Automotive Technology 6th Edition
Chapter 105 DISC BRAKES OPERATION
Opening Your Class

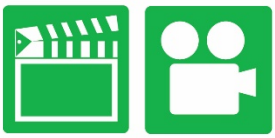
KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain learning objectives to students as listed below: 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. 5. Discuss brake rotors, disc brake designs, and rear disc brakes. 6. This chapter will help prepare for the Brakes (A5) ASE certification test content area "C" (Disc Brake Diagnosis and Repair).
Establish the Mood or Climate	Provide a ***WELCOME,*** Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 105 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Chapter 105 Disc Brake Operation
	**1. SLIDE 1 CH105 DISC BRAKES**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF**
	
	**Videos**
	**Disc Brake Apply & Release (View) (Download)** **Retract Caliper Piston (View)**
	**EXPLAIN TECH TIP:**
	2. **SLIDE 2 EXPLAIN Figure 105-1** exploded view of a typical disc brake assembly. 3. **SLIDE 3 EXPLAIN Figure 105-2** Braking force is applied equally to both sides of the brake rotor. 4. **SLIDE 4 EXPLAIN Figure 105-3** Disc brakes can absorb & dissipate a great deal of heat. During this demonstration, brakes were gently applied as engine drove front wheels until rotor became cherry red. During normal braking, the rotor temperature can exceed 350° F (180° C), & about 1,500° F (800° C) on a race vehicle. 5. **SLIDE 5 EXPLAIN Figure 105-4** Slots and holes in the brake linings help prevent gas and water fade. 6. **SLIDE 6 EXPLAIN Figure 105-5** The square-cut O-ring not only seals hydraulic brake fluid, but also retracts the caliper piston when the brake pedal is released.
	**EXPLAIN TECH TIP:** ***Check Tire Size for a Pulling Problem*** **If an unequal braking problem is being diagnosed, check that front tires match and that rear tires match. Brakes slow and stop wheels.**

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	Unequal diameter tires create an unequal braking force. The result may be a pulling toward one side while braking. Tire diameter can vary from one tire manufacturer to another even though size designation is same. Even slight differences in the wear of tires can cause a different tire diameter and,therefore, a different braking force.
	**DISCUSSION: Ask students to discuss how disc brakes work. Why do disc brakes provide more stopping power than drum brakes? Ask students to talk about why disc brakes are resistant to brake fade. What is effect of disc brakes' larger swept area when compared to drum brakes? Ask students to discuss why disc brakes do not experience mechanical fade.**
	**DISCUSSION: Ask students to talk about how lining fade occurs in disc brakes and compare this to what happens with drum brakes. Ask students to talk about how gas fade takes place in disc brake systems. Why is gas fade less severe for disc brake than for drum brake systems?**
	7. **SLIDE 7 EXPLAIN Figure 105-6** Antirattle clips reduce brake pad movement and vibration. 8. **SLIDE 8 EXPLAIN Figure 105-7** Antivibration shims are used behind the pads on many disc brake caliper designs.
	**EXPLAIN TECH TIP: *Wax the Wheels* Brake dust from semimetallic brake pads often discolors front wheels. Customers often complain to service technicians about this problem, but it is normal for front wheels to become dirty because iron and other metallic and nonmetallic components wear off front disc brake pads and adhere to the wheel covers. A coat of wax on wheels or wheel covers helps prevent damage and makes it easier to wash off the brake dust.**
	**ON-VEHICLE ASEEDUCATION TASK: Research applicable DISC BRAKE vehicle and service information, such as brake system operation, vehicle service history, precautions, and TSBs.**
Education Foundation	

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	**DISCUSSION:** **Ask students to talk about how disc brakes are self-adjusting by design.**
	9. **SLIDE 9 EXPLAIN Figure 105-8** This brake caliper attaches to the front spindle. 10. **SLIDE 10 EXPLAIN Figure 105-9** A rear disc brake caliper often attaches to a mounting bracket on the rear axle housing on this rear-wheel-drive vehicle.
	**DEMONSTRATION:** **Show students how splash shield is designed to protect the inner side of rotor from moisture and other road contaminants.**
	**DEMONSTRATION:** **Show students an example of a disc brake pad. Ask students to compare its construction to a brake shoe. Show students an example of disc brake pad-wear indicators. How do these work to alert driver that brake must be replaced?**
	11. **SLIDE 11 EXPLAIN Figure 105-10** A typical disc brake pad. 12. **SLIDE 12 EXPLAIN Figure 105-11** prevent noise, bent tabs on backing plate hold some brake pads to caliper
	13. **SLIDE 13 EXPLAIN Figure 105-12** Holes in the backing plate are a common method of locating a pad in the caliper. 14. **SLIDE 14 EXPLAIN Figure 105-13** Retainer springs lock the pad to the caliper piston to prevent brake noise.
	15. **SLIDE 15 EXPLAIN Figure 105-14** lining edges of some brake pads are tapered to help prevent vibration. 16. **SLIDE 16 EXPLAIN Figure 105-15** Typical pad wear sensor operation. It is very important that the disc brake pads are installed on the correct side of the vehicle to be assured that the wear sensor will make a noise when the pads are worn. If the pads with a sensor are installed on the opposite side of the vehicle, the sensor tab is turned so that the rotor touches it going the opposite direction. Usually the correct direction is where the rotor contacts the sensor before contacting the pads when the wheels are being rotated in the forward direction.

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	17. **SLIDE 17 EXPLAIN Figure 101-16** Electrical wear indicators ground a warning light circuit when the pads need replacement. 18. **SLIDE 18 EXPLAIN Figure 101-17** Mold-bonded linings are commonly used in many applications.
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***Why Are Some Brake Pads Slotted and Others Not?*** **Brake pads are designed by vehicle manufacturer for each specific application. Some are tapered at the ends and others are slotted and many are tapered and slotted. According to brake design engineers, these features are designed to help reduce brake noise. By changing size of the pad area or by breaking it up into sections by slotting, frequency of sound generated during braking changes. For best results, use a replacement brake pad that has the same design features as the original brake pads.**
	**DISCUSSION:** **Ask students to discuss semimetallic friction materials. Why must the rotor have a very smooth finish when semimetallic brake pad linings are used?**
	**DISCUSSION:** **Ask students to talk about the use of carbon fiber reinforced carbon (CFRC) as a friction material. Where else is carbon fiber being used on automobiles today?**
	**DEMONSTRATION:** **Show students the lining edge codes from a disc brake pad and discuss what the codes indicate**
	**DISCUSSION:** **Ask students to discuss the problem of disc brake dust. What damage is caused if brake dust is not washed off? Ask students to talk about why disc brakes do not function effectively as parking brakes when compared with drum brakes. How is this problem resolved on cars that have four-wheel disc brakes?**

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	**Although dust is common and can stain the wheel, orange (rust) staining is usually a sign that brakes need service.**
	**HANDS-ON TASK: Have students remove wheels of a car with front disc brakes and identify whether the pads have wear indicators and what design of caliper they are. Have the students remove the caliper and check the slides that mount the caliper to the spindle. Have the students determine if the caliper is floating or is rusted so it will not move.**
	**19. SLIDE 19 EXPLAIN Figure 105-18** Disc brake rotors can be either solid or vented.
	**DEMONSTRATION: Show students examples of brake rotors and discuss their construction**
	**Rust build up in the cooling fins of a rotor can cause excessive heat build up and can cause a new brake job to fail prematurely.**
	**20. SLIDE 20 EXPLAIN Figure 105-19** (a) Many fixed caliper disc brakes use a simple retaining pin to hold the disc brake pads. (b) Removing the retainer pin allows the brake pads to be removed. (c) Notice the cross-over hydraulic passage that connects both sides of the caliper. **21. SLIDE 21 EXPLAIN Figure 105-20 T**his floating caliper mounts on a separate anchor plate that bolts to the vehicle suspension. **22. SLIDE 22 EXPLAIN Figure 105-21** Hydraulic force on the piston (left) is applied to the inboard pad and the caliper housing itself. The reaction of the piston pushing against the rotor causes the entire caliper to move toward the inside of the vehicle (large arrow). Since the outboard pad is retained by the caliper, the reaction of the moving caliper applies the force of the outboard pad against the outboard surface of the rotor
	**DEMONSTRATION: Show students a disc brake caliper and demonstrate how it works**

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	**23. SLIDE 23 EXPLAIN Figure 105-22** Caliper flex can cause tapered wear of the brake lining. **24. SLIDE 24 EXPLAIN Figure 105-23** A typical single-piston floating caliper. In this type of design, the entire caliper moves when the single piston is pushed out of the caliper during a brake application. When the caliper moves, the outboard pad is applied against the rotor. **25. SLIDE 25 EXPLAIN Figure 105-24** Floating calipers are supported by rubber O-rings or plastic bushings. **26. SLIDE 26 EXPLAIN Figure 105-25** Metal guide pins and sleeves are used to retain and locate floating calipers.
	**DEMONSTRATION: Show students examples of floating & sliding caliper disc brakes. What are advantages & disadvantages of these caliper designs?**
	**DISCUSSION: Ask students to discuss the importance of aligning fixed calipers so they are centered over the disc rotor. What problems may result from improperly aligned fixed calipers? Ask students to talk about the advantages and disadvantages of fixed caliper designs**
	**Inboard and outboard pads that wear at different rates could be a sign of seized slides.**
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What Is a Low-Drag Caliper?*** **A low-drag caliper differs from a standard caliper in area of square-cut O-ring. A V-shaped cutout allows O-ring to deflect more and, as a result, is able to pull caliper piston back into bore when brakes are released. Because of this further movement, brake pads are pulled farther from the rotor and are less likely to drag. The negative aspect of this design is that greater volume of brake fluid is needed to achieve a brake application. To compensate for this need for greater brake fluid volume, a quick-take-up master cylinder was designed and is used whenever low-drag calipers are used. • SEE**

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	**FIGURE 105–26.** **27. SLIDE 27 EXPLAIN Figure 105-26** In a standard disc brake caliper, the square-cut O-ring deforms when the brakes are applied and returns the piston to its original (released) position due to the elastic properties of the rubber seal. In a low-drag caliper design, the groove for the square-cut O-ring is V-shaped, allowing for more retraction. When the brake pedal is released, the piston is moved away from the rotor farther, resulting in less friction between the disc brake pads and the rotor when the brakes are released **28. SLIDE 28 EXPLAIN Figure 105-27** Exploded view of a typical sliding brake caliper. **29. SLIDE 29 EXPLAIN Figure 105-28** Sliding calipers move on machined ways
	**HANDS-ON TASK: Have students disassemble brake caliper and clean the square cut o-ring. Have students reassemble the brake caliper.**
	**30. SLIDE 30 EXPLAIN Figure 105-29** Exploded view of a typical rear disc brake with an integral parking brake. The parking brake lever mechanically pushes the caliper piston against the rotor. **31. SLIDE 31 EXPLAIN Figure 105-30** This single-piston brake caliper is mechanically actuated to serve as a parking brake. **32. SLIDE 32 EXPLAIN Figure 105-31** Drum parking brakes are fitted inside the rotors on this vehicle equipped with rear disc brakes.