Automotive Technology 6th Edition
Chapter 55 Charging System Diagnosis & Service
Opening Your Class

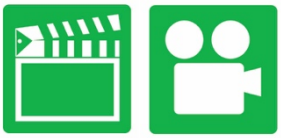
KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features 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 various methods to test the charging system. 2. Describe how to inspect and adjust the drive belts. 3. Discuss alternator output test and minimum required output. 4. Explain how to remove, disassemble, reassemble, and install an alternator and test its component parts. 5. Describe remanufactured alternators. 6. This chapter will help prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "D" (Charging 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: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 55 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	CH 55 Charging Diagnosis
     	**1. TITLE SLIDE 1 CHARGING SYSTEM DIAGNOSIS AND SERVICE** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF** **Videos** 2. **SLIDE 2 EXPLAIN Figure 55-1** 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 the negative (-) battery terminal. 3. **SLIDE 3 EXPLAIN Figure 55-2** A scan tool can be used to diagnose charging system problems. **DISCUSS FREQUENTLY ASKED QUESTION:** ***What Is a Full-Fielding Test?*** **Full fielding is a procedure used on older non-computerized vehicles for bypassing the voltage regulator that could be used to determine if alternator is capable of producing its designed output. This test is no longer performed for following reasons.** • **Voltage regulator is built into alternator, requiring that entire assembly be replaced even if just regulator is defective.** • **When regulator is bypassed, alternator can produce high voltage (over 100 volts in some cases), which could damage all of the electronic circuits. Always follow OEM testing procedures.**

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	**EXPLAIN TECH TIP:** ***Use a Test Light to Check for a Defective Fusible Link:*** **Most alternators use a fusible link or mega fuse between the output terminal and positive (+) terminal of battery. If this fusible link or fuse is defective (blown), then charging system does not operate at all. Many alternators have been replaced repeatedly because of a blown fusible link that was not discovered until later. A quick and easy test to check if the fusible link is okay is to touch a test light to output terminal. With the other end of test light attached to a good ground, fusible link or mega fuse is okay if light comes on. This test confirms that circuit between alternator and battery has continuity. • SEE FIGURE 55–3.**
	4. **SLIDE 4 EXPLAIN FIGURE 55-3** Before replacing an alternator, the wise technician checks that battery voltage is present at output and battery voltage sense terminals
	**DEMONSTRATION: Show schematic diagrams from several different vehicles and point out circuit protection devices to the students. Try to find examples of systems using maxi fuses, fusible links, and mega fuses. Show the students how to determine the location of the devices.**
	5. **SLIDE 5 EXPLAIN Figure 55-4** (a) accessory drive belt is worn and requires replacement. Newer belts are made from ethylene propylene diene monomer (EPDM). This rubber does not crack like older belts & may not show wear even though the ribs do wear & can cause slippage. **FIGURE 55–4 (b)** ***A belt wear gauge being used to check a belt. It should fit tightly but if it is able to be moved side to side, then the belt is worn and should be replaced.***
	**DEMONSTRATION: Show the students how to use a stethoscope to isolate a belt/bearing noise concern. Figure 55-4**
 	**DEMONSTRATION: Show & 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**

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    	**such as pattern failures with regard to wire harness routing and control module calibrations.** **DISCUSS CHART 55-1 Typical belt tension for various widths of belts. Tension is force needed to depress belt as displayed on a belt tension gauge.** 6. **SLIDE 6 EXPLAIN Figure 55-5** Check service information for the exact marks where the tensioner should be located for proper belt tension. 7. **SLIDE 7 EXPLAIN FIGURE 55–6** 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. 8. **SLIDE 8 EXPLAIN FIGURE 55–7** special tool is needed to remove and install overrunning alternator pulleys or dampeners. 9. **SLIDE 9 EXPLAIN Figure 55-8** Testing AC ripple at the output terminal of the alternator is more accurate than testing at the battery due to the resistance of the wiring between the alternator and the battery. The reading shown on the meter, set to AC volts, is only 78 mV (0.078 V), far below what the reading would be if a diode were defective. **EXPLAIN TECH TIP: *The Lighter Plug Trick*** **Battery voltage measurements can be read through lighter socket. Simply construct a test tool using a lighter plug at one end of a length of two-conductor wire and other end connected to a double banana plug. Double banana plug fits most meters in common (COM) terminal and volt terminal of meter. This is handy to use while road testing vehicle under real-life conditions. Both DC voltage and AC ripple voltage can be measured. • SEE FIGURE 55–9.** 10. **SLIDE 10 EXPLAIN FIGURE 55–9** Charging system voltage can be easily checked at the lighter plug by connecting a lighter plug to voltmeter through a double banana plug. **Measure AC Ripple (View) (Download)**

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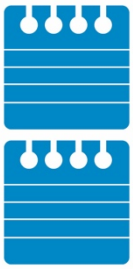	**Many charging systems are computer controlled, so some charging system problems can be fixed by recalibrating control module** **Scan tool snap shot function or vehicle data recorder is good way to monitor charging system operation on test drive. Scan tool, digital storage oscilloscope, or vehicle data recorder can capture glitches that might be difficult to find with a DMM** 11. **SLIDE 11 EXPLAIN FIGURE 55-10** 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 rotary dial. AC ripple current should be < 10% of 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.**
	**ASEEDUCATION Task Sheet: Perform charging system output test; determine necessary action.**
	**Task Sheet: Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions. (P-1)**
	**ASEEDUCATION Task Sheet: Inspect, adjust, or replace generator (alternator) drive belts, pulleys, and tensioners; check pulley and belt alignment Remove, inspect, and install generator (alternator)**
	**ASEEDUCATION Task Sheet Perform charging circuit voltage drop tests; determine necessary action.**
	
	12. **SLIDE 12 EXPLAIN Figure 55-11** Voltmeter hookup to test the voltage drop of the charging circuit.
	13. **SLIDE 13 EXPLAIN Figure 55-12** typical tester used to test batteries as well as the cranking and charging system. Always follow the operating instructions.

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	Charging Circuit Volt Drop Ground Side (View) (Download) Charging Circuit Volt Drop Power Side (View) (Download)
	**HANDS-ON TASK:** **Have students locate amp rating of alternators on several different vehicles. Have them report where information was located and what ratings were.**
	**EXPLAIN TECH TIP:** ***Use a Fused Jumper Wire as a Diagnostic Tool:*** **When diagnosing an alternator charging problem, try using a fused jumper wire to connect the positive and negative terminals of alternator directly to the positive and negative terminals of battery. If a definite improvement is noticed, the problem is in the wiring of the vehicle. High resistance, due to corroded connections or loose grounds, can cause low alternator output, repeated regulator failures, slow cranking, and discharged batteries. A voltage drop test of the charging system can also be used to locate excessive resistance (high voltage drop) in the charging circuit, but using a fused jumper wire is often faster and easier.**
	14. **SLIDE 14 EXPLAIN Figure 55-13** The best place to install a charging system tester amp probe is around the alternator output terminal wire, as shown.
	**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.**
	**EXPLAIN TECH TIP:** ***Bigger Is Not Always Better*** **Many technicians are asked to install a higher output alternator to allow use of emergency equipment or other high amperage equipment. Although many higher output units can be physically installed, it is important *not to forget to upgrade the wiring* and the fusible link(s) in alternator circuit. Failure to upgrade the wiring could lead to overheating. The usual failure locations are at junctions or electrical connectors.**

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 	**15. SLIDE 15 EXPLAIN FIGURE 55-14** 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**.** **DISCUSS FREQUENTLY ASKED QUESTION: *What Is a "Clock Position"?* Most alternators of a particular manufacturer can be used on a variety of vehicles, which may require wiring connections placed in various locations. For example, a Chevrolet and a Buick alternator may be identical except for position of rear section containing electrical connections. The four through bolts that hold two halves together are equally spaced; therefore, rear alternator housing can be installed in any one of four positions to match the wiring needs of various models. Always check clock position of original and be sure that it matches replacement. • SEE FIGURE 55–15.**
	**16. SLIDE 16 EXPLAIN FIGURE 55–15** Explanation of clock positions. Because the four through bolts are equally spaced, it is possible for an alternator to be installed in one of four different clock positions. The connector position is determined by viewing the alternator from the diode end with the threaded adjusting lug in the up or 12 o'clock position. Select the 3 o'clock, 6 o'clock, 9 o'clock, or 12 o'clock position to match the unit being replaced. **17. SLIDE 17 EXPLAIN FIGURE 55–16** Testing an alternator rotor using an ohmmeter.
	**EXPLAIN TECH TIP: *The Sniff Test:* When checking for the root cause of an alternator failure, one test that a technician could do is to sniff (smell) alternator. If the alternator smells like a dead rat (rancid smell), the stator windings have been overheated by trying to charge a discharged or defective battery. If the battery voltage is continuously low, the voltage regulator continues supplying full-field current to the alternator. The voltage regulator is designed to cycle on and off to**

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	maintain a narrow charging system voltage range. If the battery voltage is continually below cutoff point of voltage regulator, alternator is continually producing current in stator windings. This constant charging can often overheat the stator and burn the insulating varnish covering the stator windings. If alternator fails the sniff test, technician should replace stator and other alternator components that are found to be defective and replace or recharge and test the battery.
	**DISCUSSION: Discuss importance of checking wire harness routing before removing old alternator. What could result from routing the wire harness incorrectly?**
	18. **SLIDE 18 EXPLAIN FIGURE 55-17** If the ohmmeter reads infinity between any two of the three stator windings, the stator is open and, therefore, defective. The ohmmeter should read infinity between any stator lead and the steel laminations. If the reading is less than infinity, the stator is grounded. Stator windings cannot be tested if shorted because normal resistance is very low. 19. **SLIDE 19 EXPLAIN FIGURE 55–18** A diode trio can be tested using an analog (needle-type) ohmmeter or a digital meter set to "diode check".
	**Ohmmeter Test, Alternator Rotor (View) (Download)** **Ohmmeter Test, Alternator Stator (View) (Download)**
	20. **SLIDE 20 EXPLAIN FIGURE 55–19** A typical rectifier bridge that contains all six diodes in one replaceable assembly.
	21. **SLIDE 21 EXPLAIN FIGURE 55-20** Brush holder assembly with new brushes installed. Holes in brushes are used to hold brushes up in holder when it is installed. After rotor has been installed, retaining pin is removed which allows brushes to contact slip rings
	**DISCUSS FREQUENTLY ASKED QUESTION: *What is Considered to be Normal Rotor Slip Ring Wear?* Many alternators can be restored to useful service by replacing only wear item that they have, which are the brushes. The**

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 	**brushes ride on the surface of the slip rings of rotor and these need to be round with a surface that is free from grooves that would reduce contact surface area where brushes ride. Slight wear or discoloration is usually normal and can be cleaned using fine sandpaper. The slip rings also need to be perfectly round. • SEE FIGURE 55–21.** 22. **SLIDE 22 EXPLAIN FIGURE 55–21** An example of a rotor assembly that, if tested to be within specification, is suitable to be reinstalled after the slip rings have been cleaned. **DISCUSS CASE STUDY: The Two-Minute Alternator Repair: A Chevrolet pickup truck was brought to a shop for routine service. The customer stated that battery required a jump start after a weekend of sitting. The technician tested the battery and the charging system voltage using a small handheld digital multimeter. The battery voltage was 12.4 volts (about 75% charged), but charging voltage was also 12.4 volts at 2,000 RPM. Because normal charging voltage should be 13.5 to 15 volts, it was obvious that the charging system was not operating correctly. The technician checked the dash and found that the "charge" light was not on. Before removing the alternator for service, the technician checked the wiring connection on the alternator. When the connector was removed, it was discovered to be rusty. After the contacts were cleaned, the charging system was restored to normal operation. The technician had learned that the simple things should always be checked first before tearing into a big or expensive repair.** **Summary:**

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	• Complaint—Customer stated that battery had to be jump-started after sitting for a weekend. • Cause—Tests confirmed that alternator was not charging and a rusty connection at alternator was found during a visual inspection. • • Correction—Cleaning electrical terminals at alternator restored proper operation of charging system. 23. SLIDES 23-58 OPTIONAL COVERAGE of ALTERNATOR OVERHAUL