PEARSON NEW INTERNATIONAL EDITION

Automotive Chassis Systems

James D. Halderman

Sixth Edition

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SUMMARY

1. Care should be exercised when removing a brake drum so as not to damage the drum, backing plate, or other vehicle components.
2. After disassembly of the drum brake component, the backing plate should be inspected and cleaned.
3. Most experts recommend replacing the wheel cylinder as well as all brake springs as part of a thorough drum brake overhaul.
4. Measure the brake drum and adjust the brake shoes to fit the drum.
5. Use care to prevent getting grease on brake linings. It can cause the brake to grab.

REVIEW QUESTIONS

1. Explain how to remove a brake drum.
2. List all items that should be lubricated on a drum brake.
3. List the steps necessary to follow when replacing drum brake linings.
4. Explain why many vehicle manufacturers do not recommend the wheel cylinder be honed.

CHAPTER QUIZ

1. Technician A says that the tinnerman nuts are used to hold the brake drum on and should be reinstalled when the drum is replaced. Technician B says that a drum should be removed inside a sealed vacuum enclosure or washed with water or solvent to prevent possible asbestos dust from being released into the air. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
2. The backing plate should be replaced if the shoe contact areas (pads or ledges) are worn more than _____.
   a. 1/2 inch (13 mm)
   b. 1/4 inch (7 mm)
   c. 1/8 inch (4 mm)
   d. 1/16 inch (1.5 mm)
3. Technician A says that silicone brake grease can be used to lubricate the shoe contact ledges. Technician B says that synthetic brake grease, lithium brake grease, or anti-seize compound can be used as a brake lubricant. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
4. Most brake experts and vehicle manufacturers recommend replacing brake lining when the lining thickness is _____.
   a. 0.030 inch (0.8 mm)
   b. 0.040 inch (1.0 mm)
   c. 0.050 inch (1.3 mm)
   d. 0.060 inch (1.5 mm)
5. Technician A says that starwheel adjusters use different threads (left- and right-handed) for the left and right sides of the vehicle. Technician B says that the threads and end caps of the adjusters should be lubricated with brake grease before being installed. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
6. Technician A says that many vehicle manufacturers recommend that wheel cylinders not be honed because of the special surface finish inside the bore. Technician B says that some experts recommend that the wheel cylinders be replaced every time the brake linings are replaced. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B
7. Most manufacturers recommend that brake parts should be cleaned with _____.
   a. Clean water only
   b. Denatured alcohol
   c. Stoddard solvent
   d. Detergent and water
8. Old brake shoes are often returned to the manufacturer when new friction material is installed. These old shoes are usually called the _____.
   a. Core
   b. Web
   c. Rim
   d. Nib

9. After assembling a drum brake, it is discovered that the brake drum will not fit over the new brake shoes. Technician A says that the parking brake cable may not have been fully released. Technician B says to check to see if both shoes are contacting the anchor pin. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B

10. Technician A says to use masking tape temporarily over the lining material to help prevent getting grease on the lining. Technician B says that grease on the brake lining can cause the brakes to grab. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technicians A and B
   d. Neither Technician A nor B

GLOSSARY

Bearingized A hard surface created inside a wheel cylinder or master cylinder by forcing a hardened steel ball through the bore.

Brake hardware kit Springs, clips, and other hardware items to replace the original items when the brake lining or pads are replaced.

Speed nuts Used to keep the brake drum on at the assembly plant. Can be removed and discarded when servicing drum brakes for the first time; also called Tinnerman nuts.

Tinnerman nuts Used to keep the brake drums on at the assembly plant. Can be removed and discarded when servicing the drum brake for the first time; also called speed nuts.

DISC BRAKES

LEARNING OBJECTIVES

After studying this chapter, the reader will be able to:

1. Describe the parts and operation of disc brakes.
2. Describe the construction of disc brake pads.
3. Discuss the brake pad assembly methods and brake lining composition.
4. Describe the difference between fixed caliper and floating or sliding caliper.

This chapter will help you prepare for the Brakes (A5) ASE certification test content area "C" (Disc Brake Diagnosis and Repair).

KEY TERMS

Anchor plate
Antirattle clips
Aramid fiber
Bonded linings
Brake block
Brake pad
CFRC
Fixed brake caliper
Floating caliper
Gas fade
Integrally molded
Kevlar
Lining fade
Low-drag caliper
Mechanical fade
Mold bonded lining
NAO
NAS
Natural frequency
Nonasbestos
Pad wear indicators
Pin-slider caliper
Riveted linings
Semimets
Sintered metal
Sintering
Sliding caliper
Swept area
Water fade
Ways

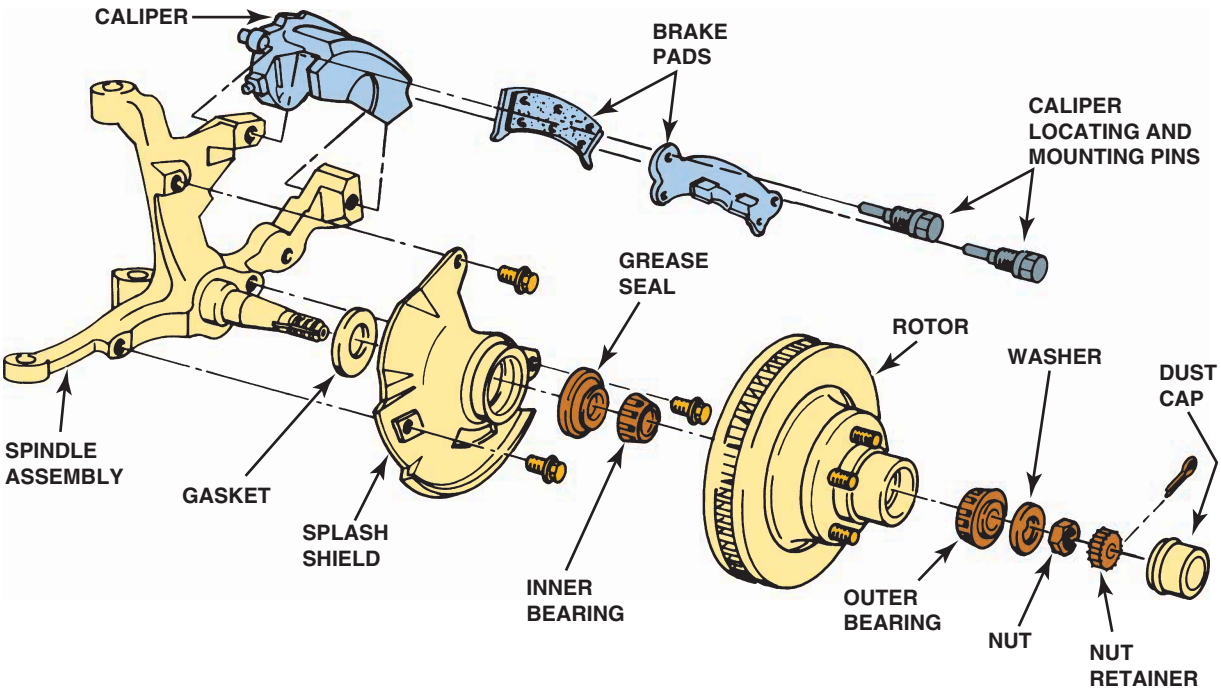

FIGURE 1 An exploded view of a typical disc brake assembly.

DISC BRAKES

PARTS AND OPERATION

Disc brakes use a piston(s) to squeeze friction material (pads) on both sides of a rotating disc (rotor). Disc may be spelled *disk* by some manufacturers, but *disc* is the SAE (Society of Automotive Engineers) term and the most commonly used spelling in the industry. The rotor is attached to and stops the wheel.

Disc brakes are used on the front wheels of late-model vehicles, and on the rear wheels of an increasing number of automobiles. Disc brakes were adopted primarily because they can supply greater stopping power than drum brakes with less likelihood of fade. This makes disc brakes especially well suited for use as front brakes, which must provide 60% to 80% of the vehicle's total stopping power.

DISC BRAKE ADVANTAGES

Although increased federal brake performance standards hastened the switch to disc brakes, the front drum brakes would eventually have been eliminated anyway because disc brakes are superior in almost every respect. The disc brake friction assembly has several significant strong points, and only a few relatively minor weak points. ● **SEE FIGURE 1**.

The main advantages of the disc brake include the following:

FADE RESISTANCE. The main design features that help disc brakes avoid heat-induced fade is their cooling ability because all of the major parts of a disc brake are exposed to the air flowing over the friction assembly. Many brake rotors also have cooling passages cast into them to further reduce operating temperatures and have greater fade resistance than drum brakes because they have greater swept area. **Swept area** is the amount of brake drum or rotor friction surface that moves past the brake linings every time the drum or rotor completes a rotation. Disc brakes are resistant to all kinds of fade, including the following:

- **Mechanical fade** is not a problem with disc brakes because, unlike a brake drum, the disc brake rotor expands *toward* the brake linings as it heats up rather than *away* from them. This fundamental design difference makes it physically impossible for heat to cause the rotor to expand out of contact with the brake linings. Because of this, there is never the need to move the brake linings out to keep them in contact with the rotor, so brake pedal travel does not increase. If the brake pedal on a vehicle with disc brakes drops toward the floor, it is almost always a sign of vapor lock, a fluid leak, fluid bypassing the seals in the master cylinder, or mechanical fade of the rear *drum* brakes.
- **Lining fade** can and does occur if the brakes become overheated. A little bit of heat brings the brake pads to

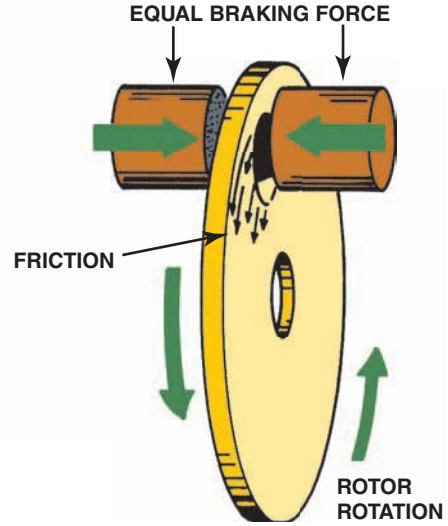

FIGURE 2 Braking force is applied equally to both sides of the brake rotor.

FIGURE 3 Disc brakes can absorb and dissipate a great deal of heat. During this demonstration, the brakes were gently applied as the engine drove the front wheels until the rotor became cherry red. During normal braking, the rotor temperature can exceed 350°F (180°C), and about 1,500°F (800°C) on a race vehicle.

their operating temperature and actually increases the friction coefficient of the lining material. A warm brake performs better than a cold brake. However, when too much heat is generated by braking, the lining material overheats. Its friction coefficient drops, and lining fade occurs.

The primary symptom of lining fade is a hard brake pedal that requires the driver to apply greater force to maintain stopping power. Unlike the similar situation in a drum brake, however, increased application force will not distort the brake rotor because the caliper applies equal force to both sides. ● **SEE FIGURE 2**.

Increased pressure will, however, create even more heat, and if brake lining temperatures continue to increase, gas fade and vapor lock of the hydraulic system can occur. If the pads are overheated to the point where the lining material is physically damaged, the brakes will not recover their full stopping power until the pads are replaced. ● **SEE FIGURE 3**.

- **Gas fade** is a problem only under severe braking conditions when hot gases and dust particles from the linings are trapped between the brake linings and rotor, where they act as lubricants. The symptoms of gas fade are the same as those for lining fade. The pedal becomes hard and increased force is required to maintain stopping power.

Even though disc brakes operate at higher temperatures than drum brakes, they have fewer problems with gas fade for a number of reasons.

1. Disc brakes do not have a drum to contain gases and particles in the area around the brake linings.
2. The constant flow of air over the brake carries away contaminants that might otherwise build up.
3. The surface area of the brake lining material in a disc brake is smaller than that of a comparable drum brake and this allows gases and particles to escape more easily.

To help prevent gas fade, many brake pads have slots cut in the lining material. These slots allow gases and dust particles to escape. ● **SEE FIGURE 4**. The holes required in riveted linings also perform this function. For even greater protection against gas fade, high-performance vehicles and motorcycles sometimes have holes or slots cut into the rotor. These openings allow gases and water to escape, and their sharp edges continually wipe loose particles off the linings.

- **Water fade** is not a big problem with disc brakes because centrifugal force created by the spinning rotor

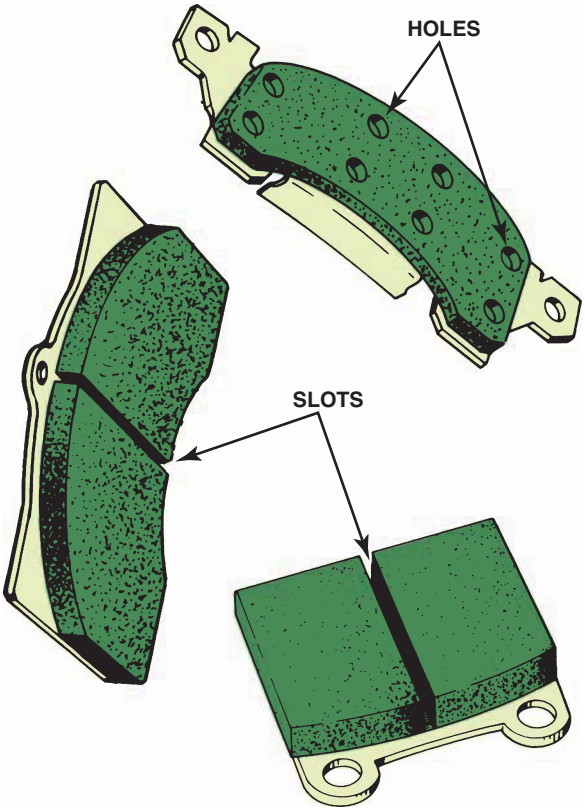

FIGURE 4 Slots and holes in the brake linings help prevent gas and water fade.

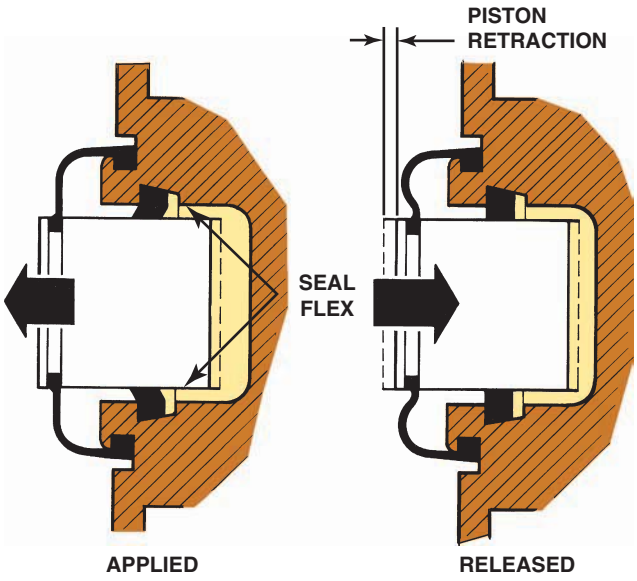

FIGURE 5 The square-cut O-ring not only seals hydraulic brake fluid but also retracts the caliper piston when the brake pedal is released.

throws off most moisture, and the brake pads positioned only a few thousandths of an inch away from the rotor continuously wipe it clean. When the brakes are applied, the leading edge of the brake pad lining material wipes the last bit of water from the disc. Once good lining-to-rotor contact is established, water is unable to enter the space between the linings and rotor until the brakes are released.

Although far more resistant to water fade than drum brakes, disc brakes are not entirely free from its effects. Splash shields and the vehicle's wheels help keep water off of the rotor, and the brake lining materials specified for most vehicles minimize the effects of water fade.

SELF-ADJUSTING ABILITY. Disc brakes are self-adjusting because any wear of the linings is automatically compensated for by the action of the brake caliper.

When the brakes are applied, the caliper pistons move out as far as needed to force the brake pads into contact with the rotor. When the brakes are released, the piston retracts only the small distance dictated by rotor runout and piston seal flex. ● **SEE FIGURE 5**. The surface finish on the piston must be clean to allow the piston to slide past this seal. Excessive friction between the caliper piston and the caliper bore can prevent the piston from retracting. If the force of the caliper seal is not strong enough, the piston stays in the applied position. Because the brake pads are still in contact with the rotor, one or both pads will show excessive wear.

FREEDOM FROM PULL. A disc brake will stop straighter under a wider range of conditions than will a drum brake. A disc brake is self-cleaning, will throw off most water, and is less likely to pull.

Disc brakes do not have self-energizing or servo action. Because disc brakes do not use friction between the linings and rotor to increase their braking power, the effects of a loss of friction on one side of the vehicle are far less pronounced than with drum brakes.

DISC BRAKE DISADVANTAGES

The most notable fact about the disadvantages of disc brakes is that there are so few. The weaknesses of disc brakes include the following:

- **No Self-Energizing or Servo Action**—The disc brake's lack of self-energizing or servo action is a disadvantage for two reasons.