ATE5 Chapter 93 BRAKING SYSTEM PRINCIPLES

Opening Your Class

KEY ELEMENT	EXAMPLES
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: 1. Discuss the energy principles that apply to brakes. 2. Discuss the mechanical principles that apply to brakes. 3. Discuss the friction principles that apply to brakes. 4. Describe how brakes can fade due to excessive heat. 5. Describe how deceleration rate are measured.
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 93: ATE5 Chapter Images

ICONS	CH93 Braking System Principles
	1. **SLIDE 1 CH93 BRAKING SYSTEM PRINCIPLES**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED**
	**Videos**
	2. **SLIDE 2 EXPLAIN Figure 93-1** Energy which is the ability to perform work exists in many forms. 3. **SLIDES 3 EXPLAIN Figure 93-2** Kinetic energy increases in direct proportion to the weight of vehicle. 4. **SLIDES 4 EXPLAIN Figure 93-3** Kinetic energy increases as the square of any increase in vehicle speed.
	**The four engines of a Boeing 747 produce 188000 pounds of thrust, while one solid rocket booster produces more than 17 times as much thrust.**
	**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?**
	**DISCUSSION: Ask students to discuss the principle of kinetic energy and how the relationship between weight and speed influences brake design**
	**DEMONSTRATION: Using a small weight of a pound or less place it on the side of a soda can. Now take the same weight and drop it from three inches. Then drop weight from a foot above the can. The weight never changes but the speed does.**
	5. **SLIDES 5 EXPLAIN Figure 93-4** Inertia creates weight transfer that requires the front brakes to provide most of the braking force. 6. **SLIDE 6 EXPLAIN Figure 93-5** Front wheel drive vehicles have most of their weight over the front wheels.

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	**DISCUSSION:** discuss inertia of a moving object is also a factor in brake design. Who first described this physical property? Discuss how weight is transferred in a vehicle when the brakes are applied and how the vehicle's inertia factors in. Because the front brakes have to shoulder the majority of the load, what types of braking systems would be best suited to this task?
	**DEMONSTRATION:** Using a two liter bottle filled half way with water & cap tightly screwed on lay bottle on its side on bench. Push the bottle across the table slowly and then stop it. Do this again at a progressively faster rate. Students should observe how the water moves forward, weight transfer
	7. **SLIDE 7 EXPLAIN Figure 93-6** brake pedal assembly is a second-class lever design that provides a 5 to 1 mechanical advantage.
	Brake Pedal Force (View) (Download) Brake Pedal Travel (View) (Download) Brake Swept Area (View) (Download)
	**DISCUSSION:** Ask students to talk about the mechanical principle of leverage. How does a brake pedal use a fulcrum and the principle of leverage to change the energy applied by the driver's foot into a more useful form of energy?
	**HANDS-ON TASK:** Have students hold a hammer near ITS head. Then move their hands out to the end of the handle. This will demonstrate to them the principles of a third class lever. **If it was not for the mechanical advantage of levers we would all be living in caves.**
	
	8. **SLIDE 8 EXPLAIN Figure 93-7** coefficient of friction in this example is 0.5. 9. **SLIDE 9 EXPLAIN Figure 93-8** friction material affects coefficient of friction which is just 0.05 in this example. 10. **SLIDE 10 EXPLAIN Figure 93-9** static coefficient of friction of an object at rest is higher than the kinetic (dynamic) friction coefficient once in motion

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	**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?**
	**HANDS-ON TASK: 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?**
	**DISCUSSION: Ask students to talk about amount of heat converted from kinetic energy during braking. What are factors that determine increase in brake temperature? Where is heat absorbed? Ask students to talk about mechanical brake fade and what causes it. How can the driver restore some brake power? Why is mechanical fade not an issue for disc brakes? Ask students to discuss the causes of lining fade. How can partial brake power be restored, and what are the possible consequences?**
	**Show ANIMATION: Coefficient of Friction (View) (Download)**
	**Use a lower gear when descending hills to reduce the possibility of brake fade.**
	**ON-VEHICLE NATEF TASK: Research applicable vehicle and service information, such as brake system operation, etc. Page 285**
	**Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**