

Automotive Electrical & Engine Performance 8/E











Chapter 18 Cranking System Diagnosis & Service





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.	<p>Explain the chapter learning objectives to the students.</p> <ol style="list-style-type: none"> 1. Discuss how to perform a voltage drop test on the cranking circuit. 2. Perform control circuit testing and starter amperage test, and determine necessary action. 3. Explain starter motor service and bench testing. <p style="color: blue;">This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area “C” (Starting System Diagnosis and Repair).</p>
Establish the Mood or Climate	Provide a <i>WELCOME</i> , 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






DOWNLOAD Chapter 18 Chapter Images: From
http://www.jameshalderman.com/books_a8.html#anchor2









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        	<p>1. SLIDE 1 CH18 CRANKING SYSTEM DIAGNOSIS & SERVICE</p> <p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED</p> <p><u>Videos</u></p> <p>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.H TML#ANCHOR2 DOWNLOAD CROSSWORD PUZZLE (MICROSOFT WORD) (PDF) WORD SEARCH PUZZLE (MICROSOFT WORD) (PDF) <u>Starter Circuit Voltage Drop Tests</u> <u>Starter Circuit Voltage Drop Tests 2</u></p> <p>Starter Circuit (View) (Download) Starter Circuit Neutral Safety Switch (View) (Download) DC Motor (View) (Download)</p>
	<p>2. SLIDE 2 EXPLAIN Figure 18-1</p> <p><u>EXPLAIN TECH TIP: Voltage Drop Is Resistance</u> Many technicians have asked, "Why measure voltage drop when resistance can be easily measured using an ohmmeter?" Think of a battery cable with all strands of cable broken, except for one strand. If an ohmmeter were used to measure the resistance of cable, reading would be very low, probably less than 1 ohm. However, cable is not capable of conducting amount of current necessary to crank engine. In less severe cases, several strands can be broken, thereby affecting operation of starter motor. Although resistance of battery cable does not indicate an increase, restriction to</p>



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   	<p>current flow causes heat and a drop of voltage available at the starter. Because resistance is not effective until current flows, measuring voltage drop (differences in voltage between two points) is most accurate method of determining the true resistance in a circuit. How much is too much? According to Bosch Corporation, all electrical circuits should have a maximum of 3% loss of the circuit voltage to resistance. Therefore, in a 12-volt circuit, maximum loss of voltage in cables and connections should be 0.36 volt ($12 * 0.03 = 0.36$ volt). The remaining 97% of the circuit voltage (11.64 volts) is available to operate electrical device (load). Just remember:</p> <ul style="list-style-type: none"> • Low-voltage drop = Low resistance • High-voltage drop = High resistance <p>DISCUSSION: Discuss how battery condition is critical to the function of all electrical and electronic systems in the vehicle. After verifying a customer's concern about a fault in the cranking system, what should be checked?</p> <p>DEMONSTRATION: Show how to use service information to look up starting system control circuit. Have them help you identify different components of starting system control circuit.</p> <p>HANDS-ON TASK: Have the students print out a schematic of the starter circuit for vehicle they will be working on and point out the test points. Discuss with them that starter circuits and components can vary greatly from vehicle to vehicle, and from OEM to OEM.</p> <ol style="list-style-type: none"> 3. SLIDE 3 EXPLAIN Figure 18-2 Voltmeter hookups for voltage drop testing of a solenoid-type cranking circuit. 4. SLIDE 4 EXPLAIN Figure 18-3 Voltmeter hookups for voltage drop testing of a Ford cranking circuit. 5. SLIDE 5 EXPLAIN Figure 18-4 To test the voltage drop of the battery cable connection, place one voltmeter lead on the battery terminal and the other voltmeter lead on the cable end and crank the engine. The voltmeter will read the difference in voltage between the two leads, which should not exceed 0.20 volt (200 mV).

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	<p>EXPLAIN TECH TIP: A Warm Cable Equals High Resistance: If a cable or connection is warm to touch, there is electrical resistance in cable or connection. The resistance changes electrical energy into heat energy. Therefore, if a voltmeter is not available, touch battery cables and connections while cranking engine. If any cable or connection is hot to touch, it should be cleaned or replaced.</p>
 	<p>DEMONSTRATION: Show students how to perform a voltage drop test on starter motor circuit of a live vehicle. Emphasize disabling the vehicle. Also, emphasize how not to accidentally turn wrenches, jewelry, & other metal objects into arc welders.</p>
	<p>EXPLAIN TECH TIP: Watch the Dome Light</p>
	<p>When diagnosing any starter-related problem, open door of vehicle and observe the brightness of dome or interior light(s). The brightness of any electrical lamp is proportional to voltage of the battery. Normal operation of starter results in a slight dimming of dome light. If light remains bright, problem is usually an open in control circuit.</p> <p>If light goes out or almost goes out, there could be a problem with following:</p> <ul style="list-style-type: none"> • Shorted or grounded armature of field coils inside starter • Loose or corroded battery connections or cables • Weak or discharged battery
	<p>DEMONSTRATION: Use a jump box & remote start switch to set up a starter on a bench. Place alligator clips on ends of DMM leads to perform a voltage drop test on the starter control circuit. Use a bugged wire with a spliced-in resistor to show what unwanted resistance in the signal side of the circuit can do to overall circuit function.</p>
	<p>6. SLIDE 6 EXPLAIN FIGURE 18–5 A starter amperage tester uses an amp probe around the positive or negative battery cables.</p>

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      	<p>7. SLIDES 7 EXPLAIN FIGURE 18–6 The starter is located under the intake manifold on this Cadillac Northstar engine.</p> <p>DISCUSS CASE STUDY: <i>Case of the No-Crank Camaro:</i> Camaro SS equipped with a 6.2 liter V-8 and six speed manual transmission had the car towed to a shop for a no crank, no start condition. Technician used a scan tool and was able to retrieve a stored diagnostic trouble code (DTC) P0807. This code indicated a fault with clutch pedal position (CPP) sensor. The clutch pedal position sensor was removed and it was found to be internally shorted. A new sensor was installed and the technician performed a relearn procedure as specified in service information. The car was then able to crank and start and the verified that no codes were present.</p> <p>Summary:</p> <ul style="list-style-type: none"> • Complaint—customer stated the engine would not cranks or start. • Cause—shorted clutch pedal position (CPP) sensor. • Correction—clutch pedal position sensor was repalce4d a relearn procedure was performed. <p>DISCUSSION: Have the students talk about the use of noninvasive test procedures; for instance, using a scan tool to check for proper starter operation by commanding the starter relay on and off. How can noninvasive test procedures save time and prevent unnecessary damage to wiring and components?</p> <p>DEMONSTRATION: Show Scan Tool Diagnosis process from the above discussion.</p> <p>DISCUSSION: Discuss ways current can be measured in a circuit, such as using a DMM in series set on amps, using Ohm’s law to calculate current</p>

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    	<p>based on voltage & resistance, or measuring magnetic field surrounding a circuit by using an inductive pickup. When should each type of measurement be used?</p> <ol style="list-style-type: none"> SLIDE 8 EXPLAIN Figure 18-7 An exploded view of a typical solenoid-operated starter. SLIDE 9 EXPLAIN Figure 18-8 GM solenoid ohmmeter check. The reading between 1 and 3 (S terminal and ground) should be 0.4 to 0.6 ohm (hold-in winding). The reading between 1 and 2 (S terminal and M terminal) should be 0.2 to 0.4 ohm (pull-in winding). SLIDE 10 EXPLAIN Figure 18-9 Measuring an armature shaft for runout using dial indicator & V-blocks. SLIDE 11 EXPLAIN Figure 18-10 Replacement starter brushes should be installed so the beveled edge matches the rotation of the commutator. <p><u>DEMONSTRATION:</u> Show the students how to properly bench-test a starter. Emphasize that the remote starter cables should not smoke during this test.</p> <p><u>HANDS-ON TASK:</u> Have students bench test a starter before and after taking it apart to encourage them to pay attention and be careful during the service procedure.</p> <ol style="list-style-type: none"> SLIDE 12 EXPLAIN Figure 18-11 A shim (or half shim) may be needed to provide the proper clearance between the flywheel teeth of the engine & pinion teeth. <p><u>EXPLAIN TECH TIP:</u> Reuse Drive-End Housing to Be Sure: Most GM starter motors use a pad mount and attach to engine with bolts through the drive-end (nose) housing. Many times when a starter is replaced on a GM vehicle, starter makes noise because of improper starter pinion-to-engine flywheel ring gear clearance. Instead of spending a lot of time shimming new starter, simply remove drive-end housing from original starter and install it on replacement starter. Service bushing in the drive-end housing, if needed. Because original starter did not produce excessive gear engagement noise, the replacement starter is also okay. Reuse</p>

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	<p>any shims that were used with the original starter. This is preferable to removing and reinstalling the replacement starter several times until the proper clearance is determined.</p>
	<p>13. SLIDES 13-94 OPTIONAL STARTER OVERHAUL</p>
	<p>ASE EDUCATION TASK C4: REMOVE AND INSTALL STARTER IN A VEHICLE</p>
	<p>ASE EDUCATION TASK C1. PERFORM STARTER CURRENT DRAW TESTS; DETERMINE NEEDED ACTION</p>
	<p>ASE EDUCATION TASK C2. PERFORM STARTER CIRCUIT VOLTAGE DROP TESTS; DETERMINE NEEDED ACTION.</p>
	<p>ASE EDUCATION TASK C3. INSPECT AND TEST STARTER RELAYS AND SOLENOIDS; DETERMINE NEEDED ACTION.</p>
	<p>ASE EDUCATION TASK C5. INSPECT AND TEST SWITCHES, CONNECTORS, AND WIRES OF STARTER CONTROL CIRCUITS; DETERMINE NEEDED ACTION.</p>
	

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 	ASE EDUCATION TASK C6 DIFFERENTIATE BETWEEN ELECTRICAL AND ENGINE MECHANICAL PROBLEMS THAT CAUSE SLOW-CRANK OR NO-CRANK CONDITION