# Automotive Technology 5th Edition
# Chapter 56 LIGHTING & SIGNALING CIRCUITS
## 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:<br>1. Describe how an exterior lighting systems works.<br>2. Read and interpret a bulb chart.<br>3. Discuss the operation of brake lights and turn signals.<br>4. Inspect, replace, and aim headlights and bulbs.<br>5. Explain adaptive front lighting and other lighting systems in an automobile.<br>6. Discuss troubleshooting procedures for lighting and signaling circuits. |
| **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 56: ATE5 Chapter Images**

| ICONS | Chapter 56 Lighting & Signaling Circuits |
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|  | 1. **SLIDE 1 Chapter 56 LIGHTING & SIGNALING CIRCUITS** |
|  | **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/**<br>**WEB SITE IS CONSTANTLY UPDATED**<br>**Videos** |
| | 2. **SLIDE 2 EXPLAIN Figure 56-1** Dual-filament (double-contact) bulbs contain both a low-intensity filament for taillights or parking lights and a high-intensity filament for brake lights and turn signals. Bulbs come in a variety of shapes and sizes. The numbers shown are the trade numbers.<br>3. **SLIDE 3 EXPLAIN Figure 56-2** 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: Have students discuss how a dual filament bulb works. What are advantages of a dual filament bulb versus single filament bulb?** |
|  | **DISCUSSION: Have students discuss benefits of using LEDs in place of conventional lamps. What are environmental impacts? What are cost benefits?** |
|  | 4. **SLIDE 4 EXPLAIN Figure 56-3** 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. |
|  | **DEMONSTRATION: Show examples of 3157, 3157NA, and 3157A bulbs, or similar bulbs, to help them distinguish difference between bulb suffixes** |

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|  | 5. **SLIDE 5 EXPLAIN Figure 56-4** Corrosion caused the two terminals of this dual-filament bulb to be electrically connected.<br>6. **SLIDE 6 EXPLAIN Figure 56-5** Often the best diagnosis is a thorough visual inspection. This bulb was found to be filled with water, which caused weird problems.<br>7. **SLIDE 7 EXPLAIN Figure 56-6** This single-filament bulb is being tested with a digital multimeter set to read resistance in ohms. The reading of 1.1 ohms is the resistance of the bulb when cold. As soon as current flows through the filament, the resistance increases about 10 times. It is the initial surge of current flowing through the 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: Have students build and measure the same circuit FROM DEMO on a TRAINER** |
|  | 8. **SLIDE 8 EXPLAIN Figure 56-7** Typical brake light and taillight circuit showing the brake switch and all of the related circuit components. |
|  | Hazard Lights (View) (Download)<br>Lights, Turn & Stop (View) (Download)<br>Rear Lights (View) (Download)<br>Stop Lights (View) (Download)<br>Turn Indicators (View) (Download) |

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| | 9. **SLIDE 9 EXPLAIN Figure 56-8** replacement LED taillight bulb is constructed of many small, individual light-emitting diodes<br>10. **SLIDE 10 EXPLAIN Figure 56-9** The 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.<br>11. **SLIDE 11 EXPLAIN Figure 56-10** When the stop lamps and turn signals share a common bulb filament, stop light current flows through the turn signal switch.<br>12. **SLIDE 12 EXPLAIN Figure 56-11** 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.<br>13. **SLIDE 13 EXPLAIN Figure 56-12** Two styles of two-prong flasher units.<br>14. **SLIDE 14 EXPLAIN Figure 56-13** 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. |
|  | **DEMONSTRATION: Show 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.** |
|  | **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.** |
|  | 15. **SLIDE 15 EXPLAIN Figure 56-14** 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 |
|  | **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** |

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|  | **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. |
|  | 16. **SLIDE 16 EXPLAIN Figure 56-15** 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 the switch.<br>17. **SLIDE 17 EXPLAIN Figure 56-16** A typical four-headlight system using sealed beam headlights.<br>18. **SLIDE 18 EXPLAIN Figure 56-17** typical composite headlamp assembly. The lens, housing, and bulb sockets are usually included as a complete assembly.<br>19. **SLIDE 19 EXPLAIN Figure 56-18** Handle a halogen bulb by base to prevent skin's oil from getting on glass |
|  | Courtesy Lights (View) (Download)<br>Headlight Circuit, Parking Lights (View) (Download)<br>Headlight Circuit, High Beam (View) (Download)<br>Headlight Circuit, Low Beam (View) (Download) |
|   | **DISCUSSION:** students discuss HALOGEN BULBS. Why should you never touch a halogen bulb with your fingers? |
|  | 20. **SLIDE 20 EXPLAIN Figure 56-19** igniter contains the ballast and transformer needed to provide high-voltage pulses to the arc tube bulb.<br>21. **SLIDE 21 EXPLAIN Figure 56-20** HID (xenon) headlights emit a whiter light than halogen headlights and 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? |

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|              | **HID headlights are also known as xenon lights.**<br><br>**DISCUSSION: Have students talk about operation of a transformer. Why is transformer needed in HID headlight system?**<br>**ON-VEHICLE NATEF TASK Identify system voltage and other precautions associated with HID headlights. (P-3) Page 171**<br><br>22. **SLIDE 22 EXPLAIN Figure 56-21** LED headlights usually require multiple units to provide the needed light as seen on this Lexus LS600h.<br><br>**DISCUSSION: Have the students talk about benefits of LED Headlights. How long do they last? What are their environmental benefits?**<br>**HANDS-ON TASK: Have students download Headlight Circuit for a lab vehicle & have a discussion on circuit**<br><br>23. **SLIDE 32 EXPLAIN Figure 56-22** Typical headlight aiming diagram as found in service information.<br>24. **SLIDE 24 EXPLAIN Figure 56-23** Many composite headlights have a built-in bubble level to make aiming easy and accurate.<br>**ON-VEHICLE NATEF TASK: Diagnose lighting concerns; determine necessary action (INCLUDES AIMING). (P-1) Page 170**<br><br>25. **SLIDE 25 EXPLAIN Figure 56-24** Adaptive front lighting systems rotate the low-beam headlight in the direction of travel.<br>26. **SLIDE 26 EXPLAIN Figure 56-25** 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.<br>27. **SLIDE 27 EXPLAIN Figure 56-26** Typical dash-mounted switch that allows the driver to disable the front lighting system. |

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|   | **DISCUSSION: Have students discuss operation of ADAPTIVE FRONT LIGHTING Systems (AFS). Which types of vehicles are equipped with AFS? How can a diagnostic scan tool be used to test the 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 students location of each component in system and which other modules and sensors in vehicle are used in conjunction with** |
|  | **28. SLIDE 28 EXPLAIN Figure 56-27** Typical daytime running light (DRL) circuit. Follow the arrows from the DRL module through both headlights. Notice that the left and right headlights are connected in series, resulting in increased resistance, less current flow, and dimmer than normal lighting. When the normal headlights are turned on, both headlights receive full battery voltage, with the left headlight grounding through the DRL module. |
|   | **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 electronically.** |
|  | **29. SLIDE 29 EXPLAIN Figure 56-28** 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. |
|   | **DEMONSTRATION: Build Rheostat or potentiometer circuit on a 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?** |

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|  | **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** |
|  | **30. SLIDE 30 EXPLAIN Figure 56-29** 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. |
|   | **DISCUSSION: talk about operation of photoresistors & photodiodes. How could these components be incorporated into automatic Headlight circuits?** |
|   | **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?** |
|  | **31. SLIDE 31 EXPLAIN Figure 56-30** 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. |
|  | **32. SLIDES 32-37 OPTIONAL TAILLIGHT BULB REPLACEMENT** |
|  | **38. SLIDES 38-49 OPTIONAL OPTICAL HEADLIGHT AIMING** |
|  | **Crossword Puzzle (Microsoft Word) (PDF)**<br>**Word Search Puzzle (Microsoft Word) (PDF)** |