

# Introduction to Automotive Service

## Chapter 36 Brakes & Antilock Braking Systems

### Opening Your Class

KEY ELEMENT	EXAMPLES
<b>Introduce Content</b>	This course or class serves as an introduction to the world of automotive service. It correlates material to task lists specified by ASE and NATEF.
<b>Motivate Learners</b>	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.
<b>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.</b>	<p>Explain learning objectives to students.</p> <ol style="list-style-type: none"> <li>1. Prepare for the Brakes (A5) ASE certification test.</li> <li>2. List the parts and terms for drum and disc brakes</li> <li>3. List the six brake system categories.</li> <li>4. Describe the purpose and function of the ABS.</li> <li>5. Describe the procedure recommended for brake drum removal.</li> <li>6. List the items that should be checked during a brake inspection</li> </ol>
<b>Establish the Mood or Climate</b>	Provide a <b>WELCOME</b> , Avoid put downs and bad jokes.
<b>Complete Essentials</b>	Restrooms, breaks, registration, tests, etc.
<b>Clarify and Establish Knowledge Base</b>	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.

## ICONS

## CH36 Brakes/Antilock Braking Systems



### 1. SLIDE 1 CH36 BRAKES/ANTILOCK BRAKING SYSTEMS



Check for **ADDITIONAL VIDEOS & ANIMATIONS** @ <http://www.jameshalderman.com/>  
**WEB SITE IS UPDATED REGULARLY**



### 2. SLIDE 2 **EXPLAIN** Brake System Fundamentals



**DISCUSSION:** Ask students to discuss meaning of "energy." How many types of energy can they identify relating to automobile manufacture and operation? Ask students to talk about the principle of kinetic energy. Why is kinetic energy the central foundation of brake system design and operation?



**4 engines of a Boeing 747 produce 188000 pounds of thrust, while one solid rocket booster produces more than 17 times as much thrust.**



Show **ANIMATION: KINETIC ENERGY & STOPPING DISTANCE**

[www.myautomotivelab.com](http://www.myautomotivelab.com)

[http://media.pearsoncmg.com/ph/chet/chet\\_myautomotivelab\\_2/Brakes/auto\\_animations/ch04\\_fig04\\_2/index.html](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/ch04_fig04_2/index.html)



**DISCUSSION:** Ask students to discuss principle of friction. Invite them to provide examples of friction. How does a braking system use principle of friction to slow and stop a car? Ask students to talk about factors that determine coefficient of friction in an automobile braking system. Ask students to discuss role of friction contact area in determining coefficient of friction. Why does tire width have a direct impact on coefficient of friction but brake-pad size does not?

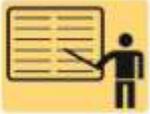
ICONS	CH36 Brakes/Antilock Braking Systems
	<p><b>HANDS-ON TASK:</b> Have the same student drag a heavy object with a smooth bottom surface across the shop floor, and approximate the friction coefficient of this object. What are the implications for disc and brake pad materials?</p>
	<p><b>Show ANIMATION: Friction on Floating Caliper</b> <a href="http://www.myautomotivelab.com">www.myautomotivelab.com</a>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/ch05_fig_05_7/index.html">http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/ch05_fig_05_7/index.html</a></p>
	<p><b>Show ANIMATION: Coefficient of Friction: Brake Fade</b> <a href="http://www.myautomotivelab.com">www.myautomotivelab.com</a>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/ch04_fig_04_14/index.html">http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/ch04_fig_04_14/index.html</a></p>
	<ol style="list-style-type: none"> <li>3. SLIDE 3 <b>EXPLAIN</b> FIGURE 36-1 Typical vehicle brake system showing all typical components</li> <li>4. SLIDE 4 <b>EXPLAIN</b> Brake System Fundamentals</li> </ol>
	<p><b>ANIMATION: Drum Brake Operation</b>  <a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a></p>
	<ol style="list-style-type: none"> <li>5. SLIDE 5 <b>EXPLAIN</b> FIGURE 36-2 Typical DRUM brake assembly</li> </ol>
	<p><b>DISCUSSION:</b> Ask students to talk about advantages of disc brakes and their primary use today. Invite students to explain how self-energizing action enables drum brakes to apply more stopping power for the same amount of force as disc brakes. Also ask students to discuss the servo action of some drum brake systems that allows one brake shoe to help apply the other to augment stopping power. Ask students to discuss how drum brakes are also used as parking brakes</p>
	<p><b>DEMONSTRATION:</b> Show students a disassembled drum brake and describe its component parts</p>
	<p><b>ON-VEHICLE NATEF TASK (A5-A-3)</b> Research applicable <b>DRUM BRAKE</b> vehicle and service information, such as brake system operation, vehicle service history, service precautions and</p>

ICONS	CH36 Brakes/Antilock Braking Systems
	<p><b>TSBs (P-1)</b>  <b>Show VIDEO: 1 MINUTE: DRUM BRAKE ADJUSTERS</b> <a href="http://www.myautomotivelab.com">www.myautomotivelab.com</a>  <a href="http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=Drum%20Brake%20Adjusters&amp;clip=pandc/chet/2012/automotive/A5-B8.mov&amp;caption=chet_mylibs/akamai/2012/automotive/xml/A5-B8.adb.xml">http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=Drum%20Brake%20Adjusters&amp;clip=pandc/chet/2012/automotive/A5-B8.mov&amp;caption=chet_mylibs/akamai/2012/automotive/xml/A5-B8.adb.xml</a></p>
	<p>6. SLIDE 6 <b>EXPLAIN</b> FIGURE 36-3 Typical <b>DISC</b> brake assembly</p>
	<p><b><u>Disc Brake Apply &amp; Release</u></b>  <a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a></p>
	<p><b><u>DISCUSSION:</u></b> Ask students to talk about how disc brakes are self-adjusting by design.</p>
	<p><b><u>DEMONSTRATION:</u></b> Show students how splash shield is designed to protect the inner side of rotor from moisture and other road contaminants.</p>
	<p><b><u>DEMONSTRATION:</u></b> 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?</p>
	<p><b><u>DEMONSTRATION:</u></b> Show students the lining edge codes from a disc brake pad and discuss what the codes indicate</p>
	<p><b><u>DISCUSSION:</u></b> 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?</p>
	<p>7. SLIDE 7 <b>EXPLAIN</b> CHART 36-1 Terms used to describe disc and drum brake parts.  8. SLIDE 8 <b>EXPLAIN</b> Brake System Categories</p>

ICONS	CH36 Brakes/Antilock Braking Systems
	<p>9. SLIDE 9 <b>EXPLAIN</b> FIGURE 36-4 Typical brake system components.</p> <p>10. SLIDE 10 <b>EXPLAIN</b> Brake System Categories</p> <p>11. SLIDE 11 <b>EXPLAIN</b> FIGURE 36-5 The red brake warning light will remain on after a bulb test if there is a fault with the hydraulic part of the brake system</p>
	<p><b><u>DEMONSTRATION:</u></b> Show students an example of a combination valve and discuss how it combines the functions of the pressure-differential switch, metering valve, and proportioning valve.</p>
	<p><b><u>Brake Combination Valve</u></b></p> <p><b><u>Metering Valve</u></b></p> <p><b><u>Parking Brake Warning Light</u></b></p> <p><b><u><a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a></u></b></p>
	<p><b><u>DISCUSSION:</u></b> Have students talk about the kinds of customer complaints they may encounter if the combination valve was not operating properly</p>
	<p><b><u>DISCUSSION:</u></b> Have students talk about the problems that could arise from an improperly adjusted brake light switch.</p>
	<p><b><u>DEMONSTRATION:</u></b> Show student how to check for proper fluid movement in the master cylinder reservoir.</p>
	<p>12. SLIDE 12 <b>EXPLAIN</b> FIGURE 36.6 amber <b>ABS</b> warning lamp</p> <p>13. SLIDE 13 <b>EXPLAIN</b> <b>ABS Brakes</b></p>
	<p><b><u>ABS Operation</u></b></p> <p><b><u><a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a></u></b></p>
	<p>14. SLIDE 14 <b>EXPLAIN</b> FIGURE 36-7 Typical components of an antilock braking system (ABS) used on a rear-wheel-drive vehicle</p>

ICONS	CH36 Brakes/Antilock Braking Systems
	<p><b>DISCUSSION:</b> Ask students to discuss the purpose and function of ABS systems. How do they work to prevent wheel lock-up and help the driver maintain steering control? Ask students to discuss the meaning of tire slip and how it relates to traction. Ask students to discuss how road conditions impact tire slip and braking distances</p>
	<p><b>DISCUSSION:</b> Ask students to talk about operation of ABS. How does <u>antilock control module monitor</u> the relative deceleration rates of wheels during braking? Ask students to talk about how solenoids are used with ABS to hold, release, and reapply hydraulic pressure to the brakes.</p>
	<p><b>Show ANIMATION: ABS PRESSURE CONTROL</b> <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/18/ABS_ControlPressure_Anim/index.html">www.myautomotivelab.com</a>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/18/ABS_ControlPressure_Anim/index.html">http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/18/ABS_ControlPressure_Anim/index.html</a></p>
	<p><b>Show ANIMATION: ABS CONTROL STRATEGY</b> <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/ch18_fig18_17/index.html">www.myautomotivelab.com</a>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/ch18_fig18_17/index.html">http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/Brakes/auto_animations/ch18_fig18_17/index.html</a></p>
	<p><b>DISCUSSION:</b> Ask students to talk about how a <u>4-channel ABS system works</u>. What is advantage of having each wheel equipped with its own speed sensor? Ask students to discuss how a <u>3-channel ABS system works</u>. What is advantage of this configuration, and where would you find it most often? Ask students to discuss how a <u>single-channel ABS system</u> works. What types of vehicle generally have single-channel systems and why? Ask students to talk about the differences between integral &amp; nonintegral brakes. Why has <u>nonintegral ABS</u> become most common system today?</p>
	<p><b>DEMONSTRATION:</b> Show location of the ABS <u>wheel speed sensors (WSS)</u> and discuss how they let the control module know when the wheel is about to lock up.</p>
	<p><b>DISCUSSION:</b> Ask students to talk about why <u>air gap</u> between end of a wheel speed sensor and its tone ring are vital to the proper operation of ABS.</p>

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	<p><b><u>DEMONSTRATION:</u></b> Show students an example of a digital wheel speed sensor, and discuss how it works. What are the advantages of this type of sensor over a conventional wheel speed sensor?</p>
	<p><b><u>HANDS-ON TASK:</u></b> Have students use a high lighter to trace ABS circuit on a <u>WIRING DIAGRAM</u>. Have them trace circuit from the module to four wheel speed sensors. Marking with a different color any connections in circuit.</p>
	<p>15. SLIDE 15 <b>EXPLAIN</b> drum brake inspection</p>
	<p>16. SLIDE 16 <b>EXPLAIN</b> FIGURE 36-8 Tinnerman nuts are used at the assembly plant to prevent the brake drum from falling off until wheels are installed</p>
	<p><b><u>DISCUSSION:</u></b> Ask students to discuss how to remove a brake drum that is rusted to wheel hub. What methods are most effective in loosening drum? Ask students to talk about how to remove a brake drum when brake shoes have worn into drum. What method is recommended for dealing with this problem?</p>
	<p><b><u>DEMONSTRATION:</u></b> Show students how to perform cutting-the-nails trick to remove a brake drum when linings have worn a groove into drum.</p>
	<p>17. SLIDE 17 <b>EXPLAIN</b> FIGURE 36-9 Cracked brake lining must be replaced</p>
	<p><b><u>HANDS-ON TASK:</u></b> Once the brake drum is removed, have students inspect the backing plate for wear. If the backing plate shows excessive wear, have students replace it. If not, have them service the backing plate. Have students remove the return, or retracting, springs of the drum brakes and then remove the hold-down springs and other brake parts. Ask students to inspect return, hold-down, and connecting springs and determine whether they can be reused or need to be replaced.</p>

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	<p><b><u>SAFETY ISSUE:</u></b> Recommend that students use a solvent to wet down brake shoes &amp; brake components after brake drum is removed to prevent spread of airborne asbestos. Advise them to take proper precautions, such as using a liquid soaking agent, before removing a brake drum to be sure that any asbestos particles inside do not become airborne. Dispose of brake clean and cleaning solvents use to wet down the brakes according to EPA regulations.</p>
	<p>18. SLIDE 18 <b>EXPLAIN</b> Adjusting Drum Brakes</p>
	<p>19. SLIDE 19 <b>EXPLAIN</b> FIGURE 36-10 The first step in using a brake shoe clearance gauge is to adjust it to the drum inside diameter and tighten the lock screw</p>
	<p>20. SLIDE 20 <b>EXPLAIN</b> FIGURE 36-11 Place the gauge over the shoes and adjust the brakes until they contact the inside of the gauge</p>
	<p>21. SLIDE 21 <b>EXPLAIN</b> Adjusting Drum Brakes</p> <p><b><u>ON-VEHICLE NATEF TASK (A5-C-1) Diagnose drum brake concerns; determine necessary action. (P-1) Page 304</u></b></p>
	<p>22. SLIDE 22 <b>EXPLAIN</b> Disc Brake Inspection</p> <p><b>Show VIDEO: 2 MINUTES: DISC BRAKE DIAGNOSIS <a href="http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=Video%20of%20Calipers%20102.3&amp;clip=pandc/chet/2012/automotive/A5-C6.mov&amp;caption=chet/chet_mylibs/akamai/2012/automotive/xml/A5-C6.adb.xml">www.myautomotivelab.com</a></b></p> <p><small><a href="http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=Video%20of%20Calipers%20102.3&amp;clip=pandc/chet/2012/automotive/A5-C6.mov&amp;caption=chet/chet_mylibs/akamai/2012/automotive/xml/A5-C6.adb.xml">http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=Video%20of%20Calipers%20102.3&amp;clip=pandc/chet/2012/automotive/A5-C6.mov&amp;caption=chet/chet_mylibs/akamai/2012/automotive/xml/A5-C6.adb.xml</a></small></p>
	<p>23. SLIDE 23 <b>EXPLAIN</b> FIGURE 36-12 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 forward direction</p>

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	<p><b>DEMONSTRATION:</b> Show students how to do the bleed and squirt test to determine if a brake is being completely released.</p>
 Brake Bleeding	<p><u>Bleeding Brakes and Air</u>  <u>Bleeding Brakes, Gravity</u>  <u>Bleeding Brakes, Pressure Bleeder</u>  <u>Bleeding Brakes, Reverse Injection</u>  <u>Bleeding Brakes, Vacuum</u></p>
	<p><a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a>  <b>DISCUSSION:</b> Ask students to discuss the process of visually inspecting disc brakes. What should they do beyond checking the thickness of the lining?</p>
	<p>24. <b>SLIDE 24 EXPLAIN FIGURE 36-13</b> Most disc brake calipers have a brake inspection opening. For a thorough inspection, however, the caliper should be removed and the entire braking system thoroughly inspected</p> <p>25. <b>SLIDE 25 EXPLAIN FIGURE 36-14</b> Minimum thickness for various types of disc brake pads. If the pads are worn, pad wear sensors often make a “chirping” or squealing sound when vehicle is moving. Do not confuse that noise for a defective wheel bearing or other fault</p>
	<p><b>HANDS-ON TASK:</b> Have students carry out the steps to remove disc brake calipers. Have students inspect the calipers they have removed, and select students to report their observations to the class.</p>
	<p><b>ON-VEHICLE NATEF TASK (A5-A-3)</b> Research applicable vehicle and service information, such as brake system operation, etc. (P-1) Page 285</p>
	<p>Have students interview a local shop owner via telephone. Ask the owner what procedures are in place at their shop to insure brake repairs that meet state laws and regulations. Have them report their findings during the next class</p>
	<p><b>Homework:</b> complete Ch36 crossword puzzle:  <a href="http://www.jameshalderman.com/links/book_intro/cw/crossword_ch_36.pdf">http://www.jameshalderman.com/links/book_intro/cw/crossword_ch_36.pdf</a></p>

