Automotive Steering, Suspension, & Alignment 7e
Chapter 9 ELECTRONIC SUSPENSION SYSTEMS
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Steering and Suspension Systems with Wheel Alignment and Drive Axles.** 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 learning objectives to students as listed on SLIDE. 1. Explain the characteristics of the various sensors used for electronic suspension control. 2. Describe electronic suspension system actuators. 3. List the types of electronic suspension systems. 4. Describe the parts and operation of the automatic level control system. **The chapter helps prepare for ASE Suspension and Steering (A4) certification test content area "B" (Suspension System 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: This lesson plan is based on Automotive Steering, Suspension, & Alignment 7th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com
LINK CHP 9: Chapter Images

ICONS	Chapter 9 Electronic Suspension
	**1. SLIDE 1 CH9 ELECTRONIC SUSPENSION SYSTEMS** **2. SLIDES 2-3 EXPLAIN Objectives**
	**Check for VIDEOS & ANIMATIONS @** **http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **Suspension System (55 Links)**
	
	**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)**
	**Electronic Suspension System (View) (Download)** **Suspension Level Control (View) (Download)**
	
	**3. SLIDE 3 EXPLAIN Figure 9-2** Input devices monitor conditions and provide information to the electronic control module, which processes the information and operates the actuators to control the movement of the suspension**.** **4. SLIDE 4 EXPLAIN Figure 9-3** typical electronic suspension height sensor, which bolts to the body and connects to the lower control arm through a control link and lever. **5. SLIDE 5 EXPLAIN Figure 9-4** When suspension action moves the lever, it rotates the slotted disc and varies how much of the photo transistor is exposed to the LEDs, which vary the input signal.
	**DEMONSTRATION: Show examples of electronic suspension height sensors FIGURE 9-4**
	**Ice build-up on sensor linkages can cause sensor damage.**

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	**DISCUSSION: Ask the students to discuss symptoms that indicate a problem with an automobile's height sensor FIGURE 9-4**
	6. **SLIDE 6 EXPLAIN Figure 9-5** Typical suspension position sensor. 7. **SLIDE 7 EXPLAIN Figure 9-6** three-wire suspension position sensor schematic. 8. **SLIDE 8 EXPLAIN Figure 9-7** suspension height sensor.
	**DEMONSTRATION: Show examples of suspension position sensors Figure 9-6. Show the students an example of suspension height sensor & show how it is mounted FIGURE 9-7**
	**When you are backprobing 3-wire sensor, reference voltage on all 3 wires indicates a bad ground**
	9. **SLIDE EXPLAIN Figure 9-8** steering wheel position (handwheel position) sensor wiring schematic and how the signal varies with the direction that steering wheel is turned.
	**EPS Torque Sensor (View) (Download)**
	10. **SLIDE 10 EXPLAIN Figure 9-9** handwheel position sensor is located at the base of the steering column. 11. **SLIDE 11 EXPLAIN Figure 9-10** Steering wheel (handwheel) position sensor schematic.
	**DEMONSTRATION: Show examples of handwheel position sensors FIGURE 9-10**
	**DISCUSSION: Ask the students to discuss some uses for the additional signals that a handwheel sensor can produce: FIGURE 9-10**
	**Be sure to read & Follow OEM instructions on disabling an airbag before working on steering column.**

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	12. **SLIDE 12 EXPLAIN Figure 9-11** VS sensor information transmitted to EBCM by Class 2 serial data. 13. **SLIDE 13 EXPLAIN Figure 9-12** air pressure sensor. 14. **SLIDE 14 EXPLAIN Figure 9-13** schematic showing the lateral acceleration sensor and the EBCM. 15. **SLIDE 15 EXPLAIN FIGURE 9–14** The lateral accelerometer sensor (G-sensor) is usually located under the center console
	16. **SLIDE 16 EXPLAIN Figure 9-15** Yaw rate sensor showing the typical location and schematic. 17. **SLIDE 17 EXPLAIN Figure 9-16** magnetic field is created whenever an electrical current flows through a coil of wire wrapped around an iron core.
	**DEMONSTRATION: Show examples of standalone yaw rate sensors and a yaw rate sensor combined with a lateral accelerometer sensor** **FIGURE 9-15**
	18. **SLIDE 18 EXPLAIN Figure 9-17** When magnets are near each other, like poles repel and opposite poles attract. 19. **SLIDE 19 EXPLAIN Figure 9-18** When electrical current magnetizes the plunger in a solenoid, magnetic field moves the plunger against spring force. With no current, spring pushes plunger back to its original position. 20. **SLIDE 20 EXPLAIN Figure 9-19** This air supply solenoid blocks pressurized air from the air spring valves when off. The plunger pulls upward to allow airflow to the air spring valves when the solenoid is energized. 21. **SLIDE 21 EXPLAIN Figure 9-20** An actuator motor uses a permanent magnet and four stator coils to drive the air spring control rod. 22. **SLIDE 22 EXPLAIN Figure 9-21** The stator coils of the actuator are energized in three ways to provide soft, medium, or firm ride from the air springs and shock absorbers
	23. **SLIDE 23 EXPLAIN Figure 9-22** Selectable Ride as used on Chevrolet and GMC pickup trucks. 24. **SLIDE 24 EXPLAIN Figure 9-23** ALC maintains the same ride height either loaded or unloaded by increasing or decreasing the air pressure in the rear air shocks.

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	**DISCUSSION: Ask the students to discuss whether manufacturers other than General Motors have systems similar to the Automatic Level Control (ALC) system FIGURE 9-23**
	**25. SLIDE 25 EXPLAIN Figure 9-24** A typical schematic showing the air suspension compressor assembly and sensor
	26. SLIDE 26 EXPLAIN Figure 9-25 The typical variable-rate air spring system uses three height sensors, two in the front and one in the rear, to monitor trim height and to provide input signals to the ECM.
	**DISCUSSION: Ask the students to discuss whether manufacturers other than Ford offer variable-rate air spring system or one similar to it. FIGURE 9-25**
	**27. SLIDE 27 EXPLAIN Figure 9-26** The air spring compressor assembly is usually mounted on rubber cushions to help isolate it from the body of the vehicle. All of the air entering or leaving the air springs flows through the regenerative air dryer.
	28. SLIDE 28 EXPLAIN Figure 9-27 solenoid valve at top of each spring regulates airflow into and out of air spring.
	**29. SLIDE 29 EXPLAIN Figure 9-28** Schematic showing the shock control used in the RSS system.
	30. SLIDE 30 EXPLAIN FIGURE 9.29 Diagram of the components and connections of the real-time damping and road-sensing suspension system.
	31. SLIDE 31 EXPLAIN Figure 9-30 Bi-state dampers (shocks) use a solenoid to control fluid flow in the unit to control compression and rebound actions.
	**DEMONSTRATION: Show the students examples of bi-state dampers FIGURE 9-30**
	**32. SLIDE 32 EXPLAIN Figure 9-31** Solenoid valve controlled shock absorber circuit showing the left front (LF) shock as an example.
	**DEMONSTRATION: Use schematic in Figure 9–32 to show the students how a CCR module works.**

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	**33. SLIDE 33 EXPLAIN Figure 9-32** A typical CCR module schematic. **34. SLIDE 34 EXPLAIN Figure 9-33** The three dampening modes of a CCR shock absorber. **35. SLIDE 35 EXPLAIN Figure 9-34** Integral shock solenoid. **36. SLIDE 36 EXPLAIN FIGURE 9.35** A typical ZF Sachs self-leveling shock, as used on the rear of a Chrysler minivan.
	**DEMONSTRATION: Show the students examples of self leveling shocks and explain how they work.**
	**37. SLIDE 37 EXPLAIN Figure 9-36** Schematic of the ALC system. **38. SLIDE 38 EXPLAIN Figure 9-37** Air compressor assembly can be located at various locations depending on the vehicle. **39. SLIDE 39 EXPLAIN Figure 9-38** The exhaust solenoid is controlled by rear integration module (RIM)
	**40. SLIDE 40 EXPLAIN Figure 9-39** Schematic showing the rear integration module (RIM) and how it controls the ALC compressor.
	**DEMONSTRATION: Show the students examples of scan tools they could use to command solenoids and verify their operation.**
	**ON-VEHICLE NATEF TASK: Test and diagnose components of electronically controlled suspension systems using a scan tool; determine necessary action**
	**41. SLIDE 41 EXPLAIN Figure 9-40** Vehicles that use magneto-rheological shock absorbers have a sensor located near each wheel, as shown on this C6 Corvette. **42. SLIDE 42 EXPLAIN Figure 9-41** The controller for the magneto-rheological suspension system on a C6 Corvette is located behind the right front wheel. **43. SLIDE 43 EXPLAIN Figure 9-42** A cutaway of a magneto-rheological shock absorber as displayed at the Corvette Museum in Bowling Green, Kentucky.

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	**DEMONSTRATION:** Show the students sensors and controllers for magneto-rheological suspension systems **FIGURE 9-42**
	**DISCUSSION:** Ask the students to discuss the strategy they would use to find an electrical fault in a leveling system. **FIGURE 9-43**
	**OPTIONAL SEARCH INTERNET:** Have students use Internet to research suspension position sensors. Ask them to be prepared to list at least 10 different models of VEHICLES and names given to suspension position sensors in those models in a class discussion.