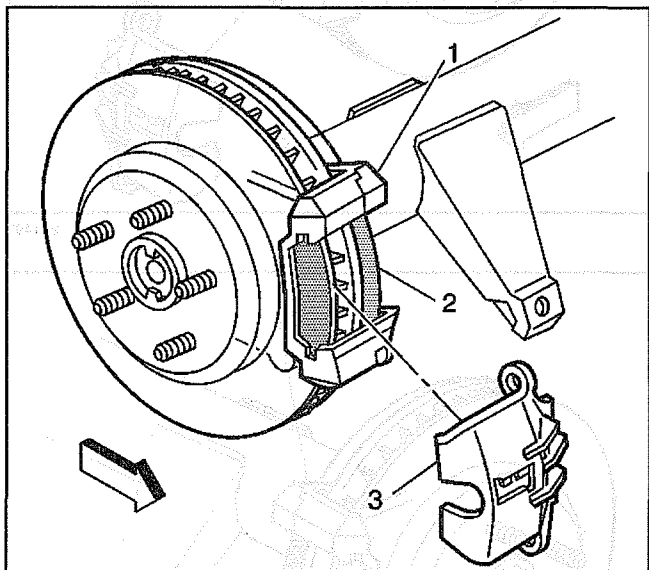
11. Lubricate the inner diameters of the caliper bolt & bushings with silicone grease. Also lubricate the caliper bolts with silicone grease.
12. Inspect the inner and outer pads for wear.
13. Inspect the inner and outer pads for maximum taper.
 - Maximum taper of the rear brake pads is 0.15 mm (0.006 in).
 - If the pads are tapered beyond the maximum specification, replace the inner and outer pads as a complete set only.

Installation Procedure

1. Install the inner and outer pads (2) into the mounting plate (1).



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2. Install the rear brake caliper (3) over the brake pads (2) and into the caliper mounting plate (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install new brake caliper guide pin bolts.

Tighten

Tighten the brake caliper guide pin bolts to 37 N·m (72 lb ft).

4. Install the following components, if removed:
 - The brake hose
 - The new brake hose fitting gaskets
5. Install the brake hose fitting bolt.

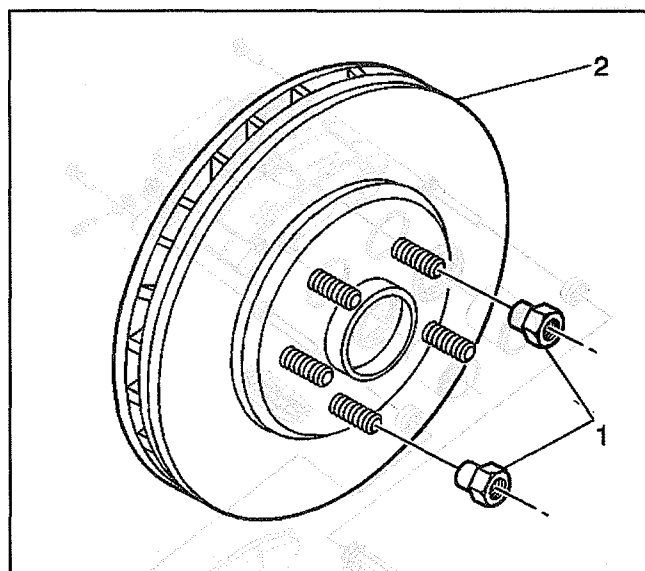
Tighten

Tighten the brake hose fitting bolt to 30 N·m (22 lb ft).

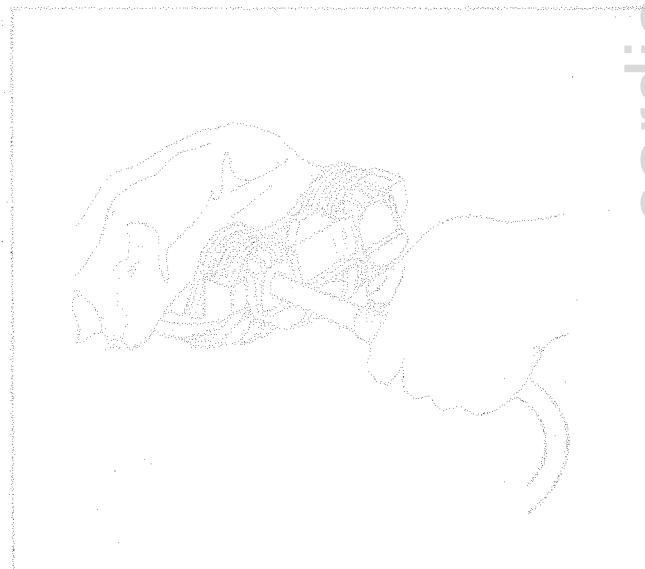
6. Bleed the brake hydraulic system, if the brake hose fitting was removed. Refer to the following procedures:
 - *Hydraulic Brake System Bleeding (Manual Bleeding)*
 - *Hydraulic Brake System Bleeding (Pressure Bleeding)*
 - *Hydraulic Brake System Bleeding (When To Bleed)*
7. Remove the wheel nuts securing the rotor.
8. Install the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
9. Lower the vehicle.
10. While the engine is running, pump the brake pedal slowly and firmly three times in order to seat the inner and outer pads.
11. Check the brake hydraulic system for leaks.

Brake Caliper Inspection

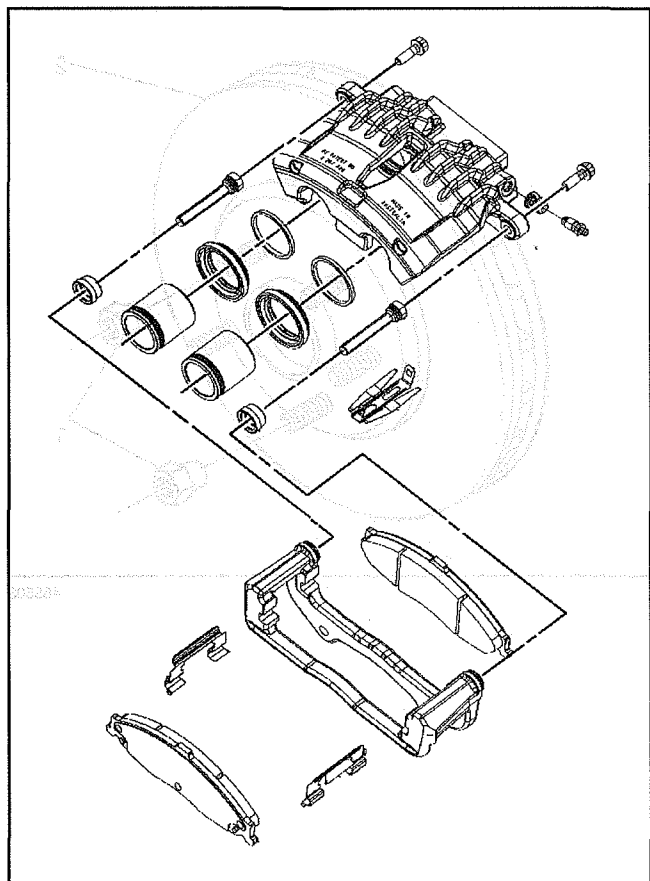
- Check the calipers for outward signs of leaking fluid and cracked or damaged piston boots.
- Check the calipers for excessive corrosion on the brake pad guiding surface.
- Perform all other types of caliper inspections during unit repair.



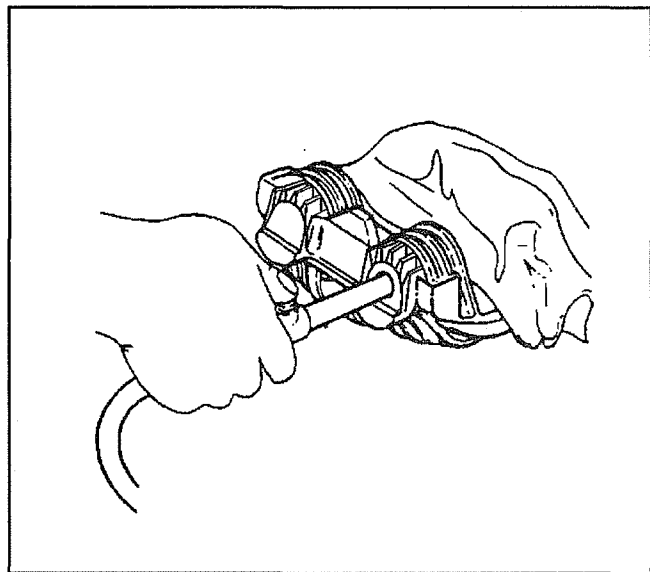
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Brake Caliper Overhaul (Front)

Disassembly Procedure

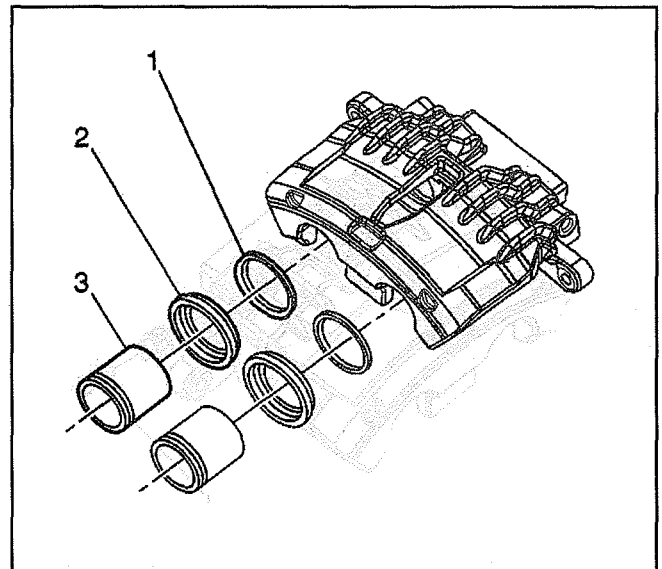
Important:

- Replace all the components included in the repair kits used to service this brake caliper.
- Lubricate the rubber parts with clean brake fluid to make assembly easier.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace the brake pads in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform the service operations on a clean bench, free from all mineral oil materials.

Caution: Do not place your fingers in front of the piston in order to catch or protect the piston while applying compressed air. This could result in serious injury.

1. Remove the brake caliper from the vehicle. Refer to *Brake Caliper Replacement (Front)*.
2. Remove the pistons by directing compressed air into the brake hose inlet fitting port of the brake caliper housing.

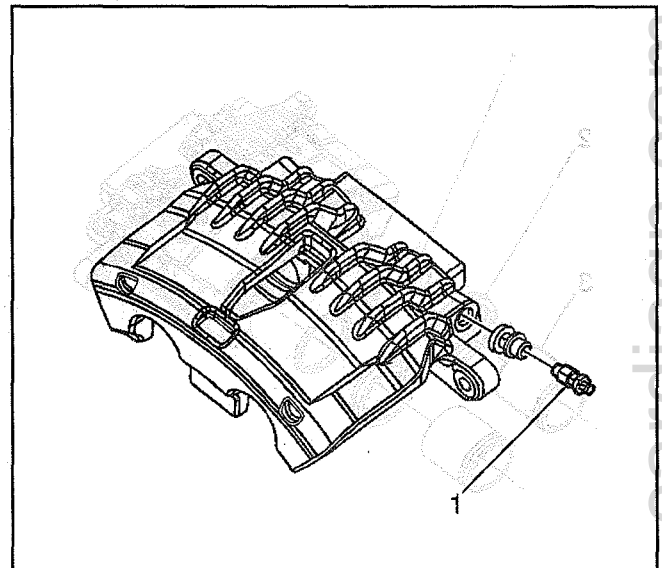
3. Remove the piston boots (2).
4. Remove the piston seals (1).



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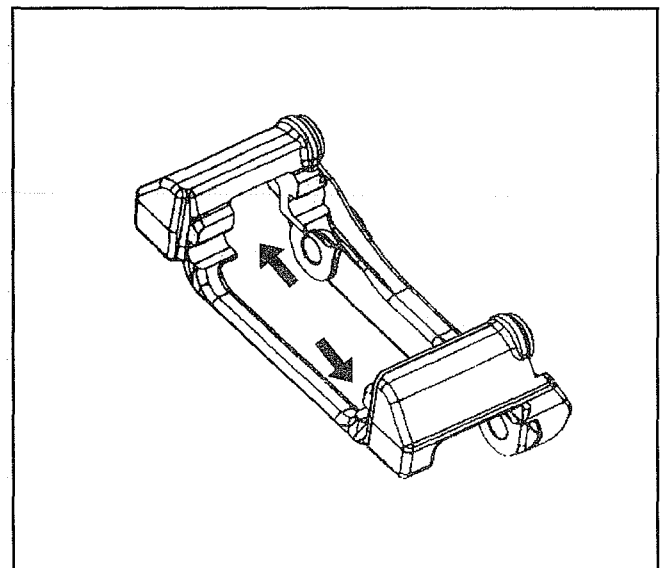
5. Remove the brake caliper bleed screw cap.
6. Remove the brake caliper bleed screw (1).
7. Inspect the brake caliper bores and piston seal grooves for scoring and corrosion. If badly scored or corroded around the piston seal area, replace the brake caliper housing.



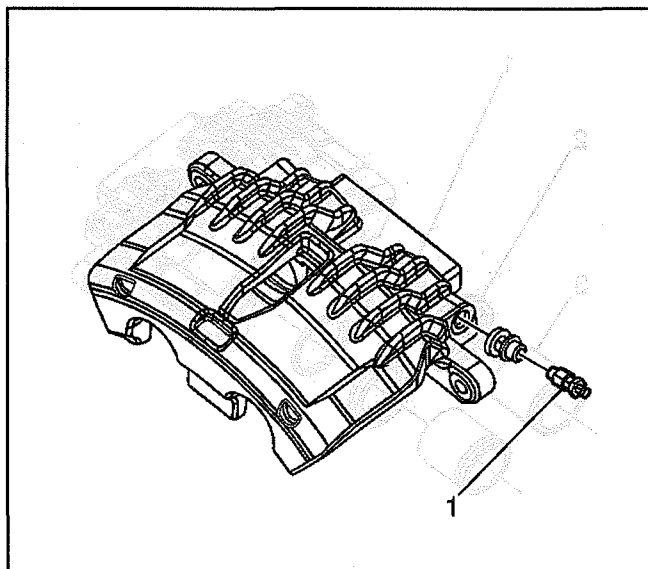
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8. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace the brake caliper mounting bracket if necessary.
9. Clean all the residue from the brake pad guiding surfaces on the brake caliper housing and the brake caliper mounting bracket.
10. Clean all the parts not included in the repair kit with denatured alcohol.
11. Dry all the parts with filtered unlubricated compressed air.
12. Blow out all passages in the brake caliper housing and the brake caliper bleeder valve.

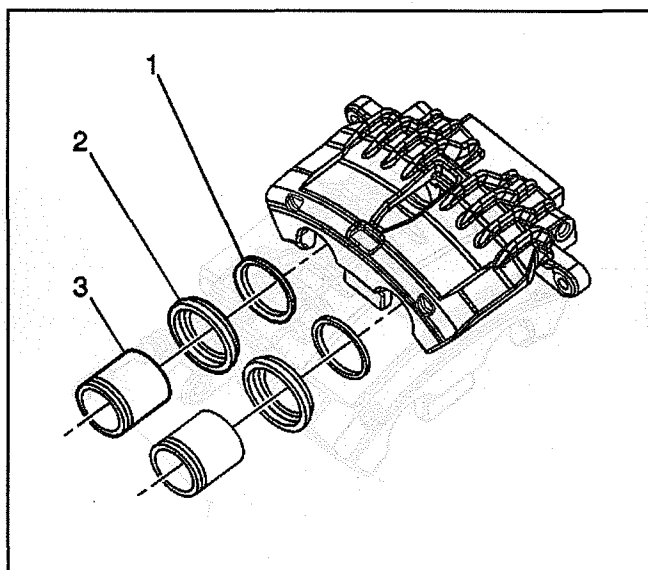


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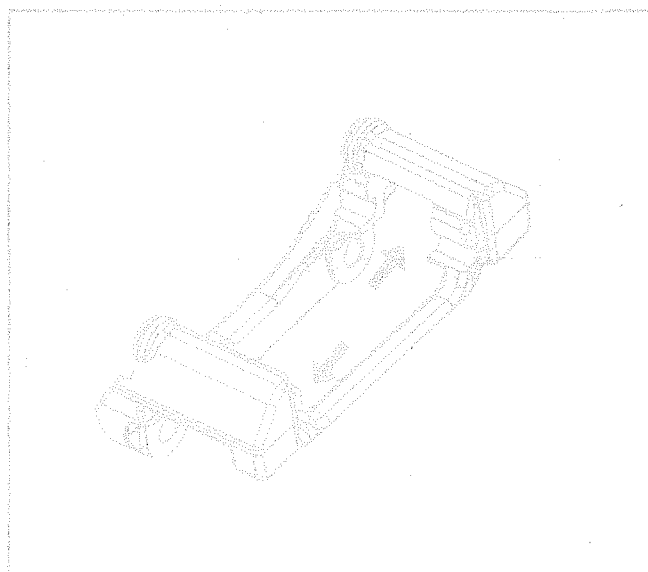
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Assembly Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the brake caliper bleed screw (1).

Tighten

Tighten the brake caliper bleed screw to 12 N·m (106 lb in).

2. Install the brake caliper bleed screw cap.

3. Lubricate the new piston seals and the brake caliper bore seal grooves with brake fluid.
4. Install new seals (1) into the brake caliper bore seal grooves.

5. Make sure the seals are not twisted.
6. Lubricate the brake caliper bores and the pistons with brake fluid.

7. Install the boot (2) and piston (3).

7.1. Install the boot over the end of the piston so that the fold will face toward the brake caliper housing piston bore opening.

7.2. Seat the boot into the brake caliper bore groove and slide the piston into the brake caliper bore.

7.3. Push down the piston to the bottom of the brake caliper bore.

7.4. Make sure the boot is properly seated into the piston groove and into the groove in the brake caliper bore.

7.5. Repeat Steps 5 and 6 for the remaining piston.

8. Install the brake caliper to the vehicle. Refer to *Brake Caliper Replacement (Front)*.

9. Clean all the residue from the brake pad guiding surfaces on the brake caliper housing and the brake caliper mounting bracket.

10. Clean all the parts not included in the repair kit with denatured alcohol.

11. Dry all the parts with filtered unpressurized compressed air.

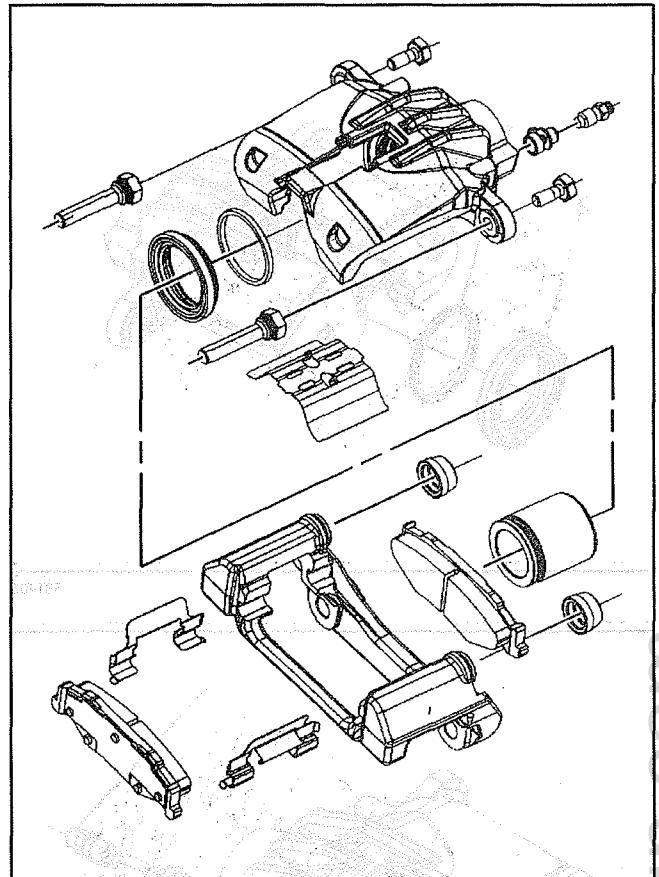
12. Blow out all passages in the brake caliper housing and the brake caliper bleed valve.

Brake Caliper Overhaul (Rear)

Disassembly Procedure

Important:

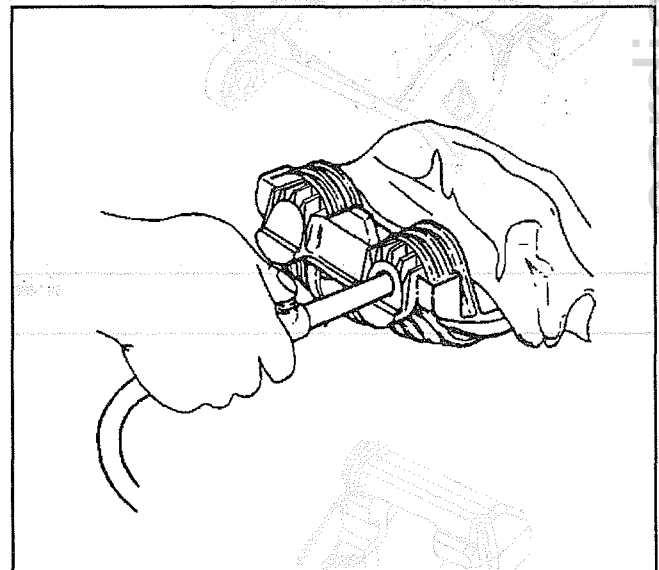
- Replace all the components included in the repair kits used to service this brake caliper.
- Lubricate the rubber parts with clean brake fluid to make assembly easier.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace the brake pads in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform the service operations on a clean bench, free from all mineral oil materials.



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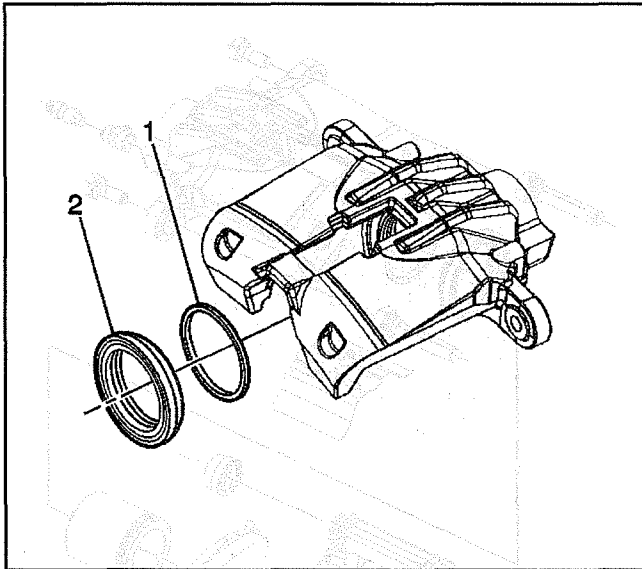
Caution: Do not place your fingers in front of the piston in order to catch or protect the piston while applying compressed air. This could result in serious injury.

1. Remove the brake caliper from the vehicle. Refer to *Brake Caliper Replacement (Rear)*.
2. Remove the piston by directing compressed air into the brake hose inlet fitting port of the brake caliper housing.

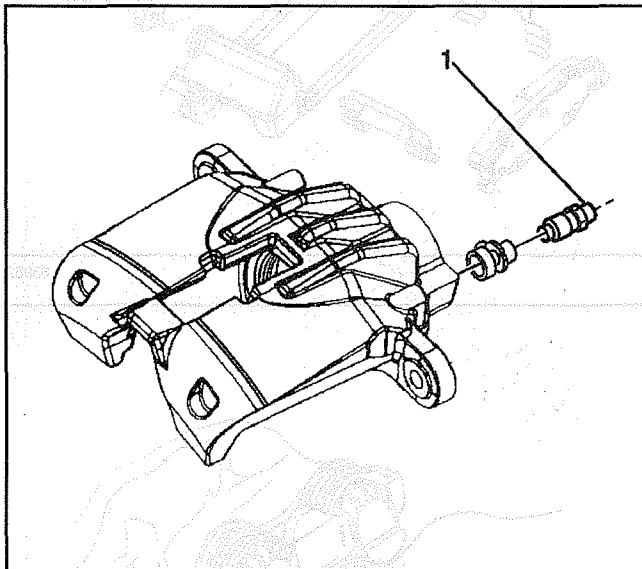


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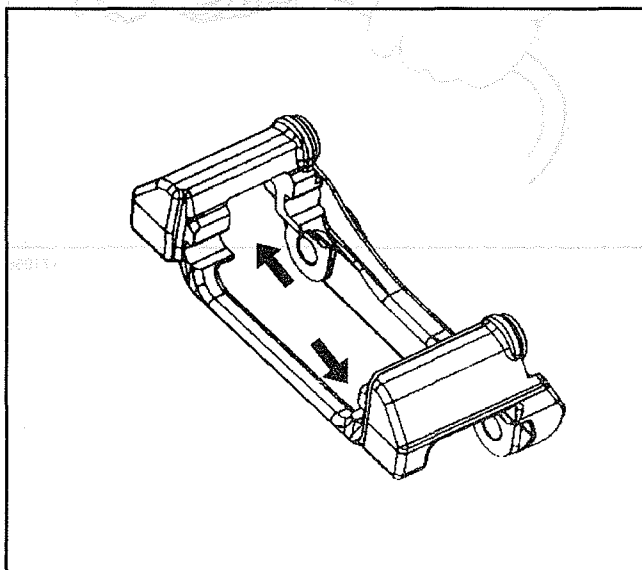
3. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace the brake caliper mounting bracket if necessary.
4. Clean all the residue from the brake pad guiding surfaces on the brake caliper housing and the brake caliper mounting bracket.
5. Clean all the parts not included in the repair kit with denatured alcohol.
6. Dry all the parts with filtered unlubricated compressed air.
7. Blow out all passages in the brake caliper housing and the brake caliper bleeder valve.



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3. Remove the piston boot (2).
4. Remove the piston seal (1).

Important:

- Replace all the components included in the repair kit used to service this brake caliper.
- Lubricate the rubber parts with clean brake fluid to make assembly easier.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace the brake pads in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform the service operations on a clean bench, free from all mineral oil materials.

5. Remove the brake caliper bleed screw cap.
6. Remove the brake caliper bleed screw (1).
7. Inspect the brake caliper bore and piston seal groove for scoring and corrosion. If badly scored or corroded around the piston seal area, replace the brake caliper housing.

Caution: Do not place your fingers in front of the piston in order to catch or protect the piston while applying compressed air. This could result in serious injury.

1. Remove the brake caliper from the vehicle. Refer to Brake Caliper Replacement (Front).
2. Remove the piston by directing compressed air into the brake hose inlet fitting port of the brake caliper housing.

8. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace the brake caliper mounting bracket if necessary.
9. Clean all the residue from the brake pad guiding surfaces on the brake caliper housing and the brake caliper mounting bracket.
10. Clean all the parts not included in the repair kit with denatured alcohol.
11. Dry all the parts with filtered unlubricated compressed air.
12. Blow out all passages in the brake caliper housing and the brake caliper bleeder valve.

Assembly Procedure

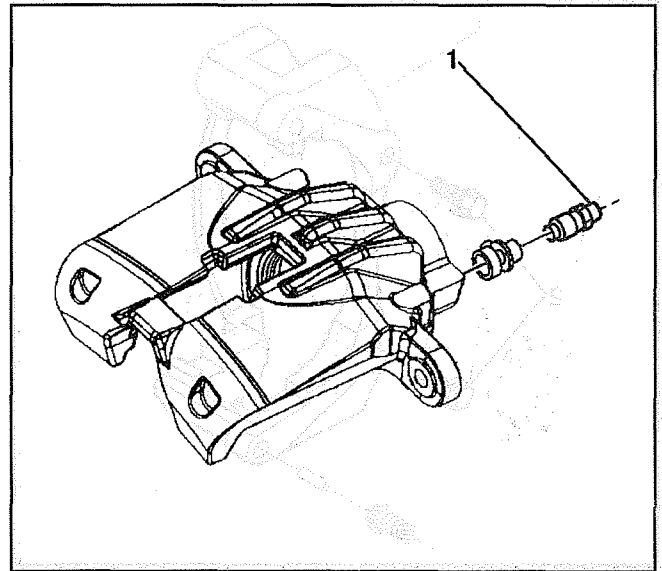
Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the brake caliper bleed screw (1).

Tighten

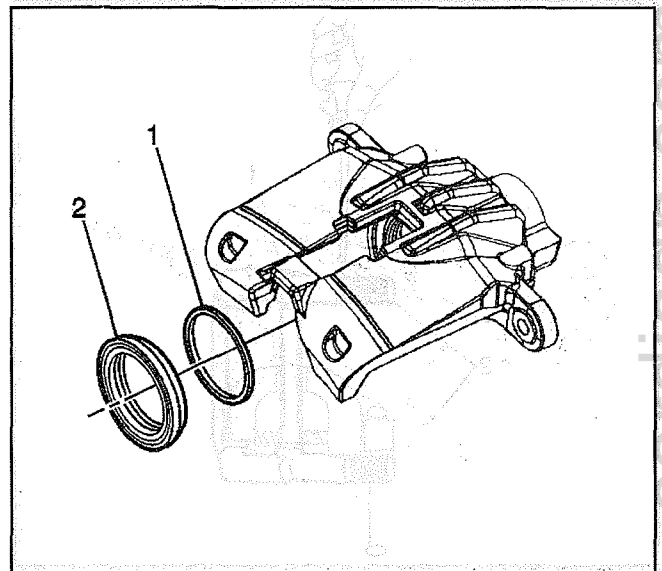
Tighten the brake caliper bleed screw to 12 N·m (106 lb in).

2. Install the brake caliper bleed screw cap.

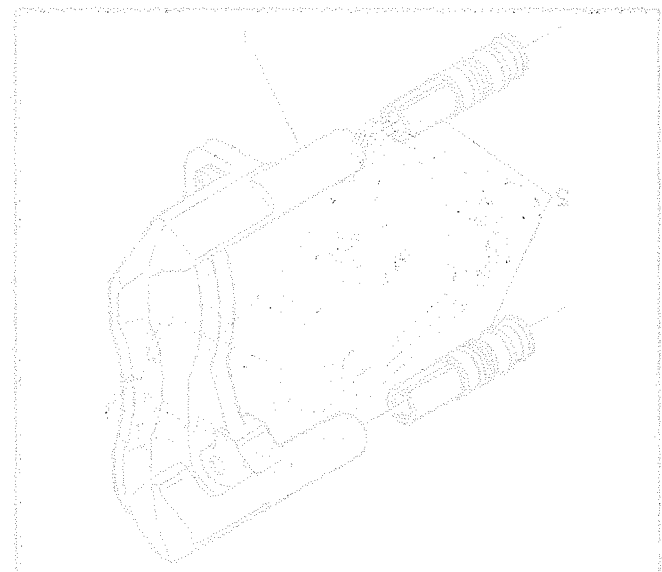


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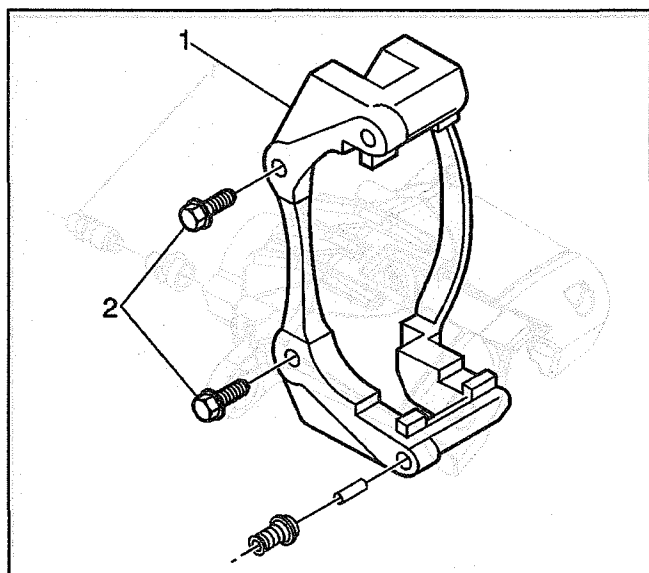
3. Lubricate the new piston seal and the brake caliper bore seal groove with brake fluid.
4. Install the new seal (1) into the brake caliper bore seal groove.
5. Make sure the seal is not twisted.
6. Lubricate the brake caliper bore and the piston with brake fluid.
7. Install the boot (2) and piston.
 - 7.1. Install the boot over the end of the piston so that the fold will face toward the brake caliper housing piston bore opening.
 - 7.2. Seat the boot into the brake caliper bore groove and slide the piston into the brake caliper bore.
 - 7.3. Push down the piston to the bottom of the brake caliper bore.
 - 7.4. Make sure the boot is properly seated into the piston groove and into the groove in the brake caliper bore.
 - 7.5. Repeat Steps 5 and 6 for the remaining piston.
8. Install the brake caliper to the vehicle. Refer to *Brake Caliper Replacement (Rear)*.



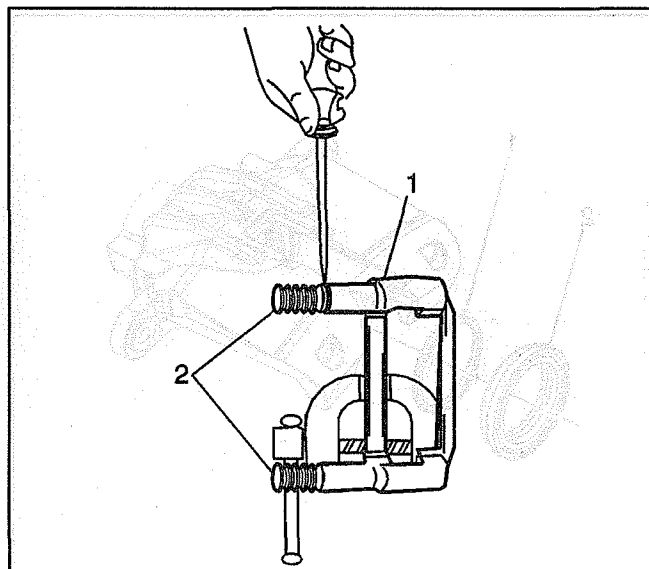
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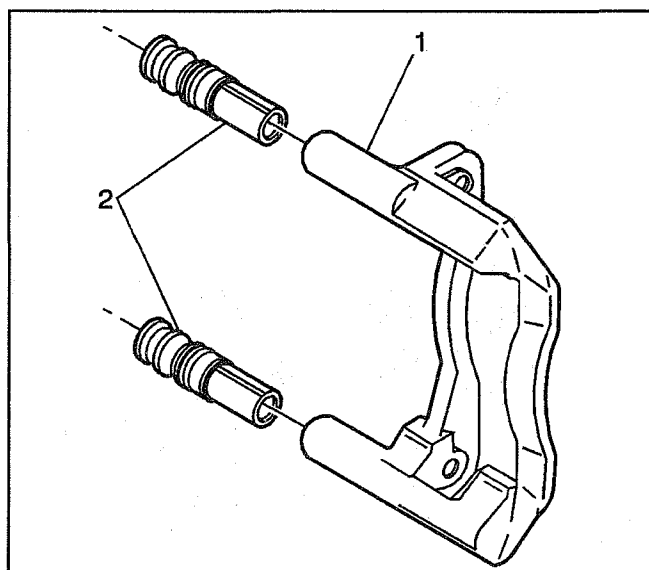
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Brake Caliper Bracket Replacement (Front)

Removal Procedure

1. Remove the inner and outer pads. Refer to *Brake Pads Replacement (Front)*.

Caution: These fasteners **MUST** be replaced with new fasteners anytime they become loose or are removed. Failure to replace these fasteners after they become loose or are removed may cause loss of vehicle control and personal injury.

2. Remove the caliper bracket bolts (2).
3. Remove the caliper bracket (1).

4. Remove the following components from the bracket (1):

- The boot bolts (2)
- The bushings

5. Inspect the bracket for cracks.

6. Replace the bracket if necessary.

Installation Procedure

1. Lubricate the following components with silicone grease:

- New bolt boots
- New bushings

2. Install the following components into the caliper bracket (1):

- The bolt boots (2)
- The bushings

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the caliper bracket with the bracket bolts.

Tighten

Tighten the caliper bolts to 100 N·m (74 lb ft).

4. Install the inner and outer brake pads. Refer to *Brake Pads Replacement (Front)*.

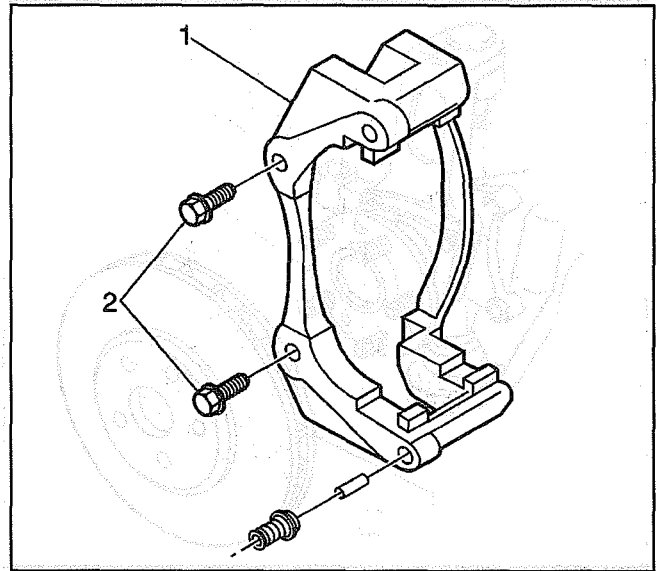
Brake Caliper Bracket Replacement (Rear)

Removal Procedure

1. Remove the inner and outer brake pads. Refer to *Brake Pads Replacement (Rear)*.

Caution: These fasteners **MUST** be replaced with new fasteners anytime they become loose or are removed. Failure to replace these fasteners after they become loose or are removed may cause loss of vehicle control and personal injury.

2. Remove the caliper bracket bolts (2).
3. Remove the caliper bracket (1).



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Installation Procedure

1. Lubricate the following components with silicone grease:
 - New bolt boots
 - New bushings
2. Install the following components into the caliper bracket (1):
 - The bolt boots (2)
 - The bushings

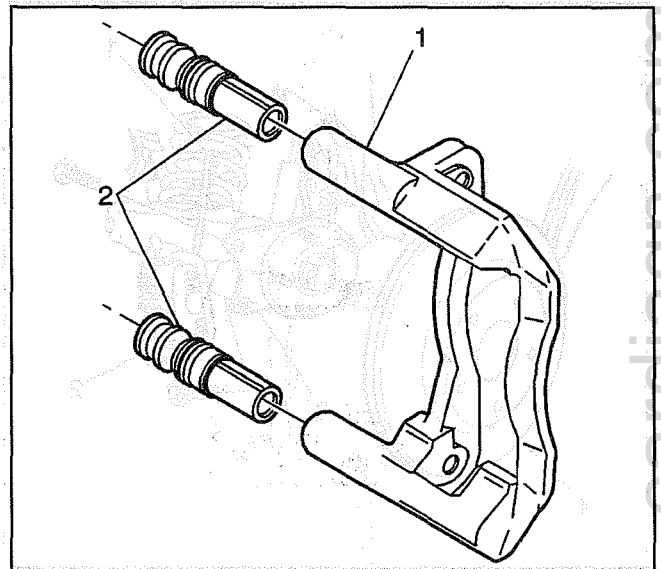
Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the caliper bracket with the bracket bolts.

Tighten

Tighten the caliper bolts to 100 N·m (74 lb ft).

4. Install the inner and outer brake pads. Refer to *Brake Pads Replacement (Rear)*.

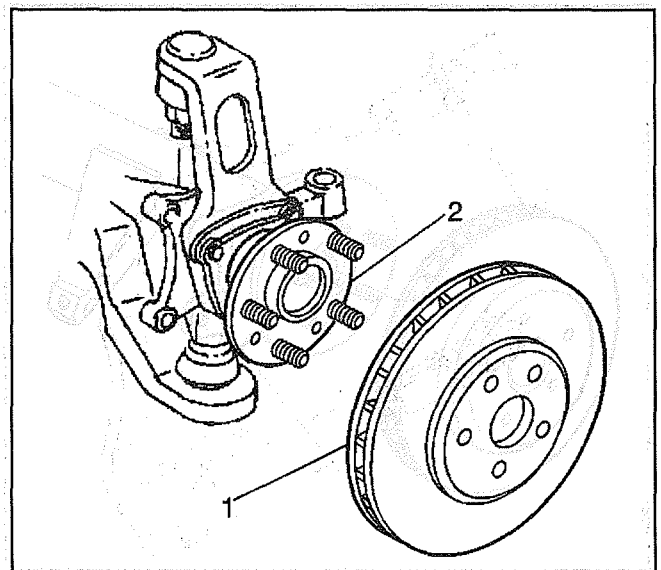


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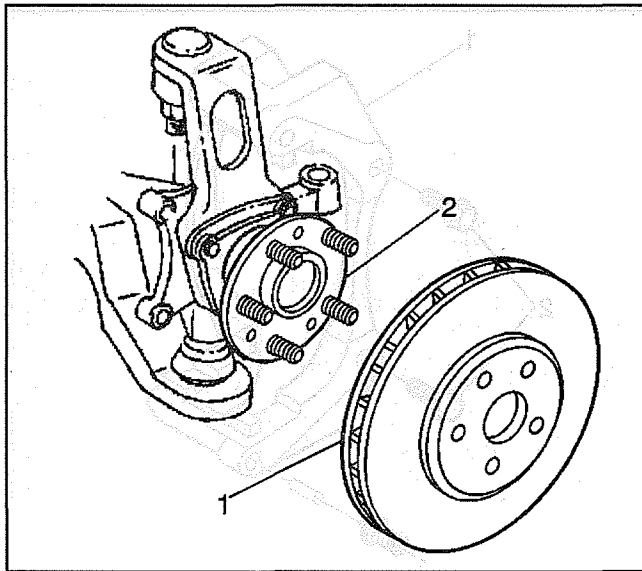
Brake Rotor Replacement (Front)

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the front brake caliper. Refer to *Brake Caliper Replacement (Front)*.
4. Remove the caliper mounting bracket bolts and the caliper mounting bracket.
5. Remove the brake rotor (1) from the wheel hub (2).
6. Clean the metal contact surfaces between the brake rotor and the hub bearing flange.



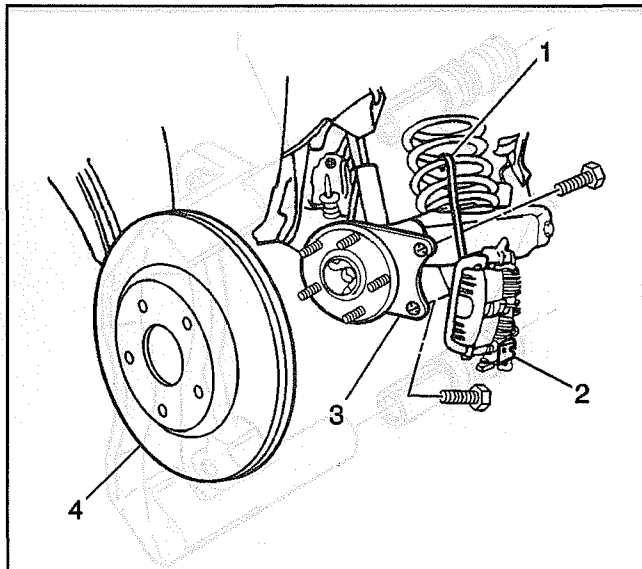
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Installation Procedure

1. Install the brake rotor (1) onto the wheel hub (2).
2. Install the caliper mounting bracket and caliper mounting bracket bolts.
3. Install the front brake caliper. Refer to *Brake Caliper Replacement (Front)*.
4. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
5. Lower the vehicle.
6. Pump the brake pedal several times until firm.



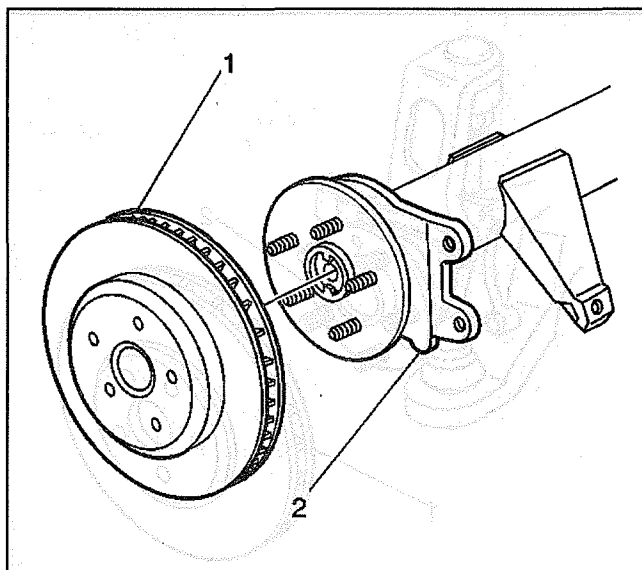
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Brake Rotor Replacement (Rear)

Removal Procedure

The rear brake rotor can be removed without separating the caliper from the mounting plate (remove as an assembly).

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the rear brake caliper (2) and mounting bracket. Support with a locally fabricated hook (1). Refer to *Brake Caliper Replacement (Rear)*.



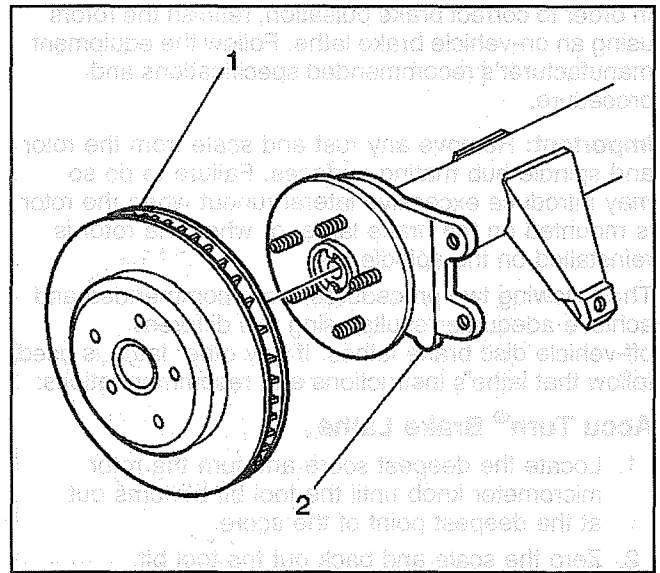
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4. Remove the brake rotor (1) from the wheel hub (2).

Installation Procedure

Notice: Any new rotor must have the protective coating removed from the friction surfaces before being placed in service. Use Goodwrench Brake Parts Cleaner P/N 123777981 or the equivalent, and wipe the surface clean with clean cloths. Do not use gasoline, kerosene, or other oil base solvents which may leave an oily residue. This residue is damaging to the brake lining and is flammable.

1. Install the brake rotor (1) onto the wheel hub (2).
2. Install the rear brake caliper and mounting plate assembly. Refer to *Brake Caliper Replacement (Rear)*.
3. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
4. Lower the vehicle.
5. Pump the brake pedal several times until the pedal is firm.



221499

Refinishing Brake Rotors (Front)

Important: DO NOT refinish brake rotors when performing routine brake maintenance, such as replacing worn disc brake pads. Refinish a rotor **ONLY** under the following circumstances:

- There is a complaint of brake pulsation.
- There is scoring greater than 1.5 mm (0.060 in).

All brake rotors have a minimum thickness dimension cast into the rotor. This dimension is not a minimum refinishing dimension. The minimum refinishing dimension is larger than the discard dimension. Do not use a brake rotor that, after refinishing, will not meet the minimum thickness shown on the rotor. Replace it with a new rotor. Refer to *Component Specifications*.

Accurate control of the rotor tolerance is necessary for proper performance of the disc brakes. Machine the rotor using precise equipment. Service machining equipment on a regular basis. Follow the manufacturer's recommended maintenance procedure. Ensure that the following tool accessories are in good condition when refinishing the rotors:

- The attaching adapters
- The tool holders
- The vibration dampeners
- The tool bits

Always use sharp cutting tools and bits. Replace cutting bits using equipment recommended by the manufacturer. Dull or worn tools leave a poor surface finish which will affect braking performance. Always use anti-chatter silencer attachments when refinishing braking surfaces. The attachments eliminate tool chatter and will result in a better surface finish. Ensure that the adapters are clean and free of nicks.

In order to correct brake pulsation, refinish the rotors using an on-vehicle brake lathe. Follow the equipment manufacturer's recommended specifications and procedure.

Important: Remove any rust and scale from the rotor and spindle hub mating surfaces. Failure to do so may introduce excessive lateral runout when the rotor is mounted on the brake lathe, or when the rotor is reinstalled on the spindle hub.

The following two procedures are recommended and achieve adequate results using two different off-vehicle disc brake lathes. If any other lathe is used, follow that lathe's instructions and recommendations:

Accu Turn® Brake Lathe

1. Locate the deepest score and turn the rotor micrometer knob until the tool bit bottoms out at the deepest point of the score.
2. Zero the scale and back out the tool bit.
3. Advance the cutter handwheel until the bits have cleared the inner edges of the rotor face.
4. Adjust the micrometer knobs for approximately 0.127 mm (0.005 in) more than the first reading. Use this method in order to resurface the rotor in one cut.

Front Rotor Finish Cut

Spindle Speed	105 rpm
Depth of Cut	As necessary
Cross Feed (per rev.)	0.08 mm (0.003 in)
Vibration Dampener	Yes

Nondirectional Finishing

Ensure that the rotor surface is nondirectional by dressing the rotor surfaces. Use a non-directional rotor finisher such as the 54-433179 Non-Directional Rotor Refinisher listed in the GM Dealer Equipment Catalog, or a suitable equivalent.

If the brake lathe is not equipped with an adequate nondirectional finishing tool, use a sanding block with 150 grit aluminum oxide sandpaper.

With the rotor turning at the equipment manufacturer's highest recommended cutting speed, sand each rotor surface for a minimum of 60 seconds using moderate pressure.

After the rotor has been sanded, clean each surface with denatured alcohol or a suitable brake cleaner.

Important: Replace any rotor that does not meet the minimum thickness specification recommended by the manufacturer. Do not resurface new brake rotors. New brake rotors are manufactured with the proper surface finish.

The finished rotor surface should be as close as possible to that of a new rotor. Failure to obtain the best possible rotor finish may affect braking performance.

Refinishing Brake Rotors (Rear)

Important: DO NOT refinish brake rotors when performing routine brake maintenance, such as replacing worn disc brake pads. Refinish a rotor ONLY under the following circumstances:

- There is a complaint of brake pulsation.
- There is scoring greater than 1.5 mm (0.060 in).

All brake rotors have a minimum thickness dimension cast into the rotor. This dimension is not a minimum refinishing dimension. The minimum refinishing dimension is larger than the discard dimension. Do not use a brake rotor that, after refinishing, will not meet the minimum thickness shown on the rotor. Always use a new rotor. Refer to *Component Specifications*.

Accurate control of the rotor tolerance is necessary for proper performance of the disc brakes. Machine the rotor using precise equipment. Service the machining equipment on a regular basis. Follow the manufacturer's recommended maintenance procedure.

Ensure that the following tool accessories are in good condition when refinishing the rotors:

- The attaching adapters
- The tool holders
- The vibration dampeners
- The tool bits

Always use sharp cutting tools and bits. Replace cutting bits using equipment that is recommended by the manufacturer. Dull or worn tools leave a poor surface finish which will affect braking performance. Always use anti-chatter silencer attachments when refinishing braking surfaces. The attachments eliminate tool chatter and will result in a better surface finish. Ensure that the adapters are clean and free of nicks.

In order to correct brake pulsation, refinish rotors using an on-vehicle brake lathe. Follow the equipment manufacturer's recommended specifications and procedure.

Important: Remove any rust and scale from the rotor and spindle hub mating surfaces. Failure to do so may introduce excessive lateral runout when the rotor is mounted on the brake lathe, or when the rotor is reinstalled on the spindle hub.

The following two procedures are recommended and achieve adequate results using two different off-vehicle disc brake lathes. If any other lathe is used, follow that lathe's instructions and recommendations:

Accu Turn® Brake Lathe

1. Locate the deepest score. Turn the rotor micrometer knob until the tool bit bottoms out at the deepest point of the score.
2. Zero the scale and back out the tool bit.
3. Advance the cutter handwheel until the bits have cleared the inner edges of the rotor face.
4. Adjust the micrometer knobs for approximately 0.127 mm (0.005 in) more than the first reading. Use this method in order to resurface the rotor in one cut.

Rear Rotor Finish Cut

Spindle Speed	105 rpm
Depth of Cut	As necessary
Cross Feed (per rev.)	0.08 mm (0.003 in)
Vibration Dampener	Yes

Rotor Mounting Adapter

Tools Required

- J 37160-A Rotor Mounting Adapter
- J 37160-50 Rotor Mounting Adapter Sleeve

Important: Verify that the mounting surfaces of these components are clean and free from nicks, burrs or rust.

1. Inspect all of the mounting hardware for the following conditions:

- Rust
- Nicks
- Dirt
- Abnormal wear

For proper results, ensure that all components are in good condition and clean.

2. Inspect the rotor:

- Measure the lateral runout. Refer to *Brake Rotor Lateral Runout Check*.
- Measure the thickness variation. Refer to *Brake Rotor Thickness Variation Check*.

Ensure that the mounting surface of the rotor is clean and free from rust and nicks.

3. Mount the J 37160-A on a spindle arbor.

- Use a suitable combination of spacers or collets in order to tighten the J 37160-A to the arbor.
- When using lathes with a 7/8-inch spindle arbor, use the J 37160-50 with the J 37160-A.
- The J 37160-50 is not required with lathes using a 1-inch spindle arbor.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Mount the rotor onto the J 37160-A

- Mount the clamp plate to the rotor using the enclosed bolts/screws.
- The rotor may be installed and removed while the J 37160-A is mounted on the machine spindle.

Tighten

Tighten the rotor mounting adapter nuts in a cross pattern to 34 N·m (23 lb ft).

5. Install the anti-chatter silencer onto the rotor.
6. Set the spindle speed to approximately 150 RPM (or mid-range).
7. While the machine is running, bring the tool bit up and touch off.
 - Stop the machine.
 - Inspect the witness mark. If the witness mark goes $\frac{3}{4}$ of the way around, the rotor is mounted properly.
 - Continue turning the rotor using normal methods in order to resurface the rotor.
8. If the witness mark does not go $\frac{3}{4}$ of the way around, repeat the above steps.

Nondirectional Finishing

Ensure that the rotor surface is nondirectional by dressing the rotor surfaces. Use a non-directional rotor finisher such as the 54-433179 Non-Directional Rotor Refinisher listed in the GM Dealer Equipment Catalog, or a suitable equivalent.

If the brake lathe is not equipped with an adequate nondirectional finishing tool, use a sanding block with 150 grit aluminum oxide sandpaper.

After the rotor has been sanded, clean each surface with denatured alcohol or a suitable brake cleaner.

With the rotor turning at the equipment manufacturer's highest recommended cutting speed, sand each rotor surface for a minimum of 60 seconds using moderate pressure.

Important: Replace any rotor that does not meet the minimum thickness specification recommended by the manufacturer. Do not resurface new brake rotors. New brake rotors are manufactured with the proper surface finish.

The finished rotor surface should be as close as possible to that of a new rotor. Failure to obtain the best possible rotor finish may affect braking performance.

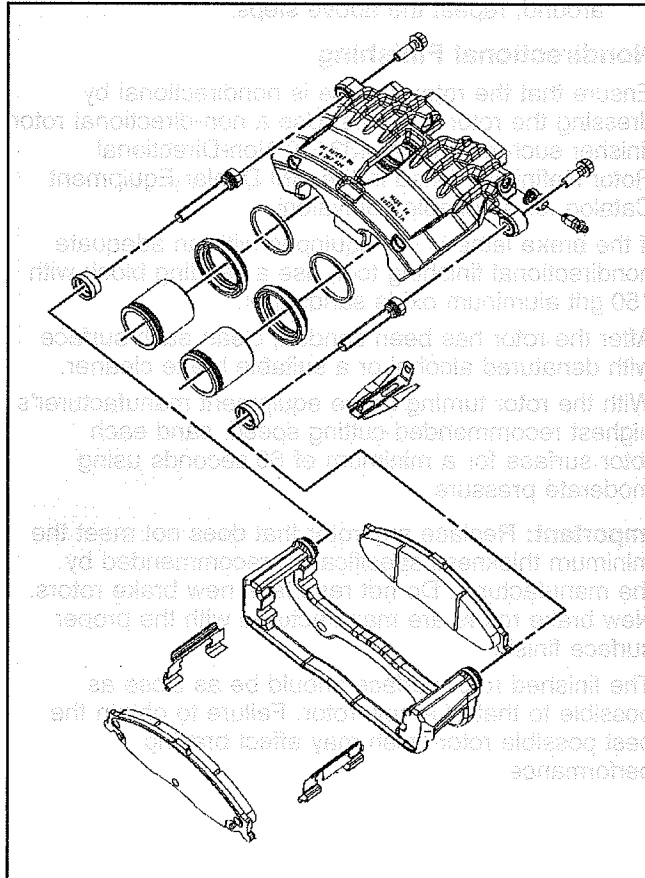
Description and Operation

Disc Brakes System Description (Front)

Front Brake Rotor

The front brake rotor is a machined, cast iron ventilated rotor. The rotor is cast with cooling fins between the friction surfaces. The internal fins or vanes radiate from the center of the rotor to the outer edge of the rotor. This design enables the rotor to act as its own cooling fan.

Front Brake Caliper



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The aluminum dual piston front caliper used on this vehicle is mounted onto the front brake caliper mounting plate, and ultimately to the steering knuckle. Applying the brake pedal creates hydraulic pressure. This pressure exerts equally against the bottom of the pistons and against the bottom of the cylinder bores. The pressure applied to the pistons transmits to the inner pad and forces the pad against the inner rotor surface. The pressure applied to the bottom of the cylinders forces the caliper to slide in the caliper bolt bushings toward the center of the vehicle. This movement forces the outer section of the caliper against the back of the outer pad and presses the pad against the outer rotor surface. As hydraulic pressure builds, the pads press against the rotor surface with increasing force. The increasing force

causes the vehicle to stop. In addition, it is this sliding action that allows a disc brake caliper to compensate for wear of the inner and outer pads. If upon inspection, it is found that one pad is significantly thicker or thinner than its counterpart, it would be an indication that the caliper is not sliding freely, and therefore not self-adjusting as it is should.

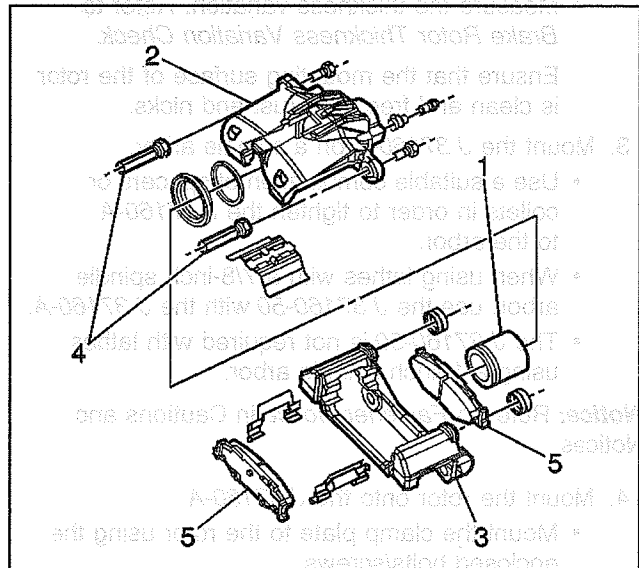
The brake caliper piston seals, while sealing the hydraulic circuit at the wheels, have a second function. These seals while firmly mounted in their channels, do distort very slightly under brake actuation. When the brakes are applied, the movement of the pistons out of the caliper bores distort the piston seals. When the brake pedal is released, the piston returns only as far as the seal was distorted. While this distortion of the seal shape is very minimal, it is enough to allow the brake pads to retract very slightly so as to eliminate any significant drag of the brakes.

Disc Brakes System Description (Rear)

Rear Brake Rotor

The rear brake rotor is a composite cast iron ventilated rotor. The rear brake rotor has a stamped sheet metal flange which is insert cast. The internal fins or vanes between the friction surfaces radiate from the center of the rotor to the outer edge of the rotor. This design enables the rotor to act as its own cooling fan.

Rear Brake Caliper



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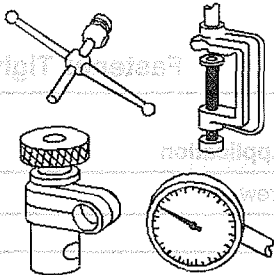
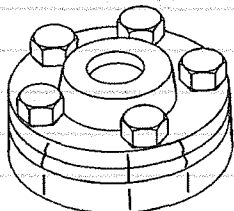
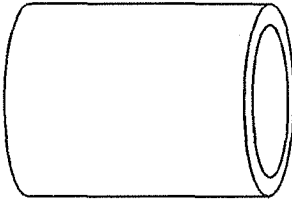
The rear brake caliper has a single piston (1) in an aluminum housing (2). The housing is suspended in an anchor bracket (3) on two guide pins (4). The caliper mounts to the steering knuckle with two mounting bolts. Applying the brake pedal creates hydraulic pressure. This pressure exerts equally against the bottom of the piston and against the bottom of the cylinder bore. The pressure applied to the piston transmits to the brake pads (5). The brake pads clamp down on the rotor, creating friction in order to stop the car.

Application of the parking brake causes the following components to move outward:

- The pushrod (23)
- The actuating collar (10)
- The clamp rod (19)

The outward motion of the above components causes the caliper to move inward. Inward motion of the caliper forces the brake pads against the rotor in order to hold the vehicle in place. The parking brake mechanism is completely independent of the hydraulic braking system.

Special Tools and Equipment

Illustration	Tool Number/ Description
	J 8001 Dial Indicator Set
	J 37160-A Brake Rotor Mounting Adapter
	J 37160-50 Brake Rotor Mounting Adapter Arbor