
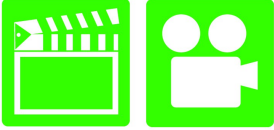




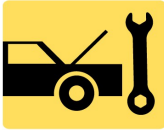











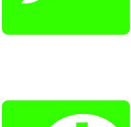




# Automotive Maintenance and Light Repair, 1<sup>ST</sup> Edition







## Chapter 31 CHARGING SYSTEM

### Opening Your Class

KEY ELEMENT	EXAMPLES
<b>Introduce Content</b>	This course or class covers <b>Automotive Maintenance and Light Repair</b> . It correlates material to task lists specified by ASE and NATEF.
<b>Motivate Learners</b>	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.
<b>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.</b>	Explain the chapter learning objectives to the students. <ul style="list-style-type: none"><li>⤵ Discuss the various methods to test the charging system.</li><li>⤵ Discuss the alternator output test.</li><li>⤵ Explain how to disassemble an alternator and test its component parts.</li><li>⤵ This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area “D” (Charging System Diagnosis and Repair).</li></ul>
<b>Establish the Mood or Climate</b>	Provide a <i>WELCOME</i> , Avoid put downs and bad jokes.
<b>Complete Essentials</b>	Restrooms, breaks, registration, tests, etc.
<b>Clarify and Establish Knowledge Base</b>	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	Ch31 CHARGING SYSTEM
   	<p><b>1. SLIDE 1 CH31 CHARGING SYSTEM</b></p> <p><b>2. SLIDES 2-3 EXPLAIN OBJECTIVES</b></p> <p><b>Check for ADDITIONAL VIDEOS &amp; ANIMATIONS @ <a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a> WEB SITE REGULARLY UPDATED</b></p> <p><b><u>Charging System</u></b></p> <p><b><u>Charging Circuit Volt Drop Ground Side</u></b></p> <p><b><u>Charging Circuit Volt Drop Power Side</u></b></p> <p><b>4. SLIDE 4 EXPLAIN PRINCIPLES OF ALTERNATOR OPERATION</b></p>
  <p><b>QUESTION</b></p>	<p><b>5. SLIDE 5 EXPLAIN Figure 31-1 typical alternator on a Chevrolet V-8 engine.</b></p> <p><b>6. SLIDE 6 EXPLAIN Figure 31-2 end frame toward the drive belt is called the drive-end housing and the rear section is called the slip-ring-end housing.</b></p>
	<p><b><u>DISCUSSION: HAVE STUDENTS TALK ABOUT FUNCTION OF GENERATOR, OR MOTOR, USED IN HYBRID VEHICLES. HOW CAN AN ALTERNATOR ALSO FUNCTION AS A MOTOR?</u></b></p> <p><b><u>ON-VEHICLE TASK: USE VOCABULARY SCAVENGER HUNT TASK SHEET TO IDENTIFY PARTS ON VEHICLE RELATED TO CHARGING SYSTEM THAT CORRESPOND WITH LETTER ON THE TASK SHEET &amp; DESCRIBE PURPOSE OF EACH PART.</u></b></p>
	<p><b><u>HANDS-ON TASK: HAVE THE STUDENTS LOCATE THE STICKER OR STAMP THAT SHOWS THE ALTERNATOR AMPERAGE RATING ON SEVERAL DIFFERENT ALTERNATORS.</u></b></p>
  <p><b>QUESTION</b></p>	<p><b><u>DISCUSSION: DISCUSS THE PROS AND CONS OF USING AN OAP OR OAD PULLEY. WHY ISN'T AN OAP OR OAD BEING USED ON EVERY VEHICLE?</u></b></p>
	<p><b><u>DEMONSTRATION: SHOW EXAMPLES OF ROTOR &amp; STATOR WINDINGS. HAVE THEM HELP YOU IDENTIFY EACH COMPONENT &amp; EXPLAIN PURPOSE.</u></b></p>

ICONS	Ch31 CHARGING SYSTEM
 <p>QUESTION</p>	<p><b>DISCUSSION:</b> HAVE THE STUDENTS DISCUSS HOW DIODES FUNCTION AS A VALVE. WHAT IS THE DIFFERENCE BETWEEN AN NPN AND A PNP?</p>
 <p>QUESTION</p>	<p><b>DISCUSSION:</b> DRAW A PATTERN OF 3 PHASE VOLTAGE. SHOW WHAT HAPPENS TO GRAPH WHEN DIODES ARE USED TO RECTIFY THE CURRENT.</p>
	<p><b>HANDS-ON TASK:</b> HAVE STUDENTS DRAW A SCHEMATIC OF WYE CONNECTED STATOR</p>
 <p>QUESTION</p>	<p><b>DISCUSSION:</b> HAVE STUDENTS DISCUSS THE DIFFERENCE BETWEEN DELTA CONNECTED STATORS AND WYE CONNECTED STATORS. WHAT ARE ADVANTAGES OF EACH TYPE? WHICH TYPE HAS A HIGHER OUTPUT?</p>
 <p>QUESTION</p>	<p><b>DISCUSSION:</b> HAVE STUDENTS TALK ABOUT THE THREE MAIN FACTORS THAT AFFECT THE OUTPUT OF AN ALTERNATOR. WHY IT IS IMPORTANT TO CHECK THE OUTPUT OF AN ALTERNATOR AT OFF-IDLE ENGINE SPEED?</p>
 <p>QUESTION</p>	<p><b>DISCUSSION:</b> HAVE THE STUDENTS DISCUSS WHY VOLTAGE REGULATORS ARE A NECESSARY PART OF THE CHARGING SYSTEM. HOW IS THE FIELD CURRENT CONTROLLED? HAVE THE STUDENTS TALK ABOUT BATTERY CONDITION AND CHARGING VOLTAGE. WHY CAN IT BE SAID THAT THE BATTERY IS THE TRUE VOLTAGE REGULATOR?</p>
 <p>QUESTION</p>	<p><b>DISCUSSION:</b> HAVE THE STUDENTS TALK ABOUT THE EPM SYSTEM USED ON GM VEHICLES. WHAT ARE SIX DIFFERENT MODES OF OPERATION?</p>
 <p>QUESTION</p>	<p><b>DEMONSTRATION:</b> SHOW STUDENTS HOW TO PERFORM A QUICK CHECK ON A CHARGING SYSTEM BY CHECKING THE STATIC AND DYNAMIC VOLTAGES WITH A DMM. ALSO, DEMONSTRATE HOW TO CHECK THE SUPPLIED VOLTAGE AT THE ALTERNATOR CONNECTOR. ENGINE OFF, SHOULD BE 12.6 VOLTS. ENGINE RUNNING AT 1500 RPM ABOUT 14.5 VOLTS.</p>
	
	<p><b>Charging Circuit Volt Drop Ground Side</b> <b>Charging Circuit Volt Drop Power Side</b></p>

ICONS	Ch31 CHARGING SYSTEM
	<p>7. SLIDE 7 EXPLAIN CHARGING SYSTEM TESTING &amp; SERVICE</p> <p>8. SLIDE 8 EXPLAIN Figure 31-3 digital multimeter should be set to read DC volts, with the red lead connected to the positive (+) battery terminal and the black meter lead connected to negative (-) battery terminal.</p> <p>9. SLIDE 9 EXPLAIN Figure 31-4 scan tool can be used to diagnose charging system problems.</p> <p>10. SLIDE 10 EXPLAIN FIGURE 31-5 Before replacing an alternator, the wise technician checks that battery voltage is present at the output and battery voltage sense terminals. If not, then there is a fault in the wiring.</p>
	<p><b>DEMONSTRATION: SHOW SCHEMATIC DIAGRAMS FROM SEVERAL DIFFERENT VEHICLES AND POINT OUT THE CIRCUIT PROTECTION DEVICES TO THE STUDENTS. TRY TO FIND EXAMPLES OF SYSTEMS USING MAXI FUSES, FUSIBLE LINKS, AND MEGA FUSES. SHOW HOW TO DETERMINE LOCATION OF DEVICES.</b></p>
	<p>11. SLIDE 11 EXPLAIN DRIVE BELT INSPECTION/ADJUSTMENT</p> <p>12. SLIDE 12 EXPLAIN Figure 31-6 This accessory drive belt is worn &amp; requires replacement. Newer belts are made from ethylene propylene diene monomer (EPDM). This rubber does not crack like older belts &amp; may not show wear even though ribs do wear &amp; can cause slippage</p> <p>13. SLIDE 13 EXPLAIN CHART 31-1</p>
	<p><b>DEMONSTRATION: SHOW THE STUDENTS HOW TO USE A STETHOSCOPE TO ISOLATE A BELT/BEARING NOISE CONCERN</b></p>
 	<p><b>DEMONSTRATION: SHOW &amp; DISCUSS INFORMATION PROVIDED BY SERVICE BULLETINS AND PRACTICE OF CHECKING FOR SERVICE BULLETINS AS PART OF DIAGNOSING CHARGING SYSTEM CONCERNS. POINT OUT THAT SERVICE BULLETINS CAN CONTAIN INFORMATION ABOUT PROBLEMS SUCH AS PATTERN FAILURES WITH REGARD TO WIRE HARNESS ROUTING AND CONTROL MODULE CALIBRATIONS.</b></p>

## ICONS

## Ch31 CHARGING SYSTEM



14. **SLIDE 14 EXPLAIN Figure 31-7** Check service information for the exact marks where the tensioner should be located for proper belt tension.

15. **SLIDE 15 EXPLAIN FIGURE 31-8** This overrunning alternator dampener (OAD) is longer than an overrunning alternator pulley (OAP) because it contains a dampener spring as well as a one-way clutch. Be sure to check that it locks in one direction.

16. **SLIDE 16 EXPLAIN: AC RIPPLE VOLTAGE CHECK**

17. **SLIDE 17 EXPLAIN Figure 31-9** Testing AC ripple at the output terminal of the alternator is more accurate than testing at the battery due to the resistance of wiring between the alternator and battery. The reading shown on meter, set to AC volts, is only 78 mV (0.078 V), far below what reading would be if a diode were defective.

18. **SLIDE 18 EXPLAIN: TESTING AC RIPPLE CURRENT**



### **SHOW VIDEO: TESTING CHARGING SYSTEM OUTPUT VIDEO:**

[HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET\\_MYLIBS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=TESTING%20CHARGING%20SYSTEM%20OUTPUT&CLIP=PANDC/CHET/2012/AUTOMOTIVE/STARTING\\_CHARGING\\_ELECT/A6T6.MOV&CAPTION=CHET/CHET\\_MYLIBS/AKAMAI/2012/AUTOMOTIVE/STARTING\\_CHARGING\\_ELECT/XML/A6T6.XML](http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=testing%20charging%20system%20output&clip=pandc/chet/2012/automotive/starting_charging_elect/a6t6.mov&caption=chet/chet_mylibs/akamai/2012/automotive/starting_charging_elect/xml/a6t6.xml)



19. **SLIDE 19 EXPLAIN FIGURE 31-10** Charging system voltage can be easily checked at the lighter plug by connecting a lighter plug to the voltmeter through a double banana plug.

20. **SLIDE 20 EXPLAIN Figure 31-11** mini clamp-on meter can be used to measure alternator output as shown here (105.2 Amp). Then meter can be used to check AC current ripple by selecting AC Amps on the rotary dial. AC ripple current should be less than 10% of the DC current output.



**DEMONSTRATION: DEMONSTRATE WAYS TO DO AN ALTERNATOR OUTPUT TEST. SHOW STUDENTS HOW TO PERFORM CARBON PILE TEST WITH AVR OR EQUIVALENT TOOL. HAVE STUDENTS INTERPRET RESULTS BY COMPARING THEM TO OEM SPECIFICATIONS.**



### **SHOW VIDEO: BENCH TESTING ALTERNATOR COMPONENTS VIDEO**

[HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET\\_MYLIBS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=BENCH%20TESTING%20ALTERNATOR%20COMPONENTS&CLIP=PANDC/CHET/2012/AUTOMOTIVE/STARTING\\_CHARGING\\_ELECT/A6T7.MO](http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=bench%20testing%20alternator%20components&clip=pandc/chet/2012/automotive/starting_charging_elect/a6t7.mo)

## ICONS

## Ch31 CHARGING SYSTEM

V&CAPTION=CHET/CHET\_MYLABS/AKAMA1/2012/AUTOMOTIVE/STARTING\_CHARGING\_ELECT/XMLE/A6T7.XML



21. SLIDE 21: EXPLAIN CHARGING SYSTEM VOLTAGE DROP TESTING

22. SLIDE 22 EXPLAIN Figure 31-12 Voltmeter hookup to test the voltage drop of the charging circuit.

23. SLIDE 23 EXPLAIN: ALTERNATOR OUTPUT TEST

24. SLIDE 24 EXPLAIN Figure 31-13 typical tester used to test batteries as well as the cranking and charging system. Always follow the operating instructions



**HANDS-ON TASK: HAVE STUDENTS LOCATE AMP RATING OF ALTERNATORS ON SEVERAL DIFFERENT VEHICLES. HAVE THEM REPORT WHERE INFORMATION WAS LOCATED & WHAT RATINGS WERE.**



**DEMONSTRATION: DEMONSTRATE HOW TO PROPERLY REMOVE AN ALTERNATOR USING OEM SERVICE PROCEDURES. HAVE THE STUDENTS LOOK UP THE LABOR TIME FOR THE ALTERNATOR R&R OPERATION FOR SEVERAL DIFFERENT VEHICLES AND REPORT THEIR FINDINGS TO CLASS.**



25. SLIDES 25-26 EXPLAIN Alternator Removal

27. SLIDE 27 EXPLAIN FIGURE 31-14 Replacing an alternator is not always as easy as it is from a Buick with a 3800 V-6, where the alternator is easy to access. Many alternators are difficult to access, and require the removal of other components.

28. SLIDES 28-30 EXPLAIN: ALTERNATOR INSTALLATION







**DISCUSSION: HAVE THE STUDENTS DISCUSS THE IMPORTANCE OF CHECKING THE WIRE HARNESS ROUTING BEFORE REMOVING THE OLD ALTERNATOR. WHAT COULD RESULT FROM ROUTING THE WIRE HARNESS INCORRECTLY?**

**NATEF MLR TASK A6D1 PERFORM CHARGING SYSTEM OUTPUT TEST; DETERMINE NECESSARY ACTION.**



**NATEF MLR TASK A6D2 INSPECT, ADJUST, OR REPLACE GENERATOR (ALTERNATOR) DRIVE BELTS; CHECK PULLEYS AND TENSIONERS FOR WEAR; CHECK PULLEY AND BELT ALIGNMENT.**

ICONS	Ch31 CHARGING SYSTEM
 	<p><b><u>NATEF MLR TASK A6D3 REMOVE, INSPECT, AND RE-INSTALL GENERATOR (ALTERNATOR).</u></b></p>
 	<p><b><u>NATEF MLR TASK A6D4 PERFORM CHARGING CIRCUIT VOLTAGE DROP TESTS; DETERMINE NECESSARY ACTION.</u></b></p>
	<p><b>32. SLIDE 32 EXPLAIN: TESTING RECTIFIER</b></p> <p><b>33. SLIDE 33 EXPLAIN Figure 55-19 typical rectifier bridge contains all 6 diodes in one replaceable assembly</b></p> <p><b>34. SLIDE 34 EXPLAIN: REASSEMBLING ALTERNATOR</b></p> <p><b>35. SLIDES 35-37 EXPLAIN: ALTERNATOR INSTALLATION</b></p> <p><b>38. SLIDE 38 EXPLAIN SUMMARY</b></p>