A5 BRAKES 7th Edition

Chapter 17 ABS Components and Operation

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 need for antilock braking systems (ABS). 2. Describe the operation and system configurations of ABS. 3. Describe the purpose and function of the ABS components, such as wheel speed sensors, electronic control unit, ABS warning lamp, and hydraulic modulator assembly. **This chapter will help you prepare for the Brakes (A5) ASE certification test content areas "G" (Electronic Brake Control 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 17: Chapter Images

ICONS	Ch17 ABS Components and Operation
	**1. SLIDE 1 ABS Components and Operation**
	**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)**
	**ABS Modulator (View) (Download)** **ABS Operation (View) (Download)**
	**DEMONSTRATION: SHOW ABS COMPONENTS**
	**2. SLIDE 2 EXPLAIN Figure 17-1** Max braking traction occurs when tire slip is between 10%-20%. A rotating tire has 0% slip & locked-up wheel has 100% slip
	**3. SLIDE 3 EXPLAIN Figure 17-2** Traction is determined by pavement conditions and tire slip. **4. SLIDE 4 EXPLAIN Figure 17-3** A 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 17-4** A 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 17-5** Being able to steer and control the vehicle during rapid braking is one major advantage of an antilock braking system.

ICONS	Ch17 ABS Components and Operation
	**DISCUSSION:** ASK STUDENTS TO DISCUSS 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 MEANING OF TIRE SLIP AND HOW IT RELATES TO TRACTION. ASK STUDENTS TO DISCUSS HOW ROAD CONDITIONS IMPACT TIRE SLIP AND BRAKING DISTANCES
	**DISCUSSION:** ASK STUDENTS TO TALK ABOUT OPERATION OF ABS. HOW DOES ANTILOCK CONTROL MODULE MONITOR RELATIVE DECELERATION RATES OF WHEELS DURING BRAKING? TALK ABOUT HOW SOLENOIDS ARE USED WITH ABS TO HOLD, RELEASE, & REAPPLY HYDRAULIC PRESSURE TO THE BRAKES.
	**ABS MODULATOR**
	**ABS OPERATION**
	**ABS Traction Control (44 Links)** VIDEOS
	7. **SLIDE 7 EXPLAIN Figure 18-6** 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.
	**DEMONSTRATION:** SHOW STUDENTS HOW THE ABS WORKS ON THE TRAINER OR LAB VEHICLE
	8. **SLIDE 8 EXPLAIN Figure 18-7** ABS configuration includes 4-channel, 3-channel, and single-channel. 9. **SLIDE 9 EXPLAIN Figure 18-8** A typical integral ABS unit that combines the function of the master cylinder, brake booster, and antilock braking system in one assembly. 10. **SLIDE 10 EXPLAIN Figure 18-9** A typical nonintegral-type (remote) ABS.

DISCUSSION: Talk about how 4-channel ABS system works. What is advantage of having each wheel equipped with its own speed sensor? Discuss how 3-channel ABS system works. What is advantage of this configuration, and where would you find it? Ask students to discuss how a single-channel ABS system works. What types of vehicle generally have single-channel systems and why? Ask students to talk about the differences between integral & nonintegral brakes. Why has nonintegral ABS become most common system today?

11. **SLIDE 11 EXPLAIN FIGURE 17.10** Typical inputs and outputs for brake control modules.
12. **SLIDE 12 EXPLAIN Figure 17-11** Wheel speed sensors for the rear wheels may be located on the rear axle, on the transmission, or on the individual wheel knuckle.
13. **SLIDE 13 EXPLAIN Figure 17-12** A schematic of a typical wheel speed sensor. The toothed ring is also called a *tone ring*.
14. **SLIDE 14 EXPLAIN Figure 17-13** Wheel speed sensors produce an alternating current (AC) signal with a frequency that varies in proportion to wheel speed.
15. **SLIDE 15 EXPLAIN FIGURE 17.14** A typical passive variable-reluctance sensor produces a sine wave (continuously variable) output signal which is then converted to a square wave inside the PCM and/ or the electronic brake control module (EBCM)
16. **SLIDE 16 EXPLAIN Figure 17-15** A digital wheel speed sensor produces a square wave output signal.

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: DISCUSS WHY AIR GAP BETWEEN END OF WHEEL SPEED SENSOR AND ITS TONE RING ARE VITAL TO 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.

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 WHEEL AND OTHER SENSORS TO CONTROL HYDRAULIC PRESSURE DURING BRAKING TO PREVENT WHEEL LOCK-UP

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 17-16** 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 17-17** isolation or hold phase of an ABS on a Bosch 2 system.
19. **SLIDE 19 EXPLAIN Figure 17-18** 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 17-19** control module reapplies pressure to affected brake circuit once tire achieves traction so that normal braking can continue.
21. **SLIDE 21 EXPLAIN FIGURE 17.20** typical ABS hydraulic control assembly.
22. **SLIDE 22 EXPLAIN FIGURE 17.21** 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.

DEMONSTRATION: SHOW INTEGRAL ABS MASTER CYLINDER. SHOW HOW THEY WORK TOGETHER FOR CONVENTIONAL & 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 NATEF TASK: DEPRESSURIZE HIGH-PRESSURE COMPONENTS OF THE ELECTRONIC BRAKE CONTROL SYSTEM

DEMONSTRATION: SHOW STUDENTS HOW ABS HYDRAULIC MODULATOR WORKS ON THE TRAINER

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?

23. SLIDES 23-34 OPTIONAL EXPLAIN WHEEL SPEED SENSOR

SEARCH INTERNET: HAVE STUDENTS INVESTIGATE THE EDUCATION REQUIREMENTS, EXPERIENCE AND CERTIFICATION REQUIRED TO ENTER THE CAREER OF BRAKES TECHNICIAN WITH A FOCUS ON ABS DIAGNOSIS AND REPAIR.