Automotive Electrical & Engine Performance 8/E

Chapter 23 Safety, Comfort and Convenience Accessories

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Electrical & Engine Performance 8th edition provides complete coverage of automotive areas pertaining vehicle electrical systems and engine performance. 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, and Animations that are listed in this Lesson Plan. This Lesson Plan also references ASEEducation (NATEF) Task Sheets available from Jim's web site.
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. Describe the procedure used to check for spark. 2. List the steps necessary to check and/or adjust ignition timing on engines equipped with a distributor. 3. Inspect and test ignition coils. 4. Describe how to test the ignition system using an oscilloscope. 5. Inspect and test ignition system pickup sensor or triggering devices. 6. Discuss what to inspect and look for during a visual inspection of the ignition system. 7. Diagnose ignition system related problems. 8. Inspect and test ignition system secondary circuit wiring and components. **This chapter will help you prepare for Engine Repair (A8) ASE certification test content area "B" (Ignition 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 Electrical & Engine Performance 8th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

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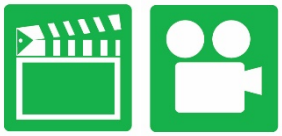
ICONS	Ch23 Safety, Comfort/Convenience ACC.
	**1. SLIDE 1 CH23 Safety, Comfort and Convenience Accessories**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	**Videos**
	**At the beginning of this class, you can download the crossword puzzle & Word Search from Jim's web site to familiarize your class with terms in this chapter & then discuss them, see below:** **HTTP://WWW.JAMESHALDERMAN.COM/BOOKS_A8.HTML#ANCHOR2** **DOWNLOAD** **CROSSWORD PUZZLE (MICROSOFT WORD) (PDF)** **WORD SEARCH PUZZLE (MICROSOFT WORD) (PDF**
	
	**2. SLIDE 2 EXPLAIN FIGURE 23–1** Two horns are used on this vehicle. Many vehicles use only one horn, often hidden underneath the vehicle.
	**DEMONSTRATION: USING DIFFERENT TUNING FORKS, DEMONSTRATE HOW DIFFERENT FREQUENCY VIBRATIONS PRODUCE DIFFERENT SOUND**
	**YOU CAN USE A TEST LIGHT TO DIAGNOSE CONTINUOUS HORN OPERATION COMPLAINTS. CONNECT TEST LIGHT IN PLACE OF HORN. LIGHT WILL GO OUT WHEN PROBLEM LOCATED.**
	**3. SLIDE 3 EXPLAIN Figure 23-2** typical horn circuit. Note that the horn button completes the ground circuit for the relay.
	4. SLIDE 4 EXPLAIN FIGURE 23–3 typical schematic of a horn circuit. Note that the horn relay can be activated by either the horn switch in the steering wheel or by the body control module (BCM).
	**DEMONSTRATION: SHOW STUDENTS HOW TO USE A DMM TO TEST HORN RELAY**

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   	**HANDS-ON TASK:** **HAVE STUDENTS USE DMM TO TEST VARIOUS HORN SYSTEM COMPONENTS SUCH AS FUSES AND SWITCHES.** **HANDS-ON TASK:** **PROVIDE STUDENTS WITH A VEHICLE THAT HAS AN INOPERATIVE HORN. HAVE THEM USE TEST EQUIPMENT TO DIAGNOSE AND REPAIR THE HORN CIRCUIT.** 5. **SLIDE 5 EXPLAIN FIGURE 23–4** motor and linkage bolt to the body and connect to the switch with a wiring harness. 6. **SLIDE 6 EXPLAIN Figure 23-5** typical wiper motor with the housing cover removed. The motor itself has a worm gear on shaft that turns small intermediate gear, which then rotates gear and tube assembly, which rotates the crank arm (not shown) that connects to wiper linkage. 7. **SLIDE 7 EXPLAIN Figure 23-6** wiring diagram of a two-speed windshield wiper circuit using a three-brush, two-speed motor. The dashed line for the multifunction lever indicates that the circuit shown is only part of the total function of the steering column lever. 8. **SLIDE 8 EXPLAIN FIGURE 23–7** A circuit diagram is necessary to troubleshoot a windshield wiper problem. 9. **SLIDE 9 EXPLAIN FIGURE 23–8** wiper motor and linkage mount under the cowl panel on many vehicles**.** **DISCUSS FREQUENTLY ASKED QUESTION: *HOW DO WIPERS PARK?* SOME VEHICLES HAVE WIPER ARMS THAT PARK LOWER THAN NORMAL OPERATING POSITION, SO THEY ARE HIDDEN BELOW HOOD WHEN NOT IN OPERATION. THIS IS CALLED A DEPRESSED PARK POSITION. WHEN WIPER MOTOR IS TURNED OFF, PARK SWITCH ALLOWS MOTOR TO CONTINUE TO TURN UNTIL THE WIPER ARMS REACH BOTTOM EDGE OF THE WINDSHIELD. THEN PARK SWITCH REVERSES THE CURRENT FLOW THROUGH WIPER MOTOR, WHICH MAKES A PARTIAL REVOLUTION IN OPPOSITE DIRECTION. WIPER LINKAGE PULLS WIPER ARMS DOWN**

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   	**BELOW THE LEVEL OF HOOD AND PARK SWITCH IS OPENED, STOPPING WIPER MOTOR.** **DEMONSTRATION: SHOW STUDENTS INNER WORKINGS OF AN ELECTRIC WIPER MOTOR AND HOW TO INSPECT THE MOTOR FOR DEFECTS** **EXPLAIN TECH TIP: *Scan Tool Bi-Directional Control:* Most vehicles built since 2000 can have the lighting and accessory circuits checked using a scan tool. You can use following:** **Factory level scan tools:** • **Tech 2 or Multiple Diagnostic Interface (MDI) (GM)** • **DRB III, Star Scan, Star Mobile, WiTech, or MicroPOD II(Chrysler-Jeep vehicles)** • **New Generation Star or IDS (Ford)** • **Honda Diagnostic System (HDS)** • **TIS Tech Stream (Toyota/Lexus) An enhanced aftermarket scan tool has body bidirectional** • **control capability, including:** • **Snap-on Modis, Solus, or Verus** • **OTC Genisys** • **Auto-Enginuity** **Using a bidirectional scan tool allows you to command operation of electrical accessories, such as horns, windows, lights, door locks, and wipers. • SEEFIGURE 23–9.** **If the circuit operates correctly when commanded by the Scan tool and does not function using the switch(s), follow service information instructions for the exact tests and testing procedures to follow for the vehicle being tested.** 10. **SLIDE 10** EXPLAIN **FIGURE 23–9** A typical schematic showing how relays inside the front control module are all tied to other modules on the bus. **DISCUSSION: DISCUSS DIFFERENCE BETWEEN SERIES-WOUND FIELD & SHUNT FIELD MOTORS. HOW ARE ELECTRICAL CONNECTIONS MADE TO EACH?**

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DEMO	**DEMONSTRATION:** SHOW STUDENTS HOW WIPER/WASHER OPERATES
QUESTION	**DISCUSSION:** DISCUSS WHAT CONTROLS ACTUAL OPERATION OF THE WIPER. WHAT ELSE COULD COME ON WHEN THE WIPERS ARE ON?
QUESTION	**DISCUSSION:** DISCUSS HOW WIPER MOTORS MAY BE MADE TO OPERATE AT MORE THAN ONE SPEED. ASK STUDENTS TO EXPLAIN LOW &HIGH-SPEED OPERATION.
QUESTION	**DISCUSSION:** DISCUSS DIFFERENT WINDSHIELD WIPER MODES OF OPERATION. WHY ARE THERE VARIATIONS AMONG WIPER SYSTEMS AND CIRCUITS?
	11. **SLIDE 11 EXPLAIN FIGURE 23–10** typical windshield washer reservoir and pump assembly. 12. **SLIDE 12 EXPLAIN FIGURE 23–11** Washer pumps usually install into the reservoir and are held in place with a retaining ring. 13. **SLIDE 13 EXPLAIN FIGURE 23–12** typical rain-sensing module located on inside of windshield near inside rearview mirror.
DEMO	**DEMONSTRATION:** SHOW STUDENTS HOW TO USE A WIRING DIAGRAM TO TRACE CURRENT FLOW THROUGH A TYPICAL WIPER CIRCUIT.
DEMO	**DEMONSTRATION:** SHOW STUDENTS HOW TO TRACE CURRENT FLOW THROUGH WINDSHIELD WIPER COMBINATION/MULTIFUNCTION SWITCHES
	HANDS-ON TASK: HAVE STUDENTS DOWNLOAD A WIPER SYSTEM WIRING DIAGRAM AND USING A HIGHLIGHTER TRACE THE CURRENT FLOW.
DEMO	**DEMONSTRATION:** SHOW STUDENTS HOW TO CORRECTLY REMOVE TRIM PANELS TO GAIN ACCESS TO REAR WIPER MOTORS WITHOUT DAMAGING THE MOUNTING CLIPS/HARDWARE.

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	**HANDS-ON TASK:** HAVE STUDENTS GAIN ACCESS TO WIPER LINKAGE USED TO LUBE COMPONENTS AND INSPECT IT FOR PROPER OPERATION.
	**DISCUSSION:** DISCUSS HOW TO DETERMINE WHETHER INOPERATIVE WIPER CONCERNS ARE CAUSED BY MECHANICAL OR ELECTRICAL MALFUNCTIONS. WHAT IS INDICATED BY DETERMINING WHETHER VOLTAGE IS AVAILABLE OR NOT?
	**DEMONSTRATION:** SHOW THE STUDENTS HOW TO CONNECT A **SCAN TOOL** TO RETRIEVE INFORMATION REGARDING SYSTEMS CONTROLLED BY **BCM**. EXPLAIN HOW RAIN SENSE MODULE USES DIODES & PHOTOCELLS TO MEASURE MOISTURE LEVELS ON WINDSHIELD.
	14. **SLIDE 14 EXPLAIN FIGURE 23–13** electronics in the rain-sense wiper module can detect the presence of rain drops under various lighting conditions.
	**DISCUSSION:** DISCUSS DIFFERENT METHODS USED TO CONTROL INTERMITTENT (PULSE) WIPER OPERATION. WHAT DOES THE VARIABLE RESISTOR, OR RHEOSTAT, CONTROL?
	**EXPLAIN TECH TIP:** ***Rain Sense and Cruise Control*** **Rain-sense wiper module communicates with BCM over data links and, if rain is heavy, a signal is sent to deactivate cruise control. A message is then displayed on instrument panel warning that cruise control is not available. This is normal operation and is used to help prevent vehicle from hydroplaning during heavy rain. Normal cruise control operation resumes when the rain intensity is reduced. This is normal operation and not a fault with cruise control system.**
	**DEMONSTRATION:** SHOW STUDENTS HOW TO INSPECT WASHER SYSTEMS FOR LINE- AND SQUIRT-NOZZLE BLOCKAGE.

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	**YOU CAN ADD A LITTLE WASHER FLUID TO A COMPLETELY EMPTY RESERVOIR & CHECK IT FOR LEAKS BEFORE COMPLETELY FILLING IT. THIS WILL PREVENT WASTING WASHER FLUID ON SYSTEMS THAT HAVE A LEAKING RESERVOIR.**
	**DISCUSSION: DISCUSS THE WINDSHIELD WASHER RESERVOIR. HOW CAN YOU TELL THE WINDSHIELD WASHER & COOLANT OVERFLOW RESERVOIRS APART?**
	**DISCUSSION: DISCUSS USING WINDSHIELD WASHER FLUID INSTEAD OF REGULAR WATER. WHAT CAN HAPPEN IN FREEZING WEATHER IF PURE WATER IS USED?**
	**Rain Sensing (View) (Download)**
	**DISCUSSION: : HAVE THE STUDENTS DISCUSS HOW THE RAIN SENSE MODULE WORKS. WHAT HAPPENS WHEN WIPER SWITCH IS LEFT ON SENSE POSITION ALL OF TIME?**
	**HANDS-ON TASK: HAVE THE STUDENTS EXPLAIN HOW WIPER MOTORS MAY BE MADE TO OPERATE AT MORE THAN ONE SPEED. GRADE STUDENTS ON THEIR ABILITY TO EXPLAIN LOW & HIGH-SPEED MOTOR OPERATION.**
	**15. SLIDE 15 EXPLAIN FIGURE 23–14** exploded view of a cruise control assembly used on a vehicle that does not have an electronic throttle. Stepper motor is connected to the throttle of the engine and is used to increase or decrease engine speed to maintain the set speed.
	**EXPLAIN TECH TIP: *Bump Problems:* Cruise control problem diagnosis can involve a complex series of checks and tests. Troubleshooting procedures vary among manufacturers (and year), so always check service information for exact vehicle being serviced. However, every cruise control system uses a brake safety switch and, if vehicle has manual transmission, a clutch safety switch. The purpose of these safety switches is to ensure that cruise control system is disabled if brakes or clutch are applied. Some systems use a redundant brake**

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	pedal safety switch. If the cruise control "cuts out" or disengages itself while traveling over bumpy roads, the most common cause is a misadjusted brake (and/or clutch) safety switch (es). Often, a simple readjustment of these safety switches cures intermittent cruise control disengagement problems. **CAUTION: Always follow the OEMS recommended safety switch adjustment procedures. If the brake safety switch (es) is misadjusted, it could keep pressure applied to the master brake cylinder, resulting in severe damage to the braking system.** **EXPLAIN TECH TIP: *Check the Brake Lights*** On many vehicles, the cruise control does not work if brake lights are not working. This includes the third brake light, commonly called the center high-mounted stop light (CHMSL). Always check for proper operation of brake lights first if the cruise control does not work.
	**DEMONSTRATION:** Use a lab vehicle to show students components of cruise control system. If possible, show multiple OEM systems to demonstrate different designs.
	**HANDS-ON TASK:** Have the students describe cruise control systems and how they operate. Have them create a table to list some common causes of inoperative cruise control systems.
	**DISCUSSION: Discuss use of multiple safety switches. Why is a clutch or BRAKE switch necessary?**
	**DISCUSSION: Have students talk about integration of cruise control system with ECM. Does this help with troubleshooting procedures?**
	When servicing cruise control system, you will be close to air bag & ABS. Service Information will instruct you when to disarm and/or depressurize these systems. Failure to follow these procedures can result in personal injury & costly repairs.

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 	**16. SLIDE 16 EXPLAIN FIGURE 23–15** Circuit diagram of a typical electronic cruise control system**.** **DISCUSS FREQUENTLY ASKED QUESTION: *WILL RADAR CRUISE CONTROL SET OFF MY RADAR DETECTOR? IT IS DOUBTFUL.* RADAR USED FOR RADAR CRUISE CONTROL SYSTEMS OPERATES ON FREQUENCIES NOT DETECTABLE BY POLICE RADAR DETECTOR UNITS. ADAPTIVE CRUISE CONTROL RADAR WORKS ON FREQUENCIES:** • **76 TO 77 GHZ (LONG RANGE)** • **24 GHZ (SHORT RANGE)** **THE FREQUENCIES USED FOR THE VARIOUS TYPES OF POLICE RADAR INCLUDE:** • **X-BAND: 8 TO 12 GHZ** • **K-BAND: 24 GHZ** • **KA-BAND: 33 TO 36 GHZ** **THE ONLY TIME THERE MAY BE INTERFERENCE IS WHEN RADAR CRUISE CONTROL, AS PART OF A PRE-COLLISION SYSTEM, STARTS TO USE SHORT-RANGE RADAR (SRR) IN THE 24 GHZ FREQUENCY. THIS COULD TRIGGER RADAR DETECTOR, BUT IS AN UNLIKELY EVENT, AND OCCURS JUST BEFORE A POSSIBLE COLLISION WITH A VEHICLE COMING TOWARD YOU.**
	**17. SLIDE 17 EXPLAIN FIGURE 23–16** electronic throttle control (ETC) system uses a sensor that measures the position and the speed of the driver's foot on the accelerator pedal. A throttle position sensor measures throttle angle. An electric motor operates the movement of the throttle plate using commands from the PCM.
	**DISCUSSION: discuss Electronic Throttle Cruise Control. What components are not needed with this system?**

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	**18. SLIDE 18 EXPLAIN FIGURE 23–17** Adaptive cruise control can use radar to determine the distance of another vehicle in front. The control unit then checks the driver selected speed and the sets the distance between the vehicles to determine what action is needed. The PCM then can operate the throttle or the brakes through the antilock brake/electronic stability control system to slow the vehicle, if needed, to maintain the set distance.
	**19. SLIDE 19 EXPLAIN FIGURE 23–18** Most radar cruise control systems use radar, both long and short range. Some systems use optical or infrared cameras to detect objects.
	**DISCUSSION: Have the students talk about the Radar Cruise Control Systems. How do these systems operate?**
	**DISCUSSION: Discuss why Radar Cruise Control does not normally interfere with a radar detector. What are the frequencies of long-range and short range radar?**
	**20. SLIDE 20 EXPLAIN FIGURE 23–19** schematic showing that the side view mirrors are heated along with the rear window defogger whenever the rear window switch (lower right) is turned to the on position.
	**DISCUSSION: Discuss heated mirrors. What are the purpose and function of these mirrors?**
	**EXPLAIN TECH TIP: *The Infrared Camera Test*** **It is difficult to test for the proper operation of all grids of a rear window defogger unless the rear window happens to be covered with fog. A common trick that works is to turn on the rear defogger and look at the outside of the rear window glass using an infrared camera. The image shows if all sections of the rear grids are working. • SEE FIGURE 23–20.**
	**21. SLIDE 21 EXPLAIN FIGURE 23–20** A typical image captured using an infrared camera of a rear defogger that is working as designed.
	**22. SLIDE 22 EXPLAIN FIGURE 23–21** A rear window defogger electrical grid can be tested using a voltmeter to check for a decreasing voltage as meter lead is moved

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	from the power side toward ground side. As voltmeter positive lead is moved along the grid (on inside of vehicle), voltmeter reading should steadily decrease the meter approaches ground side of grid. **23. SLIDE 23 EXPLAIN FIGURE 23–22** typical repair material contains conductive silver filled polymer, which dries in 10 minutes and is usable in 30 minutes.
QUESTION	**DISCUSSION: Have students talk about steps & tools required to test Rear Window Defroster grid. Will all gridlines have same voltage drop?**
DEMO	**DEMONSTRATION: Show students how to test a rear window defroster grid with DMM. Have them note the voltage drop from the power side to ground side of window.**
DEMO	**DEMONSTRATION: Show students rear window defroster grid. Show how to repair a broken or damaged grid using repair material.**
DEMO	**DEMONSTRATION: Show the glass from a heated mirror. Why doesn't heated mirror use grids similar to those in rear window glass?**
	ON-VEHICLE TASK repair a broken or damaged grid using repair material
Education Foundation	**ASEEDUCATION TASK G1: Diagnose operation of comfort and convenience accessories and related circuits (such as: power window, power seats, pedal height, power locks, truck locks, remote start, moon roof, sun roof, sun shade, remote keyless entry, voice activation, steering wheel controls, back-up camera, park assist, cruise control, and auto dimming headlamps); determine needed repairs.**
Education Foundation	**ON-VEHICLE ASEEDUCATION TASK Diagnose operation of safety systems and related circuits (such as: horn, airbags, seat belt pretensioners, occupancy classification, wipers, washers, speed control/collision avoidance, heads-up display, park assist, and back-up camera); determine needed repairs.**

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      	**ON-VEHICLE ASEEDUCATION TASK** **Diagnose body electronic systems circuits using a scan tool; check for module communication errors (data communication bus systems); determine needed action.** 24. **SLIDE 24 EXPLAIN FIGURE 23–23** A typical power window circuit using PM motors. Control of the direction of window operation is achieved by directing the polarity of the current through the non-grounded motors. The only ground for the entire system is located at the master control (driver's side) switch assembly. **DEMONSTRATION: Show students how Power Windows Operate** 25. **SLIDE 25 EXPLAIN FIGURE 23–24** electric motor and a regulator assembly raise and lower the glass on a power window. 26. **SLIDE 26 EXPLAIN FIGURE 23–25** A master power window control panel with the buttons & cover removed. 27. **SLIDE 27 EXPLAIN FIGURE 23–26** typical electric power door lock circuit diagram. Note that the control circuit is protected by a fuse, whereas power circuit is protected by a circuit breaker. As with the operation of power windows, power door locks typically use reversible permanent magnet (PM) non-grounded electric motors. These motors are geared mechanically to lock–unlock mechanism. **EXPLAIN TECH TIP:** ***Programming Auto Down/Up Power Windows:*** **Many vehicles are equipped with automatic operation that can cause window to go all the way down (or up) if switch is depressed beyond a certain point or held for a fraction of a second. Sometimes this feature is lost if battery in the vehicle has been disconnected. Although this programming procedure can vary depending on make and model, many times the window(s) can be reprogrammed without using a scan tool by depressing and holding the down button for 10 seconds. If the vehicle is equipped with an auto up feature, repeat the procedure by holding the button**

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	up for 10 seconds. Always check exact service information for the vehicle being serviced. **DEMONSTRATION: POWER WINDOWS: Trace circuit so students understand how both motor terminals are at ground potential before switches are moved. Trace current flow so students understand how power is reversed.**
	Power Door Locks (View) (Download) Power Seat Control (View) (Download) Power Window Regulator (View) (Download) Power Windows (View) (Download)
	**EXPLAIN TECH TIP: *Check Glove Box Switch Position:* A common customer complaint is that the trunk or lift gate can be opened manually, but it cannot be opened using remote. Most vehicles are equipped with a lock-out switch in the glove compartment (instrument panel compartment) that can be switched off, and the glove box door locked to limit access when the vehicle is parked, and the valet has the key to the ignition. If the switch is in the locked position, the trunk cannot be opened using the remote. Check that first before following the recommended diagnostic procedures found in service information. • SEE FIGURE 23–27.**
	28. SLIDE 28 EXPLAIN **FIGURE 23–27** switch to disable outside opening of trunk/lift gate is often in glove box.
	**DEMONSTRATION: Demonstrate procedure for checking master power window switch. Use a test light & DMM to test for current on proper wires when the switch is activated.**
 	**DISCUSSION: Discuss programming procedure for auto up/down power windows. Why would it be helpful to be able to program windows without using scan tool? Point out that many of the systems in newer vehicles are accessible only with a dedicated OEM scan tool or laptop computer.**

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	**When servicing power windows, keep your fingers & hands away from linkage while it is in operation or when removing components. Linkage has sharp edges & can cause serious injury**
	**DEMONSTRATION: Show students how to remove a door panel. Explain hidden fasteners.**
	**ON-VEHICLE Have students remove a door panel.**
	29. **SLIDE 29 EXPLAIN FIGURE 23–28** exploded view of a typical **moveable roof** showing the location of the motor and the drain tubes that direct water to ground.
	**DEMONSTRATION: Trace POWER SEATS:circuit so students understand how POWER SEATS OPERATE**
	30. **SLIDE 30 EXPLAIN FIGURE 23–29** control for operation of the **powered inside sun shade** on this Chevrolet Impala is in the overhead control panel.
	31. **SLIDE 31 EXPLAIN FIGURE 23–30 power seat** uses electric motors under seat, which drive cables that extend to operate screw jacks (up and down) or gears to move the seat forward and back
	**DEMONSTRATION: Remove power driver seat from a lab vehicle. Flip seat over & point out parts of power seat assembly**
	**HANDS-ON TASK: Have students remove a power seat from lab vehicle. Remind them that they always need to use on-line service information to find proper procedure.**
	**DISCUSSION: Discuss power seat motors. What is the advantage to having a separate motor for each function instead of having one-housing with multiple armatures?**
	**DISCUSSION: Discuss power seat circuits. Why is a circuit breaker used instead of fuse for power seat circuit protection?**

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	**32. SLIDE 32 EXPLAIN FIGURE 23–31** A typical **power seat circuit diagram.** Notice that each motor has a built-in electronic (solid-state) PTC circuit protector. The seat control switch can change the direction in which motor(s) runs by reversing the direction in which the current flows through the motor.
	**DISCUSSION: Discuss electrically heated seats. How are seats heated? How is temperature regulated?**
	**33. SLIDE 33 EXPLAIN FIGURE 23–32** A typical **memory seat module** showing the three-wire potentiometer used to determine seat position.
	**OPTIONAL HANDS-ON TASK: Have students program a memory seat position to suit their size. Have them talk about memory seats. How might this function be helpful where several people share a car?**
	**DISCUSSION: Discuss heated & cooled seats. What is a thermoelectric device (TED)? How are most seats equipped?**
	**34. SLIDE 34 EXPLAIN FIGURE 23–33** heating element of a **heated seat** is a replaceable part, but service requires that the upholstery be removed. The yellow part is seat foam material and entire white cover is replaceable heating element. This is then covered by seat material.
	**DISCUSSION: Discuss components of a heated & cooled steering wheel. How does heater and cooling operate?**
	**35. SLIDE 35 EXPLAIN FIGURE 23–34 Peltier effect** device is capable of heating or cooling, depending on the polarity of the applied current.
	**DEMONSTRATION: Demo how to diagnose power options**
	**ON-VEHICLE ASEEDUCATION TASK G1: Diagnose operation of comfort and convenience accessories and related circuits (such as: power window, power seats, pedal height, power locks, truck locks, remote start, moon roof, sun roof, sun**
	

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	shade, remote keyless entry, voice activation, steering wheel controls, back-up camera, park assist, cruise control, and auto dimming headlamps); determine needed repairs.
	**36. SLIDE 36 EXPLAIN FIGURE 58–35** A fan is used to move the **heated or cooled air to heat or cool** the bottom or the back of the seat.
	EXPLAIN TECH TIP: *Check the Seat Filter:* Heated and cooled seats often use a filter to trap dirt and debris to help keep the air passages clean. If a customer complains of a slow heating or cooling of the seat, check the air filter and replace or clean as necessary. Check service information for the exact location of the seat filter and for instructions on how to remove and/or replace it.
	**37. SLIDE 37 EXPLAIN FIGURE 23–36** heated steering wheel is controlled by a switch on the steering wheel in this vehicle.
	38. SLIDE 38 EXPLAIN FIGURE 23–37 typical **adjustable pedal assembly**. Both the accelerator and the brake pedal can be moved forward and rearward by using the adjustable pedal position switch**.**
	EXPLAIN TECH TIP: *Check the Remote memory* function may be programmed to a particular key fob remote, which commands the adjustable pedals to move to the position set in memory. Always check the settings of all remotes before attempting to repair a problem that may not be a problem.
	**DISCUSS CASE STUDY: *CASE OF THE HAUNTED MIRRORS:* OWNER COMPLAINED THAT WHILE DRIVING, EITHER ONE OR OTHER, OUTSIDE MIRROR FOLDED IN WITHOUT ANY BUTTON BEING DEPRESSED. UNABLE TO VERIFY THE CUSTOMER CONCERN, THE SERVICE TECHNICIAN LOOKED AT THE OWNER'S MANUAL TO FIND OUT EXACTLY HOW THE MIRRORS WERE SUPPOSED TO WORK. IN MANUAL, A CAUTION STATEMENT SAID THAT IF THE MIRROR IS**

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	ELECTRICALLY FOLDED INWARD AND THEN MANUALLY PUSHED OUT, THE MIRROR DOES NOT LOCK INTO POSITION. THE POWER FOLDING MIRRORS MUST BE ELECTRICALLY CYCLED OUTWARD, USING THE MIRROR SWITCHES TO LOCK THEM IN POSITION. ***AFTER CYCLING BOTH MIRRORS INWARD AND OUTWARD ELECTRICALLY, THE PROBLEM WAS SOLVED.*** **SEE FIGURES 23–38 & FIGURE 23–39.** **SUMMARY:** • **COMPLAINT—CUSTOMER STATED THAT OUTSIDE POWER FOLDING MIRROR FOLDED BY ITSELF AT TIMES.** • **CAUSE—MIRRORS MUST BE MOVED ELECTRICALLY, NOT MANUALLY, TO WORK CORRECTLY.** • **CORRECTION—CYCLING MIRRORS ELECTRICALLY RESTORED PROPER OPERATION.**
	**39. SLIDE 39 EXPLAIN FIGURE 23–38** Electrically folded mirror in the folded position. **40. SLIDE 40 EXPLAIN FIGURE 23–39 electric mirror control is located on the driver's side door panel on this Cadillac Escalade.**
	**DEMONSTRATION: DEMO RKE operation**
	**41. SLIDE 41 EXPLAIN FIGURE 23–40 A key fob remote.**
	**DEMONSTRATION: Obtain several remote keyless entry fobs or transmitters to show to your students. Separate the cases of the fobs to let students see the internal components, especially keypad touch areas on circuit board. Discuss range**

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	of remote keyless entry key fobs. What is meant by "line of sight"?
	**42. SLIDE 42 EXPLAIN FIGURE 23–41** A typical vehicle showing the location of the various components of the remote keyless entry system**.**
	43. SLIDE 43 EXPLAIN FIGURE 23–42 (a) If the passive key is within about 15 feet (5 meters) of the vehicle when the door handle is touched, the door unlocks, allowing access to the interior. (b) The engine starts if the smart key is detected being inside the vehicle.
	**DISCUSSION: Have students talk about ROLLING CODE TRANSMITTERS. What other component uses rolling code technology?**
	**DISCUSSION: Discuss REMOTE KEYLESS ENTRY (RKE) Systems & their components involved in these systems. How do electronic key fobs or transmitters work?**
	**HANDS-ON TASK: Divide students into groups. Have them work together to create a spreadsheet that shows procedures for programming remote keyless entry transmitters.**
	**DEMONSTRATION: USE LAB VEHICLE to Show components of Antitheft System. Activate system to show how lamps flash & horn or siren sounds.**
	**DISCUSSION: Have students talk about antitheft systems. What are components of antitheft system?**
	**Antitheft System (View) (Download)**
	**DISCUSSION: Have students talk about the use of special keys for antitheft systems. What happens if an unprogrammed key is used?**
	**DISCUSSION: Discuss diagnostic steps used for troubleshooting antitheft system. Why is it important to have accurate service data before troubleshooting any electronic system?**

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    	**ON-VEHICLE ASEEDUCATION TASK G2** **Diagnose operation of security/anti-theft systems and related circuits (such as: theft deterrent, door locks, remote keyless entry, remote start, and starter/fuel disable); determine needed repairs.** **44. SLIDE 44 EXPLAIN FIGURE 23–43** Typical **HomeLink garage door opener buttons.** Notice that three different units can be controlled from the vehicle using the HomeLink system. **45. SLIDE 45 EXPLAIN FIGURE 23–44** A **remote start system** allows the engine to be started from a distance, usually form inside the house before leaving for the day. Most systems only allow the engine for run for ten minutes. **WARNING: Never use remote start to start the engine if vehicle is located inside a garage or an area without proper ventilation, or if a car cover is covering the body of the vehicle.** **EXPLAIN TECH TIP: *Try to Purchase an Aftermarket System* That Has a Long Range Most factory remote start systems have a range of 400 to 600 feet (120-180 m) and may work as far away as 1,500 feet (450 m) in open areas. The distance is affected by buildings and walls, which can greatly reduce the effective range. If purchasing an aftermarket remote start device, look for a high transmitter power rating because this is the value that determines the range of the remote. Many units are advertised as having a 500-foot range or 3,000-foot range, but these numbers are for areas without any obstructions. While few vehicle owners need to start their vehicles from more than 1,000 feet away, most want to start a vehicle from inside a building. A longer range (more transmitter power) is needed if it is used from a mall, sporting events, parking garages, hospitals, or restaurants. If in doubt, pay a little more to get a more powerful unit.**

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 	**ON-VEHICLE ASEEDUCATION TASK G6:** **.Describe the process for software transfer, software updates, or reprogramming of electronic modules.**