Automotive Chassis Systems 7th Edition

Chapter 6 Hydraulic Valves and Switches

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. Describe the operation of a residual check valve. 2. Describe the operation of a pressure-differential switch and a brake fluid level sensor switch. 3. Describe the operation of the proportioning valve. 4. Discuss the need and use of a metering valve. 5. Describe how a brake light switch works. **This chapter will help prepare for ASE Brakes (A5) certification test**
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 Automotive Chassis Systems 7th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 6: Chapter Images

ICONS	Ch06 Hydraulic Valves and Switches
	**1. SLIDE 1 HYDRAULIC VALVES & SWITCHES**
	**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**
	**Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**
	**2. SLIDE 2 EXPLAIN Figure 6-1** Most residual check valves are located under the tubing seats in the master cylinder outlet ports. **3. SLIDE 3 EXPLAIN Figure 6-2** momentary drop in pressure created when the brakes are released can draw air into the hydraulic system. **4. SLIDE 4 EXPLAIN Figure 6-3** use of cup expanders is the main reason why residual check valves are not used in most braking systems today.
	**DEMONSTRATION: SHOW STUDENTS AN EXAMPLE OF A RESIDUAL CHECK VALVE AND DISCUSS HOW IT MAINTAINS SLIGHT PRESSURE ON THE ENTIRE HYDRAULIC SYSTEMS FOR DRUM BRAKES. HOW DOES THIS PRESSURE PREVENT AIR FROM ENTERING THE HYDRAULIC SYSTEM IF THERE IS A SMALL HOLE OR LEAK?**
	**5. SLIDE 5 EXPLAIN Figure 6-4** red brake warning lamp. **6. SLIDE 6 EXPLAIN Figure 6-5** leak in hydraulic system causes unequal pressures between the two different brake circuits. This difference in pressures causes the plunger inside the pressure-differential switch to move, which completes the electrical ground circuit for the red brake warning lamp.

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	7. **SLIDE 7 EXPLAIN Figure 6-6** pressure-differential switch piston is used to provide the electrical ground for the red brake warning light circuit.
	**DEMONSTRATION: SHOW STUDENTS AN EXAMPLE OF A PRESSURE-DIFFERENTIAL SWITCH AND TALK ABOUT HOW IT WORKS TO WARN THE DRIVER OF LOSS OF PRESSURE ON DUAL MASTER-CYLINDER SYSTEMS**
	**DISCUSSION: ASK STUDENTS TO DISCUSS THE ACTIONS THEY SHOULD TAKE IF THE BRAKE WARNING LAMP REMAINS ILLUMINATED AFTER THE HYDRAULIC SYSTEM HAS BEEN REPAIRED AND BLED.**
	8. **SLIDE 8 EXPLAIN Figure 6-7** movable contact brake fluid level switch. When the brake fluid level and float drop, the rod-mounted contact completes the electrical circuit which turns on the red brake warning lamp. 9. **SLIDE 9 EXPLAIN Figure 6-8** magnetic brake fluid level switch.
	10. **SLIDE 10 EXPLAIN Figure 6-9** Many proportioning valves are mounted directly to the master cylinder in the outlet to the rear brakes. 11. **SLIDE 11 EXPLAIN Figure 6-10** Typical proportioning valve pressure relationship. Note that, at low pressures, the pressure is the same to the rear brakes as is applied to the front brakes. After the split point, only a percentage (called the slope) of the master cylinder pressure is applied to the rear brakes. 12. **SLIDE 12 EXPLAIN Figure 6-11** Chrysler proportioning valve. Note that slope and split point are stamped on the housing. 13. **SLIDE 13 EXPLAIN Figure 6-12** These two proportioning valves are found under the vehicle on this Dodge minivan.
	**DEMONSTRATION: SHOW STUDENTS AN EXAMPLE OF A PROPORTIONING VALVE AND DISCUSS HOW IT HELPS TO IMPROVE BRAKE BALANCE DURING HARD STOP BY DISTRIBUTING DIFFERENT FORCES TO FRONT AND REAR BRAKES.**

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	**14. SLIDE 14 EXPLAIN Figure 6-13** proportioning valve piston can travel within the range shown without reducing pressure to the rear brakes. **15. SLIDE 15 EXPLAIN Figure 6-14** At split point, proportioning valve piston closes fluid passage through valve.
	**DISCUSSION: DISCUSS WHY VEHICLES WITH FRONT DISC & REAR DRUM BRAKES REQUIRE A PROPORTIONING VALVE. HOW DOES PROPORTIONING VALVE DETERMINE HOW TO ALLOCATE PRESSURE TO FRONT & REAR BRAKES?**
	**PROPORTIONING VALVE**
	**16. SLIDE 16 EXPLAIN Figure 6-15** height-sensing proportioning valve provides the vehicle with variable brake balance. The valve allows higher pressure to be applied to the rear brakes when the vehicle is heavily loaded and less pressure when vehicle is lightly loaded.
	**17. SLIDE 17 EXPLAIN Figure 6-16** stepped cam is used to alter split point of this height-sensing proportioning valve.
	18. SLIDE 18 EXPLAIN Figure 6-17 proportioning valve pressure test can be performed using two pressure gauges —one to register the pressure from the master cylinder and the other gauge to read the pressure being applied to the rear brakes. This test has to be repeated in order to read the pressure to each rear wheel.
	**DEMONSTRATION: SHOW HEIGHT SENSING PROPORTIONING VALVE ON MINI VAN. HOW WOULD LOAD CHANGE ON THIS TYPE OF VEHICLE?**
	**DISCUSSION: HAVE STUDENTS TALK ABOUT WHAT KIND OF VEHICLES THEY MAY SERVICE THAT WOULD HAVE A HEIGHT SENSING PROPORTIONING VALVE.**
	**IF A VEHICLE EQUIPPED WITH FLOATING CALIPERS PULLS TO ONE SIDE DURING BRAKING, OPPOSITE-SIDE CALIPER IS NOT FLOATING PROPERLY.**

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	**HANDS-ON TASK:** USING PRESSURE GAUGES HAVE STUDENTS FOLLOW THE PROCEDURES TO TEST A DEFECTIVE PROPORTIONING VALVE.
	**DEMONSTRATION:** SHOW STUDENTS AN EXAMPLE OF AN ELECTRONIC BRAKE-PROPORTIONING SYSTEM AND DISCUSS HOW IT USES THE ABS SOLENOIDS TO REDUCE THE PRESSURE TO THE REAR-WHEEL BRAKES WHEN THE WHEEL DECELERATION RATES ARE DIFFERENT.
	**Metering Valve**
	19. **SLIDE 19 EXPLAIN Figure 6-18** metering valve when the brakes are not applied. Notice the brake fluid can flow through the metering valve to compensate for brake fluid expansion and contraction that occurs with changes in temperature. 20. **SLIDE 20 EXPLAIN Figure 6-19** metering valve under light brake pedal application. 21. **SLIDE 21 EXPLAIN Figure 6-20** metering valve during a normal brake application
	**DEMONSTRATION:** SHOW STUDENTS A METERING VALVE AND DISCUSS HOW IT WORKS TO PREVENT THE FRONT DISC CALIPERS FROM BEING IN CONTACT WITH THE DISCS UNTIL REAR DRUM BRAKE SHOES HAVE BEEN ENGAGED.
	**HANDS-ON TASK:** HAVE STUDENTS DIAGNOSE AND TEST A DEFECTIVE METERING VALVE BY FIRST PERFORMING A VISUAL INSPECTION AND THEN USING PRESSURE GAUGES. SELECT A STUDENT TO PRESENT THE RESULTS, SUGGEST POSSIBLE CAUSES, AND OFFER SOLUTIONS
	**DISCUSSION:** ASK STUDENTS TO DISCUSS WHY FRONT-WHEEL DRIVE SYSTEMS DO NOT USE METERING VALVES.
	**ON-VEHICLE NATEF TASK** INSPECT, TEST, AND/OR REPLACE METERING (HOLD-OFF), PROPORTIONING (BALANCE), PRESSURE DIFFERENTIAL, AND COMBINATION VALVES

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	**Brake Combination Valve**
	22. **SLIDE 22 EXPLAIN Figure 6-21** two-function combination valves. 23. **SLIDE 23 EXPLAIN Figure 6-22** Combination valve containing metering, pressure-differential (warning switch), and proportioning valves all in one unit. This style often called "pistol grip" design because proportioning valve section resembles grip section of a handgun.
	**DEMONSTRATION: 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.**
	**DISCUSSION: HAVE STUDENTS TALK ABOUT THE KINDS OF CUSTOMER COMPLAINTS THEY MAY ENCOUNTER IF THE COMBINATION VALVE WAS NOT OPERATING PROPERLY**
	24. **SLIDE 24 EXPLAIN Figure 6-23** Typical brake light switches
	**PARKING BRAKE WARNING LIGHT**
	**PRESSURE DIFFERENTIAL SWITCH/VALVE**
	**DEMONSTRATION: SHOW PROPER WAY TO ADJUST THE BRAKE LIGHT SWITCH**
	**DISCUSSION: HAVE STUDENTS TALK ABOUT THE PROBLEMS THAT COULD ARISE FROM AN IMPROPERLY ADJUSTED BRAKE LIGHT SWITCH.**

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	ON-VEHICLE NATEF TASK DIAGNOSE PRESSURE CONCERNS IN THE BRAKE SYSTEM USING HYDRAULIC PRINCIPLES.
	ON-VEHICLE NATEF TASK DIAGNOSE BRAKING CONCERNS CAUSED BY HYDRAULIC MALFUNCTIONS.
	ON-VEHICLE NATEF TASK INSPECT, TEST AND/OR REPLACE COMPONENTS OF BRAKE WARNING LIGHT SYSTEM
	ON-VEHICLE NATEF TASK CHECK OPERATION OF BRAKE STOP LIGHT SYSTEM AND DETERMINE NECESSARY ACTION