A5 BRAKES 7th Edition

Chapter 15 Machining Brake Drums and Rotors

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. Explain the factors that cause rotor damage. 2. Discuss brake drum distortion. 3. Discuss disc brake rotors and causes of rotor distortion. 4. Explain the procedure for machining a disc brake rotor. **This chapter will help you prepare for the Brakes (A5) ASE certification test content areas "B" (Drum Brake Service) and "C" (DISC Brakes Service).**
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: This lesson plan is based on A5 BRAKES 7th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 15: Chapter Images

ICONS	Ch15 Machining Brake Drums and Rotors

1. **SLIDE 1 MACHINING BRAKE DRUMS AND ROTORS**

Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/

WEB SITE IS CONSTANTLY UPDATED

Videos

At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them

Word Search Puzzle (Microsoft Word) (PDF)

Word Search Puzzle (Microsoft Word) (PDF)

Rotor, Remove and Replace (View) (Download)
Rotor Thickness Measurements (View) (Download)

2. **SLIDE 2** EXPLAIN **Figure 15-1** Types of brake drums. Regardless of design, all types use cast iron as a friction surface.
3. **SLIDE 3** EXPLAIN **Figure 15-2** airflow through cooling vents helps brakes from overheating.
4. **SLIDE 4** EXPLAIN **Figure 15-3** Scored drums and rotors often result in metal-to-metal contact.

DEMO

DEMONSTRATION: SHOW BRAKE DRUM THAT DISPLAYS EVIDENCE OF SCORING. ASK STUDENTS TO SPECULATE ON CAUSES OF SCORING. WHY ARE DRUM BRAKES MORE PRONE TO SCORING THAN DISC BRAKES?

DEMO

DEMONSTRATION: SHOW STUDENTS A BRAKE DRUM THAT HAS CRACKS, AND DISCUSS THE POSSIBLE CAUSES OF THE CRACKING. SHOW STUDENTS HOW TO DO THE TAP TEST TO DETERMINE IF A BRAKE DRUM IS CRACKED.

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5. **SLIDE 5** EXPLAIN **Figure 15-4** Cracked drums/rotors must be replaced.
6. **SLIDE 6** EXPLAIN **Figure 15-5** heat-checked surface of a disc brake rotor.
7. **SLIDE 7** EXPLAIN **Figure 15-6** These dark hard spots are created by heat that actually changes the metallurgy of cast-iron drum. Most experts recommend replacement of any brake drum that has these hard spots.

DISCUSSION: **DISCUSS HEAT CHECKING IN BRAKE DRUMS. HOW IS IT DIFFERENT FROM CRACKING AND WHAT CAUSES IT?**

DEMONSTRATION: **SHOW A BRAKE DRUM THAT DISPLAYS EVIDENCE OF HARD, OR CHILL, SPOTS. HOW ARE HARD SPOTS CAUSED AND WHAT PROBLEMS DO THEY CREATE? SHOW STUDENTS AN EXAMPLE OF A BRAKE DRUM THAT DISPLAYS BELLMOUTH DISTORTION, AND DISCUSS WHAT CAUSES IT.**

DEMONSTRATION: **SHOW BRAKE DRUM THAT HAS GONE OUT-OF-ROUND. ASK STUDENTS TO DISCUSS THE CAUSES OF OUT-OF-ROUND BRAKE DRUM DISTORTION AND ITS SYMPTOMS. ASK STUDENTS TO TALK ABOUT ECCENTRIC DISTORTION OF BRAKE DRUMS. WHAT ARE THE SYMPTOMS OF ECCENTRIC DISTORTION & WHAT PROBLEMS DOES IT CAUSE? HOW CAN IT BE AVOIDED OR RESOLVED? SHOW STUDENTS HOW TO PERFORM THE PARKING BRAKE TRICK TO DIAGNOSE BRAKE-PEDAL PULSATION.**

DISCUSSION: **ASK STUDENTS TO DISCUSS ISSUE OF DRUM DISTORTION. HOW DOES EVEN MINUTEST SHIFT IN POSITION CAUSE DRUM DAMAGE?**

8. **SLIDE 8** EXPLAIN **Figure 15-7** Bellmouth brake drum distortion.
9. **SLIDE 9** EXPLAIN **Figure 15-8** Out-of-round drum distortion
10. **SLIDE 10** EXPLAIN **Figure 15-9** Eccentric brake drum distortion.

DEMONSTRATION: **SHOW STUDENTS HOW TO REMOVE A BRAKE DRUM, AND THEN ASK THEM TO INSPECT IT FOR DISTORTION. HAVE STUDENTS USE A MICROMETER TO MEASURE THE BRAKE DRUMS THEY REMOVED PREVIOUSLY**

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DISCUSSION: **ASK STUDENTS TO TALK ABOUT WHY BRAKE DRUMS ON THE SAME AXLE SHOULD HAVE AS CLOSE TO THE SAME ID AS POSSIBLE. WHAT IS INDICATED WHEN THE BRAKE DRUM CHAMFER IS NOT VISIBLE?**

HANDS-ON TASK: **HAVE STUDENTS REMOVE A BRAKE DRUM THAT IS STUCK ON THE HUB MY USING THE HAMMER TAPE METHOD TO RELEASE IT FROM THE HUB.**

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11. **SLIDE 11 EXPLAIN Figure 15-10** A straightedge can be used to check for brake drum warpage.

12. **SLIDE 12 EXPLAIN Figure 15-11** Discard diameter and maximum diameter are brake drum machining and wear limits.
13. **SLIDE 13 EXPLAIN Figure 15-12** Most brake drums have a chamfer around the edge. If the chamfer is no longer visible, the drum is usually worn (or machined) to its maximum allowable ID.

Brake Drum Micrometer (View) (Download)
Micrometer Metric (View) (Download)

14. **SLIDE 14 EXPLAIN Figure 15-13** Typical needle-dial brake drum micrometer. The left movable arm is set to the approximate drum diameter and the right arm to the more exact drum diameter. The dial indicator (gauge) reads in thousandths of an inch.

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15. **SLIDE 15 EXPLAIN Figure 15-14** (a) A rotor or brake drum with a bearing hub should be installed on a brake lathe using the appropriate size collet that fit bearing cups (races). (b) A hubless rotor or brake drum requires a spring and a tapered centering cone. A faceplate should be used on both sides of rotor or drum to provide support. Always follow operating instructions for specified setup for brake lathe being used.
16. **SLIDE 16 EXPLAIN Figure 15-15** A self-aligning spacer (SAS) should always be used between the drum or rotor and the spindle retaining nut to help ensure an even clamping force and to prevent the adapters and cone from getting into a bind. A silence band should always be installed to prevent turning-tool chatter and to ensure a smooth surface finish.

DEMONSTRATION: SHOW STUDENTS HOW TO USE A SELF-ALIGNING SPACER (SAS) TO ENSURE THAT SPINDLE NUT APPLIES AN EVEN FORCE TO THE DRUM. SHOW STUDENTS THE STEPS INVOLVED IN USING LATHE TO MACHINE A DRUM BRAKE

DISCUSSION: HAVE STUDENTS TALK ABOUT MICROMETER INDICATOR ON THE FEED HANDLE OF THE BRAKE LATHE. HOW CAN THIS MICROMETER BE USED FOR BOTH METRIC AND STANDARD MEASUREMENTS?

17. **SLIDE 17 EXPLAIN Figure 15-16** After installing a brake drum on the lathe, turn the cutting tool outward until the tool just touches the drum. This is called a scratch cut.
18. **SLIDE 18 EXPLAIN Figure 15-17** After making a scratch cut, loosen the retaining nut, rotate the drum on the lathe, and make another scratch cut. If both cuts are in the same location, the drum is installed correctly on the lathe and drum machining can begin.
19. **SLIDE 19 EXPLAIN Figure 15-18** Set the depth of cut indicator to zero just as turning tool touches the drum
20. **SLIDE 20 EXPLAIN Figure 15-19** lathe has a dial that is "diameter graduated". This means that a reading of 0.030 in. indicates a 0.015 in. cut that increases the inside diameter of the brake drum by 0.030 in.
21. **SLIDE 21 EXPLAIN Figure 15-20** Notice chatter marks at edge of friction-area surface of brake drum. These marks were caused by vibration of drum because the technician failed to wrap dampening strap (silencer band) over friction-surface portion of brake drum.

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DEMONSTRATION: SHOW STUDENTS HOW TO INSPECT, MEASURE, AND MACHINE BRAKE DRUMS

ON-VEHICLE NATEF TASK: INSPECT, MEASURE, AND MACHINE BRAKE DRUMS.

22. **SLIDE 22 EXPLAIN Figure 15-21** This excessively worn (thin) rotor was removed from the vehicle in this condition. It is amazing that vehicle was able to stop with such a thin rotor.
23. **SLIDE 23 EXPLAIN Figure 15-22** Severely worn vented disc brake rotor. The braking surface has been entirely worn away exposing the cooling fins. The owner brought the vehicle to a repair shop because of a “little noise in the front.” Notice the straight vane design.
24. **SLIDE 24 EXPLAIN Figure 15-23** Directional vane vented disc brake rotors. Note that the fins angle toward the rear of the vehicle. It is important that this type of rotor be reinstalled on correct side of vehicle.
25. **SLIDE 25 EXPLAIN Figure 15-24** Typical composite rotor that uses cast iron friction surfaces and a steel center section
26. **SLIDE 26 EXPLAIN Figure 15–25** A show vehicle equipped with high-performance brakes including cross-drilled brake rotors.

DEMONSTRATION: SHOW STUDENTS EXAMPLES OF SOLID AND VENTED DISC ROTORS, AND DISCUSS THEIR CONSTRUCTION, WHERE THEY ARE USED, AND HOW THEY WORK TO DISSIPATE HEAT.

DISCUSSION: ASK STUDENTS TO TALK ABOUT DIFFERENCES BETWEEN CROSS-DRILLED & SLOTTED ROTORS. HOW DOES EACH AID IN DISPERSING GAS AND DUST PARTICLES? ASK STUDENTS TO DISCUSS ALUMINUM METAL MATRIX COMPOSITE ROTORS. WHAT ARE THE ADVANTAGES OF THIS TYPE OF ROTOR CONSTRUCTION? HOW CAN THEY BE DISTINGUISHED FROM CONVENTIONAL CAST IRON ROTORS? WHAT ARE THE SPECIAL SERVICING REQUIREMENTS FOR ALUMINUM METAL MATRIX COMPOSITE ROTORS?

ANIMATION: ROTOR LATERAL RUNOUT

WWW.MYAUTOMOTIVELAB.COM

HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/BRAKES/AUTO_ANIMATIONS/CH15_FIG15_26/INDEX.HTML

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SHOW ANIMATION: MEASURING ROTOR LATERAL RUNOUT W/DIAL INDICATOR

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HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/BRAKES/AUTO_ANIMATIONS/CH15_FIG15_28/INDEX.HTML

Rotor Runout

Rotor Runout & Steering Wheel Shake

Rotor Thickness Variation & Brake Pedal Pulsation

ROTOR RUNOUT

ROTOR MEASURING

27. **SLIDE 27 EXPLAIN Figure 15–26** Brake rotor lateral-runout distortion
28. **SLIDE 28 EXPLAIN Figure 15-27** Before measuring lateral runout with a dial indicator (gauge), remove any wheel bearing end play by tightening the spindle nut to 10 to 20 ft-lb with a torque wrench. This step helps prevent an inaccurate reading. If the vehicle is to be returned to service, be sure to loosen the spindle nut and retighten to specifications (usually, finger tight) to restore proper bearing clearance
29. **SLIDE 29 EXPLAIN Figure 15-28** (a) Rotate the disc brake rotor one complete revolution while observing the dial indicator (gauge). (b) Most vehicle manufacturers specify a maximum runout of about 0.003 in. (0.08 mm).
30. **SLIDE 30 EXPLAIN Figure 15-29** Brake rotor lack-of-parallelism distortion.
31. **SLIDE 31 EXPLAIN Figure 15-30** (a) Disc brake rotor thickness variation (parallelism). (b) rotor measured with a micrometer at 4 or more equally spaced locations around rotor.

DEMONSTRATION: SHOW DISC ROTOR THAT EXHIBITS LACK OF PARALLELISM. ASK THEM TO TALK ABOUT WHAT CAUSES LACK OF PARALLELISM AND WHAT PROBLEMS CAN RESULT.

DISCUSSION: ASK STUDENTS TO DISCUSS PROBLEM OF LATERAL RUNOUT (LRO) OF DISC ROTOR. WHAT CAUSES LRO? WHAT PROBLEMS RESULT FROM LRO? ASK STUDENTS TO TALK ABOUT HOW DISTORTION CAN OCCUR IN A DISC BRAKE ROTOR. WHY ARE EFFECTS OF

ICONS	Ch15 Machining Brake Drums and Rotors

DISTORTION MORE PRONOUNCED ON DISC BRAKE ROTOR THAN ON A DRUM BRAKE?

DISCUSSION: **HAVE STUDENTS TALK ABOUT HOW A TIRE THAT IS NOT TRUE CAN CAUSE A VIBRATION THAT COULD BE CONFUSED WITH A BRAKE PROBLEM. HAVE STUDENTS TALK ABOUT HOW THEY WOULD DETERMINE IF THE VIBRATION BEING FELT IS FROM THE TIRES OR FROM BRAKES**

32. **SLIDE 32 EXPLAIN FIGURE 15.31 C**arbon-ceramic brake (CCB) rotor on a Ferrari.
33. **SLIDE 33 EXPLAIN Figure 15-32** digital readout rotor micrometer is an accurate tool to use when measuring a rotor. Both fractional inches and metric millimeters are generally available.

DEMONSTRATION: **SHOW STUDENTS WHERE MINIMUM RECOMMENDED THICKNESS IS ON A DISC ROTOR, & DISCUSS SIGNIFICANCE OF THIS MEASUREMENT.**

34. **SLIDE 34 EXPLAIN Figure 15-33** If fingernail catches on a groove in rotor, rotor should be machined.
35. **SLIDE 35 EXPLAIN Figure 15-34** This rusted rotor should be machined.
36. **SLIDE 36 EXPLAIN Figure 15-35** Rotors that have deep rust pockets usually cannot be machined.

RUST IS VERY HARD ON CUTTING BITS. REMOVE AS MUCH AS YOU CAN BEFORE RUNNING CUTTER OVER ROTOR.

37. **SLIDE 37 EXPLAIN Figure 15-36** Electronic surface finish machine. Reading shows about 140 μin. This is much too rough for use but is typical for a rough cut surface

DEMONSTRATION: **SHOW STUDENTS HOW TO DO THE BALLPOINT PEN TEST TO DETERMINE IF THE FRICTION SURFACE OF A BRAKE DRUM OR DISC ROTOR IS SMOOTH ENOUGH.**

DEMONSTRATION: **SHOW STUDENTS THE CORRECT PROCEDURE FOR MACHINING A DISC BRAKE ROTOR.**

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38. **SLIDE 38 EXPLAIN Figure 15-37** Most positive rake brake lathes can cut any depth in one pass, thereby saving time. A typical negative rake lathe uses a three-sided turning tool that can be flipped over, thereby giving six cutting edges.
39. **SLIDE 39 EXPLAIN Figure 15-38** Recommended adapters & location for machining hubbed & hubless rotors.
40. **SLIDE 40 EXPLAIN Figure 15-39 (a)** Composite adapter fitted to a rotor. **(b)** Composite rotor properly mounted on a lathe.
41. **SLIDE 41 EXPLAIN Figure 15-40** damper is necessary to reduce cutting-tool vibrations that can cause rough surface finish.
42. **SLIDE 42 EXPLAIN Figure 15-41** After installing the rotor on the brake lathe, turn the cutting tool in just enough to make a scratch cut.

43. **SLIDE 43 EXPLAIN Figure 15-42** After making a scratch cut, loosen the retaining nut and rotate the rotor on the spindle of the lathe one-half turn. Tighten the nut and make a second scratch cut. The second scratch cut should be side-by-side with the first scratch if the rotor is installed correctly on the brake lathe

44. **SLIDE 44 EXPLAIN Figure 15-43 (a)** This technician uses two sanding blocks each equipped with 150-grit aluminum-oxide sandpaper.
45. **SLIDE 45 EXPLAIN Figure 15-43 (b)** With the lathe turned on, the technician presses the two sanding blocks against the surface of the rotor after the rotor has been machined, to achieve a smooth microinch surface finish.

46. **SLIDE 46 EXPLAIN Figure 15-44 (a)** After machining and sanding the rotor, it should be cleaned. In this case brake cleaner from an air pressurized spray can is used.
47. **SLIDE 47 EXPLAIN Figure 15-44 (b)** With the lathe turning, the technician stands back away from the rotor and sprays both sides of the rotor to clean it of any remaining grit from the sanding process. This last step ensures a clean, smooth surface for the disc brake pads and a quality brake repair. Sanding each side of the rotor surface for one minute using a sanding block and 150-grit aluminum-oxide sandpaper after a finish cut gives rotor proper smoothness and finish.
48. **SLIDE 48 EXPLAIN Figure 15-45** A grinder with sandpaper can be used to give a smooth non-directional surface finish to the disc brake rotor.

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49. **SLIDE 49** EXPLAIN **Figure 15-46** correct final surface finish should be smooth and non-directional.
50. **SLIDE 50** EXPLAIN **Figure 15-47** Rust should always be cleaned from both the rotor and hub whenever rotors are machined or replaced. An air-powered die grinder with a sanding disc makes quick work of cleaning this hub.

ROTOR MACHINING

ROTOR/DRUM MACHINING AMMCO

Rotor Runout & Steering Wheel Shake (View) (Download)

Rotor Runout (View) (Download)

ROTOR THICKNESS VARIATION & BRAKE PEDAL PULSATION (VIEW) (DOWNLOAD)

DISCUSSION: ASK STUDENTS TO TALK ABOUT DIFFERENCES BETWEEN A ROUGH AND FINISH CUT ON LATHE. ASK STUDENTS TO DISCUSS DIFFERENCE BETWEEN POSITIVE & NEGATIVE RAKE LATHES. WHICH IS PREFERABLE FOR MACHINING BRAKE ROTORS AND WHY? ASK STUDENTS TO DISCUSS PRECONDITIONS FOR MACHINING ROTOR

HANDS-ON TASK: HAVE STUDENTS MACHINE DISC ROTOR. GRADE STUDENTS ON THEIR ABILITY TO COMPLETE THE TASK CORRECTLY AND FOLLOW SAFETY PROCEDURES. USING A MICROMETER, HAVE STUDENTS MEASURE THICKNESS OF ROTOR AFTER THEY HAVE PERFORMED FINISH CUT TO DETERMINE IF IT COMPLIES WITH OEM SPECS

ON-VEHICLE NATEF TASK: INSPECT, MEASURE, AND MACHINE A DISC BRAKE ROTOR

51. **SLIDE 51** EXPLAIN **Figure 15-48** A typical hub-mount on-the-vehicle lathe. This particular lathe oscillates while machining the rotor, thereby providing a smooth and non-directional finish at the same time
52. **SLIDE 52** EXPLAIN **Figure 15–49** A wheel stud was replaced on the rotor hub assembly when it was discovered to be stripped.

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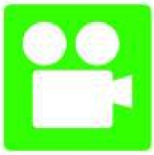
 	**DEMONSTRATION:** **SHOW STUDENTS THE CORRECT PROCEDURE FOR ON-THE-VEHICLE ROTOR MACHINING**
	**ON-CAR BRAKE LATHE VIDEO**
	**HANDS-ON TASK:** **HAVE STUDENTS FOLLOW THE STEPS TO MACHINE A ROTOR WHILE IT'S ON THE VEHICLE. GRADE THEM ON THEIR ABILITY TO COMPLETE THE TASK CORRECTLY AND FOLLOW SAFETY PROCEDURES.**
	70. **SLIDES 70-183 EXPLAIN OPTIONAL DRUM & ROTOR ON&OFF CAR MACHINING**
	184. **SLIDES 184-186 EXPLAIN SUMMARY**
	**SEARCH INTERNET:** **HAVE STUDENTS RESEARCH THE PROCESS OF CONVECTION AND HOW IT PLAYS A ROLE IN THE ABSORPTION OF HEAT WITHIN A DRUM OR DISC BRAKE SYSTEM. ASK THEM TO REPORT THEIR FINDINGS TO THE CLASS.**