Automotive Technology 6th Edition
Chapter 110 ABS COMPONENTS & 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. Explain the need for Antilock brake system (ABS). 2. Describe the operation, components, and system configurations of ABS. 3. Explain the operation of passive and active wheel speed sensors. 4. This chapter will help prepare for the Brakes (A5) ASE certification test content area "D" (Electronic Brake Control Systems: Antilock Brake System (ABS), Traction Control System (TCS), and Electronic Stability Control System (ESC) 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

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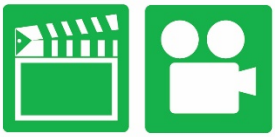
NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Chapter 110 ABS Operation
	**1. SLIDE 1 CH110 ABS COMPONENTS & OPERATION**
	**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**
	
	**DEMONSTRATION: Show students the ABS components**
	**2. SLIDE 2 EXPLAIN Figure 110-1** Max braking traction occurs when tire slip is between 10%-20%. A rotating tire has 0% slip & locked-up wheel has 100% slip
	**DISCUSS FREQUENTLY ASKED QUESTION: *When Was ABS First Used?* Antilock brake systems were first used in 1950s on aircraft and then first used on a 1970 Lincoln Continental using a rear-wheel braking system called "Sure Track" as an option. Also in 1970, General Motors Corporation offered a rear-wheel antilock brake system on selected rear wheel-drive vehicles, which was called "Track Master" made by AC Electronics Division of GM. In 1971, Chrysler Imperial offered a three-channel system that used four wheel speed sensors built by Bendix Corporation, called "Sure Brake" by Chrysler.**
	**3. SLIDE 3 EXPLAIN Figure 110-2** Traction is determined by pavement conditions and tire slip.

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	4. **SLIDE 4 EXPLAIN Figure 110-3** good driver can control tire slip more accurately than an ABS if the vehicle is traveling on a smooth, dry road surface. 5. **SLIDE 5 EXPLAIN Figure 110-4** wedge of gravel or snow in the front of a locked wheel can help stop a vehicle faster than would occur if the wheel brakes were pulsed on and off by an antilock braking system 6. **SLIDE 6 EXPLAIN Figure 110-5** Being able to steer and control the vehicle during rapid braking is one major advantage of an antilock braking system.
	**EXPLAIN TECH TIP:** ***Tire "Chirp" Noise During Hard Braking Is Normal*** **Sometimes customers state that they do not think that their antilock brake system (ABS) is working correctly because they heard the tires making noise (chirping sound) during hard braking. This is normal as the tires slip about 20% during an ABS stop.**
	**DISCUSSION: discuss purpose and function of ABS systems. How do they work to prevent wheel lock-up and help the driver maintain steering control? Discuss meaning of tire slip and how it relates to traction. Discuss how road conditions impact tire slip and braking distances**
	**DISCUSSION: discuss operation of ABS. How does antilock control module monitor the relative deceleration rates of wheels during braking? Discuss how solenoids are used with ABS to hold, release, and reapply hydraulic pressure to brakes.**
	**Antilock Braking System (View) (Download)**
	7. **SLIDE 7 EXPLAIN Figure 110-6** A typical stop on a slippery road surface without antilock brakes. Notice that the wheels stopped rotating and skidded until the vehicle finally came to a stop.
	8. **SLIDE 8 EXPLAIN Figure 110-7** ABS configuration includes **4-channel, 3-channel, and single-channel**.

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	**DEMONSTRATION: Show students how the ABS works on a trainer**
	**DISCUSS FREQUENTLY ASKED QUESTION: *What Is an Integral ABS?* Integral antilock systems were used on some vehicles in 1980s and combine the brake master cylinder and ABS hydraulic modulator, pump, and accumulator into one assembly. Integral systems do not have a vacuum booster for power assist and rely instead on pressure generated by the electric pump for this purpose. • SEE FIGURE 110–8.**
	9. **SLIDE 9 EXPLAIN Figure 110-8** typical integral ABS unit that combines function of master cylinder, brake booster, and antilock braking system in one assembly. 10. **SLIDE 10 EXPLAIN Figure 110-9** typical non-integral-type (remote) ABS.
	**DISCUSSION: discuss how a 4-channel ABS system works. What is advantage of having each wheel equipped with its own speed sensor? Ask students to discuss how a 3-channel ABS system works. What is advantage of this configuration, and where would you find it most often? Ask students to discuss how a single-channel ABS system works. What types of vehicle generally have single-channel systems and why? Discuss differences between integral & nonintegral brakes. Why has nonintegral ABS become most common system?**
	11. **SLIDE 11 EXPLAIN FIGURE 110–10** Typical inputs and outputs for brake control modules.. 12. **SLIDE 12 EXPLAIN Figure 110-11** Wheel speed sensors for the rear wheels may be located on the rear axle, on transmission, or on individual wheel knuckle. 13. **SLIDE 13 EXPLAIN Figure 110-12** schematic of a typical wheel speed sensor. The toothed ring is also called a *tone ring*. 14. **SLIDE 14 EXPLAIN Figure 110-13** Wheel speed sensors produce an alternating current (AC) signal with a frequency that varies in proportion to wheel speed.

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	15. **SLIDE 15 EXPLAIN FIGURE 110–14** typical passive variable-reluctance sensor produces a sine wave (continuously variable) output signal which is then converted to a square wave inside PCM and/or electronic brake control module (EBCM)
	**DEMONSTRATION: Show location of the ABS wheel speed sensors (WSS) and discuss how they let the control module know when the wheel is about to lock up.**
	**DISCUSSION: Ask students to talk about why air gap between end of a wheel speed sensor and its tone ring are vital to the proper operation of ABS.**
	**DEMONSTRATION: 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?**
	**DISCUSSION: Have students talk about why to use a brass feeler gauge when checking the air gap on a wheel speed sensor.**
	**DISCUSSION: Have students talk about why a wheel speed sensor produces an alternating current.**
	**HANDS-ON TASK: Have students check a wheel speed sensor with DMM.**
	16. **SLIDE 16 EXPLAIN FIGURE 110–15** digital wheel speed sensor produces a square wave output signal**.**
	**DISCUSSION: Ask students to talk about the purpose and function of ABS Warning Lamp. What is indicated when light comes on or stays on while driving? What actions does ABS take?**
	**DEMONSTRATION: Show students the ABS electronic control module, and discuss how it uses input from the wheel and other sensors to control hydraulic pressure during braking to prevent wheel lock-up**

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	**DISCUSSION: Ask students to discuss the conditions under which the ABS control module goes into active mode and takes control of vehicle braking. What actions does it take when active? When does it return to standby mode?**
	17. **SLIDE 17 EXPLAIN Figure 110-16** ABS three-way solenoid can increase, maintain, or decrease brake pressure to a given brake circuit.
	**DEMONSTRATION: Show students an ABS 3-way solenoid, and discuss how it works to open and close valves between the master cylinder and the individual brake circuits to increase, maintain, or decrease pressure to those circuits.**
	**DISCUSSION: Ask students to talk about ABS brake pressure control cycle. What is the function of isolation solenoid in the pressure-holding stage? What is the role of release solenoid in pressure-reduction stage if wheel starts to lock? What occurs during the pressure-increase stage?**
	18. **SLIDE 18 EXPLAIN Figure 110-17** isolation or hold phase of an ABS on a Bosch 2 system. 19. **SLIDE 19 EXPLAIN Figure 110-18** During pressure reduction stage, pressure is vented from the brake circuit so the tire can speed up and regain traction. 20. **SLIDE 20 EXPLAIN Figure 110-19** control module reapplies pressure to affected brake circuit once tire achieves traction so that normal braking can continue. 21. **SLIDE 21 EXPLAIN FIGURE 110–20** typical ABS hydraulic control assembly.
	**WARNINGA fully charged accumulator in an old integral ABS system can store up to 2,700 PSI (19,000 kPa) of pressure for power-assist braking and for reapplying the brakes during hold–release–reapply cycle for antilock braking. This stored pressure represents a potential hazard for a brake technician who is servicing the brakes, so the accumulator should be depressurized prior to doing any type of brake service work by pumping the brake pedal 25 to 40 times with the ignition key off.**

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	**EXPLAIN TECH TIP:** ***Best to Keep Stock Tire Diameter.*** **Vehicles equipped with antilock brakes are "programmed" to pulse brakes at just right rate for maximum braking effectiveness. A larger tire rotates at a slower speed and a smaller-than-normal tire rotates at a faster speed. Therefore, tire size affects the speed and rate of change in speed of wheels as measured by wheel speed sensors. While changing tire size will not prevent ABS operation, it will cause less effective braking during hard braking with ABS activated. Using the smaller spare tire can create such a difference in wheel speed compared with other wheels that a false wheel speed sensor code may be set and an amber ABS warning lamp on the dash may light. However, most ABS will still function with spare tire installed, but the braking performance will not be as effective. For best overall performance, always replace tires with the same size and type as specified by the vehicle manufacturer.**
	**DISCUSS CASE STUDY*: Weird Chevrolet Truck Brakes.*** **The owner of a newer Chevrolet pickup truck complained that sometimes after stopping on a hill, the brakes felt as if brakes were slow to release when driver removed his foot from the brake pedal and started to accelerate when traffic light turned green. The technician was able to duplicate the concern if stopped on a hill either upward or downward. The technician discovered when searching service information that the vehicle was equipped with a hill assist program. This part of the antilock brake system holds brake applied if the longitudinal acceleration sensor senses that vehicle was on a hill and the driver exerted a force to the brake pedal to keep vehicle stopped. Under these conditions, the ABS controller maintained brake fluid pressure**

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	in the system to keep brakes applied until driver released brake pedal. What driver was feeling was slight delay in releasing of brakes when brake pedal was released. **Summary** • Complaint—Brakes are slow to release at times. • Cause—Normal condition when the vehicle is stopped on a hill when equipped with hill assist. • Correction—Informed driver that this is normal operation due to hill assist function.
	**DEMONSTRATION:** Show Integral ABS Master Cylinder. Show students how they work together for conventional brakes and ABS brakes.
	**DEMONSTRATION:** Show how to SAFELY depressurize an integral ABS Accumulator
	**DISCUSSION:** Ask students to discuss why accumulator should be depressurized prior to servicing an integral ABS. Ask students to discuss the function of pump motor in restoring brake pressure during ABS braking. How is pump motor activated during an ABS stop? How does it also generate power assist for conventional braking in some systems?
 	**ON-VEHICLE ASEEDUCATION TASK D1** Depressurize high-pressure components of the electronic brake control system.
	**DEMONSTRATION:** Show students how ABS Hydraulic Modulator works on the trainer

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	**HANDS-ON TASK:** Have students use a high lighter to trace ABS circuit on a **WIRING DIAGRAM**. Have them trace circuit from the module to four wheel speed sensors. Marking with a different color any connections in circuit.
	**DISCUSSION:** Ask students to talk about reason for brake-pedal pulsation during an ABS stop. What may be indicated if the brake pedal pulses during a non-ABS stop? Ask students to talk about the function of the electronic controller in an ABS. What aspects of ABS operation does it control?
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What Is "Automatic Braking"?*** **Automatic braking is often part of a safety package that includes radar cruise control and will apply the brakes in event of a possible collision. Sensors such as radar, sonar, and/or cameras are used depending on the system to detect distance to another object. The controller, usually an ABS controller, then issues a warning if a collision is possible. This warning can include one or more of the following:** 1. **A buzzer** 2. **A warning light flashing on the dash** 3. **A vibration of the driver's seat** **If warnings are ignored, the automatic braking system will intervene and either provide brake assist or apply brakes autonomously (by itself) to achieve maximum braking in an effort to avoid a collision. • SEE FIGURE 110–21**
	21. **SLIDE 21 EXPLAIN FIGURE 110–21** Sensors are used to detect when the distance is closing fast enough that a collision may be possible and the system intervenes and automatically applies the brakes if needed.. 22. **SLIDES 22-33 OPTIONAL EXPLAIN WHEEL SPEED SENSOR**

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	**SEARCH INTERNET:** Have students investigate education requirements, experience and certification required to enter the career of brakes technician with focus on ABS diagnosis and repair.