Automotive Technology 6th Edition
Chapter 119 ELECTRONIC SUSPENSION SYSTEMS
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. Discuss the need for electronic suspension systems. 2. Explain the characteristics of the various sensors used for electronic suspension control. 3. Describe electronic suspension system actuators. 4. List the types of electronic suspension systems. 5. Describe the parts and operation of the automatic level control system. 6. Explain the procedure to troubleshoot rear electric leveling systems. 7. Explain how magneto-rheological shocks work. 8. This chapter will help prepare for ASE Suspension and Steering (A4) certification content area "C" (Related Suspension and Steering 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: 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:

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1. **SLIDE 1 CH119 ELECTRONIC SUSPENSION SYSTEMS**

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2. **SLIDE 2** EXPLAIN **Figure 119-1** An electronically controlled suspension system can help reduce body roll and other reactions better than most conventional suspension systems.
3. **SLIDE 3** EXPLAIN **Figure 119-2** 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 119-3** 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 119-4** 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 119-4

Ice build-up on sensor linkages can cause sensor damage.

ICONS	Chapter 119 Electronic Suspension
	DISCUSSION: **Ask the students to discuss symptoms that indicate a problem with an automobile's height sensor** **FIGURE 119-4**
	6. **SLIDE 6** **EXPLAIN** **Figure 119-5** Typical suspension position sensor. 7. **SLIDE 7** **EXPLAIN** **Figure 119-6** three-wire suspension position sensor schematic. 8. **SLIDE 8** **EXPLAIN** **Figure 119-7** A suspension height sensor.
	DEMONSTRATION: **Show examples of suspension position sensors** **Figure 119-6**. **Show the students an example of suspension height sensor & show how it is mounted** **FIGURE 119-7**
	When you are backprobing 3-wire sensor, reference voltage on all 3 wires indicates a bad ground
	9. **SLIDE 9** **EXPLAIN** **Figure 119-8** The steering wheel position (handwheel position) sensor wiring schematic and how the signal varies with the direction that the steering wheel is turned. 10. **SLIDE 10** **EXPLAIN** **Figure 119-9** The handwheel position sensor is located at the base of the steering column. 11. **SLIDE 11** **EXPLAIN** **Figure 119-10** Steering wheel (handwheel) position sensor schematic.
	DEMONSTRATION: **Show examples of handwheel position sensors** **FIGURE 119-10**
	DISCUSSION: **Ask the students to discuss some uses for the additional signals that a handwheel sensor can produce:** **FIGURE 119-10**
	Be sure to read & Follow OEM instructions on disabling an airbag before working on steering column.
	12. **SLIDE 12** **EXPLAIN** **Figure 119-11** VS sensor information transmitted to EBCM by Class 2 serial data. 13. **SLIDE 13** **EXPLAIN** **Figure 119-12** air pressure sensor.

ICONS	Chapter 119 Electronic Suspension

14. **SLIDE 14** EXPLAIN **Figure 119-13** schematic showing the lateral acceleration sensor and the EBCM.

EXPLAIN TECH TIP: ***The Lateral Acceleration Sensor Needed to Control the Electronic Suspension.*** **The lateral acceleration sensor is one part of group of sensors that provides information needed for suspension to be able to react to driver commands and road conditions. Using just steering wheel position sensor would not be enough information for the suspension controller to determine the cornering loads. • SEE FIGURE 119–14.**

15. **SLIDE 15** EXPLAIN **Figure 119-14** visual inspection showed a liquid had spilled.
16. **SLIDE 16** EXPLAIN **Figure 119-15** Yaw rate sensor showing the typical location and schematic.
17. **SLIDE 17** EXPLAIN **Figure 119-16** A 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 115-15**

18. **SLIDE 18** EXPLAIN **Figure 119-17** When magnets are near each other, like poles repel and opposite poles attract.
19. **SLIDE 19** EXPLAIN **Figure 119-18** When electrical current magnetizes the plunger in a solenoid, the magnetic field moves the plunger against spring force. With no current, the spring pushes the plunger back to its original position.
20. **SLIDE 20** EXPLAIN **Figure 119-19** 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 119-20** An actuator motor uses a permanent magnet and four stator coils to drive the air spring control rod.
22. **SLIDE 22** EXPLAIN **Figure 119-21** The stator coils of the actuator are energized in three ways to provide

ICONS	Chapter 119 Electronic Suspension

soft, medium, or firm ride from the air springs and shock absorbers.

23. **SLIDE 23 EXPLAIN Figure 119-22** Selectable Ride as used on Chevrolet and GMC pickup trucks.
24. **SLIDE 24 EXPLAIN Figure 119-23** ALC maintains the same ride height either loaded or unloaded by increasing or decreasing air pressure in rear air shocks.

DISCUSSION: Ask the students to discuss whether manufacturers other than General Motors have systems similar to the Automatic Level Control (ALC) system FIGURE 119-23

25. **SLIDE 25 EXPLAIN Figure 119-24** A typical schematic showing the air suspension compressor assembly and sensor.
26. **SLIDE 26 EXPLAIN Figure 119-25** 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 115-25

27. **SLIDE 27 EXPLAIN Figure 119-26** 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 119-27** A solenoid valve at the top of each spring regulates airflow into and out of the air spring.
29. **SLIDE 29 EXPLAIN Figure 119-28** Schematic showing Computer Command Ride (CCR) system
30. **SLIDE 30 EXPLAIN Figure 119-29** Schematic showing the shock control used in the RSS system.
31. **SLIDE 31 EXPLAIN** Figure 119-30 Bi-state dampers (shocks) use a solenoid to control fluid flow in the unit to control compression and rebound actions.

EXPLAIN TECH TIP: *Check the RPO Code*

Whenever working on the suspension system, check RPO (regular production option) code for type of suspension used. For example, the F55 RPO

may be called by a different name depending on the make and model of vehicle. Also, service procedures will be different on same vehicle depending on whether it is equipped with an F45 or an F55 system. The General Motors vehicle RPO codes are on a sticker on the spare tire cover in trunk or in glove compartment.

DEMONSTRATION: Show the students examples of bi-state dampers FIGURE 119-30

32. **SLIDE 32 EXPLAIN Figure 119-31** Solenoid valve controlled shock absorber circuit showing the left front (LF) shock as an example.

DEMONSTRATION: Use the schematic in Figure 119–32 to show the students how a CCR module works.

33. **SLIDE 33 EXPLAIN Figure 119-32** A typical CCR module schematic.
34. **SLIDE 34 EXPLAIN Figure 119-33** The three dampening modes of a CCR shock absorber.
35. **SLIDE 35 EXPLAIN Figure 119-34** Integral shock solenoid.

DEMONSTRATION: Show the students examples of self leveling shocks and explain how they work.

DISCUSS FREQUENTLY ASKED QUESTION: *What Are Self-Leveling Shocks?* ZF Sachs, supplies a self-leveling shock absorber to several vehicle manufacturers, such as Chrysler for use on rear of minivans, plus BMW, Saab, and Volvo. The self-leveling shocks are entirely self contained and do not require use of height sensors or an external air pump. • SEE FIGURE 119–35. The shock looks like a conventional shock absorber but contains following components:

- **Two reservoirs in the outer tube**

ICONS	Chapter 119 Electronic Suspension

- **An oil reservoir (low-pressure reservoir)**
- **A high-pressure chamber Inside piston rod is pump chamber containing an inlet and an outlet valve. When a load is placed in rear of vehicle, it compresses suspension and shock absorber. When vehicle starts to move, internal pump is activated by movement of body. Extension of the piston rod causes oil to be drawn through inlet valve into pump. When shock compresses, oil is forced through outlet valve into high-pressure chamber. The pressure in oil reserve decreases as pressure in high-pressure chamber increases. The increasing pressure is applied to piston rod, which raises the height of vehicle.**

When vehicle's normal height is reached, no oil is drawn into chamber. Because shock is mechanical, vehicle needs to be moving before the pump starts to work. It requires about 2 miles of driving for shock to reach normal ride height. The vehicle also needs to be driven about 2 miles after a load has been removed from the vehicle for it to return to normal ride height.

36. **SLIDE 36 EXPLAIN Figure 119-35** typical ZF Sachs self-leveling shock, as used on the rear of a Chrysler minivan
37. **SLIDE 37 EXPLAIN Figure 119-36** Schematic of the ALC system
38. **SLIDE 38 EXPLAIN Figure 119-37** Air compressor assembly can be located at various locations depending on the vehicle.
39. **SLIDE 39 EXPLAIN Figure 119-38** The exhaust solenoid is controlled by rear integration module (RIM).

ICONS	Chapter 119 Electronic Suspension
	40. SLIDE 40 EXPLAIN **Figure 119-39** 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.
Education Foundation	**ON-VEHICLE ASEEDUCATION TASK: Test and diagnose components of electronically controlled suspension systems using a scan tool; determine necessary action.**
	DISCUSS FREQUENTLY ASKED QUESTION:
	41. SLIDE 41 EXPLAIN **Figure 119-40** 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 119-41** The controller for the magneto-rheological suspension system on a C6 Corvette is located behind the right front wheel.
	43. SLIDE 43 EXPLAIN **Figure 119-42** A cutaway of a magneto-rheological shock absorber as displayed at the Corvette Museum in Bowling Green, Kentucky.
	DEMONSTRATION: Show the students sensors and controllers for magneto-rheological suspension systems FIGURE 119-42
	OPTIONAL SEARCH INTERNET: Have students use nternet to research suspension position sensors. Ask them to be prepared to list at least 10 different models of automobiles and the names given to the suspension position sensors in those models in a class discussion.