

DISC BRAKES

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DESCRIPTION AND OPERATION

DESCRIPTION

The front wheel disc brake consists of two major parts: The brake disc and the brake caliper with the two friction pads. See Figure 5B-20.

The brake disc is attached to the inside of the wheel hub flange by four bolts and centered on a shoulder of the hub. The brake caliper consists of two halves: the mounting half, arranged on the inside of the brake disc, and the rim half. The two halves are firmly attached to each other by four bolts. Two flanges on the mounting half serve as attachment of the brake caliper to the steering knuckle. The brake caliper is positioned behind the front suspension cross member at steering knuckle spindle level. It is attached to the steering knuckle by two bolts. Both caliper halves act as brake cylinders and each houses a piston and a fluid seal. The fluid seal, of square cross section, is positioned in an annular groove of the caliper bore, preventing fluid leakage past the piston and entry of water and dirt. The pistons and caliper half bores are protected against entry of water

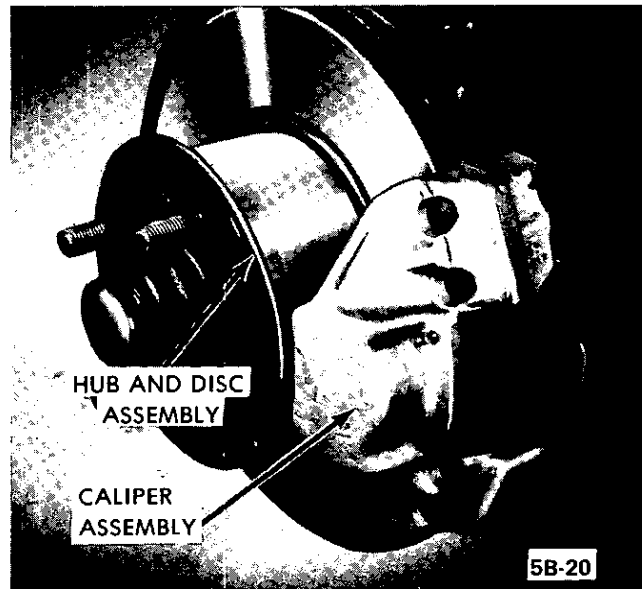
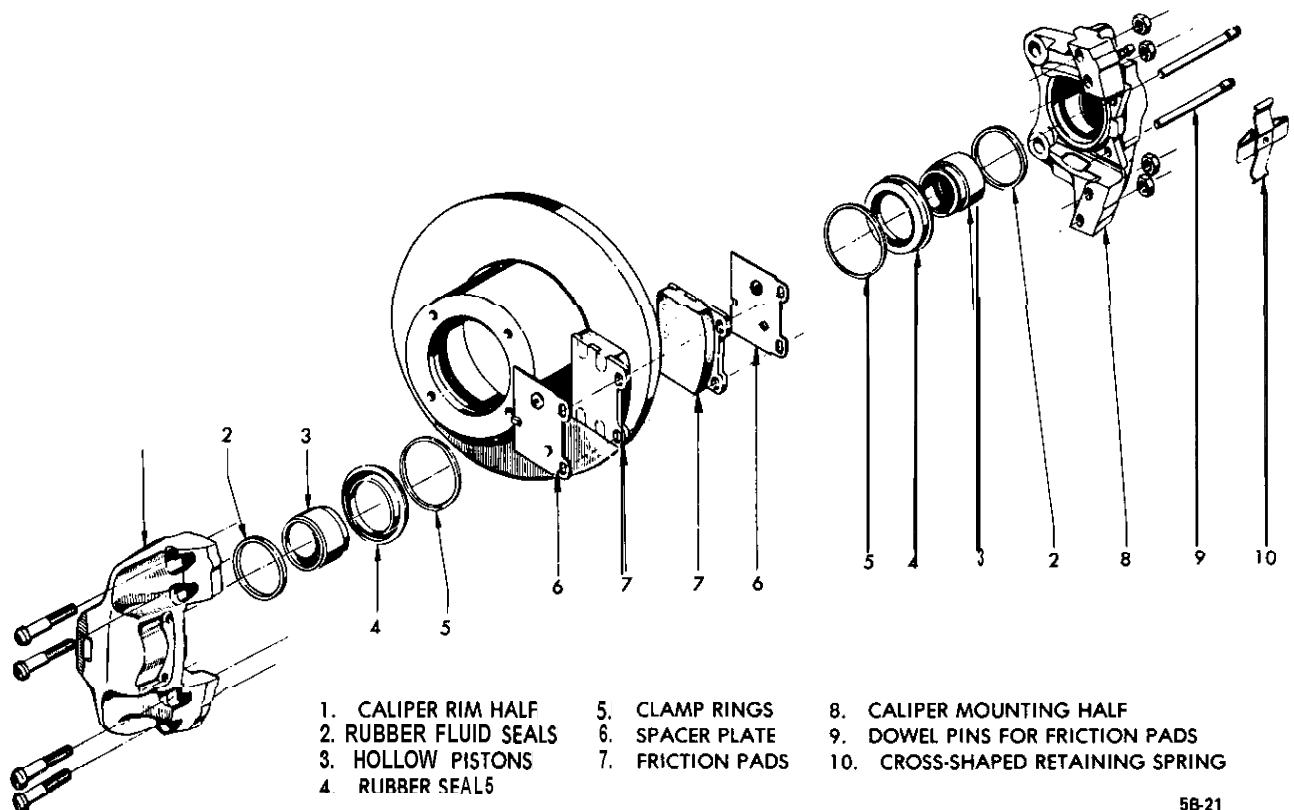


Figure 5B-20 Left Front Disc Brake Assembly

and dirt in brake disc direction by a rubber seal, held on the caliper half collar by a clamp ring and against



5B-21

Figure 5B-21 Left Front Disc Brake - Exploded View

the piston circumference by its inherent tension. See Figure 5B-21. Both pistons are hollow. The open end of each piston faces the brake disc.

A sheet metal spacer plate with two impressions for preventing the piston from rotating is installed between each piston and friction pad and **secured by** the friction pad dowel pins. The two friction pads are positioned on the right and left of the brake disc recesses in the caliper halves. Each friction pad consists of a backing plate with friction material, which is abrasive-coated, bonded to it. The friction pad assemblies are held in position in the brake caliper by two dowel pins, secured by slit dowel pin retainers, and by a cross-shaped retaining spring which is **pre-loaded** and positioned under the dowel pins, thus pressing the friction pads and spacer plates firmly against the pistons. The front brake line leading from the brake master cylinder attaches to a distribution tee from which a brake line leads to each front wheel caliper. The caliper bores are interconnected by fluid ducts within the caliper halves.

OPERATION

The front wheel disc brakes have self-adjusting pistons. See Figure 5B-22.

The adjustment of the pads is effected by the pistons which push the friction pads ahead towards the brake disc for a distance equivalent to the amount of friction pad wear. This means that the greater the wear the closer the pistons move **towards** the brake disc. A running clearance exists between friction pads and brake disc when the brakes are in "off" position. This running clearance is provided **by** the rubber fluid seals which are positioned in the caliper half bores and which tightly grip and exert their pre-load pressure on the pistons. The rubber fluid seals also prevent the pistons from being pushed into the caliper half bores more than the distance equivalent to the running clearance. As the friction pads are adjusted by the pistons, there must be no static pressure in the front brake circuit when the brakes are in "off" position. Non-existence of a static pressure in the front brake circuit is achieved by eliminating the check valve in the brake master cylinder on the front brake circuit. During brake application the pressure from the brake master cylinder is transferred to the pistons in the brake caliper. The pistons move ahead and press the friction pads against both friction **sur-**faces of the rotating brake disc. The force exerted on the brake pedal determines the pressure of the friction pads against the brake disc. On releasing the brake pedal, the brake lines of the front brake circuit, including the caliper half bores, are relieved of hy-

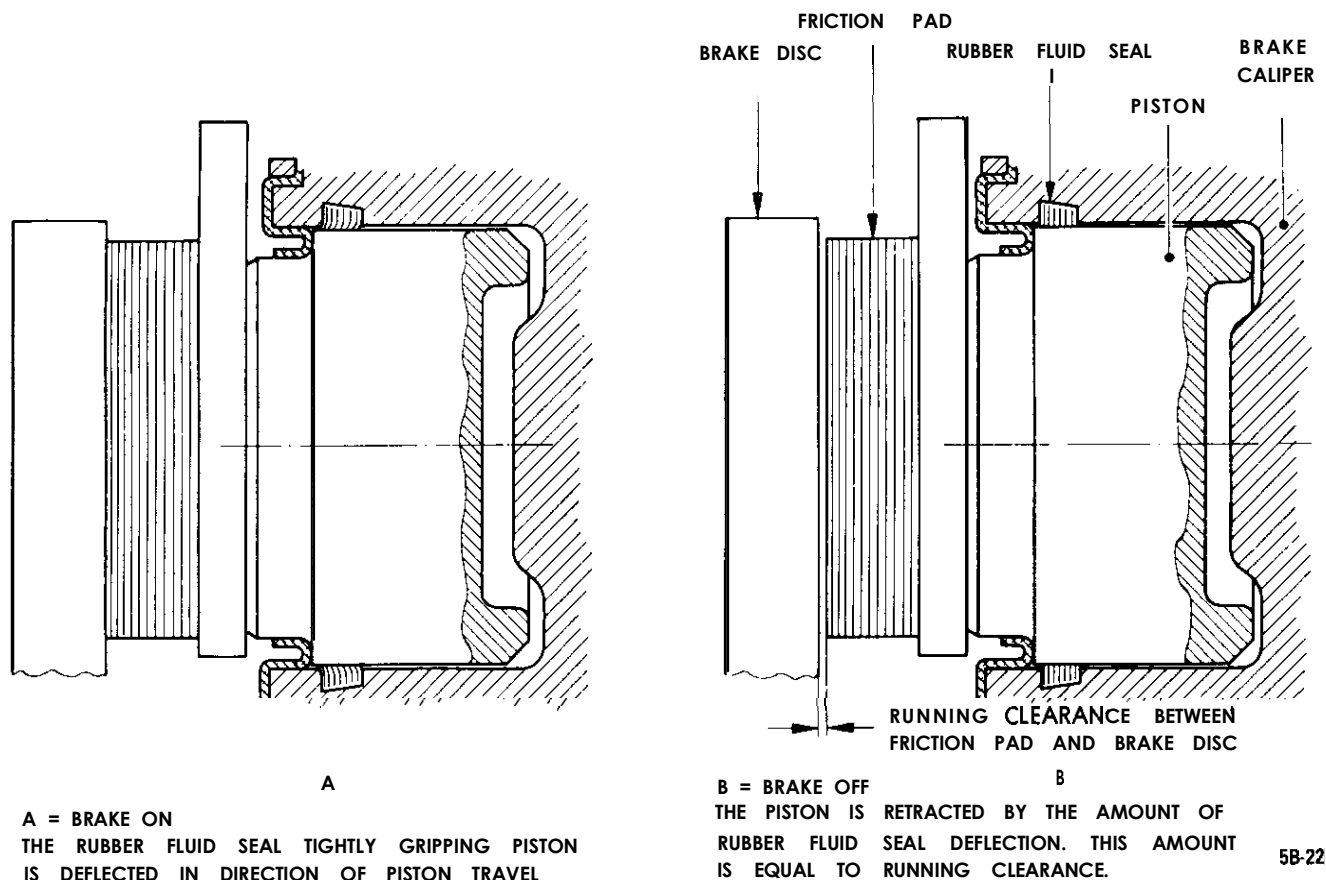


Figure 5B-22 Rubber Fluid Seal -Automatic Piston Retraction

draulic pressure, and the friction pads and pistons move away from the brake disc, leaving a small running clearance. The brake disc can now rotate freely.

The amount of brake travel is dependent upon the amount of running clearance. For this reason the runout of the brake disc should be checked, besides bleeding of the brake system and adjusting the rear brake shoes, when the pedal free travel is too great.

The running clearance between brake disc and friction pads is attained as follows: When the pistons in the caliper halves are moved towards the brake disc

during braking, the rubber seals in the annular grooves of the brake caliper bores deflect laterally in the direction of piston movement. See Figure 5B-22, View (A). The seal remains deflected for the duration of the braking operation. After braking, the caliper bores are relieved of hydraulic pressure and the rubber seals resume their normal position, thus pulling or retracting the pistons. The distance traveled by the pistons is equal to that of the running clearance between brake disc and friction pads.

The shifting of the pistons in the direction of the brake disc due to friction pad wear has no effect on the running clearance. The running clearance remains the same in all piston positions.

DIAGNOSIS

DISC BRAKE TROUBLE DIAGNOSIS

Condition	Possible Cause	Correction
Pulls	1. Incorrect tire pressures.	1. Inflate evenly on both sides to the recommended pressures (see Owner's Manual).

Condition	Possible Cause	Correction
	2. Front end out of line.	2. Check and align to manufacturer's specifications.
	3. Unmatched tires on same axle.	3. Tires with approximately the same amount of tread should be used on the same axle.
	4. Restricted brake tubes or hoses.	4. Check for soft hoses and damaged lines. Replace with new hoses and new double-walled steel brake tubing.
	5. Malfunctioning caliper assembly.	5. Frozen caliper - check for stuck or sluggish pistons, proper lubrication.
	6. Defective or damaged shoe and lining (grease or brake fluid on lining or bent shoe).	6. Install new shoe and lining in complete axle sets.
	7. Malfunctioning rear brakes.	7. Check for brake adjustment, defective lining (grease or brake fluid on lining) or defective wheel cylinders. Repair as necessary.
	8. Loose suspension parts.	8. Check all suspension mountings.
	9. Loose calipers.	9. Check and torque bolts to specifications.
Brake Roughness or Chatter (Pedal Pulsates)	1. Excessive lateral runout .	1. Check per instructions and replace or machine the rotor, if not within specifications.
	2. Parallelism not within specifications.	2. Check per instructions and replace or machine the rotor, if not within specifications.
	3. Wheel bearings not adjusted.	3. Adjust wheel bearings to correct specifications.
	4. Rear drums out of round.	4. Check runout and, if not within specifications, turn the drums within specifications.
	5. Shoe reversed (steel against iron).	5. Replace shoe and lining and machine rotor within specifications.
Excessive Pedal Effort	1. Malfunctioning power brake.	1. Check power brake and repair, if necessary.

Condition	Possible Cause	Correction
	2. Partial system failure.	2. Check front and rear brake system and repair, if necessary. Also, check brake warning light, if a failed system is found and light did not function.
	3. Excessively worn shoe and lining.	3. Check and replace in axle sets.
	4. Piston in caliper stuck or sluggish.	4. Remove caliper and rebuild.
	5. Fading brakes due to incorrect lining.	5. Remove and replace with original equipment lining.
	6. Vacuum leak.	6. Check for ruptured hose or loose attachment.
Excessive Pedal Travel	1. Partial brake system failure.	1. Check both front and rear system for a failure and repair. Also, check warning light - it should have indicated a failure.
	2. Insufficient fluid in master cylinder.	2. Fill reservoirs with approved brake fluid. Check for leaks.
	3. Poor rear brake adjustment.	3. Adjust rear brake per specifications.
	4. Air trapped in system.	4. Bleed system.
	5. Bent shoe and lining.	5. Replace axle set of shoe and lining.
Dragging Brakes (A very light drag is present in all disc brakes immediately after pedal is released.)	1. Master cylinder pistons not returning correctly.	1. With reservoir cover off, check for fluid spurt at bypass holes as pedal is depressed. Adjust push rod, if necessary, or rebuild master cylinder.
	2. Restricted brake tubes or hoses.	2. Check for soft hoses or damaged tubes and replace with new hoses and new double-walled steel brake tubing.
	3. Incorrect parking brake adjustment on rear brakes.	3. Check and readjust to correct specifications.
	4. Check valve installed in outlet to front disc brakes.	4. Check master cylinder outlet and remove check valve if present.
Grabbing or Uneven Braking Action (All conditions listed under "Pulls" .)	1. Malfunction of power brake unit.	1. Check operation and repair, if necessary.

Condition	Possible Cause	Correction
	2. Binding brake pedal mechanism.	2. Check and lubricate, if necessary.
	3. Corroded caliper assembly.	3. Clean and lubricate.

MAINTENANCE AND ADJUSTMENTS

DISC BRAKE MAINTENANCE

Checking Brake Fluid Level

The brake fluid level in the brake fluid container must be checked during **predelivery** inspection, then every 3,000 miles during inspection and preventive maintenance servicing.

The brake fluid level must not be higher than the inscription "MAX" and must be at least up to "MIN". Replenish brake fluid, if necessary.

Because of the relatively large brake caliper bore cross section and the self-adjustment of the disc brakes, resulting in a greater piston travel to compensate for friction pad wear, the brake fluid level drops faster than in fluid containers for drum brakes with their smaller wheel brake cylinders. For this reason pay special attention to the fluid level in the **brake** fluid container.

Drop of brake fluid level can be due to friction pad wear and may not be due to leakage in the braking system.

On loss of brake fluid due to leakage, the brake system must be checked thoroughly.

Friction Pad Adjustment

Friction pad adjustment is not necessary on the front wheel disc brakes as this is done automatically by the pistons in the brake calipers.

Lubricating Front Wheel Bearings

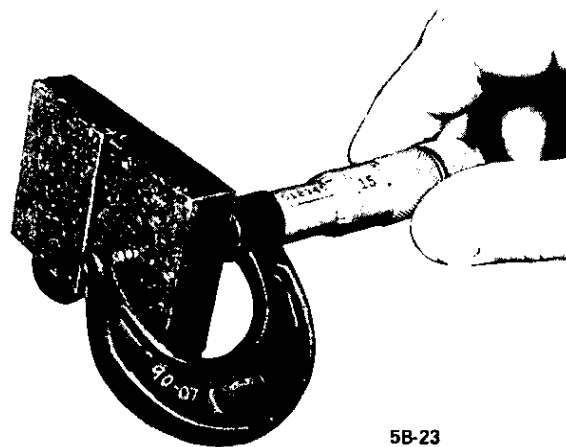
When removing one or both brake discs, check lubrication of front wheel bearings and the cavity of the wheel hub and replenish if necessary (see operation "Removing and Reinstalling Brake Disc"). When carrying out other work on disc brakes which does not necessitate the removal and installation of the brake disc, lubricating wheel bearings is not necessary.

Checking Disc Brake Friction Pads for Wear

Whenever a disc brake equipped car is in for periodic service, while the car is raised, the friction pads in both brake calipers should be checked for wear by making a simple measurement. Worn or oily friction pads must be replaced.

Measure friction pad wear as follows:

1. Remove friction pads.
2. Using a one-inch micrometer, measure the thickness of the pad and friction plate. See Figure 5B-23.



5B-23

Figure 5B-23 Checking Brake Friction Pad Thickness

3. If any one of the four measurements is less than **.280**, replace all four friction pads. (Partial replacement of friction pads would cause unequal braking.)

Removal and Installation of Friction Pads

1. Raise car and remove front wheels.
2. Drive dowel pins out of brake calipers toward center of car. See Figure 5B-24. Dowel pins must be driven inward because they are secured by enlarge fluted inner ends.
3. Remove friction pads from brake calipers. See Figure 5B-25.

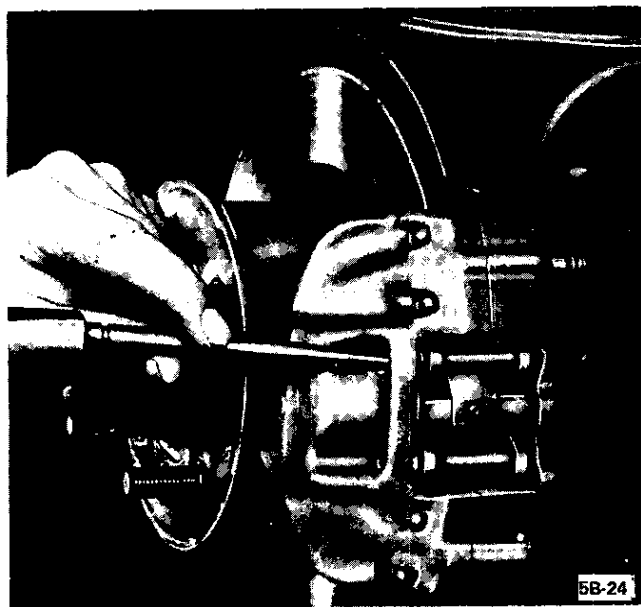


Figure 5B-24 Removing Dowel Pins

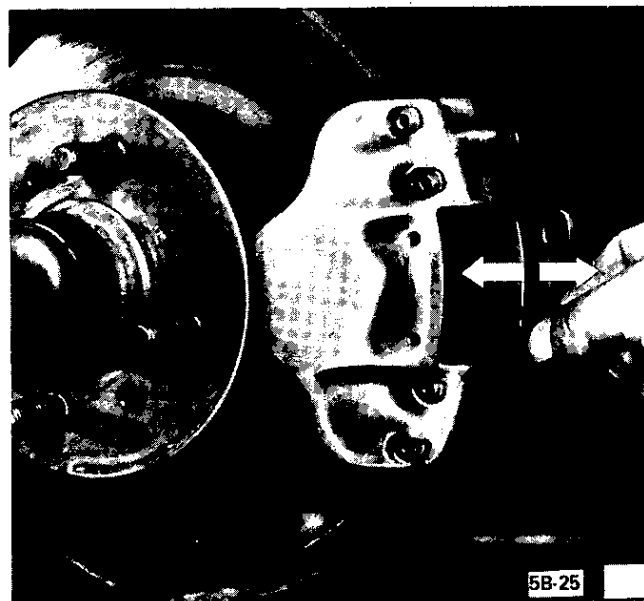


Figure 5B-25 Removing Friction Pads

4. Check rubber seals for wear. If rubber seals are hardened, brittle or cracked, they must be replaced as follows:

(a) Remove brake caliper from steering knuckle and brake disc. Leave hose attached to brake caliper.

(b) Remove seal clamp rings with screwdriver and remove seal rings from calipers. See Figure 5B-26.

(c) Install new rubber seals and clamp rings. Make sure rubber seal is properly seated. Make sure clamp ring is correctly positioned on rubber seal.

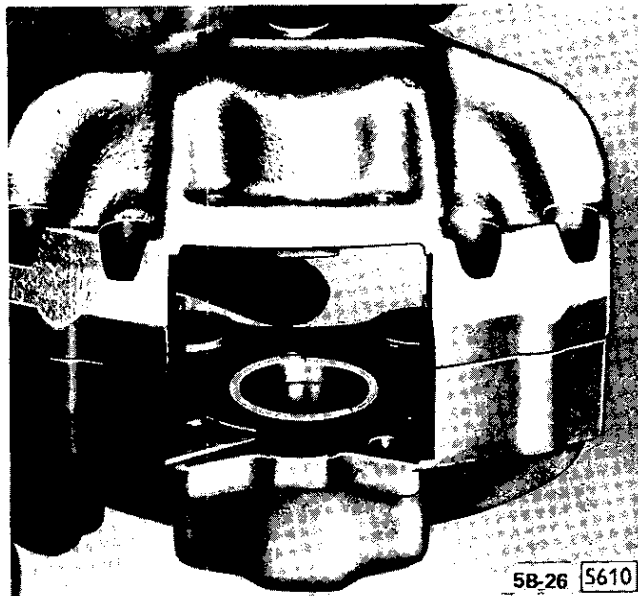


Figure 5B-26 Removing or Installing Rubber Seal Clamp Ring

(d) Attach brake caliper to steering knuckle and torque bolts to 72 lb.ft. *Prior to installation of caliper, make sure contacting surfaces of both caliper and steering knuckle are perfectly clean and free of any burrs.*

CAUTION: *This disc brake caliper attachment fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

5. Before installing new friction pads, press both pistons of each caliper to bottom of their bores, using Return Clamp J-22430. While pressing piston into bores, open caliper bleeder valve to prevent excess brake fluid from overflowing master cylinder container. As soon as pistons are bottomed, tighten bleeder valve.

6. Check brake disc for lateral runout.

7. Install new friction pads into brake caliper. *Friction pads must be free enough to be easily moved in their caliper recesses.* See Figure 5B-25.

If new friction pads are not free, it will be necessary to remove pads and clean recesses and recess corners with a wooden spatula and then with denatured alcohol and a brush. After cleaning, blow out recesses with compressed air. Remove any high spots on edges of friction pads contacting caliper recesses with

a fine cut file. **Do not use any solvent except denatured alcohol. Do not use a metallic scraper tool.**

8. With a punch, drive one dowel pin from inboard side through caliper and friction pads to stop. Install new cross-shaped retaining spring under installed dowel pin, then install second dowel pin. Loose fitting dowel pins must be replaced.

9. Before operating vehicle, depress brake pedal several times to adjust friction pads to brake discs. Check brake fluid level and add fluid as necessary to bring level up to "MAX" on reservoir.

Car owners must be informed that a break-in period exists for new friction pads, and that they must avoid unnecessary, forceful braking during the first 125 miles after installation of new friction pads.

Checking Brake Disc for Lateral Runout

1. Remove front wheel assembly.
2. Remove front wheel bearing hub cap and spindle nut cotter pin. Tighten spindle nut until all free play is removed from wheel bearings.
3. To check disc **runout**, use Dial Indicator Set J-8001. Attach dial support C-clamp to an upper ball joint attaching bolt as shown in Figure 5B-27. Position dial indicator button against brake disc 1/2 inch from outer circumference.

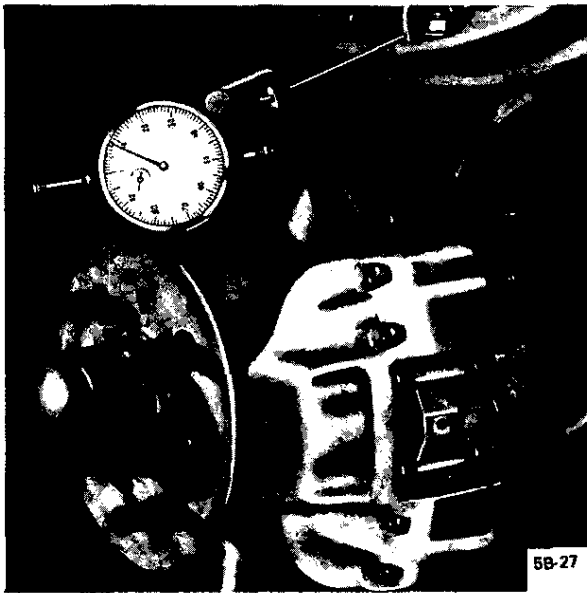


Figure 5B-27 Checking Brake Disc Lateral Runout

4. Rotate disc, reading maximum dial indicator movement. Maximum permissible **runout** is .004 inch.
5. If **runout** exceeds .004 inch, remove disc and hub

assembly and true disc in a suitable disc turning lathe, following manufacturer's instructions. The depth of cut on each side of disc should be just deep enough to get a true flat surface.

6. After truing disc on both sides, check thickness with a micrometer. A disc with a thickness of less than .394 inch is liable to warp after hard braking and, therefore, must be discarded.

7. Reinstall brake disc and hub assembly, removing all play from wheel bearings. Repeat **runout check**. If **runout** still exceeds .001 inch, replace brake disc.

8. Adjust front wheel bearings.

9. Reinstall front wheel assembly.

MAJOR REPAIR

REMOVING AND INSTALLING BRAKE CALIPER

1. Remove left or right front wheel and remove friction pads from brake caliper.

2. Loosen brake line to brake caliper union nut several turns. Unscrew brake caliper plus brake hose bracket from steering knuckle. Remove it from brake disc and swing it sideways. Then unscrew brake pipe from brake hose and remove brake caliper and brake pipe (bent pipe). To prevent brake fluid loss, close brake hose with a plug.

3. Prior to installation, **check contacting surfaces of the brake caliper and steering knuckle to make sure they are free of any burrs and dirt.**

4. Install brake caliper on steering knuckle and torque attaching bolts to 72 lb.ft. See Figure 5B-28.

CAUTION: This disc brake caliper attachments fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

5. Attach brake pipe to brake hose.

6. Install friction pads and replace wheel.

REMOVING AND INSTALLING BRAKE DISC

1. Jack-up and support front of car and remove front

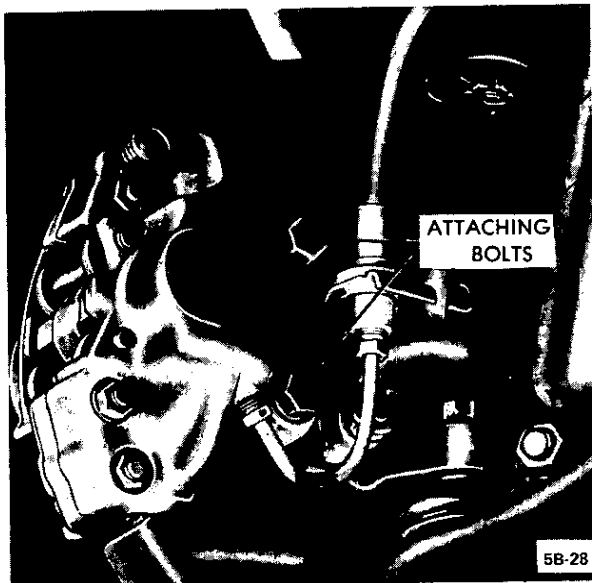


Figure 5B-28 Brake Caliper to Steering Knuckle Attaching Bolts

wheel. Disconnect brake caliper with friction pads from steering knuckle **and** support the assembly as shown in Figure 5B-29.

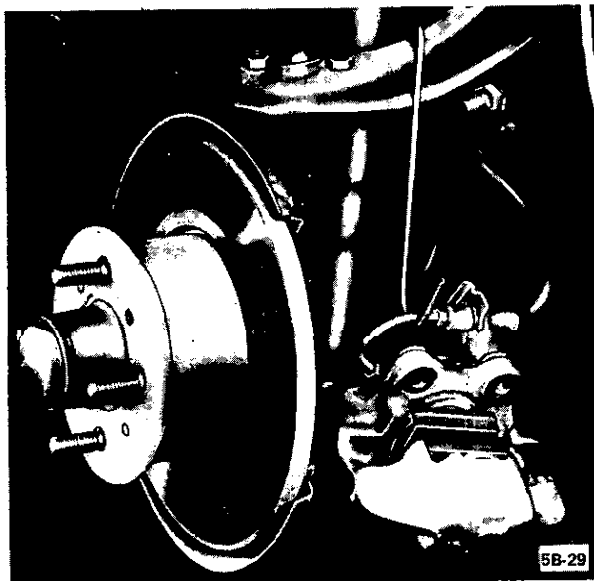


Figure 5B-29 Supporting Brake Caliper

2. Remove front wheel hub and disc assembly along with wheel bearings.

3. Mount brake disc and wheel hub between soft metal jaws in vise. **Do not hold too tightly, to avoid bending** wheel bolts. Remove **four** star head bolts with lockwashers using Star Wrench Adapter J-21737. **Prior to removal, mark position of brake disc in relation to wheel hub.** See Figure 5B-30.

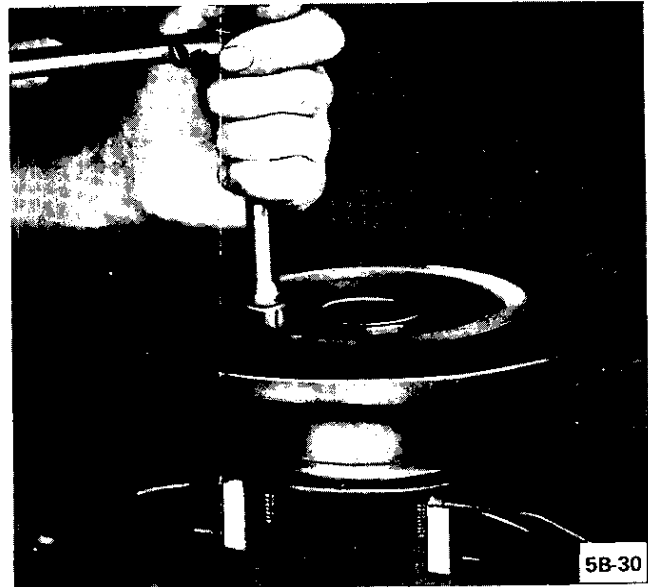


Figure 5B-30 Removing Brake Disc to Hub Bolts

4. Pull brake disc from wheel hub. Do not drive it off. Install in reverse sequence, paying attention to the following:

5. Prior to installation of the brake disc, ensure that the contacting surface of brake disc to wheel hub is free of burrs, dirt and high spots. If necessary, remove high spots and check disc for flatness on a surface plate. Carefully remove burrs with a scraper or file.

6. Also check contacting surface of wheel hub to brake disc to **make** sure it is in good condition. The same applies to brake disc aligning shoulder on wheel hub. See Figure 5B-31

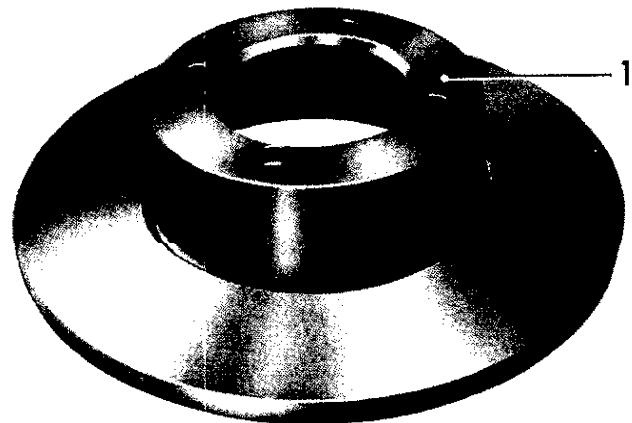


Figure 5B-31 Brake Disc to Hub Contact Surface

CAUTION: Fasteners in Steps 7 and 9 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

7. Install brake disc on wheel hub and torque attaching bolts to 36 lb.ft. If old brake disc is reused, pay attention to locator marks on brake disc and wheel hub.

8. Prior to installing brake disc and hub assembly to steering knuckle, check lubrication of both roller bearings and quantity of grease in cavity of wheel hub. If necessary, repack front wheel bearings.

9. Adjust front wheel bearing clearance and tighten brake caliper to steering knuckle, attaching bolts to a torque of 72 lb.ft. Prior to installing brake caliper to steering knuckle, ensure that all contacting surfaces are free of dirt and burrs. Also make sure that the friction pads are not damaged when sliding the brake caliper onto brake disc.

10. Install wheel assembly, remove supports and lower front of car.

REMOVING AND INSTALLING BRAKE DISC SHIELD

Removal

1. Remove brake disc.
2. Remove disc shield from steering knuckle by removing one Phillips head screw on the outside and on the inside, the lower steering arm and disc shield to steering knuckle bolt. Remove paper gaskets from steering knuckle. See Figure 5B-32.

Installation

1. Prior to placing new paper gasket between brake disc shield and steering knuckle, lightly coat both surfaces of paper gasket with chassis lubricant.
2. Install disc and tighten disc shield and steering arm to steering knuckle bolt to a torque of 47 lb.ft.

CAUTION: This steering arm and steering knuckle to backing plate fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the

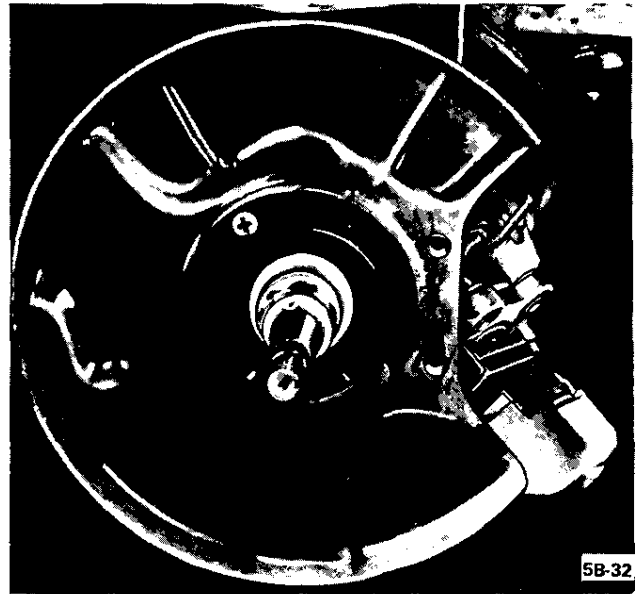


Figure 5B-32 Brake Disc Shield Attached to Steering Knuckle

same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

3. Replace one Phillips head screw on outside of disc. See Figure 5B-32.

DISASSEMBLY AND ASSEMBLY OF BRAKE CALIPER

1. Remove brake pipe from brake caliper. If both calipers have to be repaired, it is advisable to mark them with "L" or "R" on removal to avoid errors when installing parts, such as pistons, etc. The brake caliper halves must not be disassembled during repair work. All work, such as pressing out pistons, replacing seals in brake caliper, is carried out with the two caliper halves bolted together.

2. Pry clamp rings from rubber seals, using a screwdriver (Figure 5B-26) and remove rubber seals.

3. Remove piston first from caliper rim half (Figure 5B-33), and then out of the caliper mounting half (Figure 5B-34) of the brake caliper, using mounting clamp J-22429. To be able to force the piston out of the caliper rim half, block the piston in the caliper mounting half with mounting clamp J-22429 as shown in Figure 5B-33. To force the piston out of the caliper mounting half, place the mounting clamp on caliper rim half, as shown in Figure 5B-34, and tighten wing nut so that the rubber plate seals off the caliper rim half bore. Then connect compressed air hose to brake line connection in the caliper mounting

half, and blow out pistons, carefully regulating air flow. When removing pistons, proceed with extreme caution and always keep the fingers of the hand holding the brake caliper away from the piston.

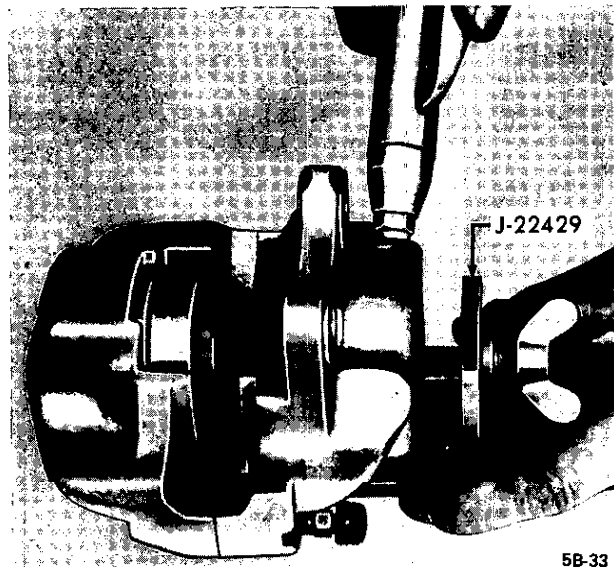


Figure 5B-33 Removing Caliper Rim Half Piston

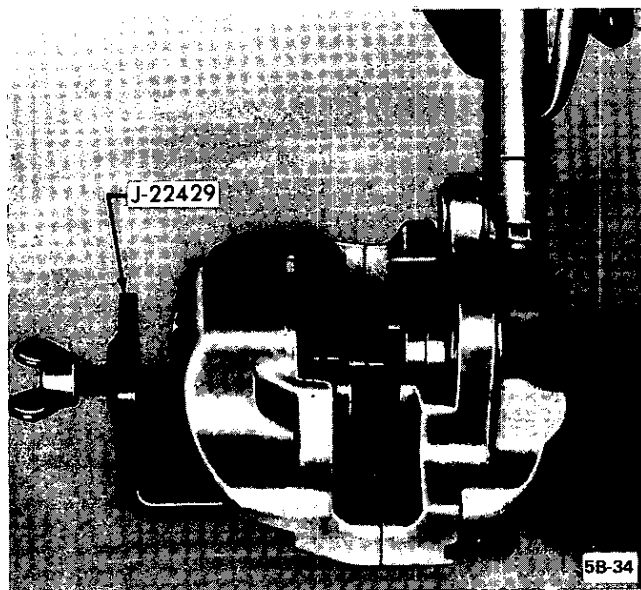


Figure 5B-34 Removing Caliper Mounting Half Piston

4. Pry rubber fluid seals out of the annular grooves in the caliper half bores. See Figure 5B-35.

5. Check all parts of the brake caliper for wear. If the caliper half bores are scored or rusted, use a new complete brake caliper and friction pads. Small, light rust spots in the caliper half bores or on the pistons can be removed with fine emery cloth. If pistons are damaged, even though the caliper half bores are in

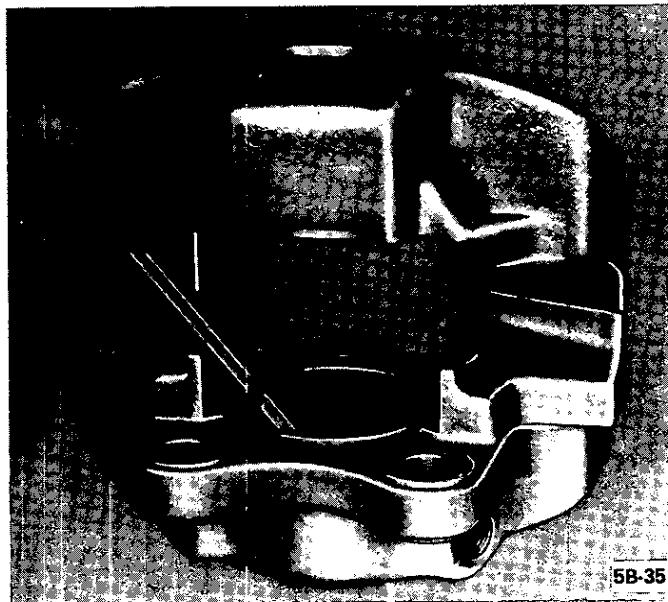


Figure 5B-35 Removing Rubber Fluid Seal From Caliper Bore

good condition, the piston must be replaced. The rubber fluid seals and rubber seals with **clamp** rings for the pistons are to be replaced every time repair work is carried out on the brake caliper.

6. Thoroughly clean all reusable parts - complete brake caliper and pistons - with denatured alcohol and dry with compressed air. Prior to cleaning, screw bleeder valve out of caliper.

7. Lightly coat new rubber fluid seals with brake fluid and insert fluid seals into grooves of brake caliper bores.

8. Place brake caliper into vise to install pistons. After installing one piston, change position of brake caliper in vise to install second piston. The piston to friction pad spacer plates should be used as a gauge to locate relieved edge of piston at 20 degrees to horizontal during piston installation. See Steps 9-10-11-12.

9. Place caliper mounting half in vise and coat its bore and piston lightly with brake fluid. Then push piston, with hollow end towards brake disc, into the caliper bore. Turn piston so that the relieved edge faces downwards at an angle of 20 degrees and facing in brake disc direction. The guide surface in the caliper half recess at the brake pipe connection side, will properly align the piston. Push piston into caliper bore up to the stop.

10. Change position of brake caliper and install second piston in the same manner.

11. Install new rubber seals with clamp rings. Make sure that the rubber seals are properly seated on the

caliper half collars and the clamp rings are correctly positioned on rubber seals.

12. Install brake caliper on steering knuckle, torquing bolts to 72 lb.ft.

CAUTION: *This disc brake caliper attachments fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number*

or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

13. Attach brake pipe to caliper and torque to 22 lb.ft.

14. Bleed brakes as necessary.

SPECIFICATIONS

DISC BRAKE SPECIFICATIONS

General Specifications

Disc Brake Type	2 Piston Fixed Caliper	Disc
Location	Front Wheels Only	
Disc Type	Solid Cast Iron	
Disc Diameter	9.370	
Disc Lateral Runout (Maximum)	.004	
Disc Thickness (New)	.430	
Disc Thickness (Minimum)	.394	
Disc Parallelism (Thickness Tolerance)	.0006	
Brake Shoe and Lining Type	Bonded	
Brake Shoe and Lining Thickness (New)	.550	
Brake Shoe and Lining Minimum Thickness Before Replacement	.280	
Disc Brake Master Cylinder Bore	.810	
Disc Brake Caliper Cylinder Bore - GT	1.770	
Disc Brake Caliper Cylinder Bore Opel 1900 and Manta	1.890	
Disc Brake Shoe Adjustment	Self-Adjusting	

Torque Specifications

Use a reliable torque wrench to tighten the parts listed, to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly-lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

	Name	Torque Lb.Ft.
Bolt	Brake Caliper to Steering Knuckle	72
Bolt	Brake Disc to Wheel Hub	36
Bolt	Brake Disc Shield to Steering Knuckle and Steering Arm	47
Nut	Brake Pipe to Caliper	22