A5 BRAKES 6th Edition

Chapter 12 Disc Brakes

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Brakes.** It correlates material to task lists specified by ASE and NATEF.
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 the chapter learning objectives to the students. 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.
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.

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  	**1. SLIDE 1 DISC BRAKES** **2. SLIDES 2-3 EXPLAIN OBJECTIVES** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **4. SLIDES 4-6 EXPLAIN** Disc Brakes **7. SLIDE 7 EXPLAIN** Figure 12-1 typical disc brake assembly. **8. SLIDE 12 EXPLAIN Figure 12-2** Braking force is applied equally to both sides of the brake rotor. **9. SLIDE 13 EXPLAIN Figure 12-3** 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. **10. SLIDE 10 EXPLAIN Figure 12-4** Slots and holes in the brake linings help prevent gas and water fade. **11. SLIDE 11 EXPLAIN Figure 12-5** The square-cut O-ring not only seals hydraulic brake fluid, but also retracts the caliper piston when the brake pedal is released.
	**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**

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	**SYSTEMS. WHY IS GAS FADE LESS SEVERE FOR DISC BRAKE THAN FOR DRUM BRAKE SYSTEMS?** **12. SLIDE 12 EXPLAIN Figure 12-6** Antirattle clips reduce brake pad movement and vibration. **13. SLIDE 13 EXPLAIN Figure 12-7** Antivibration shims are used behind pads on many disc brake caliper designs.
	**ON-VEHICLE NATEF TASK: RESEARCH APPLICABLE DISC BRAKE VEHICLE AND SERVICE INFORMATION, SUCH AS BRAKE SYSTEM OPERATION, VEHICLE SERVICE HISTORY, SERVICE PRECAUTIONS, AND TSB**
	**DISCUSSION: ASK STUDENTS TO TALK ABOUT HOW DISC BRAKES ARE SELF-ADJUSTING BY DESIGN.**
	**14. SLIDE 14 EXPLAIN** Disc Brake Construction **15. SLIDE 15 EXPLAIN Figure 12-8** brake caliper attaches to front spindle. **16. SLIDE 16 EXPLAIN Figure 12-9** 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 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?**
	**17. SLIDE 17 EXPLAIN Figure 12-10** A typical disc brake pad. **18. SLIDE 18 EXPLAIN Figure 12-11** To prevent noise, bent tabs on backing plate hold some brake pads to the caliper housing. **19. SLIDE 19 EXPLAIN Figure 12-12** Holes in backing plate are a common method of locating a pad in caliper. **20. SLIDE 20 EXPLAIN Figure 12–13** Retainer springs

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	lock the pad to the caliper piston to prevent brake noise. 21. **SLIDE 21** EXPLAIN **Figure 12-14** lining edges of some brake pads are tapered to help prevent vibration. 22. **SLIDE 22** EXPLAIN **Figure 12-15** 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. 23. **SLIDE 23** EXPLAIN **Figure 12-16** Electrical wear indicators ground a warning light circuit when the pads need replacement. 24. **SLIDE 24** EXPLAIN Disc Pad ASM Methods 25. **SLIDE 25** EXPLAIN **Figure 12-17** Mold-bonded linings are commonly used in many applications. 26. **SLIDE 26** EXPLAIN Disc Brake Pads Brake Lining Composition
	**DISCUSSION: ASK STUDENTS TO DISCUSS SEMIMETALLIC FRICTION MATERIALS. WHY MUST ROTOR HAVE A VERY SMOOTH FINISH WHEN SEMIMETALLIC BRAKE PAD LININGS ARE USED?**
	**DISCUSSION: ASK STUDENTS TO TALK ABOUT USE OF CARBON FIBER REINFORCED CARBON (CFRC) AS FRICTION MATERIAL. WHERE ELSE IS CARBON FIBER BEING USED ON AUTOMOBILES?**
	**DEMONSTRATION: SHOW STUDENTS THE LINING EDGE CODES FROM A DISC BRAKE PAD AND DISCUSS WHAT THE CODES INDICATE**

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	**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?
	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.
	**27. SLIDE 27** EXPLAIN **Figure 12-18** Disc brake rotors can be either solid or vented.
	**DEMONSTRATION:** SHOW STUDENTS EXAMPLES OF BRAKE ROTORS AND DISCUSS THEIR CONSTRUCTION
	RUST BUILD UP IN COOLING FINS OF A ROTOR CAN CAUSE EXCESSIVE HEAT BUILD UP AND CAN CAUSE A NEW BRAKE JOB TO FAIL PREMATURELY.
	**28. SLIDE 28** EXPLAIN **Figure 12-19** (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. **29. SLIDE 29** EXPLAIN **Figure 12-20** This floating

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	caliper mounts on a separate anchor plate that bolts to the vehicle suspension. **30. SLIDE 30 EXPLAIN Figure 12-21** 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**
	**31. SLIDE 31 EXPLAIN Figure 12-22** Caliper flex can cause tapered wear of the brake lining. **32. SLIDE 32 EXPLAIN Figure 12-23** 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. **33. SLIDE 33 EXPLAIN Figure 12-24** Floating calipers are supported by rubber O-rings or plastic bushings. **34. SLIDE 34 EXPLAIN Figure 12-25** 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.**

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	**35. SLIDE 35 EXPLAIN Figure 12–26** 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, further resulting in less friction between the disc brake pads and the rotor when the brakes are released
	**36. SLIDE 36 EXPLAIN Figure 12-27** Exploded view of a typical sliding brake caliper.
	37. SLIDE 37 EXPLAIN Figure 12-28 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.**
	**38. SLIDE 38 EXPLAIN Figure 12-29** 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.
	39. SLIDE 39 EXPLAIN Figure 12-30 This single-piston brake caliper is mechanically actuated to serve as a parking brake.
	40. SLIDE 40 EXPLAIN Figure 12-31 Drum parking brakes are fitted inside the rotors on this vehicle equipped with rear disc brakes.
	41. SLIDES 41-45 EXPLAIN SUMMARY