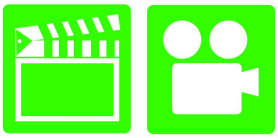
Automotive Maintenance and Light Repair, 1ST Edition

Chapter 32 Lighting & Signaling Circuits

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers **Automotive Maintenance and Light Repair.** 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. ⁀ Describe how an exterior lighting systems works. ⁀ Read and interpret a bulb chart. ⁀ Discuss the operation of brake lights and turn signals. ⁀ Inspect, replace, and aim headlights and bulbs. ⁀ Discuss troubleshooting procedures for lighting and signaling circuits. ⁀ This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area “E” (Lighting 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.

ICONS	Ch32 Lighting & Signaling Circuits
	**1. SLIDE 1 CH32 Lighting & Signaling Circuits** **2. SLIDES 2-3 EXPLAIN OBJECTIVES** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED**
 	**Hazard Lights** **Headlight Circuit** **Headlight Circuit, Parking Lights** **Headlight Circuit, High Beam** **Headlight Circuit, Low Bea**
	**4. SLIDE 4 EXPLAIN** Exterior Lighting **5. SLIDE 5 EXPLAIN** Bulb Numbers **6. SLIDE 6 EXPLAIN Figure 32-1** Dual-filament (double-contact) bulbs contain both low-intensity filament for taillights or parking lights and a high-intensity filament for brake lights & turn signals. Bulbs come in a variety of shapes and sizes. Numbers shown are trade numbers. **7. SLIDES 7-11 EXPLAIN CHART 32-1** **12. SLIDE 12 EXPLAIN Figure 32-2** Bulbs that have the same trade number have the same operating voltage and wattage. The NA means that the bulb uses a natural amber glass ampoule with clear turn signal lenses.
	**DEMONSTRATION: PASS A DUAL-FILAMENT BULB AROUND CLASSROOM AND POINT OUT DOUBLE CONTACTS ON THE BOTTOM AND THE METAL CASE USED FOR GROUND**
 	**DISCUSSION: DISCUSS HOW A DUAL FILAMENT BULB WORKS. WHAT ARE ADVANTAGES OF A DUAL FILAMENT BULB VERSUS SINGLE FILAMENT BULB?**
 	**DISCUSSION: DISCUSS BENEFITS OF USING LEDS IN PLACE OF CONVENTIONAL LAMPS. WHAT ARE ENVIRONMENTAL IMPACTS & BENEFITS?**
	**13. SLIDE 13 EXPLAIN Figure 32-3** Close-up a 2057 dual-filament (double-contact) bulb that failed. Notice that the top filament broke from its mounting and melted onto the lower filament. This bulb caused the dash lights to come on whenever the brakes were applied.

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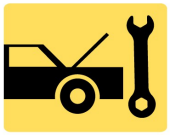
	**DEMONSTRATION: SHOW EXAMPLES OF 3157, 3157NA, AND 3157A BULBS, OR SIMILAR BULBS, TO HELP THEM DISTINGUISH DIFFERENCE BETWEEN BULB SUFFIXES**
	14. **SLIDE 14 EXPLAIN Figure 32-4** Corrosion caused the two terminals of this dual-filament bulb to be electrically connected & **EXPLAIN Figure 32-5** Often the best diagnosis is a thorough visual inspection. This bulb was found to be filled with water, which caused weird problems.
	15. **SLIDE 15 EXPLAIN Figure 32-6** Single-filament bulb is being tested with DMM set to read resistance in ohms. 1.1 ohms is resistance of bulb when cold. As soon as current flows through filament, resistance increases about 10 times. It is initial surge of current flowing through filament when bulb is cool that causes many bulbs to fail in cold weather as a result of reduced resistance. As temperature increases, resistance increases.
	**DEMONSTRATION: SHOW THE STUDENTS HOW TO TEST THE RESISTANCE OF BULB USING A DMM.**
	**DISCUSSION: HAVE STUDENTS TALK ABOUT IMPORTANCE OF SELECTING CORRECT BULB FOR A LAB VEHICLE. HOW IS THE AMOUNT OF LIGHT PRODUCED BY A BULB DETERMINED?**
	**DEMONSTRATION: BUILD A LIGHT BULB CIRCUIT ON TRAINER MEASURE RESISTANCE OF EACH BULB WITH A DMM & USING OHM'S LAW AND CALCULATE THE RESISTANCE OF SEVERAL DIFFERENT LAMPS WITH A GIVEN SOURCE VOLTAGE OF 9 AND 12 VOLTS.**
	**HANDS-ON TASK: THEN HAVE STUDENTS BUILD AND MEASURE THE SAME CIRCUIT FROM THE DEMO ON TRAINER**
	16. **SLIDE 16 EXPLAIN Figure 32-7** brake light and taillight circuit showing brake switch and all of related circuit components.
	17. **SLIDE 17 EXPLAIN FIGURE 32–8** A replacement LED taillight bulb is constructed of many small, individual light-emitting diodes

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	Hazard Lights
	18. **SLIDE 18 EXPLAIN** Turn Signals 19. **SLIDE 19 EXPLAIN Figure 32-9** typical turn signal switch includes various springs and cams to control the switch and to cause the switch to cancel after a turn has been completed. 20. **SLIDE 20 EXPLAIN Figure 32-10** When the stop lamps and turn signals share a common bulb filament, stop light current flows through the turn signal switch. 21. **SLIDE 21 EXPLAIN Figure 32-11** When a right turn in signaled, the turn signal switch contacts send flasher current to the right-hand filament and brake switch current to the left-hand filament. 22. **SLIDE 22 EXPLAIN Figure 32-12** Two styles of two-prong flasher units. 23. **SLIDE 23 EXPLAIN** Turn Signals 24. **SLIDE 24 EXPLAIN Figure 32-13** A hazard warning flasher uses a parallel resistor across the contacts to provide a constant flashing rate regardless of the number of bulbs used in the circuit.
DEMO	**DEMONSTRATION: SHOW STUDENTS WHAT A SINGLE ELEMENT STOP LAMP/TURN SIGNAL LOOKS LIKE IN OPERATION ON VEHICLE. DO SAME WITH A VEHICLE THAT HAS DUAL ELEMENT BULBS IN STOP LAMP/TURN SIGNAL CIRCUIT.**
QUESTION	**DISCUSSION: DISCUSS OPERATION OF STOP LAMP/TURN SIGNAL CIRCUIT WITH A SINGLE FILAMENT BULB. HOW MANY WIRES ARE FOUND AT TERMINAL CONNECTOR? DISCUSS OPERATION OF A STOP LAMP/TURN SIGNAL CIRCUIT WITH A DUAL FILAMENT BULB.**
	25. **SLIDE 25 EXPLAIN Figure 32-14** side-marker light goes out whenever there is voltage at both points X and Y. These opposing voltages stop current flow through the side-marker light. The left turn light and left park light are actually the same bulb (usually 2057) and are shown separately to help explain how the side-marker light works on many vehicles

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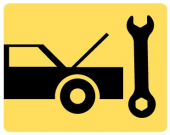
	**DISCUSSION:** DISCUSS FUNCTION OF TURN SIGNAL FLASHER. HOW DOES EACH DIFFERENT TYPE OF FLASHER ACCOMPLISH THIS TASK? DISCUSS HOW TO LOCATE TURN SIGNAL FLASHER. USE COMPONENT LOCATION VIEW IN ON-LINE SERVICE INFORMATION TO FIND FLASHER
	**DEMONSTRATION:** DISPLAY A SCHEMATIC OF A TYPICAL TURN SIGNAL CIRCUIT & SHOW STUDENTS WHICH SWITCHES ARE GANGED TOGETHER. SHOW HOW GANGED SWITCHES CHANGE STATE AT SAME TIME.
	**DEMONSTRATION:** USING TRAINER ; SIMULATE A TURN SIGNAL BULB CIRCUIT & MEASURE ITS RESISTANCE AND AMPERAGE USING A DMM
	**HANDS-ON TASK:** HAVE STUDENTS BUILD TURN SIGNAL CIRCUIT ON TRAINER, AS SHOWN IN PREVIOUS DEMO & MEASURE ITS RESISTANCE AND AMPERAGE USING A DMM.
	**Headlight Circuit** **Headlight Circuit, Parking Lights** **Headlight Circuit, High Beam** **Headlight Circuit, Low Bea**
	26. **SLIDE 26 EXPLAIN** Headlights 27. **SLIDE 27 EXPLAIN Figure 32-15** Typical headlight circuit diagram. Note that the headlight switch is represented by a dotted outline indicating that other circuits (such as dash lights) also operate from switch. 28. **SLIDE 28 EXPLAIN Figure 32-16** A typical four-headlight system using sealed beam headlights & **EXPLAIN Figure 32-17** typical composite headlamp assembly. The lens, housing, and bulb sockets are usually included as a complete assembly. 29. **SLIDE 29 EXPLAIN FIGURE 32–18** Handle a halogen bulb by base to prevent skin's oil from getting on glass.
	**DISCUSSION:** STUDENTS DISCUSS HALOGEN BULBS. WHY SHOULD YOU NEVER TOUCH A HALOGEN BULB WITH YOUR FINGERS?

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	30. SLIDE 30 EXPLAIN HIGH-INTENSITY DISCHARGE HEADLIGHTS 31. SLIDE 31 EXPLAIN **Figure 32-19** igniter contains ballast & transformer needed to provide high-voltage pulses to arc tube bulb & **EXPLAIN Figure 23-20** HID (xenon) headlights emit a whiter light than halogen headlights & usually look blue compared to halogen bulbs
	**DISCUSSION:** DISCUSS OPERATION & OPERATIONAL STATES OF HID (HIGH-INTENSITY DISCHARGE HEADLIGHTS). WHAT COMPONENTS MAKE UP THE SYSTEM? WHAT COSTS ARE ASSOCIATED WITH HID LIGHTS? WHAT IS A BALLAST RESISTOR?
	HID HEADLIGHTS ARE ALSO KNOWN AS XENON LIGHTS.
	**DISCUSSION:** HAVE STUDENTS TALK ABOUT OPERATION OF A TRANSFORMER. WHY IS TRANSFORMER NEEDED IN HID HEADLIGHT SYSTEM?
	NATEF MLR TASK A6E3 IDENTIFY SYSTEM VOLTAGE AND SAFETY PRECAUTIONS ASSOCIATED WITH HIGH-INTENSITY DISCHARGE HEADLIGHTS.
	32. SLIDE 32 EXPLAIN LIGHTING
	33. SLIDE 33 EXPLAIN **Figure 32-21** LED headlights usually require multiple units to provide the needed light as seen on this Lexus LS600h.
	**DISCUSSION:** HAVE THE STUDENTS TALK ABOUT BENEFITS OF LED HEADLIGHTS. HOW LONG DO THEY LAST? WHAT ARE THEIR ENVIRONMENTAL BENEFITS?
	HANDS-ON TASK: HAVE STUDENTS DOWNLOAD HEADLIGHT CIRCUIT FOR A LAB VEHICLE & HAVE A DISCUSSION ON CIRCUIT

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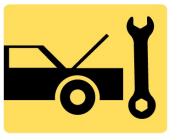
	34. **SLIDE 34 EXPLAIN Figure 32-22** Typical headlight aiming diagram as found in service information. 35. **SLIDE 35 EXPLAIN Figure 32-23** Many composite headlights have a built-in bubble level to make aiming easy and accurate.
	**NATEF MLR TASK A6E2 AIM HEADLIGHTS.**
	36. **SLIDE 36 EXPLAIN Figure 32-24** Adaptive front lighting systems rotate the low-beam headlight in the direction of travel. 37. **SLIDE 37 EXPLAIN Figure 32-25** A typical adaptive front lighting system uses two motors: one for the up and down movement and the other for rotating the low-beam headlight to the left and right & **EXPLAIN Figure 32-26** Typical dash-mounted switch that allows the driver to disable the front lighting system.
	**DISCUSSION: HAVE STUDENTS DISCUSS OPERATION OF ADAPTIVE FRONT LIGHTING SYSTEMS (AFS). WHICH TYPES OF VEHICLES ARE EQUIPPED WITH AFS? HOW CAN A SCAN TOOL BE USED TO TEST FUNCTION AFS SYSTEMS**
	**HANDS-ON TASK: HAVE STUDENTS DOWNLOAD A WIRING DIAGRAM FOR ADAPTIVE FRONT LIGHTING SYSTEMS (AFS) EQUIPPED VEHICLE. LOCATE COMPONENTS ON A VEHICLE IF POSSIBLE AND TAG THEM.**
	**DEMONSTRATION: PROVIDE SCHEMATIC OF ADAPTIVE FRONT LIGHTING SYSTEMS (AFS). SHOW LOCATION OF EACH COMPONENT IN SYSTEM & WHICH OTHER MODULES AND SENSORS IN VEHICLE ARE USED IN CONJUNCTION WITH**
	38. **SLIDES 38-39 EXPLAIN LIGHTING** 40. **SLIDE 40 EXPLAIN Figure 32-27** daytime running light (DRL) circuit. Follow arrows from DRL module through both headlights. Notice that left & right headlights are connected in series, resulting in increased resistance, less current flow, & dimmer than normal lighting. When normal headlights are turned on, both headlights receive full battery voltage, with left headlight grounding through the DRL module.

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QUESTION	**DISCUSSION: OPERATION OF DAYTIME RUNNING LIGHTS (DRL). WHAT ARE SAFETY BENEFITS OF DAYTIME RUNNING LIGHTS?**
	DAYTIME RUNNING LAMPS (DRLS): VEHICLES WITH DRLS MAY NOT HAVE FLASH TO PASS FUNCTION. NEWER VEHICLES MAY USE A LAMP CONTROL MODULE (LCM) TO CONTROL DRLS
	41. **SLIDE 41 EXPLAIN Figure 32-28** Most vehicles use positive switching of the high- and low-beam headlights. Notice that both filaments share the same ground connection. Some vehicles use negative switching and place the dimmer switch between filaments and ground.
DEMO	**DEMONSTRATION: BUILD RHEOSTAT OR POTENTIOMETER CIRCUIT ON TRAINER. DISCUSS OPERATION OF A RHEOSTAT. SHOW THEM HOW RESISTANCE IN A RHEOSTAT CHANGES AS KNOB IS TURNED. WHAT AUTOMOTIVE APPLICATIONS MIGHT USE RHEOSTATS? WHAT IS DIFFERENCE BETWEEN RHEOSTAT & POTENTIOMETER?**
	DIMMER SWITCH CONNECTED MECHANICALLY TO CONTROL LEVER & COMMON FAILURE ITEM (DEPENDING ON USE) DUE TO MECHANICAL NATURE OF SWITCH
	DOME LIGHTS MAY BE CONTROLLED ELECTRONICALLY THROUGH BCM
	42. **SLIDE 42 EXPLAIN Figure 32-29** A typical courtesy light doorjamb switch. Newer vehicles use the door switch as an input to the vehicle computer and the computer turns the interior lights on or off. By placing the lights under the control of the computer, the vehicle engineers have the opportunity to delay the lights after the door is closed and to shut them off after a period of time to avoid draining the battery.
	COURTESY LIGHTS
QUESTION	**DISCUSSION: TALK ABOUT OPERATION OF PHOTORESISTORS & PHOTODIODES. HOW COULD THESE COMPONENTS BE INCORPORATED INTO AUTOMATIC HEADLIGHT CIRCUITS?**

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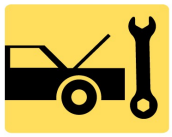
	**DISCUSSION: DISCUSS HOW COMPUTER IS USED TO CONTROL COURTESY LIGHTS AND ILLUMINATED ENTRY ON SOME VEHICLES. WHAT ARE SYSTEM'S INPUTS AND HOW DOES THE COMPUTER RECEIVE DATA FROM ALL OF THEM?**
	43. **SLIDE 43 EXPLAIN Figure 32-30** An automatic dimming mirror compares the amount of light toward the front of the vehicle to the rear of the vehicle and allies a voltage to cause the gel to darken the mirror
 	**NATEF MLR TASK A6E1 INSPECT INTERIOR AND EXTERIOR LAMPS AND SOCKETS INCLUDING HEADLIGHTS AND AUXILIARY LIGHTS (FOG LIGHTS/DRIVING LIGHTS); REPLACE AS NEEDED..**
	44. **SLIDE 44 EXPLAIN FEEDBACK**
	45. **SLIDES 45-47 EXPLAIN LIGHTING SYSTEM DIAGNOSIS** 48. **SLIDES 48-53 EXPLAIN TAILLIGHT BULB REPLACEMENT** 54. **SLIDES 54-65 EXPLAIN HEADLIGHT AIMING**
	**SHOW VIDEO: DIAGNOSING TURN SIGNALS WWW.MYAUTOMOTIVELAB.COM** HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=DIAGNOSING%20TURN%20SIGNALS&CLIP=PANDC/CHET/2012/AUTOMOTIVE/STARTING_CHARGING_ELECT/A6T8.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/STARTING_CHARGING_ELECT/XML/A6T8.XML