Disc Brakes

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve	17 N•m	13 lb ft
Brake Caliper Bracket Bolt	100 N•m	74 lb ft
Brake Caliper Guide Pin Bolt	28 N•m	21 lb ft
Brake Hose Fitting Bolt	40 N•m	30 lb ft
Brake Pipe Fitting	18 N•m	13 lb ft
Brake Rotor Bolt	9 N•m	80 lb in
Brake Shield Bolt	9 N•m	80 lb in

Disc Brake Component Specifications

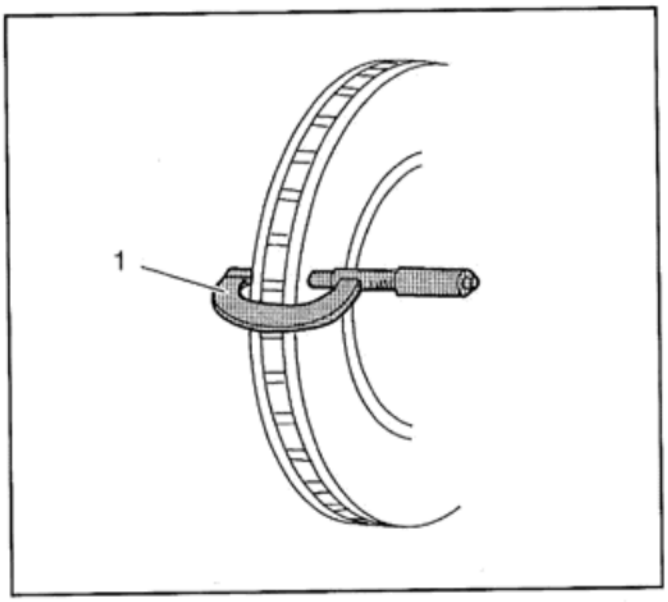
Application	Specification	
	Metric	English
Front Rotor		
Rotor Diameter	276.0 mm	10.866 in
Rotor Discard Thickness*	23.0 mm	0.905 in
Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in
Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
Rotor Maximum Allowable Thickness Variation	0.02 mm	0.0008 in
Rotor Minimum Allowable Thickness After Refinish	24.0 mm	0.945 in
Rotor Thickness New	26.0 mm	1.024 in
Rear Rotor		
Rotor Diameter	268.0 mm	10.551 in
Rotor Discard Thickness*	10.0 mm	0.393 in
Rotor Maximum Allowable Assembled Lateral Runout	0.05 mm	0.002 in
Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
Rotor Maximum Allowable Thickness Variation	0.02 mm	0.0008 in
Rotor Minimum Allowable Thickness After Refinish	10.2 mm	0.402 in
Rotor Thickness New	12.0 mm	0.472 in
* All brake rotors have a minimum thickness dimension cast into them. Replace any rotor that is worn or machined below this specification.		

Diagnostic Information and Procedures

Brake Rotor Thickness Measurement

Warning: Refer to Brake Dust Warning on page 0-4.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to *Front Disc Brake Pads Replacement on page 5-61*.



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2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Using a micrometer (1) calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the thickness of the brake rotor at four or more points, evenly spaced around the brake rotor.

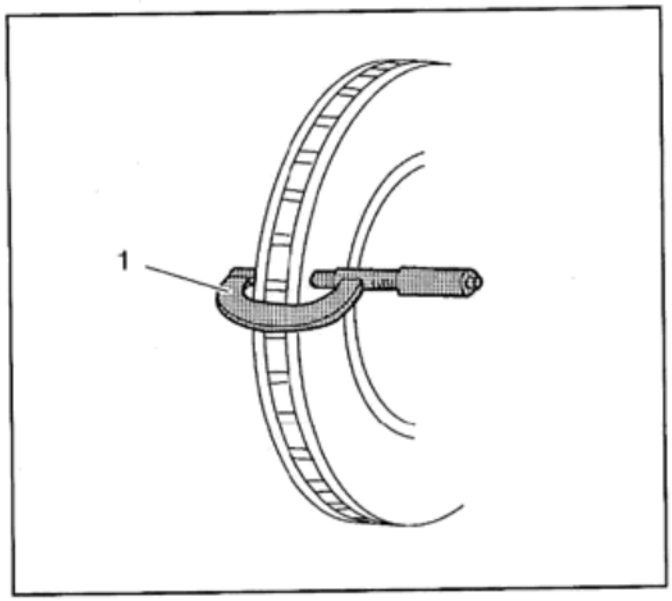
   Make sure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the brake rotor, about 13 mm (1/2 in), for each measurement.
4. Compare the lowest thickness measurement recorded to the specifications. Refer to *Disc Brake Component Specifications on page 5-54*.
5. If the lowest thickness measurement of the brake rotor is above the minimum allowable thickness after refinishing specification, the brake rotor may be able to be refinished, depending upon surface and wear conditions which may be present.
6. If the lowest thickness measurement of the brake rotor is at or below the discard thickness specification, the brake rotor requires replacement.

Brake Rotor Thickness Variation Measurement

Warning: Refer to Brake Dust Warning on page 0-4.

Note: Any disc brake rotor that exhibits thickness variation exceeding the maximum acceptable level must be refinished or replaced. Thickness variation exceeding the maximum acceptable level can cause brake pulsation.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to *Front Disc Brake Pads Replacement on page 5-61*.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.



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3. Using a micrometer (1) calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the thickness of the brake rotor at 4 or more points, evenly spaced around the brake rotor.

   Make sure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the brake rotor, about 13 mm (1/2 in), for each measurement.
4. Calculate the difference between the highest and lowest thickness measurements recorded to obtain the amount of thickness variation.

Note: Whenever a brake rotor is refinished or replaced, the assembled lateral runout (LRO) of the brake rotor must be measured to make sure optimum performance of the disc brakes.

5. Compare the thickness variation measurement to the following specification:

Specification

- J93, J94: **0.02 mm (0.0008 in)**
- JPW, J97: **0.02 mm (0.0008 in)**

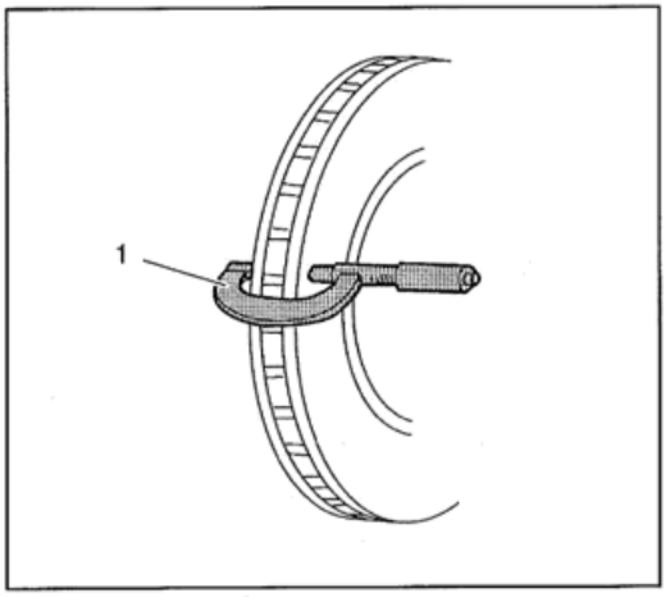
6. If the brake rotor thickness variation measurement exceeds the specification, the brake rotor requires refinishing or replacement.

Brake Rotor Surface and Wear Inspection

Warning: Refer to Brake Dust Warning on page 0-4.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to *Front Disc Brake Pads Replacement on page 5-61*.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Inspect the friction surfaces of the brake rotor for the following braking surface conditions:
   - Heavy rust and/or pitting

     Light surface rust can be removed with an abrasive disc. Heavy surface rust and/or pitting must be removed by refinishing the brake rotor.
   - Cracks and/or heat spots
   - Too much blueing discoloration
4. If the friction surfaces of the brake rotor exhibit one or more of the braking surface conditions, the brake rotor requires refinishing or replacement.



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5. Using a micrometer (1) calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the scoring depth of any grooves present on the brake rotor friction surfaces.
6. Compare the groove scoring depth recorded to the following specification:

   Specification

   Brake rotor maximum allowable scoring: 1.50 mm (0.059 in) .
7. If the brake disc rotor scoring depth exceeds the specification, or if an excessive amount of scoring is present, the brake rotor requires refinishing or replacement.

Brake Rotor Assembled Lateral Runout Measurement

Special Tools

- *CH-41013* Rotor Surfacing Kit
- *CH-42450-A* Wheel Hub Resurfacing Kit
- *CH-45101* Hub and Wheel Runout Gauge
- *CH-45101-100* Conical Brake Rotor Washers

For equivalent regional tools, refer to *Special Tools on page 5-86*.

Warning: Refer to Brake Dust Warning on page 0-4.

Note:

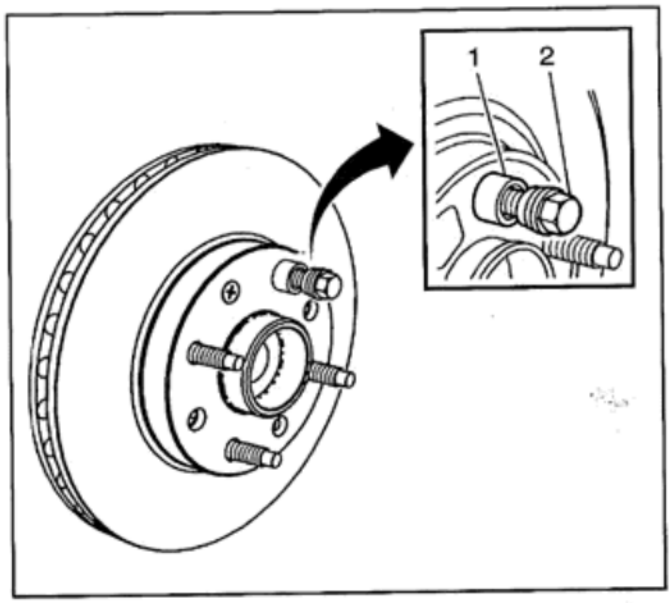
- Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4,800–11,300 km (3,000–7,000 mi).
- Brake rotor thickness variation MUST be inspected BEFORE inspecting for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to *Brake Rotor Thickness Variation Measurement on page 5-55*.

1. Matchmark the position of the brake rotor to the wheel studs if this has not been done already.

Note: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

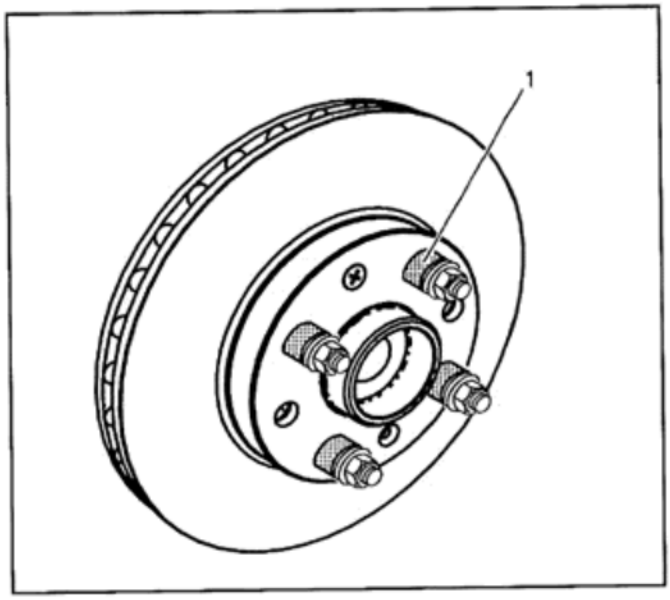
2. Inspect the mating surface of the hub/axle flange and the brake rotor to make sure that there are no foreign particles, corrosion, rust, or debris remaining. If the wheel hub/axle flange and/or brake rotor mating surfaces exhibit these conditions, perform the following steps:
   2.1. Remove the brake rotor from the vehicle. Refer to *Front Brake Rotor Replacement on page 5-77*.
   2.2. Using the *CH-42450-A* wheel hub resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
   2.3. Using the *CH-41013* rotor resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the brake rotor.
   2.4. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

3. Install the rotor to the hub/axle flange using the matchmark made prior to removal.



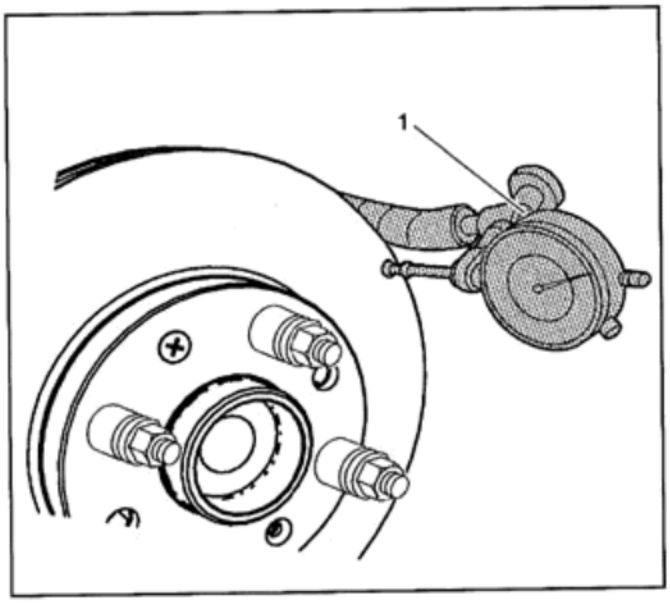
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4. Hold the brake rotor firmly in place against the hub/axle flange and install one of the *CH-45101-100* conical brake rotor washers (1), and one lug nut (2) onto the upper-most wheel stud.
5. Continue to hold the brake rotor secure and tighten the lug nut firmly by hand.



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6. Install the remaining *CH-45101-100* conical brake rotor washers (1) and lug nuts onto the wheel studs and tighten the nuts firmly by hand in the tightening sequence.
7. Tighten the lug nuts in sequence, in order to properly secure the rotor. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
8. If the brake rotor has been REFINISHED or REPLACED with a new rotor, proceed to step 14.
9. If the brake rotor meets the following criteria, proceed to step 10.
   - The rotor is within specifications and is being REUSED.
   - The rotor has NOT been refinished.
   - The rotor does not exhibit thickness variation exceeding the maximum allowable level.



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10. Mount a dial indicator, *CH-45101* hub and wheel runout gauge (1), or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
11. Measure and record the assembled LRO of the brake rotor:
    11.1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    11.2. Rotate the rotor until the highest reading is displayed on the dial.
    11.3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    11.4. Measure and record the amount of assembled LRO.
12. Compare the brake rotor assembled LRO to the following specification:

    Specification

    Front brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)
13. If the brake rotor assembled LRO is within specifications, proceed to step 18.

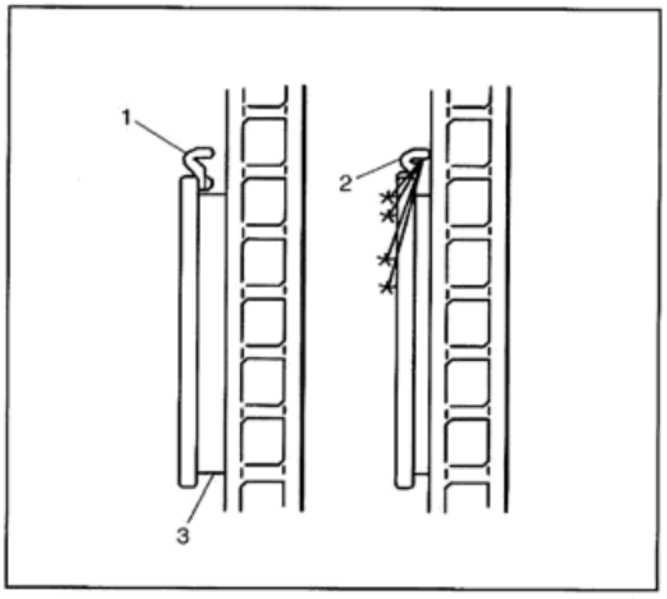
    If the brake rotor assembled LRO exceeds the specification, refinish the rotor to ensure true parallelism. Refer to *Brake Rotor Refinishing on page 5-85*. After refinishing the rotor, proceed to step 14.

14. Mount a dial indicator, *CH-45101* hub and wheel runout gauge, or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
15. Measure and record the assembled LRO of the brake rotor.
    15.1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    15.2. Rotate the rotor until the highest reading is displayed on the dial.
    15.3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    15.4. Measure and record the amount of assembled LRO.
16. Compare the brake rotor assembled LRO to the following specification:

    Specification

    Front brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in) .
17. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to *Brake Rotor Assembled Lateral Runout Correction on page 5-83*.
18. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the brake rotor in place before removing the *CH-45101-100* conical brake rotor washers and the lug nuts.

Brake Pad Inspection

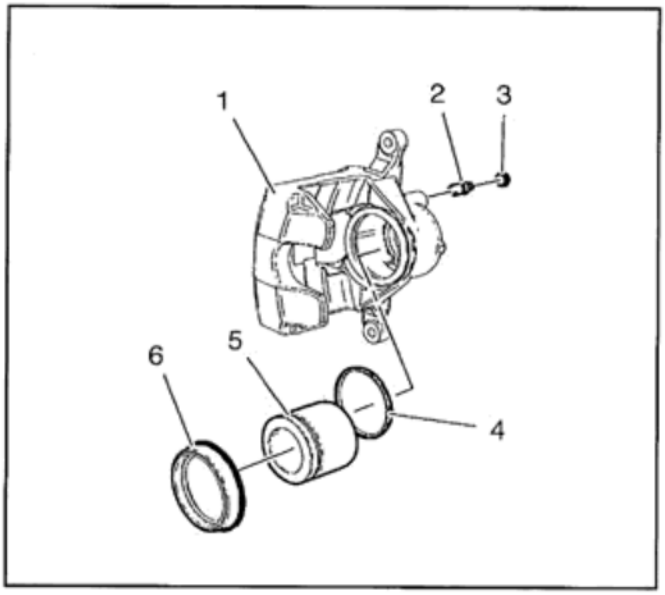


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Warning: Refer to Brake Dust Warning on page 0-4.

1. Inspect the disc brake pads at regular intervals, or whenever the tire and wheel assemblies are removed from the vehicle.
2. If replacement is necessary, always replace disc brake pads in axle sets.
3. Inspect both edges of the disc brake pad friction surfaces (3). The highest rate of wear normally occurs at the trailing edge of the disc brake pads.
4. Inspect the thickness of the disc brake pads (3) in order to ensure that they have not worn prematurely. The disc brake pad wear should be approximately even per axle set.
5. Front brake pads have integral, audible wear sensors (1). When the disc brake pad wear reaches the minimum allowable thickness, the wear sensor contacts the disc brake rotor (2). The wear indicator will then produce an audible, high-pitched warning noise during wheel rotation.
6. Replace the disc brake pads when the friction surface (3) is worn to within 2.00 mm (0.079 in) of the mounting plates.
7. Verify that any disc brake pad shims that may be required are in place and not damaged or excessively corroded. Replace any missing or damaged shims in order to preserve proper disc brake performance.
8. Replace the disc brake pads if any have separated from the mounting plates.
9. Inspect the disc brake pads friction surfaces for cracks, fractures, or damage which may cause noise or otherwise impair disc brake performance.

Brake Caliper Inspection

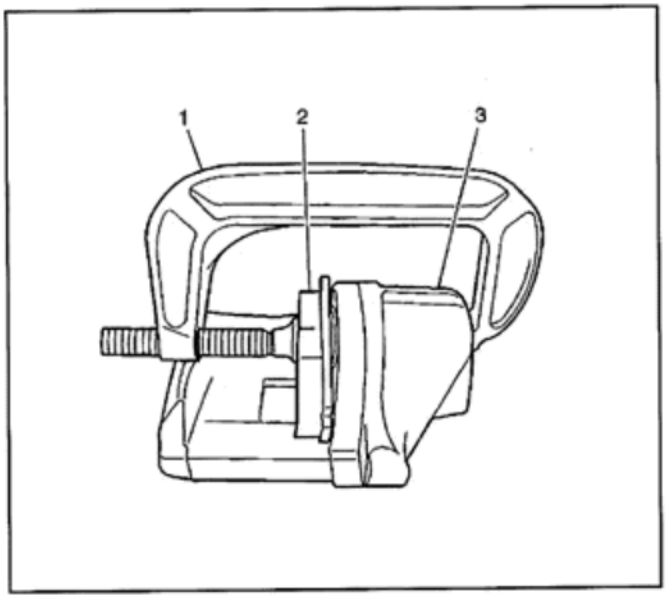


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Warning: Refer to Brake Dust Warning on page 0-4.

1. Inspect the brake caliper housing (1) for cracks, excess wear, and/or damage. If any of these conditions are present, the brake caliper requires replacement.

2. Inspect the caliper piston dust boot seal (2) for cracks, tears, cuts, deterioration and/or improper seating in the caliper body. If any of these conditions are present, the brake caliper requires overhaul or replacement.
3. Inspect for brake fluid leakage around the caliper piston dust boot seal (6) and on the disc brake pads. If there is any evidence of brake fluid leakage, the brake caliper requires overhaul or replacement.

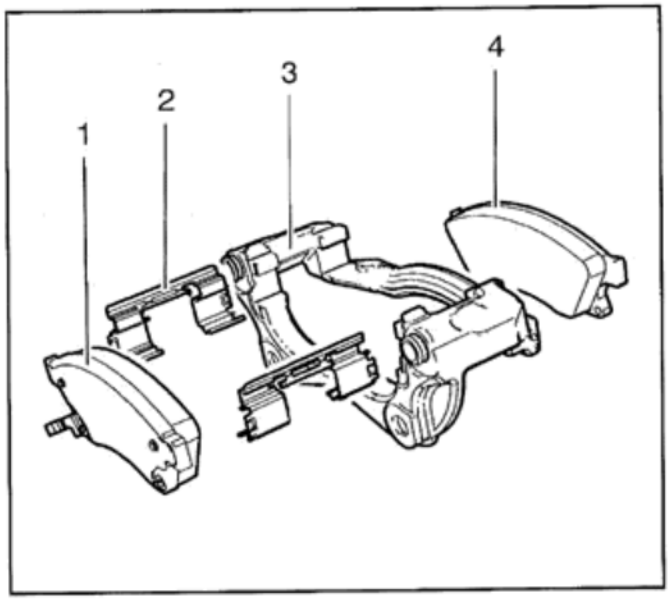


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4. Inspect for smooth and complete travel of the caliper pistons into the caliper bores:
   - The movement of the caliper pistons into the caliper bores should be smooth and even. If the caliper piston is frozen or difficult to bottom, the caliper requires overhaul or replacement.
   - Insert a discarded inner brake pad (2) or block of wood in front of the piston. Using a large C-clamp (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the piston in the bore.

Front Disc Brake Mounting and Hardware Inspection

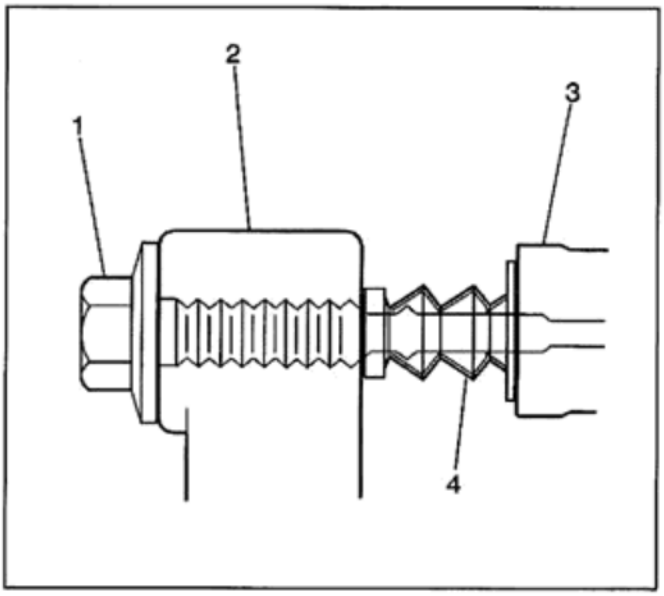
Warning: Refer to Brake Dust Warning on page 0-4.



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1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level then no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level then remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
5. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
6. Grasp the brake caliper housing and try to move the brake caliper housing up/down and forward/reverse in relation to the brake caliper mounting bracket (3). If excessive looseness is observed the brake caliper bracket bushings and/or the brake caliper mounting bolts may need to be replaced.
7. Compress the front caliper pistons.
   7.1. Install a large C-clamp over the top of the caliper housing and against the back of the outboard pad (1).
   7.2. Slowly tighten the C-clamp until the pistons are pushed completely into the caliper bores.
   7.3. Remove the C-clamp from the caliper.

8. With the pistons compressed into the caliper bores, grasp the brake caliper housing and slide it back and forth on the brake caliper mounting bolts. Check for smooth operation. If the brake caliper housing slide force is high or the brake caliper housing does not slide smoothly, inspect the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings for wear or damage. If wear or damage conditions are found, replacement of the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings is necessary.
9. Remove the brake caliper mounting bolts from the brake caliper mounting bracket and support the brake caliper using heavy mechanics wire. Do Not remove the hydraulic brake hose from the caliper. Refer to *Front Brake Caliper Replacement on page 5-65*.
10. Remove the disc brake pads (1, 2) from the brake caliper mounting bracket (3).
11. Inspect the disc brake pad mounting hardware for the following:
    - Missing mounting hardware.
    - Excessive corrosion.
    - Bent pad retainer spring (2).
    - Looseness at the brake caliper mounting bracket (3).
    - Looseness at the disc brake pads (1, 4).
    - Excessive contaminants in the brake caliper mounting bracket (3) surface and threads.
12. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
13. Ensure the disc brake pads are held firmly in place on the brake caliper mounting bracket, yet slide easily on the mounting hardware without binding.



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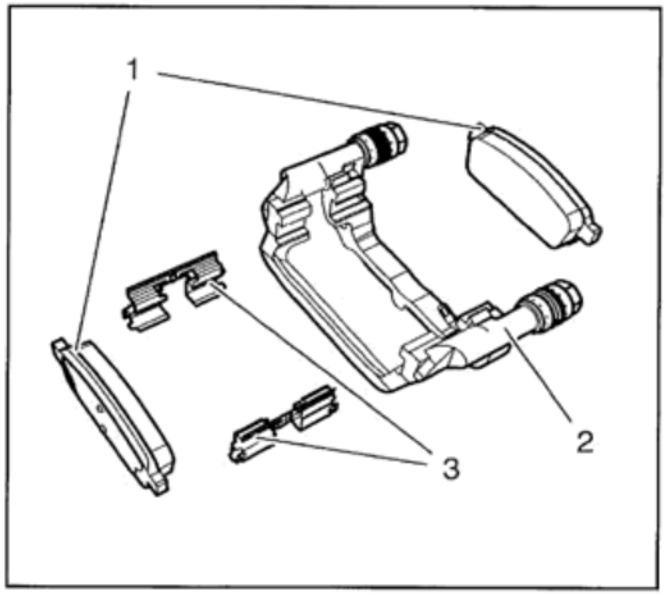
14. Inspect the caliper bolts (1) for the following:
    - Binding
    - Seizing
    - Looseness in the brake caliper mounting bracket (3).
    - Bent or damaged brake caliper mounting bolts (1).
    - Cracked or torn boots (4).
    - Missing boots.
    - Bent or damaged brake caliper mounting bracket (3).
    - Cracked or damaged brake caliper (2).
15. If any of the conditions listed are found then the brake caliper mounting hardware requires replacement.
16. Install the disc brake pads to the brake caliper mounting bracket.
17. Install the disc brake caliper to the brake caliper mounting bracket. Refer to *Front Brake Caliper Replacement on page 5-65*.

Rear Disc Brake Mounting and Hardware Inspection

Warning: Refer to Brake Dust Warning on page 0-4.

Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

1. Without disconnecting the hydraulic brake hose fitting, remove rear brake caliper and support with heavy mechanics wire. Refer to *Rear Disc Brake Pads Replacement on page 5-63*.



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2. Remove the disc brake pads (1) from the brake caliper mounting bracket (2).
3. Inspect the disc brake pad mounting hardware (3) for the following:
    - Missing mounting hardware.
    - Excessive corrosion.

- Bent pad retainer spring.
- Looseness at the brake caliper bracket.
- Looseness at the disc brake pads.
- Excessive contaminants in the brake caliper bracket surface and caliper bracket bolt threaded holes.

4. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
5. Ensure the disc brake pads are held firmly in place on the caliper bracket, yet slide easily on the mounting hardware without binding.
6. Install the disc brake pads to the caliper bracket.
7. Install the rear brake caliper to the bracket. Refer to *Rear Disc Brake Pads Replacement on page 5-63*

Repair Instructions

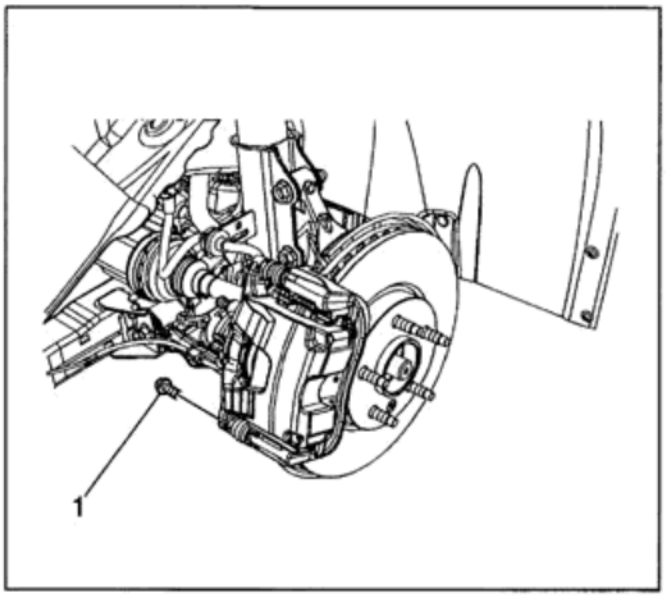
Front Disc Brake Pads Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

Note: Always replace disc brake pads in axle sets.

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
5. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
6. Place a large C-clamp over the brake caliper body and against the outer brake pad.
7. Using the C-clamp, compress the brake caliper piston fully into the brake caliper bore.



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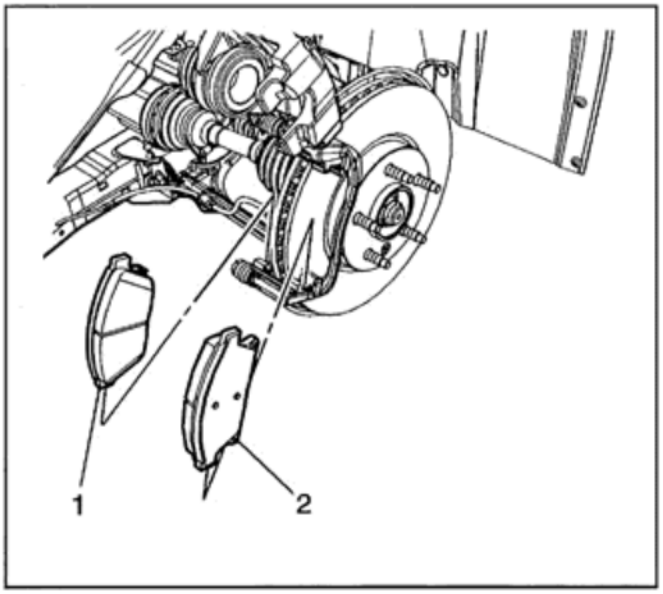
Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

8. Using a backup wrench to hold the brake caliper guide pin stationary, remove the lower brake caliper guide pin bolt (1).

Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

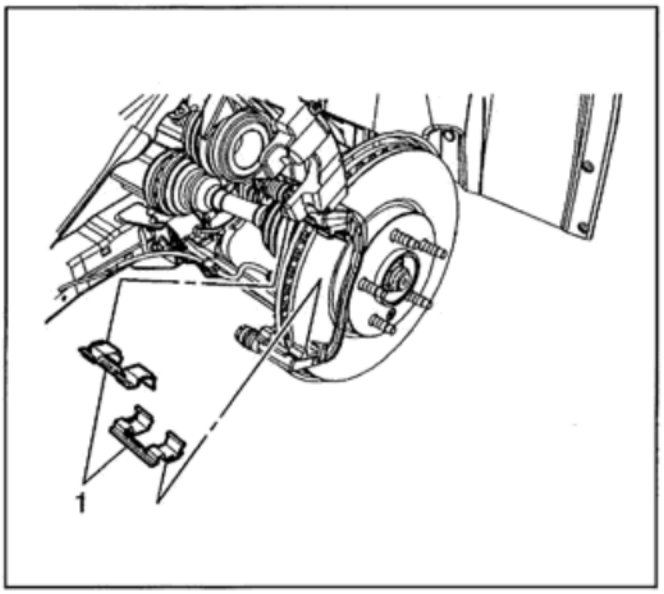
9. Rotate the brake caliper upward and support with heavy mechanics wire or equivalent.



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Note: Note the location of the brake pad wear sensor for correct installation.

10. Remove the inner brake pad (1).
11. Remove the outer brake pad (2).

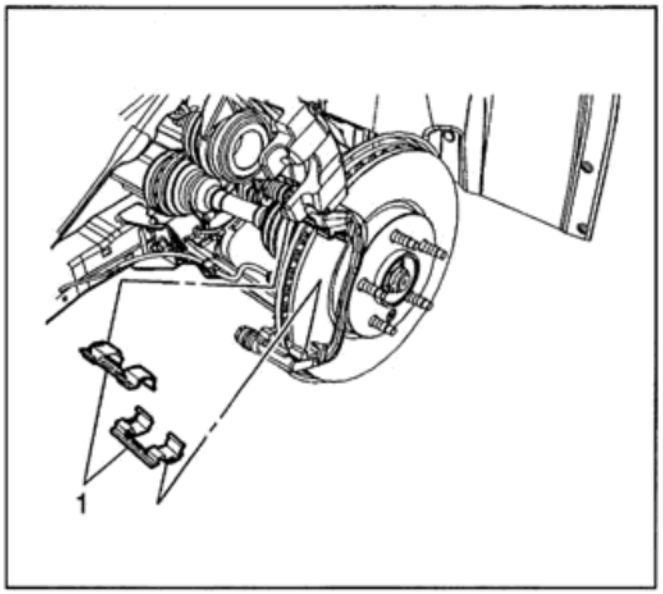


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12. Remove the upper and lower brake pad springs (1).
13. If installing new brake pads, discard the brake pad springs.

Installation Procedure

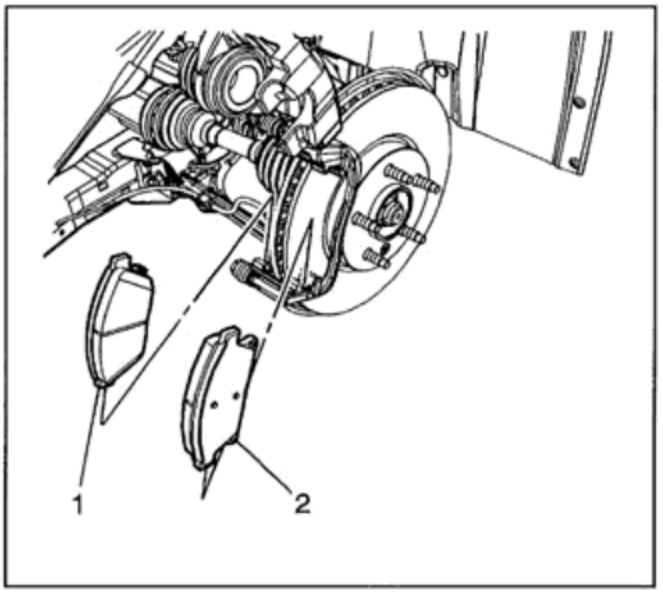
1. Thoroughly clean the contact surfaces of the brake caliper bracket of any corrosion or debris.



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Note: If installing new brake pads, install new brake pad springs.

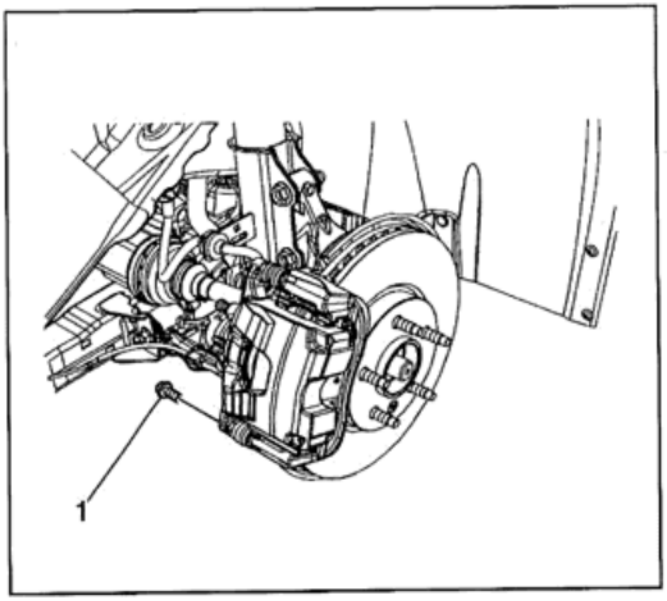
2. Install the upper and lower brake pad springs (1).



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Note: Note the location of the brake pad wear sensor for correct installation.

3. Install the inner brake pad (1).
4. Install the outer brake pad (2).
5. Position the brake caliper over the brake pads and to the caliper bracket.



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Caution: Refer to *Fastener Caution on page 0-8*.

6. Using a backup wrench to hold the brake caliper guide pin stationary, install the lower brake caliper guide pin bolt (1) and tighten to **28 N•m (21 lb ft)**.
7. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
8. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
9. Slowly release the brake pedal.
10. Wait 15 seconds, then repeat steps 8-9 until a firm brake pedal is obtained. This will properly seat the brake caliper piston and brake pads.
11. Fill the master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling on page 5-145*.
12. Burnish the brake pads and rotors. Refer to *Brake Pad and Rotor Burnishing on page 5-65*.

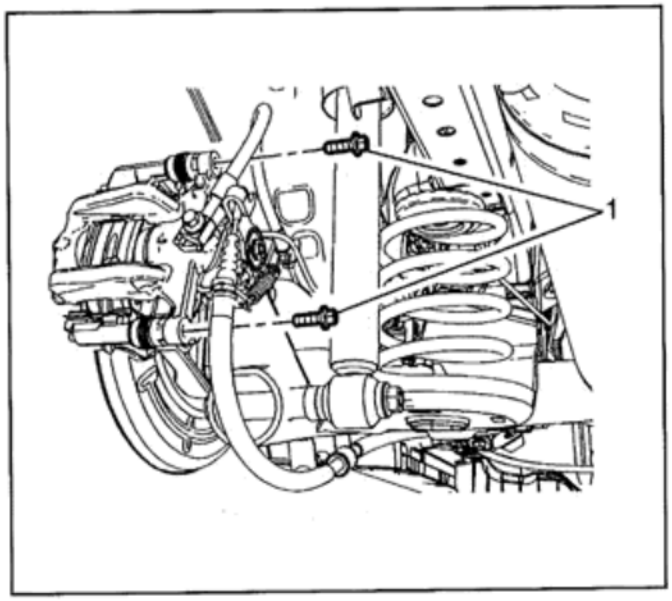
Rear Disc Brake Pads Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

Note: Always replace disc brake pads in axle sets.

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
5. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.



2843743

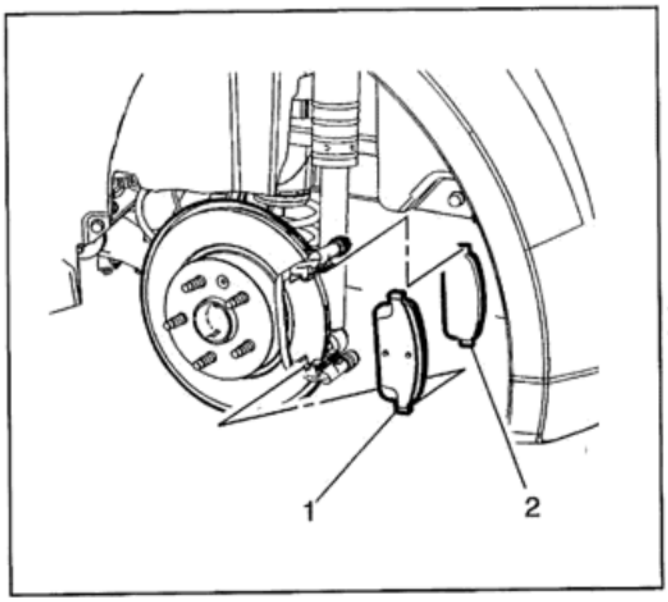
Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

6. Using a backup wrench to hold the brake caliper guide pins stationary, remove the brake caliper guide pin bolts (1).

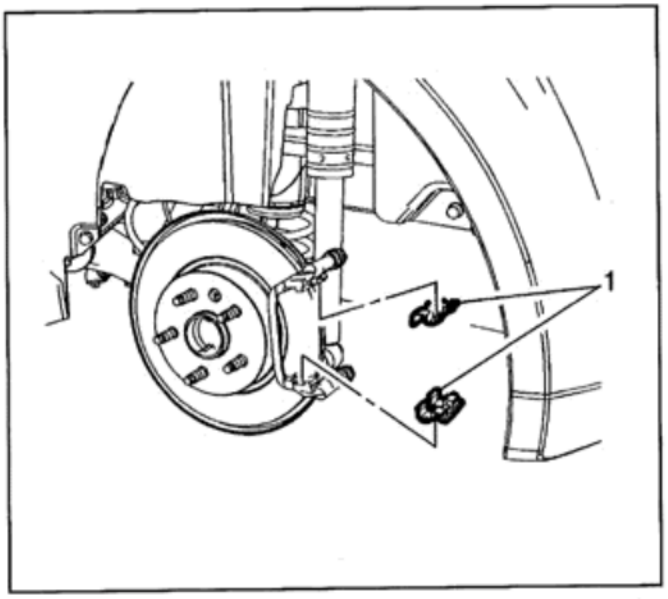
Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

7. Remove the brake caliper and support with heavy mechanics wire.



2843745

8. Remove the outer disc brake pad (1).
9. Remove the inner disc brake pad (2).



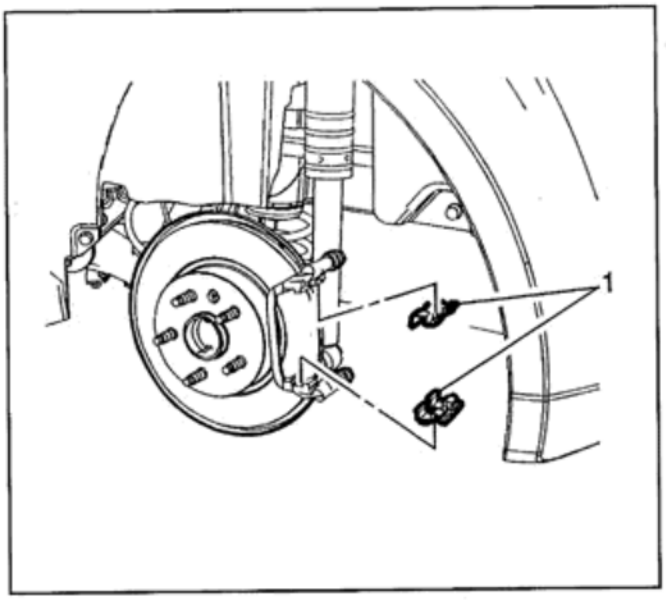
2843746

Note: If replacing the disc brake pads, discard the springs.

10. Remove the disc brake pad springs (1).

Installation Procedure

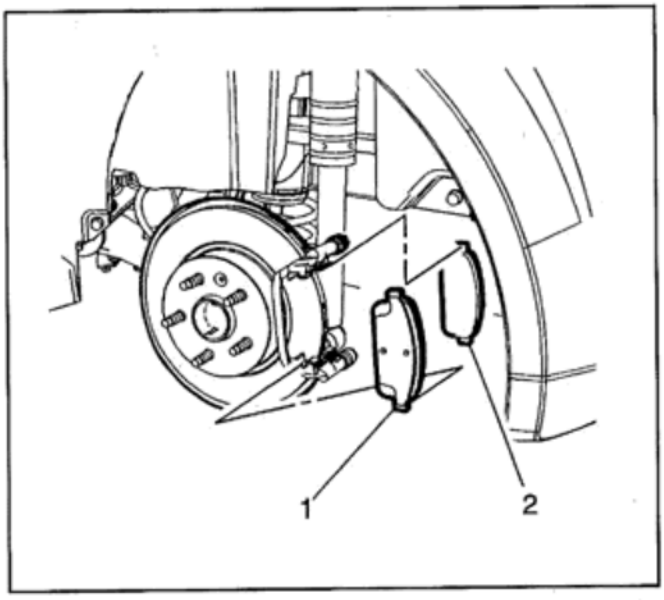
1. Using a brake caliper piston spanner tool, rotate the caliper piston clockwise while applying pressure to the face of the caliper piston to compress the piston into the caliper bore.
2. Thoroughly clean the contact surfaces of the brake caliper bracket of any corrosion or debris.



2843746

Note: If installing new brake pads, install new brake pad springs.

3. Install the disc brake pad springs (1).

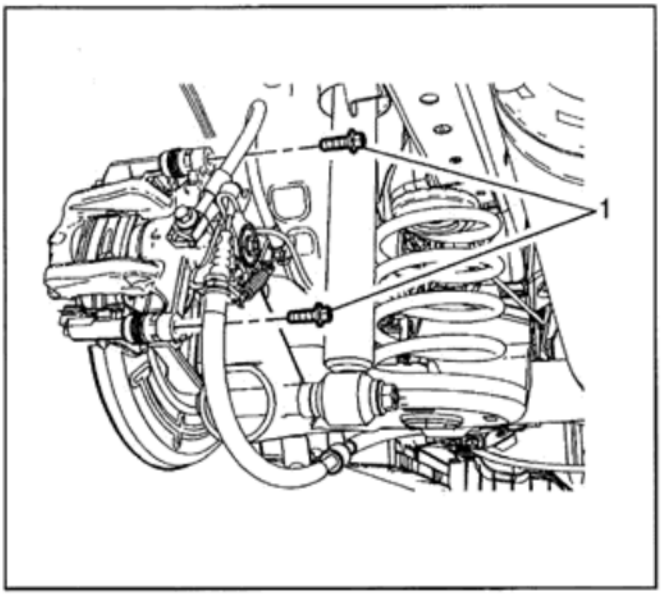


2843745

4. Install the outer disc brake pad (1).
5. Install the inner disc brake pad (2).

Note: Ensure the notches in the caliper piston are properly aligned with the pins on the disc brake pad backing plate.

6. Position the brake caliper over the disc brake pads and to the caliper bracket.



2843743

Caution: Refer to *Fastener Caution on page 0-8*.

7. Using a backup wrench to hold the brake caliper guide pins stationary, install the brake caliper guide pin bolts (1) and tighten to **28 N•m (21 lb ft)**.
8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
9. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
10. Slowly release the brake pedal.
11. Wait 15 seconds, then repeat steps 9-10 until a firm brake pedal is obtained. This will properly seat the brake caliper piston and brake pads.
12. Fill the master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling on page 5-145*.
13. Burnish the brake pads and rotors. Refer to *Brake Pad and Rotor Burnishing on page 5-65*.

Brake Pad and Rotor Burnishing

Warning: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

Burnishing the brake pads and brake rotors is necessary in order to ensure that the braking surface are properly prepared after service has been performed on the disc brake system.

This procedure should be performed whenever the disc brake rotors have been refinished or replaced, and/or whenever the brake pads have been replaced.

1. Select a smooth road with little or no traffic.
2. Accelerate the vehicle to 48 km/h (30 mph).

Note: Use care to avoid overheating the brakes while performing this step as it may adversely affect the heating characteristics of the NEW brake pad material.

3. Using moderate pressure, apply the brakes to bring the vehicle to a stop. Do not allow the brakes to lock.
4. Repeat steps 2 and 3 until approximately 20 stops have been completed. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

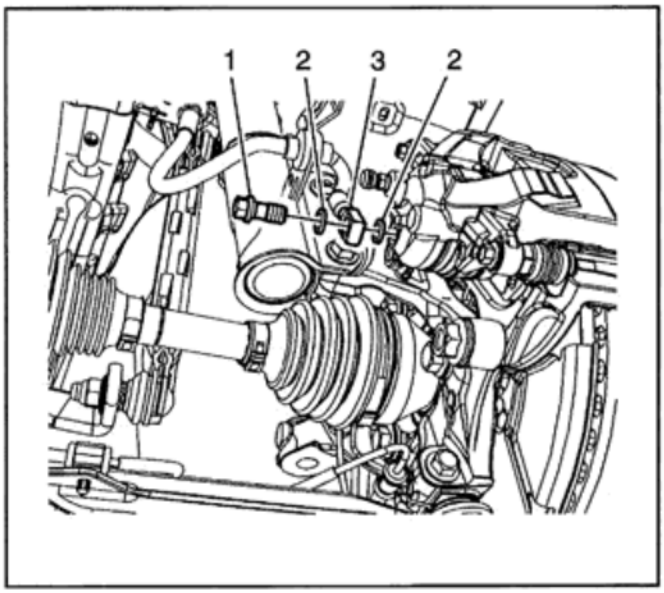
Front Brake Caliper Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.

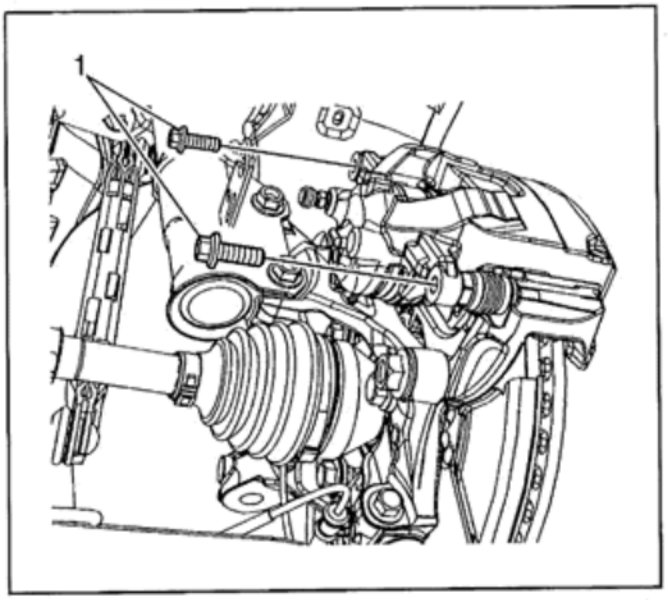


2375918

3. Remove the brake hose fitting bolt (1).

Note: Do not reuse the brake hose fitting gaskets.

4. Remove and discard the brake hose fitting gaskets (2) from the brake hose fitting (3).
5. Cap the brake hose fitting to prevent brake fluid loss and contamination.



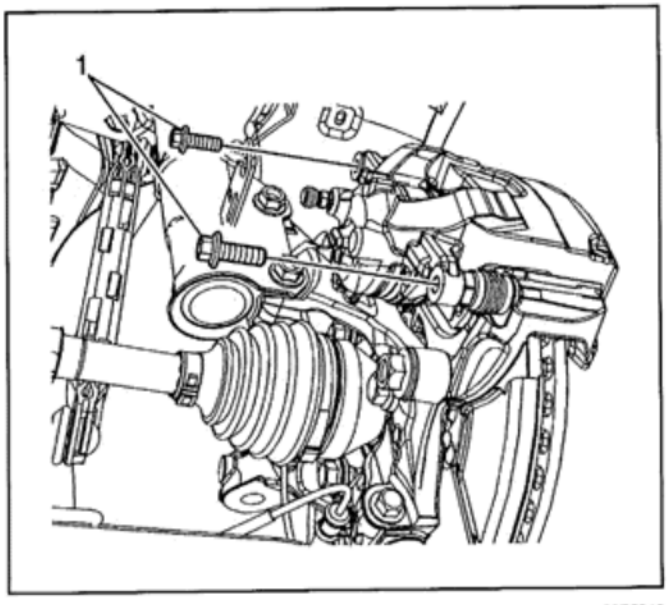
2375919

Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

6. Using a backup wrench to hold the brake caliper guide pin stationary, remove the brake caliper guide pin bolts (1).
7. Remove the brake caliper.

Installation Procedure

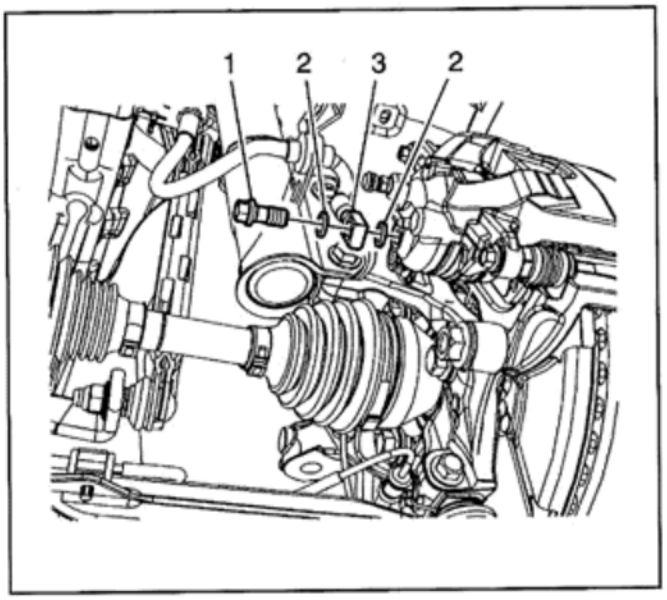


2375919

1. Position the brake caliper over the brake pads and to the caliper bracket.

Caution: Refer to *Fastener Caution on page 0-8.*

2. Using a backup wrench to hold the brake caliper guide pin stationary, install the brake caliper guide pin bolts (1) and tighten to **28 N•m (21 lb ft)**.



2375918

Note: Install new brake hose fitting gaskets.

3. Assemble the brake hose fitting bolt (1) and the 2 new brake hose fitting gaskets (2) to the brake hose fitting (3).
4. Install the brake hose assembly and tighten the brake hose fitting bolt to **40 N•m (30 lb ft)**.
5. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Pressure) on page 5-169* or *Hydraulic Brake System Bleeding (Manual) on page 5-170.*
6. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60.*

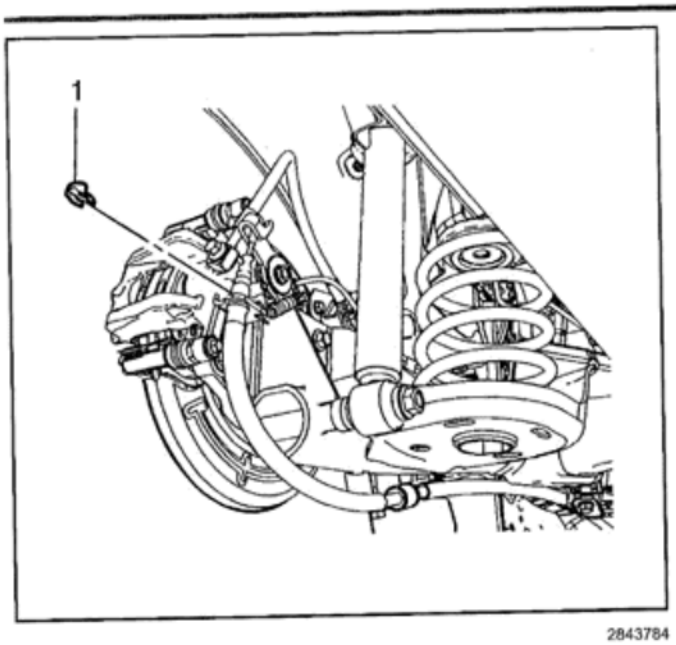
Rear Brake Caliper Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

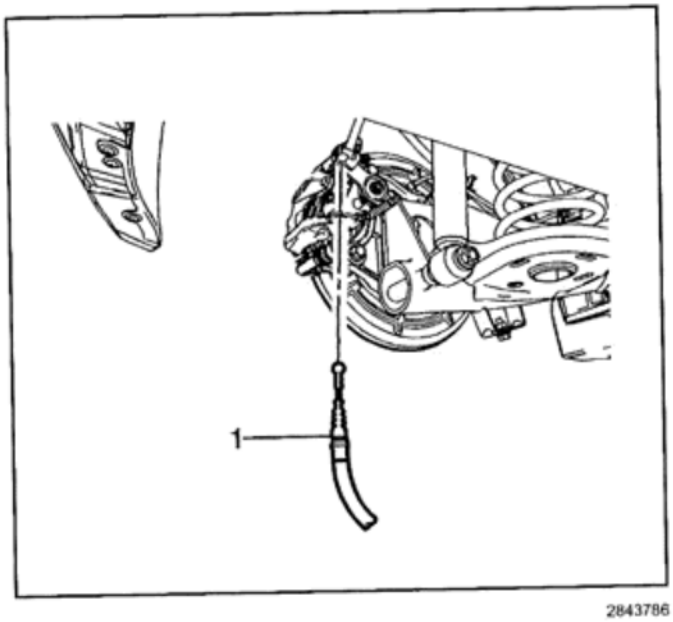
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31.*
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60.*



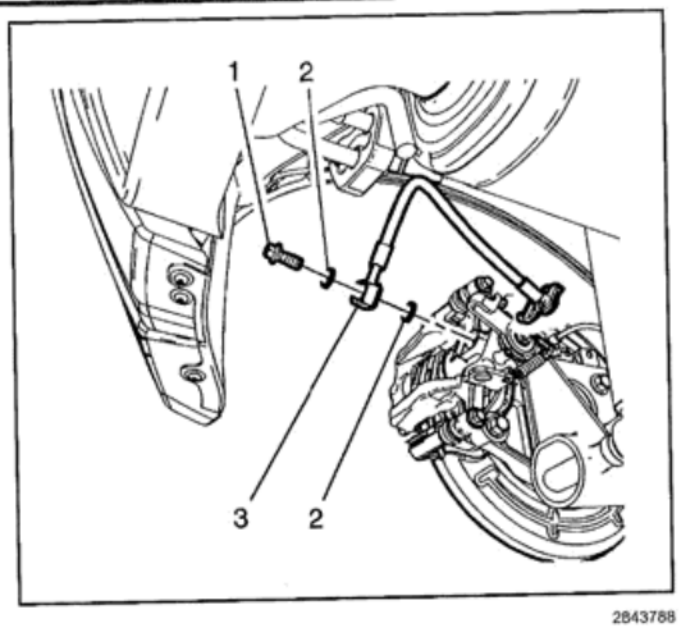
2843784

3. Remove the parking brake cable retaining clip (1) from the parking brake cable bracket.



2843786

4. Disconnect the parking brake cable (1) from the actuator lever, remove the cable from the bracket and position aside.

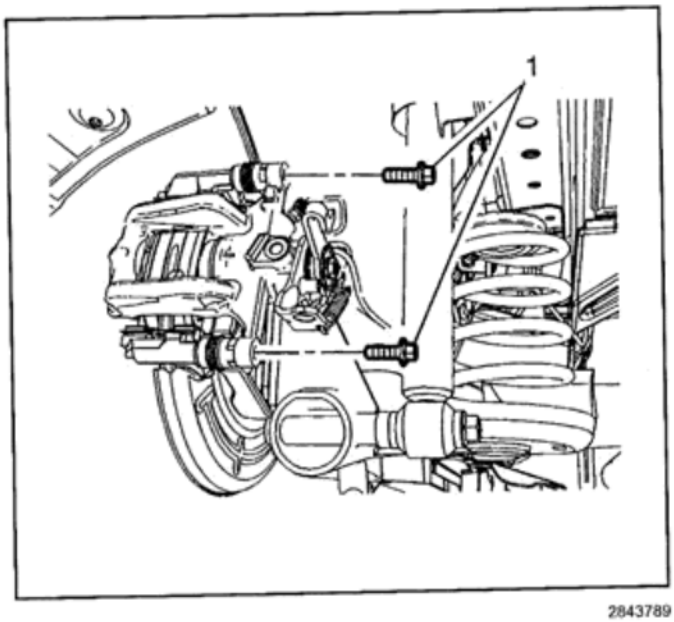


2843788

5. Remove the brake hose fitting bolt (1).

Note: Do not reuse the brake hose fitting gaskets.

6. Remove and discard the brake hose fitting gaskets (2) from the brake hose fitting (3).
7. Cap the brake hose fitting to prevent brake fluid loss and contamination.



2843789

Note:

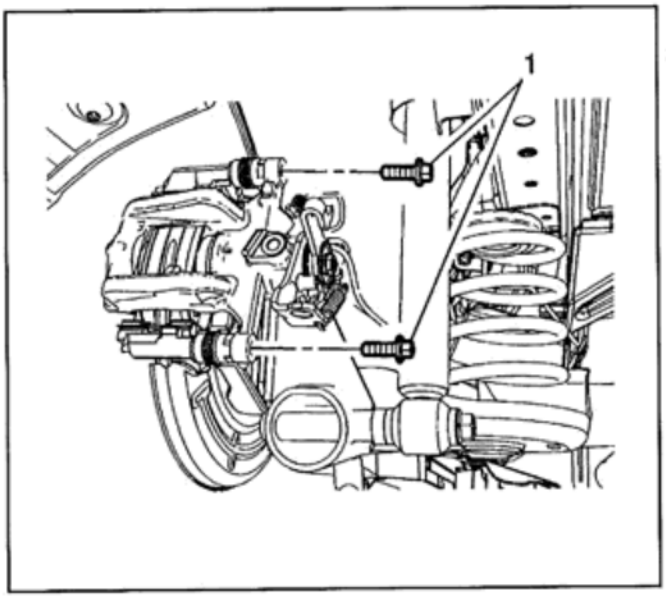
- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

8. Using a backup wrench to hold the brake caliper guide pins stationary, remove the brake caliper guide pin bolts (1).
9. Remove the brake caliper.

Installation Procedure

Note: The brake caliper piston must be fully retracted into the caliper bore before installation.

1. Using a brake caliper piston spanner tool, rotate the brake caliper piston clockwise while applying pressure to the face of the caliper piston to compress the piston into the caliper bore.



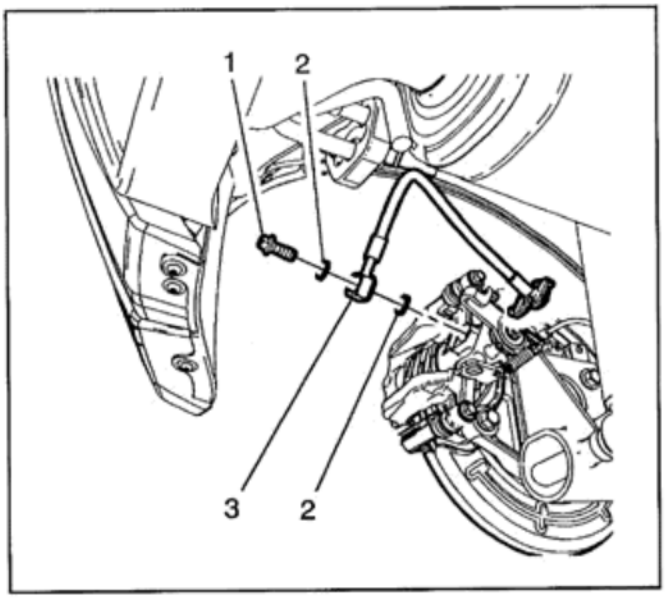
2843789

Note: Ensure the notches in the caliper piston are properly aligned with the pins on the disc brake pad backing plate.

2. Position the brake caliper over the brake pads and to the caliper bracket.

Caution: Refer to *Fastener Caution on page 0-8*.

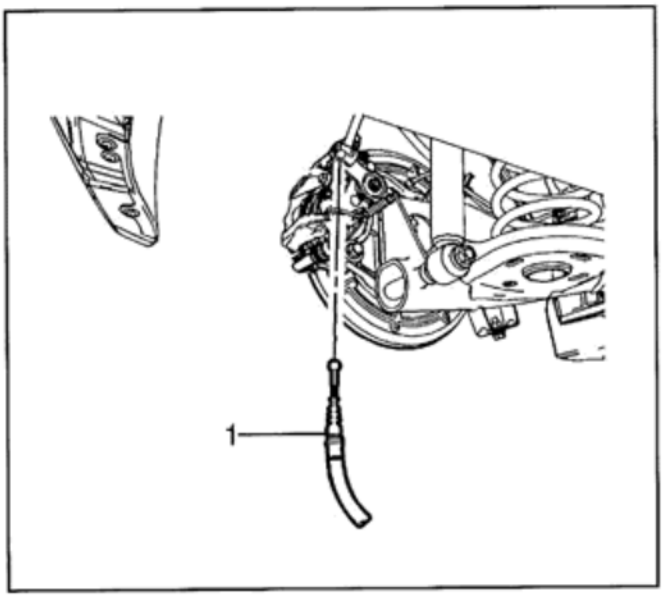
3. Using a backup wrench to hold the brake caliper guide pins stationary, install the brake caliper guide pin bolts (1) and tighten to **28 N•m (21 lb ft)**.



2843788

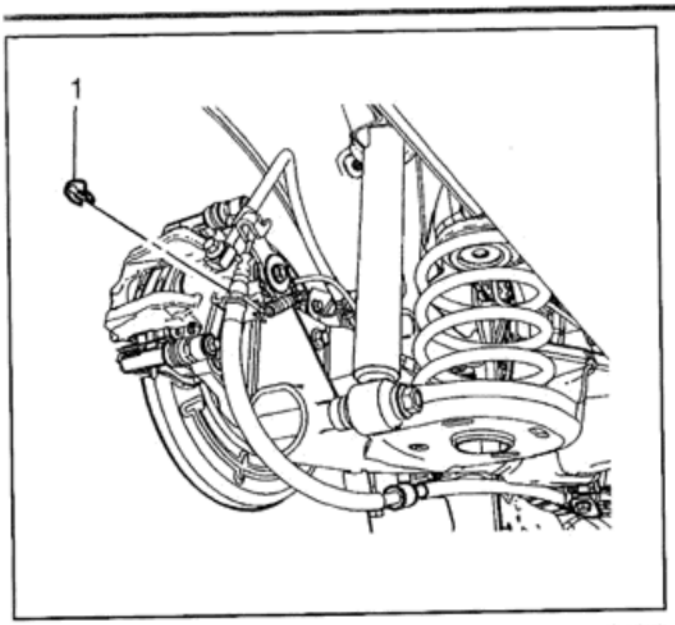
Note: Install new brake hose fitting gaskets.

4. Assemble the brake hose fitting bolt (1) and the new brake hose fitting gaskets (2) to the brake hose fitting (3).
5. Install the brake hose assembly and tighten the brake hose fitting bolt to **40 N•m (30 lb ft)**.



2843786

6. Install the parking brake cable (1) to the parking brake cable bracket and the actuator lever.



2843784

7. Install the parking brake cable retaining clip (1) from the parking brake cable bracket.
8. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Pressure) on page 5-169* or *Hydraulic Brake System Bleeding (Manual) on page 5-170*.
9. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.

Front Brake Caliper Overhaul

Disassembly Procedure

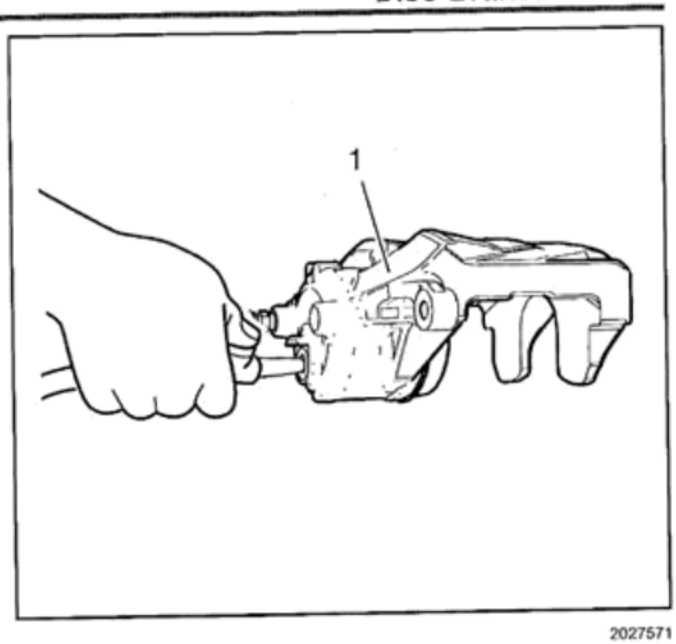
Warning: Refer to Brake Dust Warning on page 0-4.

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Warning: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.

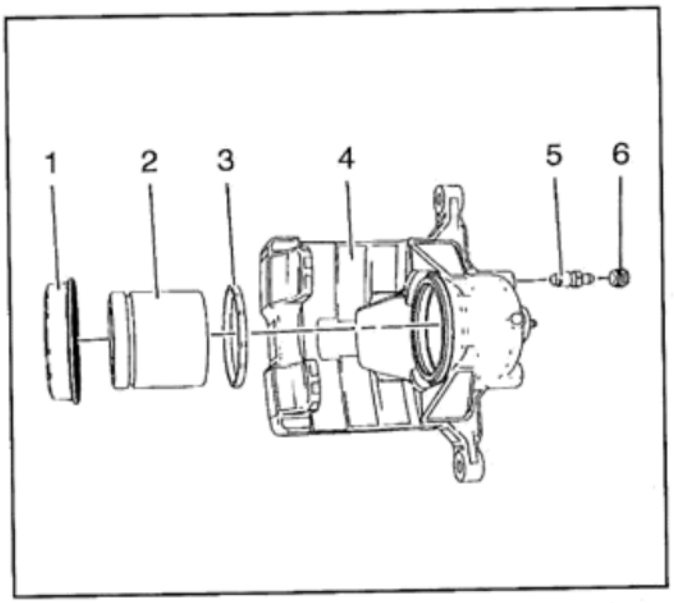
Caution: Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.

1. Remove the brake caliper from the vehicle. Refer to *Front Brake Caliper Replacement on page 5-65*.



2027571

2. Remove the brake caliper piston from the caliper bore by directing low pressure compressed air into the caliper (1) through the fluid inlet hole.



2027576

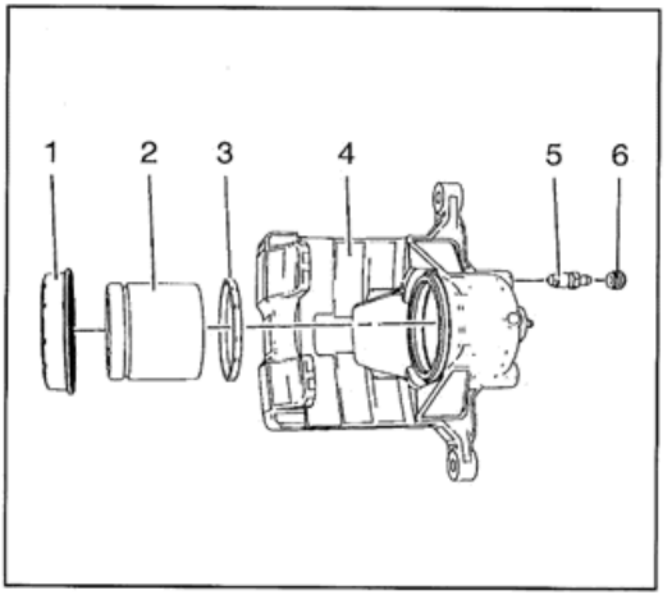
3. Remove the piston dust boot seal (1) from the seal counterbore in the caliper (4). Discard the boot seal.
4. Using a small wooden or plastic tool, remove the piston seal (3) from the caliper bore. Discard the piston seal.
5. Remove the bleeder valve cap (6).
6. Remove the bleeder valve (5).

Note: Do not use abrasives to clean the brake caliper piston.

7. If cracks, scoring, pitting, excessive rust, and/or excessive corrosion are present in the caliper bore, replace the caliper assembly.

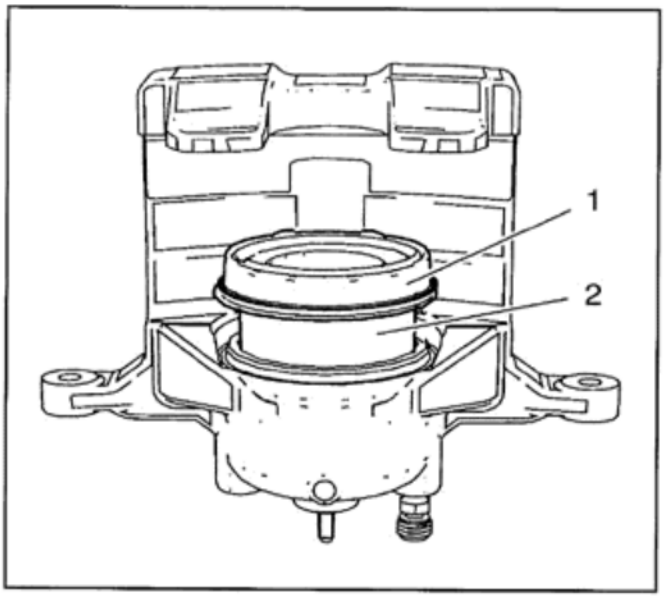
8. If light rust or light corrosion are present in the caliper bore, attempt to remove the imperfection with a fine emery paper. If the imperfection cannot be removed, replace the caliper assembly.
9. Clean the brake caliper piston bore and seal counterbore, and the caliper piston with denatured alcohol, or equivalent.
10. Dry the caliper piston bore and counterbore, and the piston with non-lubricated, filtered, compressed air.
11. Inspect the caliper piston for cracks, scoring, and/or damage to the plating. Replace the caliper piston if any of these conditions exist.
12. Inspect the caliper mounting holes for cracks, scoring, pitting, rust and/or excessive corrosion. Replace the caliper assembly if any of these conditions exist.

Assembly Procedure



2027576

1. Lubricate the new piston seal (3) with brake fluid from a clean, sealed brake fluid container.
2. Install the lubricated, new piston seal into the caliper bore.
3. Apply a thin coat of brake fluid from a clean, sealed brake fluid container.



2027577

4. Install the new piston dust boot seal (1) over the caliper piston (2).
5. Install the bottom half of the caliper piston into the caliper bore.
6. Compress the caliper piston to the bottom of the caliper bore.
7. Fully seat the piston dust boot seal into caliper counterbore.

Caution: Refer to *Fastener Caution on page 0-8.*

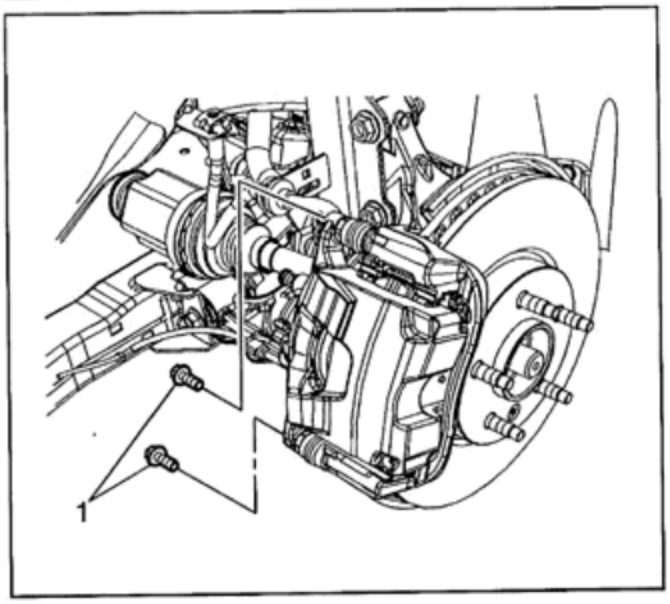
8. Install the bleeder valve to the caliper.
   - J93, J94: Tighten the valve to **17** N•m **(13 lb ft)**
   - JPW, J97: Tighten the valve to **9** N•m **(80 lb in)**
9. Install the bleeder valve cap.
10. Install the brake caliper to the vehicle. Refer to *Front Brake Caliper Replacement on page 5-65.*

Front Brake Caliper Bracket Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31.*
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60.*



2375920

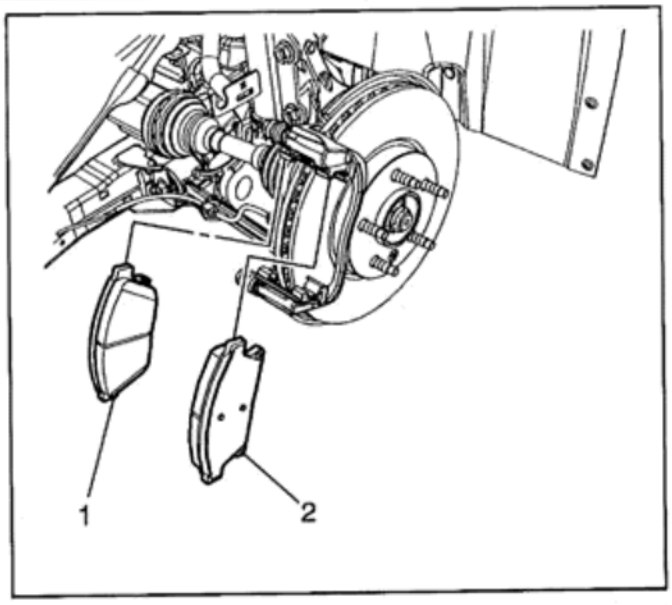
Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

3. Hold the brake caliper guide pin stationary and remove the brake caliper guide pin bolts (1).

Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

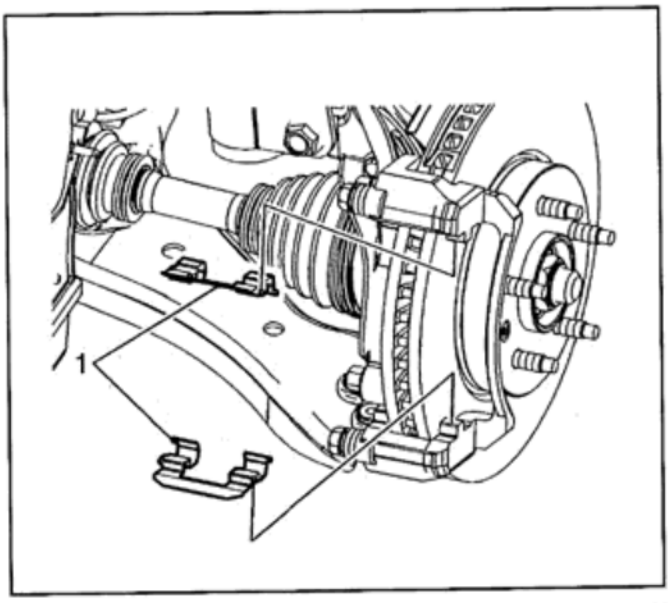
4. Remove the brake caliper and support with heavy mechanics wire or equivalent.



2375921

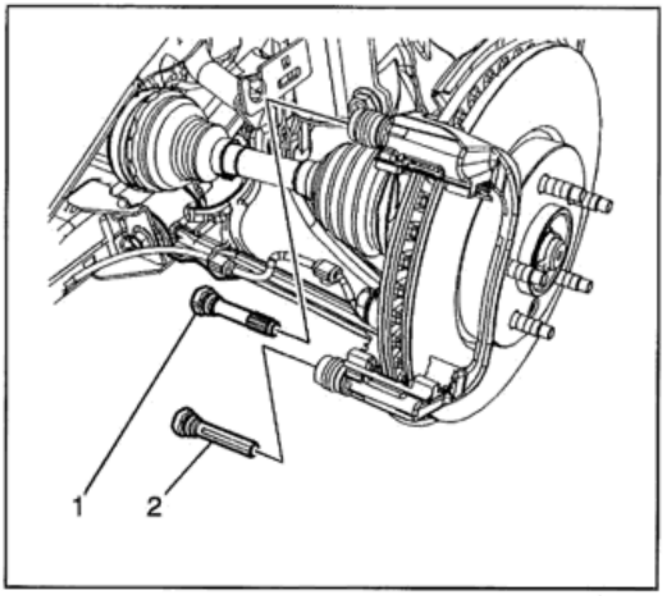
Note: Note the location of the wear sensor for correct installation.

5. Remove the inner brake pad (1).
6. Remove the outer brake pad (2).



1873947

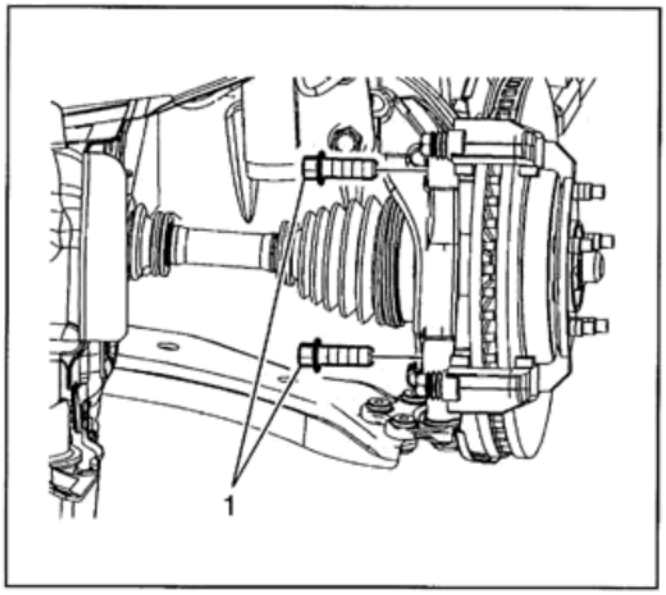
7. Remove the brake pad springs (1).



2375922

Note: The upper brake caliper guide pin is equipped with a bushing and must be installed in the same location.

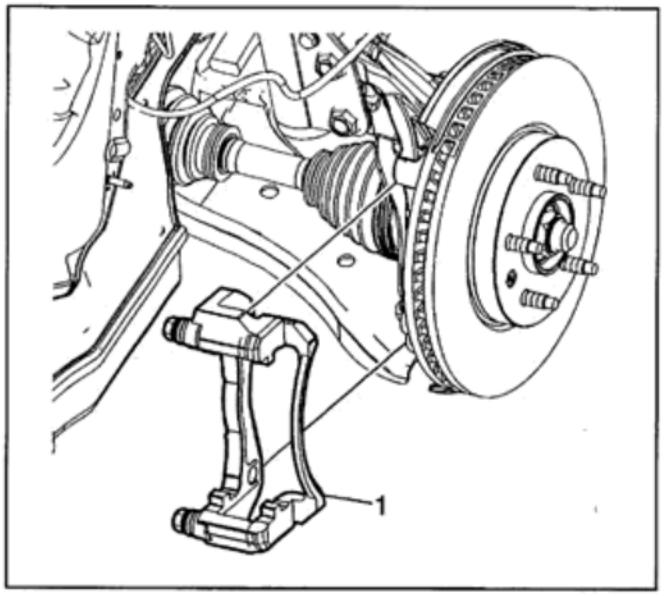
8. Remove the upper brake caliper guide pin (1).
9. Remove the lower brake caliper guide pin (2).
10. Remove the 2 brake caliper guide pin seals.



1873953

Note: Do not reuse the brake caliper bracket bolts.

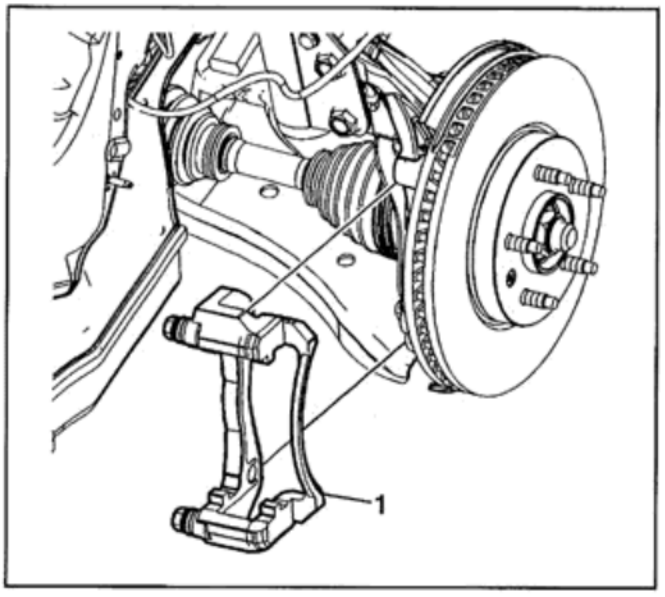
11. Remove and discard the brake caliper bracket bolts (1).



1873956

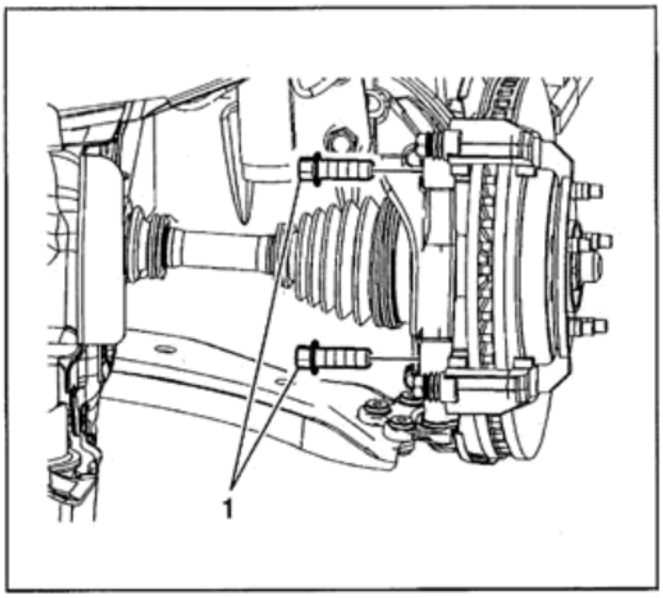
12. Remove the brake caliper bracket (1).

Installation Procedure



1873956

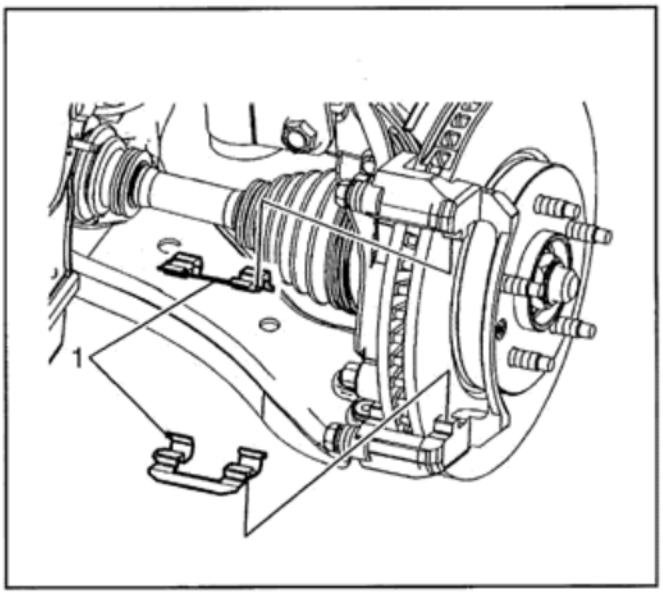
1. Install the brake caliper bracket (1).



1873953

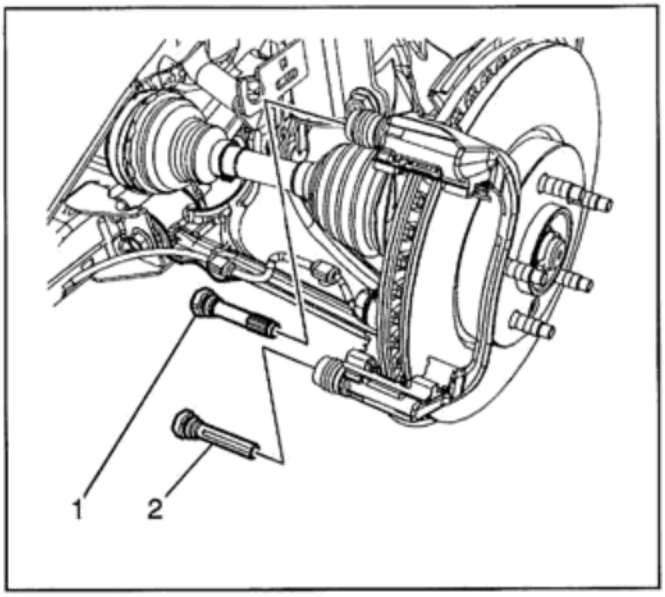
Caution: Refer to *Fastener Caution on page 0-8.*

2. Install 2 new brake caliper bracket bolts (1) and tighten to **100 N•m (74 lb ft)**.



1873947

3. Install the brake pad springs (1).

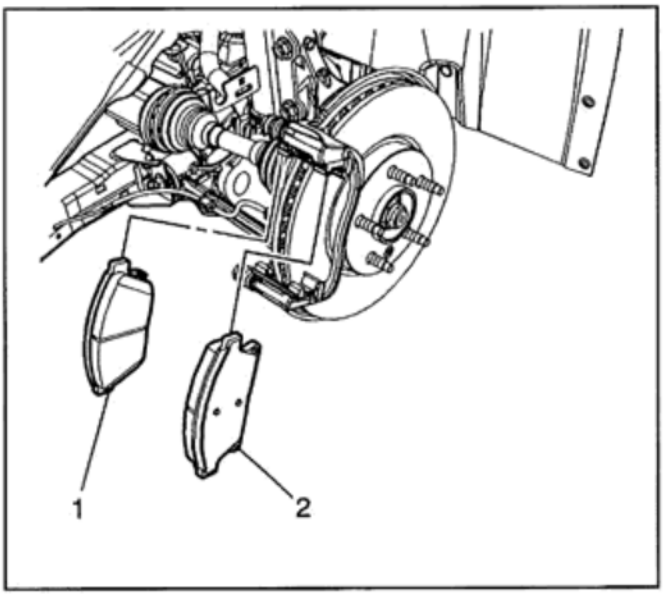


2375922

4. Install the 2 brake caliper guide pin seals.
5. Ensure the brake caliper guide pin seals are fully seated in the groove of the brake caliper bracket.

Note: The upper brake caliper guide pin is equipped with a bushing and must be installed in the same location.

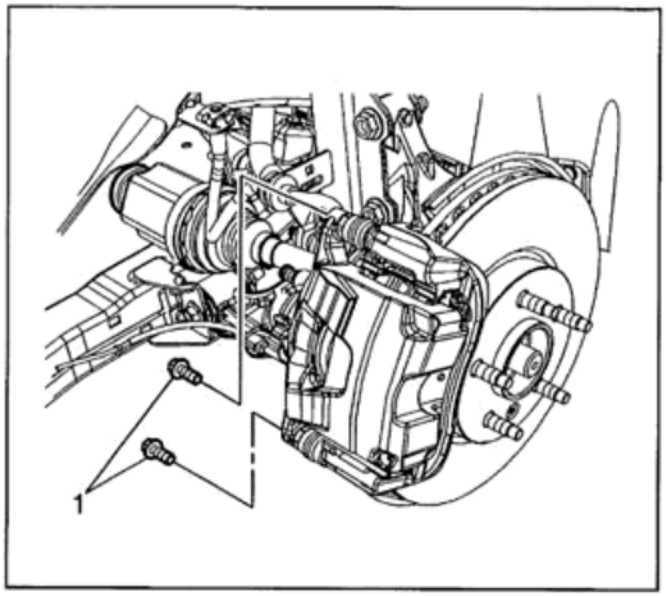
6. Install the upper brake caliper guide pin (1).
7. Install the lower brake caliper guide pin (2).
8. Ensure the brake caliper guide pin seals are fully seated in the groove of the brake caliper guide pins.



2375921

Note: Note the location of the wear sensor for correct installation.

9. Install the inner brake pad (1).
10. Install the outer brake pad (2).
11. Position the brake caliper over the brake pads and to the caliper bracket.



2375920

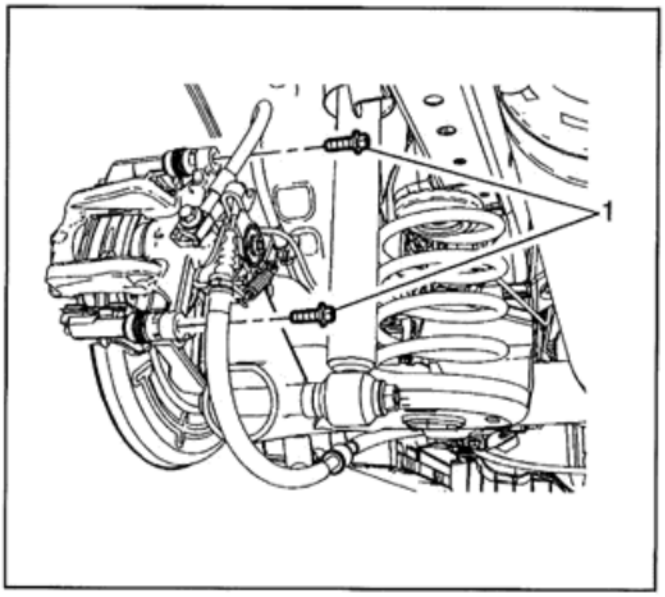
12. Using a backup wrench to hold the brake caliper guide pin stationary, install the brake caliper guide pin bolts (1) and tighten to **28 N•m (21 lb ft)**.
13. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.

Rear Brake Caliper Bracket Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.



2843743

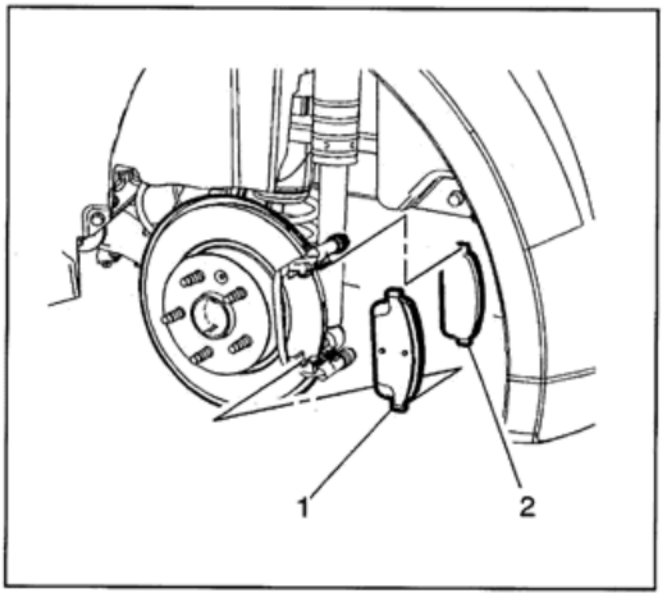
Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

3. Using a backup wrench to hold the brake caliper guide pins stationary, remove the brake caliper guide pin bolts (1).

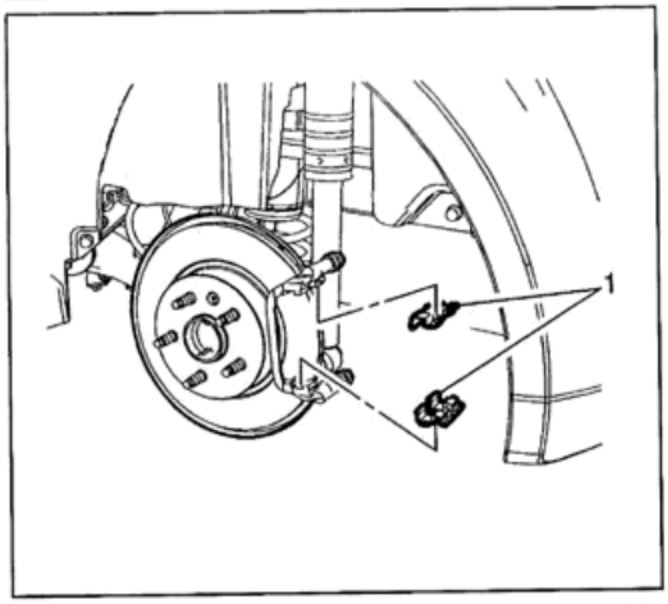
Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove the brake caliper and support with heavy mechanics wire.



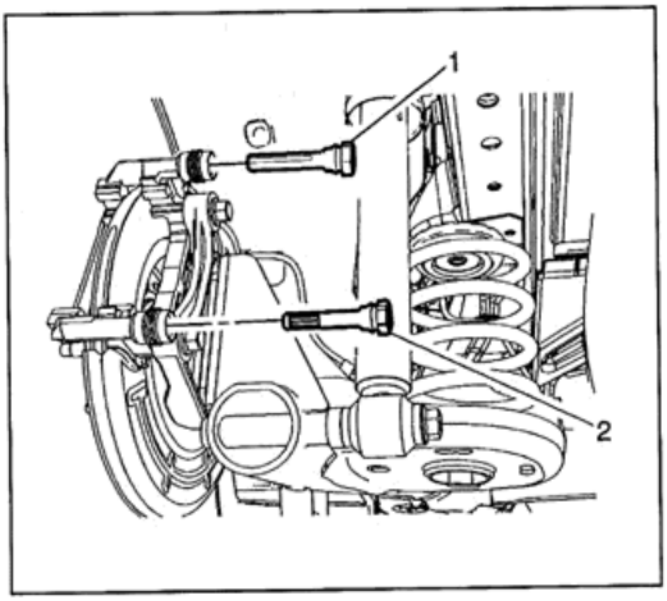
2843745

5. Remove the outer disc brake pad (1).
6. Remove the inner disc brake pad (2).



2843746

7. Remove the disc brake pad springs (1).

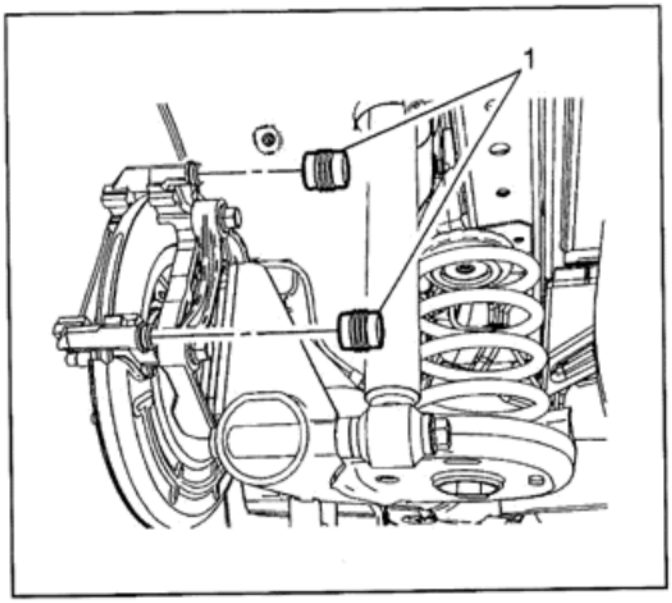


2844041

8. Remove the upper brake caliper guide pin (1).

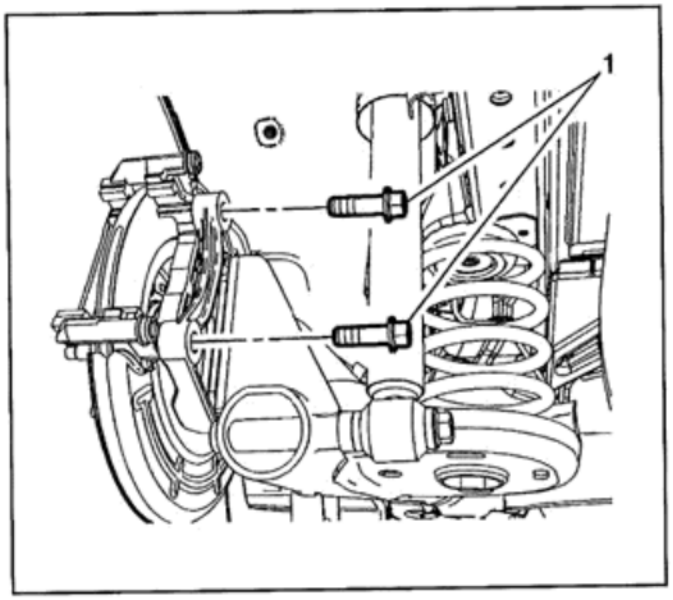
Note: The lower brake caliper guide pin is equipped with a bushing and must be installed in the same location.

9. Remove the lower brake caliper guide pin (2).



2844044

10. Remove the brake caliper guide pin seals (1).



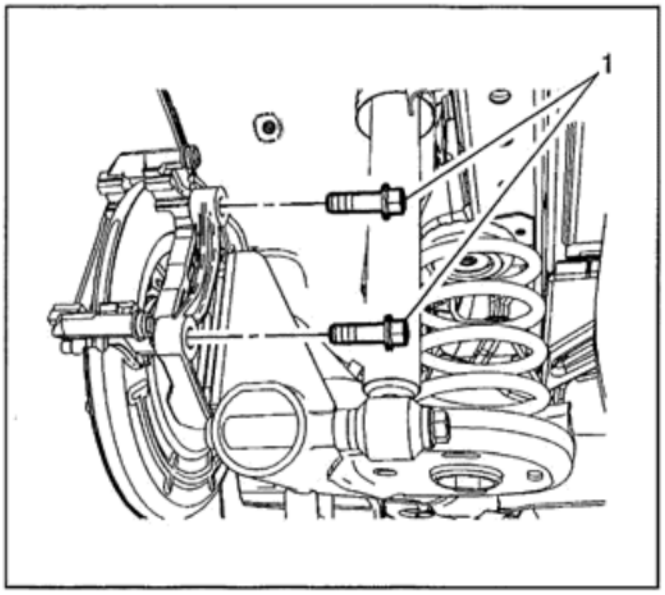
2844047

Note: Do not reuse the brake caliper bracket bolts.

11. Remove and discard the brake caliper bracket bolts (1).
12. Remove the rear brake caliper bracket.

Installation Procedure

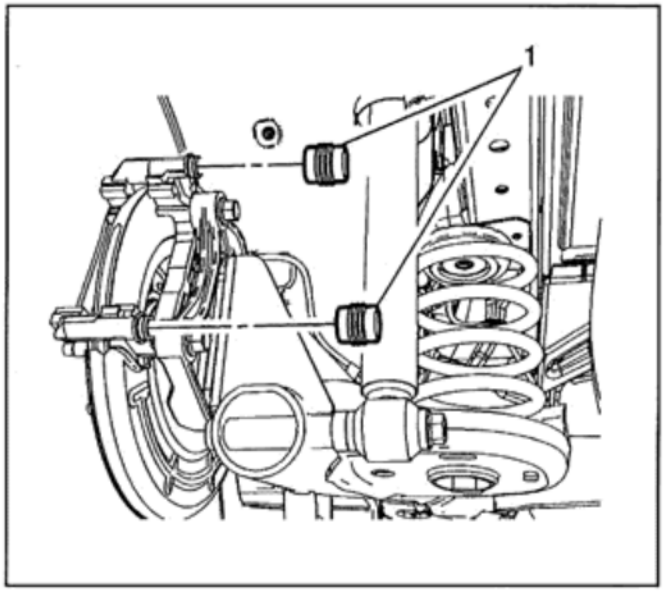
1. Install the rear brake caliper bracket.



2844047

Caution: Refer to *Fastener Caution on page 0-8.*

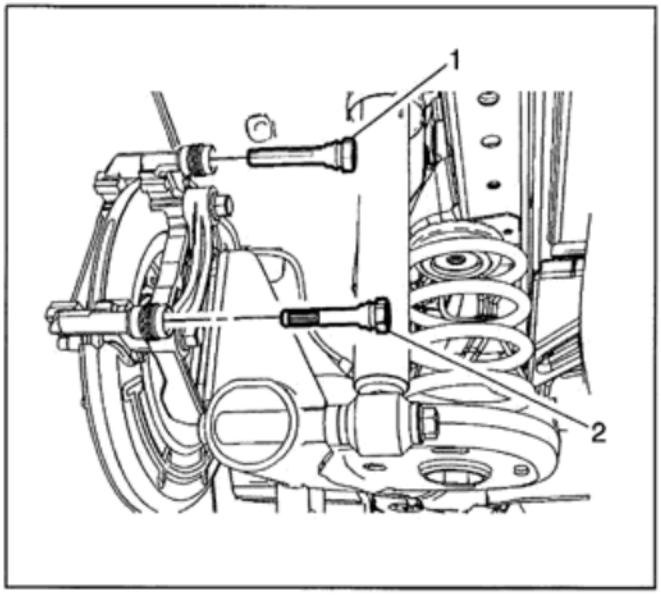
2. Install new brake caliper bracket bolts (1) and tighten to **100** N•m **(74 lb ft)**.



2844044

Note: Ensure the brake caliper guide pin seals are fully seated in the groove of the brake caliper bracket.

3. Install the brake caliper guide pin seals (1).

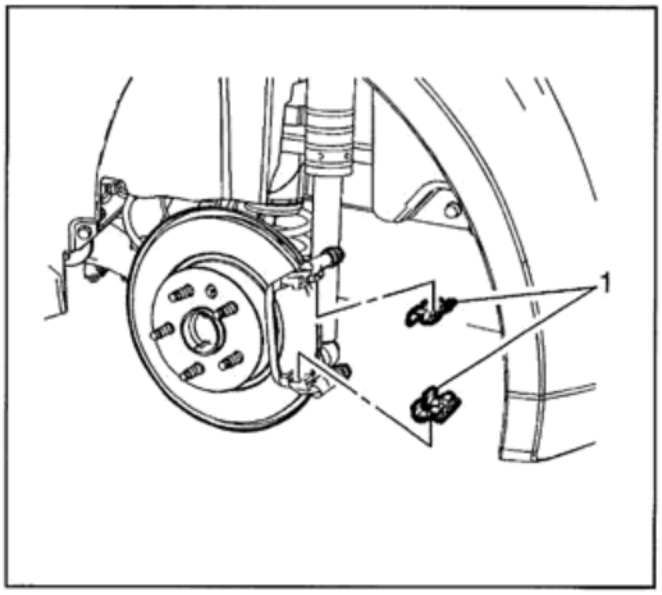


2844041

4. Install the upper brake caliper guide pin (1).

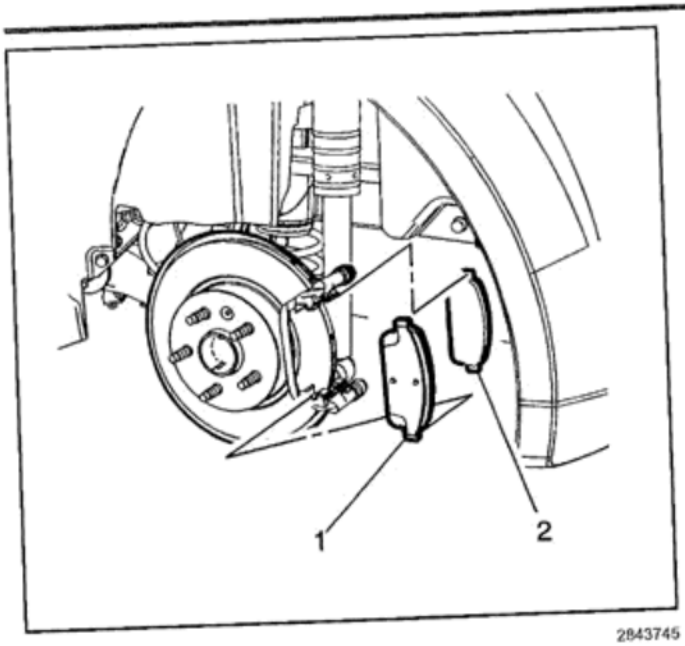
Note: The lower brake caliper guide pin is equipped with a bushing and must be installed in the same location.

5. Install the lower brake caliper guide pin (2).



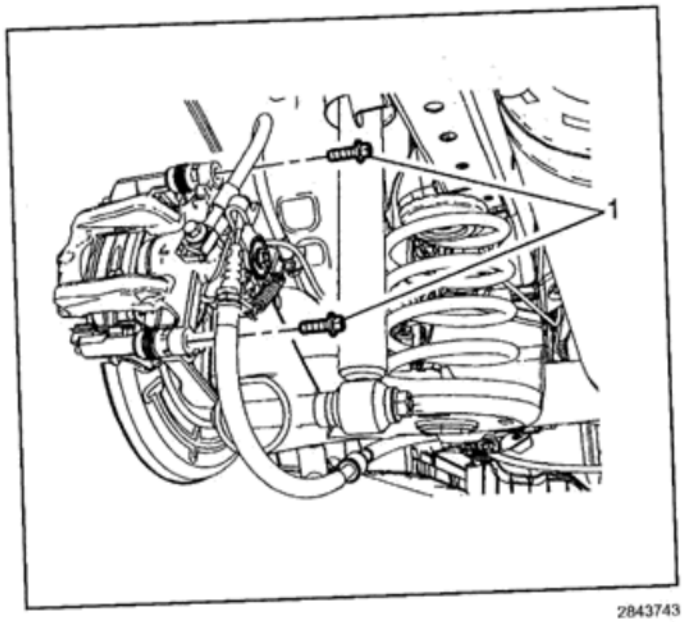
2843746

6. Install the disc brake pad springs (1).



2843745

7. Install the outer disc brake pad (1).
8. Install the inner disc brake pad (2).
9. Position the brake caliper over the disc brake pads and to the brake caliper bracket.



2843743

10. Using a backup wrench to hold the brake caliper guide pins stationary, install the brake caliper guide pin bolts (1) and tighten to **28 N•m (21 lb ft)**.
11. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.

Front Brake Rotor Replacement

Special Tools

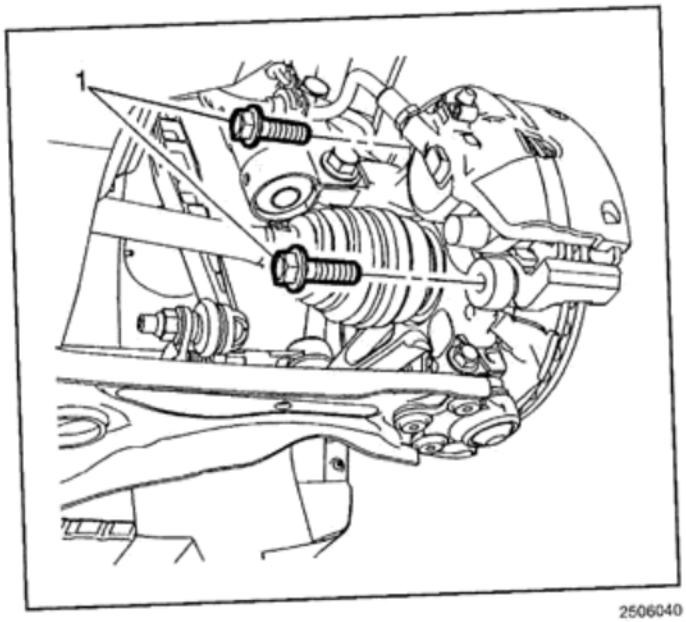
- *CH-41013* Rotor Resurfacing Kit
- *CH-42450-A* Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to *Special Tools on page 5-86*.

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.



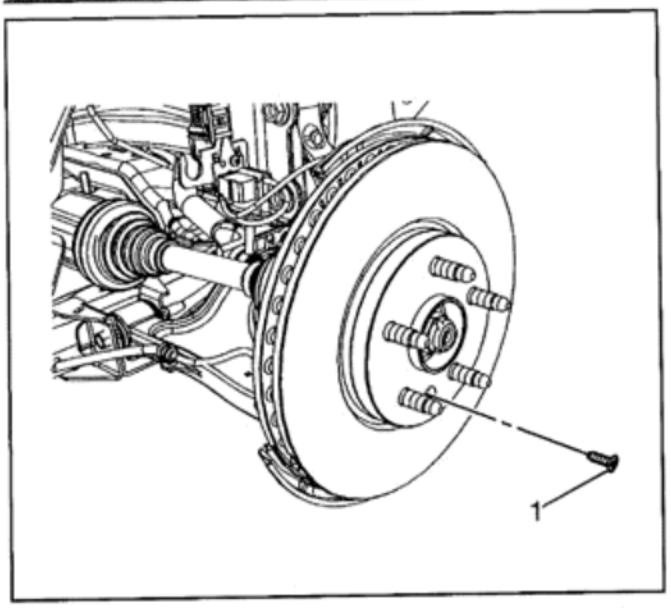
2506040

Note: Do not reuse the brake caliper bracket bolts.

3. Remove and discard the brake caliper bracket bolts (1).

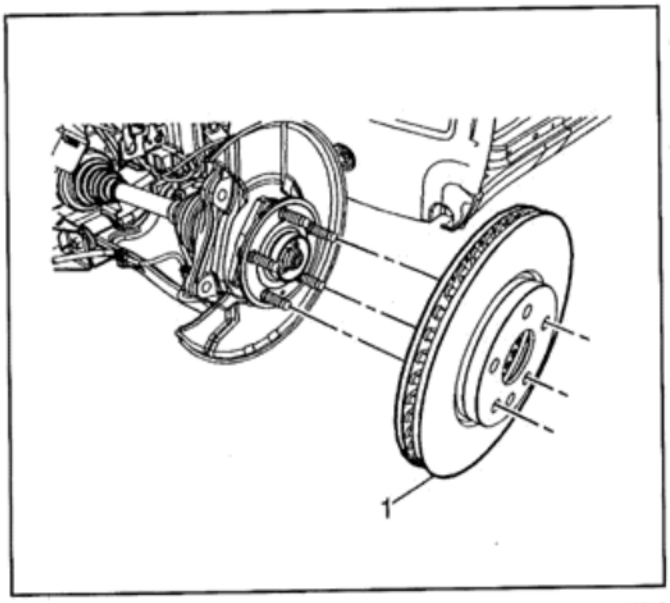
Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove the brake caliper and bracket as an assembly and support with heavy mechanics wire or equivalent.



2332712

5. Remove the brake rotor bolt (1).

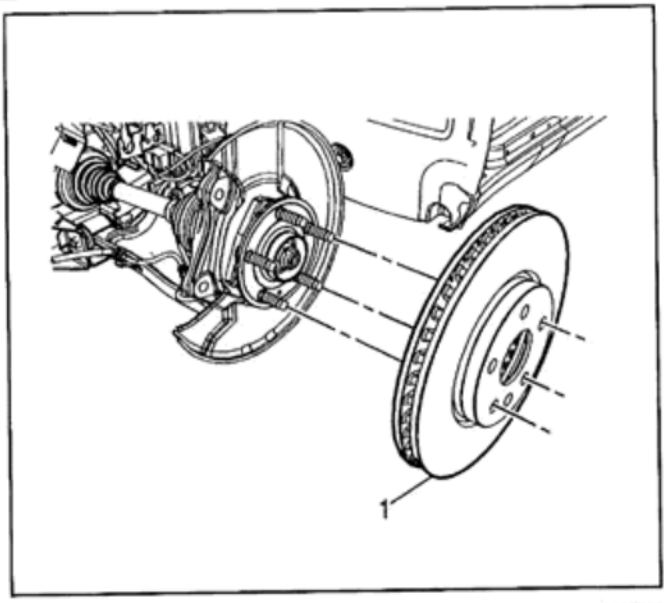


2332713

6. Remove the brake rotor (1).

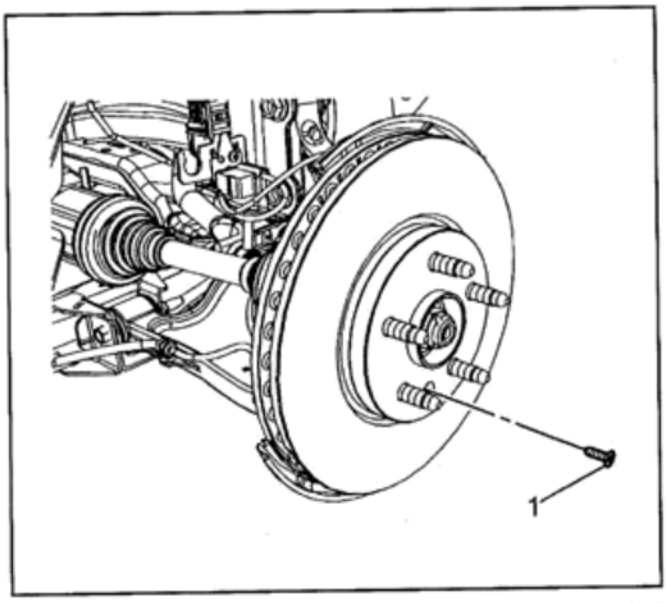
Installation Procedure

1. If installing a new brake rotor, clean the friction surfaces of the brake rotor with denatured alcohol or equivalent.
2. Using the *CH-42450-A* Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
3. Using the *CH-41013* Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the rotor to the hub/axle flange.



2332713

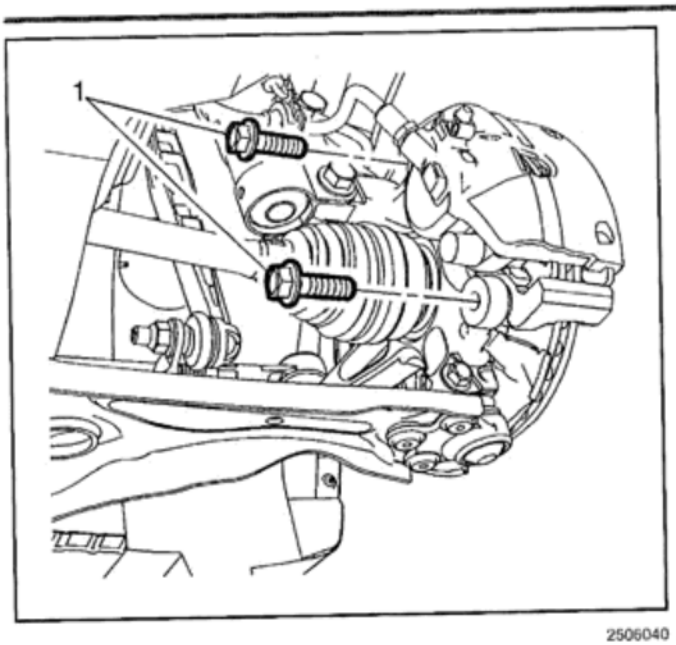
4. Install the brake rotor (1).



2332712

Caution: Refer to *Fastener Caution on page 0-8.*

5. Install the brake rotor bolt (1) and tighten to **9 N•m (80 lb in)**
6. Position the brake caliper and bracket assembly over the brake rotor and to the steering knuckle.



2506040

Note: Do not reuse the brake caliper bracket bolts.

7. Install 2 new brake caliper bracket bolts (1) and tighten to **100 N•m (74 lb ft)**.
8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
9. Burnish the brake pads and rotors. Refer to *Brake Pad and Rotor Burnishing on page 5-65*.

Rear Brake Rotor Replacement

Special Tools

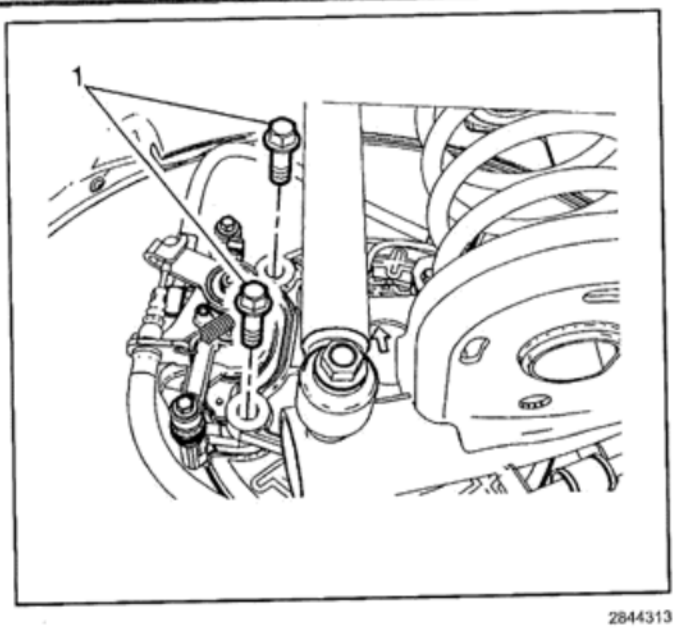
- *CH-41013* Rotor Resurfacing Kit
- *CH-42450-A* Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to *Special Tools on page 5-86*.

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.



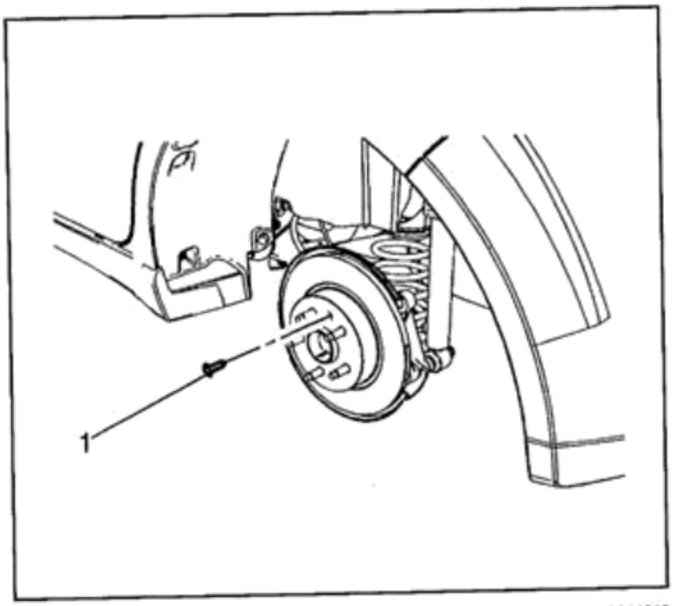
2844313

Note: Do not reuse the brake caliper bracket bolts.

3. Remove and discard the brake caliper bracket bolts (1).

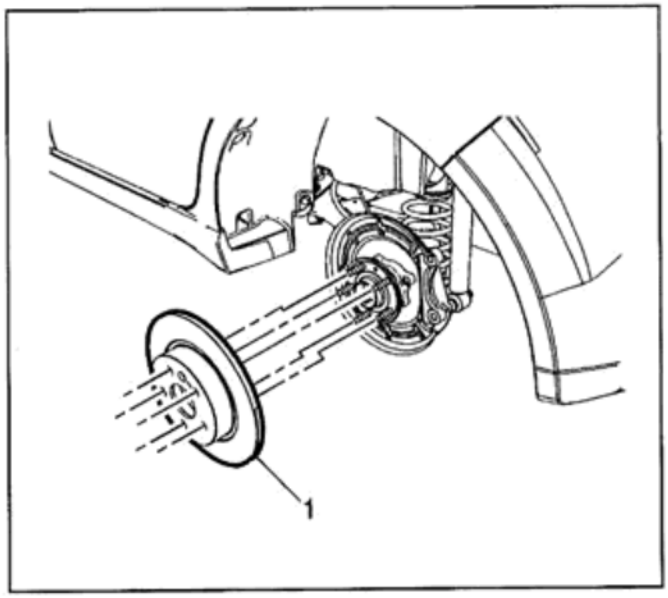
Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove the brake caliper and bracket as an assembly and support with heavy mechanics wire.



2844319

5. Remove the brake rotor bolt (1).

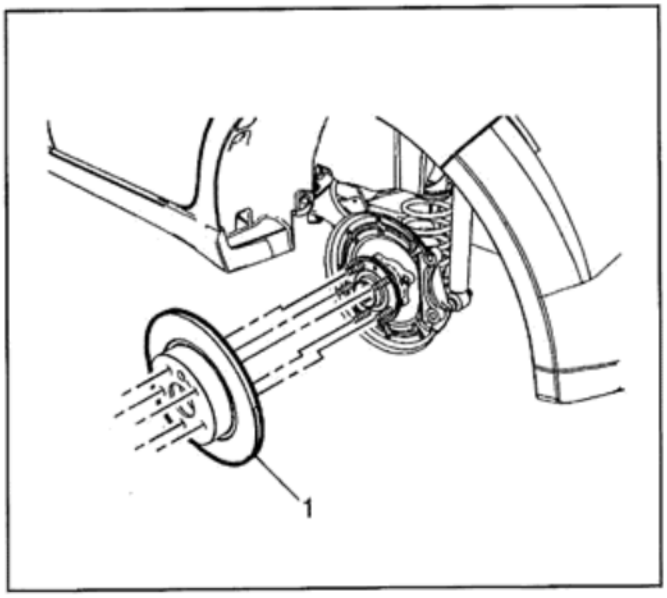


2844324

6. Remove the brake rotor (1).

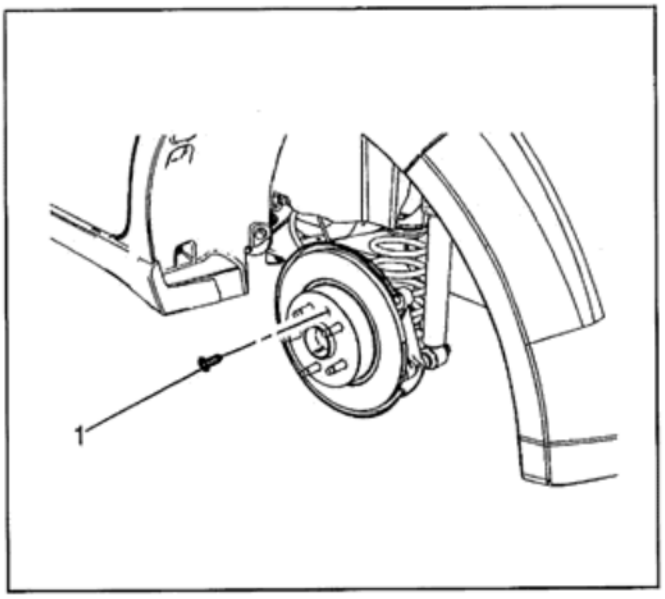
Installation Procedure

1. If installing a new brake rotor, clean the friction surfaces of the brake rotor with denatured alcohol.
2. Using the *CH-42450-A* Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
3. Using the *CH-41013* Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the rotor to the hub/axle flange.



2844324

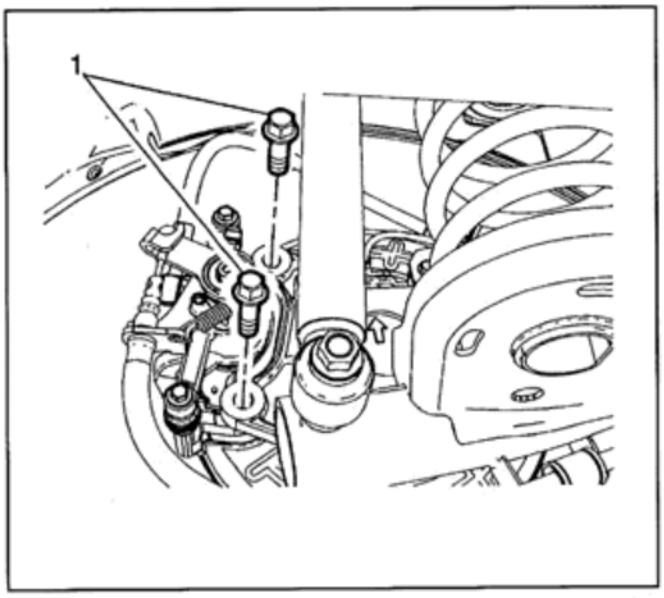
4. Install the brake rotor (1).



2844319

Caution: Refer to *Fastener Caution on page 0-8*.

5. Install the brake rotor bolt (1) and tighten to **9** N•m **(80 lb in)**.
6. Position the brake caliper and bracket assembly over the brake rotor and to the suspension knuckle.



2844313

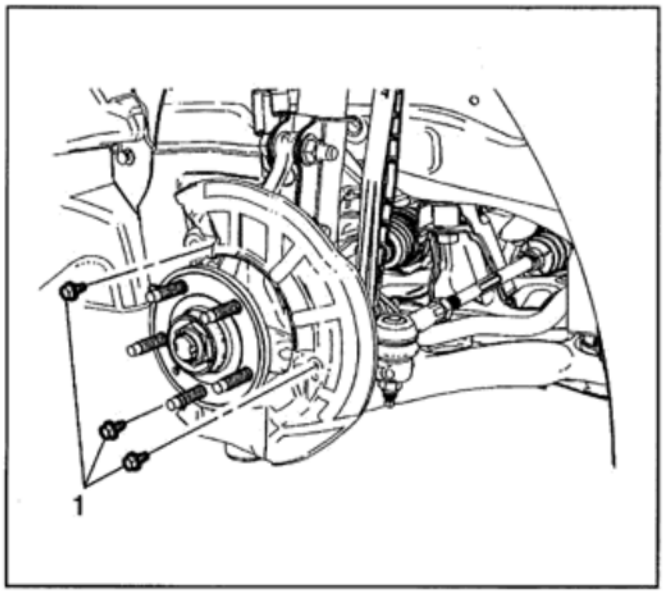
7. Install new brake caliper bracket bolts (1) and tighten to **100** N•m **(74 lb ft)**.
8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
9. Burnish the brake pads and rotors. Refer to *Brake Pad and Rotor Burnishing on page 5-65*.

Front Brake Shield Replacement

Removal Procedure

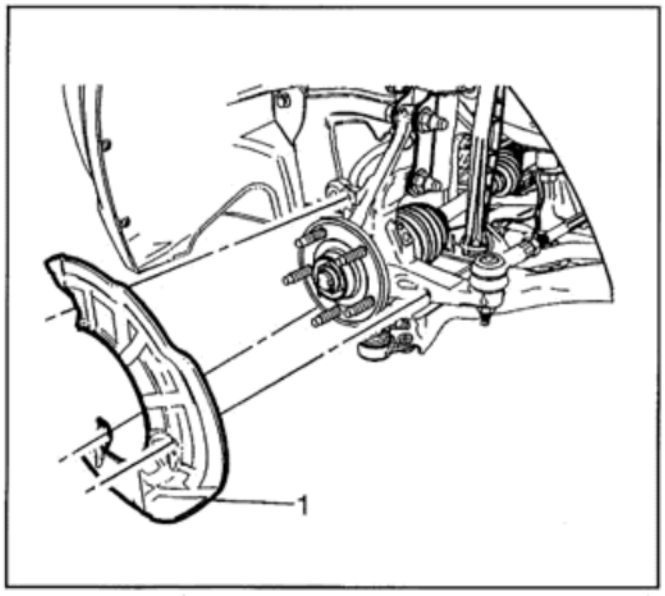
Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
2. Remove the front tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
3. Remove the front brake rotor. Refer to *Front Brake Rotor Replacement on page 5-77*.



2512954

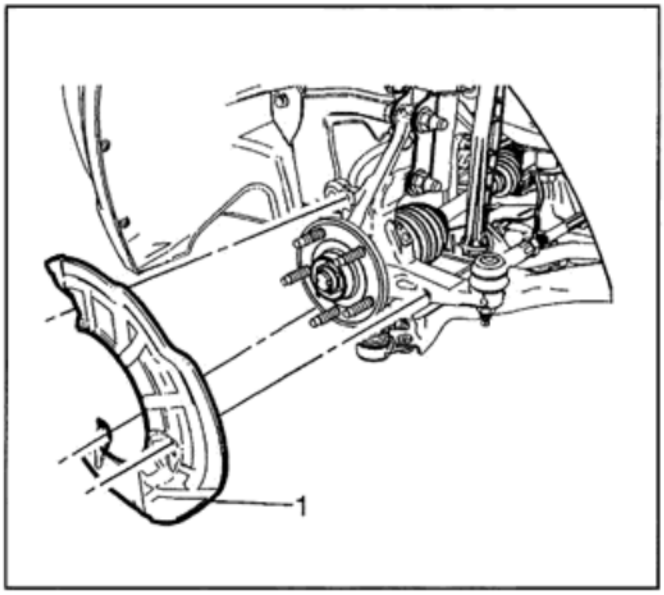
4. Remove the front brake shield bolts (1).



2512955

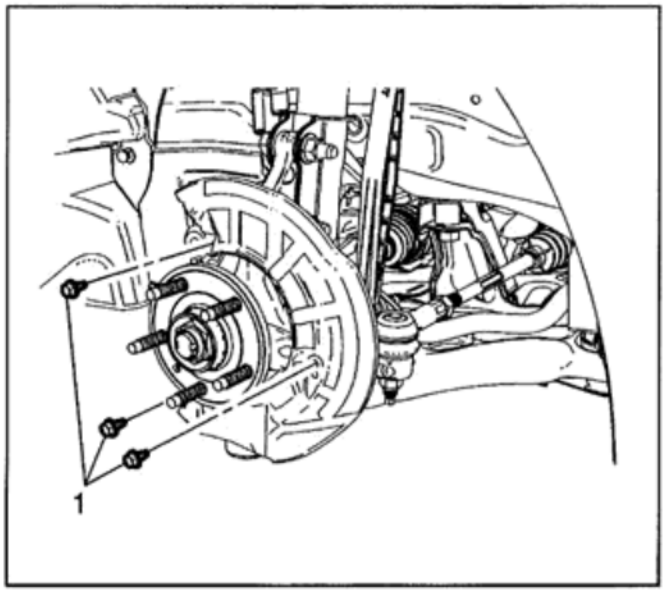
5. Remove the front brake shield (1).

Installation Procedure



2512955

1. Install the front brake shield (1).



2512954

Caution: Refer to *Fastener Caution on page 0-8*.

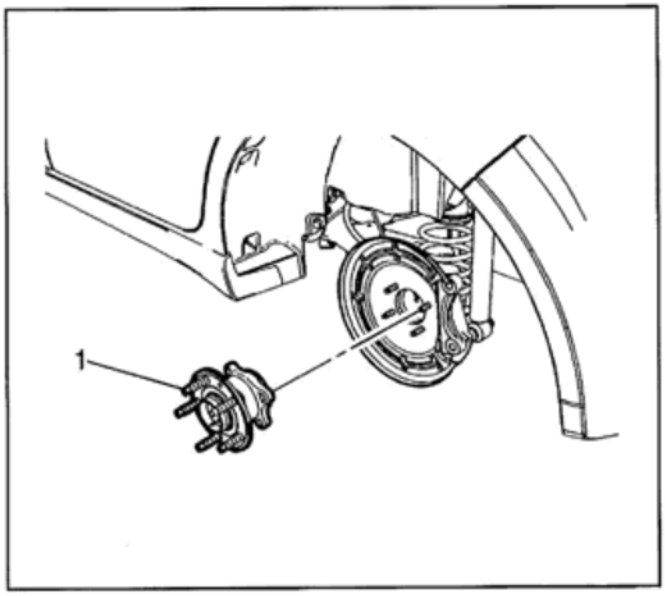
2. Install the front brake shield bolts (1) and tighten to **9 N•m (80 lb in)**.
3. Install the front brake rotor. Refer to *Front Brake Rotor Replacement on page 5-77*.
4. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.

Rear Brake Shield Replacement

Removal Procedure

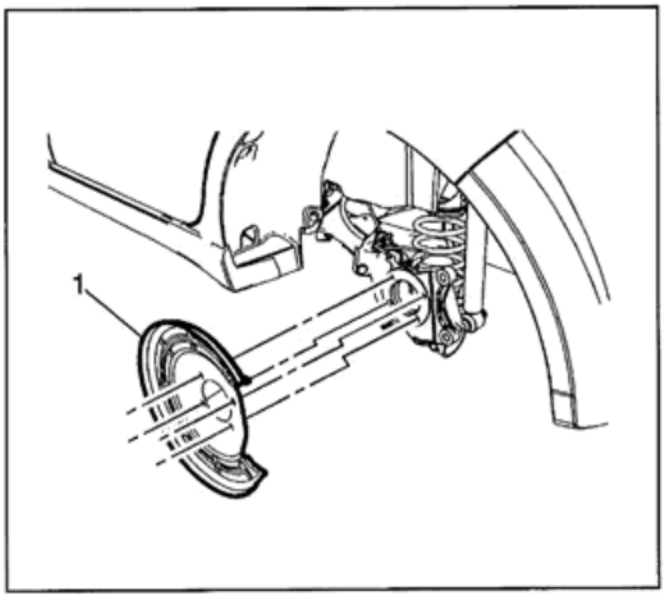
Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
2. Remove the rear tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
3. Remove the rear brake rotor. Refer to *Rear Brake Rotor Replacement on page 5-79*.



2844406

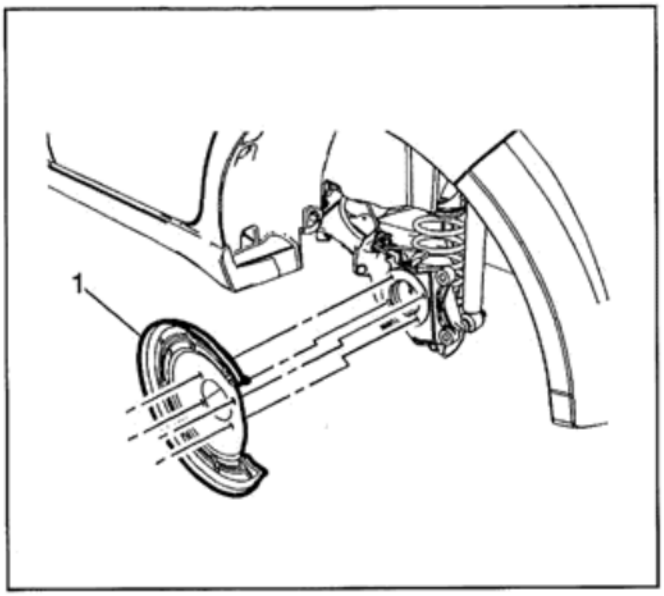
4. Remove the rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement (Drum Brake) on page 16-24* or *Rear Wheel Bearing and Hub Replacement (Disc Brake) on page 16-25*.



2844410

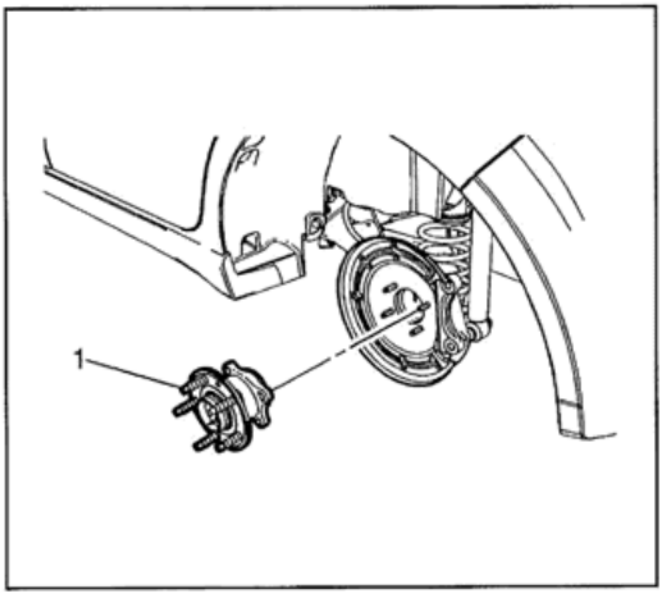
5. Remove the rear brake shield (1).

Installation Procedure



2844410

1. Install the rear brake shield (1).



2844406

2. Install the rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement (Drum Brake) on page 16-24* or *Rear Wheel Bearing and Hub Replacement (Disc Brake) on page 16-25*.
3. Install the rear brake rotor. Refer to *Rear Brake Rotor Replacement on page 5-79*.
4. Install the rear tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.

Brake Rotor Assembled Lateral Runout Correction

Note:

- Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to *Brake Rotor Thickness Variation Measurement on page 5-55*.
- Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4,800–11,300 km (3,000–7,000 mi). Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-56*.

Review the following acceptable methods for bringing the brake disc assembled LRO to within specifications. Determine which method to use for the vehicle being repaired.

- The indexing method of correcting assembled LRO is most effective when the LRO specification is only exceeded by a relatively small amount: 0.025–0.127 mm (0.001–0.005 in). Indexing is used to achieve the best possible match of high spots to low spots between related components. Refer to *Brake Rotor Assembled Lateral Runout Correction - Indexing on page 5-83*.
- The on-vehicle brake lathe method is used to bring the LRO to within specifications through compensating for LRO while refinishing the brake rotor. Refer to *Brake Rotor Assembled Lateral Runout Correction - On Vehicle Lathe on page 5-84*.

If the assembled LRO cannot be corrected using these methods, then other components must be suspected as causing and/or contributing to the LRO concern.

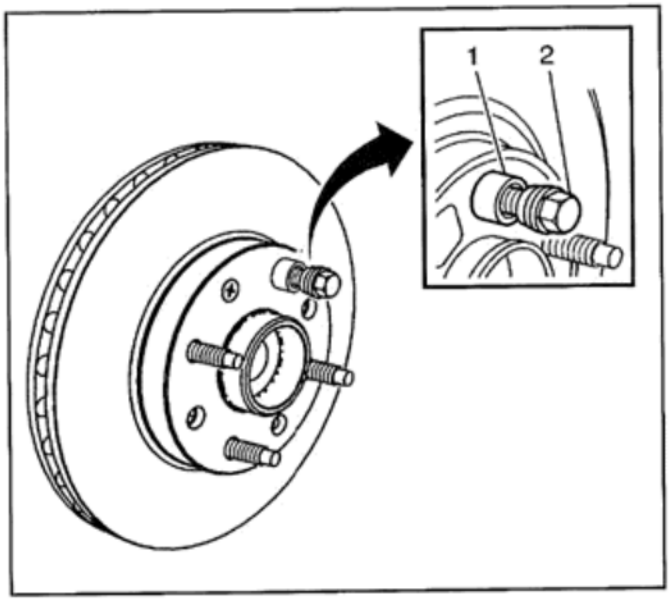
Brake Rotor Assembled Lateral Runout Correction - Indexing

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to *Special Tools on page 5-86*.

Warning: Refer to Brake Dust Warning on page 0-4.

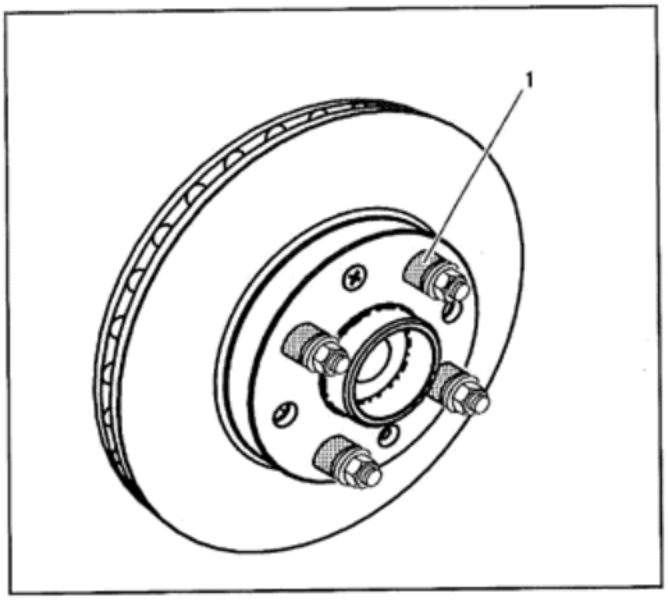


2308615

Note:

- Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to *Brake Rotor Thickness Variation Measurement on page 5-55*.
- Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4,800–11,300 km (3,000–7,000 mi). Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-56*.

1. Remove the *CH-45101-100* conical brake rotor washers and the lug nuts that were installed during the assembled LRO measurement procedure.
2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
3. Index the brake rotor in a different orientation to the hub/axle flange.
4. Hold the rotor firmly in place against the hub/axle flange and install one of the *CH-45101-100* conical brake rotor washers (1) and one lug nut (2) onto the upper-most wheel stud.
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.



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6. Install the remaining *CH-45101-100* conical brake rotor washers and lug nuts onto the wheel studs (1) and tighten the nuts firmly by hand in the tightening sequence.
7. Tighten the lug nuts in sequence, in order to properly secure the rotor. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
8. Measure the assembled LRO of the brake rotor. Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-56*.
9. Compare the amount of change between this measurement and the original measurement.
10. If this measurement is within specifications, proceed to step 14.
11. If this measurement still exceeds specifications, repeat steps 1–9 until the best assembled LRO measurement is obtained.
12. Matchmark the final location of the rotor to the wheel studs if the orientation is different than it was originally.
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to *Brake Rotor Assembled Lateral Runout Correction on page 5-83*.
14. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the *CH-45101-100* conical brake rotor washers and the lug nuts.

Brake Rotor Assembled Lateral Runout Correction - On Vehicle Lathe

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to *Special Tools on page 5-86*.

Warning: Refer to Brake Dust Warning on page 0-4.

Note:

- Brake rotor thickness variation MUST be checked before checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to *Brake Rotor Thickness Variation Measurement on page 5-55*.
- Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4,800–11,300 km (3,000–7,000 mi). Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-56*.

1. Ensure that the brake caliper and brake caliper bracket that are already being supported, are clear from contacting any rotating components, such as the brake rotor.
2. Remove the *CH-45101-100* conical brake rotor washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Set up the lathe, following the manufacturer instructions.
5. Refinish the brake rotor, following the brake lathe manufacturers instructions.
6. After each successive cut, inspect the brake rotor thickness. Refer to *Brake Rotor Thickness Measurement on page 5-55*.
7. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced. After replacing the brake rotor, proceed to step 10.
8. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
   8.1. Follow the brake lathe manufacturer recommended speed setting for applying a non-directional finish.
   8.2. Using moderate pressure, apply the non-directional finish:
      - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
      - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.
   8.3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
9. Remove the lathe from the vehicle.
10. Measure the assembled LRO of the brake rotor. Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-56*.

11. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to *Brake Rotor Assembled Lateral Runout Correction on page 5-83*.
12. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the brake rotor in place before removing the *CH-45101-100* conical brake rotor washers and the lug nuts.

Brake Rotor Refinishing

Special Tools

- *CH-41013* Rotor Resurfacing Kit
- *CH-42450-A* Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to *Special Tools on page 5-86*.

Warning: Refer to Brake Dust Warning on page 0-4.

Note:

- The disc brake rotors do not require refinishing as part of routine brake system service. New disc brake rotors do not require refinishing.

  Do not refinish disc brake rotors in an attempt to correct the following conditions:

  – Brake system noise – squeal, growl, groan
  – Uneven and/or premature disc brake pad wear
  – Superficial or cosmetic corrosion/rust of the disc brake rotor friction surface
  – Scoring of the disc brake rotor friction surface less than the maximum allowable specification
- Before refinishing a brake rotor, the rotor MUST first be checked for adequate thickness to allow the rotor to be refinished and remain above the minimum allowable thickness after refinish specification. Refer to *Brake Rotor Thickness Measurement on page 5-55*.

  Disc brake rotors should only be refinished if they have adequate thickness to be refinished and if one or more of the following conditions exist:

  – Thickness variation in excess of the maximum allowable specification
  – Excessive corrosion/rust and/or pitting
  – Cracks and/or heat spots
  – Excessive blueing discoloration
  – Scoring of the disc brake rotor surface in excess of the maximum allowable specification
- Disc brake rotors may need to be refinished as part of the process for correcting brake rotor assembled lateral runout (LRO) that exceeds the maximum allowable specification.

Note: If the vehicle is equipped with cross-drilled rotors, use a lathe with positive rake tooling. This setup requires less cutting pressure, which will result in less vibration, and a better surface finish. Also, use a vibration dampener when cutting. Otherwise, refinish according to the following instructions.

Note: Whenever the brake rotor has been separated from the hub/axle flange, clean any rust or contaminants from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in increased assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the *CH-42450-A* Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
2. Using the *CH-41013* Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.
4. Mount the brake rotor to the brake lathe according to the lathe manufacturer's instructions, ensuring that all mounting attachments and adapters are clean and free of debris.
5. Ensure that any vibration dampening attachments are securely in place.
6. With the brake lathe running, slowly bring in the cutting tools until they just contact the brake rotor friction surfaces.
7. Observe the witness mark on the brake rotor. If the witness mark extends approximately three-quarters or more of the way around the brake rotor friction surface on each side, the brake rotor is properly mounted to the lathe.
8. If the witness mark does not extend three-quarters or more of the way around the brake rotor, re-mount the rotor to the lathe.
9. Following the brake lathe manufacturer's instructions, refinish the brake rotor.
10. After each successive cut, inspect the brake rotor thickness. Refer to *Brake Rotor Thickness Measurement on page 5-55*.
11. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced.
12. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
    12.1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish.
    12.2. Using moderate pressure, apply the non-directional finish:
    - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
    - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.

Note: Thoroughly cleaning the brake rotor will prevent the possible transfer of finite metal dust left as a by-product of machining to the brake pad material during the burnishing process, thereby reducing the possibility for brake squeal or other brake noises to occur.

12.3. After applying a non-directional finish, clean each friction surface of the brake rotor with a solution of mild dish washing detergent and water, or a GM approved brake cleaner and a clean shop towel to remove metal particles remaining from machining. Repeat the cleaning process if necessary to remove all metal particles.

13. Remove the brake rotor from the brake lathe.
14. Measure the assembled LRO of the brake rotor to ensure optimum performance of the disc brakes. Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-56*.
15. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to *Brake Rotor Assembled Lateral Runout Correction on page 5-83*.

Description and Operation

Disc Brake System Description and Operation

System Component Description

The disc brake system consists of the following components:

Disc Brake Pads: Applies mechanical output force from the hydraulic brake calipers to friction surfaces of brake rotors.

Disc Brake Rotors: Uses mechanical output force applied to friction surfaces from the disc brake pads to slow speed of tire and wheel assembly rotation.

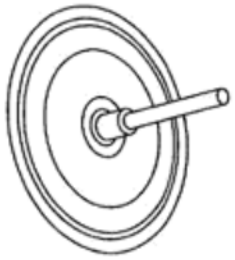
Disc Brake Pad Hardware: Secures disc brake pads firmly in proper relationship to the hydraulic brake calipers. Enables a sliding motion of brake pads when mechanical output force is applied.

Disc Brake Caliper Hardware: Provides mounting for hydraulic brake caliper and secures the caliper firmly in proper relationship to caliper bracket. Enables a sliding motion of the brake caliper to the brake pads when mechanical output force is applied.

System Operation

Mechanical output force is applied from the hydraulic brake caliper pistons to the inner brake pads. As the pistons press the inner brake pads outward, the caliper housings draw the outer brake pads inward. This allows the output force to be equally distributed. The brake pads apply the output force to the friction surfaces on both sides of the brake rotors, which slows the rotation of the tire and wheel assemblies. The correct function of both the brake pad and brake caliper hardware is essential for even distribution of braking force.

Special Tools and Equipment

Illustration	Tool Number/Description
 2028167	CH-41013 J 41013 Rotor Resurfacing Kit
 2028165	CH-42450-A J 42450-A Wheel Hub Resurfacing Kit
 2028166	CH-45101 J 45101 Hub and Wheel Runout Gauge
 2028164	CH-45101-100 J 45101-100 Conical Brake Rotor Washers