# ATE5 Chapter 104 MACHINING BRAKE DRUMS & ROTORS

## Opening Your Class

| KEY ELEMENT | EXAMPLES |
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| **Introduce Content** | This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references. |
| **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:<br>1. Explain the factors that cause rotor damage.<br>2. Discuss brake drum distortion.<br>3. Explain how to machine a brake drum and when a brake drum should be discarded.<br>4. Discuss disc brake rotors and causes of rotor distortion.<br>5. Explain the procedure for machining a disc brake rotor. |
| **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 the 5th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com**

**LINK CHP 104: ATE5 Chapter Images**

| ICONS | Chapter 104 Machining Drum/Rotor |
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| | **1. SLIDE 1 CH104 MACHINING BRAKE DRUMS & ROTORS** |
| | **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED**<br>**Videos** |
| | 2. **SLIDE 2 EXPLAIN Figure 104-1** Types of brake drums. Regardless of the design, all types use cast iron as a friction surface.<br>3. **SLIDE 3 EXPLAIN Figure 104-2** The airflow through cooling vents helps brakes from overheating.<br>4. **SLIDE 4 EXPLAIN Figure 104-3** Scored drums and rotors often result in metal-to-metal contact. |
| DEMO | **DEMONSTRATION: Show students a 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.** |
| | 5. **SLIDE 5 EXPLAIN Figure 104-4** Cracked drums or rotors must be replaced.<br>6. **SLIDE 6 EXPLAIN Figure 104-5** A heat-checked surface of a disc brake rotor.<br>7. **SLIDE 7 EXPLAIN Figure 104-6** 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. |
| QUESTION | **DISCUSSION: Ask students to talk about the issue of heat checking in brake drums. How is it different from cracking and what causes it?** |

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| DEMO | **DEMONSTRATION:** Show students an example of 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. |
| DEMO | **DEMONSTRATION:** Show students an example of a 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 and 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. |
| QUESTION | **DISCUSSION:** Ask students to discuss the issue of drum distortion. How does even the minutest shift in position cause drum damage? |
| | 8. **SLIDE 8 EXPLAIN Figure 104-7** Bellmouth brake drum distortion.<br>9. **SLIDE 9 EXPLAIN Figure 104-8** Out-of-round brake drum distortion.<br>10. **SLIDE 10 EXPLAIN Figure 104-9** Eccentric brake drum distortion. |
| DEMO | **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 |
| QUESTION | **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. |
| DEMO | **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.**

11. **SLIDE 11 EXPLAIN Figure 104-10** A straightedge can be used to check for brake drum warpage.

12. **SLIDE 12 EXPLAIN Figure 104-11** Discard diameter and maximum diameter are brake drum machining and wear limits.

**Brake Drum Micrometer (View) (Download)**

13. **SLIDE 13 EXPLAIN Figure 104-12** Most brake drums have a chamfer around the edge
14. **SLIDE 14 EXPLAIN Figure 104-13** needle-dial brake drum micrometer. Left movable arm is set to approximate drum diameter and the right arm to the more exact drum diameter. The dial indicator (gauge) reads in thousandths of an inch.
15. **SLIDE 15 EXPLAIN Figure 104-14** (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 104-15** 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.

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**DEMONSTRATION: Show students how to use a self-aligning spacer (SAS) to ensure that the spindle nut applies an even force to the drum. Show students the steps involved in using a lathe to machine a drum brake**

**DISCUSSION: Have students talk about the 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 104-16** 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 104-17** 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 104-18** Set depth of cut indicator to zero just as the turning tool touches the drum.
20. **SLIDE 20 EXPLAIN Figure 104-19** 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 104-20** 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.

**ON-VEHICLE NATEF TASK: Inspect, measure, and machine brake drums. Page 315**

22. **SLIDE 22 EXPLAIN Figure 104-21** This excessively worn (thin) rotor was removed from the vehicle in this condition. It is amazing that the vehicle was able to stop with such a thin rotor.
23. **SLIDE 23 EXPLAIN Figure 104-22** 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 104-23** Directional vane

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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 104-24** Typical composite rotor that uses cast iron friction surfaces and a steel center section

**DEMONSTRATION: Show solid and vented disc rotors, and discuss their construction, where they are used, and how they work to dissipate heat.**

**DISCUSSION: discuss 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?**

Rotor Runout & Steering Wheel Shake (View) (Download)
Rotor Runout (View) (Download)
Rotor Thickness Variation & Brake Pedal Pulsation (View) (Download)

26. **SLIDE 26 EXPLAIN FIGURE 104-25** This Porsche is equipped with high-performance brakes including cross-drilled brake rotors.
27. **SLIDE 27 EXPLAIN FIGURE 104-26** Brake rotor lateral-runout distortion.
28. **SLIDE 28 EXPLAIN FIGURE 104-27** 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.
29. **SLIDE 29 EXPLAIN FIGURE 104-28** (a) Rotate the disc brake rotor one complete revolution while observing the dial indicator (gauge). (b) Most OEMS specify a maximum runout of about 0.003 inch (0.08 mm).
30. **SLIDE 30 EXPLAIN Figure 104-29** Brake rotor lack-of-parallelism distortion.
31. **SLIDE 31 EXPLAIN Figure 104-30** (a) Disc brake rotor thickness variation (parallelism). (b) The rotor should be measured with a micrometer at four or more equally spaced locations around the rotor.

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**DEMONSTRATION:** **Show students a 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 the problem of lateral runout (LRO) of a 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 the effects of distortion more pronounced on a 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 104-32** 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 104-33** If fingernail catches on a groove in rotor, rotor should be machined.
35. **SLIDE 35 EXPLAIN Figure 104-34** This rusted rotor should be machined.
36. **SLIDE 36 EXPLAIN Figure 104-35** 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 104-36** Electronic surface finish machine. The reading shows about 140 $\mu$ in. 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.**

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| | **DEMONSTRATION: Show students the correct procedure for machining a disc brake rotor.**<br><br>38. **SLIDE 38 EXPLAIN Figure 104-37** 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.<br>39. **SLIDE 39 EXPLAIN Figure 104-38** Recommended adapters and location for machining hubbed and hubless rotors.<br>40. **SLIDE 40 EXPLAIN Figure 104-39 (a)** Composite adapter fitted to a rotor.<br>41. **SLIDE 41 EXPLAIN Figure 104-40** A damper is necessary to reduce cutting-tool vibrations that can cause a rough surface finish.<br>42. **SLIDE 42 EXPLAIN Figure 104-41** After installing the rotor on the brake lathe, turn the cutting tool in just enough to make a scratch cut.<br>43. **SLIDE 43 EXPLAIN Figure 104-42** 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.<br>44. **SLIDE 44 EXPLAIN Figure 104-43 (a)** This technician uses two sanding blocks each equipped with 150-grit aluminum-oxide sandpaper.<br>45. **SLIDE 45 EXPLAIN Figure 104-43 (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.<br>46. **SLIDE 46 EXPLAIN Figure 104-44 (a)** After machining and sanding the rotor, it should be cleaned. In this case brake cleaner from an air pressurized spray can is used.<br>47. **SLIDE 47 EXPLAIN Figure 104-44 (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 |

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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 the rotor the proper smoothness and finish.

48. **SLIDE 48 EXPLAIN Figure 104-45** A grinder with sandpaper can be used to give a smooth non-directional surface finish to the disc brake rotor.
49. **SLIDE 49 EXPLAIN Figure 104-46** correct final surface finish should be smooth and non-directional.
50. **SLIDE 50 EXPLAIN Figure 104-47** Rust should always be cleaned from both the rotor and the hub whenever the rotors are machined or replaced. An air-powered die grinder with a sanding disc makes quick work of cleaning this hub.

**DISCUSSION: Ask students to talk about the differences between a rough and finish cut on a lathe. Ask students to discuss the difference between positive and negative rake lathes. Which is preferable for machining brake rotors and why? Ask students to discuss the preconditions for machining a disc 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. Page 316**

51. **SLIDE 51 EXPLAIN Figure 104-48** 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

**DEMONSTRATION: Show students the correct procedure for on-the-vehicle rotor machining**

**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.**

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| <br><br> | 51. **SLIDE 51 EXPLAIN FIGURE 104-49** A wheel stud was replaced on rotor hub assembly when it was discovered to be stripped<br>52. **SLIDES 52-166 EXPLAIN OPTIONAL DRUM & ROTOR ON&OFF CAR MACHINING**<br>**SEARCH INTERNET: Have students research process of convection and how it plays a role in absorption of heat within a drum or disc brake system.**<br>**Crossword Puzzle (Microsoft Word) (PDF)**<br>**Word Search Puzzle (Microsoft Word) (PDF** |