

Automotive Technology 6th Edition

Chapter 53 Cranking 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.	<p>Explain learning objectives to students as listed:</p> <ol style="list-style-type: none"> 1. Explain the procedure to troubleshoot a starting system problem. 2. Discuss how to perform a voltage drop test on the cranking circuit. 3. Perform control circuit testing and starter amperage test, and determine needed action. 4. Describe the procedure to remove a starter motor. 5. Explain starter motor service and bench testing. 6. Describe the procedure to install a starter motor. 7. Describe how to ensure proper clearance between the starter pinion and the engine flywheel. 8. This chapter will help prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "C" (Battery and Starting Systems 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 53 Chapter Images: From http://www.jameshalderman.com/automotive_principles.html

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

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1. SLIDE 1 CRANKING SYSTEM DIAGNOSIS & SERVICE

Check for **ADDITIONAL VIDEOS & ANIMATIONS**
@ <http://www.jameshalderman.com/>
WEB SITE IS CONSTANTLY UPDATED

http://www.jameshalderman.com/automotive_principles.html
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Crossword Puzzle (Microsoft Word) (PDF)

Word Search Puzzle (Microsoft Word) (PDF)

Videos

[Starter Circuit \(View\) \(Download\)](#)

[Starter Circuit Neutral Safety Switch \(View\) \(Download\)](#)

[DC Motor \(View\) \(Download\)](#)

10. SLIDE 10 **EXPLAIN** Figure 53-1

EXPLAIN TECH TIP: Voltage Drop Is Resistance

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 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

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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:

- **Low-voltage drop = Low resistance**
- **High-voltage drop = High resistance**

DISCUSS FREQUENTLY ASKED QUESTION:

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?

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.

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.

11. SLIDE 11 HEADER: VOLTAGE DROP TESTING

12. SLIDES 12-17 READ & EXPLAIN TEXT

18. SLIDE 18 **EXPLAIN** Figure 53-2 Voltmeter hookups for voltage drop testing of a solenoid-type cranking circuit.

19. SLIDE 19 **EXPLAIN** Figure 53-3 Voltmeter hookups for voltage drop testing of a Ford cranking circuit.

20. SLIDE 20 **EXPLAIN** Figure 53-4 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).

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

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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.

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.

EXPLAIN TECH TIP: *Watch the Dome Light*

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.

If light goes out or almost goes out, there could be a problem with following:

- **Shorted or grounded armature of field coils inside starter**
- **Loose or corroded battery connections or cables**
- **Weak or discharged battery**

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.

21. SLIDE 21 **EXPLAIN** FIGURE 53–5 A starter amperage tester uses an amp probe around the positive or negative battery cables.
22. SLIDES 22 **EXPLAIN** FIGURE 53–6 The starter is located under the intake manifold on this Cadillac Northstar engine.

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DISCUSS CASE STUDY: *Case of the No-Crank Camaro:* 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.

Summary:

- **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.

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?

DEMONSTRATION: Show Scan Tool Diagnosis process from the above discussion.



QUESTION



QUESTION

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 based on voltage & resistance, or measuring magnetic field surrounding a circuit by using an

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What to DO: CH53 Cranking Diagnosis inductive pickup. When should each type of measurement be used?

23. **SLIDE 23 EXPLAIN** **FIGURE 53-7** An exploded view of a typical solenoid-operated starter.
24. **SLIDE 24 EXPLAIN** **Figure 53-8** 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).
25. **SLIDE 25 EXPLAIN** **Figure 53-9** Measuring an armature shaft for runout using dial indicator & V-blocks.
26. **LIDE 26 EXPLAIN** **Figure 53-10** Replacement starter brushes should be installed so the beveled edge matches the rotation of the commutator.

DEMONSTRATION: Show the students how to properly bench-test a starter. Emphasize that the remote starter cables should not smoke during this test.

HANDS-ON TASK: 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.

27. **SLIDE 27 EXPLAIN** **Figure 53-11** A shim (or half shim) may be needed to provide the proper clearance between the flywheel teeth of the engine & pinion teeth.

EXPLAIN TECH TIP: 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 any shims that were used with the original starter. This is preferable to removing and reinstalling the

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replacement starter several times until the proper clearance is determined.

28. SLIDES 28-94 OPTIONAL STARTER OVERHAUL

DEMONSTRATION: Show how to properly hook up and perform a starter current draw test using an AVR tester or similar equipment. Explain how AVR can be used to perform a variety of starting & charging tests in a short amount of time.

ASEEDUCATION Task Sheet: Remove and install starter in a vehicle (P-1)

Starter Disassembly & Testing

ASEEDUCATION Task Sheet Inspect and test starter relays and solenoids; determine necessary action. (P-2)

ASEEDUCATION TASK: Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action. (P-2)

ASEEDUCATION Task Sheet Perform starter current draw tests; determine necessary action. (P-1)

Combined Perform starter circuit voltage drop tests; determine necessary action. (P-1)

ASEEDUCATION Differentiate between electrical and engine mechanical problems that cause slow-crank or no-crank condition (P-2)